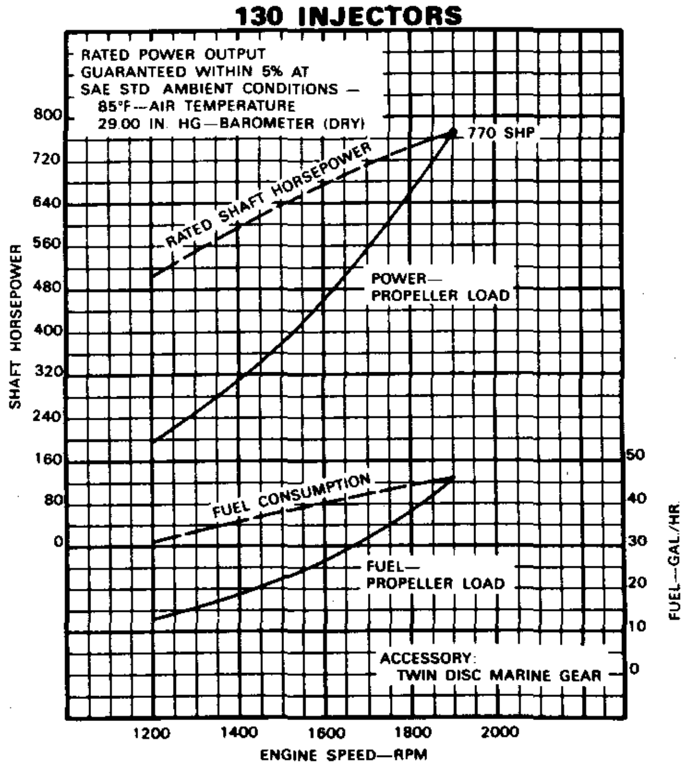
12V-149 CREW BOAT
130 INJECTORS



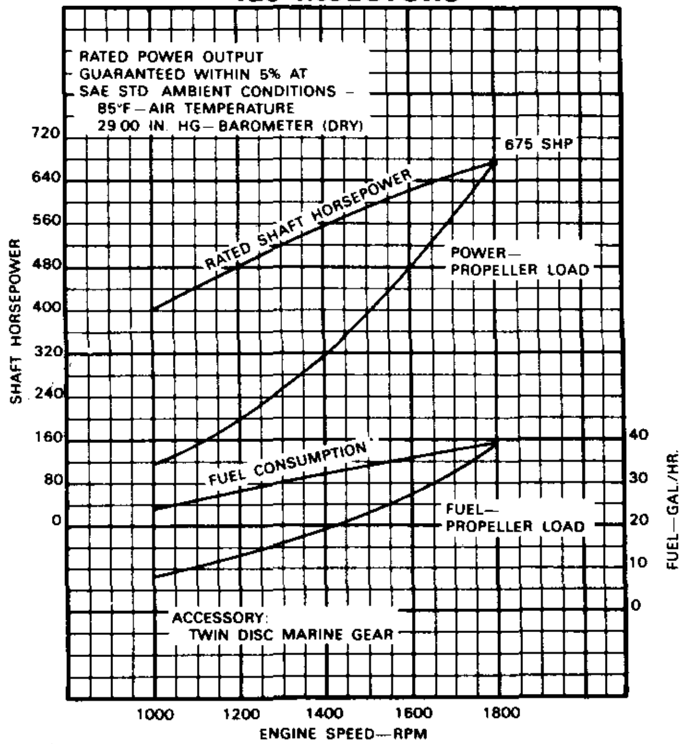
12V-149

CREW BOAT
130 INJECTORS

TWIN DISC MG-527 MARINE GEAR

		3-BLADE PROPELLER			4-BLADE PROPELLER		
		GEAR RATIOS			GEAR RATIOS		
KNOTS	MPH	2.07	2.92	3.86	2.07	2.92	3.86
6.1	7			61 x 37			58 x 38
6.9	8		52 x 32	61 x 38		49 x 32	57 x 39
7.8	9	42 x 26	51 x 33	61 x 39	40 x 26	48 x 33	57 x 40
8.7	10	42 x 26	51 x 33	60 x 40	40 x 27	48 x 34	57 x 41
9.7	11	42 x 27	51 x 34	60 x 42	39 x 27	48 x 35	56 x 42
10.4	12	42 x 28	51 x 35	60 x 43	39 x 28	48 x 36	56 x 44
11.2	13	42 x 28	51 x 36	60 x 44	39 x 29	48 x 37	56 x 45
12.1	14	42 x 29	51 x 37	60 x 46	39 x 29	47 x 38	56 x 46
13.0	15	41 x 30	51 x 38	59 x 47	39 x 30	47 x 39	55 x 48
13.8	16	41 x 30	50 x 39	59 x 49	39 x 31	47 x 40	55 x 49
14.7	17	41 x 31	50 x 40	59 x 50	38 x 31	47 x 41	55 x 51
15.6	18	41 x 32	50 x 41	58 x 52	38 x 32	47 x 42	55 x 52
16.5	19	41 x 32	50 x 42	58 x 53	38 x 33	47 x 43	55 x 53
17.3	20	41 x 33	49 x 44	57 x 55	38 x 34	47 x 44	54 x 54
18.2	21	41 x 34	49 x 45		38 x 34	46 x 45	
19.1	22	40 x 35	49 x 46		38 x 35	46 x 46	
19.9	23	40 x 35	48 x 47		38 x 36	46 x 47	
20.8	24	40 x 36			38 x 36		
21.7	25	40 x 37			38 x 37		
22.5	26	40 x 38			38 x 38		
23.4	27	39 x 39					

12V-149 WORK BOAT
120 INJECTORS

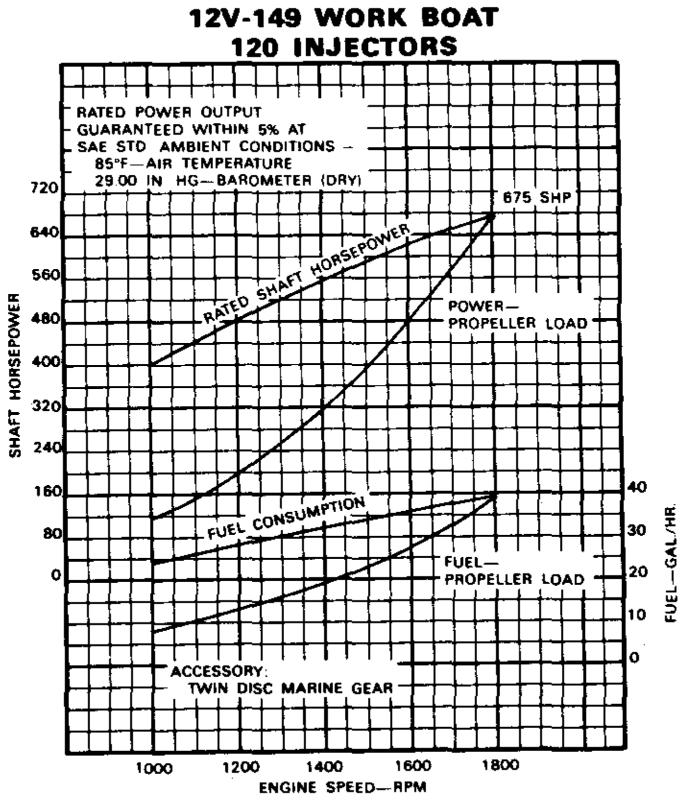


12V-149

WORK BOAT
120 INJECTORS

TWIN DISC MG
▲ 527 & ★ 540
MARINE GEAR

KNOTS	MPH	3-BLADE PROPELLER					
		GEAR RATIOS					
		▲ 2.92	▲ 3.86	▲ 5.17	★ 6.18	★ 7	★ 9.13
3.5	4						103 x 61
4.4	5					88 x 54	102 x 64
5.2	6			73 x 45	81 x 51	88 x 56	102 x 66
6.1	7	52 x 32	61 x 38	73 x 46	81 x 52	88 x 57	102 x 68
6.9	8	52 x 32	61 x 39	73 x 48	81 x 54	87 x 59	101 x 71
7.8	9	52 x 33	61 x 40	72 x 49	80 x 56	87 x 62	101 x 74
8.7	10	52 x 34	61 x 41	72 x 51	80 x 58	87 x 64	100 x 77
9.7	11	51 x 35	61 x 43	72 x 53	79 x 60	86 x 67	99 x 81
10.4	12	51 x 36	60 x 44	71 x 55	79 x 63	85 x 70	98 x 85
11.2	13	51 x 37	60 x 45	71 x 57	78 x 65	85 x 73	97 x 89
12.1	14	51 x 38	60 x 47	70 x 59	78 x 68	84 x 76	
13.0	15	51 x 39	59 x 49	70 x 61	77 x 71	83 x 79	
13.8	16	50 x 40	59 x 50	69 x 63	76 x 73		
14.7	17	50 x 41	59 x 52	69 x 65			
15.6	18	50 x 43	58 x 53				
16.5	19	50 x 44					

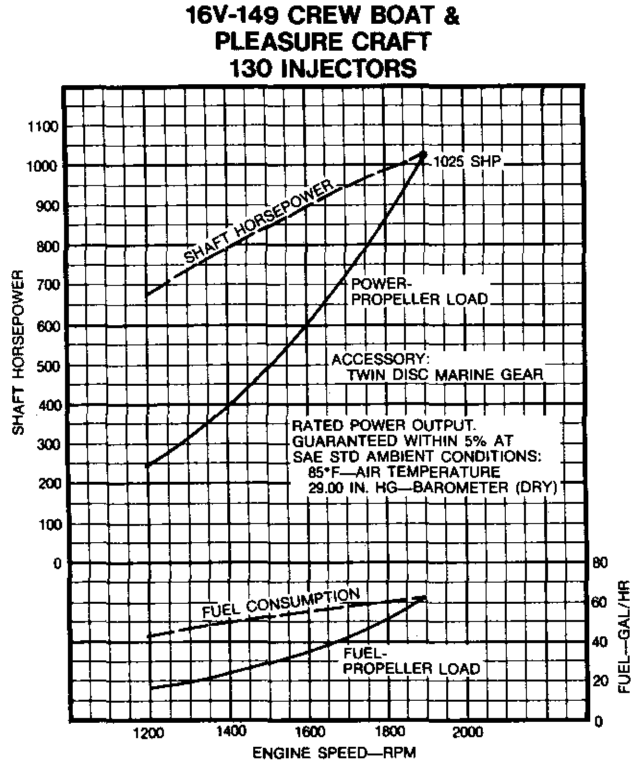


12V-149

WORK BOAT
120 INJECTORS

TWIN DISC MG
▲ 527 & ★ 540
MARINE GEAR

		4-BLADE PROPELLER					
		GEAR RATIOS					
KNOTS	MPH	▲2.92	▲3.86	▲5.17	★6.18	★7	★9.13
4.4	5						97 x 64
5.2	6			69 x 45	76 x 51	83 x 56	96 x 67
6.1	7		58 x 38	68 x 47	76 x 53	82 x 58	95 x 69
6.9	8	49 x 33	57 x 40	68 x 48	75 x 55	82 x 60	94 x 72
7.8	9	49 x 34	57 x 41	68 x 50	75 x 57	81 x 63	94 x 75
8.7	10	48 x 34	57 x 42	67 x 52	75 x 59	81 x 65	93 x 78
9.7	11	48 x 35	57 x 43	67 x 53	74 x 61	80 x 68	93 x 82
10.4	12	48 x 36	56 x 45	67 x 55	74 x 63	80 x 70	93 x 85
11.2	13	48 x 37	56 x 46	66 x 57	74 x 66	80 x 73	92 x 89
12.1	14	48 x 39	56 x 47	66 x 60	73 x 68	79 x 76	
13.0	15	47 x 40	56 x 49	66 x 62	73 x 71	79 x 79	
13.8	16	47 x 41	55 x 51	65 x 63	72 x 73		
14.7	17	47 x 42	55 x 52	65 x 65			
15.6	18	47 x 43	55 x 53				
16.5	19	47 x 44					



16V-149

PLEASURE CRAFT CREW BOAT 130 INJECTORS

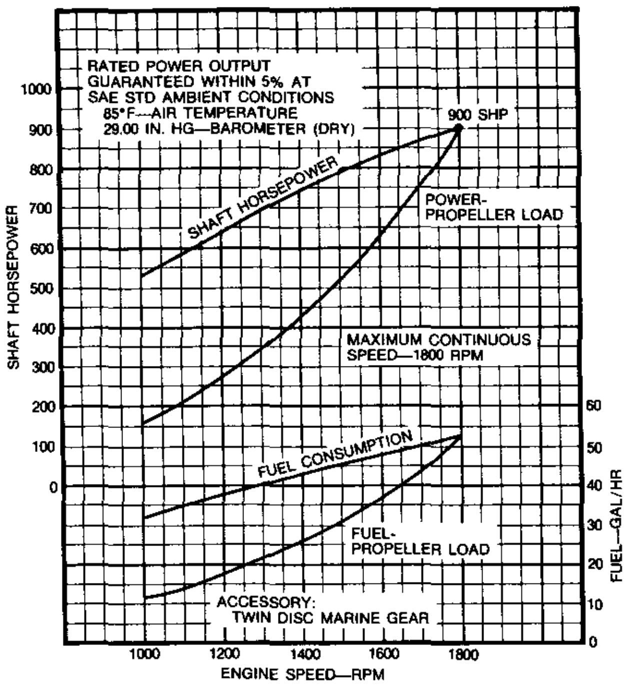
TWIN DISC MG-540 MARINE GEAR

		3-BLADE PROPELLER				4-BLADE PROPELLER			
		GEAR RATIOS				GEAR RATIOS			
KNOTS	MPH	1.93	2.90	3.26	3.91	1.93	2.90	3.26	3.91
6.1	7				65 x 40				62 x 41
6.9	8		55 x 34	59 x 37	65 x 41		52 x 34	55 x 37	61 x 42
7.8	9	43 x 26	55 x 35	58 x 37	65 x 42		51 x 35	55 x 38	61 x 43
8.7	10	43 x 27	54 x 35	58 x 38	65 x 43	40 x 27	51 x 36	55 x 39	61 x 44
9.7	11	43 x 27	54 x 36	58 x 39	65 x 45	40 x 28	51 x 37	54 x 40	60 x 45
10.4	12	43 x 28	54 x 37	58 x 40	64 x 46	40 x 28	51 x 38	54 x 41	60 x 47
11.2	13	43 x 29	54 x 38	58 x 42	64 x 48	40 x 29	50 x 39	54 x 42	60 x 48
12.1	14	43 x 29	54 x 39	58 x 43	64 x 49	40 x 30	50 x 40	54 x 43	60 x 50
13.0	15	42 x 30	54 x 40	57 x 44	64 x 51	40 x 30	50 x 41	54 x 45	59 x 51
13.8	16	42 x 31	53 x 41	57 x 45	63 x 52	40 x 31	50 x 42	53 x 46	59 x 53
14.7	17	42 x 31	53 x 43	57 x 47	63 x 54	39 x 32	50 x 43	53 x 47	59 x 54
15.6	18	42 x 32	53 x 44	57 x 48		39 x 32	50 x 44	53 x 48	59 x 56
16.5	19	42 x 33	53 x 45	56 x 49		39 x 33	50 x 45	53 x 49	
17.3	20	42 x 33	52 x 46			39 x 34	49 x 46		
18.2	21	42 x 34				39 x 34			
19.1	22	41 x 35				39 x 35			
19.9	23	41 x 36				39 x 36			
20.8	24					39 x 37			

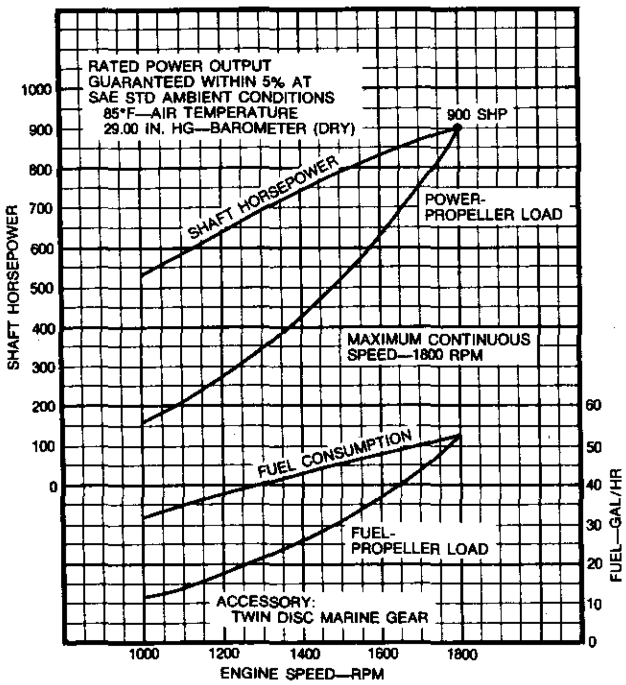
16V-149 • WORK BOAT 120 INJECTORS

TWIN DISC MG-540 MARINE GEAR

16V-149 WORK BOAT
120 INJECTORS



		3-BLADE PROPELLER							
		GEAR RATIOS							
KNOTS	MPH	2.90	3.26	3.91	4.60	5.17	6.18	7.00	9.13
4.4	5							92 x 55	108 x 66
5.2	6						85 x 52	92 x 57	107 x 68
6.1	7			65 x 40	72 x 44	77 x 48	85 x 54	92 x 59	107 x 70
6.9	8	54 x 33	58 x 36	65 x 41	71 x 45	76 x 49	85 x 55	91 x 60	107 x 73
7.8	9	54 x 34	58 x 37	65 x 42	71 x 47	76 x 50	85 x 57	91 x 62	106 x 75
8.7	10	54 x 35	58 x 38	65 x 43	71 x 48	76 x 52	84 x 59	91 x 65	106 x 78
9.7	11	54 x 36	58 x 39	64 x 44	71 x 49	76 x 54	84 x 61	90 x 57	105 x 82
10.4	12	54 x 36	58 x 40	64 x 45	70 x 51	75 x 55	84 x 63	90 x 69	104 x 85
11.2	13	54 x 37	58 x 41	64 x 47	70 x 52	75 x 57	83 x 66	89 x 72	104 x 89
12.1	14	54 x 38	57 x 42	64 x 48	70 x 54	75 x 59	83 x 68	89 x 75	103 x 93
13.0	15	53 x 40	57 x 43	63 x 49	69 x 56	74 x 61	82 x 70	88 x 70	102 x 97
13.8	16	53 x 41	57 x 44	63 x 51	69 x 58	74 x 63	81 x 73	87 x 81	
14.7	17	53 x 42	57 x 45	63 x 52	69 x 59	73 x 65	81 x 75	86 x 83	
15.6	18	53 x 43	56 x 47	62 x 54	68 x 61	73 x 67	80 x 78		
16.5	19	53 x 44	56 x 48	62 x 55	68 x 63	72 x 69			
17.3	20	52 x 45	56 x 49	62 x 57	67 x 65				
18.2	21	52 x 46	55 x 50	61 x 58					
19.1	22	52 x 47	55 x 51	61 x 60					
19.9	23	51 x 48	55 x 53						
20.8	24	51 x 49							



16V-149

WORK BOAT
120 INJECTORS

TWIN DISC MG-540 MARINE GEAR

KNOTS	MPH	4-BLADE PROPELLER — GEAR RATIOS 2.90	3.26	3.91	4.60	5.17	6.18	7.00	9.13
4.4	5								102 x 66
5.2	6						81 x 53	87 x 58	101 x 69
6.1	7				68 x 45	72 x 48	80 x 54	87 x 60	101 x 71
6.9	8		55 x 36	61 x 41	67 x 46	72 x 50	80 x 56	86 x 62	100 x 74
7.8	9	51 x 34	55 x 37	61 x 42	67 x 47	71 x 51	79 x 58	86 x 64	99 x 77
8.7	10	51 x 35	54 x 38	61 x 43	66 x 49	71 x 53	79 x 60	85 x 66	99 x 79
9.7	11	51 x 36	54 x 39	60 x 45	66 x 50	71 x 54	78 x 62	85 x 68	98 x 82
10.4	12	50 x 37	54 x 40	60 x 46	66 x 52	70 x 56	78 x 64	85 x 71	98 x 86
11.2	13	50 x 38	54 x 41	60 x 47	66 x 53	70 x 58	78 x 66	84 x 74	97 x 89
12.1	14	50 x 39	54 x 42	59 x 49	65 x 55	70 x 60	77 x 69	84 x 76	97 x 93
13.0	15	50 x 40	53 x 44	59 x 50	65 x 56	70 x 62	77 x 71	84 x 79	96 x 96
13.8	16	50 x 41	53 x 45	59 x 51	65 x 58	69 x 64	77 x 73	83 x 81	
14.7	17	50 x 42	53 x 46	59 x 53	65 x 60	69 x 66	76 x 75	83 x 84	
15.6	18	49 x 43	53 x 47	59 x 54	64 x 61	69 x 67	76 x 77		
16.5	19	49 x 44	53 x 48	59 x 55	64 x 63	69 x 69			
17.3	20	49 x 45	53 x 49	58 x 57	64 x 64				
18.2	21	49 x 46	52 x 50	58 x 58					
19.1	22	49 x 47	52 x 51						
19.9	23	49 x 48							
20.8	24	49 x 49							

Detroit Diesel Allison
Division of General Motors Corporation

EFFECT OF ENVIRONMENTAL CONDITIONS ON DETROIT DIESEL ENGINES

FEBRUARY, 1975

Engineering Technical Data Dept.

ENGINEERING BULLETIN No.40

18 SA 0208

ENGINEERING BULLETIN N

DATE REVISED	PAGE REVISED	GENERAL DESCRIPTI

EFFECT OF ENVIRONMENTAL CONDITIONS

ON

DETROIT DIESEL ENGINES

February, 1975

Engineering Technical Data Dept.

ENGINEERING

BULLETIN

NO. 40

18SA208

EFFECT OF ENVIRONMENTAL CONDITIONS
ON
DETROIT DIESEL ENGINES

Page

1. Introduction ---------- 1
2. Engine Rating Baseline ---------- 1
3. Detroit Diesel Allison Baseline ---------- 1
4. Worldwide Baselines ---------- 2
   4.1 Test Code Baselines ---------- 5
   4.2 Test Code Correction to SAE ---------- 5
5. Worldwide Site Conditions ---------- 2
   5.1 Relief Maps and Population Locations ---------- 7-18
6. Effects of Environmental Conditions on Engine Performance ---------- 6
   6.1 Effect of Site Altitude ---------- 6
      6.1.1 Example Calculations ---------- 6
   6.2 Effect of Inlet Temperature ---------- 6
      6.2.1 Example Calculations ---------- 6
   6.3 Effect of Humidity ---------- 6
      6.3.1 Example Calculations ---------- 22
   6.4 Combination Effect of Altitude, Temperature and Humidity ---------- 22
      6.4.1 Example Calculations ---------- 22
7. Effects of Environmental Conditions on Engine Operating Characteristics - 22
   7.1 Air Box Pressure ---------- 22
   7.2 Compression Pressure ---------- 23
   7.3 Exhaust Back Pressure ---------- 23
   7.4 Intake Restriction ---------- 23
   7.5 Cooling System ---------- 23
8. Effect of Ambient Conditions on Exhaust Smoke ---------- 24
9. Effect of Ambient Conditions on Gaseous Emissions ---------- 24
10. Altitude Derating Curves ---------- 32-65

1. INTRODUCTION

As Detroit Diesel Allison expands its diesel engine sales into the world market, more consideration must be given to environmental conditions in the various countries throughout the world. It is very important to understand that varying ambient conditions do affect engines in performance, smoke and gaseous emissions.

The following has been written to cover in some detail the effects of individual as well as combinations of varying environmental conditions with all presently available information.

2. ENGINE RATING BASELINE

Power developed by an internal combustion engine, either gasoline or diesel, depends on the amount of fuel burned with the available oxygen in the cylinder. The amount of oxygen in a cubic foot of air is reduced if water vapor is present, or if the air is expanded due to increased temperature or reduced pressure, and likewise the rated engine output will be reduced as a result of these environmental conditions. Therefore, when an engine performance curve is issued, a baseline is indicated stating that this performance is for a certain air temperature, barometric pressure, and humidity. This is another way of saying that the output shown is that which would be achieved at the specific atmospheric conditions.

3. DETROIT DIESEL ALLISON BASELINE

Since 1962 Detroit Diesel Allison adopted the new SAE baseline for standard ambient conditions which is 85°F (29.4°C), elevation 500 feet (152.4 m) and a dry air density of .0705 lb/cu ft (1.129 Kg/m^3). This density varies only slightly from the previous baseline density of .0684 lb/cu ft (1.096 Kg/m^3), and therefore, engine ratings were not changed.

Detroit Diesel Allison favors this air density as it represents the average operating conditions which are typical for both laboratory work and field operating conditions in the major portion of the United States, most of Europe and the Soviet Union. We found this baseline to be more realistic when preparing engine performance from laboratory data, as only occasionally is it necessary to adjust for environmental changes.

Advertised performance for the basic engine is often published based on 60°F (15.6°C) and sea level (dry air) for comparison with other diesel engine makes. This baseline is also used for government or municipal contracts when required.

Sea level (dry air) and 60°F (15.6°C) is a theoretical condition that does not even exist at the sea shore, where a much higher humidity usually prevails. It might be expected that marine applications would operate at this baseline, but it has been found that engine room temperatures average above 100°F (38°C), and humidity is at least 50%, therefore, even these applications are operating very close to our baseline air density of .0705 lbs/cu ft (1.129 Kg/m^3).

Pages 3 and 4, Charts 1 and 2 show a tabulation for all of our engines indicating a correction factor that can be multiplied by our naturally aspirated basic engine ratings to obtain 60°F (15.6°F), and sea level performance. It should be kept in mind when using this chart that this is a comparison baseline only and is not used for developing other data such as net performance and converter matches which are based on the SAE standard ambient conditions.

4. WORLDWIDE BASELINES

Since the variation in air density affects power output, engine manufacturers have attempted to develop correction formulae to determine output as various atmospheric conditions.

Throughout the world various standards have been established and in each of these the baseline air density is usually a different value. Page 5, Chart 3 shows air densities for these various standards together with temperature, altitude and relative humidity.

Chart 4 on page 5 also shows engine performance corrections for these various standards to accommodate the variables of temperature, altitude, and humidity. It can be noted from this chart that an engine corrected to the same conditions using these various standards would show a different performance. Therefore, much confusion exists today in this area because there is no definite standardized correction method.

The SAE Test Code Committee under the Engine Group has developed an appropriate formula for correcting operating conditions published under SAE J816b. This is applicable to all diesel and gasoline engines for determining corrected output performance.

5. WORLDWIDE SITE CONDITIONS

The following charts cover the land elevations for various areas around the world and also indicate population density to locate the possible areas of higher usage.

Chart 5, page 7 shows the United States land elevation and Chart 6, page 8 covers the population distribution. As mentioned previously the SAE baseline of 85°F (29.4°C) and 500 feet (152.4 m), (29.00 in. Hg (98.19 kPa) dry barometer) is the accepted standard for diesel engines in the United States as being representative of the average conditions.

South America shown on Charts 7 and 8, pages 9 and 10 indicate that most people live at altitudes substantially higher than the United States. Areas of large populations at 5000 feet (1524 m) would not be unusual.

The Mexico population distribution map Chart 6, page 8, shows that most of the habitation is in Central Mexico. With Mexico City located at an elevation of 7,349 feet (2240 metres) and the second largest city, Guadalajara at 5,180 feet (1579 metres).

CHART 1

NATURALLY ASPIRATED
BASIC ENGINE BASELINE CONVERSION FACTOR
(SAE TO 60°F AND SEA LEVEL)

This factor converts engine performance from SAE Standard Ambient Conditions: 85°F (29.4°C) air temperature, 29.00 in. Hg (98.19 kPa) barometer (dry), .0705 lb./cu.ft. (1.129 Kg/m^3) to 60°F (15.6°C) and sea level, 29.92 in. Hg (101.32 kPa) barometer (dry), .0765 lb./cu. ft. (1.225 Kg/m^3).

Engine RPM	V92 SERIES			
	9270	9275	9280	9285
1200	1.039	1.041	1.043	1.048
1400	1.029	1.040	1.038	1.040
1600	1.018	1.025	1.030	1.035
1800	1.018	1.016	1.024	1.028
2000	1.016	1.017	1.023	1.028
2100	1.020	1.021	1.022	1.026
2300	1.019	1.020	1.022	1.025

Engine RPM	L-71N & V71N SERIES (4 VALVE HEAD)			
	C & N55	C & N60	C & N65	C & N70
1200	1.035	1.047	1.069	1.082
1400	1.034	1.045	1.065	1.077
1600	1.035	1.044	1.060	1.072
1800	1.031	1.041	1.055	1.067
2000	1.026	1.038	1.048	1.061
2100	1.025	1.035	1.044	1.058
2300	-	-	-	1.052

Engine RPM	L-71N SERIES (2 VALVE HEAD)				
	71N5	N55	N60	N65	N70
1200	1.034	1.039	1.048	1.057	1.066
1400	1.032	1.036	1.044	1.053	1.063
1600	1.030	1.034	1.041	1.049	1.060
1800	1.027	1.031	1.038	1.045	1.055
2000	1.025	1.029	1.036	1.042	1.049
2100	1.024	1.027	1.035	1.040	1.047
2300	1.022	1.025	1.034	1.036	1.041

CHART 2

Engine RPM	L-53 & V53 SERIES (4 VALVE HEAD)		
	C & N40	C & N45	C & N50
1200	1.031	1.043	1.070
1500	1.026	1.036	1.057
1800	1.025	1.032	1.048
2000	1.024	1.030	1.044
2200	1.023	1.029	1.040
2500	1.021	1.027	1.034
2800	1.020	1.025	1.030

Engine RPM	L-53 SERIES			
	(2 VALVE HEAD)		(4 VALVE HEAD)	
	S & N40	S & N45	S40	S45
1200	1.043	1.055	1.028	1.038
1500	1.034	1.045	1.023	1.030
2000	1.022	1.045	1.023	1.030
2200	1.020	1.045	1.023	1.030
2500	-	-	1.023	1.030
2800	-	-	1.023	1.030

CHART 3

TEST CODE BASELINES

Test Code	Barometric Pressure In. Hg	(kPa)	% Humidity or Vapor Pressure	(kPa)	Air Inlet Temp.	(°C)	Air Density (Dry)	(Kg/m^3)
SAE J816b	29.38	(99.49)	0.38	(1.29)	85°	(29.4)	.0705	(1.129)
BSAU 141a	29.92	(101.32)	0%		68°	(20)	.0751	(1.203)
BS 649	30.1	(101.93)	0.6	(2.03)	85°	(29.4)	.0718	(1.150)
BS 2953	30.1	(101.93)	0.6	(2.03)	85°	(29.4)	.0718	(1.150)
DIN 6270	30.1	(101.93)	0.6	(2.03)	68°	(20)	.0728	(1.166)
DIN 70020	29.92	(101.32)	0%		68°	(20)	.0751	(1.203)
UIC 623 OR	29.4	(99.56)	0.4	(1.35)	68°	(20)	.0728	(1.166)
ISO/TC 22	29.92	(101.32)	0%		68°	(20)	.0751	(1.203)
ISO/TC 70	29.5	(99.9)	0.6	(2.03)	80.6°	(27)	.0709	(1.136)
ISO/DIS 3046	30.1	(101.93)	0.6	(2.03)	80.6°	(27)	.0725	(1.161)
ISUZU Method	29.92	(101.32)	0.4	(1.35)	68°	(20)	.0741	(1.187)

CHART 4

TEST CODE CORRECTIONS*

From	To		SAE Method Corr.	Designated Corr.	DDA
ISO/TC 70 (.0709 lb/ft^3)	SAE J816b (.0705 lb/ft^3)		.99786	.99729	.9975
BS 649 (.0718)	"	"	.98344	.98264	.9929
ISO/DIS 3046 (.0725)	"	"	.97658	.98213	.9875
ISUZU Method (.0741)	"	"	.96187	.96798	.9770
BS 2953 (.0718)	"	"	.98344	.98250	.9929
DIN 6270 (.0728)	"	"	.97886	.96619	.9855
UIC 623 OR (.0728)	"	"	.97886	.98183	.9855
BS AU 141a 1971 (.0751)	"	"	.94795	.96246	.9750
DIN 70020 (.0751)	"	"	.94795	.96627	.9750
ISO/TC 22 3/71 (.0751)	"	"	.94795	.97276	.9750

*The percent correction values shown are based on a specific engine and injector combination to show the relative difference, and may vary with injector size. Consult specific engine rating and standard for exact corrections.

Africa shown on Charts 9 and 10, pages 11 and 12, show that practically all of the population lives at elevations in excess of 2,000 feet (610 metres), and has very little habitable flatland on its extensive coast line.

Areas like Turkey shown on Chart 13, page 15 occupy what is known as the plateau of Asia Minor, which lies at an elevation substantially above 2,500 feet (762 metres).

Spain shown on Chart 13, page 15 is located at a much higher elevation than the rest of Central Europe. The major portion of the population living at an altitude of more than 2,000 feet (610 metres) , Chart 12 on page 14.

Charts 15 and 16, page 17 and 18 indicate the worldwide areas of relative temperature ranges and moisture content.

6. EFFECTS OF ENVIRONMENTAL CONDITIONS ON ENGINE PERFORMANCE

6.1 Effect of Site Altitude

The derating charts shown at the end of this bulletin indicate the power loss that would be experienced at a given site and temperature. These charts are used to determine the percent loss with SAE conditions being the baseline air density .0705 lb/ft^3 (1.129 Kg/m^3). The derating is arrived at by determining the site altitude on the chart and reading directly upwards to the proper engine speed. See example on Chart 17, page 19.

6.2 Effect of Inlet Temperature

Chart 18, page 20, shows the effect of air temperature on the equivalent altitude that will be seen by the engine and the resulting air density that will be available for combustion.

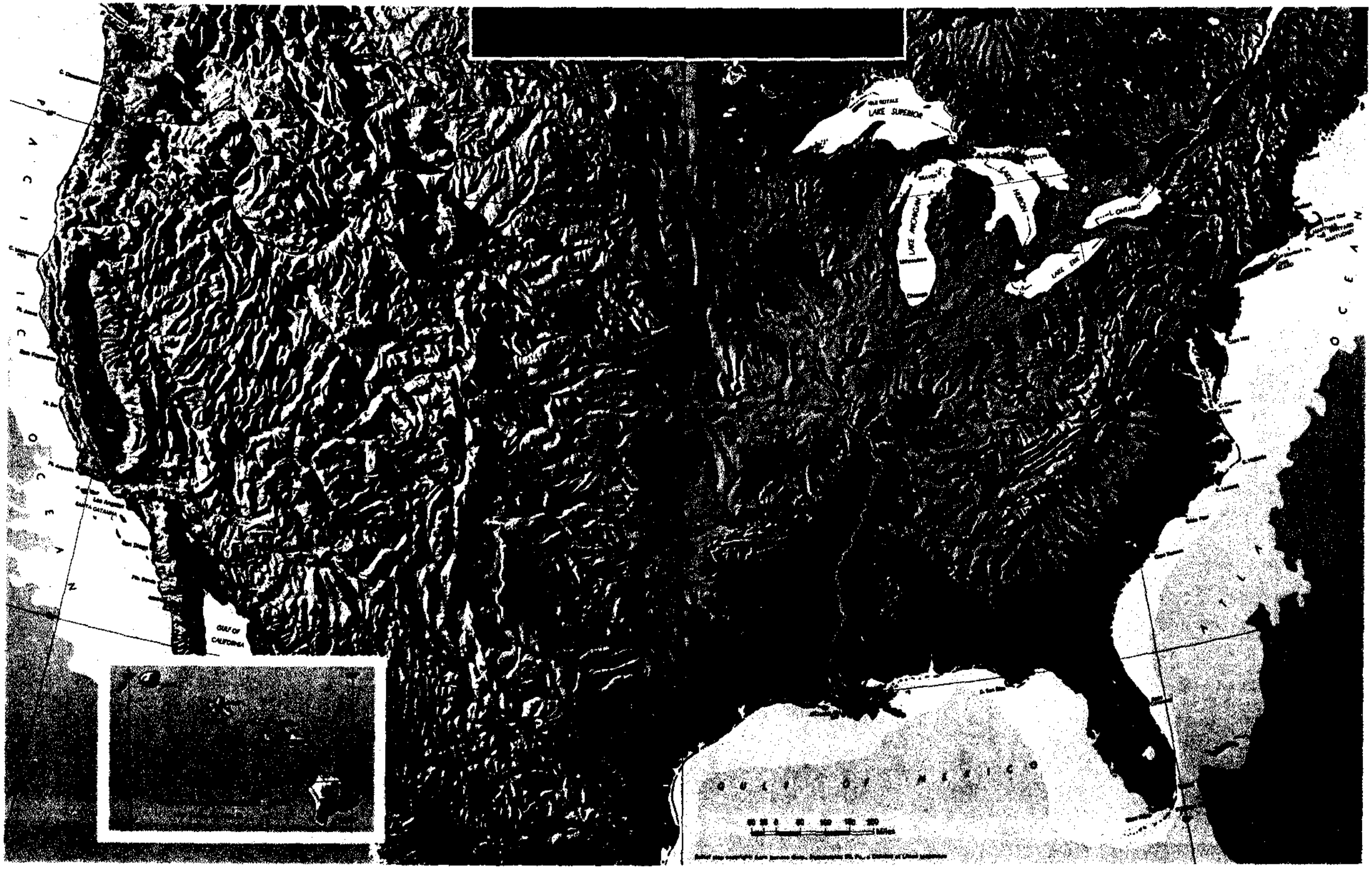
The example shown on the above chart indicates that a 6,000 foot (1829 metres) site altitude with a temperature of 70°F (21°C) is equivalent to 5,700 feet (1737 metres). The altitude value is then used to determine what the engine derating would be based on, see Charts 25 through 59.

6.3 Effect of Humidity

To determine the effect of humidity on the equivalent altitude refer to Chart 19, page 21. This chart represents the effect of both humidity and temperature. When humidities are less than 40% they can be disregarded for all practical purposes and only temperature corrections need be made for altitude adjustments.

When relative humidities are 40% and above, site altitudes must be adjusted by using the above referenced Chart 19 on page 21. Select the vertical line of the site altitude and the inlet air temperature diagonal corresponding to the nearest humidity reading. Read across to the side margin to determine

(Continued on Page 22)



Courtesy of Nystrom

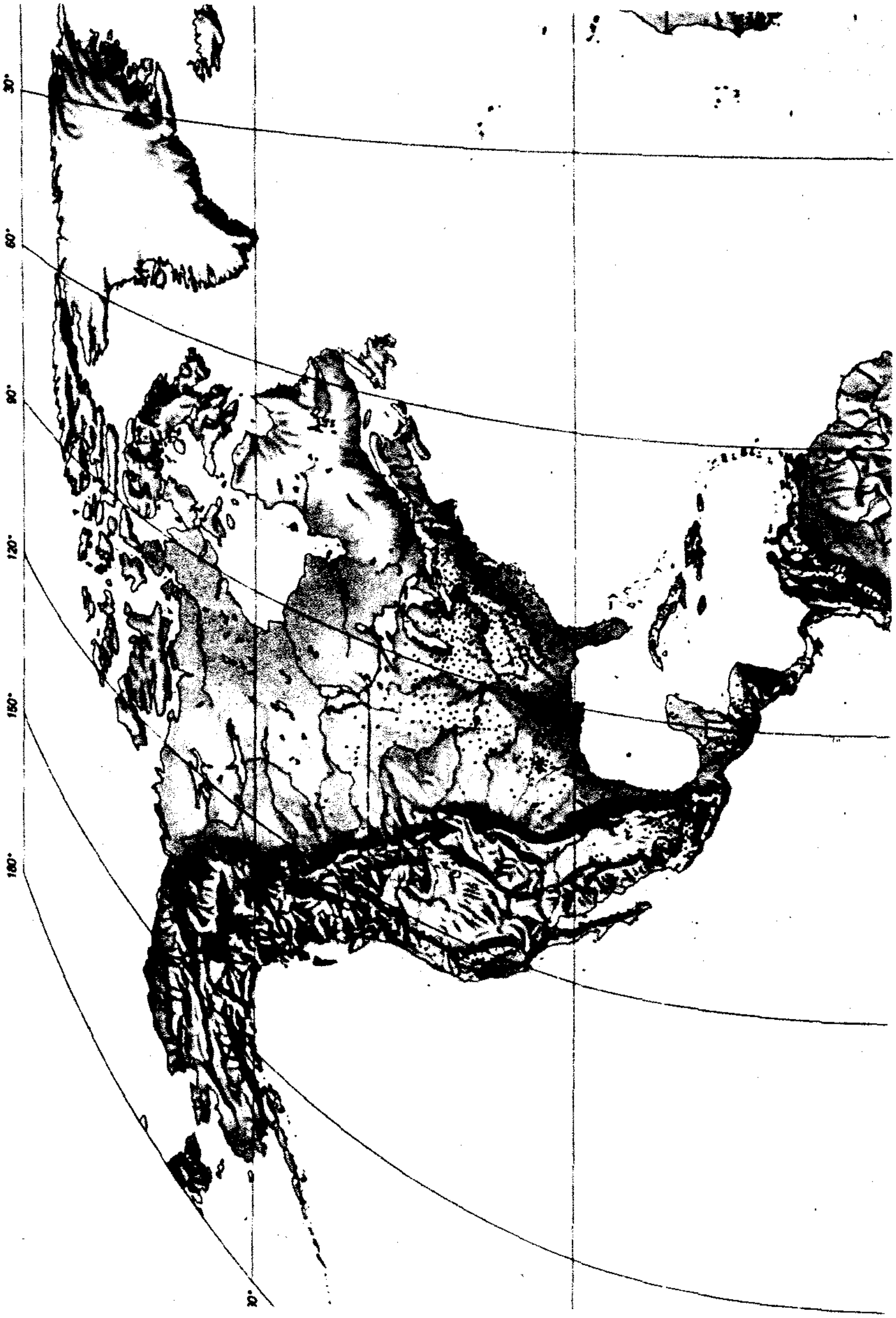
THE COUNTRIES of the world, as they might be seen by an astronaut, appear on the relief maps on this and the following pages. Looking down, we see the snow- and ice-covered regions edging the Arctic Ocean; the Antarctic, bleak and formidable in its cold isolation; the lands becoming warmer as we approach the Equator; the shadowy forms of hills rising above the general level of the Earth; the great mountain ranges in all their ruggedness, forming immense natural barriers as they sweep across the continents regardless of man-imposed boundaries; the low-lying plains, some richly fertile, others wide, arid wastes.

In magnificent relief, we see the coastline, sometimes falling abruptly, sometimes sloping gently, down into the sea, which gives a clear pattern of the shapes of continents in their early evolution. We become aware of the vastness of the oceans, the great depths in many of them, and their submerged peaks and mountain ranges.

LAND ELEVATIONS

Above 10,000 feet	1000 to 2000 feet
5000 to 10,000 feet	500 to 1000 feet
2000 to 5000 feet	Sea level to 500 feet

This map and the reliefs on pages 30-35 and 42-44 are vertically magnified 20 times. On the maps on pages 24-29 and 36-37 the vertical magnification is 30 times; on pages 38-41 it is 25 times.



One Dot Represents
100,000 people

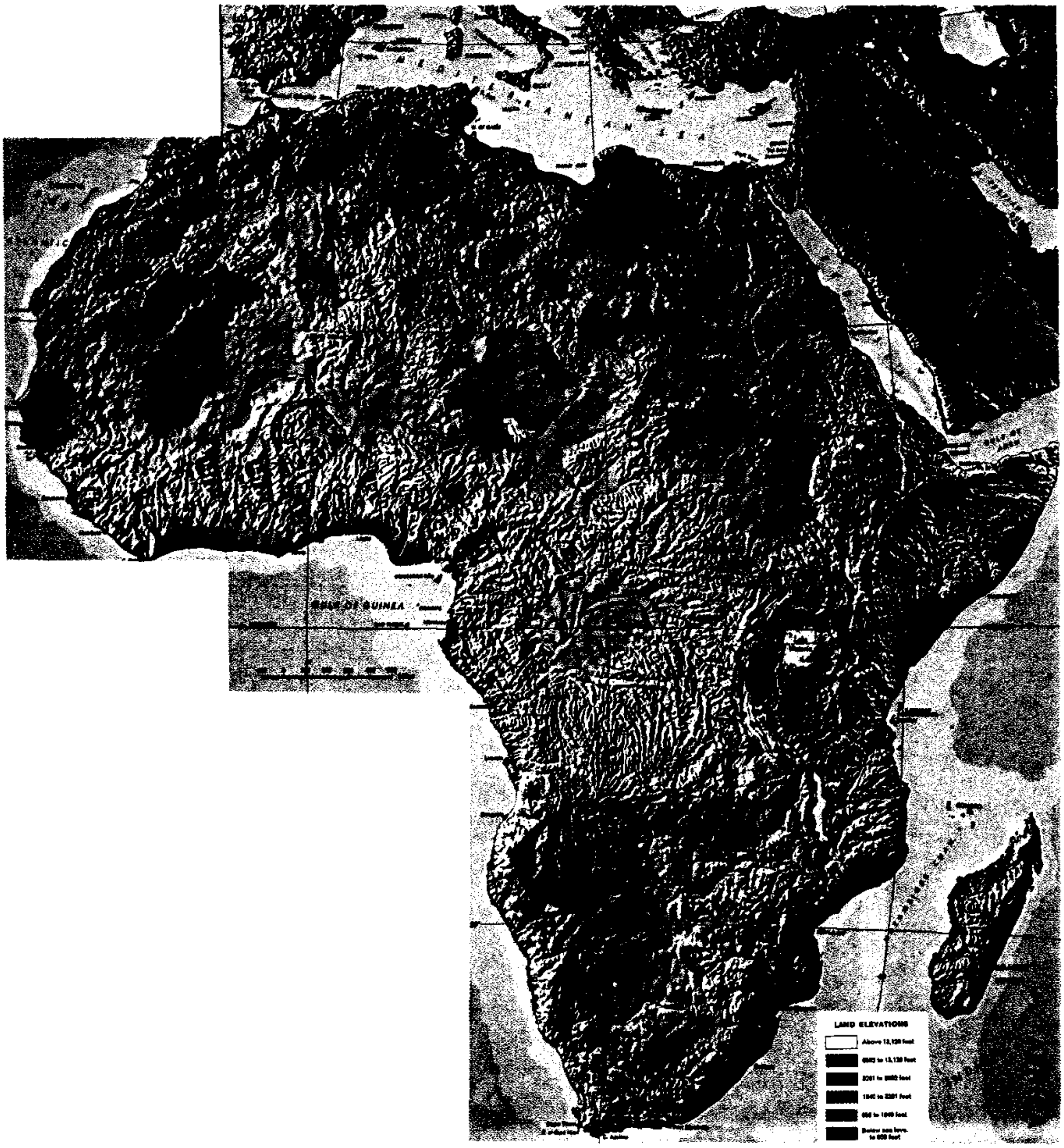
CHART 6
(8)

Courtesy of Nystrom

CHART 7
(9)

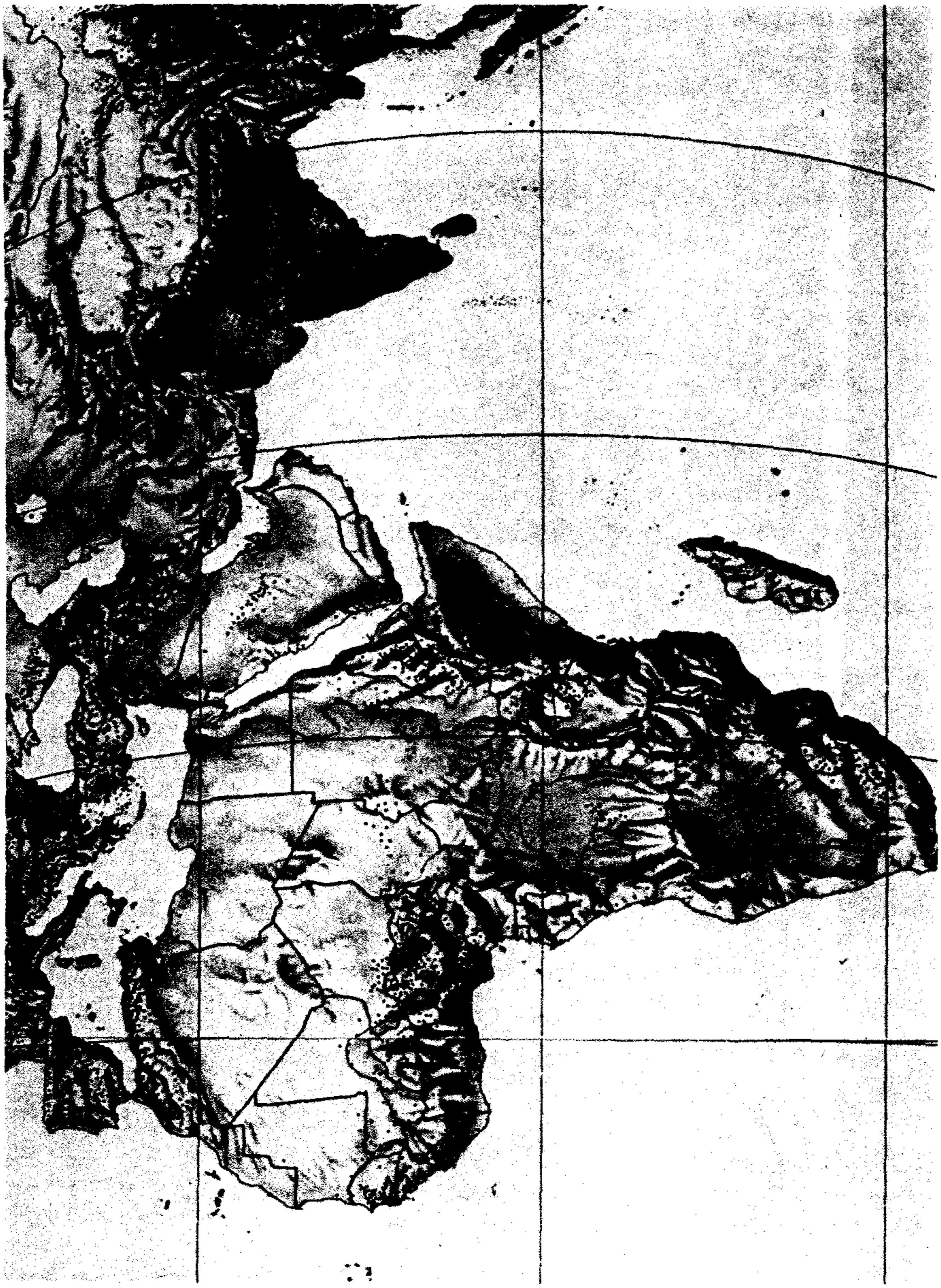
One Dot Represents
100,000 people

CHART 8
(10)



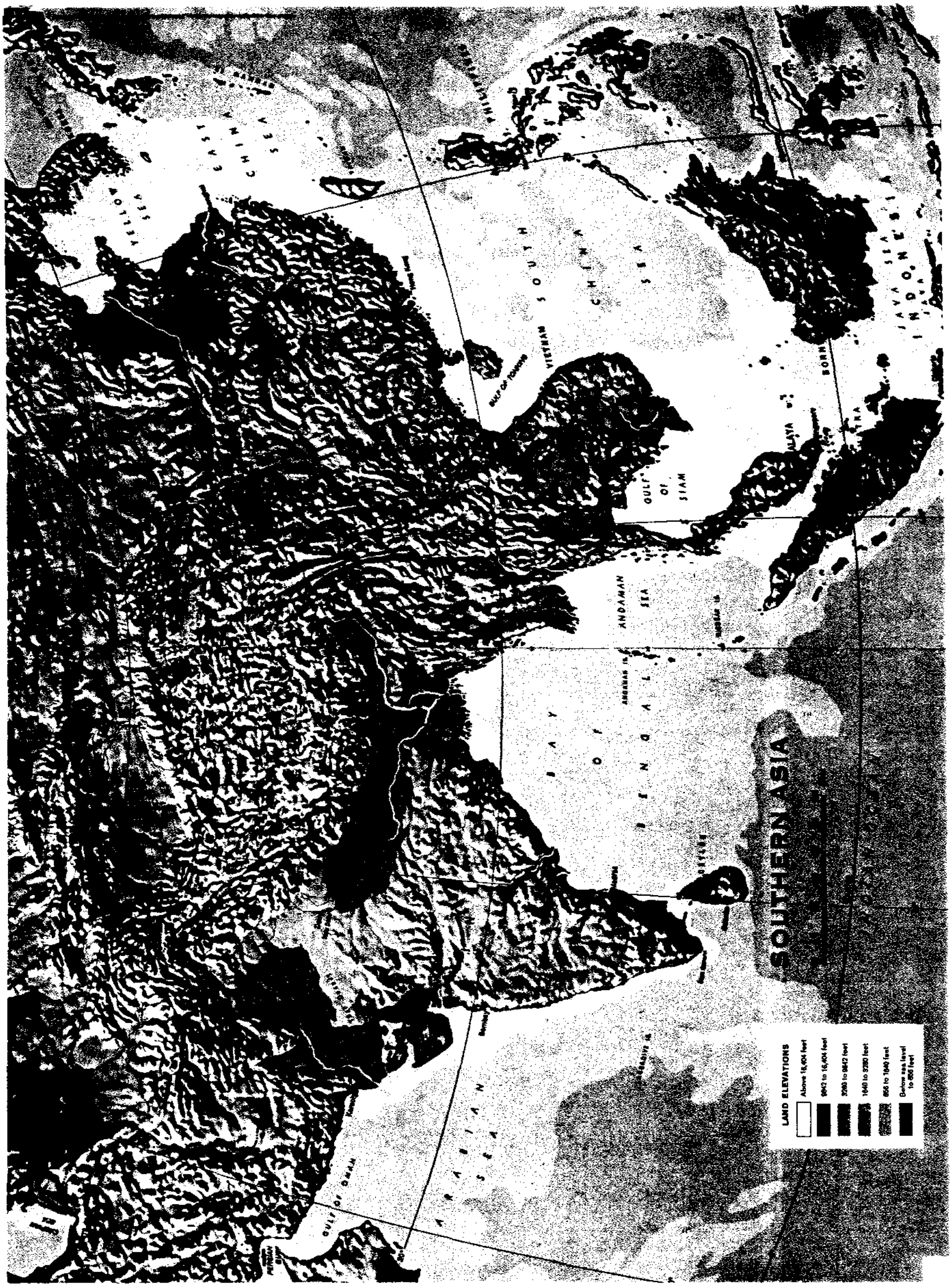
Courtesy of Rystrom

CHART 9
(11)



One Dot Represents
100,000 people

CHART 10
(12)



Courtesy of Nystrom

CHART 11
(13)

POPULATION OF THE WORLD

One Dot Represents
100,000 people

CHART 12
(14)

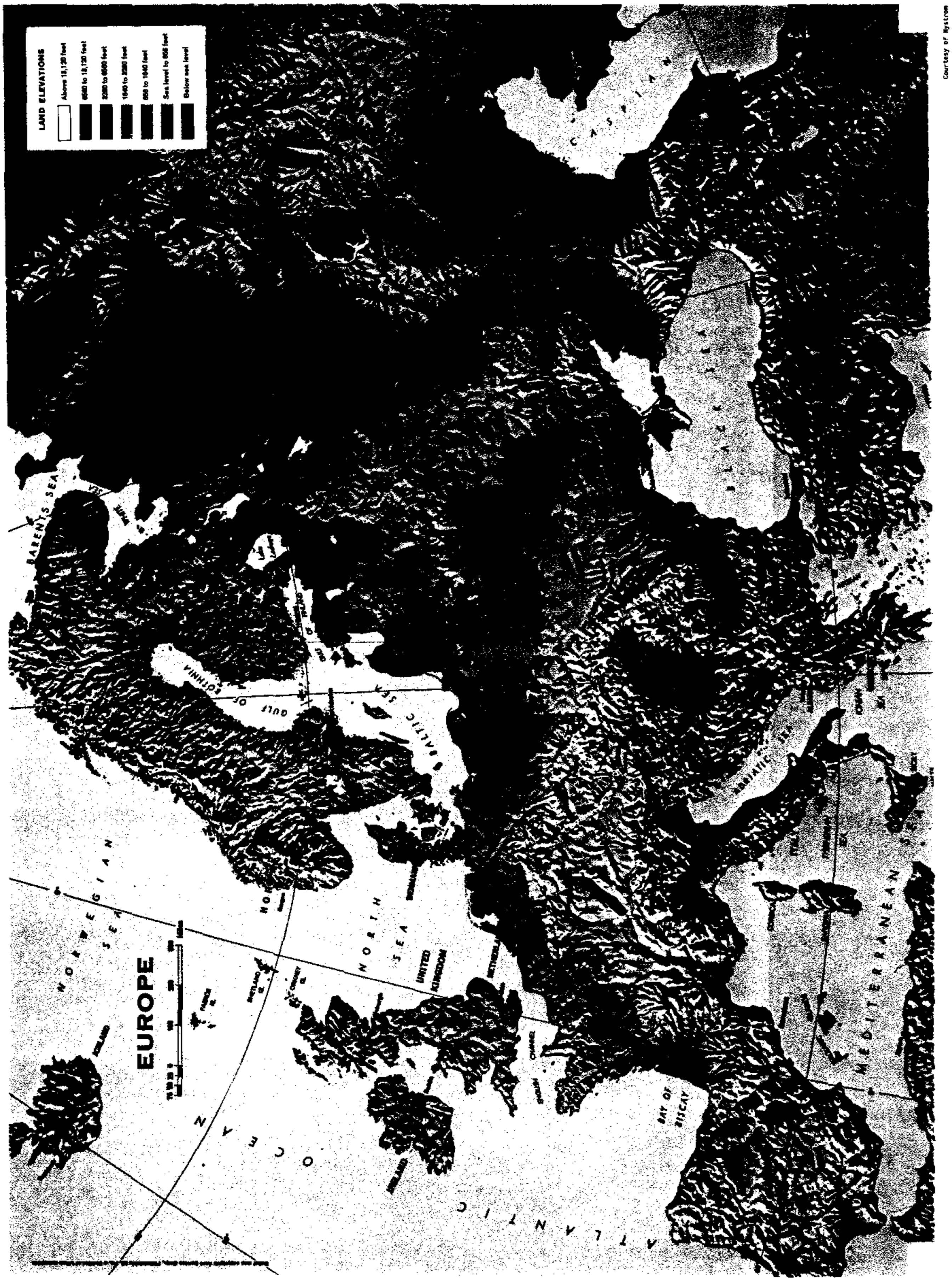
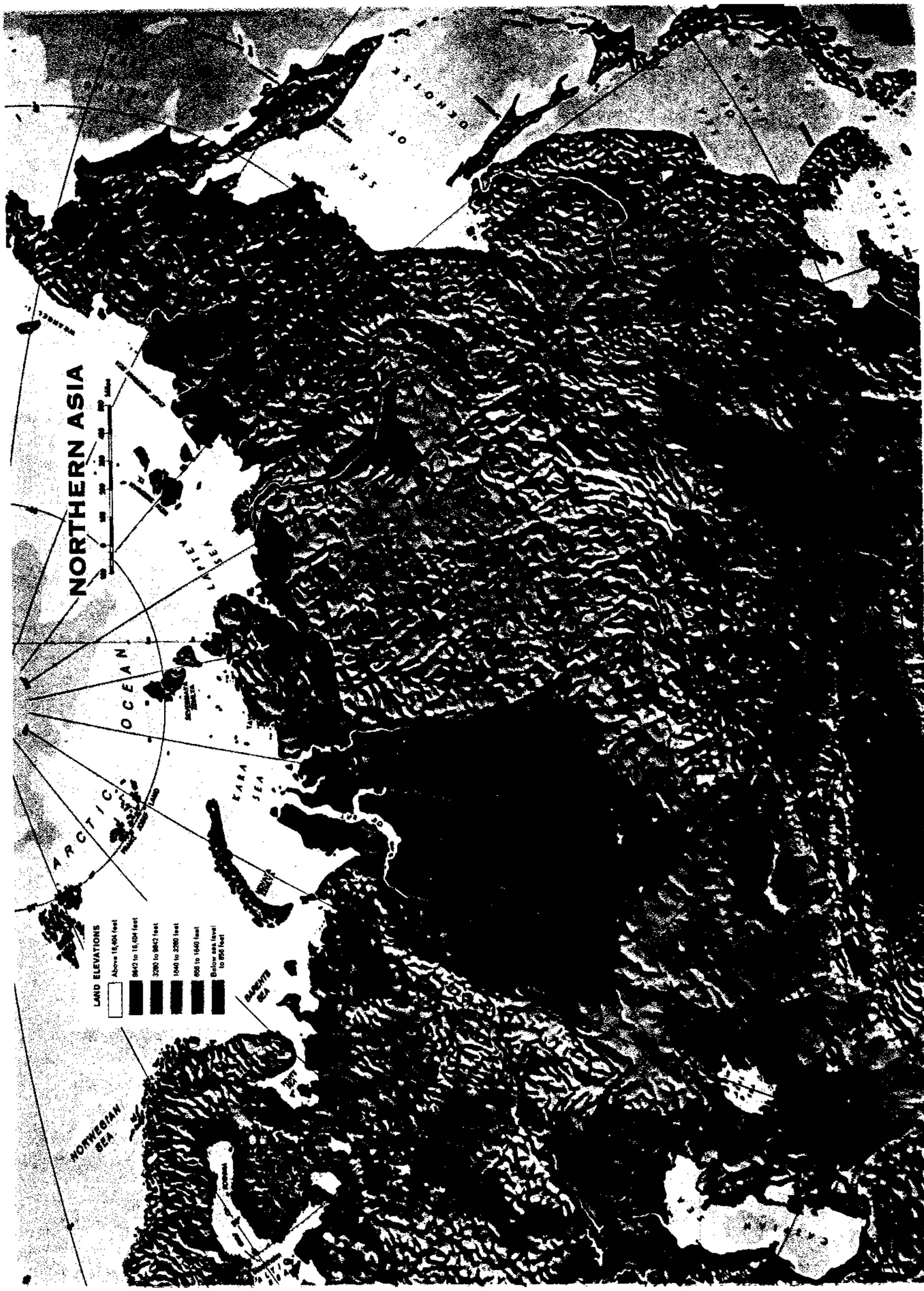

LAND ELEVATIONS
Above 13,120 feet
6560 to 13,120 feet
3280 to 6560 feet
1640 to 3280 feet
656 to 1640 feet
Sea level to 656 feet
Below sea level
EUROPE
CASPIAN
BLACK SEA
BARENTS SEA
GULF OF BOTHNIA
BALTIC SEA
NORWEGIAN SEA
NORTH SEA
UNITED KINGDOM
ADRIATIC SEA
MEDITERRANEAN SEA
BAY OF BISCAY
ATLANTIC OCEAN
Courtesy of Nystrom

CHART 13
(15)

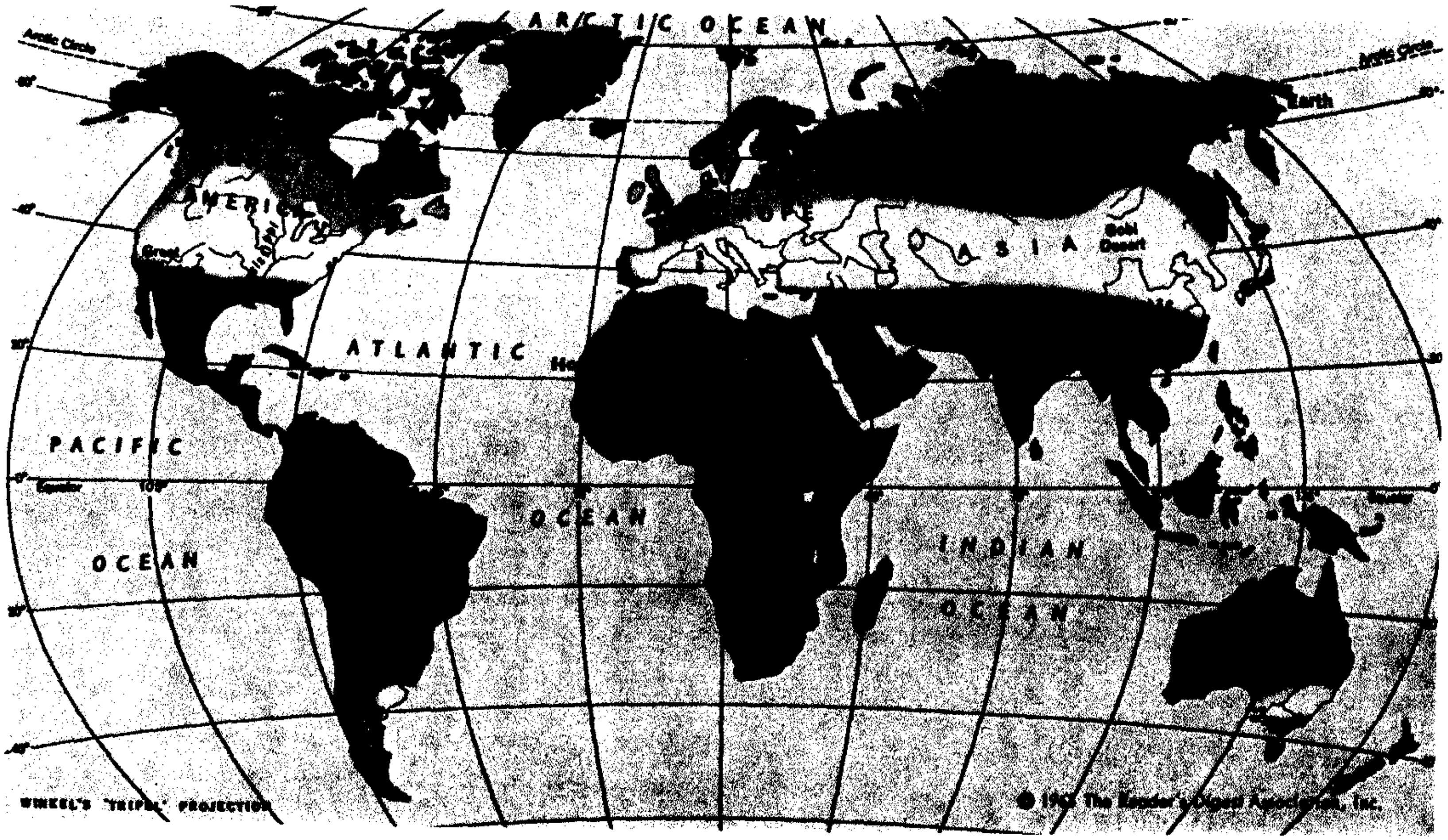


Courtesy of Nystrom

CHART 14

CHART 15
(17)

HOW HOT IS IT?



ALWAYS COLD

WARM SUMMER
COLD WINTER

HOT SUMMER
COLD WINTER

ALWAYS WARM

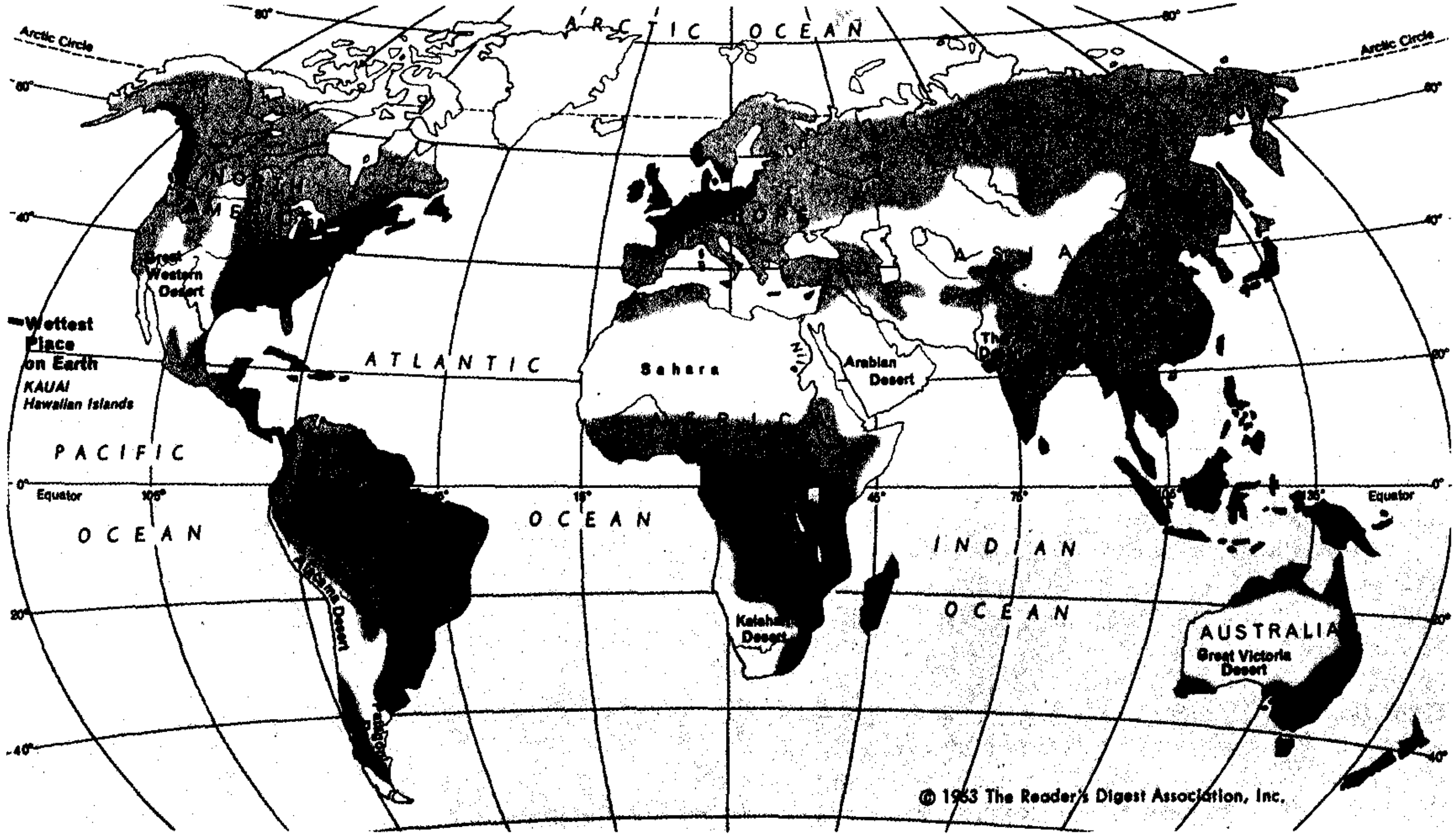
HOT SUMMER
WARM WINTER

ALWAYS HOT

Almost all of our heat comes from the Sun. Therefore the more vertical the Sun's position, the more heat we receive. Air is warmed chiefly by contact with the Earth's surface. The sea both warms and parts with its heat more slowly, so that climates near oceans are more equable than those inland. The highest temperatures have been recorded in the Sahara, the lowest in Siberia and the Antarctic.

The heat of the Tropics is somewhat distributed by ocean currents and winds. Thanks to the Gulf Stream and prevailing southeasterly winds, the average temperature of the British Isles is 50°F.; Labrador, in the same latitude, averages 32°F.

HOW WET IS IT?



LIGHT SNOW
SELDOM RAINY
LIGHT SEASONAL RAIN
HEAVY SEASONAL RAIN
RAINFALL IN EVERY MONTH

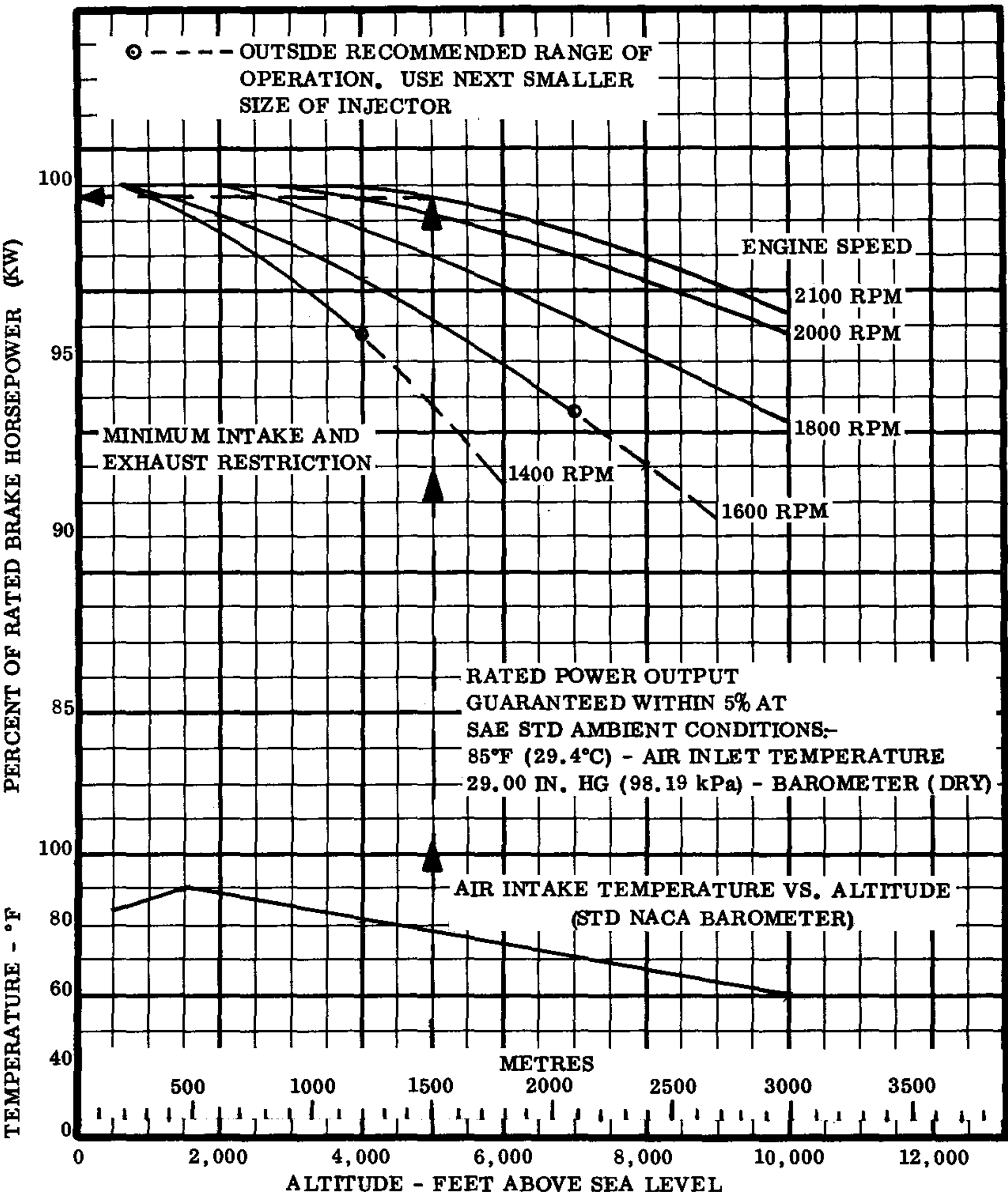
Air is most likely to be moist over the sea and where temperatures are high. The wettest places are in the Tropics, where moist sea air rises on the windward slopes of high mountains. Rainfall belts move northward and southward with the Sun, so that some places, such as the Mediterranean, have most of their rain in winter, while others, such as the Monsoon areas, have more in summer.

The driest areas on Earth are where winds have blown for long distances over heated land, or, more locally, where a range of mountains extracts all the rain on its windward side, leaving what is called a rain shadow on its leeward side.

CHART 17

Detroit Diesel Allison
Division of General Motors Corporation

TYPICAL ALTITUDE
DERATING CURVE

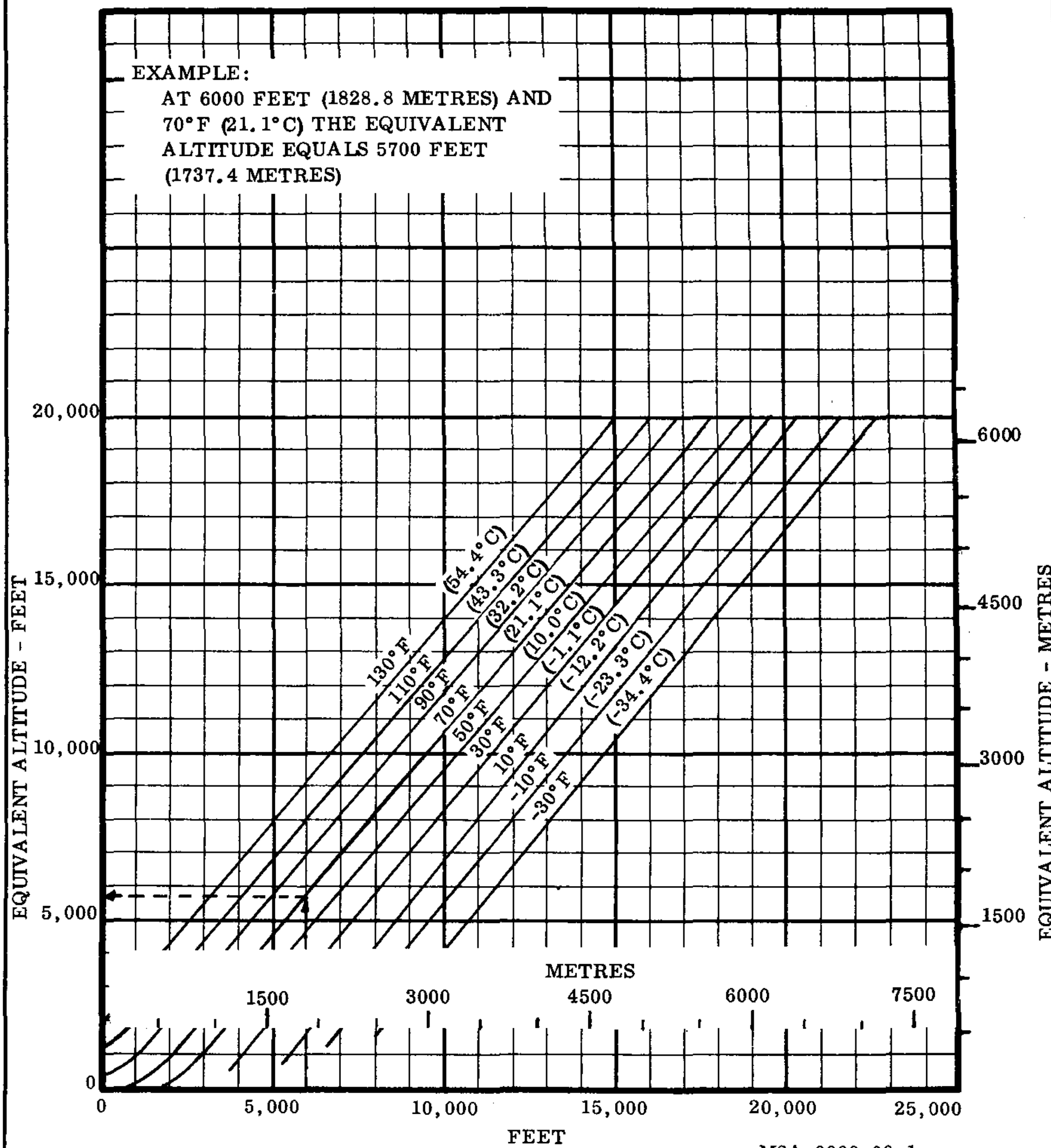


ENGINEERING-TECHNICAL DATA DEPT.

DE 3769

Detroit Diesel Allison
Division of General Motors Corporation

EQUIVALENT ALTITUDE CHART



SITE ALTITUDE

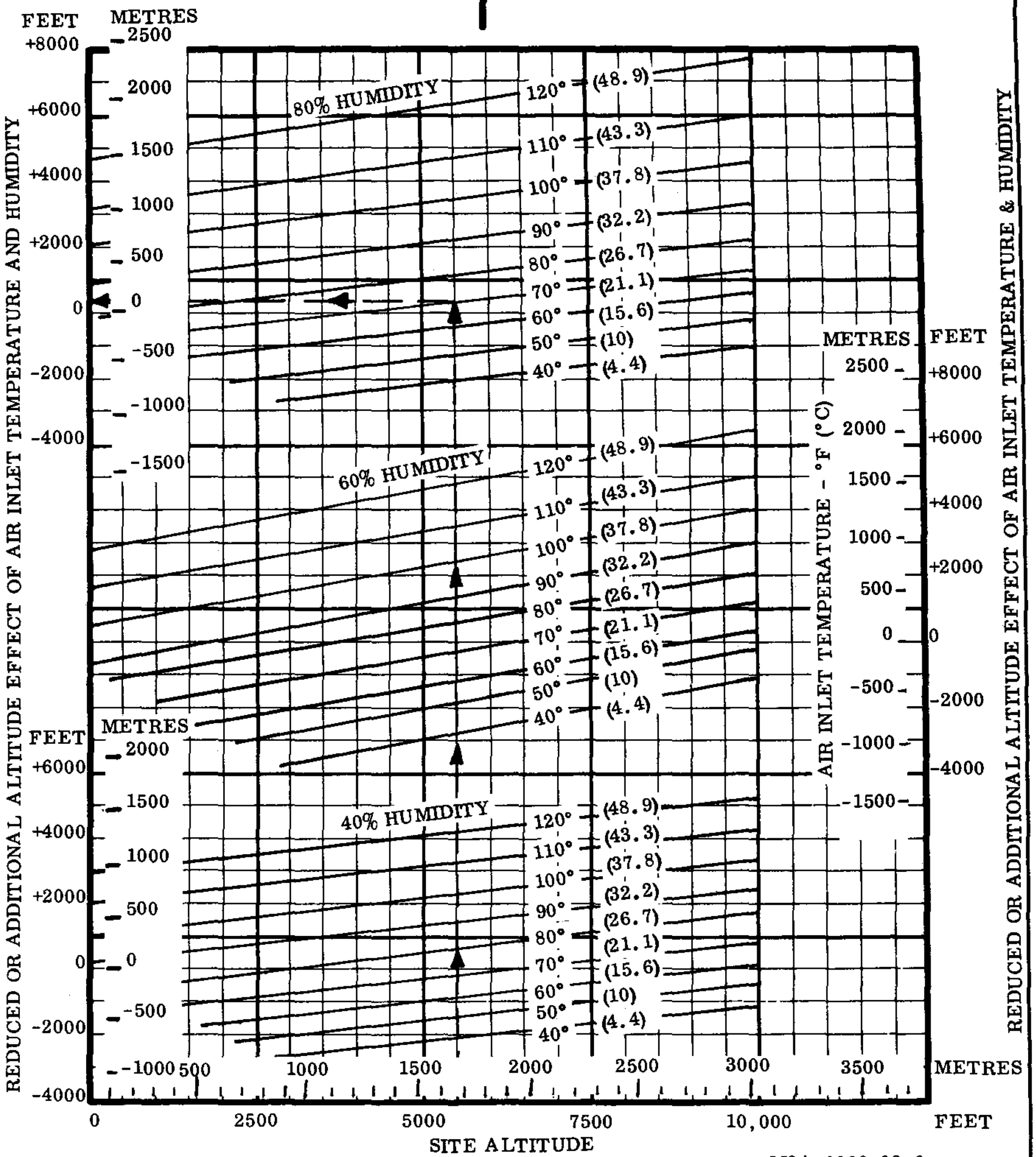
M2A-0000-00-1
Rev. 10-21-74

ENGINEERING-TECHNICAL DATA DEPT.

DE 3769-1

Detroit Diesel Allison
Division of General Motors Corporation

ALTITUDE CORRECTION TO TEST SITE FOR AIR INLET TEMPERATURE AND HUMIDITY



M2A-0000-00-6
Rev. 10-21-74

ENGINEERING-TECHNICAL DATA DEPT.

DE 3769-1

if the adjusted altitude is to be more or less than the site. If a plus sign precedes the adjustment figure, add this figure to the site altitude to obtain the adjusted altitude. If the sign is minus, deduct from the site altitude and use this adjusted altitude for engine derating shown on Charts 25 through 59.

Using a 5,500 foot (1676 metres) and 70°F (21°C) example with 80% relative humidity on Chart 19, page 21 the following is determined: Locate the 5,500 foot (1676 metres) site vertical line intersection with the diagonal 70°F (21°C) temperature line, in the 80% humidity group. Read across to the left side margin to determine the altitude adjustment which in this case is plus 400 (122 metres) feet. The total equivalent altitude being 5,900 feet (1798 metres) including 80% humidity. This equivalent altitude is then used to determine the derating based on Charts 25 through 59.

7. EFFECTS OF ENVIRONMENTAL CONDITIONS ON ENGINE OPERATING CHARACTERISTICS

Thus far our discussion has dealt with only engine performance as being affected by air density. Other items also affected are air box pressure, compression pressures, intake restriction, exhaust back pressure and cooling system. Charts 20 through 23 on pages 25 through 28 show corrections or percents of published values at various site altitudes which can be used for checking engine operation and establishing intake and exhaust back pressure limits.

To insure proper restriction settings and pressure readings for the items mentioned at altitudes above the rated baseline the charts on pages 25 through 28 should be used to compensate for change in air density. ALL PUBLISHED INTAKE RESTRICTION, EXHAUST BACK PRESSURE, COMPRESSION PRESSURE AND AIR BOX PRESSURE VALUES ARE BASED ON SAE CONDITIONS OF .0705 LB/FT^3 (1.129 Kg/m^3) OR 29.00 IN. HG (98.19 kPa) BAROMETER (DRY) AND 85°F (29.4°C).

For example:

A Detroit Diesel engine assembled in Detroit, Michigan at 29.00 in. Hg (98.19 kPa) dry barometer and 85°F (29.4°C) is measured and shows the following: an air box pressure of 8 in. Hg (27.1 kPa), 4 in. Hg (13.5 kPa) exhaust back pressure, 16 in. H_2O (3.98 kPa) air inlet restriction and with a compression pressure of 425 psi (2930 kPa).

This same engine at a site altitude of 10,000 feet (3048 metres) and 60°F (15.6°C) will result in the following readings:

7.1 Air Box Pressure

Selecting the proper site altitude on Chart 20, page 25 and moving along a vertical line to a temperature of 60°F (15.6°C) results in a reading horizontally of 82%. Therefore, 8 in. Hg (27.1 kPa) x .82 = 6.56 in. Hg (22.2 kPa). This derated value is to be used as the comparable reading obtained at 500 feet (152.4 metres).

7.2 Compression Pressure: The equivalent compression pressure value (Pc) is calculated by the following means:

Minimum compression at .0705 lb/cu ft (1.129 Kg/m^3) = 425 psi (2930 kPa)

Air density at 10,000 feet (3048 metres) and 60°F (15.6°C) is calculated by air density $= 1.326 \times \frac{\text{barometer (dry)}}{T}$

Where T = Absolute temperature
= 460 + t
Where t = Temperature degrees fahrenheit at site.

See Chart 24, page 29 for barometric pressures at various altitudes as well as temperatures based on DDA baseline.

$$\text{Air density (10,000 feet)} = \frac{1.326 \times 20.58}{460 + 60}$$

$$= .0525 \text{ lb/cu ft } (.841 \text{ Kg/m}^3)$$

$$\frac{Pc}{.0525} = \frac{425}{.0705}$$

Pc = 316 psi (2178 kPa) corrected

7.3 Exhaust Back Pressure: Referring to Chart 22, page 27 and selecting the vertical line corresponding to 10,000 feet (3048 metres) indicates that the pressure would result in the following:

4 in. Hg (13.5 kPa) x .87 = 3.48 in. Hg (11.78 kPa)

This indicates that the measured value would be approximately 3.48 in. Hg (11.78 kPa) at the site altitude and would be regarded as the maximum allowable exhaust back pressure at this altitude for a naturally aspirated engine.

7.4 Inlet Restriction: To determine inlet restriction changes use Chart 23 on page 28. 16 In. H_2O (3.99 kPa) inlet restriction at DDA's baseline condition would result in the following at the above mentioned site conditions:

16 in. H_2O (3.99 kPa) x .745 = 11.9 in. H_2O (2.96 kPa)

The new value determined this way represents the maximum inlet restriction for a clean cleaner plus duct at 10,000 feet (3048 metres) for a naturally aspirated engine.

7.5 Cooling System: The cooling system is effected similarly to the above items. The system is based on a baseline or maximum operating condition as described in the Cooling System Bulletin No. 28. When the operation varies from the specified conditions there will be a change in cooling index.

The cooling index for a given cooling system will vary by approximately two (2) degrees °F (1.1°C) per 1000 feet (304.8 metres) change in altitude. The cooling index is a numerical value of the cooling ability of a given cooling system stated in two ways as follows:

1. Air-to-Water (ATW)
2. Air-to-Boil (ATB)

The air-to-water (ATW) is the difference between engine coolant out and ambient air temperature. If the ATW index is 100°F (55°C) at SAE conditions 500 feet (152.4 metres) calculated as follows:

180°F (82°C) -80°F (27°C) = 100°F (55°C) ATW index

The corrected value for a site condition of 9,500 feet (2896 metres) would be approximately 18°F or an ATW index of 118°F (66°C).

The air-to-boil (ATB) value is the ambient temperature at which engine coolant would theoretically be leaving the engine in a boiling condition. The coolant is always considered to be water at sea level or 212°F (100°C). Using a coolant temperature of 180°F (82°C), ambient 80°F (27°C) and boiling point of 212°F (100°C), the resultant ATB is 112°F (44°C) at SAE conditions of 500 feet (152.4 metres).

212°F (boil) -180°F (coolant) + 80°F (ambient) = 112°F (44°C) ATB

At a 9,500 foot site altitude the ATB value would be corrected by 112°F -18°F with 94°F (34°C) being the new value.

8. EFFECT OF ENVIRONMENTAL CONDITIONS ON EXHAUST SMOKE

Although there are no specific requirements to be met throughout the world there are areas that have maximum limits on smoke. The United Kingdom (BSAU 141a) and United States (Federal Register) are two areas that require automotive engine manufacturers to certify exhaust smoke and the list will grow larger as the air pollution restrictions increase with the increase in internal combustion engine population.

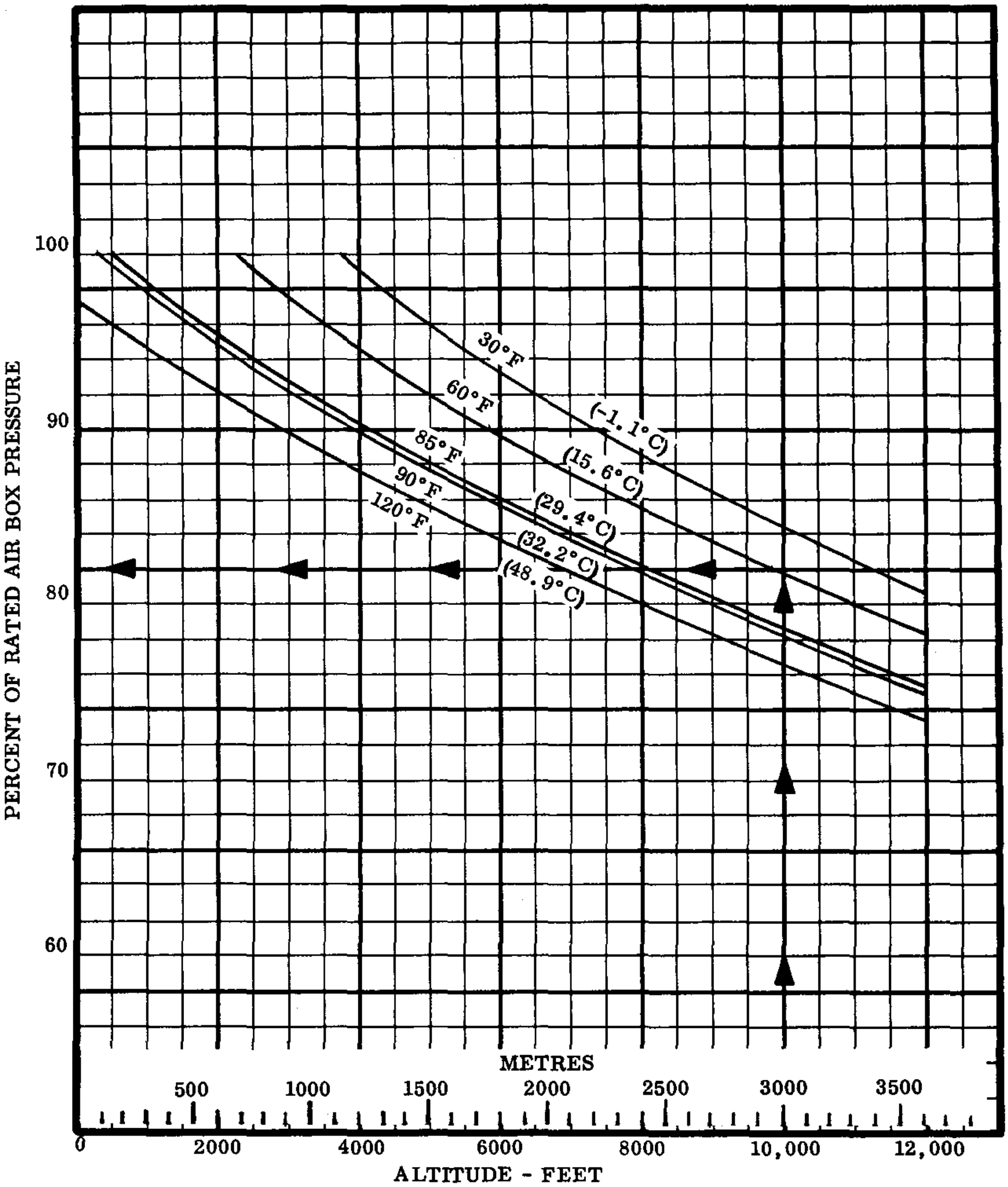
At the present time there are no curves or derating factors available on Detroit Diesel engines to show the effect of altitude on exhaust smoke. Data is available for Detroit Diesel engines with respect to Federal certification requirements only.

9. EFFECT OF ENVIRONMENTAL CONDITIONS ON GASEOUS EMISSIONS

At the present time there are no heavy duty diesel gaseous requirements at altitude in any of present day existing standards.

Detroit Diesel Allison
Division of General Motors Corporation

AIR BOX PRESSURE DERATING FOR ALTITUDE
ALL NATURALLY ASPIRATED MODELS
AND ENGINE SPEEDS



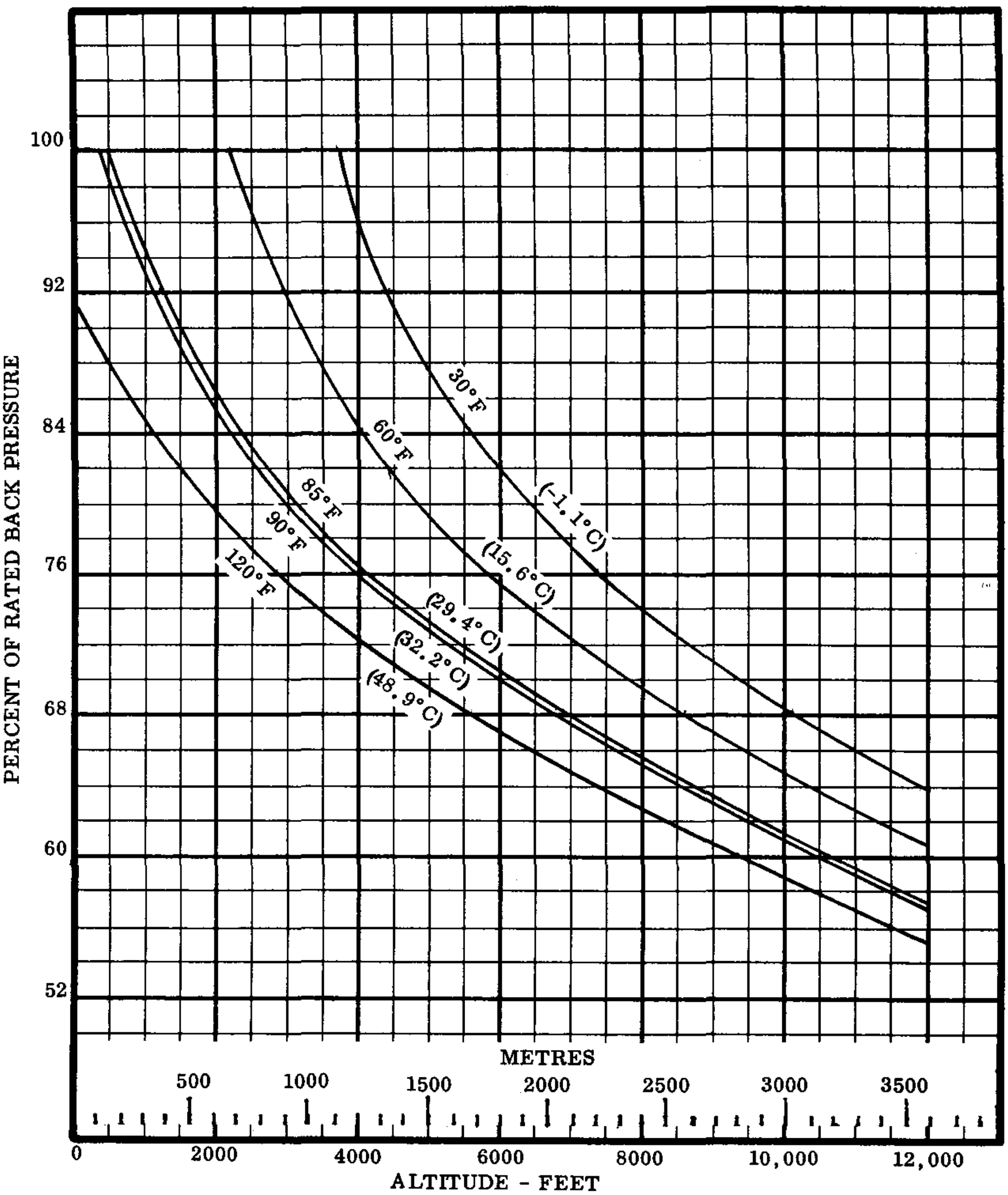
B3A-0001-00-2
Rev. 12-14-74

ENGINEERING-TECHNICAL DATA DEPT.

DE 3769

Detroit Diesel Allison
Division of General Motors Corporation

BACK PRESSURE DERATING FOR ALTITUDE
AT ALL SPEEDS
MODELS 71
(2 VALVE HEAD)
NATURALLY ASPIRATED



C2A-0001-00-3
Rev. 12-13-74

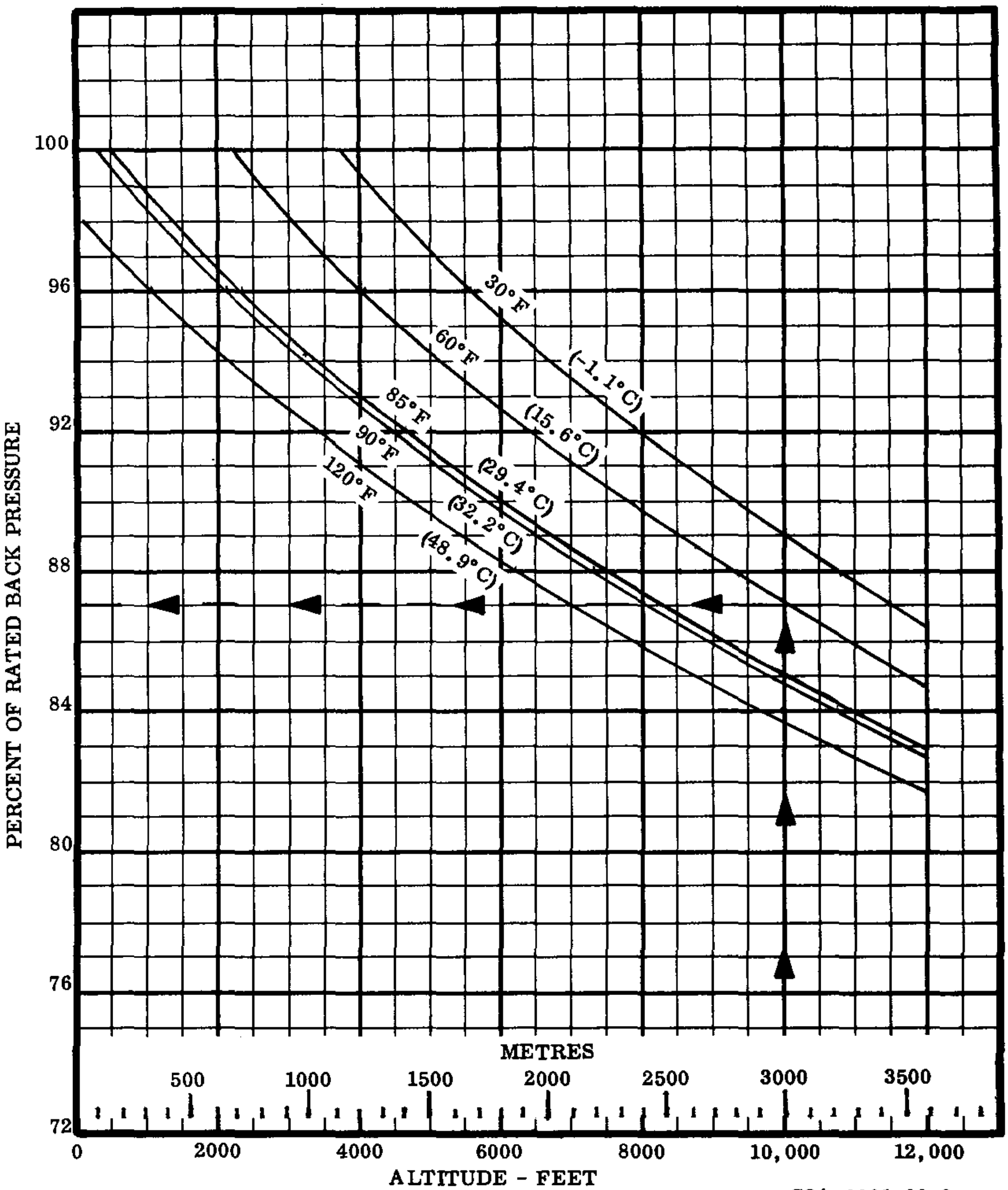
ENGINEERING-TECHNICAL DATA DEPT.

DE 3769

CHART 22

Detroit Diesel Allison
Division of General Motors Corporation

BACK PRESSURE DERATING FOR ALTITUDE
AT ALL SPEEDS
MODELS 53N, 71N, V71N, V92 & 149
(4 VALVE HEAD)
NATURALLY ASPIRATED



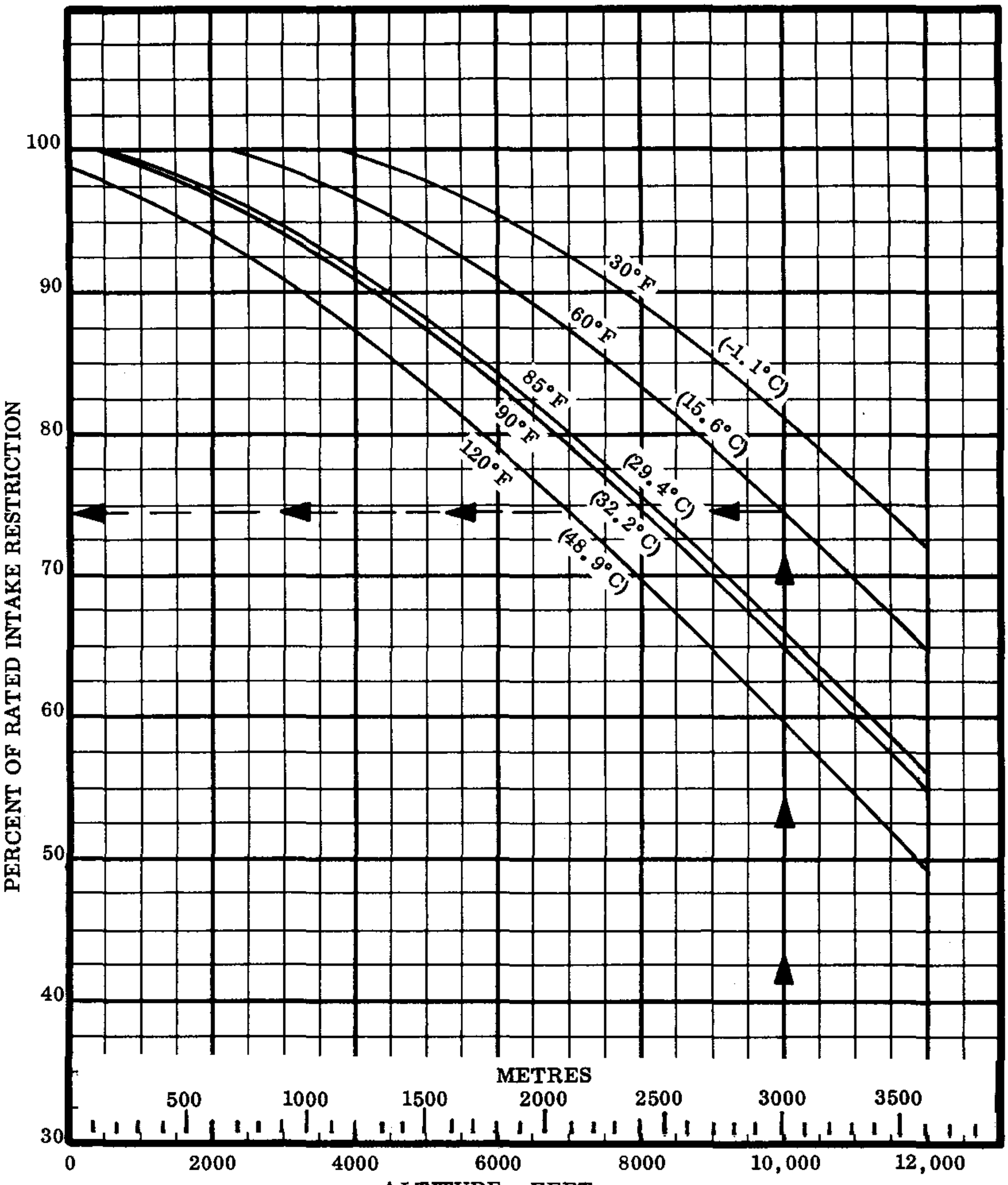
C2A-0001-00-2
Rev. 12-13-74

ENGINEERING-TECHNICAL DATA DEPT.

DE 3769

Detroit Diesel Allison
Division of General Motors Corporation

INTAKE DEPRESSION DERATING FOR ALTITUDE
ALL ENGINES AND ENGINE SPEEDS



S1A-0001-00-2
Rev. 12-13-74

ENGINEERING-TECHNICAL DATA DEPT.

OE 3769

CHART 24

BAROMETRIC PRESSURES AND AIR TEMPERATURES USED FOR DDA ALTITUDE CORRECTION

ALTITUDE Feet	(Metres)	PRESSURE In. Hg	(kPa)	TEMPERATURE °F	(°C)
Sea level	(0)	29.92	(101.31)	60	(15.6)
+500	(152.4)	29.00	(98.19)	85	(29.4)
1,000	(304.8)	28.86	(97.72)	88	(31.1)
1,500	(457)	28.33	(95.93)	90	(32.2)
2,000	(610)	27.82	(94.20)	88.2	(31.2)
2,500	(762)	27.31	(92.47)	86.4	(30.2)
3,000	(914)	26.81	(90.78)	84.6	(29.2)
3,500	(1067)	26.32	(89.12)	82.8	(28.2)
4,000	(1219)	25.84	(87.49)	81.0	(27.2)
4,500	(1372)	25.36	(85.87)	79.2	(26.2)
5,000	(1524)	24.89	(84.28)	77.4	(25.2)
5,500	(1676)	24.43	(82.72)	75.6	(24.2)
6,000	(1829)	23.98	(81.20)	73.8	(23.2)
6,500	(1981)	23.53	(79.67)	72.0	(22.2)
7,000	(2134)	23.09	(78.18)	70.2	(21.2)
7,500	(2286)	22.65	(76.69)	68.4	(20.2)
8,000	(2438)	22.22	(75.24)	66.6	(19.2)
8,500	(2591)	21.80	(73.81)	64.8	(18.2)
9,000	(2743)	21.38	(72.39)	63.0	(17.2)
9,500	(2896)	20.98	(71.04)	61.2	(16.2)
10,000	(3048)	20.58	(69.68)	59.4	(15.2)
10,500	(3200)	20.18	(68.33)	57.6	(14.2)
11,000	(3353)	19.79	(67.01)	55.8	(13.2)
11,500	(3505)	19.40	(65.69)	54.0	(12.2)
12,000	(3658)	19.03	(64.44)	52.2	(11.2)
12,500	(3810)	18.65	(63.15)	50.4	(10.2)
13,000	(3962)	18.29	(61.93)	48.6	(9.2)
13,500	(4115)	17.93	(60.71)	46.8	(8.2)
14,000	(4267)	17.57	(59.49)	45.0	(7.2)
14,500	(4420)	17.22	(58.31)	43.2	(6.2)
15,000	(4572)	16.88	(57.16)	41.4	(5.2)
15,500	(4724)	16.54	(56.00)	39.6	(4.2)
16,000	(4877)	16.21	(54.89)	37.8	(3.2)

DERATING CURVES:

The following is a list of Altitude Derating curves for the various engine series and injector sizes:

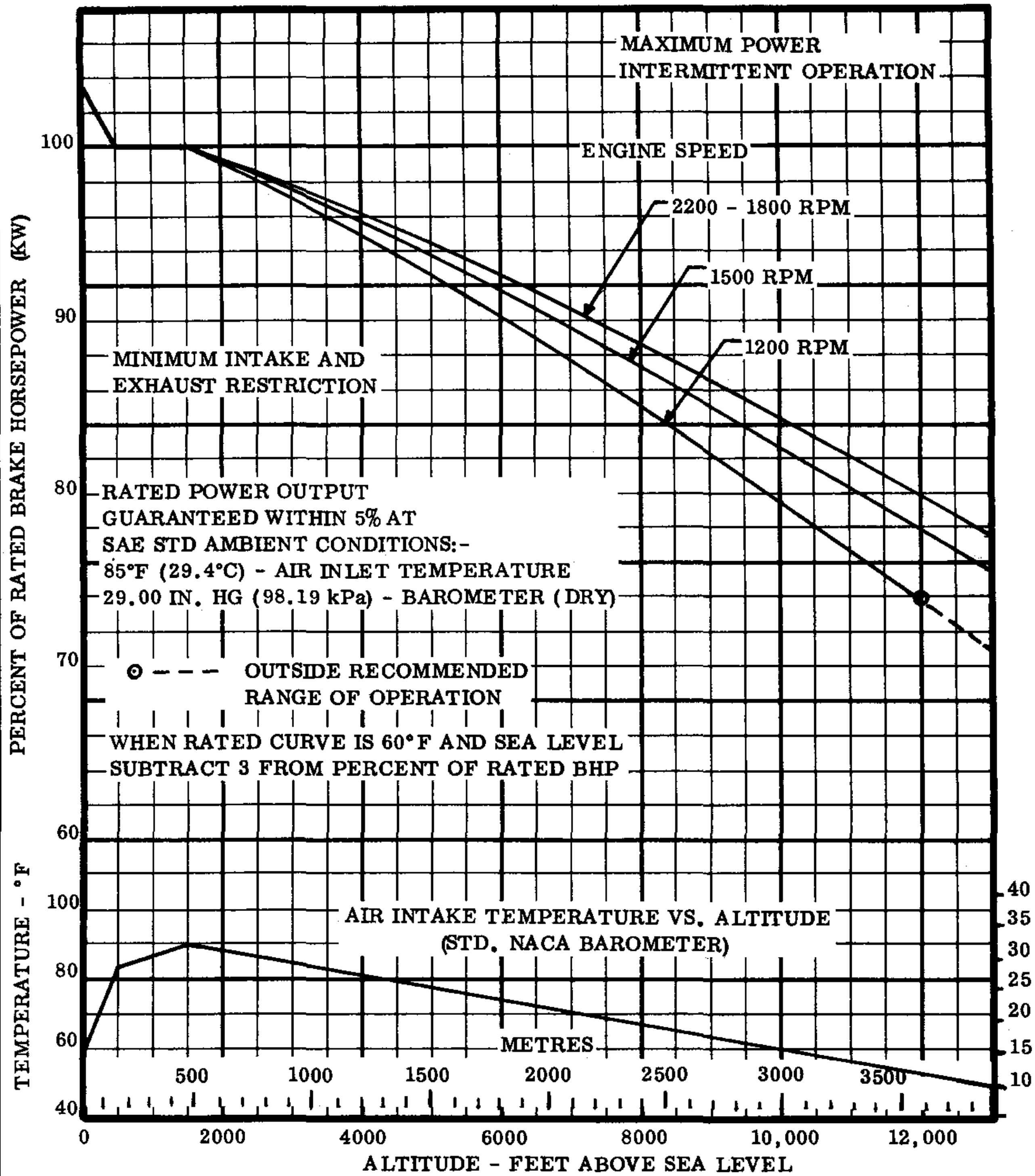
Engine	Injector	Curve Number	Chart No.
Series 53 (2V)	S & N40	E4A-5000-11-1	25
Series 53 (2V)	S & N45	E4A-5000-11-1A	26
Series 53 (4V)	C, N & S40	E4A-5000-12-1	27
Series 53 (4V)	C, N & S45	E4A-5000-12-1A	28
Series 53 (4V)	C & N50	E4AR-5000-52-1A	29
L & V-71N (4V)	71C5 & 71N5	E4A-0000-52-2	30
L & V-71N (4V)	C & N55	E4A-0000-02-1	31
L & V-71N (4V)	C & N60	E4A-0000-02-2	32
L & V-71N (4V)	C & N65	E4AR-0000-52-1A	33
L & V-71N (4V)	C & N70	E4AR-0000-12-2	34
L-71N (2V)	N55	E4A-1000-51-5	35
L-71N (2V)	N60	E4A-1000-51-2	36
L-71N (2V)	N65	E4A-1000-51-3	37
L-71N (2V)	N70	E4A-1000-51-4	38
L & V-71T	N60	E4AR-7000-32-3	39
L & V-71T	N65	E4AR-7000-32-1	40
L & V-71T	N70	E4AR-7000-32-2	41
L & V-71T	N75	E4A-7000-32-2	42
L & V-71T	N80	E4A-7000-32-3	43
L & V-71T	N90 (Gen. Appl.)	E4A-7000-32-5	44
L & V-71T	N90	E4A-7000-32-4	45
149	120	E4AR-9000-12-2	46
149	130	E4AR-9000-12-1	47
149T & TI	140	E4AR-9000-32-2	48

Engine	Injector	Curve Number	Chart No.
149T & TI	150	E4AR-9000-32-1	49
149T & TI	165	E4AR-9000-32-3	50
149TI	180	E4AR-9000-32-4	51
V92	9270	E4A-0000-52-3	52
V92	9275	E4A-0000-02-3	53
V92	9280	E4A-0000-02-4	54
V92	9285	E4AR-0000-52-2	55
V92T	9280	E4AR-8000-32-4	56
V92T	2985	E4AR-0000-32-1	57
V92T	9290	E4AR-8000-32-2	58
V92T	9295	E4AR-8000-32-3	59

CHART 25

Detroit Diesel Allison
Division of General Motors Corporation

SERIES 53 ENGINE
(2 VALVE HEAD)
ALTITUDE PERFORMANCE
S40 & N40 INJECTORS



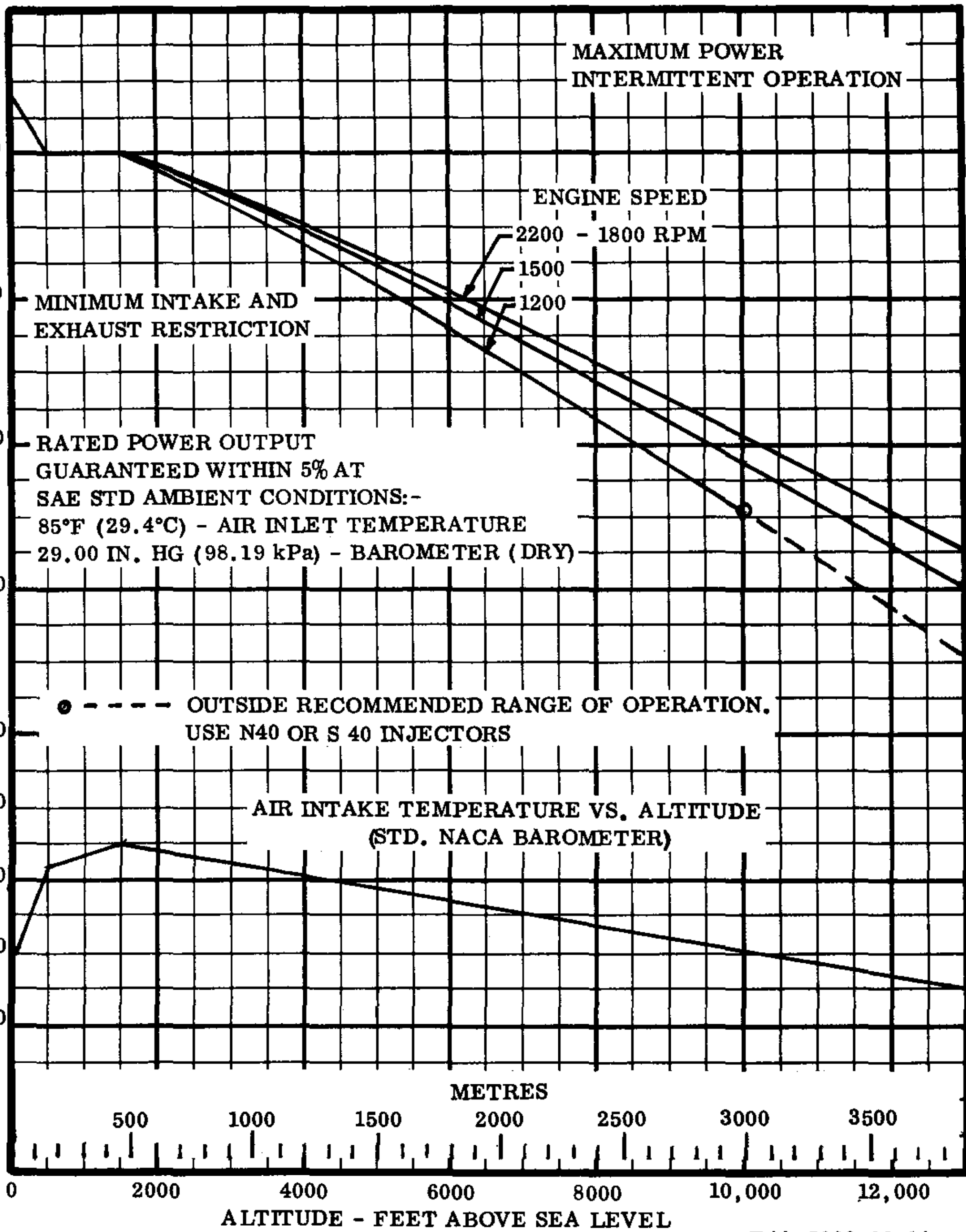
E4A-5000-11-1
Rev. 10-21-74

ENGINEERING-TECHNICAL DATA DEPT.

DE 3769

Detroit Diesel Allison
Division of General Motors Corporation

SERIES 53 ENGINE
(2 VALVE HEAD)
ALTITUDE PERFORMANCE
N45 & S45 INJECTORS



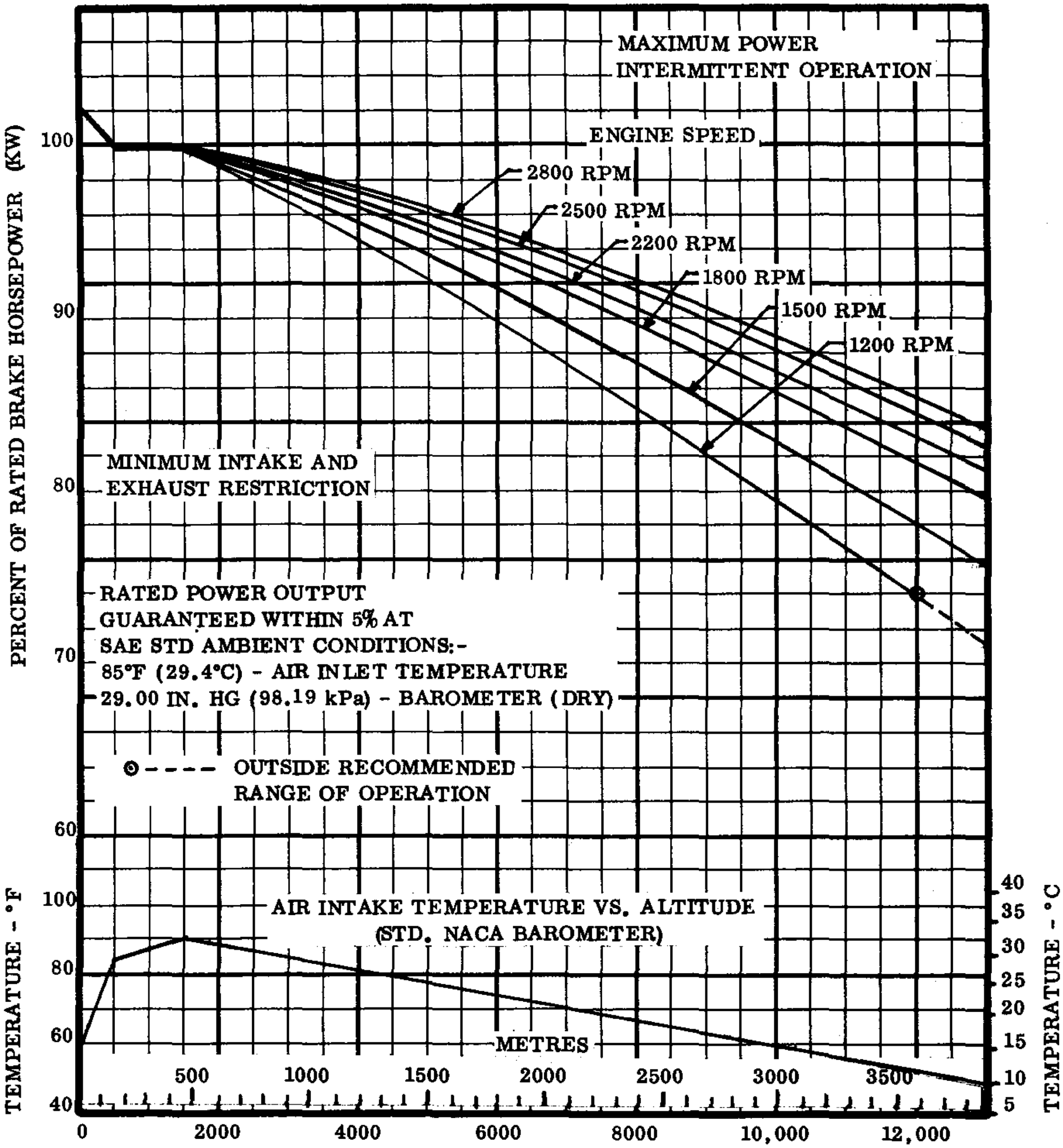
E4A-5000-11-1A
Rev. 2-6-75

ENGINEERING-TECHNICAL DATA DEPT.

DE 3769

Detroit Diesel Allison
Division of General Motors Corporation

SERIES 53 ENGINE
(4 VALVE HEAD)
ALTITUDE PERFORMANCE
S40, N40 & C40 INJECTORS



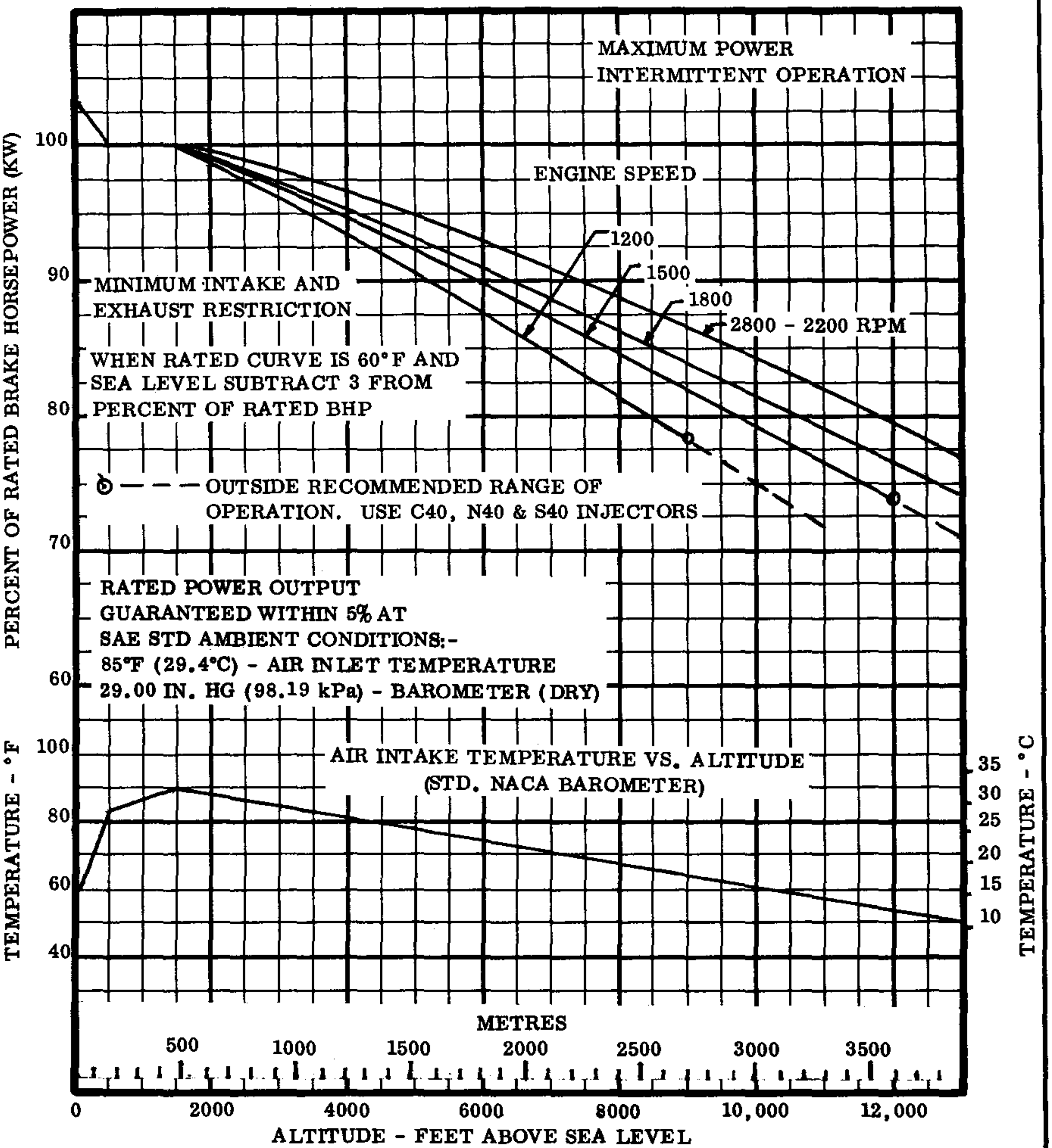
E4A-5000-12-1
Rev. 10-21-74

ENGINEERING-TECHNICAL DATA DEPT.

DE 3769

Detroit Diesel Allison
Division of General Motors Corporation

SERIES 53 ENGINE
(4 VALVE HEAD)
ALTITUDE PERFORMANCE
C45, N45 & S45 INJECTORS



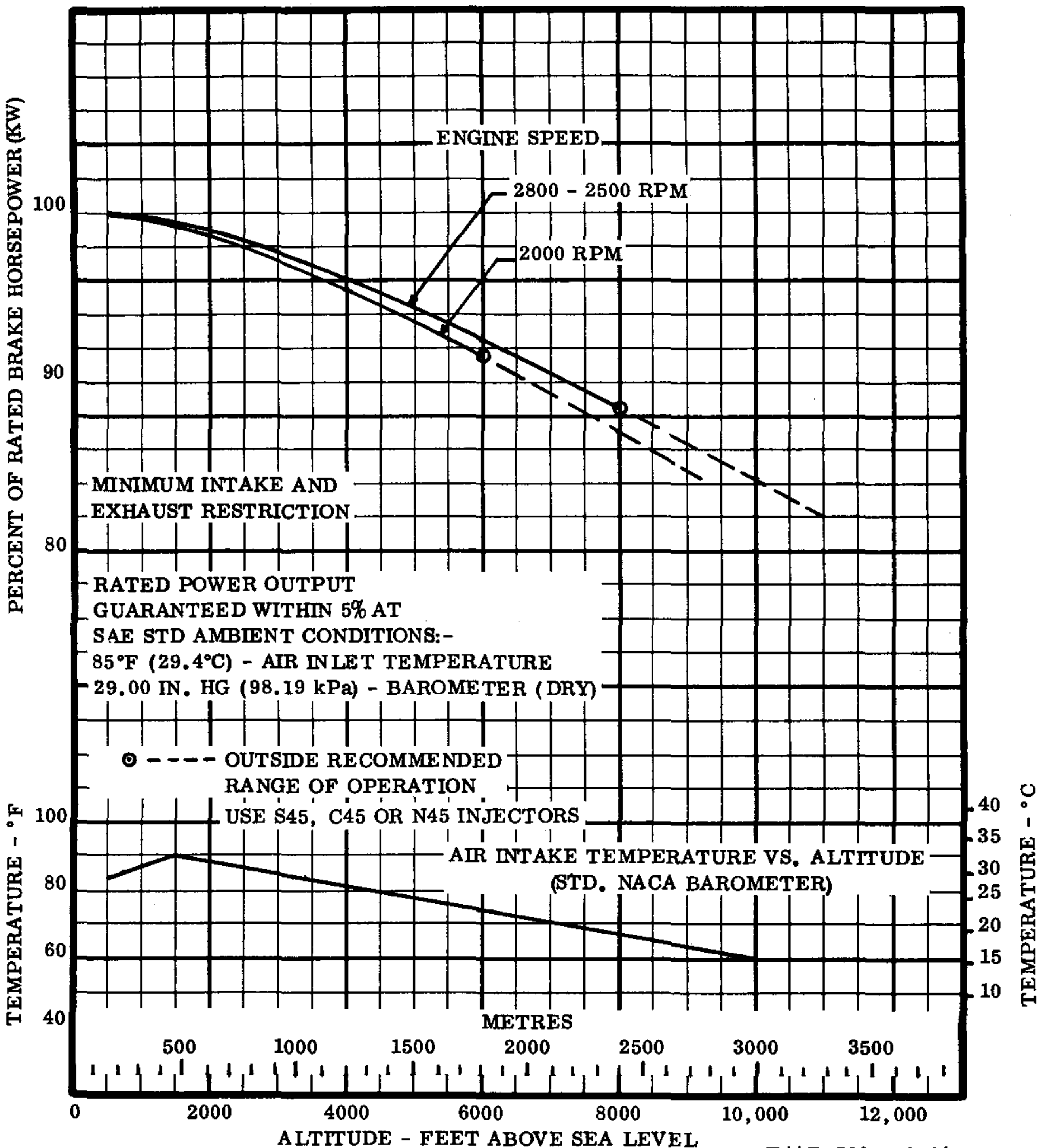
E4A-5000-12-1A
Rev. 3-5-75

ENGINEERING-TECHNICAL DATA DEPT.

DE 3769

Detroit Diesel Allison
Division of General Motors Corporation

SERIES 53N ENGINE
(4 VALVE HEAD)
ALTITUDE PERFORMANCE
C50 & N50 INJECTORS



E4AR-5000-52-1A
Rev. 10-21-74

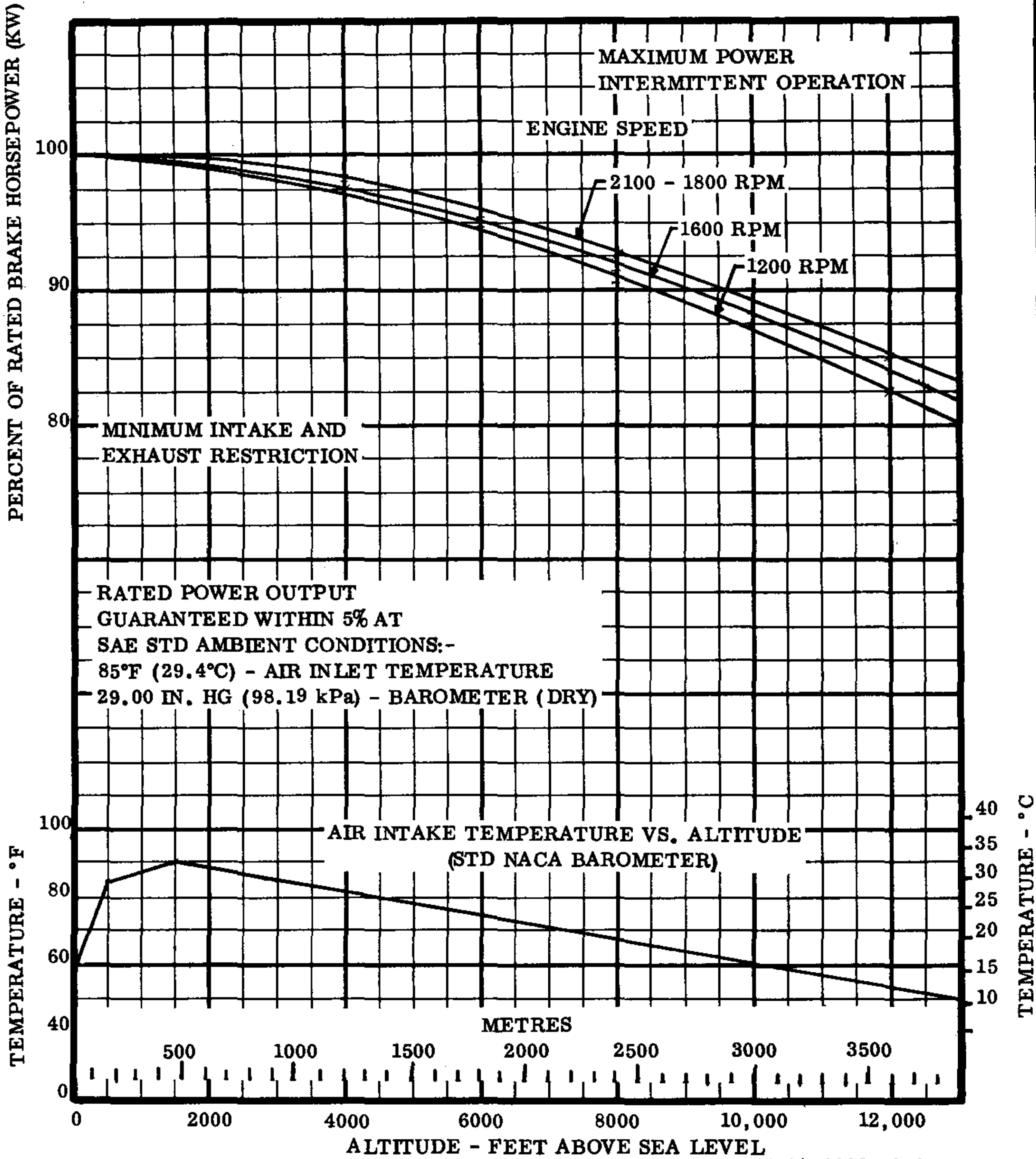
ENGINEERING-TECHNICAL DATA DEPT.

DE 3769

CHART 30

Detroit Diesel Allison
Division of General Motors Corporation

SERIES 71N & V71N ENGINES
(4 VALVE HEAD)
ALTITUDE PERFORMANCE
71C5 & 71N5 INJECTORS



E4A-0000-52-2
Rev. 10-21-74

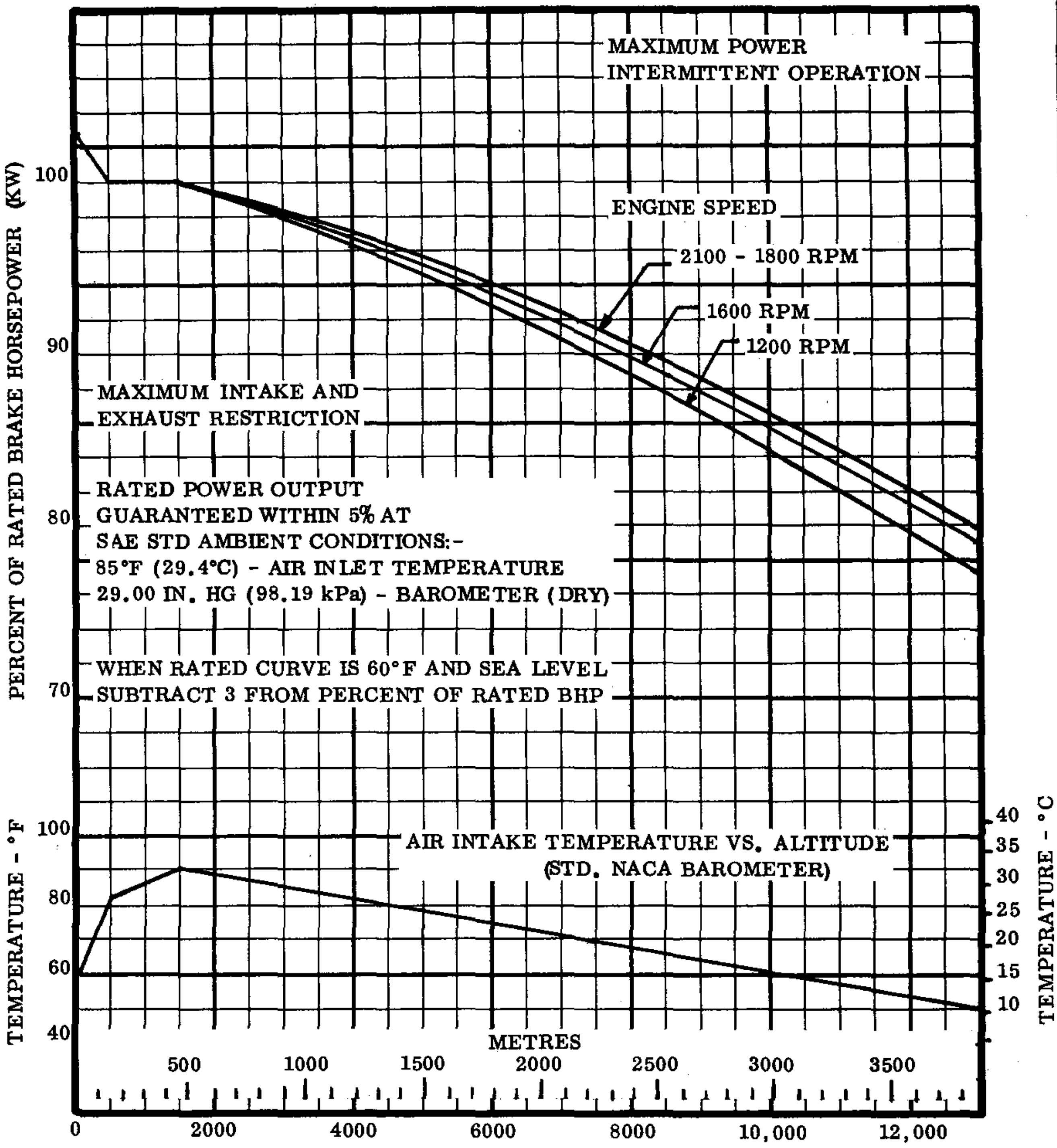
ENGINEERING-TECHNICAL DATA DEPT.

DE 3769

CHART 31

Detroit Diesel Allison
Division of General Motors Corporation

SERIES 71N AND V71N ENGINES
(4 VALVE HEAD)
ALTITUDE PERFORMANCE
N55 & C55 INJECTORS



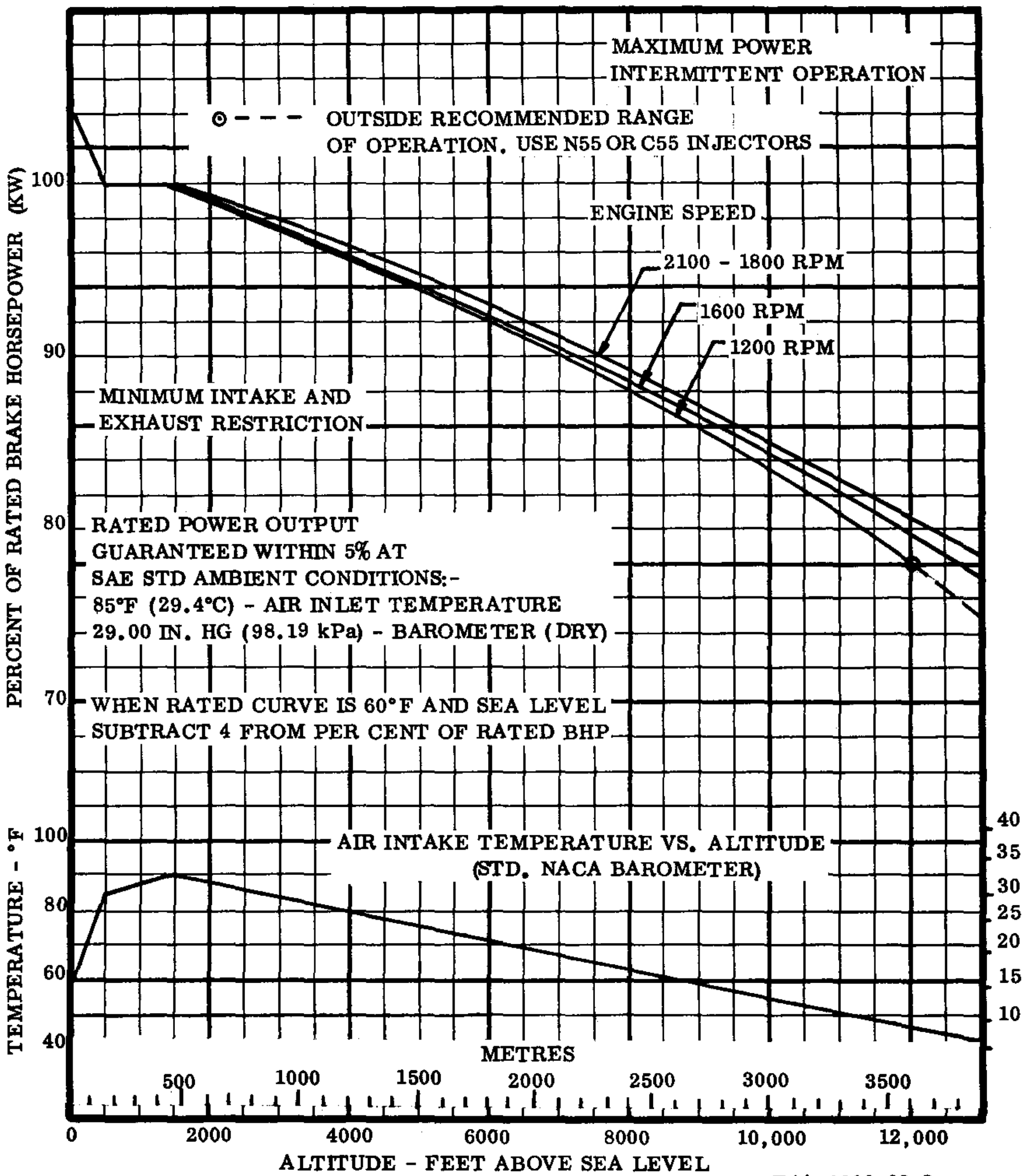
ENGINEERING-TECHNICAL DATA DEPT.

E4A-0000-02-1
Rev. 10-23-73

CHART 32

Detroit Diesel Allison
Division of General Motors Corporation

SERIES 71N & V71N ENGINE
(4 VALVE HEAD)
ALTITUDE PERFORMANCE
N60 & C60 INJECTORS



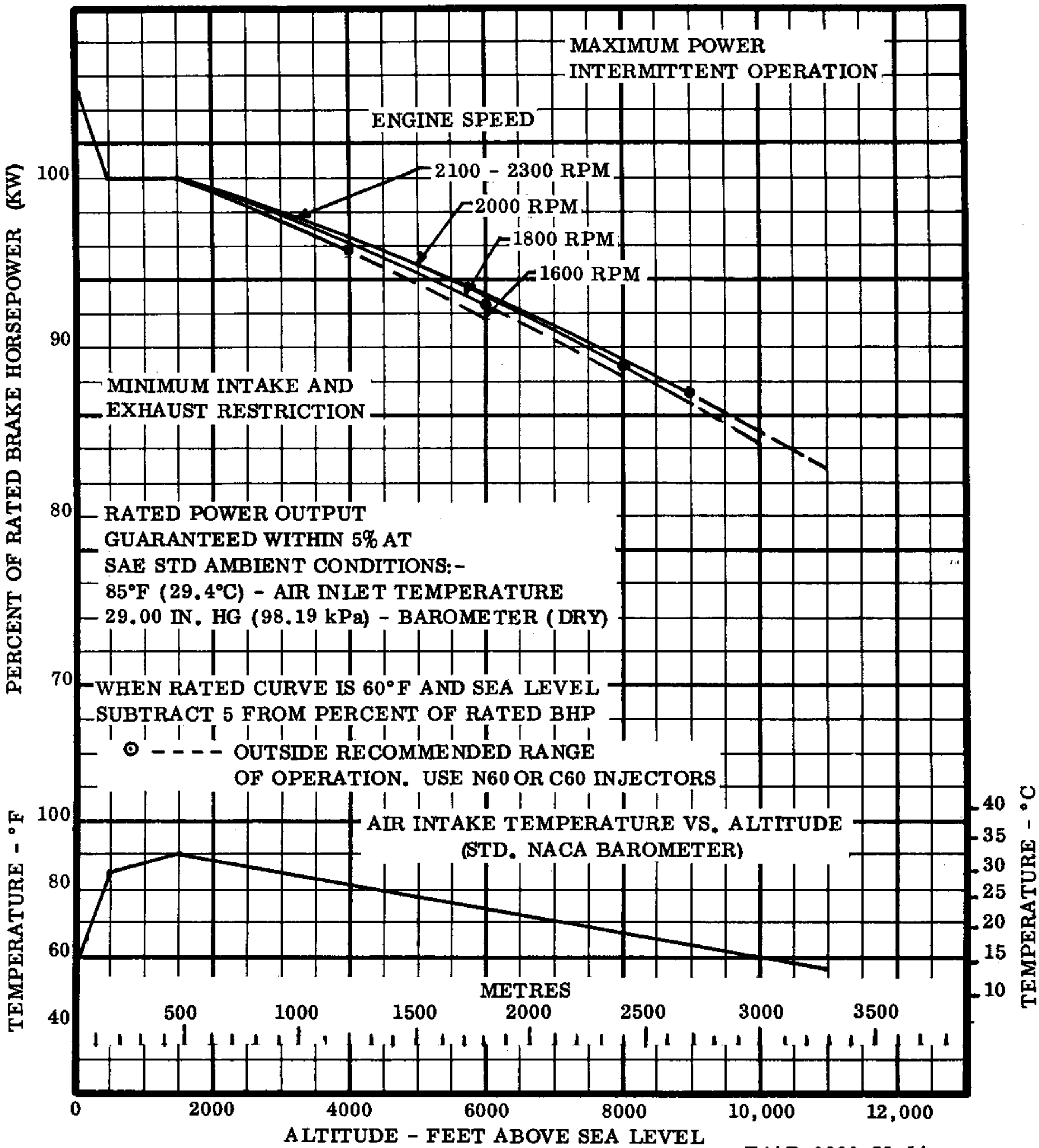
E4A-0000-02-2
Rev. 10-29-74

ENGINEERING-TECHNICAL DATA DEPT.

DE 3769

Detroit Diesel Allison
Division of General Motors Corporation

SERIES 71N AND V-71N ENGINES
ALTITUDE PERFORMANCE
N65 & C65 INJECTORS



E4AR-0000-52-1A
Rev. 10-23-74

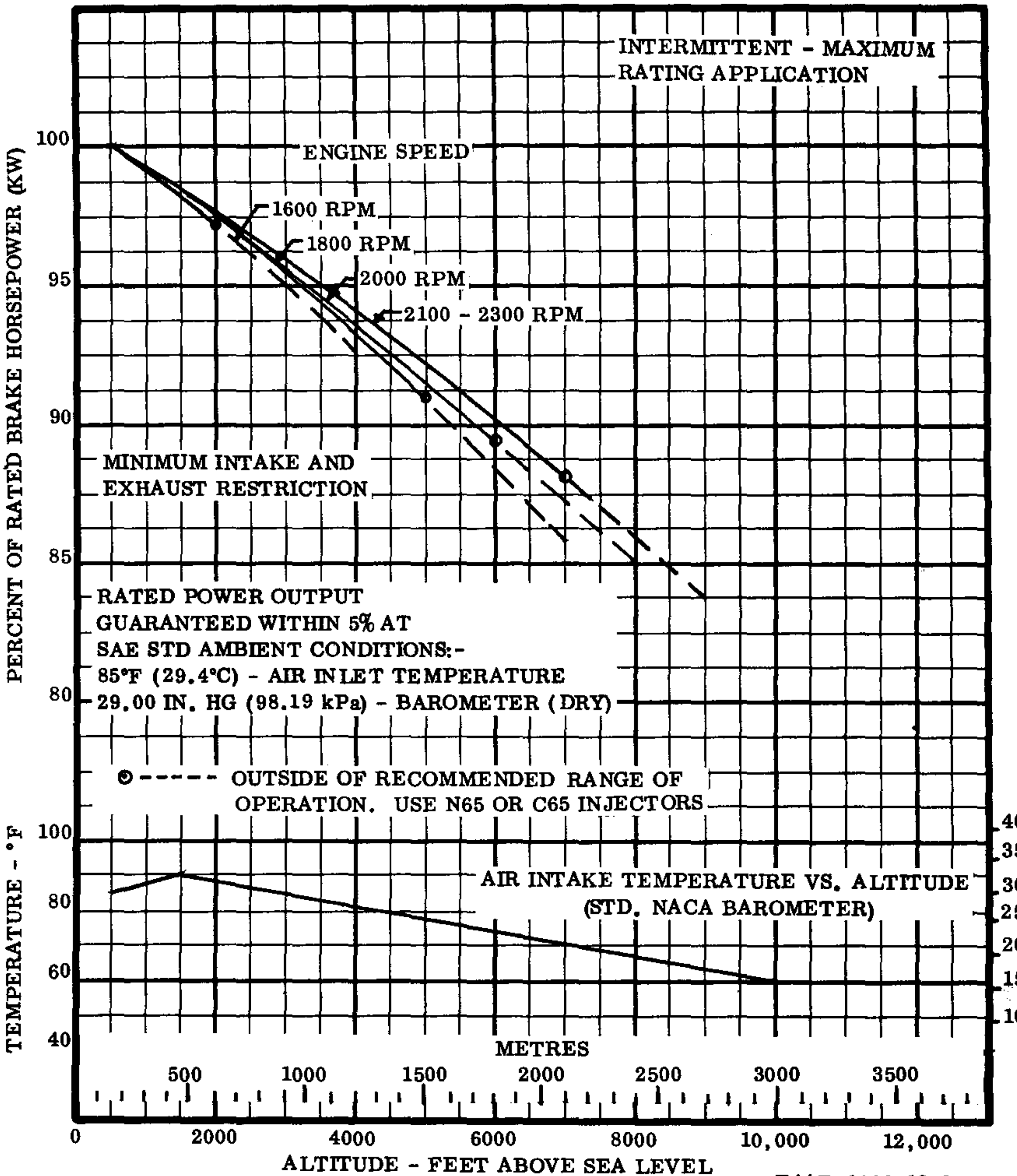
ENGINEERING-TECHNICAL DATA DEPT.

DE 3769

CHART 34

Detroit Diesel Allison
Division of General Motors Corporation

SERIES 71N AND V-71N ENGINES
ALTITUDE PERFORMANCE
N70 & C70 INJECTORS



E4AR-0000-12-2
Rev. 10-23-74

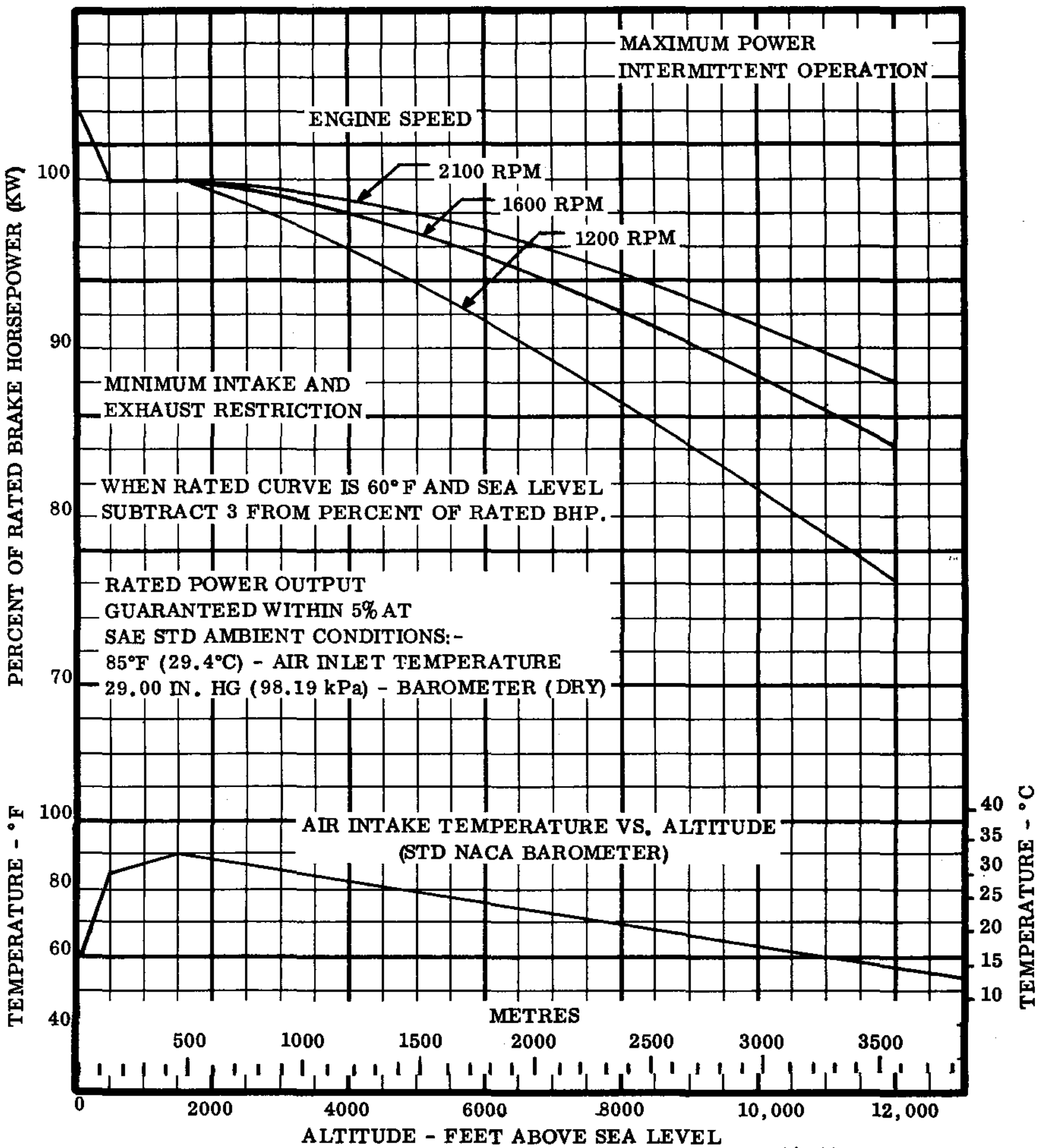
ENGINEERING-TECHNICAL DATA DEPT.

DE 3769

CHART 35

Detroit Diesel Allison
Division of General Motors Corporation

PRELIMINARY
SERIES 71N(2V) ENGINES
ALTITUDE PERFORMANCE
N55 INJECTORS

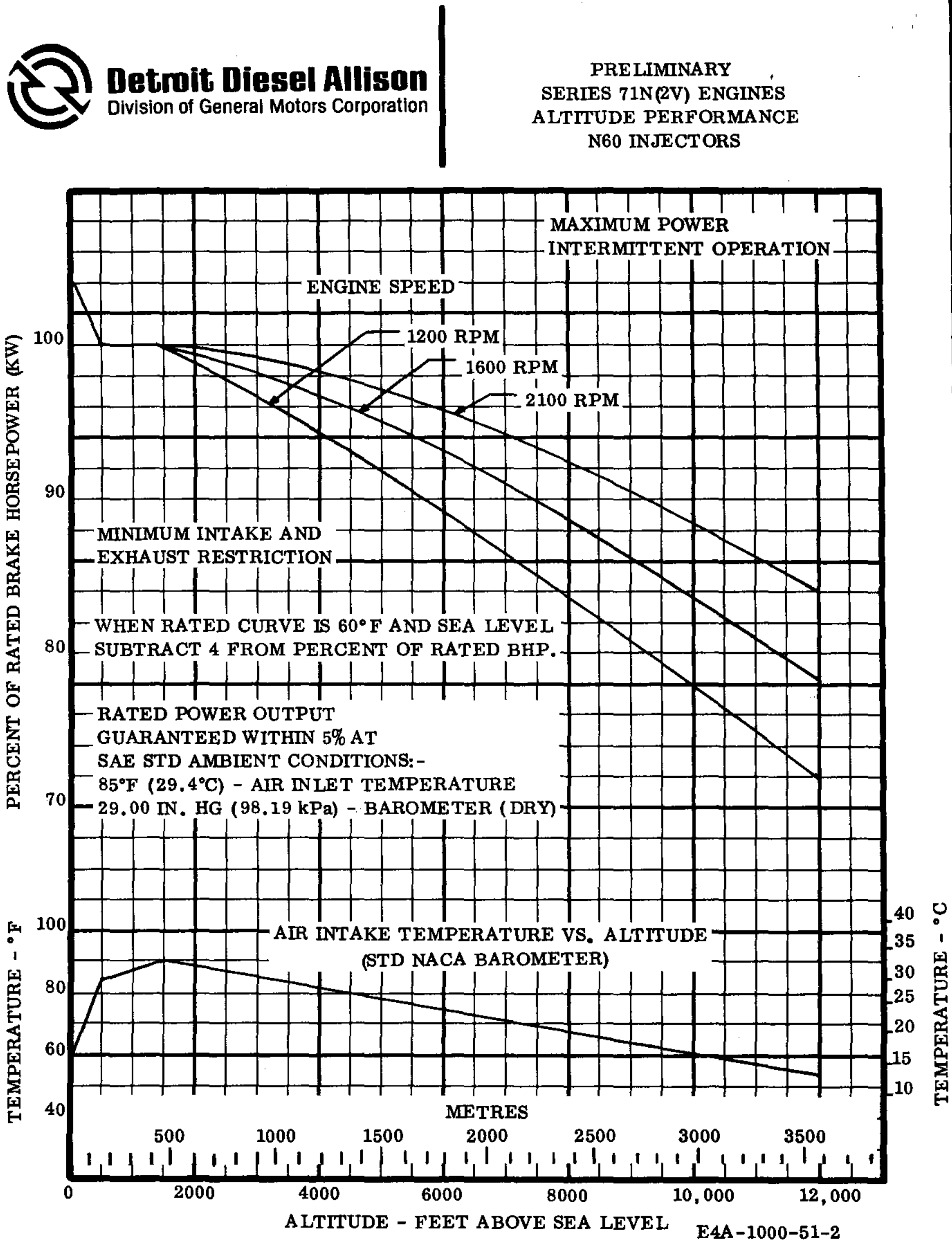


E4A-1000-51-5
2-27-75

ENGINEERING-TECHNICAL DATA DEPT.

DE 3769

CHART 36



E4A-1000-51-2
2-27-75

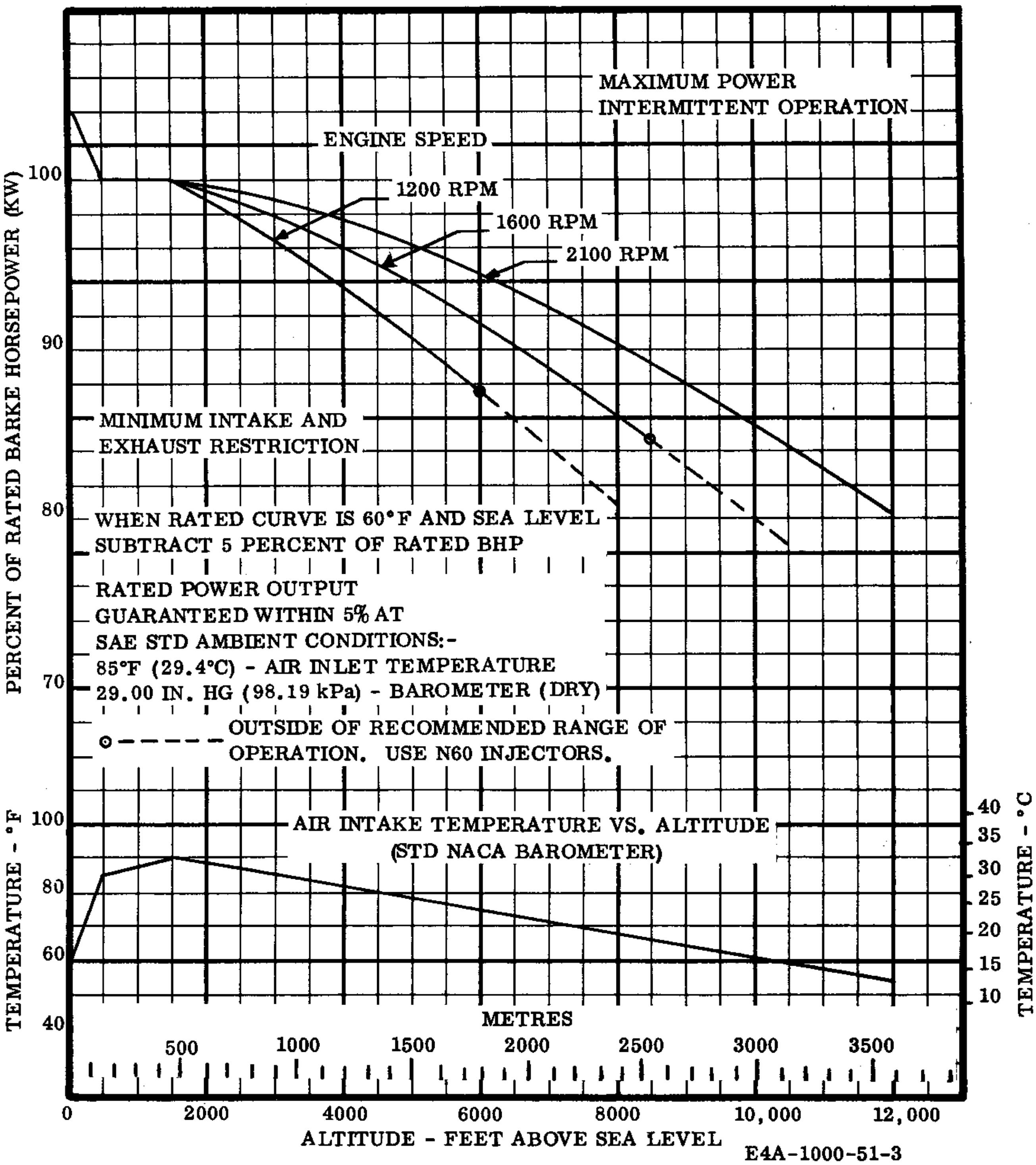
ENGINEERING-TECHNICAL DATA DEPT.

DE 3769

CHART 37

Detroit Diesel Allison
Division of General Motors Corporation

PRELIMINARY
SERIES 71N(2V) ENGINES
ALTITUDE PERFORMANCE
N65 INJECTORS



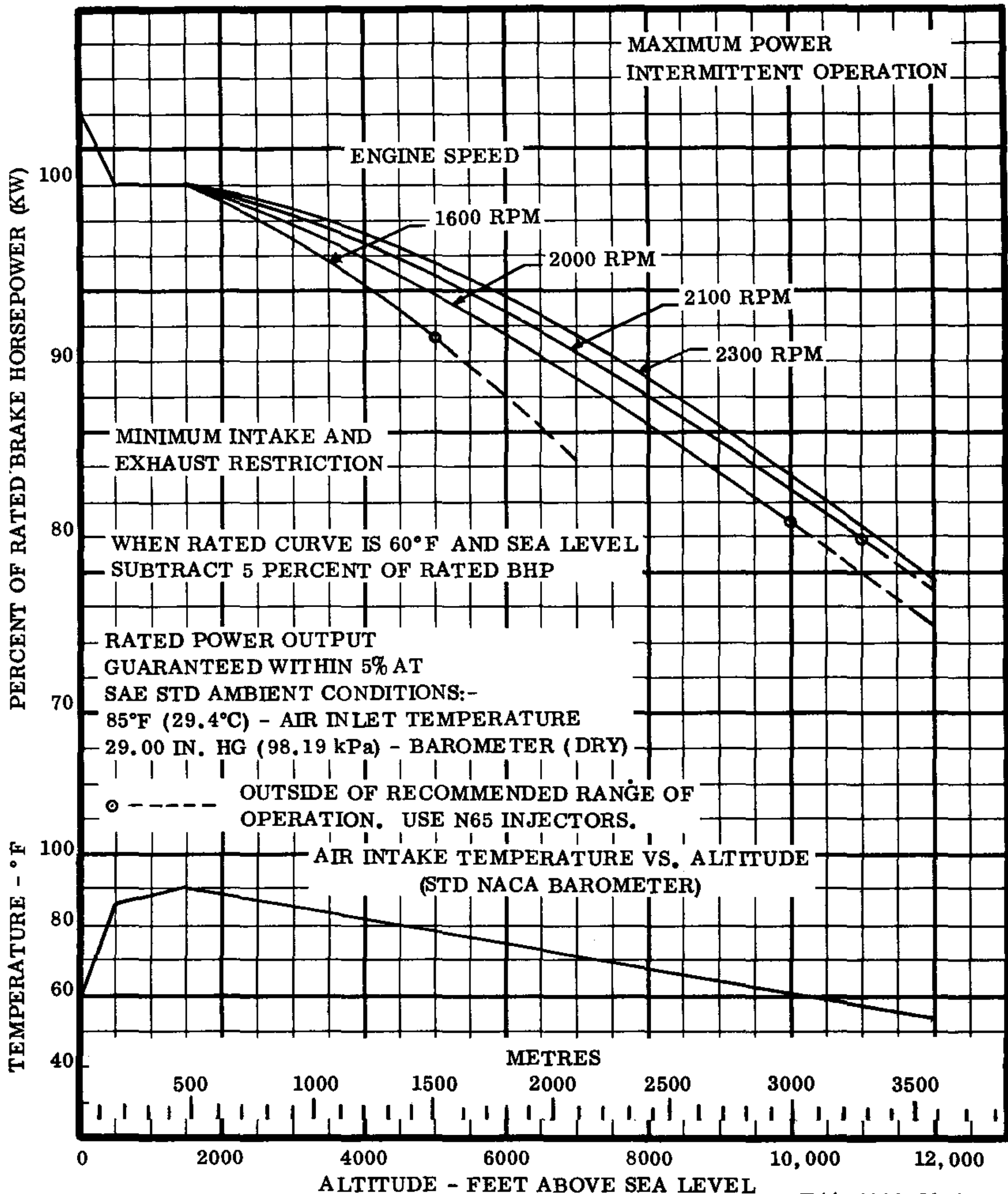
E4A-1000-51-3
2-27-75

ENGINEERING-TECHNICAL DATA DEPT.

DE 3769

Detroit Diesel Allison
Division of General Motors Corporation

PRELIMINARY
SERIES 71N(2V) ENGINES
ALTITUDE PERFORMANCE
N70 INJECTORS



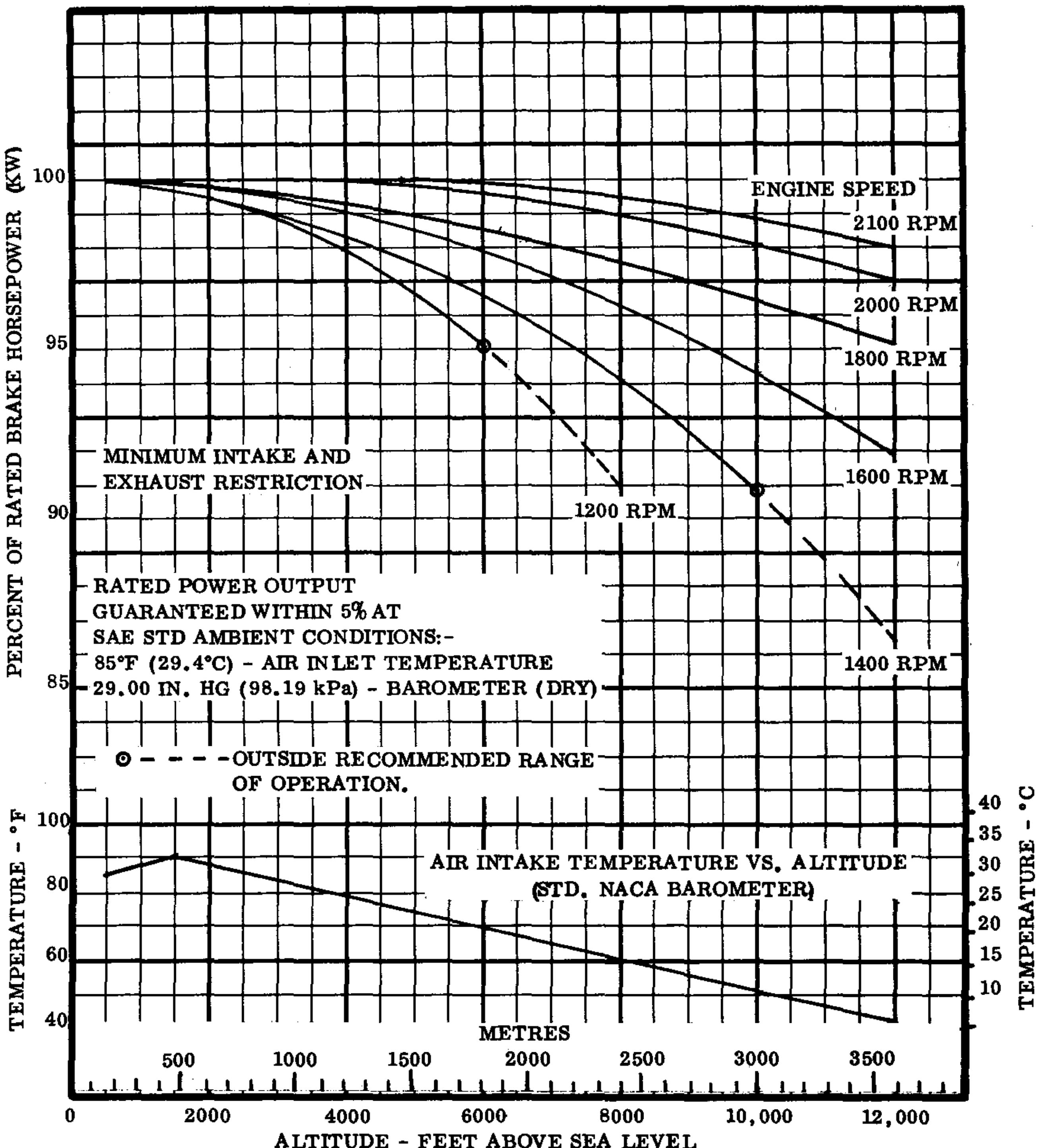
E4A-1000-51-4
2-27-75

ENGINEERING-TECHNICAL DATA DEPT.

DE 3769

Detroit Diesel Allison
Division of General Motors Corporation

SERIES V71T ENGINES
ALTITUDE PERFORMANCE
N60 INJECTORS



E4AR-7000-32-3
Rev. 10-23-74

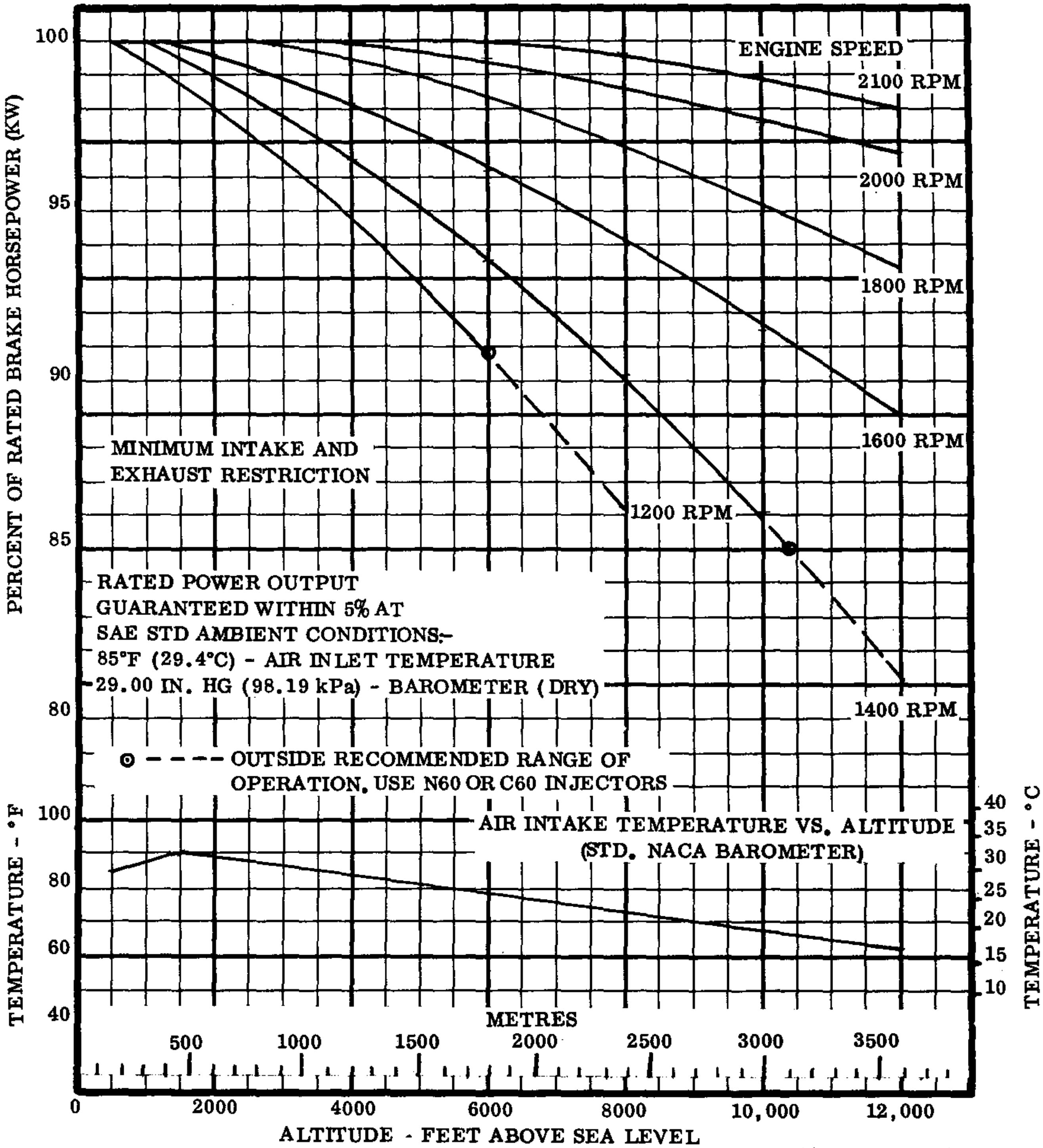
ENGINEERING-TECHNICAL DATA DEPT.

DE 3769

CHART 40

Detroit Diesel Allison
Division of General Motors Corporation

SERIES V71T ENGINES
ALTITUDE PERFORMANCE
N65 & C65 INJECTORS



E4AR-7000-32-1
Rev. 10-23-74

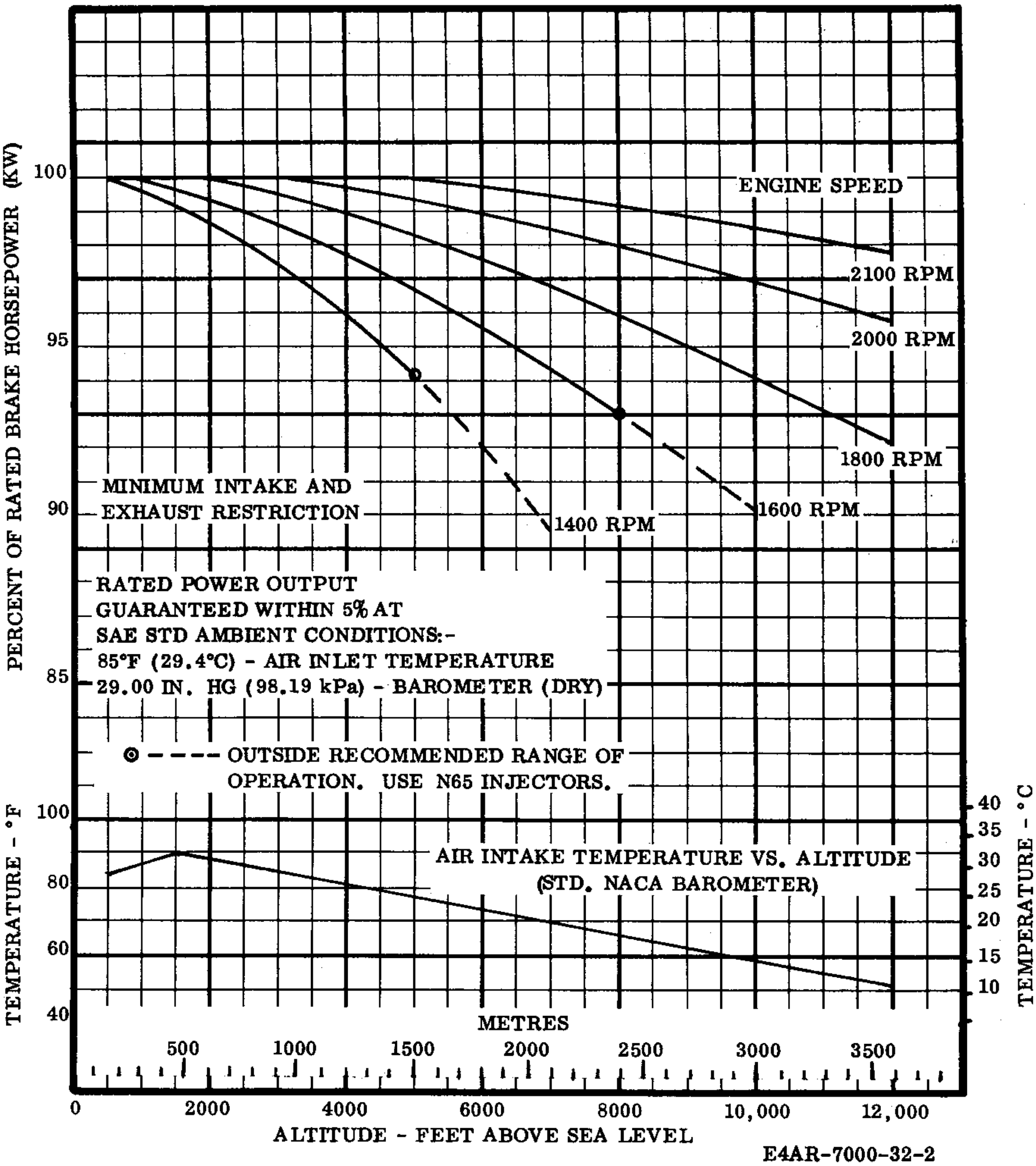
ENGINEERING-TECHNICAL DATA DEPT.

DE 3769

CHART 41

Detroit Diesel Allison
Division of General Motors Corporation

SERIES V71T ENGINES
ALTITUDE PERFORMANCE
N70 INJECTORS



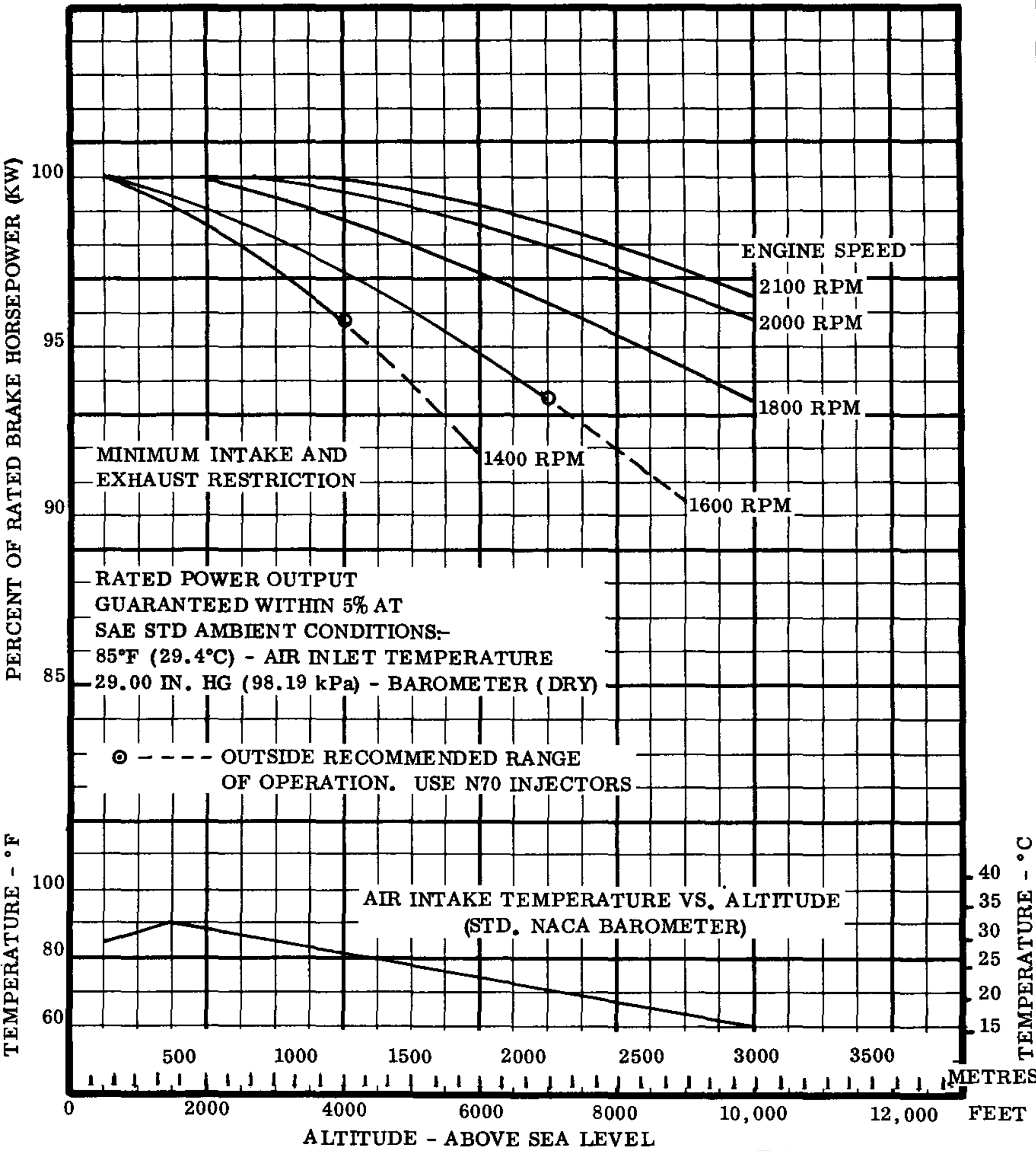
E4AR-7000-32-2
Rev. 10-24-74

ENGINEERING-TECHNICAL DATA DEPT.

DE 3769

Detroit Diesel Allison
Division of General Motors Corporation

SERIES V71T ENGINES
ALTITUDE PERFORMANCE
N75 INJECTORS



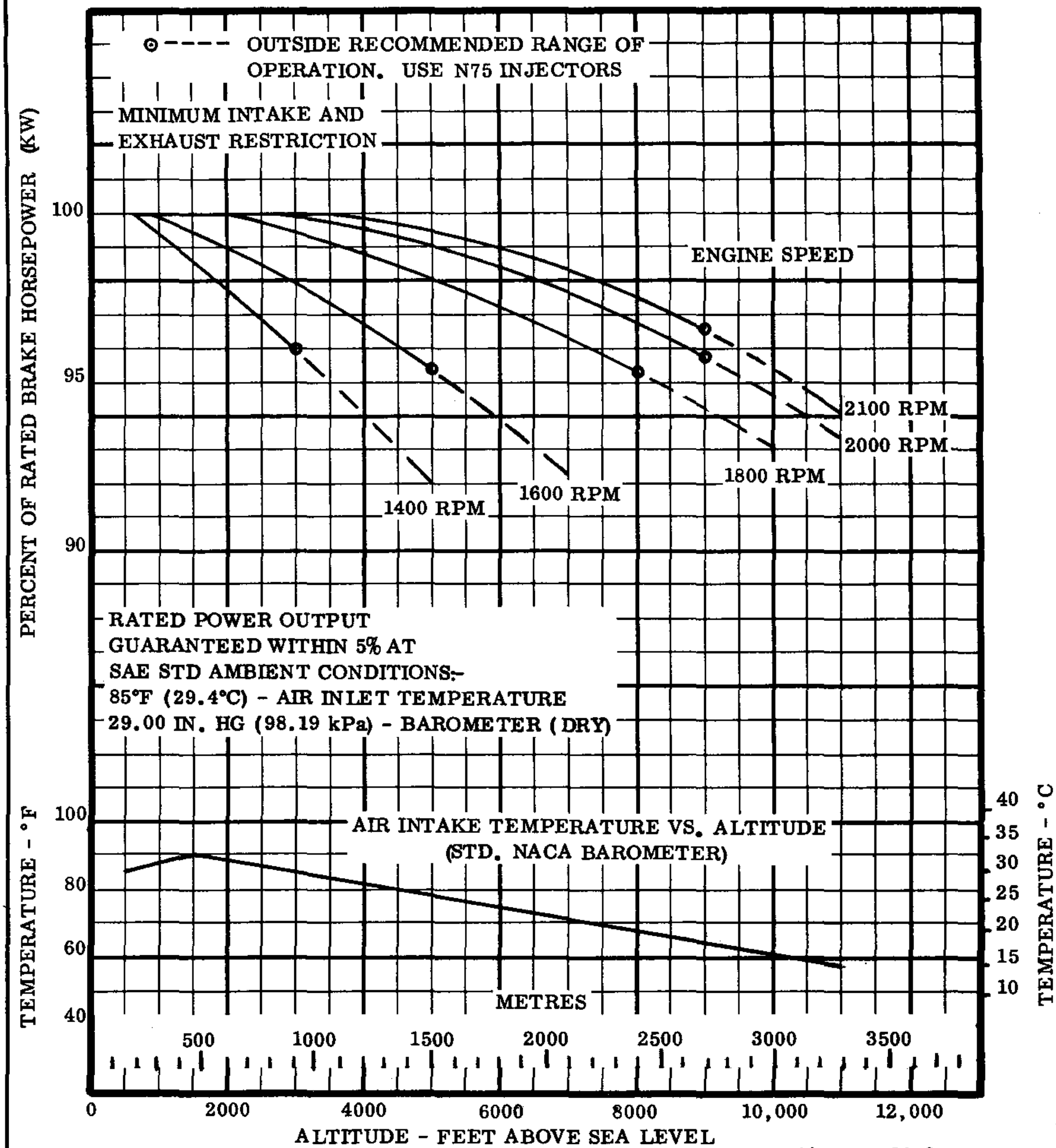
E4A-7000-32-2
Rev. 10-24-74

ENGINEERING-TECHNICAL DATA DEPT.

DE 3769

Detroit Diesel Allison
Division of General Motors Corporation

SERIES V71T ENGINES
ALTITUDE PERFORMANCE
N80 INJECTORS



E4A-7000-32-3
Rev. 10-29-74

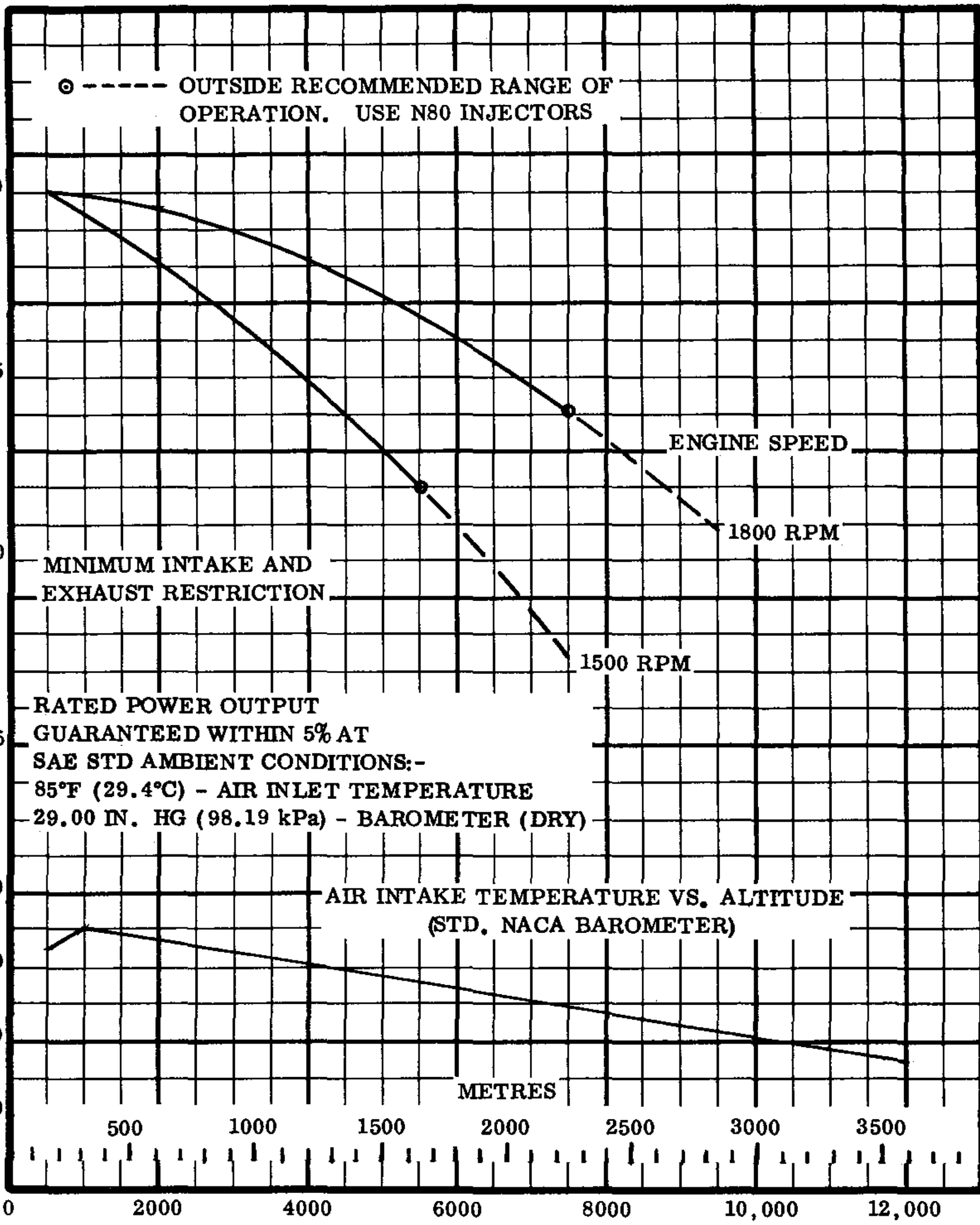
ENGINEERING-TECHNICAL DATA DEPT.

DE 3769

CHART 44

Detroit Diesel Allison
Division of General Motors Corporation

SERIES V71T ENGINES
ALTITUDE PERFORMANCE
GENERATOR SET APPLICATION
N90 INJECTORS



E4A-7000-32-5
Rev. 10-29-74

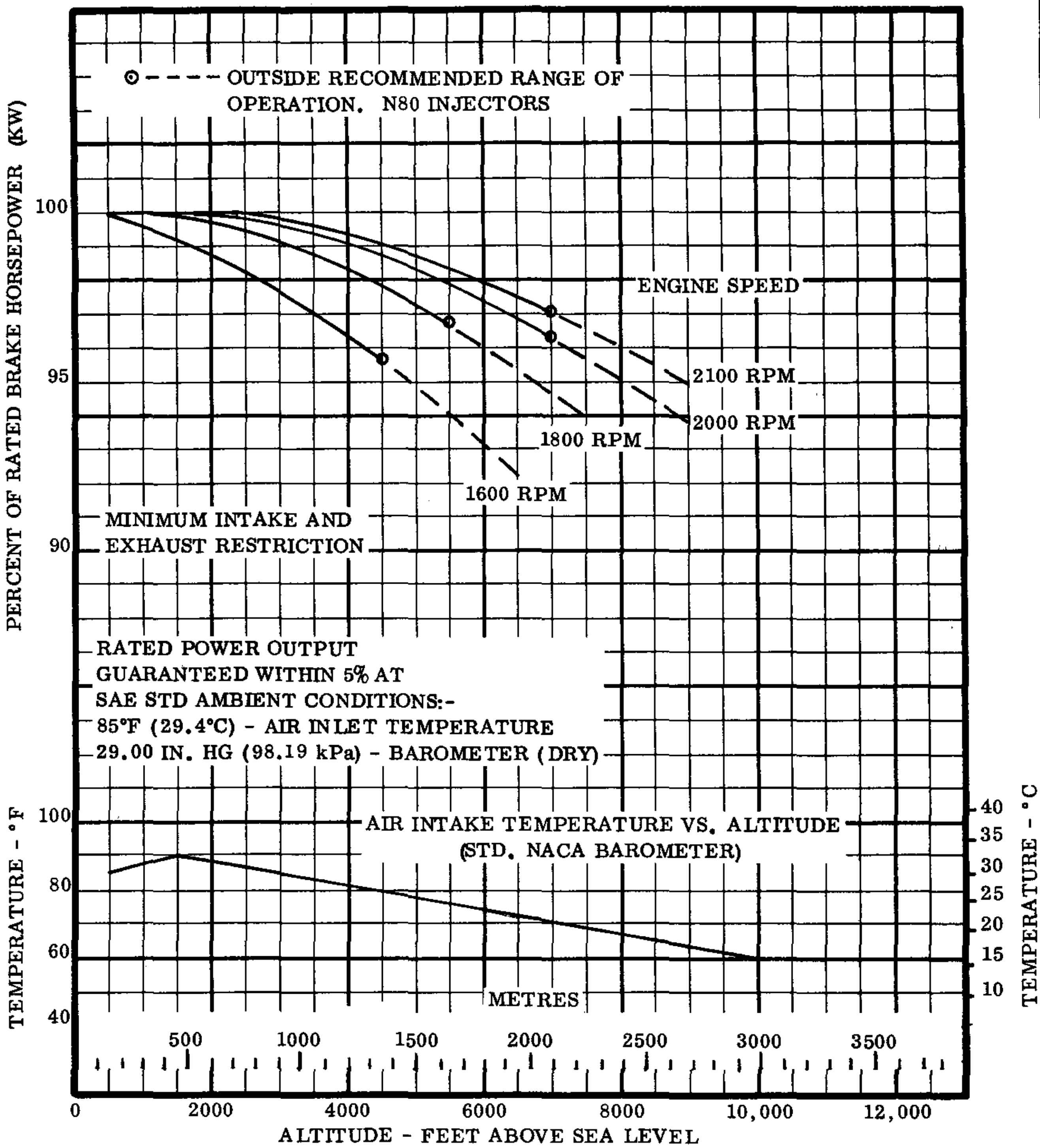
ENGINEERING-TECHNICAL DATA DEPT.

DE 3769

CHART 45

Detroit Diesel Allison
Division of General Motors Corporation

SERIES V71T ENGINES
ALTITUDE PERFORMANCE
N90 INJECTORS



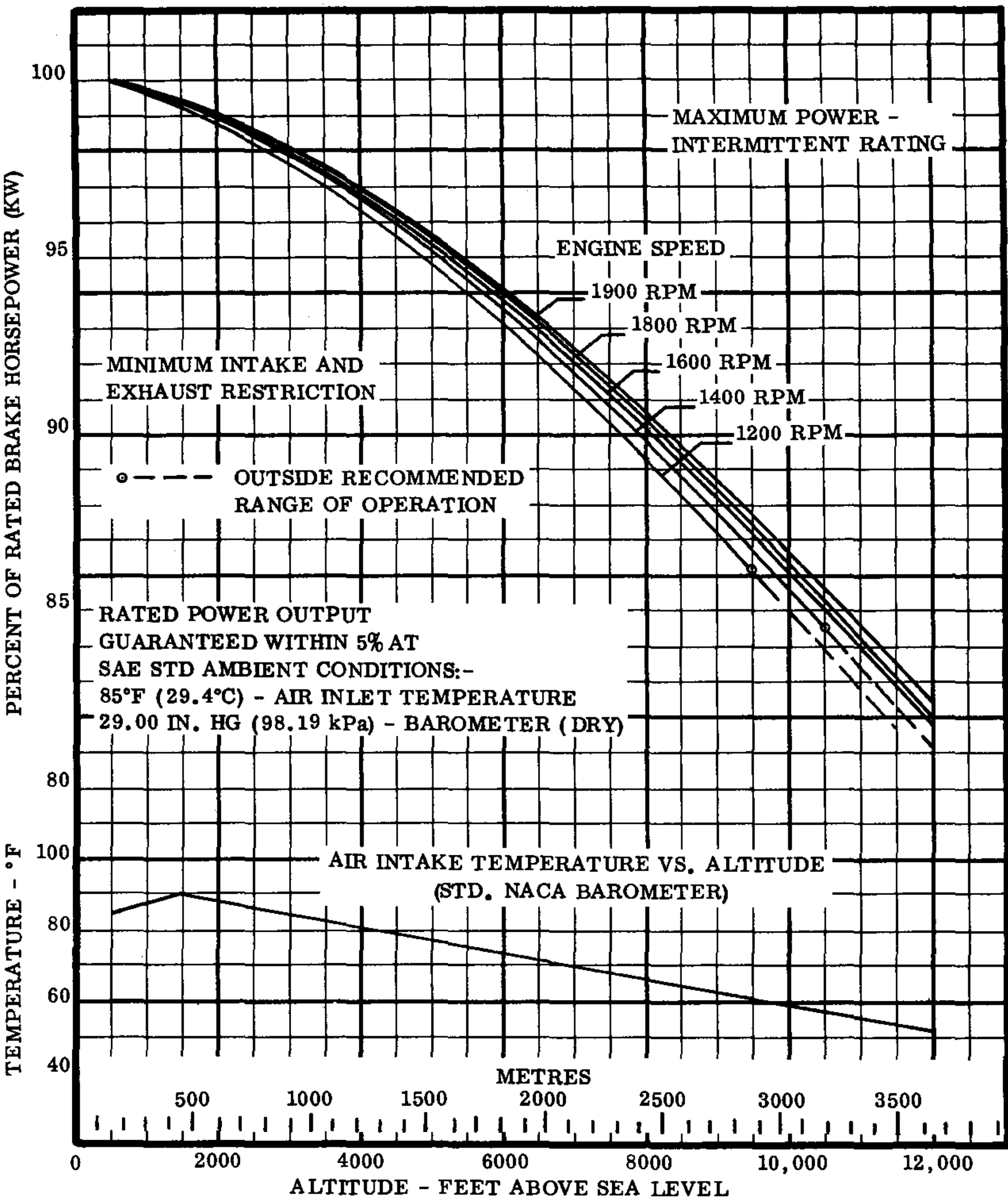
E4A-7000-32-4
Rev. 10-29-74

ENGINEERING-TECHNICAL DATA DEPT.

DE 3769

Detroit Diesel Allison
Division of General Motors Corporation

SERIES 149 ENGINES
ALTITUDE PERFORMANCE
120 INJECTORS



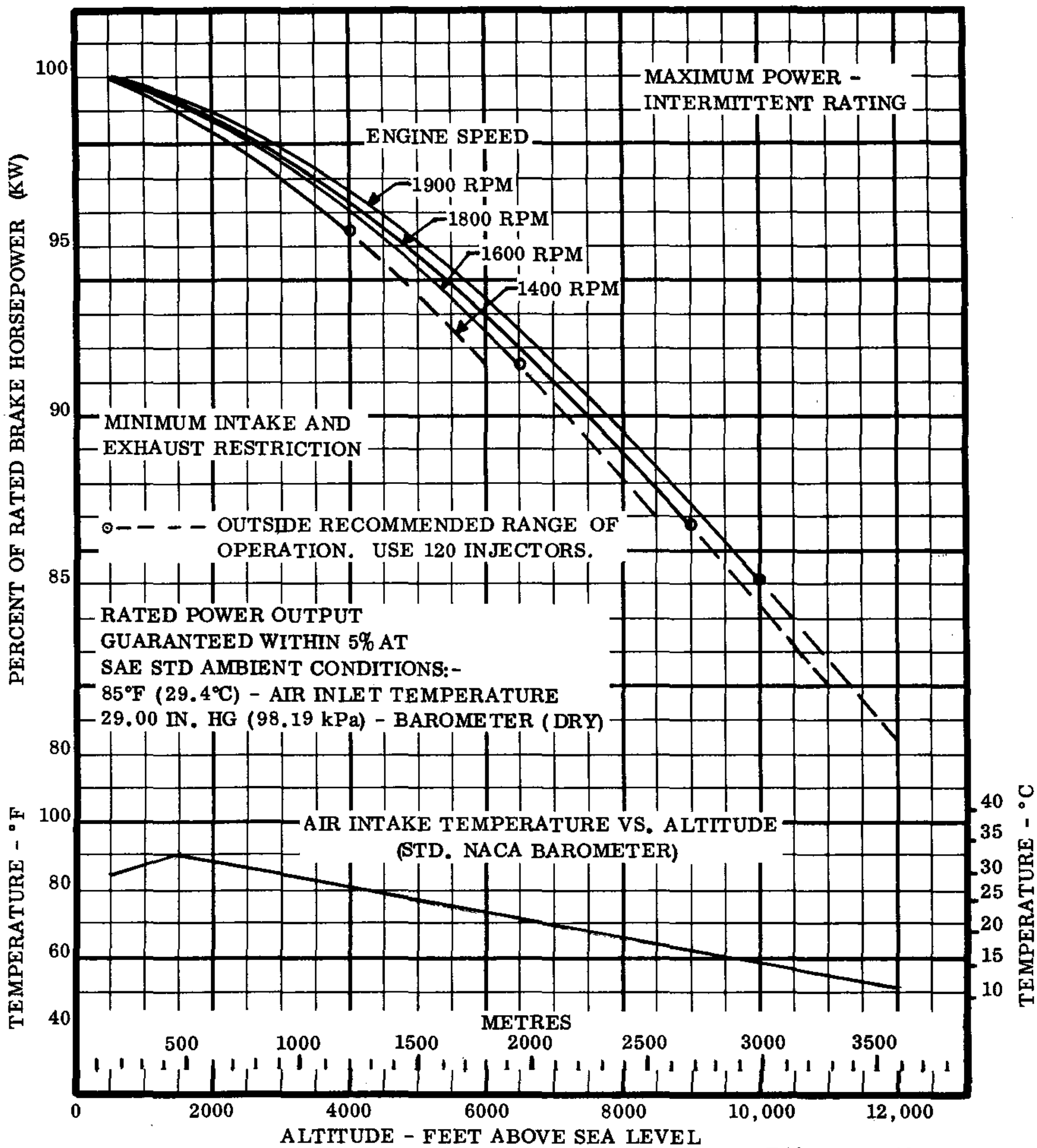
E4AR-9000-12-2
2-21-75

ENGINEERING-TECHNICAL DATA DEPT.

DE 3769

Detroit Diesel Allison
Division of General Motors Corporation

SERIES 149 ENGINES
ALTITUDE PERFORMANCE
130 INJECTORS



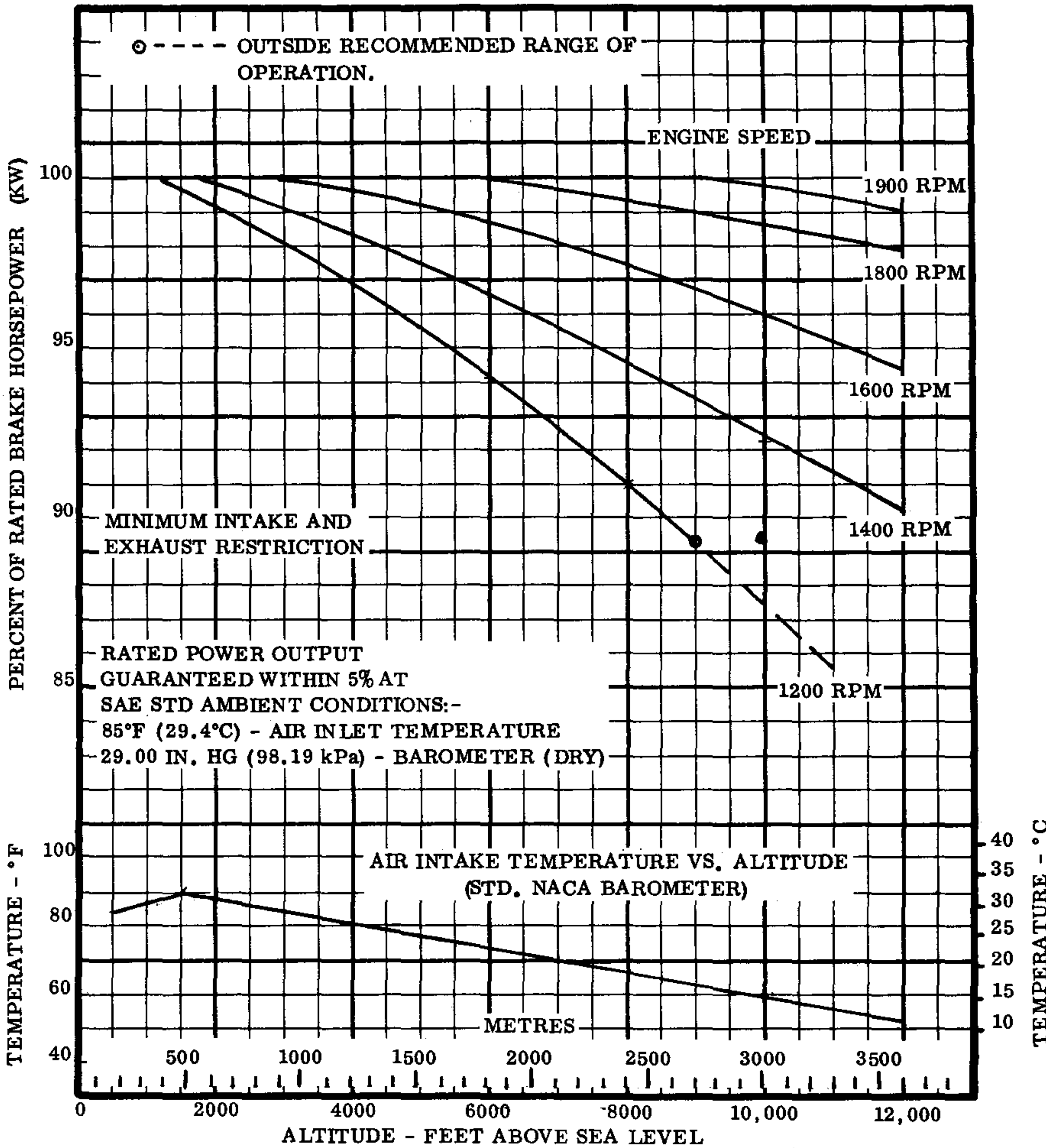
E4AR-9000-12-1
Rev. 10-29-74

ENGINEERING-TECHNICAL DATA DEPT.

DE 3769

Detroit Diesel Allison
Division of General Motors Corporation

SERIES 149T & TI ENGINES
ALTITUDE PERFORMANCE
140 INJECTORS



E4AR-9000-32-2
Rev. 10-29-74

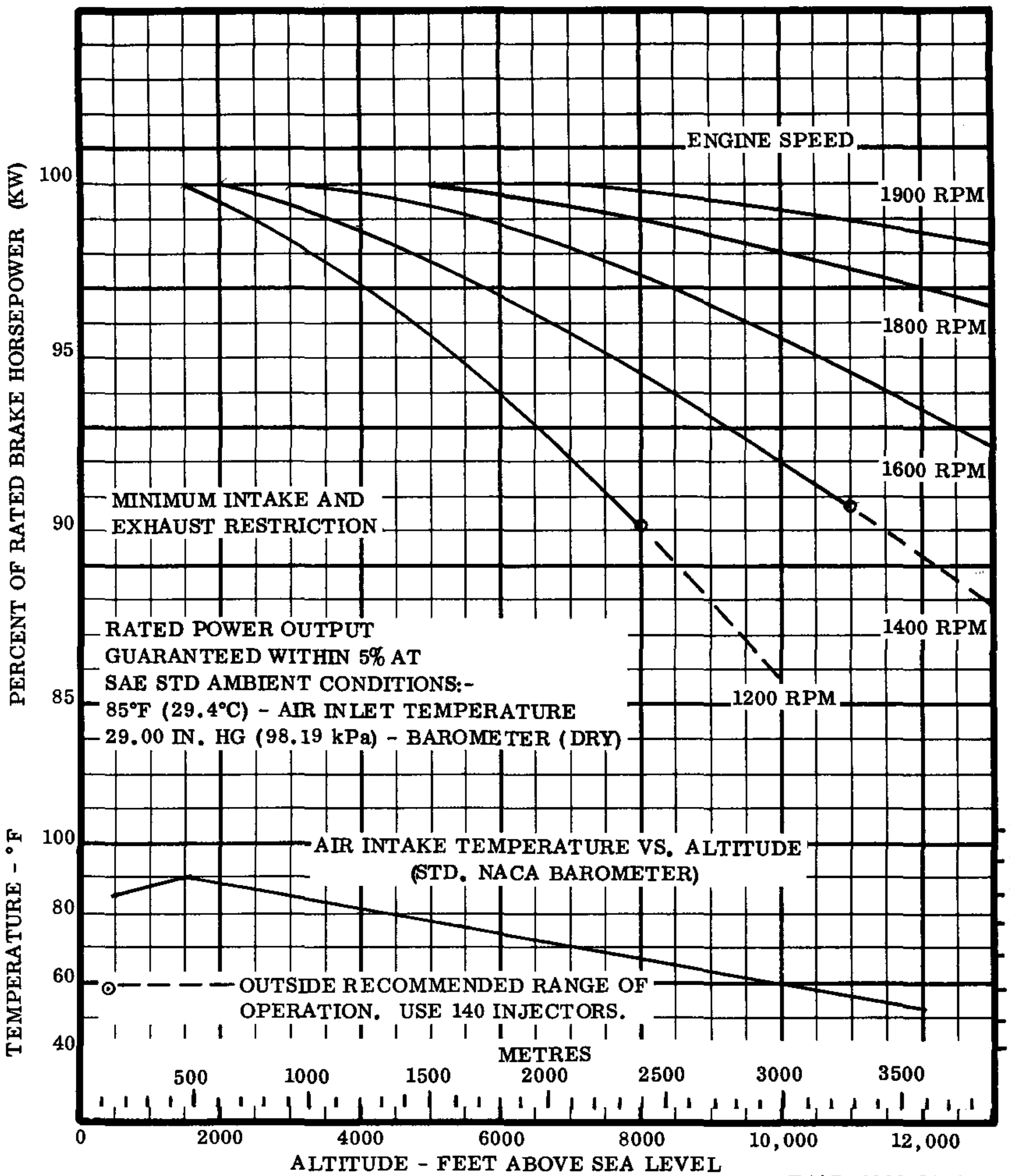
ENGINEERING-TECHNICAL DATA DEPT.

DE 3769

CHART 49

Detroit Diesel Allison
Division of General Motors Corporation

SERIES 149T & TI ENGINES
ALTITUDE PERFORMANCE
150 INJECTORS



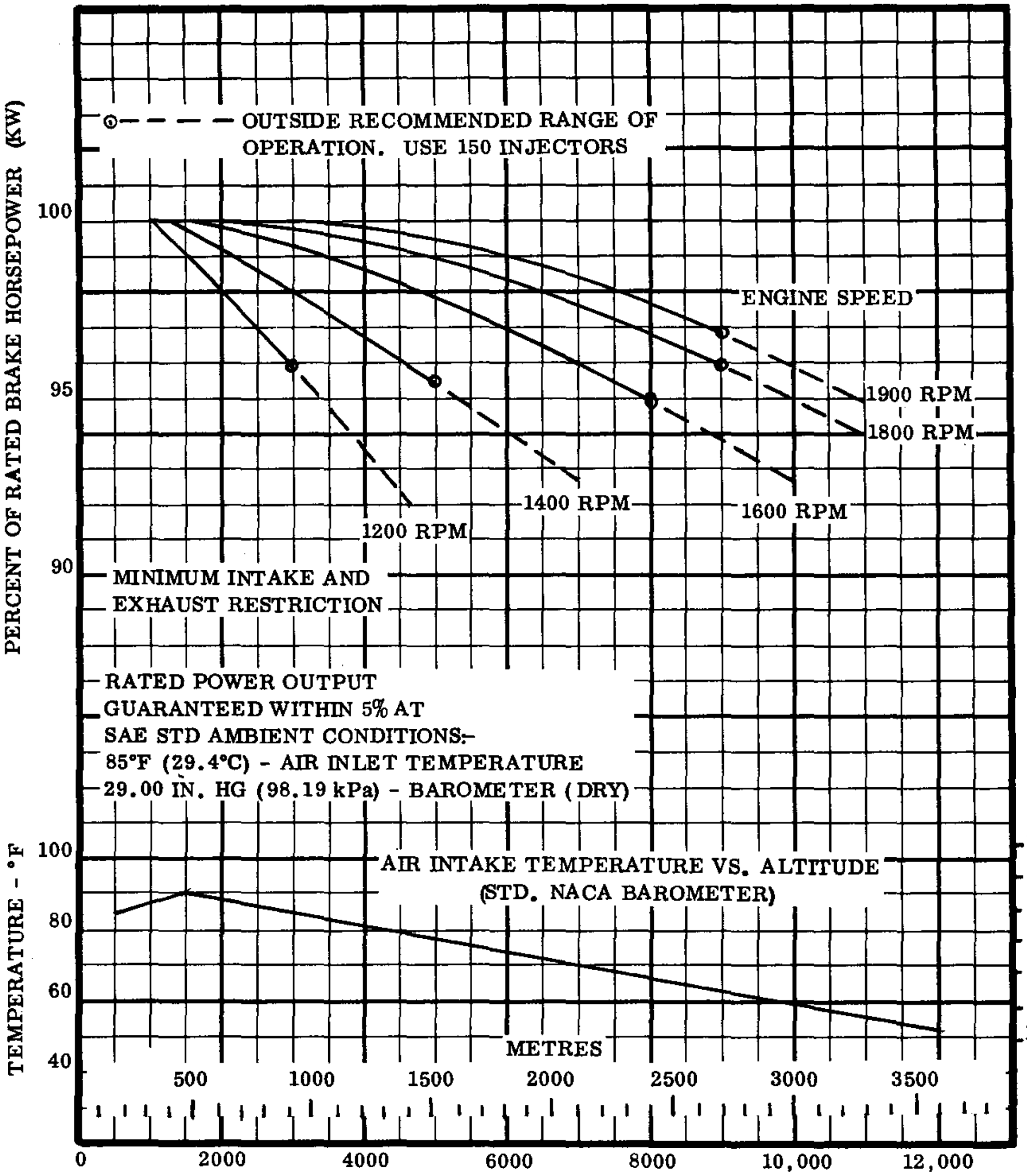
E4AR-9000-32-1
Rev. 10-29-74

ENGINEERING-TECHNICAL DATA DEPT.

DE 3769

Detroit Diesel Allison
Division of General Motors Corporation

SERIES 149T & TI ENGINES
ALTITUDE PERFORMANCE
165 INJECTORS



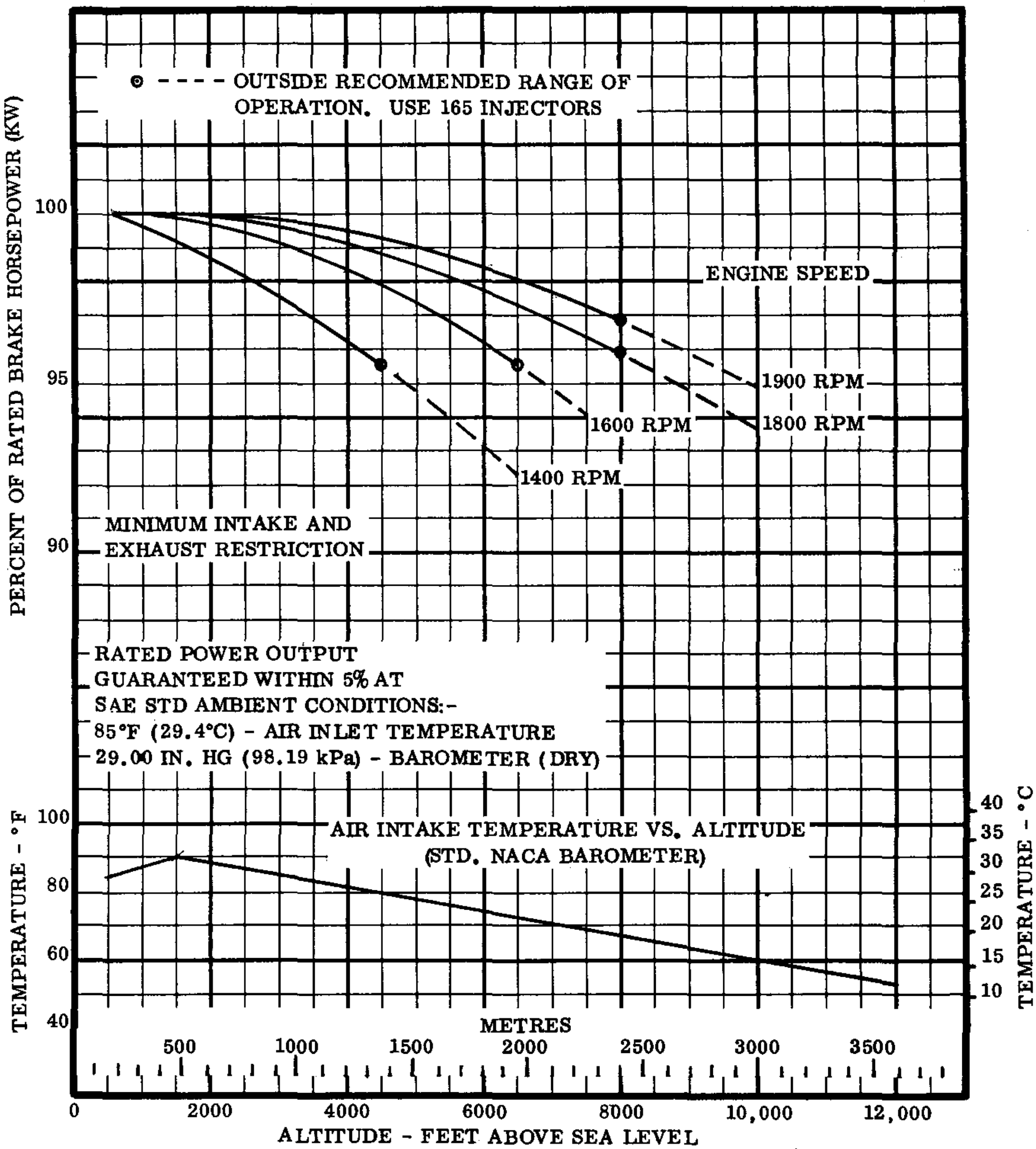
E4AR-9000-32-3
Rev. 10-31-74

ENGINEERING-TECHNICAL DATA DEPT.

DE 3769

Detroit Diesel Allison
Division of General Motors Corporation

SERIES 149TI ENGINES
ALTITUDE PERFORMANCE
180 INJECTORS



E4AR-9000-32-4
Rev. 10-29-74

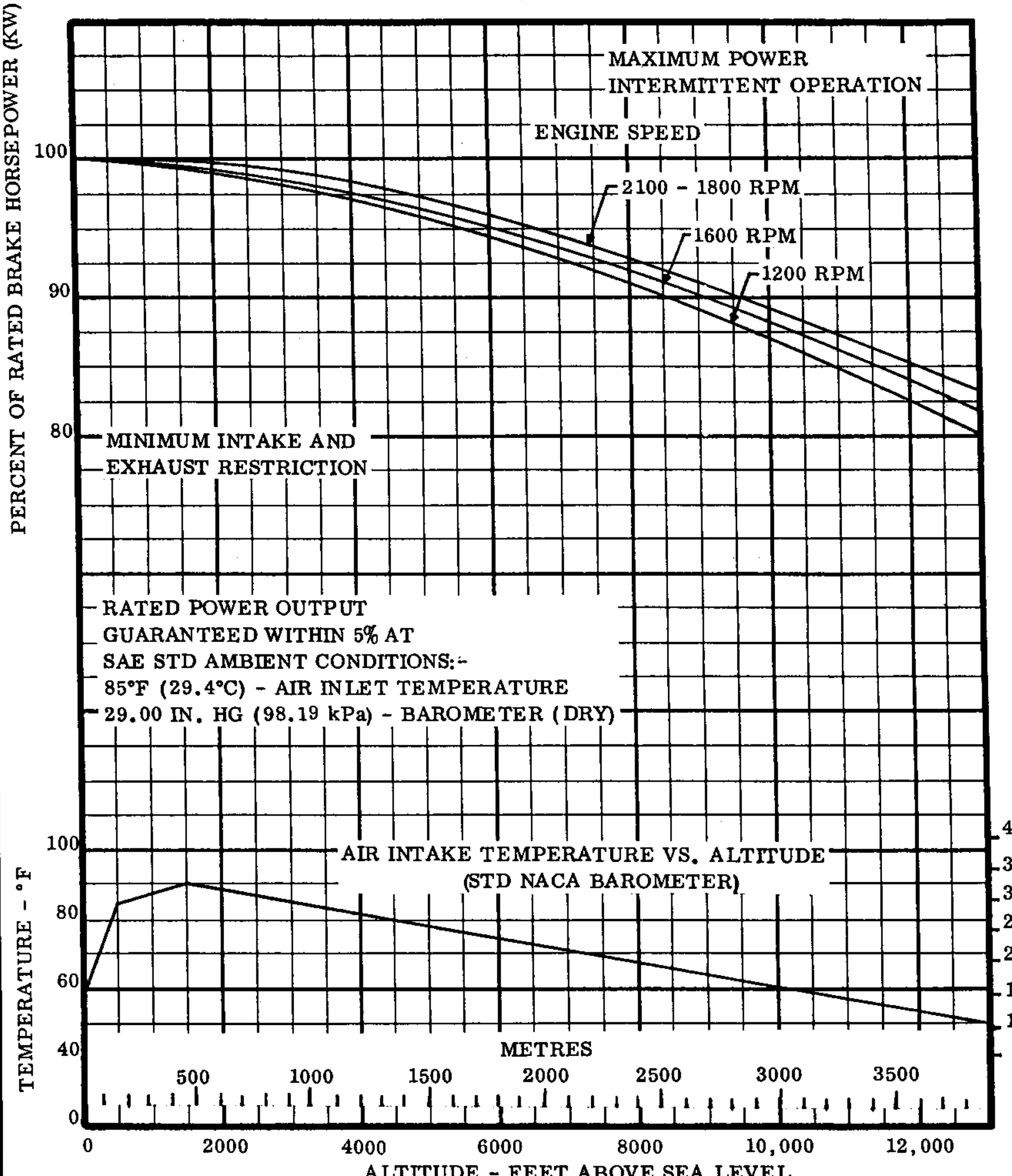
ENGINEERING-TECHNICAL DATA DEPT.

DE 3769

CHART 52

Detroit Diesel Allison
Division of General Motors Corporation

PRELIMINARY
SERIES 92 ENGINE
ALTITUDE PERFORMANCE
9270 INJECTORS



E4A-0000-52-3
1-31-75

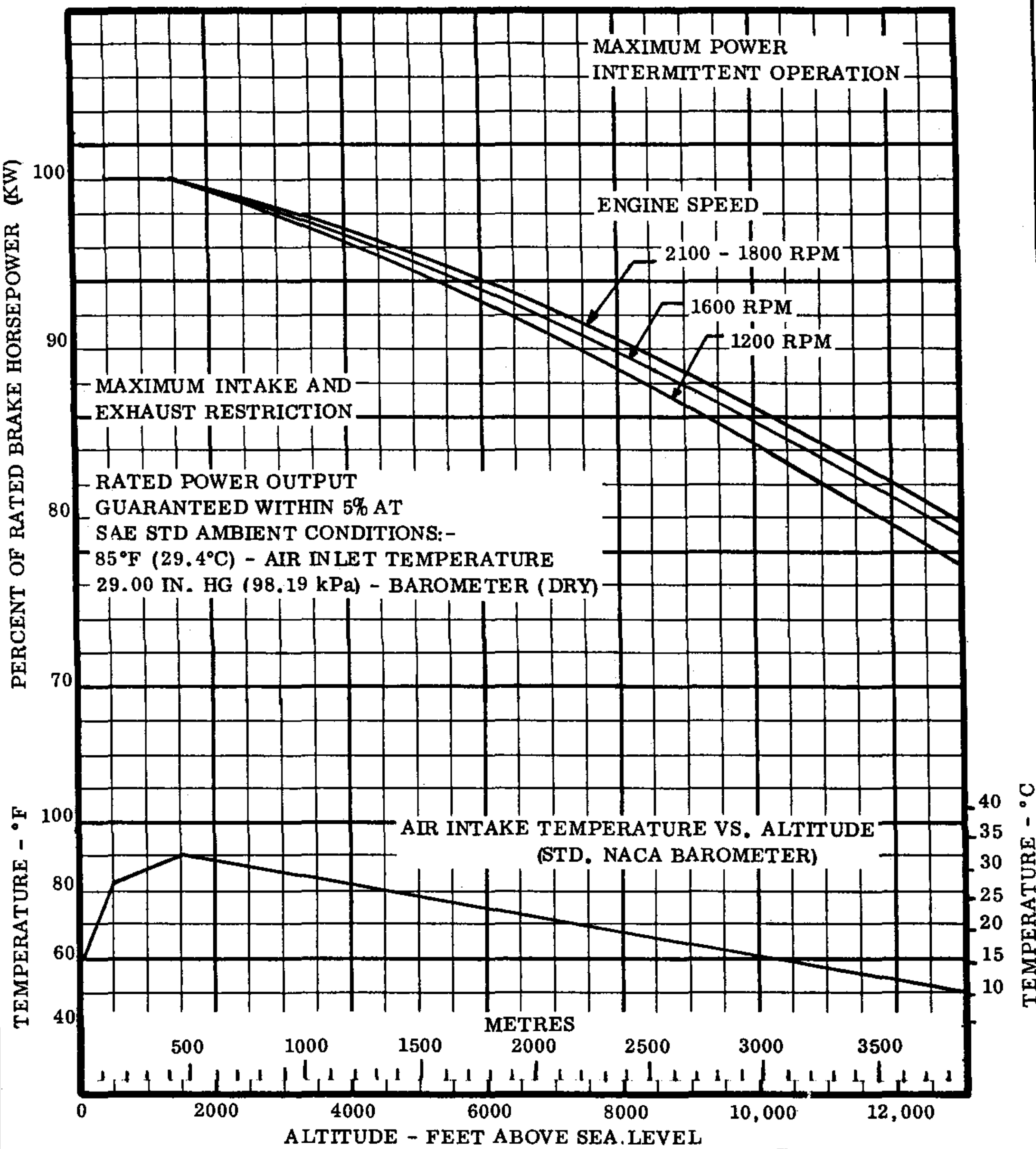
ENGINEERING-TECHNICAL DATA DEPT.

DE 3769

CHART 53

Detroit Diesel Allison
Division of General Motors Corporation

PRELIMINARY
SERIES 92 ENGINE
ALTITUDE PERFORMANCE
9275 INJECTORS



E4A-0000-02-3
1-31-75

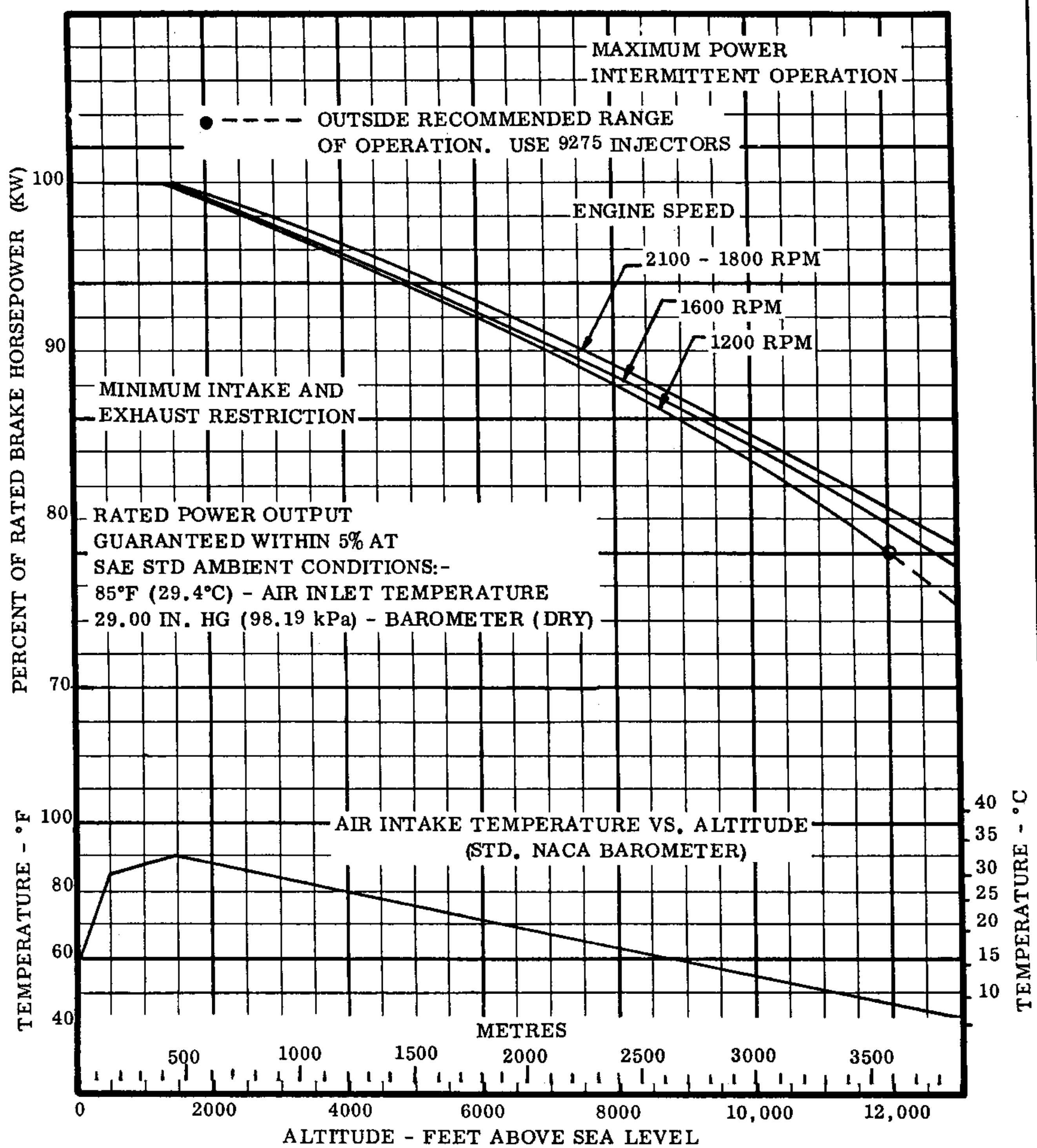
ENGINEERING-TECHNICAL DATA DEPT.

DE 3769

CHART 54

Detroit Diesel Allison
Division of General Motors Corporation

PRELIMINARY
SERIES 92 ENGINE
ALTITUDE PERFORMANCE
9280 INJECTORS



E4A-0000-02-4
1-31-75

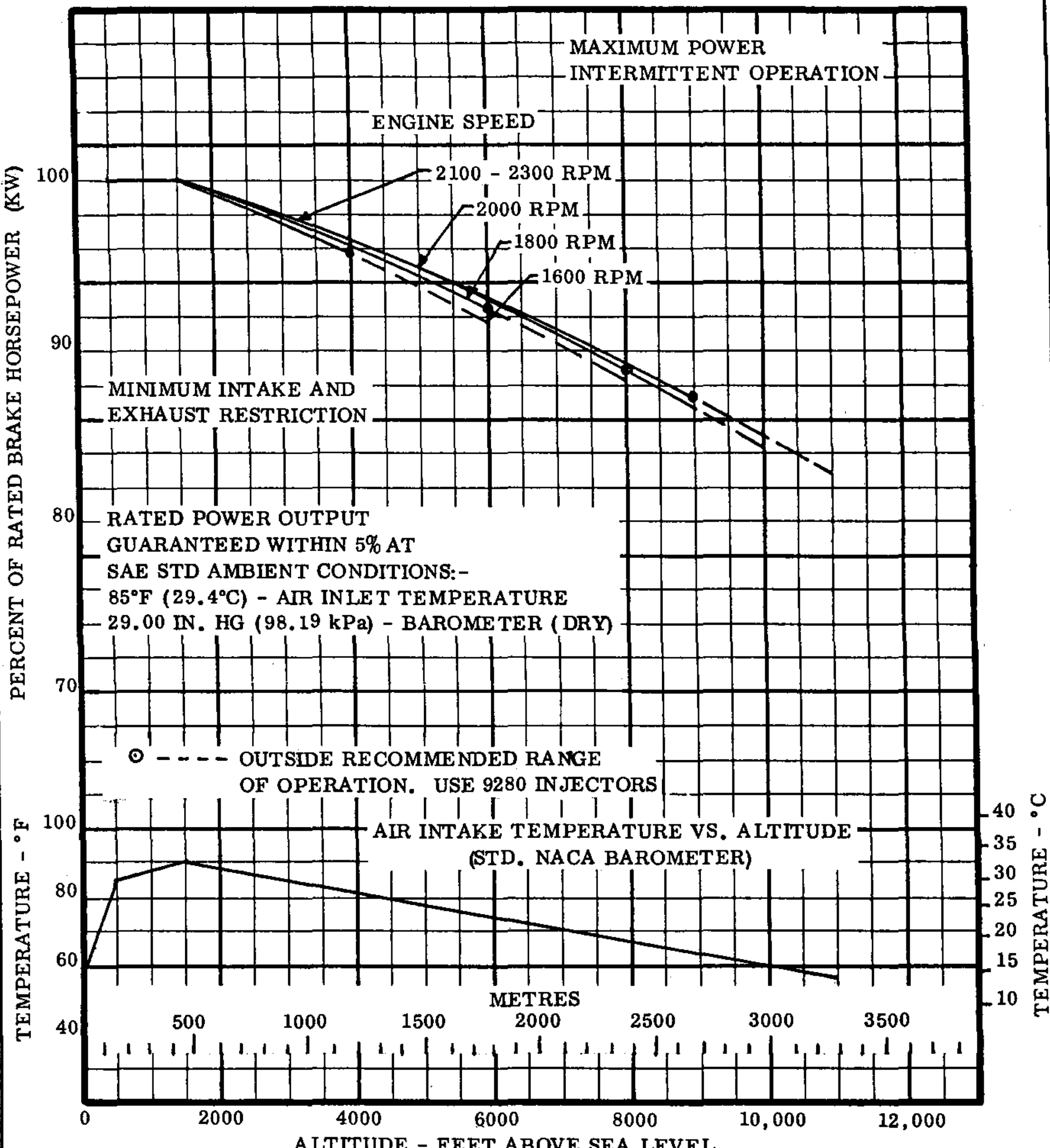
ENGINEERING-TECHNICAL DATA DEPT.

DE 3769

CHART 55

Detroit Diesel Allison
Division of General Motors Corporation

PRELIMINARY
SERIES 92 ENGINE
ALTITUDE PERFORMANCE
9285 INJECTORS

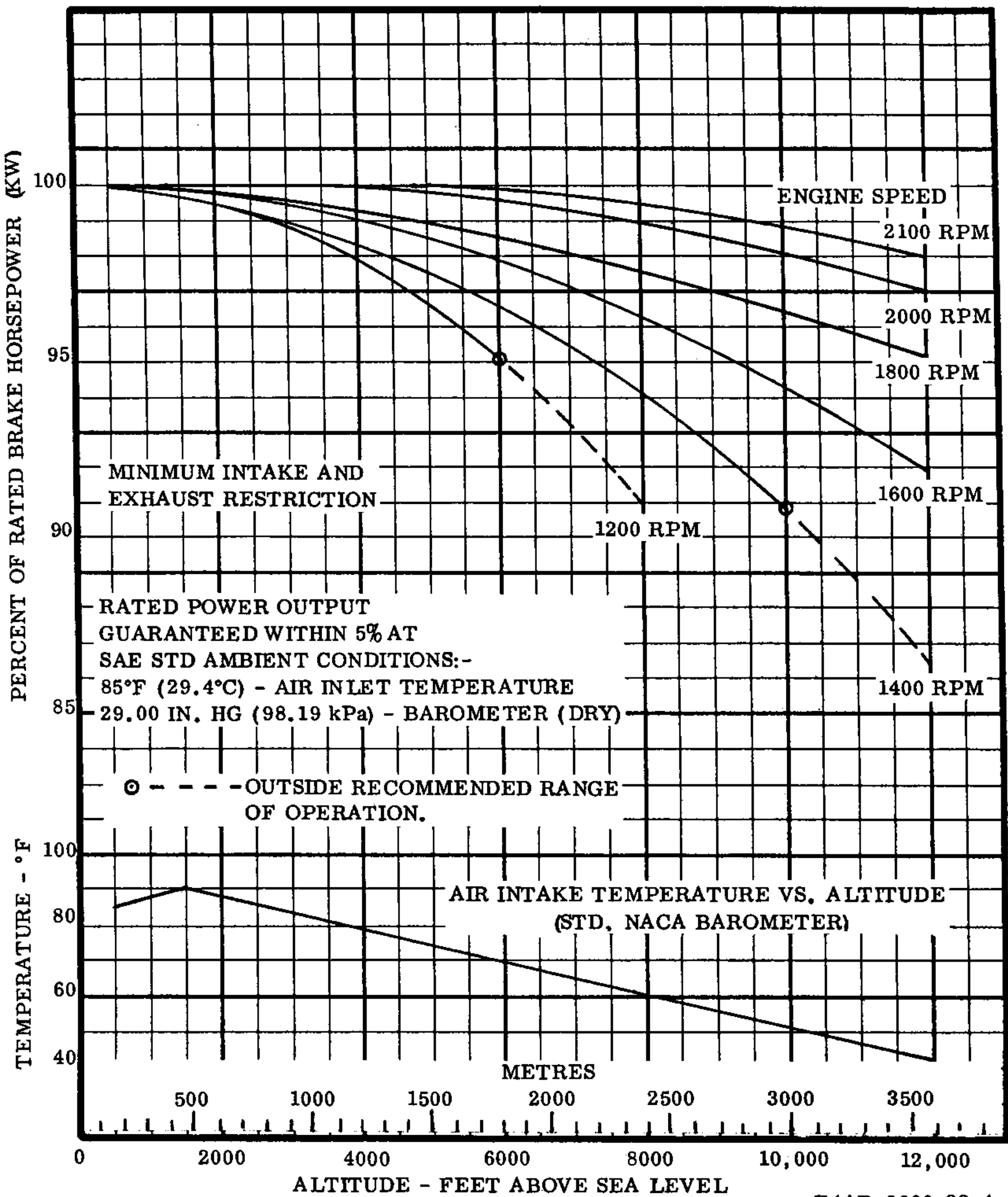


E4AR-0000-52-2
1-31-75

ENGINEERING-TECHNICAL DATA DEPT.

Detroit Diesel Allison
Division of General Motors Corporation

PRELIMINARY
SERIES V92 ENGINES
ALTITUDE PERFORMANCE
9280 INJECTORS
TURBOCHARGED



E4AR-8000-32-4
1-29-75

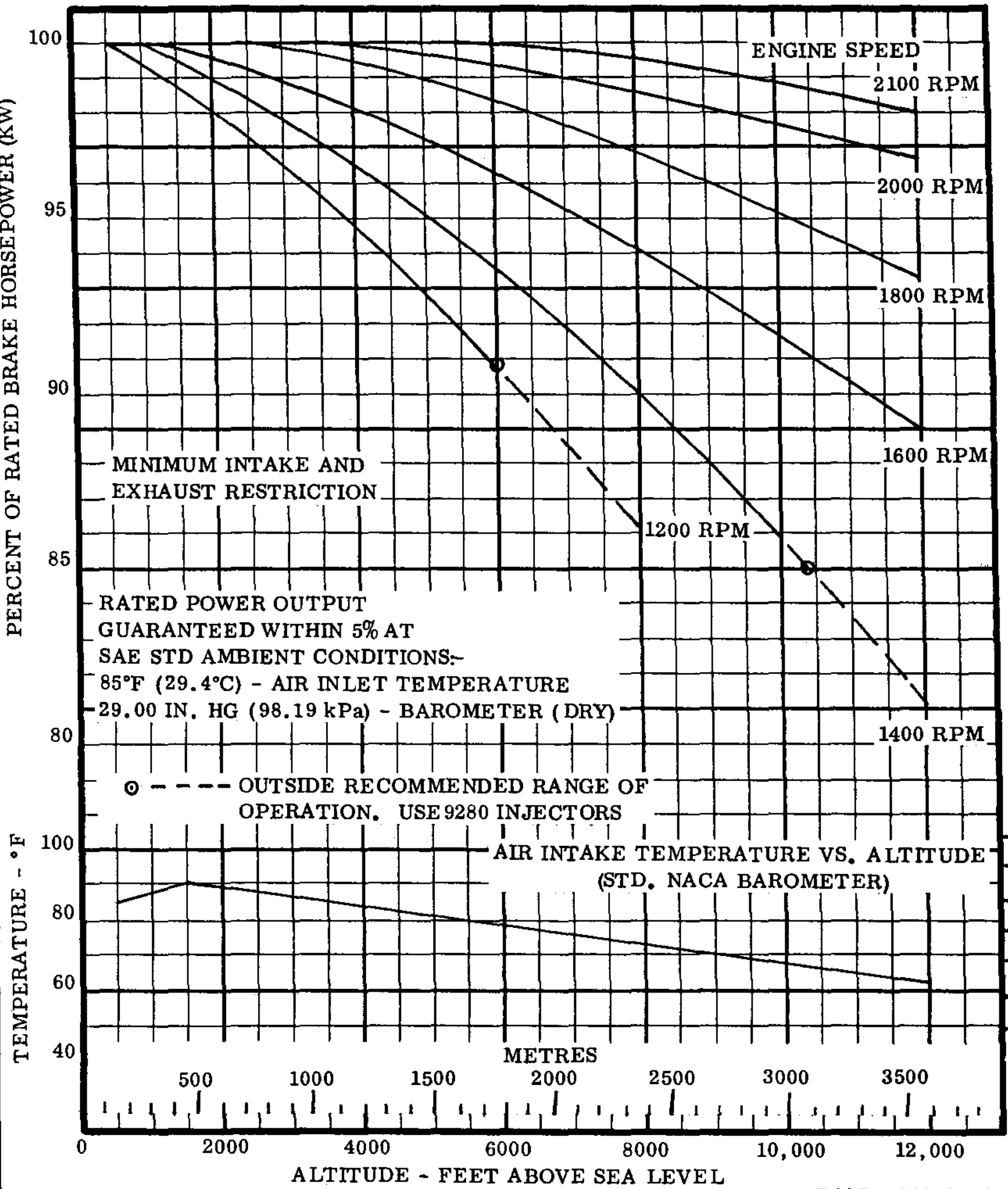
ENGINEERING-TECHNICAL DATA DEPT.

DE 3769

CHART 57

Detroit Diesel Allison
Division of General Motors Corporation

PRELIMINARY
SERIES 92 ENGINE
ALTITUDE PERFORMANCE
9285 INJECTORS
TURBOCHARGED



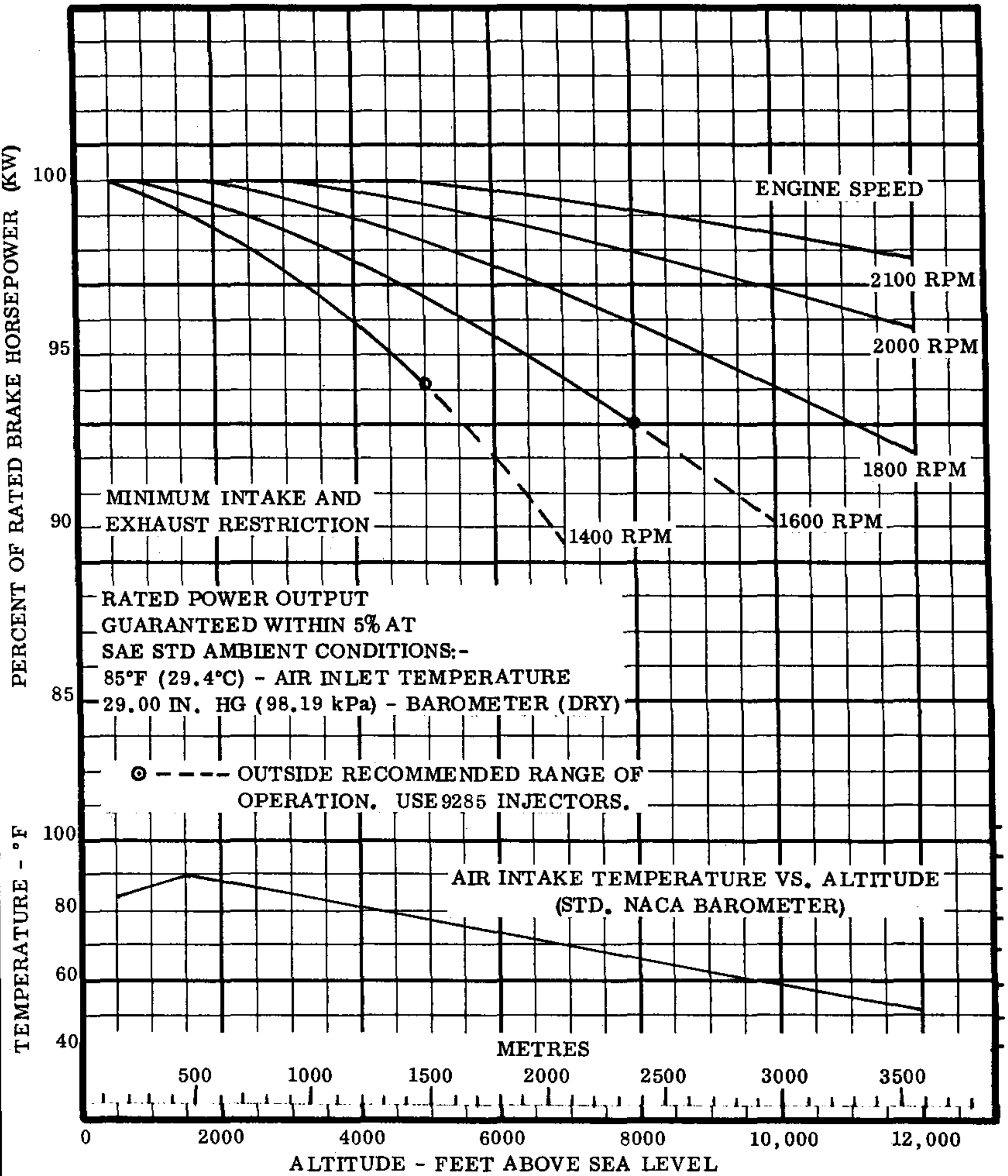
E4AR-0000-32-1
1-31-75

ENGINEERING-TECHNICAL DATA DEPT.

DE 3769

Detroit Diesel Allison
Division of General Motors Corporation

PRELIMINARY
SERIES V92 ENGINES
ALTITUDE PERFORMANCE
9290 INJECTORS
TURBOCHARGED



E4AR-8000-32-2
1-29-75

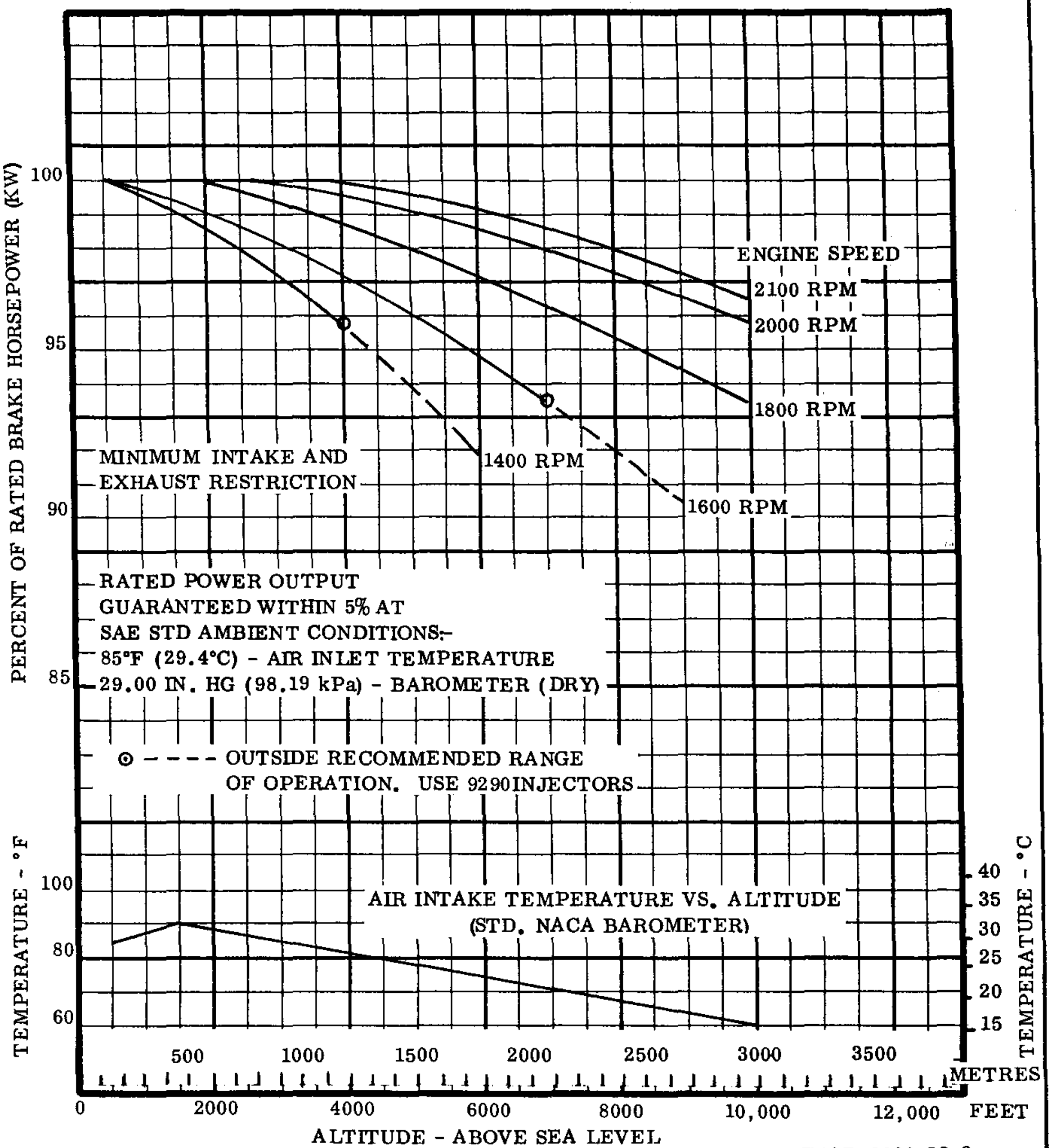
ENGINEERING-TECHNICAL DATA DEPT.

DE 3769

CHART 59

Detroit Diesel Allison
Division of General Motors Corporation

PRELIMINARY
SERIES V92 ENGINES
ALTITUDE PERFORMANCE
9295 INJECTORS
TURBOCHARGED



E4AR-8000-32-3
1-29-75

ENGINEERING-TECHNICAL DATA DEPT.

DE 3769