Too Cool, a TR

Too cool in winter and too hot in summer seems to be part of the birthright of a TR in Australia or any place outside the "Mother Country".

All the "other" cars we own run at a constant temperature (about 82°C) regardless of the conditions outside or what it is we demand of them, except the TR! This has bothered me from the start of our restoration, so there was special care taken to rebuild the radiator with a new late TR4 core and fit a thermo-fan with temperature controller and the T336 non original thermostat from the register.

The temperature gauge was restored by a reliable instrument technician so I thought we were onto a winner, until we ventured into slow traffic on a hot day or cruised across the Hay Plains in 35°C, when the temperature varied quite a bit as we went between cloud shadows?

This along with popular folk-law, convinced me that the TR does not have a large enough radiator so as we so often do, I went down the track of rectifying that problem by fitting a Volvo radiator and larger capacity thermo-fan.

Well the first trial came with a journey up the Washpool Ranges of the Gwydir Hwy on a 35°C day stuck behind a B-Double. The temperature kept climbing and climbing and we could not pull over or stop due to the narrow steep road and traffic behind us. This was not the result I was looking for or expecting from all the time, expense and effort of the radiator upgrade.

Since radiator capacity was not the answer, it was time for a rethink of how the system works.

Most if not all air conditioning systems which use water, have a constant output pump and then modulate the temperature in each location using balancing/ modulating control valves to compensate for area demand

The TR cooling system should work the same way so there must be a problem with the balance between flow and demand.

What are the needs of system?

- Car radiators usually only provide a 10°C drop in temperature, so the ambient temperature and the amount of air flowing through the radiator are going to be major considerations.

- The next variable is the demand or heat being generated by the engine, which can combined with high ambient temperatures and low airflow, be another major consideration.

- I concluded that the TR water pump produces a range of about 8 to 22GPM at 5 1/2 PSI, (1000-4000RPM) so the next step was to look at how all this came together to cope with the best and worst conditions.

- Radiator manufacturers recommend a maximum flow of 1.5 GPM in any one tube of the radiator which means that the TR radiator maxes out at 36 GPM from the flow point of view (no crank hole).

- The next thing to look at is the system resistance which is usually about 3PSI across the radiator and about 1 PSI for the pipes and hoses etc at maximum flow.

- Now it was time to look at the "Balancing valve"/ Thermostat. By definition a **"Thermostatic Radiator Valve** (TRV) is a self-regulating valve fitted to a system which controls the temperature by regulating the flow of hot water to a radiator."

I tested my Register unit and found that it began opening at 72°C and was fully open at 81°C. The TR manual specifies an opening temp of 158°F (70°C) and fully open at 197°F (92°C) for the original shrouded unit.

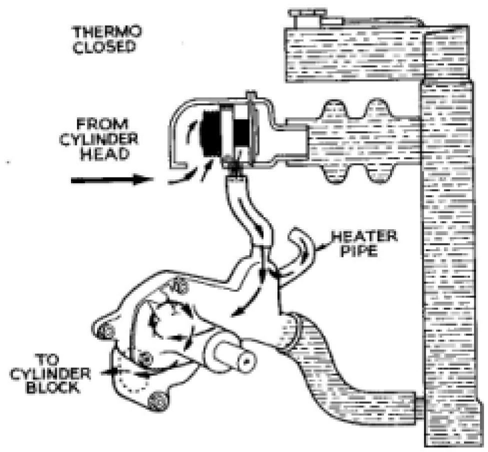


Fig 3 Circulation of Water before the Thermostat has opened.

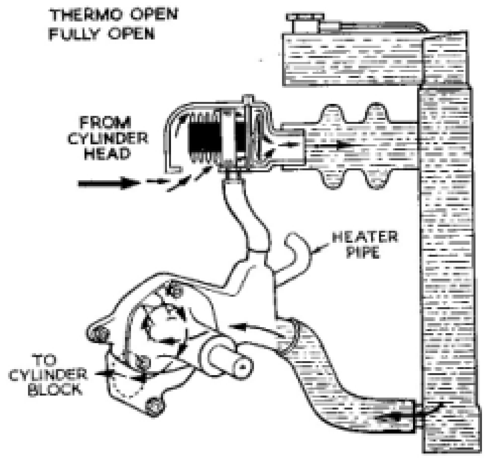


Fig. 4 Circulation when the Thermostat is open.

The Question is: Why is the opening temperature set so low and how does this concept perform in balancing the flow with demand?

Going one step further I looked at the capacity of the Thermostat and found that the flow area or flow coefficient of my unit was about 10 which means it was taking up to 65% of the available pump energy when it was fully open, which was all the time.

No wonder the car ran too cool most of the time and then too hot when the demand or the ambient temp went up.

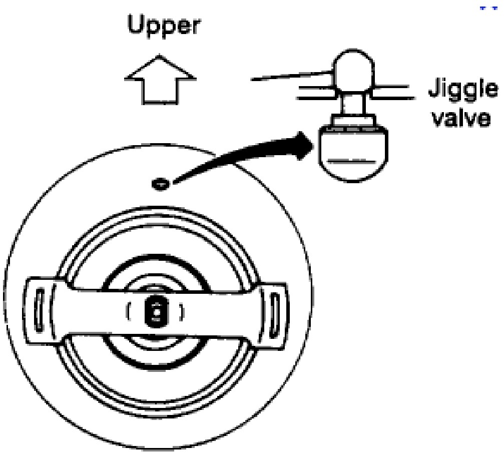
What I needed was a thermostat which could flow up to the maximum pump output and be only partially open at normal running temperature. This would allow the thermostat to modulate and balance the flows to keep a constant temperature regardless of either the ambient temperature, the air flow rate through the radiator or the output of the engine.

This is in effect what happens when using a variable speed water pump controlled by a temperature controller.

The answer came in a TRIDON Model TT2000-170 high capacity Thermostat purchased from Supercheap® Autos for about $20.00. (These are available from most Automotive Parts Suppliers)

This unit has a fully open flow area 2.3 times the size and uses only a fraction of the available pump energy

According to my tests, this increased the capacity by more than 50%



This unit also has an air-bleed jiggle pin already fitted, which reduces the amount of air that can be trapped in the system. Trapped air can cause corrosion of the housing and further reduces the capacity of the thermostat.

There are a number of available temperature ranges but after testing them all, I found that a 77°C unit was in balance with the pump at 82°C and only 25% open, which allows for more than enough increased flow when the demand increases.

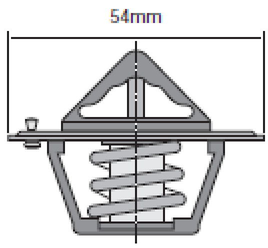
Temperature Conversion

Celcius °C		Fahrenheit °F	Celcius °C		Fahrenheit °F
60	–	140	84	–	182
71	–	160	85	–	185
74	–	165	86	–	187
75	–	167	88	–	190
77	–	170	89	–	192
79	–	174	91	–	195
80	–	176	92	–	198
82	–	180	95	–	203

TT2000 Series

High Flow version of TT1 series

Conventional type with jiggle pin



Temp.	Part No.	Temp.	Part No.
71°C	TT2000-160	77°C	TT2000-170
82°C	TT2000-180	88°C	TT2000-190
89°C	TT2000-192	91°C	TT2000-195

TRIDON

Thermostat

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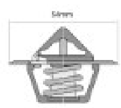
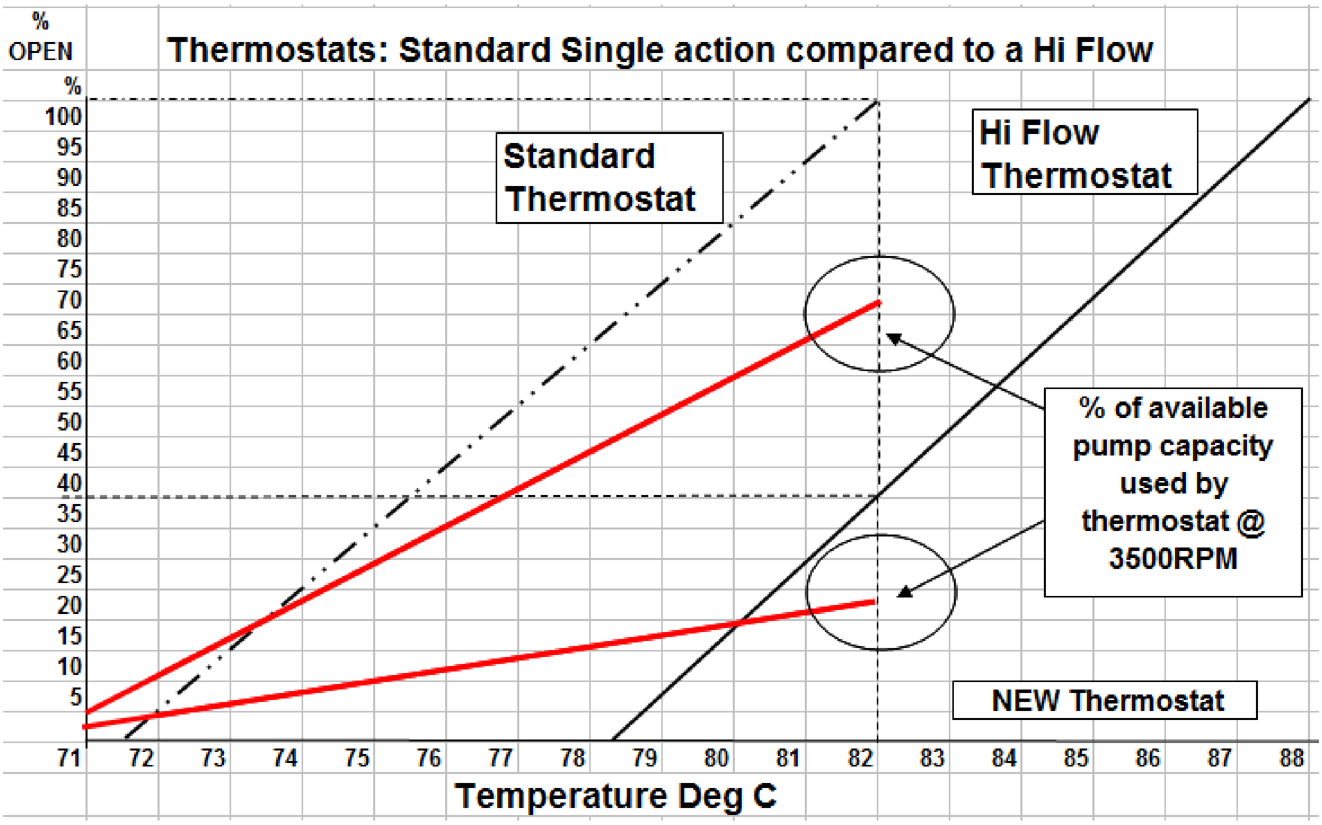
- The thermostat is a temperature control valve assembly used in the vehicle cooling system. Located in a housing usually at the front of the vehicle engine; the thermostat allows circulation of coolant through the radiator once the predetermined engine temperature is achieved.
- There are various styles of thermostats available including conventional, by-pass, thermostat housing assemblies, High Flow and inserts used in conjunction with original housing.
- Thermostats bearing the High Flow logo are Tridon High Flow thermostats. Tridon's range of High Flow thermostats are designed to improve cooling system performance. The High Flow thermostat has a larger valve allowing up to 50% more coolant flow, eliminating the need to use a cooler temperature thermostat.
- Tridon High Flow Thermostats are designed to upgrade the vehicles standard thermostat.
- The thermostat must be compatible with the vehicle cooling system; the Tridon thermostat range has been carefully researched and engineered to suit each specific application.
- Please refer to the Tridon Part Finder for the correct thermostat for your application.

TT2000-170	**Thermostat (High Flow)**	Thermostat (High Flow)	• Opening Temp: 77°C • Flange Dia: 54mm • Foot Dia: - • Height: - • Conventional style thermostat with jiggle pin. • High flow version of TT1 series.	

Following is a diagrammatic representation of the 2 thermostats, showing approximately how much of the available pump energy each one absorbs.

I am of the opinion, that there is no need to upgrade the radiator without first confirming that all the available flow and cooling capacity has been used up for a standard TR engine

However, as the power output is increased by performance tuning, there will be additional demand put on the cooling capacity which might exceed the ability of the standard radiator in high ambient temperatures. There is also room for improvement in the water pump impeller design as the one we use will most likely be cavitating at high RPM and lack capacity at idle. High RPM pump performance is less of a problem as this will usually be associated with high airflows, however low speed output is much more of a concern.



The result of changing to this thermostat was dramatic. The gauge now sits firmly covering the "1" of 185°F even in 6°C early mornings and only moved to half cover the "8" after thrashing the car up the Bunya Mountain on a 29°C day (about 15minutes with hairpin bends and some 1st gear work). Extended idling in 35°C in Longreach gave about the same result.

I am now also of the opinion that the factory designed setup lacks the flexibility to achieve optimum performance in our climate.

The shrouded thermostats can not effectively modulate the flow as there is a conflict between shutting of the bypass and balancing the flow to the radiator, compounded by the very high head losses induced by this type of unit.

The T336 unshrouded thermostats even where correctly fitted are still too cold and too restrictive to be able to perform properly. These engines will only sometimes run at optimum temperature and probably run either too cold or too hot most of the time.

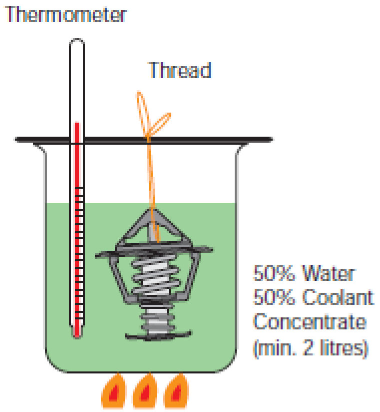
Having gone through all of this I happened upon Graham Campbell's article in "*TR Register – Technical Tips 2" section 2 – Cooling, p62*. He came to same conclusion by modifying and fitting the biggest thermostat he could squeeze in (from a Nissan Skyline/Ford). The effect was similar and he was completely satisfied however since the TT200-170 is cheap, fits straight in and is off the shelf it is a suitable solution for most of us.

So before you embark on an expensive modification to your TR cooling system, take a good look at what you have and how to get the most out of it. It might be as simple as a $20.00 trip to the shops and only take 10 minutes to fit.

<u>Here are a few technical tips courtesy of Tridon®</u>

Thermostat Testing Procedure

- Fill test container with 50% water and 50% coolant concentrate (minimum 2 litres).
- Open the thermostat and insert a fine thread under the valve seat.
- Suspend the thermostat by the thread in the container. The thermostat must be fully submerged and not touch any part of the container.
- Place a thermometer into the coolant so that the bulb is adjacent to the thermostat temperature sensing pill.
- Heat the liquid slowly from cold and agitate the test fluid for accurate results
- Observe the thermometer and note the temperature at once when the thermostat drops from the thread. This reading is the commencement to open temperature.



- The temperature should be increased and the thermostat observed to make sure it fully opens. The thermostat should be fully open at approximately 12°C (22°F) above the specified opening temperature. For example a thermostat with an opening temperature of 82°C should be fully open at 82°C+12°C = 94°C
- The distance of travel to achieve the fully open temperature is the centre orifice diameter divided by 4. For example, orifice DIA 24mm÷4 = 6mm. 6mm travel is the fully open extended position.
- Note: As there is a tolerance of 2.5°C plus or minus of the nominated rating, a thermostat should be replaced if it opens at a temperature more than 6°C (11°F) below or 3°C (5°F) above the specified opening temperature.
- Any testing needs to be done with the water heated at a slow, steady rate with the thermostat being placed into the water at room temperature. This allows the thermostat to heat up consistently and to normalise as the water is heating up. If the water is allowed to heat too quickly it can begin to boil before an accurate temperature is taken. At the same time, if there is too much bubbling in the water incorrect temperature readings may be taken. The thermostat will also take a little time to react to the temperature of the water.

When cool, carefully examine the thermostat valve to make certain it is properly seated. If it does not seat properly, it should be replaced.

Thermostats do not work intermittently - they either work or do not work.
Should a thermostat fail it can either fail in the open or closed position.

I hope this works as well for you as it does for us.

Cheers

Rob