Hydrocarbon management

HM 79

Shore tank handbook. Tank design and ancillary equipment relating to measurement and sampling of hydrocarbon liquids in shore tanks

energy institute

HM 79

SHORE TANK HANDBOOK
TANK DESIGN AND ANCILLIARY EQUIPMENT RELATING TO MEASUREMENT AND SAMPLING OF HYDROCARBON LIQUIDS IN SHORE TANKS

First edition

February 2021

Published by
Energy Institute, London
The Energy Institute is a professional membership body incorporated by Royal Charter 2003
Registered charity number 1097899

The Energy Institute (EI) is the chartered professional membership body for the energy industry, supporting over 23 000 individuals working in or studying energy and 200 energy companies worldwide. The EI provides learning and networking opportunities to support professional development, as well as professional recognition and technical and scientific knowledge resources on energy in all its forms and applications.

The EI's purpose is to develop and disseminate knowledge, skills and good practice towards a safe, secure and sustainable energy system. In fulfilling this mission, the EI addresses the depth and breadth of the energy sector, from fuels and fuels distribution to health and safety, sustainability and the environment. It also informs policy by providing a platform for debate and scientifically-sound information on energy issues.

The EI is licensed by:
– the Engineering Council to award Chartered, Incorporated and Engineering Technician status, and
– the Society for the Environment to award Chartered Environmentalist status.

It also offers its own Chartered Energy Engineer, Chartered Petroleum Engineer, and Chartered Energy Manager titles.

A registered charity, the EI serves society with independence, professionalism and a wealth of expertise in all energy matters.

This publication has been produced as a result of work carried out within the Technical Team of the 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:

ADNOC
BP Exploration Operating Co Ltd
BP Oil UK Ltd
Chevron North Sea Ltd
Chevron Products Company
Chrysaor
CLH
CNOOC
ConocoPhillips Ltd
DCC Energy
Drax Group
EDF Energy
EDPR
ENI
E. ON UK
Equinor
ExxonMobil International Ltd
Innogy
Ithaca Energy
Intertek
Kuwait Petroleum International Ltd
Neptune Energy
Ørsted
Phillips 66
Prax
Qatar Petroleum
Repsol Sinopec
RWE npower
Saudi Aramco
Scottish Power
SGS
Shell UK Oil Products Limited
Shell U.K. Exploration and Production Ltd
Siemens Gamesa Renewables
Spirit Energy
SSE
TAQA Bratani
Total E&P UK Limited
Total UK Limited
Uniper
Valero
Vattenfall
Vitol Energy
Woodside
World Fuel Services

However, it should be noted that the above organisations have not all been directly involved in the development of this publication, nor do they necessarily endorse its content.

ISBN 978 1 78725 230 1

Published by the Energy Institute

Hard copy and electronic access to EI and IP publications is available via our website, **https://publishing.energyinst.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

Contents continued

LIST OF FIGURES

Page

Figures

FOREWORD

The Energy Institute's (EI's) Hydrocarbon Management Committee (HMC) is responsible for the production and maintenance of standards and guidelines covering various aspects of static and dynamic measurement of petroleum. The Hydrocarbon Management Committee 4 (HMC-4) deals primarily with the measurement and loss of crude oil and oil products, focusing in particular on transport in the marine environment and associated shore assets.

HMC-4 is made up of experts from the oil industry, cargo inspectors, ship owners and representatives from Marine Terminals. It is a truly international panel with representatives from most Western European countries, the Middle East, Far East, and North and South America. Equipment manufacturers and experts with specific knowledge of measurement techniques are regularly invited to present papers to the committee.

The EI maintains liaison with parallel working groups of the American Petroleum Institute's (API's) Committee on Petroleum Measurement, and other organisations concerned with quantitative measurement in other countries and industries.

The EI Hydrocarbon Management guidelines are widely used by the petroleum industry, and have received recognition in many countries by consumers and the authorities. In order to promote their wide adoption internationally, it is the policy to submit selected guidelines via the British Standards Institute (BSI) to the International Organization for Standardization's (ISO's) technical committee TC-28 Petroleum Products and Lubricants, as potential International Standards.

A full list of Hydrocarbon Management guidelines is available on request from the EI.

The EI Hydrocarbon Management guidelines are recommended for general adoption, but should be read and interpreted in conjunction with safety, environmental, weights and measures, customs and excise and other regulations in force in the particular country in which they are to be applied. Such regulatory requirements have precedence over corresponding clauses in the EI document except where the requirements of the latter are more rigorous, when its use is recommended. Users should also consider contractual constraints imposed by charterers, cargo owners, ship owners and any other interested party.

Although it is believed that adoption of the recommendations of this guideline will assist the user, the Energy Institute cannot accept any responsibility, of whatsoever kind, for damage or alleged damage arising or otherwise occurring on vessels or in or about premises where this document has been applied as final responsibility for adequate preparation of the vessel to receive a cargo lies with the parties controlling this task.

Users of these guidelines are invited to send comments, suggestions, or details of relevant experience to:

Technical Department
Hydrocarbon Management
Energy Institute
61 New Cavendish Street
London
W1G 7AR
United Kingdom
www.energyinst.org

ACKNOWLEDGEMENTS

Members of EI HMC-4 have been associated with the production of this guideline. Membership at the time of publication is as follows:

Bazan
BP Oil International Ltd
CEPSA
Chevron
Chinese Petroleum Corporation
CITGO
ConocoPhillips
ENI SpA
Equinor
Essar Oil UK
ExxonMobil Company
GALP Energia
Koch
Marathon Petroleum Company LLC
Mercuria
Monroe Energy
Petrobras
Petroineos
Phillips 66
PMI Pemex
PREEM
Qatar Gas
Repsol
Saras SpA
Shell
Saudi Aramco
Sumed
Total
Unipec
Valero

The EI would also like to acknowledge the following companies for allowing the publication of the following images: Process Measurement & Analysis Ltd and Belfield Decantation Valve for Figures 5 and 6; Agar Corporation Inc for Figures 7 and 8; SPX Flow, Plenty Mixers with additional text from Adrian Russell for Figures 11 and 12; Butterworth Inc, Tank Washing Machines for Figure 13; and UK Sampling Gauges Ltd for Figures 17 and 18.

1 INTRODUCTION AND SCOPE

1.1 SCOPE

This document identifies the standards and considers alternative designs and equipment used in onshore storage tanks for petroleum liquids, specifically concerning satisfying measurement and sampling requirements.

Other issues such as foundation stability, mechanical design, coating and corrosion protection, fire protection, filling and emptying connections, access for inspection and cleaning, are not addressed.

While many of the comments will also apply to other types of tankage, only vertical cylindrical storage tanks are considered here, as they are the most common design.

Good practice is presented, while considering safety and environmental issues which are of increasing concern.

The document will be of use to all those involved with measurement and sampling of petroleum liquids, and guides those considering installation or upgrade of shore tanks regarding the need to allow for measurement and sampling activities.

The document is also a useful reference and training guide.

1.2 INTRODUCTION

1.2.1 General

The quantity and quality of hydrocarbon liquid in a tank will need to be determined regularly for inventory, and possibly for custody transfer or fiscal purposes.

Traditionally, gauging and sampling has been carried out by operators or independent inspectors climbing to the top of the tank to use a gauging tape and bob, along with sample bottles or beakers lowered into the tank through a hatch or a stilling-well cap near the edge of the roof. Temperatures were determined using cup-case (or wood-back) thermometers, which allow a small amount of liquid to be retrieved to the top of the tank, complete with a mercury-in-glass thermometer, to allow the temperature from any level to be read.

Electronic gauging devices such as portable electronic thermometers (PETs) and ullage, temperature, interface instruments (UTIs), along with more sophisticated samplers, have now largely replaced these techniques. However, manual gauging and sampling still requires personnel to access the roof of the tank. Access to tank roofs is increasingly restricted on safety grounds. Safety concerns, along with environmental considerations, have driven technical developments such that automatic gauging systems, which are now able to provide levels of accuracy (strictly speaking – uncertainty) are acceptable for custody transfer and fiscal measurements.

However, a range of measurement techniques is still in use, depending on the location and age of the installation.

While automatic systems are now available for level and temperature measurement, sampling generally continues to require roof access. However, environmental protection requirements demand that vapour releases are prevented or limited, restricting opportunities for opening gauging and sampling points. The use of relatively large hatch openings for gauging and sampling is becoming increasingly rare with smaller diameter (typically 50 mm – 2 inch or possibly 100 mm – 4 inch) flanged fittings provided. These allow use of UTIs and various samplers which pass through vapour control valves (VCVs) and portable fittings, which contain either wiper systems to restrict vapour releases, or are completely enclosed. While restricted and closed sampling systems have been in use for ships' tanks for some time, they are heavy and bulky and not suited for regular use on shore tanks. Permanent installation of the main part of the equipment is an option, but this introduces problems around cleanliness and sample contamination. It also remains necessary to use the stairways while carrying the sample containers and samples.

1.2.2 Continued access to tank tops

While accurate automatic measurements are achievable, automatic gauges need to be verified manually and, of course, sampling continues to require roof access.

The need for access to a tank top will depend on the equipment installed. The standard for checking that any gauging equipment is reading correctly is a calibrated gauging device which can be traced to national standards. Also, some commercial contracts still require manual measurements to be used as a basis for custody transfer quantities.

As noted, while some internal floating systems are available for clean products, obtaining samples irrespective of the fill level (usually an upper, middle, and lower sample) generally requires sampling from the tank top. Samples from fixed side tappings may not provide samples from the correct levels in accordance with applicable standards, but may still provide adequate samples as long as the tank contents are homogenous.

Some sites may require personnel to work in pairs to provide safety supervision while accessing tanks. However, due to economic constraints, additional personnel may not always be available, and as a result access to tank tops for measuring and sampling may be severely restricted. Therefore, while all are agreed that access to tank tops should be minimised, there are often no alternatives and the emphasis has to be on providing safe access when required, and ensuring that safety precautions are in place and that personnel are properly trained (see section 6).