PURGING MANUAL

FOURTH EDITION

September 2018

AGA
American Gas Association

PURGING MANUAL

FOURTH EDITION

September 2018

American Gas Association
400 North Capitol St. NW
Washington, DC 20001

Catalog No. XK1801

Disclaimer & Copyright

The American Gas Association's (AGA) Operations and Engineering Section provides a forum for industry experts to bring their collective knowledge together to improve the state of the art in the areas of operating, engineering and technological aspects of producing, gathering, transporting, storing, distributing, measuring and utilizing natural gas.

Through its publications, of which this is one, AGA provides for the exchange of information within the natural gas industry and scientific, trade and governmental organizations. Many AGA publications are prepared or sponsored by an AGA Operations and Engineering Section technical committee. While AGA may administer the process, neither AGA nor the technical committee independently tests, evaluates or verifies the accuracy of any information or the soundness of any judgments contained therein.

AGA disclaims liability for any personal injury, property or other damages of any nature whatsoever, whether special, indirect, consequential or compensatory, directly or indirectly resulting from the publication, use of or reliance on AGA publications. AGA makes no guaranty or warranty as to the accuracy and completeness of any information published therein. The information contained therein is provided on an "as is" basis and AGA makes no representations or warranties including any expressed or implied warranty of merchantability or fitness for a particular purpose. Nothing contained in this document should be viewed as an endorsement or disapproval of any particular manufacturer or product.

In issuing and making this document available, AGA is not undertaking to render professional or other services for or on behalf of any person or entity. Nor is AGA undertaking to perform any duty owed by any person or entity to someone else. Anyone using this document should rely on his or her own independent judgment or, as appropriate, seek the advice of a competent professional in determining the exercise of reasonable care in any given circumstances.

AGA has no power, nor does it undertake, to police or enforce compliance with the contents of this document. Nor does AGA list, certify, test or inspect products, designs or installations for compliance with this document. Any certification or other statement of compliance is solely the responsibility of the certifier or maker of the statement.

AGA does not take any position with respect to the validity of any patent rights asserted in connection with any items that are mentioned in or are the subject of AGA publications, and AGA disclaims liability for the infringement of any patent resulting from the use of or reliance on its publications. Users of these publications are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, is entirely their own responsibility.
Users of this publication should consult applicable federal, state and local laws and regulations. AGA does not, through its publications, intend to urge action that is not in compliance with applicable laws, and its publications may not be construed as doing so. Information concerning safety and health risks, proper installation or use, performance or fitness or suitability for any purpose with respect to particular products or materials should be obtained from the User's employer, the manufacturer or supplier of the raw material used.

Changes to this document may become necessary from time to time. If changes are believed appropriate by any person or entity, such suggested changes should be communicated to AGA in writing and sent to: ***Operations & Engineering Section, American Gas Association, 400 North Capitol Street, NW, 4th Floor, Washington, DC 20001, U.S.A. or E-mail to*** **publications@aga.org**. ***Suggested changes must include: contact information, including name, address and any corporate affiliation; full name of the document; suggested revisions to the text of the document; the rationale for the suggested revisions; and permission to use the suggested revisions in an amended publication of the document.***

Acknowledgements

Robert (Bob) D. Wilson, currently with the Northeast Gas Association (formerly with National Grid), served as the chairman and led the revision of this document. AGA greatly appreciates his many, many hours of hard work and his commitment to the safety of the natural gas industry. AGA extends its sincere thanks to the **Northeast Gas Association** and **National Grid** for their support of Bob's work. National Grid also offered the services of **Edward Marian,** supported by **Parashar Sheth (Perry),** to help complete this document. AGA thanks them for their assistance.

The revision of the document was first initiated by a task group of AGA's Distribution and Transmission Engineering Committee (now known as AGA's Engineering Committee) with members from gas distribution and transmission companies and related service providers. **Hans Bell** with UGI Utilities (formerly with NICOR) served as the chairman of the task group. **Michael Lyons,** also with UGI Utilities (formerly with PECO Energy), remained a substantive contributor from the beginning to the end of the revision process. Sections 6 and 7 of this document were revised under the leadership of **Kevin Ritz** with Baltimore Gas & Electric (BGE). AGA thanks these individuals for their contributions. Others who were involved in the document's revision are –

Lisa Lawler – Enbridge Gas Distribution
Kowsiya Vijayaratnam – Enbridge Gas Distribution
Joseph Ryan – LG&E-KU, PPL Companies
Dave Klimas – EN Engineering
Chuck Kanoy – NiSource Inc.

AGA also acknowledges and thanks the following individuals who reviewed and provided extensive comments on the various versions of the draft document.

Christian Overgaard – Gas Distribution and Transmission Consultant
Andrew Argeski – PSE&G
William Gruhlke – WEC
Michael Noone – Xcel Energy
Jeff Webb – Avista Corp.
Joe Ewing – Puget Sound Energy
Marc Mechlowicz – Southern California Gas Company
Alla Denisova – CenterPoint Energy
Buddy Secor – DOT's Pipeline & Hazardous Materials Safety Administration (PHMSA)
Thach Nguyen – PHMSA
C. J. Osman - Interstate Natural Gas Association of America (INGAA)
Carl Weimer – Pipeline Safety Trust (PST)

In addition, AGA would like to thank the large number of individuals who reviewed the document and returned a ballot that approved the document or approved the document with some comments, which were of help as well. Last but not the least, AGA thanks the AGA Engineering Committee for their support in this effort.

Christina Sames
Vice President
Operations & Engineering Services

Ali M. Quraishi
Senior Director
Operations & Engineering Services

Table of Contents

TABLES/FIGURES

Tables:

Figures:

APPENDICES

PREFACE

Recognition of industry-wide increased focus on process safety involving purging operations prompted revision of AGA's "Purging Principles and Practices," Third Edition, 2001, now designated as "Purging Manual," Fourth Edition, 2018. The former document served the gas industry and other related industries for decades as the primary resource and reference on principles and practices to help conduct safe and effective purging operations. This manual builds on those principles and practices with more detailed information for routine day-to-day as well as non-routine complex purging operations.

The information provided in this manual is based on sound engineering theories and practices, and years of experience in performing safe purging operations. The intent is to provide the user with core engineering and operating fundamentals to analyze, plan, develop and conduct purge procedures with the goal of minimizing risks associated with purging operations. It is important to recognize that each purge operation is unique and presents site-specific challenges. While typical routine purge operations involving short segments of pipe are generally covered in individual company standard operating procedures, however, the fundamental concepts addressed in this manual still apply. It is essential that the individuals planning and preparing purge procedures and the field operations personnel performing purge operations become familiar with the fluid dynamics and gas chemistry explained in this manual. Relevant industry standards, such as those issued by the National Fire Protection Association (NFPA), as well as local, state and federal regulatory agencies require adequate precautions be taken to minimize or control mixtures of flammable gas and air to prevent unintended ignition during purging, welding and cutting operations.

There is no "one-size-fits-all" solution to safe and efficient purging operations. As a result, the user shall apply the information in this manual with caution, recognizing that site-specific conditions shall be considered and addressed as appropriate in the planning and execution of any purging operations.

Updated diagrams of flammability end-points for developing purge plans and procedures prior to purging operations are included in this revision. The manual also provides recommendations to minimize methane emissions during purging operations. Appendices include a process safety purging checklist, and examples of purging procedures for gas piping in distribution system and in power plant operations. The appendices also include the complete research report published in 1997 by the Gas Research Institute (GRI), now known as the Gas Technology Institute (GTI). The GRI Report details the core engineering principles of fluid dynamics that will help the reader understand the basis of application of these principles in purging operations.

The GRI Report was also accompanied with a software package (Purge Program) that is currently being updated by GTI with the cooperation of AGA and some members of Operations Technology Development (OTD). GTI has targeted this to be released before the end of 2018. The program can be used for modeling purge operations based on actual field conditions. Section 5.0 discusses various purging calculations and examples of application of these calculations. The updated purging software can be applied to site-specific conditions other than the examples in this manual.

SCOPE

This manual provides theory and general procedures for safe and efficient purging into and out of service of systems containing flammable gas in order to maintain a safe atmosphere inside and outside of the system being purged during and after purging operation. System may refer – individually or collectively − to pipes, tanks/vessels, LNG, LPG and other facilities and pertinent equipment and components.

1.0 GENERAL INFORMATION

1.1 Introduction

Purging, as implied in this manual, is the process of a flammable gas being either removed from or introduced into a system. When a flammable gas is purged into or out of service by air, the interface between the gas and the air may create a flammable mixture inside the system as well as outside when it is discharged into air. A flammable gas, when purged into or out of service by an inert gas, may create a flammable mixture when it is discharged outside into the air. Proper purging operation will eliminate or minimize the formation and discharge of a flammable gas mixture, thus helping to avoid conditions for hazardous uncontrolled ignition.

Controlling formation of a flammable mixture during purging is necessary even though no apparent source of ignition is present. This can be accomplished by means of controlled injection of purge gas to prevent formation of a flammable mixture of gas and air. Figure 1-1 represents the concentration profile at the interface between the purge gas and the purged gas. The mixed gas region length (usually starting as 98% purge gas concentration at the beginning to 98% purged gas concentration at the end of the mixed gas region) grows as the gas interface moves along the pipe with increasing percentage of purge gas. Carefully controlled purging of air from pipelines by direct displacement with natural gas has been safely conducted for many years with the recognition that a controllable flammable mixture is present. Purging of natural gas from pipelines by direct displacement with air under controllable conditions is also considered an acceptable industry practice. Direct displacement purging techniques may be applicable to system other than pipelines where applicable.

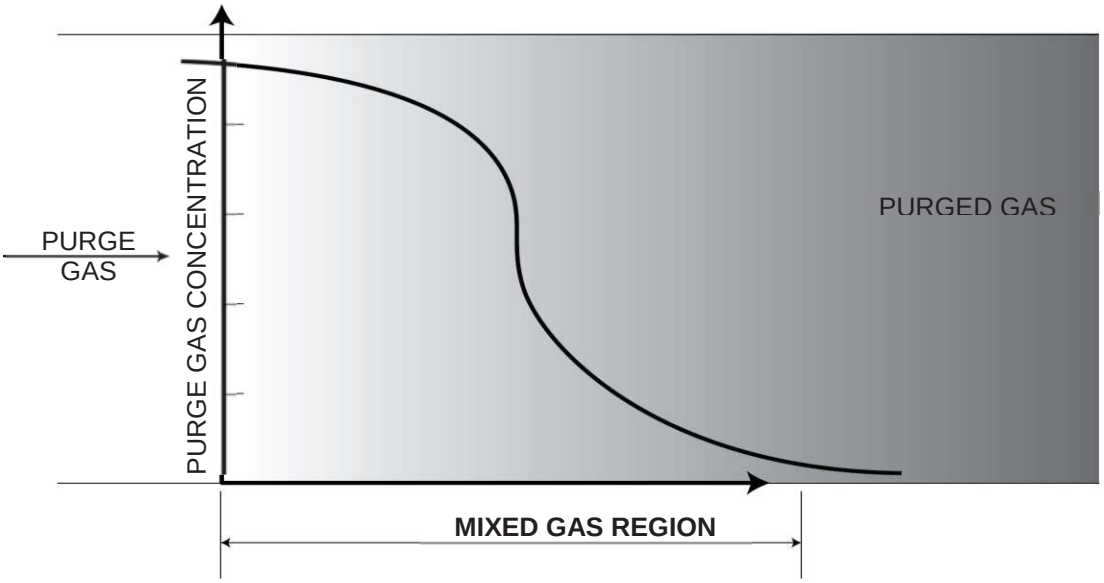

Figure 1-1
Concentration profile at the interface between the purge gas and the purged gas