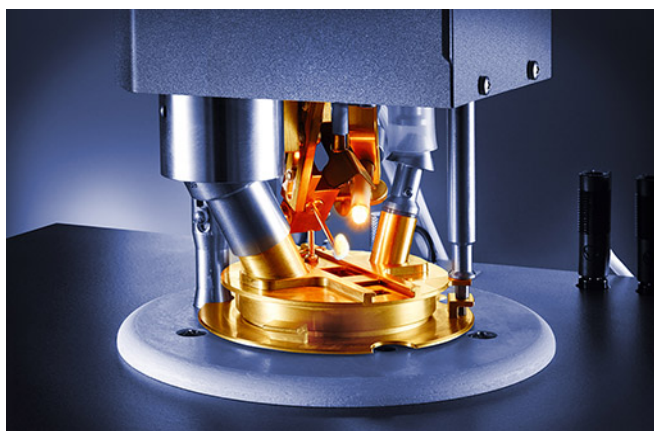


## ABA 4: Correlation Between Standard Cup and Mini-Cup

Relevant for: Chemical Industry, Petroleum Industry, Cosmetic Industry, R&D

Using the sample quantity stated in the standard for determining a flash point is not always possible. Sometimes a material is very expensive or only a small volume is available. As a solution Anton Paar offers the mini-cup for the ABA 4 flash point tester.



Anton Paar designed ABA 4 to measure flash points between  $-30\text{ }^{\circ}\text{C}$  and  $110\text{ }^{\circ}\text{C}$  (with the liquid-cooled model) fully complying with the standard methods for flash point determination according to ISO 13736.

When determining the flash point of a liquid it is not always possible to use the sample quantity of 75 mL as stated in the standard. Sometimes there is only a small sample quantity available or the liquid to be analyzed can be very expensive. Addressing such problems Anton Paar designed the mini-cup to offer a simple solution requiring the small sample volume of only 15 mL, reducing the sample amount needed.

### 1 Introduction

This Application Report describes the flash point determination with two different sample amounts: approximately 75 mL for the standard cup and 15 mL for the mini-cup. Flash point tests with 16 different samples were performed using the ABA 4 flash point tester to investigate whether the results achieved with the two cup sizes show an acceptable correlation which is in the reproducibility of the test method ISO 13736. A valid reproducibility would make it possible to use the mini-cup saving expensive sample material or to perform tests when only a small sample amount is available.

ABA 4 is an automatic closed-cup flash point tester for testing the flammability of a liquid. The flash point is the lowest temperature at which the vapors of a sample ignite upon the application of an ignition source. The two ignition systems of the ABA 4 give the user the flexibility to work with an electric or gas igniter: If the gas ignition is used, the electric igniter will automatically relight the gas flame during the test – making it a reliable and secure instrument. ABA 4 is applicable for liquids such as jet fuels, solvents, chemicals, etc.

### 2 Accessories

To test the samples with the standard cup and the mini-cup, the following accessories were used:

- Standard test cup
- Lid, suitable for standard test cup and mini-cup
- Multi-detector
- Mini-cup
- Mini-lid
- Multi-detector, short for mini-cup
- Electric igniter
- Recirculating cooler

### 3 Instrument

For determining the flash points of the different liquids, some having a flash point lower than +10 °C, the liquid-cooled model of the ABA 4 was used.

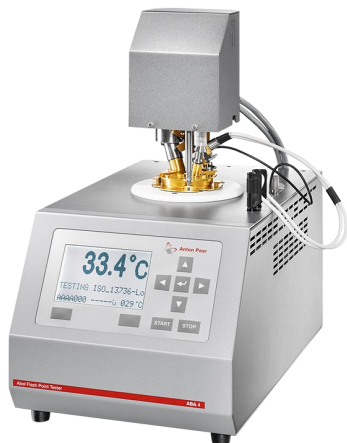


Figure 1: ABA 4 liquid-cooled

### 4 Samples

16 different samples were tested using both the standard test cup and the mini-cup to have results from different materials covering the range of -7 °C to 82 °C. The flash points of the following samples were determined:

Samples tested with both cup sizes	
Isooctane	n-Decane
n-Heptane	Diesel fuel 823
Toluene	Ethanol 5 %
Ethanol 100 %	Fuel oil 827
Octane	n-Undecane
n-Nonane	Fuel oil 828
Cyclohexanone	Diesel fuel 824
Jet-A1 825	n-Dodecane

### 5 Settings

For both tests, standard test cup and mini-cup, the program "ISO\_13736-Lo" was used.

Version	Program
Standard test cup	ISO_13736-Lo
Mini-cup (15 mL)	ISO_13736-Lo

Table 1: Cup size and corresponding programs

### 6 Instrument Preparation

The tests for standard test cup and mini-cup are prepared as follows.



Figure 2: ABA 4 standard test cup with lid and multi-detector

#### 6.1 Preparation of Standard Test Cup

- Switch on the ABA 4.
- Fill the sample into the standard test cup up to the filling mark (approx. 75 mL).
- Place the lid on the test cup.
- Insert the multi-detector into the lid.
- Place the complete test assembly into the ABA 4.



Figure 3: ABA 4 mini-cup with lid and short multi-detector

#### 6.2 Preparation of Mini-Cup

- Switch on the ABA 4.
- Fill the sample into the mini-cup up to the filling mark (15 mL).
- Place the lid on the test cup.
- Insert the short multi-detector into the lid.
- Place the complete test assembly into the ABA 4.

## 7 Measurement

- Turn the multi-function head into measuring position.
- Select program “ISO\_13736-Lo” for standard test cup and mini-cup.
- Select the expected flash point of the sample. For example: EFLP = 63 °C.
- Enter the sample name.
- Start the test by pressing <RUN>.
- After finishing the test the instrument shows the result and cools down automatically to ambient temperature.
- After cooling down, remove the test insert and clean the parts.

## 8 Results

Table 2 compares the flash point results gained with the standard test cup with the flash point results gained with the mini-cup.

Sample	Flash point standard cup [°C]	Flash point mini-cup [°C]	Δ dev. [°C]
Isooctane	-7.0	-5.5	1.5
n-Heptane	-4.0	-4.0	0.0
Toluene	7.0	8.5	1.5
Ethanol 100 %	13.5	13.0	0.5
Octane	16.0	16.0	0.0
n-Nonane	33.0	33.5	0.5
Cyclohexanone	42.0	43.5	1.5
Jet-A1 825	47.0	47.5	0.5
n-Decane	50.0	49.0	1.0
Diesel fuel 823	58.0	58.5	0.5
Ethanol 5 %	59.5	56.5	3.0
Fuel oil 827	60.0	59.5	0.5
n-Undecane	66.5	65.0	1.5
Fuel oil 828	69.0	68.0	1.0
Diesel fuel 824	82.5	80.0	2.5
n-Dodecane	82.5	82.5	0.0

Table 2: Flash point results

### Reproducibility of Test Results

The reproducibility for the flash point results is determined according to the formula given in ISO 13736:

$$R = 3.2 \text{ °C} \quad (1)$$

## 9 Discussion

Aim of the test was to examine a correlation between the ABA 4 standard test cup and mini-cup. It was found out that the test results show an excellent correlation in this study within the reproducibility of the test method ISO 13736 between both test cup sizes for most types of samples. Meaning the mini-cup can be a good alternative to the standard test cup when only a small sample amount is available.

Please be aware that tests performed with the mini-cup are only for internal purposes. If you are analyzing samples for official purposes, it is recommended to use the standardized test cup and the sample volume according to the standard method ISO 13736.

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