A GENTLEMAN'S GUIDE TO CLASSIC SMITHS AUTOMOTIVE GAUGES

Part II – Electrical senders (transmitters)

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NOTES RE CONVENTIONS USED WITHIN THE TEXT:

Throughout the text the letter "n" has been used to denote any number. Where the number is significant it has been provided in full. Otherwise irrelevant numbers have been replaced. e.g. TT nn00 = TT3800, TT4200, TT4800 etc.

Where required in this document, a nominal battery voltage of 12 Volts has been used. In real life, the fully charged voltage of a lead-acid cell is about 2.4 Volts to give an actual voltage of about 13.6V. Using the "real" value will change only the numbers and not the method of operation described.

The terms "**earth return**" and "**insulated return**" are sometimes found when describing senders of any type. An "earth return" sender relies on the body of the sender to connect through the vehicle's bodywork to complete the electrical circuit to the battery. An "insulated return" sender has no electrical connection to the body of the sender but has two terminals and requires a separate wire to connect one of these terminals to the chassis side of the circuit. Insulated return senders are usually only encountered in fibreglass-bodied cars and larger commercial vehicles.

The term "characteristic" refers to the response of a sender to changes in the measured parameter. Senders may have the same range of operating resistance values but the mid-scale value, as indicated by the gauge, is dependent on the sender's characteristic or behaviour. Looking at *fig.16*, the curve for a temperature sender shows its behaviour, or characteristic, in response to temperature change. A linear characteristic would simply be a straight line between scale limit values.

As you will soon realise, this document deals with temperature senders, or temperature transmitters, in more detail than fuel and pressure senders. This is by design as temperature gauges and senders create a lot of confusion both to users and on the part of some vendors. Much more than fuel gauge senders and (oil) pressure senders. To a large extent this is due to the gauge technologies being rendered obsolete by the manufacturers – Smiths in this case. Thermal ("TE") senders are virtually unobtainable and "semiconductor" ("TC") senders are getting harder to find as time goes on. A "home-brew" interface is described on a MG Magnette page (link provided later) and it may not be long before this is the only option for continued use of the ("TC") "semiconductor" gauges though a different circuit would be required for these.

Information supplied within this document is assumed to be reasonably accurate. Due to limited numbers of temperature senders available to test and possible "aging" of these (older) senders, data presented may be at variance with the original specification for these devices. Cross-reference data taken from manufacturers publications is assumed to be accurate. (But see comments in section "*TEMPERATURE SENDERS DISCUSSION*".)

How information supplied here is used is the end user's responsibility.

INTRODUCTION:

This document investigates the operation of senders, or transmitters, used to drive the electrical fuel, temperature and oil pressure gauges produced by Smiths into the 1970s. As noted in part 1, there were several different types of electrical gauge produced, each of which has different electrical characteristics.

Where possible, information presented in this document has been sourced from Smiths data or from results of bench-testing. In the case of fuel and pressure senders, the number of items to hand was limited and, in the case of pressure senders some assumptions have been made which, while probably are correct, may not be "right on the nail".

In the case of temperature senders, only the more common "classic" water temperature senders have been discussed. Other senders, such as TT4808, TT4809…TT4811 are known but are not dealt with here. Suffixes, "/nn(X)" are not always provided in this document.

Table A below sets out the types of Smiths electrical gauge, and the order, in which senders are discussed here.

***TABLE A*: GAUGES AND SENDERS REFERRED IN THIS DOCUMENT**

Parameter	Gauge prefixes	Sender prefixes
Fuel level	FG, BF, ACF	FT, TF, TFS, TK, others?
Temperature	TC, TE, BT, ACT	TT
Pressure	BP, ACP	PT, PTR

I would like to acknowledge Peter Wilkinson of Smiths Instruments, UK (Caerbont Automotive Instruments) for providing much useful data and discussion on temperature senders to confirm or update the information on these senders set out in this document.

Fig. 2 shows a bimetal fuel gauge for different resistance values. Due to the gauges inherent non-linear characteristic, a relatively small change in resistance (20 > 33Ω) can make a significant difference to the indicated value at the upper end of the scale. A similar change in sender resistance at the low end of the scale would barely be noticeable. Thus a "USA standard" sender would never show a full tank but would read correctly at "Empty". This same "error" would have an oil pressure gauge reading low at higher pressures which should not be a problem but would be a problem with a temperature gauge as overheating of the engine may be indicated by a less than full-scale reading.

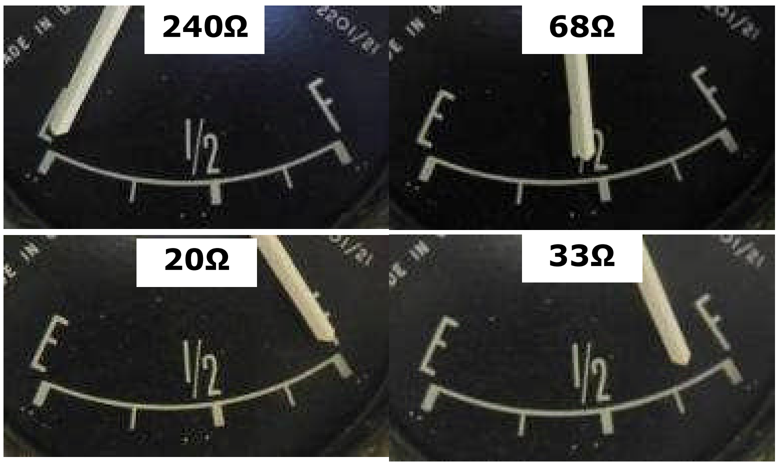


Figure 2: Bimetal gauge calibration and pointer position at 33Ω. 240 - 33Ω is an American standard range.

FUEL TANK SENDERS:

Fuel tank level senders were produced in a variety of forms having different terminals, mounting position (top, side), arm lengths, angle through which the arm moves, floats and fixings. Some (later) units have low-level switches fitted for driving warning lamps. For the senders/gauge combinations dealt with here, there are only two resistance ranges applicable to the various gauges: 3Ω to 80Ω (e.g. FT5300/73 @ 3.3Ω to 80Ω) for the FG gauge and ≥240Ω to ≤20Ω for the BF and ACF gauges. (Note that resistance values given here are for the full range of the resistance element but the useful range may be less than this.)

Fig. 3 at right shows the internal construction of the FT3331/56 fuel tank level sender. This is from an early Triumph Herald and works with the "FG" type of gauge. The resistance range of this unit is 0–85 Ohms empty to full.

Fig. 4 below shows the internal construction of a later TF1002/008, fuel tank level sender. This has a measured resistance range of 245 – 15 Ohms and is used with a bimetal, "BF" type gauge. The resistance element is wound on a shaped former approximating the response of the gauge. (The wiper arm here is shown towards the "Full" position.)

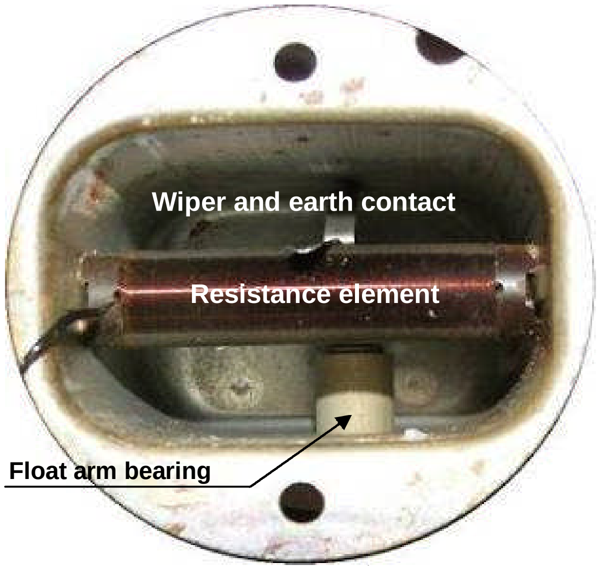


Figure 3: FT 3331/56 fuel tank level sender

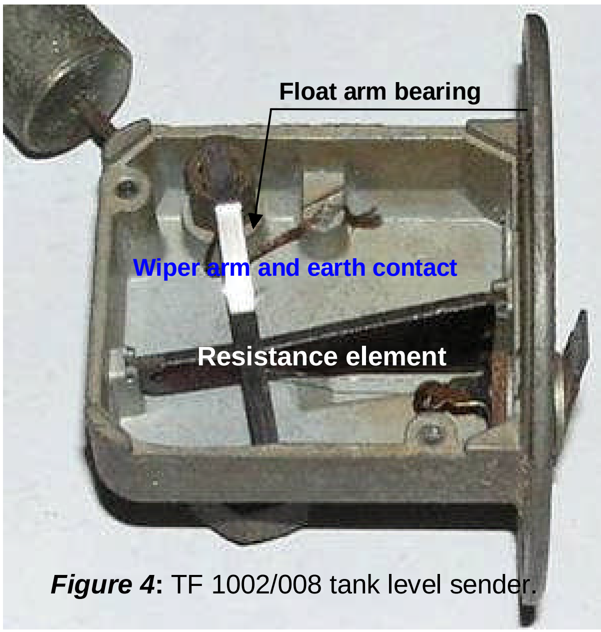


Figure 4: TF 1002/008 tank level sender.

As noted in *Table A*, there are a number of prefixes used for these senders. These are set out in a table on the following page. Those senders including an "S" in their prefix include a low fuel level warning light switch and have an extra terminal for this. The fuel gauge terminal is marked "T" and the switch terminal "W". A third terminal is supplied on many senders and may be marked "E" (for "earth") or, for those senders with a sheet-metal mounting flange/plate rather than diecast, may be unmarked and a "spade" terminal spot welded directly to the mounting flange.

Fuel tank level sender ranges are available from Caerbont/Smiths, as set out in *Table C* below, of which only two (**bold text**) are of interest here.

For an "FG" type fuel gauge, only senders with a range of 0-80 Ohms or 3-80 Ohms (Empty > Full) are suitable (bold underlined text in *Table C*). For "BF" bimetal gauges, a sender having a resistance range of 240 > 20 Ohms (Empty > Full) is required. Note that the 240-33 Ohm items listed are very close but will never indicate "FULL" as demonstrated in *fig.1* in the section "A CLOSER LOOK AT GAUGE CALIBRATION" earlier in this document.

***Table C*: Fuel tank level sender resistances**		
Sender type	**Resistance Values**	
	Empty	**Full**
Euro	10	180
Smiths early (FG gauges)	**3**	**80**
Classic (Smiths bimetal gauges)	**240**	**20**
USA	240	33

Resistance range and characteristic (these terms are not equivalent) are the most critical parameters as far as operation with a particular gauge is concerned. Further options for mounting abound and for any application these will need to be determined. If trying to find a sender for an older vehicle you may have to resort to a sender with adjustable arm length and suitable range of movement (specified in degrees).

With a bit of fiddling, a sender with a slightly wider resistance range than that expected by a gauge may be pressed into service so that only a part of the resistive element is used. By way of example, Caerbont's website has several senders listed with values in the 0 – 83 Ohms range any of which could be expected to work with an "FG" type gauge. By adjusting the length of the float arm and/or bending the float arm (official Smiths procedure for servicing earlier tank level senders) or end stop, matching of the limit resistances should be readily achieved.

Resistance ranges provided by manufacturers denote the resistance values at minimum and maximum scale values or calibration marks in that order.

It may be possible to find a suitable sender with low-level switch if you wish to add this feature. The addition of an "S" to the prefix indicates the presence of a low fuel level switch contact. By way of example, Hillman Super Minx cars, about 1965, could have been fitted with either a TF9002/008 (no switch) or a TFS3006/500 (with switch) fuel level sender.

***TABLE D*: FUEL TANK LEVEL SENDER IDENTIFICATION:**	
Sender code	**Matching gauge type**
FT, TM, TMS, KP	FG - Moving Iron gauge
TF, TFS, TB, TBS	BF - Bimetal

If the only suitable sender has an "insulated return" this is not a problem as a wire from the return terminal to earth is all the extra work required. Similarly, different types of terminal(s) on a sender are readily accommodated either by fitting a new connector to the connecting wire or using an adapter cable (which you may need to construct).

Smiths Water (Oil) Temperature Senders:

Of the Smiths senders dealt with here, temperature senders are those that have caused the most grief. Ideally you will replace a temperature sender with that specified for the vehicle of interest. But for older vehicles this may not be easily done or even not possible, as the original sender is no longer manufactured.

If you have re-powered a vehicle with an engine from another manufacturer then you may require a sender with a different thread to the Smiths "standard" 5/8 UNF. It may be possible to find a suitable sender but the better idea may be to purchase gauge and sender as a set. The website "http://danr.mhartman.net/wp-content/uploads/Senders-Report.pdf" provides some useful tips (for Smiths bimetal gauges). Some of the current range of senders from Caerbont/Smiths may also be suitable. (These have not been used or tested at this time.)

Do not use thread sealing tapes or compounds when fitting temperature senders that rely on the housing for an electrical connection ("Earth return"). The electrical contact between the sender and the housing is part of the measuring circuit and poor electrical contact here will cause a gauge to read low or not at all! Senders should seal on the bevelled surface (TT3nnn), against a washer (TT4nnn) or on the thread itself (NPT, NPTF)

BIMETAL SENDER:

Figure 5: Smiths TT 1200/01 bimetal temperature sender.

The temperature sender used with "TE" type gauges, *fig. 5* at right, contains a bimetal element and functions as a temperature-sensitive voltage regulator, which is why a separate voltage regulator is not used with these gauges. Physically it looks very much like a Bourdon tube temperature gauge bulb and was held in place by a separate nut or threaded collar. These senders are designated TT1200/00 or TT1200/01 etc. There is also a 24V variant marked TT1300/01 which has a heating coil resistance of c100 Ohms, where the 12V sender has a resistance of c25 Ohms.

The TT1800 senders have a blade type connection.

Fig.6 shows a sketch of the temperature transmitter element and *fig. 7* below is a photograph of an aftermarket device. Unlike the later "BT" gauges, these transmitters and gauges do not require a separate instrument voltage regulator.

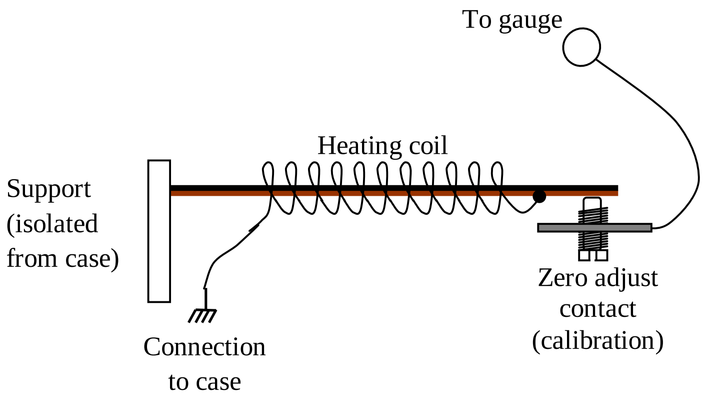
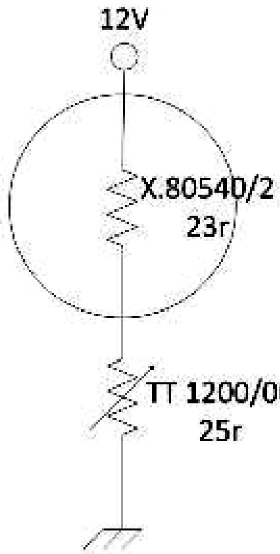


Figure 6: Bimetal temperature transmitter circuit (TT1200 type) as used with "TE" type gauge.

Figure 7: Bimetal temperature sensing element (Aftermarket unit but similar to Smiths sender.)

For the purposes of the following description I will treat each resistance as equal and of 25r (25 Ohms).

At right is a circuit diagram of the TE style gauge and sender. The resistances shown are as-measured for the heating coils in a gauge and sender to hand. Normal manufacturing tolerances may produce different values but they should be close to those shown here.



When voltage is first applied, a current of 0.24 Amps (12V/50r) will flow through the circuit. Each resistor consists of a length of nichrome wire wound around a bimetal bar and each will dissipate about 1.5 Watts, heating and causing the bimetal elements to bend. In the case of the gauge, the pointer will move from its "rest" position at HOT towards the COLD position. The bimetal element within the TT 1200 sender will also be heated and bend until such time as it breaks the circuit, the bimetal strip inside the sender will open the circuit and begin cooling. The bimetal strip will "unbend" fairly quickly and the sequence will repeat. As the temperature of the sender increases the rate of cooling of the bimetal strip reduces and the contacts remain open for a longer period. The effect of this is to vary the current as shown in *figs 8, 9 and 10* below. (The on time, when the contacts are closed is shown as constant here and the off time varies according to the temperature of the sender. This is simply due to the fact that the rate of cooling of the bimetal bar will be a function of the temperature of the sender's body – the cooler the sender is, the quicker heat will be removed.)

***FIG. 8*: SENDER "OUTPUT" WHEN COLD**

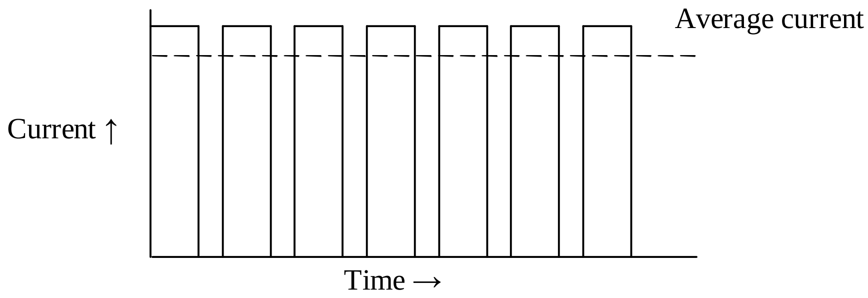


***FIG. 9*: SENDER "OUTPUT" WHEN NORMAL**

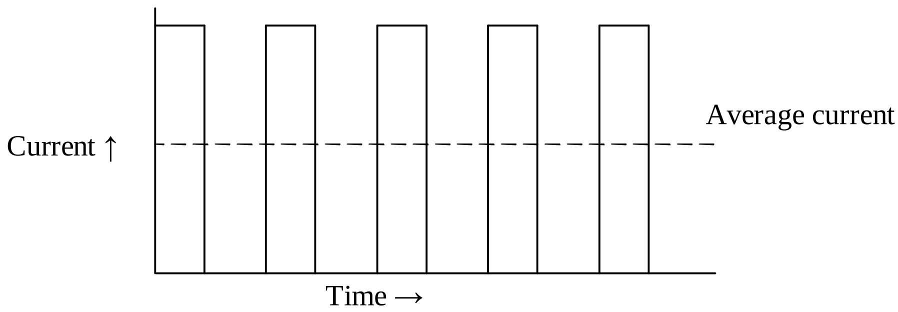
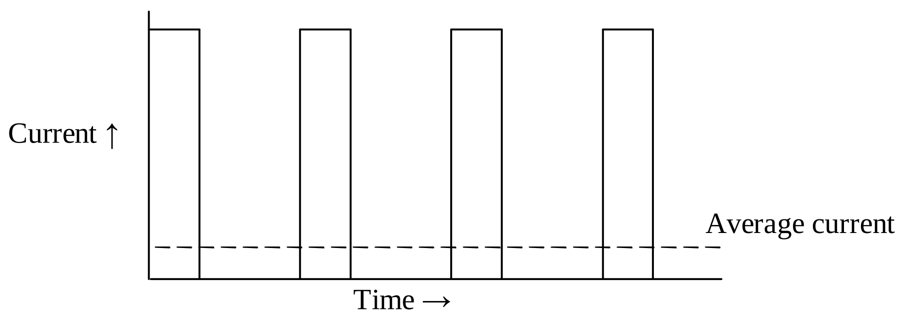


***FIG. 10*: SENDER "OUTPUT" WHEN HOT**



This interrupted current, hence heating effect in the gauge, can be equated to a series resistance passing the average current and the calibration of these gauges is done in this way. For the record, a resistance of 68 Ohms in series with the gauge should indicate at the COLD scale mark and a resistance of 310 Ohms should have the gauge indicating HOT.

Since the effect of these sensors is to reduce the average current (increase the (effective) resistance) with temperature, these senders are sometimes described as "Positive Temperature Coefficient, or "PTC" senders. All later gauges used "Negative Temperature Coefficient" or "NTC" senders, where the resistance of the sender reduces as the temperature increases.

Varying voltage in the car's electrical system will have little effect on these gauges. Any increase in voltage will increase the heating effect of both heating coils, reducing the duty-cycle of the sender while increasing the heating of the bimetal element in the gauge. The two effects will cancel to produce a consistent value for a given temperature irrespective of the voltage applied (within reasonable limits).

TT1200 series senders are no longer made although N.T.G. Motor Services Ltd. In the UK offer a solid-state (PTC Thermistor) replacement sender for the TT 1200/00 but it is definitely not cheap! If you have a faulty TT 1200/00 type sender, then have a look at the following website which has a good article on repairing/adapting these gauges/senders:

https://www.magnette.org/tech-tips/maintenance/miscellaneous/516-the-temperature-gauge-problem-solving

I also note that Flying Spares sell a "TE" gauge and sender combination, for Rolls-Royce/Bentley cars which also includes an "black-box" to match a later (TT3800) sender to this older gauge. Which can be seen at https://www.flyingspares.com/coolant-temperature-gauge-sender-early-series-1-models-ud1357sxr.html. I suspect the contents of this "black-box" is similar in design to the one transistor circuit in the link above.

It may be possible to find a visually similar BTnnnn gauge that could be substituted for the X or TE type gauge. This would enable an NTC thermistor type sender to be fitted. For Smiths gauge clusters, the gauges themselves are generally interchangeable between cluster housings that use the same gauge retaining method (clamp/screw) and the faceplates, and usually the pointers. can be swapped if needs be. To preserve the original look, you may need to re-paint a replagement gauge pointer. Done well, the only visible change is that the pointer indicates COLD with the ignition off.

Table E below lists the known variants of Smiths "thermal" senders. Other variants in the TT1300 range, (/00, /02), as in the TT1200 range, may also have been produced.

***Table E*: – Smiths "thermal" type senders**		
Sender	**Terminal**	**Voltage**
TT1200/00	Snap-on	12
TT1200/01	Screw	12
TT1200/02	Threaded stud	12
TT1300/01	Screw	24
TT1800/00	Blade	12
TT5200/00	Screw (2) – Insulated return	12
TT5300/00	Screw (2) – Insulated return	24

Construction of a Smiths thermistor type sender.

Fig. 11 below is a sketch of a Smiths TT4802 sender. All Smiths thermistor-based senders about this time use this same construction. Thermistor type senders are used for all temperature gauges other than the "TE" prefixed gauges.

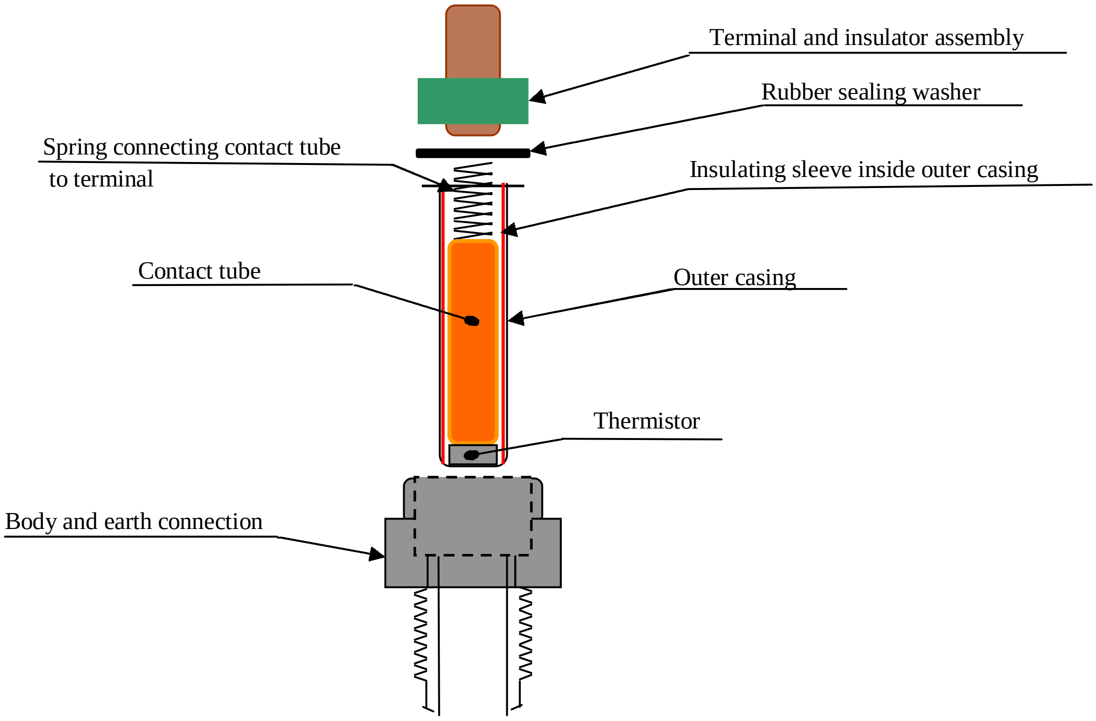


Figure 11: Showing general construction of a thermistor type sender

Fig. 12 at right shows the thermistor element from a Smith sender (TT 4802/00). This is the item that does the temperature to current conversion to drive the gauge. There are a number of these thermistors used by Smiths in their senders but each thermistor requires the same temperature to resistance characteristic to match that of the gauge. The reason for this is simple. As all gauges of a type are calibrated to the same values, differences in operating heat ranges of the engine and gauge are accommodated by changing the thermistor – a small disc of material 6mm in diameter. No other changes need to be made

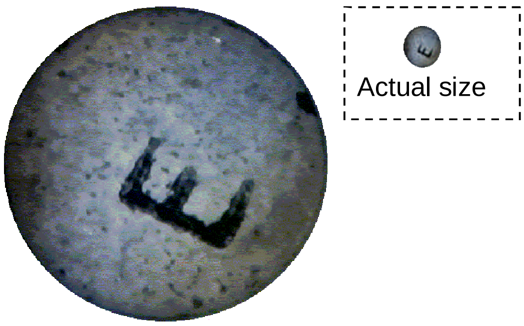


Figure 12: Thermistor disc from Smiths sender

Contact with the thermistor is required over the full area of the disc. This is achieved by applying a thin layer of metal (silvering) to each surface. *Fig. 13* shows a "faulty" thermistor disc where part of the silvering has been damaged, either through mechanical abrasion due to a weak contact spring or electrolytic action arising from moisture ingress. The end result was an unusable high resistance as the area of contact has been reduced to only that portion of the disc in contact with the contact tube.

Figure 13: Damaged thermistor disc,

The sketch in *fig. 14* at right shows the sender construction by another manufacturer. Rather than relying on a mechanical contact between the separate components of the sender, here the connections are soldered or welded. This provides a more reliable connection and eliminates the type of failure shown in *fig.13*. The sender may be filled with oil to facilitate conduction of heat between the outer case, usually a single piece of brass, and the internal thermistor. Other manufacturers use a similar construction to the Smiths sender in *fig. 11*.

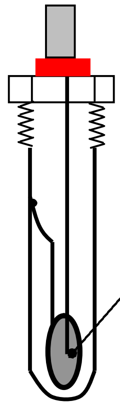


Figure 14: Internal construction of a modern temperature sender.

TEMPERATURE SENDERS DISCUSSION:

As can be seen in the *Table E* listing variants in the thermal range of sender, patterns in the numbering system used by Smiths during the 1960s and 1970s can be seen. Before about 1964, other part numbering formats were in use. A TT4800/00, sender was formerly known as a "TT3501/00". All Smiths temperature senders are prefixed "TT" (for "Temperature Transmitter").

Note that the TTnn00/00 and TTnn00/00 senders are used only with "TC" prefixed gauges.

The prefix is followed by a four digit number which appears to have the following significance for the older senders:

Figure 15: The difference between a TT380x and TT480x is in the body – TT380x (bevel or cone seal) on left , TT480x (face seal) on right.

Reading left to right, the first digit is either a 1, 3, 4, 5 or 6 for the senders to hand.

"1" indicates the sender is retained by a separate nut. These numbers were used only for the thermal type senders for the "TE" prefixed gauges, and the numbering is slightly different as shown in Table D earlier.

"3" indicates a male thread and a bevelled sealing surface (see *fig. 15*).

"4" indicates a male thread and a face seal (*Fig. 15*) and requires a sealing washer.

"5" Is the TT1nnn/nn style thermal sender range but with an insulated return.

"6" as TT680n indicates an insulated return sender, i.e. two terminals. For a (newer) TT681n device an NPTF tapered thread and earth return is indicated.

The next digit indicates the type of electrical connection.

"2" is either a screw or a threaded stud and nut.

"4" indicates a "Snap-on" or "bullet" style terminal.

"8" indicates a ¼" blade terminal.

The last two of the four digits together mostly indicate the resistance characteristic of the sender.

Following this is a "/" followed by a further two numbers and possibly a letter. Generally for Smiths, the two digits after the slash indicate a minor change. (Similar patterns can be discerned in the numbering of the gauges themselves.) Letters indicate a change in construction of the device, not always visible to the end user. In the case of these senders, an "A" on the end of the part number almost certainly means the body (see *fig. 15* above) is made of steel as opposed to brass in the earlier units and that the insulator around the terminal will be colour-coded rather than black only for the non-A senders.

The colours of the insulator, for Smiths senders, identify the temperature range of the sender and are shown in Table F. Note the production colour change for the TT4800/00A! (As a general rule, insulators on senders with an "A" suffix will be colour-coded. Those without the A suffix will be black but note that black is also the colour code for TTnn03/00A senders.)

***TABLE F* – TT4800 SERIES SENDERS**

Sender	Temp. Range deg. C	Collar Colour
TT4800/00 (brass body)	30 - 110	black
TT4800/00A (steel body)	30 - 110	green
TT3801/00A	30 - 110	green
TT4801/00A	30 - 120	brown
TT4802/00A	45 - 120	red/maroon
TT4803/00A	50 - 140	black
TT4804/00A	45 - 120	red/maroon
TT4805/00A (Brass body)	45 - 120	red
TT4806/00A	50 – 140	black

The colour denotes the temperature range over which the sender operates but does not indicate the actual resistance range of the sender. Resistance range is tailored for a specific gauge type. Bimetal gauges require a sender that is specified for use with bimetal gauges, which appears to have the same response as an Air-Cored gauge with the sender connected to the "A" winding. Other senders, working with the "B" or "C" windings of the Air-Cored gauge, have quite different resistance ranges. (*Air-Cored gauges have three separate wound coils and can be produced with the sender connected across any one coil.*)

As with any scheme, there are exceptions. In this case it is the TT3801/00(A) which is unique and is not equivalent to the TT4801, the TT3n04/00 is the electrical equivalent of the TT4n01/00 sender. The TT 3805/00 is unique and is a special - the oil temperature transmitter fitted to late 1969 onwards to Volvo P1800 cars and has a temperature range of 80 – 180 deg. C (from Smiths data). The TT4805/00 is a water temperature sender fitted to some Rover saloons. The TT4804/00A may also be considered an odd man out as, unlike the other senders in TT48nn series, it has a metric thread but is electrically equivalent to the TT4n02.

The entries for Rolls Royce and Bentley cars specify the TT3201/00. The TT3201/00 is given as an "SC" type transmitter on the details page, TT3201 implying a "Bimetal" type sender as for TT4201 in the scheme described above. The associated Rolls Royce/Bentley temperature gauge is a TC6215/00, so this is definitely an "SC" type transmitter. This is an exception to the general rule set out earlier. The TT3201/00 is an SC type sender but the TT3801/00 is a Bimetal type! This sender does have the expected bevel seal.

Vendors of Smiths (equivalent) temperature senders are inconsistent in the matter of compatibility. Some list a device as being equivalent to both a TT4nnn and TT3nnn unit. They may be electrically equivalent but sealing may be a problem. It may be possible to get a TT38nn sender, used in place of a TT48nn, to seal reliably using a special washer made for the job.

Other vendors state that one device replaces several Smiths senders, such as TT4801/TT4802/TT4803. In this case, electrical compatibility may align with one or none of the senders but not all.

One specialist supplier for a certain marque advertises a temperature sender that fits the whole range of a model. Since this model range includes both "TC" and bimetal gauges, a minimum of two senders should be offered. It's a little disappointing that a "specialist" vendor should get this wrong.

Cross references between sender manufacturers may not be much use if you require a sender with a different thread. Many cross-references will be for senders that are electrically equivalent and also physically compatible. Electrically equivalent senders with different threads and/or terminals may not be listed as equivalents.

Caerbont Automotive Instruments/Smiths Instruments list a TT4802/00A which appears to be the same as the older item. Ditto for the TT4803/00A. But note that a TT4803/00A has the same characteristics as the earlier sender but a TT4803/01 has the "Euro" characteristic which is used in some of their "ACT" gauges.

MATCHING TEMPERATURE SENDERS WITH GAUGES:

All temperature gauges are calibrated to set sender resistances for each gauge type (TE/TC/BT). The calibration points are marked on the gauge but do not necessarily correspond to the dial marking.

Matching a sender to a gauge is probably less critical for a gauge marked "C-N-H" as opposed to one with markings in degrees Centigrade or Fahrenheit. Fitting the wrong sender may give an increase or decrease in the "Normal" pointer position.

A document by Michael Hartman and Tom Hayden, an inventory of Sunbeam Alpine gauges (http://mhartman.net/files/sunbeam/Sunbeam Alpine Gauge Inventory.pdf), is of interest here. The dial markings are in degrees rather than the more common C-N-H format. The TT4802 sender is seen to have a range of 50 – 120 deg. C. *Table G* below summarises data from the Sunbeam Alpine document (sender data added).

***Table G*: Sunbeam Alpine data (from Hartman/Hayden document)**

Alpine Series I to V	Gauge	Scale	* Radiator cap – lb/in2	Voltage	* Sender part # Smiths	Rootes
Series I 1959–60	TC4304/00	90-170-190-230 deg. F		12	TT4800/00	P.46371
Series II 1960–63	TC4304/00	90-170-190-230 deg. F		12	TT4800/00	P.46371
Series III 1963–64	BT2201/02	120-170-200-250 deg. F	* 9	10	TT4802/00A	1205552
Series IV 1964–65	BT2201/02	120-170-200-250 deg. F	* 9	10	TT4802/00A	1205552
Series V 1965–68	BT2202/03	50-85-120 deg. C	* 9	10	TT4802/00A	1205552
* Source: Rootes/Chrysler Publication No. 6600992 Reprinted January 1968						

Refer to "*Modifying the response of a temperature sender*" on the next page where the effect of adding resistance to a temperature gauge circuit is briefly discussed.

MODIFYING THE RESPONSE OF A TEMPERATURE SENDER:

If you find a transmitter that has a characteristic that is very close to what is required, it may be possible to tweak it to match a gauge.

If a gauge is reading high, it is reasonable to add a small series resistance to bring the sender into calibration. The effects of adding series and parallel resistors can be seen in the chart in fig. 16. below.

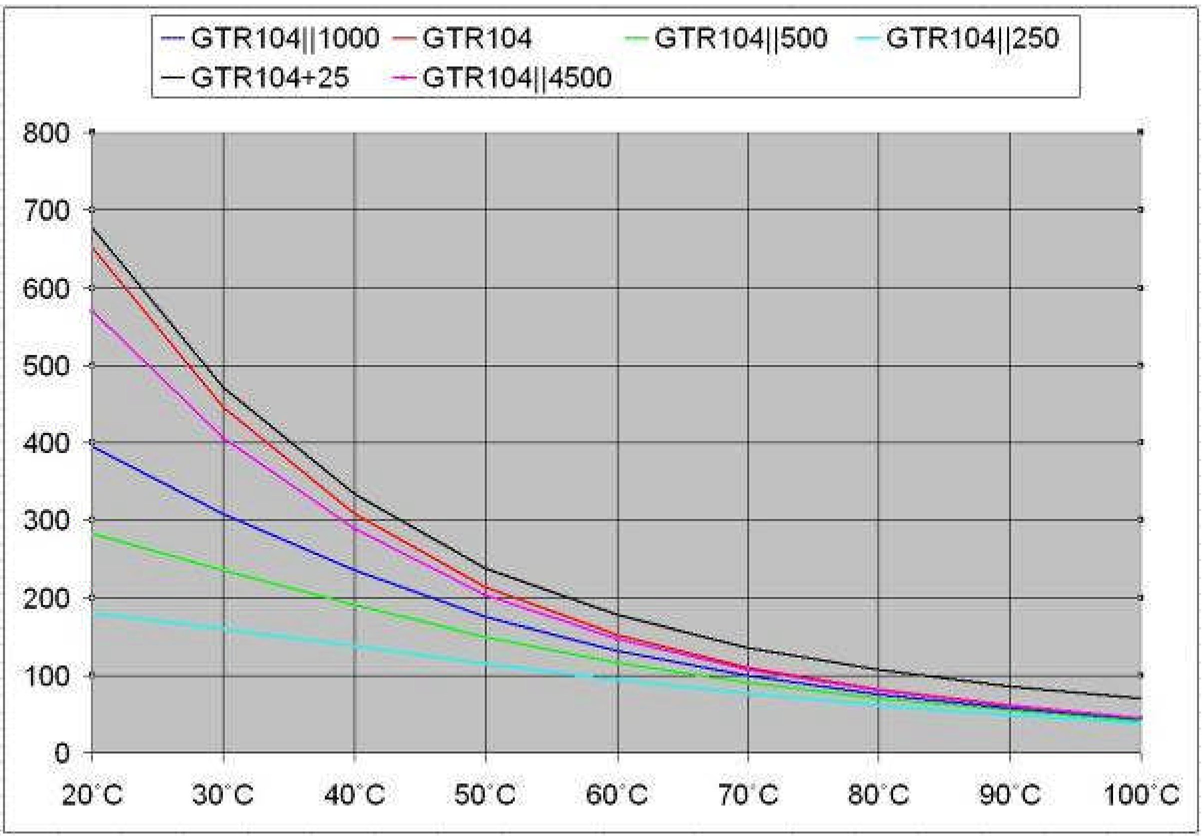


Figure 16: Effect of series and parallel resistors on temperature sender characteristic.
Note: "||" means "in parallel with

The red trace in fig. 16 is for the sender alone. The black trace shows how adding a series resistance simply moves the line upwards on the graph across the full sender resistance range which will slightly reduce the reading on the gauge. The more resistance added, the greater the effect but this will also limit the maximum reading shown by the gauge.

What happens with an added parallel resistor is demonstrated by the light-blue, light-green, blue and magenta traces. The effect of the parallel resistance is to modify the response of the sender, flattening the sender's characteristic at the lower temperatures. Note that very little effect occurs at higher temperatures!

Successfully modifying a temperature gauge and sender will only be achieved if the target sender's resistance is close to that of the original. The better option is to get a sender with the correct response to the gauge. Possibly easier said than done!

OIL PRESSURE SENDERS:

The early electrical oil pressure senders manufactured by Smiths were essentially a pressure-variable instrument voltage regulator. An abridged version of the instrument voltage regulator operation, from A Gentleman's guide to Smiths gauges part 1, is set out below.

THE BIMETAL INSTRUMENT VOLTAGE REGULATOR:

Fig. 17 shows the Smiths instrument voltage regulator looking from above. As shown, the bimetal element is not a simple bar but is a square "U" shape. The bimetal element itself is made as a single piece of metal. It is anchored to the base plate (not shown) at the end of one of the arms and this is the "I" terminal of the device. One end of the heating coil is connected to this terminal through the bimetal element itself. The contact to make or break the supply to the gauges is on the end of the opposite arm which also carries the heating coil. The black line at the base of the U at the left of the diagram represents a bent up section of metal to resist bending as can be seen in *fig. 18* which shows a side view of the works of this voltage regulator.

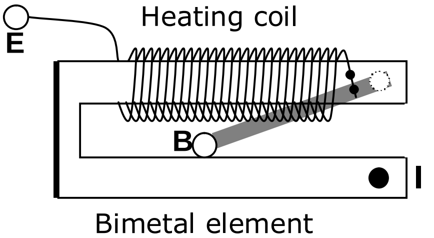


Figure 17: Instrument voltage regulator plan view

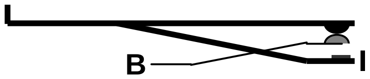


Figure 18: Instrument voltage regulator elevation

This same construction is found in all bimetal gauges and in oil pressure senders but not in bimetal temperature senders such as the TT 1200/00, which responds to changes in "ambient" temperature. "Ambient" temperature, in this case of a temperature sender, is the temperature of the water in the car's cooling system.

BIMETAL OIL PRESSURE SENDERS ("PT"):

Note: If your oil pressure gauge has an "ACP" prefix it uses a resistive pressure sender and **not** a bimetal type.

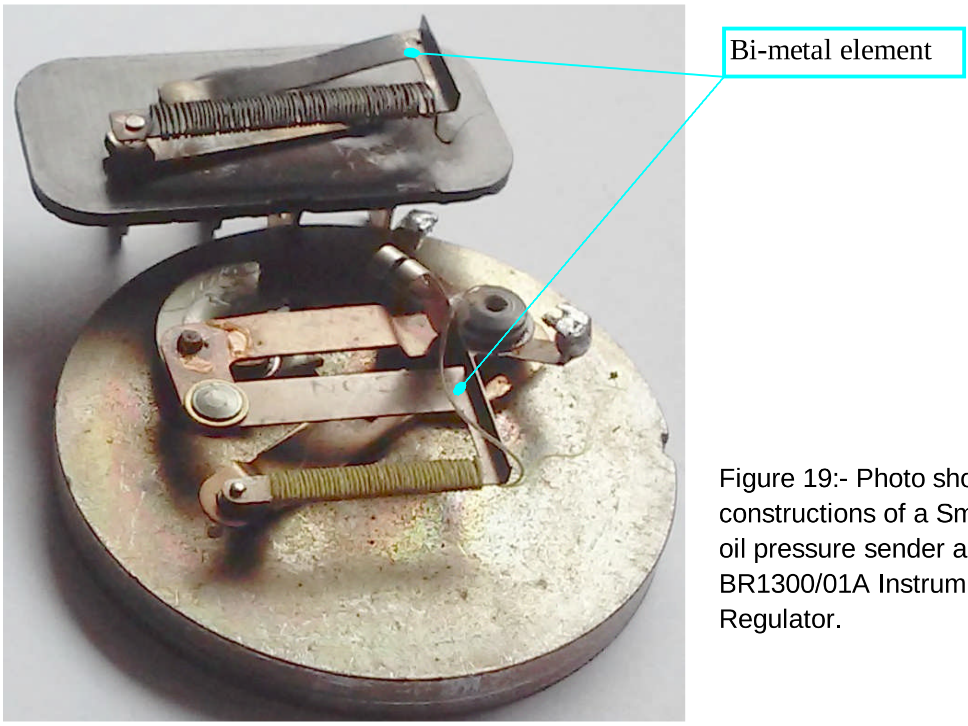


Figure 19:- Photo showing the similar constructions of a Smiths PTR 1307/10 oil pressure sender and a Smiths BR1300/01A Instrument Voltage Regulator.

As noted above, the bimetal oil pressure sender uses a similar construction to an instrument voltage regulator. It has the same shaped bimetal element as the IVR which provides temperature compensation for the device.

Fig. 20 below shows the circuit diagram and a diagrammatic representation of this sender. The resistor R_{CALIB} varies with the different ranges (span) of these senders. Given that all the gauges are calibrated to the same values, then any difference in scale needs to be accommodated in the sender. This is the way it is done here. The particular 24V unit dismantled here had a 470Ω calibration resistor. Other resistor values seen in Smiths 12V units are 130Ω and 270Ω. I am ***assuming*** that the 270Ω resistor would be for a 0 – 60 psi gauge and the 130Ω resistor from a 0 – 100 psi instrument. The bimetal element is tensioned by the action of pressure against the diaphragm and the coil has to heat the bimetal bar to a higher temperature to initially remove the pressure-induced tension and then to open the circuit. Due to this higher operating temperature the average gauge current increases at higher pressures.

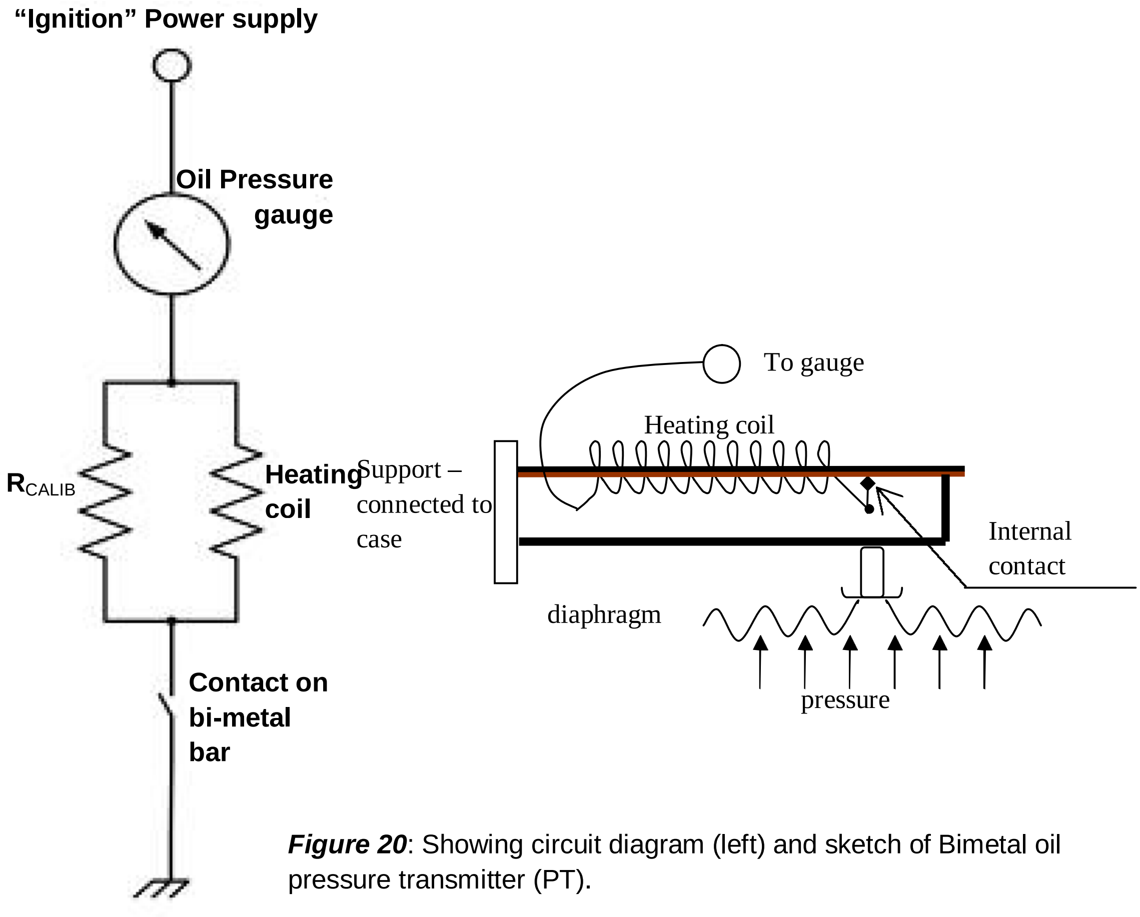


Figure 20: Showing circuit diagram (left) and sketch of Bimetal oil pressure transmitter (PT).

Fig. 21 is a photograph of the "works" of a "PT" type sender. A diaphragm that responds to changes in pressure sits below this assembly and is connected by a short rod that passes through the base plate and bears against the arm sitting below the heating coil on the bimetal element in this photograph.

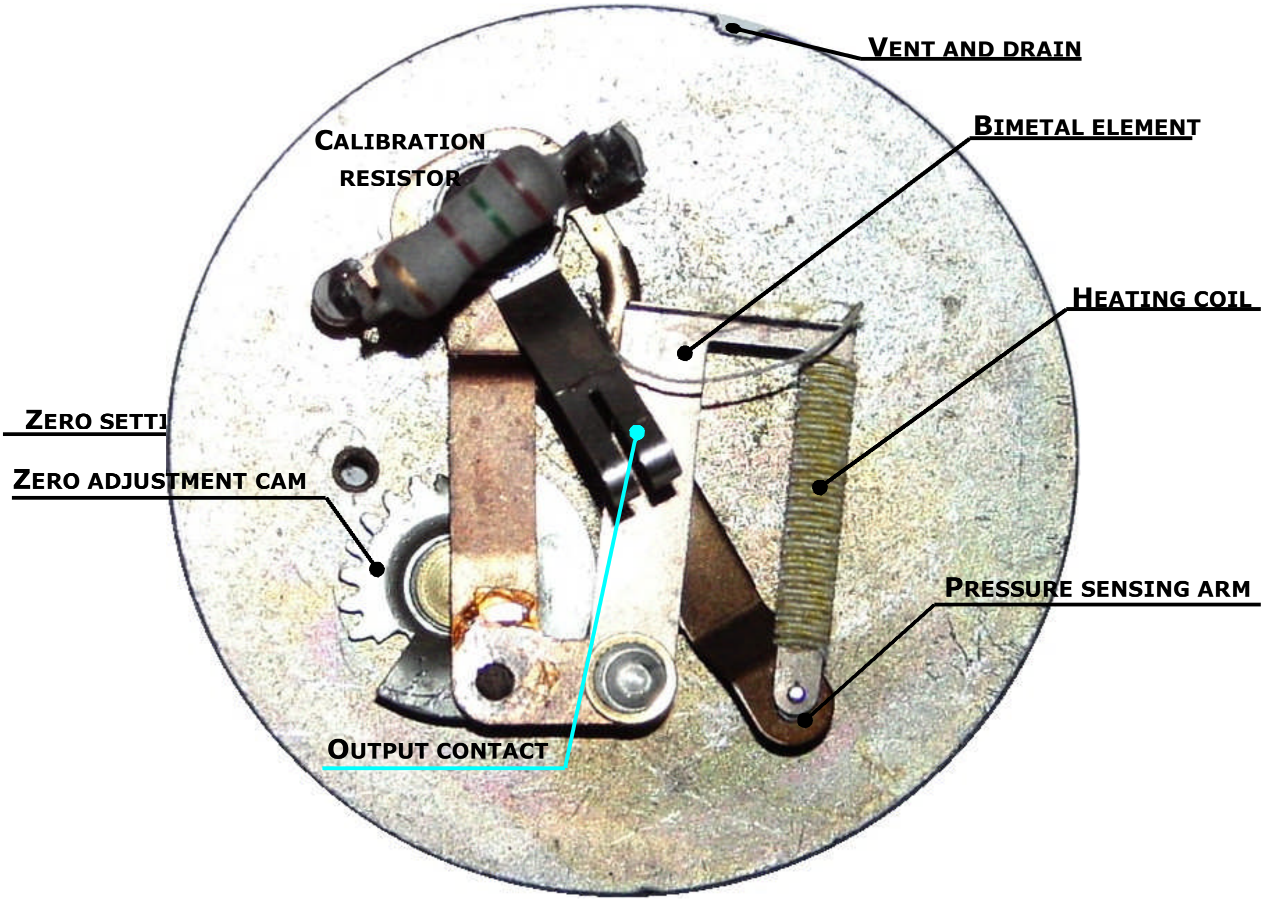


Figure. 21: Bimetal pressure sender internal construction.

The hole to the left of and above the zero-adjust cam receives a spigot on the special adjusting tool. The cam itself comprises a circular ramp that lifts the mounting point of the bimetal element. (This is the copper-coloured bar running vertically above the cam itself.)

The calibration resistor can be seen to the upper left of the photo. (Note that this 150Ω resistor is not from the original unit but was one of several different values fitted during testing with this sender.)

Both the zero and span values of the sender are set at the time of manufacture and are not available as user adjustments.

Photos in *figs 22 and 23* below show a dismantled bimetal pressure transmitter. This particular unit is a 24V PT 1307/10 sender but is typical of all units of this type. It comprises a hard brass diaphragm fitted between two metal plates with a compressed O-ring to provide an oil seal against the lower (RH here) plate in *fig. 22*. On the upper part of this capsule assembly (LH here) a pin attached to the bimetal sending unit protrudes through the centre hole and bears against the centre of the diaphragm. This pin transmits the movement of the diaphragm to the bimetal sensor assembly. The formed diaphragm itself acts like a spring to oppose the applied pressure.

***Figure. 22*:** Lower portion of bimetal pressure transmitter .

Fig. 23 below shows the upper portion of the pressure sender. The base is on the right. The cover at left is spun over the base and connection to the sender is by way of a spring that bears against the brass disc you can see in the centre of the cover pressing on the right.

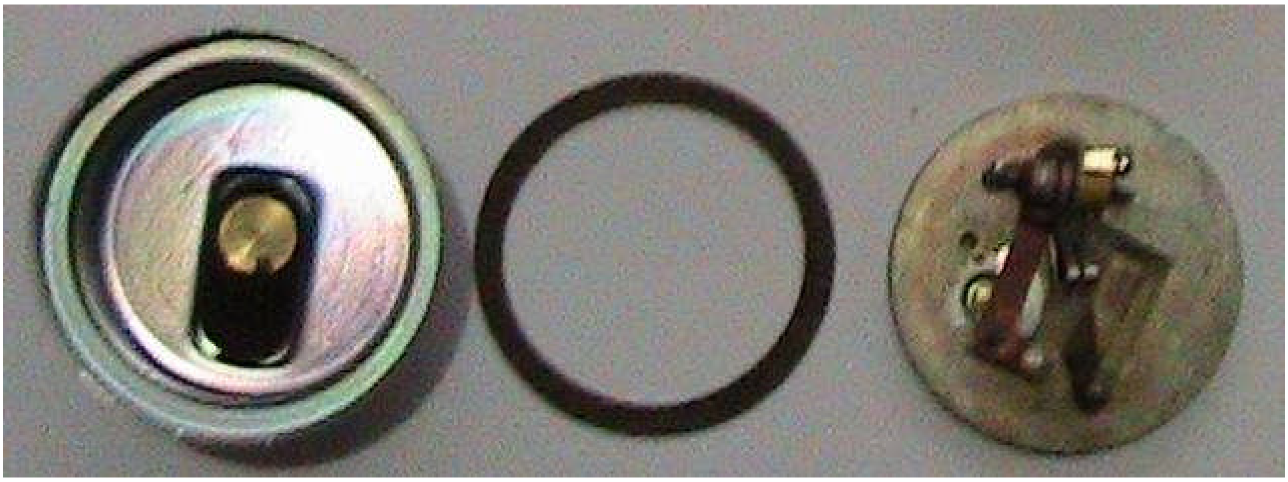


***Figure. 23*:** Sender mechanism of bimetal pressure sender .

This resistor is in parallel with the heater winding and is thus switched in and out of circuit. For this reason, "matching" of one of these senders in a manner as described in the section on temperature senders may not be practical. Any external parallel resistor would add a current that varied only with battery voltage, in addition to the switched output of the sender. A series resistor could work but will reduce the maximum reading of the gauge which may not be an issue as it is the lower part of the gauge scale that is critical in these gauges.

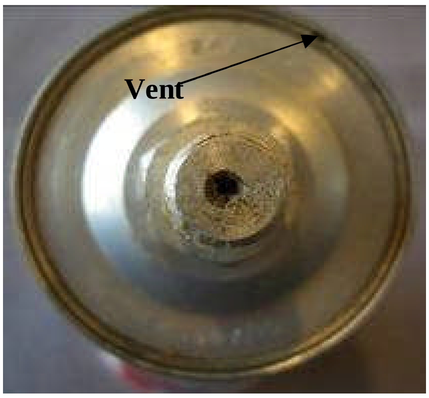


***Figure. 24*:** Bottom view of Smiths pressure sender

At right, *fig. 24* shows an underside view of the sender prior to dismantling. There is a small chase cut in the side of the plate that forms the upper part of the pressure capsule and also the baseplate for the sender's electrical bits. This vents the top portion of the sender to atmosphere and the cover rim is centre-punched to mark this point. It is important that this point sits at the lowest point of the sender so that any water that may condense inside the sender can drain. These senders are heated by the engine and cool when the engine cools down after use and movement of the sensing diaphragm will expel or draw air (and moisture) into the sender. If this vent is at a high point, water may collect inside the sender over time. Note that the contact between the sender internal works and the contact on top of the case is simply two bits of metal held together by spring tension. Thus any corrosion that may occur on these contact surfaces inside the sender can affect the accuracy of the sender.

VARIABLE RESISTANCE-TYPE OIL PRESSURE SENDER ("PTR"):

Variable resistance senders are used with "ACP" air-cored pressure gauges. The basic operation of a resistance type sender is shown in *fig. 25*. It is very simple with a crank operated by the diaphragm moving a wiper arm which contacts a resistive element connected to the gauge. The action is simply to place a greater or lesser resistance in series with the gauge which is displayed as oil pressure on the gauge.

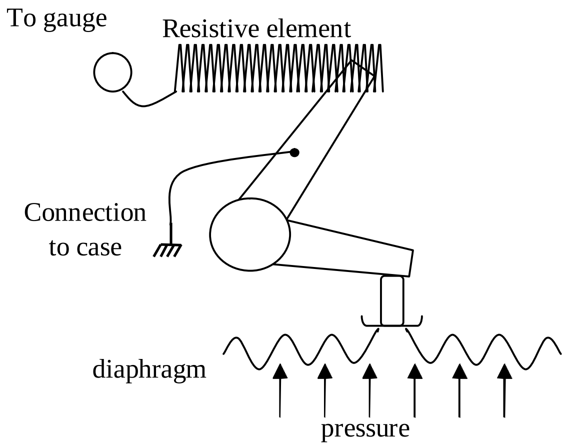


***Figure 25*:** Variable resistance type oil pressure transmitter.

This type of sender looks very much like the bimetal type and may be distinguished only by the part number or by measuring resistance between the sender terminal and case. A resistive sender should measure about 240 Ohms at zero pressure where a bimetal sender should read 40 - 65 Ohms provided the internal contacts are closed.

OIL PRESSURE SENDER DISCUSSION:

There are a few things to keep in mind if using these senders. You cannot directly replace a bimetal type sender with a variable resistance type. The bimetal sender may be considered to perform the functions of pressure sender and instrument voltage regulator. It may be possible to replace a bimetal sender with a variable resistance type for the "BP" gauges but the gauge would then need to be supplied from the instrument voltage regulator.

You cannot use a bimetal type sender with an "ACP", or air cored, type gauge. It simply does not work. Testing indicates that the higher resistance of the "ACP" gauge reduces current to below that required to operate the bimetal sender. The gauge will sit at a fixed high value sensing the combined resistance of the heating coil and any calibration resistor across it (see circuit diagram in *fig.19*).

TROUBLESHOOTING ELECTRICAL OIL PRESSURE SENDERS:

Bimetal type senders in particular seem to give a lot of trouble. Perhaps this is not surprising as they run at a higher temperature and are subject to vibration from the engine. The weak point is the electrical contacts within the sender. Test the gauge by substituting resistors (240 and 20 Ohms for BP/ACP gauges) at the engine and if the gauge operates correctly then the sender is the problem. Re-check at the gauge if necessary to prove the wiring.

Senders may have tapered BSP or NPT(F) threads. These should not require any form of sealant tape or compound to seal. Some senders seal with a soft (fibre/aluminium/copper) washer against a land on the block casting. Thread seal tape or compound should be avoided. Senders use the threaded pressure connection as an earth return for the sender and sealing compounds can interfere with this electrical connection.

When replacing a resistance type sender, make sure you get one with the correct resistance range. Smiths use 240 Ohms (zero) to 20 Ohms (full-scale). Common ranges are 10-180 Ohms ("Euro") and 240-33 Ohms (USA) as for fuel tank level sensors. This last will work with Smiths gauges but will read low at higher pressures. Furthermore, senders are calibrated for a particular pressure range. This needs to match the gauge. A sender calibrated for a 0-100 psi range is going to indicate a little over ½ the actual pressure on a 60 psi gauge. On the other hand, a sender calibrated for 0-60 psi is going to give a high reading on a 0-100 psi gauge.

As noted above, the resistance between terminal and case of a bimetal type sender should be 65 Ohms or less. Ideally you would check this resistance with some pressure applied. A cam (*fig. 21* above) sets the zero position of the bimetal element and it is possible that with no pressure applied that the internal contacts could be open in which case no resistance can be measured. If testing these senders on the bench apply a little pressure (1 - 2 psi) to the sender to check. A bimetal sender that tests open-circuit with no pressure applied may in fact be serviceable.

Appendix A – Smiths Temperature Transmitter data:

The following data has been reproduced from a document supplied by Peter Wilkinson of Caerbont Automotive Instruments and titled "SMITHS TEMPERATURE TRANSMITTERS" (Ref. No. SE 5824/972). This document appears to have been prepared in mid to late 1972.

Any entry that gives a production start date of 1970 or later needs to be considered carefully. Changes to transmitters (senders) after mid-1972 are not recorded here.

Also note that the listing here is only for those vehicles using Smiths electrical temperature gauges. Earlier vehicles would have used Bourdon tube gauges and some vehicles were fitted with other brands in some years.

There was one known "error" in this listing and that is the first entry, "A.C., Greyhound (Bristol engine). A transmitter type "TT3500/00A" was listed but this unit is unknown and does not appear in the details list at the end of this Appendix. (This details list is part of the original transmitters document.) In an earlier numbering scheme used by Smiths the TT4800/00 was designated "TT3501/00". It may be that a TT3500/00 was an earlier part number for the TT3800/00. TT3800/00A is assumed to be the correct value based on production dates and tables have been updated to reflect this. Should any further information identifying the correct part number come to hand then this entry will be updated at that time.

Bentley and Rolls Royce cars have TT3201/00 senders listed. These are most likely to be, and are electrically equivalent to the TT4200/00 (screw connection).

Obvious typographical errors found within this listing have been corrected.

While not definitive, the following timing for the introduction and cessation of the various types of Smiths temperature gauges can be derived from the applications listed here and other sources that are believed to be reliable:

Sender type	**First application date**	**Last application date**
Thermal (TE)	1953	1965
Semiconductor (TC)	1957	1971
Bimetal (BT)	1959	Current
Air cored (ACT)	1974	Current

Temperature senders currently available from CAI are suitable for bimetal and air cored gauges only.

MAKE AND MODEL	YEAR	CODE
A.C		
Greyhound (Bristol engine)	1960 on	TT3800/00
Frau 428	May 1970 on	TT6811/01
A.E.C.		
Regal IV & V	Feb. 1961 on	TT5300/00
Mercury Mk I	Feb. 1961 on	TT5300/00
New Mercury 12 ton	Feb. 1961 on	TT5300/00
Reliance Chassis type 2 MU3 RA	1962 on	TT5300/00
Mandator Mk II & V	Feb. 1961 on	TT5300/00
New Mandator	Jul. 1963 on	TT5300/00
Monarch Mk VI	Feb. 1961 on	TT5300/00
Mammoth Major Mk VI	Feb. 1961 on	TT5300/00
Bonneted Mammoth 4 & 6	Feb. 1961 on	TT5300/00
Bridgemaster	Feb. 1961 on	TT5300/00
Durban	Feb. 1961 on	TT5300/00
Marshall	Feb. 1961 on	TT5300/00
Merlin-Merryweather	Feb. 1961 on	TT5300/00
Mustang Mk II	Feb. 1961 on	TT5300/00
ALBION		
Chieftan, Claymore, Reiver, Victor and Clydesdale	Sept. 58 – Sept. 60	TT1300/01
ARMSTRONG SIDDELEY		
Star Sapphire	1958 - 1960	TT3800/00A
ASTON MARTIN		
D.B.S	1967 on	TT4802/00A
AUSTIN (CARS)		
Super Seven De Luxe	Oct. 61 – Jul. 64	TT3800/00A
Super Seven De Luxe	Aug. 64 – Sept. 67	TT3802/00A
Mini, Mk II 850cc & 1000cc Super De Luxe	Oct. 67 on	TT3802/00A
Cooper and Cooper "S"	Oct. 61 – Sept. 64	TT3800/00A
Cooper & Cooper "S" 1000cc & Cooper "S" 1275cc	Oct. 64 – Sept. 67	TT3802/00A
Cooper Mk II & Cooper "S" Mk II 1275cc	Oct. 67 on	TT3802/00A
1100, 1100 Mk II & 1300 Series	1963 – Sept. 71	TT3802/00A
1100 Mk III & 1300 MK III Series	Oct. 71 on	TT3803/00A
Maxi 1500 & 1750	1969 on	TT3803/00A
1800 & 1800 Mk II	1964 on	TT3802/00A
Marina 1.8 & 1.8 GT (U.S.A & Canada)	1972 on	TT3803/00A
2200	1972 on	TT3803/00A
A 40 Mk II	1961 on	TT3802/00A
A 55 Cambridge & Countryman	1958 - 1961	TT3800/00A
A 55 Van & Pick-Up	1962 - 1963	TT1800/00
½ ton Van & Pick-Up	Jul. 1963 on	TT3800/00A
A 60 Cambridge & Countryman	Oct. 1961 on	TT3800/00A
A 99	1959 - 1961	TT3800/00A
A 110	1961 – May 1964	TT3800/00A
A 110	Jun. 1964 on	TT3802/00A
3 Litre	Oct. 1967 on	TT3802/00A
Princess	1959 – Jul. 1963	TT3800/00A

MAKE AND MODEL	YEAR	CODE
AUSTIN CARS) (Continued)		
Princess	Aug. 1964 on	TT3802/00A
Civilian Champ	1953 on	TT1200/01
Gipsy	Sept. 1963 0n	TT3800/00A
FX 4 Taxi	1958 – Sept. 71	TT3800/00A
FX 4 Taxi	Oct. 1971 on	TT3803/00A
AUSTIN (COMMERCIAL)		
10/12 Cwt. Van	Sept. 1960 on	TT3800/00A
152 15 Cwt. Van	Jun. 1956 on	TT1200/01
152 16/18 Van	1961 on	TT3800/00A
LD 4 A 15/25 Cwt.	May 60 – Feb. 61	TT1200/00
LD 4 A 15/25 Cwt.	Mar. 1961 on	TT3200/00A
LD 54 A 25/30 Cwt.	May 60 – Feb. 61	TT1200/00
LD 54 A 25/30 Cwt.	Mar. 1961 on	TT3200/00A
5 & 7 Ton "FH" Cab Series I F/C U/Floor engine	1963 - 1964	TT3800/00A
Series III N/C 3, 5, 6,7 ton & Prime Mover	Oct. 1960 on	TT3800/00A
Series IV FG Cab 30 Cwt.	Nov. 1959 on	TT3800/00A
Series IV FG Cab 2, 3, 4 & 5 ton	1959 on	TT3800/00A
Series IV 2, 3, 4 & 5 ton Low Loader	1963 - 1968	TT3800/00A
FG Cab 2 & 3 ton with type 8 Borg Warner Auto transmission	Mar. 1967 on	TT3800/00A
FG Cab 1½, 2, 3, 4 & 5 ton	Aug.-69	TT3802/00A
Series IV 5 ton 504 & 7 ton 702 FF Cab	1958 - 1960	TT3200/00A
Series IV 5, 7 ton & Prime Mover	1960 on	TT3800/00A
FM Cab 2, 3 & 4 ton	Sept. 66 – Jun. 68	TT3804/00A
FM Cab 2, 3 & 4 ton	Jul. 1968 on	TT3800/00A
350, 420 & 440 Van	Sept. 1968 on	TT3804/00A
F.F.K. 240 12 ton	Apr. 1961 on	TT3800/00A
W.F. Normal Control (Earth Return Wiring)	Oct. 64 – Jul. 68	TT3802/00A
W.F. Normal Control (Earth Return Wiring)	Aug. 1961 on	TT3804/00A
W.F. Normal Control (Insulated Return Wiring)	Oct. 1964 on	TT6800/00
F.J. Cab Forward Control (Earth return wiring)	Oct. 1964 on	TT3804/00A
F.J. Cab Forward Control (Insulated return wiring)	Oct. 1964 on	TT6800/00A
B.M.C (Commercial)		
702 7 ton Forward Control "FF" Cab	Jun. 1968 on	TT3200/00A
CV 147 LR & CV 151 LR	Oct. 1968 on	TT3802/00A
CV 147 LR & CV 151 LR Series (Insulated return)	Oct. 1968 on	TT6802/00
CV 148 LR Series (Earth return)	May 1969 on	TT3802/00A
CV 148 LR Series (Insulated return)(2 units fitted)	May 1969 on	TT6802/00
BENTLEY		
S2, & S3 Series **(UD3012)**	1959 – Sept. 65	TT3201/00
"T" Series	Oct. 65 – Sept. 70	TT3800/00A
BOND		
Equipe	May 1963 on	TT4801/00A
BRISTOL		
411	Oct. 69 – Jun. 70	TT4803/00A
411	Jul. 1970 on	TT3803/00A

MAKE AND MODEL	YEAR	CODE
BRITISH LEYLAND CARS		
Mini Series	Oct. 1969 on	TT3803/00A
BRITISH LEYLAND (COMMERCIAL)		
180 & 200 J4 Van & Pick-Up	Nov. 1970 on	TT3802/00A
CITROEN (BRITISH BUILT)		
DS 19	Apr. 62 - 67	TT3800/00A
COMMER		
COB Series I & II	1958 - 1962	TT3800/00A
COB Series III	1963 on	TT4800/00A
8 A Express Delivery Van	1960 - 1961	TT1200/00
Imp Van	Nov. 1965 on	TT4802/00A
"K" Range Trucks 1½, 2 & 3 ton	Oct. 61 – Sept. 66	TT4800/00A
"K" Range Trucks 1½, 2 & 3 ton	Oct. 1966 on	TT4802/00A
1500 Series (Walk-thru) Van	Nov. 1959 on	TT4800/00A
2500 Series (Walk-thru) Van	Aug. 1965 on	TT4800/00A
1501 Tractor Unit	Apr. 1967 on	TT4802/00A
C53 Range	Feb. 63 - Sept. 66	TT4800/00A
C53 Range	Oct. 1966 on	TT4802/00A
C59 A Range	Mar. 59 - 65	TT4800/00A
Maxiload 14 – 16 ton Range (12 Volt)	Sept. 63 - Sept. 66	TT4800/00A
Maxiload 14 – 16 ton Range (12 Volt)	Oct. 1966 on	TT4802/00A
Maxiload 14 – 16 ton Range (24 Volt)	Mar. 1965 on	TT4802/00A
PB Van	May 1971 on	TT4802/00A
DAIMLER (CARS)		
SP250	1959 - 1964	TT3800/00A
XDM 2 2½ Litre V8	1962 on	TT4801/00A
XDM 3 4½ Litre	1968 on	TT4201/00A
V8 250 Saloon	1968 on	TT4801/00A
4½ Litre Majestic Major DQ450	1962 on	TT3800/00A
4½ Litre Hearse, Ambulance & Limousine DR 450	1962 on	TT3800/00A
Sovereign 2.8 Litre & 4.2 Litre	1966 – Nov. 70	TT4801/00A
Sovereign 2.8 Litre & 4.2 Litre	Dec. 1970 on	TT4802/00A
DAIMLER (COMMERCIAL)		
Fleetline Buses	Jan. 1963 on	TT5300/00
Roadliner Buses	Jan. 63 - Oct. 70	TT5300/00
Roadliner Buses	Nov. 1970 on	TT6800/00
DODGE (CARS)		
Avenger 1250cc & 1500cc	1970 on	TT4802/00A
DODGE (COMMERCIAL)		
Fargo FK 160	Jul. 1969 on	TT4800/00A
Fargo FK 500 & FK 700	Jul. 1969 on	TT4802/00A
Fargo FKB 300	Jul. 1969 on	TT4802/00A
Courier 1622cc & 1800cc	Feb. 1963 on	TT3200/00A

MAKE AND MODEL	YEAR	CODE
FORD (CARS)		
New Anglia 105E & 307E Van	Sept. 59 - May 61	TT3802/00A
New Anglia 105E & 307E Van	Jun. 61 - Jun. 65	TT3803/00A
New Anglia De Luxe 105E & 307E Van	Feb. 61 – Jan. 62	TT3802/00A
New Anglia De Luxe 105E & 307E Van	Feb. 62 – Jun. 65	TT3803/00A
105E Estate Car	Oct. 61 – Dec. 61	TT3802/00A
105E Estate Car	Jan. 62 – Jun. 65	TT3803/00A
Cortina 113E GT	Apr. 63 – Jun. 65	TT4803/00A
Corsair	1962 – Jun. 65	TT4800/00A
Corsair GT	1963 – Jun. 65	TT4803/00A
Zephyr Mk III & Zodiac Mk III	1962 - 1966	TT3803/00A
FORD (COMMERCIAL)		
New Anglia 105E & 307E Van	Sept. 59 – May 61	TT3802/00A
New Anglia 105E & 307E Van	Jun. 61 - Jun. 65	TT3803/00A
Thames Trader 1½, 2, 3, 4, 5 & 7 ton	Apr. 1962 on	TT3803/00A
"D" Series (Special Order Vehicle)	Jul. 1965 on	TT6801/00A
Normal Control Truck	Mar. 1962 on	TT3803/00A
G.S.M.		
Delta Sports Car	1961 - 1962	TT1200/01
HILLMAN		
Husky Series II	1960 - 1963	TT3200/00A
Husky Series III	1963 on	TT4800/00A
Minx IIIA, IIIB & IIIC	1959 - 1963	TT4800/00A
Minx V & VI	1963 – Dec. 66	TT4802/00A
Minx Saloon, Estate & GT	Jan. 1967 on	TT4802/00A
Super Minx Mk I, II, II & IV	1961 on	TT4802/00A
Hunter Mk I, II & GT	1966 on	TT4802/00A
Imp Series	1963 on	TT4802/00A
Avenger 1250cc & 1500cc	1970 on	TT4802/00A
HILLMAN (COMMERCIAL)		
Imp Van	1963 on	TT4802/00A
HUMBER		
Hawk II	1960 - 1962	TT4800/00A
Hawk III & IV	1962 - 1967	TT4800/00A
Super Snipe I & II	1958 - 1960	TT3200/00A
Super Snipe III	1960 - 1962	TT3800/00A
Super Snipe IV & V	1962 on	TT4802/00A
Sceptre I, II & Arrow	1963 on	TT4802/00A
INNOCENTI		
I.4.	Sept. 1964 on	TT3802/00A
INTERNATIONAL HARVESTER		
B 450	Nov. 1962 on	TT3200/00A
B 614 & B 634	1967 on	TT3800/00A
Industrial Tractor Series B	Mar. 1969 on	TT4807/00

MAKE AND MODEL	YEAR	CODE
JAGUAR		
2.4 Mk II & 3.4 Mk II	Oct. 1959 on	TT4801/00A
240 & 340	Oct. 1967 on	TT4800/00A
3.4 "S" Type	Sept. 1963 on	TT4801/00A
3.8 Mk II	Oct. 1959 on	TT4801/00A
3.8 "S" Type	Sept. 1963 on	TT4801/00A
MK X 3.8	1961 on	TT4201/00A
MK X 4.2	1964 on	TT4201/00A
420 4.2	1966 on	TT4801/00A
420 G 4.2	1966 on	TT4201/00A
"E" Type Sports Car Series	Mar. 61- Mar. 71	TT4201/00A
XJ6 2.8 & 4.2	Oct. 68 - Nov. 70	TT4801/00a
XJ6 2.8 & 4.2	Dec. 1970 on	TT4802/00A
XJ25 "E" Type 12 Cylinder	Apr. 1971 on	TT4802/00A
JENSEN		
541 CT	1962 - 1965	TT6810/00
CV8 Mk III	1965 - 1966	TT6810/00
Interceptor II & FF II	Oct. 1969 on	TT3803/00A
Interceptor III, FF III & SP Saloon	Jan. 1972 on	TT3803/00A
Healey J.H. 1	Mar. 1972 on	TT6811/01
LEYLAND (COMMERCIAL)		
2 ton Van & Pick-Up	Feb. 1963 on	TT4801/00A
Nuffield 344 & 384 Tractor	Nov. 1969 on	TT4801/00A
LOTUS		
Elan 2+2	Oct. 67 - Mar. 68	TT3803/00A
Elan 2+2 Series II	Apr. 1968 on	TT6811/01
Elan +2 "S"	Nov.68 - Jun. 69	TT3803/00A
Elan +2 "S"	Jul. 1969 on	TT6811/01
Europa (PS) & Phase II (PS)	Jan. 67 - Oct.71	TT4804/00A
Europa Phase III Twin Cam	Nov. 1971 on	TT6811/01
Seven Series 4	Oct. 1970 on	TT4804/00
MARKOS		
2 Litre Ford engine	Oct. 1969 on	TT6811/00
2 Litre Volvo engine	Oct. 1969 on	TT3802/00A
Mantis (M70)	Sept. 1970 on	TT6801/01
M.G.		
1100, 1100 Mk II & 1300	1962 on	TT3802/00A
M.G.B & M.G.B. G.T. (U.S.A. & Sweden only)	Oct. 1967 on	TT3802/00A
M.G.B. & M.G.B. G.T Mk II (U.S.A., Germany & Sweden only)	Jun. 1971 on	TT3802/00A
M.G.C. & M.G.C. G.T. (U.S.A. only)	Oct. 1967 on	TT3802/00A
Magnette Mk III & Mk IV	1959 on	TT3800/00A

MAKE AND MODEL	YEAR	CODE
MASERATI		
(Suitable for both Oil Temp. & Water Temp. Indicator)		
Model 101/10 (6 Cylinder)	Sept. 1965 on	TT3804/00A
107 & 112 (8 Cylinder)	Oct. 1963 on	TT3804/00A
108 (6 Cylinder)	Oct. 1963 on	TT3804/00A
109 (6 Cylinder)	Sept. 1965 on	TT3804/00A
115 (8 Cylinder)	Sept. 1967 on	TT3804/00A
MONTERVERDI		
High Speed (Switzerland)	Mar. 68 - Feb. 70	TT3804/00A
High Speed (Switzerland)	Mar. 1970 on	TT4802/00A
MORGAN		
Plus Four 2 Seater	Jan. 1958 on	TT1200/01
Plus Four 4 Seater	Mar. 1956 on	TT1200/01
Plus Four Super Sports	Apr. 1962 on	TT1200/01
Plus Four Plus	Apr. 1962 on	TT1200/00
Plus 8	Sept. 1968 on	TT4801/00A
4/4 1600 Ford Engine	Sept. 1969 on	TT6811/01
MORRIS (CARS)		
Mini Super Deluxe	1961 - Jul. 1964	TT3800/00A
Mini Super Deluxe	Aug..64 - Sept. 67	TT3802/00A
Mini Mk II 850cc & 1000cc Super Deluxe	Oct.1967 on	TT3802/00A
Cooper & Cooper "S"	1961 – Sept. 64	TT3800/00A
Cooper, Cooper Mk II, Cooper "S" & Cooper "S" Mk II	Oct.1964 on	TT3802/00A
1100, 1100 Mk II, 1300, 1300 G.T.	1962 on	TT3802/00A
1300 Mk III Traveller	Oct. 1971 on	TT3803/00A
Marina 1300 & 1800	Apr. 1971 on	TT3803/00A
1800, 1800 Mk II, 1800 "S" & 1800 "S" Mk II	Mar. 1966 on	TT3802/00A
2200 (6 Cylinder)	Mar. 1972 on	TT3803/00A
Oxford V & VI	1959 on	TT3800/00A
10 Cwt. Van	1962 - 1963	TT1800/00
½ ton Van & Pick-Up	Jul. 1963 on	TT3800/00A
MORRIS (COMMERCIAL)		
J 2 15 Cwt.	Jun. 56 - Oct. 59	TT1200/01
J 2 16/18 Cwt.	Nov. 1961 on	TT3800/00A
J 4 10/12 Cwt.	Sept. 1960 on	TT3800/00A
J 4 180 & 200	Sept. 1968 on	TT3802/00A
"EA" Cab (CV 102)	Sept. 1968 on	TT3804/00A
JU 250	Jul. 1967 on	TT3802/00A
LD 4M & LD 5M	May 60 - Feb. 61	TT1200/00
LD 4M & LD 5M	Mar. 1961 on	TT3200/00A
5 & 7 ton FH Cab Series I	1963 on	TT3800/00A
Series III Normal Control 3, 5, 6, 7 ton & Prime Mover	Oct. 1960 on	TT3800/00A
Series IV FG Cab 1½ , 2, 3, 4 & 5 ton	1959 – Jul. 69	TT3800/00A
F.G. Cab 1½ ,2 ,3, 4 & 5 ton (12V earth return)	Aug. 1969 on	TT3800/00A
F.G. Cab 1½ ,2 ,3, 4 & 5 ton (12V insulated return)	Aug. 1969 on	TT6802/00

MAKE AND MODEL	YEAR	CODE
MORRIS (COMMERCIAL) (Continued)		
F.G. Cab 3 & 4 ton (24V)	Aug. 1969 on	TT3802/00A
Series IV 2, 3, 4 & 5 ton Low Loader	Sept. 1963 on	TT3800/00A
Series IV 5 & 7 ton F.F. Cab	1958 - 1959	TT3200/00A
Series IV 5 & 7 ton F.F. Cab	1960 on	TT3800/00A
F.J. Underfloor engine (Earth return)	Oct. 1964 on	TT3804/00A
F.J. Underfloor engine (Insulated return)	Oct. 1964 on	TT6800/00
F.M. Cab 2, 3 & 4 ton	Sept. 66 – Jun. 68	TT3804/00A
F.M. Cab 2, 3 & 4 ton	Jul. 1968 on	TT3802/00A
NUFFIELD		
3/45 Mk II & 4/65 Mk II Tractor	Jul. 1967 on	TT3804/00A
344 & 384 Tractor	Nov. 1969 on	TT3802/00A
PLYMOUTH		
Cricket 1250cc & 1500cc	Jun. 1971 on	TT4802/00A
RELIANT		
Regal 3 Wheeler	1960 - 1962	TT4800/00A
FW 5 & FW 5A (Turkey)	Oct.1966 on	TT6811/00
Sabre 6	1963 - 1964	TT3804/00A
Carmel (FW 3)	1962 - 1964	TT3802/00A
Rebel 700 (FW 4)	Apr. 1968 on	TT4802/00A
Regent Van	1960 - 1964	TT3800/00A
Sussita Estate Car	1962 - 1964	TT3800/00A
Regent IV Estate Car	1964 - 1966	TT3802/00A
Scimitar G.T.	1964 - 1966	TT3804/00A
RILEY		
Elf	1961 – Sept. 64	TT3800/00A
Elf Mk II & Mk III	Oct. 1964 on	TT3802/00A
Kestrel 1100 Mk I, 1100 Mk II & 1300	Sept. 1965 on	TT3802/00A
One Point Five	1957 - 1965	TT3200/00A
Two Point Six	1957 - 1959	TT3200/00A
ROLLS ROYCE		
Silver Cloud Series S.2 & S.3 **(UD3012)**	Sept. 1959 on	TT3201/00A
Silver Shadow	Oct. 65 – Sept. 70	TT3800/00A
Corniche	May 1971 on	TT3800/00A
Phantom V & VI (**UD3012)**	Aug.. 1959 on	TT3201/00A
ROVER		
"95" & "110" (P4)	1962 - 1965	TT3802/00A
2.6 Litre & 3.0 Litre (P5)	Oct. 1962 on	TT3802/00A
3½ Litre V8 (P5B)	Sept. 1967	TT4806/00
2000 (P6)	Oct. 63 – Nov. 65	TT4801/00A
2000 & 2000 T.C. (P6)	Oct. 63 – Nov. 65	TT4801/00A
2000 & 2000 T.C. (P6)	Nov. 1967 on	TT4805/00
3500 & 3500 "S" Mk II (P6B)	Apr. 1968 on	TT4806/00
Landrover Series II B & Series III	Mar. 1967 on	TT3804/00A
Range Rover Phase I	Mar. 1967 on	TT4806/00A

MAKE AND MODEL	YEAR	CODE
SCAMMELL		
Scarab 4	Jul. 1963 on	TT4800/00A
SINGER		
Chamois Series	1964 on	TT4802/00A
Gazelle IIIA & IIIB	1959 - 1961	TT1200/01
Gazelle Mk IIIC Saloon	1961 - 1963	TT1800/00
Gazelle IIIC Estate & Coupe	1961 - 1963	TT1200/01
Gazelle V & VI	1963 - 1966	TT4802/00A
Gazelle	Jan. 1967 on	TT4802/00A
Vogue Series	1961 on	TT4802/00A
STANDARD		
Ensign 4 cylinder	1960 - 1961	TT3800/00A
Ensign 6 cylinder	1960 - 1961	TT4800/00A
New Ensign	1962 - 1963	TT3800/00A
Vignale, Vanguard 4 cylinder	1960 - 1963	TT3800/00A
Vignale, Vanguard 6 cylinder	1960 - 1963	TT4800/00A
SUNBEAM		
Imp Sports	1966 on	TT4802/00A
Stiletto Coupe	1967 on	TT4802/00A
Rapier III & IIIA	1959 -1963	TT4800/00A
Rapier IV & V	1963 - 1967	TT4802/00A
Rapier Arrow	1967 on	TT4802/00A
Rapier H. 120 (Holbay Conversion) (Water Temp.)	1968 on	TT4802/00A
Rapier H. 120 (Holbay Conversion) (Oil Temp.)	1968 on	TT4803/00A
Alpine Series I & II	1959 - 1963	TT4800/00A
Alpine Series III, IV, V & G.T.	1963 on	TT4802/00A
Superleggaria	1963 on	TT4802/00A
Tiger 250	1964 - 1967	TT4802/00A
Tiger II	1967 on	TT6812/00
TRIUMPH		
Pony (Israel & Iran)	1967 on	TT4802/00A
TR4	1961 – May 62	TT3802/00A
TR4 & TR4A	Jun. 62 – Mar. 65	TT3804/00A
TR4	Apr. 65 – Sept. 67	TT3802/00A
TR5	Oct. 67 – Dec.67	TT4802/00A
TR5 & TR6	Jan. 1968 on	TT4803/00A
Spitfire 4 (Mk I)	Oct. 62 – Jan. 64	TT4801/00A
Spitfire Mk I, Mk II & MK III	Feb. 64 – Dec. 67	TT4802/00A
Spitfire Mk III & Mk IV	Jan. 68 on	TT4803/00A
Spitfire 1500	1973 on	TT4803/00A
G.T.6	Oct. 66 – Dec. 67	TT4802/00A
G.T.6 Mk II & III	Jan. 1968 on	TT4803/00A
Herald Series	1959 – May 66	TT4800/00A
Herald Series	Jun. 66 – Dec. 67	TT4802/00A
Herald Series	Jan. 1968 on	TT4803/00A
1300 & 1300 T.C.	Oct.65 – Dec. 67	TT4802/00A
1300 & 1300 T.C.	Jan. 68 – Feb. 68	TT4803/00A
1300 & 1300 T.C.	Mar. 1968 on	TT4802/00A
Toledo 1300 & 1500	Aug. 1970 on	TT4803/00A

MAKE AND MODEL	YEAR	CODE
TRIUMPH (Continued)		
1500 (F.W.D.)	Sept. 1970 on	TT4803/00A
1500 (Israel & South Africa only	Jul. 1969 on	TT4802/00A
Dolomite 1850cc	Jan. 1972 on	TT4802/00A
Vitesse Sports-Six & Mk II	1962 – Sept. 66	TT4800/00A
Vitesse 2 Litre & Mk II 2 Litre	Jan. 1968 on	TT4803/00A
2000	Oct. 63 – Dec. 67	TT4802/00A
2000 & 2000 Mk II	Jan. 1968 on	TT4803/00A
2.5 P.I. & Mk II	Jan. 1968 on	TT4803/00A
Stag 3 Litre	Jan. 1970 on	TT4803/00A
T.V.R.		
2500	Dec. 1971 on	TT4803/00A
UNIPOWER		
G.T.	Apr. 1969 on	TT3802/00A
VOLVO		
P1800 Sports Car (Water Temp)	Aug. 69 on	TT3802/00A
P1800 Sports Car (Oil Temp)	Apr. 1969 on	TT3805/00
P1800E Sports Car (Water Temp)	Oct. 1969 on	TT3802/00A
P1800E Sports Car (Oil Temp.)	Oct. 1969 on	TT3805/00
P1800ES Sports Car (Water Temp.)	Oct. 1971 on	TT3802/00A
P1800ES Sports Car (Oil Temp.)	Oct. 1971 on	TT3805/00
VANDEN PLAS		
Princess 3 Litre & Mk II	1959 on	TT3800/00A
Princess 4 Litre "R"	1964 on	TT3802/00A
1100 & 1300 Series	1963 on	TT3802/00A
WOLSELEY		
Hornet	1961 – Sept.64	TT3800/00A
Hornet Mk II & Mk III	Oct. 1964 on	TT3802/00A
1100 & 1300 Series	Sept. 1965 on	TT3802/00A
1500	1957 - 1965	TT3200/00A
15/50	1956 - 1958	TT1200/01
15/60	1958 - 1961	TT3800/00A
16/60	1961 on	TT3800/00A
18/85 & Mk II & Mk III "S"	1967 on	TT3802/00A
6/99	1959 - 1961	TT3800/00A
6/110	1961 – May 64	TT3800/00A
6/110 Mk II	Jun. 1964 on	TT3802/00A
Six (6 Cylinder)	Mar. 1972 on	TT3803/00A

SMITHS TEMPERATURE SENDER NOMINAL OPERATING RANGES	
SENDER NUMBER	OPERATING TEMPERATURE RANGE (°C)
TTnn00/00	30 - 110
TT3801/00	30 - 110
TT3n04/00 & TT4n01/00	30 - 120
TTnn02/00	45 - 130
TTnn03/00	50 - 140
TT3805/00	80 – 180 (80 – 160?)

Smiths Temperature Transmitter Details:

CODE	TYPE	ELECTRICAL CONNECTION	THREAD FORM AND SEATING TYPE	TRANSMITTER RESISTANCE AT 100°C (OHMS)	VOLTAGE
TT.1200/00	TH	Snap-on	5/8" 18 TPI UNF Taper Seat	n/a	12
TT.1200/01	TH	Screw	5/8" 18 TPI UNF Taper Seat	n/a	12
TT.1200/02	TH	Screw	5/8" 18 TPI UNF Taper Seat	n/a	12
TT.1300/00	TH	Snap-on	5/8" 18 TPI UNF Taper Seat	n/a	24
TT.1300/01	TH	Screw	5/8" 18 TPI UNF Taper Seat	n/a	24
TT.1800/00	TH	Blade	5/8" 18 TPI UNF Taper Seat	n/a	12
TT.3200/00A	SC	Screw	5/8" 18 TPI UNF Taper Seat	11.4 - 15.3 OHMS	12
TT.3201/00A	SC	Screw	5/8" 18 TPI UNF Taper Seat	11.4 - 15.3 OHMS	12
TT.3400/00A	SC	Snap-on	5/8" 18 TPI UNF Taper Seat	11.4 - 15.3 OHMS	12
TT.3800/00A	SC	Blade	5/8" 18 TPI UNF Taper Seat	11.4 - 15.3 OHMS	12
TT.3801/00A	BR	Blade	5/8" 18 TPI UNF Taper Seat	22.4 - 32.5 OHMS	10
TT.3802/00A	BR	Blade	5/8" 18 TPI UNF Taper Seat	37.4 - 47.6 OHMS	10
TT.3803/00A	BR	Blade	5/8" 18 TPI UNF Taper Seat	43.2 -57.6 OHMS	10
TT.3804/00A	BR	Blade	5/8" 18 TPI UNF Taper Seat	27.9 - 35.7 OHMS	10
TT.3805/00	BR	Blade	5/8" 18 TPI UNF Taper Seat	112.9 - 161.4 OHMS	10
TT.4200/00A	SC	Screw	5/8" 18 TPI UNF Flat Seat	11.4 - 15.3 OHMS	12
TT.4201/00A	BR	Screw	5/8" 18 TPI UNF Flat Seat Plated	27.9 - 35.7 OHMS	10
TT.4800/00A	SC	Blade	5/8" 18 TPI UNF Flat Seat	11.4 - 15.3 OHMS	12
TT.4801/00A	BR	Blade	5/8" 18 TPI UNF Flat Seat	27.9 - 35.7 OHMS	10
TT.4802/00A	BR	Blade	5/8" 18 TPI UNF Flat Seat	37.4 - 47.6 OHMS	10
TT.4802/01A	BR	Blade	5/8" 18 TPI UNF Flat Seat Plated	37.4 - 47.6 OHMS	10
TT.4803/00A	BR	Blade	5/8" 18 TPI UNF Flat Seat	43.2 -57.6 OHMS	10
TT.4804/00A	BR	Blade	18 x 1.5mm Flat Seat	37.4 - 47.6 OHMS	10
TT.4805/00	BR	Blade	5/8" 18 TPI UNF Flat Seat Brass	37.4 - 47.6 OHMS	10
TT.4806/00	BR	Blade	5/8" 18 TPI UNF Flat Seat Brass	43.2 -57.6 OHMS	10
TT.4807/00	SC	Blade	14 x 1.5mm Flat Seat	11.4 - 15.3 OHMS	12
TT.5200/00	TH	Double Screw (Insulated Return)	3/4" UNF Taper Seat	n/a	12
TT.5300/00	TH	Double Screw (Insulated Return)	3/4" UNF Taper Seat	n/a	24
TT.6800/00	BR	Double Blade (Insulated Return)	5/8" 18 TPI UNF Taper Seat	27.9 - 35.7 OHMS	10
TT.6801/00	BR	Double Blade (Insulated Return)	5/8" 18 TPI UNF Taper Seat	43.2 -57.6 OHMS	10
TT.6802/00	BR	Double Blade (Insulated Return)	5/8" 18 TPI UNF Taper Seat	37.4 - 47.6 OHMS	10
TT.6810/00	BR	Blade	1/4" 18 TPI NPTF Dry Seal	37.4 - 47.6 OHMS	10
TT.6811/00	BR	Blade	1/8" 27 TPI NPTF Dry Seal	37.4 - 47.6 OHMS	10
TT.6811/01	BR	Blade	1/8" 27 TPI NPTF Dry Seal	43.2 -57.6 OHMS	10
TT.6812/00	BR	Blade	3/8" 18 TPI NPTF Dry Seal	37.4 - 47.6 OHMS	10

BR = Bimetal Resistance for use with "BT" prefix gauges (also "ACT" prefix gauges to Smiths Instruments spec.).
SC = semiconductor for use with iron-core ("TC" prefix) gauges.
TH = Thermal for use with "TE" prefix gauges.

APPENDIX B - TEMPERATURE SENDERS CROSS REFERENCE:

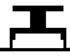
Cross reference information for (older) "Classic" Smiths senders in the following table is taken from manufacturers' cross-reference data. ***It is thought to be accurate though equivalents may not be electrically exact.***

Note that in the case of Intermotor (possibly also FAE) senders, an additional "0" digit was added to earlier part numbers. Thus a 52700 part may also be listed as a "5270" etc.

SMITHS PART #	OTHER MANUFACTURER	OTHER PART #	THREAD	SEAL	TERMINAL
TT3800	FACET++	7.3020	5/8 UNF	Bevel	Blade
	Intermotor	52700	5/8 UNF	Bevel	Blade
	Unipart	GTR102 (NLA)	5/8 UNF	Bevel	Blade
TT3801	CI (Quinton Hazell)	XTT49	5/8 UNF	Bevel	Blade
	FAE	31110	5/8 UNF	Bevel	Blade
	Fuel Parts	CTS6078	5/8 UNF	Bevel	Blade
	Kerr Nelson	STT009	5/8 UNF	Bevel	Blade
TT3802	CI (Quinton Hazell)	XTT11	5/8 UNF	Bevel	Blade
	Delco Remy	7954935, SU 6	5/8 UNF	Bevel	Blade
	FACET	7.3021	5/8 UNF	Bevel	Blade
	FAE	31190	5/8 UNF	Bevel	Blade
	Intermotor	52710	5/8 UNF	Bevel	Blade
	Kerr Nelson	STT005	5/8 UNF	Bevel	Blade
	Lucas	SNB102	5/8 UNF	Bevel	Blade
	Unipart	GTR104	5/8 UNF	Bevel	Blade

(NLA) = No longer available. ("Old stock" units may be found occasionally.)

++ A sender packaged as a FACET 7.3020 was obtained but the sender itself is marked "5720" which is the equivalent Intermotor part number. It has been tested against a used TT4800/00A and the correlation is excellent!

SMITHS PART #	OTHER MANUFACTURER	OTHER PART #	THREAD	SEAL	TERMINAL
TT3803	CI (Quinton Hazell)	XTT15	5/8 UNF	Bevel	Blade
	Delco Remy	7954972, SU 7	5/8 UNF	Bevel	Blade
	FACET	7.3046	5/8 UNF	Bevel	Blade
	FAE	31490	5/8 UNF	Bevel	Blade
	Fuel Parts	CTS6077	5/8 UNF	Bevel	Blade
	Intermotor	52760	5/8 UNF	Bevel	Blade
	Kerr Nelson	STT004	5/8 UNF	Bevel	Blade
	Lucas	SNB103	5/8 UNF	Bevel	Blade
	Unipart	GTR108	5/8 UNF	Bevel	Blade
TT3804	Electrically equivalent to TT4201/TT4801.				
TT3806	Intermotor	52900	5/8 UNF	Bevel	Blade
	Unipart	GTR103	5/8 UNF	Bevel	
TT4200 **TT4800**	No face-sealing equivalent has been found. (See TT3800 for electrical equivalent.)■				
TT4201/ **TT4801**	CI (Quinton Hazell)	XTT14	1/8 NPTF	Face	Stud
	FACET	7.3010	1/8 NPT	Face	Stud
	FAE	32080	1/8 NPTF	Thread	3/16″ Stud
	Fuel Parts	CTS6076	1/8 NPTF	Thread	Stud
	Intermotor	52770	1/8 NPTF	Thread	Stud
	Kerr Nelson	STT008	1/8 NPTF	Thread	Stud
	Lucas	SNB108	1/8 NPTF	Thread	Blade
	Unipart	GTR114	1/8 NPTF	Thread	Stud

Note: the only difference between TT4201 and TT4801 senders is the terminal connection – screw vs blade.

(NLA) = No longer available. (“Old stock” units may be found occasionally.)

■At time of revision, James Paddock Ltd in England were selling TT4800/00A senders. These were listed under the Triumph part no. 121997 and do not appear in search resilts when TT4800 is searched for.

SMITHS PART #	**OTHER MANUFACTURER**	**OTHER PART #**	**THREAD**	**SEAL**	**TERMINAL**
TT4802	CI (Quinton Hazell)	XTT12	5/8 UNF	Face	Blade
	Delco Remy	7966267, SU 15	5/8 UNF	Face	Blade
	FAE	31200	5/8 UNF	Face	Blade
	Intermotor	52720	1/8 NPTF	Thread	Stud
	Kerr Nelson	STT034	5/8 UNF	Face	Blade
	Lucas	SNB105	5/8 UNF	Face	Blade
	Unipart	GTR106	5/8 UNF	Face	Blade
TT4803	CI (Quinton Hazell)	XTT13	5/8 UNF	Face	Blade
	FACET	7.3047	5/8 UNF	Face	Blade
	FAE	31210	5/8 UNF	Face	Blade
	Fuel Parts	CTS6075	5/8 UNF	Face	Blade
	Intermotor	52730	5/8 UNF	Face	Blade
	Kerr Nelson	STT010	5/8 UNF	Face	Blade
	Lucas	SNB106	5/8 UNF	Face	Blade

Re NPT and NPTF threads. NPT threads require a sealing compound to be leak proof. NPTF threads rely on a metal-to-metal seal, achieved by distortion of the threads themselves when fitting.

(NLA) = No longer available. ("Old stock" units may be found occasionally.)

ELECTRICAL EQUIVALENCE DATA (TENTATIVE):		
"Classic" sender part number	*Ohms @ 100 ℃*	*Replacement Smiths senders*
TT3n00/00A = TT4n00/00A	11.4 - 15.3	
TT3801/00A is unique	22.4 - 32.5	
TT3n02/00A = TT4n02/00A	37.4 - 47.6	TT3001-8N
TT3n03/00A = TT4n03/00A	43.2 -57.6	TT6811-01
TT3n04/00A = TT4n01/00A	27.9 - 35.7	
TT3805/00A	112.9 - 161.4	(Oil temp 0 – 180 deg. C)
TT3n06/00A = TT3n03/00A?	43.2 -57.6	TT6811-01
TT4n06/00 = TT4n03/00A (supercedes TT4n06?)	43.2 -57.6	TT6811-01
TT4804/00A = TT4802/00A but M18 x 1.5 metric thread	37.4 - 47.6	TT3001-8N
Sender equivalence in RH column is from (tentative) data supplied by Smiths and are all "Bimetal" type but thread sizes differ in most cases.		

APPENDIX C:- SUPERSESSION LIST, SENDERS (TRANSMITTERS)

FUEL TANK UNITS:

OLD PART #	CAR	YEAR	MODEL	NEW PART #
48421	Ford			FT 1100/00
51014				FT 5300/51
51591	Bentley			FT 6311/00
53164				FT 5300/54
53613				FT 5100/05
55747	Jaguar			FT 5346/36
55824				FT 5300/49
55847				FT 5300/57
55866	Triumph			FT 5300/55
64163	Austin Marine			FT 6310/00
64198	MG		Magnette ZA- ZB	FT5786/04
64468	Singer			FT 5366/05
64475	Austin		A-95	FT 5300/31
64475				FT 5300/42
64511				FT 5346/19
64878	Hillman		Husky	FT 5300/10
65630	Sunbeam		Talbot	FT 5366/02
65657	Austin		A-40 Somerset-Sports; A-90	FT 5300/59
65694	MG		Magnette ZA	FT 5300/44
65694	Morris	55-56	Minor Series II	FT 5300/44
65704				FT6300/00
65706	Morris		Oxford	FT 5300/45
65716	Singer			FT 5366/06
70198	Hillman	54~56	Minx MK VIII	FT 5300/46
70251	Rover			FT 5300/48
70309	Riley			FT 5346/31
70310	Riley			FT 5300/81
70317	Rover			FT 5340/05
70382	MG		Magnette ZA	FT 5300/44
70382	MG	All	TD	FT 5786/00
70413	Jaguar	49~54	XK120	FT 5386/02
75706				FT 5300/45
76031	Ford			FT 5366/03
76157	Austin		Marine	FT 5320/08
76238	Austin		A-30	FT 5346/11
76788	Jaguar	51~ Left Tank	MK VII; MK VIII; MK IX	FT 5300/28
76790	Jaguar	51~ Right Tank	MK VII; MK VIII; MK IX	FT 5300/29
76844	Rover	52~58; 59~	75-90-105R; 80; P5	FT 5300/24
76847	Humber		Snipe	FT 5346/12
76864	Triumph			FT 5366/08
76874				FT 5300/80
79984	Armstrong Siddeley			FT 5320/09
80033	Hillman		Husky	FT 5300/80
80052	MG		Magnette ZB	FT 5300/52
80828	Nash	All	Metropolitan	FT 5320/13

OLD PART #	CAR	YEAR	MODEL	NEW PART #
80858				FT 5346/15
80872	Austin		Marine	FT 5346/14
80875	Austin Healey		All	FT 5300/15
80934	Ford			FT 5320/11
80952	Austin Healey		Sprite Bugeye- MK II; A-35	FT 5300/32
80958	Austin		A-50	FT 5300/36
80997				FT 5300/35
86003	Bristol			FT 5389/00
86030	Jaguar	54~56	XK 150 All; XK140	FT 5340/03
86038				FT 5346/03
86049	Bristol			FT 5320/05
86077	Austin		A-95	FT 5300/17
86082	Austin Healey		All to BJ8	FT 5300/15
86088	Austin	To 1958	A-50; A-55; A55 MK II	FT 5300/16
86088	TVR	1960		FT 5300/16
86088	Jaguar			FT 5300/28
86108	Jaguar	55~59	2.4; 3.4	FT 5386/01
64529/1	Rolls Royce			FT 5340/01
70330/1	Jaguar	49~51	MK V	FT 5386/03
76784/1	Jaguar			FT 5300/80
80084/2	Hillman	56~59	Minx Deluxe; Special I-II	FT 3315/00
80085/1	Jaguar		XK150 All	FT 3331/02
80085/1	Triumph	58~62	TR3; XK150 All	FT 3331/02
80087/2	Sunbeam		Talbot	FT 3345/01
80087/2	Triumph	57~	TR10	FT 3345/01
80090/2/1	Ford			FT 2370/00
80092/1	Ford			FT 2300/01
80092/2/1	Bentley	59~	T S2 Series	FT 2370/00
80092/2/1	Rolls Royce			FT 2370/00
FT 6312/00	Rolls Royce			FT 6364/00
KP 7106/00	Austin	All	America	KP 7117/00
KP 7106/00	Austin	All	Mini	KP 7117/00
KP 7106/00	MG	All	1100	KP 7117/00
KP 7106/00	Morris	All	Mini	KP 7117/00
KP 7115/00	Austin	10-64~	Cooper	KP 7115/01
KP 7115/01	Austin	10-64~	Cooper S	KP 7115/02
TBS 1010/039	Austin	All	Vanden Plas Princess 1100	KP 7117/00
TBS 1010/039	Austin	All	America	KP 7117/00
TBS 1010/039	Austin	All	Mini	KP 7117/00
TBS 1010/039	MG	All	1100	KP 7117/00
TBS 1010/039	Morris	All	Mini	KP 7117/00
TBS 5114/002	Plymouth		Cricket	KP 7124/00
TBS 5114/013	Austin	All	Marina	KP 7124/00
TBS 5514/000				KP 7126/00
TFS 9002/000				KP 7122/00
Y 86112	MG	56~59	A	FT 5300/20
64188	Rover	52~58; 59~	75-90-105R; 100	FT 6360/00

TEMPERATURE SENDERS:

OLD PART #	CAR	YEAR	MODEL	NEW PART #
76207	Hillman	54~58	Minx MK VIII; Deluxe I-II	TT 1200/00
76207/1	MG; A-35; A-55		Metropolitan; Singer Gazelle	TT 1200/01
76207/1	Singer		Gazelle MK IIa- III	TT 1200/01
TT 3501/00	Hillman	58~60	Minx Deluxe All	TT 4800/00
TT 3501/00	Sunbeam	1960	Alpine III; Sunbeam Rapier	TT 4800/00
TT 3501/00	Triumph	59~61	Herald S-1000- 2 & 3-Seater	TT 4800/00
TT 3501/00	Triumph	63~	Herald Sports Six; Vitesse	TT 4800/00

APPENDIX D – TRIUMPH SERVICE BULLETINS T-64-38 AND T-65-48

TO: ALL TRIUMPH DEALERS - WESTERN ZONE

BULLETIN T-64-38

ATTN: SERVICE DEPARTMENT
SUBJECT: TRIUMPH SPITFIRE TEMPERATURE GAUGE TRANSMITTER

DATE: NOVEMBER 25, 1964

For complaints of low or nil temperature reading on the Triumph Spitfire, the transmitter should immediately be suspected, as faults in manufacture have been found.

Each transmitter is date coded in addition to the Smiths part number and codes 5/4, 6/4 and 7/4 (May, June and July 1964) are particularly suspect. Date codes before and after should be satisfactory.

There is also the possibility that another range of transmitter may have been fitted in error, which will also result in a false instrument reading.

In addition to part numbers, identification of the correct transmitter can also be made by the color of the plastic mold securing the Lukar clip which should be Maroon.

Part numbers for Spitfire and other models Smiths Temperature Transmitter are as follows:

Application data from Triumph service bulletin T-64-38 Nov. 1964						
Model	Triumph Part # **	Smiths Part #	Colour	Gauge type **	Scale **	Voltage
Spitfire to FC26303	137386	TT4801/00	Brown	Bimetal (BT)	C-N-H	10
Spitfire FC26303 on	137705	TT4802/00	Red	Bimetal (BT)	C-N-H	10
Herald Coupe	121997	TT4800/00	Green	Semiconductor (TC)	C-N-H	12
TR4 - domed glass	131062	TT3802/00	Red	Bimetal (BT2300/01)	30-85-120	10
TR4 – flat glass	134435	TT3804/00	Red	Bimetal (BT2203/03)	C-N-H or 30-70-100	10
Sports Six (1600)	121997	TT4800/00	Green	Semiconductor (TC)	C-N-H	**12**
Vitesse 2 L (early)**	137386	TT4801/00	Brown	Bimetal (BT)	C-N-H	10
Vitesse 2 L (late)**	137705	TT4802/00	Red	Bimetal (BT)	C-N-H	10
** Derived from other sources						

Note the entry (in red) in the "Volts" column. The original Service Bulletin had "10" for this value. This is incorrect. It may be that about this time the "Sports Six" cars (aka "Vitesse") were being fitted with bimetal, or "10 Volt" gauges. Early Sports Six cars have a 12V, TC4303/03 temperature gauge fitted.

LEYLAND TRIUMPH SALES COPPANYE,

WESTERN ZONE

TO: ALL TRIUMPH DEALERS - WESTERN ZONE

DEPT: SERVICE DEPARTMENT BULLETIN T-65-48

SUBJECT: HIGH READING TEMPERATURE - TR-4A

DATE:

This bulletin is issued to avoid unnecessary investigation on your behalf.

Reports of overheating have been received and the following information will assist in rectification.

In the event of abnormally high readings being obtained on the temperature gauge on Triumph TR-4A cars from CTC-53000, a correction can usually be made by substituting the existing temperature transmitter bulb with transmitter bulb bearing the Smiths part No. TT 3802/00, Triumph part No. 131062. This transmitter, which was used on the Triumph TR-4 models, is at present identified by a red plastic insulator.

Should you cane across any Triumph TR-4A cars fitted with the Smiths temperature gauge that is calibrated 30 -70-100 as distinct from the current specification which is merely face marked C-N-H, the Smiths bellows type of thermostat should be used or a 70 degree C waxed type of Weston Thompson thermostat in the event of a high reading complaint being involved.

Change log

Date	Version	Change list
September 2020	1.0	Initial release document
September 2020	1.1	Minor corrections to text. Added Triumph service bulletins.
October 2020	2.0	Major rewrite, Much of the more technical data transferred to part III.
March 2021	2.0	Minor re-wording of some sections, corrected errors in figure references, corrected several typos
July 2021	2.1	Addition of Smiths temperature sender application list as an appendix. Cross reference data has also been moved to the appendices. Some re-writing of sections within the document. Added Triumph Service Bulletin T-65-48
October 2022	2.1	Minor typographical errors corrected and some re-wording of portions.