

CGA P-8—2013

**SAFE PRACTICES GUIDE
FOR CRYOGENIC
AIR SEPARATION PLANTS**

FIFTH EDITION



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Contents	Page
1 Introduction.....	1
2 Scope	1
3 Typical ASU features.....	1
4 Definitions.....	3
5 Health hazards	7
5.1 Cryogenic liquids	7
5.2 Gas products	8
5.3 Asphyxiation	8
5.4 Oxygen hazards	9
5.5 Protective clothing and personal protective equipment.....	9
6 General plant considerations.....	10
6.1 Site selection	10
6.2 Safety factors in plant layouts.....	10
6.3 Materials of construction.....	10
6.4 Insulation—other than coldbox	11
6.5 Cleaning	12
6.6 Electrical requirements.....	12
6.7 Noise	12
7 Intake air quality	13
7.1 Contaminants	13
7.2 Reactive contaminants that concentrate in oxygen.....	14
7.3 Reactive contaminants that concentrate in nitrogen.....	15
7.4 Plugging components.....	15
7.5 Haze and smoke from fires.....	15
7.6 Contaminant sources.....	16
7.7 Identification of contaminants.....	16
7.8 Location of air intake	16
7.9 Monitoring intake air	17
8 Compressors	17
8.1 Axial compressors	17
8.2 Centrifugal compressors.....	17
8.3 Other dynamic compressor considerations	18
8.4 Reciprocating compressors	18
8.5 Diaphragm compressors	20
8.6 Rotary positive displacement compressors.....	21
8.7 Refrigerant gas compressors	21
8.8 Screw compressors	21
8.9 Lubrication systems.....	21
8.10 Coolers and separators	23
8.11 Suction filters or screens	23
8.12 Special considerations for oxygen service	23
8.13 Operating and maintenance procedures	23
9 Air contaminant removal.....	24
9.1 Removal methods.....	24
9.2 Contaminant removal stages.....	25
9.3 Prepurification unit operation.....	27
9.4 REVEX operation	29
9.5 Supplemental mechanical chillers	31
9.6 Caustic scrubbers.....	31

10	Expanders	32
10.1	Loss of loading and overspeed.....	32
10.2	Oil contamination of the process	33
10.3	Abnormally low temperatures.....	34
10.4	Solids in gas stream	34
10.5	Loss of lubrication.....	34
10.6	Abnormal bearing temperature.....	35
10.7	Abnormal vibration.....	35
10.8	Abnormal speed	35
10.9	Critical speed.....	35
10.10	Fouling of expander with ice or carbon dioxide	35
10.11	Startup and shutdown	36
10.12	Operating and maintenance procedures	36
11	Cryogenic pumps	36
11.1	General.....	36
11.2	Types of pumps	37
11.3	Materials of construction.....	37
11.4	Pump system design	37
11.5	Special considerations for oxygen service	38
11.6	Pump motor.....	38
11.7	Pump operation	39
11.8	Operating and maintenance procedures	39
12	Coldbox	39
12.1	Removing particulate material	39
12.2	Cryogenic adsorbers	40
12.3	Liquid levels.....	41
12.4	Monitoring contaminants	42
12.5	Argon separation and purification.....	42
12.6	Noncondensable purge	43
12.7	Coldbox cleaning.....	44
12.8	Safe holding time for LOX	44
12.9	Liquefaction of air in the main heat exchanger.....	44
12.10	Process upsets	44
13	Control systems.....	45
13.1	Instrumented systems functions	45
13.2	Critical safety systems.....	46
13.3	Operational safety systems	46
13.4	Routine plant operation control systems	47
13.5	Unattended or partially attended operation	47
13.6	Remote operation.....	48
13.7	Additional considerations for computer-based control systems	48
13.8	Additional considerations for failsafe systems.....	49
13.9	Alarm system.....	49
13.10	Regulatory considerations	50
14	Product handling equipment.....	50
14.1	Liquid storage.....	50
14.2	High pressure gas storage vessels	51
14.3	Liquid vaporizers	51
15	Cooling systems	52
16	Plant piping.....	52
16.1	General design considerations for plant piping	52
16.2	General design considerations for check valves	52
16.3	Oxygen piping hazards.....	53

16.4	Pressure relief devices	53
16.5	Cryogenic piping	54
16.6	Dead legs	54
16.7	Carbon steel piping	55
16.8	Venting	55
16.9	Product delivery	55
17	Shutdown procedures	56
17.1	Coldbox shutdown	56
17.2	Liquid and gas disposal	56
17.3	Plant derime	57
18	Repair and inspection	57
18.1	General maintenance considerations	57
18.2	Supervisory control	57
18.3	Special construction and repair considerations	58
18.4	Coldbox hazards	58
18.5	Hazards of working in oxygen-enriched or oxygen-deficient atmospheres	59
18.6	Cleaning	59
19	Operations and training	59
19.1	Operating procedures	59
19.2	Commissioning procedures	59
19.3	Emergency procedures	60
19.4	Management of change	60
19.5	Personnel training	60
20	References	61

Figure

Figure 1—Representative air separation plant flow diagram	2
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Tables

Table 1—Effects at various oxygen breathing levels	9
Table 2—Plugging, reactive, and corrosive contaminants in air	13
Table 3—Typical default air quality design basis	14
Table 4—Typical removal in PPU process	26
Table 5—Typical removal in REVEX process	26
Table 6—Cryogenic adsorber names	40

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 must include 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 peculiar 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 (HP) 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 HP column

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