1.Extract from Course F15: *'Best practice flame brazing of aluminium'*

……The specific heat capacity of a material is a measure of the amount of heat needed to raise one kilogram of that material by one degree centigrade. Thus, the lower the heat capacity of a material the smaller the quantity of heat needed to increase its temperature by a given amount. In consequence, and due to their differing specific heat capacities, when brazing copper to stainless steel in order to bring parts of equal weight to brazing temperature simultaneously it is clear that *more heat* will need to be applied to the steel than to the copper. From this it is clear that the practical aspects of heat-pattern development in any particular assembly are based upon this fundamental fact!

Heat and temperature

Some people consider that 'heat' and 'temperature' are the opposite sides of the same coin! This is a serious misunderstanding of their relationship. A simple example will explain why this is so. Take the situation where you are attending a firework party with your five-year old daughter. You will let her hold a 'sparkler' in her hand. That the individual sparks being given off by the firework are at a temperature of about 1400ºC is a fact that you can choose to ignore because *your* experience tells you that even if they fall on her hand they will not burn her. When the firework display is finished, and you all go back indoors you will not allow your daughter to make herself a hot drink by pouring the water into her mug from a kettle that has just boiled. This is because *your* experience gives you cause to fear that she might scald herself even though the temperature of the water is a mere 100ºC!

This is a situation that clearly demonstrates the difference between heat and temperature. The sparks are 14 times *hotter* than the water, but because of their very small *weight* they contain only a very tiny amount of *heat energy.* The water on the other hand has a comparatively very high mass and, as a consequence, contains *a substantial quantity of heat energy*. Although the water is at a very much lower temperature than the sparks, because the *quantity* of heat that it contains is very high it is capable of causing a severe scald.

A physicist would summarise this situation by commenting:

"The water contains substantially more ***total energy*** than the sparks"!

N.B. This consideration has direct 'read-across' to flames.

When a series of different gas mixtures are burnt some possess hotter flames than others. (See **Table 3**) However, and as in the case of the 'sparkler' and the boiling water, it is ***not*** true that the hotter the flame the greater the amount of energy that it will provide. This is because:

The *temperature* of a particular gas mixture that is burning depends upon the chemical reaction that is occurring as the flame burns. Indeed, a chemist *might* say that the flame is a visible sign that an exothermic chemical reaction is taking place!

The *quantity of heat* that is generated when the gas mixture burns depends only on *the quantity* of that mixture that is burnt!

Gas Mixture	Flame Temperature °C
Oxygen – Acetylene	3200
Oxygen-Hydrogen*	**2950**
Oxygen-Propane	2850
Oxygen-Natural gas	2850
Acetylene-Compressed air	2600
Natural gas-Compressed air	1925
Propane-Entrained air (Bunsen burner!)	1700

Caution**, this flame is almost **invisible!

Table 3: Flame temperature of some gas mixtures used for flame brazing……..