

Heating Oil Measurement Accuracy

JSutills Technical Note: JSC001

Applies To: EnCalcOL, EnCalcOU

Operating Systems: Windows 2000, Windows XP, Windows Vista, Windows 7

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General

When using EnCalcOL or ENCalcOU to monitor heating oil consumption the calculated results may appear to be inconsistent. There are a number of reasons for this which are explained below along with tips for minimising these errors.

Depth Measurement Accuracy

The lower the oil consumption per day and the more frequently measurements are taken the more accurate depth measurements have to be to get a realistic measurement of oil consumption. For example a depth measurement error of 0.25 inch on a 48inch high 2000 litre tank is equivalent to an error of just over 10 litres. If daily usage is 7 litres a day and measurements are taken weekly this is equivalent to an error of around 21%. The two biggest sources of measurement error are those due to the accuracy of the measuring stick and parallax error. Parallax error occurs when the reading is not taken by looking at exactly 90 degrees (straight on) to the measuring stick or ruler.

Tanks Fitted With Level Gauges

Often tanks are fitted with an external gauge that shows the level in the tank. These usually take the form of a long tube the height of the tanks where the outlet pipe is. These rarely have any depth markings on them and if they do they are often inaccurate. To use these gauges properly you need to know where the bottom of the tank is, not easy if it is a banded (double skinned) tank. The simplest way to allow for this is measure the depth of the tank and mark the top of the gauge level with the top of inner tank (not the top of the filler or neck of the tank) measure the distance from this point to the base of the outside tank. Subtract the tank depth and you will know how high above the base the bottom of the inner tank is. With this information either the gauge can be marked in inches or centimetres or you will know how much to subtract from the depth measure from the base of the outer tank.

Variation Of Volume With Temperature

The volume of oil increases with temperature, however provided a simple precaution is taken these errors will end up being negligible in practice. Oil expands by 0.001/Degree Centigrade/Litre (0.00056/Degree Fahrenheit/Litre) or 0.001/Degree Centigrade/Gallon (0.00056/Degree Fahrenheit/Gallon). For example a 20 degree C change in temperature of a half full 2000 litre 48 inch high tank gives an increase in volume of 20 litres or around half an inch. If daily usage is 7 litres a day and measurements are taken weekly this is equivalent to an error of around 40%. This is obviously a very extreme example but it is worth making sure measurements are done early in the morning each time to avoid the effect of direct sunlight heating the tank and causing errors. This effect also means it is not a good idea to fill tanks absolutely full. A similar error can occur when a tank is filled with oil at a different temperature to that already in the tank for this reason it is best not to take level measurements for several hours after a tank has been filled.

Finding Out The Real Capacity Of A Tank

Sooner or later it will become obvious there is a problem measuring oil consumption in that when oil is added to the tank the consumption per day shoots up or goes down significantly for no apparent reason and then goes back to normal on the subsequent readings. This is due to the tank capacity being a nominal rather than an absolute figure. There can be quite a variation between quoted and actual tank capacities, especially with plastic tanks. Solving this problem is straightforward but does involve a bit of maths.

- Measure the oil level before and after a delivery - the difference (depth 1) is equivalent to the amount of oil added
- Using the tanks quoted capacity work out how much oil depth 1 equals (nominal oil used)
- Divide oil added by nominal oil used and multiply the result by the quoted tank capacity - gives the actual capacity

Done correctly this will reduce this type of error almost to zero. For cylindrical tanks it is important the same depths are used because the change of volume with depth is non linear. It does of course assume that the delivery volume is accurate.

Enter the actual capacity in EnCalcOL or EnCalcOU instead of the nominal capacity. Note previous recorded results in the log files will not be changed.

For example:

Tank Quoted Capacity = 1760 litres (cylindrical tank 48 inch depth)

Oil Added = 500 litres (starting depth 20 inches, fill up depth 30.5)

Volume represented by 20 inches to 30.5 inches using tanks nominal capacity is 486 litres

Actual capacity of tanks is $(500 / 486) * 1760 = 1811$ litres (a difference of 2.9%)