

Compensating Leads



COMPENSATING LEADS

FOR USE WITH THERMOCOUPLES

Due to the variety of compensating leads and their lengths it is not possible to list every type available. The lists overleaf cover the more standard types of leads which are in fairly common use on modern aircraft.

TYPICAL COMPENSATING LEADS

SPEC.	TYPICAL SUB.SPEC.	TYPE		LENGTH	RESISTANCE (OHMS)	F.D.
L.1.	372	A	Copper/Constantan P.V.C. covered	5 ft (1.524 m)	1.75	1015
L.1.	130	A	" " " "	10 ft (3.048 m)	1.75	1015
L.1.	131	A	" " " "	20 ft (6.096 m)	1.75	1015
L.1.	132	A	" " " "	30 ft (9.144 m)	1.75	1015
L.1.	133	A	" " " "	40 ft (12.192 m)	1.75	1015
L.1.	134	A	" " " "	50 ft (15.239 m)	1.75	1015
L.1.	300	B	" " " "	10 ft (3.048 m)	0.875	1015
L.1.	301	B	" " " "	20 ft (6.096 m)	0.875	1015
L.1.	302	B	" " " "	30 ft (9.144 m)	0.875	1015
L.1.	303	B	" " " "	40 ft (12.192 m)	0.875	1015
L.1.	304	B	" " " "	50 ft (15.239 m)	0.875	1015



SPEC.	TYPICAL SUB. SPEC.	TYPE		LENGTH	RESISTANCE (OHMS)	F. D.
L.1.	140	C	Copper/Constantan P.V.C. covered	10 ft (3.048 m)	0.583	1015
L.1.	141	C	" " " "	20 ft (6.096 m)	0.583	1015
L.1.	169	D	" " Rubber covered	30 ft (9.144 m)	1.75	1015
L.1.	170	D	" " " "	40 ft (12.192 m)	1.75	1015
L.1.	171	D	" " " "	50 ft (15.239 m)	1.75	1015
L.1.	-	E	" " " "		0.875	1015
L.1.	-	F	" " " "	20 ft (6.096 m)	0.583	1015
L.2.	367	B	Nickel/Chromium V Nickel/Aluminium. P. V. C. covered	10 ft (3.048 m)	0.857	1015
L.2.	368	B	" " " "	20 ft (6.096 m)	0.857	1015
L.2.	369	B	" " " "	30 ft (9.144 m)	0.857	1015
L.2.	370	B	" " " "	40 ft (12.192 m)	0.857	1015
L.2.	371	B	" " " "	50 ft (15.239 m)	0.857	1015



THE ENCOMP THERMOCOUPLE SYSTEM

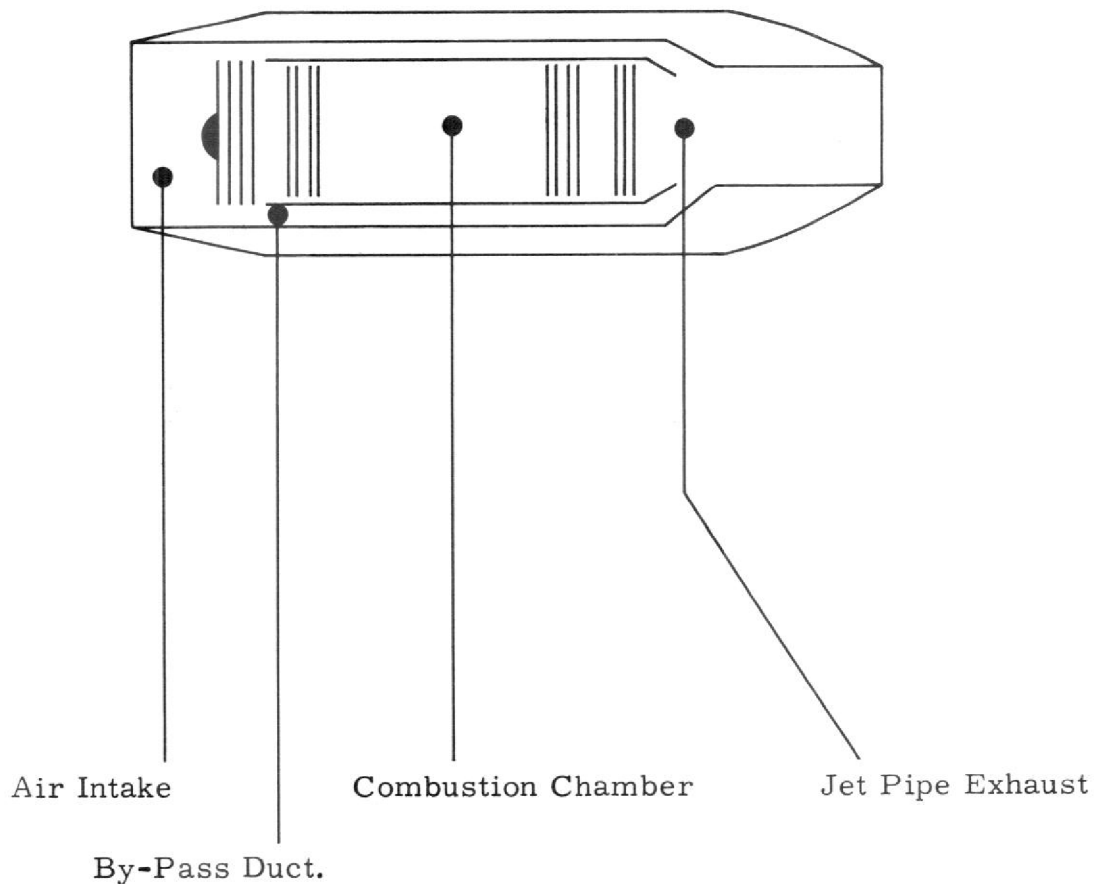
The registered name ENCOMP covers a measuring system developed to indicate the flame temperature of By-Pass Jet Engines.

For the purpose of defining the various stations on Jet Engines the following terms are used:-

T.1	Air Intake	Temp.
T.4	Flame	Temp.
T.6	Exhaust Gas	Temp.

The remaining terms T2, T3 and T5 are used in reference to inter-stage temperatures where the stations vary from one engine to another.

TYPICAL BY-PASS JET ENGINE

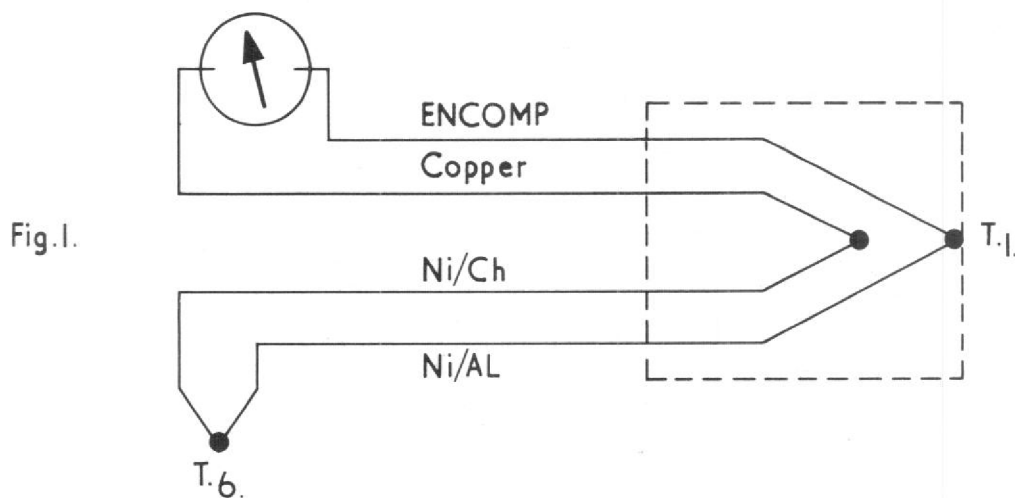


It is required to provide the pilot with an indication of flame temperature as defined by the expression

$$T_4 = \alpha (T_6 - nT_1)$$

where 'n' is a constant, less than 1, which is applicable to a particular type of by-pass engine.

This measurement is made, in the ENCOMP System, by connecting in series with the normal T_6 (Exhaust Gas) Thermocouple System, a special T_1 (Air Intake) Thermocouple which has two junctions, as shown in Fig.1 below.



As will be seen from Fig.1, the Copper and ENCOMP conductors of the T_1 Thermocouple are extended right back to the pilot's indicator.

ENCOMP material is a special Nickel-Copper Alloy chosen such that its e.m.f output versus Copper is $(1-n)$ times the output of Nickel/Chromium versus Nickel/Aluminium.

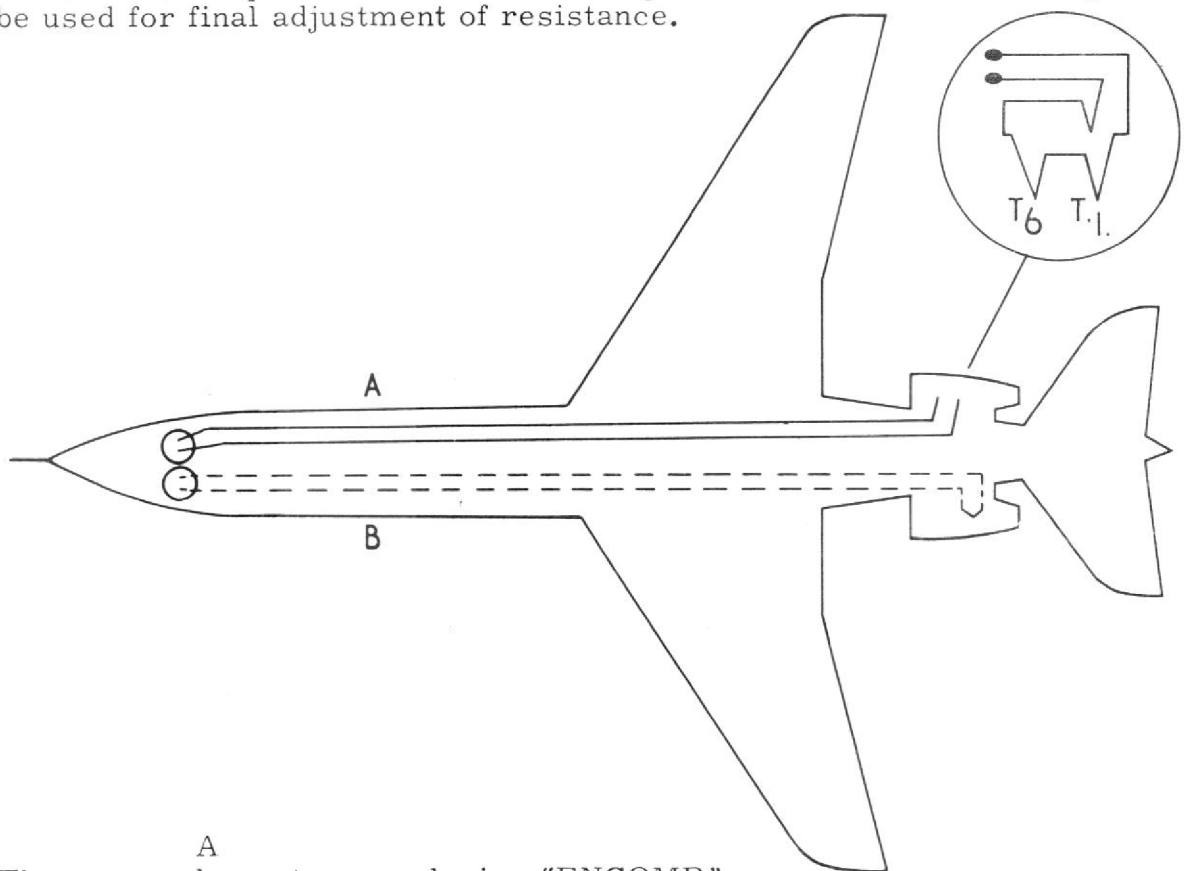
It can be shown that the e.m.f output of the ENCOMP System follows the expression $T_6 - nT_1$. Therefore, the pilot's T.G.T. Indicator will indicate T_1 , the flame temperature.

In addition to giving the desired Compensation the ENCOMP System affords a considerable saving in weight since the Copper and ENCOMP Cables used have a combined specific resistance of less than $\frac{1}{3}$ rd, that of the Ni/Ch and Ni/Al pair. In general, maximum weight saving is achieved by using the thinnest possible Copper conductors, consistent with other considerations.

Two typical T.G.T. Systems are shown below together with approximate values of resistance and weight. "A" is the ENCOMP System and "B" a standard System without T_1 Compensation and employing Ni/Ch and Ni/Al cables.

The total cable run between the T_6 Thermocouples and the Indicators is assumed to be 150 ft. The Resistance values satisfy a T.G.T. indicator system having a total external resistance, including T_6 Thermocouples, of 25 ohms.

In both examples it is assumed that adjustable series resistance spools will be used for final adjustment of resistance.



A			
Thermocouple system employing "ENCOMP"			
150ft of No.18 "ENCOMP" cable	= 15 ohms		Approx.
150ft of No.18 "Copper" cable	= 0.9 ohms		Approx.
T_1 Thermocouple Leads (11ft)	= 6.5 ohms		Approx.
Total Resistance	= 22.4 ohms		Approx.
Total Weight of Cable	= 2.8 lbs.		
B			
Thermocouple system employing Ni/Ch v Ni/Al Cables.			
150ft of No.2 Ni/Ch cable	= 15 ohms		Approx.
150ft of No.2 Ni/Al cable	= 6 ohms		Approx.
Total Resistance	= 21 ohms		Approx.
Total Weight of Cable	= 8 lbs.		



ENCOMP MATERIAL $n = 0.28$

To meet the particular requirements of both Engine and Aircraft manufacturers "ENCOMP" cable is available with "Nyvin" or "Efglas" insulation and in the following sizes.

SIZE	RES. Ohms/100ft	NYVIN/COVERED	EFGLAS COVERED
16	6.8	L.9.735	L.9.741
18	8.2	L.9.739	L.9.736
20	14.3	L.9.740	L.9.742

Terminal Tags manufactured from "ENCOMP" are available for use with the above cables. Sizes and Part Numbers for these are given below.

0	BA	No. 173671
2	BA	No. 175467
4	BA	No. 177781
6	BA	No. 177782

$\frac{1}{8}$ th and $\frac{1}{4}$ " diameter rod can be supplied and this is covered by specification M.P.S 42 sub.24.

INDICATORS

Special versions of the models S196, S218 and S452 are supplied for use with the ENCOMP Thermocouple System.

General information on these models is given in section 5.

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