A comparison of N.A.E. and conventional reheat systems

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SUBJECT A COMPARISON OF N.A.E. AND CONVENTIONAL REHEAT SYSTEMS

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ISSUED TO INTERNAL

A COMPARISON OF N.A.E. AND CONVENTIONAL REHEAT SYSTEMS

INTRODUCTION

A request has been made for a comparison between an N.A.E. reheat system and an idealized conventional high-boost reheat system, suitable for application to an Orenda 11 engine. Comparisons are made under the following headings: thrust boost obtainable; fuel consumption at equal thrust boost; system weight; and availability.

THRUST BOOST OBTAINABLE

The maximum thrust boosts obtainable with the two types of reheat system are shown in Figure 1; the limiting factor was considered to be the reheat temperature, which was set at 1800°K in both cases. The N.A.E. system may operate at elevated turbine temperatures either with or without engine overspeed, and in this comparison the engine is assumed to be overspeeded by 2%. Since the engine is customarily throttled back to 97% of rated speed at altitude, this means that the N.A.E. system should permit the engine to be run at 99% of rated speed at the flight condition.

FUEL CONSUMPTION

The fuel consumptions of the two systems with a common sea level static boost of 35% are shown in Figure 2; the corresponding net thrust boost at the flight condition is 47%.

SYSTEM WEIGHT

The additional weights per engine for the two reheat systems are compared in Figure 3, and are tabulated together with the centres of gravity below. The chief difference between the two systems lies in the use of an anti-howl liner and heat shield in all known conventional systems, as compared with an external cooling shroud with the N.A.E. system.

N.A.E. SYSTEM		COMPONENT	CONVENTIONAL SYSTEM	
Weight (lb)	Centre of Gravity (in.aft of trunnions)		Weight (lb)	Centre of Gravity (in.aft of trunnions)
100	215	Variable Nozzle	100	215
30	0	Ignition & Control	30	0
40	150	Tailpipe	40	150
10	150	Flame Holder	15	150
30	150	Shroud	-	-
-	-	Liner & Shield	90	150
210			275	

AVAILABILITY

An N.A.E. system intended for experimental installation on an Orenda engine in a CF-100 aircraft has been built and done preliminary running at N.A.E. No comparable conventional system is known to be immediately available for this application.

APPENDIX

EFFECTS ON AIRCRAFT RANGE

A comparison of various thrust augmentation schemes for the CF-100 Mk V aircraft operating on a conventionalized mission is presented in Reference 1. Of particular interest are calculations illustrating the effect of fitting a 35% boost N.A.E. reheat system to both a standard Orenda XI and also to an uprated (8500 lb) Orenda engine.

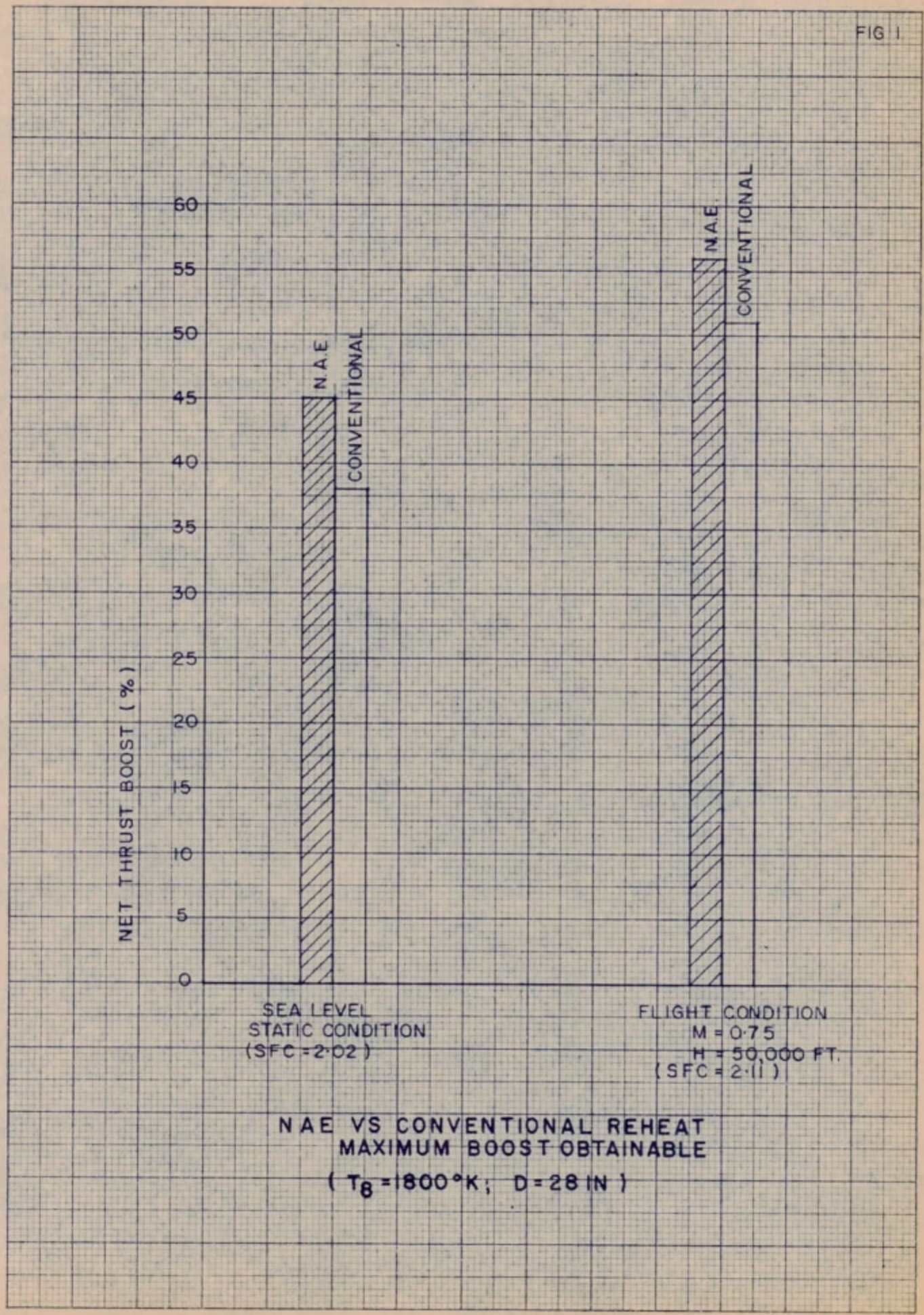
If the N.A.E. system were replaced by a conventional system in these missions, there would be a range penalty for the conventional system of 10 nautical miles (in about 350) for both engines. This penalty is due to the poorer specific of the conventional system as shown in Figure 2.

The range comparisons of Reference 1 were based on a fuel capacity limited by the aircraft tankage, and hence the weight saving of the N.A.E. system could not be exploited for carrying fuel. If this weight saving could be converted to additional fuel, the range differential between the two reheat systems would increase by 24 nautical miles.

REFERENCE

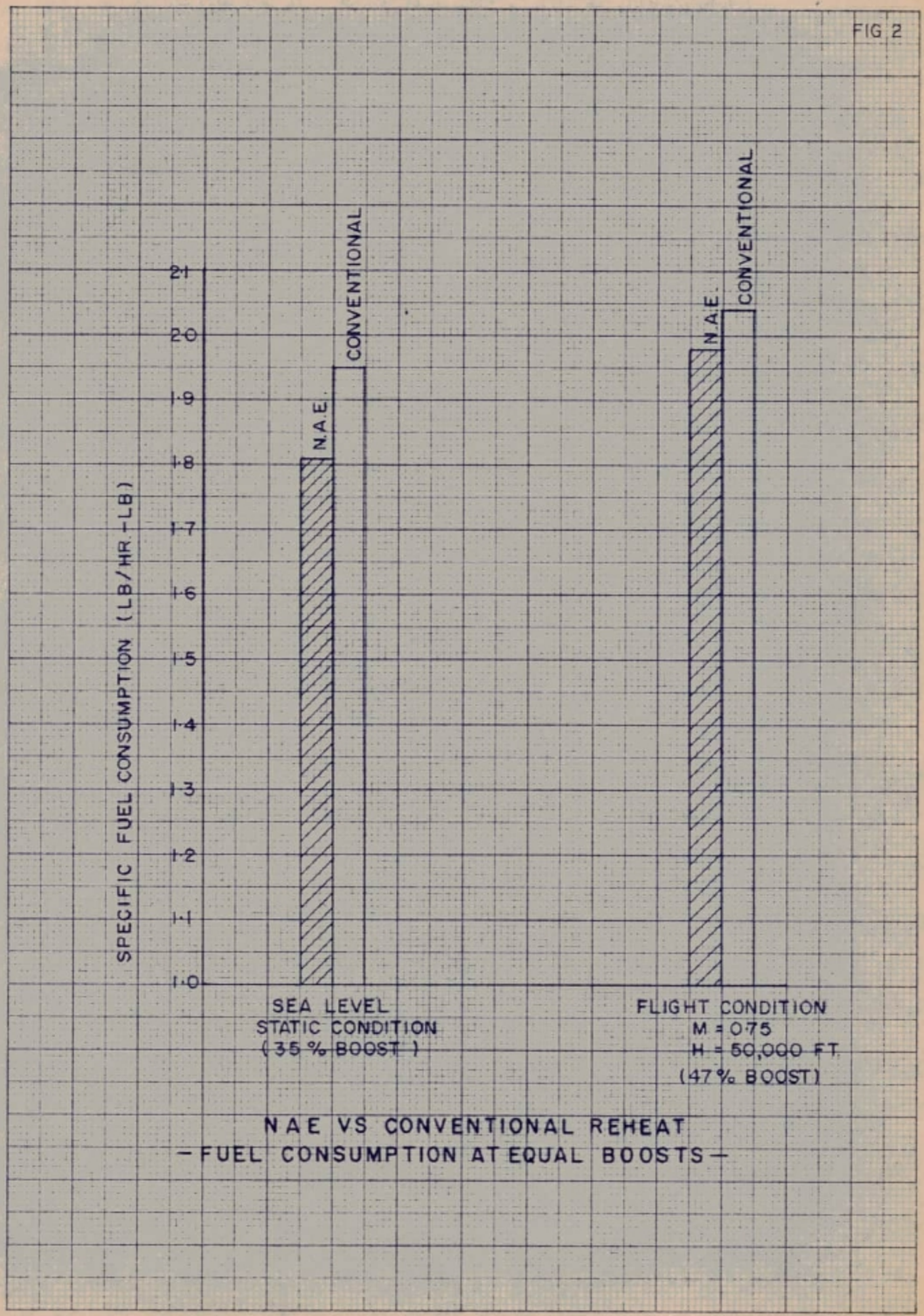
1. Gould, D.G. "Estimated Performance of the CF-100 Mk V Aircraft with Uprated Engines (8,500 lb SLS) and with Reheat Thrust Augmentation." N.A.E. Laboratory Memorandum FR-36(e), April 1956.

FIG 1



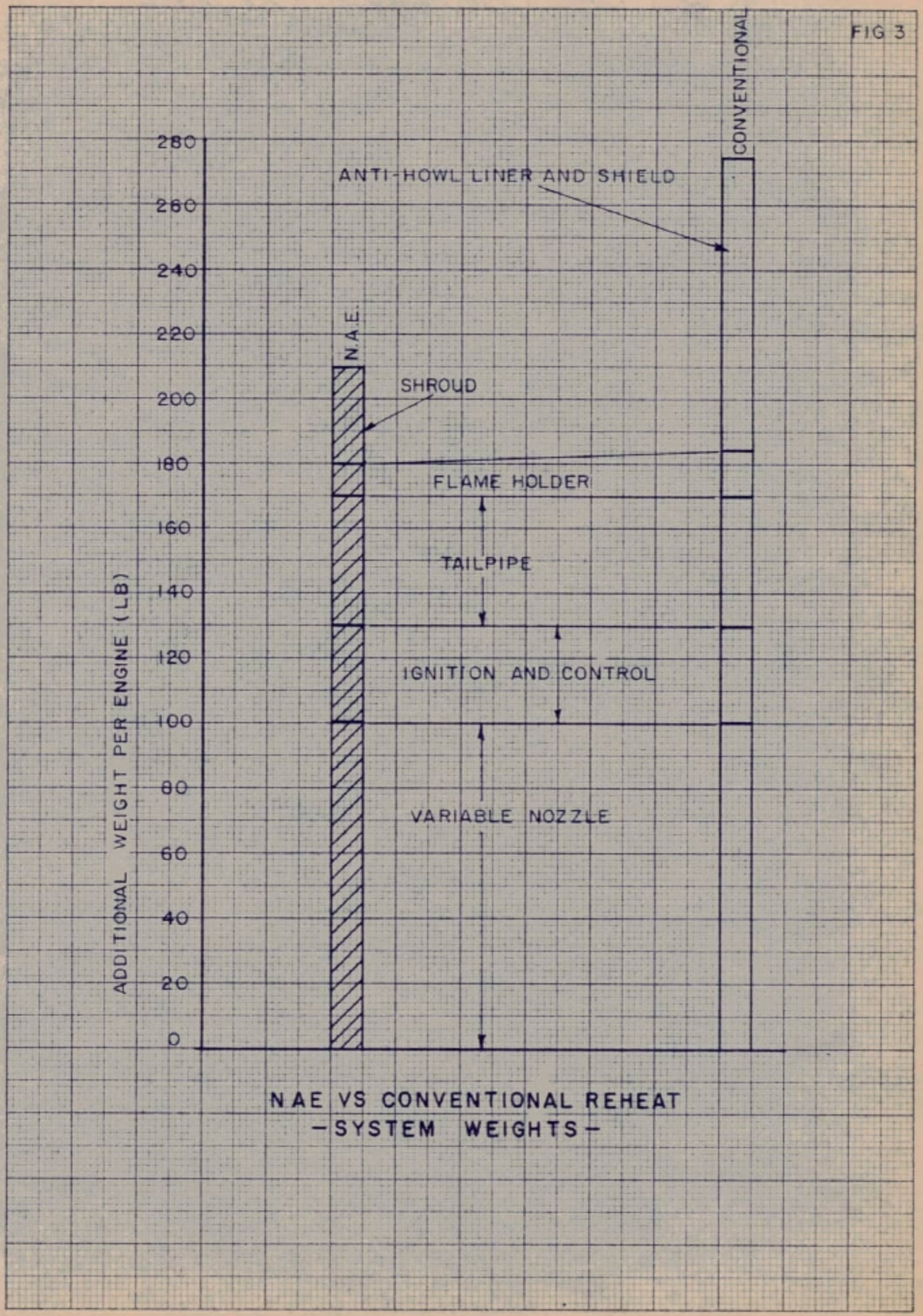
NAE VS CONVENTIONAL REHEAT
MAXIMUM BOOST OBTAINABLE
(T_8 = 1800°K; D = 28 IN)

FIG 2



NAE VS CONVENTIONAL REHEAT
– FUEL CONSUMPTION AT EQUAL BOOSTS –

FIG 3



NAE VS CONVENTIONAL REHEAT
—SYSTEM WEIGHTS—