EI Research report

Investigation into the minimum auto-ignition temperature of fuels in open-air conditions

energy institute

EI RESEARCH REPORT

INVESTIGATION INTO THE MINIMUM AUTO-IGNITION TEMPERATURE OF FUELS IN OPEN-AIR CONDITIONS

1st edition

May 2020

Published by
Energy Institute, London
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Registered charity number 1097899

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The EI gratefully acknowledges the financial contributions towards the scientific and technical programme from the following companies

BP Exploration Operating Co Ltd
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Uniper
Valero
Vattenfall
Vitol Energy
Woodside
World Fuel Services

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ISBN 978 1 78725 168 7

Published by the Energy Institute

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ACKNOWLEDGEMENTS

This research report was undertaken by Mike Sherratt, independent consultant, at the request of the Energy Institute's (EI's) Distribution and Marketing Committee (DMC) which comprises the following members:

Christopher Betts	Total Lindsey Oil Refinery Limited
Tony Brown	Federation of Petroleum Suppliers
Ian Goldsworthy	Valero Energy Ltd
Ivan Harling	Phillips 66 Ltd
Matthew Hudson	Shell Ltd
Zaf Iqbal	BP Oil UK Ltd
Toni Needham	Energy Institute
Mark Palmer	ExxonMobil Ltd
Barrie Salmon	Tank Storage Association
Teresa Sayers	Downstream Fuel Association

The EI also gratefully acknowledges the support and assistance given by Phillips 66 Ltd, Total Lindsey Oil Refinery, BP and Intertek for the supply of samples. To Garry Rickard (Intertek) for the aliquoting and transport of samples to the USA and to Timothy J Kidwell, South West Research Institute (SWRI) and Scott A. Hutzler (SWRI) for organising and managing the testing.

Technical editing was carried out by Toni Needham, Technical Manager (EI).

FOREWORD

The EI's DMC commissioned this research report into the minimum auto-ignition temperature (AIT) of fuels in open-air conditions. The investigation and report were undertaken by Mike Sherratt, consultant.

There were three phases to the work: the first was a desktop study into existing research regarding literature, test methods and associated results; the second, a discussion with industry about the suitable fuels to be tested and the test methods to be used; the third involved a test house carrying out AIT and hot-surface ignition temperature (HSIT) tests using sample fuels provided by Total Lindsey Oil Refinery, Phillips 66, Humber Oil Refinery, BP and Intertek. The DMC decided that the fuels to be tested would be representative for each fuel class so that the lowest ignition temperature in each class would cover the other fuels in the market in each class.

Following this research, the EI recommends that industry should consider that the following conditions be met to prevent hot-surface ignition or auto-ignition of fuels: hot surfaces exceeding 500 °C should be avoided where there is a possibility of fuels being splashed or spilt (where Euro 6 engine regeneration could cause a problem, the reader is invited to look at the cooling rates suggested within the report); auto-ignition of fuels could occur at any temperature above 200 °C in an enclosed space. If these conditions cannot be met then the site should put in place any such mitigation as is deemed necessary by risk assessment so as to avoid the possibility of auto-ignition of the product.

1 INTRODUCTION

This study was conducted in order to evaluate the AITs of typical UK fuels in order to validate measurement expectations for these fuels, and thus to allow considerations on whether current EI guidelines needed revision.

There are no reports of auto-ignition of spilt product ever having occurred during loading, which may or may not be as a result of the practice of protecting engines and exhaust systems from spilt product. Whereas the AIT of diesel is given as circa 240 °C in material safety data sheets (MSDSs), the EI *Model code of safe practice Part 1: The selection, installation, inspection and maintenance of electrical and non-electrical apparatus in hazardous areas* (8th edition) and *Model code of safe practice Part 15: Area classification for installations handling flammable fluids (*3rd edition),[1] both stated under the section for conditions for auto-ignition:

'*Under open-air ventilation conditions, it is generally more difficult to raise the temperature of a gas or vapour release to above auto-ignition temperature, with the result that auto-ignition temperatures measured in small confined volume tests are very conservative in relationship to the maximum safe temperature of a hot surface in open air.*

Nevertheless, consideration should be given to avoiding very hot surfaces, eg with an internal fluid temperature above 650 °C in process plant in hazardous areas, even with open-air ventilation'.

This report covers three phases of work carried out between August 2016 and June 2019 into the auto-ignition of liquid fuels commonly used in the UK. The first phase included a literature search of international test methods and associated test results. The report (see Annex A) recommended that a programme should be initiated to test UK fuels for HSIT and AIT and emphasised the importance of using specific standardised test methods.

The second phase included discussions with industry to enable the recommendation of a test matrix, sources for the test fuels, a test house to prepare and transport the aliquoted samples and a test house to carry out the test work.

The third phase included finalising the fuels matrix (Annex C), fuel sources, test requirements, aliquoting / transport, testing, analysis of the test results (Annex D) and this final report.

1 These EI guidelines have since been updated to 9th and 4th edition respectively and do not contain the text outlined, which appeared in the 8th and 3rd editions of these guidelines.