APPLICATION NOTE | DDS CALORIMETERS

MUNITION PROPELLANT

WARNING

On all unknown materials always start with very small sample to determine approx. CV of the material and to avoid danger. Never stand with any part of the body over any of the calorimeter system. During a determination, step away from the unit.

INTRODUCTION

The material to be tested is munitions propellant that generates its own oxygen on combustion. I.e., it does not require oxygen in the atmosphere to sustain combustion.

BACKGROUND

The propellant cannot be ignited in the same manner as coal samples because the oxygen is replaced by nitrogen that prevents the cotton from burning. Consequently, the firing wire must be extended so that it can touch the sample and the firing voltage must be increased. The test sample had a very low CV so the mass was increased to 2gram so as obtained a significant temperature rise of the vessel.

EQUIPMENT REQUIRED

The following is a list of the equipment required to conduct this application.

- DDS Calorimeter system
- Crucibles
- Extended firing wire
- Nitrogen bottle
- Low-pressure nitrogen regulator

SET UP

Attach the low-pressure regulator to the nitrogen bottle and then connect to the filling station. Remove the conventional firing wire from the vessel and replace with extended firing wire that will touch the sample. Increase the firing voltage to 35 – 40 volts (40 volts is maximum available voltage). If the sample does not ignite reduced the size (length and or diameter) of the firing wire. Experiment to determine optimum voltage, length and diameter. If the sample ignites but a misfire is indicated then set the 'MISFIRE LIMIT'=0.

An alternative is to increase the mass of the sample. Only do this in small steps to avoid dangerous situations.

CALIBRATION

2 methods of calibration are available:

1. Pre-calibrate the vessel using oxygen and benzoic acid.
2. Use nitrogen and a propellant with a known value as the calibration standard.

PROCEDURE

1. Weigh out a sample into a crucible – about 2 gram – determined by experimentation.
2. Transfer the mass to the calorimeter.
3. Prepare the vessel in the conventional manner, ensuring the firing wire touches the sample.
4. Pressurize the vessel with nitrogen to 500KPA
5. Insert the vessel into the calorimeter.
6. Close the lid to start the determination.
7. Do not extend any part of your body over the calorimeter during the determination.
8. Once the analysis is complete, remove the vessel, depressurize, cool and clean.
9. The vessel is now ready for another determination.

RESULTS

Using a DDS Calorimeter, these are a typical set of results obtained:

Munitions Propellant

Sample	Weight	Result (MJ/Kg)
1	1.9722	5.13
2	1.8934	5.11
3	1.9528	5.12
4	1.9954	5.14
5	1.9376	5.12
6	1.9501	5.12
7	1.8872	5.13
8	1.9569	5.14
9	1.9254	5.11
10	1.9348	5.13

Average:	5.13 MJ/kg
Standard Deviation:	0.01 MJ/kg
% Relative standard deviation:	0.2%
Maximum to minimum difference:	0.03 MJ/kg

CONCLUSION

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