NFPA 99
Health Care Facilities

Cross-Reference to the Changes in Medical Gas and Vacuum Systems (Chapter 4) from the 1996 to 1999 Editions

Mark Allen, Editor
Notes on Using this Pamphlet:
This pamphlet is presented as a service to users of the National Fire Protection Association’s Standard for Healthcare Facilities, the NFPA 99. The pamphlet seeks to simplify understanding the changes which have occurred between the document as published in 1996 and the document as published in 1999.

Users are cautioned that this pamphlet is intended to be used in conjunction with the standard, which should be obtained from:

National Fire Protection Association
1 Batterymarch Park
Quincy, MA  02269-9101
Phone 1-800-344-3555
Internet www.NFPA.org.

This pamphlet is not intended to be exhaustive and there may be changes of significance omitted from this document.

This pamphlet is not a publication of the National Fire Protection Association. Any opinions expressed and/or interpretations given or implied are the sole responsibility of Beacon Medical and the editor, and should not be relied upon without reference to the standard.

This edition 6 March 2000
Previous edition 6 August 1999

There is available an electronic version of this document in Adobe Acrobat (PDF) format. If you would like to receive the document in that format, please e-mail mallen@beaconmedical.com and indicate you would like an electronic version of the ‘99 Changes booklet.

Comments on this booklet or on any aspect of medical gases are welcome and encouraged. Please send to mallen@beaconmedical.com

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Table of Contents

A Quick Overview of Major Changes ........ 4

The Quick Overview is intended to help the reader to gain an appreciation for the more substantial technical changes.

A Discussion on Levels ....................... 7

The Discussion on Levels is intended to help understand this complex initiative and to give some practical guidance on how to apply the Levels.

A Cross Reference between Editions ........ 8

The Cross Reference is intended to allow a paragraph by paragraph comparison of the two documents.
Major Changes

Notes on Major Changes

Introduction:
The NFPA 99 1999 revision of Chapter 4 definitely has fewer significant technical changes than have many previous editions. This said, the 1999 revision is undoubtedly one of the more significant in the history of the standard. The most significant changes are found not in Chapter 4 but in the parts of the standard which determine how Chapter 4 is applied - in Chapters 12 to 20, the occupancy chapters. In the changes to these occupancy chapters, we are seeing the further working out of the “Levels” strategy first hinted at in the 1996 edition, and which will be a cornerstone of the standard for years into the future. (see the discussion on Levels which follows)

Within Chapter 4, a first pass review will reveal that the sections for Level 2 - marked “Reserved” in the 1996 edition now are fleshed out, there are several revisions to diagrams, there are some new diagrams, and there is a remarkable amount of text marked as changed by the line to the left. (The changed text marked by the lines is not necessarily changed. Some has merely been reorganized, and unfortunately there are real changes which are not indicated. The lines are not very useful.)

There are two currents which will be noted in the changes: a continuing effort to make the book more “user friendly” offset by a concern that the book’s user friendly features are being abused, leading to a need to tighten up, especially as regards Figures and Tables.

Changes - General:
- Laboratories are more fully included in the scope of the chapter. That is, there are now fewer cases where laboratories are not covered. (see Definition of Laboratory)
- Waste Anesthetic Gas Disposal now has an official name - “Waste Anesthetic Gas Disposal” or “WAGD”. This name will replace “evacuation”, “scavenging”, etc. WAGD is now officially within the scope of Chapter 4, ending a long and acrimonious debate on whether it belongs to Chapter 5 as an Environmental System or Chapter 4 as a piped medical gas system. (see 4-1.1 Scope)
- The recommended Vacuum sizing methodology which has been in the Appendix since the incorporation of NFPA 56K into the NFPA 99, has been restored and moved into Appendix C. (see C-4.3)
- A new document, the CGA E-10 “Recommended Practice for Maintenance of Medical Gas and Vacuum Systems in Healthcare Facilities” has been included in the references. (see B-1.2.6)

Changes - Level 1 Systems:
- Where a manifold room opens onto an egress corridor (see NFPA 101) mechanical ventilation is required. (see 4-3.1.1.2(c))
- A new Figure 4-3.1.1.8(h) has been broken out of the old Figure 4-3.1.2 to more completely illustrate the Emergency Oxygen Connection. (see Figure 4-3.1.1.8(h)
- Figure 4-3.1.1.9 has been dramatically changed. This was felt to be one of the most abused figures in the book, and has been changed to reflect the text more exactly, as well as to guide the user to the appropriate text. (note that some users have reported incorrect paragraph references).
Illustration #1

Alarms for Medical Air Compressor Sources

Note: What is illustrated here is the minimum permitted by the standard. Many users prefer more comprehensive alarm arrangements. There are additional safety devices required as well.
The figure should be used as a graphical table of contents, to find the relevant text. It is not and never was intended to be used by itself. (see Figure 4-3.1.1.9)

• A point of confusion regarding alarms on medical air systems has been resolved: Certain operating alarms are now allowed to be relayed to the master alarms as a “Compressor Fault” signal in lieu of having individual indicators. (see Illustration 1 overleaf)

• Two alternate methods of piping air accessory items are explicitly permitted. (see 4-3.1.1.9 (h) and Figures 4-3.1.1.9 (h)1 and 4-3.1.1.9 (h)2

• There is a new Table 4-3.1.2.4 including three important pieces of information:

First, it eliminates the need to reference a separate Compressed Gas Association document for color coding and symbology.

Second, it provides a listing of “Standard Pressures” for reference when considering the paragraphs on “Nonstandard Pressures” (4-3.1.2.11).

Third, it provides a color coding scheme for non-medical air and non-medical vacuum (practically, these will be found most useful for Level 3 installations) and for Laboratory Air and Laboratory Vacuum. (see Table 4-3.1.2.4)

• There is no longer any allowance for brazers to be qualified on site - they must qualify in the same manner and by the same tests in all cases.

• In the 1996 edition, when corrections were performed prior to verification, the verifier was required to report these corrections. This is no longer true. (see 4-3.4.1.1)

• Table 4-3.4.1.4 has been completely re-worked - it is now much more comprehensive. (see Table 4-3.4.1.4)

• Three changes of note have been made in the testing arena:
  First: when a failure occurs in the required particulate testing of 25% of all zones, all zones (100%) must then be tested. (see 4-3.4.1.3(e))
  Second: Some tests previously mandated to be performed with nitrogen may now be done with source gas. (see 4-3.4.1.3)
  Third: A transient flow test has been added for oxygen and air outlets (see 4-3.4.1.3(h)6)

Changes - Level 2 Systems:
• This section, marked “Reserved” in the 1996 edition has been fleshed out to include a whole series of requirements, largely borrowed directly from the equivalent section in Level 1. (see 4-4)
See the Section on “A Discussion of Levels” in this pamphlet for more details.

Changes - Level 3 Systems:
• Editorially, the paragraph references in the 1996 edition have been replaced with the actual text in this edition.
A number of changes have occurred in this process. Among them:
  - The prohibition on flexible connectors in patient systems (see 4-3.1.2.9(h) incorporated by reference in 1996 was not included in the 1999. Interesting enough, this prohibition does exist for Gas Powered Device gas systems.
  - testing for soft tubing buried in slabs now follows the same rules as any other tubing.
  - flared fittings are permitted only at outlets and manifolds where exposed.
  - 95-5 solder may no longer be used on Gas Powered Device gas systems. (see 4-5.1.3.1 (c))
  - a paragraph “grandfathering” older Piped Patient gas systems has been added. (see 4-5.4.1.1)
A Discussion on Levels

Introduction:
The NFPA 99 1999 greatly extends the Levels initiative NFPA started with the 1996 edition. This initiative began a proposal made for the 1996 edition which involved changing the requirements for medical gas systems based on the complexity of the procedures intended to be performed there.

This proposal was not incorporated into the 1996 edition due to its sweeping implications and the wide effect it would have in other areas of the standard. However, pieces of it did enter the code and can be seen in the exceptions found in Chapters 12-19, for example in NFPA 99 1996 13-3.4.1

“If installed, patient gas systems shall conform to Level 1 gas systems of Chapter 4.

A single alarm panel, as described in 4-4.3.1.2.1(b)2 shall be mounted in an area of continuous surveillance while the facility is in operation.

Exception No. 1: Medical air compressors shall be permitted to be simplex.

Exception No. 2: Dryers, after-coolers, filters, and regulators, as listed in 4-3.1.1.9 (g) shall be permitted to be simplex.

Exception No. 3: One alarm panel that complies with 4-3.1.2.1(b)3a,b,c and d and with 4-3.1.2.1(c)2 and 5 shall be permitted.

Exception No. 4: Pressure switches shall be mounted at the source with a pressure gauge or readout located at the master alarm panel.”

These exceptions in the 1996 standard all derive from the original proposal for “Level 2”.

The underlying concept of less complex systems for less dependent patient populations continued to drive the thinking as the 1999 was in preparation. The 1999 reflects the next iteration in this process. Thus the sections on Level 2 no longer say simply “Reserved” as placeholders for something in the future, Level 3 now no longer references Level 1 but is nearly stand-alone, and the occupancy chapters (12-20) now contain the beginnings of a “decision tree”, helping choose which Level applies in a given facility.

The eventual goal is to be able to provide an appropriate level of medical gases (and ultimately other systems as well, eg. essential electrical systems) based on the procedures done in that facility, not the name over the door. This is a response to the simple fact that in today’s healthcare environment the name over the door is becoming less and less meaningful.

The levels program explicitly throws the responsibility for a crucial decision back on the owner (where it always has belonged). However, a fact of today’s healthcare environment is that some owners are uncomfortably willing to cut corners to save a few dollars. The Levels program therefore opens an opportunity to the owner who is willing to trade risk for money. It is the resultant risk to patients which is the weakness of the plan.

Compounding this potential problem is the simple fact that the decision trees as now written are simplistic, incomplete and difficult to interpret. There is no additional guidance on how to fit specific cases.

Overall, Beacon recommends, except where the owner requires a specific level (and is therefore willing to accept the consequences of that decision) that only Level 1 be used as a basis for design.

As NFPA refines the decision trees in the 2002 edition edition and beyond, expect the Levels to become more useful and eventually to be the starting point in any med gas design process.
Cross Reference

<table>
<thead>
<tr>
<th>Key</th>
<th>1996</th>
<th>1999</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green</td>
<td>Text in Green indicates additions (new material) added to this edition</td>
<td>A-1-2</td>
</tr>
<tr>
<td>Red</td>
<td>Text in Red indicates material deleted from this edition</td>
<td></td>
</tr>
<tr>
<td>Blue</td>
<td>Text in Blue indicates text which has changed. Requirements are generally the same.</td>
<td></td>
</tr>
<tr>
<td>Magenta</td>
<td>Text in Magenta indicates text which has been rewritten for clarity.</td>
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<table>
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<th>1996</th>
<th>1999</th>
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<tr>
<td><strong>1-6 Organization</strong></td>
<td><strong>A-1-2</strong></td>
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<td>Section 1-6 contains notes on using the document and on it's history.</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>1996</th>
<th>1999</th>
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<tbody>
<tr>
<td><strong>Definition of Laboratory ;</strong></td>
<td><strong>Definition of Laboratory ;</strong></td>
</tr>
<tr>
<td>The definition for laboratory contains exclusions for section laboratories and labs in which oxygen is administered (eg. pulmonary function labs), and under some circumstances blood donor rooms, and clinical service areas.</td>
<td>These exclusions are removed.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>1996</th>
<th>1999</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Definition of Nitrogen, Oil Free, Dry (Nitrogen for Testing and System Operation) ;</strong></td>
<td><strong>Definition of Nitrogen, Oil Free, Dry (Nitrogen for Brazing and Testing) ;</strong></td>
</tr>
<tr>
<td>This gas is required to be CGA Grade M.</td>
<td>Nitrogen for these uses is Nitrogen NF. NFPA 99 no longer includes “system operation” in the definition. What grade of gas the facility chooses to administer is outside the scope of NFPA 99.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>1996</th>
<th>1999</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>4-1.1 Chapter 4 Scope</strong></td>
<td><strong>4-1.1 Chapter 4 Scope</strong></td>
</tr>
<tr>
<td>Waste Anesthetic Gas Disposal is explicitly added to the scope of Chapter 4.</td>
<td>A specific statement of why has been added in a list of hazards enumerated in 4-2.4.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>1996</th>
<th>1999</th>
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</thead>
<tbody>
<tr>
<td><strong>4-3.1.1.2(a) (10) (b) Gas Storage Facilities</strong></td>
<td><strong>4-3.1.1.2(a) (10) (b) Gas Storage Facilities</strong></td>
</tr>
<tr>
<td>Outdoor gas storage adjacent to a wall is required to be 25 feet from any opening in the building.</td>
<td>Outdoor gas storage adjacent to a wall is required to comply with NFPA 50 “Bulk Oxygen Systems at Consumer Sites”</td>
</tr>
<tr>
<td><strong>4-3.1.1.2(c) Storage Locations (&lt;3000 ft³) opening onto Egress Corridors</strong></td>
<td><strong>4-3.1.1.2(c) Storage Locations (&lt;3000 ft³) opening onto Egress Corridors</strong></td>
</tr>
<tr>
<td>Such locations may be ventilated mechanically or naturally.</td>
<td>Mechanical ventilation is required and natural venting is not to be used.</td>
</tr>
<tr>
<td><strong>4-3.1.1.7(b)(2) Cylinder reserves</strong></td>
<td><strong>4-3.1.1.7(b)(1) Cylinder reserves</strong></td>
</tr>
<tr>
<td>A contents alarm is required on cylinder reserves without check valves.</td>
<td>A contents alarm is always required on cylinder reserves.</td>
</tr>
<tr>
<td><strong>4-3.1.8 Oxygen and Medical Air are only for use in</strong></td>
<td></td>
</tr>
</tbody>
</table>
4-3.1.1.8(e) Venting of Relief Valves
Relief valves must be vented to the outside if the total capacity is 3,000 ft³ or greater.

4-3.1.1.8(h) Emergency Oxygen Inlet
When the oxygen supply is located remote from the building, the Emergency Low Pressure Gaseous Oxygen Inlet is required.

The connection must be accessible to emergency supply vehicles and must be located on the building itself (e.g., it cannot be at the oxygen supply site).

A new diagram (4-3.1.1.8(h)) shows the arrangement of the connection.

Fig. 4-3.1.1.9 Medical Air Figure
A schematic of a Level 1 medical air system.

4-3.1.1.9(i)3 Compressor Requirements
Section 3 has been broken out more clearly as a requirement for all compressors.

4-3.1.1.9(i)3 CO/Dewpoint Alarms
CO Alarms must be in the local alarm at the compressor site and relayed to the master through the “Compressor Fault” indicator. Dew Point alarms must be in the local alarm at the compressor site and relayed to each master alarm as a separate signal. (see Illustration #1) (see also 4-3.1.2.2(b)3(g))
Changes NFPA 99 1996 to 1999, Chapter 4

1996

4-3.1.2.3(a) Demand checks are required for each switch or sensor. (4-3.1.2.1(a)6)
Wiring must be in conduit (4-3.1.2.1(a)8)

4-3.1.2.2

4-3.1.2.2(a)6 Demand Checks are required to be gas specific.

4-3.1.2.2(a)8 Wiring must be supervised or protected as per the NFPA 70 National Electrical Code, section 517-30.

4-3.1.2.2(b)6 Service Valves
Note: 4-3.1.2.2(b)9 is a partial duplication.

4-3.1.2.2(b)7 Valve Types

4-3.1.2.2(b)8 Valve Location

4-3.1.2.2(b)10 Flammable Gases

4-3.1.2.2(d)4 ¶ 2 Required valves

4-3.1.2.2(d)5 Critical Care

4-3.1.2.2(d)6 Anesthetizing Locations

4-3.1.2.2(d) Station Outlets

4-3.1.2.2(c) Surface Mounted Medical Gas Rail Systems

4-3.1.2.3(b) Installer Qualifications

4-3.1.2.3(b)1(a) Qualification Tests

4-3.1.2.3(b)2 Allowance for on-site Qualification

4-3.1.2.3(c) Brazed Joints

4-3.1.2.3(c)1(b) Dissimilar metals can be brazed with BCup or BAg series filler metal.

1999

4-3.1.2.1(a) Demand Checks are required to be gas specific.

4-3.1.2.2(a)8 Wiring must be supervised or protected as per the NFPA 70 National Electrical Code, section 517-30.

4-3.1.2.7

4-3.1.2.1(b) Qualification Tests

Macroetching has been deleted as an acceptable test.

On site qualification is no longer allowed.

4-3.1.2.8(b) Dissimilar metal must be brazed with BAg series filler metal.

4-3.1.2.8(b)3 Cut tubing must be reamed.
4-3.1.2.3(d) Threaded Joints

Threaded joints are permitted only for the connection of devices such as pressure gauges, switches, etc.

4-3.1.2.2(a) Gas Piping

4-3.1.2.2(a)6 sizing
4-3.1.2.2(a)7 supports
4-3.1.2.2(a)8 joints
4-3.1.2.2(a)9 fittings
4-3.1.2.2(a)10 turns
4-3.1.2.2(a)11 protection

Buried piping must be enclosed in a “continuous split enclosure”.

Piping inside buildings but underground or in concrete must be installed in conduit.

4-3.1.2.2(a)12 risers
4-3.1.2.2(a)13 kitchens/electrical switchgear
4-3.1.2.2(a)14 other piping (
4-3.1.2.2(a)15 protection (
4-3.1.2.2(a)16 hoses and flex connectors
4-3.1.2.2(a)16 conversion of use

4-3.1.2.2(c) Surface Mounted Rail Systems

4-3.1.2.2(c)1
4-3.1.2.2(c)2
4-3.1.2.2(c)3
4-3.1.2.2(c)4
4-3.1.2.2(c)5
4-3.1.2.2(c)6
4-3.1.2.2(c)7

4-3.1.2.2 Station Outlets

Refers to CGA C-9 for color coding

4-3.1.2.2 (d) 4 ¶2, 5 & 6
4-3.1.2.2 (d) 7
4-3.1.2.2 (d) 8
4-3.1.2.2 (d) 9

4-3.1.2.2 (e) Manufactured Assemblies

4-3.1.2.2 (e) 1
4-3.1.2.2 (e) 1 a
4-3.1.2.2 (e) 1 b

4-3.1.2.8(a) Threaded Joints

Tubing is to be ASTM B-819, Type K or L.

Tubing immediately attached to the outlet (outlet pigtail) must be 3/8” OD.

4-3.1.2.7 (d) Seismic bracing is required where building codes dictate.

4-3.1.2.9 (a)
4-3.1.2.9 (b)
4-3.1.2.9 (c)
4-3.1.2.9 (d)
4-3.1.2.9 (e)
4-3.1.2.9 (f)
4-3.1.2.9 (g)
4-3.1.2.9 (h)
4-3.1.2.9 (i)

Cross Reference

4-3.1.2.4 Station Outlets

New Table 4-3.1.2.4 for color coding, standard pressures and symbology.

4-3.1.2.3 (f), (m), & (n)
4-3.1.2.4(e)
4-3.1.2.4(f)
4-3.1.2.4(g)

4-3.1.2.6 Manufactured Assemblies

4-3.1.2.6 (a)
4-3.1.2.6 (a) 1
4-3.1.2.6 (a) 2
Key
Text in **Green** indicates additions (new material) added to this edition
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### 1996

4-3.1.2.2 (e) 1 c
4-3.1.2.2 (e) 1 d
4-3.1.2.2 (e) 1 e
4-3.1.2.2 (e) 2
4-3.1.2.2 (e) 2 a
4-3.1.2.2 (e) 2 b
4-3.1.2.2 (e) 2 c

### 1999

4-3.1.2.6 (a) 3
4-3.1.2.6 (a) 4
4-3.1.2.6 (a) 5
4-3.1.2.6 (b)
4-3.1.2.6 (b) 1
4-3.1.2.6 (b) 2
4-3.1.2.6 (b) 3

### 4-3.1.2.3 Installation Requirements

**4-3.1.2.3(a) General**

4-3.1.2.3(a) 1 Clean Materials
4-3.1.2.3(a) 2 On Site Cleaning
4-3.1.2.3(b) Qualification of Brazing Procedures

#### 4-3.1.2.3(b) 1 Basic requirement
Qualification by sectioning, pull test or macroetching of a test coupon

4-3.1.2.3(b) 1a Qualification test
4-3.1.2.3(b) 1b
4-3.1.2.3(b) 1c
4-3.1.2.3(b) 1d
4-3.1.2.3(b) 1d i
4-3.1.2.3(b) 1d ii
4-3.1.2.3(b) 1d iii
4-3.1.2.3(b) 1e
4-3.1.2.3(b) 1f

#### 4-3.1.2.3(b) 2 On site qualification of Brazers

#### 4-3.1.2.3(c) Brazed Joints

### 4-3.1.2.10 Installation Requirements

**First sentence is deleted.** Second sentence is moved to 4-3.1.2.10 (a) 3

**Deleted, but see 4-3.1.2.7, 4-3.1.2.8 and 4-3.1.2.10**

### 4-3.1.2.7(f)

### 4-3.1.2.1 (c)

### 4-3.1.2.12 Qualification of Brazing Procedures

#### 4-3.1.2.12 (a) Macroetching is no longer an acceptable test.

#### 4-3.1.2.12 (b)

#### 4-3.1.2.12 (c)

#### 4-3.1.2.12 (d)

#### 4-3.1.2.12 (d) 1 Procedures no longer can be qualified to ASME/ AWS but must meet NFPA 99

#### 4-3.1.2.12 (d) 2

#### 4-3.1.2.12 (d) 3

#### 4-3.1.2.12 (e)

#### 4-3.1.2.12 (f)

### 4-3.1.2.12 (f)

### 4-3.1.2.8 (b) Brazed Joints

#### 4-3.1.2.8 (b) 1

#### 4-3.1.2.8 (b) 2

#### 4-3.1.2.8 (b) 3 Reaming is now required

#### 4-3.1.2.8 (b) 4

#### 4-3.1.2.8 (b) 5 (c)

#### 4-3.1.2.8 (b) 6
defective joints may be repaired twice.

4-3.1.2.3(d) Threaded Joints

4-3.1.2.3(d)1
4-3.1.2.8 (a) 1 Threaded Joints are limited to connections for pressure gauges, pressure switches, and similar
4-3.1.2.8 (b) 11 defective joints may be repaired once.

4-3.1.2.3(d)2
4-3.1.2.8 (a) 2
4-3.1.2.8 (a) 3

4-3.1.2.8 (b) 7
4-3.1.2.8 (b) 8
4-3.1.2.8 (b) 9
4-3.1.2.8 (b) 10

4-3.1.2.8 (b) 11 defective joints may be repaired once.

4-3.1.2.8 (a) Threaded Joints

4-3.1.2.8 (a) 1 Threaded Joints are limited to connections for pressure gauges, pressure switches, and similar
4-3.2.2.2 (j) buried piping must be enclosed in a “continuous split enclosure”

4-3.2.2.3 Vacuum System Valve Boxes
4-3.2.2.4 Vacuum System Valves not in Boxes
4-3.2.2.5 Vacuum System Station Inlets
4-3.2.2.6 Vacuum System Shutoff Valves
4-3.1.2.3 (a)

4-3.2.2.7 Vacuum System Station Inlets
4-3.2.2.7 (f)
4-3.2.2.8 Master Alarm for Vacuum Systems
4-3.2.2.8 (a)
4-3.2.2.9 Area Alarms for Vacuum Systems
4-3.2.2.9 (d)
4-3.2.2.10 Vacuum System Gauges
4-3.2.2.10 (a)

4-3.2.2.11 Installation of Vacuum System Piping

4-3.3 WAGD Systems
4-3.3.1 Source-Level 1
4-3.3.1.1 General
4-3.3.1.2 Dedicated WAGD
4-3.3.1.3 WAGD using Med-Surg Vacuum
4-3.3.1.4 WAGD by Venturi

4-3.3.2 Distribution Level 1 WAGD
4-3.3.2.1 WAGD Distribution Network
4-3.3.2.2 WAGD Valves and Dampers
4-3.3.2.3 WAGD Inlets
4-3.3.2.4 WAGD Alarms
4-3.3.2.5 WAGD Network Installation
4-3.4 Performance Criteria and Testing - Level 1
4-3.4.1 Piped Gas Systems

4-3.4.1.1 General

“certify” the system(s)
4-3.4.1.1 ¶4 Test the entire system following a breach.

4-3.4.1.1 ¶5 Submit test reports documenting corrections

4-3.4.1.2 Installer Testing

Perform installer pressure test with walls open.

4-3.4.1.2 (c) Standing Pressure Test
4-3.4.1.2 (d) Piping Purge Test
4-3.4.1.2 (e) Cross Connection Test

4-3.4.1.3 System Verification

4-3.4.1.3 (e) Particulate test 25% of the zones

4-3.4.1.3 (h) 6 An additional criteria for Oxygen and air outlets flow has been added - a transient flow.

4-3.4.1.4 Source Equipment Verification

4-3.4.1.4 (b) 2b Air quality test shall be performed after a minimum of 24 hours of operation.

General note on changes in the testing requirements:
The testing requirements have been re-ordered to reflect general practice. Thus the test for the standing pressure test now follows the purge test instead of preceding it as in earlier editions.

4-3.4.2 Piped Vacuum Systems - Level 1

4-3.4.2.1 Performance

4-3.4.2.2 Testing

4-3.4.2.2 (b) 2 Standing Pressure Test Perform this test with the walls open.
4-3.4.2.2 (b) 3 Initial Cross-Connection Test

4-3.4.3 WAGD Systems

4-3.4.3.1
4-3.4.3.2

Cross Reference

Table 4-3.4.1.4 Table has been completely reworked
4-3.4.2 Piped Vacuum Systems - Level 1
4-3.4.2.1 Performance
4-3.4.2.2 Testing
4-3.4.2.2 (b) 2 Standing Pressure Test Perform this test as convenient.
4-3.4.2.2 (b) 3 Initial Cross-Connection Test
4-3.4.2.2 (c) 5 Source Equipment Verification

4-3.4.3 WAGD Systems
4-3.4.3.1
4-3.4.3.2
## Changes NFPA 99 1996 to 1999, Chapter 4

<table>
<thead>
<tr>
<th>1996</th>
<th>1999</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-3.4.3.3</td>
<td>4-3.4.3.3</td>
</tr>
<tr>
<td>4-3.4.3.4</td>
<td>4-3.4.3.4</td>
</tr>
<tr>
<td>4-3.4.3.5</td>
<td>4-3.4.3.5</td>
</tr>
<tr>
<td>4-3.4.3.6</td>
<td>4-3.4.3.6</td>
</tr>
<tr>
<td>4-3.5 Administration - Level 1</td>
<td>4-3.5 Administration - Level 1</td>
</tr>
<tr>
<td>4-3.5.1 Responsibility of Governing Body</td>
<td>4-3.5.1 Responsibility of Governing Body</td>
</tr>
<tr>
<td>4-3.5.2 Gas Systems Policies</td>
<td>4-3.5.2 Gas Systems Policies</td>
</tr>
<tr>
<td>4-3.5.2.1 Gases in Cylinders and Liquefied Containers - Level 1</td>
<td>4-3.5.2.1 Gases in Cylinders and Liquefied Containers - Level 1</td>
</tr>
<tr>
<td>4-3.5.2.1(b)25</td>
<td>4-3.5.2.1(b)25 An allowance has been made for single cylinders in use for immediate patient care. Such cylinders do not have to be kept in enclosures.</td>
</tr>
<tr>
<td>4-3.5.2.2 Storage of Cylinders and Containers - Level 1</td>
<td>4-3.5.2.2 Storage of Cylinders and Containers - Level 1</td>
</tr>
<tr>
<td>4-3.5.2.3 Patient Gas Systems - Level 1</td>
<td>4-3.5.2.3 Patient Gas Systems - Level 1</td>
</tr>
<tr>
<td>4-3.5.3 Gas Systems Recordkeeping - Level 1</td>
<td>4-3.5.3 Gas Systems Recordkeeping - Level 1</td>
</tr>
<tr>
<td>4-3.5.4 Gas Systems Information and Warning Signs</td>
<td>4-3.5.4 Gas Systems Information and Warning Signs</td>
</tr>
<tr>
<td>4-3.5.5 Gas System Transport and Delivery - Level 1</td>
<td>4-3.5.5 Gas System Transport and Delivery - Level 1</td>
</tr>
<tr>
<td>4-3.5.6 Vacuum System Policies - Level 1</td>
<td>4-3.5.6 Vacuum System Policies - Level 1</td>
</tr>
<tr>
<td>4-3.5.7 Vacuum System Recordkeeping - Level 1</td>
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</tr>
<tr>
<td>4-3.5.8 Vacuum System Information and Warning Signs</td>
<td>4-3.5.8 Vacuum System Information and Warning Signs</td>
</tr>
<tr>
<td>4-3.5.9 WAGD System Policies - Level 1</td>
<td>4-3.5.9 WAGD System Policies - Level 1</td>
</tr>
<tr>
<td>4-4 Level 2 Level 2 exists only as a “placeholder” in the 1996 edition.</td>
<td>4-4 Piped Gas Systems (Source and Distribution) Level 2 Level 2 is identical to Level 1 except: - Simplex compressors and air accessories are permitted</td>
</tr>
</tbody>
</table>

**Key**
- Text in **Green** indicates additions (new material) added to this edition
- Text in **Red** indicates material deleted from this edition
- Text in **Blue** indicates text which has changed. Requirements are generally the same.
- Text in **Magenta** indicates text which has been rewritten for clarity.
4-5 Level 3 Piped Systems
4-5.1 Piped Gas Systems (Source and Distribution)
Level 3
4-5.1.1 Source - Level 3
4-5.1.1.1
Cylinders are to be treated as in Level 1 by reference.
4-5.1.1.2 Source - Level 3
Level 1 requirements apply by reference

Note on 4-3.1.1.2 (b) and (c) These sections in the 1996 version are the sections often assumed to apply to “Level 3” installations. A careful reading will show that all of the Level 1 requirements apply except for the provision for locked gates (4-3.1.1.2 11 (c))

4-5.2 Piped Vacuum Systems
Level 2 is identical to Level 1 except simplex pumps are permitted.

4-5.3 Piped WAGD Systems
Level 2 is identical to Level 1 except simplex producers are permitted.

4-5.4 Performance Criteria and Testing
4-5.4.1 Piped Gases
As for Level 1
4-5.4.2 Piped Vacuum
As for Level 1
4-5.4.3 Piped WAGD
As for Level 1

4-5.5 Administration - Level 2
4-5.5.1 Responsibility of Governing Body
Reserved
4-5.5.2 Piped Gases
As for Level 1
4-5.5.3 Piped Vacuum
As for Level 1
4-5.5.4 Piped WAGD
As for Level 1

4-4.2 Piped Vacuum Systems
Level 2 is identical to Level 1 except simplex pumps are permitted.

4-4.3 Piped WAGD Systems
Level 2 is identical to Level 1 except simplex producers are permitted.

4-4.4 Performance Criteria and Testing
4-4.4.1 Piped Gases
As for Level 1
4-4.4.2 Piped Vacuum
As for Level 1
4-4.4.3 Piped WAGD
As for Level 1

4-4.5 Administration - Level 2
4-4.5.1 Responsibility of Governing Body
Reserved
4-4.5.2 Piped Gases
As for Level 1
4-4.5.3 Piped Vacuum
As for Level 1
4-4.5.4 Piped WAGD
As for Level 1
1996 | 1999
---|---
4-5.1.3 Level 3 Patient Gas Supply Systems | 4-5.1.3 Level 3 Patient Gas Supply Systems
4-5.1.1.4 Level 3 Gas Powered Devices Supply Systems | 4-5.1.1.4 Level 3 Gas Powered Devices Supply Systems
4-5.1.2 Distribution for Patients - Level 3 | 4-5.1.2 Distribution for Patients - Level 3
  4-5.1.2.1 | 4-5.1.2.1
  4-5.1.2.2 | 4-5.1.2.2
  4-5.1.2.3 | 4-5.1.2.3
  4-5.1.2.4 | 4-5.1.2.4
  4-5.1.2.5 | 4-5.1.2.5
  4-5.1.2.6 | 4-5.1.2.6
  4-5.1.2.7 | 4-5.1.2.7
  4-5.1.2.8 Warning Systems | 4-5.1.2.8 Warning Systems
    4-5.1.2.8 (d) | The wording for medical gas master alarms (4-3.1.2.1 (b) 3e is inserted here. (partially redundant to 4-5.1.2.8 (a)), but adds the 20% above and below operating pressure alarm requirement.
    4-5.1.2.8 (e) | Some wording changes
  4-5.1.2.9 Pressure Gauges | 4-5.1.2.9 Pressure Gauges
    Guages must be cleaned for oxygen service and marked “Use No Oil”
4-5.1.2.10 Gas Piping | 4-5.1.2.10 Gas Piping
  4-3.1.2.2(a) is incorporated by reference | The wording of 4-3.1.2.7 has been inserted with changes.
Except soft tubing (ASTM B-88) is allowed up to 1/2” OD | 4-5.1.2.10 (a) 3a When piping is installed in a slab, soft annealed tubing (ASTM B-88) may be used
4-5.1.2.1 0 (a)3b The tube must pass through a conduit.
4-5.1.2.1 0 (a)3c No joints may exist below the slab
4-5.1.2.1 0 (a)3d Except that outlets may be installed after the tubing is run.
4-5.1.2.1 0 (a)3e Testing is the same as for standard pipe.

Except that flared fittings are permitted.
4-5.1.2.1 (a)4 Flared fittings are limited to outlets and manifolds where exposed.

The limitation on flexible connectors is not present in Level 3 systems
4-5.1.2.10 (h)3 On site cleaning is allowed with limitations in Level 3 Systems.

4-5.1.2.11 Shut off Valves
Section 4-3.1.2.2 (b)4 is incorporated by reference
4-5.1.2.12 Gas Station Outlets
Section 4-3.1.2.4 is inserted with changes. Floor mounting provision is retained.
Manufactured Assemblies may be connected using DISS or noninterchangeable semi-permanent connector.

4-5.1.3  Distribution for Gas Powered Devices Level 3
Note on 4-5.1.3 - This section is intended for application to systems providing tool power. The requirements are a subset of the requirements for patient gas systems reflecting the less critical intended use of these systems.
4-5.1.3.1(c) Joints may be brazed, soldered or threaded.
4-5.1.3.1(e) Inserted from 4-3.1.2.9 (c)
4-5.1.3.1(f) Inserted from 4-3.1.2.9 (f)
4-5.1.3.1(g) Inserted from 4-3.1.2.9 (g)
4-5.1.3.1(h) Inserted from 4-3.1.2.2 (a) 16

4-5.2 Piped Vacuum Systems - Level 3
4-5.2.1 Source
4-5.2.2 Distribution
4-5.3 WAGD - Level 3
4-5.4 Performance Criteria and Testing - Level 3
4-5.4.1 Piped Patient Gas Systems
4-5.4.1.1 General
4-5.4.1.3 System Verification and Final Testing

Changes NFPA 99 1996 to 1999, Chapter 4
Changes NFPA 996 to 1999, Chapter 4

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Text in Blue indicates text which has changed. Requirements are generally the same.
Text in Magenta indicates text which has been rewritten for clarity.

1996 1999

4-5.4.1.3 (c) 4-5.4.1.3 (c) the wording of 4-3.4.1.2 (e) is inserted here.
4-5.4.2 Piped Gas-Powered Devices Gas Systems 4-5.4.2 Piped Gas-Powered Devices Gas Systems
4-5.4.3 Piped Vacuum Systems 4-5.4.3 Piped Vacuum Systems
4-5.4.4 Piped WAGD 4-5.4.4 Piped WAGD

4-5.5 Administration - Level 3 4-5.5 Administration - Level 3
4-5.5.1 Responsibility of Governing Body 4-5.5.1 Responsibility of Governing Body

4-5.5.2 Gas Systems Policies 4-5.5.2 Gas Systems Policies
4-5.5.2.1 4-3.5.2.1 is incorporated by reference
4-5.5.2.1 (c)2d Additional wording differentiating between types of regulator is inserted here
4-5.5.2.1 (c)2d or system is added noting that these procedures apply to systems as well as apparatus
4-5.5.2.2 4-3.5.2.2 is inserted here in part
4-5.5.2.2 (a) The second sentence, dealing with anesthetising locations is removed. The third sentence dealing with fastening cylinders in storage locations is removed. The fourth sentence dealing with cylinders stored in anesthetising locations is removed.
The section from 4-3.5.2.2 (b)3 dealing with outdoor storage of cylinders is removed

4-5.5.2.3 Patient Gas Systems - Level 3 4-5.5.2.3 Patient Gas Systems - Level 3
4-5.5.2.3 (b) section exempts veterinary facilities from some provisions.
4-5.5.2.3 (c) 4-3.1.1.3 is incorporated by reference.
4-3.5.2.3 (c) is incorporated by reference.

4-5.5.3 Gas System Recordkeeping - Level 3 4-5.5.3 Gas System Recordkeeping - Level 3

Cross Reference
4-5.5.4 Gas System Information and Warning Signs
4-5.5.5 4-3.5.5 is incorporated by reference.
4-5.5.6 Vacuum Systems Policies
4-5.5.7 Vacuum Systems Recordkeeping
4-5.5.8 Vacuum Systems Information and Warning Signs
4-5.5.9 WAGD Policies
4-6 Level 4 Piped Systems
4-6.1 Piped Gas Systems - Level 4
4-6.2 Piped Vacuum - Level 4
4-6.3 Piped WAGD - Level 4
4-6.4 Performance Criteria and Testing - Level 4
4-6.5 Administration - Level 4

Chapters 12-20 Occupancy Specific Requirements

Occupancies: Chapters 12 - 19

In the 1996 edition, Chapters 12 - 17 cover:
12: Hospitals
13: Ambulatory Health Care Centers
14: Clinic
15: Medical Dental Office
16: Nursing Home
17: Limited Care Facilities
18: Home Care
19: Hyperbaric Facilities

In the 1999 edition, Chapters 12 - 17 cover:
12: Hospitals
13: Other
14: reserved
15: reserved
16: Nursing Home
17: Limited Care Facilities
18: Home Care
19: Hyperbaric Facilities
20: Freestanding Birthing Center

A “decision tree” has been added to each of chapters 12-17 (see X-3.4) to help determine what level of system applies.
C-4.3.4 Recommended Vacuum Source Sizing
This sizing methodology, which has been part of the appendix since the incorporation of the NFPA 56K, was missing a critical piece in the 1996 edition. Part of the material was in Appendix A and part was in Appendix C. The lost piece has been restored, and the entire methodology has been relocated to Appendix C.

B-1.2.6 The CGA E-10 “Maintenance of Medical Gas and Vacuum Systems in Healthcare Facilities” is an added reference. This document is obtained from the Compressed Gas Association.