CGA P-8—2020

GUIDELINE FOR SAFE PRACTICES FOR CRYOGENIC AIR SEPARATION PLANTS

SIXTH EDITION

CGA
Compressed Gas Association
The Standard For Safety Since 1913

PREFACE:

As part of a program of harmonization of industry standards, the Compressed Gas Association (CGA) has published CGA P-8, *Guideline for Safe Practices for Cryogenic Air Separation Plants*, jointly produced by members of the International Harmonization Council.

This publication is intended as an international harmonized standard for the worldwide use and application of all members of the Asia Industrial Gases Association (AIGA), Compressed Gas Association (CGA), European Industrial Gases Association (EIGA), and Japan Industrial and Medical Gases Association (JIMGA). Each association's technical content is identical, except for regional regulatory requirements and minor changes in formatting and spelling.

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NOTE—Technical changes from the previous edition are underlined.

SIXTH EDITION: 2020
FIFTH EDITION: 2013
FOURTH EDITION: 2005
REAFFIRMED: 1994, 2002
THIRD EDITION: 1989

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1 Introduction

This publication provides guidance on the safe operation of cryogenic air separation plants. It is based on the experience of CGA member companies that operate cryogenic air separation units (ASUs).

Industrial cryogenic air separation has some potential hazards that must be recognized and addressed. The hazards include electricity, gases under pressure, very low temperatures, the ability of oxygen to accelerate combustion, and the asphyxiant properties of nitrogen, argon, and the rare gases [1].[1]

Cryogenic air separation technology is not static; it has been progressing for decades and will continue to do so because of engineering development efforts. Consequently, plant process cycles, equipment, and operating conditions can be and are of varying kinds. Therefore, this publication includes generalized statements and recommendations on matters for which there is a diversity of opinion or practice. Users of this guide should recognize that it is presented with the understanding that it cannot take the place of sound engineering judgment, training, and experience. It does not constitute, and should not be construed to be, a code of rules or regulations.

2 Scope

This publication serves the interest of those associated or concerned with air separation plant operations and applies to safety in the design, location, construction, installation, operation, and maintenance of cryogenic air separation plants. Emphasis is placed on equipment and operational and maintenance features that are specific to cryogenic air separation processes. Limited coverage is given to plant equipment such as air compressors, which are used in other industrial applications and for which safe practices in design, installation, and use have already been established elsewhere. Further, as this publication is not intended as a universal safe practice manual for specific design and safety features, it is also important to refer to the operating manuals of the equipment suppliers.

The following are excluded from this publication:

- cylinder filling facilities;
- rare gas purification systems; and
- product transmission piping outside the plant boundaries.

3 Typical ASU features

Cryogenic ASUs have these features:

- air compression;
- air contaminant removal;
- heat exchange;
- distillation; and
- expansion (or other refrigeration sources).

Figure 1 is an example of a flow diagram for separating air by cryogenic distillation producing oxygen, nitrogen, and argon products. Air is compressed in the main air compressor (MAC) to between 4 atm and 10 atm. It is then cooled to ambient temperature. Trace contaminants such as water, carbon dioxide, and heavy hydrocarbons are removed using systems such as a prepurification unit (PPU) or a reversing heat exchanger (REVEX). The main heat exchanger cools the air to near its liquefaction temperature before entering the high pressure distillation column. Some of the air is reduced in pressure in the expander to produce refrigeration, overcoming heat leak and process inefficiencies. Gaseous nitrogen from the top of the high pressure column is condensed by the reboiler and the liquid used to reflux both columns. Condensing nitrogen releases heat to vaporize liquid oxygen

[1] References are shown by bracketed numbers and are listed in order of appearance in the reference section.