OREGON OCCUPATIONAL SAFETY AND HEALTH DIVISION
DEPARTMENT OF CONSUMER AND BUSINESS SERVICES

PROGRAM DIRECTIVE

Program Directive A-186
Issued May 30, 1981
Revised February 2, 2017

SUBJECT: Compressed Gas: Securing Compressed Gas Cylinders

AFFECTED STANDARDS/ DIRECTIVES:
OAR 437-002-2101, Compressed Gases (General Requirements)
OAR 437-002-2102, Acetylene
OAR 437-002-2253, Oxygen-Fuel Gas Welding and Cutting
1926.350 Repealed with the adoption of OAR 437-002-2253

PURPOSE: This directive clarifies requirements for securing compressed gas cylinders in Oregon.

BACKGROUND: The National Welding Supply Association brought to federal OSHA's attention that citations were issued to its manufacturer and distributor members in various parts of the country by compliance officers attempting to apply the standard, 1926.350(a)(9), to the activity of compressed gas manufacturers and distributors. 1926.350 (Gas welding and cutting) applies to gas welding or cutting on a construction site; it does not apply to manufacturers and distributors of welding gases prior to delivery at the construction site. In addition, manufacturers and distributors have personnel experienced in the handling of the cylinders, capping of cylinders, racking cylinders with care, and storing the cylinders in an upright position. Continual chaining and unchaining, for example, of hundreds of cylinders as they move out of the plant and off the loading docks may produce other hazards.

On May 1, 2015, Oregon OSHA repealed 1926.350. 1926.350 was replaced by OAR 437-002-2253, the Oxygen-Fuel Gas Welding and Cutting rule, within Division 2, Subdivision Q. This rule applies to both general industry and construction activities engaged in oxygen-fuel gas welding, cutting, brazing, soldering and thermal spraying. There are additional Oregon OSHA rules for securing compressed gas cylinders when this rule does not apply. These include 437-002-2101 Compressed Gases (General Requirements), and 437-002-2102 Acetylene, both within Division 2, Subdivision H.

ACTION: Oregon OSHA staff will use the guidelines in this directive to verify compressed gas cylinders are properly secured from movement and to ensure the uniform application of the following regulations:

- 437-002-2101 Compressed Gases (General Requirements),
- 437-002-2102 Acetylene, and
- 437-002-2253 Oxygen-fuel Gas Welding and Cutting.

Appendix C of this program directive provides a summary of acceptable cylinder securing methods based on rule.

DEFINITIONS:

Secure *– Arrange to prevent movement (including lashing and chaining), or a minimum of three points of contact with other cylinders or walls.*

Definitions Note: Both 437-002-2102(1)(b) and 437-002-2253(2) define the term "secure" as stated above; however, 437-002-2101 does not define the term "secure."

This definition, as defined by 437-002-2102 and 437-002-2253, establishes two acceptable methods for restraining eligible compressed gas cylinders. The two methods will be identified in this program directive as Method A and Method B and are as follows:

1) **Method A:** Lashing and chaining

   When cylinder movement is prevented using Method A, then the guidance provided in Appendix A – Method A: Securing Cylinders with Lashing and Chaining beginning on page 11 of this Program Directive must be followed.

2) **Method B:** Three points of contact with other cylinders or walls

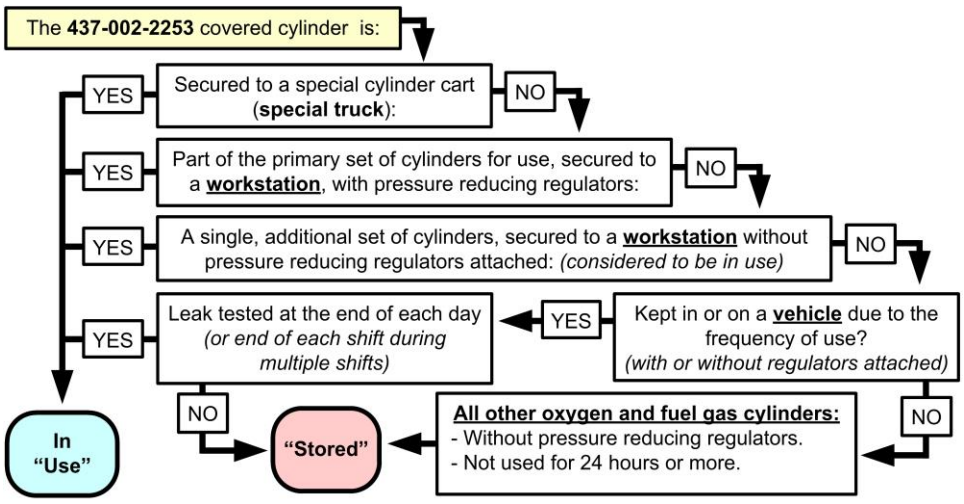
   When cylinder movement is prevented using Method B, then the guidance provided in Appendix B – Method B: Securing Cylinders with Three Points of Contact beginning on page 15 of this Program Directive must be followed.

Stored *– Cylinders without attached regulators, cylinders not secured to a workstation, or cylinders that have not been used for 24 hours or more will be considered stored. This does not include cylinders secured on a cart.*

NOTE 1: A cylinder(s) loaded into a vehicle for movement to a worksite or place of business is not in storage.

NOTE 2: Requirements for the separation of oxidizers and fuel gases do not apply when cylinders are being transported to a work site or place of business.

Definitions Note: 437-002-2253(2) defines the term "stored" as stated above; however, 437-002-2101 and 437-002-2102 do not define "stored." To assist in understanding when cylinders regulated by 437-002-2253 are "stored," use the following flow chart:



Use *– Withdrawing and using the gas in a non-recoverable manner for applications other than manufacturing or repackaging of compressed gasses.*

> **Definitions Note:** Both 437-002-2102(1)(b) and 437-002-2253(2) define the term "use" as stated above. 437-002-2101, by the incorporation of the Compressed Gas Association's (CGA) consensus standard Pamphlet P-1 2008, 11th Edition, defines the term "use" differently; however, it is substantially similar with the definition above. "Use" is defined by the CGA Pamphlet P-1 2008, 11th Edition as: *Act of withdrawing and applying the product gas in a nonrecoverable manner for applications other than manufacturing and/or repackaging of compressed gases.*

Valve end up *– The tops of all acetylene cylinders are elevated so that the cylinders are inclined at an angle of not less than 30 degrees from horizontal (to protect against loss of acetone).*

> **Definitions Note**: 437-002-2253(2) defines the phrase "valve end up" as stated above; however, both 437-002-2101 and 437-002-2102 do not define "valve end up."

INSPECTION GUIDANCE AND CITATION POLICIES:

A. OAR 437-002-2253, Oxygen-Fuel Gas Welding and Cutting

When fuel gases, including acetylene, propylene, propane and natural gas, are used with oxygen for welding and cutting in either general industry or construction, 437-002-2253 in Division 2, Subdivision Q applies. The following five activities are included in the scope of 437-002-2253(1) and are defined in 437-002-2253(2):

- Welding,
- Cutting,
- Soldering,
- Brazing, and
- Flame coating (thermal spraying).

Cylinders covered by this rule are considered to be either in "use" or "stored." They cannot be in a state of use and storage at the same time. Both of these terms are defined in 437-002-2253(2). The following three rules in this standard address securing compressed gas cylinders; one for cylinders in use and two for stored cylinders:

- 437-002-2253(8)(a)(A) – use
- 437-002-2253(6)(b)(B) – stored
- 437-002-2253(6)(h) – stored.

1. **OAR 437-002-2253(8)(a)(A).** Use of Oxygen and Fuel Gas Cylinders:

   When oxygen or fuel gas cylinders are in "use," they must be secured from movement as required by 437-002-2253(8)(a)(A).

   Inspection Guidance for cylinders in "use":

   Review the scope and application in 437-002-2253(1) to determine if the cylinders under review are covered by 437-002-2253. Verify that the cylinders are in "use" and not "stored." Evaluate compressed gas cylinders in storage in accordance with 437-002-2253(6)(b)(B) and 437-002-2253(6)(h). When cylinders are found to be in "use," evaluate the employer's method of restricting the cylinder's movement and the method's effectiveness. Cylinders that are in "use" are considered to be in compliance when the cylinders are:

   - Restricted from movement in accordance with Method A of the definition of "secure" in the DEFINITIONS section of this program directive, and
   - Positioned with the valve end up.

Due to attachments such as regulators, hoses, and torch sets, compressed gas cylinders in use are not eligible to be restricted from movement with Method B (three points of contact with other cylinders or walls) because the valve caps cannot be in place as required by 437-002-2253(6)(b)(A).

Citation Policy:

Consider citations for violations of 437-002-2253(8)(a)(A) when compressed gas cylinders are in "use" and are not:

- Restricted from movement in accordance with Method A of the definition of "secure" in the DEFINITIONS section of this program directive, and
- Positioned with the valve end up.

2. **OAR 437-002-2253(6)(b)(B)** Storage of Oxygen and Fuel Gas Cylinders:

When oxygen or fuel gas cylinders regulated by 437-002-2253 are "stored," they must be secured from movement as required by 437-002-2253(6)(b)(B) and 437-002-2253(6)(h).

Inspection Guidance for cylinders that are "stored":

Review the scope and application in 437-002-2253(1) to determine if the cylinders under review are covered by 437-002-2253. Verify that the cylinders are "stored" and not in "use." Evaluate compressed gas cylinders in use in accordance with 437-002-2253(8)(a)(A). When cylinders are "stored," evaluate the employer's method of restricting the cylinder's movement and the method's effectiveness. Cylinders that are "stored" are considered to be in compliance when the cylinders are:

- Restricted from movement in accordance with either Method A or Method B of the definition of "secure" in the DEFINITIONS section of this program directive, and
- Positioned with the valve end up.

Citation Policy:

Consider citations for violations of 437-002-2253(6)(b)(B) when compressed gas cylinders are "stored" and are not:

- Restricted from movement in accordance with either Method A or Method B of the definition of "secure" in the DEFINITIONS section of this program directive, and
- Positioned with the valve end up.

3. **OAR 437-002-2253(6)(h)** Storage of Oxygen and Fuel Gas Cylinders:

When oxygen or fuel gas cylinders regulated by 437-002-2253 are "stored," they must also be restricted from movement as required by 437-002-2253(6)(h) in addition to 437-002-2253(6)(b)(B). This rule requires the storage of oxygen and fuel-gases in cylinders, portable tanks, rail tank cars, or motor vehicle cargo tanks are in accordance with Compressed Gas Association (CGA) Pamphlet P-1 2008, 11th Edition, Safe Handling of Compressed Gases in Containers.

Compressed Gas Association (CGA) Pamphlet P-1 2008, 11th Edition, Section 5.8.4 Cylinder position in storage states the following:

"All compressed gas cylinders in service or in storage at user locations shall be secured to prevent falling or rolling. At gas suppliers' facilities and distributors' warehouses, the nesting of cylinders is considered an equivalent safe manner of storage. Nesting of cylinders might not be adequate in seismically active areas, so additional measures may be required to prevent the cylinders from falling (see Pamphlet P-1 2008, Appendix A). Properly secured gas cylinders may be stored in a horizontal position. "

Inspection Guidance for cylinders that are "stored":

Review the scope and application in 437-002-2253(1) to determine if the cylinders under review are covered by 437-002-2253. Verify that the cylinders are "stored" and not in "use." Evaluate compressed gas cylinders in use in accordance with 437-002-2253(8)(a)(A). When cylinders are "stored," evaluate the employer's method of restricting the cylinder's movement and the method's effectiveness. Cylinders that are "stored" are considered to be in compliance when the cylinders are:

- restricted from movement in accordance with either Method A or Method B of the definition of "secure" in the DEFINITIONS section of this program directive, and
- positioned with the valve end up.

Citation Policy:

Consider securing deviations from the Compressed Gas Association's Pamphlet P-1 2008, 11th Edition, Section 5.8.4 as de minimis when end users of compressed gas cylinders (those that

consume compressed gases in a non-recoverable way) as well as gas manufacturers and distributors (those that supply compressed gases to end users) secure cylinders in compliance with 437-002-2253(6)(b)(B).

B. OAR 437-002-2102 Acetylene

When acetylene is used for non-welding or non-cutting activities, 437-002-2102 Acetylene in Division 2, Subdivision H applies. The following is a partial list of activities regulated by this rule when acetylene is used:

Annealing, antiquing of wood, babbitting, descaling, flame hardening, flame softening, food preparation, glass finishing, heating bolts, leather edging, masonry curing, metal forming, paint burning, preheating, priming, and sculpture patina.

> **Note:** 437-002-2102 is a Division 2 standard that applies to general industry activities and does not directly apply to the construction industry. However, when a specific type of construction equipment, process or practice is not limited to the construction industry, the provisions contained in this rule can be applicable to the construction industry (see OAR 437-003-0005 Additional Applicability).

OAR 437-002-2102(1)(c)(A)(ii). Acetylene Cylinders General Requirements:

Acetylene cylinders must be secured from movement as required by 437-002-2102(1)(c)(A)(ii).

Inspection Guidance for acetylene cylinders:

Determine if the acetylene cylinders under review are covered by 437-002-2102 (Acetylene) or 437-002-2253 (Oxygen-Fuel Gas Welding and Cutting) based on the activity for which the acetylene is being used. Evaluate the employer's method of restricting the acetylene cylinders movement and the method's effectiveness. Acetylene cylinders with attachments installed such as regulators are considered to be in use and are not in storage. When attachments such as regulators are removed, the cylinders are in storage.

- (In Use) Cylinders that are in "use" are considered to be in compliance when the cylinders are restricted from movement in accordance with Method A of the definition of "secure" in the DEFINITIONS section of this program directive.

- (Storage) Cylinders in storage are considered to be in compliance when the cylinders are restricted from movement in accordance with either Method A or Method B of the definition of "secure" in the DEFINITIONS section of this program directive

Citation Policy:

a) Consider citations for violations of 437-002-2102(1)(c)(A)(ii) when acetylene cylinders are in "use" and are not restricted from movement in accordance with Method A of the definition of "secure" in the DEFINITIONS section of this program directive.

b) Consider citations for violations of 437-002-2102(1)(c)(A)(ii) when acetylene cylinders are in "storage" and are not restricted from movement in accordance with either Method A or Method B of the definition of "secure" in the DEFINITIONS section of this program directive.

C. **OAR 437-002-2101 Compressed Gases (General Requirements)**

When compressed gas cylinders such as helium, argon, carbon dioxide, and oxygen are used for activities not covered by 437-002-2253 Oxygen-fuel Gas Welding and Cutting or 437-002-2102 Acetylene, then this rule applies.

> **Note:** 437-002-2101 is a Division 2 standard that applies to general industry activities and does not directly apply to the construction industry. However, when a specific type of construction equipment, process or practice is not limited to the construction industry, the provisions contained in this rule can be applicable to the construction industry (see OAR 437-003-0005 Additional Applicability).

Cylinders must be restricted from movement as required by 437-002-2101(2). This rule requires the handling, storage, and utilization of all compressed gases in cylinders, portable tanks, rail tank cars, or motor vehicle cargo tanks to be in accordance with the Compressed Gas Association's (CGA) Pamphlet P-1 2008, 11th Edition, Safe Handling of Compressed Gases in Containers. This pamphlet applies to compressed gas users (end users) and gas suppliers. Section 5.8.4 of Pamphlet P-1 2008 does **not** allow compressed gas cylinders at end **user** locations to be nested. Nesting is a method that is functionally the same as Method B of the definition of "secure" in the DEFINITIONS section of this program directive. Pamphlet P-1 2008 allows gas

suppliers to nest flat bottomed cylinders. Pamphlet P-1 2008 defines "gas supplier," "nesting," and "user" as follows:

> ***Gas supplier*** *– "Business that produces, fills, and/or distributes compressed gases."*
>
> ***Nesting*** *– "Method of securing flat-bottomed cylinders upright in a tight mass using a contiguous three-point system whereby all cylinders within a group have a minimum of three points of contact with other cylinders, wall, or bracing."*
>
> ***User*** *– "Individual, group, or business entity that uses the containerized gas in a nonrecoverable manner."*

Inspection Guidance for compressed gas cylinders:

Based on the activity for which the compressed gas is being used, determine if the cylinders are covered by 437-002-2101 Compressed Gases (General Requirements) or whether 437-002-2253 (Oxygen-Fuel Gas Welding and Cutting) or 437-002-2102 (Acetylene) applies instead. Evaluate the employer's method of restricting the movement of the compressed gas cylinders and the method's effectiveness.

Citation Policy:

a) At end user locations, consider citations for violations of 437-002-2101(2) when compressed gas cylinders are not restricted from movement in accordance with Method A of this program directive. Reference in the variable language Section 5.8.4 of the Compressed Gas Association's (CGA) Pamphlet P-1 2008, 11th Edition, Safe Handling of Compressed Gases in Containers.

b) At gas supplier and gas distributor locations, consider citations for violations of 437-002-2101(2) when compressed gas cylinders are not restricted from movement in accordance with either Method A or Method B of the definition of "secure" in the DEFINITIONS section of this program directive.

EFFECTIVE DATE: This directive is effective immediately and will remain in effect until canceled or superseded.

History: Issued 10-1-1981 Revised 10-11-1993, 6-1-2001, 8-1-2002, 10-1-2013, and 2-2-2017

Appendix A –

Method A: Securing Cylinders with Lashing and Chaining

437-002-2102 (Acetylene) and 437-002-2253 (Oxy-fuel Gas Welding and Cutting) define the term "secure" the same. This definition identifies two acceptable methods for arranging cylinders to prevent movement. The two methods are:

1) "Lashing and chaining," and
2) "Three points of contact with other cylinders or walls."

This appendix describes "lashing and chaining" and is identified in this program directive as Method A.

Method A: Lashing and chaining

When cylinder movement is restricted using Method A, cylinders must be controlled from movement that could result in cylinders falling over, rolling, or striking other objects. The standards do not require both lashing and chaining to occur simultaneously, nor do the rules prescribe the minimum material specifications necessary to accomplish either lashing or chaining.

Cylinders vary greatly in height, diameter and weight. Each cylinder secured by Method A must be examined on a case-by-case basis. The evaluation of the method's effectiveness is performance-based. Figures B, C, D, E, and F in this appendix depict appropriate and inappropriate lashing/chaining designs. Compliance has been achieved when either lashing or chaining restricts cylinders from falling over, rolling, or striking other objects.

Method A: Material specifications:

Common material components generally used to secure cylinders from falling over, rolling, or striking other objects include (see Figure A):

- Anchorage
- Anchorage connectors
- Connector components (associated)
- Cradle
- Safety restraints

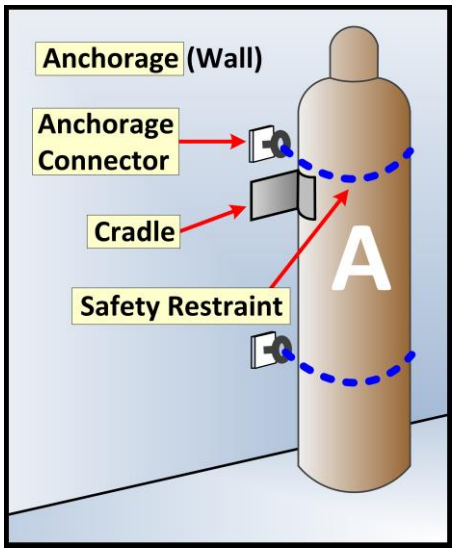


Figure A

Anchorages must be sturdy enough to support the forces applied to them from the cylinders, safety restraints and anchorage connectors. Anchorages are the integral supporting structure for the entire lashing or chaining system. Walls, workbenches, specifically designed cylinder carts (special trucks) and specially designed cylinder storage racks can be eligible examples of suitable anchorages based on an evaluation of their structural integrity.

Anchorage Connectors must be sturdy enough to support the forces applied to them from the cylinders and safety restraints. Anchorage connectors must be properly designed and installed to ensure that they cannot pull out, break off, or otherwise become unattached from the anchorage. Eye bolts and eye lag screws are examples of common anchorage connectors. Care must be taken to ensure that the selected anchorage connector is appropriate for attachment to the selected anchorage. For example, an eye lag screw installed only in drywall material may fail (pull-out) with minimal applied pressure.

Connector Components (associated) are the miscellaneous devices and couplers used to join together safety restraints and anchorage connectors. They must be sturdy enough to support the forces applied to them from the cylinders and safety restraints. Connector components must be properly designed and installed to ensure that they cannot become unattached from the anchorage connector or the safety restraints. Repair (lap) links and quick links are examples of connector components when chains or cables are used as a safety restraint.

Cradles are optional equipment designed to limit the horizontal movement of cylinders and are often used as a best management practice in conjunction with safety restraints.

Safety Restraints must be sturdy enough to support the forces applied to them from the cylinders, which may be contacted. Safety restraints must be properly designed and installed to ensure that they cannot become unattached from the connector components or anchorage connectors. The use of two horizontal safety restraints is a best management practice proven to prevent cylinder movement when correctly installed. When two safety restrains are used, they should horizontally cross the cylinder at approximately 1/3 and 2/3 the cylinder's height. When a single safety restraint is used, the restraint should horizontally across they cylinder at approximately 2/3 the cylinder's height. The use of a single safety restraint is not a best management practice and can contribute to a cylinder not being sufficiently restricted from movement to prevent falling over, rolling, or striking other objects. Regardless of whether a single restraint or multiple are used, an evaluation of they system's effectiveness must be performed. The location of the safety restraint is performance-based.

Additionally, an evaluation of the material's strength and durability needs to be conducted to ensure that the restraint material is sufficiently strong to prevent failure, leading to cylinders falling over, rolling, or striking other objects. Substantial materials such as chain, rope, cable, and heavy nylon cinching straps are examples of acceptable safety restraints. Insufficient materials include but are not limited to string, twine, elastic bands, elastic cords, and electrical cords.

The following provides examples of appropriate and deficient Method A designs:

Best Practice Design: **Figure B**:

In this example, two safety restraints are used. The safety restraints tightly cross the cylinder at 1/3 and 2/3 the cylinder's height. The cylinder cannot slip out under the lower safety restrain or trip over the upper safety restraint.

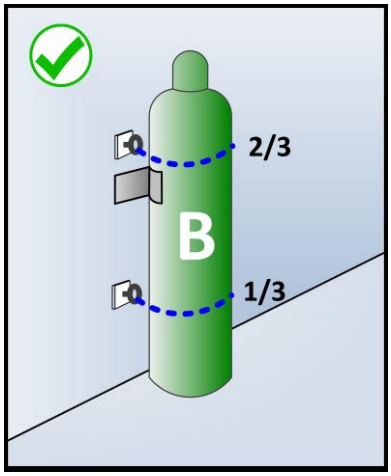


Figure B

Anchorage connectors are located in close proximity to the sides of the cylinder to restrict horizontal movement. The horizontal distance between the anchorage connectors limits the total cylinder capacity to two or less. Limiting the restraint system to two cylinders is a best management practice.

A wall bracket cradle is installed to additionally restrict horizontal cylinder movement when the second cylinder is removed.

Inadequate Design: **Figure C:**

In this example the restraint system was designed to contain more than two cylinders. When cylinders are removed from the system, the remaining cylinders are vulnerable to sideways movement and are not effectively restrained. Even though the safety restraints tightly cross the remaining cylinder at 1/3 and 2/3 the cylinder's height, the anchorage connectors are too far apart to prevent the single cylinder from falling over within the safety restraint system.

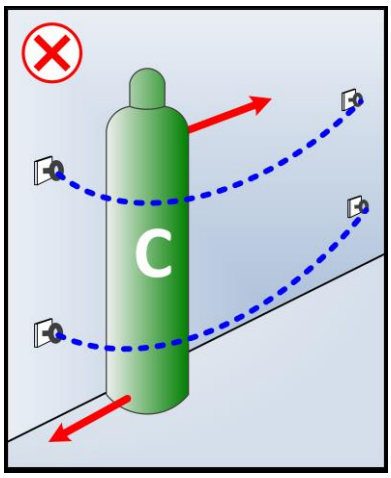


Figure C

Special care must be taken when multiple cylinders are restrained within a single safety restraint system. Consideration must be taken to account for the stability of the remaining cylinders when others are removed. Cylinder dividers such as cradles may address the concern when installed and used according to their intended design. It is a best management practice to limit the total number of cylinders protected by a single restraint system to two.

Inadequate Design: **Figure D:**

In this example, the restraint system was designed to contain just one cylinder with a single safety restraint. The anchorage connectors are installed close to each side of the cylinder to prevent sideways movement. Additionally, the safety restraint tightly crosses the cylinder, eliminating slack that can allow cylinder movement; however, the anchorage connectors are installed too high. The excessive height of the single safety restraint allows the cylinder to slip out from under the safety restraint if contacted near the cylinder's base.

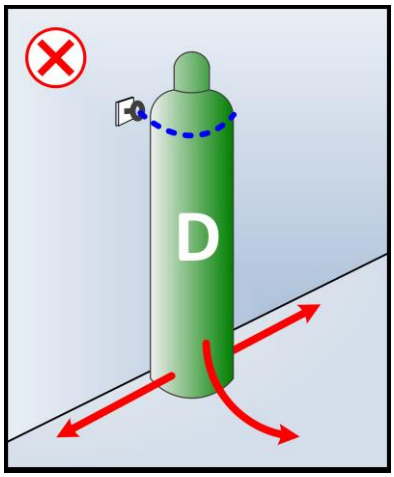


Figure D

Inadequate Design: **Figure E:**

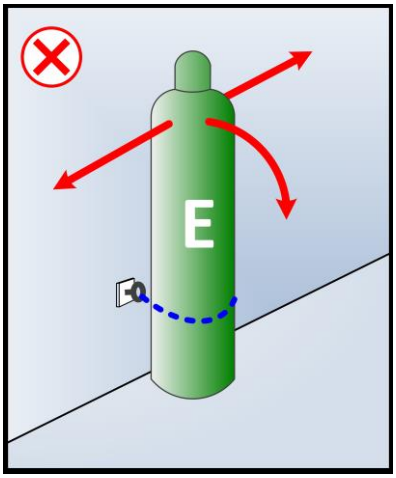


Figure E

In this example, the restraint system was designed to contain just one cylinder with a single safety restraint. The anchorage connectors are installed close to each side of the cylinder to prevent sideways movement. Additionally, the safety restraint tightly crosses the cylinder, eliminating slack that can allow cylinder movement; however, the anchorage connectors are installed too low. The cylinder can "trip" over the safety restraint if contacted near the cylinder's shoulder or valve protection cap. Even if the cylinder does not completely fall over, the additional pressure applied to the anchorage connectors may cause them to fail, leading to the cylinder falling over.

Inadequate Design: **Figure F:**

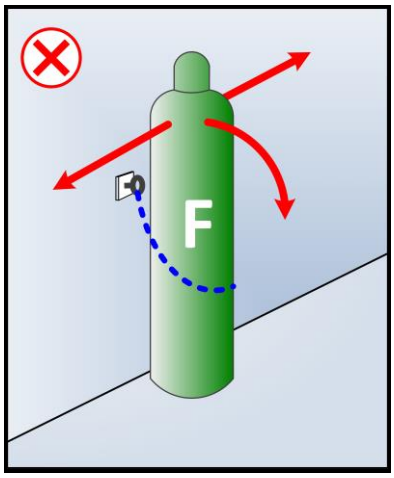


Figure F

In this example, the restraint system was designed to contain just one cylinder with a single safety restraint. The anchorage connectors are installed close to each side of the cylinder to prevent sideways movement. Additionally, the anchorage connectors where installed at approximately 2/3 the cylinder's height; however, due to the excessive length of the safety restraint material, slack is introduced into system. Because of this slack, the restraint system does not effectively prevent the cylinder from "tripping" over the safety restraint if contacted near the cylinder's shoulder or valve protection cap.

Appendix B –

Method B: Securing Cylinders with "Three Points of Contact"

437-002-2102 (Acetylene) and 437-002-2253 (Oxy-fuel Gas Welding and Cutting) define the term "secure" the same. The definition identifies two acceptable methods for arranging cylinders to prevent movement. The two methods are:

1) "Lashing and chaining," and
2) "Three points of contact with other cylinders or walls."

This appendix describes "three points of contact with other cylinders or walls" and is identified in this program directive as Method B.

The following Oregon OSHA regulations allow, with limitations, the use of "three points of contact with other cylinders or walls" to restrict compressed gas cylinders from movement:

- 437-002-2101 Compressed Gases (General Requirements)
- 437-002-2102 Acetylene
- 437-002-2253 Oxygen-fuel Gas Welding and Cutting

Review Section A (437-002-2253), Section B (437-002-2102), and Section C (437-002-2101) of this program directive to verify when the "three points of contact with walls or other cylinders" identified in the DEFINITIONS section of the program directive as Method B under the term "secure" is permitted by rule.

A. Method B: Three points of contact (Wall Assisted).

When this method is permitted by rule, all of the following conditions must be satisfied to sufficiently restrict compressed gas cylinders from movement:

- Only cylinders with flat bottoms are eligible.
- All cylinders must be the same diameter.
- All cylinders must be the same height.
- The supporting surface (e.g., floor) must be of a sufficiently smooth finish and free of debris to prevent cylinder rocking or wobbling.
- The supporting surface (e.g., floor) must be firm enough to support the cylinder's maximum weight without settling.
- The supporting surface (e.g., floor) must be level.
- Cylinders must physically contact other cylinders/wall. Gaps between cylinders or the wall are not allowed.
- A minimum cluster of five cylinders is required to achieve each cylinder's mandatory three points of contact.

Figure 1 below represents an appropriate grouping of cylinders to maintain three points of contact when assisted by a wall.

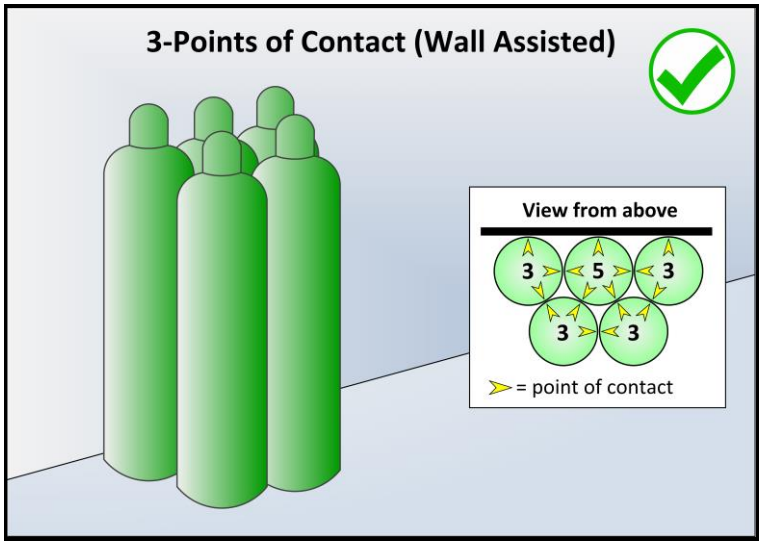


Figure 1: ***Three Points of Contact (Wall Assisted)***

When cylinders are added or removed from the cluster, other methods of restricting cylinder movement will be required. Method A in the definition of "secure" in the DEFINITIONS section of this program directive can be used for those cylinders that cannot maintain the minimum of three points of contact while assisted by a wall. Figure 2 below depicts cylinders that do not maintain the mandatory three points of contact when assisted by a wall.

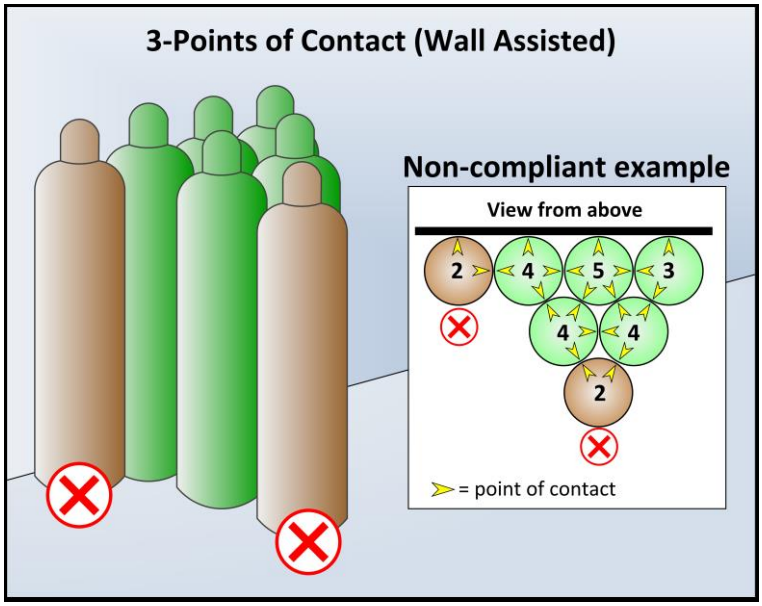


Figure 2: ***Non-compliant / Three Points of Contact (Wall Assisted)***

B. <u>Method B:</u> Three points of contact (Unassisted).

When this method is permitted by rule, all of the following conditions must be satisfied to sufficiently restrict compressed gas cylinders from movement:

- Only cylinders with flat bottoms are eligible.
- All cylinders must be the same diameter.
- All cylinders must be the same height.
- The supporting surface (e.g., floor) must be of a sufficiently smooth finish and free of debris to prevent cylinder rocking or wobbling.
- The supporting surface (e.g., floor) must be firm enough to support the cylinder's maximum weight without settling.
- The supporting surface (e.g., floor) must be level.
- Cylinders must physically contact other cylinders/wall. Gaps between cylinders or the wall are not allowed.
- A minimum cluster of seven cylinders is required to achieve each cylinder's mandatory three points of contact.

Figure 3 below represents an appropriate grouping of cylinders to maintain three points of contact when unassisted by a wall.

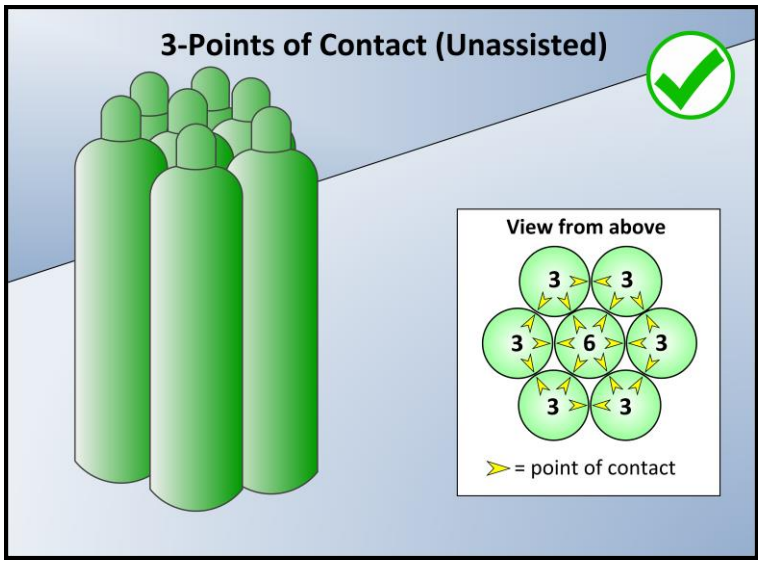


Figure 3: ***Three Points of Contact (Unassisted)***

When cylinders are added or removed from the cluster, methods of restricting cylinder movement such as lashing, chaining, or other equivalent physical methods are required for those cylinders that cannot maintain the minimum of "three points of contact." (See cylinder shown in Figure 4 below.)

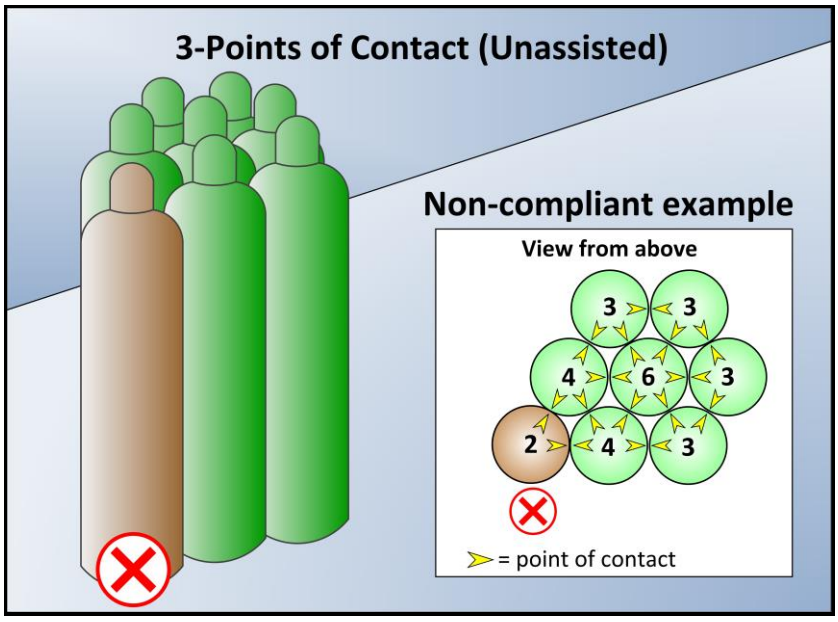


Figure 4: ***Non-compliant / Three Points of Contact (Unassisted)***

Appendix C –

Summary of Acceptable Cylinder Securing Methods by Rule

Rule	End users	Gas supplier facilities & distributors' warehouses
437-002-2101 **Compressed Gases**	**Cylinder in Use:** Method A	**Cylinder in Use:** Note: When gas distributors and suppliers consume "use" compressed gases in a non-recoverable way, they are considered "end users."
	Cylinder in Storage: Method A	**Cylinder in Storage:** Method A or Method B
437-002-2102 **Acetylene**	**Cylinder in Use:** Method A	**Cylinder in Use:** Note: When gas distributors and suppliers consume "use" compressed gases in a non-recoverable way, they are considered "end users."
	Cylinder in Storage: Method A (or) Method B	**Cylinder in Storage:** Method A or Method B
437-002-2253 **Oxygen-Fuel Gas Welding and Cutting**	**Cylinder in Use:** Method A and Valve End Up	**Cylinder in Use:** Note: When gas distributors and suppliers consume "use" compressed gases in a non-recoverable way, they are considered "end users."
	Cylinder in Storage: Method A and Valve End Up (or) Method B and Valve End Up	**Cylinder in Storage:** Method A and Valve End Up (or) Method B and Valve End Up