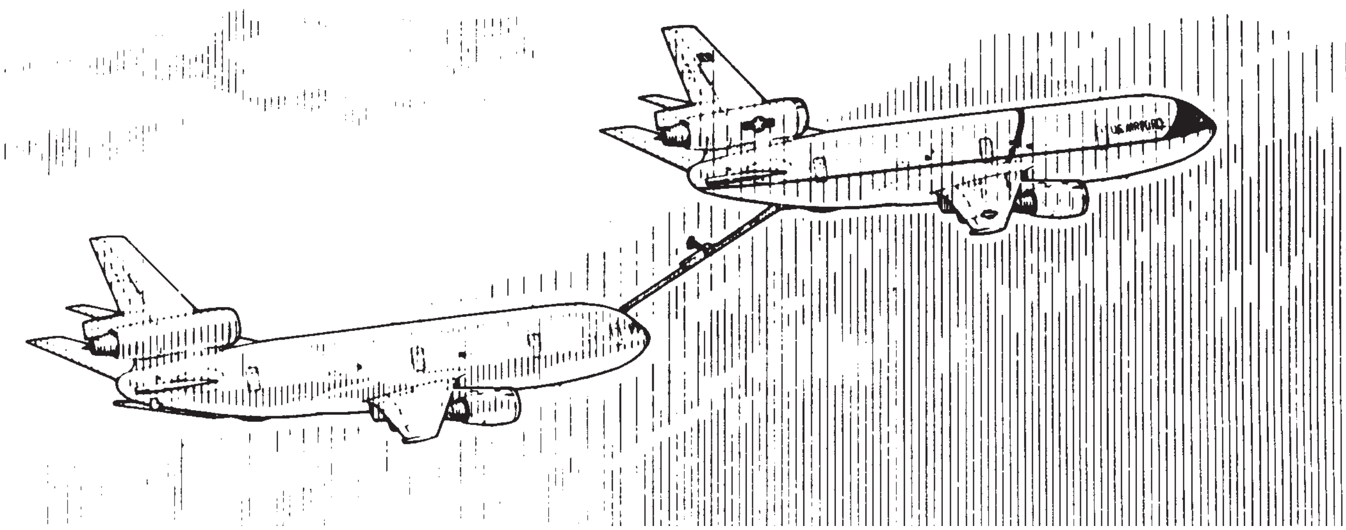
FLIGHT MANUAL PERFORMANCE DATA

USAF SERIES
KC-10A
AIRCRAFT



Prepared by HEBCO, INC.
GS-35F-0148K

This publication supersedes TO 1C-10(K)A-1-1S-28 dated 13 July 2005.

Commanders are responsible for bringing this publication to the attention of all affected Air Force Personnel.

This publication is incomplete without TO 1C-10(K)A-1.

Refer to https://www.toindex-s.wpafb.af.mil for current status of Flight Manuals, Safety/Operational Supplements, and Flight Crew Checklist.

DISCLOSURE NOTICE - This information is furnished upon the condition that it will not be released to another nation without the specific authority of the Department of the Air Force of the United States, that it will be used for military purposes only, that individual or corporate rights originating in the information, whether patented or not will be respected, that the recipient will report promptly to the United States, any known or suspected compromise, and that the information will be provided substantially the same degree of security afforded it by the Department of Defense of the United States. Also, regardless of any other markings on the document, it will not be downgraded or declassified without written approval of the originating United States agency.

DISTRIBUTION STATEMENT D - Distribution authorized to the Department of Defense and U.S. DoD contractors only, Administrative or Operational Use, 11 May 1987. Other requests shall be referred to 544 ACSS, Tinker AFB, OK 73145-3018.

WARNING - This document contains technical data whose export is restricted by the Arms Export Control Act (Title 22, U.S.C., Sec. 2751 et seq.) or the Export Administration Act of 1979, as amended (Title 50, U.S.C., App. 2401 et seq.). Violations of these export laws are subject to severe criminal penalties. Disseminate in accordance with provisions of DoD Directive 5230.25.

HANDLING AND DESTRUCTION NOTICE - Comply with distribution statement and destroy by any method that will prevent disclosure of the contents or reconstruction of the document.

PUBLISHED UNDER AUTHORITY OF THE SECRETARY OF THE AIR FORCE

1 APRIL 1990

CHANGE 9 1 MARCH 2008

LIST OF EFFECTIVE PAGES

INSERT LATEST CHANGED PAGES. DESTROY SUPERSEDED PAGES.

NOTE: The portion of the text affected by the changes is indicated by a vertical line in the outer margins of the page. Changes to illustrations are indicated by miniature pointing hands.

Dates of issue for original and changed pages are:

Original	0	1 Apr 90
Change	1	15 Oct 92
Change	2	15 Oct 93
Change	3	30 Apr 95
Change	4	15 Jul 95
Change	5	1 Feb 97
Change	6	15 Sep 98
Change	7	1 Jun 02
Change	8	1 Feb 05
Change	9	1 Mar 08

TOTAL NUMBER OF PAGES IN THIS PUBLICATION IS 640 CONSISTING OF THE FOLLOWING:

Page No.	*Change No.
Title	9
A - B	9
C Blank	9
SR Legend 1	9
SR Legend 2	2
Status Page 1	9
Status Page 2 Blank	9
i Deleted	6
ii Blank Deleted	6
iii - iv	0
v	4
vi Blank	4
vii	0
viii Blank	0
1-1	0
1-2	5
1-3 - 1-4	0
1-5	2
1-6	0
1-7 - 1-8	5
1-9 - 1-15	0
1-16	4
1-17 CP - 1-18 CP	4
1-19	0
1-20 CP	0
1-21	8
1-22 Blank	8
2-1 - 2-2	0
2-3	7
2-4 - 2-5	0
2-6	8
2-7 - 2-8	0
2-9 CP	0
2-10 - 2-14	0
3-1 - 3-2	8
3-3	7
3-4	4
3-5 - 3-6	8
3-7	7
3-8	5
3-9	7
3-10	9
3-10A	7
3-10B Blank	7
3-11	7
3-12	8
3-13	4
3-14	5
3-15 - 3-16	9
3-17	7
3-18	2
3-19 - 3-20	9
3-20A	9
3-20B Blank	9
3-21 - 3-22	7
3-23	0
3-24	8
3-24A - 3-24B	8
3-25	2
3-26 - 3-27	9
3-28 - 3-29	4
3-30	8
3-31	0
3-32	7
3-32A	8
3-32B	9
3-32C - 3-32D Added	9
3-33	8
3-34 - 3-42	0
3-42A Deleted	9
3-42B Blank Deleted	9
3-43	7
3-44 - 3-73	0
3-74	7
3-75	9
3 76	0
3-76A	3
3-76B Blank	3
3-77	3
3-78 - 3-90	0
3-91	8
3-92	7
3-92A - 3-92B	7
3-93	7
3-94	0
3-94A	9
3-94B Blank	9
3-95	7
3-96 - 3-103	0
3-104	7
3-105	0
3-106	5
3-107 - 3-108	7
3-109	2
3-110	8
3-110A - 3-110B	8
3-111 - 3-112	8
3-113 - 3-114	4
4-1	4
4-2 - 4-4	0
4-5	8
4-6	0
4-7	8
4-8	0
4-9 CP	0
4-10 - 4-12	0
4-13	4
4-14 - 4-16 Deleted	4
4-17 - 4-19	0
4-20 - 4-21	5
4-22 CP	5
4-23 - 4-24	4
4-25 - 4-26	0
4-27	8
4-28	0
5-1 - 5-5	0
5-6	8
5-7 - 5-59	0
5-60 - 5-61 CP	0
5-62 - 5-66	0
5-67 CP	0
5-68 Blank	0
6-1 - 6-3	0
6-4	8
6-5 CP - 6-6 CP	5
6-7 - 6-8	0
7-1 - 7-2	8
7-3 - 7-6	0
7-7 CP	5
7-8 - 7-19	0
7-20 Blank	0
8-1	0

*Zero in this column indicates an original page.

USAF

LIST OF EFFECTIVE PAGES

*Zero in this column indicates an original page.

KC-10A
SPECIAL RIGHTS LEGEND

◪ 31-00		Modifications to instruments:
	▮ 31-15	ARO compartment panels including boom operators instrument panel and overhead ARO instrument panel
◪ 33-00		Modifications to lighting systems, including:
	▮ 33-15	ARO refueling display and instrument panels lighting
	▮ 33-45	Anticollision and rendezvous lights
	▮ 33-49	Wing lights and fuselage lights
	▮ 33-49-1	Formation lights
	▮ 33-49-2	Aerial refueling underbody lights
	▮ 33-61	ARO instrument and panel lights
	▮ 33-62	ARO compartment lights
◪ 34-00		Modifications to navigation systems, including:
	▮ 34-21-4	TACAN radio magnetic indicators
	▮ 34-54	IFF transponder
	▮ 34-56	TACAN
	▮ 34-58	UHF ADF
	▮ 34-59-1	I-Band beacon
	▮ 34-59-2	J-Band beacon
◪ 35-00		Modifications to oxygen systems, including:
	▮ 35-10	Crew oxygen supply system
	◪ 35-20	Passenger oxygen system excluding chemical oxygen generator
◪ 36-00		Modifications to the pneumatics systems, including:
	▮ 36-23	Manifold failure detection system
◪ 51-00		Structural modifications to the DC-10 to accommodate the above systems and stations, including:

- ▮ ARO Compartment
- ▮ Forward/aft fuselage tanks
- ▮ UARRSI
- ▮ Attachments for barrier nets
- ▮ Boom installation
- ▮ Drogue installation
- ▮ Aerial refueling system
- ▮ Revised aft cg position

◪ 52-00		Doors
	▮ 52-49	ARO sighting door
	▮ 52-57	ARO compartment door
	▮ 52-60	Crew exit/entry ladder and crew walkways
◪ 53-00		Fuselage
	▮ 53-54	ARO and boom fairings
◪ 56-00		Windows
	▮ 56-44	ARO scanning windows and mirrors

LEGEND:

▯ Indicates that the line-item is not applicable.

◪ Indicates that the Government has UNLIMITED RIGHTS to a portion of that line-item.

▮ Indicates that the Government has UNLIMITED RIGHTS to 100 percent of that line-item.

STATUS PAGE

This page contains a listing of the related Operational and/or Safety Supplements that currently affect the Flight Manual on the date of this publication.

CURRENT SAFETY AND OPERATIONAL SUPPLEMENTS	DATE	SHORT TITLE

SAFETY AND OPERATIONAL SUPPLEMENTS INCORPORATED IN THIS CHANGE	DATE	SHORT TITLE
S-28	13 Jul 05	V_{MCG} RCR Correction

RECINDED SAFETY AND OPERATIONAL SUPPLEMENTS	DATE	SHORT TITLE

SCOPE. This manual along with TO 1C-10(K)A-1 contains the necessary performance data information for safe and efficient operation of your airplane. These instructions provide you with a general knowledge of the airplane and its characteristics and specific operating procedures.

Your experience is recognized; therefore, basic flight principles are avoided. Instructions in this manual are prepared to be understandable by the least experienced crew that can be expected to operate the airplane. This manual provides the best possible operating instructions under most circumstances, but it is not a substitute for sound judgment. Multiple emergencies, adverse weather, terrain, etc. may require a modification of the procedures.

PERMISSIBLE OPERATIONS. The Flight Manual takes a "positive approach" and normally states only what you can do. Unusual operations or configurations are prohibited unless specifically covered herein. Clearance from the using command must be obtained before any questionable operation, which is not specifically permitted in this manual, is attempted.

HOW TO BE ASSURED OF HAVING LATEST DATA. Refer to TO 01-1-3 for a listing of all current flight manuals, safety supplements, operational supplements, and checklists. Also check the Flight Manual cover page, the title block of each safety and operational supplement, and all status pages attached to formal safety and operational supplements. Clear up all discrepancies before flight.

ARRANGEMENT. This manual is divided into fairly independent sections to simplify reading it straight through or using it as a reference manual. All sections must be read thoroughly and fully understood for safe and efficient airplane operation.

SAFETY SUPPLEMENTS. Information involving safety will be promptly forwarded to you in a safety supplement. Urgent information is published in interim safety supplements and transmitted by teletype. Formal supplements are mailed. The supplement title block and status page (published with formal supplement only) should be checked to determine the supplement's effect on the manual and other outstanding supplements.

OPERATIONAL SUPPLEMENTS. Information involving changes to operating procedures will be forwarded to you by operational supplements. The procedure for handling operational supplements is the same as for safety supplements.

CHECKLISTS. The Flight Manual contains itemized procedures with necessary amplifications. The checklist contains itemized procedures without the amplification. Primary line items in the Flight Manual and Checklist are identical. If a formal safety or operational supplement affects your checklist, the affected checklist page will be attached to the supplement. Retain until superseded.
HOW TO GET PERSONAL COPIES. Each flight crew member is entitled to personal copies of the Flight Manual, Safety Supplements, Operational Supplements and Checklists. The required quantities should be ordered before you need them to assure their prompt receipt. Check with your publication distribution officer - it is his job to fulfill your TO requests. Basically, you must order the required quantities from the Numerical Index and Requirement Table (NIRT). TO 00-5-1 and 00-5-2 give detailed information for ordering these publications. Make sure a system is established at your base to deliver these publications to the flight crews immediately.
MANUAL BINDERS. Looseleaf binders and sectionalized tabs are available for use with your manual. They are obtained through local purchase procedures and are listed in the Federal Supply Schedule (FSC Group 75, Office Supplies, Part 1). Check with your local supply personnel for assistance in procuring these items.

WARNINGS, CAUTIONS, AND NOTES. The following definitions apply to "Warnings", "Cautions", and "Notes" found throughout the manual.

WARNING

Operating procedures, techniques, etc., which could result in personal injury or loss of life if not carefully followed.

CAUTION

Operating procedures, techniques, etc., which could result in damage to equipment if not carefully followed.

NOTE

An operating procedure, technique, etc., which is considered essential to emphasize.

SHALL, WILL, SHOULD, AND MAY. The following definitions apply to the words shall, will, should, and may.

SHALL or WILL	-	The instructions or procedure prefaced by shall or will are mandatory.
SHOULD	-	Normally used to indicate a preferred but nonmandatory method of accomplishment.
MAY	-	An acceptable or suggested means of accomplishment.

YOUR RESPONSIBILITY - TO LET US KNOW. Recommended changes to this manual will be submitted as prescribed in AFI 11-215. Submit AF Form 847, Recommendation for Change of Publication through your Standardization/Evaluation channels, through 15th AF/DOV, 575 Waldron Street, Travis AFB CA 94535-2150/or 21st AF/DOV, 1907 Arnold Ave, McGuire AFB NJ 08641-5613, to OC-ALC/LKR, Tinker AFB OK 73145-3018.

PERFORMANCE DATA

TABLE OF CONTENTS

SECTION I

INTRODUCTION

TABLE OF CONTENTS

Page

LIST OF CHARTS

LIST OF CHARTS (Continued)

INTRODUCTION

The charts in this manual present complete performance information for normal and emergency operation. Sufficient data are presented for preflight and inflight planning of an entire mission.

The performance data presented in this manual are applicable to the CF6-50C2 engine using Jet A-1 fuel at a density of 6.7 pounds per gallon.

To check applicability to other fuels, refer to the Limitations Section of TO 1C-10(K)A-1.

All charts that present an emergency operation or operation with one or two engines inoperative are identified by a black slashed border.

SYMBOLS AND DEFINITIONS

(See figure 1-1.)

Symbol	Definition	Symbol	Definition
A/C	Air Conditioning	DI	Drag Index
Accel	Acceleration	Dist	Distance
AEGR	All Engine Ground Roll	EAS	Equivalent Airspeed - Calibrated Airspeed Corrected for Compressibility
A/L	Allowable Limit (N_1 Setting)	EFL	Equivalant Field Length
Alt	Altitude	EGT	Exhaust Gas Temperature
A/R	Air Refueling	Elev	Elevation
ASE	Automatic Slat Extension	Equiv	Equivalent
BTMS	Brake Temperature Moni-toring System	EXT	Extended
Btu/lb	British Thermal Units Per Pound	°F	Degrees Fahrenheit
°C	Degrees Centigrade	FF	Fuel Flow
CAS	Calibrated Airspeed - Instrument Reading Cor-rected for Instrument And Position Error	FL	Field Length
CFCC	Correction Factor for Configuration Changes	FPM, fpm	Feet Per Minute
CFL	Critical Field Length	FT, ft	Feet
CG, cg	Center-of-Gravity	g	Acceleration Due To Gravity
CGLW	Climb Gradient Limiting Weight	GA	Go-Around
CGR	Center Gear Retracted	GW	Gross Weight
CK	Check	H, h	Height
Cu Ft	Cubic Feet	Hg	Mercury
DDT	Double Dual Tandem	HR	Hour(s)
Deg	Degrees	IAS	Indicated Airspeed - Instrument Reading Uncorrected
		ICAO	International Civil Aviation Organization

Figure 1-1. Symbols and Definitions (Sheet 1)

Symbol	Definition	Symbol	Definition
IMN	Indicated Mach Number	MIN, min	Minutes
in	Inches	MLW	Maximum Unrestricted Landing Weight
ISA	International Standard Atmosphere	MPH, mph	Miles Per Hour
Kilogram	Equals 2.2046 Pounds	MTOGW	Maximum Takeoff Gross Weight
KCAS	Calibrated Airspeed, Knots	NAM	Nautical Air Miles
KEAS	Equivalent Airspeed, Knots	NM	Nautical Miles
KIAS	Indicated Airspeed, Knots	NM/1000 LB	Nautical Miles Per 1000 Pounds Of Fuel
Kts	Knots	$\%N_1$	Percent Of Engine Low-Pressure Rotor RPM
LAV	Lavatory	OAT	Outside Air Temperature
LB/HR	Pounds per Hour	OBST HT	Obstacle Height
LDG	Landing	OBST DIST	Obstacle Distance
M_D	Design Diving Speed in Mach Number	OCLW	Obstacle Clearance Limiting Weight
M_{MO}	Maximum Operating Limit Mach Number	OWBI	One Wheel Brake Inoperative
MAC, mac	Mean Aerodynamic Chord	P	Pressure
MAW	Maximum Allowable Weight When $V_1 = V_{MCG}$	P_O	Pressure, Standard Atmosphere At Sea Level
MAX	Maximum	PSI	Pounds Per Square Inch
MCL	Maximum Climb Thrust	PWR	Power
MCR	Maximum Cruise Thrust	RA	Runway Available
MCT	Maximum Continuous Thrust	RALW	Runway Available Limiting Weight
MEL	TO 1C-10(K)A-1-2 (Minimum Equipment List)		
Meter	Equals 3.28 Feet		

Figure 1-1. Symbols and Definitions (Sheet 2)

Symbol	Definition	Symbol	Definition
R/C	Rate of Climb	TAS	True Airspeed - Equivalent Airspeed Corrected for Density
RCR	Runway Condition Reading	TAT	Total Air Temperature
R/D	Rate of Descent	TD	Touchdown
RET	Retracted	TDT	Twin Delta Tandem
RL	Runway Length	Temp	Temperature
RPM, rpm	Revolution Per Minute	TO	Takeoff
RSC	Runway Surface Condition	TOGW	Takeoff Gross Weight
RTO	Rejected Takeoff	TRT	Takeoff Rated Thrust
Rwy Hdg	Runway Heading	TSLW	Tire Speed Limiting Weight
S	Single	TT	Twin Tandem
SAT	Static Air Temperature	V	Velocity
SBTT	Single Belly Twin Tandem	VA	Design Maneuvering Speed
SDR	Stopping Distance Ratio	V_{APP}	Final Approach Speed
SID	Standard Instrument Departure	V_C	Maximum Cruise Speed
Sec	Seconds	V_{CEF}	Critical Engine Failure Speed
Slug	Unit of Force in English System	V_D	Design Diving Speed
SL	Sea Level	V_{FR}	Flap Retraction Speed
Sq Ft	Square Feet	$V_{L/D}$	Airspeed For Maximum Ratio Of Lift To Drag
Sq In	Square Inches	V_{LOF}	Liftoff Speed
ST	Single Tandem	V_{MB}	Maximum Braking Speed
STD, std	Standard	V_{MBE}	Maximum Brake Energy Speed
T	Twin		

Figure 1-1. Symbols and Definitions (Sheet 3)

Symbol	Definition
V_{MCA}	Minimum Control Speed With One Engine Inoperative - In Flight
V_{MCG}	Minimum Control Speed With One Engine Inoperative - On Ground
V_{MM}	Minimum Maneuver Speed
V_{MO}	Maximum Operating Limit Speed
V_{MU}	Minimum Unstick Speed
V_R	Rotation Speed
$V_{R\ MIN}$	Minimum Rotation Speed
V_S	Minimum Stalling Speed
V_{S1g}	1g Stalling Speed
V_{SR}	Slat Retraction Speed
V_{TD}	Touchdown Speed
V_{TH}	Threshold Speed
V_1	Decision Speed

Symbol	Definition
V_2	Climbout Speed
WT	Weight
@	At
Δ, δ (Delta)	Increment of Weight, Airspeed, etc. and Air Pressure Ratio (P/Po)
δ f	Wing Flap Deflection
ρ (Rho)	Air Density, Slugs Per Cubic Foot
σ (Sigma)	Air Density Ratio ($\rho/\rho o$)
θ (Theta)	Temperature Ratio (T/To)
$\sqrt{\ }$	Square Root
$<$	Less Than
$>$	Greater Than
$\leq$	Less Than or Equal To
$\geq$	Greater Than or Equal To
$1/\sqrt{\sigma}$ (SMOE)	Atmosphere Density Ratio

Figure 1-1. Symbols and Definitions (Sheet 4)

CHART EXPLANATION

STANDARD ATMOSPHERE TABLE

The U.S. Standard Atmosphere, 1962, prepared by the National Aeronautics and Space Administration defines a set of standard values for temperature, density and pressure in the atmosphere. These values define the standard day conditions. The ICAO Standard Atmosphere is in agreement with these values. A standard atmosphere table is presented in figure 1-2.

ATMOSPHERIC DENSITY RELATIONSHIPS

The inverse square root of the density root, $1/\sqrt{\sigma}$ (SMOE), and density altitude are presented as a function of temperature and pressure altitude in figure 1-3.

BAROMETRIC PRESSURE VS PRESSURE ALTITUDE CONVERSION

Figure 1-4 provides data relating the barometric pressure, measured in inches of Hg, to the pressure altitude. The chart gives a pressure altitude value for each 0.01 inch increment from 27.00 inches to 32.09 inches of Hg.

TEMPERATURE CONVERSION CHART

The temperature conversion chart, figure 1-5, provides a convenient means of converting from degrees Centigrade to degrees Fahrenheit, or vice versa.

TRUE MACH NUMBER VS TRUE AIRSPEED CONVERSION

True Mach number vs true airspeed conversion charts are presented in figures 1-6 and 1-7 for inflight use and mission planning use, respectively. The data are a function of outside air temperature. Figure 1-7, which is plotted as a function of pressure altitude, is based on standard day conditions.

TRUE MACH NUMBER VS CALIBRATED AIRSPEED CONVERSION

Figure 1-8 provides a conversion from true Mach number to calibrated airspeed, or vice versa, and is dependent upon the pressure altitude.

CRUISE BUFFET-ONSET BOUNDARY

The cruise buffet-onset boundary charts are presented in figure 1-9 for slats retracted, figure 1-10 for slats extended (takeoff position), and figure 1-11 for flaps (to 15 degrees) and slats (takeoff position) extended. These charts provide the information necessary to determine buffet-onset limits in terms of load factor (margin), bank angle, Mach number (except in figure 1-11), airspeed, or pressure altitude.

NOTE

- Do not extend slats to the landing position: Slat placard speeds are reduced from 270 KIAS or 0.55 Mach (whichever is less) to 221 KIAS or 0.51 Mach.
- Buffet characteristics in the clean configuration are discussed in the Limitations Section of TO 1C-10(K)A-1.

Indicated Mach number and/or airspeed for buffet-onset is determined by entering the chart with the desired load factor (margin) or bank angle, reading across to the gross weight, then up to the given altitude and across to the indicated Mach number and/or airspeed. By reversing the previous procedure it is possible to determine the buffet-onset load factor (margin) or bank angle at a given Mach number and/or airspeed.

STICK SHAKER ACTUATION SPEEDS

Stall warning is provided by the stick shaker at approximately 5 knots above the 1g stalling speed. The stick shaker speeds, along with the effect of CG location, are provided in figure 1-12 for slats retracted and in figure 1-13 for slats extended.

DRAG INDEX TABLE

Any additional drag above the level defined for the clean configuration, drag index = 0, will result in degradation of the airplane performance. Figure 1-14 provides drag index values for the possible sources of additional drag. The drag index numbers should be added together if more than one source of additional drag is present. These data, used in connection with the effect of drag index charts in later parts of this manual, provide the means of estimating the effect of additional drag on the performance presented in this manual.

STANDARD ATMOSPHERE TABLE

Note:
1. Standard Day
2. Po = 14.70 lb/sq in = 29.921 in of Hg
3. ρo = 0.002378 slug/cu ft
4. 1 in Hg = 70.727 lb/sq ft = 0.49116 lb/sq in

PRESSURE ALTITUDE - FEET	TEMPERATURE °C	TEMPERATURE °F	DENSITY RATIO	$\frac{1}{\sqrt{\sigma}}$	SPEED OF SOUND KTS	PRESSURE IN. HG	PRESSURE RATIO
0	15.00	59.00	1.0000	1.0000	661.48	29.92	1.0000
1000	13.02	55.43	.9711	1.0148	659.20	28.86	.9644
2000	11.04	51.87	.9428	1.0299	656.91	27.82	.9298
3000	9.06	48.30	.9151	1.0454	654.62	26.82	.8962
4000	7.08	44.74	.8881	1.0611	652.32	25.84	.8637
5000	5.09	41.17	.8617	1.0773	650.01	24.90	.8321
6000	3.11	37.60	.8359	1.0937	647.69	23.98	.8014
7000	1.13	34.04	.8106	1.1107	645.36	23.09	.7716
8000	-0.85	30.47	.7860	1.1279	643.03	22.22	.7428
9000	-2.83	26.90	.7620	1.1456	640.68	21.39	.7148
10,000	-4.81	23.34	.7385	1.1637	638.33	20.58	.6877
11,000	-6.79	19.77	.7156	1.1822	635.97	19.79	.6614
12,000	-8.78	16.21	.6932	1.2011	633.60	19.03	.6360
13,000	-10.76	12.64	.6713	1.2205	631.22	18.29	.6113
14,000	-12.74	9.07	.6500	1.2403	628.83	17.58	.5875
15,000	-14.72	5.51	.6292	1.2607	626.44	16.89	.5643
16,000	-16.70	1.94	.6090	1.2815	624.03	16.22	.5420
17,000	-18.68	-1.63	.5892	1.3028	621.62	15.57	.5203
18,000	-20.66	-5.19	.5699	1.3246	619.19	14.94	.4994
19,000	-22.64	-8.76	.5511	1.3470	616.76	14.34	.4791
20,000	-24.62	-12.32	.5328	1.3700	614.31	13.75	.4595
21,000	-26.61	-15.89	.5150	1.3935	611.86	13.18	.4406
22,000	-28.59	-19.46	.4976	1.4176	609.40	12.64	.4223
23,000	-30.57	-23.02	.4807	1.4424	606.92	12.11	.4046
24,000	-32.55	-26.59	.4642	1.4678	604.44	11.60	.3876
25,000	-34.53	-30.16	.4481	1.4938	601.95	11.10	.3711
26,000	-36.51	-33.72	.4325	1.5206	599.44	10.63	.3552
27,000	-38.49	-37.29	.4173	1.5480	596.93	10.17	.3398
28,000	-40.47	-40.85	.4025	1.5762	594.40	9.72	.3250
29,000	-42.46	-44.42	.3881	1.6052	591.87	9.30	.3107
30,000	-44.44	-47.99	.3741	1.6349	589.32	8.89	.2970
31,000	-46.42	-51.55	.3605	1.6654	586.76	8.49	.2837
32,000	-48.40	-55.12	.3473	1.6968	584.19	8.11	.2709
33,000	-50.38	-58.68	.3345	1.7291	581.61	7.74	.2586
34,000	-52.36	-62.25	.3220	1.7623	579.02	7.38	.2467
35,000	-54.34	-65.82	.3099	1.7964	576.42	7.04	.2353
36,000	-56.32	-69.38	.2981	1.8315	573.80	6.71	.2243
37,000	-56.50	-69.70	.2844	1.8753	573.57	6.40	.2138
38,000	-56.50	-69.70	.2710	1.9209	573.57	6.10	.2038
39,000	-56.50	-69.70	.2583	1.9677	573.57	5.81	.1942
40,000	-56.50	-69.70	.2462	2.0155	573.57	5.54	.1851
41,000	-56.50	-69.70	.2346	2.0645	573.57	5.28	.1764
42,000	-56.50	-69.70	.2236	2.1147	573.57	5.03	.1681

SA1C-45C

Figure 1-2.

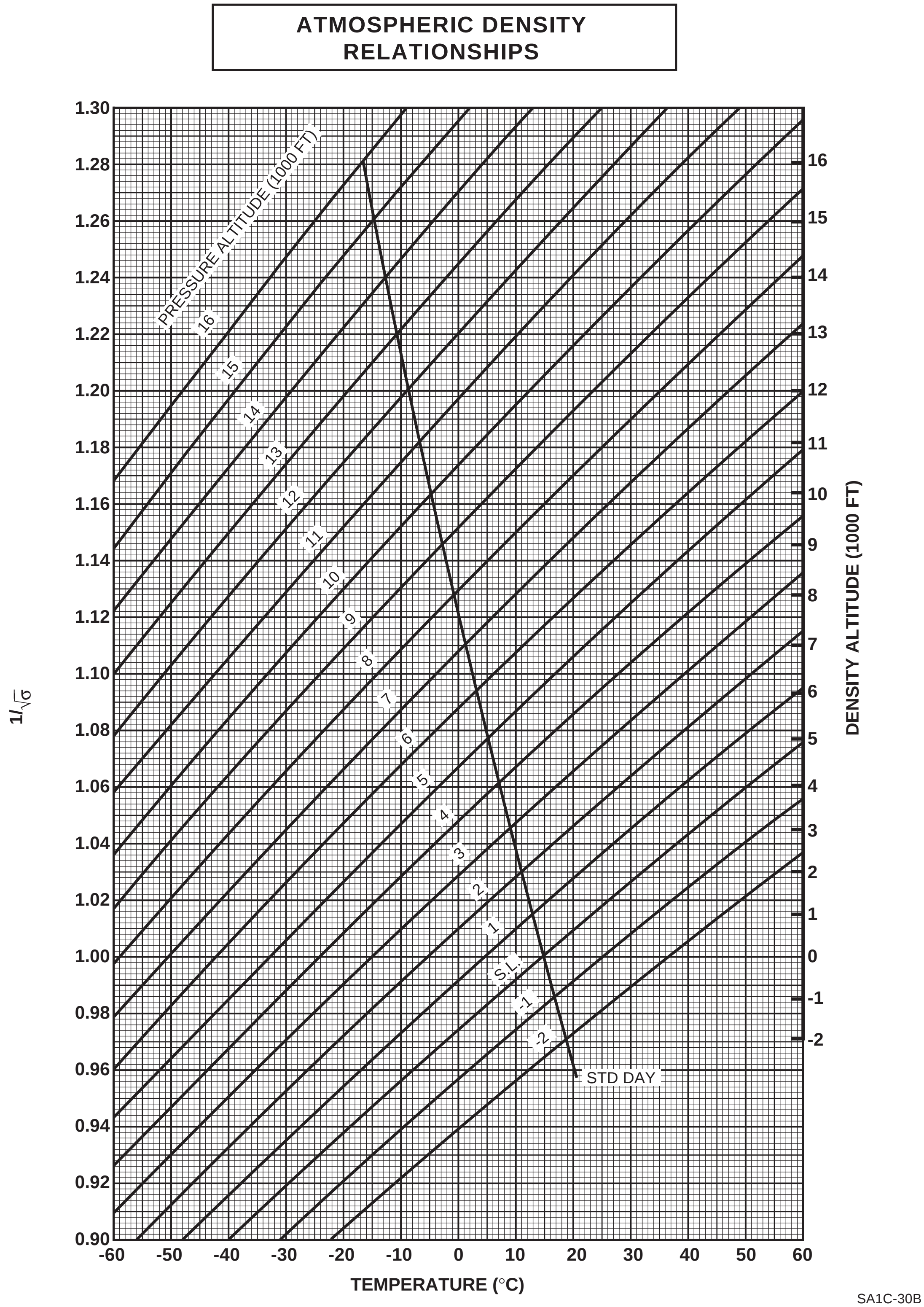

ATMOSPHERIC DENSITY
RELATIONSHIPS
PRESSURE ALTITUDE (1000 FT)
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
S.L.
-1
-2
STD DAY
1.30
1.28
1.26
1.24
1.22
1.20
1.18
1.16
1.14
1.12
1.10
1.08
1.06
1.04
1.02
1.00
0.98
0.96
0.94
0.92
0.90
$1/\sqrt{\sigma}$
-60 -50 -40 -30 -20 -10 0 10 20 30 40 50 60
TEMPERATURE (°C)
DENSITY ALTITUDE (1000 FT)
16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 -1 -2
SA1C-30B

Figure 1-3.

BAROMETRIC PRESSURE VS PRESSURE ALTITUDE CONVERSION

INCHES OF Hg	PRESSURE ALTITUDE (FT)									
	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
27.0	2815	2805	2795	2785	2775	2765	2755	2745	2735	2725
27.1	2715	2705	2695	2685	2675	2665	2655	2645	2635	2625
27.2	2615	2605	2595	2585	2575	2565	2555	2545	2535	2525
27.3	2515	2505	2495	2485	2475	2465	2455	2445	2435	2426
27.4	2416	2406	2396	2386	2376	2366	2356	2346	2336	2326
27.5	2316	2307	2297	2287	2277	2267	2257	2247	2237	2227
27.6	2218	2208	2198	2188	2178	2168	2158	2149	2139	2129
27.7	2119	2109	2099	2089	2080	2070	2060	2050	2040	2030
27.8	2021	2011	2001	1991	1981	1972	1962	1952	1942	1932
27.9	1923	1913	1903	1893	1884	1874	1864	1854	1844	1835
28.0	1825	1815	1805	1796	1786	1776	1766	1757	1747	1737
28.1	1727	1718	1708	1698	1689	1679	1669	1659	1650	1640
28.2	1630	1621	1611	1601	1592	1582	1572	1562	1553	1543
28.3	1533	1524	1514	1504	1495	1485	1475	1466	1456	1446
28.4	1437	1427	1417	1408	1398	1389	1379	1369	1360	1350
28.5	1340	1331	1321	1312	1302	1292	1283	1273	1264	1254
28.6	1244	1235	1225	1216	1206	1196	1187	1177	1168	1158
28.7	1149	1139	1129	1120	1110	1101	1091	1082	1072	1063
28.8	1053	1044	1034	1024	1015	1005	996	986	977	967
28.9	958	948	939	929	920	910	901	891	882	872
29.0	863	853	844	834	825	815	806	796	787	778
29.1	768	759	749	740	730	721	711	702	693	683
29.2	674	664	655	645	636	627	617	608	598	589
29.3	579	570	561	551	542	532	523	514	504	495
29.4	486	476	467	457	448	439	429	420	411	401
29.5	392	382	373	364	354	345	336	326	317	308
29.6	298	289	280	270	261	252	242	233	224	215
29.7	205	196	187	177	168	159	149	140	131	122
29.8	112	103	94	85	75	66	57	47	38	29
29.9	20	10	+1	-8	-17	-27	-36	-45	-54	-64
30.0	-73	-82	-91	-100	-110	-119	-128	-137	-147	-156
30.1	-165	-174	-183	-193	-202	-211	-220	-229	-238	-248
30.2	-257	-266	-275	-284	-294	-303	-312	-321	-330	-339
30.3	-348	-358	-367	-376	-385	-394	-403	-413	-422	-431
30.4	-440	-449	-458	-467	-476	-486	-494	-504	-513	-522
30.5	-531	-540	-549	-558	-568	-577	-586	-595	-604	-613
30.6	-622	-631	-640	-649	-658	-667	-676	-686	-695	-704
30.7	-713	-722	-731	-740	-749	-758	-767	-776	-785	-794
30.8	-803	-812	-821	-830	-839	-848	-857	-866	-875	-884
30.9	-893	-902	-911	-920	-929	-938	-947	-956	-965	-974
31.0	-983	-992	-1001	-1010	-1019	-1028	-1037	-1046	-1055	-1064
31.1	-1073	-1082	-1091	-1100	-1109	-1118	-1127	-1136	-1145	-1154
31.2	-1163	-1172	-1181	-1189	-1198	-1207	-1216	-1225	-1234	-1243
31.3	-1252	-1261	-1270	-1279	-1288	-1297	-1305	-1314	-1323	-1332
31.4	-1341	-1350	-1359	-1368	-1377	-1385	-1394	-1403	-1412	-1421
31.5	-1430	-1439	-1448	-1456	-1465	-1474	-1483	-1492	-1501	-1510
31.6	-1518	-1527	-1536	-1545	-1554	-1563	-1571	-1580	-1589	-1598
31.7	-1607	-1616	-1624	-1633	-1642	-1651	-1660	-1669	-1677	-1686
31.8	-1695	-1704	-1713	-1721	-1730	-1739	-1748	-1757	-1765	-1774
31.9	-1783	-1792	-1800	-1809	-1818	-1827	-1836	-1844	-1853	-1862
32.0	-1871	-1879	-1888	-1897	-1906	-1914	-1923	-1932	-1941	-1949

SA1C-235A

Figure 1-4.

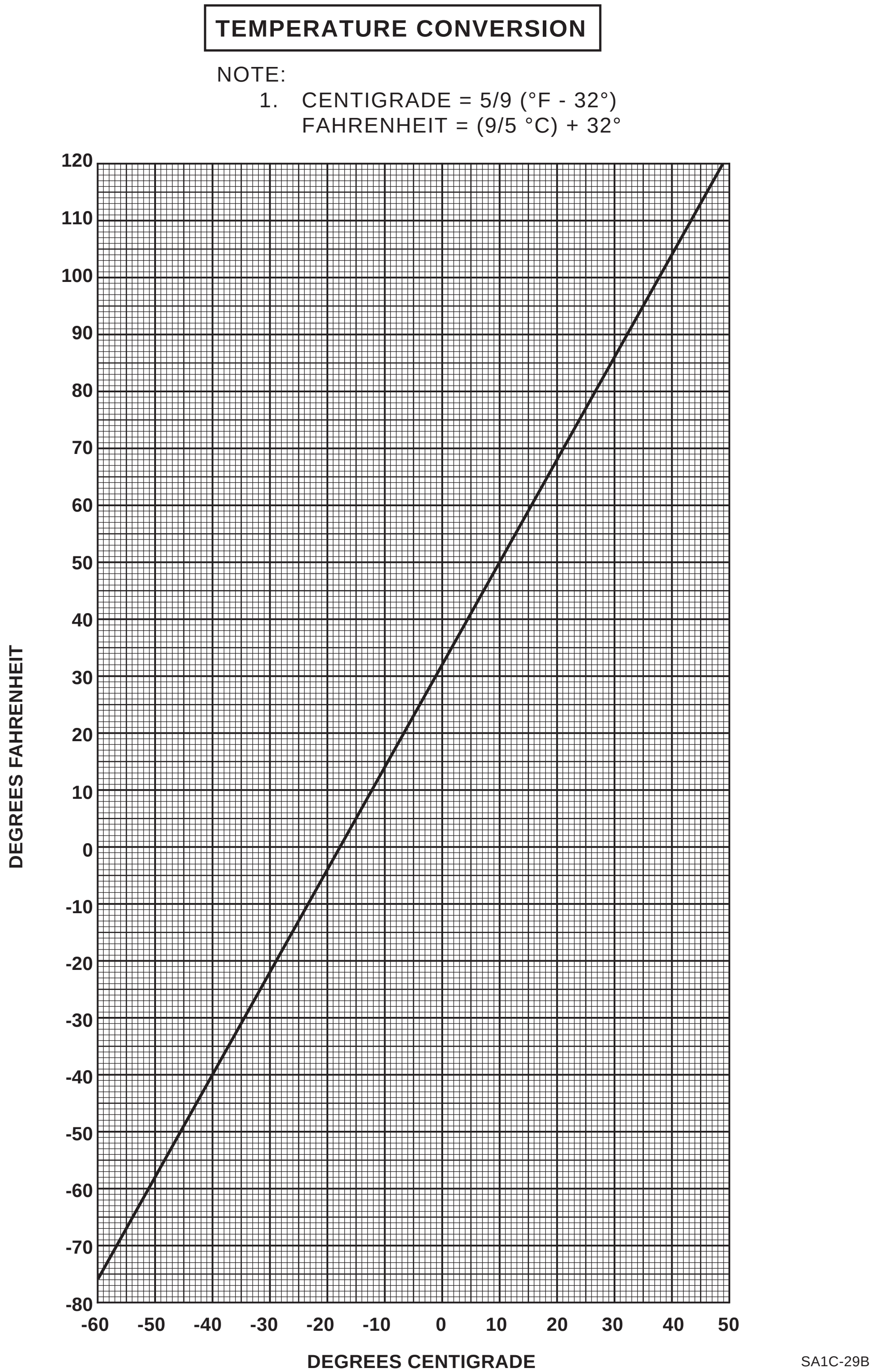

TEMPERATURE CONVERSION
NOTE:
1. CENTIGRADE = 5/9 (°F - 32°)
FAHRENHEIT = (9/5 °C) + 32°
DEGREES FAHRENHEIT
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-60 -50 -40 -30 -20 -10 0 10 20 30 40 50
DEGREES CENTIGRADE
SA1C-29B

Figure 1-5.

TRUE MACH NUMBER VS TRUE AIRSPEED CONVERSION - FOR INFLIGHT USE

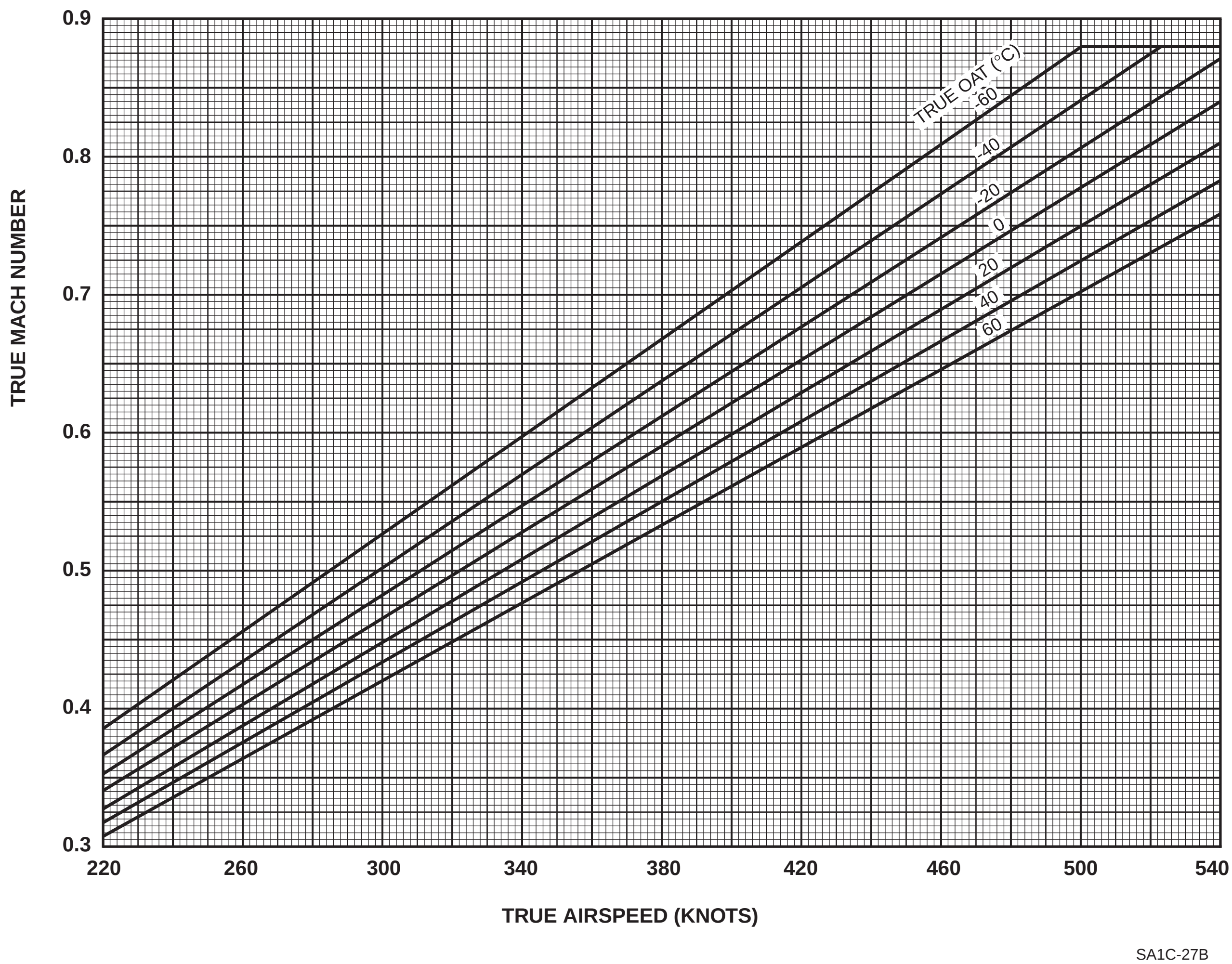


Figure 1-6.

TRUE MACH NUMBER VS TRUE AIRSPEED CONVERSION - FOR MISSION PLANNING

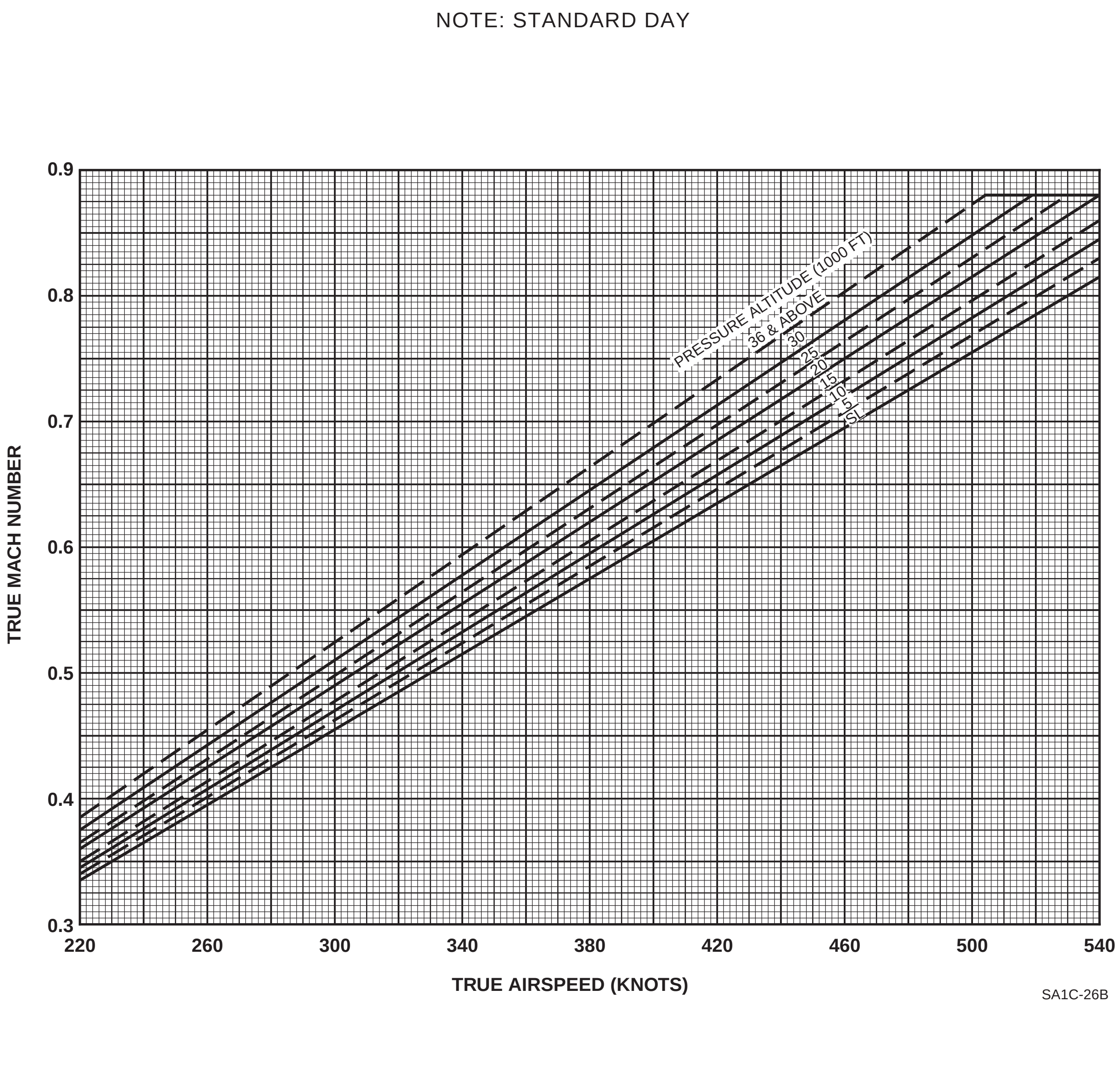


Figure 1-7.

TRUE MACH NUMBER VS CALIBRATED AIRSPEED CONVERSION

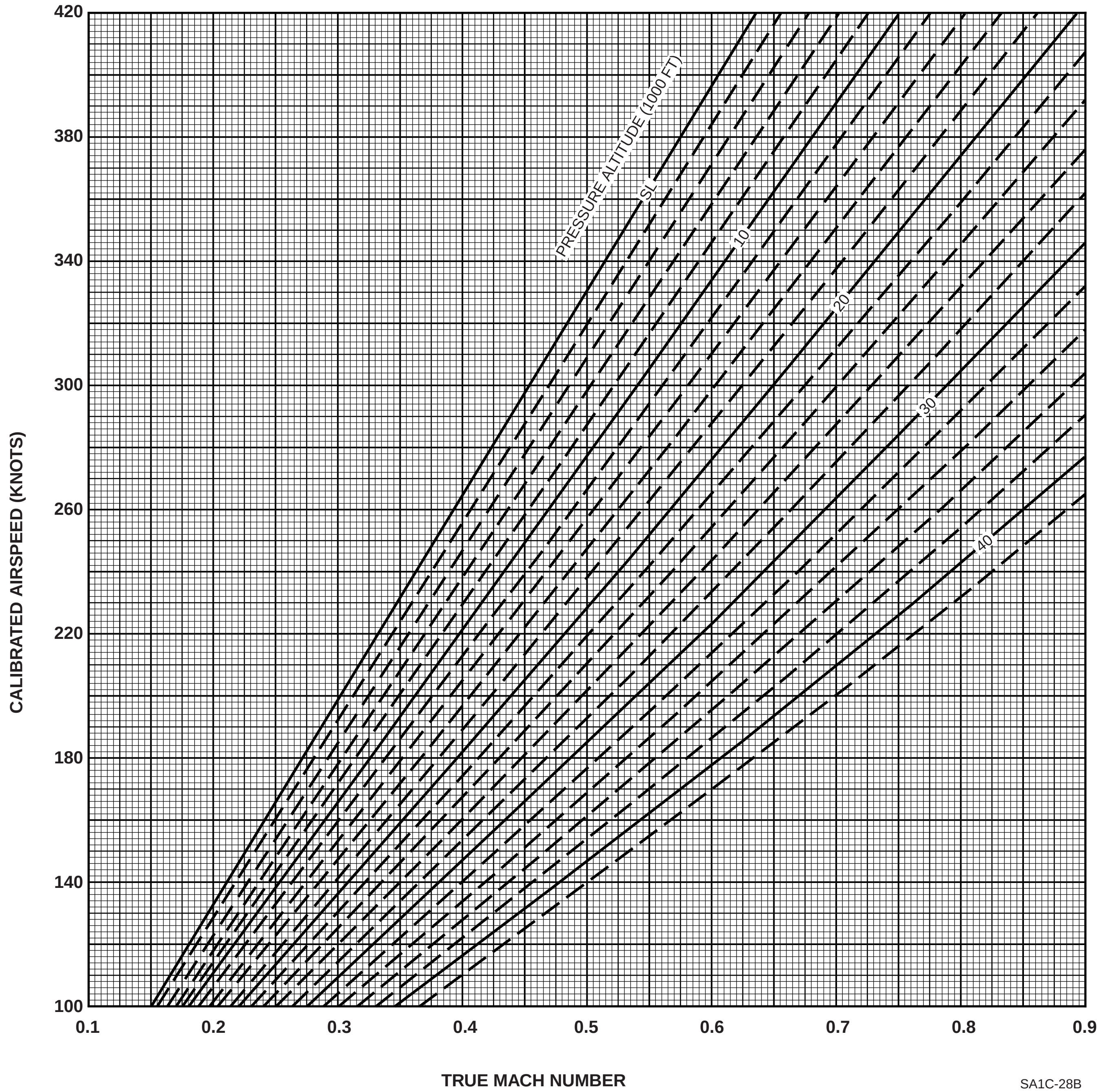


Figure 1-8.

CRUISE BUFFET-ONSET BOUNDARY SLATS RETRACTED

NOTE:

1. CG = 24% MAC. INCREASE COMPUTED SPEED BY 0.5 KIAS PER ONE PERCENT FORWARD MOVEMENT OF THE CG LOCATION. DECREASE COMPUTED SPEED BY 0.3 KIAS PER ONE PERCENT AFT MOVEMENT OF THE CG LOCATION
2. TO COMPUTE MINIMUM AIR REFUELING SPEED, ADD 5.0 KIAS TO THE 1.2G BUFFET SPEED
3. TO COMPUTE MINIMUM AIR REFUELING SPEED, WHENEVER WING AERIAL REFUELING PODS ARE INSTALLED, ADD 10 KIAS TO THE 1.2G BUFFET SPEED (WITH TCTO 1C-10(K)A-956)

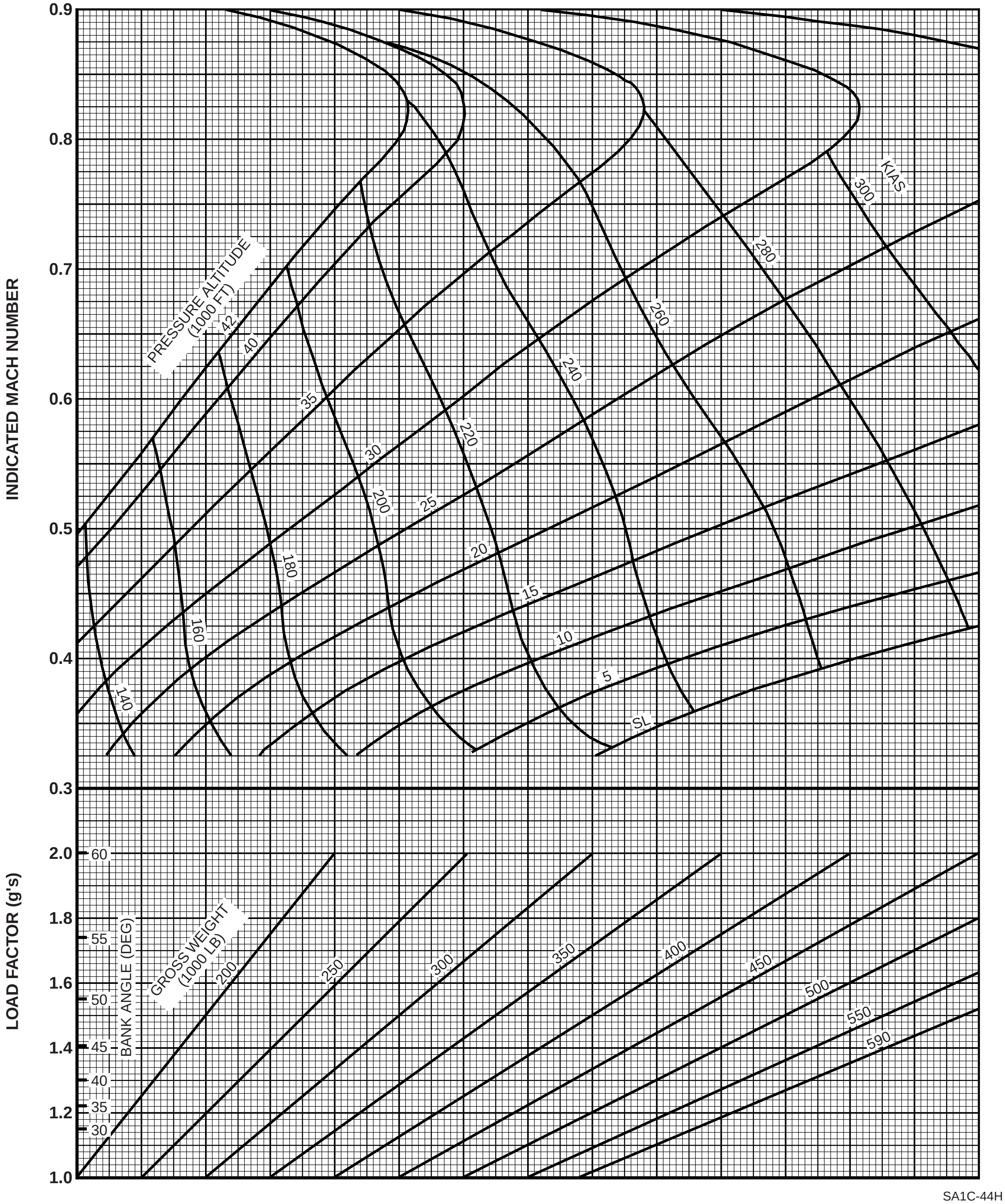


Figure 1-9.

CRUISE BUFFET-ONSET BOUNDARY SLATS EXTENDED

NOTE:

1. SLATS EXTENDED TO THE TAKEOFF POSITION
2. CG = 24% MAC. INCREASE COMPUTED SPEED BY 0.5 KIAS PER ONE PERCENT FORWARD MOVEMENT OF THE CG LOCATION. DECREASE COMPUTED SPEED BY 0.3 KIAS PER ONE PERCENT AFT MOVEMENT OF THE CG LOCATION
3. TO COMPUTE MINIMUM AIR REFUELING SPEED. ADD 5.0 KIAS TO THE 1.2G BUFFET SPEED
4. TO COMPUTE MINIMUM AIR REFUELING SPEED, WHENEVER WING AERIAL REFUELING PODS ARE INSTALLED, ADD 10 KIAS TO THE 1.2G BUFFET SPEED (WITH TCTO 1C-10(K)A-956)

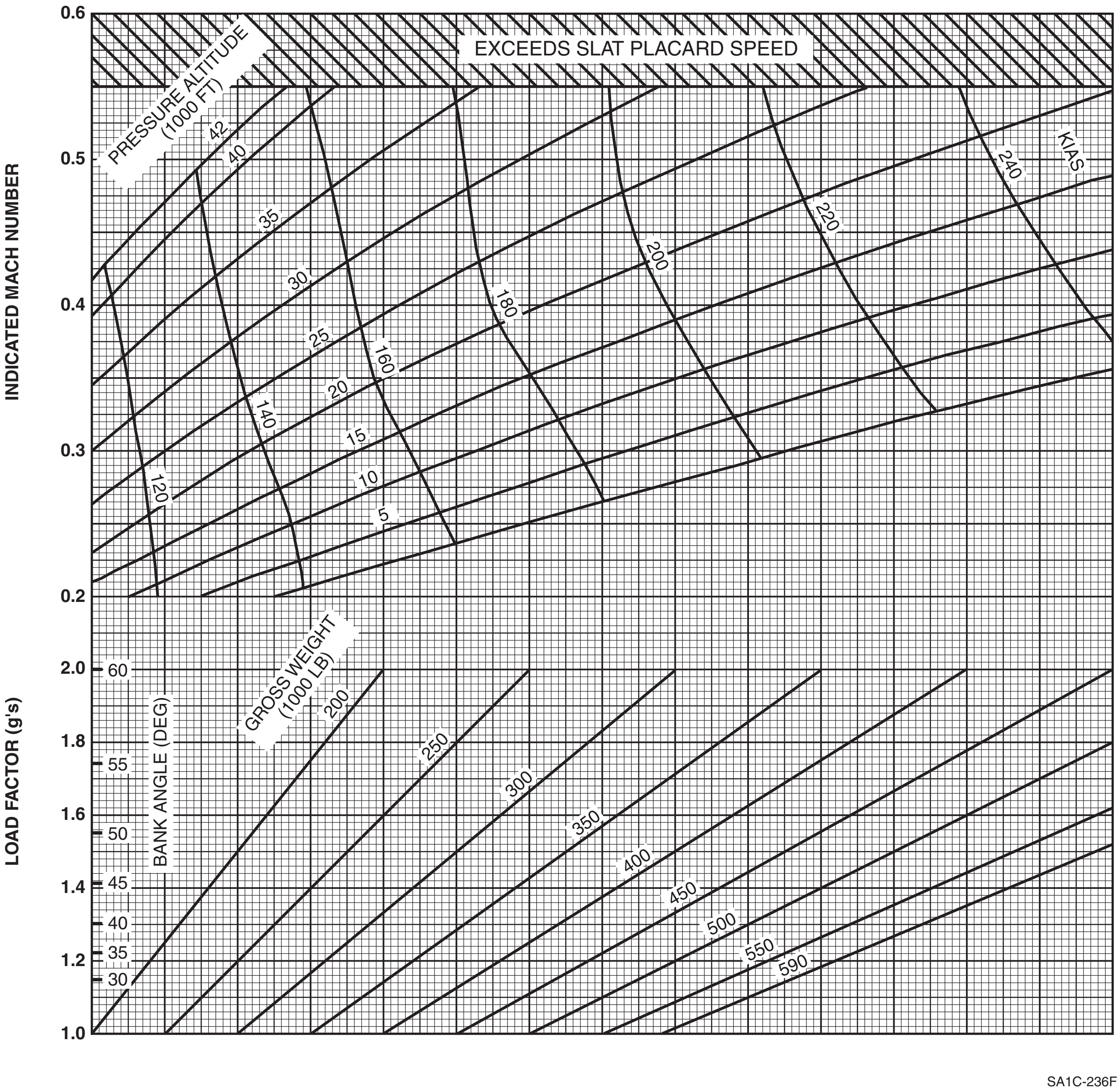


Figure 1-10.

CRUISE BUFFET-ONSET BOUNDARY - FLAPS AND SLATS EXTENDED

NOTE:

1. SLATS EXTENDED TO THE TAKEOFF POSITION
2. CG = 24% MAC. INCREASE COMPUTED SPEED BY 0.5 KIAS PER ONE PERCENT FORWARD MOVEMENT OF THE CG. DECREASE SPEED BY 0.3 KIAS PER ONE PERCENT AFT MOVEMENT OF THE CG
3. TO COMPUTE MINIMUM AIR REFUELING SPEED. ADD 5.0 KIAS TO THE 1.2G BUFFET SPEED
4. TO COMPUTE MINIMUM AIR REFUELING SPEED, WHENEVER WING AERIAL REFUELING PODS ARE INSTALLED, ADD 10 KIAS TO THE 1.2G BUFFET SPEED (WITH TCTO 1C-10(K)A-956)

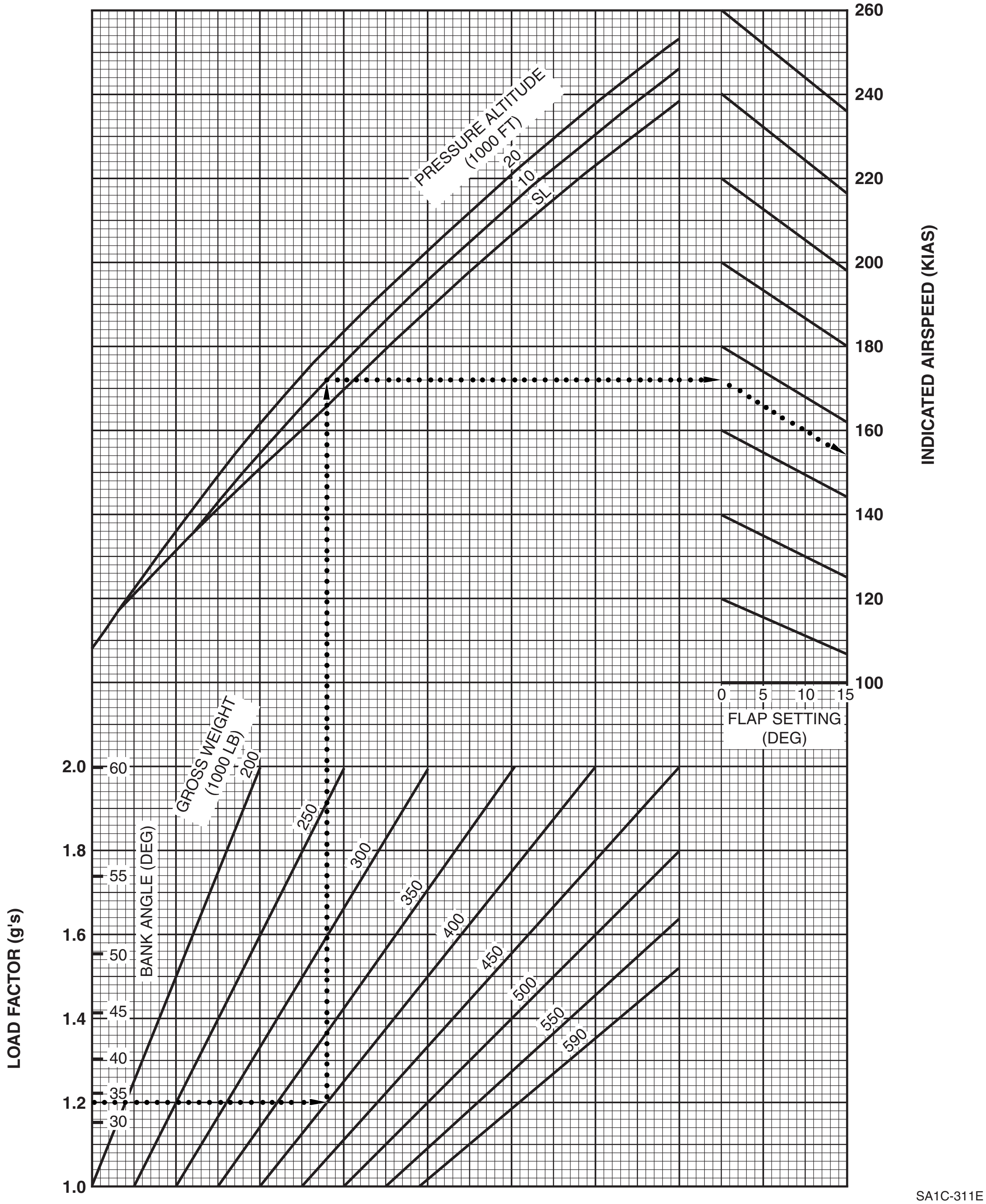


Figure 1-11.

STICK SHAKER ACTUATION SPEEDS SLATS RETRACTED

NOTE:
1. CG = 8% MAC
2. VALID FROM SEA LEVEL TO 20,000 FT

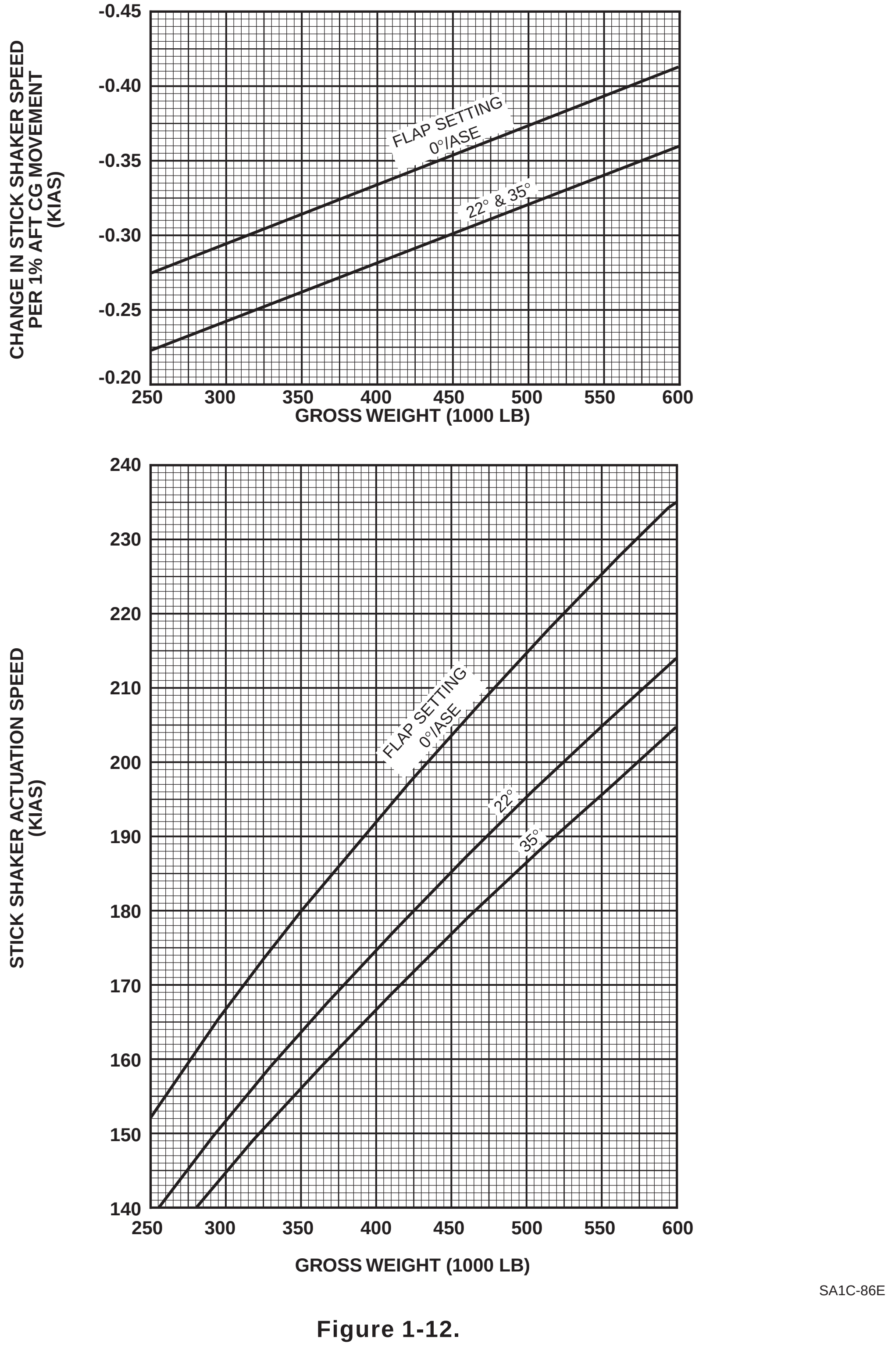


Figure 1-12.

STICK SHAKER ACTUATION SPEEDS SLATS EXTENDED

NOTE:
1. CG = 8% MAC
2. VALID FROM SEA LEVEL TO 15,000 FT

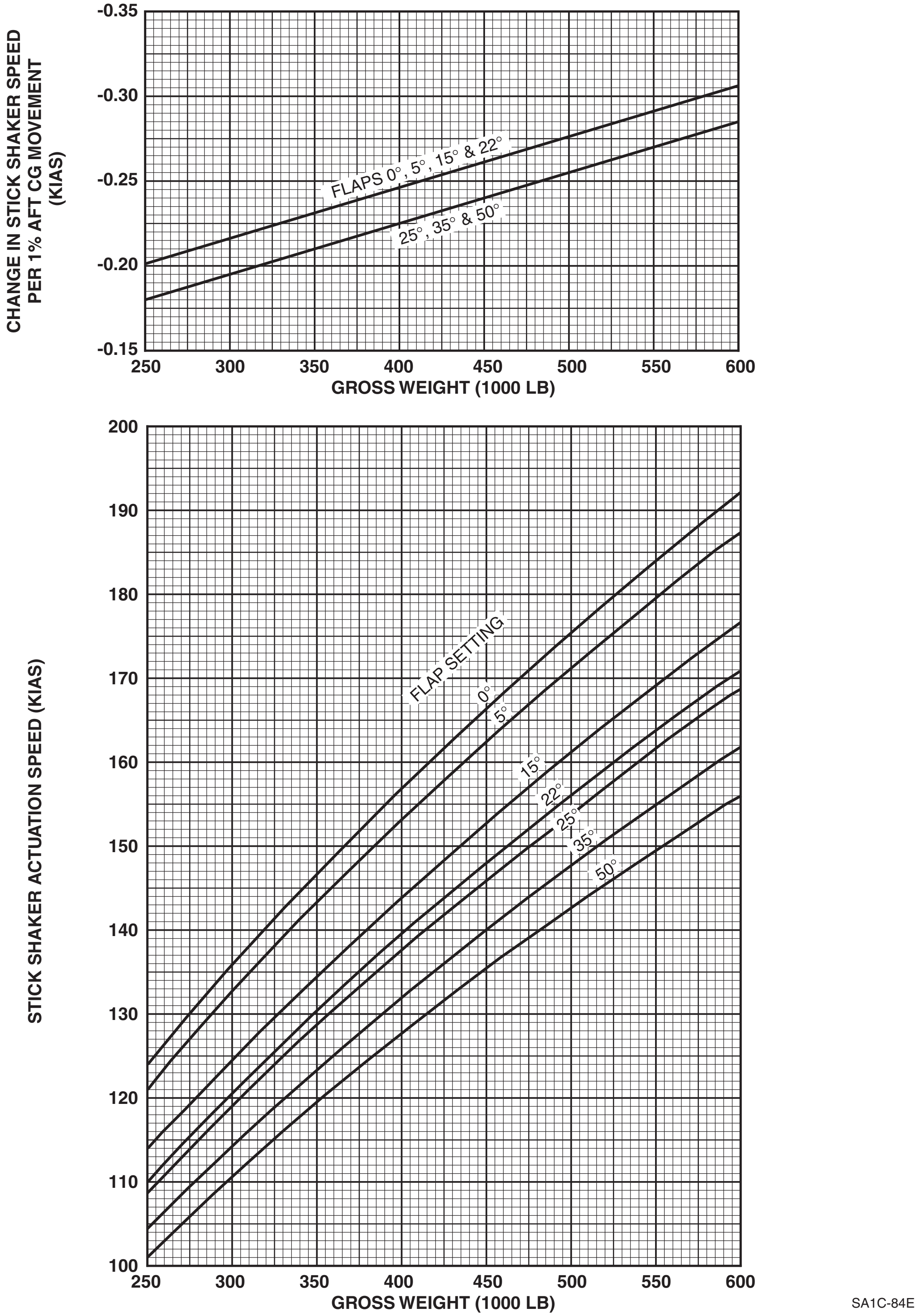


Figure 1-13.

DRAG INDEX TABLE

NOTE:

- THE FOLLOWING TABLE PROVIDES DRAG INDEX VALUES REFLECTING THE ADDITIONAL DRAG FOR CONFIGURATION DEVIATIONS FROM THE CLEAN CONFIGURATION
- USE WING AIR REFUELING PODS INSTALLED DRAG INDEX FOR RANGE AND TIME ONLY

ITEM	NUMBER OF ITEMS	DRAG INDEX PER ITEM
AIR REFUELING BOOM DEPLOYED	1	16.5
HOSE AND DROGUE DEPLOYED	1	8.0
ARO SIGHTING DOOR OPEN	1	2.0
UARRSI AND LIGHT REFLECTOR DOORS OPEN	1	1.0
MAIN LANDING GEAR “FLIPPER” DOORS MISSING	2	1.3
MAIN LANDING GEAR STRUT DOORS MISSING	2	8.3
APU EXHAUST DOOR MISSING (APU MAY NOT BE OPERATED)	1	0.3
APU INLET DOOR MISSING (APU NOT OPERATING)	1	1.5
APU INLET DOOR MISSING (APU OPERATING)	1	0.0
AFT LAVATORY SERVICE PANEL DOOR MISSING	1	0.5
OTHER SERVICE OR CONTROL PANEL DOORS MISSING	8	0.3
AFT CORE COWL SLOW-OUT DOORS MISSING	6	0.8
WING PYLON TRAILING EDGE ACCESS PANELS MISSING	2	3.1
LANDING GEAR DOOR SEALS MISSING	18	0.1
FIXED THRUST REVERSER SEALS MISSING	3	0.2
TAIL CONE HINGE FAIRINGS MISSING	2	0.5
INBOARD FLAP TRACK FAIRINGS MISSING	2	1.2
REVERSER TRACK FAIRINGS MISSING	12	0.1
AIR DRIVEN GENERATOR WITH POWER EXTRACTION	1	2.5
NIGHT (ENHANCED A/R) LIGHTING INSTALLATIONS	1	0.2
LOWER STABILIZER SPRING FAIRINGS MISSING	2	1.5
LOWER SLAT TRACK COVERS MISSING	36	0.4
UPPER SLAT TRACK COVERS MISSING	38	3.8
UPPER SLAT ICE PROTECTION TELESCOPING DUCT COVERS MISSING	2	3.8
WING AIR REFUELING PODS INSTALLED (WITH TCTO 1C-10(K)A-956)		
A. Clean wing, Hose and Drogue Retracted	2	5.0
B. Slats or Slats/Flaps Extended, Hose and Drogue Retracted	2	19.0
C. Clean wing, Hose and Drogue Deployed	2	13.5
D. Slats or Slats/Flaps Extended, Hose and Drogue Deployed	2	27.5

SA1C-271G

Figure 1-14.

SECTION II

ENGINE DATA

TABLE OF CONTENTS

Page

LIST OF CHARTS

INTRODUCTION

The charts presented in this section give the N_1 setting for each rated thrust level, the N_1 setting for full reverse thrust, and the N_1 setting data for reduced takeoff thrust operation. Also provided is a chart to convert outside air temperature to total air temperature.

DEFINITION OF TERMS

TAKEOFF RATED THRUST (TRT)

Takeoff rated thrust provides the maximum thrust available. It is used only for takeoff (set on the runway) and is time-limited to ten minutes of continuous use in the event of an engine failure. Under normal conditions (all engines operating), it is time-limited to five minutes continuous use.

GO-AROUND THRUST

This rating provides the maximum thrust available during approach and landing. The Go-Around N_1 accounts for changes in N_1 from the takeoff values due to ram effects which occur with increase in airspeed. This rating is also time-limited to ten minutes of continuous use in the event of an engine failure. Under normal conditions (all engines operating), GA thrust is limited to five minutes of continuous use.

MAXIMUM CONTINUOUS RATED THRUST

The Maximum Continuous rating is used if one or more engines are inoperative. It may also be used during refueling operations.

MAXIMUM CLIMB RATED THRUST

The Maximum Climb rating provides thrust at the maximum N_1 approved for normal climb. The turbine inlet temperature for this rating is lower than that for the Maximum Continuous rating.

MAXIMUM CRUISE RATED THRUST

The Maximum Cruise rating is the maximum thrust recommended for three engines operating during normal cruise.

REVERSE THRUST SETTING

Reverse thrust is available as an additional retarding force for slowing the airplane during rejected takeoff and landing roll. The reverse thrust N_1 setting curve presents data for full reverse-thrust operation.

REDUCED TAKEOFF THRUST

Reduced takeoff thrust is a reduced level of thrust compared to takeoff rated thrust. The takeoff rated thrust N_1 settings are reduced to provide a lower level of thrust sufficient to meet the mission requirements. Reduced takeoff thrust may be used if the airplane has more takeoff weight capability than is required to perform the mission. The use of reduced takeoff thrust is discussed in Section III.

NORMALIZATION SPEEDS

The N_1 setting curves were derived at speeds that are typical for operation at each engine rating. The normalization speeds for the CF6-50C2 N_1 setting curves are as follows:

NOTE

Landings and unplanned go-arounds are allowed at outside temperatures up to a maximum of 55°C.

RATING	NORMALIZATION SPEED
TRT	60 KIAS
GA	180 KIAS
MCT	250 KIAS/.82 MACH
MCL	250 KIAS TO 10,000 FT. 320 KIAS/.83 MACH ABOVE 10,000 FT.
MCR	375 KIAS/.83 MACH

NORMAL BLEED

Normal bleed operation is defined as air-conditioning on, ice protection off, bleed air for lavatory and galley ventilation, and shaft-power extraction for airplane hydraulic and electrical power requirements. Corrections are provided to account for other bleed operation.

FACTORS AFFECTING ENGINE PERFORMANCE

TEMPERATURE

Engine rated thrust of the CF6-50C2 engines is flat rated for temperatures up to the break temperature. Flat rated thrust refers to the portion of the temperature-thrust graph that does not vary with temperature. This portion extends from the coldest temperatures up to the break temperature, and is at a value that is below the maximum available thrust level for these temperatures. Above the break temperature, the engine thrust decreases as the temperature increases. This is because in actuality the highest thrust level that can be achieved always decreases as temperature increases. Therefore, the break temperature is simply the point of intersection between the line for maximum thrust and the flat rated thrust line. The flat rated thrust level increases with altitude, thus the break temperature becomes a function of pressure altitude.

NOTE

Landings and unplanned go-arounds are allowed at outside temperatures up to a maximum of 55°C.

PRESSURE ALTITUDE

Engine thrust is affected by pressure altitude due to the change in air density at altitude. The engine thrust decreases as the altitude increases.

BLEED AIR FOR SYSTEMS OPERATION

The use of bleed air for systems operation reduces the available thrust for a given rating; an exception to this is takeoff with wing ice protection on. In this case, the thrust increases because the N_1 additive is positive. This is a special case and was necessary to satisfy aircraft manufacturer CF6-50C2 takeoff thrust setting parameters with wing anti-ice on.

When one or more engine cowl anti-ice valves are inoperative in the open position (MEL item), turn the associated anti-ice valve switch(es) "ON" before takeoff. If the outside air temperature is greater than 8°C, apply the performance penalties found in Section 3 of this manual.

VELOCITY

Engine thrust varies with velocity such that the available thrust decreases as the airplane velocity increases.

CHART EXPLANATION AND EXAMPLE PROBLEMS

N_1 SETTINGS FOR RATED THRUST

Figures 2-1 through 2-5 present N_1 settings for various rated thrust levels. The charts are constructed based on normal bleed usage, with corrections provided for other bleed usage.

The charts are entered with temperature and read up to the appropriate pressure altitude line to determine N_1. The data are presented versus total air temperature (TAT) except for takeoff rated thrust, which is presented versus outside air temperature.

On the Maximum Continuous, Maximum Climb, and Maximum Cruise curves, the altitude lines reverse their trend at the tropopause (36,089 feet). Ratings are normally devised to keep turbine temperature constant. In order to maintain constant turbine temperatures above the tropopause, the N_1 settings must be lowered.

Example 1:

Given:

Total Air Temperature = -35°C

Normal bleed

Pressure Altitude = 4,000 Feet

Find:

N_1 Setting for Go-Around Rated Thrust

Solution:

Enter figure 2-2 with -35°C and read up to the altitude of 4,000 feet. The N_1 setting is 102.5%.

N_1 SETTING FOR MAXIMUM REVERSE THRUST

Figure 2-6 presents the N_1 settings which provide the maximum reverse thrust. The N_1 setting is a function of total air temperature. Data are presented for normal bleed and for all bleeds off.

Example 2:

Given:

Total Air Temperature = -37°C

Normal bleed

Find:

N_1 Setting for Maximum Reverse Thrust

Solution:

Enter figure 2-6 with the total air temperature and use the normal bleed line. The N_1 setting for maximum reverse thrust is 95%.

N_1 SETTING FOR REDUCED TAKEOFF THRUST

The N_1 setting data for reduced takeoff thrust are provided in figure 2-7 for air-conditioning on and in figure 2-8 for air-conditioning off. The N_1 setting curves for reduced takeoff thrust are similar in appearance to N_1 setting curves for rated thrust, but this is deceptive - the charts are very different.

The N_1 setting curves for reduced takeoff thrust are used by making two temperature entries, first at the assumed temperature (refer to Section III) and also at the actual outside air temperature. Extend the assumed temperature entry up to the N_1 cutoff line, then follow the guidelines until an intercept point with the outside air temperature entry is reached. At this point, read the N_1 setting for reduced takeoff thrust on the vertical scale.

NOTE

- If engine, or engine and wing ice protection is required, reduce the assumed temperature by 3 degrees C before determining the Reduced Thrust Takeoff N_1 setting.
- If wing ice protection is required, add a ΔN_1 of one percent to the N_1 setting for reduced takeoff thrust.

Example 3:

Given:

Outside Air Temperature = -5°C

Assumed Temperature = 45°C

Pressure Altitude = Sea Level

Air-conditioning Off

Find:

N_1 Setting for Reduced Takeoff Thrust

Solution:

Make two temperature entries to figure 2-8, at -5°C and 45°C. From 45°C, read up to the N_1 cutoff line for sea level. Follow the guidelines down until the outside air temperature scale is -5°C. The N_1 setting for reduced takeoff thrust is 101.9%.

OUTSIDE AIR TEMPERATURE VS TOTAL AIR TEMPERATURE CONVERSION

The total air temperature is dependent upon the outside air temperature and the velocity of the airplane. Figure 2-9 presents OAT vs TAT as a function of Mach number.

Example 4:

Given:

Outside Air Temperature = 10°C

Mach Number = 0.40

Find:

Total Air Temperature

Solution:

Enter figure 2-9 with the outside air temperature of 10°C and read in to the 0.40 Mach number line. The total air temperature is 19°C.

N_1 SETTING FOR TAKEOFF THRUST SET BETWEEN 40 AND 80 KNOTS

NOTE:

1. ONE, TWO, OR THREE ENGINES OPERATING
2. ONE AIR-CONDITIONING PACK PER WING ENGINE "ON", LAVATORY AND GALLEY VENTILATION BLEEDS "ON", ENGINE ICE PROTECTION "ON" OR "OFF" AND WING ICE PROTECTION "OFF"
3. FOR OTHER BLEED CONDITIONS APPLY APPROPRIATE CORRECTIONS SHOWN
   A. ENGINE BLEED FOR AIR-CONDITIONING PACKS "OFF" AND LAVATORY AND GALLEY VENTILATION BLEEDS "ON" OR "OFF"
   F. WING ICE PROTECTION "ON"
4. FOR ENGINE ICE PROTECTION "ON" WHEN OAT IS GREATER THAN 8°C, DECREASE N_1 BY 0.5%.

CAUTION

- **N_1 SETTING NOT TO EXCEED 117%**
- **TAKEOFF THRUST SET BETWEEN 40 AND 80 KNOTS MAY NOT BE USED HIGHER THAN 2000 FT PRESSURE HEIGHT ABOVE THE AIRFIELD PRESSURE ALTITUDE**

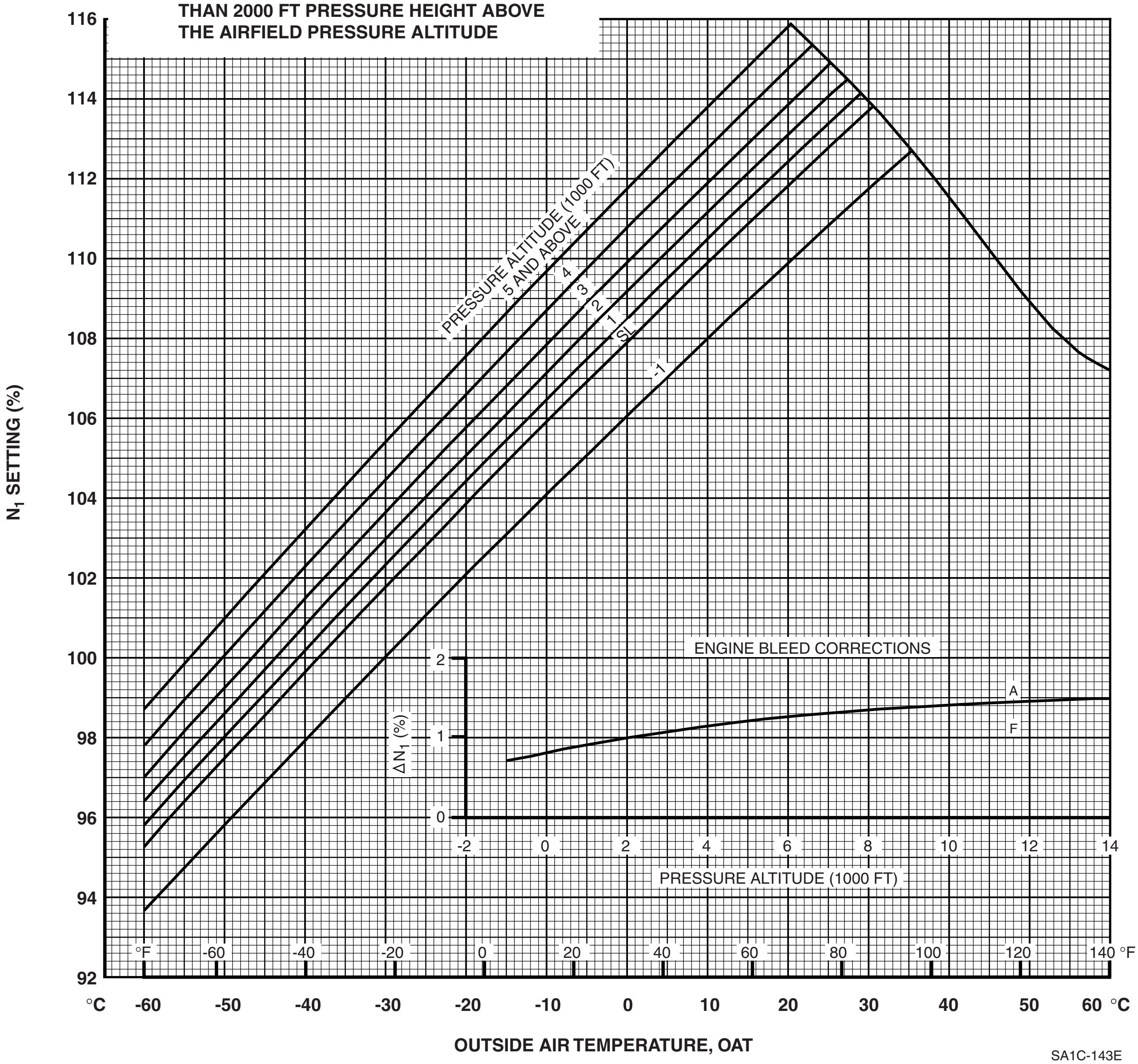
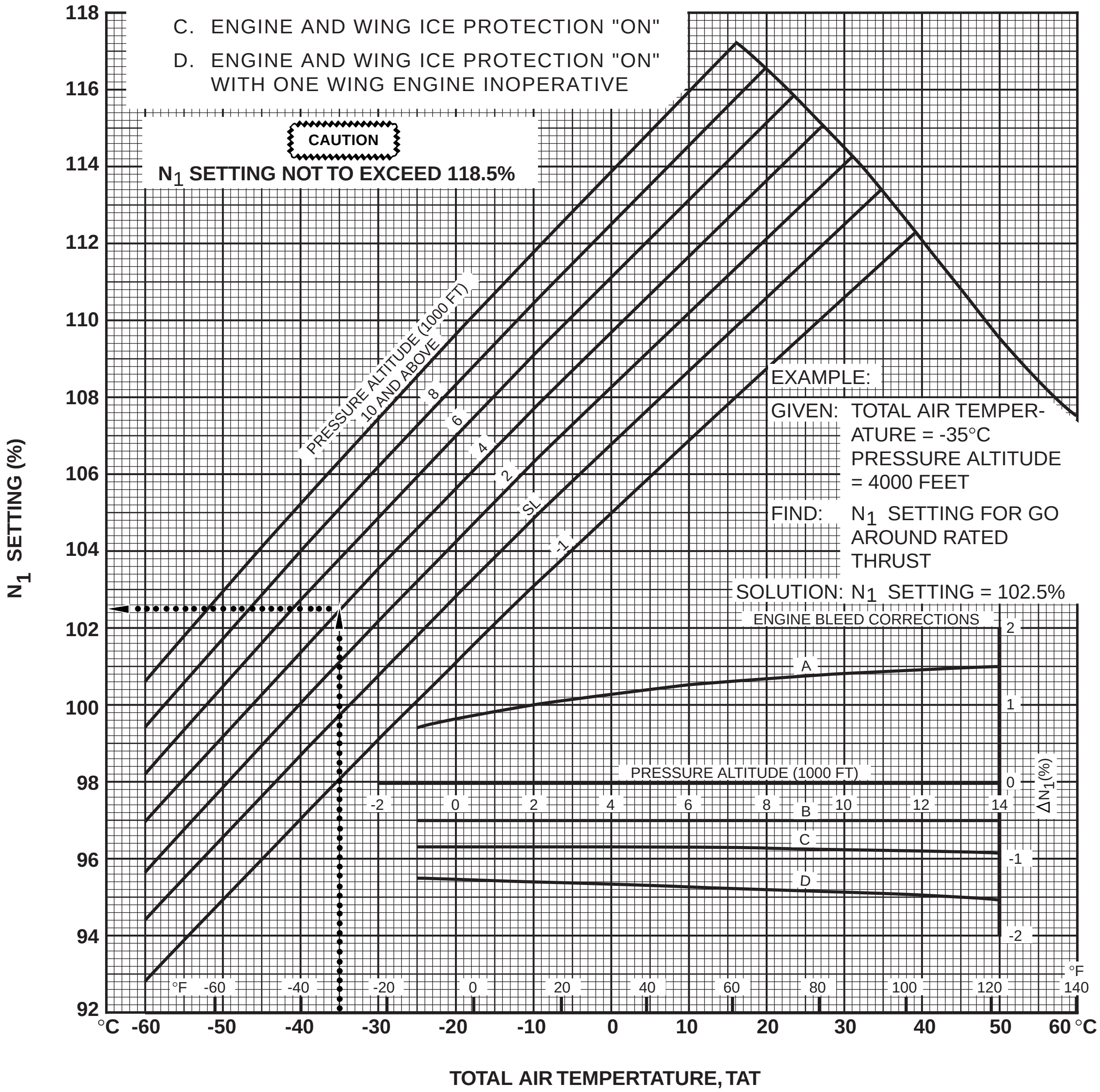


Figure 2-1.

N_1 SETTING FOR GO-AROUND THRUST

NOTE:

1. ONE, TWO, OR THREE ENGINES OPERATING INFLIGHT SETTING
2. ONE AIR-CONDITIONING PACK PER WING ENGINE "ON", LAVATORY AND GALLEY VENTILATION BLEEDS "ON", ENGINE ICE PROTECTION "OFF" AND WING ICE PROTECTION "OFF"
3. FOR OTHER ENGINE BLEED CONDITIONS APPLY APPROPRIATE CORRECTIONS SHOWN
   - A. ENGINE BLEED FOR AIR-CONDITIONS PACKS "OFF" AND LAVATORY AND GALLEY VENTILATION BLEEDS "ON" OR "OFF"
   - B. ENGINE ICE PROTECTION "ON"
   - C. ENGINE AND WING ICE PROTECTION "ON"
   - D. ENGINE AND WING ICE PROTECTION "ON" WITH ONE WING ENGINE INOPERATIVE



SA1C-144E

Figure 2-2.

N_1 SETTING FOR MAXIMUM CONTINUOUS THRUST

NOTE:

1. ONE OR TWO ENGINES OPERATING INFLIGHT SETTING OR FOR USE DURING REFUELING
2. ONE AIR CONDITIONING PACK PER WING ENGINE "ON" LAVATORY AND GALLEY VENTILATION BLEEDS "ON" AND ENGINE AND WING ICE PROTECTION "OFF"
3. FOR OTHER ENGINE BLEED CONDITIONS APPLY APPROPRIATE CORRECTIONS SHOWN
   - A. ENGINE BLEED FOR AIR CONDITIONING PACKS "OFF" AND LAVATORY AND GALLEY VENTILATION BLEEDS "ON" OR "OFF"
   - B. ENGINE ICE PROTECTION "ON"
   - C. ENGINE AND WING ICE PROTECTION "ON"
   - D. ENGINE AND WING ICE PROTECTION "ON" WITH ONE WING ENGINE INOPERATIVE

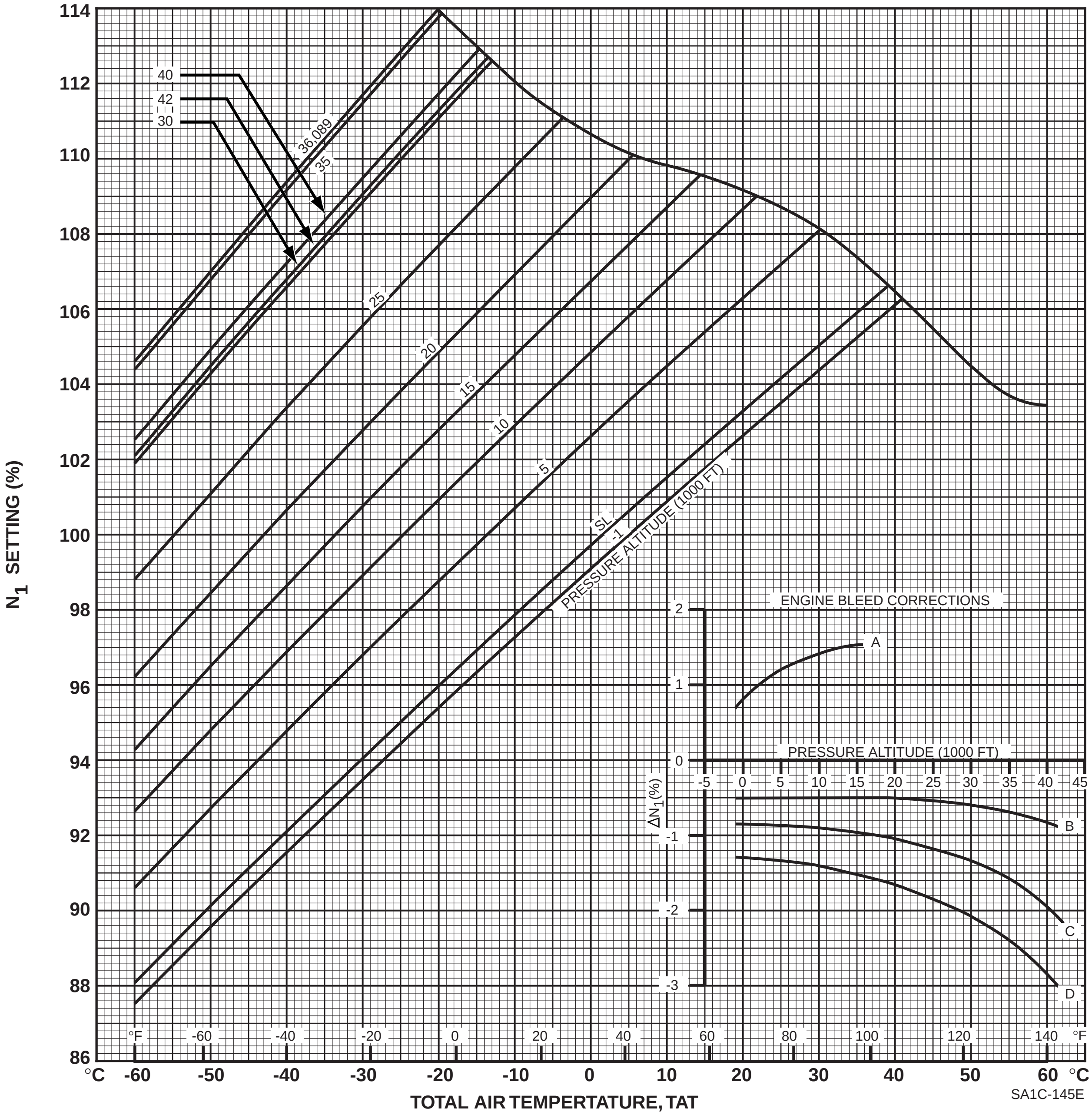


Figure 2-3.

N_1 SETTING FOR MAXIMUM CLIMB THRUST

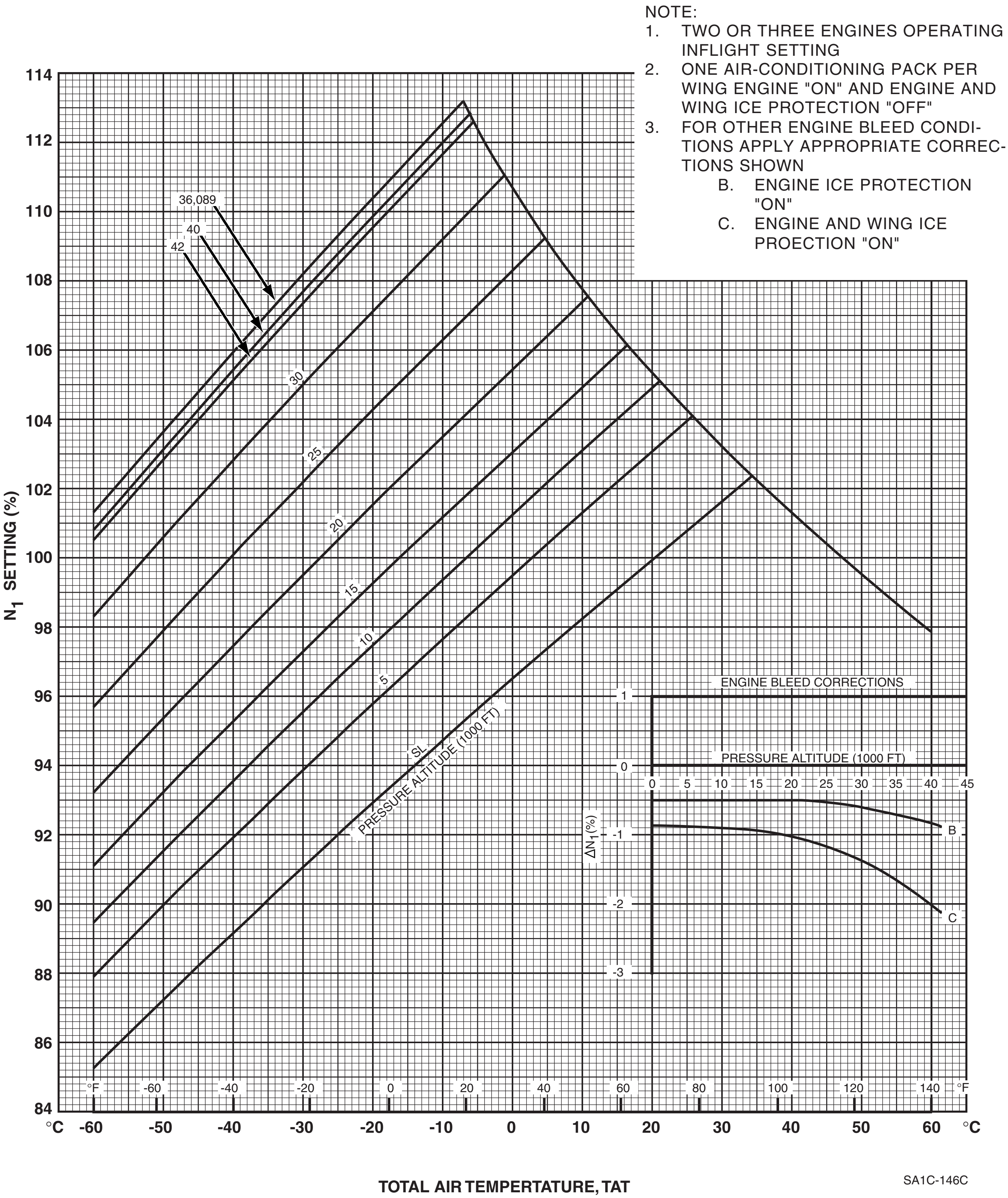


Figure 2-4.

N_1 SETTING FOR MAXIMUM CRUISE THRUST

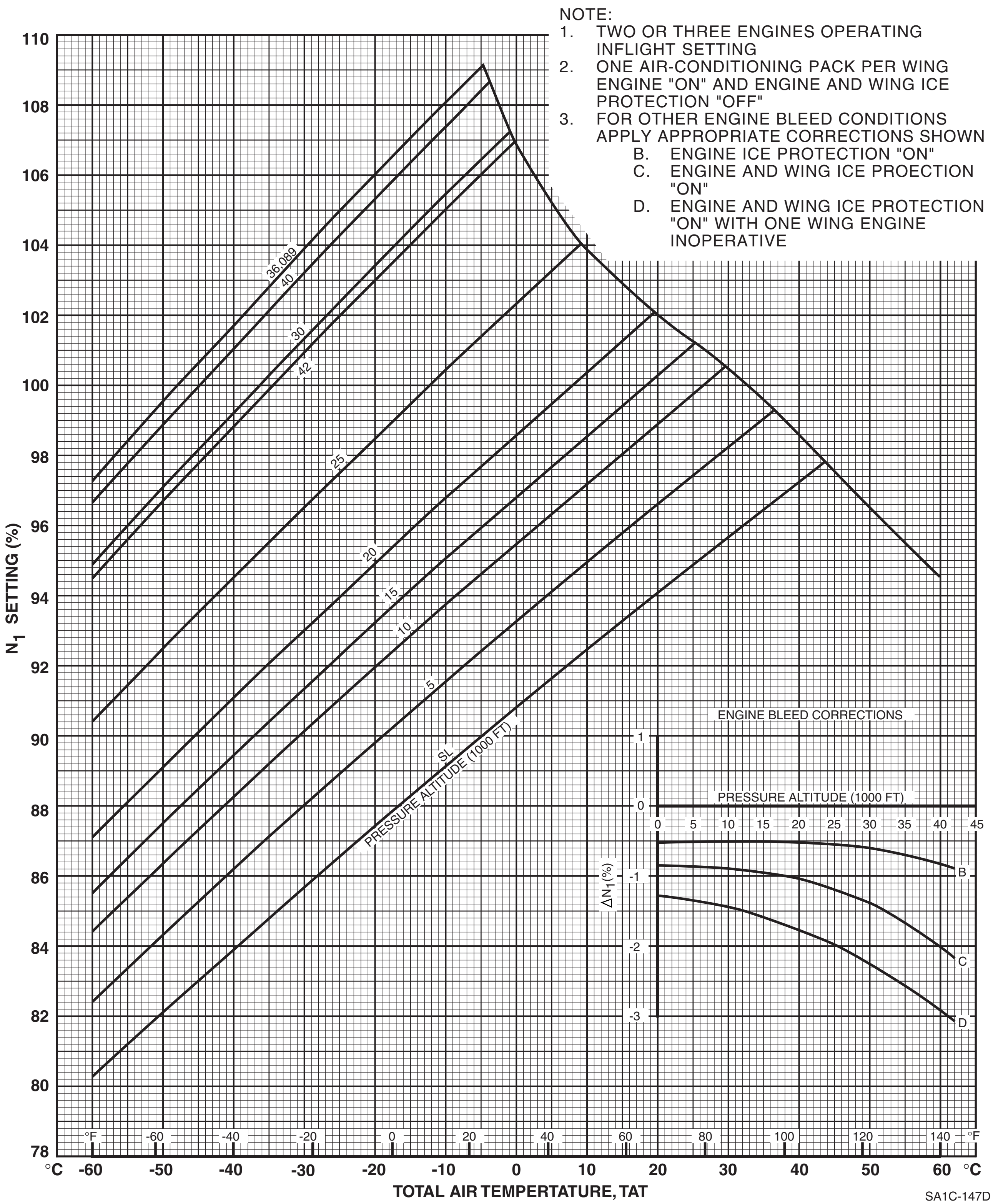


Figure 2-5.

N_1 SETTING FOR MAXIMUM REVERSE THRUST

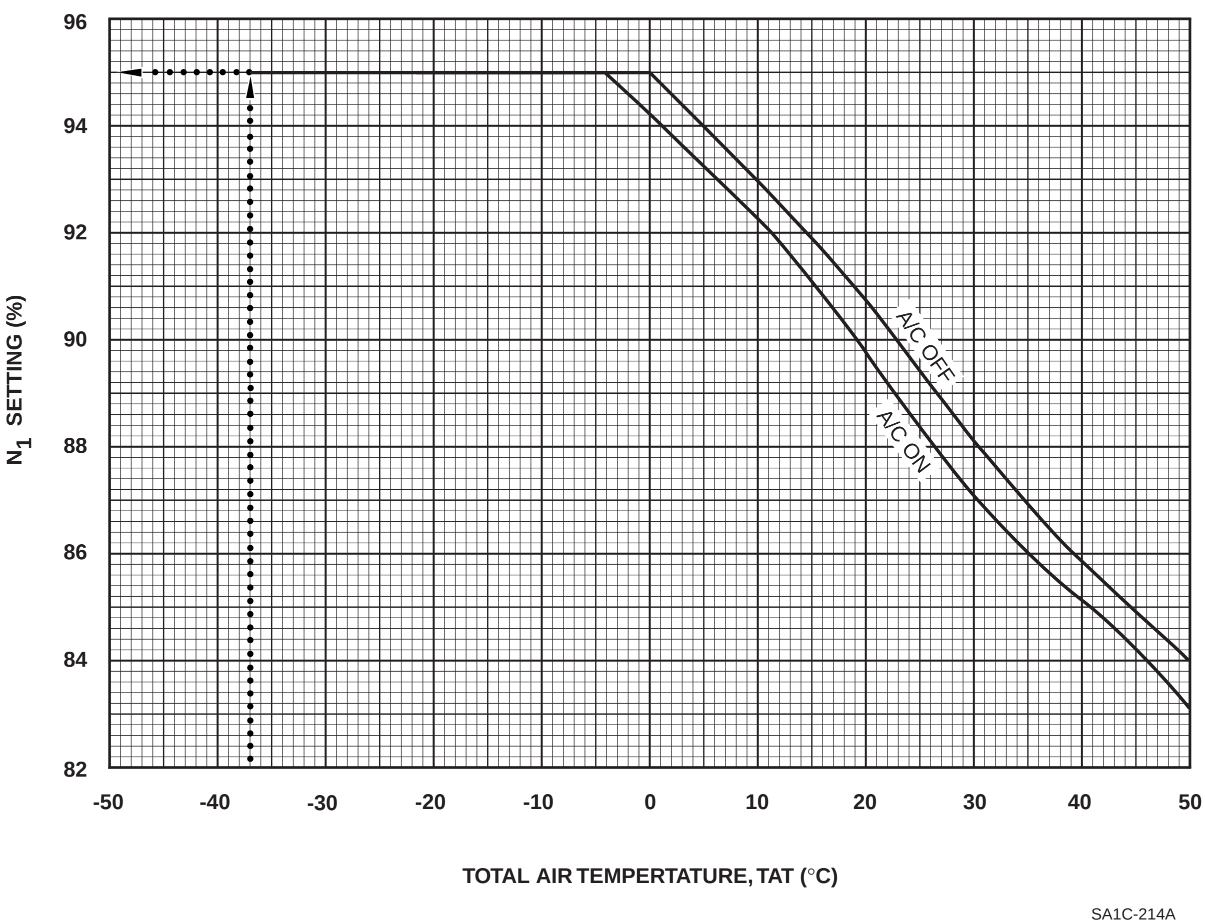


Figure 2-6.

N_1 SETTING FOR REDUCED TAKEOFF THRUST SET BETWEEN 40 AND 80 KNOTS AIR CONDITIONING PACKS "ON"

NOTE:
1. THREE ENGINES OPERATING
2. ENGINE BLEED FOR AIR-CONDITIONING PACKS "ON" AND LAVATORY AND GALLEY VENTILATION BLEEDS "ON'
3. VALID FROM SEA LEVEL TO 14,000 FEET
4. THE ASSUMED TEMPERATURE MUST BE EQUAL TO OR GREATER THAN THE THRUST FLAT RATED (BREAK) TEMPERATURE AT THE RESPECTIVE ALTITUDE:

ALTITUDE (FT)	°C	ALTITUDE (FT)	°C
SL	30	3000	25
1000	29	4000	23
2000	27	5000 TO 14,000	20

5. IF ENGINE OR ENGINE AND WING ICE PROTECTION IS REQUIRED, REDUCE THE ASSUMED TEMPERATURE BY 3°C BEFORE DETERMINING THE DERATED N_1
6. FOR WING ICE PROTECTION ON, INCREASE THE N_1 BY 1.0%
7. WHEN USING THE "TO FLX" (FLEXIBLE TAKEOFF) MODE OF THE THRUST COMPUTER, SET THE TAKEOFF ASSUMED TEMPERATURE IN THE "ASSUMED TEMP" SELECTOR. IF ENGINE ANTI-ICE IS USED, SET THE ASSUMED TEMPERATURE USED TO DETERMINE THE REDUCED THRUST TAKEOFF N_1 SETTING

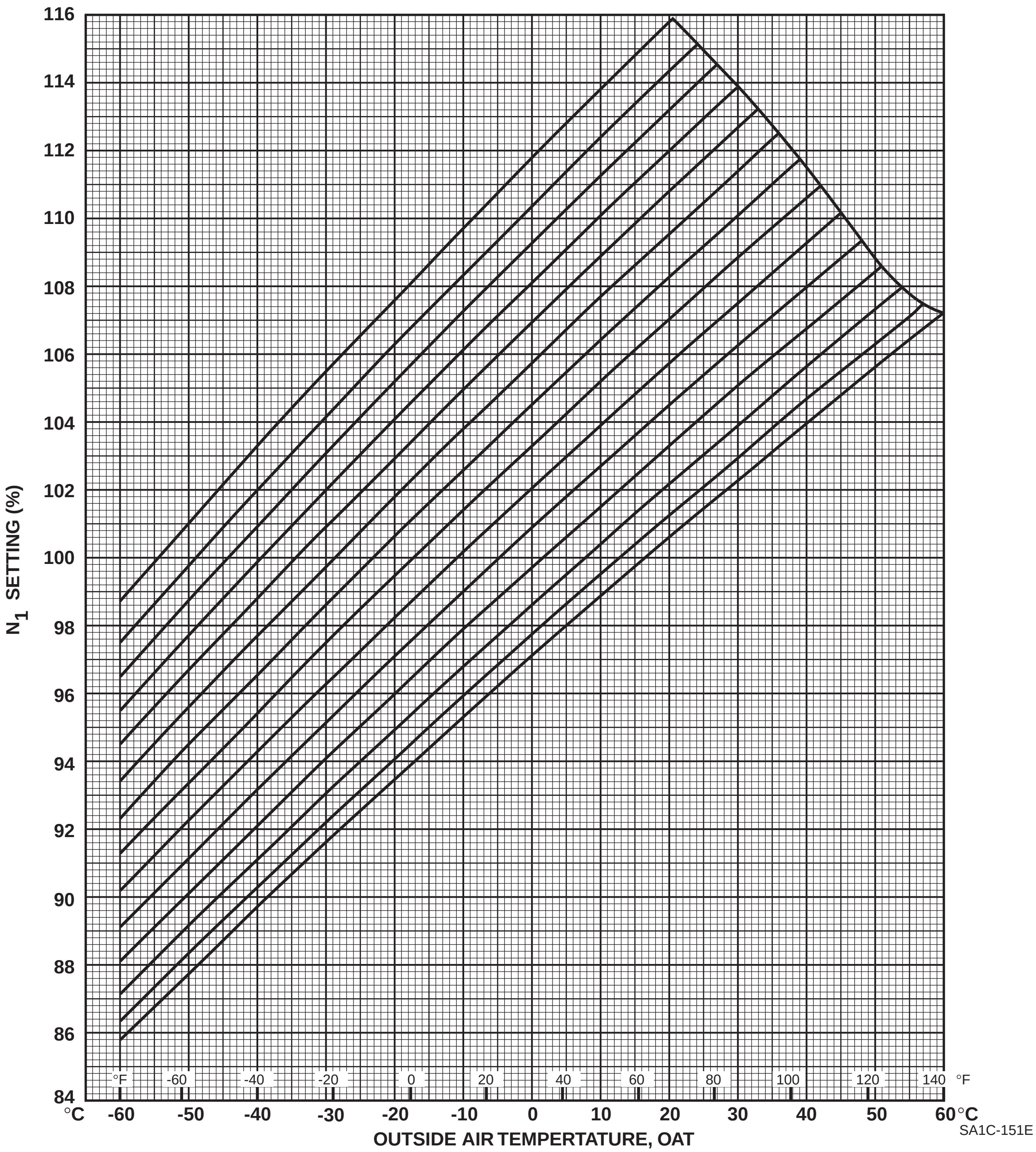


Figure 2-7.

N_1 SETTING FOR REDUCED TAKEOFF THRUST SET BETWEEN 40 AND 80 KNOTS AIR CONDITIONING PACKS "OFF"

NOTE:

1. THREE ENGINES OPERATING
2. ENGINE BLEED FOR AIR-CONDITIONING PACKS "OFF" AND LAVATORY AND GALLEY VENTILATION BLEEDS "ON" OR "OFF"
3. VALID FROM SEA LEVEL TO 14,000 FEET
4. THE ASSUMED TEMPERATURE MUST BE EQUAL TO OR GREATER THAN THE THRUST FLAT RATED (BREAK) TEMPERATURE AT THE RESPECTIVE ALTITUDE:

ALTITUDE (FT)	°C	ALTITUDE (FT)	°C
SL	30	3000	25
1000	29	4000	23
2000	27	5000 TO 14,000	20

5. IF ENGINE OR ENGINE AND WING ICE PROTECTION IS REQUIRED, REDUCE THE ASSUMED TEMPERATURE BY 3°C BEFORE DETERMINING THE DERATED N_1
6. FOR WING ICE PROTECTION ON, INCREASE THE N_1 BY 1.0%
7. WHEN USING THE "TO FLX" (FLEXIBLE TAKEOFF) MODE OF THE THRUST COMPUTER, SET THE TAKEOFF ASSUMED TEMPERATURE IN THE "ASSUMED TEMP" SELECTOR. IF ENGINE ANTI-ICE IS USED, SET THE ASSUMED TEMPERATURE USED TO DETERMINE THE REDUCED THRUST TAKEOFF N_1 SETTING

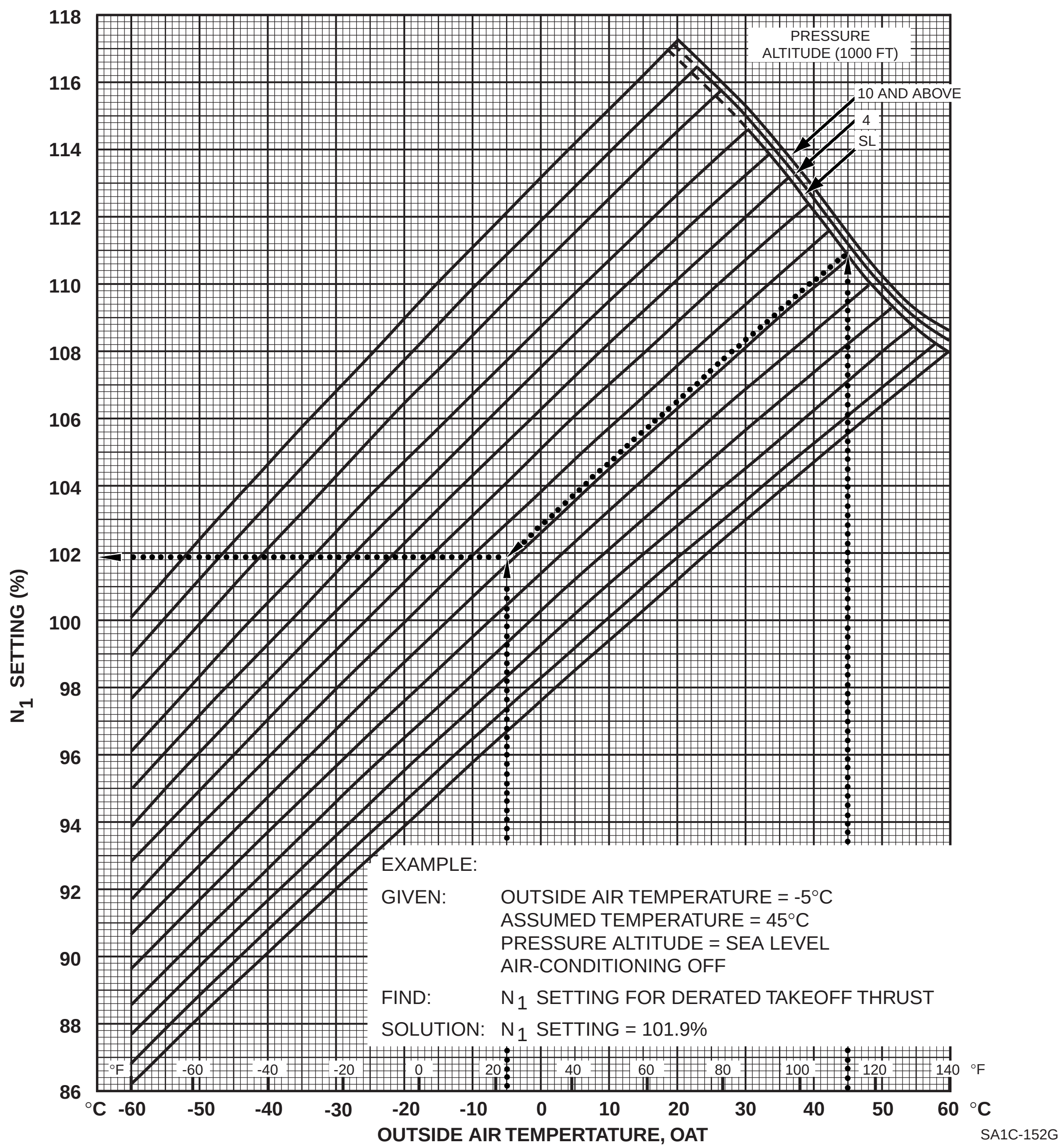


Figure 2-8.

OUTSIDE AIR TEMPERATURE VS TOTAL AIR TEMPERATURE CONVERSION

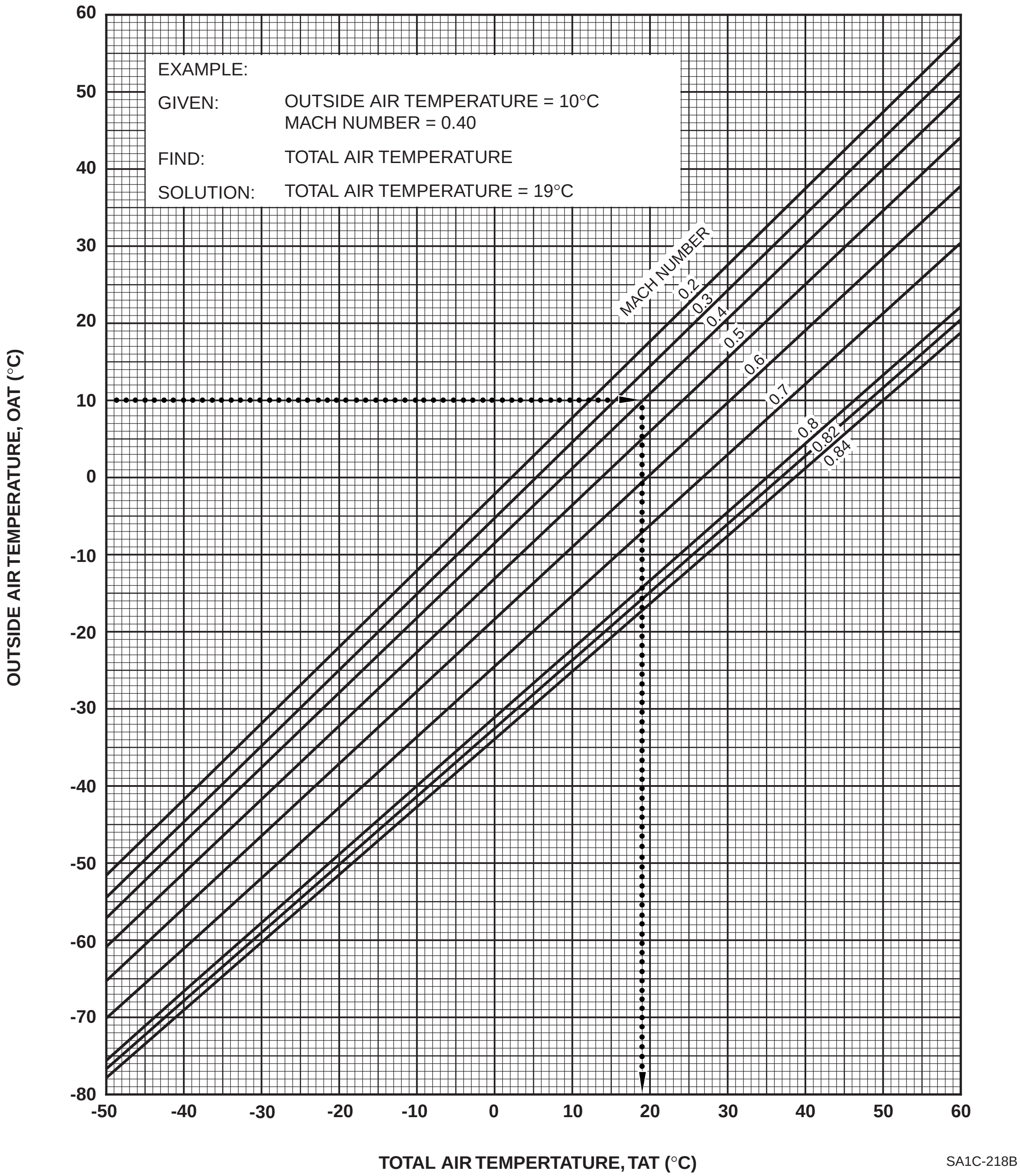


Figure 2-9.

SECTION III
TAKEOFF

TABLE OF CONTENTS

LIST OF CHARTS

LIST OF CHARTS (Continued)

INTRODUCTION

The charts and tables in this section provide the information necessary to determine the takeoff and climbout performance of the airplane. Data are included to determine the optimum flap and MTOGW, climb gradient limiting weight, obstacle clearance, takeoff speeds, brake energy, tire speed, minimum control speed limits and stabilizer settings. Data are presented for a complete range of weights, altitudes, temperatures, flap settings, winds, and runway slopes plus corrections for runway condition reading (RCR) and runway surface condition (RSC) where appropriate. Correction factors to takeoff performance are provided for reduced braking and center-gear-retracted operations. All performance data (except minimum control speeds) are based on the maximum thrust available from the engines for a particular N_1 setting. Minimum control speeds are based on the maximum thrust available at a given N_1 setting. Complete takeoff planning data, including reduced thrust operation, are also provided. Takeoff data is based on acceleration on all three engines, experience an engine failure at V_1, continuing the takeoff on remaining two engines and lifting off at the end of computed CFL. Performance criteria is based on being at "0" feet at the end of CFL.

DEFINITION OF TERMS

TAKEOFF GROSS WEIGHT (TOGW)

Takeoff gross weight is the actual weight of the airplane at brake release.

MAXIMUM TAKEOFF GROSS WEIGHT AT OPTIMUM TAKEOFF FLAP SETTING (MTOGW)

Maximum takeoff gross weight at optimum takeoff flap setting is the highest weight which satisfies both runway available limiting weight and climb gradient limiting weight. The actual takeoff gross weight of the airplane may be restricted to a weight less than the maximum takeoff gross weight due to other takeoff weight requirements, such as tire speed, brake energy, etc.

RUNWAY LENGTH (RL) AND RUNWAY AVAILABLE (RA)

The runway length is the actual paved length of the runway. The runway available is the runway length minus the alignment distance and runway reductions required for obstacle clearance.

RCR

The runway condition reading (RCR) is a measure of coefficient of friction between the tire and runway surface and is used to define the surface condition to establish the stopping capability of the airplane.

CORRECTION FACTOR FOR CONFIGURATION CHANGES (CFCC)

The correction factor for configuration changes (CFCC) is a parameter which determines the stopping capability with various airplane deceleration devices inoperative or a configuration change which affects the stopping capability. The CFCC grid is provided only on takeoff charts that are based on RCR 23 to 18. When utilizing CFCC, RCR correction will not be used.

EQUIVALENT FIELD LENGTH (EFL)

Equivalent field length is the runway available corrected for actual aircraft and runway conditions. This length is used to determine runway available limiting weight.

NOTE

EFL can be greater or less than RA.

CRITICAL FIELD LENGTH (CFL)

The critical field length is the distance required to accelerate with all engines operating to the critical engine failure speed and then either continue to accelerate to the liftoff speed with two engines operating, or stop in the same distance.

RUNWAY AVAILABLE LIMITING WEIGHT (RALW)

The runway available limiting weight is the weight at which the critical field length equals the runway available.

CLIMB GRADIENT

The climb gradient is the ratio of the change in height to the distance traveled in steady climbing flight with zero wind. The label "GROSS CLIMB GRADIENT" appearing on the obstacle charts only occurs at the instant the gear is fully retracted during takeoff with a failed engine. It is used as a reference value for determining a given flight path altitude-distance profile on the climbout flight path charts. The reference gradient is used to relate a given flight path altitude-distance profile to a maximum takeoff gross weight.

WARNING

> This gradient is not a ratio or percentage of actual flight path height to flight path distance, and must not be used to verify a linear climb gradient requirement.

CLIMB GRADIENT LIMITING WEIGHT (CGLW)

The climb gradient limiting weight is the highest weight at the specified airfield altitude and temperature which yields a required reference engine-out climb gradient.

The required reference climb gradient may be determined by obstacle clearance requirements from the flight path altitude distance profile charts or by the minimum required engine out climb gradient of 2.5 percent.

OPTIMUM FLAP SETTING

The optimum flap is that setting which provides the MTOGW.

TIRE SPEED LIMITING WEIGHT (TSLW)

The tire speed limiting weight is the weight at which the all engine liftoff speed equals the tire placard speed of 204 knots (235 mph) groundspeed.

GROUND MINIMUM CONTROL SPEED (V_{MCG})

The ground minimum control speed is the minimum airspeed at which the airplane, while on the ground, can experience a wing engine failure and maintain directional control, with takeoff thrust set on the remaining engines, without exceeding a lateral deviation of 25 feet from runway centerline. During reduced thrust takeoffs, power on the remaining engines may be increased to takeoff rated thrust only after reaching 135 knots (worst case wet/icy V_{MCG}/ $V_{R\ MIN}$). The charted V_{MCG} value is the wet/icy V_{MCG}. RCR values of 10 or greater allow the benefit of nose gear steering and results in a reduced V_{MCG} for V_1 computations.

WARNING

> When performing a reduced thrust takeoff and an asymmetric power condition results from loss of a wing engine; advancing power to takeoff rated thrust on remaining engines prior to reaching 135 KIAS may result in insufficient lateral control and aircraft may depart the confines of the runway since V_{MCG} is calculated using assumed temperature.

CRITICAL ENGINE FAILURE SPEED (V_{CEF})

The critical engine failure speed is the speed at which the airplane can experience an engine failure and either stop or accelerate to the liftoff speed in the same distance, that distance being critical field length.

MAXIMUM ALLOWABLE WEIGHT WHEN $V_1 = V_{MCG}$ (MAW)

The maximum allowable weight when V_1 = V_{MCG} is the weight at which the airplane can accelerate with all engines operating, experience an engine failure at a V_1 equal to V_{MCG}, and stop in the runway available.

MAXIMUM BRAKING SPEED (V_{MBE})

The maximum braking speed is the highest speed from which the airplane can be stopped without exceeding the flight-tested brake energy.

DECISION SPEED (V_1)

The takeoff decision speed is the higher of V_{CEF} and V_{MCG}, not to exceed V_{MBE}. The decision speed is used to determine whether to continue the takeoff or abort following an engine failure.

ROTATION SPEED (V_R)

The rotation speed is the speed at which rotation from a three point attitude is initiated. The takeoff performance charts are based on a rotation time of four seconds to achieve liftoff speed. Rotation speed may not be less than $V_{R\ MIN}$

MINIMUM ROTATION SPEED ($V_{R\ MIN}$)

The minimum rotation speed is the minimum airspeed at which the airplane, after rotation from a three-point attitude, can experience a wing engine failure and maintain directional control (on the ground) without exceeding a lateral deviation of 25 feet from the center-line of the runway. The minimum rotation speed is the wet/icy V_{MCG} speed.

CLIMBOUT SPEED (V_2)

The climbout speed is the recommended speed for a one-engine inoperative climbout. It is established at a height of 50 feet and maintained until the acceleration height is reached. The climbout speed always exceeds the 1.15 V_{S1G} requirement and was chosen to provide adequate fuselage clearance at liftoff using a smooth, steady rotation technique. Climbout speed is dependent upon the rotation speed; therefore, if rotation speed is increased to equal $V_{R\ MIN}$, the climbout speed must be increased by the same increment. The KC-10 has enough stall margin to turn with 25° of bank at V_2 +10 on takeoff should there be a need to maneuver.

SCREEN HEIGHT

The screen height is the departure end of the runway crossing height restriction. Screen height restrictions are computed the same as obstacles. Screen heights require adjustment to runway available to allow the aircraft climbout flight path to meet end of the runway height restrictions.

PRESSURE HEIGHT FOR ACCELERATION

The pressure height for acceleration with one engine inoperative is the height above the runway where level-off acceleration should be initiated to ensure the climbout flight path altitude profile for obstacle clearance is achieved.

ALL ENGINE CLIMB GRADIENT

All engine climb gradient data is included to provide a means of calculating standard instrument departure (SID) requirements of all engine operating rate of climb for takeoff and climb configurations.

WARNING

> This data will not be used to determine obstacle clearance capabilities in lieu of the engine out climb gradient data.

The All Engine Climb Gradient Takeoff Rated Thrust chart (figure 3-22A) is used when the all engine climb requirement ends at or below pressure height for acceleration. It measures all engine climb gradient with the gear fully retracted, flaps and slats in the takeoff configuration, all engines operating at takeoff thrust, and climbout speed at V_2 + 10 Knots.

The All Engine Climb Gradient, Maximum Climb Thrust Chart (figure 3-22B) is normally used to verify the all engine climb gradient at the top of the all engine climb restriction but may be used at any altitude above acceleration height. When an all engine climb requirement ends above pressure height for acceleration the all engine climb gradient is measured with the flaps and slats retracted, all engines operating at maximum climb thrust, and climbout speed at VSR.

AIR MINIMUM CONTROL SPEED (V_{MCA})

The air minimum control speed is the minimum speed at which the airplane can experience a wing engine failure and maintain directional control utilizing full rudder deflection and not more than five degrees of bank angle. Air minimum control speed does not limit KC-10A takeoff performance.

ASSUMED TEMPERATURE

The assumed temperature is the maximum outside air temperature at which all takeoff requirements are satisfied for the given airfield/runway at the actual airplane gross weight. Assumed temperature is used to compute reduced thrust takeoff data.

CLIMBOUT FLIGHT PATH

The climbout flight path is the altitude-distance profile for a climbout with one-engine inoperative (Figure 3-1).

The climbout flight path is divided into four climb segments; first, second, transition, and final. The first segment is defined as the climb segment just after critical field length/lift off and continues until the landing gear is retracted. The speed will vary between V_{LOF} and V_2 at 50 feet. The second segment starts at the point the gear is fully retracted and continues until the aircraft reaches Pressure Height for Acceleration. The minimum speed for this segment is V_2. The transition segment is the portion of the flight path during which the airplane is accelerated in level flight to the V_{SR}. Flaps and slats are retracted as the recommended flap and slat retraction speeds are reached. In the final segment the airplane climbs at V_{SR} using MCT power with the gear, flaps, and slats retracted.

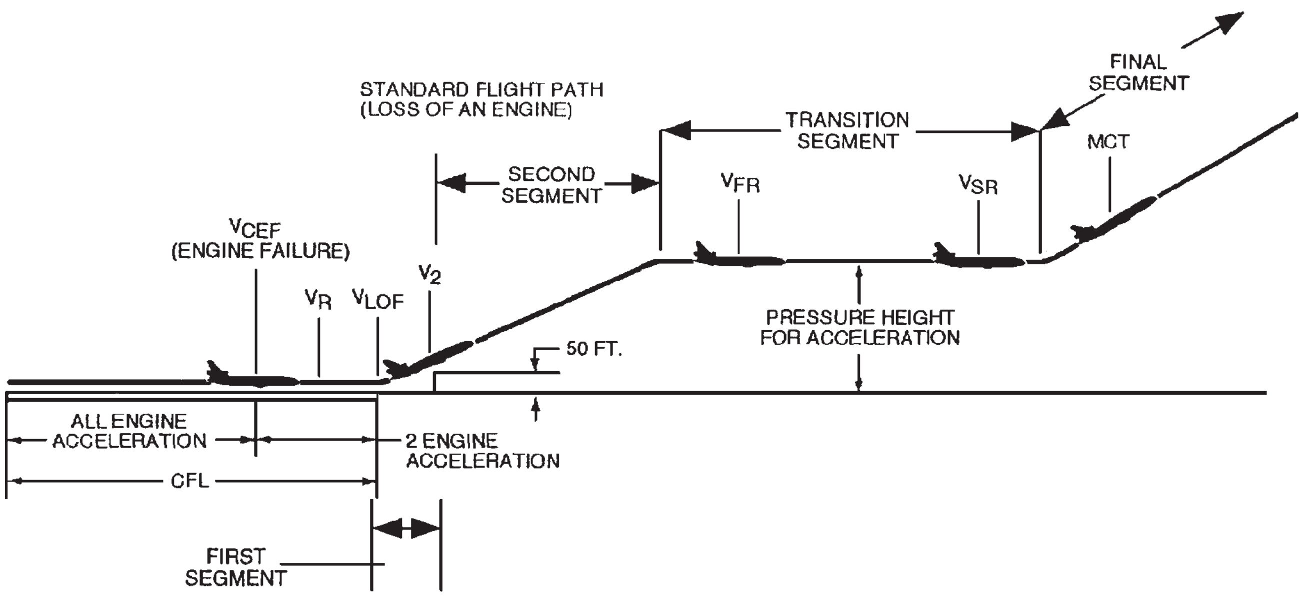


Figure 3-1. Standard Flight Path (Loss Of An Engine)

FACTORS AFFECTING TAKEOFF

GROSS WEIGHT

As the airplane gross weight is increased, the critical field length and takeoff speeds are increased and the climb gradient capability is decreased.

AIR DENSITY

The takeoff capability of the airplane is affected by the air density, which varies with temperature and pressure altitude. The best performance is obtained at low pressure altitudes and cold temperatures.

WARNING

Takeoff data is presented for pressure altitudes of -1000 ft. to 14,000 ft; the temperature data is restricted by the environmental envelope of the airplane which extends from -54 degrees C to 50 degrees C, not to exceed Standard Day +40 degrees C. Takeoff shall not be attempted for conditions outside these ranges.

NOTE

The takeoff performance data shown for temperatures beyond the environmental envelope are to be used for reduced thrust operation only.

THRUST

The engine thrust is directly proportional to air density. The CF6-50C2 engine thrust is constant to a given temperature (flat rated) for each pressure altitude, beyond this flat rated temperature engine thrust decreases with temperature. The engine thrust is also dependent on the airplane velocity and the time from brake release; the thrust decreases as the velocity increases and as the time from brake release increases.

ENGINE BLEED

The maximum thrust available for takeoff occurs when engine bleed for aircraft ice protection is on and all other bleeds are off. Normal bleed for takeoff is air conditioning on and ice protection off. Corrections are presented on the takeoff performance charts for bleed operation, where applicable. The ice protection corrections are not valid when OAT is greater than 8°C.

ENGINE ANTI-ICE VALVE INOPERATIVE

For operation with one or more engine cowl anti-ice shutoff valves inoperative in the open position, turn the associated Engine Anti-Ice Switches ON before takeoff. Use the Thrust Rating Computer to set power on all engines.

The Thrust Rating Computer applies a 0.5% N_1 reduction if any engine anti-ice switch is selected to ON, OAT is greater than 8°C, and either T.O. or TO FLX is selected. The following performance corrections are required to compensate for the resulting decrease in rated thrust:

Reduce limiting takeoff weights (RALW, CGLW, TSLW, MAW) by 1.9%. Resulting MTOGW will be 1.9% lower than that with all cowl anti-ice valves operative.

Determine the takeoff speeds (V_{CEF}, V_{MBE}, V_R, V_2, V_{FR}, and V_{SR}) at the actual takeoff weight increased by 1.9%. When determining assumed temp from figure 3-9, read down the optimum flap line to actual TOGW increased by 1.9%.

NOTE

Since data is not provided for weights above 600,000 pounds MTOGW is effectively limited to 588,810 pounds when the 1.9% correction is applied to determine takeoff speeds.

FLAP SETTING

A runway length limited takeoff gross weight is directly proportional to flap setting and the climbout gross weight is inversely proportional to flap setting. A specific flap setting will yield the best compromise of the takeoff and climbout requirements. This flap angle is referred to as the OPTIMUM FLAP, and on the KC-10A can be selected to any angle between 5 and 25 degrees. The optimum flap provides the greatest possible takeoff gross weight capability for the existing conditions.

WIND

The reported wind direction and velocity can be inaccurate due to irregularities in terrain or obstacles in the area of the measuring equipment.

Consideration of wind is noted on the performance charts whenever applicable. For application of wind to takeoff performance, refer to the chart explanation, Wind Summary and Wind Component charts.

The effect of wind on takeoff is dependent on the wind velocity, gust increment, and direction. For performance calculations, the wind is separated into a runway wind component which may be a headwind or a tailwind and a crosswind component.

Headwind reduces the distance required for takeoff due to a reduction in ground speed; however, since winds are unpredictable, this advantage should only be used if required for mission accomplishment. Tailwind increases the distances required for takeoff; consequently, takeoff with a tailwind is not recommended.

WARNING

If the tailwind exceeds 10 knots, or the crosswind component exceeds 31 knots on a dry runway, takeoff will not be attempted. For other than a dry runway, refer to the Maximum Allowable Crosswind During Takeoff chart.

CAUTION

If the wind direction is greater than 45 degrees from the runway heading, or when the crosswind component exceeds 23 knots, the crosswind component affects the number 2 engine inlet airflow characteristics requiring that a rolling takeoff be made.

Wind direction and velocity are often variable. The calculation of wind components should be made using conservative values for wind velocity and direction. For headwinds, use the steady wind value and the maximum deviation from the runway heading to determine the headwind component. Prior to using the wind correction grids, multiply the headwind component by 50 percent. For tailwinds, use the steady wind value plus the gust increment and the minimum deviation from the runway heading to determine the tailwind component. Prior to using the wind correction grids, multiply the tailwind component by 150 percent. The crosswind component is determined by using the steady wind value plus the gust increment and the maximum deviation from the runway heading.

STABILIZER SETTING

The takeoff stabilizer setting is dependent on the center-of-gravity location and the flap setting. The takeoff setting is a compromise between desirable rotation characteristics and the necessity for retrimming during the takeoff climb. Takeoff performance is based on use of the correct stabilizer setting.

RUNWAY SLOPE

Consideration for runway slope is provided whenever applicable. Downhill slopes improves takeoff acceleration and reduces stopping capability. For uphill slopes the reverse is true.

FROST AND ICE

Frosting of the underside of the wings below the fuel tanks will occur when the fuel temperature is low, the outside air temperature is above freezing and humidity is high. This type of frost re-forms after removal on the ground. Takeoff with ice or frost on the lower wing surface is permitted, provided it is caused by fuel cooling of the adjacent air and that the thickness of the frost or ice is not excessive. A coating of frost thicker than 1/8 inch (3.2 mm) or ice thicker than 1/16 inch (1.6 mm) should be removed before departure. Where a coating remains on the underside of the wing in the fuel tank region, the Climb Gradient Limiting Weight penalties are 0.8% for 1/8 inch (3.2 mm) of frost and 1.2% for 1/16 inch (1.6 mm) of ice. Operations with adhering frost or ice on other than the wing lower surface fuel tank are not permitted.

RCR

The RCR is used to determine the stopping capability of the airplane.

Factors such as wetness, bumpiness, rubber buildup, and runway grooving affect RCR values. The approximate RCR values presented in Section IX are different in order to maintain the same SDR values.

NOTE

Takeoff charts are provided at various RCR ranges as well as RSC values. The RCR correction grids on the RCR 17-12, 11-8, and 7-3 charts start out flat and then slope up/down at a breakpoint. This breakpoint represents the charted RCR values for each range. The slope portion represents correlated data. The flat portion is where overlap from the previous range was integrated to provide continuity between the charts without loss of capability.

Some approximate RCR values to be used when an RCR value is not provided are listed below with the corresponding runway condition. These approximate RCR values represent selected stopping distance ratio (SDR) values of 1.0 for dry conditions, 1.5 for wet conditions on a grooved or porous surface, 2.0 for wet conditions on a smooth, hard surface, and 3.0 for icy conditions. The approximate RCR values presented in Section IX are different; however, the values were chosen to maintain the same SDR values.

RUNWAY CONDITION	RCR	EQUIVALENT BRAKING ACTION
Dry	23	Good
Wet (Grooved)	14	Medium
Wet (Porous)	14	Medium
Wet	10	Medium
Icy	6	Poor

Runways covered with snow have an RCR somewhere between wet and icy. It is recommended that a conservative RCR be used when runway conditions are not clearly defined.

CORRECTION FACTOR FOR CONFIGURATION CHANGES (CFCC)

The correction factor for configuration changes (CFCC) is used to determine the stopping capability of an airplane with various deceleration devices inoperative or a configuration change which affects the stopping capability. It relates the configuration change to the loss of deceleration capability due to reduced coefficient of friction with the runway. The CFCC is applicable for all RCR values. The CFCC grid is provided only on takeoff charts that are based on RCR 23 to 18. When utilizing CFCC, RCR correction will not be used.

RSC

Runway Surface Condition (RSC) is a measure of the contaminant depth on the runway. The contaminant depth causes a significant increase in the takeoff distance due to the retarding effect from tires displacing the contaminant and additional drag from the contaminant impinging on the aircraft. The contaminant retarding effect increases with velocity until the aircraft attains hydroplaning speed. From this point, tire induced retarding force is significantly reduced and relatively constant to liftoff.

WARNING

- Takeoffs shall not be attempted with over 1/2 inch of wet snow, slush, and/or water, or 4 inches of dry snow on the runway.
- If RSC conditions exist, takeoff is not allowed with one wheel brake inoperative (OWBI), center gear retracted (CGR), or anti-skid braking system inoperative.

NOTE

Use the following conversions to determine RSC with dry snow:

DRY SNOW	=	RSC
>0-2 in	=	.25
>2-4 in	=	.50

NOTE

- If the takeoff performance is corrected for RSC, then RCR corrections are not required.
- If the RSC is reported as .10 inch or below of standing water, the runway is considered wet, not contaminated; use an RCR of 10 to 14 for takeoff computations. Do not apply RSC takeoff restrictions or corrections to performance data, flap setting, runway available (WARP), and reduced thrust usage.
- If the RSC is reported as more than .10 inch of standing water, use a .25 or .50 RSC for takeoff and a 6 RCR for landing. Use a 6 RCR to figure maximum crosswind for takeoff and landing.

CENTER-OF-GRAVITY

The performance data are presented for a center-of-gravity (CG) location of 8 percent MAC. Correction grids are provided, where applicable, for CG locations from 8 percent MAC to 30 percent MAC. The takeoff capability of the aircraft is increased as the CG location is moved aft.

ALIGNMENT DISTANCE

The minimum alignment distance is 300 feet. More may be required for extenuating conditions (i.e., 180° turn, etc.).

REVERSE THRUST

Reverse thrust is used during takeoff only in the event of a rejected takeoff. The effects of reverse thrust are included in the calculations of normal takeoff performance. (Charts are also provided in Supplemental Performance Section XII for dispatch with inoperative reverse thrust. These charts must be used when dispatching with any engine thrust reverser inoperative.) Due to the high speeds achieved during the takeoff run and the delay time before full reverse thrust is attained, reverse thrust may be less important than prompt braking action by the pilot except on wet or icy runways where braking capability is greatly reduced. However, maximum allowable reverse thrust on the remaining engines is required to achieve charted performance.

NOTE

> Reverse thrust may be employed at thrust levels up to the maximum reverse thrust mechanical stop or 95% N_1, whichever occurs first. The reverse thrust mechanical stop limits N_2 to approximately 95%. N_1 at a constant N_2 is a function of TAT. The higher the TAT, the lower the N_1. At 0°C, approximately 95% N_1 will be obtained from 95% N_2. Below 0°C, N_1 should be limited by throttle to 95%.

STATIC TAKEOFF

A static takeoff is accomplished with the aircraft aligned on the runway, brakes set, and engines advanced to approximately takeoff power. Brakes are released and final power adjustment is made prior to 80 knots.

ROLLING TAKEOFF

The procedures for planning a rolling takeoff are similar to those for a static takeoff. Rolling takeoff must be used when the wind direction is greater than 45 degrees from the runway heading or when the crosswind component exceeds 23 knots. For a rolling takeoff, the engines should be advanced promptly and smoothly to takeoff thrust. After accounting for the alignment distance, no additional field length penalty is required for a rolling takeoff.

CLIMBOUT FLIGHT PATH

The climbout flight path is the altitude profile for climbout with one-engine inoperative and without turning flight. The aircraft climbout flight path is divided into four climb segments; first, second, transition, and final. The first segment is defined as the climb segment just after lift-off and continues until the landing gear retracted. The climbout flight path is calcualted assuming gear retraction is initiated three seconds after liftoff and completed 10.5 seconds later. The speed will vary between V_{LOF} and V_2 at 50 feet. The second segment starts at the point the gear is fully retracted and continues until the aircraft reaches Pressure Height for Acceleration. The minimum speed for this segment is V_2. The transition segment is the portion of the flight path during which the aircraft is accelerated in level flight to the V_{SR}. Flaps and slats are retracted as the recommended flap and slat retraction speeds are reached. In the final segment the aircraft climbs at V_{SR} with the landing gear, flaps, and slats retracted. After operating at takeoff rated thrust for ten minutes or upon reaching 2000 feet pressure altitude above the airfield, whichever occurs first, the thrust is reduced to maximum continuous power (MCT).

CAUTION

- The normal takeoff thrust duration of five minutes may only be extended to ten minutes for engine inoperative contingency. Comply with applicable maintenance procedures.
- The flight path profiles are for a straight-out flight path, and do not include the performance loss due to a turning climb-out flight path.

PRESSURE HEIGHT FOR ACCELERATION

The pressure height for acceleration is the height above the runway where level-off acceleration should be initiated to ensure the climbout flight path altitude profile for obstacle clearance is achieved. The pressure height for acceleration corresponds to the geometric height for level-off acceleration shown in the climbout flight path.

When noise abatement is not a factor, the minimum three engine pressure height for acceleration is 800 feet above the runway. The minimum pressure height for acceleration with an engine inoperative is 400 feet above the runway. If the minimum acceleration height does not provide sufficient obstacle clearance, the pressure height for acceleration is based on the obstacle clearance height.

FLIGHT DIRECTOR

The flight director takeoff mode speed/attitude control system is programmed to compute the all engines operating or one-engine inoperative climbout speed as appropriate. Refer to Section IV of TO 1C-10(K)A-1 for Engine Failure After V_1 Procedure.

CAUTION

- Following the loss of an engine, during an obstacle limited takeoff do not follow the flight director takeoff mode pitch commands when V_2 speed is corrected for airplane center of gravity.
- Following the loss of an engine, during an obstacle limited takeoff do not follow the flight director takeoff mode pitch commands when a reduced thrust takeoff is being performed at weights where the airplane is V_{MCG} limited (V_{MCG} is V_1) and rotation speed (V_R) was increased to minimum rotation speed (V_{RMIN}).
- The takeoff profile for obstacle clearance and climb gradient is based on maintaining the computed climb speed. Therefore, the airspeed indicator is the primary instrument for takeoff guidance.
- When the airplane is V_{MCG} limited during reduced thrust operation, the required V_2 speed is higher than that commanded by the flight director.

NOTE

Flight director pitch guidance may be used under the above conditions by preselecting a vertical speed of approximately 2000 feet per minute prior to commencing the takeoff roll. Manually fly the airplane to the correct climb speed after takeoff and select IAS HOLD.

AUXILIARY POWER UNIT (APU)

The performance data presented in this section are for operation with the APU off. To account for APU doors open when calculating gross weight increase the climb gradient required by an increment of 0.08 percent and reduce the runway available by 0.6 percent.

CONFIGURATION DEVIATION LIST

Configuration deviations from the standard airplane configuration increase the airplane drag and, as a result, impose an airplane performance penalty. Figure 1-14 is used to calculate the total drag index for the configuration deviations. This drag additive impacts the maximum takeoff gross weight (MTOGW) and takeoff speeds.

NOTE

> The performance data presented in this manual is for operation without Wing Aerial Refueling Pods Installed. To allow use of this data when Wing Air Refueling Pods are installed, first refer to that paragraph for determining the appropriate MTOGW. Then perform the drag index penalties computation, as indicated below, to arrive at a reduced MTOGW.

To account for any configuration deviations, first determine the MTOGW (configuration deviations not considered). Then use figure 1-14 to calculate the total drag index for the configuration deviations (do not include Wing Air Refueling Pods in this calculation). Calculate a reduced MTOGW by lowering the MTOGW by 2000 pounds for each unit of drag index. Takeoff is permitted if the TOGW is less than or equal to this reduced MTOGW.

Takeoff speeds must be calculated for a gross weight which corresponds to the TOGW increased by 2000 pounds for each unit of drag index.

WING AIR REFUELING PODS (WITH TCTO 1C-10(K)A-956)

The performance data presented in this manual are for operation without Wing Aerial Refueling Pods installed.

The following applies when calculating the allowable Takeoff Gross Weight with Wing Aerial Refueling Pods installed.

To compute the Equivalent Field Length, or determine the MAW when $V_1 = V_{MCG}$, reduce the runway available by the following:

Reduction	Condition
3.9%	for RCR 2 3 to RCR 3
5.5%	for RSC 0.25 inch
13.4%	for RSC 0.50 inch

Add 0.52 to the required climb gradient to determine the Climb Gradient Limiting Weight.

Once MTOGW is determined, factor in any additional drag index penalties as calculated in the preceding paragraph "CONFIGURATION DEVIATION LIST" to arrive at a reduced MTOGW. If actual TOGW is at or below this reduced MTOGW then takeoff is permitted.

ENGINE FAIL LIGHT

Takeoff is allowed with the engine fail light inoperative. With the engine fail light inoperative, additional time (and distance) may be required before the pilot becomes aware of an engine problem. To account for this increased recognition time in calculating the allowable takeoff gross weight, reduce the runway available by 400 feet.

BANK ANGLE

Banked flight imposes a load factor on the airplane which requires an increase in thrust to maintain the same climb gradient. Thus, if the thrust and speed are constant, the climb gradient available decreases as the bank angle increases.

TAKEOFF PLANNING

A flowchart outlining the following procedures has been included in the TAKEOFF PLANNING GUIDE in figure 3-4. The outline is entered at the top with the given takeoff conditions. The planning then proceeds along a path through the applicable branches in either a horizontal or descending manner until a solution is reached at the bottom of the outline.

It is imperative that these procedures be used in planning to ensure all factors affecting takeoff are properly considered in the correct order. Deviations from these procedures may result in incorrect takeoff data.

Takeoff planning begins with the computation of MTOGW and optimum flap setting for all takeoffs.

Specific procedures are then described under maximum thrust takeoff, or reduced thrust takeoff, and TOGW is checked against TSLW, V_{MCG}, and V_{MBE} limitations, and if required, adjusting TOGW and optimum flap setting.

DETERMINE MTOGW AND OPTIMUM FLAP SETTING

Begin by calculating the wind components from figure 3-6, adjusting the components as described in figure 3-5 and checking wind limitations. If an obstacle is present along the flight path, determine the obstacle height and obstacle distance from the liftoff end of the runway.

If departure end of runway elevation is not known and a downhill slope exists, determine the obstacle height using the following formula:

OBSTACLE HEIGHT =

$$\text{OBST HT (MSL)} - \left(\text{FLD ELEV} - \frac{\text{RWY LENGTH X \%SLOPE}}{100}\right)$$

For this height and distance, using the most limiting flap correction, determine the gradient required for obstacle clearance from figure 3-7. If this gradient is equal to or less than 2.5 percent, the obstacle is not limiting, and a value of 2.5 percent is used.

If applicable, determine the CFCC from figure 3-8. Determine runway available limiting weight (RALW) and climb gradient limiting weight (CGLW) from figure 3-9 for given conditions and climb gradient required.

To determine optimum takeoff flap setting and MTOGW, parallel the RALW and CGLW lines on sheet 3 of figure 3-9 until they meet as shown in figure 3-2. Read across and down to determine MTOGW and optimum takeoff flap setting respectively. Set TOGW equal to or less than MTOGW.

NOTE

When CGLW is less than RALW and as such the CGLW and RALW lines do not intersect, proper performance chart interpretation dictates you follow the CGLW line until it peaks (MTOGW). This is the optimum flap setting for the condition.

If MTOGW was computed for obstacle clearance (climb gradient greater than 2.5 percent), it may be possible to determine a higher MTOGW. If this is desired, use the following procedure:

Attempt this procedure by selecting a runway distance less than the actual runway available.

NOTE

- When runway cutback procedures are used for obstacle clearance, use the original (full) runway available to determine MAW when $V_1 = V_{MCG}$.
- Recommend a reduction of runway available of approximately 200 feet for obstacle distances up to 2000 feet, and 500 feet for obstacle distances beyond.
- This decrease in runway available and increase in obstacle distance may result in a higher MTOGW.

Recalculate the obstacle height (for runway slope) and obstacle distance from the adjusted liftoff point.

NOTE

For runway slope, the obstacle height must be adjusted by the ΔHT determined by the following formula:

$$\Delta HT = \frac{(\text{Rwy Reduction}) \times \text{Slope (percent)}}{100}$$

ΔHT is negative for downhill and positive for uphill runway slopes.

With these adjusted values for height and distance, using the most limiting flap correction, redetermine the gradient required for obstacle clearance. If the gradient is equal to or less than 2.5 percent, use a value of 2.5 percent.

Redetermine the MTOGW and optimum flap setting for the adjusted RALW and CGLW from figure 3-9. If this results in a higher MTOGW, continue this procedure until the desired TOGW is achieved, MTOGW decreases, or the maximum allowable flap setting is attained.

Set TOGW equal to or less than MTOGW.

Determine Maximum or Reduced Thrust Takeoff

If TOGW is less than MTOGW, reduced thrust should be used if the aircraft and runway conditions permit.

NOTE

Failure to use reduced thrust to the maximum extent allowable increases engine wear which directly contributes to decreased engine life.

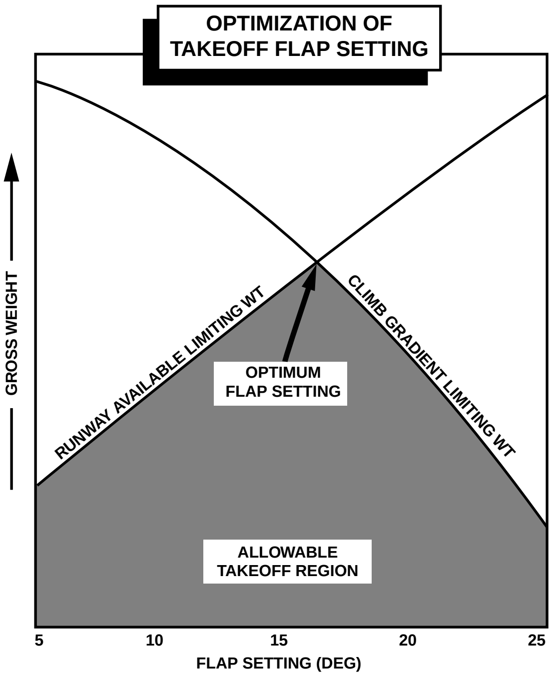


Figure 3-2. Optimization of Takeoff Flap Setting

WARNING

Reduced thrust usage is not permitted if:

- RCR value is less than 10.
- RSC is used for TOLD computations.
- The anti-skid braking system or one main gear wheel brake is inoperative.
- One center gear wheel brake is inoperative and takeoff gross weight is greater than 460,000 pounds.
- Headwinds are used for mission accomplishment.
- Suspected windshear is reported.
- Commercial Type II deicing/anti-icing fluid has been applied.

NOTE

The takeoff performance of the aircraft is not affected by the application of MIL SPEC or Commercial Type IV deicing/anti-icing fluid.

Complete remaining takeoff planning under maximum thrust takeoff or reduced thrust takeoff as applicable.

MAXIMUM THRUST TAKEOFF

CHECK TIRE SPEED LIMITATION

Determine the TSLW from figure 3-10 and compare the TOGW to the TSLW. If the TOGW is equal to or less than the TSLW, proceed to determine V_1.

If the TOGW exceeds the TSLW, plot TSLW for various flap settings up to 20° on sheet 3 of figure 3-9 and compare with CGLW as shown in figure 3-3. Find the highest weight in the allowable takeoff region, use this weight as the TOGW and use the corresponding flap setting as the takeoff flap setting.

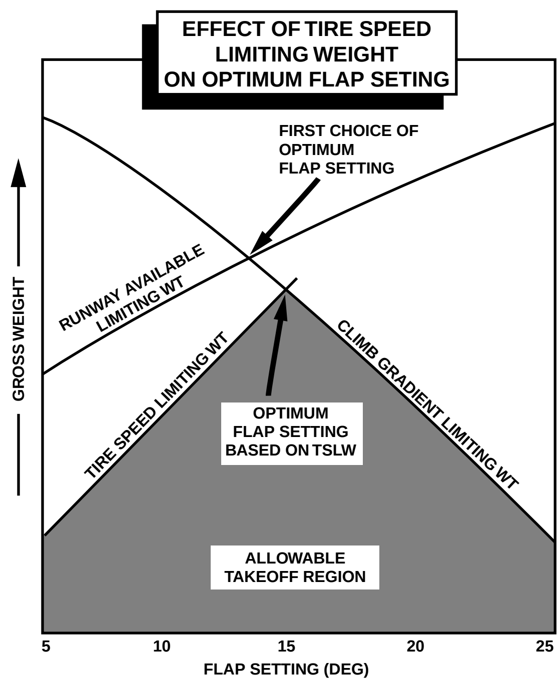


Figure 3-3. Effect of Tire Speed Limiting Weight on Optimum Flap Setting

DETERMINE V_1

Determine V_1 by computing V_{MCG} from figure 3-11, V_{CEF} from figure 3-12, and V_{MBE} from figure 3-13.

V_1 is the higher Of V_{CEF} and V_{MCG}, not to exceed V_{MBE}.

If V_1 is V_{CEF}, the V_{MCG} and V_{MBE} limitations are satisfied and no adjustments to the TOGW are required.

If V_1 is V_{MCG}, it may be necessary to reduce the TOGW. Begin by entering the appropriate Maximum Allowable Weight when $V_1 = V_{MCG}$ chart (figure 3-14) with runway available and solve for MAW. For dry, wet, or icy runways, use the optimum takeoff flap setting.

NOTE

When an RSC is used in TOLD planning, use 25 deg flaps only. The MAW is the MTOGW.

If V_1 is V_{MBE}, the TOGW must be reduced until V_1 is not limited by V_{MBE}. For most cases, reducing the TOGW by 3500 pounds for every knot V_{CEF} exceeds V_{MBE} will satisfy the V_{MBE} limitation. However, if V_1 is limited by V_{MBE} at this weight, additional weight reduction is required. After each weight reduction, redetermine V_{CEF} and V_{MBE} and recalculate V_1.

DETERMINE V_R AND V_2

Determine V_R from figure 3-15, $V_{R\ MIN}$ from figure 3-11 and V_2 from figure 3-16.

If V_R is less than $V_{R\ MIN}$, increase V_R to equal $V_{R\ MIN}$ and increase V_2 by the same increment.

COMPLETE TAKEOFF PLANNING

Determine V_{FR}, V_{SR}, and V_{MM} from figure 3-17, the stabilizer setting from figure 3-18, the pressure height for acceleration from figure 3-19 and the N_1 setting for takeoff from figure 3-20. Compute emergency return speeds and landing distance based on TOGW using 35° flaps.

REDUCED THRUST TAKEOFF

The assumed temperature is used to set N_1 thrust for takeoff and determine airplane performance.

NOTE

Actual temperature is used to compute pressure height for acceleration.

NOTE

- The assumed temperature may not exceed the temperature limits of the environmental envelope by more than 10 degrees C. Refer to limitations section in TO 1C-10(K)A-1.
- The assumed temperature must be equal to or greater than the thrust flat rated (break) temperature at the airfield pressure altitude.

Altitude (ft)	Degree C
SL	30
1000	29
2000	27
3000	25
4000	23
5000 to 14,000	20

If calculations yield an assumed temperature less than shown above, a maximum thrust takeoff is required.

DETERMINE ASSUMED TEMPERATURE

Proceed to determine the assumed temperature using the optimum flap setting determined by the MTOGW.

Enter figure 3-9 where MTOGW and optimum flap setting occur, read down to TOGW while maintaining the optimum flap setting. From this intersection, parallel the RALW and CGLW values. If at any time the bottom of the chart (figure 3-9, sheet 3) is intersected, proceed to the next chart with that gross weight value (280,000 lb). Assumed temperature is determined from both RALW and CGLW temperature grids.

Use the lowest of these two assumed temperatures as the assumed temperature for thrust reduction.

DETERMINE TSLW

Determine the TSLW from figure 3-10 at the assumed temperature. If the TOGW is equal to or less than the TSLW proceed to determine V_1.

If TOGW is greater than TSLW, perform a maximum thrust takeoff.

DETERMINE V_1

Determine V_{MCG} from figure 3-11 with the assumed temperature.

Determine V_{CEF} from figure 3-12 and VMBE from figure 3-13 with assumed temperature.

V_1 is the higher of V_{CEF} and V_{MCG}, not to exceed V_{MBE}

If V_1 is V_{CEF}, the V_{MCG} and V_{MBE} requirements are satisfied and no adjustment to the assumed temperature is required.

In the event V_1 is V_{MCG}, enter figure 3-14 with takeoff conditions and assumed temperature and determine MAW. If MAW is less than TOGW, maximum takeoff thrust must be used.

If V_1 is V_{MBE}, the assumed temperature must be reduced. Use figure 3-13 to calculate an assumed temperature for which V_{MBE} is equal to V_{CEF}. This is the new assumed temperature.

DETERMINE V_R AND V_2

If V_1 is V_{CEF} or V_{MBE}, using assumed temperature, determine V_R and V2 from figures 3-15 and 3-16, respectively.

If V_1 is V_{MCG}, using assumed temperature, determine V_R and V_2 from figures 3-15 and 3-16 respectively. Determine $V_{R\ MIN}$, using the assumed temperature, from figure 3-11.

If V_R is less than $V_{R\ MIN}$, increase V_R to equal $V_{R\ MIN}$ and increase V_2 by the same increment.

COMPLETE TAKEOFF PLANNING

Determine V_{FR}, V_{SR} and V_{MM} from figure 3-17 and stabilizer setting from figure 3-18.

With actual temperature, determine pressure-height for acceleration from figure 3-19.

Determine the N_1 setting for takeoff from figure 2-7, 2-8 or 3-21, using the assumed temperature.

NOTE

- If engine, or engine and wing ice protection is required, reduce the assumed temperature by 3 degrees C before determining the Reduced Thrust Takeoff N_1 setting.
- If wing ice protection is required, add a ΔN_1 of one percent to the N_1 setting for reduced takeoff thrust.
- When using the TO FLX (Flexible Takeoff) Mode of the Thrust Computer, set the takeoff assumed temperature in the ASSUMED TEMP Selector. If engine anti-ice is used, set the assumed temperature used to determine the Reduced Thrust Takeoff N_1 Setting.

Compute emergency return speeds and landing distance based on TOGW using 35° flaps.

CHART EXPLANATION AND EXAMPLE PROBLEMS

TAKEOFF PLANNING GUIDE

Figure 3-4 presents a takeoff planning flowchart for optimum flap takeoff gross weight determination.

WIND SUMMARY

The wind summary in figure 3-5 explains how the wind components are used for performance calculations.

WIND COMPONENT

The runway component and the crosswind component may be found from figure 3-6 if the wind velocity, gust increment, and direction are known. The chart may be linearly interpolated for intermediate values of wind velocity and wind angle.

NOTE

The maximum demonstrated crosswind component is 31 knots on a dry runway.

Example 1:

Given:

Wind Velocity = 40 Knots Headwind

Wind Angle = 40 Degrees

Find:

Runway Wind Component

Crosswind Component

Takeoff Limitations Due to Wind

Solution:

Enter figure 3-6 at the origin and move radially outward at the wind angle of 40 degrees until the 40-knot wind velocity line is reached. This point is in the region labeled CAUTION ROLLING TAKEOFFS ONLY, and this is the takeoff limitation. Read down to determine the crosswind component of 25.6 knots; read to the left to obtain 30.5 knots headwind component.

MAXIMUM ALLOWABLE CROSSWIND DURING TAKEOFF

Existing crosswind components will be compared to the Maximum Allowable Crosswind During Takeoff (figure 3-6A). The chart values represent the maximum crosswind in which the aircraft can maintain directional control on the runway as a function of Runway Condition Reading (RCR). When existing crosswind exceeds the maximum allowable crosswind, the takeoff will not be attempted. Refer to "RCR" this section, for discussion of Runway Condition Reading.

Example 1a:

Given:

RCR = 18

Find:

Maximum Allowable Crosswind

Solution:

Enter figure 3-6A with the actual RCR of 18 and read across to the RCR correction grid. The maximum allowable crosswind is 28 knots.

CLIMBOUT FLIGHT PATH

The climbout flight path is calculated assuming gear retraction is initiated 3 seconds after liftoff and is completed 10.5 seconds later.

Figure 3-7 consists of 11 sheets, all of which present obstacle height versus obstacle distance for various climb gradient lines and correction grids for flap setting, wind, and slope. The constant gradient lines reflect the lowest composite path, considering the effects of all altitudes, temperatures and engine bleeds. Figure 3-7 allows the gradient required for obstacle clearance to be determined.

NOTE

The effect of slope shown on this chart is an additional correction to account for variation in performance to 50 feet due to runway slope. Corrections to obstacle height to account for runway slope effects (discussed in Takeoff Planning) must also be made.

NOTE

If the gradient required exceeds 9.0 percent, increase the distance to the obstacle (with a corresponding reduction in the runway available) such that the gradient required is 9.0 percent or less.

Example 2:

Given:

Obstacle Height above Liftoff = 400 Feet

Obstacle Distance from Liftoff = 12,400 Feet

Flap Setting = 15 Degrees

Tailwind = 10 Knots (Calculated)

Runway Slope = 1% Downhill

Find:

Gradient Required for Obstacle Clearance

Solution:

Make height correction of 24 feet for one percent downhill slope. Enter figure 3-7, sheet 2, with the adjusted obstacle height of 424 feet and the obstacle distance of 12,400 feet. Make corrections to the obstacle distance for 15-degree flaps and 10 knots tailwind. Interpolating the climb gradient lines gives a value of 4.3 percent as the gradient required for obstacle clearance.

MINIMUM CLIMB GRADIENT

Linear climb restrictions are normally expressed as a rate-of-climb in feet per minute (fpm) on published departure procedures (SIDs, Published IFR Departure Procedures, etc). These rates can be converted to an equivalent linear climb gradient in terms of feet per nautical mile (ft/Nm). To ensure that the non-linear KC-10 climbout flight path does not penetrate the linear path defined by a climb restriction, Gross Climb Gradients have been adjusted in figure 3-6B using pre-determined departure end crossing heights and runway reductions.

WARNING

- Runway reductions greater than those printed in figure 3-6B will not be used in an attempt to lower the required climb gradient. Therefore, when using E-TOLD, the runway cutback feature must be disabled.
- When using minimum climb gradient procedures, the MTOGW will be based on climb gradients printed on sheets 1 and 2 of figure 3-6B and runway length reduced by lineup distance and runway cutback; runway available. Use these values for the remainder of manual TOLD calculations and input values for E-TOLD calculations.

NOTE

For airfields with published screen heights, compare computed runway reductions/climb gradients from AF Form 4089, Obstacle Clearance Worksheet, with the runway cutbacks/ minimum climb gradients from Fig 3-6B. Use the largest runway reduction and climb gradient for TOLD computations.

Compute End of Restriction Height (AGL) by subtracting runway departure end field elevation from the published climb restriction height (MSL).

Next, determine if the restriction ends at/above or below the charted pressure height for acceleration (1505).

Then, enter sheet 1 or 2 of figure 3-6B with Climb Restriction (Ft/NM) and End of Restriction Height (AGL), correcting for downhill slope and tailwind as necessary and determine climb gradient and cutback required.

Example 2A:

Given:

Runway Length = 10,000 feet

Lineup Distance = 300 feet

Wind = Zero

Runway Slope = Zero

Maintain 300 ft/Nm climb to 1200 feet AGL

Find:

Gross Climb Gradient Required

Runway Reduction

Runway Available

Solution:

Enter sheet 1 of figure 3-6B with a climb restriction of 300 ft/Nm, intersect the block corresponding to the 1200 feet AGL row. Result is a 5.38% gross required climb gradient and 1515 foot required runway reduction. Runway Available (RA) will be Runway Length (RL) minus lineup distance and runway reduction.

RA = 10,000 - 300 - 1515 = 8185

Example 2B:

Given:

Runway Length = 10,000 feet

Lineup Distance = 300 feet

Wind = Zero

Runway Slope = Zero

Maintain 260 ft/Nm climb to 2200 feet AGL

Find:

Gross Climb Gradient Required

Runway Reduction

Runway Available

Solution:

Enter the bottom chart on sheet 1 of figure 3-6B with a climb restriction of 260 ft/Nm, read down to the 1505 foot AGL row. Result is a 7.41% gross required climb gradient and 570 foot required runway reduction. Runway available (RA) will be runway length (RL) minus lineup distance and runway reduction.

RA = 10,000 - 300 - 570 = 9130

Example 2C:

Given:

Runway Length = 10,000 feet

Lineup Distance = 300 feet

Wind = 8 knot calculated tailwind

Maintain 300 ft/Nm climb to 1200 feet AGL

Airfield required screen = 35 feet

Find:

Gross Climb Gradient Required

Runway Reduction

Runway Available

Solution:

Enter Sheet 1 of figure 3-6B with a climb restriction of 300 ft/Nm, read down the column, and intersect the block corresponding to the 1200 feet AGL row. Result is a 5.38% gross uncorrected climb gradient and 1515 foot required runway reduction. To correct climb gradient for tailwind, multiply tailwind correction by knots of tailwind; then add product to uncorrected gradient.

Gross Required Climb Gradient = .06 x 8 = 0.48
0.48 + 5.38 = 5.86

Since the airfield had a published required screen height of 35 feet, enter sheet 1 of figure 3-7 with a screen height of 35 feet and read to the right to intersect a gross climb gradient of 5.86%. A runway reduction of 1560 feet is read from the obstacle distance axis. Compare the runway reduction required to meet the climb restriction with the reduction required to meet the screen height. Runway available (RA) will be runway length (RL) minus lineup distance and the greatest runway reduction.

RA = 10,000 - 300 - 1560 = 8140.

CORRECTION FACTOR FOR CONFIGURATION CHANGES (CFCC)

The CFCC chart, figure 3-8, provides data for center gear retracted, one wheel brake inoperative, or the anti-skid braking system inoperative. The chart is used by entering with the reported (or approximated) RCR and reading up to the desired line. The CFCC is found by reading the vertical scale. The CFCC is then used to calculate the performance instead of the reported RCR.

Example 3:

Given:

RCR = 14

Anti-skid Braking System Inoperative

Find:

CFCC

Solution:

Enter figure 3-8 with the actual RCR of 14. Read up to the antiskid inoperative line. Reaching the vertical scale, the CFCC is 17.

MAXIMUM TAKEOFF GROSS WEIGHT AT OPTIMUM TAKEOFF FLAP SETTING (MTOGW)

Figure 3-9 allows the maximum takeoff gross weight and the optimum takeoff flap setting based on runway available and climb gradient requirements, to be determined. Figure 3-9 combines the data found in the critical field length and the climb gradient limiting weight charts.

Example 4:

Given:

Outside Air Temperature = 15°C

Pressure Altitude = Sea Level

Tailwind = 15 Knots (Calculated)

Zero Slope

RCR = 23

CFCC = 0

CG = 8% MAC

Air Conditioning ON

Ice Protection Off

Climb Gradient = 4%

Runway Available = 12,000 Feet

Find:

Maximum Takeoff Gross Weight and Optimum Takeoff Flap Setting Based on Runway Available and Climb Gradient Limitations.

Solution:

Begin by using sheet 1 of figure 3-9 to calculate the equivalent field length by entering with the runway available of 12,000 feet, making a correction for 15 knots tailwind, and air conditioning on. The equivalent field length is found to be 9850 feet.

Enter sheet 2 with the OAT and pressure altitude and follow the guidelines to account for the equivalent field length determined from sheet 1. Read the runway available limiting weight (RALW) at five-degrees flap setting on the vertical scale as 528,000 pounds.

Enter sheet 5 with the OAT and pressure altitude and read an uncorrected climb gradient limiting weight (CGLW) of 562,000 pounds.

Enter sheet 4 with the uncorrected climb gradient limiting weight from sheet 5 and correct for air-conditioning on and climb gradient to get a climb gradient limiting weight at 25° flaps of 496,000 pounds.

Sheet 3 may now be entered from the left side with RALW at five-degrees flaps and from the right side with the CGLW at 25-degrees flaps. Follow the respective guidelines until the RALW equals the CGLW. The flap setting where this occurs is the optimum flap setting. For this problem, the optimum flap setting is 10.3 degrees and the maximum takeoff gross weight, based on RALW and CGLW is 545,000 pounds.

TIRE SPEED LIMITING WEIGHT

The tire speed limiting weight is the weight where the all engines operating lift off speed is equal to the tire placard speed of 204 knots (235 mph) groundspeed. The data are presented in figure 3-10.

Example 5:

Given:

Outside Air Temperature = 32°C

Pressure Altitude = 8,000 Feet

Flap Setting = 11 Degrees

Tailwind 8 knots calculated

CG = 8% MAC

Find:

Tire Speed Limiting Weight

Solution:

Enter figure 3-10 with 32°C outside air temperature and 8,000 feet pressure altitude. Correct for 11-degree flap setting and the tire speed limiting weight is 437,000 pounds.

GROUND MINIMUM CONTROL SPEED (V_{MCG})

The ground minimum control speeds are based on the maximum thrust on the tail engine and one wing engine and the other wing engine windmilling. The ground minimum control speed data are found in figure 3-11.

Example 6:

Given:

Outside Air Temperature = 40°C

Pressure Altitude = 6,000 Feet

Flap Setting = 5 Degrees

Ice Protection Off

RCR = 6 (Oil on runway)

Find:

Ground Minimum Control Speed

Solution:

Using figure 3-11, the outside air temperature of 40°C, and the pressure altitude of 6,000 feet yield a value of 118.5 KIAS.

CRITICAL ENGINE FAILURE SPEED (V_{CEF})

Critical engine failure speed data are presented in figure 3-12 for all runway conditions. Sheet 1 allows an uncorrected V_{CEF} to be determined which is then corrected, using sheet 2, and sheet 3 on RCR 23 to 18 charts, for flap setting, bleed, wind, slope, CG location, RCR, and CFCC (on RCR 23 to 18 charts only).

Example 7:

Given:

Outside Air Temperature = 42°C

Pressure Altitude = -1,000 Feet

Gross Weight = 580,000 Pounds

Flap Setting = 15 Degrees

Ice Protection Off

Air Conditioning Off

Tailwind = 10 Knots (Calculated)

Zero Slope

CG = 8% MAC

RCR = 23

CFCC = 0

Find:

Critical Engine Failure Speed

Solution:

Use sheet 1 of figure 3-12 with the outside air temperature of 42°C, pressure altitude of -1,000 feet, and the gross weight of 580,000 pounds to determine the uncorrected V_{CEF} of 177.5 KIAS. Using sheet 2, correct for flap setting and tailwind to obtain the V_{CEF} speed of 165.0 KIAS.

MAXIMUM BRAKING SPEED (V_{MBE})

The maximum braking speed data presented in figure 3-13 are based on the critical engine failure speed from which the airplane can be brought to a stop without exceeding the energy absorption capacity of the brakes. The data presented on sheet 1 are for the normal airplane configuration with all gear down with or without antiskid braking on all wheels. Sheet 2 provides data for other configurations giving the V_{MBE} in groundspeed. Once the groundspeed is found from sheet 2, sheet 1 may be entered at this groundspeed to correct the data to indicated airspeed. Takeoff is not allowed above the presented weights. For weights lighter than shown, determine V_{MBE} at the lightest weight shown.

Example 8:

(Mission accomplishment with head wind used)

Given:

Outside Air Temperature = 40°C

Pressure Altitude = Sea Level

Gross Weight = 500,000 Pounds

Flap Setting = 5 Degrees

Headwind = 10 Knots (Calculated)

Slope = 2.0% Uphill

Find:

Maximum Braking Speed

Solution:

Enter sheet 1 of figure 3-18 with the gross weight of 500,000 pounds and the runway slope of 2.0 percent uphill. Use the guidelines to account for 10 knots headwind, sea level pressure altitude, 40°C outside air temperature, and 5-degree flap setting. The maximum braking speed is 202 KIAS.

MAXIMUM ALLOWABLE WEIGHT WHEN V_1 = V_{MCG}

If V_{CEF} is less than V_{MCG}, it may be necessary to reduce the takeoff weight if it is greater than the V_{MCG} limited weight.

Example 9:

Given:

Pressure Altitude = Sea Level

Outside Air Temperature = 15°C

Runway Available = 6800 Ft.

Wind = 10 Knot Tailwind (Calculated)

Slope = 1% Uphill

Ice Protection Off.

Air-conditioning Off.

RCR = 19.

CFCC = 0.

Find:

Maximum Allowable Weight When V_1 = V_{MCG}

Solution:

Enter sheet 2 of figure 3-14 with the runway available and correct to reference conditions for RCR, slope, and wind. Enter sheet 1 of figure 3-14 with the altitude and temperature and read down, then enter with the reference MAW distance and read across until intersecting at a weight. This is the Maximum Allowable Weight When V_1 = V_{MCG}. MAW = 470,000 lbs.

ROTATION SPEED (V_R)

The rotation speeds are presented in figure 3-15. However, V_R must always be checked to ensure that V_R is not less than $V_{R\ MIN}$.

MINIMUM ROTATION SPEED ($V_{R\ MIN}$)

The minimum rotation speeds are based on takeoff thrust setting on the tail engine and one wing engine with the other wing engine windmilling. The minimum rotation speed data are found in figure 3-11.

CLIMBOUT SPEED (V_2)

Figure 3-16 provides the climbout speeds. However, if the V_R speed must be increased to equal $V_{R\ MIN}$, the V_2 speed must be increased by the same increment.

FLAP AND SLAT RETRACTION SPEEDS AND MINIMUM MANEUVER SPEEDS

These speeds are presented in figure 3-17 versus gross weight. Use linear interpolation for intermediate weights.

TAKEOFF INTO SUSPECTED WINDSHEAR

WARNING

Takeoff will not be attempted when:

- Severe loss shear conditions exist or are forecast at or below 2000 feet AGL.
- Any severe windshear activity exists or is forecast due to convective activity.

If takeoff into suspected windshear condition is necessary, the following steps apply to performance computations:

a. Use the longest runway available with the least probability of windshear encounter.

b. Use maximum thrust. A bleeds off takeoff may be required. The use of autothrottles and/or autopilot CWS is not recommended.

c. Compute takeoff speeds based on gross weight for existing runway and obstacle conditions.

1. Compute actual gross weight V_1, V_R, and V_2.
2. Compute performance limiting V_1, V_R, and V_2.
3. Set speed bugs to computed performance limiting V_1, V_R, and V_2 speeds.

CAUTION

Performance limiting V_1, V_R, and V_2 will be limited to a 20 knot increase. When $V_{R\ MIN} = V_R$ the performance limiting gross weight V_R will not exceed actual gross weight charted V_R by more than 20 knots.

NOTE

During light gross weights, it is possible that performance limiting V_1 may equal or exceed performance limiting V_R (V_R not to exceed actual gross weight charted V_R by more than 20 knots). In this case the performance limiting gross weight V_R value will be V_1.

4. Compare the actual gross weight charted V_R to performance limiting charted V_R.

WARNING

- Takeoff into suspected windshear will not be attempted unless the charted performance limiting V_R exceeds the charted actual weight V_R by at least 10 knots.
- Never will the V_R bug speed be set to less than $V_{R\ MIN}$.

d. Set V_{FR} and V_{SR} bugs to the actual gross weight speeds.

NOTE

If the performance limited V_2 is higher than the actual gross weight V_{FR}, set the V_{FR} bug to the performance limited V_2.

e. Never rotate later than a point where sufficient runway is available to ensure flight path obstacle clearance. After airborne, implement the Maximum Performance Maneuver if necessary.

STABILIZER SETTING

The airplane nose-up stabilizer setting may be determined from figure 3-18. Linear interpolation may be used for intermediate flap settings.

Example 10:

Given:

CG = 12% MAC

Flap Setting = 20 Degrees

Find:

Stabilizer Setting

Solution:

Enter figure 3-18 with the CG location of 12% MAC and the flap setting of 20 degrees and obtain an airplane nose-up stabilizer angle of 7.2 degrees.

PRESSURE HEIGHT FOR ACCELERATION

Figure 3-19 allows the pressure height for acceleration to be determined corresponding to the geometric height for acceleration shown in the climbout flight path chart (figure 3-7). These heights are the recommended acceleration heights for two engine climbout.

When noise abatement is not a factor, the minimum three engine pressure height for acceleration is 800 feet above the runway. The minimum pressure height for acceleration with an engine inoperative is 400 feet above the runway. If the minimum acceleration height does not provide sufficient obstacle clearance, the pressure height for acceleration is based on the obstacle clearance height.

Example 11:

Given:

Outside Air Temperature = -10°C

Pressure Altitude = 2000 Feet

Find:

Pressure Height for Acceleration

Solution:

Enter figure 3-19 with 2000 feet pressure altitude and -10°C outside air temperature. Read down to the pressure height line and determine that the pressure height for acceleration is 1625 feet above the airfield.

N_1 SETTING

Figure 3-20 presents the N_1 setting for Takeoff Thrust. See Section II for chart explanation.

REDUCED THRUST TAKEOFF N_1 SETTING

The reduced thrust takeoff N_1 setting may be determined from figure 3-21 if the assumed temperature and the outside air temperature are known. The data are valid from sea level to 14,000 feet with the restriction that the assumed temperature may not be less than the thrust flat rated (break) temperature (the thrust flat rated temperatures are indicated on the chart).

Example 12:

Given:

Outside Air Temperature = -20°C

Assumed Temperature = 41°C

Pressure Altitude = 2000 Feet

Engine and Wing Ice Protection On

Air Conditioning On

Find:

Reduced Thrust Takeoff N_1 Setting

Solution:

When reduced thrust is used with ice protection on, the assumed temperature must be reduced by 3°C prior to determining the reduced thrust N_1 setting. Therefore, enter figure 3-21 with the assumed temperature of 38°C and the actual temperature of -20°C. This yields a reduced thrust N_1 setting of 101.0 percent. This value must be increased by 1.0 percent for wing ice protection on, which gives a reduced thrust N_1 setting for takeoff of 102.0 percent.

CONVERSION FROM GRADIENT TO RATE OF CLIMB

The calculation of takeoff performance as discussed in this section is based on climb gradient; rate of climb data is not required. However, figure 3-22 allows climb gradient to be converted to rate of climb in units of feet per minute.

Example 13:

Given:

Outside Air Temperature = 0°C

Pressure Altitude = 4000 Feet

Gross Weight = 520,000 Pounds

Climb Gradient = 4.0 Percent

Airspeed = 184 KCAS

Find:

Rate of Climb

Solution:

Enter figure 3-22 with the airspeed of 184 KCAS and the pressure altitude of 4000 feet. Use the guidelines to account for 0°C outside air temperature and 4.0 percent climb gradient. The rate of climb is 790 feet per minute.

ALL ENGINE CLIMB GRADIENT

Figures 3-22A and 3-22B provide all engine climb gradient. The data in figure 3-22A are based on the all engine climbout speed and is used below pressure height for acceleration (landing gear retracted slats extended), (V_2+10 KIAS) while the data in 3-22B are based on slat retract (V_{SR}) airspeed and is used above pressure height for acceleration.

Example 14:

Given:

Outside Air Temperature = +30°C

Pressure Altitude = 4000 Feet

Gross Weight = 520,000 Pounds

Flaps and Slats = 15°/EXT

Engine and Wing Ice Protection = Off

Find:

All Engine Climb Gradient (%)

All Engine Climb Gradient (FT/NM)

Solution:

Enter figure 3-22A with the outside air temperature of +30°C, pressure altitude of 4000 feet, gross weight of 520,000 pounds, and flap setting of 15 degrees to obtain a Gross Climb Gradient of 10%.

To convert the Gross Climb Gradient in percent to feet per nautical mile enter figure 3-23 with a climb gradient of 10% to the reference line and read down to a climb gradient in feet per nautical mile of 610 feet. This chart may also be used to convert the missed approach climb gradient in percent (%) to ft/nm.

BRAKE COOLING TIME

Brake temperature data are provided in figure 3-24 to allow the minimum brake cooling time to be determined. The cooling time is dependent on the initial brake temperature and the maximum-allowable brake temperature. The initial brake temperature is the temperature of the hottest brake, after reaching a peak value, as read from the brake temperature monitoring system (BTMS). The peak value occurs approximately 15 to 20 minutes after landing. The maximum-allowable brake temperature is the highest brake temperature which permits the energy from the subsequent rejected takeoff (stopping from V_1) to be completely absorbed. The cooling time determined from figure 3-24 is the time from reading the BTMS value (after peak) until the maximum allowable brake temperature is reached.

Example 15:

Given:

BTMS Temperature = 300°C

Gross Weight = 520,000 Pounds

Pressure Altitude = 2000 Feet

Outside Air Temperature = 22°C

Tailwind = 10 Knots (Calculated)

Slope = 1% Up

V_1 = 150 KIAS

Find:

Brake Cooling Time

Solution:

Enter the OAT scale of figure 3-24 at 22°C, read up to the 2000 foot pressure altitude line and then across to the 150 KIAS V_1 line.
Proceed down to correct for a 10 knot tailwind, continue down to the 520,000 pound gross weight line, and read across to determine

the reference RTO energy of 67 x 10^6 foot-pounds. Using this value, enter sheet 2, correct for 1 percent uphill slope and convert the RTO energy to the maximum-allowable brake temperature of 200°C. Next, enter the temperature scale with the BTMS temperature reading and follow the guidelines until the temperature is equal to the maximum-allowable brake temperature. At this point, read down to determine the required brake cooling time of 45 minutes.

TAKEOFF PLANNING GUIDE

TAKEOFF PLANNING GUIDE

STEP 1

List given information (i.e., pressure altitude, OAT, wind, slope, engine bleed, RCR, RSC, obstacle height and distance, runway length and heading, alignment distance, gross weight, CG location, as applicable.

STEP 2

1. Determine runway wind component and crosswind component from figure 3-6.
2. Use wind data to check if takeoff is not allowed due to excessive tailwind or crosswind component.
3. Adjust wind component as described in figure 3-5.
4. Determine if a rolling takeoff is required due to crosswind using figure 3-6.

STEP 2A

If a climbout obstacle or minimum climb restriction exists or an SDP is available, proceed to step 3, 4 or 5 below as required, otherwise to step 6.

MINIMUM CLIMB RESTRICTION EXISTS

CLIMBOUT OBSTACLE EXISTS

STEP 3

If a climbout obstacle and a minimum climb restriction exist use the most limiting for takeoff planning. Determine the obstacle height above liftoff end of the runway and the obstacle distance from the liftoff end of the runway. If departure end of runway elevation is not known and a downhill slope exists, determine obstacle height using the following formula.

OBSTACLE HEIGHT =
OBST HT (MSL)-(FIELD ELEV-$\frac{\text{RWY LENGTH x \% SLOPE)}}{100}$

STEP 3A

Determine the gradient required for obstacle clearance at the obstacle height and distance from step 3 using figure 3-7. Note: Use the most limiting flap correction.

STEP 3B

Compare the gradient required for obstacle clearance to the minimum required gradient of 2.5%. If the gradient required for obstacle clearance is less than or equal to 2.5%, the obstacle is not limiting.

SPECIAL DEPARTURE PROCEDURE EXISTS

STEP 5

Enter figure 3-7 with effective obstacle height and corrected obstacle distance printed on SDP and read climb gradient.

STEP 4

If a climbout obstacle and a minimum climb restriction exist use the most limiting for takeoff planning. Determine AGL height of restriction.

AGL RESTRICTION HEIGHT =
TOP OF RESTRICTION-RUNWAY DEP END ELEV

STEP 4A

Using AGL restriction height from step 4, obtain required climb gardient and runway reduction from sheet 1 or 2 of figure 3-6B.

STEP 4B

If airfield has published required screen height, compare runway reduction required to meet screen height to runway reduction required to meet climb restriction; use larger of two.

STEP 4C

Determine runway available.
RUNWAY AVAILABLE =
RUNWAY LENGTH - LINE UP DIST - RUNWAY REDUCTION.

STEP 4D

Use climb gradient obtained in step 4A and runway available from step 4C for remainder of TOLD Calculations.

Figure 3-4. (Sheet 1)

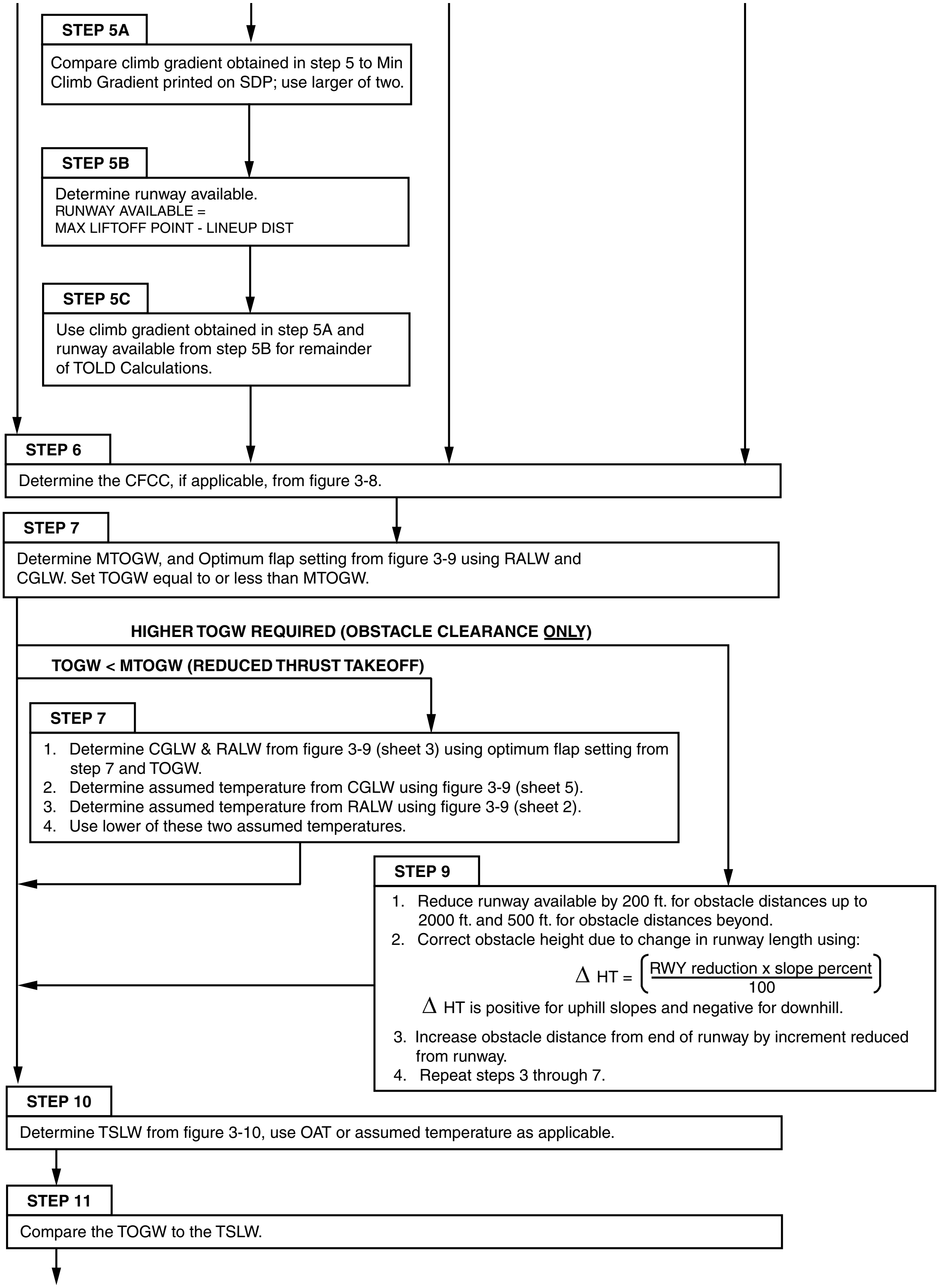


Figure 3-4. (Sheet 2)

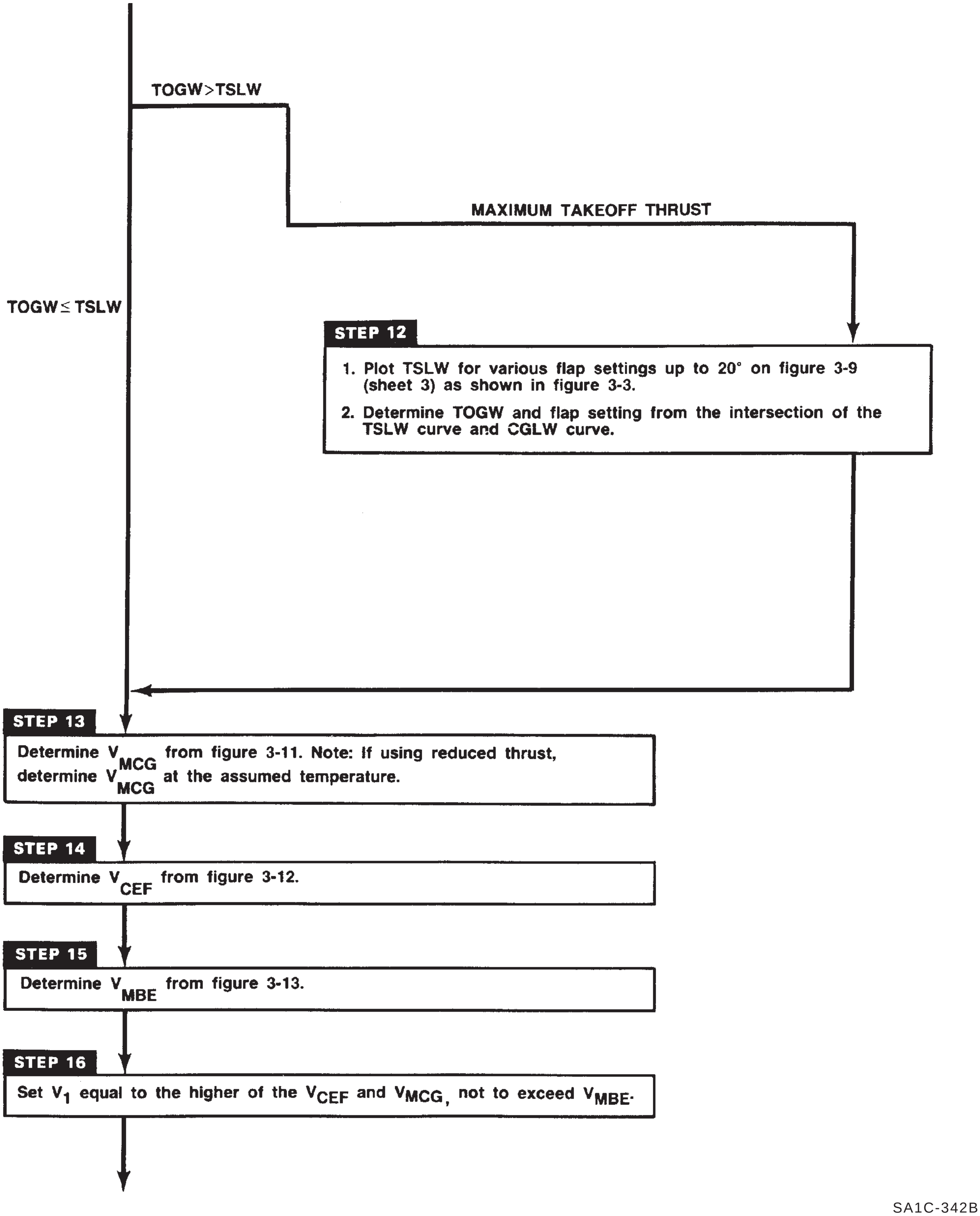


Figure 3-4. (Sheet 3)

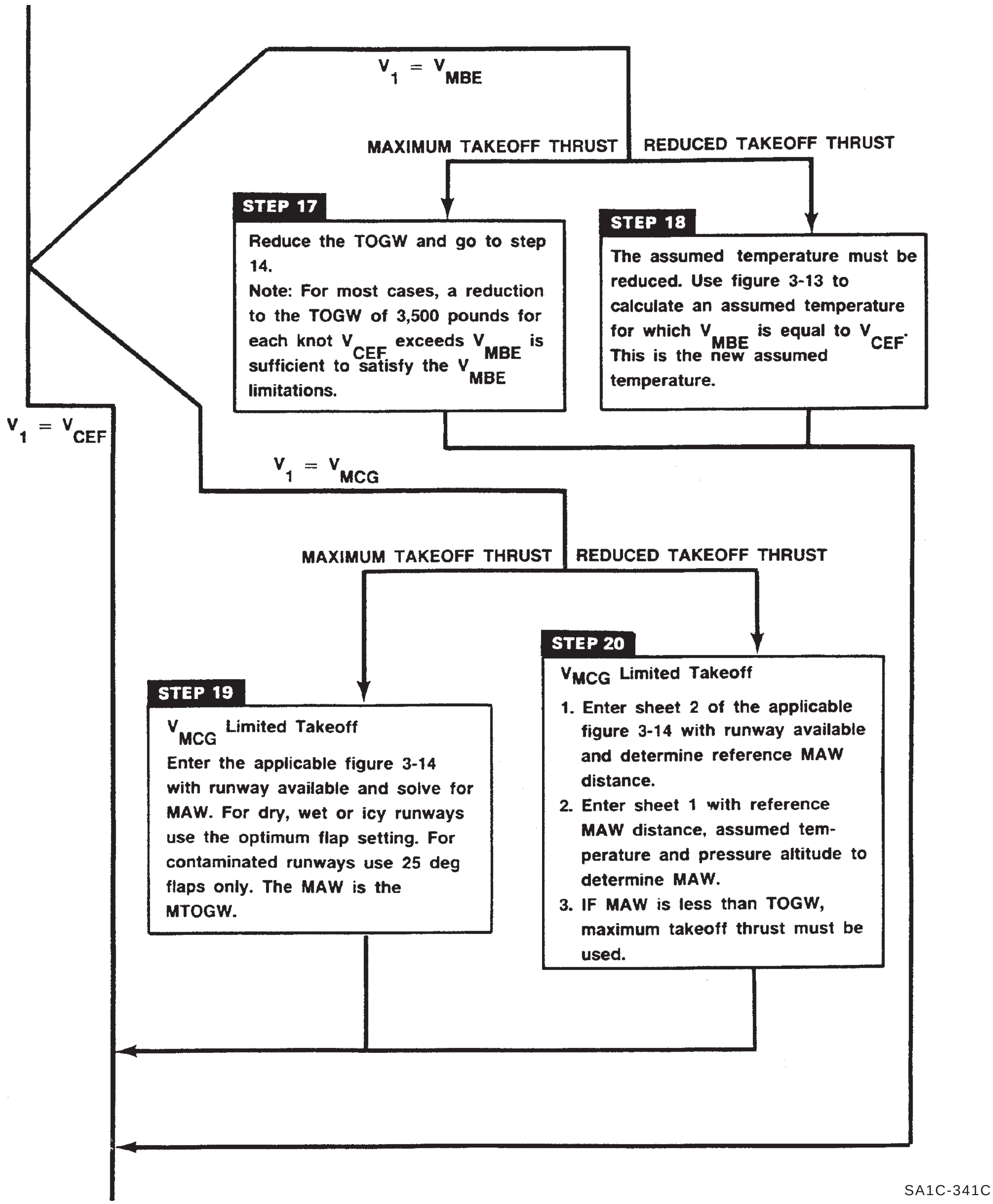


Figure 3-4. (Sheet 4)

STEP 21

Determine V_R from figure 3-15.

STEP 22

Determine $V_{R\ MIN}$ from figure 3-11.

$V_R \geq V_{R\ MIN}$ (go to STEP 24)

$V_R < V_{R\ MIN}$

STEP 23

Increase V_R to equal $V_{R\ MIN}$ and increase V_2 in step 24 by the same increment.

STEP 24

Determine V_2 from figure 3-16. If V_R was increased to equal $V_{R\ MIN}$ increase V_2 by the same increment.

STEP 25

Determine V_{FR}, V_{SR}, and V_{MM} from figure 3-17.

STEP 26

Determine the stabilizer setting from figure 3-18.

STEP 27

Determine the pressure height of acceleration from figure 3-19.

STEP 28

Determine the N_1 setting for takeoff from figure 3-20 or figure 3-21.

STEP 29

Determine MAX allowable Brake Temp from figure 3-24.

STEP 30

Compute emergency return speeds and landing distance based on TOGW using 35° flaps.

F03-004S05

Figure 3-4. (Sheet 5)

WIND SUMMARY - TAKEOFF

TYPE OF WIND	HOW TO OBTAIN COMPONENT	USE OF WIND COMPONENT
HEADWIND	Runway Wind Component Enter wind component chart with steady wind value. If wind direction is variable, use the maximum deviation from the runway heading.	Apply 50 percent of component to all applicable takeoff charts, when required for mission accomplishment. Do not account for headwinds on terrain clearance.
TAILWIND	Runway Wind Component Enter wind component chart with steady wind value plus the gust increment. If wind direction is variable, use the minimum deviation from the runway heading.	Apply 150 percent of component to all applicable takeoff charts. Check maximum takeoff tailwind limitations.
CROSSWIND	Crosswind Component Enter wind component chart with steady wind value plus the gust increment. If wind direction is variable, use the maximum deviation from run-way heading.	Check maximum takeoff crosswind limitation.
GUSTS	Gust Increment Reported wind in excess of steady wind value.	

Figure 3-5. Wind Summary - Takeoff

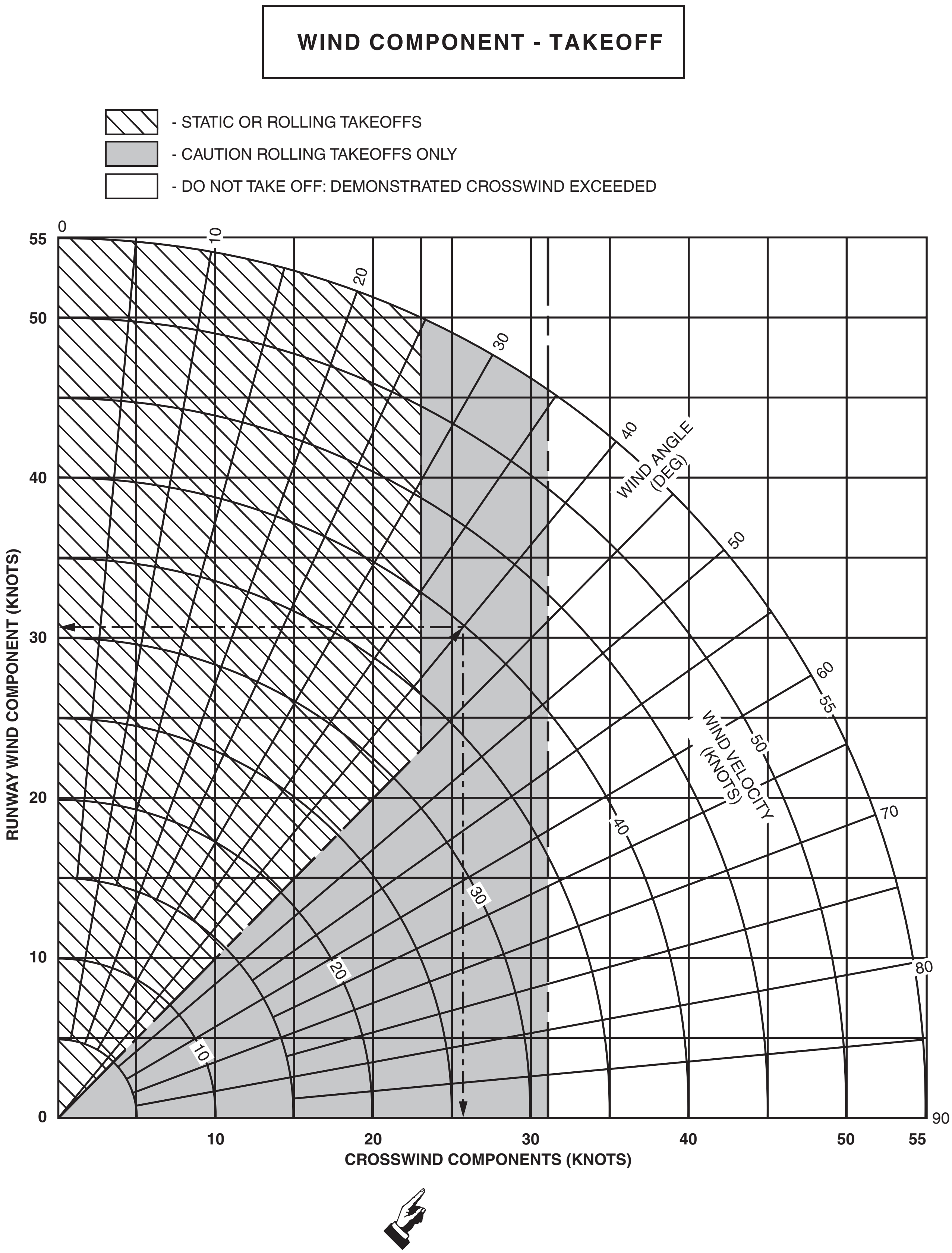
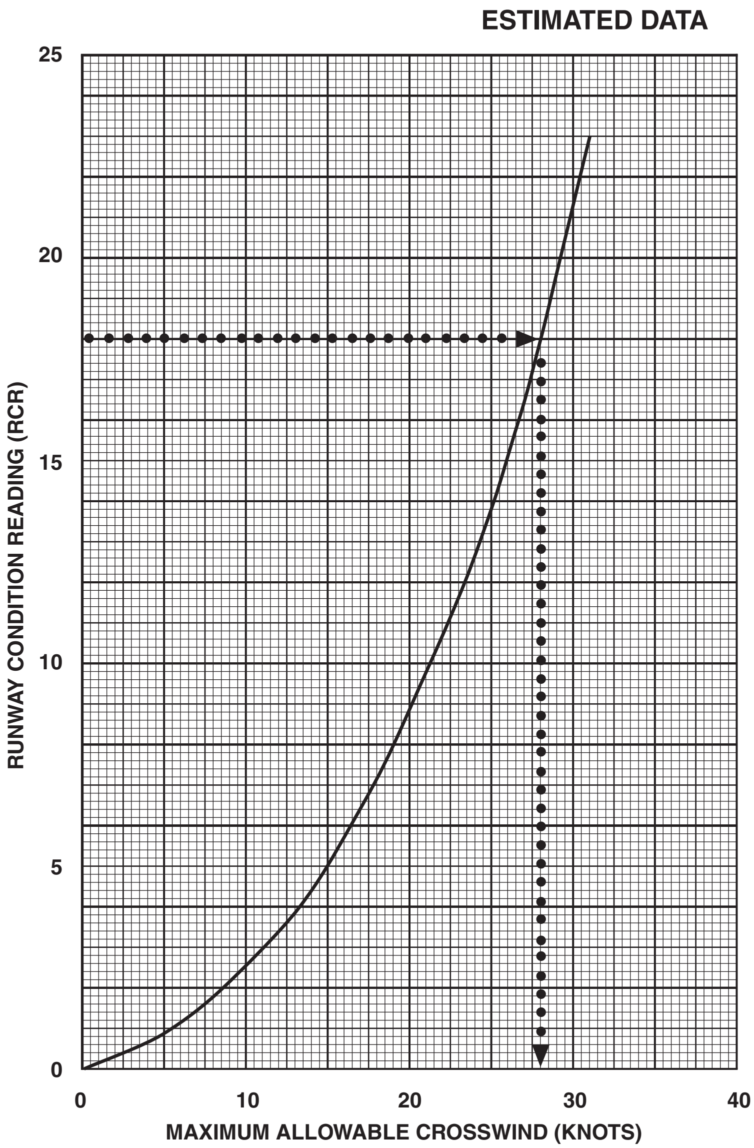

WIND COMPONENT - TAKEOFF
- STATIC OR ROLLING TAKEOFFS
- CAUTION ROLLING TAKEOFFS ONLY
- DO NOT TAKE OFF: DEMONSTRATED CROSSWIND EXCEEDED
WIND ANGLE (DEG)
WIND VELOCITY (KNOTS)
RUNWAY WIND COMPONENT (KNOTS)
CROSSWIND COMPONENTS (KNOTS)
0
10
20
30
40
50
55
60
70
80
90

Figure 3-6.

MAXIMUM ALLOWABLE CROSSWIND DURING TAKEOFF

GE CF6-50C2 ENGINES

EXAMPLE:
GIVEN:
RCR = 18
FIND:
Maximum allowable crosswind
SOLUTION:
Maximum allowable crosswind = 28 knots



CAG(IGDS) SA1C-603

Figure 3-6A.

MINIMUM CLIMB GRADIENT

Note:
1. End of Restriction Height (AGL) = Top of Min Climb Restriction (MSL) - Rwy Departure End Field Elev.
2. For each .01 Downhill slope, increase climb gradient % using Downhill Slope Correction additive.
3. For each knot tailwind, increase climb gradient % using Tailwind Correction additive.

MINIMUM CLIMB RESTRICTION ENDING BELOW PRESSURE HEIGHT FOR ACCELERATION

CLIMB RESTRICTION (FT/NM) — CLIMB GRADIENT (%) / RUNWAY CUTBACK (FT)

End of Restriction Height (AGL)	Downhill Slope Correction (+% Gradient)	Tailwind Correction (+% Gradient)	152	200	210	220	230	240	250	260	270	280	290	300	310	320
1500	.02	.06	2.87 1698	3.69 1645	3.87 1633	4.04 1621	4.21 1608	4.38 1596	4.56 1582	4.72 1569	4.89 1556	5.06 1542	5.24 1527	5.41 1513	5.59 1497	5.76 1482
1400	.02	.06	2.87 1698	3.69 1645	3.87 1633	4.04 1621	4.21 1608	4.38 1596	4.56 1582	4.72 1569	4.89 1556	5.06 1542	5.24 1527	5.41 1513	5.58 1498	5.75 1483
1300	.02	.06	2.86 1699	3.69 1645	3.86 1633	4.04 1621	4.21 1608	4.38 1596	4.55 1583	4.72 1569	4.89 1556	5.06 1542	5.23 1528	5.40 1514	5.56 1500	5.73 1485
1200	.02	.06	2.86 1699	3.69 1645	3.86 1633	4.04 1621	4.21 1608	4.38 1596	4.55 1583	4.72 1569	4.88 1557	5.06 1542	5.22 1529	5.38 1515	5.54 1502	5.70 1488
1100	.02	.06	2.86 1699	3.69 1645	3.86 1633	4.03 1621	4.20 1609	4.37 1596	4.54 1583	4.71 1570	4.87 1557	5.03 1545	5.19 1531	5.35 1518	5.51 1504	5.67 1490
1000	.02	.06	2.86 1699	3.68 1646	3.85 1634	4.03 1621	4.20 1609	4.36 1597	4.52 1585	4.68 1573	4.84 1560	5.00 1547	5.16 1534	5.32 1520	5.47 1508	5.63 1494
900	.02	.06	2.85 1699	3.67 1647	3.84 1635	4.02 1622	4.17 1611	4.33 1599	4.50 1586	4.65 1575	4.81 1562	4.96 1550	5.11 1538	5.27 1525	5.42 1512	5.57 1499
800	.02	.06	2.83 1701	3.65 1648	3.82 1636	3.98 1625	4.14 1613	4.30 1602	4.45 1590	4.60 1579	4.76 1566	4.91 1554	5.06 1542	5.21 1530	5.36 1517	5.50 1505
700	.03	.06	2.82 1701	3.60 1651	3.77 1640	3.93 1628	4.09 1617	4.24 1606	4.40 1594	4.55 1583	4.70 1571	4.84 1560	4.98 1549	5.13 1536	5.28 1524	5.42 1512
600	.03	.06	2.79 1703	3.54 1655	3.70 1645	3.86 1633	4.03 1621	4.18 1610	4.33 1599	4.48 1588	4.62 1577	4.76 1566	4.89 1556	5.04 1544	5.20 1531	5.35 1518
500	.04	.06	2.72 1707	3.46 1661	3.62 1650	3.77 1640	3.92 1629	4.07 1618	4.22 1608	4.38 1596	4.54 1583	4.69 1572	4.85 1559	5.01 1546	5.17 1533	5.33 1520
400	.04	.06	2.62 1713	3.33 1669	3.49 1659	3.66 1647	3.83 1636	4.01 1623	4.17 1611	4.34 1599	4.49 1587	4.65 1575	4.81 1562	4.95 1551	5.12 1537	5.28 1524
300	.05	.07	2.55 1717	3.32 1670	3.48 1659	3.65 1648	3.82 1636	3.99 1624	4.16 1612	4.33 1599	4.48 1588	4.64 1576	4.81 1562	4.95 1551	5.12 1537	5.27 1525
200	.08	.08	2.55 1717	3.32 1670	3.47 1660	3.64 1649	3.81 1637	3.97 1626	4.14 1613	4.32 1600	4.47 1589	4.63 1576	4.80 1563	4.95 1551	5.11 1538	5.26 1526
100	.09	.08	2.54 1718	3.23 1676	3.35 1668	3.48 1659	3.60 1651	3.72 1643	3.84 1635	3.95 1627	4.07 1618	4.19 1610	4.31 1601	4.43 1592	4.55 1583	4.67 1573

MINIMUM CLIMB RESTRICTION ENDING AT OR ABOVE PRESSURE HEIGHT FOR ACCELERATION

CLIMB RESTRICTION (FT/NM) — CLIMB GRADIENT (%) / RUNWAY CUTBACK (FT)

End of Restriction Ht (AGL)	Downhill Slope Correction +% Gradient	Tailwind Correction +% Gradient	152	200	210	220	230	240	250	260	270	280	290	300	310	320	330
≥1505	.01	.05	4.67 571	5.91 577	6.16 577	6.42 576	6.67 576	6.92 574	7.16 573	7.41 570	7.66 568	7.90 565	8.15 562	8.39 560	8.64 558	8.89 556	>9.0 N/A

Figure 3-6B. (Sheet 1)

MINIMUM CLIMB GRADIENT

Note:
1. End of Restriction Height (AGL) = Top of Min Climb Restriction (MSL) - Rwy Departure End Field Elev.
2. For each .01 Downhill slope, increase climb gradient % using Downhill Slope Correction additive.
3. For each knot tailwind, increase climb gradient % using Tailwind Correction additive.

MINIMUM CLIMB RESTRICTION
ENDING BELOW PRESSURE HEIGHT FOR ACCELERATION (CONTINUED)

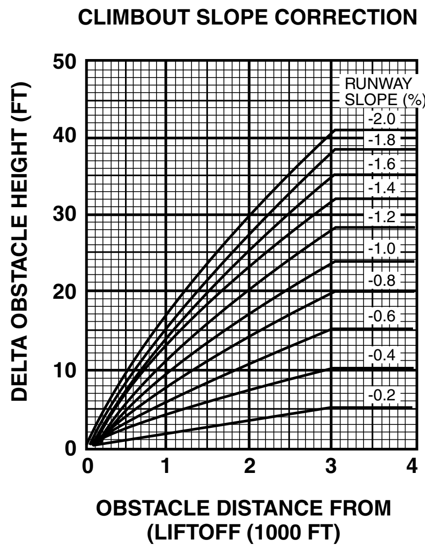
			CLIMB RESTRICTION (FT/NM)																	
			330	340	350	360	370	380	390	400	410	420	430	440	450	460	470	480	490	500
End of Restriction Height (AGL)	Downhill Slope Correction (+% Gradient)	Tailwind Correction (+% Gradient)	CLIMB GRADIENT (%) RUNWAY CUTBACK (FT)																	
1500	.02	.06	5.93 1467	6.09 1453	6.26 1437	6.43 1421	6.59 1405	6.75 1390	6.92 1373	7.10 1355	7.28 1336	7.47 1316	7.66 1296	7.83 1278	8.02 1257	8.20 1237	8.38 1216	8.55 1197	8.72 1177	8.88 1158
1400	.02	.06	5.92 1468	6.08 1453	6.24 1439	6.40 1424	6.56 1408	6.72 1393	6.89 1376	7.07 1358	7.25 1339	7.43 1321	7.61 1302	7.79 1282	7.97 1262	8.14 1244	8.32 1223	8.49 1204	8.66 1184	8.82 1165
1300	.02	.06	5.89 1471	6.06 1455	6.22 1441	6.37 1426	6.53 1411	6.69 1396	6.86 1379	7.03 1362	7.20 1344	7.38 1326	7.56 1307	7.74 1288	7.91 1269	8.09 1249	8.26 1230	8.43 1211	8.60 1191	8.75 1173
1200	.02	.06	5.87 1473	6.02 1459	6.18 1444	6.33 1430	6.49 1415	6.65 1400	6.82 1383	6.97 1368	7.15 1350	7.32 1332	7.50 1313	7.67 1295	7.85 1276	8.02 1257	8.18 1239	8.35 1220	8.52 1200	8.68 1182
1100	.02	.06	5.83 1476	5.98 1463	6.14 1448	6.29 1434	6.45 1419	6.60 1404	6.76 1389	6.92 1373	7.08 1357	7.25 1339	7.42 1322	7.60 1303	7.76 1285	7.93 1267	8.10 1248	8.27 1229	8.43 1211	8.58 1193
1000	.02	.06	5.78 1481	5.93 1467	6.09 1453	6.24 1439	6.39 1425	6.54 1410	6.70 1395	6.85 1380	7.01 1364	7.17 1348	7.34 1330	7.51 1312	7.67 1395	7.83 1278	7.99 1260	8.17 1240	8.36 1219	8.54 1198
900	.02	.06	5.73 1485	5.88 1472	6.03 1458	6.18 1444	6.32 1431	6.47 1417	6.62 1402	6.77 1388	6.92 1373	7.07 1358	7.23 1341	7.41 1323	7.59 1304	7.78 1283	7.96 1264	8.15 1242	8.34 1221	8.52 1200
800	.02	.06	5.66 1491	5.80 1479	5.95 1465	6.10 1452	6.24 1439	6.39 1425	6.54 1410	6.70 1395	6.87 1378	7.04 1361	7.21 1343	7.39 1325	7.57 1306	7.75 1286	7.94 1266	8.12 1246	8.31 1224	8.48 1205
700	.03	.06	5.56 1500	5.71 1487	5.87 1473	6.03 1458	6.19 1443	6.35 1428	6.52 1412	6.68 1397	6.85 1380	7.02 1363	7.18 1347	7.37 1327	7.54 1309	7.72 1290	7.90 1270	8.08 1250	8.27 1229	8.44 1210
600	.03	.06	5.52 1503	5.67 1490	5.83 1476	6.01 1460	6.17 1445	6.33 1430	6.49 1415	6.66 1399	6.82 1383	6.99 1366	7.16 1349	7.33 1331	7.51 1312	7.68 1294	7.86 1275	8.03 1256	8.21 1236	8.40 1214
500	.04	.06	5.49 1506	5.65 1492	5.81 1478	5.97 1464	6.13 1449	6.30 1433	6.49 1418	6.62 1402	6.79 1386	6.95 1370	7.12 1353	7.28 1336	7.46 1317	7.63 1299	7.80 1281	7.97 1262	8.14 1244	8.32 1223
400	.04	.06	5.44 1510	5.60 1496	5.75 1483	5.91 1469	6.08 1453	6.24 1439	6.41 1423	6.57 1407	6.73 1392	6.89 1376	7.07 1358	7.22 1342	7.38 1326	7.55 1308	7.72 1290	7.88 1272	8.05 1254	8.22 1235
300	.05	.07	5.43 1511	5.59 1497	5.74 1484	5.90 1470	6.06 1455	6.22 1441	6.38 1425	6.54 1410	6.70 1395	6.86 1379	7.03 1362	7.18 1347	7.35 1329	7.52 1311	7.68 1294	7.84 1277	8.02 1257	8.19 1238
200	.08	.08	5.42 1512	5.57 1499	5.72 1486	5.88 1472	6.03 1458	6.18 1444	6.33 1430	6.47 1417	6.61 1403	6.76 1389	6.91 1374	7.05 1360	7.19 1345	7.33 1331	7.48 1315	7.62 1300	7.77 1284	7.92 1268
100	.09	.08	4.78 1565	4.90 1555	5.02 1545	5.12 1537	5.24 1527	5.35 1518	5.45 1509	5.56 1500	5.67 1490	5.78 1481	5.89 1471	6.00 1461	6.10 1452	6.21 1441	6.32 1431	6.43 1421	6.54 1410	6.65 1400

Figure 3-6B. (Sheet 2)

CLIMBOUT FLIGHT PATH

NOTE:

1. ONE ENGINE INOPERATIVE.
2. APPLICABLE FOR ALL ALTITUDES, TEMPERATURES, AND ENGINE BLEEDS
3. BASED ON 10 MINUTES TAKEOFF THRUST FOLLOWED BY MAXIMUM CONTINUOUS THRUST
4. APPLY THE DOWNHILL SLOPE CORRECTION TO OBSTACLE HEIGHT BEFORE DETERMINING THE GRADIENT REQUIRED FOR OBSTACLE CLEARANCE. THERE IS NO CORRECTION FOR UPHILL SLOPES
5. IF THE GRADIENT REQUIRED EXCEED 9.0 PERCENT, INCREASE THE DISTANCE TO THE OBSTACLE (WITH A CORRESPONDING REDUCTION IN THE RUNWAY AVAILABLE) SUCH THAT THE GRADIENT REQUIRED IS 9.0 PERCENT OR LESS



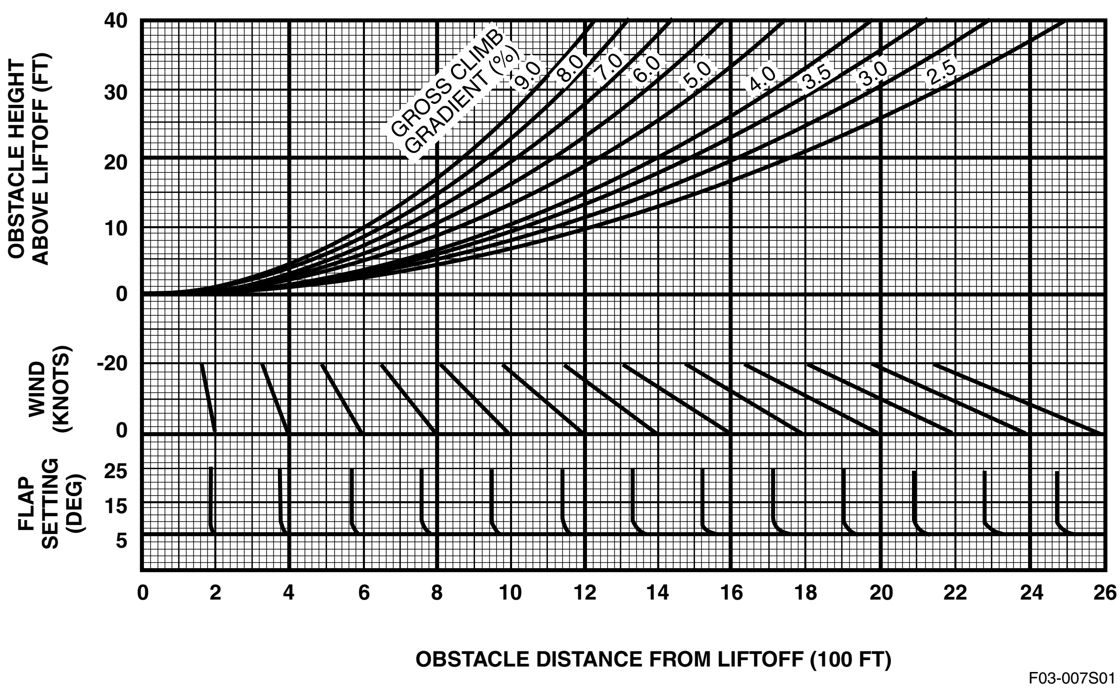


Figure 3-7. (Sheet 1)

CLIMBOUT FLIGHT PATH

NOTE:
USE SHEET 1 FOR OBSTACLES FALLING WITHIN THE SHADED AREA.

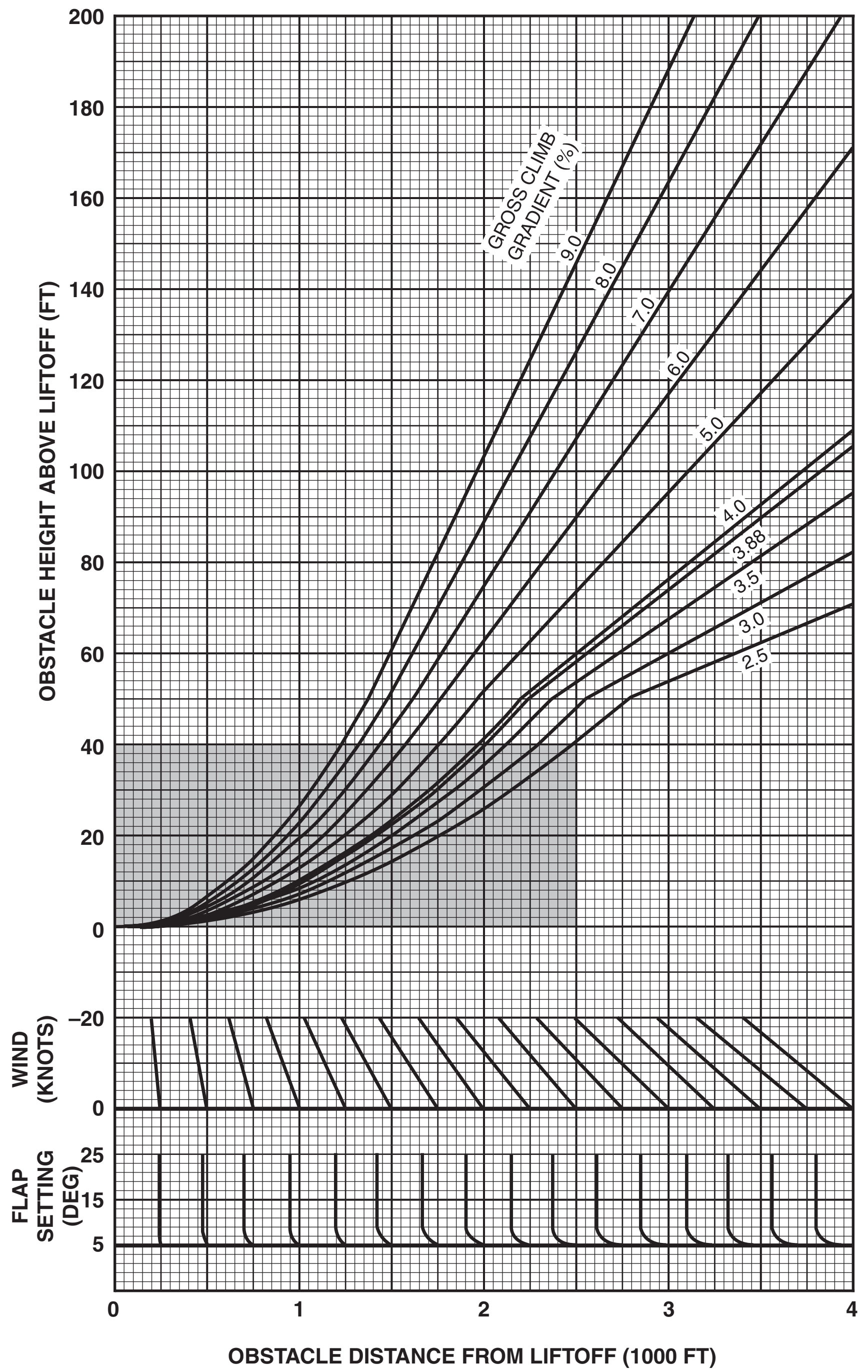


Figure 3-7. (Sheet 1A)

CLIMBOUT FLIGHT PATH

NOTE:
BASED ON TEN MINUTES OF TAKEOFF THRUST
FOR DOWNHILL SLOPES, INCREASE THE OBSTACLE HEIGHT BY 24 FEET PER 1% SLOPE.
NO CORRECTION IS REQUIRED FOR UPHILL SLOPES

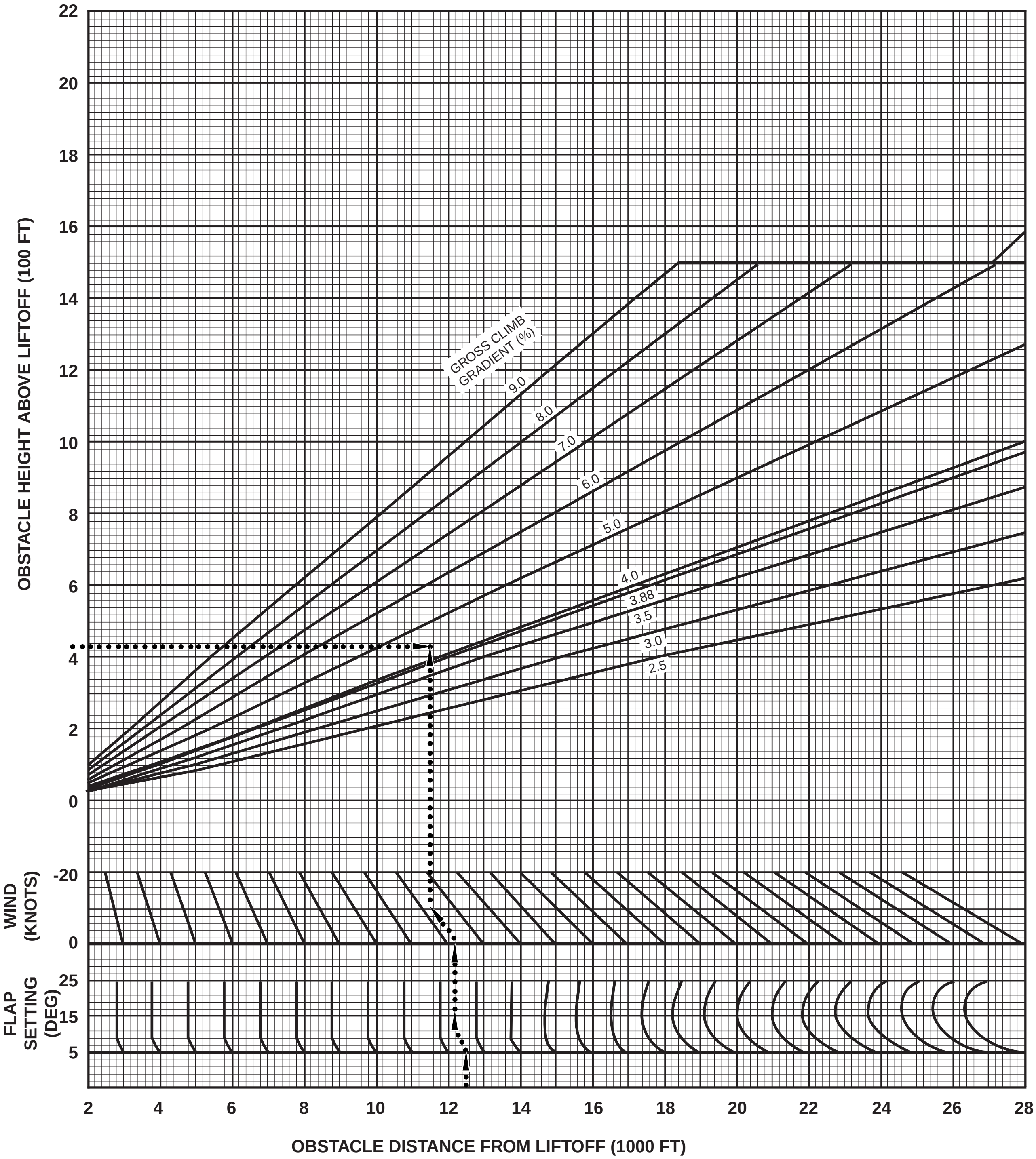


Figure 3-7. (Sheet 2)

CLIMBOUT FLIGHT PATH

NOTE:
BASED ON TEN MINUTES OF TAKEOFF THRUST
FOR DOWNHILL SLOPES, INCREASE THE OBSTACLE HEIGHT BY 24 FEET PER 1% SLOPE.
NO CORRECTION IS REQUIRED FOR UPHILL SLOPES

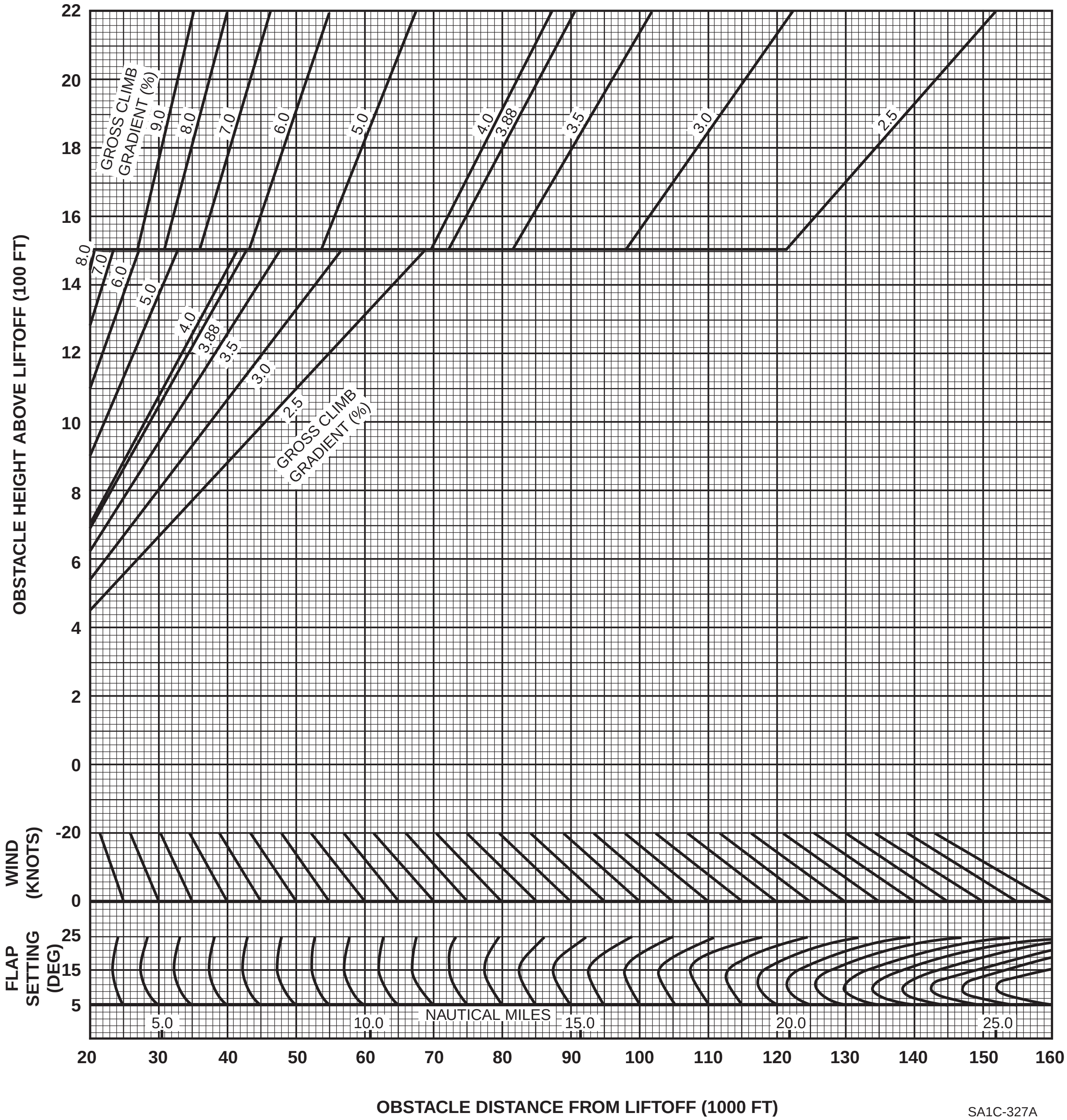


Figure 3-7. (Sheet 3)

CLIMBOUT FLIGHT PATH

NOTE:
BASED ON TEN MINUTES OF TAKEOFF THRUST
FOR DOWNHILL SLOPES, INCREASE THE OBSTACLE HEIGHT BY 24 FEET PER 1% SLOPE.
NO CORRECTION IS REQUIRED FOR UPHILL SLOPES

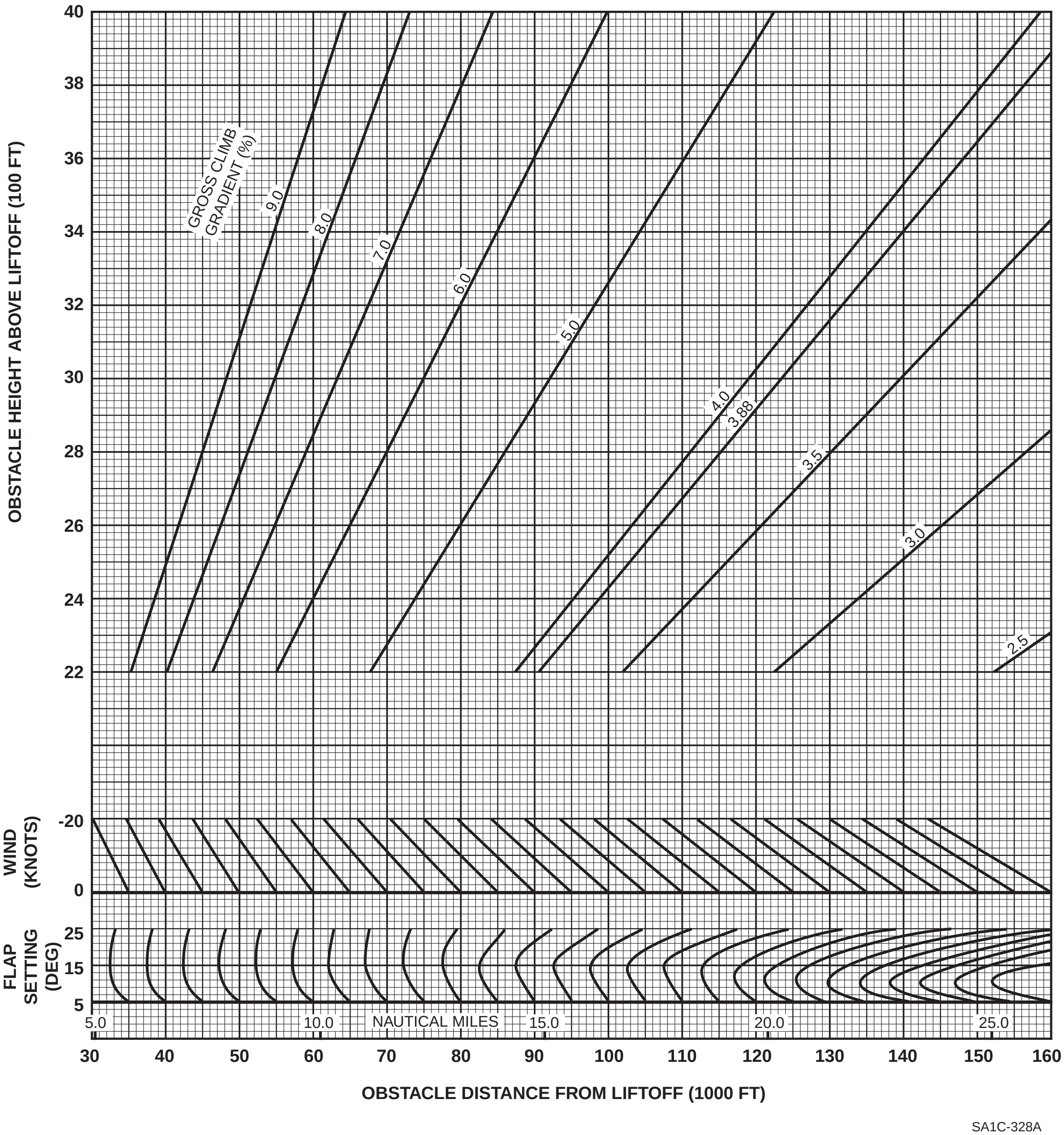


Figure 3-7. (Sheet 4)

CLIMBOUT FLIGHT PATH

NOTE:
BASED ON TEN MINUTES OF TAKEOFF THRUST
FOR DOWNHILL SLOPES, INCREASE THE OBSTACLE HEIGHT BY 24 FEET PER 1% SLOPE.
NO CORRECTION IS REQUIRED FOR UPHILL SLOPES

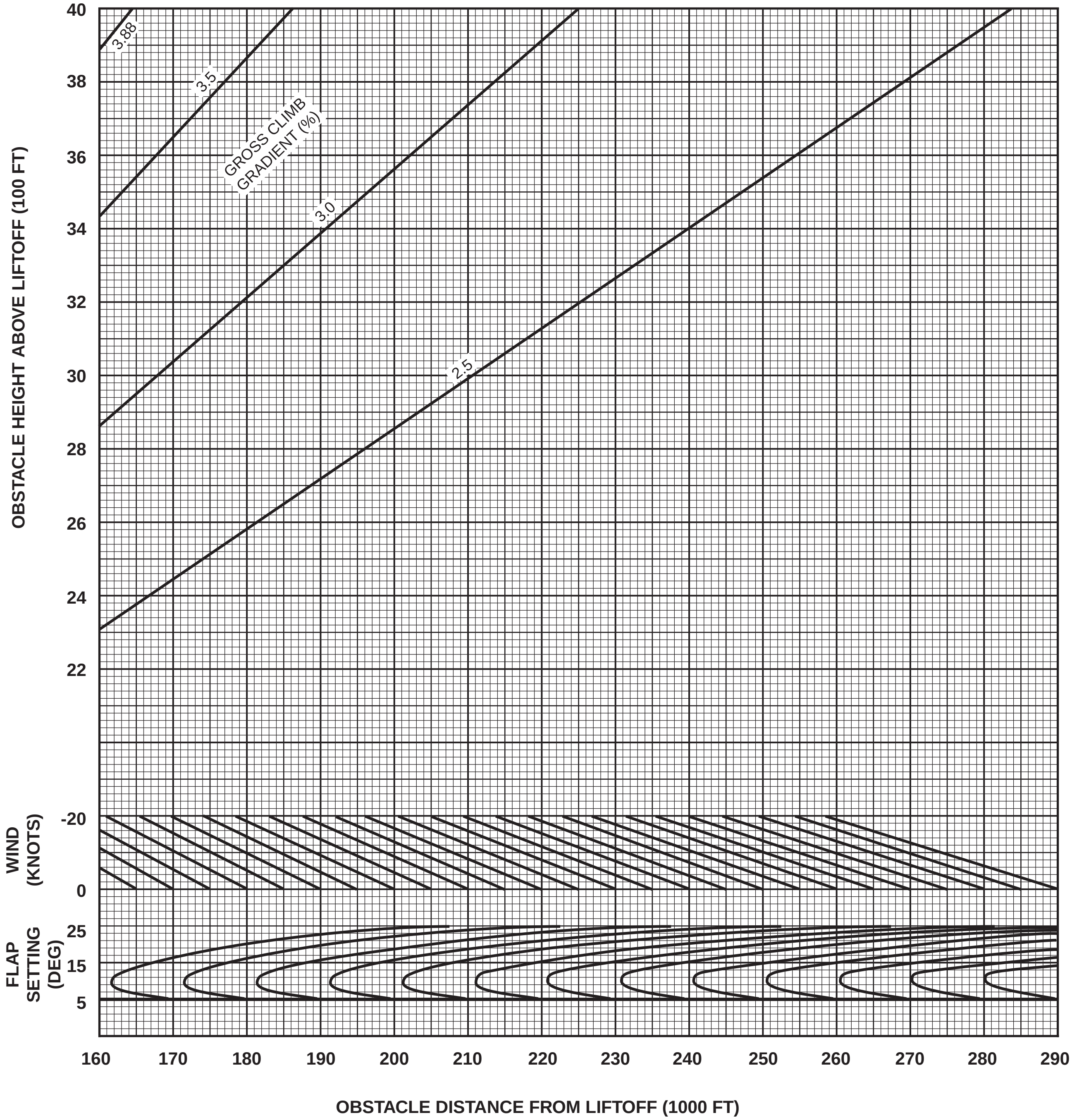


Figure 3-7. (Sheet 5)

CLIMBOUT FLIGHT PATH

NOTE:
BASED ON TEN MINUTES OF TAKEOFF THRUST
FOR DOWNHILL SLOPES, INCREASE THE OBSTACLE HEIGHT BY 24 FEET PER 1% SLOPE.
NO CORRECTION IS REQUIRED FOR UPHILL SLOPES

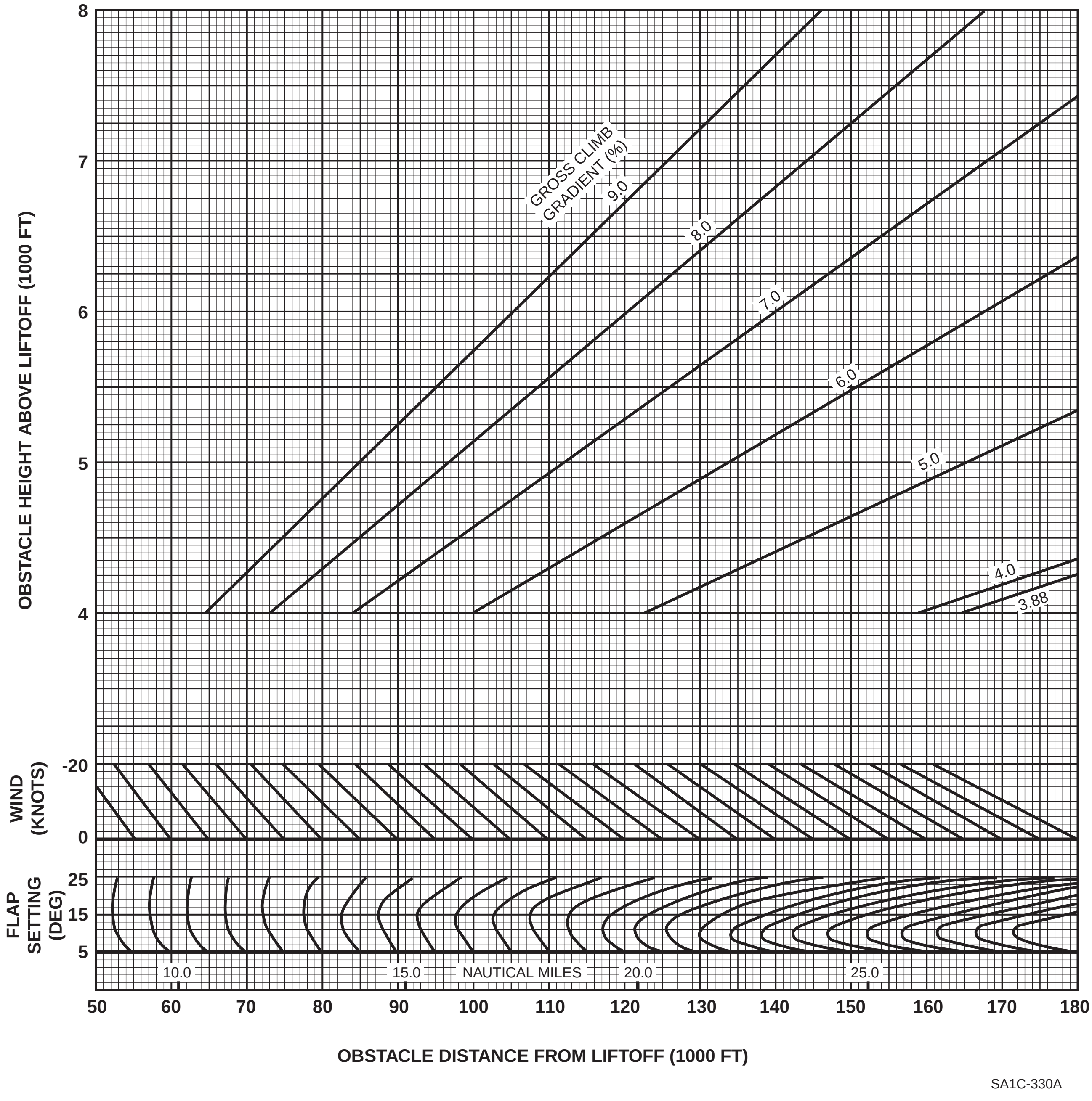


Figure 3-7. (Sheet 6)

CLIMBOUT FLIGHT PATH

NOTE:
BASED ON TEN MINUTES OF TAKEOFF THRUST
FOR DOWNHILL SLOPES, INCREASE THE OBSTACLE HEIGHT BY 24 FEET PER 1% SLOPE.
NO CORRECTION IS REQUIRED FOR UPHILL SLOPES

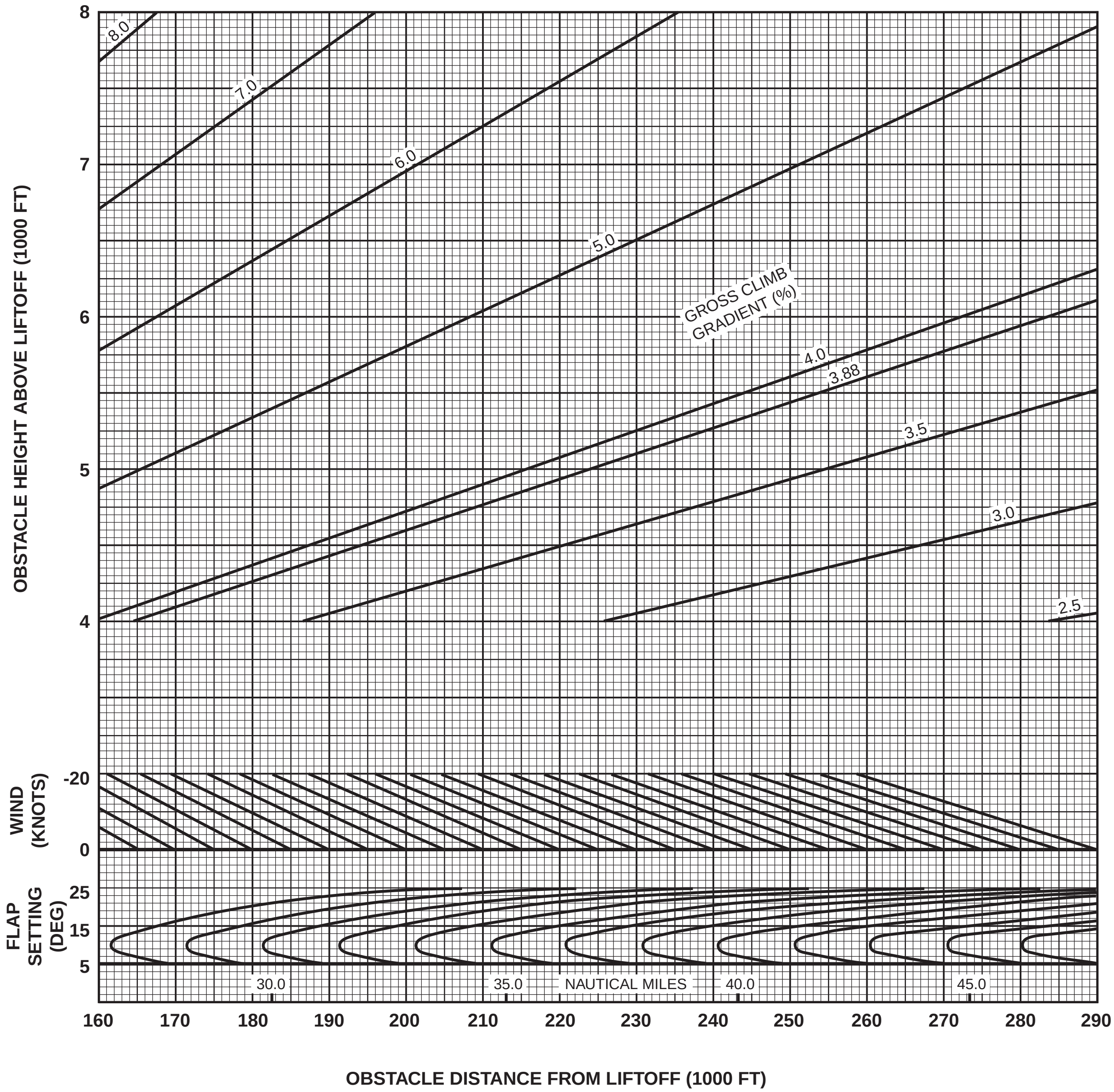


Figure 3-7. (Sheet 7)

CLIMBOUT FLIGHT PATH

NOTE:
BASED ON TEN MINUTES OF TAKEOFF THRUST
FOR DOWNHILL SLOPES, INCREASE THE OBSTACLE HEIGHT BY 24 FEET PER 1% SLOPE.
NO CORRECTION IS REQUIRED FOR UPHILL SLOPES

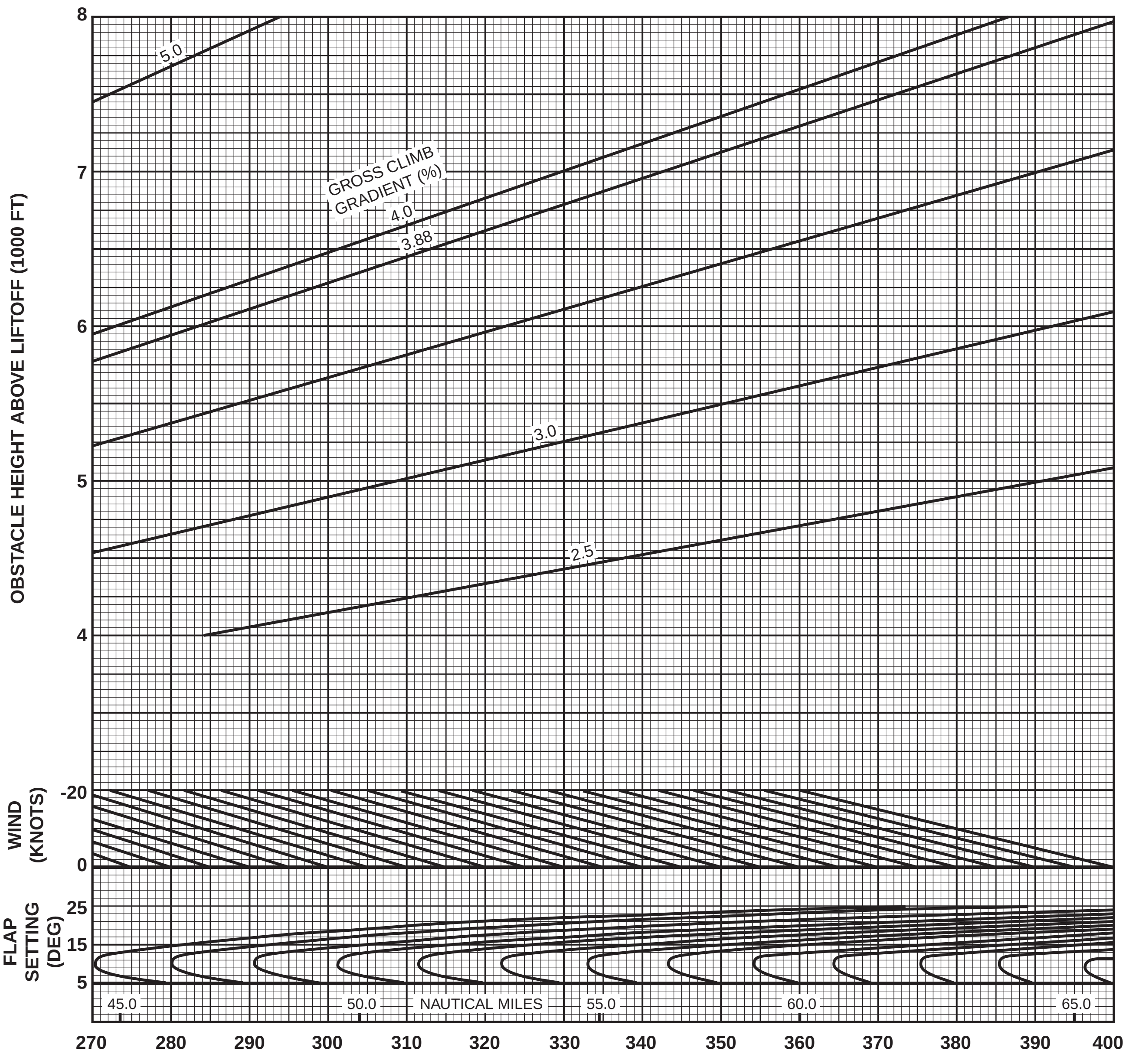


Figure 3-7. (Sheet 8)

CLIMBOUT FLIGHT PATH

NOTE:
BASED ON TEN MINUTES OF TAKEOFF THRUST
FOR DOWNHILL SLOPES, INCREASE THE OBSTACLE HEIGHT BY 24 FEET PER 1% SLOPE.
NO CORRECTION IS REQUIRED FOR UPHILL SLOPES

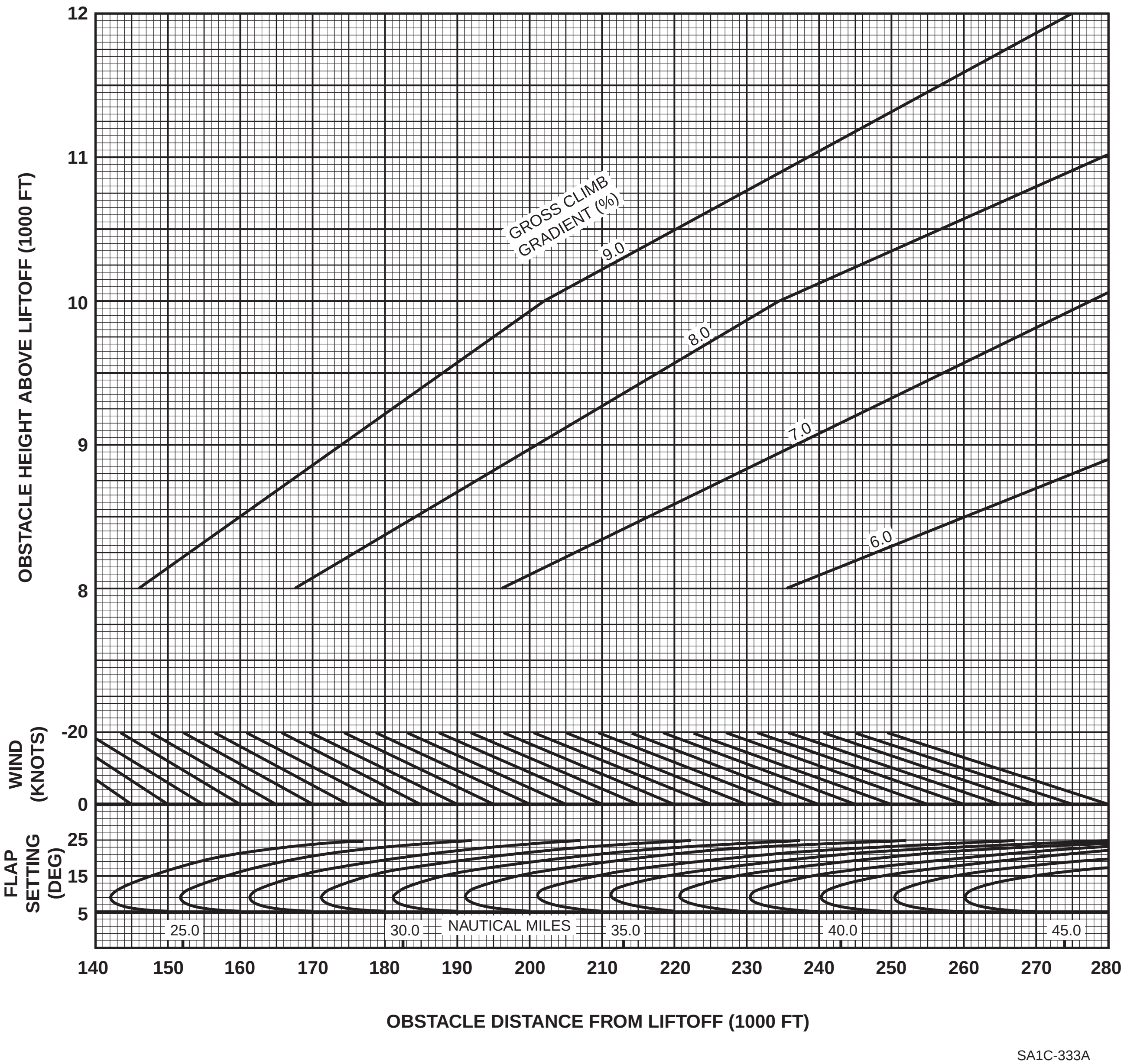


Figure 3-7. (Sheet 9)

CLIMBOUT FLIGHT PATH

NOTE:
BASED ON TEN MINUTES OF TAKEOFF THRUST
FOR DOWNHILL SLOPES, INCREASE THE OBSTACLE HEIGHT BY 24 FEET PER 1% SLOPE.
NO CORRECTION IS REQUIRED FOR UPHILL SLOPES

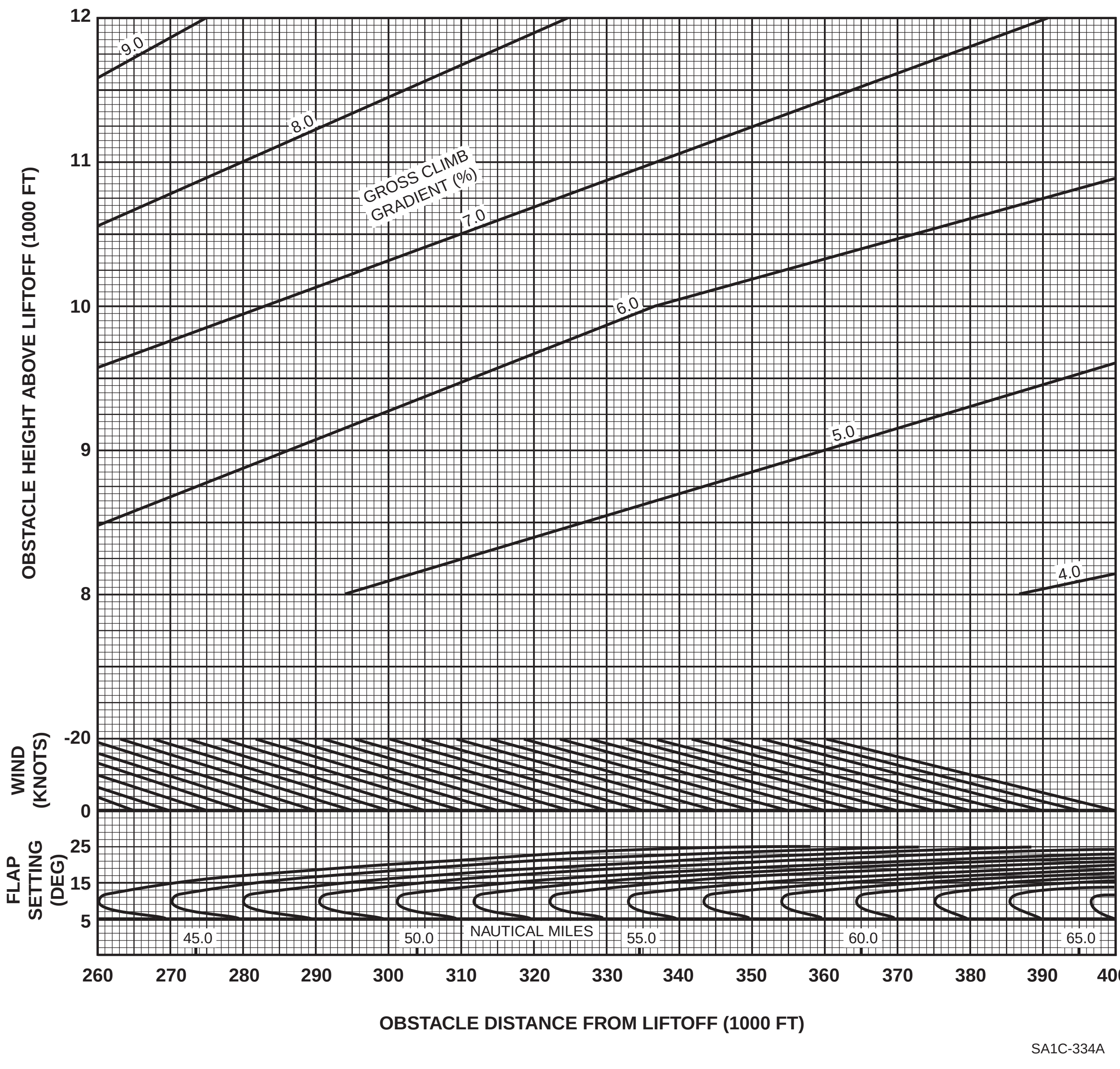


Figure 3-7. (Sheet 10)

CORRECTION FACTOR FOR CONFIGURATION CHANGES, CFCC

WARNING

DO NOT TAKEOFF WITH A CFCC IF RSC CONDITIONS EXISTS.

NOTE:
1. ONE WHEEL BRAKE INOPERATIVE DATA ARE VALID FOR CENTER GEAR EXTENDED OR RETRACTED
2. ANTI-SKID INOPERATIVE DATA ARE VALID FOR CENTER GEAR EXTENDED OR RETRACTED
3. USE CFCC ON RCR 23 TO 18 CHARTS ONLY

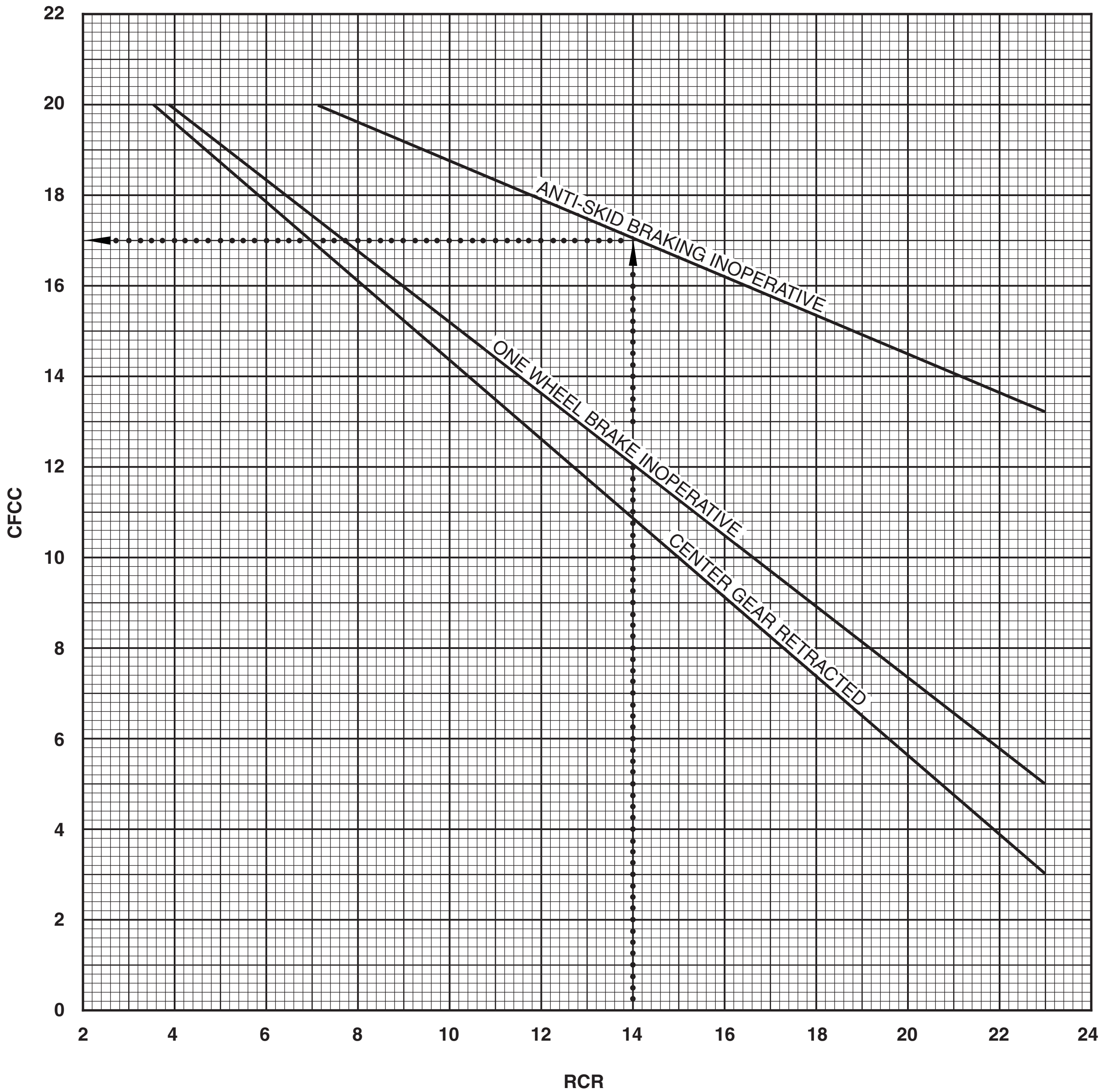


Figure 3-8.

MAXIMUM TAKEOFF GROSS WEIGHT AT OPTIMUM TAKEOFF FLAP SETTING RCR = 23 TO 18 / WITH REVERSE THRUST

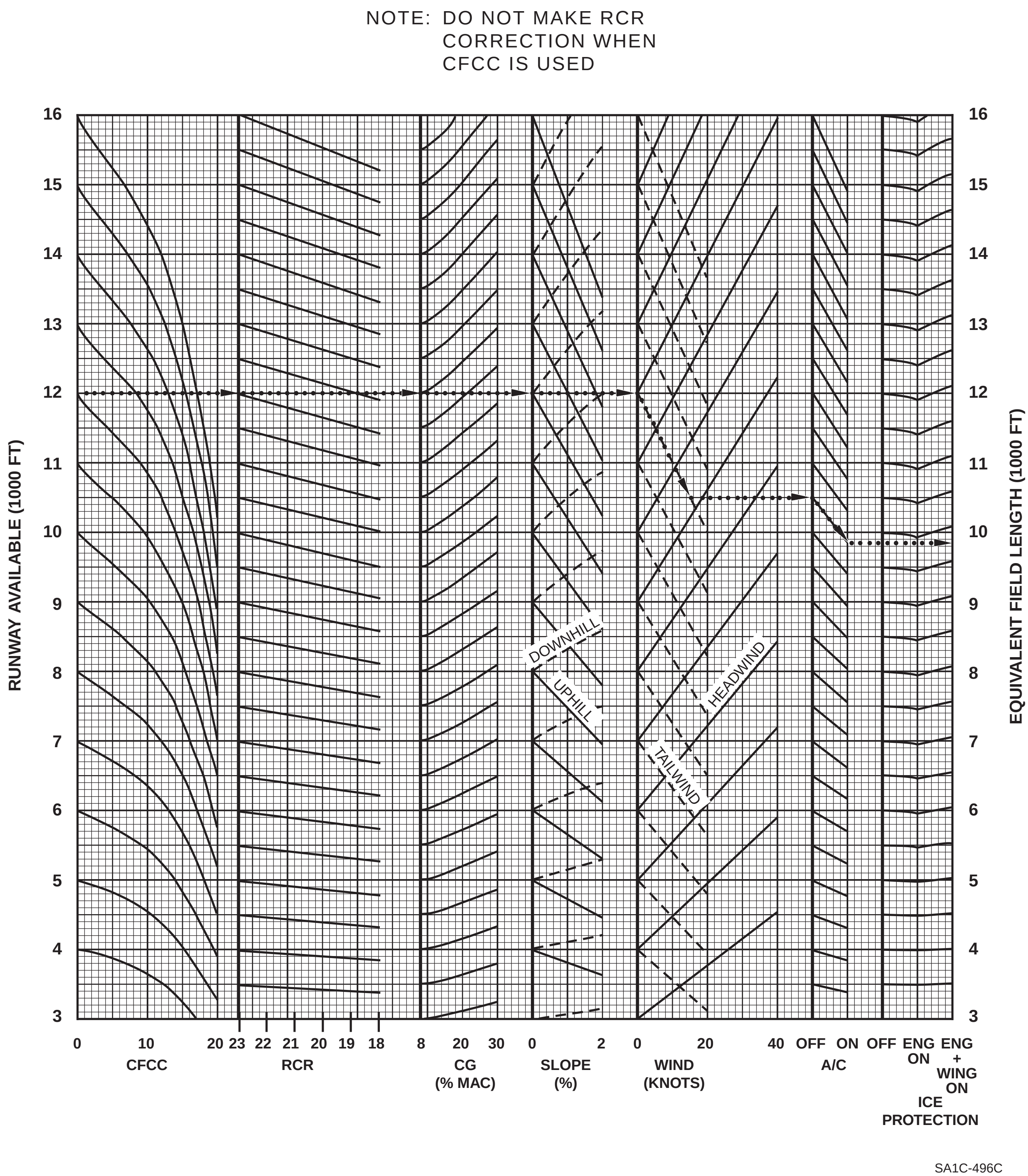


Figure 3-9A. (Sheet 1)

MAXIMUM TAKEOFF GROSS WEIGHT AT OPTIMUM TAKEOFF FLAP SETTING
RCR = 23 TO 18 / WITH REVERSE THRUST

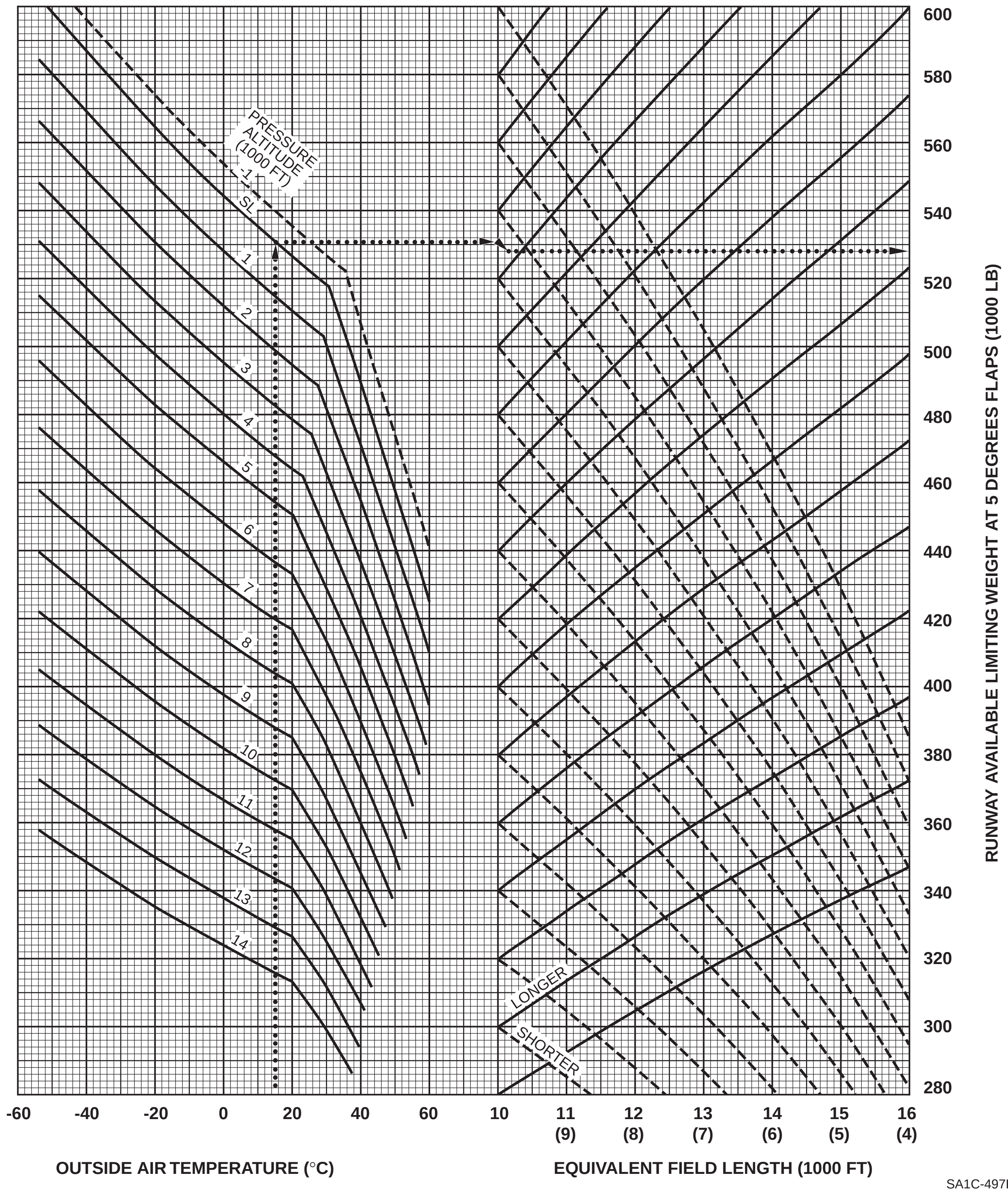


Figure 3-9A. (Sheet 2)

MAXIMUM TAKEOFF GROSS WEIGHT AT OPTIMUM TAKEOFF FLAP SETTING
RCR = 23 TO 18 / WITH REVERSE THRUST

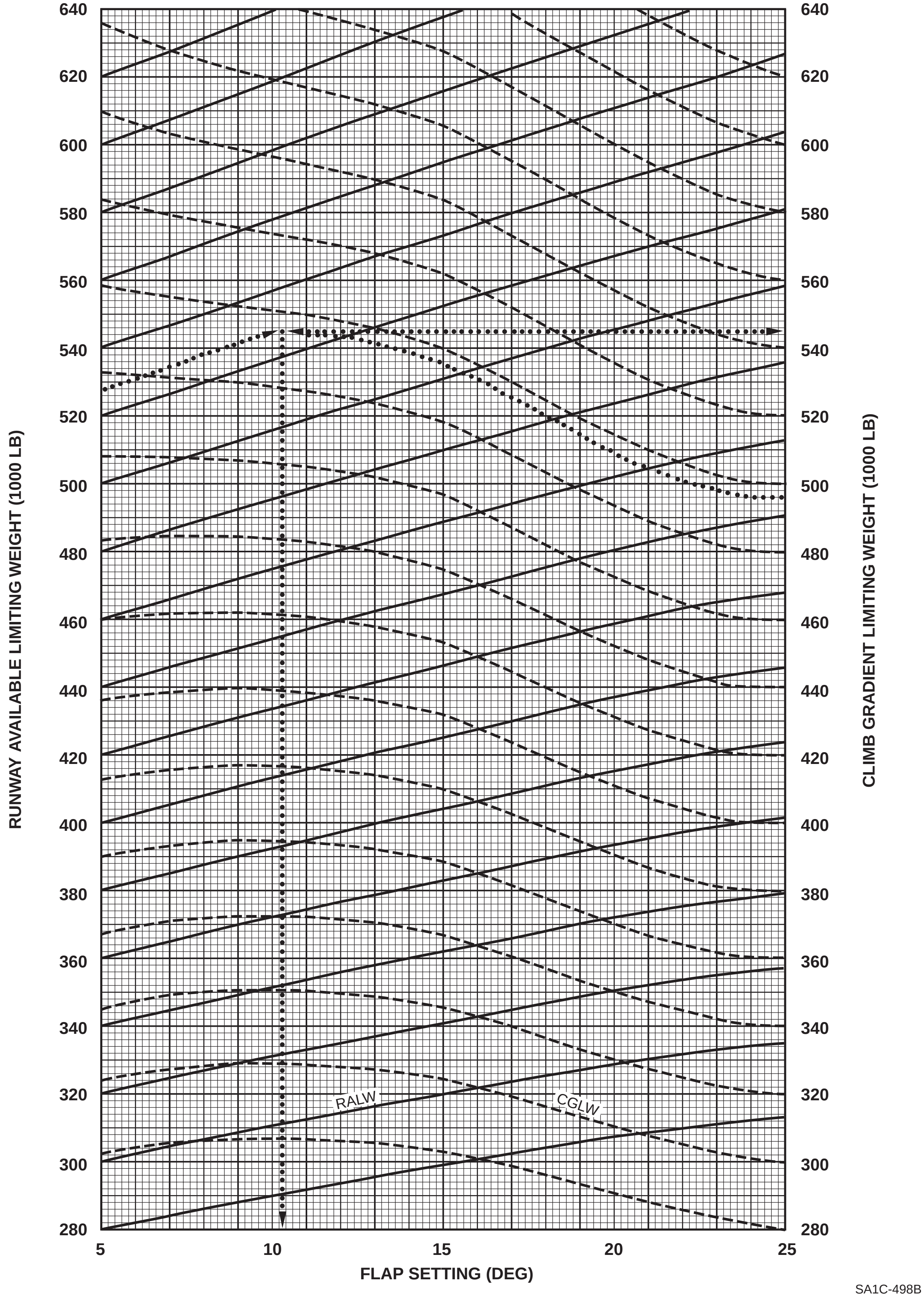


Figure 3-9A. (Sheet 3)

MAXIMUM TAKEOFF GROSS WEIGHT AT OPTIMUM TAKEOFF FLAP SETTING
RCR = 23 TO 18 / WITH REVERSE THRUST

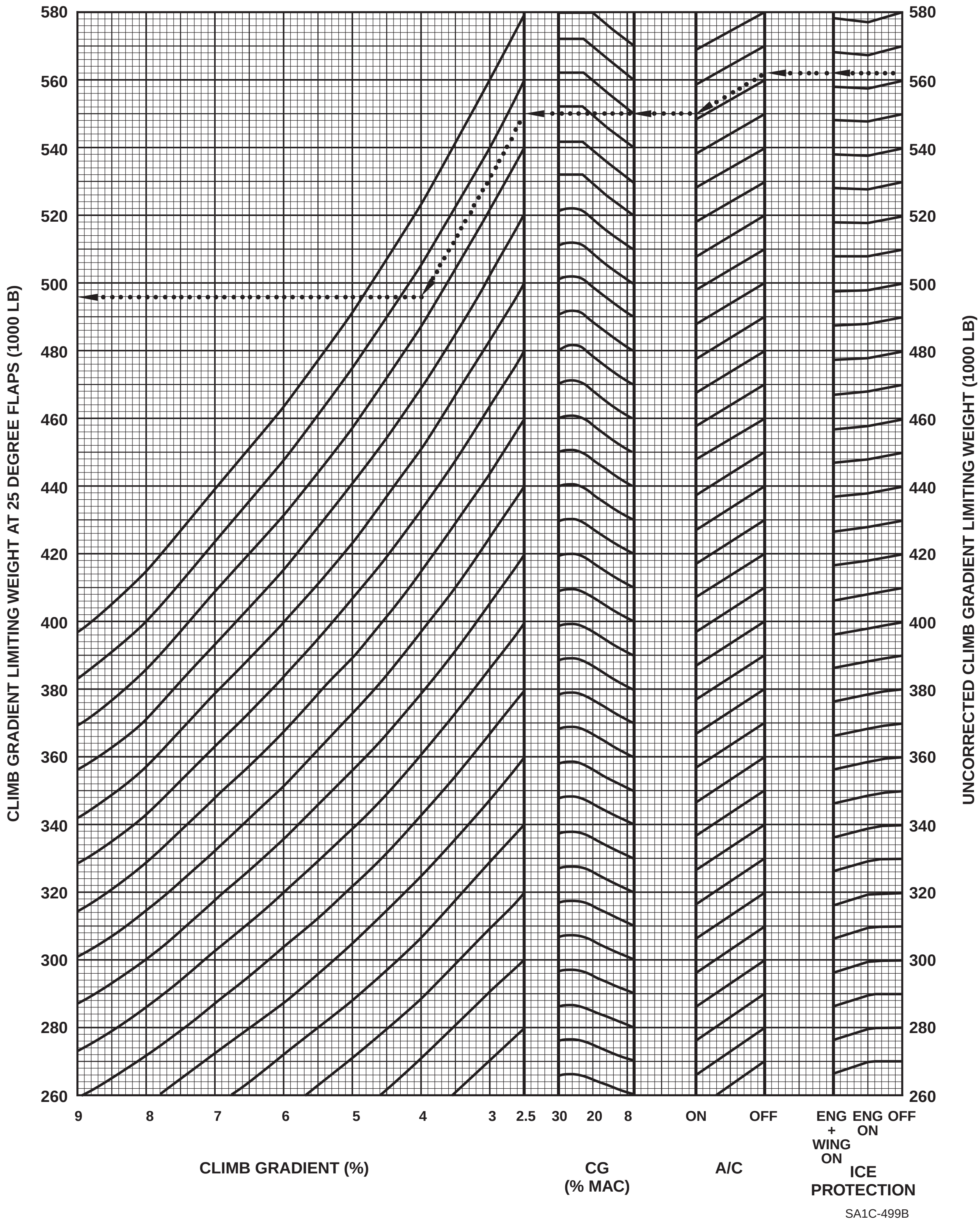


Figure 3-9A. (Sheet 4)

MAXIMUM TAKEOFF GROSS WEIGHT AT OPTIMUM TAKEOFF FLAP SETTING
RCR = 23 TO 18 / WITH REVERSE THRUST

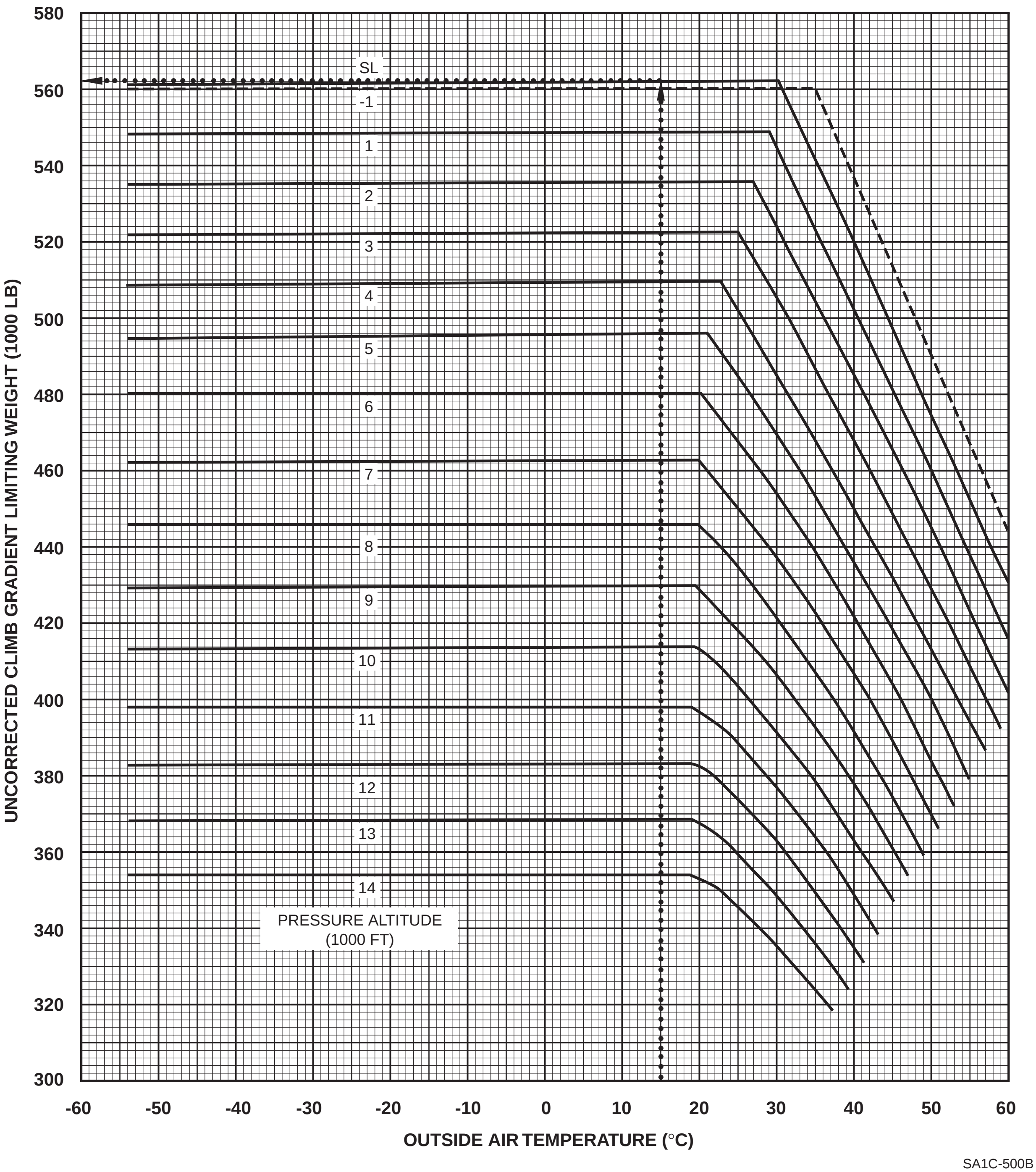


Figure 3-9A. (Sheet 5)

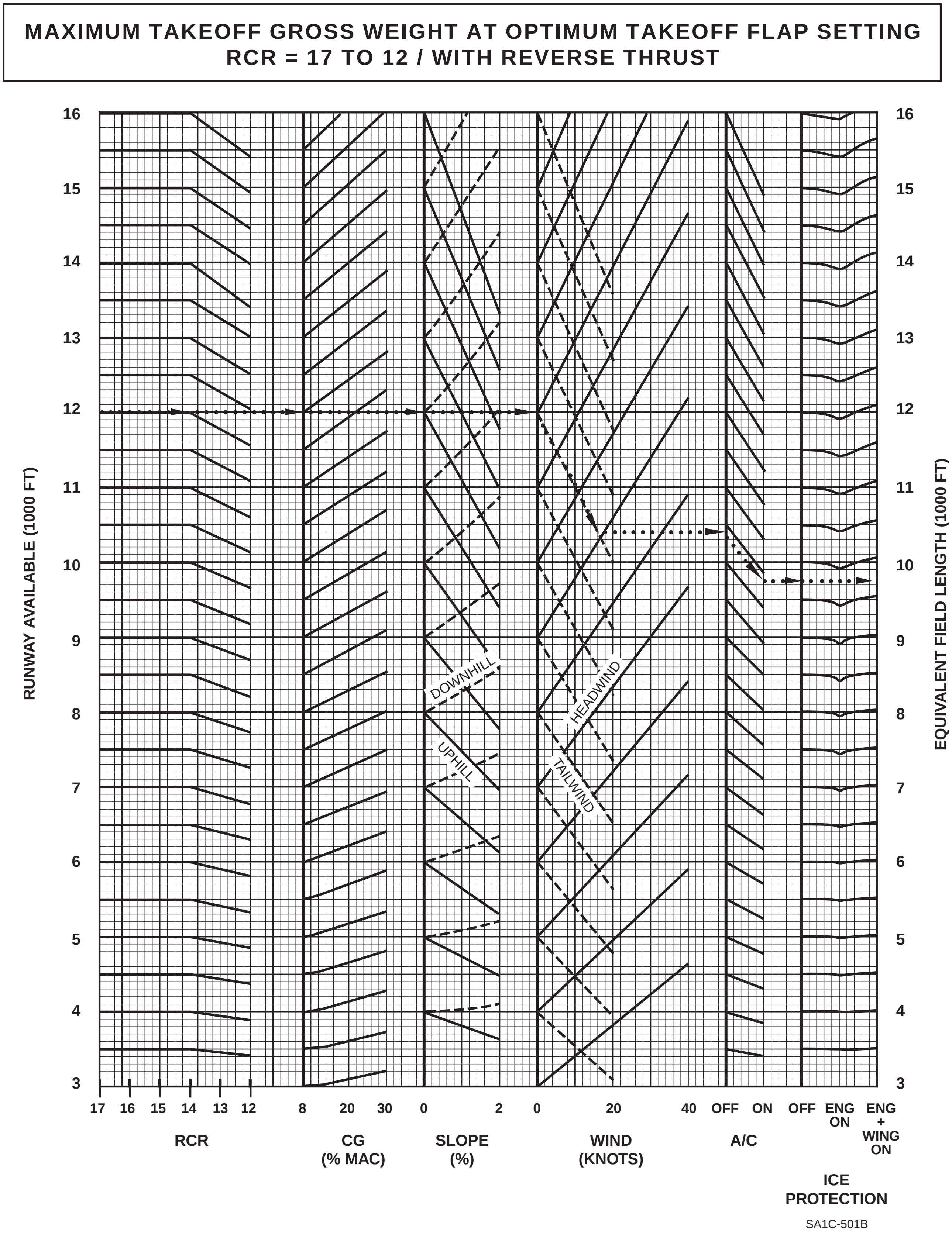


Figure 3-9B. (Sheet 1)

MAXIMUM TAKEOFF GROSS WEIGHT AT OPTIMUM TAKEOFF FLAP SETTING
RCR = 17 TO 12 / WITH REVERSE THRUST

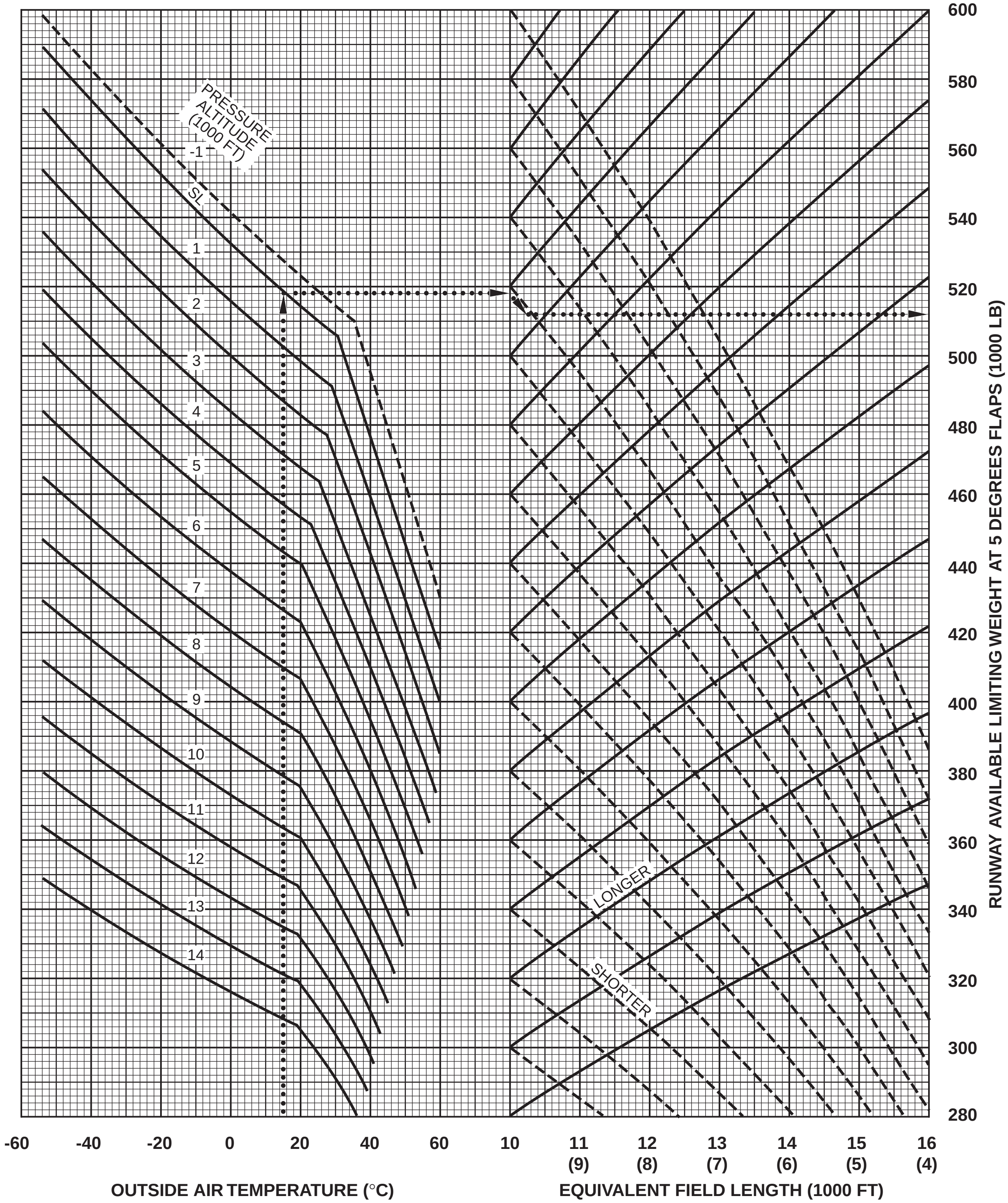


Figure 3-9B. (Sheet 2)

MAXIMUM TAKEOFF GROSS WEIGHT AT OPTIMUM TAKEOFF FLAP SETTING RCR = 17 TO 12 / WITH REVERSE THRUST

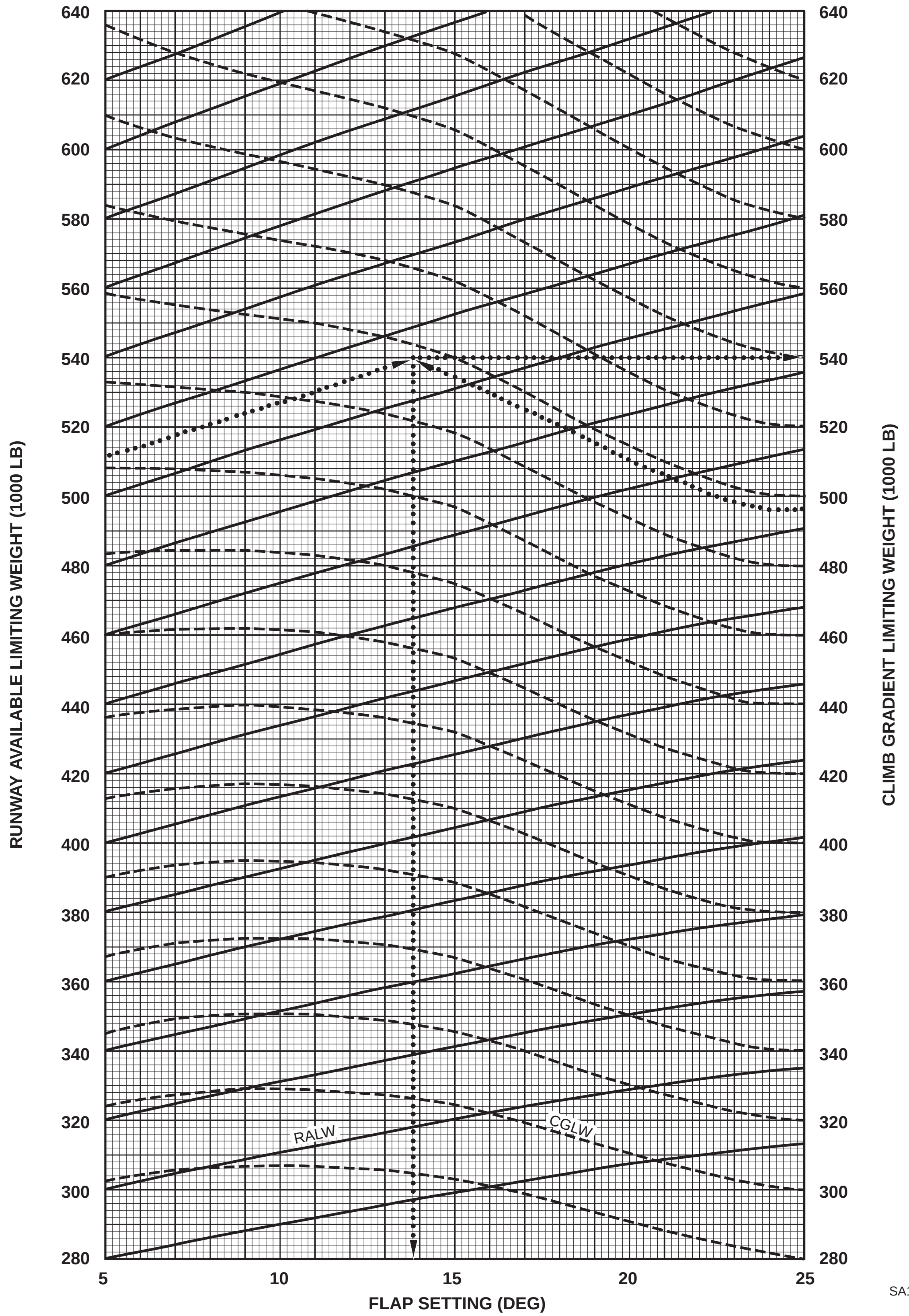


Figure 3-9B. (Sheet 3)

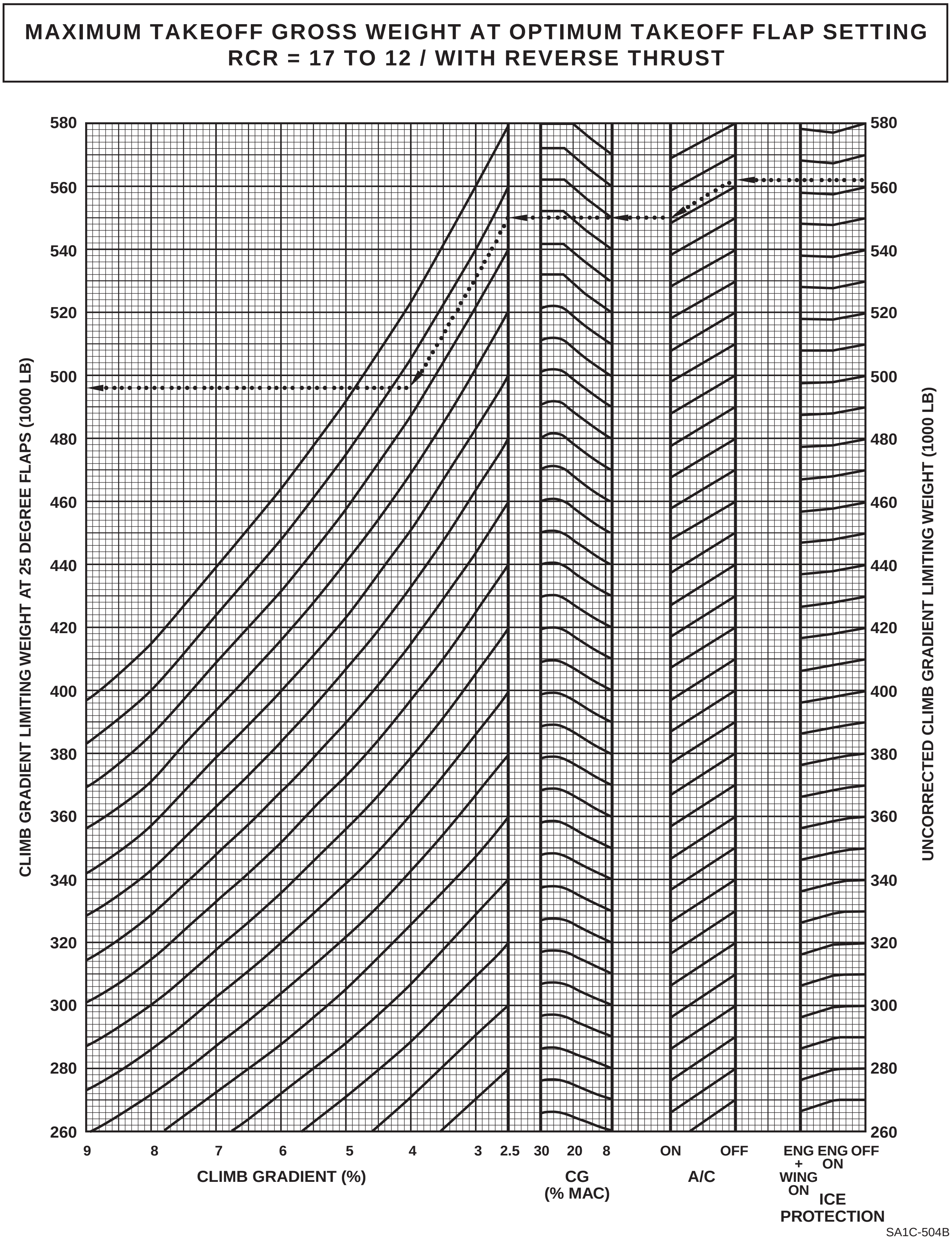


Figure 3-9B. (Sheet 4)

**MAXIMUM TAKEOFF GROSS WEIGHT AT OPTIMUM TAKEOFF FLAP SETTING
RCR = 17 TO 12 / WITH REVERSE THRUST**

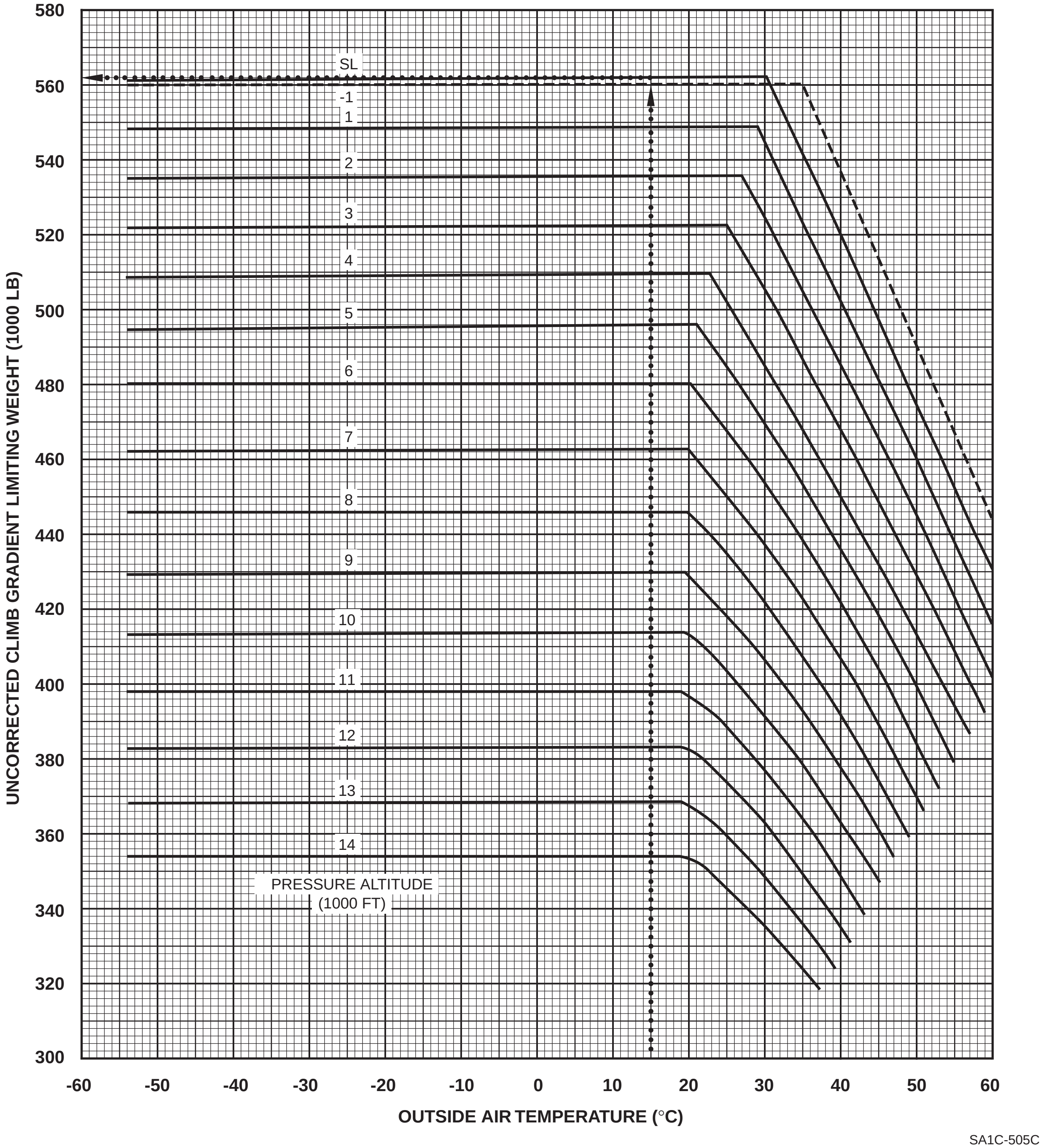


Figure 3-9B. (Sheet 5)

MAXIMUM TAKEOFF GROSS WEIGHT AT OPTIMUM TAKEOFF FLAP SETTING
RCR = 11 TO 8 / WITH REVERSE THRUST

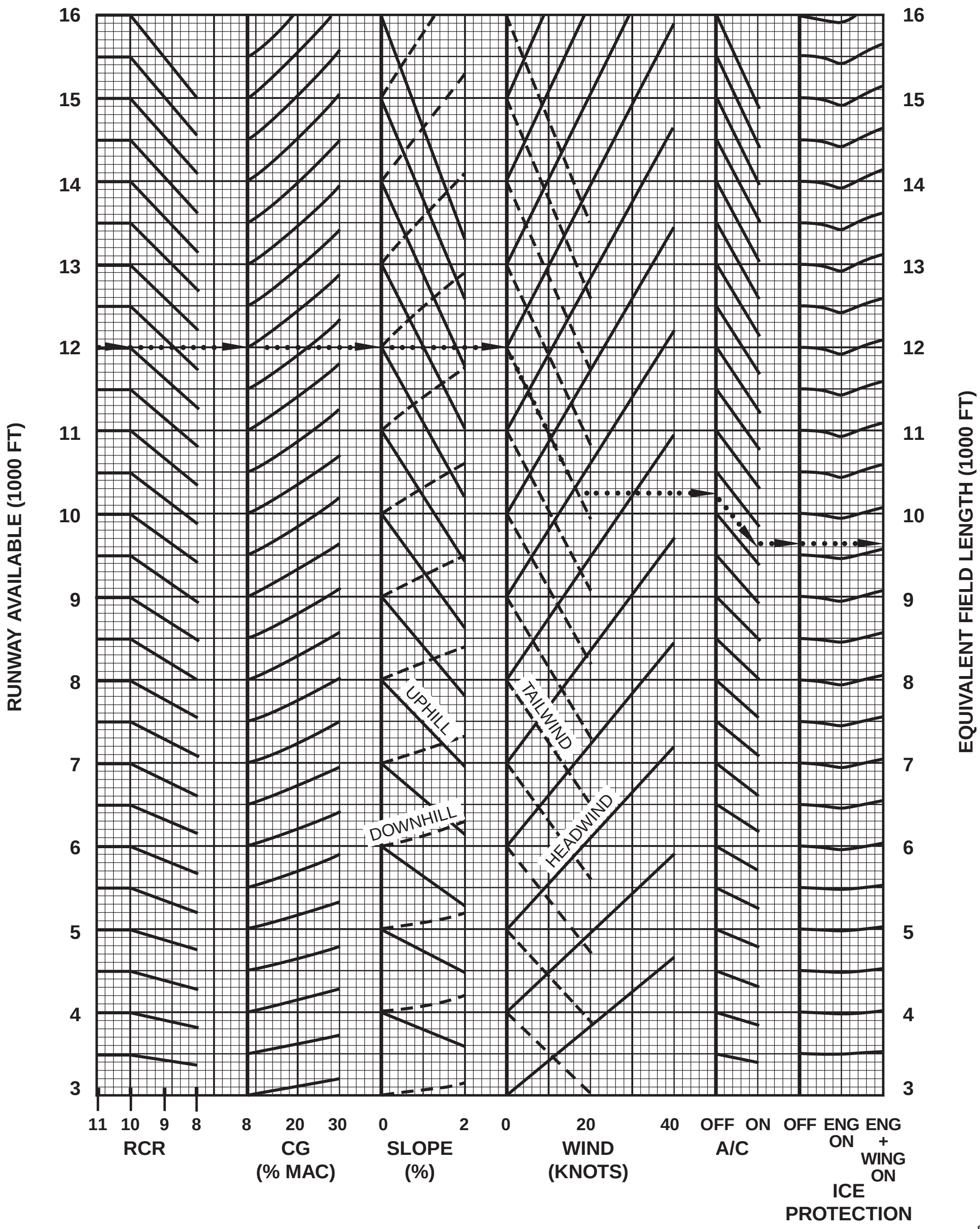


Figure 3-9C. (Sheet 1)

MAXIMUM TAKEOFF GROSS WEIGHT AT OPTIMUM TAKEOFF FLAP SETTING
RCR = 11 TO 8 / WITH REVERSE THRUST

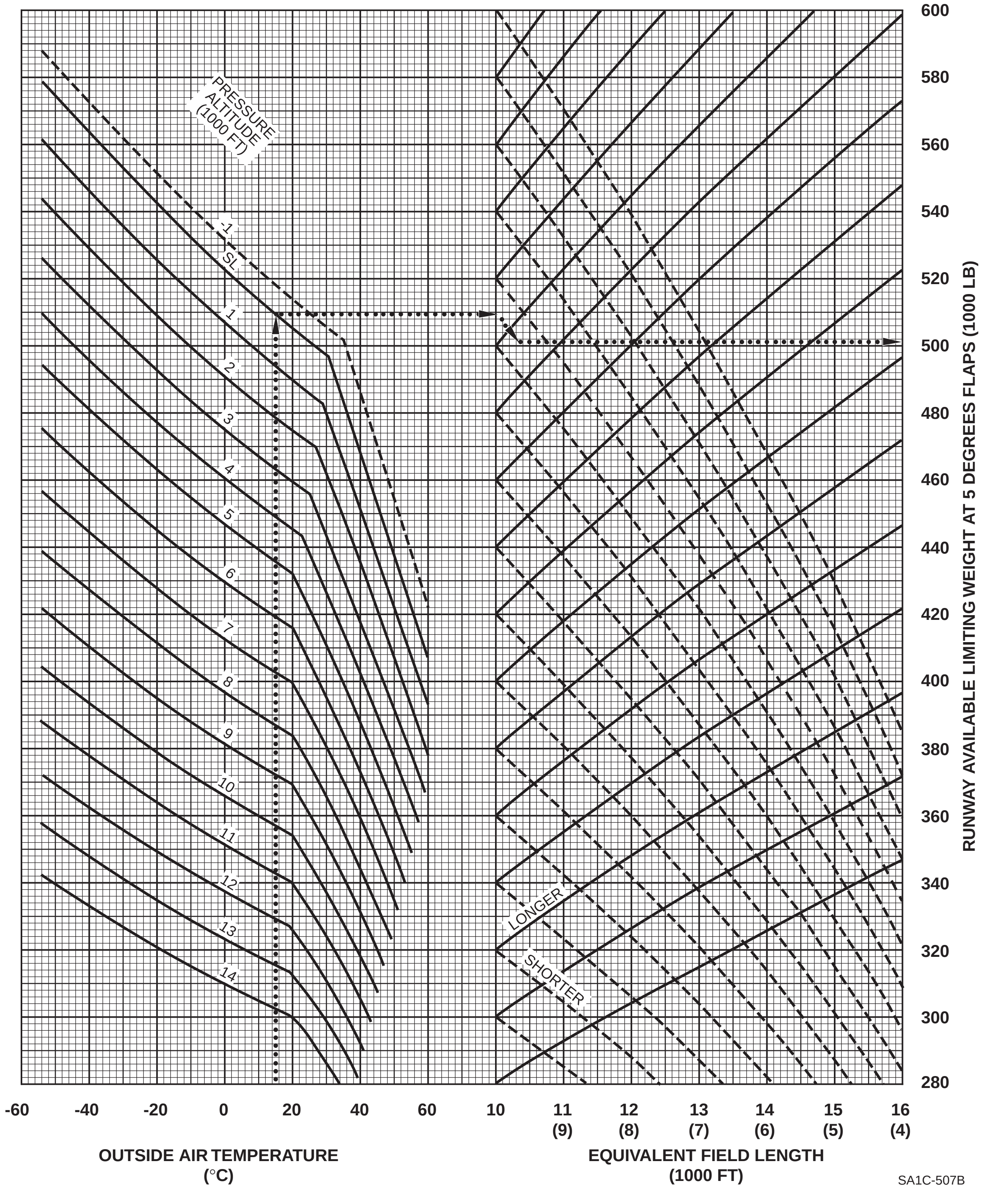


Figure 3-9C. (Sheet 2)

MAXIMUM TAKEOFF GROSS WEIGHT AT OPTIMUM TAKEOFF FLAP SETTING
RCR = 11 TO 8 / WITH REVERSE THRUST

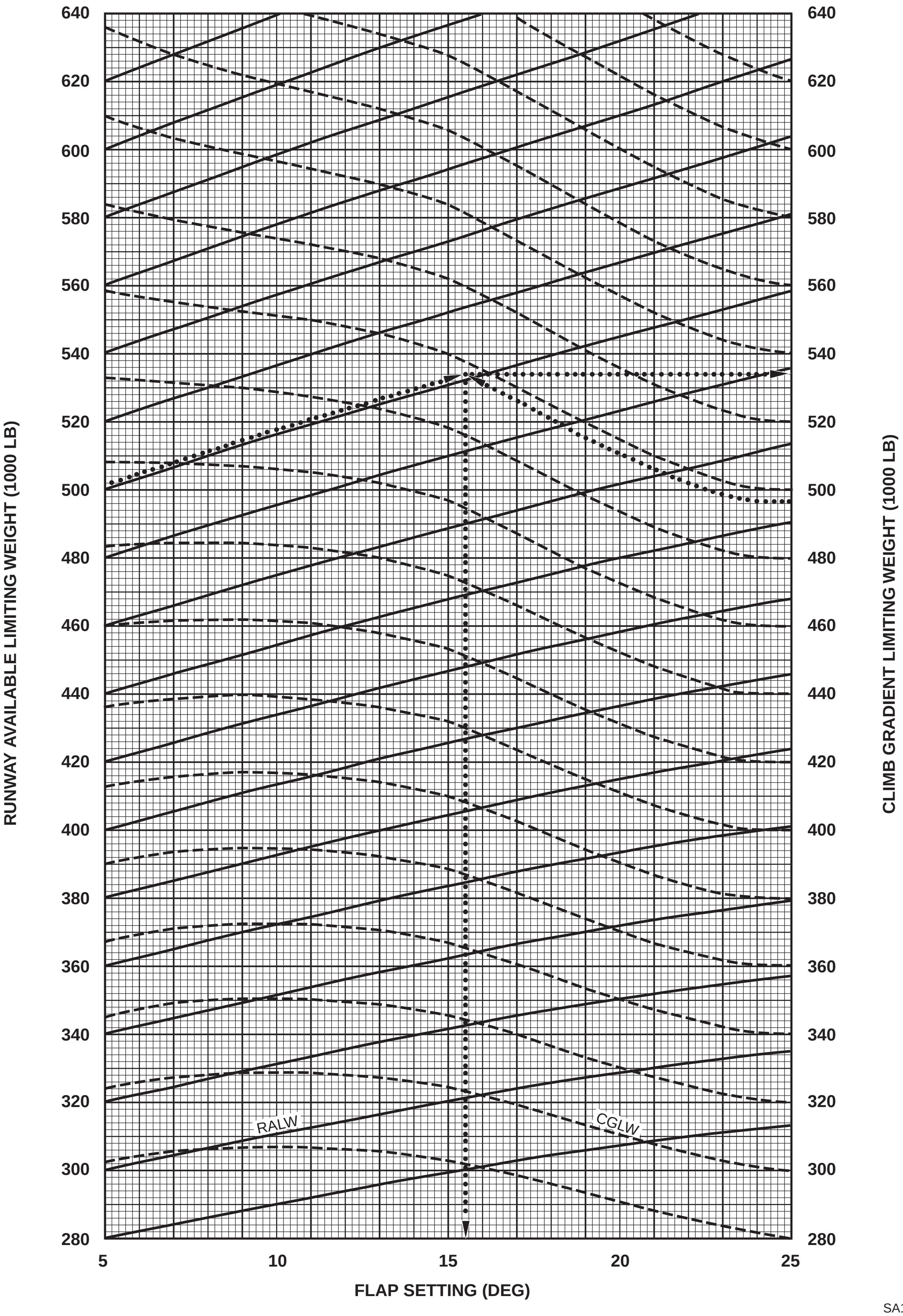


Figure 3-9C. (Sheet 3)

MAXIMUM TAKEOFF GROSS WEIGHT AT OPTIMUM TAKEOFF FLAP SETTING RCR = 11 TO 8 / WITH REVERSE THRUST

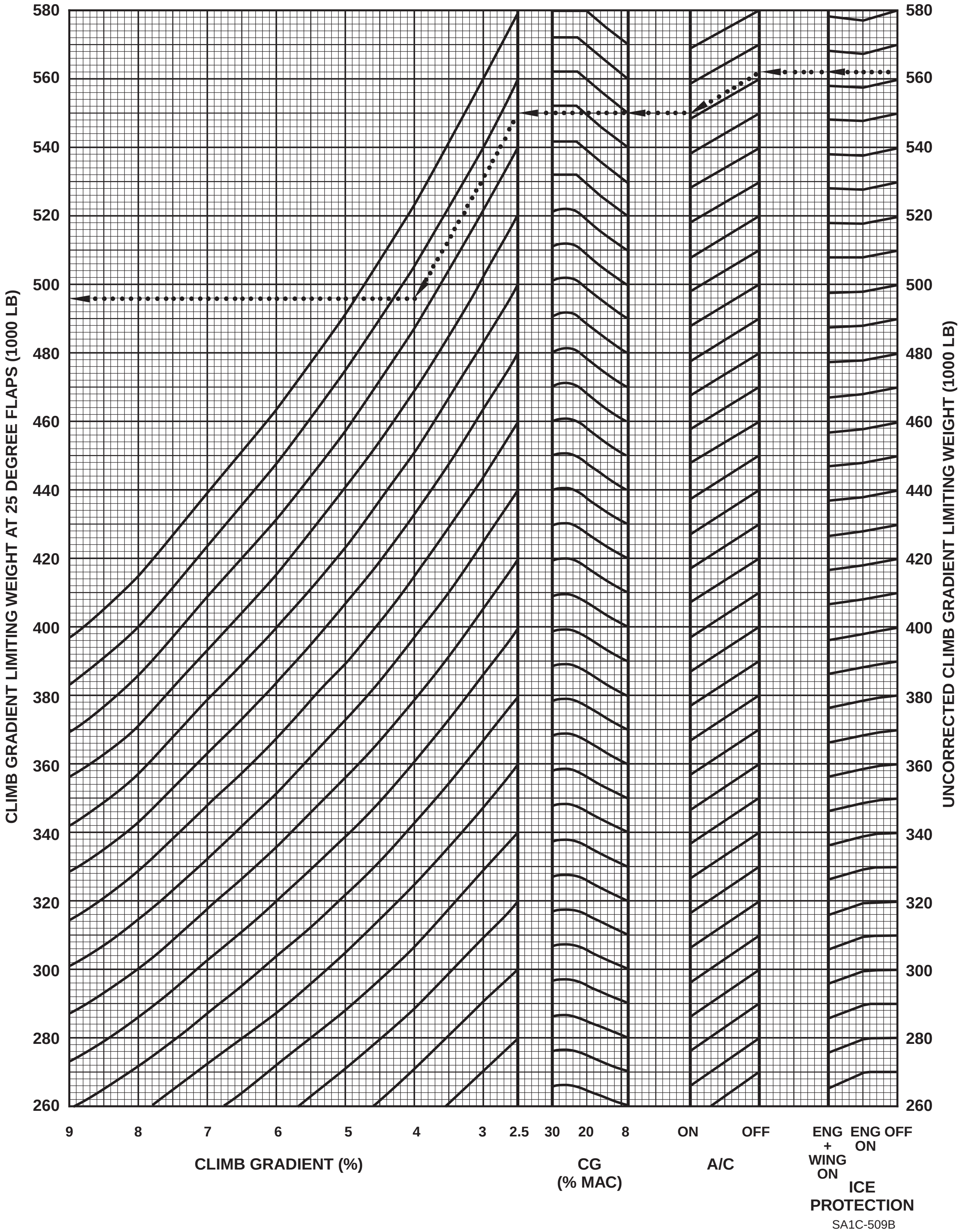


Figure 3-9C. (Sheet 4)

MAXIMUM TAKEOFF GROSS WEIGHT AT OPTIMUM TAKEOFF FLAP SETTING
RCR = 11 TO 8 / WITH REVERSE THRUST

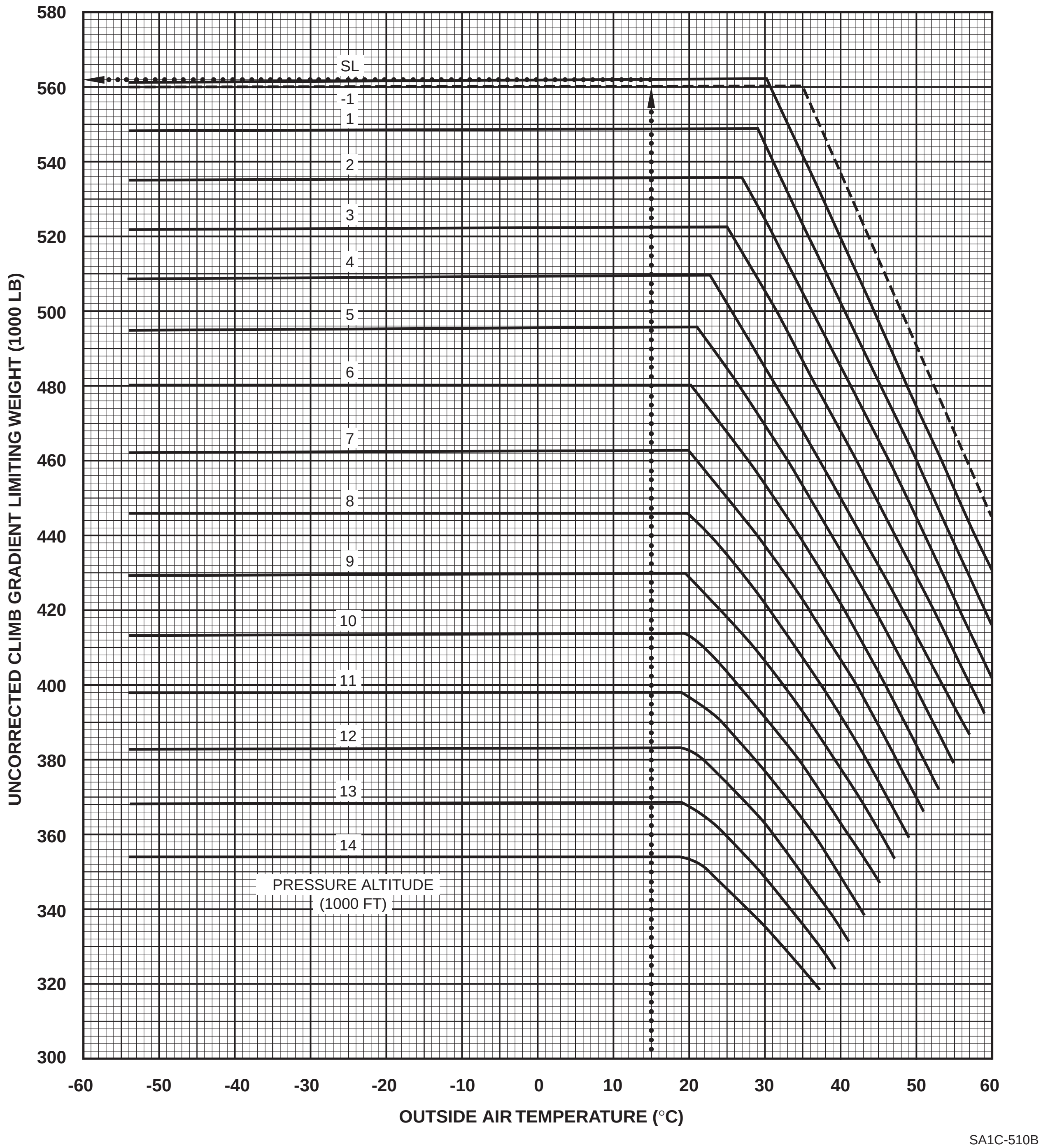


Figure 3-9C. (Sheet 5)

MAXIMUM TAKEOFF GROSS WEIGHT AT OPTIMUM TAKEOFF FLAP SETTING RCR = 7 TO 3 / WITH REVERSE THRUST

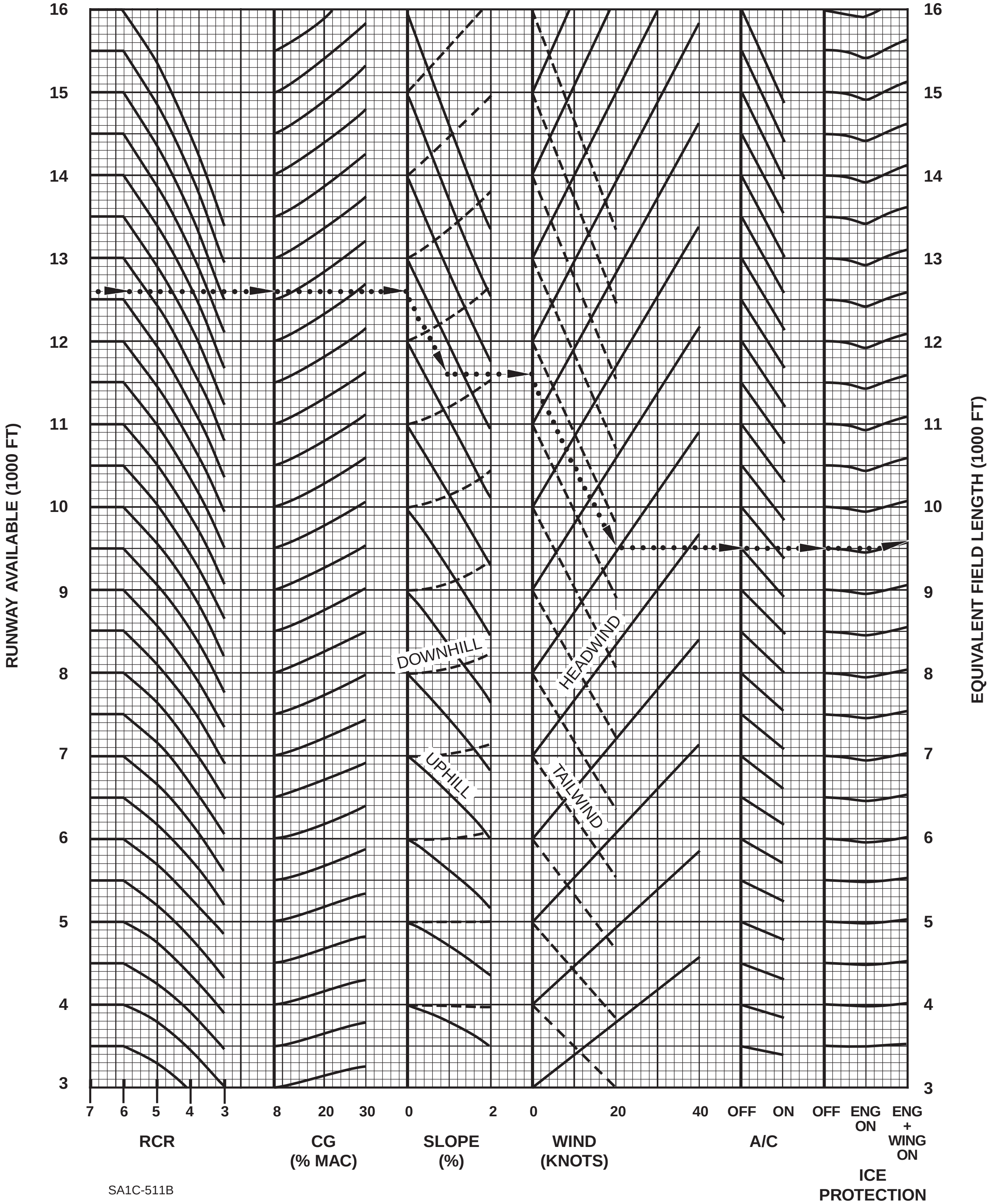


Figure 3-9D. (Sheet 1)

MAXIMUM TAKEOFF GROSS WEIGHT AT OPTIMUM TAKEOFF FLAP SETTING RCR = 7 TO 3 / WITH REVERSE THRUST

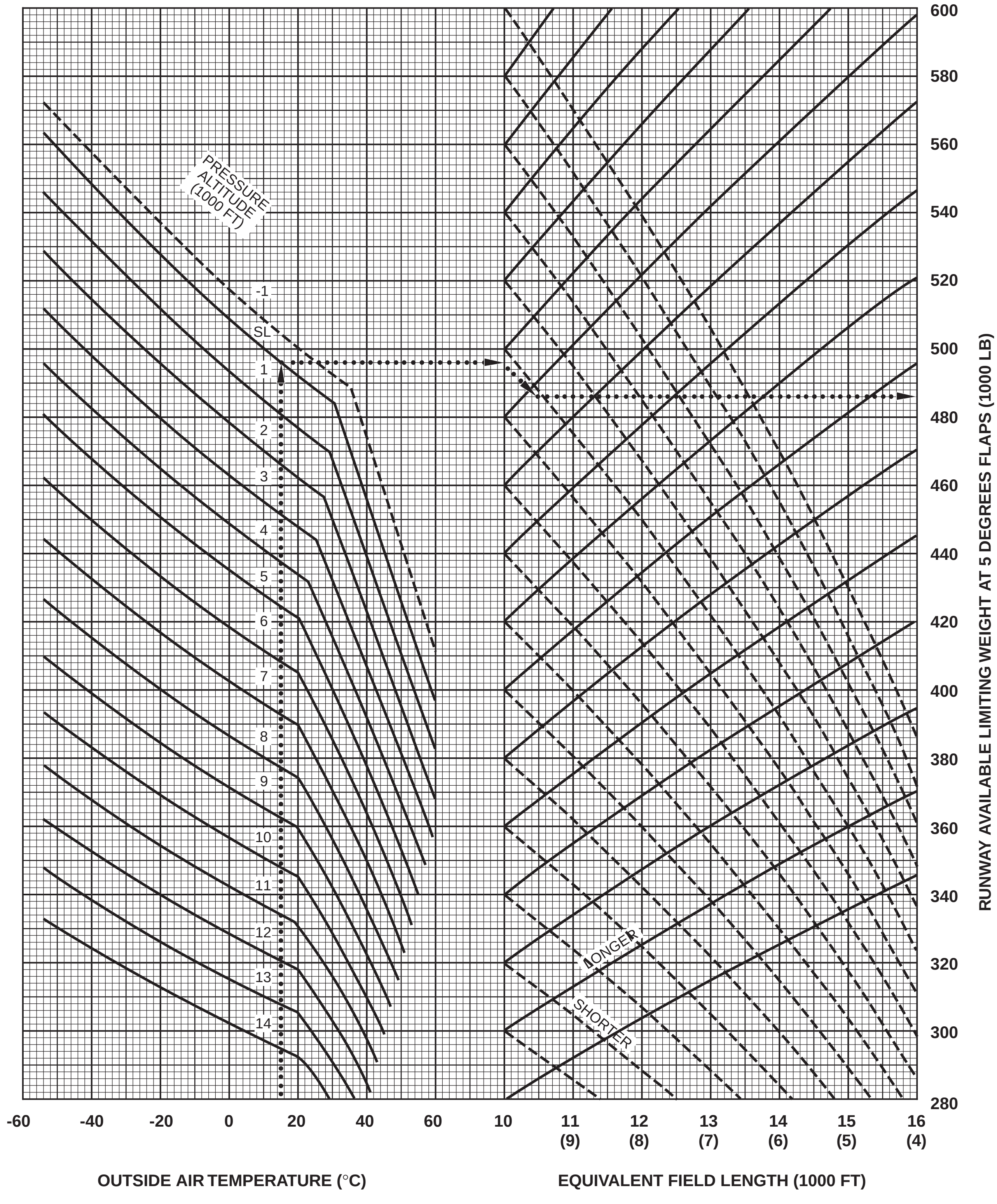


Figure 3-9D. (Sheet 2)

MAXIMUM TAKEOFF GROSS WEIGHT AT OPTIMUM TAKEOFF FLAP SETTING
RCR = 7 TO 3 / WITH REVERSE THRUST

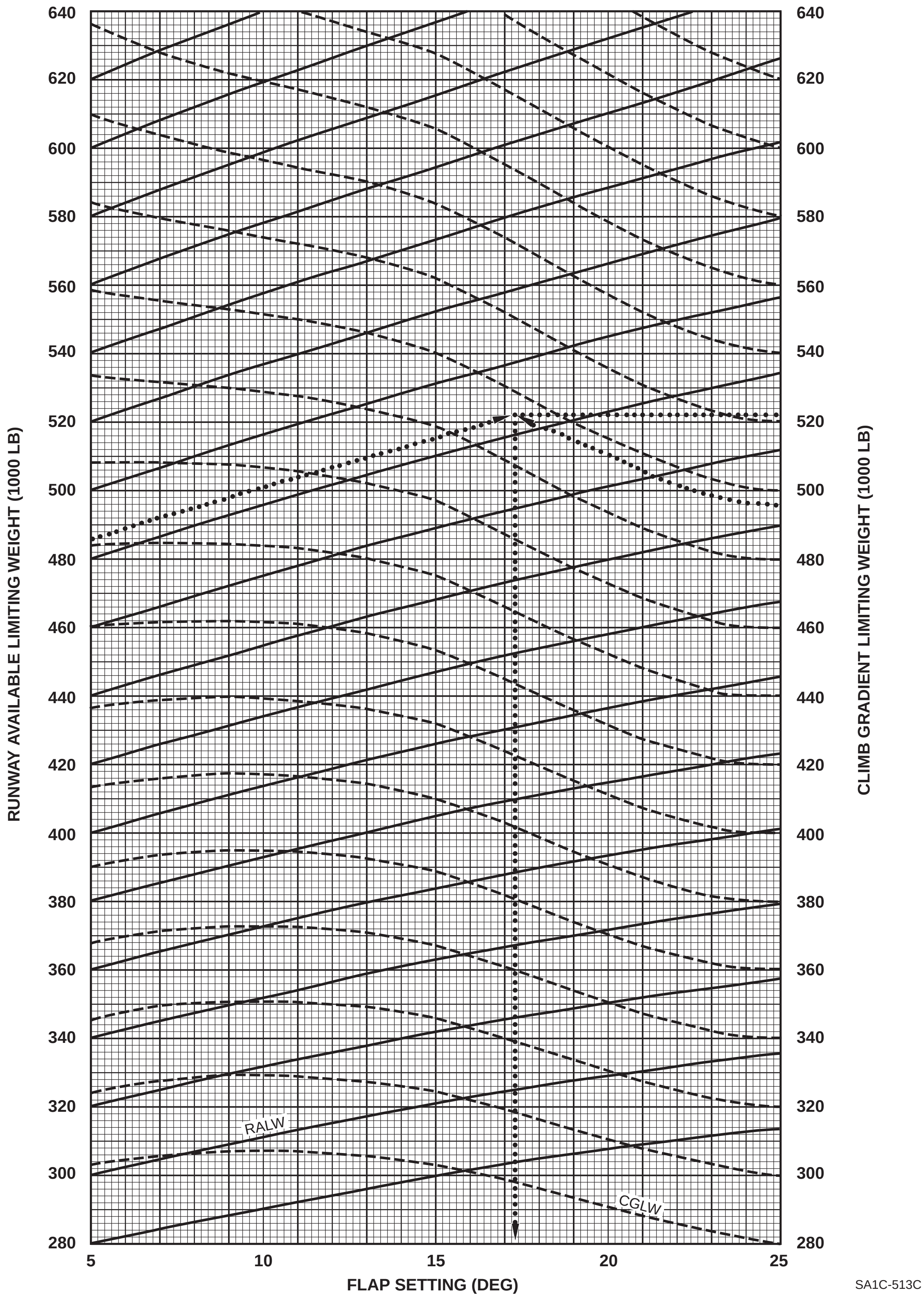


Figure 3-9D. (Sheet 3)

MAXIMUM TAKEOFF GROSS WEIGHT AT OPTIMUM TAKEOFF FLAP SETTING
RCR = 7 TO 3 / WITH REVERSE THRUST

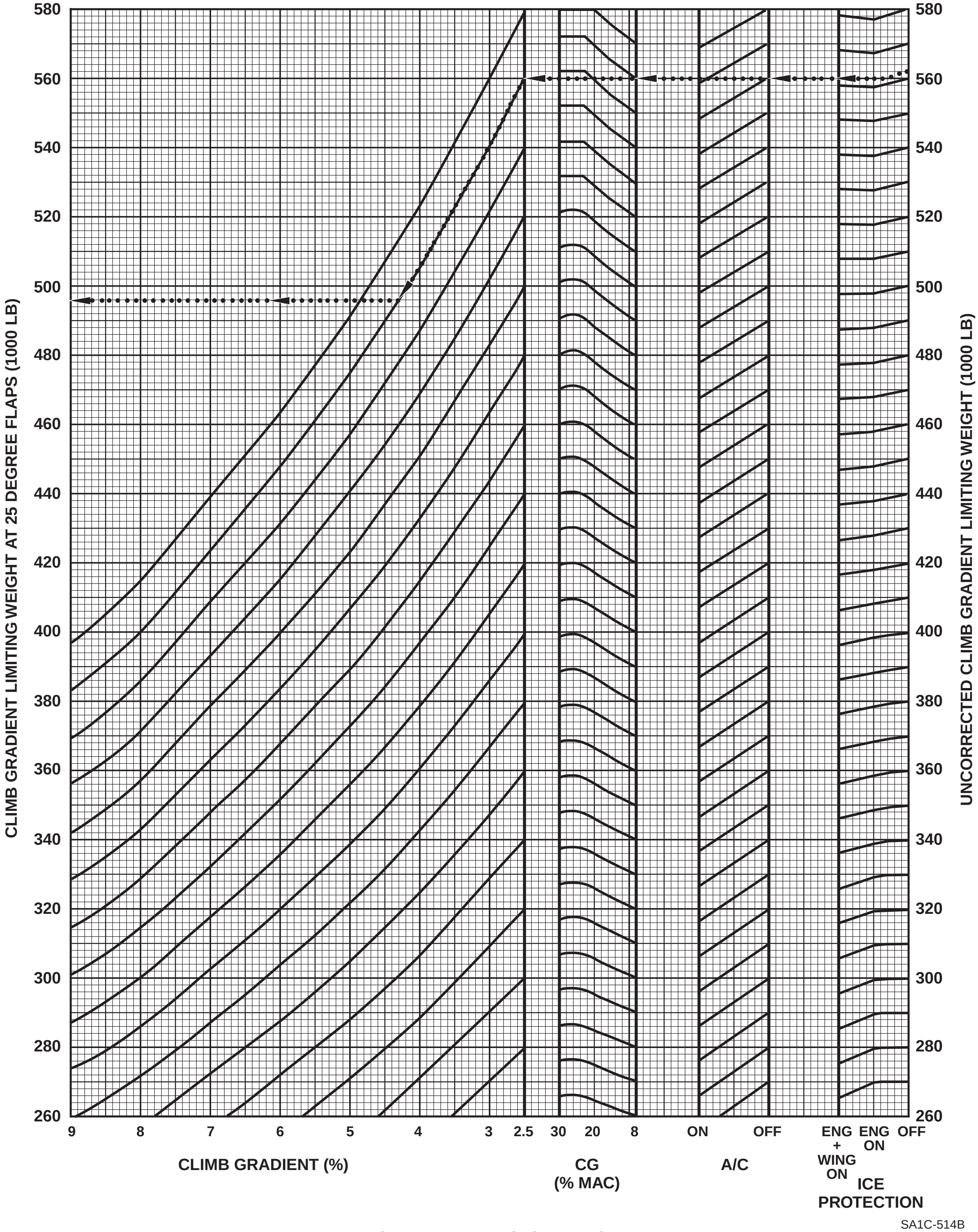


Figure 3-9D. (Sheet 4)

MAXIMUM TAKEOFF GROSS WEIGHT AT OPTIMUM TAKEOFF FLAP SETTING
RCR = 7 TO 3 / WITH REVERSE THRUST

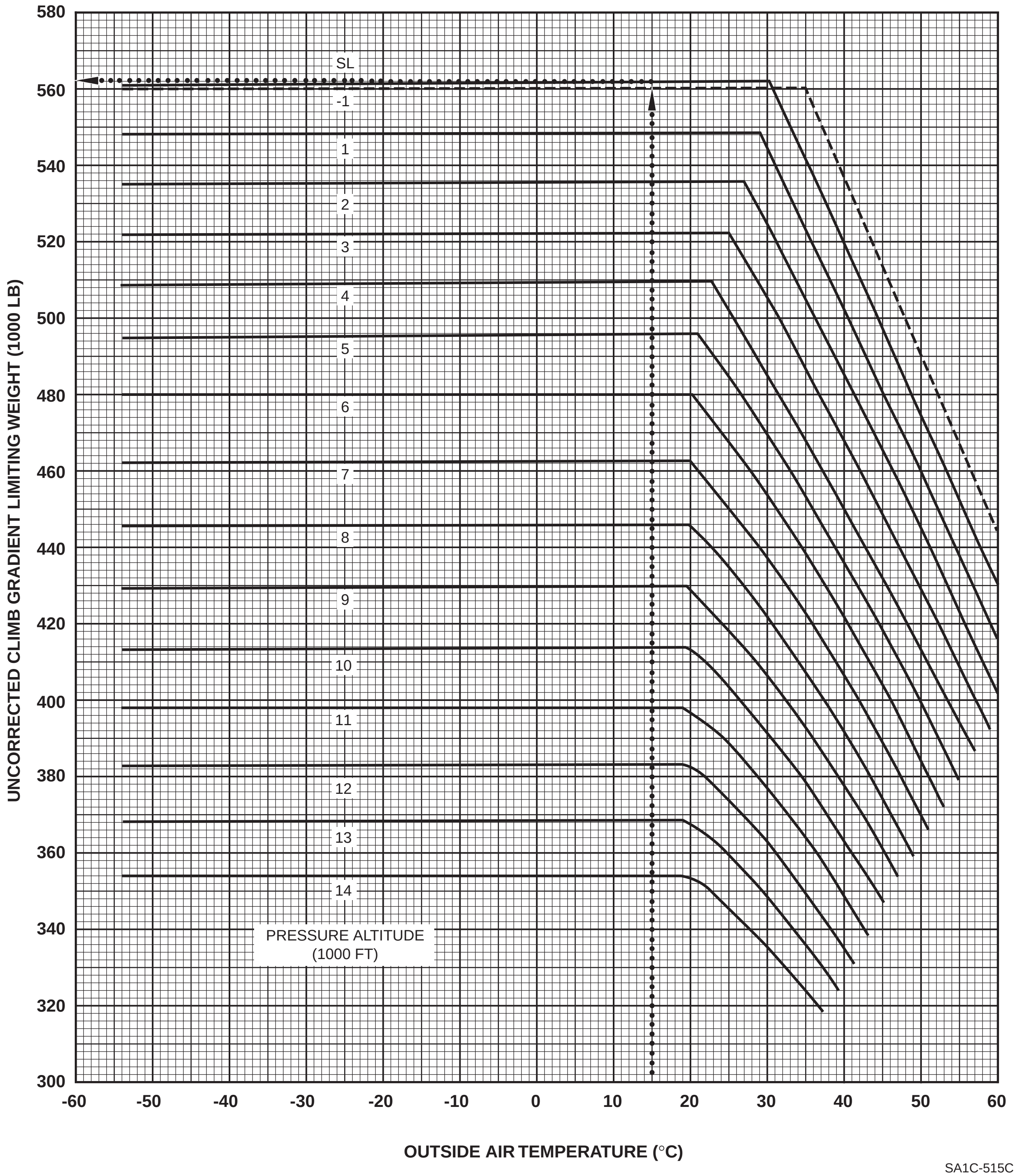


Figure 3-9D. (Sheet 5)

MAXIMUM TAKEOFF GROSS WEIGHT AT OPTIMUM TAKEOFF FLAP SETTING RSC = 0.25 IN / WITH REVERSE THRUST

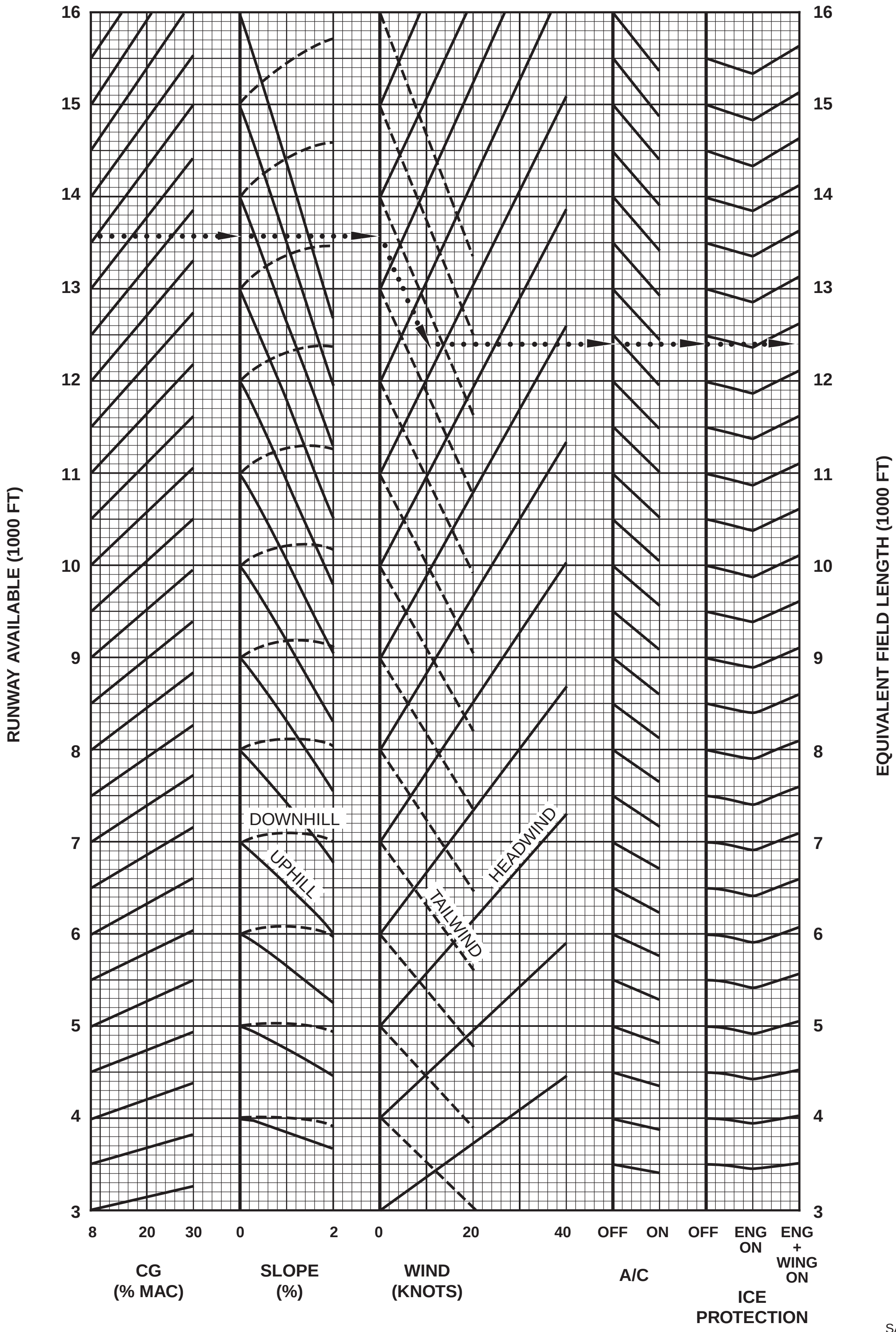


Figure 3-9E. (Sheet 1)

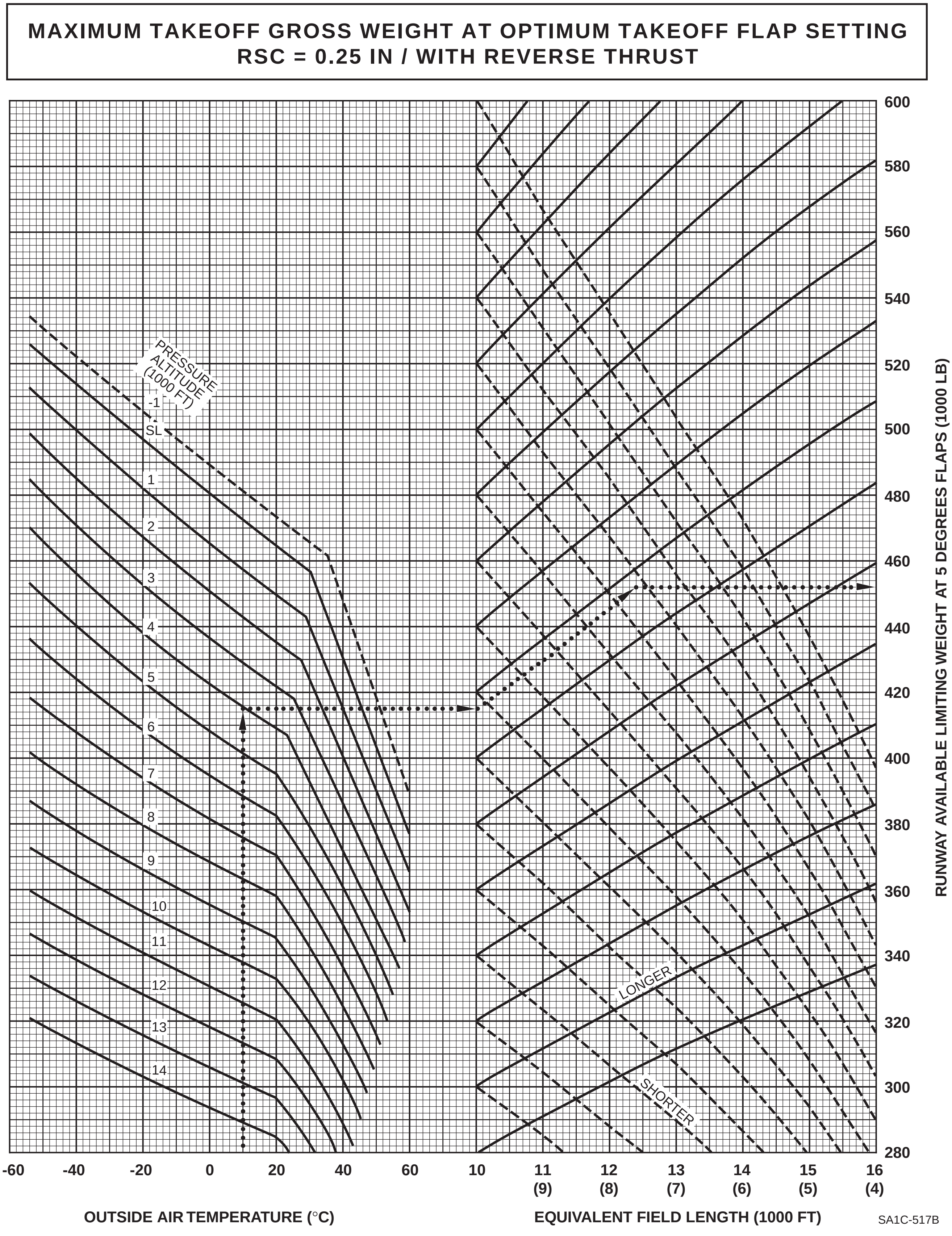


Figure 3-9E. (Sheet 2)

MAXIMUM TAKEOFF GROSS WEIGHT AT OPTIMUM TAKEOFF FLAP SETTING
RSC = 0.25 IN / WITH REVERSE THRUST

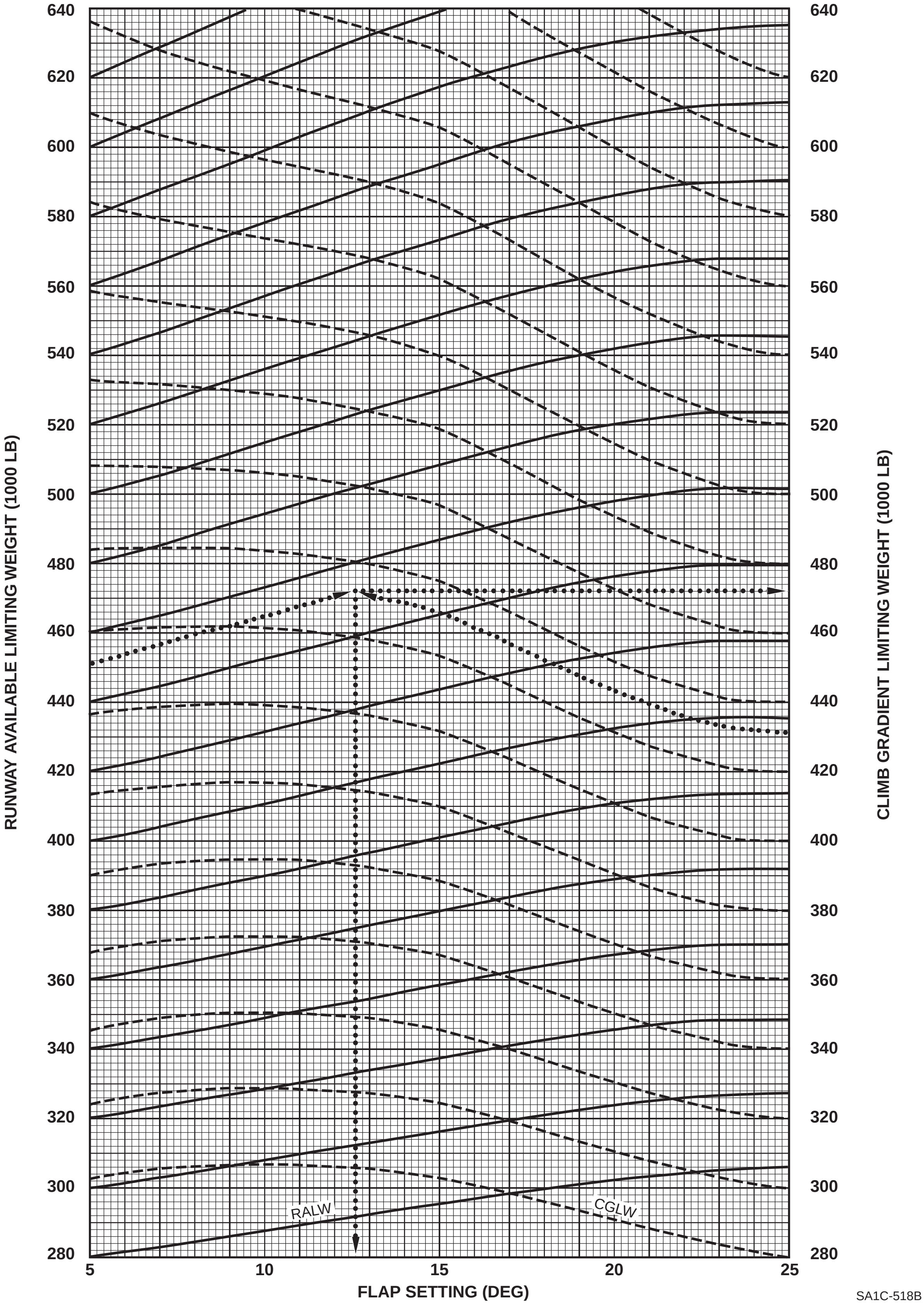


Figure 3-9E. (Sheet 3)

MAXIMUM TAKEOFF GROSS WEIGHT AT OPTIMUM TAKEOFF FLAP SETTING
RSC = 0.25 IN / WITH REVERSE THRUST

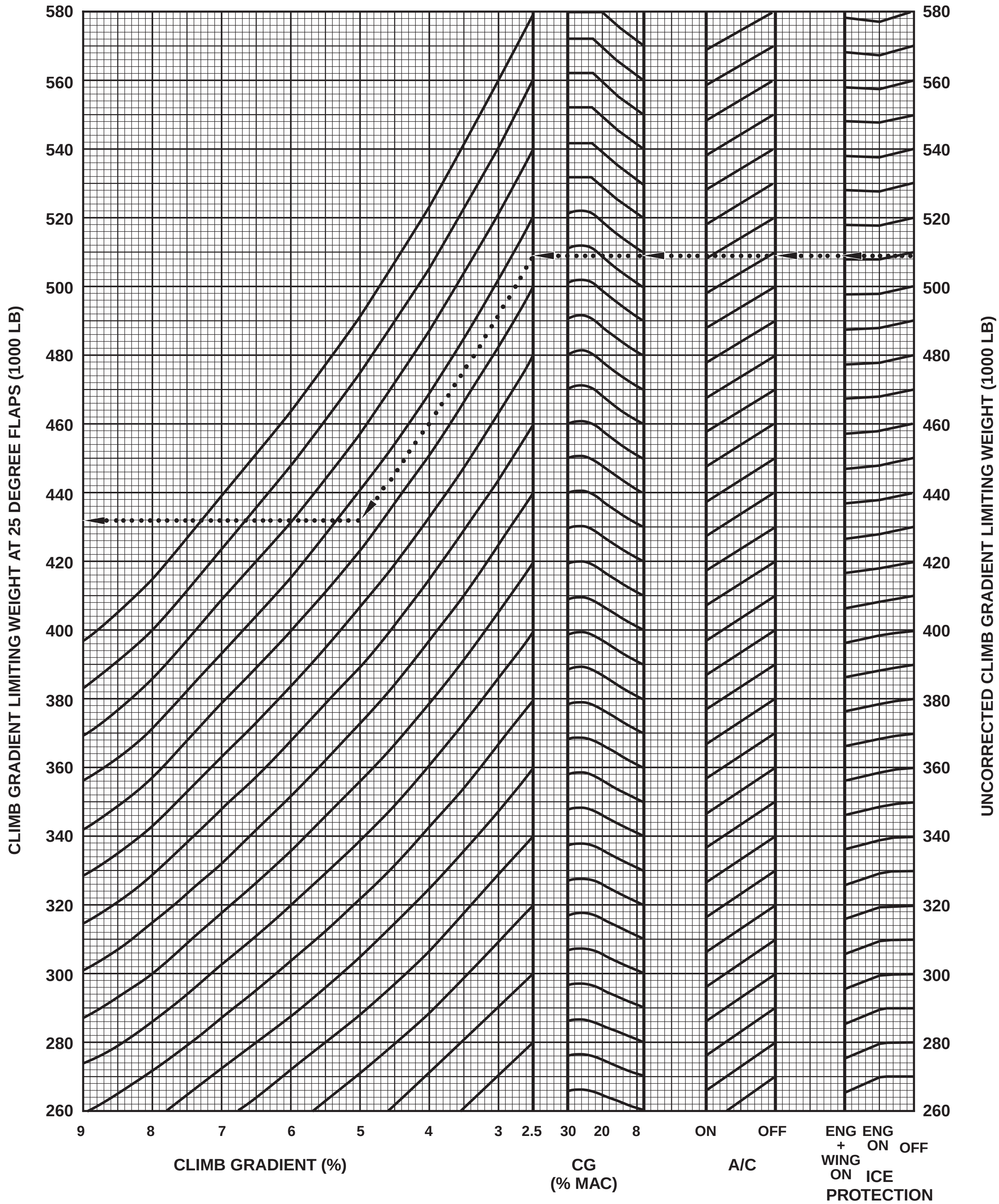


Figure 3-9E. (Sheet 4)

MAXIMUM TAKEOFF GROSS WEIGHT AT OPTIMUM TAKEOFF FLAP SETTING RSC = 0.25 IN / WITH REVERSE THRUST

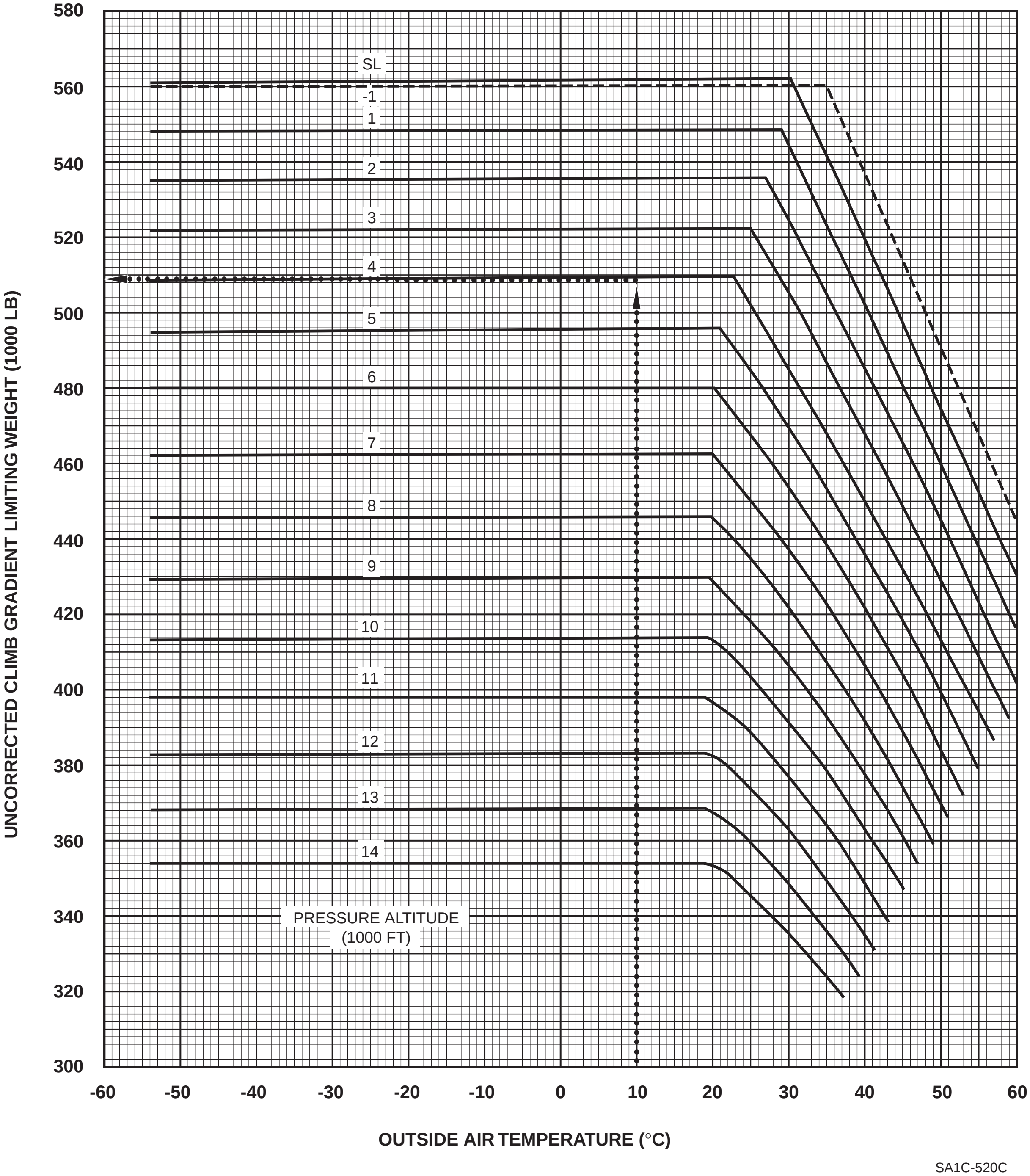


Figure 3-9E. (Sheet 5)

MAXIMUM TAKEOFF GROSS WEIGHT AT OPTIMUM TAKEOFF FLAP SETTING RSC = 0.50 IN / WITH REVERSE THRUST

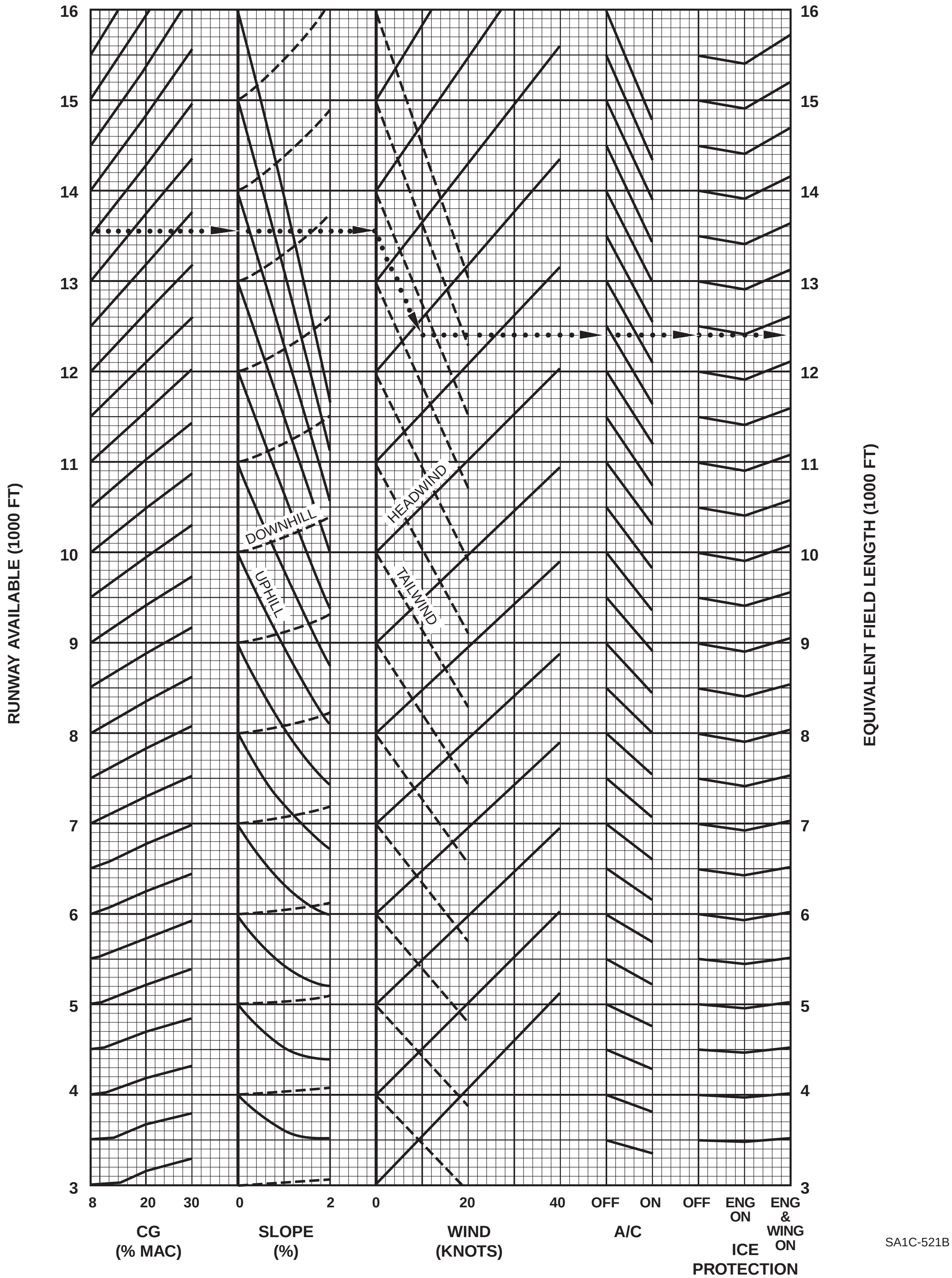


Figure 3-9F. (Sheet 1)

MAXIMUM TAKEOFF GROSS WEIGHT AT OPTIMUM TAKEOFF FLAP SETTING
RSC = 0.50 IN / WITH REVERSE THRUST

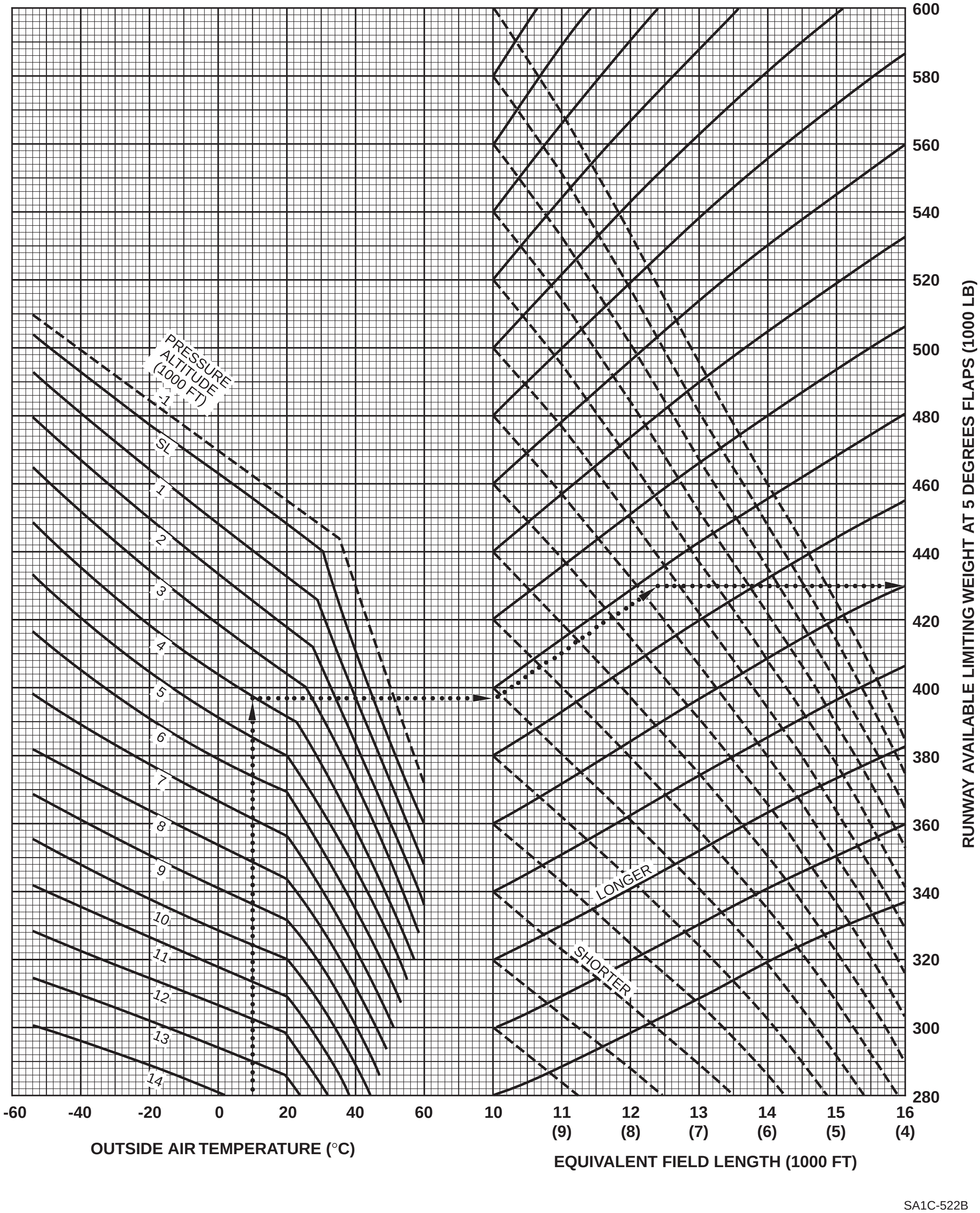


Figure 3-9F. (Sheet 2)

MAXIMUM TAKEOFF GROSS WEIGHT AT OPTIMUM TAKEOFF FLAP SETTING
RSC = 0.50 IN / WITH REVERSE THRUST

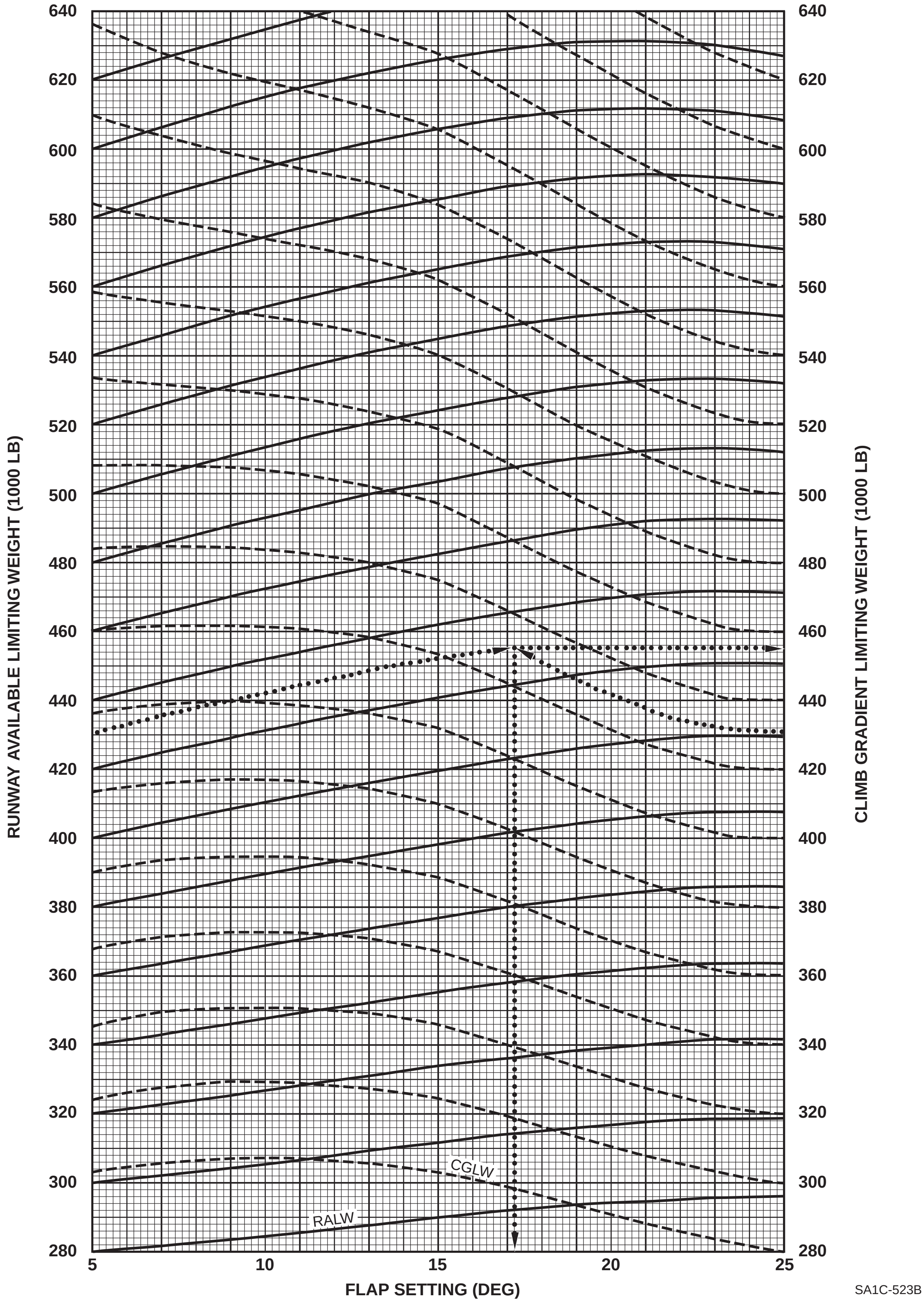


Figure 3-9F. (Sheet 3)

MAXIMUM TAKEOFF GROSS WEIGHT AT OPTIMUM TAKEOFF FLAP SETTING
RSC = 0.50 IN / WITH REVERSE THRUST

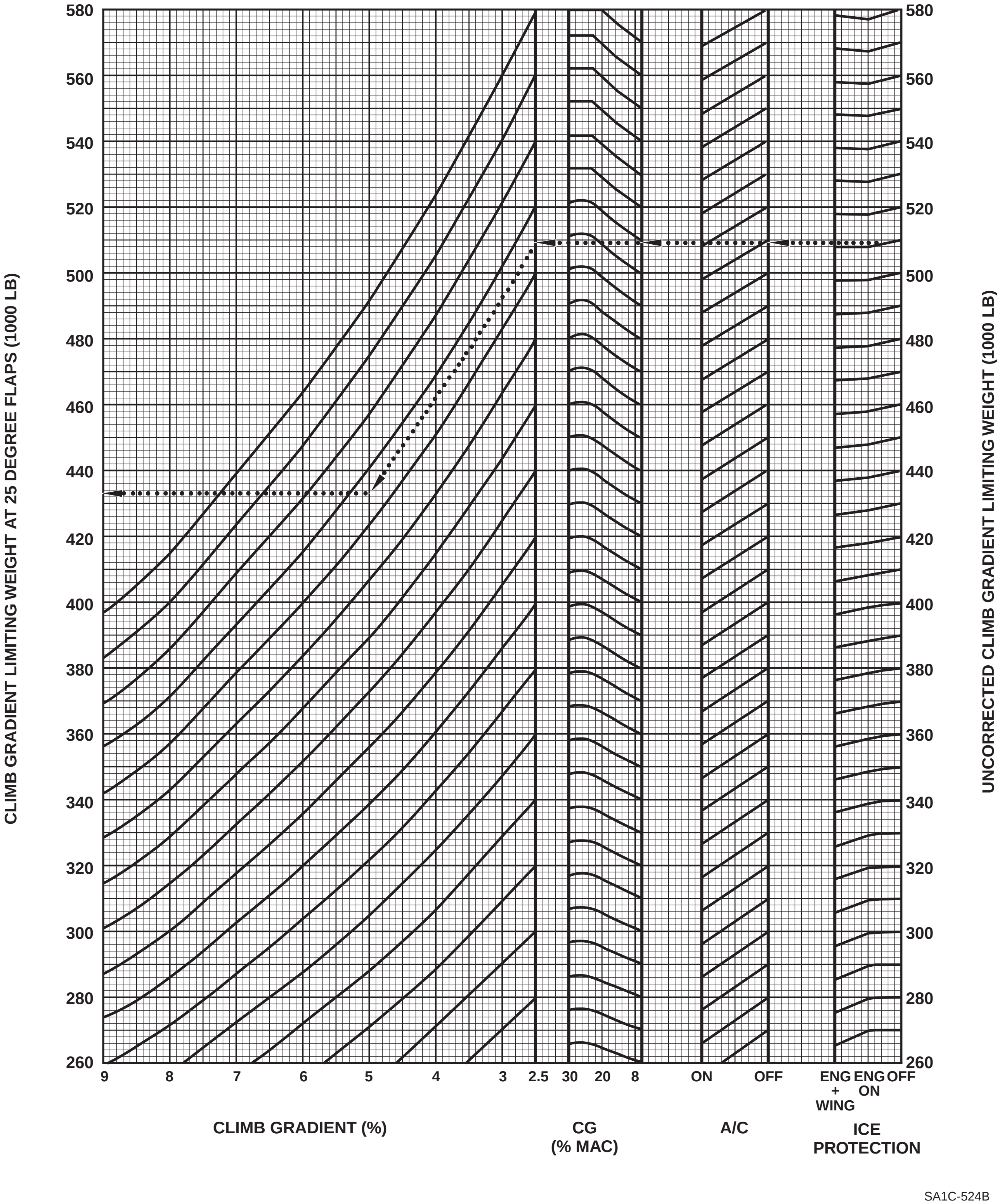


Figure 3-9F. (Sheet 4)

MAXIMUM TAKEOFF GROSS WEIGHT AT OPTIMUM TAKEOFF FLAP SETTING RSC = 0.50 IN / WITH REVERSE THRUST

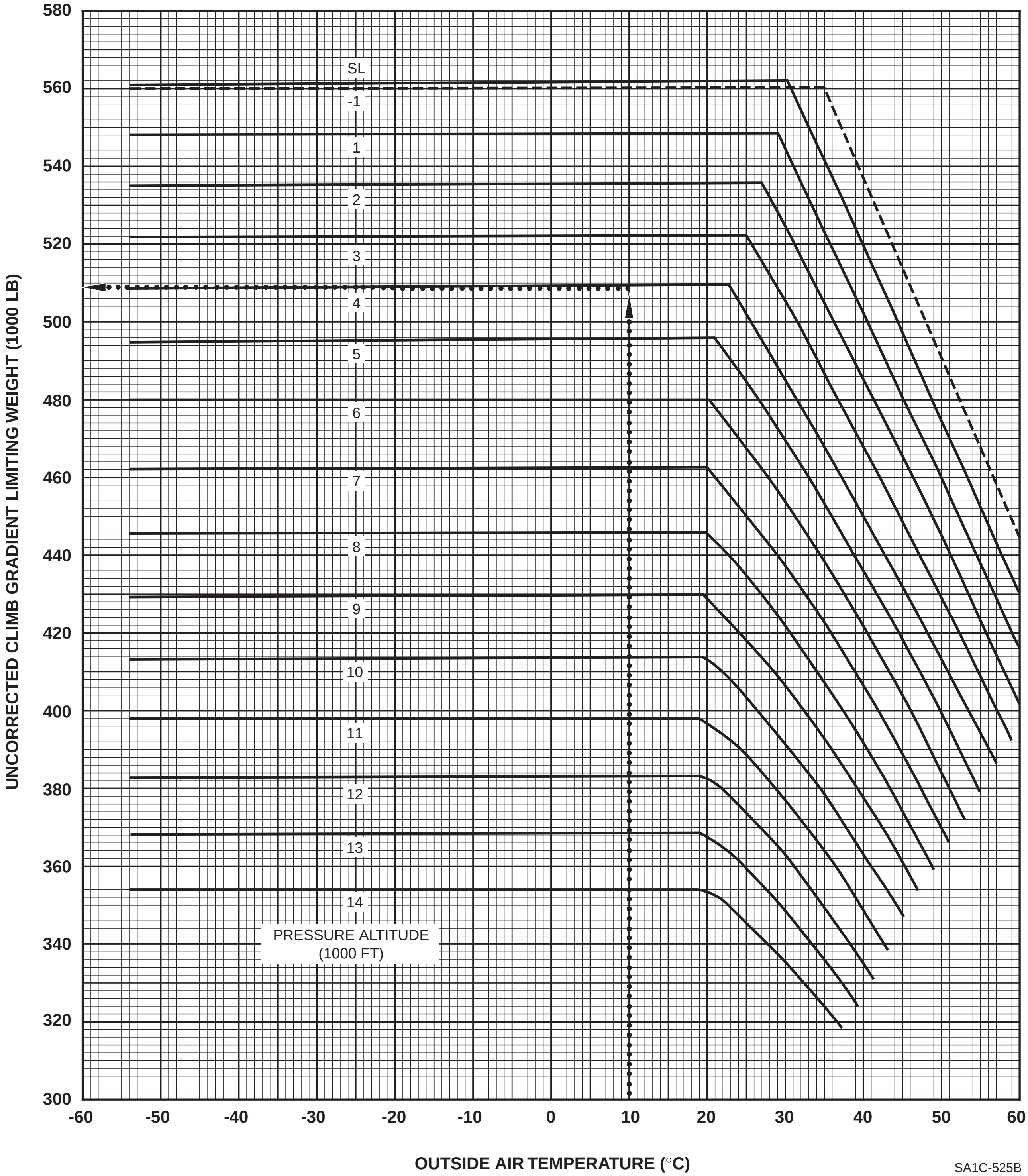


Figure 3-9F. (Sheet 5)

TIRE SPEED LIMITING WEIGHT

NOTE:

1. BASED ON 204 KNOTS (235 MPH) RATED TIRES
2. TIRE SPEED IS NOT LIMITING FOR FLAP SETTINGS GREATER THAN OR EQUAL TO 20°

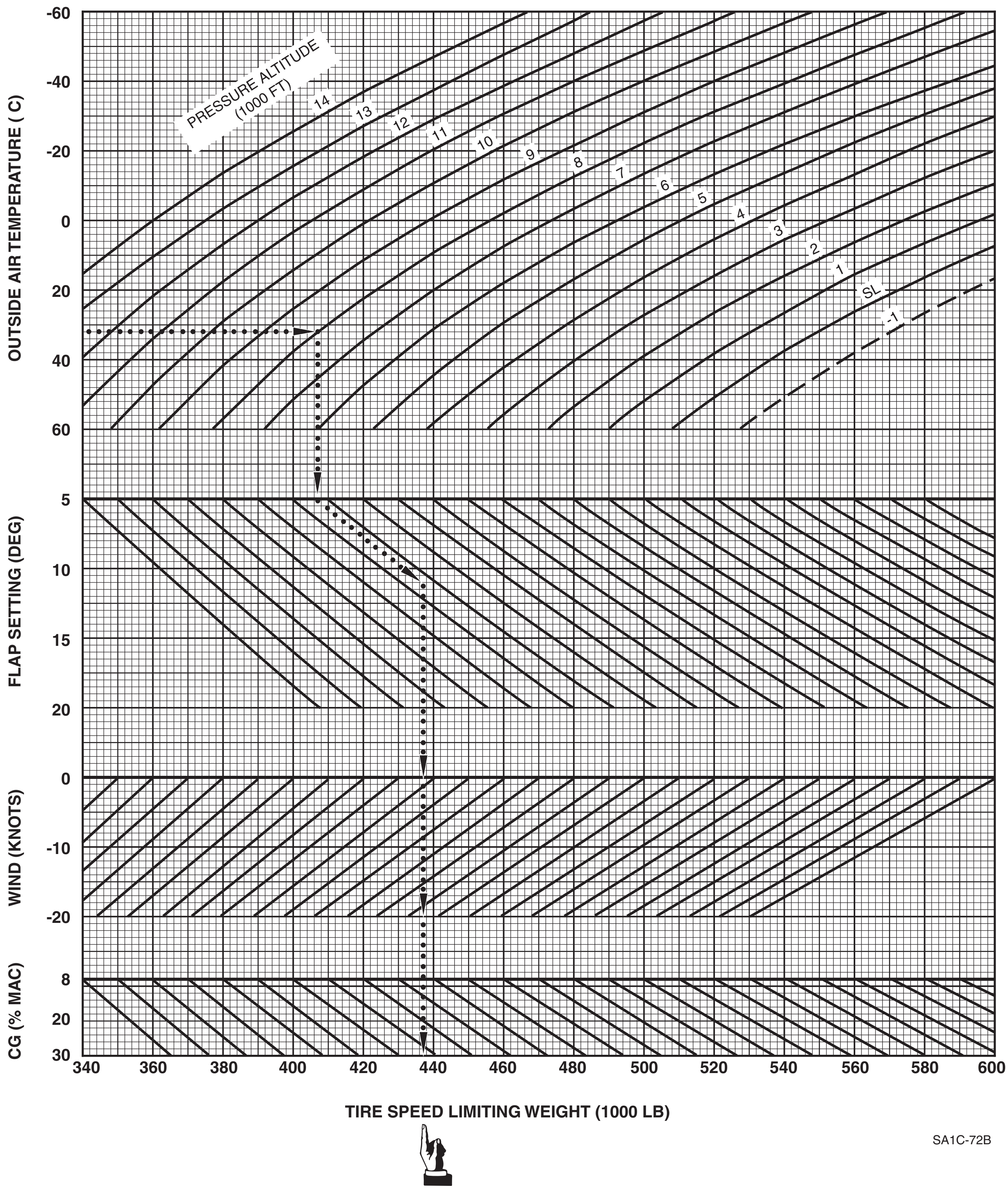


Figure 3-10.

GROUND MINIMUM CONTROL SPEED, V_{MCG}

NOTE:

1. ONE WING ENGINE INOPERATIVE
2. HARD SURFACE RUNWAY
3. V_{MCG} CORRECTION IF RCR GREATER THAN OR EQUAL TO 10 AND NO RSC AND CROSSWIND COMPONENT LESS THAN OR EQUAL TO 10: SUBTRACT 10 KNOTS.
4. FOR ENGINE & WING ICE PROTECTION ON, INCREASE V_{MCG} BY 1.2 KIAS

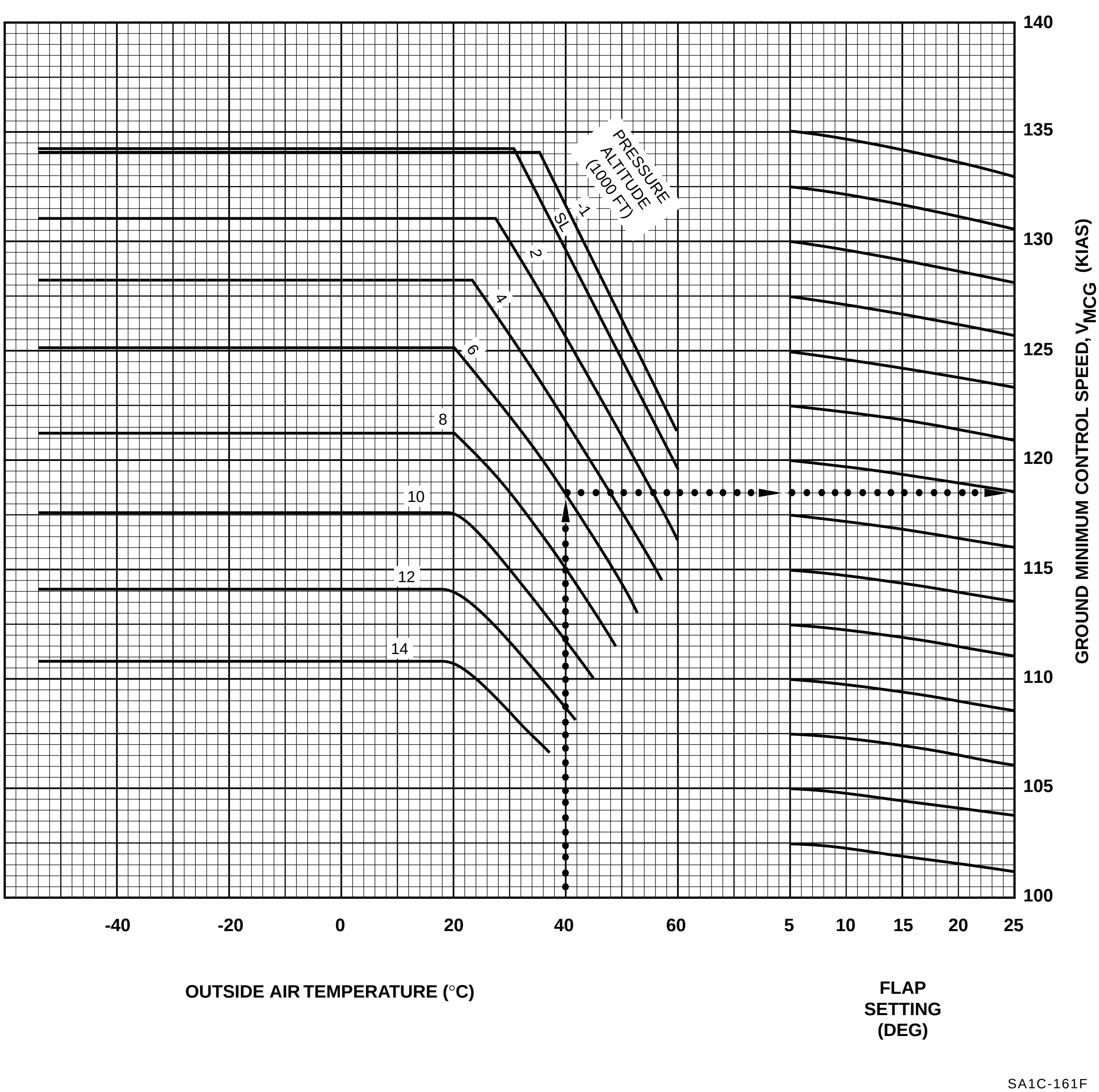


Figure 3-11.

CRITICAL ENGINE FAILURE SPEED, V_{CEF}
RCR = 23 TO 18 / WITH REVERSE THRUST

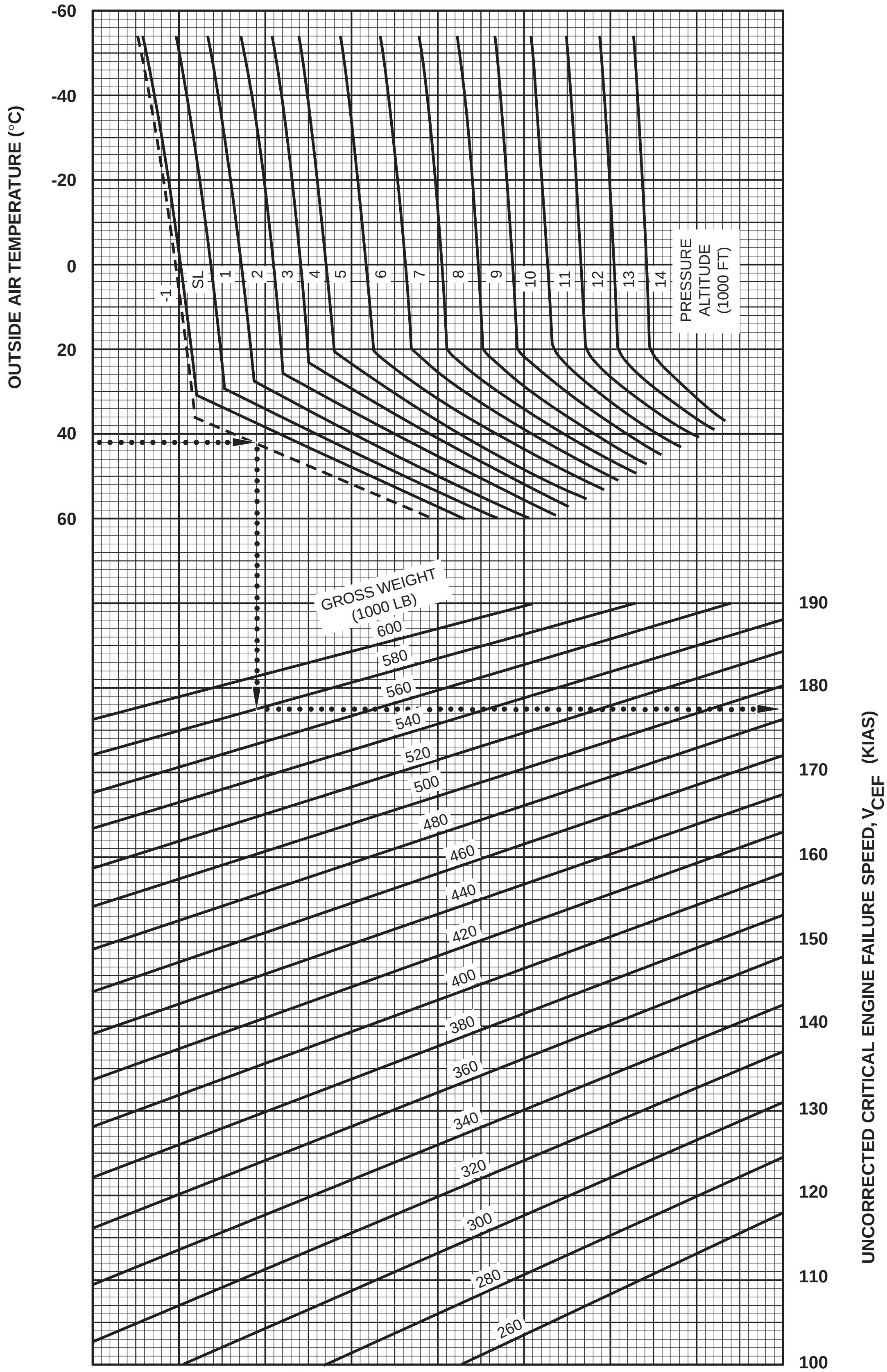


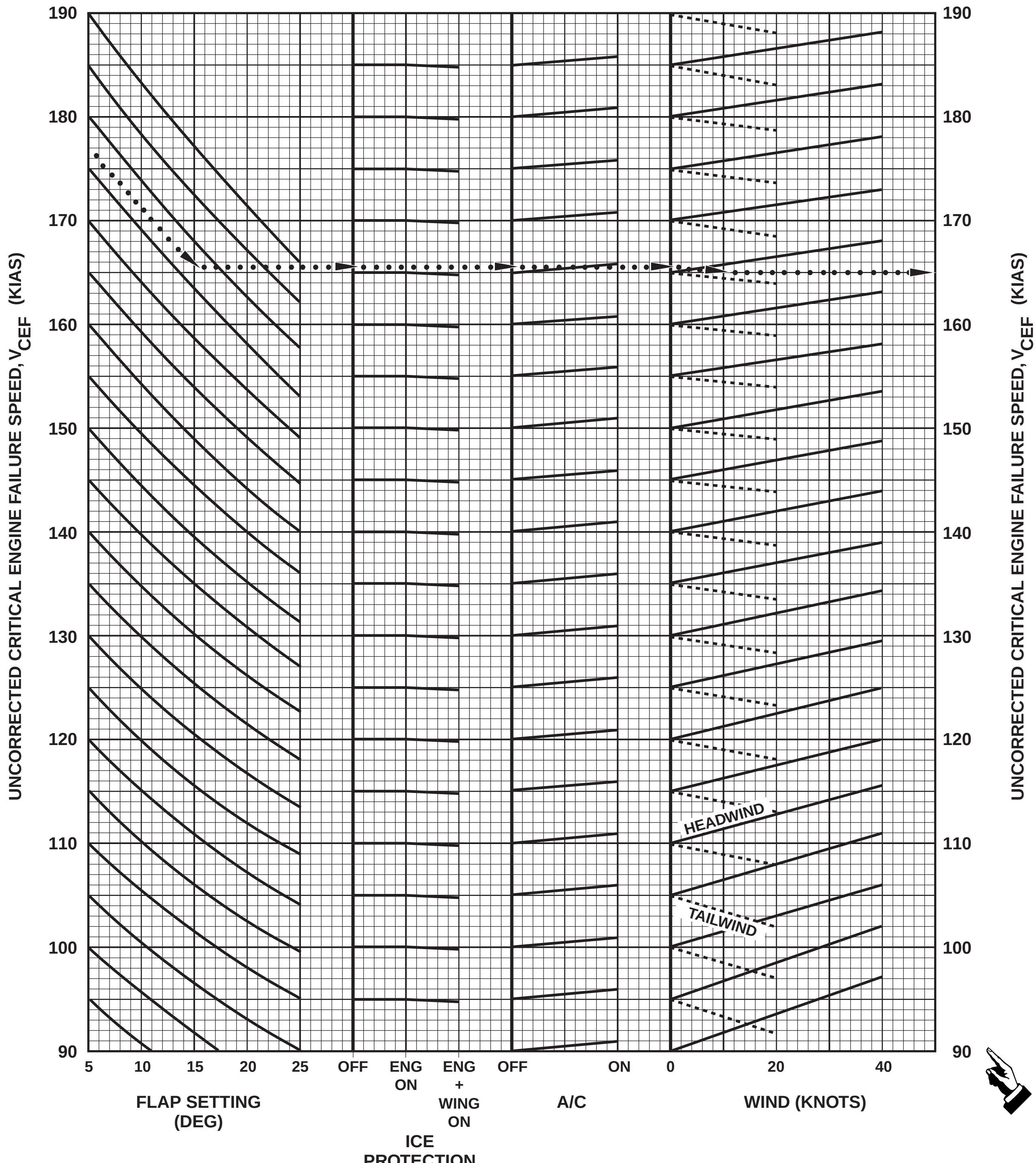
Figure 3-12A. (Sheet 1)

SA1C-465B

CRITICAL ENGINE FAILURE SPEED, V_{CEF}
RCR = 23 TO 18 / WITH REVERSE THRUST

NOTE:

DO NOT MAKE RCR CORRECTION WHEN CFCC IS USED



CAG(IGDS)

SA1C-526C

Figure 3-12A. (Sheet 2)

CRITICAL ENGINE FAILURE SPEED, V_{CEF}
RCR = 23 TO 18 / WITH REVERSE THRUST

NOTE:

DO NOT MAKE RCR CORRECTION WHEN CFCC IS USED

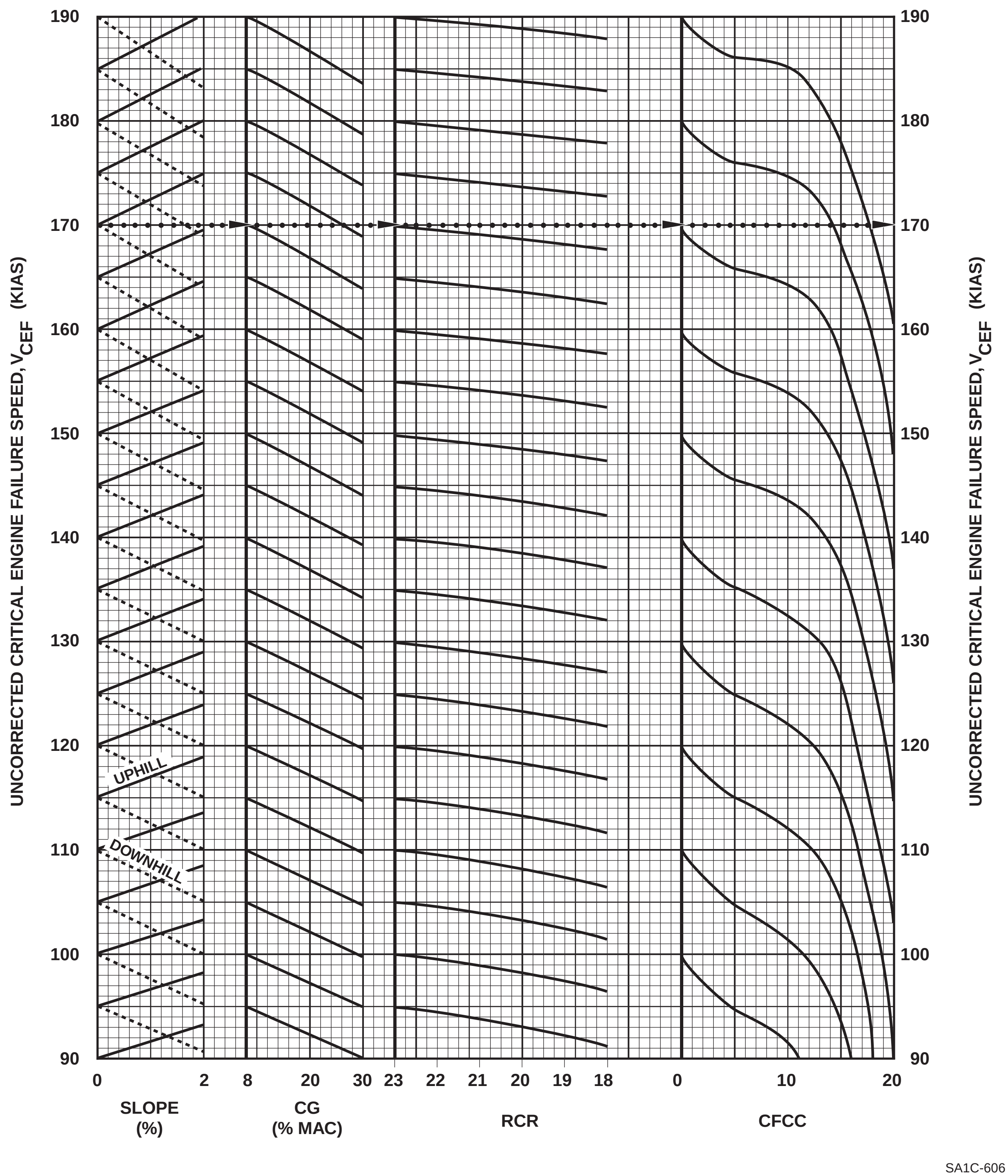


Figure 3-12A. (Sheet 3)

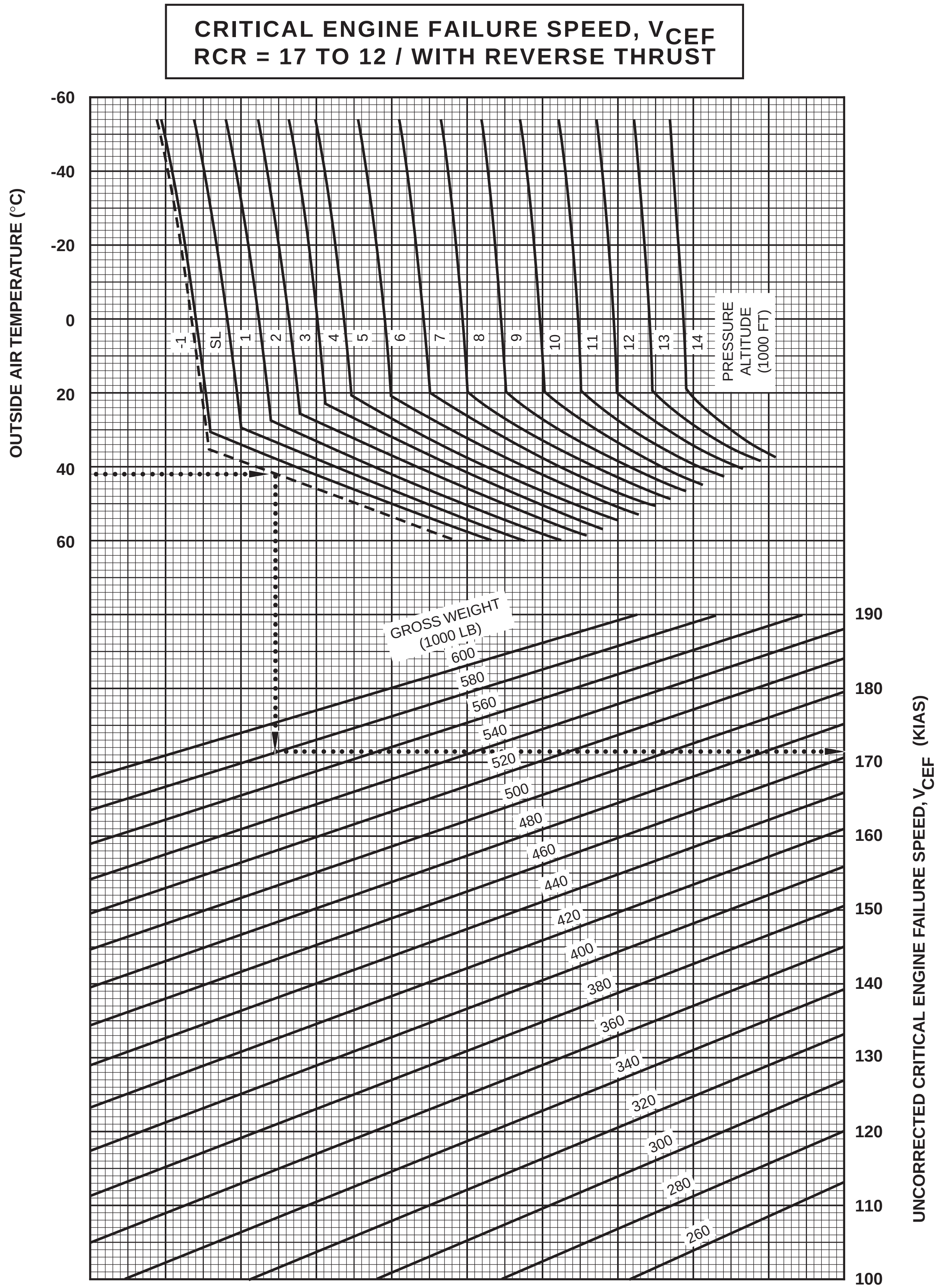


Figure 3-12B. (Sheet 1)

SA1C-466B

CRITICAL ENGINE FAILURE SPEED, V_{CEF}
RCR = 17 TO 12 / WITH REVERSE THRUST

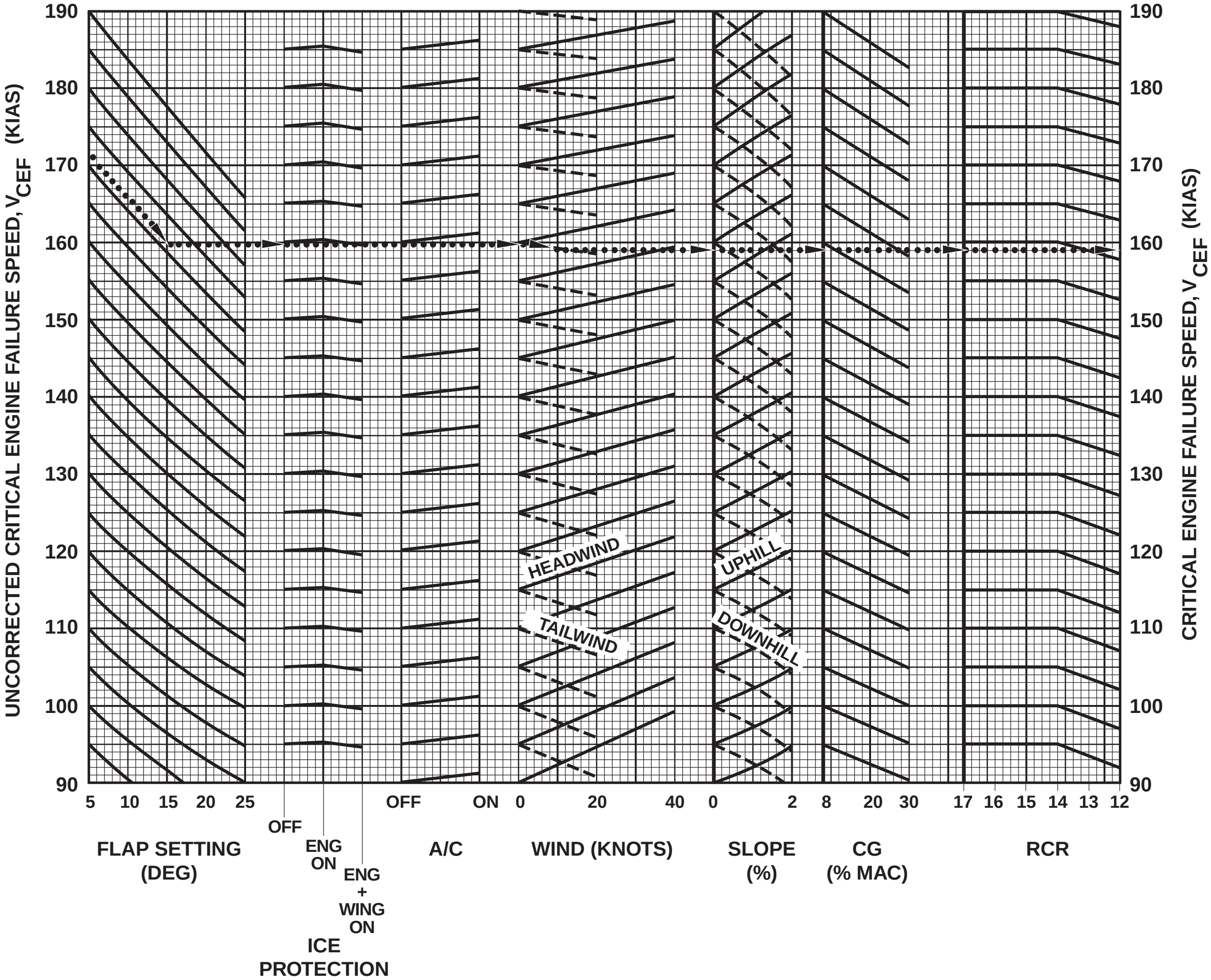


Figure 3-12B. (Sheet 2)

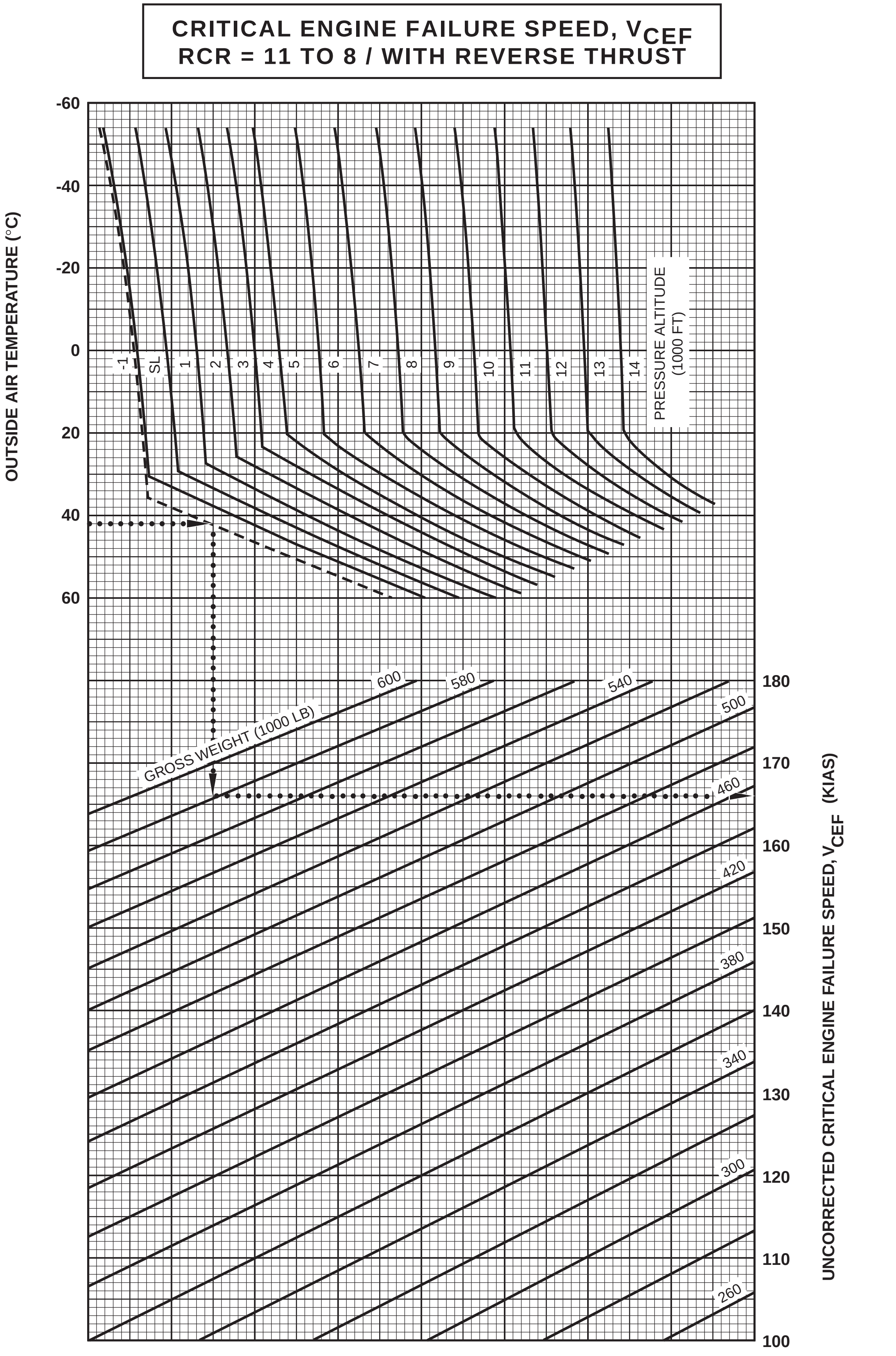


Figure 3-12C. (Sheet 1)

CRITICAL ENGINE FAILURE SPEED, V_{CEF}
RCR = 11 TO 8 / WITH REVERSE THRUST

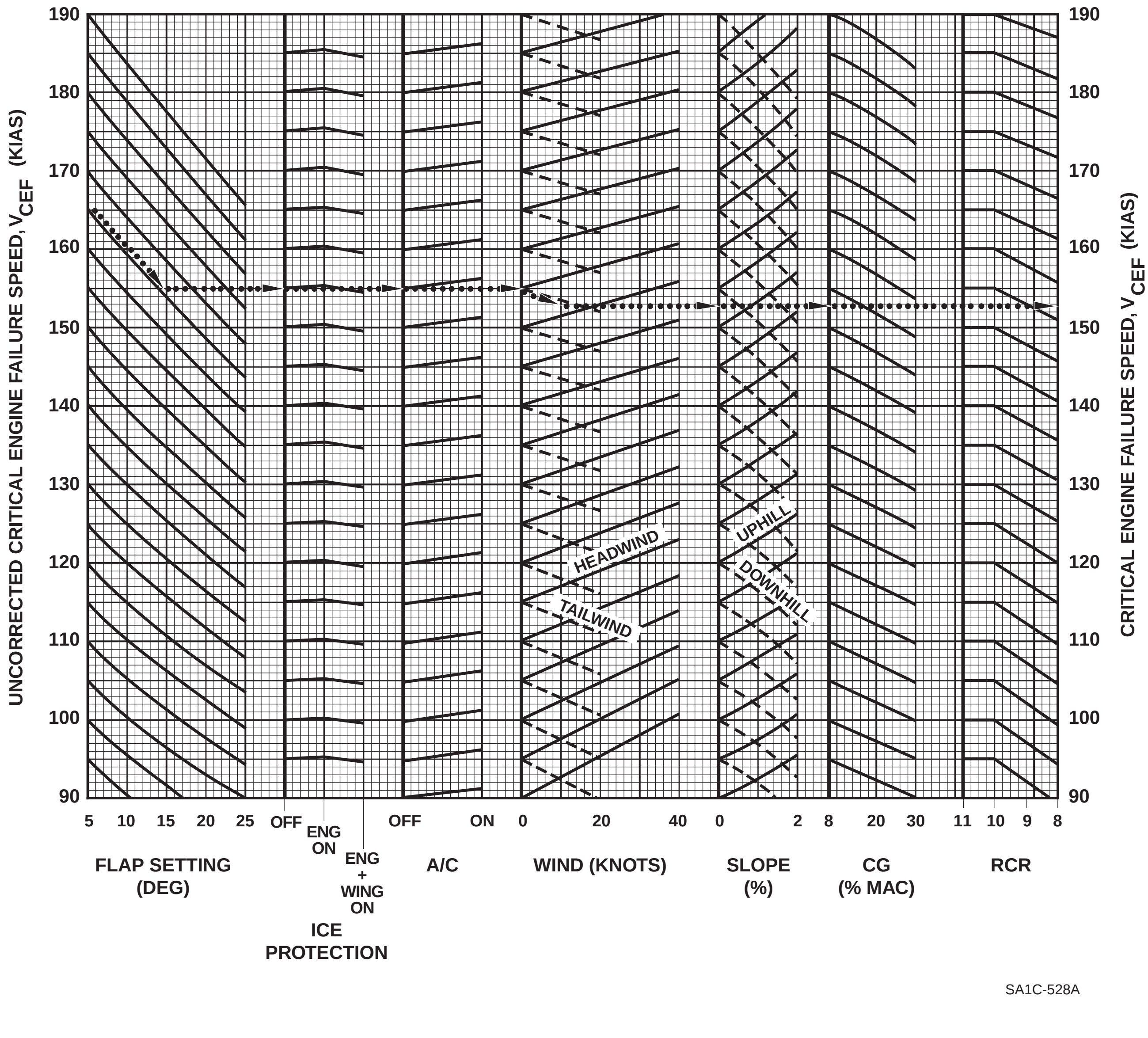


Figure 3-12C. (Sheet 2)

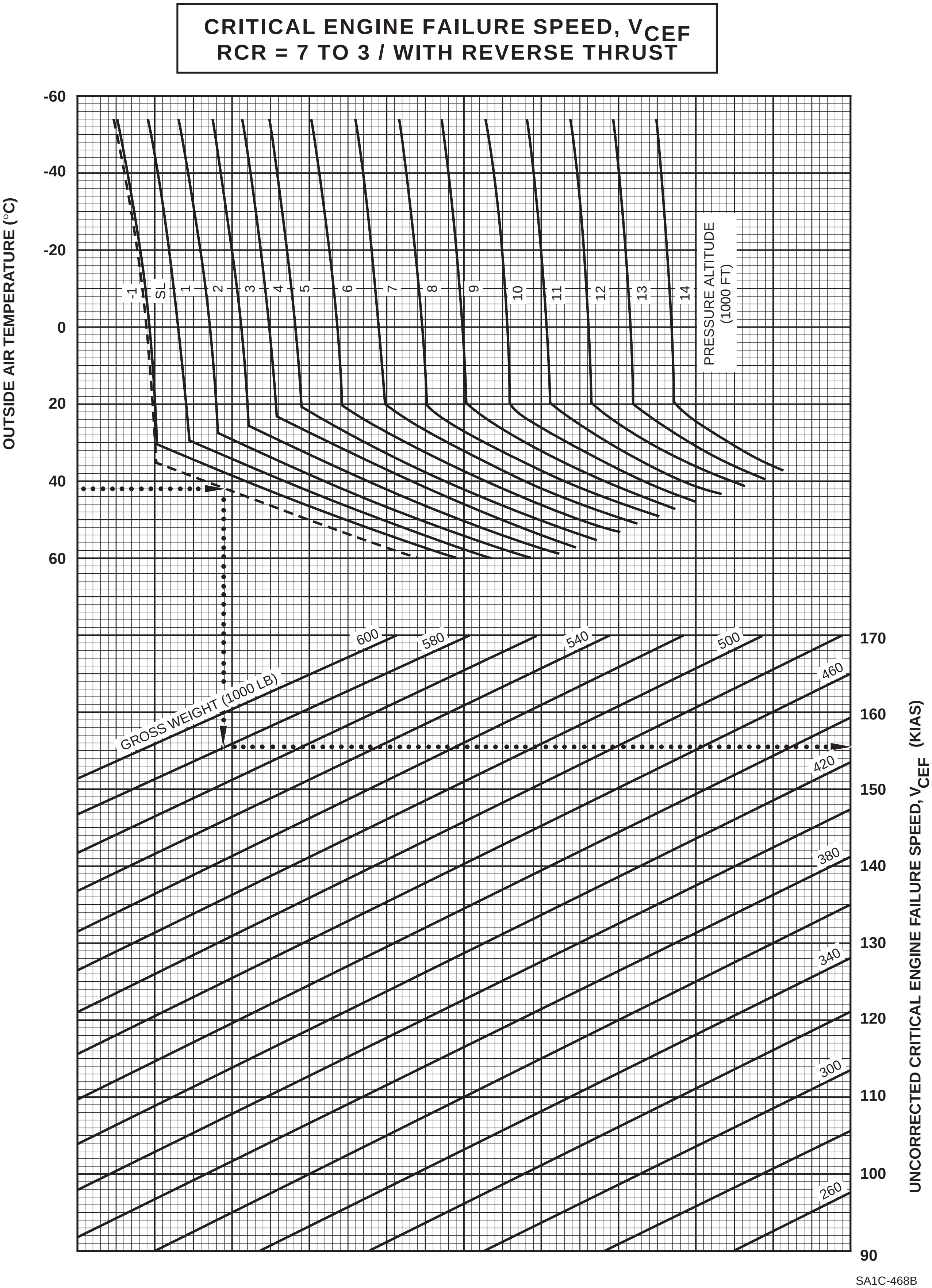


Figure 3-12D. (Sheet 1)

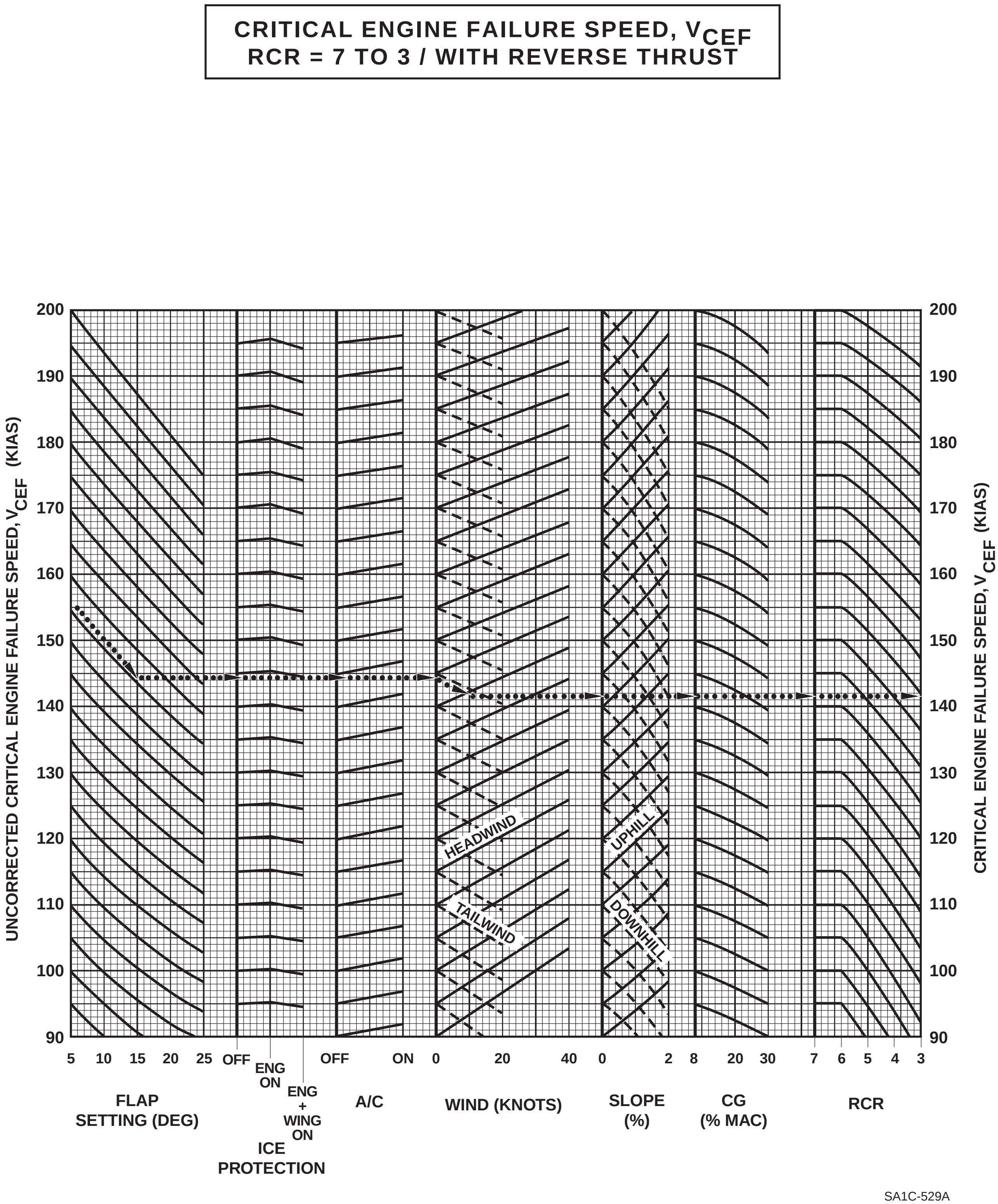


Figure 3-12D. (Sheet 2)

CRITICAL ENGINE FAILURE SPEED, V_{CEF}
RSC = 0.25 IN / WITH REVERSE THRUST

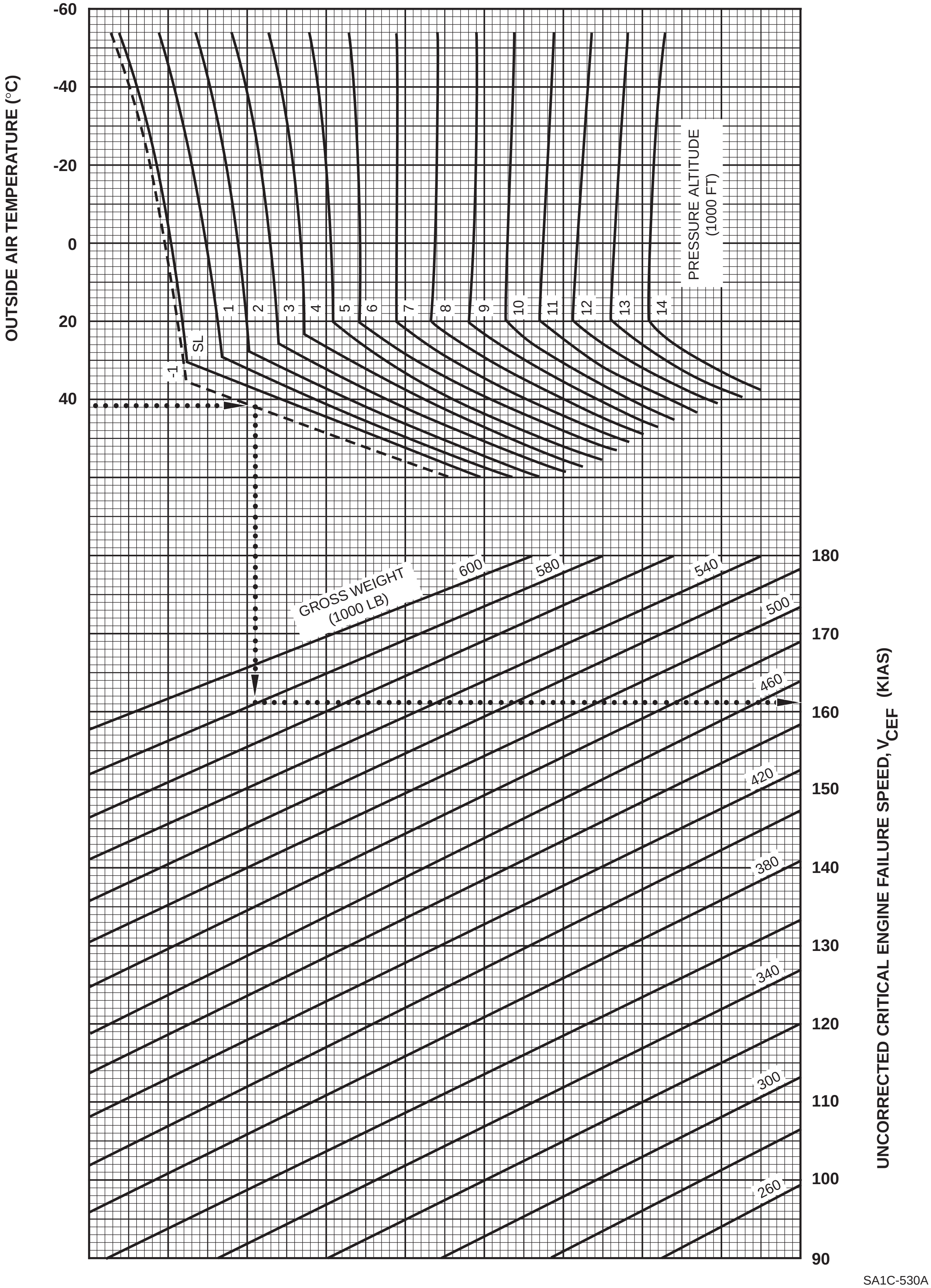


Figure 3-12E. (Sheet 1)

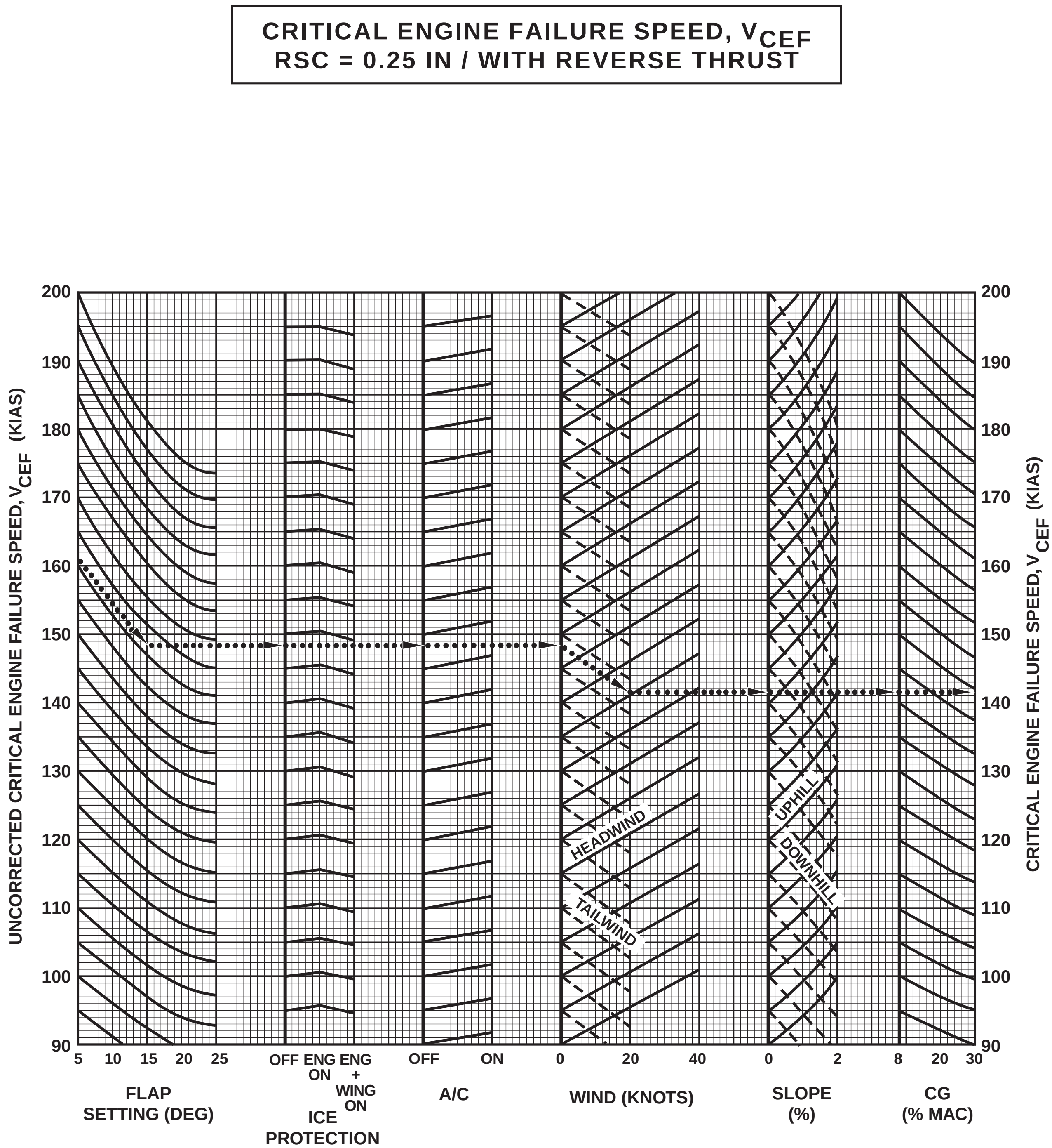


Figure 3-12E. (Sheet 2)

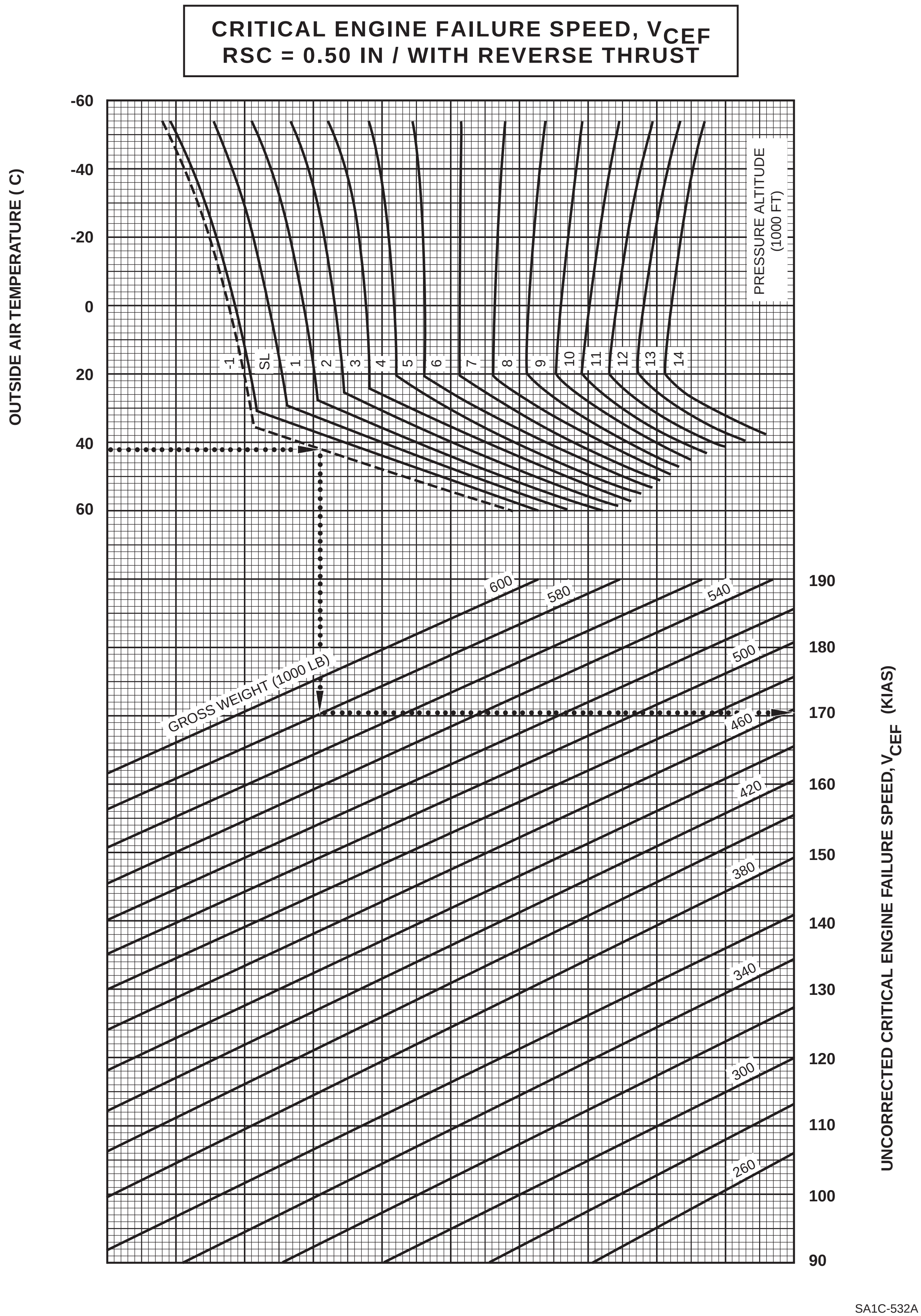


Figure 3-12F. (Sheet 1)

CRITICAL ENGINE FAILURE SPEED, V_{CEF}
RSC = 0.50 IN / WITH REVERSE THRUST

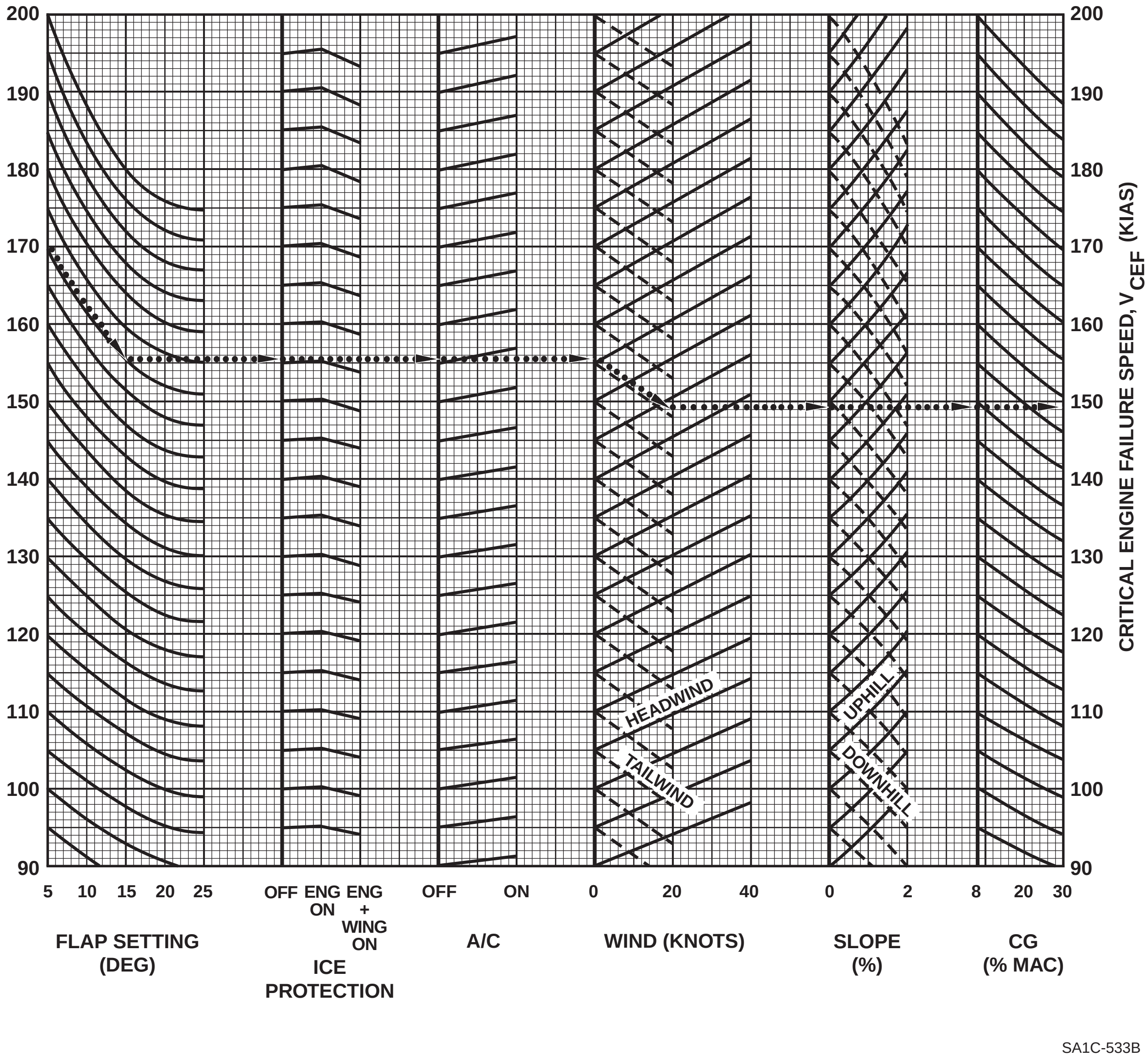


Figure 3-12F. (Sheet 2)

MAXIMUM BRAKING SPEED, V_{MBE}

NOTE:
1. FOR WEIGHTS LIGHTER THAN SHOWN, DETERMINE VMBE AT THE LIGHTEST WEIGHT SHOWN
2. ANTI-SKID INOPERATIVE OR OPERATIVE EXCEPT AS PRESENTED ON SHEET 2

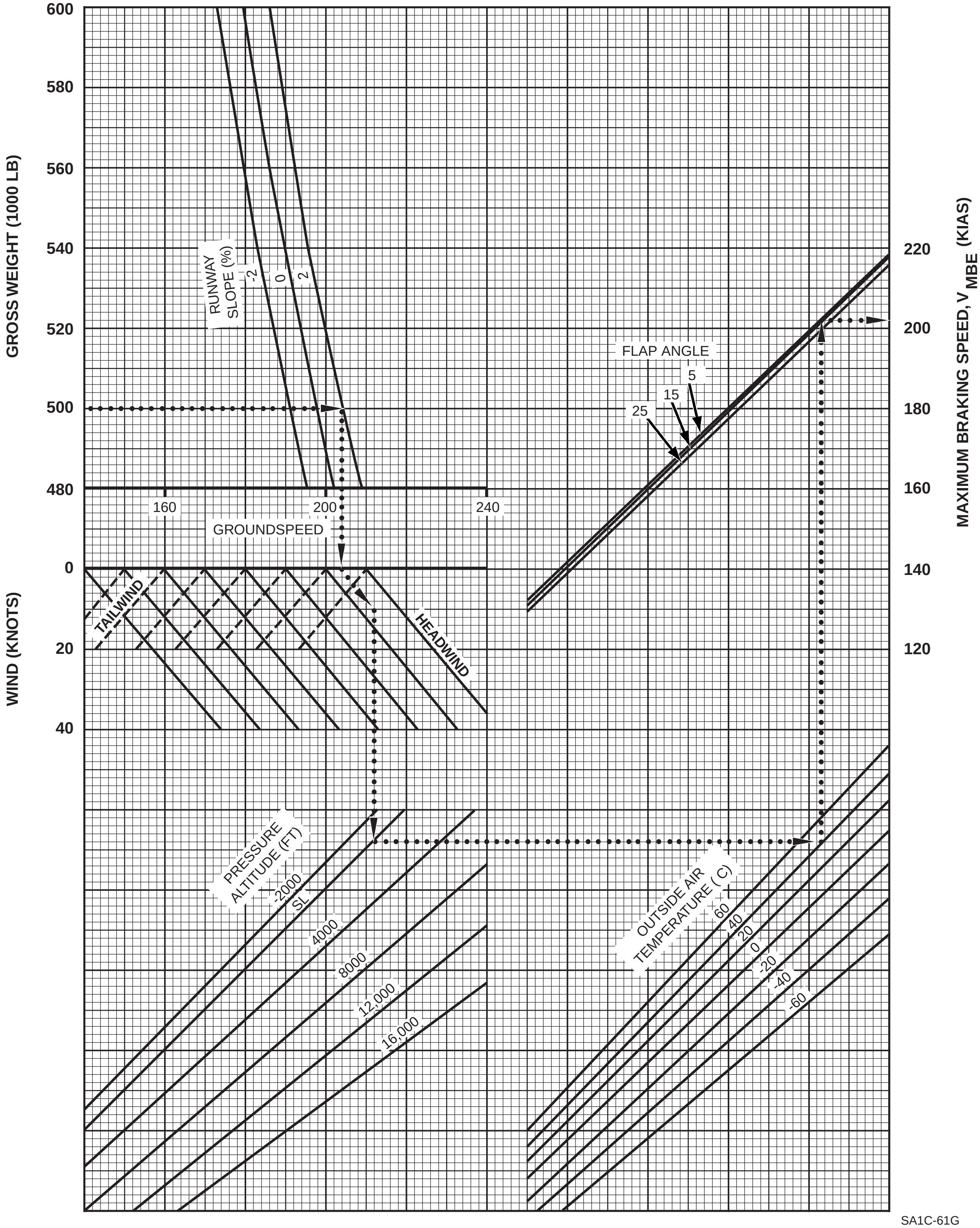


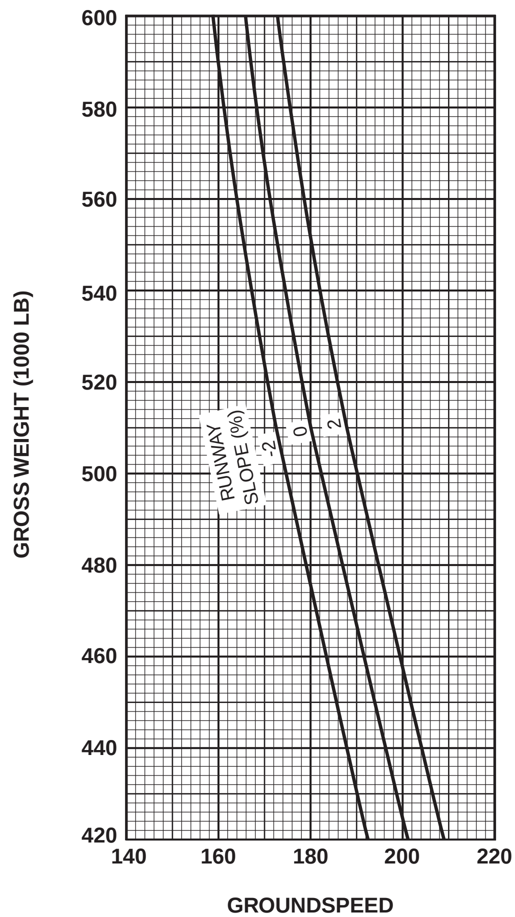
Figure 3-13. (Sheet 1)

MAXIMUM BRAKING SPEED, V_{MBE}

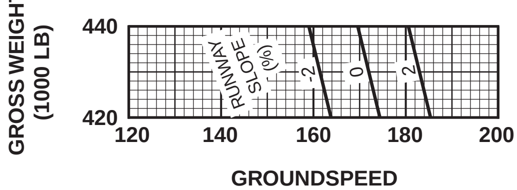
NOTE:

TAKEOFF IS NOT ALLOWED ABOVE THE PRESENTED WEIGHTS. FOR WEIGHTS LIGHTER THAN SHOWN, DETERMINE V_{MBE} AT THE LIGHTEST WEIGHT SHOWN.

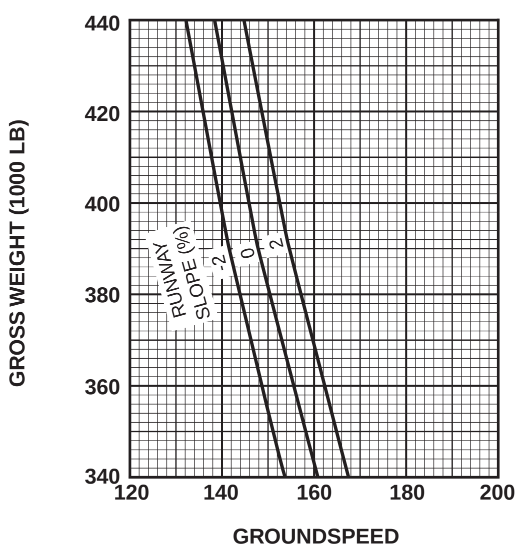
ONE WHEEL BRAKE INOPERATIVE



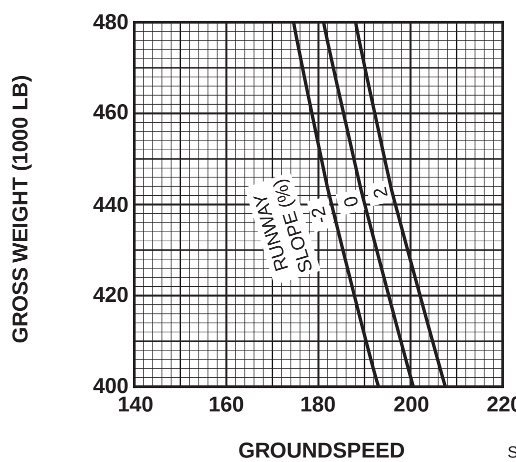
ANTI-SKID BRAKING INOPERATIVE PLUS CENTER GEAR RETRACTED



ONE WHEEL BRAKE INOPERATIVE PLUS CENTER GEAR RETRACTED



CENTER GEAR RETRACTED



SA1C-252B

Figure 3-13. (Sheet 2)

MAXIMUM ALLOWABLE WEIGHT WHEN $V_1 = V_{MCG}$
RCR = 23 TO 18 / WITH REVERSE THRUST

NOTE: APPLICABLE FOR ALL FLAP SETTINGS

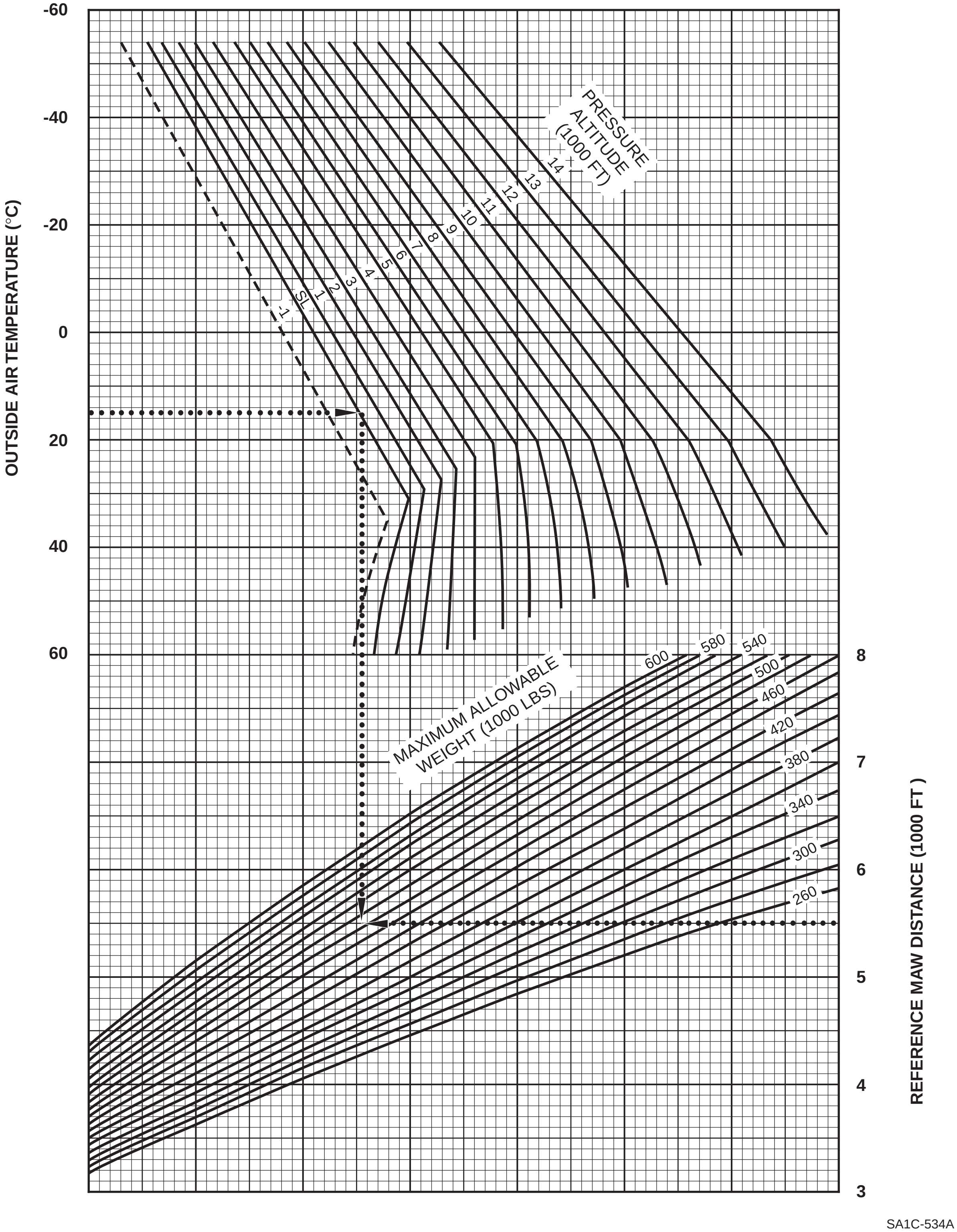


Figure 3-14A. (Sheet 1)

MAXIMUM ALLOWABLE WEIGHT WHEN $V_1 = V_{MCG}$
RCR = 23 TO 18 / WITH REVERSE THRUST

NOTE:

IF CFCC CORRECTION IS USED:

- DO NOT MAKE AN RCR CORRECTION.
- USE CFCC A IF ACTUAL RCR IS GREATER THAN OR EQUAL TO 10 AND CROSSWIND COMPONENT IS LESS THAN OR EQUAL TO 10 KNOTS.
- USE CFCC B IF ACTUAL RCR IS LESS THAN 10 AND/OR CROSSWIND COMPONENT IS GREATER THAN 10 KNOTS.

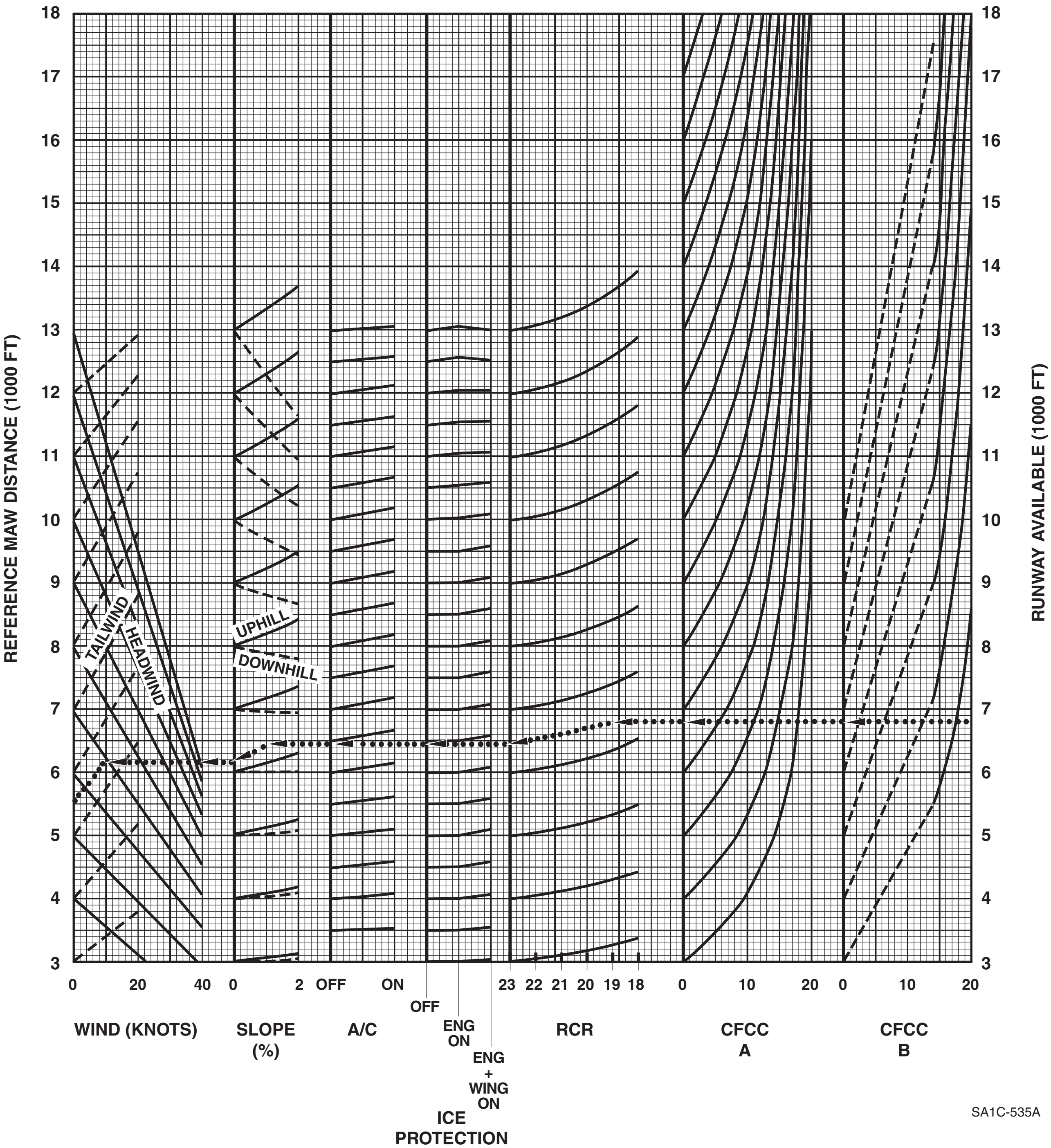


Figure 3-14A. (Sheet 2)

MAXIMUM ALLOWABLE WEIGHT WHEN $V_1 = V_{MCG}$
RCR = 23 TO 18 / WITH REVERSE THRUST

NOTE: CORRECTION NOT REQUIRED IF CROSSWIND COMPONENT IS LESS THAN OR EQUAL TO 10 KNOTS, OR IF CFCC IS USED.

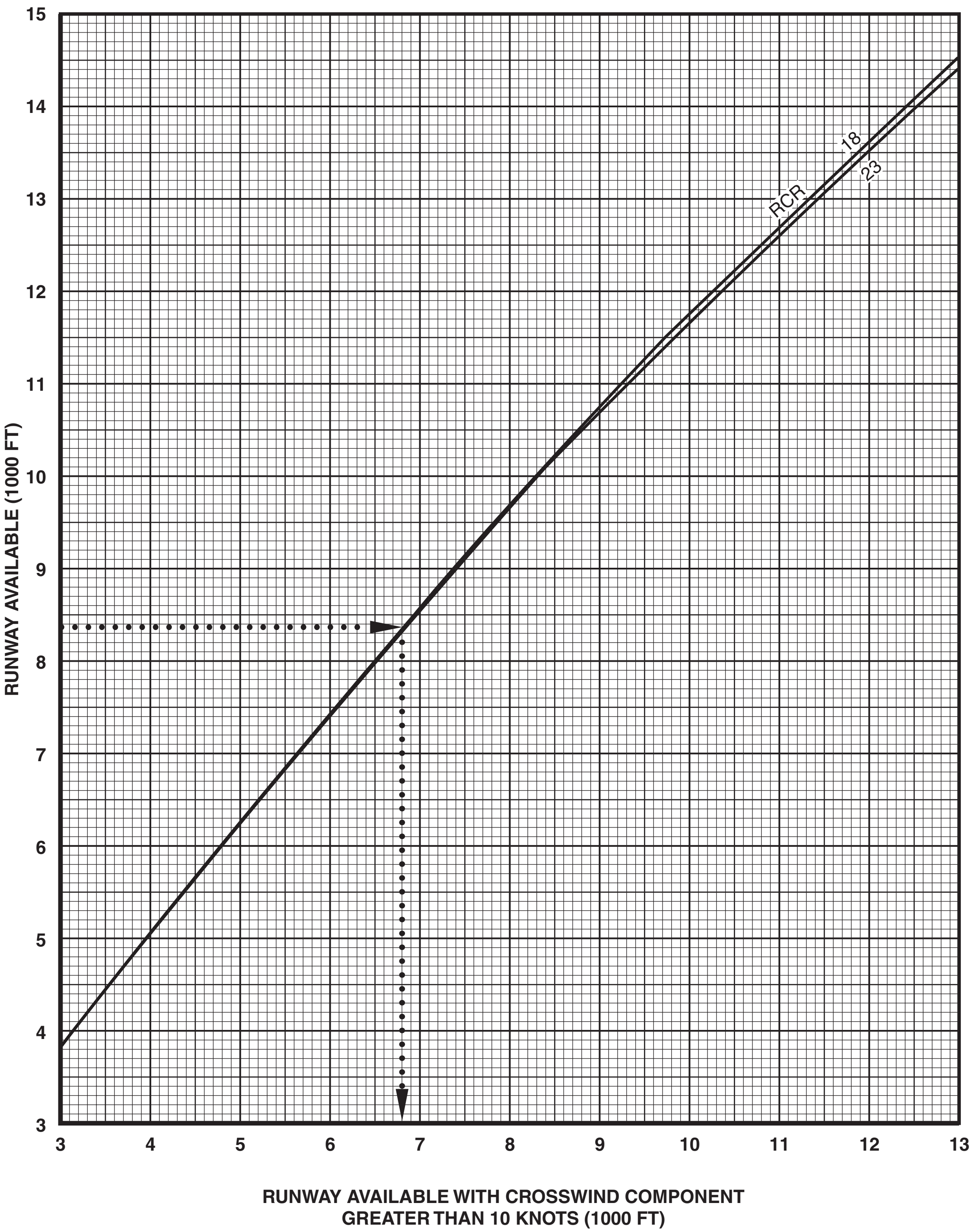


Figure 3-14A. (Sheet 3)

MAXIMUM ALLOWABLE WEIGHT WHEN $V_1 = V_{MCG}$
RCR = 17 TO 12 / WITH REVERSE THRUST

NOTE: APPLICABLE FOR ALL FLAP SETTINGS

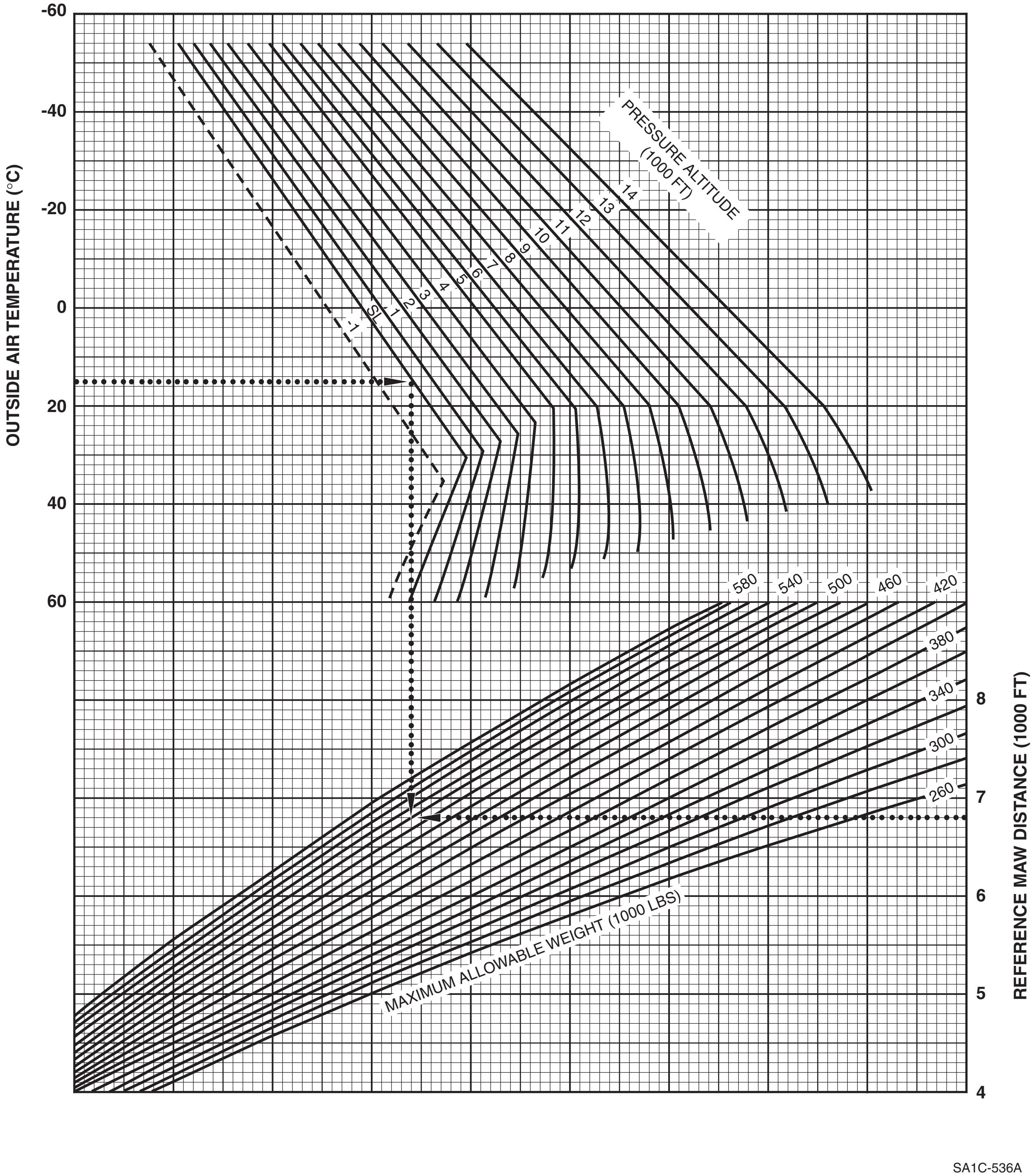


Figure 3-14B. (Sheet 1)

MAXIMUM ALLOWABLE WEIGHT WHEN $V_1 = V_{MCG}$
RCR = 17 TO 12 / WITH REVERSE THRUST

NOTE: IF CROSSWIND COMPONENT IS GREATER THAN 10 KNOTS, CORRECT RUNWAY AVAILABLE USING SHEET 3 BEFORE ENTERING SHEET 2.

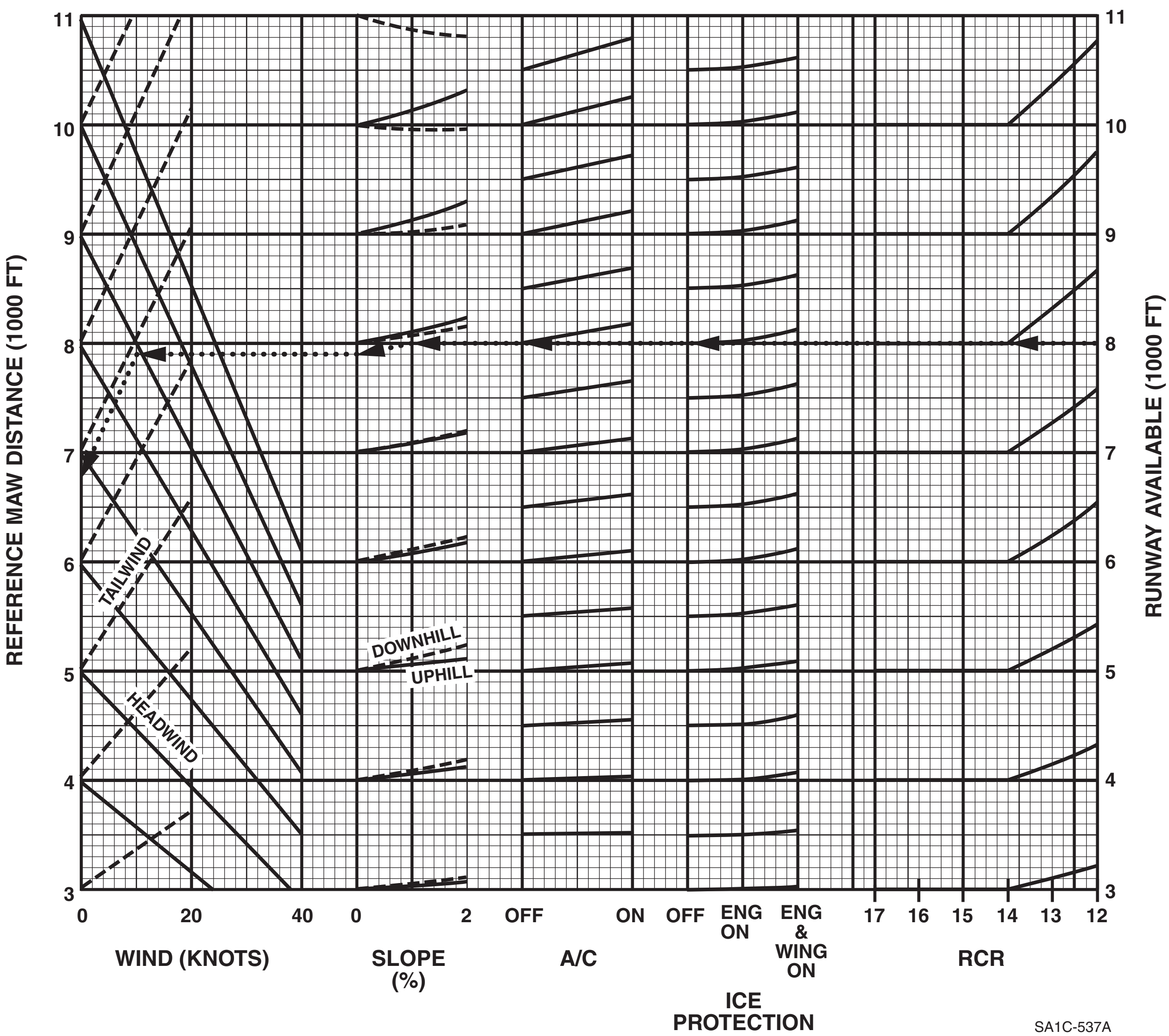


Figure 3-14B. (Sheet 2)

MAXIMUM ALLOWABLE WEIGHT WHEN $V_1 = V_{MCG}$
RCR = 17 TO 12 / WITH REVERSE THRUST

NOTE: CORRECTION NOT REQUIRED IF CROSSWIND COMPONENT IS LESS THAN OR EQUAL TO 10 KNOTS.

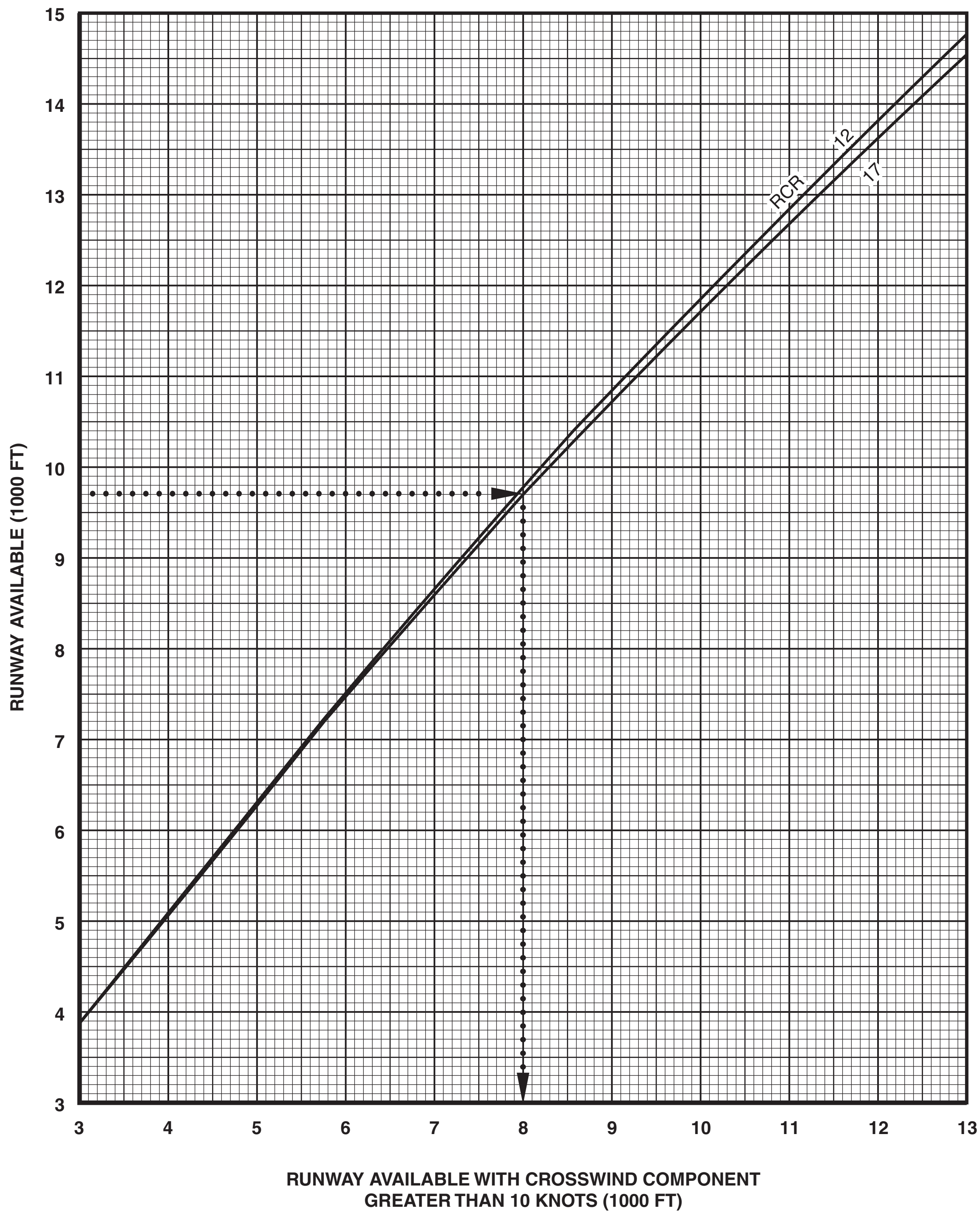


Figure 3-14B. (Sheet 3)

MAXIMUM ALLOWABLE WEIGHT WHEN $V_1 = V_{MCG}$
RCR = 11 TO 8 / WITH REVERSE THRUST

NOTE: APPLICABLE FOR ALL FLAP SETTINGS.

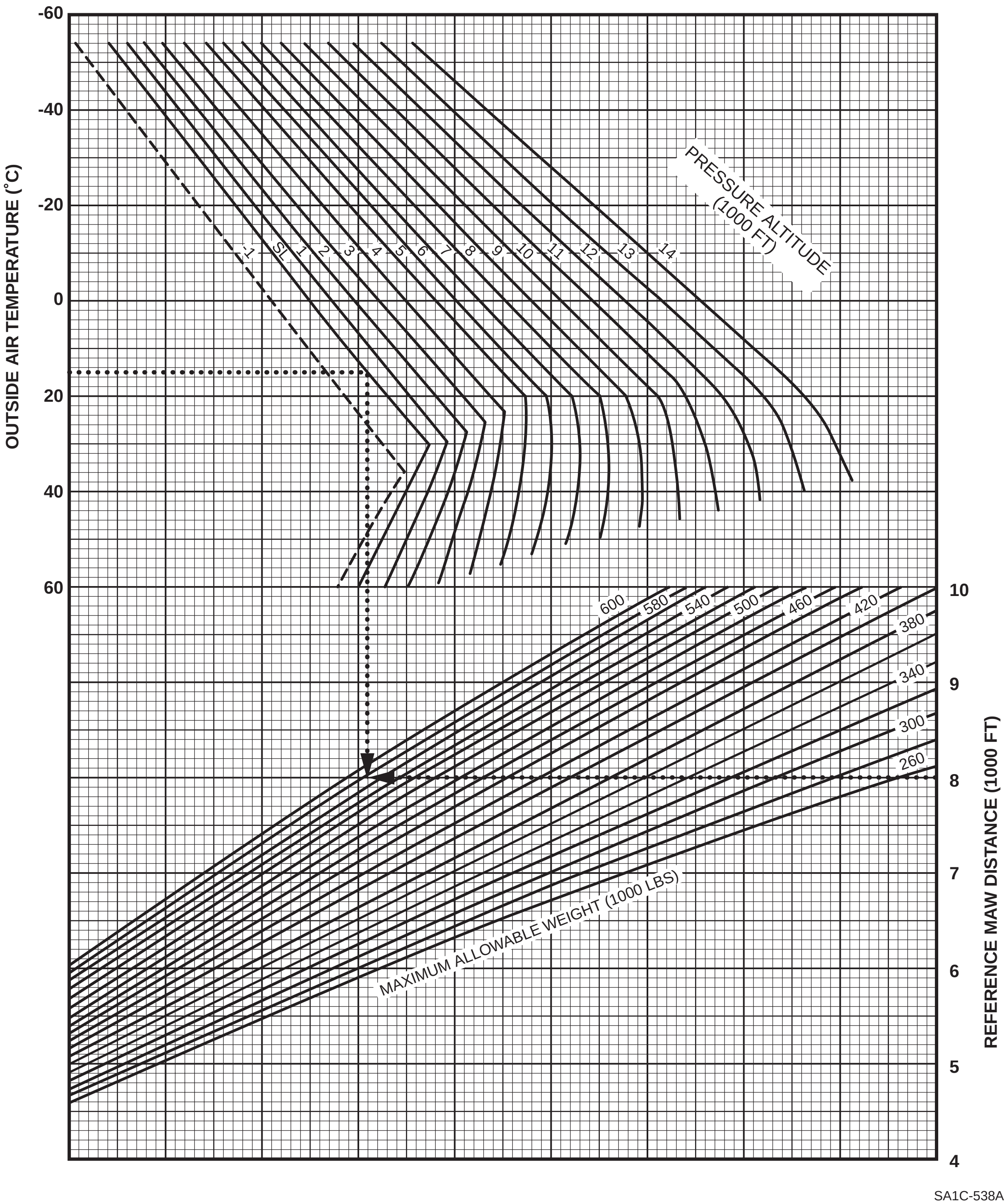


Figure 3-14C. (Sheet 1)

MAXIMUM ALLOWABLE WEIGHT WHEN $V_1 = V_{MCG}$
RCR = 11 TO 8 / WITH REVERSE THRUST

NOTE: IF CROSSWIND COMPONENT IS GREATER THAN 10 KNOTS, CORRECT RUNWAY AVAILABLE USING SHEET 3 BEFORE ENTERING SHEET 2.

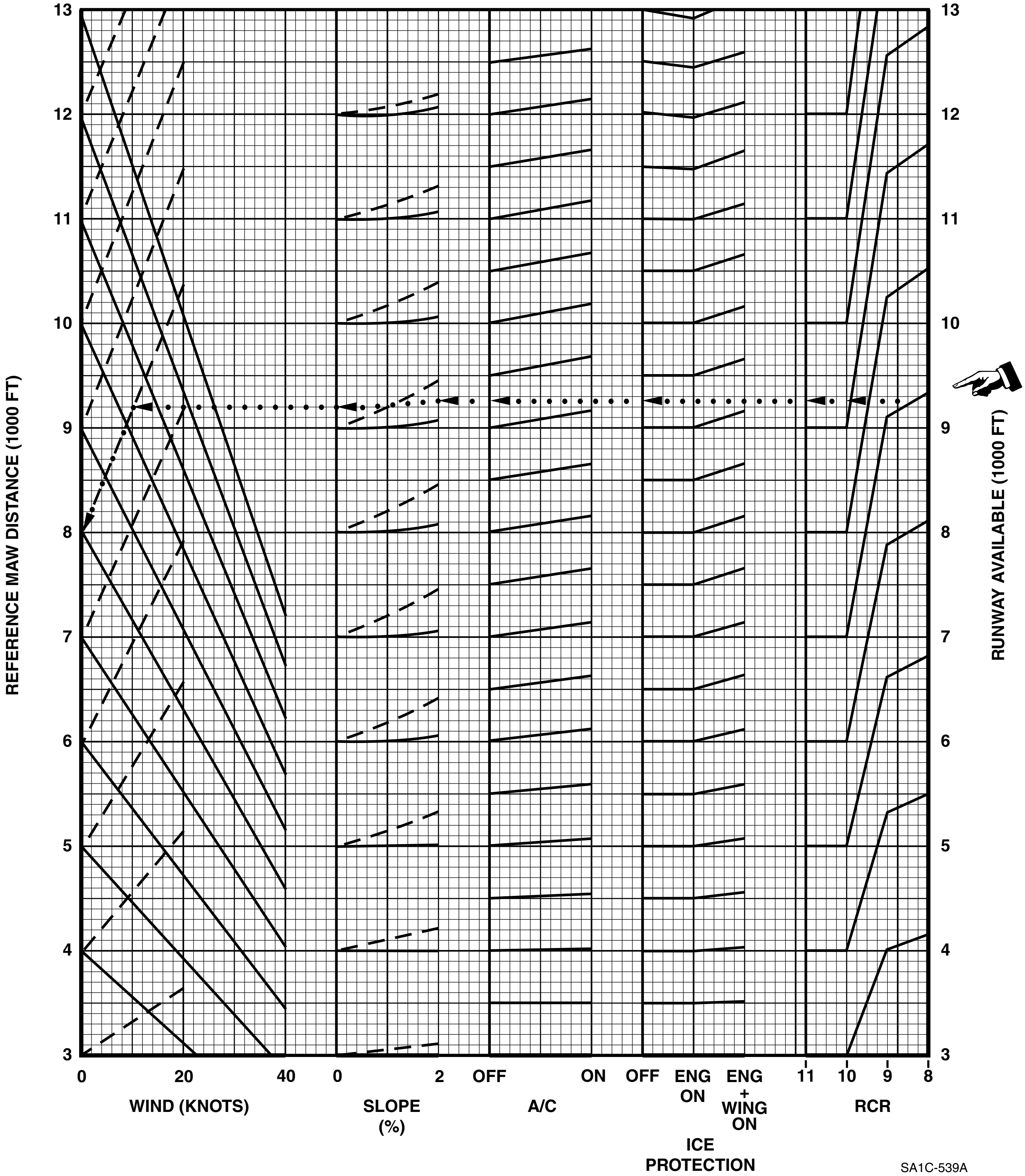


Figure 3-14C. (Sheet 2)

MAXIMUM ALLOWABLE WEIGHT WHEN $V_1 = V_{MCG}$
RCR = 11 TO 8 / WITH REVERSE THRUST

NOTE: CORRECTION NOT REQUIRED IF CROSSWIND COMPONENT IS LESS THAN OR EQUAL TO 10 KNOTS OR IF RCR IS LESS THAN 10.

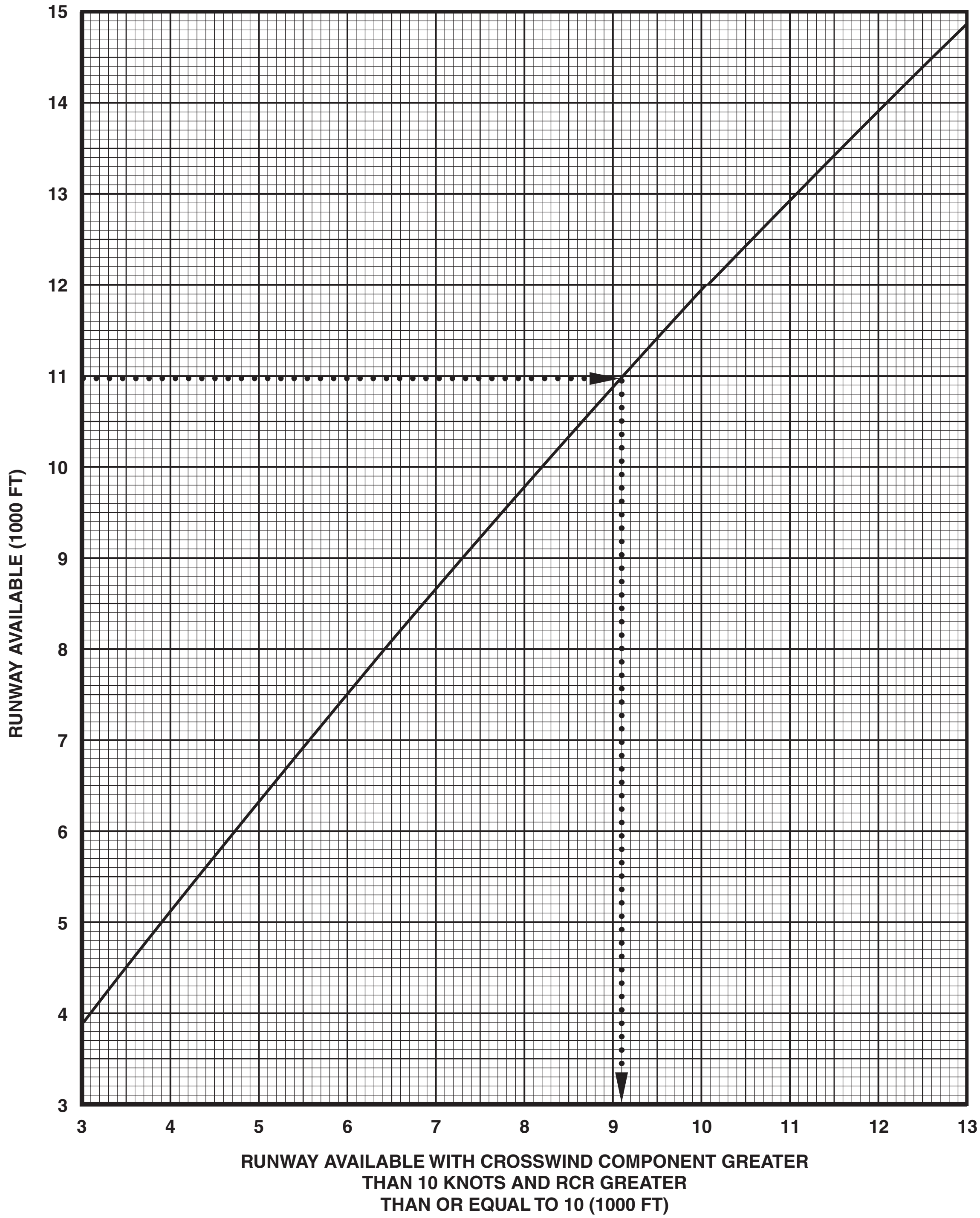


Figure 3-14C. (Sheet 3)

MAXIMUM ALLOWABLE WEIGHT WHEN $V_1 = V_{MCG}$
RCR = 7 TO 3 / WITH REVERSE THRUST

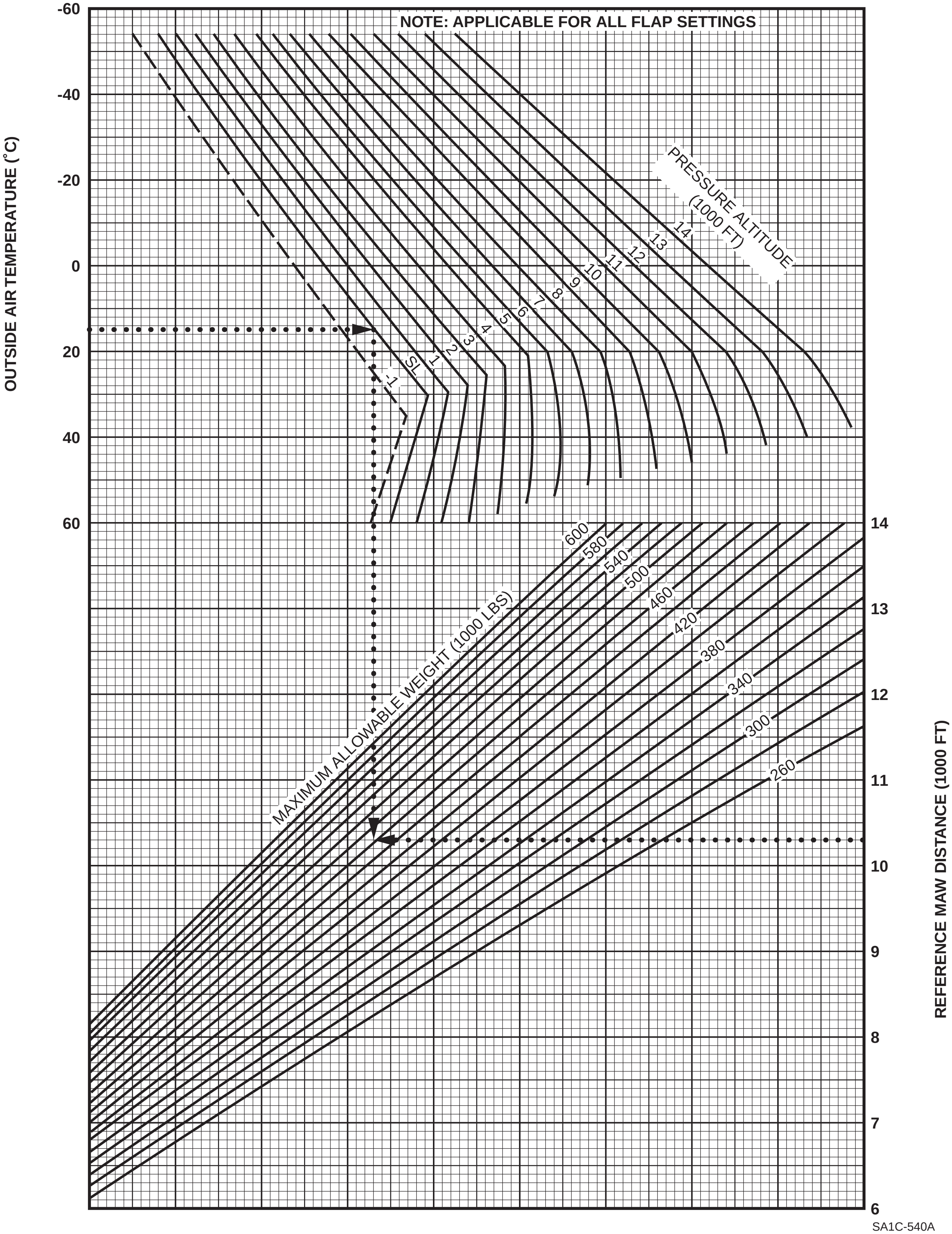


Figure 3-14D. (Sheet 1)

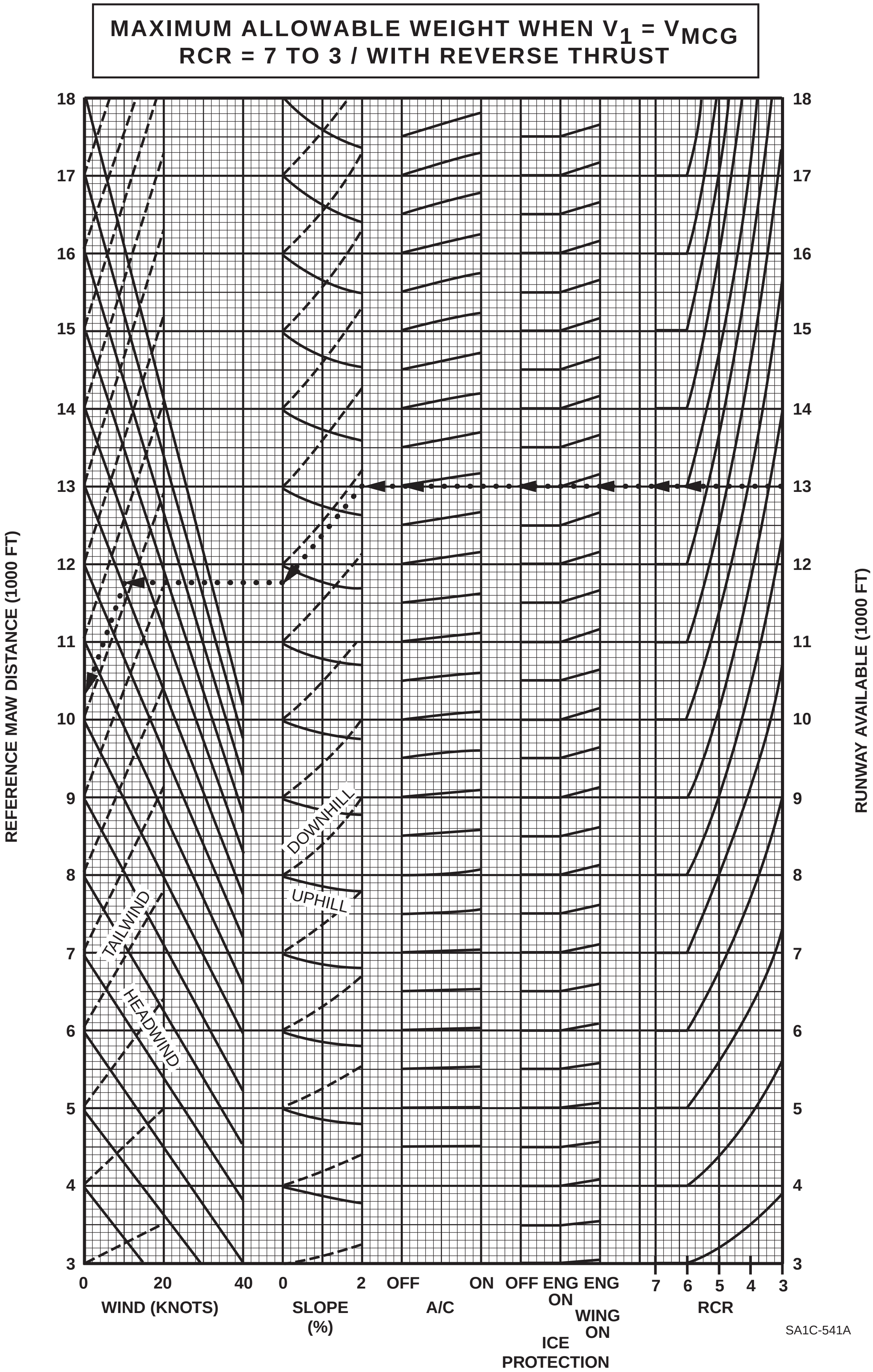


Figure 3-14D. (Sheet 2)

MAXIMUM ALLOWABLE WEIGHT WHEN $V_1 = V_{MCG}$ RSC = 0.25 IN / WITH REVERSE THRUST

NOTE:
FLAP SETTING = 25˚

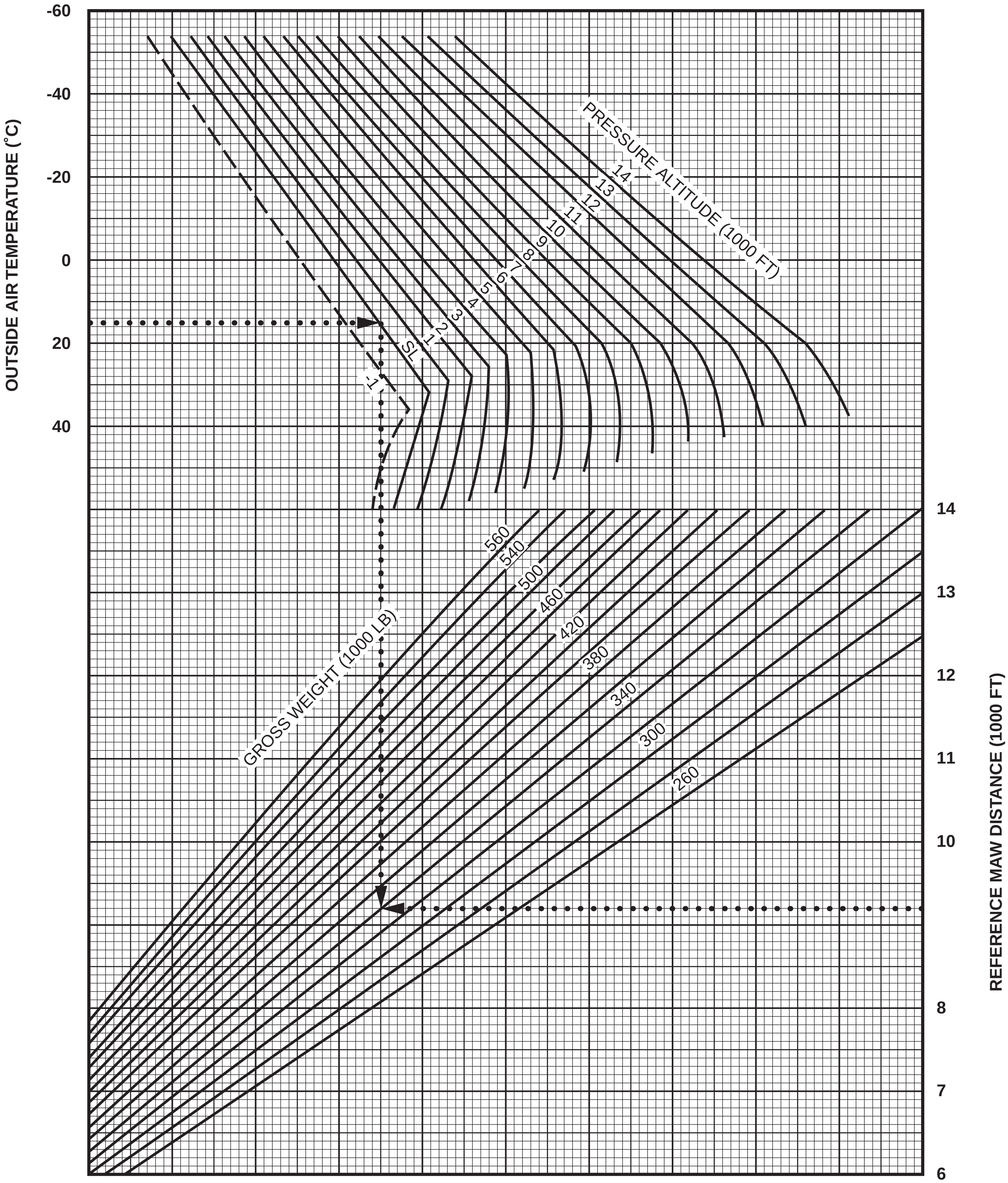


Figure 3-14E. (Sheet 1)

SA1C-559A

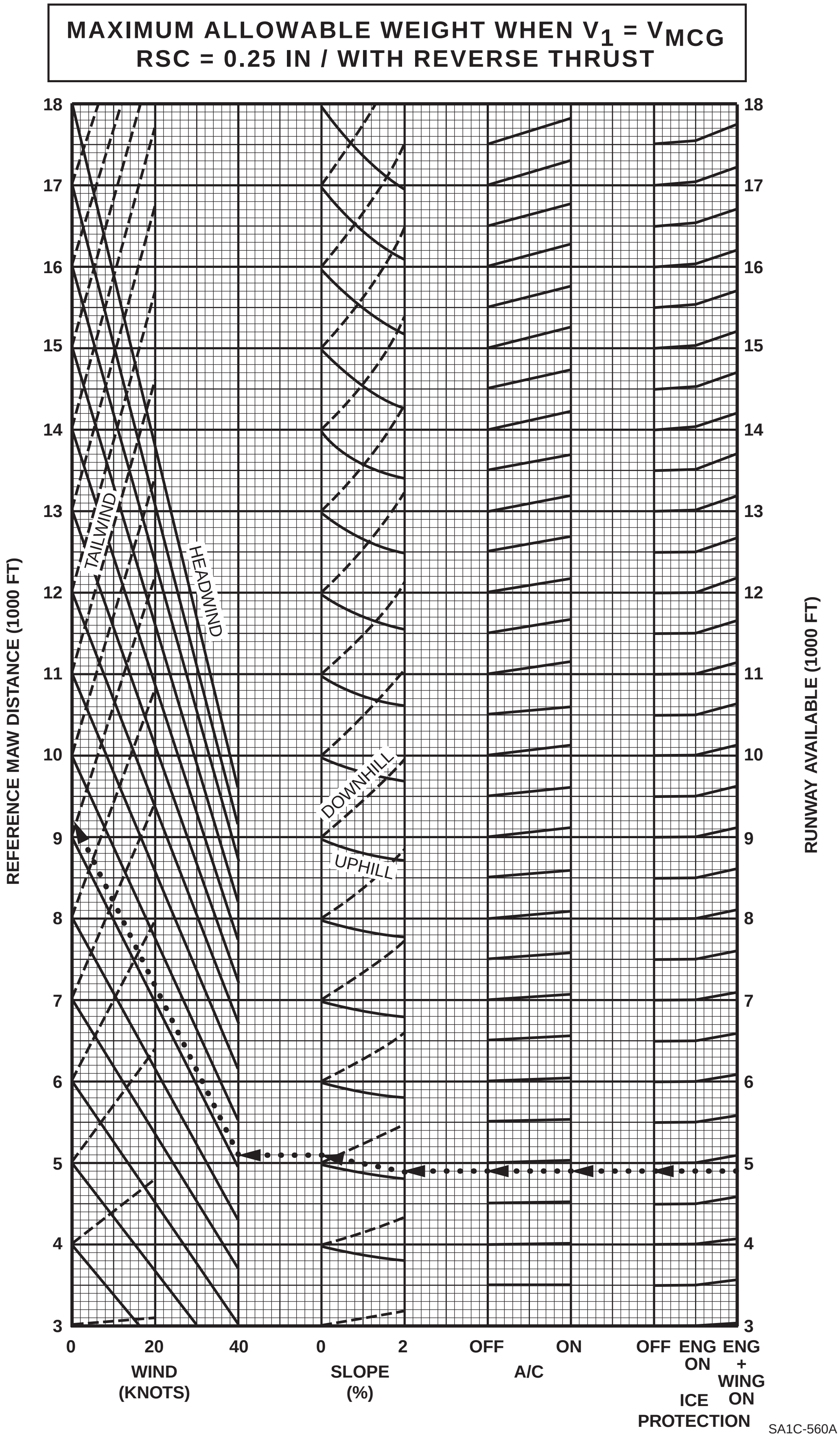


Figure 3-14E. (Sheet 2)

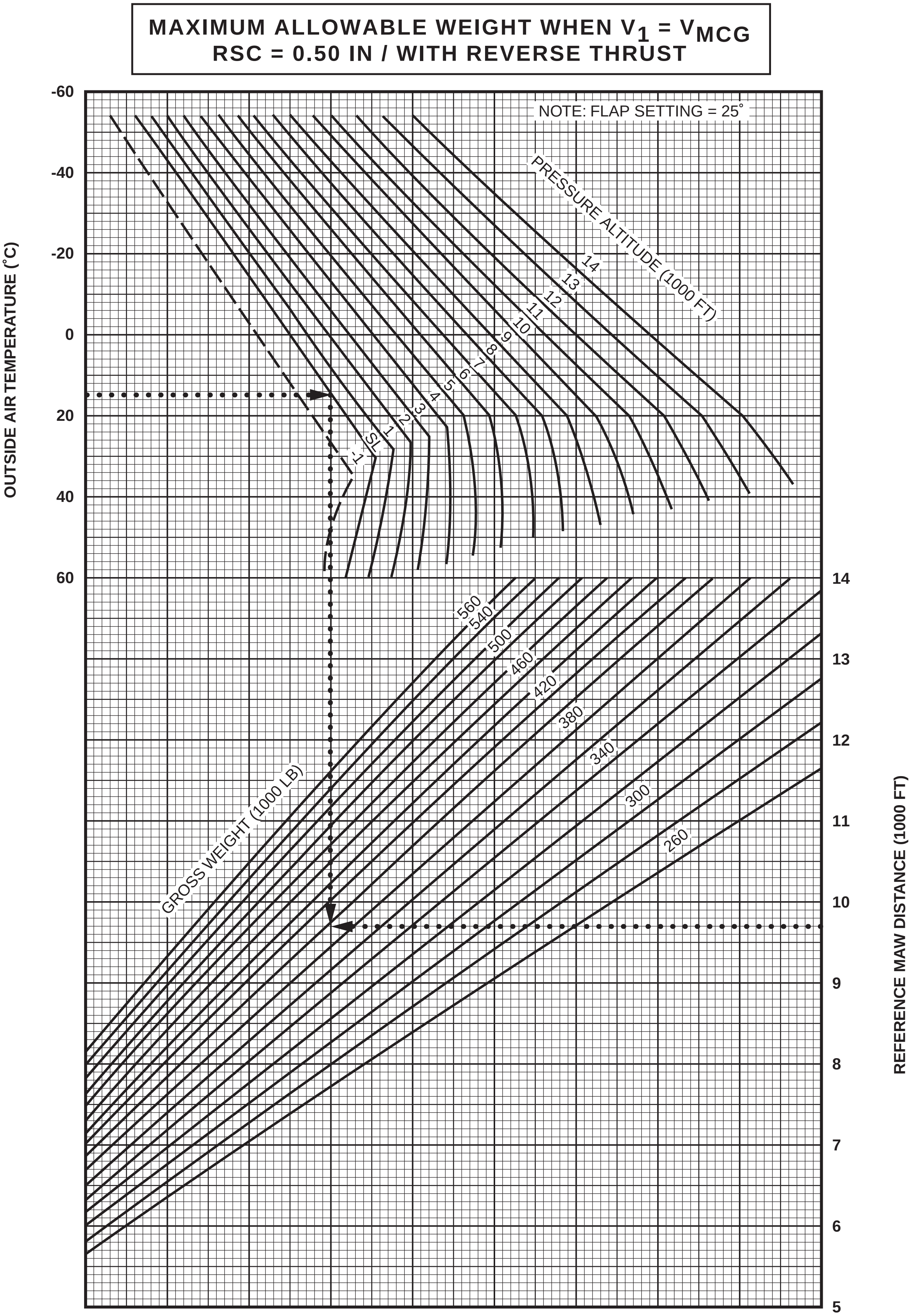


Figure 3-14F. (Sheet 1)

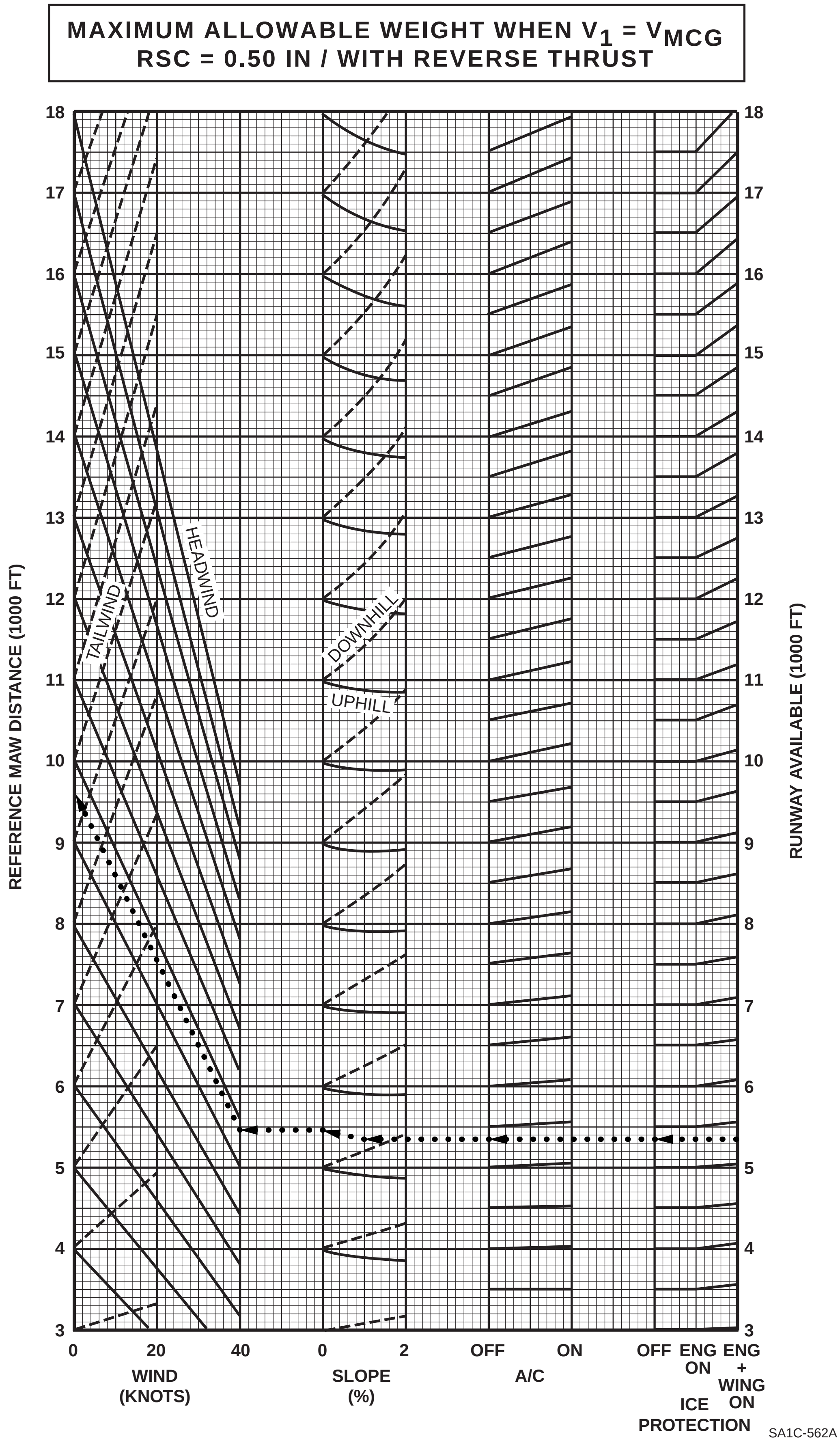


Figure 3-14F. (Sheet 2)

ROTATION SPEED, V_R

NOTE:
1. HARD SURFACE RUNWAY
2. APPLICABLE FOR ALL WINDS AND ICE PROTECTION BLEEDS
3. CORRECTED $V_R = V_R + \Delta V$
4. DATA PRESENTED AT CG = 8% MAC

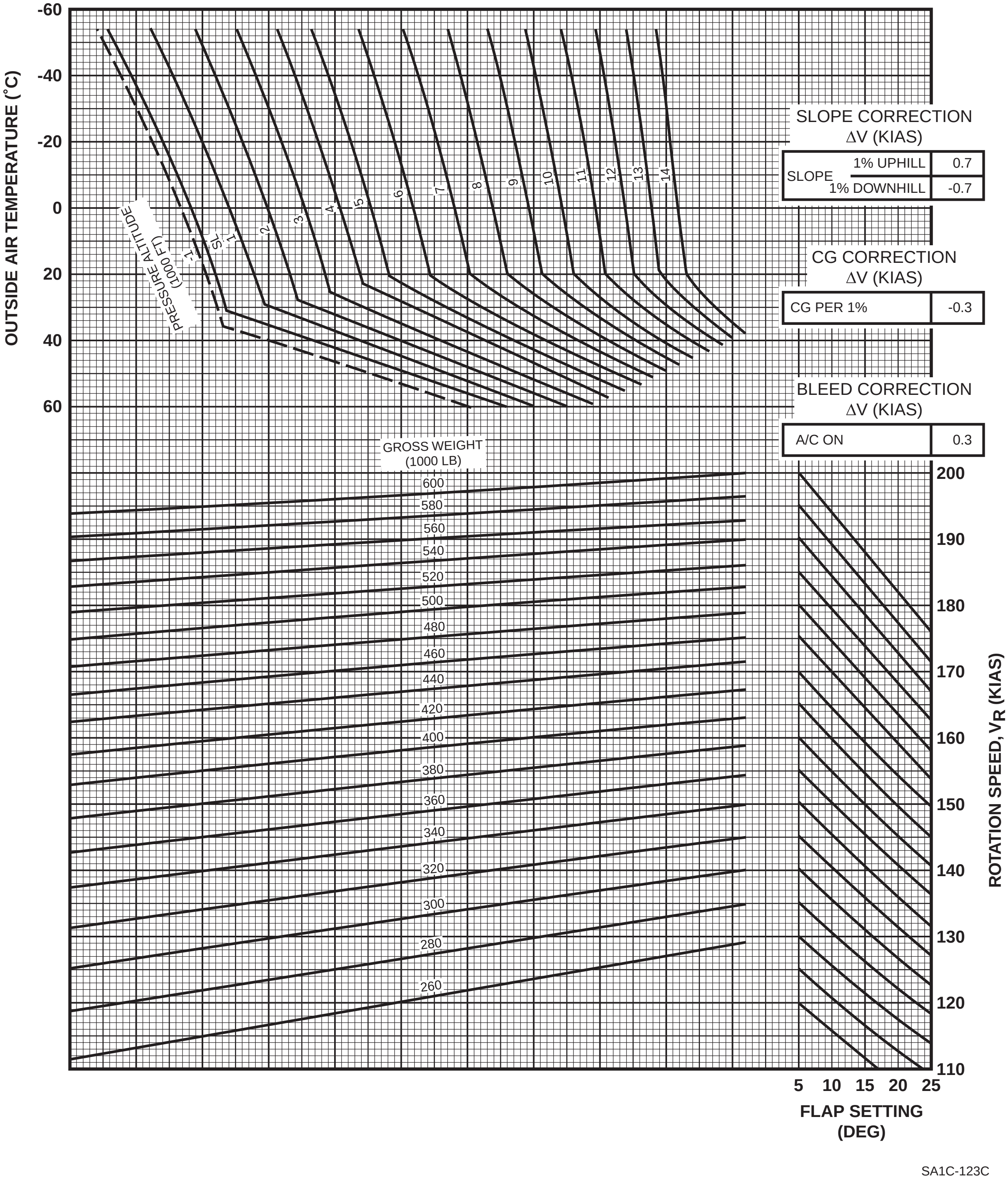
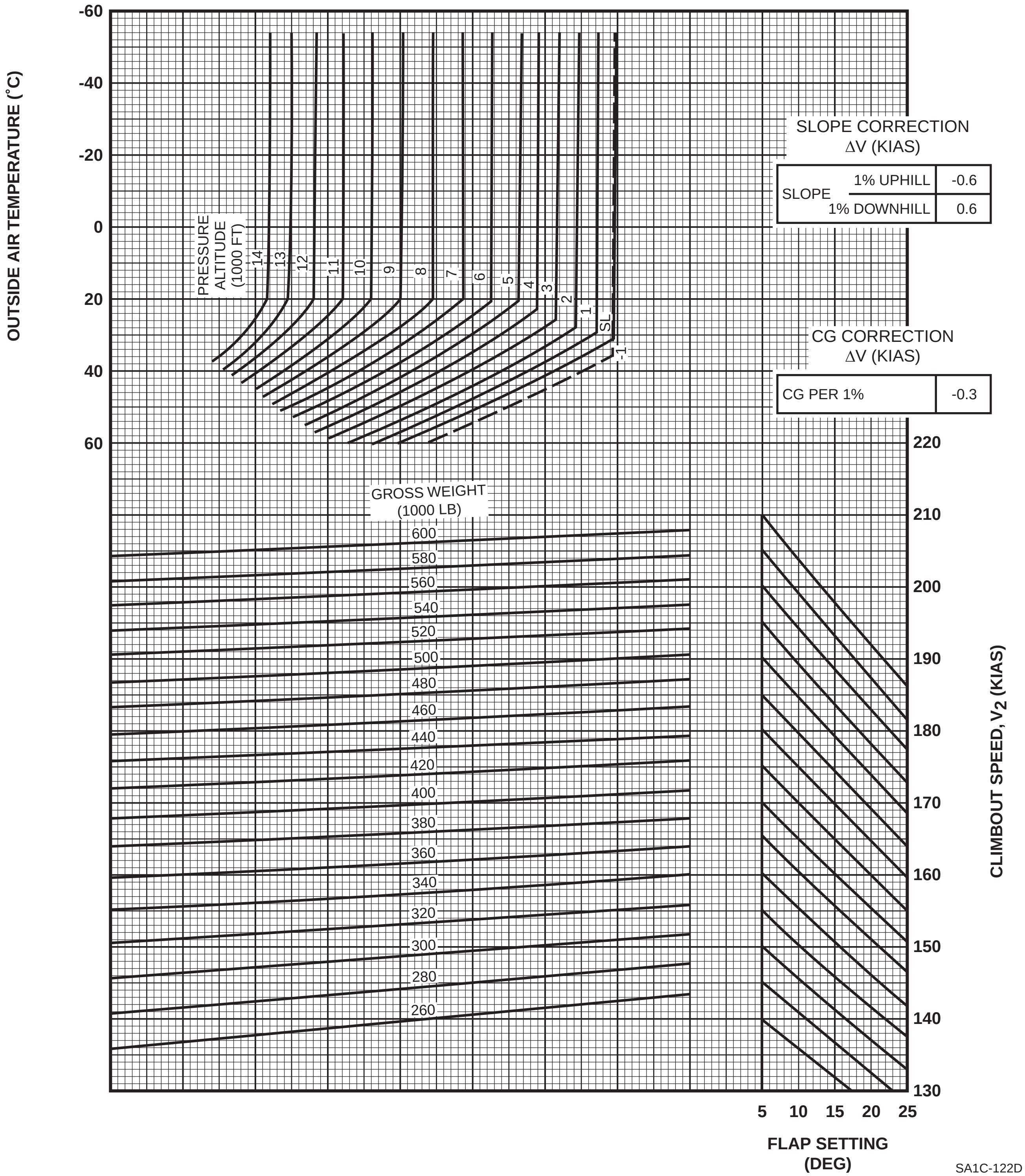


Figure 3-15.

CLIMBOUT SPEED, V_2

NOTE:
1. APPLICABLE FOR ALL WINDS AND ENGINE BLEEDS
2. CORRECTED $V_2 = V_2 + \Delta V$
3. DATA PRESENTED AT CG = 8% MAC



SLOPE CORRECTION ΔV (KIAS)

SLOPE	1% UPHILL	-0.6
	1% DOWNHILL	0.6

CG CORRECTION ΔV (KIAS)

CG PER 1%	-0.3

Figure 3-16.

FLAP AND SLAT RETRACTION SPEEDS AND MINIMUM MANEUVER SPEEDS

NOTE: SPEEDS ARE ONLY VALID TO 14,000 FT PA.

GROSS WEIGHT (1000 LB)	V_{FR} (KIAS)	V_{SR} (KIAS)	V_{MM} (KIAS)
600	210	258	294
590	208	256	292
580	207	253	289
570	205	251	287
560	203	249	284
550	201	247	282
540	199	244	279
530	197	242	277
520	195	240	274
510	194	238	271
500	192	235	268
490	190	233	266
480	188	230	263
470	186	228	260
460	184	226	257
450	182	223	255
440	180	221	252
430	178	218	249
420	176	216	246
410	174	213	243
400	172	210	240
390	170	208	237
380	167	205	234
370	165	202	231
360	163	200	228
350	160	197	225
340	158	194	222
330	156	191	219
320	153	188	215
310	151	185	212
300	149	182	208
290	146	179	204
280	144	176	201
270	141	173	197
260	138	170	194

SA1C-253C

Figure 3-17.

STABILIZER SETTING

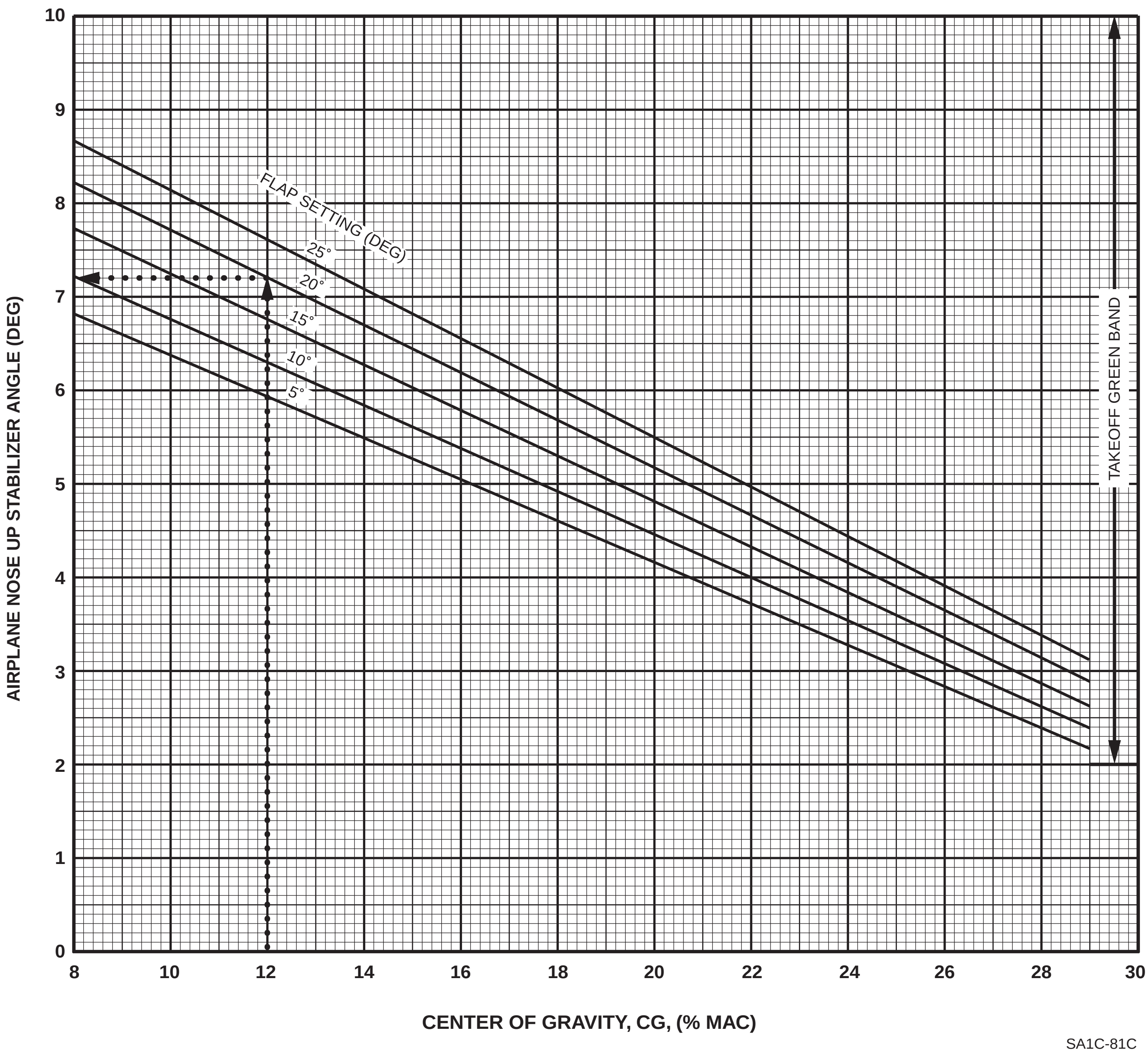


Figure 3-18.

PRESSURE HEIGHT FOR ACCELERATION

NOTE:
1. ONE ENGINE INOPERATIVE.
2. VALID FOR ALL FLAP SETTINGS.

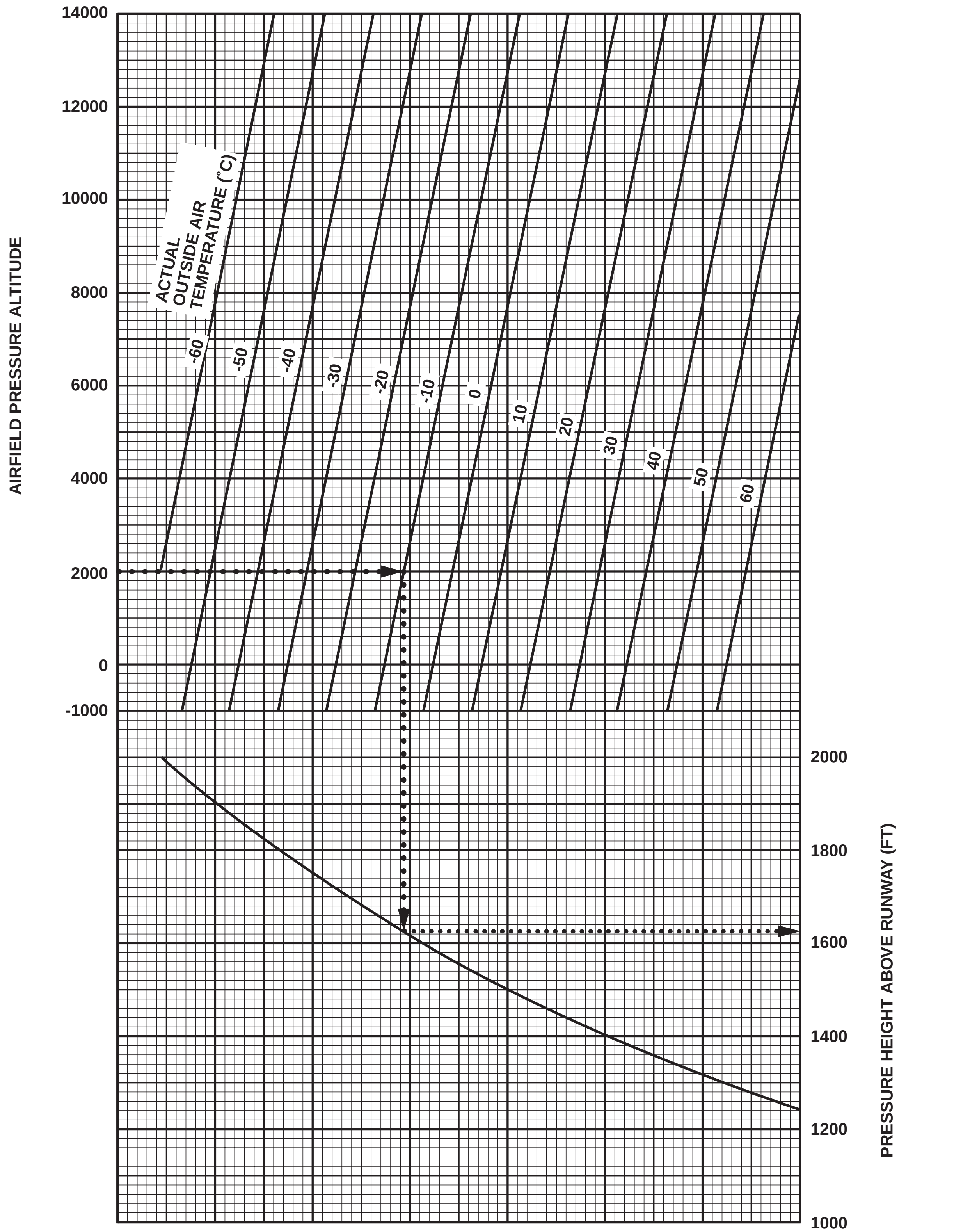


Figure 3-19.

N_1 SETTING FOR TAKEOFF THRUST SET BETWEEN 40 AND 80 KNOTS

NOTE:

1. ONE, TWO, OR THREE ENGINES OPERATING
2. ONE AIR-CONDITIONING PACK PER WING ENGINE "ON", LAVATORY AND GALLEY VENTILATION BLEEDS "ON", ENGINE ICE PROTECTION "ON" OR "OFF" AND WING ICE PROTECTION "OFF"
3. FOR OTHER BLEED CONDITIONS APPLY APPROPRIATE CORRECTIONS SHOWN
   A. ENGINE BLEED FOR AIR-CONDITIONING PACKS "OFF" AND LAVATORY AND GALLEY VENTILATION BLEEDS "ON" OR "OFF"
   F. WING ICE PROTECTION "ON"
4. FOR ENGINE ICE PROTECTION "ON", DECREASE N1 BY 0.5% IF OAT IS GREATER THAN 8°C.

CAUTION

- N1 SETTING NOT TO EXCEED 117%
- TAKEOFF THRUST SET BETWEEN 40 AND 80 KNOTS MAY NOT BE USED HIGHER THAN 2000 FT PRESSURE HEIGHT ABOVE THE AIRFIELD PRESSURE ALTITUDE

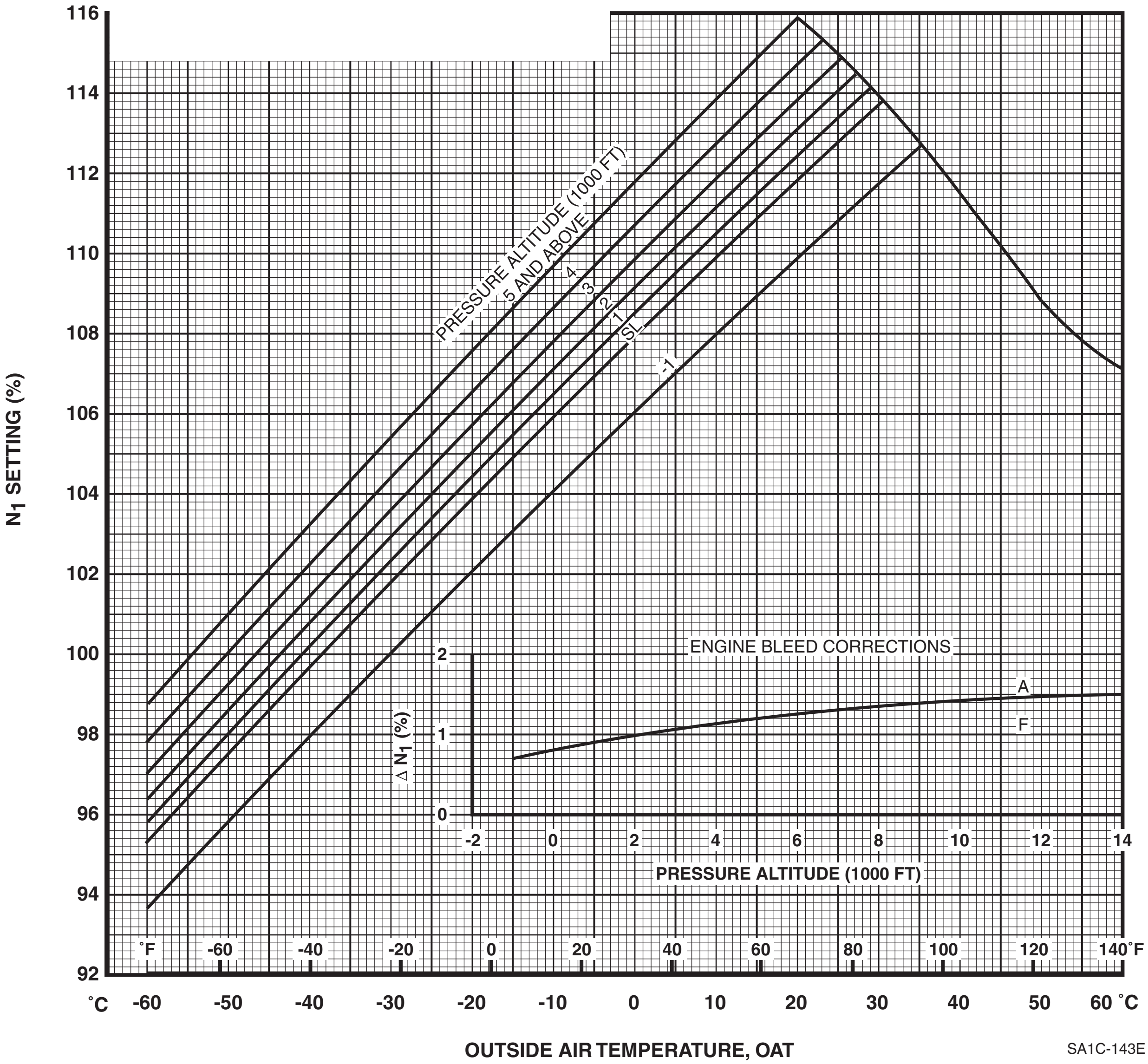


Figure 3-20.

REDUCED THRUST TAKEOFF N_1 SETTING

ASSUMED TEMP DEG C	OUTSIDE AIR TEMPERATURE - DEGREES C																	
	-40	-30	-20	-10	0	10	20	21	22	23	24	25	26	27	28	29	30	31
60	89.7	91.6	93.5	95.3	97.1	98.8	100.6	100.7	100.9	101.1	101.3	101.4	101.6	101.8	101.9	102.1	102.3	102.4
59	89.9	91.8	93.7	95.5	97.3	99.1	100.8	101.0	101.1	101.3	101.5	101.6	101.8	102.0	102.2	102.3	102.5	102.7
58	90.1	92.0	93.9	95.7	97.5	99.3	101.0	101.2	101.4	101.5	101.7	101.9	102.1	102.2	102.4	102.6	102.7	102.9
57	90.3	92.2	94.1	96.0	97.8	99.5	101.3	101.5	101.6	101.8	102.0	102.1	102.3	102.5	102.7	102.8	103.0	103.2
56	90.6	92.5	94.4	96.2	98.0	99.8	101.6	101.7	101.9	102.1	102.3	102.4	102.6	102.8	102.9	103.1	103.3	103.5
55	90.9	92.8	94.7	96.5	98.3	100.1	101.9	102.1	102.2	102.4	102.6	102.7	102.9	103.1	103.3	103.4	103.6	103.8
54	91.1	93.1	95.0	96.8	98.7	100.4	102.2	102.4	102.6	102.7	102.9	103.1	103.2	103.4	103.6	103.8	103.9	104.1
53	91.4	93.4	95.3	97.2	99.0	100.8	102.6	102.7	102.9	103.1	103.2	103.4	103.5	103.8	103.9	104.1	104.3	104.5
52	91.8	93.7	95.6	97.5	99.3	101.1	102.9	103.1	103.3	103.4	103.6	103.8	104.0	104.1	104.3	104.5	104.7	104.8
51	92.1	94.1	96.0	97.9	99.7	101.5	103.3	103.5	103.6	103.8	104.0	104.2	104.3	104.5	104.7	104.9	105.0	105.2
50	92.5	94.4	96.4	98.2	100.1	101.9	103.7	103.9	104.0	104.2	104.4	104.6	104.7	104.9	105.1	105.3	105.4	105.6
49	92.8	94.8	96.7	98.6	100.5	102.3	104.1	104.3	104.4	104.6	104.8	105.0	105.1	105.3	105.5	105.7	105.8	106.0
48	93.2	95.2	97.1	99.0	100.9	102.7	104.5	104.7	104.8	105.0	105.2	105.4	105.5	105.7	105.9	106.1	106.3	106.4
47	93.5	95.5	97.5	99.4	101.3	103.1	104.9	105.1	105.3	105.4	105.6	105.8	106.0	106.1	106.3	106.5	106.7	106.8
46	93.9	95.9	97.9	99.8	101.7	103.5	105.3	105.5	105.7	105.9	106.0	106.2	106.4	106.6	106.7	106.9	107.1	107.3
45	94.3	96.3	98.3	100.2	102.1	103.9	105.7	105.9	106.1	106.3	106.5	106.6	106.8	107.0	107.2	107.3	107.5	107.7
44	94.7	96.7	98.7	100.6	102.5	104.3	106.2	106.3	106.5	106.7	106.9	107.1	107.2	107.4	107.6	107.8	108.0	108.1
43	95.1	97.1	99.0	101.0	102.9	104.8	106.6	106.8	107.0	107.1	107.3	107.5	107.7	107.9	108.0	108.2	108.4	108.6
42	95.4	97.5	99.4	101.4	103.3	105.2	107.0	107.2	107.4	107.6	107.7	107.9	108.1	108.3	108.5	108.6	108.8	109.0
41	95.8	97.8	99.8	101.8	103.7	105.6	107.4	107.6	107.8	108.0	108.2	108.4	108.5	108.7	108.9	109.1	109.3	109.4
40	96.2	98.2	100.2	102.2	104.1	106.0	107.9	108.0	108.2	108.4	108.6	108.8	109.0	109.1	109.3	109.5	109.7	109.9
39	96.6	98.6	100.6	102.6	104.5	106.4	108.3	108.5	108.7	108.8	109.0	109.2	109.4	109.6	109.8	109.9	110.1	110.3
38	97.0	99.0	101.0	103.0	104.9	106.8	108.7	108.9	109.1	109.3	109.5	109.6	109.8	110.0	110.2	110.4	110.6	110.7
37	97.3	99.4	101.4	103.4	105.3	107.3	109.1	109.3	109.5	109.7	109.9	110.1	110.2	110.4	110.6	110.8	111.0	111.2
36	97.7	99.8	101.8	103.8	105.7	107.7	109.6	109.7	109.9	110.1	110.3	110.5	110.7	110.9	111.0	111.2	111.4	111.6
35	98.1	100.1	102.2	104.2	106.1	108.1	110.0	110.1	110.3	110.5	110.7	110.9	111.1	111.3	111.5	111.6	111.8	112.0
34	98.4	100.5	102.6	104.6	106.5	108.5	110.4	110.6	110.8	110.9	111.1	111.3	111.5	111.7	111.9	112.1	112.2	112.4
33	98.8	100.9	103.0	105.0	106.9	108.9	110.8	111.0	111.2	111.4	111.5	111.7	111.9	112.1	112.3	112.5	112.7	112.8
32	99.2	101.3	103.3	105.4	107.3	109.3	111.2	111.4	111.6	111.8	112.0	112.1	112.3	112.5	112.7	112.9	113.1	113.3
31	99.5	101.6	103.7	105.7	107.7	109.7	111.6	111.8	112.0	112.2	112.4	112.5	112.7	112.9	113.1	113.3	113.5	113.7
30	99.9	102.0	104.1	106.1	108.1	110.1	112.0	112.2	112.4	112.6	112.8	112.9	113.1	113.3	113.5	113.7	113.9	
29	100.2	102.4	104.4	106.5	108.5	110.5	112.4	112.6	112.8	113.0	113.2	113.3	113.5	113.7	113.9	114.1		
28	100.6	102.7	104.8	106.9	108.9	110.9	112.8	113.0	113.2	113.4	113.6	113.7	113.9	114.1	114.3			
27	100.9	103.1	105.2	107.2	109.2	111.2	113.2	113.4	113.6	113.8	113.9	114.1	114.3	114.5				
26	101.3	103.4	105.5	107.6	109.6	111.6	113.6	113.8	114.0	114.2	114.3	114.5	114.7					
25	101.6	103.8	105.9	108.0	110.0	112.0	114.0	114.2	114.4	114.5	114.7	114.9						
24	102.0	104.1	106.3	108.3	110.4	112.4	114.4	114.5	114.7	114.9	115.1							
23	102.3	104.5	106.6	108.7	110.8	112.8	114.7	114.9	115.1	115.3								
22	102.7	104.9	107.0	109.1	111.1	113.1	115.1	115.3	115.5									
21	103.0	105.2	107.4	109.5	111.5	113.5	115.5	115.7										
20	103.2	105.4	107.6	109.7	111.8	113.8	115.8											

EXAMPLE:

GIVEN: OAT = -20°C
ASSUMED TEMPERATURE = 41°C
PRESSURE ALTITUDE = 2,000 FT
ICE PROTECTION ON
AIR CONDITIONING ON

FIND: DERATED N_1 SETTING FOR TAKE-OFF

SOLUTION: DERATED N_1 SETTING FOR TAKEOFF = 102.0%

Note:

1. Valid from Sea Level to 14,000 feet
2. Data based on AC ON
3. The assumed temperature must be equal to or greater than the thrust flat rated (break) temperature at the respective altitude:

Altitude (ft)	°C	Altitude (ft)	°C
SL	30	3000	25
1000	29	4000	23
2000	27	5000 TO 14,000	20

4. If engine or engine and wing ice protection is required, reduce the assumed temperature by 3°C before determining the derated N_1
5. For wing ice protection ON, increase the N_1 by 1.0%.
6. Thrust is reduced approximately 1.8% per ΔN_1 where ΔN_1 is the difference between full thrust N_1 and the N_1 based on the assumed temperature
7. When using the TO FLX (Flexible Takeoff) Mode of the Thrust Computer, set the takeoff assumed temperature in the ASSUMED TEMP Selector. If engine anti-ice is used, set the assumed temperature used to determine the Reduced Thrust Takeoff N_1 Setting (i.e. 3°C less)

Figure 3-21. (Sheet 1)

REDUCED THRUST TAKEOFF N_1 SETTING

ASSUMED TEMP DEG C	OUTSIDE AIR TEMPERATURE - DEGREES C																		
	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
60	102.6	102.8	103.0	103.1	103.3	103.5	103.6	103.8	104.0	104.1	104.3	104.4	104.6	104.8	104.9	105.1	105.3	105.4	105.6
59	102.8	103.0	103.2	103.3	103.5	103.7	103.8	104.0	104.2	104.3	104.5	104.7	104.8	105.0	105.2	105.3	105.5	105.7	105.8
58	103.1	103.2	103.4	103.6	103.7	103.9	104.1	104.2	104.4	104.6	104.7	104.9	105.1	105.2	105.4	105.6	105.7	105.9	106.1
57	103.3	103.5	103.7	103.8	104.0	104.2	104.3	104.5	104.7	104.8	105.0	105.2	105.3	105.5	105.7	105.8	106.0	106.2	106.3
56	103.6	103.8	104.0	104.1	104.3	104.5	104.6	104.8	105.0	105.1	105.3	105.5	105.6	105.8	106.0	106.1	106.3	106.5	106.6
55	103.9	104.1	104.3	104.5	104.6	104.8	105.0	105.1	105.3	105.5	105.6	105.8	106.0	106.1	106.3	106.5	106.6	106.8	107.0
54	104.3	104.4	104.6	104.8	105.0	105.1	105.3	105.5	105.6	105.8	106.0	106.1	106.3	106.5	106.6	106.8	107.0	107.1	107.3
53	104.6	104.8	105.0	105.1	105.3	105.5	105.7	105.8	106.0	106.2	106.3	106.5	106.7	106.8	107.0	107.2	107.3	107.5	107.7
52	105.0	105.2	105.3	105.5	105.7	105.9	106.0	106.2	106.4	106.5	106.7	106.9	107.0	107.2	107.4	107.6	107.7	107.9	108.1
51	105.4	105.6	105.7	105.9	106.1	106.2	106.4	106.6	106.8	106.9	107.1	107.3	107.4	107.6	107.8	107.9	108.1	108.3	108.5
50	105.8	106.0	106.1	106.3	106.5	106.6	106.8	107.0	107.2	107.3	107.5	107.7	107.8	108.0	108.2	108.4	108.5	108.7	108.9
49	106.2	106.4	106.5	106.7	106.9	107.1	107.2	107.4	107.6	107.7	107.9	108.1	108.3	108.4	108.6	108.8	108.9	109.1	
48	106.6	106.8	105.9	107.1	107.3	107.5	107.6	107.8	108.0	108.2	108.3	108.5	108.7	108.8	109.0	109.2	109.4		
47	107.0	107.2	107.4	107.5	107.7	107.9	108.1	108.2	108.4	108.6	108.8	108.9	109.1	109.3	109.4	109.6			
46	107.5	107.6	107.8	108.0	108.2	108.3	108.5	108.7	108.9	109.0	109.2	109.4	109.5	109.7	109.9				
45	107.9	108.1	108.2	108.4	108.6	108.8	108.9	109.1	109.3	109.5	109.6	109.8	110.0	110.1					
44	108.3	108.5	108.7	108.8	109.0	109.2	109.4	109.5	109.7	109.9	110.1	110.2	110.4						
43	108.7	108.9	109.1	109.3	109.5	109.6	109.8	110.0	110.2	110.3	110.5	110.7							
42	109.2	109.4	109.5	109.7	109.9	110.1	110.3	110.4	110.6	110.8	111.0								
41	109.6	109.8	110.0	110.2	110.3	110.5	110.7	110.9	111.0	111.2									
40	110.0	110.2	110.4	110.6	110.8	110.9	111.1	111.3	111.5										
39	110.5	110.7	110.8	111.0	111.2	111.4	111.6	111.7											
38	110.9	111.1	111.3	111.5	111.6	111.8	112.0												
37	111.3	111.5	111.7	111.9	112.1	112.2													
36	111.8	112.0	112.1	112.3	112.5														
35	112.2	112.4	112.6	112.7															
34	112.6	112.8	113.0																
33	113.0	113.2																	
32	113.4																		

Note:

1. Valid from Sea Level to 14,000 feet.
2. Data based on A/C ON.
3. The assumed temperature must be equal to or greater then the thrust flat rated (break) temperature at the respective altitude:

ALTITUDE (FT)	°C	ALTITUDE (FT)	°C
SL	30	3000	25
1000	29	4000	23
2000	27	5000 TO 14,000	20

4. If engine or engine and wing ice protection is required, reduce the assumed temperature by 3°C before determining the derated N_1,
5. For wing ice protection ON, increase the N_1 by 1.0%.
6. Thrust is reduced approximately 1.8% per ΔN_1 where ΔN_1 is the difference between full thrust N_1 and the N_1 based on the assumed temperature.
7. When using the TO FLX (Flexible Takeoff) mode of the Thrust Computer, set the takeoff assumed temperature in the ASSUMED TEMP Selector. If engine anti-ice is used, set the assumed temperature used to determine the Reduced Thrust Takeoff N_1 Setting (i.e. 3°C less).

SA1C-179E

Figure 3-21. (Sheet 2)

CONVERSION FROM GRADIENT TO RATE OF CLIMB IN FT/MINUTE

NOTE:
1. USE AIRSPEED CALIBRATION CURVES IN SECTION XII TO OBTAIN CALIBRATED AIRSPEED.
2. USE FIGURE 3-23 TO CONVERT CLIMB GRADIENT FROM PERCENT GRADIENT TO FT/NM.

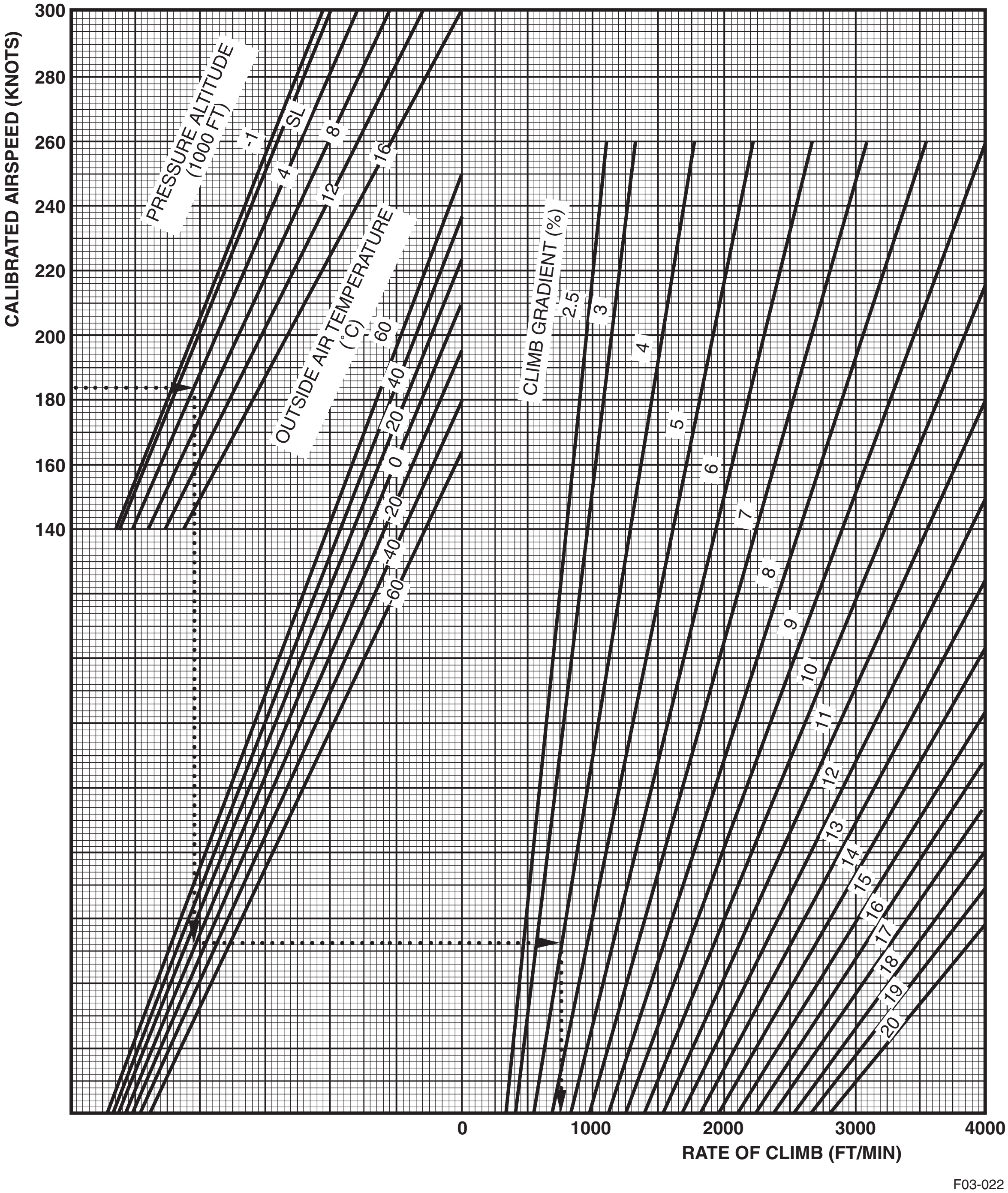


Figure 3-22.

ALL ENGINE CLIMB GRADIENT
TAKEOFF RATED THRUST

NOTE:
1. ALL ENGINES OPERATING AT TAKEOFF THRUST.
2. SLATS EXTENDED AND GEAR UP.
3. CLIMB SPEED = V_2 +10 KIAS.
4. USE FIGURE 3-23 TO CONVERT GRADIENT FROM % TO FT/NM.

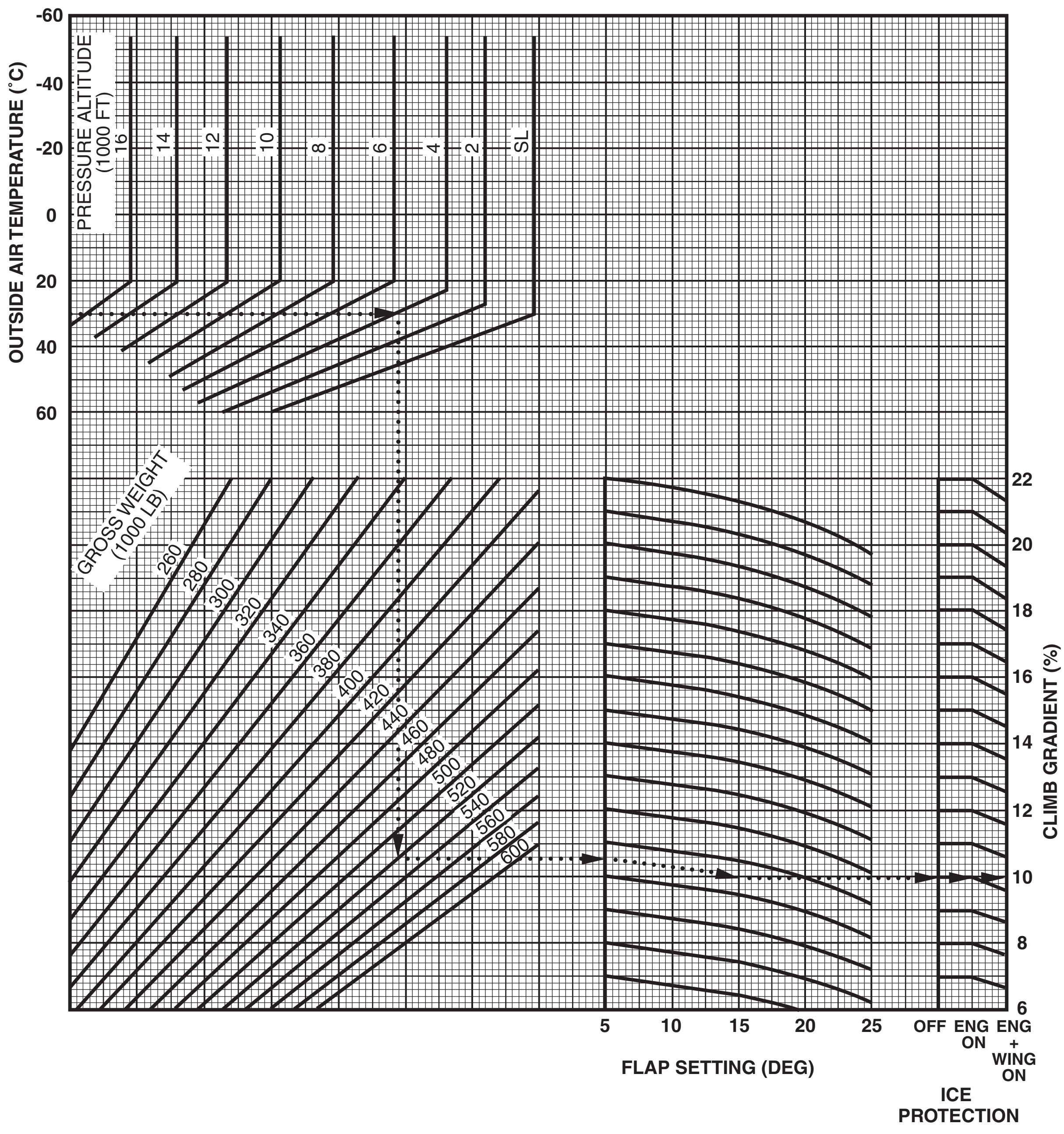


Figure 3-22A.

ALL ENGINE CLIMB GRADIENT MAXIMUM CLIMB THRUST

NOTE:
1. ALL ENGINES OPERATING AT MAXIMUM CLIMB THRUST.
2. FLAPS & SLATS RETRACTED AND GEAR UP.
3. CLIMB SPEED = V_{SR}.
4. USE FIGURE 3-23 TO CONVERT GRADIENT FROM % TO FT/NM.

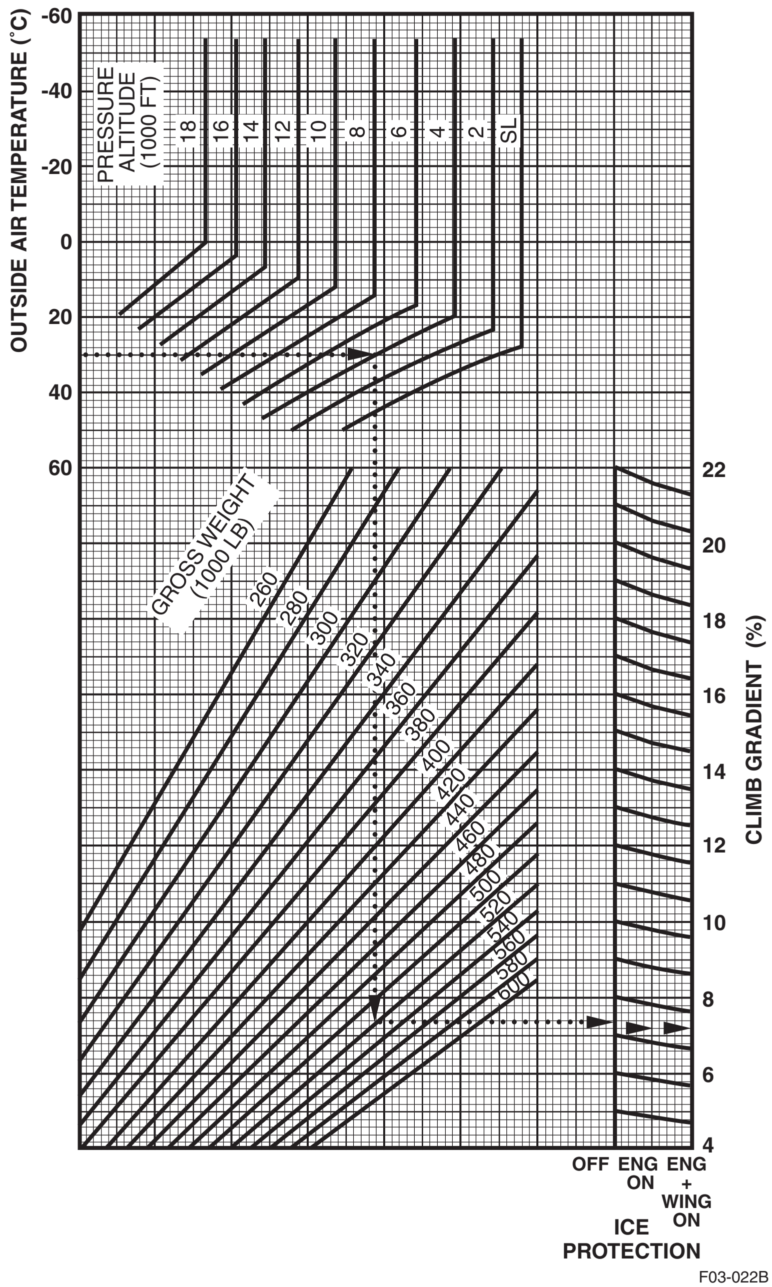


Figure 3-22B.

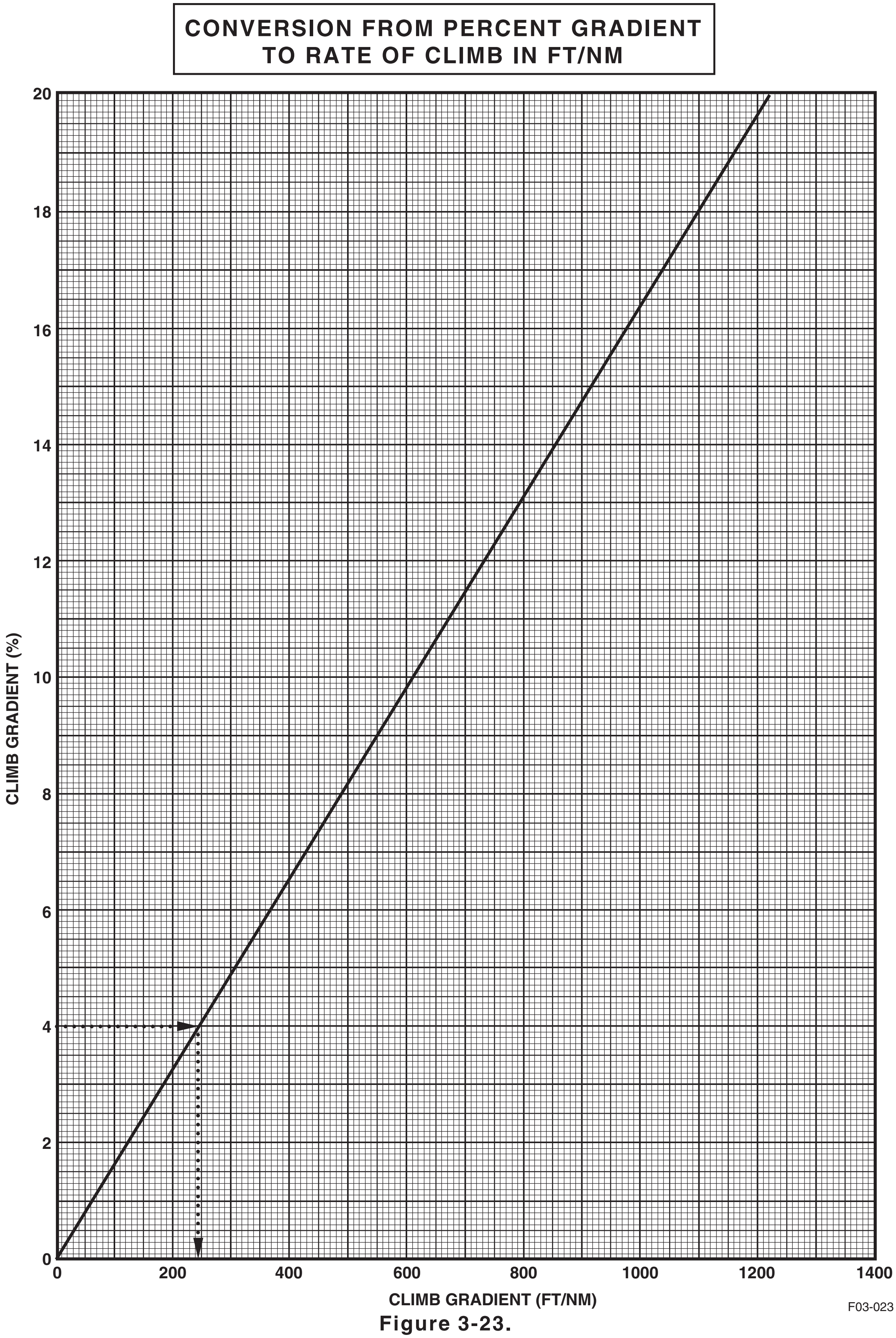
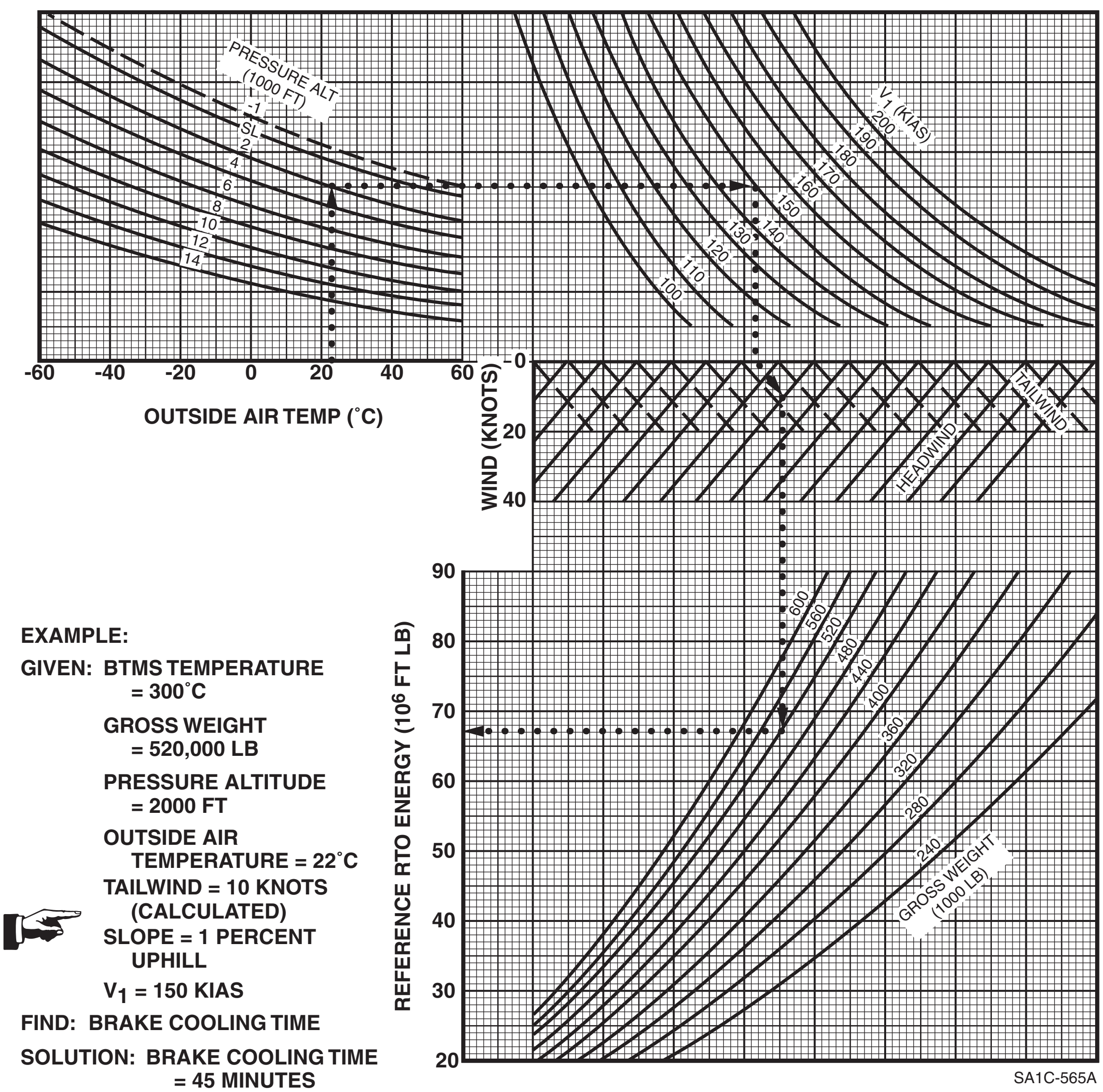

CONVERSION FROM PERCENT GRADIENT TO RATE OF CLIMB IN FT/NM
CLIMB GRADIENT (%)
0
2
4
6
8
10
12
14
16
18
20
CLIMB GRADIENT (FT/NM)
0
200
400
600
800
1000
1200
1400
F03-023

Figure 3-23.

BRAKE-COOLING TIME

NOTE:

1. READ BTMS AFTER PEAK VALUE IS REACHED (APPROXIMATELY 15-20 MINUTES AFTER LANDING)
2. SPOILERS DEPLOYED
3. NO REVERSE THRUST
4. CENTER GEAR EXTENDED
5. ALL BRAKES OPERATING
6. DOWNHILL SLOPE CORRECTION IS BASED ON RCR = 23. FOR RCR < 23 BUT RCR ≥ 10 DOUBLE THE DOWNHILL SLOPE CORRECTION. WHEN RCR < 10 OR WHEN THERE IS A RSC, TRIPLE THE DOWNHILL SLOPE CORRECTION.
7. VALID FOR ALL FLAP SETTINGS
8. ALWAYS USE ACTUAL OUTSIDE AIR TEMPERATURE



EXAMPLE:

GIVEN: BTMS TEMPERATURE = 300˚C

GROSS WEIGHT = 520,000 LB

PRESSURE ALTITUDE = 2000 FT

OUTSIDE AIR TEMPERATURE = 22˚C

TAILWIND = 10 KNOTS (CALCULATED)

SLOPE = 1 PERCENT UPHILL

V_1 = 150 KIAS

FIND: BRAKE COOLING TIME

SOLUTION: BRAKE COOLING TIME = 45 MINUTES

Figure 3-24. (Sheet 1)

BRAKE-COOLING TIME

NOTE:

1. READ BTMS AFTER PEAK VALUE IS REACHED (APPROXIMATELY 15-20 MINUTES AFTER LANDING)
2. SPOILERS DEPLOYED
3. NO REVERSE THRUST
4. CENTER GEAR EXTENDED
5. ALL BRAKES OPERATING
6. DOWNHILL SLOPE CORRECTION IS BASED ON RCR = 23. FOR RCR < 23 BUT RCR ≥ 10 DOUBLE THE DOWNHILL SLOPE CORRECTION. WHEN RCR < 10 OR WHEN THERE IS A RSC, TRIPLE THE DOWNHILL SLOPE CORRECTION
7. VALID FOR ALL FLAP SETTINGS
8. ALWAYS USE ACTUAL OUTSIDE AIR TEMPERATURE

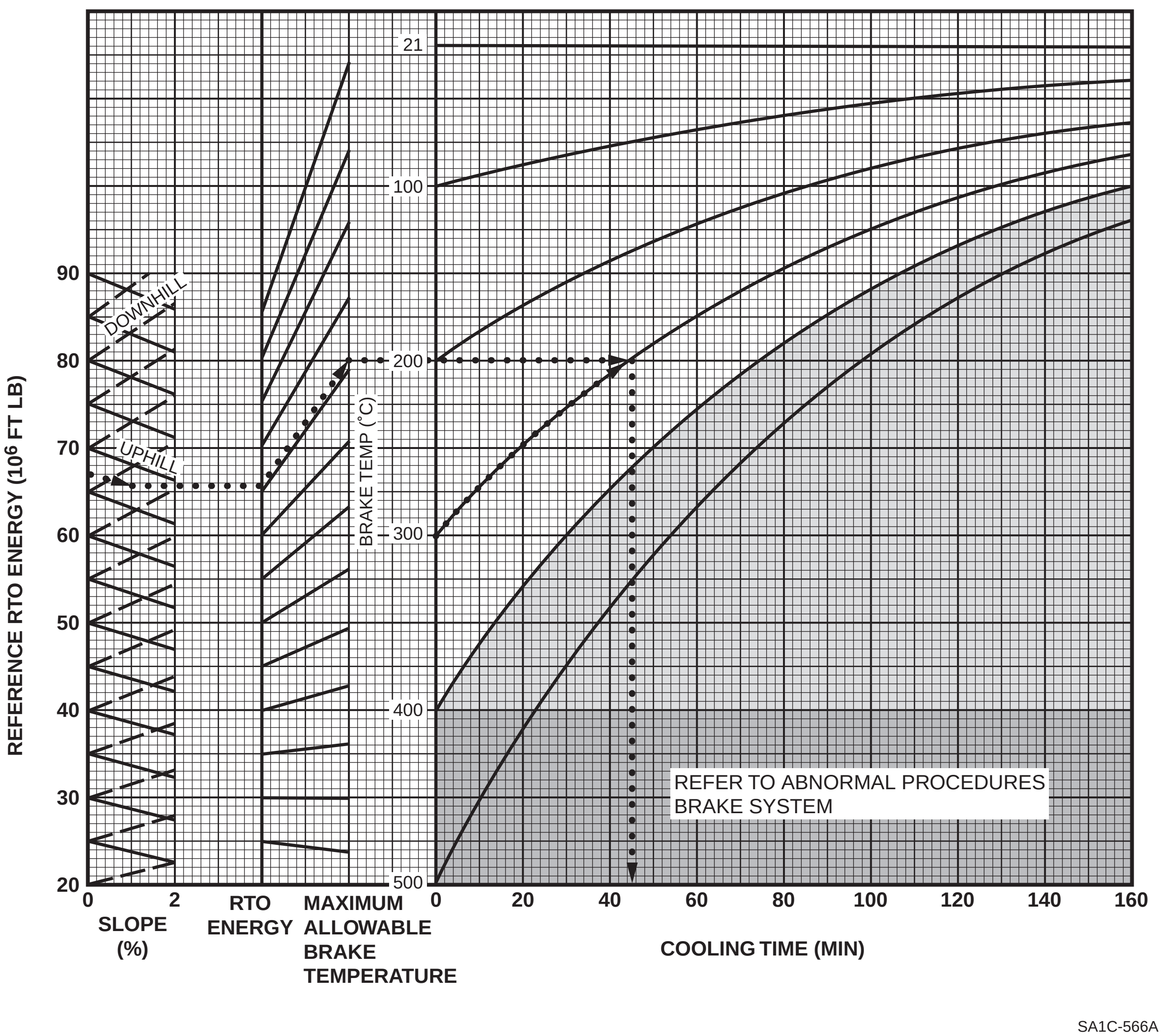


Figure 3-24. (Sheet 2)

MODEL: KC-10A
ENGINES: CF6-50C2
DATE: 1 OCTOBER 1983
DATA BASIS: FLIGHT TEST

BRAKE ENERGY

NOTE:
1. CENTER GEAR EXTENDED
2. ALL BRAKES OPERATING
3. SPOILERS DEPLOYED
4. NO REVERSE THRUST
5. DOWNHILL SLOPE CORRECTION IS BASED ON RCR = 23. FOR RCR < 23 BUT RCR ≥ 10 DOUBLE THE DOWNHILL SLOPE CORRECTION. WHEN RCR < 10 OR WHEN THERE IS A RSC, TRIPLE THE DOWNHILL SLOPE CORRECTION
6. VALID FOR ALL FLAP SETTINGS
7. USE BTMS TEMPERATURE PRIOR TO BRAKE APPLICATION.
8. IF THE BTMS IS INOPERATIVE, ASSUME AN INITIAL BTMS TEMPERATURE IS 100°C
9. ALWAYS USE ACTUAL OUTSIDE AIR TEMPERATURE
10. USE ACTUAL WIND CONDITIONS

EXAMPLE:
GIVEN:
INITIAL BTMS TEMPERATURE = 100°C
GROSS WEIGHT = 520,000 LB
PRESSURE ALTITUDE = 2000 FT
OUTSIDE AIR TEMPERATURE = 22°C
TAILWIND = 10 KNOTS
SLOPE = 1 PERCENT UPHILL
BRAKE INITIATION SPEED = 150 KIAS
FIND:
BRAKE-LIMITATION ZONE
SOLUTION:
DANGER ZONE

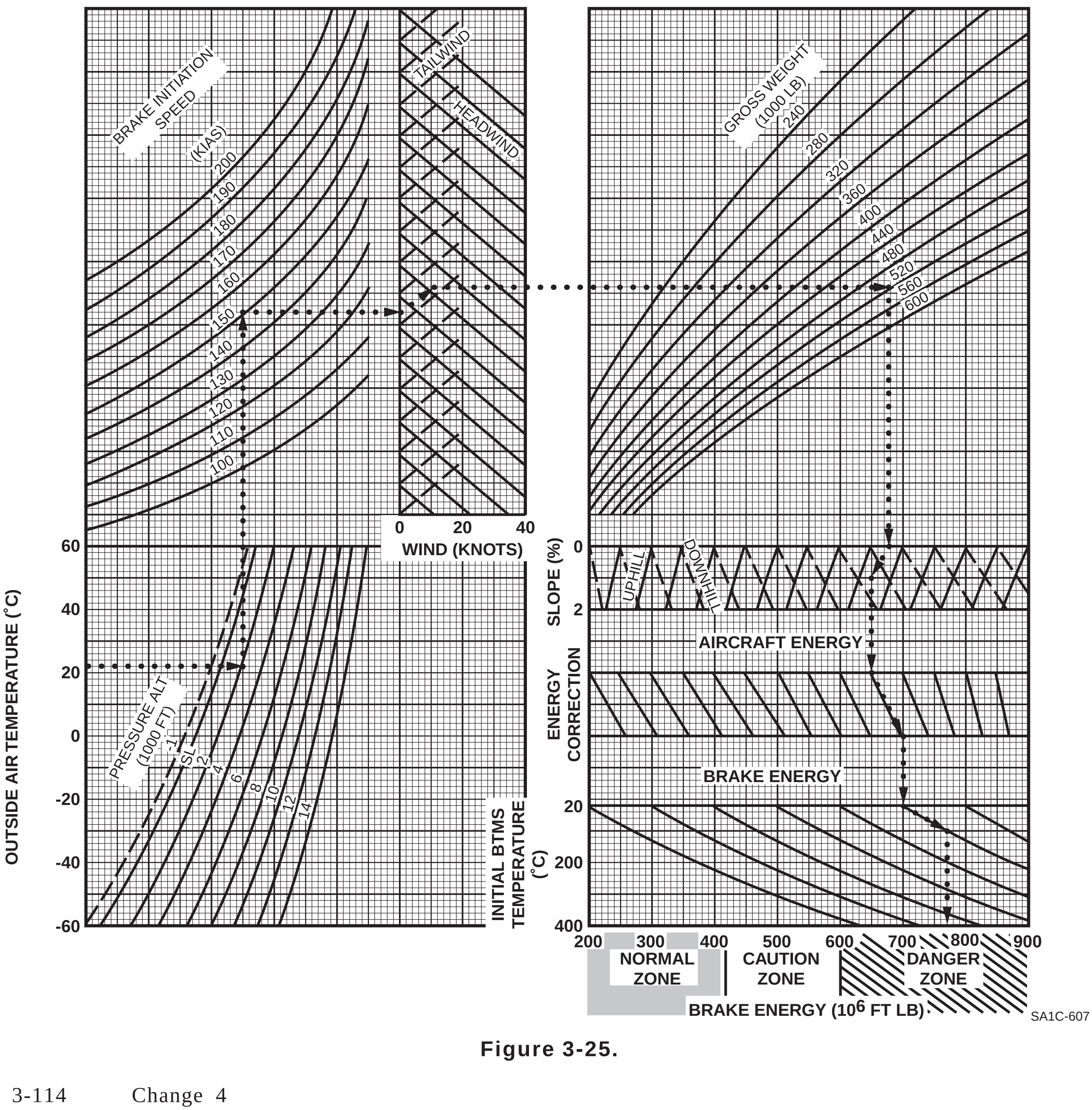


Figure 3-25.

SECTION IV

CLIMB

TABLE OF CONTENTS

Page

LIST OF CHARTS

LIST OF CHARTS (Continued)

INTRODUCTION

The climb charts in this section provide information necessary for planning airplane climb performance. Values of fuel, distance and time to climb, and recommended climb speeds may be obtained for climb to all altitudes up to the service ceiling. The effect of drag index on fuel, distance and time to climb, and on all service ceiling is also shown. All climb data are based on flight test results. The fuel consumption values provided are increased by five percent relative to the engine specification level.

DEFINITION OF TERMS

CLIMB SPEED SCHEDULE

The climb speed schedule is defined as the speed schedule used to achieve the climb performance provided in this section. The climb speeds below 10,000 feet are shown versus gross weight in figure 4-1 and are based on 250 KIAS or the minimum manuever speed, whichever is higher. The climb speeds above 10,000 feet are as follows:

Three engine climb - 330 KIAS up to 27,402 feet, then at Mach = 0.82

Two engine climb - 300 KIAS up to 27,993 feet, then at Mach = 0.76

SERVICE CEILING

The service ceiling is defined as the highest altitude at which a 100 feet per minute rate of climb can be maintained at a given gross weight and temperature using rated thrust at the recommended climb speed. Three engine service ceiling is based on maximum climb thrust and two engine service ceiling is based on maximum continuous thrust.

CRUISE CEILING

Cruise ceiling is defined as the highest altitude at which a 300 feet per minute rate of climb can be maintained at a given gross weight and temperature using rated thrust at the recommended climb speed. Three engine cruise ceiling is based on maximum cruise thrust and two engine cruise ceiling is based on maximum continuous thrust.

OPTIMUM ALTITUDE

For a given gross weight and airspeed, the optimum altitude is that altitude at which the airplane achieves the greatest specific range.

NORMAL BLEED

Normal bleed includes bleed air for all A/C packs operational, lavatory and galley ventilation, and shaft-power extraction for airplane hydraulic and electrical power requirements.

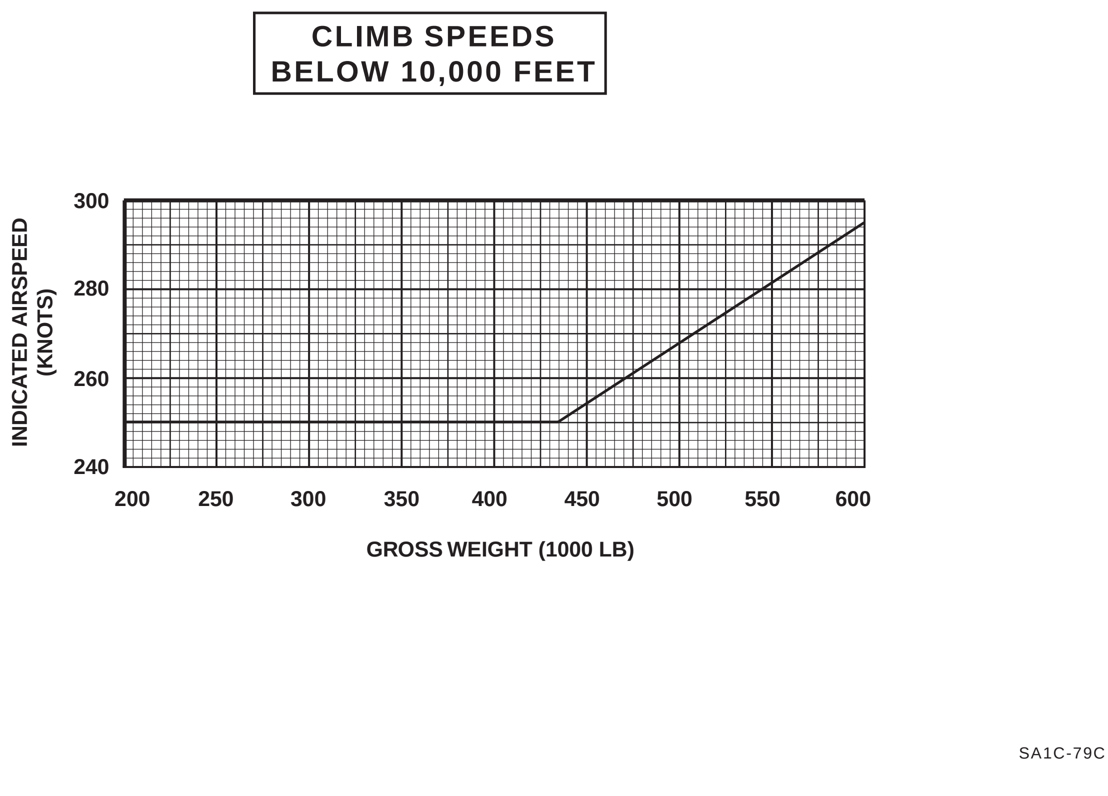


Figure 4-1. Climb Speeds Below 10,000 Feet

FACTORS AFFECTING CLIMB PERFORMANCE

TEMPERATURE

Changes in temperature are critical to the climb performance since it directly affects the engine thrust level. The effects of changes in the outside air temperature are presented on each chart by means of temperature correction grids. The grids give a ±20°C temperature deviation from standard day.

DRAG INDEX (DI)

Data presented in this section are based on a clean configuration, DI=0. Any increase in drag will result in a reduction in the climb performance. Drag index values for non-standard configurations are presented in Section I.

AIRSPEED

The speed at which maximum rate of climb is obtained varies with gross weight and altitude due to variations in drag and thrust. However, the benefits obtained by using a climb schedule during which airspeed is constantly changing are minimal and are negated by the impracticality of operation. For this reason, the climb speed schedules were selected as the best single airspeed/Mach number for overall climb operations. A ±10 knot variance in speed has a negligible effect on climb performance.

ENGINE BLEED

The use of engine anti-ice protection when the engine anti-ice shutoff valves are inoperative in the open position (MEL item) requires the following corrections to ice protection off performance when outside air temperature is above 8°C.

For one or more engine cowl anti-ice valves inoperative in the open position, the N_1 correction for Engine Anti-Ice "On" is applied to all engines. Limiting climb weights must be reduced by 3.0%. All climb speeds must correspond to actual climb weight.

WIND VELOCITY

The distance to climb is affected by wind velocity due to the change in groundspeed. Tailwinds increase the groundspeed, thus increasing the distance to climb. Headwinds reduce the distance to climb.

Correction grids are provided on the distance to climb charts for winds of ±100 knots. Headwind is defined as negative and tailwind is defined to be positive. Fuel and time to climb are unaffected by wind.

TAKEOFF ALLOWANCE

Typical fuel, distance and time required from brake release to 2,000 feet, including cleanup and acceleration to the climb speed, are as follows:

Three engine operation, 2,500 pounds, 8 nautical miles, and 2.5 minutes.

Two engine operation: 4,000 pounds, 16 nautical miles, and 5.5 minutes

All the above allowances are not included in the climb charts.

CHART EXPLANATION AND EXAMPLE PROBLEMS

N_1 SETTING

Figures 4-2, 4-3, and 4-4 present the N_1 settings for the Maximum Continuous Thrust, Maximum Climb Thrust, and Maximum Cruise Thrust ratings, respectively. See Section II for chart explanation.

FUEL, DISTANCE AND TIME TO CLIMB

Fuel, distance and time to climb data are provided for three engine climb in figures 4-5 through 4-7. For derated climb, see figures 12-89 through 12-91, and for two engine climb, figures 4-11 through 4-13. Three engine climb is at Maximum Climb Thrust, derated climb is at Maximum Cruise Thrust until the rate of climb decreases to 500 feet per minute and then at Maximum Climb Thrust. Two engine climb is at Maximum Continuous Thrust. The speed schedule is shown in each chart as are the optimum cruise altitude and standard day cruise and service ceiling data. Tabular fuel, distance and time to climb data are provided in figures 4-14 through 4-16 for standard day, zero wind condition.

For climbs starting from sea level, enter the charts at the start of climb gross weight and follow the gross weight guidelines up to the desired altitude to find the values of fuel, distance or time at that altitude.

NOTE

- Two separate 10,000 feet altitude lines are presented in each of the fuel, distance and time to climb charts. This represents the fuel, distance and time required to accelerate from the climb speed below 10,000 feet to the climb speed used above 10,000 feet.
- Charted climb data need not be corrected for takeoff allowances due to negligible effects.

Example 1:

Given:

Initial Climb Weight = 410,000 Pounds

Start of Climb Altitude = Sea Level

Zero Wind

Temperature = Std +10°C

Find:

Fuel, Distance and Time to Climb to 32,000 Feet with All Engines Operating

Solution:

Enter the Fuel to Climb chart, figure 4-5, with the initial climb weight, proceeding along a path parallel to the gross weight guidelines up to 32,000 feet altitude. Use correction grids for necessary temperature and wind deviations and read a value for fuel burned of 8,800 pounds. In a similar manner, the values for distance to climb and time to climb may be determined from figures 4-6 and 4-7, respectively, to be 91.0 nautical miles and 13.4 minutes.

For climbs from initial altitudes other than sea level or for step climbs between two cruise altitudes, enter the charts at the gross weight at the start of climb and read vertically (not along the gross weight guidelines) to the initial climb altitude. Determine the fuel, distance and time at this altitude. Then proceed following the gross weight guidelines to the final climb altitude and determine the fuel, distance and time at this altitude. The differences between the initial and final values are the fuel, distance and time required to climb from the initial to the final altitude.

Example 2:

Given:

Gross Weight = 370,000 Pounds

Temperature = Std Day

Headwind = 50 Knots

Initial Climb Altitude = 15,000 Feet

Final Climb Altitude = 30,000 Feet

Number of Operating Engines = 2

Find:

Fuel, Distance and Time Required to Climb

Solution:

Enter the two engine Fuel to Climb chart, figure 4-11, at 370,000 pounds and read vertically to 15,000 feet. The fuel to climb value at this condition is 4,200 pounds. Follow the gross weight guidelines (which account for fuel burned while climbing) from 15,000 feet to 30,000 feet and read the fuel to climb value of 10,300 pounds. The difference between the fuel to climb value at 30,000 feet and the fuel to climb value at 15,000 feet is the fuel required to climb between the two altitudes.

For this problem, the fuel to climb is 6,100 pounds.

Values for distance to climb and time to climb are found in a similar manner. The distance value must be corrected for a 50 knot headwind. The value for distance to climb, from figure 4-12, is 90 nautical miles and the time to climb, from figure 4-13, is 16 minutes.

SERVICE CEILING

Three engine and two engine service ceiling data are presented in figures 4-17 through 4-20. These charts provide the capability for determining service ceiling for various temperatures, weights and drag index configurations. Linearly interpolate figures 4-17 and 4-18 or 4-19 and 4-20 for temperatures between Std +10°C and Std +20°C.

Example 3:

Given:

Gross Weight = 500,000 Pounds

Temperature = Std +20°C

Drag Index = 55

Find:

Service Ceiling for Three Engine Operation

Solution:

Use figure 4-18 to obtain data for three engine operation at Std +20°C. Enter with a drag index of 55 and read up to the 500,000 pound gross weight line. The service ceiling is found to be 34,600 feet.

EFFECT OF DRAG INDEX

The effect of drag index on the fuel, distance and time required to climb may be accounted for by first determining the fuel, distance and time values based on zero drag index and then using the appropriate effect of drag index chart to adjust the value to the correct drag index.

Figure 4-21 may be used in conjunction with figures 4-5 through 4-7 to account for drag index on three engines operating fuel, distance and time to climb, and figure 4-22 may be used in conjunction with figures 4-11 through 4-14 for two engines operating data.

NOTE

> Three engine drag index data are not applicable to the derated schedule. Flying the derated climb schedule with non-zero drag index values is not recommended.

Example 4:

Given:

Fuel to Climb = 8,800 LB @ DI=0

Distance to Climb = 91 NM @ DI=0

Time to Climb = 13.4 Min @ DI=0

Drag Index = 50

Find:

Fuel, Distance and Time to Climb with Three Engines Operating

Solution:

Enter the drag index correction grids for fuel, distance and time to climb presented in figure 4-21 with the given DI=0 values for fuel, distance and time. Correct for a drag index of 50 by following the guidelines. The corrected values for fuel, distance and time to climb are as follows:

Fuel = 11,500 Pounds
Dist = 116 NM
Time = 17.4 Minutes

N_1 SETTING FOR MAXIMUM CONTINUOUS THRUST

NOTE:

1. ONE OR TWO ENGINES OPERATING INFLIGHT SETTING OR FOR USE DURING REFUELING.
2. ONE AIR CONDITIONING PACK PER WING ENGINE "ON" LAVATORY AND GALLEY VENTILATION BLEEDS "ON" AND ENGINE AND WING ICE PROTECTION "OFF".
3. FOR OTHER ENGINE BLEED CONDITIONS APPLY APPROPRIATE CORRECTIONS SHOWN.
   - A. ENGINE BLEED FOR AIR CONDITIONING PACKS "OFF" AND LAVATORY AND GALLEY VENTILATION BLEEDS "ON" OR "OFF"
   - B. ENGINE ICE PROTECTION "ON"
   - C. ENGINE AND WING ICE PROTECTION "ON"
   - D. ENGINE AND WING ICE PROTECTION "ON" WITH ONE WING ENGINE INOPERATIVE

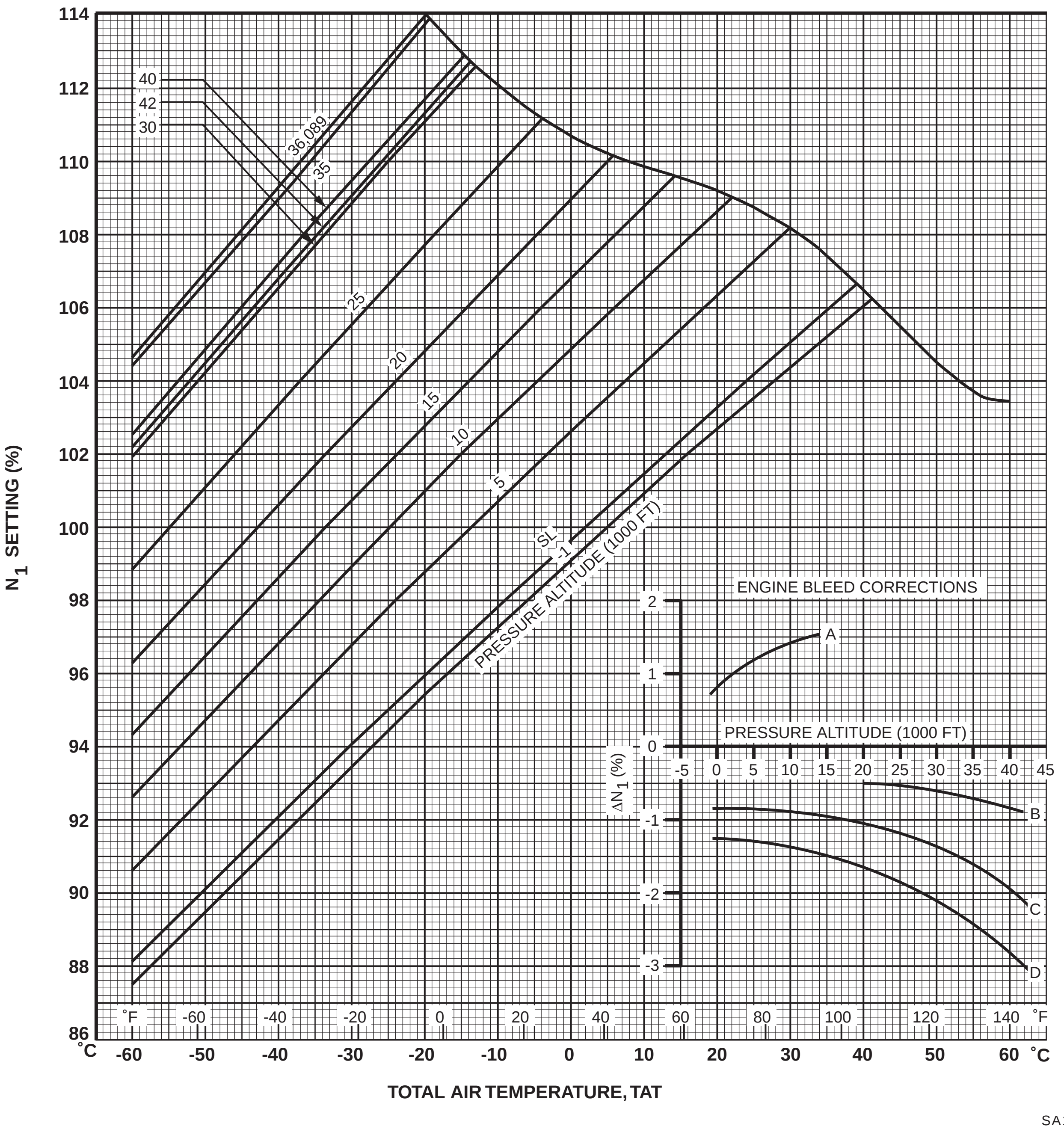


Figure 4-2.

N_1 SETTING FOR MAXIMUM CLIMB THRUST

NOTE:

1. TWO OR THREE ENGINES OPERATING INFLIGHT SETTING
2. ONE AIR-CONDITIONING PACK PER WING ENGINE "ON" AND ENGINE AND WING ICE PROTECTION "OFF"
3. FOR OTHER ENGINE BLEED CONDITIONS APPLY APPROPRIATE CORRECTIONS SHOWN

   B. ENGINE ICE PROTECTION "ON"

   C. ENGINE AND WING ICE PROTECTION "ON"

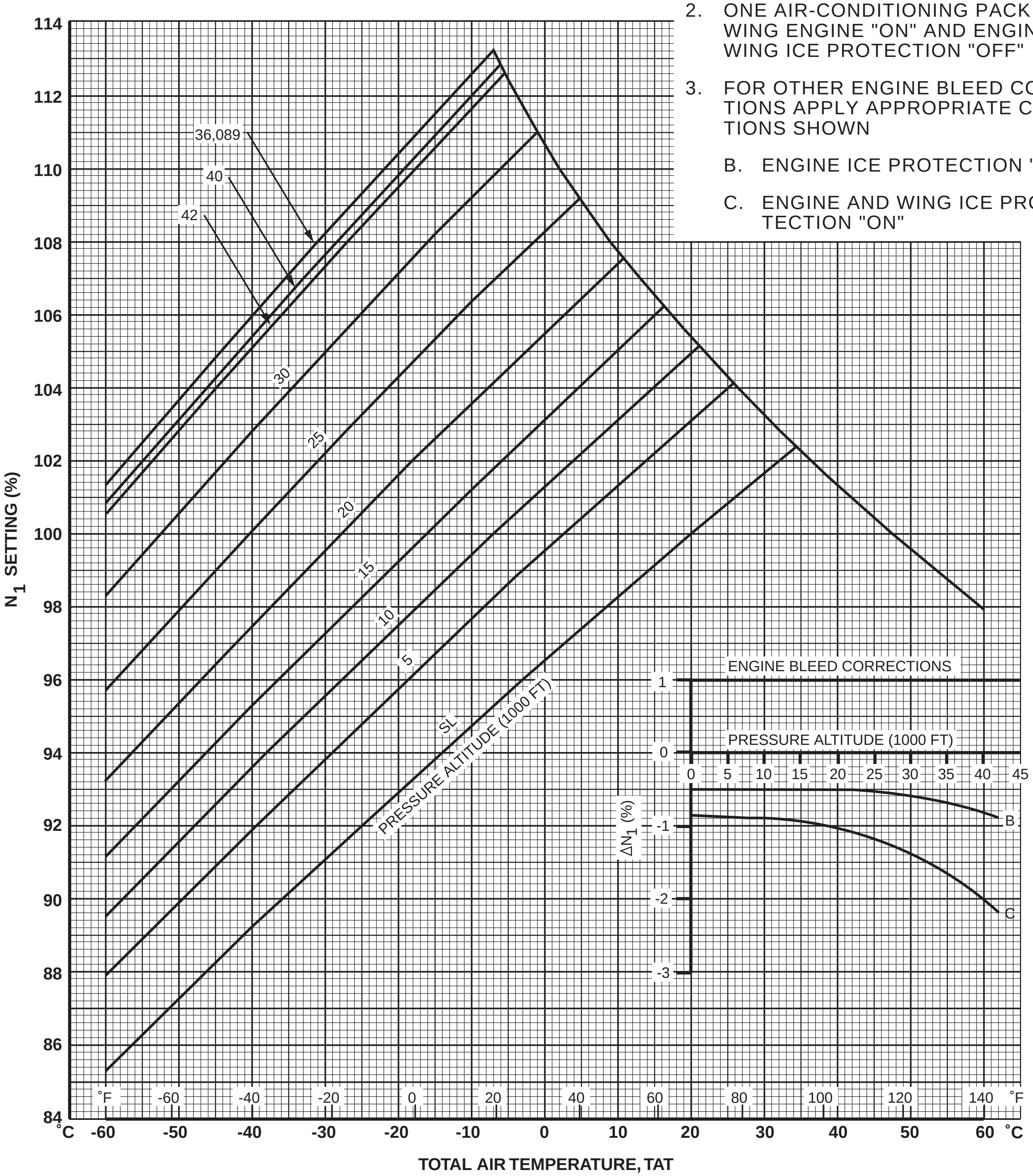


Figure 4-3.

N_1 SETTING FOR MAXIMUM CRUISE THRUST

NOTE:
1. TWO OR THREE ENGINES OPERATING INFLIGHT SETTING
2. ONE AIR-CONDITIONING PACK PER WING ENGINE "ON" AND ENGINE AND WING ICE PROTECTION "OFF"
3. FOR OTHER ENGINE BLEED CONDITIONS APPLY APPROPRIATE CORRECTIONS SHOWN
   B. ENGINE ICE PROTECTION "ON"
   C. ENGINE AND WING ICE PROTECTION "ON"
   D. ENGINE AND WING ICE PROTECTION "ON" WITH ONE WING ENGINE INOPERATIVE

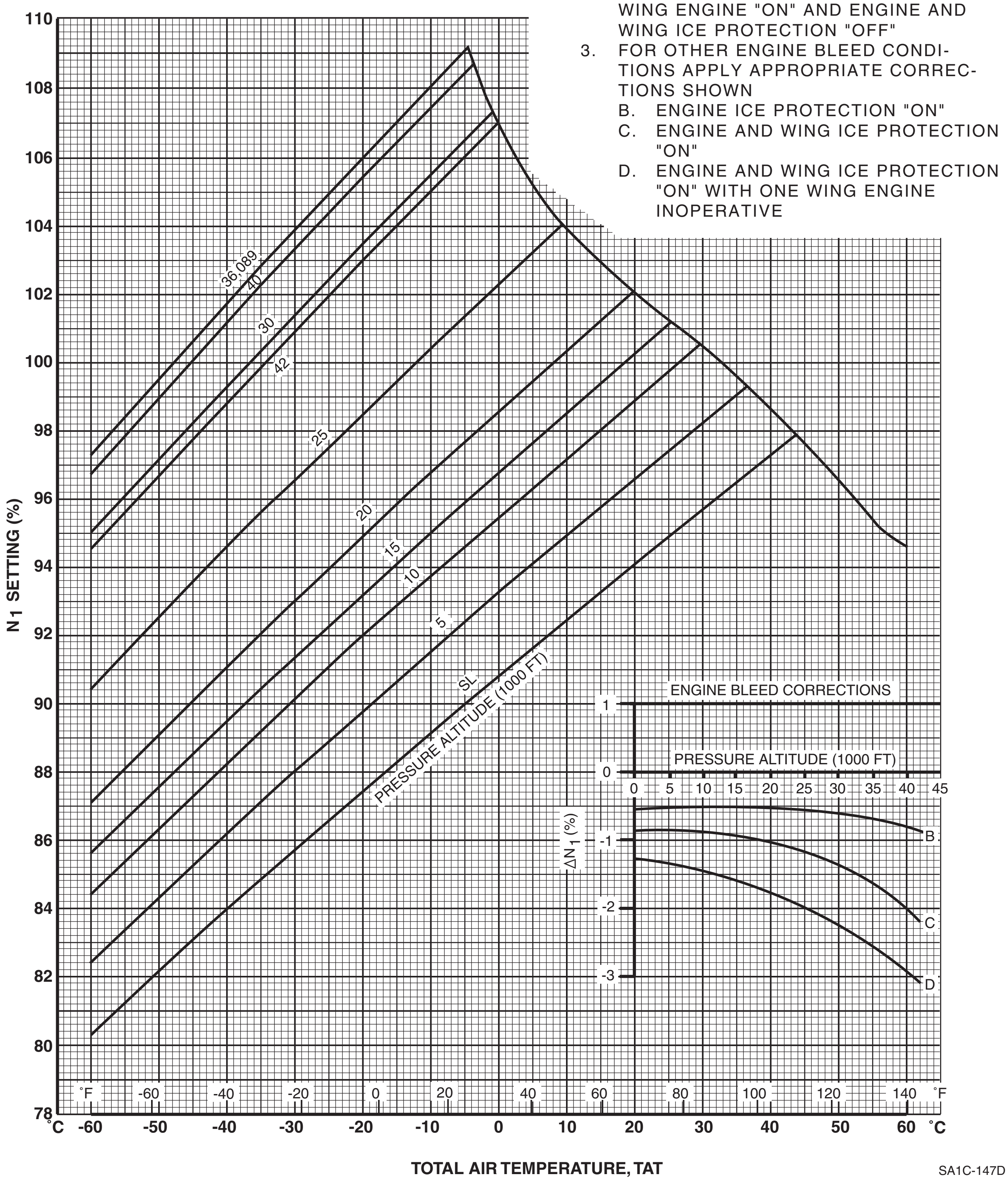


Figure 4-4.

THREE ENGINE CLIMB-FUEL TO CLIMB

NOTE:
1. CLEAN CONFIGURATION
2. MAXIMUM CLIMB THRUST
3. CLIMB AT SPEED SHOWN IN FIGURE 4-1 TO 10,000 FT THEN AT 330 KIAS TO 27,402 FT, THEN AT MACH = 0.82

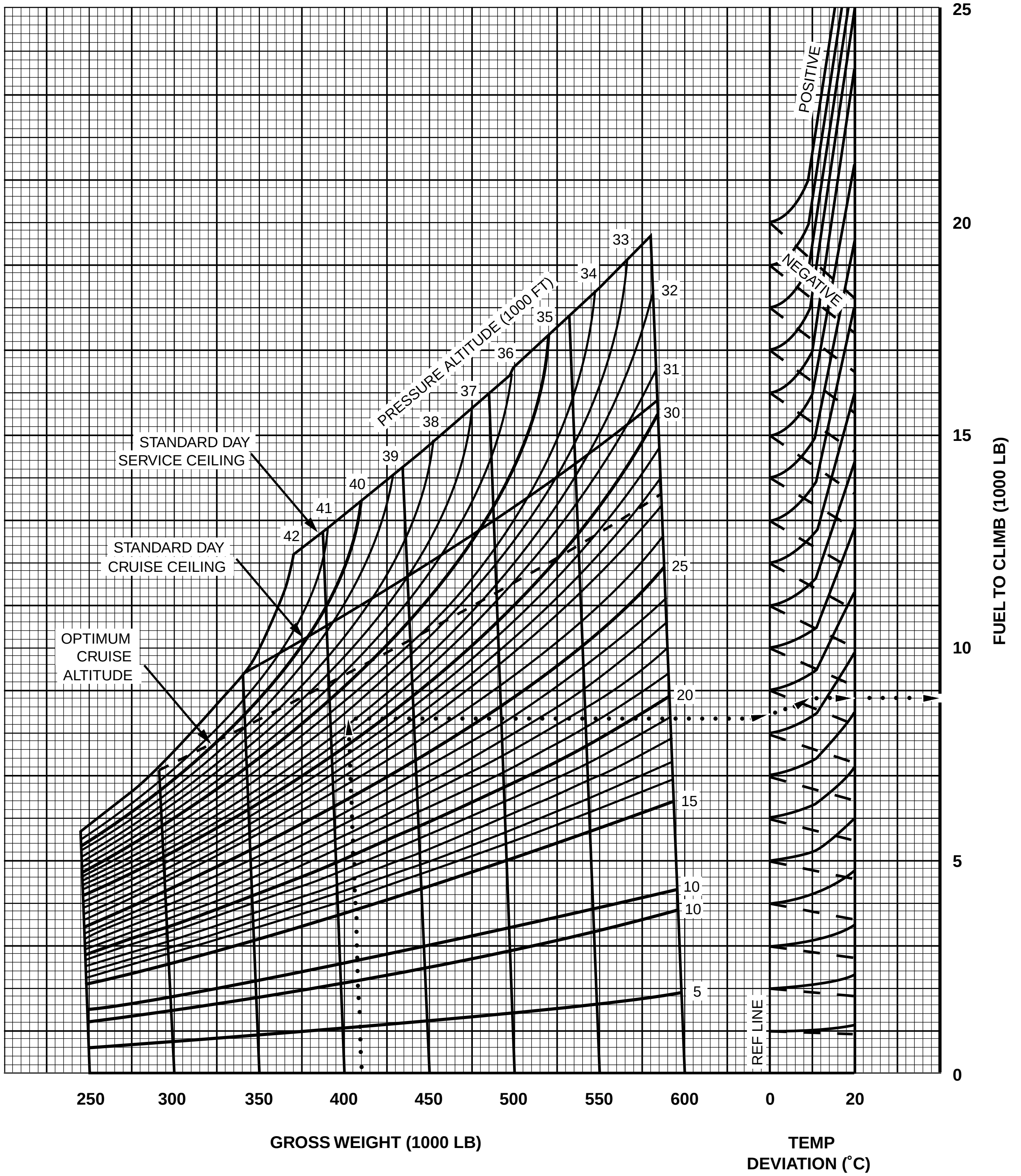


Figure 4-5.

THREE ENGINE CLIMB-DISTANCE TO CLIMB

NOTE:

1. CLEAN CONFIGURATION
2. MAXIMUM CLIMB THRUST
3. CLIMB AT SPEED SHOWN IN FIGURE 4-1 TO 10,000 FT THEN AT 330 KIAS TO 27,402 FT, THEN AT MACH = 0.82

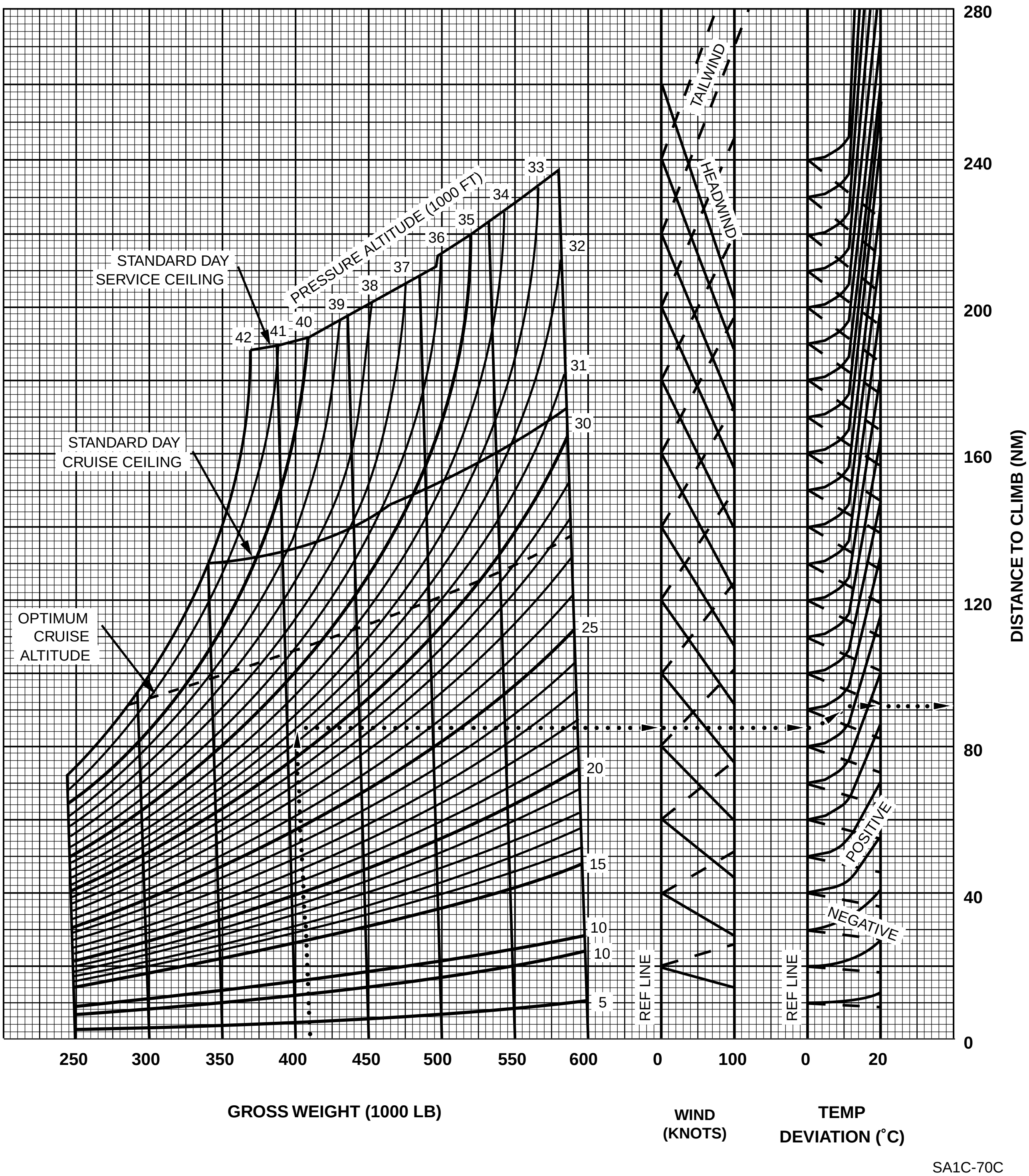


Figure 4-6.

THREE ENGINE CLIMB-TIME TO CLIMB

NOTE:
1. CLEAN CONFIGURATION
2. MAXIMUM CLIMB THRUST
3. CLIMB AT SPEED SHOWN IN FIGURE 4-1 TO 10,000 FT THEN AT 330 KIAS TO 27,402 FT, THEN AT MACH = 0.82

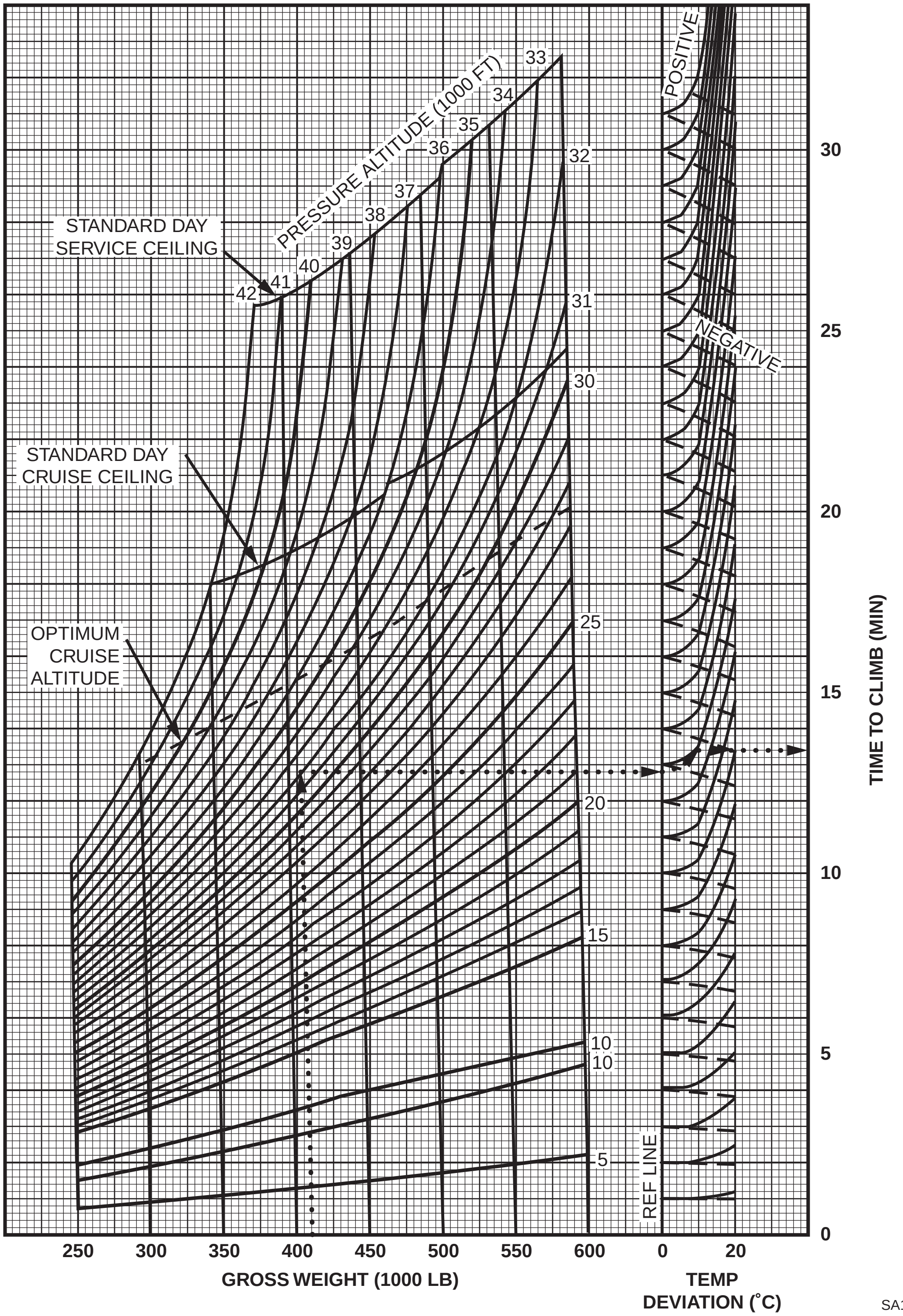


Figure 4-7.

All data on page 4-14 through page 4-16 including figure 4-8 through 4-10 deleted.

TWO ENGINE CLIMB-FUEL TO CLIMB

NOTE:

1. CLEAN CONFIGURATION
2. MAXIMUM CONTINUOUS THRUST
3. CLIMB AT SPEED SHOWN IN FIGURE 4-1 TO 10,000 FT, THEN AT 300 KIAS TO 27,993 FT, THEN AT MACH = 0.76

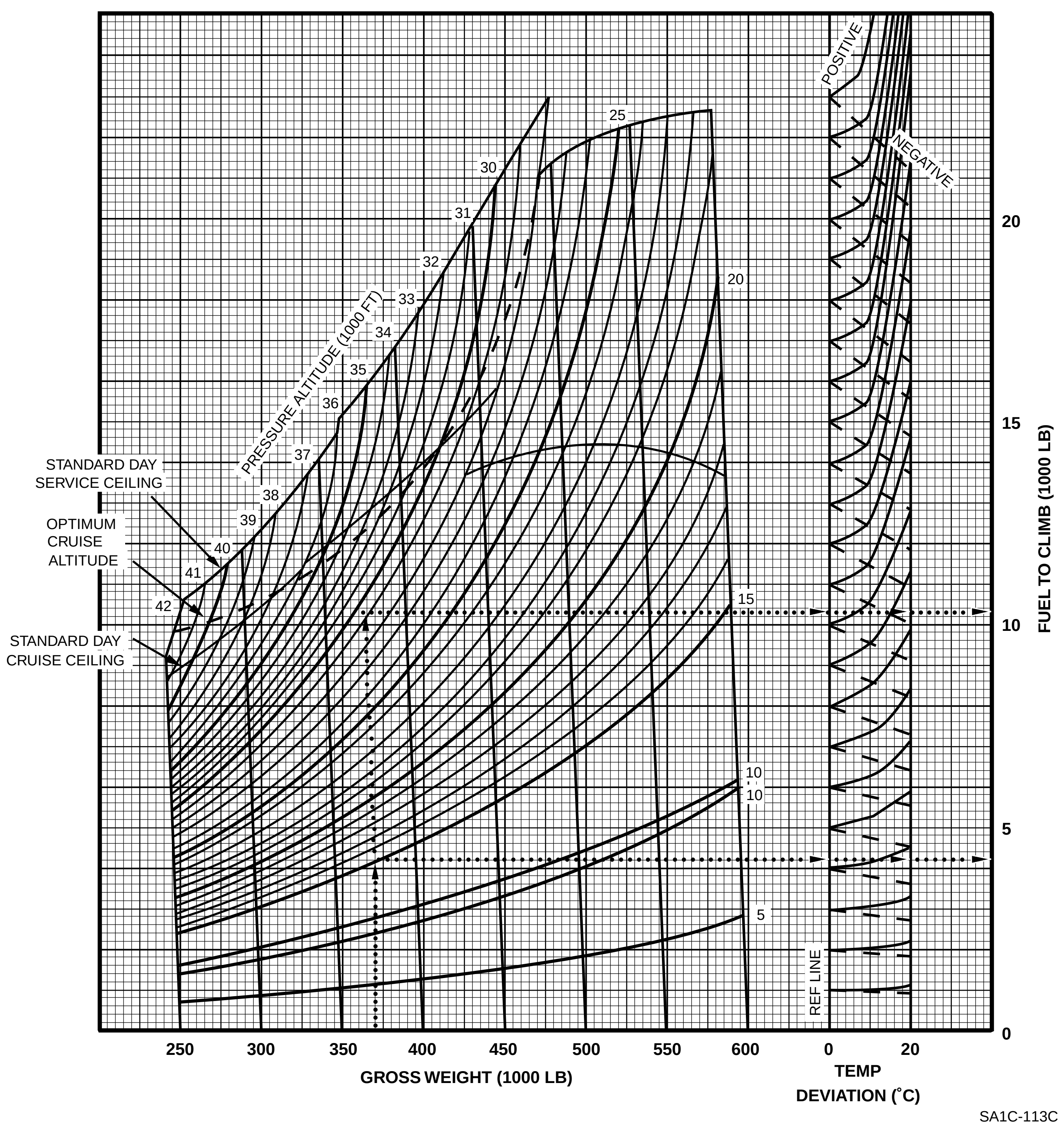


Figure 4-11.

TWO ENGINE CLIMB - DISTANCE TO CLIMB

NOTE:

1. CLEAN CONFIGURATION
2. MAXIMUM CONTINUOUS THRUST
3. CLIMB AT SPEED SHOWN IN FIGURE 4-1 TO 10,000 FT THEN AT 300 KIAS TO 27,993 FT, THEN AT MACH = 0.76

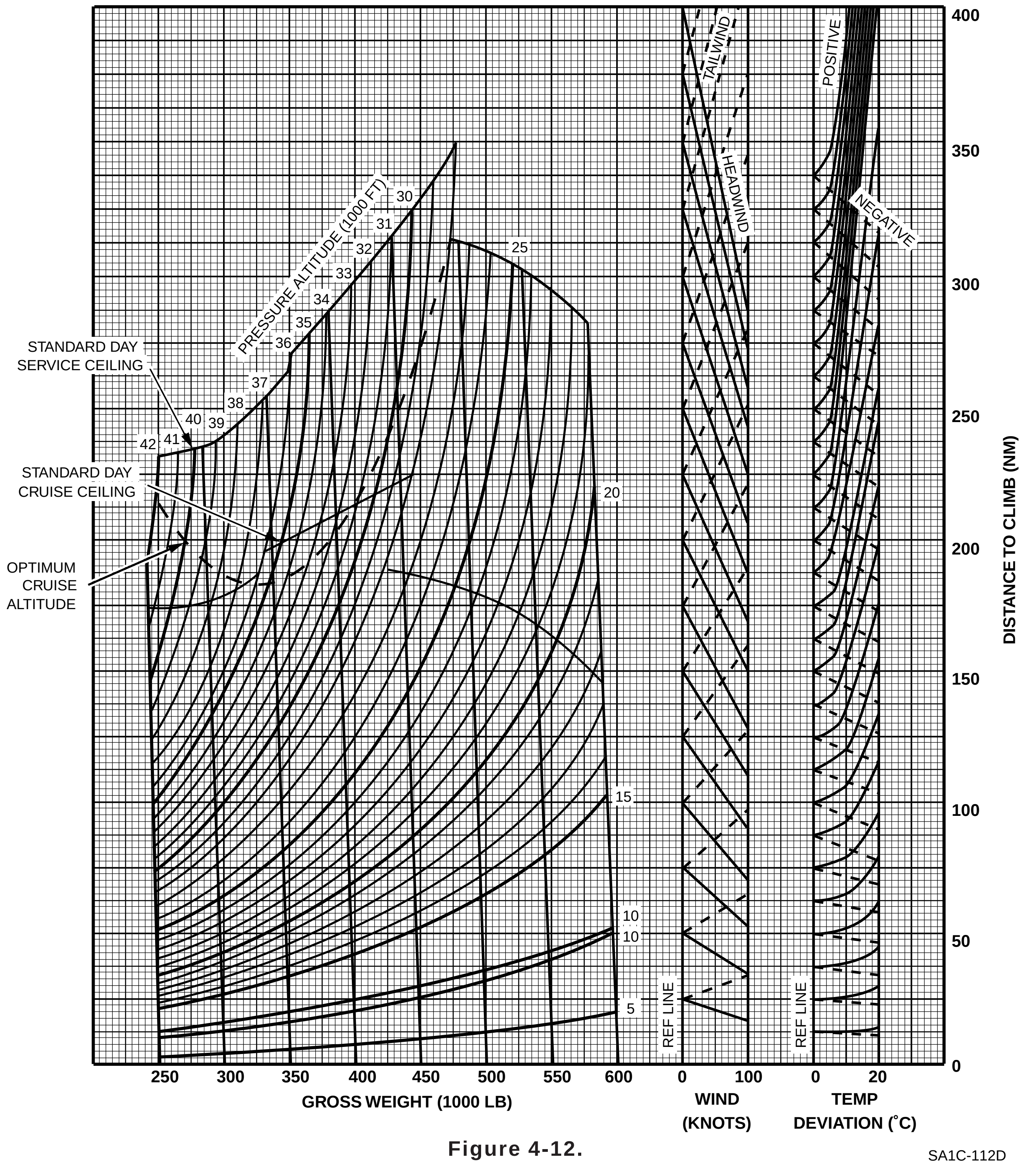


Figure 4-12.

SA1C-112D

TWO ENGINE CLIMB-TIME TO CLIMB

NOTE:
1. CLEAN CONFIGURATION
2. MAXIMUM CONTINUOUS THRUST
3. CLIMB AT SPEED SHOWN IN FIGURE 4-1 TO 10,000 FT THEN AT 300 KIAS TO 27,993 FT THEN CLIMB AT MACH = 0.76

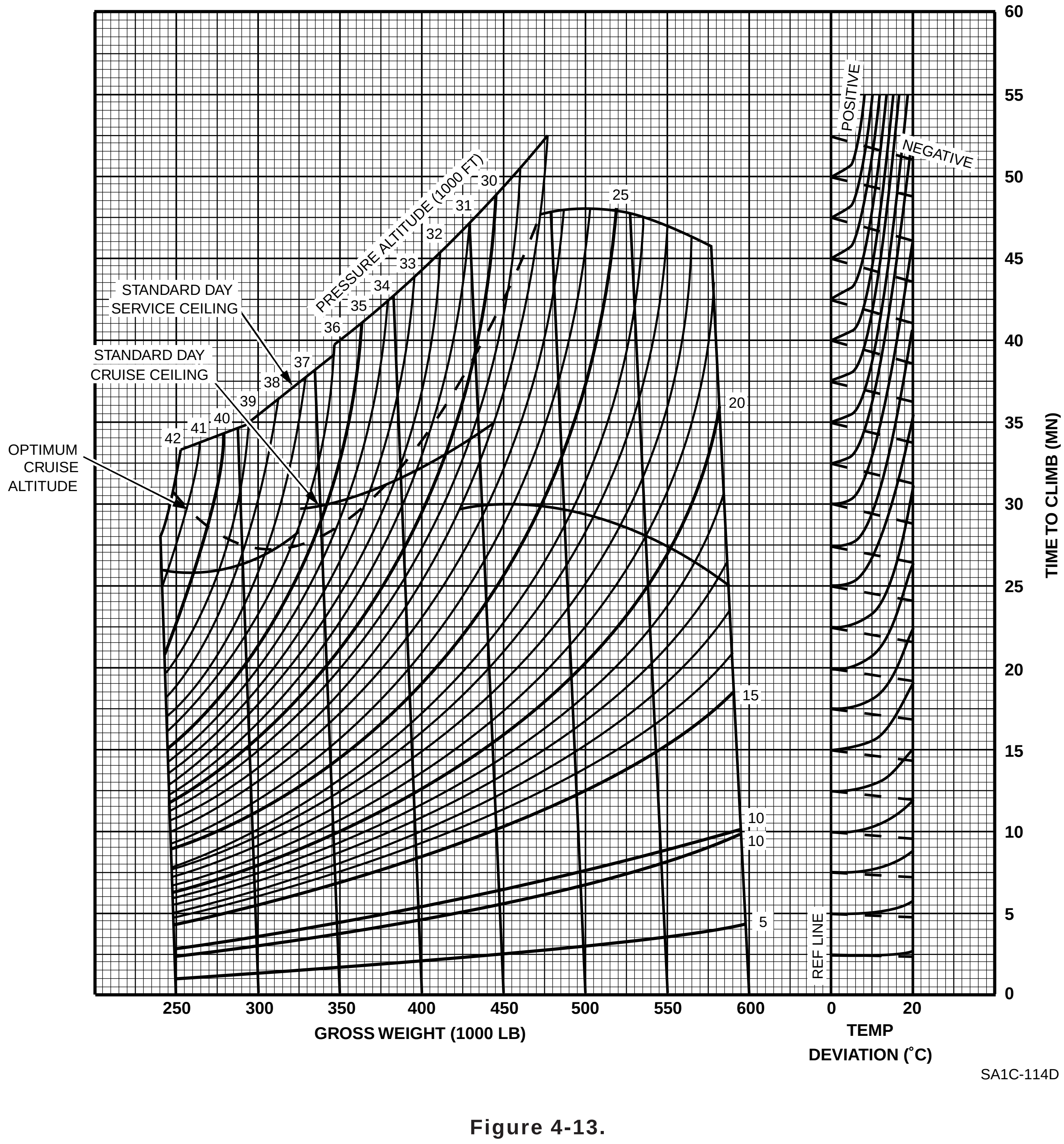


Figure 4-13.

THREE ENGINE CLIMB TABLE

NOTE:

1. CLEAN CONFIGURATION
2. MAXIMUM CLIMB THRUST
3. STANDARD DAY AND ZERO WIND
4. CLIMB PER FIGURE 4-1 TO 10,000 FT THEN AT 330 KIAS TO 27,402 FT THEN CLIMB AT MACH = 0.82
5. BASED ON CLIMB FROM SEA LEVEL

	FUEL (LB) DISTANCE (NM) TIME (MIN)												
PRESSURE ALTITUDE (FT)	INITIAL CLIMB GROSS WEIGHT (LB)												
	300,000	325,000	350,000	375,000	400,000	425,000	450,000	475,000	500,000	525,000	550,000	575,000	600,000
41,000	7000 89 13	7900 101 14	8900 116 16	10,200 138 19	12,700 189 25								
37,000	6200 70 10	6900 78 11	7700 87 13	8500 98 14	9400 110 16	10,500 123 18	11,800 142 20	13,600 170 24					
33,000	5600 58 9	6200 64 10	6800 71 11	7500 79 12	9300 87 13	9100 96 14	10,000 105 16	10,900 117 17	12,000 130 19	13,200 147 21	14,900 168 24	17,300 205 28	
29,000	5000 48 7	5600 53 8	6100 59 9	6700 65 10	7400 71 11	8000 78 12	8700 85 13	9500 94 14	10,300 103 15	11,200 113 17	12,200 124 18	13,300 137 20	14,600 152 22
25,000	4300 38 6	4800 42 7	5300 47 8	5800 51 8	6300 56 9	6900 61 10	7400 66 11	8000 72 12	8600 79 12	9300 86 13	10,000 93 14	11,000 102 16	11,800 111 17
20,000	3400 27 5	3800 30 5	4200 33 6	4600 36 6	5000 38 7	5400 43 7	5800 46 8	6300 50 9	6700 54 9	7200 58 10	7700 63 10	8200 68 11	8800 73 12
15,000	2600 18 3	2900 20 4	3200 22 4	3500 24 5	3800 26 5	4100 29 5	4400 30 6	4700 33 6	5000 36 7	5300 39 7	5600 41 7	6000 44 8	6400 48 8
10,000	1800 11 2	2000 12 3	2200 14 3	2400 15 3	2600 16 3	2900 18 4	3100 19 4	3300 20 4	3400 22 4	3600 23 5	3800 25 5	4000 27 5	4200 28 5
10,000	1500 8 2	1600 9 2	1800 10 2	2000 11 3	2100 12 3	2300 13 3	2500 14 3	2700 16 3	2900 18 4	3100 19 4	3300 20 4	3600 23 4	3800 24 5
5,000	700 4 1	800 4 1	900 5 1	1000 5 1	1000 6 1	1100 6 1	1200 7 2	1300 7 2	1400 8 2	1500 8 2	1600 9 2	1700 10 2	1800 10 2

SA1C-63G

Figure 4-14.

DERATED CLIMB TABLE

NOTE:
1. CLEAN CONFIGURATION
2. THREE ENGINE MAXIMUM CRUISE THRUST TO 500 FPM THEN MAXIMUM CLIMB THRUST
3. STANDARD DAY AND ZERO WIND
4. CLIMB PER FIGURE 4-1 TO 10,000 FT THEN AT 330 KIAS TO 27,402 FT THEN CLIMB AT MACH = 0.82
5. BASED ON CLIMB FROM SEA LEVEL

FUEL (LB) DISTANCE (NM) TIME (MIN)													
PRESSURE ALTITUDE (FT)	INITIAL CLIMB GROSS WEIGHT (LB)												
	300,000	325,000	350,000	375,000	400,000	425,000	450,000	475,000	500,000	525,000	550,000	575,000	600,00
41,000	8000 118 17	9000 135 19	10,300 157 22	11,800 180 25	14,200 230 30								
37,000	7000 94 14	7900 105 15	8800 119 17	9900 134 19	11,100 150 22	12,600 175 25	14,300 199 28	16,300 230 33					
33,000	6400 79 12	7100 88 13	7900 99 15	8800 110 16	9800 120 18	10,900 138 20	12,100 155 23	13,500 175 25	15,200 200 29	17,200 227 32	19,500 260 37	21,500 283 40	
29,000	5900 68 10	6400 75 12	7100 85 13	7900 94 14	8800 100 16	9700 116 18	10,700 129 20	11,900 144 22	13,200 162 24	14,700 182 27	16,500 208 30	18,000 221 32	18,500 218 32
25,000	4900 55 9	5500 61 10	6100 68 11	6800 75 12	7500 80 13	8300 90 15	9100 102 16	10,000 115 18	11,000 126 20	12,200 141 22	13,600 160 24	15,200 180 27	15,700 178 27
20,000	3900 38 7	4300 43 7	4700 47 0	5300 52 9	6800 60 10	6400 63 11	7000 70 12	7600 77 13	8300 84 14	9100 93 15	10,000 103 17	11,000 114 18	12,100 126 20
15,000	2900 25 5	3200 28 5	3500 30 6	3900 33 6	4300 40 7	4700 40 8	5100 44 8	5500 48 9	6000 53 10	6500 58 10	7000 63 11	7600 69 12	8200 75 13
10,000	2000 15 3	2200 16 3	2400 18 4	2700 20 4	2900 20 5	3200 24 5	3500 26 6	3800 29 6	4100 31 6	4300 34 7	4600 36 7	5000 40 8	5300 43 8
10,000	1600 11 2	1800 12 3	1900 13 3	2200 15 3	2400 16 4	2600 18 4	2800 20 4	3100 22 5	3400 25 5	3700 27 6	4000 30 6	4400 33 7	4800 37 7
5,000	800 5 1	900 5 1	1000 6 1	1100 7 2	1200 8 2	1300 8 2	1400 9 2	1500 10 2	1700 11 2	1800 12 3	2000 13 3	2100 15 3	2300 16 3

SA1C-65F

Figure 4-15.

TWO ENGINE CLIMB TABLE

NOTE:
1. CLEAN CONFIGURATION
2. MAXIMUM CONTINOUS THRUST
3. STANDARD DAY AND ZERO WIND
4. CLIMB PER FIGURE 4-1 TO 10,000 FT THEN AT 300 KIAS TO 27,993 FT THEN CLIMB AT MACH = 0.76
5. BASED ON CLIMB FROM SEA LEVEL

FUEL (LB) DISTANCE (NM) TIME (MIN)													
PRESSURE ALTITUDE (FT)	INITIAL CLIMB GROSS WEIGHT (LB)												
	300,000	325,000	350,000	375,000	400,000	425,000	450,000	475,000	500,000	525,000	550,000	575,000	600,000
41,000													
37,000	9400 160 24	11600 198 30											
33,000	7900 117 18	9100 134 21	10500 160 25	12,400 194 29	15,200 246 37								
29,000	6700 90 14	7700 103 17	8700 119 19	10,000 138 22	11,500 161 25	13,400 191 30	16,000 234 36	20,000 306 46					
25,000	5500 65 11	6200 74 13	6900 84 14	7900 96 16	8900 109 18	10,100 125 21	11,500 144 24	13,200 168 27	15,500 202 33	18,800 253 40			
20,000	4100 43 8	4600 48 9	5200 54 10	5800 61 11	6500 68 12	7300 77 14	8100 86 15	9000 97 17	10,100 110 19	11,400 126 22	13,000 146 25	15,200 175 29	18,500 219 36
15,000	3000 28 5	3400 31 6	3800 35 7	4200 39 8	4700 43 8	5200 48 9	5700 53 10	6300 59 11	6900 65 12	7600 72 13	8300 81 15	9300 91 16	10,400 103 18
10,000	2000 16 4	2300 18 4	2500 20 4	2800 23 5	3100 25 5	3500 28 6	3800 31 6	4100 34 7	4400 37 8	4800 41 8	5200 44 9	5600 49 9	6100 54 10
10,000	1800 13 3	2000 15 3	2200 17 4	2400 19 5	2700 21 5	3000 23 5	3300 26 6	3600 29 6	4000 33 7	4400 37 7	4900 41 8	5400 46 9	6000 52 10
5,000	800 6 1	900 7 2	1000 7 2	1200 8 2	1300 9 2	1500 10 2	1600 11 3	1700 13 3	1900 14 3	2100 16 3	2300 17 4	2500 19 4	2700 22 4

SA1C-62F

Figure 4-16.

THREE ENGINE SERVICE CEILING-STANDARD TO STANDARD + 10°C DAY

NOTE:

1. MAXIMUM CLIMB THRUST
2. GROSS WEIGHT BASED ON CLIMB FROM SEA LEVEL
3. SHADED AREA REPRESENTS MACH CHANGEOVER DURING CLIMB. DUE TO DECREASING TAS DURING CLIMB AT CONSTANT MACH, THE EFFECT OF DRAG INDEX DECREASES, RESULTING IN AN INCREASE IN SERVICE CEILING

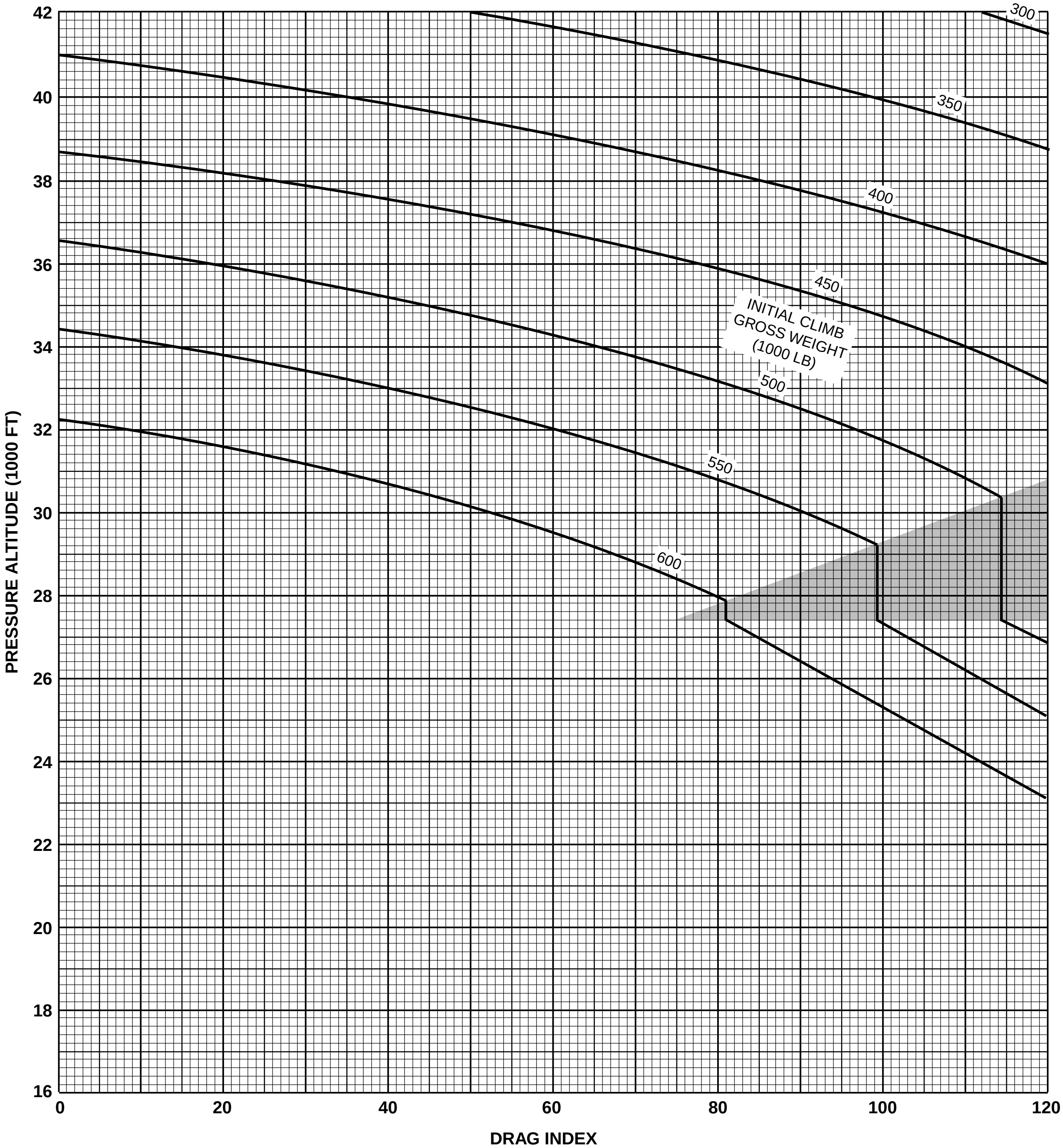


Figure 4-17.

SA1C-85E

THREE ENGINE SERVICE CEILING-STANDARD + 20°C DAY

NOTE:

1. MAXIMUM CLIMB THRUST
2. GROSS WEIGHT BASED ON CLIMB FROM SEA LEVEL
3. SHADED AREA REPRESENTS MACH CHANGEOVER DURING CLIMB. DUE TO DECREASING TAS DURING CLIMB AT CONSTANT MACH, THE EFFECT OF DRAG INDEX DECREASES, RESULTING IN AN INCREASE IN SERVICE CEILING

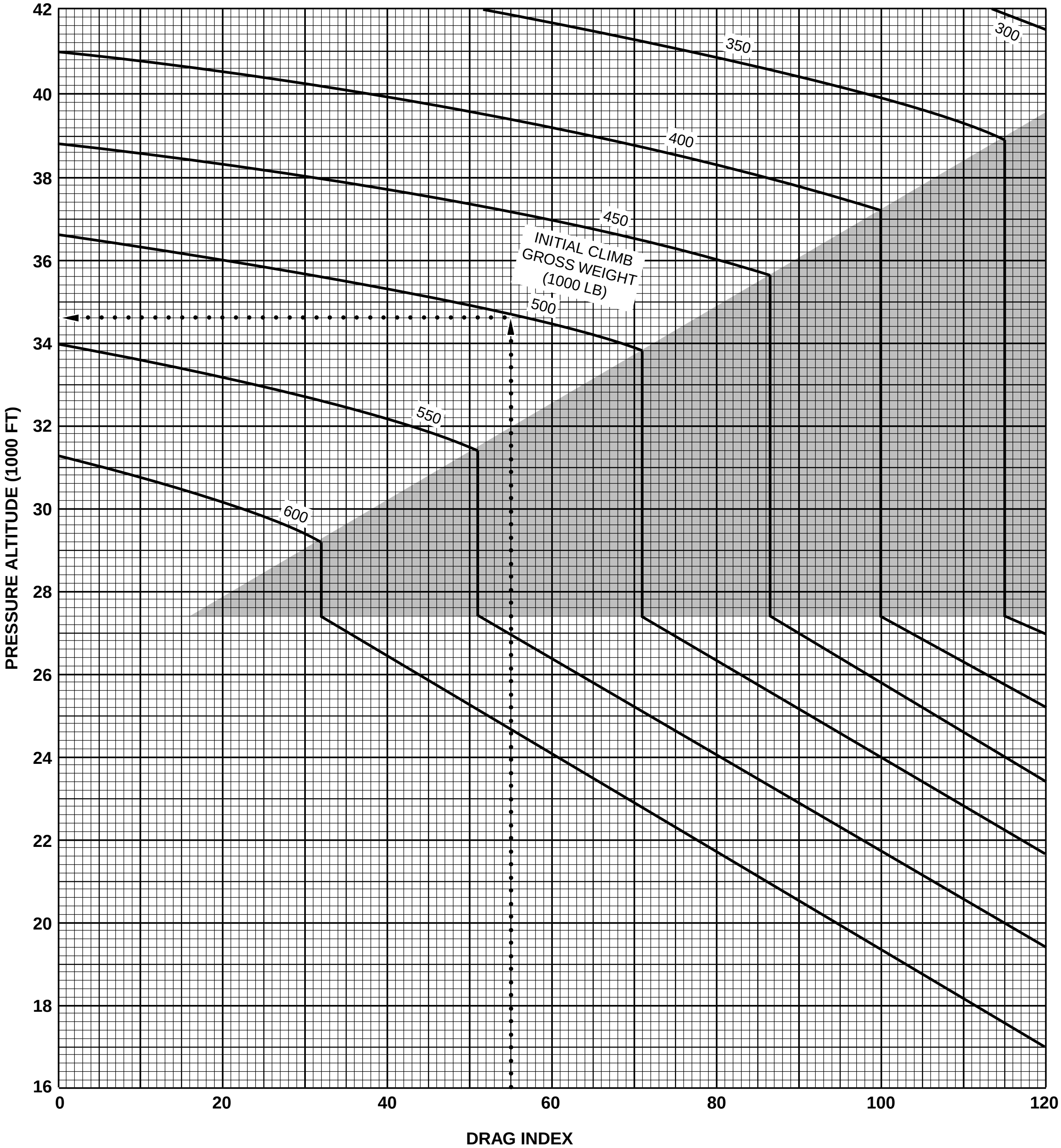


Figure 4-18.

TWO ENGINE SERVICE CEILING-STANDARD TO STANDARD + 10°C DAY

NOTE:
1. MAXIMUM CONTINUOUS THRUST
2. GROSS WEIGHT BASED ON CLIMB FROM SEA LEVEL
3. SHADED AREA REPRESENTS MACH CHANGEOVER DURING CLIMB. DUE TO DECREASING TAS DURING CLIMB AT CONSTANT MACH, THE EFFECT OF DRAG INDEX DECREASES, RESULTING IN AN INCREASE IN SERVICE CEILING

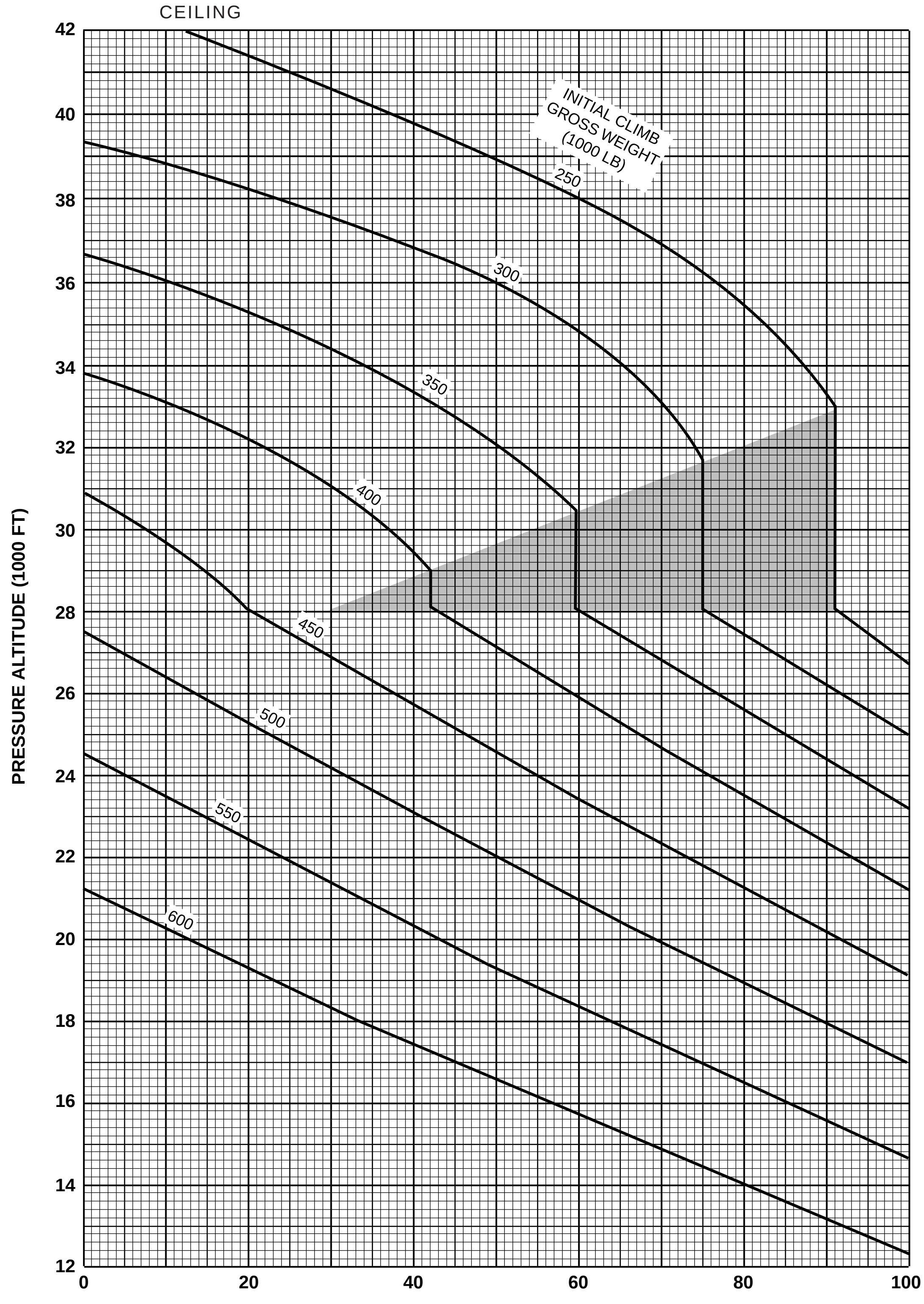


Figure 4-19.

SA1C-64D

TWO ENGINE SERVICE CEILING-STANDARD + 20°C DAY

NOTE:
1. MAXIMUM CONTINUOUS THRUST
2. GROSS WEIGHT BASED ON CLIMB FROM SEA LEVEL
3. SHADED AREA REPRESENTS MACH CHANGEOVER DURING CLIMB. DUE TO DECREASING TAS DURING CLIMB AT CONSTANT MACH, THE EFFECT OF DRAG INDEX DECREASES, RESULTING IN AN INCREASE IN SERVICE CEILING

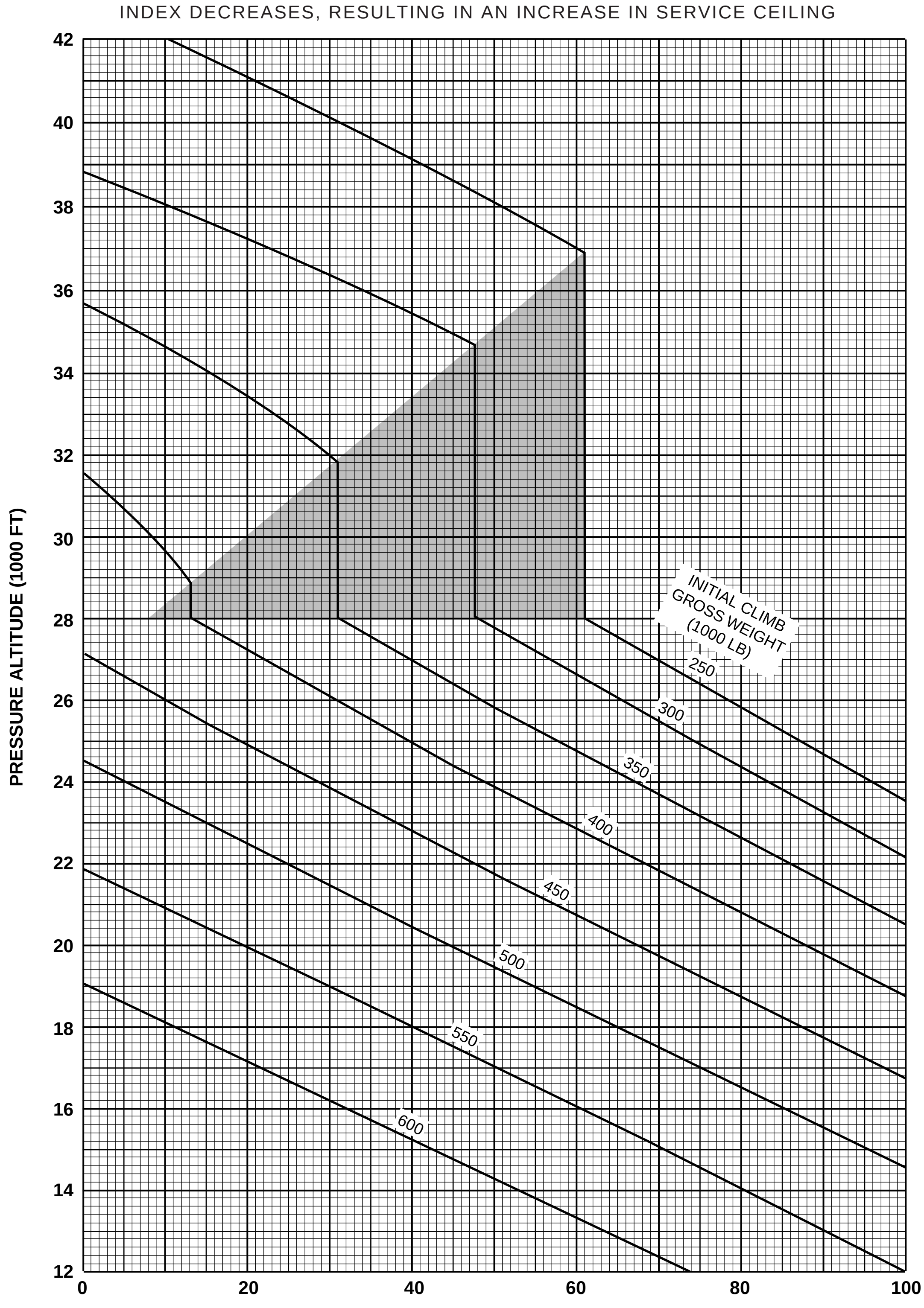


Figure 4-20.

SA1C-220B

EFFECT OF DRAG INDEX ON THREE ENGINE CLIMB

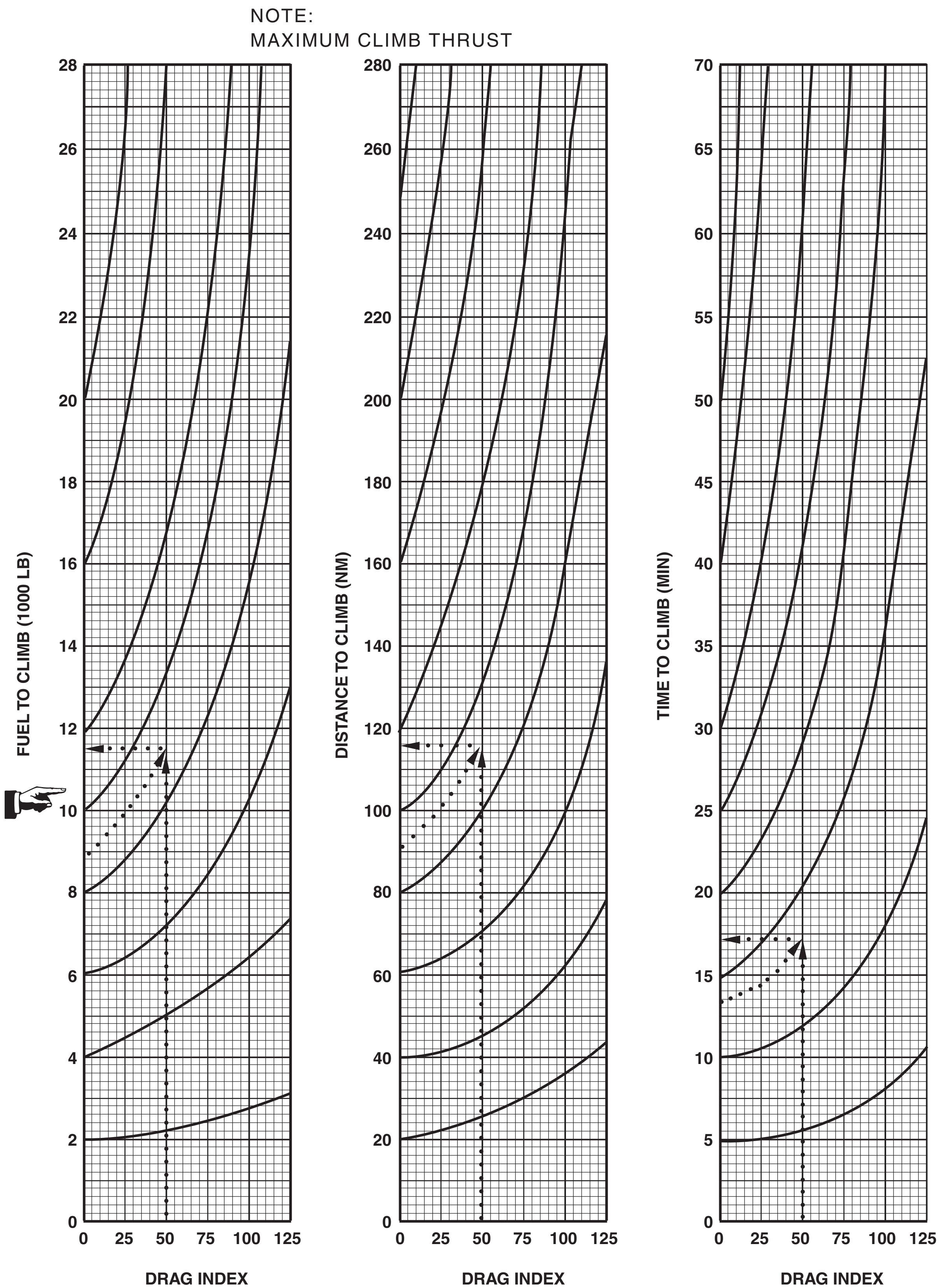


Figure 4-21.

EFFECT OF DRAG INDEX ON TWO ENGINE CLIMB

NOTE:
MAXIMUM CONTINUOUS THRUST

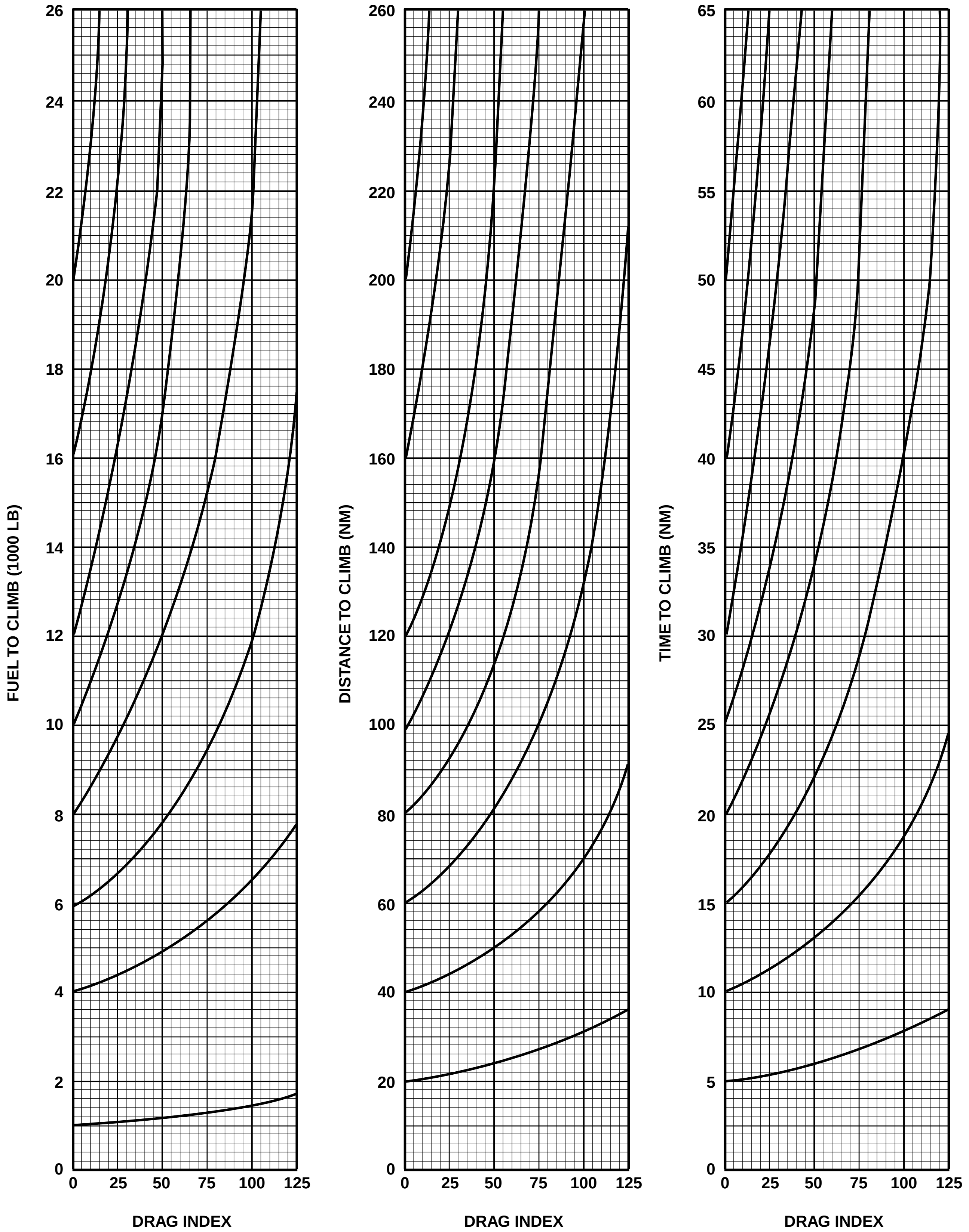


Figure 4-22.

SA1C-222B

SECTION V
CRUISE

TABLE OF CONTENTS

Page

LIST OF CHARTS

List of Charts (Continued)

List of Charts (Continued)

INTRODUCTION

The charts and tables in this section present information necessary for planning a cruise segment for any given mission. Specific range, integrated range and time, optimum altitude, and effect of drag index data are provided for three and two engine operation. Also provided are the effects of wind, altitude, and speed on range for three engine operation. All cruise data are derived from flight test results. The fuel flows provided are increased by five percent relative to the engine specification level.

DEFINITION OF TERMS

CRUISE-CLIMB

Cruise-climb involves maintaining a constant speed and climbing the airplane as the gross weight decreases. This flight technique provides maximum range capability when the proper altitude-gross weight schedule is followed.

STEP CRUISE

Step cruise is a flight procedure with periodic changes in altitude as required in order to approximate optimum performance (optimum step climb). This flight technique gives a compromise between cruise-climb and cruise at constant altitude. Step cruise yields range performance which is within 0.5 percent of the cruise-climb performance level.

Step cruise is initiated by leveling at an altitude 2,000 feet above the optimum altitude for initial cruise gross weight. This altitude is maintained until the airplane is 2,000 feet below the optimum altitude for the present gross weight. The airplane is then climbed to 2,000 feet above optimum altitude and the process repeated (see Figure 5-1).

OPTIMUM ALTITUDE

For a given gross weight and airspeed, the optimum altitude is that altitude at which the airplane achieves the greatest specific range.

CONSTANT RATING CRUISE

The constant rating cruise is a cruise technique that consists of setting a thrust rating and allowing airspeed to increase as fuel is consumed, while maintaining a constant altitude.

CONSTANT SPEED/MACH CRUISE

This is a cruise technique that consists of maintaining a preselected airspeed/Mach number at constant altitude by periodic reduction of thrust.

LONG RANGE CRUISE

Long range cruise is a cruise procedure whereby the airplane is flown at the faster of the two speeds which provide 99 percent of the maximum obtainable nautical miles per pound of fuel at a specified weight and altitude. Long range cruise provides a significant increase in speed with only a one percent loss in fuel economy. Long range cruise can be flown using a constant altitude cruise, step cruise, or cruise-climb flight profile. Use of the long range cruise procedure usually requires a continuous change in speed as fuel is consumed; however, for the KC-10A, the long range cruise speed is a constant Mach number when using a step cruise flight profile.

NORMAL BLEED

All cruise performance is computed on the basis of normal bleed conditions. This includes bleed air for A/C packs operating, lavatory and galley ventilation bleeds, and shaft-power extraction for airplane hydraulic and electrical power requirements.

MAXIMUM ENDURANCE SPEED

The maximum endurance speed is the speed that allows for the longest time aloft. It is based on the speed at which the fuel consumption rate is at a minimum.

FACTORS AFFECTING RANGE PERFORMANCE

TEMPERATURE

Temperature deviations from standard day have a negligible effect on the range performance.

Temperature effects on the maximum thrust limits are provided for deviations up to 20°C above standard day conditions.

AIRSPEED

To maximize range performance, select airspeeds close to the long range cruise speed. Higher airspeeds decrease mission time requirements but range performance decreases rapidly with speeds above the long range cruise speed.

ALTITUDE

To maximize range performance, fly the airplane within ±2,000 feet of the optimum cruise altitude. Within this band, the specific range performance averages 0.5 percent less than the specific range at the optimum altitude. The range performance decreases rapidly for altitude deviations of more than 2,000 feet from optimum.

CENTER OF GRAVITY (CG)

The CG location has a minimal effect on range performance for small changes in CG. However, the effect can be large for loadings near the forward limit. All cruise performance data are calculated using a CG location of 24 percent MAC. The specific range changes by 0.2 percent per one percent MAC movement, with aft movement of the CG location resulting in improved specific range.

FUEL HEATING VALUE

All cruise performance are calculated using a fuel heating value of 18,550 Btu/lb. Use of fuels with a lower heat content reduces range performance proportionately.

BLEED

The air-conditioning and wing ice protection flows are taken from the pneumatic manifold which is supplied by either low-pressure (8th stage) or compressor discharge airbleed, depending on the available bleed pressure. Since compressor discharge bleed is more penalizing than eighth stage bleed, the losses increase when the bleed switches from the eighth stage to the compressor discharge port (14th stage). This effect is noticeable on several specific range lines as a break where the specific range is reduced.

The use of engine anti-ice protection when the engine anti-ice shutoff valves are inoperative in the open position (MEL item) results in the cruise fuel flow being increased by 1.3%.

DRAG INDEX (DI)

Data presented in this section are based on a clean configuration, DI=0. Any increase in the airplane drag will result in a decrease in the range capability. Drag index values are presented for nonstandard configurations in Section I.

NOTE

The night (enchanced A/R) lighting installations are included in the baseline configuration. However, the data presented herein do not include drag for those installations because it results in negligible differences in performance.

WIND

Range is affected by wind velocity due to the change in ground speed. Tailwinds increase ground speed, thus increasing the range capability, while headwinds decrease the range capability.

CHART EXPLANATION AND EXAMPLE PROBLEMS

N_1 SETTING

Figures 5-2 and 5-3 present the N_1 settings for the Maximum Continuous Thrust and Maximum Cruise Thrust ratings, respectively. See Section II for chart explanation.

EFFECT OF FLYING OFF-SPEED ON RANGE

The effect on range of flying faster or slower than the long range cruise speed is shown in figure 5-4. This chart shows the percent gain or loss in range performance versus Mach number deviation from the long range cruise speed. This chart is valid for three engine cruise at the optimum altitude.

Example 1:

Given:

Cruise 0.02 Mach Number Faster Than the Long Range Cruise Speed

Find:

Reduction in Range

Solution:

Enter figure 5-4 at 0.02 Mach number deviation and find the percent of range as 94.8. Therefore, the reduction in range is 5.2 percent.

EFFECT OF WIND AND ALTITUDE ON RANGE

Figure 5-5 presents the effects of wind and altitude on range performance. This chart is valid for three engine cruise at the long range cruise speed. The chart may be used to determine the range penalty for flying off optimum altitude or the effect of wind on range. The chart may also be used to determine the wind advantage required to offset flight at nonoptimum altitudes. Wind advantage is defined as the increase in tailwind (or the decrease in headwind) at the non-optimum altitude compared to the optimum altitude.

Example 2:

Given:

Long Range Cruise at 6,000 Feet Below Optimum Altitude

Find:

Reduction in Range

Required Wind Advantage for Range at Lower Altitude to Equal Range at Optimum Altitude

Solution:

Enter figure 5-5 at -6,000 feet and read vertically to the zero wind advantage line to determine the percent of range as 94.8. Thus, the range loss for equal wind at both altitudes is 5.2 percent. Continue to read vertically to the 100 percent line and interpolate the wind advantage lines to obtain a wind advantage of 28 knots required for the range at the lower altitude to equal the range at the optimum altitude.

SPECIFIC RANGE

Specific range charts are given for three engine operation in figures 5-6 through 5-32, for two engine operation in figures 5-33 through 5-42, and for three engine slats extended operation in figures 5-43 through 5-46.

These charts show the available nautical miles per 1,000 pounds of fuel for a given altitude, plotted versus Mach number (and indicated airspeed) for a range of gross weights. Lines for 99 percent maximum nautical miles per pound of fuel, maximum endurance, 1.2G buffet boundary, maximum operating limit speed, and constant percent N_1 required are indicated on each chart.

The specific range charts are based on standard conditions. For non-standard days, the specific range correction is negligible and a correction to the N_1 required is provided. The specific range data are for a clean configuration except for the slats-extended charts. Separate slats-extended charts are provided because the maximum operating speeds, long range cruise speeds, and 1.2G buffet boundary speeds are substantially different from the corresponding clean configuration values.

The specific range charts are normally read by entering with a known Mach/IAS and reading vertically to the given gross weight to determine the specific range and N_1 required. For long range cruise operation, the chart is entered at the intersection of the gross weight and the 99 percent maximum nautical miles per pound of fuel line to determine the performance.

Example 3:

Given:

Gross Weight = 520,000 Pounds

Cruise Altitude = 30,000 Feet

Number of Operating Engines = 3

Cruise Speed = Mach 0.82

Temperature = Std +10°C

Find:

Specific Range

N_1 Required

Solution:

Enter figure 5-24 at a Mach number of 0.82 and read vertically to the gross weight. Determine the specific range as 22.2 NM/1000 LB. Interpolate to obtain the standard day percent N_1 required as 97.5. Correct the N_1 by 2. 0 percent RPM for 10°C above standard day to obtain the percent N_1 required as 99.5.

Example 4:

Given:

Gross Weight = 320,000 Pounds

Cruise Altitude = 5,000 Feet

Number of Operating Engines = 3

Type of Cruise = Long Range

Temperature = Std Day

Find:

Specific Range

N_1 Required

Cruise Mach Number

Cruise Speed in IAS

Maximum Endurance Speed in IAS

Solution:

Enter figure 5-7 at the intersection of the 99 percent maximum nautical miles per pound of fuel line and the given gross weight line. Read the scale on the side to determine the specific range of 18.8 NM/1000 LB. Interpolate to obtain the percent N_1 required of 71.7. The cruise speed is obtained by reading down from the initial intersection point to the Mach number scale. The Mach number is 0.502 and the cruise speed is 306 KIAS.

The maximum endurance speed is obtained by reading down from the intersection of the line for maximum endurance and the line at the given gross weight. The speed for maximum endurance is 189 KIAS.

INTEGRATED RANGE AND TIME

Integrated range and time charts are presented for three engine step cruise operation and for both three engine and two engine constant altitude operation in figures 5-47 through 5-52. These charts allow the determination of cruise range and time for the given fuel consumption or the determination of a fuel required to cruise a given range. All charts are based on standard day, zero wind conditions.

To determine the cruise range and time for a given fuel consumption, enter the curves with the initial and final weights and determine the values of range and time at each weight. The differences between the initial and final values are the cruise range and time.

To determine the fuel and time required to cruise a given distance, enter the curve at the initial cruise weight and determine values for range and time. Add the given cruise distance to the range value at the initial cruise weight to obtain a range value at the final cruise weight. Enter the curve with this range value to obtain the final cruise weight. Obtain a value for time at the final cruise weight. The cruise fuel required is the difference between the initial and final cruise weights and the cruise time is the difference between the two time values.

Example 5:

Given:

Initial Cruise Weight = 500,000 Pounds

Final Cruise Weight = 310,000 Pounds

Cruise Altitude = 33,000 Feet

Cruise Speed = Long Range

Number of Operating Engines = 3

Find:

Cruise Range and Time

Solution:

Enter figures 5-49 and 5-50 at 500,000 pounds to obtain a range of 850 nautical miles and a time of 1.73 hours. Enter again at 310,000 pounds and obtain a range of 6,180 nautical miles and a time of 13.09 hours. Subtracting corresponding values, the cruise range is 5,330 nautical miles and the cruise time is 11.36 hours.

Example 6:

Given:

Initial Cruise Weight = 500,000 Pounds

Cruise Distance = 1,800 NM

Cruise Altitude = 20,000 Feet

Cruise Speed = Long Range

Number of operating Engines = 2

Find:

Cruise Fuel and Time Required

Solution:

Enter figures 5-51 and 5-52 at 500,000 pounds to obtain a range of 1,790 nautical miles and a time of 4.0 hours. Add 1,800 nautical miles to 1,790 nautical miles to obtain a range value of 3,590 nautical miles.

Enter figure 5-51 at this range value and obtain a final cruise weight of 414,000 pounds. The cruise fuel required is the difference between the initial and final cruise weights and is 86,000 pounds. Enter figure 5-52 at the final cruise weight and read a time value of 8.1 hours. The difference between the two time values is 4.1 hours, which is the cruise time.

OPTIMUM ALTITUDE CRUISE PERFORMANCE

Optimum performance charts are given for both three engine operation and two engine operation in figures 5-53 and 5-54, respectively. These charts show the speed, altitude, and specific range for optimum cruise performance versus gross weight. Curves are provided for both 99 percent and 100 percent maximum nautical miles per pound of fuel for temperatures up to STD +20°C.

The optimum speed, altitude, and specific range data are obtained by entering the appropriate chart, figure 5-53 or 5-54, with the given gross weight and reading either the 99 percent or 100 percent maximum nautical miles per pound of fuel line at given temperature.

Example 7:

Given:

Gross Weight 480,000 Pounds

Temperature = STD DAY

Number of Operating Engines = 3

Find:

Values of Altitude, Speed and Specific Range for Optimum Performance at the Long Range Cruise Speed.

Solution:

Enter figure 5-53 with 480,000 pounds and read up to the STD DAY, 99 percent nautical miles per pound of fuel lines for speed, altitude, and specific range and find the following values:

Speed = 0.824 Mach

Altitude = 32,000 Feet

Specific Range = 23.8 NM/1000 LB

BUFFET PROTECTION AND OPTIMUM CRUISE PERFORMANCE

Figure 5-55 presents the buffet margin available versus gross weight and altitude. Also shown is the three engine operation optimum cruise altitude line. The data are valid for speeds between Mach 0.82 and Mach 0.83 (which includes the long range cruise speed). The chart shows that the available load factor to buffet onset is 1.5G at optimum altitude and 1.35G at an altitude 2,000 feet above optimum (the greatest deviation from optimum for step cruise operation). The chart is based on a center of gravity location of 24 percent MAC with corrections for more forward CG locations.

Example 8:

Given:

Gross Weight = 500,000 Pounds

Altitude = 33,000 Feet

CG Location = 24% MAC

Find:

Buffet Protection

Solution:

Enter figure 5-55 with the gross weight and altitude. At the intersection of these two entries, determine the load factor at buffet onset to be 1.4G, resulting in a 0.4g margin.

EFFECT OF DRAG INDEX ON RANGE

The effect of drag index chart, figure 5-56, gives the effects of additional drag on the range performance, in terms of a specific range correction factor. This chart is used in situations where the total airplane drag is greater than that for the clean configuration. A table of drag index values of various drag items is given in Section I.

Example 9:

Given:

Clean Configuration Specific Range = 16 NM/1000 LB

Number of Operating Engines = 2

Drag Index = 65

Find:

Specific Range for Non-Standard Configuration

Solution:

Enter figure 5-56 with the drag index number and determine a range correction factor of 0.775. Multiply the clean configuration specific range by this value and obtain a specific range for the non-standard configuration of 12.4 NM/1000 LB.

CRUISE N_1 AND FUEL FLOW PER ENGINE

Tabular data are provided for three engine cruise at Mach 0.82 in figure 5-57. The table is based on standard day with corrections for non-standard conditions. The table provides target N_1 setting and fuel flow per engine versus altitude and gross weight. The optimum altitude for each gross weight is shaded. Maximum Cruise Thrust limits for temperatures up to Std +15°C are given as a heavy line which shows the KC-10A is not thrust limited for step cruise operation.

NOTE

N_1 setting values are "target" settings only. Small deviations from the chart values may be required to obtain the correct speed.

OPTIMUM STEP CLIMB

Ⓐ INITIAL CLIMB

Ⓑ INITIAL LEVEL OFF (2000 FEET ABOVE OPTIMUM ALTITUDE)

Ⓒ 4000 FEET STEP AT CLIMB SPEED AND CLIMB THRUST

Ⓓ LEVEL OFF

Ⓔ 2000 FEET ABOVE OPTIMUM ALTITUDE

Ⓕ OPTIMUM ALTITUDE

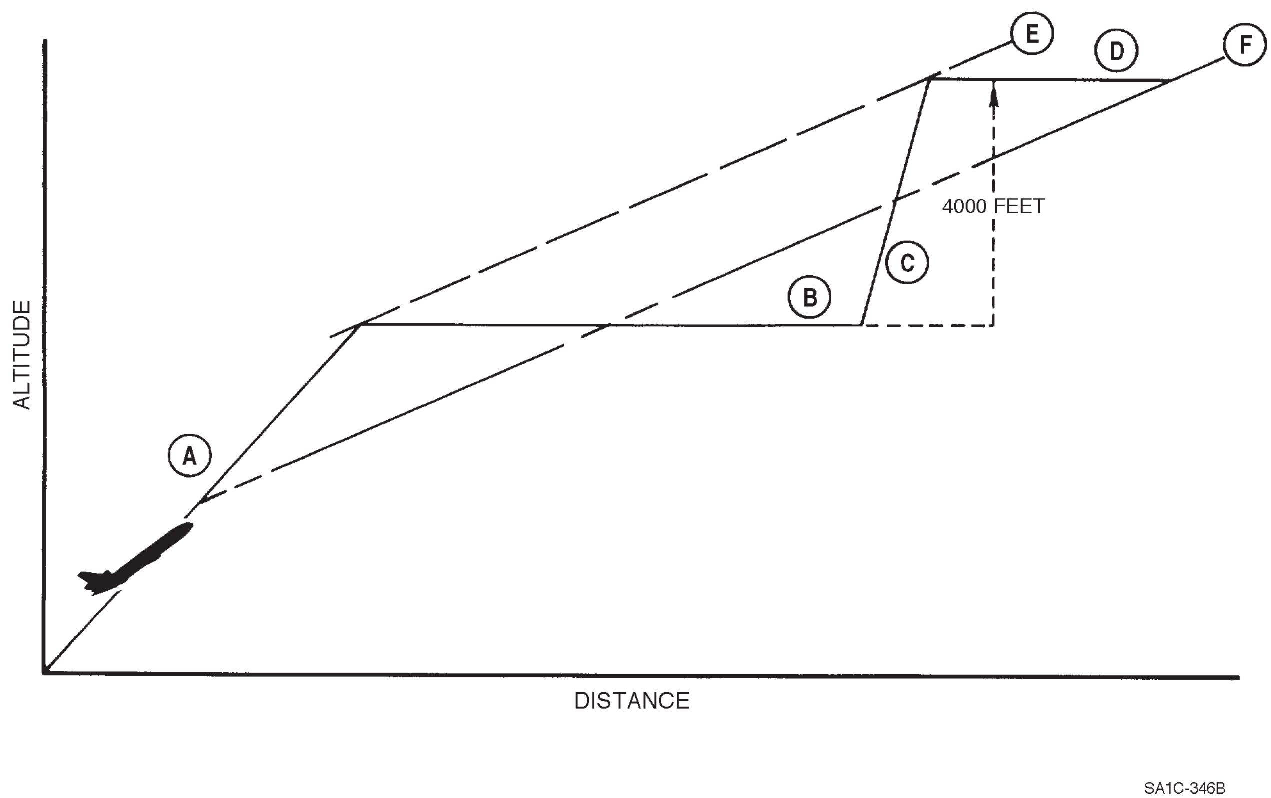


Figure 5-1.

N_1 SETTING FOR MAXIMUM CONTINUOUS THRUST

NOTE:

1. ONE OR TWO ENGINES OPERATING INFLIGHT SETTING OR FOR USE DURING REFUELING.
2. ONE AIR CONDITIONING PACK PER WING ENGINE "ON" LAVATORY AND GALLEY VENTILATION BLEEDS "ON" AND ENGINE AND WING ICE PROTECTION "OFF".
3. FOR OTHER ENGINE BLEED CONDITIONS APPLY APPROPRIATE CORRECTIONS SHOWN.
   - A. ENGINE BLEED FOR AIR CONTIONING PACKS "OFF" AND LAVATORY AND GALLEY VENTILATION BLEEDS "ON" OR "OFF"
   - B. ENGINE ICE PROTECTION "ON"
   - C. ENGINE AND WING ICE PROTECTION "ON"
   - D. ENGINE AND WING ICE PROTECTION "ON" WITH ONE WING ENGINE INOPERATIVE

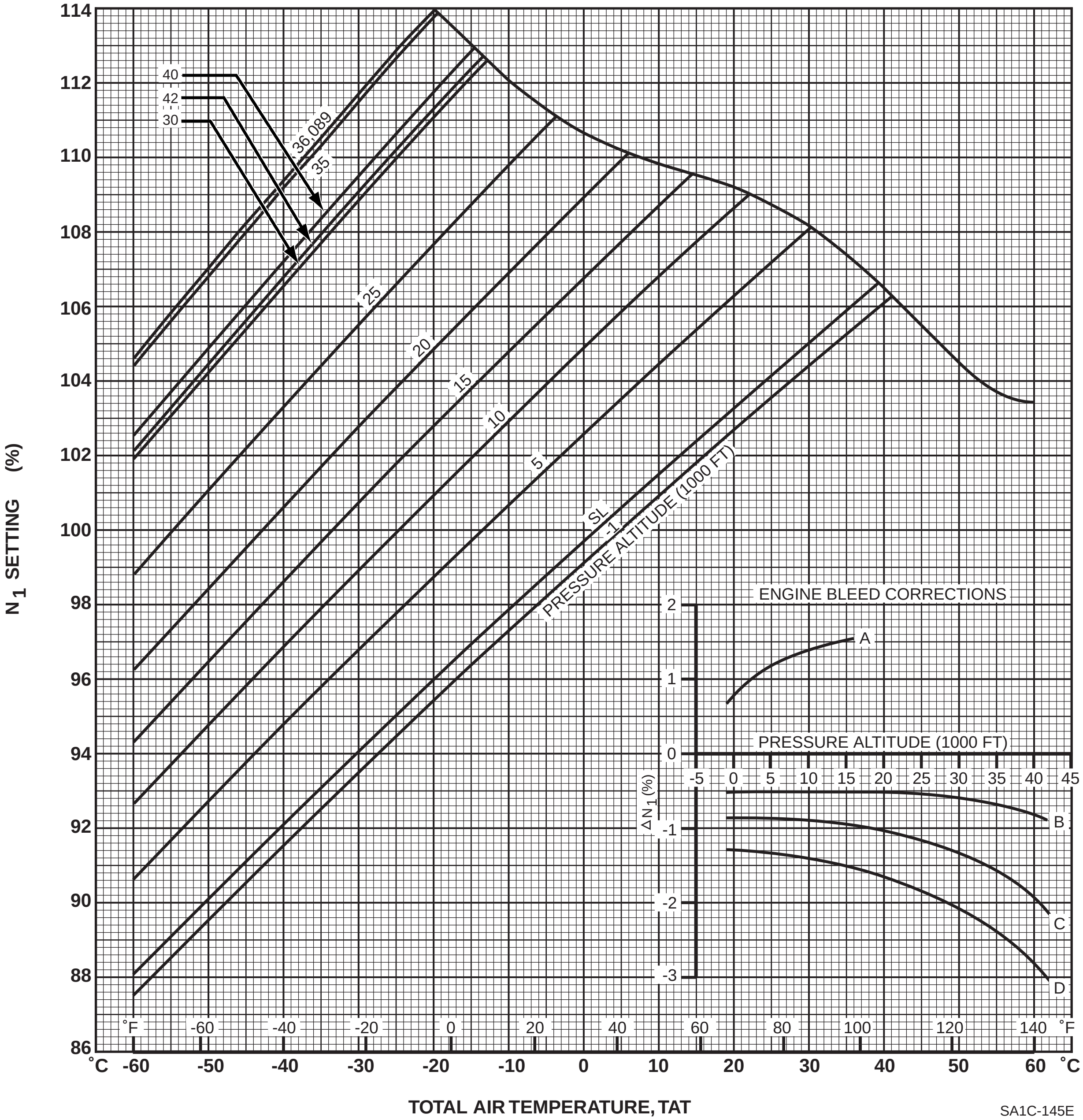


Figure 5-2.

N$_1$ SETTING FOR MAXIMUM CRUISE THRUST

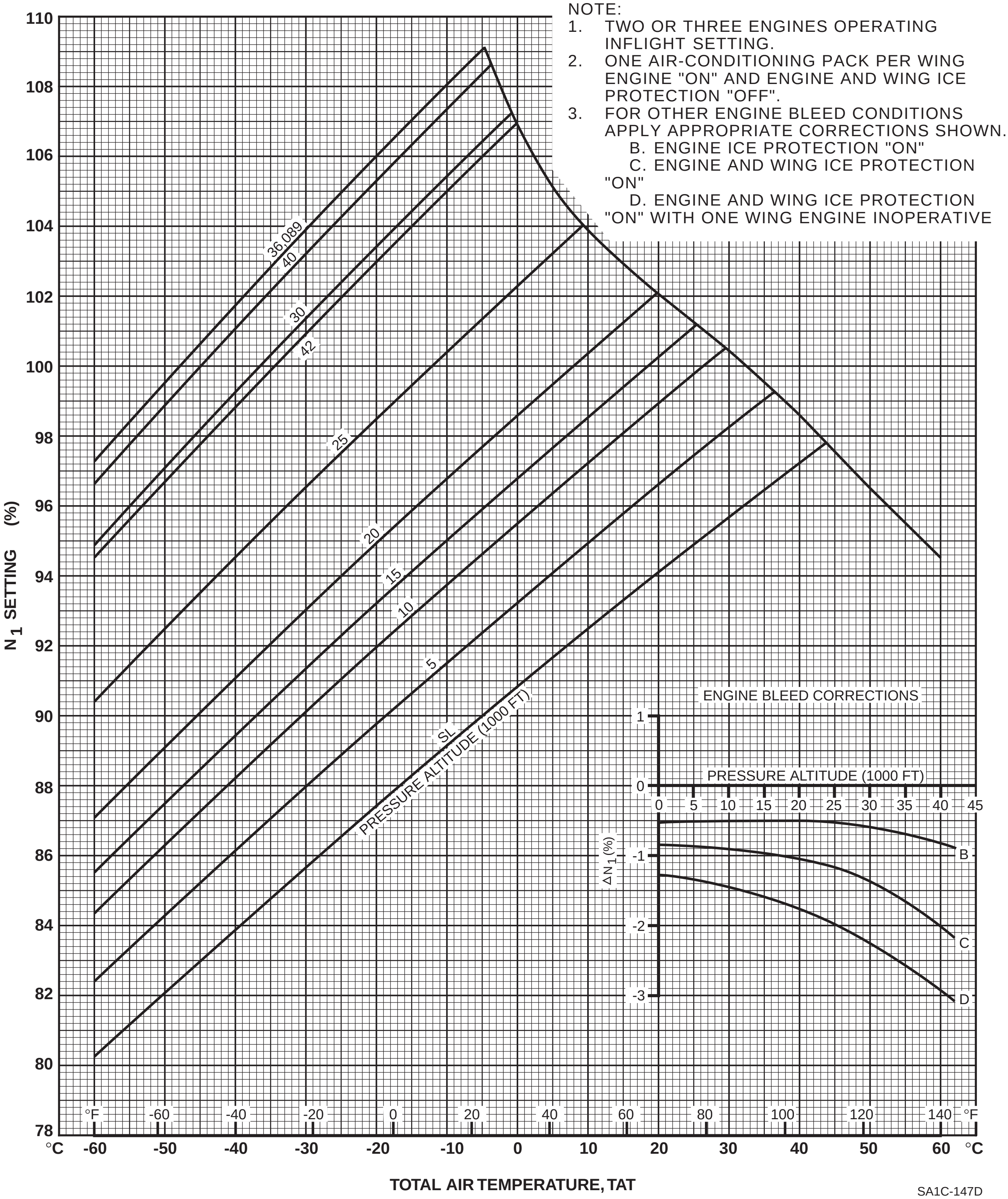


Figure 5-3.

EFFECT OF FLYING OFF-SPEED ON RANGE

NOTE:

1. THREE ENGINE OPERATION
2. CLEAN CONFIGURATION
3. GOOD FOR ALL TEMPERATURES
4. BASED ON CRUISE AT OPTIMUM ALTITUDE

EXAMPLE: CRUISE AT .02 MACH NUMBER FASTER THAN LONG RANGE CRUISE SPEED

FIND: REDUCTION IN RANGE

SOLUTION: REDUCTION IN RANGE = 5.2%

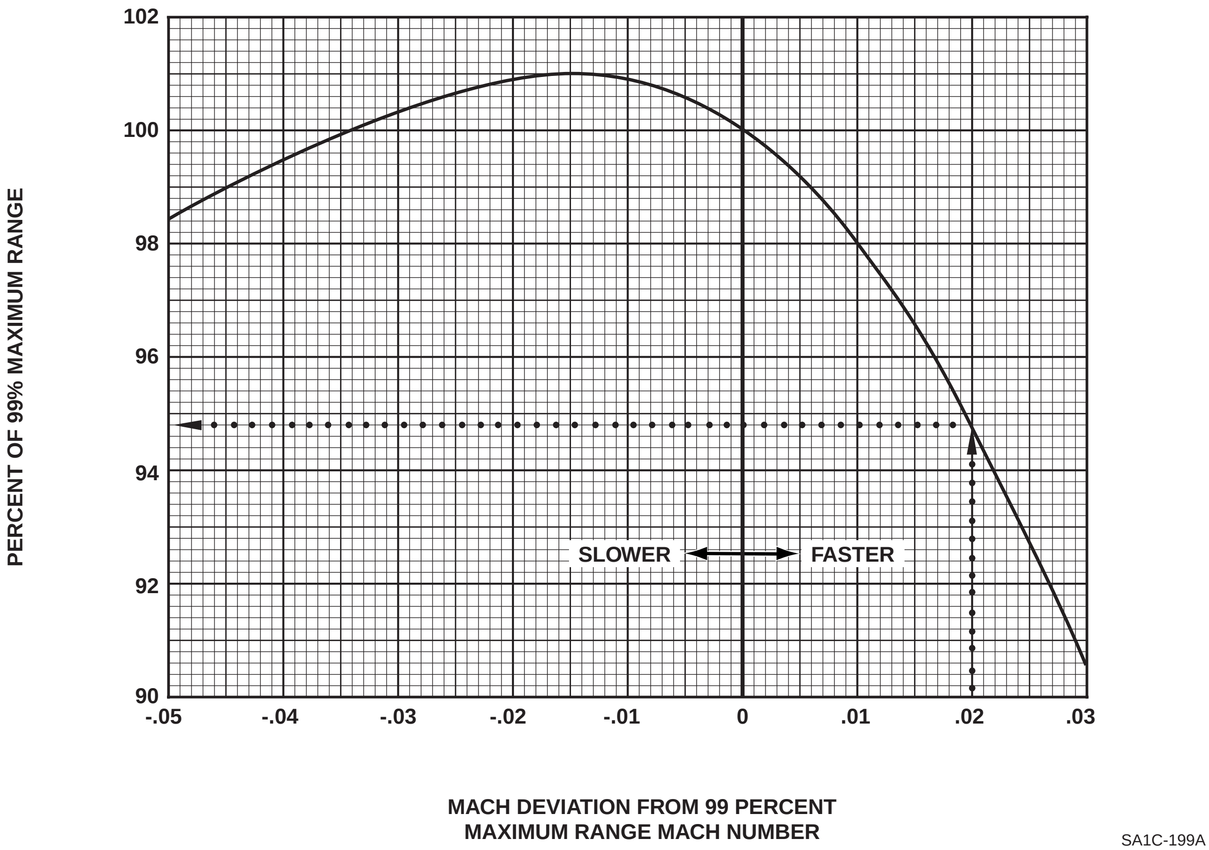


Figure 5-4.

EFFECT OF WIND AND ALTITUDE ON RANGE

NOTE:

1. THREE ENGINE OPERATION
2. CLEAN CONFIGURATION
3. GOOD FOR ALL TEMPERATURES
4. BASED ON CRUISE AT OPTIMUM ALTITUDE

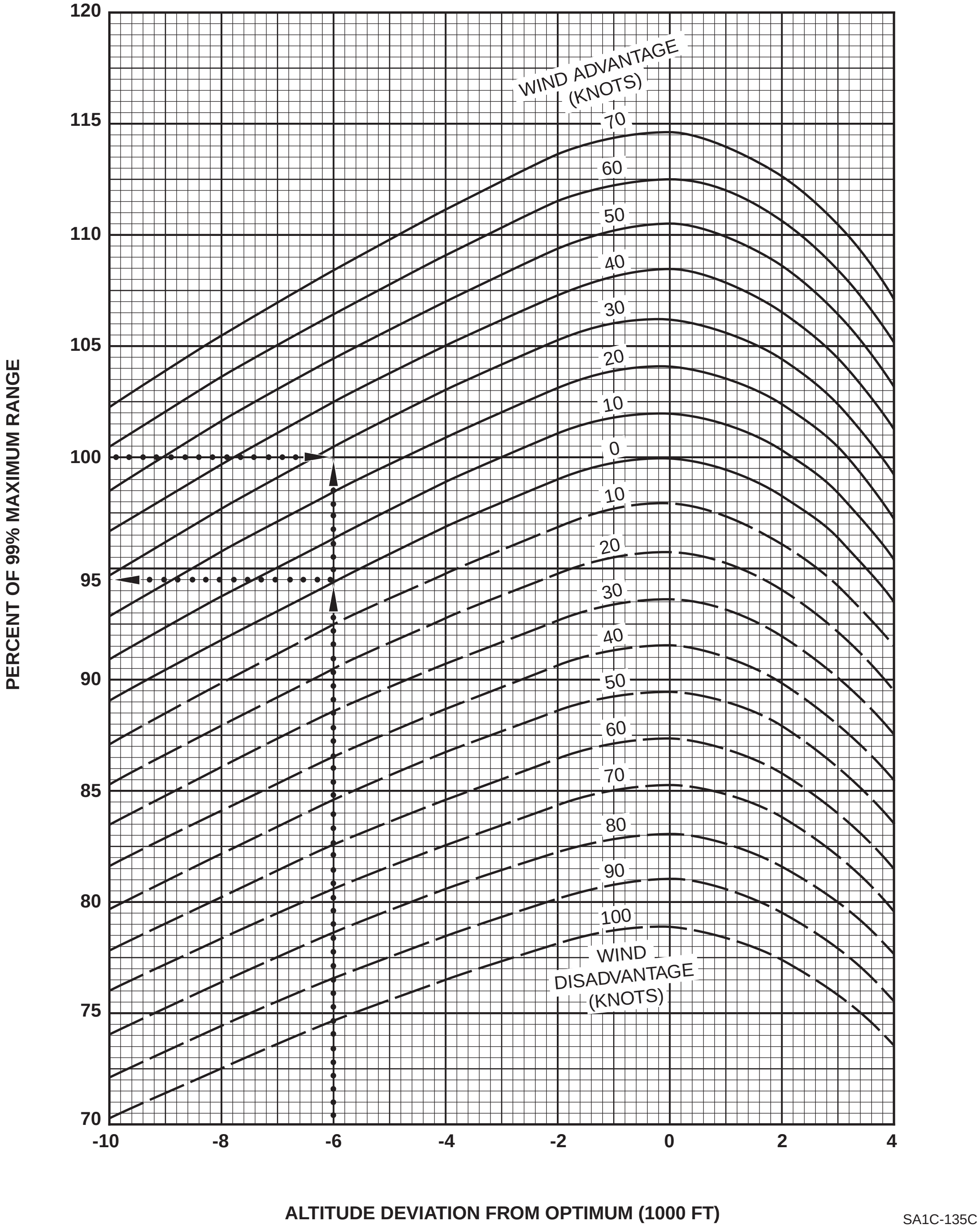


Figure 5-5.

THREE ENGINE SPECIFIC RANGE
TRUE PRESSURE ALTITUDE SEA LEVEL

NOTE:

1. CLEAN CONFIGURATION
2. STANDARD DAY
3. INCREASE % N_1 BY 0.11 PER °C ABOVE STANDARD

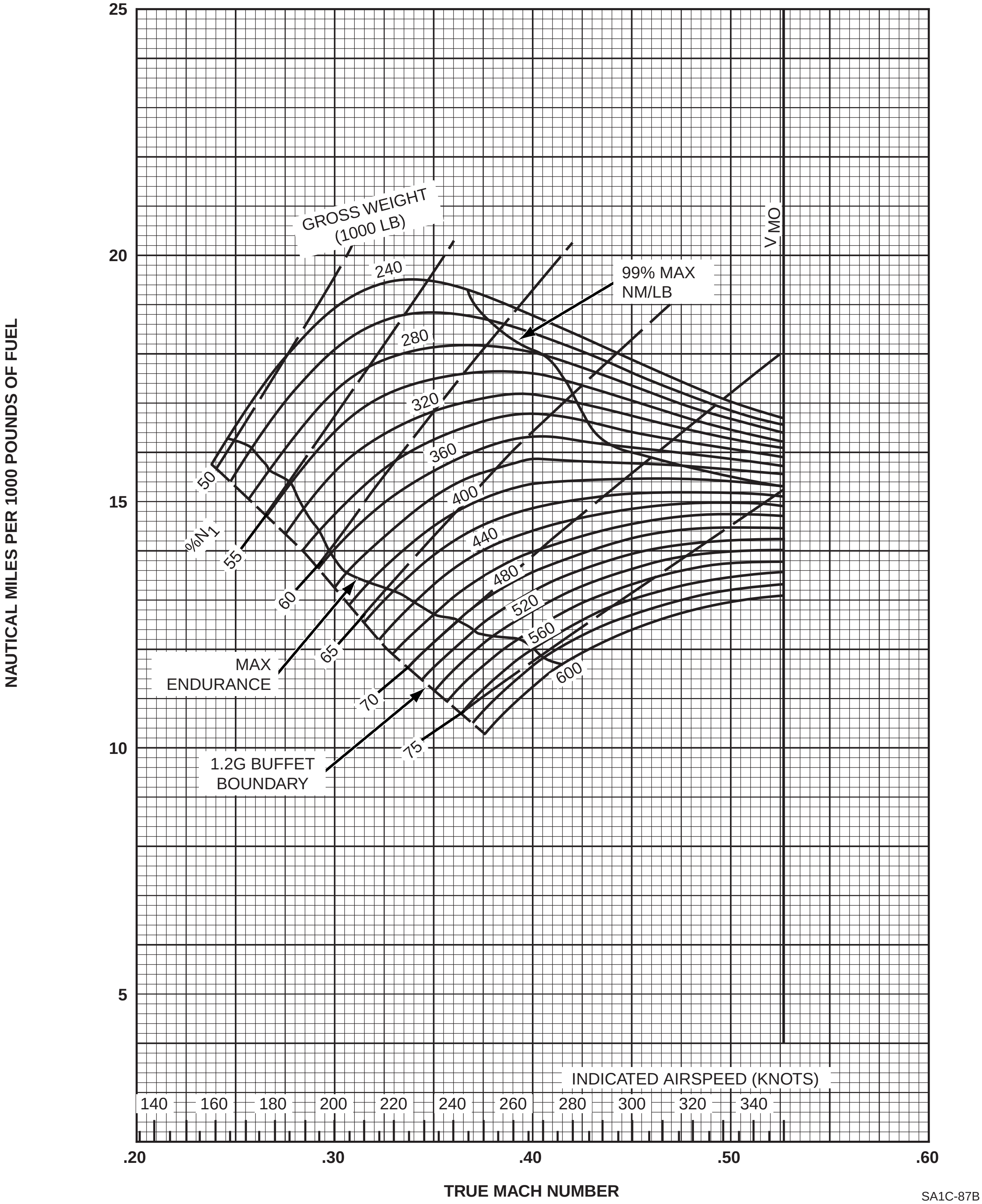


Figure 5-6.

THREE ENGINE SPECIFIC RANGE
TRUE PRESSURE ALTITUDE 5000 FT

NOTE:

1. CLEAN CONFIGURATION
2. STANDARD DAY
3. INCREASE % N_1 BY 0.13 PER °C ABOVE STANDARD

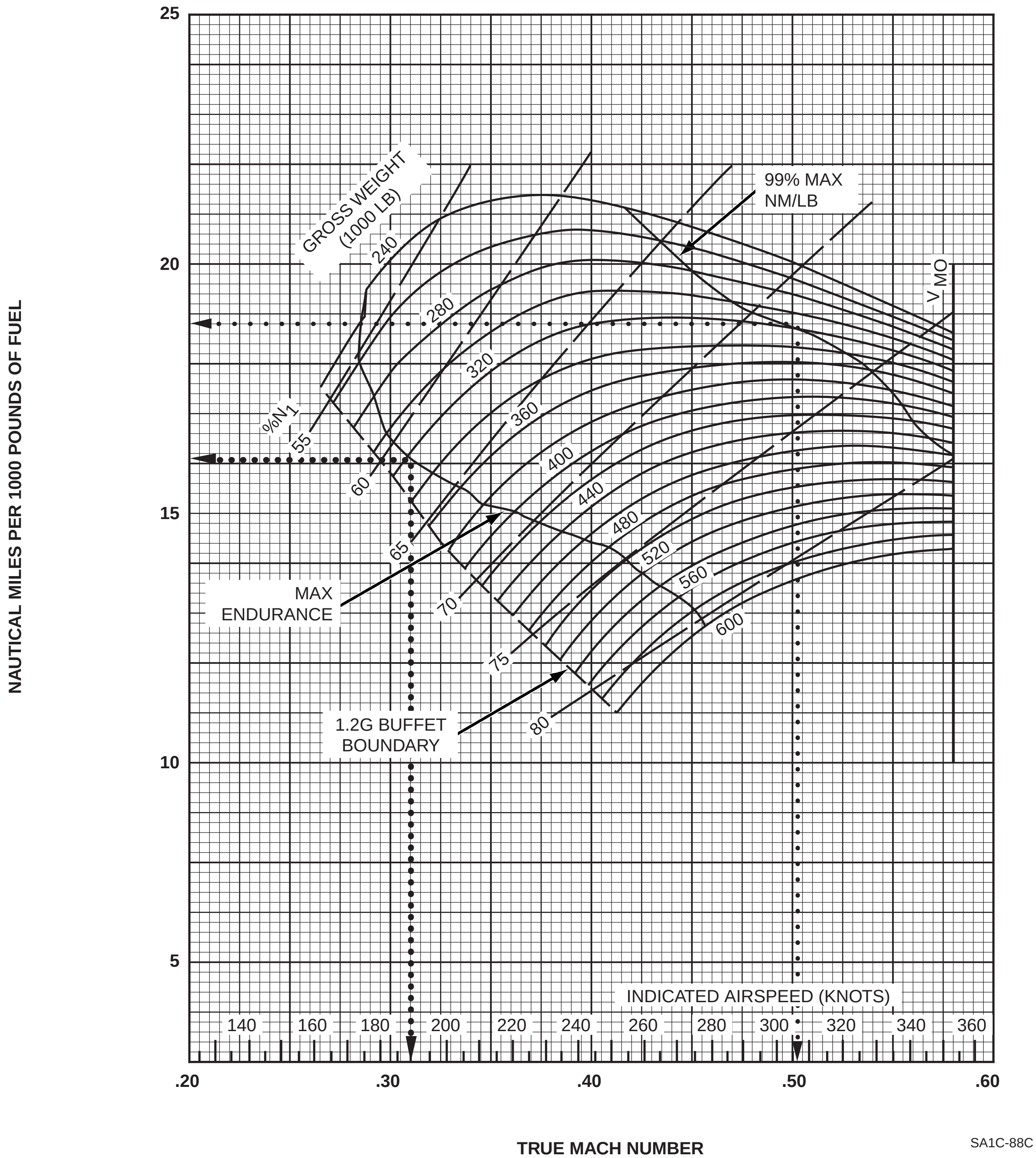


Figure 5-7.

THREE ENGINE SPECIFIC RANGE
TRUE PRESSURE ALTITUDE 8000 FT

NOTE:

1. CLEAN CONFIGURATION
2. STANDARD DAY
3. INCREASE % N_1 BY 0.14 PER °C ABOVE STANDARD

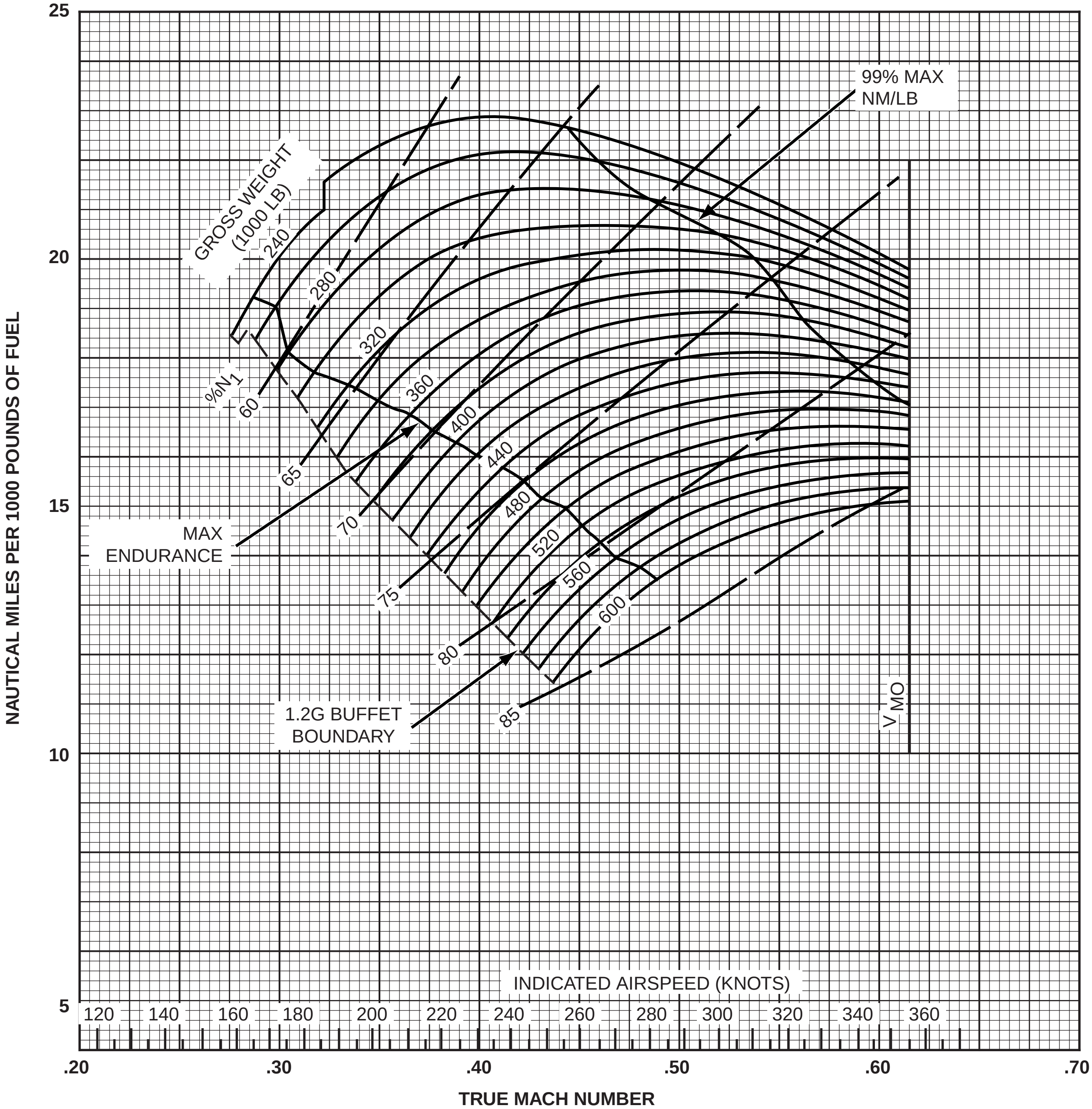


Figure 5-8.

THREE ENGINE SPECIFIC RANGE
TRUE PRESSURE ALTITUDE 10,000 FT

NOTE:

1. CLEAN CONFIGURATION
2. STANDARD DAY
3. INCREASE % N_1 BY 0.13 PER °C ABOVE STANDARD

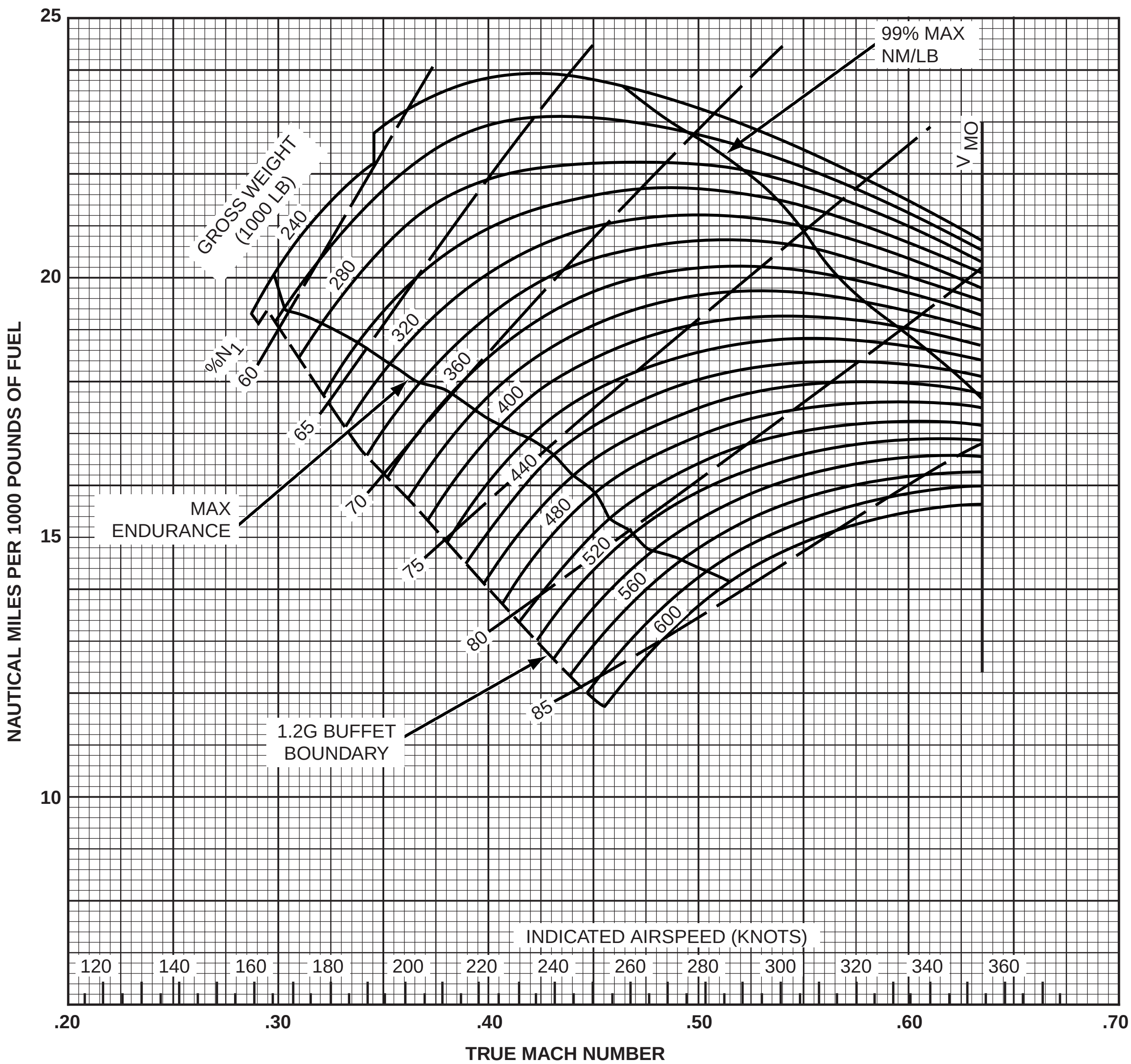


Figure 5-9.

THREE ENGINE SPECIFIC RANGE
TRUE PRESSURE ALTITUDE 12,000 FT

NOTE:

1. CLEAN CONFIGURATION
2. STANDARD DAY
3. INCREASE % N_1 BY 0.15 PER °C ABOVE STANDARD

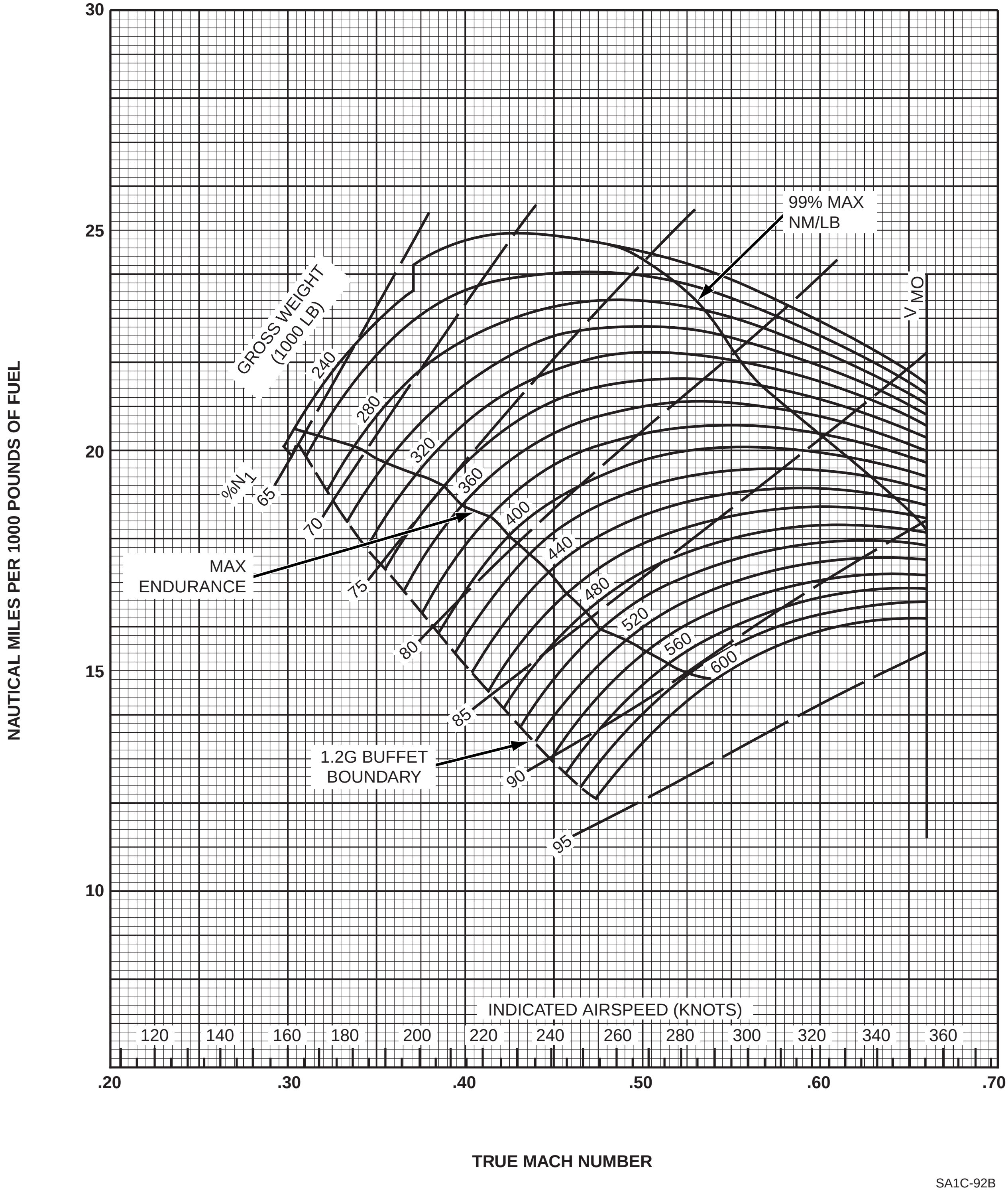


Figure 5-10.

THREE ENGINE SPECIFIC RANGE
TRUE PRESSURE ALTITUDE 14,000 FT

NOTE:

1. CLEAN CONFIGURATION
2. STANDARD DAY
3. INCREASE % N_1 BY 0.14 PER °C ABOVE STANDARD

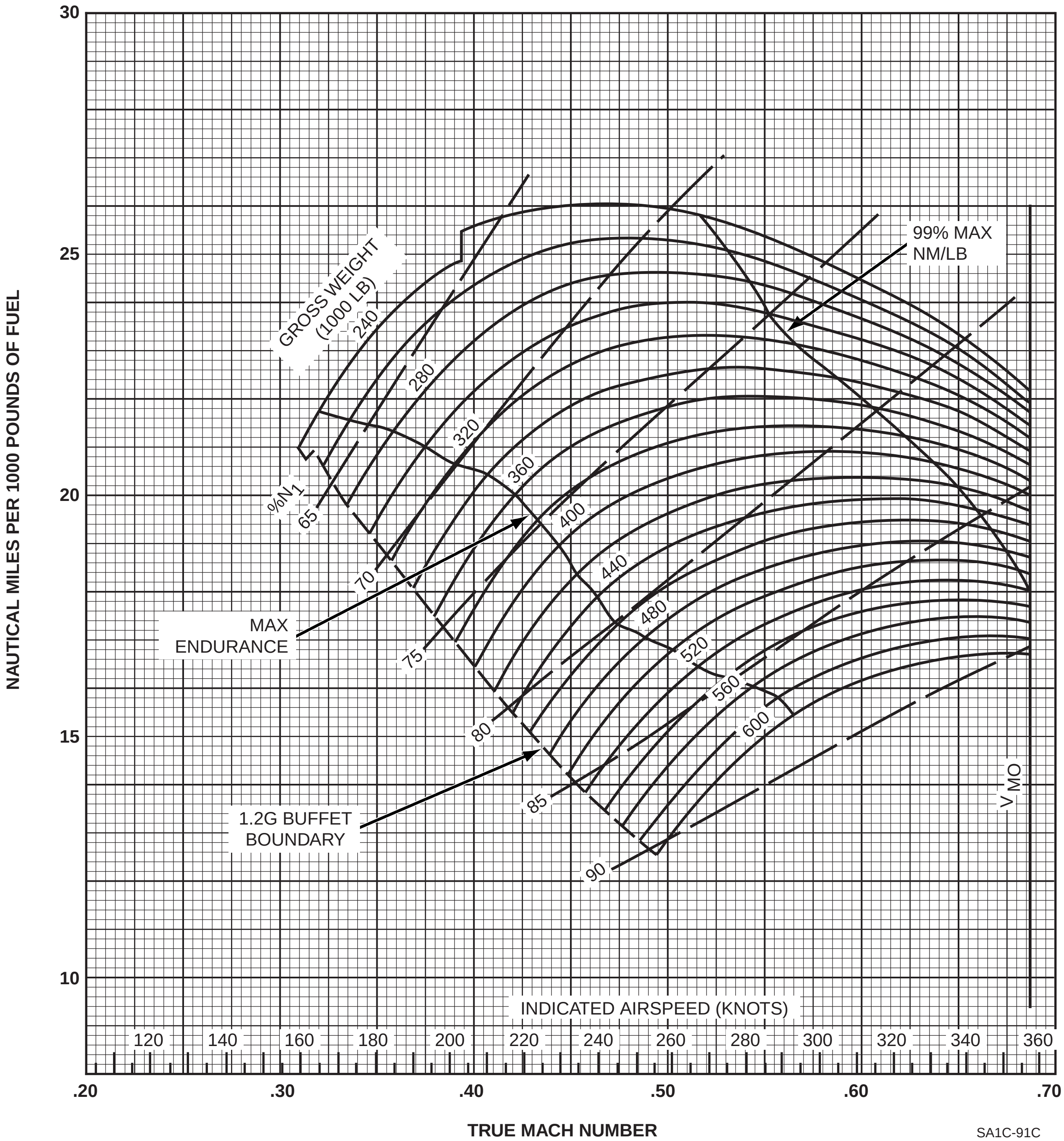


Figure 5-11.

THREE ENGINE SPECIFIC RANGE
TRUE PRESSURE ALTITUDE 16,000 FT

NOTE:

1. CLEAN CONFIGURATION
2. STANDARD DAY
3. INCREASE % N_1 BY 0.15 PER °C ABOVE STANDARD

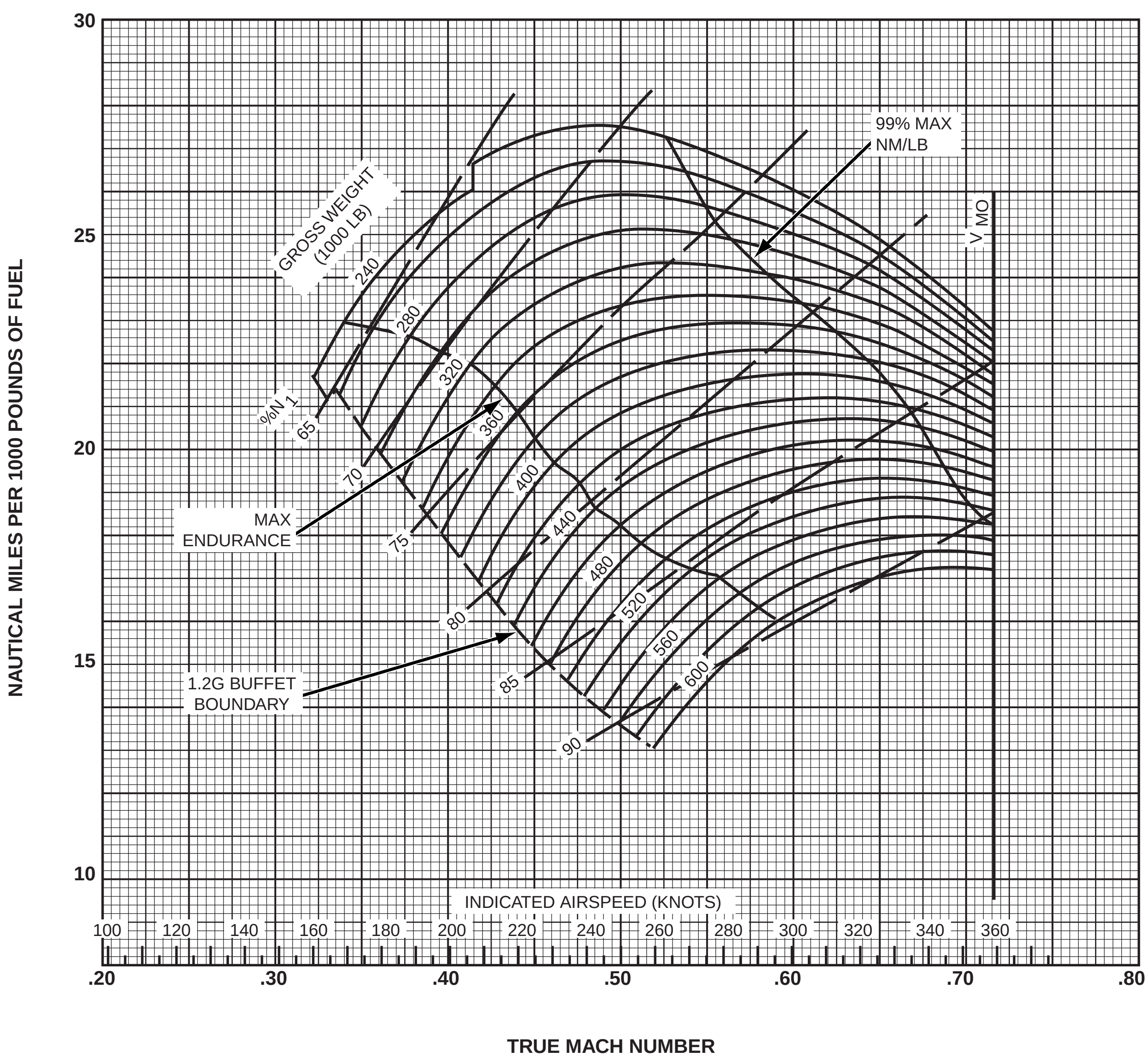


Figure 5-12.

THREE ENGINE SPECIFIC RANGE
TRUE PRESSURE ALTITUDE 18,000 FT

NOTE:

1. CLEAN CONFIGURATION
2. STANDARD DAY
3. INCREASE % N_1 BY 0.15 PER °C ABOVE STANDARD

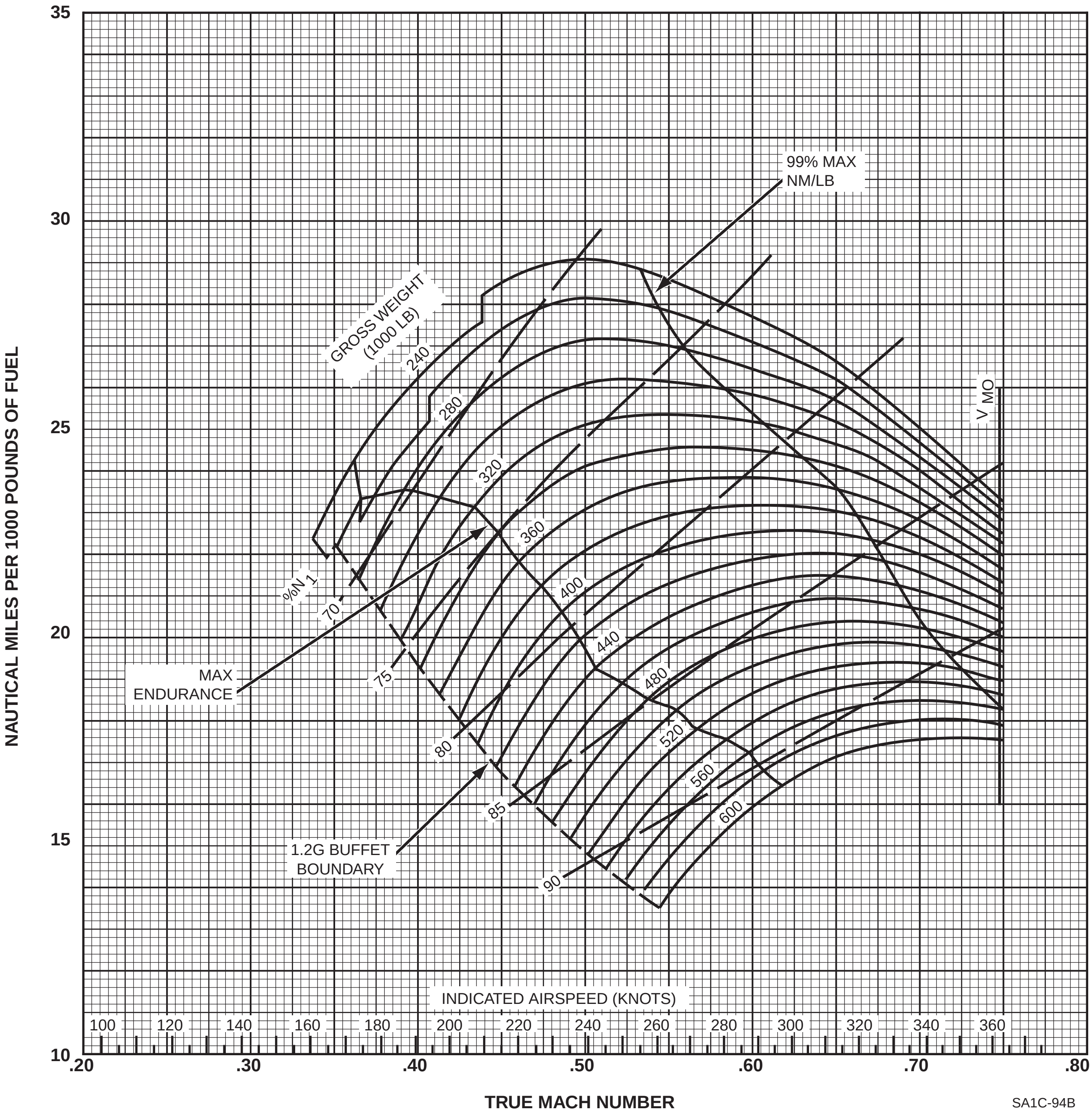


Figure 5-13.

THREE ENGINE SPECIFIC RANGE
TRUE PRESSURE ALTITUDE 20,000 FT

NOTE:

1. CLEAN CONFIGURATION
2. STANDARD DAY
3. INCREASE % N_1 BY 0.17 PER °C ABOVE STANDARD

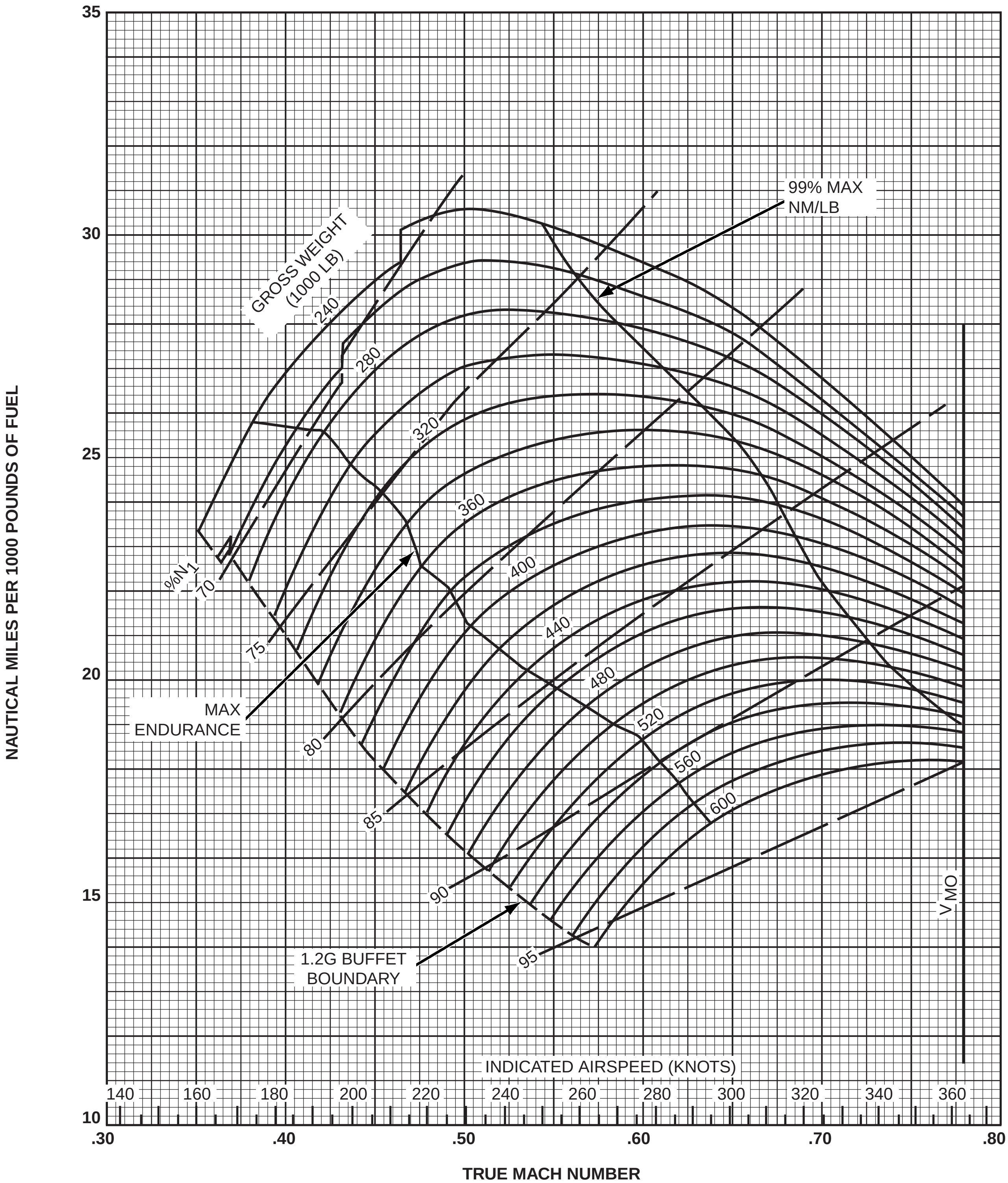


Figure 5-14.

THREE ENGINE SPECIFIC RANGE
TRUE PRESSURE ALTITUDE 21,000 FT

NOTE:

1. CLEAN CONFIGURATION
2. STANDARD DAY
3. INCREASE % N_1 BY 0.17 PER °C ABOVE STANDARD

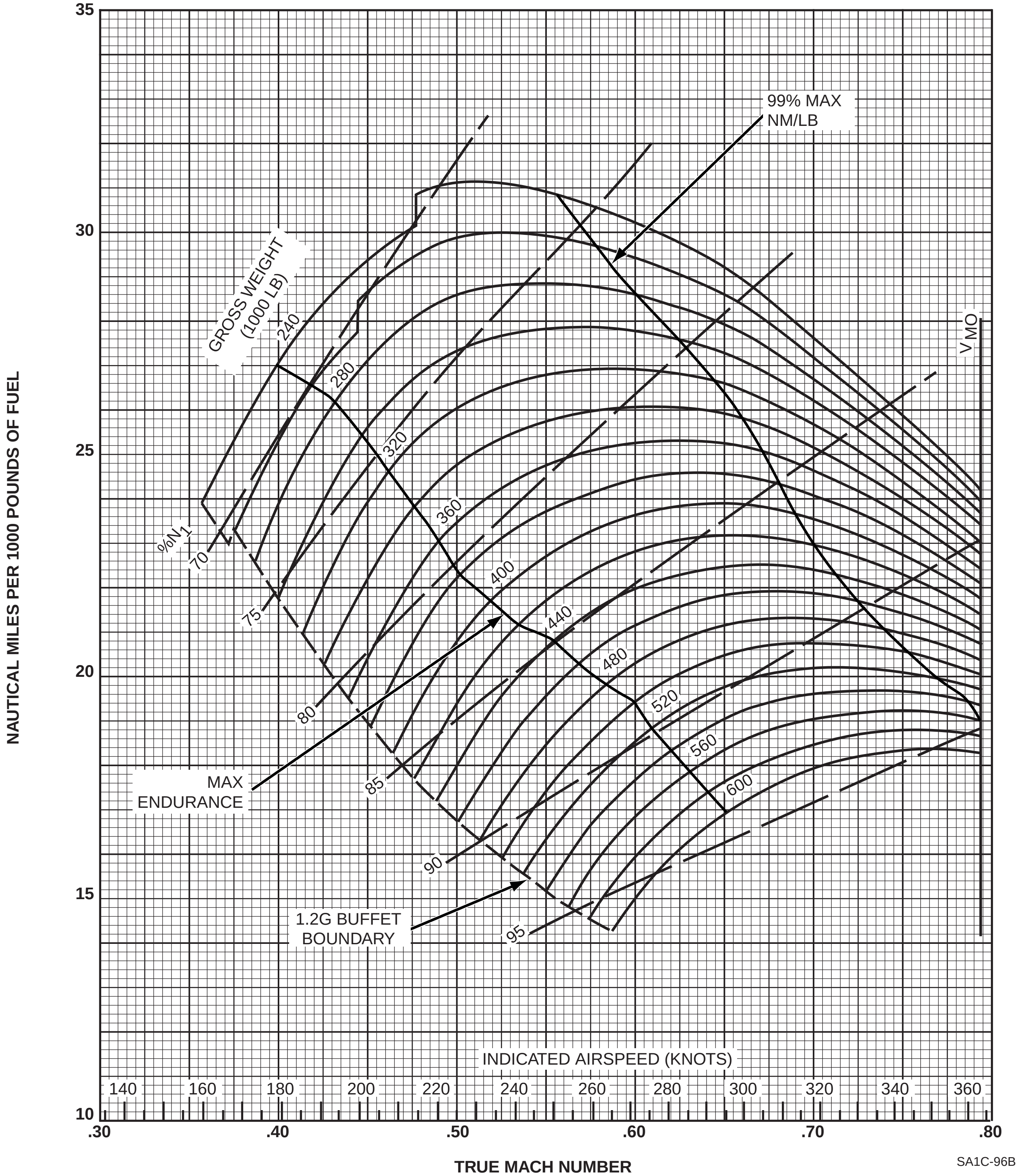


Figure 5-15.

THREE ENGINE SPECIFIC RANGE
TRUE PRESSURE ALTITUDE 22,000 FT

NOTE:

1. CLEAN CONFIGURATION
2. STANDARD DAY
3. INCREASE % N_1 BY 0.18 PER °C ABOVE STANDARD

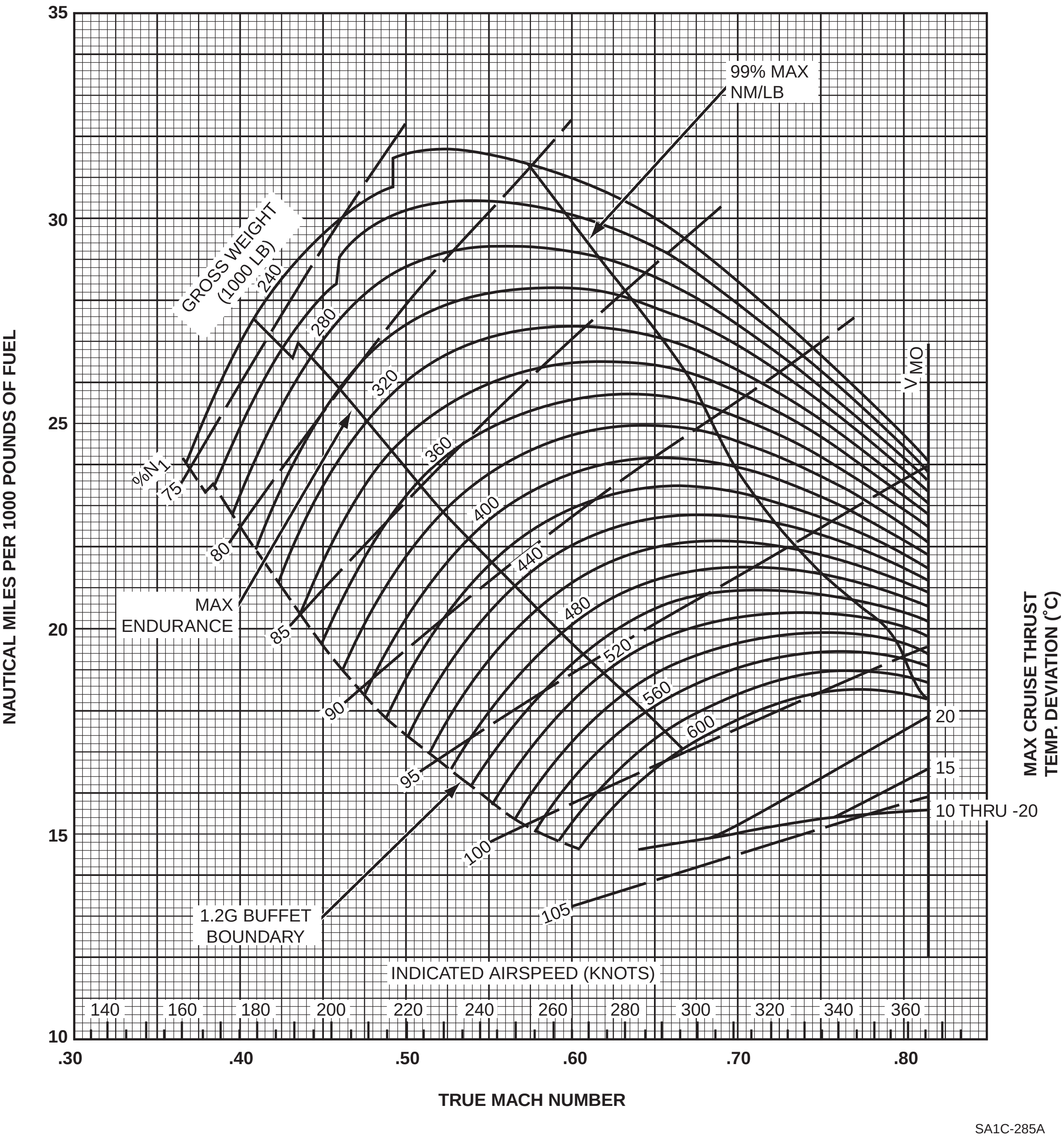


Figure 5-16.

THREE ENGINE SPECIFIC RANGE
TRUE PRESSURE ALTITUDE 23,000 FT

NOTE:

1. CLEAN CONFIGURATION
2. STANDARD DAY
3. INCREASE % N_1 BY 0.18 PER °C ABOVE STANDARD

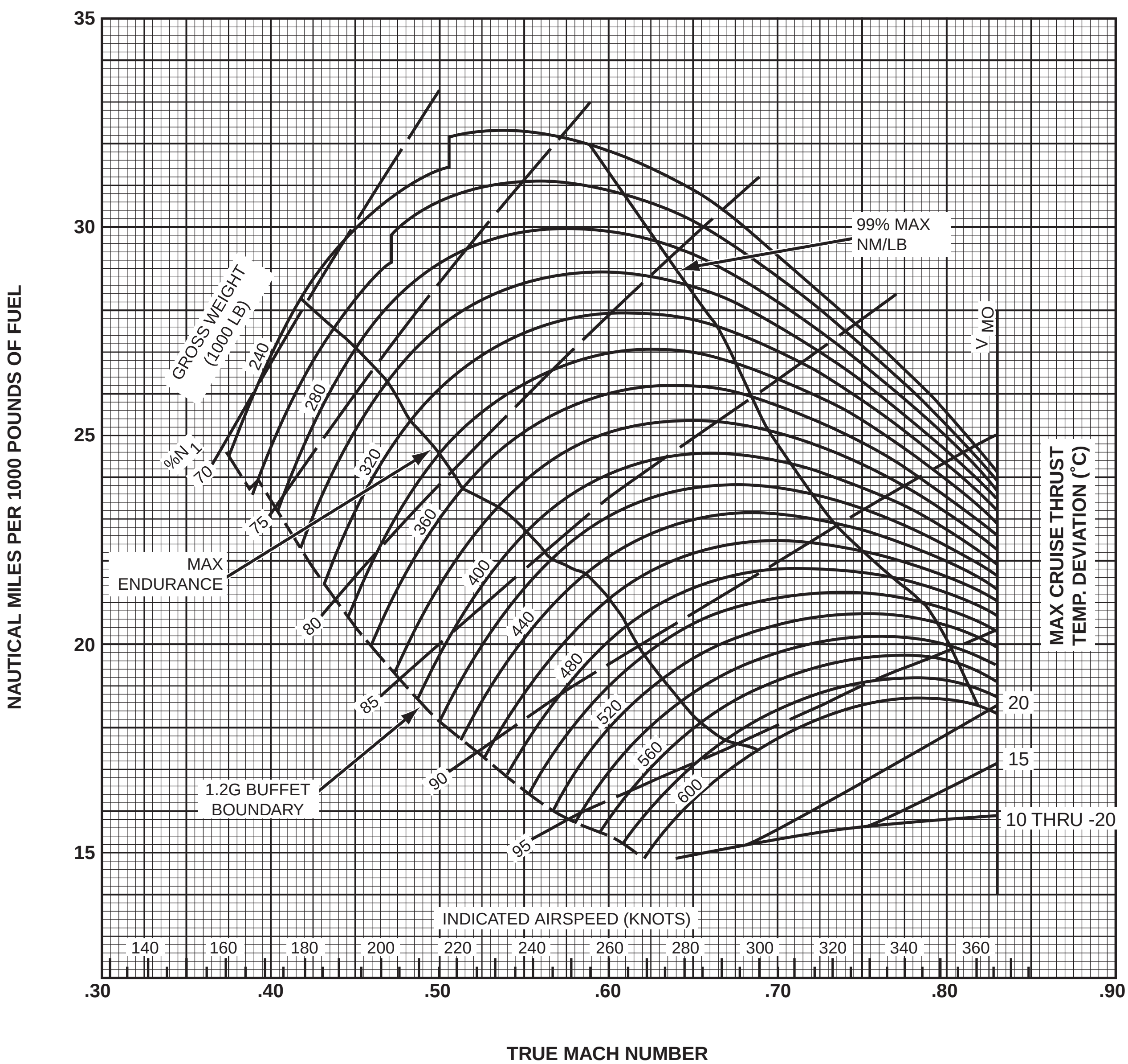


Figure 5-17.

THREE ENGINE SPECIFIC RANGE
TRUE PRESSURE ALTITUDE 24,000 FT

NOTE:

1. CLEAN CONFIGURATION
2. STANDARD DAY
3. INCREASE % N_1 BY 0.19 PER °C ABOVE STANDARD

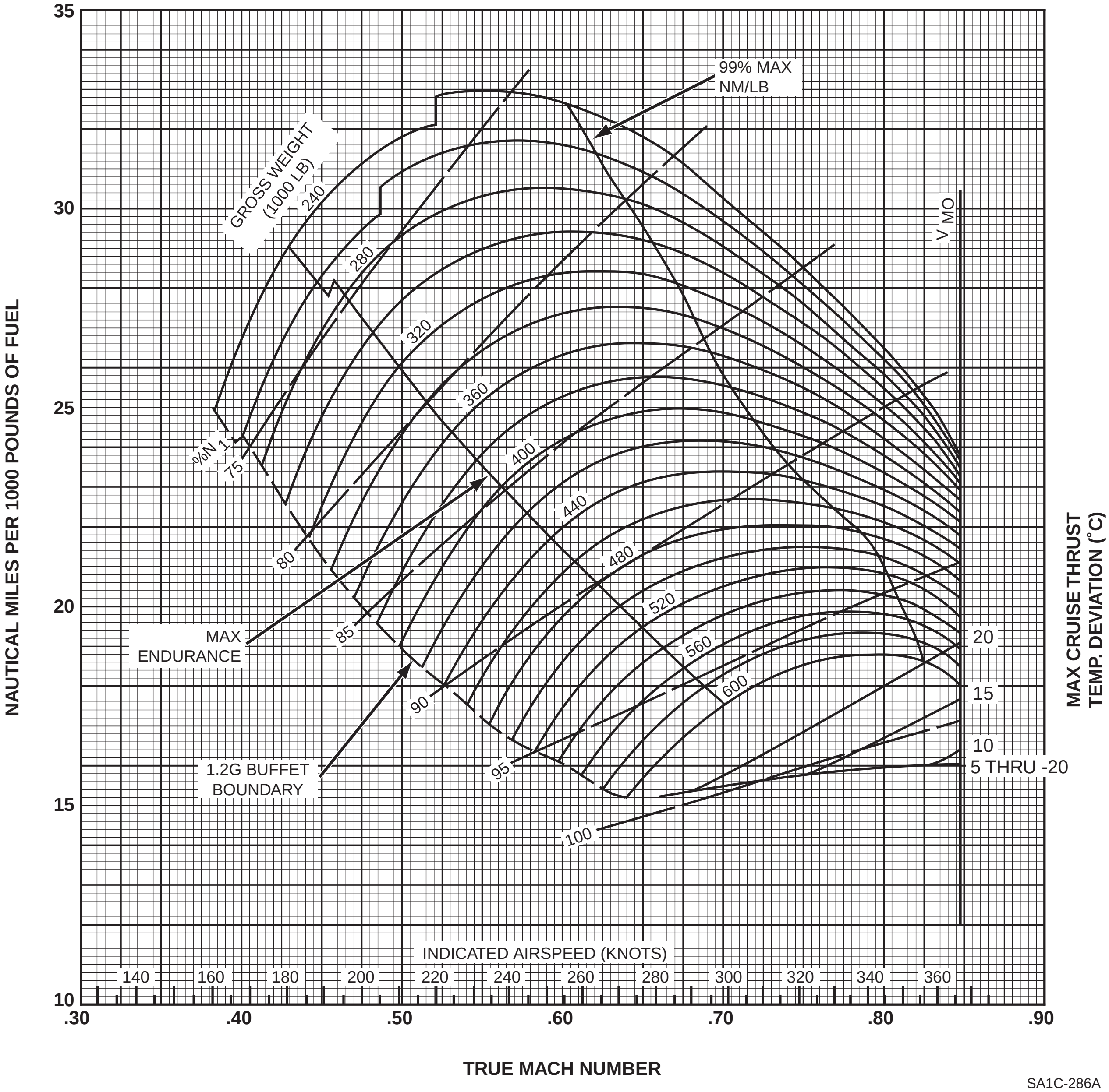


Figure 5-18.

THREE ENGINE SPECIFIC RANGE
TRUE PRESSURE ALTITUDE 25,000 FT

NOTE:

1. CLEAN CONFIGURATION
2. STANDARD DAY
3. INCREASE % N_1 BY 0.19 PER °C ABOVE STANDARD

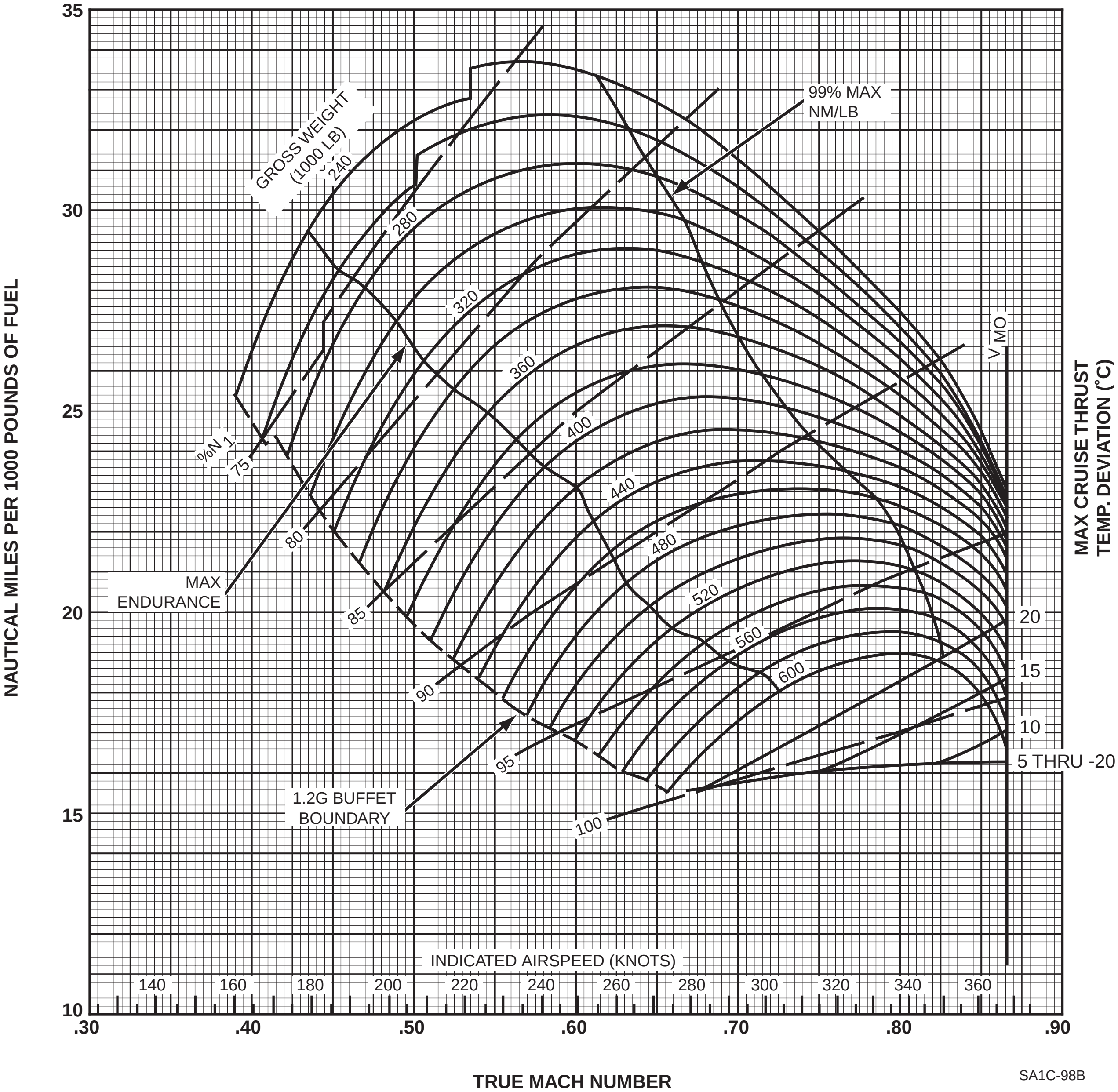


Figure 5-19.

THREE ENGINE SPECIFIC RANGE
TRUE PRESSURE ALTITUDE 26,000 FT

NOTE:

1. CLEAN CONFIGURATION
2. STANDARD DAY
3. INCREASE % N_1 BY 0.19 PER °C ABOVE STANDARD

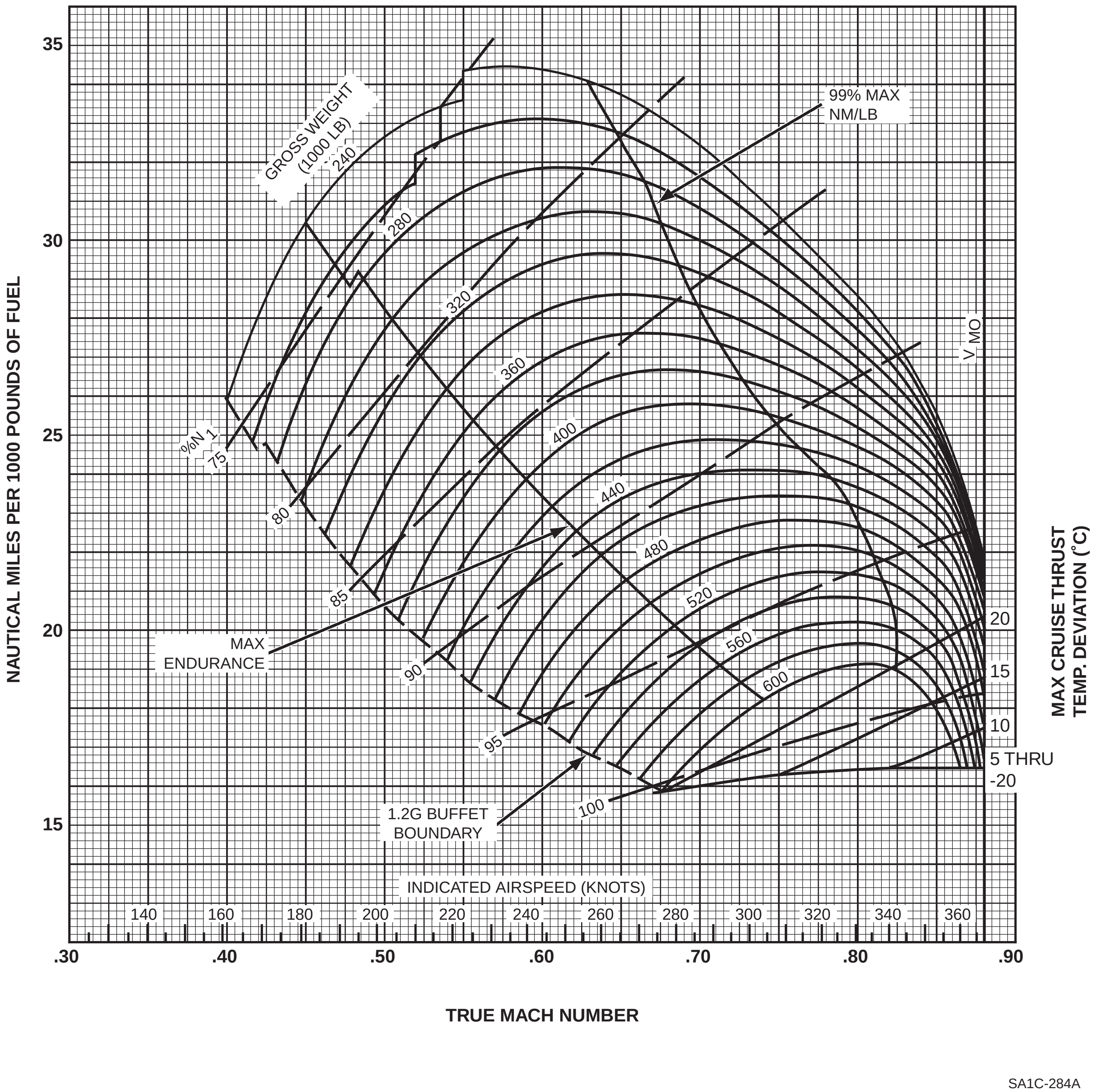


Figure 5-20.

THREE ENGINE SPECIFIC RANGE
TRUE PRESSURE ALTITUDE 27,000 FT

NOTE:

1. CLEAN CONFIGURATION
2. STANDARD DAY
3. INCREASE % N_1 BY 0.19 PER °C ABOVE STANDARD

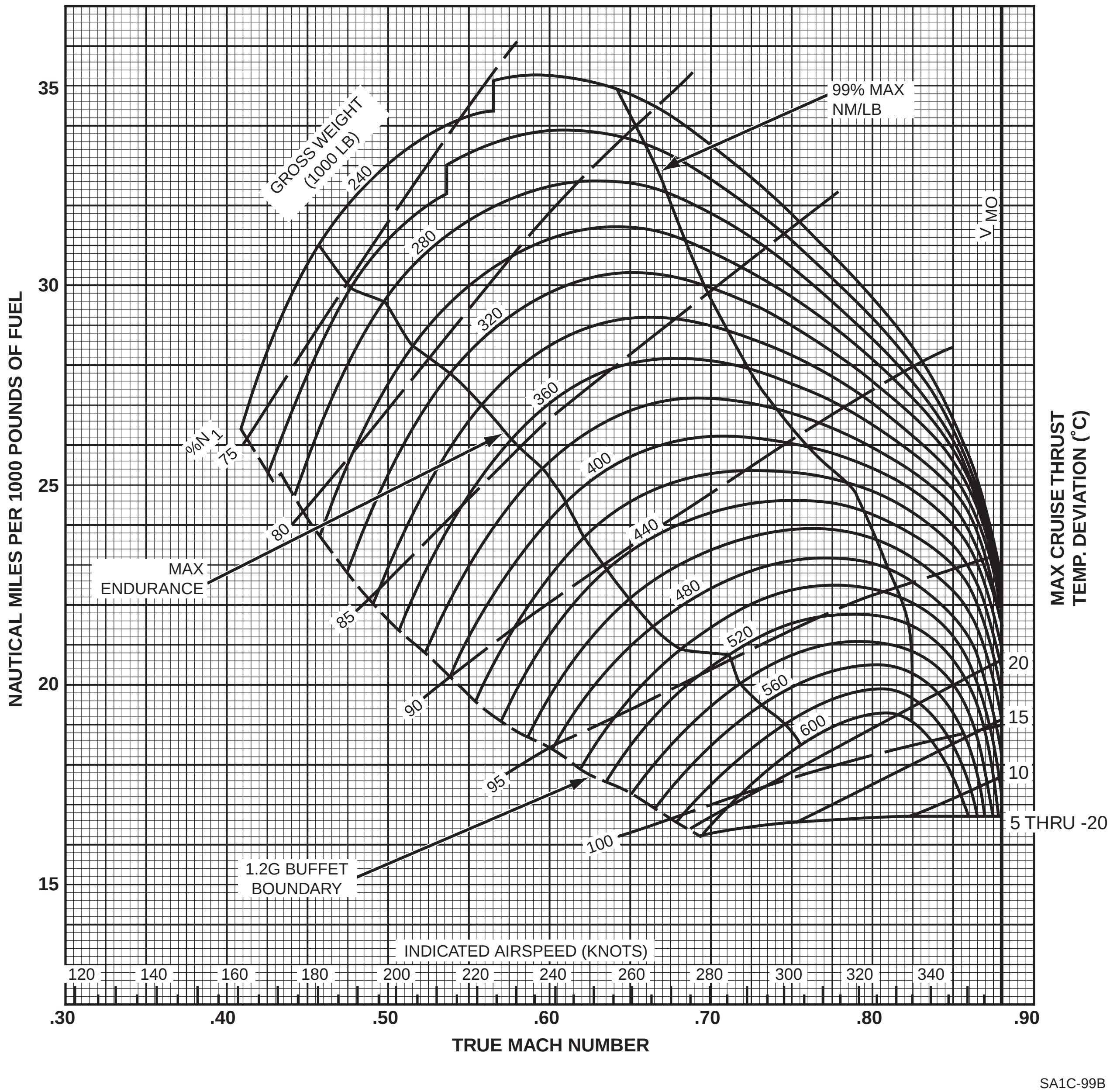


Figure 5-21.

THREE ENGINE SPECIFIC RANGE
TRUE PRESSURE ALTITUDE 28,000 FT

NOTE:

1. CLEAN CONFIGURATION
2. STANDARD DAY
3. INCREASE % N_1 BY 0.20 PER °C ABOVE STANDARD

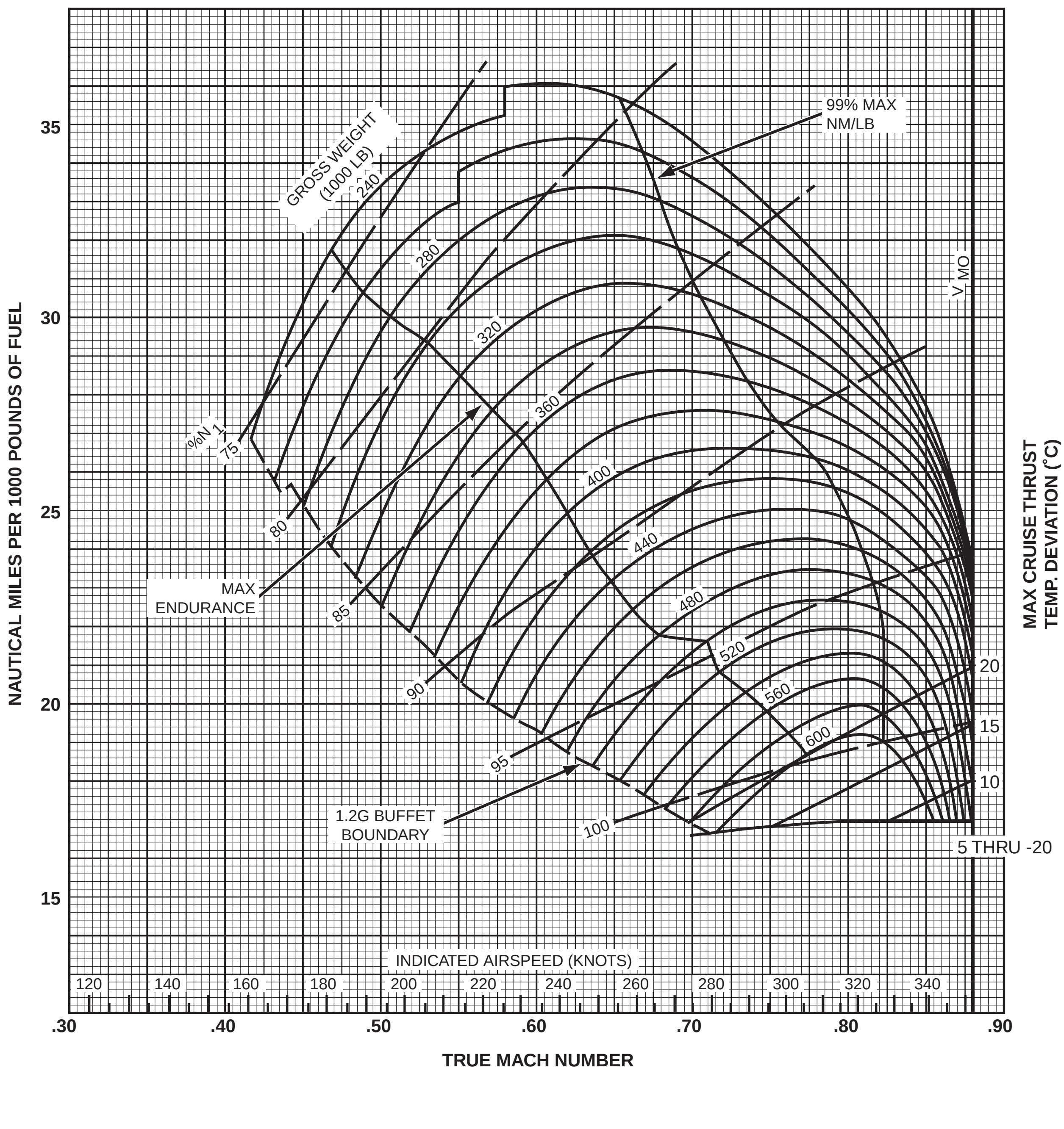


Figure 5-22.

THREE ENGINE SPECIFIC RANGE
TRUE PRESSURE ALTITUDE 29,000 FT

NOTE:

1. CLEAN CONFIGURATION
2. STANDARD DAY
3. INCREASE % N_1 BY 0.20 PER °C ABOVE STANDARD

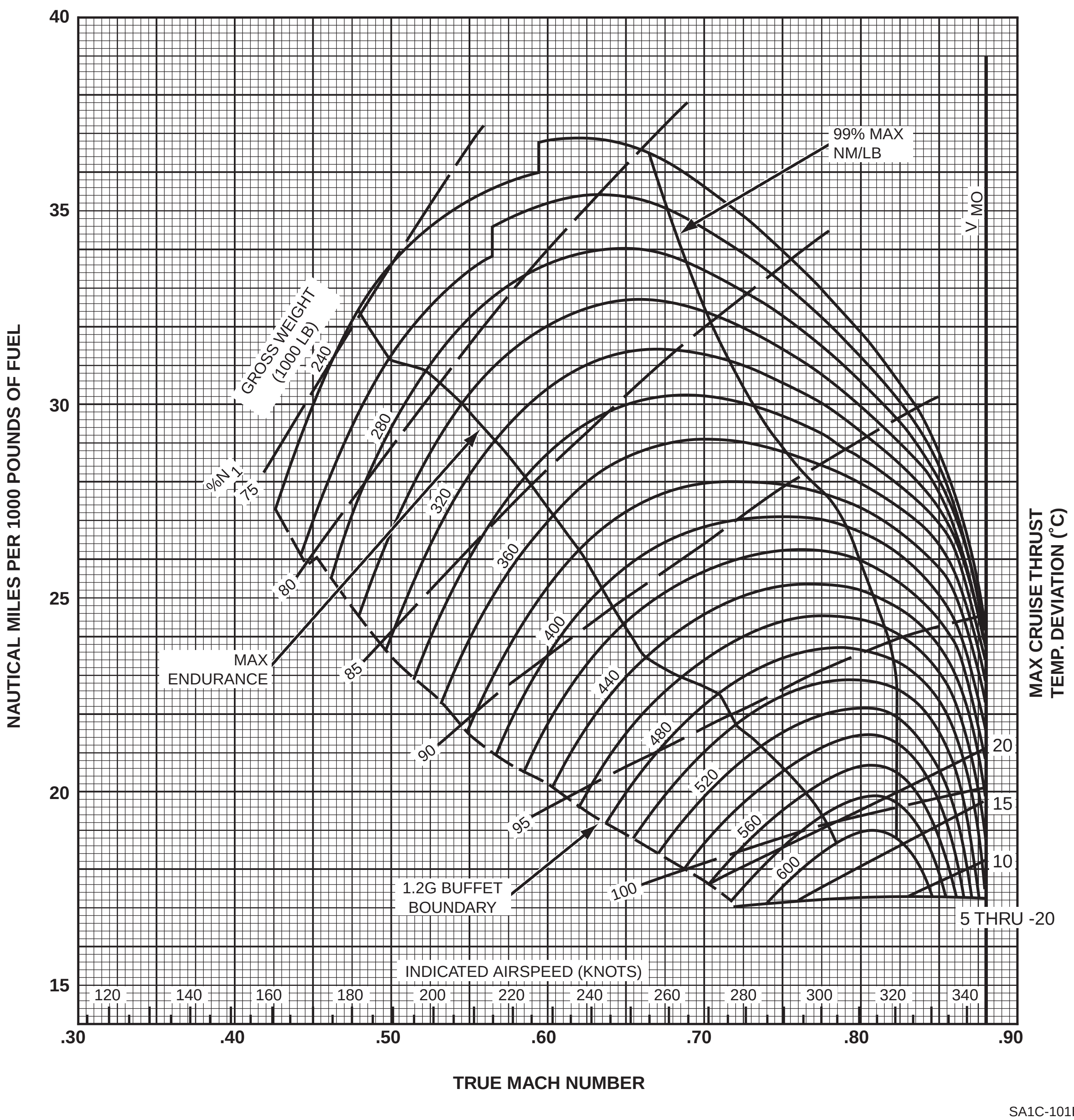


Figure 5-23.

THREE ENGINE SPECIFIC RANGE
TRUE PRESSURE ALTITUDE 30,000 FT

NOTE:

1. CLEAN CONFIGURATION
2. STANDARD DAY
3. INCREASE % N_1 BY 0.20 PER °C ABOVE STANDARD

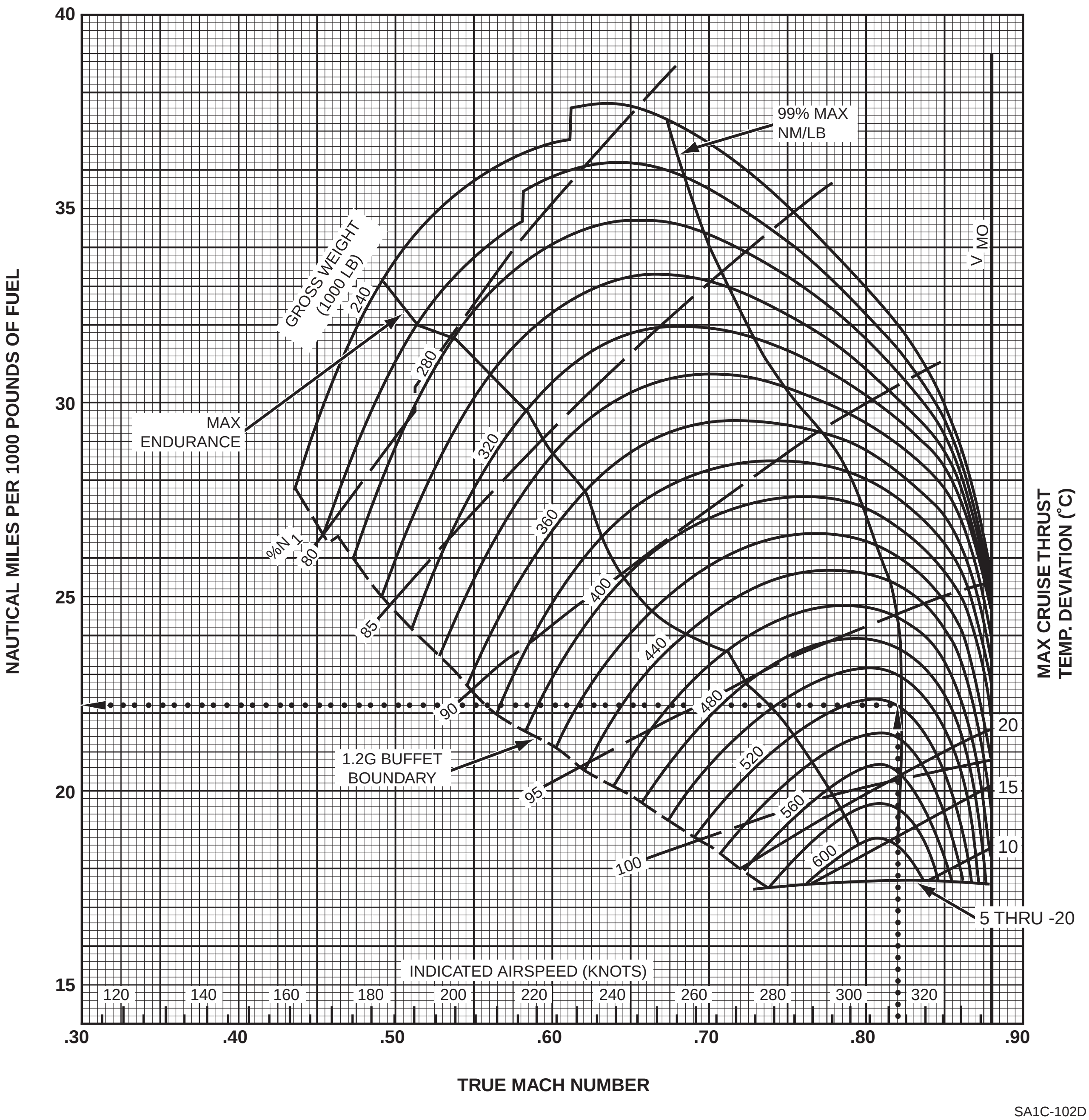


Figure 5-24.

THREE ENGINE SPECIFIC RANGE
TRUE PRESSURE ALTITUDE 31,000 FT

NOTE:

1. CLEAN CONFIGURATION
2. STANDARD DAY
3. INCREASE % N_1 BY 0.21 PER °C ABOVE STANDARD

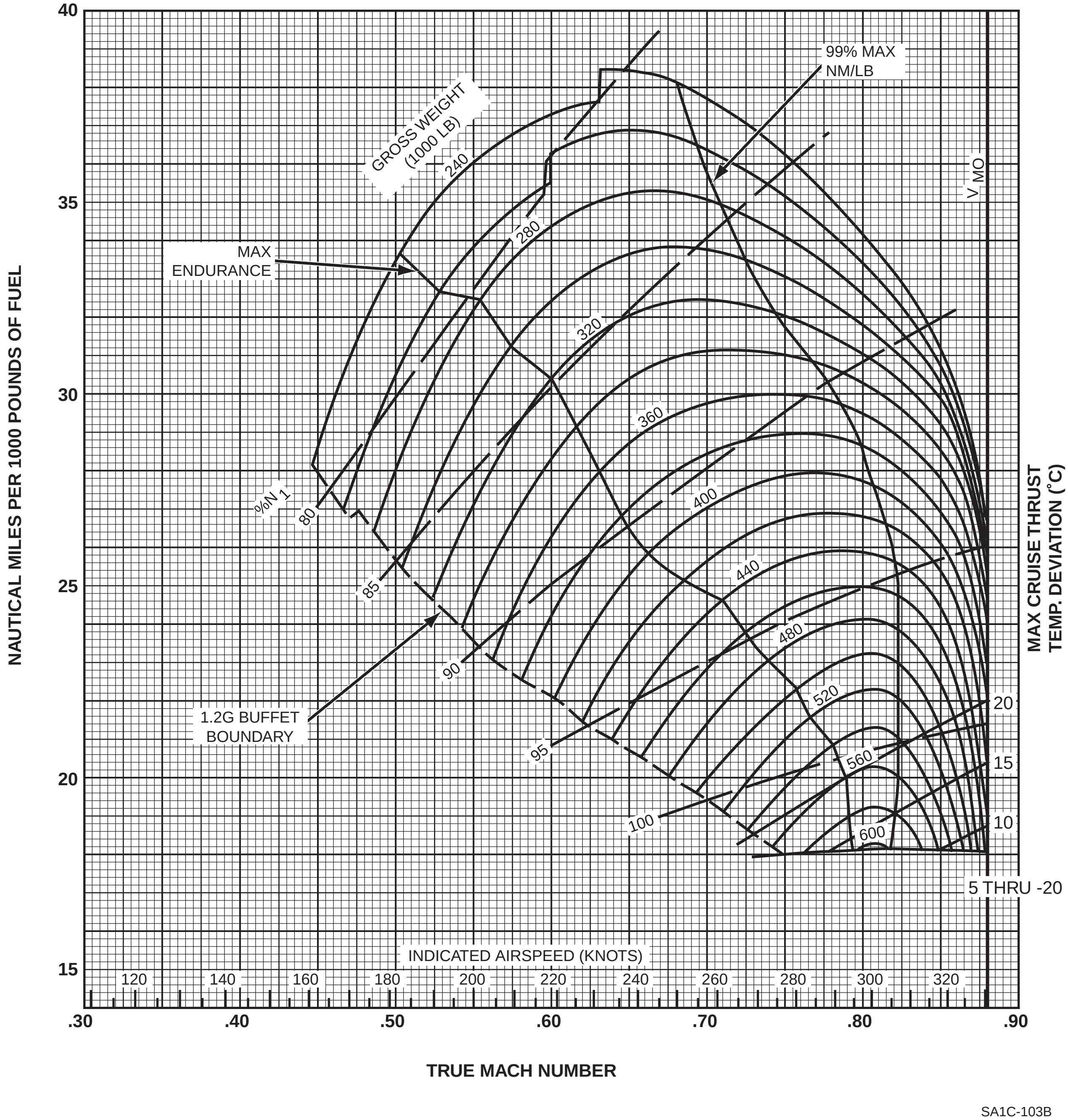


Figure 5-25.

THREE ENGINE SPECIFIC RANGE
TRUE PRESSURE ALTITUDE 32,000 FT

NOTE:

1. CLEAN CONFIGURATION
2. STANDARD DAY
3. INCREASE % N_1 BY 0.21 PER °C ABOVE STANDARD

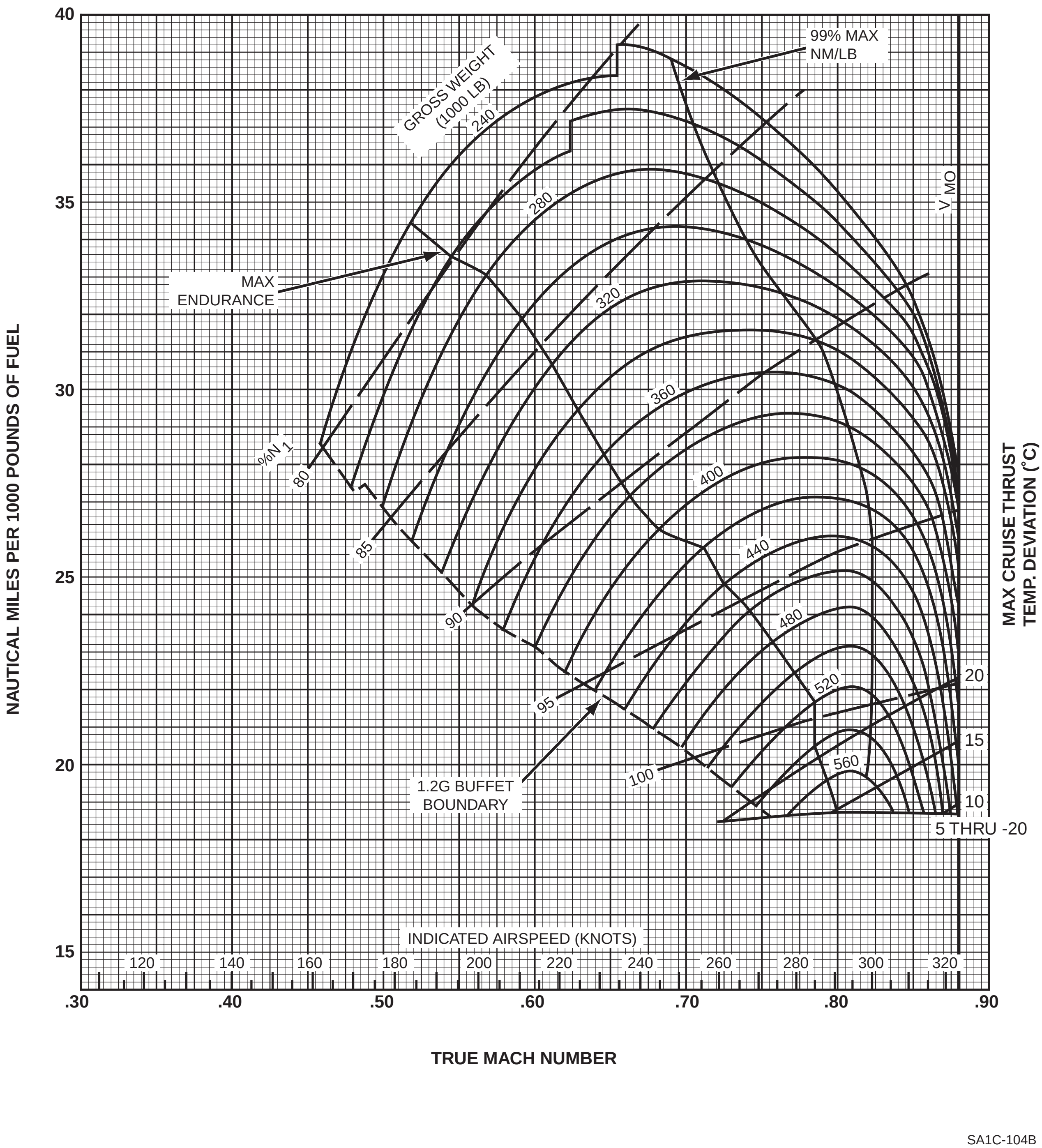


Figure 5-26.

THREE ENGINE SPECIFIC RANGE
TRUE PRESSURE ALTITUDE 33,000 FT

NOTE:

1. CLEAN CONFIGURATION
2. STANDARD DAY
3. INCREASE % N_1 BY 0.21 PER °C ABOVE STANDARD

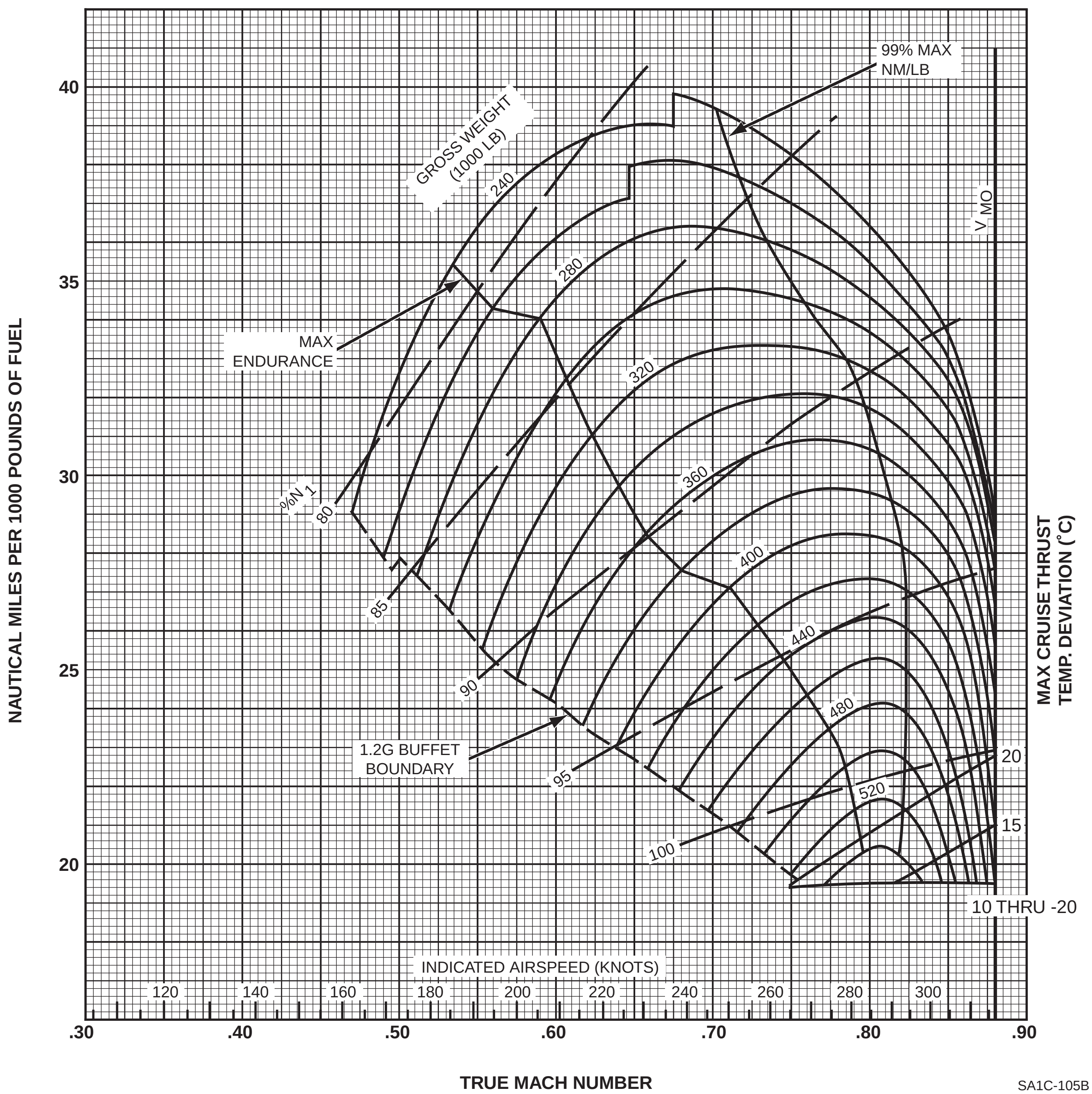


Figure 5-27.

THREE ENGINE SPECIFIC RANGE
TRUE PRESSURE ALTITUDE 35,000 FT

NOTE:

1. CLEAN CONFIGURATION
2. STANDARD DAY
3. INCREASE % N_1 BY 0.22 PER °C ABOVE STANDARD

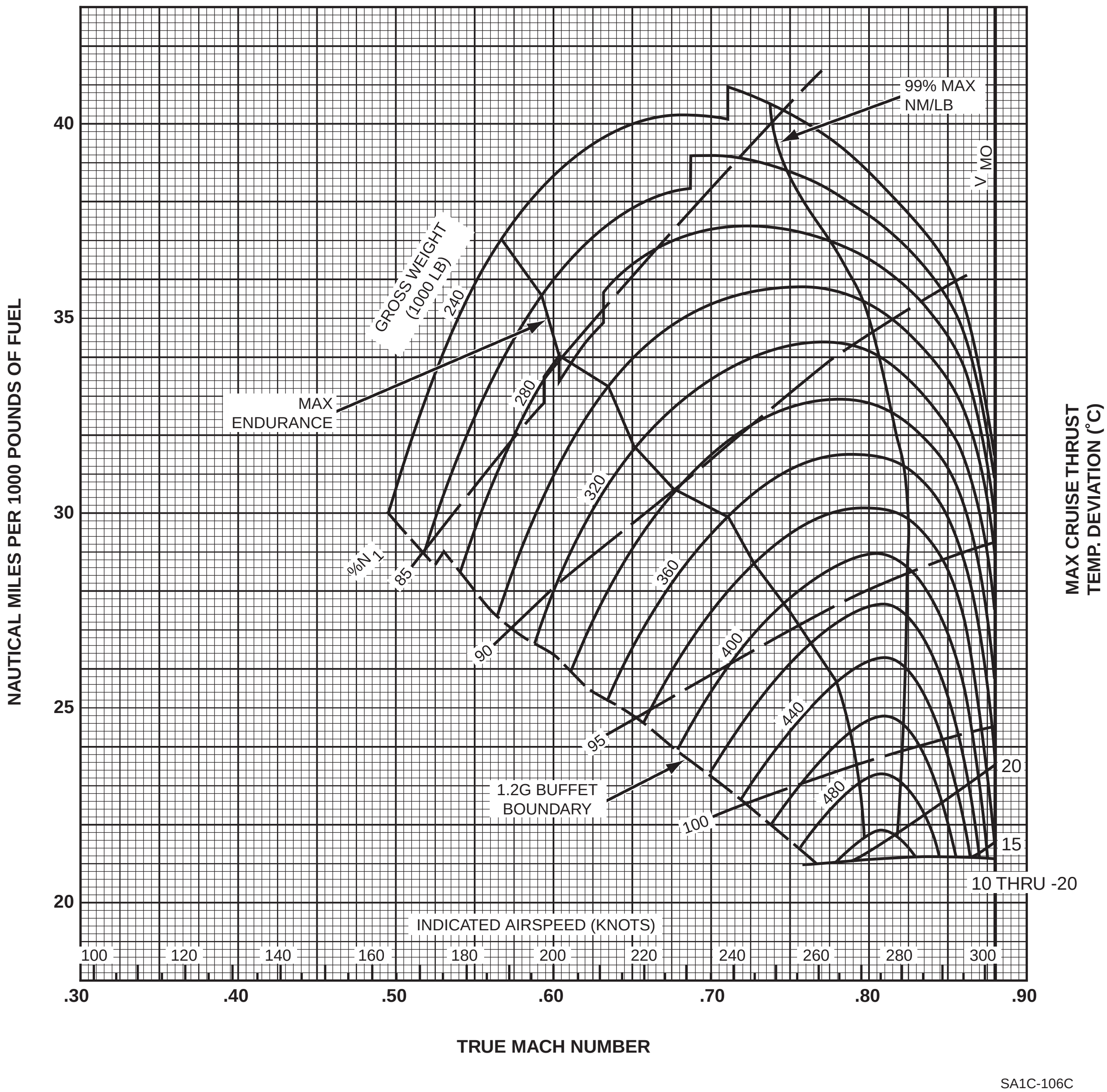


Figure 5-28.

THREE ENGINE SPECIFIC RANGE
TRUE PRESSURE ALTITUDE 37,000 FT

NOTE:

1. CLEAN CONFIGURATION
2. STANDARD DAY
3. INCREASE % N_1 BY 0.22 PER °C ABOVE STANDARD

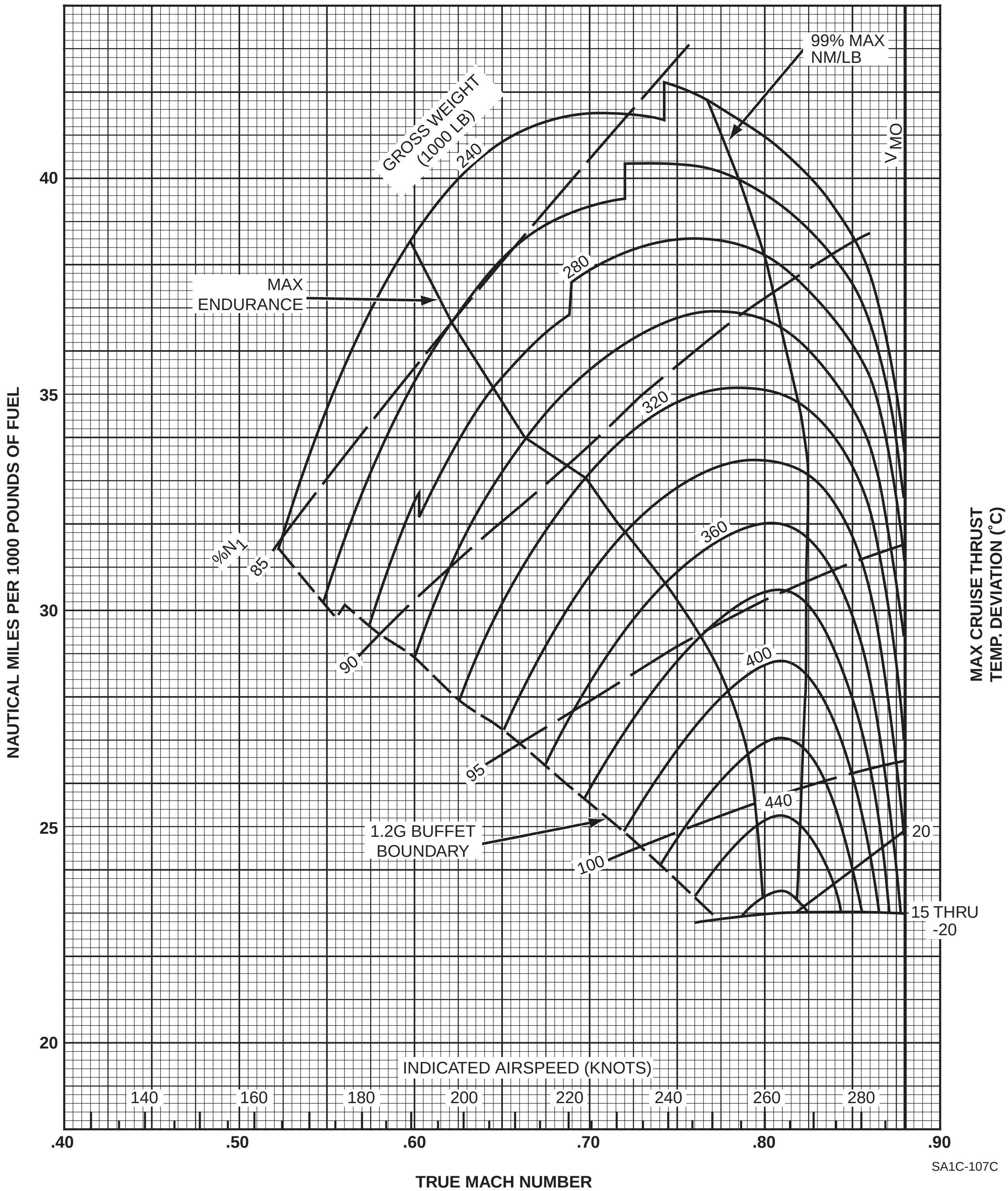


Figure 5-29.

THREE ENGINE SPECIFIC RANGE
TRUE PRESSURE ALTITUDE 39,000 FT

NOTE:

1. CLEAN CONFIGURATION
2. STANDARD DAY
3. INCREASE % N_1 BY 0.22 PER °C ABOVE STANDARD

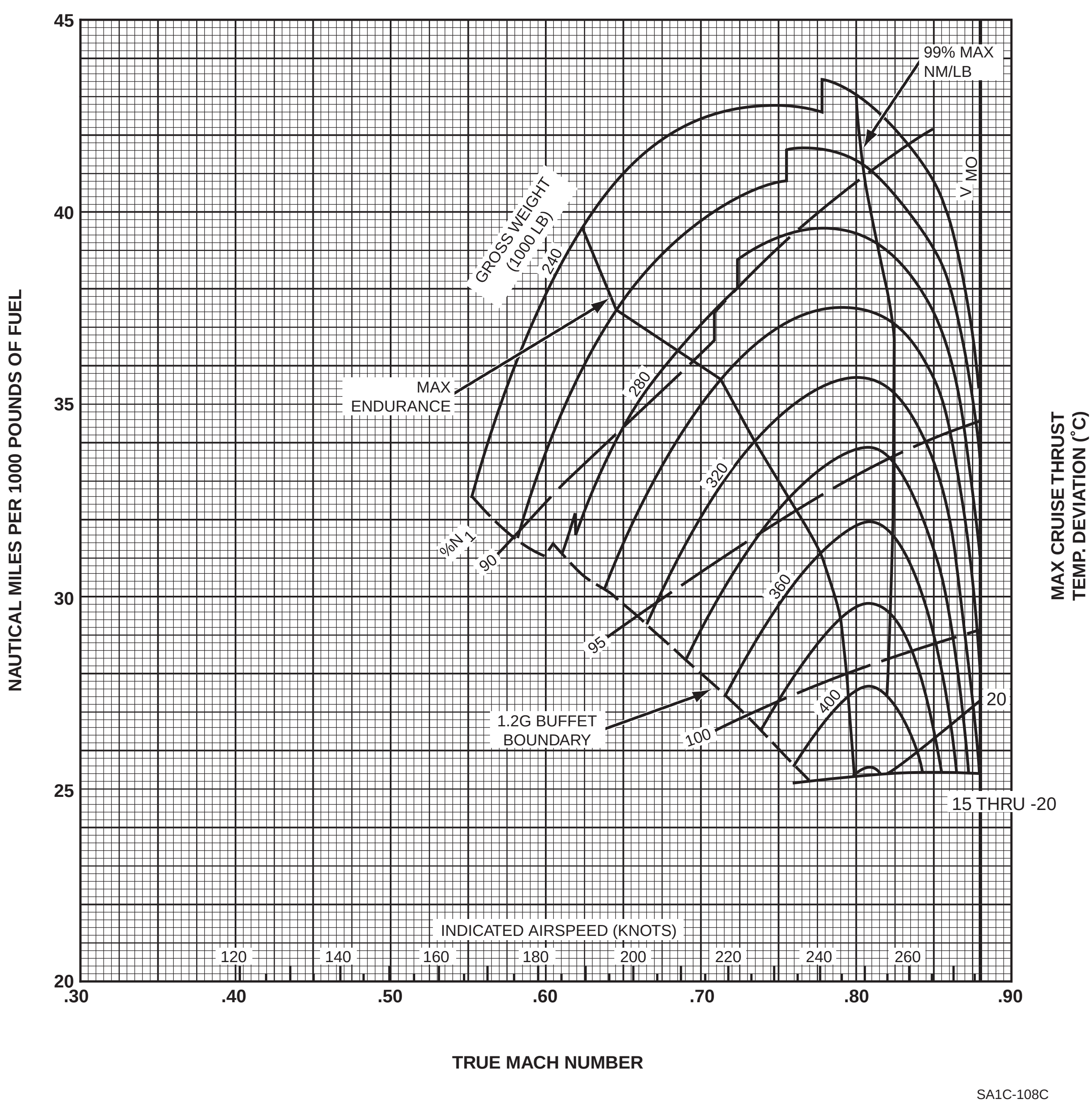


Figure 5-30.

THREE ENGINE SPECIFIC RANGE
TRUE PRESSURE ALTITUDE 41,000 FT

NOTE:

1. CLEAN CONFIGURATION
2. STANDARD DAY
3. INCREASE % N_1 BY 0.23 PER °C ABOVE STANDARD

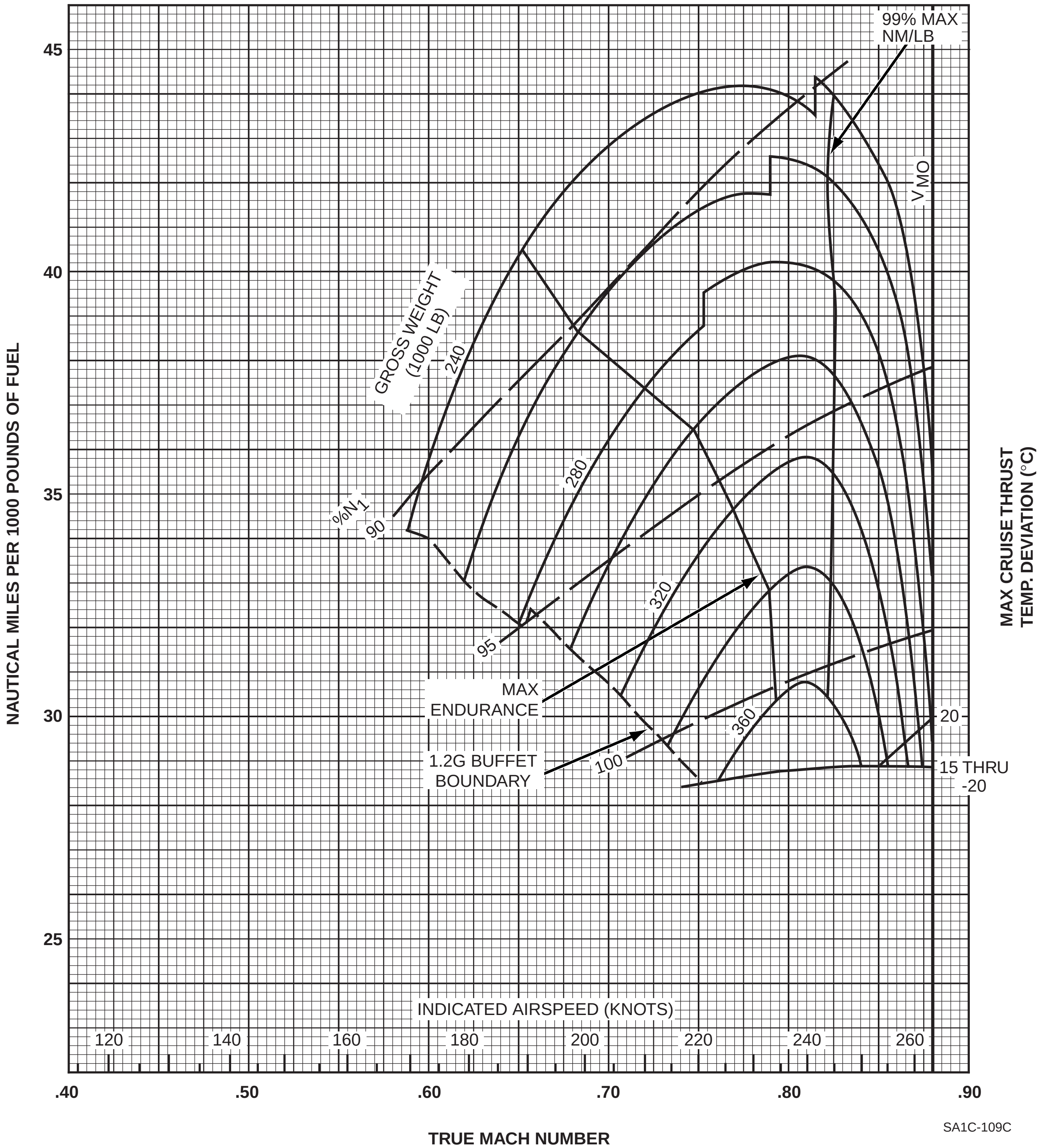


Figure 5-31.

THREE ENGINE SPECIFIC RANGE
TRUE PRESSURE ALTITUDE 42,000 FT

NOTE:

1. CLEAN CONFIGURATION
2. STANDARD DAY
3. INCREASE % N_1 BY 0.23 PER °C ABOVE STANDARD

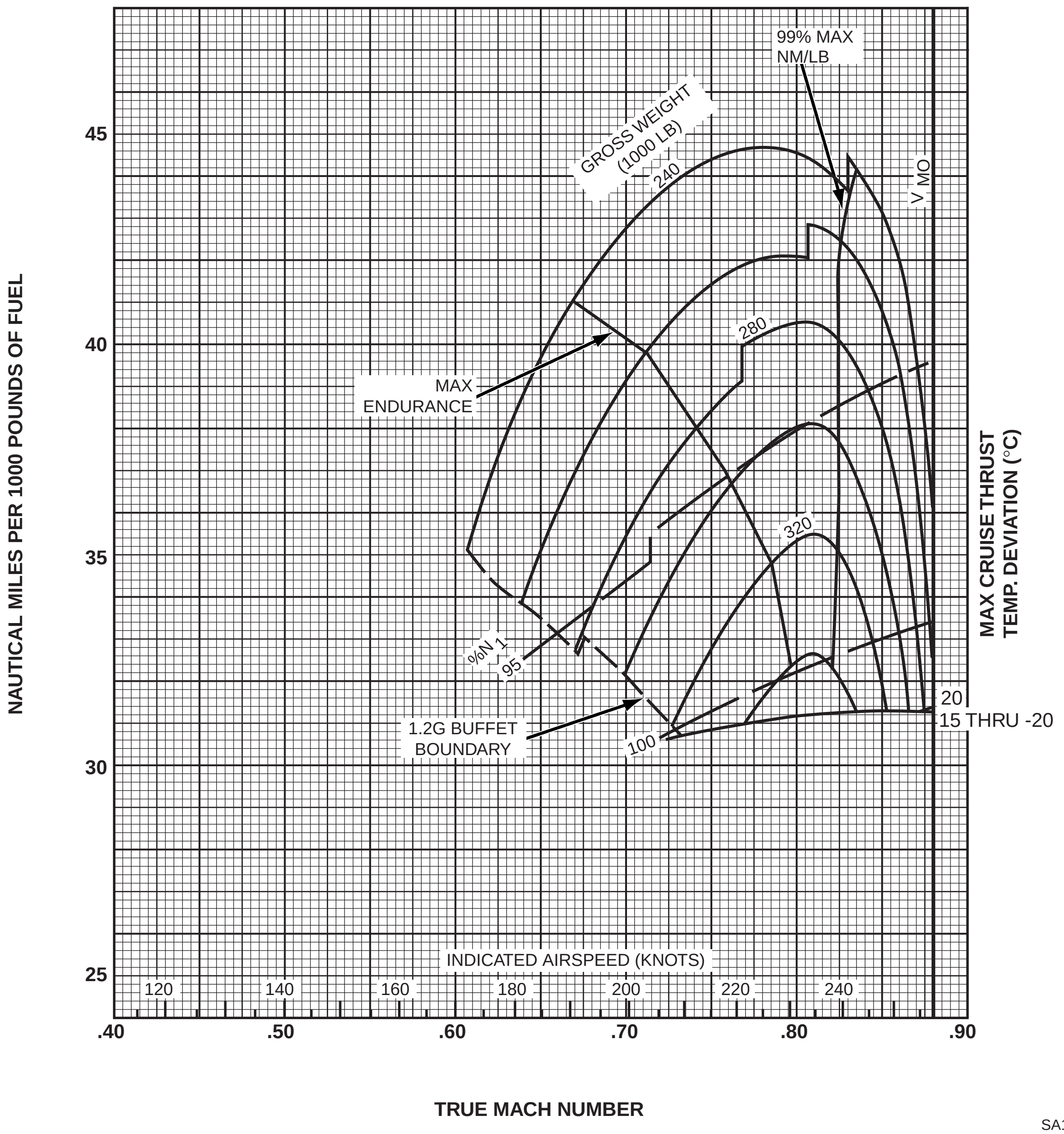


Figure 5-32.

TWO ENGINE SPECIFIC RANGE
TRUE PRESSURE ALTITUDE SEA LEVEL

NOTE:

1. CLEAN CONFIGURATION
2. STANDARD DAY
3. INCREASE % N_1 BY 0.13 PER °C ABOVE STANDARD

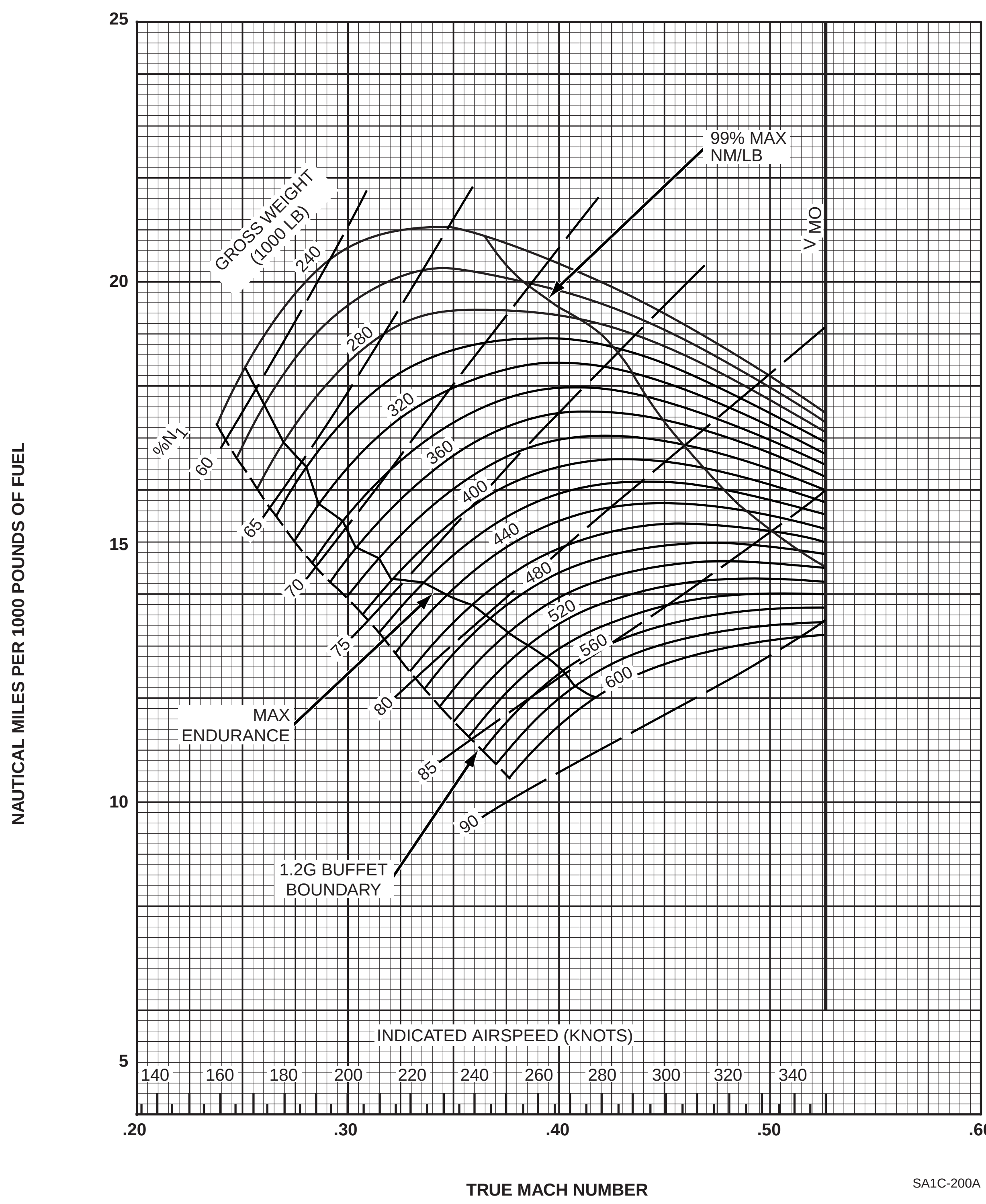


Figure 5-33.

TWO ENGINE SPECIFIC RANGE
TRUE PRESSURE ALTITUDE 5000 FT

NOTE:

1. CLEAN CONFIGURATION
2. STANDARD DAY
3. INCREASE % N_1 BY 0.15 PER °C ABOVE STANDARD

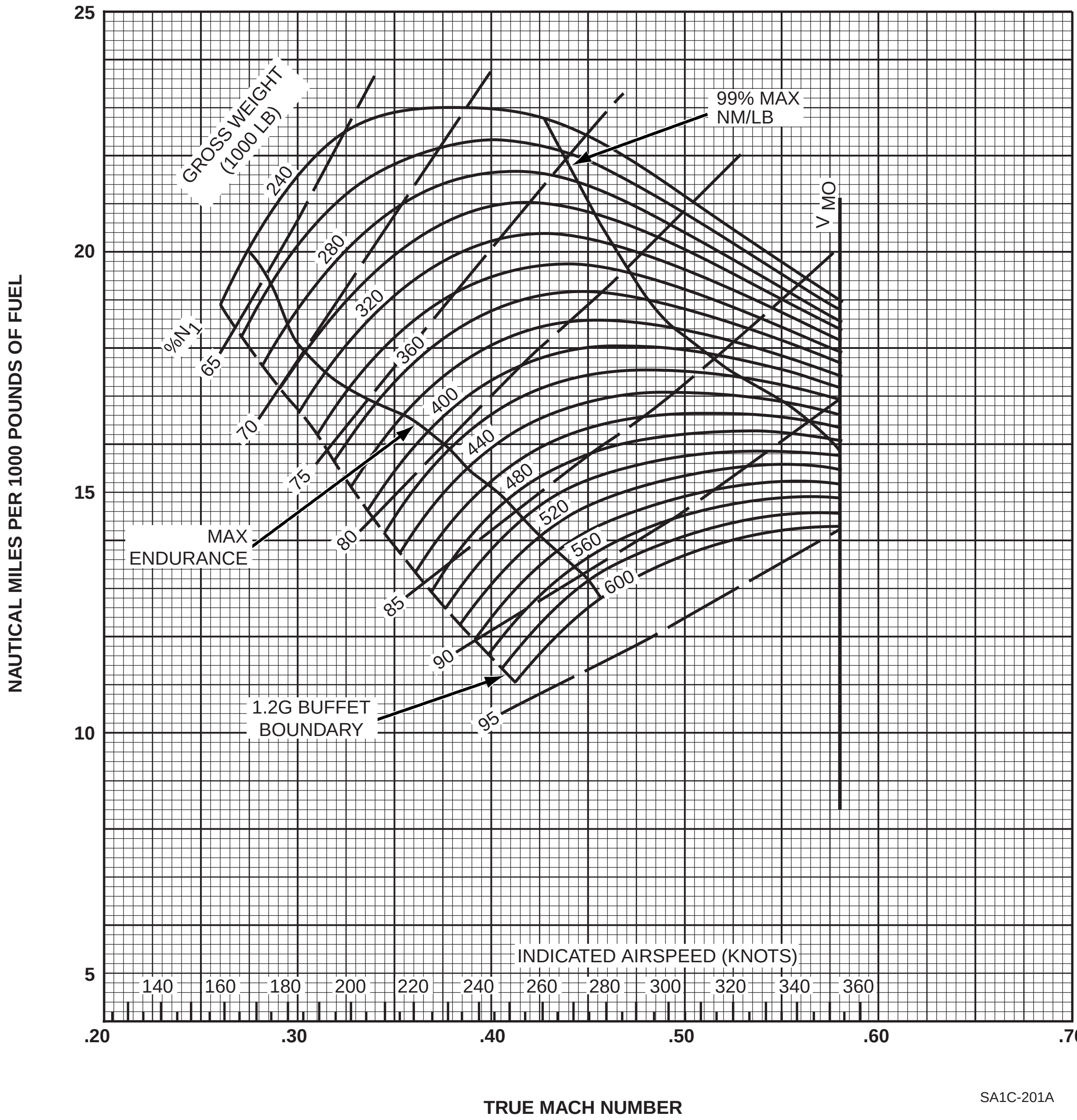
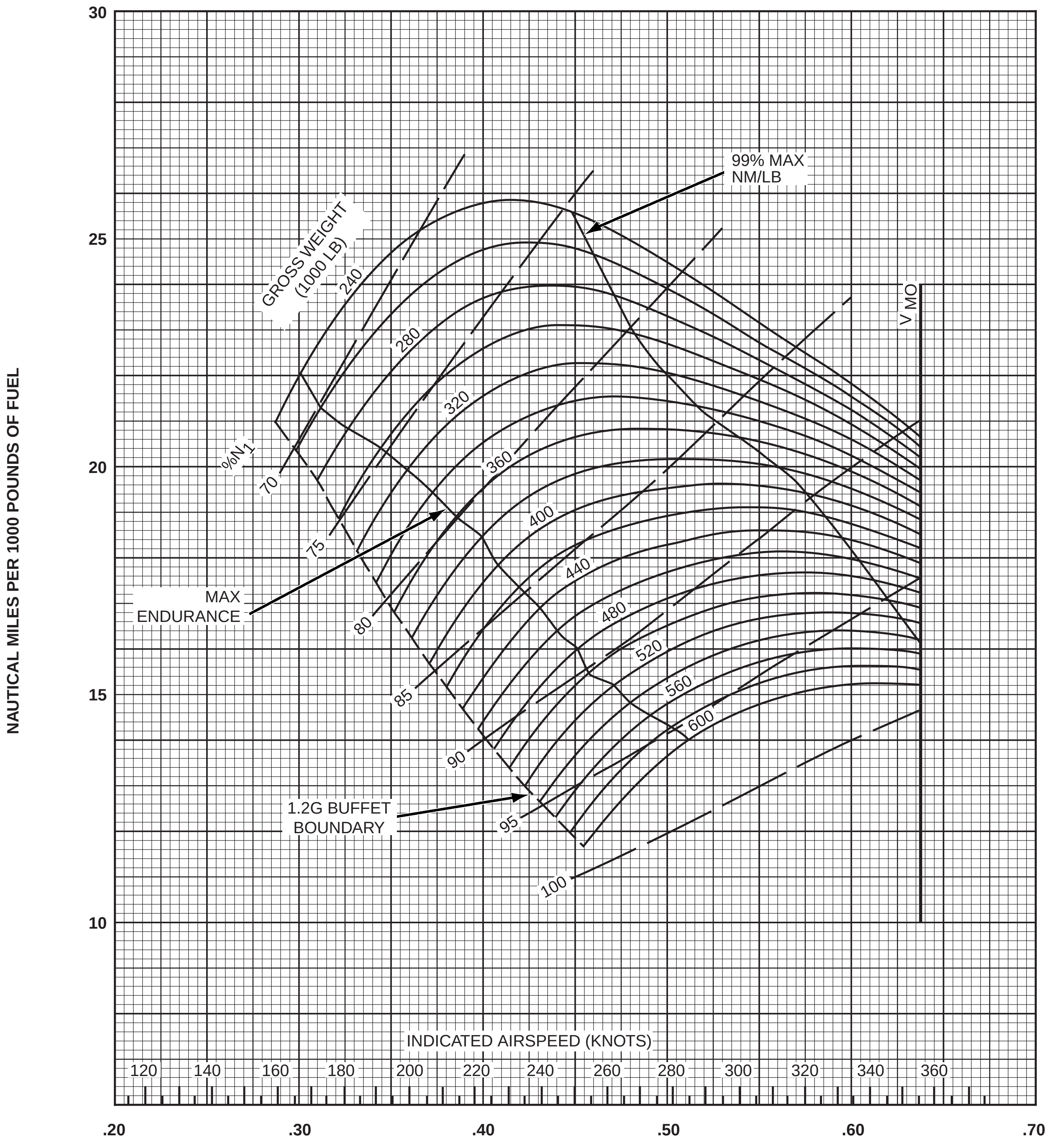


Figure 5-34.

TWO ENGINE SPECIFIC RANGE
TRUE PRESSURE ALTITUDE 10,000 FT

NOTE:

1. CLEAN CONFIGURATION
2. STANDARD DAY
3. INCREASE % N_1 BY 0.16 PER °C ABOVE STANDARD



SA1C-202B

Figure 5-35.

TWO ENGINE SPECIFIC RANGE
TRUE PRESSURE ALTITUDE 15,000 FT

NOTE:

1. CLEAN CONFIGURATION
2. STANDARD DAY
3. INCREASE % N_1 BY 0.18 PER °C ABOVE STANDARD

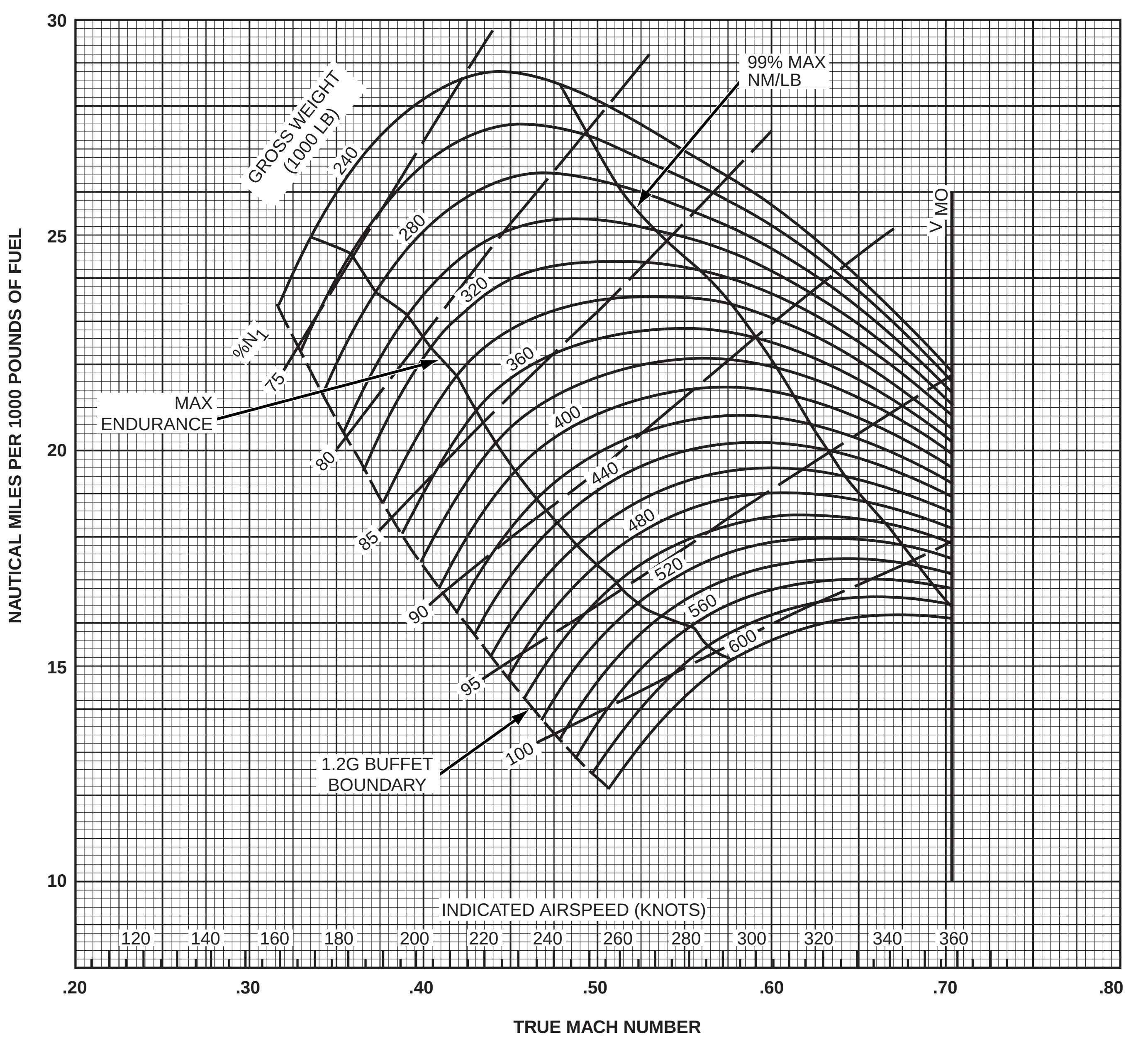


Figure 5-36.

TWO ENGINE SPECIFIC RANGE
TRUE PRESSURE ALTITUDE 20,000 FT

NOTE:

1. CLEAN CONFIGURATION
2. STANDARD DAY
3. INCREASE % N_1 BY 0.19 PER °C ABOVE STANDARD

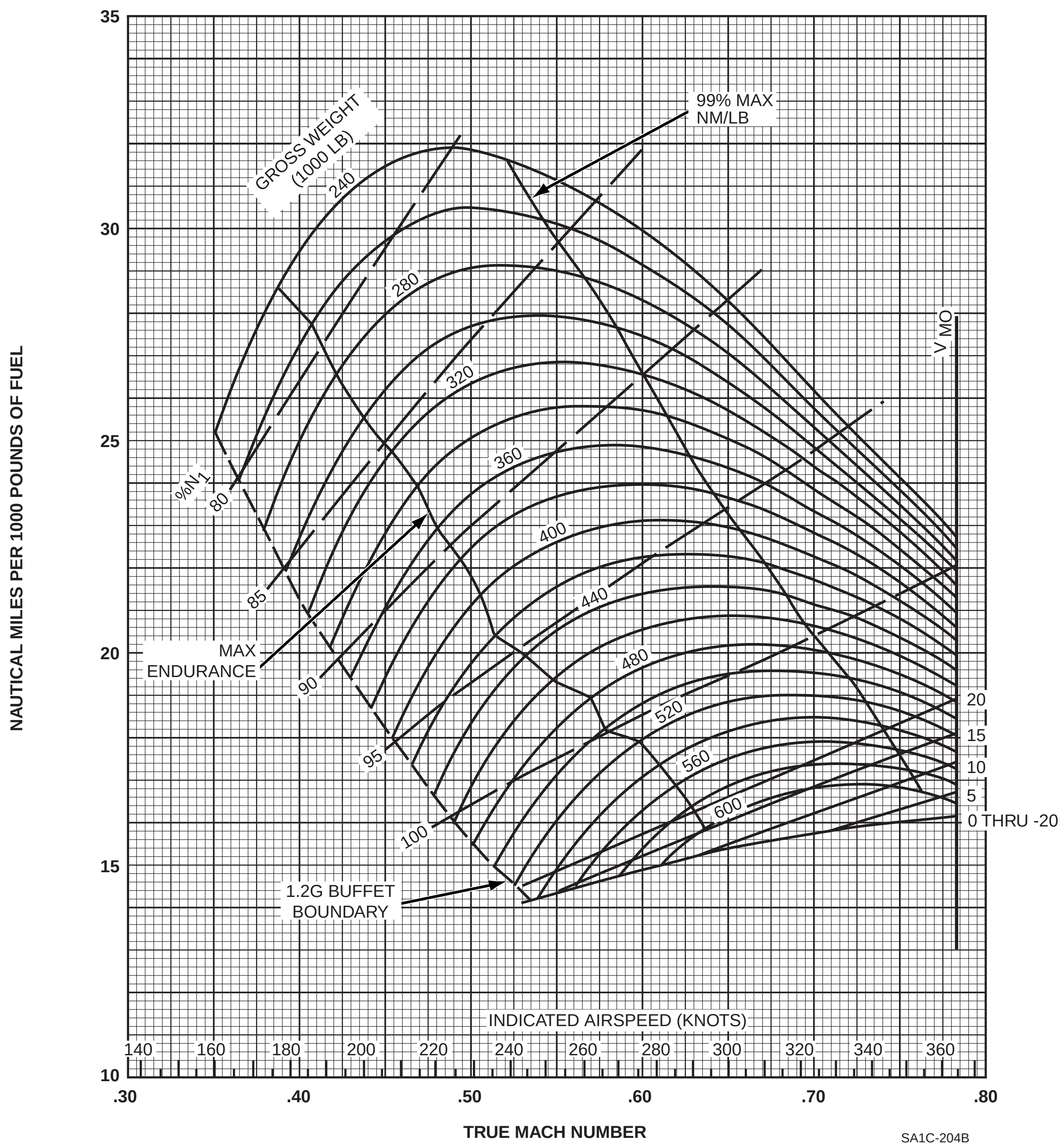


Figure 5-37.

TWO ENGINE SPECIFIC RANGE
TRUE PRESSURE ALTITUDE 25,000 FT

NOTE:

1. CLEAN CONFIGURATION
2. STANDARD DAY
3. INCREASE % N_1 BY 0.22 PER °C ABOVE STANDARD

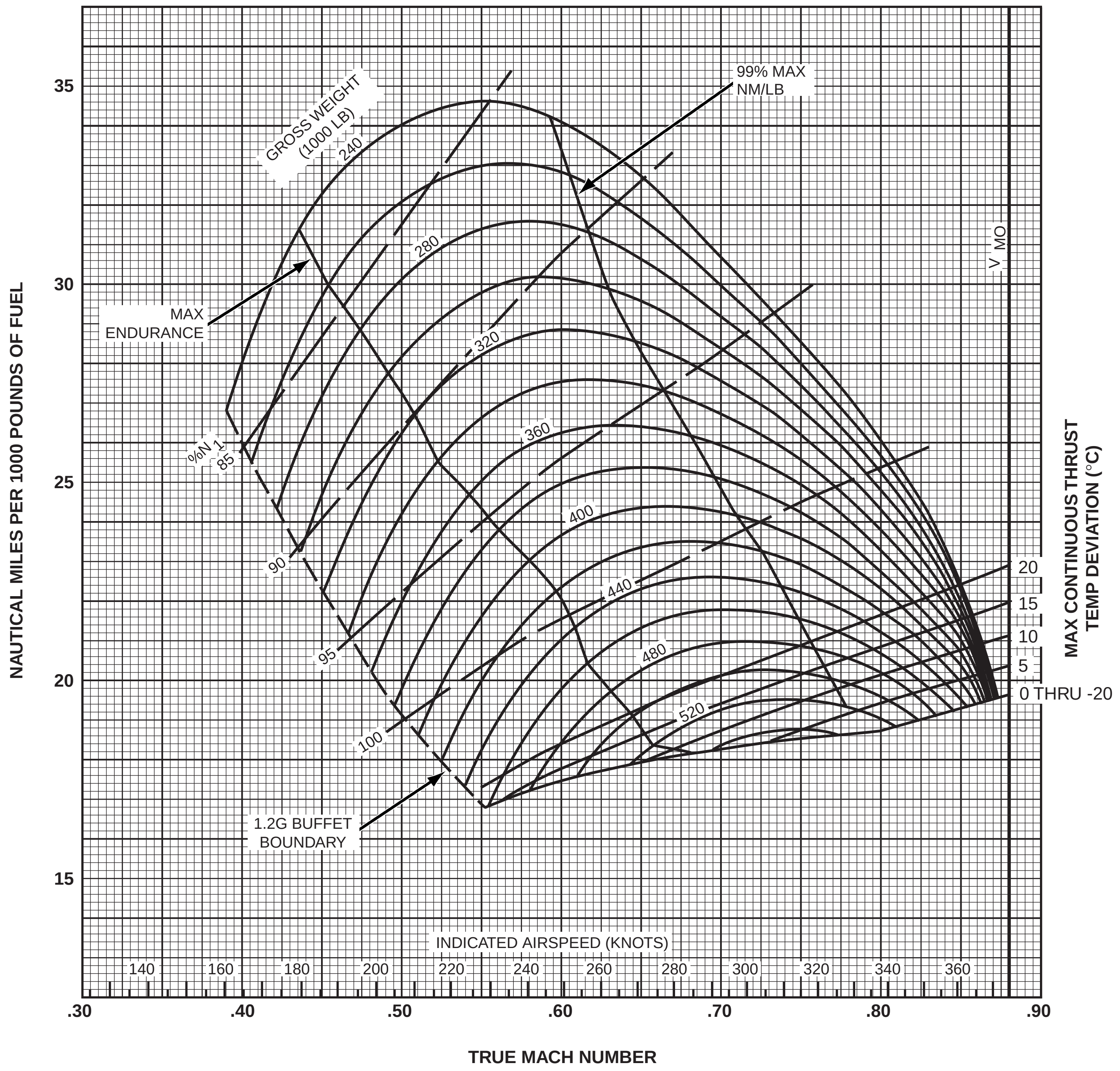


Figure 5-38.

TWO ENGINE SPECIFIC RANGE
TRUE PRESSURE ALTITUDE 27,000 FT

NOTE:

1. CLEAN CONFIGURATION
2. STANDARD DAY
3. INCREASE % N_1 BY 0.22 PER °C ABOVE STANDARD

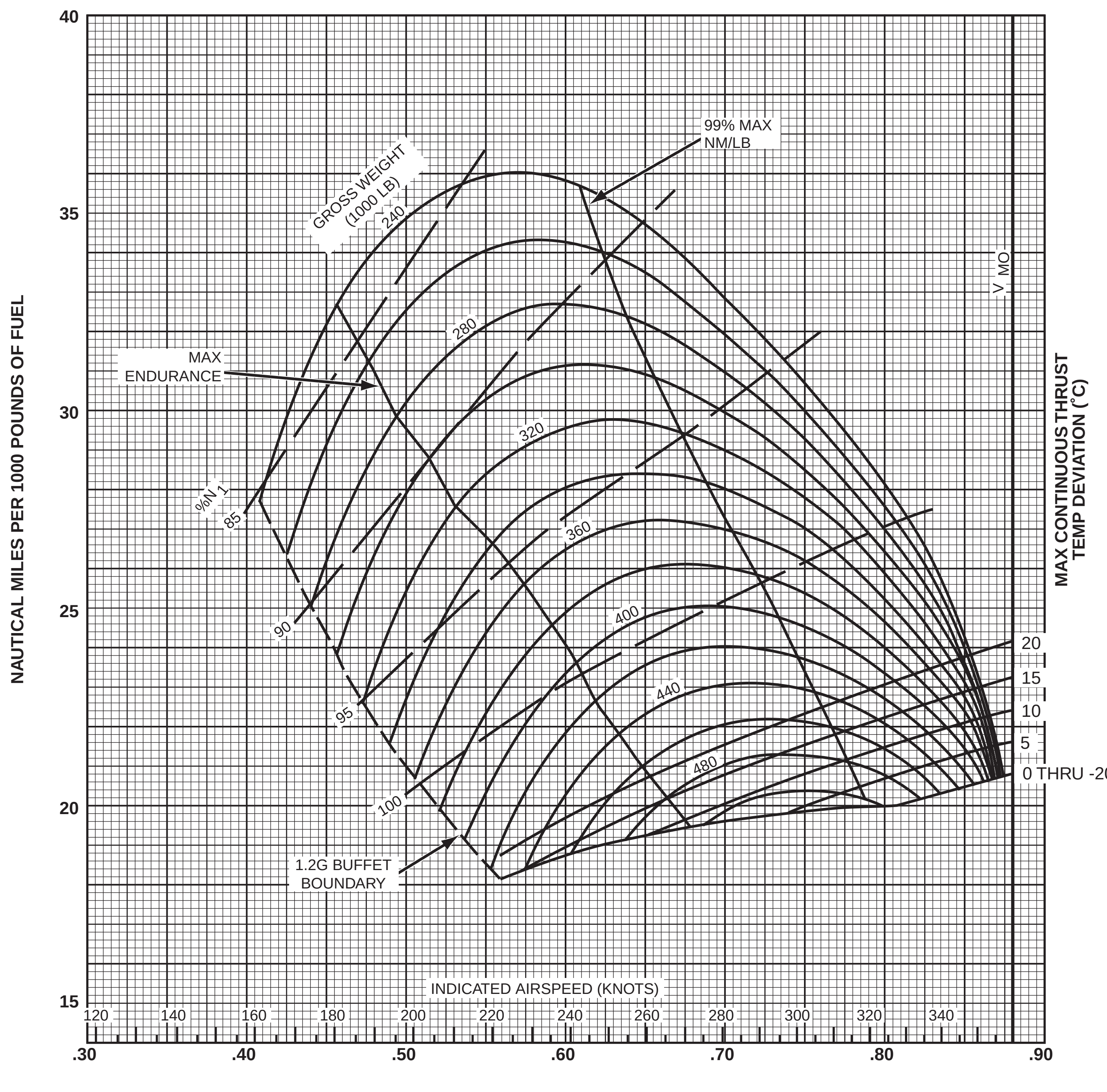


Figure 5-39.

TWO ENGINE SPECIFIC RANGE
TRUE PRESSURE ALTITUDE 29,000 FT

NOTE:

1. CLEAN CONFIGURATION
2. STANDARD DAY
3. INCREASE % N_1 BY 0.22 PER °C ABOVE STANDARD

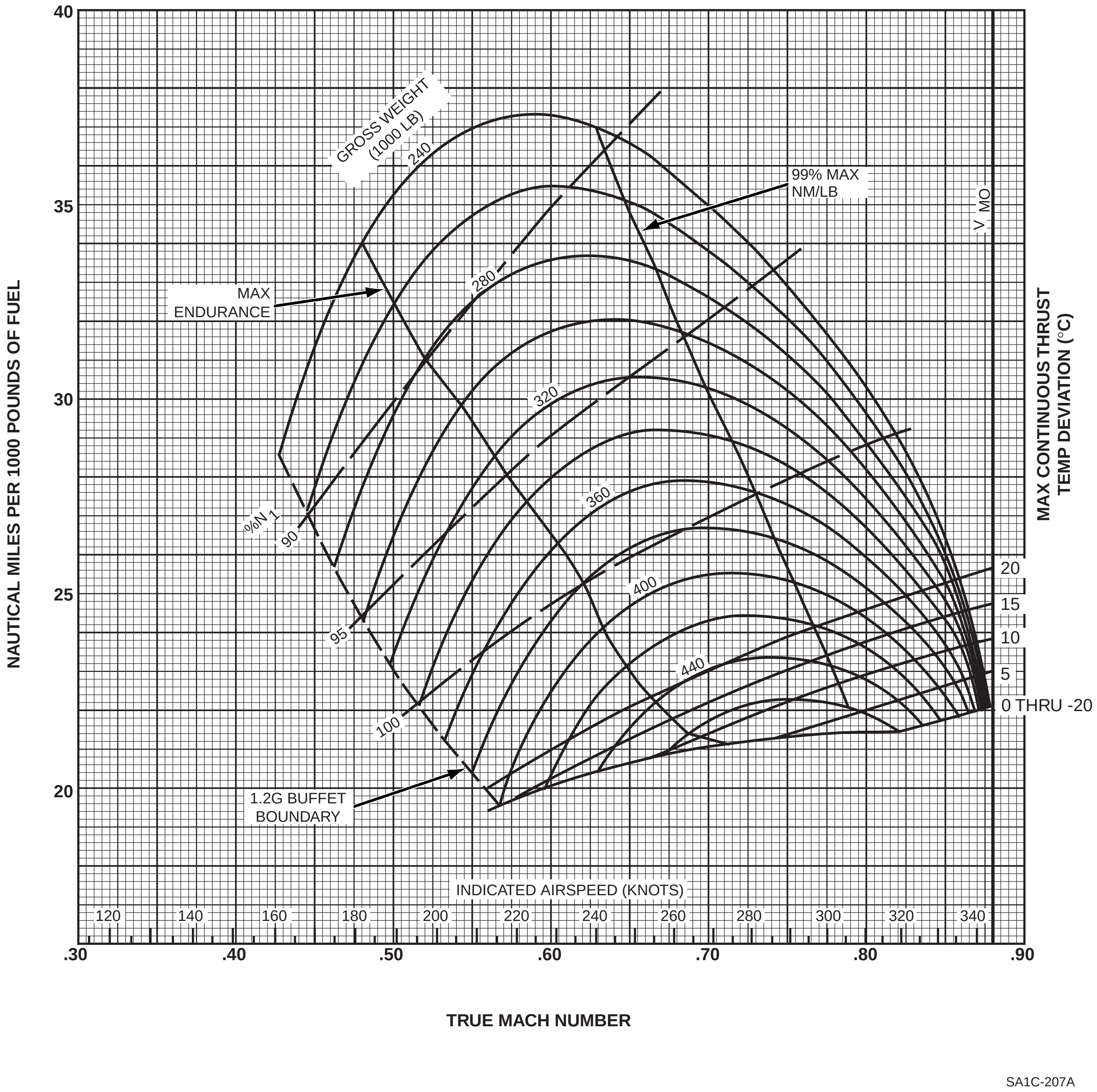


Figure 5-40.

TWO ENGINE SPECIFIC RANGE
TRUE PRESSURE ALTITUDE 31,000 FT

NOTE:

1. CLEAN CONFIGURATION
2. STANDARD DAY
3. INCREASE % N_1 BY 0.22 PER °C ABOVE STANDARD

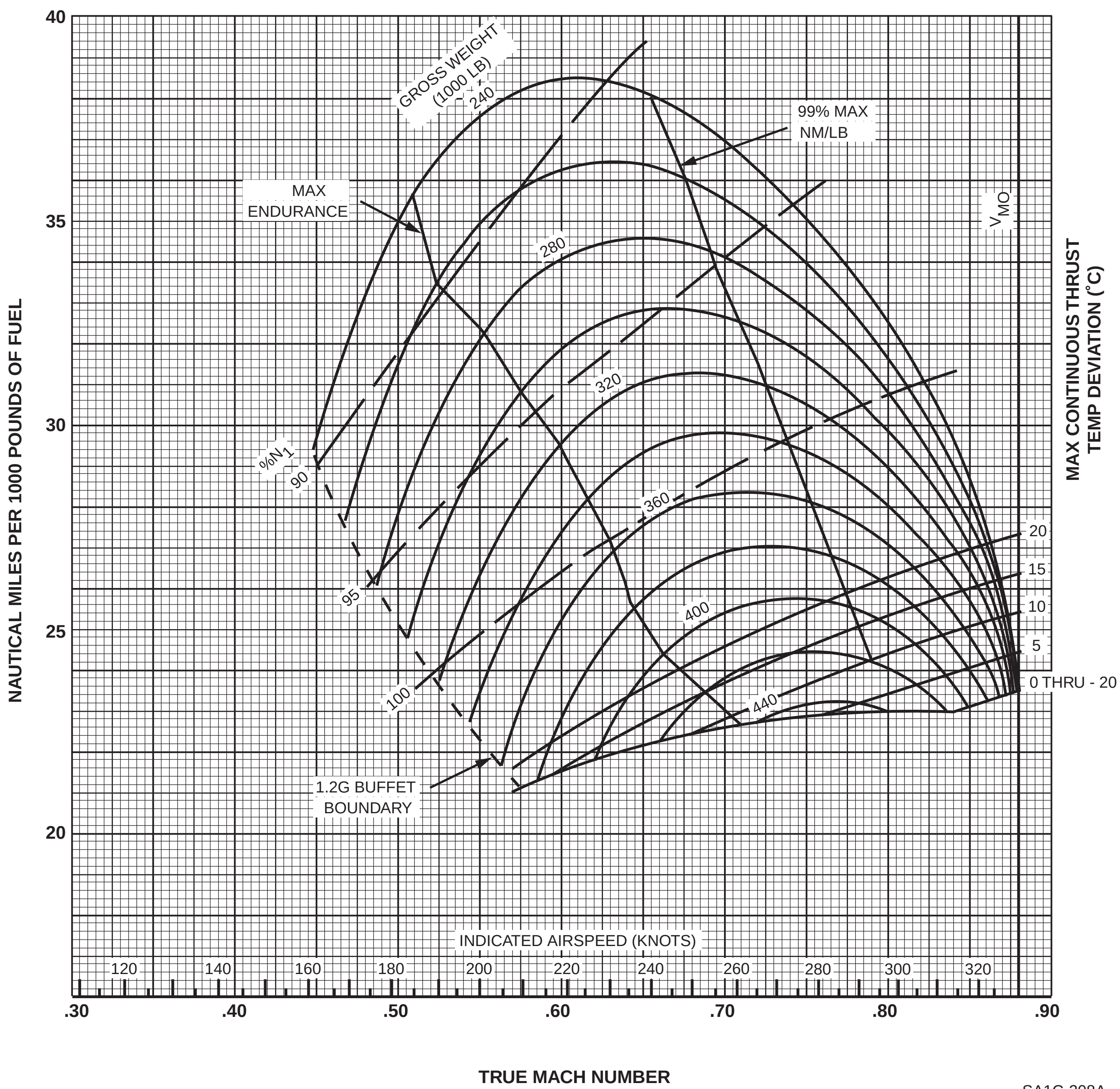


Figure 5-41.

TWO ENGINE SPECIFIC RANGE
TRUE PRESSURE ALTITUDE 33,000 FT

NOTE:

1. CLEAN CONFIGURATION
2. STANDARD DAY
3. INCREASE % N_1 BY 0.23 PER °C ABOVE STANDARD

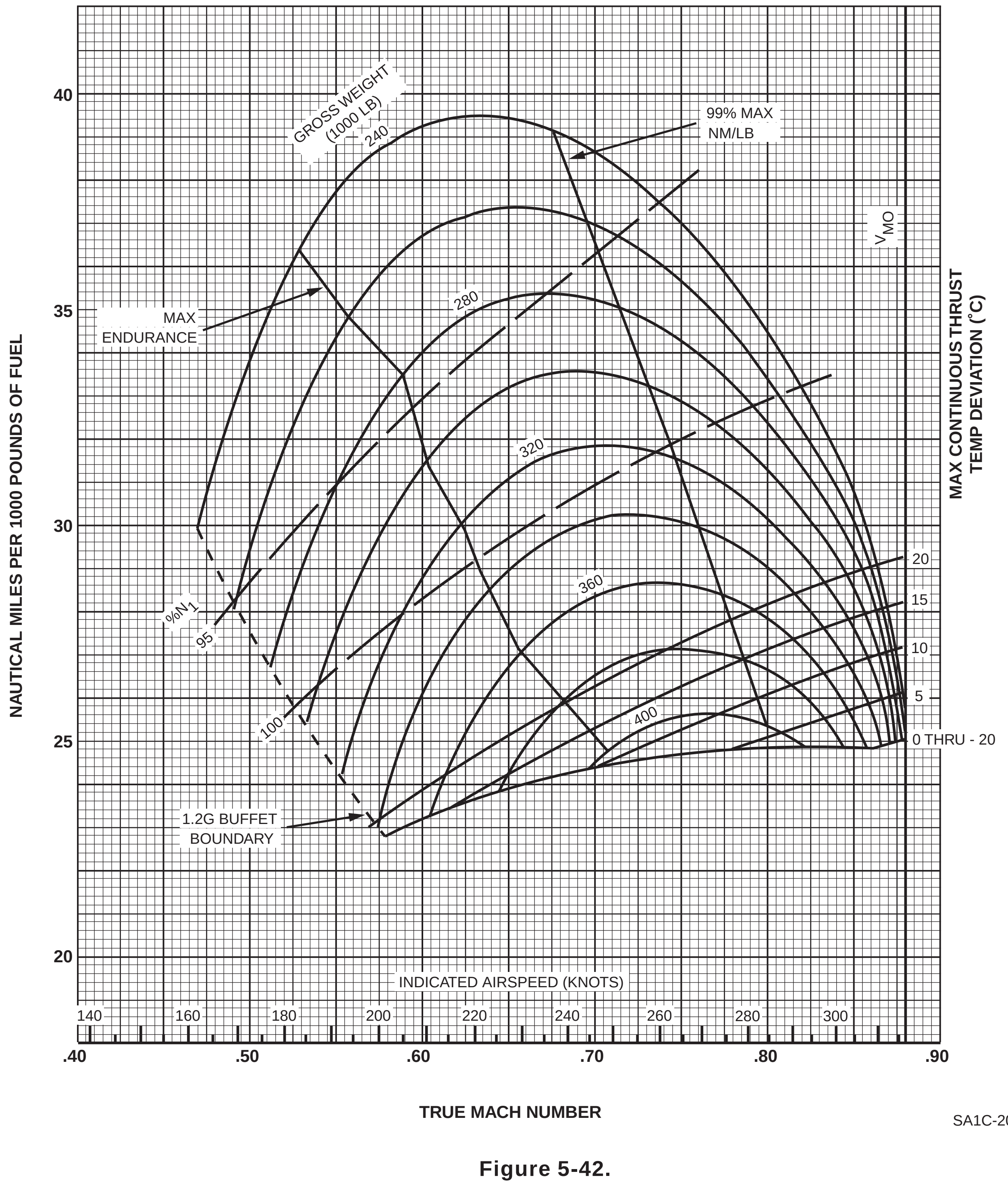
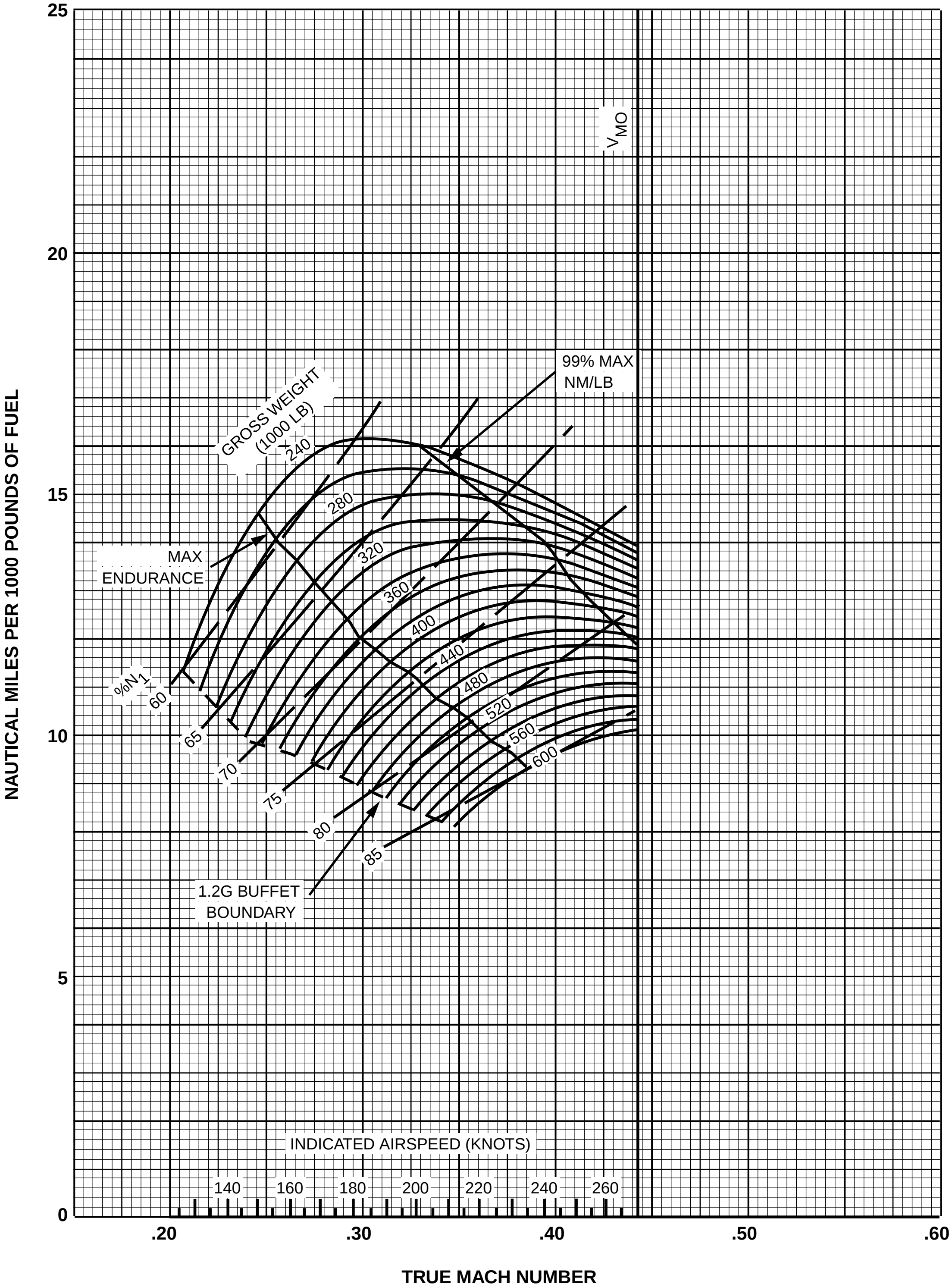


Figure 5-42.

THREE ENGINE SPECIFIC RANGE
SLATS EXTENDED
TRUE PRESSURE ALTITUDE 5000 FT

NOTE:

1. STANDARD DAY
2. INCREASE % N_1 BY 0.13 PER °C ABOVE STANDARD



SA1C-210B

Figure 5-43.

THREE ENGINE SPECIFIC RANGE
SLATS EXTENDED
TRUE PRESSURE ALTITUDE 10,000 FT

NOTE:

1. STANDARD DAY
2. INCREASE % N_1 BY 0.14 PER °C ABOVE STANDARD

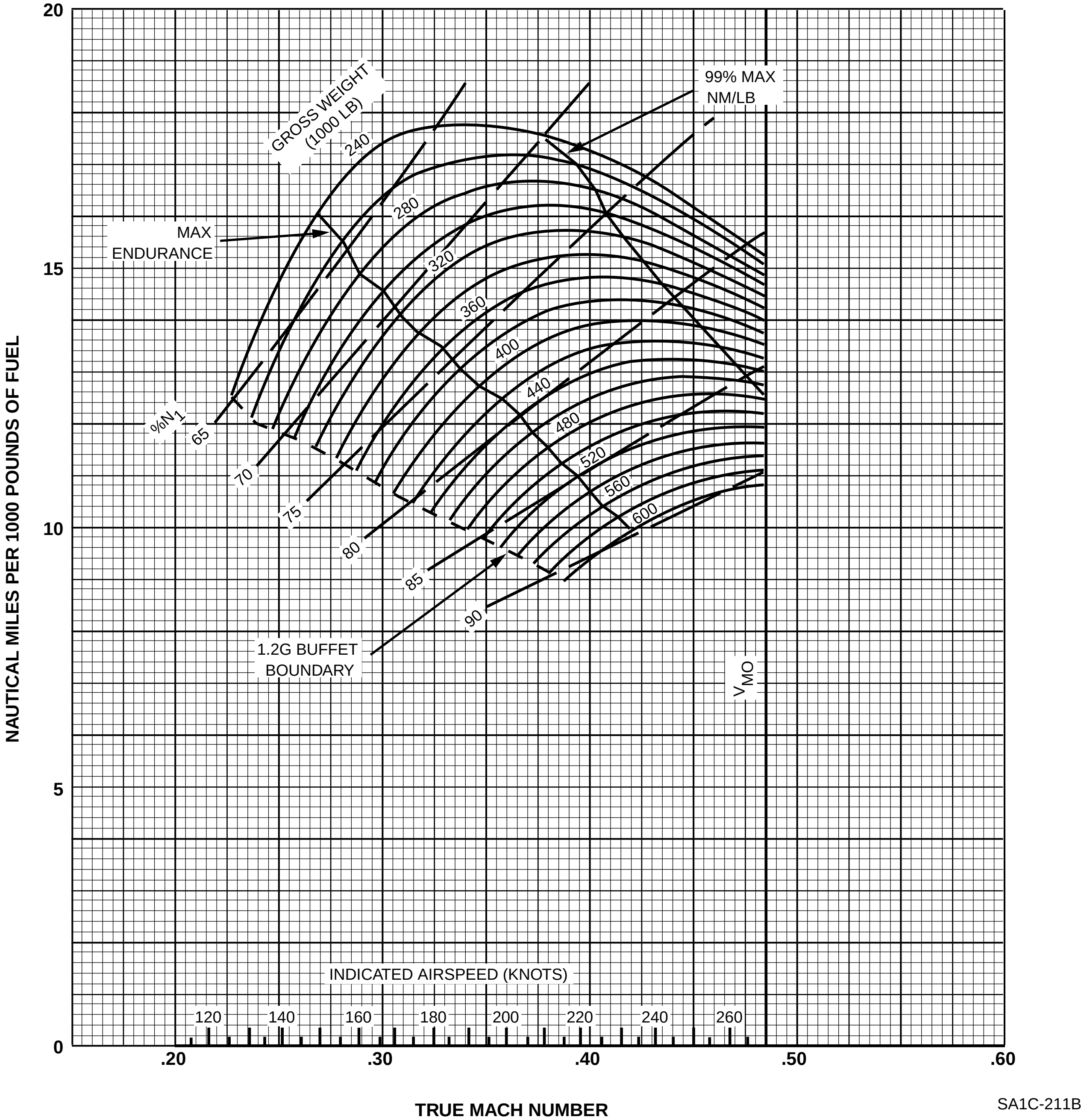


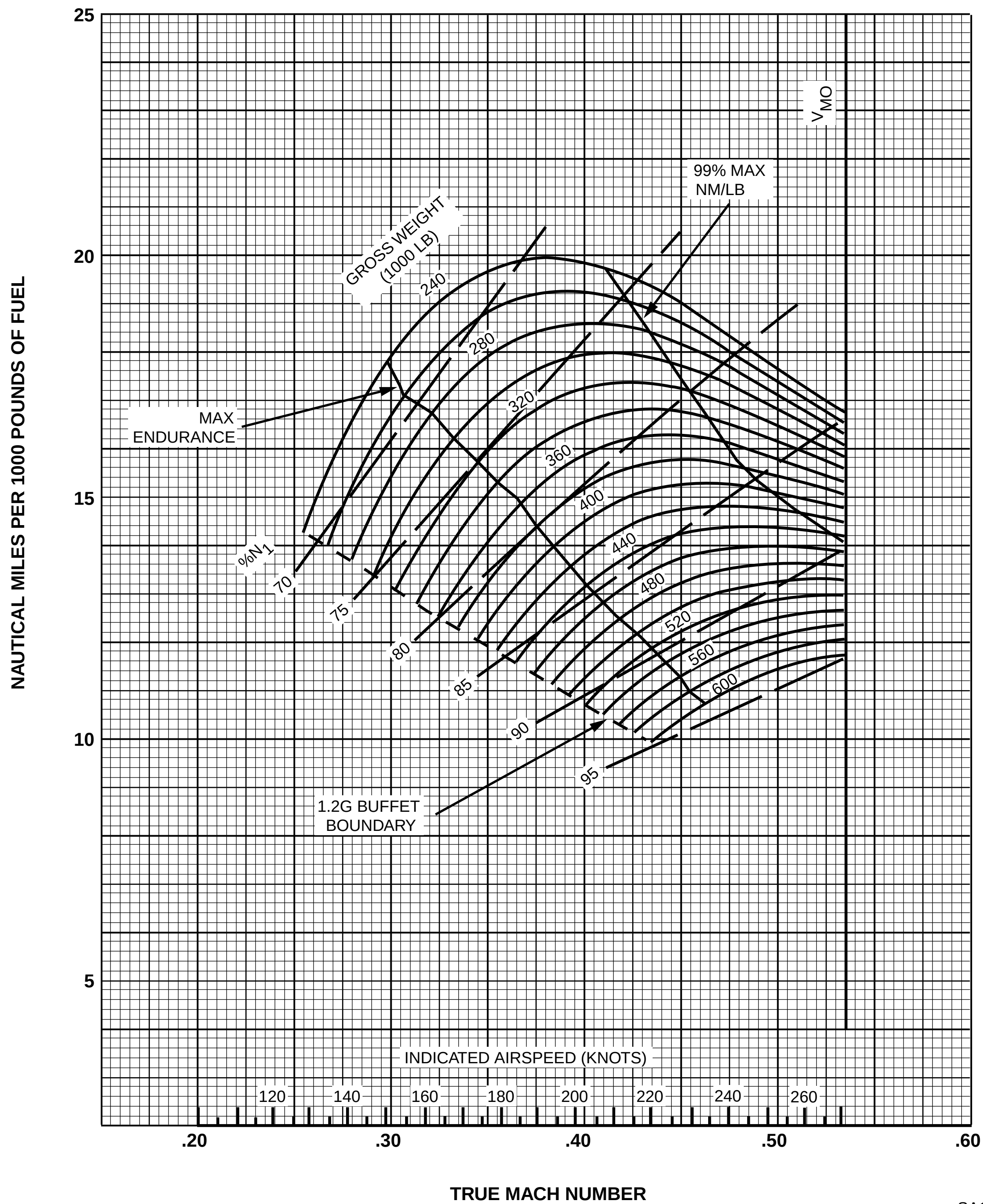
Figure 5-44.

THREE ENGINE SPECIFIC RANGE

SLATS EXTENDED
TRUE PRESSURE ALTITUDE 15,000 FT

NOTE:

1. STANDARD DAY
2. INCREASE % N_1 BY 0.15 PER °C ABOVE STANDARD



SA1C-212B

Figure 5-45.

THREE ENGINE SPECIFIC RANGE
SLATS EXTENDED
TRUE PRESSURE ALTITUDE 20,000 FT

NOTE:

1. STANDARD DAY
2. INCREASE % N_1 BY 0.17 PER °C ABOVE STANDARD

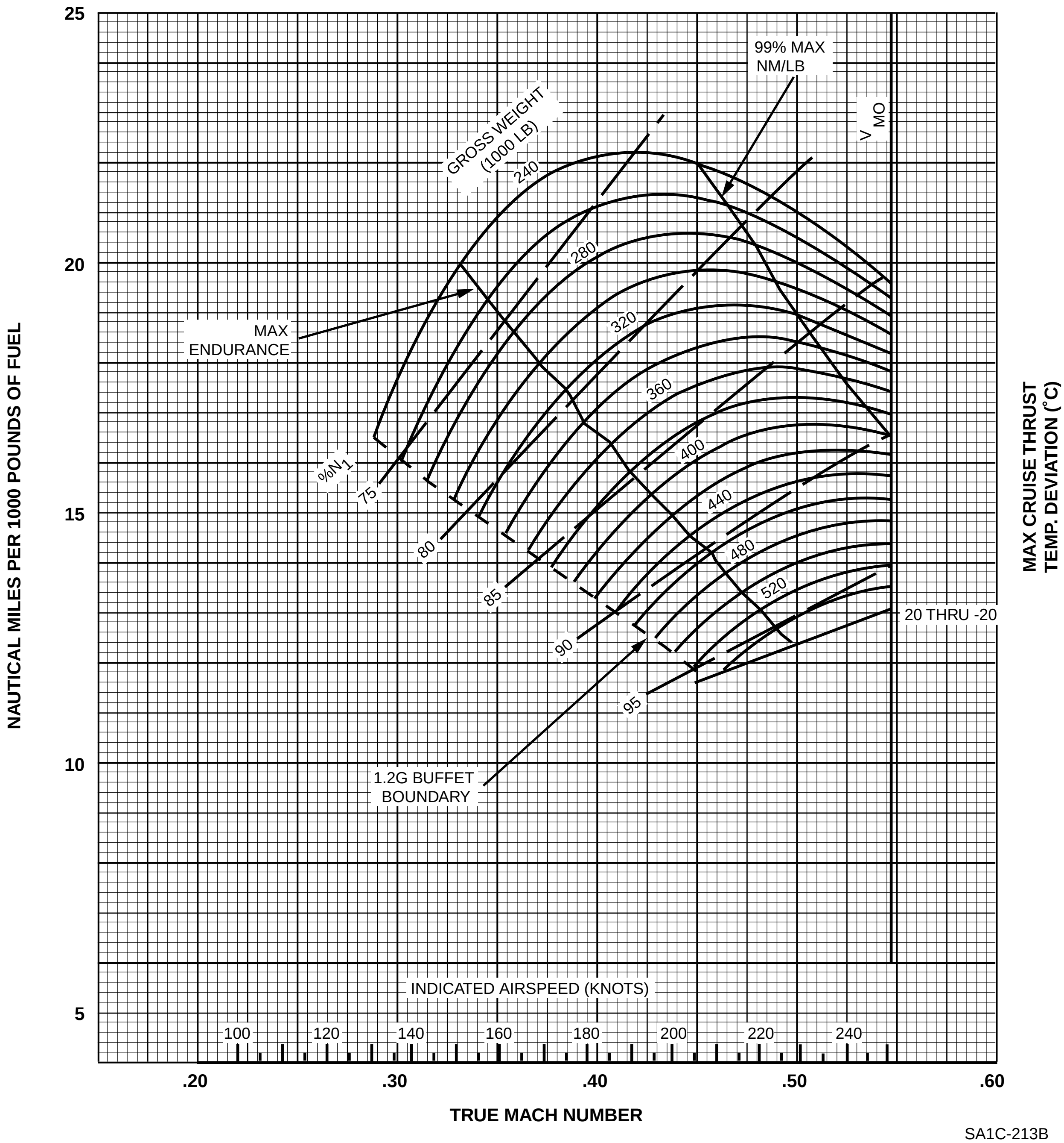


Figure 5-46.

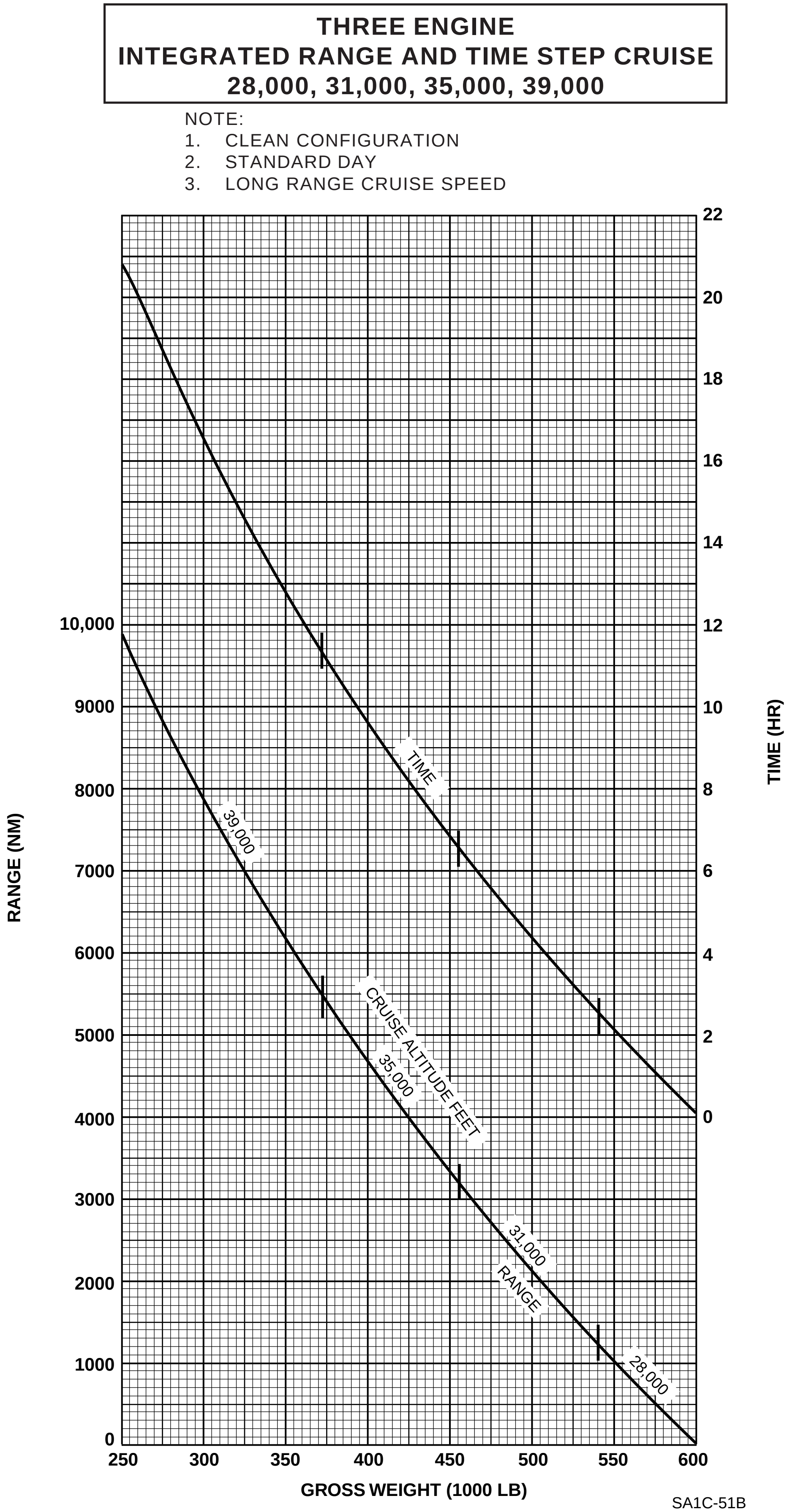

THREE ENGINE
INTEGRATED RANGE AND TIME STEP CRUISE
28,000, 31,000, 35,000, 39,000
NOTE:
1. CLEAN CONFIGURATION
2. STANDARD DAY
3. LONG RANGE CRUISE SPEED
RANGE (NM)
TIME (HR)
GROSS WEIGHT (1000 LB)
TIME
RANGE
CRUISE ALTITUDE FEET
39,000
35,000
31,000
28,000
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10,000
0
2
4
6
8
10
12
14
16
18
20
22
250
300
350
400
450
500
550
600
SA1C-51B

Figure 5-47.

THREE ENGINE
INTEGRATED RANGE AND TIME STEP CRUISE
29,000, 33,000, 37,000, 41,000

NOTE:
1. CLEAN CONFIGURATION
2. STANDARD DAY
3. LONG RANGE CRUISE SPEED

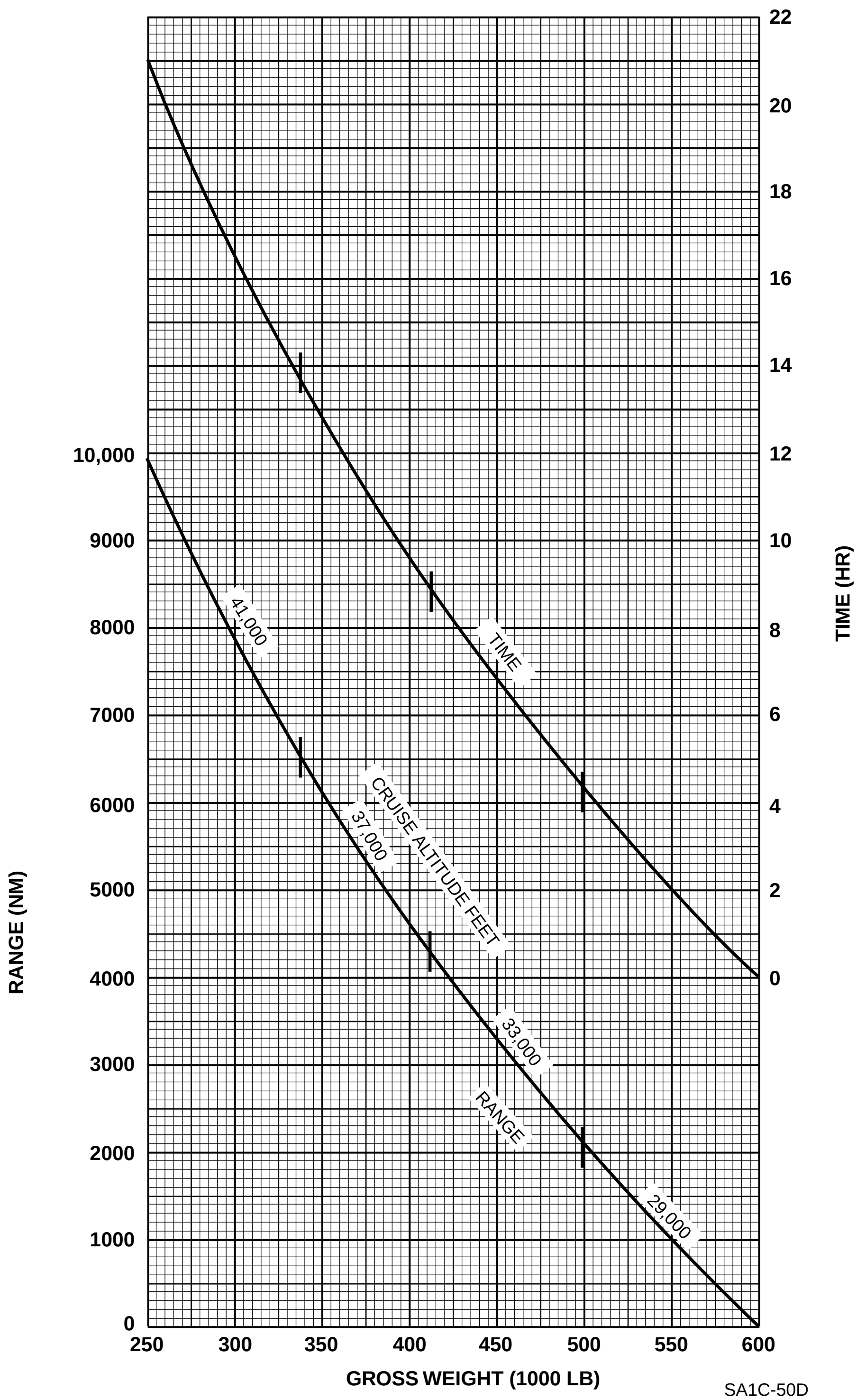


Figure 5-48.

THREE ENGINE INTEGRATED RANGE
CONSTANT ALTITUDE CRUISE

NOTE:
1. CLEAN CONFIGURATION
2. STANDARD DAY
3. LONG RANGE CRUISE SPEED

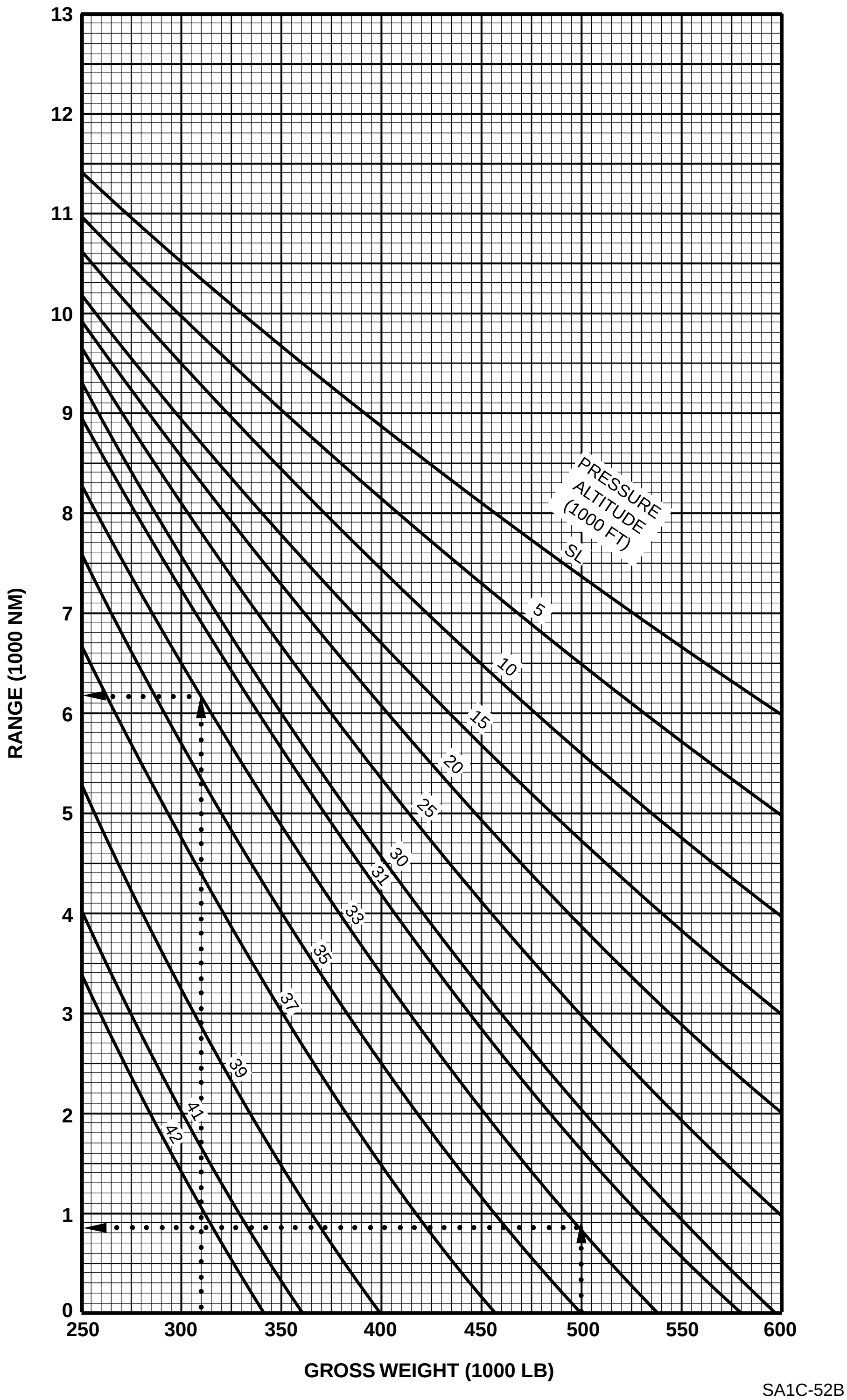


Figure 5-49.

THREE ENGINE INTEGRATED TIME
CONSTANT ALTITUDE CRUISE

NOTE:
1. CLEAN CONFIGURATION
2. STANDARD DAY
3. LONG RANGE CRUISE SPEED

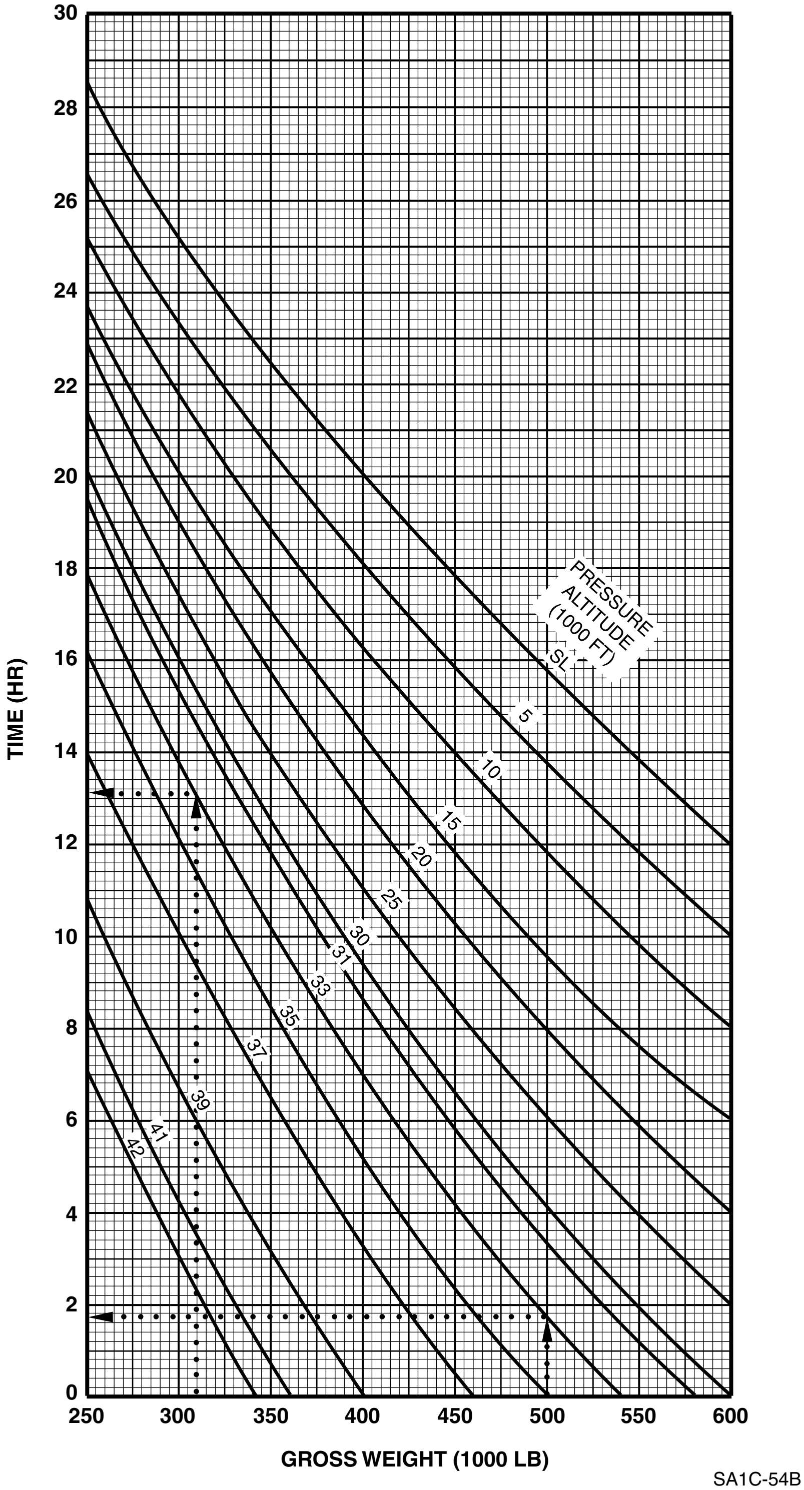


Figure 5-50.

TWO ENGINE INTEGRATED RANGE
CONSTANT ALTITUDE CRUISE

NOTE:
1. CLEAN CONFIGURATION
2. STANDARD DAY
3. LONG RANGE CRUISE SPEED

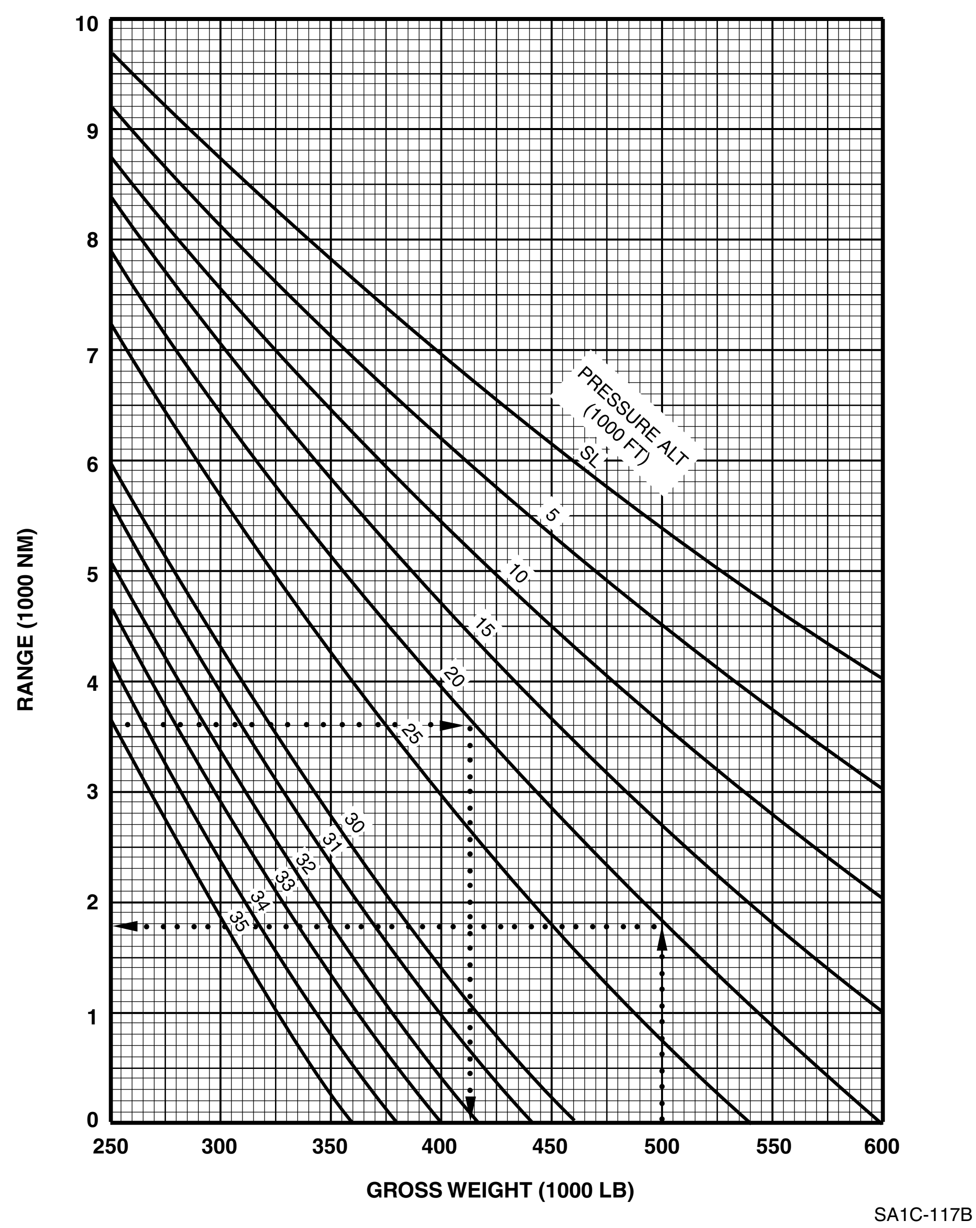


Figure 5-51.

TWO ENGINE INTEGRATED TIME
CONSTANT ALTITUDE CRUISE

NOTE:
1. CLEAN CONFIGURATION
2. STANDARD DAY
3. LONG RANGE CRUISE SPEED

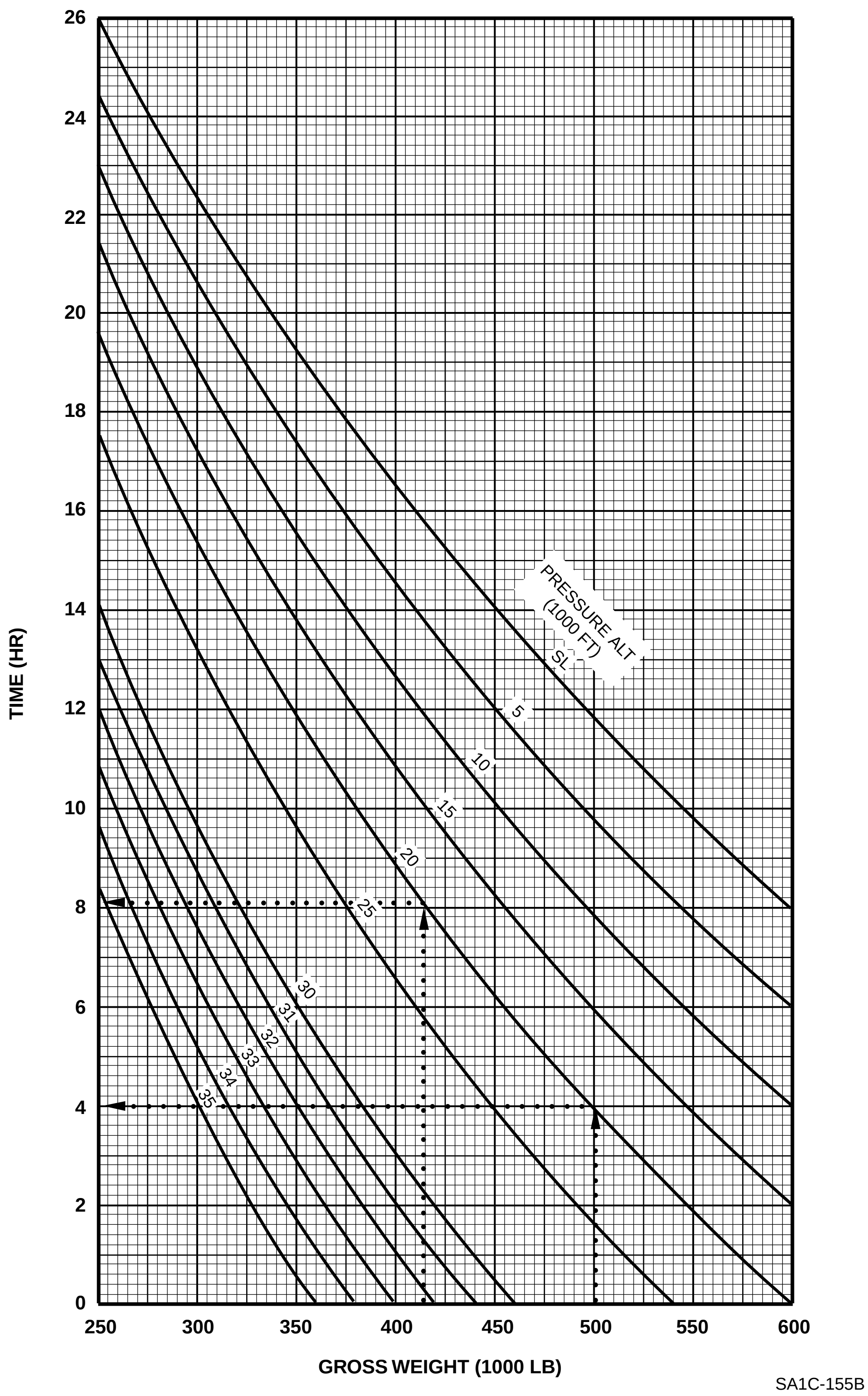


Figure 5-52.

THREE ENGINE OPTIMUM ALTITUDE
CRUISE PERFORMANCE

NOTE:

1. CLEAN CONFIGURATION
2. STANDARD DAY

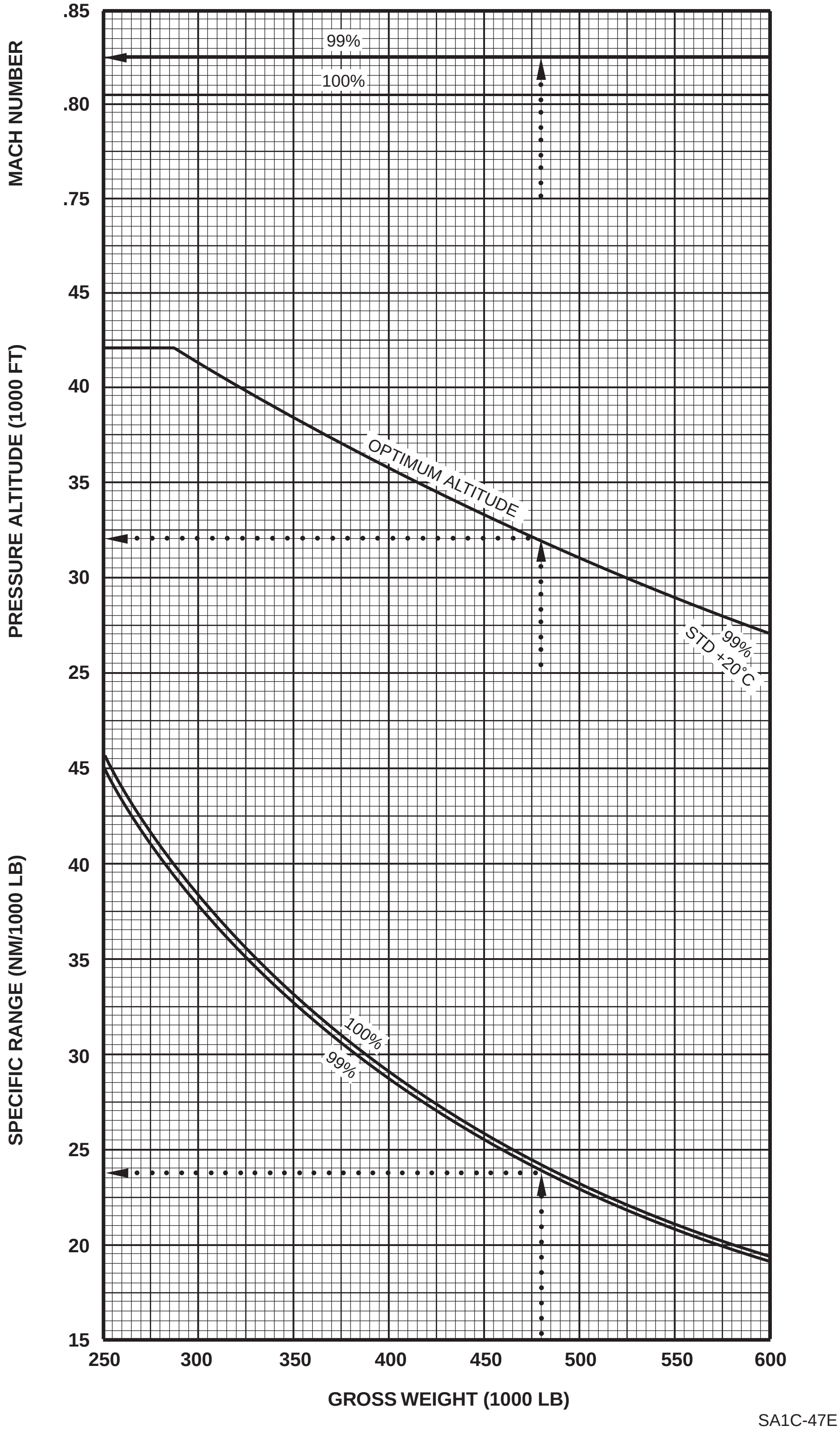


Figure 5-53.

TWO ENGINE OPTIMUM ALTITUDE CRUISE PERFORMANCE

NOTE:
1. CLEAN CONFIGURATION
2. STANDARD DAY +20°C

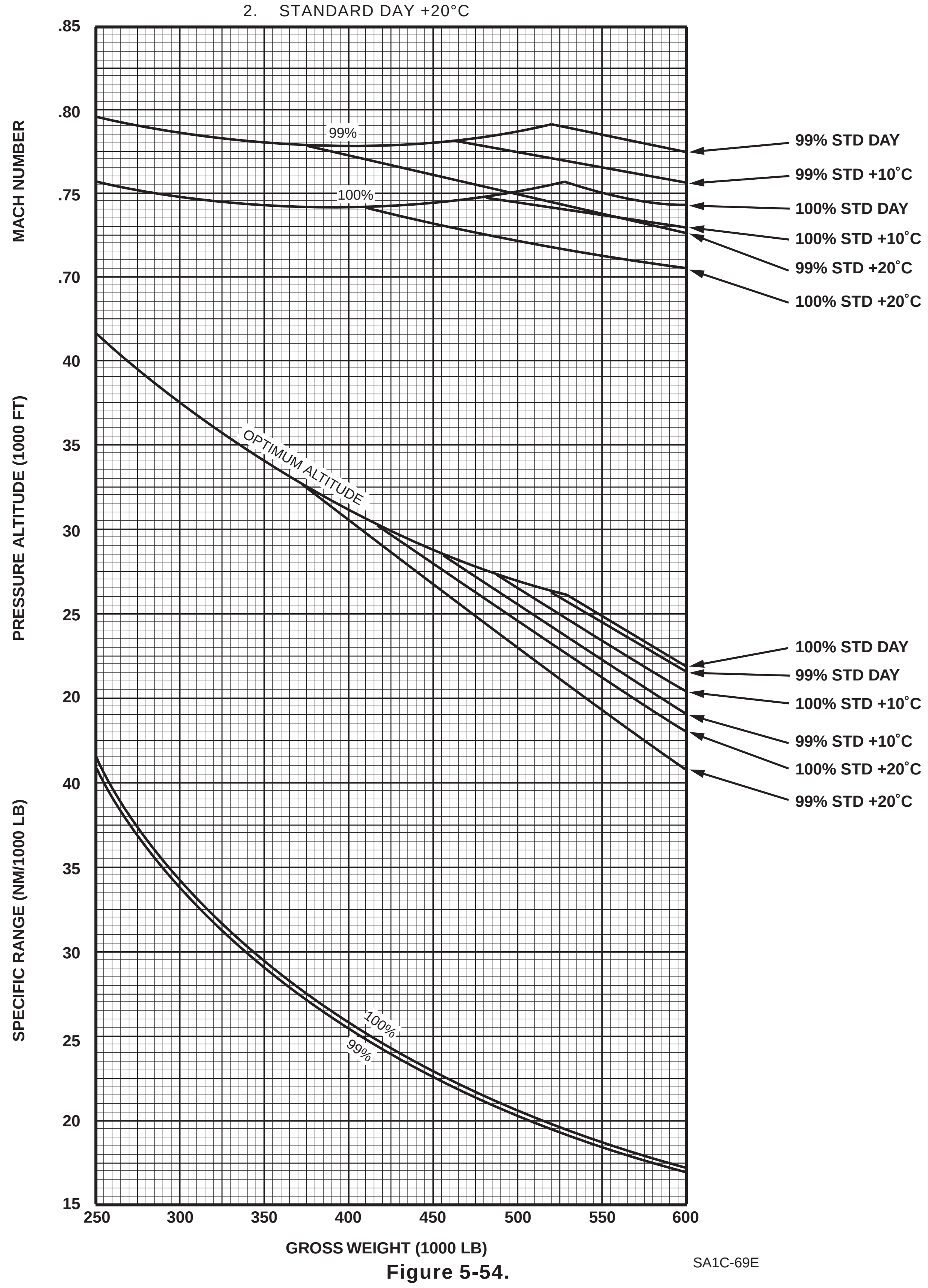


Figure 5-54.

BUFFET PROTECTION AND OPTIMUM CRUISE ALTITUDE

NOTE:

1. THREE ENGINE OPERATION
2. CLEAN CONFIGURATION
3. GOOD FOR ALL TEMPERATURES
4. APPLICABLE FOR MACH 0.82 TO MACH 0.83
5. CG = 24% MAC, REDUCE BUFFET LIMITED ALTITUDE BY 90 FT AND OPTIMUM ALTITUDE BY 60 FT FOR EACH 1% MAC FORWARD MOVEMENT OF THE CG LOCATION

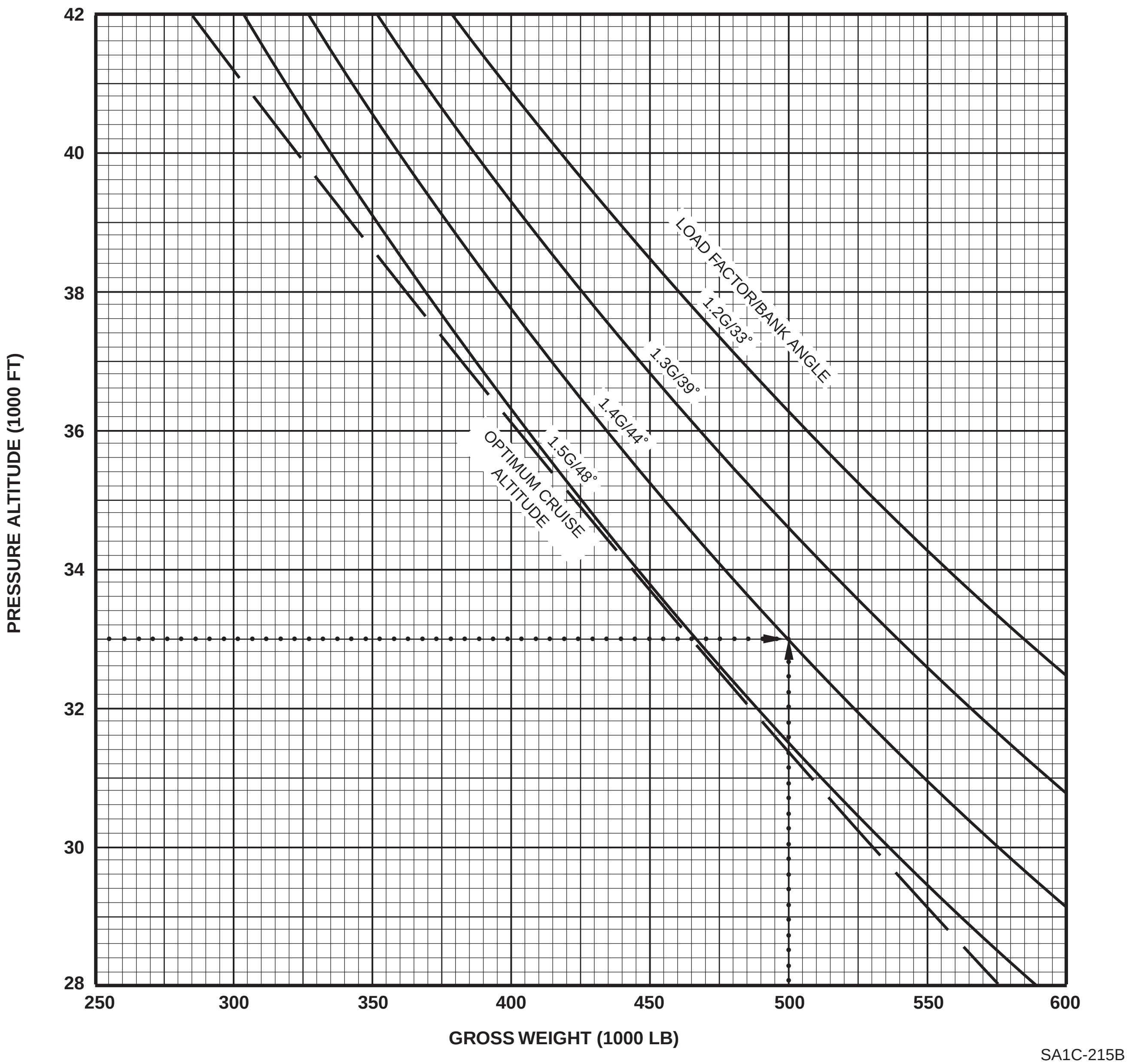


Figure 5-55.

EFFECT OF DRAG INDEX ON RANGE

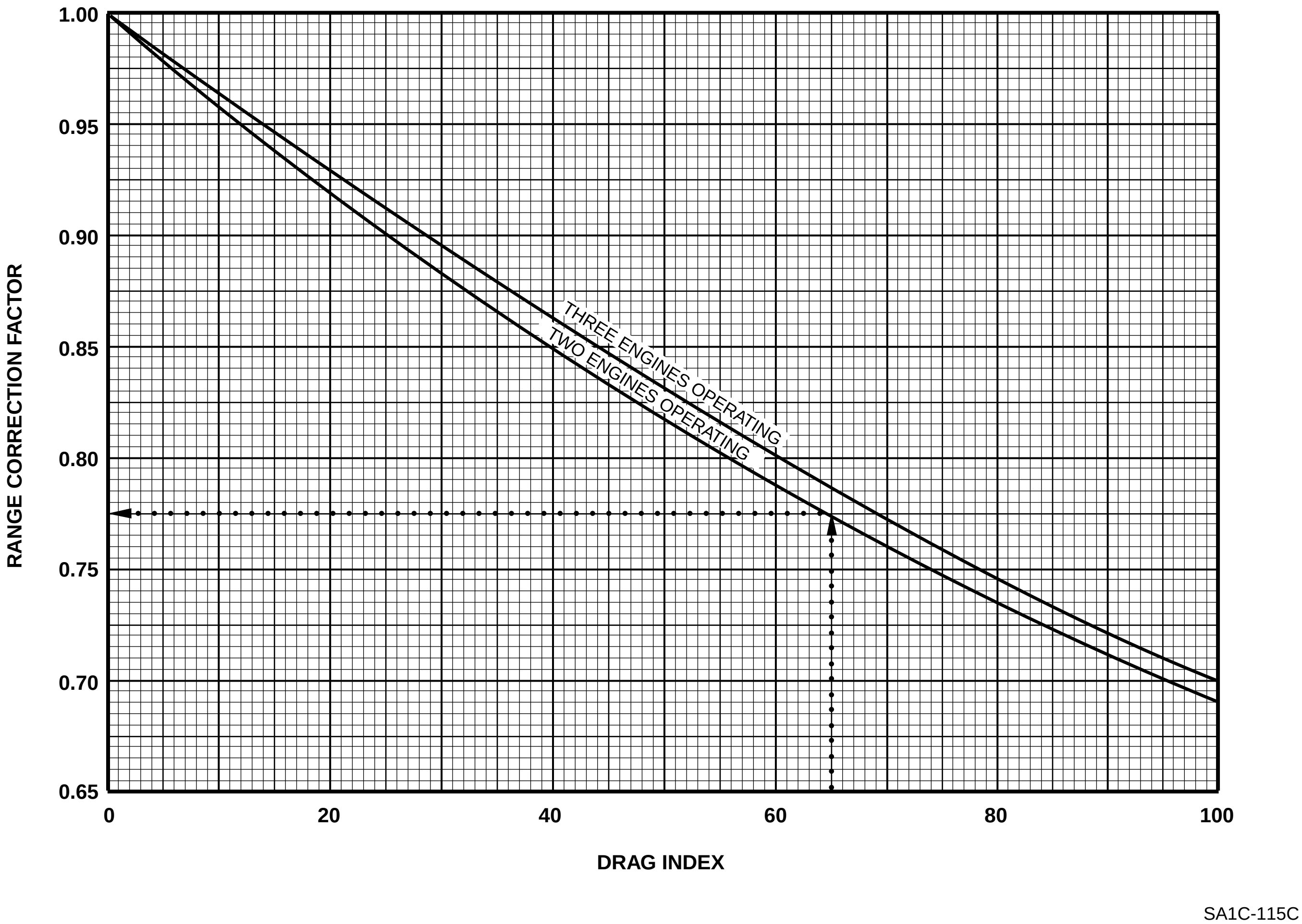


Figure 5-56.

CRUISE N_1 AND FUEL FLOW PER ENGINE - MACH 0.82

NOTE:
1. THREE ENGINE OPERATION
2. CLEAN CONFIGURATION
3. STANDARD DAY
4. ADD 0.21% ΔN_1 PER °C ABOVE STANDARD
5. ADD 18 LB/HR FUEL FLOW PER °C ABOVE STANDARD
6. SHADED AREA REPRESENTS OPTIMUM RANGE ALTITUDE
7. HEAVY LINE REPRESENTS MAXIMUM CRUISE THRUST LIMIT (STD TO STD + 15°C)

PRESSURE ALTITUDE (1000 FT)			25	27	29	31	33	35	37	39	41
		IAS(KTS)	347	333	319	306	292	280	267	255	243
		TAS(KTS)	494	490	485	481	477	473	470	470	470
GROSS WEIGHT (1000 LB)	580	N_1 (% RPM)	97.2	98.1	99.8	103.1					
		FF (LB/HR)	8500	8260	8180	8410					
	560	N_1 (% RPM)	96.6	97.4	98.7	101.2					
		FF (LB/HR)	8280	8020	7870	7970					
	540	N_1 (% RPM)	96.0	96.7	97.7	99.6	103.5				
		FF (LB/HR)	8070	7800	7590	7570	7850				
	520	N_1 (% RPM)	95.5	96.1	96.9	98.3	101.2				
		FF (LB/HR)	7890	7570	7340	7238	7380				
	500	N_1 (% RPM)	94.9	95.4	96.2	97.2	99.4	103.7			
		FF (LB/HR)	7710	7360	7120	6950	6980	7280			
	480	N_1 (% RPM)	94.4	94.8	95.4	96.3	97.9	101.2			
		FF (LB/HR)	7550	7180	6900	6700	6620	6810			
	460	N_1 (% RPM)	93.9	94.2	94.7	95.5	96.6	99.0	104.2		
		FF (LB/HR)	7380	7000	6690	6470	6330	6380	6747		
	440	N_1 (% RPM)	93.4	93.6	94.0	94.7	95.5	97.2	101.2		
		FF (LB/HR)	7230	6840	6510	6250	6070	6020	6260		
	420	N_1 (% RPM)	93.0	93.1	93.4	93.9	94.6	95.8	98.7		
		FF (LB/HR)	7100	6680	6330	6050	5850	5720	5830		
	400	N_1 (% RPM)	92.6	92.5	92.8	93.1	93.8	94.7	96.8	101.2	
		FF (LB/HR)	6980	6530	6170	5870	5630	5470	5464	5720	
	380	N_1 (% RPM)	92.2	92.1	92.2	92.4	92.9	93.7	95.2	98.5	
		FF (LB/HR)	6870	6400	6020	5690	5430	5250	5170	5290	
	360	N_1 (% RPM)	91.8	91.7	91.6	91.8	92.1	92.8	94.0	96.5	100.7
		FF (LB/HR)	6760	6290	5880	5540	5260	5040	4920	4930	5140
	340	N_1 (% RPM)	91.4	91.3	91.1	91.1	91.4	91.8	93.0	94.9	97.9
		FF (LB/HR)	6650	6180	5750	5390	5100	4850	4710	4650	4720
	320	N_1 (%RPM)	91.0	90.8	90.7	90.6	90.7	91.0	91.9	93.6	95.8
		FF (LB/HR)	6540	6070	5640	5260	4940	4680	4500	4420	4400
	300	N_1 (%RPM)	90.6	90.4	90.3	90.1	90.0	90.2	91.0	92.5	94.2
		FF (LB/HR)	6440	5960	5540	5150	4800	4520	4330	4200	4140

SA1C-216B

Figure 5-57.

SECTION VI

HOLDING

TABLE OF CONTENTS **Page**

LIST OF CHARTS

INTRODUCTION

The charts in this section present information for planning a holding segment for any mission. Fuel flows, target N_1 settings, and recommended holding speeds as functions of altitude and gross weight may be obtained for three, two, or one engine operation. All holding data are based on flight test results. The fuel flows provided are increased five percent relative to the engine specification level.

DEFINITION OF TERMS

HOLDING SPE ED

The recommended holding speeds are all minimum fuel flow speeds and are always above the 1.2G buffet onset speeds. If use of autothrottles is desired, holding at a higher speed may be necessary since the minimum fuel flow speed may be less than $1.5V_S$ ($1.4V_S$, slats extended).

FACTORS AFFECTING HOLDING

AIRSPEED

The holding speeds have been chosen to minimize fuel consumption while maintaining controllability and sufficient speed margin above the buffet or stall during banked flight up to 30 degrees.

BANK ANGLE

Banked flight imposes a load factor on the airplane which requires an increase in thrust to maintain level flight. Thus, the target N_1 setting and fuel flow increase for banked flight. Charted speed values increase with bank angle to enhance endurance.

TEMPERATURE

The data presented in this section are based on standard day conditions. To account for higher than standard day temperature, increase the fuel flow by 35 pounds per hour for each degree Centigrade above standard and increase the target N_1 setting by 0.20 percent RPM per degree Centigrade above standard.

DRAG INDEX (DI)

The data presented in this section are based on a clean configuration, DI=0. Any increase in drag results in an increase in the fuel flow at the recommended holding speeds. Drag index values are presented in Section I.

ENGINE BLEED

The use of engine anti-ice protection when the engine anti-ice shutoff valves are inoperative in the open position (MEL item) results in the holding fuel flow being increased by 0.5% for each affected engine.

EFFECT OF HOLDING ON ENDURANCE

Normally, holding is accomplished at the recommended holding speed for the maximum bank angle used during holding. If use of autothrottles is desired and endurance is not a factor, holding may be accomplished at a higher speed. To maximize endurance, it may be necessary to turn autothrottles off. Sufficient stall margin is provided at all charted holding speeds. Turns during holding effectively decrease endurance. To minimize this effect, airspeed may be varied according to the bank angle being used. Fly the charted holding speed for 0° bank angle during straight and level flight, and fly the charted holding speed for the appropriate bank angle during turns. By increasing the length of the straight and level portion of the flight path (decreasing the total time in the turns), an additional improvement in endurance will be obtained. Changing altitude and minimizing bank angle can also improve endurance. This can be determined from the holding chart fuel flow values.

NOTE

At low altitudes, the minimum fuel flow speed may be somewhat lower than the minimum drag speed. In this case, a further decrease in airspeed will require an increase in thrust.

CHART EXPLANATION AND EXAMPLE PROBLEMS

EFFECT OF DRAG INDEX ON HOLDING

Figure 6-5 provides a means for correcting the fuel flow data in this section for drag indices up to 100.

This chart is used by entering with the appropriate drag index and determining a fuel flow multiplying factor.

Example:

Given:

Drag Index = 80

Uncorrected Fuel Burn = 31,625 lbs.

Find:

Fuel Burned for Three Engine Operation with the Increased Configuration Drag

Solution:

From figure 6-5 for a drag index of 80, the following multiplying factor is determined:

Fuel Flow Multiplier = 1.20

Use uncorrected fuel burn and multiplying factor from above to correct for drag index.

Corrected Fuel Burn = 37,950 Pounds

THREE ENGINE HOLDING

NOTE:

1. CLEAN CONFIGURATION
2. STANDARD DAY
3. ADD 0.20% ΔN_1 PER °C ABOVE STANDARD
4. ADD 35 LB/HR FUEL FLOW PER °C ABOVE STANDARD
5. FOR WEIGHTS LIGHTER THAN SHOWN, DETERMINE HOLDING PERFORMANCE AT THE LIGHTEST WEIGHT SHOWN.

BANK ANGLE	GROSS WEIGHT AT INDICATED BANK ANGLE (1000 LB)																	
30°		242	260	277	294	312	329	346	364	381	398	416	433	450	468	485	502	520
25°		254	272	290	308	326	344	362	381	399	417	435	453	471	489	508	526	544
20°	244	263	282	301	319	338	357	376	395	413	432	451	470	488	507	526	545	564
10°	256	276	295	315	335	355	374	394	414	433	453	473	492	512	532	551	571	591
0°	260	260	300	320	340	360	380	400	420	440	460	480	500	520	540	560	580	600
PRESSURE ALTITUDE (1000 FT)	IAS (KTS) N_1 (% RPM) TOTAL FF (LB/HR)																	
41	198 90.4 10140	211 92.2 11040	219 93.8 11750	226 95.7 12720	233 97.7 13790	235 100.3 14980												
39	198 87.7 9890	207 89.7 10790	218 91.3 11470	226 93.0 12390	233 94.6 13340	240 96.4 14330	245 98.3 15430	247 100.8 16660								OPERATIONAL CAPABILITY EXCEEDED		
37	197 85.1 9700	202 87.2 10530	212 88.9 11200	223 90.5 12090	232 92.0 13000	240 93.6 13930	246 95.1 14890	253 96.6 15900	256 98.5 17010	258 100.8 18250	260 103.6 19630							
35	197 82.8 9600	201 84.9 10210	213 86.7 11010	218 88.4 11870	227 90.1 12780	239 91.5 13680	245 92.9 14590	252 94.3 15530	258 95.7 16500	265 97.1 17520	268 98.8 18630	270 100.8 19860	271 103.2 21200					
33	194 80.9 9510	204 82.9 10080	211 84.9 10880	217 86.7 11690	222 88.4 12550	230 89.9 13440	238 91.4 14370	250 92.6 15290	257 93.9 16230	263 95.2 17190	269 96.5 18180	275 97.8 19210	280 99.2 20330	282 101.0 21520	283 103.1 22850			
31	192 78.9 9500	202 81.1 10020	210 83.0 10800	218 84.8 11600	225 86.5 12420	232 88.1 13260	237 89.6 14140	243 91.1 15060	250 92.4 16000	261 93.5 16950	267 94.7 17900	273 95.9 18890	280 97.1 19890	285 98.3 20920	290 99.5 22030	293 101.0 23210	294 102.8 24480	
29	189 76.9 9490	198 79.2 10030	208 81.1 10770	214 83.0 11540	224 84.7 12350	230 86.3 13170	236 87.9 14010	240 89.3 14880	249 90.6 15790	254 92.0 16740	261 93.2 17690	273 94.2 18660	278 95.3 19630	284 96.4 20620	290 97.5 21630	295 98.6 22660	301 99.7 23750	305 100.9 24900
27	188 75.2 9520	197 77.2 10030	204 79.2 10800	213 81.1 11560	222 82.8 12320	227 84.5 13130	237 86.0 13970	242 87.5 14820	247 88.9 15680	252 90.2 16570	256 91.6 17510	265 92.7 18480	270 93.9 19450	283 94.8 20440	288 95.8 21410	294 96.8 22400	300 97.8 23420	306 98.8 24450
25	188 73.5 9580	195 75.5 10090	202 77.3 10830	209 79.2 11600	218 81.0 12390	227 82.7 13160	233 84.2 13960	239 85.8 14800	248 87.1 15660	253 88.5 16550	256 89.8 17430	263 91.0 18350	266 92.2 19310	275 93.3 20290	282 94.3 21290	289 95.3 22290	298 96.2 23270	304 97.1 24260
23	186 71.7 9630	195 73.9 10100	201 75.7 10820	208 77.4 11560	215 79.1 12340	222 80.8 13150	230 82.4 13940	240 83.9 14740	245 85.4 15580	253 86.7 16440	259 88.0 17310	264 89.2 18210	269 90.4 19100	273 91.5 20030	277 92.7 20980	285 93.7 21970	292 94.6 22980	297 95.6 23960
21	184 69.9 9687	193 72.1 10220	201 74.1 10820	208 75.8 11530	214 77.4 12280	220 78.9 13040	226 80.5 13850	234 82.1 14690	241 83.5 15510	250 84.9 16330	256 86.2 17190	264 87.5 18080	269 88.6 18960	275 89.8 19860	280 90.9 20750	283 92.0 21670	287 93.0 22620	295 93.9 23590
19	181 66.6 9797	192 70.4 10200	200 72.3 10870	206 74.1 11560	214 75.8 12270	220 77.3 13020	226 78.7 13780	232 80.2 14580	236 81.7 15420	244 83.1 16270	251 84.4 17110	260 85.7 17960	266 86.9 18830	274 88.0 19730	281 89.1 20610	286 90.2 21510	290 91.2 22410	294 92.2 23310
15	177 65.0 9840	186 67.2 10550	194 69.0 11190	204 70.7 11850	211 72.3 12520	217 74.0 13240	223 75.5 13980	228 77.0 14740	234 78.3 15550	241 79.5 16370	247 80.7 17200	253 82.0 18050	260 83.3 18900	267 84.5 19740	275 85.6 20570	282 86.7 21390	287 87.8 22250	295 88.8 23130
10	168 60.0 9980	178 62.1 10720	187 64.4 11500	196 66.5 12290	205 68.4 13040	213 69.9 13700	219 71.3 14390	226 72.7 15090	233 74.1 15820	238 75.5 16580	244 76.8 17360	251 78.0 18160	255 79.1 18990	261 80.2 19830	269 81.2 20670	273 82.2 21530	280 83.3 22390	287 84.3 23240
5	172 55.3 10220	177 57.3 10930	182 59.2 11660	188 61.3 12440	196 63.3 13210	204 65.3 14020	212 67.1 14840	220 68.8 15630	228 70.2 16340	234 71.4 17050	241 72.6 17760	248 73.8 18470	254 74.9 19210	259 76.1 19990	264 77.3 20770	270 78.3 21570	274 79.4 22390	279 80.3 23240
SL	173 51.4 10620	179 53.3 11280	185 55.2 11970	189 56.9 12670	195 58.6 13400	199 60.2 14160	204 62.0 14960	211 63.7 15740	220 65.4 16540	227 67.1 17390	234 68.6 18230	241 69.9 19020	247 71.2 19790	254 72.2 20490	260 73.3 21210	266 74.3 21950	270 75.3 22700	276 76.2 23470

SA1C-360D

Figure 6-1.

LOW ALTITUDE HOLDING
SLATS EXTENDED

NOTE:

1. THREE ENGINE OPERATION
2. STANDARD DAY
3. ADD 0.20% ΔN_1 PER °C ABOVE STANDARD
4. ADD 35 LB/HR FUEL FLOW PER °C ABOVE STANDARD
5. FOR WEIGHTS LIGHTER THAN SHOWN, DETERMINE HOLDING PERFORMANCE AT THE LIGHTEST WEIGHT SHOWN.

	BANK ANGLE	GROSS WEIGHT AT INDICATED BANK ANGLE (1000 LB)																	
	30°		242	260	277	294	312	329	346	364	381	398	416	433	450	468	485	502	520
	25°		254	272	290	308	326	344	362	381	399	417	435	453	471	489	508	526	544
	20°	244	263	282	301	319	338	357	376	395	413	432	451	470	488	507	526	545	564
	10°	256	276	295	315	335	355	374	394	414	433	453	473	492	512	532	551	571	591
	0°	260	280	300	320	340	360	380	400	420	440	460	480	500	520	540	560	580	600
		IAS (KTS) N_1 (% RPM) TOTAL FF (LB/HR)																	
PRESSURE ALTITUDE (1000 FT)	20	157 73.0 10740	164 75.1 11550	170 76.9 12380	177 178.7 13200	181 180.5 14040	187 82.3 14910	191 184.0 15780	196 85.5 16670	201 87.0 17560	207 88.4 18460	211 89.7 19350	215 90.9 20260	218 92.1 21170	222 93.3 22140	226 94.6 23160	230 95.8 24230		
	15	156 68.3 11000	161 70.4 11750	169 72.5 12560	174 74.5 13390	180 76.3 14220	186 77.8 15080	191 79.3 15920	195 80.8 16790	200 82.3 17690	204 83.8 18600	209 85.2 19520	213 86.5 20450	217 87.8 21400	221 89.0 22360	226 90.1 23320	228 91.3 24290	231 92.3 25280	236 93.3 26260
	10	156 63.7 11350	162 66.0 12190	167 68.1 13000	173 69.9 13760	178 71.7 14550	185 73.4 15370	190 75.1 16230	195 76.7 17100	200 78.1 17980	205 79.4 18860	208 80.6 19740	213 81.9 20650	217 83.1 21550	221 84.4 22520	224 85.6 23480	229 86.8 24460	233 87.9 25460	236 89.0 26450
	5	157 59.0 11590	162 61.2 12460	168 63.4 13330	173 65.4 14200	178 67.3 15060	182 69.1 15900	188 70.6 16690	193 72.1 17500	198 73.6 18320	204 75.1 19200	208 76.5 20080	213 77.8 20980	217 79.1 21880	222 80.2 22800	226 81.3 23720	231 82.3 24630	232 83.3 25580	238 84.3 26520
	0	157 55.1 11930	163 57.0 12720	168 58.9 13550	174 60.8 14410	178 62.6 15320	184 64.4 16220	188 66.2 17110	193 67.8 18000	198 69.4 18880	203 70.8 19730	208 72.1 20530	212 73.4 21350	217 74.6 22210	221 75.8 23070	225 77.1 23980	229 78.3 24900	233 79.4 25820	238 80.4 26740

SA1C-180F

Figure 6-2.

TWO ENGINE HOLDING

NOTE:
1. CLEAN CONFIGURATION
2. STANDARD DAY
3. ADD 0.20% ΔN_1 PER °C ABOVE STANDARD
4. ADD 35 LB/HR FUEL FLOW PER °C ABOVE STANDARD
5. FOR WEIGHTS LIGHTER THAN SHOWN. DETERMINE HOLDING PERFORMANCE AT THE LIGHTEST WEIGHT SHOWN.

BANK ANGLE	GROSS WEIGHT AT INDICATED BANK ANGLE (1000 LB)																	
30°		242	260	277	294	312	329	346	364	381	398	416	433	450	468	485	502	520
25°		254	272	290	308	326	344	362	381	399	417	435	453	471	489	508	526	544
20°	244	263	282	301	319	338	357	376	395	413	432	451	470	488	507	526	545	564
10°	256	276	295	315	335	355	374	394	414	433	453	473	492	512	532	551	571	591
0°	260	280	300	320	340	360	380	400	420	440	460	480	500	520	540	560	580	600
PRESSURE ALTITUDE (1000 FT)	IAS (KTS) N_1 (% RPM) TOTAL FF (LB/HR)																	
39	197 100.5 10060																	
37	196 96.7 9740	202 99.7 10700																
35	196 94.0 9530	204 96.4 10460	212 98.9 11400	214 102.1 12410								OPERATIONAL CAPABILITY EXCEEDED						
33	194 91.8 9320	204 94.2 10240	211 96.5 11160	217 98.7 12090	222 101.3 13080													
31	190 89.7 9180	202 92.0 10030	208 94.3 10960	218 96.4 11890	224 98.4 12820	231 100.5 13780	237 102.8 14810											
29	189 87.7 9110	196 89.9 9910	206 92.1 10760	214 94.2 11680	223 96.2 12630	229 98.1 13570	236 100.0 14530	240 102.1 15530	245 104.5 16590									
27	188 85.8 9100	196 88.0 9870	202 90.0 10660	211 92.1 11530	221 94.0 12430	227 96.0 13390	236 97.8 14360	242 99.5 15330	248 101.3 16310	251 103.3 17340	256 105.4 18430	254 109.1 18920						
25	188 83.9 9110	195 86.1 9880	201 88.2 10660	211 90.0 11460	216 92.0 12320	225 93.8 13220	233 95.6 14170	239 97.4 15160	248 99.0 16150	252 100.7 17160	257 102.3 18170	262 104.1 19220	266 106.1 20340					
23	186 82.0 9080	195 84.2 9830	201 86.3 10600	208 88.3 11390	214 90.1 12200	221 91.8 13040	228 93.6 13950	238 95.2 14890	245 96.9 15880	250 98.5 16900	259 100.0 17900	264 101.5 18920	270 103.0 19940	273 104.7 21000	277 106.4 22110	285 108.1 23280		
21	186 79.9 9030	193 82.3 9770	201 84.4 10540	208 86.4 11300	214 88.2 12090	220 90.0 12910	226 91.6 13730	231 93.3 14630	239 94.9 15580	248 96.4 16560	255 97.9 17570	259 99.4 18610	269 100.7 19630	274 102.1 20650	280 103.5 21670	283 105.0 22720	287 106.6 23820	
19	184 78.2 9030	193 80.3 9740	200 82.5 10490	206 84.5 11260	214 86.4 12030	220 88.1 12820	226 89.8 13630	232 91.3 14460	236 92.9 15330	243 94.4 16260	250 95.9 17240	258 97.3 18240	265 98.6 19280	270 100.1 20340	280 101.3 21360	285 102.5 22380	290 103.8 23410	293 105.2 24430
15	181 74.9 9130	189 77.0 9850	197 78.8 10560	204 80.7 11310	212 82.5 12080	217 84.4 12870	224 86.1 13690	228 87.8 14520	234 89.3 15370	241 90.7 16240	247 92.1 17120	254 93.3 17990	259 94.6 18870	265 95.9 19830	272 97.2 20790	282 98.4 21780	286 99.6 22800	291 100.9 23850
10	173 70.2 9340	181 72.3 10010	191 74.6 10740	200 76.6 11480	207 78.4 12230	214 79.9 12990	221 81.5 13760	227 83.0 14560	233 84.6 15380	240 86.1 16230	244 87.6 17080	251 88.9 17950	255 90.2 18830	261 91.4 19720	267 92.6 20620	273 93.8 21530	281 94.8 22410	284 95.9 23290
5	174 65.7 9650	180 68.0 10360	185 70.0 11050	192 71.9 11710	199 73.8 12410	208 75.7 13170	216 77.4 13930	224 79.0 14700	231 80.4 15480	237 81.7 16270	242 83.0 17060	248 84.2 17880	254 85.6 18720	260 86.9 19580	264 88.2 20460	270 89.3 21340	274 90.4 22230	279 91.6 23130
SL	174 61.1 9800	179 63.3 10550	187 65.5 11300	192 67.6 12040	198 69.5 12780	203 71.3 13480	209 72.8 14160	214 74.4 14850	223 76.0 15610	231 77.5 16390	239 79.0 17180	245 80.3 17960	251 81.5 18760	256 82.6 19570	262 83.7 20380	267 84.8 21210	272 85.9 22070	277 87.0 22950

SA1C-361D

Figure 6-3.

ONE ENGINE HOLDING

NOTE:
1. CLEAN CONFIGURATION
2. STANDARD DAY
3. ADD 0.20% ΔN_1 PER °C ABOVE STANDARD
4. ADD 35 LB/HR FUEL FLOW PER °C ABOVE STANDARD
5. FOR WEIGHTS LIGHTER THAN SHOWN, DETERMINE HOLDING PERFORMANCE AT THE LIGHTEST WEIGHT SHOWN.

BANK ANGLE	GROSS WEIGHT AT INDICATED BANK ANGLE (1000 LB)												
30°		242	260	277	294	312	329	346	364	381	398	416	433
25°		254	272	290	308	326	344	362	381	399	417	435	453
20°	244	263	282	301	319	338	357	376	395	413	432	451	470
10°	256	276	295	315	335	355	374	394	414	433	453	473	492
0°	260	280	300	320	340	360	380	400	420	440	460	480	500
PRESSURE ALTITUDE (1000 FT)	IAS (KTS) N_1 (% RPM) TOTAL FF (LB/HR)												
23	188 105.1 9470												
21	189 101.6 9180	195 105.4 10180							OPERATIONAL CAPABILITY EXCEEDED				
19	186 98.8 8960	194 102.1 9900	202 105.4 10910										
15	182 94.2 8780	191 96.8 9590	198 99.5 10490	206 102.3 11450	213 105.1 12470								
10	178 90.0 8860	185 92.3 9620	193 94.3 10360	201 96.3 11140	210 98.5 11990	215 100.8 12910	222 103.2 13910	229 105.4 14970					
5	179 85.2 9000	185 87.8 9710	191 90.0 10460	197 92.2 11230	204 94.1 12020	211 95.8 12790	219 97.5 13580	226 99.2 14430	232 101.1 15350	241 103.0 16320	243 105.1 17350		
SL	179 80.9 9120	186 83.1 9870	192 85.3 10610	198 87.6 11320	204 89.7 12060	209 91.6 12830	215 93.4 13620	220 95.1 14410	226 96.6 15220	234 98.0 16010	240 99.4 16840	247 100.9 17710	253 102.5 18650

SA1C-362C

Figure 6-4.

EFFECT OF DRAG INDEX ON HOLDING

NOTE:
APPLICABLE FOR ONE, TWO OR THREE ENGINE OPERATION

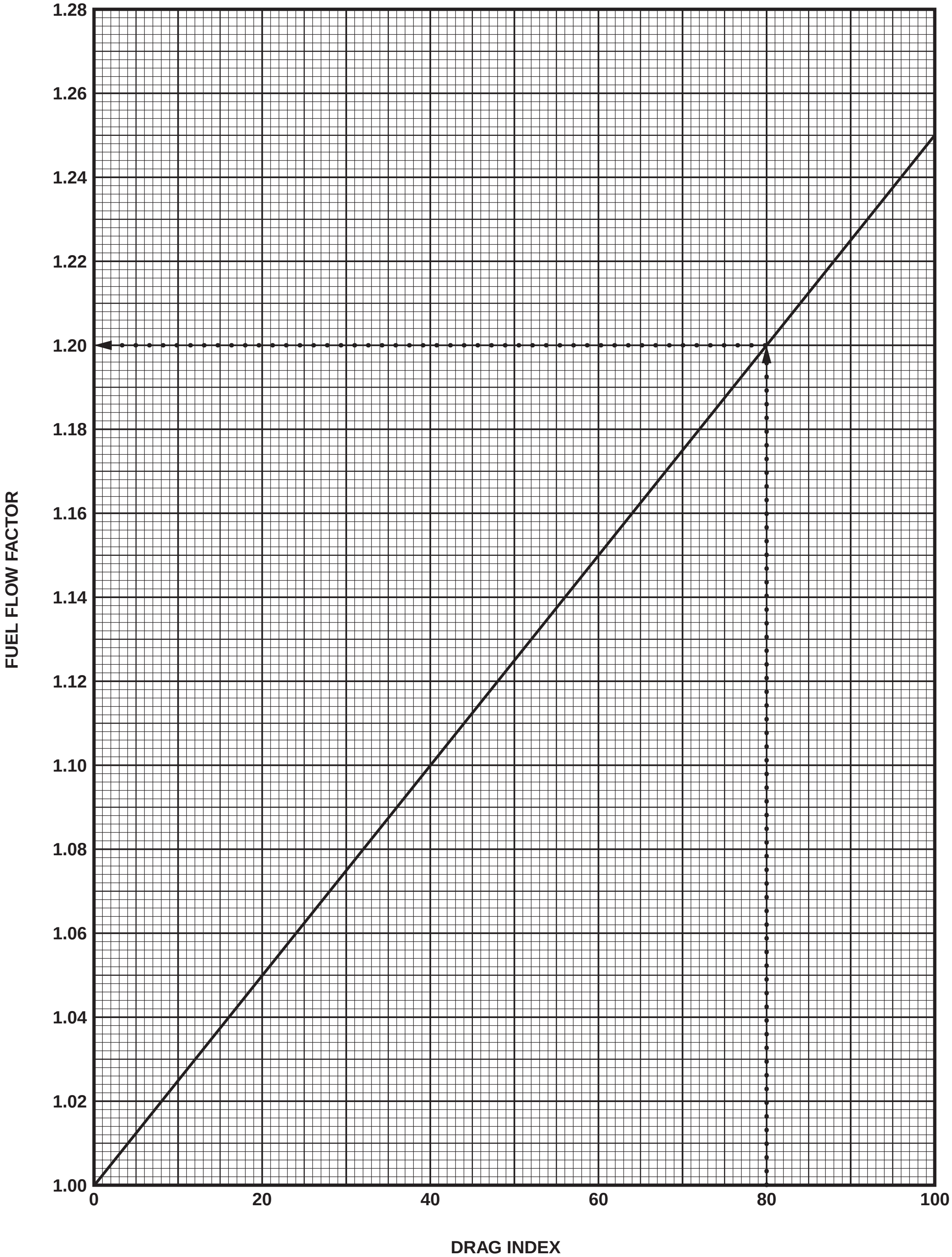


Figure 6-5.

SA1C-46D

SECTION VII

AIR REFUELING

TABLE OF CONTENTS

LIST OF CHARTS

INTRODUCTION

The data contained in this section provide the information necessary to plan refueling operations with the KC-10A and KC-135. Data are presented for the fuel consumed during orbit for tanker operation. Formating capability and fuel consumed during air refueling charts are provided for the KC-10A as a receiver. The fuel consumption values are increased five percent relative to the engine specification level.

With TCTO 1C-10(K)A-956, when refueling from the fuselage -mounted or wing-mounted aerial refueling pod hose/drogue system, the appropriate charted values of this section must be adjusted for the drag additives from figure 1-14, Drag Index Table. Airspeed/altitude envelopes for hose/drogue refueling are presented in TO 1C-10(K)A-1, Section III, Limitations.

NOTE

The following will apply with the wing-mounted pod hose/drogue in trail: With KC-10A flaps/slats at 0°/RET, the hose/drogue extension/retraction envelope is 230 KIAS to 280 KIAS.

DEFINITION OF TERMS

FORMATING CAPABILITY

The formating capability is normally the maximum receiver weight at which refueling position can be maintained in the downwash of the tanker. When the tanker is in receiver position, the formating capability is the maximum receiver weight in free air and the maximum tanker weight at which the refueling position can be maintained with the tanker in the downwash of the receiver. The formating capability is based on a drag index of 0, maximum continuous thrust, and a 200 feet per minute rate-of-climb capability at the heaviest air refueling weight. The formating capability with one engine inoperative includes the drag of a locked rotor on the inoperative engine, and is also applicable when the inoperative engine is windmilling.

FACTORS AFFECTING AIR REFUELING

FORMATING ALTITUDE AND AIRSPEED

Formating altitude and airspeed may be limited by either the receiver or the tanker. Generally, the receiver limits the formating capability at the end of refueling while the tanker limits the formating capability at the start of refueling. Under conditions where the altitude and speed requirements cannot be satisfied it is always better for the receiver to sacrifice altitude in lieu of speed.

CAUTION

- The pressure altitude of 25,000 feet should be used as the base planning altitude for receiver air refueling. Altitudes up to 2,000 feet below optimum altitude for gross weight at the end of air refueling may be used. In no case will air refueling be planned above a pressure altitude of 31,000 feet.
- When air refueling the KC-10 to inflight maximum gross weight, the planned air refueling altitude will be no higher than the pressure altitude of 25,500 feet.

NOTE

- Flight test results indicated an airspeed of 320 KCAS was optimum at 590,000 pounds.
- Tanker air refueling speeds for specific receivers are found in TO 1-1C-1-33.
- When refueling as a tanker, the minimum air refueling speed will be no less than the following:

1. The specific receiver aircraft recommended speed.
2. The 1. 2 G buffet speed plus any "noted" correction.
3. The boom or drogue air speed limitations.

TEMPERATURE

Temperatures above standard day increase the fuel consumption and decrease the formating capability. To account for higher than standard temperature, increase the fuel flow by 0.25 percent per degree Centigrade above standard.

TANKER WEIGHT

Normally, the downwash from the tanker causes a deflection of the relative wind at the receiver. This phenomenon requires the receiver to increase thrust in order to maintain the selected altitude and airspeed. The effects of the tanker weight and downwash are included in the data presented in this section. When the tanker is in the receiver position, the opposite is true, as indicated in the discussion of receiver weight which follows.

RECEIVER WEIGHT

Receiver weight affects air refueling such that heavier weights have higher fuel consumption and less climb gradient capability.

When the tanker is in the receiver position (reverse refueling), the downwash from the receiver (in the tanker position) causes a deflection of the relative wind. This phenomenon requires the tanker to increase thrust in order to maintain the selected altitude and airspeed. The effects of the receiver weight and downwash are included in the data presented in this section for the tanker in the receiver position.

THRUST

The Maximum Continuous Thrust rating is the highest rated thrust permissible during refueling operation. This thrust level provides the maximum refueling capabilities. When less thrust is required to maintain refueling position, the fuel consumption during refueling is reduced.

DRAG INDEX (DI)

In the event that the KC-10A is being refueled while flying with non-zero drag index, additional thrust is required to offset the increased drag. This results in higher fuel consumption and a reduction in the formating capability. Refer to Section I to determine the drag index for non-standard configurations. Increase fuel flow by 0.4 percent for each unit of drag index. Reduce formating capability by 1,400 pounds with all engines operating or 1,800 pounds with one engine inoperative for each unit of drag index.

FUEL TRANSFER RATE

The KC-10A as a tanker can transfer fuel at up to 7,800 pounds per minute. In addition, from the receiver position, the KC-10A can pump fuel up to the "tanker" at a rate of approximately 1,000 pounds per minute.

ENGINE BLEED

The use of engine anti-ice protection when the engine anti-ice shutoff valves are inoperative in the open position (MEL item) results in the following corrections to the ice protection off performance:

Fuel flow during orbit must be increased by 1.5%.

Formating capability is affected in that the maximum receiver weight for a given tanker weight must be reduced by 3%.

The fuel consumption during air refueling is affected in that the fuel flow must be increased by 1.5% for a given receiver weight.

ORBIT

The standard tanker orbit airspeed is 275 KIAS or Mach 0.78, whichever is lower, but not below AR Orbit Speed (Fig. 7-1). The standard tanker orbit pattern airspeed for A-10 refueling is 255 KIAS to facilitate the rendezvous slow down to the A-10 air refueling speed; this may require a configuration of 0/EXT (Fig. 7-2). Orbit speeds provide safe maneuvering capability at all gross weights and altitudes, while ensuring sufficient thrust is available and thrust limitations are not exceeded. If extensive delay is anticipated, use procedures in Chapter 6, Holding.

NOTE

If no air refueling orbit delay is anticipated, 275 KIAS (255 KIAS for A-10) or maximum endurance speed (see Chapter 5), whichever is greater, may be used for the rendezvous turn.

CHART EXPLANATION AND EXAMPLE PROBLEMS

FUEL CONSUMPTION AND SPEED DURING ORBIT

Fuel consumption during orbit as a function of gross weight and altitude is provided in figures 7-1, 7-2, and 7-7. The fuel flow shown is based on the parameters contained in the Inertial Navigation System and includes the effect of bank angle and recommended orbit speeds.

Example 1:

Given:

All Engines Operating

Gross Weight at Start of Orbit 540,000 Pounds

Pressure Altitude = 25,000 Feet

Temperature = Std + 10°C

Find:

Fuel Consumption During Orbit

Speed During Orbit

Solution:

Enter the AR Orbit Table (figure 7-1) at 25,000 feet and read across to where it intersects the column for 540,000 pounds. The indicated airspeed is 304 KIAS and the total fuel flow is 401 pounds per minute. Making the adjustment for Std + 10°C the fuel consumption during orbit is 407 pounds per minute.

FORMATING CAPABILITY

Formating capability of the KC-10A as a receiver is provided in figures 7-3, 7-4, and figures 7-8 through 7-10. Figures 7-3, 7-8, and 7-10 are applicable for refueling with another KC-10A while figures 7-4 and 7-9 are based on refueling with a KC-135. Figures 7-3, 7-4, 7-8, and 7-9 are based on maximum continuous thrust while maintaining a 200 feet per minute rate-of-climb capability in the downwash of the respective tanker. Figure 7-10 is based on maximum continuous thrust while maintaining a 200 feet per minute rate-of-climb capability with the tanker in the downwash of the receiver and the receiver in free air.

Formating capability varies with tanker weight, therefore, the formating capability should be checked at the initial tanker weight and also at the final tanker weight. The planned receiver initial and final weights cannot exceed the corresponding formating capability values (from the chart) if the scheduled refueling is to be achieved.

Example 2:

Given:

All Engines Operating

KC-10A Tanker Gross Weight 490, 000 Pounds

Temperature = Std. +20°C

Pressure Altitude = 25,000 Feet

Airspeed = 290 KIAS

Find:

Formating Capability

Solution:

From figure 7-3, the formating capability is 572,600 pounds.

FUEL CONSUMPTION DURING AIR REFUELING

Fuel flow of the KC-10A as a receiver is provided in figures 7-5, 7-6, and figures 7-11 through 7-13. Figures 7-5, 7-11, and 7-13 are applicable for refueling with another KC-10A while figure 7-6 and 7-12 are based on refueling with a KC-135.

To find fuel burned during a refueling segment, the chart should be entered with the average tanker and receiver weights. If an instantaneous fuel burned value is desired, enter the chart with the actual tanker and receiver weights.

Example 3:

Given:

All Engines Operating

KC-10A Tanker Gross Weight = 500,000 Pounds

KC-10A Receiver Gross Weight = 400,000 Pounds

Pressure Altitude = 25,000 Feet

Airspeed = 290 KIAS

Temperature = Std Day

Find:

Fuel Consumption During Air Refueling

Solution:

Use figure 7-5 for KC-10A/KC-10A air refueling. Enter with the receiver gross weight and read up to the tanker gross weight line. The fuel consumption during air refueling is 363 pounds per minute.

AR ORBIT TABLE

NOTE:

1. THREE ENGINE OPERATION
2. STANDARD DAY
3. MAXIMUM ENDURANCE SPEED OR 275 KIAS WHICHEVER IS HIGHER
4. ADD 0.20% ΔN_1 PER °C ABOVE STANDARD
5. ADD 0.6 LB/MIN FUEL FLOW PER °C ABOVE STANDARD
6. 25° BANK

	GROSS WEIGHT (1000 LB)																
	280	300	320	340	360	380	400	420	440	460	480	500	520	540	560	580	600
	IAS (KTS) N_1 (% RPM) TOTAL FF (LB/MIN)																
PRESSURE ALTITUDE (1000 FT)																	
35	275 90.1 224	275 91.0 233	275 92.1 243	275 93.2 255	275 94.2 266	275 95.5 280	275 97.0 296	275 99.0 316	275 101.3 339	275 104.1 364					**OPERATIONAL CAPABILITY EXCEEDED**		
33	275 88.8 223	275 89.6 231	275 90.5 240	275 91.6 251	275 92.7 263	275 93.9 276	275 95.1 290	275 96.5 306	277 98.1 325	280 99.9 346	282 102.0 369	284 104.4 395					
31	275 87.3 223	275 88.3 231	275 89.2 240	275 90.2 250	275 91.2 260	275 92.3 273	275 93.6 287	275 94.8 302	276 96.2 319	282 97.5 338	288 98.8 357	293 100.4 378	296 102.1 401	296 104.3 426			
29	275 85.7 223	275 86.7 231	275 87.7 240	275 88.7 250	275 89.7 260	275 90.8 272	275 92.0 285	275 93.2 299	275 94.5 315	281 95.7 333	287 96.9 352	293 98.1 370	299 99.3 390	304 100.7 411	306 102.3 433	308 104.1 457	
27	275 83.9 223	275 84.9 232	275 86.0 240	275 87.0 250	275 88.1 260	275 89.2 271	275 90.4 284	275 91.6 298	275 92.9 313	278 94.1 330	286 95.3 348	292 96.4 366	298 97.5 385	305 98.6 404	310 99.7 423	316 100.8 444	319 102.2 466
25	275 82.3 225	275 83.3 233	275 84.3 242	275 85.4 251	275 86.4 261	275 87.6 272	275 88.7 284	275 89.9 297	275 91.2 312	275 92.5 328	278 93.8 346	287 94.9 364	297 95.9 383	304 96.9 401	309 97.9 419	315 98.9 438	321 99.9 458
23	275 80.8 227	275 81.7 234	275 82.7 242	275 83.8 251	275 84.6 261	275 85.9 271	275 87.0 283	275 88.2 295	275 89.5 309	275 90.8 325	275 92.1 341	283 93.2 359	289 94.4 378	295 95.4 396	309 96.3 414	314 97.2 432	320 98.2 451
21	275 79.3 228	275 80.3 235	275 81.2 244	275 82.2 252	275 83.3 261	275 84.3 271	275 85.4 282	275 86.6 294	275 87.8 307	275 89.0 322	277 90.3 338	282 91.5 355	285 92.7 372	294 93.7 390	300 94.8 408	308 95.8 426	319 96.6 444
19	275 77.9 230	275 78.8 237	275 79.7 245	275 80.7 254	275 81.7 263	275 82.7 273	275 83.8 283	275 84.9 294	275 86.1 306	275 87.3 320	277 88.6 336	282 89.8 352	289 90.9 369	293 92.0 385	297 93.1 402	305 94.1 420	310 95.1 438
17	275 76.4 232	275 77.3 240	275 78.2 248	275 79.2 256	275 80.1 265	275 81.1 275	275 82.2 285	275 83.2 296	275 84.4 307	275 85.5 320	275 86.8 334	279 88.0 351	288 89.2 367	293 90.3 383	300 91.4 400	303 92.4 417	307 93.4 434
15	275 74.9 235	275 75.8 243	275 76.7 250	275 77.7 259	275 78.7 268	275 79.6 278	275 80.5 288	275 81.6 298	275 82.6 310	275 83.8 322	275 85.0 336	279 86.2 351	284 87.4 366	293 88.6 382	298 89.7 399	304 90.7 415	311 91.7 432
12	275 72.7 240	275 73.5 247	275 74.4 255	275 75.4 263	275 76.3 272	275 77.3 281	275 78.3 291	275 79.2 301	275 80.0 313	275 81.2 325	275 82.3 338	275 83.5 353	280 84.8 368	287 85.9 383	295 87.0 398	300 88.1 414	308 89.1 430
10	275 71.6 246	275 72.4 253	275 73.2 260	275 74.0 268	275 74.9 276	275 75.9 285	275 76.9 294	275 77.8 305	275 78.8 315	275 79.8 327	275 80.7 340	275 81.8 354	276 82.9 369	284 84.1 384	290 85.3 400	298 86.4 415	305 87.4 430
8	275 70.2 250	275 71.0 256	275 71.7 263	275 72.5 270	275 73.4 278	275 74.2 287	275 75.2 296	275 76.2 306	275 77.2 317	275 78.2 328	275 79.3 341	275 80.3 354	275 81.3 369	280 82.4 385	286 83.4 401	293 84.5 416	301 85.6 432

SA1C-358D

Figure 7-1.

A-10 AR ORBIT TABLE

NOTE:

1. THREE ENGINE OPERATION
2. STANDARD DAY
3. CHANGEOVER FROM 0°/RET TO 0°/EXT OCCURS WHEN MAXIMUM ENDURANCE SPEED (25° BANK) EXCEEDS 255 KIAS
4. ADD 0.20% ΔN_1 PER °C ABOVE STANDARD
5. ADD 0.6 LB/MIN FUEL FLOW PER °C ABOVE STANDARD
6. A-10 A/R WITH KC-10 GROSS WEIGHT ABOVE 540,000 LBS IS NOT RECOMMENDED DUE TO A-10 POWER LIMITATIONS
7. 25° BANK

	0°/RET								0°/EXT								
	GROSS WEIGHT (1000 LB)																
	280	300	320	340	360	380	400	420	440	460	480	500	520	540	560	580	600
PRESSURE ALTITUDE (1000 FT)	IAS (KTS) N_1 (% RPM) TOTAL FF (LB/MIN)																
21	255 77.6 211	255 78.7 220	255 79.8 229	255 81.0 239	255 82.3 249	255 83.6 261	255 84.9 274	255 86.4 281	255 93.0 363	255 94.1 378	255 95.1 392	255 96.3 408			OPERATIONAL CAPABILITY EXCEEDED		
19	255 76.1 212	255 77.1 221	255 78.2 230	255 79.4 240	255 80.5 250	255 81.8 261	255 83.2 274	255 84.6 288	255 91.9 373	255 92.8 385	255 93.7 398	255 94.7 412	255 95.8 427				
17	255 74.5 214	255 75.6 223	255 76.7 232	255 77.8 241	255 78.9 251	255 80.1 262	255 81.4 275	255 82.8 288	255 90.2 373	255 91.1 385	255 92.0 397	255 92.9 411	255 93.9 425	255 94.9 441	255 96.0 457		
15	255 73.0 218	255 74.1 226	255 75.2 235	255 76.3 244	255 77.4 254	255 78.5 265	255 79.7 277	255 80.9 290	255 82.3 305	255 89.4 388	255 90.3 400	255 91.2 414	255 92.2 428	255 93.1 442	255 94.1 458	255 95.2 475	255 96.3 493
13	255 71.6 222	255 72.6 229	255 73.6 238	255 74.8 247	255 75.9 256	255 77.1 267	255 78.2 279	255 79.4 291	255 80.6 305	255 87.7 390	255 88.6 402	255 89.5 415	255 90.5 429	255 91.5 444	255 92.5 459	255 93.4 476	255 94.4 492
10	255 69.6 228	255 70.5 235	255 71.5 243	255 72.5 252	255 73.5 261	255 74.7 271	255 75.9 282	255 77.1 294	255 78.3 307	255 85.0 392	255 86.0 404	255 86.9 417	255 87.9 431	255 88.9 446	255 89.9 461	255 90.9 477	255 92.0 494
8	255 68.3 232	255 69.3 240	255 70.2 248	255 71.1 256	255 72.1 265	251 73.2 274	255 74.2 284	255 75.4 296	255 76.6 308	255 77.9 322	255 84.1 405	255 85.1 418	255 86.1 431	255 87.1 446	255 88.2 461	255 89.2 477	255 90.2 494

SA1C-359C

Figure 7-2.

FORMATING CAPABILITY
KC-10A RECEIVER/KC-10A TANKER

NOTE:

1. PRESSURE ALTITUDE = 25,000 FT
2. AIRSPEED = 290 KIAS
3. THREE ENGINES AT MAXIMUM CONTINUOUS THRUST
4. RECEIVER MAINTAINS 200 FPM RATE-OF-CLIMB CAPABILITY IN TANKER DOWNWASH
5. REDUCE FORMATING CAPABILITY BY 1400 LB PER UNIT OF DRAG INDEX

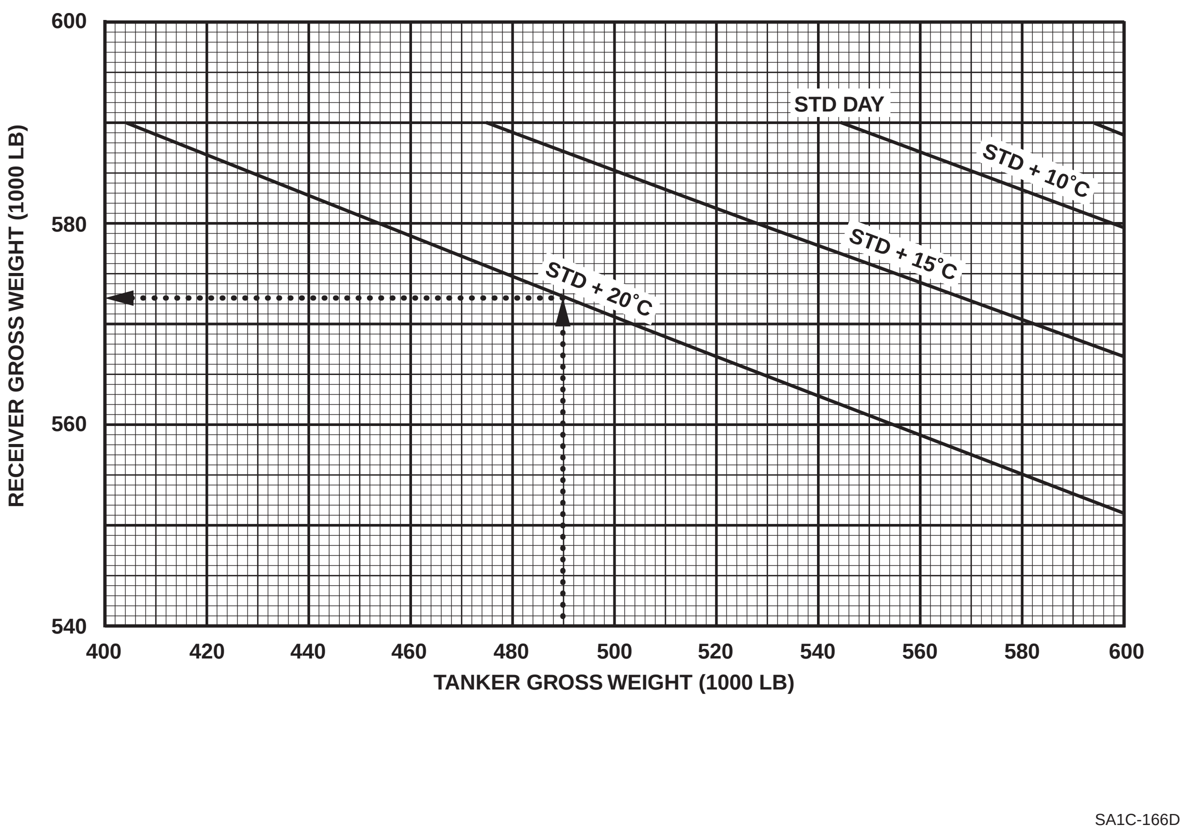


Figure 7-3.

FORMATING CAPABILITY
KC-10A RECEIVER/KC-135 TANKER

NOTE:

1. PRESSURE ALTITUDE = 25,000 FT
2. AIRSPEED= 290 KIAS
3. THREE ENGINES AT MAXIMUM CONTINUOUS THRUST
4. RECEIVER MAINTAINS 200 FPM RATE-OF-CLIMB CAPABILITY IN TANKER DOWNWASH
5. REDUCE FORMATING CAPABILITY BY 1400 LB PER UNIT OF DRAG INDEX

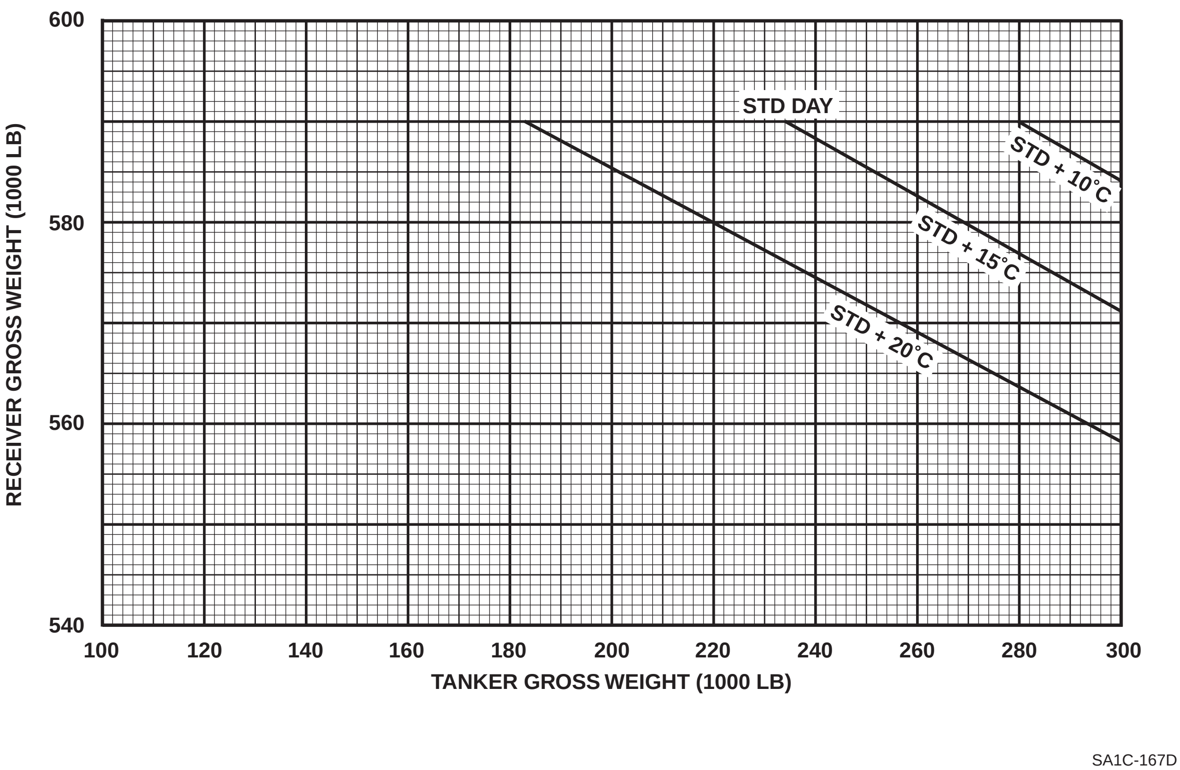
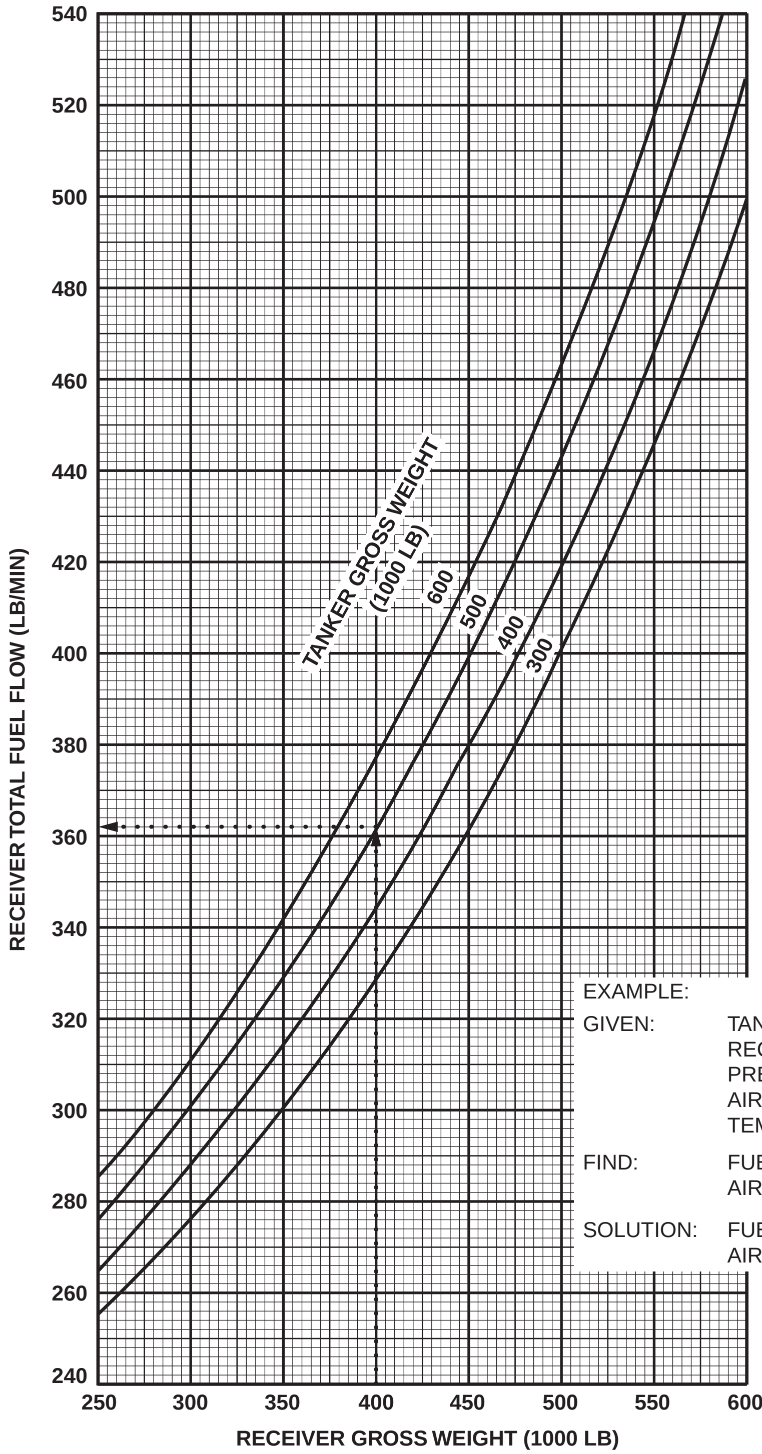


Figure 7-4.

FUEL CONSUMPTION DURING AIR REFUELING
KC-10A RECEIVER/KC-10A TANKER



NOTE:

1. PRESSURE ALTITUDE = 25,000 FT
2. AIRSPEED = 290 KIAS
3. RECEIVER MAINTAINS 200 FPM RATE-OF-CLIMB CAPABILITY IN TANKER DOWNWASH
4. INCREASE FUEL FLOW BY 0.25% PER ˚C ABOVE STANDARD DAY
5. INCREASE FUEL FLOW BY 0.40% PER UNIT OF DRAG INDEX

EXAMPLE:

GIVEN: TANKER GROSS WEIGHT = 500,000 LB
RECEIVER GROSS WEIGHT = 400,000 LB
PRESSURE ALTITUDE = 25,000 FT
AIRSPEED = 290 KIAS
TEMPERATURE = STD DAY

FIND: FUEL CONSUMPTION DURING AIR REFUELING

SOLUTION: FUEL CONSUMPTION DURING AIR REFUELING = 363 LB/MIN

SA1C-156D

Figure 7-5.

FUEL CONSUMPTION DURING AIR REFUELING
KC-10A RECEIVER/KC-135 TANKER

NOTE:
1. PRESSURE ALTITUDE = 25,000 FT
2. AIRSPEED = 290 KIAS
3. RECEIVER MAINTAINS 200 FPM RATE-OF-CLIMB CAPABILITY IN TANKER DOWNWASH
4. INCREASE FUEL FLOW BY 0.25% PER °C ABOVE STANDARD
5. INCREASE FUEL FLOW BY 0.40% PER UNIT OF DRAG INDEX

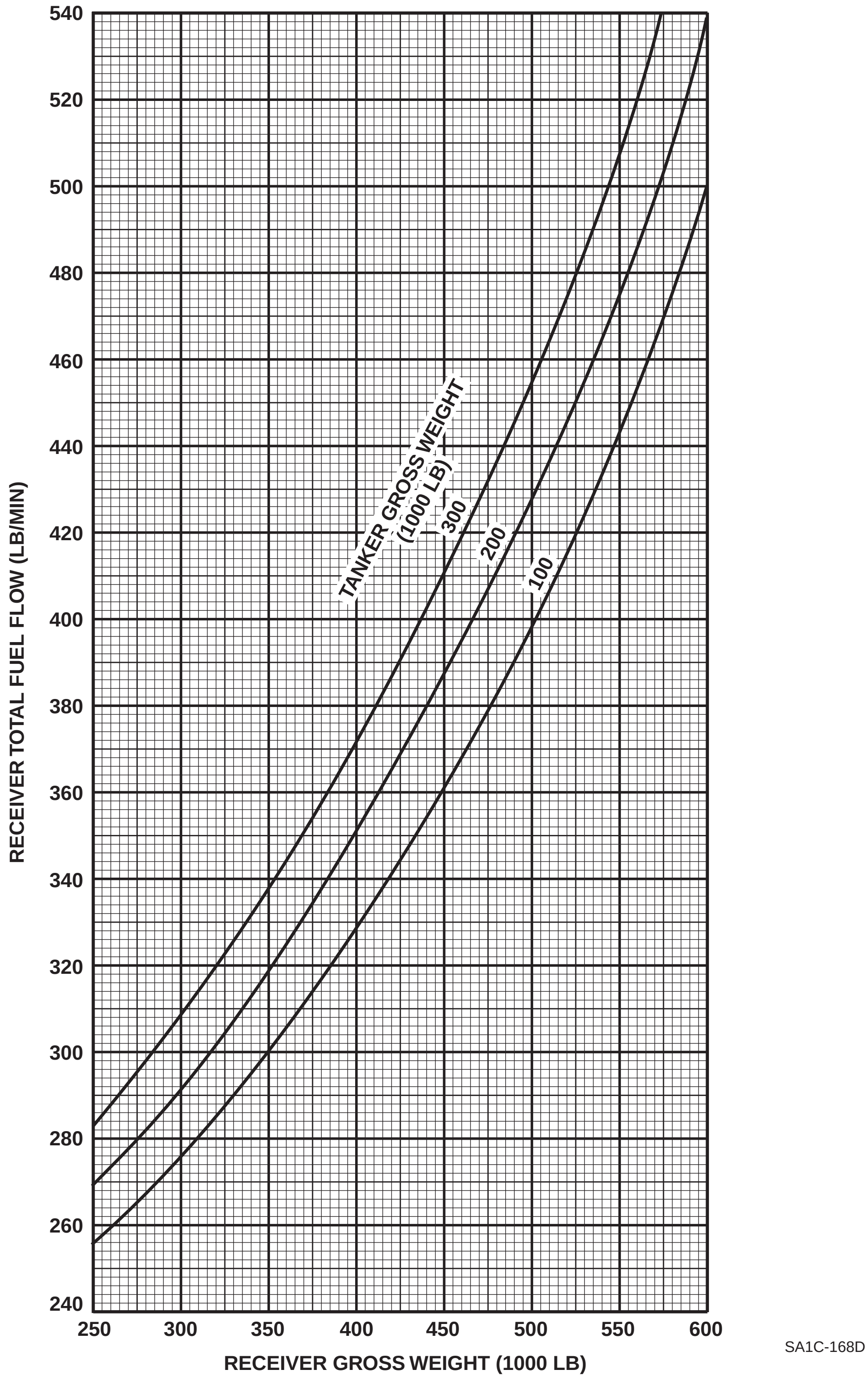


Figure 7-6.

TWO ENGINE AR ORBIT TABLE

NOTE:

1. STANDARD DAY
2. MAXIMUM ENDURANCE SPEED OR 275 KIAS WHICHEVER IS HIGHER
3. ADD 0.20% ΔN_1 PER °C ABOVE STANDARD
4. ADD 0.6 LB/MIN FUEL FLOW PER °C ABOVE STANDARD
5. BASED ON LOCKED ROTOR
6. 25° BANK

	GROSS WEIGHT (1000 LB)															
	280	300	320	340	360	380	400	420	440	460	480	500	520	540	560	580
	IAS (KTS) N_1(% RPM) TOTAL FF (LB/MIN)															
PRESSURE ALTITUDE (1000 FT)																
31	275 99.3 240	275 100.6 250	275 102.2 260													
29	275 97.2 236	275 98.3 246	275 99.6 256	275 101.1 268												
27	275 95.5 234	275 96.5 244	275 97.6 254	275 98.8 264	275 100.2 276											
25	275 93.9 234	275 94.9 242	275 95.9 252	275 97.0 264	275 98.2 274	275 99.5 286										
23	275 92.3 232	275 93.3 240	275 94.3 250	275 95.4 260	275 96.5 272	275 97.7 284										
21	275 90.7 230	275 91.7 238	275 92.7 248	275 93.8 258	275 94.9 270	275 96.1 280	275 97.2 294									
19	275 89.1 230	275 90.0 238	275 91.0 248	275 92.1 256	275 93.2 267	275 94.3 278	275 95.5 290	275 96.7 304								
17	275 87.5 232	275 88.4 240	275 89.4 248	275 90.4 256	275 91.5 267	275 92.6 278	275 93.7 288	275 94.9 302	275 96.1 314							
15	275 85.9 234	275 86.8 242	275 87.8 250	275 88.8 258	275 89.8 268	275 90.9 278	275 92.0 290	275 93.1 302	275 94.3 314	275 95.5 328	278 96.9 344					
12	275 83.3 236	275 84.3 244	275 85.3 252	275 86.3 262	275 87.4 270	275 88.4 280	275 89.5 292	275 90.6 302	275 91.7 314	275 92.9 328	275 94.1 342	275 95.3 356	276 96.7 374			
10	275 81.8 238	275 82.6 246	275 83.5 254	275 84.6 262	275 85.6 272	275 86.7 282	275 87.8 294	275 88.9 304	275 90.0 316	275 91.2 330	275 92.4 342	275 93.6 356	275 94.8 374	283 96.0 390	286 97.2 408	
8	275 80.3 240	275 81.2 246	275 82.0 254	275 82.9 264	275 83.9 274	275 84.9 284	275 86.1 294	275 87.2 304	275 88.3 316	275 89.5 330	275 90.6 342	275 91.8 356	275 93.1 372	281 94.3 390	284 95.7 408	293 96.5 422

SA1C-348D

Figure 7-7.

FORMATING CAPABILITY
KC-10A (ONE ENGINE INOPERATIVE) RECEIVER/KC-10A TANKER

NOTE:

1. PRESSURE ALTITUDE = 25,000 FT
2. SPEED = 290 KIAS
3. TWO ENGINES AT MAXIMUM CONTINUOUS THRUST
4. RECEIVER MAINTAINS 200 FPM RATE-OF-CLIMB CAPABILITY IN TANKER DOWNWASH
5. REDUCE FORMATING CAPABILITY BY 1800 LB PER UNIT OF DRAG INDEX

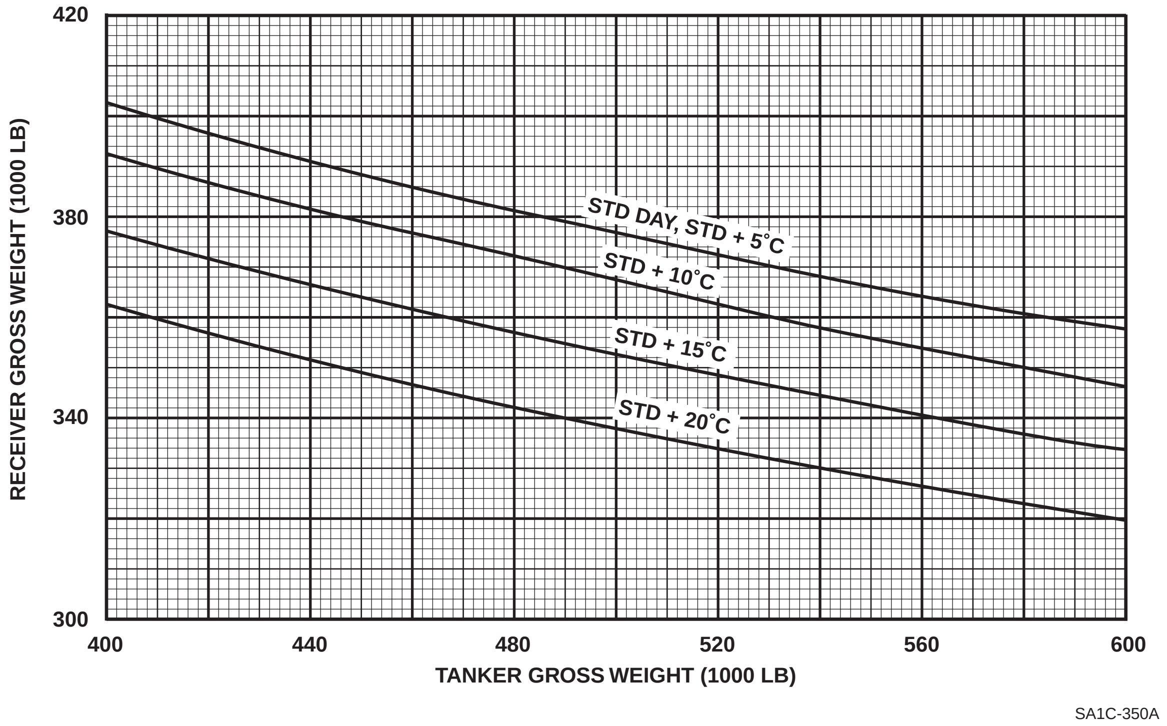


Figure 7-8.

FORMATING CAPABILITY
KC-10A (ONE ENGINE INOPERATIVE) RECEIVER/KC-135 TANKER

NOTE:
1. PRESSURE ALTITUDE = 25,000 FT
2. SPEED = 290 KIAS
3. TWO ENGINES AT MAXIMUM CONTINUOUS THRUST
4. RECEIVER MAINTAINS 200 FPM RATE-OF-CLIMB CAPABILITY IN TANKER DOWNWASH
5. REDUCE FORMATING CAPABILITY BY 1800 LB PER UNIT OF DRAG INDEX

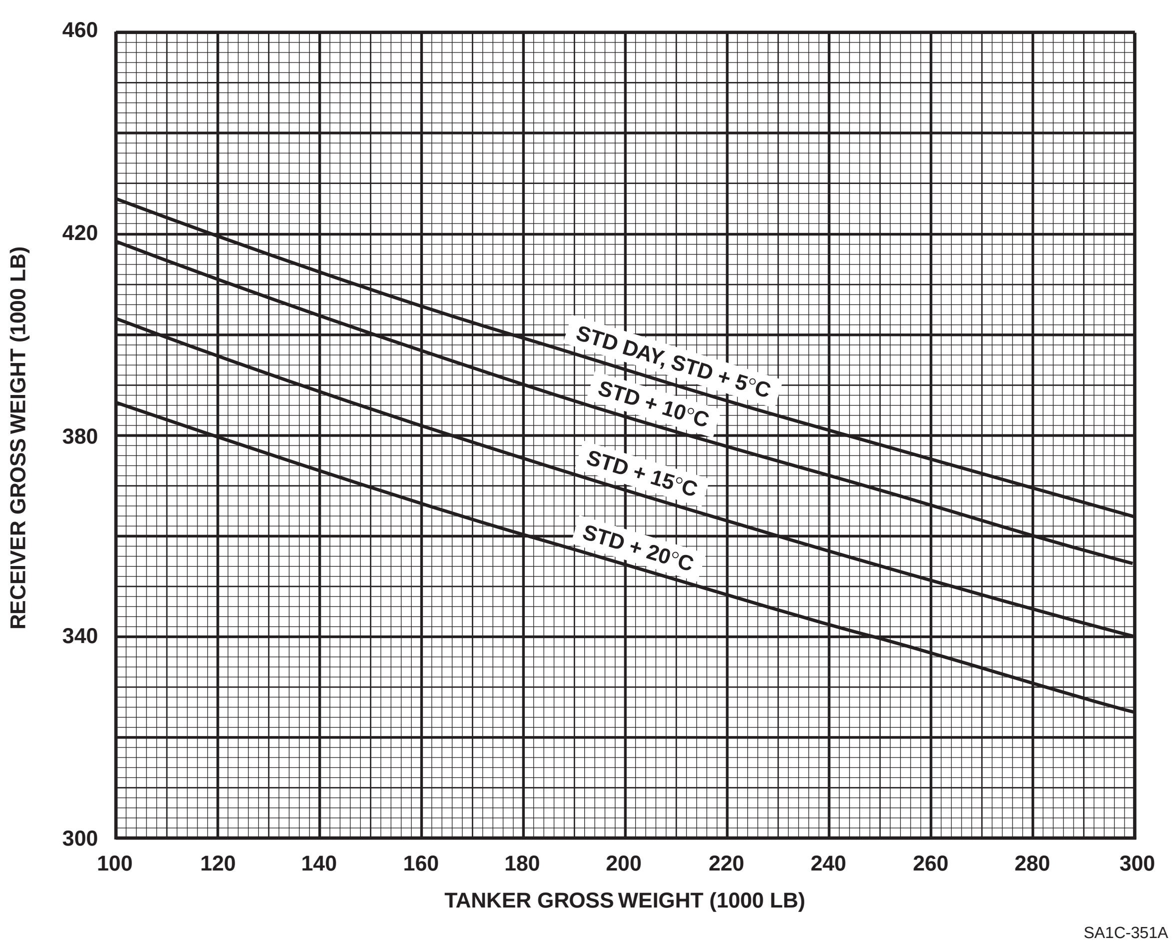


Figure 7-9.

FORMATING CAPABILITY
KC-10A (ONE ENGINE INOPERATIVE) RECEIVER IN TANKER POSITION/
KC-10A TANKER IN RECEIVER POSITION (REVERSE REFUELING)

NOTE:
1. PRESSURE ALTITUDE = 25,000 FT
2. SPEED = 290 KIAS
3. TWO ENGINES AT MAXIMUM CONTINUOUS THRUST
4. TANKER MAINTAINS 200 FPM RATE-OF-CLIMB CAPABILITY IN RECEIVER DOWNWASH
5. RECEIVER MAINTAINS 200 FPM RATE-OF-CLIMB CAPABILITY
6. REDUCE FORMATING CAPABILITY BY 1800 LB PER UNIT OF DRAG INDEX

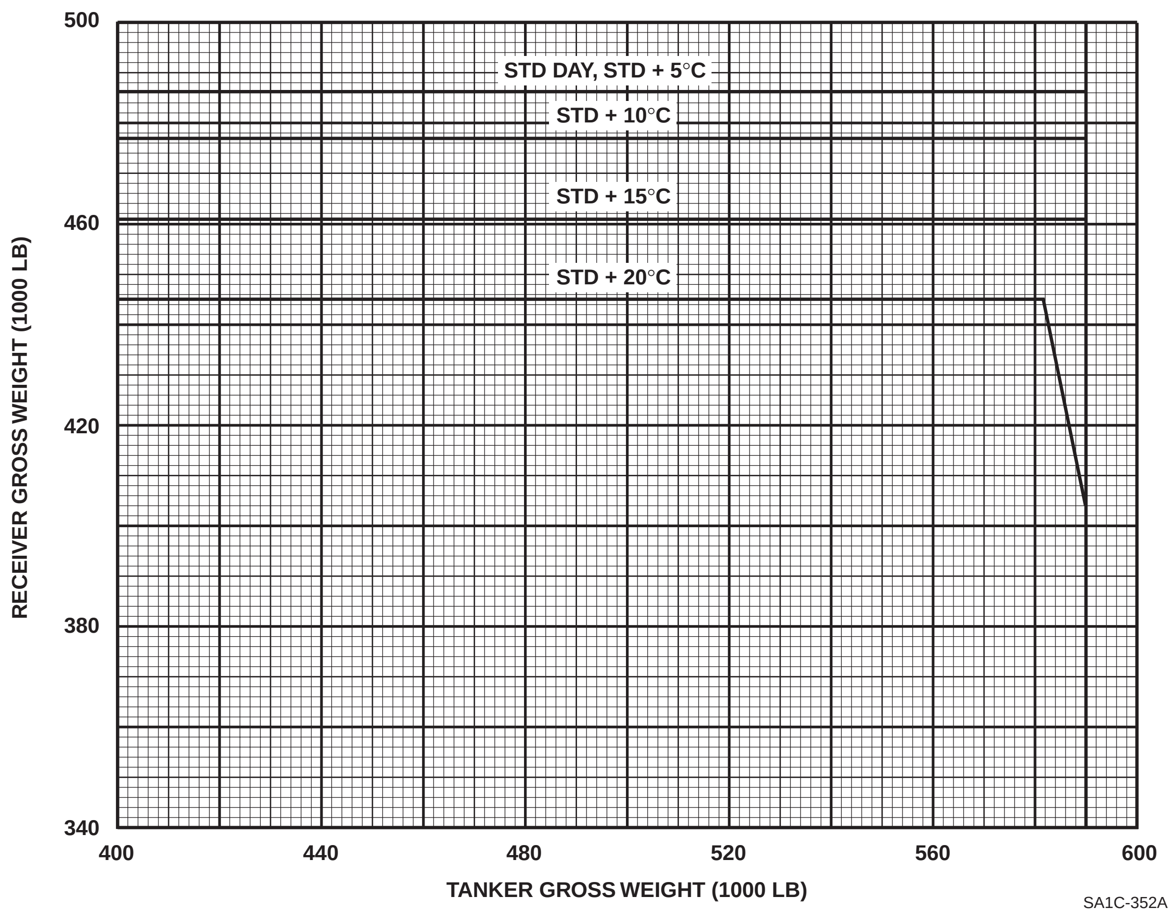


Figure 7-10.

FUEL CONSUMPTION
DURING AIR REFUELING
KC-10A (ONE ENGINE INOPERATIVE) RECEIVER/KC-10A TANKER

NOTE:
1. PRESSURE ALTITUDE = 25,000 FT
2. SPEED = 290 KIAS
3. RECEIVER MAINTAINS 200 FPM RATE-OF-CLIMB CAPABILITY IN TANKER DOWNWASH
4. INCREASE FUEL FLOW BY 0.25% PER °C ABOVE STANDARD DAY
5. INCREASE FUEL FLOW BY 0.40% PER UNIT OF DRAG INDEX

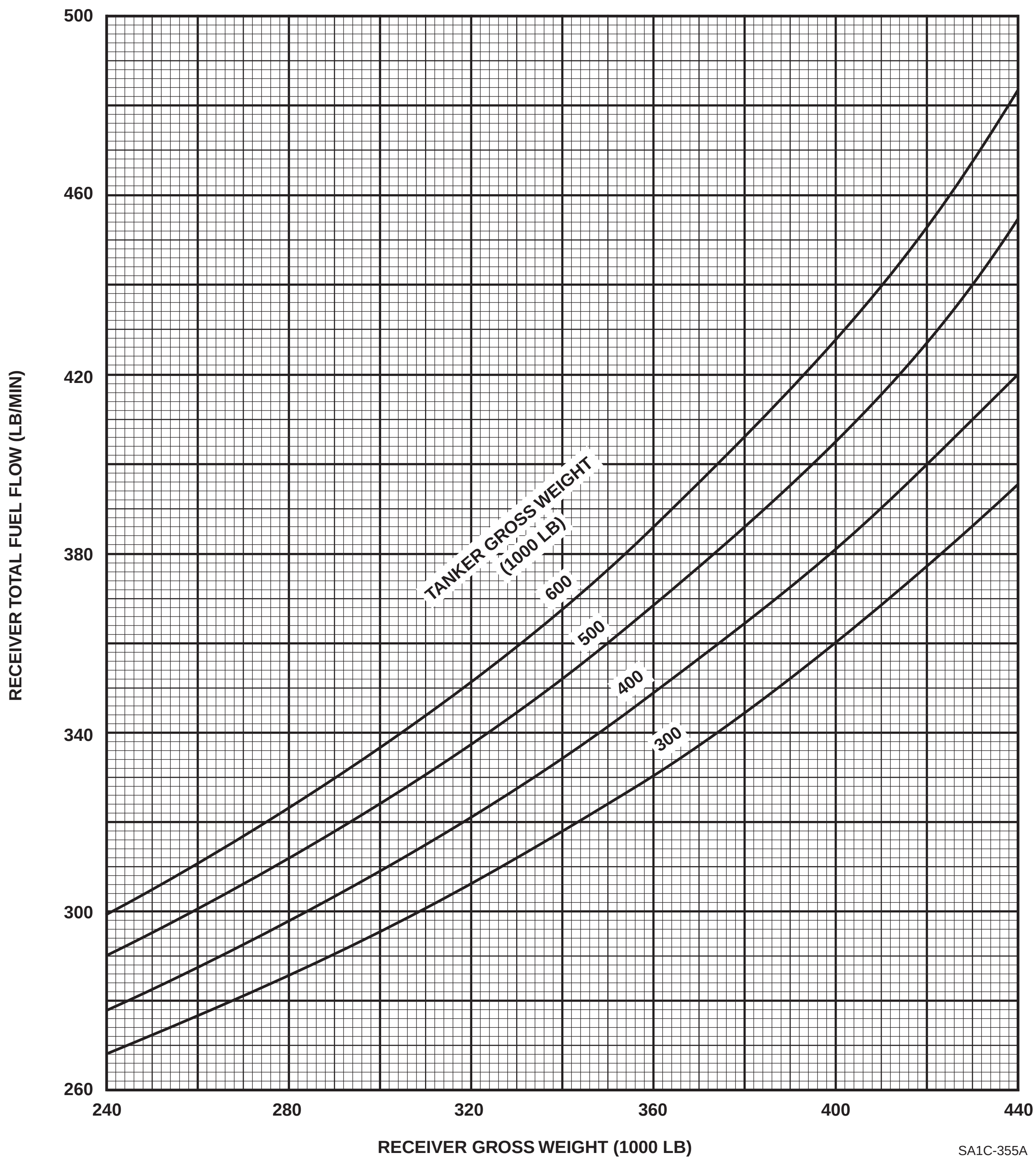


Figure 7-11.

FUEL CONSUMPTION
DURING AIR REFUELING
KC-10A (ONE ENGINE INOPERATIVE) RECEIVER/KC-135 TANKER

NOTE:
1. PRESSURE ALTITUDE = 25,000 FT
2. SPEED = 290 KIAS
3. RECEIVER MAINTAINS 200 FPM RATE-OF-CLIMB CAPABILITY IN TANKER DOWNWASH
4. INCREASE FUEL FLOW BY 0.25% PER °C ABOVE STANDARD DAY
5. INCREASE FUEL FLOW BY 0.40% PER UNIT OF DRAG INDEX

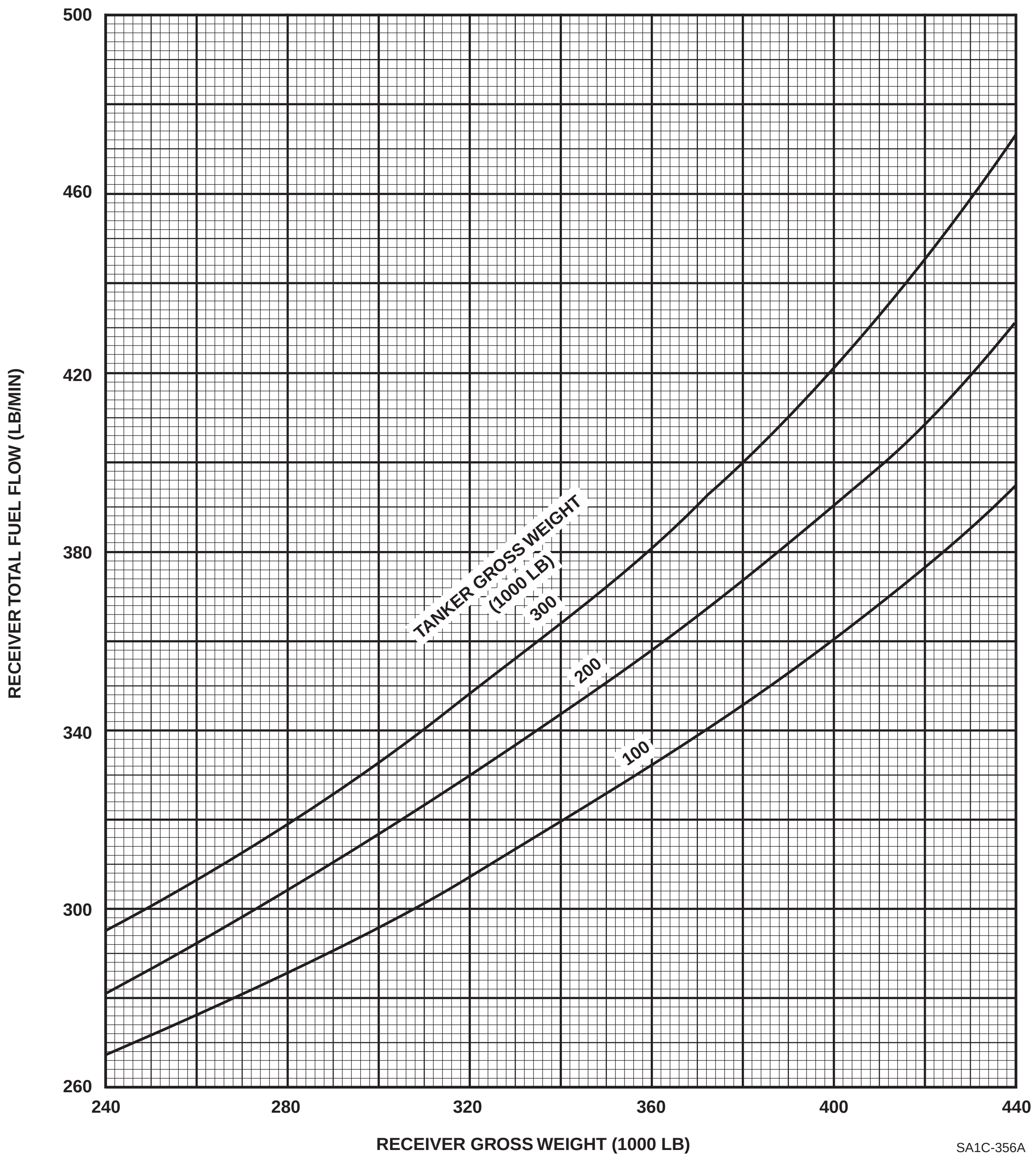


Figure 7-12.

FUEL CONSUMPTION
DURING AIR REFUELING
KC-10A (ONE ENGINE INOPERATIVE) RECEIVER IN TANKER POSITION/
KC-10A TANKER IN RECEIVER POSITION (REVERSE REFUELING)

NOTE:

1. PRESSURE ALTITUDE = 25,000 FT
2. SPEED = 290 KIAS
3. TANKER MAINTAINS 200 FPM RATE-OF-CLIMB CAPABILITY IN RECEIVER DOWNWASH
4. RECEIVER MAINTAINS 200 FPM RATE-OF-CLIMB CAPABILITY
5. INCREASE FUEL FLOW BY 0.25% PER °C ABOVE STANDARD DAY
6. INCREASE FUEL FLOW BY 0.40% PER UNIT OF DRAG INDEX

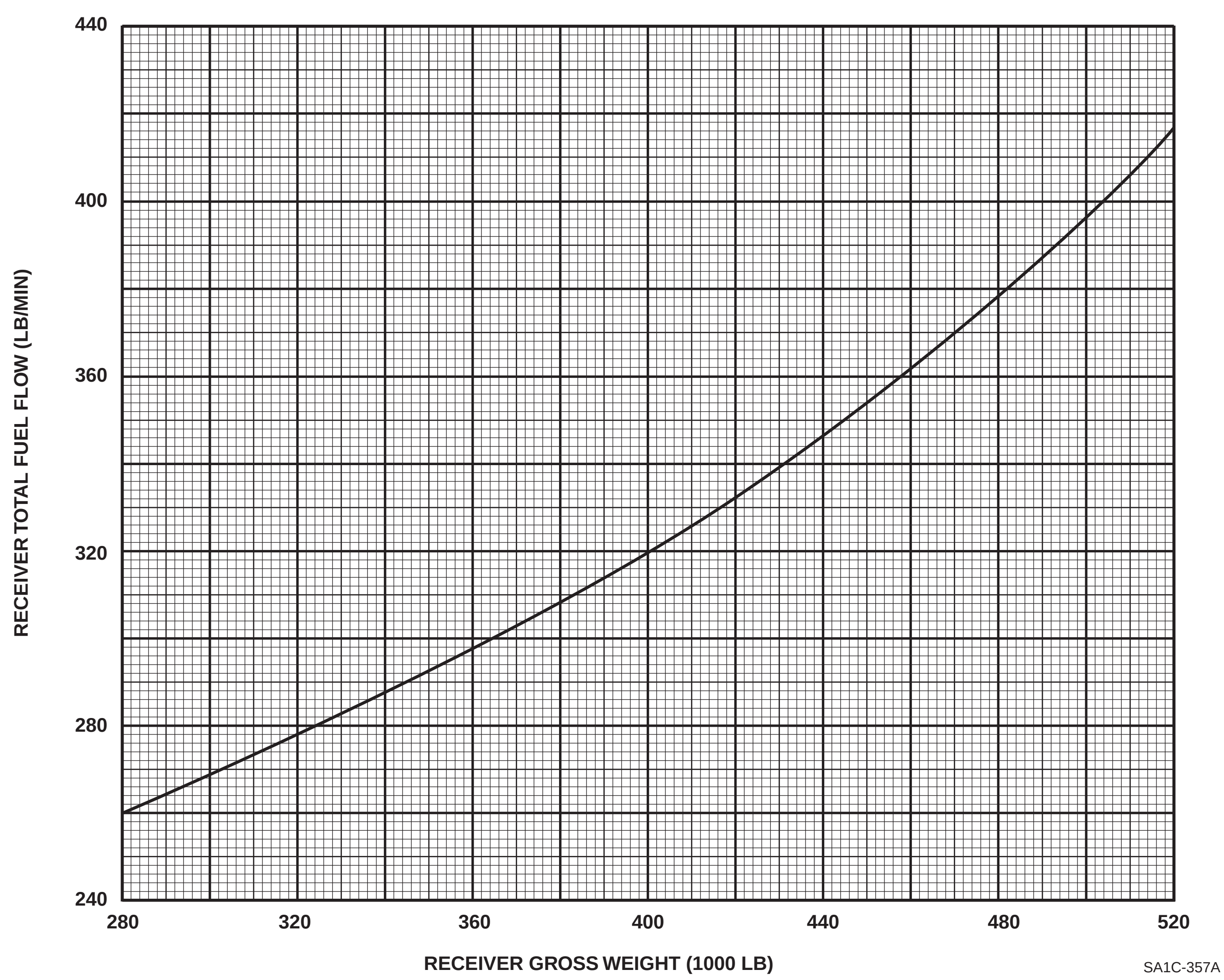


Figure 7-13.

SECTION VIII

DESCENT

TABLE OF CONTENTS

LIST OF CHARTS

INTRODUCTION

This section contains performance charts for fuel, distance and time to descend. These charts provide the data necessary to plan a descent from any altitude up to the cruise ceiling. All descent data are based on flight test results. The fuel consumption values provided are increased by five percent relative to the engine specification level.

DEFINITION OF TERMS

LONG RANGE DESCENT

The speed schedule for long range descent is Mach 0.82 down to 39,766 feet pressure altitude, and 250 KIAS for all lower altitudes.

ENROUTE DESCENT

The speed schedule for enroute descent is Mach 0.82 down to 28,857 feet pressure altitude, then 320 KIAS down to 10,000 feet, then 250 KIAS below 10,000 feet.

PENETRATION DESCENT

The speed schedule for the penetration descent is the same as the speed schedule for the long range descent. Below 20,000 feet, drag devices are used as required to meet altitude restrictions on the penetration.

CAUTION

> The landing gear may only be extended at speeds below the gear extension placard speed of 260 KIAS. When the gear is down, the airplane may be accelerated to a speed of 300 KIAS.

EMERGENCY DESCENT

Emergency descent data are not presented since the data are not needed for planning purposes. The emergency descent speed schedule is Mach 0.85 down to 26,468 feet pressure altitude and below this altitude the descent speed is 350 KIAS.

FACTORS AFFECTING DESCENT

TEMPERATURE

The data presented in this section are based on standard day temperature; the effect of non-standard days is negligible.

THRUST

The recommended engine thrust setting is idle on all three engines.

AIRPLANE DRAG

Descents are normally made in the clean configuration, however, to increase the rate of descent, the speed brakes may be deployed. If speed brakes alone do not give an adequate rate of descent, the landing gear may be lowered, provided the airspeed is below the gear extension placard speed of 260 KIAS. Flight with the gear extended is limited to 300 KIAS.

The fuel, distance and time to descend decrease by 3 percent per 10 units of drag index.

WIND

The distance to descend is affected by wind velocity due to the change in groundspeed. Tailwinds increase the groundspeed, thus increasing the distance to descend by 3 percent per 10 knots. Headwinds reduce the distance to descend by 3 percent per 10 knots.

All other data in this section are unaffected by wind.

GROSS WEIGHT

The effect of gross weight on the fuel, distance, and time to descend is negligible.

AIRSPEED

The airplane has structural placard speeds which must not be exceeded during high speed descent. These placard speeds are given in the Limitations Section of TO 1C-10(K)A-1.

CHART EXPLANATION AND EXAMPLE PROBLEMS

The fuel, distance and time required to descend data are provided in figures 8-1 through 8-3. Each of these figures presents data for a separate speed schedule. The speed schedule and average rate of descent are indicated on each chart.

The data presented are fuel, distance and time to descend to sea level. For descents terminating at altitudes other than sea level, the difference between the initial and final altitude values is the fuel, distance and time necessary to descend between the two altitudes.

A descent table is presented in figure 8-4.

Example 1:

Given:

Long Range Descent

Clean Configuration

Zero Wind

Find:

Fuel, Distance and Time to Descend from 27,000 Feet to 15,000 Feet

Solution:

Enter figure 8-1 at 27,000 feet and 15,000 feet and determine the fuel, distance and time values for both altitudes. Subtract the values at 15,000 feet from the values at 27,000 feet.

From 27,000 Feet:

Fuel = 1,730 Pounds
Dist = 99 NM
Time = 19.5 Minutes

From 15,000 Feet:

Fuel = 1,250 Pounds
Dist = 56 NM
Time = 12.2 Minutes

From 27,000 Feet to 15,000 Feet:

Fuel = 480 Pounds
Dist = 43 NM
Time = 7.3 Minutes

The tabular long range descent data in figure 8-4 could have been used in place of figure 8-1.

Example 2:

Given:

Enroute Descent

Clean Configuration

Zero Wind

Find:

Fuel, Distance and Time to Descend from 33,000 Feet to Sea Level

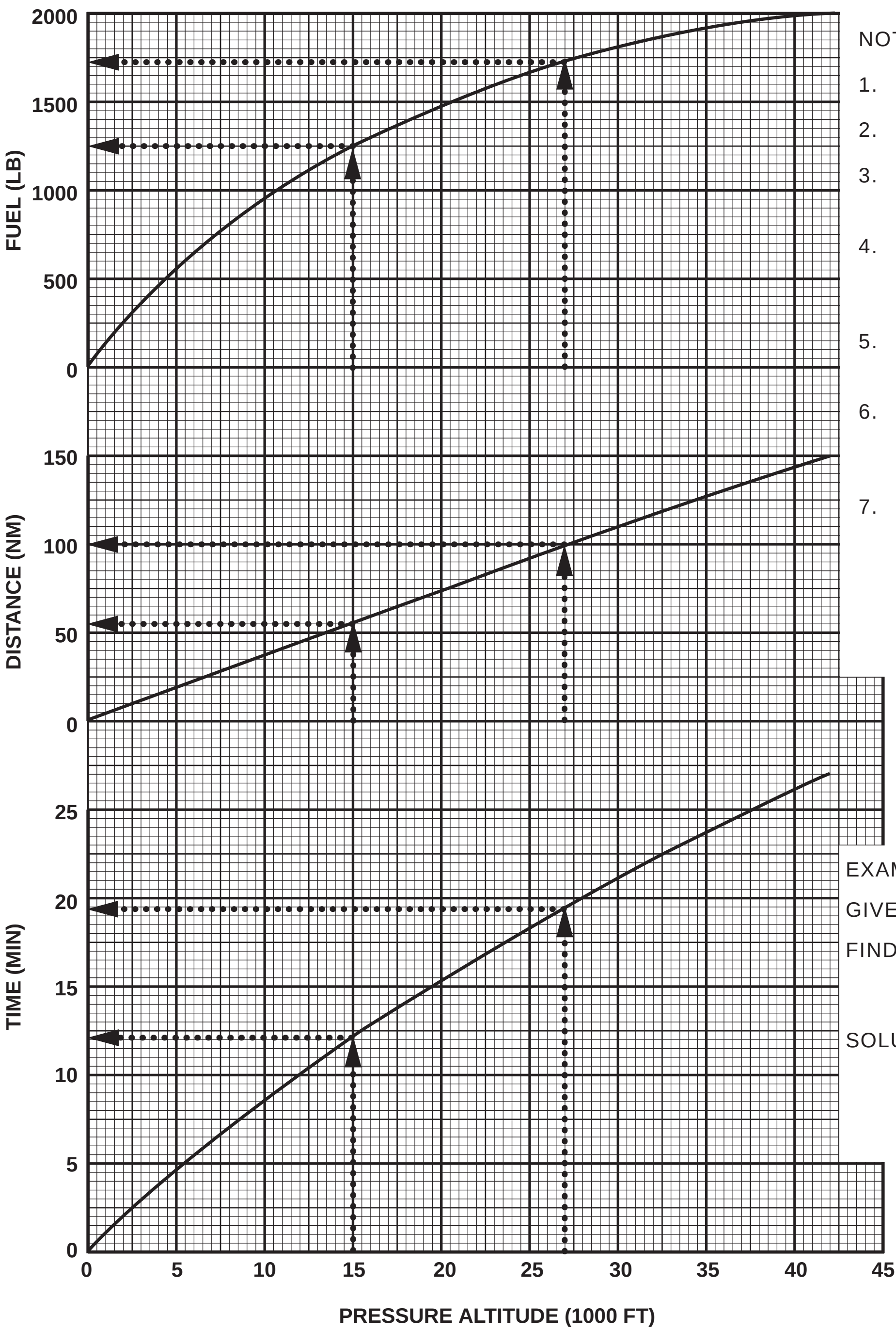
Solution:

Enter figure 8-2 at 33,000 feet and read values for fuel, distance and time:

Fuel = 1,690 Pounds
Dist = 114 NM
Time = 19.5 Minutes

The tabular enroute descent data in figure 8-4 could have been used in place of figure 8-2.

LONG RANGE DESCENT



NOTE:

1. CLEAN CONFIGURATION
2. IDLE THRUST
3. GOOD FOR ALL WEIGHTS AND TEMPERATURES
4. SPEED SCHEDULE - MACH 0.82 ABOVE 39,766 FT THEN 250 KIAS TO SEA LEVEL
5. AVERAGE RATE OF DESCENT IS 1400 FPM
6. DECREASE FUEL, DISTANCE AND TIME TO DESCEND BY 3% PER 10 UNITS OF DRAG INDEX
7. INCREASE DISTANCE TO DESCEND BY 3% PER 10 KNOTS TAILWIND. DECREASE DISTANCE TO DESCEND BY 3% PER 10 KNOTS HEADWIND

EXAMPLE:

GIVEN: LONG RANGE DESCENT

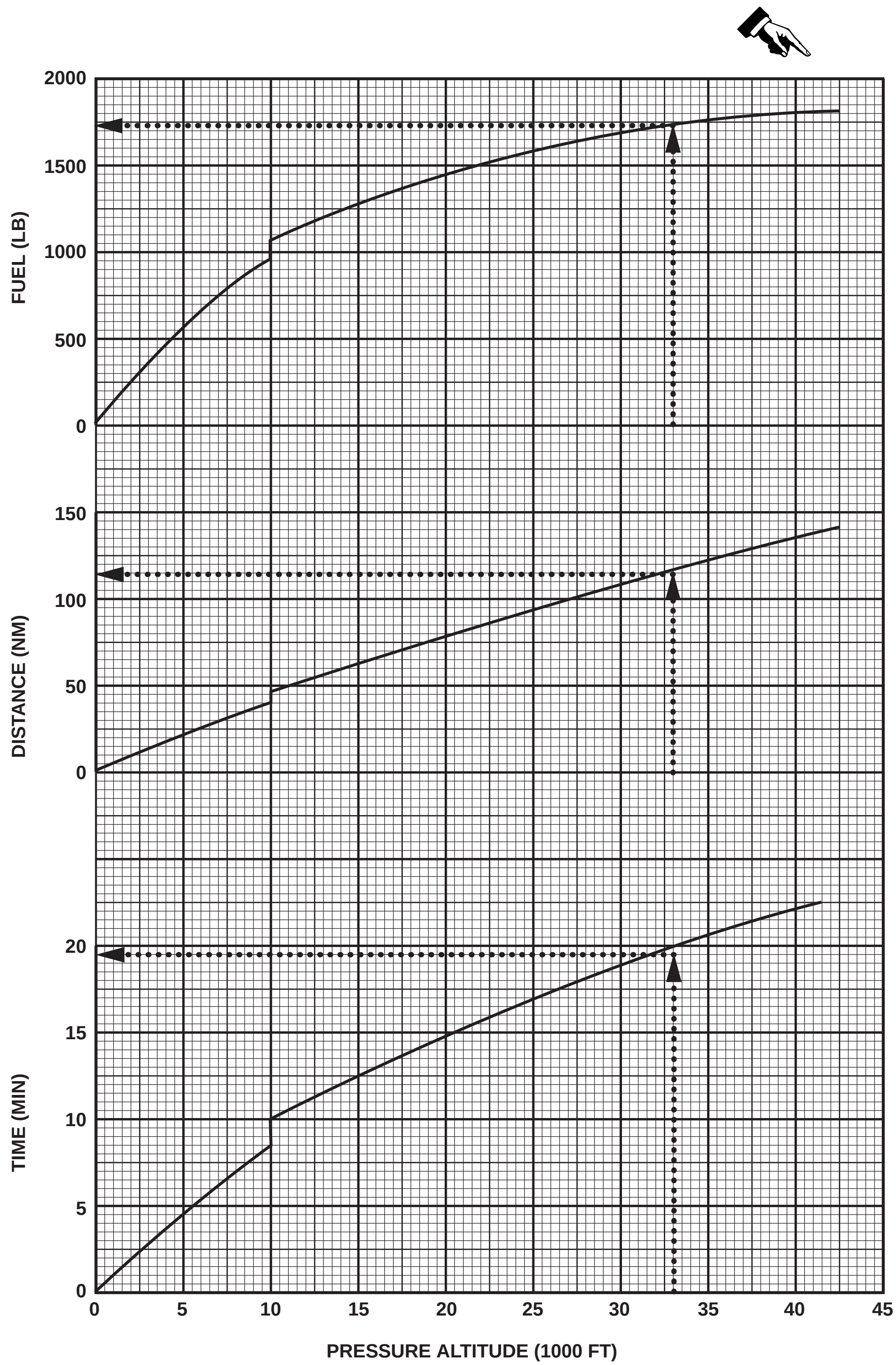
FIND: FUEL, DISTANCE AND TIME TO DESCEND FROM 27,000 FT TO 15,000 FT

SOLUTION: FUEL = 480 LB
DISTANCE = 43 NM
TIME = 7.3 MIN

SA1C-4C

Figure 8-1.

ENROUTE DESCENT



NOTE:

1. CLEAN CONFIGURATION
2. IDLE THRUST
3. GOOD FOR ALL WEIGHTS AND TEMPERATURES
4. SPEED SCHEDULE - MACH 0.82 ABOVE 28,857 FT THEN 320 KIAS TO 10,000 FT THEN 250 KIAS TO SEA LEVEL
5. AVERAGE RATE OF DESCENT IS 1600 FPM
6. DECREASE FUEL, DISTANCE AND TIME TO DESCEND BY 3% PER 10 UNITS OF DRAG INDEX
7. INCREASE DISTANCE TO DESCEND BY 3% PER 10 KNOTS TAILWIND. DECREASE DISTANCE TO DESCEND BY 3% PER 10 KNOTS HEADWIND

EXAMPLE:

GIVEN: ENROUTE DESCENT

FIND: FUEL, DISTANCE AND TIME TO DESCEND FROM 33,000 FT TO SEA LEVEL

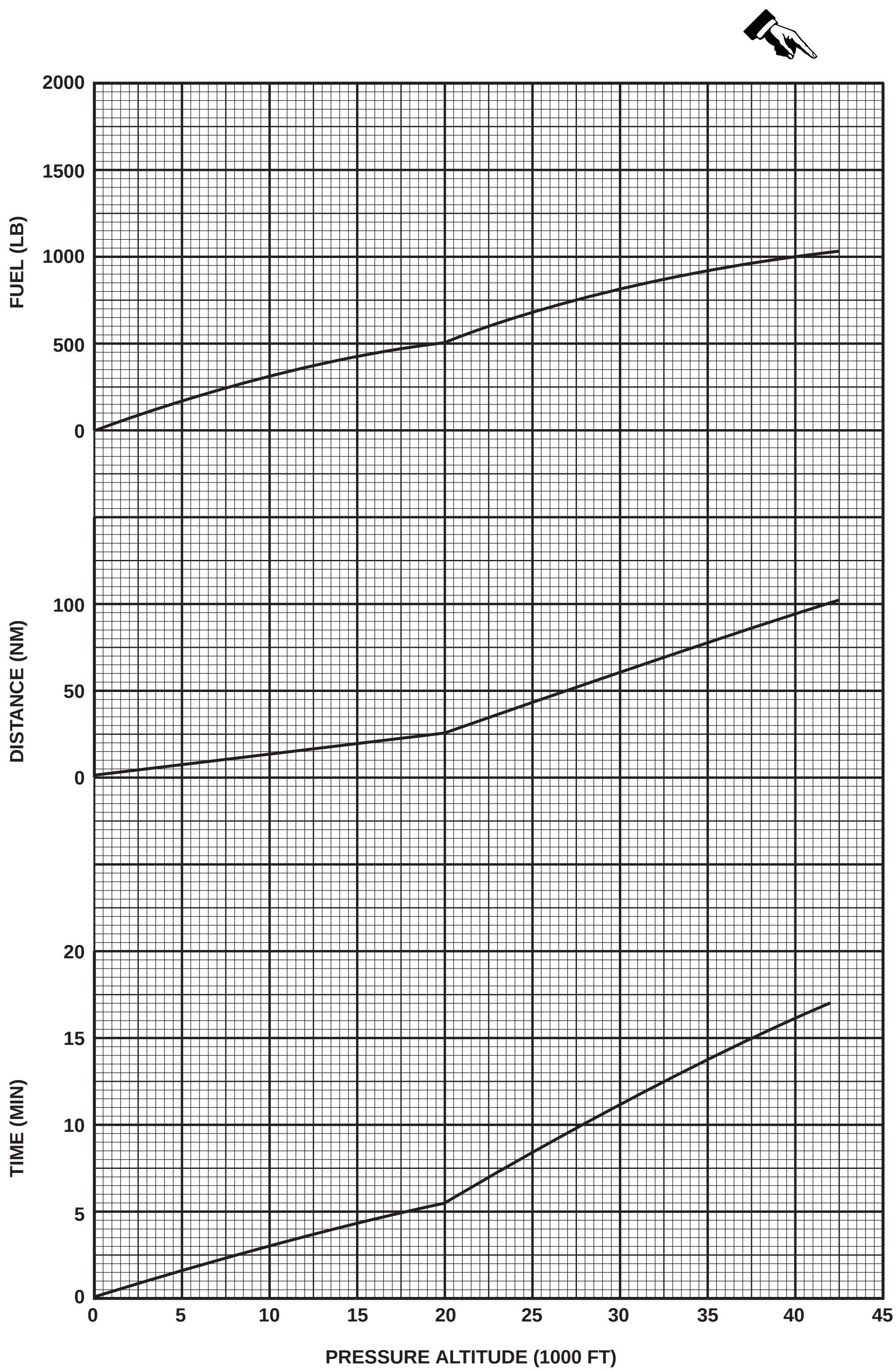
SOLUTION: FUEL = 1690 LB
DISTANCE = 114 NM
TIME = 19.5 MIN

SA1C-3D

CAG(IGDS)

Figure 8-2.

PENETRATION DESCENT



NOTE:

1. CLEAN CONFIGURATION
2. IDLE THRUST
3. GOOD FOR ALL WEIGHTS AND TEMPERATURES
4. SPEED SCHEDULE - MACH 0.82 ABOVE 39,766 FT THEN 250 KIAS TO 20,000 FT, THEN DEPLOY GEAR AND SPEED BRAKES AND DESCEND TO SEA LEVEL AT 250 KIAS
5. AVERAGE RATE OF DESCENT BELOW 20,000 FT IS 4000 FPM
6. DECREASE FUEL, DISTANCE AND TIME TO DESCEND BY 3% PER 10 UNITS OF DRAG INDEX
7. INCREASE DISTANCE TO DESCEND BY 3% PER 10 KNOTS TAILWIND. DECREASE DISTANCE TO DESCEND BY 3% PER 10 KNOTS HEADWIND.

SA1C-83D

Figure 8-3.

DESCENT TABLES

NOTE:
1. GOOD FOR ALL WEIGHTS AND TEMPERATURES
2. LONG RANGE DESCENT - MACH 0.82 ABOVE 39,766 FT THEN 250 KIAS TO SEA LEVEL AVERAGE RATE OF DESCENT IS 1400 FPM
3. ENROUTE DESCENT - MACH 0.82 ABOVE 28,857 FT THEN 320 KIAS TO 10,000 FT, THEN 250 KIAS TO SEA LEVEL AVERAGE RATE OF DESCENT IS 1600 FPM
4. PENETRATION DESCENT - MACH 0.82 ABOVE 39,766 FT THEN 250 KIAS TO 20,000 FT, THEN DEPLOY GEAR AND SPEED BRAKES AND DESCEND TO SEA LEVEL AT 250 KIAS AVERAGE RATE OF DESCENT BELOW 20,000 FT IS 4000 FPM
5. DECREASE FUEL, DISTANCE AND TIME TO DESCEND BY 3% PER 10 UNITS OF DRAG INDEX
6. INCREASE DISTANCE TO DESCEND BY 3% PER 10 KNOTS TAILWIND DECREASE DISTANCE TO DESCEND BY 3% PER 10 KNOTS HEADWIND

PRESSURE ALTITUDE (FT)	LONG RANGE DESCENT	ENROUTE DESCENT	PENETRATION DESCENT
	FUEL (LB) DISTANCE (NM) TIME (MIN)	FUEL (LB) DISTANCE (NM) TIME (MIN)	FUEL (LB) DISTANCE (NM) TIME (MIN)
41,000	2000 145 27	1800 135 22	1000 100 17
37,000	1900 133 25	1800 125 21	1000 85 15
33,000	1900 120 23	1700 114 20	900 70 13
29,000	1800 105 21	1600 103 18	800 57 11
25,000	1700 91 18	1600 92 17	700 43 8
20,000	1500 74 16	1400 76 15	500 25 6
15,000	1300 56 12	1300 61 12	400 20 4
10,000	1000 38 9	1000 38 9	300 13 3
5,000	600 20 5	600 20 5	200 6 2
0	0 0 0	0 0 0	0 0 0

SA1C-154C

Figure 8-4.

SECTION IX

APPROACH AND LANDING

TABLE OF CONTENTS

LIST OF CHARTS

List of Charts (Continued)

INTRODUCTION

The data provided in this section enable the user to determine landing performance for a wide variety of configurations. The data presented include threshold and touchdown speeds and flare and landing ground roll distances. The data are based on flight test results adjusted to the most forward center of gravity.

DEFINITION OF TERMS

APPROACH AND LANDING SPEEDS

The final approach speed is threshold speed plus wind additives. The final approach speed is maintained until initiation of landing flare. The threshold speed is the minimum speed at a wheel height of 50 feet above the runway. It is a function of the minimum stalling speeds, $1.3V_S$ for slats extended, and $1.35V_S$ for slats retracted. Without wind additives, the speed at a wheel height of 50 feet above the runway is equal to the final approach speed which equals the threshold speed. With wind additives, the speed at a wheel height of 50 feet above the runway is equal to the final approach speed which is equal to the threshold speed plus wind additives. The touchdown speeds are based on a flight test derived speed loss from threshold to touchdown.

AIR MINIMUM CONTROL SPEED (V_{MCA})

The air minimum control speed is the minimum speed at which a wing engine can be lost and directional control maintained utilizing full rudder deflection and not more than five degrees of bank angle. Air minimum control speed is not limiting unless full or partial rudder failure has occurred.

FLARE DISTANCE

The flare distance is the air distance traveled beginning at threshold, 50 feet above the runway, and ending at touchdown. The data are based on reducing thrust at the threshold and initiating flare.

MAXIMUM LANDING AND IN-FLIGHT LIMITING WEIGHTS

The maximum unrestricted landing weight (MLW) of the KC-10A is 436,000 pounds at the design R/D at touchdown of 10 feet per second (600 FPM). With anti-skid inoperative or with the center gear retracted the MLW's are 411,000 and 400,000 pounds, respectively.

Overweight landings and training approaches are discussed in the Limitations Section of TO 1C-10(K)A-1.

RCR

The Runway Condition Reading (RCR) system is used to define the surface condition of the runway in order to evaluate the stopping capability of the airplane. Factors such as wetness, bumpiness, rubber buildup, and runway grooving affect the RCR value of the runway, with the primary factor being the wetness of the runway. An RCR value of 23 is assigned to a dry runway in average condition.

EQUIVALENT RCR

The equivalent RCR is a parameter which determines the stopping capability with various airplane deceleration devices inoperative or a configuration change which affects the stopping capability.

STOPPING DISTANCE RATIO (SDR)

The Stopping Distance Ratio is the ratio of the landing ground roll at a chosen RCR to the landing ground roll at an RCR of 23.

GO-AROUND

Go-Around refers to an attempt to land which is aborted during the final approach. If go-around is initiated, the maximum allowable thrust setting is takeoff thrust set inflight, which is labeled go-around thrust to ensure correct usage.

FACTORS AFFECTING APPROACH AND LANDING

APPROACH AND LANDING SPEEDS

The approach and landing speeds are the primary factor affecting the flare and landing ground roll distances. The approach and landing speeds are a function of outside air temperature, pressure altitude, gross weight, and flap/slat configuration.

INCREASED THRESHOLD SPEED

Wind additives are applied to the minimum threshold speed for wind gusts and for steady state winds in excess of 20 knots to protect the airspeed from dropping below the recommended flying speed. The minimum threshold speed should be increased by the full gust increment plus one-half the steady state reported wind in excess of 20 knots. The total increase in speed should not exceed 20 knots. Maintain the resulting approach speed (threshold plus additives) until initiation of the landing flare. Increased threshold speed may increase the landing ground roll due to higher touchdown speed.

FLAP/SLAT CONFIGURATION

The flap and slat positions affect the approach and landing speeds and the flare and landing ground roll distances due to the variation in lift and drag with flap and slat positions. Data are presented at a reference flap/slat configuration of 50-degrees flaps with the slats extended. Charts or correction grids are provided to adjust these data to other flap/slat configurations.

ENGINE BLEED

The use of engine anti-ice protection when the engine anti-ice shutoff valves are inoperative in open position (MEL item) requires the following corrections to ice protection off performance when the outside air temperature is above 8°C:

For one engine cowl anti-ice valve inoperative in the open position, when the N_1 correction for engine anti-ice "On" is applied only to the engine with the engine cowl anti-ice valve inoperative in the open position, limiting approach and landing weights must be reduced by 1.3%. The Thrust Rating Computer may not be used for setting thrust. All approach and landing speeds must correspond to the actual weight.

For one or more engine cowl anti-ice valves inoperative in the open position, when the N_1 correction for engine anti-ice "On" is applied to all engines. Limiting approach and landing weights must be reduced by 1.3%. All approach and landing speeds must correspond to the actual weight.

OBSTACLE CLEARANCE

If an obstacle is present near the approach end of the runway, a variation in the approach flight path may be required. Obstacles may also be encountered when executing a missed approach with an engine inoperative. Use figure 12-30 to calculate engine out missed approach climb gradient.

WIND

The effect of wind on approach and landing depends on the wind velocity, gust increment, and direction. For performance calculations, the wind is broken into a runway component, which may be a headwind or tailwind, and a crosswind component. Headwinds improve landing performance and tailwinds reduce landing performance.

WARNING

If tailwind component exceeds 10 knots, or the crosswind component exceeds 31 knots on a dry runway, landing will not be attempted. For other than a dry runway, refer to the Maximum Allowable Crosswind During Landing chart.

SLOPE

Runway slope affects the deceleration capability of the airplane. Uphill slopes make stopping distances shorter and downhill slopes make stopping distances longer. On wet runways, where deceleration capability is reduced, slope has a larger effect. Corrections for ±2 percent slope are provided where applicable. Uphill slope corrections need only be applied when required for mission accomplishment.

RCR/RSC

The data provided in this section are based on a dry runway (RCR 23). For RCR values less than 23, the landing ground roll increases. Corrections are provided to account for other RCR values. Some approximate RCR values are listed below with the corresponding runway condition.

APPROXIMATE RCR	RUNWAY CONDITION
23	Dry
12	wet (grooved)
12	Wet (porous)
8	Wet
4	Icy

It is recommended that a conservative RCR be used when runway conditions are not clearly defined.

NOTE

- If the RSC is reported as .10 inch or below of standing water, the runway is considered wet, not contaminated; use an RCR of 8 to 12 for landing computations.
- If the RSC is reported as more than .10 inch of standing water, use a .25 or .50 RSC for takeoff and a 6 RCR for landing. Use a 6 RCR to figure maximum crosswind for takeoff and landing.
- When an RSC condition is reported to consist of slush, use a conservative RCR of 4 when temperatures are near freezing.
- When an RCR is not reported, runways covered with snow have an RCR somewhere between wet and icy.

EQUIVALENT RCR

The equivalent RCR is used to determine the stopping capability of an airplane with various deceleration devices inoperative or a configuration change which affects the stopping capability. It relates the configuration change to

the loss of deceleration capability due to reduced coefficient of friction with the runway. The equivalent RCR is applicable for wet or dry runway conditions.

SPOILERS

The spoilers are used to reduce wing lift and provide improved braking effectiveness during the landing ground roll. Spoilers are normally deployed using the automatic ground spoiler extension system. If manual spoiler deployment is used the data provided in this section are equally applicable with a slight correction (TO 1C-10(K)A-1). If the spoilers are not deployed, the landing ground roll is increased significantly (figure 9-13).

ANTI-SKID BRAKING

The data presented in this section include the effect of anti-skid braking. The anti-skid braking system is designed to maximize the braking force without locking the wheels.

WARNING

- If the anti-skid braking system is inoperative, the landing ground roll is increased significantly (figure 9-13).
- When braking with anti-skid system inop, extreme care is required to avoid skids which could result in worn/blown tires and possible center landing gear lower drag link failure.

DUAL HYDRAULIC FAILURE

A dual hydraulic failure results in the inability to obtain a full range of flap/slat configurations, spoiler deflection, and possibly a loss of the anti-skid braking system. Which hydraulic systems are lost determine which capabilities are lost. The loss of any of these deceleration devices results in increased landing ground roll distances.

CHART EXPLANATION AND EXAMPLE PROBLEMS

N_1 SETTING FOR GO-AROUND THRUST

Figure 9-1 presents the N_1 settings for the Go-Around Thrust rating. See Section II for chart explanation.

WIND SUMMARY CHART

A wind summary chart is provided in figure 9-2 to explain how to obtain a wind component as well as how to use the wind component values.

WIND COMPONENT

The runway component and the crosswind component may be found from figure 9-3 if the wind velocity, gust increment, and direction are known. The chart may be linearly interpolated for intermediate values of wind velocity and wind angle.

NOTE

The maximum demonstrated crosswind component is 31 knots on a dry runway.

Example 1:

Given:

30-Knot Headwind at an Angle of 30 Degrees to the Runway

Find:

Headwind Component and Crosswind Component.

Solution:

Enter figure 9-3 at the origin and move radially outward at a wind angle of 30 degrees until the 30-knot wind velocity line is reached. Read down to find the crosswind component is 15 knots. Read to the left to determine that the headwind component is 26 knots.

MAXIMUM ALLOWABLE CROSSWIND DURING LANDING

Existing crosswind components will be compared to the Maximum Allowable Crosswind During Landing (figure 9-3A). The chart values represent the maximum crosswind in which the aircraft can maintain directional control on the runway as a function of Runway Condition Reading (RCR). When existing crosswind exceeds the maximum allowable crosswind, the landing will not be attempted. Refer to "RCR" this section for discussion of Runway Condition Reading.

Example 1a:

Given:

RCR = 18

Find:

Maximum Allowable Crosswind

Solution:

Enter figure 9-3A with the actual RCR of 18 and read across to the RCR correction grid. The maximum allowable crosswind is 28 knots.

THRESHOLD SPEEDS

Threshold speeds are presented in figure 9-4 through 9-8. Figure 9-4 provides slats retracted data and figures 9-5 through 9-8 provide slats extended data at flap settings of 0, 22, 35, and 50 degrees, respectively.

A table of threshold speeds is provided in figure 9-9. These speeds are applicable from sea level to 2,000 feet pressure altitude.

Example 2:

Given:

Flap Setting = 50 Degrees

Altitude = Sea Level

Gross Weight = 370,000 Pounds

Find:

Threshold Speed

Solution:

Enter figure 9-8 with the gross weight of 370,000 pounds and read up to the sea level line for threshold speed. The threshold speed is 140.8 KIAS.

TOUCHDOWN SPEED

Figure 9-10 presents touchdown speed versus gross weight for all applicable landing flap/slat configurations. The speeds are presented as groundspeed to provide a check of tire speed and maximum braking speed limitations.

The tire speed limitation is 204 knots (235 mph) groundspeed, therefore landing is not recommended unless the touchdown groundspeed is less than this value.

Example 3:

Given:

Gross Weight = 325,000 Pounds

Flap/Slat Configuration = 50°/EXT

Altitude = 2,000 Feet

Temperature = 40°C

Zero Wind

Find:

Touchdown Groundspeed

Solution:

Enter sheet 1 of figure 9-10 with the gross weight of 325,000 pounds and read the 50°/EXT line. Determine the equivalent touchdown speed from the vertical scale and use this value to enter sheet 2. Use the pressure altitude and temperature corrections to convert to groundspeed and read the touchdown groundspeed on the right side of sheet 2 as 138 knots.

MAXIMUM BRAKING SPEEDS

The maximum groundspeed at which braking may be initiated without exceeding the flight-tested airplane energy is presented versus gross weight and runway slope in figure 9-11. The touchdown speed should be less than the maximum braking speed for safe operation; when landing at weights less than MLW, maximum braking speed is not limiting.

Example 4:

Given:

Gross Weight = 390,000 Pounds

One Wheel Brake Inoperative Plus Center Gear Retracted

Slope = 2% Uphill

Find:

Maximum Braking Speed

Solution:

Enter figure 9-11 with the gross weight of 390,000 pounds and read across to the one wheel brake inoperative plus center gear retracted configuration line. Read down to the 2 percent uphill slope line. The maximum braking speed is 160.5 knots.

FLARE DISTANCE

The flare distances are presented in figure 9-12. The data are presented versus gross weight and pressure altitude and are factored by 167 percent to account for wind, slope, increased approach speed, shallow approach, and non-standard temperatures. The flare distance is added to the landing ground roll to determine the total landing distance.

Example 5:

Given:

Pressure Altitude = 5,000 Feet

Gross Weight = 360,000 Pounds

Flap Setting = 35 Degrees

Find:

Flare Distance

Solution:

Enter figure 9-12 with 5,000 feet pressure altitude and read up to 360,000 pounds gross weight. Read across, correct for 35-degrees flaps, and the flare distance is 2,010 feet.

EQUIVALENT RCR

The equivalent RCR chart, figure 9-13, provides a means for determining the landing ground roll with center gear retracted, one wheel brake inoperative, no spoiler deployment, or anti-skid braking system inoperative. The chart is used by entering with the reported (or approximated) RCR and reading up to the desired line. The equivalent RCR is found by reading the vertical scale and is used to obtain a SDR from figure 9-14. This SDR is used to find the landing ground roll.

Example 6:

Given:

RCR = 14

One Wheel Brake Inoperative

Find:

Equivalent RCR

Solution:

Enter figure 9-13 with an RCR of 14 and read up to the one wheel brake inoperative line. The equivalent RCR is 11.

STOPPING DISTANCE RATIO (SDR)

The stopping distance ratio is determined from figure 9-14 by knowing the RCR and the runway slope. When the SDR is obtained, it is used as a correction to landing ground roll.

Example 7:

Given:

RCR = 14

Slope = 1% Downhill

Find:

SDR

Solution:

Enter figure 9-14 with an RCR of 14 and read across to the slope correction grid. Correct SDR for 1 percent downhill slope and the SDR is 1.4.

LANDING GROUND ROLL

Figure 9-15 gives the landing ground roll and provides correction grids for flap setting, increased approach speed, wind, slope, and stopping distance ratio (SDR). The landing ground roll distances are based on the use of ground spoilers, center gear extended, and the anti-skid braking system operative. The landing ground roll is added to the flare distance to determine the total landing distance.

NOTE

Figure 9-13 provides data for center gear retracted, one wheel brake inoperative, no spoiler deployment, or anti-skid braking system inoperative when the SDR is based on equivalent RCR.

Example 8:

Given:

Outside Air Temperature = 24°C

Pressure Altitude = 5,000 Feet

Gross Weight = 410,000 Pounds

Flap Setting = 50 Degrees

Headwind = 20 Knots (Calculated)

Slope = 0.5% Uphill

RCR = 23

Find:

Landing Ground Roll

Solution:

Enter sheet 1 of figure 9-15 with the outside air temperature of 24°C. Read across to the 5,000 feet pressure altitude line and then read down and interpolate for 410,000 pounds. The reference landing ground roll may be read as 3,150 feet. Enter sheet 2 with the reference landing ground roll. Make corrections for 20-knot headwind and 0.5 percent uphill slope. Determine SDR from figure 9-14 to be 1. 0 at RCR = 23. The landing ground roll is 2,600 feet.

FLARE DISTANCE FOR VARIOUS FLAP/SLAT CONFIGURATIONS

To find the unfactored flare distance for various flap/slat configurations, use figure 9-12 to determine the flare distance at 50°/EXT for the given gross weight and pressure altitude. Enter figure 9-16 with the flare distance for 50°/EXT, read up to the desired flap/slat line and read the unfactored (no 167 percent factor) flare distance from the vertical scale.

If desired, the unfactored flare distance may be multiplied by the 167 percent factor to account for wind, slope, increased approach speed, shallow approach, and nonstandard temperatures.

Example 9:

Given:

Flare Distance at 50°/EXT = 1,500

Feet

Flap/Slat Configuration = 22°/RET

Find:

Unfactored Flare Distance at 22°/RET

Solution:

Enter figure 9-16 with the flare distance at 50°/EXT and read up to the 22°/RET line. The unfactored flare distance at 22°/RET is 1,890 feet.

LANDING GROUND ROLL FOR VARIOUS FLAP/SLAT CONFIGURATIONS

To find the landing ground roll for various flap/slat configurations, use figure 9-15 to determine the landing ground roll at 50-degrees flaps with the slats extended. With this value, enter figure 9-17 and read up to the desired flap/slat line. The landing ground roll for this flap/slat configuration is read on the vertical scale.

Example 10:

Given:

Landing Ground Roll at 50°/EXT = 2,300 Feet

Flap/Slat Configuration = 22°/RET

Find:

Landing Ground Roll at 22°/RET

Solution:

Enter figure 9-17 with the landing ground roll at 50°/EXT and read up to the 22°/RET line. The landing ground roll at 22°/RET is 5,100 feet.

DUAL HYDRAULIC FAILURE

To find the landing ground roll considering a dual hydraulic failure, use figure 9-15 to determine the landing ground roll at 50-degrees flaps with the slats extended. Enter figure 9-18 and determine a ground roll multiplier for the desired configuration. Multiply the 50°/EXT landing ground roll value by the ground roll multiplier to determine the landing ground roll with a dual hydraulic failure.

Example 11:

Given:

Landing Ground Roll at 50°/EXT = 2,000 Feet

Flap/Slat Configuration = 0°/EXT

Failed Hydraulic Systems = 1 and 2

Gross Weight = 360,000 Pounds

RCR = 23

Find:

Landing Ground Roll

Solution:

From figure 9-18, the ground roll multiplier for the given configuration is 1.45. No additional corrections for flap/slat configurations or RCR are required, therefore the landing ground roll is 2,900 feet.

NOTE

For landing with one or both wing thrust reversers deactivated, increase the calculated landing ground roll by 10%.

N_1 SETTING FOR GO-AROUND THRUST

NOTE:

1. ONE, TWO, OR THREE ENGINES OPERATING INFLIGHT SETTING
2. ONE AIR-CONDITIONING PACK PER WING ENGINE "ON", LAVATORY AND GALLEY VENTILATION BLEEDS "ON", ENGINE ICE PROTECTION "OFF" AND WING ICE PROTECTION "OFF"
3. FOR OTHER ENGINE BLEED CONDITIONS APPLY APPROPRIATE CORRECTIONS SHOWN
   - A. ENGINE BLEED FOR AIR-CONDITIONING PACKS "OFF" AND LAVATORY AND GALLEY VENTILATION BLEEDS "ON" OR "OFF"
   - B. ENGINE ICE PROTECTION "ON"
   - C. ENGINE AND WING ICE PROTECTION "ON"
   - D. ENGINE AND WING ICE PROTECTION "ON" WITH ONE WING ENGINE INOPERATIVE

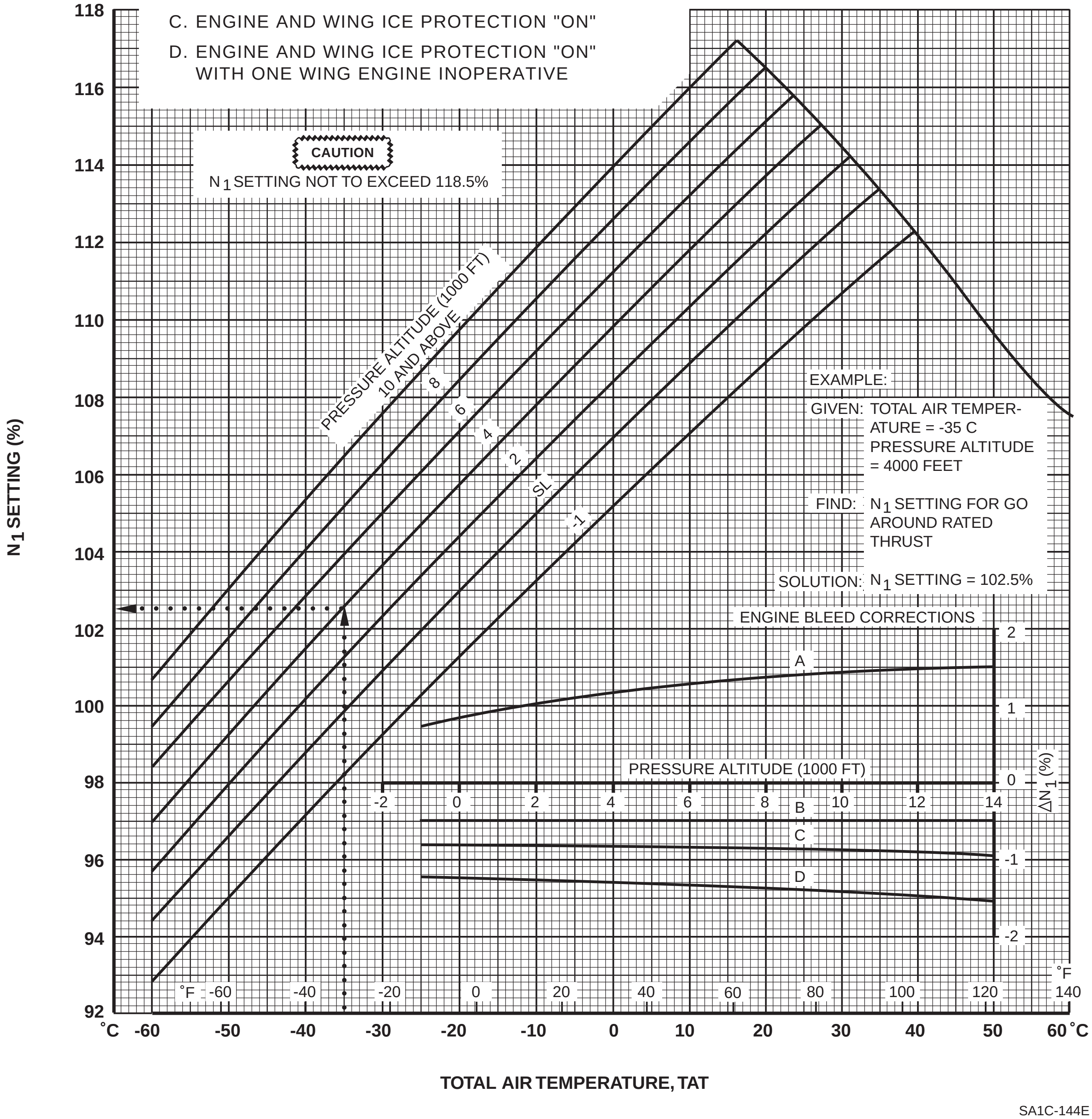


Figure 9-1.

WIND SUMMARY - LANDING

TYPE OF WIND	HOW TO OBTAIN COMPONENT	USE OF WIND COMPONENT
HEADWIND	Runway Wind Component Enter wind component chart with steady wind value. If wind direction is variable, use the maximum deviation from the runway heading.	Apply 50 percent of component to all applicable landing charts, when required for mission accomplishments. Increase threshold speed by one-half of the steady state reported wind in excess of 20 knots.
TAILWIND	Runway Wind Component Enter wind component chart with steady wind value plus the gust increment. If wind direction is variable, use the minimum deviation from the runway heading.	Apply 150 percent of component to all applicable landing charts. Increase threshold speed by one-half of the steady state reported wind in excess of 20 knots.
CROSSWIND	Crosswind Component Enter wind component chart with steady wind value plus the gust increment. If wind direction is variable, use the maximum deviation from the runway heading.	Increase threshold speed by one-half of the steady state reported wind in excess of 20 knots.
GUST	Gust Increment Report wind in excess of steady wind value.	Increase threshold speed by the full gust increment.

NOTE

- The total increase in threshold speed, from all causes, should not exceed 20 knots.
- Landing ground roll shall be adjusted for the increase in threshold speed due to gusts or steady state reported wind in excess of 20 knots.

Figure 9-2. Wind Summary - Landing

WIND COMPONENT - LANDING

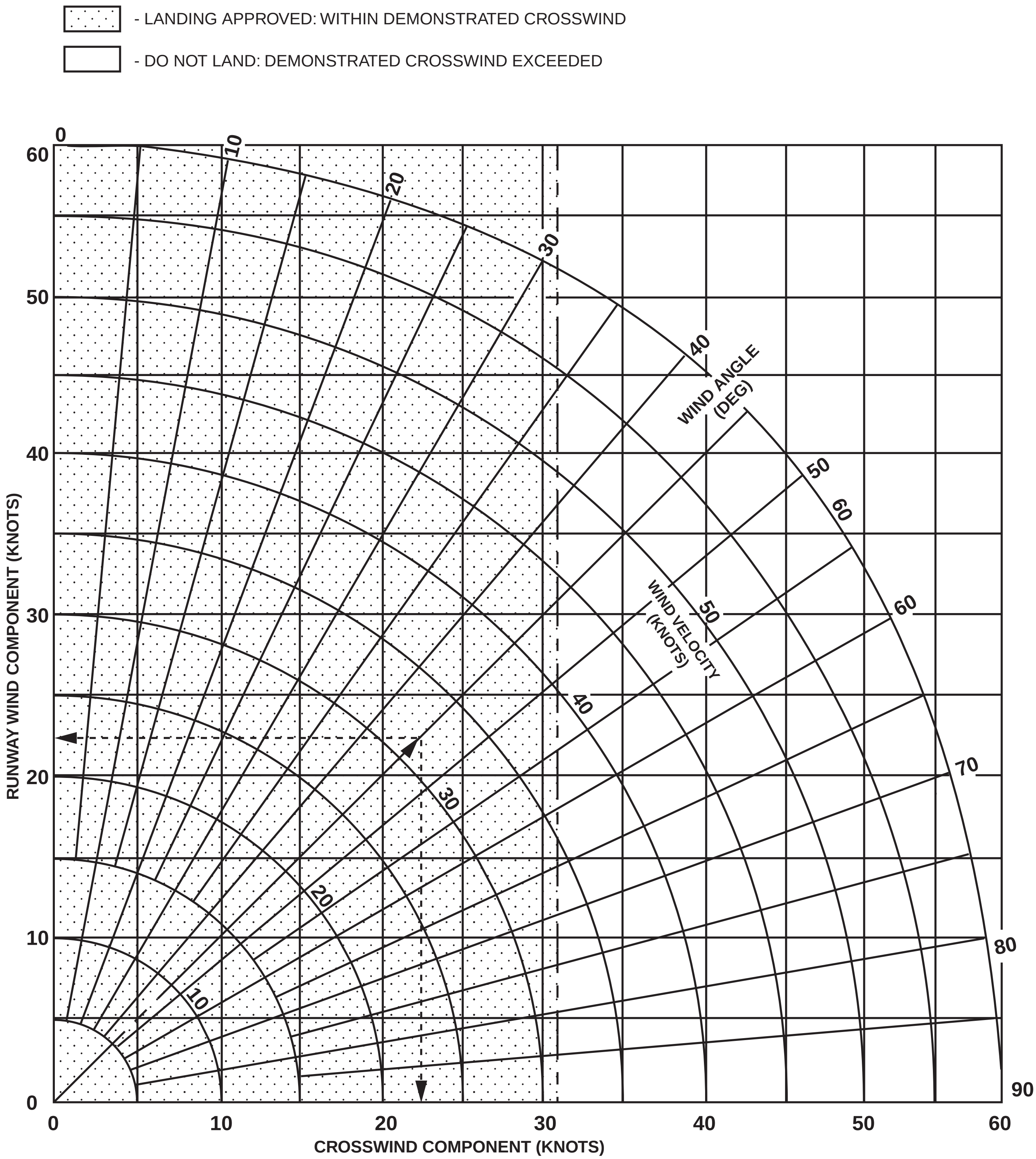


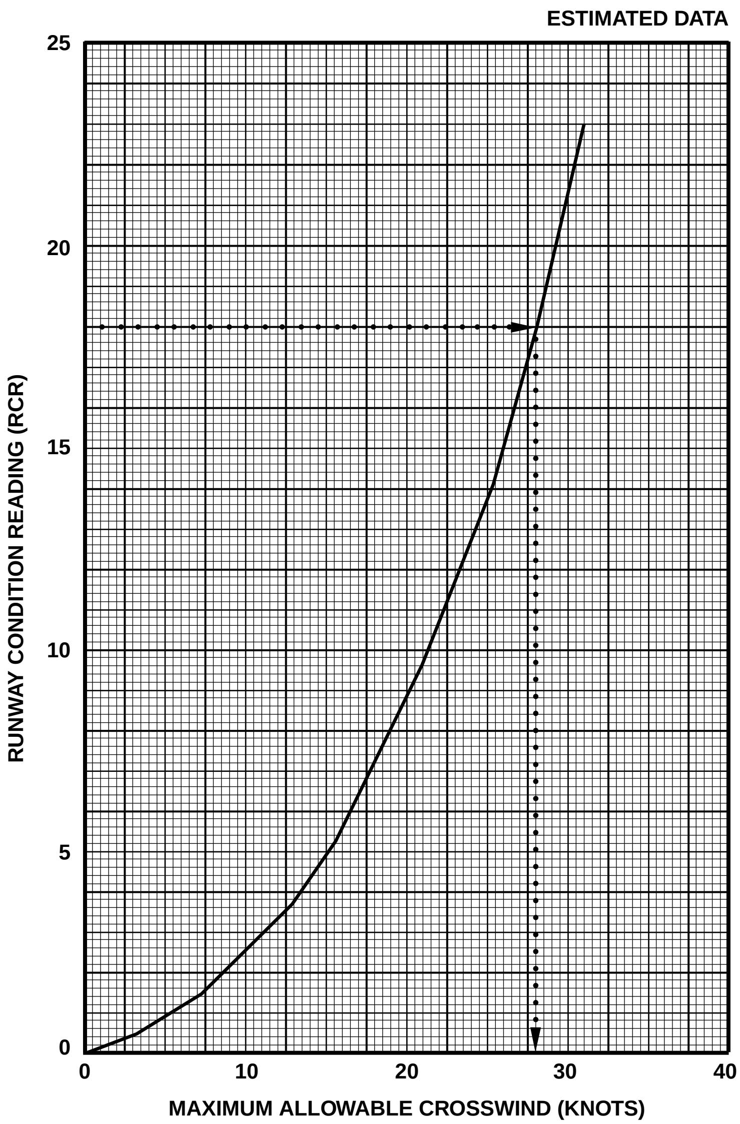
Figure 9-3.

MAXIMUM ALLOWABLE CROSSWIND DURING LANDING

GE CF6-50C2 ENGINES

EXAMPLE:

GIVEN:
RCR = 18
FIND:
Maximum allowable crosswing
SOLUTION:
Maximum allowable crosswind = 28 knots



CAG(IGDS)

SA1C-604

Figure 9-3A.

				LANDING WEIGHT (X 1000)																	
				260	280	300	320	340	360	380	400	420	440	460	480	500	520	540	560	580	600
3-ENG AND 2-ENG	NORMAL CONFIG. SPEEDS	MIN. MAN.	(1.5VS) 0°/RET	194	201	208	215	222	228	234	240	246	252	257	263	268	274	279	284	289	294
			(1.5VS) 0°/EXT	167	173	179	185	191	196	202	207	212	217	222	227	231	236	240	245	249	253
			(1.4VS) 22°/EXT	136	142	147	152	157	162	166	170	175	179	182	186	190	195	199	204	208	212
		THRES.	(1.3VS) 35°/EXT	122	126	131	135	139	144	147	151	154	158	161	165	168	172	176	180	184	188
			(1.3VS) 50°/EXT	118	122	127	131	135	139	143	146	149	153	156	160	163	167	170	175	179	183
ABNORM. CONFIG. SPEEDS "SLATS EXTENDED"		MIN. MAN.	(1.5VS) 0°/EXT	167	173	179	185	191	196	202	207	212	217	222	227	231	236	240	245	249	253
			(1.4VS) 22°/EXT	136	142	147	152	157	162	166	170	175	179	182	186	190	195	199	204	208	212
		THRES.	(1.3VS) 0°/EXT	142	147	152	157	162	167	171	175	180	184	188	192	196	200	204	208	212	217
			(1.3VS) 22°/EXT	128	133	138	142	146	151	155	159	162	166	170	174	178	182	185	189	192	195
ABNORM. CONFIG. SPEEDS "SLATS RETRACTED"		MIN. MAN.	(1.5VS) 0°/RET	194	201	208	215	222	228	234	240	246	252	257	263	268	274	279	284	289	294
			(1.4VS) 15°/RET*	177	183	189	195	201	207	213	219	224	229	235	240	245	249	254	260	264	268
			(1.4VS) 22°/RET	172	178	184	190	196	202	207	212	218	223	228	233	237	242	247	251	256	261
		THRES.	(1.35VS) 0°/RET	175	181	188	194	200	205	211	216	222	227	232	237	242	246	251	256	260	264
			(1.35VS) 22°RET#	165	171	177	182	188	193	199	204	209	214	218	223	228	233	237	240	244	248
			(1.35VS) 35°RET#	158	164	170	175	180	186	191	196	200	205	210	214	219	223	227	231	235	239
SINGLE ENGINE		MIN. MAN.	(1.5VS) 0°/RET	194	201	208	215	222	228	234	240	246	252	257	263	268	274	279	284	289	294
		APPR.	(1.5VS) 0°/EXT	167	173	179	185	191	196	202	207	212	217	222	227	231	236	240	245	249	253
		THRES.	(1.3VS) 0°/EXT	142	147	152	157	162	167	171	175	180	184	188	192	196	200	204	208	212	217

NOTE

- AREAS ENCLOSED IN HEAVY BLACK LINES REPRESENT SPEEDS IN EXCESS OF FLAP STRUCTURAL LIMITS.
- *INDICATES INTERPOLATED DATA.
- # SPEEDS VALID FOR SLATS RETRACTED OR SLATS ASYMMETRIC.
- YELLOW AREA REPRESENTS WEIGHTS EXCEEDING MAX UNRESTRICTED LANDING WEIGHT.
- THRESHOLD SPEEDS VALID FROM SL TO 2000 FT. REFER TO TO 1C-10(K)A-1-1 FOR ALTITUDES ABOVE 2000 FT.

Figure 9-3B.

THRESHOLD SPEEDS - SLATS RETRACTED

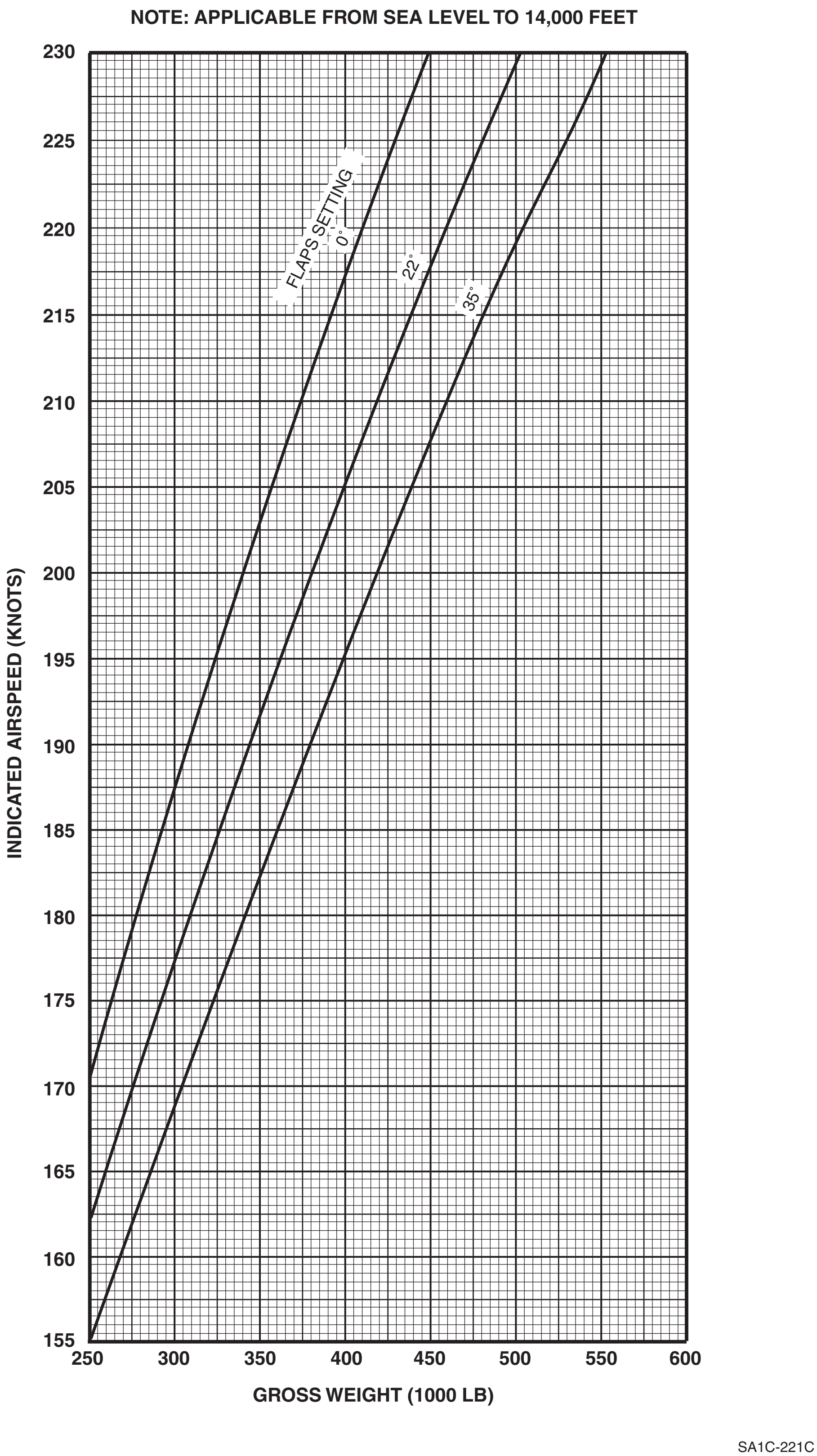


Figure 9-4.

THRESHOLD SPEEDS/0-DEGREES FLAPS

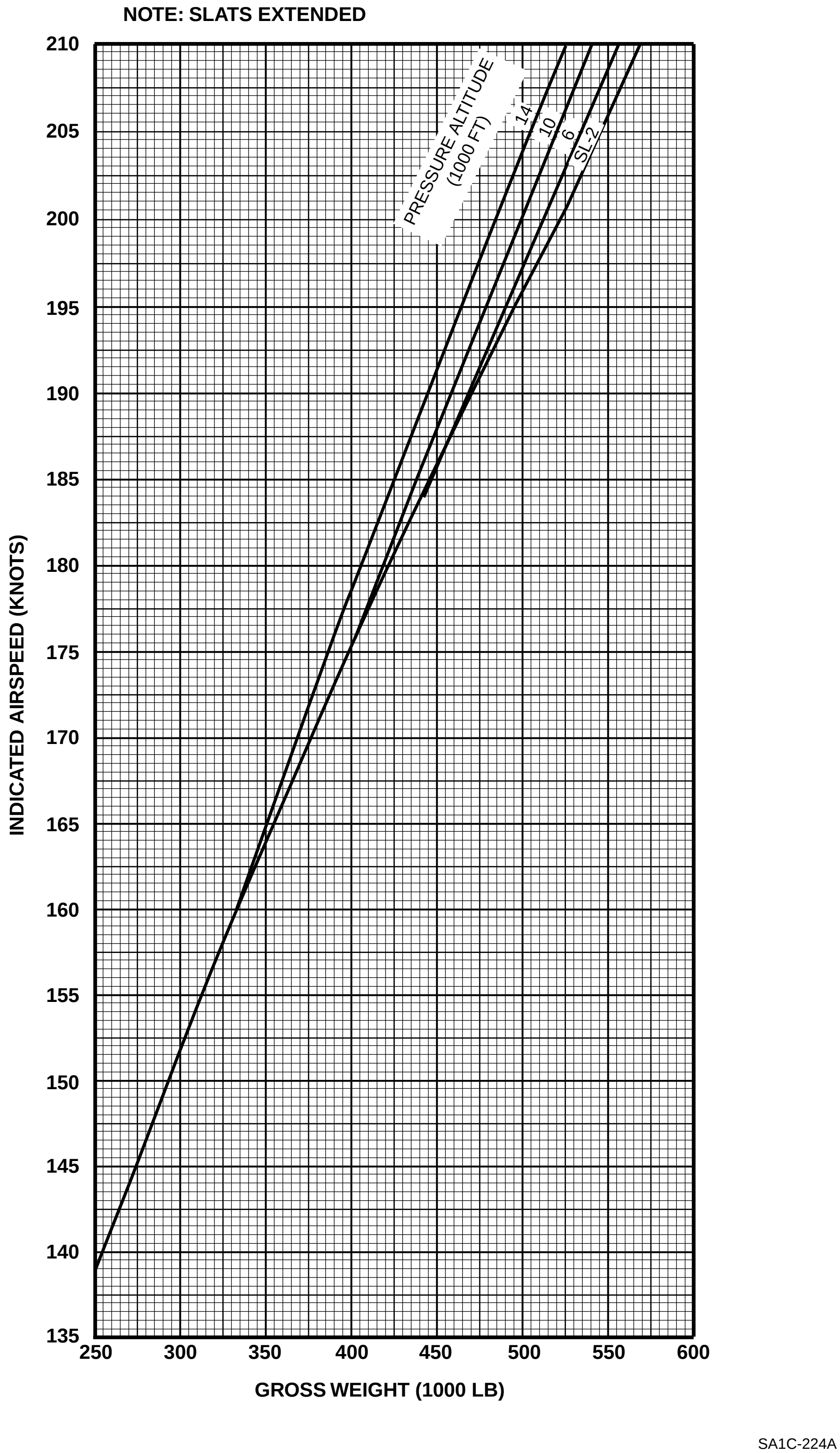


Figure 9-5.

THRESHOLD SPEEDS/22-DEGREES FLAPS

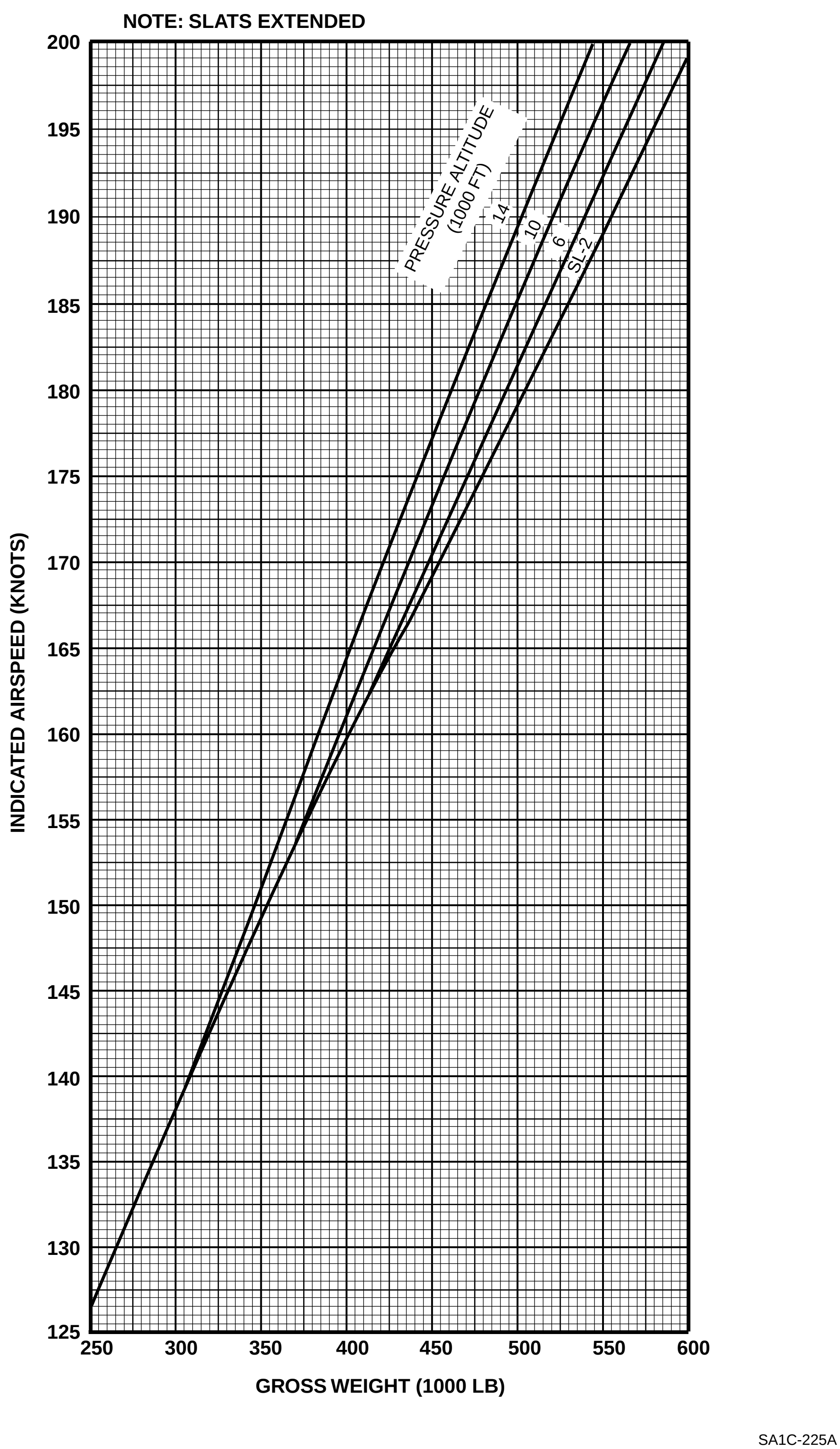


Figure 9-6.

THRESHOLD SPEEDS/35-DEGREES FLAPS

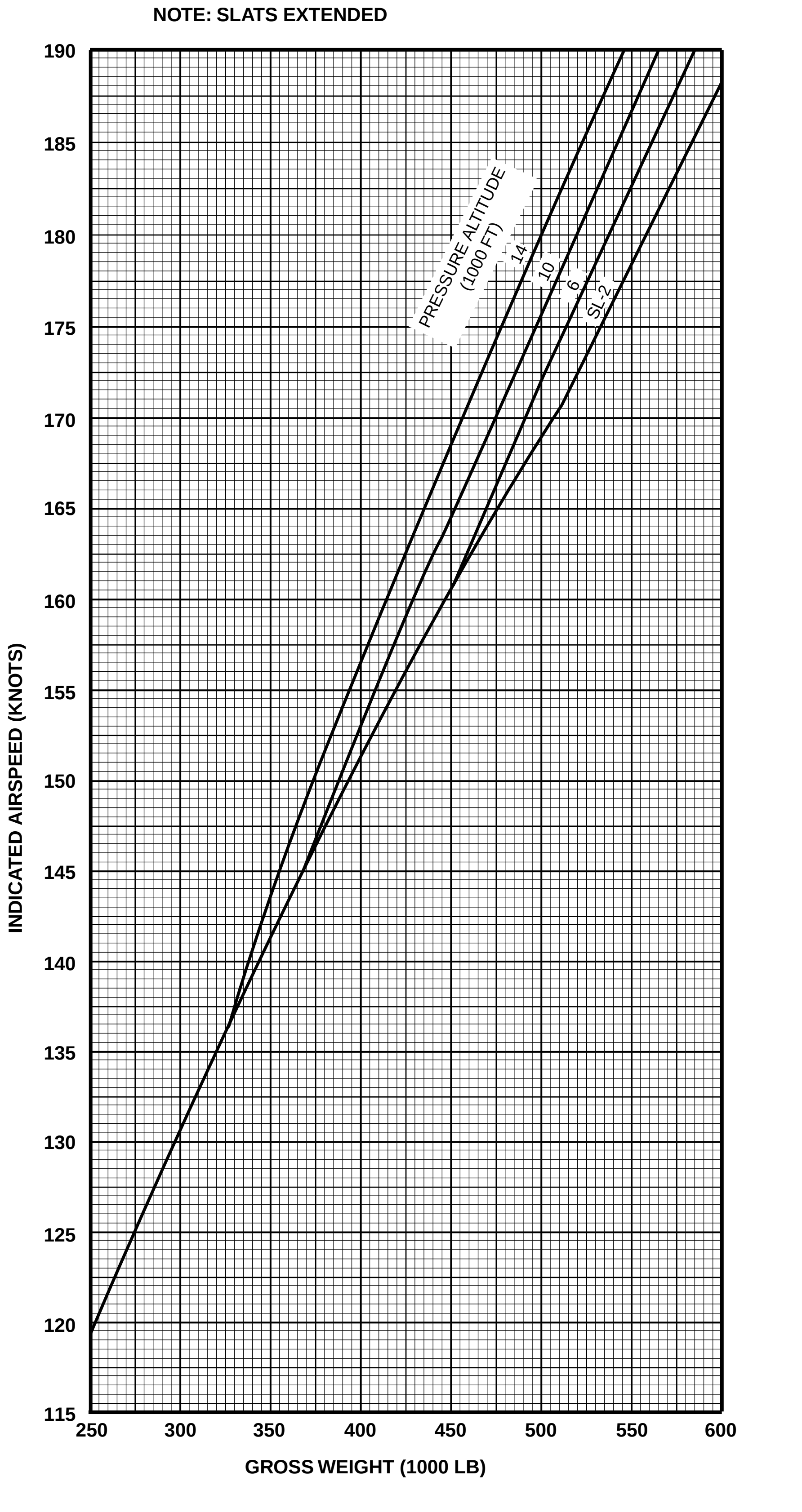


Figure 9-7.

THRESHOLD SPEEDS/50-DEGREES FLAPS

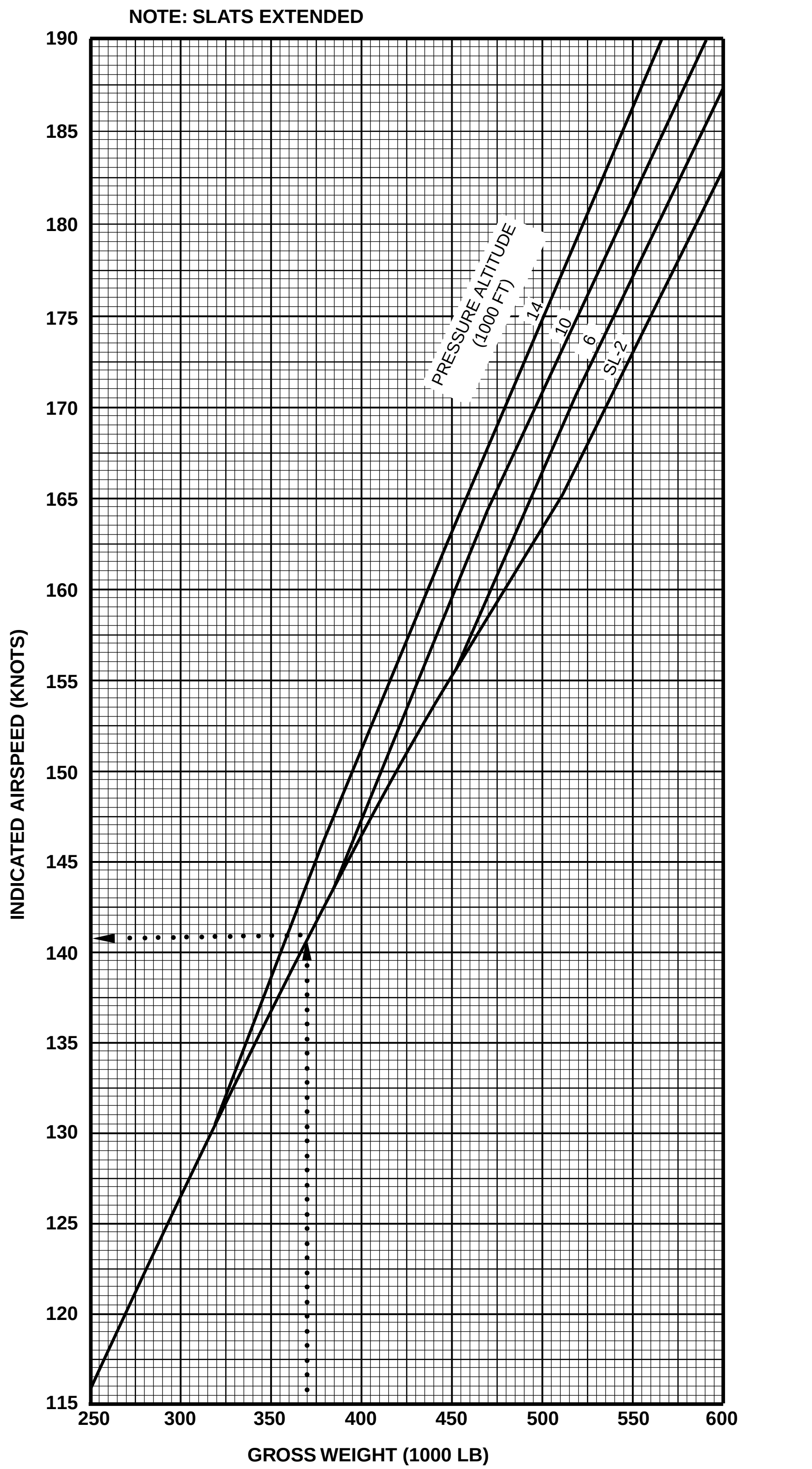


Figure 9-8.

THRESHOLD SPEEDS TABLE

NOTE:

1. MAXIMUM UNRESTRICTED LANDING WEIGHT IS 436,000 LB
2. DATA ARE VALID FROM SEA LEVEL TO 2,000 FT
3. GOOD FOR ALL TEMPERATURES

THRESHOLD SPEEDS (KIAS)							
GROSS WEIGHT (1000 LB)	0°/RET	22°/RET	35°/RET	0°/EXT	22°/EXT	35°/EXT	50°/EXT
600	265.0	251.0	240.0	216.5	199.0	188.5	
580	261.0	246.5	235.5	212.5	195.0	184.5	
560	256.0	242.0	231.5	208.5	190.5	181.0	
540	251.5	238.0	227.5	204.0	186.5	177.0	
520	246.5	233.0	223.0	200.0	182.5	173.0	
500	241.5	229.0	218.5	196.0	179.0	169.0	
480	237.0	224.5	214.0	192.0	174.5	165.5	
460	232.0	219.5	210.0	188.0	170.5	162.5	
440	227.5	214.5	205.0	184.0	166.5	158.5	153.5
420	222.0	209.5	200.5	179.5	163.0	155.0	150.0
400	216.5	205.0	195.5	175.5	159.5	151.5	146.0
380	211.0	199.5	191.0	171.0	156.0	147.5	142.5
360	205.5	194.0	185.5	166.5	151.0	143.5	138.5
340	199.5	188.5	180.0	161.5	146.5	139.5	135.0
320	193.5	183.0	175.0	157.0	142.0	135.0	130.5
300	188.0	177.5	169.5	152.0	138.0	131.0	126.5
280	181.0	171.5	164.0	146.5	133.0	126.5	122.0
260	174.5	165.5	158.0	141.5	128.5	121.5	118.0

SA1C-228B

Figure 9-9.

TOUCHDOWN SPEEDS

NOTE:

1. MAXIMUM UNRESTRICTED LANDING WEIGHT IS 436,000 LB
2. TIRE LIMIT SPEED IS 204.17 KNOTS GROUNDSPEED

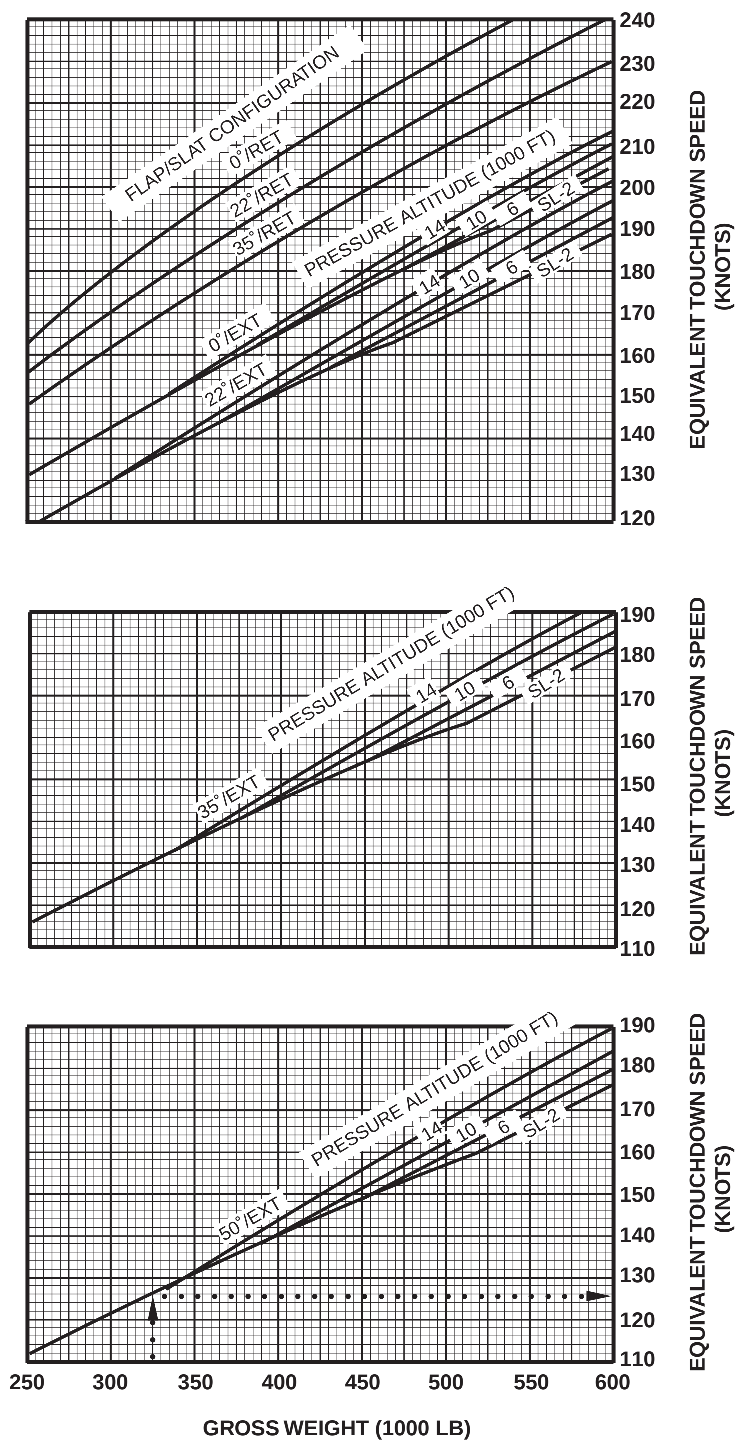


Figure 9-10. (Sheet 1)

TOUCHDOWN SPEEDS

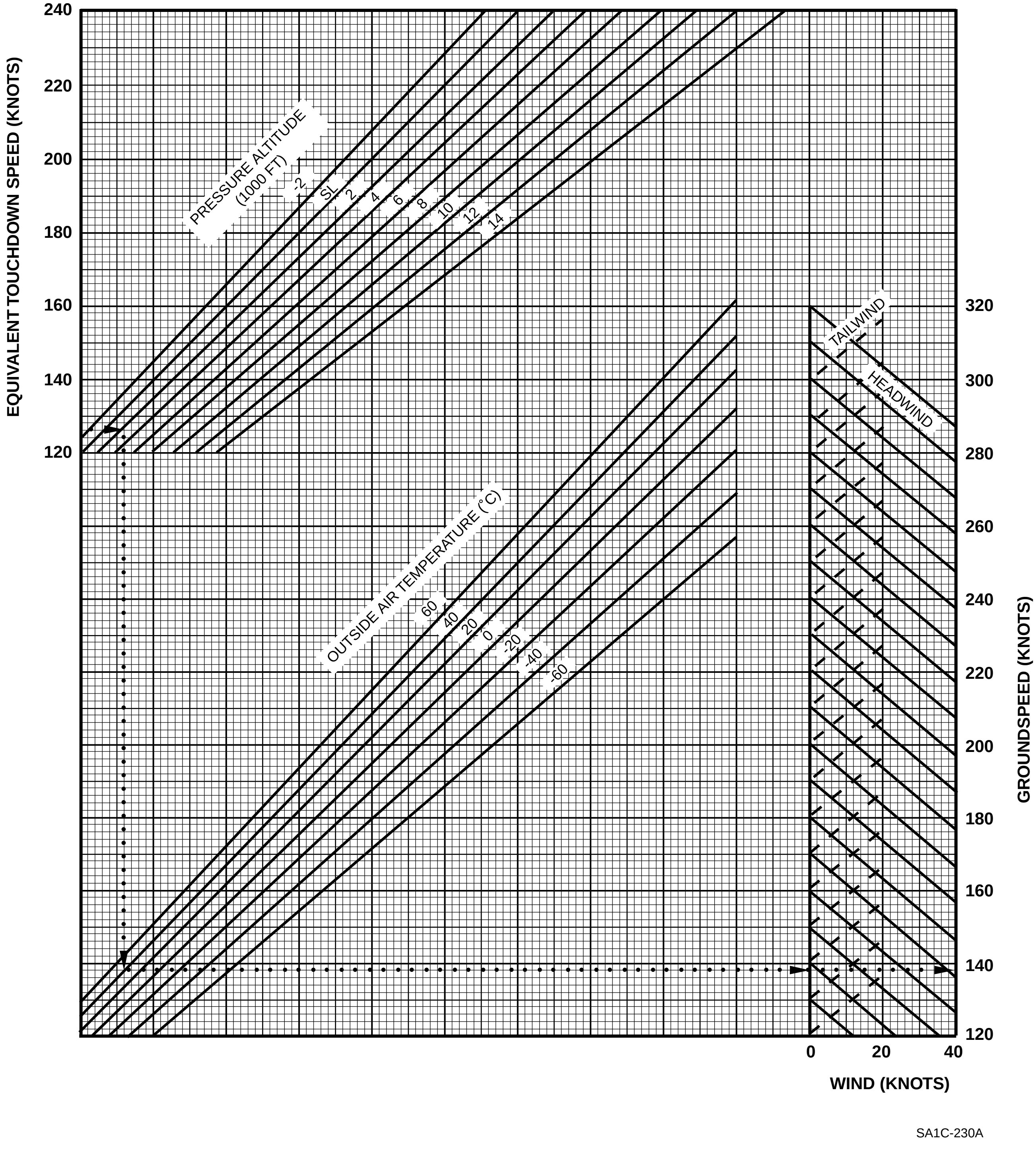


Figure 9-10. (Sheet 2)

MAXIMUM BRAKING SPEEDS

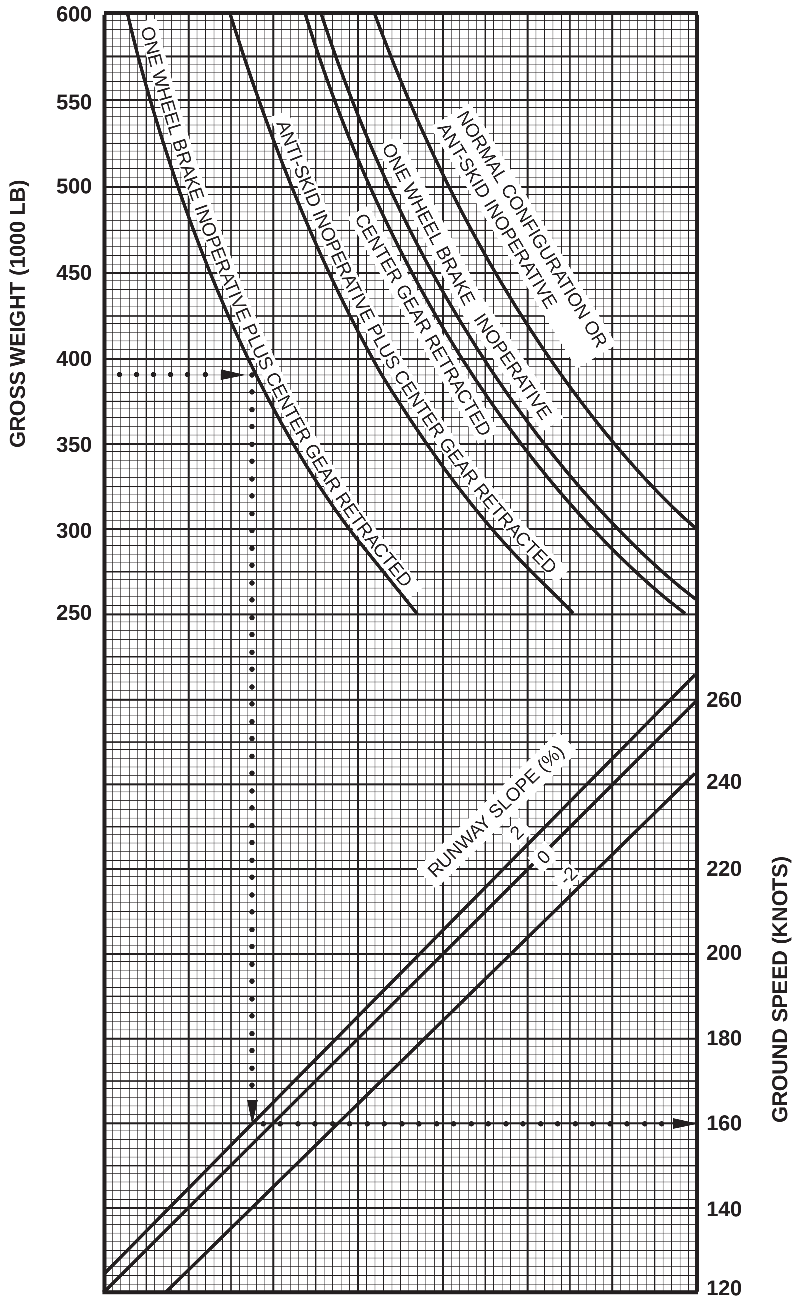


Figure 9-11.

FLARE DISTANCE

NOTE:

1. MAXIMUM UNRESTRICTED LANDING WEIGHT IS 436,000 LB
2. DATA INCLUDE A 167% FACTOR ON FLIGHT TEST DEMINSTRATED VALUES TO ACCOUNT FOR ALL WINDS, SLOPES, TEMPERATURES, AND APPROACH SPEEDS

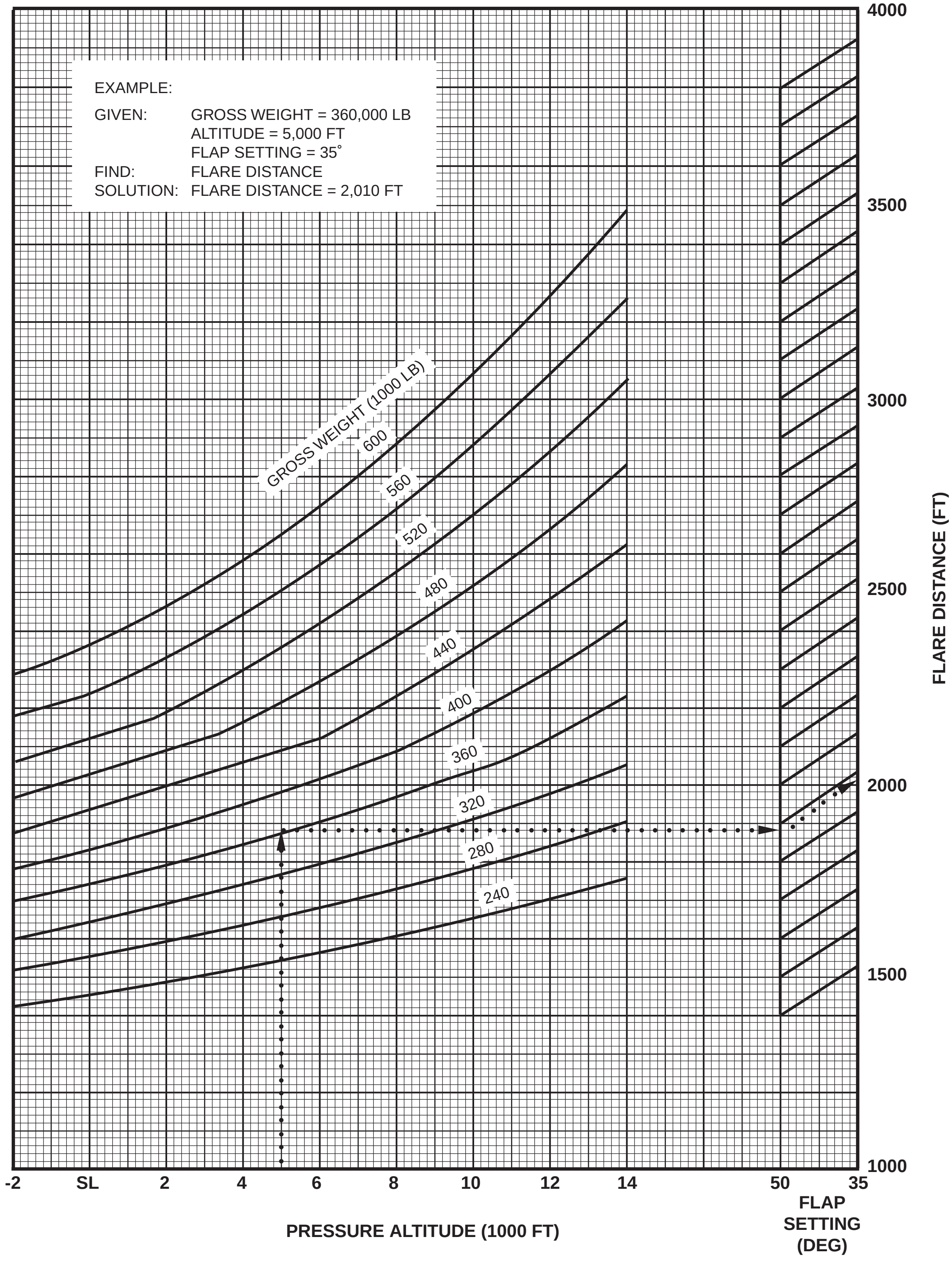


Figure 9-12.

EQUIVALENT RCR

NOTE:

1. THESE DATA ARE VALID FOR 35° AND 50° FLAP SETTINGS ONLY
2. ONE WHEEL BRAKE INOPERATIVE DATA ARE VALID FOR CENTER GEAR EXTENDED OR RETRACTED
3. ANTI-SKID INOPERATIVE DATA ARE VALID FOR CENTER GEAR EXTENDED OR RETRACTED

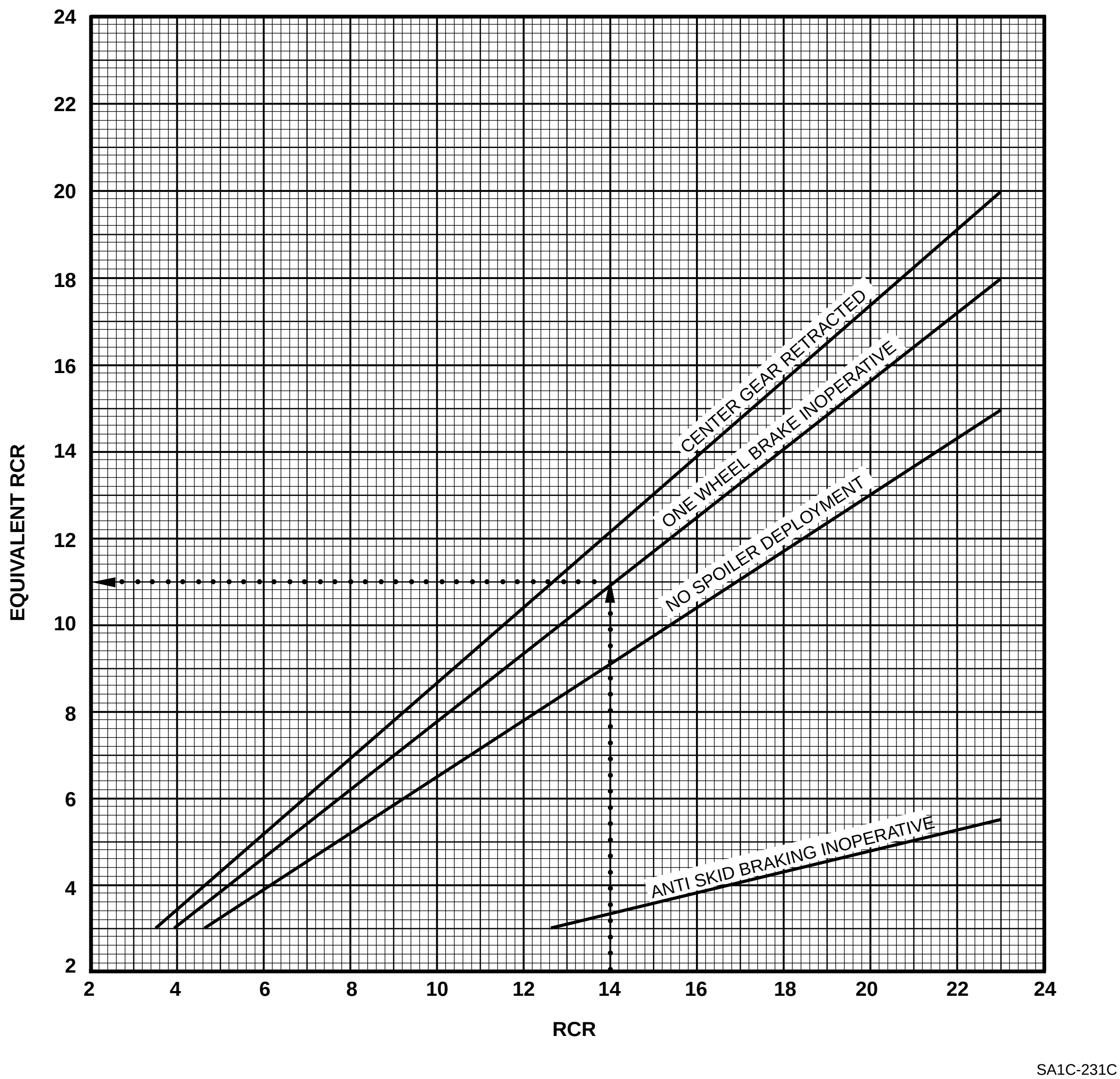


Figure 9-13.

STOPPING DISTANCE RATIO

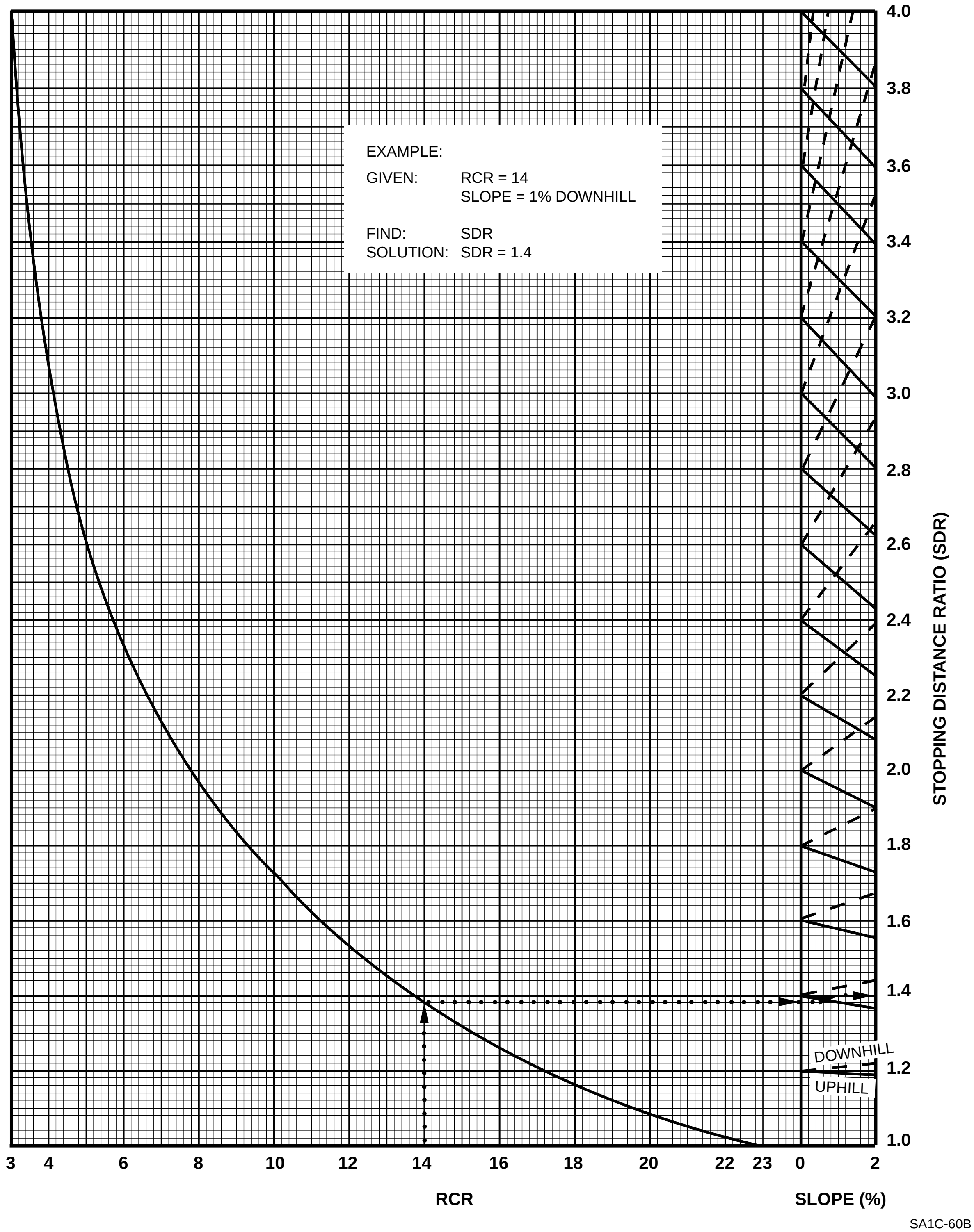


Figure 9-14.

LANDING GROUND ROLL

NOTE:

1. MAXIMUM UNRESTRICTED LANDING WEIGHT IS 436,000 LB
2. MAXIMUM ANTI-SKID BRAKING
3. SPOILERS EXTENDED
4. CENTER GEAR EXTENDED

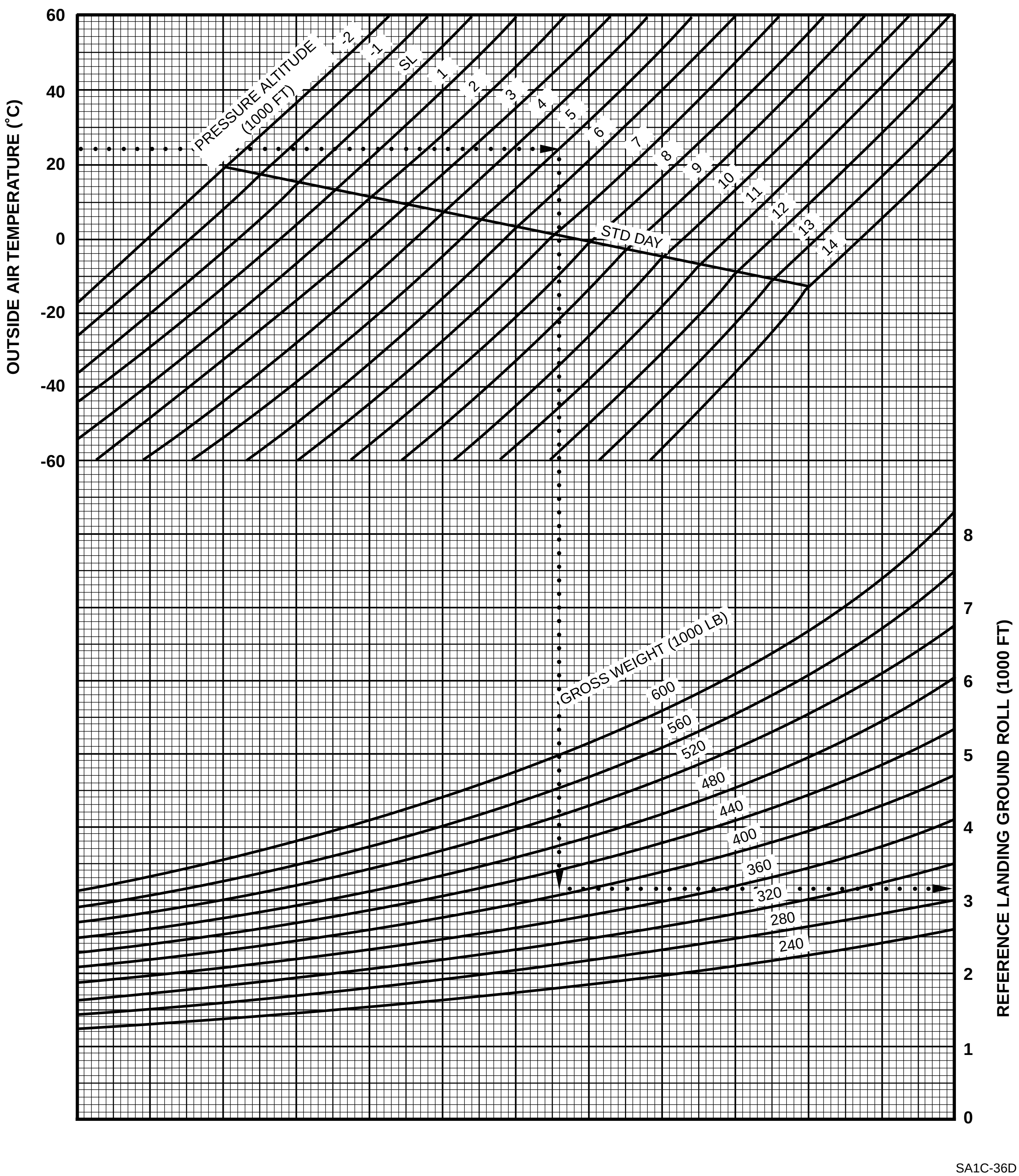


Figure 9-15. (Sheet 1)

LANDING GROUND ROLL

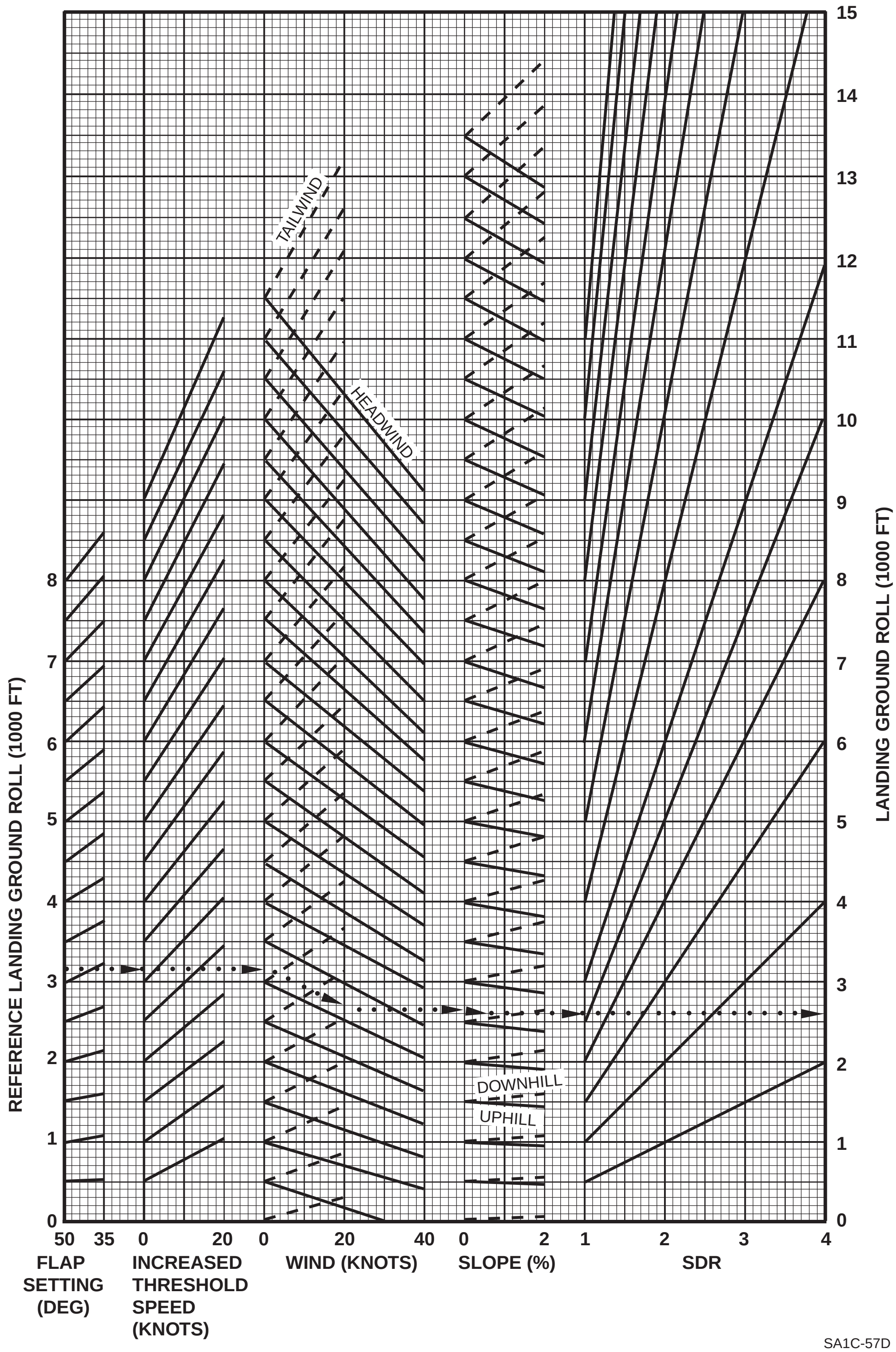


Figure 9-15. (Sheet 2)

FLARE DISTANCE FOR VARIOUS FLAP/SLAT CONFIGURATIONS

NOTE:

FLARE DISTANCES FOR VARIOUS FLAP/SLAT CONFIGURATIONS ARE NOT FACTORED BY 167 PERCENT. IF DESIRED, A FACTOR MAY BE APPLIED TO ACCOUNT FOR WIND, SLOPE, INCREASED THRESHOLD SPEED, SHALLOW APPROACH, AND NON-STANDARD TEMPERATURES

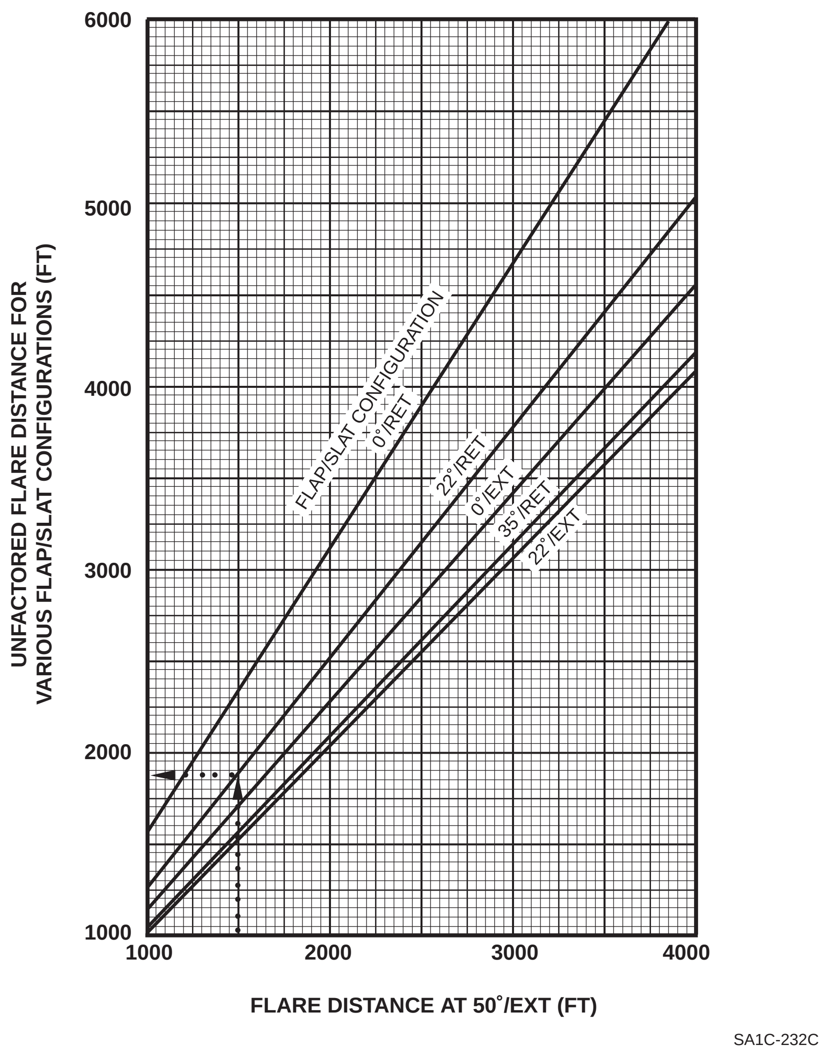


Figure 9-16.

LANDING GROUND ROLL FOR VARIOUS FLAP/SLAT CONFIGURATIONS

NOTE:
IN THE EVENT OF DUAL HYDRAULIC FAILURE, TO DETERMINE THE LANDING GROUND ROLL REFER TO DUAL HYDRAULIC FAILURE CHART

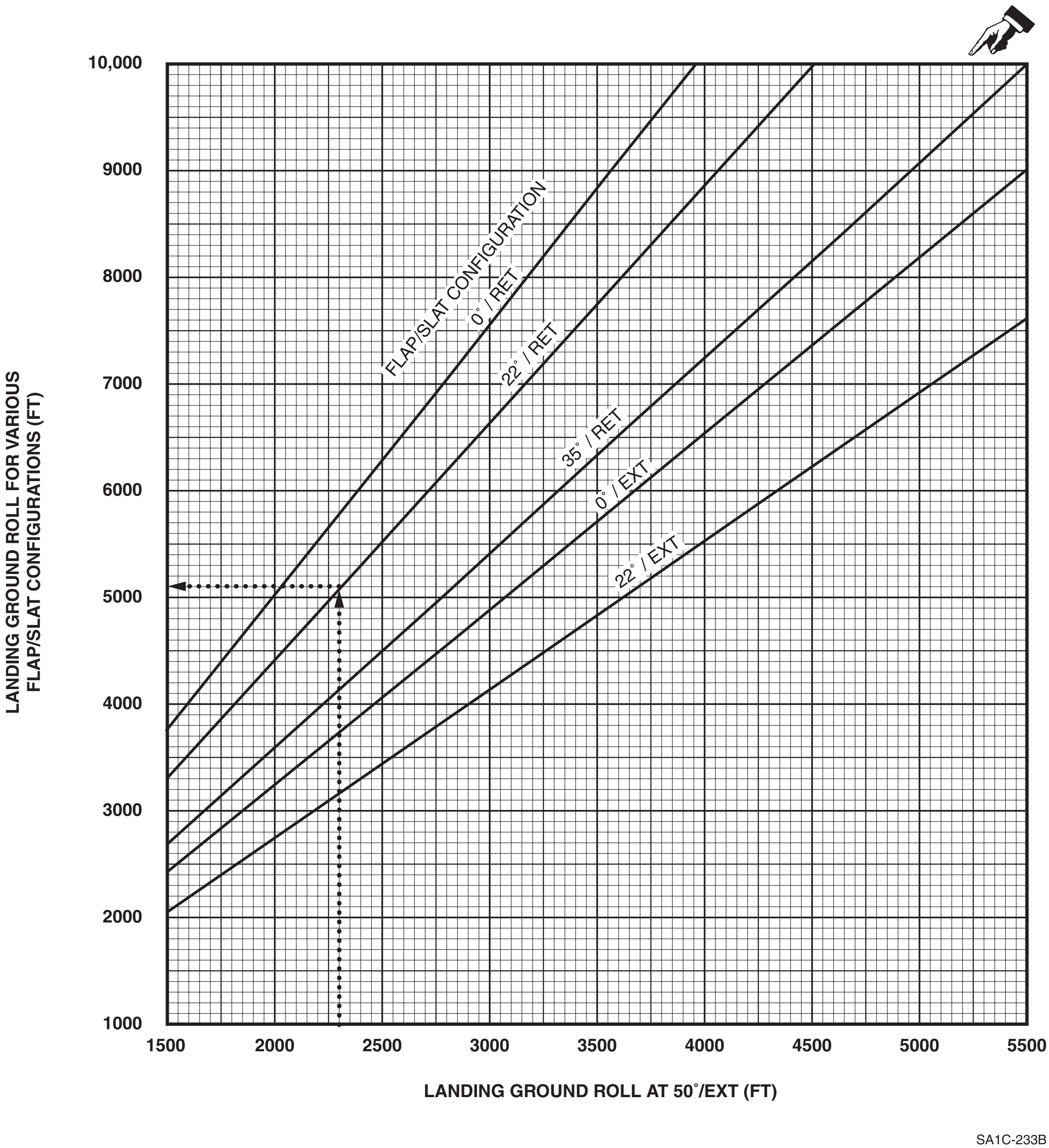


Figure 9-17.

DUAL HYDRAULIC FAILURE

NOTE:

1. ANTI-SKID INOPERATIVE (MANUAL BRAKING)
2. DATA INCLUDES THE EFFECT OF REVERSE THRUST
3. DATA INCLUDES THE EFFECT OF V_{MCA} LIMITATIONS
4. THE GROUND ROLL MULTIPLIER IS USED BASED ON THE 50°/EXT LANDING DISTANCES CALCULATED AT THE ACTUAL RCR
5. FOR LANDING WITH ONE OR BOTH WING THRUST REVERSERS DEACTIVATED, INCREASE THE CALCULATED LANDING GROUND ROLL BY 10%.

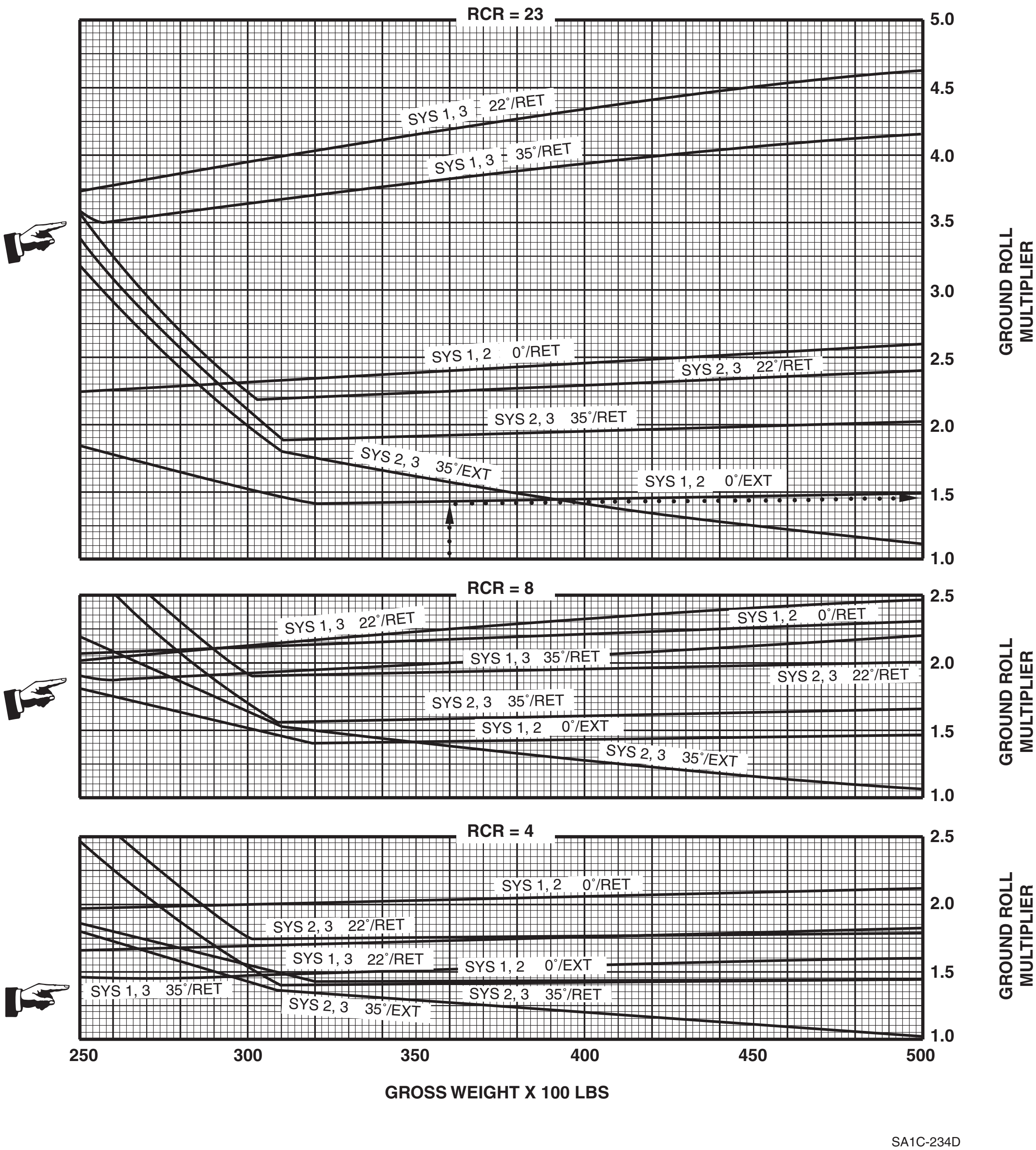


Figure 9-18.

SECTION X

MISSION PLANNING

TABLE OF CONTENTS

LIST OF CHARTS

INTRODUCTION

The purpose of the mission planning section is to tie together all the data presented in other sections, illustrate how the data are used to plan a mission, and present miscellaneous data not applicable to a specific mission segment. Example problems are presented to illustrate how the data are used to plan a mission. The figures presented include a TOLD card worksheet, an obstacle clearance worksheet, a TOLD card, flight planning charts, a reserve fuel chart, alternate airfield planning charts, runway weight bearing capacity charts, brake cooling time charts, and weight-CG chart. All data are based on flight test results. The fuel flows provided are increased by five percent relative to the engine specification level.

MISCELLANEOUS DATA

APU FUEL CONSUMPTION

Ground operation of the auxiliary power unit (APU) at sea level requires a fuel flow of 350 pounds per hour for typical operation and 500 pounds per hour for maximum load. For inflight operation, the APU fuel flow is 300 pounds per hour.

ENGINE START FUEL

The fuel burned during engine start is approximately 30 pounds per engine.

ENGINE FUEL CONSUMPTION DURING GROUND OPERATION

The fuel consumption during ground operation varies from 120 pounds per minute at takeoff weights to 90 pounds per minute at landing weights. The ground idle consumption is 80 pounds per minute.

MISSION PLANNING ALLOWANCES FOR FUEL CONSUMPTION DURING GROUND OPERATION

A standard figure of 1,500 pounds is normally used for mission planning, but may be increased by 100 pounds per minute of ground engine operation in excess of 15 minutes.

TAKEOFF ALLOWANCES

Data accounting for the flight segment from brake release to 2,000 feet above the airfield are presented in Section IV, where takeoff allowances are presented for both three and two engine operation.

FUEL CONSUMPTION FOR APPROACH AND LANDING

A standard figure of 3,000 pounds is normally used for mission planning.

TRAFFIC PATTERN (TRANSITION) FUEL CONSUMPTION

Assume that the fuel consumption while in a traffic pattern is 18,000 pounds per hour. This value is an approximation based upon USAF values obtained during traffic pattern operation.

EXAMPLE MISSION SCENARIOS

NOTE

Fuel burns and gross weights obtained in the solutions have been rounded off to the nearest 100 lbs.

MISSION 1:

Round robin mission of 4,400 NM with a C-5A refueling.

Given:

Ramp Gross Weight = 591,500 Pounds

Brake Release Gross Weight 590,000 Pounds

Ramp Fuel = 345,400 Pounds

Zero Fuel Weight = 246,100 Pounds

Zero Wind

Standard Day

Mission Definition:

1. Takeoff.
2. Climb to 29,000 feet.
3. Constant altitude cruise at Mach 0.825 to 2,000 NM from departure airfield.
4. Orbit for 15 minutes at 20,000 feet.
5. Offload fuel to C-5A at 20,000 feet. Speed is 275 KIAS/369 KTAS. Distance covered in segment is 200 NM.
6. Climb to 37,000 feet.
7. Long range step cruise 37,000/41,000 feet.
8. Enroute descent to sea level.
9. Total mission distance is 4,400 NM.
10. Distance to planned alternate is 200 NM.

Reserves Definition:

Alternate Fuel - Altitude, speed, time and fuel to the alternate as determined from figure 10-15 based on gross weight overhead destination.

MISSION I PROFILE

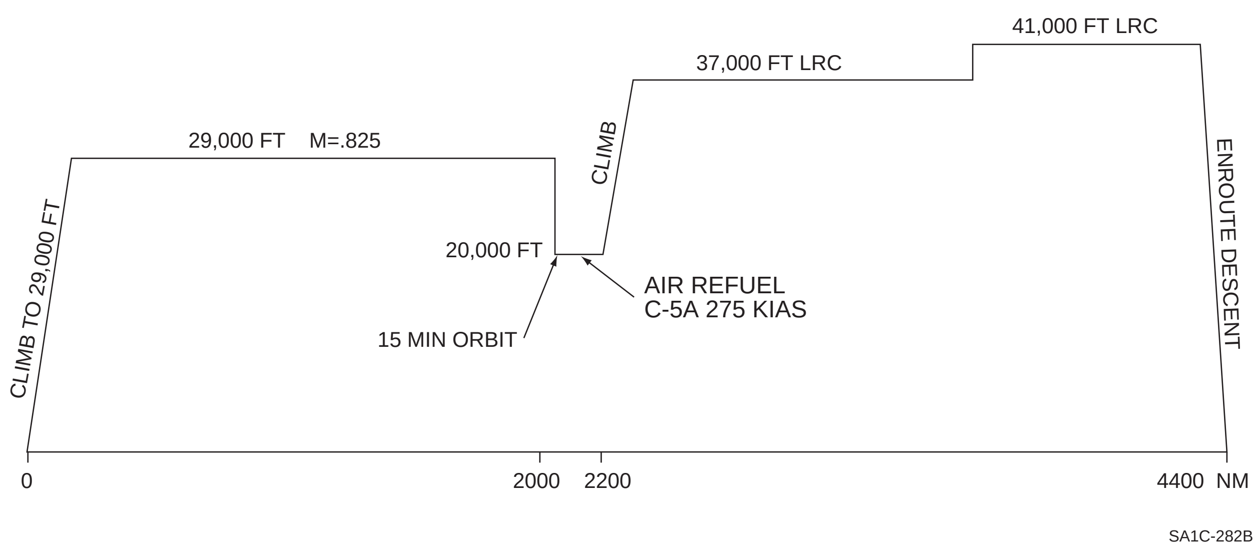


Figure 10-1. Mission I Profile

Holding Fuel - Pressure altitude 10,000 feet for 45 minutes at 25-degree bank angle (based on gross weight at overhead alternate).

Approach and Landing Fuel Allowance of 3,000 pounds.

Find:

Maximum Offload Capability

Fuel Burned for Total Mission

Solution:

1. Takeoff allowances for the segment from brake release to 2,000 feet above the airfield are presented in Section IV. The values are 2,500 pounds, 8 NM, and 2.5 minutes.

2. The initial climb weight is 587,500 pounds. The climb fuel and distance may be determined using figures 4-5 and 4-6, respectively. The values are 14,000 pounds and 144 NM.

3. The initial cruise weight is 573,500 pounds. The remaining cruise distance is 2,000 - 144 - 8 = 1,848 NM.

4. Enter figure 5-49 (Three Engine Integrated Range) with the initial cruise weight of 573,500 pounds and cruise altitude of 29,000 feet to determine the initial range of 700 NM. Add the initial range of 700 NM to the remaining cruise distance to the orbit point as determined from step 3 (1,848 NM + 700 NM = 2,548 NM). Reenter figure 5-49 with the cruise distance of 2,548 NM and cruise altitude of 29,000 feet to determine the final cruise weight of 487,500 pounds.

5. From figure 7-1, 15 minutes orbit at 20,000 feet with the initial orbit gross weight of 487,500 pounds requires 343 pounds per minute fuel flow, resulting in a fuel burned value of 5,100 pounds. The final weight of this segment is therefore 482,400 pounds.

The initial weight of the fuel offload segment is 482,400 pounds. To determine the fuel offload, the mission must be worked backwards to calculate the final weight of the offload segment.

Steps 6 through 9 calculate reserve fuel and inflight gross weight overhead the destination.

6. Adding the zero fuel weight and the approximate fuel required for approach and landing (3,000 pounds), the approximate weight at the end of holding is found to be 249,100 pounds.

7. Enter figure 6-1 with 249,100 pounds, bank angle of 25 degrees, and pressure altitude of 10,000 feet to obtain a fuel flow of 10,720 LB/HR. For 45 minutes, the fuel burned is 8,000 pounds. Add this value to 249,100 pounds to obtain the approximate gross weight at overhead alternate of 257,100 pounds. Enter figure 6-1 with 257,100 pounds, bank angle of 25 degrees, and pressure altitude of 10,000 feet to obtain a fuel flow of 10,850 LB/HR. For 45 minutes, the fuel burned is 8,100 pounds. The gross weight at overhead alternate is therefore 249,100 + 8,100 = 257,200 pounds. The holding fuel, based on gross weight at overhead alternate, is 8,100 pounds.

8. Use figure 10-15 to determine the altitude, Mach, fuel burn, and time for diverting to the alternate. Entering with zero wind and the distance to the alternate (200 NM), the altitude, Mach, fuel burn, and time to the alternate are 39,000 feet, 0.82 Mach, 11,700 pounds of fuel, and 32 minutes, respectively.

9. The total reserve fuel is 3,000 + 11,700 + 8,100 = 22,800 pounds. The inflight gross weight overhead the destination is the zero fuel weight plus reserves, which is 246,100 + 22,800 = 268,900 pounds.

10. The descent fuel, distance, and time values are obtained from figure 8-5 as 1,800 pounds, 135 NM, and 22 minutes.

11. The end of cruise weight is found by adding the inflight gross weight overhead the destination of 268,900 pounds and the fuel required for an enroute descent of 1,800 pounds yielding a value of 270,700 pounds.

Steps 12-15 calculate the climb and cruise segments following the fuel offload segment in order to determine the final weight of the fuel offload segment.

12. Use figure 5-48 to calculate the initial gross weight required to cruise the remaining distance of 2,065 NM (4,400 - 2,200 - 135 = 2,065 NM). A value of 327,000 pounds is found. Note that the chart indicates that a cruise altitude of 41,000 feet is maintained throughout this cruise segment.

13. Using 327,000 pounds as the top-of-climb weight, calculate the fuel burned and distance required to climb from 20,000 feet to 41,000 feet, using figures 4-5 and 4-6, respectively. The required fuel burn is 4,200 pounds and the distance is 74 NM.

14. Subtract 74 NM from the cruise distance of 2,065 NM to obtain a new cruise distance of 1,991 NM. Use figure 5-48 to calculate the initial gross weight for a cruise of 1,991 NM. A value of 325,000 pounds is determined.

15. Using 325,000 pounds as the top-of-climb weight, calculate the fuel burned and distance required to climb from 20,000 feet to 41,000 feet using figures 4-5 and 4-6, respectively. The required fuel burn is 4,200 pounds and the distance is 73 NM.

16. Add the top-of-climb weight of 325,000 pounds to the fuel burned required during climb of 4,200 pounds to obtain the initial climb weight of 329,200 pounds. This weight is the final weight of the fuel offload segment.

17. Use the initial and final weights of the off load segment to determine an average weight of 405,800 pounds (482,400 - 329,200) for the segment. From figure 5-14, determine the specific range to be 23.1 NM/1000 LB.

$$\frac{\text{Distance}}{\text{Specific Range}} = \text{Fuel Burned}$$

Multiply this by the range factor of 0.935 from figure 5-56, based on the drag index for the boom deployed and ARO sighting door open to be 18.5 from figure 1-15. The specific range becomes 21.6 NM/1000 LB. Using this value, the fuel burned is 9,260 pounds.

The fuel offload is the initial segment weight minus the final segment weight minus the fuel burned during the air refueling segment. This gives a value of 143,940 pounds for the fuel offload.

18. The following fuel burned values were determined for this mission:

Ramp fuel burned = 1,500 pounds

Takeoff allowance = 2,500 pounds

Climb to 29,000 feet fuel burned = 14,000 pounds

Cruise at 29,000 feet fuel burned = 86,000 pounds

Orbit fuel burned = 5,100 pounds

Offload segment fuel burned = 9,260 pounds

Climb from 20,000 to 41,000 fuel burned = 4,200 pounds

Cruise at 41,000 fuel burned = 54,300 pounds

Descent fuel burned = 1,800 pounds

The total fuel burned is 178,760 pounds.

The fuel offload is 143,940 pounds.

MISSION 2:

Tactical fighter deployment involving 6 refuelings of F-15 fighters and 2 refuelings by another KC-10A.

Given:

Ramp Weight = 567,500 pounds

Brake Release Gross Weight = 566,000 pounds

Ramp Fuel = 321,400 pounds

Zero Fuel Weight = 246,100 pounds

Zero Wind

Standard Day

Cruise Speed (including refueling segments) = 310 KIAS/465 KTAS

Cruise Altitude (including refueling segments) = 29,000 Feet

Mission Definition:

1. Takeoff.

2. Climb to 29,000 feet.

3. Cruise until total mission time is 50 minutes. (Segment CR1)

4. Offload 54,800 pounds in 42 minutes. (Segment AR1)

5. Cruise for 46 minutes. (Segment CR2)

6. Offload 52,400 pounds in 42 minutes. (Segment AR2)

7. Cruise for 102 minutes. (Segment CR3)

8. Offload 74,800 pounds in 42 minutes. (Segment AR3)

9. Onload Fuel in 31 minutes. (Segment REC AR1)

10. Cruise for 34 minutes. (Segment CR4)

11. Offload 63,700 pounds in 42 minute. (Segment AR4)

12. Cruise for 79 minutes. (Segment CR5)

13. Onload Fuel in 30 minutes. (Segment REC AR2)

14. Offload 91,600 pounds in 45 minutes. (Segment AR5)

15. Cruise for 98 minutes. (Segment CR6)

16. Offload 50,300 pounds in 51 minutes. (Segment AR6)

17. Cruise for 107 minutes. (Segment CR7)

18. Enroute descent to sea level.

19. Distance to planned alternate is 200 NM.

Reserves Definition:

Alternate fuel - Altitude, Mach, time and fuel to the alternate as determined from figure 10-15 based on gross weight overhead destination.

Holding Fuel - 10,000 feet pressure altitude for 45 minutes at 25-degree bank angle (based on gross weight at destination).

Approach and Landing Fuel Allowance of 3,000 pounds.

Find:

Total Fuel Burned

Minimum Fuel onload Required to

Perform Mission

Fuel Onload Values at First and Second Air Refueling of KC-10A.

Solution:

1. The takeoff allowances accounting for the segment from brake release to 2,000 feet above the airfield are presented in Section IV. The values are 2,500 pounds, 8 NM, and 2.5 minutes.

2. The initial climb weight is 563,500 pounds. The climb fuel, distance, and time may be determined using figures 4-5, 4-6 and 4-7, respectively. The values are 12,800 pounds, 130 NM, and 19 minutes.

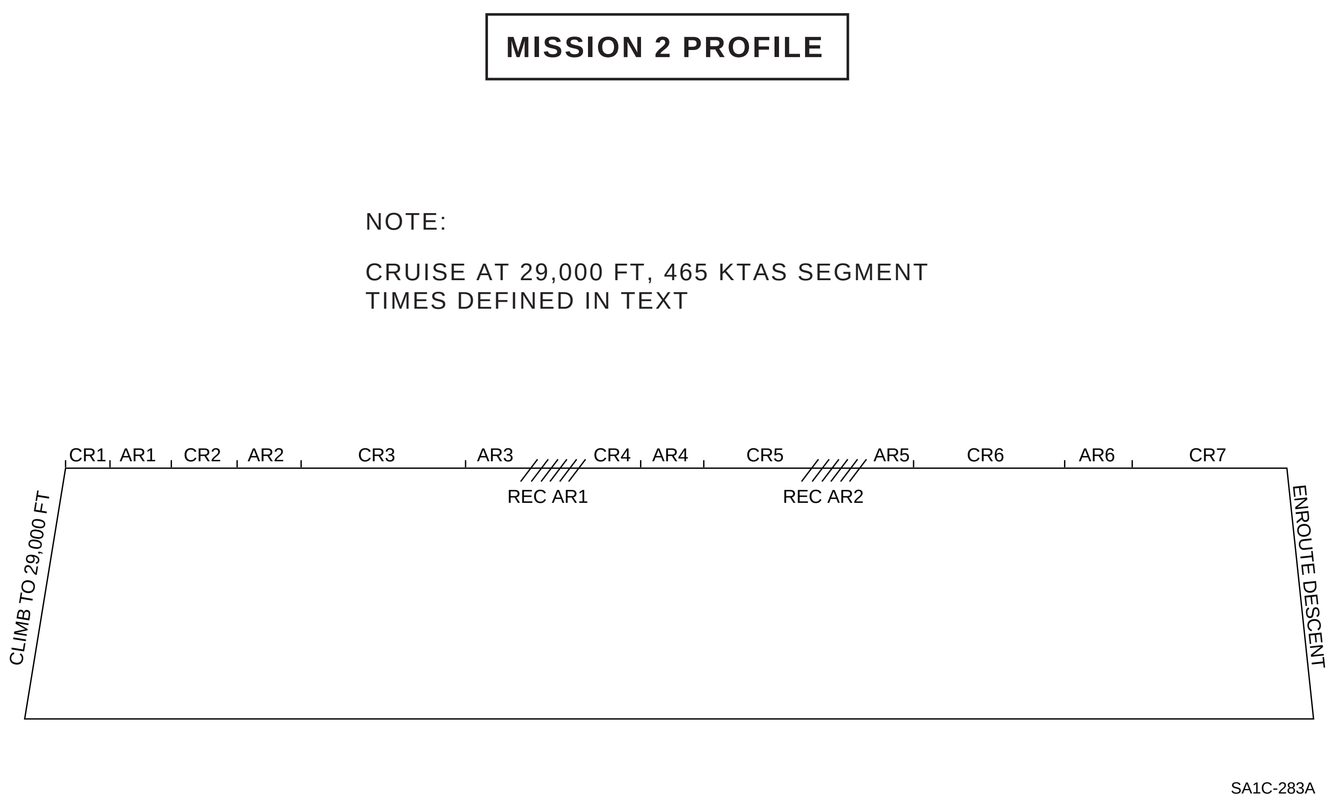


Figure 10-2. Mission 2 Profile

3. The initial weight for segment CR1 is found by subtracting the takeoff and climb fuel burned from the takeoff gross weight. The initial weight is 550,700 pounds. Similarly, the initial time for this segment is 21.5 minutes. Therefore, the time for this cruise segment is 50 - 21.5 = 28.5 minutes.

4. The fuel burned for segment CR1 may be determined using the following equation:

$$\frac{(\text{TAS x Time})}{\text{Specific Range}} = \text{Fuel Burned}$$

Read figure 5-23 at a gross weight of 550,700 pounds to obtain a specific range of 21.0 NM/ 1000 LB. Using the above equation, the fuel burned is 10,500 pounds. Use this value to determine that the final weight of the segment is 540,200 pounds and the average weight of the segment is 545,400 pounds. Read figure 5-23 at the average weight to obtain a specific range of 21.2 NM/1000 LB. Using the above equation, the fuel burned for this segment is 10,400 pounds. The final weight of this segment is therefore 540,300 pounds.

5. The initial weight of segment AR1 is 540,300 pounds. The final weight is unknown, however, an offload of 54,800 pounds is accomplished during this segment, therefore the final weight is less than 540,300 - 54,800 = 485,500 pounds. A first approximation of the average weight in this segment is 512,900 pounds. Read figure 5-23 at 512,900 pounds and the specific range is 22.4 NM/1000 LB. Multiply this by the range correction factor of 0.940 from figure 5-56, based on the drag index for boom deployed of 18.5 from figure 1-15. The specific range becomes 21.1 NM/1000 LB. Using this value, the fuel burned is 15,400 pounds. Using the fuel burned to make a better estimate of the average weight for this segment, the end-of-segment weight becomes 540,300 -54,800 - 15,400 = 470,100 pounds. The average weight is thus 505,200 pounds. Read figure 5-23 at 505,200 pounds and the specific range is 22.7 NM/1000 LB. Multiply by the range correction factor and the specific range is 21.3 NM/1000 LB. This gives a fuel burned of 15,300 pounds. The final weight for this segment is therefore 470,200 pounds.

6. In the same manner as described above, the fuel burned values for segments CR2, AR2, CR3, and AR3 were calculated. The values are listed below.

Segment	Fuel Burned (LB)
CR2	14,700
AR2	13,400
CR3	28,600
AR3	11,800

7. Subtracting all the fuel burned values and fuel offload values, the final weight for Segment AR3 is 274,500 pounds. This is also the initial weight for Segment REC AR1.

To determine the fuel onload, the mission must be worked backwards to find the final weight of Segment REC AR1.

8. Adding the zero fuel weight and the approximate fuel required for approach and landing (3000 pounds), the weight at the end of holding is 249,100 pounds.

9. Enter figure 6-1 with 249,100 pounds, 25-degree bank angle, and 10,000 feet pressure altitude and obtain a fuel flow of 10,720 LB/HR. For 45 minutes, the fuel burned is 8,000 pounds. Add this value to 249,100 pounds to obtain an approximate gross weight, at the destination, of 257,100 pounds. Enter figure 6-1 with 257,100 pounds, 25-degree bank angle, and 10,000 feet pressure altitude and obtain a fuel flow of 10,850 LB/HR. The fuel burned for 45 minutes is 8,100 pounds. The gross weight at the destination is therefore 249,100 + 8,100 = 257,200 pounds. The holding fuel, based on gross weight at destination, is 8,100 pounds.

10. Use figure 10-15 to determine the altitude, Mach, fuel burn, and time for diverting to the planned alternate. Entering with zero wind and the distance to the alternate (200 NM), the altitude, Mach, fuel burn, and time to the alternate are 39,000 feet, 0.82 Mach, 11,700 pounds of fuel, and 32 minutes, respectively.

11. The total reserve fuel is 3,000 + 11,700 + 8,100 = 22,800 pounds. The inflight gross weight overhead the destination is the zero fuel weight plus reserves, which is 246,100 + 22,800 = 268,900.

12. Use figure 8-4 to determine the fuel, distance, and time required for an enroute descent from 29,000 feet to sea level. The values are 1,600 pounds, 103 NM, and 18 minutes.

13. The end of Segment CR7 gross weight is therefore 268,900 + 1,600 = 270,500 pounds.

14. Using the procedure discussed while finding the fuel burned for Segments CR1 and AR1, the following fuel burned values are determined:

Segment	Fuel Burned (LB)
CR7	27,200
AR6	14,600
CR6	27,600
AR5	14,900

15. Adding the above fuel burned values and the fuel offload values for Segments AR5 and AR6 to the end of Segment CR7 weight, the weight at the start of Segment AR5 is 496,700 pounds. This is also the end of Segment REC AR2 weight.

16. To minimize the total fuel onload, the onload at REC AR2 must be maximized and the onload at REC AR1 minimized. This results in lower average weights than any other distribution of the onload fuel. The maximum possible onload during Segment REC AR2 is 234,000 pounds, based on 7,800 pounds per minute for 30 minutes. It is assumed that the minimum weight to which the airplane is flown, before being refueled in segment REC AR2, is equal to the zero fuel weight plus the reserve fuel. Thus, the minimum weight for the problem is 246,100 + 22,800 = 268,900 pounds. Assuming an initial weight of 268,900 pounds, the average weight for segment REC AR2 is 385,900 pounds. Reading figure 7-5 at this receiver weight and assuming a tanker weight of 560,000 pounds, the receiver fuel flow is 360 pounds per minute, which results in a fuel burned of 10,800 pounds in 30 minutes. The fuel onload is equal to the final segment weight plus the

fuel burned during the segment minus the initial segment weight, therefore the fuel onload is 496,700 + 10,800 - 268,900 = 238,600 pounds. This value exceeds 234,000 pounds, which requires that the initial segment weight be increased. For this solution, the initial segment weight is increased by 4,600 pounds to 273,500 pounds. Using this weight, a new average weight is found and figure 7-5 is read again. The resulting fuel burned is 10,900 pounds.

17. The fuel onload during Segment REC AR2 is the final segment weight minus the initial segment weight plus the fuel burned during the segment. Thus, 496,700 - 273,500 + 10,900 = 234,100 pounds.

The fuel onload value is slightly more than the maximum allowable fuel transfer for this problem, but the difference results in negligible differences in the mission-fuel burned.

18. The following fuel burned values may now be determined:

Segment	Fuel Burned (LB)
CR5	20,000
AR4	12,000
CR4	9,600

19. The final weight of Segment REC AR1 may now be found. The value is 378,800 pounds.

20. Using the initial and final weights of Segment REC AR1 the average weight of the segment is 326,200 pounds. From figure 7-5, assuming a tanker gross weight of 575,000 pounds, the fuel flow is 322 pounds per minute, which gives a fuel burned of 10,000 pounds in 31 minutes. Using this fuel burn, the new average weight of the segment is 331,200 pounds. Using the new average weight of 331,200 pounds the new fuel burn is 10,000 pounds. In this case, fuel averaging was not a factor.

21. The onload fuel for Segment REC AR1 is the segment final weight minus the segment initial weight plus the fuel burned during the segment, thus 378, 800 - 274 300 + 10,000 = 114,500 pounds.

22. The total mission fuel burned is 257,900 pounds. The fuel onload at REC AR1 is 114,500 pounds. The fuel onload at REC AR2 is 234,000 pounds.

CHART EXPLANATION AND EXAMPLE PROBLEMS

TOLD CARD

Figures 10-3, 10-4, and 10-5 contain samples of the Takeoff and Landing Data (TOLD) Card and Worksheets. Both of these worksheets (TOLD Card Worksheet, figure 10-3, and Obstacle Clearance Worksheet, figure 10-4), aid in the computation of takeoff and landing data required for the TOLD card. The TOLD Card (figure 10-5) is used to present the computed data for crew use. The values presented on the sample TOLD Card and worksheets are obtained from Example 1. Six example problems are presented to demonstrate the use of charts and completion of the TOLD Card and Worksheets.

TOLD Card Worksheet (figure 10-3): Record takeoff conditions and TOLD computations on the TOLD Card Worksheet during mission planning. It is not necessary to place a number in each block. A check mark (✓) in a block indicates that the condition was checked, but did not exist, was not a factor, or that a chart was checked, and the result was outside the parameters of the chart. Takeoff and emergency return data is based upon brake release gross weight. The landing conditions portion of the TOLD Card Worksheet is optional for normal operations. For abnormal or emergency conditions, the applicable blocks of the landing portion of the worksheet must be completed.

Obstacle Clearance Worksheet (figure 10-4): An optional Obstacle Clearance Worksheet is provided to aid in computing takeoff data when departure obstacles may be a factor. This form flows with performance manual obstacle clearance procedures and includes all appropriate notes. As the worksheet is optional, any portion may be left blank.

TOLD Card (figure 10-5): Complete the Takeoff portion of the TOLD Card for all takeoffs. Include emergency return data (V speeds and landing distance) in the Landing portion of the TOLD Card for takeoff. Complete the Landing portion of the TOLD Card for all landings. When completed, the TOLD Card will be revised if: (1) landing flap/slat configuration changes, (2) when any abnormal or emergency condition exists that would change landing distance or speeds, (3) whenever landing gross weight changes 20,000 pounds or more, or (4) when a change in RCR would significantly affect landing distance.

All procedures and performance data for TOLD card completion are obtained from this manual. EXCEPTION: Maneuvering and threshold speeds for landing and emergency return are obtained from TO 1C-10(K)A-1CL-1. (NOTE: When pressure altitude exceeds 2000 feet, compute threshold speeds using Section IX data.) Compute landing distance using Section IX data. All procedures and performance data for TOLD card completion may also be obtained from the KC-10 Electronic TOLD Tool.

Example I (Given Mission TOGW):

Given:

Gross Weight = 520,000 lbs.

Center of Gravity = 26% MAC

Outside Air Temperature = +20°C

Dew Point = ✓

Anti-ice Off

Pressure Altitude = +2050 feet

Wind Direction Calm

Wind Velocity = ✓

Runway Heading = 190°

Runway Available = 10,200 feet (Runway Length = 10,500 feet)

RCR = 23

RSC = 0

Slope = 0.8% DN

Elevation = 2021 feet

Obstacle Height = 2039 feet (MSL)

Obstacle Distance = 3200 feet

Air-conditioning Off

Reverse Thrust

Find:

Data required for completion of TOLD Card (Given Mission TOGW).

Solution:

1. Determine wind components and check wind limitation using figure 3-6:

Runway wind component (winds calm) = ✓

Static or rolling takeoff may be used.

2. Departure Planning. Use departure planning procedures to determine if takeoff is limited by obstacle clearance or crossing height restrictions.

Climbout obstacle exists.

3. Determine the obstacle height above the liftoff end of the runway and the obstacle distance from the liftoff end of the runway:

Obstacle height (AGL) = Obstacle Height (2039 feet MSL) minus departure end of runway elevation (1940 feet MSL) = 99 feet AGL

Obstacle Distance = 3200 feet

4. Correct Obstacle Height for downhill slope.

Departure end of runway elevation is known (99 feet AGL).

Downhill slope correction for climbout flight path (figure 3-7) = 20 feet

Corrected obstacle height = 119 feet

5. Using figure 3-7, determine the gradient required for obstacle clearance using the obstacle height and distance obtained from steps 3 and 4 (Note: Use the most limiting flap setting):

Gradient required for Obstacle Clearance = 6.0%

6. Determine Takeoff Climb Gradient required. Compare the gradient required for obstacle clearance to the minimum required gradient of 2.5%. The gradient requirement for obstacle clearance is greater than 2.5%, therefore, the obstacle may be limiting.

Climb Gradient = 6.0%

7. CFCC = ✓ (Not Applicable)

8. Determine EFL, RALW, CGLW, MTOGW, and Optimum Flap Setting using figure 3-9A (RCR 23-18/With Reverse Thrust):

EFL = 11,275 feet

RALW = 524,000 lbs

CGLW = 437,000 lbs

MTOGW = 481,000 lbs

Optimum Flap Setting = 6.0°

MTOGW of 481,000 lbs is less than required mission gross weight of 520,000 lbs. Continue with takeoff planning procedures to determine if MTOGW can be increased.

9. Reduce runway available by 500 feet (increases distance to obstacle).

New runway available = 9700 feet

10. Correct obstacle height due to change in runway length using procedures from notes 2 and 3 on the Obstacle Clearance Worksheet.

Corrected obstacle height = 115 feet

11. Add runway reduction to obstacle distance.

New obstacle distance = 3700 feet

12. Recompute Climb Gradient required to clear obstacle using figure 3-7.

Climb Gradient required = 4.9%

13. Determine EFL, RALW, CGLW, MTOGW, and Optimum Flap Setting using figure 3-9A (RCR 23-18/With Reverse Thrust):

EFL = 10,700 feet

RALW = 510,000 lbs

CGLW = 466,000 lbs

MTOGW = 514,000 lbs

Optimum Flap Setting = 6.4°

MTOGW of 514,000 lbs is less than required mission gross weight of 520,000 lbs. Continue with takeoff planning procedures to determine if MTOGW can be increased.

14. Reduce runway available again by 500 feet and recompute MTOGW and Optimum Flap Setting:

New runway available = 9200 feet

15. Correct obstacle height due to change in runway length using procedures from notes 2 and 3 on the Obstacle Clearance Worksheet.

Corrected Obstacle Height = 110 feet

16. Add runway reduction to obstacle distance.

New Obstacle Distance = 4200 feet

17. Recompute Climb Gradient required to clear obstacle using figure 3-7.

Climb Gradient required = 4.05%

18. Determine EFL, RALW, CGLW, MTOGW, and Optimum Flap Setting using figure 3-9A (RCR 23-18/With Reverse Thrust):

EFL = 10,250 feet

RALW = 500,000 lbs

CGLW = 493,000 lbs

MTOGW = 532,000 lbs

Optimum Flap Setting = 15.2°

MTOGW now exceeds required mission gross weight. Continue takeoff data computations using TOGW of 520,000 lbs and an optimum flap setting of 15.2°.

19. Determine TSLW from figure 3-10:

TSLW > 600,000 lbs

20. Compare TOGW to the TSLW. Use the lower value as the TOGW:

TOGW = 520,000 lbs

21. Determine VMCG from figure 3-11:

VMCG = 120 KIAS

22. Determine VCEF from figure 3-12:

VCEF = 146 KIAS

23. Determine VMBE from figure 3-13:

VMBE = 180 KIAS

24. Set V1 equal to the higher of VCEF and VMCG, not to exceed VMBE:

V1 = 146 KIAS

25. Compare V1 to VCEF, VMCG, and VMBE. V1 is set by VCEF, therefore, VMCG and VMBE are not limiting.

26. MAW = ✓ (Not applicable, V1 is set by VCEF)

27. Determine VR from figure 3-15:

VR = 164 KIAS

28. Determine VR MIN from figure 3-11:

VR MIN = 130 KIAS

29. Compare VR to VR MIN. Use the higher value as VR:

VR = 164 KIAS

30. Determine V2 from figure 3-16. If VR was increased to equal VR MIN, increase the corrected V2 speed by the same amount.

V2 = 177 KIAS

31. Determine VFR, VSR and VMM from figure 3-17.

VFR = 195 KIAS

VSR = 240 KIAS

VMM = 274 KIAS

32. Determine Stabilizer Setting from figure 3-18:

STAB = 3.4 units

33. Determine the Pressure Height for Acceleration from figure 3-19:

Pressure Height for Acceleration = 1460 feet

34. Determine the Takeoff N1 setting from figure 3-20 or 2-1:

Takeoff N1 = 114.1%

35. Compute emergency return data:

Landing weight = 520,000 lbs

36. Determine Minimum Maneuver speeds (VMM) using figure 9-3B:

VMM 0°/RET = 274 KIAS

VMM 0°/EXT = 236 KIAS

VMM 22°/EXT = 195 KIAS

37. Determine threshold speed from figure 9-7 (Note: Figure 9-3B tabular threshold speeds are only valid for pressure altitudes up to 2,000 feet):

VTH 35°/EXT = 173 KIAS

38. Determine $1/\sqrt{\sigma}$ using figure 1-3:

$1/\sqrt{\sigma}$ = 1.0465

39. Determine Approximate Threshold TAS by multiplying Threshold IAS by $1/\sqrt{\sigma}$:

VTH TAS = 181 KIAS

40. Determine Flare Distance using figure 9-12:

Flare Distance = 2330 feet

41. Determine Landing Ground Roll using figure 9-15:

Landing Ground Roll = 3940 feet

42. Compute Landing Distance by adding Flare Distance and Landing Ground Roll together.

Landing Distance = 6270 feet

Example 2 (Reduced Thrust):

Given:

Gross Weight = 480,000 lbs.

Center of Gravity = 23% MAC

Outside Air Temperature = +25°C

Dew Point = ✓

Anti-ice Off

Pressure Altitude = +100 feet

Wind Direction = 170°

Wind Velocity = 10 Gust 16 knots

Runway Heading = 140°

Runway Available = 11,700 feet (Runway Length = 12,000 feet)

RCR = 10

RSC = 0

Slope = 0.5% UP

Elevation = 85 feet

Obstacle Height = 252 feet (MSL)

Obstacle Distance = 12,800 feet

Air-conditioning On

Reverse Thrust

Find: Data required for completion of TOLD Card (Reduced Thrust).

Solution:

1. Determine wind components and check wind limitation using figure 3-6:

Runway wind component (not mission accomplishment) = ✓ (headwind not used in calculations). Crosswind component = 8 knots.

Static or rolling takeoff may be used.

2. Departure Planning. Use departure planning procedures to determine if takeoff is limited by obstacle clearance or crossing height restrictions.

Climbout obstacle exists.

3. Determine the obstacle height above the liftoff end of the runway and the obstacle distance from the liftoff end of the runway:

obstacle height (AGL) = Obstacle Height (252 feet MSL) minus Departure end of runway elevation (85 feet MSL) = 167 feet AGL

Obstacle Distance = 12,800 feet

4. Using figure 3-7, determine the gradient required for obstacle clearance using the obstacle height and distance obtained from step 3 (Note: Use the most limiting flap setting):

Gradient required for Obstacle Clearance = ✓ (Less than 2.5%)

5. Determine Climb Gradient required. Compare the climb gradient required for obstacle clearance to the minimum required climb gradient of 2.5%. The gradient requirement for obstacle clearance is less than 2.5%, therefore 2.5% is the required climb gradient.

Climb Gradient = 2.5%

6. CFCC = ✓ (Not Applicable)

7. Determine EFL, RALW, CGLW, MTOGW, and Optimum Flap Setting using figure 3-9C (RCR 11-8/With Reverse Thrust):

EFL = 11,000 feet

RALW = 523,000 lbs

CGLW = 560,000 lbs

MTOGW = 573,000 lbs

Optimum Flap Setting = 21.0°

A Reduced Thrust takeoff can be accomplished since the computed

MTOGW of 573,000 lbs is greater than required mission gross weight of 480,000 lbs.

TOGW = 480,000 lbs

8. Determine the assumed temperature from figure 3-9C (Sheet 3) by entering the chart where MTOGW and the optimum flap setting occur, read down to TOGW while maintaining the optimum flap setting. From this intersection, parallel the RALW and CGLW values. Assumed temperature is determined from both RALW and CGLW temperature grids.

RALW Assumed Temperature = 55°C

CGLW Assumed Temperature = 50°C

9. Determine TSLW at the assumed temperature from figure 3-10:

TSLW > 600,000 lbs

10. Compare TOGW to the TSLW. Use the lower value as the TOGW:

TOGW = 480,000 lbs

11. Determine VMCG at the assumed temperature from figure 3-11:

VMCG = 113 KIAS

12. Determine VCEF at the assumed temperature from figure 3-12C (RCR 11-8/With Reverse Thrust):

VCEF = 131 KIAS

13. Determine VMBE at the assumed temperature from figure 3-13:

VMBE = 190 KIAS

14. Set V1 equal to the higher of VCEF and VMCG, not to exceed VMBE:

V1 = 131 KIAS

15. Compare V1 to VCEF, VMCG, and VMBE. V1 is set by VCEF, therefore VMCG and VMBE and VMBE are not limiting.

16. MAW = (Not applicable, V1 is set by VCEF)

17. Determine VR at the assumed temperature from figure 3-15:

VR = 154 KIAS

18. Determine VR MIN at the assumed temperature from figure 3-11:

VR MIN = 123 KIAS

19. Compare VR to VR MIN. Use the higher value as VR:

VR = 169 KIAS

20. Determine V2 at the assumed temperature from figure 3-16. If VR was increased to equal VR MIN, increase the corrected V2 speed by the same amount.

V2 = 169 KIAS

21. Determine VFR, VSR and VMM from figure 3-17:

VFR = 188 KIAS

VSR = 230 KIAS

VMM = 263 KIAS

22. Determine Stabilizer Setting from figure 3-18:

STAB = 4.4 Units

23. Determine the Pressure Height for Acceleration at the actual temperature from figure 3-19:

Pressure Height for Acceleration = 1450 feet

24. Determine the Reduced Thrust Takeoff N1 setting from figure 3-21:

Reduced Thrust Takeoff N1 = 104.6%

25. Compute emergency return data:

Landing Weight = 480,000 lbs

26. Determine Minimum Maneuver speeds (VMM) and Threshold speed (VTH) using figure 9-3:

VMM 0°/RET = 263 KIAS

VMM 0°/EXT = 227 KIAS

VMM 22°/EXT = 186 KIAS

VTH 35°/EXT = 165 KIAS

27. Determine $1/\sqrt{\sigma}$ using figure 1-3:

$1/\sqrt{\sigma}$ = 1.019

28. Determine approximate approach TAS by adding wind additives (6 knot gust) to Threshold IAS and multiply by SMOE Vapp TAS = 174 KIAS:

VAPP TAS = 174 KIAS

29. Determine Flare Distance using figure 9-12:

Flare Distance = 2160 feet

30. Determine Stopping Distance Ratio using figure 9-14:

SDR = 1.74

31. Determine Landing Ground Roll using figure 9-15:

Landing Ground Roll = 6650 feet

32. Compute Landing Distance by adding Flare Distance and Landing Ground Roll together.

Landing Distance = 8810 feet

Example 3 (Non-Standard configuration, no reverse thrust, distant obstacle):

Given:

Gross Weight = 540,000 lbs.

Center of Gravity = 26% MAC

Outside Air Temperature = +17°C

Dew Point = ✓

Anti-ice Off

Pressure Altitude = +68 feet

Wind Direction Calm

Wind Velocity = ✓

Runway Heading = 230°

Runway Available = 11,500 feet (Runway Length = 11,800 feet)

RCR = 12

RSC = 0

Slope = 0

Elevation = 76 feet

Obstacle Height = 1446 feet (MSL)

Obstacle Distance = 6.4 NM (38,912 feet)

Air-conditioning On

No Reverse Thrust

Configuration = One Wheel Brake and One Thrust Reverser Inoperative

Find: Data required for completion of TOLD Card (Non-standard configuration, no reverse thrust, distant obstacle).

Solution:

1. Determine wind components and check wind limitation using figure 3-6:

Runway wind component (winds are calm) = ✓

Static or rolling takeoff may be used.

2. Departure Planning. Use departure planning procedures to determine if takeoff is limited by obstacle clearance or crossing height restrictions.

Climbout obstacle exists.

3. Determine the obstacle height above the liftoff end of the runway and the obstacle distance from the liftoff end of the runway:

Obstacle height (AGL) = Obstacle Height (1446 feet MSL) minus Departure end of runway elevation (76 feet MSL) = 1370 feet AGL

Obstacle Distance = 38,912 feet

4. Using figure 3-7, determine the gradient required for obstacle clearance using the obstacle height and distance obtained from step 3 (Note: Use the most limiting flap setting):

Gradient required for obstacle Clearance = 4.2%.

5. Determine Climb Gradient required. Compare the climb gradient required for obstacle clearance to the minimum required to climb gradient of 2.5%. The gradient requirement for obstacle clearance is greater than 2.5%, therefore, the obstacle may be limiting.

Climb Gradient = 4.2%

6. Determine CFCC for one wheel brake inoperative from figure 3-8:

CFCC = 13.6

7. Determine EFL, RALW, CGLW, MTOGW, and Optimum Flap Setting from figure 12-33A (RCR 23-18/No Reverse Thrust). CGLW will be computed using a climb gradient of 4.2% to ensure obstacle clearance.

Notes:

“No Reverse Thrust” charts will be used since one thrust reverser is inoperative.

Provisions for CFCC correction are only provided on Maximum Takeoff Gross Weight at Optimum Takeoff Flap Setting, VCEF, CFL, and MAW charts based on RCR values of 23-18.

EFL = 9450 feet

RALW = 512,000 lbs

CGLW = 500,000 lbs

MTOGW = 542,000 lbs

Optimum Flap Setting = 14.6°

8. Compare MTOGW (542,000 lbs) to required mission TOGW (540,000 lbs). Set TOGW equal to or less than MTOGW.

TOGW = 540,000 lbs

MTOGW of 542,000 lbs is greater than required mission TOGW of 540,000 lbs. A reduced thrust takeoff cannot be accomplished since one wheel brake is inoperative. Complete remainder of takeoff computations using the required mission TOGW of 540,000 lbs and the optimum flap setting of 14.6°.

9. Determine TSLW from figure 3-10:

TSLW ✓

10. Compare TOGW to the TSLW. Use the lower value as the TOGW:

TOGW = 540,000 lbs

11. Determine VMCG from figure 3-11:

VMCG = 123 KIAS

12. Determine VCEF from figure 12-34A (RCR 23-18/No Reverse Thrust):

VCEF = 139 KIAS

13. Determine VMBE from figure 3-13:

VMBE = 172 KIAS

14. Set V1 equal to the higher of VCEF and VMCG, not to exceed VMBE:

V1 = 139 KIAS

15. Compare V1 to VCEF, VMCG, and VMBE. V1 is set by VCEF, therefore, VMCG and VMBE are not limiting.

16. MAW = ✓ (Not applicable, V1 is set by VCEF)

17. Determine VR from figure 3-15:

VR = 168 KIAS

18. Determine VR MIN from figure 3-11:

VR MIN = 133 KIAS

19. Compare VR to VR MIN. Use the higher value as VR:

VR = 168 KIAS

20. Determine V2 from figure 3-16. If VR was increased to equal VR MIN, increase the corrected V2 speed by the same amount.

V2 = 180 KIAS

21. Determine VFR, VSR and VMM from figure 3-17:

VFR = 199 KIAS

VSR = 244 KIAS

VMM = 279 KIAS

22. Determine Stabilizer Setting from figure 3-18:

STAB = 3.3 Units

23. Determine the Pressure Height for Acceleration at the actual temperature from figure 3-19:

Pressure Height for Acceleration = 1500 feet

24. Determine the Takeoff N1 setting from figure 3-20:

Takeoff N1 = 111.2 %

25. Compute emergency return data:

Landing weight = 540,000 lbs

26. Determine Minimum Maneuver speeds (VMM) and Threshold Speed (VTH) using figure 9-3B:

VMM 0°/RET = 279 KIAS

VMM 0°/EXT = 240 KIAS

VMM 22°/EXT = 199 KIAS

VTH 35°/EXT = 176 KIAS

27. Determine l/$\sqrt{\sigma}$ using figure 1-3:

1/$\sqrt{\sigma}$ = 1. 004

28. Determine Approximate Threshold TAS by multiplying Threshold IAS by 1/$\sqrt{\sigma}$:

VTH TAS = 177 KIAS

29. Determine Flare Distance using figure 9-12:

Flare Distance = 2310 feet

30. Determine the Equivalent RCR for One Wheel Brake Inoperative from figure 9-13.

Equivalent RCR = 9.3

31. Determine Stopping Distance Ratio using figure 9-14:

SDR = 1.74

32. Determine Landing Ground Roll using figure 9-15:

Landing Ground Roll = 5600 feet

33. Compute Landing Distance by adding Flare Distance and Landing Ground Roll together.

Landing Distance = 7910 feet

Example 4 (VMCG Limited Reduced Thrust Takeoff)

Given:

Gross Weight = 305,000 lbs

Center of Gravity = 23%

Outside Air Temperature = +5°C

Dew Point = ✓

Anti-ice Off

Pressure Altitude = +4025 feet

Wind Direction = 330°

Wind Velocity = 6 Knots

Runway Heading = 120°

Runway Available = 8500 feet (Runway Length = 8,800 feet)

RCR = 14

RSC = 0

Slope = 0.4% UP

Elevation = 3968 feet

Obstacle Height = ✓

Obstacle Distance = ✓

Air-conditioning On

Reverse Thrust

Find: Data required for completion of TOLD Card (VMCG Limited Reduced Thrust Takeoff)

Solution:

1. Determine wind components and check wind limitation using figure 3-6:

Runway wind component: Crosswind = 3 knots. Tailwind component = 5 knots.

Calculated Tailwind = 7.5 knots.

2. Departure Planning. Use departure planning procedures to determine if takeoff is limited by obstacle clearance or crossing height restrictions.

Departure obstacles or crossing height restrictions are not a factor.

3. Determine Climb Gradient. Obstacle clearance is not a factor, the minimum climb gradient of 2.5% will be used.

4. CFCC = ✓ (Not Applicable)

5. Determine EFL, RALW, CGLW, MTOGW, and Optimum Flap Setting using figure 3-9B (RCR 17-12/With Reverse Thrust). CGLW will be computed using a climb gradient of 2.5%.

EFL = 7550 feet

RALW = 406,000 lbs

CGLW = 508,000 lbs

MTOGW = 453,000 lbs

Optimum Flap Setting = 25°

6. A Reduced Thrust takeoff can be accomplished since the computed MTOGW of 453,000 lbs is greater than required mission gross weight of 305,000 lbs.

TOGW = 305,000 lbs

7. Determine the assumed temperature from figure 3-9B (Sheet 3) by entering the chart where MTOGW and the optimum flap setting occur, read down to TOGW while maintaining the optimum flap setting. From this intersection, parallel the RALW and CGLW values. Assumed temperature is determined from both RALW and CGLW temperature grids.

RALW Assumed Temperature = 57°C

CGLW Assumed Temperature = 57°C

8. Determine TSLW at the assumed temperature from figure 3-10:

TSLW = ✓

9. Compare TOGW to the TSLW. Use the lower value as the TOGW:

TOGW = 305,000 lbs

10. Determine VMCG at the assumed temperature from figure 3-11:

VMCG = 103 KIAS

11. Determine VCEF at the assumed temperature from figure 3-12B (RCR 17-12/With Reverse Thrust)

VCEF = 96 KIAS

12. Determine VMBE at the assumed temperature from figure 3-13:

VMBE = 168 KIAS

13. Set V1 equal to the higher of VCEF and VMCG, not to exceed VMBE:

V1 = 103 KIAS

14. Compare V1 to VCEF, VMCG, and VMBE. V1 is set by VMCG, therefore, the assumed temperature must be checked.

15. Determine the Maximum Allowable Weight at the assumed temperature of 57°C using figure 3-14B (RCR 17-12/With Reverse Thrust):

MAW = 520,000 lbs

Compare MAW (520,000 lbs) with TOGW. If the TOGW is greater than the MAW, maximum takeoff thrust must be used.

MAW > TOGW (305,000 lbs)

Therefore, the assumed temperature is 57°C.

16. Determine VR at the assumed temperature from figure 3-15:

VR = 117 KIAS

17. Determine VR MIN (VMCG uncorrected for RCR) at the assumed temperature from figure 3-11:

VR MIN = 113 KIAS

18. Compare VR to VR MIN. Use the higher value as VR:

VR = 117 KIAS

19. Determine V2 at the assumed temperature from figure 3-16. If VR was increased to equal VR MIN, increase the corrected V2 speed by the same amount.

V2 = 127 KIAS

20. Determine VFR, VSR and VMM from figure 3-17:

VFR = 150 KIAS

VSR = 184 KIAS

VMM = 210 KIAS

21. Determine Stabilizer Setting from figure 3-18:

STAB = 4.7 Units

22. Determine the Pressure Height for Acceleration at the actual temperature from figure 3-19:

Pressure Height for Acceleration = 1520 feet

23. Determine the Reduced Thrust Takeoff N1 setting from figure 3-21 or 2-7:

Reduced Thrust Takeoff N1 = 98.7%

24. Compute emergency return data:

Landing weight = 305,000 lbs

25. Determine Minimum Maneuver speeds (VMM) using figure 9-3B:

VMM 0°/RET = 210 KIAS

VMM 0°/EXT 181 KIAS

VMM 22°/EXT 148 KIAS

26. Determine Threshold speed from figure 9-7 (Note: figure 9-3B tabular threshold speeds are only valid for pressure altitudes up to 2,000 feet.):

VTH (35/ext) = 132 KIAS

27. Determine $1/\sqrt{\sigma}$ using figure 1-3:

$1/\sqrt{\sigma}$ = 1.0575

28. Determine Approximate Threshold TAS by multiplying Threshold IAS by $1/\sqrt{\sigma}$:

VTH TAS = 140 KIAS

29. Determine Flare Distance using figure 9-12:

Flare Distance = 1840 feet

30. Determine Stopping Distance Ratio using figure 9-14:

SDR = 1.37

31. Determine Landing Ground Roll using figure 9-15:

Landing Ground Roll = 3400 feet

32. Compute Landing Distance by adding Flare Distance and Landing Ground Roll together.

Landing Distance = 5240 feet

Example 5 (VMCG Limited)

Given:

Gross Weight = Determine MTOGW

Center of Gravity = 23%

Outside Air Temperature = +3°C

Dew Point = +1°C

Anti-ice On

Pressure Altitude = +500 feet

Wind Direction = 330°

Wind Velocity = 5 Knots

Runway Heading = 040°

Runway Available = 10,500 feet (Runway Length = 10,800 feet)

RCR = 6

RSC = 0

Slope = 0.3% DN

Elevation = 536 feet

Obstacle Height = ✓

Obstacle Distance = ✓

Air-conditioning Off

Reverse Thrust

Find: Maximum Allowable Takeoff Gross Weight (VMCG Limited)

Solution:

1. Determine wind components and check wind limitation using figure 3-6:

Runway wind component: Crosswind = 5 knots.

Headwind = Component -2 knots/ Calculated -1 knot.

Rolling takeoff required due to crosswind limitations.

2. Departure Planning. Use departure planning procedures to determine if takeoff is limited by obstacle clearance or crossing height restrictions.

Departure obstacles or crossing height restrictions are not a factor.

3. Determine Climb Gradient. Obstacle clearance is not a factor, the minimum climb gradient of 2.5% will be used (Required for flight).

4. CFCC = ✓ (Not Applicable)

5. Determine EFL, RALW, CGLW, MTOGW, and Optimum Flap Setting using figure 3-9D (RCR 7-3/With Reverse Thrust). CGLW will be computed using a climb gradient of 2.5%.

EFL = 11,150 feet

RALW = 525,000 lbs

CGLW = 565,000 lbs

MTOGW = 576,500 lbs

Optimum Flap Setting = 21.5°

Determine TSLW from figure 3-10:

TSLW = ✓

6. Compare TOGW to the TSLW. Use the lower value as the TOGW:

TOGW = 576,500 lbs

7. Determine VMCG from figure 3-11:

VMCG = 132 KIAS

8. Determine VCEF from figure 3-12D (RCR 7-3/With Reverse Thrust):

VCEF = 127 KIAS

10. Determine VMBE from figure 3-13:

VMBE = 184 KIAS

11. Set v1 equal to the higher of VCEF and VMCG, not to exceed VMBE:

V1 = 132 KIAS

12. Compare V1 to VCEF, VMCG, and VMBE. V1 is set by VMCG, therefore, the Maximum Allowable Weight When V1 = VMCG must be determined.

13. Determine the Maximum Allowable Weight using figure 3-14D (RCR 7-3/With Reverse Thrust)

MAW = 490,000 lbs

Set TOGW to equal MAW.

14. Determine VR from figure 3-15:

VR = 152 KIAS

15. Determine VR MIN from figure 3-11 (VMCG uncorrected for RCR)

VR MIN = 132 KIAS

16. Compare VR to VR MIN. Use the higher value as VR:

VR = 152 KIAS

17. Determine V2 at the assumed temperature from figure 3-16. If VR was increased to equal VR MIN, increase the corrected V2 speed by the same amount.

V2 = 166 KIAS

18. Determine VFR, VSR and VMM from figure 3-17:

VFR = 190 KIAS

VSR = 233 KIAS

VMM = 266 KIAS

19. Determine Stabilizer Setting from figure 3-18:

STAB = 4.5 Units

20. Determine the Pressure Height for Acceleration at the actual temperature from figure 3-19:

Pressure Height for Acceleration 1570 feet

21. Determine the Takeoff N1 setting from figure 3-20 or 2-1:

Takeoff N1 = 110.6 %

22. Compute emergency return data:

Landing weight = 490,000 lbs

23. Determine Minimum Maneuver speeds (VMM) and Threshold Speed (VTH) using figure 9-3B:

VMM 0°/RET = 266 KIAS

VMM 0°/EXT = 229 KIAS

VMM 22°/EXT = 188 KIAS

VTH (35°/EXT) = 167 KIAS

24. Determine $1/\sqrt{\sigma}$ using figure 1-3:

$1/\sqrt{\sigma}$ = 0.9875

25. Determine Approximate Threshold TAS by multiplying Threshold IAS by $1/\sqrt{\sigma}$:

VTH TAS = 165 KIAS

26. Determine Flare Distance using figure 9-12:

Flare Distance = 2200 feet

27. Determine Stopping Distance Ratio using figure 9-14:

SDR = 2.38

28. Determine Landing Ground Roll using figure 9-15:

Landing Ground Roll = 7650 feet

29. Compute Landing Distance by adding Flare Distance and Landing Ground Roll together.

Landing Distance = 9850 feet

Example 5A (Establishing a 152 ft/nm gradient in the absence of any obstacle or gradient information.)

Given:

Runway Length = 10,000 feet

Lineup Distance = 300 feet

Wind = Zero

No published minimum climb gradient

No obstacles listed

Find:

Gross Climb Gradient Required

Runway Reduction

Runway Available

Solution:

1. Assume gradient will be required to a height above the Pressure Height for Acceleration and calculate distance required to climb to 1505 AGL at 152 feet/nm.

2. Enter bottom chart of figure 3-6B sheet 1 with 152 ft/nm climb restriction and move down to ≥1505 row. Read 4.67% gross climb gradient and 571 foot runway reduction.

3. Runway available will be runway length minus lineup distance minus runway reduction. RA = 10,000 - 300 - 571 = 9129 feet

Example 5B Using the airfield required screen height and/or published obstacles with minimum climb gradient.

Given:

Runway Length = 8000 feet

Lineup Distance = 300 feet

Wind = Zero

Maintain 400 feet/nm climb to 900' AGL

Screen height = 35 feet

Published IFR Departure identifies the following

TAKEOFF OBSTACLES:

Obstacle #1: 156' AGL at 4916 feet distance

Obstacle #2: 141' AGL at 4871 feet distance

Obstacle #3: 108' AGL at 4400 feet distance

Find:

Gross Climb Gradient Required

Runway Reduction

Runway Available

Solution:

Low, close-in obstacles that are identified in Published IFR Departure procedures ("Trouble-T's") are not considered when the minimum climb gradient is established for a given runway. As a result, the figure 3-7 gross climb gradient required to clear these obstacles must be compared to the figure 3-7 gross climb gradient required to meet the published minimum climb gradient established for the departure procedure. The most restrictive gross climb gradient must be used as the basis for TOLD.

1. Compute gross climb gradients for identified obstacles.

Obstacle #1 = 156' AGL at 4916 feet = 4.5% gross climb gradient

Obstacle #2 = 141' AGL at 4871 feet = 4.1% gross climb gradient

Obstacle #3 = 108' AGL at 4400 feet = 3.8% gross climb gradient

Obstacle #1 is the most restrictive and must be compared to the gross climb gradient that is derived from the published minimum climb gradient.

2. Compute gross climb gradient for the published minimum climb gradient.

3. Climb restriction is to 900 feet AGL, which is below Pressure Height for Acceleration.

4. Enter sheet 2 of figure 3-6B with a climb restriction of 400 ft/nm and move down to the row corresponding to 900 ft AGL end of restriction height. Read 6.77% required gross climb gradient 1388 foot runway reduction.

5. Compare gross climb gradient based on Obstacle #1 to gross climb gradient based on 400 feet/nm climb gradient.

Obstacle-based gradient of 4.5% is less than climb-based gradient of 6.77%, use 6.77% gross climb gradient as the basis for TOLD.

6. Enter sheet 3 of figure 3-7 with a screen height of 35 feet and a gross climb gradient of 6.77%. A runway reduction of 1400 feet is read from the obstacle distance axis after making the most limiting flap correction. Runway available will be RA minus lineup distance minus runway reduction.

RA = 8000 - 300 - 1400 = 6300

If takeoff cannot be accomplished, consider reducing published climb gradient by up to 48 feet/nm if mission requirements dictate.

Example 5C (Determining the restriction height AGL from a published climb restriction and 48 feet/nm reduction in minimum climb gradient.)

Given:

Departure End of Runway Elevation = 1535 feet

MSL

Runway Length = 10,000 feet

Lineup Distance = 300 feet

Wind = Zero

Climb Restriction = 330 feet/nm to 6000 feet MSL

Find:

Gross Climb Gradient Required

Runway Reduction

Runway Available

Solution:

1. Determine restriction height (AGL) by subtracting departure end of runway elevation (MSL) from climb restriction (MSL).

Restriction height = 6000' - 1535' = 4465' AGL

2. Compare restriction height to Pressure Height for Acceleration (1505'). Since Restriction height is above Pressure Height for Acceleration, use chart on bottom of figure 3-6B (sheet 1) to determine gross climb gradient and runway reduction. Minimum climb restriction of 330 feet/nm exceeds the maximum value of 320 feet/nm. The 330 feet/nm gradient cannot be met with an engine inoperative.

3. Calculate new climb gradient requirement New Minimum Gradient = 330 feet/nm - 48 feet/nm = 282 feet/nm. Round up to 290 feet/nm to allow use of tabulated data.

4. Enter bottom chart on sheet 1 of figure 3-6B with 290 foot/nm climb restriction and move down to ≥1505 row. Read 8.15% gross climb gradient and 562 foot runway reduction.

5. Runway available will be runway length minus lineup distance minus runway reduction. RA = 10,000 - 300 - 562 = 9138 feet

Example 6 (Landing with Hydraulic Systems 1 and 2 inoperative):

Given:

Gross Weight = 280,000 lbs

Outside Air Temperature = +20°C

Pressure Altitude = Sea Level

Wind Direction Calm

Wind Velocity = ✓

Runway Heading = 040°

Runway Length = 13,500 feet

RCR = 23

Slope = 0

Flaps/Slats = 0°/RET

Air-conditioning On

Anti-ice Off

Find: Landing distance and speeds with Hydraulic Systems 1 and 2 inoperative.

Solution:

1. Determine $1/\sqrt{\sigma}$ using figure 1-3:

$1/\sqrt{\sigma}$ = 1.008

2. Determine GA N1 setting using figure 9-1 (if thrust rating computer is inoperative) :

GA N1 = 110.6 %

3. Determine wind components and check wind limitation using figure 9-3:

Runway wind component = ✓ (Winds calm)

4. Determine Threshold speed using figure 9-4:

VTH = 181 KIAS

5. Determine Approximate Threshold TAS by multiplying Threshold IAS by $1/\sqrt{\sigma}$:

VTH TAS = 183 KIAS

6. Determine Touchdown speed from figure 9-10:

VTD = 180 Knots Ground Speed

7. Compare VTD Ground Speed to Tire Limit speed of 204 knots Ground Speed:

Tire Limit Speed > VTD (VTD not limiting)

8. Determine VMB from figure 9-11:

VMB > 260 Knots Ground Speed

9. Compare VMB to VTD:

VMB > VTD (Maximum Braking Speed is not limiting)

10. Determine Flare Distance for 50°/EXT using figure 9-12:

Flare Distance = 1555 feet

11. Equivalent RCR ✓ (not applicable)

12. SDR = ✓ (not applicable)

13. Determine Landing Ground Roll for 50°/EXT using figure 9-15:

Landing Ground Roll = 1750 feet

14. Determine Corrected Flare Distance for abnormal flap/slat configuration of 0°/RET using figure 9-16:

Corrected Flare Distance = 2420 feet

15. Determine Landing Ground Roll Multiplier for 0°/RET using figure 9-18:

Landing Ground Roll Multiplier = 2.3

16. Multiply the 50°/EXT Landing Ground Roll determined in step 13 by the Landing Ground Roll Multiplier determined in step 15:

Corrected Landing Ground Roll 4025 feet

17. Determine Landing Distance by adding the Corrected Flare Distance from step 14 to the Corrected Landing Ground Roll in step 16:

Landing Distance = 6445 feet

18. Determine Minimum Maneuver speed for 0°/RET using TO 1C-10(K)A-1CL-1:

VMM 0°/RET = 201 KIAS

FLIGHT PLANNING

The flight planning charts present the time and fuel values required to takeoff, climb, and cruise. The charts are presented in terms of ground distance versus landing weight (zero fuel weight plus landing fuel), with a wind correction on the ground distance. The three engine takeoff allowances and climb data used to construct the flightplanning charts are presented in Section IV; the cruise data are presented in Section V.

Flight planning charts are presented for 31,000/35,000/39,000 feet step cruise operation at the long range cruise speed, Mach 0.82 and Mach 0.83 in figures 10-6 through 10-8, respectively.

Data for constant altitude cruise at Mach 0.82 are presented for cruise altitudes of 31,000 feet, 33,000 feet, and 35,000 feet in figures 10-9 through 10-11, respectively.

Example 8:

Given:

Speed = Long Range Cruise

Temperature = Std +10°C

Headwind = 25 Knots

Ground Distance = 3,200 NM

Landing Weight = 280,000 Pounds

Number of Engines Operating = 3

Find:

Time and Fuel for a 31,000/35,000/39,000 Feet Step Cruise

Solution:

Enter sheet 1 of figure 10-6 with the headwind of 25 knots and read up to the 3,200 nautical mile ground distance. Read across to 280,000 pounds landing weight and read the standard day values of time and fuel:

Time = 7:16 Hours: Minutes
Fuel = 105,900 Pounds

Subtract 7 minutes to adjust the time for Std +10°C temperature. The final values for time and fuel are as follows:

Time = 7:09 Hours: Minutes
Fuel = 105,900 Pounds

ADDITIONAL FUEL REQUIRED - CLIMB VS CRUISE

Figure 10-12 gives the additional fuel required to climb from sea level to altitude instead of cruising the same distance at the specified altitude. The climb fuel is based on the three engine climb schedule and includes allowances for takeoff and climbout to 2,000 feet above the airfield (refer to Section IV). The cruise is based on flying at the long range cruise speed with zero wind, standard day conditions. Various altitudes, from sea level to 42,000 feet, including the optimum altitude, are presented.

Figure 10-12 is useful when planning a mission in reverse to find the required takeoff gross weight. If figure 10-12 is used, the cruise may be assumed to start directly over the takeoff point, at cruise altitude. The fuel quantity from figure 10-12 is then added to the initial gross weight (at cruise altitude) to determine the actual takeoff gross weight.

Example 9:

Given:

Pressure Altitude = 20,000 Feet

Gross Weight = 370,000 Pounds

Number of Engines Operating = 3

Find:

Additional Fuel Required to Climb Instead of Cruise at Altitude

Solution:

Enter figure 10-12 with the gross weight of 370,000 pounds and read up to the 20,000 feet pressure altitude line. The additional fuel required to climb instead of cruising at altitude is 4,900 pounds.

RESERVE FUEL VS CRUISE TIME

The reserve fuel data provided in figure 10-13 are based on the fuel required for a long range step cruise for 10 percent of the cruise time or 20 minutes of maximum endurance flight at sea level, whichever is greater. Data are presented for several landing weights. Figure 10-13 is useful for reserve fuel planning purposes.

Example 10:

Given:

Cruise Time = 6 Hours

Landing Weight = 320,000 Pounds

Find:

Reserve Fuel

Solution:

Using figure 10-13, the reserve fuel is found by entering the chart with a cruise time of 6 hours and reading up to the 320,000 landing weight line. The reserve fuel value is 8,000 pounds.

TIME AND FUEL TO ALTERNATE - OPTIMUM ALTITUDE

Figure 10-14 presents the time and fuel required to reach an alternate destination. The time, fuel, and optimum altitude values are presented versus ground distance for several initial diversion weights. The time and fuel values are only applicable for zero wind, standard day conditions. The fuel values include an allowance for 15 minutes maximum endurance at sea level. The flight profile includes a climb from sea level, long range cruise at the optimum altitude, and enroute descent to sea level. For very short alternate distances, the optimum cruise altitude may never be reached, in which case the flight profile will consist of a climb and descent only.

Example 11:

Given:

Ground Distance = 300 NM

Initial Gross Weight = 400,000 Pounds

Find:

Time and Fuel to Alternate

Optimum Cruise Altitude

Solution:

Enter figure 10-14 with 300 nautical miles. Read up to the 400,000 pound gross weight line to find the required fuel is 17,000 pounds. The time is not a function of weight and has a value of 47.5 minutes. The optimum cruise altitude is found to be 36,000 feet.

TIME AND FUEL TO ALTERNATE - CONSTANT ALTITUDE

Figure 10-15 presents the time and fuel values required to reach an alternate destination. The time and fuel values are presented in terms of ground distance versus altitude for a landing weight of 300,000 pounds, with a wind correction on the ground distance. Provisions for other landing weights are made by means of a correction grid giving the fuel correction values for each 10,000 pound increase in landing weight above 300,000 pounds. The flight profile used includes a climb from 2,000 feet, constant altitude cruise, and enroute descent to sea level. The cruise speeds used are 310 KIAS up to 31,000 feet, and Mach 0. 82 for higher altitudes. The fuel values include an allowance for 15 minutes maximum endurance at sea level.

Example 12:

Given:

Cruise Altitude = 14,000 Feet

Temperature = Std Day

Headwind = 50 Knots

Ground Distance = 475 NM

Landing Weight = 420,000 Pounds

Find:

Time and Fuel to Alternate

Solution:

Enter sheet 1 of figure 10-15 with the 50-knot headwind component. Read up to the ground distance of

475 NM and read over to the 14,000 feet data column. The time and fuel values from the table are as follows:

Time = 1:31 Hours:Minutes
Fuel = 27,900 Pounds

The fuel value must be corrected for landing weight. Along the right side of the chart a fuel correction per 10,000 pounds landing weight above 300,000 pounds is provided. The value for this problem is 400 pounds. Therefore, the total correction is 4,800 pounds, which is added to the value obtained from the figure.

The time and fuel to alternate values are shown below:

Time = 1:31 Hours:Minutes
Fuel = 32,700 Pounds

RUNWAY WEIGHT BEARING CAPACITY CLASSIFICATION NUMBERS

Figure 10-16 presents data for various runway strength classification-number systems. Data are provided for all classification-number systems since each system is still used in some places throughout the world. Usage of the classification number systems requires that the strength of the runway has been evaluated and assigned a classification number since this number is compared to a corresponding classification number determined for the airplane. The runway strength is sufficient to allow takeoff if the classification number for the runway is larger than the classification number for the airplane.

To use figure 10-16 to determine the runway strength classification number for the KC-10A, enter the chart with the airplane gross weight, read up to the data line for the classification-number system coresponding to the runway data and read the classification number on the vertical scale. The chart may also be used to determine the maximum allowable gross weight by entering with the classification number for the runway, reading over to the appropriate data line and determining the gross weight on the bottom axis.

Given:

ACN/PCN Rigid Classification Number for Airfield = 52

Find:

Maximum Allowable Takeoff Weight (Without Overload)

Solution:

Enter figure 10-16 with the classification number of 52. Read across to the ACN/PCN Rigid data line. Read down to the gross weight scale and the maximum allowable takeoff weight (without overload) is 533,000 pounds.

RUNWAY WEIGHT BEARING CAPACITY WHEEL CONFIGURATION RATINGS

Figure 10-17 presents runway strength data based on wheel configuration ratings. This type of presentation is used as an alternative to the classification-number systems. The chart is plotted with data for various wheel configuration ratings presented versus gross weight and the twin tandem (TT) wheel configuration rating.

If a TT rating is provided for the runway, the allowable KC-10A gross weight is found by entering the chart with the TT rating, reading across to the KC-10A wheel configuration rating (SBTT) and reading the allowable gross weight value along the bottom axis.

If a rating other than the TT rating is provided, the following procedure is used to find the allowable KC-10A gross weight. Enter the chart with the gross weight allowed by the given wheel configuration rating. Read up to the line corresponding to the given rating and read horizontally over to the SBTT rating line. Read down to the gross weight scale to determine the allowable gross weight.

Example 14:

Given:

Twin Tandem (TT) Wheel Rating 278,000 Pounds

Single (S) Wheel Rating = 100,000 Pounds

Find:

Maximum Allowable Takeoff Weight (Without Overload)

Solution:

With the given information, figure 10-17 may be used in two ways to determine the maximum allowable takeoff weight, by using either the Single (S) Wheel Rating or the Twin Tandem (TT) Wheel Rating. For actual operation, the higher rating (i.e., the TT rating, for this case) should be used if more than one rating is provided. For this problem, both methods will be explained to clarify the usage of the chart.

Using the TT rating, enter the TT scale at 278,000 pounds and read over to the SBTT rating line.

Read down to the bottom scale and determine the maximum allowable takeoff weight as 480,000 pounds.

Using the S rating, enter the gross weight scale at 100,000 pounds. Read up to the S rating line. Read across to the SBTT line, then down to find the gross weight value of 480,000 pounds along the bottom scale.

RUNWAY WEIGHT BEARING CAPACITY OVERLOAD OPERATION

In the event that the previous runway strength data has shown that operation at the desired gross weight is not allowed, the use of the following overload data may allow the mission to be performed at the desired weight.

Overload operation results in a decrease in the runway life, although if overloading is used in a limited manner the decrease in runway life may be very small. In figure 10-18, the effect of overload operation on runway life is shown based on the overload factor, which is the ratio of the actual gross weight to the maximum design gross weight for the runway, and the percentage of overload operation, which is the ratio of the number of equivalent overload flights to the total number of equivalent flights for which the runway was designed.

To use figure 10-18, it is first required to determine the percentage of overload operation. It may be necessary to consult with airport authorities to have the correct percentage of overload operation calculated, but an approximate value may be determined using the table included at the top of figure 10-18. Next, the overload factor must be calculated and a check made using figure 10-18 to ensure that the overload factor does not exceed the maximum allowable overload factor for the strength of the runway. Once these parameters are known, enter the chart with the overload factor and read up to the line representing the appropriate percentage of overload operation. The percentage of design runway life may be read on the vertical scale.

Example 15:

Given:

Overload Operation = 1,000 Flights on a Medium Strength Runway

Overload Factor = 1.25

Find:

Percentage of Runway Design Life

Solution:

Using the table at the top of figure 10-18, determine that 1,000 flights on a medium strength runway is approximately a 1 percent overload operation. Using figure 10-18, enter the overload factor scale at 1.25 and read up to the 1 percent overload operation line. The percentage of runway design life is read on the vertical scale as 91 percent. This means that, due to overload operation, the runway life will only be 91 percent of the design runway life.

KC-10A WEIGHT - CG

The KC-10A weight-center of gravity (CG) chart is presented in figure 10-20 and is to be used with fuel overlay sheets to determine the airplane gross weight and CG location.

NOTE

- Be very careful to align the overlays with the vertical lines of the chart using the dashed lines provided on the overlays.
- During all missions, inflight CG must be monitored as fuel is burned, offloaded or onloaded.
- The procedure presented for the use of this chart is only one of many possible combinations (e.g., fuel can be loaded and/or offloaded on the chart in any combination of tanks and in any order).

Instructions for use of figure 10-20 are as follows:

1. Place the apex of the main tank fuel overlay over the point on the chart representing the zero fuel weight and CG previously obtained from the boom operator.

2. Find the point on the main tank fuel overlay corresponding to the main tank fuel load. This point on the chart under the overlay corresponds to the airplane gross weight and CG including the main tank fuel.

3. When fuel is present in the center wing tank, place the apex of its fuel overlay over the point corresponding to the main tank fuel load.

4. Find the point on the center wing tank fuel overlay corresponding to the center wing tank fuel load. This point on the chart under the overlay corresponds to the airplane gross weight and CG including main tank and center wing tank fuel.

5. When fuel is present in the forward or aft fuselage tanks, place the apex of the forward and aft fuselage tank fuel overlay over the point corresponding to the center wing tank fuel load.

6. Find the point on the forward and aft fuselage tank fuel overlay corresponding to the forward and aft fuselage tank fuel load. This point on the chart under the overlay corresponds to the airplane ramp gross weight and CC, and can readily be determined from the chart.

KC-10 TOLD CARD WORKSHEET

TAKEOFF CONDITIONS

GW 520.0	CG 26	OAT +20	DEW POINT ✓	ANTI-ICE ON ☐ OFF ☑
PA +2050	WIND DIR CALM	VEL ✓	RWY HDG 190	RWY AVAIL 10,200
RCR 23	RSC ✓	SLOPE 0.8DN	ELEV 2021	OBST HT 2039(MSL)
OBST DIST 3200	AC ON ☐ OFF ☑	REVERSE THRUST YES ☑ NO ☐		

TAKEOFF COMPUTATIONS

X-WIND ✓	COMP ✓	CALC ✓	CL GR 4.05	CFCC ✓
EFL 10,250	5 RALW 500.0	25 CGLW 493.0	MTOGW 532.0	FLAP 15.2

ASSUMED RALW/TEMP ✓	ASSUMED CGLW/TEMP ✓	ASSUMED TEMP ✓

TSLW ✓	VMCG 121	VCEF 146	VMBE 180	MAW ✓
VR 166	VRMIN 131	V2 174	MAX ALLOWABLE BRAKE TEMP	BRAKE ZONE

LANDING CONDITIONS

GW	OAT	PA	WIND DIR
VEL	RWY HDG	RL	RCR
SLOPE	FLAPS/SLATS		

LANDING COMPUTATION (*_Abnormal configuration_)

$1/\sqrt{\sigma}$ 1.047	GA N1	X-WIND	COMP
CALC	VTH 173	VTH TAS 181	*VTD ✓
*VMB ✓	FLARE DIST 2330	*EQUIV RCR ✓	SDR ✓
LDG GROUND ROLL 3950'	* CORRECTED FLARE DIST ✓	* CORRECTED LDG ROLL ✓	LDG DIST 6280

AF FORM 4089, 19990701 ***(EF-V2)***

Figure 10-3.

OBSTACLE CLEARANCE WORKSHEET

CG	OAT	CONDITIONS		PA	ANTI-ICE
26	+20			+2050	ON ☐ OFF ☑
AC	**WIND DIR**	**VEL**	**RWY HDG**	**RWY AVAIL**	**RCR CFCC**
ON ☐ OFF ☑	CALM	✓	190	10,200	23
RSC	**SLOPE**	**ELEV**	**① OBST HT (AGL)**	**OBS DIST**	**REVERSE THRUST**
✓	0.8DN	2021	99	3200	YES ☑ NO ☐

SIMPLIFIED SOLUTION

② DOWNHILL SLOPE CORRECTION	CORRECTED OBS HT *(OBST HT + DOWNHILL SLOPE)*	CLIMB GRADIENT REQUIRED	EFL
20	119	6.0	11,275
RALW	**CGLW**	**③ MTOGW**	**FLAPS**
524.0	437.0	481.0	6.0

OPTIMIZED SOLUTION

④ RWY REDUCTION	NEW RWY AVAIL	ORIGINAL OBST PLUS DIST RWY REDUCTION	RWY SLOPE CORRECTIONS ① ORIGINAL + OBST HT-	⑤ SLOPE + CORR -	② DOWNHILL SLOPE CORR	CORRECTED OBST HT	CLIMB GRAD REQUIRED	EFL	RALW	CGLW	MTOGW	FLAPS
500	9700	3700	99	-4	20	115	4.9	10700	510.0	466.0	514.0	6.4
500	9200	4200	99	-8	19	110	4.05	10250	500.0	493.0	532.0	15.2

NOTES

① OBST HT (AGL) = OBST HT (MSL) - lift-off end of RWY elev. If elevation for lift-off end RWY is not known, use the following formulae to determine OBST HT (AGL):

a. If RWY has uphill slope or no slope, OBST HT (AGL) = OBST HT (MSL) minus field elevation.

b. If RWY has downhill slope, OBST HT (AGL) = OBST HT (MSL) - $\left(\text{field elevation} - \frac{\text{RWY length X \% slope}}{100}\right)$

② Use the downhill slope correction as noted on the applicable climbout flight path chart.

③ If MTOGW is less than required mission gross weight, continue with optimized solution. This procedure may result in a higher MTOGW.

④ RWY reduction: It is recommended that approximately 200 feet RWY reductions be used for obstacle distances up to 2,000 feet and 500 feet RWY reductions for obstacle distances beyond 2,000 feet.

⑤ OBST HT adjustment for RWY slope (liftoff point of RWY) $\frac{\text{RWY reductions X \% slope}}{100}$ Obstacle Ht Corrections *(Plus for uphill)* *(Minus for downhill)*

AF FORM 4089, 19990701 *(REVERSE) (EF-V2)*

Figure 10-4.

KC-10 TOLD CARD

TAKEOFF		LANDING	
GW 520.0	FLAPS 15.2	GW ✓	
N1 114.1	ASSUMED TEMP ✓	LDG DIST 6280'	RCR ✓
V_1	146	MIN MANEUVER 0 ° / RET	274
V_R	166	MIN MANEUVER 0 ° / EXT	236
V_2	174	MIN MANEUVER 22 ° / EXT	195
V_{FR}	195	V_{APP} ° /	173
V_{SR}	240	V_{APP} TAS	181
0°/RET V_{MM}	274	REMARKS	
STAB	3.4		
ACCEL HT	1460AGL		

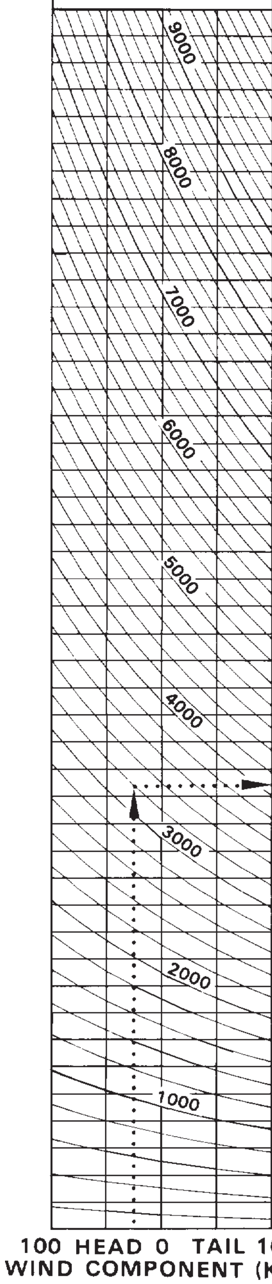
Figure 10-5.

FLIGHT PLANNING - LONG RANGE STEP CRUISE

NOTE:

1. THREE ENGINE OPERATION
2. 31,000/35,000/39,000 FT STEP CRUISE
3. FLIGHT TIMES ARE BASED ON CLIMB AND CRUISE AT STANDARD DAY. FOR NON-STANDARD CONDITIONS, ADD ONE MIN/HR PER 10°C BELOW STD. SUBTRACT ONE MIN/HR PER 10°C ABOVE STD
4. FUEL, DISTANCE, AND TIME VALUES INCLUDE TAKEOFF ALLOWANCES OF 2500 LB, 8 NM, AND 3 MIN FOR TAKEOFF OPERATION UP TO 2000 FT PRESSURE ALTITUDE

GROUND DISTANCE (NM)



LANDING WT 260,000 LB TIME HR:MIN	LANDING WT 260,000 LB FUEL 1000 LB	LANDING WT 280,000 LB TIME HR:MIN	LANDING WT 280,000 LB FUEL 1000 LB	LANDING WT 300,000 LB TIME HR:MIN	LANDING WT 300,000 LB FUEL 1000 LB	LANDING WT 320,000 LB TIME HR:MIN	LANDING WT 320,000 LB FUEL 1000 LB	LANDING WT 340,000 LB TIME HR:MIN	LANDING WT 340,000 LB FUEL 1000 LB
19:01	324.7								
18:36	314.4								
18:11	304.4								
17:46	294.6								
17:21	285.0	17:17	304.9						
16:56	275.6	16:53	294.6						
16:31	266.4	16:28	284.6						
16:07	257.4	16:03	274.8						
15:42	248.5	15:38	265.2	15:35	283.1				
15:17	239.8	15:13	255.9	15:10	272.8				
14:52	231.2	14:48	246.6	14:46	262.8				
14:27	222.8	14.23	237.6	14:21	253.0	14:19	269.5		
14:02	214.4	13.58	228.7	13:56	243.5	13:54	259.2		
13:37	206.3	13:33	220.1	13:31	234.2	13:29	249.0		
13:12	198.5	13:09	211.4	13:06	225.0	13:04	239.2		
12:47	190.7	12:44	203.0	12:41	216.0	12:39	229.4	12:38	243.8
12:21	183.1	12:19	194.6	12:16	207.1	12:14	220.0	12:13	233.5
11:56	175.5	11:54	186.5	11:51	198.5	11:50	210.7	11:48	223.5
11:31	168.0	11:28	178.7	11:26	189.8	11:25	201.6	11:23	213.7
11:05	160.7	11:03	170.9	11:02	181.5	11:00	192.7	10:58	204.2
10:40	153.5	10:38	163.3	10.37	173.1	10.35	183.9	10:33	194.8
10:15	146.4	10:13	155.7	10:12	165.1	10:10	175.3	10:08	185.6
9:49	139.4	9:47	148.2	9:46	157.3	9:45	166.7	9:43	176.6
9:24	132.4	9:22	140.9	9:21	149.5	9:20	158.4	9:19	167.8
8:59	125.8	8:57	133.6	8:56	141.9	8:55	150.0	8:54	159.1
8:34	119.3	8:31	126.5	8:30	134.3	8:30	142.2	8:29	150.5
8:08	112.8	8:06	119.6	8:05	126.8	8:05	134.4	8:04	142.1
7:43	106.4	7:41	112.6	7:40	119.6	7:40	126.7	7:39	133.7
7:17	100.2	7:16	105.9	7:15	112.3	7:14	119.1	7:14	125.7
6:52	93.9	6:50	99.4	6:49	105.3	6:49	111.5	6:49	117.9
6:27	87.8	6:25	93.0	6:24	98.3	6:24	104.1	6:23	110.0
6:01	81.8	5:59	86.6	5:59	91.4	5:58	96.9	5:58	102.4
5:36	75.9	5:34	80.3	5:33	84.8	5:33	89.6	5:33	94.8
5:10	69.9	5:09	74.1	5:08	78.3	5:08	82.7	5:08	87.4
4:45	64.3	4:43	67.9	4:43	71.8	4:43	75.7	4:42	80.1
4:19	58.7	4:18	62.0	4:17	65.4	4:17	68.8	4:17	72.8
3:54	53.1	3:52	56.0	3:52	59.2	3:52	62.3	3:52	65.8
3:27	47.3	3:27	50.1	3:26	52.9	3:26	55.8	3:26	58.8
3:02	42.2	3:02	44.5	3:01	46.8	3:01	49.4	3:01	51.8
2:36	36.7	2:36	38.8	2:36	40.9	2:36	43.1	2:36	45.2
2:11	31.5	2:11	33.2	2:10	34.9	2:10	36.8	2:10	38.7
1:45	26.0	1:45	27.5	1:45	29.1	1:45	30.6	1:45	32.2
1:19	20.9	1:19	22.1	1:19	23.4	1:19	24.6	1:20	25.9
0:54	16.0	0:54	16.9	0:54	17.8	0:54	18.7	0:54	19.6
0:29	11.1	0:29	11.6	0:29	12.2	0:29	12.7	0:29	13.3

SA1C-259B

Figure 10-6. (Sheet 1)

FLIGHT PLANNING - LONG RANGE STEP CRUISE

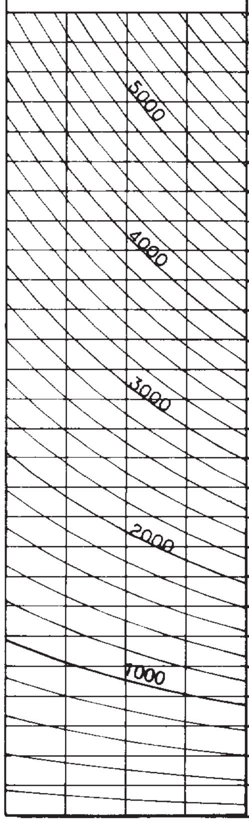
EXAMPLE:

GIVEN: SPEED LONG RANGE CRUISE SPEED
TEMP = STD + 10°C
HEADWIND = 25 KNOTS
GROUND DISTANCE = 3200 NM
LANDING WEIGHT = 280,000 LB
NUMBER OF ENGINES OPERATING = 3

FIND: TIME AND FUEL FOR A 31,000/35,000/39,000 FT STEP CRUISE

SOLUTION: TIME = 7:09 HOURS:MINUTES
FUEL = 105,900 POUNDS

GROUND DISTANCE (NM)



LANDING WT 360,000 LB		LANDING WT 380,000 LB		LANDING WT 400,000 LB		LANDING WT 420,000 LB		LANDING WT 440,000 LB	
TIME HR:MIN	FUEL 1000 LB	TIME HR:MIN	FUEL 1000 LB	TIME HR:MIN	FUEL 1000 LB	TIME HR:MIN	FUEL 1000 LB	TIME HR:MIN	FUEL 1000 LB
11:21	226.5								
10:56	216.2								
10:32	206.1								
10:07	196.3	10:05	207.1						
9:42	186.6	9:40	196.8						
9:17	177.2	9:16	186.7						
8:52	168.0	8:51	176.9	8:50	186.4				
8:27	159.0	8:26	167.2	8:25	176.1				
8:02	150.0	8:01	157.8	8:00	166.0				
7:37	141.3	7:36	148.5	7:35	156.2	7:34	164.3		
7:12	132.7	7:11	139.6	7:10	146.5	7:09	154.1		
6:48	124.2	6.46	130.6	6:45	137.2	6:44	144.1		
6:23	115.9	6:21	121.9	6:20	127.9	6:19	134.2	6:18	141.0
5:58	107.7	5:56	113.2	5:55	118.9	5:54	124.7	5:53	130.7
5:32	99.9	5:32	104.8	5:31	109.9	5:29	115.3	5:28	120.8
5:07	92.1	5:07	96.4	5:06	101.3	5:05	106.1	5:04	111.0
4:42	84.4	4:42	88.2	4:41	92.6	4:40	97.1	4:39	101.6
4:17	76.8	4:16	80.4	4:16	84.2	4:15	88.2	4:14	92.2
3:51	69.2	3:51	72.6	3:51	75.8	3:50	79.6	3:49	83.2
3:26	62.0	3:26	64.9	3:26	67.6	3:25	70.9	3:24	74.2
3:01	54.7	3:01	57.3	3:01	59.8	3:00	62.5	2:59	65.4
2:35	47.6	2:35	49.7	2:35	52.0	2:35	54.2	2:34	56.7
2:10	40.6	2:10	42.4	2:10	44.3	2:10	46.1	2:09	48.1
1:45	33.7	1:45	35.2	1:45	36.7	1:45	38.3	1:44	39.8
1:20	26.9	1:19	28.0	1:20	29.2	1:20	30.5	1:20	31.4
0:54	20.4	0:54	21.0	0:54	21.9	0:54	22.8	0:54	23.5
0:29	13.9	0:29	14.1	0:29	14.6	0:29	15.2	0:29	15.7

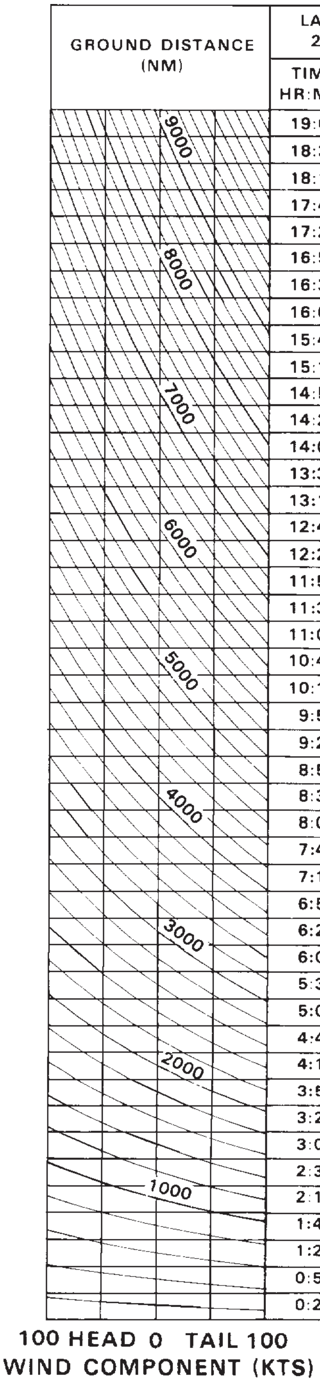
SA1C-260B

Figure 10-6. (Sheet 2)

FLIGHT PLANNING - MACH 0.82 STEP CRUISE

NOTE:

1. THREE ENGINE OPERATION
2. 31,000/35,000/39,000 FT STEP CRUISE
3. FLIGHT TIMES ARE BASED ON CLIMB AND CRUISE AT STANDARD DAY. FOR NON-STANDARD CONDITIONS, ADD ONE MIN/HR PER 10°C BELOW STD. SUBTRACT ONE MIN/HR PER 10°C ABOVE STD
4. FUEL, DISTANCE, AND TIME VALUES INCLUDE TAKEOFF ALLOWANCES OF 2500 LB, 8 NM, AND 3 MIN FOR TAKEOFF OPERATION UP TO 2000 FT PRESSURE ALTITUDE

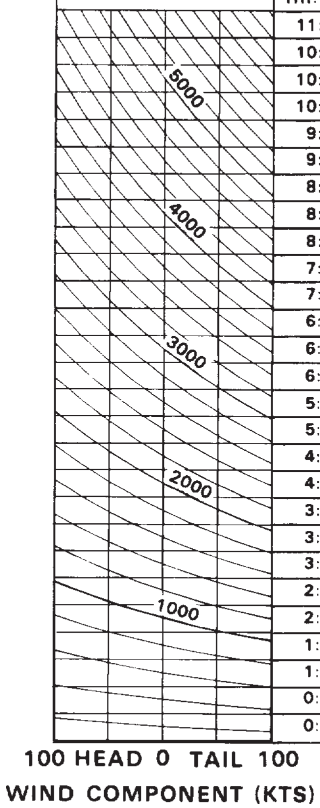


LANDING WT 260,000 LB		LANDING WT 280,000 LB		LANDING WT 300,000 LB		LANDING WT 320,000 LB		LANDING WT 340,000 LB	
TIME HR:MIN	FUEL 1000 LB	TIME HR:MIN	FUEL 1000 LB	TIME HR:MIN	FUEL 1000 LB	TIME HR:MIN	FUEL 1000 LB	TIME HR:MIN	FUEL 1000 LB
19:04	323.5								
18:39	313.2								
18:14	303.3								
17:49	293.5								
17:24	284.0	17:22	303.4						
16:59	274.7	16:57	293.1						
16:34	265.6	16:32	283.2						
16:09	256.6	16:07	273.4						
15:44	247.8	15:42	263.9	15:40	281.5				
15:19	239.1	15:17	254.6	15:15	271.2				
14:54	230.5	14:52	245.5	14:50	261.4				
14:29	222.2	14:27	236.5	14:25	251.6	14:23	268.1		
14:04	213.8	14:02	227.7	14:00	242.2	13:58	257.8		
13:39	205.8	13:37	219.0	13:35	232.9	13:33	247.6		
13:13	198.0	13:12	210.4	13:10	223.8	13:08	237.9		
12:48	190.3	12:47	202.1	12:45	214.9	12:43	228.2	12:41	242.5
12:23	182.7	12:22	193.7	12:20	206.1	12:18	218.9	12:16	232.3
11:57	175.1	11:57	185.7	11:55	197.5	11:53	209.5	11:51	222.4
11:32	167.7	11:31	177.9	11:30	188.9	11:28	200.6	11:26	212.6
11:06	160.4	11:06	170.2	11:05	180.5	11:03	191.6	11:01	203.2
10:41	153.2	10:41	162.6	10:40	172.2	10:38	183.0	10:36	193.8
10:15	146.1	10:15	155.0	10:15	164.3	10:13	174.3	10:11	184.7
9:50	139.2	9:50	147.6	9:49	156.5	9:48	165.9	9:46	175.8
9:25	132.3	9:24	140.3	9:24	148.8	9:23	157.5	9:21	166.9
8:59	125.7	8:59	133.1	8:59	141.2	8:58	149.2	8:56	158.3
8:34	119.2	8:33	126.1	8:33	133.6	8:33	141.5	8:31	149.7
8:08	112.7	8:08	119.1	8:08	126.2	8:07	133.7	8:06	141.4
7:43	106.4	7:43	112.2	7:42	119.0	7:42	126.0	7:41	133.0
7:17	100.2	7:17	105.6	7:17	111.8	7:16	118.5	7:16	125.1
6:52	93.9	6:52	99.1	6:51	104.8	6:51	110.9	6:51	117.3
6:26	87.8	6:26	92.7	6:26	97.9	6:26	103.6	6:25	109.5
6:00	81.9	6:01	86.3	6:01	90.9	6:00	96.4	6:00	102.0
5:35	76.0	5:35	80.1	5:35	84.4	5:35	89.2	5:34	94.4
5:09	70.1	5:09	73.9	5:10	77.9	5:09	82.3	5:09	87.0
4:44	64.5	4:44	67.8	4:44	71.5	4:44	75.4	4:44	79.7
4:18	58.9	4:18	61.8	4.19	65.2	4:19	68.5	4:18	72.5
3:53	53.3	3:53	55.9	3:53	59.0	3:53	62.1	3:53	65.5
3:27	47.0	3:27	50.0	3:27	52.7	3:27	55.6	3:27	58.6
3:02	42.1	3:02	44.4	3:02	46.7	3.02	49.2	3:02	51.6
2:36	36.6	2:36	38.8	2:36	40.8	2:36	42.9	2:36	45.1
2:11	31.3	2:11	33.2	2:11	34.8	2:11	36.7	2:11	38.6
1:45	25.9	1:45	27.4	1:45	29.0	1:45	30.5	1:45	32.1
1:20	21.0	1:20	22.2	1:20	23.4	1:20	24.5	1:20	25.8
0:54	16.0	0:54	16.9	0:54	17.8	0:54	18.6	0:54	19.6
0:29	11.1	0:29	11.6	0:29	12.2	0:29	12.7	0:29	13.3

SA1C-261B

Figure 10-7. (Sheet 1)

FLIGHT PLANNING - MACH 0.82 STEP CRUISE



GROUND DISTANCE (NM)	LANDING WT 360,000 LB TIME HR:MIN	LANDING WT 360,000 LB FUEL 1000 LB	LANDING WT 380,000 LB TIME HR:MIN	LANDING WT 380,000 LB FUEL 1000 LB	LANDING WT 400,000 LB TIME HR:MIN	LANDING WT 400,000 LB FUEL 1000 LB	LANDING WT 420,000 LB TIME HR:MIN	LANDING WT 420,000 LB FUEL 1000 LB	LANDING WT 440,000 LB TIME HR:MIN	LANDING WT 440,000 LB FUEL 1000 LB
	11:24	225.3								
	10:59	215.1								
	10:34	205.1								
	10:09	195.3	10:08	206.2						
	9:44	185.7	9:43	195.9						
	9:19	176.4	9:18	185.8						
	8:55	167.2	8:53	176.1	8:52	185.5				
	8:30	158.2	8:28	166.5	8:27	175.3				
	8:05	149.3	8:03	157.1	8:02	165.2				
	7:40	140.7	7:38	147.9	7:37	155.5	7:36	163.7		
	7:15	132.1	7:13	138.9	7:12	145.9	7:11	153.4		
	6:50	123.7	6:48	130.0	6:47	136.6	6:46	143.5		
	6:25	115.3	6:23	121.4	6:22	127.4	6:21	133.7	6:20	140.4
	6:00	107.2	5:58	112.7	5:57	118.4	5:56	124.2	5:55	130.2
	5:34	99.4	5:33	104.3	5:32	109.5	5:31	114.9	5:30	120.4
	5:09	91.7	5:08	96.0	5:07	100.8	5:06	105.7	5:05	110.6
	4:43	84.0	4:43	87.8	4:42	92.2	4:41	96.8	4:40	101.3
	4:18	76.5	4:18	80.0	4:17	83.8	4:16	87.9	4:15	91.9
	3:52	69.0	3:52	72.3	3:52	75.5	3:51	79.3	3:50	82.9
	3:27	61.7	3:27	64.6	3:27	67.3	3:26	70.6	3:25	73.9
	3:02	54.5	3:02	57.1	3:02	59.6	3:01	62.3	3:00	65.2
	2:36	47.4	2:36	49.5	2:36	51.8	2:36	54.0	2:35	56.6
	2:11	40.5	2:11	42.3	2:11	44.2	2:11	45.9	2:10	48.0
	1:45	33.5	1:45	35.1	1:45	36.6	1:45	38.1	1:45	39.7
	1:20	26.8	1:20	27.9	1:20	29.1	1:20	30.4	1:20	31.3
	0:54	20.3	0:54	21.0	0:54	21.8	0:55	22.8	0:55	23.4
	0:29	13.9	0:29	14.1	0:29	14.6	0:29	15.2	0:29	15.6

SA1C-262B

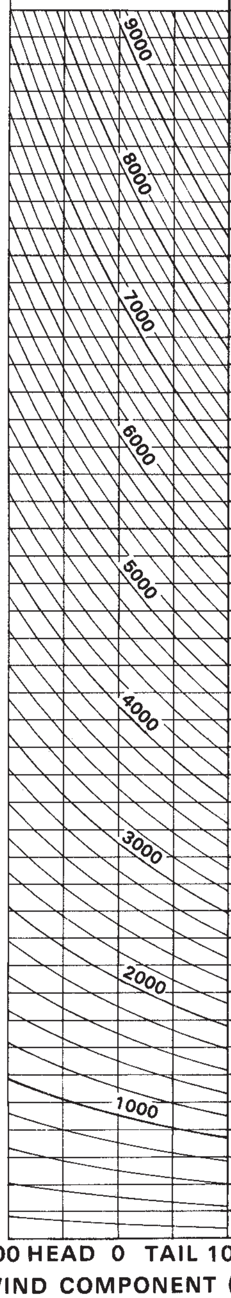
Figure 10-7. (Sheet 2)

FLIGHT PLANNING - MACH 0.83 STEP CRUISE

NOTE:

1. THREE ENGINE OPERATION
2. 31,000/35,000/39,000 FT STEP CRUISE
3. FLIGHT TIMES ARE BASED ON CLIMB AND CRUISE AT STANDARD DAY. FOR NON-STANDARD CONDITIONS, ADD ONE MIN/HR PER 10°C ABOVE STD. SUBTRACT ONE MIN/HR PER 10°C ABOVE STD
4. FUEL, DISTANCE, AND TIME VALUES INCLUDE TAKEOFF ALLOWANCES OF 2500 LB, 8 NM, AND 3 MIN FOR TAKEOFF OPERATON UP TO 2000 FT PRESSURE ALTITUDE

GROUND DISTANCE (NM)



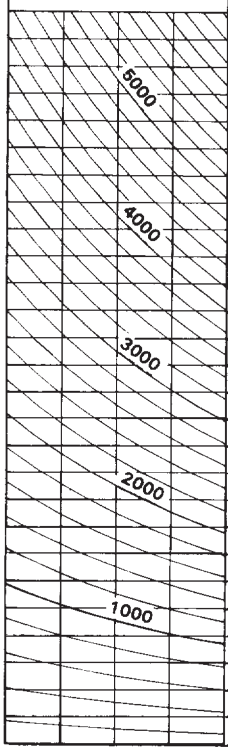
LANDING WT 260,000 LB		LANDING WT 280,000 LB		LANDING WT 300,000 LB		LANDING WT 320,000 LB		LANDING WT 340,000 LB	
TIME HR:MIN	FUEL 1000 LB	TIME HR:MIN	FUEL 1000 LB	TIME HR:MIN	FUEL 1000 LB	TIME HR:MIN	FUEL 1000 LB	TIME HR:MIN	FUEL 1000 LB
18:50	329.6								
18:25	319.1								
18:00	308.7								
17:36	298.8								
17:11	288.9	17:09	309.0						
16:46	279.4	16:44	298.6						
16:22	270.0	16:20	288.2						
15:57	260.9	15:55	278.3						
15:32	251.8	15:30	268.4	15:28	286.7				
15:08	243.0	15:05	258.9	15:04	276.3				
14:43	234.2	14:41	249.5	14:39	266.0				
14:18	225.6	14:16	240.4	14:14	256.1				
13:54	217.2	13:51	231.3	13:49	246.3	13:48	262.6		
13:29	208.8	13:27	222.5	13:25	236.9	13:23	252.1		
13:04	201.0	13:02	213.8	13:00	227.5	12:58	242.1		
12:39	193.1	12:37	205.2	12:35	218.4	12:34	232.2	12:32	246.9
12:14	185.3	12:13	196.8	12:11	209.3	12:09	222.6	12:07	236.5
11:49	177.6	11:48	188.4	11:46	200.6	11:44	213.1	11:42	226.2
11:24	169.9	11:23	180.5	11:21	191.8	11:19	203.9	11:18	216.3
10:58	162.6	10:58	172.6	10:57	183.3	10:55	194.8	10:53	206.5
10:33	155.3	10:33	164.9	10:32	174.9	10:30	185.9	10:28	197.0
10:08	148.0	10:08	157.2	10:07	166.7	10:05	177.1	10:04	187.7
9:43	141.0	9:43	149.5	9:42	158.8	9:41	168.4	9:39	178.6
9:18	134.0	9:18	142.2	9:17	150.9	9:16	160.0	9:14	169.5
8:53	127.2	8:52	134.9	8:52	143.2	8:51	151.6	8:50	160.8
8:28	120.7	8:27	127.7	8:27	135.5	8:26	143.6	8:25	152.0
8:02	114.1	8:02	120.7	8:02	127.9	8:02	135.7	8:00	143.5
7:37	107.6	7:37	113.6	7:37	120.6	7:36	127.8	7:36	135.1
7:12	101.3	7:12	106.9	7:12	113.3	7:11	120.1	7:11	126.9
6:47	95.0	6:47	100.3	6:47	106.1	6:46	112.5	6:46	119.0
6:22	88.7	6:22	93.8	6:21	99.1	6:21	105.0	6:21	111.1
5:56	82.7	5:56	87.3	5:56	92.1	5:56	97.7	5:56	103.3
5:31	76.8	5:31	81.0	5:31	85.4	5:31	90.4	5:31	95.7
5:06	70.8	5:06	74.7	5:06	78.9	5:06	83.3	5:05	88.1
4:41	65.1	4:41	68.4	4:41	72.3	4:41	76.3	4:40	80.7
4:15	59.4	4:15	62.4	4:16	65.9	4:16	69.4	4:15	73.4
3:50	53.7	3:50	56.4	3:50	59.6	3:50	62.8	3:50	66.3
3:25	47.5	3:25	50.5	3:25	53.3	3:25	56.3	3:25	59.3
3:00	42.2	3:00	44.8	3:00	47.1	3:00	49.7	3:00	52.3
2:35	36.8	2:35	39.1	2:35	41.1	2:35	43.4	2:35	45.6
2:09	31.4	2:09	33.4	2:09	35.1	2:10	37.1	2:10	39.0
1:44	25.9	1:44	27.5	1:44	29.2	1:44	30.8	1:44	32.5
1:19	21.0	1:19	22.2	1:19	23.5	1:19	24.7	1:19	26.0
0:54	16.1	0:54	17.0	0:54	17.9	0:54	18.7	0:54	19.7
0:28	11.0	0:28	11.6	0:28	12.2	0:29	12.8	0:29	13.4

SA1C-263B

Figure 10-8. (Sheet 1)

FLIGHT PLANNING - MACH 0.83 STEP CRUISE

GROUND DISTANCE (NM)



100 HEAD 0 TAIL 100

WIND COMPONENT (KTS)

LANDING WT 360,000 LB		LANDING WT 380,000 LB		LANDING WT 400,000 LB		LANDING WT 420,000 LB		LANDING WT 440,000 LB	
TIME HR:MIN	FUEL 1000 LB	TIME HR:MIN	FUEL 1000 LB	TIME HR:MIN	FUEL 1000 LB	TIME HR:MIN	FUEL 1000 LB	TIME HR:MIN	FUEL 1000 LB
11:16	229.3								
10:51	218.9								
10:27	208.5								
10:02	198.6	10:01	209.7						
9:37	188.7	9.36	199.3						
9:13	179.2	9:11	188.9						
8:48	169.7	8:47	178.9	8:45	188.7				
8:23	160.6	8:22	169.1	8:21	178.3				
7:59	151.6	7:57	159.6	7:56	167.9				
7:34	142.7	7:32	150.1	7:31	158.0	7:30	166.4		
7:09	134.0	7:08	141.0	7:07	148.2	7:06	156.0		
6:45	125.4	6:43	131.9	6:42	138.7	6:41	145.7		
6:20	117.0	6:18	123.1	6:17	129.2	6:16	135.8	6:15	142.7
5:55	108.7	5:54	114.3	5:53	120.1	5:51	126.0	5:50	132.2
5:30	100.8	5:29	105.8	5:28	111.1	5:27	116.6	5:26	122.2
5:05	92.9	5:04	97.3	5:03	102.3	5:02	107.2	5:01	112.2
4:40	85.1	4:40	89.0	4:39	93.5	4:37	98.1	4:36	102.7
4:15	77.4	4:15	81.1	4:14	85.0	4:13	89.1	4:12	93.2
3:50	69.7	3:50	73.2	3:49	76.5	3:48	80.3	3:47	84.0
3:25	62.4	3:25	65.4	3:24	68.2	3:23	71.6	3:22	74.9
3:00	55.1	3:00	57.7	2:59	60.3	2:59	63.1	2:58	65.9
2:34	47.9	2:34	50.0	2:34	52.4	2:34	54.7	2:33	57.2
2:09	40.8	2:09	42.7	2:09	44.7	2:09	46.5	2:08	48.5
1:44	33.8	1:44	35.4	1:44	37.0	1:44	38.6	1:44	40.1
1:19	27.0	1:19	28.1	1:19	29.3	1:19	30.7	1:19	31.6
0.54	20.5	0:54	21.1	0:54	22.0	0:54	22.9	0:54	23.6
0:29	13.9	0:29	14.1	0:29	14.6	0:29	15.2	0:29	15.7

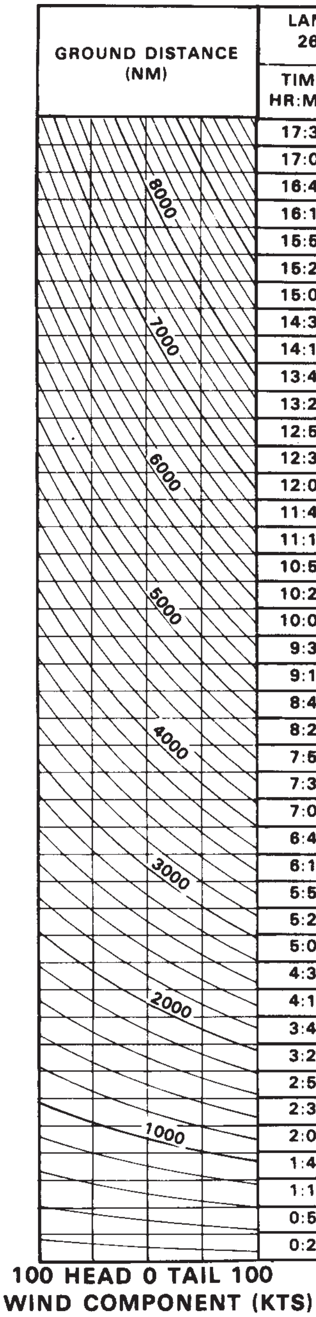
SA1C-264B

Figure 10-8. (Sheet 2)

FLIGHT PLANNING MACH 0.82 - 31,000 FEET

NOTE:

1. THREE ENGINE OPERATION
2. FLIGHT TIMES ARE BASED ON CLIMB AND CRUISE AT STANDARD DAY. FOR NON-STANDARD CONDITIONS, ADD ONE MIN/HR PER 10°C ABOVE STD. SUBTRACT ONE MIN/HR PER 10°C ABOVE STD
3. FUEL, DISTANCE, AND TIME VALUES INCLUDE TAKEOFF ALLOWANCES OF 2500 LB, 8 NM, AND 3 MIN FOR TAKEOFF OPERATION UP 10 2000 FT PRESSURE ALTITUDE



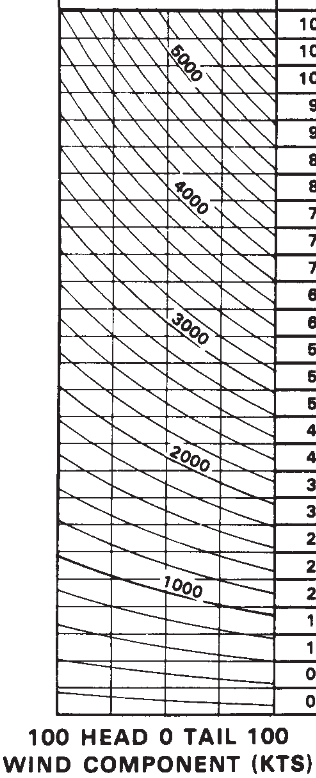
LANDING WT 260,000 LB		LANDING WT 280,000 LB		LANDING WT 300,000 LB		LANDING WT 320,000 LB		LANDING WT 340,000 LB	
TIME HR:MIN	FUEL 1000 LB	TIME HR:MIN	FUEL 1000 LB	TIME HR:MIN	FUEL 1000 LB	TIME HR:MIN	FUEL 1000 LB	TIME HR:MIN	FUEL 1000 LB
17:32	327.5								
17:07	317.3								
16:42	307.2								
16:17	297.4	16:17	309.7						
15:52	287.7	15:52	299.5						
15:27	278.4	15:27	289.2						
15:02	269.1	15:02	279.5						
14:37	260.1	14:37	269.7	14:38	281.0				
14:12	251.2	14:12	260.4	14:13	270.7				
13:47	242.5	13:47	251.1	13:48	260.9				
13:22	233.9	13:22	242.1	13:23	251.1	13:23	261.8		
12:57	225.5	12:57	233.1	12:58	241.8	12:58	251.6		
12:32	217.1	12:32	224.4	12:33	232.4	12:33	241.7		
12:07	208.8	12:08	215.8	12:08	223.4	12:08	232.0	12:08	242.0
11:42	200.8	11:43	207.2	11:43	214.4	11:43	222.5	11:43	231.7
11:17	192.7	11:18	198.9	11:18	205.7	11:18	213.2	11:18	221.9
10:53	184.9	10:53	190.6	10:53	197.0	10:53	204.1	10:53	212.1
10:28	177.1	10:28	182.5	10:28	188.5	10:28	195.2	10:28	202.7
10:03	169.3	10:03	174.5	10:03	180.1	10:03	186.4	10:03	193.3
9:38	161.7	9:38	166.5	9:38	171.8	9:38	177.7	9:38	184.2
9:13	154.2	9:13	158.7	9:13	163.7	9:13	169.2	9:13	175.3
8:48	146.7	8:48	151.0	8:48	155.7	8:48	160.8	8:48	166.5
8:23	139.4	8:23	143.4	8:23	147.7	8:23	152.5	8:23	157.9
7:58	132.1	7:58	135.8	7:58	139.9	7:58	144.4	7:58	149.3
7:33	124.9	7:33	128.3	7:33	132.1	7:33	136.3	7:33	140.9
7:08	117.8	7:08	121.0	7:08	124.5	7:08	128.3	7:08	132.6
6:43	110.7	6:43	113.7	6:43	116.9	6:43	120.5	6:43	124.5
6:18	103.7	6:18	106.4	6:18	109.4	6:18	112.7	6:18	116.4
5:53	96.8	5:53	99.3	5:53	102.1	5:53	105.1	5:53	108.4
5:28	89.9	5:28	92.2	5:28	94.7	5:28	97.6	5:28	100.6
5:03	83.1	5:03	85.2	5:03	87.5	5:03	90.0	5:03	92.8
4:38	76.4	4:38	78.3	4:38	80.4	4:38	82.7	4:38	85.2
4:13	69.6	4:13	71.4	4:13	73.3	4:13	75.4	4:13	77.7
3:48	63.0	3:48	64.6	3:48	66.2	3:48	68.1	3:48	70.1
3:23	56.4	3:23	57.8	3:23	59.3	3:23	61.0	3:23	62.8
2:58	49.8	2:58	51.1	2:58	52.4	2:58	53.9	2:58	55.4
2:33	43.2	2:33	44.4	2:33	45.6	2:33	46.8	2:33	48.2
2:08	37.0	2:08	37.9	2:08	38.8	2:08	39.9	2:08	41.4
1:43	30.5	1:43	31.3	1:43	32.1	1:43	33.0	1:43	33.9
1:18	24.0	1:18	24.7	1:18	25.4	1:18	26.1	1:18	26.9
0:53	17.6	0:53	18.2	0:53	18.8	0:53	19.4	0:53	20.0
0:28	11.4	0:28	11.8	0:28	12.2	0:28	12.6	0:28	13.1

SA1C-274B

Figure 10-9. (Sheet 1)

FLIGHT PLANNING MACH 0.82 - 31,000 FEET

GROUND DISTANCE (NM)



LANDING WT 360,000 LB		LANDING WT 380,000 LB		LANDING WT 400,000 LB		LANDING WT 420,000 LB		LANDING WT 440,000 LB	
TIME HR:MIN	FUEL 1000 LB	TIME HR:MIN	FUEL 1000 LB	TIME HR:MIN	FUEL 1000 LB	TIME HR:MIN	FUEL 1000 LB	TIME HR:MIN	FUEL 1000 LB
10:53	221.3								
10:28	211.1								
10:03	201.2								
9:38	191.5	9:38	199.8						
9:13	182.1	9:13	189.6						
8:48	172.7	8:48	179.8	8:48	187.8				
8:23	163.7	8:23	170.1	8:23	177.5				
7:58	154.7	7:58	160.7	7:58	167.4				
7:33	145.9	7:33	151.4	7:33	157.6	7:34	164.7		
7:08	137.3	7:08	142.4	7:08	148.0	7:09	154.4		
6:43	128.7	6:43	133.4	6:43	138.6	6:44	144.4		
6:18	120.4	6:18	124.7	6:18	129.3	6:19	134.6	6:19	140.6
5:53	112.1	5:53	116.1	5:54	120.4	5:54	125.1	5:54	130.4
5:28	104.0	5:28	107.5	5:29	111.4	5:29	115.8	5:29	120.6
5:03	95.9	5:03	99.2	5:04	102.8	5:04	106.6	5:04	110.8
4:38	87.9	4:39	90.9	4:39	94.1	4:39	97.6	4:39	101.4
4:13	80.1	4:14	82.8	4:14	85.7	4:14	88.7	4:14	92.1
3:48	72.4	3:49	74.8	3:49	77.3	3:49	80.1	3:49	83.1
3:23	64.7	3.24	66.8	3:24	69.0	3:24	71.5	3:24	74.1
2:58	57.2	2:59	59.0	2:59	61.0	2:59	63.1	2:59	65.4
2:34	49.6	2:34	51.2	2:34	52.9	2:34	54.8	2:34	56.7
2.09	42.3	2:09	43.6	2:09	45.1	2:09	46.6	2:09	48.2
1:44	35.0	1:44	36.1	1:44	37.3	1:44	38.5	1:44	39.9
1:19	27.7	1:19	28.6	1:19	29.5	1:19	30.5	1:19	31.5
0:54	20.6	0:54	21.3	0:54	21.9	0:54	22.7	0:54	23.4
0:29	13.5	0:29	13.9	0:29	14.4	0:29	14.9	0:29	15.3

SA1C-275A

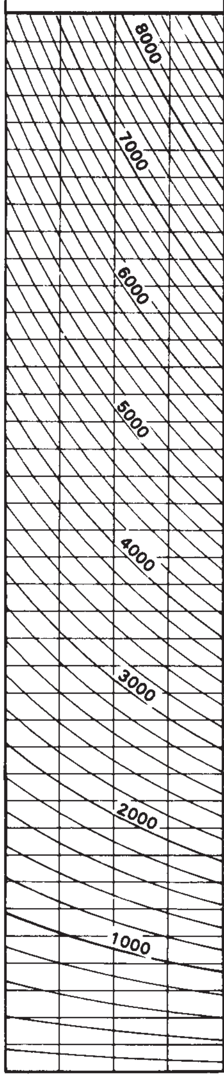
Figure 10-9. (Sheet 2)

FLIGHT PLANNING - MACH 0.82 - 33,000 FEET

NOTE:

1. THREE ENGINE OPERATION
2. FLIGHT TIMES ARE BASED ON CLIMB AND CRUISE AT STANDARD DAY. FOR NON-STANDARD CONDITIONS, ADD ONE MIN/HR PER 10°C BELOW STD. SUBTRACT ONE MIN/HR PER 10°C ABOVE STD
3. FUEL, DISTANCE, AND TIME VALUES INCLUDE TAKEOFF ALLOWANCES OF 2500 LB, 8 NM, AND 3 MIN FOR TAKEOFF OPERATION UP TO 2000 FT PRESSURE ALTITUDE

GROUND DISTANCE (NM)



100 HEAD 0 TAIL 100
WIND COMPONENT (KTS)

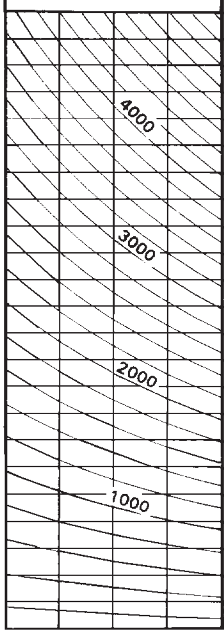
LANDING WT 260,000 LB		LANDING WT 280,000 LB		LANDING WT 300,000 LB		LANDING WT 320,000 LB		LANDING WT 340,000 LB	
TIME HR:MIN	FUEL 1000 LB	TIME HR:MIN	FUEL 1000 LB	TIME HR:MIN	FUEL 1000 LB	TIME HR:MIN	FUEL 1000 LB	TIME HR:MIN	FUEL 1000 LB
16:26	286.0								
16:00	276.4								
15:35	267.0								
15:10	257.8								
14:45	248.7	14:45	260.6						
14:20	240.1	14:20	251.0						
13:54	231.4	13:55	241.8						
13:29	223.1	13:29	232.7	13:29	244.1				
13:04	214.9	13:04	223.8	13:04	234.5				
12:39	206.8	12:39	215.2	12:39	225.1				
12:14	198.9	12:14	206.7	12:14	216.0	12:14	226.5		
11:48	191.0	11:49	198.5	11:49	207.0	11:49	216.9		
11:23	183.4	11:23	190.3	11:23	198.3	11:24	207.4		
10:58	175.7	10:58	182.4	10:58	189.7	10:58	198.3	10:58	208.1
10:33	168.2	10:33	174.5	10:33	181.4	10:33	189.2	10:33	198.4
10:08	160.8	10:08	166.7	10:08	173.2	10:08	180.5	10:08	188.9
9:42	153.4	9:43	159.0	9:43	165.2	9:43	171.8	9:43	179.7
9:17	146.2	9:17	151.4	9:18	157.3	9:18	163.5	9:18	170.6
8:52	139.1	8:52	144.0	8:52	149.4	8:52	155.3	8:53	161.9
8:27	132.1	8:27	136.6	8:27	141.8	8:27	147.2	8:27	153.2
8:02	125.2	8:02	129.3	8:02	134.2	8:02	139.3	8:02	144.8
7:36	118.4	7:37	122.2	7:37	126.7	7:37	131.4	7:37	136.6
7:11	111.6	7:11	115.2	7:12	119.3	7:12	123.7	7:12	128.5
6:46	104.9	6:46	108.2	6:46	111.9	6:46	116.1	6:47	120.6
6:21	98.2	6:21	101.4	6:21	104.8	6:21	108.5	6:21	112.7
5:56	91.6	5:56	94.5	5:56	97.7	5:56	101.1	5:56	105.0
5:31	85.1	5:31	87.8	5:31	90.7	5:31	93.8	5:31	97.3
5:05	78.7	5:05	81.1	5:06	83.8	5:06	86.5	5:06	89.7
4:40	72.2	4:40	74.5	4:40	77.0	4:40	79.5	4:41	82.3
4:15	65.9	4:15	67.9	4:15	70.2	4:15	72.4	4:15	75.0
3:50	59.7	3:50	61.5	3:50	63.5	3:50	65.5	3:50	67.7
3:25	53.4	3:25	55.0	3:25	56.9	3:25	58.7	3:25	60.6
2:59	47.0	2:59	48.6	3:00	50.3	3:00	51.9	3:00	53.6
2:34	41.0	2:34	42.4	2:34	43.8	2:34	45.2	2:35	46.6
2:09	34.8	2:09	36.1	2:09	37.4	2:09	38.6	2:09	39.8
1:44	28.9	1:44	29.9	1:44	30.9	1:44	31.9	1:44	33.0
1:19	22.0	1:19	22.8	1:19	24.6	1:19	25.4	1:19	26.3
0:54	17.2	0:54	17.8	0:54	18.4	0:54	19.0	0:54	19.6
0:28	11.3	0:28	11.7	0:28	12.1	0:29	12.5	0:29	13.0

SA1C-276B

Figure 10-10. (Sheet 1)

FLIGHT PLANNING - MACH 0.82 - 33,000 FEET

GROUND DISTANCE (NM)



100 HEAD 0 TAIL 100
WIND COMPONENT (KTS)

LANDING WT 360,000 LB		LANDING WT 380,000 LB		LANDING WT 400,000 LB		LANDING WT 420,000 LB		LANDING WT 440,000 LB	
TIME HR:MIN	FUEL 1000 LB	TIME HR:MIN	FUEL 1000 LB	TIME HR:MIN	FUEL 1000 LB	TIME HR:MIN	FUEL 1000 LB	TIME HR:MIN	FUEL 1000 LB
9:43	188.8								
9:18	179.1								
8:53	169.5								
8:27	160.4	8:27	168.6						
8:02	151.2	8:02	158.9						
7:37	142.5	7:37	149.4						
7:12	133.8	7:12	140.2	7:12	147.5				
6:47	125.4	6:47	131.1	6:47	137.9				
6:21	117.2	6:22	122.3	6:22	128.3				
5:56	109.1	5:56	113.7	5:57	125.1				
5:31	101.1	5:31	105.3	5:31	110.0	5:31	115.5		
5:06	93.2	5:06	97.1	5:06	101.4	5:06	106.1		
4:41	85.5	4:41	88.9	4:41	92.7	4:41	97.0	4:41	101.9
4:16	77.9	4:16	81.0	4:16	84.3	4:16	87.9	4:16	92.3
3:50	70.3	3:50	73.1	3:50	76.1	3:51	79.3	3:51	83.0
3:25	62.9	3:25	65.4	3:25	68.0	3:25	70.6	3:25	73.9
3:00	55.5	3:00	57.7	3:00	60.1	3:00	62.3	3:00	65.0
2:35	48.2	2:35	50.1	2:35	52.2	2:35	54.1	2:35	56.3
2:10	41.1	2:10	42.7	2:10	44.5	2:10	46.1	2:10	47.8
1:44	34.1	1:44	35.3	1:45	36.9	1:45	38.2	1:45	39.6
1:19	27.1	1:19	28.1	1:19	29.3	1:19	30.3	1:20	31.4
0:54	20.3	0:54	21.0	0:54	21.9	0:54	22.6	0:54	23.4
0:29	13.5	0:29	13.9	0:29	14.5	0:29	15.0	0:29	15.5

SA1C-277A

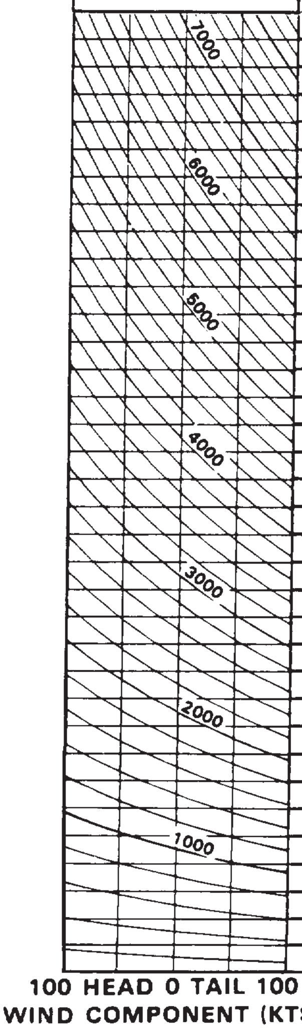
Figure 10-10. (Sheet 2)

FLIGHT PLANNING MACH 0.82 - 35,000 FEET

NOTE:

1. THREE ENGINE OPERATION
2. FLIGHT TIMES ARE BASED ON CLIMB AND CRUISE AT STANDARD DAY. FOR NON-STANDARD CONDITIONS, ADD ONE MIN/HR PER 10°C BELOW STD. SUBTRACT ONE MIN/ HR PER 10°C ABOVE STD
3. FUEL, DISTANCE, AND TIME VALUES INCLUDE TAKEOFF ALLOWANCES OF 2500 LB. 8 NM, AND 3 MIN FOR TAKEOFF OPERATION UP TO 2000 FT PRESSURE ALTITUDE

GROUND DISTANCE (NM)



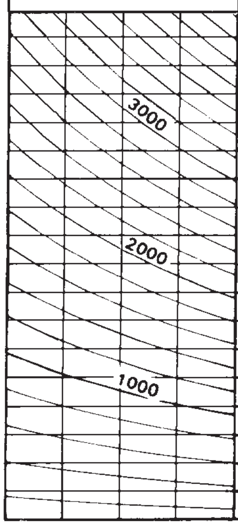
LANDING WT 260,000 LB		LANDING WT 280,000 LB		LANDING WT 300,000 LB		LANDING WT 320,000 LB		LANDING WT 340,000 LB	
TIME HR:MIN	FUEL 1000 LB	TIME HR:MIN	FUEL 1000 LB	TIME HR:MIN	FUEL 1000 LB	TIME HR:MIN	FUEL 1000 LB	TIME HR:MIN	FUEL 1000 LB
14:53	241.0								
14:27	232.0								
14:02	223.5								
13:36	215.1	13:36	227.0						
13:11	206.9	13:11	217.9						
12:45	199.0	12:46	208.9						
12:20	191.0	12:20	200.6						
11:55	183.4	11:55	192.2	11:55	202.9				
11:29	175.8	11:29	184.1	11:29	193.8				
1:04	168.3	11:04	176.2	11:04	185.2				
10:38	161.0	10:39	168.3	10:39	176.8	10:39	186.6		
10:13	153.8	10:13	160.7	10:13	168.5	10:13	177.6		
9:48	146.7	9:48	153.2	9:48	160.6	9:48	168.6		
9:22	139.8	9:22	145.8	9:22	152.6	9:22	160.2	9:23	169.3
8:57	132.9	8:57	138.5	8:57	144.9	8:57	151.9	8:57	160.3
8:31	126.1	8:31	131.2	8:32	137.3	8:32	143.8	8:32	151.2
8:06	119.5	8:06	124.3	8:06	129.8	8:06	135.9	8:06	142.7
7:40	112.9	7:41	117.4	7:41	122.5	7:41	128.0	7:41	134.4
7:15	106.4	7:15	110.5	7:15	115.2	7:15	120.4	7:15	126.2
6:50	100.0	6:50	103.8	6:50	108.1	6:50	112.9	6:50	118.3
6:24	93.6	6:24	97.2	6:24	101.2	6:25	105.5	6:25	110.3
5:59	87.3	5:59	90.6	5:59	94.3	5:59	98.2	5:59	102.7
5:33	81.1	5:33	84.2	5:34	87.5	5:34	91.0	5:34	95.1
5:08	74.9	5:08	77.8	5:08	80.9	5:08	84.0	5:08	87.7
4:43	68.8	4:43	71.4	4:43	74.2	4:43	77.1	4:43	80.4
4:17	62.8	4:17	65.1	4:17	67.7	4:17	70.2	4:18	73.1
3:52	56.8	3:52	58.9	3:52	61.3	3:52	63.6	3:52	66.1
3:26	50.9	3:26	52.7	3:26	54.9	3:27	57.0	3:27	59.2
3:01	44.7	3:01	46.7	3:01	48.6	3:01	50.3	3:01	52.3
2:36	39.0	2:36	40.7	2:36	42.4	2:36	43.9	2:36	45.6
2:10	33.6	2:10	34.8	2:10	36.2	2:10	37.5	2:10	38.9
1:45	28.0	1:45	29.0	1:45	30.0	1:45	31.1	1:45	32.3
1:19	22.0	1:45	23.0	1:45	24.0	1:19	24.9	1:20	25.8
0:54	16.9	0:54	17.5	0:54	18.1	0:54	18.7	0:54	19.4
0:29	11.1	0:29	11.6	0:29	12.1	0:29	12.5	0:29	13.0

SA1C-278B

Figure 10-11. (Sheet 1)

FLIGHT PLANNING MACH 0.82 - 35,000 FEET

GROUND DISTANCE (NM)



100 HEAD 0 TAIL 100
WIND COMPONENT (KTS)

LANDING WT 360,000 LB		LANDING WT 380,000 LB		LANDING WT 400,000 LB		LANDING WT 420,000 LB		LANDING WT 440,000 LB	
TIME HR:MIN	FUEL 1000 LB	TIME HR:MIN	FUEL 1000 LB	TIME HR:MIN	FUEL 1000 LB	TIME HR:MIN	FUEL 1000 LB	TIME HR:MIN	FUEL 1000 LB
7:41	141.9								
7:16	132.9								
6:50	124.3								
6:25	115.9	6:25	122.6						
5:59	107.7	5:59	113.5						
5:34	99.7	5:34	104.9						
5:08	91.8	5:09	96.5	5:09	102.2				
4:43	84.1	4:43	88.3	4:43	93.1				
4:18	76.5	4:18	80.3	4:18	84.5	4:18	89.4		
3:52	69.0	3:52	72.4	3:52	76.1	3:52	80.4		
3:27	61.7	3:27	64.7	3:27	67.9	3:27	71.4		
3:01	54.5	3:01	57.1	3:02	59.9	3:02	62.8	3:02	66.5
2:36	47.5	2:36	49.5	2:36	52.0	2:36	54.5	2:36	57.4
2:22	40.5	2:11	42.3	2:11	44.3	2:11	46.3	2:11	48.5
1:45	33.6	1:45	35.0	1:45	36.7	1:45	38.4	1:45	40.1
1:20	26.8	1:20	27.8	1:20	29.2	1:20	30.4	1:20	31.7
0:54	20.2	0:54	20.9	0:54	21.9	0:55	22.8	0:55	23.7
0:29	13.5	0:29	14.0	0:29	14.6	0:29	15.2	0:29	15.7

SA1C-279A

Figure 10-11. (Sheet 2)

ADDITIONAL FUEL REQUIRED - CLIMB VS CRUISE

NOTE:
1. INCLUDES TAKEOFF ALLOWANCE OF 2500 POUNDS
2. BASED ON LONG RANGE CRUISE SPEED
3. ZERO WIND
4. STANDARD DAY

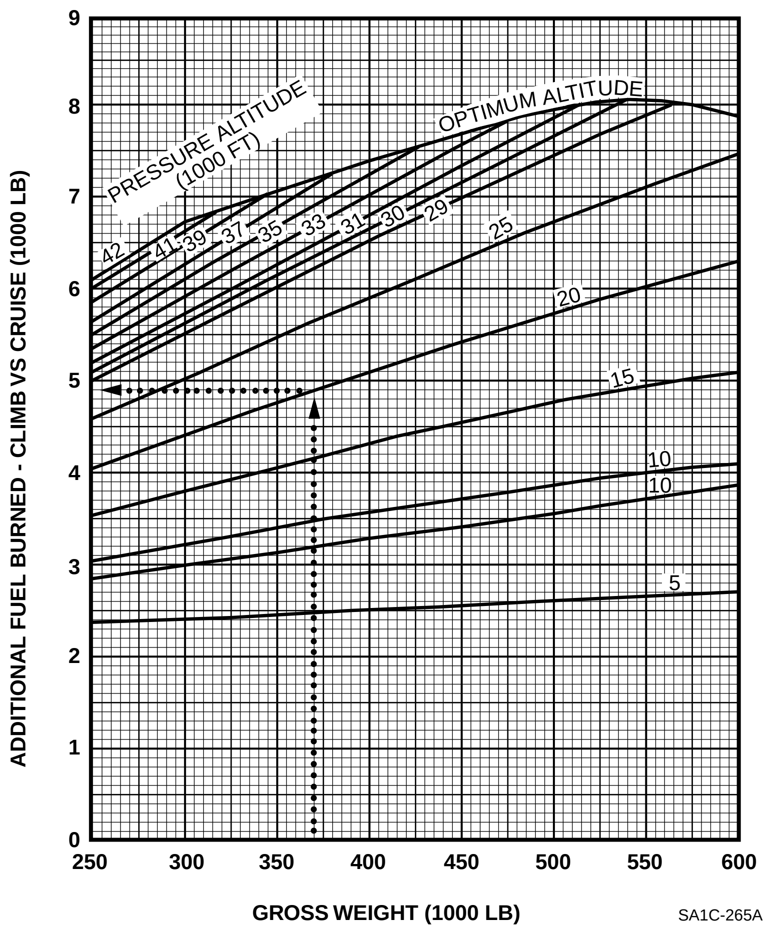


Figure 10-12.

RESERVE FUEL VS CRUISE TIME

NOTE:
BASED ON FUEL BURNED FOR 31,000/36,000/39,000 STEP CRUISE FOR 10% OF CRUISE TIME AT LONG RANGE CRUISE SPEED, OR 20 MINUTES MAX ENDURANCE AT SEA LEVEL, WHICHEVER IS GREATER

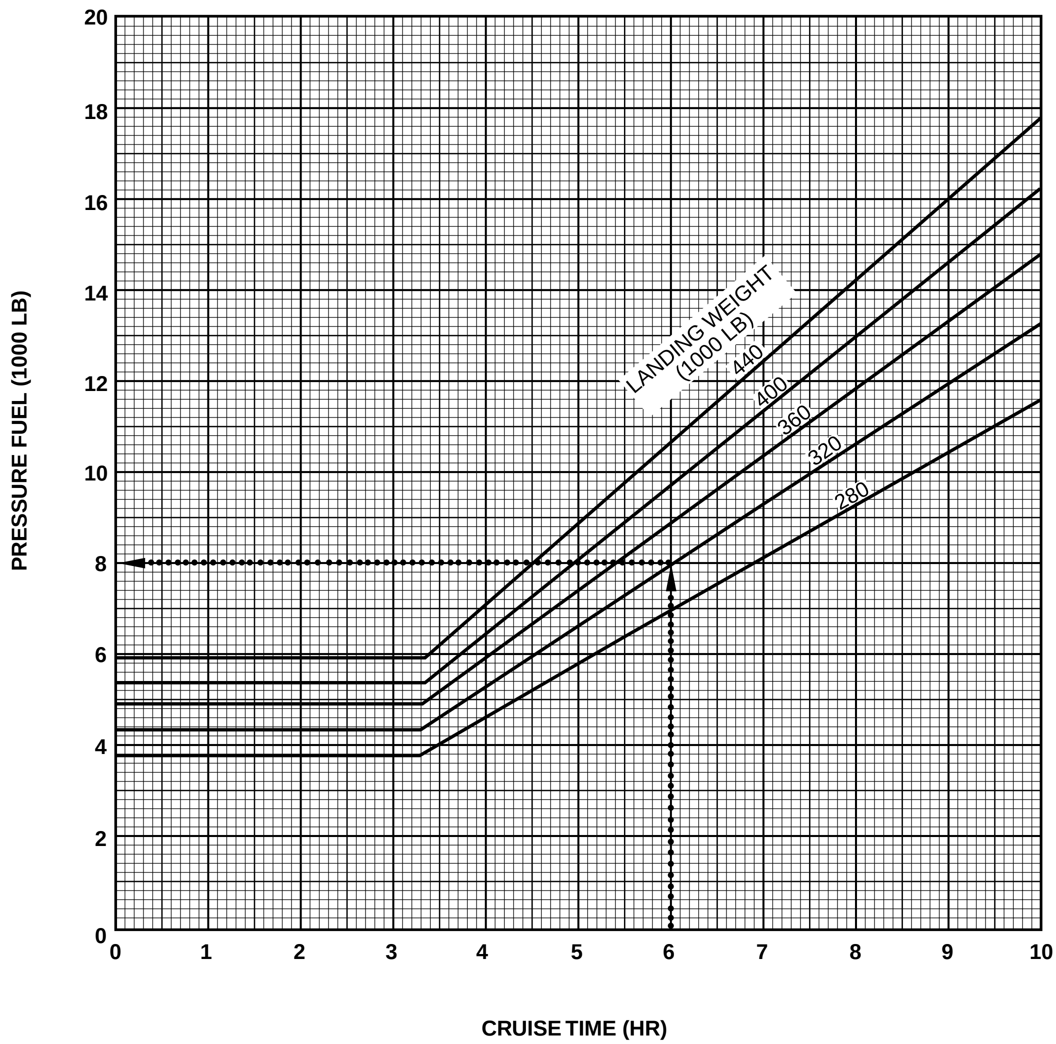


Figure 10-13.

TIME AND FUEL TO ALTERNATE- OPTIMUM ALTITUDE

NOTE:

1. BASED ON LONG RANGE CRUISE AND ENROUTE DESCENT
2. ZERO WIND
3. STANDARD DAY
4. FUEL BURNED VALUES INCLUDE CLIMB, CRUISE, DESCENT, AND ALLOWANCE FOR 15 MINUTES MAXIMUM ENDURANCE AT SEA LEVEL

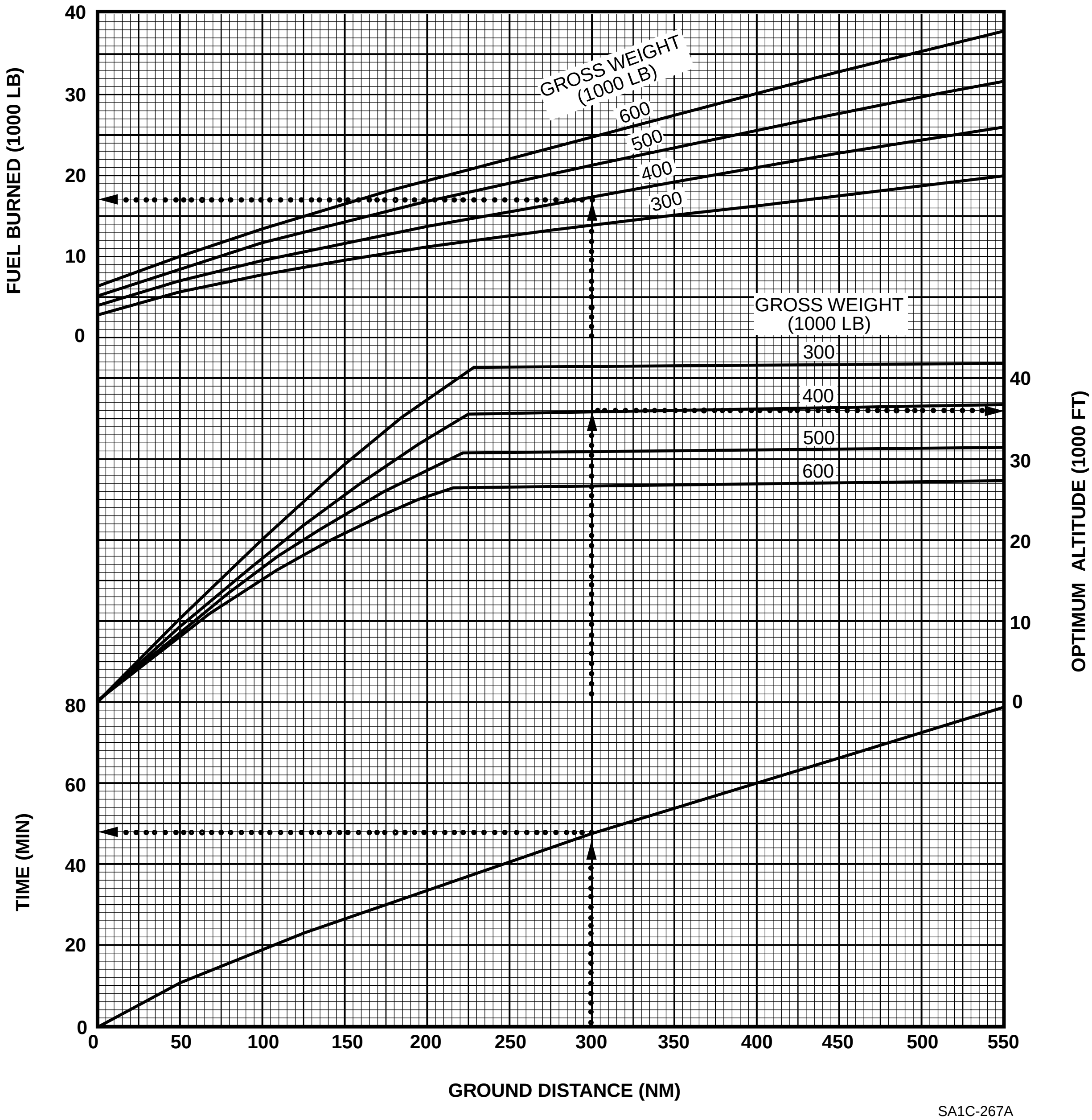


Figure 10-14.

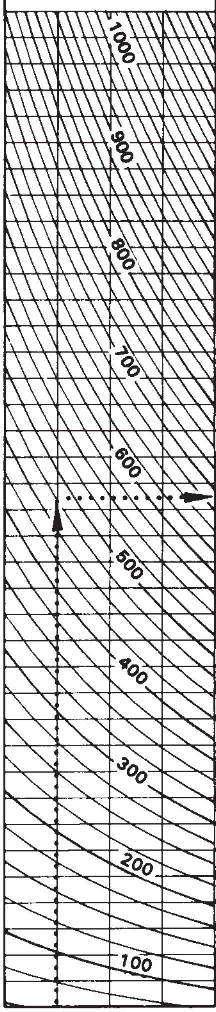
TIME AND FUEL TO ALTERNATE

CONSTANT ALTITUDE
12,000 FT TO 20,000 FT

NOTE:
1. THREE ENGINE OPERATION
2. LANDING WEIGHT = 300,000 LB
3. BASED ON SPEED OF 310 KIAS
4. FLIGHT TIMES ARE BASED ON CLIMB, CRUISE, AND DESCENT AT STANADARD DAY. FOR NON-STANDARD CONDITIONS, ADD ONE MIN/HR PER 10°C BELOW STD. SUBSTRACT ONE MIN/HR PER 10°C ABOVE STD
5. FUEL VALUES INCLUDE CLIMB, CRUISE, DESCENT, AND ALLOWANCE FOR 15 MIN HOLD AT SEA LEVEL

EXAMPLE:
GIVEN: CRUISE ALTITUDE = 14,000 FT
TEMPERATURE = STD DAY
HEADWIND = 50 KNOTS
GROUND DISTANCE = 475 NM
LANDING WEIGHT = 420,000 LB
FIND: TIME AND FUEL TO ALTERNATE
SOLUTION: TIME = 1:31 HOURS:MINUTES
FUEL = 37,700 LB

GROUND DISTANCE (N.M.)



100 HEAD 0 TAIL 100
WIND COMPONENT (KTS)

TOTAL FLIGHT TIME AND TRIP FUEL										
12,000 FT		14,000 FT		16,000 FT		18,000 FT		20,000 FT		FUEL CORRECTION (LB)
TAS 366 KTS		377 KTS		388 KTS		400 KTS		412 KTS		
TIME HR:MIN	FUEL 1000 LB	TIME HR:MIN	FUEL 1000 LB	TIME HR:MIN	FUEL 1000 LB	TIME HR:MIN	FUEL 1000 LB	TIME HR:MIN	FUEL 1000 LB	
2:47	49.9	2:42	48.2	2:38	46.5	2:34	45.0	2:30	43.7	700
2:43	48.8	2:38	47.0	2:34	45.4	2:30	43.9	2:26	42.6	
2:39	47.6	2:35	45.9	2:30	44:3	2:26	42.8	2:23	41.6	
2:35	46.4	2:31	44.7	2:27	43.2	2:23	41.8	2:19	40.6	
2:30	45.2	2:27	43.6	2:23	42.1	2:19	40.7	2:15	39.6	
2:26	44.0	2:23	42.5	2:19	41.0	2:15	39.7	2:12	38.6	600
2:22	42.8	2:19	41.3	2:15	39.9	2:11	38.7	2:08	37.6	
2:18	41.6	2:15	40.2	2:11	38.8	2:08	37.6	2:04	36.6	
2:14	40.4	2:11	39.1	2:07	37.8	2:04	36.6	2:01	35.6	
2:10	39.3	2:07	37.9	2:03	36.7	2:00	35.6	1:57	34.6	
2:06	38.1	2:03	36.8	1:59	35.6	1:56	34.6	1:53	33.7	
2:02	36.9	1:59	35.7	1:56	34.6	1:53	33.5	1:50	32.7	
1:58	35.8	1:55	34.6	1:52	33.5	1:49	32.5	1:46	31.7	500
1:54	34.6	1:51	33.5	1:48	32.4	1:45	31.5	1:42	30.7	
1:49	33.5	1:47	32.4	1:44	31.3	1:41	30.4	1:39	29.7	
1:45	32.3	1:43	31.3	1:40	30.3	1:38	29.4	1:35	28.7	
1:41	31.1	1:39	30.1	1:36	29.2	1:34	28.4	1:32	27.7	
1:37	30.0	1:35	29.0	1:32	28.1	1:30	27.4	1:28	26.7	
1:33	28.8	$\boxed{1:31}$	$\boxed{27.9}$	1:29	27.1	1:26	26.3	1:24	25.7	
1:29	27.6	1:27	26.8	1:25	26.0	1:23	25.3	1:21	24.7	400
1:25	26.5	1:23	25.7	1:21	24.9	1:19	24.3	1:17	23.7	
1:21	25.3	1:19	24.6	1:17	23.9	1:15	23.2	1:13	22.7	
1:17	24.1	1:15	23.4	1:13	22.8	1:11	22.2	1:10	21.7	
1:13	23.0	1:11	22.3	1:09	21.7	1:08	21.2	1:06	20.7	
1:09	21.8	1:07	21.2	1:05	20.6	1:04	20.2	1:02	19.8	
1:04	20.7	1:03	20.1	1:01	19.6	1:00	19.1	0:59	18.8	
1:00	19.5	0:59	19.0	0:58	18.5	0:56	18.1	0:55	17.8	
0:56	18.4	0:55	17.9	0:54	17.5	0:53	17.1	0:52	16.8	300
0:52	17.2	0:51	16.8	0:50	16.4	0:49	16.1	0:48	15.9	
0:48	16.1	0:47	15.7	0:46	15.4	0:45	15.1	0:44	14.9	
0:44	14.9	0:43	14.6	0:42	14.3	0:41	14.1	0:41	13.9	
0:40	13.8	0:39	13.5	0:38	13.3	0:38	13.1	0:37	12.9	
0:36	12.6	0:35	12.4	0:34	12.2	0:34	12.1	0:33	12.0	
0:32	11.5	0:31	11.3	0:31	11.2	0:30	11.1	0:30	11.0	
0:28	10.4	0:27	10.2	0:27	10.1	0:26	10.1	0:26	10.0	200
0:23	9.2	0:23	9.1	0:23	9.1	0:23	9.0	0:22	9.0	
0:19	8.1	0:19	8.0	0:19	8.0	0:19	8.0	0:19	8.1	
0:15	6.9	0:15	6.9	0:15	7.0	0:15	7.0	0:15	7.0	

FUEL CORRECTION FOR EACH 10,000 LB INCREASE IN LANDING WEIGHT

SA1C-268A

Figure 10-15. (Sheet 1)

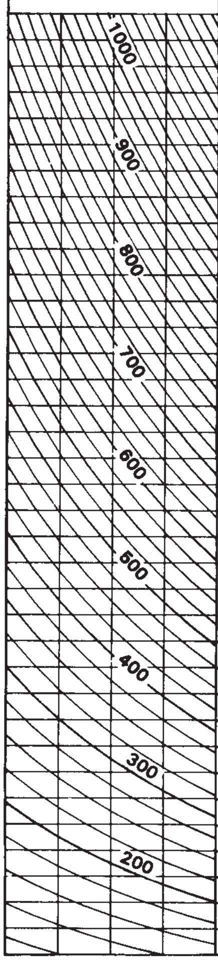
TIME AND FUEL TO ALTERNATE

CONSTANT ALTITUDE
21,000 FT TO 29,000 FT

NOTE:

1. THREE ENGINE OPERATION.
2. LANDING WEIGHT = 300,000 LB.
3. BASED ON SPEED OF 310 KIAS.
4. FLIGHT TIMES ARE BASED ON CLIMB, CRUISE, AND DESCENT AT STANDARD DAY. FOR NON-STANDARD CONDITIONS, ADD ONE MIN/HR PER 10°C BELOW STD. SUBTRACT ONE MIN/HR PER 10°C ABOVE STD.
5. FUEL VALUES INCLUDE CLIMB, CRUISE, DESCENT, AND ALLOWANCE FOR 15 MIN HOLD AT SEA LEVEL.

GROUND DISTANCE (N.M.)



100 HEAD 0 TAIL 100
WIND COMPONENT (KTS)

TOTAL FLIGHT TIME AND TRIP FUEL										
21,000 FT		23,000 FT		25,000 FT		27,000		29,000		FUEL CORRECTION (LB)
TAS 419 KTS		432 KTS		445 KTS		459 KTS		473 KTS		
TIME HR:MIN	FUEL 1000 LB	TIME HR:MIN	FUEL 1000 LB	TIME HR:MIN	FUEL 1000 LB	TIME HR:MIN	FUEL 1000 LB	TIME HR:MIN	FUEL 1000 LB	
2:28	43.2	2:24	42.2	2:20	41.3	2:17	40.3	2:13	39.4	700
2:24	42.2	2:20	41.2	2:17	40.3	2:13	39.4	2:10	38.5	
2:21	41.2	2:17	40.3	2:13	39.4	2:10	38.5	2:07	37.7	
2:17	40.2	2:13	39.3	2:10	38.5	2:07	37.6	2:04	36.8	600
2:13	39.2	2:10	38.3	2:07	37.6	2:04	36.7	2:01	35.9	
2:10	38.2	2:07	37.4	2:03	36.6	2:00	35.8	1:57	35.1	
2:06	37.2	2:03	36.4	2:00	35.7	1:57	34.9	1:54	34.2	
2:03	36.2	2:00	35.5	1:57	34.8	1:54	34.0	1:51	33.3	
1:59	35.3	1:56	34.5	1:53	33.9	1:50	33.1	1:48	32.5	
1:56	34.3	1:53	33.6	1:50	32.9	1:47	32.2	1:45	31.6	500
1:52	33.3	1:49	32.6	1:46	32.0	1:44	31.3	1:42	30.7	
1:48	32.3	1:46	31.7	1:43	31.1	1:41	30.4	1:38	29.8	
1:45	31.3	1:42	30.7	1:40	30.2	1:37	29.5	1:35	29.0	
1:41	30.4	1:39	29.8	1:36	29.2	1:34	28.6	1:32	28.1	
1:38	29.4	1:35	28.8	1:33	28.3	1:31	27.7	1:29	27.2	
1:34	28.4	1:32	27.9	1:30	27.4	1:28	26.8	1:26	26.4	
1:30	27.4	1:28	26.9	1:26	26.5	1:24	25.9	1:22	25.5	400
1:27	26.5	1:25	26.0	1:23	25.5	1:21	25.1	1:19	24.6	
1:23	25.5	1:21	25.0	1:19	24.6	1:18	24.2	1:16	23.8	
1:20	24.5	1:18	24.1	1:16	23.7	1:14	23.3	1:13	22.9	
1:16	23.5	1:14	23.1	1:13	22.8	1:11	22.4	1:10	22.0	
1:12	22.5	1:11	22.2	1:09	21.8	1:08	21.5	1:07	21.2	
1:09	21.6	1:07	21.2	1:06	20.9	1:05	20.6	1:03	20.3	
1:05	20.6	1:04	20.3	1:03	20.0	1:01	19.7	1:00	19.4	
1:02	19.6	1:00	19.3	0:59	19.1	0:58	18.8	0:57	18.6	300
0:58	18.7	0:57	18.4	0:56	18.2	0:55	17.9	0:54	17.7	
0:55	17.7	0:53	17.5	0:52	17.3	0:52	17.1	0:51	16.9	
0:51	16.7	0:50	16.5	0:49	16.4	0:48	16.2	0:48	16.0	
0:47	15.8	0:47	15.6	0:46	15.5	0:45	15.3	0:44	15.2	
0:44	14.8	0:43	14.7	0:42	14.6	0:42	14.4	0:41	14.3	
0:40	13.8	0:40	13.7	0:39	13.6	0:38	13.5	0:38	13.4	
0:37	12.9	0:36	12.8	0:36	12.7	0:35	12.7	0:35	12.6	
0:33	11.9	0:33	11.9	0:32	11.8	0:32	11.8	0:32	11.7	200
0:29	11.0	0:29	10.9	0:29	10.9	0:29	10.9	0:28	10.9	
0:26	10.0	0:26	10.0	0:25	10.0	0:25	10.0	0:25	10.0	
0:22	9.0	0:22	9.1	0:22	9.1	0:22	9.2	0:22	9.3	

FUEL CORRECTION FOR EACH 10,000 LB INCREASE IN LANDING WEIGHT

SA1C-269A

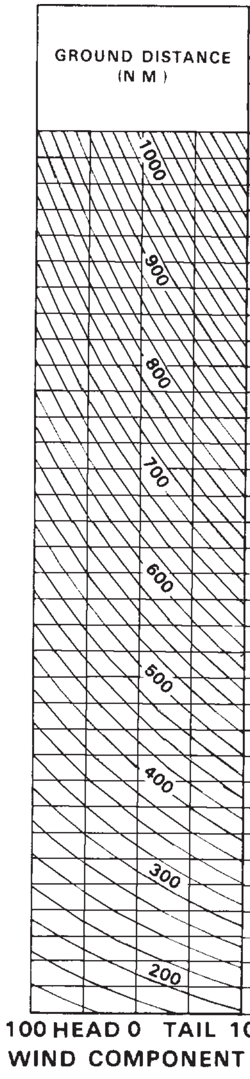
Figure 10-15. (Sheet 2)

TIME AND FUEL TO ALTERNATE

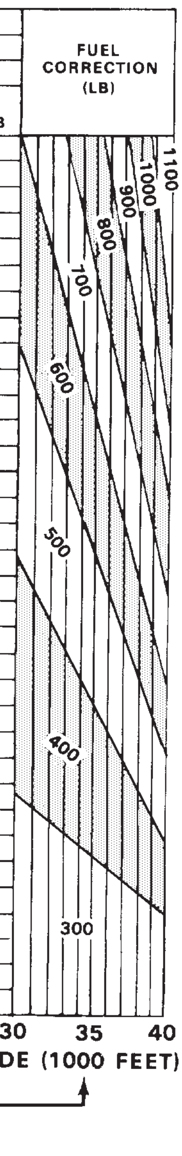
CONSTANT ALTITUDE
31,000 FT TO 39,000 FT

NOTE:

1. THREE ENGINE OPERATION.
2. LANDING WEIGHT = 300,000 LB.
3. BASED ON SPEED OF MACH 0.82.
4. FLIGHT TIMES ARE BASED ON CLIMB, CRUISE, AND DESCENT AT STANDARD DAY. FOR NON-STANDARD CONDITIONS, ADD ONE MIN/HR PER 10°C BELOW STD. SUBTRACT ONE MIN/HR PER 10°C ABOVE STD.
5. FUEL VALUES INCLUDE CLIMB, CRUISE, DESCENT, AND ALLOWANCE FOR 15 MINUTES HOLD AT SEA LEVEL.



TOTAL FLIGHT TIME AND TRIP FUEL									
31,000 FT		33,000 FT		35,000 FT		37,000 FT		39,000 FT	
TAS 481 KTS		477KTS		473 KTS		470 KTS		470 KTS	
TIME HR:MIN	FUEL 1000 LB	TIME HR:MIN	FUEL 1000 LB	TIME HR:MIN	FUEL 1000 LB	TIME HR:MIN	FUEL 1000 LB	TIME HR:MIN	FUEL 1000 LB
2:11	38.4	2:12	37.0	2:13	35.8	2:14	35.1	2:14	34.6
2:08	37.5	2:09	36.2	2:10	35.1	2:11	34.3	2:11	33.9
2:05	36.7	2:06	35.4	2:07	34.3	2:07	33.6	2:07	33.2
2:02	35.9	2:03	34.6	2:04	33.6	2:04	32.9	2:04	32.5
1:59	35.0	2:00	33.8	2:01	32.8	2:01	32.1	2:01	31.7
1:56	34.2	1:57	33.0	1:57	32.0	1:58	31.4	1:58	31.0
1:53	33.3	1:53	32.2	1:54	31.3	1:55	30.6	1:55	30.3
1:50	32.5	1:50	31.4	1:51	30.5	1:51	29.9	1:51	29.6
1:46	31.7	1:47	30.6	1:48	29.8	1:48	29.2	1:48	28.8
1:43	30.8	1:44	29.8	1:45	29.0	1:45	28.4	1:45	28.1
1:40	30.0	1:41	29.0	1:41	28.2	1:42	27.7	1:42	27.4
1:37	29.2	1:38	28.2	1:38	27.5	1:39	27.0	1:39	26.7
1:34	28.3	1:35	27.4	1:35	26.7	1:35	26.2	1:35	26.0
1:31	27.5	1:31	26.6	1:32	25.9	1:32	25.5	1:32	25.2
1:28	26.6	1:28	25.8	1:29	25.2	1:29	24.7	1:29	24.5
1:25	25.8	1:25	25.0	1:26	24.4	1:26	24.0	1:26	23.8
1:21	25.0	1:22	24.2	1:22	23.7	1:23	23.3	1:23	23.1
1:18	24.1	1:19	23.4	1:19	22.9	1:19	22.5	1:19	22.3
1:15	23.3	1:16	22.7	1:16	22.1	1:16	21.8	1:16	21.6
1:12	22.5	1:12	21.9	1:13	21.4	1:13	21.1	1:13	20.0
1:09	21.6	1:09	21.1	1:10	20.6	1:10	20.3	1:10	20.2
1:06	20.8	1:06	20.3	1:07	19.9	1:07	19.6	1:07	19.5
1:03	19.9	1:03	19.5	1:03	19.1	1:04	18.9	1:04	18.8
1:00	19.1	1:00	18.7	1:00	18.4	1:00	18.2	1:00	18.0
0:56	18.3	0:57	17.9	0:57	17.6	0:57	17.4	0:57	17.3
0:53	17.5	0:54	17.1	0:54	16.9	0:54	16.7	0:54	16.6
0:50	16.6	0:50	16.4	0:51	16.1	0:51	16.0	0:51	15.9
0:47	15.8	0:47	15.6	0:47	15.4	0:48	15.3	0:48	15.2
0:44	15.0	0:44	14.8	0:44	14.6	0:44	14.6	0:44	14.5
0:41	14.2	0:41	14.0	0:41	13.9	0:41	13.8	0:41	13.8
0:38	13.4	0:38	13.2	0:38	13.2	0:38	13.1	0:38	13.1
0:35	12.5	0:35	12.5	0:35	12.4	0:35	12.4	0:35	12.4
0:32	11.7	0:32	11.7	0:32	11.7	0:32	11.7	0:32	11.7
0:28	10.9	0:28	10.9	0:28	10.9	0:28	10.8	0:28	10.8



SA1C-270A

Figure 10-15. (Sheet 3)

RUNWAY WEIGHT BEARING CAPACITY CLASSIFICATION NUMBERS

NOTE:
1. MEDIUM SUBGRADE
2. PAVEMENT LCN FROM DMAAC IS LCN/LCG UNLESS OTHERWISE NOTED

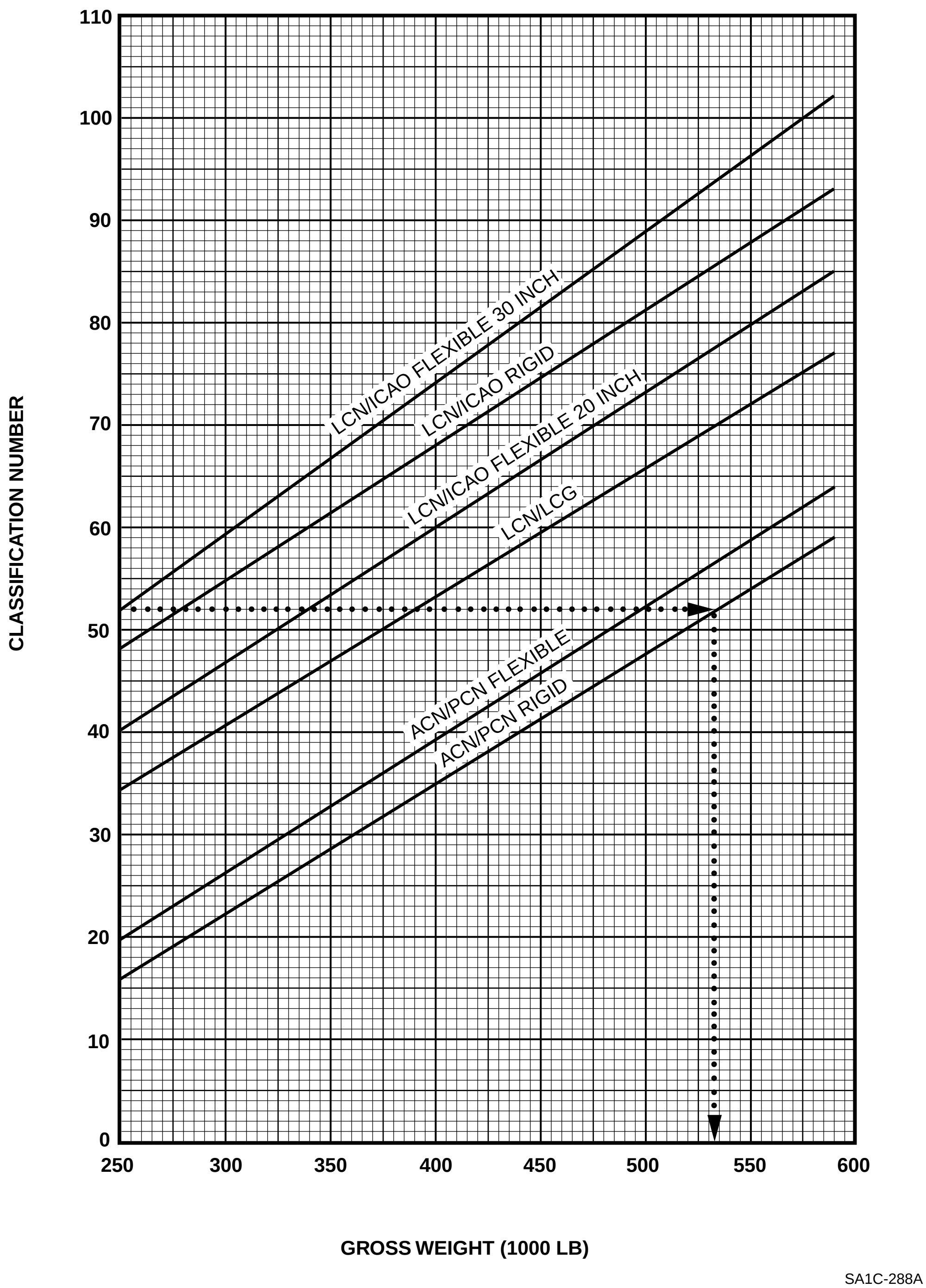


Figure 10-16.

RUNWAY WEIGHT BEARING CAPACITY WHEEL CONFIGURATION RATINGS

NOTE:
MEDIUM SUBGRADE

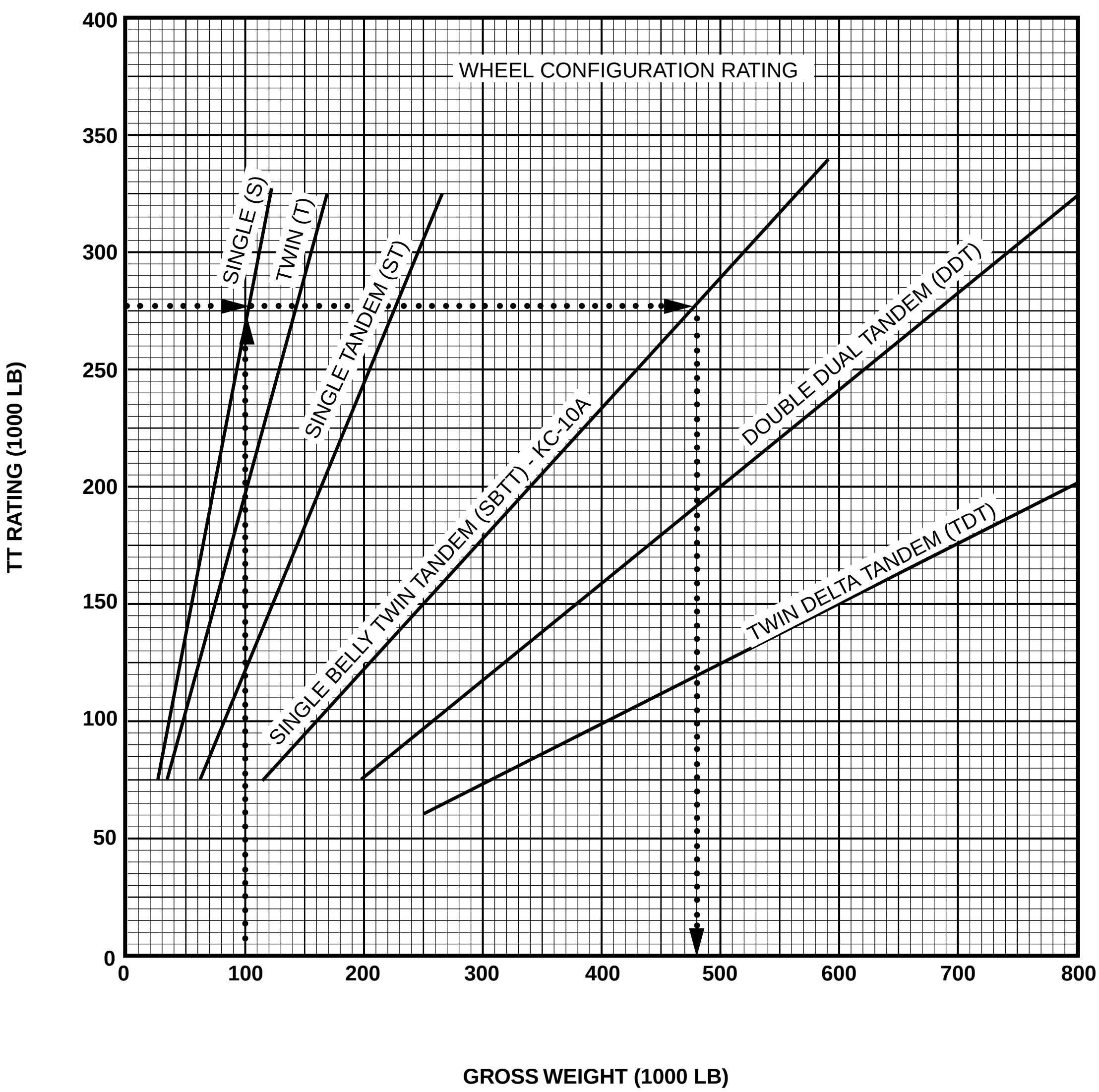


Figure 10-17.

RUNWAY WEIGHT BEARING CAPACITY OVERLOAD OPERATION

PERCENTAGE OF OVERLOAD OPERATION					
AIRFIELD STRENGTH RATING	NUMBER OF OVERLOAD FLIGHTS				
	1	10	100	1,000	10,000
STRONG	-	0.002%	0.02%	0.2%	2.0%
MEDIUM	0.001%	0.01%	0.1%	1.0%	10.0%
WEAK	0.004%	0.04%	0.4%	4.0%	40.0%

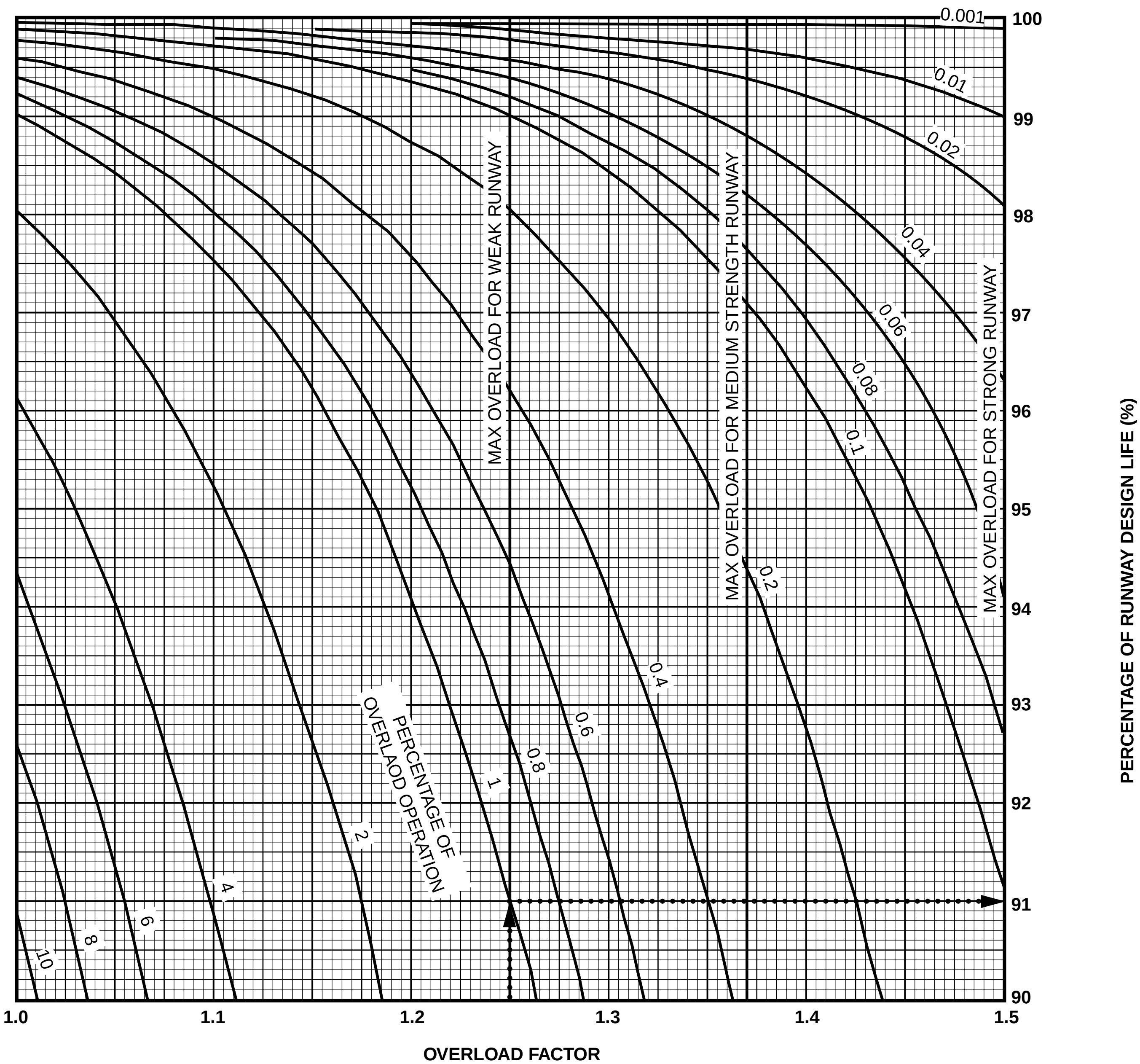


Figure 10-18.

All data on pages 10-58 through 10-59/(10-60 Blank), including Figure 10-19, deleted.

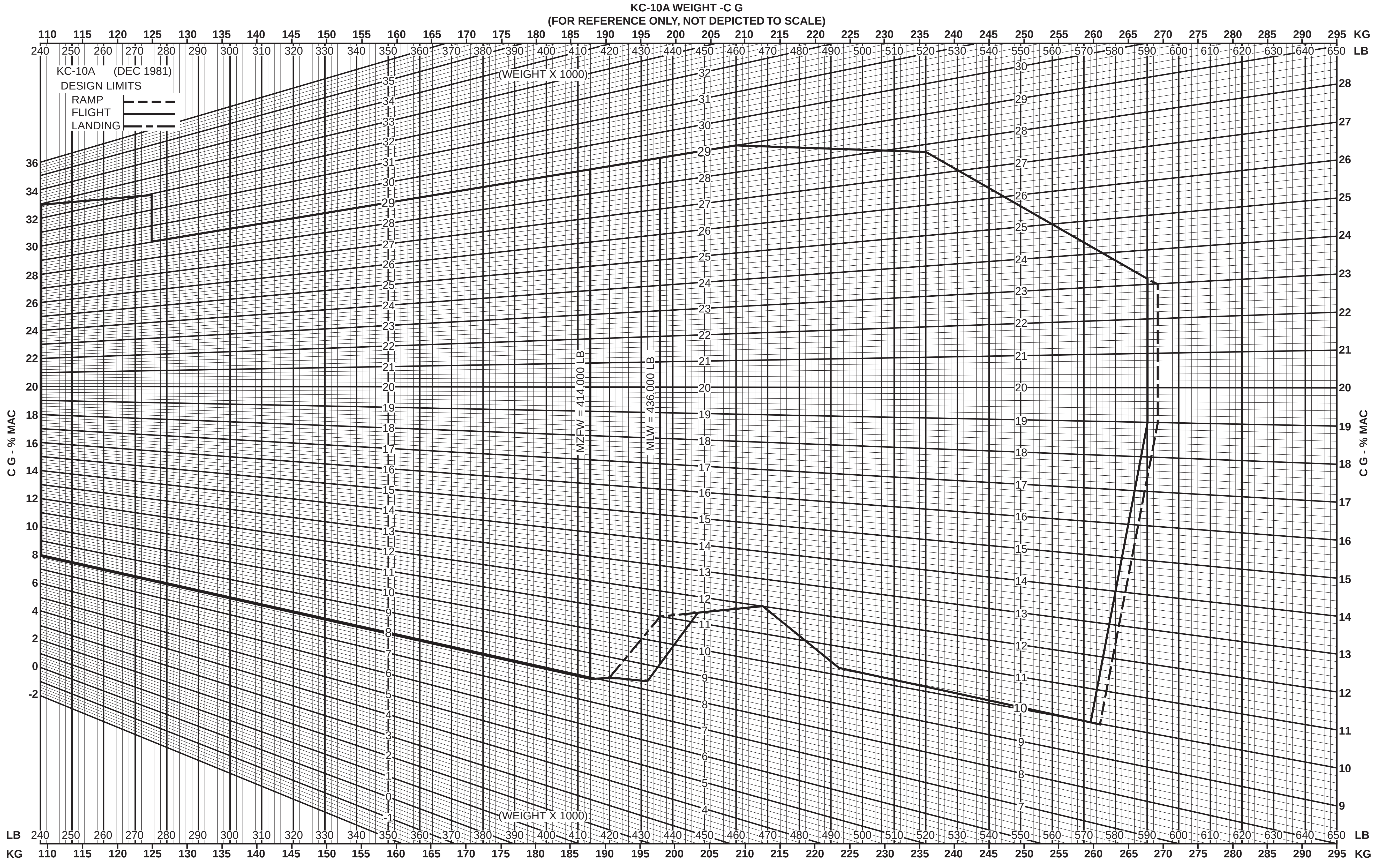

KC-10A WEIGHT -C G
(FOR REFERENCE ONLY, NOT DEPICTED TO SCALE)
KC-10A (DEC 1981)
DESIGN LIMITS
RAMP
FLIGHT
LANDING
(WEIGHT X 1000)
MZFW = 414,000 LB
MLW = 436,000 LB
C G - % MAC
KG
LB
SA1C-292A

Figure 10-20.

SECTION XI

DRIFTDOWN

TABLE OF CONTENTS **Page**

LIST OF CHARTS

INTRODUCTION

This section provides the information necessary to plan and execute a one engine or two engine operating driftdown. Performance charts in this section are for one engine operation and include driftdown speeds, terrain clearance, altitude capability, and integrated range and time.

All driftdown data in this section are derived from flight test results corrected to a net level of performance that provides both an altitude capability margin and a fuel consumption markup. Performance data for two engine operation altitude capability and integrated range and time are presented in Section V.

DEFINITION OF TERMS

DRIFTDOWN

Driftdown is a forced descent resulting from the loss of power from one or more engines. Driftdown is a necessary flight procedure in the event of engine failure when cruising above the maximum service ceiling for the number of engines still in operation.

DRIFTDOWN ALTITUDE CAPABILITY

The driftdown altitude capability is the maximum altitude which can be maintained for one engine operation at maximum continuous thrust based on flying at the recommended driftdown speed.

CRUISE-CLIMB ALTITUDE CAPABILITY

The cruise-climb altitude capability is the maximum altitude which can be maintained by flying at 270 KIAS with one engine operating at maximum continuous thrust.

CRUISE-CLIMB SEGMENT

The cruise-climb segment is the flight segment used after driftdown and is based on operating at the maximum continuous thrust rating and a speed of 270 KIAS. The cruise-climb flight procedure yields maximum range after driftdown.

GROSS VERSUS NET PERFORMANCE

Gross performance is the actual airplane performance capability. Net performance is the gross performance level minus 0.3 percent gradient capability. Net performance yields approximately 2,000 feet lower altitude capability. In addition, the use of net performance provides a five percent fuel flow increase relative to the gross performance level. All charts in this section present net driftdown performance.

DRIFTDOWN PROCEDURES

If engine failure should occur, perform driftdown in the following manner:

1. Advance throttle(s) on remaining engine(s) to the maximum continuous rating.

2. Maintain altitude until airspeed decreases to approximately Mach 0.82/280 KIAS and start driftdown.

3. Establish correct driftdown speed using figure 11-2.

4. For one engine operating, determine the bottom of driftdown altitude capability from figure 11-6 or, if terrain clearance requirements exist, determine the terrain clearance capability from figures 11-4 and 11-5. For two engines operating determine the altitude capability from Section V.

NOTE

> Fuel dumping may be required in order to meet minimum terrain clearance requirements. However, fuel dumping should be minimized so as not to adversely affect the range capability of the airplane.

5. Descend to the bottom-of-driftdown altitude using maximum continuous thrust while maintaining an optimum driftdown speed.

6. After reaching the bottom-of-driftdown altitude establish the cruise airspeed corresponding to the number of operating engines and proceed to destination.

WARNING

> If both wing engines fail, loss of air-conditioning capability will result in loss of cabin pressurization. Passengers will have 22 minutes of oxygen from the time of the second engine failure. If passengers are on board, activate the APU to attempt maintaining cabin pressurization and begin normal driftdown procedure. If cabin pressurization cannot be maintained and terrain clearance and distance to a suitable landing field are not limiting, descend to 13,000 feet (or 10,000 feet, if possible) within 22 minutes of the second engine failure. Otherwise, follow the normal driftdown procedure and fly the recommended driftdown flight profile.

FACTORS AFFECTING DRIFTDOWN PERFORMANCE

THRUST

All driftdown information is based on the maximum continuous thrust rating with minimum engine performance. The maximum continuous thrust rating should be used for optimum driftdown performance. Using lower thrust ratings will result in decreased driftdown range and time.

Engine thrust is flat rated with temperature up to a thrust break temperature, after which the thrust decreases with temperature.

OUTSIDE AIR TEMPERATURE

Data are presented for Std to Std +15°C, which reflects the flat rated engine thrust level, and at Std +20°C where the thrust is based on temperatures greater than the break temperature.

The deviation of the outside air temperature above standard day also affects the relationship of pressure height versus geometric height. Since obstacle heights are presented as geometric heights and performance data are presented based on pressure heights, figure 11-3 has been included to allow conversion of geometric height to pressure height for temperature deviations of ±20°C from standard day.

SPEED

Driftdown should be flown at the speeds recommended in figure 11-2 to obtain optimum driftdown performance. Deviations of ±10 knots from these recommended speeds will result in negligible losses.

After reaching the bottom of driftdown, the airplane should be accelerated to the cruise-climb speed of 270 KIAS for one engine operating or the long range cruise speed with two engines operating. Maintain this speed for the remainder of the mission.

DRAG

All driftdown charts and information presented are for the clean configuration.

Any increase in drag above that defined for the clean configuration will result in reduced (worse) driftdown performance.

Under circumstances where additional drag is unavoidable, reduce the terrain-clearance altitude capability and the bottom-of-driftdown altitude capability by 125 feet for each unit of drag index. In addition, increase the fuel consumed during driftdown by 100 pounds per unit of drag index.

AIR-CONDITIONING BLEED

The KC-10A is equipped with a ram air ventilation system which allows the air-conditioning system to be shut off below 10,000 feet. Turning off the air-conditioning system reduces the bleed air required from the engine, therefore increasing the thrust available and the altitude capability. If this bleed condition is selected, the air-conditioning pack must subsequently be turned on during the cruise-climb operation if 10,000 feet is exceeded. The recommended procedure is to level off at 10,000 feet with the air-conditioning pack off and hold 270 KIAS by throttling back until the cruise-climb weight with one air-conditioning pack is attained, as shown in figure 11-7. This will require approximately 14,000 pounds of fuel burnoff at 10,000 feet. After this weight is reached, the air-conditioning pack is turned on, the throttle advanced to the maximum continuous thrust rating, and the airplane is again climbed at 270 KIAS.

ICE PROTECTION BLEED

Use of the ice protection bleed results in a reduction in the available thrust. Consequently, with engine plus wing ice protection ON, the terrain-clearance altitude and the bottom-of-driftdown altitude capabilities are reduced by 1000 feet. The time, distance, and fuel to reach bottom of driftdown are not significantly affected by usage of ice protection bleed.

WEIGHT

The airplane weight has a large influence on the driftdown. The driftdown path, altitude capability and specific range data are all dependent on the weight.

When the gross weight is such that the driftdown path or the driftdown altitude capability causes terrain clearance problems, the gross weight must be reduced by fuel dumping.

The fuel dump rate may be assumed to be 5,000 pounds per minute. If dumping 30,000 pounds or less, the assumption of an instantaneous airplane weight reduction produces negligible differences in the driftdown profile.

ALTITUDE

The terrain clearance charts, figures 11-4 and 11-5 are based on driftdown from 29,000 feet. If the actual top of driftdown altitude is above 29,000 feet, the fuel burned, distance and time to driftdown increase slightly; however, the differences from the chart values are negligible.

If the top-of-driftdown altitude is less than 29,000 feet, the fuel burned, distance and time to driftdown are less. The recommended procedure for determining these values is to use the terrain clearance charts, first to find the values based on driftdown from 29,000 feet and second to find the incremental values to driftdown from

29,000 feet to the actual top-of-driftdown altitude. Subtract the incremental values of fuel burned, distance, and time from the value based on 29,000 feet top-of-driftdown altitude to obtain the correct values of fuel burned, distance, and time from the actual top-of-driftdown altitude.

TWO ENGINE DRIFTDOWN

Charts of altitude capability and terrain clearance for the two engines operating condition are not provided in this section since reasonable cruise altitudes sufficient for all terrain clearance can be maintained at normal weights for two engine operation.

Conservative information for flight planning may be obtained by assuming the airplane instantaneously descends to the altitude that can be maintained with two engines operating at maximum continuous thrust (refer to Section V). The two engine operating specific range, or integrated range data presented in Section V may be used to plan the remainder of the mission. For extended operation, climbing to higher altitudes should be considered. Optimum altitude data are given in Section V.

CHART EXPLANATION AND EXAMPLE PROBLEMS

N_1 SETTING

Figure 11-1 presents the N_1 setting for the Maximum Continuous Thrust rating. See Section II for chart explanation.

DRIFTDOWN SPEEDS

Figure 11-2 presents driftdown speed versus gross weight and altitude. These data are applicable for both one and two engine operation.

Example 1:

Given:

Gross Weight = 470,000 Pounds

Altitude = 30,000 Feet

Find:

Driftdown Speed

Solution:

Enter figure 11-2 with the gross weight and altitude and read a driftdown speed of 278 KIAS.

GEOMETRIC ALTITUDE TO PRESSURE ALTITUDE CONVERSION

Figure 11-3 is provided to allow geometric altitudes to be converted to pressure altitudes for outside air temperature deviations from standard day. Data are presented at Std and Std ±20°C; these data may be linearly interpolated for intermediate temperatures.

Example 2:

Given:

Geometric Altitude = 12,000 Feet

Temperature = Std +20°C

Find:

Pressure Altitude

Solution:

Enter figure 11-3 with the geometric altitude. Use the Std +20°C line to determine the pressure altitude as 11,200 feet.

TERRAIN CLEARANCE

The fuel burned, distance, and time to driftdown, as well as terrain clearance information, may be determined from figures 11-4 and 11-5. Figure 11-4 presents data for Std to Std +15°C and figure 11-5 presents Std +20°C data.

These charts are based on a top-of-driftdown altitude of 29,000 feet with one air-conditioning pack on above 10,000 feet and both air-conditioning packs off below 10,000 feet.

Example 3:

Given:

Top-of-Driftdown Gross Weight = 430, 000 Pounds

Temperature = Std +10°C

Tailwind = 50 Knots

Ice Protection Off

Drag Index = 0

Find:

Bottom-of-Driftdown Altitude

Fuel Burned, Distance, and Time Required to Driftdown

Solution:

Enter figure 11-4 with 430,000 pounds and read across to the bottom of driftdown line.

Interpolate for the bottom-of-driftdown altitude:

Altitude = 7,100 Feet

Interpolate for the fuel burned:

Fuel Burned = 18,000 Pounds

Read down to the time scale:

Time = 73 Minutes

Correct for 50-knot tailwind and read the ground distance:

Ground Distance = 442 NM

If terrain is higher than 7,100 feet pressure altitude (7,350 feet geometric altitude) anywhere along the driftdown path, terrain clearance must be checked as in example 4.

Example 4:

Given:

Critical terrain at 8,000 feet geometric altitude and 200 nautical miles ground distance from engine failure.

Temperature = Std +20°C

Headwind = 50 Knots

Ice Protection Off

Drag Index = 0

Top-of-Driftdown Gross Weight = 450, 000 Pounds

Find:

Maximum Allowable Top-of-Driftdown Weight

Fuel Dumping Requirements

Bottom-of -Driftdown Altitude

Fuel Burned, Distance, and Time Required to Driftdown

Solution:

Enter figure 11-3 with 8,000 feet geometric height and find the pressure altitude:

Pressure Altitude = 7,460 Feet

Enter figure 11-5 with the ground distance to the critical terrain and correct for 50-knot headwind to find the air distance:

Air Distance = 236 NM

Read up to the terrain height to determine the maximum allowable top-of-driftdown gross weight:

Gross Weight = 432,000 Pounds

Since this weight is lower than the actual gross weight at engine failure, fuel must be dumped.

Fuel Dumping = 18,000 Pounds.

Read across to the bottom of driftdown line and interpolate for the bottom-of-driftdown altitude and fuel burned:

Altitude = 5,500 Feet

Fuel Burned = 20,000 Pounds

Read down to the time scale:

Time = 81.5 Minutes

Correct for 50-knot headwind and read the ground distance to the bottom of driftdown:

Ground Distance = 355 NM

DRIFTDOWN ALTITUDE CAPABILITY

Figure 11-6 shows altitude capability for a one engine operating driftdown versus bottom-of-driftdown gross weight and temperature deviations from standard day. This chart is based on driftdown at the recommended driftdown speed. The altitude capability shown is for one air-conditioning pack operating above 10,000 feet and both packs off below 10,000 feet.

Example 5:

Given:

Bottom-of-Driftdown Gross Weight = 445, 000 Pounds

Temperature = Std Day

Ice Protection Off

Drag Index = 0

Find:

Driftdown Altitude Capability

Solution:

Enter figure 11-6 with 445,000 pounds and use the Std to Std +15°C line to determine the driftdown altitude capability of 4,100 feet.

CRUISE-CLIMB ALTITUDE CAPABILITY

The one engine cruise-climb altitude capability may be determined from figure 11-7. The data are presented versus bottom-of-driftdown gross weight and temperature deviation from standard day and are based on the cruise-climb speed of 270 knots. The altitude capability shown is for one air-conditioning pack operating above 10,000 feet and both packs off below 10,000 feet.

INTEGRATED RANGE AND TIME

Figure 11-8 provides integrated range and time for one engine operation following a driftdown. The chart is based on maintaining the bottom-of-driftdown altitude at maximum continuous thrust until the speed increases to 270 KIAS and then cruise-climbing at this speed.

The chart may be used to determine the range and time available from the bottom of driftdown for a known amount of fuel remaining or it may be used to determine the time and fuel required to fly a specified range.

Example 6:

Given:

Bottom-of-Driftdown Gross Weight = 445,000 Pounds

Temperature = Std Day

Ice Protection Off

Drag Index = 0

Find:

Fuel Burnoff and Time Required to Cruise-Climb 1,700 Nautical Miles

Solution:

Enter figure 11-8 with 445,000 pounds and determine values for range and time:

Range = 520 NM

Time = 2.1 Hours

Add 1,700 Nautical Miles to the Value Determined for Range:

1,700 + 520 = 2,220 NM

Determine the gross weight which gives a value of 2,220 nautical miles for range:

Final Gross Weight = 356,000 Pounds

Read the value of time at 356,000 pounds:

Time = 7.7 Hours

The fuel burnoff is the difference between the initial gross weight and the final gross weight:

445,000 - 356,000 = 89,000 Pounds

The time required is the difference between the final time and the initial time:

7.7 - 2.1 = 5.6 Hours

N_1 SETTING FOR MAXIMUM CONTINUOUS THRUST

NOTE:
1. ONE OR TWO ENGINES OPERATING INFLIGHT SETTING OR FOR USE DURING REFUELING.
2. ONE AIR CONDITIONING PACK PER WING ENGINE "ON" LAVATORY AND GALLEY VENTILATION BLEEDS "ON" AND ENGINE AND WING ICE PROTECTION "OFF".
3. FOR OTHER ENGINE BLEED CONDITIONS APPLY APPROPRIATE CORRECTIONS SHOWN.
   A. ENGINE BLEED FOR AIR CONDITIONING PACKS "OFF" AND LAVATORY AND GALLEY VENTILATION BLEEDS "ON" OR "OFF"
   B. ENGINE ICE PROTECTION "ON"
   C. ENGINE AND WING ICE PROTECTION "ON"
   D. ENGINE AND WING ICE PROTECTION "ON" WITH ONE WING ENGINE INOPERATIVE

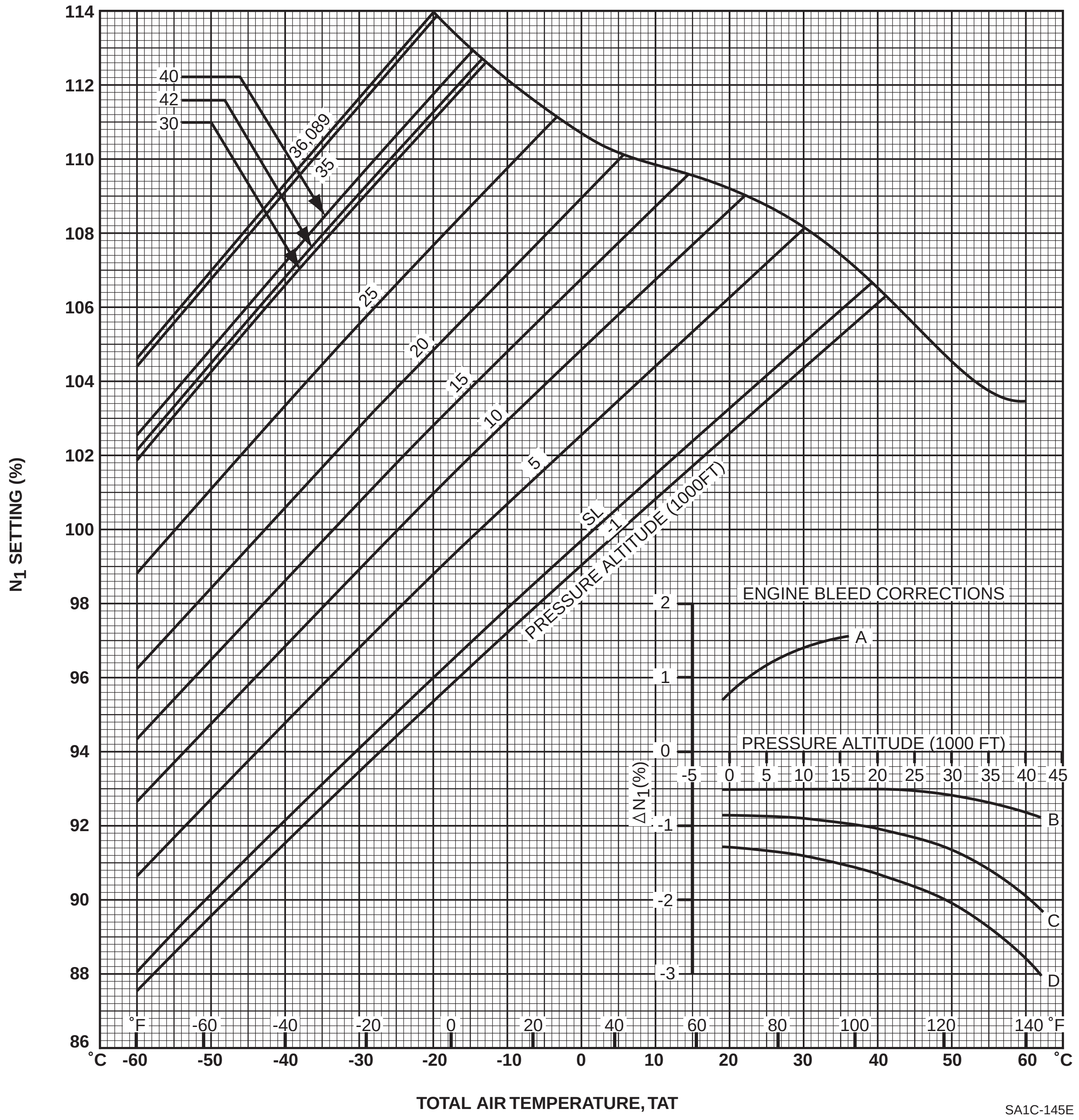


Figure 11-1.

DRIFTDOWN SPEEDS

NOTE:
1. APPLICABLE FOR ONE OR TWO ENGINE OPERATION
2. CLEAN CONFIGURATION

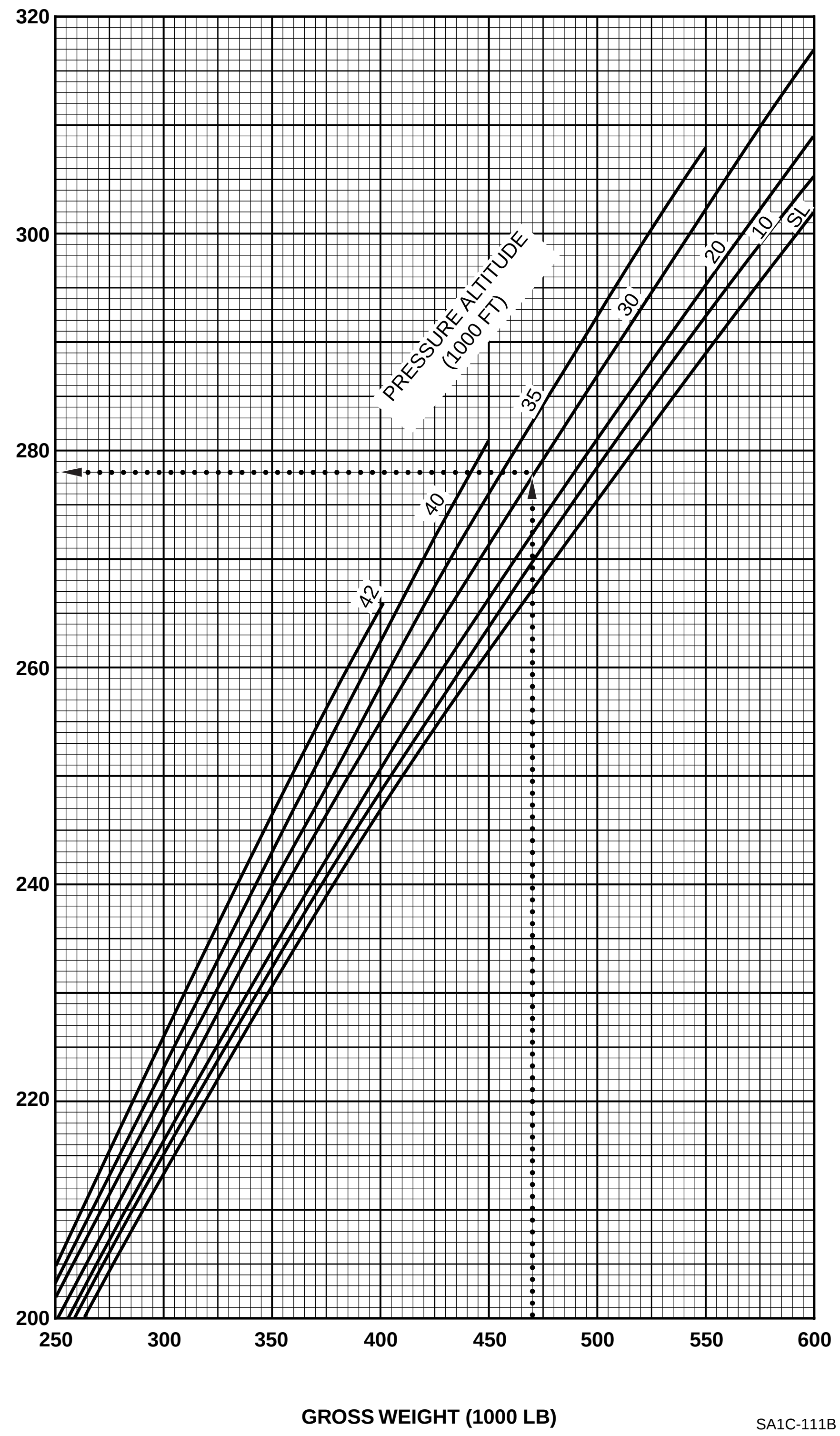


Figure 11-2.

GEOMETRIC ALTITUDE TO PRESSURE ALTITUDE CONVERSION

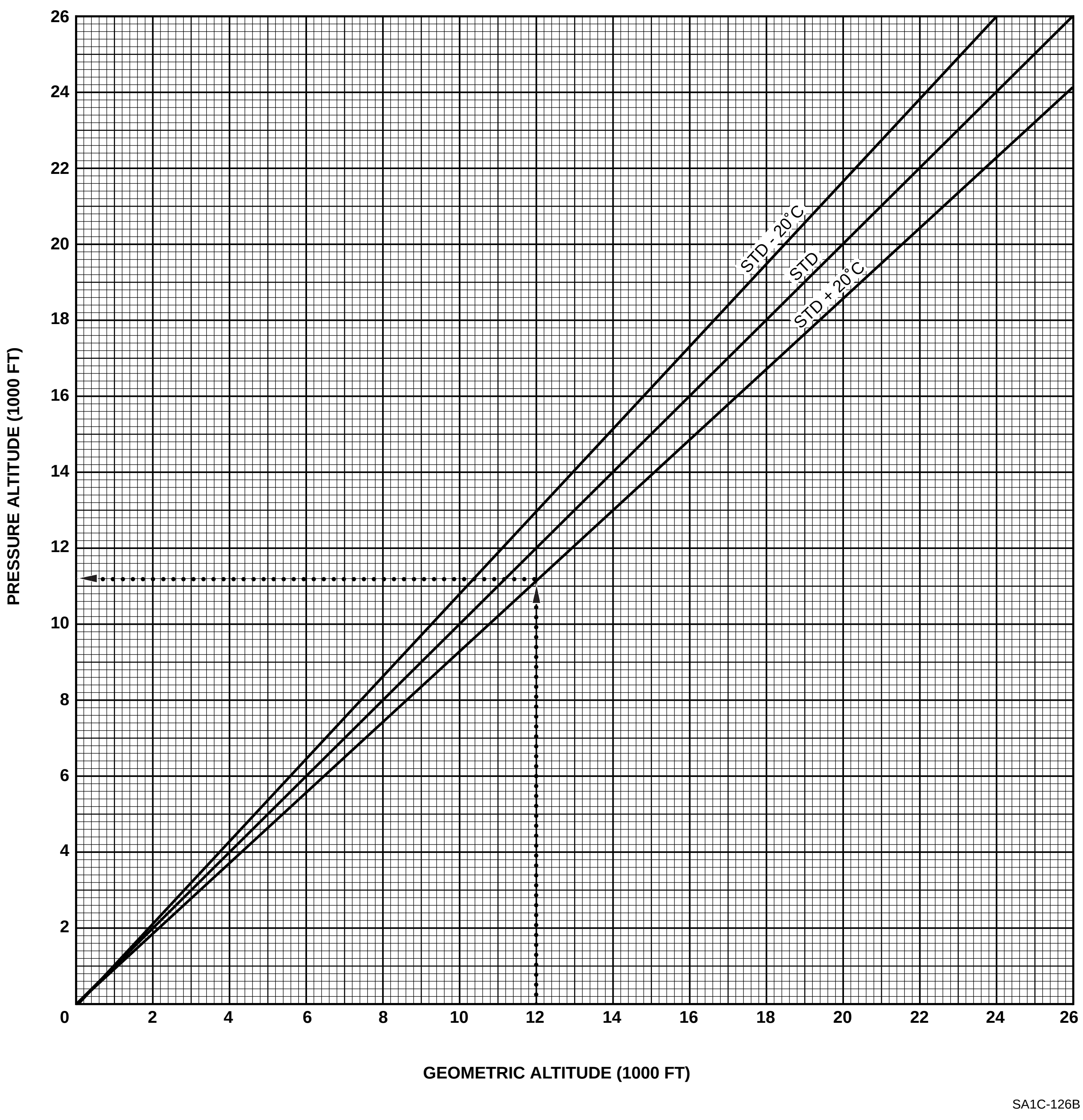


Figure 11-3.

TERRAIN CLEARANCE
STANDARD TO STANDARD + 15°C

NOTE:
1. CLEAN CONFIGURATION
2. MAXIMUM CONTINUOUS THRUST
3. NET PERFORMANCE
4. ICE PROTECTION OFF
5. REDUCE ALTITUDE CAPABILITY BY 125 FEET PER UNIT OF DRAG INDEX
6. REDUCE ALTITUDE CAPABILITY BY 1000 FEET FOR ENGINE PLUS WING ICE PROTECTION ON

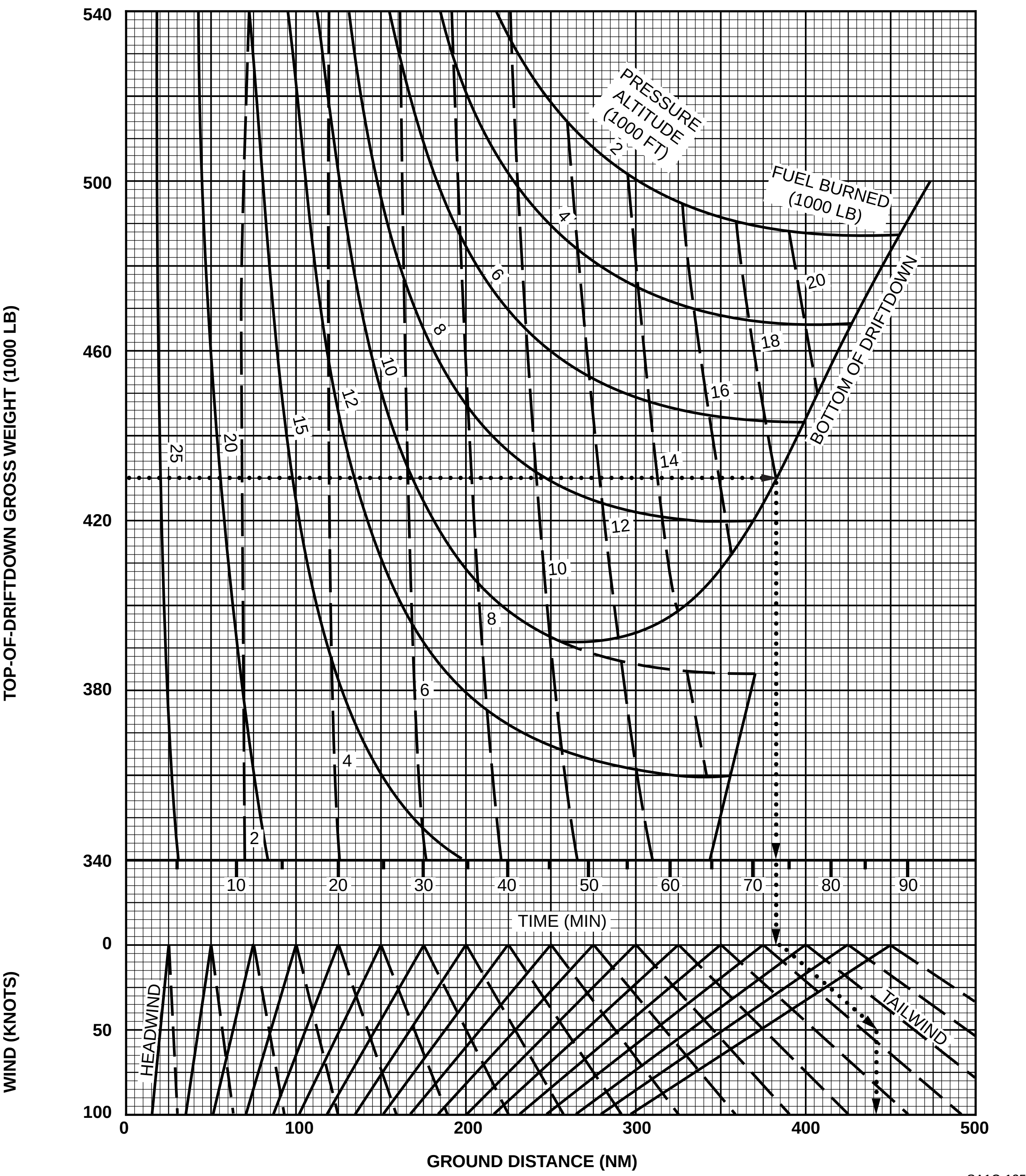


Figure 11-4.

TERRAIN CLEARANCE
STANDARD + 20°C

NOTE:
1. CLEAN CONFIGURATION
2. MAXIMUM CONTINUOUS THRUST
3. NET PERFORMANCE
4. ICE PROTECTION OFF
5. REDUCE ALTITUDE CAPABILITY BY 125 FEET PER UNIT OF DRAG INDEX
6. REDUCE ALTITUDE CAPABILITY BY 1000 FEET FOR ENGINE PLUS WING ICE PROTECTION ON

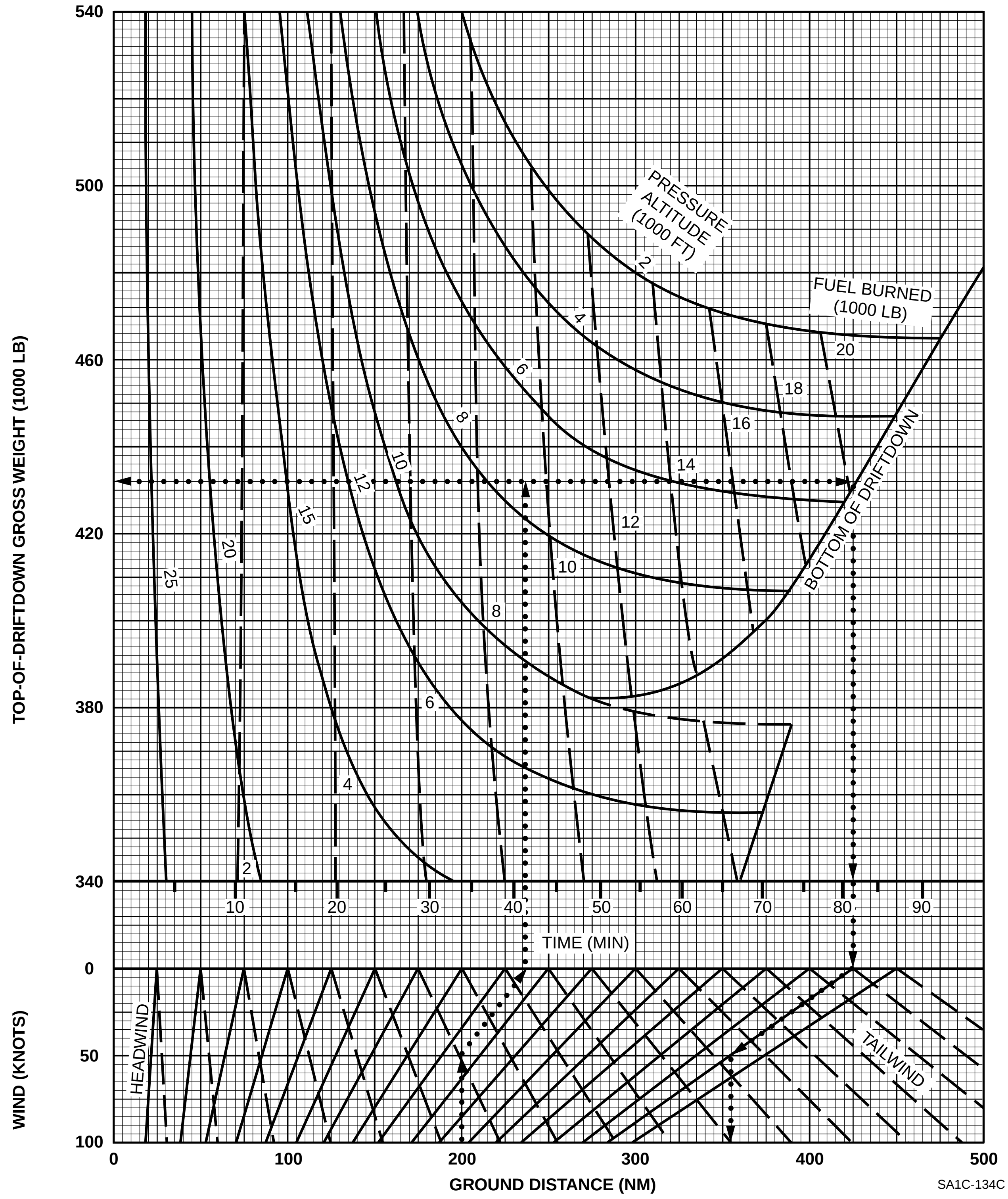


Figure 11-5.

DRIFTDOWN ALTITUDE CAPABILITY

NOTE:
1. CLEAN CONFIGURATION
2. MAXIMUM CONTINUOUS THRUST
3. NET PERFORMANCE
4. DRIFTDOWN SPEED
5. ICE PROTECTION OFF
6. REDUCE ALTITUDE CAPABILITY BY 125 FEET PER UNIT OF DRAG INDEX
7. REDUCE ALTITUDE CAPABILITY BY 1000 FEET FOR ENGINE PLUS WING ICE PROTECTION ON

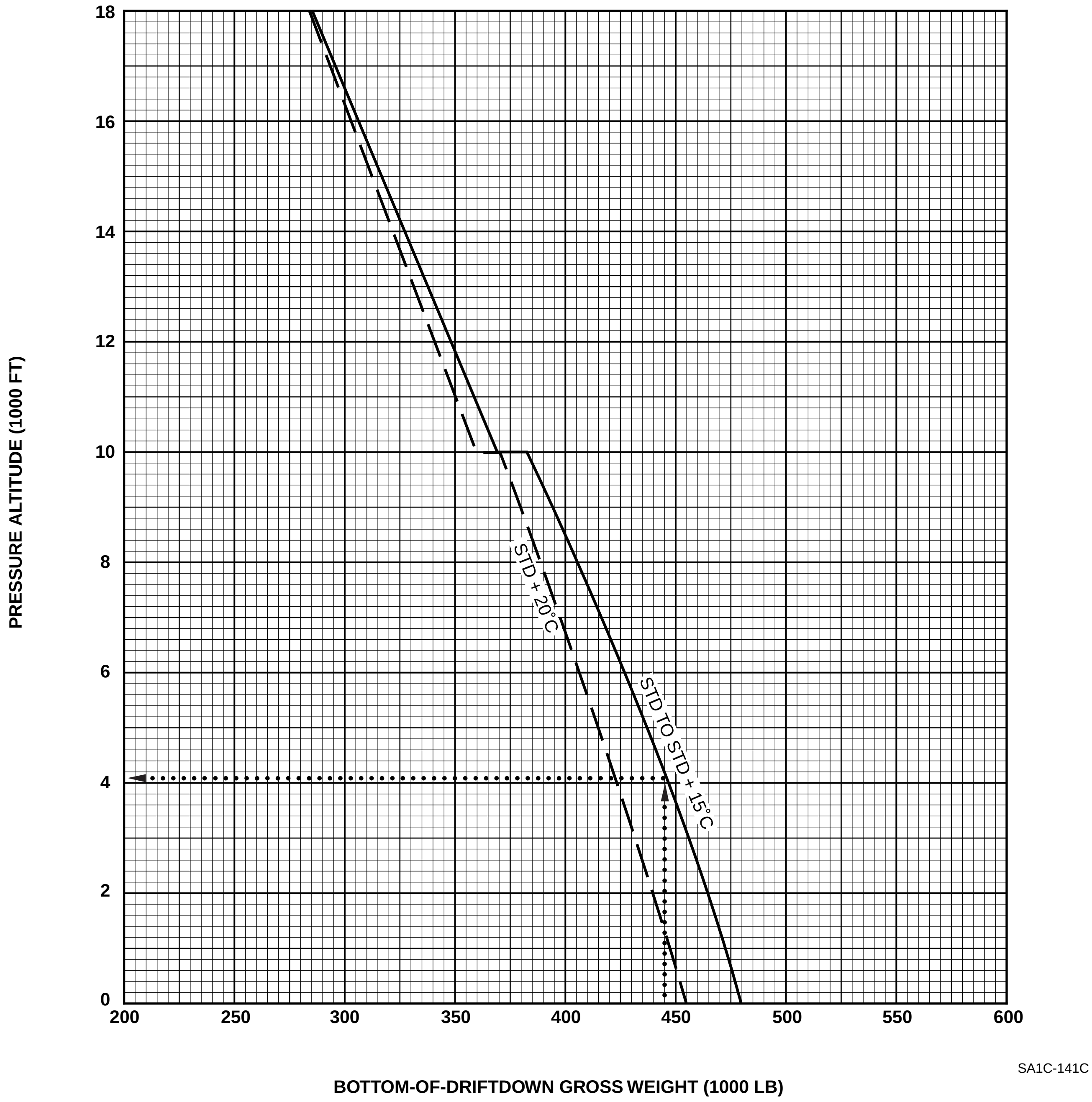


Figure 11-6.

CRUISE-CLIMB ALTITUDE CAPABILITY

NOTE:
1. CLEAN CONFIGURATION
2. MAXIMUM CONTINUOUS THRUST
3. NET PERFORMANCE
4. CRUISE-CLIMB SPEED = 270 KIAS
5. ICE PROTECTION OFF
6. REDUCE ALTITUDE CAPABILITY BY 125 FEET PER UNIT OF DRAG INDEX
7. REDUCE ALTITUDE CAPABILITY BY 1000 FEET FOR ENGINE PLUS WING ICE PROTECTION ON

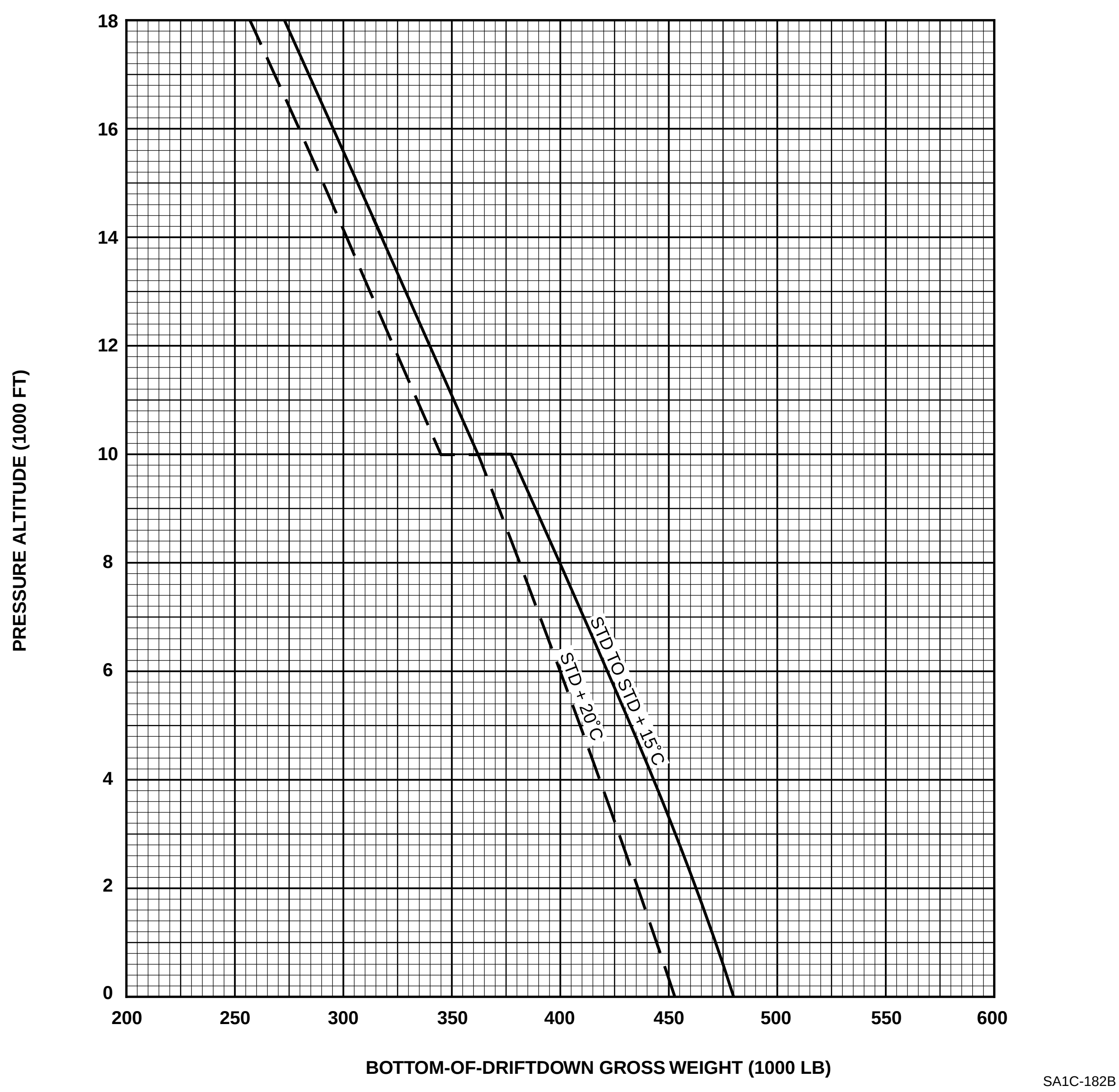


Figure 11-7.

INTEGRATED RANGE AND TIME

NOTE:
1. CLEAN CONFIGURATION
2. MAXIMUM CONTINUOUS THRUST
3. NET PERFORMANCE
4. ICE PROTECTION OFF
5. STD TO STD + 15°C
6. DECREASE RANGE BY 1.5% AND TIME BY 3% FOR STD + 20°C
7. DECREASE TIME AND RANGE BY 0.50% PER UNIT OF DRAG INDEX
8. DECREASE TIME BY 1.5% AND RANGE BY 3% FOR ENGINE PLUS WING ICE PROTECTION ON

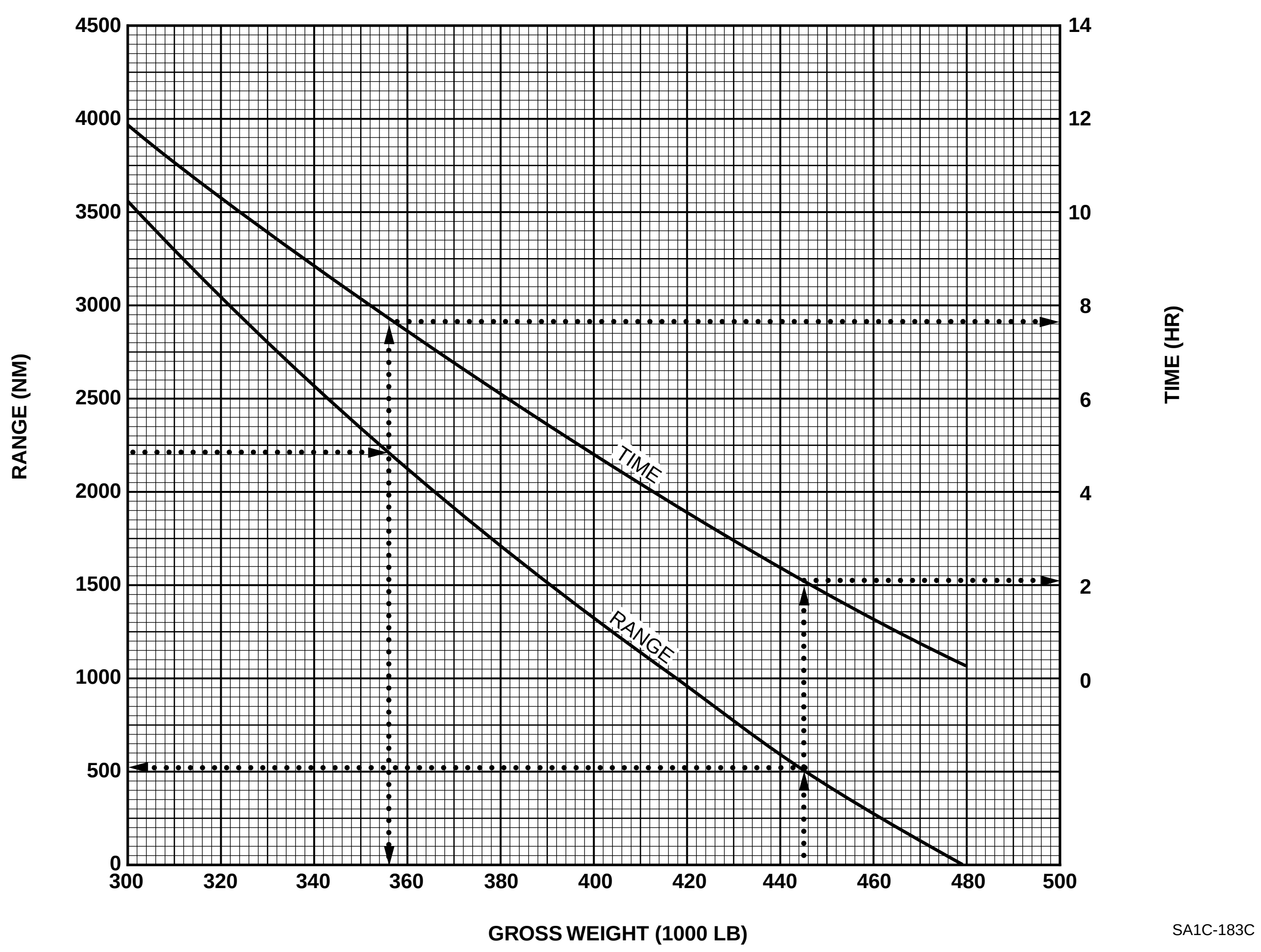


Figure 11-8.

SECTION XII

SUPPLEMENTAL PERFORMANCE

TABLE OF CONTENTS

LIST OF CHARTS

List of Charts (Continued)

List of Charts (Continued)

List of Charts (Continued)

List of Charts (Continued)

INTRODUCTION

The data presented in this section are applicable for airplane configurations not discussed in the preceding sections. These data are included to satisfy performance data requirements established after issuance of the basic manual. The basis for these data is flight-test results although the fuel consumption values are increased five percent relative to the engine specification level.

DEFINITION OF TERMS

CRITICAL FIELD LENGTH (CFL)

The critical field length is the distance required to accelerate with all engines operating to the critical engine failure speed and then either continue to accelerate to the liftoff speed with two engines operating, or stop in the same distance.

ALL ENGINE GROUND ROLL (AEGR)

The all engine ground roll is the distance required for the airplane to accelerate to the liftoff speed with all engines operating.

EFFECTIVE WEIGHT

The effective weight is the actual gross weight multiplied by the load factor imposed on the airplane during banked flight. The use of effective weight instead of the actual gross weight allows aircraft performance to be determined for banked flight.

GEAR DOWN FLIGHT (FERRY OPERATIONS)

This section provides charts, tables and takeoff planning guidance necessary to compute takeoff and flight performance data for gear down flight. Explanation of charts, drag penalties and example problems are provided under CHART EXPLANATION AND EXAMPLE PROBLEMS.

FACTORS AFFECTING TAKEOFF

AUXILIARY POWER UNIT (APU)

The performance data presented in this section are for operation with the APU off. The following corrections must be made to account for APU operation:

Climb Gradient (Figure 12-30): Decrease computed gradient by 0.08 percent.

Critical Field Length (Figure 12-31): Increase Critical Field Length by 0.6 percent.

Maximum Takeoff Gross Weight at Optimum Takeoff Flap Setting (Figure 12-33): Increase the climb gradient required by an increment of 0. 08 percent and reduce runway available by 0.6 percent.

MAW (Figure 12-35): Reduce runway available by 0.6 percent.

Climb Gradient Limiting Weight (Figure 12-36): Decrease Climb Gradient Limiting Weight by 0.4 percent.

CHART EXPLANATION AND EXAMPLE PROBLEMS

MACHMETER CALIBRATION

Machmeter calibration charts are provided for the normal system in figure 12-1, and for the alternate system in figure 12-2. The charts are used to correct indicated Mach number to true Mach number. The calibrations shown are for use with flaps up and with the slats either extended or retracted.

Example 1:

Given:

Indicated Mach Number (Normal System) = 0.70

Find:

True Mach Number

Solution:

Enter figure 12-1 with the indicated Mach number of 0.70 and read up to the diagonal line. The true Mach number is 0.70.

AIRSPEED CALIBRATION ON THE GROUND

Airspeed calibration for the normal system are presented in figure 12-3. These data are used to convert from indicated airspeed and are applicable at and below rotation speed, with the slats extended or retracted.

Example 2:

Given:

Indicated Airspeed = 135 Knots

Flap Setting = 15 Degrees

Find:

Calibrated Airspeed

Solution:

Enter figure 12-3 with the indicated airspeed of 135 knots and a flap setting of 15° to get a ΔV of 0.9 knots. Add this to the indicated airspeed to get a calibrated airspeed of 134.1 knots.

AIRSPEED CALIBRATION

Airspeed calibration charts are provided for the normal static system in figure 12-4 and for the alternate system and the standby indicators in figure 12-5. These data are valid up to 15,000 feet pressure altitude with the slats either extended or retracted and are presented as a function of flap setting and gross weight. The charts convert between indicated airspeed and calibrated airspeed. For airspeeds above 270 KIAS (flaps up) refer to figure 12-6.

Example 3:

Given:

Indicated Airspeed (Normal System) = 140 Knots

Flap Setting = 15 degrees

Weight = 340,000 lbs.

Find:

Calibrated Airspeed

Solution:

Enter figure 12-4, sheet 2, with a 15° flap setting, an indicated airspeed of 140 knots, and a weight of 340,000 lbs. This gives a ΔV of -3.8 knots. Add this to the indicated airspeed to get a calibrated airspeed of 136.2 knots.

INDICATED AIRSPEED VS CALIBRATED AIRSPEED CONVERSION

For high speeds encountered at cruise altitudes, figure 12-6 through 12-8 are presented for the normal system, alternate system, and standby indicators, respectively. These data are for use with flaps up and slats either extended or retracted. The chart is applicable for all altitudes from sea level to 42,000 feet pressure altitude. These data are used to convert between indicated airspeed and calibrated airspeed. The calibrated airspeed is useful in obtaining the equivalent airspeed, which can then be used on charts such as the stall speed charts.

Example 4:

Given:

Indicated Airspeed (Normal System) = 310 Knots

Indicated Pressure Altitude = Sea Level

Find:

Calibrated Airspeed

Solution:

Enter figure 12-6 with an indicated airspeed of 310 knots. Read up to the indicated pressure altitude at sea level. Reaching the vertical scale, the calibrated airspeed is 308 knots.

EQUIVALENT AIRSPEED VS CALIBRATED AIRSPEED CONVERSION

Equivalent airspeed may be converted to calibrated airspeed by entering figure 12-9 with the equivalent airspeed, and reading to the given pressure altitude and/or Mach number to obtain the correction increment. Add this increment to the equivalent airspeed to determine the calibrated airspeed.

CALIBRATED AIRSPEED VS EQUIVALENT AIRSPEED CONVERSION

Calibrated airspeed may be converted to equivalent airspeed by entering figure 12-10 with the calibrated airspeed and reading to the given pressure altitude and/or Mach number to obtain the correction increment. Subtract this increment from the calibrated airspeed to determine the equivalent airspeed.

ALTIMETER CALIBRATION

Altimeter calibration charts are provided for the normal static system in figure 12-11 and for the alternate system and standby indicators in figure 12-12. These data are valid up to 15,000 feet pressure altitude with the slats extended or retracted and are a function of flap setting and gross weight.

Example 5:

Given:

Indicated Airspeed (Normal System) = 170 Knots

Gross Weight = 540,000 lbs.

Flap Setting = 20 Degrees

Indicated Pressure Altitude 5,000 feet

Find:

True Pressure Altitude

Solution:

Enter figure 12-11 with a flap setting of 20°, and indicated airspeed of 170 knots, and a gross weight of 540,000 pounds. This gives Δh of -70 feet. Add this value to the indicated pressure altitude to get a true pressure altitude of 4930 feet.

ALTIMETER CALIBRATION AT CRUISE ALTITUDE

The altimeter calibration charts for high speed operation are presented in figures 12-13 through 12-15 for the normal system, alternate system and standby indicators, respectively. These data are based on the flaps up configuration and are valid from sea level to 42,000 feet pressure altitude.

Example 6:

Given:

Indicated Airspeed (Normal System) = 300 Knots

Indicated Pressure Altitude 15,000 feet

Find:

True Pressure Altitude

Solution:

Enter figure 12-13 with an indicated airspeed of 300 knots and an indicated pressure altitude of 15,000 feet. This gives Δh of -30.5 feet. Add this value to the indicated pressure altitude to get a true pressure altitude of 14,969.5 feet.

1g STALLING SPEED

The 1g stalling speed, V_{S1G}, is the minimum speed at which the lift generated is equal to the weight of the aircraft. V_{S1G} data are presented in figures 12-16 through 12-19.

MINIMUM STALLING SPEED

The minimum stalling speed, V_S, is the minimum speed attained during the flight test stall maneuver and occurs during a period of the stall where the lift generated is less than the weight of the aircraft. V_S is less than the lg stalling speed. V_S data are presented in figures 12-20 through 12-26.

CLEAN-CONFIGURATION STALL BOUNDARY

The speed schedule shown in figure 12-28 defines the minimum allowable airspeeds for maintaining flight without reaching the clean-configuration stall speed. The speed schedule shown should be avoided because moderate to heavy buffet may be encountered since the margin to stall is minimal. Inadvertent speed reductions below this speed schedule due to maneuver requirements or other reasons can result in clean-configuration stall. All the charted speeds are presented at the most forward CG position, 8% MAC, and at zero degrees bank angle. Correction for non-zero bank angles are provided in figure 12-29.

NOTE

- The clean-configuration stall boundary speed must not be confused with the cruise buffet-onset boundary. The stall-boundary speed is much closer to the stalling speed and results in more severe airframe buffet than does the cruise buffet-onset speed.
- Buffet characteristics in the clean configuration are discussed in the Limitations Section of TO 1C-10(K)A-1.

CLIMB GRADIENT

The climb gradient data presented in figure 12-30 are based on climbout at V_2 with two engines operating, the gear retracted, and with the airplane in the takeoff flap/slat configuration. The climb gradient is used to check obstacle clearance capability. Figure 12-30 may also be used to determine the climb gradient limiting weight or obstacle clearance limiting weight if the gradient required is known. Figure 12-30 provides 0° bank climb gradient data. As the bank angle increases, climb gradient decreases. This chart may also be used to calculate engine out missed approach climb gradient.

NOTE

The climb gradient chart in Section XII may be used to verify the climb capability data computed in Section III. In this case, the climb gradient depicted in Section XII must be equal to or greater than the climb gradient computed in Section III.

Example 7:

Given:

Outside Air Temperature = 30°C

Pressure Altitude = 10,000 Feet

Gross Weight = 420,000 Pounds

Flap Setting = 5 Degrees

Ice Protection Off

Air-conditioning On

CG = 8% MAC

Find:

Climb Gradient Available

Solution:

Use the outside air temperature, pressure altitude, and gross weight to find the reference climb gradient of 3.48 percent, from sheet 1 of figure 12-30. Enter sheet 2 with this value and correct for air-conditioning on to obtain the climb gradient available of 2.72 percent.

CRITICAL FIELD LENGTH (CFL)

The critical field length data presented in figures 12-31 and 12-32 are used to check the runway available limitation. The critical field length data are balanced to liftoff, which requires that the distance to accelerate and stop is the same as the distance to accelerate and liftoff, when an engine failure occurs at the V_1 speed.

The calculation of CFL is based on a three second pilot reaction time from engine failure during which the airplane continues to accelerate with full thrust on the two operating engines and zero thrust on the inoperative engine. This is followed by a constant speed segment of 1.1 seconds during which the throttles are pulled to idle, the spoilers are deployed (auto spoilers may be used), and the brakes applied. Stopping is accomplished using full anti-skid braking. Maximum allowable reverse thrust shall be used as quickly as possible after initiation of the abort. Charts are also provided for dispatch with inoperative reverse thrust.

Example 8:

(Mission accomplishment with headwind used)

Given:

Outside Air Temperature = 15°C

Pressure Altitude = Sea Level

Gross Weight = 520,000 Pounds

Flap Setting = 15 Degrees

Ice Protection Off

Air-conditioning Off

With Reverse Thrust

Headwind = 10 Knots (Calculated)

Zero Slope

RCR = 23

CG = 8% MAC

CFCC = 0

Find:

Critical Field Length

Solution:

Enter sheet 1 of figure 12-31A (RCR 23-18/With Reverse Thrust), with 15°C outside air temperature and find the reference distance of 4,500 feet. From sheet"2, the reference critical field length is found to be 9,750 feet, using the reference distance and 520,000 pounds gross weight.

Enter sheet 3 with the reference critical field length and correct for 15 degrees flaps and 10 knots headwind to determine that the critical field length is 7,950 feet.

MAXIMUM TAKEOFF GROSS WEIGHT AT OPTIMUM TAKEOFF FLAP SETTING (NO REVERSE THRUST)

Figures 12-33A through 12-33F provide data for determining maximum takeoff gross weight and optimum flap setting with reverse thrust inoperative.

Refer to Section III for chart explanation and example problem.

CRITICAL ENGINE FAILURE SPEED (VCEF)

Figures 12-34A through 12-34F provide critical engine failure speed data with reverse thrust inoperative. Refer to Section III for chart explanation and example problem.

MAXIMUM ALLOWABLE WEIGHT WHEN V_1 = V_{MCG}(MAW)

Figures 13-35A through 13-35F are used to compute the maximum allowable weight when V_1 = V_{MCG} (MAW). Data presented in this section are based on reverse thrust inoperative. Refer to Section III for chart explanation and example problem.

CLIMB GRADIENT LIMITING WEIGHT (CGLW)

The climb gradient limiting weight data shown in figure 12-36 are based on a minimum climb gradient at V_2 speed of 2.5 percent.

Example 9:

Given:

Outside Air Temperature = 38°C

Pressure Altitude = 10,000 Feet

Flap Setting = 10 Degrees

Air-conditioning On

Engine Ice Protection On

CG = 8% MAC

Find:

Climb Gradient Limiting Weight

Solution:

Enter sheet 1 of figure 12-36 with the outside air temperature of 38°C and the pressure altitude of 10,000 feet and find the reference CGLW of 430,000 pounds. Use this value to enter sheet 2 and correct for 10 degrees flaps, engine ice protection on, and air-conditioning on to determine that the climb gradient limiting weight is 397,000 pounds.

ALL ENGINE GROUND ROLL (AEGR)

The all engine ground roll data are presented in figure 12-37.

Example 10:

Given:

Outside Air Temperature = 20°C

Pressure Altitude = 5,000 Feet

Gross Weight = 520,000 Pounds

Flap Setting = 15 Degrees

Ice Protection Off

Air-conditioning off

Zero Wind

Downhill Slope = 2%

CG = 15% MAC

Find:

All Engine Ground Roll

Solution:

Enter sheet 1 of figure 12-37 with 20°C outside air temperature and find the reference distance of 5,330 feet. From sheet 2, the reference all engine ground roll is found to be 11,850 feet, using the reference distance and 520,000 pound gross weight.

Enter sheet 3 with the reference all engine ground roll and correct for 15 degrees flaps, 2% downhill slope, and 15% CG to determine that the all engine ground roll is 9,630 feet.

FLAPS AND SLATS EXTENDED CRUISE DATA

Figures 12-38 through 12-52 provide specific range data for three engine operation for flaps and slats extended and the air refueling boom in the normal precontact position.

The flaps and slats extended cruise data are provided to enable the KC-10A to refuel receivers which require low formating altitudes and airspeeds. Since these data are applicable to refueling operation, the drag of the air refueling boom in the normal precontact position with the ARO sighting door open is included in the specific range data.

These charts are used in the same manner as the specific range charts presented in Section V; refer to Section V for example problems. The data are linear and can be interpolated for altitudes between the presented 5,000 feet altitude increments.

NOTE

> The extension of flaps and slats increases the gross weight capability of the KC-10A for low-altitude and low-airspeed refueling; however, the acceleration capability is degraded and the air-refueling boom envelope and response to control inputs may be degraded.

GEAR DOWN FLIGHT - LIMITATIONS

Gear down flight is restricted to a MTOGW of 425, 000 pounds, a fixed takeoff flap setting of 10 degrees, air conditioning off and maximum takeoff thrust. Takeoff is not permitted from a contaminated runway (covered by snow, ice or slush) when the aircraft is V_{MCG} limited.

Climbout flight path charts in Section III are not applicable. Consequently, the see-and-avoid procedure will be used for takeoff planning. Takeoff should not be attempted unless there is a reasonable assurance that obstacle clearance can be maintained.

The maximum operating speed for gear down flight is 270 KIAS or Mach.55, whichever is lower. These speed limits are imposed in order to provide a safety margin to the maximum design speed, and to preclude excess drag penalties while operating in the part of the flight regime which provides the greatest specific range.

The environmental envelope in TO 1C-10(K)A-1 is unchanged except the maximum altitude is now limited to 30,000 feet.

WARNING

Do not use climbout flight path charts in Section III for gear down flight.

GEAR DOWN FLIGHT - TAKEOFF

A gear down takeoff planning guide is provided as figure 12-54. This planning guide addresses takeoff computations up through the determination of V_1 speed. Once V_1 is determined, the planning guide will refer you to the appropriate step of the takeoff planning guide in Section III.

The runway available limiting weight is determined at 10 degree flaps with air conditioning off for the given conditions.

The climb gradient limiting weight at 10 degree flaps is based on an actual climb gradient of 2.5% with gear down. To account for gear down drag, add a 1.9% gradient increment to the minimum climb gradient of 2.5% for a corrected climb gradient of 4.4 %, for use in figure 3-9.

Example 12:

Given:

Outside Air Temperature = 5°C

Pressure Altitude = 8,000 feet

Zero Wind

Zero Slope

Flap Setting = 10 Degrees

RCR = 23

CFCC = 0

CG = 8% MAC

Air Conditioning OFF

Ice Protection OFF

With Reverse Thrust

Runway Available = 9,510 feet

Find:

Takeoff Gross Weight Based On Runway Available and 2.5% Climb Gradient for Gear Down Flight.

Solution:

1. Determine the runway available limiting weight (RALW) for gear down flight at 10 degree flaps. Enter sheet 1 of figure 3-9A and proceed across the chart without corrections to obtain an equivalent field length of 9,510 feet. Enter sheet 2 with the OAT and pressure altitude and follow the guidelines to account for the equivalent field length determined from sheet 1 and read the RALW at five-degree flap setting on the vertical scale as 400,000 pounds. Enter sheet 3 from the left side with the RALW of 400,000 pounds at five-degree flaps and follow the respective guidelines up to 10 degree flaps. This yields a RALW of 412,800 pounds for gear down flight.

2. Determine the climb gradient limiting weight (CGLW) for gear down flight at 10 degree flaps. Enter sheet 5 with the OAT and pressure altitude and read an uncorrected CGLW of 446,000 pounds. Enter sheet 4 with this uncorrected CGLW from sheet 5 and

correct for the climb gradient using 4.4% (2.5% + 1.9%) to obtain a CGLW at 25 degree flaps of 392,100 pounds. Enter sheet 3 from the right side with the CGLW at 25 degree flaps and follow the respective guidelines until the CGLW reaches 10 degree flaps. This yields a CGLW of 432,300 pounds for gear down flight.

3. The lower of the RALW from step 1 and the CGLW from step 2 yields a TOGW of 412,800 pounds for gear down flight.

NOTE

After the flight engineer computes the gear down flight takeoff data, the pilot will independently verify the allowable takeoff gross weight, using the same method.

GEAR DOWN FLIGHT - CLIMB

Figures 12-55 through 12-62 provide gear down climb performance. The N_1 setting charts in Section IV are also applicable to gear down flight. Refer to Section IV for chart explanations and example problems.

The climb speed schedules are as follows:

Three engine climb - 250 KIAS up to 20,290 feet, then at Mach.55

Two engine climb - 250 KIAS

The optimum altitude line presented on the two engine gear down chart is the standard day service ceiling.

NOTE

Three engine and two engine drag index data in Section IV are not applicable for gear down operation. Flying with non-zero drag index values is not permitted.

GEAR DOWN FLIGHT - CRUISE

Figures 12-63 through 12-87 provide cruise performance for two and three engine gear down flight operations. Refer to Section V for specific range chart explanations and example problems.

The maximum endurance speed for gear down flight is below the 1.2G buffet speed.

NOTE

Three engine and two engine drag index data in Section V are not applicable for gear down operation. Flying with non-zero drag index values is not permitted.

GEAR DOWN FLIGHT - DESCENT

Figure 12-88 presents the gear down descent data.

The speed schedule for gear down flight is Mach .55 down to 20,290 feet, then 250 KIAS for all lower altitudes.

NOTE

Flying with non-zero drag index values is not permitted for gear down operation.

EFFECT OF BANK ANGLE ON PERFORMANCE

Figure 12-53 provides effective weight as a function of bank angle. The effective weight is used to determine the performance data for banked flight.

Example 11:

Given:

Gross Weight = 420,000 Pounds

Bank Angle = 20°

Find:

Effective Weight

Solution:

Enter figure 12-53 with the actual gross weight and read across to the line for a bank angle of 20°. The effective weight is found to be 447,000 pounds.

MACHMETER CALIBRATION - NORMAL SYSTEM

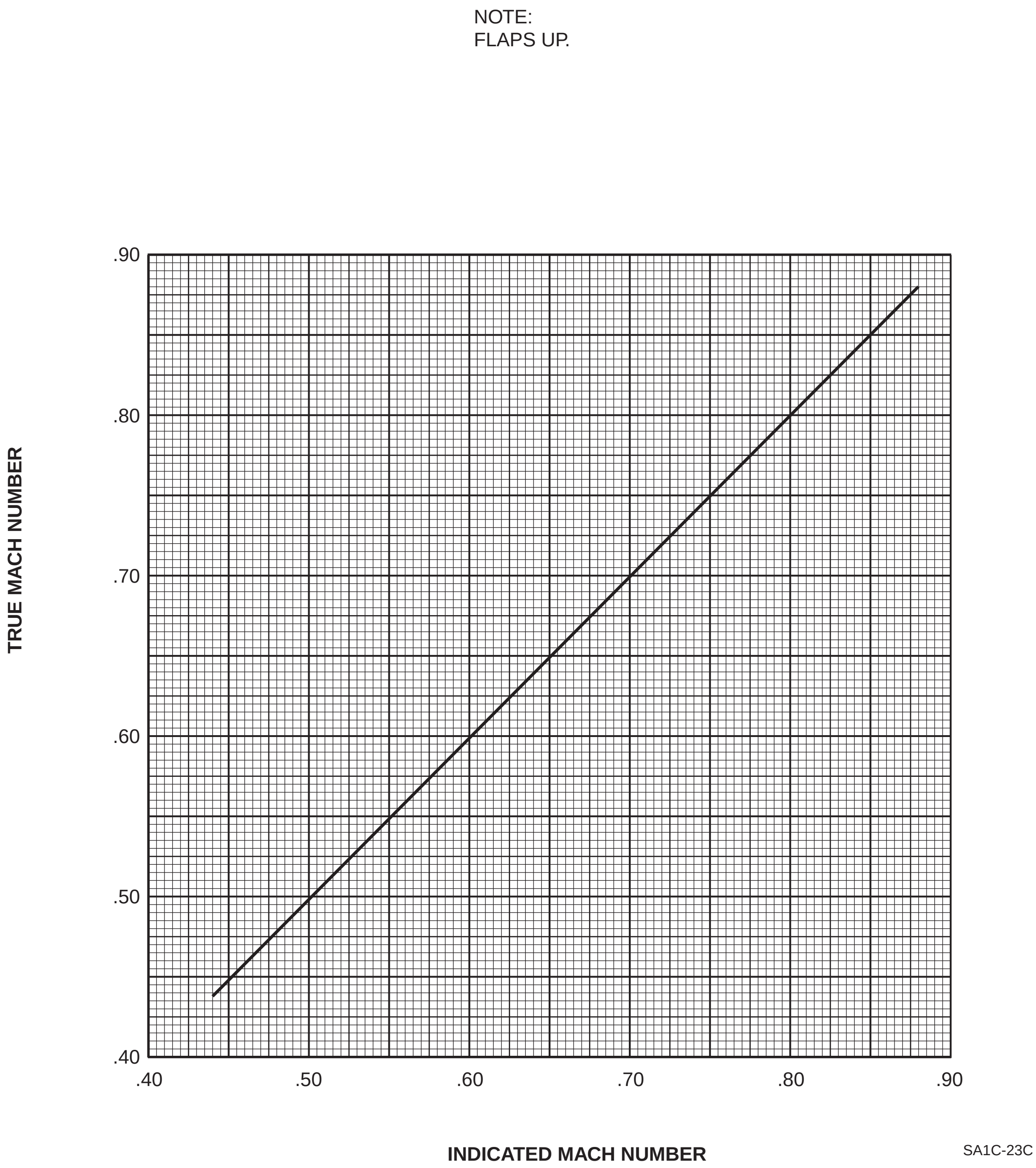


Figure 12-1.

MACHMETER CALIBRATION-ALTERNATE SYSTEM

NOTE:
FLAPS UP.

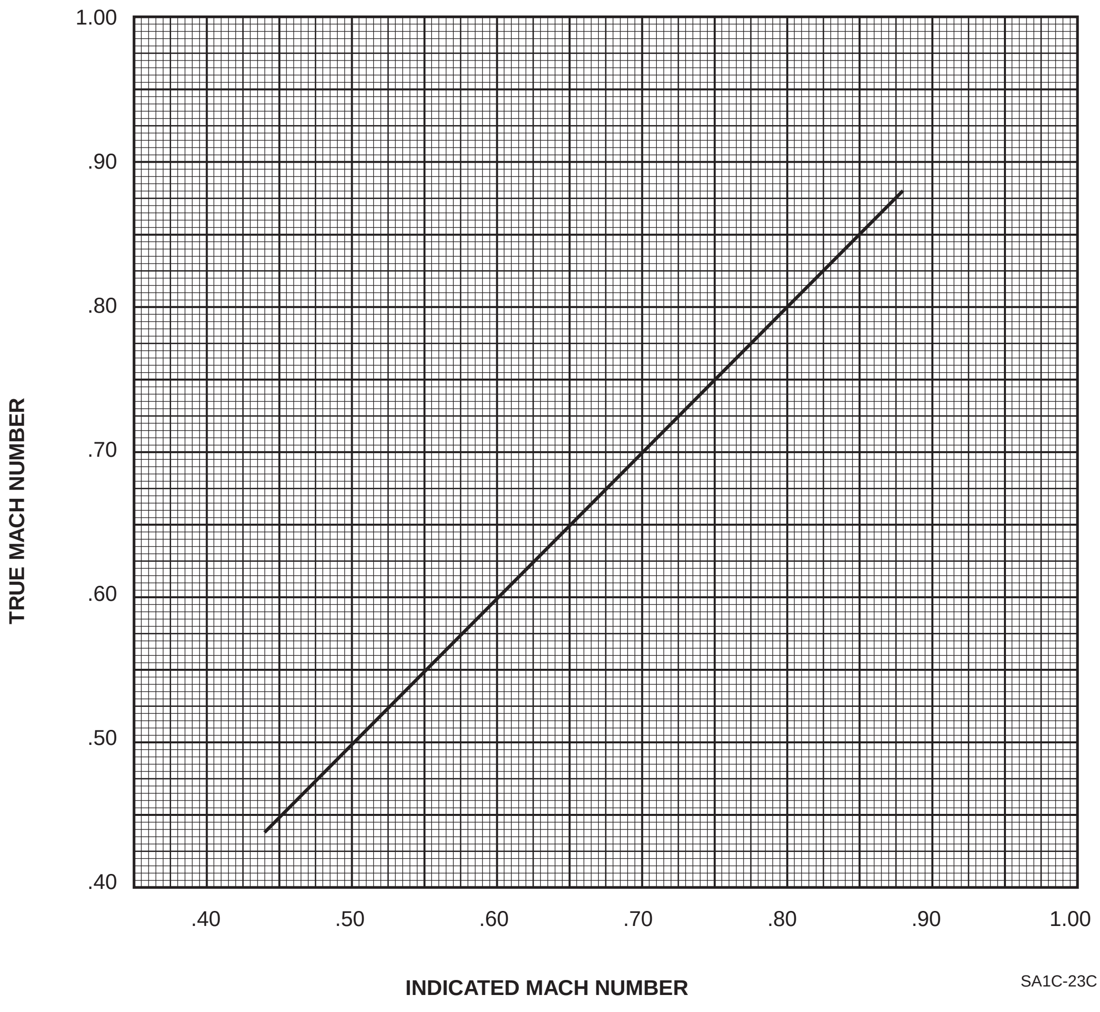


Figure 12-2.

AIRSPEED CALIBRATION ON THE GROUND - NORMAL SYSTEM

NOTE:

1. VALID FROM SEA LEVEL TO 15,000 FEET - SLATS RETRACTED OR SLATS EXTENDED.

2. CALIBRATED AIRSPEED = INDICATED AIRSPEED + ΔV.

3. APPLICABLE AT AND BELOW V_R.

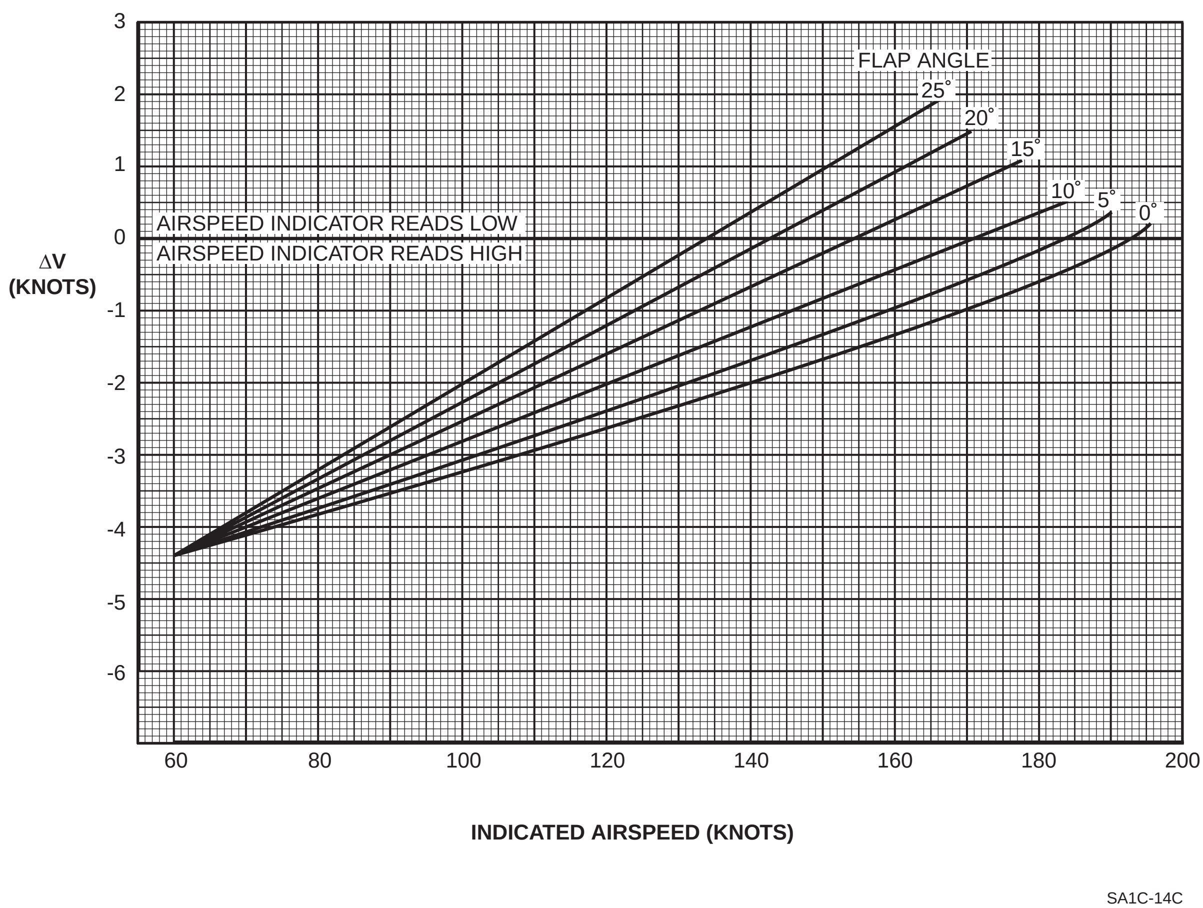
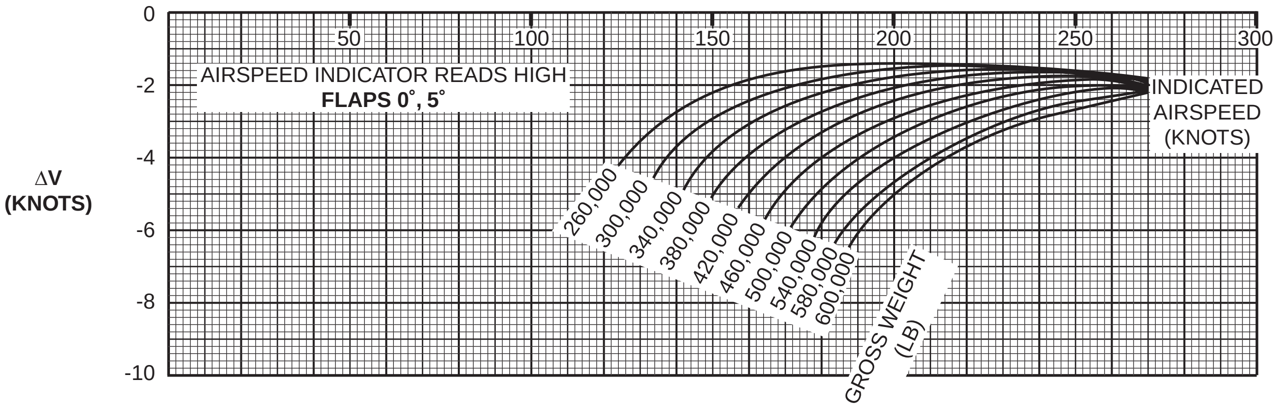


Figure 12-3.

AIRSPEED CALIBRATION - NORMAL SYSTEM

NOTE:

1. VALID FROM SEA LEVEL TO 15,000 FEET - SLATS RETRACTED OR SLATS EXTENDED.
2. CALIBRATED AIRSPEED = INDICATED AIRSPEED + ΔV.
3. CORRECTIONS ARE UNAFFECTED BY POSITION OF LANDING GEAR.
4. INTERPOLATE FOR INTERMEDIATE FLAP SETTINGS.



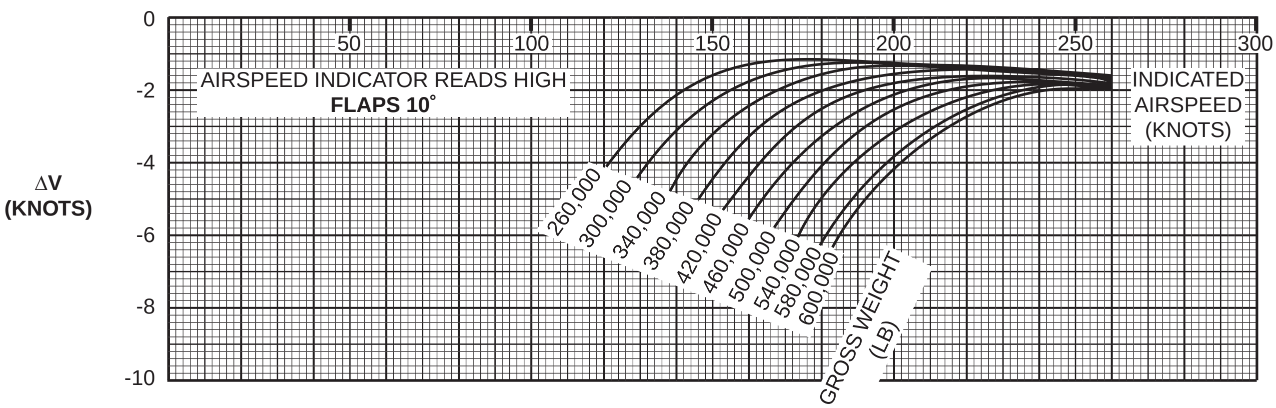
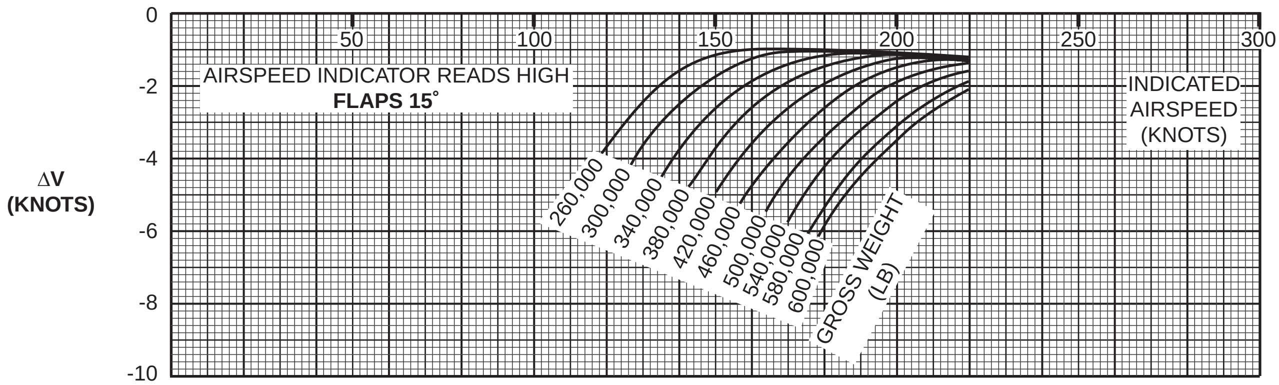


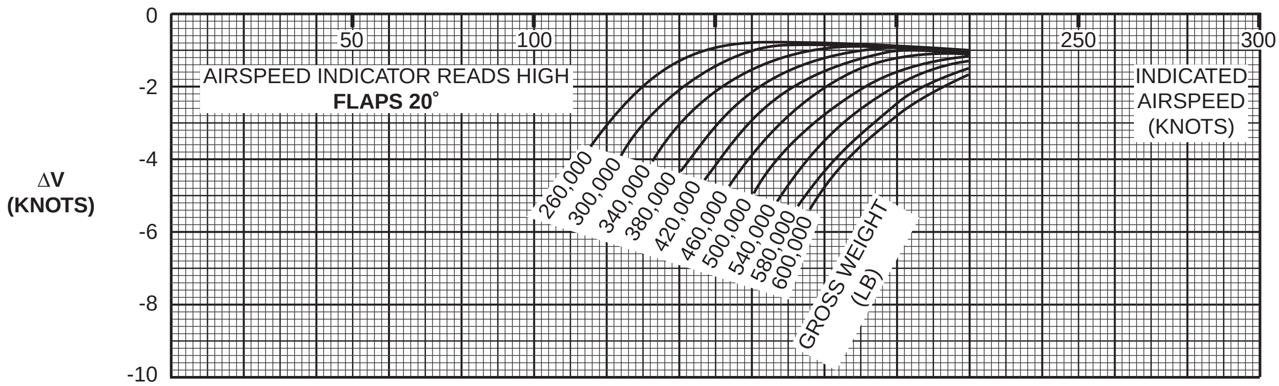
Figure 12-4. (Sheet 1)

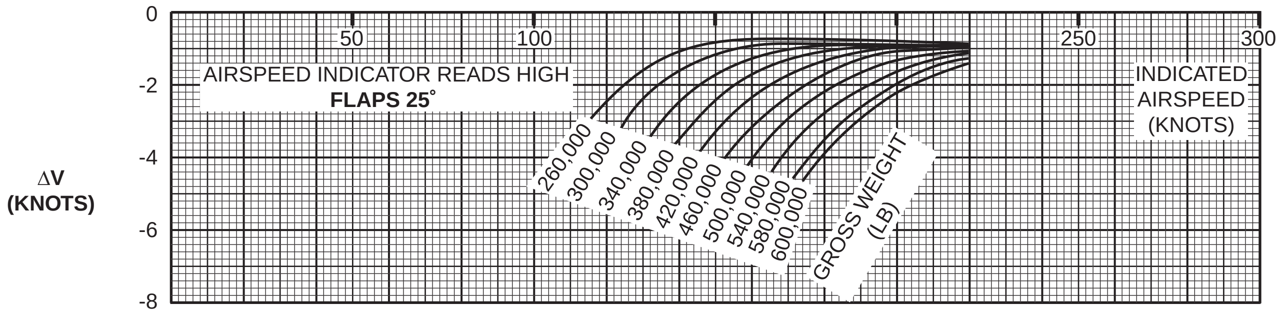
SA1C-5C

AIRSPEED CALIBRATION - NORMAL SYSTEM

NOTE:
1. VALID FROM SEA LEVEL TO 15,000 FEET - SLATS RETRACTED OR SLATS EXTENDED.
2. CALIBRATED AIRSPEED = INDICATED AIRSPEED + ΔV.
3. CORRECTIONS ARE UNAFFECTED BY POSITION OF LANDING GEAR.
4. INTERPOLATE FOR INTERMEDIATE FLAP SETTINGS.







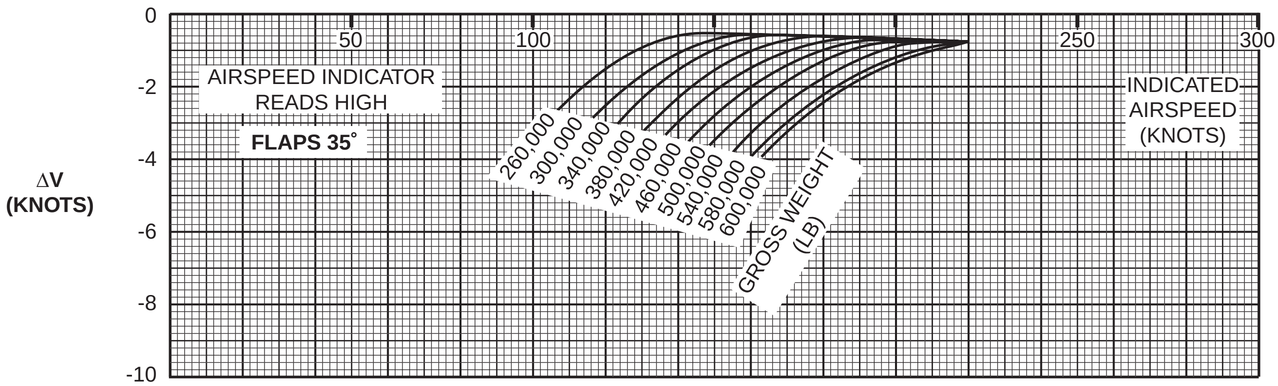
SA1C-6C

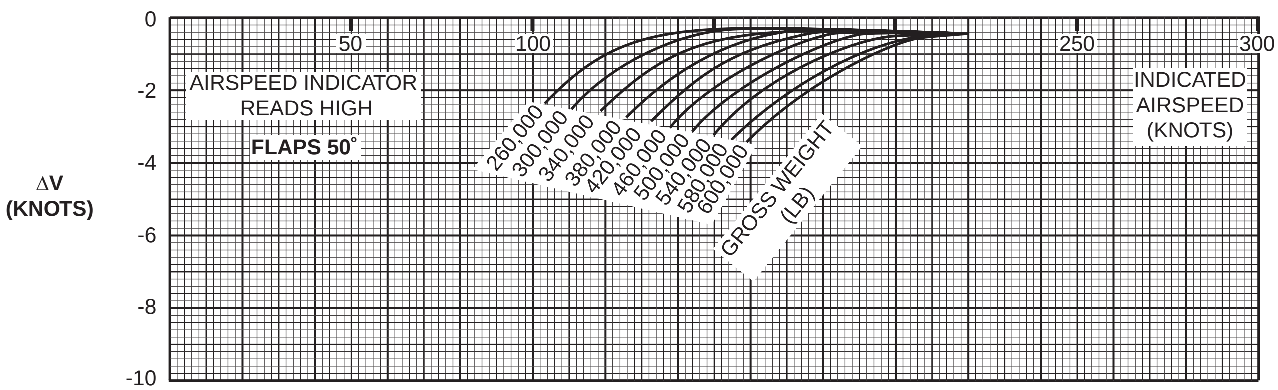
Figure 12-4. (Sheet 2)

AIRSPEED CALIBRATION - NORMAL SYSTEM

NOTE:

1. VALID FROM SEA LEVEL TO 15,000 FEET - SLATS RETRACTED OR SLATS EXTENDED.
2. CALIBRATED AIRSPEED = INDICATED AIRSPEED + ΔV.
3. CORRECTIONS ARE UNAFFECTED BY POSITION OF LANDING GEAR.





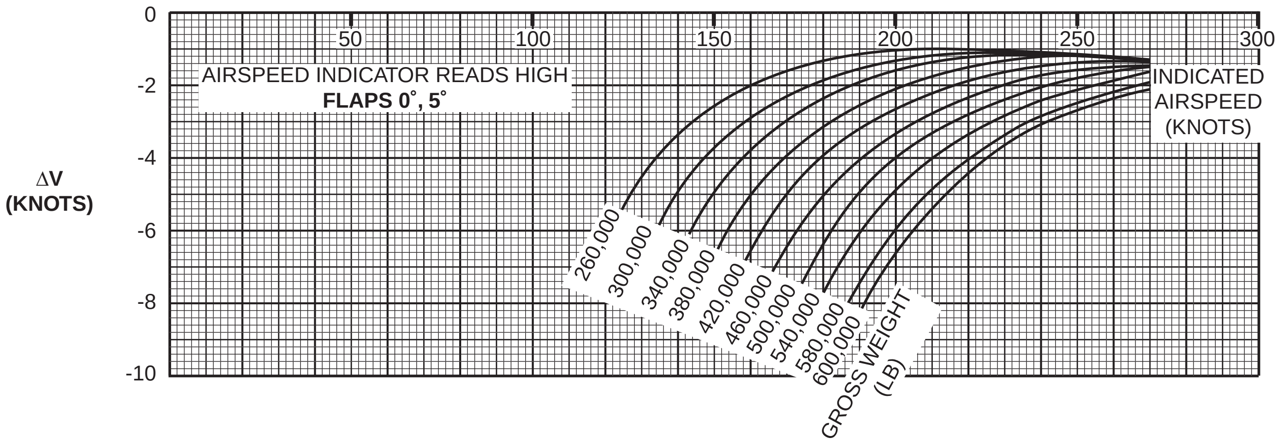
SA1C-7C

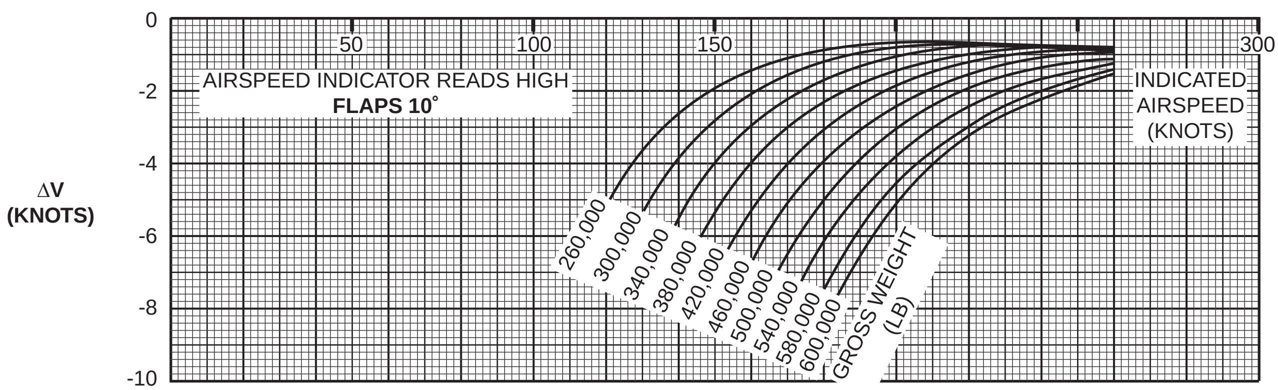
Figure 12-4. (Sheet 3)

AIRSPEED CALIBRATION - ALTERNATE SYSTEM AND STANDBY INDICATORS

NOTE:

1. VALID FROM SEA LEVEL TO 15,000 FEET - SLATS RETRACTED OR SLATS EXTENDED.
2. CALIBRATED AIRSPEED = INDICATED AIRSPEED + ΔV.
3. CORRECTIONS ARE UNAFFECTED BY POSITION OF LANDING GEAR.
4. INTERPOLATE FOR INTERMEDIATE FLAP SETTINGS.





SA1C-9C

Figure 12-5. (Sheet 1)

AIRSPEED CALIBRATION - ALTERNATE SYSTEM AND STANDBY INDICATORS

NOTE:
1. VALID FROM SEA LEVEL TO 15,000 FEET - SLATS RETRACTED OR SLATS EXTENDED.

2. CALIBRATED AIRSPEED = INDICATED AIRSPEED + ΔV.

3. CORRECTIONS ARE UNAFFECTED BY POSITION OF LANDING GEAR.

4. INTERPOLATE FOR INTERMEDIATE FLAP SETTINGS.

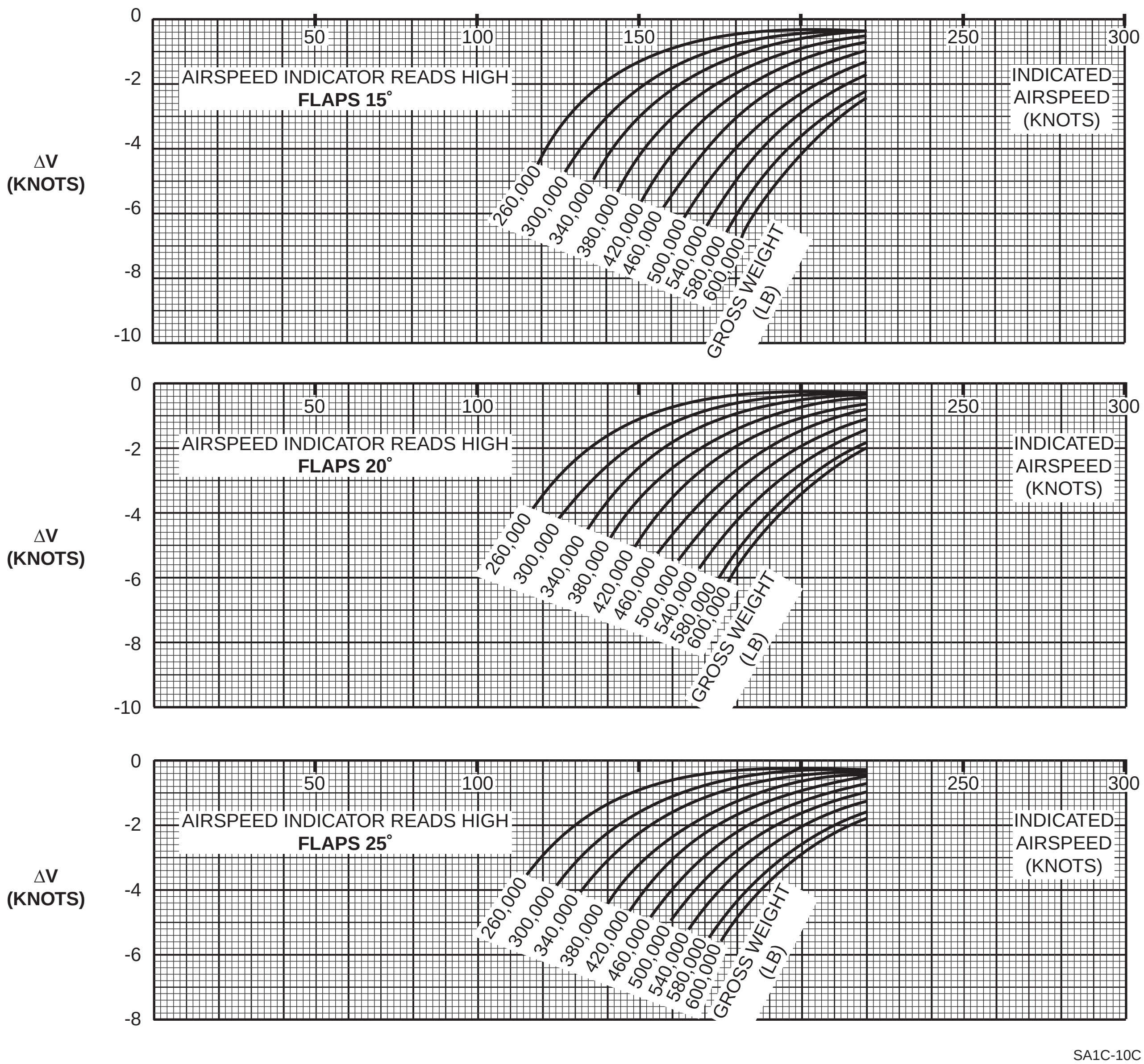


Figure 12-5. (Sheet 2)

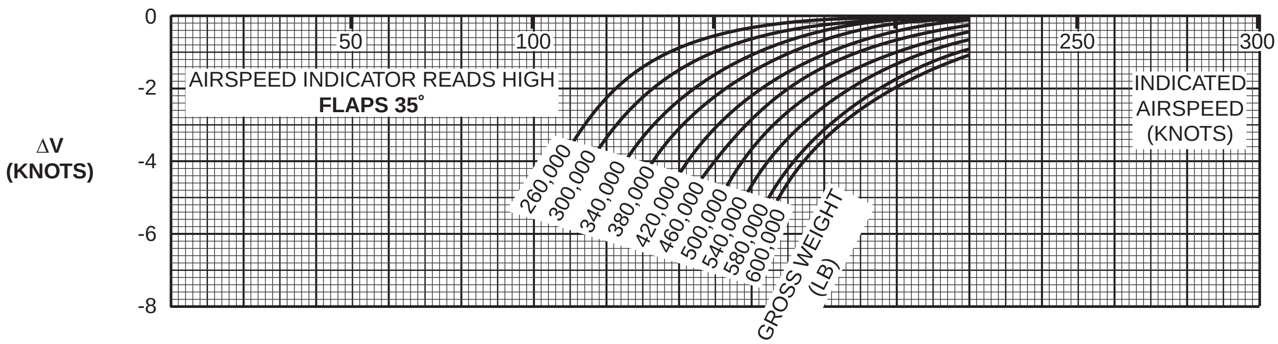
AIRSPEED CALIBRATION - ALTERNATE SYSTEM AND STANDBY INDICATORS

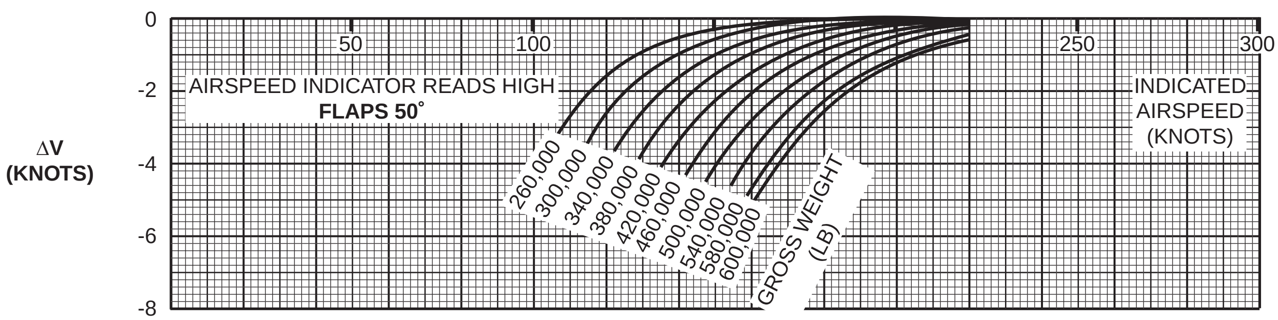
NOTE:

1. VALID FROM SEA LEVEL TO 15,000 FEET - SLATS RETRACTED OR SLATS EXTENDED.

2. CALIBRATED AIRSPEED = INDICATED AIRSPEED + ΔV.

3. CORRECTIONS ARE UNAFFECTED BY POSITION OF LANDING GEAR.





SA1C-11C

Figure 12-5. (Sheet 3)

INDICATED AIRSPEED VS CALIBRATED AIRSPEED CONVERSION - NORMAL SYSTEM

NOTE:
FLAPS UP.

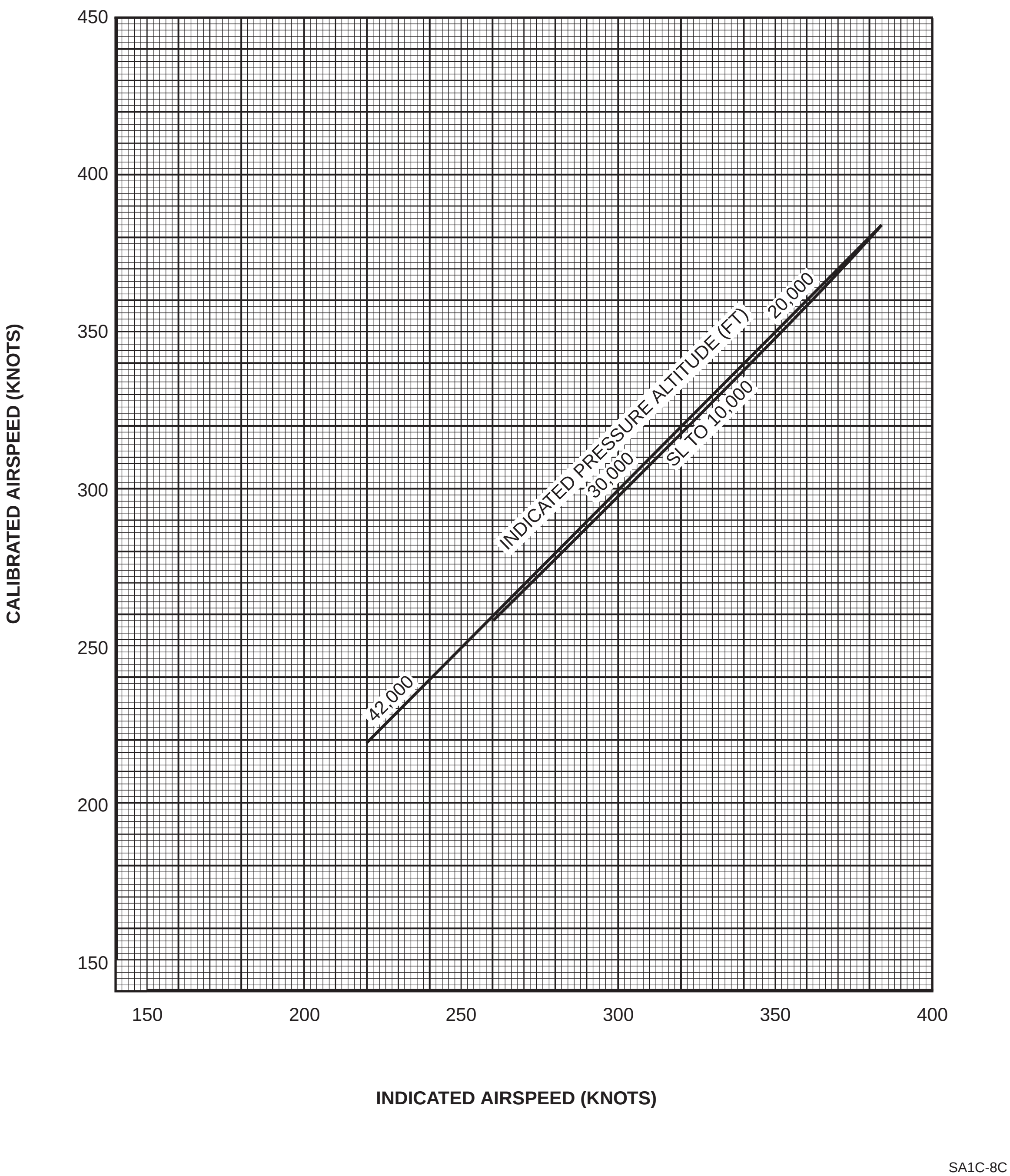


Figure 12-6.

INDICATED AIRSPEED VS CALIBRATED AIRSPEED CONVERSION- ALTERNATE SYSTEM

NOTE:
FLAPS UP.

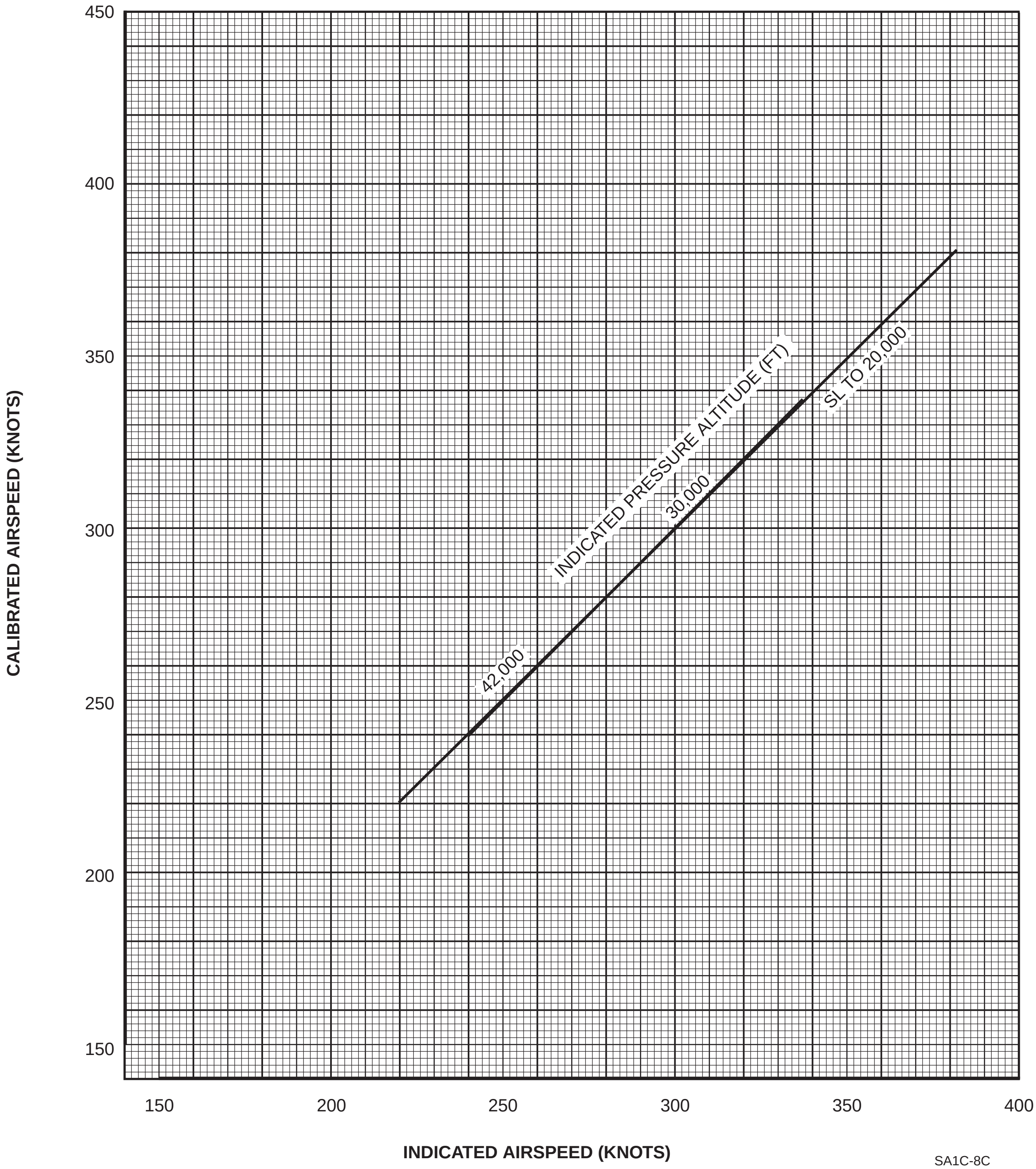


Figure 12-7.

INDICATED AIRSPEED VS CALIBRATED AIRSPEED CONVERSION -STANDBY INDICATORS

NOTE:
FLAPS UP.

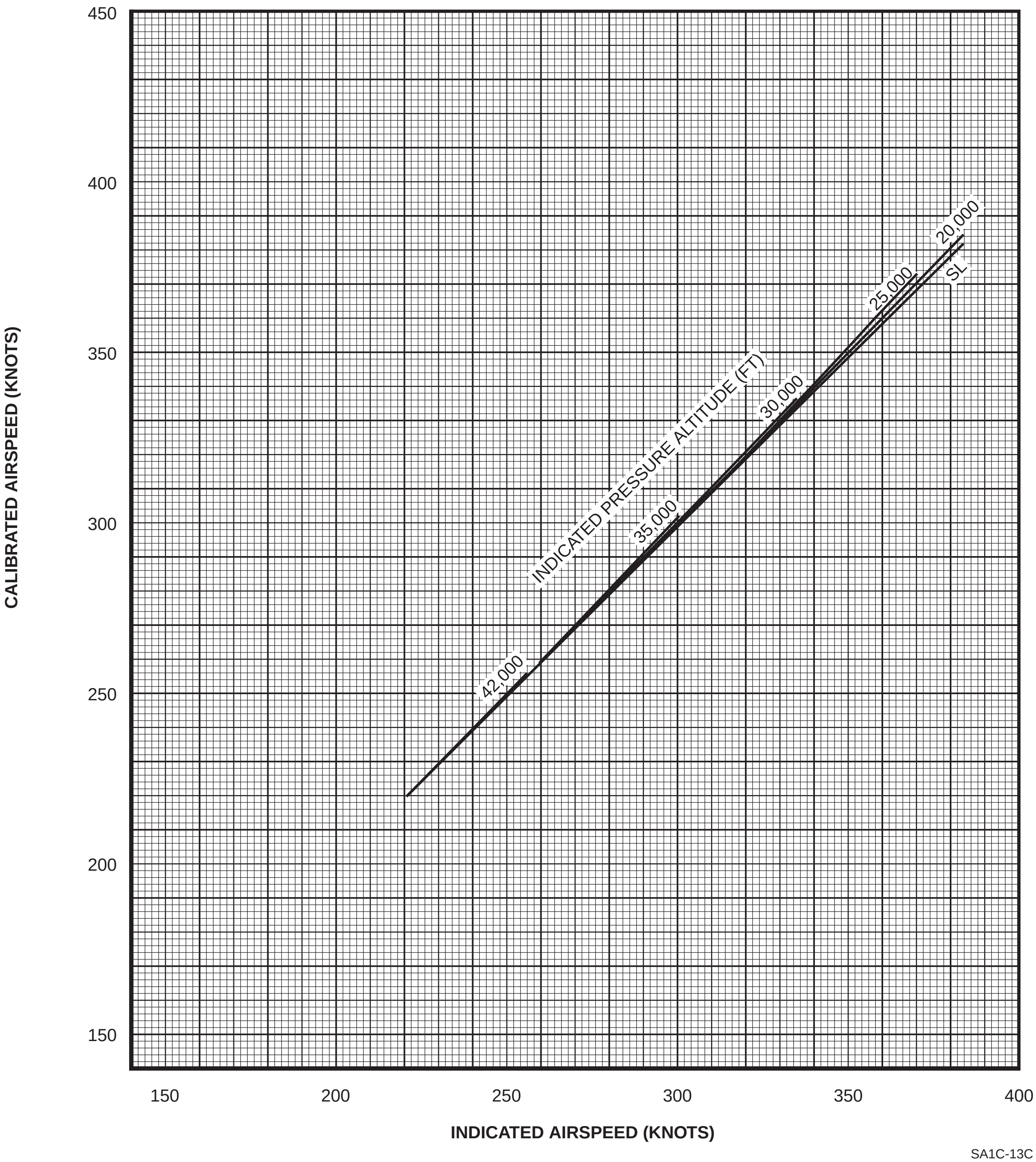


Figure 12-8.

EQUIVALENT AIRSPEED VS CALIBRATED AIRSPEED CONVERSION

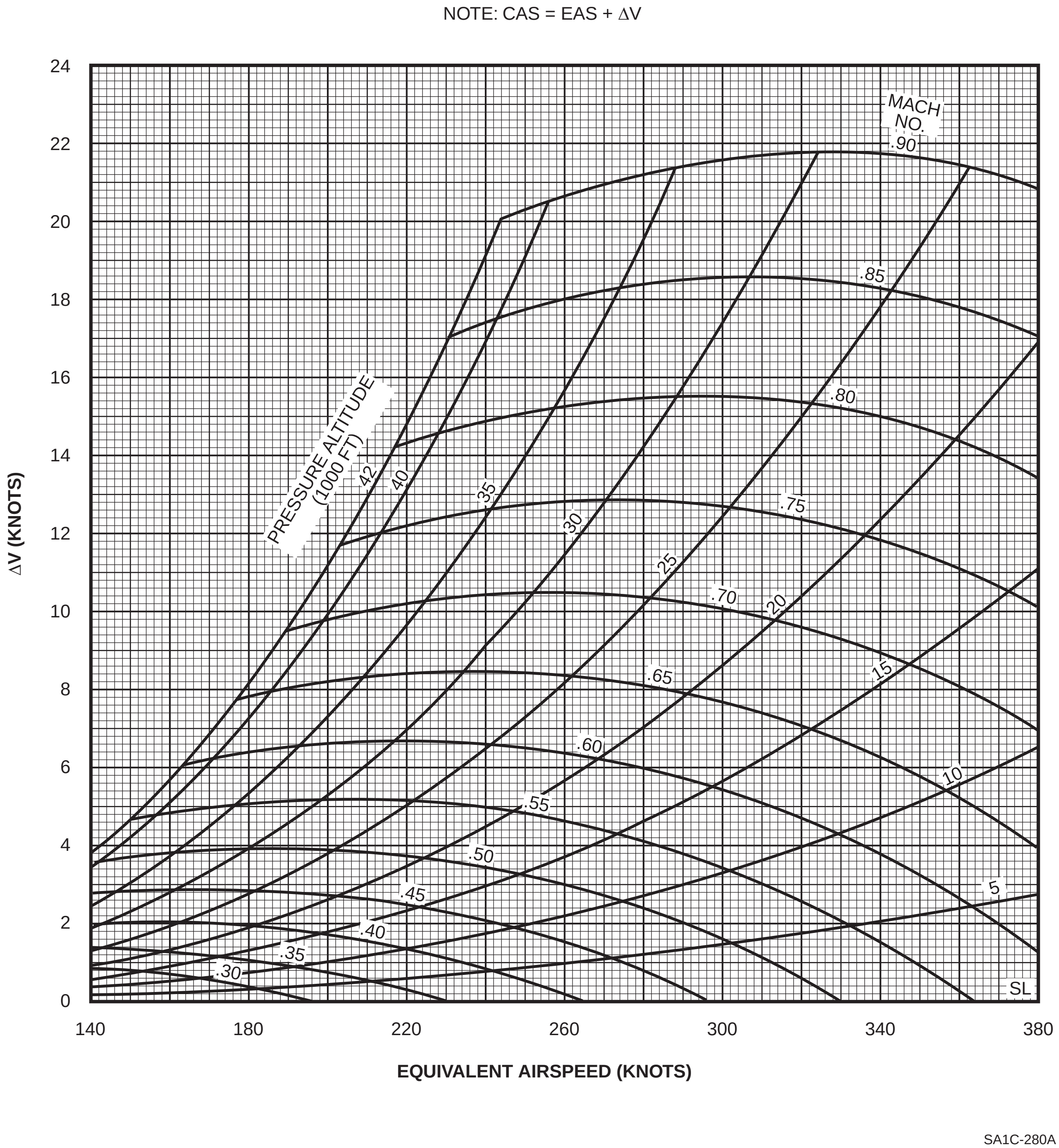


Figure 12-9.

CALIBRATED AIRSPEED VS EQUIVALENT AIRSPEED CONVERSION

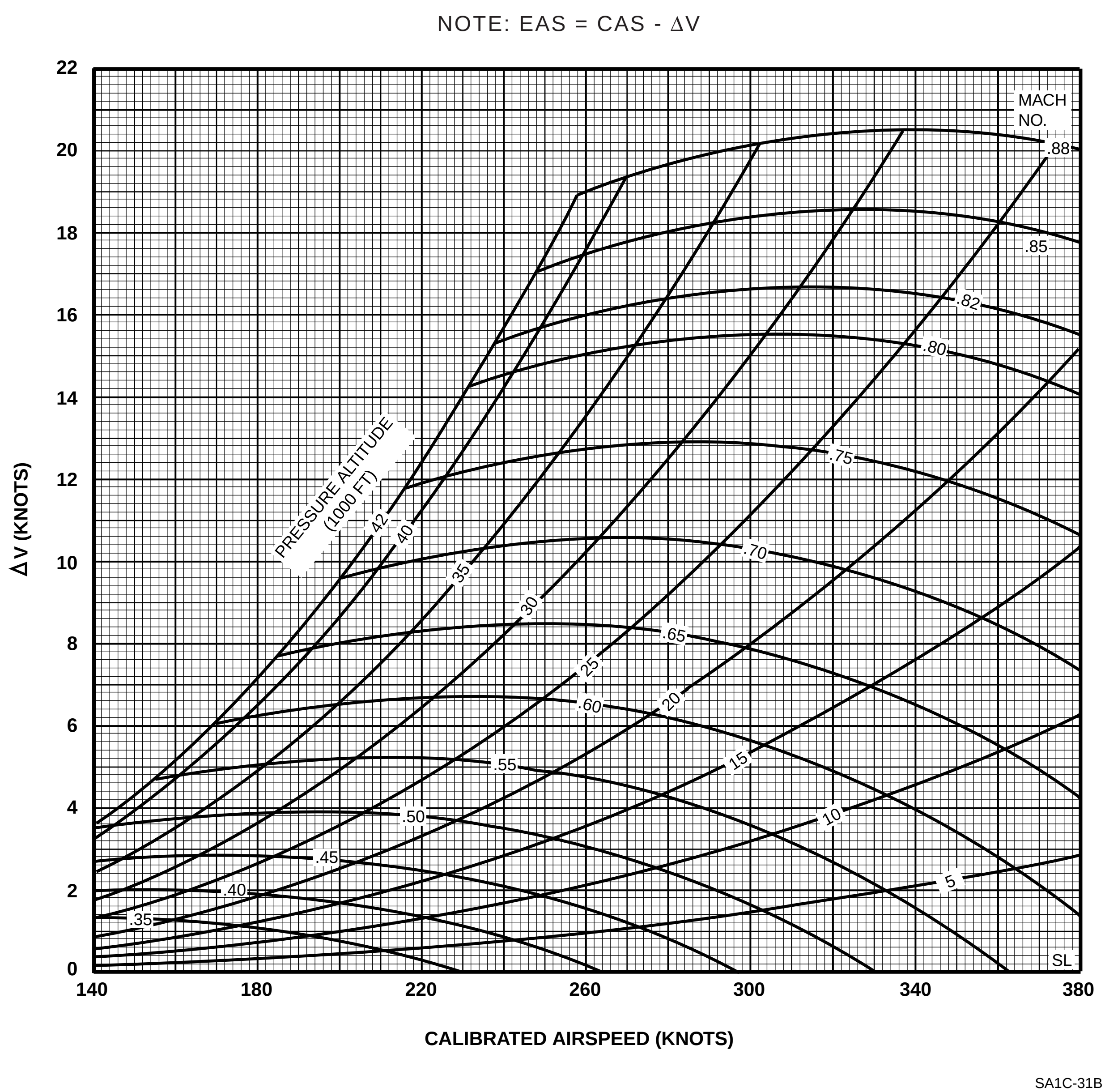


Figure 12-10.

ALTIMETER CALIBRATION - NORMAL SYSTEM

NOTE:
1. VALID FROM SEA LEVEL TO 15,000 FEET - SLATS RETRACTED OR SLATS EXTENDED.
2. TRUE PRESSURE ALTITUDE = INDICATED PRESSURE ALTITUDE + Δh.
3. CORRECTIONS ARE UNAFFECTED BY POSITION OF LANDING GEAR.
4. INTERPOLATE FOR INTERMEDIATE FLAP SETTING.

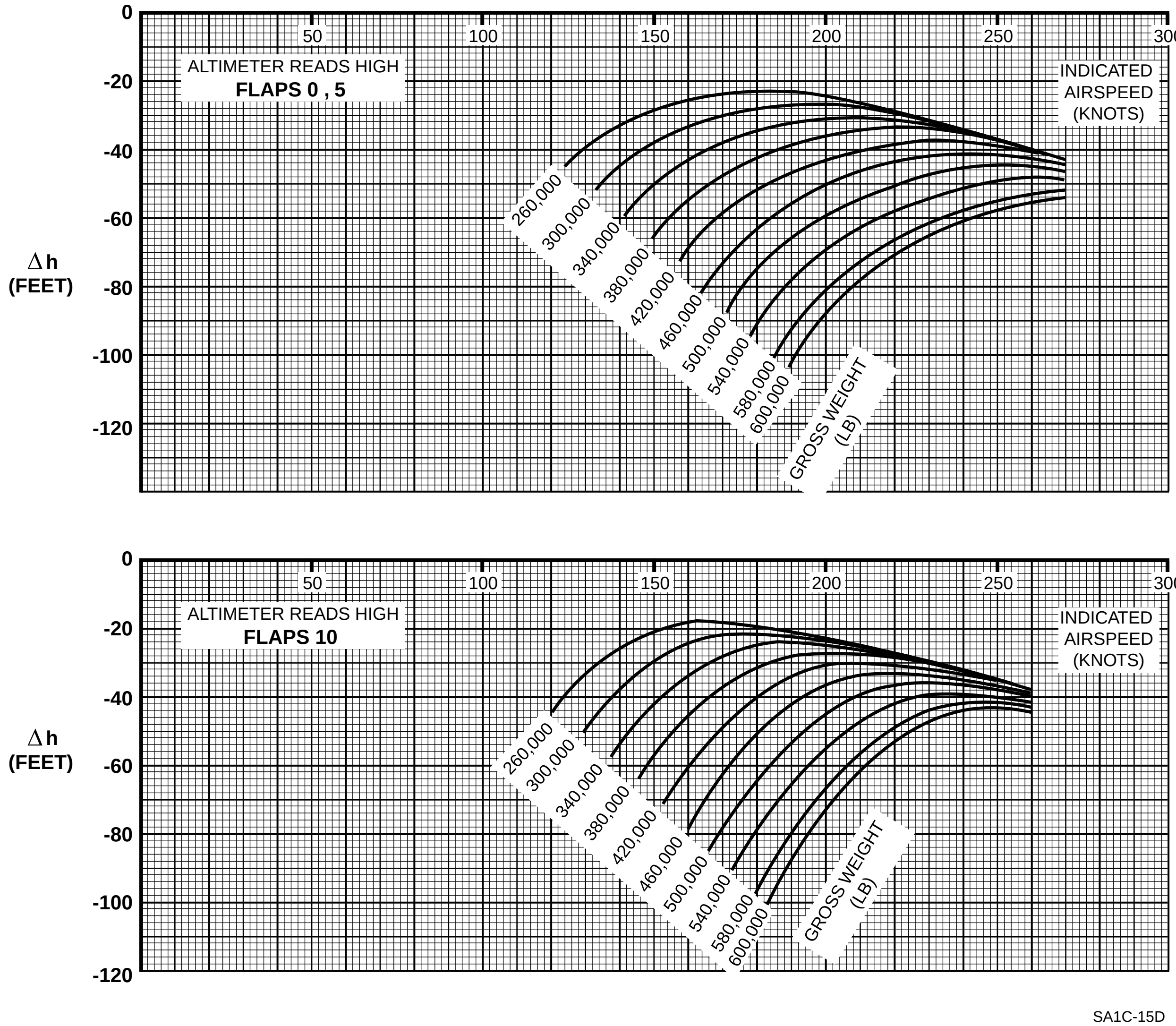


Figure 12-11. (Sheet 1)

ALTIMETER CALIBRATION - NORMAL SYSTEM

NOTE:
1. VALID FROM SEA LEVEL TO 15,000 FEET - SLATS RETRACTED OR SLATS EXTENDED.
2. TRUE PRESSURE ALTITUDE = INDICATED PRESSURE ALTITUDE + Δh.
3. CORRECTIONS ARE UNAFFECTED BY POSITION OF LANDING GEAR.
4. INTERPOLATE FOR INTERMEDIATE FLAP SETTING.

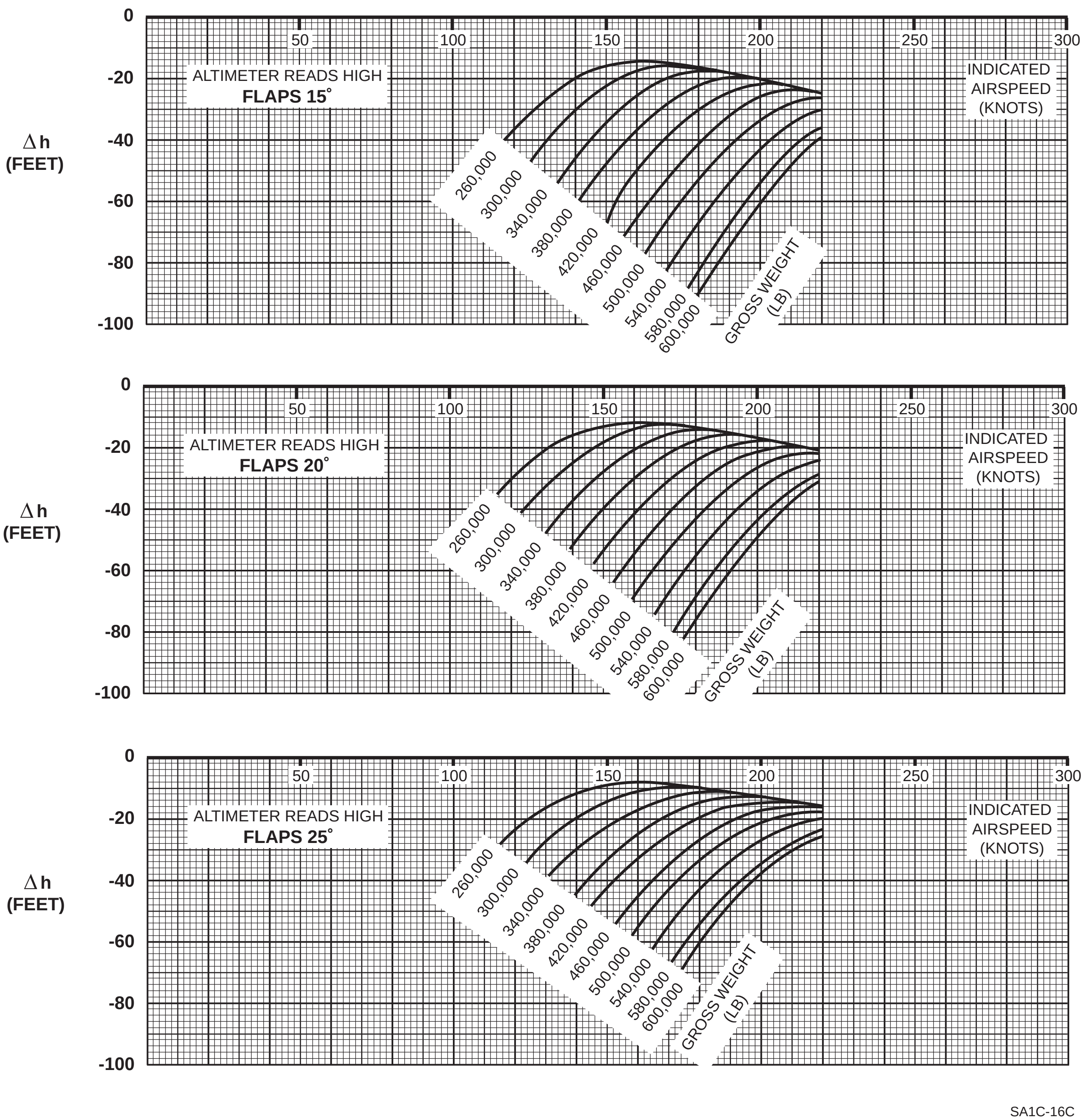
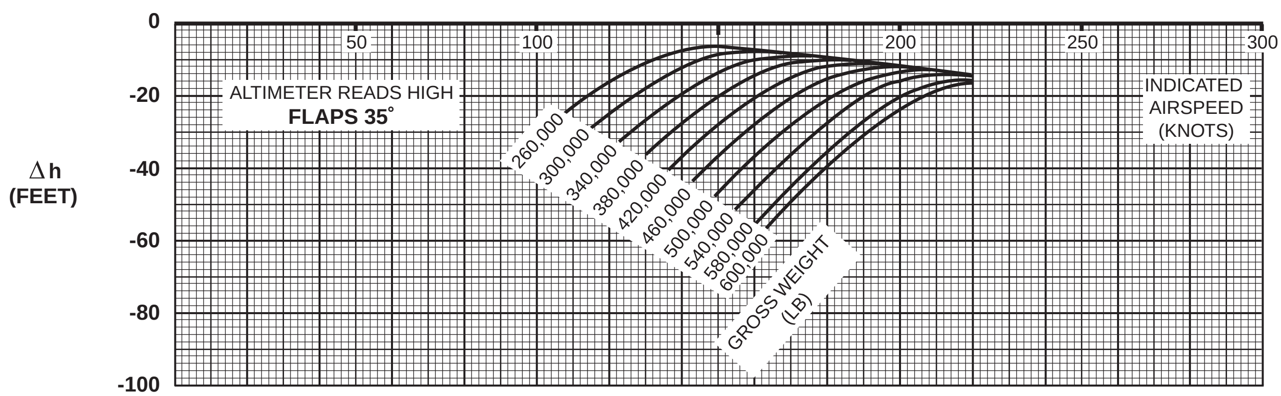


Figure 12-11. (Sheet 2)

ALTIMETER CALIBRATION - NORMAL SYSTEM

1. VALID FROM SEA LEVEL TO 15,000 FEET - SLATS RETRACTED OR SLATS EXTENDED.
2. TRUE PRESSURE ALTITUDE = INDICATED PRESSURE ALTITUDE + Δh.
3. CORRECTIONS ARE UNAFFECTED BY POSITION OF LANDING GEAR.



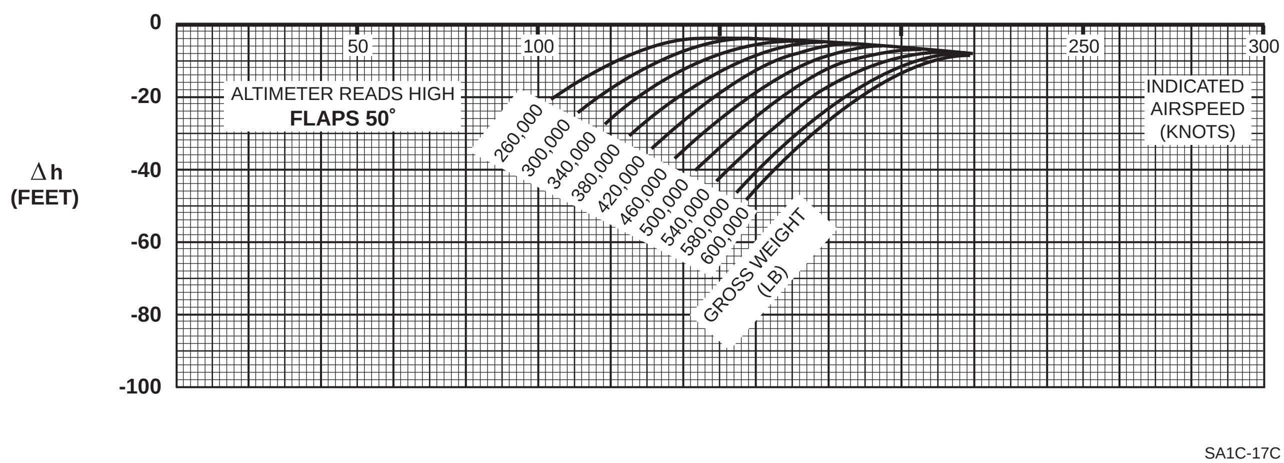
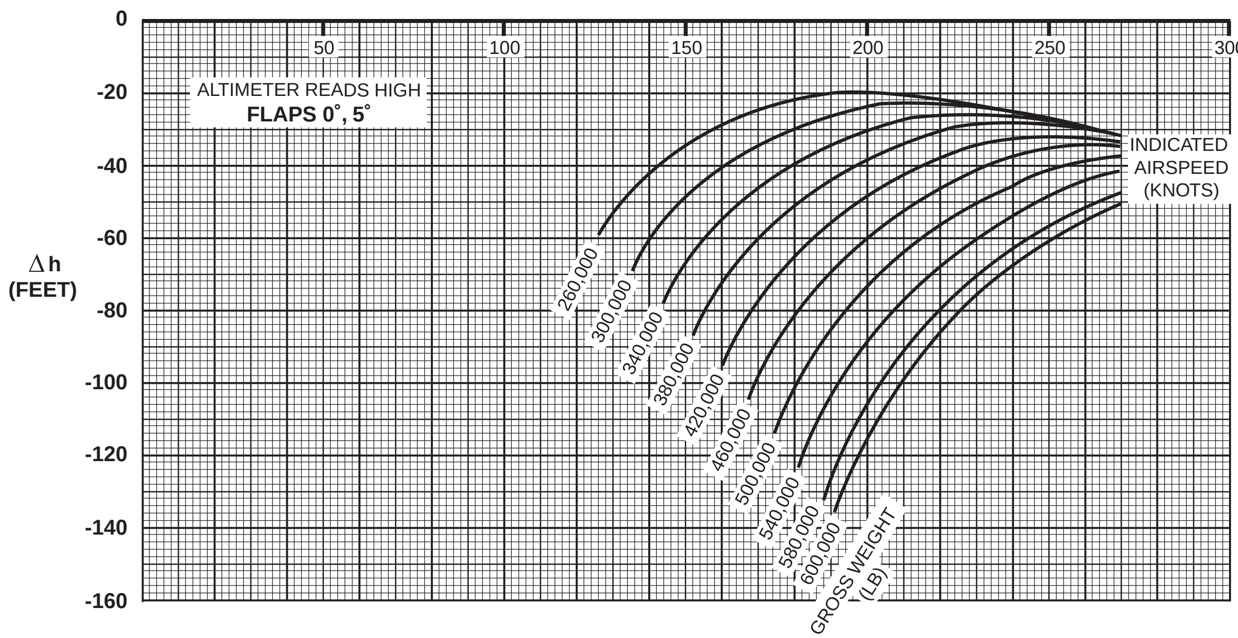


Figure 12-11. (Sheet 3)

ALTIMETER CALIBRATION - ALTERNATE SYSTEM AND STANDBY INDICATORS

NOTE:
1. VALID FROM SEA LEVEL TO 15,000 FEET - SLATS RETRACTED OR SLATS EXTENDED.
2. TRUE PRESSURE ALTITUDE = INDICATED PRESSURE ALTITUDE + Δh.
3. CORRECTIONS ARE UNAFFECTED BY POSITION OF LANDING GEAR.
4. INTERPOLATE FOR INTERMEDIATE FLAP SETTING.



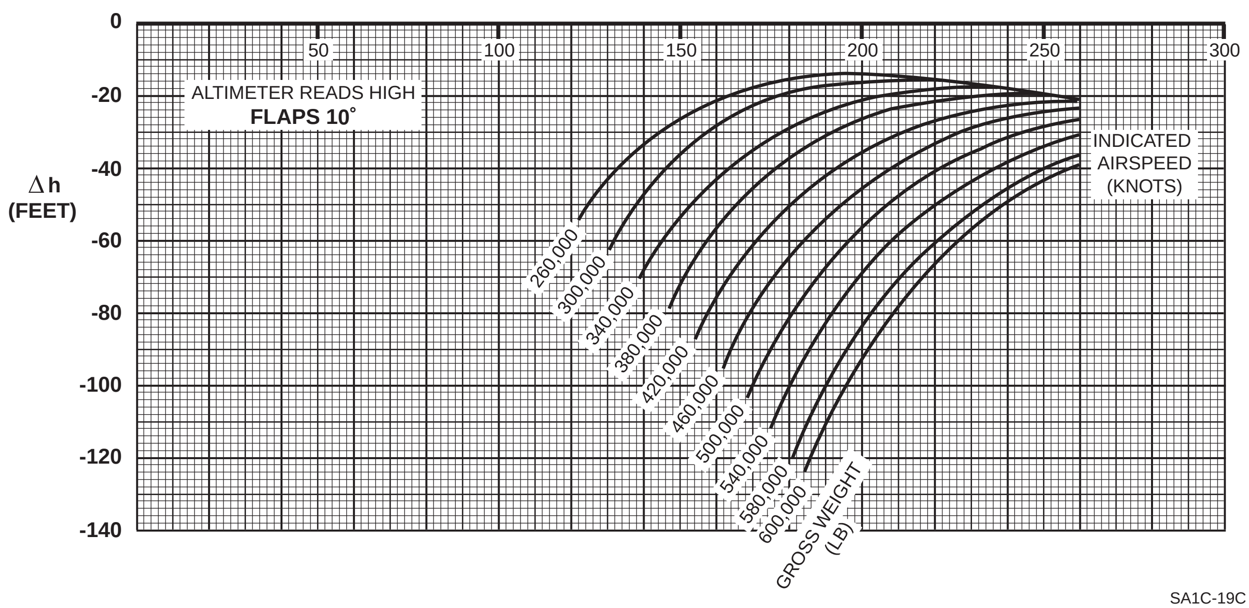
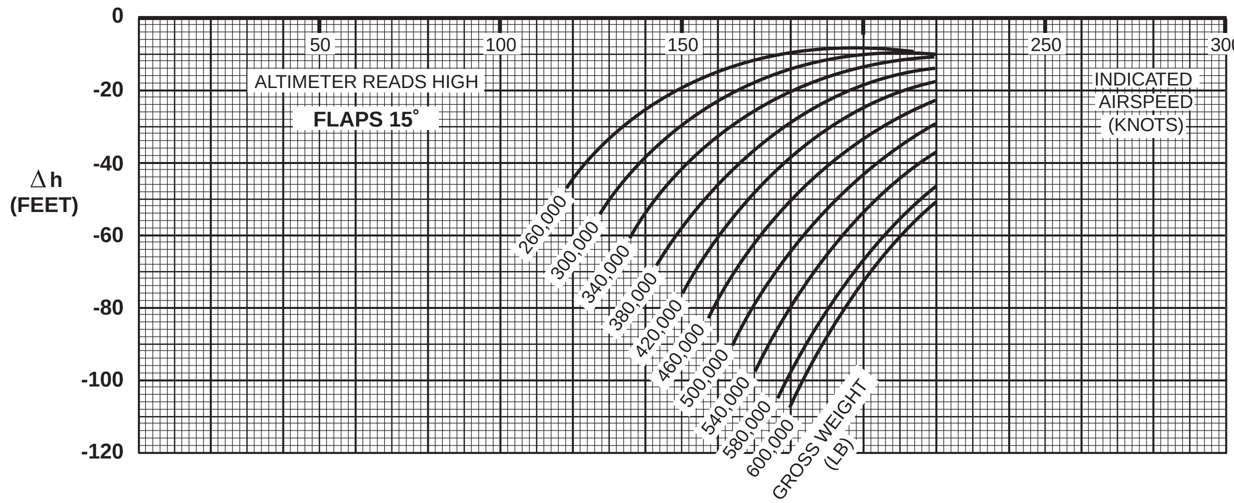


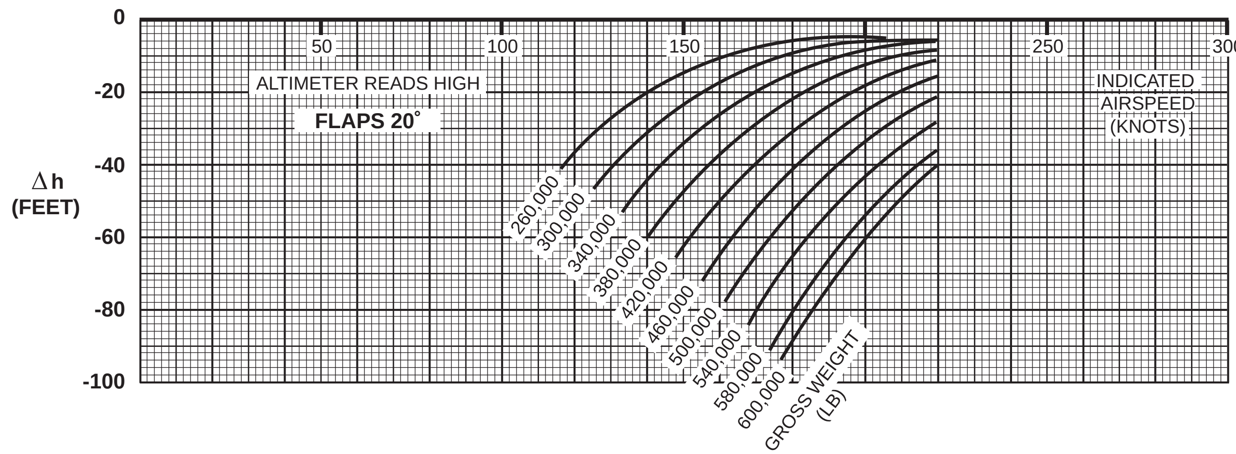
Figure 12-12. (Sheet 1)

ALTIMETER CALIBRATION - ALTERNATE SYSTEM AND STANDBY INDICATORS

NOTE:

1. VALID FROM SEA LEVEL TO 15,000 FEET - SLATS RETRACTED OR SLATS EXTENDED.
2. TRUE PRESSURE ALTITUDE = INDICATED PRESSURE ALTITUDE + Δh.
3. CORRECTIONS ARE UNAFFECTED BY POSITION OF LANDING GEAR.
4. INTERPOLATE FOR INTERMEDIATE FLAP SETTINGS.





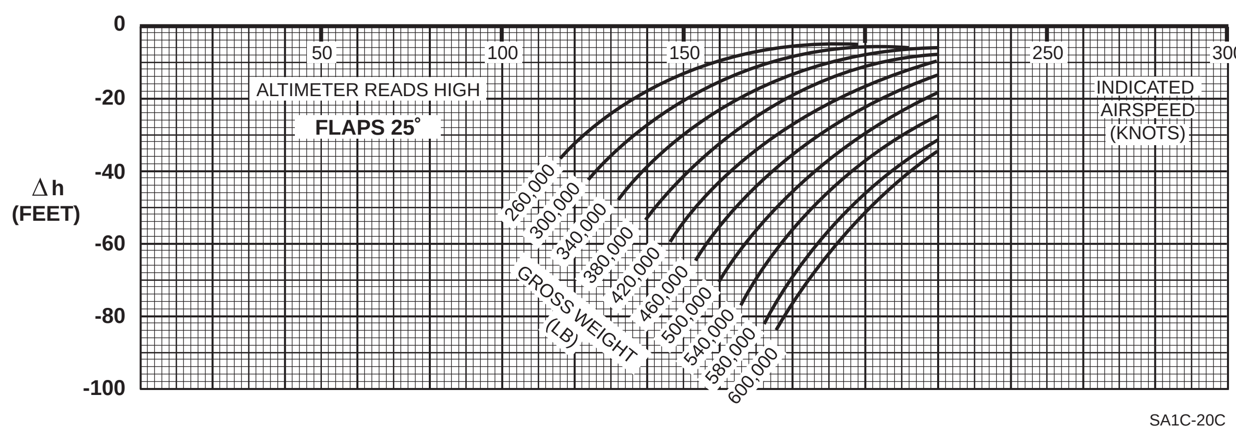
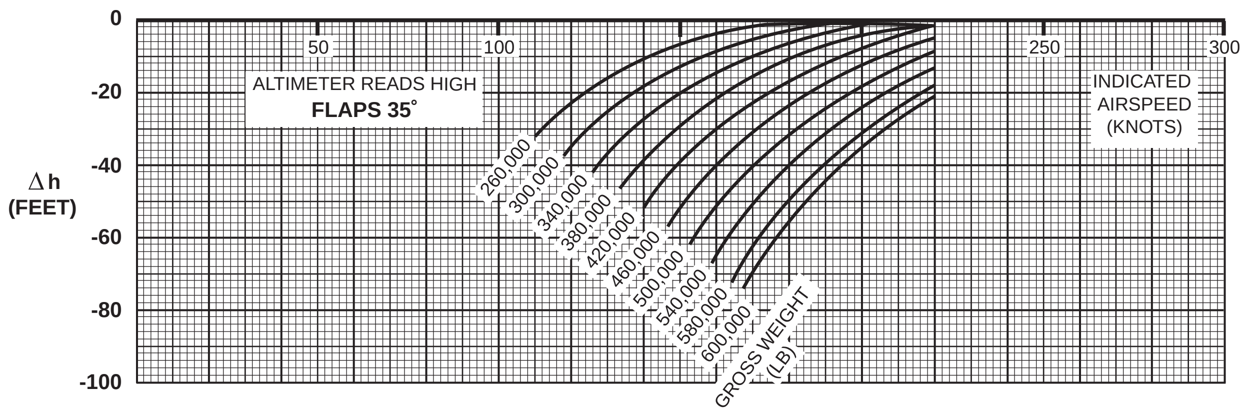


Figure 12-12. (Sheet 2)

ALTIMETER CALIBRATION - ALTERNATE SYSTEM AND STANDBY INDICATORS

NOTE:

1. VALID FROM SEA LEVEL TO 15,000 FEET - SLATS RETRACTED OR SLATS EXTENDED.
2. TRUE PRESSURE ALTITUDE = INDICATED PRESSURE ALTITUDE + Δh.
3. CORRECTIONS ARE UNAFFECTED BY POSITION OF LANDING GEAR.



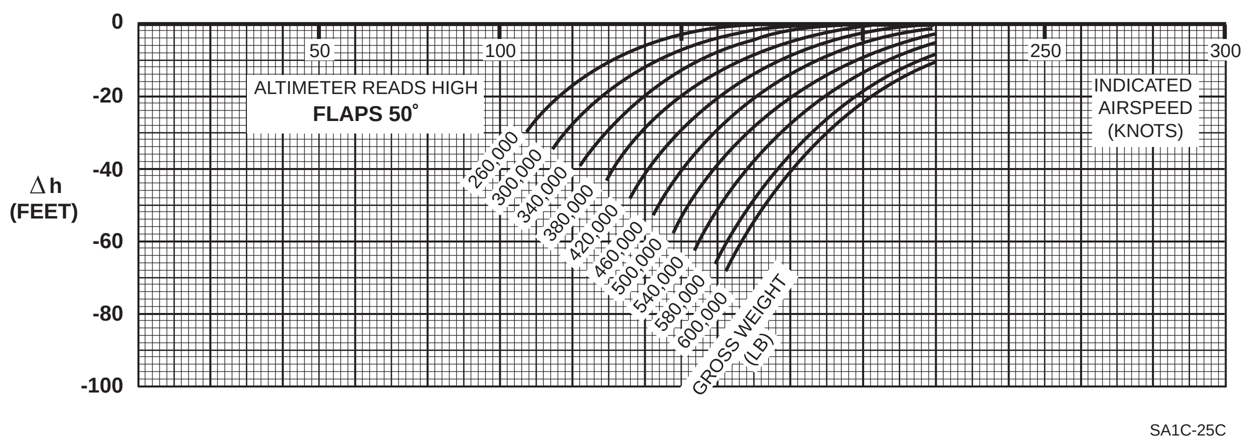


Figure 12-12. (Sheet 3)

ALTIMETER CALIBRATION AT CRUISE ALTITUDE - NORMAL SYSTEM

NOTE:

1. FLAPS UP.
2. TRUE PRESSURE ALTITUDE = INDICATED PRESSURE ALTITUDE + Δh.

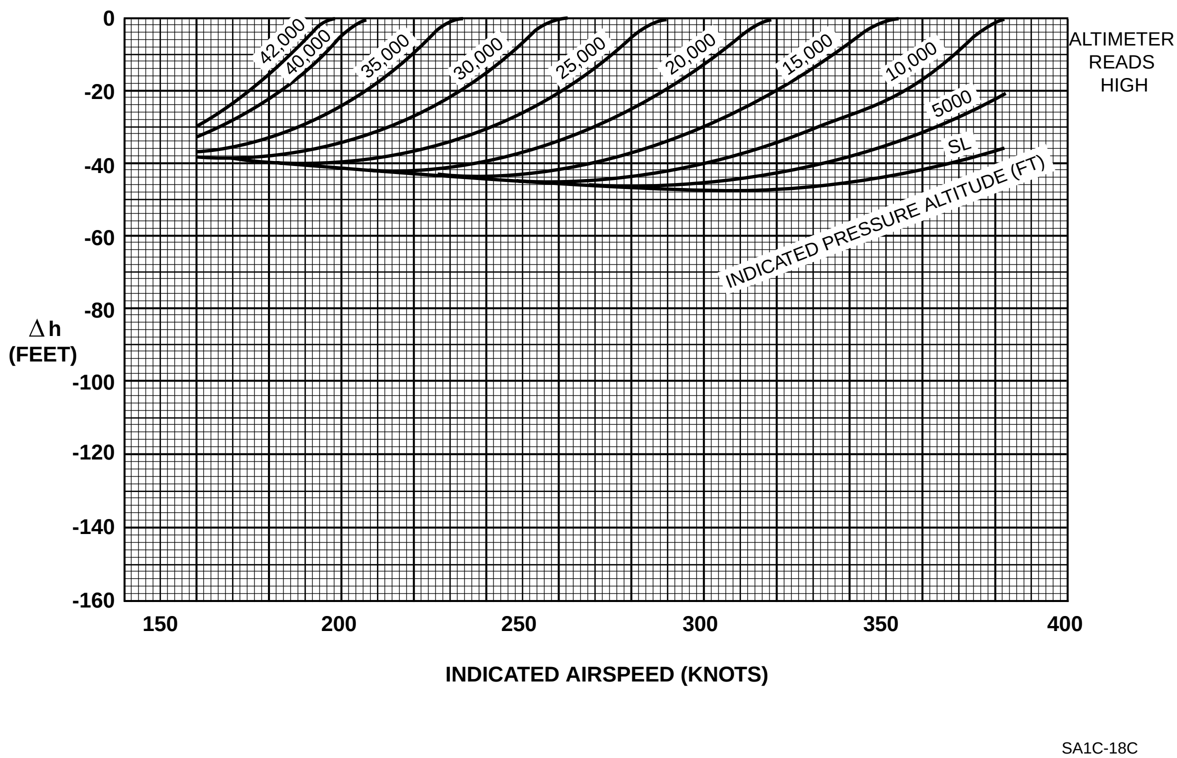


Figure 12-13.

ALTIMETER CALIBRATION AT CRUISE ALTITUDE -ALTERNATE SYSTEM

NOTE:

1. FLAPS UP.
2. TRUE PRESSURE ALTITUDE = INDICATED PRESSURE ALTITUDE + Δh.

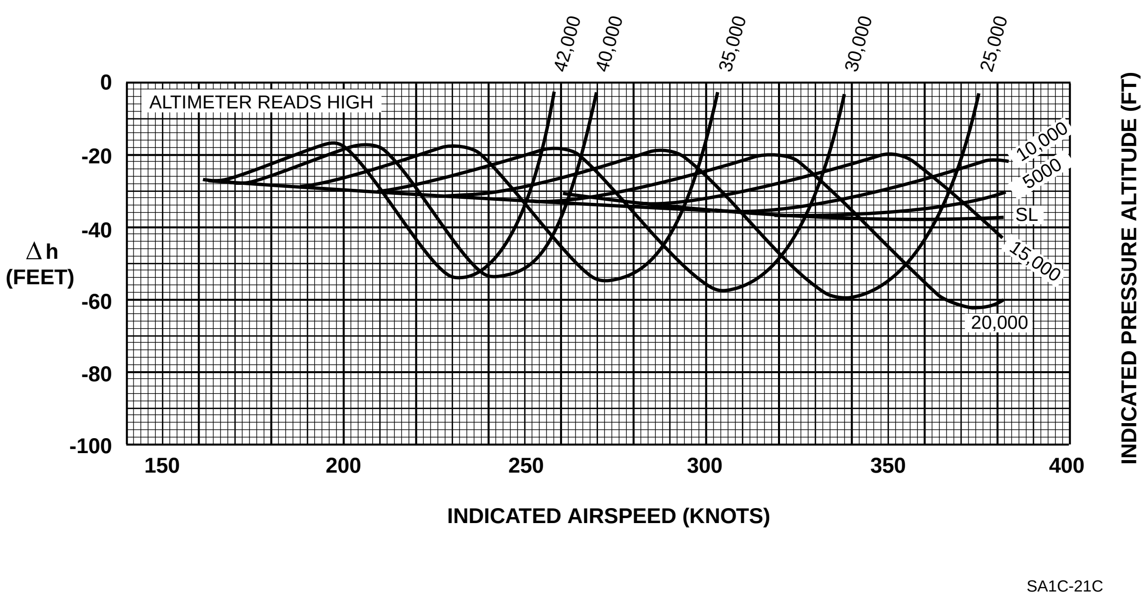


Figure 12-14.

ALTIMETER CALIBRATION AT CRUISE ALTITUDE - STANDBY INDICATORS

NOTE:

1. FLAPS UP.
2. TRUE PRESSURE ALTITUDE = INDICATED PRESSURE ALTITUDE + Δh.

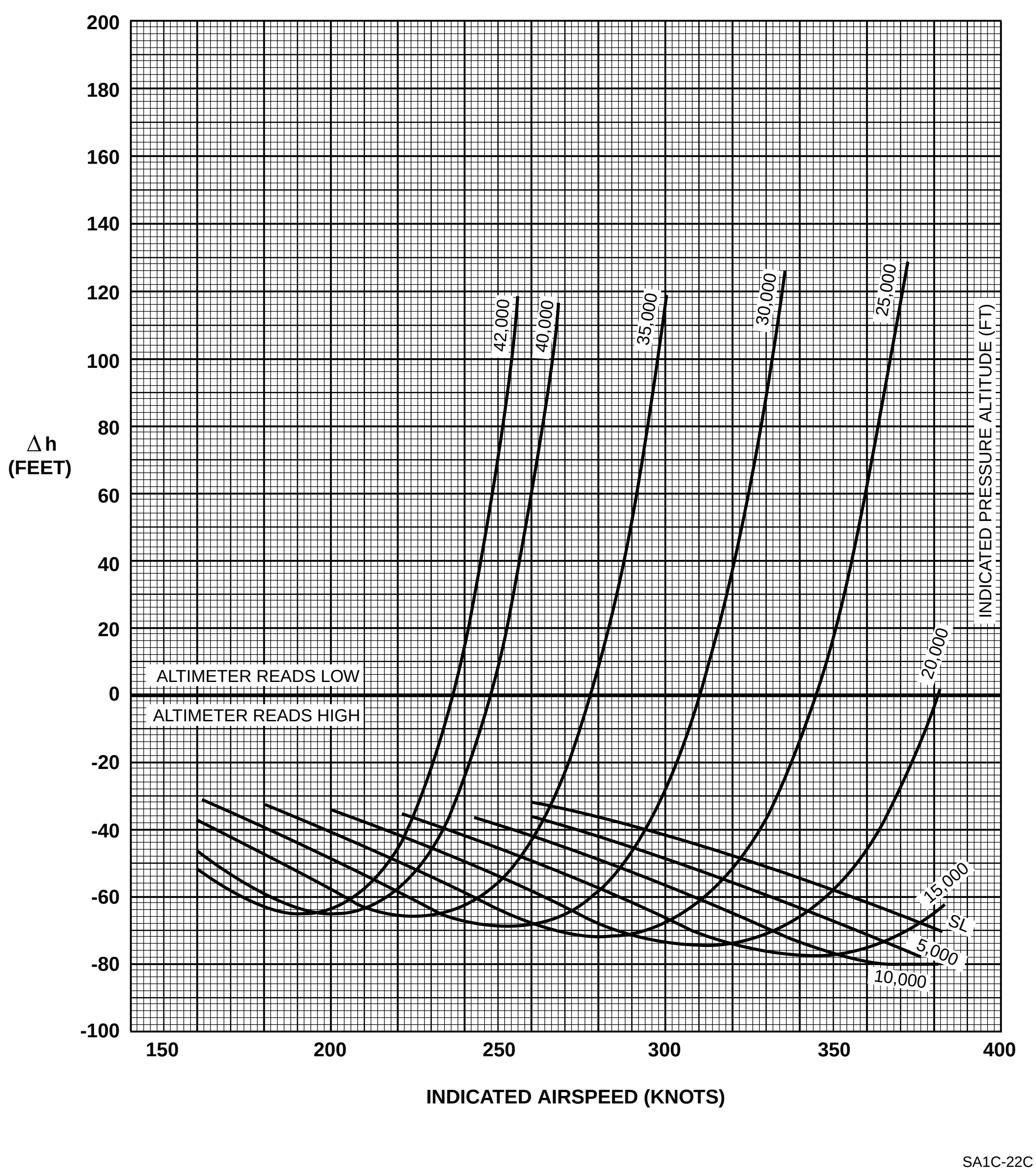


Figure 12-15.

ESTIMATED 1g STALLING SPEEDS
0-DEGREES FLAPS

NOTE:

1. CG = 8% MAC
2. SLATS EXTENDED

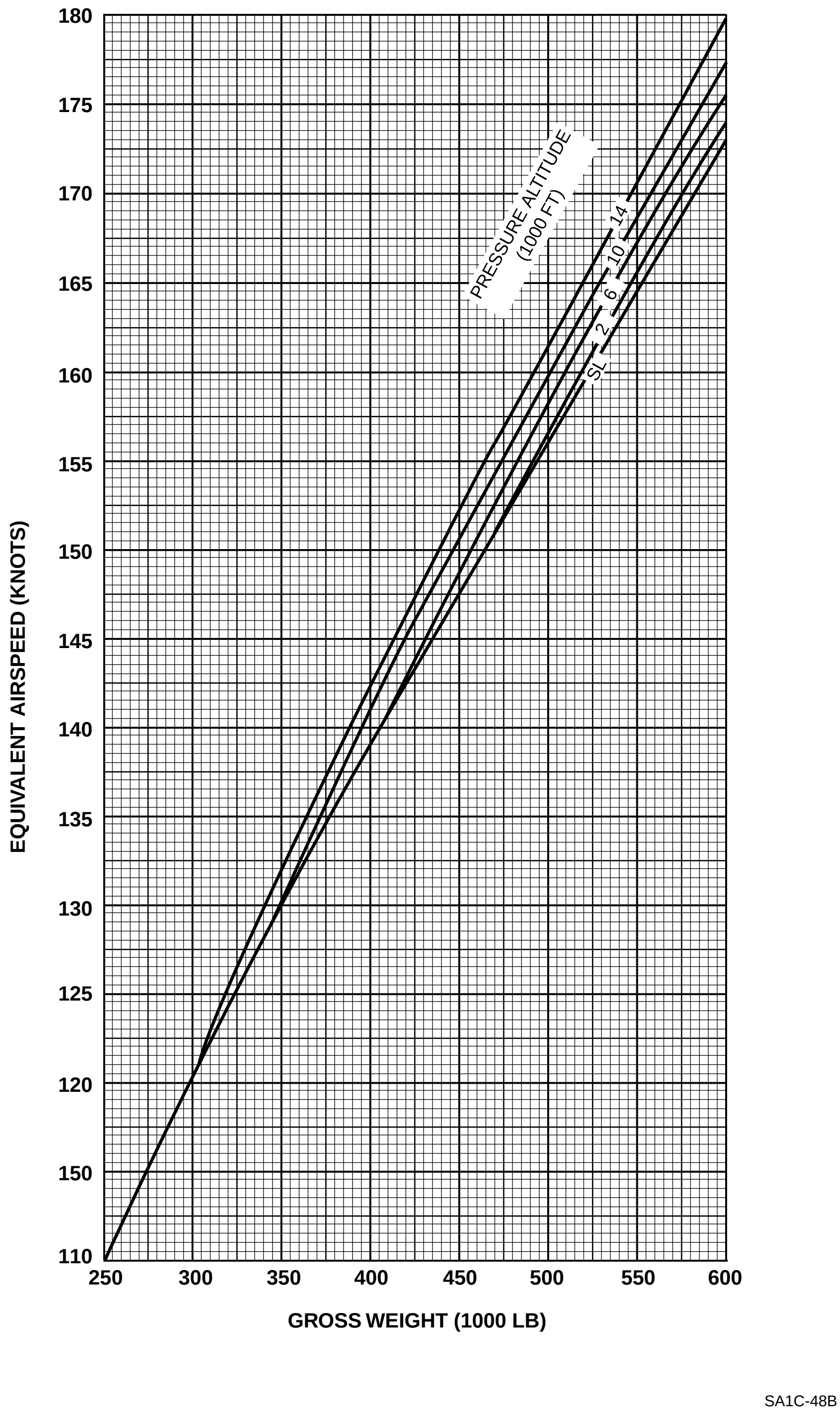


Figure 12-16.

ESTIMATED 1g STALLING SPEEDS 5-DEGREES FLAPS

NOTE:

1. CG = 8% MAC
2. SLATS EXTENDED

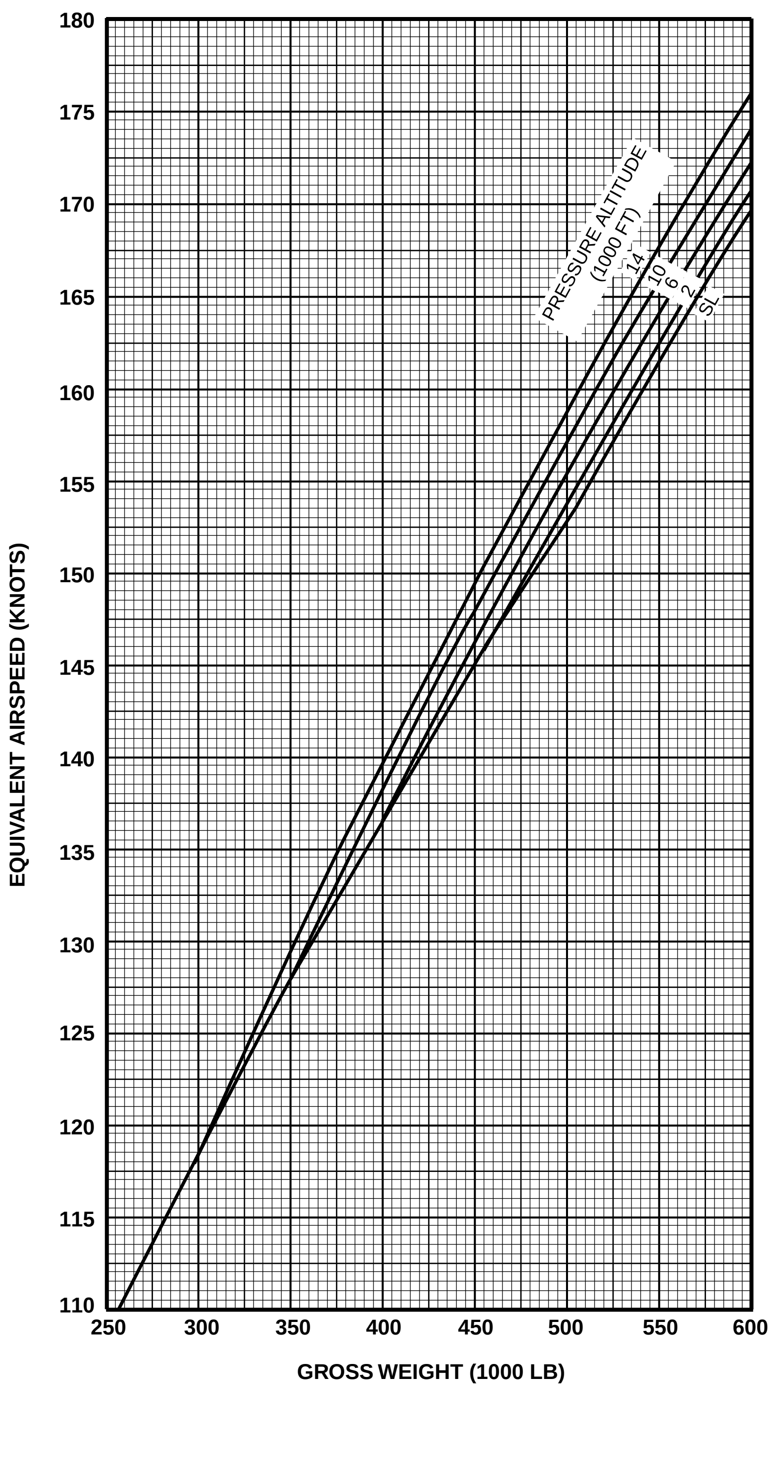


Figure 12-17.

ESTIMATED 1g STALLING SPEEDS
15-DEGREES FLAPS

NOTE:
1. CG = 8% MAC
2. SLATS EXTENDED

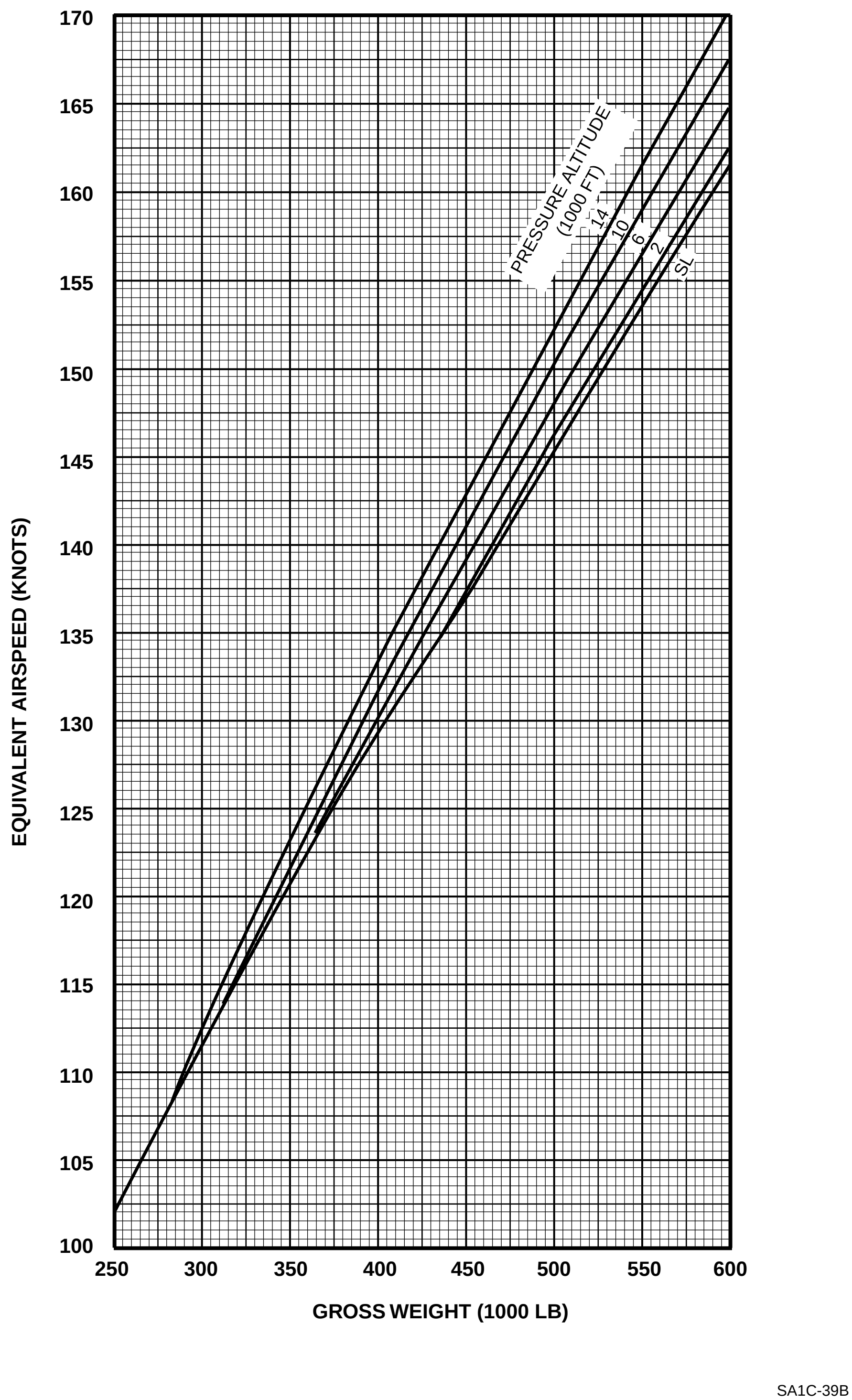


Figure 12-18.

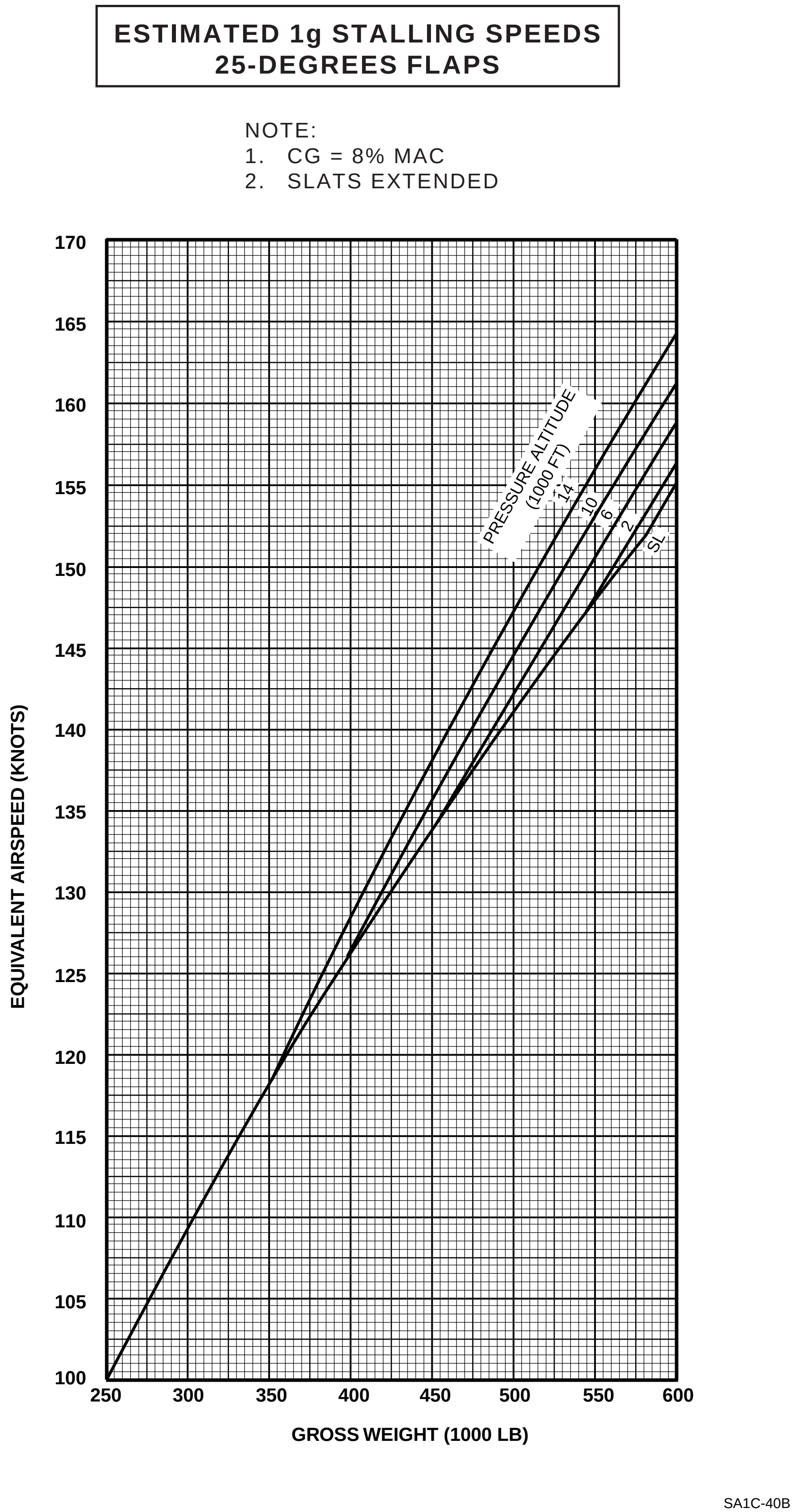

ESTIMATED 1g STALLING SPEEDS
25-DEGREES FLAPS
NOTE:
1. CG = 8% MAC
2. SLATS EXTENDED
PRESSURE ALTITUDE (1000 FT)
14
10
6
2
SL
EQUIVALENT AIRSPEED (KNOTS)
170
165
160
155
150
145
140
135
130
125
120
115
110
105
100
250
300
350
400
450
500
550
600
GROSS WEIGHT (1000 LB)
SA1C-40B

Figure 12-19.

MINIMUM STALLING SPEEDS 0-DEGREES FLAPS

NOTE:
1. CG = 8% MAC
2. SLATS EXTENDED

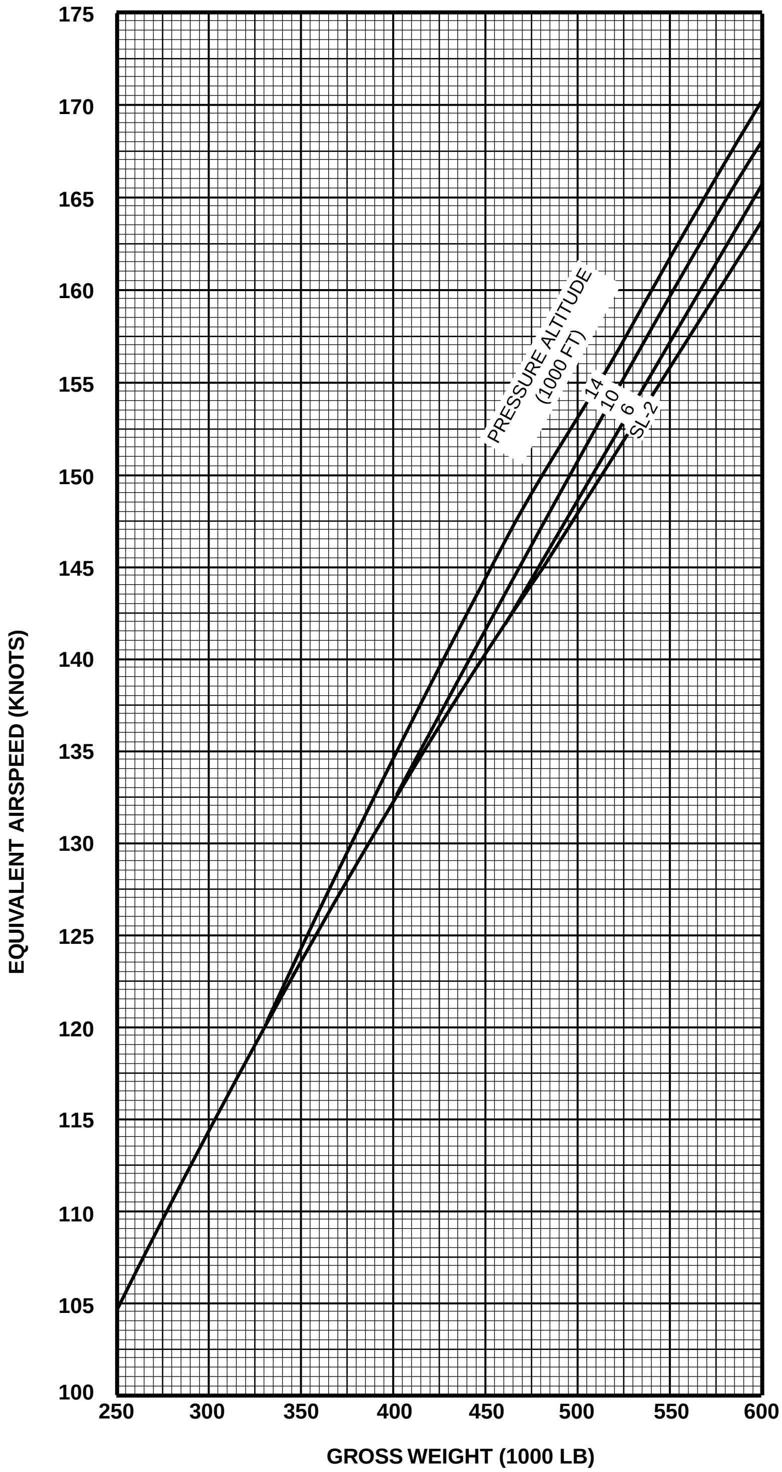


Figure 12-20.

SA1C-237A

MINIMUM STALLING SPEEDS 5-DEGREES FLAPS

NOTE:
1. CG = 8% MAC
2. SLATS EXTENDED

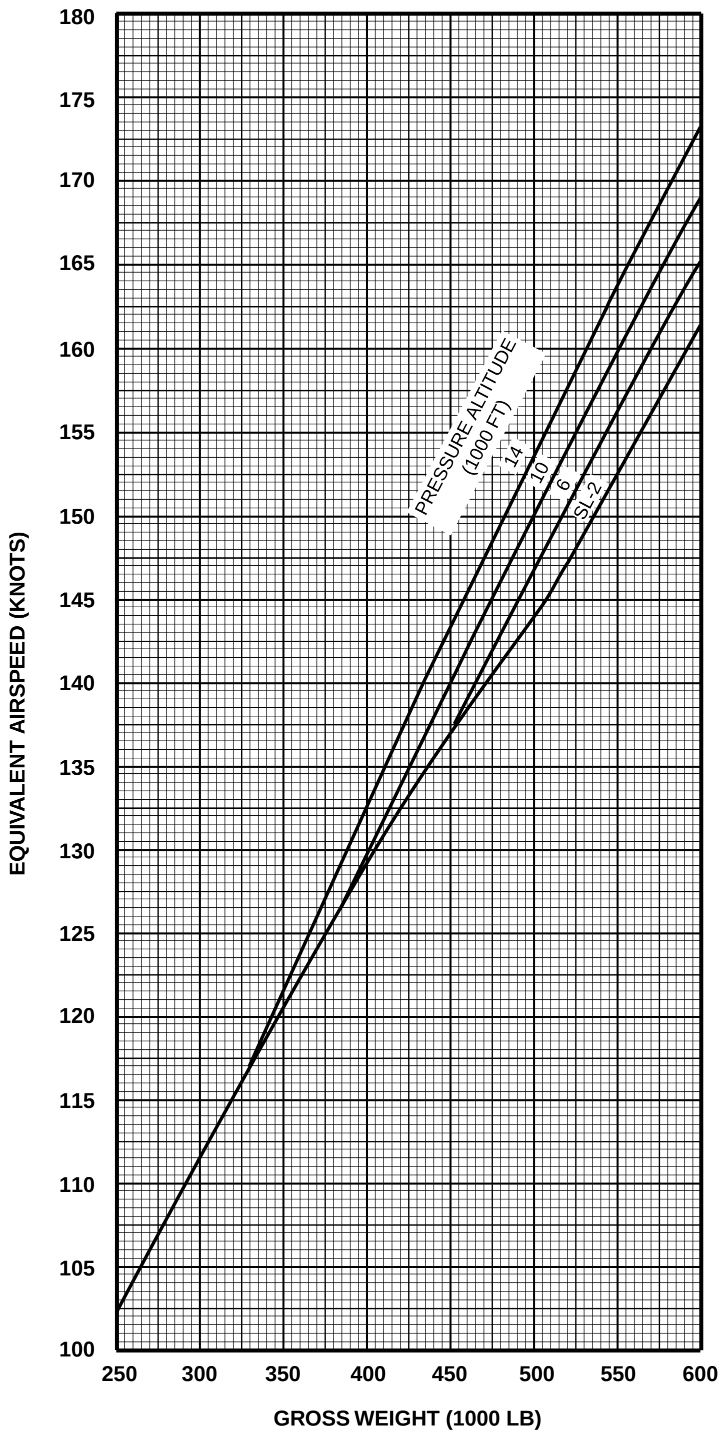


Figure 12-21.

SA1C-238A

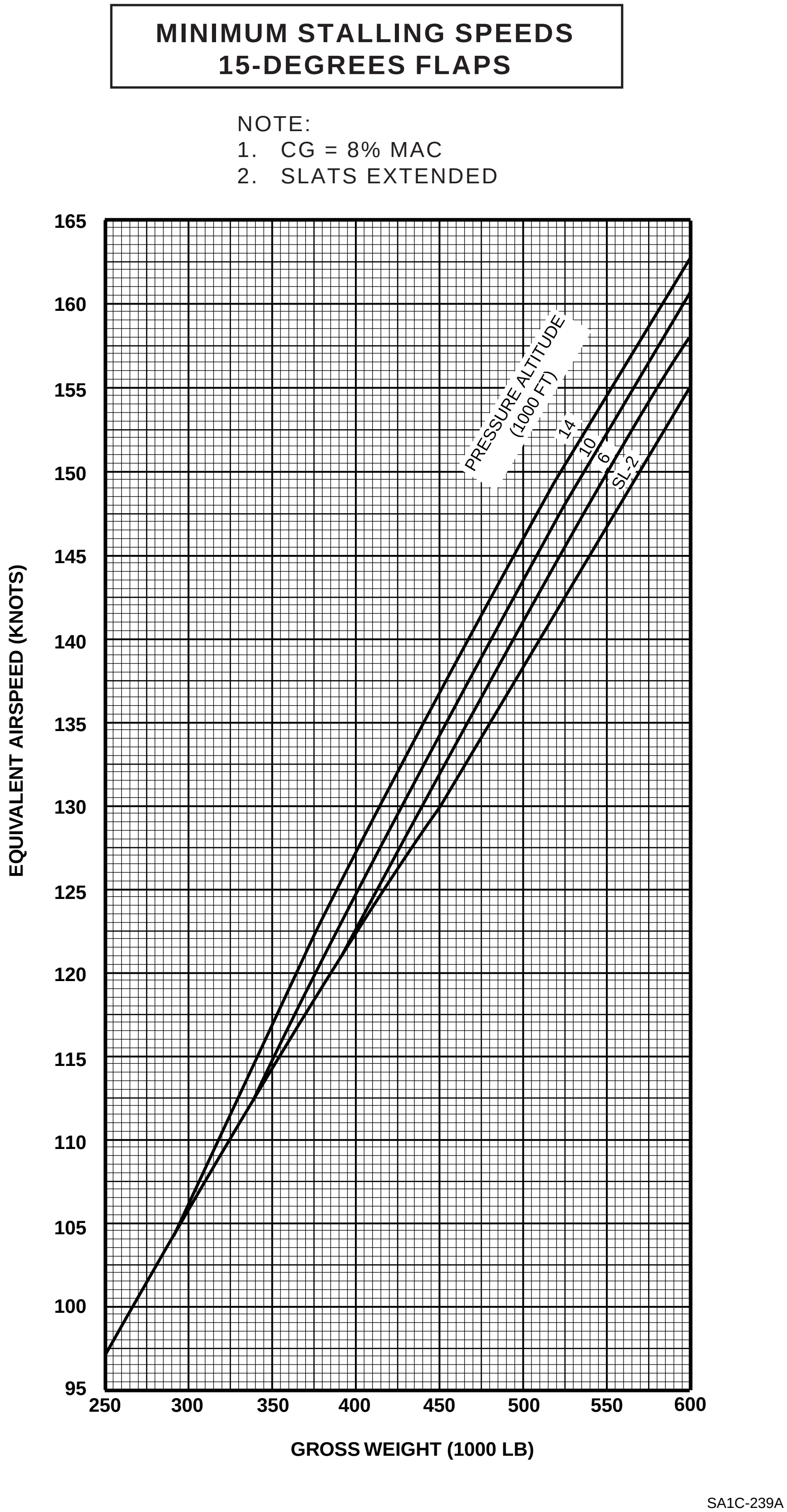

MINIMUM STALLING SPEEDS
15-DEGREES FLAPS
NOTE:
1. CG = 8% MAC
2. SLATS EXTENDED
PRESSURE ALTITUDE
(1000 FT)
14
10
6
SL-2
EQUIVALENT AIRSPEED (KNOTS)
165
160
155
150
145
140
135
130
125
120
115
110
105
100
95
250
300
350
400
450
500
550
600
GROSS WEIGHT (1000 LB)
SA1C-239A

Figure 12-22.

MINIMUM STALLING SPEEDS
25-DEGREES FLAPS

NOTE:
1. CG = 8% MAC
2. SLATS EXTENDED

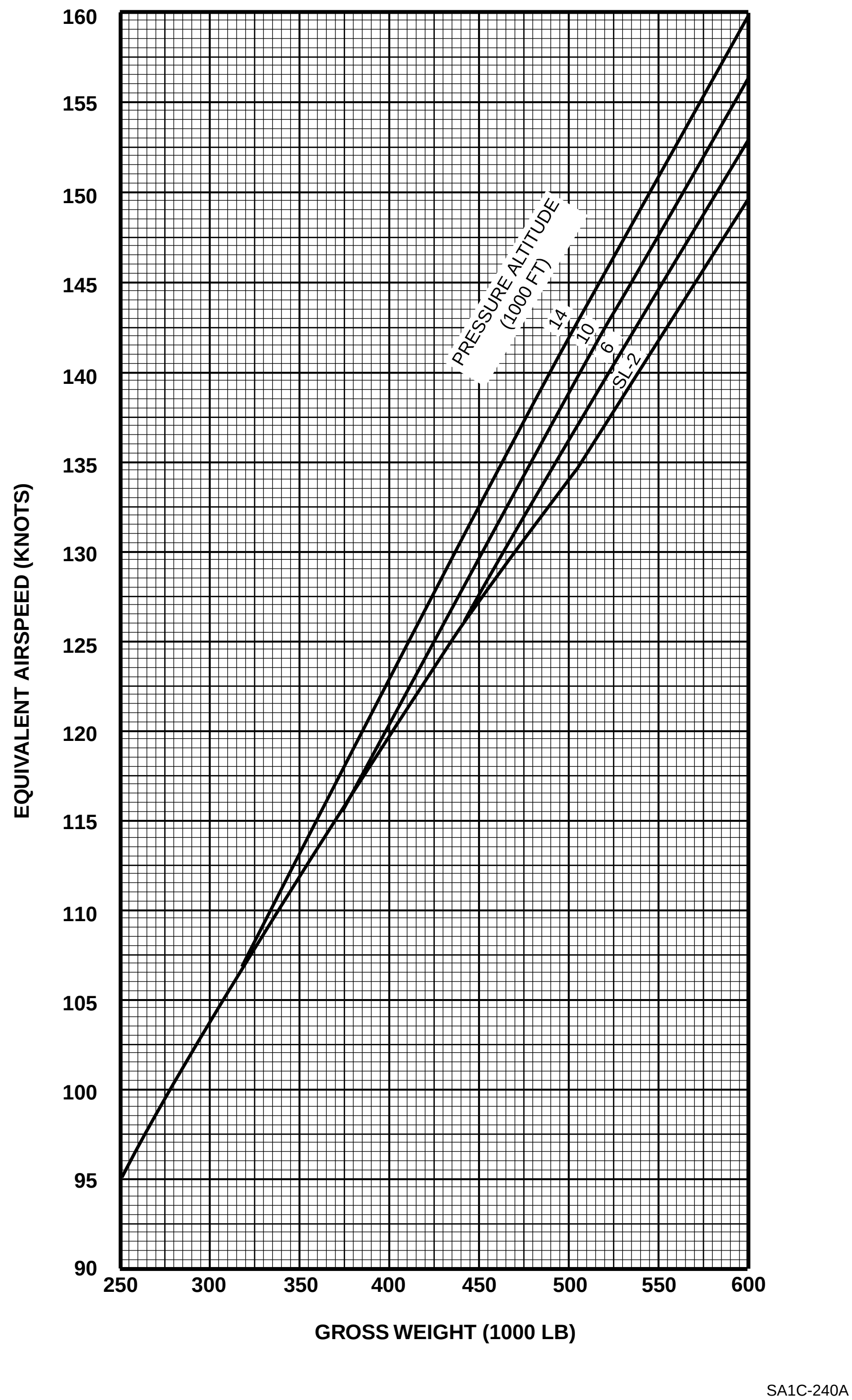


Figure 12-23.

MINIMUM STALLING SPEEDS 35-DEGREES FLAPS

NOTE:
1. CG = 8% MAC
2. SLATS EXTENDED

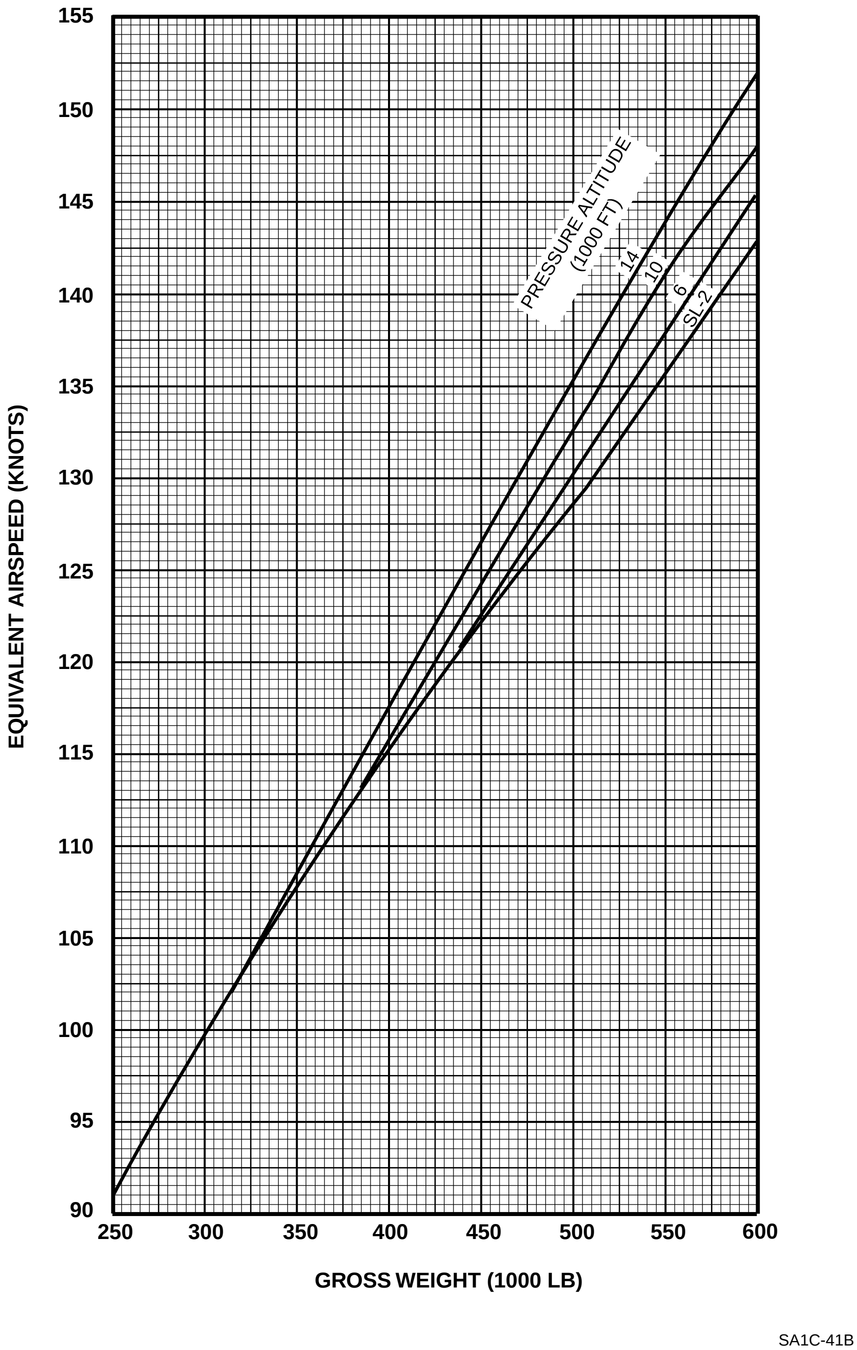


Figure 12-24.

MINIMUM STALLING SPEEDS
50-DEGREES FLAPS

NOTE:
1. CG = 8% MAC
2. SLATS EXTENDED

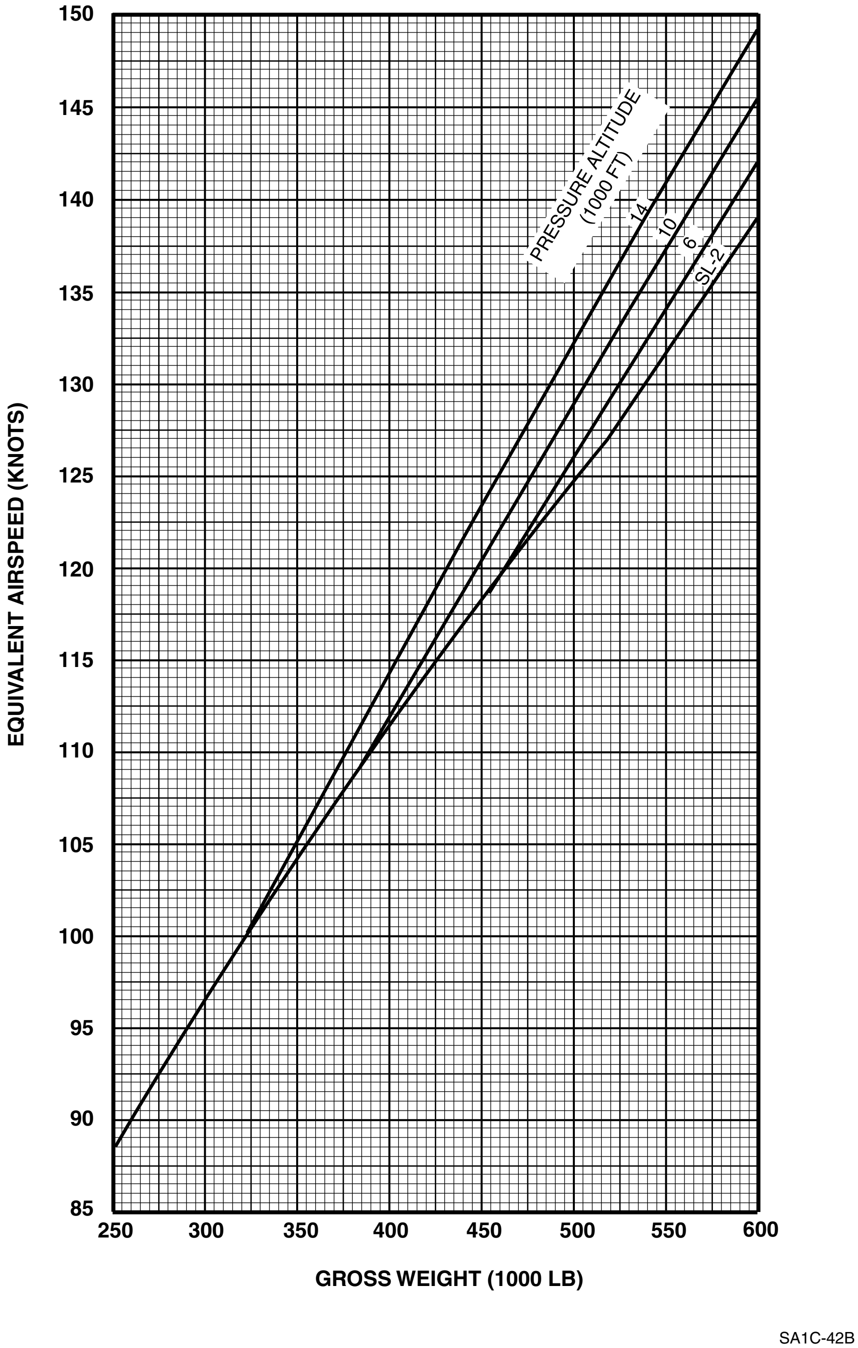


Figure 12-25.

MINIMUM STALLING SPEEDS SLATS RETRACTED

1. CG = 8% MAC
2. VALID FROM SEA LEVEL TO 15,000 FT

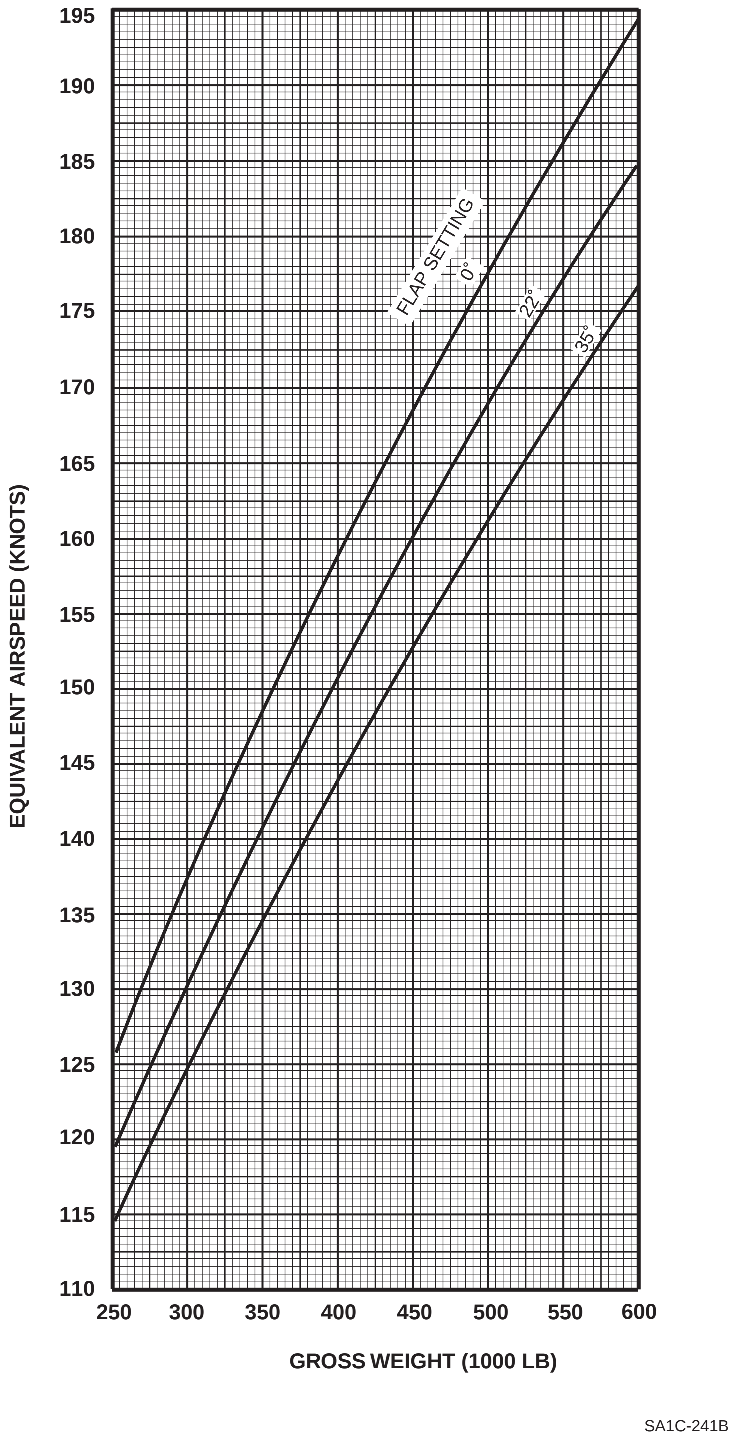


Figure 12-26.

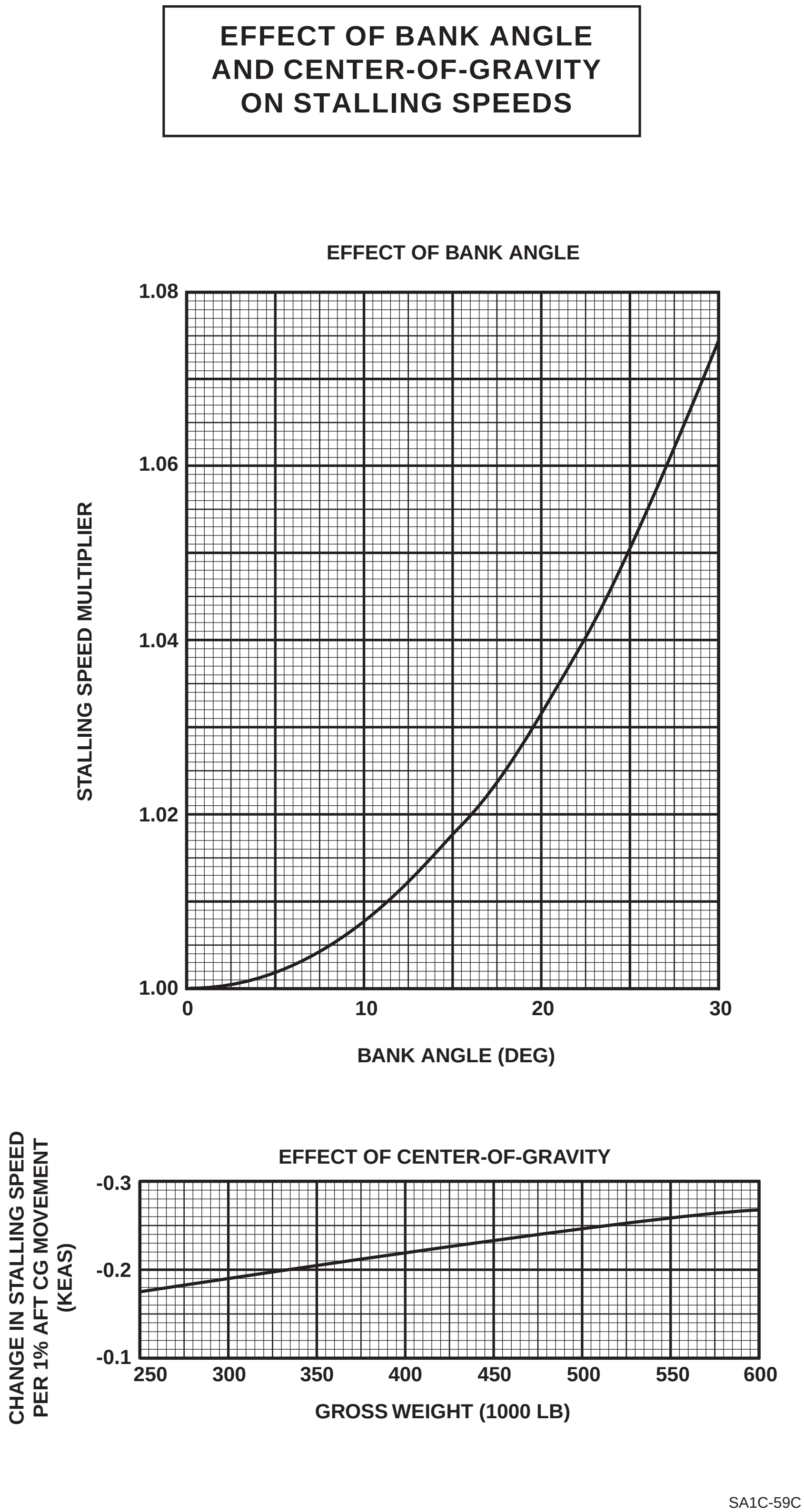
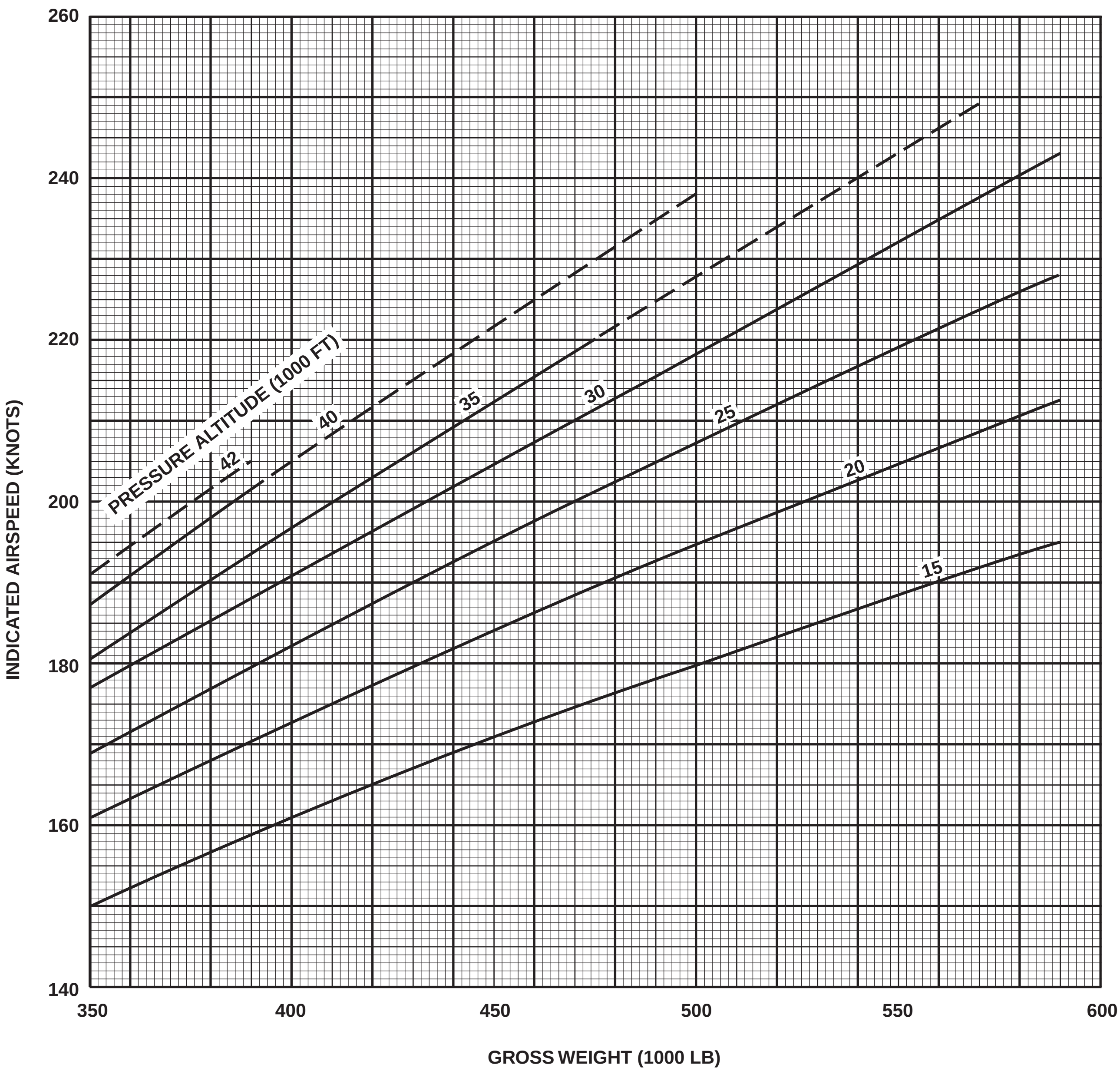

EFFECT OF BANK ANGLE
AND CENTER-OF-GRAVITY
ON STALLING SPEEDS
EFFECT OF BANK ANGLE
STALLING SPEED MULTIPLIER
1.08
1.06
1.04
1.02
1.00
0
10
20
30
BANK ANGLE (DEG)
EFFECT OF CENTER-OF-GRAVITY
CHANGE IN STALLING SPEED PER 1% AFT CG MOVEMENT (KEAS)
-0.3
-0.2
-0.1
250
300
350
400
450
500
550
600
GROSS WEIGHT (1000 LB)
SA1C-59C

Figure 12-27.

CLEAN-CONFIGURATION STALL BOUNDARY SPEED

NOTE:
1. CLEAN CONFIGURATION
2. DASHED LINES INDICATE REGION ABOVE NORMAL CRUISE CAPABILITY
3. CG AT 8% MAC
4. BANK ANGLE = 0°



SA1C-335A

Figure 12-28.

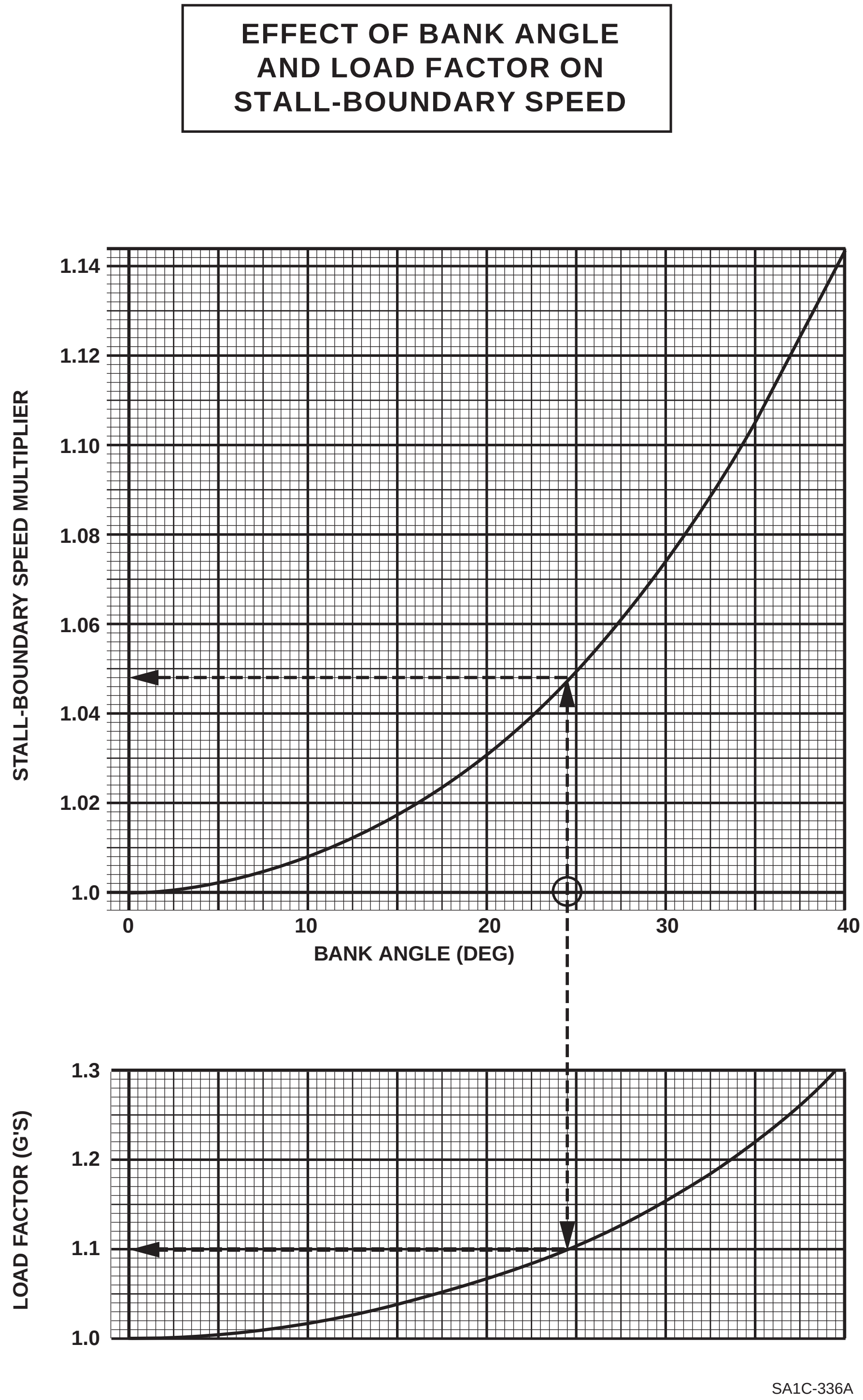

EFFECT OF BANK ANGLE
AND LOAD FACTOR ON
STALL-BOUNDARY SPEED
STALL-BOUNDARY SPEED MULTIPLIER
1.14
1.12
1.10
1.08
1.06
1.04
1.02
1.0
0
10
20
30
40
BANK ANGLE (DEG)
LOAD FACTOR (G'S)
1.3
1.2
1.1
1.0
SA1C-336A

Figure 12-29.

CLIMB GRADIENT

NOTE:

1. ONE ENGINE INOPERATIVE
2. SLATS EXTENDED
3. GEAR UP

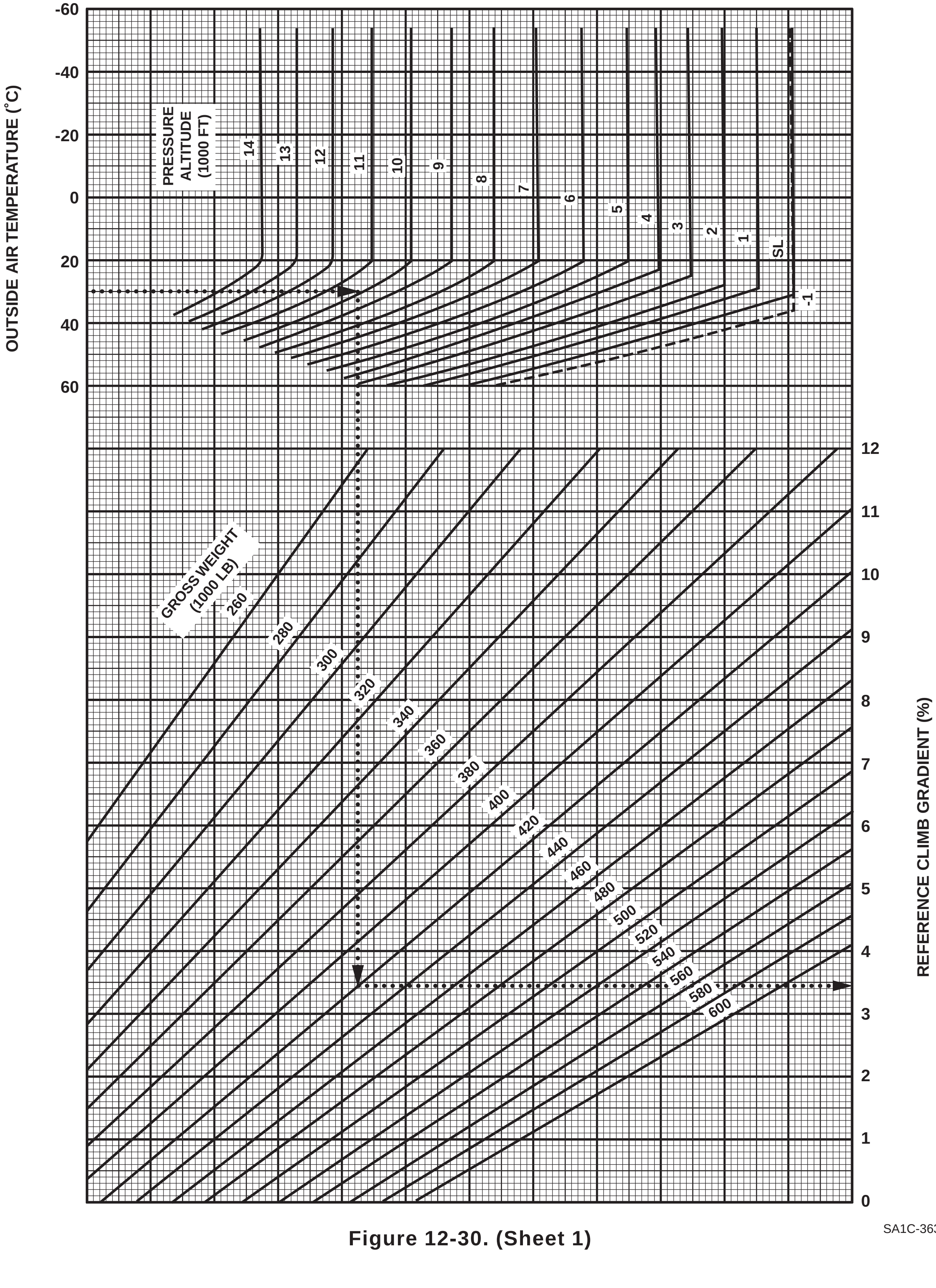


Figure 12-30. (Sheet 1)

SA1C-363B

CLIMB GRADIENT

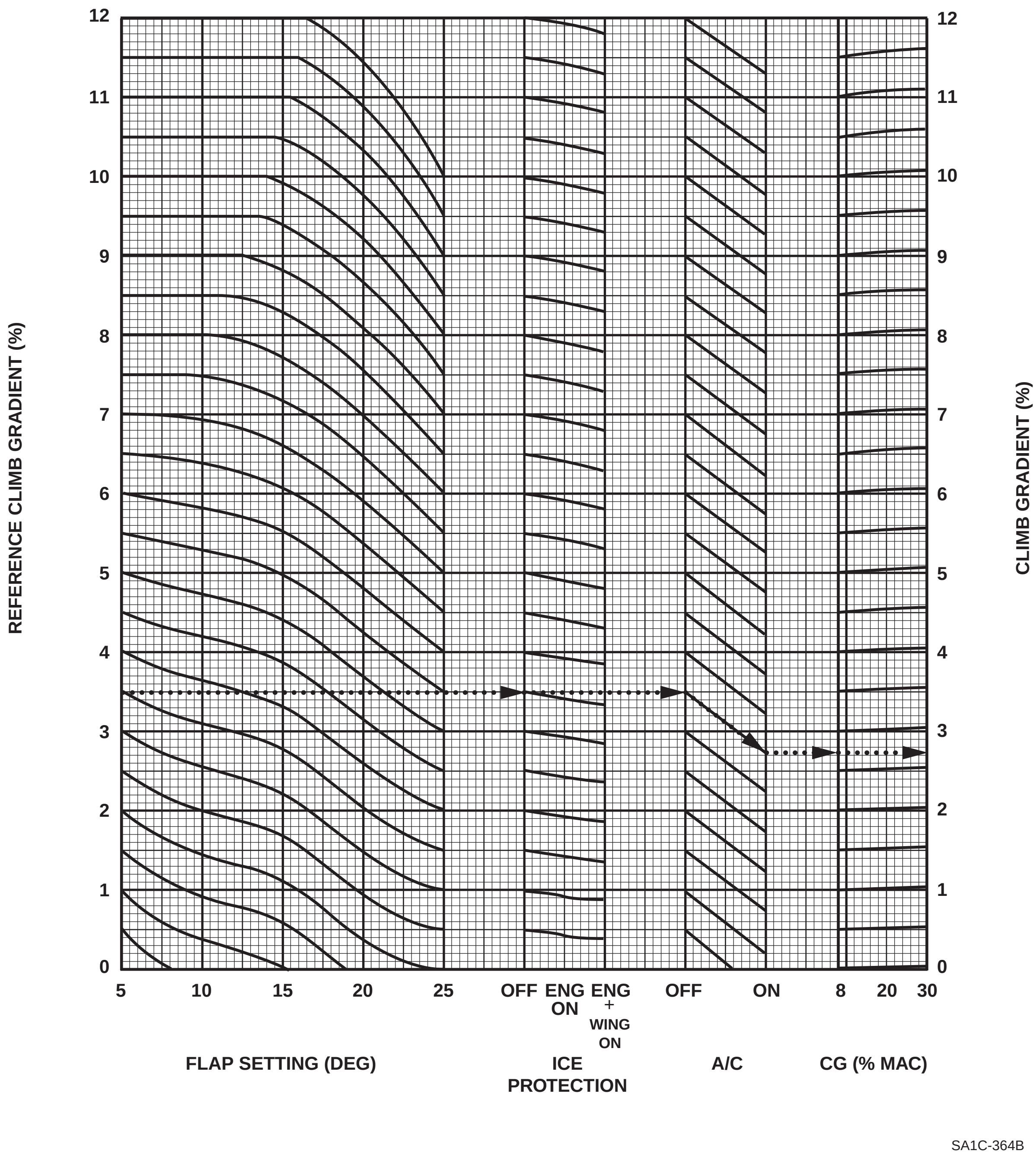


Figure 12-30. (Sheet 2)

CRITICAL FIELD LENGTH
RCR = 23 TO 18/WITH REVERSE THRUST

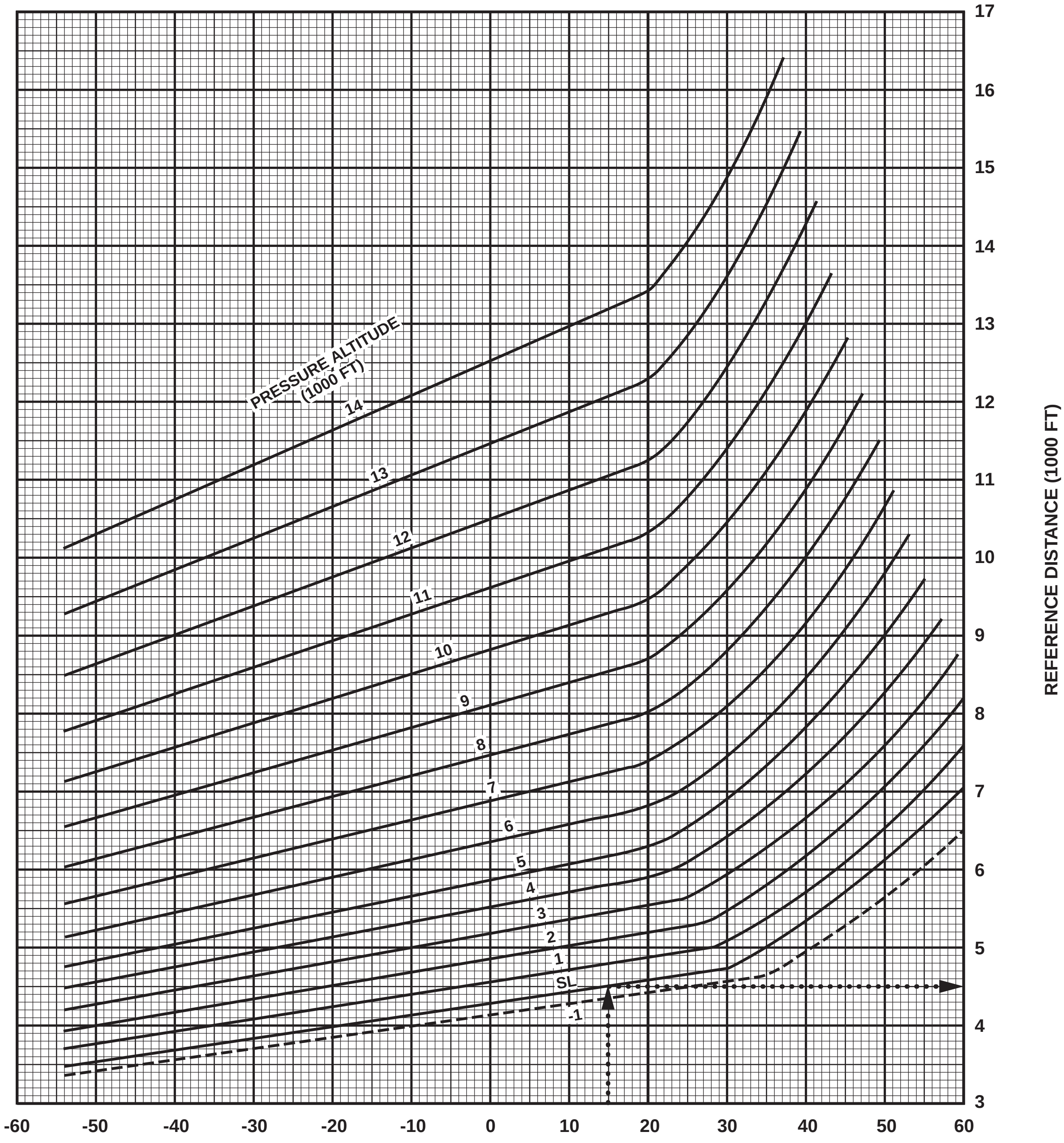


Figure 12-31A. (Sheet 1)

CRITICAL FIELD LENGTH
RCR = 23 TO 18/WITH REVERSE THRUST

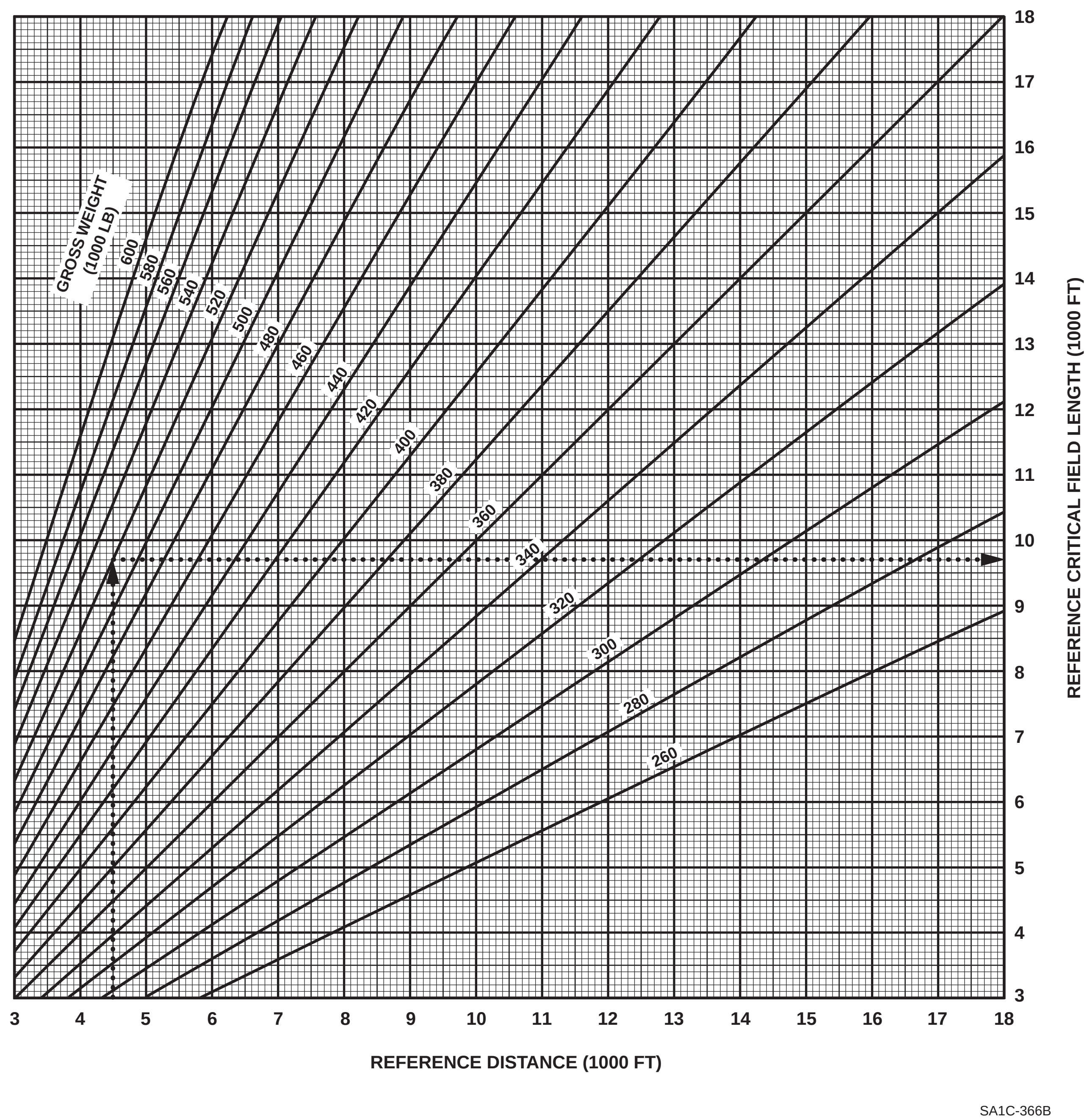


Figure 12-31A. (Sheet 2)

CRITICAL FIELD LENGTH
RCR = 23 TO 18/WITH REVERSE THRUST

NOTE: DO NOT MAKE RCR CORRECTION WHEN CFCC IS USED.

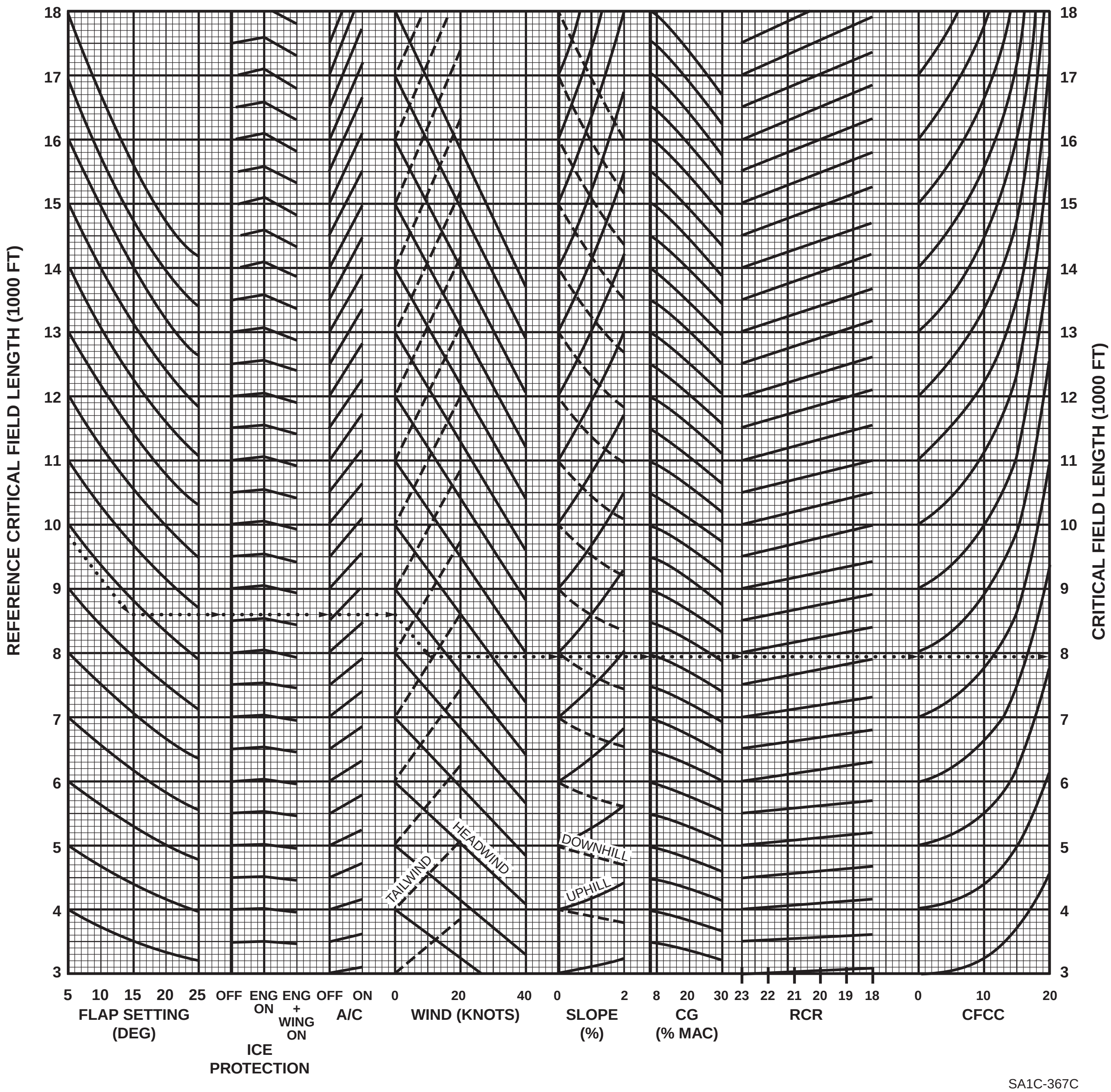


Figure 12-31A. (Sheet 3)

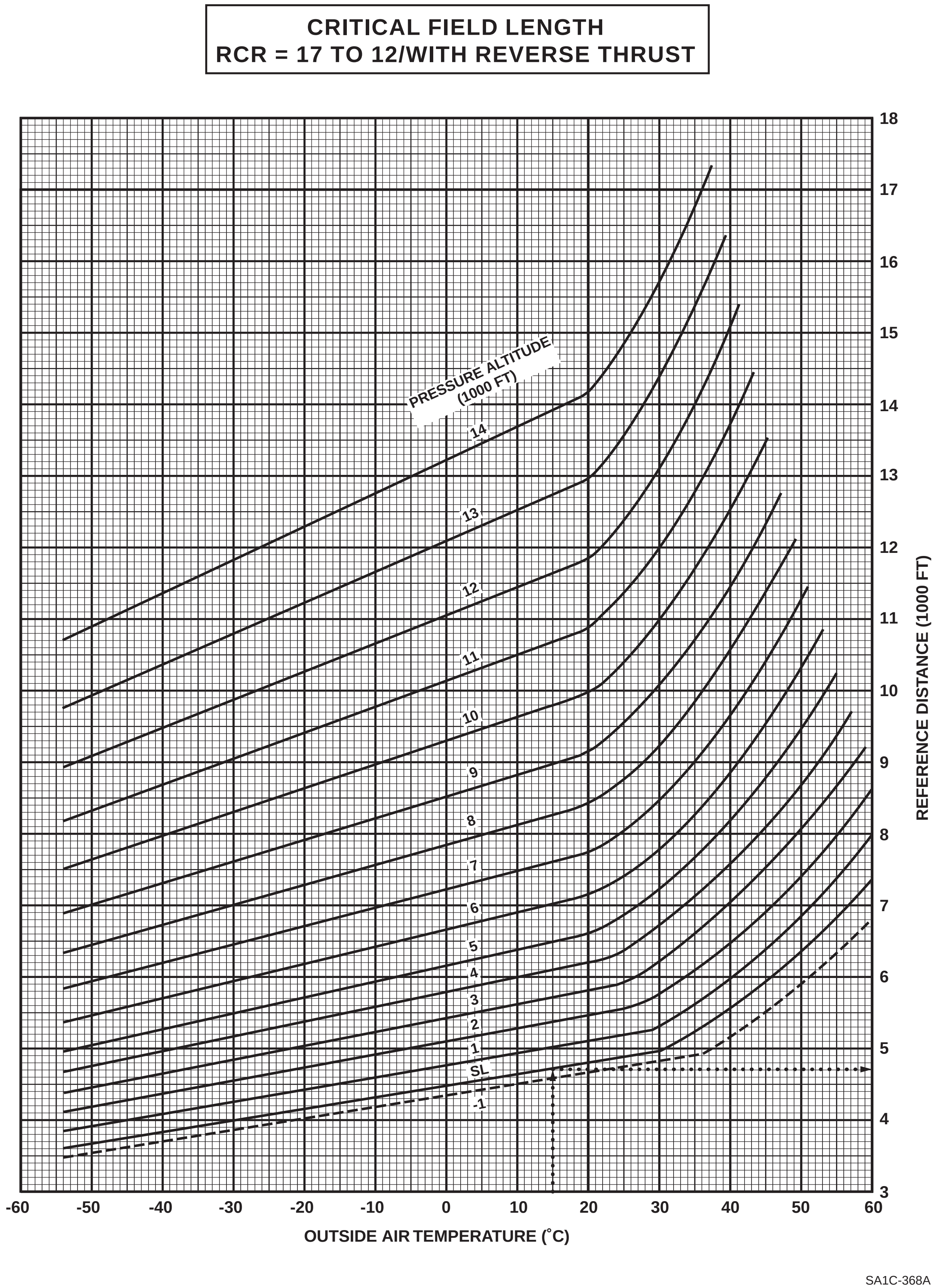


Figure 12-31B. (Sheet 1)

CRITICAL FIELD LENGTH
RCR = 17 TO 12/WITH REVERSE THRUST

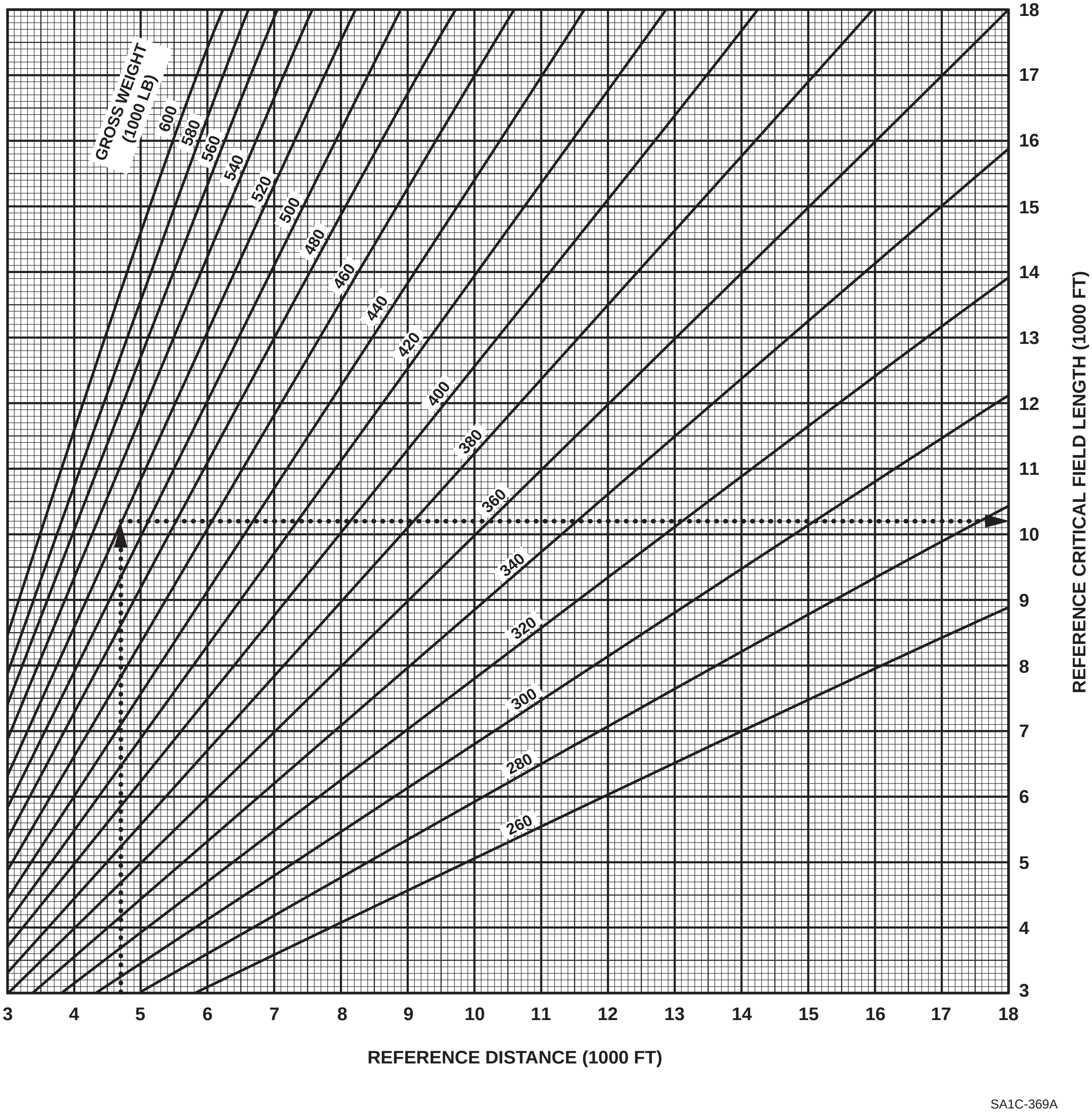


Figure 12-31B. (Sheet 2)

CRITICAL FIELD LENGTH
RCR = 17 TO 12/WITH REVERSE THRUST

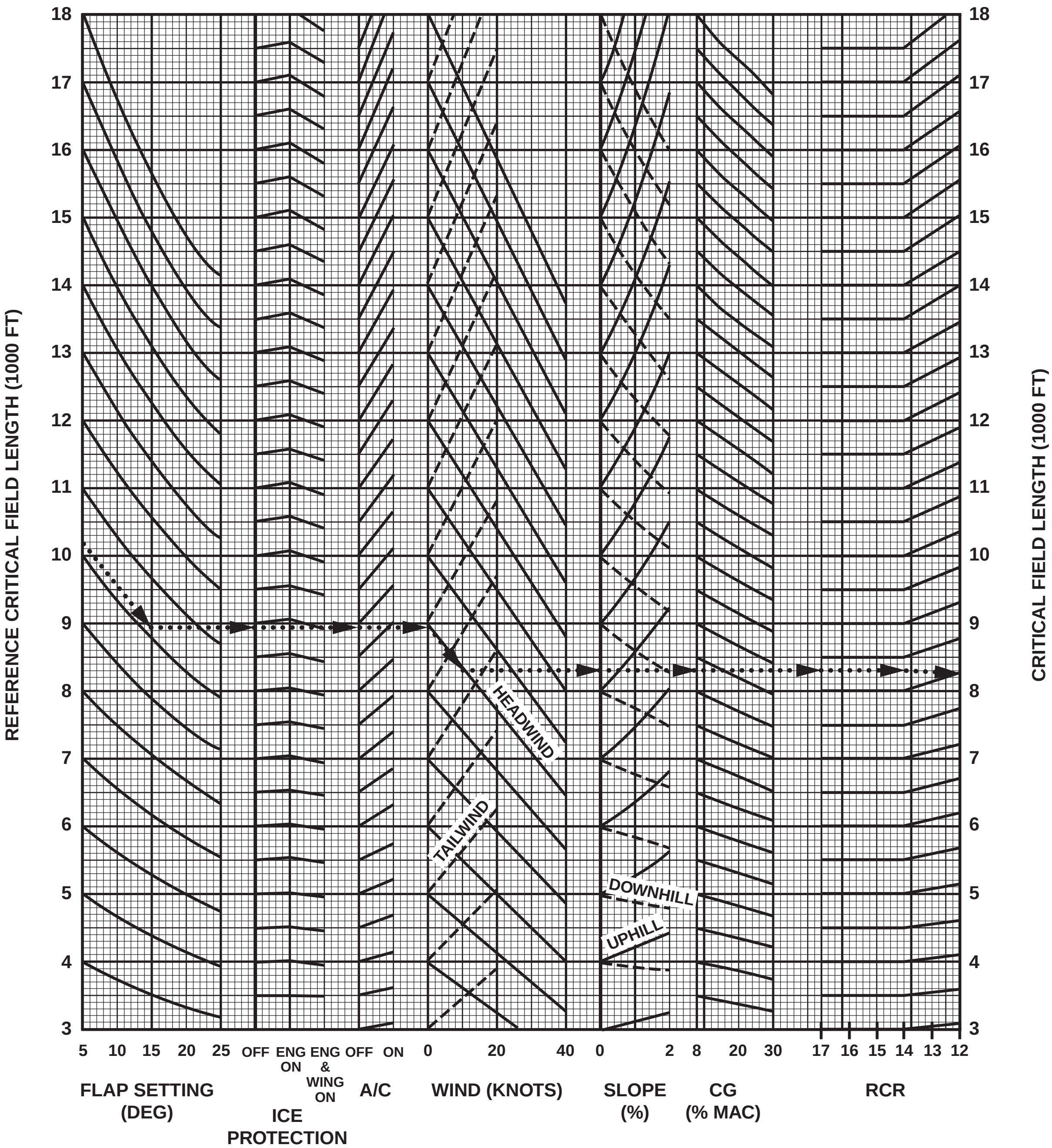


Figure 12-31B. (Sheet 3)

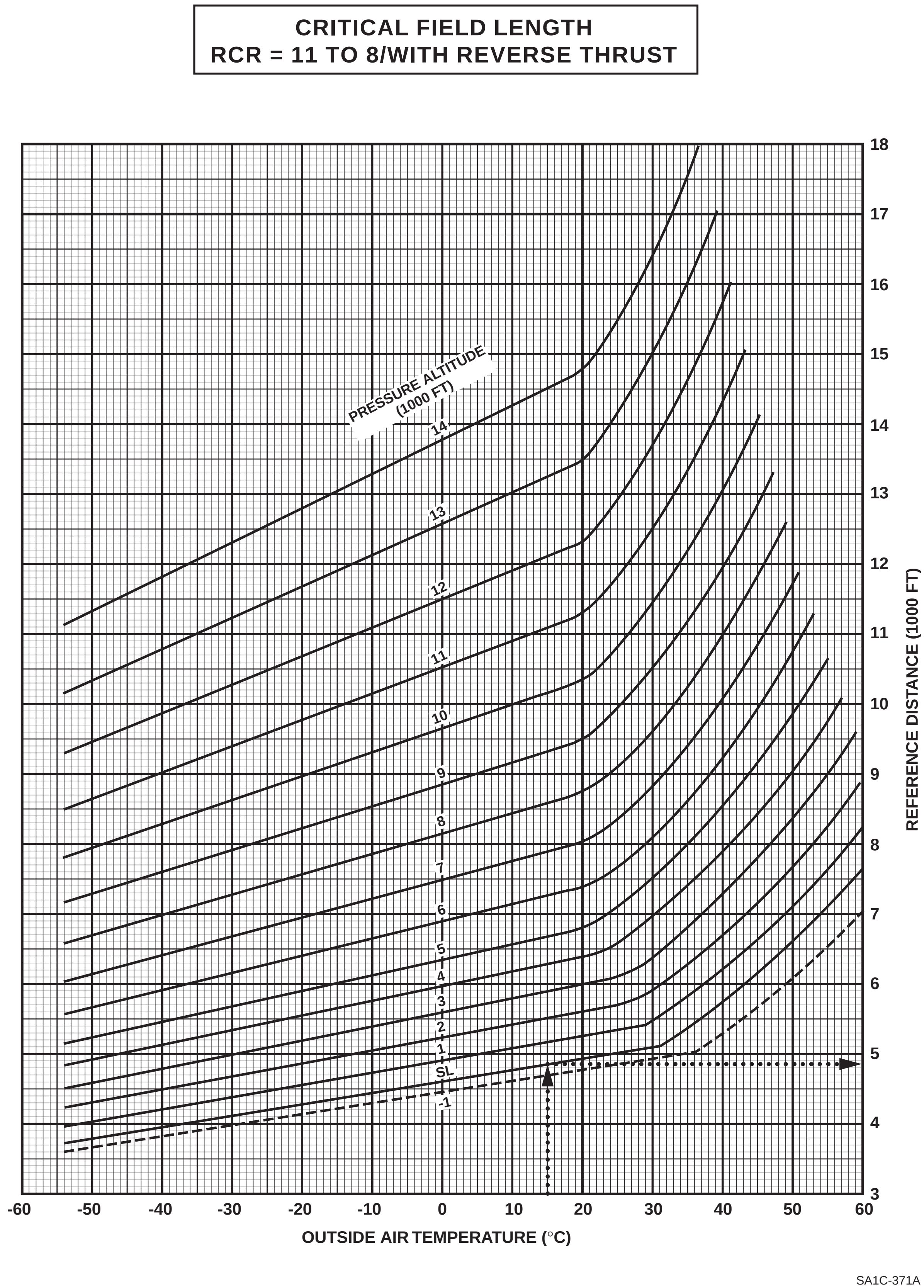


Figure 12-31C. (Sheet 1)

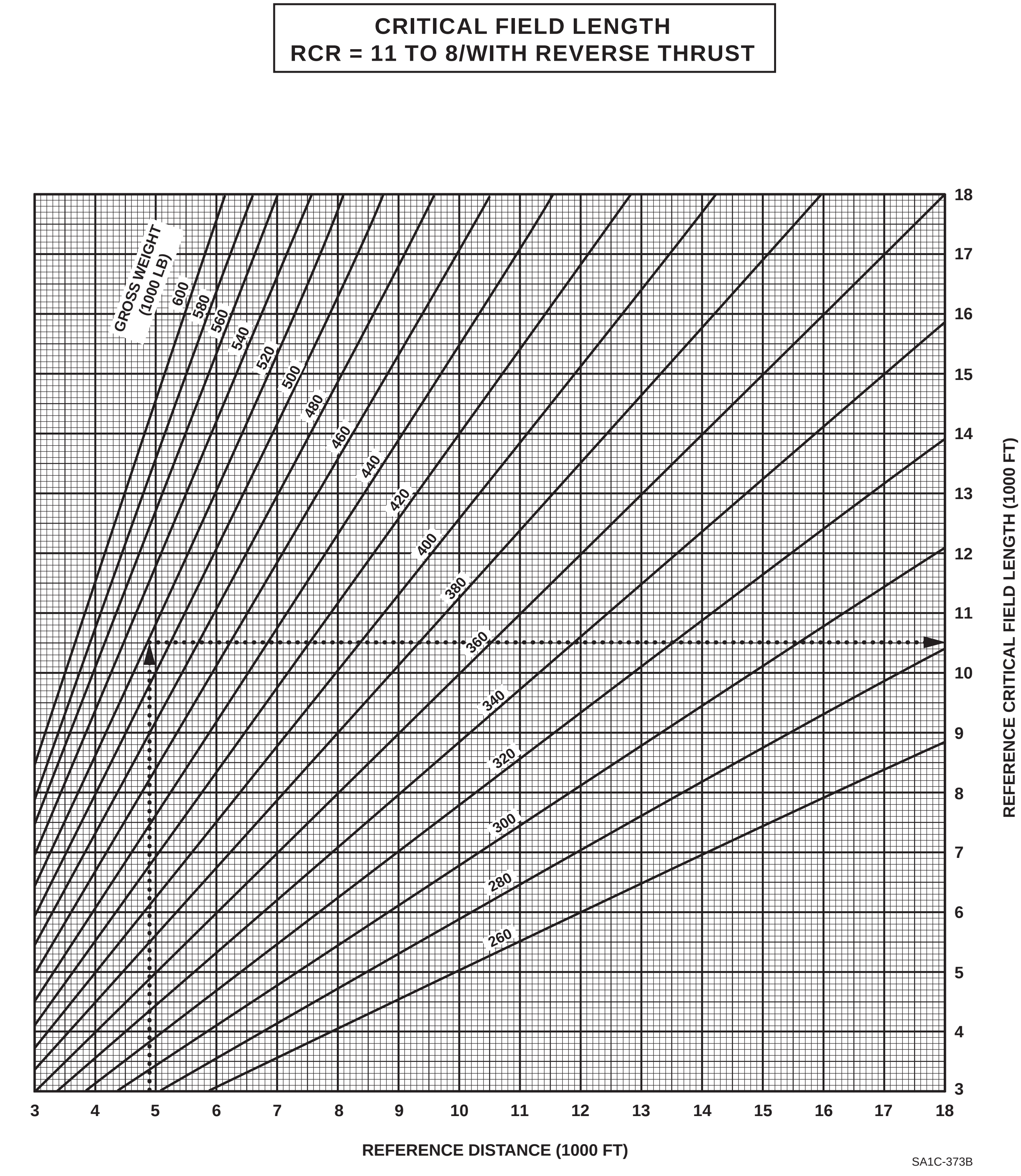
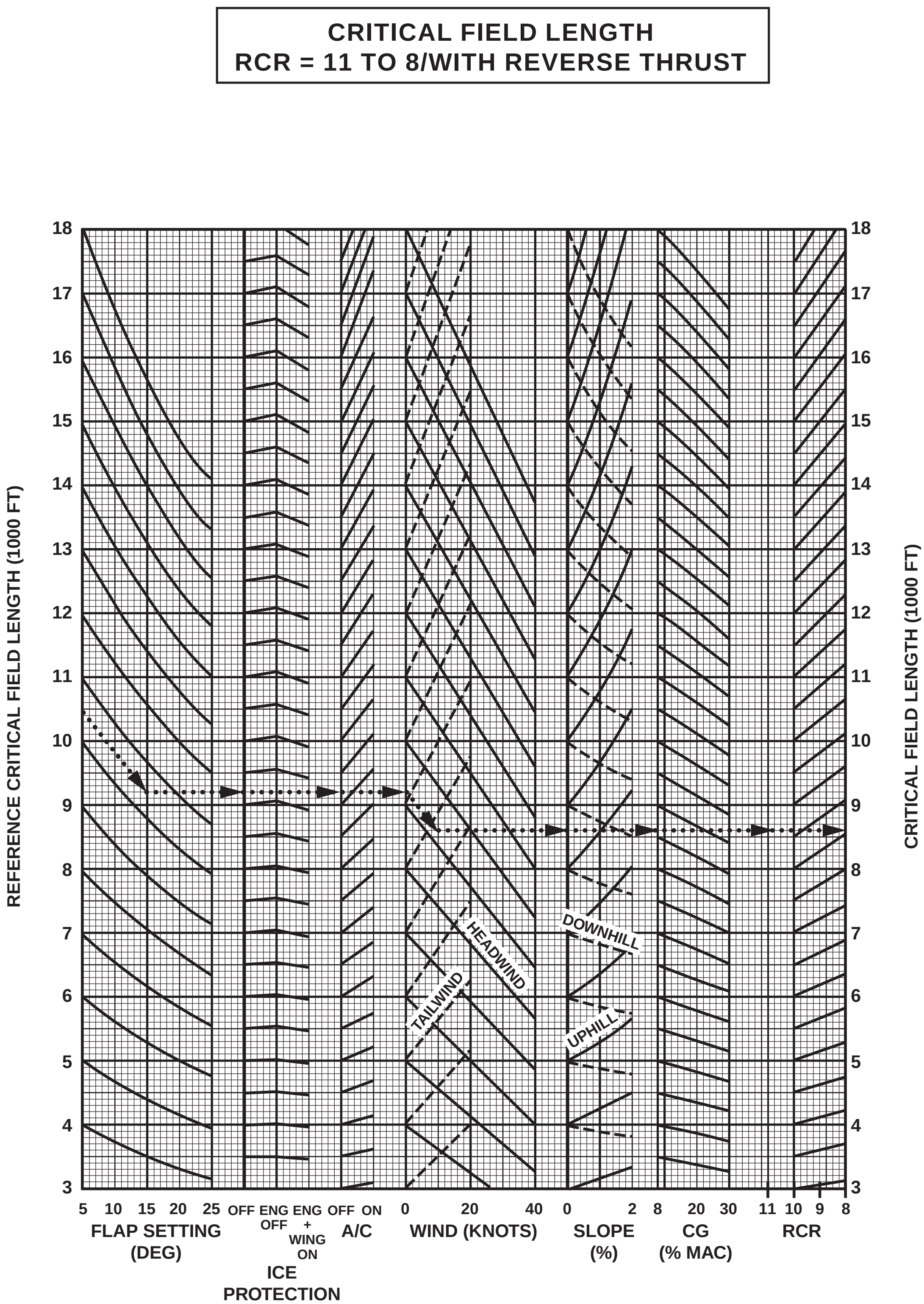


Figure 12-31C. (Sheet 2)



SA1C-374B

Figure 12-31C. (Sheet 3)

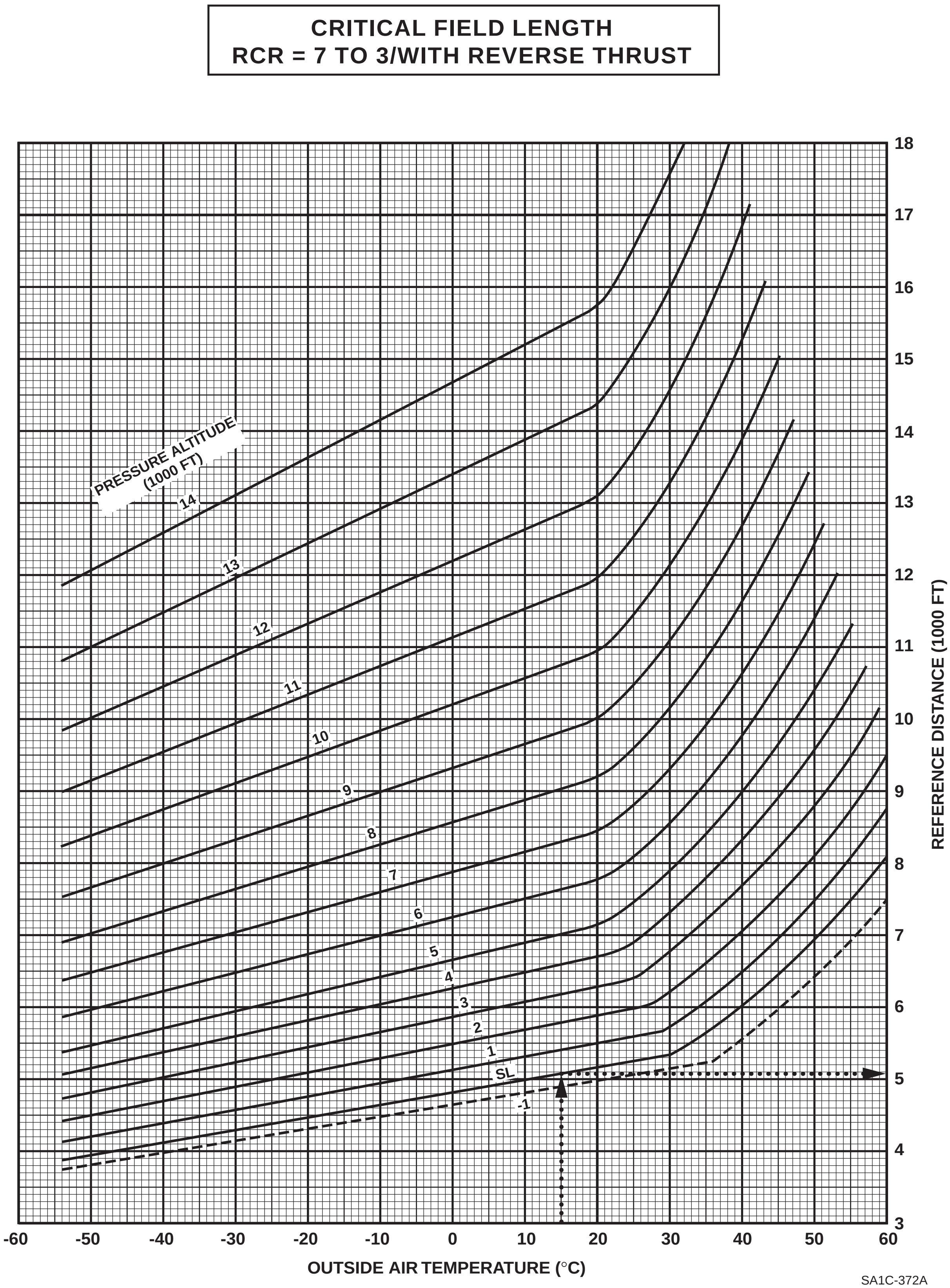


Figure 12-31D. (Sheet 1)

CRITICAL FIELD LENGTH
RCR = 7 TO 3/WITH REVERSE THRUST

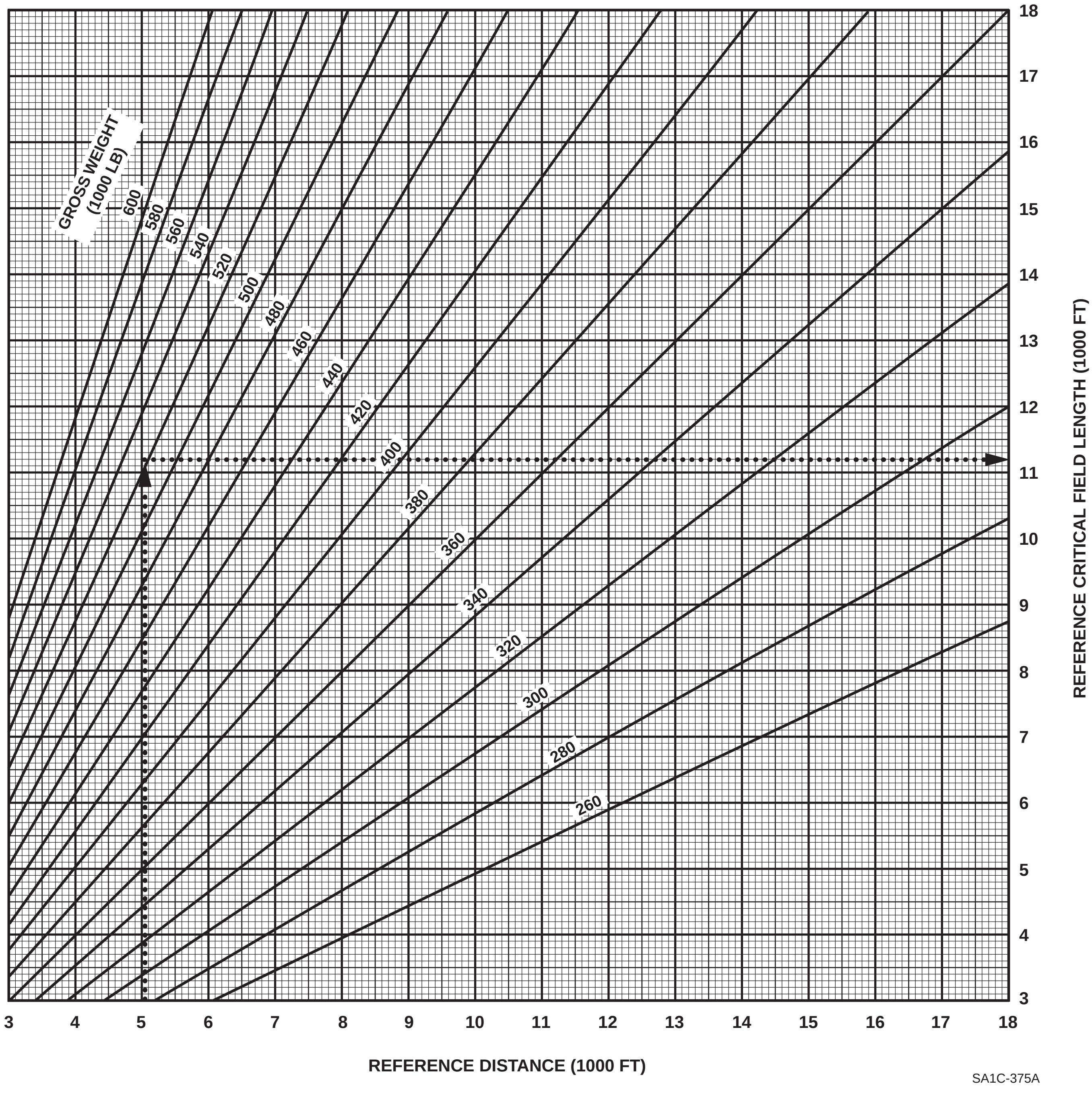


Figure 12-31D. (Sheet 2)

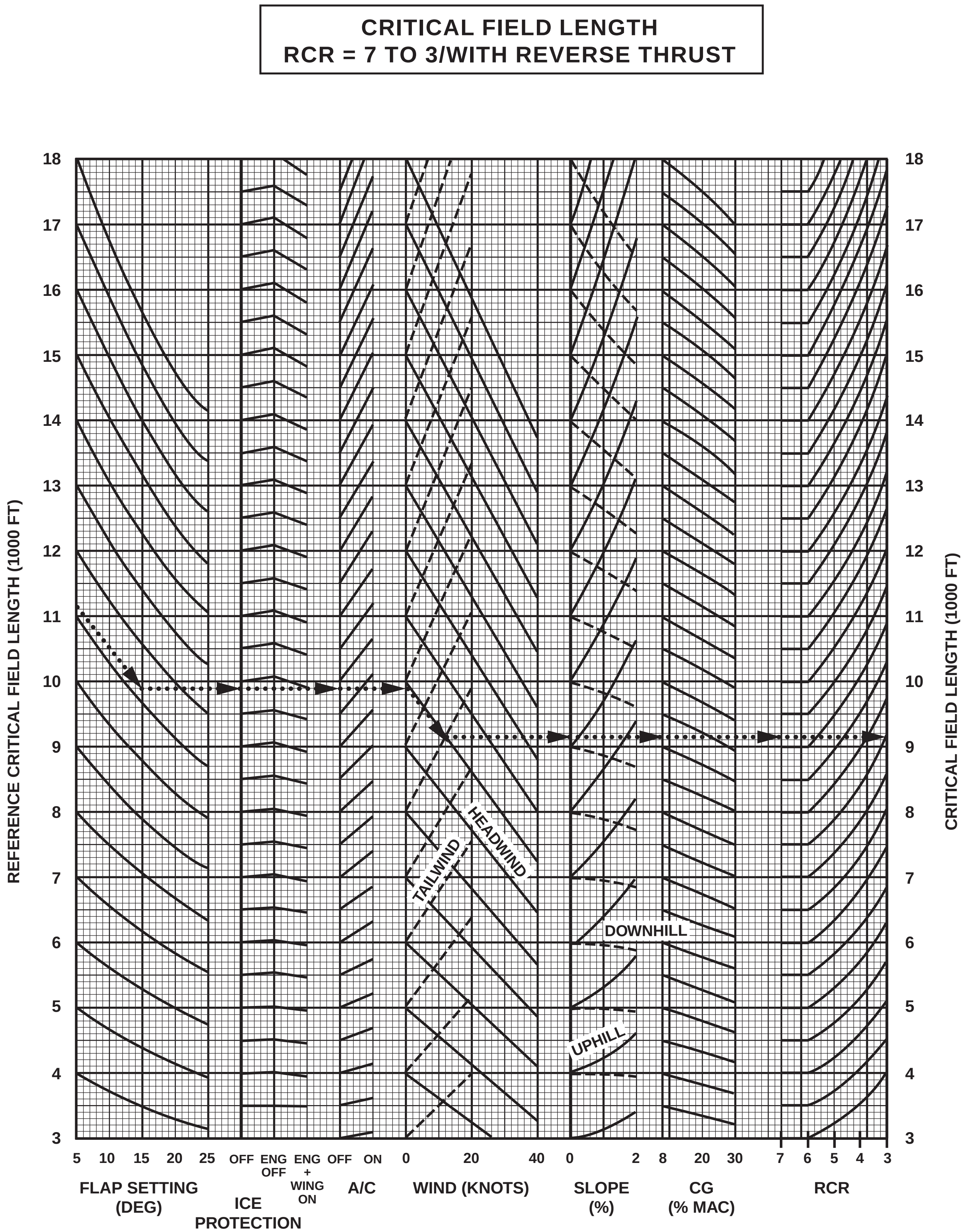


Figure 12-31D. (Sheet 3)

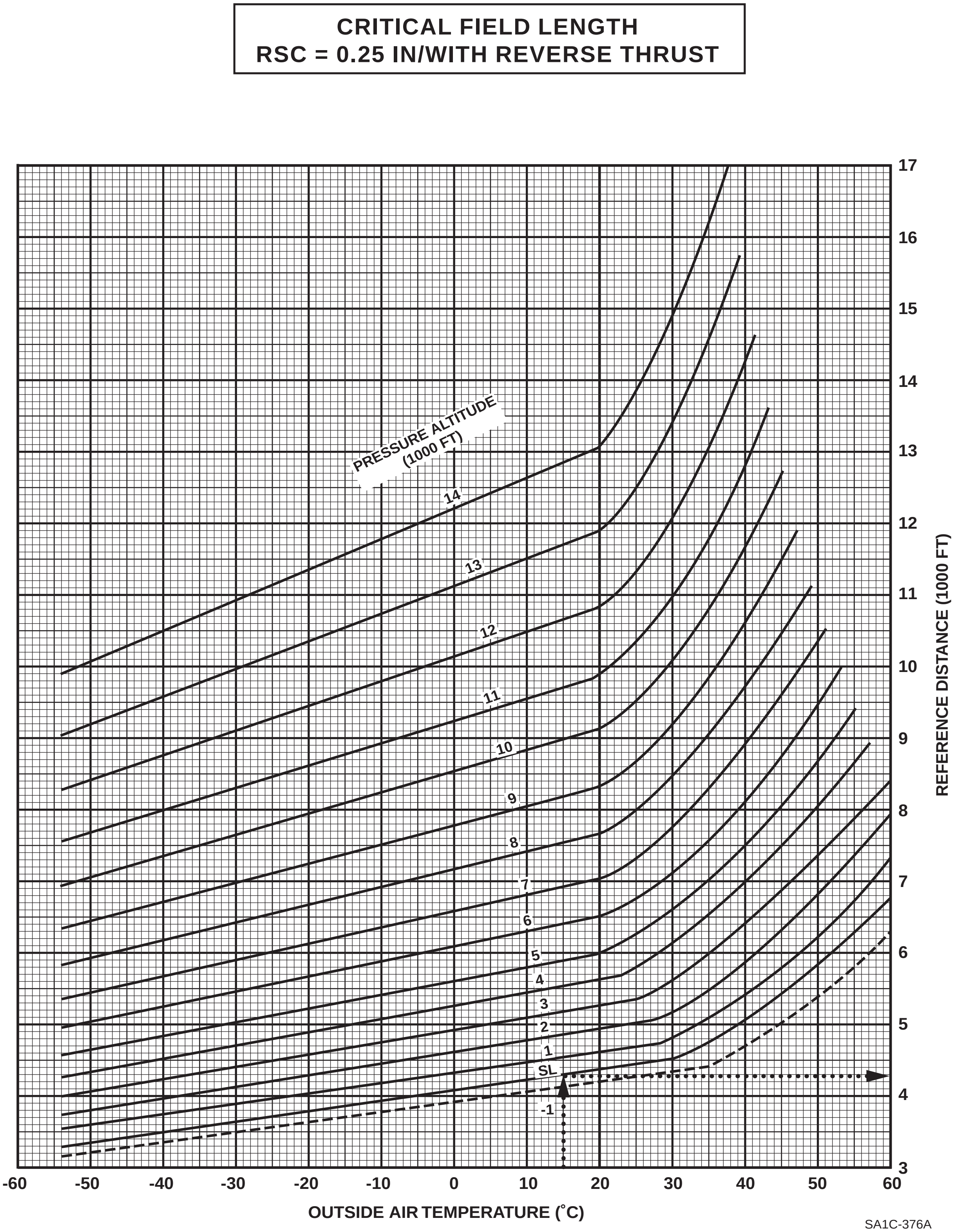


Figure 12-31E. (Sheet 1)

CRITICAL FIELD LENGTH
RSC = 0.25 IN/WITH REVERSE THRUST

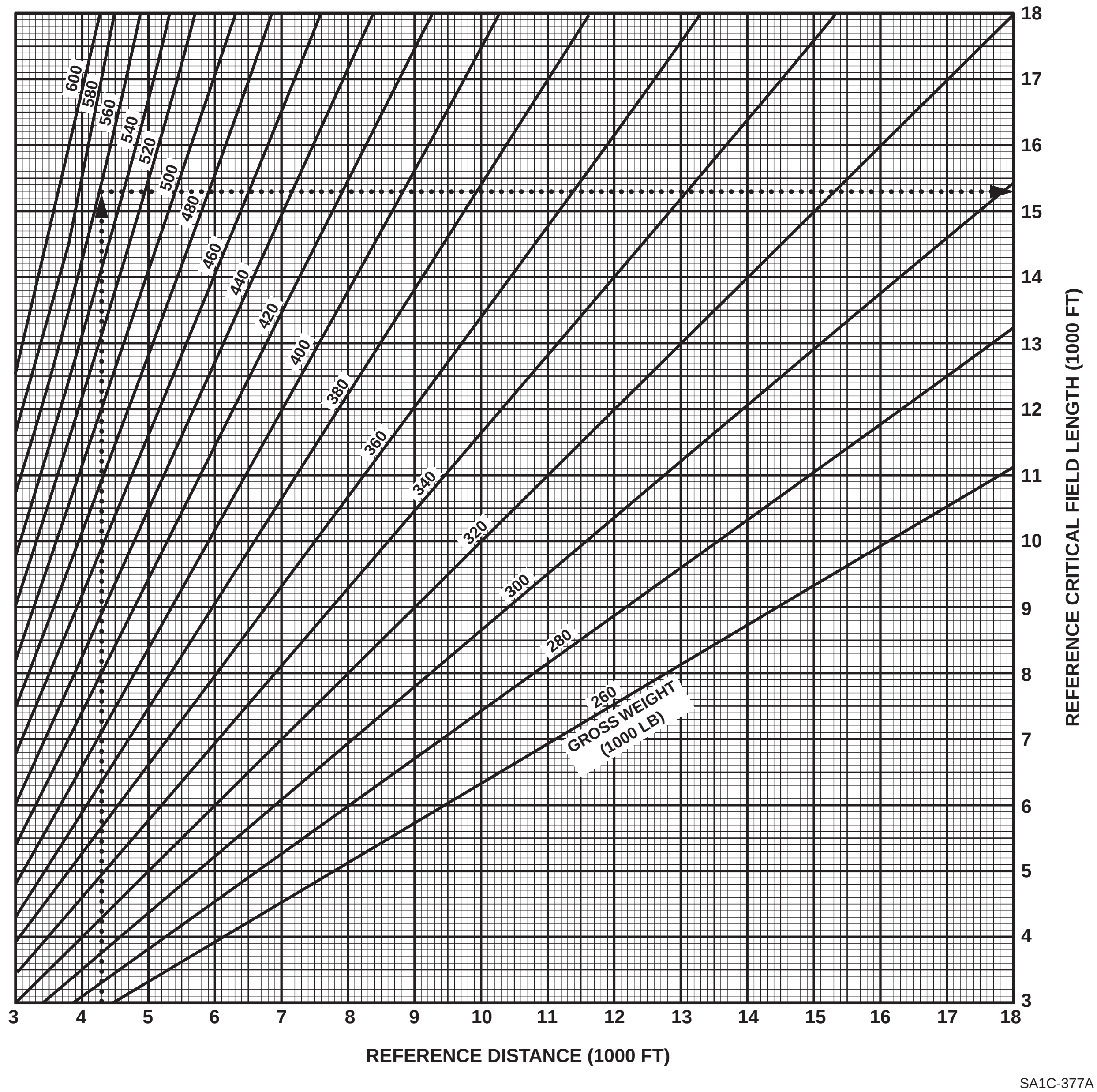


Figure 12-31E. (Sheet 2)

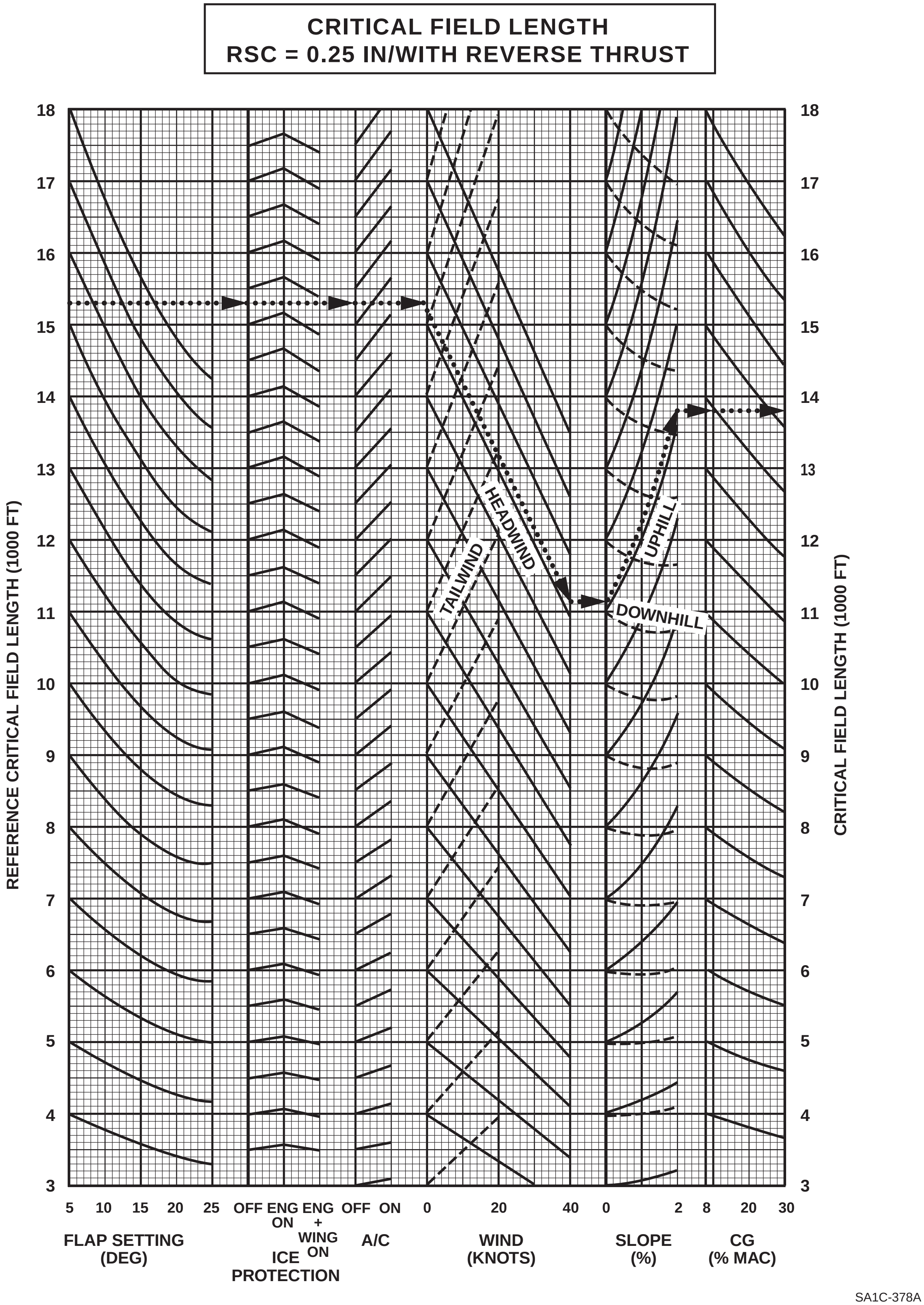


Figure 12-31E. (Sheet 3)

CRITICAL FIELD LENGTH
RSC = 0.50 IN/WITH REVERSE THRUST

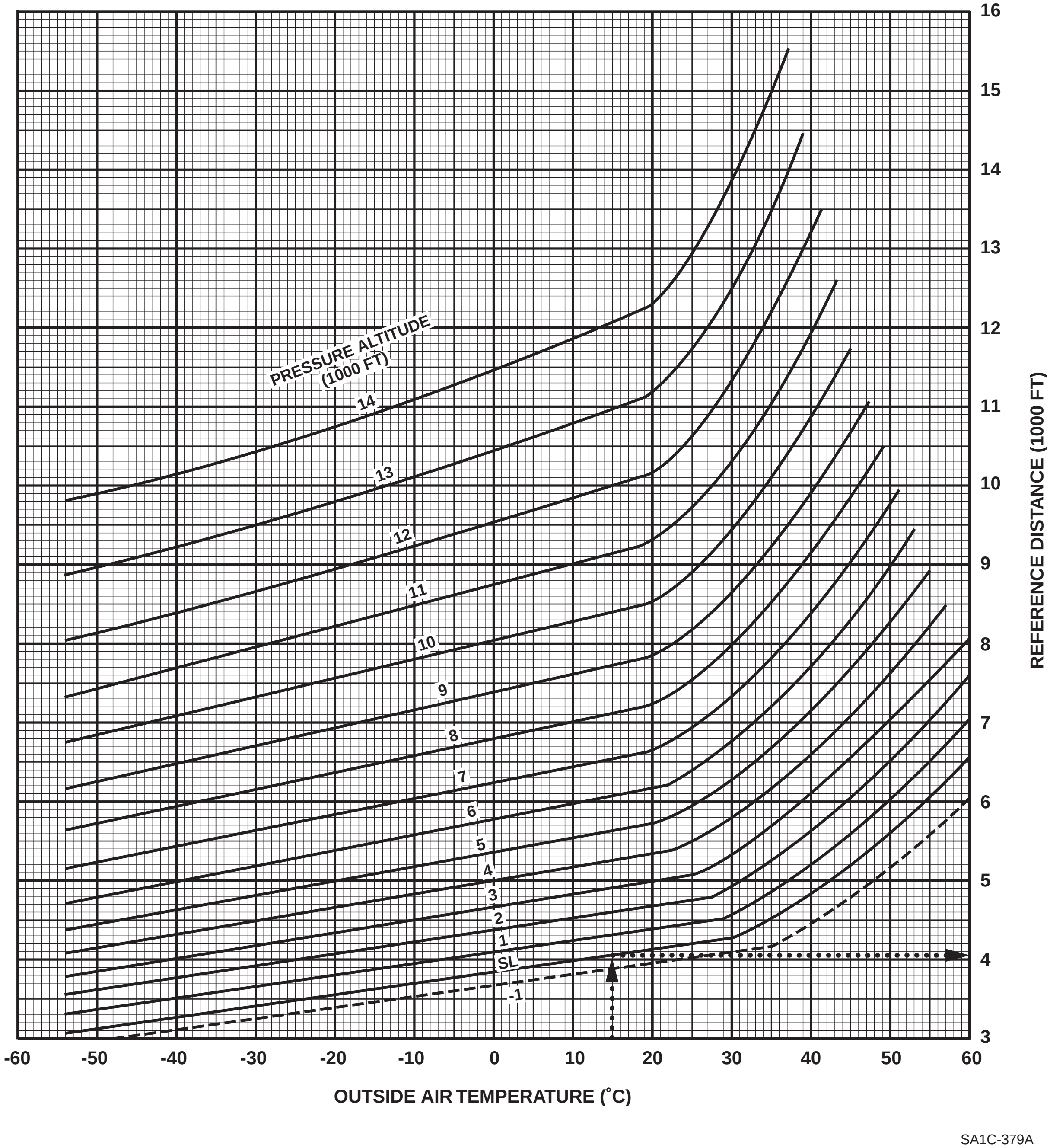


Figure 12-31F. (Sheet 1)

CRITICAL FIELD LENGTH
RSC = 0.50 IN/WITH REVERSE THRUST

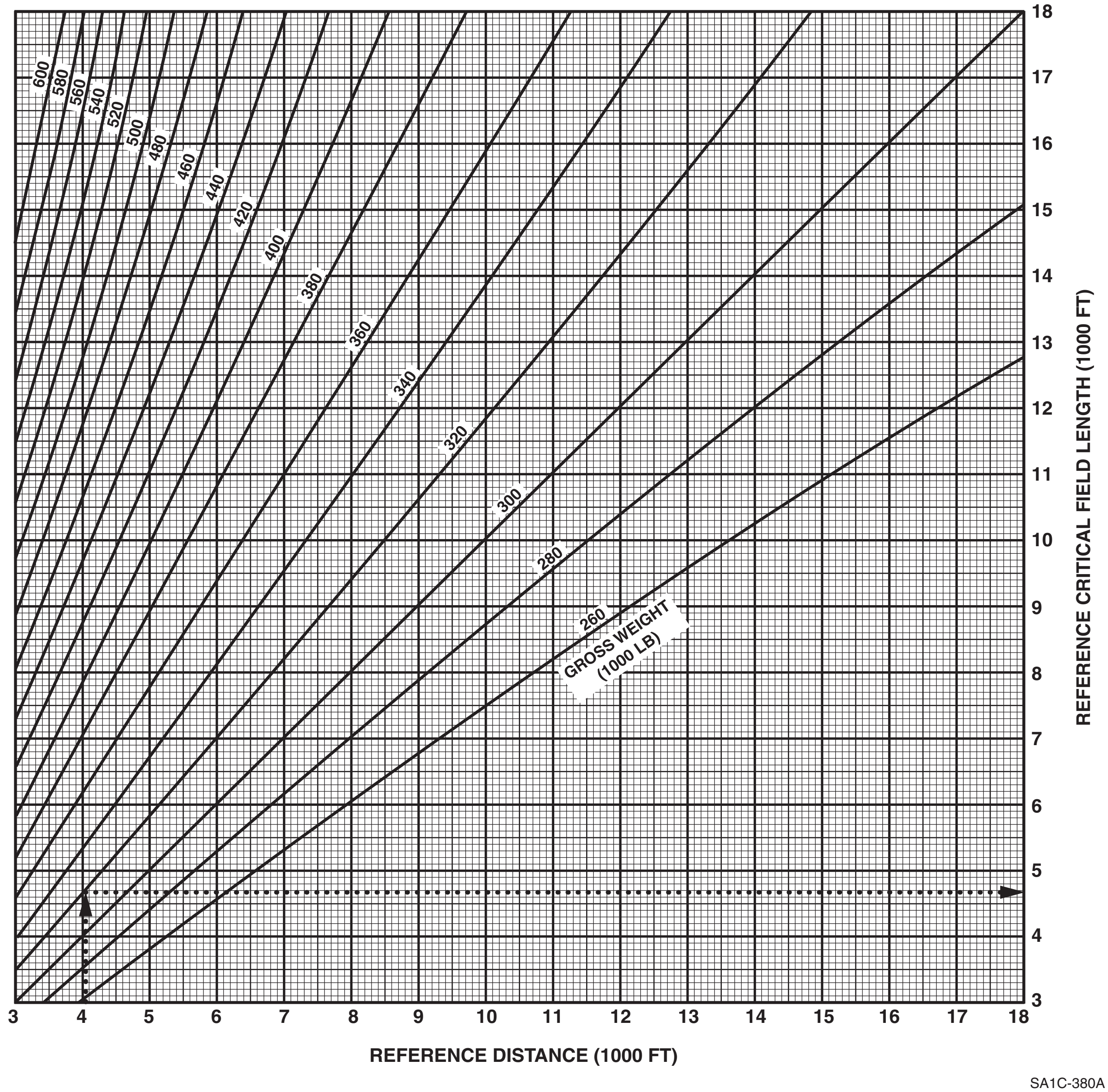


Figure 12-31F. (Sheet 2)

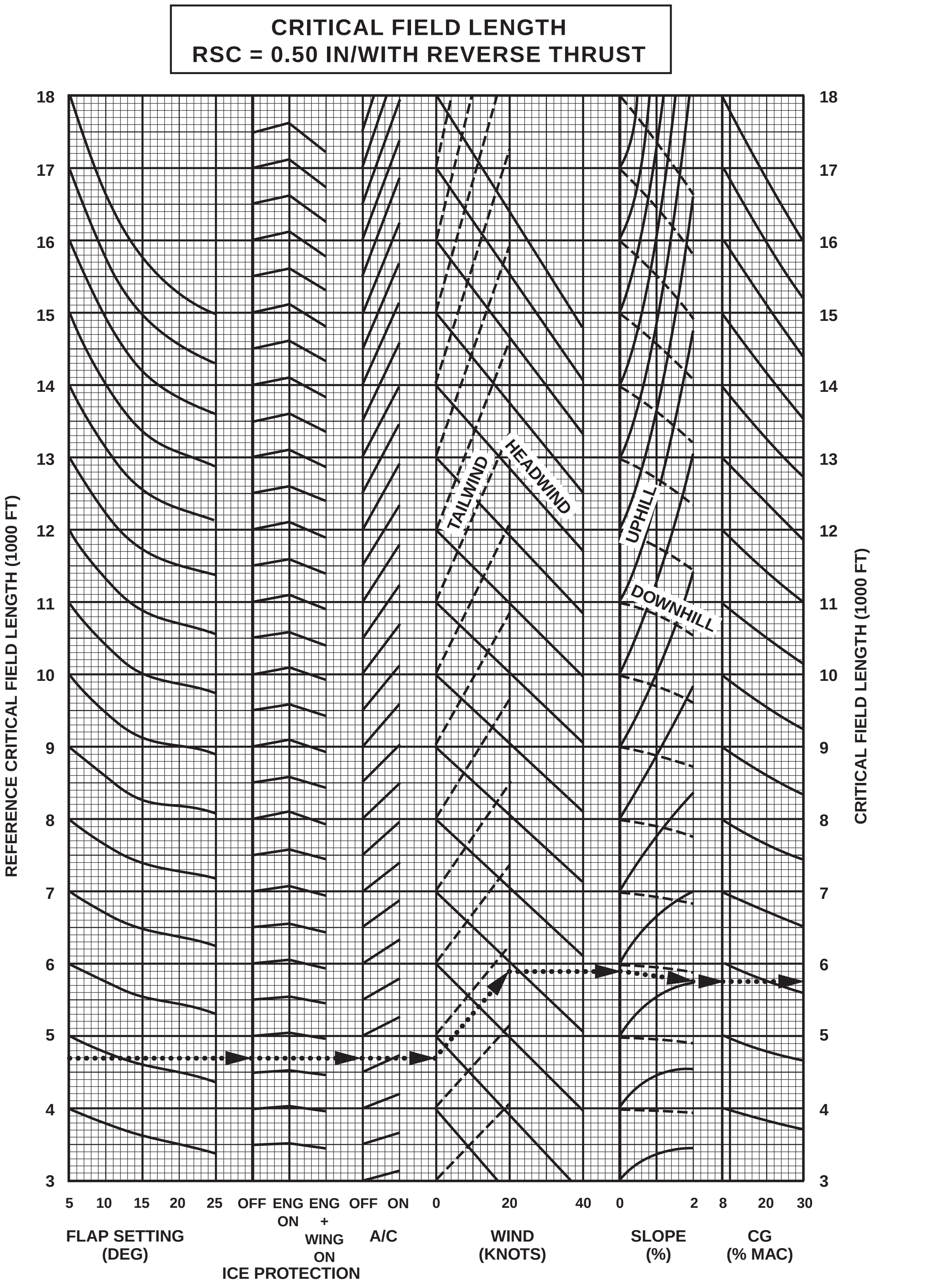


Figure 12-31F. (Sheet 3)

CRITICAL FIELD LENGTH
RCR = 23 TO 18/NO REVERSE THRUST

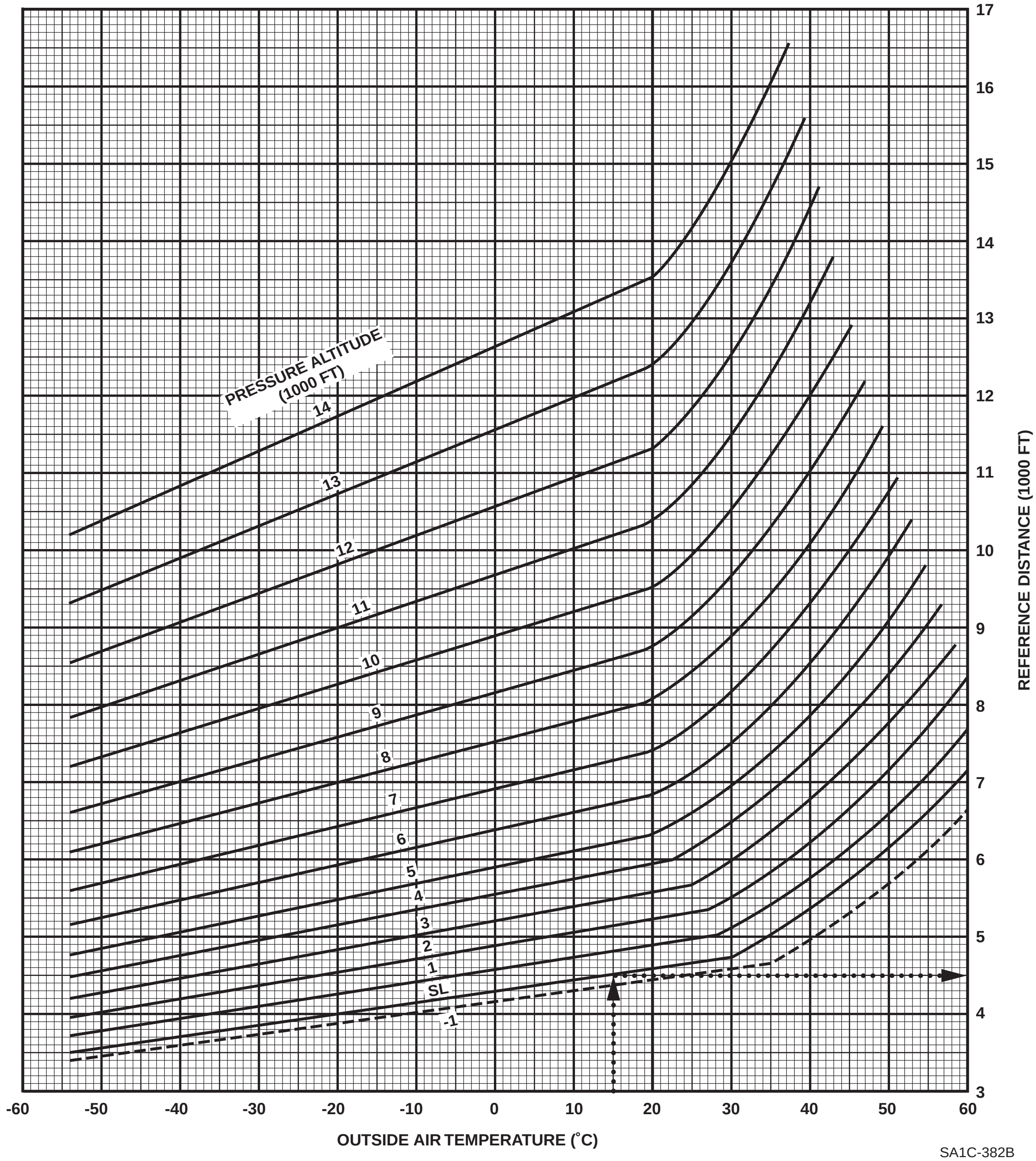


Figure 12-32A. (Sheet 1)

CRITICAL FIELD LENGTH
RCR = 23 TO 18/NO REVERSE THRUST

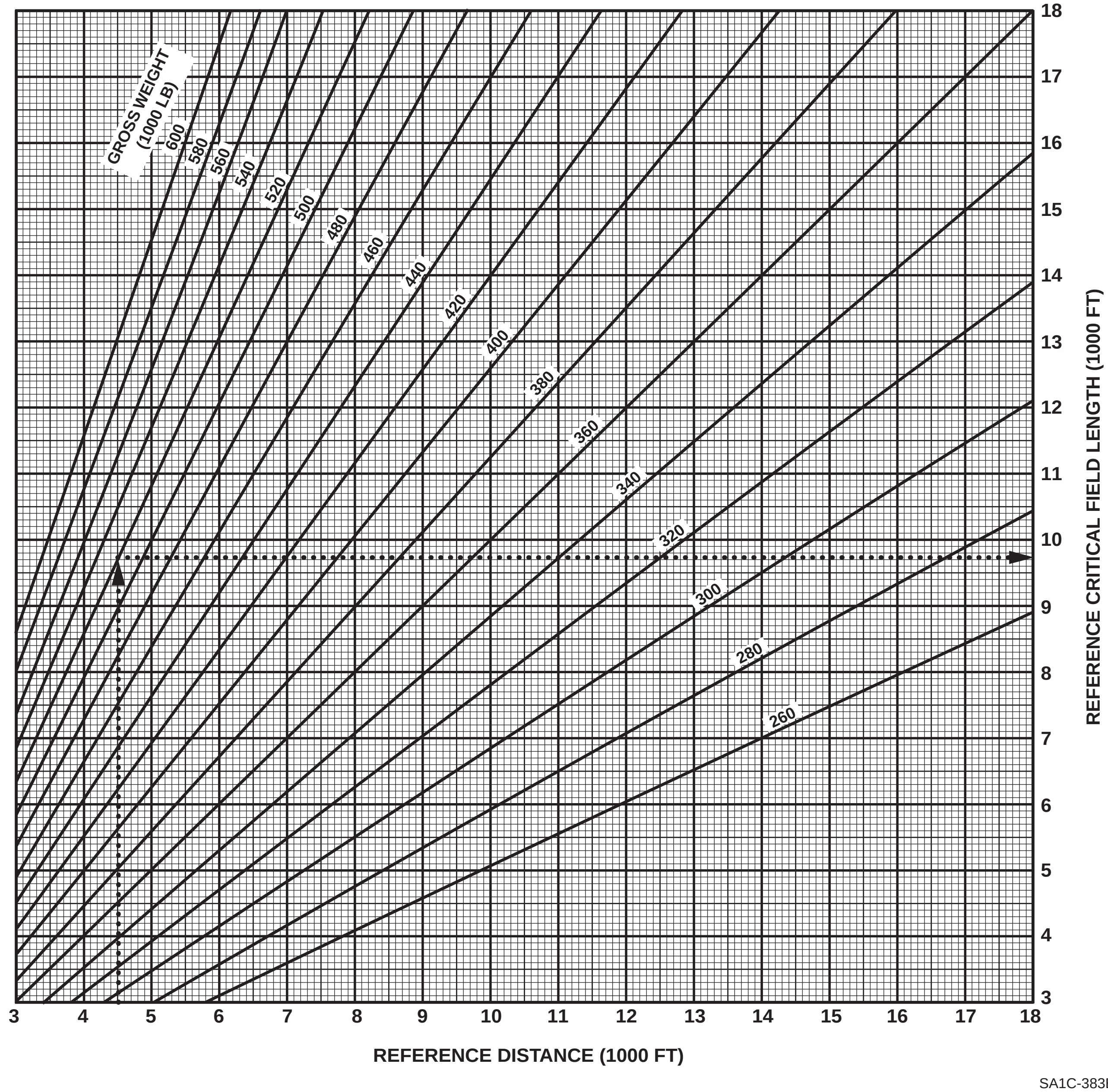


Figure 12-32A. (Sheet 2)

CRITICAL FIELD LENGTH
RCR = 23 TO 18/NO REVERSE THRUST

NOTE:

DO NOT MAKE RCR CORRECTION WHEN CFCC IS USED.

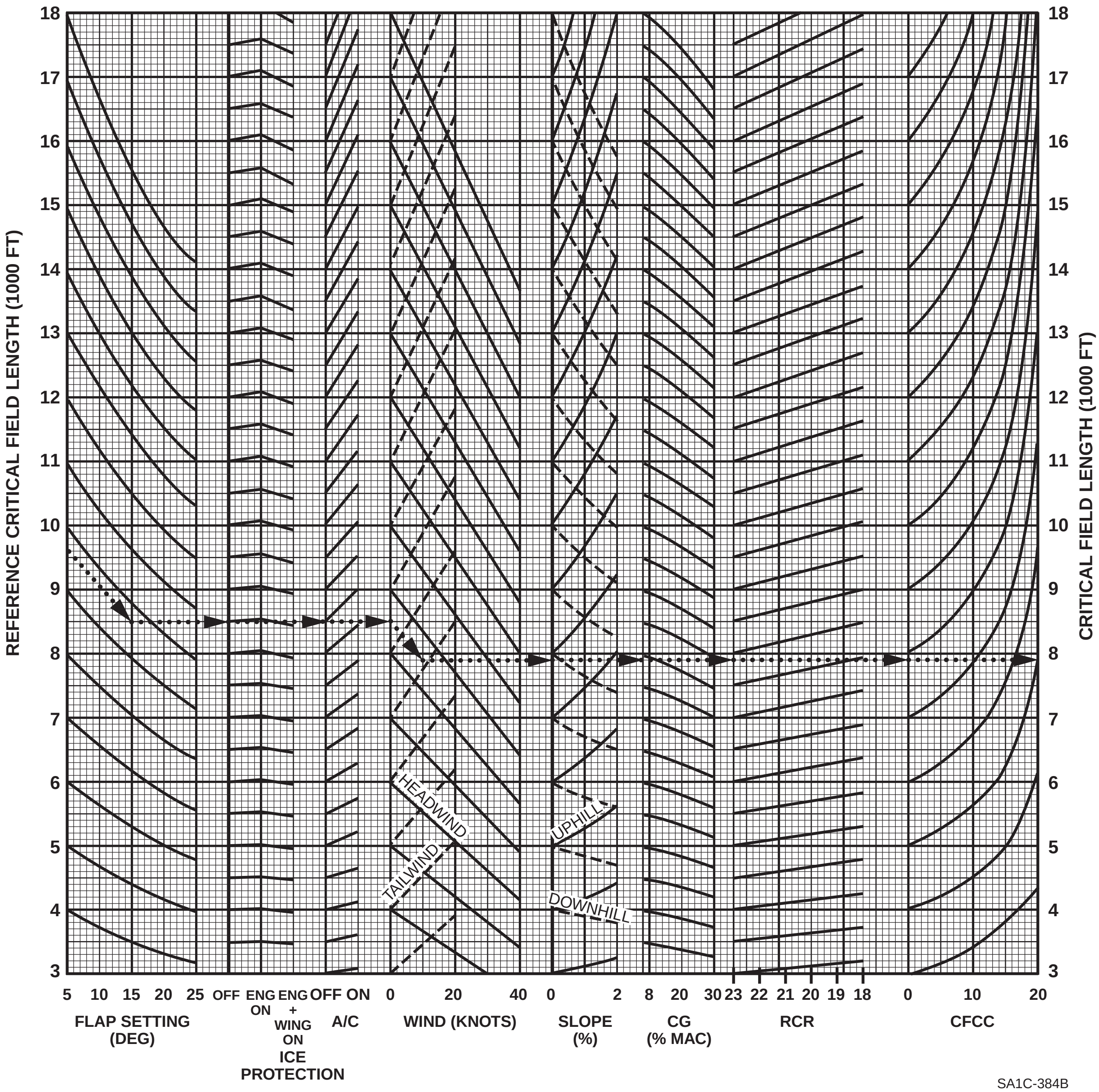


Figure 12-32A. (Sheet 3)

CRITICAL FIELD LENGTH
RCR = 17 TO 12/NO REVERSE THRUST

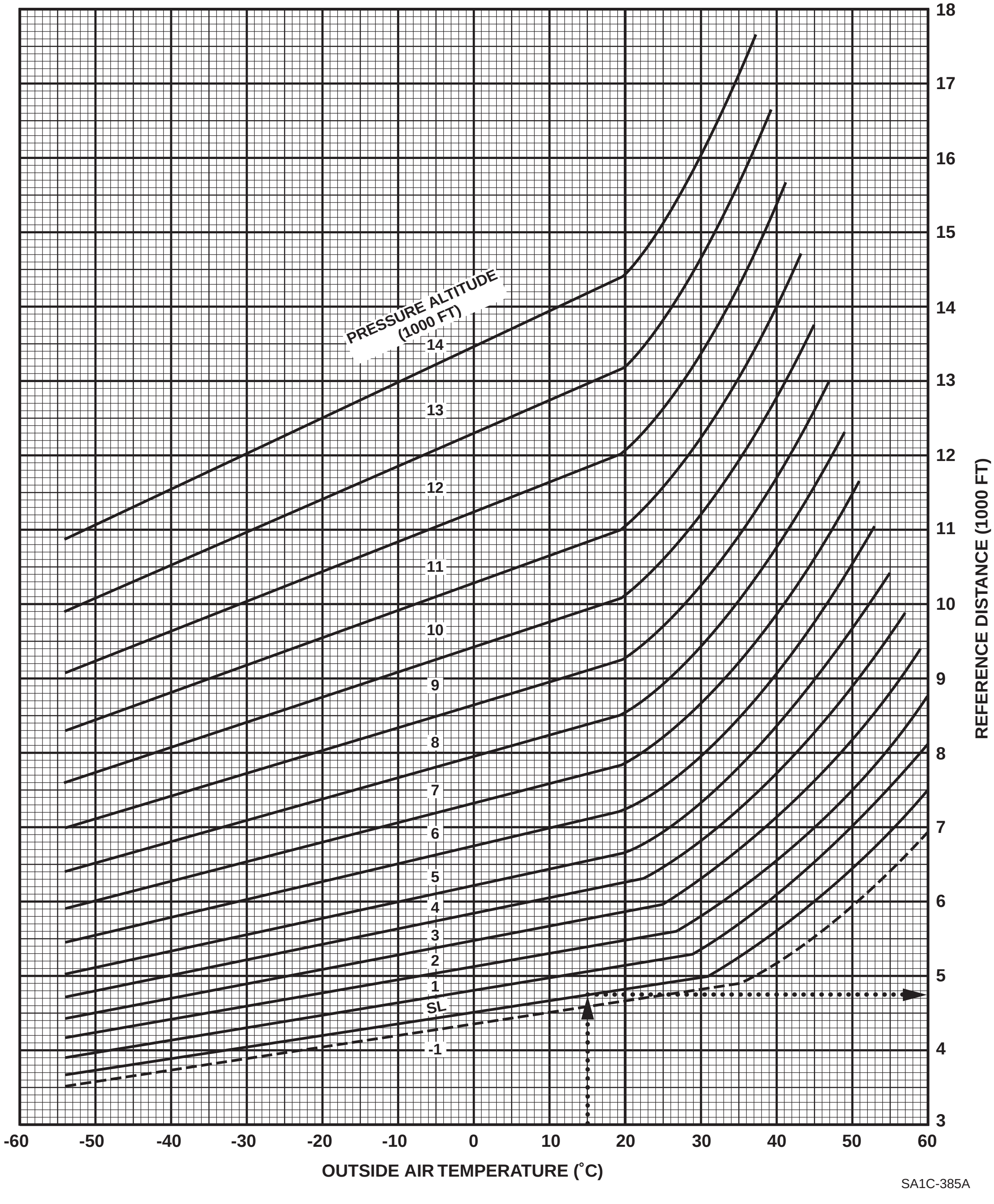


Figure 12-32B. (Sheet 1)

CRITICAL FIELD LENGTH
RCR = 17 TO 12/NO REVERSE THRUST

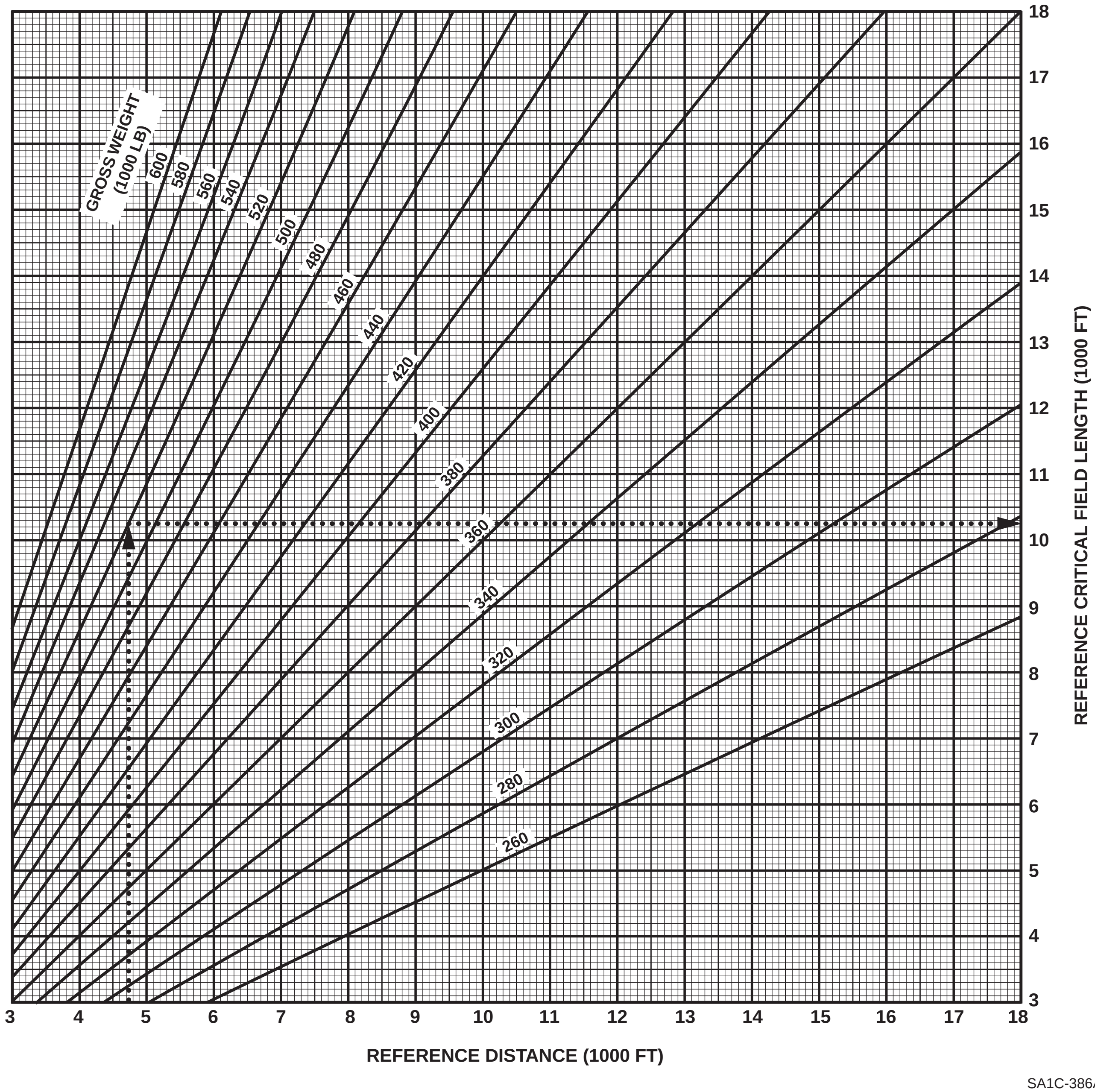


Figure 12-32B. (Sheet 2)

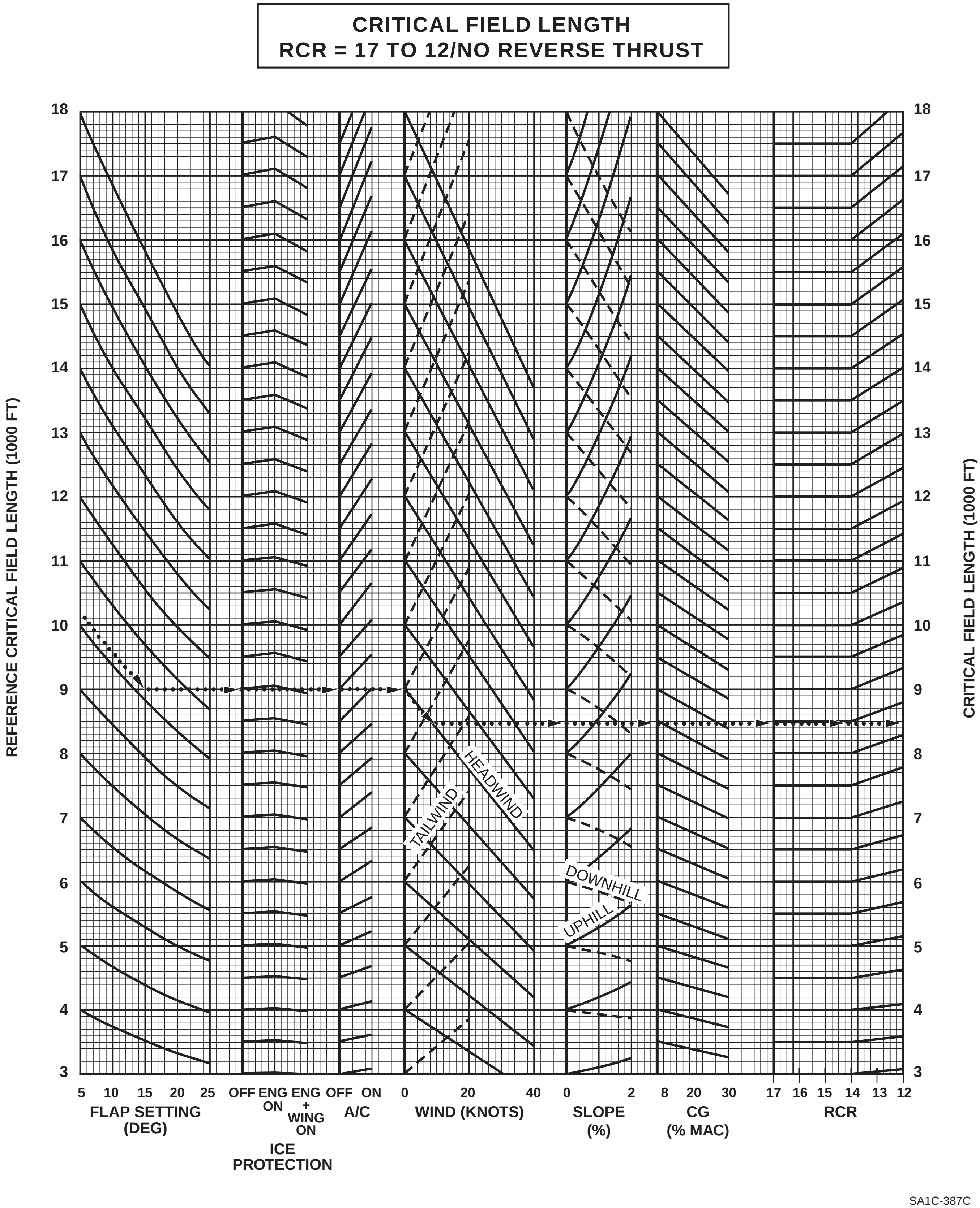


Figure 12-32B. (Sheet 3)

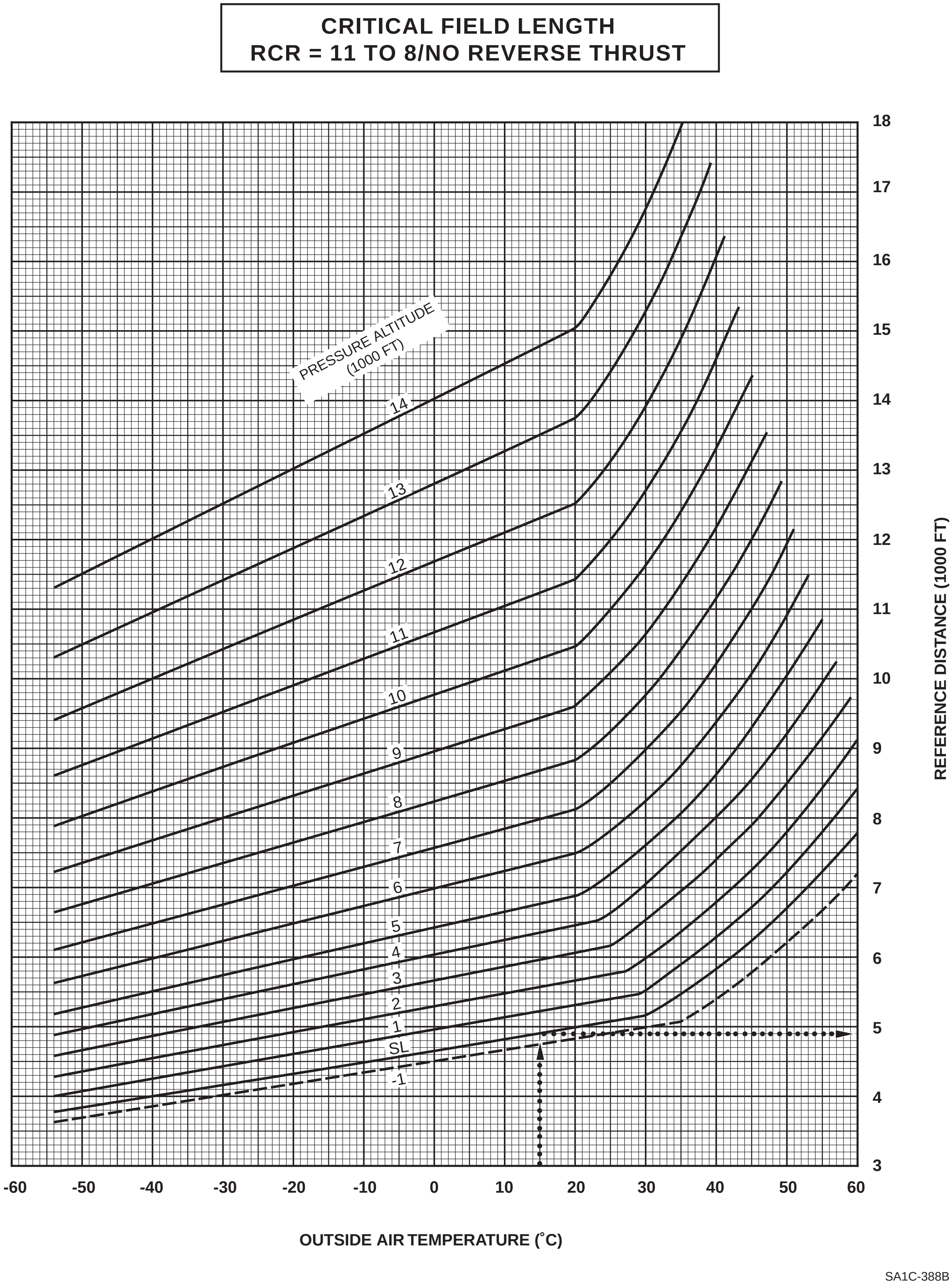


Figure 12-32C. (Sheet 1)

CRITICAL FIELD LENGTH
RCR = 11 TO 8/NO REVERSE THRUST

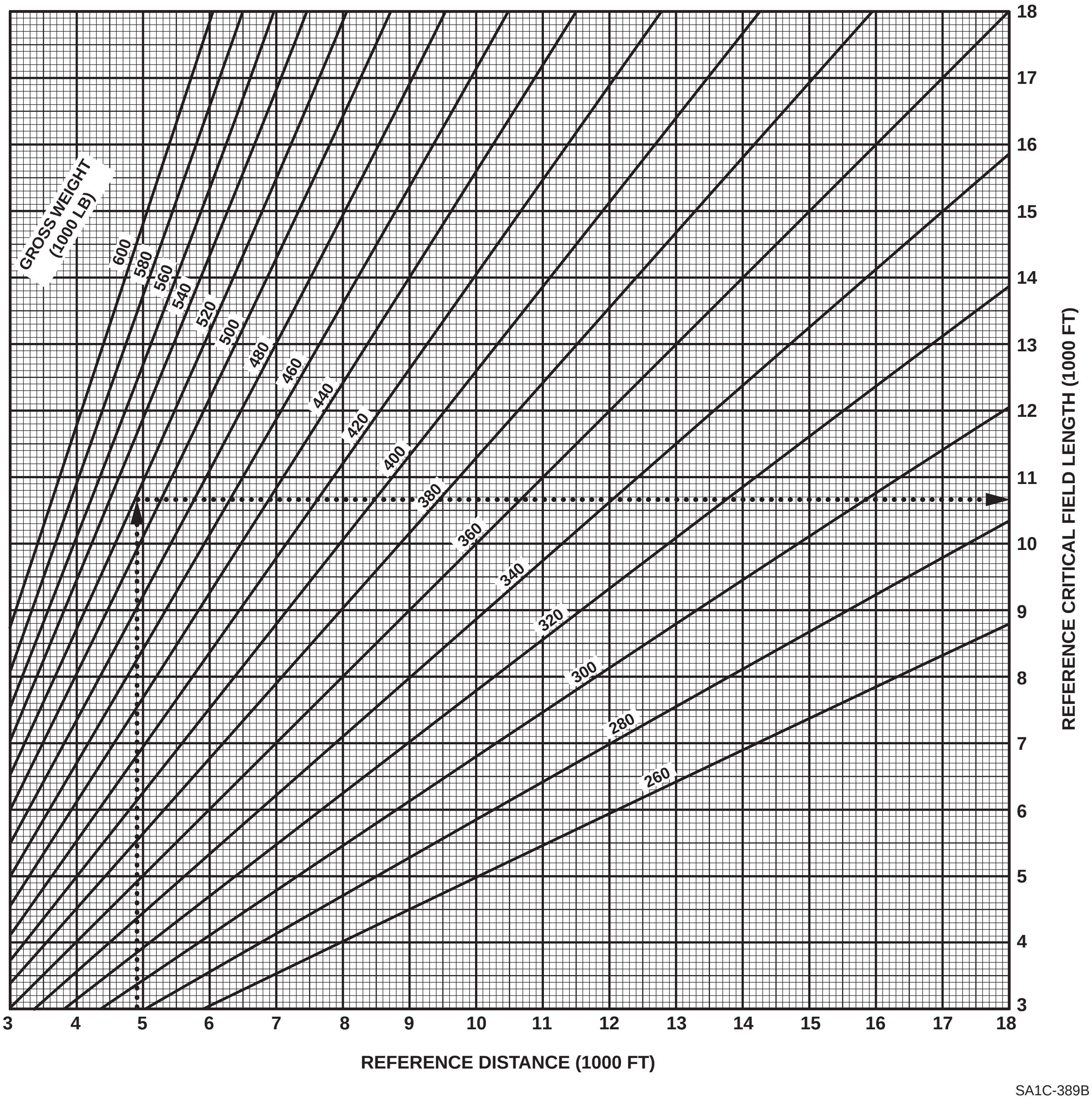


Figure 12-32C. (Sheet 2)

CRITICAL FIELD LENGTH
RCR = 11 TO 8/NO REVERSE THRUST

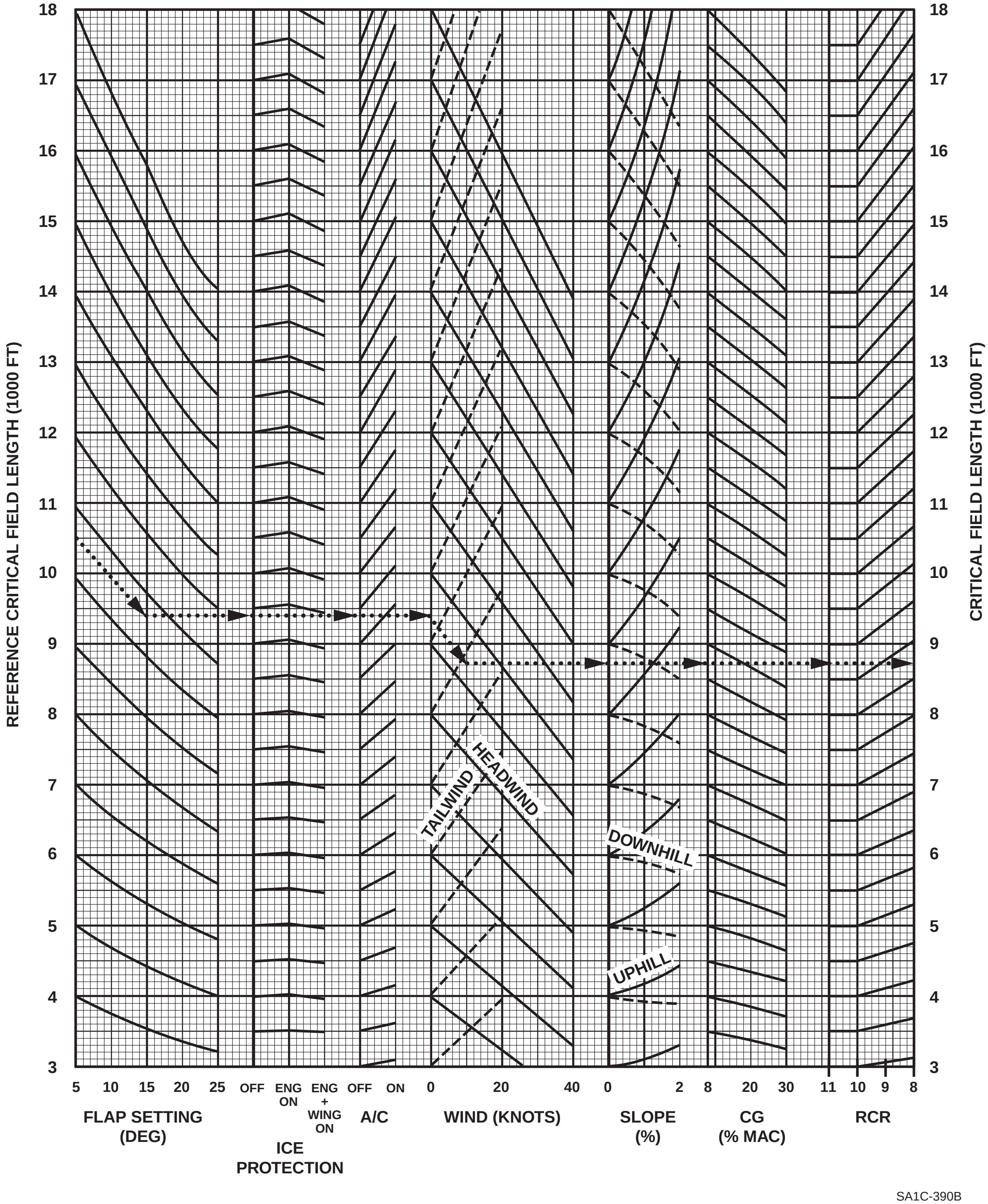


Figure 12-32C. (Sheet 3)

CRITICAL FIELD LENGTH
RCR = 7 TO 3/NO REVERSE THRUST

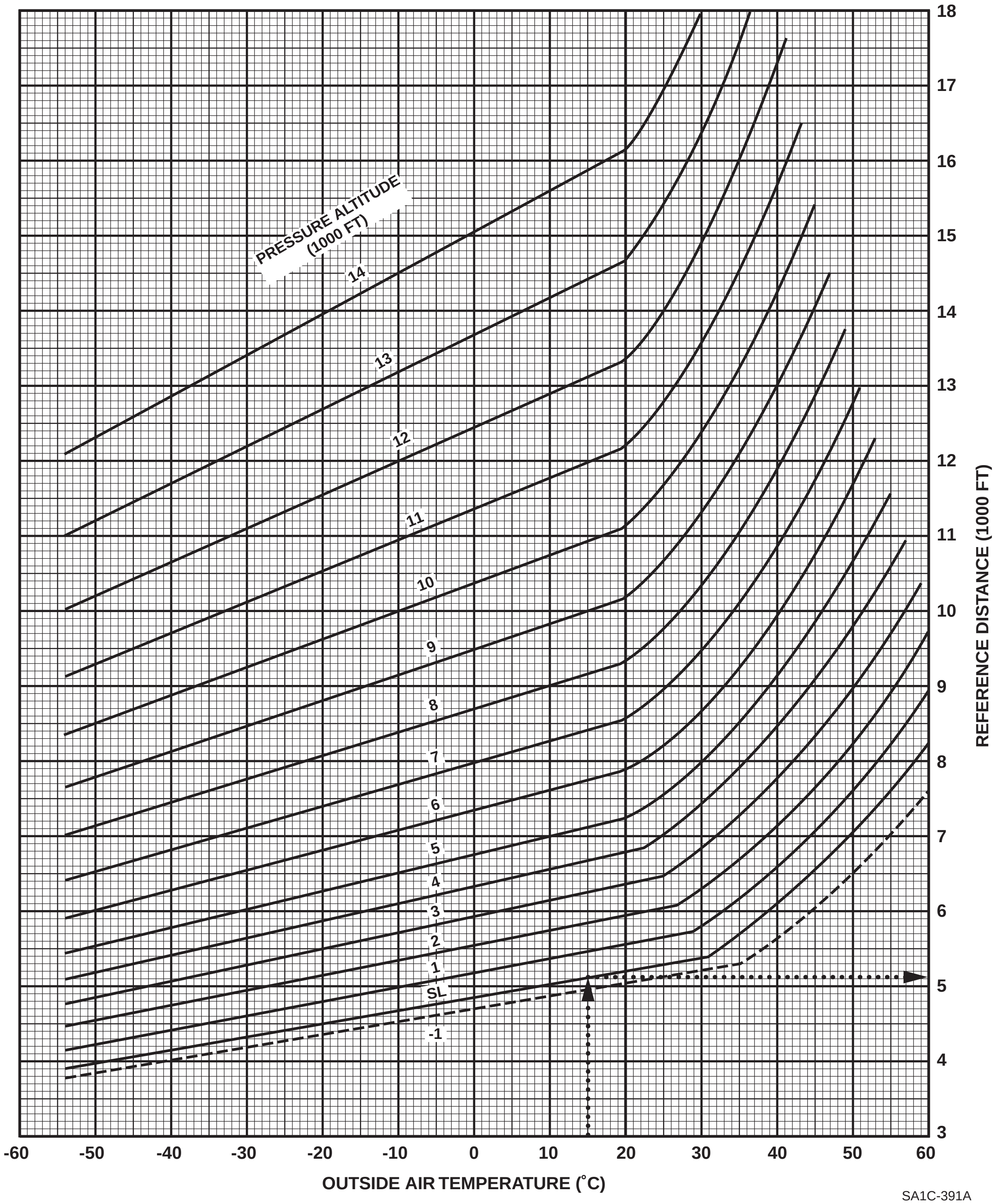


Figure 12-32D. (Sheet 1)

CRITICAL FIELD LENGTH
RCR = 7 TO 3/NO REVERSE THRUST

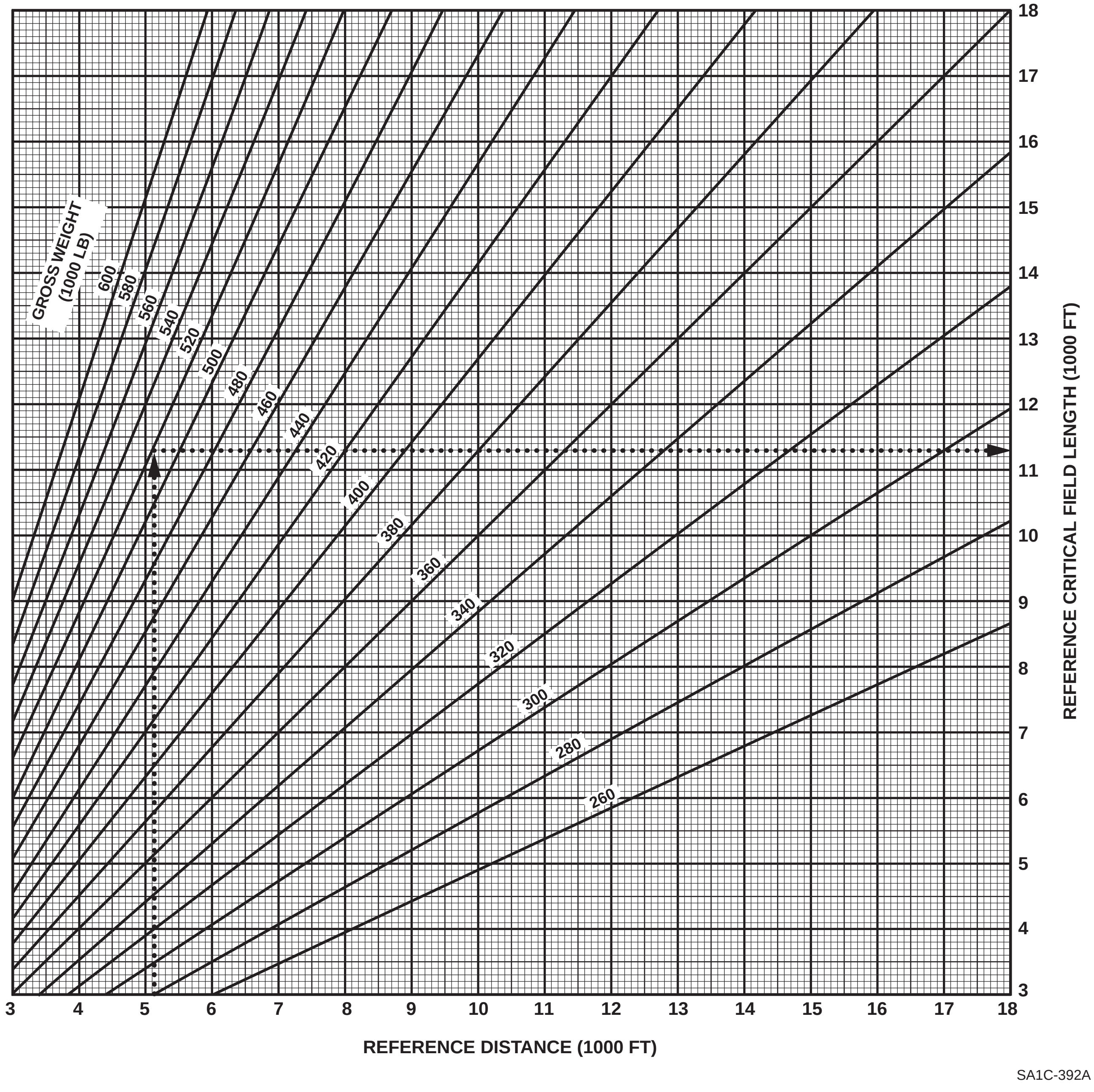


Figure 12-32D. (Sheet 2)

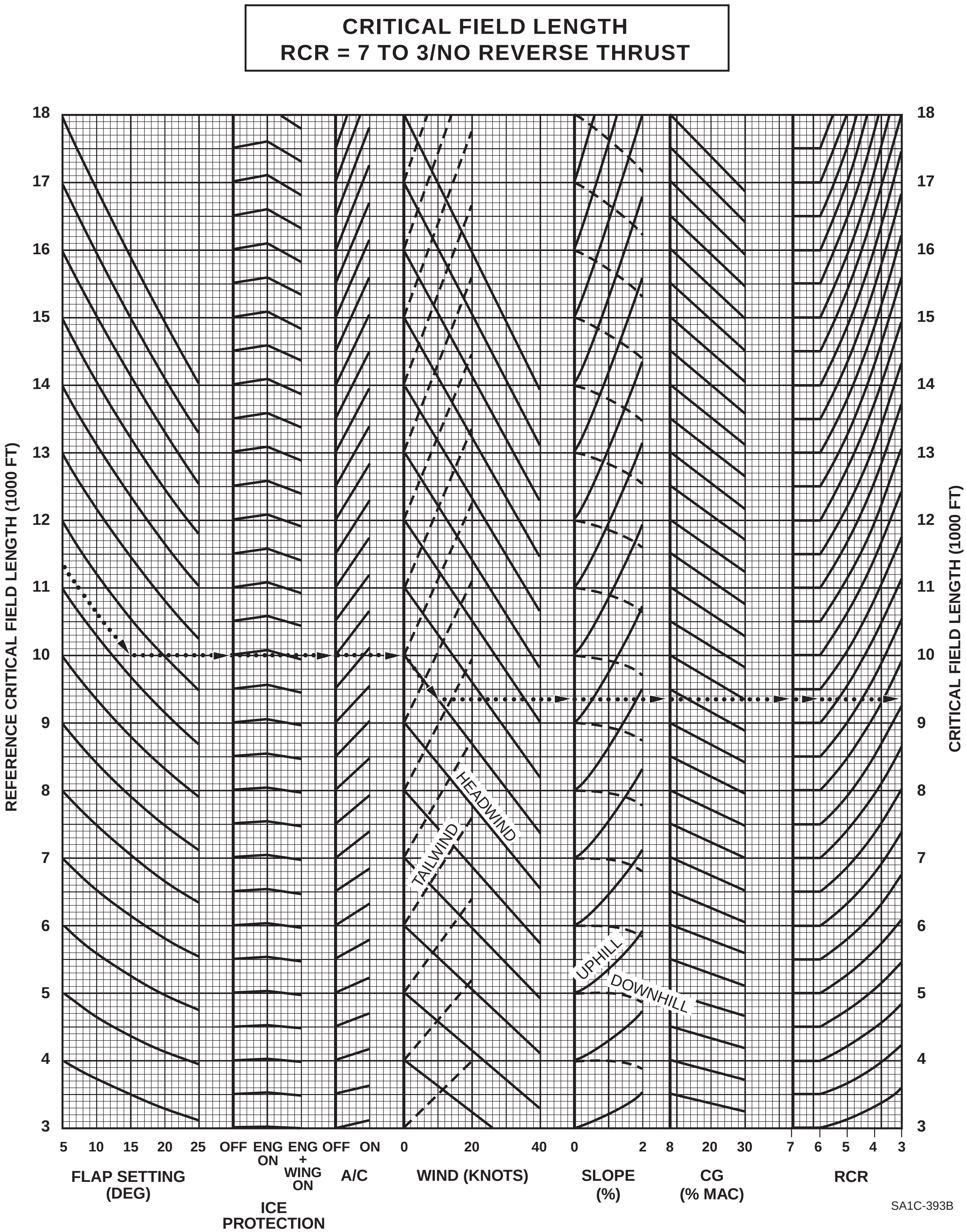


Figure 12-32D. (Sheet 3)

CRITICAL FIELD LENGTH
RSC = 0.25 IN/NO REVERSE THRUST

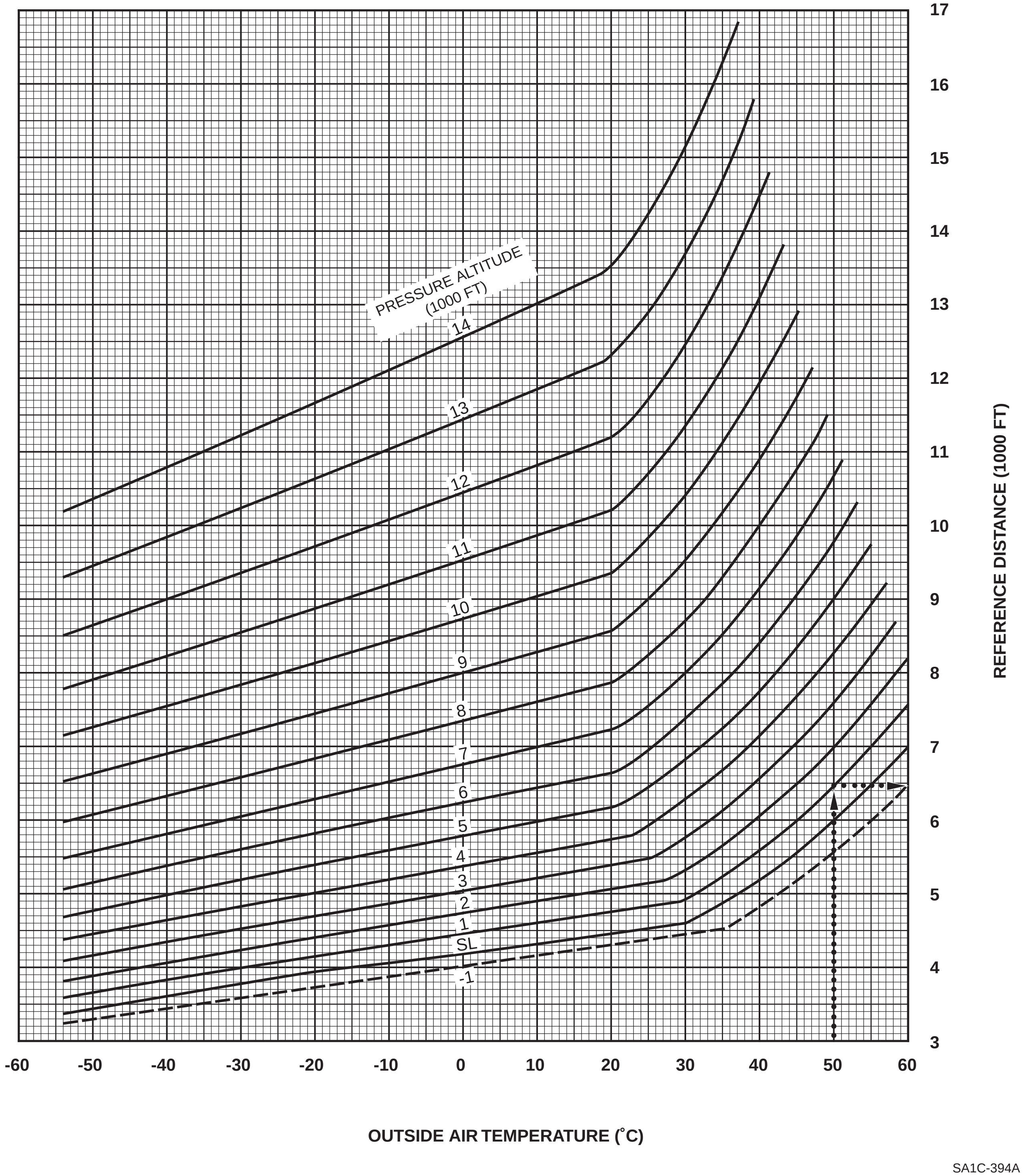


Figure 12-32E. (Sheet 1)

CRITICAL FIELD LENGTH
RSC = 0.25 IN/NO REVERSE THRUST

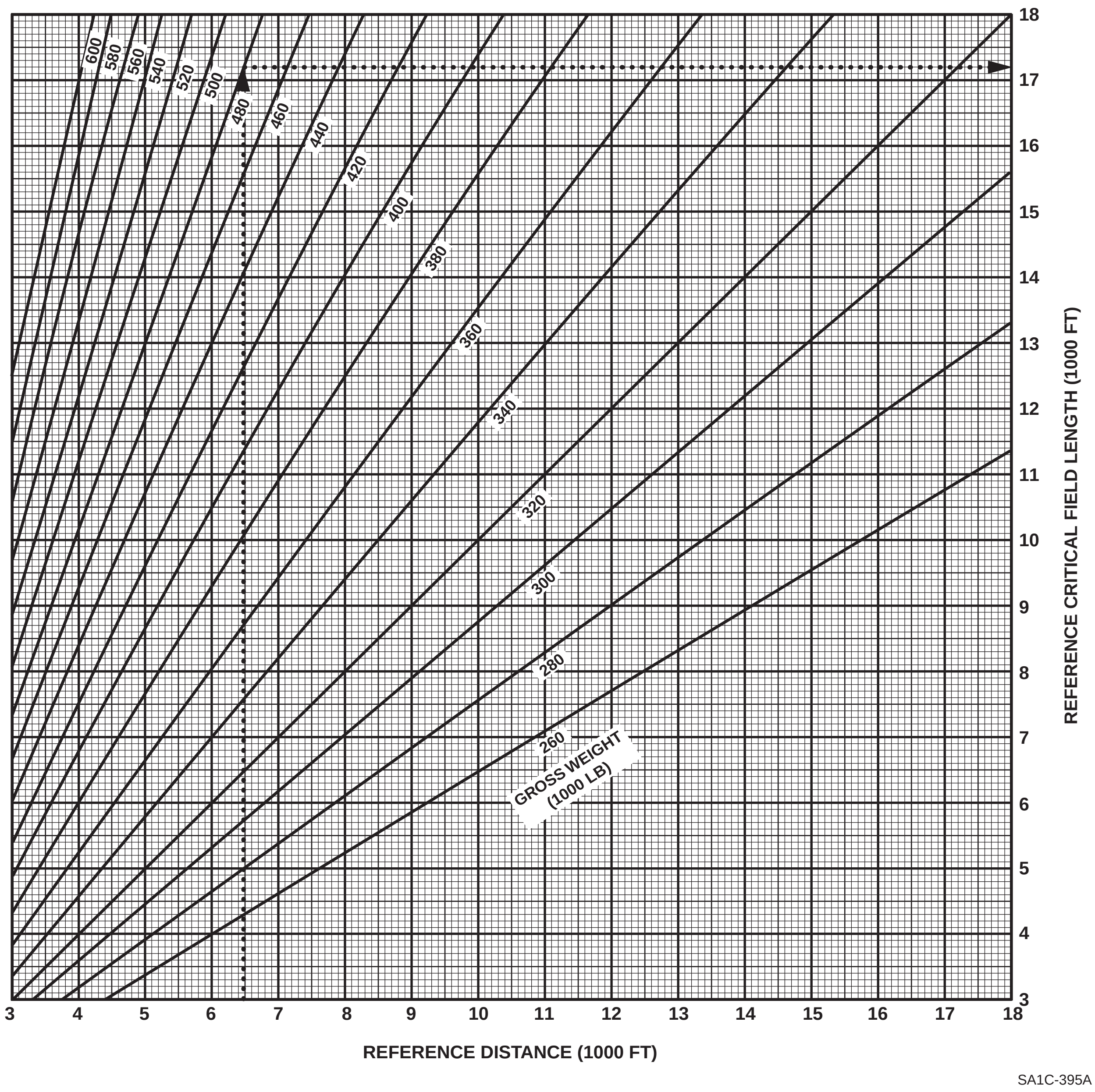


Figure 12-32E. (Sheet 2)

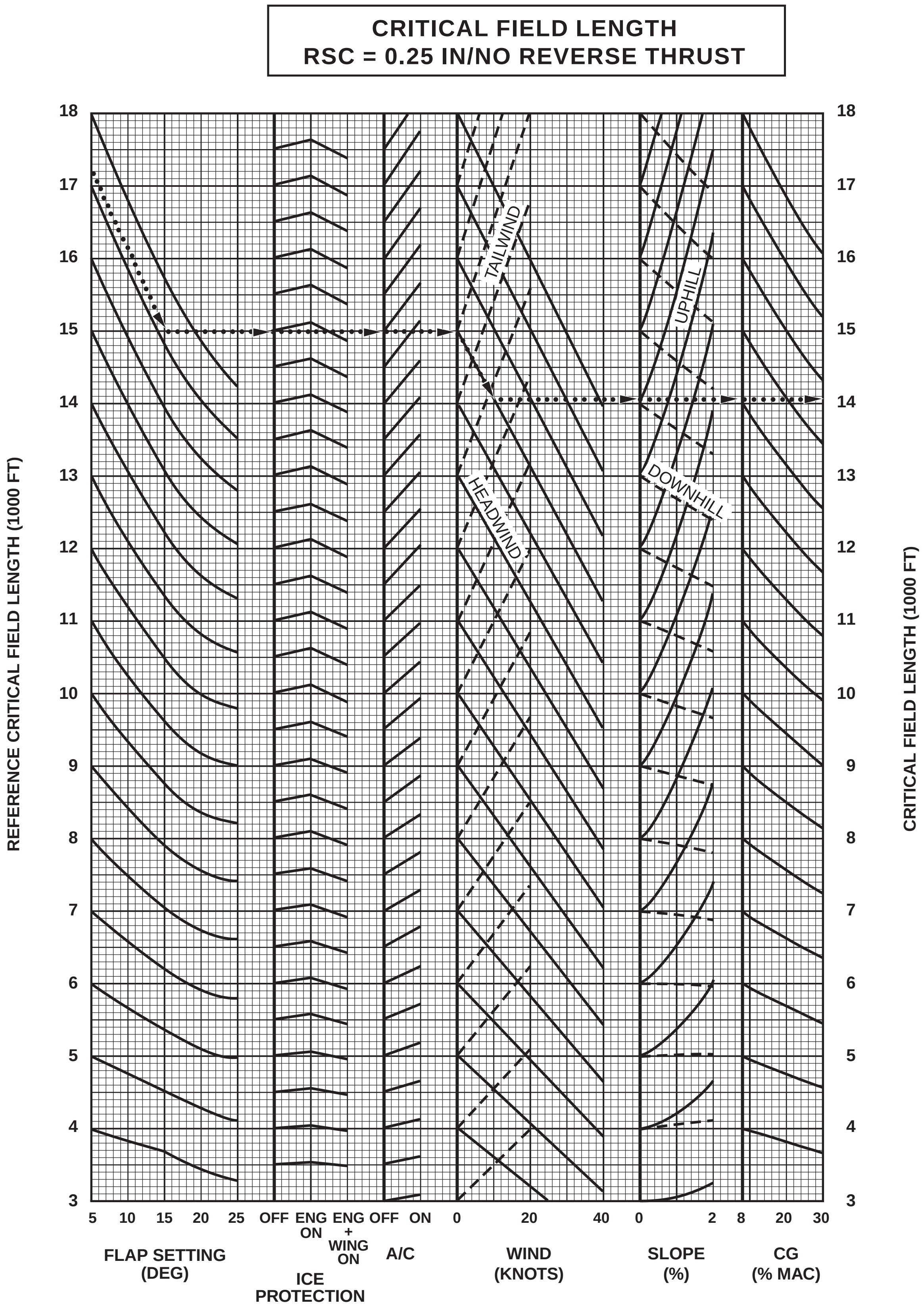


Figure 12-32E. (Sheet 3)

CRITICAL FIELD LENGTH
RSC = 0.50 IN/NO REVERSE THRUST

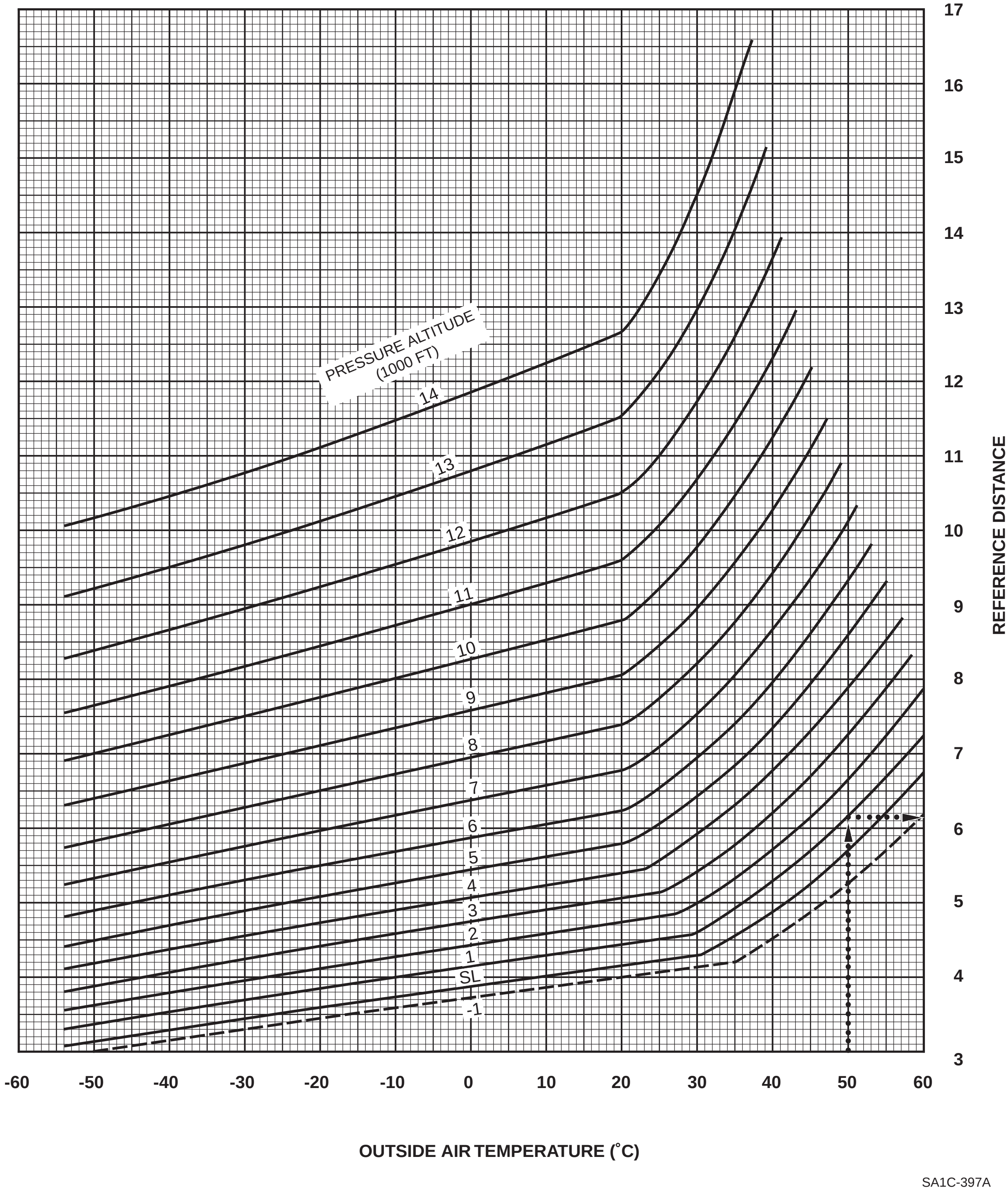


Figure 12-32F. (Sheet 1)

CRITICAL FIELD LENGTH
RSC = 0.50 IN/NO REVERSE THRUST

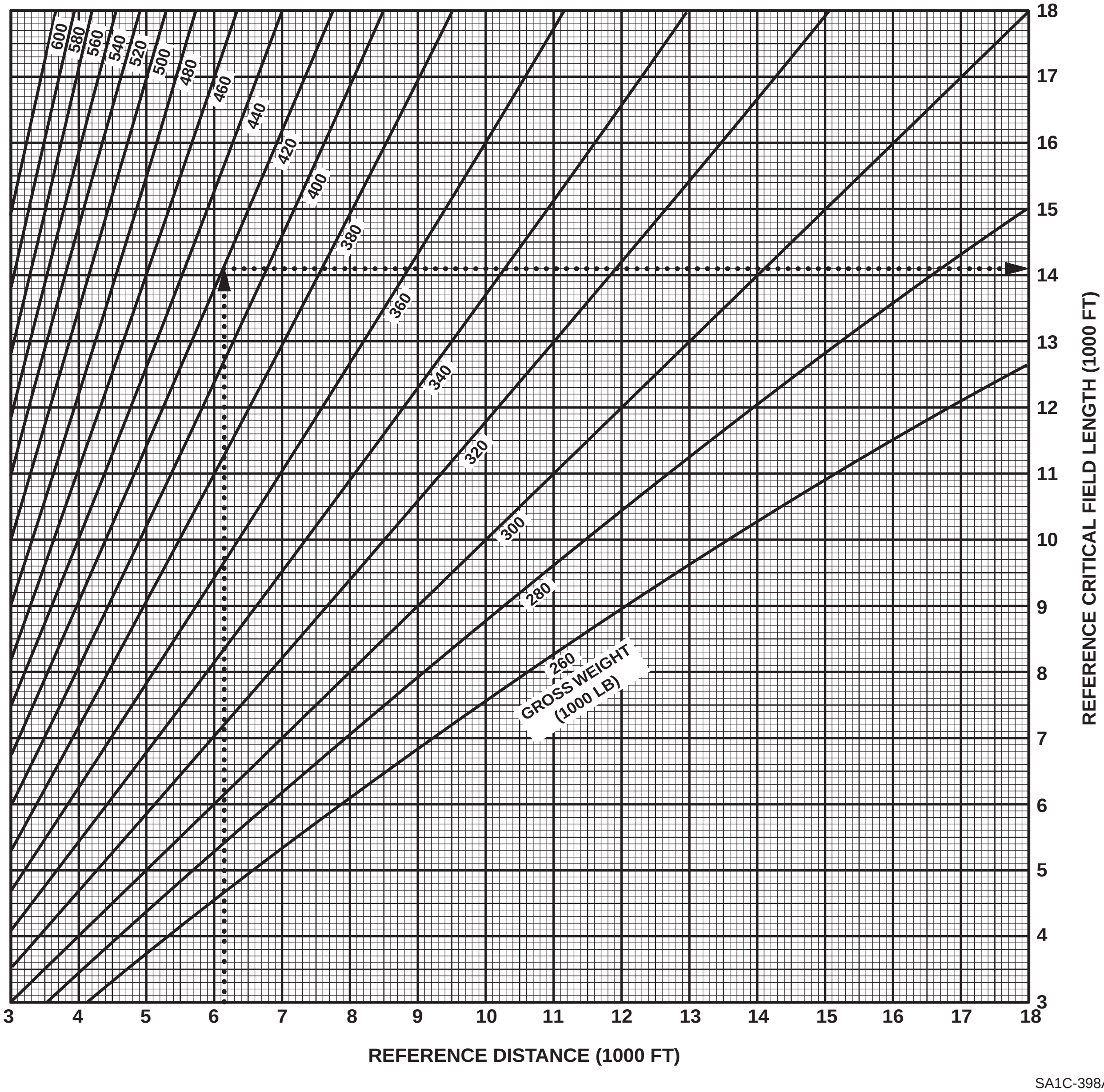


Figure 12-32F. (Sheet 2)

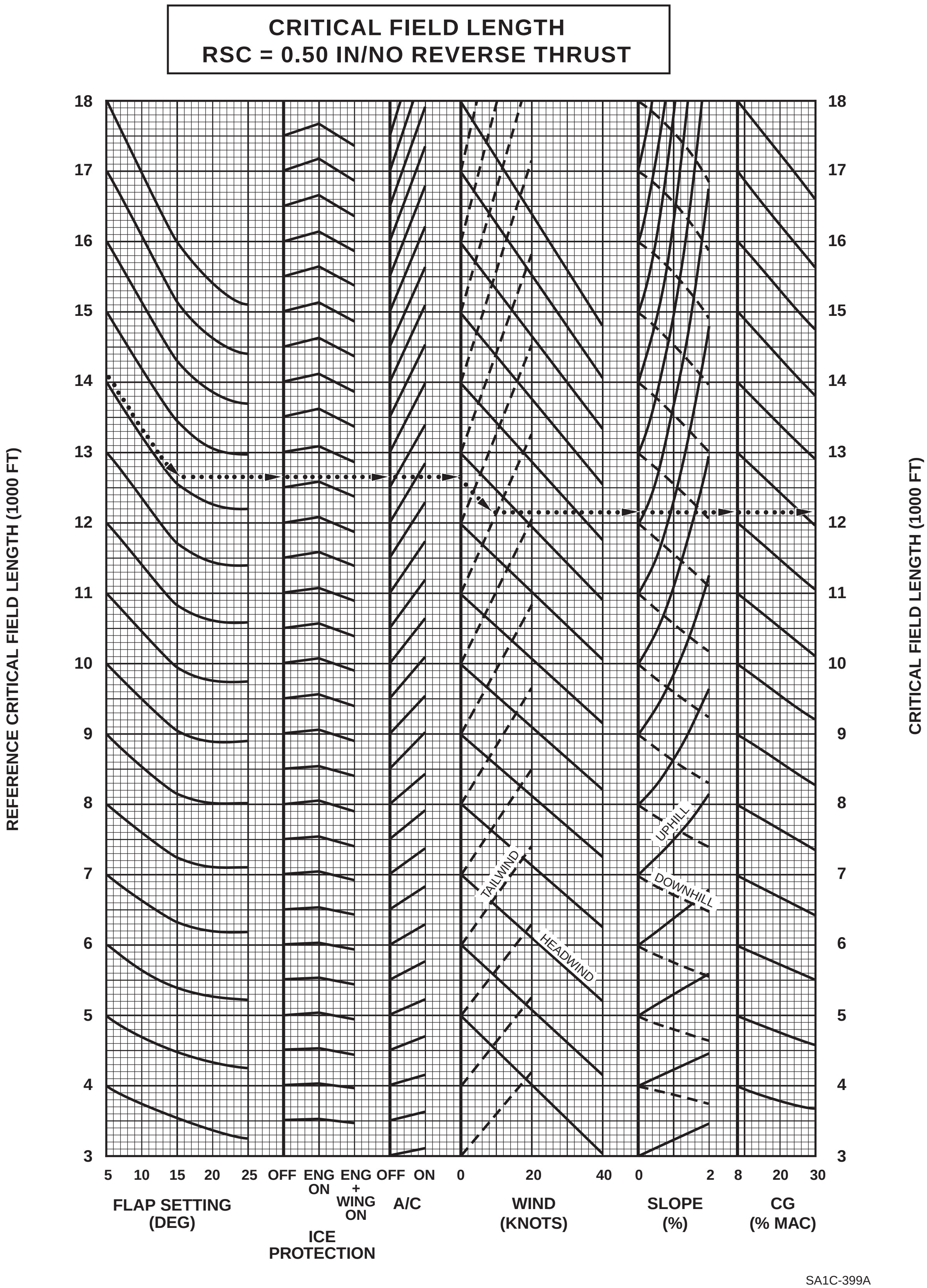


Figure 12-32F. (Sheet 3)

MAXIMUM TAKEOFF GROSS WEIGHT AT OPTIMUM TAKEOFF FLAP SETTING
RCR = 23 TO 18 /NO REVERSE THRUST

NOTE: DO NOT MAKE RCR CORRECTION WHEN CFCC IS USED.

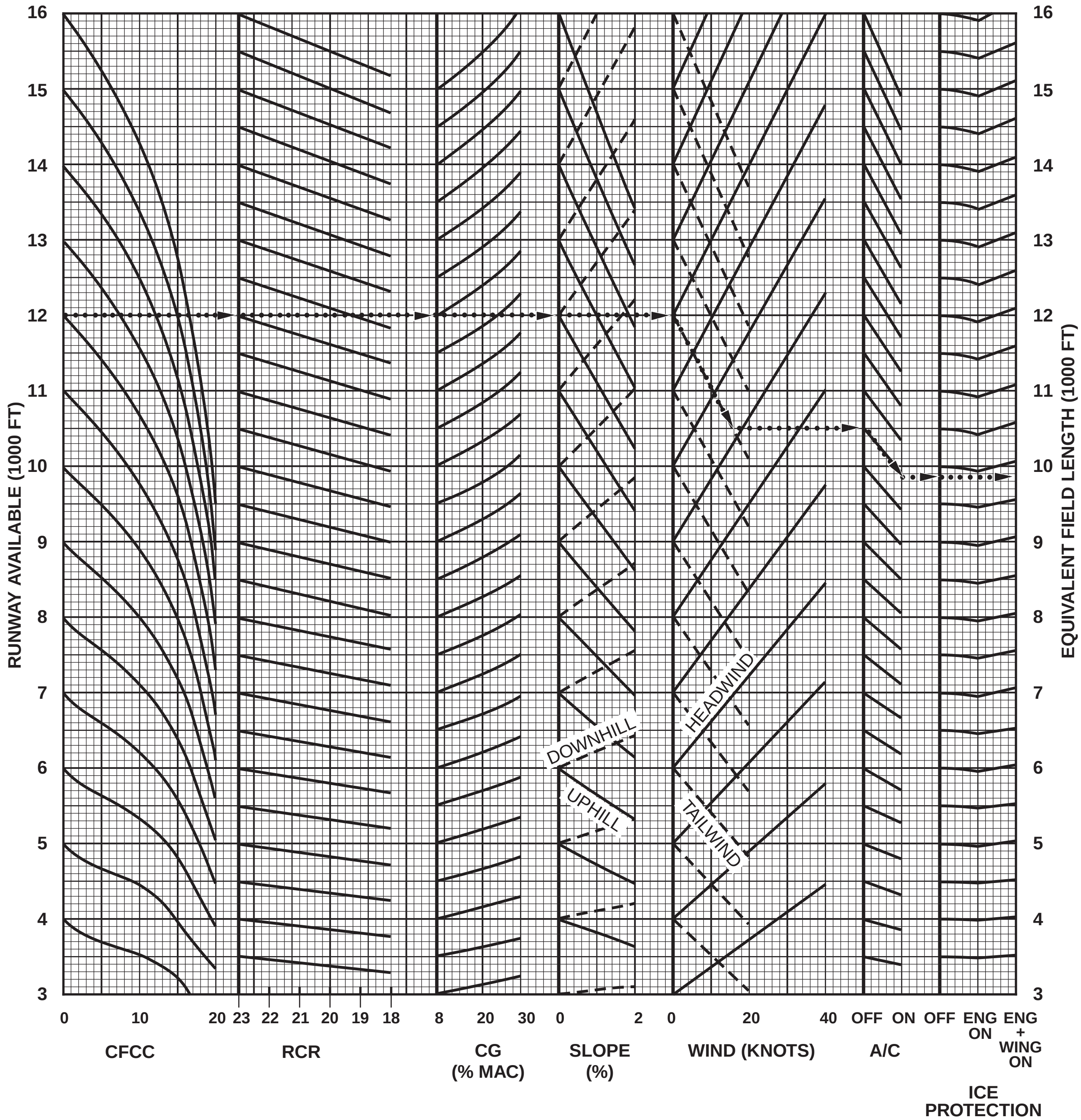


Figure 12-33A. (Sheet 1)

MAXIMUM TAKEOFF GROSS WEIGHT AT OPTIMUM TAKEOFF FLAP SETTING
RCR = 23 TO 18 /NO REVERSE THRUST

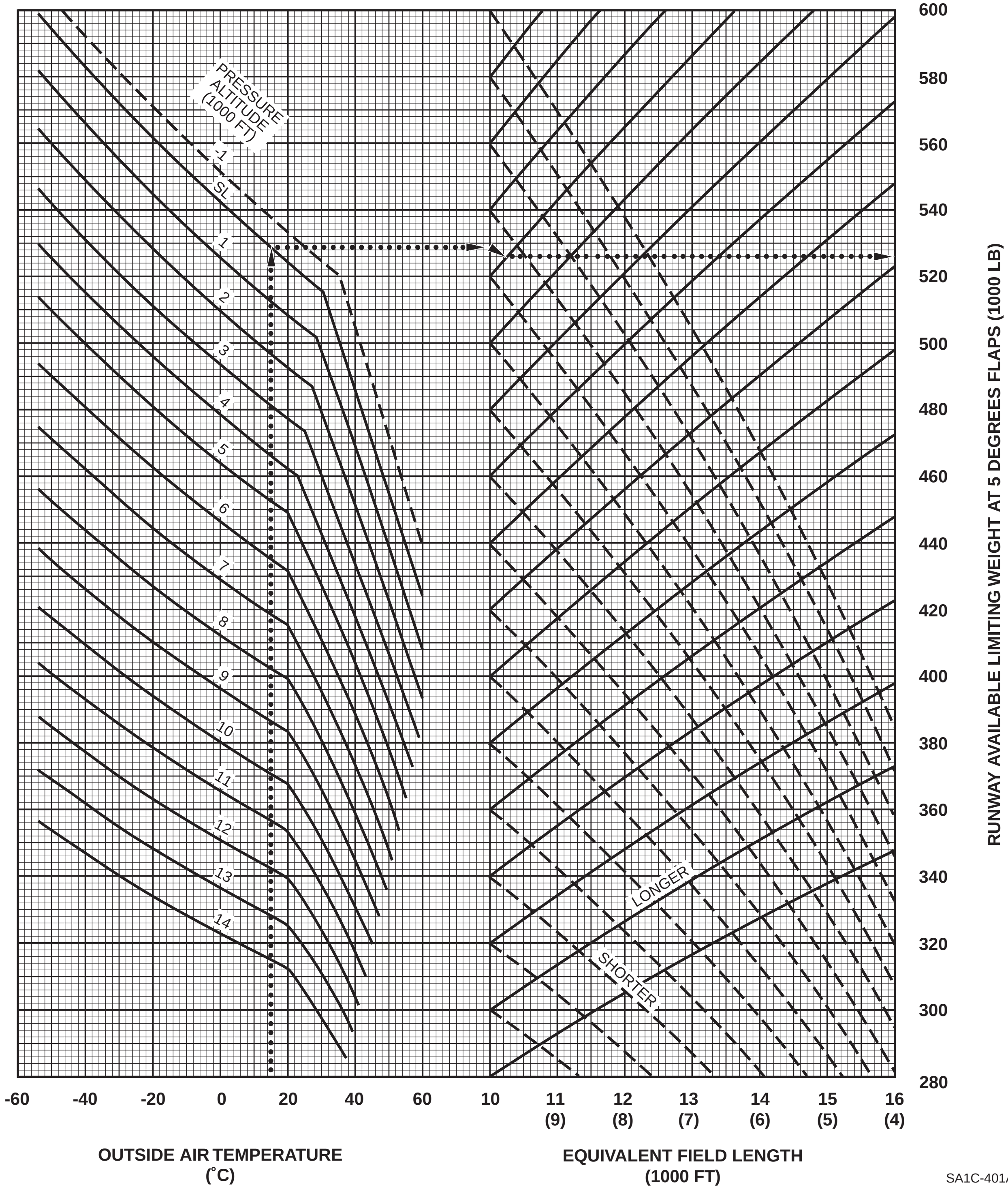


Figure 12-33A. (Sheet 2)

MAXIMUM TAKEOFF GROSS WEIGHT AT OPTIMUM TAKEOFF FLAP SETTING RCR = 23 TO 18 /NO REVERSE THRUST

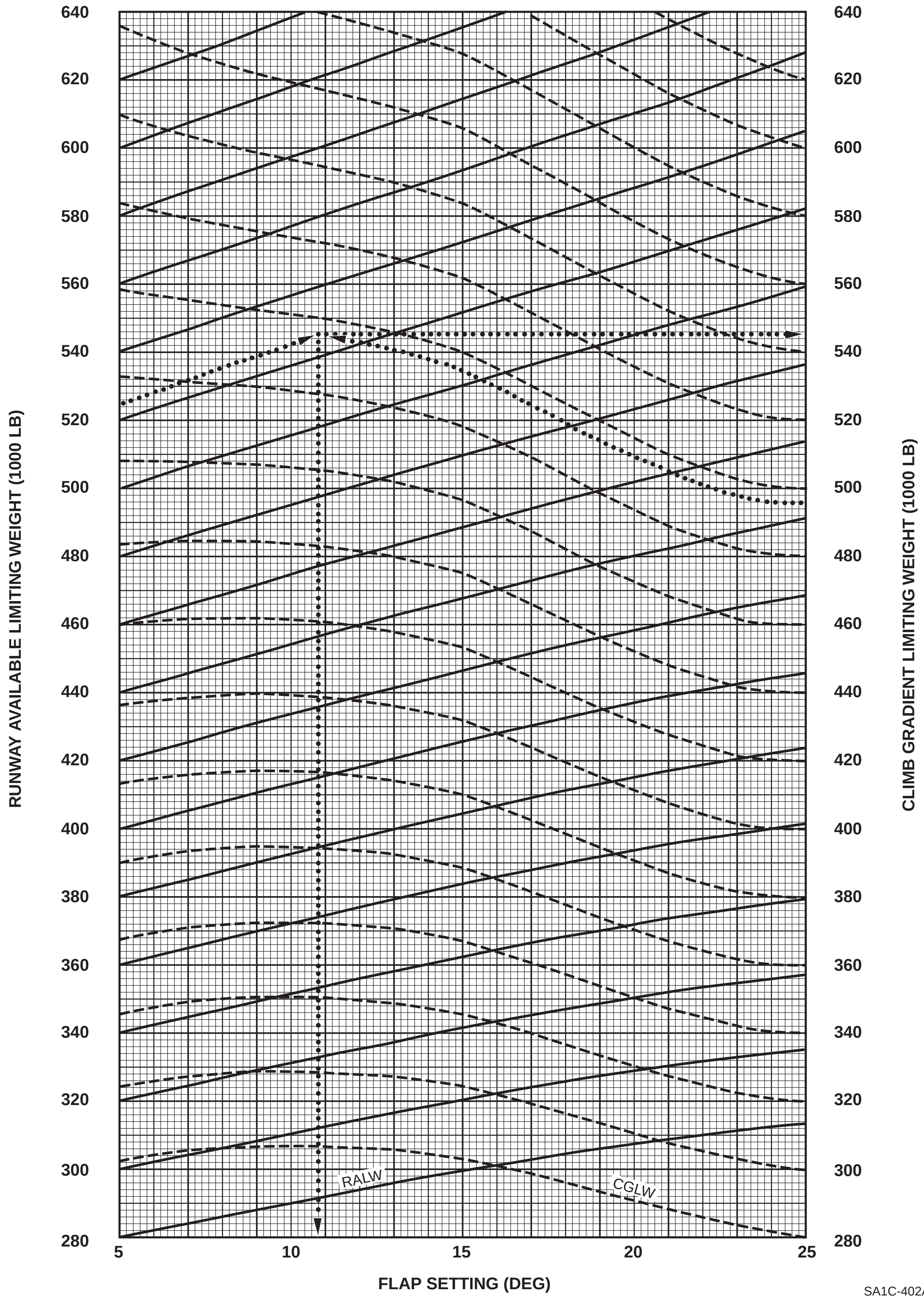


Figure 12-33A. (Sheet 3)

MAXIMUM TAKEOFF GROSS WEIGHT AT OPTIMUM TAKEOFF FLAP SETTING RCR = 23 TO 18 /NO REVERSE THRUST

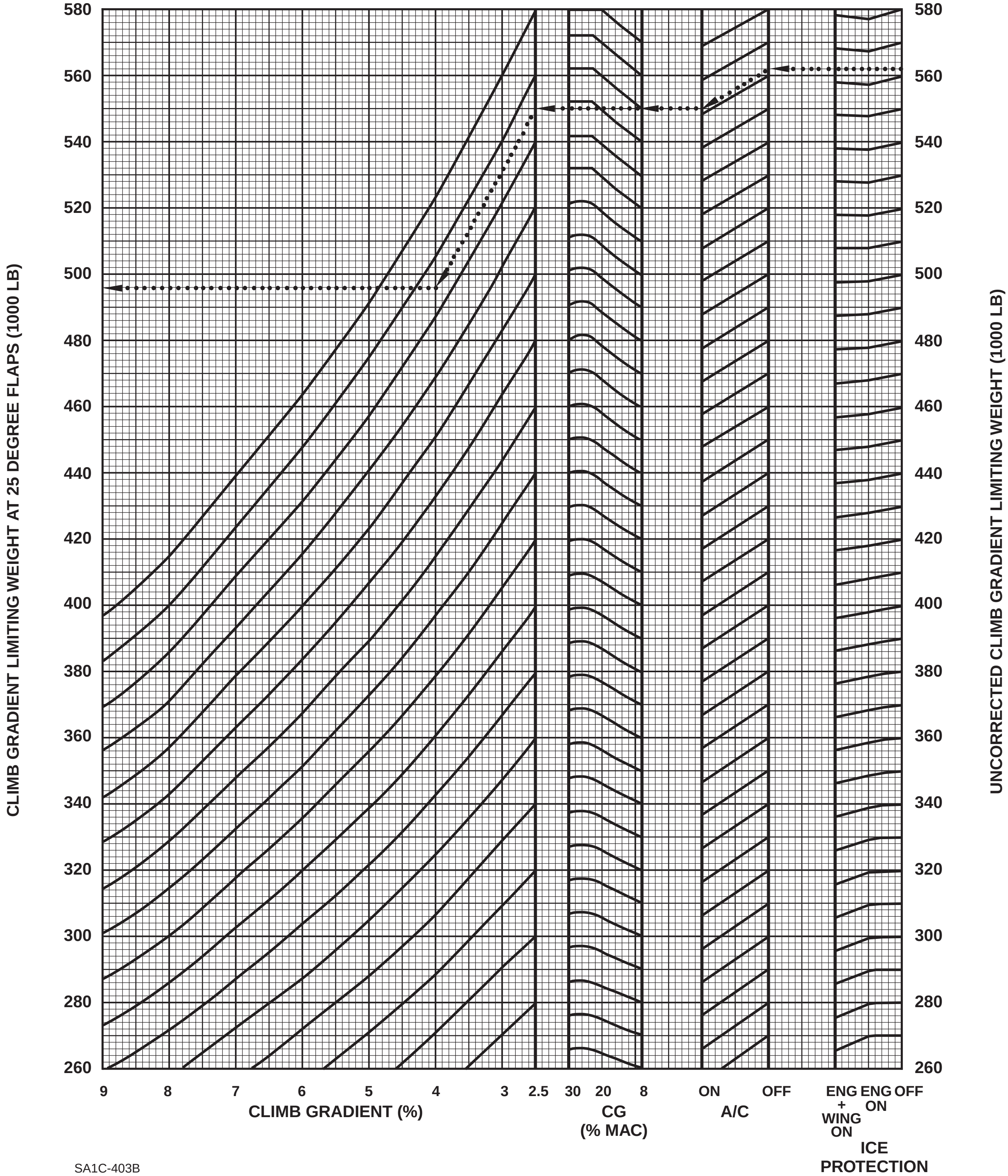


Figure 12-33A. (Sheet 4)

MAXIMUM TAKEOFF GROSS WEIGHT AT OPTIMUM TAKEOFF FLAP SETTING
RCR = 23 TO 18 /NO REVERSE THRUST

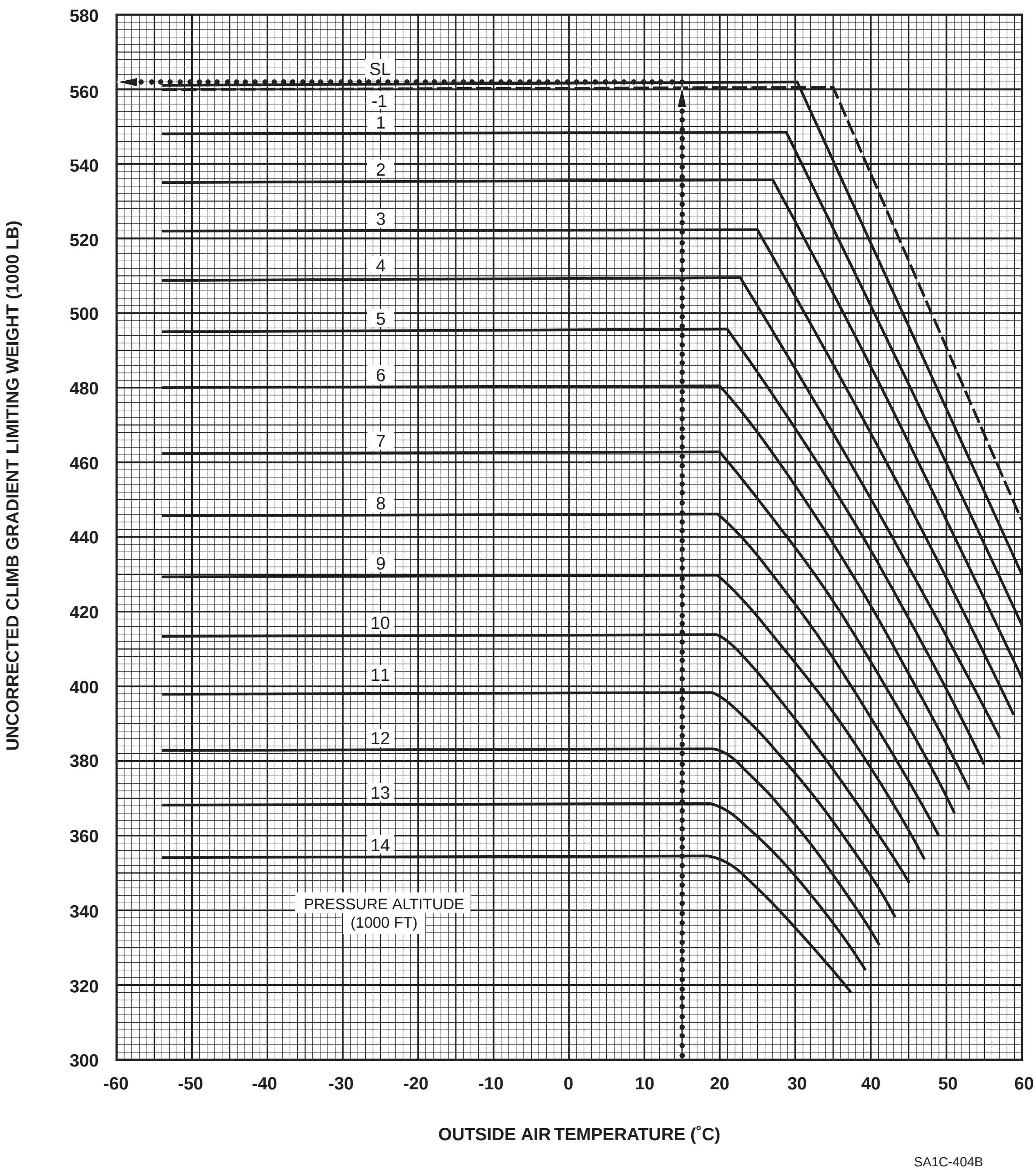
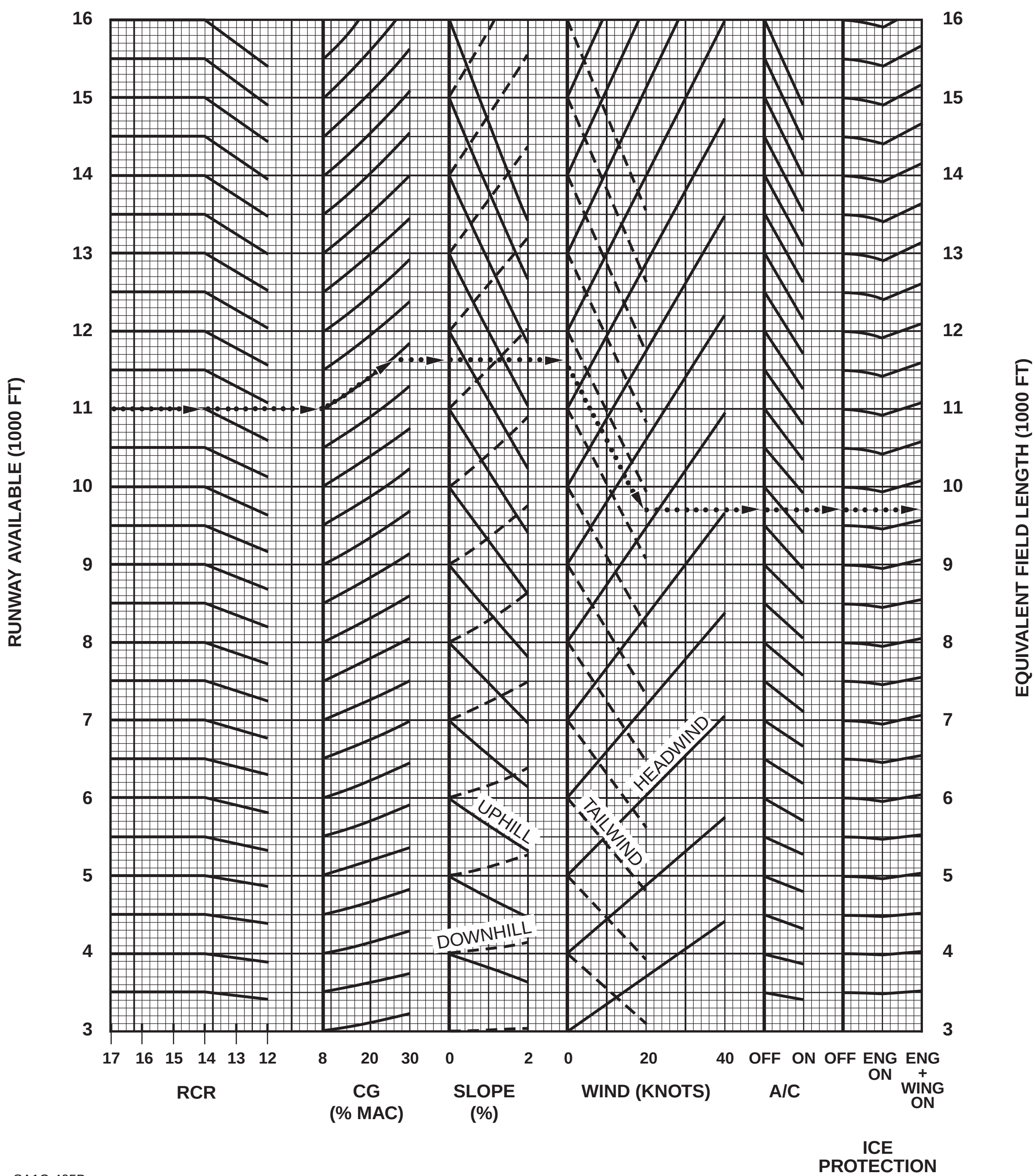


Figure 12-33A. (Sheet 5)

MAXIMUM TAKEOFF GROSS WEIGHT AT OPTIMUM TAKEOFF FLAP SETTING
RCR = 17 TO 12 /NO REVERSE THRUST



SA1C-405B

Figure 12-33B. (Sheet 1)

MAXIMUM TAKEOFF GROSS WEIGHT AT OPTIMUM TAKEOFF FLAP SETTING
RCR = 17 TO 12 /NO REVERSE THRUST

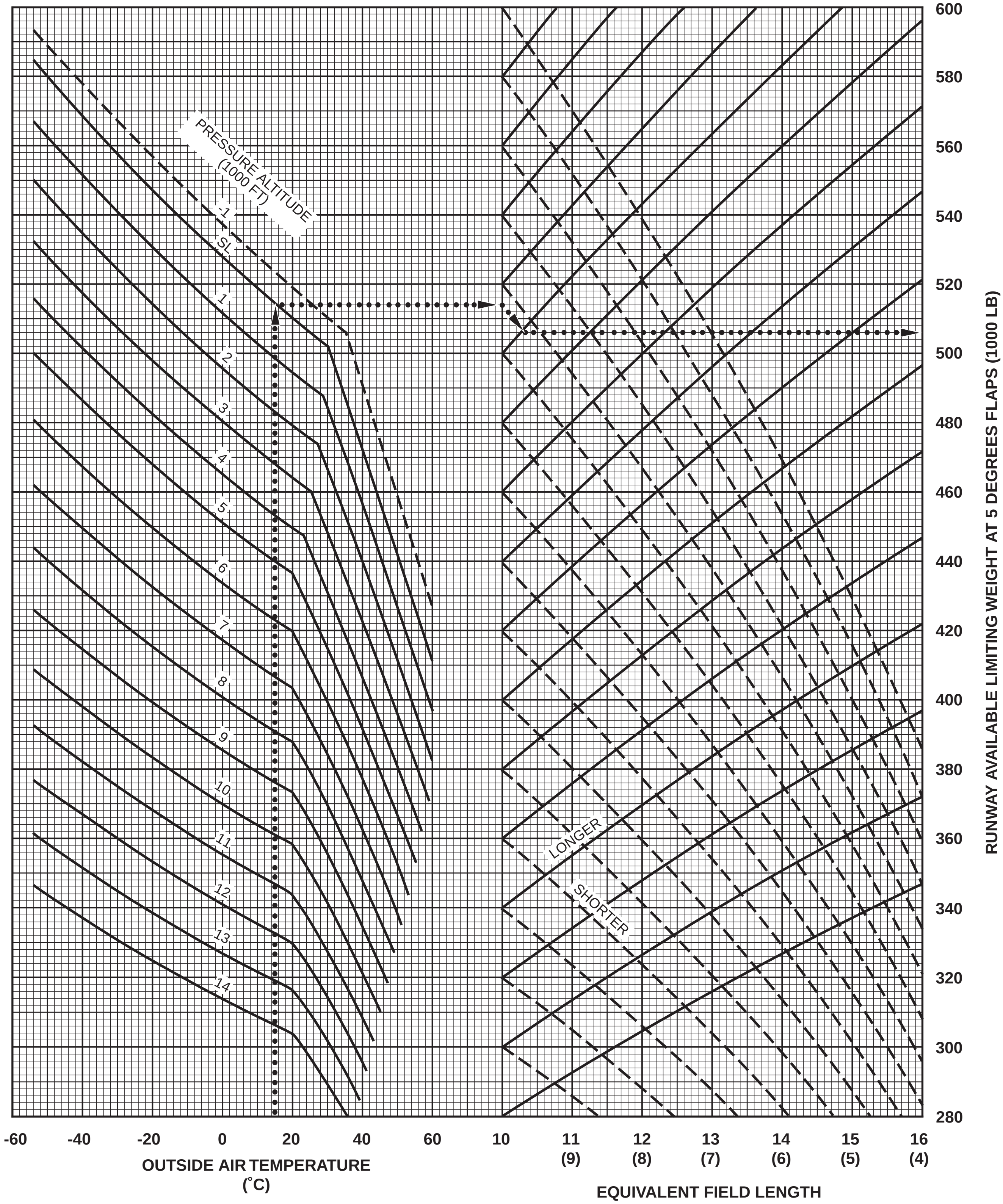


Figure 12-33B. (Sheet 2) SA1C-406A

MAXIMUM TAKEOFF GROSS WEIGHT AT OPTIMUM TAKEOFF FLAP SETTING RCR = 17 TO 12 /NO REVERSE THRUST

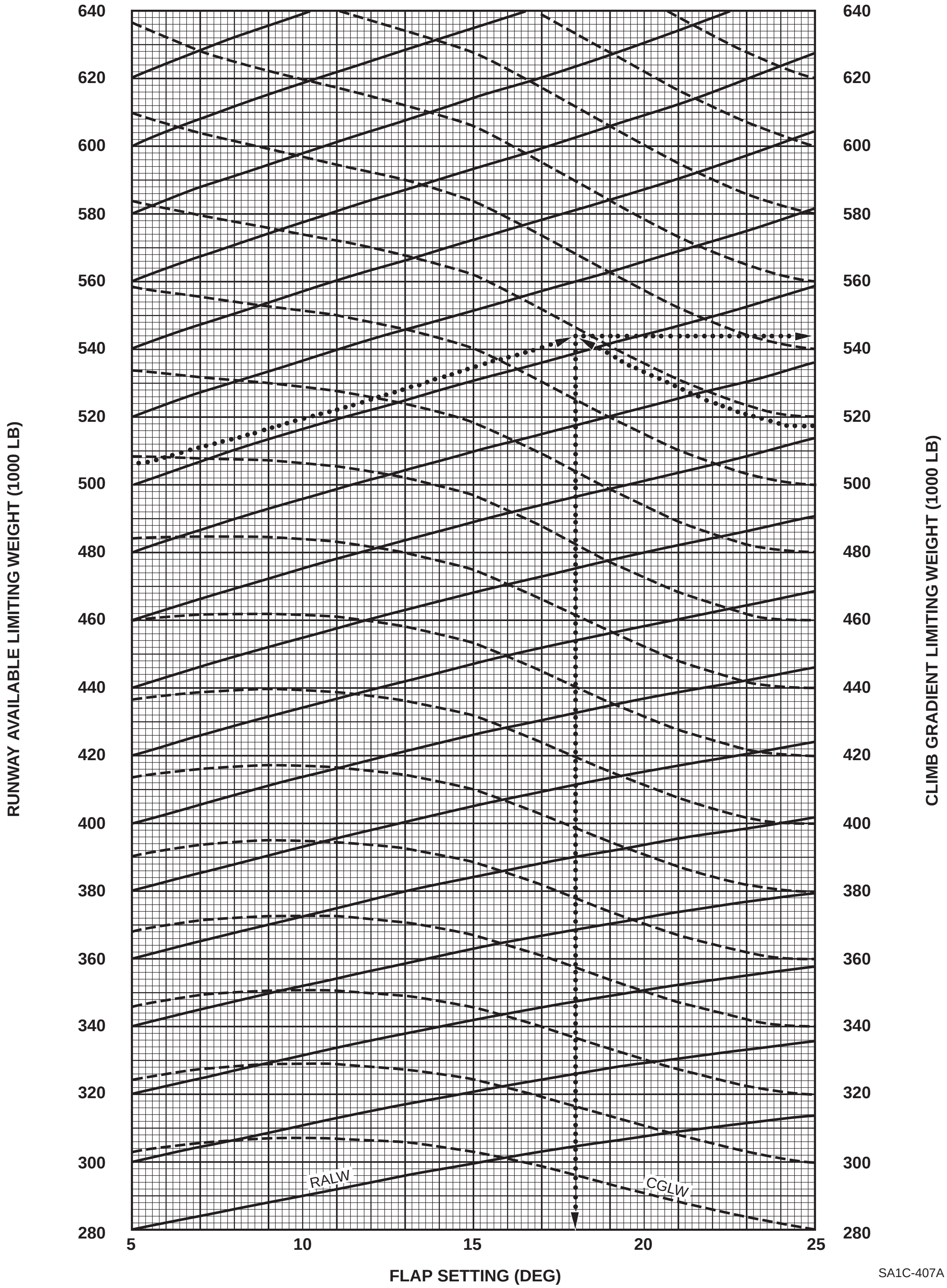


Figure 12-33B. (Sheet 3)

MAXIMUM TAKEOFF GROSS WEIGHT AT OPTIMUM TAKEOFF FLAP SETTING
RCR = 17 TO 12 /NO REVERSE THRUST

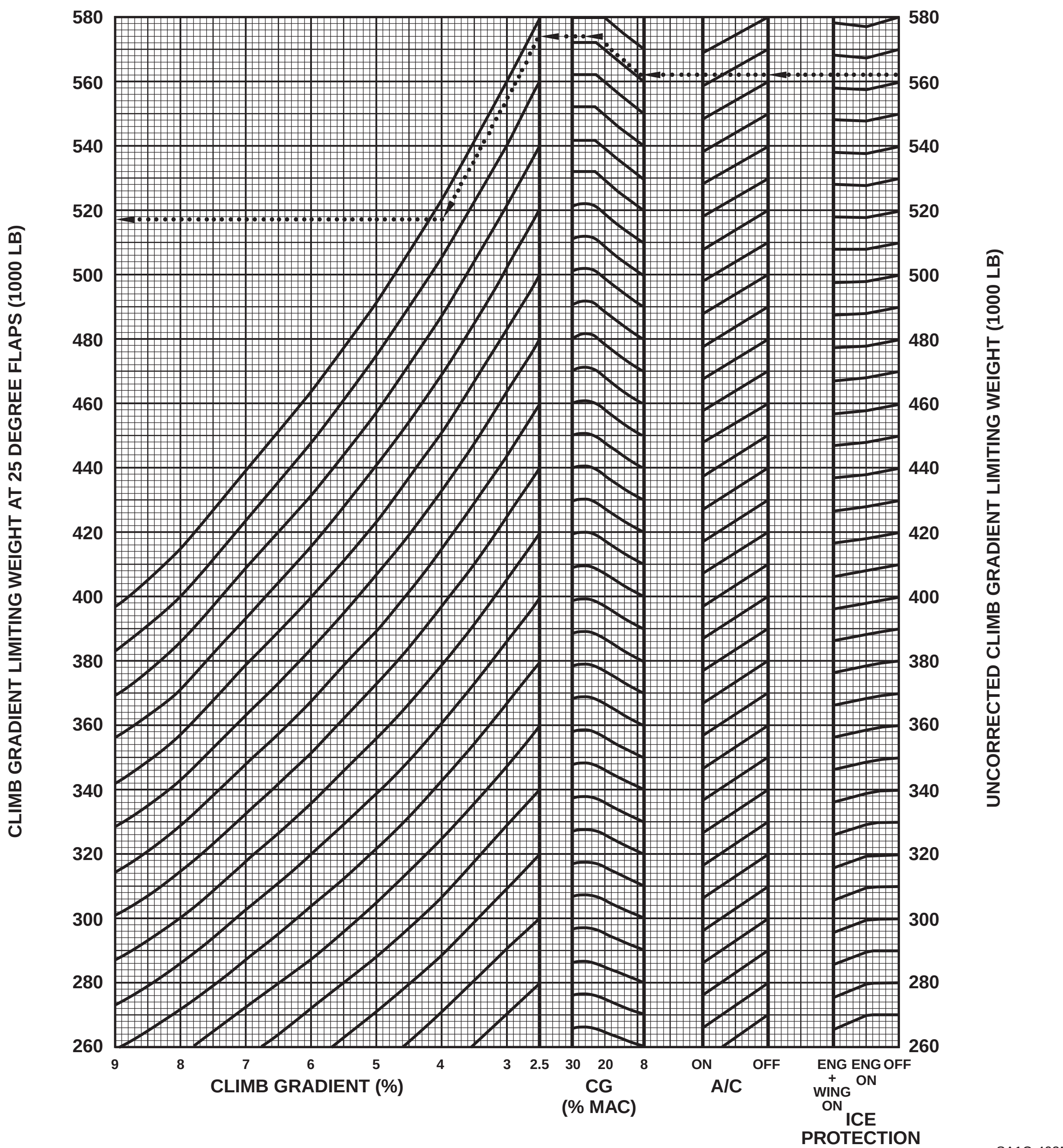


Figure 12-33B. (Sheet 4)

MAXIMUM TAKEOFF GROSS WEIGHT AT OPTIMUM TAKEOFF FLAP SETTING
RCR = 17 TO 12 /NO REVERSE THRUST

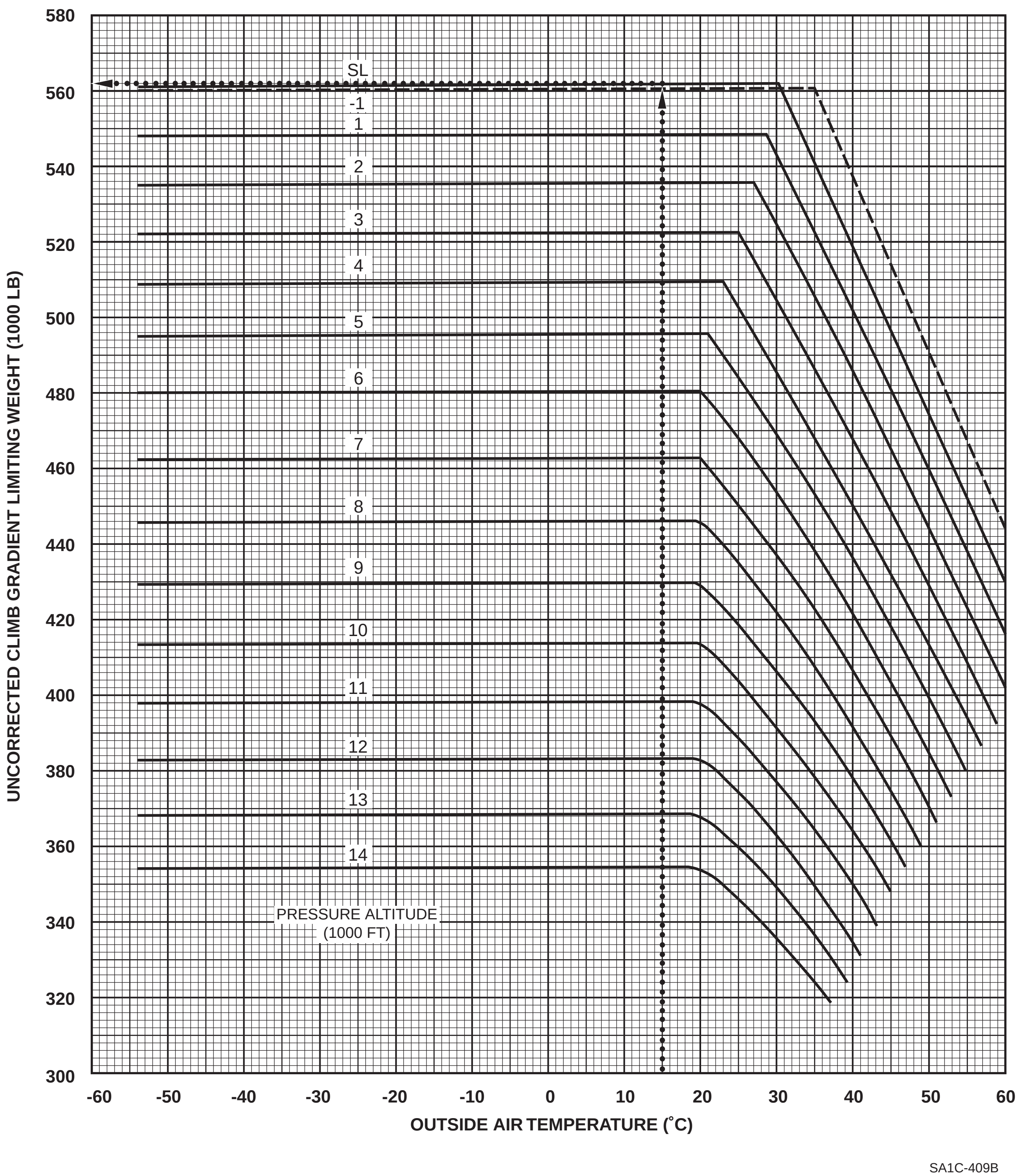


Figure 12-33B. (Sheet 5)

MAXIMUM TAKEOFF GROSS WEIGHT AT OPTIMUM TAKEOFF FLAP SETTING RCR = 11 TO 8 /NO REVERSE THRUST

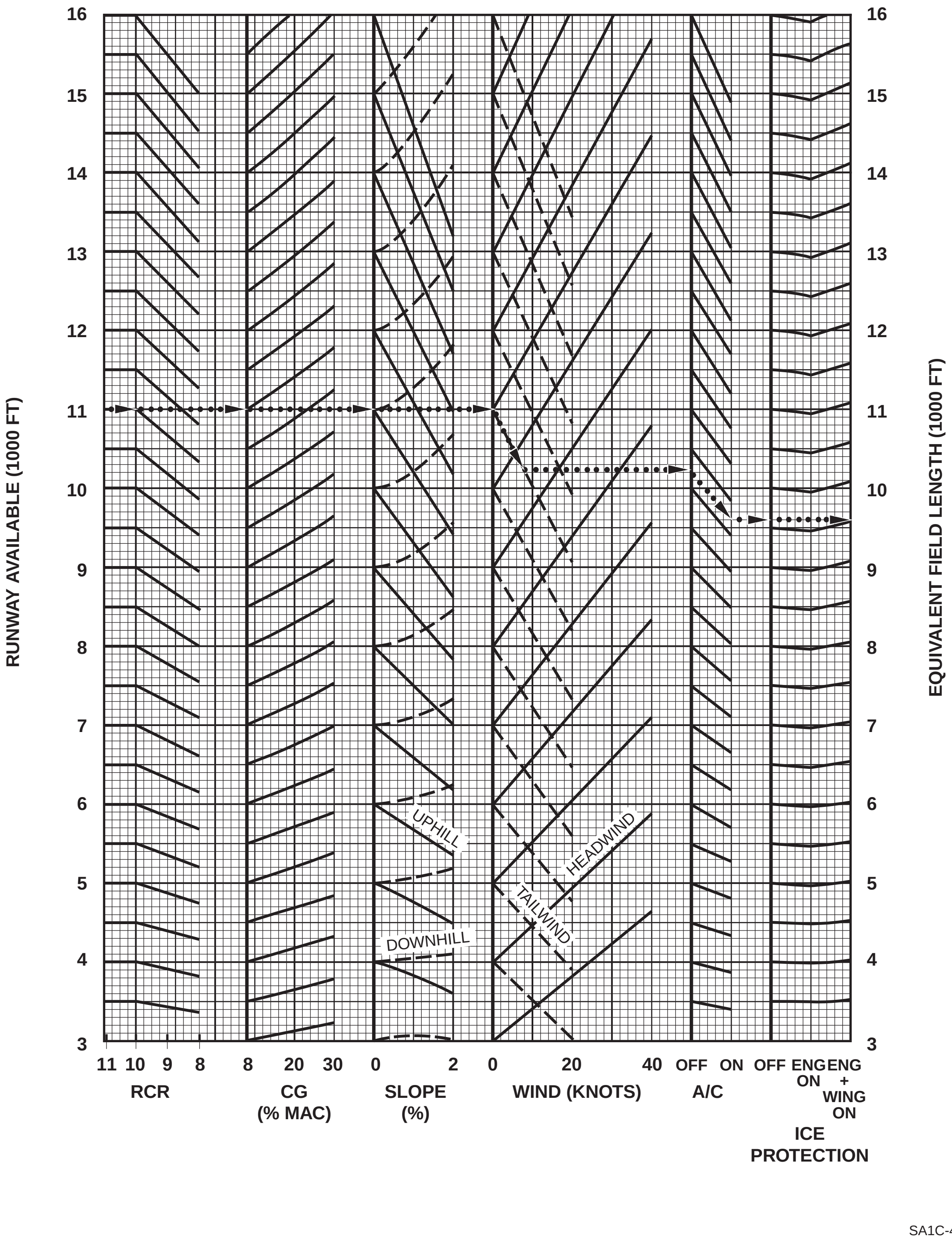


Figure 12-33C. (Sheet 1)

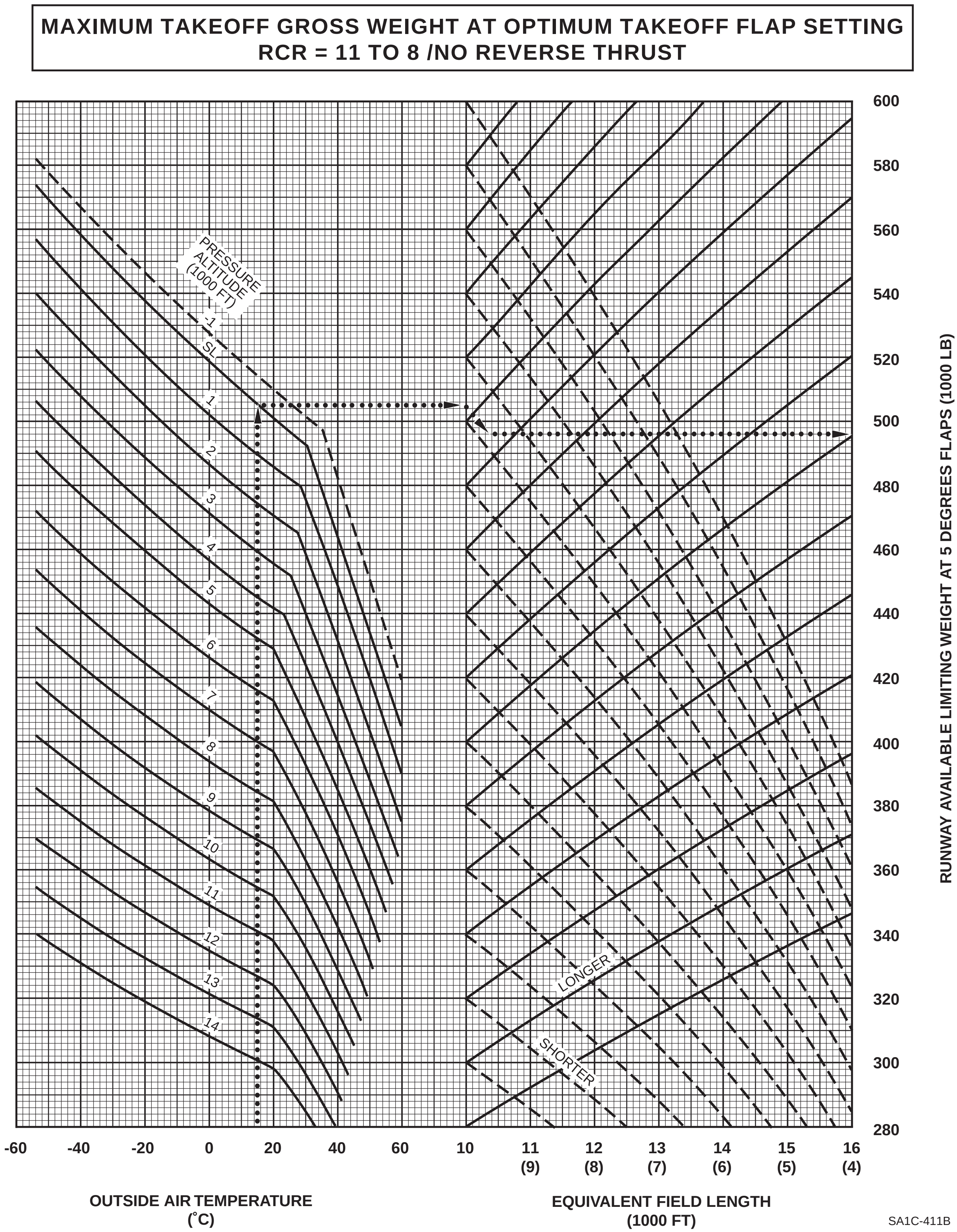


Figure 12-33C. (Sheet 2)

MAXIMUM TAKEOFF GROSS WEIGHT AT OPTIMUM TAKEOFF FLAP SETTING
RCR = 11 TO 8 /NO REVERSE THRUST

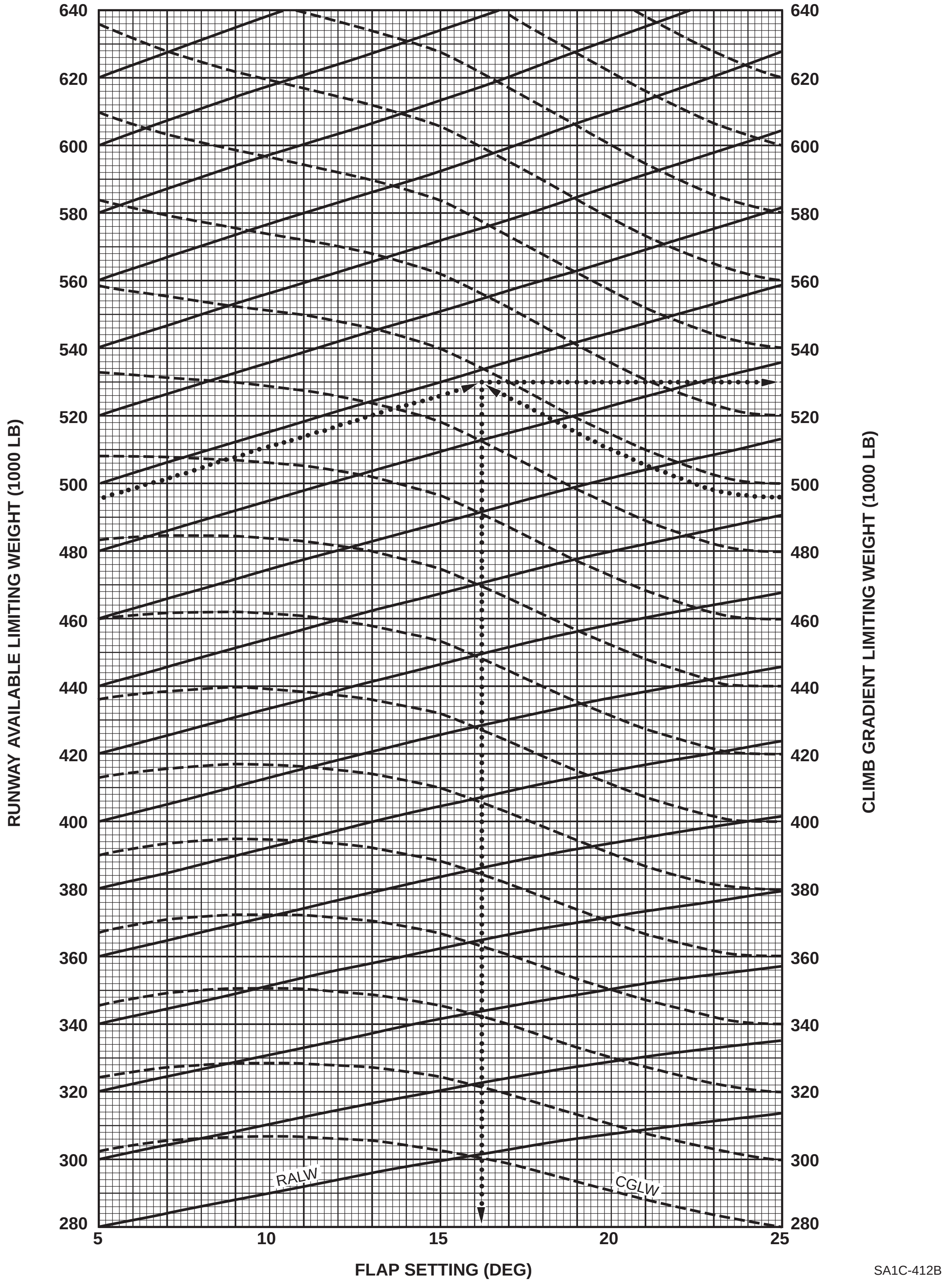


Figure 12-33C. (Sheet 3)

MAXIMUM TAKEOFF GROSS WEIGHT AT OPTIMUM TAKEOFF FLAP SETTING RCR = 11 TO 8 /NO REVERSE THRUST

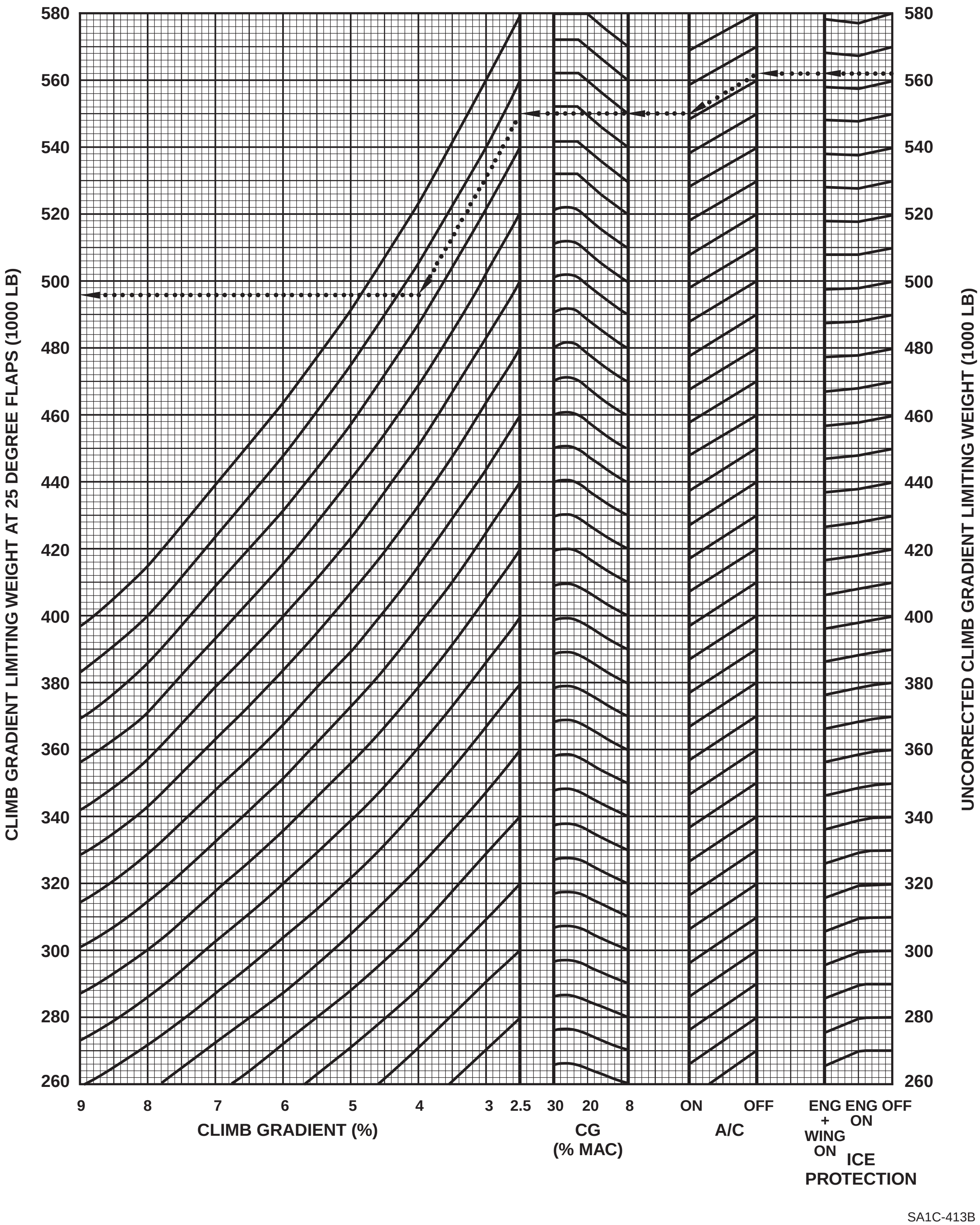


Figure 12-33C. (Sheet 4)

MAXIMUM TAKEOFF GROSS WEIGHT AT OPTIMUM TAKEOFF FLAP SETTING RCR = 11 TO 8 /NO REVERSE THRUST

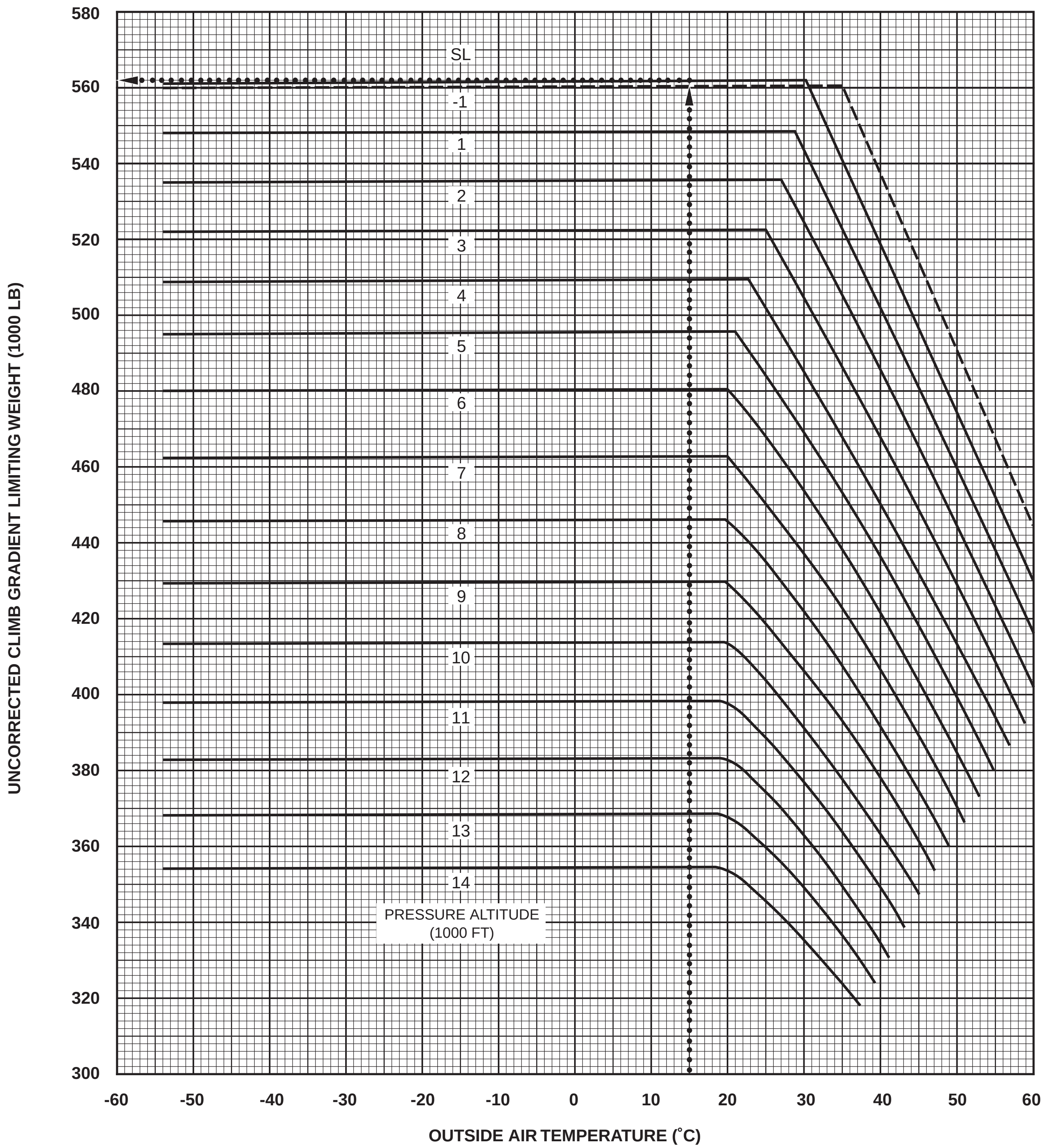


Figure 12-33C. (Sheet 5)

MAXIMUM TAKEOFF GROSS WEIGHT AT OPTIMUM TAKEOFF FLAP SETTING
RCR = 7 TO 3 /NO REVERSE THRUST

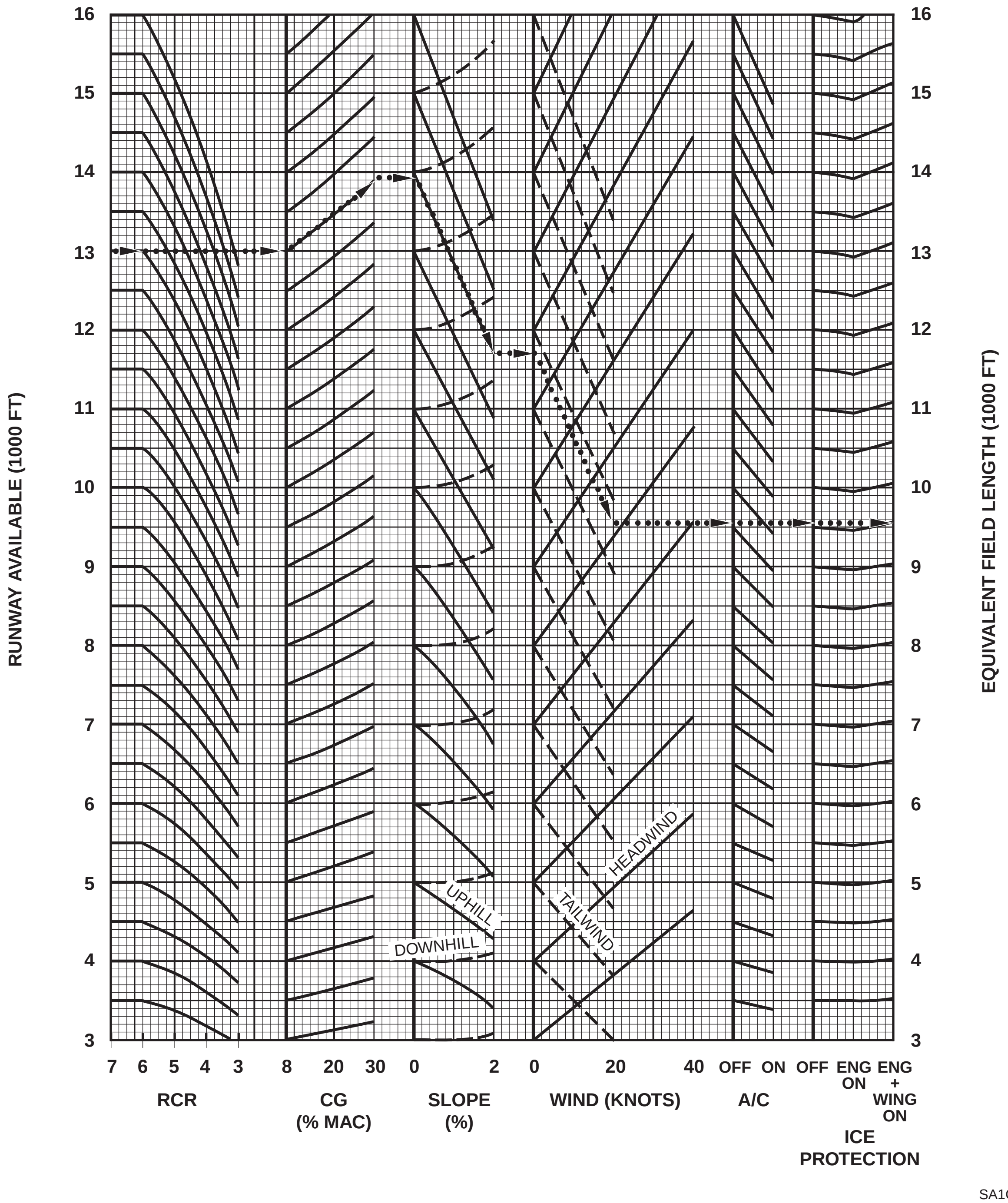


Figure 12-33D. (Sheet 1)

MAXIMUM TAKEOFF GROSS WEIGHT AT OPTIMUM TAKEOFF FLAP SETTING
RCR = 7 TO 3 /NO REVERSE THRUST

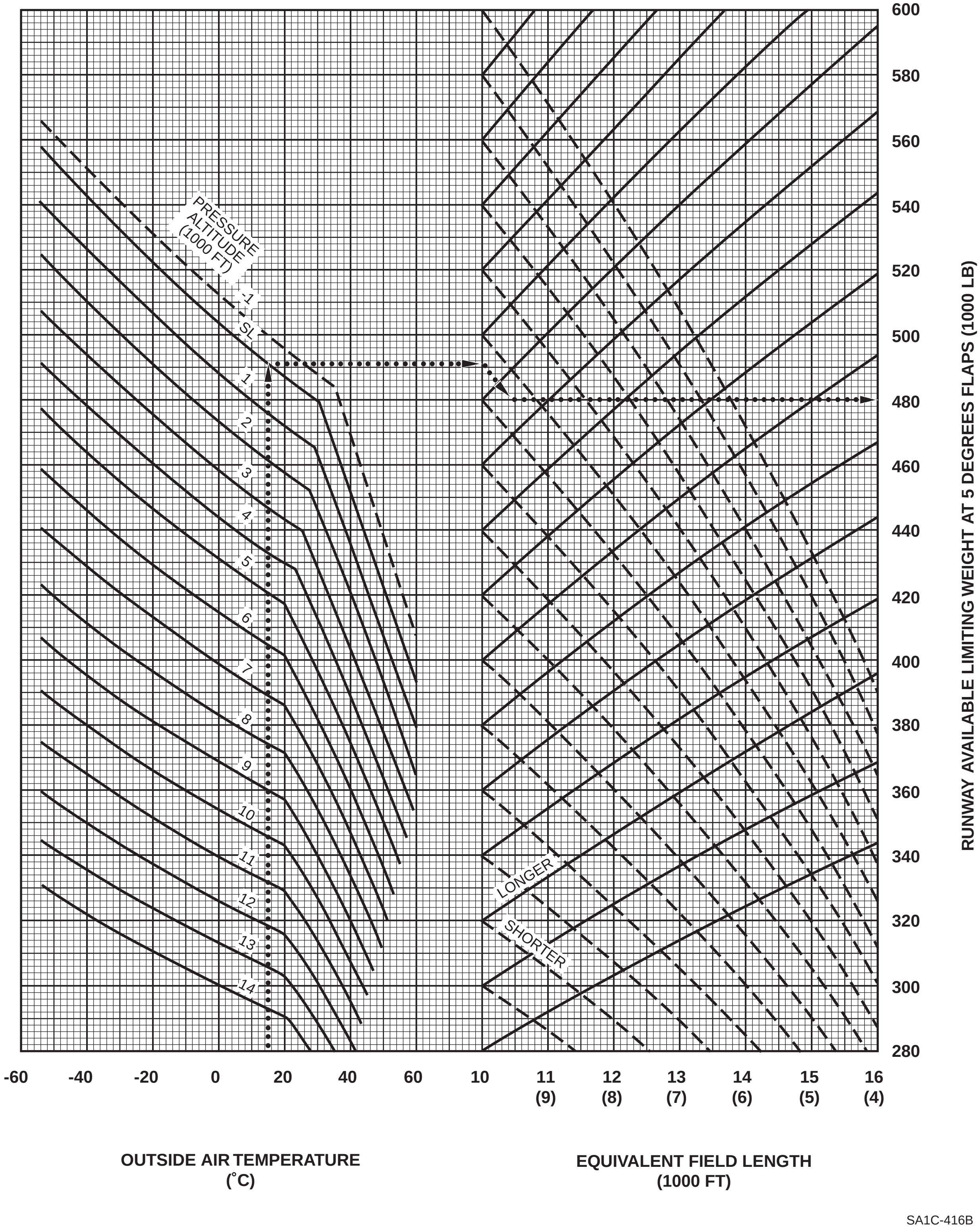


Figure 12-33D. (Sheet 2)

MAXIMUM TAKEOFF GROSS WEIGHT AT OPTIMUM TAKEOFF FLAP SETTING RCR = 7 TO 3 /NO REVERSE THRUST

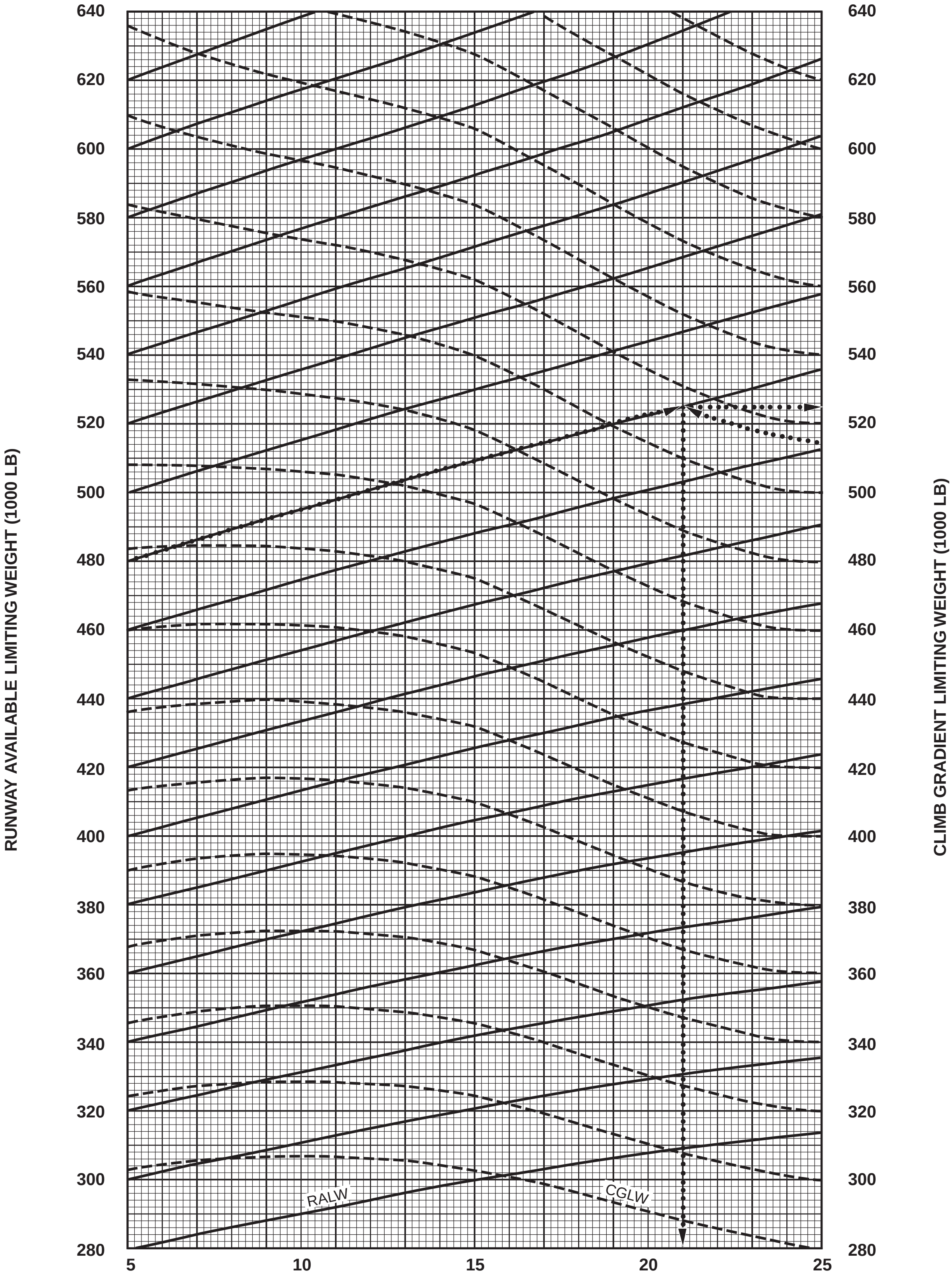


Figure 12-33D. (Sheet 3)

MAXIMUM TAKEOFF GROSS WEIGHT AT OPTIMUM TAKEOFF FLAP SETTING
RCR = 7 TO 3 /NO REVERSE THRUST

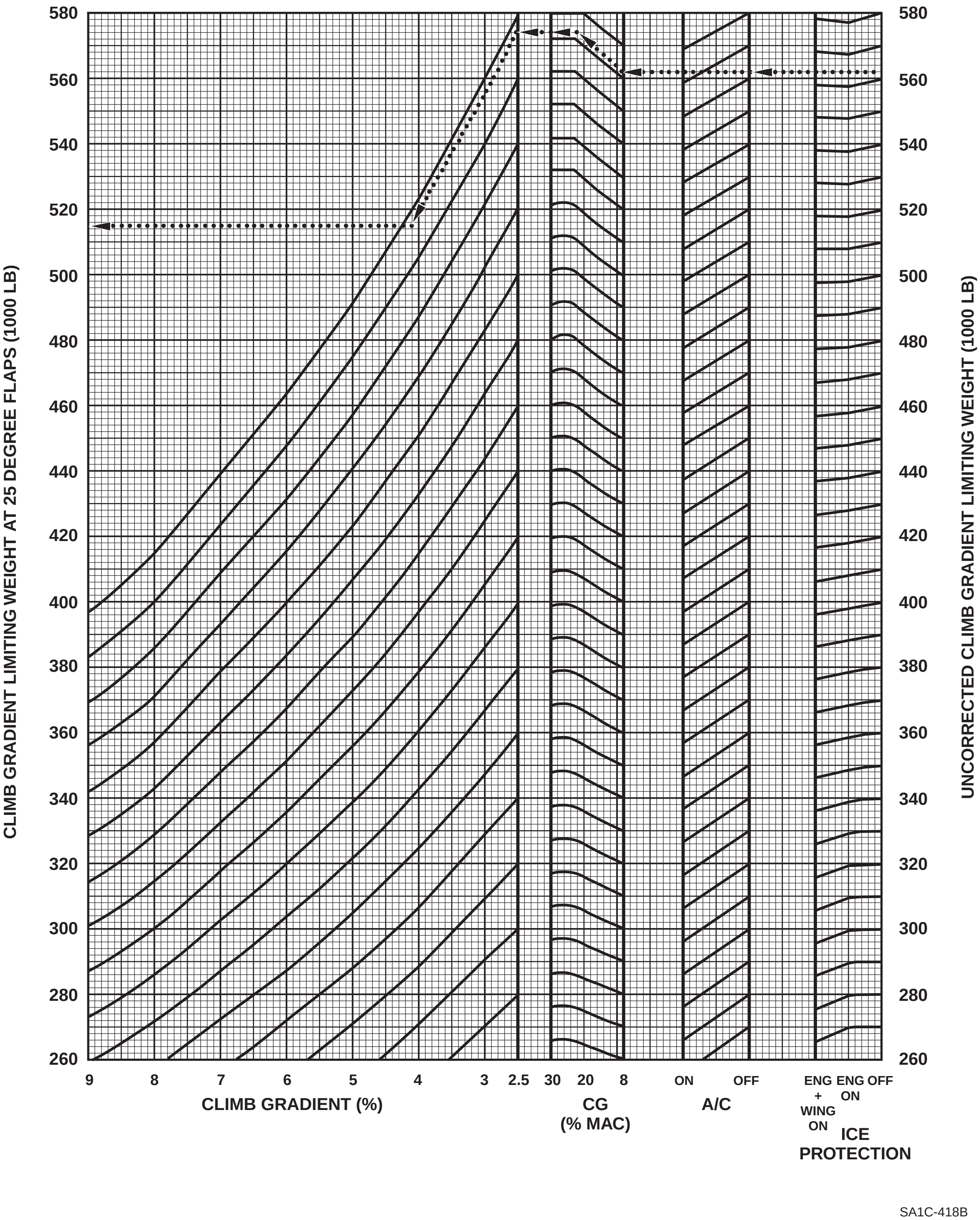


Figure 12-33D. (Sheet 4)

MAXIMUM TAKEOFF GROSS WEIGHT AT OPTIMUM TAKEOFF FLAP SETTING
RCR = 7 TO 3 /NO REVERSE THRUST

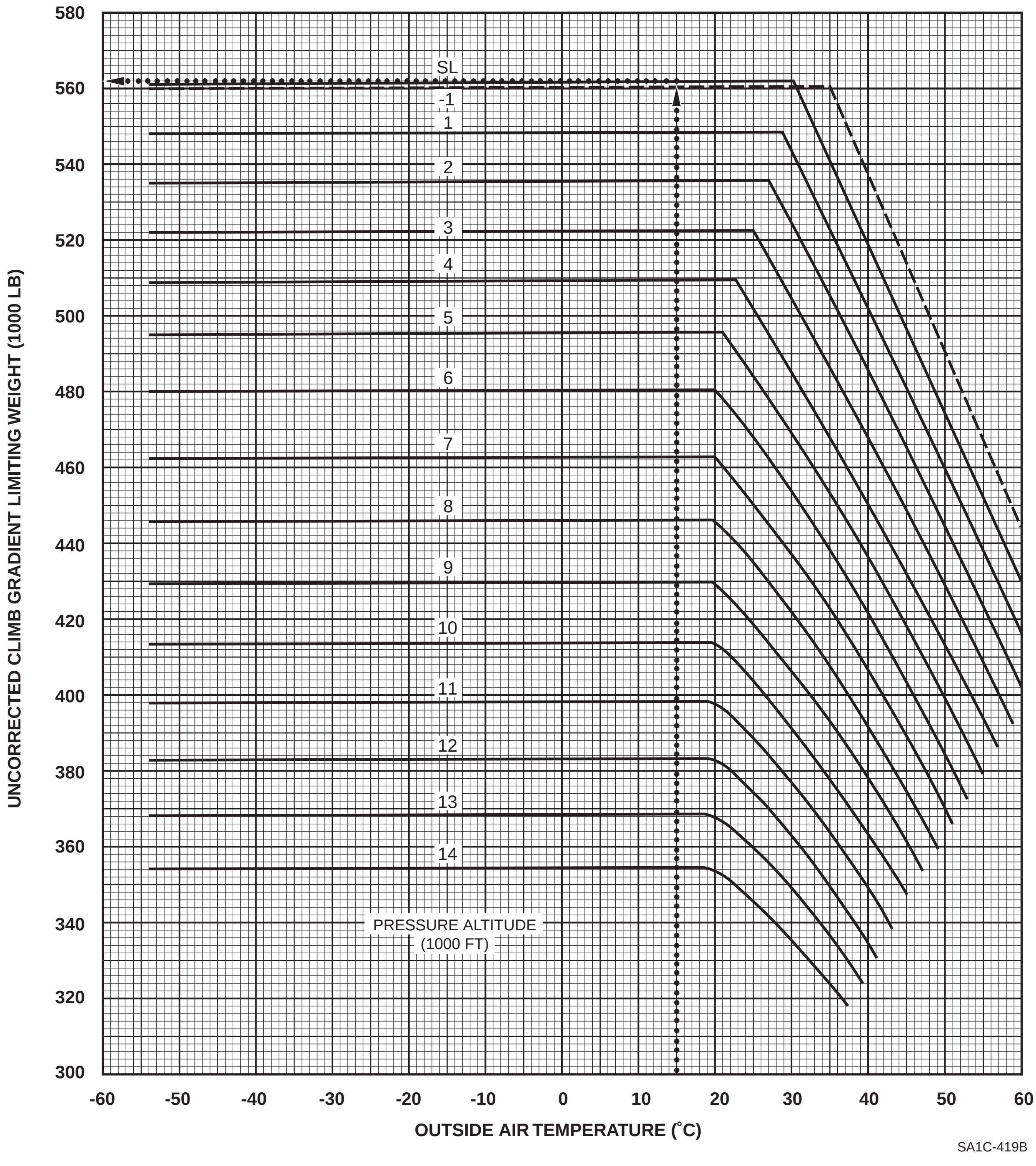


Figure 12-33D. (Sheet 5)

**MAXIMUM TAKEOFF GROSS WEIGHT AT OPTIMUM TAKEOFF FLAP SETTING
RSC = 0.25 IN/NO REVERSE THRUST**

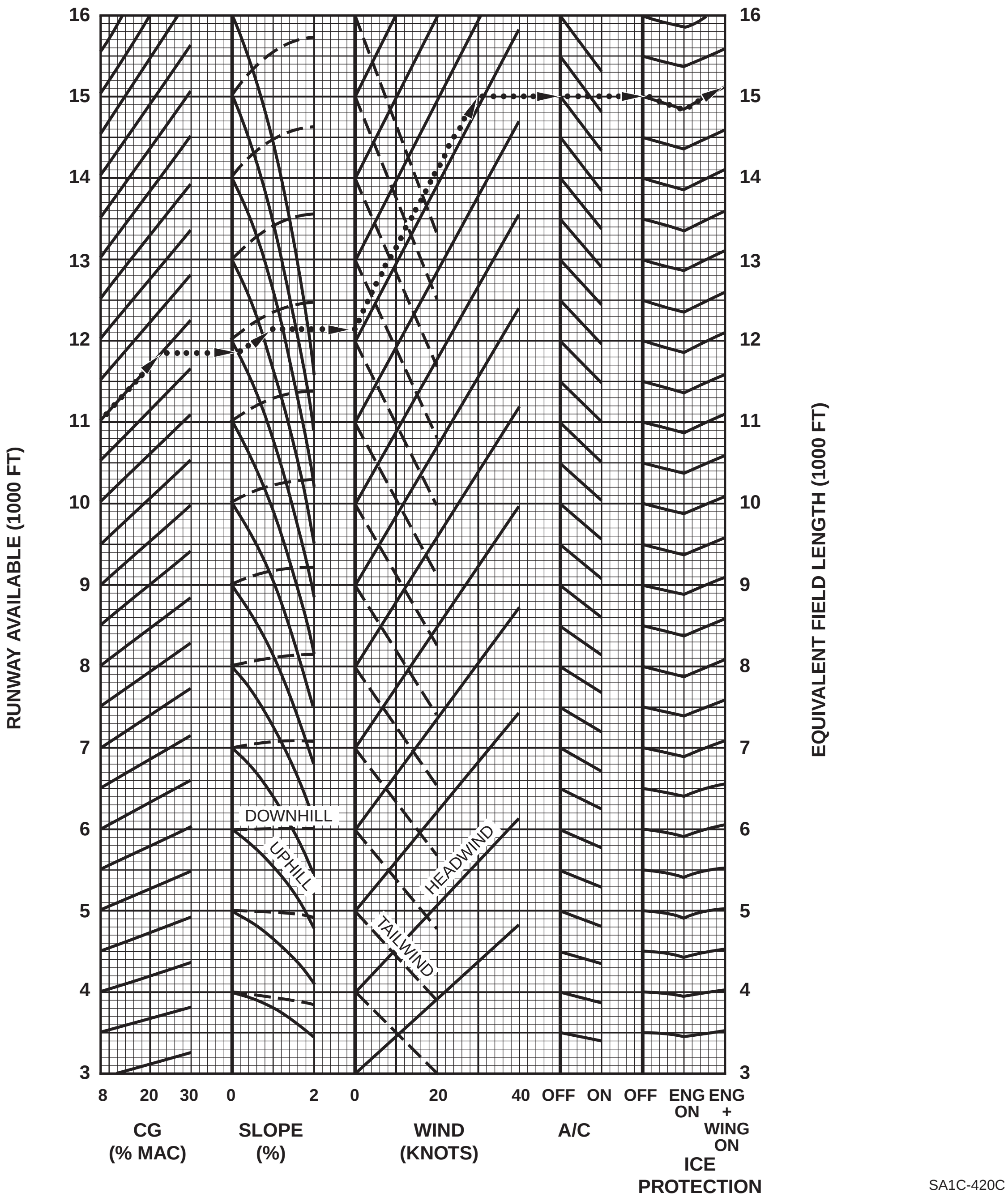


Figure 12-33E. (Sheet 1)

MAXIMUM TAKEOFF GROSS WEIGHT AT OPTIMUM TAKEOFF FLAP SETTING
RSC = 0.25 IN/NO REVERSE THRUST

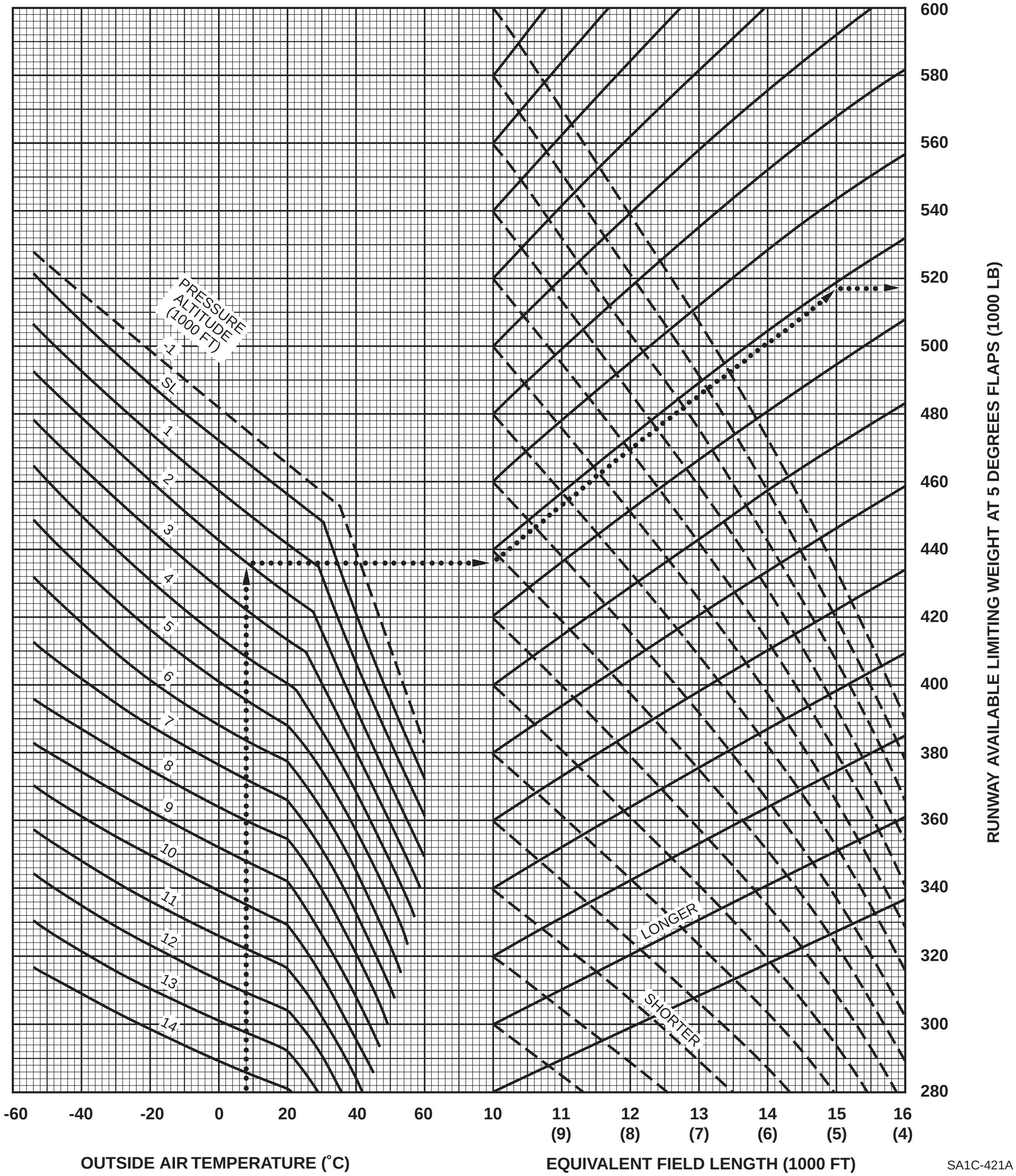


Figure 12-33E. (Sheet 2)

MAXIMUM TAKEOFF GROSS WEIGHT AT OPTIMUM TAKEOFF FLAP SETTING
RSC = 0.25 IN/NO REVERSE THRUST

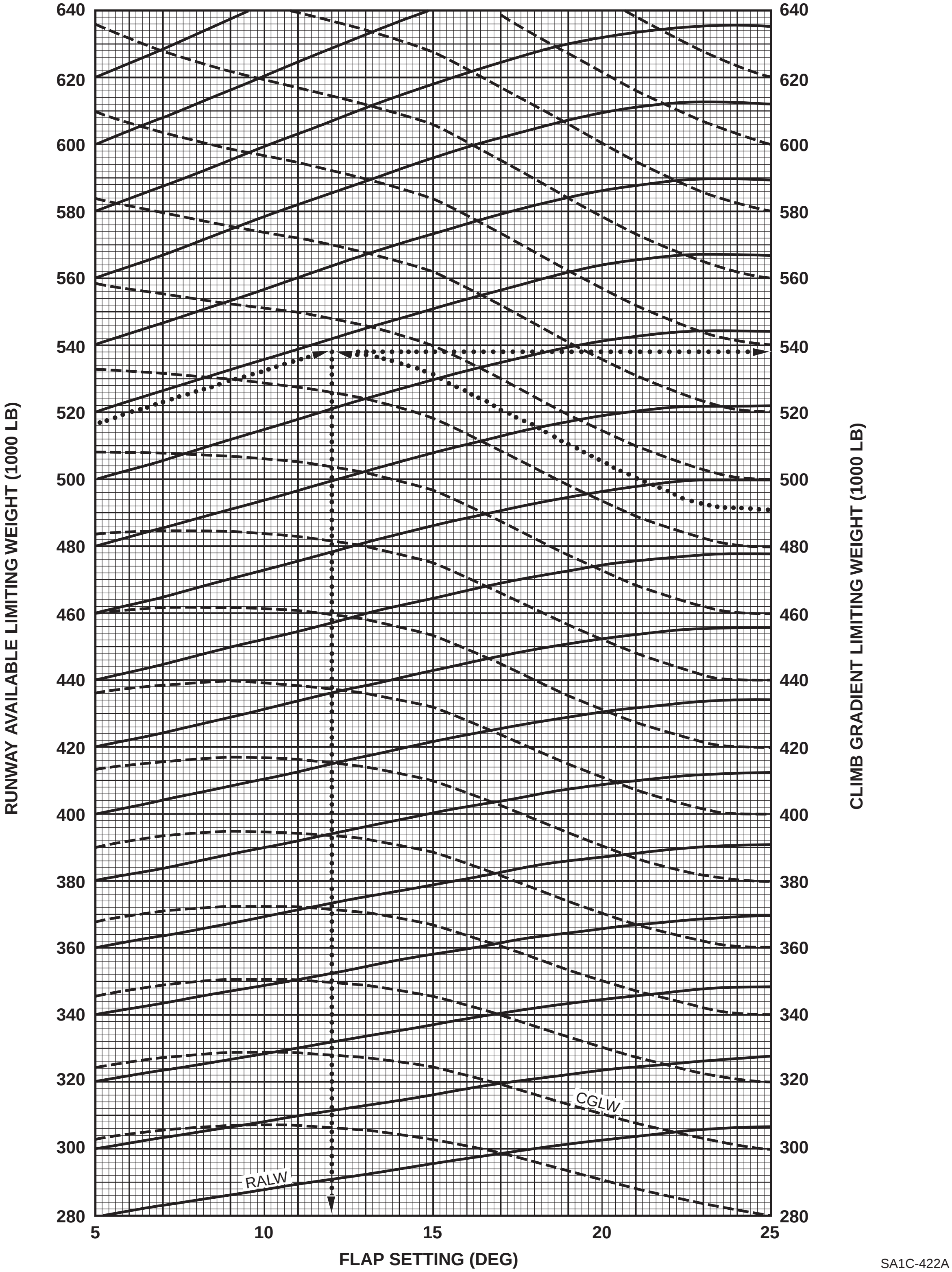


Figure 12-33E. (Sheet 3)

MAXIMUM TAKEOFF GROSS WEIGHT AT OPTIMUM TAKEOFF FLAP SETTING RSC = 0.25 IN/NO REVERSE THRUST

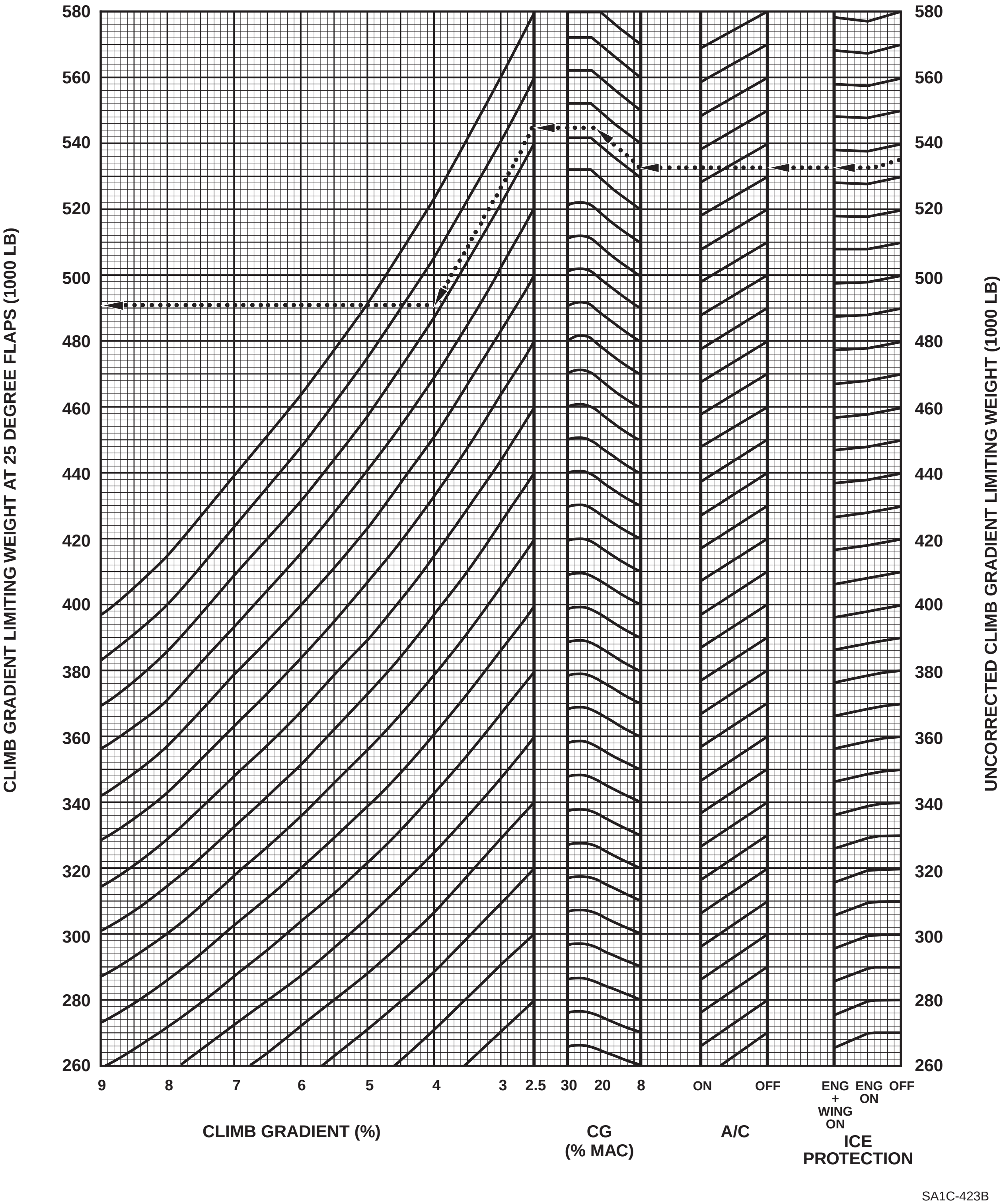


Figure 12-33E. (Sheet 4)

MAXIMUM TAKEOFF GROSS WEIGHT AT OPTIMUM TAKEOFF FLAP SETTING
RSC = 0.25 IN/NO REVERSE THRUST

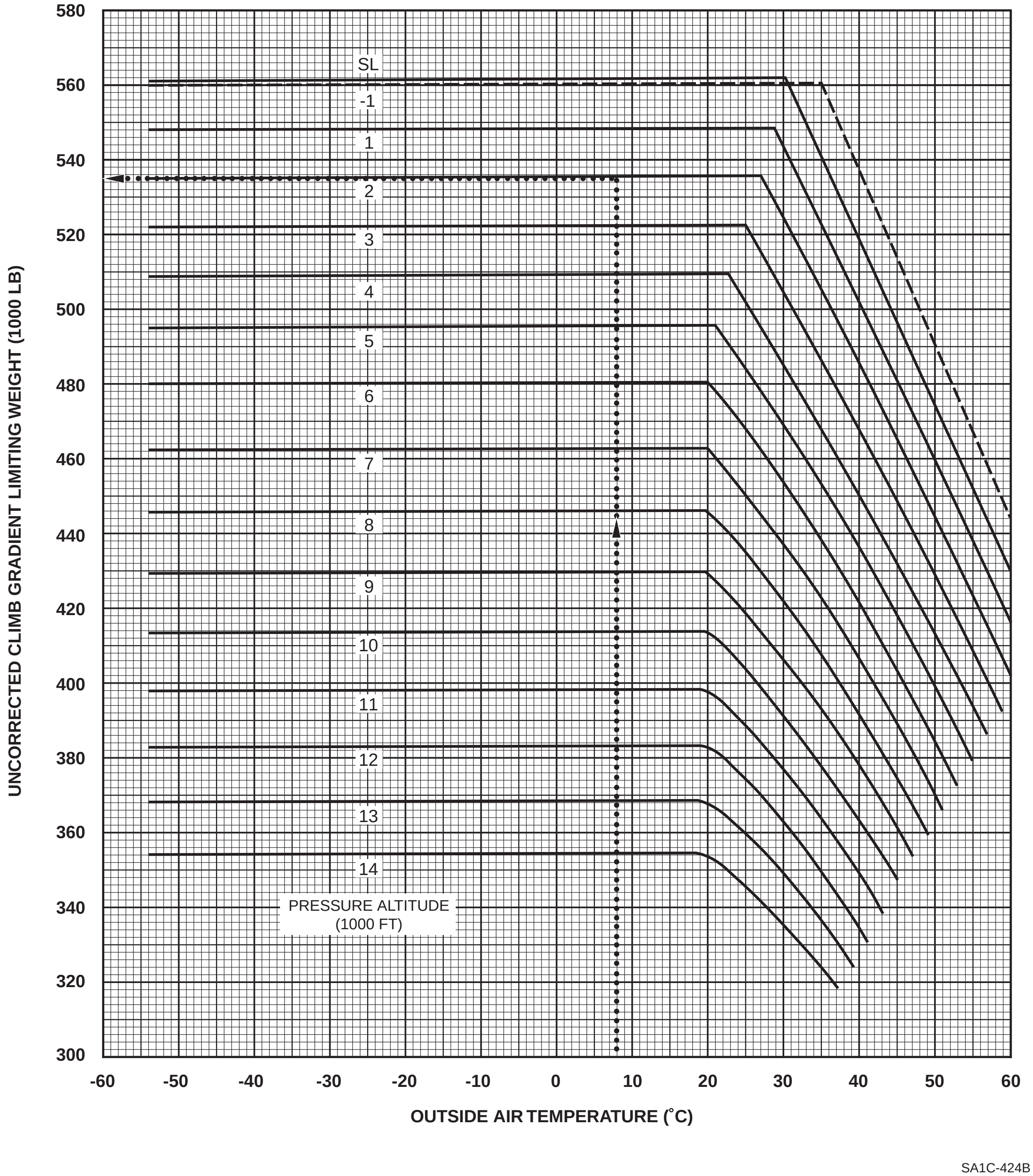


Figure 12-33E. (Sheet 5)

MAXIMUM TAKEOFF GROSS WEIGHT AT OPTIMUM TAKEOFF FLAP SETTING RSC = 0.50 IN/NO REVERSE THRUST

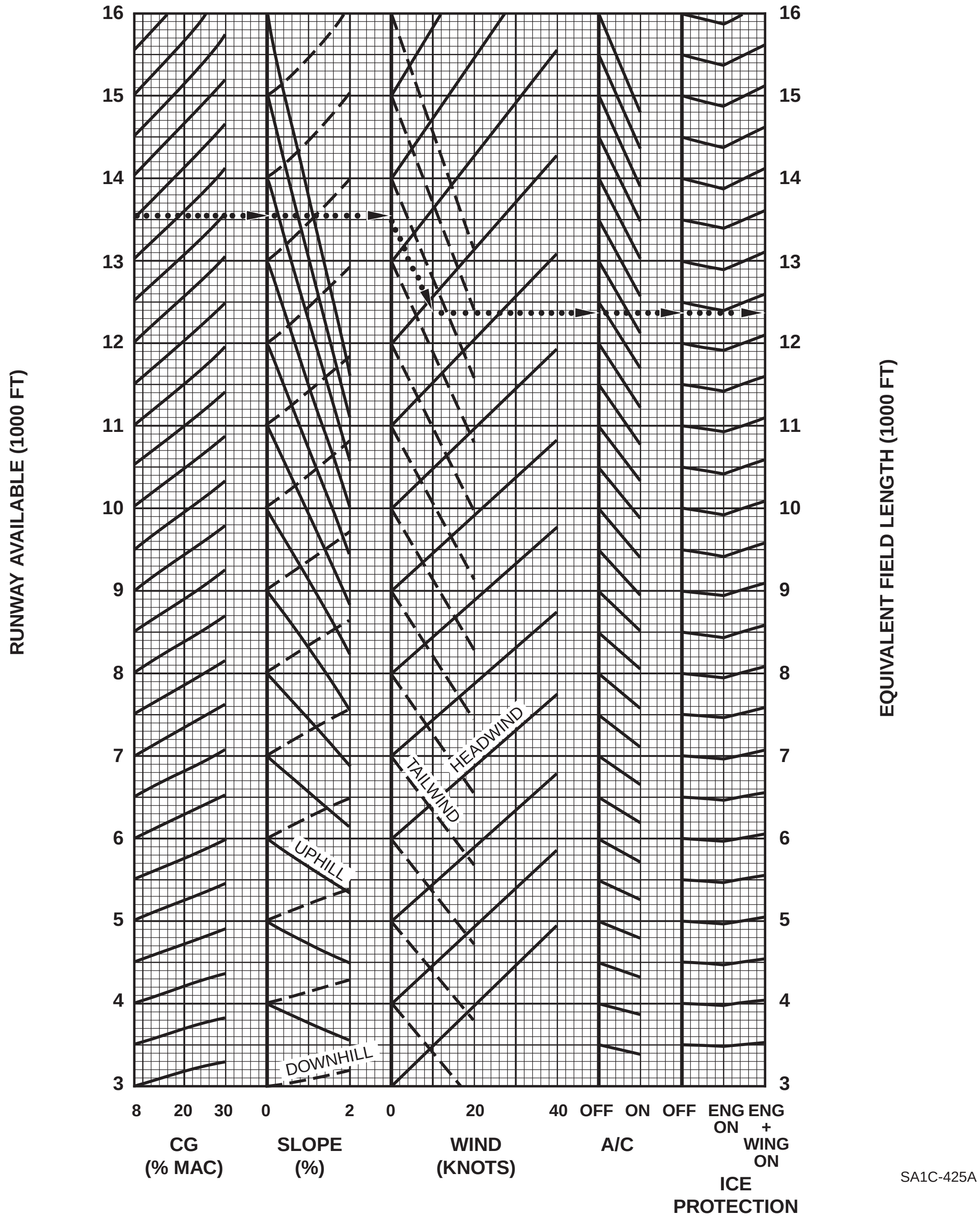


Figure 12-33F. (Sheet 1)

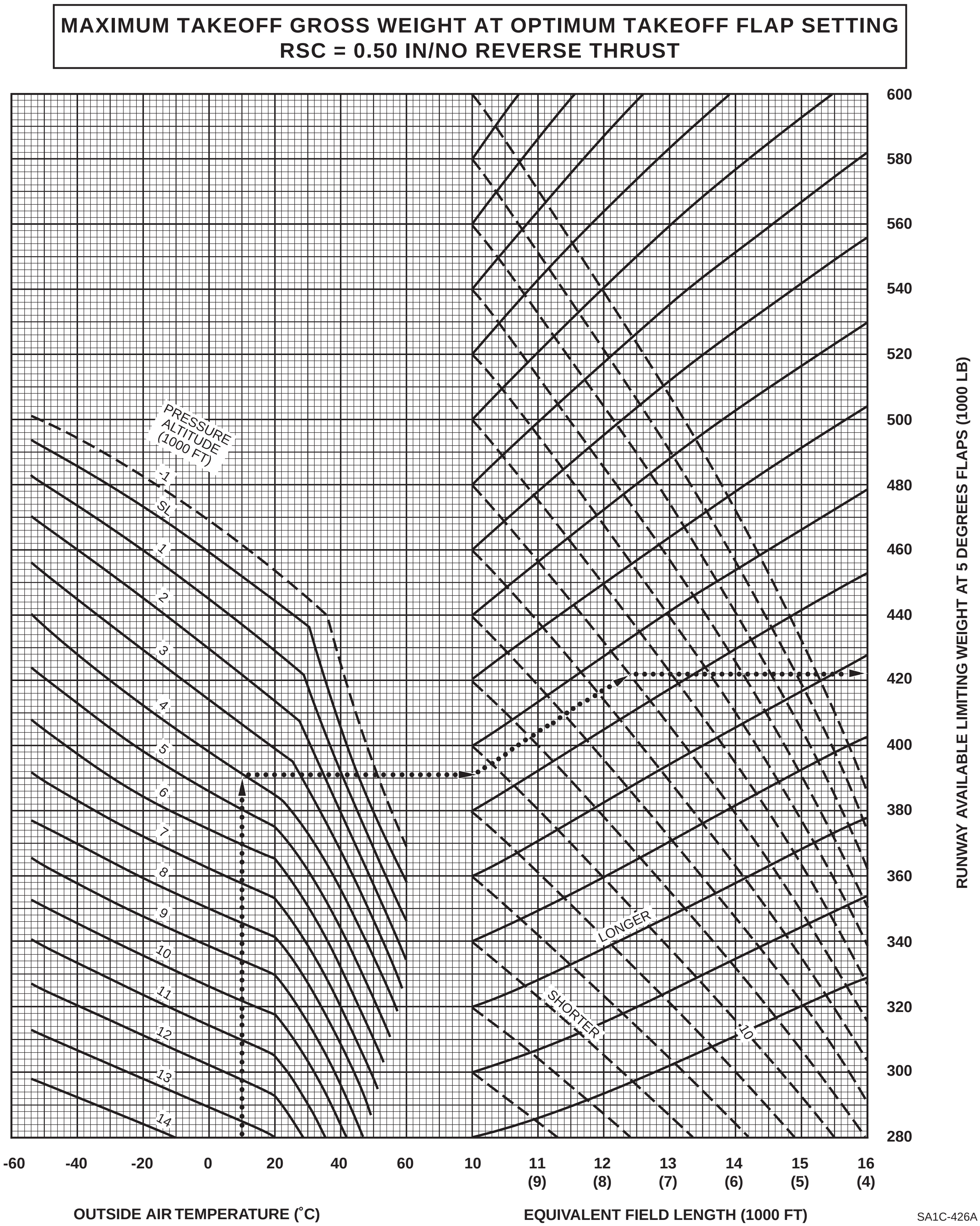


Figure 12-33F. (Sheet 2)

MAXIMUM TAKEOFF GROSS WEIGHT AT OPTIMUM TAKEOFF FLAP SETTING
RSC = 0.50 IN/NO REVERSE THRUST

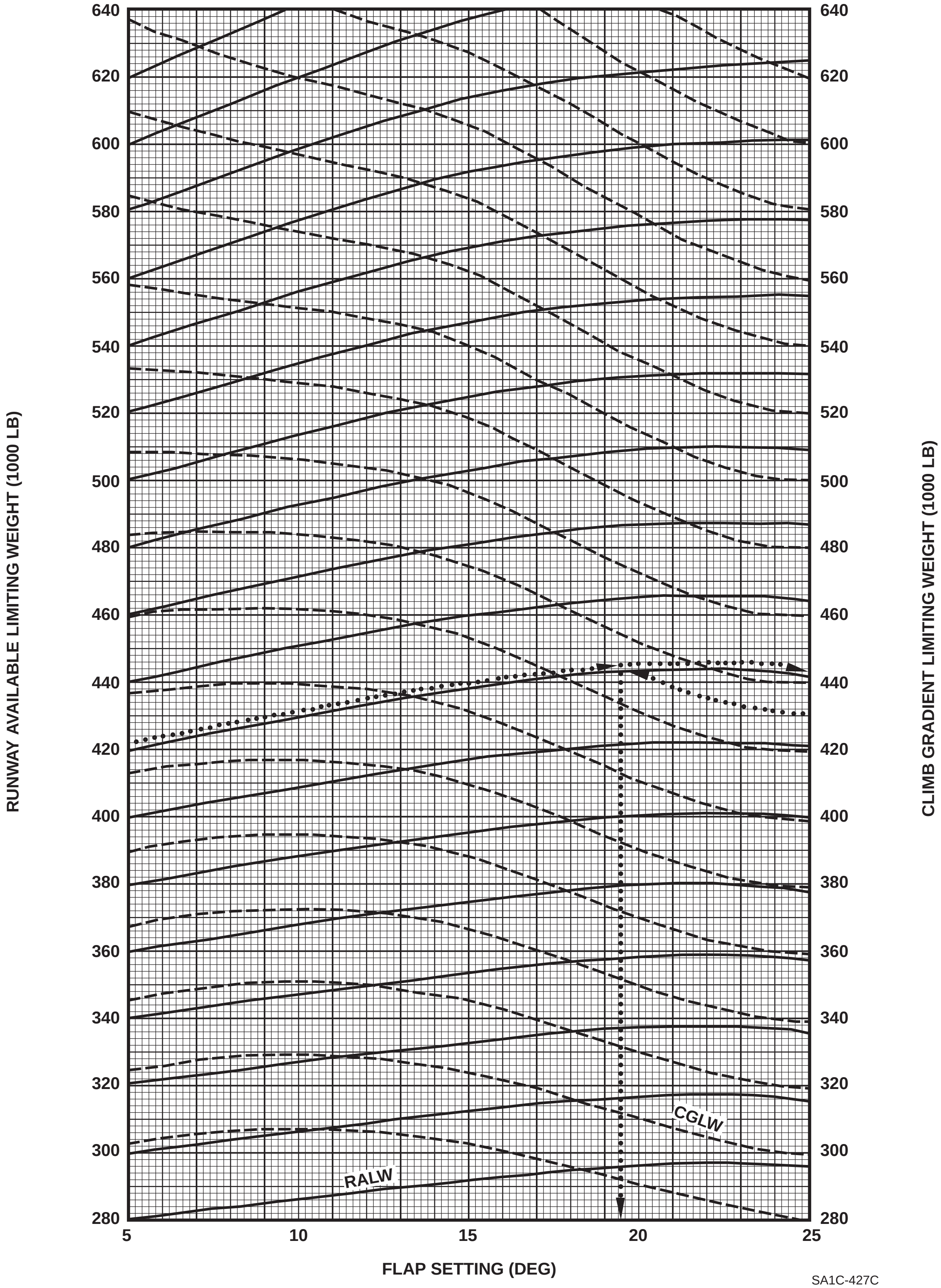


Figure 12-33F. (Sheet 3)

MAXIMUM TAKEOFF GROSS WEIGHT AT OPTIMUM TAKEOFF FLAP SETTING RSC = 0.50 IN/NO REVERSE THRUST

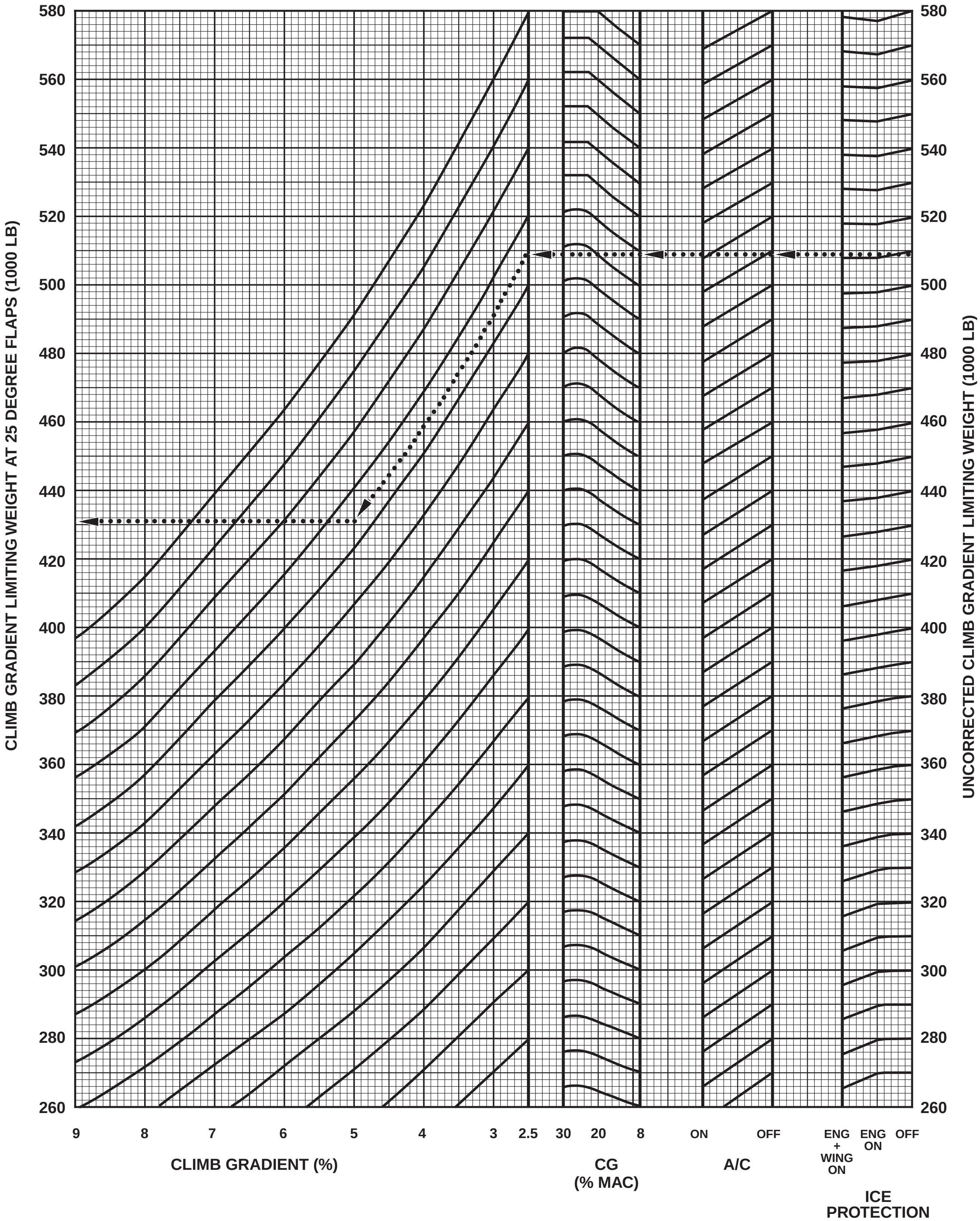


Figure 12-33F. (Sheet 4)

MAXIMUM TAKEOFF GROSS WEIGHT AT OPTIMUM TAKEOFF FLAP SETTING
RSC = 0.50 IN/NO REVERSE THRUST

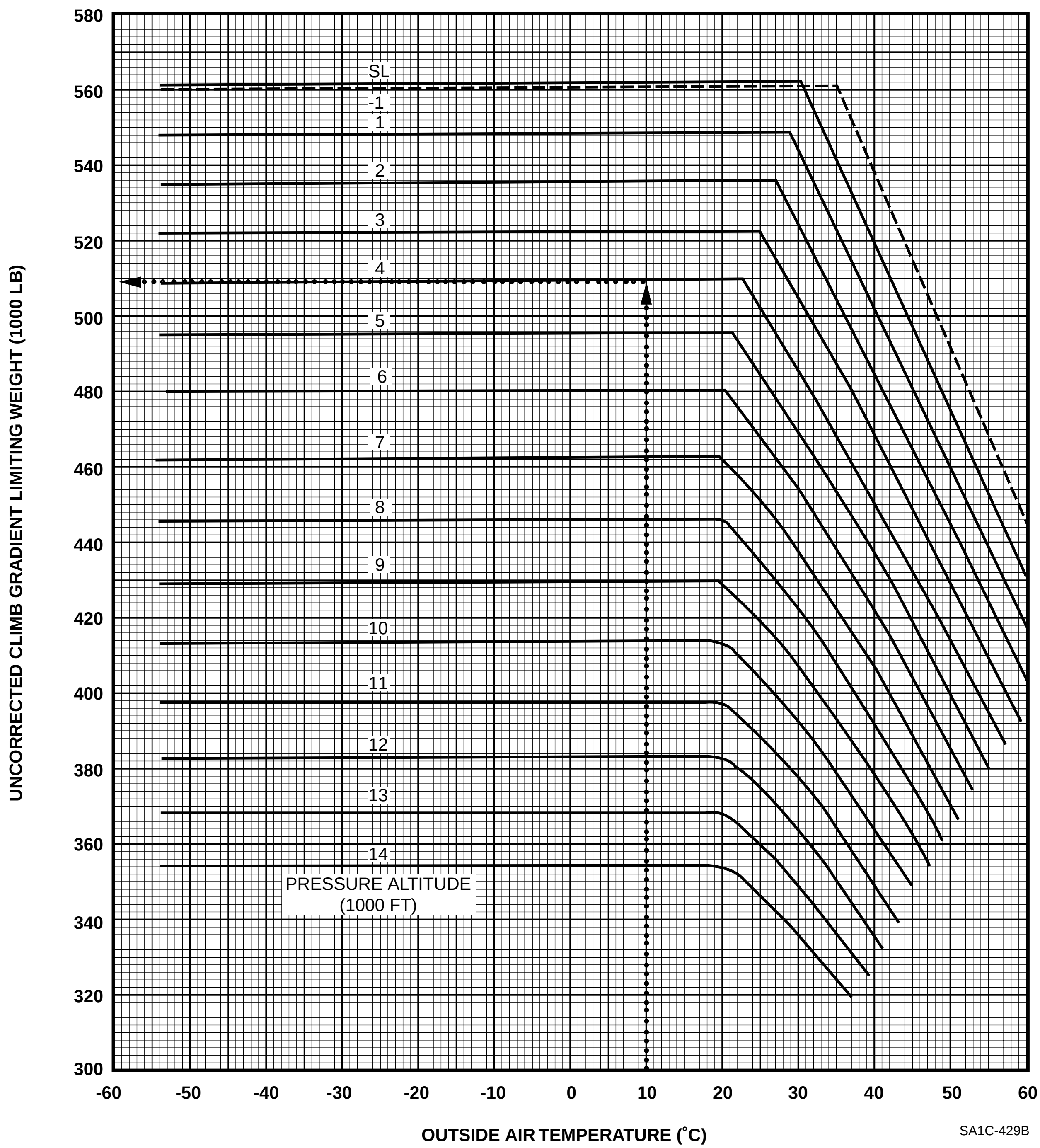
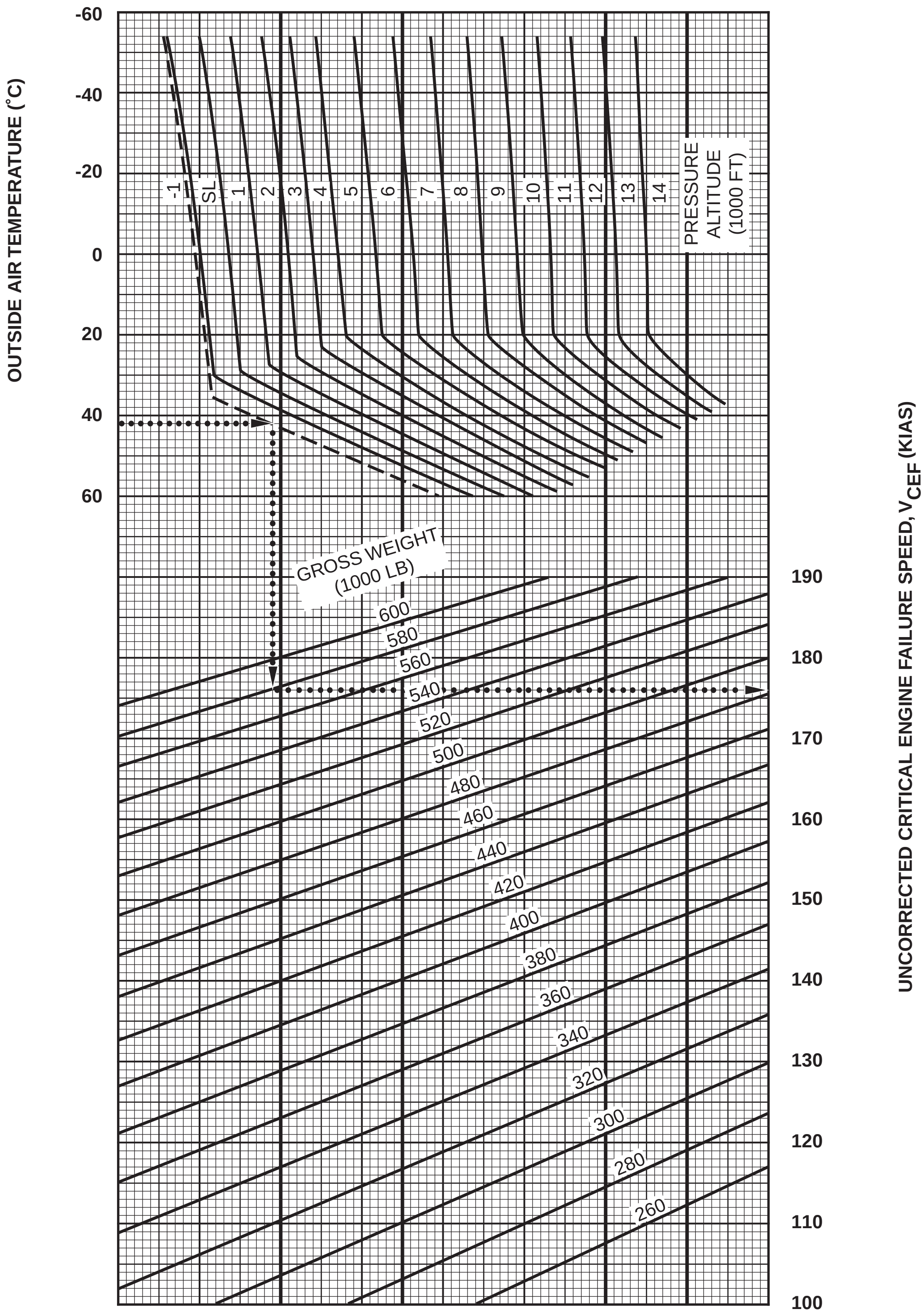


Figure 12-33F. (Sheet 5)

CRITICAL ENGINE FAILURE SPEED, V_{CEF}
RCR = 23 TO 18/NO REVERSE THRUST



SA1C-459A

Figure 12-34A. (Sheet 1)

CRITICAL ENGINE FAILURE SPEED, V_{CEF}
RCR = 23 TO 18/NO REVERSE THRUST

NOTE: DO NOT MAKE RCR CORRECTION WHEN CFCC IS USED

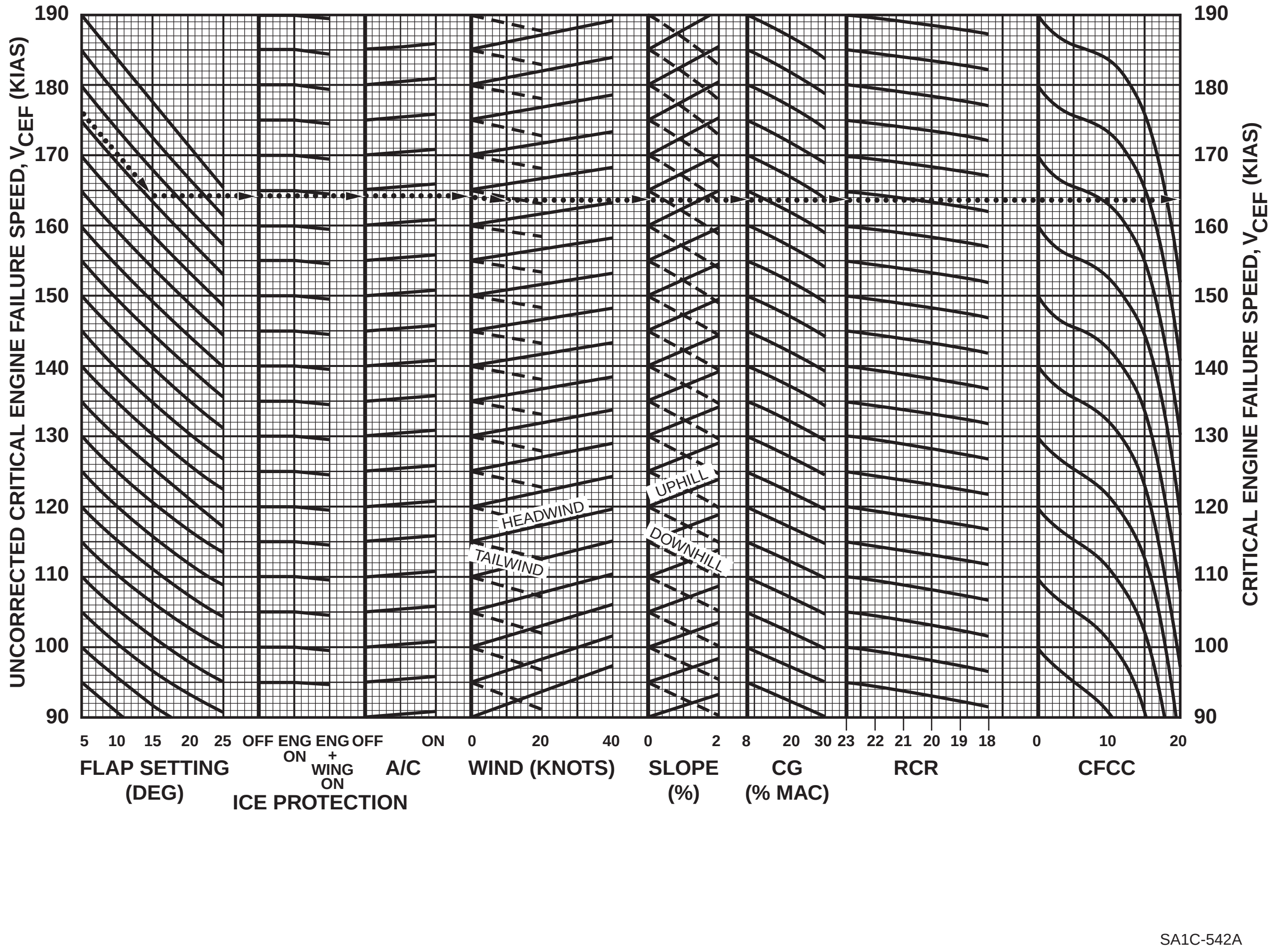


Figure 12-34A. (Sheet 2)

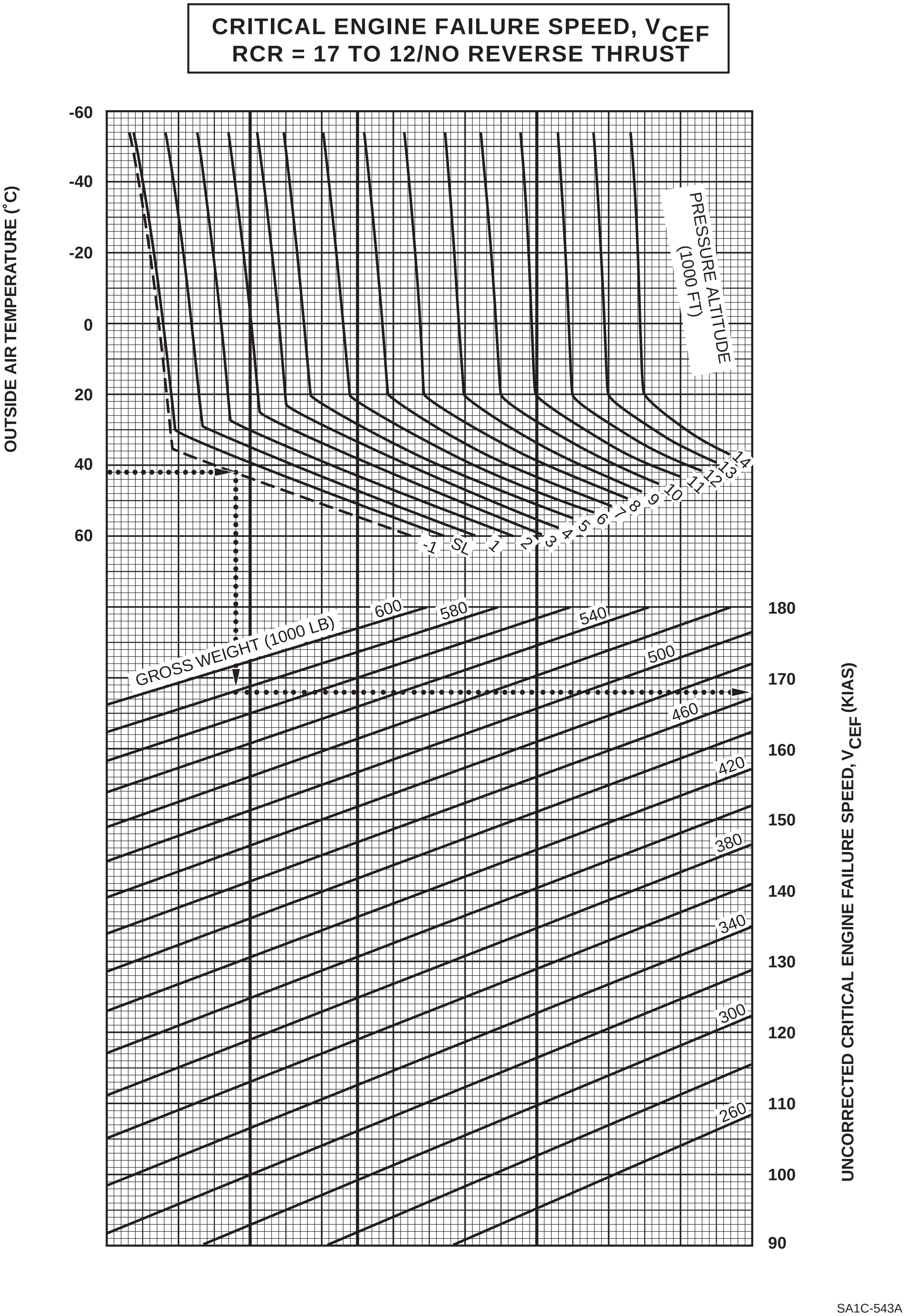


Figure 12-34B. (Sheet 1)

CRITICAL ENGINE FAILURE SPEED, V_{CEF}
RCR = 17 TO 12/NO REVERSE THRUST

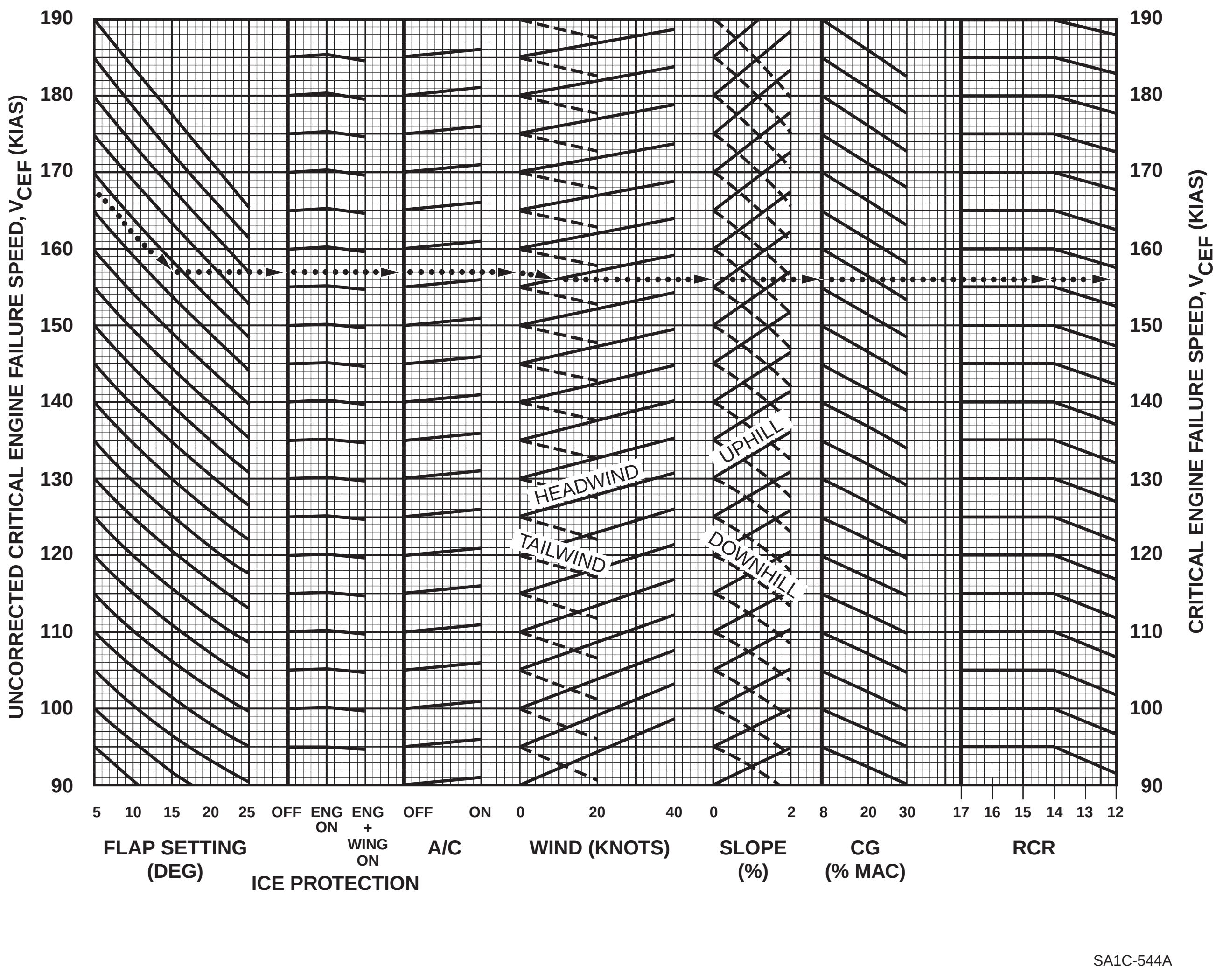


Figure 12-34B. (Sheet 2)

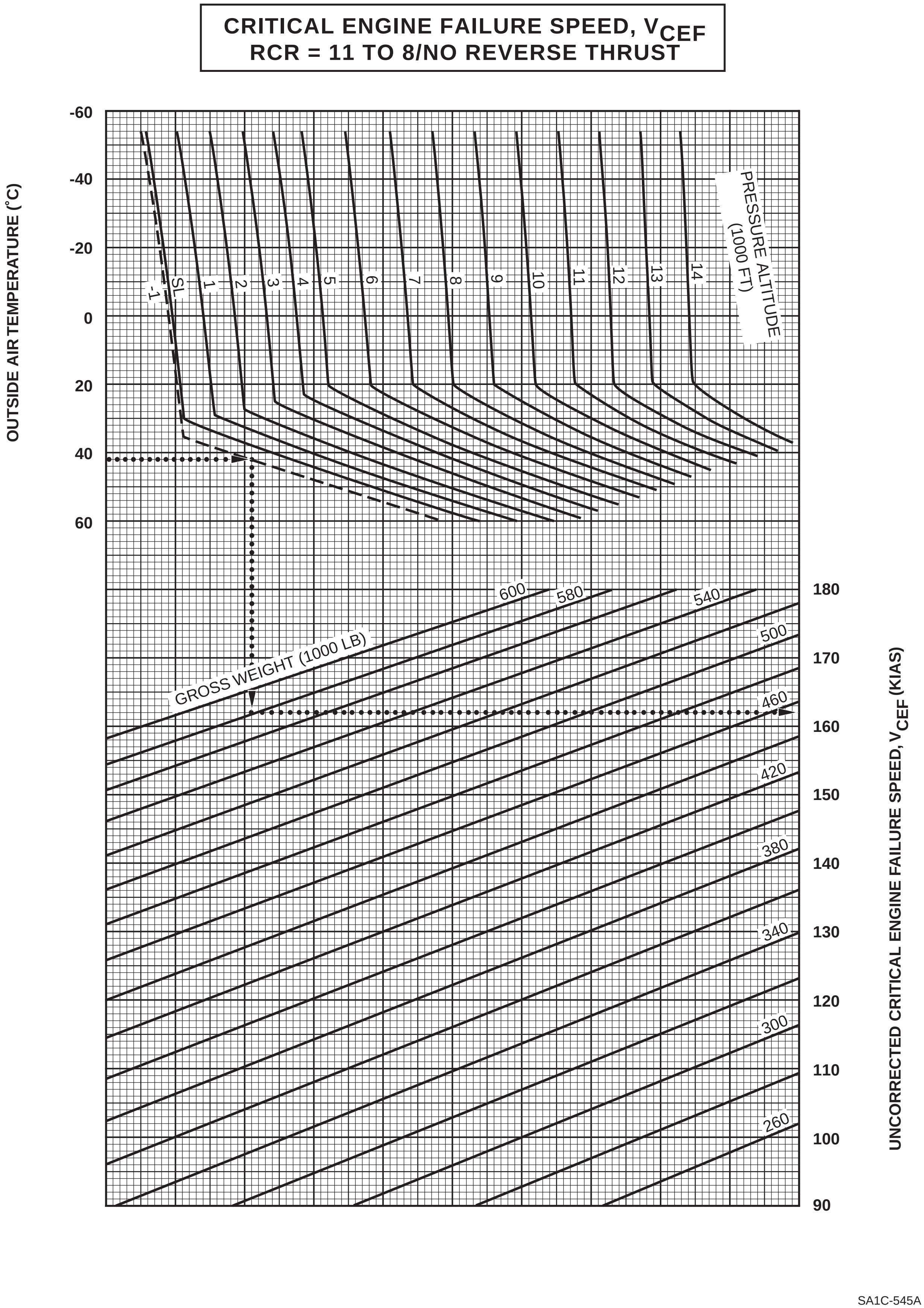


Figure 12-34C. (Sheet 1)

CRITICAL ENGINE FAILURE SPEED, V_{CEF}
RCR = 11 TO 8/NO REVERSE THRUST

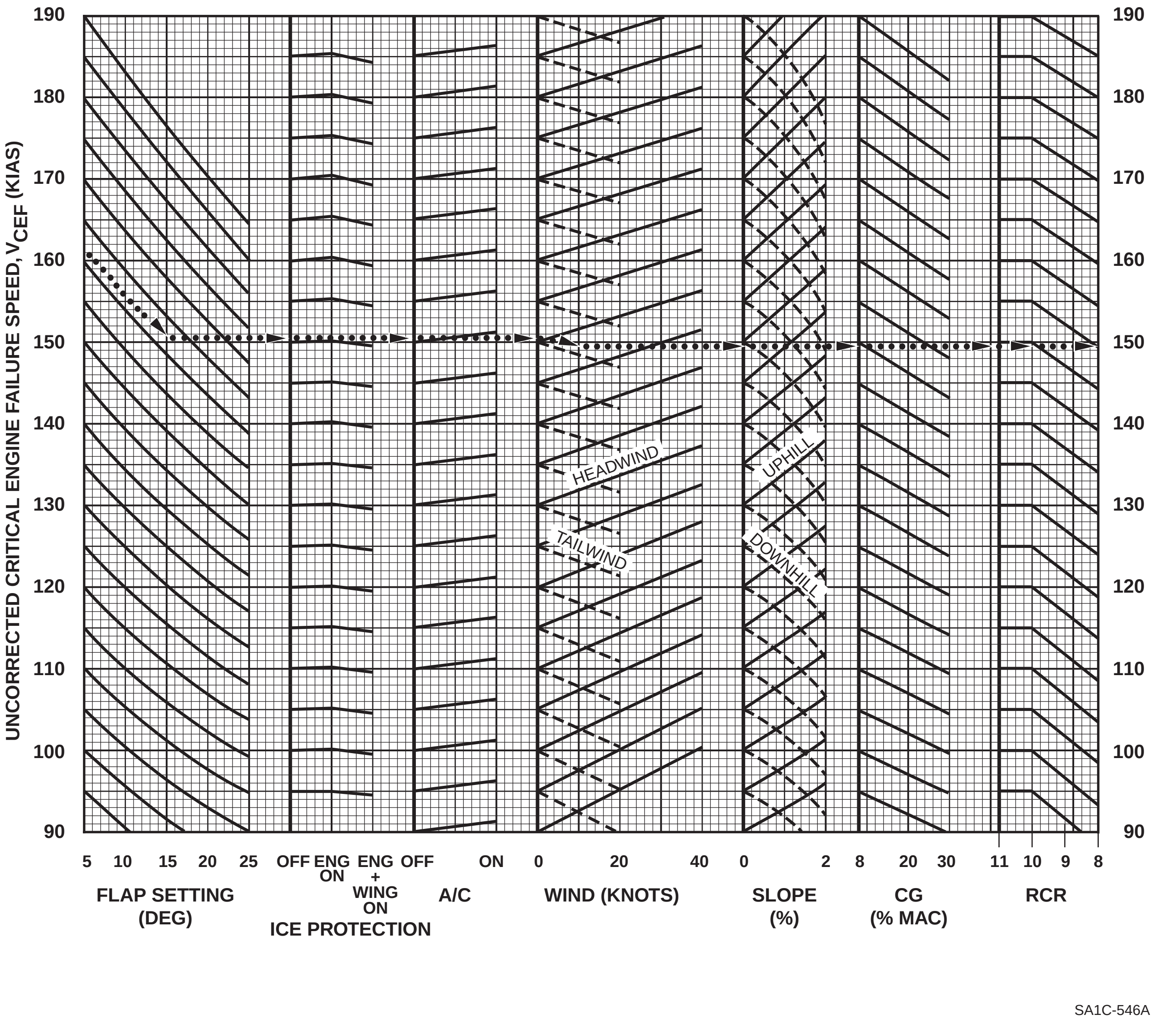


Figure 12-34C. (Sheet 2)

CRITICAL ENGINE FAILURE SPEED, V_{CEF}
RCR = 7 TO 3/NO REVERSE THRUST

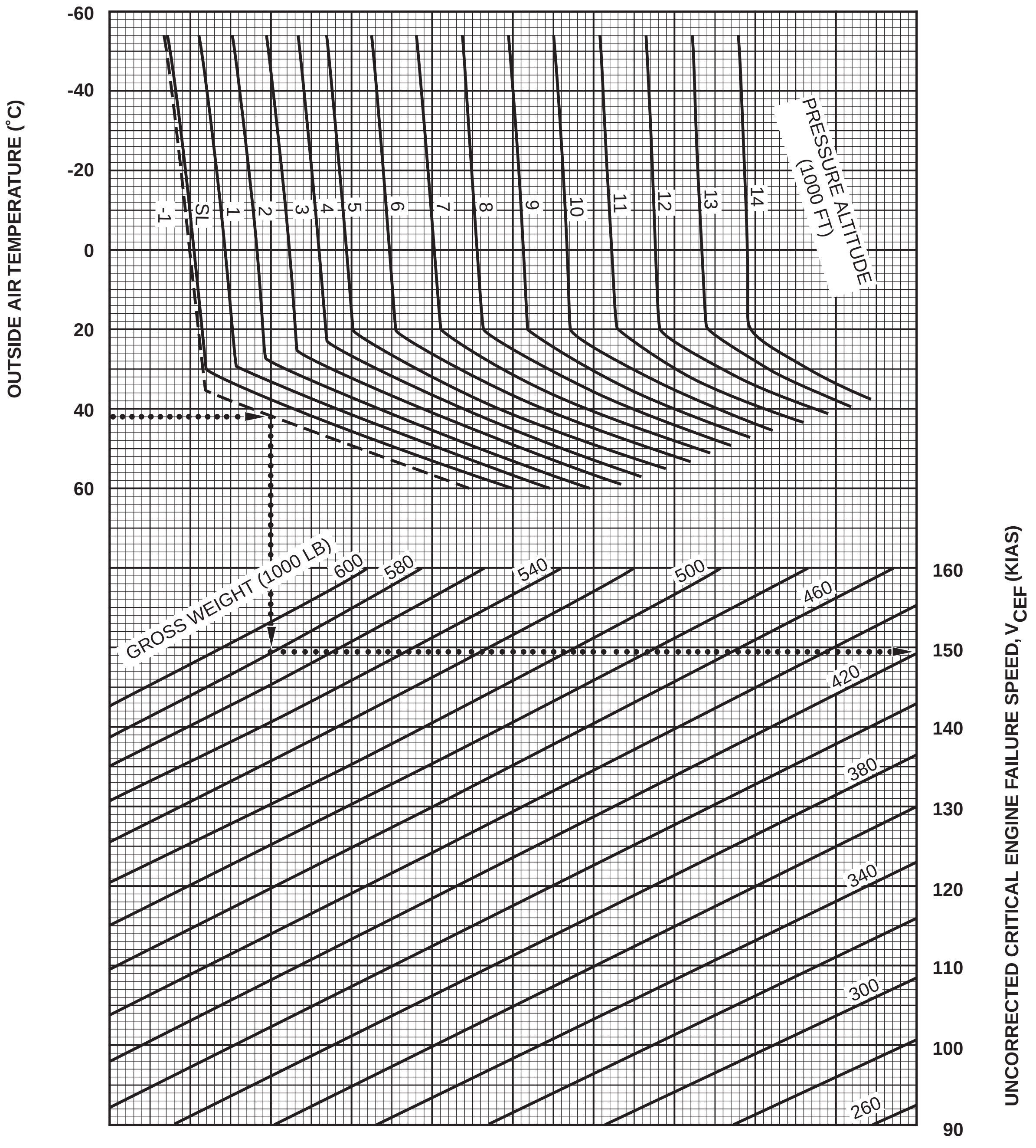


Figure 12-34D. (Sheet 1)

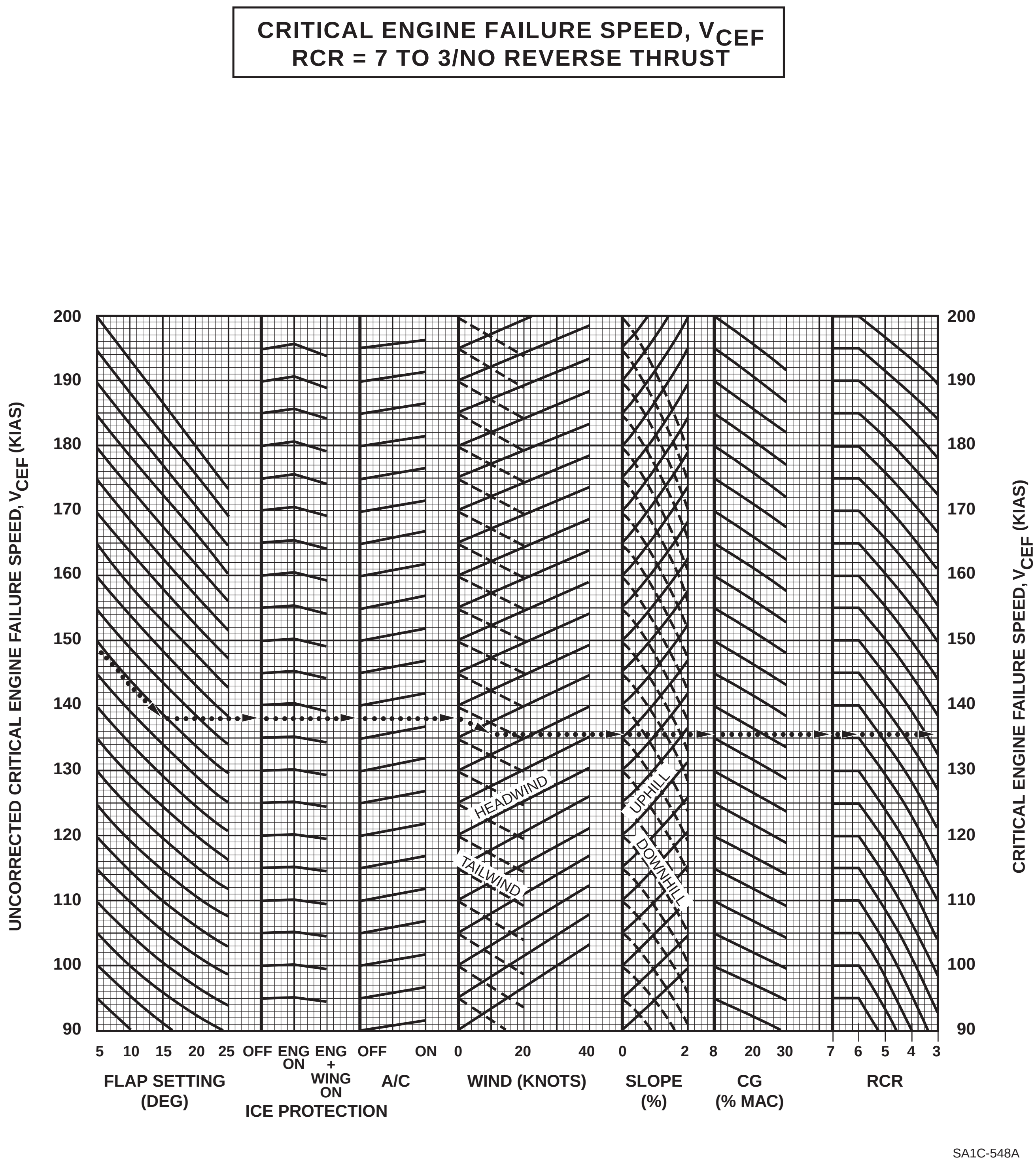


Figure 12-34D. (Sheet 2)

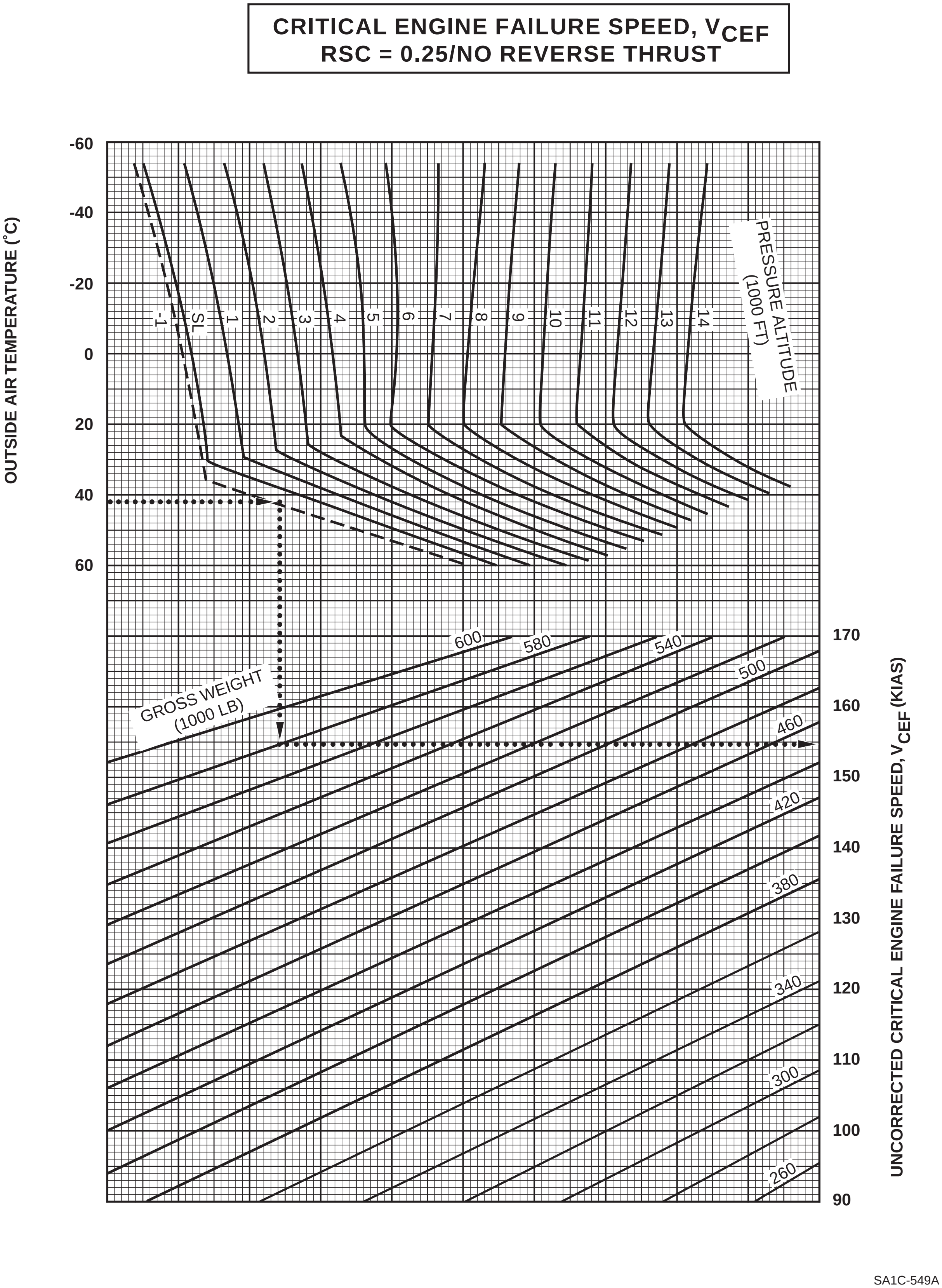


Figure 12-34E. (Sheet 1)

CRITICAL ENGINE FAILURE SPEED, V_{CEF}
RSC = 0.25 IN/NO REVERSE THRUST

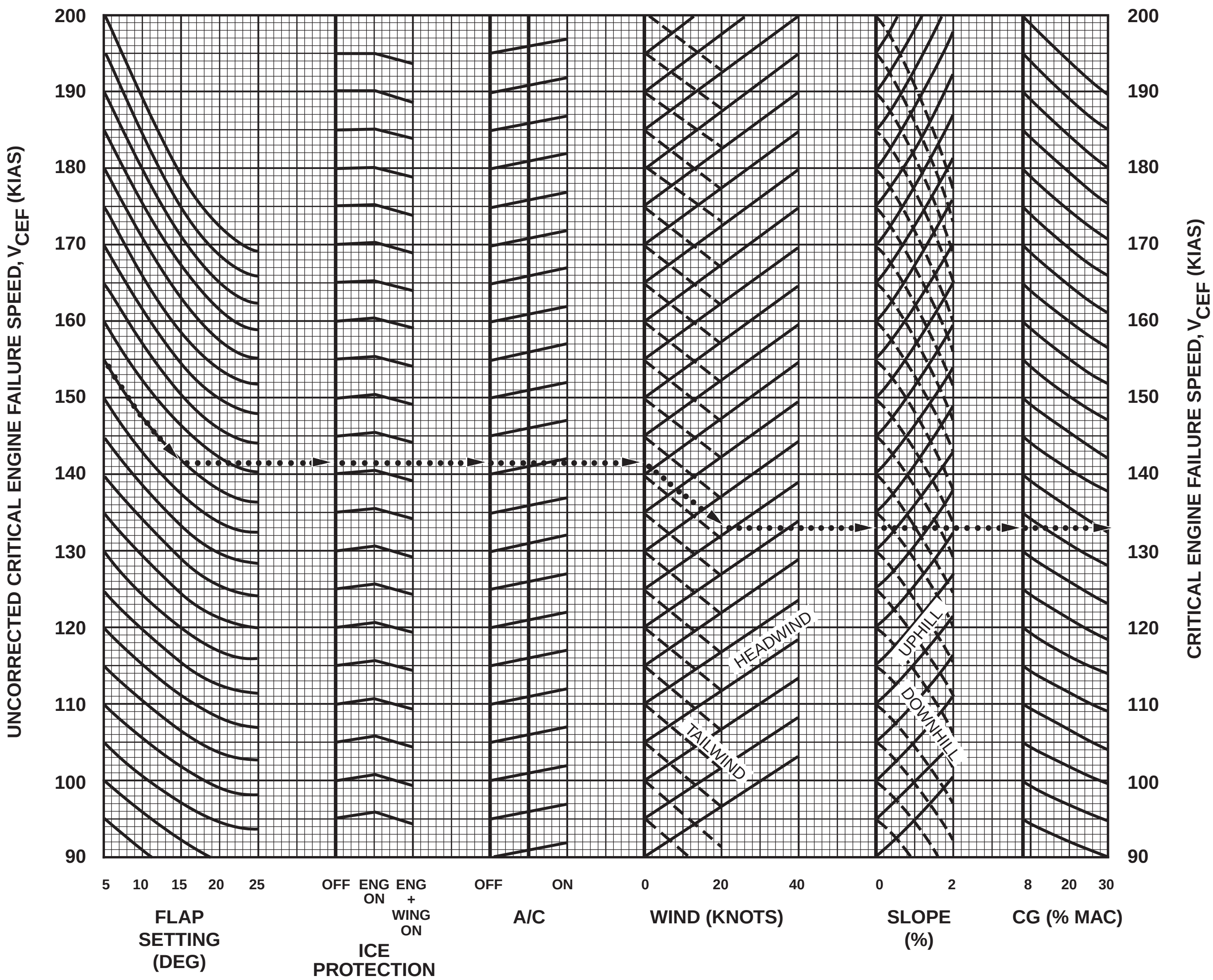


Figure 12-34E. (Sheet 2)

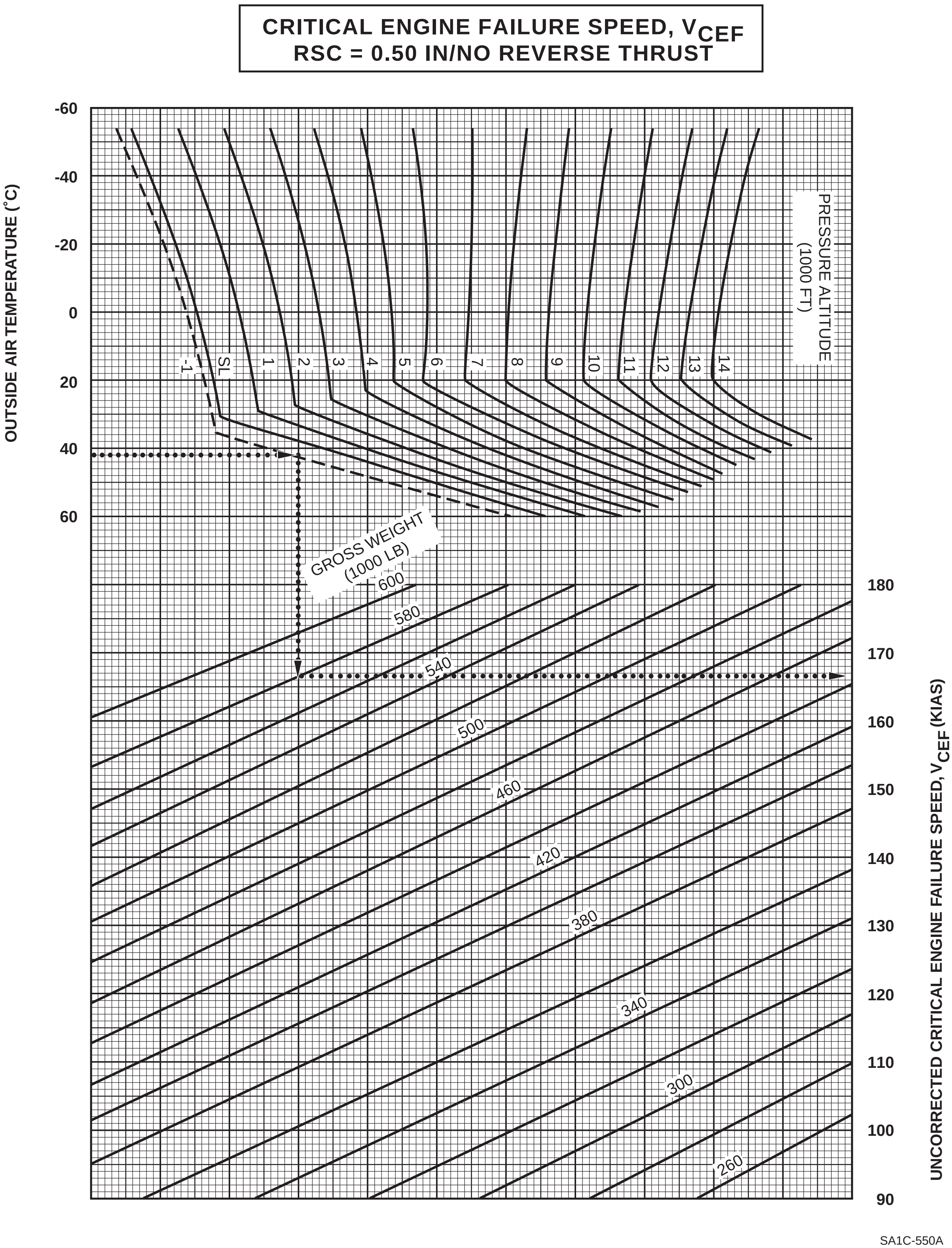


Figure 12-34F. (Sheet 1)

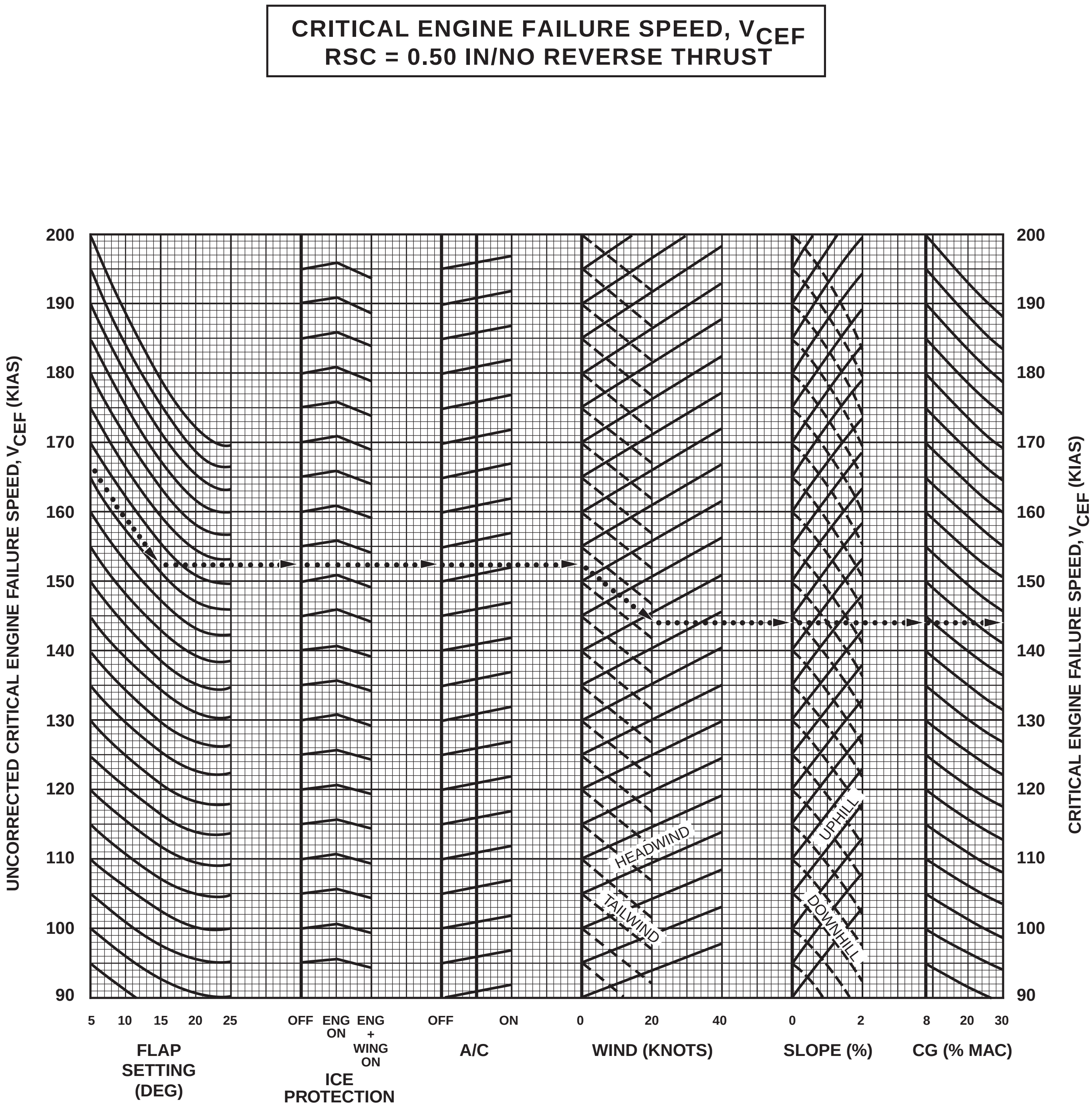


Figure 12-34F. (Sheet 2)

MAXIMUM ALLOWABLE WEIGHT WHEN $V_1 = V_{MCG}$
RCR = 23 TO 18/NO REVERSE THRUST

NOTE: APPLICABLE FOR ALL FLAP SETTINGS.

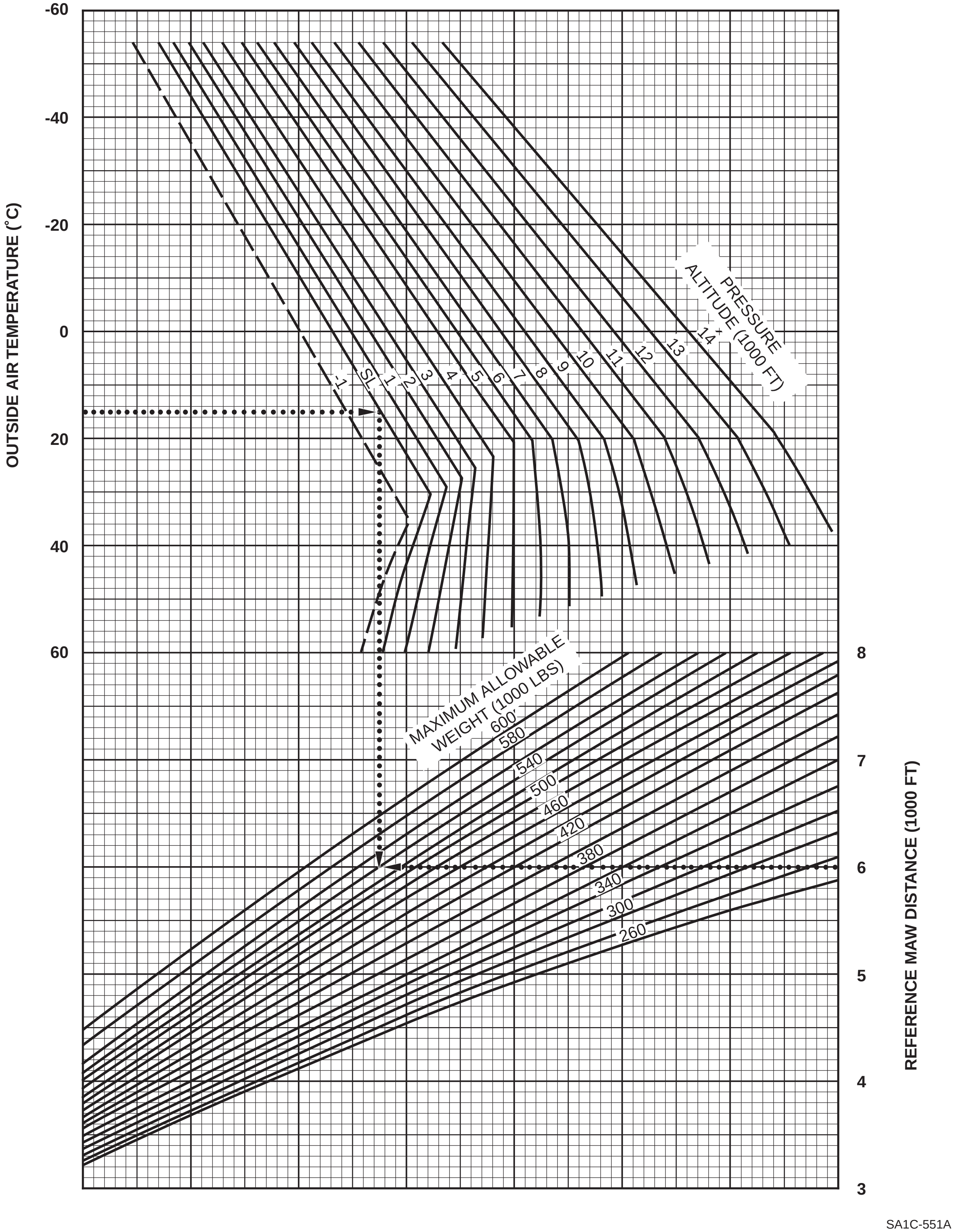


Figure 12-35A. (Sheet 1)

MAXIMUM ALLOWABLE WEIGHT WHEN $V_1 = V_{MCG}$
RCR = 23 TO 18/NO REVERSE THRUST

NOTE:

1. IF ACTUAL RCR IS GREATER THAN OR EQUAL TO 10, AND CROSSWIND COMPONENT IS LESS THAN OR EQUAL TO 10 KNOTS, USE CFCC A.
2. IF ACTUAL RCR IS LESS THAN 10, AND/OR CROSSWIND COMPONENT IS GREATER THAN 10 KNOTS, USE CFCC B.
3. DO NOT MAKE RCR CORRECTION WHEN CFCC IS USED.
4. IF CROSSWIND COMPONENT IS GREATER THAN 10 KNOTS, CORRECT RUNWAY AVAILABLE USING SHEET 3 BEFORE ENTERING SHEET 2. DO NOT MAKE THIS CORRECTION WHEN CFCC IS USED.

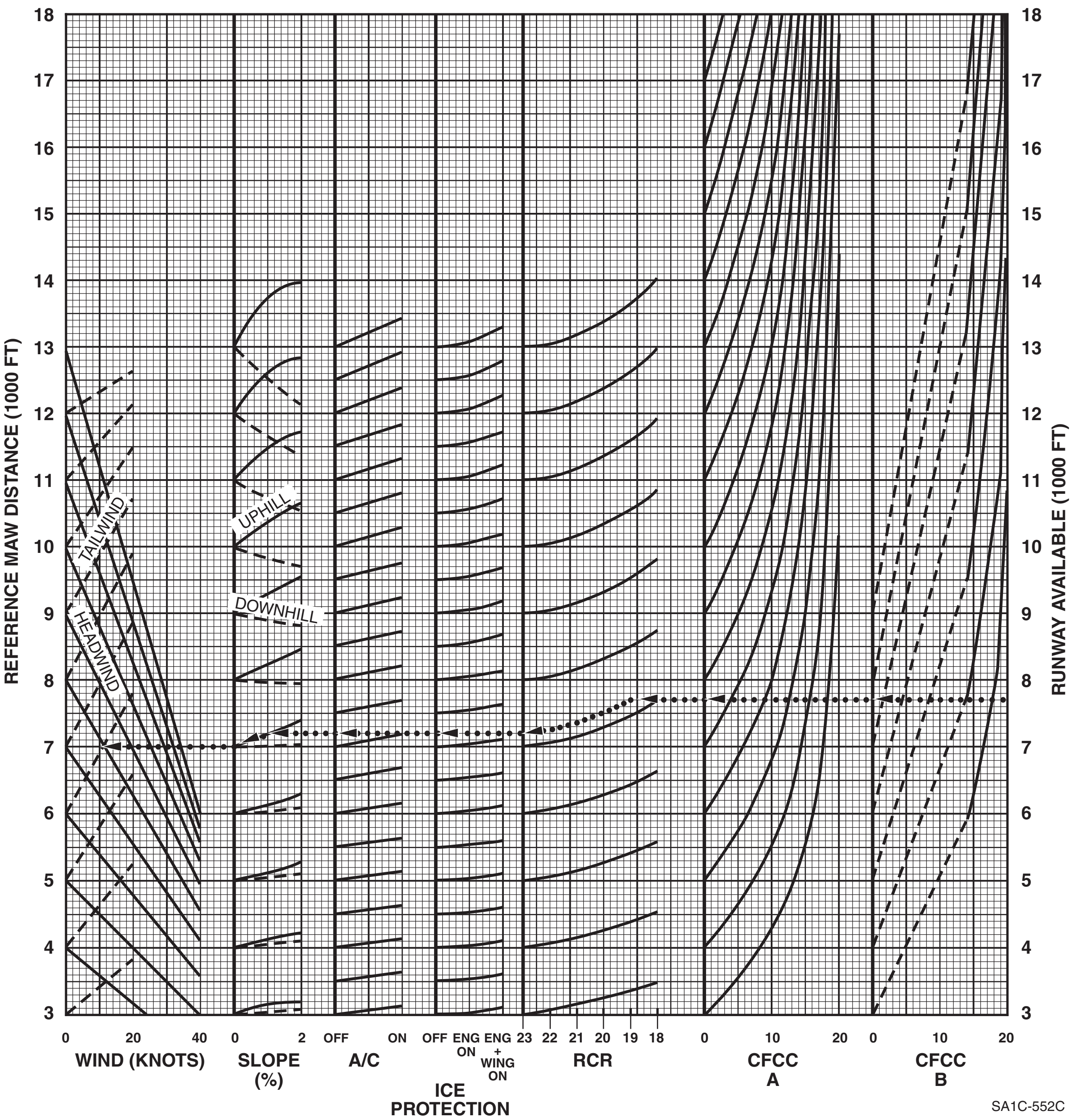


Figure 12-35A. (Sheet 2)

MAXIMUM ALLOWABLE WEIGHT WHEN $V_1 = V_{MCG}$
RCR = 23 TO 18/NO REVERSE THRUST

NOTE: CORRECTION NOT REQUIRED IF CROSSWIND COMPONENT IS LESS THAN OR EQUAL TO 10 KNOTS, OR IF CFCC IS USED.

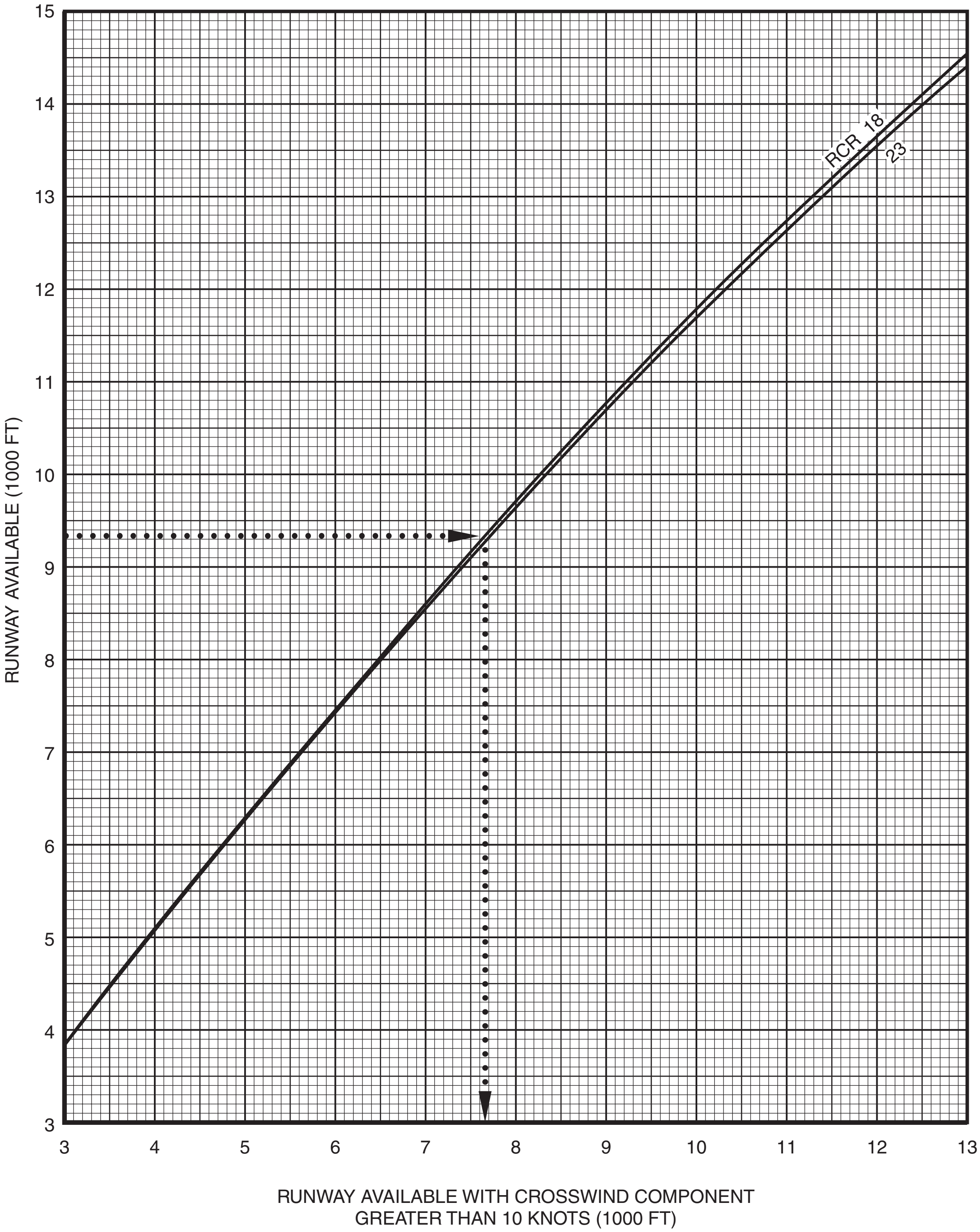


Figure 12-35A. (Sheet 3)

MAXIMUM ALLOWABLE WEIGHT WHEN $V_1 = V_{MCG}$
RCR = 17 TO 12/NO REVERSE THRUST

NOTE: APPLICABLE FOR ALL FLAP SETTINGS.

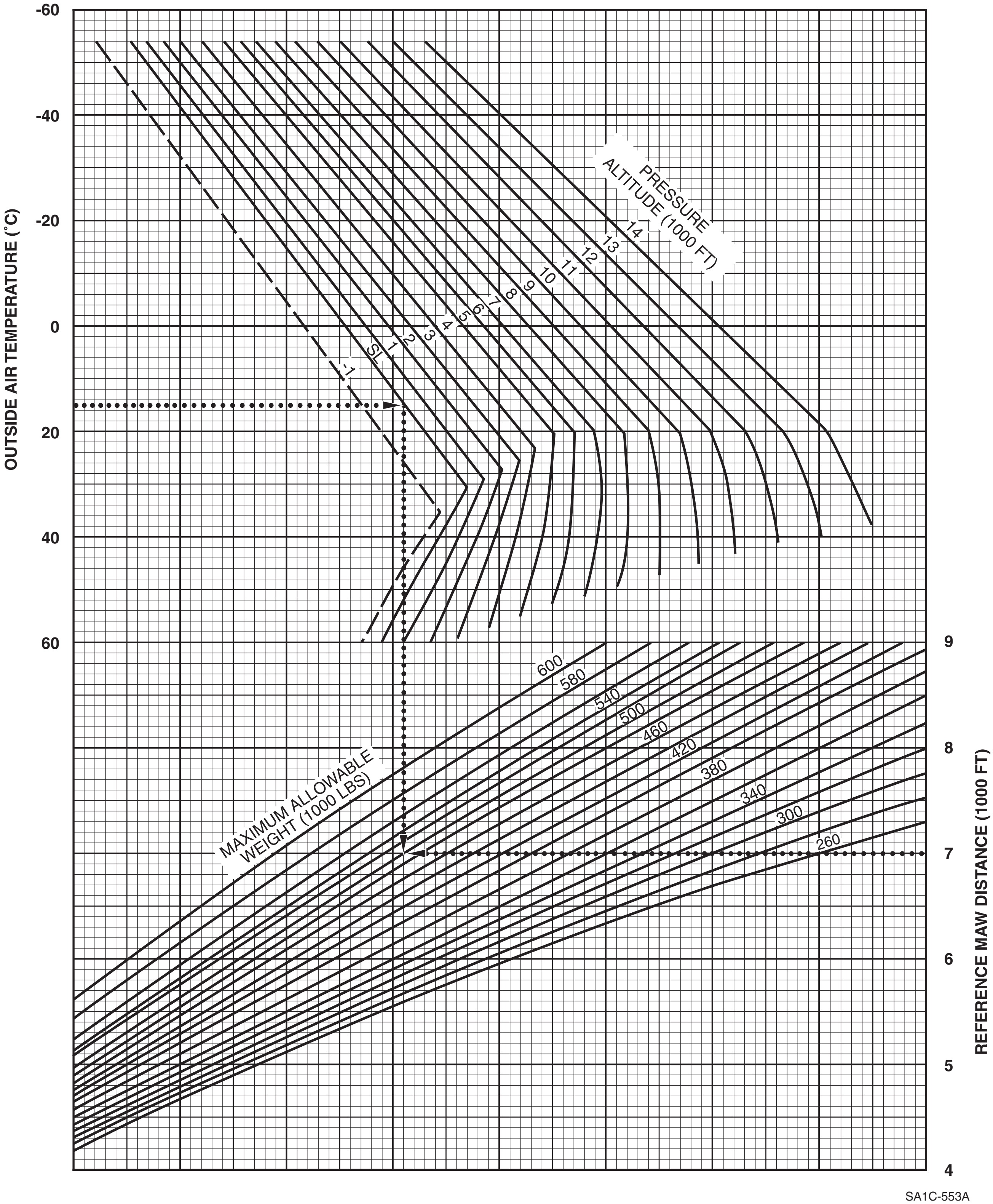


Figure 12-35B. (Sheet 1)

MAXIMUM ALLOWABLE WEIGHT WHEN $V_1 = V_{MCG}$
RCR = 17 TO 12/NO REVERSE THRUST

NOTE: IF CROSSWIND COMPONENT IS GREATER THAN 10 KNOTS, CORRECT RUNWAY AVAILABLE USING SHEET 3 BEFORE ENTERING SHEET 2.

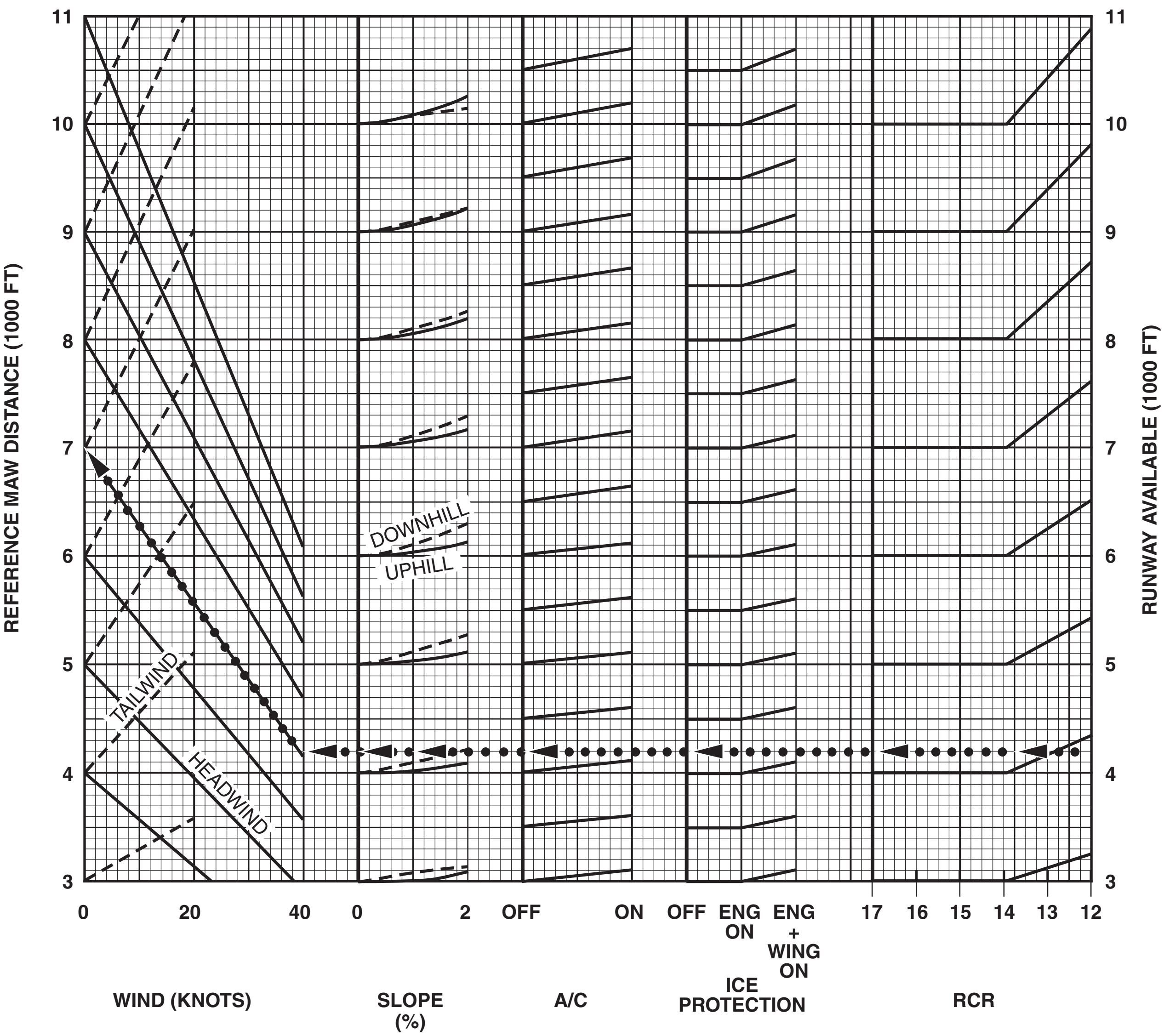


Figure 12-35B. (Sheet 2)

MAXIMUM ALLOWABLE WEIGHT WHEN $V_1 = V_{MCG}$
RCR = 17 TO 12/NO REVERSE THRUST

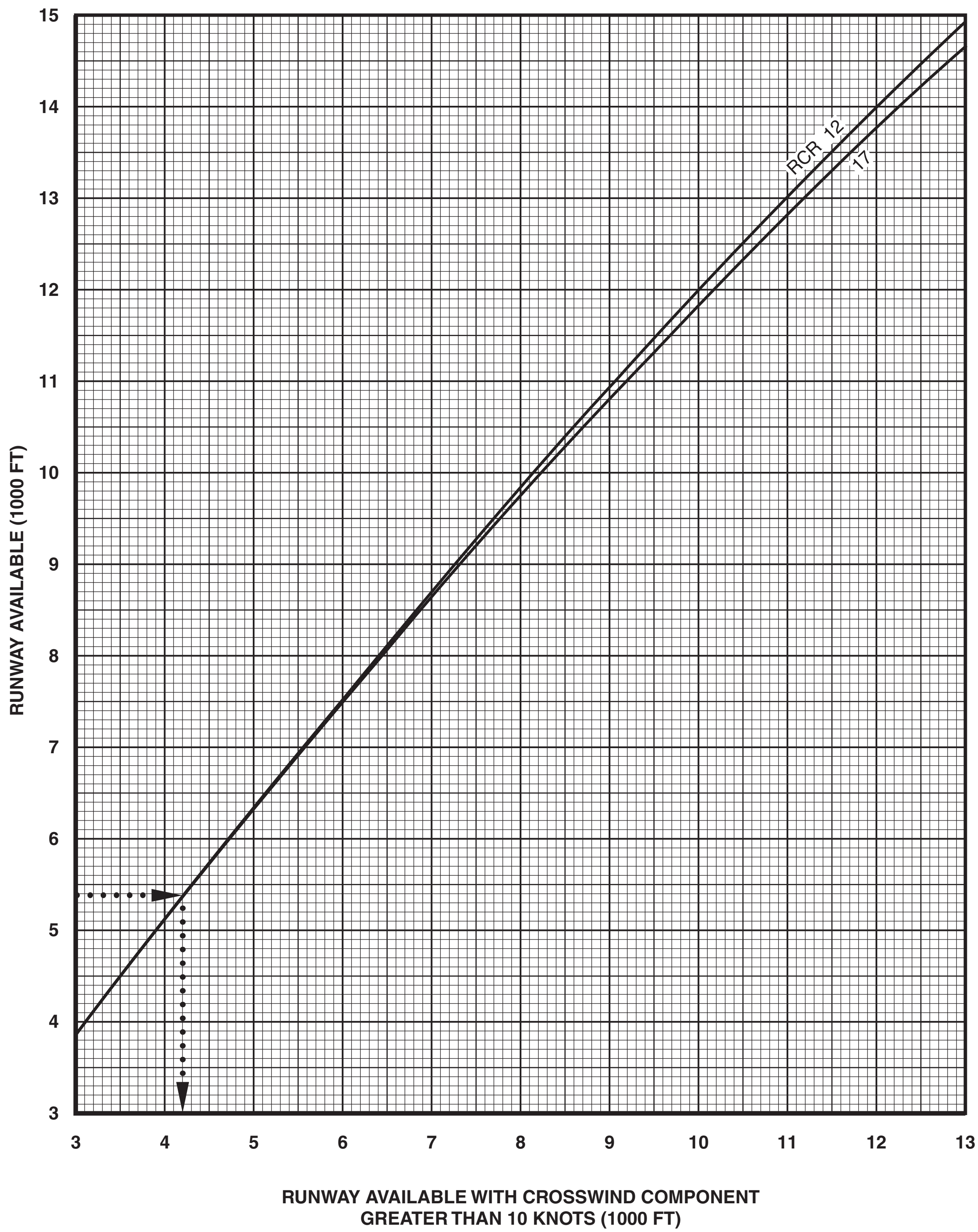


Figure 12-35B. (Sheet 3)

MAXIMUM ALLOWABLE WEIGHT WHEN $V_1 = V_{MCG}$
RCR = 11 TO 8/NO REVERSE THRUST

NOTE: APPLICABLE FOR ALL FLAP SETTINGS.

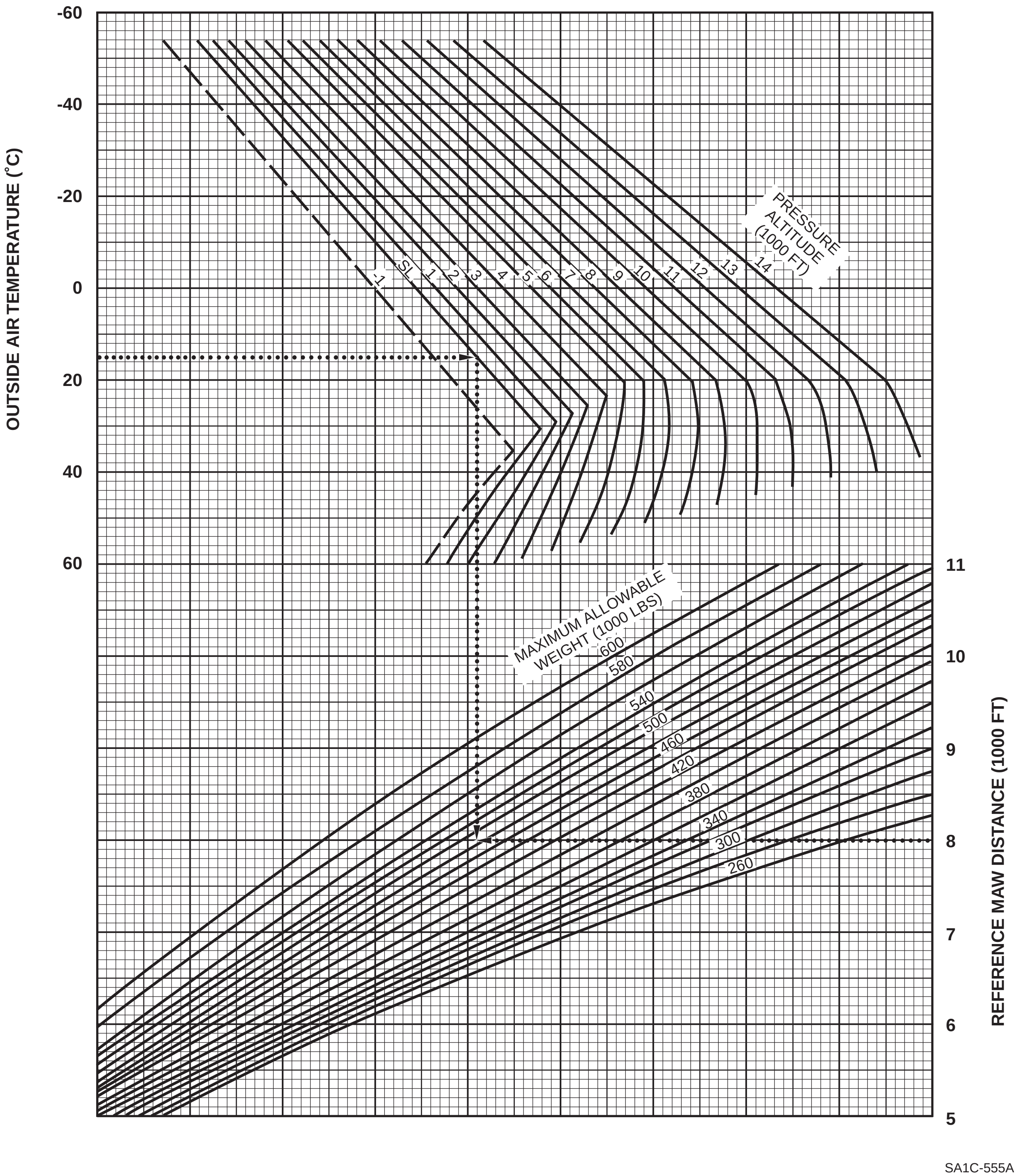


Figure 12-35C. (Sheet 1)

MAXIMUM ALLOWABLE WEIGHT WHEN $V_1 = V_{MCG}$ RCR = 11 TO 8/NO REVERSE THRUST

NOTE: IF CROSSWIND COMPONENT IS GREATER THAN 10 KNOTS, CORRECT RUNWAY AVAILABLE USING SHEET 3 BEFORE ENTERING SHEET 2.

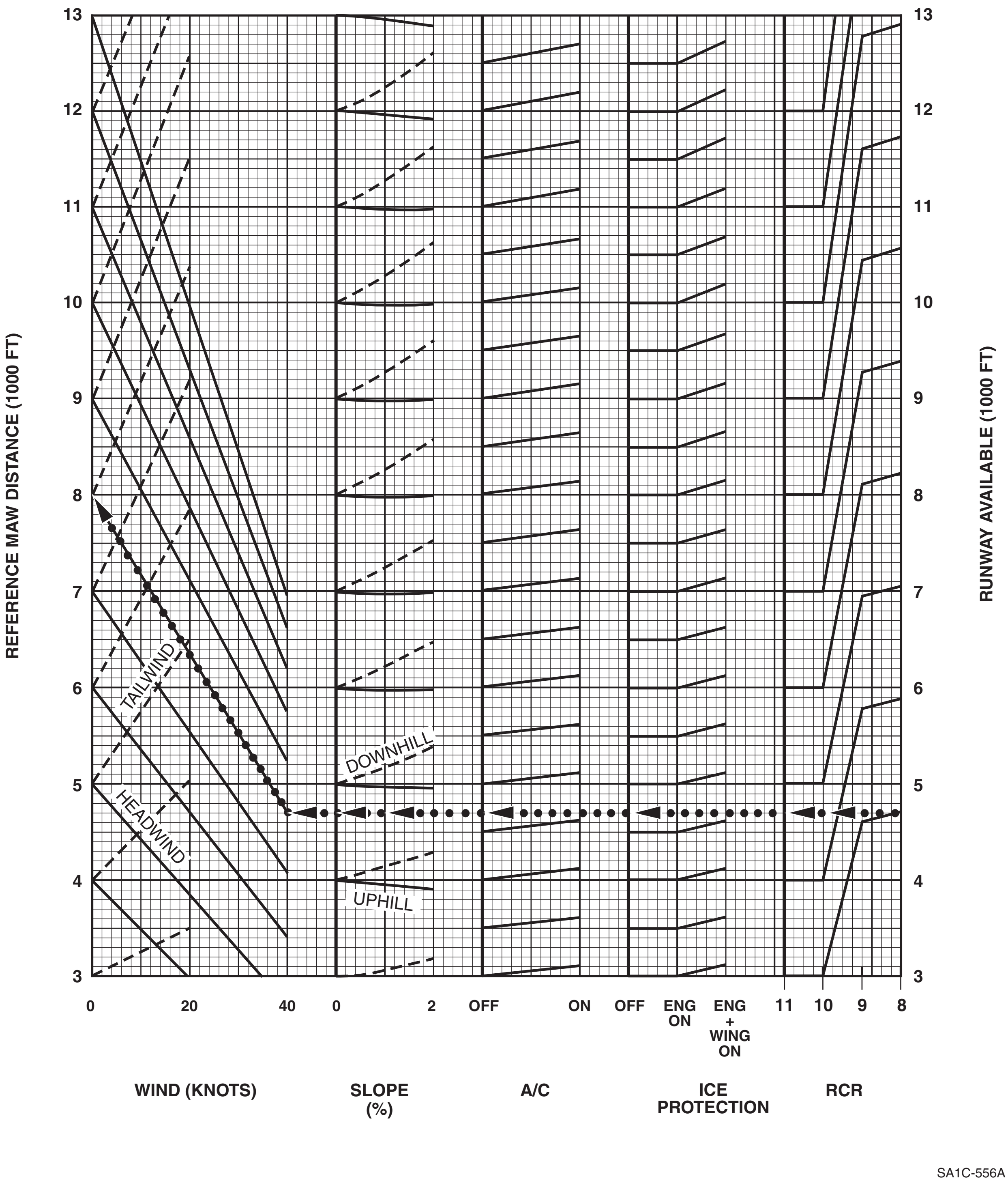


Figure 12-35C. (Sheet 2)

MAXIMUM ALLOWABLE WEIGHT WHEN $V_1 = V_{MCG}$
RCR = 11 TO 8/NO REVERSE THRUST

NOTE: CORRECTION NOT REQUIRED IF CROSSWIND COMPONENT IS LESS THAN OR EQUAL TO 10 KNOTS OR IF RCR IS LESS THAN 10.

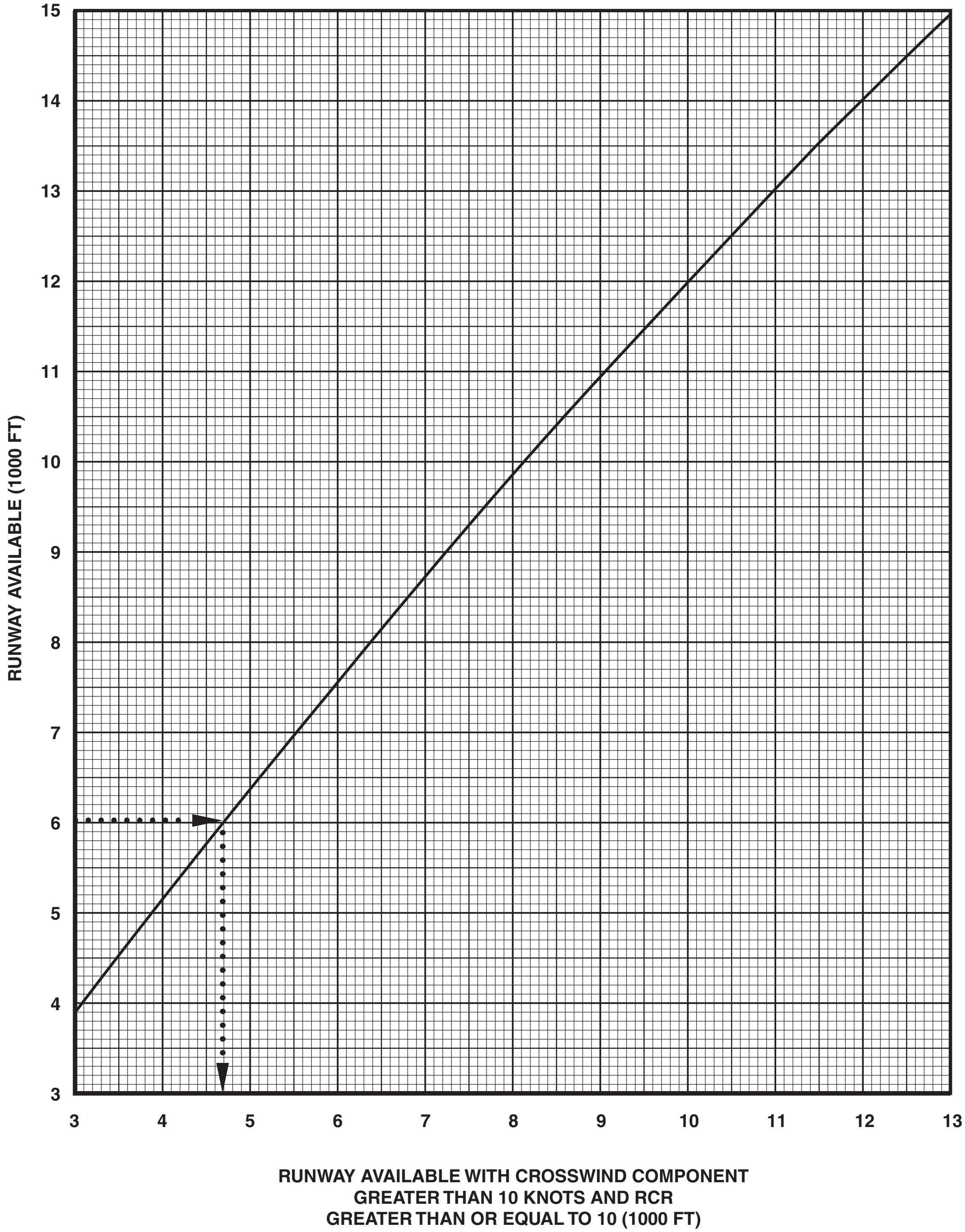


Figure 12-35C. (Sheet 3)

MAXIMUM ALLOWABLE WEIGHT WHEN $V_1 = V_{MCG}$ RCR = 7 TO 3/NO REVERSE THRUST

NOTE: APPLICABLE FOR ALL FLAP SETTINGS.

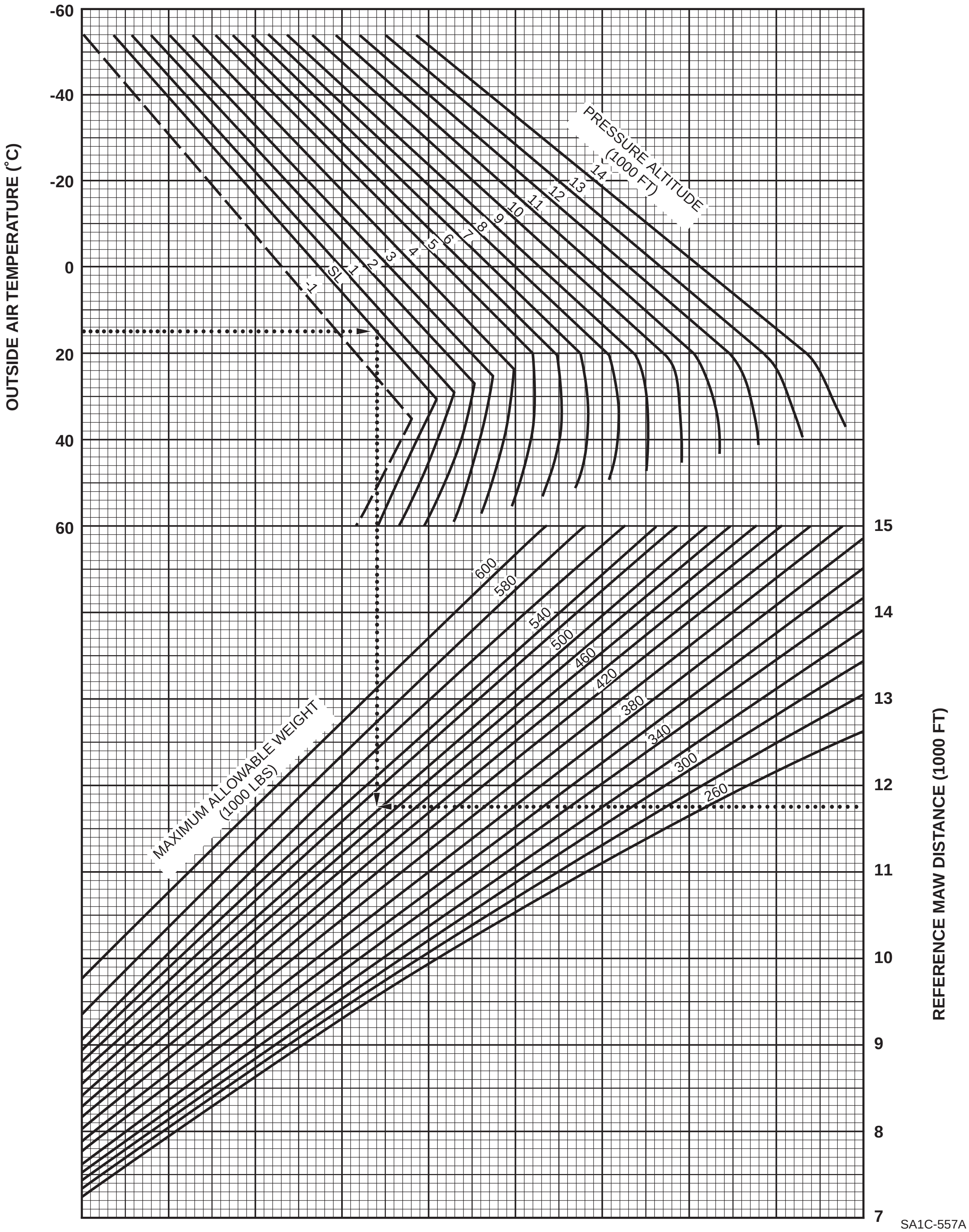


Figure 12-35D. (Sheet 1)

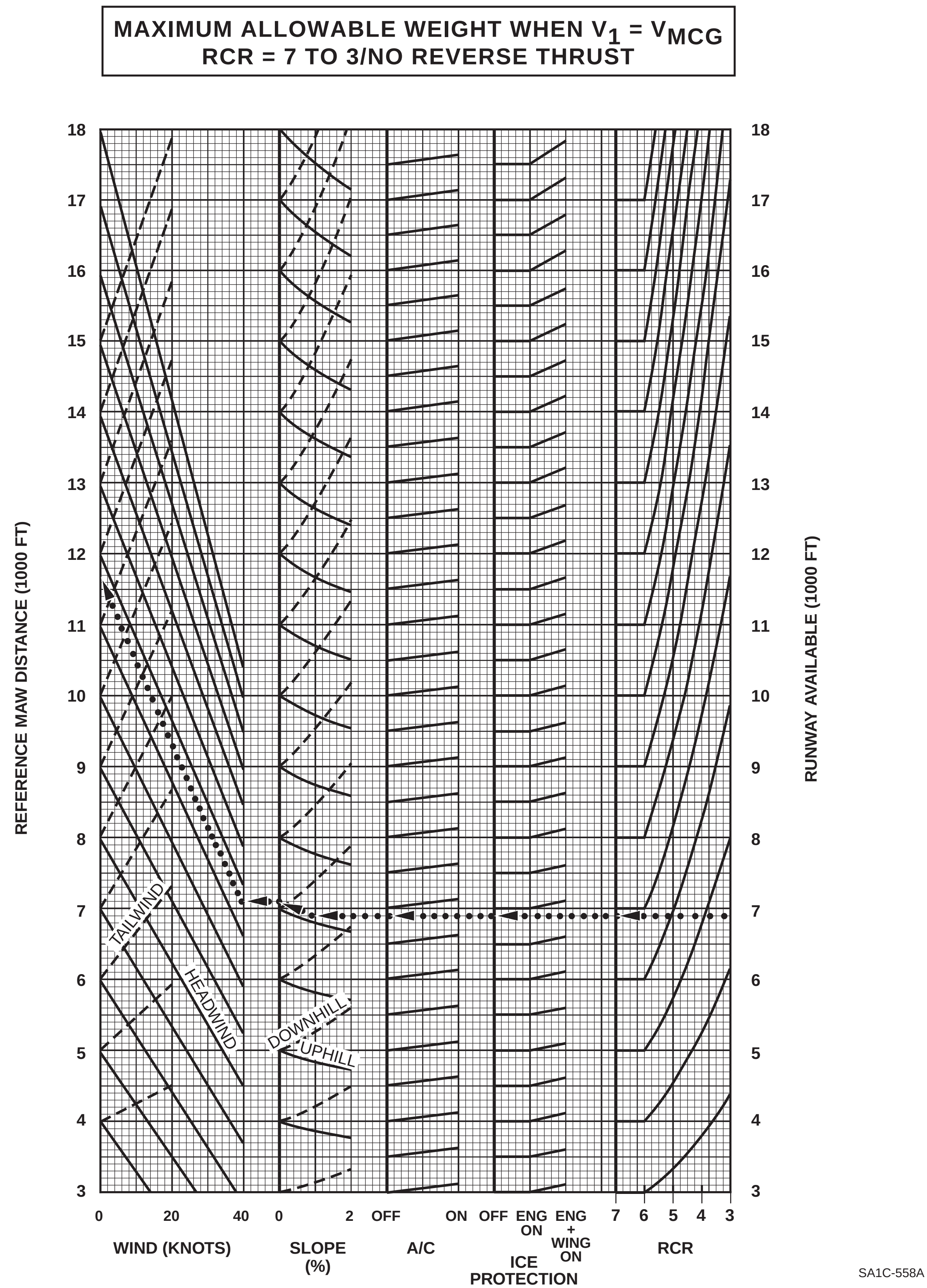


Figure 12-35D. (Sheet 2)

MAXIMUM ALLOWABLE WEIGHT WHEN $V_1 = V_{MCG}$
RSC = 0.25 IN/NO REVERSE THRUST

NOTE:

FLAP SETTING = 25°.

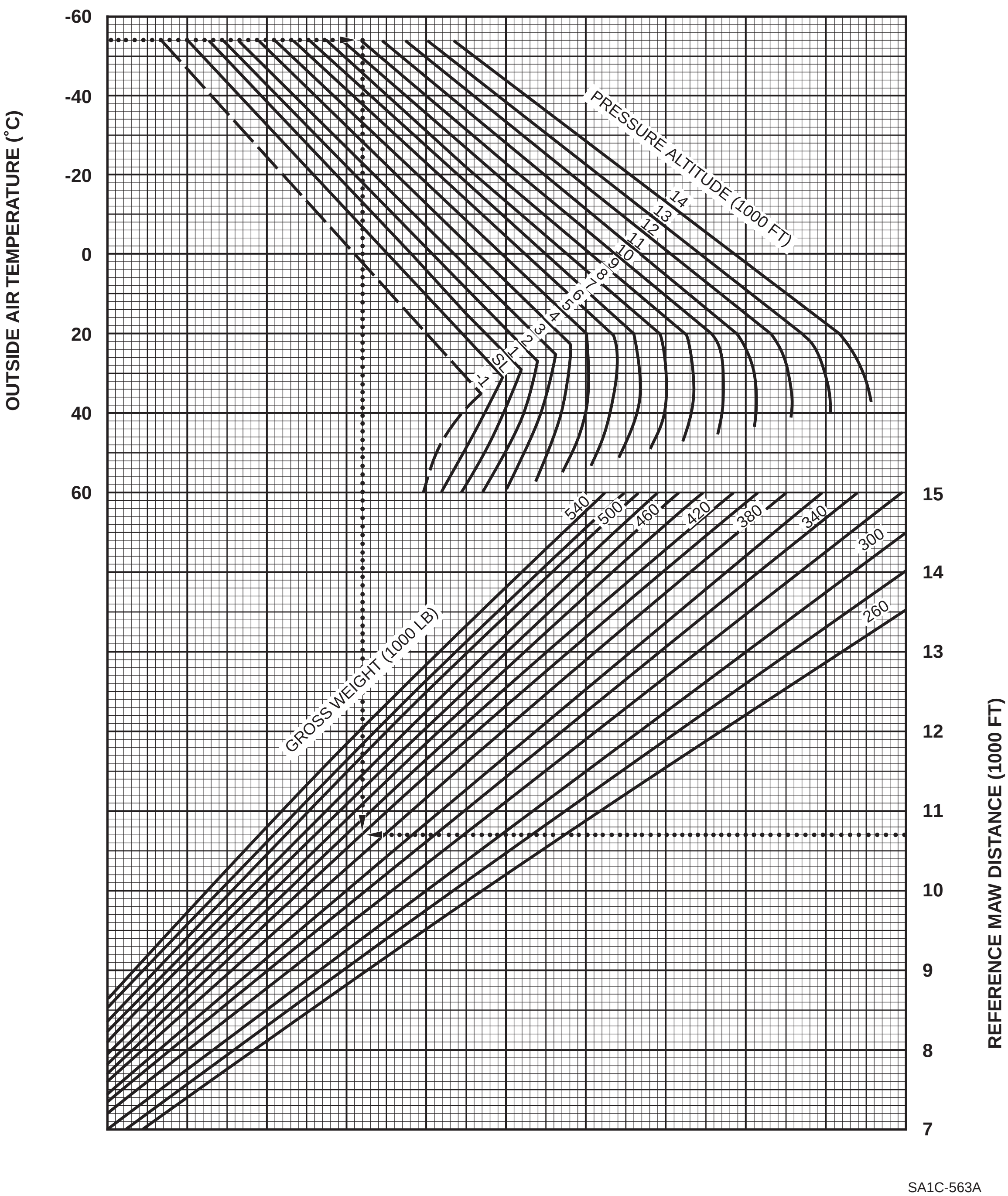


Figure 12-35E. (Sheet 1)

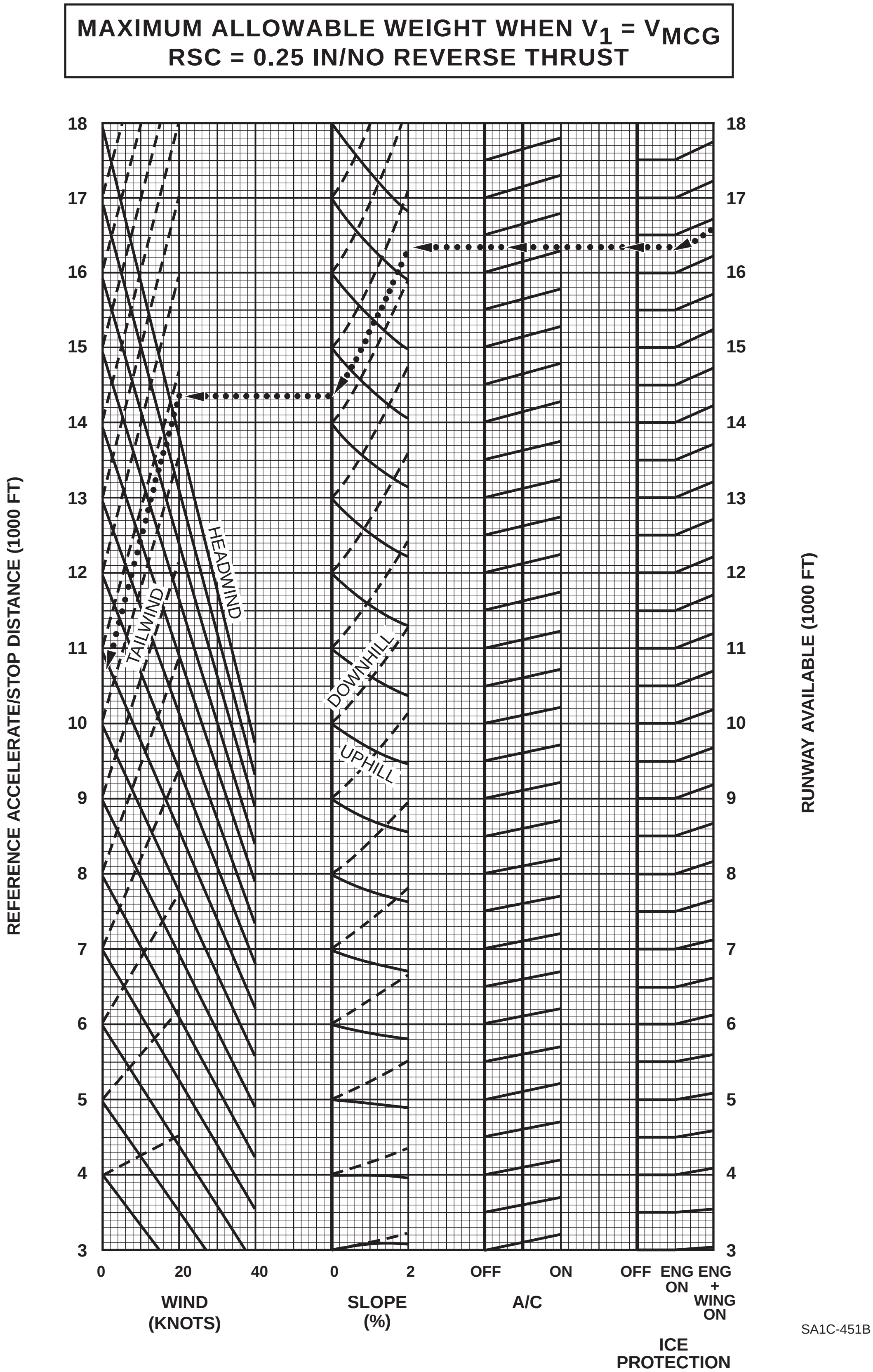


Figure 12-35E. (Sheet 2)

MAXIMUM ALLOWABLE WEIGHT WHEN $V_1 = V_{MCG}$
RSC = 0.50/NO REVERSE THRUST

NOTE: FLAP SETTING = 25°.

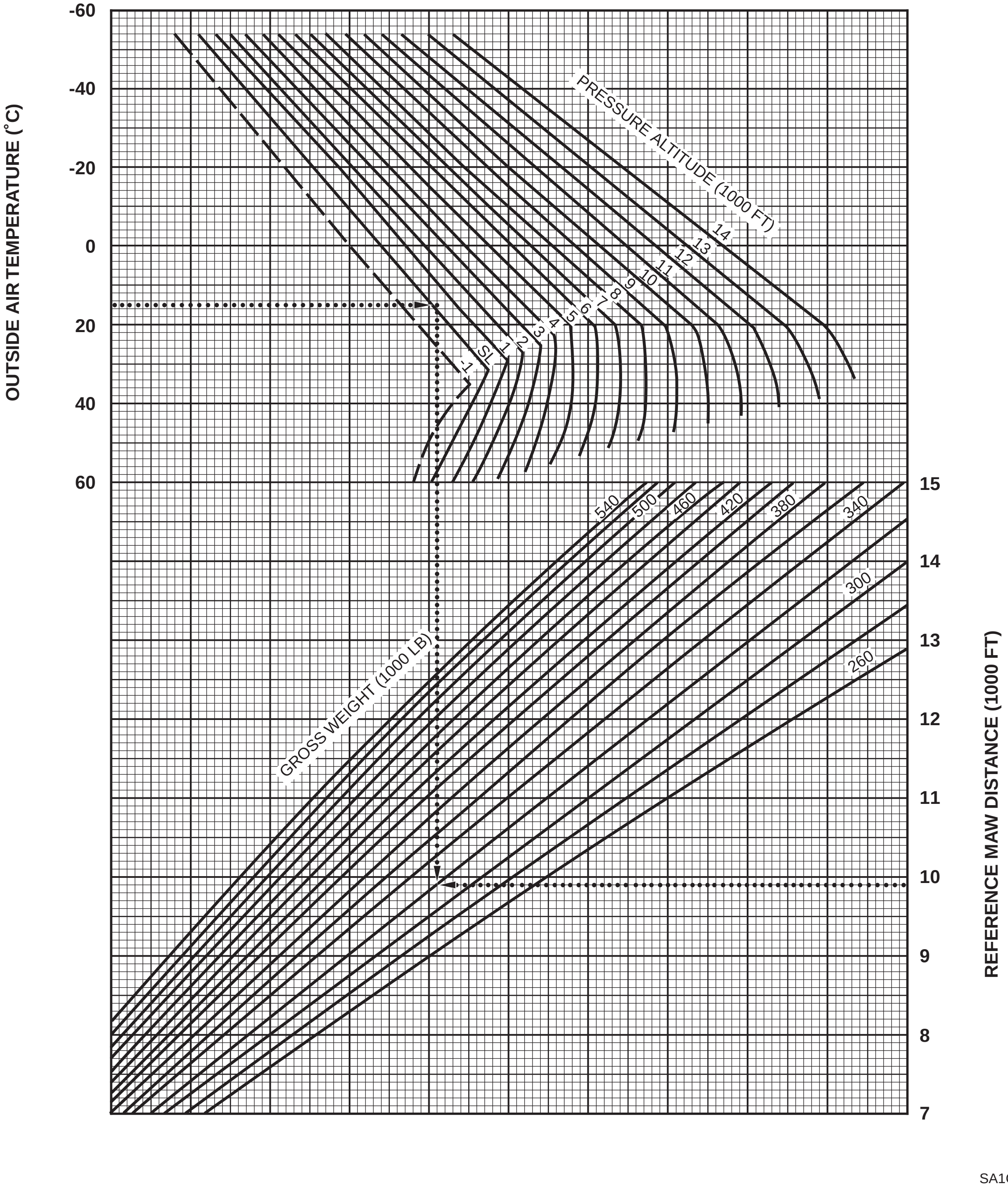


Figure 12-35F. (Sheet 1)

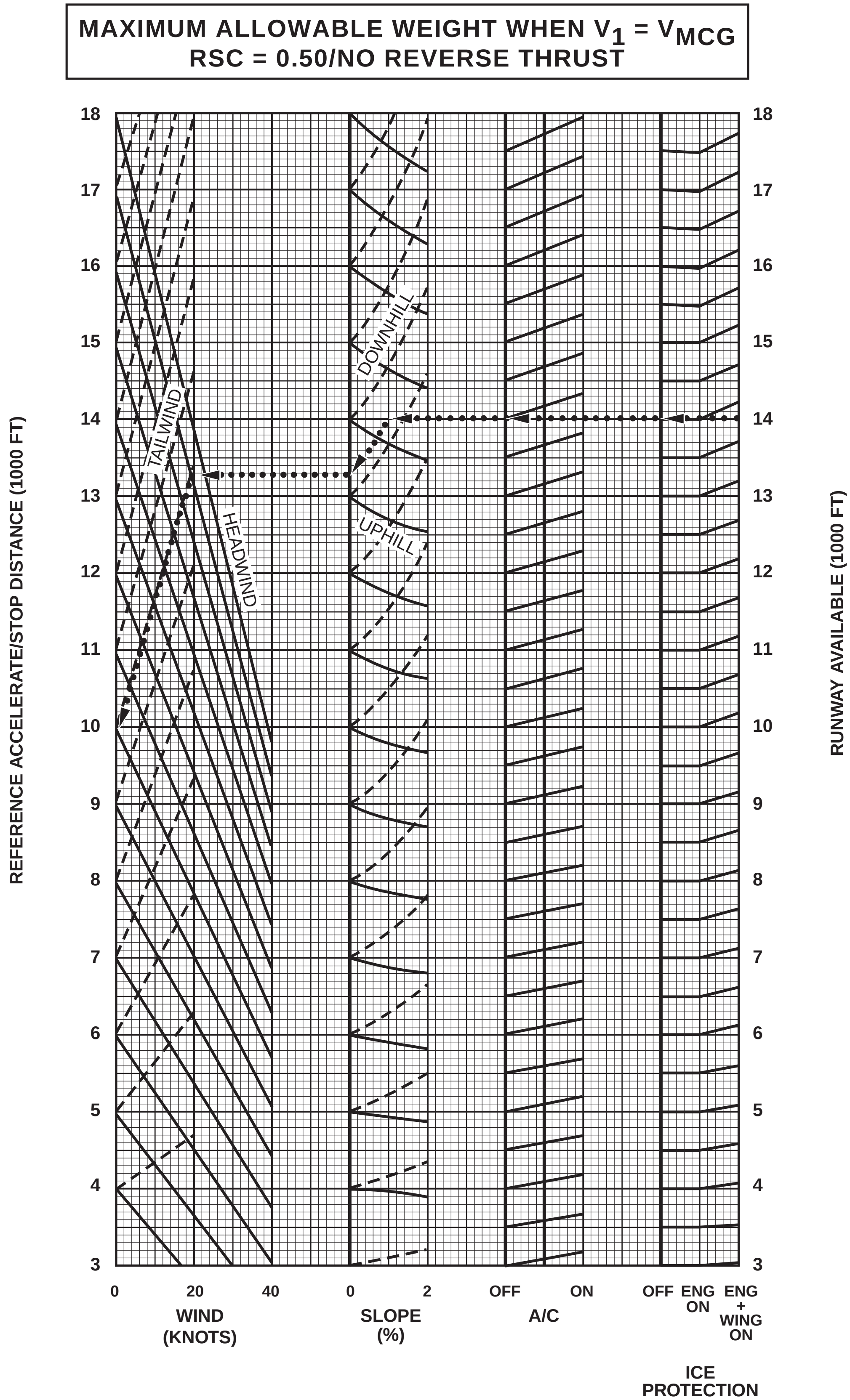


Figure 12-35F. (Sheet 2)

CLIMB GRADIENT LIMITING WEIGHT

NOTE:
1. ONE ENGINE INOPERATIVE.
2. 2.5% GRADIENT.
3. GEAR UP.
4. SLATS EXTENDED.

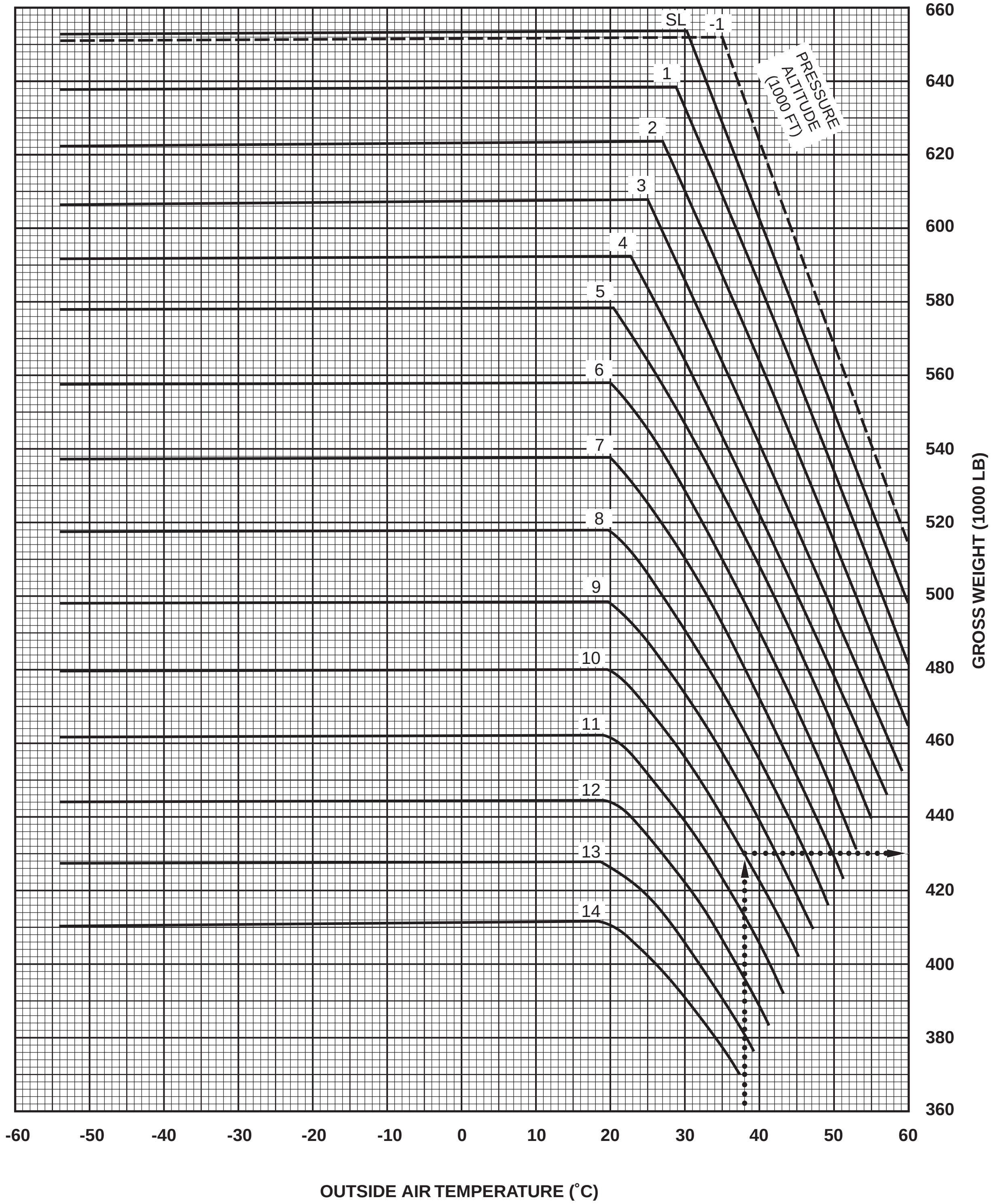


Figure 12-36. (Sheet 1)

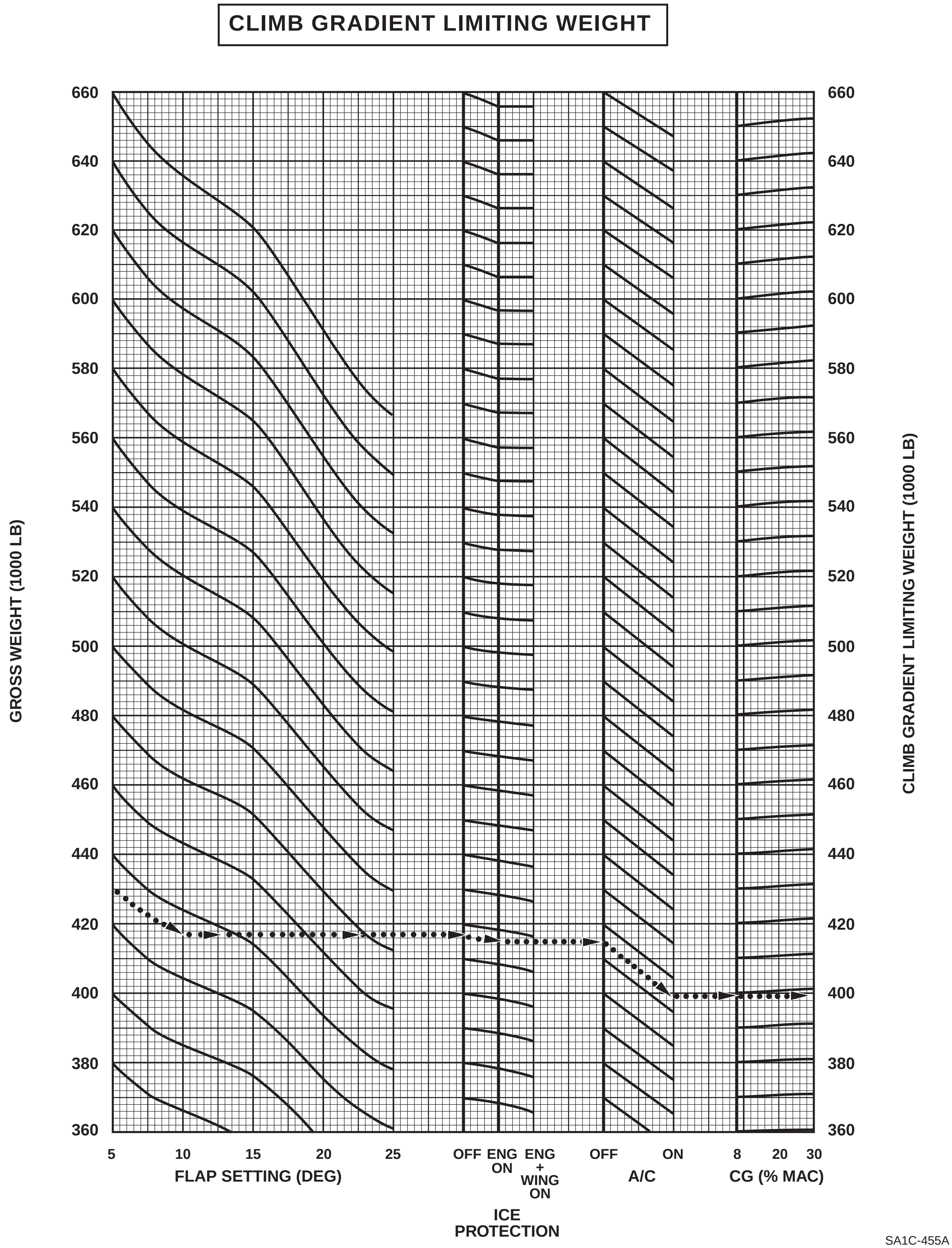


Figure 12-36. (Sheet 2)

ALL ENGINE GROUND ROLL

EXAMPLE:

GIVEN: OAT = 20°C
PRESSURE ALTITUDE = 5,000 FT.

FIND: REFERENCE DISTANCE.

SOLUTION: REFERENCE DISTANCE = 5,330 FT.

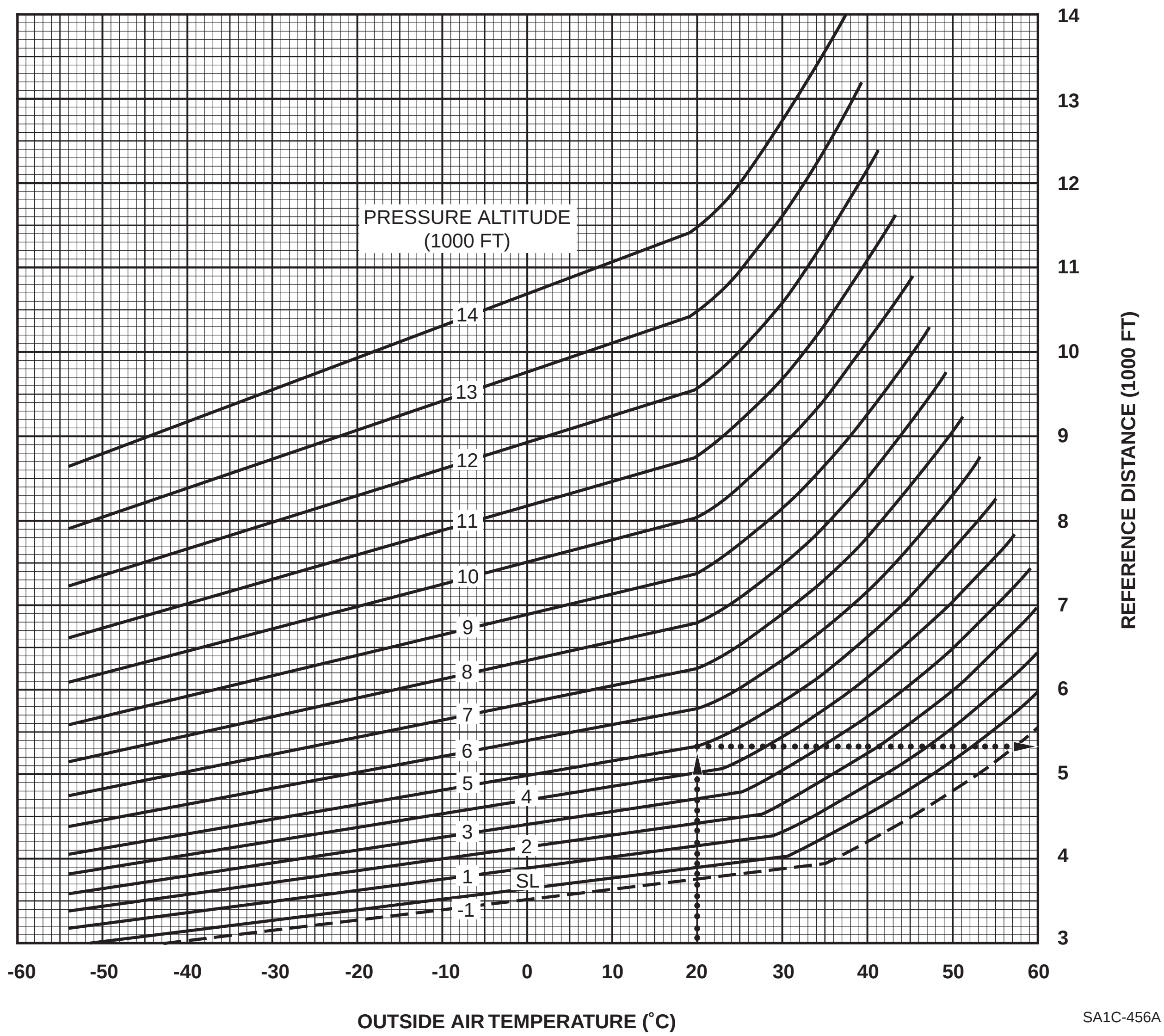


Figure 12-37. (Sheet 1)

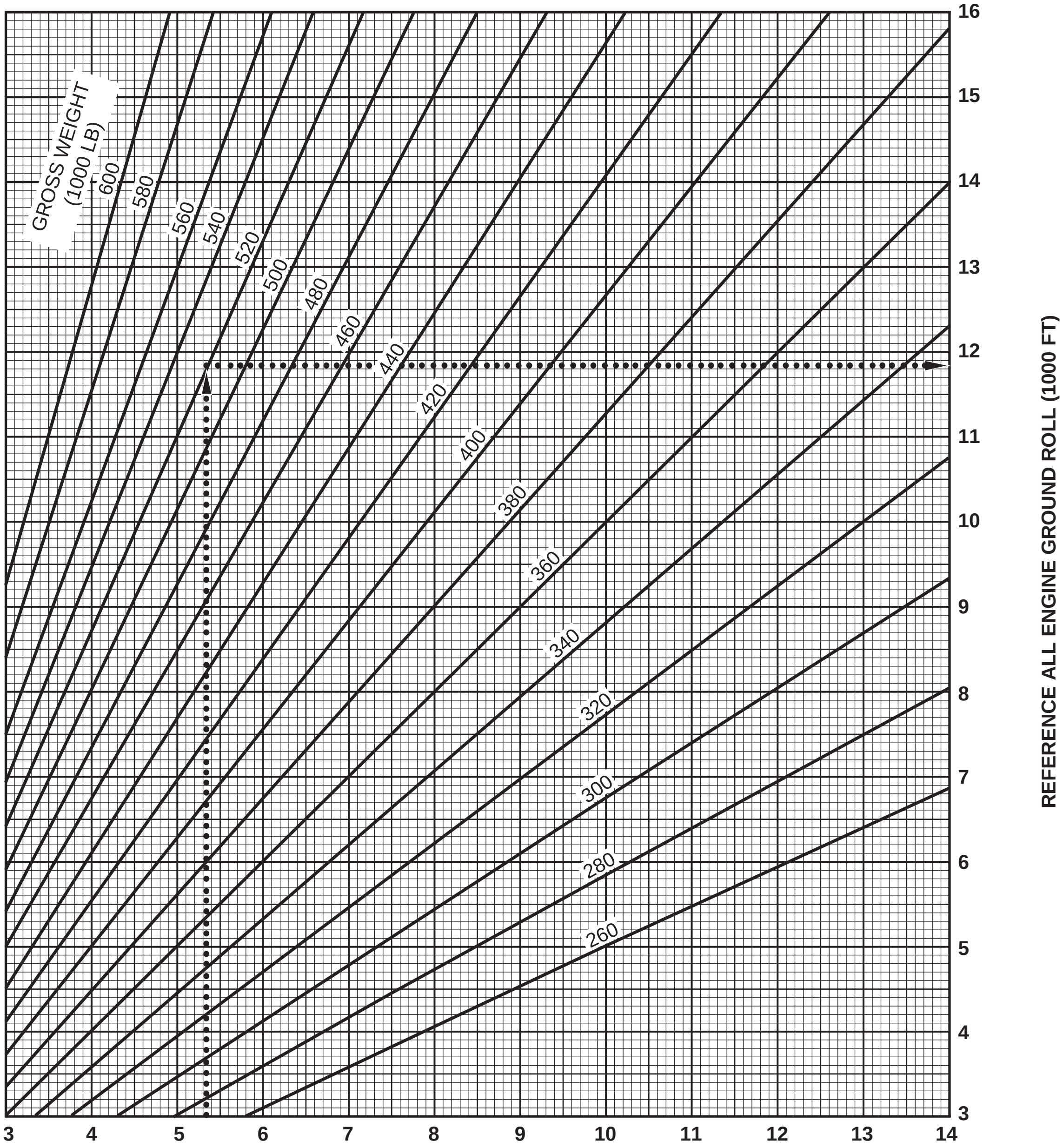
ALL ENGINE GROUND ROLL

EXAMPLE:

GIVEN: REFERENCE DISTANCE = 5,330 FT (FROM SHEET 1)
GROSS WEIGHT = 520,000 LB.

FIND: REFERENCE ALL ENGINE GROUND ROLL.

SOLUTION: REFERENCE ALL ENGINE GROUND ROLL = 11,850 FT.



SA1C-457A

Figure 12-37. (Sheet 2)

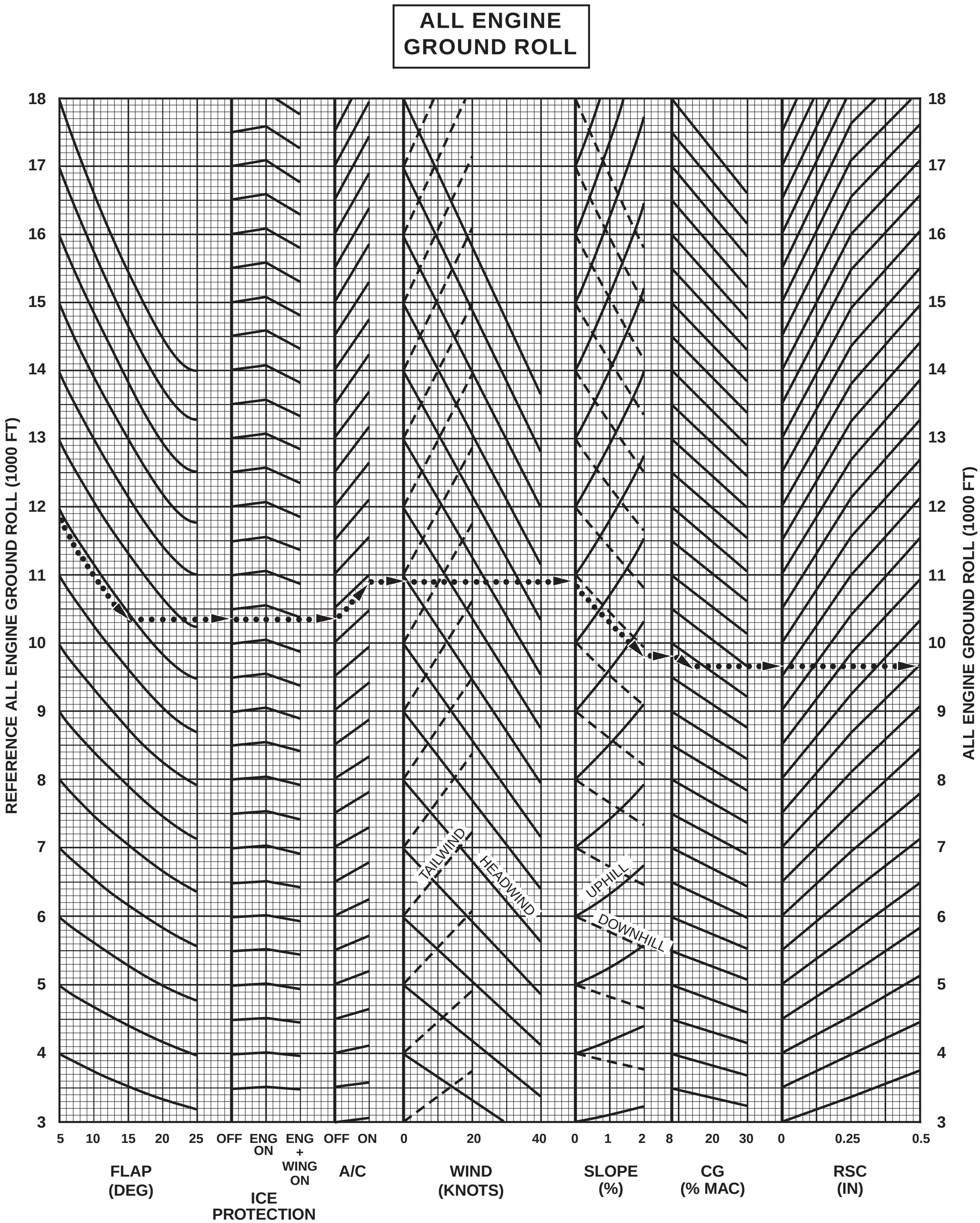


Figure 12-37. (Sheet 3)

THREE ENGINE SPECIFIC RANGE
5-DEGREES FLAPS-
TRUE PRESSURE ALTITUDE SEA LEVEL

NOTE:
1. SLATS EXTENDED (TAKEOFF POSITION).
2. STANDARD DAY.
3. INCREASE $\%N_1$ BY 0.11 PER °C ABOVE STANDARD.
4. AIR REFUELING BOOM DEPLOYED.

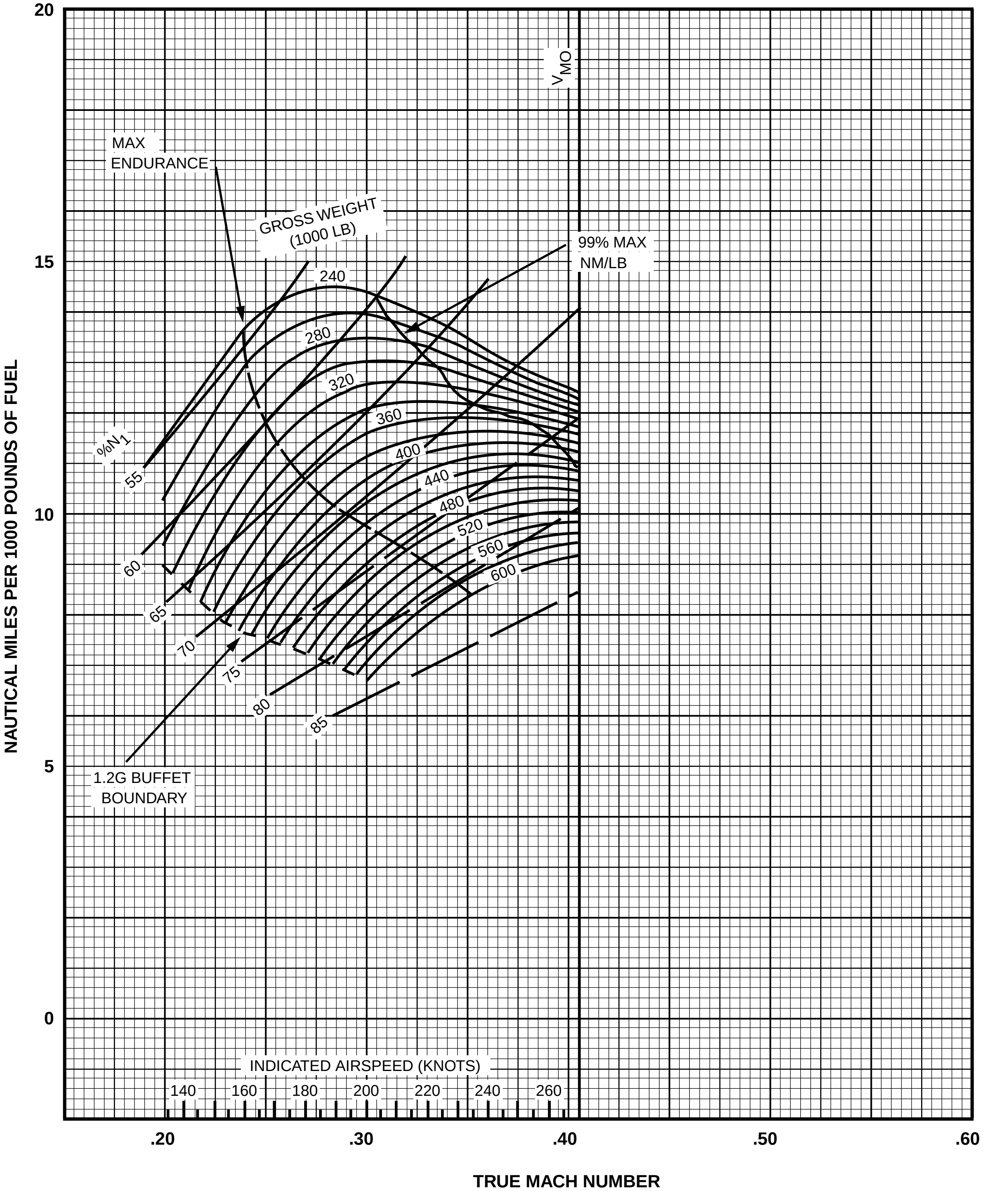


Figure 12-38.

THREE ENGINE SPECIFIC RANGE 5-DEGREES FLAPS- TRUE PRESSURE ALTITUDE 5,000 FT

NOTE:
1. SLATS EXTENDED (TAKEOFF POSITION).
2. STANDARD DAY.
3. INCREASE $\%N_1$ BY 0.13 PER °C ABOVE STANDARD.
4. AIR REFUELING BOOM DEPLOYED.

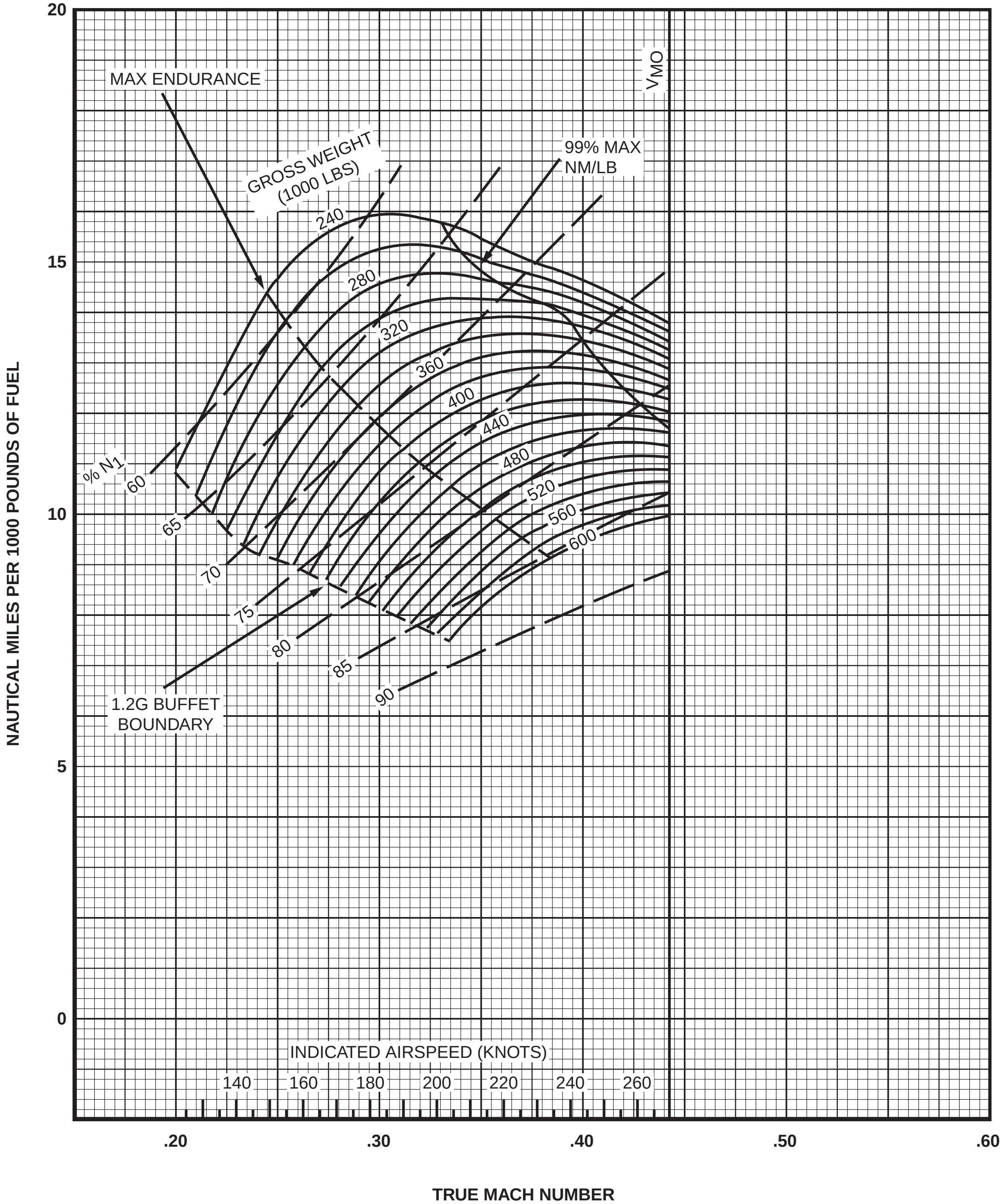
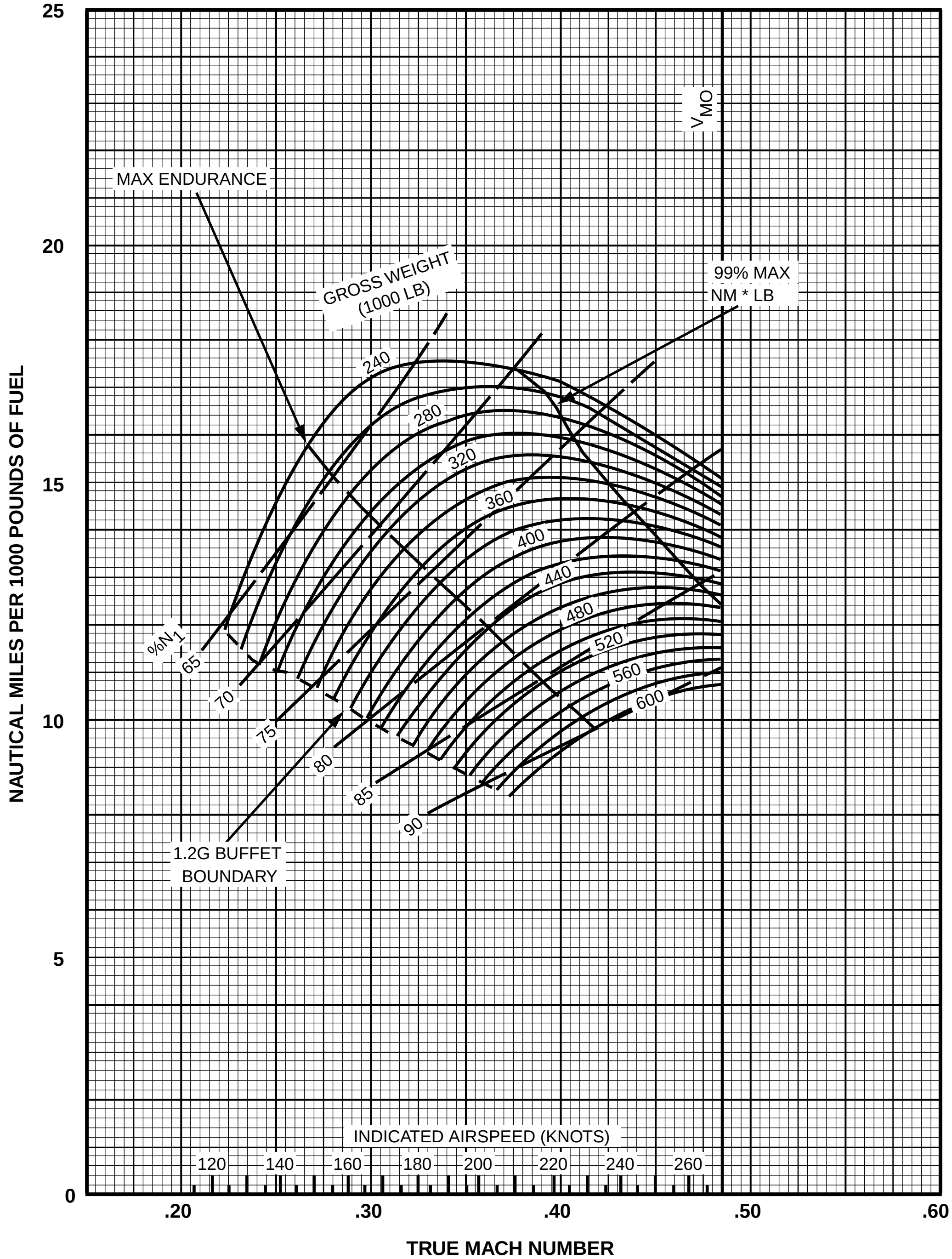


Figure 12-39.

SA1C-294A

THREE ENGINE SPECIFIC RANGE
5-DEGREES FLAPS-
TRUE PRESSURE ALTITUDE 10,000 FT

NOTE:
1. SLATS EXTENDED (TAKEOFF POSITION).
2. STANDARD DAY.
3. INCREASE $\%N_1$ BY 0.14 PER °C ABOVE STANDARD.
4. AIR REFUELING BOOM DEPLOYED.



SA1C-295A

Figure 12-40.

THREE ENGINE SPECIFIC RANGE
5-DEGREES FLAPS-
TRUE PRESSURE ALTITUDE 15,000 FT

NOTE:
1. SLATS EXTENDED (TAKEOFF POSITION).
2. STANDARD DAY.
3. INCREASE %N_1 BY 0.15 PER °C ABOVE STANDARD.
4. AIR REFUELING BOOM DEPLOYED.

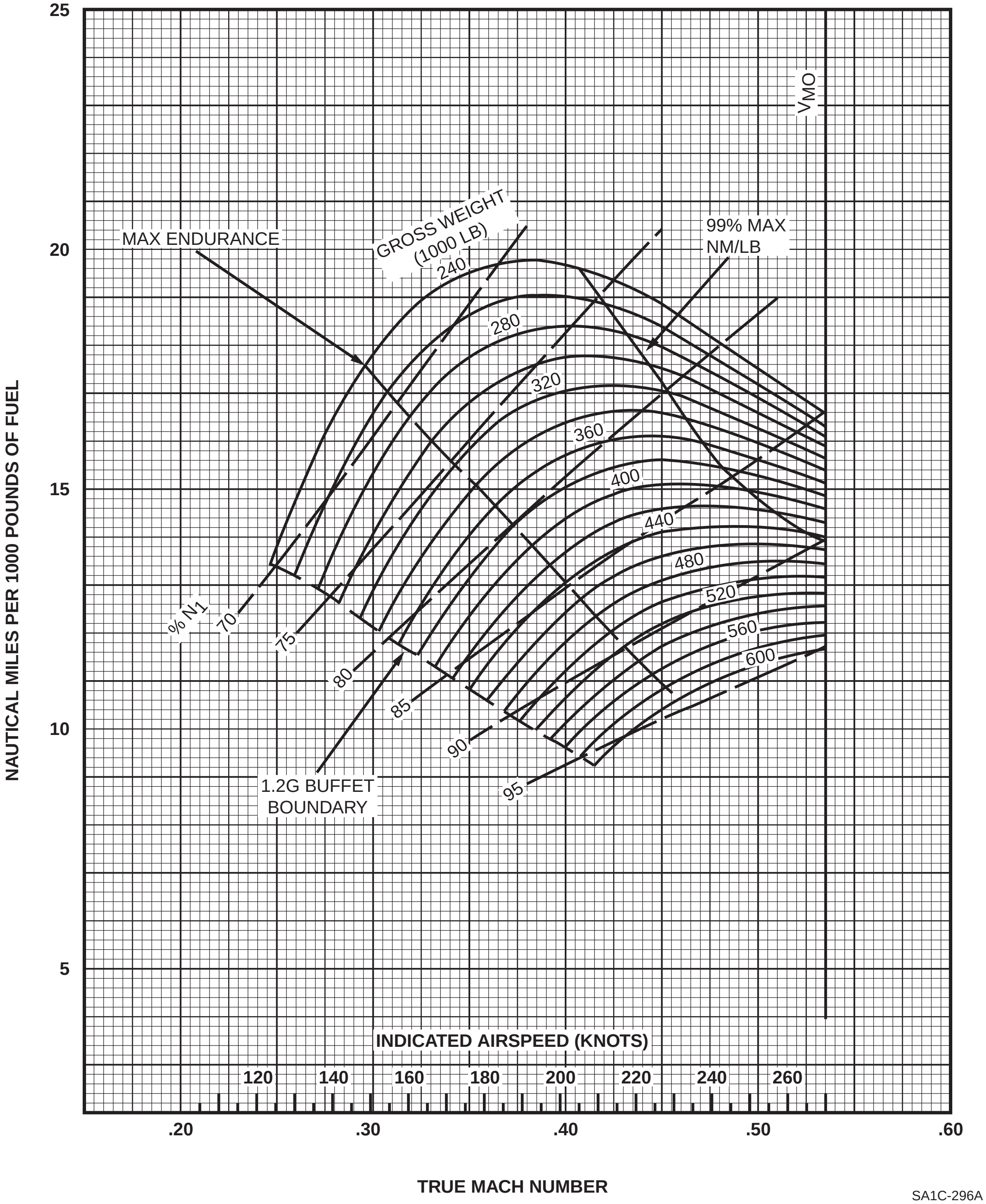


Figure 12-41.

THREE ENGINE SPECIFIC RANGE
5-DEGREES FLAPS-
TRUE PRESSURE ALTITUDE 20,000 FT

NOTE:
1. SLATS EXTENDED (TAKEOFF POSITION).
2. STANDARD DAY.
3. INCREASE $\%N_1$ BY 0.17 PER °C ABOVE STANDARD.
4. AIR REFUELING BOOM DEPLOYED.

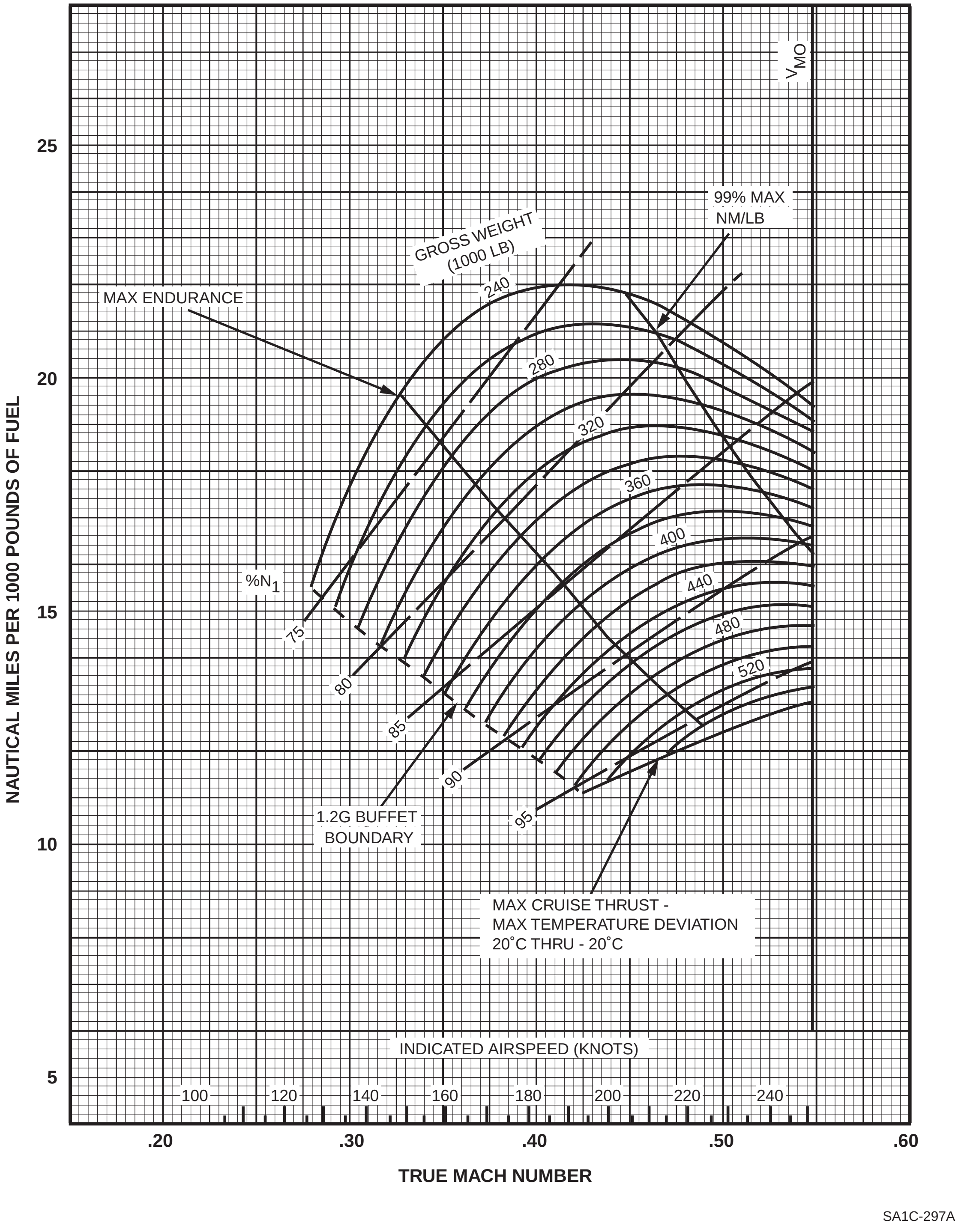


Figure 12-42.

THREE ENGINE SPECIFIC RANGE
10-DEGREES FLAPS-
TRUE PRESSURE ALTITUDE SEA LEVEL

NOTE:
1. SLATS EXTENDED (TAKEOFF POSITION).
2. STANDARD DAY.
3. INCREASE %N_1 BY 0.11 PER °C ABOVE STANDARD.
4. AIR REFUELING BOOM DEPLOYED.

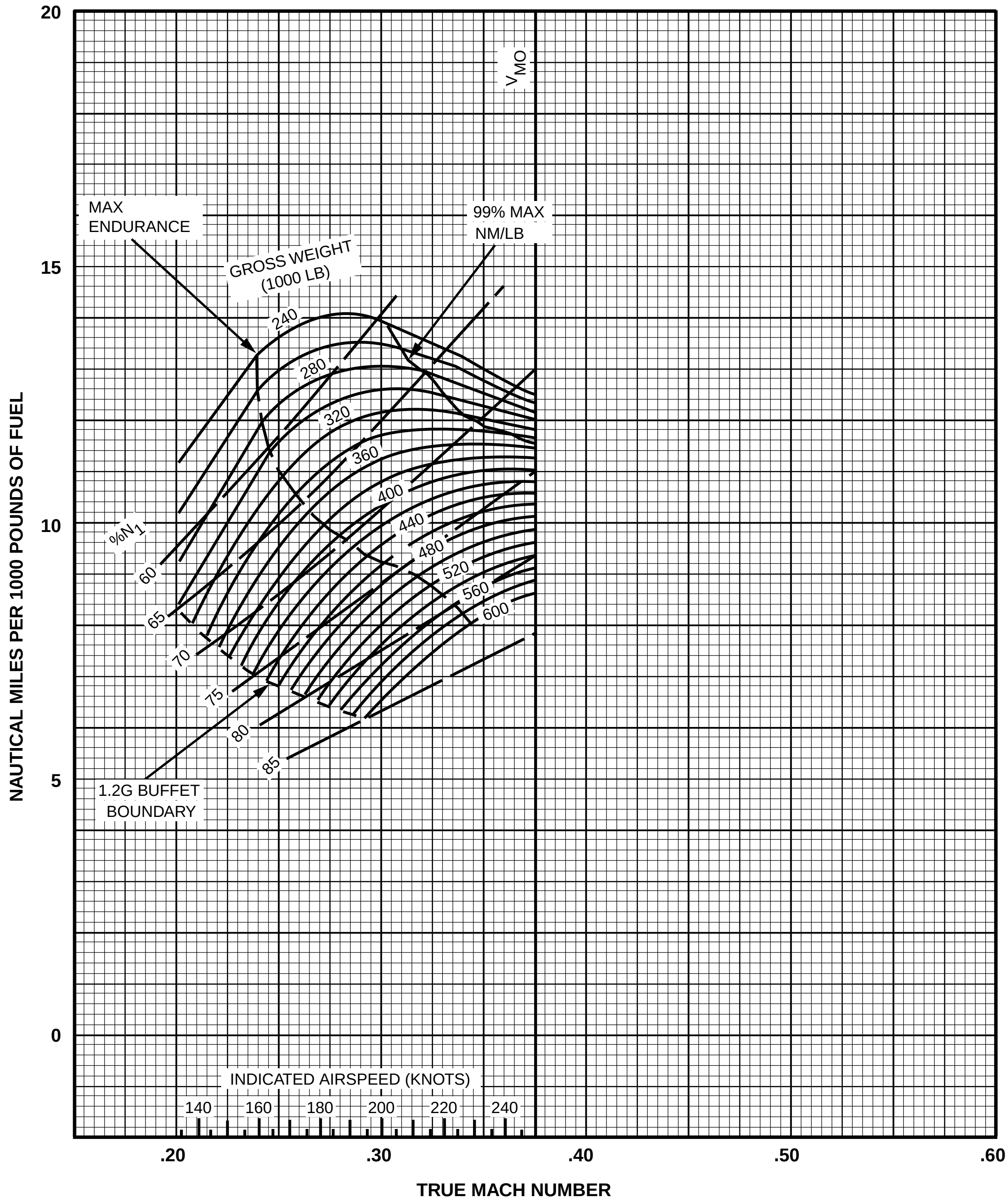


Figure 12-43.

THREE ENGINE SPECIFIC RANGE 10-DEGREES FLAPS - TRUE PRESSURE ALTITUDE 5,000 FT

NOTE:

1. SLATS EXTENDED (TAKEOFF POSITION).
2. STANDARD DAY.
3. INCREASE $\%N_1$ BY 0.13 PER °C ABOVE STANDARD.
4. AIR REFUELING BOOM DEPLOYED.

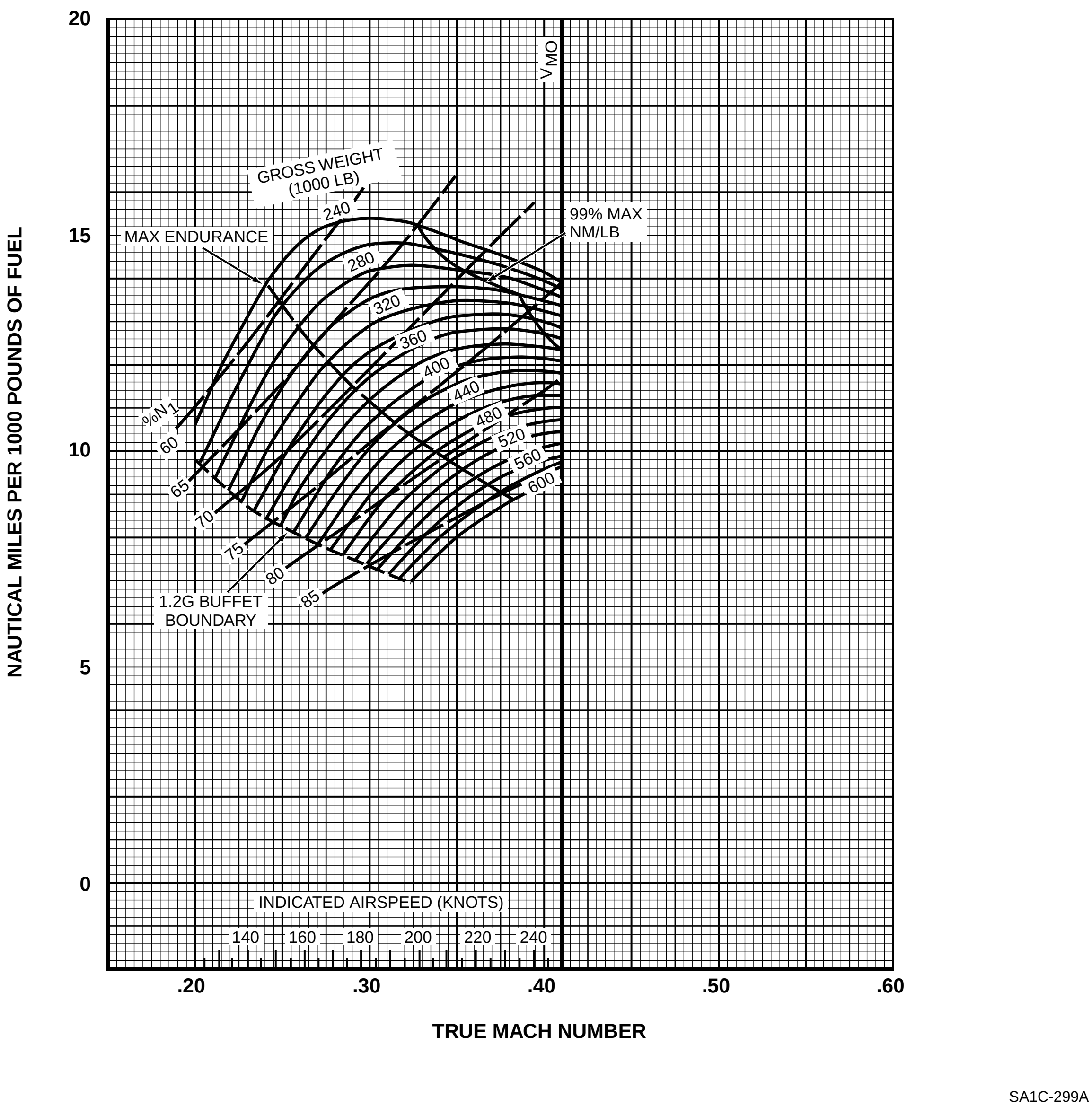
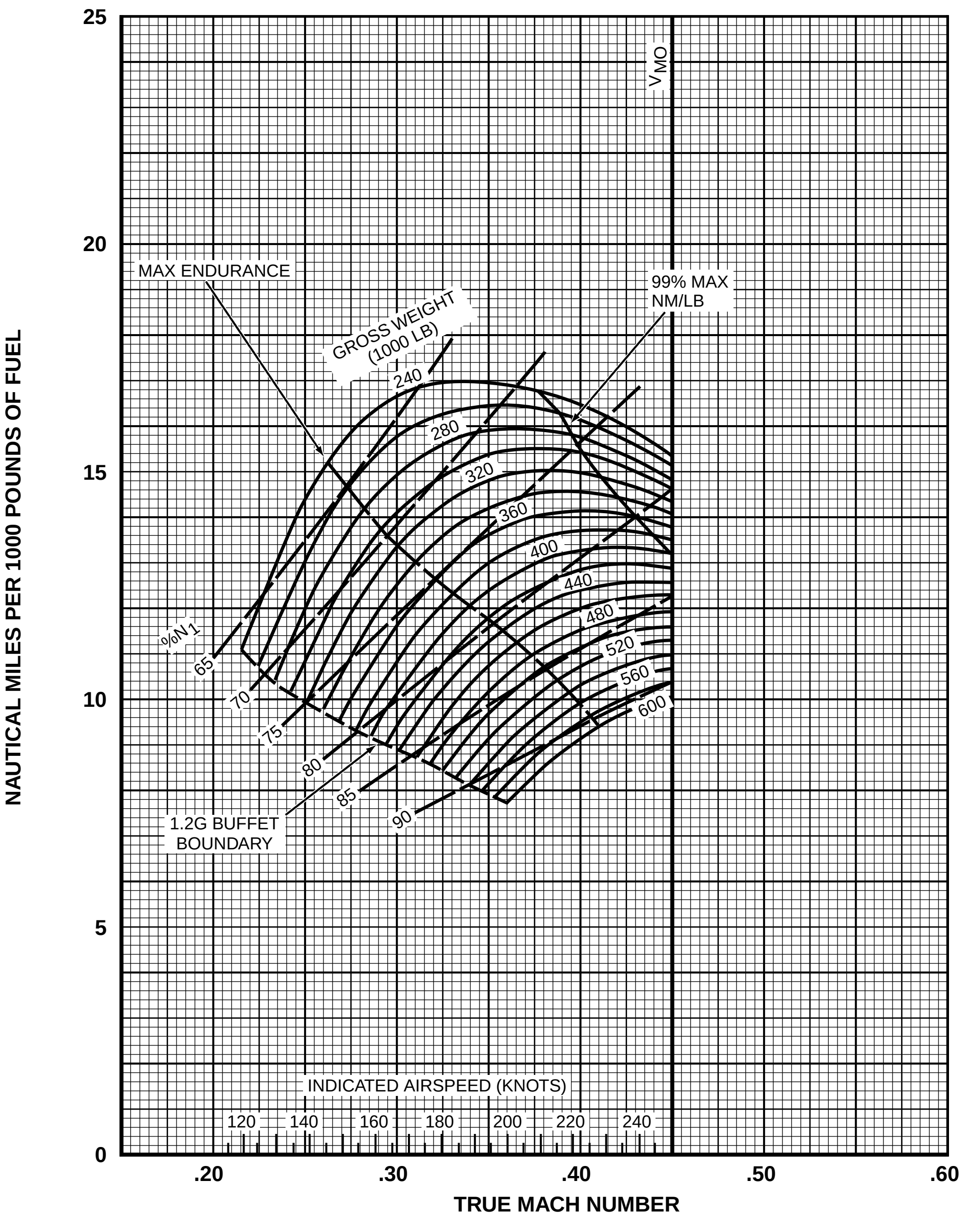


Figure 12-44.

**THREE ENGINE SPECIFIC RANGE
10-DEGREES FLAPS -
TRUE PRESSURE ALTITUDE 10,000 FT**

NOTE:

1. SLATS EXTENDED (TAKEOFF POSITION).
2. STANDARD DAY.
3. INCREASE $\%N_1$ BY 0.14 PER °C ABOVE STANDARD.
4. AIR REFUELING BOOM DEPLOYED.



SA1C-300B

Figure 12-45.

THREE ENGINE SPECIFIC RANGE
10-DEGREES FLAPS -
TRUE PRESSURE ALTITUDE 15,000 FT

NOTE:

1. SLATS EXTENDED (TAKEOFF POSITION).
2. STANDARD DAY.
3. INCREASE $\%N_1$ BY 0.15 PER °C ABOVE STANDARD.
4. AIR REFUELING BOOM DEPLOYED.

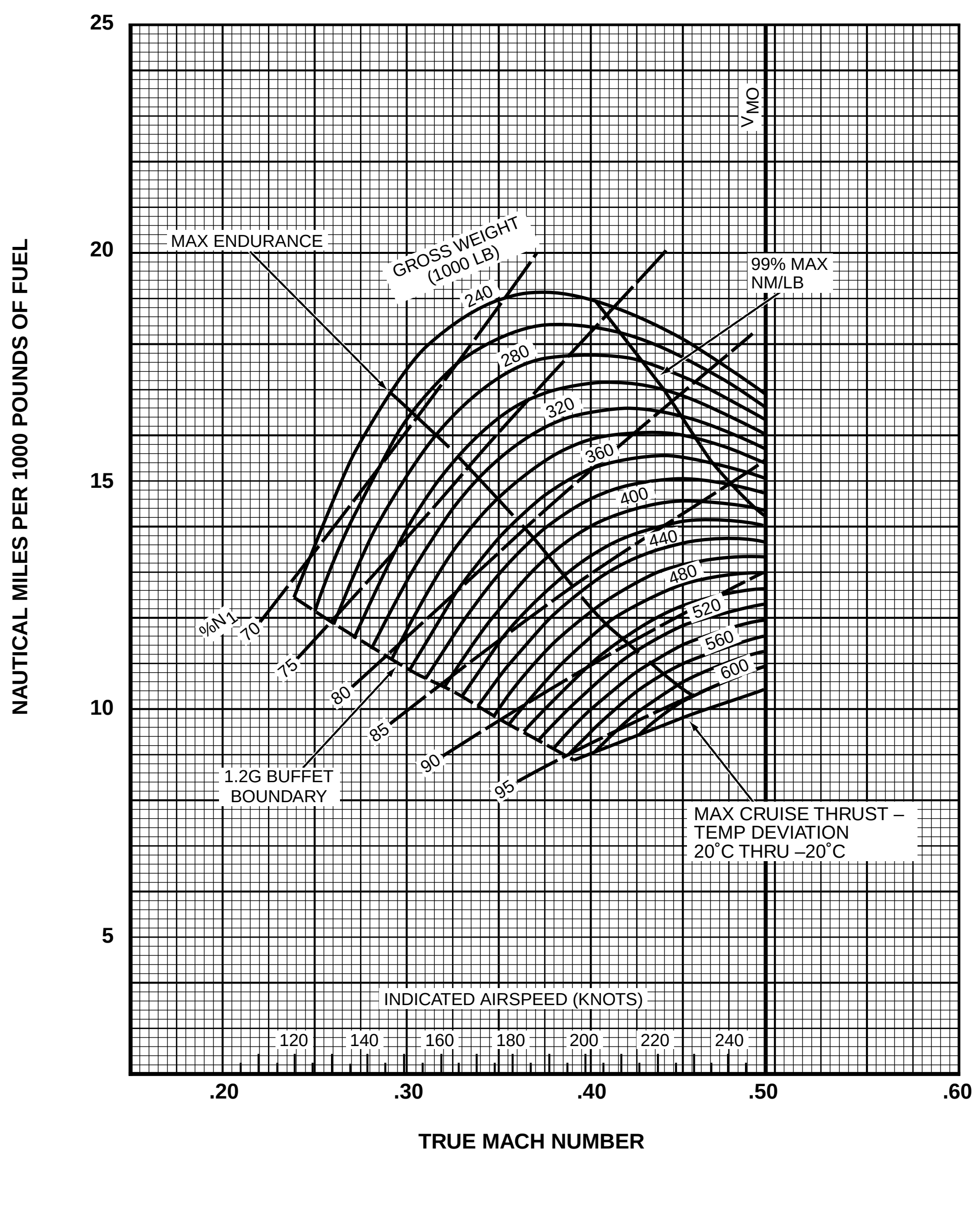


Figure 12-46.

THREE ENGINE SPECIFIC RANGE 10-DEGREES FLAPS - TRUE PRESSURE ALTITUDE 20,000 FT

NOTE:

1. SLATS EXTENDED (TAKEOFF POSITION).
2. STANDARD DAY.
3. INCREASE $\%N_1$ BY 0.17 PER °C ABOVE STANDARD.
4. AIR REFUELING BOOM DEPLOYED.

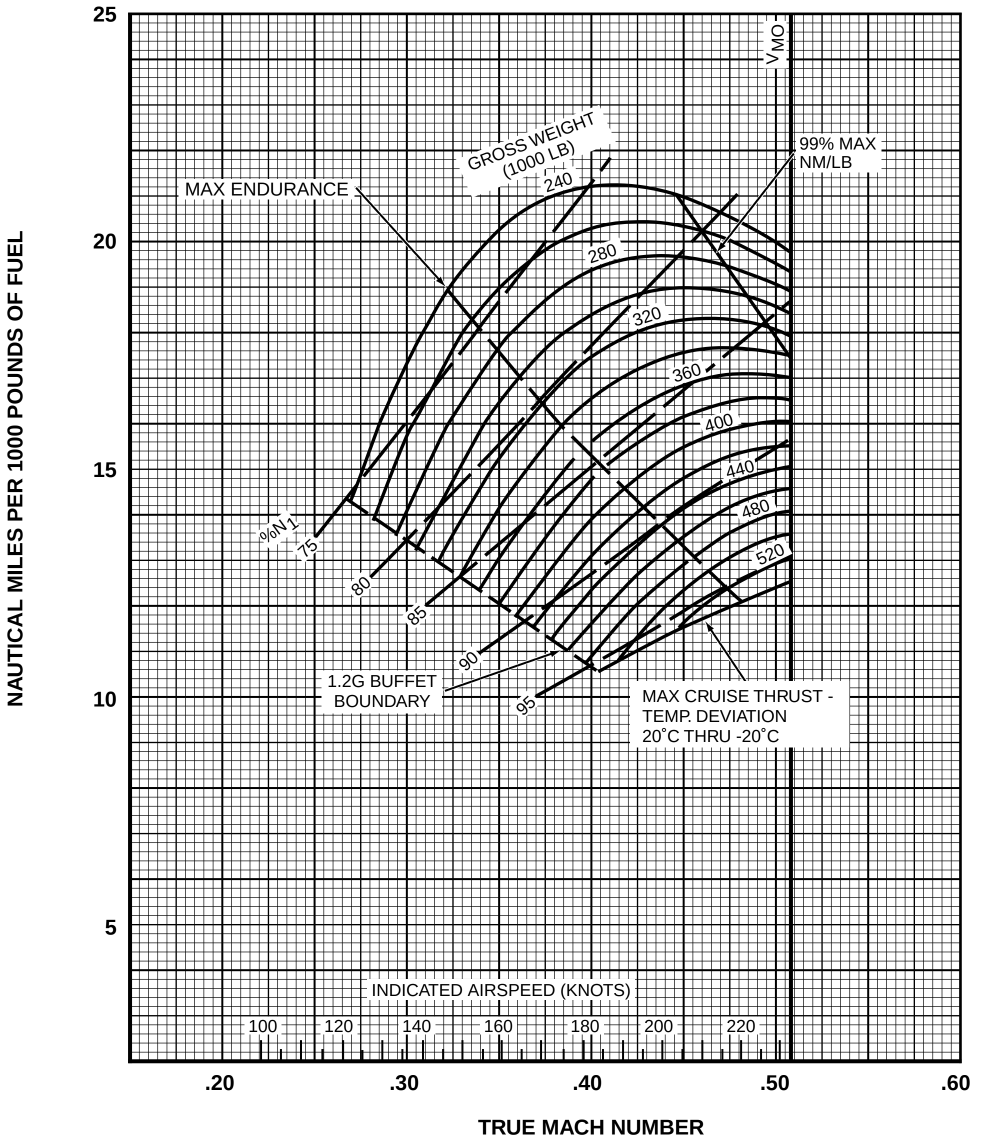


Figure 12-47.

THREE ENGINE SPECIFIC RANGE 15-DEGREES FLAPS - TRUE PRESSURE ALTITUDE SEA LEVEL

NOTE:

1. SLATS EXTENDED (TAKEOFF POSITION).
2. STANDARD DAY.
3. INCREASE $\%N_1$ BY 0.11 PER °C ABOVE STANDARD.
4. AIR REFUELING BOOM DEPLOYED.

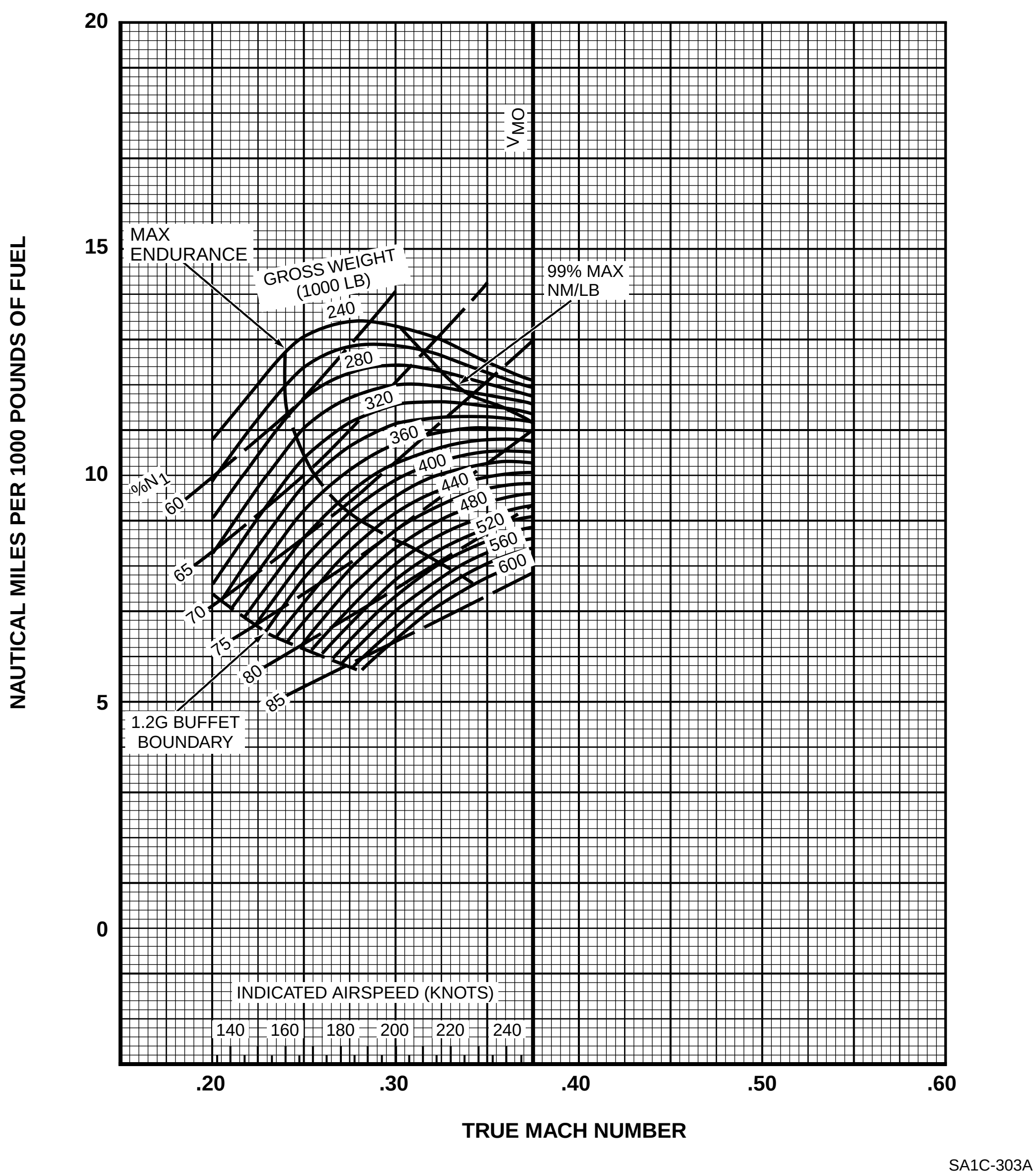


Figure 12-48.

THREE ENGINE SPECIFIC RANGE
15-DEGREES FLAPS -
TRUE PRESSURE ALTITUDE 5,000 FT

NOTE:

1. SLATS EXTENDED (TAKEOFF POSITION).
2. STANDARD DAY.
3. INCREASE $\%N_1$ BY 0.13 PER °C ABOVE STANDARD.
4. AIR REFUELING BOOM DEPLOYED.

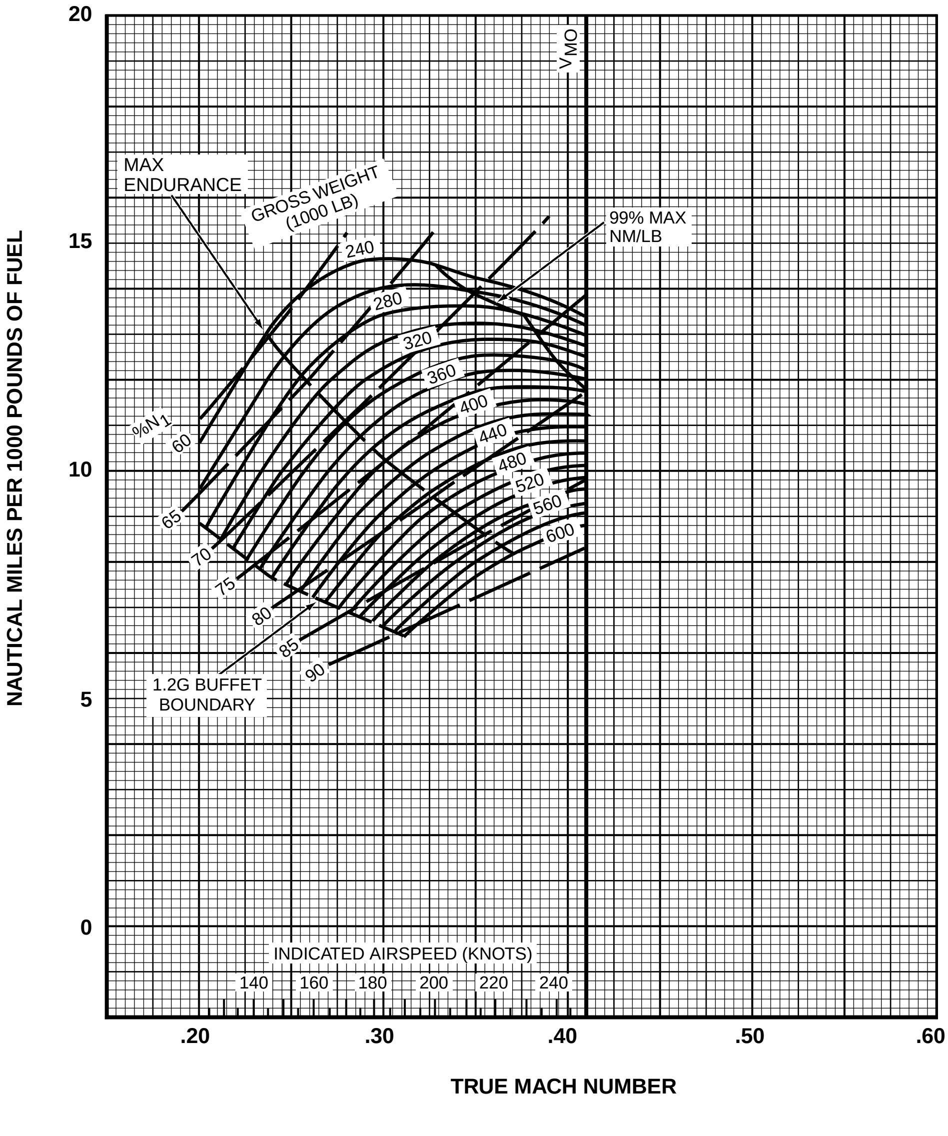


Figure 12-49.

THREE ENGINE SPECIFIC RANGE 15-DEGREES FLAPS - TRUE PRESSURE ALTITUDE 10,000 FT

NOTE:

1. SLATS EXTENDED (TAKEOFF POSITION).
2. STANDARD DAY.
3. INCREASE $\%N_1$ BY 0.14 PER °C ABOVE STANDARD.
4. AIR REFUELING BOOM DEPLOYED.

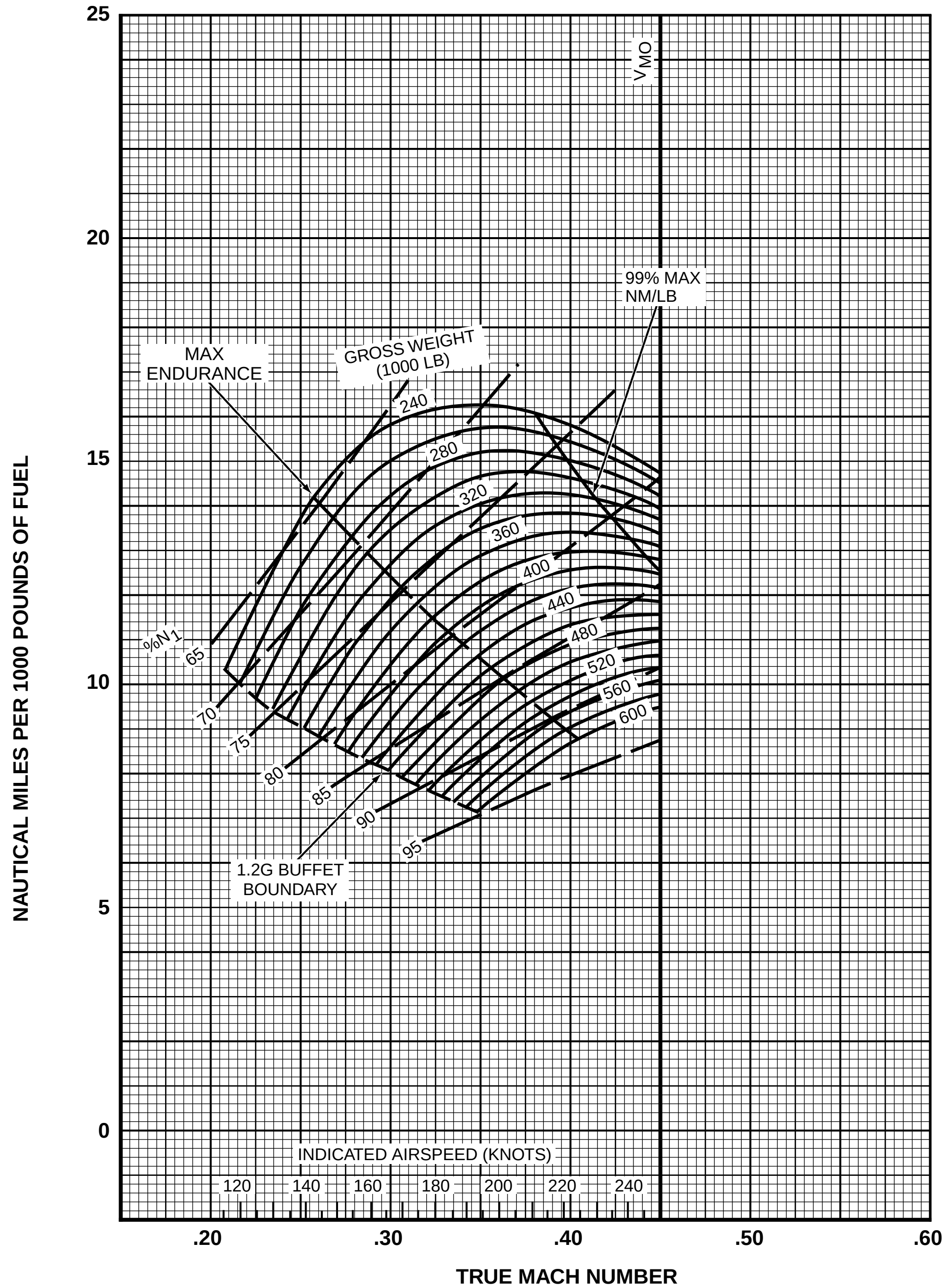


Figure 12-50.

THREE ENGINE SPECIFIC RANGE
15-DEGREES FLAPS -
TRUE PRESSURE ALTITUDE 15,000 FT

NOTE:

1. SLATS EXTENDED (TAKEOFF POSITION).
2. STANDARD DAY.
3. INCREASE $\%N_1$ BY 0.15 PER °C ABOVE STANDARD.
4. AIR REFUELING BOOM DEPLOYED.

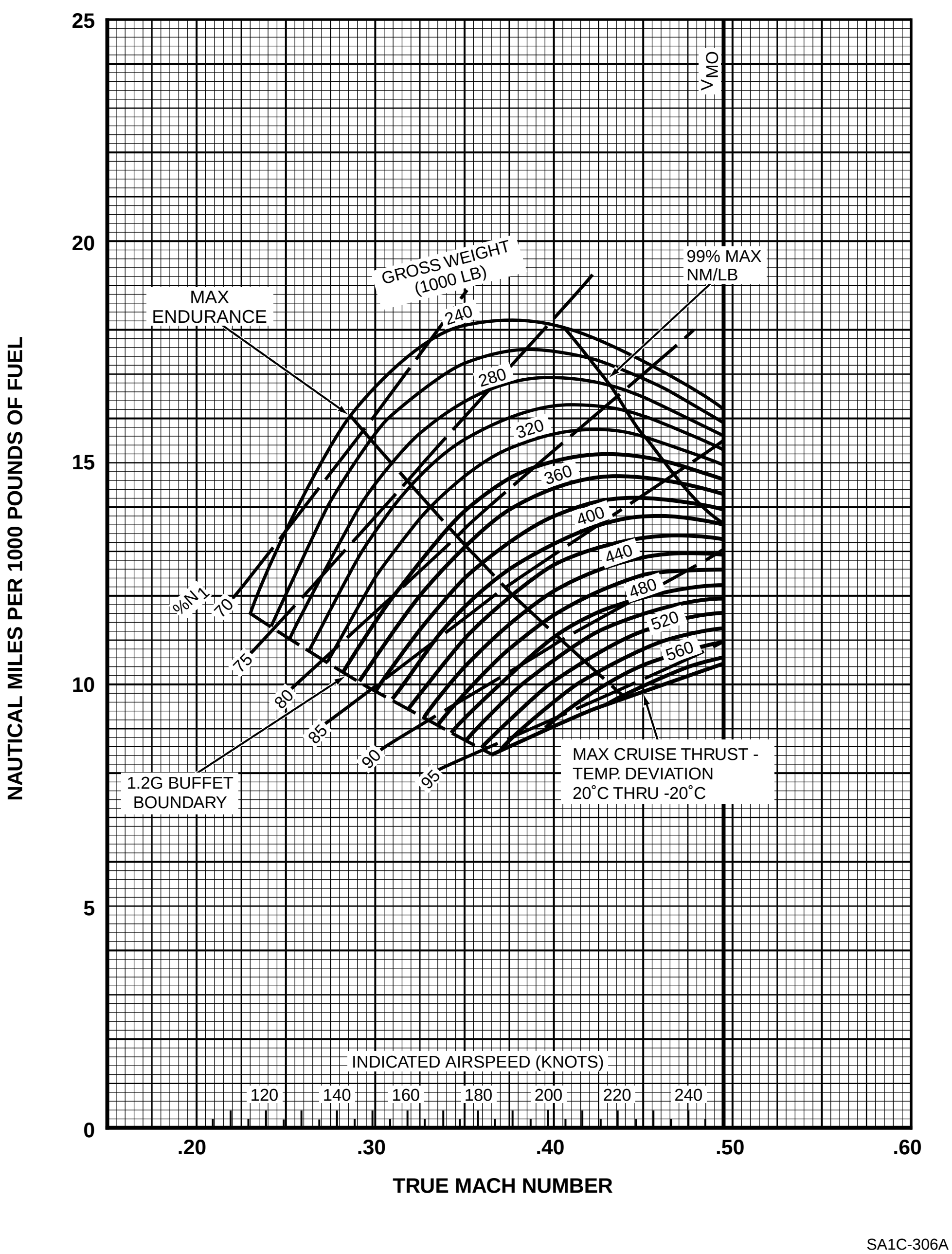


Figure 12-51.

THREE ENGINE SPECIFIC RANGE 15-DEGREES FLAPS - TRUE PRESSURE ALTITUDE 20,000 FT

NOTE:

1. SLATS EXTENDED (TAKEOFF POSITION).
2. STANDARD DAY.
3. INCREASE $\%N_1$ BY 0.17 PER °C ABOVE STANDARD.
4. AIR REFUELING BOOM DEPLOYED.

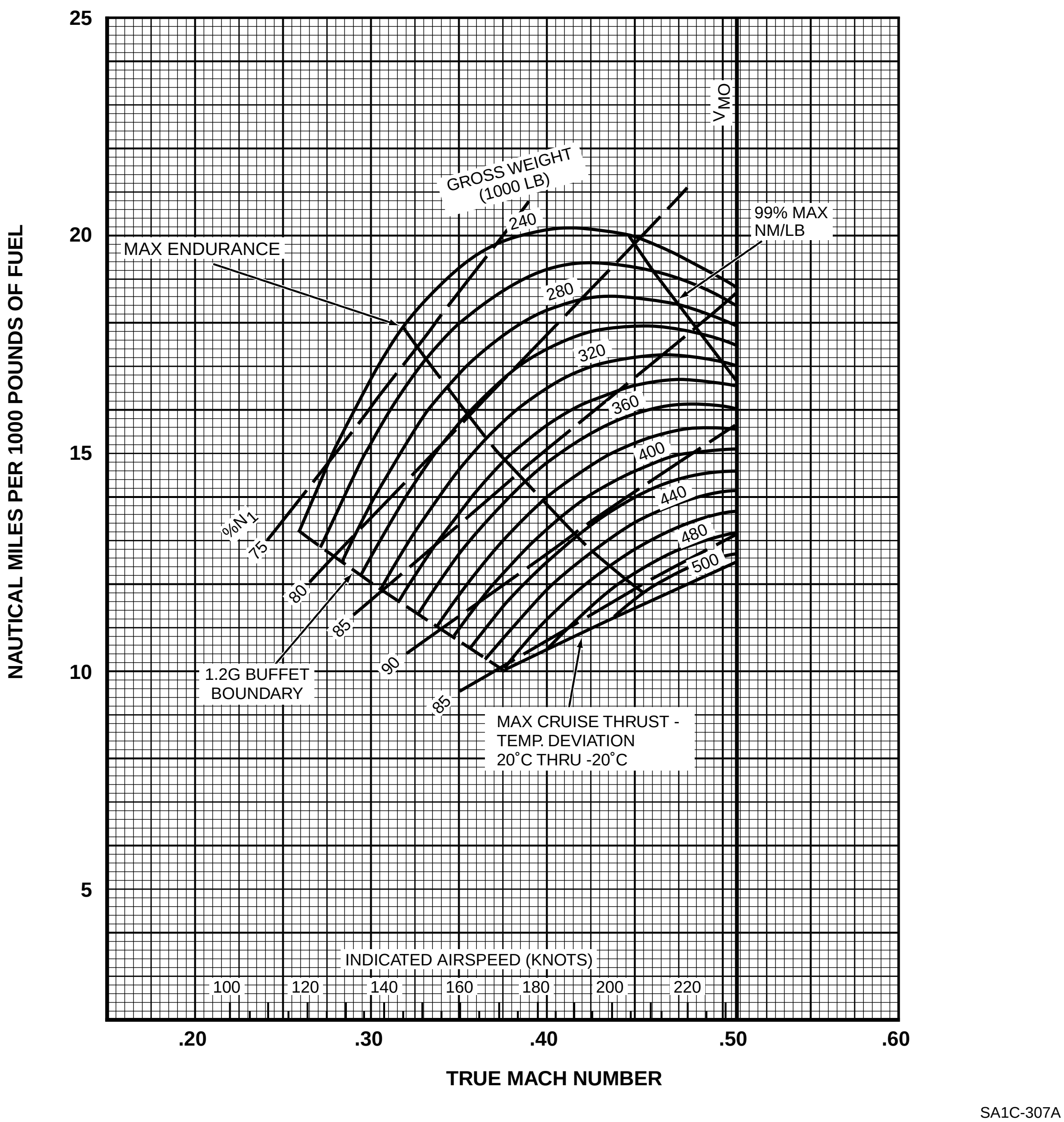


Figure 12-52.

EFFECT OF BANK ANGLE ON PERFORMANCE

NOTE:
1. CLEAN CONFIGURATION.
2. GOOD FOR ONE, TWO, OR THREE ENGINE OPERATION.

EXAMPLE:

GIVEN: GROSS WEIGHT = 420,000 LB
BANK ANGLE = 20°

FIND: EFFECTIVE WEIGHT

SOLUTION: EFFECTIVE WEIGHT = 447,000 LB

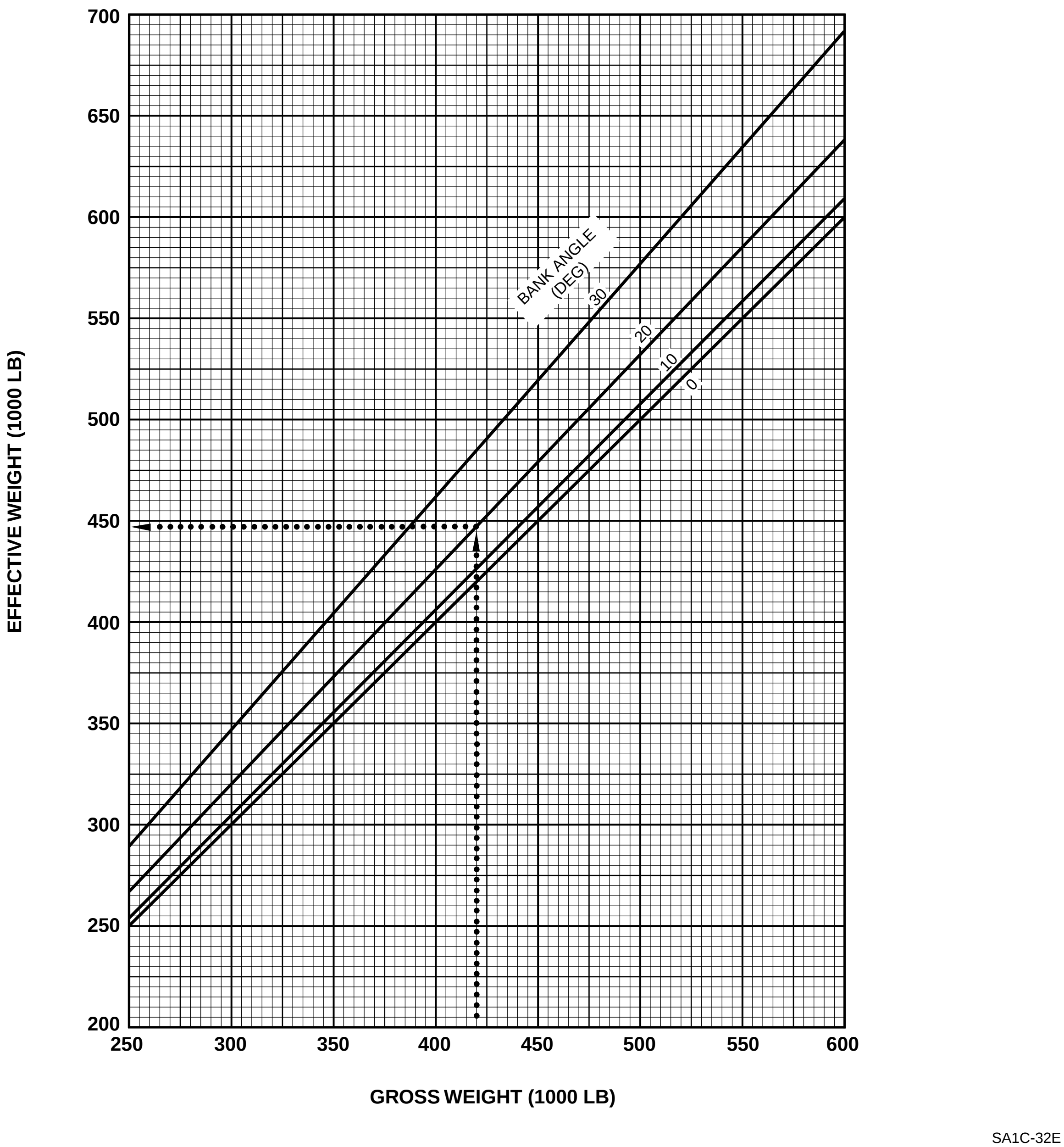


Figure 12-53.

TAKEOFF PLANNING GUIDE FOR GEAR DOWN FLIGHT

STEP 1

List given information (i.e., pressure altitude, OAT, wind, slope, engine bleed, RCR, RSC, runway length and heading, alignment distance, gross weight, CG location) as applicable.

STEP 2

1. Determine runway wind component and crosswind component from figure 3-6.
2. Use wind data to check if takeoff is not allowed due to excessive tailwind or crosswind component from figure 3-6.
3. Adjust wind component as described in figure 3-5.
4. Determine if a rolling takeoff is required due to crosswind using figure 3-6.

STEP 3

Determine the CFCC, if applicable, from figure 3-8.

STEP 4

1. Determine the RALW from figure 3-9 using sheets 1, 2, and 3 with 10 degrees flaps and air conditioning off.
2. Determine the CGLW from figure 3-9 using sheets 3, 4, and 5 with 10 degree flaps, air conditioning off, and a corrected climb gradient of 4.4%.

   NOTE: The actual climb gradient at this weight with the gear down is 2.5%. A 1.9% gradient increment is added to the minimum gradient of 2.5% to account for gear down drag.
3. Compare the RALW with the CGLW and use the lower of the two as the TOGW.

STEP 5

Determine TSLW from figure 3-10. Use OAT and 10 degree flaps.

STEP 6

Compare the TOGW to the TSLW.

SA1C-595

Figure 12-54. (Sheet 1)

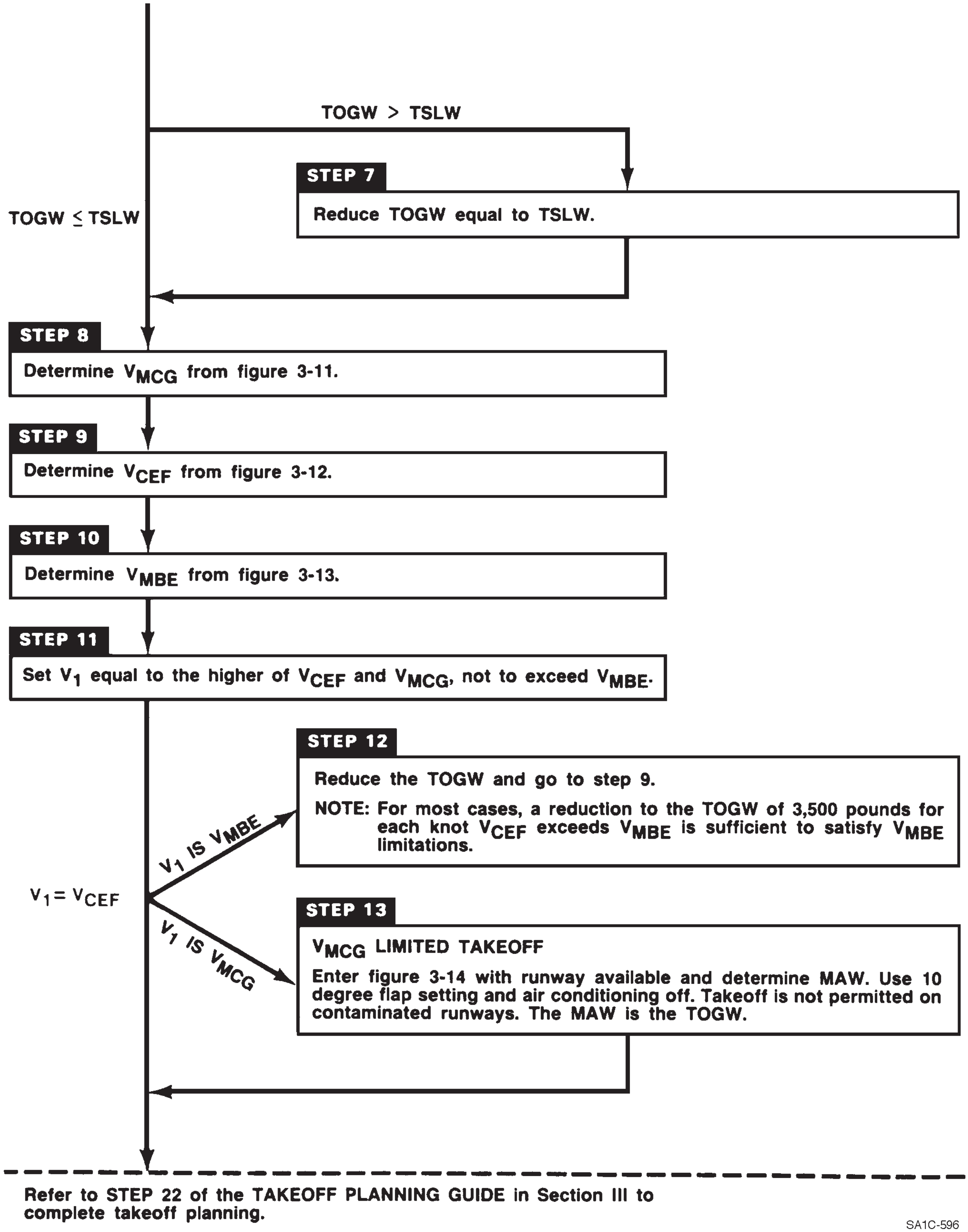


Figure 12-54. (Sheet 2)

THREE ENGINE CLIMB
FUEL TO CLIMB
GEAR DOWN FLIGHT

NOTE:
1. MAXIMUM CLIMB THRUST.
2. CLIMB AT 250 KIAS TO 20,290 FT THEN CLIMB AT MACH=0.55.
3. FLAPS AND SLATS RETRACTED.

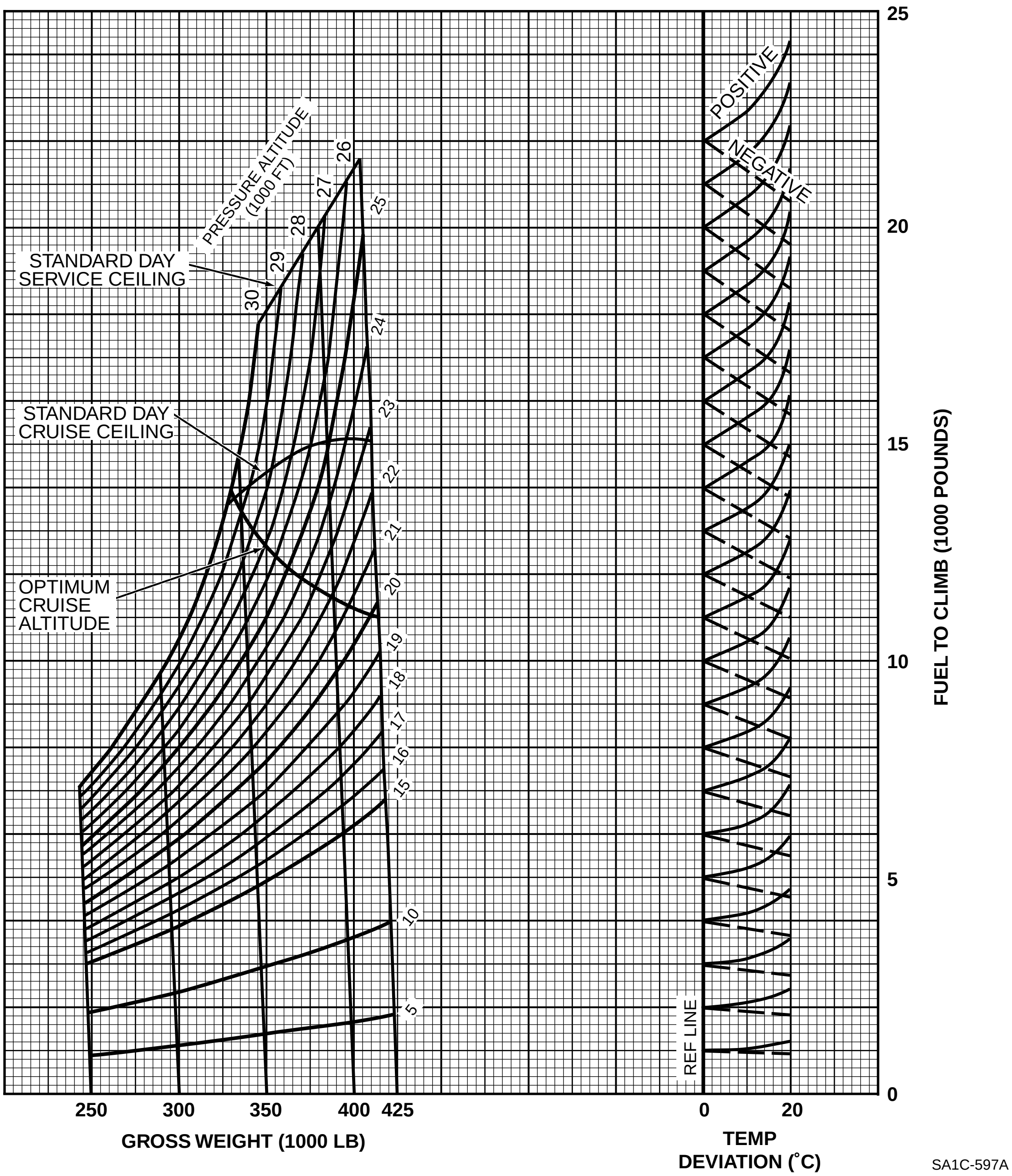


Figure 12-55.

THREE ENGINE CLIMB
DISTANCE TO CLIMB
GEAR DOWN FLIGHT

NOTE:
1. MAXIMUM CLIMB THRUST.
2. CLIMB AT 250 KIAS TO 20,290 FT
   THEN CLIMB AT MACH=0.55.
3. FLAPS AND SLATS RETRACTED.

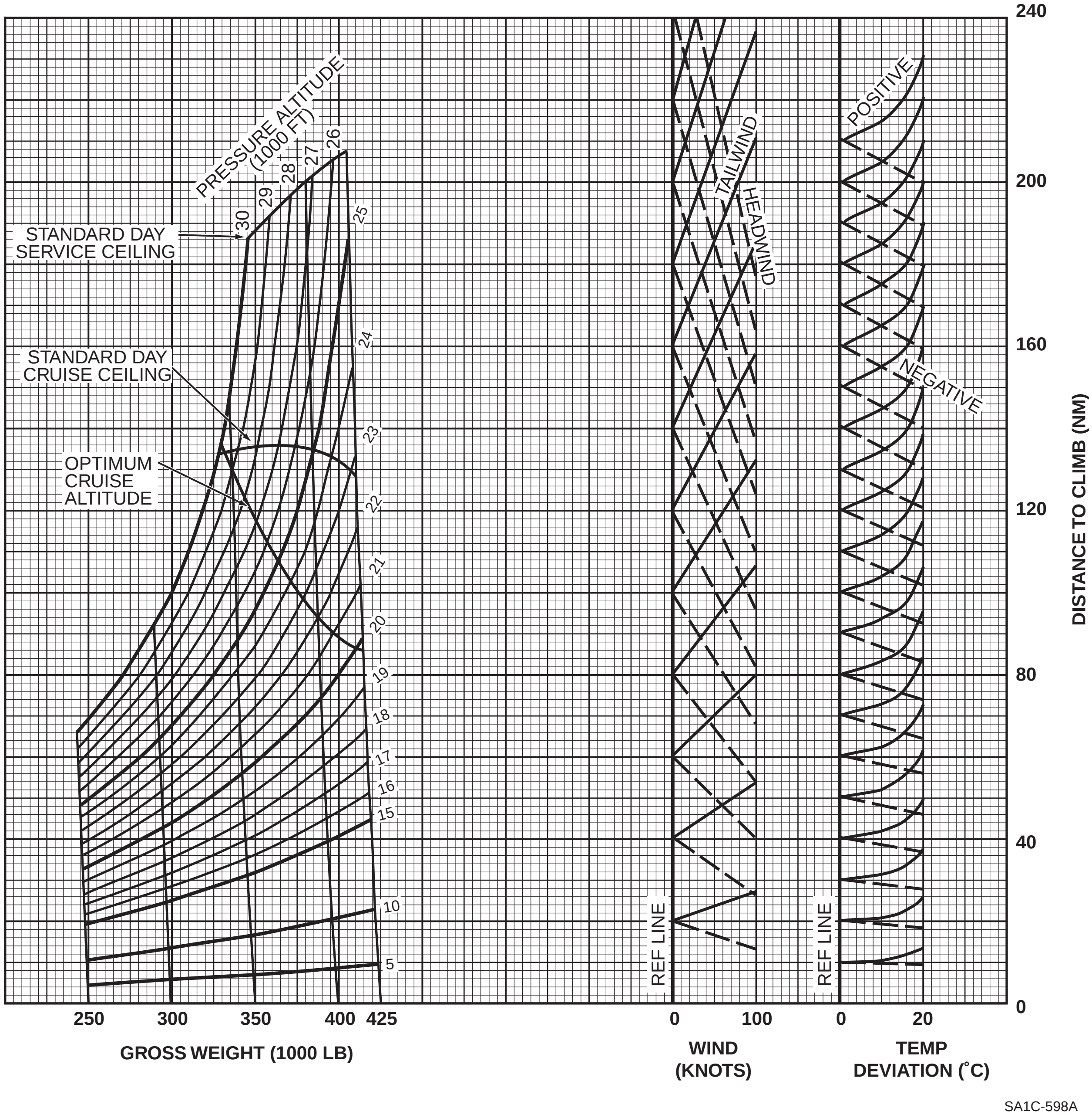


Figure 12-56.

THREE ENGINE CLIMB
TIME TO CLIMB
GEAR DOWN FLIGHT

NOTE:
1. MAXIMUM CLIMB THRUST.
2. CLIMB AT 250 KIAS TO 20,290 FT
   THEN CLIMB AT MACH=0.55.
3. FLAPS AND SLATS RETRACTED.

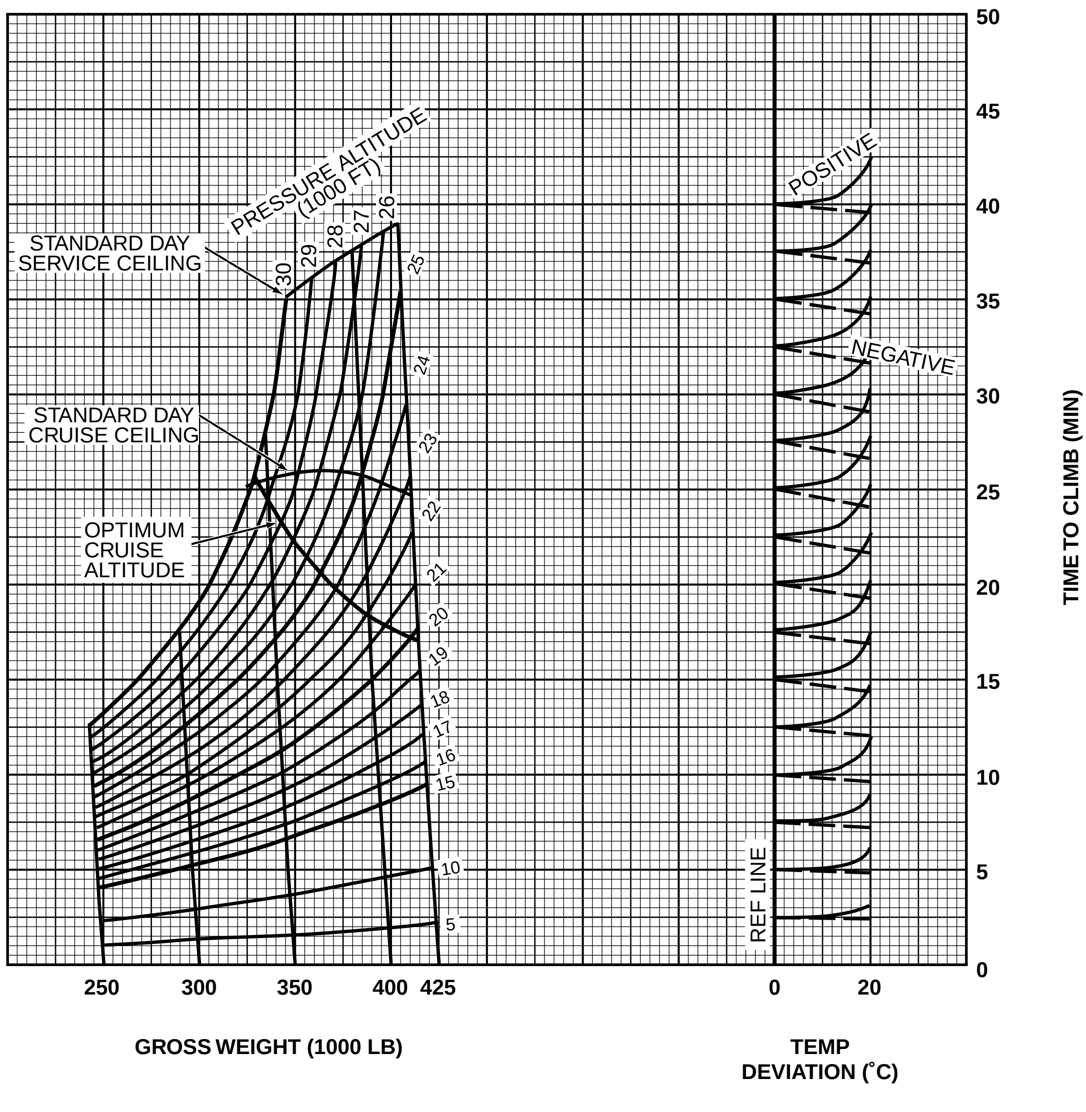


Figure 12-57.

TWO ENGINE CLIMB
FUEL TO CLIMB
GEAR DOWN FLIGHT

NOTE:
1. MAXIMUM CLIMB THRUST.
2. CLIMB AT 250 KIAS.
3. FLAPS AND SLATS RETRACTED.

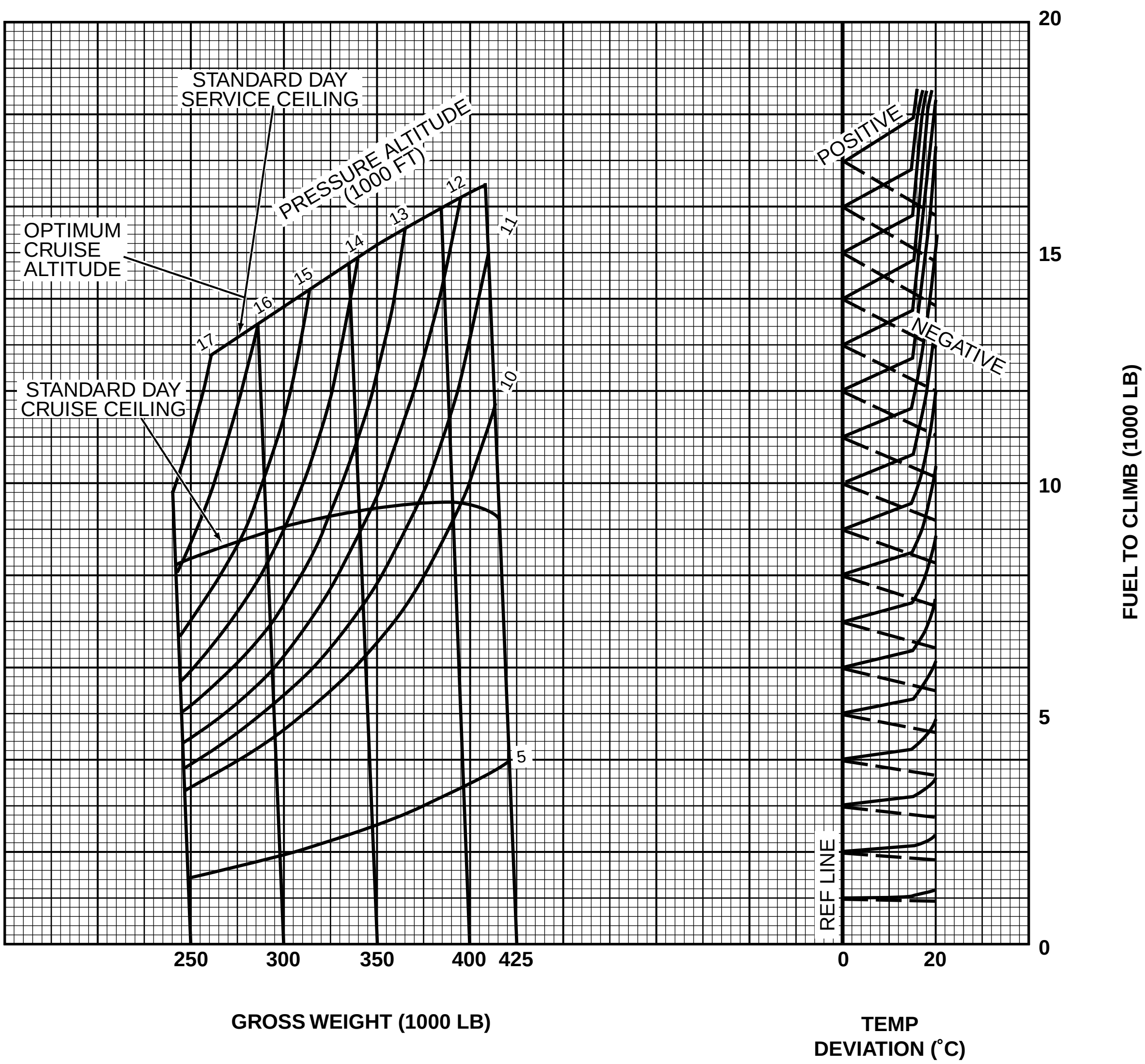


Figure 12-58.

TWO ENGINE CLIMB DISTANCE TO CLIMB GEAR DOWN FLIGHT

NOTE:
1. MAXIMUM CONTINUOUS THRUST.
2. CLIMB AT 250 KIAS.
3. FLAPS AND SLATS RETRACTED.

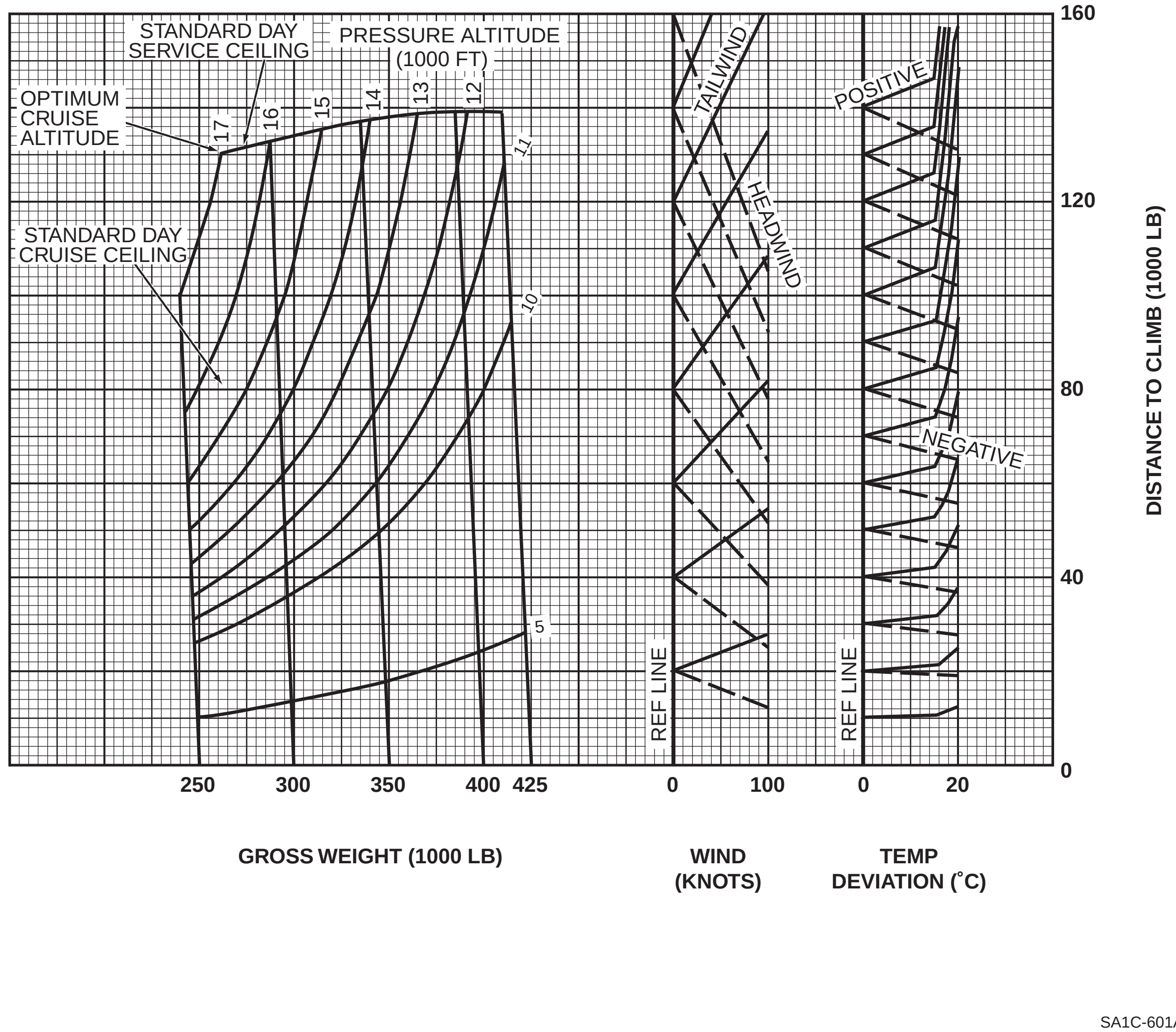


Figure 12-59.

TWO ENGINE CLIMB
TIME TO CLIMB
GEAR DOWN FLIGHT

NOTE:
1. MAXIMUM CONTINUOUS THRUST.
2. CLIMB AT 250 KIAS.
3. FLAPS AND SLATS RETRACTED.

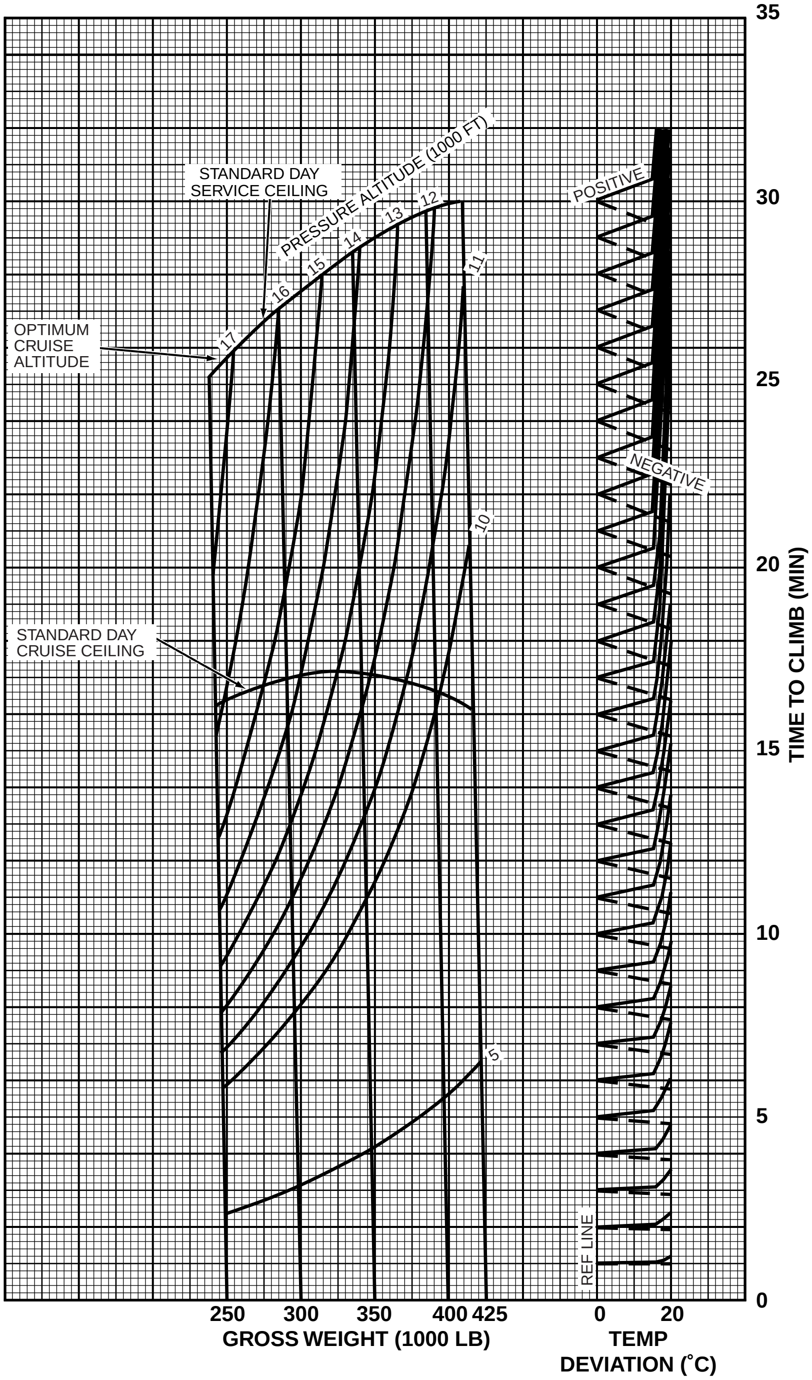


Figure 12-60.

THREE ENGINE CLIMB TABLE GEAR DOWN FLIGHT

NOTE:

1. MAXIMUM CLIMB THRUST.
2. STANDARD DAY.
3. CLIMB AT 250 KIAS TO 20,290 FT THEN CLIMB AT MACH = 0.55.
4. BASED ON CLIMB FROM SEA LEVEL.
5. FLAPS AND SLATS RETRACTED.

FUEL (LB)
DISTANCE (NM)
TIME (MIN)

PRESSURE ALTITUDE (FT)	INITIAL CLIMB GROSS WEIGHT (LB)							
	250,000	275,000	300,000	325,000	350,000	375,000	400,000	425,000
30,000	7100 66 13	8300 78 15	9800 93 18	12,000 114 22	14,800 150 28			
29,000	6800 62 12	7900 73 14	9300 86 17	11,000 104 20	13,500 131 25	18,100 185 35		
27,000	6300 55 11	7300 64 12	8400 75 14	9800 88 17	11,600 106 20	14,300 133 25	19,000 186 35	
25,000	5700 48 9	6600 56 11	7600 65 13	8800 75 15	10,300 89 17	12,200 107 21	14,900 134 26	20,000 187 35
23,000	5200 42 8	6000 48 10	6900 56 11	7900 64 13	9100 75 15	10,600 88 17	12,500 106 21	15,400 133 26
21,000	4700 36 7	5400 41 8	6100 47 9	7000 54 11	8000 62 12	9200 72 14	10,650 85 17	12,600 102 20
19,000	4100 30 6	4700 34 7	5300 39 8	6000 44 9	6800 50 10	7700 57 12	8800 66 13	10,200 77 16
17,000	3500 24 5	4000 27 6	4500 31 6	5100 35 7	5700 40 8	6500 45 9	7300 51 11	8300 58 12
15,000	3000 19 4	3400 22 5	3800 25 5	4300 28 6	4800 31 7	5400 35 8	6100 40 8	6800 45 10
10,000	1900 11 2	2100 12 3	2400 13 3	2600 15 3	2900 17 4	3200 19 4	3600 21 5	4000 23 5
5000	900 5 1	1000 5 1	1100 6 1	1200 6 1	1400 7 2	1500 8 2	1700 9 2	1800 10 2

SA1C-592A

Figure 12-61.

TWO ENGINE CLIMB TABLE GEAR DOWN FLIGHT

NOTE:

1. MAXIMUM CONTINUOUS THRUST.
2. STANDARD DAY.
3. CLIMB AT 250 KIAS.
4. BASED ON CLIMB FROM SEA LEVEL.
5. FLAPS AND SLATS RETRACTED.

FUEL (LB)
DISTANCE (NM)
TIME (MIN)

PRESSURE ALTITUDE (FT)	INITIAL CLIMB GROSS WEIGHT (LB)							
	250,000	275,000	300,000	325,000	350,000	375,000	400,000	425,000
17,000	9700 98 20							
16,000	7800 75 15	9900 96 20						
15,000	6600 60 13	8100 74 16	10,200 95 20	13,700 130 27				
14,000	5700 50 11	6800 60 13	8300 74 16	10,500 94 20	14,000 128 27			
13,000	5000 42 9	5900 50 11	7100 60 13	8600 74 16	10,700 94 20	14,300 127 27		
12,000	4400 36 8	5100 42 9	6100 50 11	7200 60 13	8800 74 16	11,000 94 20	14,700 127 27	
11,000	3800 31 7	4500 36 8	5200 42 9	6200 50 11	7400 60 13	9000 73 16	11,400 94 20	15,300 127 28
10,000	3300 26 6	3900 30 7	4500 35 8	5300 42 9	6300 49 11	7500 59 13	9200 73 16	11,700 94 21
7,000	2100 16 4	2500 18 4	2800 21 5	3300 24 5	3800 28 6	4400 32 7	5200 38 9	6300 46 10
5,000	1500 10 2	1700 12 3	1900 13 3	2200 15 4	2500 18 4	2900 21 5	3400 24 6	4000 28 7

SA1C-593A

Figure 12-62.

THREE ENGINE SPECIFIC RANGE
GEAR DOWN FLIGHT
TRUE PRESSURE ALTITUDE SEA LEVEL

NOTE:

1. STANDARD DAY.
2. INCREASE % N_1 BY 0.13 PER °C ABOVE STANDARD.
3. FOR HOLDING USE 1.2G BUFFET BOUNDARY SPEED PLUS 20 KNOTS OR V_{MO}, WHICHEVER IS LOWER.

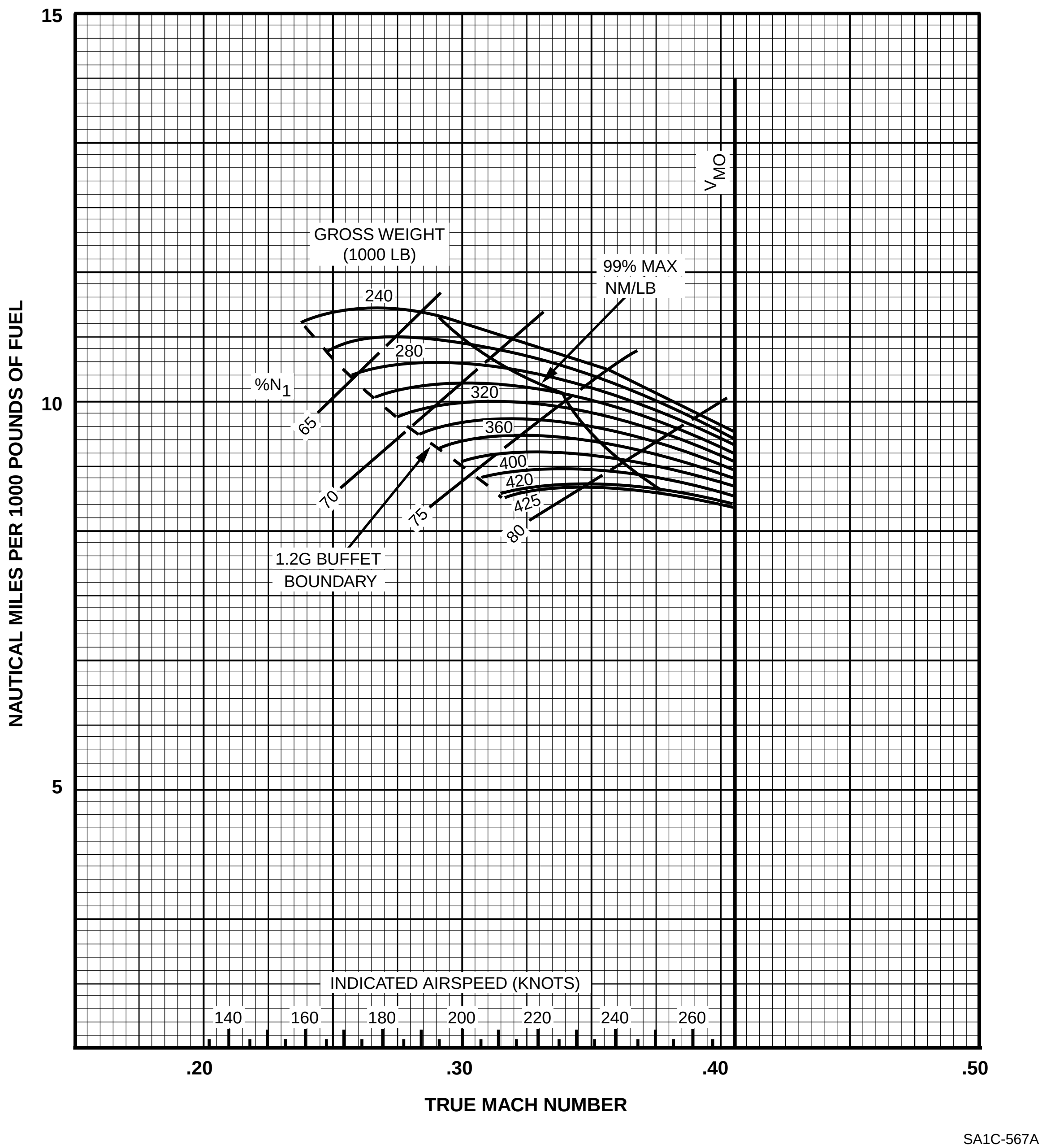


Figure 12-63.

THREE ENGINE SPECIFIC RANGE
GEAR DOWN FLIGHT
TRUE PRESSURE ALTITUDE 5000 FT

NOTE:

1. STANDARD DAY.
2. INCREASE % N_1 BY 0.14 PER °C ABOVE STANDARD.
3. FOR HOLDING USE 1.2G BUFFET BOUNDARY SPEED PLUS 20 KNOTS OR V_{MO}, WHICHEVER IS LOWER.

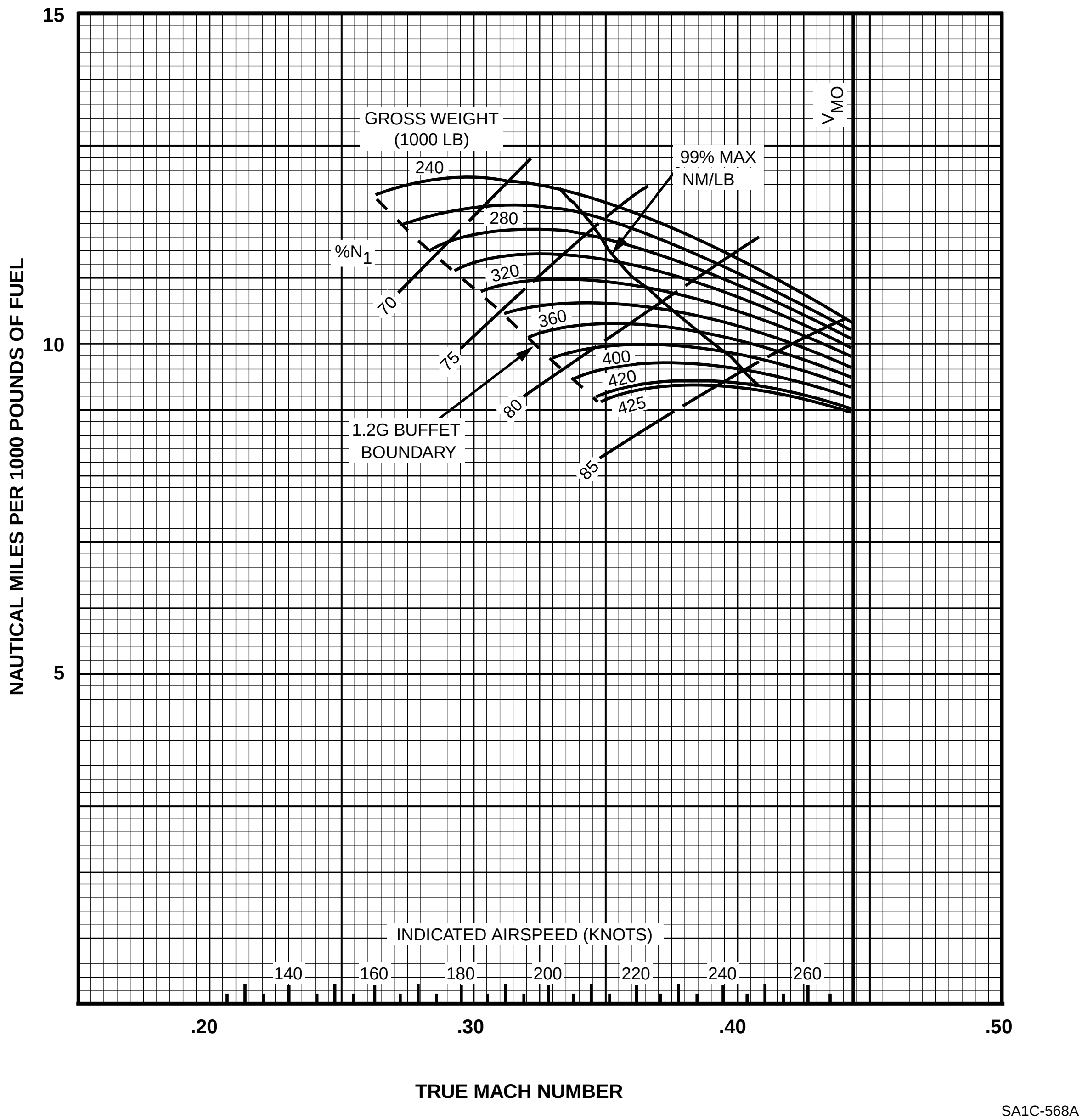


Figure 12-64.

THREE ENGINE SPECIFIC RANGE
GEAR DOWN FLIGHT
TRUE PRESSURE ALTITUDE 8,000 FT

NOTE:

1. STANDARD DAY.
2. INCREASE % N_1 BY 0.15 PER °C ABOVE STANDARD.
3. FOR HOLDING USE 1.2G BUFFET BOUNDARY SPEED PLUS 20 KNOTS OR V_{MO}, WHICHEVER IS LOWER.

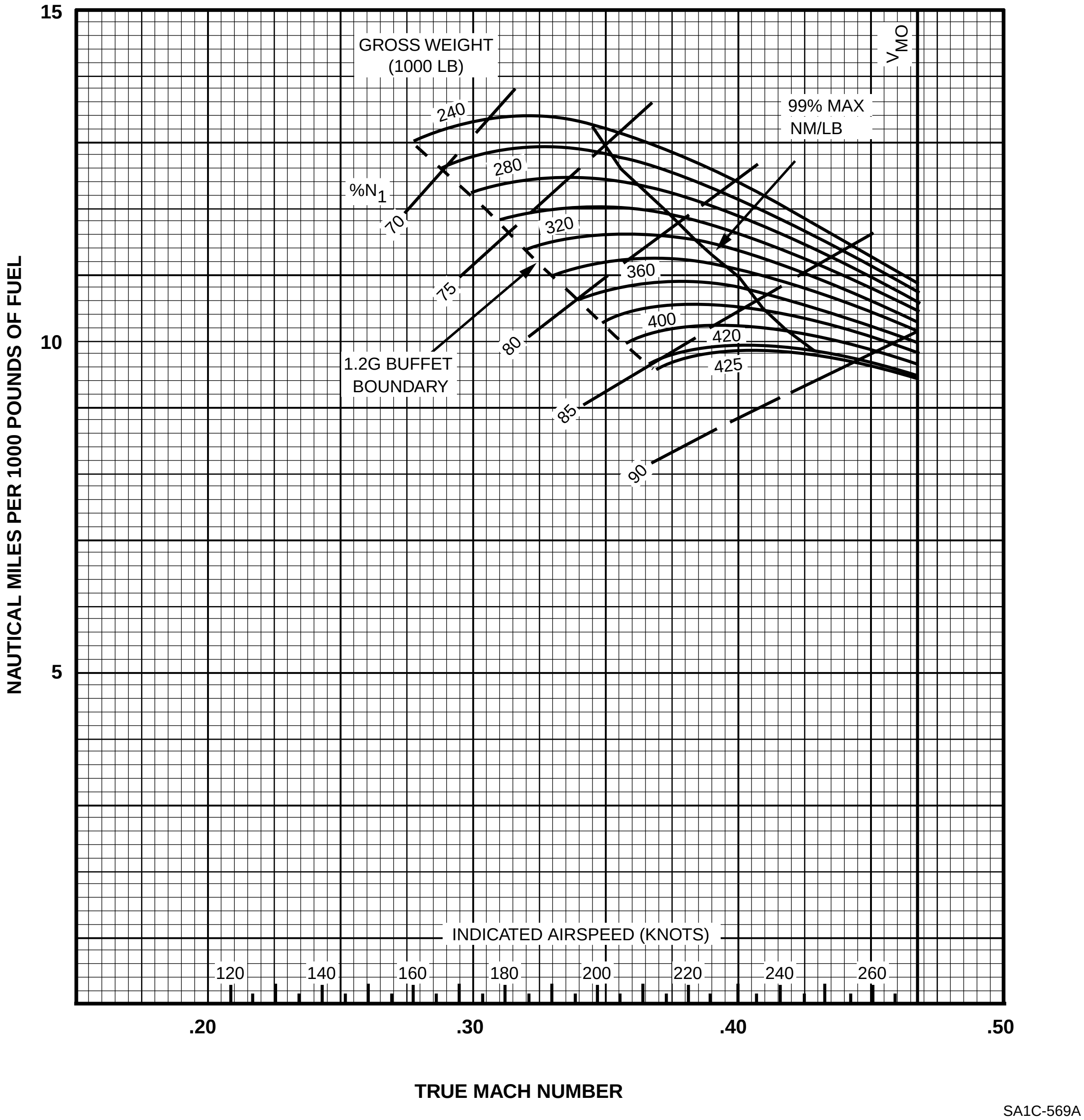


Figure 12-65.

THREE ENGINE SPECIFIC RANGE
GEAR DOWN FLIGHT
TRUE PRESSURE ALTITUDE 10,000 FT

NOTE:

1. STANDARD DAY.
2. INCREASE % N_1 BY 0.15 PER °C ABOVE STANDARD.
3. FOR HOLDING USE 1.2G BUFFET BOUNDARY SPEED PLUS 20 KNOTS OR V_{MO}, WHICHEVER IS LOWER.

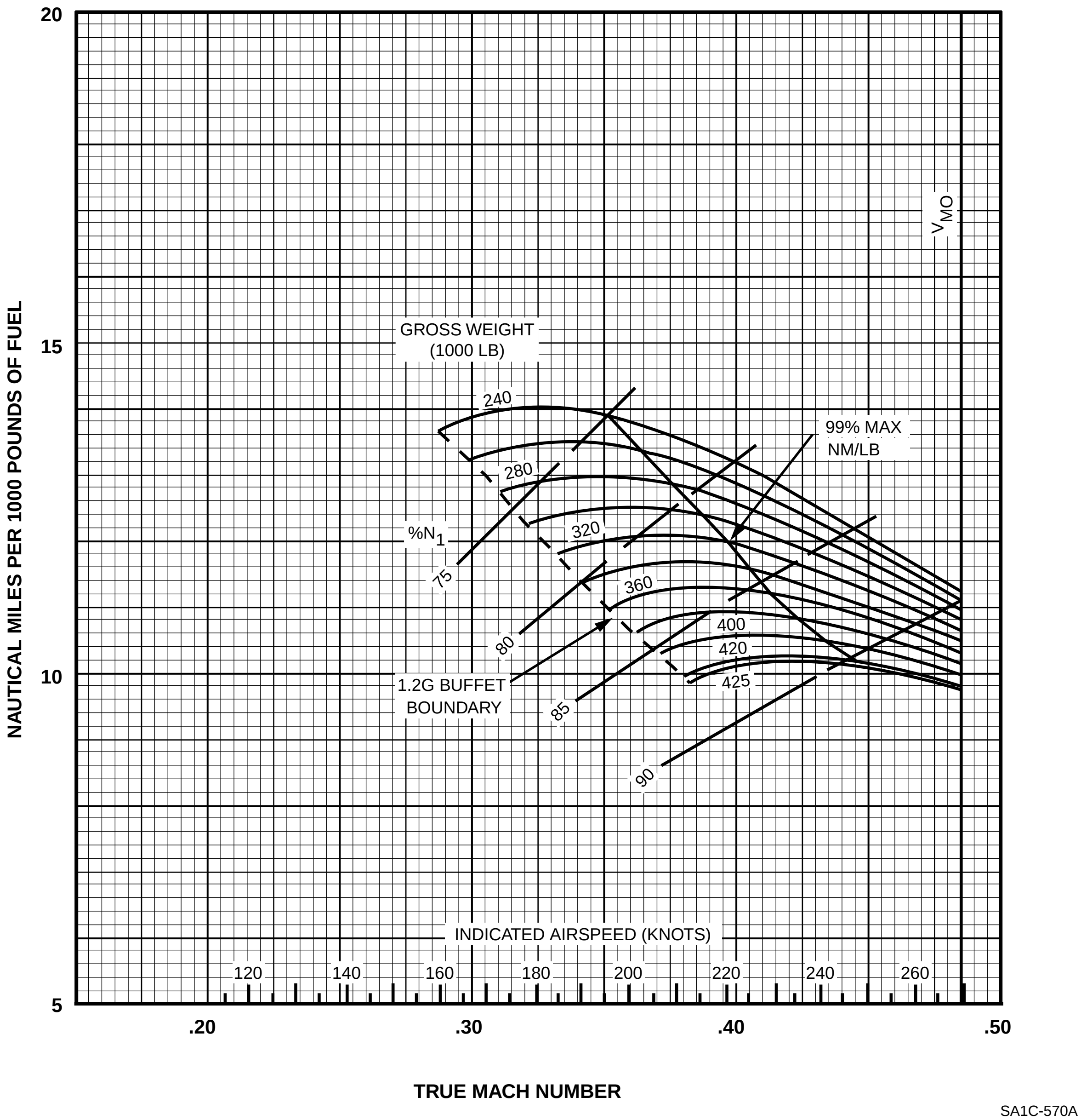


Figure 12-66.

THREE ENGINE SPECIFIC RANGE GEAR DOWN FLIGHT
TRUE PRESSURE ALTITUDE 12,000 FT

NOTE:

1. STANDARD DAY.
2. INCREASE % N_1 BY 0.16 PER °C ABOVE STANDARD.
3. FOR HOLDING USE 1.2G BUFFET BOUNDARY SPEED PLUS 20 KNOTS OR V_{MO}, WHICHEVER IS LOWER.

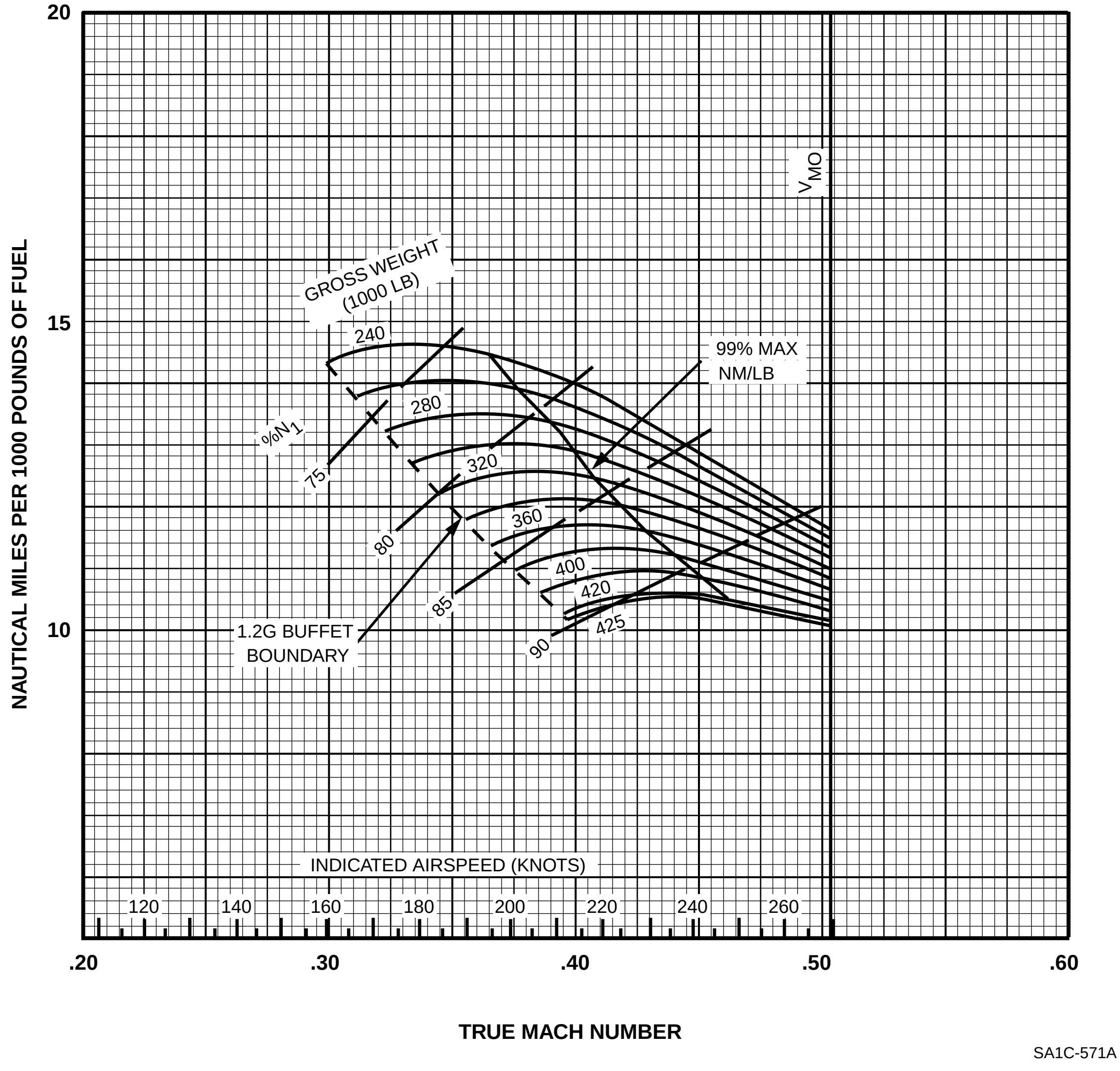


Figure 12-67.

THREE ENGINE SPECIFIC RANGE
GEAR DOWN FLIGHT
TRUE PRESSURE ALTITUDE 14,000 FT

NOTE:

1. STANDARD DAY.
2. INCREASE % N_1 BY 0.17 PER °C ABOVE STANDARD.
3. FOR HOLDING USE 1.2G BUFFET BOUNDARY SPEED PLUS 20 KNOTS OR V_{MO}, WHICHEVER IS LOWER.

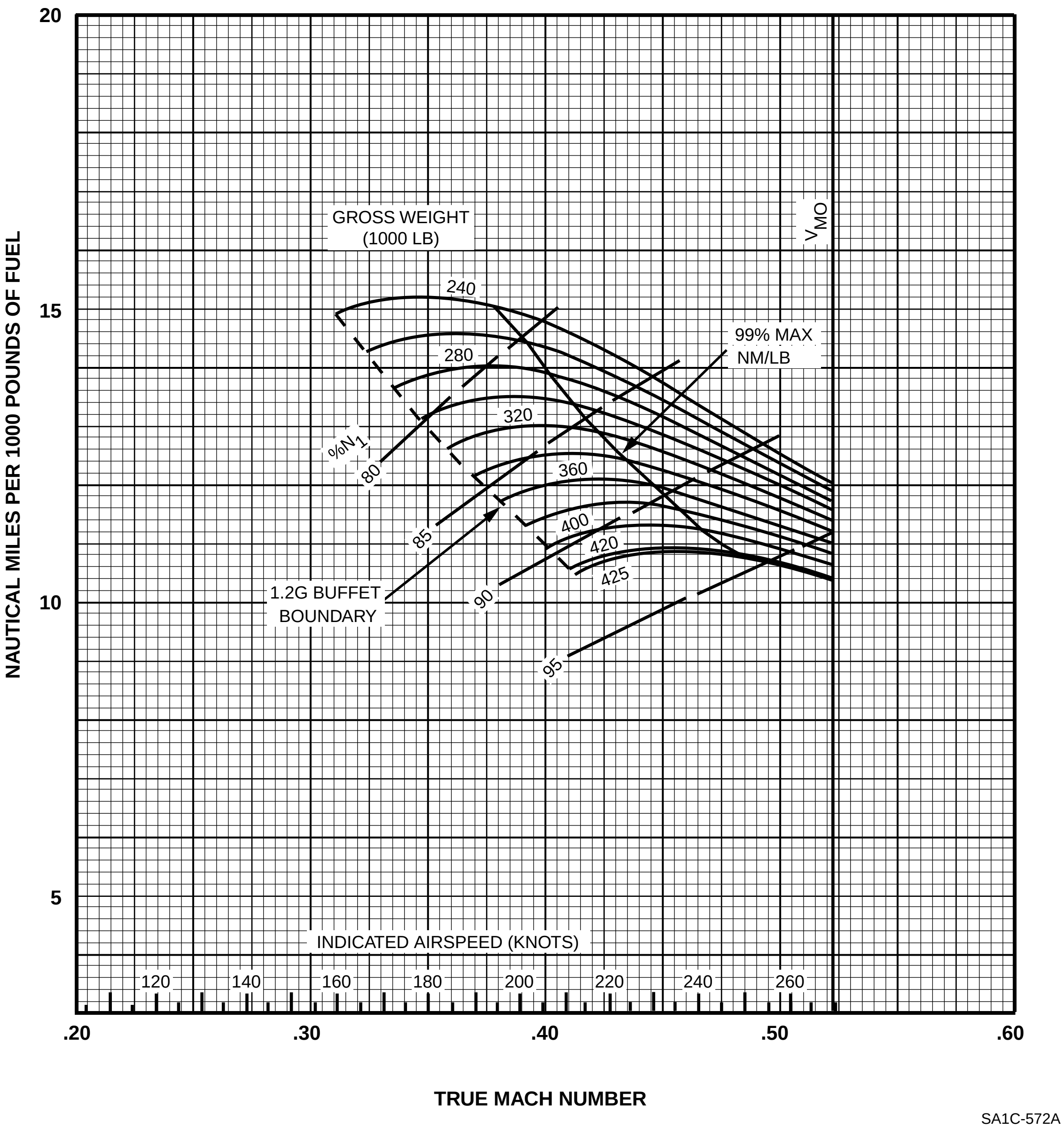


Figure 12-68.

THREE ENGINE SPECIFIC RANGE
GEAR DOWN FLIGHT
TRUE PRESSURE ALTITUDE 16,000 FT

NOTE:

1. STANDARD DAY.
2. INCREASE % N_1 BY 0.17 PER °C ABOVE STANDARD.
3. FOR HOLDING USE 1.2G BUFFET BOUNDARY SPEED PLUS 20 KNOTS OR V_{MO}, WHICHEVER IS LOWER.

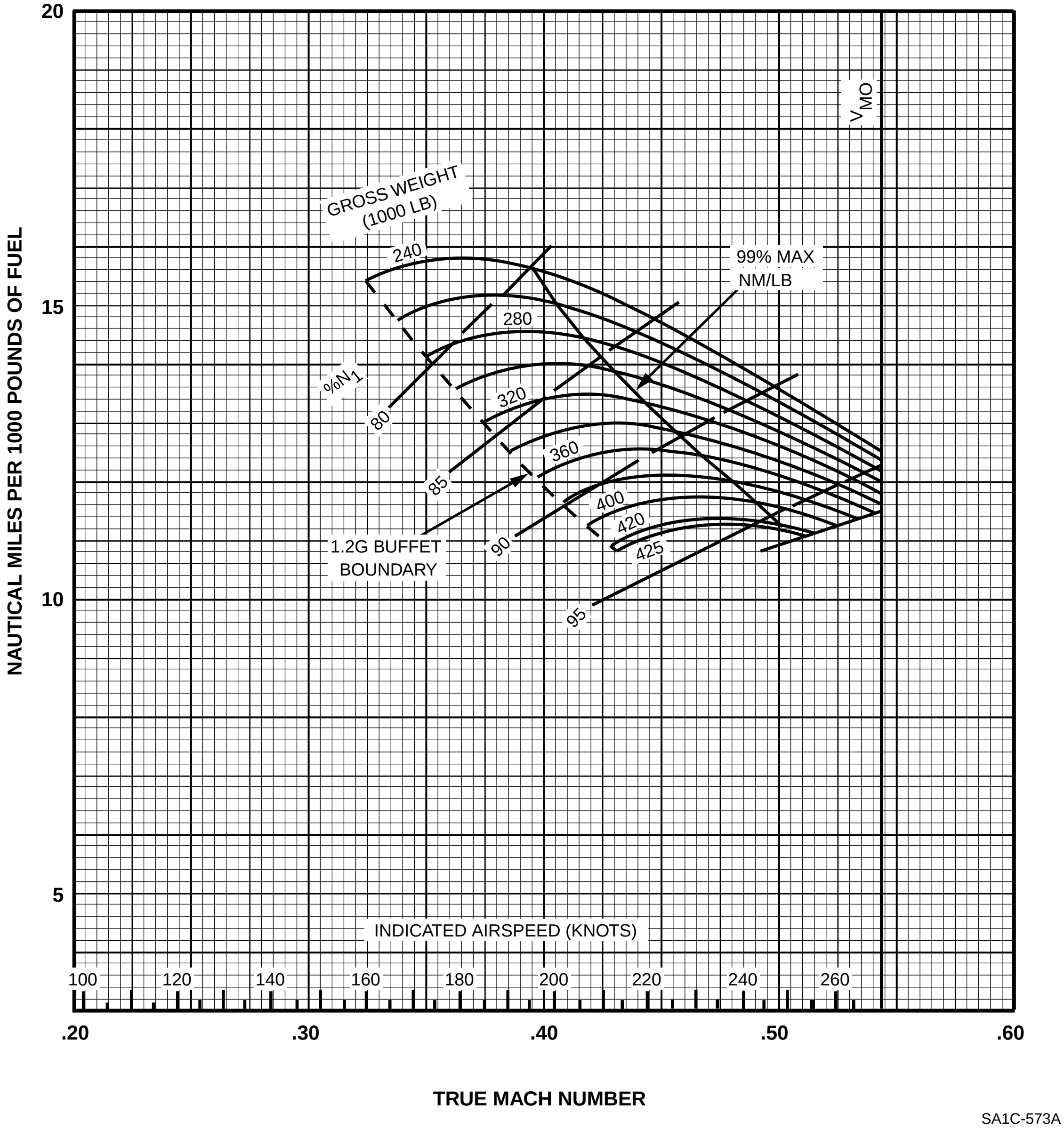


Figure 12-69.

THREE ENGINE SPECIFIC RANGE
GEAR DOWN FLIGHT
TRUE PRESSURE ALTITUDE 18,000 FT

NOTE:

1. STANDARD DAY.
2. INCREASE % N_1 BY 0.18 PER °C ABOVE STANDARD.
3. FOR HOLDING USE 1.2G BUFFET BOUNDARY SPEED PLUS 20 KNOTS OR V_{MO}, WHICHEVER IS LOWER.

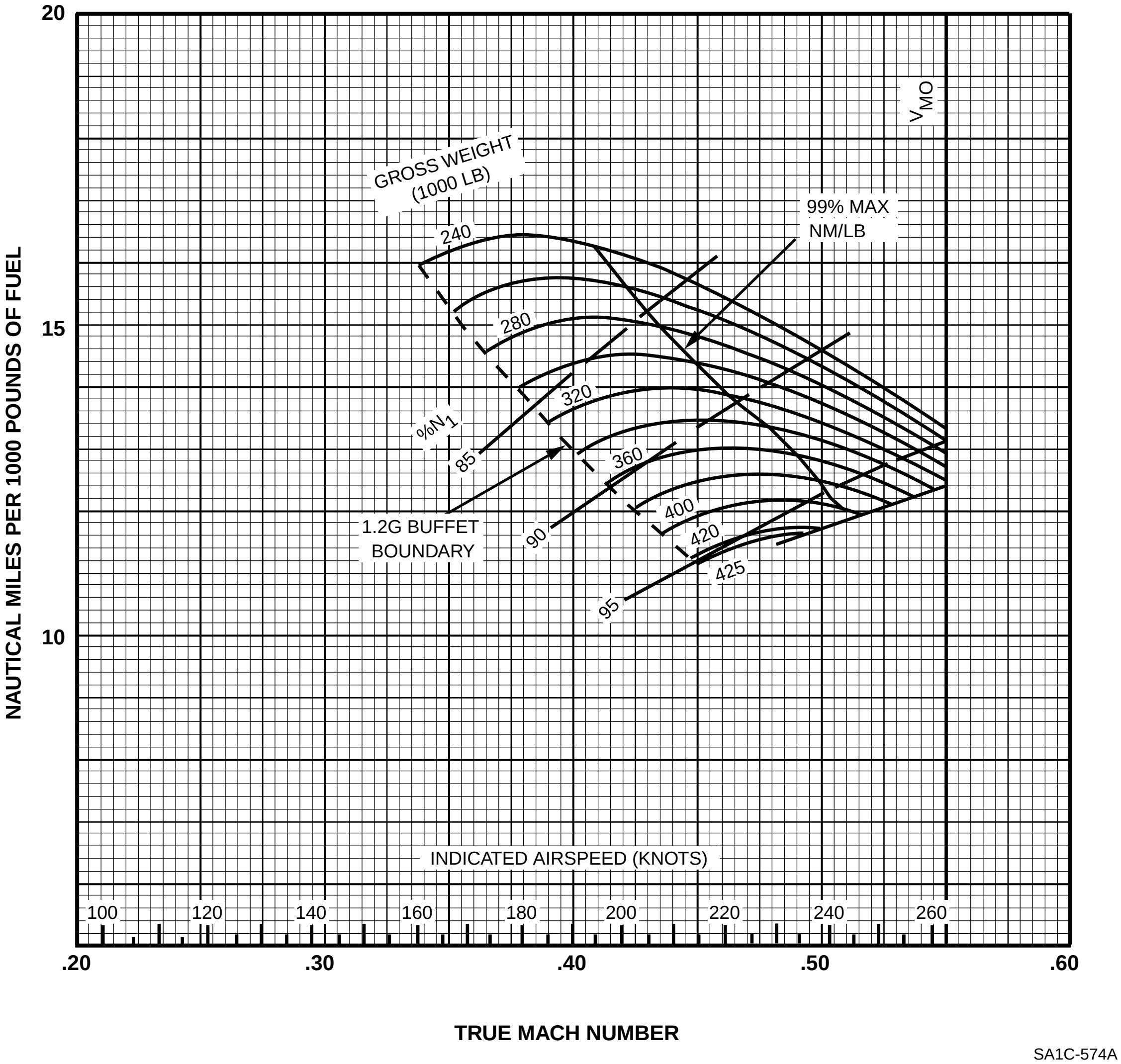


Figure 12-70.

THREE ENGINE SPECIFIC RANGE
GEAR DOWN FLIGHT
TRUE PRESSURE ALTITUDE 20,000 FT

NOTE:

1. STANDARD DAY.
2. INCREASE % N_1 BY 0.18 PER °C ABOVE STANDARD.
3. FOR HOLDING USE 1.2G BUFFET BOUNDARY SPEED PLUS 20 KNOTS OR V_{MO}, WHICHEVER IS LOWER.

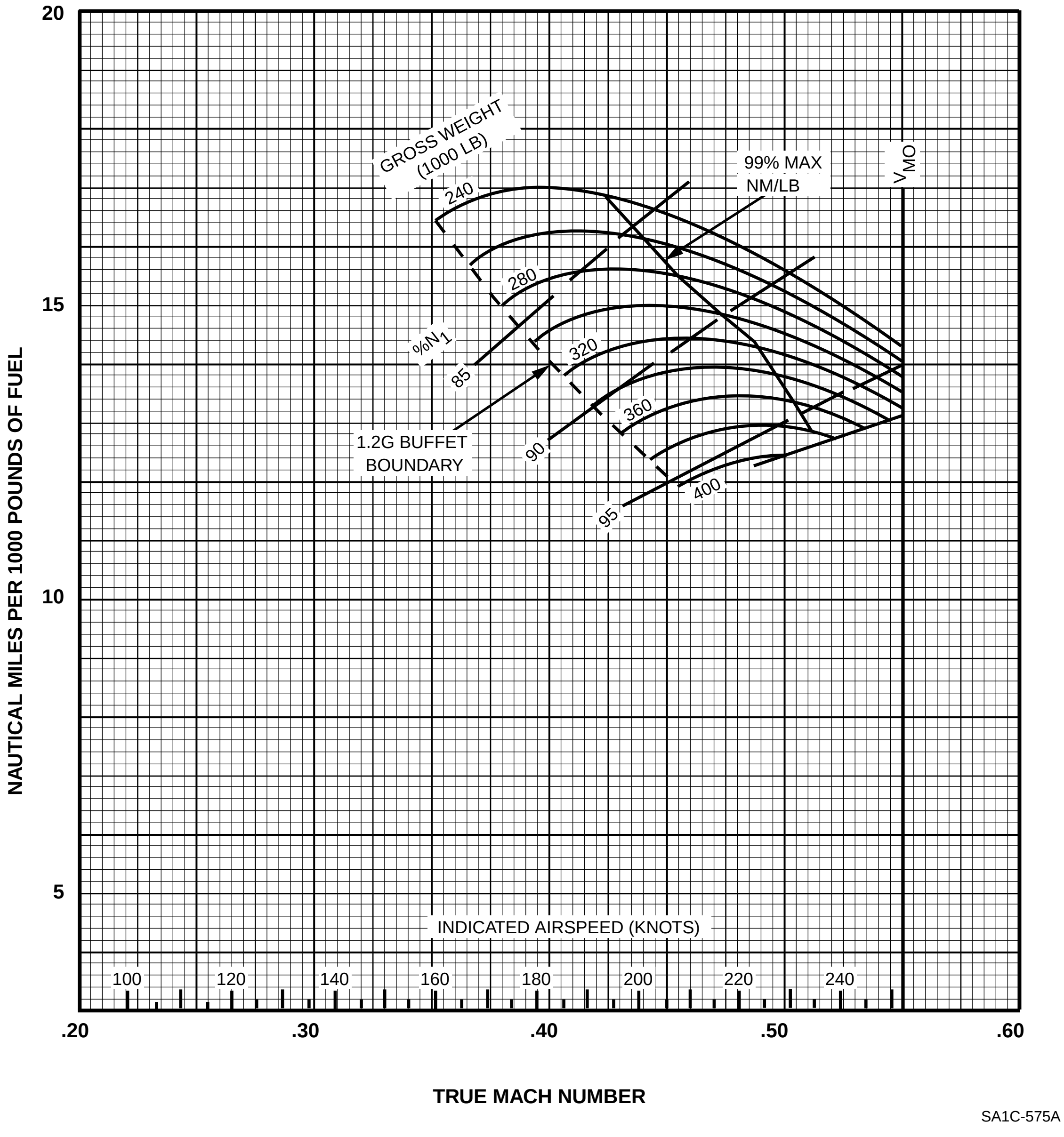


Figure 12-71.

THREE ENGINE SPECIFIC RANGE
GEAR DOWN FLIGHT
TRUE PRESSURE ALTITUDE 21,000 FT

NOTE:

1. STANDARD DAY.
2. INCREASE % N_1 BY 0.19 PER °C ABOVE STANDARD.
3. FOR HOLDING USE 1.2G BUFFET BOUNDARY SPEED PLUS 20 KNOTS OR V_{MO}, WHICHEVER IS LOWER.

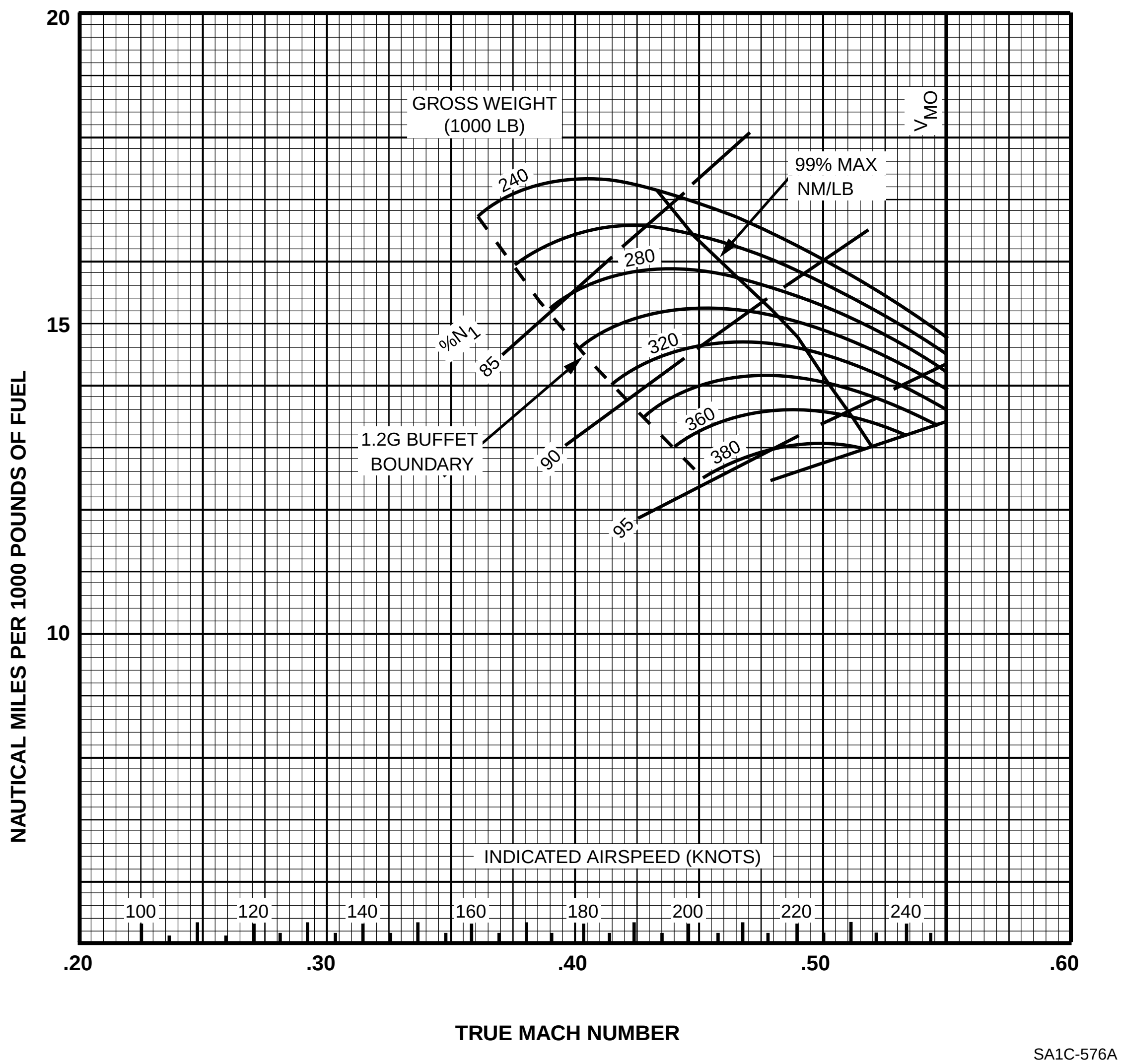


Figure 12-72.

THREE ENGINE SPECIFIC RANGE
GEAR DOWN FLIGHT
TRUE PRESSURE ALTITUDE 22,000 FT

NOTE:

1. STANDARD DAY.
2. INCREASE % N_1 BY 0.19 PER °C ABOVE STANDARD.
3. FOR HOLDING USE 1.2G BUFFET BOUNDARY SPEED PLUS 20 KNOTS OR V_{MO}, WHICHEVER IS LOWER.

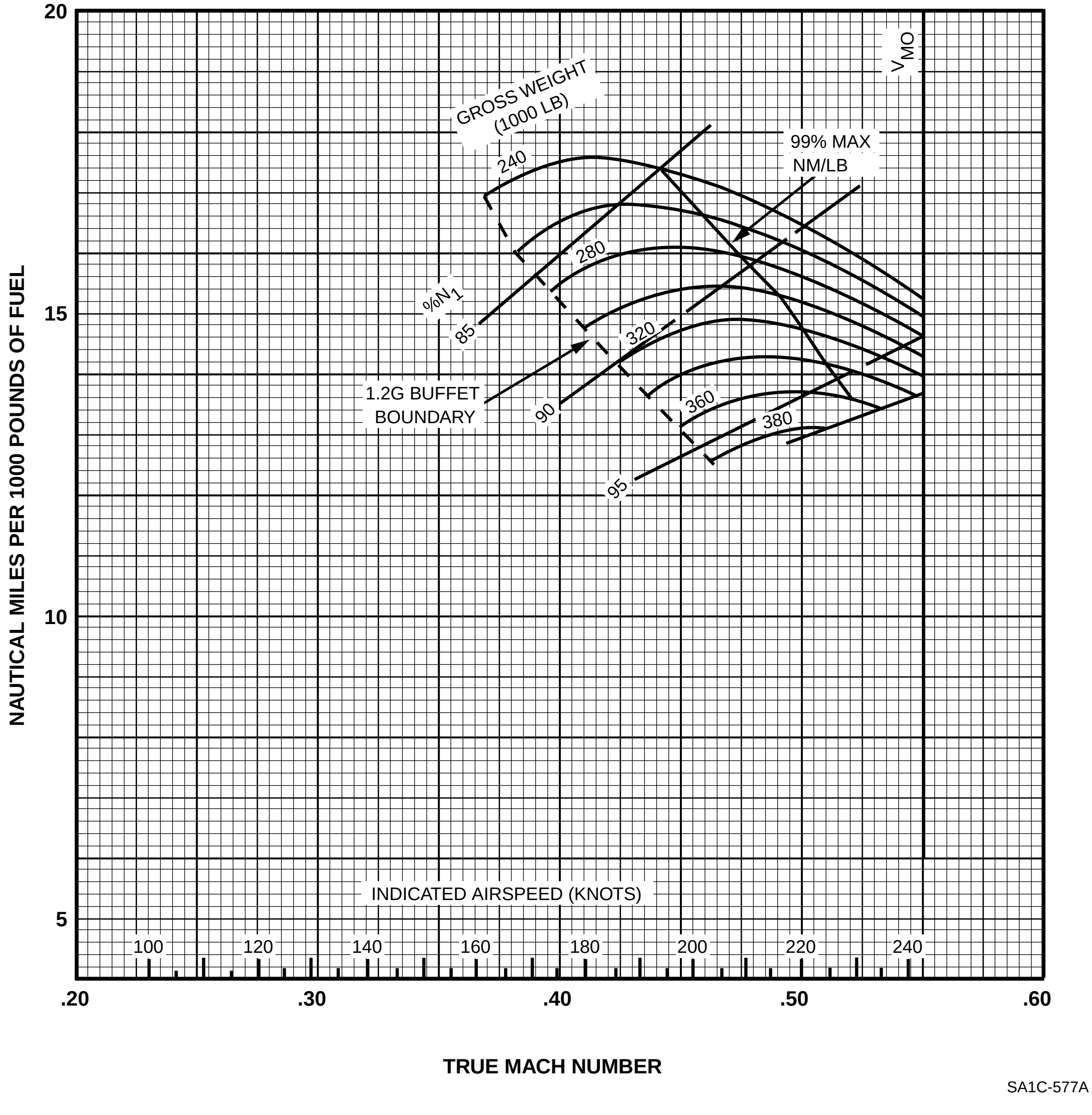


Figure 12-73.

THREE ENGINE SPECIFIC RANGE
GEAR DOWN FLIGHT
TRUE PRESSURE ALTITUDE 23,000 FT

NOTE:

1. STANDARD DAY.
2. INCREASE % N_1 BY 0.20 PER °C ABOVE STANDARD.
3. FOR HOLDING USE 1.2G BUFFET BOUNDARY SPEED PLUS 20 KNOTS OR V_{MO}, WHICHEVER IS LOWER.

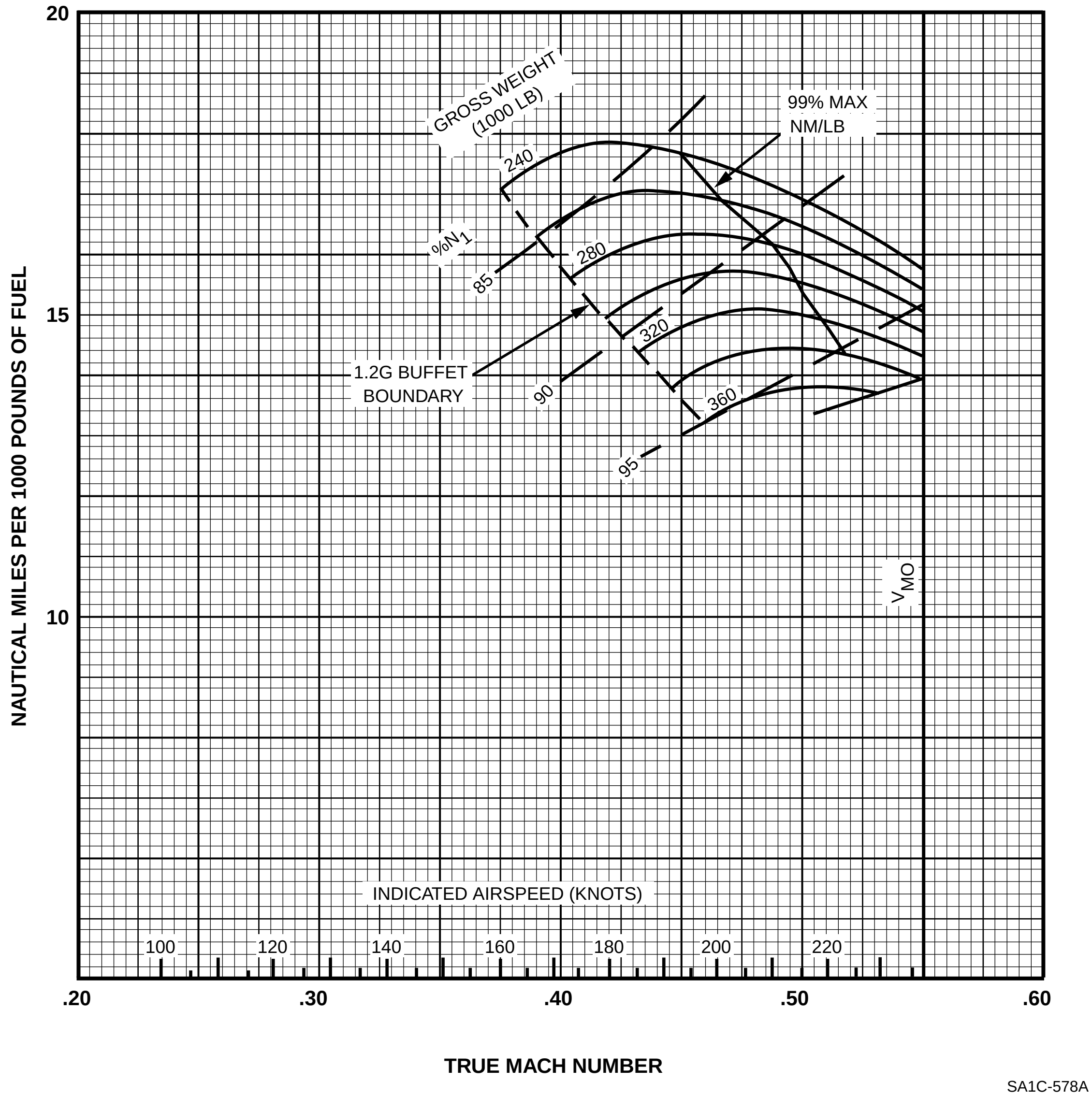


Figure 12-74.

THREE ENGINE SPECIFIC RANGE
GEAR DOWN FLIGHT
TRUE PRESSURE ALTITUDE 24,000 FT

NOTE:

1. STANDARD DAY.
2. INCREASE % N_1 BY 0.20 PER °C ABOVE STANDARD.
3. FOR HOLDING USE 1.2G BUFFET BOUNDARY SPEED PLUS 20 KNOTS OR V_{MO}, WHICHEVER IS LOWER.

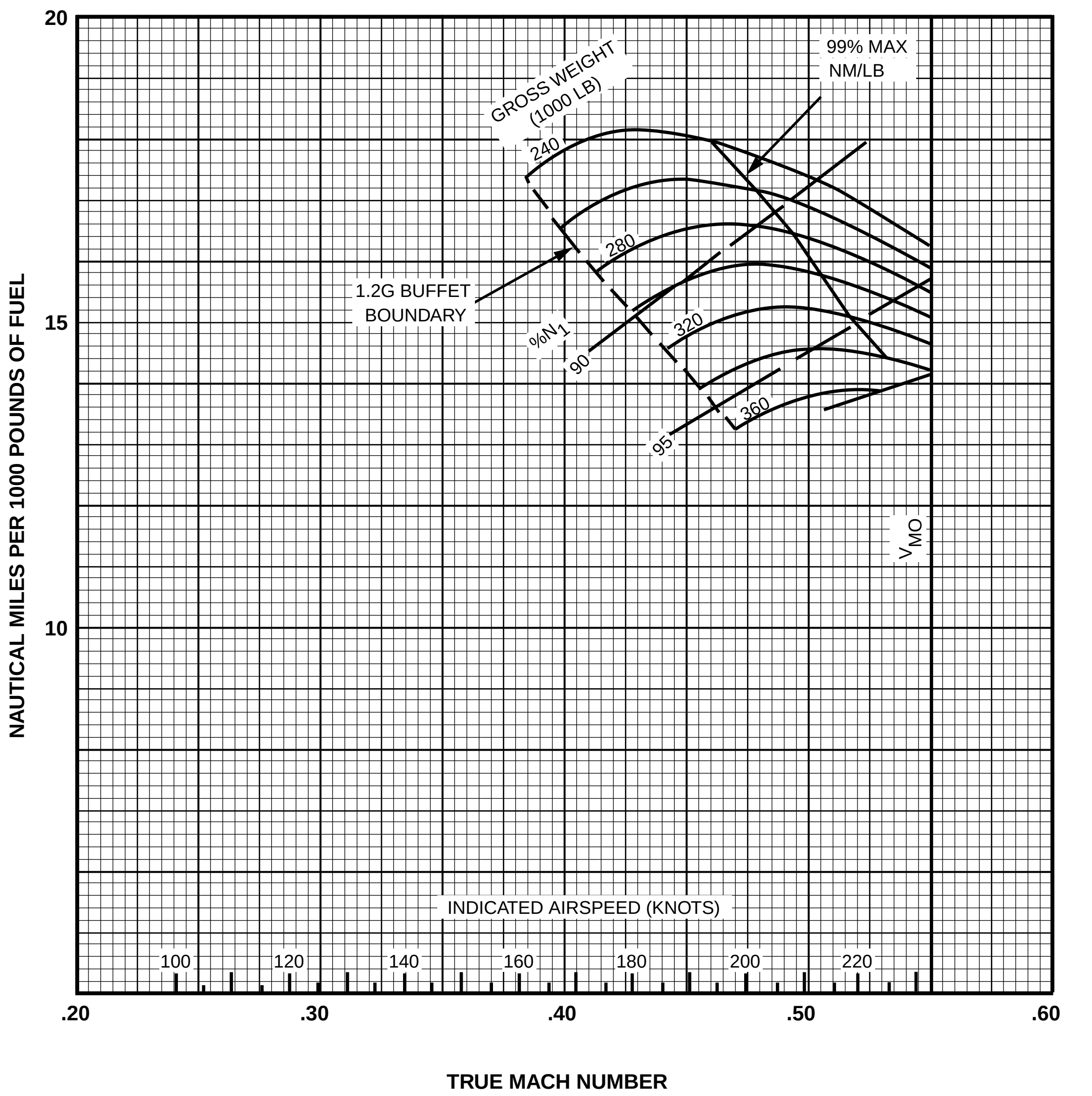


Figure 12-75.

THREE ENGINE SPECIFIC RANGE
GEAR DOWN FLIGHT
TRUE PRESSURE ALTITUDE 25,000 FT

NOTE:

1. STANDARD DAY.
2. INCREASE % N_1 BY 0.20 PER °C ABOVE STANDARD.
3. FOR HOLDING USE 1.2G BUFFET BOUNDARY SPEED PLUS 20 KNOTS OR V_{MO}, WHICHEVER IS LOWER.

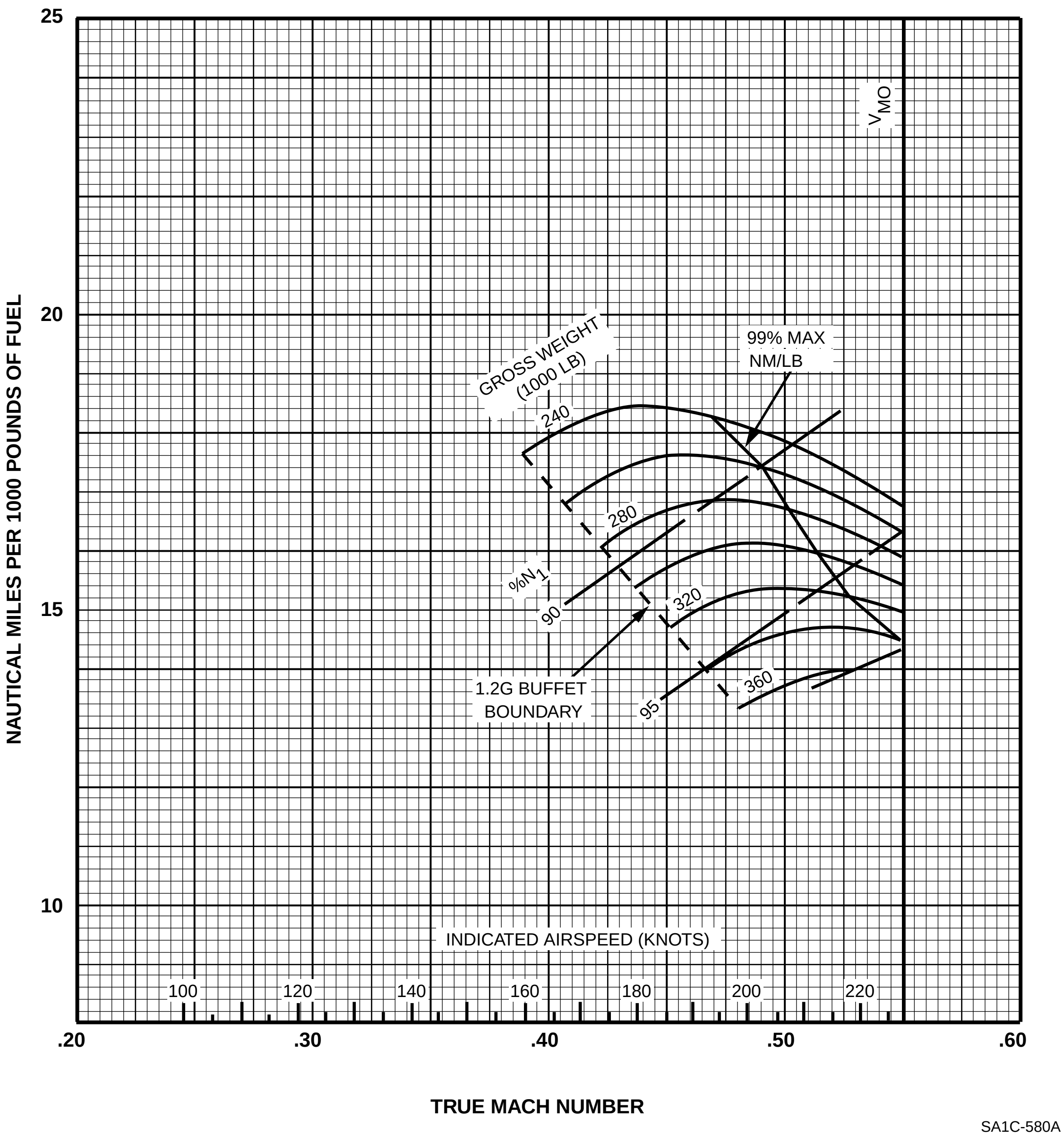


Figure 12-76.

THREE ENGINE SPECIFIC RANGE
GEAR DOWN FLIGHT
TRUE PRESSURE ALTITUDE 26,000 FT

NOTE:

1. STANDARD DAY.
2. INCREASE % N_1 BY 0.20 PER °C ABOVE STANDARD.
3. FOR HOLDING USE 1.2G BUFFET BOUNDARY SPEED PLUS 20 KNOTS OR V_{MO}, WHICHEVER IS LOWER.

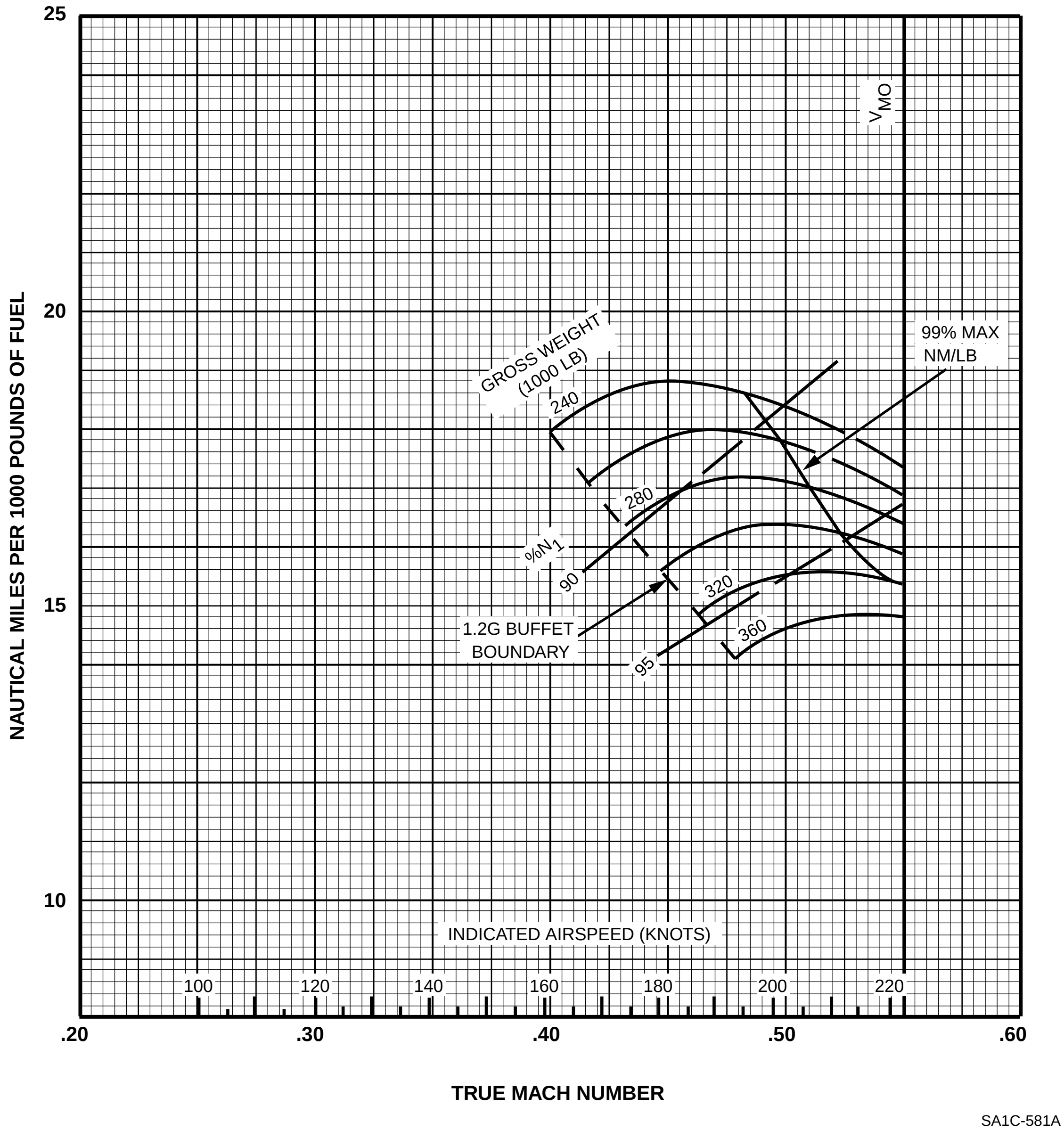


Figure 12-77.

THREE ENGINE SPECIFIC RANGE
GEAR DOWN FLIGHT
TRUE PRESSURE ALTITUDE 27,000 FT

NOTE:

1. STANDARD DAY.
2. INCREASE % N_1 BY 0.20 PER °C ABOVE STANDARD.
3. FOR HOLDING USE 1.2G BUFFET BOUNDARY SPEED PLUS 20 KNOTS OR V_{MO}, WHICHEVER IS LOWER.

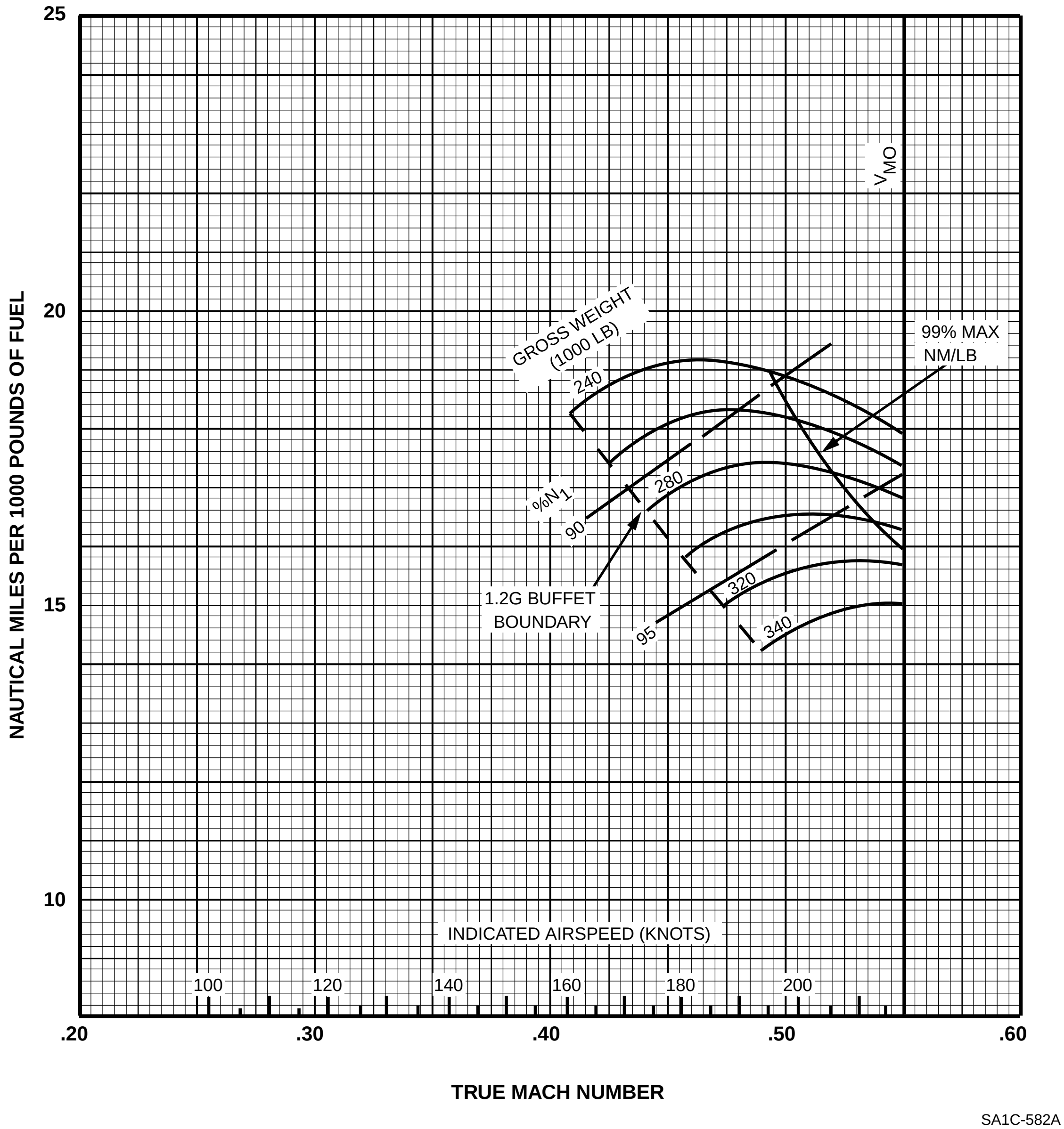


Figure 12-78.

THREE ENGINE SPECIFIC RANGE
GEAR DOWN FLIGHT
TRUE PRESSURE ALTITUDE 28,000 FT

NOTE:

1. STANDARD DAY.
2. INCREASE % N_1 BY 0.20 PER °C ABOVE STANDARD.
3. FOR HOLDING USE 1.2G BUFFET BOUNDARY SPEED PLUS 20 KNOTS OR V_{MO}, WHICHEVER IS LOWER.

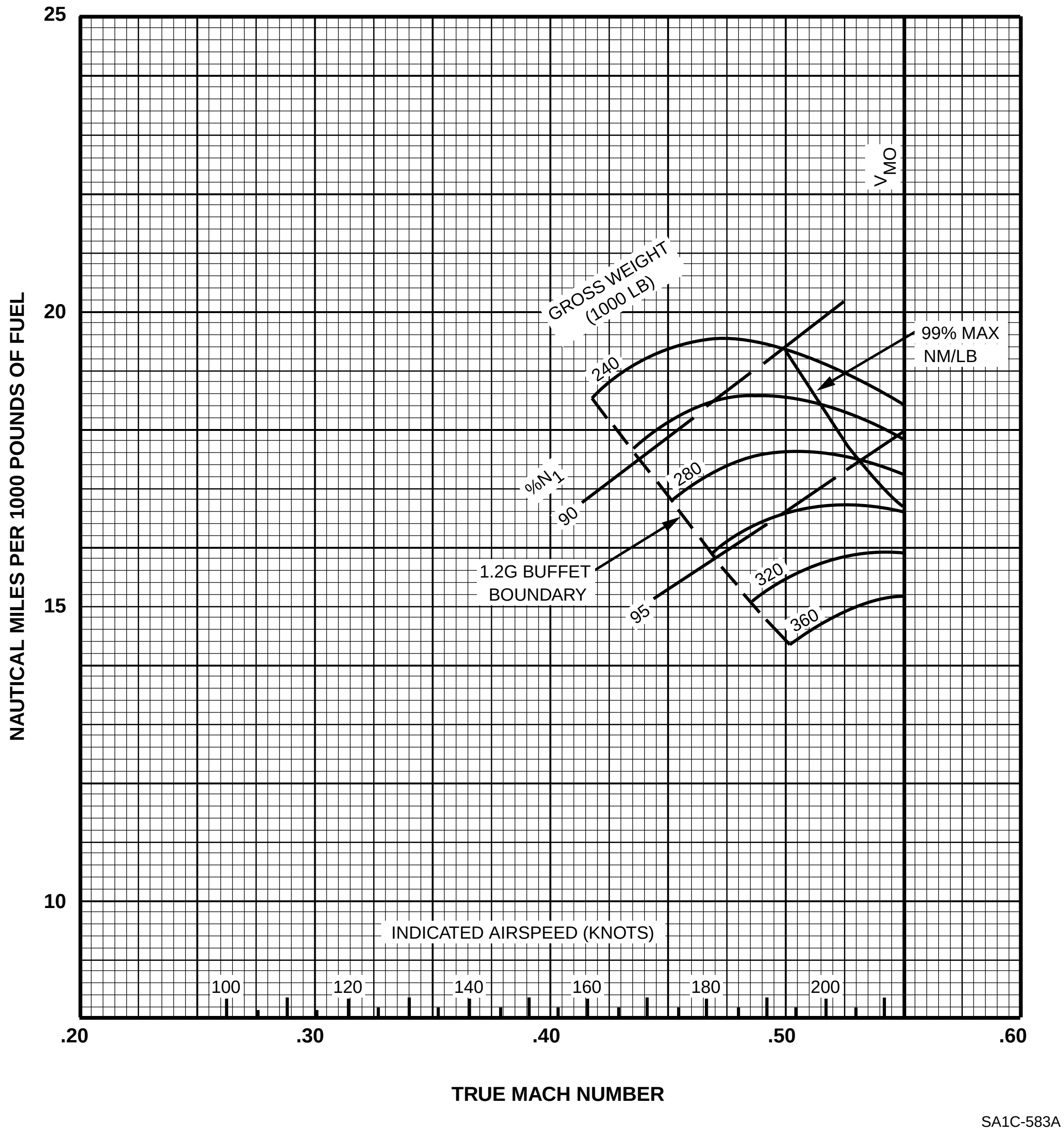


Figure 12-79.

THREE ENGINE SPECIFIC RANGE
GEAR DOWN FLIGHT
TRUE PRESSURE ALTITUDE 29,000 FT

NOTE:

1. STANDARD DAY.
2. INCREASE % N_1 BY 0.21 PER °C ABOVE STANDARD.
3. FOR HOLDING USE 1.2G BUFFET BOUNDARY SPEED PLUS 20 KNOTS OR V_{MO}, WHICHEVER IS LOWER.

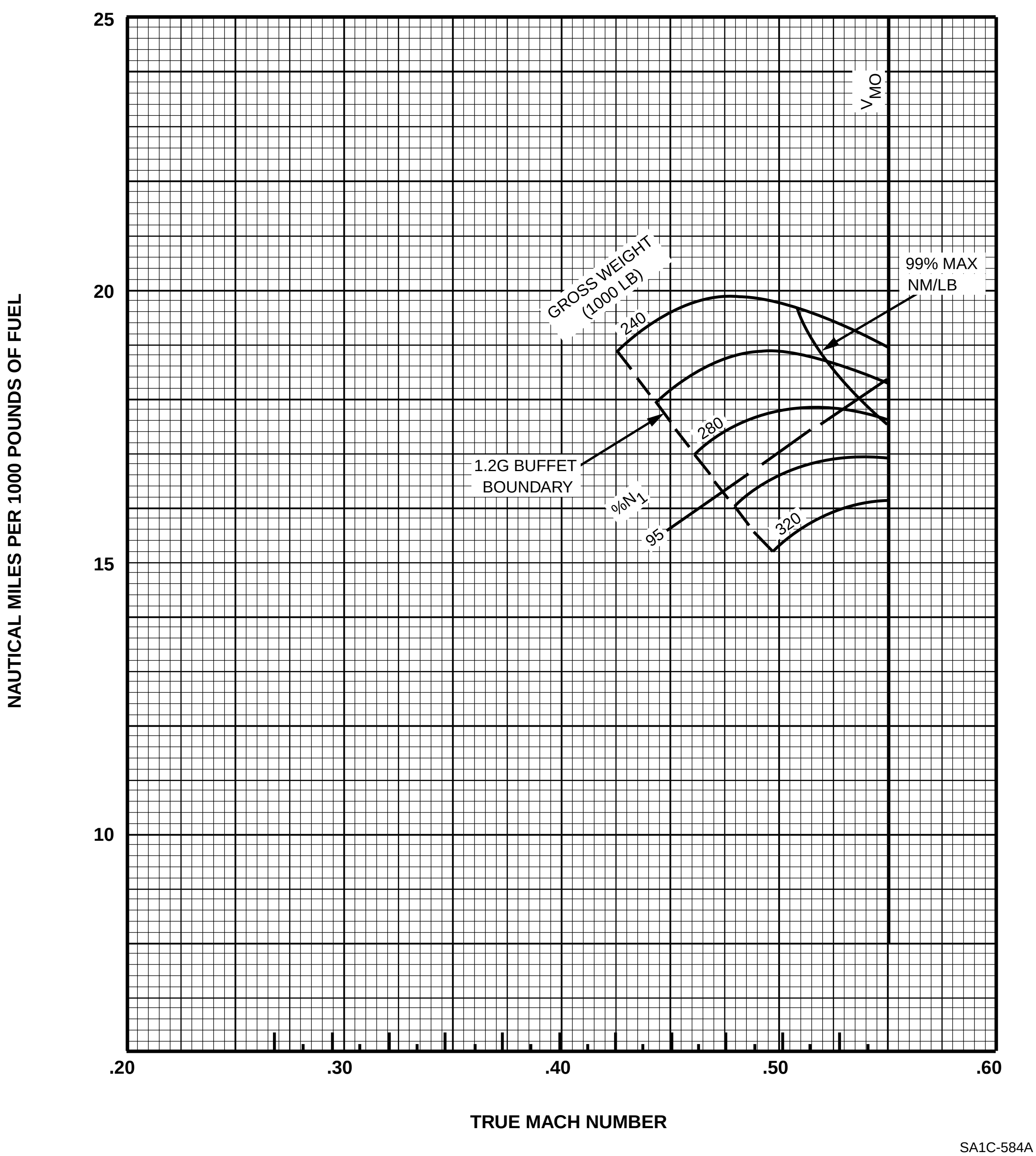


Figure 12-80.

THREE ENGINE SPECIFIC RANGE
GEAR DOWN FLIGHT
TRUE PRESSURE ALTITUDE 30,000 FT

NOTE:

1. STANDARD DAY.
2. INCREASE % N_1 BY 0.21 PER °C ABOVE STANDARD.
3. FOR HOLDING USE 1.2G BUFFET BOUNDARY SPEED PLUS 20 KNOTS OR V_{MO}, WHICHEVER IS LOWER.

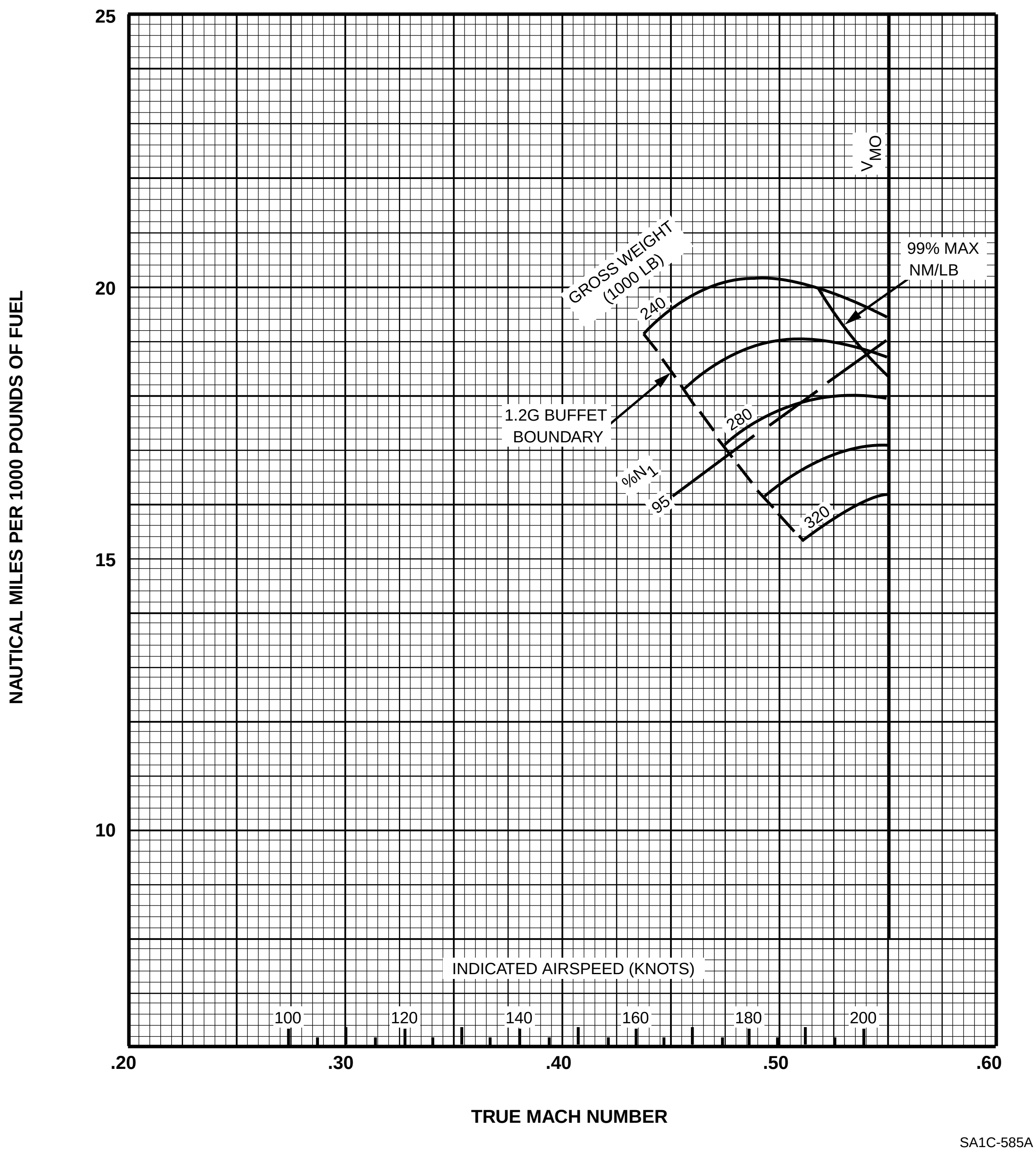


Figure 12-81.

THREE ENGINE SPECIFIC RANGE
GEAR DOWN FLIGHT
TRUE PRESSURE ALTITUDE SEA LEVEL

NOTE:

1. STANDARD DAY.
2. INCREASE % N_1 BY 0.15 PER °C ABOVE STANDARD.
3. FOR HOLDING USE 1.2G BUFFET BOUNDARY SPEED PLUS 20 KNOTS OR V_{MO}, WHICHEVER IS LOWER.

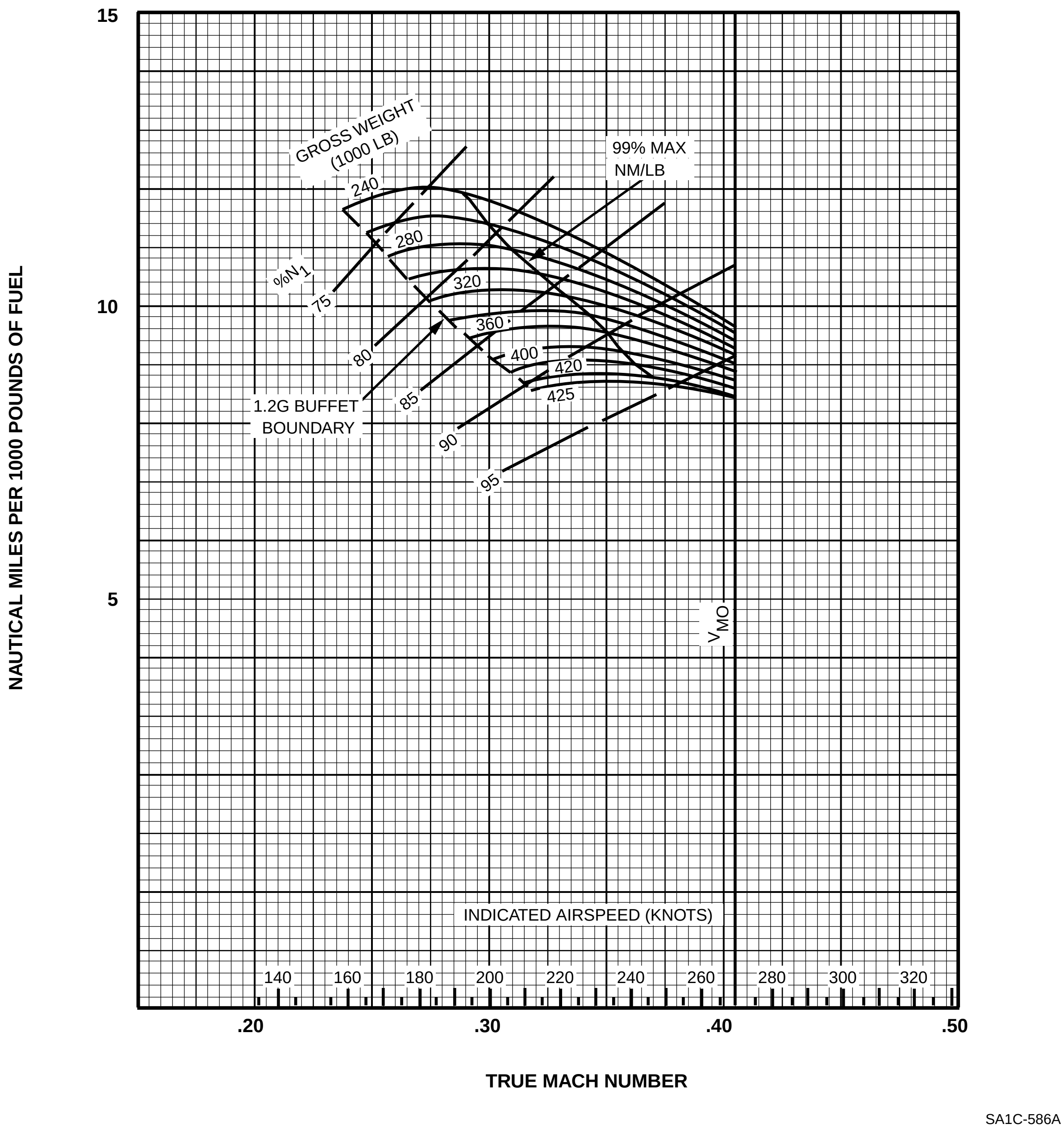


Figure 12-82.

TWO ENGINE SPECIFIC RANGE
GEAR DOWN FLIGHT
TRUE PRESSURE ALTITUDE 5,000 FT

NOTE:

1. STANDARD DAY.
2. INCREASE % N_1 BY 0.16 PER °C ABOVE STANDARD.
3. FOR HOLDING USE 1.2G BUFFET BOUNDARY SPEED PLUS 20 KNOTS OR V_{MO}, WHICHEVER IS LOWER.

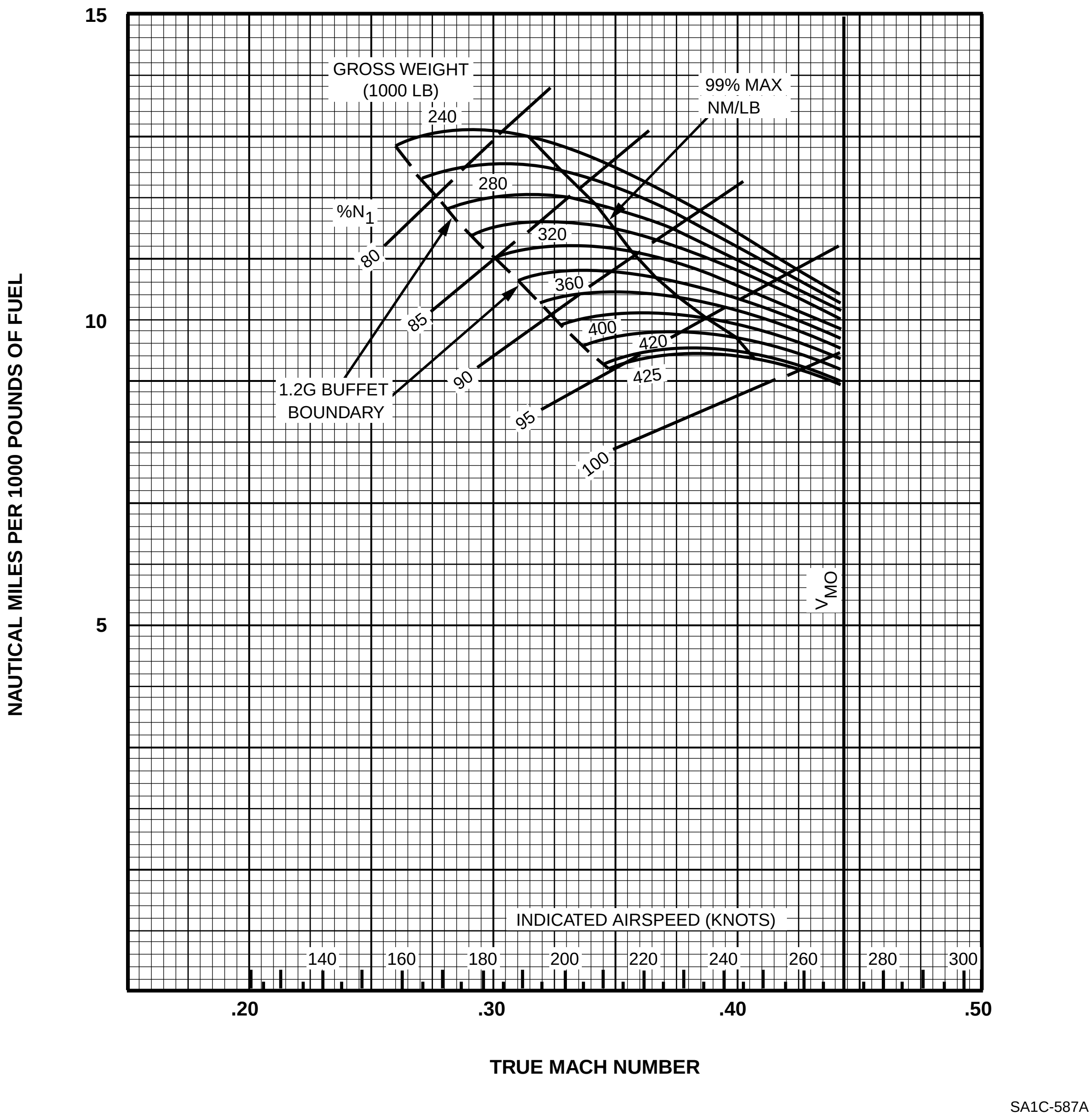


Figure 12-83.

TWO ENGINE SPECIFIC RANGE
GEAR DOWN FLIGHT
TRUE PRESSURE ALTITUDE 10,000 FT

NOTE:

1. STANDARD DAY.
2. INCREASE % N_1 BY 0.17 PER °C ABOVE STANDARD.
3. FOR HOLDING USE 1.2G BUFFET BOUNDARY SPEED PLUS 20 KNOTS OR V_{MO}, WHICHEVER IS LOWER.

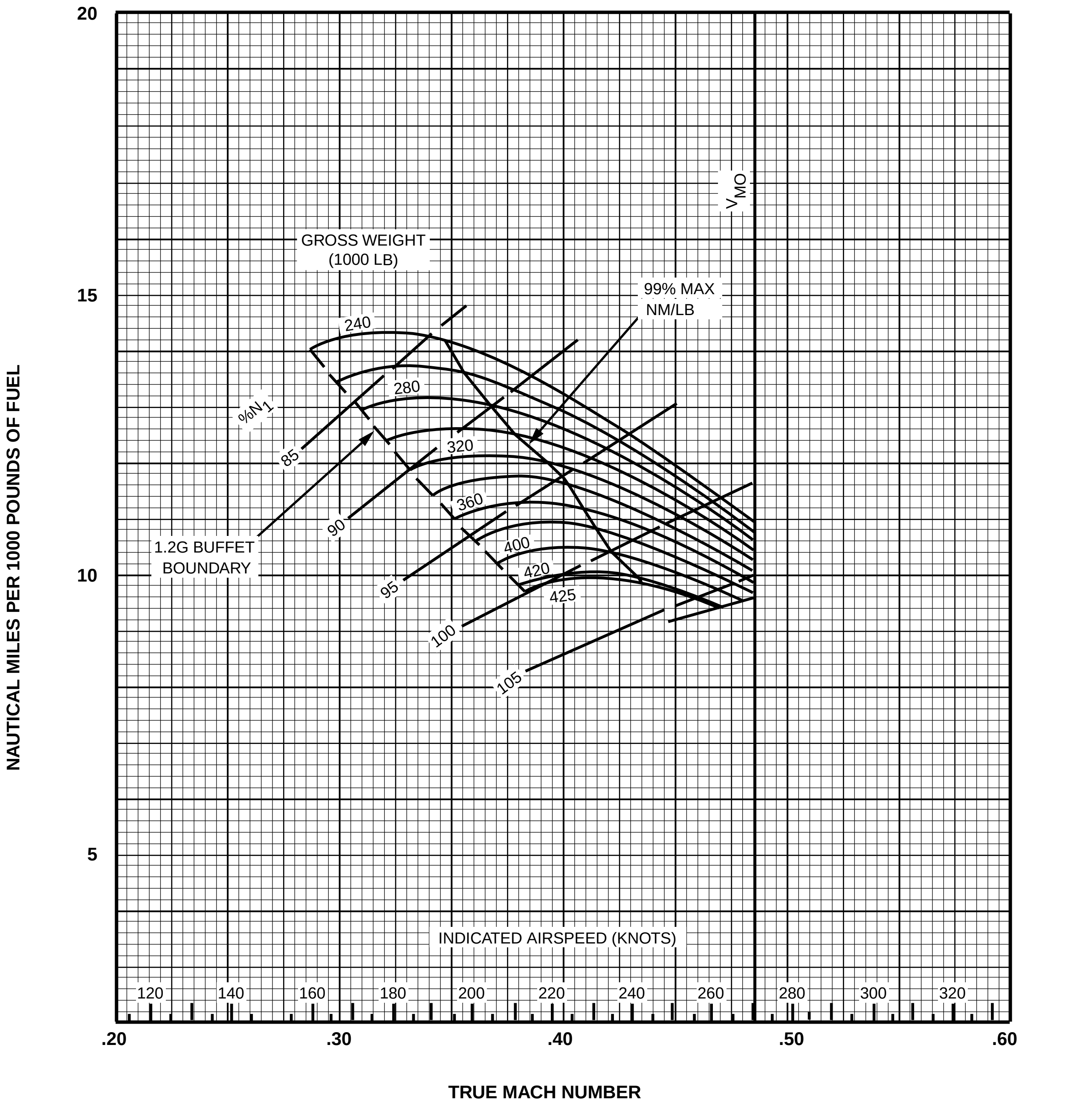


Figure 12-84.

TWO ENGINE SPECIFIC RANGE
GEAR DOWN FLIGHT
TRUE PRESSURE ALTITUDE 15,000 FT

NOTE:

1. STANDARD DAY.
2. INCREASE % N_1 BY 0.19 PER °C ABOVE STANDARD.
3. FOR HOLDING USE 1.2G BUFFET BOUNDARY SPEED PLUS 20 KNOTS OR V_{MO}, WHICHEVER IS LOWER.

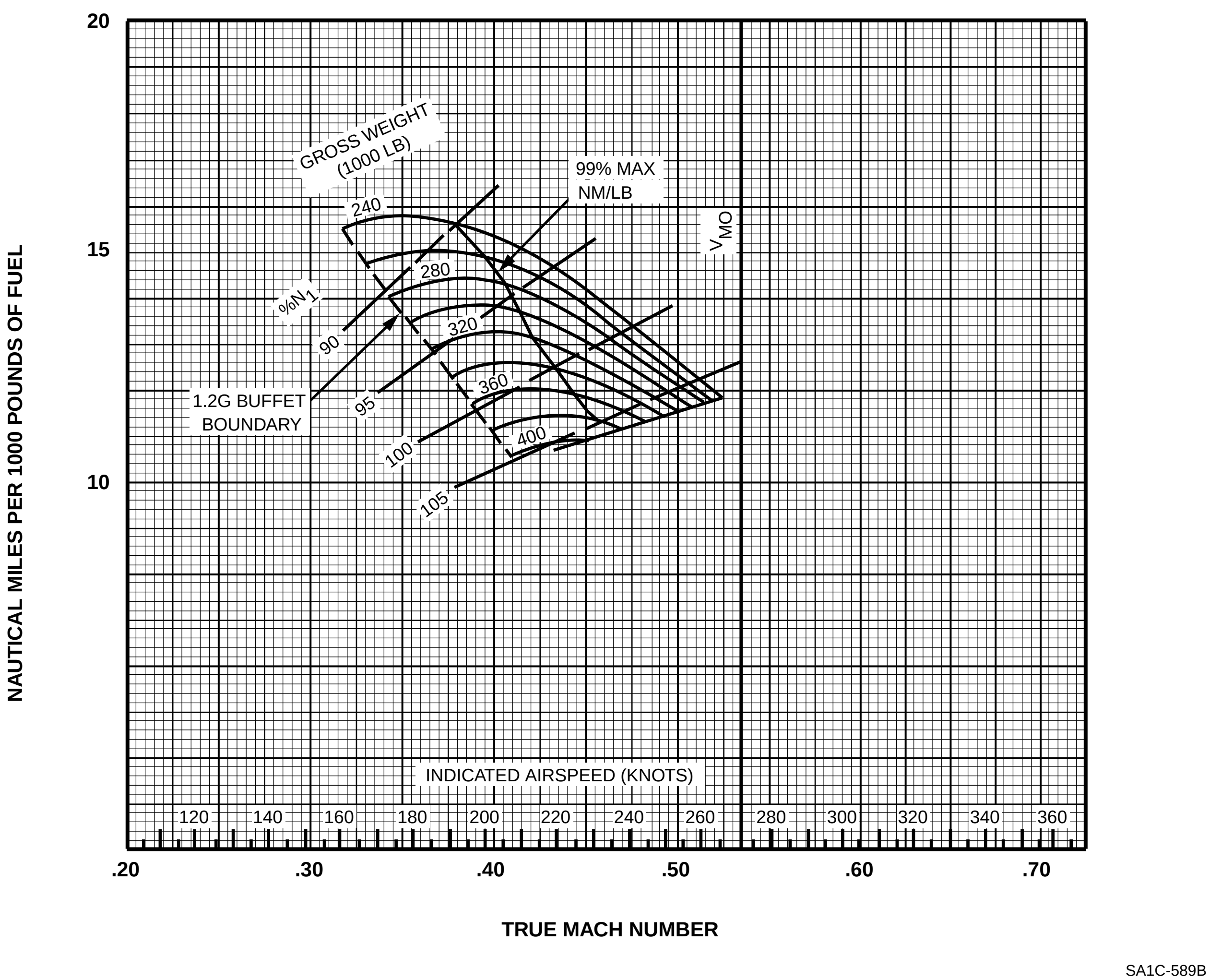


Figure 12-85.

TWO ENGINE SPECIFIC RANGE
GEAR DOWN FLIGHT
TRUE PRESSURE ALTITUDE 20,000 FT

NOTE:

1. STANDARD DAY.
2. INCREASE % N_1 BY 0.20 PER °C ABOVE STANDARD.
3. FOR HOLDING USE 1.2G BUFFET BOUNDARY SPEED PLUS 20 KNOTS OR V_{MO}, WHICHEVER IS LOWER.

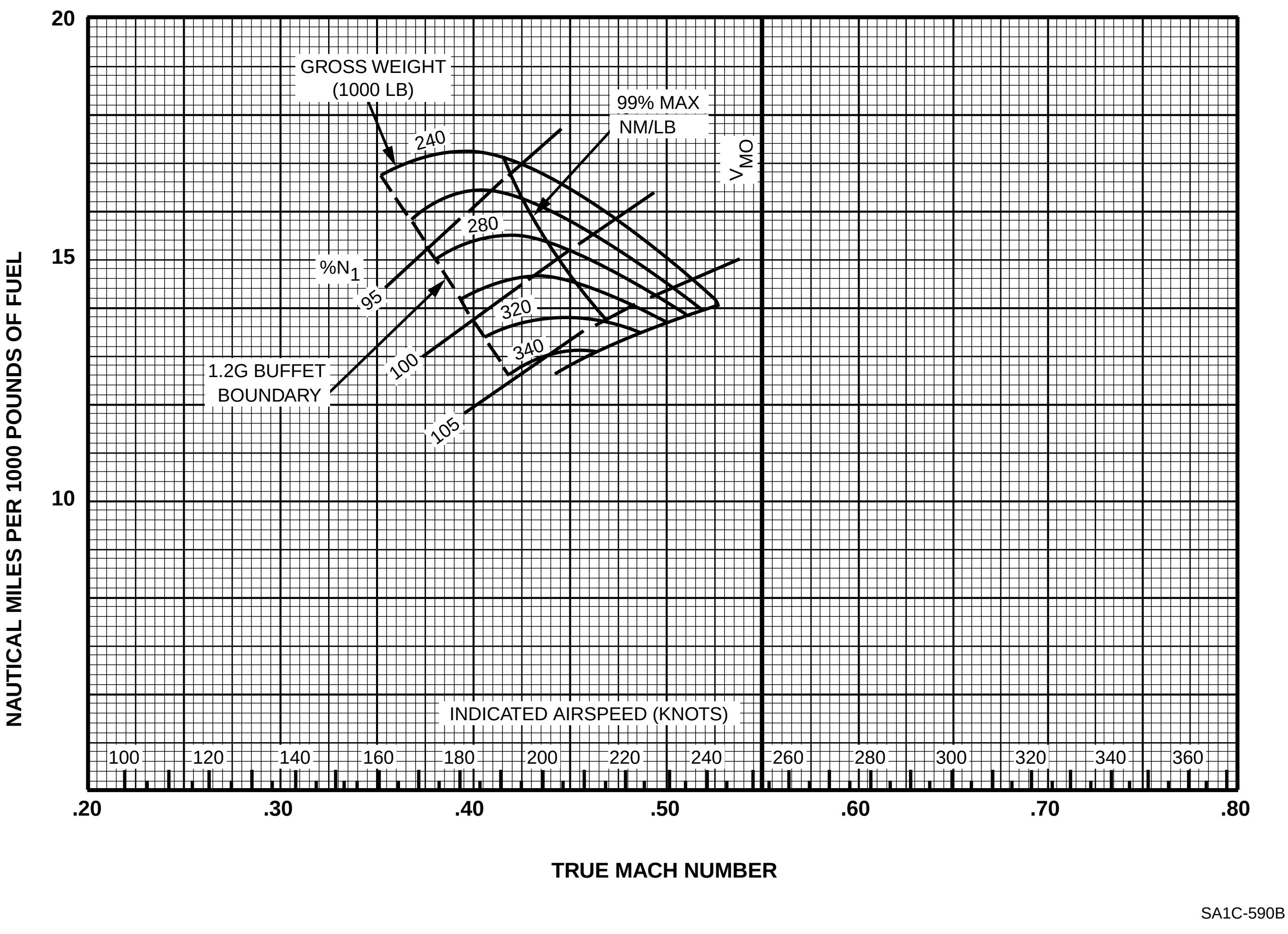


Figure 12-86.

TWO ENGINE SPECIFIC RANGE
GEAR DOWN FLIGHT
TRUE PRESSURE ALTITUDE 25,000 FT

NOTE:

1. STANDARD DAY.
2. INCREASE % N_1 BY 0.21 PER °C ABOVE STANDARD.
3. FOR HOLDING USE 1.2G BUFFET BOUNDARY SPEED PLUS 20 KNOTS OR V_{MO}, WHICHEVER IS LOWER.

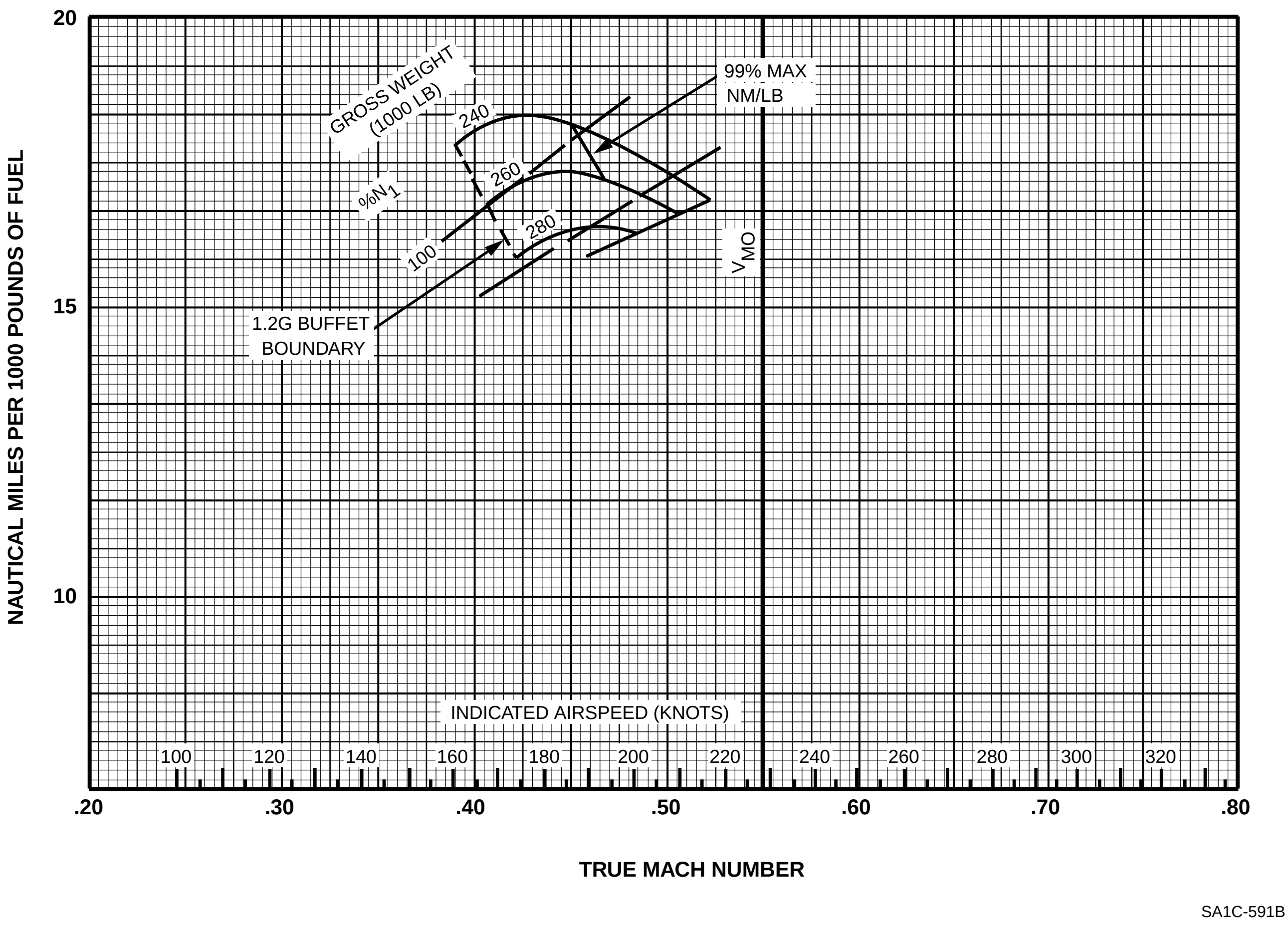


Figure 12-87.

DESCENT TABLE GEAR DOWN FLIGHT

NOTE:

1. GOOD FOR ALL WEIGHTS AND TEMPERATURES.
2. GEAR DOWN DESCENT - MACH 0.55 ABOVE 20,290 THEN 250 KIAS TO SEA LEVEL - AVERAGE RATE OF DESCENT IS 3280 FPM.
3. INCREASE DISTANCE TO DESCEND BY 3% PER 10 KNOTS TAILWIND DECREASE DISTANCE TO DESCEND BY 3% PER 10 KNOTS HEADWIND.

PRESSURE ALTITUDE (FT)	GEAR DOWN DESCENT FUEL (LB) DISTANCE (NM) TIME (MIN)
30,000	1848 60 12
29,000	1648 55 11
27,000	1227 45 9
25,000	770 36 7
23,000	725 39 8
21,000	692 36 8
19,000	652 33 7
17,000	607 29 6
15,000	558 26 6
10,000	417 17 4
5,000	237 9 2
0	0 0 0

SA1C-594

Figure 12-88.

DERATED CLIMB-FUEL TO CLIMB

NOTE:
1. CLEAN CONFIGURATION.
2. THREE ENGINE MAXIMUM CRUISE THRUST TO 500 FPM, THEN MAXIMUM CLIMB THRUST.
3. CLIMB AT SPEED SHOWN IN FIGURE 4-1 TO 10,000 FT, THEN AT 330 KIAS TO 27,402 FT, THEN AT MACH = 0.82.

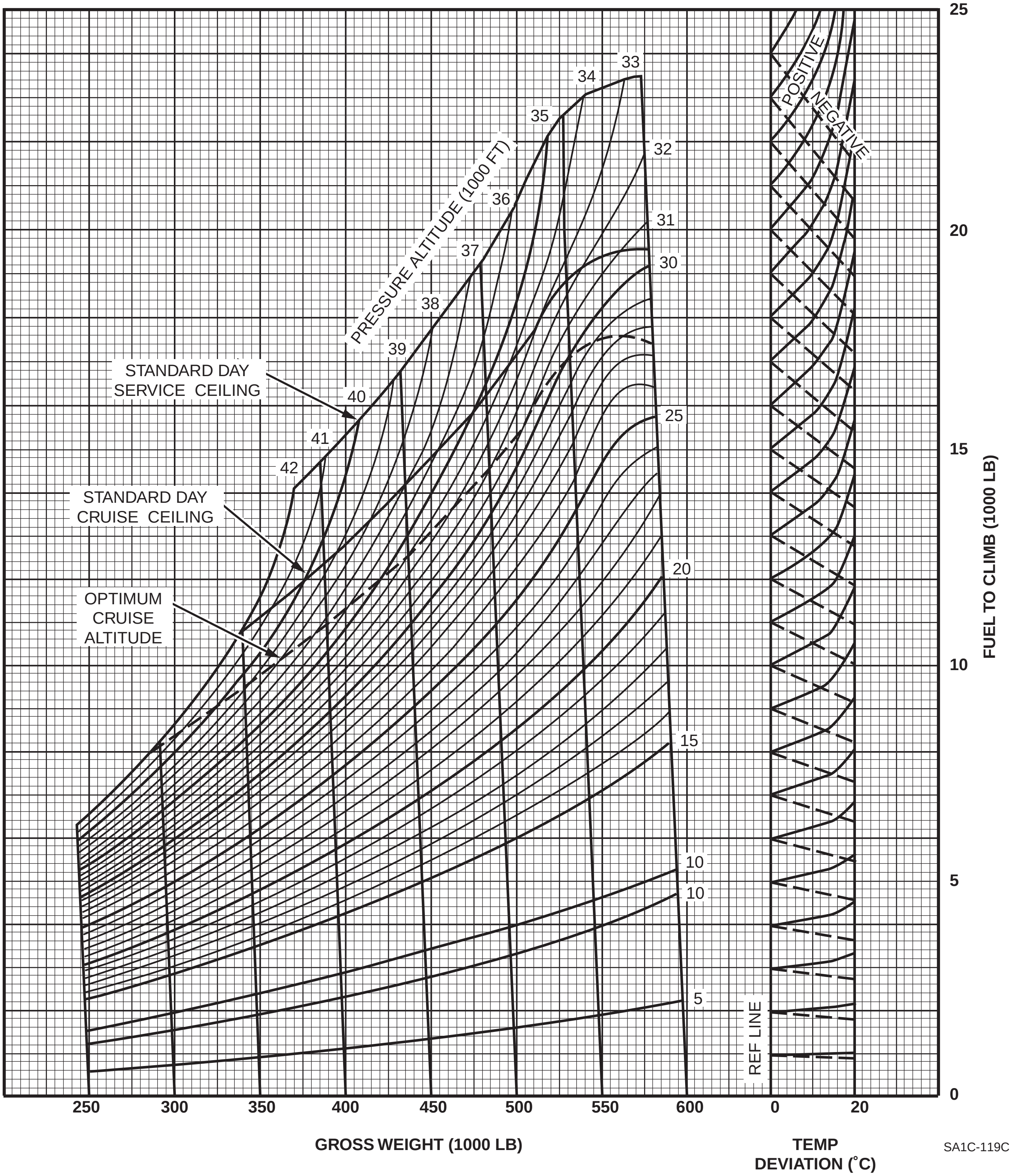


Figure 12-89.

DERATED CLIMB-DISTANCE TO CLIMB

NOTE:

1. CLEAN CONFIGURATION.
2. THREE ENGINE MAXIMUM CRUISE THRUST TO 500 FPM, THEN MAXIMUM CLIMB THRUST.
3. CLIMB AT SPEED SHOWN IN FIGURE 4-1 TO 10,000 FT, THEN AT 330 KIAS TO 27,402 FT, THEN AT MACH = 0.82.

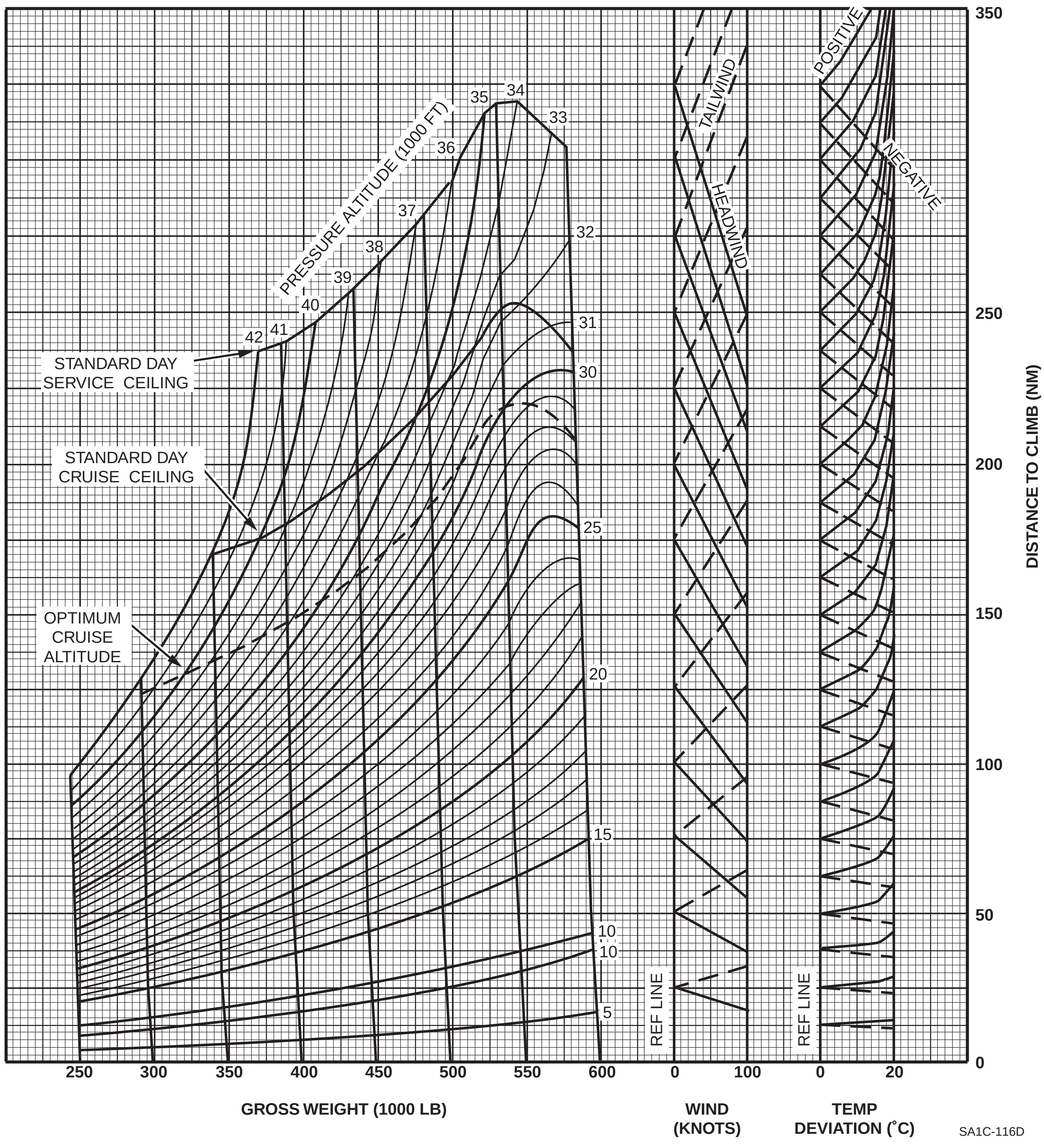


Figure 12-90.

DERATED CLIMB-TIME TO CLIMB

NOTE:
1. CLEAN CONFIGURATION.
2. THREE ENGINE MAXIMUM CRUISE THRUST TO 500 FPM, THEN MAXIMUM CLIMB THRUST.
3. CLIMB AT SPEED SHOWN IN FIGURE 4-1 TO 10,000 FT, THEN AT 330 KIAS TO 27,402 FT, THEN AT MACH = 0.82.

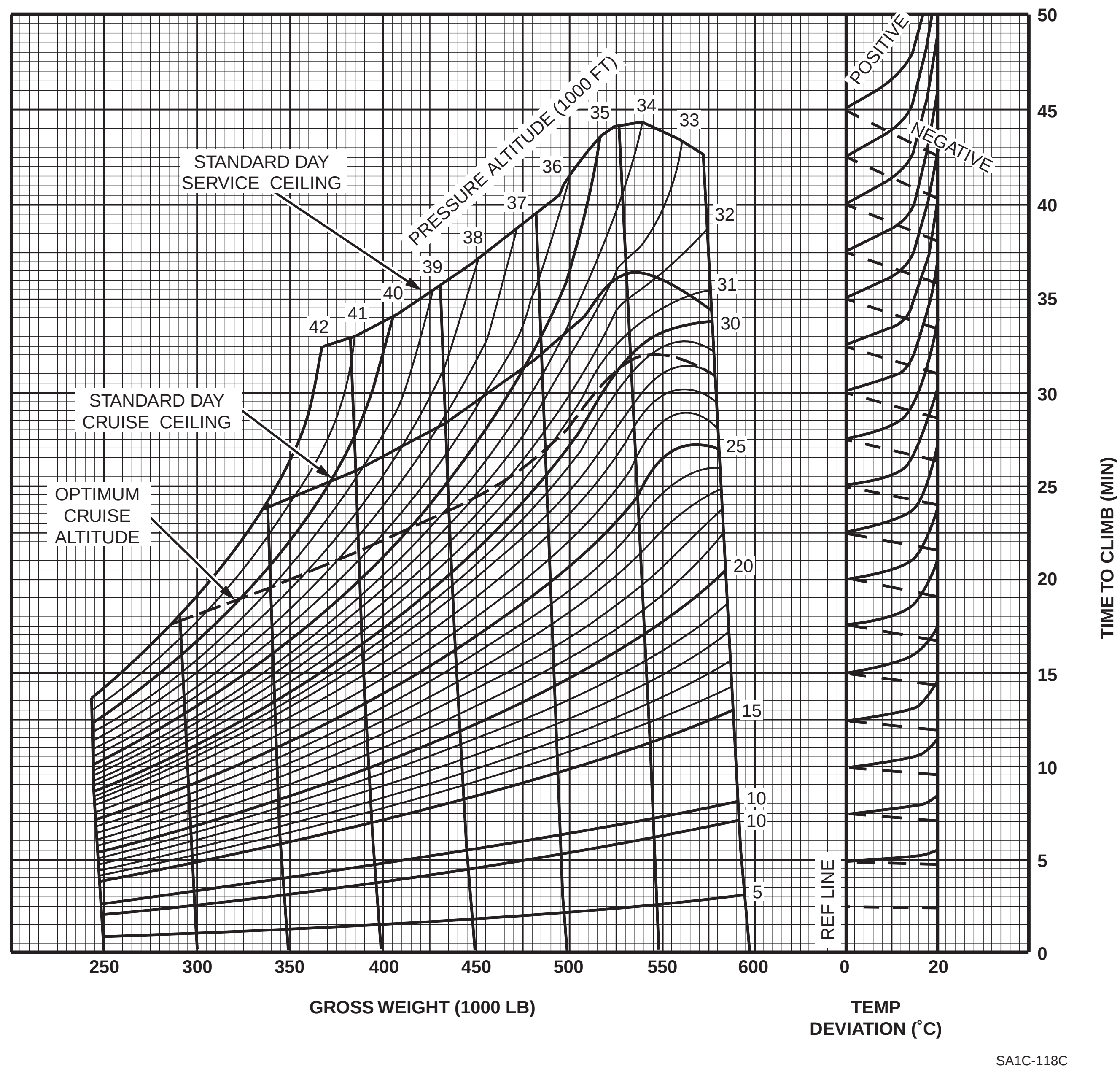


Figure 12-91.

UNCLAS

FROM: 727TH ACSG TINKER AFB OK//544TH ACSS//

TO: AL8020
HQ USAF WASHINGTON DC//XOOT//XOOSF
HQ AFSC KIRKLAND AFB NM//SEF//SEFB
HQ AMC SCOTT AFB IL//A3V//A3VK
OC-ALC TINKER AFB OK//SEF

INFO: 448 MSUG TINKER AFB OK//GBMUUB//

ACCT ACXJRF
BT
UNCLAS
SUBJECT: (U) INTERIM OPERATIONAL SUPPLEMENT (IOS) T.O. 1C-10(K)A-1-1S-29
DATED 4 AUGUST 2008

1. (U) THIS PUBLICATION SUPPLEMENTS T.O. 1C-10(K)A-1-1, DATED 1 APRIL 1990, FLIGHT MANUAL. COMMANDERS ARE RESPONSIBLE FOR BRINGING THIS SUPPLEMENT TO THE ATTENTION OF ALL AFFECTED PERSONNEL. MAJCOMS, FOAS, AND DRUS ARE RESPONSIBLE FOR RETRANSMITTING THIS IOS TO SUBORDINATE UNITS NOT INCLUDED AS ADDRESSEES ON THIS MESSAGE.

2. (U) DISTRIBUTION STATEMENT D – DISTRIBUTION AUTHORIZED TO THE DEPARTMENT OF DEFENSE AND U.S. DOD CONTRACTORS ONLY, FOR ADMINISTRATIVE OR OPERATIONAL USE, 25 MAY 1987. OTHER REQUESTS SHALL BE REFERRED TO 544 ACSS, TINKER AFB, OK 73145-3018.

3. (U) DISCLOSURE NOTICE – THIS INFORMATION IS FURNISHED UPON THE CONDITION THAT IT WILL NOT BE RELEASED TO ANOTHER NATION WITHOUT THE SPECIFIC AUTHORITY OF THE DEPARTMENT OF DEFENSE OF THE UNITED STATES, THAT IT WILL BE USED FOR MILITARY PURPOSES ONLY, THAT INDIVIDUAL OR CORPORATE RIGHTS ORIGINATING IN THE INFORMATION, WHETHER PATENTED OR NOT, WILL BE RESPECTED, THAT THE RECIPIENT WILL REPORT PROMPTLY TO THE UNITED STATES, ANY KNOWN OR SUSPECTED COMPROMISE, AND THAT THE INFORMATION WILL BE PROVIDED SUBSTANTIALLY THE SAME DEGREE OF SECURITY AFFORDED IT BY THE DEPARTMENT OF DEFENSE OF THE UNITED STATES. ALSO, REGARDLESS OF ANY OTHER MARKINGS ON THE DOCUMENT, IT WILL NOT BE DOWNGRADED OR DECLASSIFIED WITHOUT WRITTEN APPROVAL OF THE ORIGINATING UNITED STATES AGENCY.

4. (U) WARNING – THIS DOCUMENT CONTAINS TECHNICAL DATA WHOSE EXPORT IS RESTRICTED BY THE ARMS EXPORT CONTROL ACT (TITLE 22, U.S.C., SEC 2751, ET SEQ.) OR THE EXPORT ADMINISTRATION ACT OF 1979, AS AMENDED, (TITLE 50, U.S.C., APP. 2401 ET SEQ.). VIOLATIONS OF THESE EXPORT LAWS ARE SUBJECT TO SEVERE CRIMINAL PENALTIES.

5. (U) HANDLING AND DISTRUCTION NOTICE – HANDLE IN COMPLIANCE WITH DISTRIBUTION STATEMENT AND DESTROY BY ANY METHOD THAT WILL PREVENT DISCLOSURE OF THE CONTENTS OR RECONSTRUCTION OF THE DOCUMENT.

6. (U) NOTICE TO AIRCREWS: WRITE THE NUMBER OF THIS SUPPLEMENT ALONGSIDE THE CHANGED PORTION OF THE FLIGHT MANUAL. PENCIL WRITE-INS ARE AUTHORIZED TO ACCOMPLISH THE INSTRUCTIONS OF THIS SUPPLEMENT.

7. (U) PURPOSE: THIS SUPLEMENT ADDS LABELS TO THE WIND AND SLOPE GRAPHS OF FIGURE 3-14C (SHEET 2).

8. (U) INSTRUCTIONS: THE FOLLOWING INSTRUCTIONS APPLY:

A. ON PAGE 3-94A, ADD THE LABELS HEADWIND ABOVE THE SECOND SOLID LINE AND TAILWIND ABOVE THE THIRD DASHED LINE FROM THE BOTTOM OF THE CHART ON THE WIND PORTION OF THE GRAPH. ADD THE LABELS UPHILL BELOW THE THIRD SOLID LINE AND DOWNHILL ABOVE THE THIRD DASHED LINE FROM THE BOTTOM OF THE CHART ON THE SLOPE PORTION OF THE GRAPH.

9. (U) STATUS PAGE:

A. CHECKLISTS AFFECTED:

NONE

B. SAFETY AND OPERATIONAL SUPPLEMENTS:

T.O. 1C-10(K)A-1-1S-29 4 AUGUST 2008 FIGURE 3-14C (SHEET 2) WIND AND SLOPE LABELS.

C. RECINDED SUPPLEMENTS:

NONE

UNCLAS

//SIGNED//

GREGG EVANS, CHIEF
TANKER/AIRLIFT ENGINEERING DIVISION
544 ACSS

MEMO TEXT STOP

UNCLASS