international petroleum
test methods

energy
INSTITUTE

Jet fuel thermal oxidation tube rating training guidelines (IP 323)

This publication has been produced as a result of work carried out within the Technical Team of the Energy Institute (EI), funded by the EI's Technical Partners. The EI's Technical Work Programme provides industry with cost-effective, value-adding knowledge on key current and future issues affecting those operating in the energy sector, both in the UK and internationally.

For further information, please visit **http://www.energyinst.org**

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

BG Group
BP Exploration Operating Co Ltd
BP Oil UK Ltd
Centrica
Chevron
ConocoPhillips Ltd
EDF Energy
ENI
E. ON UK
ExxonMobil International Ltd
Kuwait Petroleum International Ltd
Maersk Oil North Sea UK Limited
Murco Petroleum Ltd
Nexen
Premier Oil
RWE npower
Saudi Aramco
Shell UK Oil Products Limited
Shell U.K. Exploration and Production Ltd
Statoil Hydro
Talisman Energy (UK) Ltd
Total E&P UK plc
Total UK Limited
World Fuel Services

ISBN 978 0 85293 561 3

Published by the Energy Institute

Further copies can be obtained from: Portland Customer Services, Commerce Way, Whitehall Industrial Estate, Colchester CO2 8HP, UK t: +44 (0)1206 796 351 e: **sales@portland-services.com**

Electronic access to EI and IP publications is available via our website, **www.energypublishing.org**. Documents can be purchased online as downloadable pdfs or on an annual subscription for single users and companies. For more information, contact the EI Publications Team
e: **pubs@energyinst.org**

CONTENTS

Foreword iv

Acknowledgements v

Summary vii

1 Introduction and scope 1
1.1 Introduction and application 1
1.2 Scope 1
1.3 Application 1

2 Definitions 2
2.1 Colour scale 2
2.2 Peacock 2
2.3 Abnormal 2

3 Principle 3

4 Apparatus 4
4.1 Tubes 4
4.2 Visual tube rater (VTR) 4
4.3 ASTM tube colour standard 4

5 Rating procedure 6

6 Expression of result 8
6.1 Example 1 8
6.2 Example 2 8
6.3 Example 3 8

7 Rating area criteria 9

8 Example photographs of used IP 323 tubes rating 10

FOREWORD

This publication was prepared by a task force on behalf of the Energy Institute's TMS SC-B-8 Stability of Light Distillates Panel. It is intended for anyone that follows IP 323 *Determination of thermal oxidation stability of gas turbine fuels* in laboratories worldwide.

During an EI technical workshop to review IP 323 tube rating it was evident that many analysts rarely saw IP 323 tube failures. It was also identified that ratings for marginal pass/fail tubes were highly variable. This publication has been prepared to assist in the training of analysts on various IP 323 tube deposits and their ratings. **It is intended only as a training reference guide, not for use as part of any IP 323 tube analysis.**

This publication is for guidance only and while every reasonable care has been taken to ensure the accuracy of its contents, the EI and the technical representatives listed in the acknowledgements cannot accept any responsibility for any action taken, or not taken, on the basis of this information. The EI shall not be liable to any person for any loss or damage which may arise from the use of any of the information contained in any of its publications.

The above disclaimer is not intended to restrict or exclude liability for death or personal injury caused by own negligence.

Suggested revisions are invited and should be submitted to:

Technical Department
Energy Institute
61 New Cavendish Street
London
W1G 7AR
e: **technical@energyinst.org**

ACKNOWLEDGEMENTS

This publication was prepared by:

Kevin Bower	Air BP Ltd
Richard Heins	Shell Global Solutions
Harry Read	Consultant to BP International Ltd
Garry Rickard	Intertek

Further contributions were provided by members of the EI TMS SC-B-8 Stability of Light Distillates Panel.

The EI wishes to record its appreciation of the work carried out by them and to BP International Ltd for providing the photographs in this publication.

1 INTRODUCTION, SCOPE AND APPLICATION

1.1 INTRODUCTION

The final result from undertaking IP 323 *Determination of thermal oxidation stability of gas turbine fuels* is a tube colour rating based on an arbitrary scale established by ASTM for this test method. There are also two additional yes/no criteria to indicate the presence of an apparent large excess of deposit or an unusual deposit or both.

This final tube rating is assumed to be an estimate of the condition of the degraded fuel deposit on the tube. This rating provides one basis for judging the thermal oxidative stability of the fuel sample.

When determining the visual rating of used IP 323 tubes it is critical that the visual rating procedure is carried out exactly as stipulated in IP 323.

1.2 SCOPE

This publication provides guidance on visual rating of used IP 323 tubes for the training of IP 323 users.

This publication does not provide reference standards for use in rating of used IP 323 tubes.

1.3 APPLICATION

Due to limitations of photographic and printing technology, the tube photographs in this publication are not exact matches of what is observed in the tube rater described in IP 323 and **must not be used for rating IP 323 tubes**. The photographs are intended to be used for training purposes to show the type of deposits and ratings likely to be seen when using this test method.