



## APPLICATION NOTE | DDS CALORIMETERS

### C1.1 : FUEL OILS – PART 2

#### SAMPLE – AVIATION FUEL UNKNOWN

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#### WARNING

Please note that certain fuels will spontaneously combust at room temperature and with increased pressure. When pressurizing a vessel, check that the sample did not combust, by feeling the temperature of the vessel after filling.

#### INTRODUCTION

This application note focuses on burning a fuel that evaporates or spontaneously ignites with increased pressure. This is done in accordance with the above International Standard (ASTM).

#### BACKGROUND

The calorific value (CV) of most liquid fuels can be determined in exactly the same way as solids e.g. coal, i.e. by placing the sample in a pressurized vessel, igniting the sample and measuring the released heat in a controlled environment.

#### EQUIPMENT REQUIRED

The following list of equipment will be required to conduct this application:

- DDS Calorimeter System
- Crucibles
- Firing Cotton
- Syringe
- Cellophane Tape (Crucible Cover Discs)
- Scalpel

#### OVERVIEW

The procedure is similar to that for ordinary fuels (see CAL2K Application Note - C1.1). However, the sample must be covered to prevent evaporation of the sample and to prevent oxygen from reaching the sample.

The mass and calorific Value (CV) of the cellophane tape are used as a spike value and this is automatically deducted from the result.

The firing cotton is placed on top of the cellophane.

#### PROCEDURE

1. Calibrate the vessel using 0.5g benzoic acid tablets.
2. Verify calibration using 0.5g benzoic acid tablets.
3. Place the clean crucible on the balance and tare.
4. Remove the crucible and cover it with cellophane tape (crucible cover disc), ensuring a firm seal around the edge.
5. Cut the excess tape from around the edge using a scalpel.
6. Make a small, bent flap on the top of the cellophane cover with a piece of cellophane tape. This will later cover the hole made by the syringe.



7. Place the crucible with the cellophane covered flap on the balance. Record the new weight (for spiking).
8. Enter this weight into "Spike Mass" and the calorific value of the cellophane tape (see Note 1 below) into "Spike Value".
9. Turn Spiking "ON".
10. Now press "Tare" on the balance
11. Use a syringe with a needle to insert the sample into the crucible. Insert the needle through the cellophane. Ensure the hole from the insertion will be covered by the flap.
12. Gently press down the flap so that the insertion hole is covered.
13. Place the crucible onto the holder of the outer electrode and ensure that the firing cotton lies on top of the cellophane and touches the cellophane flap.
14. When pressurizing the vessel check that the sample has not spontaneously combusted by checking that the temperature of the vessel has not increased (do this by feeling the temperature with your fingers around the exterior of the vessel wall).
15. Continue to run the determination as a normal sample.
16. When the result is displayed the spiking factor from the cellophane tape has already been deducted.

**Note 1:****Determination of the Calorific value (CV) of cellophane tape**

1. Roll up approximately 0.5g of tape and place in a crucible. Weigh this accurately, and run as a normal sample, ensuring the firing cotton touches the tape.
2. Repeat 5 times.
3. Use the average of the 5 readings as the Calorific Value of the cellophane tape.

For example:

WEIGHT	RESULTS (MJ/KG)
<b>0.6824</b>	39.027
<b>0.5199</b>	38.763
<b>0.5234</b>	38.776
<b>0.5318</b>	38.801
<b>0.5257</b>	<u>38.854</u>
	38.844 Average

**RESULTS**

3 Benzoic acid samples (26.454 MJ/Kg) were run as control samples - 2 prior to the results and 1 afterwards.

The mass used for the samples was approximately 0.3g.

The results reported are on a gross CV basis in MJ/Kg.

	MASS	MJ/KG
<b>CONTROL 1</b>	0.5251	26.494
<b>CONTROL 2</b>	0.5088	26.429
<b>CONTROL 3</b>	0.8050	26.439
<b>1</b>	0.3045	46.016
<b>2</b>	0.3200	46.100
<b>3</b>	0.3096	46.094
<b>4</b>	0.2825	46.122



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5	0.3200	46.092
6	0.3090	46.093
7	0.3029	46.119
8	0.2878	45.989
9	0.2870	46.076
10	0.2935	<u>46.103</u>
		<u>46.080 average</u>
	Standard Deviation	0.04
	%RSD	0.09
	Max-Min	0.13

%RSD = Percent Relative Deviation

Max - Min = Difference between maximum and minimum results

### CONCLUSION

Determining the calorific value of a fuel is very valuable in various industries. However, extreme caution must be exercised at all times when dealing with any fuels. Protective wear is highly recommended and all safety rules must be adhered to.