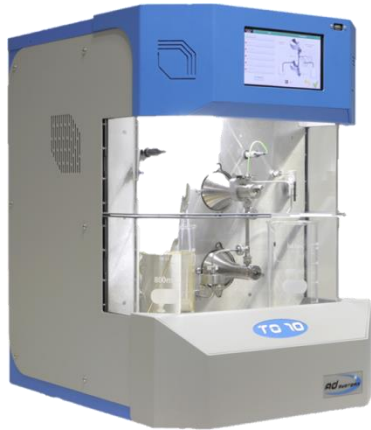




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TO 10

## Thermal Oxidation Stability Test Rig for Aviation Fuel

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## ***The TO10 has been designed to meet specific needs***

- Fuel flow control using double syringe device:
  - ❖ Perfect flow control (3mL/min +/-1%)
  - ❖ Perfect volume control (450mL +/-1%)
- Heater tube thermocouple:
  - ❖ Embedded calibration
- Bus bar temperature control:
  - ❖ Temperature profile repeatable from test to test
  - ❖ Independent control of the 2 bus bars
- Aeration control:
  - ❖ Flow and humidity control

***Seeking inclusion of the TO10 in Table 1 of ASTM D3241, we performed a set of comparison tests based on breakpoint which are presented hereafter.***

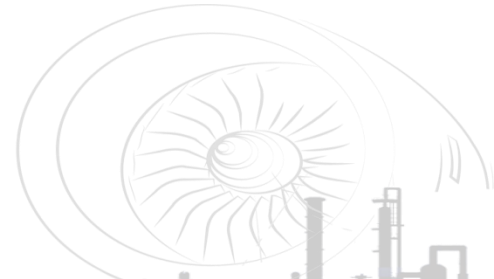
# Test Campaign

- **14** TO10 used for the study
- More than **300** Tests performed
- Fuel matrix
  - ❖ **15** samples
  - ❖ Breakpoints: 235°C to > 380°C
- Heater tubes
  - ❖ Alcor (PAC)
- Test rigs used
  - ❖ PAC Mk II, III and IV and AD Systems TO10
  - ❖ Tube rating – DR10 (ITR D3241-annex 2)

Name	Description
9475	BP UK – Jet A1
9490	TOTAL - Merox
US-J01	BP – Jet A
US-J05	Chevron
KC1904	Jet A1 (Airport)
9473	Jet A1 (Airport) - SGS
9479	CEPIA F34
9480	CEPIA F35
US-J02	Chevron
US-J03	Chevron
US-J07	Chevron
US-J04	Chevron
US-J06	Chevron
US-J08	Jet A1
TK33	Jet A

# Participating Laboratories

- The tests were carried out at three different sites:
  - AD Systems (France)
    - > TO10 and Mark IV
  - SGS Harfleur (France)
    - > Mark II and Mark III
  - Intertek Farnborough (UK)
    - > TO10

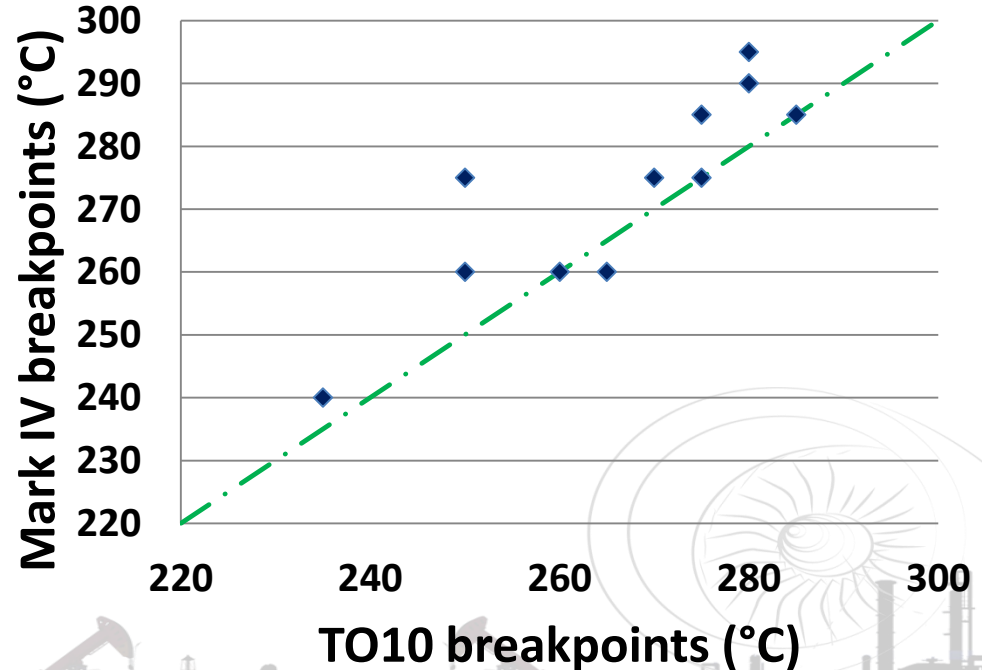


# AD Systems TO10 / PAC MK IV

Fuel	TO10	MK IV	Comments
US-J02	235	240	Delta P > 25mmHg
US-J07	250	260	
US-J03	250	275	
9475	260	260	Delta P > 25mmHg
KC1904	265	260	
9473	270	275	
9480	275	275	
9479	275	285	
US-J01	280	290	
US-J05	280	295	
9490	285	285	
US-J04	>380	N/A	aborted on MK IV on low flow alarm
US-J06	>380	>375	
US-J08	>380	>375	
TK33	>380	>375	

The average of Mark IV results is 6.8 ° C higher than TO10 results

AD Systems laboratory results (TO10 vs Mark IV)



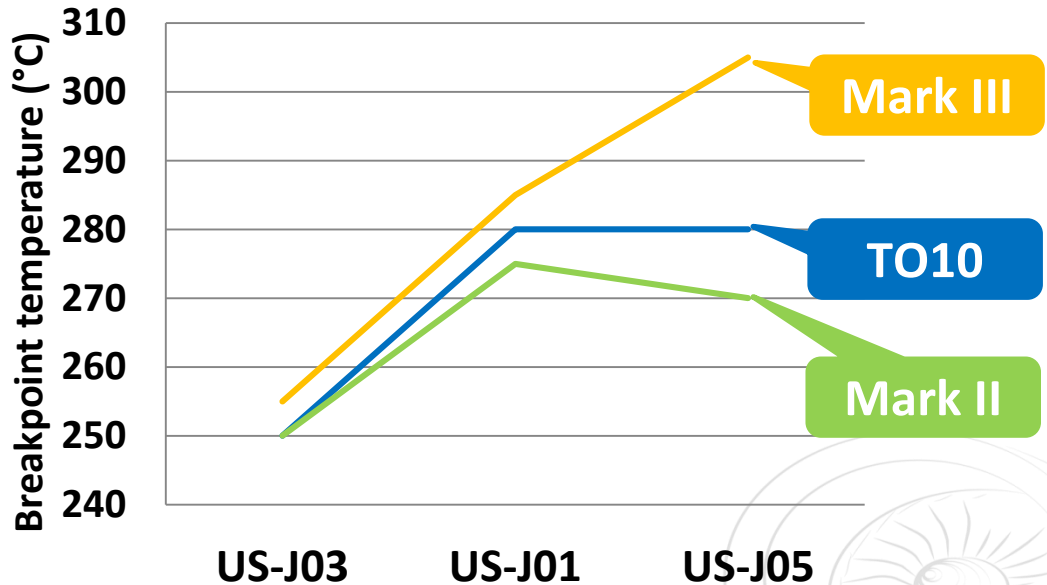
# TO10 / PAC Mk II - III

## SGS Harfleur results

Fuel	TO10	MK II	MK III
US-J01	280	275	280
US-J05	280	270	305
US-J03	250	250	255

**TO10 results are  
between Mark II and  
Mark III results**

## SGS Harfleur results

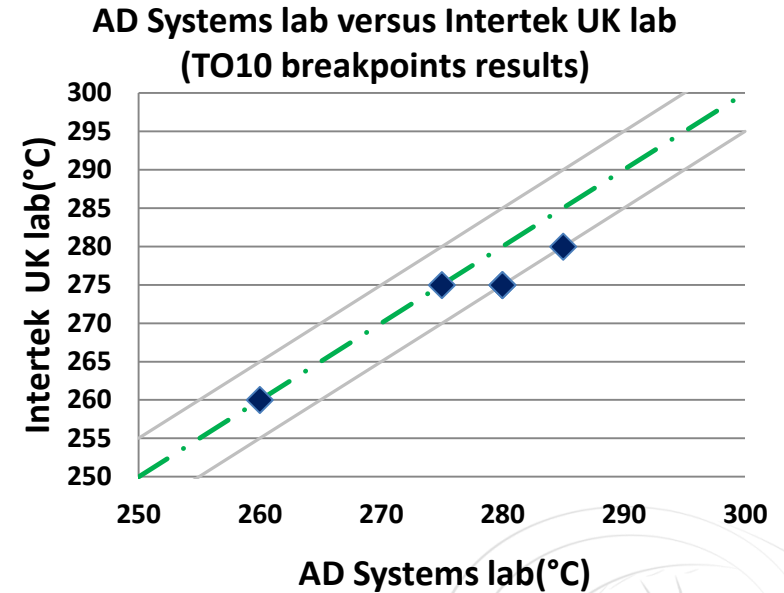


# TO10 dispersion

Comparison of TO10 results  
from  
AD Systems and Intertek UK

Fuel	TO10 AD Systems	TO10 Intertek
9475	260	260
9490	285	280
US-J01	280	275
US-J05	280	275
KC1904	275	275

Maximum difference observed 5°C



The differences observed on Breakpoints between the different versions of the apparatus used (Mark II, III and IV) do not allow an overall comparison of all results.

We observe that the results of the TO10 are reproducible independent of the laboratories and the operator.

The Breakpoints obtained on the TO10 are close to the Mark II.

The Breakpoints obtained on Mark III and Mark IV are generally higher.

Average bias observed with Mark IV is 6.8°C (from 0 to 20 ° C depending on the samples).

Lower results

Mark II

TO10

Mark III and IV

Higher results



# Thank you