

**CGA G-8.4—2013**  
**SAFE PRACTICES FOR**  
**THE PRODUCTION OF**  
**NITROUS OXIDE FROM**  
**AMMONIUM NITRATE**  
**FIRST EDITION**



**COMPRESSED GAS  
ASSOCIATION, INC.**

## PREFACE

As part of a program of harmonization of industry standards, the European Industrial Gases Association (EIGA) and the Compressed Gas Association (CGA) formed a Joint Working Group (JWG) to produce G-8.4—2013, *Safe Practices for the Production of Nitrous Oxide From Ammonium Nitrate*. This standard is intended as an international harmonized standard for the worldwide use and application of all members of the Asia Industrial Gases Association (AIGA), EIGA, Japan Industrial and Medical Gases Association (JIMGA) and CGA worldwide. The CGA edition is identical in technical content to the EIGA edition except for regional regulatory requirements (noted), and it has minor changes in formatting and spelling.

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Work Item 10-089  
Bulk Distribution Equipment and Standards Committee

FIRST EDITION: 2013

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## 1 Introduction

This publication has been prepared by member associations of the International Harmonization Council, under the lead of EIGA and is intended for the worldwide use and application by all members of the International Harmonization Council. The International Harmonization Council is composed of members from the Asia Industrial Gases Association (AIGA), Compressed Gases Association (CGA), European Industrial Gases Association (EIGA), and the Japan Industrial and Medical Gases Association (JIMGA). Regional editions may use non SI units and refer to national, and or regional legislation.

Nitrous oxide ( $N_2O$ ) has been produced and distributed by the industrial gases industry for many years. It is mainly used for medical purposes (anesthesia). It is also used in the food and electronic industries.

Severe accidents, such as violent explosion of ammonium nitrate or decomposition of nitrous oxide, have occurred at facilities producing nitrous oxide from ammonium nitrate. In addition, nitrous oxide gas in elevated concentrations can cause health effects in operators which should be prevented.

A major cause of accidents and health effects when producing nitrous oxide from ammonium nitrate has been insufficient attention to the specific properties of these materials when designing equipment and developing operating procedures. For that reason, this publication describes the properties and hazards of ammonium nitrate and nitrous oxide. On this basis, the principles and relevant details of safe production of nitrous oxide from ammonium nitrate are considered.

Regulatory requirements for medical applications shall also be followed. For example, the European Guide Good Manufacturing Practice in Europe, U.S. FDA and Health Canada good manufacturing practices in North America, as well as NFPA 99, *Health Care Facilities Code* in the United States and CSA Z305.1, *Nonflammable Medical Gas Piping Systems* in Canada for medical gas piping systems [1, 2].

## 2 Scope

This publication serves the interest of all who could in any way be associated or concerned with nitrous oxide manufacturing from the thermal decomposition of ammonium nitrate. It also serves to acquaint persons not versed in ammonium nitrate and nitrous oxide technology with those factors considered important to health and safety.

This publication applies to safety in the design, construction, installation, operation, and maintenance of nitrous oxide plants using ammonium nitrate technology. Emphasis is placed on equipment, operational, and maintenance features that are particular to nitrous oxide plants.

For details of publications covering the safe practices for storage and handling of nitrous oxide see CGA G-8.3, *Safe Practices for Storage and Handling of Nitrous Oxide* and CGA G-8.1, *Standard for Nitrous Oxide Systems at Customer Sites* [3, 4].

This publication is not applicable to the process of production from other raw materials but may be used as a guideline for the purification, drying, compression, liquefaction, and storage as applicable.

Nitrous oxide emissions during production are not covered by the scope of this publication.

## 3 Definitions

For the purpose of this publication, the following definitions apply.

### 3.1 Cylinder

Transportable pressure receptacle of a water capacity not exceeding 150 L [5].

### 3.2 Decomposition

Separation of a chemical compound into smaller elements. Ammonium nitrate and nitrous oxide separates into components in an exothermic reaction that can be accelerated by changes in pressure, temperature, energy inputs, and presence of catalyzer or impurities.