

# 3 COMPRESSED GAS SAFETY

4  
5 NIST S 7101.61

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9

## 10 1. PURPOSE

11 The purpose of this program is to establish requirements to minimize the potential hazards  
12 associated with compressed gases in cylinders, vessels, and systems.  
13  
14

## 15 2. BACKGROUND

- 16 a. NIST P 7100.00 articulates NIST’s commitment to making occupational safety and health an  
17 integral core value and vital part of the NIST culture, in part by complying with applicable  
18 laws, regulations, and other promulgated safety and health requirements.  
19
- 20 b. The content of this suborder was derived primarily from applicable Compressed Gas  
21 Association (CGA P-1) and National Fire Protection Association (NFPA) Codes/Standards  
22 (NFPA 45, NFPA 55, NFPA 70, and NFPA 704). The hazard definitions and numeric ratings  
23 in this suborder are based on NFPA definitions. These are similar to the definitions published  
24 in the 1994 version of Occupational Safety and Health Administration (OSHA) standard 29  
25 CFR 1910.1200 – *Hazard Communication*.  
26
- 27 c. Compressed gases are subject to the requirements of NIST S 7101.59: *Chemical Hazard*  
28 *Communication* and NIST S 7101.60: *Chemical Management*.  
29
- 30 d. This suborder supersedes the NIST *Health and Safety Instruction No. 5 – Compressed Gas*  
31 *Cylinders*.  
32  
33

## 34 3. APPLICABILITY

- 35 a. The provisions of this suborder apply to all NIST employees and covered associates<sup>2</sup> whose  
36 work activities involve use or storage of compressed gases.

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<sup>1</sup> The revision history for this document can be found in Appendix A.

<sup>2</sup> See NIST O 7101.00: Occupational Safety and Health Management System.

37 b. Site-specific Engineering and Administrative controls that are not practical at non-NIST sites  
38 do not apply as long as equally protective local controls and practices, consistent with  
39 applicable standards, are implemented by the host entity. Equivalency shall be determined  
40 by the OU in consultation with OSHE, as warranted.  
41

42

#### 43 4. REFERENCES<sup>3</sup>

44 a. Compressed Gas Association (CGA) Pamphlet C-6, Standards for Visual Inspection of Steel  
45 Compressed Gas Cylinders.

46

47 b. CGA Pamphlet C-7, Guide to Preparation of Precautionary Labeling and Marking of  
48 Compressed Gas Containers.

49

50 c. CGA Pamphlet C-8, Standard for Requalification of DOT-3HT, CTC-3HT, and TC-3HTM  
51 Seamless Steel Cylinders.

52

53 d. CGA Pamphlet P-1, Safe Handling of Compressed Gases in Containers.

54

55 e. CGA Pamphlet P-19, Recommended Hazard Ratings for Compressed Gases.

56

57 f. CGA Pamphlet P-20, Standard for Classification of Toxic Gas Mixtures.

58

59 g. CGA Pamphlet S-1.1, Pressure Relief Device Standards Part 1 – Cylinders for Compressed  
60 Gases.

61

62 h. CGA Pamphlet S-1.2, Pressure Relief Device Standards Part 2 – Portable Containers for  
63 Compressed Gases.

64

65 i. Industrial Ventilation, a Manual of Recommended Practice, American Conference of  
66 Governmental Industrial Hygienists (ACGIH).

67

68 j. International Organization for Standardization (ISO) Standard 10156, Gas Cylinders – Gases  
69 and Gas Mixtures – Determination of Fire Potential and Oxidizing Ability

70

71 k. ISO 10298, Determination of Toxicity of a Gas or Gas Mixture.

72

73 l. NFPA 45, Fire Protection for Laboratories Using Chemicals.

74

75 m. NFPA 50A, Gaseous Hydrogen Systems at Consumer Sites.

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<sup>3</sup> Where no date is specified, the most recent version applies.

- 76 n. NFPA 51, Design and Installation of Oxygen-Fuel Gas Systems for Welding, Cutting, and  
77 Allied Processes.  
78
- 79 o. NFPA 51B, Cutting and Welding Processes.  
80
- 81 p. NFPA 55, Compressed and Liquefied Gases in Portable Containers.  
82
- 83 q. NFPA 70, National Electric Code (NEC)  
84
- 85 r. NFPA 72, Installation, Maintenance, and Use of Protective Signaling Systems.  
86
- 87 s. NFPA 497, Recommended Practice for the Classification of Flammable Liquids, Gases, or  
88 Vapors and of Hazardous (Classified) Locations for Electrical Installations in Chemical  
89 Process Areas.  
90
- 91 t. NFPA 704, Identification of the Fire Hazards of Materials.  
92
- 93 u. Odor Thresholds for Chemicals with Established Occupational Health Standards, American  
94 Industrial Hygiene Association.  
95
- 96 v. OSHA Standard 29 CFR §1910.101, Compressed Gases (general requirements).  
97
- 98 w. OSHA Standard 29 CFR §1910.307, Hazardous (Classified) Locations  
99
- 100 x. Pocket Guide to Chemical Hazards, DHHS (NIOSH), Pub. No. 90-117, National Institute of  
101 Occupational Safety and Health LBNL/PUB-3122, Maintenance Program Guidelines for  
102 Programmatic Equipment.  
103
- 104 y. Threshold Limit Values for Chemical Substances and Physical Agents, ACGIH.  
105  
106
- 107 **5. APPLICABLE NIST DIRECTIVES**
- 108 a. NIST S 7101.20: [Work and Worker Authorization \(Based on Hazard Review\)](#)  
109
- 110 b. NIST S 7101.21: [Personal Protective Equipment \(PPE\)](#)  
111
- 112 c. NIST S 7101.22: *Hazard Signage*  
113
- 114 d. NIST S 7101.23: [Safety Education and Training](#)  
115

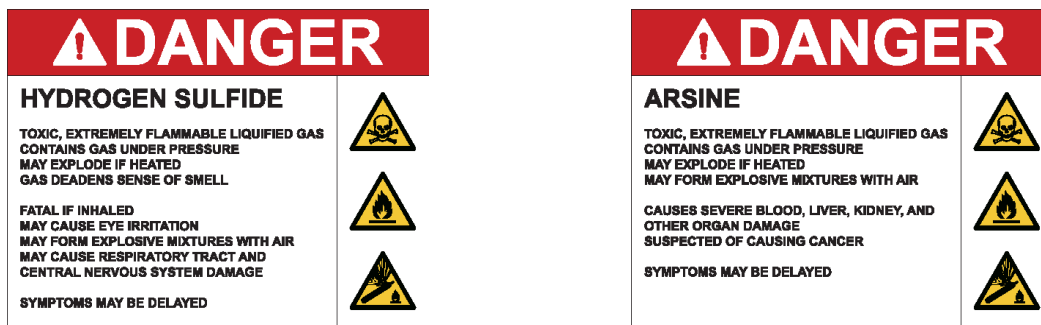
- 116 e. NIST S 7101.58: [Respiratory Protection](#)
- 117
- 118 f. NIST S 7101.59: [Chemical Hazard Communication](#)
- 119
- 120 g. NIST S 7101.60: [Chemical Management](#)
- 121
- 122 h. NIST P 7400.00: [Fire and Life Safety](#)
- 123
- 124 i. NIST S 7401.02: [Inspection, Testing, and Maintenance of Fire Protection and Life Safety](#)
- 125 [Systems](#)
- 126
- 127

128 **6. REQUIREMENTS**

- 129 a. General Requirements for the Use of Compressed Gases<sup>4</sup>

130 (1) Area Signage where Highly Toxic Gases are Present

- 131
- 132
- 133 (a) All entrances to areas containing cylinders, vessels, or systems containing highly
- 134 toxic gases or gases with an NFPA 704 health hazard rating of 4 shall be marked with
- 135 a “DANGER” sign in accordance with NIST S 7101.20: Hazard Signage. See
- 136 examples in Figure 1.
- 137



138 **Figure 1: Specific Hazard Signs for Areas Containing Highly Toxic Gases**

- 139 (2) Area Signage where Compressed Gases are Present
- 140

<sup>4</sup> Apart from hazard signage, consideration of the chemical hazards associated with the use of specific gases is covered separately in NIST S 7101.60: Chemical Management.

141 (a) If smoking is not already prohibited in and near areas containing compressed gases,  
142 signs shall be posted in such areas stating that smoking is prohibited within 25 ft (7.6  
143 m) of the storage or use area perimeter.<sup>5</sup> See an example in Figure 2.  
144



145  
146  
147  
148

**Figure 2: Smoking Prohibited Sign**

149 (3) Ventilation of Compressed Gases

- 150
- 151 (a) If compressed gases are introduced into laboratory fume hoods, steps must be taken to  
152 ensure that there is no backflow from the fume hood into the surrounding space.  
153
- 154 (b) Local and general exhaust systems used to exhaust hazardous gases shall be  
155 constructed of materials that are compatible with the gases to be exhausted.  
156
- 157 (c) Incompatible gases shall be exhausted using separate ventilation systems.  
158
- 159 (d) Ventilation systems that will handle flammable gases at concentrations of 10 percent  
160 of their Lower Explosive Limit or greater must be explosion-proof and have non-  
161 sparking exhaust fans.  
162
- 163 (e) Vacuum pumps, high-pressure systems, and pressure-relief devices protecting  
164 equipment to be attached to compressed gas cylinders, vessels, or systems containing  
165 flammable, toxic, or otherwise hazardous gases should be vented directly outdoors or  
166 through an exhaust hood discharging away from windows and doors, and no less than  
167 50 feet (ft) (15 meters (m)) from intakes of air-handling systems, air-conditioning  
168 equipment, and air compressors. If these requirements cannot be met, or their intent  
169 can be met using a different approach, the applicable hazard review must identify  
170 alternative controls that provide an equivalent level of safety.  
171

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<sup>5</sup> Smoking is prohibited in NIST buildings and within 25 ft of building entrances and air intakes.

172 (4) Gas Detection Systems for Toxic and Highly Toxic Compressed Gases  
173

174 (a) A continuous gas detection system shall be provided for the indoor storage or use of  
175 all toxic or highly toxic compressed gases in cylinders, vessels, or systems, except for  
176 toxic gases that have physiological warning properties at a level below the OSHA  
177 Permissible Exposure Limit (PEL) or ACGIH Threshold Limit Value (TLV),  
178 whichever is lower.<sup>6</sup>  
179

180 i. A continuous gas detection system may also be appropriate for other  
181 hazardous gases, including flammables, pyrophorics, oxidizers, and  
182 corrosives, particularly in cases where there are special hazards (for example,  
183 as in the case of continuous operations that are unattended). This shall be  
184 decided on a case-by-case basis during the applicable hazard review.  
185

186 (b) The gas-detection system shall detect the presence of gas at or below the ACGIH  
187 TLV, OSHA PEL, or ceiling limit of the gas, whichever is lowest, at all of the  
188 following locations:  
189

- 190 i. In the room or indoor area in which the gas is used (the point of use);  
191  
192 ii. At the location of the source container, cylinder, or tank used for delivery of  
193 the gas to the point of use;  
194  
195 iii. In the room or area in which the gas is stored; and  
196  
197 iv. At the point of discharge of the exhaust system from gas cabinets, exhausted  
198 enclosures, and gas rooms, if the point of discharge is not outside the building.  
199

200 (c) The gas detection system shall detect the presence of the gas at one-half of the  
201 Immediately Dangerous to Life and Health (IDLH) level or less at the discharge from  
202 any exhaust or waste gas treatment system that is present.  
203

204 (d) The gas-detection system shall initiate a local alarm that is both audible and visible.  
205

206 (e) All personnel who may be in the area of a local alarm shall be trained in the  
207 recognition of the alarms and in the appropriate response in the case of an alarm.  
208

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<sup>6</sup> Contact OSHE at x5375, Option 3 to determine if this requirement applies to a specific compressed gas.

209 (f) Gas detection systems shall be required to transmit a signal to a constantly attended  
210 monitoring station for any location that contains two or more compressed gas  
211 cylinders of toxic or highly toxic gas. The attending organization shall develop  
212 response protocols for each different alarm.

213  
214 (g) Activation of the gas detection system at a location where compressed gas is hooked  
215 up to a system shall automatically shut off the flow of the compressed gas related to  
216 the system being monitored.

217  
218 i. An automatic shutdown shall not be required for chemical reactors used to  
219 produce toxic or highly toxic gases when those reactors are operated at  
220 pressures less than 103.4 kPa<sup>7</sup> (15 psig), constantly attended, and have readily  
221 accessible, emergency-shutoff valves.

222  
223 (h) Newly installed and modified existing combustible gas detectors, oxygen depletion  
224 sensors, and toxic gas detectors shall be commissioned in accordance with NFPA 3,  
225 *Recommended Practice for Commissioning of Fire Protection and Life Safety*  
226 *Systems*, 2015 edition.

227  
228 Refer to NIST S 7401.02: *Inspection, Testing, and Maintenance of Fire Protection*  
229 *and Life Safety Systems* for additional information.

230  
231 (i) Combustible gas detectors, oxygen depletion sensors, and toxic gas detectors shall be  
232 commissioned, inspected, tested, and maintained in accordance with:

233  
234 i. NFPA 72, *National Fire Alarm and Signaling Code*, 2013 edition; and  
235  
236 ii. Manufacturer instructions.

237  
238 Refer to NIST S 7401.02: *Inspection, Testing, and Maintenance of Fire Protection*  
239 *and Life Safety Systems* for additional information.

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<sup>7</sup> Pressure measurements are “gauge pressure”, the pressure relative to ambient atmospheric pressure.

240 (5) Personal Protective Equipment

241

242 (a) Personal protective equipment (PPE), including respiratory protection as applicable,  
243 shall be used when working with compressed gases, as required by the applicable  
244 hazard review.<sup>8</sup>

245

246 (6) Eyewashes and Showers

247

248 (a) An eyewash station and/or safety shower shall be provided in each area where  
249 corrosive gases are used. Refer to NIST S 7101.60: *Chemical Management* for  
250 additional information.

251

252 b. Compressed Gas Cylinders

253

254 (1) Purchasing Compressed Gas Cylinders

255

256 (a) The smallest volumes and numbers of compressed gas cylinders needed to conduct  
257 the work effectively shall be purchased.

258

259 (b) Returnable lecture bottles should be purchased whenever possible.

260

261 (2) Point-of-Delivery Inspection of Compressed Gas Cylinders

262

263 Employees and associates who receive compressed gas cylinders from outside vendors  
264 shall conduct point-of-delivery inspections of the cylinders in accordance with the  
265 following considerations.<sup>9</sup> Employees and associates who receive compressed gas  
266 cylinders from other individuals within NIST are encouraged to conduct such inspections.  
267 Any cylinder not meeting these considerations should not be accepted.<sup>10</sup>

268

269 (a) Labeling Requirements

270

271 i. It shall be verified that the compressed gas cylinder is labeled and that the  
272 label contains the following information:

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<sup>8</sup> The MSDS/SDS for the chemical product will provide guidance on appropriate PPE. The NIOSH Pocket Guide to Chemical Hazards provides guidance on the selection of proper respiratory protection. Personnel shall consult with OSHE prior to using respiratory protection.

<sup>9</sup> For the purposes of this section, the Storeroom, Logistics Group, Facilities Services Division, Office of Facilities and Property Management in Gaithersburg (hereafter referred to as "Storeroom") is not considered an external vendor.

<sup>10</sup> If a cylinder not meeting these considerations has been accepted, contact OSHE at x5375, Option 3.



- 274 (i) Product identifier; and  
275  
276 (ii) Words, pictures, symbols, or combination thereof, which provide at  
277 least general information regarding the hazards of the compressed gas,  
278 and which, in conjunction with the other information immediately  
279 available to employees and associates under NIST S 7101.59:  
280 *Chemical Hazard Communication*, will provide employees and  
281 associates with the specific information regarding the physical and  
282 health hazards of the compressed gas.  
283

284 (b) Visual Inspection  
285

- 286 i. It shall be verified that the compressed gas cylinder is free of visible signs of  
287 damage, *e.g.*, cuts, digs, gouges, dents, bulging, corrosion.  
288

289 (c) Leak Testing  
290

- 291 i. It is recommended that compressed gas cylinders containing toxic, highly  
292 toxic, corrosive, or flammable gases are leak tested using a hand-held direct-  
293 reading thermal conductivity meter (preferred method) or a liquid soap  
294 solution or commercially available liquid leak detection solution. If the  
295 cylinder cap does not have openings in it, it must be removed before  
296 performing the leak test.  
297

298 (d) Valid Hydrostatic or Ultrasonic Test Date<sup>11</sup>  
299

- 300 i. It shall be verified that the compressed gas cylinder has a valid hydrostatic or  
301 ultrasonic test date clearly indicated on the cylinder, typically stamped near  
302 the shoulder or into the valve guard ring welded to the cylinder, if present.  
303 This testing is performed by the vendor or supplier prior to refilling a  
304 cylinder.<sup>12</sup>  
305

306 (i) Most cylinders require a hydrostatic or ultrasonic test every 5 years.  
307

308 (ii) Certain steel cylinders require testing only once every 10 years. These  
309 can be recognized by the five-pointed star stamped after the test date.  
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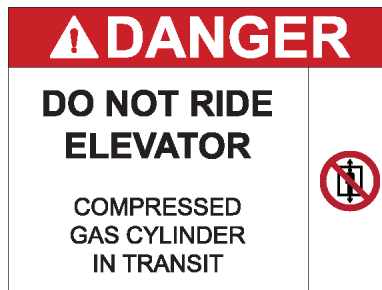
<sup>11</sup> Contact OSHE at x5375, Option 3, with questions or concerns.

<sup>12</sup> A cylinder may remain onsite, either in use or in storage, beyond its retest date. Retesting is only required when a cylinder is refilled and then transported in public. Retesting is also appropriate any time a cylinder had been damaged or potentially weakened, such as by being in a fire. [See DOT regulation 49 CFR 180.205(c)].

311 (3) Transport of Compressed Gas Cylinders

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- (a) Gas cylinders shall not be dragged, rolled on their sides, slid, or allowed to strike each other forcefully. Cylinders may be moved short distances (5-10 ft) by rolling them on their bottom edges.
- (b) When lifting a cylinder with a crane, hoist, or derrick, an appropriate lifting device, such as a cradle or net, shall be used. Cylinders shall not be lifted with magnets or slings.
- (c) Cylinders must never be lifted by their valve caps or valve guards.
- (d) Cylinders transported by truck shall be fastened securely so that they will not fall or strike each other.
- (e) Once delivered to the user, cylinders being moved more than a short distance (5-10 ft) shall only be transported in a cart or vehicle equipped to secure the cylinder in place.
  - i. Such carts or vehicles shall be inspected for defects prior to use.
  - ii. Cylinders weighing 11 Kg (25 lb) or less may be hand-carried.
- (f) If a cylinder is to be transported in an elevator, the elevator should be unoccupied, and a sign stating, “Gas Cylinder in Transit, Do Not Ride”, or equivalent, should be attached to the gas cylinder cart or the interior of the elevator. An example is shown in Figure 3. Once the gas cylinder has been placed in the elevator and the desired floor selected, the gas cylinder should be met at the selected floor.



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342  
343

**Figure 3: Sign for Transporting Compressed Gas Cylinder in Elevator**

- 344 i. Special care should be taken in moving compressed gas cylinders onto and off  
345 elevators with regard to both the elevator threshold and the opening and  
346 closing of the elevator doors.  
347  
348 ii. No one not actually engaged in transporting a compressed gas cylinder on an  
349 elevator shall be permitted in the elevator while a cylinder is in transit.  
350  
351 (g) Cylinders shall only be moved or transported with the regulator removed and the  
352 valve protection cap properly secured.  
353  
354 i. It is acceptable to move or relocate a cylinder within an individual laboratory  
355 space (*i.e.*, a single room) without removing the regulator provided the  
356 cylinder is secured and transported on a stable cart.  
357

#### 358 (4) Storage of Compressed Gas Cylinders 359

- 360 (a) Gas cylinders shall be stored only in indoor and outdoor storage areas that have been  
361 determined by a hazard assessment to meet the requirements of applicable  
362 regulations, codes, and standards, especially NFPA 45 and 55.<sup>13</sup>  
363  
364 i. Gas cylinders shall not be stored in laboratories [see Section 6b(5)(c),  
365 Maximum Number of Cylinders in Use].<sup>14</sup>  
366  
367 (b) Gas cylinders shall be stored in such areas in accordance with the requirements of  
368 applicable regulations, codes, and standards, especially NFPA 45 and 55.  
369  
370 (c) Cylinders shall not be stored in the delivery cages at Building 1 in Boulder. All  
371 cylinders shall be moved out of these cages as soon as possible after the person that  
372 ordered them is notified of their arrival, preferably that same day. Cylinders shall  
373 never stay in a cage for more than two days.  
374  
375 (d) Cylinders Stored in Building Loading Docks in Gaithersburg.<sup>15</sup>

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<sup>13</sup> For assistance in establishing new indoor or outdoor storage areas, or of modifying existing storage areas, contact OSHE at x5375, Option 3.

<sup>14</sup> A request for variance (RFV) may be submitted to the NIST AHJ by a Division Chief (or equivalent) detailing the programmatic need for storing gas cylinders in a laboratory. The NIST AHJ will evaluate the request from a safety and regulatory compliance standpoint and either approve or disapprove it. The NIST AHJ will document its evaluation and provide it to the requesting Division Chief. If the request is approved, the NIST AHJ's evaluation must be appended to appropriate hazard review(s).

<sup>15</sup> A request for waiver (RFW) may be submitted to the Chief Safety Officer by a Division Chief (or equivalent) detailing the programmatic need for exceeding the storage timeframes. In this case, the Storeroom in Gaithersburg

376 i. Cylinders of normally-stocked gases may be stored in building loading docks  
377 for no more than 30 days.

378  
379 ii. Cylinders of non-stocked (special order) gases may be stored in building  
380 loading docks for no more than 90 days.

381  
382 (e) Cylinders containing liquified flammable gases and flammable gases in solution shall  
383 be positioned in the upright position.

384  
385 i. Cylinders with a water capacity of 5 liters (1.3 gallons) or less shall be  
386 permitted to be stored in a horizontal position.

387  
388 ii. Cylinders designed for use in a horizontal position shall be permitted to be  
389 stored in a horizontal position.

390  
391 (f) Cylinders of flammable gases shall not be stored near highly flammable solids or  
392 liquids such as oil, gasoline, flammable solvents, or near combustible waste material,  
393 or similar substances. Cylinders of flammable gases, including small cylinders such  
394 as lecture bottles, shall not be stored in flammable storage cabinets if flammable or  
395 combustible solids or liquids are also present in the cabinet.

396  
397 (5) Handling and Use of Compressed Gas Cylinders

398  
399 (a) General Requirements

400  
401 i. Cylinders shall be secured at all times to prevent them from falling or being  
402 knocked over by securing them to a gas cylinder cart, framework, or fixed  
403 object by use of a restraint. Restraints shall be used in such a way that they  
404 secure each cylinder individually.<sup>16</sup>

405  
406 (i) Restraints designed for the purpose of restraining cylinders should be  
407 used.

408  
409 (ii) In locations with large numbers of compressed gas cylinders, nesting  
410 using a contiguous 3-point contact system may be utilized. For more

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and the OU responsible for managing the loading-dock storage area [see Section 9.a(2)] will be included in the safety evaluation of the request.

<sup>16</sup> The best practice for larger cylinders (e.g., 55 inches tall) is to apply one restraint one third of the way up the cylinder and a second restraint two thirds of the way up the cylinder. If only one restraint is available, it should be applied between one half and two thirds of the way up the cylinder.

411 information, refer to the definition of "nesting" in Section 7 and  
412 Appendix A of CGA P-1.

- 413
- 414 ii. Cylinders containing liquified flammable gases and flammable gases in  
415 solution shall be used in the upright position unless they are specifically  
416 designed for use in a horizontal position.
- 417
- 418 iii. Compressed gas cylinders, containers, and tanks shall not be placed where  
419 they could become a part of an electrical circuit.
- 420
- 421 iv. Compressed gas cylinders containing toxic, highly toxic, corrosive, or  
422 flammable gases should be leak tested before being put into service using a  
423 hand-held direct-reading thermal conductivity meter (preferred method) or a  
424 liquid soap solution or commercially available liquid leak detection solution.  
425 If the cylinder cap does not have openings in it, it must be removed before  
426 performing the leak test.
- 427
- 428 v. Static producing equipment located in flammable gas areas shall be grounded.
- 429 vi. Heating, where provided, shall be by indirect means. Equipment used for  
430 heating applications in rooms or areas where flammable gases are stored or  
431 used shall be listed and labeled for use in hazardous environments established  
432 by the gases present and shall be installed in accordance with the conditions of  
433 the listing and the manufacturer's installation instructions.
- 434
- 435 vii. When not in service, regulators shall be removed and valve protection caps  
436 that are not integrated into the cylinder design (and hence technically never  
437 removed) properly secured.
- 438
- 439 viii. One oxygen cylinder and one fuel gas cylinder may be located side-by-side on  
440 the same cart for welding and cutting, as long as they are in use or connected  
441 for use. When not in use or connected for use, the cylinders must be capped,  
442 removed from the cart, and placed in properly segregated storage areas, unless  
443 the cart is equipped with a five foot high, half hour rated fire wall located  
444 between the two cylinders, in which case the cylinders may remain on the cart  
445 even when not in use or connected for use.
- 446
- 447 ix. Cylinders, even when partially empty, shall never be heated by any device that  
448 could raise the surface temperature of the cylinder to above 52° C (125° F).
- 449

- 450 x. Cylinders should not be emptied to pressures lower than 172 kPa (25 psig)  
451 when such pressures could result in contaminants back-flowing into the  
452 cylinders and carrying over to when the cylinders are refilled and reused.  
453
- 454 xi. Refilling or transfilling of cylinders shall be performed only by personnel  
455 who:
- 456 (i) Are properly trained and/or qualified to refill or transfill cylinders;  
457  
458 (ii) Have the proper equipment to refill or transfill cylinders;  
459  
460 (iii) Have approved hazard reviews and written operating procedures for  
461 refilling or transfilling cylinders; and  
462  
463 (iv) Are familiar with the precautions necessary to avoid the hazards of the  
464 product being handled.  
465  
466
- 467 xii. If a cylinder is connected to a closed system where there is a possibility of  
468 flow reversal, the cylinder shall be shut off and removed from the system  
469 while the pressure remaining in the cylinder is still greater than the pressure in  
470 the closed system.

471 (b) Valves and Regulators

- 472
- 473 i. Cylinder pressure shall be reduced through a regulator mounted to the  
474 cylinder-valve outlet or through a manifold.  
475
- 476 ii. The cylinder valve shall be closed as soon as the necessary amount of gas has  
477 been released. The cylinder valve shall never be left open when the  
478 equipment is not in use, including when the cylinder is empty.  
479
- 480 iii. The cylinder valve, not the regulator, shall be used for turning gas off when  
481 the cylinder is not in use.  
482
- 483 iv. Only standard combinations of valves and fittings, as specified in CGA  
484 Standard V-1, or equivalent DIN or ISO standards, shall be used.  
485
- 486 v. Cylinders that are opened with a valve spindle or stem instead of a hand-  
487 wheel shall have a spindle key on the spindle while the cylinder is in service.  
488

489 vi. If tools are required to open cylinder caps or valves, only wrenches or tools  
490 specified by the manufacturer or supplier shall be used; tools shall not be  
491 used that could damage the cylinder, cylinder cap, or valve, or result in the  
492 valve being unintentionally opened while the cap is in place.

493

494 vii. Screwdrivers shall never be used to pry off a stuck cap.

495

496 viii. Pliers shall never be used to open a cylinder valve.

497

498 (c) Maximum Number of Cylinders in a Laboratory or Work Area

499

500 i. Cylinders not “in use” shall not be stored in the laboratory unit<sup>17</sup>.

501

502 ii. A compressed gas cylinder shall be considered to be “in use” if it is in  
503 compliance with one of the following:

504

505 (i) Connected through a regulator to deliver gas to a laboratory operation;  
506 or

507

508 (ii) Connected to a manifold being used to deliver gas to a laboratory  
509 operation; or

510

511 (iii) A single cylinder secured alongside the cylinder connected through a  
512 regulator to deliver gas to a laboratory operation as a reserve cylinder.

513

514 (iv) The restriction against keeping cylinders that are not “in use” in a  
515 laboratory may not apply to laboratories that handle only chemicals  
516 with a hazard rating of 0 or 1 for health, flammability, and instability,  
517 as defined in NFPA 704, or in situations where storing a cylinder in a  
518 laboratory does not create an additional hazard. See footnote 17  
519 regarding requesting an exception.

520

521 iii. Quantities of compressed and liquefied gases in laboratories and work areas  
522 shall be in accordance with NFPA 55.<sup>18</sup>

523

524 (i) The number of lecture-bottles in use or reserve shall be limited to 25  
525 per lab or work area.

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<sup>17</sup> Variances are possible under certain circumstances to increase the maximum number of cylinders in a space.  
Please contact OSHE for assistance at x5375, option #3.

<sup>18</sup> For assistance in determining quantity limits, contact OSHE at x5375, Option 3

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(6) Mechanically Ventilated Enclosures and Gas Cabinets

(a) Lecture bottle-sized cylinders of the following gases located in laboratories shall be kept in continuously mechanically ventilated hoods or other continuously mechanically ventilated enclosures:

- i. All gases that have a NFPA 704 health hazard rating of 3 or 4;
- ii. All gases that have a NFPA 704 health hazard rating of 2 without physiological warning properties such as odor or irritation; and
- iii. Pyrophoric gases.

(b) Compressed gas cylinders that are larger than lecture bottles and contain the following gases shall be kept in approved continuously mechanically ventilated, sprinklered gas cabinets:

- i. All gases that have a NFPA 704 health hazard rating of 3 or 4;
- ii. All gases that have a NFPA 704 health hazard rating of 2 without physiological warning properties; and
- iii. Pyrophoric gases.

(c) Gas cabinets shall be constructed in accordance with NFPA 55.

(d) Gas cabinets shall be tested before they are put into service for any of the following events to ensure that the velocity at the face of the access ports or windows, with the access port or window open, is at least 200 ft per minute (fpm) average, and at least 150 fpm at each single point of measurement:

- i. Installation;
- ii. Modification; or
- iii. Repaired.

(e) Gas cabinets shall be tested annually to ensure they meet the criteria listed in Section 6.b(6)(d).



- 565 (f) Gas cabinets shall be used as follows:  
566  
567 i. Gas cabinets shall contain no more than three containers, cylinders, or tanks;  
568 and  
569  
570 ii. Incompatible gases shall be stored and used in separate gas cabinets.  
571

572 (7) Disposition of Empty and No-Longer-Needed Compressed Gas Cylinders  
573

574 (a) When a cylinder is emptied to a pressure of 172 kPa (25 psig), the following actions  
575 shall be taken:

- 576  
577 i. The regulator shall be removed;  
578  
579 ii. If the cylinder is designed to take a valve cap, the valve cap shall be installed;  
580  
581 iii. The cylinder shall be marked as empty; and  
582  
583 iv. The cylinder shall be returned to the storage area for pickup.  
584

585 (b) If the contents of a cylinder are unknown or appropriate DOT labeling is not present  
586 on the cylinder, the cylinder shall not be moved from the laboratory. OSHE shall be  
587 contacted to assist with the identification of the cylinder contents and to provide  
588 guidance on appropriate disposal procedures.  
589

590 (c) Lecture bottles shall not be abandoned in building loading docks or other storage  
591 areas.  
592

593 (d) Chemical Waste Pick-Up requests shall be submitted to OSHE for pick-up and  
594 disposal of empty and no-longer-needed lecture bottles.  
595

596 c. Compressed Gas Vessel and System Design  
597

598 (1) System Design  
599

600 (a) All systems shall be designed and constructed in accordance with the references listed  
601 in Section 4 of this suborder.  
602

- 603 (b) Supply, piping, valves, connections, *etc.*, must be placed in such a way that they can  
604 be inspected and will not release into an occupied area without sufficient ventilation  
605 to prevent an oxygen-deficient atmosphere.  
606
- 607 (c) If reserve cylinders or back-up supplies are connected, the arrangement shall preclude  
608 discharge of reserve cylinders during normal operation of primary supply.  
609
- 610 (d) Systems shall be designed to be free of cross-connections that could allow gas to pass  
611 from a section of the system where the gas is intended to be present to a section of the  
612 system where the gas is not intended to be present.  
613
- 614 (e) Tubing  
615
- 616 i. Sharp tube bends shall be avoided. Tubing shall not be bent more sharply  
617 than recommended by the manufacturer.  
618
  - 619 ii. Flexible or plastic tubing shall only be used within "line of sight."  
620
  - 621 iii. Flexible tubing lengths shall be kept as short as possible, shall be protected  
622 from mechanical damage, and shall be anchored at the ends to prevent  
623 whipping in case of tubing or tube-fitting failure.  
624
  - 625 iv. Flexible tubing connections shall be secured with clamps approved for the  
626 maximum allowable pressure subjected to the connection. Flexible tubing  
627 connections shall not be secured with wire.  
628
- 629 (f) Valves  
630
- 631 i. The number and placement of valves shall be sufficient to facilitate  
632 maintenance, and to isolate systems for renovation and in case of emergency.  
633
  - 634 ii. Continuous access to valves located above ceilings, in utility rooms, or behind  
635 equipment shall be maintained.  
636
  - 637 iii. Valves shall be provided on each line running from a supply line to equipment  
638 so the equipment can be isolated for maintenance, repair, or replacement.  
639
  - 640 iv. Where fuel gas is permitted, a shut-off valve shall be provided immediately  
641 adjacent to the safety cabinet or hood or other location where the gas is used.  
642

- 643 v. On liquefied-gas systems, all terminal-block (liquid-withdrawal) valves shall:  
644  
645 (i) Be rated above the vapor pressure of the liquid gas at 38 degrees  
646 Celsius (°C) (100 degrees Fahrenheit (°F)); or  
647  
648 (ii) Have properly set relief valves permanently installed on the outlet side  
649 of each terminal-block valve.  
650

651 (g) Gauges  
652

- 653 i. Gauges subject to pressure surges or cyclic pulses shall be protected by  
654 installing a needle valve or orifice for damping.  
655  
656 ii. When large pressure gauges (over 100 mm in face diameter) are used on gas  
657 systems with operating pressures over 1.4 MPa (200 psig) or on liquid  
658 systems over 140 MPa (20,000 psig), they shall have a special safety-type  
659 design including:  
660  
661 (i) Shatterproof faces;  
662  
663 (ii) Solid fronts; and  
664  
665 (iii) Blowout or generously vented cases.  
666

667 If a large pressure gauge is used that does not have a special safety-type  
668 design, operators must be protected by a Lexan safety shield that is securely  
669 mounted over the existing gauge face, or the equivalent.  
670

671 (h) Flammable Gas-Specific Requirements  
672

- 673 i. Systems using flammable gases shall be designed to prevent a release in  
674 concentrations that are within flammable limits.  
675  
676 (i) Intentional release of any flammable gas indoors, even outside of  
677 flammable limits, must have prior approval of the NIST Authority  
678 Having Jurisdiction (AHJ). Please contact OSHE to request this  
679 approval.  
680  
681 ii. When using flammable gas-air mixtures, a flame arrester shall be utilized to  
682 prevent flashback.

- 683           iii.    When using a flammable gas in the absence of an oxidizer, a flame arrester  
684                   shall be required if a risk of flashback exists e.g. where air could infiltrate via  
685                   a leak in a closed system  
686
- 687           iv.    Backflow prevention or check valves shall be provided where the backflow of  
688                   a gas could create a hazardous condition, e.g. backflow of air into a closed  
689                   system via a purge line.  
690
- 691           v.    Electrical and electronic equipment and wiring that is to be used in gas  
692                   systems or locations where fire or explosion hazards may exist due to  
693                   flammable gases must be approved for that use.  
694
- 695                   (i)    The approval shall be from a nationally recognized testing laboratory  
696                   such as Factory Mutual Insurance Co. (FM Global) or Underwriter’s  
697                   Laboratory (UL).  
698
- 699                   (ii)   The potential hazard shall be categorized by Class and Division in  
700                   accordance with Occupational Safety and Health Administration  
701                   (OSHA) regulation 29 CFR 1910.307 and NFPA 70, Article 500.  
702
- 703                           (a) Class I: Class I locations are those in which flammable gases,  
704                           flammable liquid–produced vapors, or combustible liquid–  
705                           produced vapors are or may be present in the air in quantities  
706                           sufficient to produce explosive or ignitable mixtures.  
707
- 708                           (b) Class I, Division 1: A Class I, Division 1 location is a location (1)  
709                           In which ignitable concentrations of flammable gases, flammable  
710                           liquid–produced vapors, or combustible liquid–produced vapors  
711                           can exist under normal operating conditions.  
712
- 713                           (c) Class I, Division 2: A Class I, Division 2 location is a location (1)  
714                           In which volatile flammable gases, flammable liquid–produced  
715                           vapors, or combustible liquid–produced vapors are handled,  
716                           processed, or used, but in which the liquids, vapors, or gases will  
717                           normally be confined within closed containers or closed systems  
718                           from which they can escape only in case of accidental rupture or  
719                           breakdown of such containers or systems or in case of abnormal  
720                           operation of equipment.  
721

722 (2) Pipes, Tubing, and Component Materials

723

724 (a) Gas pipes, valves, fittings, regulators, and related components must be constructed of  
725 materials compatible with the gases to be contained and must be rated for the service.  
726 Stainless steel components are preferred in most systems. Where nonmetallic tubing  
727 is approved, additional controls may be required.

728

729 (b) Pipes and Tubing

730

731 i. Nonmetallic tubing shall not be used on flammable, toxic, and/or radioactive  
732 gas systems.

733

734 ii. Flexible tubing shall not be used for highly toxic gases.

735

736 (c) Fittings

737

738 i. Brass fittings shall be used with copper or brass tubing.

739

740 ii. Stainless-steel fittings shall be used with steel or stainless-steel tubing.

741

742 (3) Labeling of Gas Lines Emanating from Enclosures

743

744 (a) Each compressed gas line outside of the source gas cabinet or ventilated enclosure  
745 must be labeled:

746

747 i. At least every 6 m (20 ft) unless the gas line is shorter than 6 m (20 ft) and the  
748 gas line and gas source are in sight;

749

750 ii. At critical shutoff valves;

751

752 iii. At wall, floor, or ceiling penetrations; and

753

754 iv. As otherwise necessary to provide clear identification.

755

756 (b) Labels must be durable and display the gas name and direction of gas flow.

757

758 (c) Piping that may contain more than one type of gas at various times shall be marked to  
759 provide clear identification of that fact.

760

- 761 (4) System Testing  
762
- 763 (a) Prior to operation, all newly constructed, newly installed, and remodeled compressed  
764 gas systems shall be tested per all applicable codes and standards as well  
765 as manufacturer specifications.  
766
  - 767 (b) Prior to operation, all lines and equipment shall be leak tested with an inert gas.  
768
- 769 (5) Inspection and Repair  
770
- 771 (a) Flexible tubing shall be inspected for aging, deterioration, and damage with a  
772 frequency in accordance with the manufacturer's recommendations.  
773
  - 774 (b) Any tubing showing leaks, burns, wear, or other defects shall be repaired or replaced  
775 immediately. The vessel or system shall not be used until the defective part is  
776 repaired or replaced.  
777
- 778 (6) Deviations from the Requirements of Sections 6c(1)-(5)  
779
- 780 (a) When requirements for specialized compressed gas vessels or systems make it  
781 impossible to comply with any of the provisions of Sections 6c(1)-(5), measures must  
782 be implemented to provide a level of protection equivalent that provided by these  
783 provisions.  
784
  - 785 (b) Any deviations from these provisions shall be identified as part of the applicable  
786 hazard review, and the alternative measures implemented documented therein.  
787
  - 788 (c) Alternative measures may include the following:  
789
    - 790 i. Ventilated enclosures;
    - 791
    - 792 ii. Gas detectors;
    - 793
    - 794 iii. Emergency off buttons;
    - 795
    - 796 iv. Emergency power;
    - 797
    - 798 v. Pneumatic shut-off valves;
    - 799
    - 800 vi. Smoke detectors;

- 801           vii.     Fire sprinklers;
- 802
- 803           viii.    Exhaust scrubbers;
- 804
- 805           ix.     Flow restrictors; and
- 806
- 807           x.     Ventilation alarms.
- 808

809 d. Hazardous Material Release

810

811       (1) In the case of an accidental or uncontrolled release, excluding a small amount that may be  
812           released during a cylinder exchange, of a hazardous compressed gas, the individual that  
813           discovers the release shall warn others in the immediate area, move to a safe location, and  
814           report the leak.

815

816           (a) In Boulder, the incident shall be reported by dialing 911 for Boulder Fire-Rescue and  
817           x7777 for NIST Police.

818

819           (b) In Gaithersburg, the incident shall be reported by dialing x2222 for NIST Emergency  
820           Services.

821

822           (c) Ignition sources in the vicinity of leaking flammable gas should be turned off if it is  
823           obvious that this can be done safely.

824

825 e. Training

826

827       (1) Training provided by OSHE on the Compressed Gas Safety Program and activity-specific  
828           training required by applicable hazard reviews shall be assigned and documented, and its  
829           completion by affected employees and associates recorded, in accordance with the  
830           requirements, roles, and responsibilities of NIST S 7101.23: *Safety Education and*  
831           *Training*. In particular:

832

833           (a) Employees and associates who are to engage in activities involving compressed gases  
834           shall complete:

835

836           i.     The training provided by OSHE on the Compressed Gas Safety Program; and

837

838           ii.    The activity-specific training, provided by their Organizational Units, required  
839           by applicable hazard reviews.

840

841 (b) The official first-level supervisors of employees and associates who are to engage in  
842 activities involving compressed gases shall complete the training provided by OSHE  
843 on the Compressed Gas Safety Program.  
844  
845

## 846 7. DEFINITIONS

- 847 a. Asphyxiant – A material capable of reducing oxygen in a person’s body to dangerous levels,  
848 most commonly caused by displacing breathable air in an enclosed environment.  
849
- 850 b. Ceiling Limit – An occupational exposure limit that should not be exceeded during any part  
851 of the working exposure. If instantaneous exposure levels cannot be determined, an average  
852 exposure over a 15-minute time period is generally used.  
853
- 854 c. Compressed Gas – A material, or mixture of materials, that (1) is a gas at 20°C (68°F) or less  
855 at an absolute pressure of 101.325 kPa (14.696 psia) and (2) that has a boiling point of 20°C  
856 (68°F) or less at an absolute pressure of 101.325 kPa (14.7 psia) and that is liquefied, non-  
857 liquefied, or in solution, except those gases that have no other health or physical hazard  
858 properties are not considered to be compressed gases until the pressure in the packaging  
859 exceeds an absolute pressure of 280 kPa (40.6 psia) at 20°C (68°F).  
860
- 861 d. Compressed Gas Cylinder (Cylinder) – A pressure vessel designed for pressures higher than  
862 276 kPa (40 psia) and having a circular cross-section. It does not include a portable tank,  
863 multiunit tank car tank, cargo tank, or tank car.  
864
- 865 e. Corrosive Gas – A gas that causes visible destruction of, or irreversible alterations in,  
866 materials or living tissue by chemical action at the site of contact.
- 867 f. Design Pressure – The maximum pressure at which a vessel or the weakest member of a  
868 pressure system has been designed to safely function at the normal operating temperature.  
869 Also the maximum setting of a pressure-relief device on a vessel or pressure system.  
870
- 871 g. Exception – A condition for which a requirement does not apply because the condition falls  
872 outside of the scope or intent of the requirement.  
873
- 874 h. Flammable Gas – Any substance that exists in the gaseous state at normal atmospheric  
875 temperature and pressure and is capable of being ignited and burned when mixed with the  
876 proper proportions of air, oxygen, or other oxidizers.  
877
- 878 i. Highly Toxic Gas – A gas that can kill 50 percent of the test subjects (LC<sub>50</sub>) with a  
879 concentration of less than or equal to 200 parts per million (ppm), a gas that has an ACGIH  
880 TLV or OSHA PEL of one ppm or less, or a gas designated as a “Poison A” by the DOT and



- 881 defined as a poisonous gas of such nature that a very small amount of the gas mixed with air  
882 is dangerous to life. Lists of LC<sub>50</sub> values for toxic gases and vapors are available in ISO  
883 10298. (An NFPA 704 Health Hazard rating of 4 is given to gases having an LC<sub>50</sub> in air of  
884 less than or equal to 1000 ppm.)  
885
- 886 j. Hydrostatic Test – A test of the strength and leak-resistance of a compressed gas cylinder by  
887 internal pressurization with a test liquid.  
888
- 889 k. Immediately Dangerous to Life or Health (IDLH) – Defined by NIOSH as exposure to  
890 airborne contaminants that is "likely to cause death or immediate or delayed permanent  
891 adverse health effects or prevent escape from such an environment."  
892
- 893 l. Lecture Bottle – A small compressed gas cylinder up to a size of approximately 5 centimeters  
894 in diameter and 33 centimeters tall ( 2 in. x 13 in.).  
895
- 896 m. Nesting – A method of securing flat-bottom cylinders upright in a tight mass using a  
897 contiguous three-point contact system whereby all cylinders within a group have a minimum  
898 of three points of contact with other cylinders, walls, or bracing (see CGA P-1, Appendix A).  
899
- 900 n. Operating Pressure – The maximum pressure at which a vessel or pressure system is intended  
901 to be used under normal circumstances. This will generally be 5 percent to 25 percent lower  
902 than the design pressure for systems protected by a spring-loaded relief device and  
903 approximately 33 percent lower than the design pressure for systems protected by rupture-  
904 disk relief devices, depending on the fatigue life of the disc used, the temperature, and load  
905 pulsation.  
906
- 907 o. Oxidizing Gas – A gas that can initiate or support combustion and can accelerate the  
908 combustion of other materials.  
909
- 910 p. Oxygen-Deficient Atmosphere – An atmosphere containing less than 19.5 percent oxygen by  
911 volume.  
912
- 913 q. Permissible Exposure Limit (PEL) –A legally enforceable occupational exposure limit  
914 established by OSHA that sets the maximum time-weighted average concentration of an air  
915 contaminant that workers may be exposed to over an 8-hour workday of a 40-hour  
916 workweek.  
917
- 918 r. Pressure Relief Valve – A device designed to open at a predetermined pressure in order to  
919 prevent an unsafe rise of internal pressure in a pressure vessel or system.

- 920 s. Pyrophoric Gas – A chemical in a gaseous state that will ignite spontaneously in air at a  
921 temperature of 54.4°C (130°F) or below.  
922
- 923 t. Regulator – A device that controls the release of gas from cylinders or other vessels.  
924
- 925 u. Safety Data Sheet (SDS/MSDS) – A document produced by chemical manufacturers or  
926 importers in accordance with 29 CFR 1910.1200 to relay chemical, physical, and hazard  
927 information about specific substances.  
928
- 929 v. Storage Area – A designated area, either indoors or outdoors, where cylinders that are not  
930 being used, loaded, or unloaded are stored safely for future use, and to which cylinders that  
931 are empty are returned for pickup.  
932
- 933 w. Threshold Limit Value (TLV) – A recommended occupational exposure limit established by  
934 ACGIH, which is the time-weighted average of a contaminant to which nearly all workers  
935 may be repeatedly exposed day after day without adverse health effects.  
936
- 937 x. Toxic Gas – A gas with an LC<sub>50</sub> between 200 ppm to 2,000 ppm, or a gas that has an ACGIH  
938 TLV or OSHA PEL between 1 ppm to 50 ppm. Lists of LC<sub>50</sub> values for toxic gases and  
939 vapors are available in ISO 10298. (An NFPA 704 Health Hazard rating of 3 is assigned to  
940 gases having LC<sub>50</sub> air concentrations between 1,000 ppm to 3,000 ppm.)  
941
- 942 y. Transfilling – Transfer of compressed gas from one container to another.  
943
- 944 z. Variance – Authorization to have an alternative means of providing an equal or greater  
945 degree of safety (*i.e.*, equivalency) than that afforded by strict conformance to:  
946
- 947 • NIST-adopted codes and standards overseen by the NIST AHJ; or
  - 948
  - 949 • NIST-specific requirements originating from AHJ interpretations and implementation of  
950 these same adopted codes and/or standards.  
951

952 Variances do not exempt a requester from the requirement(s) and its intent.<sup>19</sup>  
953

---

<sup>19</sup> The codes “establish the minimum requirements to provide a reasonable level of safety, public health and general welfare” to building occupants. The code allows for AHJ discretion in the interpretation of the code and implementation of “policies and procedures to clarify the application of its provisions.” The code also allows for more stringent requirements to be implemented to meet the intent of the code and align with the needs of the occupants and occupancies. An individual requesting an equivalency from a more stringent NIST-specific requirement that originates from a general provision or minimum requirement in a code or standard must request a variance.

954 aa. Waiver – Authorization to have an alternative means of providing an equal or greater degree  
955 of safety (i.e. equivalency) than that afforded by strict conformance to the way NIST  
956 implements a NIST-specific requirement or regulatory requirement. Waivers do not exempt  
957 the requester from a regulatory requirement or NIST requirement, they simply permit a  
958 different means of compliance or implementation.<sup>20</sup>  
959  
960

## 961 **8. ACRONYMS**

962 a. ACGIH – American Conference of Governmental Industrial Hygienists  
963

964 b. AHJ – Authority Having Jurisdiction  
965

966 c. CFR – Code of Federal Regulations  
967

968 d. CGA – Compressed Gas Association  
969

970 e. CSO – Chief Safety Officer at NIST  
971

972 f. DOT – Department of Transportation  
973

974 g. IDLH – Immediately Dangerous to Life and Health  
975

976 h. ISO – International Organization for Standardization  
977

978 i. LC<sub>50</sub> – Lethal Concentration 50 Percent  
979

980 j. NFPA – National Fire Protection Association  
981

982 k. NIOSH – National Institute of Occupational Safety and Health  
983

984 l. OSHA – Occupational Safety and Health Administration  
985

986 m. OSHE – NIST Office of Safety, Health, and Environment  
987

988 n. PEL – Permissible Exposure Limit

---

<sup>20</sup> In some instances, the regulations task the employer with defining methods to implement requirements. For example, OSHA 1910.147(c)(5)(ii)(B) states that “Lockout and tagout devices shall be standardized within the facility in at least one of the following criteria: Color; shape; or size...” In this example, OSHA defers to the employer to establish a policy for lock color, shape, or size. If an individual wants to deviate from the requirements set forth by NIST regarding color, shape, or size of locks used for LOTO, they must request a waiver.

989 o. RFV – Request for Variance

990

991 p. RFW – Request for Waiver

992

993 q. TLV – Threshold Limit Value

994

995

996 **9. RESPONSIBILITIES**

997 a. OU Directors are responsible for:

998

999 (1) Ensuring that the requirements of Section 6 of this suborder are met in their OUs; and

1000

1001 (2) Determining which OU or division in an OU is responsible for managing gas cylinder  
1002 storage areas shared by multiple OUs.<sup>21</sup>

1003

1004 b. Chief Safety Officer is responsible for:

1005

1006 (1) Approving or disapproving all appeals of requests for variance (RFV) denied by the  
1007 NIST AHJ; and

1008

1009 (2) Approving or disapproving all requests for waiver (RFW).

1010

1011 c. Division Chiefs are responsible for:

1012

1013 (1) Submitting a RFV, RFW, and exception to the following requirements based on an  
1014 evaluation of programmatic need:

1015

1016 (a) Section 6b(4)(a)i regarding the storage of compressed gas cylinders in laboratories;

1017

1018 (b) Section 6b(4)(d)i-ii regarding the storage of compressed gas cylinders in loading  
1019 docks at NIST Gaithersburg, in consultation with the Storeroom; and

1020

1021 (c) Section 6b(5)(c)i regarding reserve cylinders being alongside cylinders in use.

1022

1023 d. NIST AHJ is responsible for:

1024

1025 (1) Making interpretations of the applicable codes/standards, deciding on the approval of  
1026 equipment and materials, and granting the special permission contemplated in some of

---

<sup>21</sup> For example, this responsibility could be assigned to the OU that is the heaviest user of gas cylinders in a particular storage area, or to a division in that OU.

1027 the rules, i.e., allowing deviation from specific requirements in the codes/standards or  
1028 permitting alternative methods where it is assured that equivalent objectives can be  
1029 achieved by establishing and maintaining effective safety; and

1030

1031 (2) Approving or disapproving RFVs.

1032

1033 e. Storeroom Supervisor is responsible for:

1034

1035 (1) Ensuring that compressed cylinders delivered to the Storeroom by outside vendors are  
1036 inspected in accordance with the requirements of Section 6b(2) on point-of-delivery  
1037 inspection of compressed gas cylinders;

1038

1039 (2) Delivering full compressed gas cylinders to building loading docks per customer orders;

1040

1041 (3) Not delivering compressed gas cylinders to building loading docks when storage rack  
1042 areas are unavailable to secure the cylinders safely;

1043

1044 (4) Ensuring that cylinders of normally-stocked gases stored in building loading docks for  
1045 more than 30 days are returned to the storeroom;

1046

1047 (5) Ensuring that cylinders of non-stocked (special order) gases stored in building loading  
1048 docks for more than 90 days are returned to the storeroom and then to the supplier; and

1049

1050 (6) Consulting with the NIST AHJ on the approval or disapproval of variances to the  
1051 requirements of Section 6b(4)(c)i-ii regarding the storage of compressed gas cylinders in  
1052 loading docks at NIST Gaithersburg.

1053

1054

1055 **10. AUTHORITIES**

1056 There are no authorities specific to this suborder.

1057

1058

1059 **11. DIRECTIVE OWNER**

1060 Chief Safety Officer

1061

1062

1063 **12. APPENDICES**

1064 a. Revision History

1065

1066  
1067

### Appendix A. Revision History

Revision	Date	Effective Date	Description of Change
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None	05/27/15	04/01/2016	None – initial document.
1	11/23/2020	TBD	<ul style="list-style-type: none"> <li>• Changed document dates to match current format.</li> <li>• Corrected typo in section 3.b.</li> <li>• Allowed transporting cylinders on cart with regulator attached within a room</li> <li>• Forbid storing flammable gas cylinders with other flammable materials</li> <li>• Added wording describing when oxygen and fuel gas cylinders could be together on a welding cart</li> <li>• Revised wording about “in use” cylinders to more closely match NFPA 45 and address exceptions</li> <li>• Added requirement to test new gas cabinets</li> <li>• Added requirements for releasing flammable gases indoors</li> <li>• Revised requirements for flame arresters and backflow prevention</li> <li>• Added requirement that electrical equipment be approved for hazardous locations</li> <li>• Added requirement for requesting variances and waivers</li> <li>• Added definitions for variance, waiver, and exception.</li> <li>• Modified Responsibilities Section to include responsibilities for requesting and approving variances and waivers</li> </ul>
2	07/09/2021	TBD	Footnote 17 modified to indicate variance and not exception is possible
3	02/14/2022	06/30/2023	<p>Administrative Revision/Correction: Reference to footnote in clause 6.b.(5)(c)ii(iv) corrected from footnote 12 to footnote 17.</p> <ul style="list-style-type: none"> <li>• NOTE: Effective date was originally TBD due to the COVID-19 pandemic. It was updated on 4/17/23.</li> </ul>

