



# NATIONAL FIRE PROTECTION ASSOCIATION

The leading information and knowledge resource on fire, electrical and related hazards

## AGENDA

### NFPA Technical Committee on Gaseous Fire Extinguishing Systems (GFE-AAA) NFPA 12/12A/2001 Second Draft Meeting (F2024)

May 14-15, 2024  
10:00 a.m. – 2:00 p.m. (EDT)

Web/Teleconference (Microsoft Teams)  
To join the meeting, please contact [ylee@nfpa.org](mailto:ylee@nfpa.org)

1. **Call to order.** Brent Ehmke.
2. **Introductions.** See committee roster attached.
3. **Chair report.** Brent Ehmke.
4. **Staff liaison report.** Steve Kaitharath.
5. **Previous meeting minutes.** May 2023 (Quincy, MA). See attached.
6. **NFPA 12 Second Draft.**
  - a. **Public Comments.** See attached.
  - b. **Task group report(s).**
    - i. **Secondary Cylinder Task Group.** Jessica Everest.
    - ii. **Maritime Task Group.** Dan Hubert.
  - c. **Committee Inputs.** See attached.
7. **NFPA 12A Second Draft.**
  - a. **Public Comments.** See attached.
  - b. **Committee Inputs.** See attached.
8. **NFPA 2001 Second Draft.**
  - a. **Public Comments.** See attached.
  - b. **Task group report(s).**
    - i. **Metric Conversions Task Group.** Katherine Adrian.
    - ii. **Maritime Task Group.** Dan Hubert.
    - iii. **Insufficient Heat Task Group.** Jessica Hubert.
    - iv. **Time Delay Task Group.** Brad Stillwell.
  - c. **Committee Inputs.** See attached.
9. **Other Business.**

**10. Future meetings.**

**11. Adjournment.**

# Address List No Phone

## Gaseous Fire Extinguishing Systems

GFE-AAA

<b>Brent S. Ehmke</b> <b>Chair</b> Ehmke Associates 6505 Myrtle Beach Drive Plano, TX 75093 <b>Alternate: Paul E. Rivers</b>	<b>SE 10/29/2012</b> <b>GFE-AAA</b>	<b>William J. Cary</b> <b>Secretary</b> Aon Risk Solutions 2551 East Saratoga Street Gilbert, AZ 85296	<b>I 08/17/2018</b> <b>GFE-AAA</b>
<b>Katherine Adrian</b> <b>Principal</b> Johnson Controls One Stanton Street Marinette, WI 54143-2542 <b>Alternate: Corey Polzin</b>	<b>M 8/2/2010</b> <b>GFE-AAA</b>	<b>Jesse Cecil</b> <b>Principal</b> Fire King LLC. 8906 Wall Street Suite #603 Austin, TX 78754	<b>IM 04/02/2020</b> <b>GFE-AAA</b>
<b>Carl W. Chappell</b> <b>Principal</b> Hilcorp Alaska 7917 S. Frontier Drive Wasilla, AK 99623	<b>U 04/14/2021</b> <b>GFE-AAA</b>	<b>Todd A. Dillon</b> <b>Principal</b> AXA XL/Global Asset Protection Services, LLC 19885 Detroit Road #316 Rocky River, OH 44116	<b>I 4/14/2005</b> <b>GFE-AAA</b>
<b>Jessica Everest</b> <b>Principal</b> Siemens 3874 Camelot Drive, SE Grand Rapids, MI 49546	<b>M 08/24/2021</b> <b>GFE-AAA</b>	<b>Raymond N. Hansen</b> <b>Principal</b> US Department of the Air Force AFCEC/COSM 139 Barnes Drive, Suite 1 Tyndall AFB, FL 32403-5319 <b>Alternate: Andrew S. Carmean</b>	<b>E 1/14/2005</b> <b>GFE-AAA</b>
<b>Scott A. Hill</b> <b>Principal</b> JENSEN HUGHES 3610 Commerce Drive, Suite 817 Baltimore, MD 21227-1652 <b>Alternate: Eric W. Forssell</b>	<b>SE 03/05/2012</b> <b>GFE-AAA</b>	<b>Steven Hodges</b> <b>Principal</b> Alion Science and Technology 85253 Ridgetop Drive Eugene, OR 97405 <b>Alternate: Josh Fritsch</b>	<b>U 08/03/2016</b> <b>GFE-AAA</b>
<b>Daniel J. Hubert</b> <b>Principal</b> Amerex/Janus Fire Systems 1102 Rupcich Drive Millennium Park Crown Point, IN 46307-7542 <b>Fire Suppression Systems Association</b>	<b>M 10/28/2014</b> <b>GFE-AAA</b>	<b>Giuliano Indovino</b> <b>Principal</b> North American Fire Guardian Technology, Inc. Safety Hi-Tech Europe Srl Via degli Olmetti, 39/E Formello (RM), 00060 Italy <b>Alternate: Emma Palumbo</b>	<b>M 1/14/2005</b> <b>GFE-AAA</b>
<b>Nick Johnson</b> <b>Principal</b> 3M Company 3M Center, 236-01-07 Maplewood, MN 55144 <b>Alternate: John G. Owens</b>	<b>M 04/14/2021</b> <b>GFE-AAA</b>	<b>Robert Kasiski</b> <b>Principal</b> FM Global 270 Central Avenue PO Box 7500 Johnston, RI 02919-4923 <b>Alternate: Raymond A. Stacy</b>	<b>I 1/14/2005</b> <b>GFE-AAA</b>

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## Gaseous Fire Extinguishing Systems

<b>Jeffrey S. Kidd</b> <b>Principal</b> The Hiller Companies 18 South Hunt Road Amesbury, MA 01913	<b>IM</b> 03/05/2012 <b>GFE-AAA</b>	<b>Joanna Minion</b> <b>Principal</b> Honeywell 115 Tabor Road Morris Plains, NJ 07950	<b>M</b> 04/02/2020 <b>GFE-AAA</b>
<b>Michael Lee Moberly</b> <b>Principal</b> BP 501 Westlake Park Boulevard Houston, TX 77079-2604	<b>U</b> 03/07/2013 <b>GFE-AAA</b>	<b>Jim Morgan</b> <b>Principal</b> Marsh Advisory 400 Bentley Oak Lane Dayton, OH 45458 <b>Alternate: Thomas A. Downey</b>	<b>I</b> 04/12/2022 <b>GFE-AAA</b>
<b>Mohamed Mushantat</b> <b>Principal</b> PLC Fire Safety Solutions 2551 Sixth Line, Unit 19 Oakville, ON L6H 0H7 Canada	<b>SE</b> 12/06/2019 <b>GFE-AAA</b>	<b>Karl Fredrik Penden</b> <b>Principal</b> Carrier/Kidde-Fenwal 400 Main Street Ashland, MA 01721 <b>Alternate: Jonathan G. Ingram</b>	<b>M</b> 08/17/2018 <b>GFE-AAA</b>
<b>Matt Pognant</b> <b>Principal</b> Liberty Mutual Property 2725 Ivy Brook Lane Buford, GA 30519 <b>Alternate: Charles O. Bauroth</b>	<b>I</b> 08/11/2020 <b>GFE-AAA</b>	<b>James R. Richardson</b> <b>Principal</b> Lisle Woodridge Fire District 1005 School Street Lisle, IL 60532	<b>E</b> 04/11/2018 <b>GFE-AAA</b>
<b>Mark L. Robin</b> <b>Principal</b> Chemours Specialty Fluorochemicals 107 Saint Andrews Court Middletown, DE 19709 <b>Alternate: Alfred J. Thornton</b>	<b>M</b> 7/28/2006 <b>GFE-AAA</b>	<b>Joseph A. Senecal</b> <b>Principal</b> Firemetrics 5 Paine Street Wellesley, MA 02481-6003	<b>SE</b> 08/17/2018 <b>GFE-AAA</b>
<b>Blake M. Shugarman</b> <b>Principal</b> UL LLC 333 Pfingsten Road Northbrook, IL 60062-2096 <b>Alternate: Kevin Holly, Jr.</b>	<b>RT</b> 11/2/2006 <b>GFE-AAA</b>	<b>Brad T. Stilwell</b> <b>Principal</b> Fike Corporation 704 South 10th Street Blue Springs, MO 64015-4263 <b>Alternate: Grant Smith</b>	<b>M</b> 1/14/2005 <b>GFE-AAA</b>
<b>Christina Thompson</b> <b>Principal</b> US Environmental Protection Agency (US EPA) 1200 Pennsylvania Ave, NW MC 6205A Washington, DC 20460 <b>Alternate: Margaret A. Sheppard</b>	<b>E</b> 08/23/2023 <b>GFE-AAA</b>	<b>Yunyong Pock Utiskul</b> <b>Principal</b> US Coast Guard 703 MLK Jr. Avenue SW Washington, DC 20593-7509 <b>Alternate: Jeffrey S. Bors</b>	<b>E</b> 11/29/2023 <b>GFE-AAA</b>

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## Gaseous Fire Extinguishing Systems

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<b>Matthew Connolly</b> <b>Voting Alternate</b> Harrington Group, Inc. 3237 Satellite Boulevard Building 300 - Suite 525 Duluth, GA 30096	<b>SE</b> 08/23/2023 <b>GFE-AAA</b>	<b>Tom Zornes</b> <b>Voting Alternate</b> Siemens 223 Pixy Court Greenfield, IN 46140 <b>Automatic Fire Alarm Association, Inc.</b>	<b>M</b> 04/02/2020 <b>GFE-AAA</b>
<b>Charles O. Bauroth</b> <b>Alternate</b> Liberty Mutual 36 Willow Lane Uxbridge, MA 01569 <b>Principal: Matt Pognant</b>	<b>I</b> 1/14/2005 <b>GFE-AAA</b>	<b>Jeffrey S. Bors</b> <b>Alternate</b> US Coast Guard 2703 MLK Jr. Avenue SW Washington, DC 20593 <b>Principal: Yunyong Pock Utiskul</b>	<b>E</b> 11/29/2023 <b>GFE-AAA</b>
<b>Andrew S. Carmean</b> <b>Alternate</b> US Department of the Air Force 139 Barnes Drive, Suite 1 Tyndall AFB, FL 32439 <b>Principal: Raymond N. Hansen</b>	<b>E</b> 08/11/2020 <b>GFE-AAA</b>	<b>Thomas A. Downey</b> <b>Alternate</b> Marsh Risk Consulting 601 Merritt 7 Norwalk, CT 06856 <b>Marsh USA Inc.</b> <b>Principal: Jim Morgan</b>	<b>I</b> 10/20/2010 <b>GFE-AAA</b>
<b>Eric W. Forssell</b> <b>Alternate</b> JENSEN HUGHES 3610 Commerce Drive, Suite 817 Jefferson, MD 21227-1652 <b>Principal: Scott A. Hill</b>	<b>SE</b> 08/11/2014 <b>GFE-AAA</b>	<b>Josh Fritsch</b> <b>Alternate</b> US Army DEVCOM Ground Vehicle Systems Center (GVSC) 6501 E Eleven Mile Road Warren, MI 48397 <b>Principal: Steven Hodges</b>	<b>U</b> 11/29/2023 <b>GFE-AAA</b>
<b>Kevin Holly, Jr.</b> <b>Alternate</b> UL LLC 333 Pfingsten Road Northbrook, IL 60062-2096 <b>Principal: Blake M. Shugarman</b>	<b>RT</b> 10/20/2010 <b>GFE-AAA</b>	<b>Jessica A. Hubert</b> <b>Alternate</b> Guardian Services Inc. 86 Bacon Drive Shelburne, VT 05482 <b>Principal: Thomas J. Wysocki</b>	<b>SE</b> 04/02/2020 <b>GFE-AAA</b>

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## Gaseous Fire Extinguishing Systems

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<b>Emma Palumbo</b> <b>Alternate</b> North American Fire Guardian Technology, Inc./Safety Hi-Tech Europe Srl Chemical Engineer Via Cavour, 96 Avezzano, AQ 67051 Italy <b>Principal: Giuliano Indovino</b>	<b>M 12/07/2018</b> <b>GFE-AAA</b>	<b>David A. Pelton</b> <b>Alternate</b> National Association of Fire Equipment Distributors (NAFED) 55 East Monroe Street Suite 1440 Chicago, IL 60603 <b>Principal: Todd W. VanGorder</b>	<b>IM 12/07/2022</b> <b>GFE-AAA</b>
<b>Corey Polzin</b> <b>Alternate</b> Johnson Controls 2300 Aerial Drive Marinette, WI 54143 <b>Principal: Katherine Adrian</b>	<b>M 11/29/2023</b> <b>GFE-AAA</b>	<b>Paul E. Rivers</b> <b>Alternate</b> Sidsson LLC 4725 31st Avenue South Minneapolis, MN 55406 <b>Principal: Brent S. Ehmke</b>	<b>SE 04/14/2021</b> <b>GFE-AAA</b>
<b>Margaret A. Sheppard</b> <b>Alternate</b> US Environmental Protection Agency Lead Environment Prot Specialist 1200 Pennsylvania Avenue, NW MC 6205T Washington, DC 20460 <b>Principal: Christina Thompson</b>	<b>E 01/14/2005</b> <b>GFE-AAA</b>	<b>Grant Smith</b> <b>Alternate</b> Fike Corporation 704 Sw 10th Street Blue Springs, MO 64015 <b>Principal: Brad T. Stilwell</b>	<b>M 08/11/2020</b> <b>GFE-AAA</b>
<b>Raymond A. Stacy</b> <b>Alternate</b> FM Approvals 1151 Boston-Providence Trnpk PO Box 9102 Norwood, MA 02062-9102 <b>Principal: Robert Kasiski</b>	<b>I 03/03/2014</b> <b>GFE-AAA</b>	<b>Alfred J. Thornton</b> <b>Alternate</b> The Chemours Company DuPont Fluorospecialties 204 Pine Knoll Circle Hockessin, DE 19707-2133 <b>Principal: Mark L. Robin</b>	<b>M 1/14/2005</b> <b>GFE-AAA</b>
<b>Ingeborg Schlosser</b> <b>Nonvoting Member</b> VdS Schadenverhuetzung Technische Prufstelle Amsterdamer Str. 174 Köln, 50735 Germany	<b>I 1/14/2005</b> <b>GFE-AAA</b>	<b>Fernando Vigar</b> <b>Nonvoting Member</b> APICI Gta. Ruiz Jimenez, 3 Madrid, 28015 Spain	<b>SE 1/14/2005</b> <b>GFE-AAA</b>

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## Gaseous Fire Extinguishing Systems

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<b>Thomas Harris</b>	10/11/2021
<b>Staff Liaison</b>	<b>GFE-AAA</b>

National Fire Protection Association  
One Batterymarch Park  
Quincy, MA 02169



# NATIONAL FIRE PROTECTION ASSOCIATION

The leading information and knowledge resource on fire, electrical and related hazards

## MINUTES

### NFPA Technical Committee on Gaseous Fire Extinguishing Systems (GFE-AAA) NFPA 12/12A/2001 First Draft Meeting (F2024)

May 10-11, 2023  
8:00am – 5:00pm (Eastern)

In-Person – Hybrid via Microsoft Teams  
NFPA Headquarters  
One Batterymarch Park  
Quincy, MA 02169

1. **Call to order.** Brent Ehmke, chair, called the meeting to order at 8:00am on May 10, 2023.
2. **Introductions.** Attendees introduced themselves and identified their affiliation. NFPA staff took attendance.
3. **Chair report.** Brent Ehmke welcomed attendees and provided an overview of the meeting.
4. **Staff liaison report.** Tom Harris and Steve Kaitharath provided an overview of the standards development process and the revision cycle schedule.
5. **Previous meeting minutes.** The minutes from September/October 2020 Web/Teleconference were approved without revision.
6. **NFPA 12 First Draft.**
  - a. **Review of Public Inputs.** The Technical Committee reviewed the Public Inputs and developed First Revisions and Committee Inputs as necessary. These will be available in the First Draft Report at [www.nfpa.org/12](http://www.nfpa.org/12).
  - b. **New task groups.** The following task groups were appointed to work subsequent to the meeting:
    - i. **Secondary Cylinder Task Group.** TG Chair: Jessica Everest. Members: Jessica Hubert, Fred Penden, Scott Hill, Ray Stacy. Review terms for secondary or “slave” cylinders that are used throughout the industry to recommend a change for standardization throughout the document.
    - ii. **Maritime Task Group.** TG Chair: Dan Hubert. Members: Pock Utiskul, Blake Shugarman, Scott Hill. Review Chapter 9 in its entirety to update information to align with the US Coast Guard requirements. Align references with how they are used within the US Maritime Organization. Committee Input 18 on Chapter 9 was created as a place holder.
7. **NFPA 12A First Draft.**

- a. **Review of Public Inputs.** The Technical Committee reviewed the Public Inputs and developed First Revisions and Committee Inputs as necessary. These will be available in the First Draft Report at [www.nfpa.org/12a](http://www.nfpa.org/12a).

## 8. NFPA 2001 First Draft.

- a. **Review of Public Inputs.** The Technical Committee reviewed the Public Inputs and developed First Revisions and Committee Inputs as necessary. These will be available in the First Draft Report at [www.nfpa.org/2001](http://www.nfpa.org/2001).
- b. **Task group report.** The following task groups provided their reports and recommendations.
  - i. **Metric Conversions.** Katherine Adrian. The task group provided a report. The task group was reconstituted to continue work.
- c. **Presentation(s).** The committee heard presentations from the following individuals.
  - i. **Toxicity/Cardiac Sensitization.** Kamleshkumar Sodani.
- d. **New task groups.** The following task groups were appointed to work subsequent to the meeting:
  - i. **Metric Conversions Task Group.** TG Chair: Katherine Adrian. Members: Joe Senecal, Steve Hodges. Review all metric conversions for accuracy. Global Committee Input 24 was created as a place holder.
  - ii. **Maritime Task Group.** TG Chair: Dan Hubert. Members: Pock Utiskul, Blake Shugarman, Scott Hill. Review Chapter 13 in its entirety to update information to align with the US Coast Guard requirements. Align references with how they are used within the US Maritime Organization. Committee Input 19 on Chapter 13 was created as a place holder.
  - iii. **Insufficient Heat Task Group.** TG Chair: Jessica Hubert. Members: Jesse Cecil, Eric Forssell, Dan Hubert, Tom Wysocki, Joe Senecal, Fred Penden, Nick Johnson. Review the submitters substantiation from Public Input 1 to develop annex material to be considered at 2<sup>nd</sup> Draft.
  - iv. **Time Delay Task Group.** TG Chair: Brad Stilwell. Members: Dan Hubert, Tom Wysocki, Grant Smith, Fred Penden, Jessica Hubert. Review situations where a time delay may not be appropriate. Committee Input 20 on section 4.3.7 was created as a place holder.

## 9. Other Business.

10. **Future meetings.** The next committee meeting will be sometime during Q2 in 2024. A meeting notification will be posted at [www.nfpa.org/12next](http://www.nfpa.org/12next), [www.nfpa.org/12Anext](http://www.nfpa.org/12Anext), and [www.nfpa.org/2001next](http://www.nfpa.org/2001next) when the meeting is scheduled.

11. **Adjournment.** The meeting was adjourned at 2:00pm on May 11, 2023.

**Attendees****Committee Members:**

<b>Day 1</b>	<b>Day 2</b>	<b>Name</b>		<b>Company</b>
✓	✓	<b>Ehmke, Brent</b>	Chair	Ehmke Associates
✓*	✓*	<b>Cary, William</b>	Secretary	Aon Risk Solutions
		<b>Adrian, Katherine</b>	Principal	Johnson Controls
✓*	✓*	<b>Cecil, Jesse</b>	Principal	Fire King LLC
		<b>Chappell, Carl</b>	Principal	Hilcorp Alaska
✓*	✓*	<b>Dillon, Todd</b>	Principal	Global Asset Protection Services, LLC
✓	✓	<b>Everest, Jessica</b>	Principal	Siemens
✓	✓	<b>Faucon, Jeffrey</b>	Principal	Harrington Group, Inc.
✓*	✓*	<b>Hansen, Raymond</b>	Principal	US Department of the Air Force
✓*	✓*	<b>Hill, Scott</b>	Principal	Jensen Hughes
✓*	✓*	<b>Hodges, Steven</b>	Principal	Alion Science and Technology
✓	✓	<b>Hubert, Daniel</b>	Principal	Fire Suppression Systems Association
		<b>Indovino, Giuliano</b>	Principal	North American Fire Guardian Technology
✓*	✓*	<b>Johnson, Nick</b>	Principal	3M Company
	✓	<b>Kasiski, Robert</b>	Principal	FM Global
✓	✓*	<b>Kidd, Jeffrey</b>	Principal	The Hiller Companies
✓*	✓*	<b>Merrick, Justin</b>	Principal	Automatic Fire Alarm Association, Inc.
		<b>Miller, John</b>	Principal	US Coast Guard
✓*	✓*	<b>Minion, Joanna</b>	Principal	Honeywell
✓*	✓*	<b>Moberly, Michael</b>	Principal	BP
✓	✓	<b>Morgan, Jim</b>	Principal	Marsh USA Inc.
✓*	✓*	<b>Mushantat, Mohamed</b>	Principal	PLC Fire Safety Solutions
✓	✓*	<b>Penden, Karl</b>	Principal	Carrier/Kidde-Fenwal
✓*	✓*	<b>Pognant, Matt</b>	Principal	Liberty Mutual Property
✓*	✓*	<b>Richardson, James</b>	Principal	Lisle Woodridge Fire District
		<b>Robin, Mark</b>	Principal	Chemours

✓*	✓*	<b>Senecal, Joseph</b>	Principal	Firemetrics
✓	✓	<b>Shugarman, Blake</b>	Principal	UL Solutions
✓	✓	<b>Stilwell, Brad</b>	Principal	Fike Corporation
✓	✓	<b>VanGorder, Todd</b>	Principal	National Association of Fire Equipment
✓	✓	<b>Wysocki, Thomas</b>	Principal	Guardian Services, Inc.
✓*	✓*	<b>Sheppard, Margaret</b>	Voting Alternate	US Environmental Protection Agency
		<b>Bauroth, Charles</b>	Alternate	Liberty Mutual
		<b>Carmean, Andrew</b>	Alternate	US Department of the Air Force
✓*		<b>Downey, Thomas</b>	Alternate	Marsh USA Inc.
		<b>Espinosa, Justin</b>	Alternate	BP Alaska
✓*	✓*	<b>Fessenden, Mark</b>	Alternate	Johnson Controls
✓*	✓*	<b>Forssell, Eric</b>	Alternate	Jensen Hughes
✓*	✓*	<b>Holly, Kevin</b>	Alternate	UL Solutions
✓	✓	<b>Hubert, Jessica</b>	Alternate	Guardian Services, Inc.
		<b>Ingram, Jonathan</b>	Alternate	Carrier/Kidde-Fenwal, Inc.
		<b>Owens, John</b>	Alternate	3M Company
✓*	✓*	<b>Palumbo, Emma</b>	Alternate	North American Fire Guardian Technology
	✓	<b>Pelton, David</b>	Alternate	National Association of Fire Equipment
✓*	✓*	<b>Rivers, Paul</b>	Alternate	Sidsson LLC
		<b>Rodino, Sarah</b>	Alternate	U.S. Coast Guard
✓	✓	<b>Smith, Grant</b>	Alternate	Fire Corporation
✓	✓*	<b>Stacy, Raymond</b>	Alternate	FM Global
✓*	✓*	<b>Thornton, Alfred</b>	Alternate	The Chemours Company
✓*	✓*	<b>Zornes, Tom</b>	Alternate	Automatic Fire Alarm Association, Inc.
		<b>Schlosser, Ingeborg</b>	Nonvoting	VdS Schadencerhuetung
		<b>Vigara, Fernando</b>	Nonvoting	APICI
✓	✓	<b>Harris, Thomas</b>	Staff Liaison	National Fire Protection Association

**Guests:**

Name	Company	Day 1	Day 2
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Steve Kaitharath	NFPA Staff	✓	✓
Chad Duffy	NFPA Staff	✓	✓
Patrick Bakaj	NFPA Staff	✓*	✓*
Tom Goss	NFPA Staff	✓*	✓*
Pock Utiskul	US Coast Guard	✓	✓
Corey Polzin	Johnson Controls	✓	✓
Jamie McNally	Carrier	✓*	✓*
Mike Kiamanesh	Waysmos USA Inc.	✓	✓
Scott Bailey	Koorsen	✓*	✓*
Christina Thompson	US EPA	✓*	✓*
Kamleshkumar Sodani	Honeywell		✓*
Scott Panowitz	BFPE	✓*	✓*
Gary Jepson	Chemours		✓*

\*Participated by teleconference

Total number in attendance: 53



## Public Comment No. 1-NFPA 12-2023 [ Section No. 3.1.3 ]

### 3.1.3 –

*Merriam-Webster's Collegiate Dictionary*, 11th edition, shall be the source for the ordinarily accepted meaning.

### Statement of Problem and Substantiation for Public Comment

jdfjdsjkjfdkjfdkjfd

#### Related Item

- PI-1

### Submitter Information Verification

**Submitter Full Name:** Committee Member1

**Organization:** NEMA

**Affiliation:** fjdkjfdjfdkjfd

**Street Address:**

**City:**

**State:**

**Zip:**

**Submittal Date:** Fri Aug 11 13:47:54 EDT 2023

**Committee:** GFE-AAA



## Public Comment No. 7-NFPA 12-2023 [ Section No. 5.5.3 ]

### **5.5.3\*** Enclosed Rotating Electrical Equipment.

**A. 5.5.** ~~3-1 3~~ Enclosed rotating electrical equipment treated as “dry electrical hazards” may include generators, exciters, converters where there is potential for ignition of insulation on windings. Stationary combustion engines and gas turbines wherein the fire risk is primarily the gas used to fuel the turbine and lube and hydraulic oils are typically treated as surface fire hazards and are addressed in NFPA 37.

5.5.3.1 For enclosed rotating electrical equipment a 30% concentration of carbon dioxide shall be achieved within 2 minutes of the start of discharge and a peak concentration of not less than 50% carbon dioxide shall be achieved within 7 minutes of the start of discharge.

#### **5.5.3.2**

For enclosed rotating electrical equipment, a minimum concentration of 30 percent shall be maintained for the deceleration period, but not less than 20 minutes.

#### **A. 5.5.3.2 1**

For enclosed rotating electrical equipment ~~with non-venting recirculating-type airflow~~, the initial discharge quantity ~~shall~~ should not be less than 1 lb (0.45 kg) of gas for each 10 ft<sup>3</sup> (0.28 m<sup>3</sup>) of enclosed volume up to 2000 ft<sup>3</sup> (56.6 m<sup>3</sup>).

#### **5.5.3.3 –**

For enclosed rotating electrical equipment

with non-venting recirculating-type airflow

, the initial discharge quantity

shall

should not be less than 1 lb (0.45 kg) of gas for each 12 ft<sup>3</sup> (0.34 m<sup>3</sup>) of enclosed volume greater than 2000 ft<sup>3</sup> (56.6 m<sup>3</sup>).

For enclosed rotating electrical equipment with dampered, non-recirculating-type airflow, the initial discharge quantity may need to be increased to compensate for possible leakage past the dampers.

**A. 5.5.3.3.4 2**

Table A. 5.5.3.3.4 2 (a) and Table A. 5.5.3.3.4 2 (b) shall may be used as a guide to estimate the quantity of gas needed for the extended discharge to maintain a minimum concentration of 30 percent for the deceleration time.

Table 5

For enclosed rotating electrical equipment with dampered, non-recirculating-type airflow, the indicated quantities of carbon dioxide, as shown in Table A .5. 5. 3.3.

4

2 (a) and Table A.5.5.3.3.2(b) , should be increased by 35 percent to compensate for possible leakage past the dampers.

When the manufacturer of the enclosed rotating electrical equipment specifies the quantity of carbon dioxide to be used for the extended discharge, the guidance of the manufacturer should be followed

Table A.5.5.3.3.2(a) Extended Discharge Protection for Enclosed Recirculating Rotating Electrical Equipment (Cubic Feet Protected for Deceleration Time)

lb CO <sub>2</sub>	Time (minutes)							
	5	10	15	20	30	40	50	60
100	1,200	1,000	800	600	500	400	300	200
150	1,800	1,500	1,200	1,000	750	600	500	400
200	2,400	1,950	1,600	1,300	1,000	850	650	500
250	3,300	2,450	2,000	1,650	1,300	1,050	800	600
300	4,600	3,100	2,400	2,000	1,650	1,300	1,000	700
350	6,100	4,100	3,000	2,500	2,000	1,650	1,200	900
400	7,700	5,400	3,800	3,150	2,500	2,000	1,600	1,200
450	9,250	6,800	4,900	4,000	3,100	2,600	2,100	1,600
500	10,800	8,100	6,100	5,000	3,900	3,300	2,800	2,200
550	12,300	9,500	7,400	6,100	4,900	4,200	3,600	3,100
600	13,900	10,900	8,600	7,200	6,000	5,200	4,500	3,900
650	15,400	12,300	9,850	8,300	7,050	6,200	5,500	4,800
700	16,900	13,600	11,100	9,400	8,100	7,200	6,400	5,600
750	18,500	15,000	12,350	10,500	9,150	8,200	7,300	6,500
800	20,000	16,400	13,600	11,600	10,200	9,200	8,200	7,300
850	21,500	17,750	14,850	12,700	11,300	10,200	9,100	8,100
900	23,000	19,100	16,100	13,800	12,350	11,200	10,050	9,000
950	24,600	20,500	17,350	14,900	13,400	12,200	11,000	9,800
1,000	26,100	21,900	18,600	16,000	14,500	13,200	11,900	10,700
1,050	27,600	23,300	19,900	17,100	15,600	14,200	12,850	11,500
1,100	29,100	24,600	21,050	18,200	16,600	15,200	13,750	12,400
1,150	30,600	26,000	22,300	19,300	17,700	16,200	14,700	13,200
1,200	32,200	27,300	23,550	20,400	18,800	17,200	15,600	14,100
1,250	33,700	28,700	24,800	21,500	19,850	18,200	16,500	14,900
1,300	35,300	30,100	26,050	22,650	20,900	19,200	17,450	15,800
1,350	36,800	31,400	27,300	23,750	22,000	20,200	18,400	16,650
1,400	38,400	32,800	28,550	24,900	23,100	21,200	19,350	17,500
1,450	39,900	34,200	29,800	26,000	24,200	22,200	20,300	18,350
1,500	41,400	35,600	31,050	27,100	25,250	23,200	21,200	19,200

Table 5 Table A .5.5. 3.3.4 2 (b) Extended Discharge for Enclosed Recirculating Rotating Electrical Equipment (Cubic Meters Protected for Deceleration Time) (SI Units)

Time (minutes)								
kg CO <sub>2</sub>	5	10	15	20	30	40	50	60
45.4	34	28.3	22.6	17	14.2	11.3	8.5	5.7
68.1	50.9	42.5	34	28.3	21.2	17	14	11.3
90.8	67.9	55.2	45.3	36.8	28.3	24.1	18.4	14.2
113.5	93.4	69.3	56.6	46.7	36.8	29.7	22.6	17
136.2	130.2	87.7	67.9	56.6	46.7	36.8	28.3	19.8
158.9	172.6	116	84.9	70.8	56.6	46.7	34	25.5
181.6	217.9	152.8	107.5	89.1	70.8	56.6	45.3	34
204.3	261.8	192.4	138.7	113.2	87.7	73.6	59.4	45.3
227	305.6	229.2	172.6	141.5	110.4	93.4	79.2	62.3
249.7	348.1	268.9	209.4	172.6	138.7	118.9	101.9	87.7
272.4	393.4	308.5	243.4	203.8	169.8	147.2	127.4	110.4
295.1	435.8	348.1	278.8	234.9	199.5	175.5	155.7	135.8
317.8	478.3	384.9	314.1	266	229.2	203.8	181.1	158.5
340.5	523.6	424.5	349.5	297.2	258.9	232.1	206.6	184
363.2	586	464.1	384.9	328.3	288.7	260.4	232.1	206.6
385.9	608.4	502.3	420.3	359.4	319.8	288.7	257.5	229.2
408.6	650.9	540.5	455.6	390.5	349.5	317	284.4	254.7
431.3	696.2	580.2	491	421.7	379.2	345.3	311.3	277.3
454	738.6	619.8	526.4	452.8	410.4	373.6	336.8	302.8
476.7	781.1	659.4	563.2	483.9	441.5	401.9	363.7	325.5
499.4	823.5	696.2	595.7	515.1	469.8	430.2	389.1	350.9
522.1	866	735.8	631.1	546.2	500.9	458.5	416	373.6
544.8	911.3	772.6	666.5	577.3	532	486.8	441.5	399
567.5	953.7	812.2	701.8	609.4	561.8	515.1	467	421.7
590.2	999	851.8	737.2	641	591.5	543.4	493.8	447.1
612.9	1041.4	888.6	772.6	672.1	622.6	571.7	520.7	471.2
635.6	1086.7	928.2	808	704.7	653.7	600	547.6	495.3
658.3	1129.2	967.9	843.3	735.8	684.9	628.3	574.5	519.3
681	1171.6	1007.5	878.7	766.9	713.2	656.6	600	543.4

**5.5.3.4 –**

For enclosed rotating electrical equipment with dampered, non-recirculating-type airflow, the indicated quantities of carbon dioxide, as shown in Table 5.5.3.3.1(a) and Table 5.5.3.3.1(b), shall be increased by 35 percent for extended discharge protection.

**Statement of Problem and Substantiation for Public Comment**

A.5.5.3 explains the type of equipment referenced in this standard as enclosed rotating electrical equipment and differentiates stationary combustion turbines and gas turbines which are typically treated as surface fire hazards covered in NFPA 37.

5.5.3.1 provides direction for the rate of application for the initial discharge for protection of rotating electrical equipment with flooding factors recommended in the related Annex material.

Returns 5.5.3.2 and 5.5.3.3 and 5.5.3.3.1 to the Annex where they existed for over 70 years as advisory material. No new information has been provided that would justify making this advisory information mandatory.

Adds advice that when the manufacturer of the enclosed rotating electrical equipment specifies the quantity of carbon dioxide to be used for the extended discharge, the guidance of the manufacturer would be appropriately followed.

**Related Item**

• PI-10 • PI-11

**Submitter Information Verification**

**Submitter Full Name:** Thomas Wysocki  
**Organization:** Guardian Services, Inc.  
**Street Address:**  
**City:**  
**State:**  
**Zip:**  
**Submittal Date:** Wed Dec 13 14:11:31 EST 2023  
**Committee:** GFE-AAA



**Public Comment No. 9-NFPA 12-2024 [ Section No. 5.5.3.3.1 ]**

A large, empty rectangular box with a thin black border, intended for the public comment text.

**5.5.3.3.1**

Table Table 5.5.3.3.1(a) and Table 5.5.3.3.1(b) shall be used as a guide to estimate the quantity of gas needed for the extended discharge to maintain a minimum concentration of 30 percent for the deceleration time. (Revise Table 5.5.3.3(a) and Table 5.5.3.3(b) DJH - See attached files for revised Tables).

Table 5.5.3.3.1(a) Extended Discharge Protection for Enclosed Recirculating Rotating Electrical Equipment (Cubic Feet Protected for Deceleration Time)

<b>Time (minutes)</b>								
<b>lb CO<sub>2</sub></b>	<b>5</b>	<b>10</b>	<b>15</b>	<b>20</b>	<b>30</b>	<b>40</b>	<b>50</b>	<b>60</b>
100	1,200	1,000	800	600	500	400	300	200
150	1,800	1,500	1,200	1,000	750	600	500	400
200	2,400	1,950	1,600	1,300	1,000	850	650	500
250	3,300	2,450	2,000	1,650	1,300	1,050	800	600
300	4,600	3,100	2,400	2,000	1,650	1,300	1,000	700
350	6,100	4,100	3,000	2,500	2,000	1,650	1,200	900
400	7,700	5,400	3,800	3,150	2,500	2,000	1,600	1,200
450	9,250	6,800	4,900	4,000	3,100	2,600	2,100	1,600
500	10,800	8,100	6,100	5,000	3,900	3,300	2,800	2,200
550	12,300	9,500	7,400	6,100	4,900	4,200	3,600	3,100
600	13,900	10,900	8,600	7,200	6,000	5,200	4,500	3,900
650	15,400	12,300	9,850	8,300	7,050	6,200	5,500	4,800
700	16,900	13,600	11,100	9,400	8,100	7,200	6,400	5,600
750	18,500	15,000	12,350	10,500	9,150	8,200	7,300	6,500
800	20,000	16,400	13,600	11,600	10,200	9,200	8,200	7,300
850	21,500	17,750	14,850	12,700	11,300	10,200	9,100	8,100
900	23,000	19,100	16,100	13,800	12,350	11,200	10,050	9,000
950	24,600	20,500	17,350	14,900	13,400	12,200	11,000	9,800
1,000	26,100	21,900	18,600	16,000	14,500	13,200	11,900	10,700
1,050	27,600	23,300	19,900	17,100	15,600	14,200	12,850	11,500
1,100	29,100	24,600	21,050	18,200	16,600	15,200	13,750	12,400
1,150	30,600	26,000	22,300	19,300	17,700	16,200	14,700	13,200
1,200	32,200	27,300	23,550	20,400	18,800	17,200	15,600	14,100
1,250	33,700	28,700	24,800	21,500	19,850	18,200	16,500	14,900
1,300	35,300	30,100	26,050	22,650	20,900	19,200	17,450	15,800
1,350	36,800	31,400	27,300	23,750	22,000	20,200	18,400	16,650
1,400	38,400	32,800	28,550	24,900	23,100	21,200	19,350	17,500
1,450	39,900	34,200	29,800	26,000	24,200	22,200	20,300	18,350
1,500	41,400	35,600	31,050	27,100	25,250	23,200	21,200	19,200

Table 5.5.3.3.1(b) Extended Discharge for Enclosed Recirculating Rotating Electrical Equipment (Cubic Meters Protected for Deceleration Time) (SI Units)

<b>Time (minutes)</b>								
<b>kg CO<sub>2</sub></b>	<b>5</b>	<b>10</b>	<b>15</b>	<b>20</b>	<b>30</b>	<b>40</b>	<b>50</b>	<b>60</b>
45.4	34	28.3	22.6	17	14.2	11.3	8.5	5.7
68.1	50.9	42.5	34	28.3	21.2	17	14	11.3
90.8	67.9	55.2	45.3	36.8	28.3	24.1	18.4	14.2
113.5	93.4	69.3	56.6	46.7	36.8	29.7	22.6	17
136.2	130.2	87.7	67.9	56.6	46.7	36.8	28.3	19.8

<b>Time (minutes)</b>								
<b>kg CO<sub>2</sub></b>	<b>5</b>	<b>10</b>	<b>15</b>	<b>20</b>	<b>30</b>	<b>40</b>	<b>50</b>	<b>60</b>
158.9	172.6	116	84.9	70.8	56.6	46.7	34	25.5
181.6	217.9	152.8	107.5	89.1	70.8	56.6	45.3	34
204.3	261.8	192.4	138.7	113.2	87.7	73.6	59.4	45.3
227	305.6	229.2	172.6	141.5	110.4	93.4	79.2	62.3
249.7	348.1	268.9	209.4	172.6	138.7	118.9	101.9	87.7
272.4	393.4	308.5	243.4	203.8	169.8	147.2	127.4	110.4
295.1	435.8	348.1	278.8	234.9	199.5	175.5	155.7	135.8
317.8	478.3	384.9	314.1	266	229.2	203.8	181.1	158.5
340.5	523.6	424.5	349.5	297.2	258.9	232.1	206.6	184
363.2	586	464.1	384.9	328.3	288.7	260.4	232.1	206.6
385.9	608.4	502.3	420.3	359.4	319.8	288.7	257.5	229.2
408.6	650.9	540.5	455.6	390.5	349.5	317	284.4	254.7
431.3	696.2	580.2	491	421.7	379.2	345.3	311.3	277.3
454	738.6	619.8	526.4	452.8	410.4	373.6	336.8	302.8
476.7	781.1	659.4	563.2	483.9	441.5	401.9	363.7	325.5
499.4	823.5	696.2	595.7	515.1	469.8	430.2	389.1	350.9
522.1	866	735.8	631.1	546.2	500.9	458.5	416	373.6
544.8	911.3	772.6	666.5	577.3	532	486.8	441.5	399
567.5	953.7	812.2	701.8	609.4	561.8	515.1	467	421.7
590.2	999	851.8	737.2	641	591.5	543.4	493.8	447.1
612.9	1041.4	888.6	772.6	672.1	622.6	571.7	520.7	471.2
635.6	1086.7	928.2	808	704.7	653.7	600	547.6	495.3
658.3	1129.2	967.9	843.3	735.8	684.9	628.3	574.5	519.3
681	1171.6	1007.5	878.7	766.9	713.2	656.6	600	543.4

## Additional Proposed Changes

<u>File Name</u>	<u>Description</u>	<u>Approved</u>
For_inclusion_extend_tables_5_5_3_3_1_a_and_b.pdf		
Supporting_Tech_backup_for_with_equations_for_Extended_Table_A.5.5.3.1_a_and_b_djh.pdf		

## Statement of Problem and Substantiation for Public Comment

The purpose for extending the data in the charts is that "rotating electrical equipment" hazards have increased significantly in size (volume) since the original charts were created.

### Related Item

- FR-21

## Submitter Information Verification

**Submitter Full Name:** Daniel Hubert  
**Organization:** Janus Fire Systems  
**Affiliation:** FSSA  
**Street Address:**  
**City:**  
**State:**

**Zip:**

**Submittal Date:** Thu Jan 04 13:22:47 EST 2024

**Committee:** GFE-AAA

**Table A.5.5.3(a) Extended Discharge Protection for Enclosed Recirculating Rotating Electrical Equipment (Cubic Feet Protected for Deceleration Time)**

lb CO <sub>2</sub>	Time (minutes)							
	5	10	15	20	30	40	50	60
100	1200	1000	800	600	500	400	300	200
150	1800	1500	1200	1000	750	600	500	400
200	2400	1950	1600	1300	1000	850	650	500
250	3300	2450	2000	1650	1300	1050	800	600
300	4600	3100	2400	2000	1650	1300	1000	700
350	6100	4100	3000	2500	2000	1650	1200	900
400	7700	5400	3800	3150	2500	2000	1600	1200
450	9250	6800	4900	4000	3100	2600	2100	1600
500	10800	8100	6100	5000	3900	3300	2800	2200
550	12300	9500	7400	6100	4900	4200	3600	3100
600	13900	10900	8600	7200	6000	5200	4500	3900
650	15400	12300	9850	8300	7050	6200	5500	4800
700	16900	13600	11100	9400	8100	7200	6400	5600
750	18500	15000	12350	10500	9150	8200	7300	6500
800	20000	16400	13600	11600	10200	9200	8200	7300
850	21500	17750	14850	12700	11300	10200	9100	8100
900	23000	19100	16100	13800	12350	11200	10050	9000
950	24600	20500	17350	14900	13400	12200	11000	9800
1000	26100	21900	18600	16000	14500	13200	11900	10700
1050	27600	23300	19900	17100	15600	14200	12850	11500
1100	29100	24600	21050	18200	16600	15200	13750	12400
1150	30600	26000	22300	19300	17700	16200	14700	13200
1200	32200	27300	23550	20400	18800	17200	15600	14100
1250	33700	28700	24800	21500	19850	18200	16500	14900
1300	35300	30100	26050	22650	20900	19200	17450	15800
1350	36800	31400	27300	23750	22000	20200	18400	16650
1400	38400	32800	28550	24900	23100	21200	19350	17500
1450	39900	34200	29800	26000	24200	22200	20300	18350
1500	41400	35600	31050	27100	25250	23200	21200	19200
1600	44500	38300	33500	29300	27400	25200	23050	20900
1700	47550	41000	36000	31550	29550	27200	24900	22600
1800	50650	43750	38500	33750	31700	29200	26800	24300
1900	53700	46500	41000	36000	33850	31200	28650	26000
2000	56800	49200	43500	38200	36000	33200	30500	27750
2100	59850	51950	45950	40450	38150	35200	32350	29450
2200	62950	54700	48450	42650	40300	37200	34200	31150
2300	66000	57400	50950	44900	42450	39200	36100	32850
2400	69100	60150	53450	47100	44600	41200	37950	34550
2500	72150	62900	55900	49350	46750	43200	39800	36250
2600	75250	65600	58400	51550	48900	45200	41650	37950
2700	78300	68350	60900	53800	51050	47200	43550	39650
2800	81400	71050	63400	56000	53200	49200	45400	41350
2900	84450	73800	65850	58250	55350	51200	47250	43100
3000	87550	76550	68350	60450	57500	53200	49100	44800
3500	102900	90200	80800	71600	68300	63200	58400	53300
4000	118300	103850	93250	82700	79050	73200	67700	61850
4500	133650	117550	105700	93850	89800	83200	77000	70350
5000	149050	131200	118100	104950	100550	93200	86350	78900

**Table A.5.5.3(b) Extended Discharge Protection for Enclosed Recirculating Rotating Electrical Equipment (Cubic Meters Protected for Deceleration Time)**

kg CO <sub>2</sub>	Time (minutes)								
	5	10	15	20	30	40	50	60	
45.4	34	28.3	22.6	17	14.2	11.3	8.5	5.7	
68.1	50.9	42.5	34	28.3	21.2	17	14.2	11.3	
90.8	67.9	55.2	45.3	36.8	28.3	24.1	18.4	14.2	
113.5	93.4	69.3	56.6	46.7	36.8	29.7	22.6	17	
136.2	130.2	87.7	67.9	56.6	46.7	36.8	28.3	19.8	
158.9	172.6	116	84.9	70.8	56.6	46.7	34	25.5	
181.6	217.9	152.8	107.5	89.1	70.8	56.6	45.3	34	
204.3	261.8	192.4	138.7	113.2	87.7	73.6	59.4	45.3	
227	305.6	229.2	172.6	141.5	110.4	93.4	79.2	62.3	
249.7	348.1	268.9	209.4	172.6	138.7	118.9	101.9	87.7	
272.4	393.4	308.5	243.4	203.8	169.8	147.2	127.4	110.4	
295.1	435.8	348.1	278.8	234.9	199.5	175.5	155.7	135.8	
317.8	478.3	384.9	314.1	266	229.2	203.8	181.1	158.5	
340.5	523.6	424.5	349.5	297.2	258.9	232.1	206.6	184	
363.2	586	464.1	384.9	328.3	288.7	260.4	232.1	206.6	
385.9	608.4	502.3	420.3	359.4	319.8	288.7	257.5	229.2	
408.6	650.9	540.5	455.6	390.5	349.5	317	284.4	254.7	
431.3	696.2	580.2	491	421.7	379.2	345.3	311.3	277.3	
454	738.6	619.8	526.4	452.8	410.4	373.6	336.8	302.8	
476.7	781.1	659.4	563.2	483.9	441.5	401.9	363.7	325.5	
499.4	823.5	696.2	595.7	515.1	469.8	430.2	389.1	350.9	
522.1	866	735.8	631.1	546.2	500.9	458.5	416	373.6	
544.8	911.3	772.6	666.5	577.3	532	486.8	441.5	399	
567.5	953.7	812.2	701.8	609.4	561.8	515.1	467	421.7	
590.2	999	851.8	737.2	641	591.5	543.4	493.8	447.1	
612.9	1041.4	888.6	772.6	672.1	622.6	571.7	520.7	471.2	
635.6	1086.7	928.2	808	704.7	653.7	600	547.6	495.3	
658.3	1129.2	967.9	843.3	735.8	684.9	628.3	574.5	519.3	
681	1171.6	1007.5	878.7	766.9	713.2	656.6	600	543.4	
726.4	1259.3	1083.4	948.7	829.9	774.7	713.2	652.6	591.7	
771.8	1346.3	1160.8	1019.1	892.8	835.5	769.8	705.3	639.9	
817.2	1433.3	1238.1	1089.5	955.8	896.3	826.4	757.9	688.2	
862.6	1520.3	1315.4	1159.9	1018.7	957	883	810.6	736.5	
908	1607.3	1392.8	1230.3	1081.7	1017.8	939.6	863.3	784.8	
953.4	1694.3	1470.1	1300.7	1144.6	1078.6	996.2	915.9	833	
998.8	1781.3	1547.4	1371.1	1207.6	1139.3	1052.8	968.6	881.3	
1044.2	1868.3	1624.8	1441.6	1270.5	1200.1	1109.4	1021.2	929.6	
1089.6	1955.3	1702.1	1512	1333.5	1260.9	1166	1073.9	977.8	
1135	2042.3	1779.4	1582.4	1396.4	1321.6	1222.6	1126.6	1026.1	
1180.4	2129.4	1856.8	1652.8	1459.4	1382.4	1279.2	1179.2	1074.4	
1225.8	2216.4	1934.1	1723.2	1522.3	1443.2	1335.8	1231.9	1122.6	
1271.2	2303.4	2011.4	1793.6	1585.3	1503.9	1392.4	1284.6	1170.9	
1316.6	2390.4	2088.8	1864	1648.2	1564.7	1449	1337.2	1219.2	
1362	2477.4	2166.1	1934.4	1711.2	1625.5	1505.6	1389.9	1267.4	
1589	2912.4	2552.8	2286.5	2026	1929.3	1788.6	1653.2	1508.8	
1816	3347.5	2939.4	2638.5	2340.7	2233.2	2071.6	1916.5	1750.1	
2043	3782.5	3326.1	2990.6	2655.5	2537	2354.6	2179.9	1991.5	
2270	4217.6	3712.8	3342.7	2970.2	2840.8	2637.6	2443.2	2232.8	

**Table A.5.5.3(a) Extended Discharge Protection for Enclosed Recirculating Rotating Electrical Equipment (Cubic Feet Protected for Deceleration Time)**

lb CO <sub>2</sub>	Time (minutes)							
	5	10	15	20	30	40	50	60
100	1200	1000	800	600	500	400	300	200
150	1800	1500	1200	1000	750	600	500	400
200	2400	1950	1600	1300	1000	850	650	500
250	3300	2450	2000	1650	1300	1050	800	600
300	4600	3100	2400	2000	1650	1300	1000	700
350	6100	4100	3000	2500	2000	1650	1200	900
400	7700	5400	3800	3150	2500	2000	1600	1200
450	9250	6800	4900	4000	3100	2600	2100	1600
500	10800	8100	6100	5000	3900	3300	2800	2200
550	12300	9500	7400	6100	4900	4200	3600	3100
600	13900	10900	8600	7200	6000	5200	4500	3900
650	15400	12300	9850	8300	7050	6200	5500	4800
700	16900	13600	11100	9400	8100	7200	6400	5600
750	18500	15000	12350	10500	9150	8200	7300	6500
800	20000	16400	13600	11600	10200	9200	8200	7300
850	21500	17750	14850	12700	11300	10200	9100	8100
900	23000	19100	16100	13800	12350	11200	10050	9000
950	24600	20500	17350	14900	13400	12200	11000	9800
1000	26100	21900	18600	16000	14500	13200	11900	10700
1050	27600	23300	19900	17100	15600	14200	12850	11500
1100	29100	24600	21050	18200	16600	15200	13750	12400
1150	30600	26000	22300	19300	17700	16200	14700	13200
1200	32200	27300	23550	20400	18800	17200	15600	14100
1250	33700	28700	24800	21500	19850	18200	16500	14900
1300	35300	30100	26050	22650	20900	19200	17450	15800
1350	36800	31400	27300	23750	22000	20200	18400	16650
1400	38400	32800	28550	24900	23100	21200	19350	17500
1450	39900	34200	29800	26000	24200	22200	20300	18350
1500	41400	35600	31050	27100	25250	23200	21200	19200
1600	44500	38300	33500	29300	27400	25200	23050	20900
1700	47550	41000	36000	31550	29550	27200	24900	22600
1800	50650	43750	38500	33750	31700	29200	26800	24300
1900	53700	46500	41000	36000	33850	31200	28650	26000
2000	56800	49200	43500	38200	36000	33200	30500	27750
2100	59850	51950	45950	40450	38150	35200	32350	29450
2200	62950	54700	48450	42650	40300	37200	34200	31150
2300	66000	57400	50950	44900	42450	39200	36100	32850
2400	69100	60150	53450	47100	44600	41200	37950	34550
2500	72150	62900	55900	49350	46750	43200	39800	36250
2600	75250	65600	58400	51550	48900	45200	41650	37950
2700	78300	68350	60900	53800	51050	47200	43550	39650
2800	81400	71050	63400	56000	53200	49200	45400	41350
2900	84450	73800	65850	58250	55350	51200	47250	43100
3000	87550	76550	68350	60450	57500	53200	49100	44800
3500	102900	90200	80800	71600	68300	63200	58400	53300
4000	118300	103850	93250	82700	79050	73200	67700	61850
4500	133650	117550	105700	93850	89800	83200	77000	70350
5000	149050	131200	118100	104950	100550	93200	86350	78900

Equations for lb CO <sub>2</sub> Greater Than 1500 lb		
Time (minutes)	Equation: Volume = a*(lb CO <sub>2</sub> ) - b	
	a	b
5	30.745	4695.5
10	27.327	5440.9
15	24.882	6288.6
20	22.245	6270.5
30	21.518	7034.1
40	20	6800
50	18.609	6715.9
60	17.055	6381.8

Equations for lb CO <sub>2</sub> Greater Than 1500 lb		
Time (minutes)	Equation: lb CO <sub>2</sub> = c*Volume + d	
	c	d
5	0.03253	152.72
10	0.03659	199.10
15	0.04019	252.74
20	0.04495	281.88
30	0.04647	326.89
40	0.05000	340.00
50	0.05374	360.90
60	0.05863	374.19

\*Added using extrapolated equations shown in sheets for each column. Values are rounded to the nearest 50 to follow in line with current table values.

**Table A.5.5.3(b) Extended Discharge Protection for Enclosed Recirculating Rotating Electrical Equipment (Cubic Meters Protected for Deceleration Time)**

kg CO <sub>2</sub>	Time (minutes)							
	5	10	15	20	30	40	50	60
45.4	34	28.3	22.6	17	14.2	11.3	8.5	5.7
68.1	50.9	42.5	34	28.3	21.2	17	14.2	11.3
90.8	67.9	55.2	45.3	36.8	28.3	24.1	18.4	14.2
113.5	93.4	69.3	56.6	46.7	36.8	29.7	22.6	17
136.2	130.2	87.7	67.9	56.6	46.7	36.8	28.3	19.8
158.9	172.6	116	84.9	70.8	56.6	46.7	34	25.5
181.6	217.9	152.8	107.5	89.1	70.8	56.6	45.3	34
204.3	261.8	192.4	138.7	113.2	87.7	73.6	59.4	45.3
227	305.6	229.2	172.6	141.5	110.4	93.4	79.2	62.3
249.7	348.1	268.9	209.4	172.6	138.7	118.9	101.9	87.7
272.4	393.4	308.5	243.4	203.8	169.8	147.2	127.4	110.4
295.1	435.8	348.1	278.8	234.9	199.5	175.5	155.7	135.8
317.8	478.3	384.9	314.1	266	229.2	203.8	181.1	158.5
340.5	523.6	424.5	349.5	297.2	258.9	232.1	206.6	184
363.2	586	464.1	384.9	328.3	288.7	260.4	232.1	206.6
385.9	608.4	502.3	420.3	359.4	319.8	288.7	257.5	229.2
408.6	650.9	540.5	455.6	390.5	349.5	317	284.4	254.7
431.3	696.2	580.2	491	421.7	379.2	345.3	311.3	277.3
454	738.6	619.8	526.4	452.8	410.4	373.6	336.8	302.8
476.7	781.1	659.4	563.2	483.9	441.5	401.9	363.7	325.5
499.4	823.5	696.2	595.7	515.1	469.8	430.2	389.1	350.9
522.1	866	735.8	631.1	546.2	500.9	458.5	416	373.6
544.8	911.3	772.6	666.5	577.3	532	486.8	441.5	399
567.5	953.7	812.2	701.8	609.4	561.8	515.1	467	421.7
590.2	999	851.8	737.2	641	591.5	543.4	493.8	447.1
612.9	1041.4	888.6	772.6	672.1	622.6	571.7	520.7	471.2
635.6	1086.7	928.2	808	704.7	653.7	600	547.6	495.3
658.3	1129.2	967.9	843.3	735.8	684.9	628.3	574.5	519.3
681	1171.6	1007.5	878.7	766.9	713.2	656.6	600	543.4
726.4	1259.3	1083.4	948.7	829.9	774.7	713.2	652.6	591.7
771.8	1346.3	1160.8	1019.1	892.8	835.5	769.8	705.3	639.9
817.2	1433.3	1238.1	1089.5	955.8	896.3	826.4	757.9	688.2
862.6	1520.3	1315.4	1159.9	1018.7	957	883	810.6	736.5
908	1607.3	1392.8	1230.3	1081.7	1017.8	939.6	863.3	784.8
953.4	1694.3	1470.1	1300.7	1144.6	1078.6	996.2	915.9	833
998.8	1781.3	1547.4	1371.1	1207.6	1139.3	1052.8	968.6	881.3
1044.2	1868.3	1624.8	1441.6	1270.5	1200.1	1109.4	1021.2	929.6
1089.6	1955.3	1702.1	1512	1333.5	1260.9	1166	1073.9	977.8
1135	2042.3	1779.4	1582.4	1396.4	1321.6	1222.6	1126.6	1026.1
1180.4	2129.4	1856.8	1652.8	1459.4	1382.4	1279.2	1179.2	1074.4
1225.8	2216.4	1934.1	1723.2	1522.3	1443.2	1335.8	1231.9	1122.6
1271.2	2303.4	2011.4	1793.6	1585.3	1503.9	1392.4	1284.6	1170.9
1316.6	2390.4	2088.8	1864	1648.2	1564.7	1449	1337.2	1219.2
1362	2477.4	2166.1	1934.4	1711.2	1625.5	1505.6	1389.9	1267.4
1589	2912.4	2552.8	2286.5	2026	1929.3	1788.6	1653.2	1508.8
1816	3347.5	2939.4	2638.5	2340.7	2233.2	2071.6	1916.5	1750.1
2043	3782.5	3326.1	2990.6	2655.5	2537	2354.6	2179.9	1991.5
2270	4217.6	3712.8	3342.7	2970.2	2840.8	2637.6	2443.2	2232.8

Equations for lb CO<sub>2</sub> Greater Than 681 kg

Time (minutes)	Equation: Volume = a*(kg CO <sub>2</sub> ) - b	
	a	b
5	1.9165	132.88
10	1.7034	153.93
15	1.5509	177.89
20	1.3866	177.35
30	1.3385	197.56
40	1.2467	192.4
50	1.16	190.03
60	1.0632	180.63

Equations for lb CO<sub>2</sub> Greater Than 681 kg

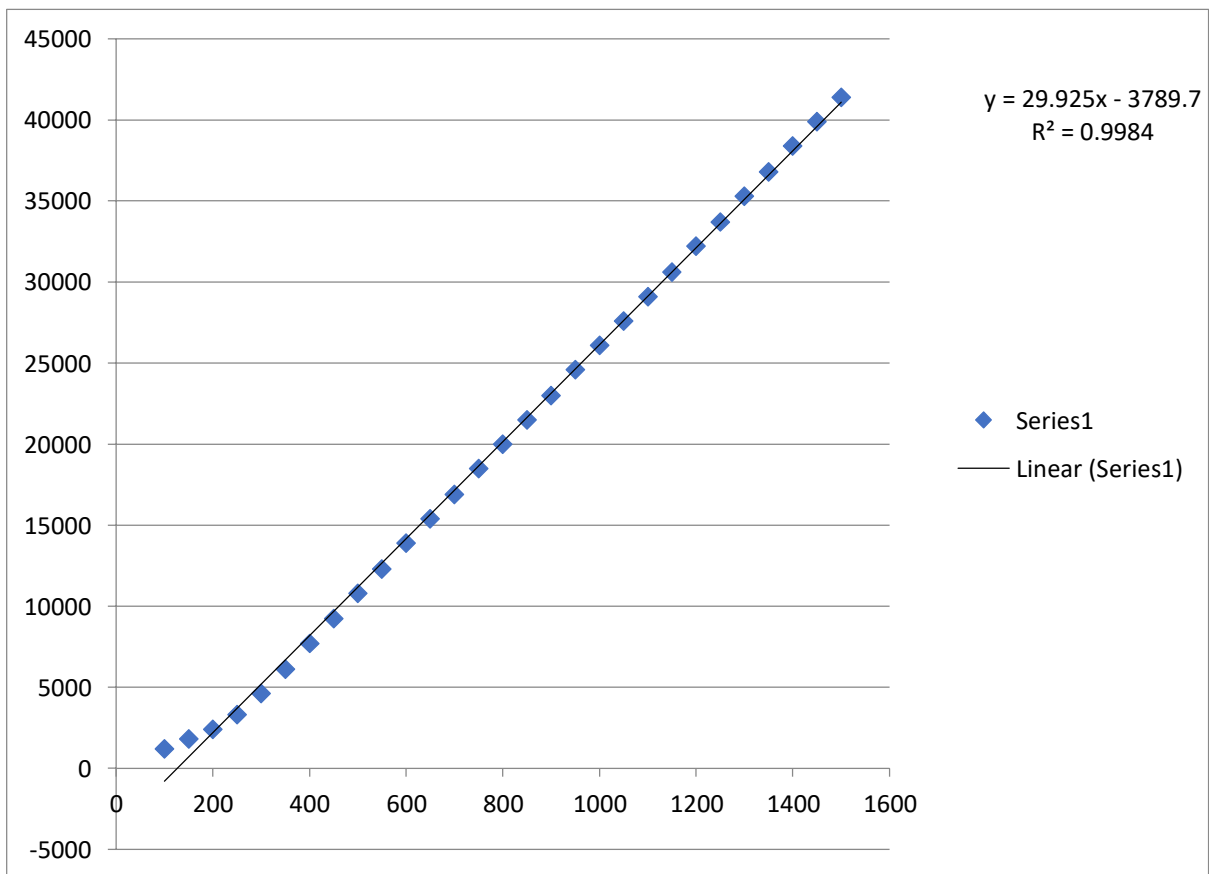
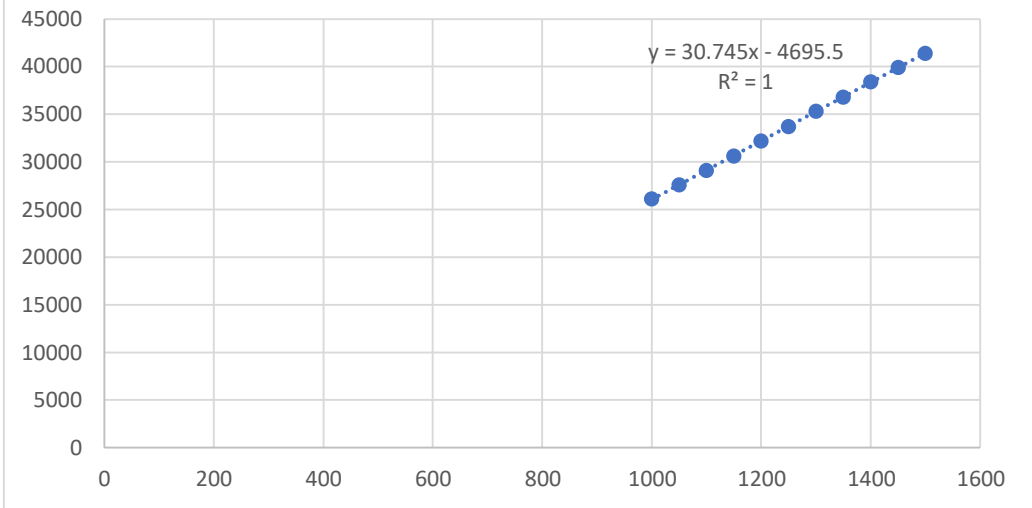
Time (minutes)	Equation: kg CO <sub>2</sub> = c*(Volume) + d	
	c	d
5	0.52178	69.33
10	0.58706	90.37
15	0.64479	114.70
20	0.72119	127.90
30	0.74710	147.60
40	0.80212	154.33
50	0.86207	163.82
60	0.94056	169.89

\*Added using extrapolated equations shown in sheets for each column. Values are rounded to the nearest 0.1 to follow in line with current table values.

Linear Regression for Volumes greater than 41,400 cu.ft. - Table  
A.5.5.3(a)

X	Y	
100	1200	X = lbs CO2
150	1800	Y = Volume covered by X
200	2400	
250	3300	
300	4600	
350	6100	
400	7700	
450	9250	
500	10800	
550	12300	
600	13900	For Recirculating Equipment
650	15400	
700	16900	
750	18500	
800	20000	
850	21500	
900	23000	
950	24600	
1000	26100	26000
1050	27600	27600
1100	29100	29100
1150	30600	30700
1200	32200	32200
1250	33700	33700
1300	35300	35300
1350	36800	36800
1400	38400	38300
1450	39900	39900
1500	41400	41400

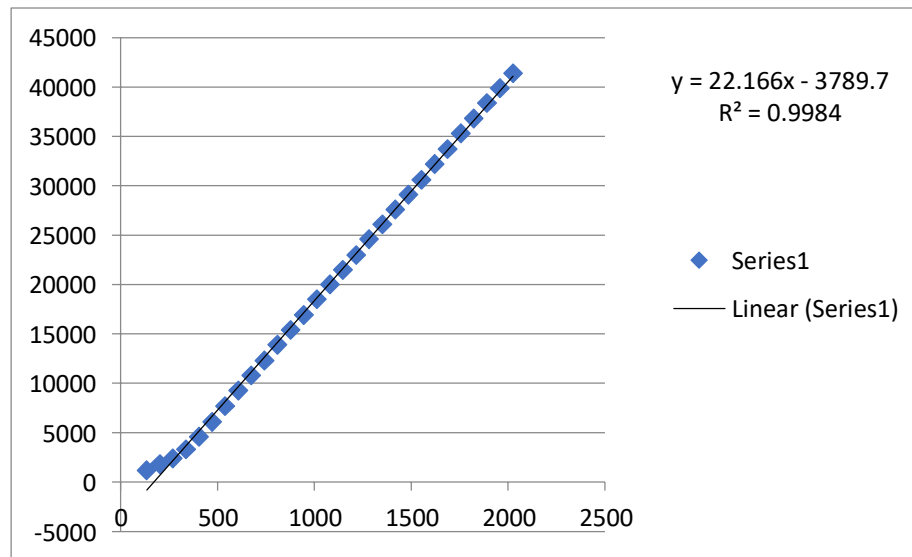
For X Values 1000 and higher



## Linear Regression for Volumes greater than 41,400 cu.ft. - Table A.5.5.3(a)

X	Y
135	1200
202.5	1800
270	2400
337.5	3300
405	4600
472.5	6100
540	7700
607.5	9250
675	10800
742.5	12300
810	13900
877.5	15400
945	16900
1012.5	18500
1080	20000
1147.5	21500
1215	23000
1282.5	24600
1350	26100
1417.5	27600
1485	29100
1552.5	30600
1620	32200
1687.5	33700
1755	35300
1822.5	36800
1890	38400
1957.5	39900
2025	41400

35% added for Non-Recirculating Equipment

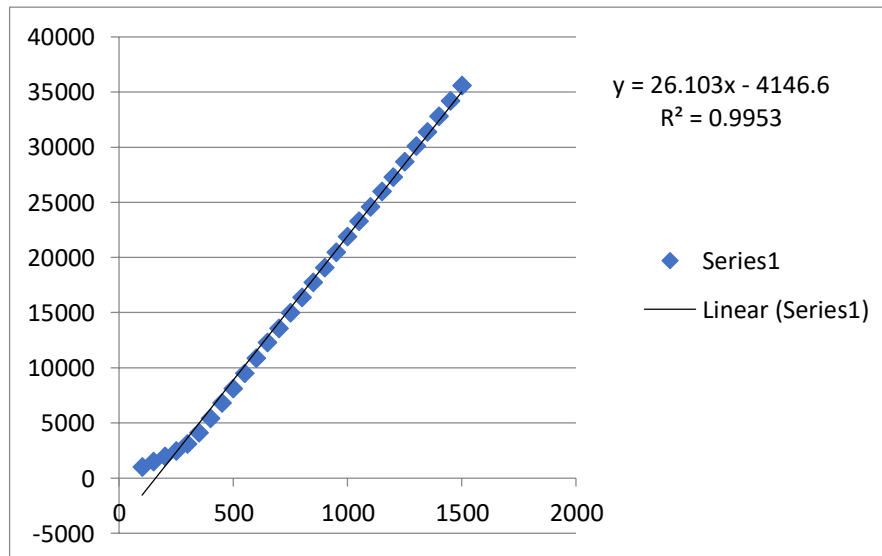


## Linear Regression for Volumes greater than 35,600 cu.ft. - Table A.5.5.3(a)

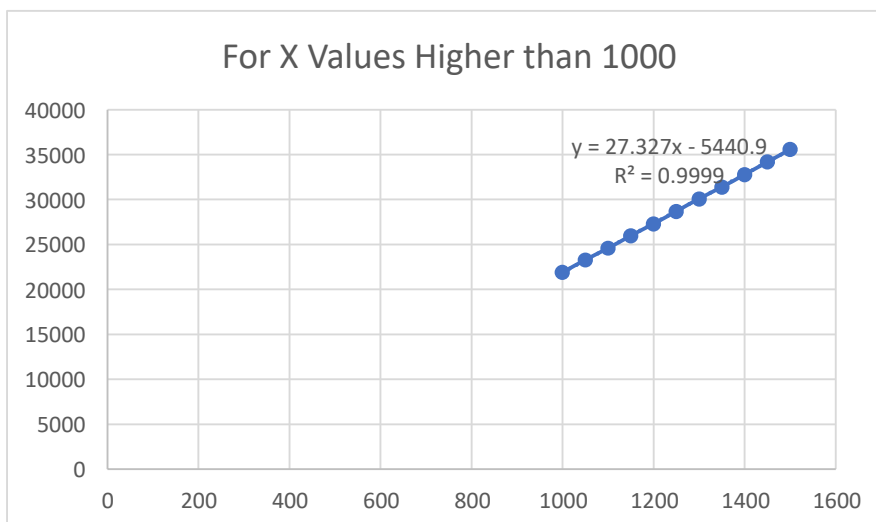
X	Y
100	1000
150	1500
200	1950
250	2450
300	3100
350	4100
400	5400
450	6800
500	8100
550	9500
600	10900
650	12300
700	13600
750	15000
800	16400
850	17750
900	19100
950	20500
1000	21900
1050	23300
1100	24600
1150	26000
1200	27300
1250	28700
1300	30100
1350	31400
1400	32800
1450	34200
1500	35600

X = lbs CO2  
 Y = Volume covered by X

For Recirculating Equipment



For X Values Higher than 1000



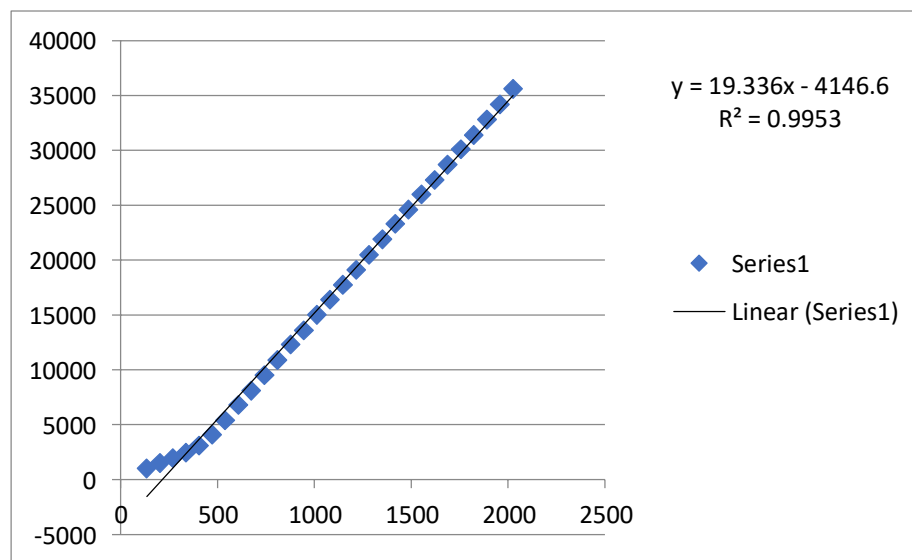
## Linear Regression for Volumes greater than 35,600 cu.ft. - Table A.5.5.3(a)

X	Y
135	1000
202.5	1500
270	1950
337.5	2450
405	3100
472.5	4100
540	5400
607.5	6800
675	8100
742.5	9500
810	10900
877.5	12300
945	13600
1012.5	15000
1080	16400
1147.5	17750
1215	19100
1282.5	20500
1350	21900
1417.5	23300
1485	24600
1552.5	26000
1620	27300
1687.5	28700
1755	30100
1822.5	31400
1890	32800
1957.5	34200
2025	35600

X = lbs CO2

Y = Volume covered by X

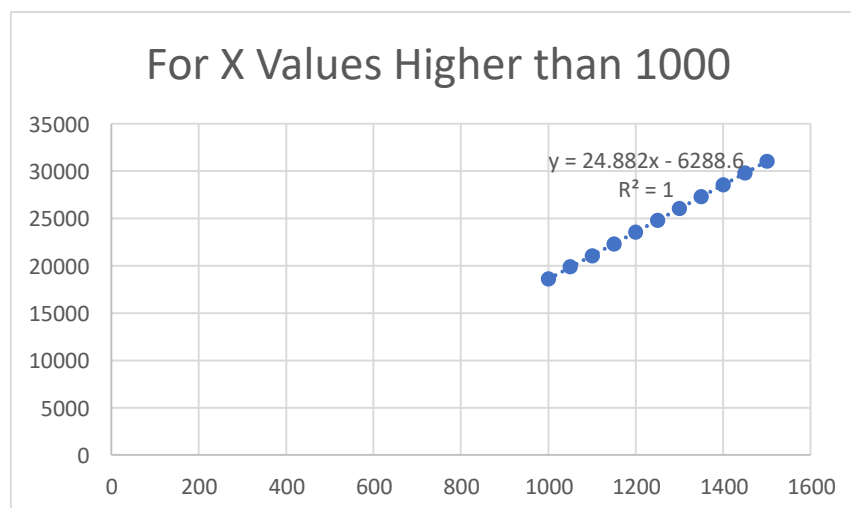
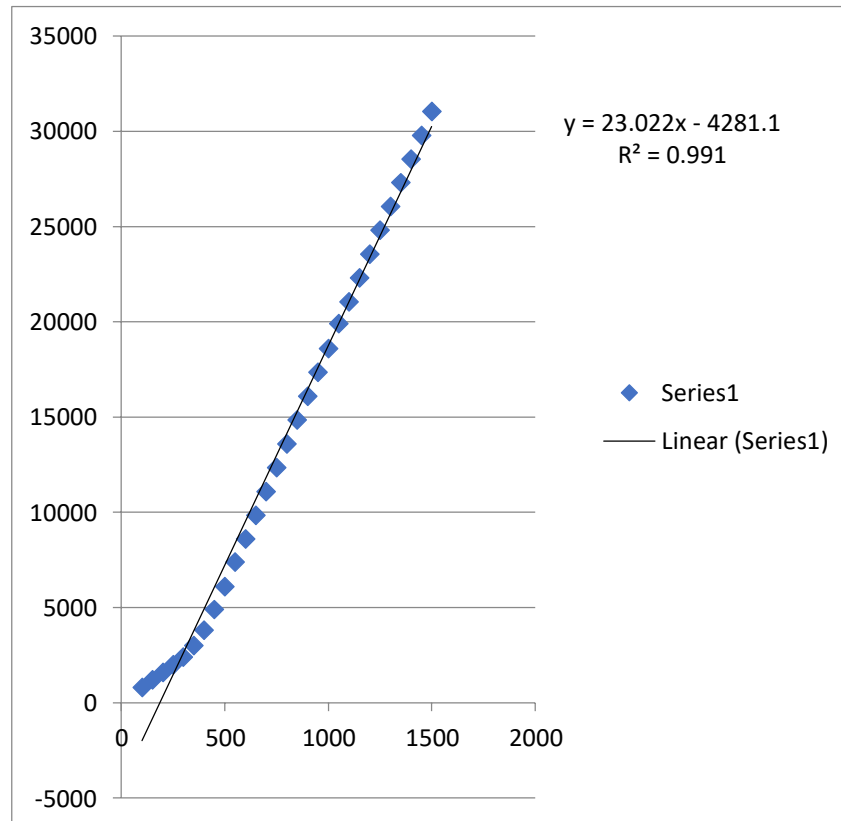
35% added for Non-Recirculating Equipment



## Linear Regression for Volumes greater than 31,050 cu.ft. - Table A.5.5.3(a)

X	Y
100	800
150	1200
200	1600
250	2000
300	2400
350	3000
400	3800
450	4900
500	6100
550	7400
600	8600
650	9850
700	11100
750	12350
800	13600
850	14850
900	16100
950	17350
1000	18600
1050	19900
1100	21050
1150	22300
1200	23550
1250	24800
1300	26050
1350	27300
1400	28550
1450	29800
1500	31050

X = lbs CO2  
 Y = Volume covered by X

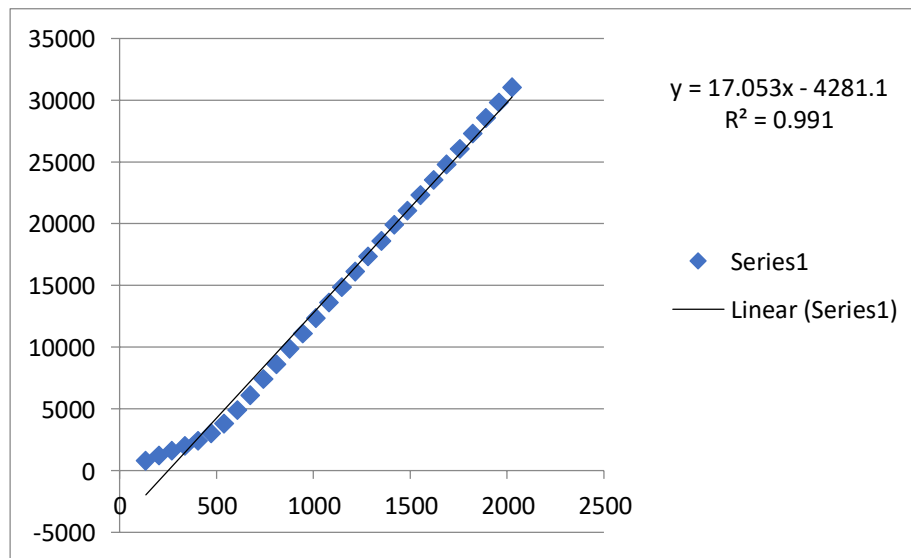


## Linear Regression for Volumes greater than 31,050 cu.ft. - Table A.5.5.3(a)

X	Y
135	800
202.5	1200
270	1600
337.5	2000
405	2400
472.5	3000
540	3800
607.5	4900
675	6100
742.5	7400
810	8600
877.5	9850
945	11100
1012.5	12350
1080	13600
1147.5	14850
1215	16100
1282.5	17350
1350	18600
1417.5	19900
1485	21050
1552.5	22300
1620	23550
1687.5	24800
1755	26050
1822.5	27300
1890	28550
1957.5	29800
2025	31050

X = lbs CO2  
 Y = Volume covered by X

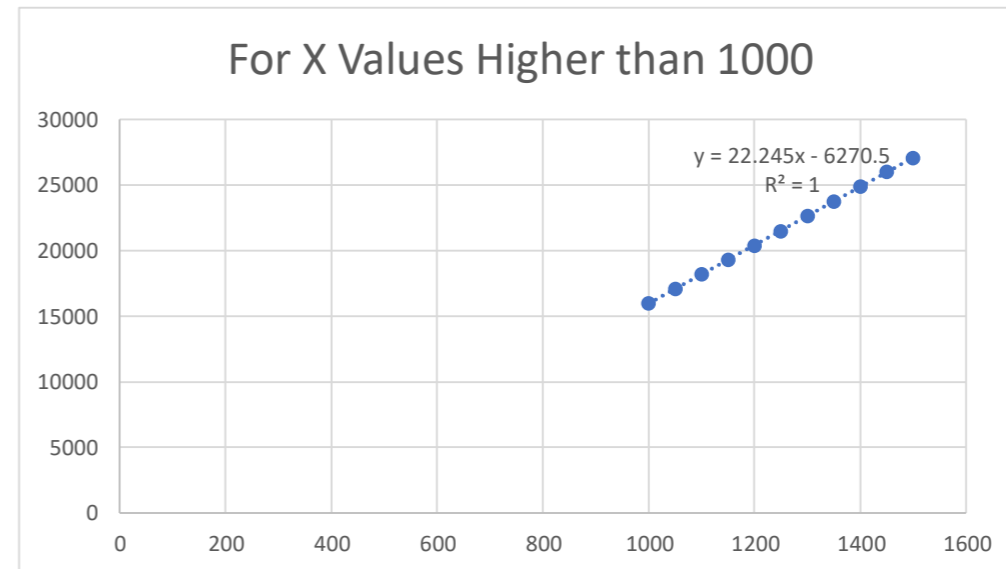
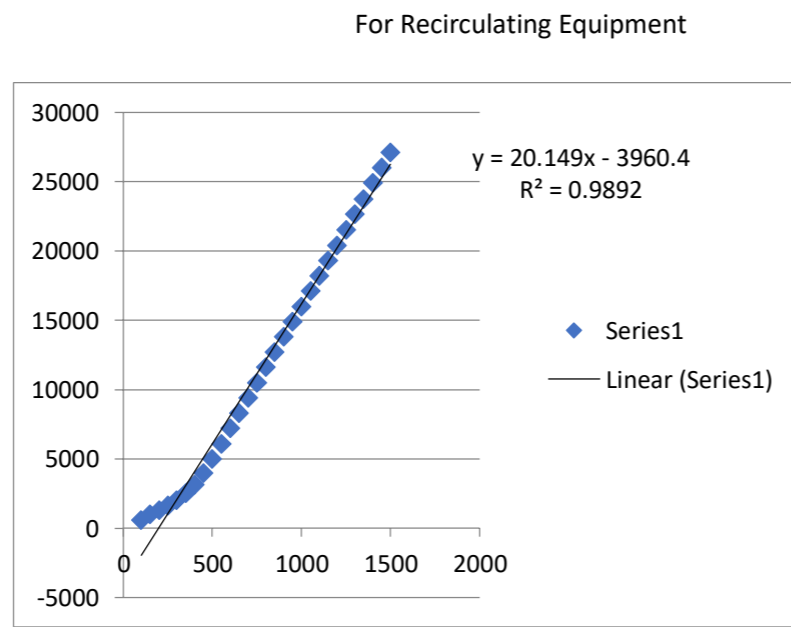
35% added for Non-Recirculating Equipment



Linear Regression for Volumes greater than 27,100 cu.ft. - Table A.5.5.3(a)

X	Y
100	600
150	1000
200	1300
250	1650
300	2000
350	2500
400	3150
450	4000
500	5000
550	6100
600	7200
650	8300
700	9400
750	10500
800	11600
850	12700
900	13800
950	14900
1000	16000
1050	17100
1100	18200
1150	19300
1200	20400
1250	21500
1300	22650
1350	23750
1400	24900
1450	26000
1500	27100

X = lbs CO2  
Y = Volume covered by X

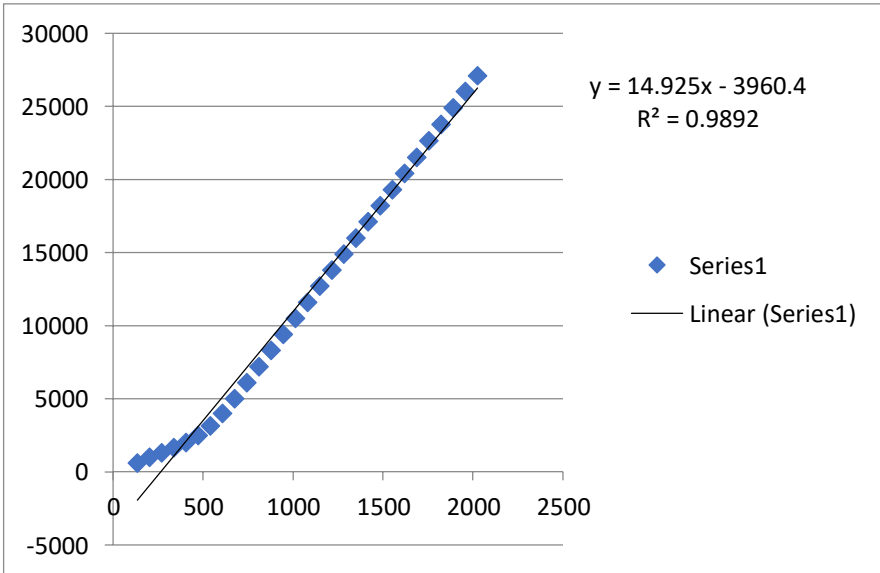


# Linear Regression for Volumes greater than 27,100 cu.ft. - Table A.5.5.3(a)

X	Y
135	600
202.5	1000
270	1300
337.5	1650
405	2000
472.5	2500
540	3150
607.5	4000
675	5000
742.5	6100
810	7200
877.5	8300
945	9400
1012.5	10500
1080	11600
1147.5	12700
1215	13800
1282.5	14900
1350	16000
1417.5	17100
1485	18200
1552.5	19300
1620	20400
1687.5	21500
1755	22650
1822.5	23750
1890	24900
1957.5	26000
2025	27100

X = lbs CO2  
 Y = Volume covered by X

35% added for Non-Recirculating Equipment

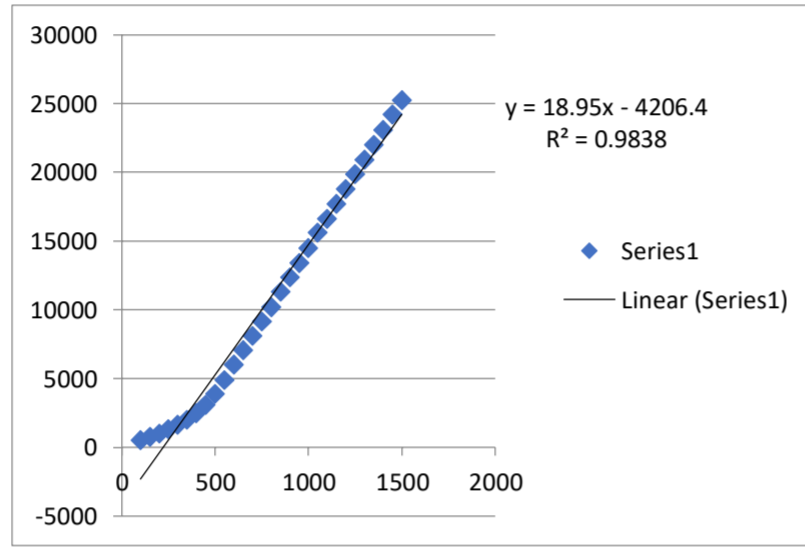


Linear Regression for Volumes greater than 25,250 cu.ft. - Table A.5.5.3(a)

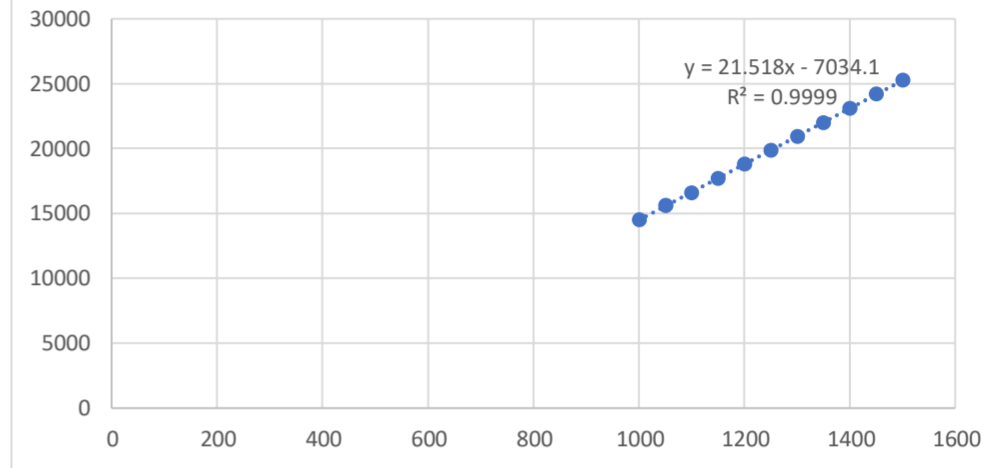
X	Y
100	500
150	750
200	1000
250	1300
300	1650
350	2000
400	2500
450	3100
500	3900
550	4900
600	6000
650	7050
700	8100
750	9150
800	10200
850	11300
900	12350
950	13400
1000	14500
1050	15600
1100	16600
1150	17700
1200	18800
1250	19850
1300	20900
1350	22000
1400	23100
1450	24200
1500	25250

X = lbs CO2  
Y = Volume covered by X

For Recirculating Equipment



For X Values Higher than 1000

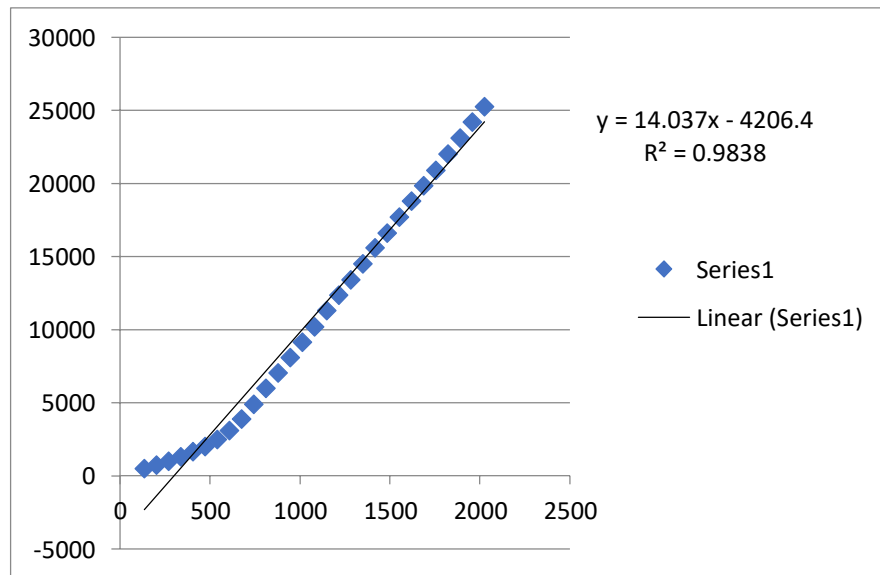


## Linear Regression for Volumes greater than 25,250 cu.ft. - Table A.5.5.3(a)

X	Y
135	500
202.5	750
270	1000
337.5	1300
405	1650
472.5	2000
540	2500
607.5	3100
675	3900
742.5	4900
810	6000
877.5	7050
945	8100
1012.5	9150
1080	10200
1147.5	11300
1215	12350
1282.5	13400
1350	14500
1417.5	15600
1485	16600
1552.5	17700
1620	18800
1687.5	19850
1755	20900
1822.5	22000
1890	23100
1957.5	24200
2025	25250

X = lbs CO2  
 Y = Volume covered by X

35% added for Non-Recirculating Equipment

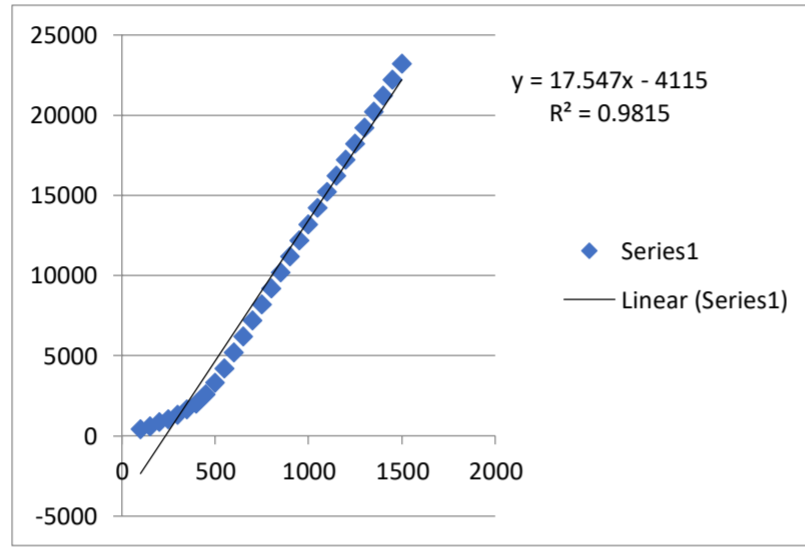


Linear Regression for Volumes greater than 23,200 cu.ft. - Table A.5.5.3(a)

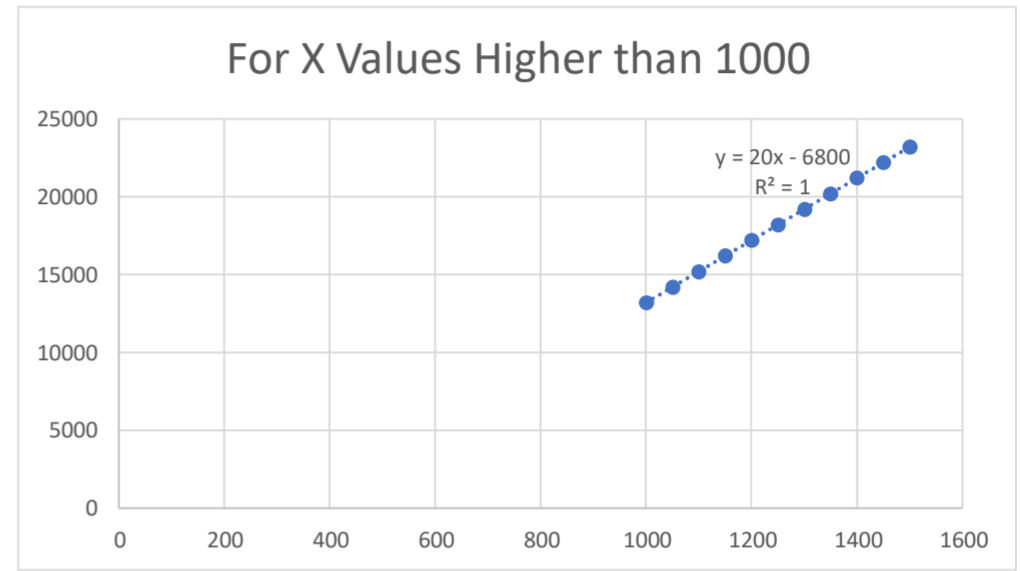
X	Y
100	400
150	600
200	850
250	1050
300	1300
350	1650
400	2000
450	2600
500	3300
550	4200
600	5200
650	6200
700	7200
750	8200
800	9200
850	10200
900	11200
950	12200
1000	13200
1050	14200
1100	15200
1150	16200
1200	17200
1250	18200
1300	19200
1350	20200
1400	21200
1450	22200
1500	23200

X = lbs CO2  
Y = Volume covered by X

For Recirculating Equipment



For X Values Higher than 1000

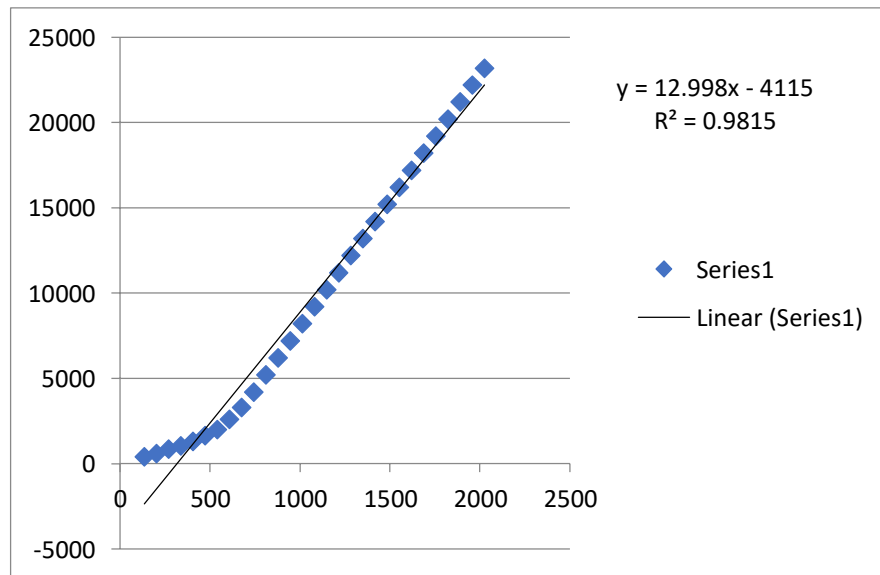


## Linear Regression for Volumes greater than 23,200 cu.ft. - Table A.5.5.3(a)

X	Y
135	400
202.5	600
270	850
337.5	1050
405	1300
472.5	1650
540	2000
607.5	2600
675	3300
742.5	4200
810	5200
877.5	6200
945	7200
1012.5	8200
1080	9200
1147.5	10200
1215	11200
1282.5	12200
1350	13200
1417.5	14200
1485	15200
1552.5	16200
1620	17200
1687.5	18200
1755	19200
1822.5	20200
1890	21200
1957.5	22200
2025	23200

X = lbs CO2  
Y = Volume covered by X

35% added for Non-Recirculating Equipment

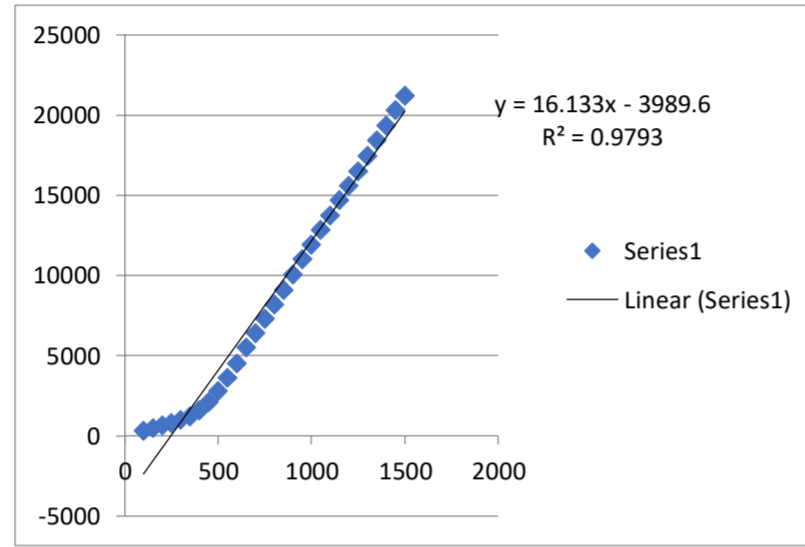


Linear Regression for Volumes greater than 21,200 cu.ft. - Table A.5.5.3(a)

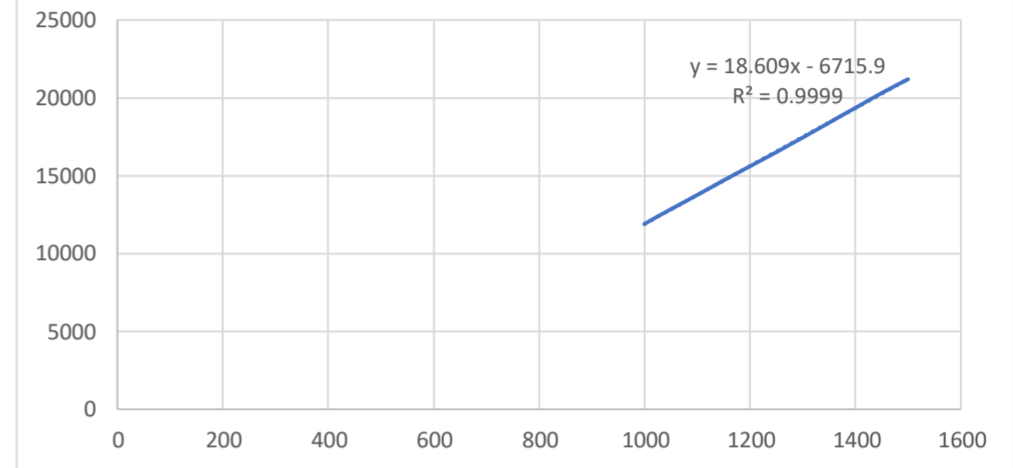
X	Y
100	300
150	500
200	650
250	800
300	1000
350	1200
400	1600
450	2100
500	2800
550	3600
600	4500
650	5500
700	6400
750	7300
800	8200
850	9100
900	10050
950	11000
1000	11900
1050	12850
1100	13750
1150	14700
1200	15600
1250	16500
1300	17450
1350	18400
1400	19350
1450	20300
1500	21200

X = lbs CO2  
Y = Volume covered by X

For Recirculating Equipment



For X Values Higher than 1000

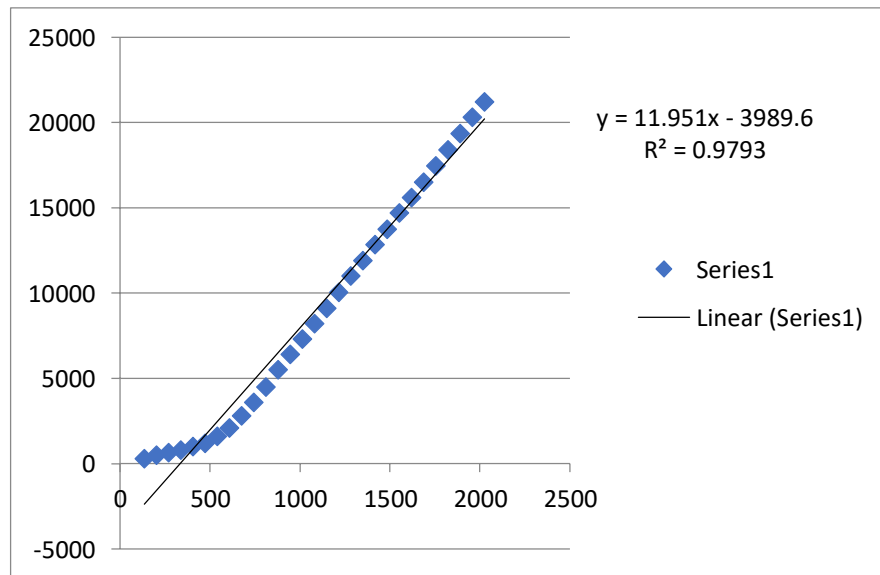


## Linear Regression for Volumes greater than 21,200 cu.ft. - Table A.5.5.3(a)

X	Y
135	300
202.5	500
270	650
337.5	800
405	1000
472.5	1200
540	1600
607.5	2100
675	2800
742.5	3600
810	4500
877.5	5500
945	6400
1012.5	7300
1080	8200
1147.5	9100
1215	10050
1282.5	11000
1350	11900
1417.5	12850
1485	13750
1552.5	14700
1620	15600
1687.5	16500
1755	17450
1822.5	18400
1890	19350
1957.5	20300
2025	21200

X = lbs CO2  
Y = Volume covered by X

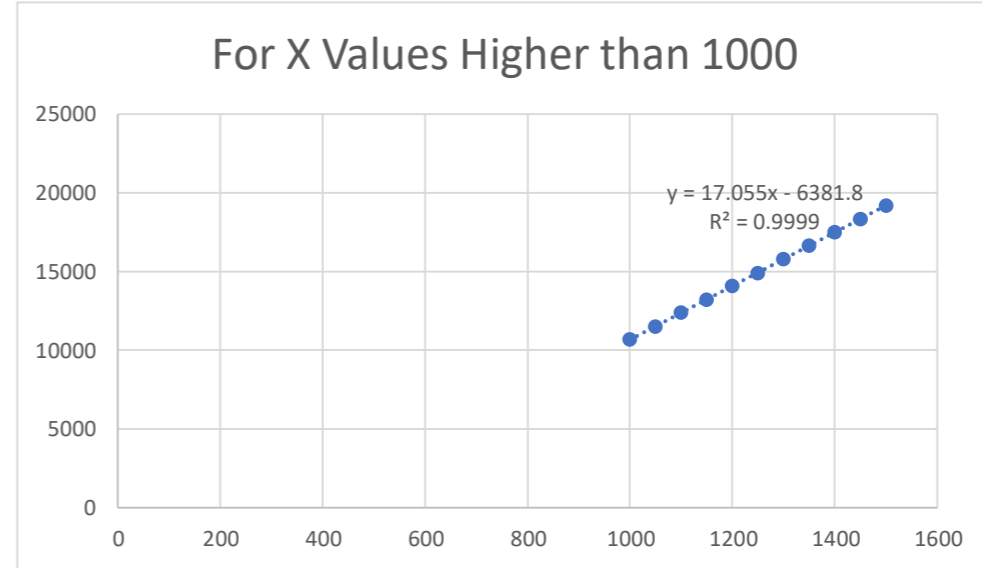
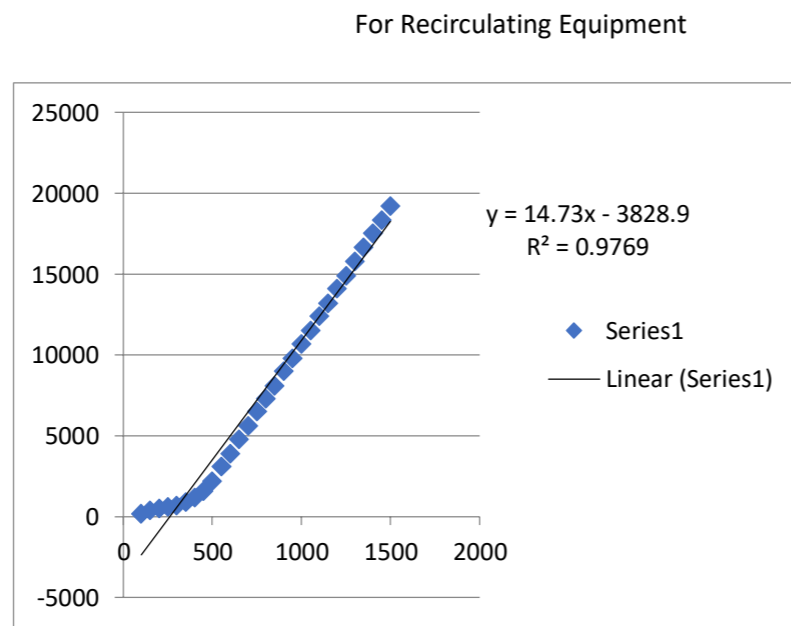
35% added for Non-Recirculating Equipment



Linear Regression for Volumes greater than 19,200 cu.ft. - Table A.5.5.3(a)

X	Y
100	200
150	400
200	500
250	600
300	700
350	900
400	1200
450	1600
500	2200
550	3100
600	3900
650	4800
700	5600
750	6500
800	7300
850	8100
900	9000
950	9800
1000	10700
1050	11500
1100	12400
1150	13200
1200	14100
1250	14900
1300	15800
1350	16650
1400	17500
1450	18350
1500	19200

X = lbs CO2  
Y = Volume covered by X

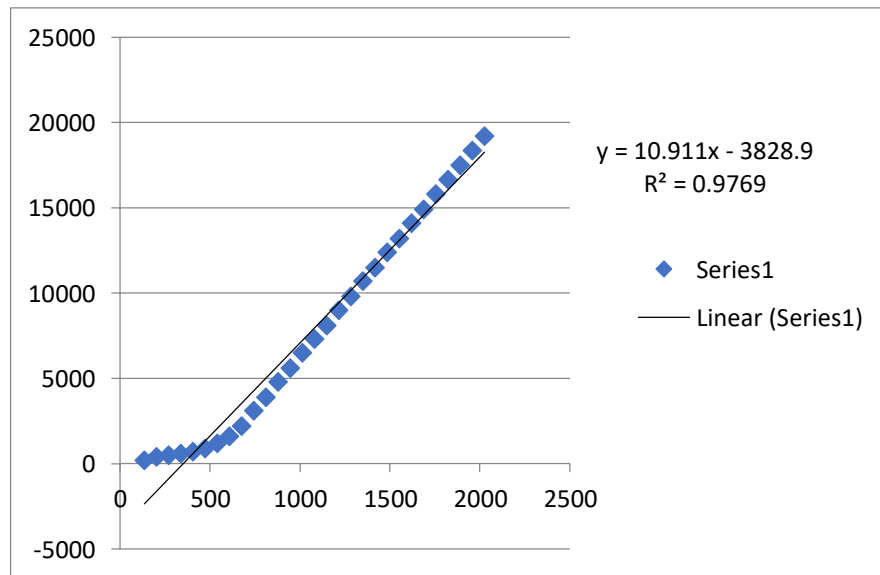


## Linear Regression for Volumes greater than 19,200 cu.ft. - Table A.5.5.3(a)

X	Y
135	200
202.5	400
270	500
337.5	600
405	700
472.5	900
540	1200
607.5	1600
675	2200
742.5	3100
810	3900
877.5	4800
945	5600
1012.5	6500
1080	7300
1147.5	8100
1215	9000
1282.5	9800
1350	10700
1417.5	11500
1485	12400
1552.5	13200
1620	14100
1687.5	14900
1755	15800
1822.5	16650
1890	17500
1957.5	18350
2025	19200

X = lbs CO2  
 Y = Volume covered by X

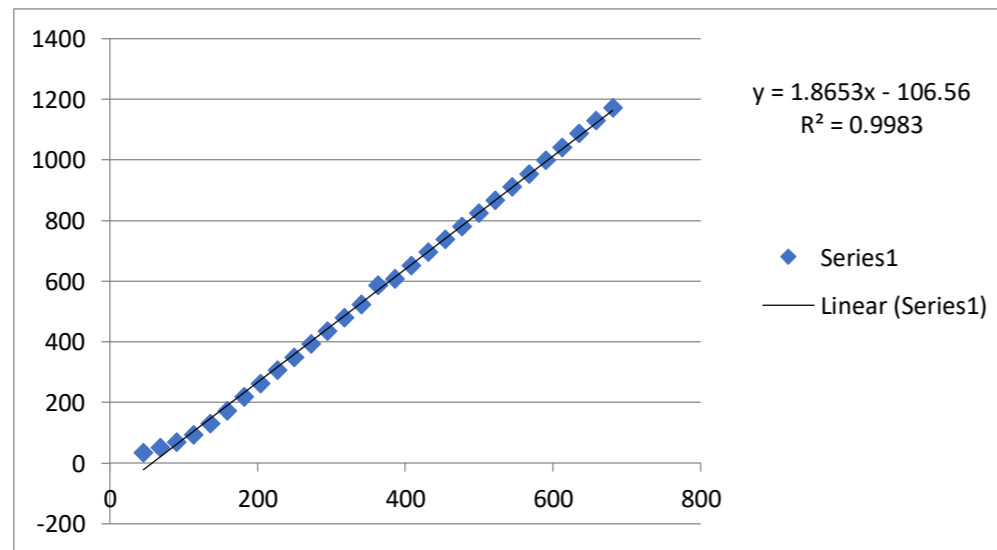
35% added for Non-Recirculating Equipment



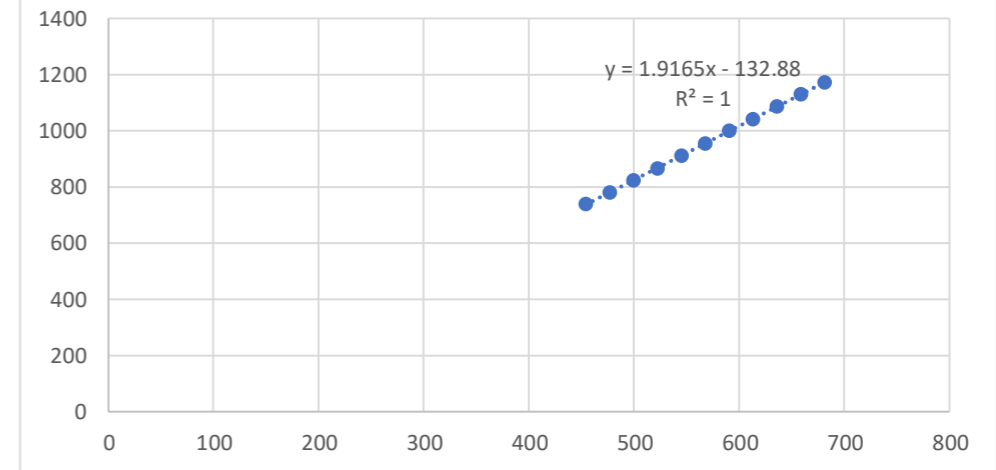
Linear Regression for Volumes greater than 1171.6cu.M. - Table A.5.5.3(b)

X	Y
45.4	34
68.1	50.9
90.8	67.9
113.5	93.4
136.2	130.2
158.9	172.6
181.6	217.9
204.3	261.8
227	305.6
249.7	348.1
272.4	393.4
295.1	435.8
317.8	478.3
340.5	523.6
363.2	586
385.9	608.4
408.6	650.9
431.3	696.2
454	738.6
476.7	781.1
499.4	823.5
522.1	866
544.8	911.3
567.5	953.7
590.2	999
612.9	1041.4
635.6	1086.7
658.3	1129.2
681	1171.6

For Recirculating Equipment



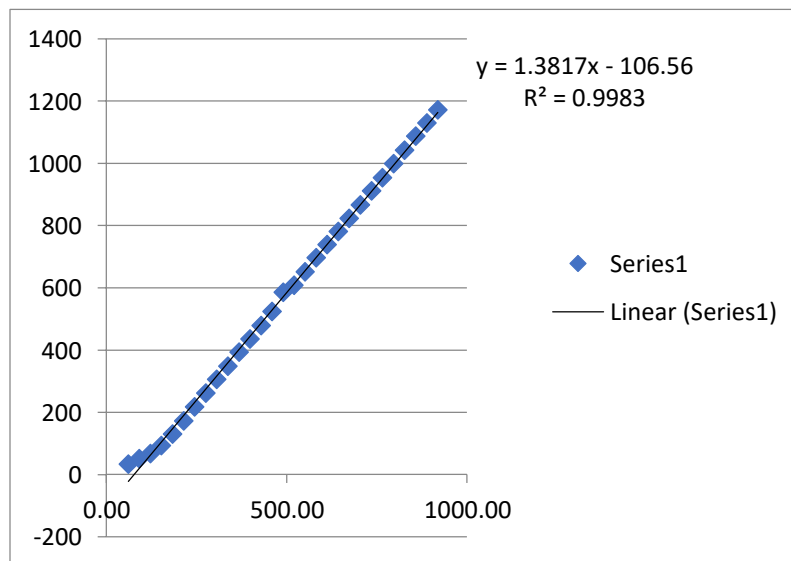
For X Values Higher than 400



## Linear Regression for Volumes greater than 1171.6 cu.M. - Table A.5.5.3(b)

X	Y
61.29	34
91.94	50.9
122.58	67.9
153.23	93.4
183.87	130.2
214.52	172.6
245.16	217.9
275.81	261.8
306.45	305.6
337.10	348.1
367.74	393.4
398.39	435.8
429.03	478.3
459.68	523.6
490.32	586
520.97	608.4
551.61	650.9
582.26	696.2
612.90	738.6
643.55	781.1
674.19	823.5
704.84	866
735.48	911.3
766.13	953.7
796.77	999
827.42	1041.4
858.06	1086.7
888.71	1129.2
919.35	1171.6

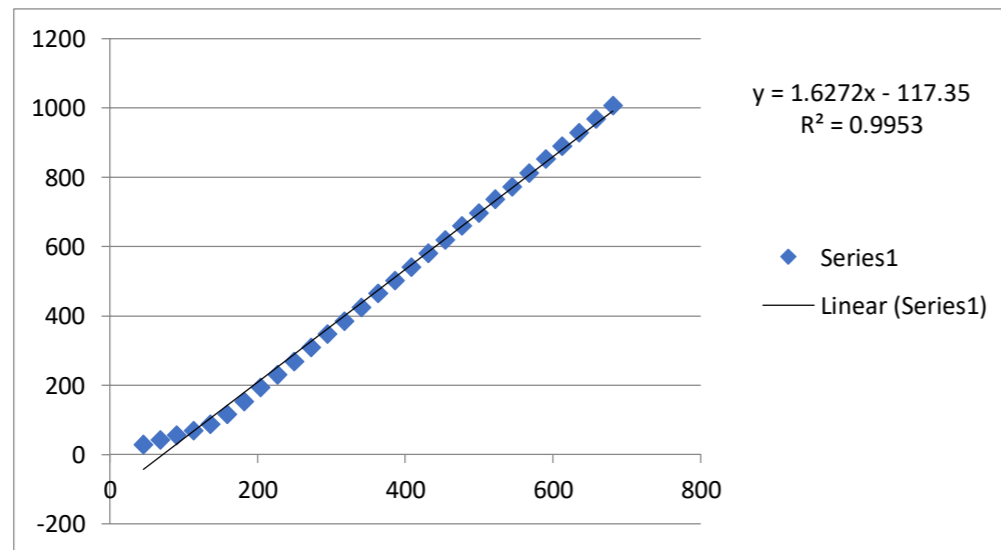
35% added for Non-Recirculating Equipment



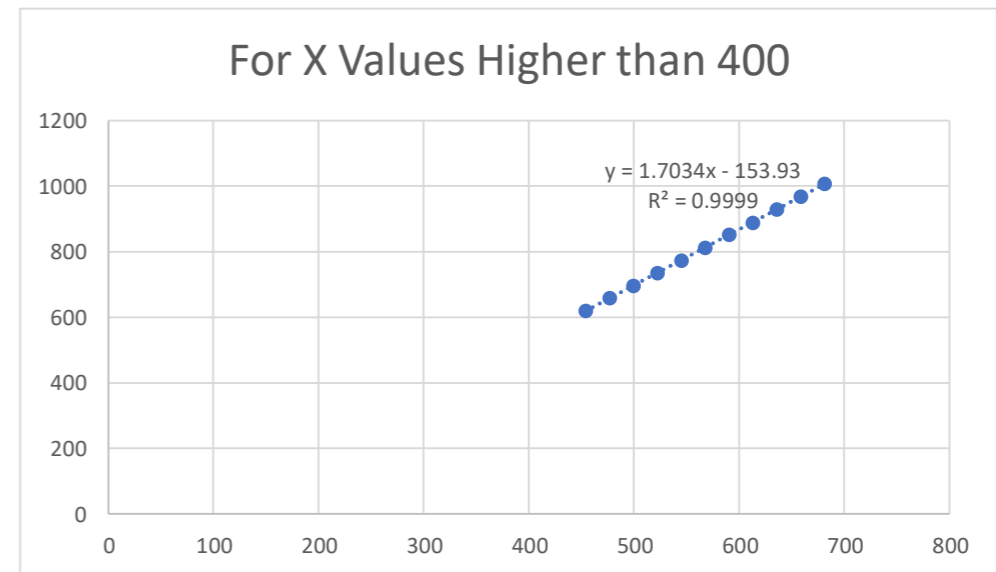
Linear Regression for Volumes greater than 1007.5cu.M. - Table A.5.5.3(b)

X	Y
45.4	28.3
68.1	42.5
90.8	55.2
113.5	69.3
136.2	87.7
158.9	116
181.6	152.8
204.3	192.4
227	229.2
249.7	268.9
272.4	308.5
295.1	348.1
317.8	384.9
340.5	424.5
363.2	464.1
385.9	502.3
408.6	540.5
431.3	580.2
454	619.8
476.7	659.4
499.4	696.2
522.1	735.8
544.8	772.6
567.5	812.2
590.2	851.8
612.9	888.6
635.6	928.2
658.3	967.9
681	1007.5

For Recirculating Equipment



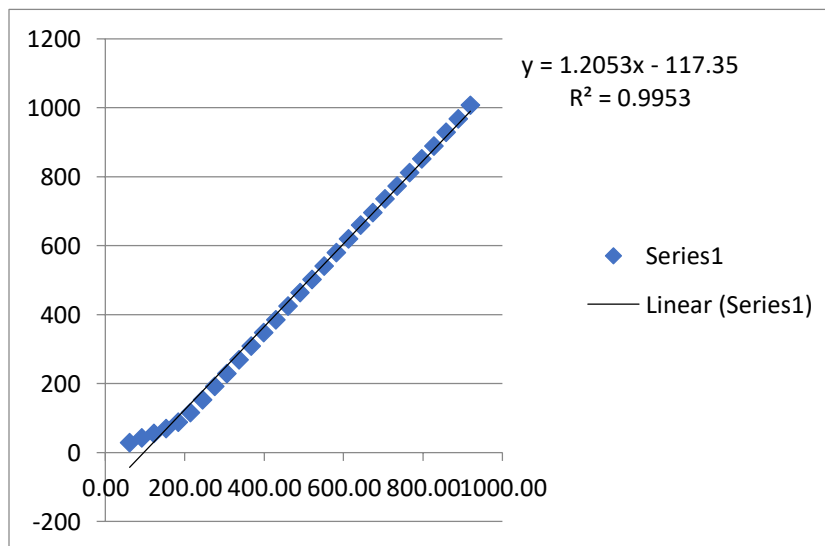
For X Values Higher than 400



## Linear Regression for Volumes greater than 1007.5 cu.M. - Table A.5.5.3(b)

X	Y
61.29	28.3
91.94	42.5
122.58	55.2
153.23	69.3
183.87	87.7
214.52	116
245.16	152.8
275.81	192.4
306.45	229.2
337.10	268.9
367.74	308.5
398.39	348.1
429.03	384.9
459.68	424.5
490.32	464.1
520.97	502.3
551.61	540.5
582.26	580.2
612.90	619.8
643.55	659.4
674.19	696.2
704.84	735.8
735.48	772.6
766.13	812.2
796.77	851.8
827.42	888.6
858.06	928.2
888.71	967.9
919.35	1007.5

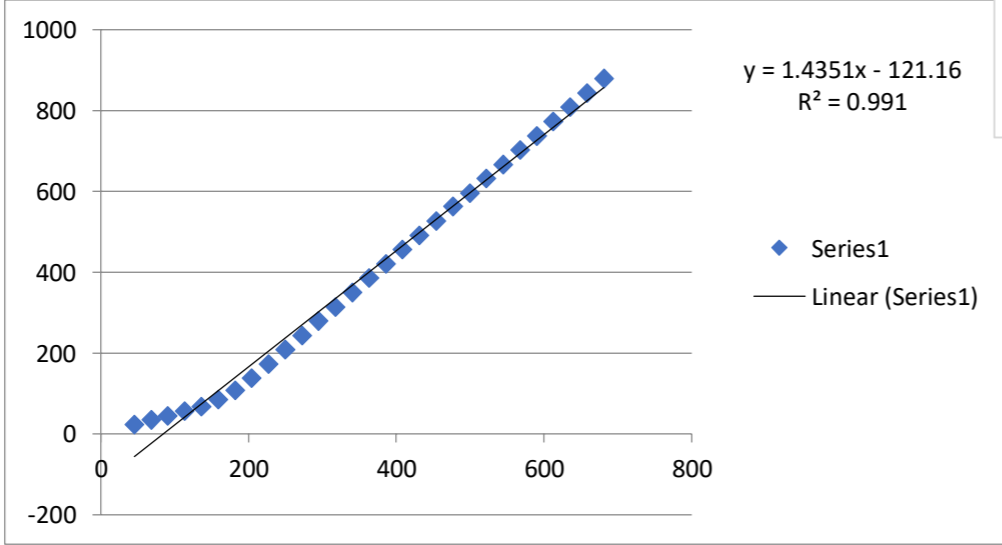
35% added for Non-Recirculating Equipment



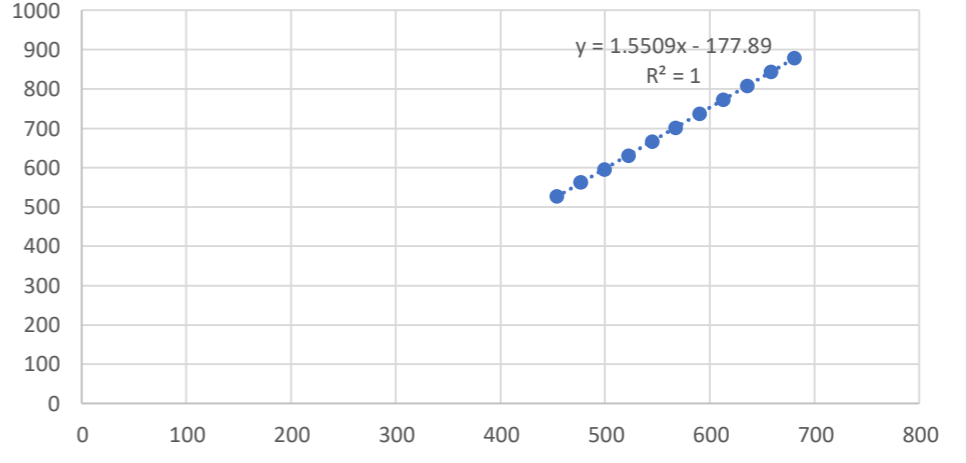
Linear Regression for Volumes greater than 878.7 cu.M. - Table A.5.5.3(b)

X	Y
45.4	22.6
68.1	34
90.8	45.3
113.5	56.6
136.2	67.9
158.9	84.9
181.6	107.5
204.3	138.7
227	172.6
249.7	209.4
272.4	243.4
295.1	278.8
317.8	314.1
340.5	349.5
363.2	384.9
385.9	420.3
408.6	455.6
431.3	491
454	526.4
476.7	563.2
499.4	595.7
522.1	631.1
544.8	666.5
567.5	701.8
590.2	737.2
612.9	772.6
635.6	808
658.3	843.3
681	878.7

For Recirculating Equipment



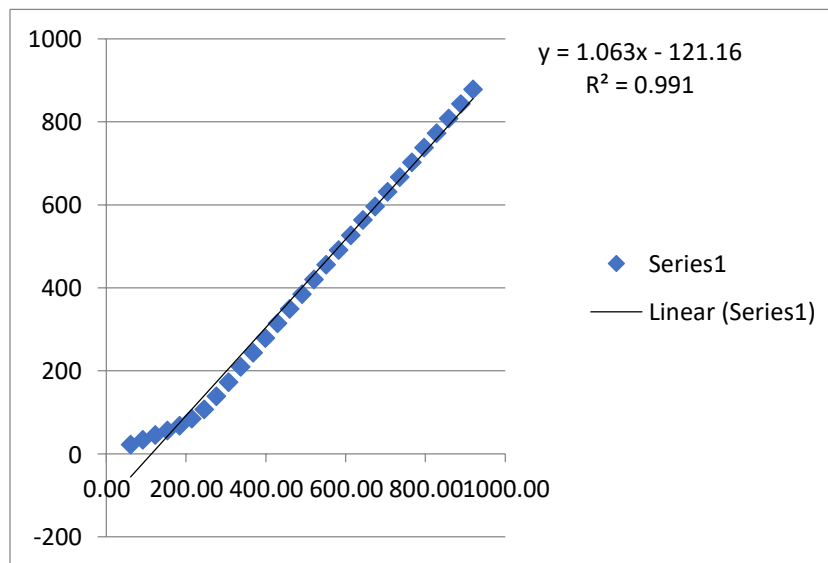
For X Values Higher than 400



## Linear Regression for Volumes greater than 878.7 cu.M. - Table A.5.5.3(b)

X	Y
61.29	22.6
91.94	34
122.58	45.3
153.23	56.6
183.87	67.9
214.52	84.9
245.16	107.5
275.81	138.7
306.45	172.6
337.10	209.4
367.74	243.4
398.39	278.8
429.03	314.1
459.68	349.5
490.32	384.9
520.97	420.3
551.61	455.6
582.26	491
612.90	526.4
643.55	563.2
674.19	595.7
704.84	631.1
735.48	666.5
766.13	701.8
796.77	737.2
827.42	772.6
858.06	808
888.71	843.3
919.35	878.7

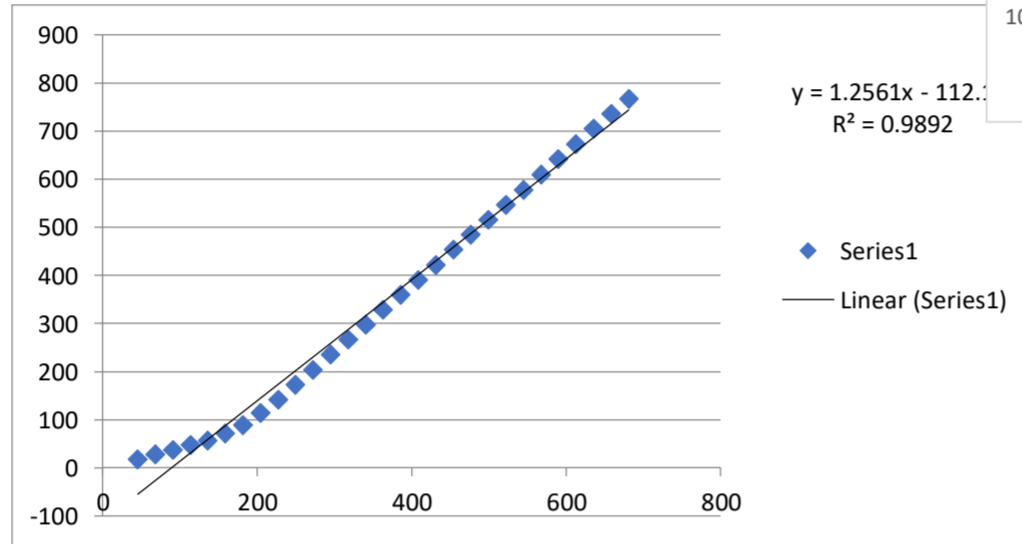
35% added for Non-Recirculating Equipment



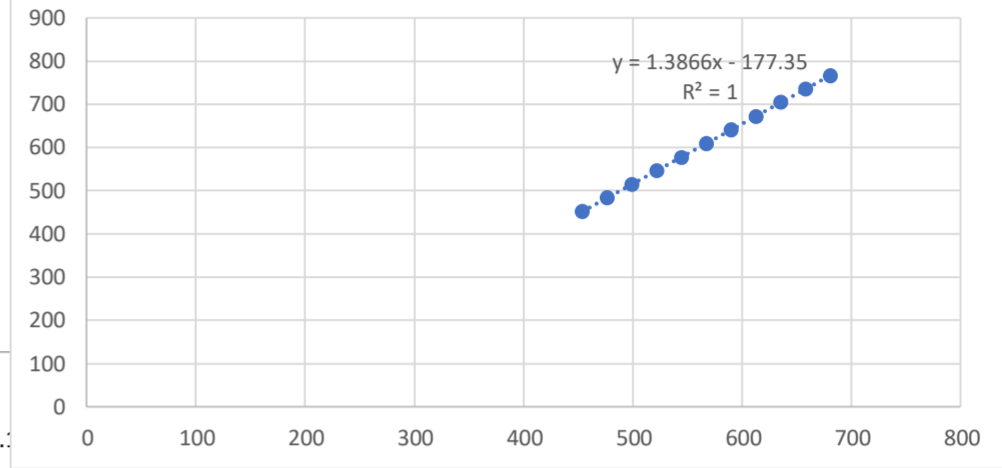
Linear Regression for Volumes greater than 766.9 cu.M. - Table A.5.5.3(b)

X	Y
45.4	17
68.1	28.3
90.8	36.8
113.5	46.7
136.2	56.6
158.9	70.8
181.6	89.1
204.3	113.2
227	141.5
249.7	172.6
272.4	203.8
295.1	234.9
317.8	266
340.5	297.2
363.2	328.3
385.9	359.4
408.6	390.5
431.3	421.7
454	452.8
476.7	483.9
499.4	515.1
522.1	546.2
544.8	577.3
567.5	609.4
590.2	641
612.9	672.1
635.6	704.7
658.3	735.8
681	766.9

For Recirculating Equipment



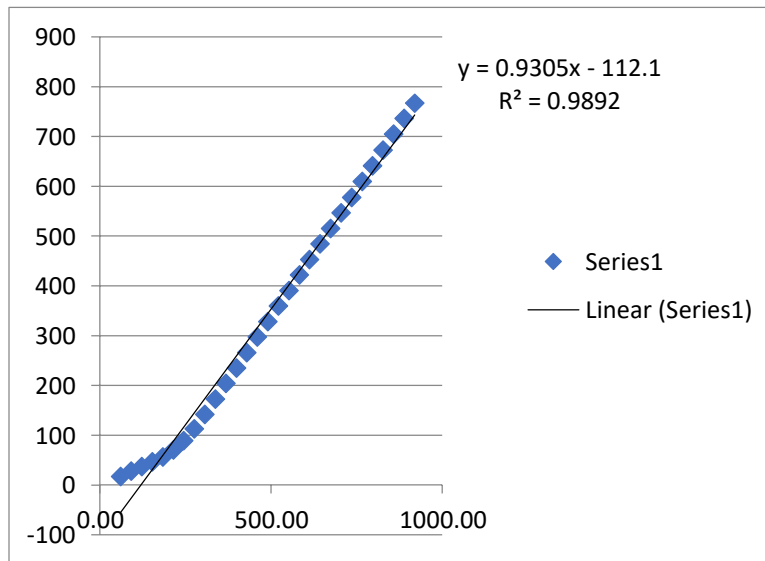
For X Values Higher than 400



## Linear Regression for Volumes greater than 766.9 cu.M. - Table A.5.5.3(b)

X	Y
61.29	17
91.94	28.3
122.58	36.8
153.23	46.7
183.87	56.6
214.52	70.8
245.16	89.1
275.81	113.2
306.45	141.5
337.10	172.6
367.74	203.8
398.39	234.9
429.03	266
459.68	297.2
490.32	328.3
520.97	359.4
551.61	390.5
582.26	421.7
612.90	452.8
643.55	483.9
674.19	515.1
704.84	546.2
735.48	577.3
766.13	609.4
796.77	641
827.42	672.1
858.06	704.7
888.71	735.8
919.35	766.9

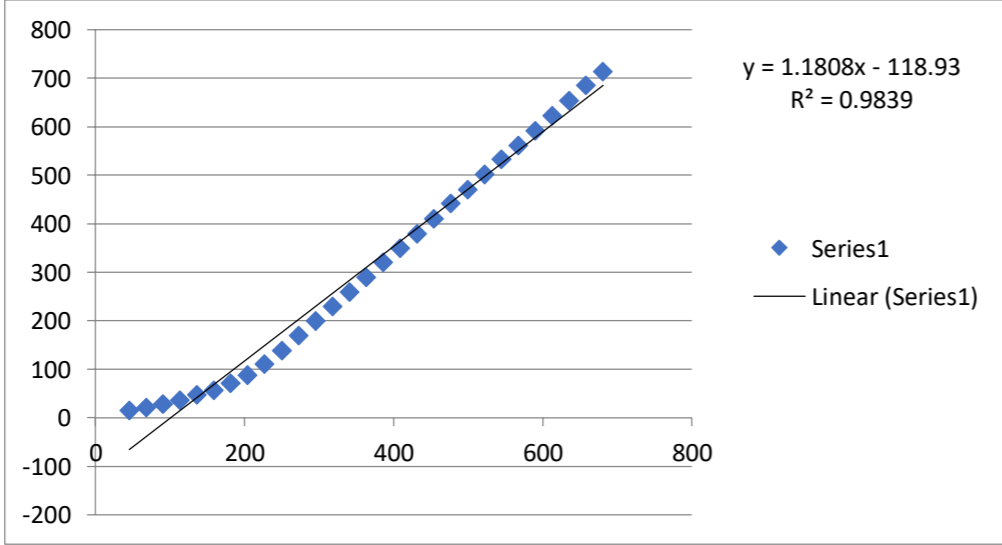
35% added for Non-Recirculating Equipment



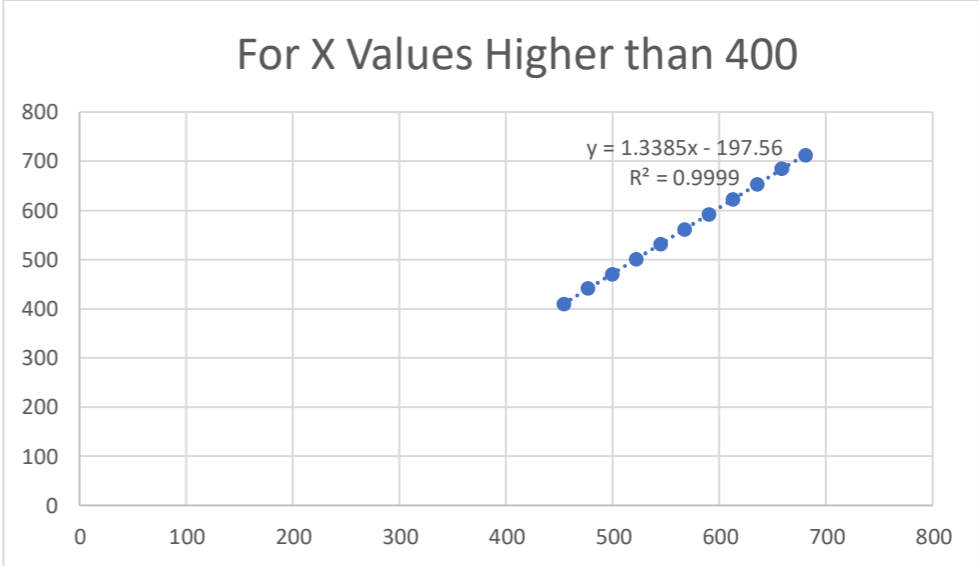
Linear Regression for Volumes greater than 713.2 cu.M. - Table A.5.5.3(b)

X	Y
45.4	14.2
68.1	21.2
90.8	28.3
113.5	36.8
136.2	46.7
158.9	56.6
181.6	70.8
204.3	87.7
227	110.4
249.7	138.7
272.4	169.8
295.1	199.5
317.8	229.2
340.5	258.9
363.2	288.7
385.9	319.8
408.6	349.5
431.3	379.2
454	410.4
476.7	441.5
499.4	469.8
522.1	500.9
544.8	532
567.5	561.8
590.2	591.5
612.9	622.6
635.6	653.7
658.3	684.9
681	713.2

For Recirculating Equipment



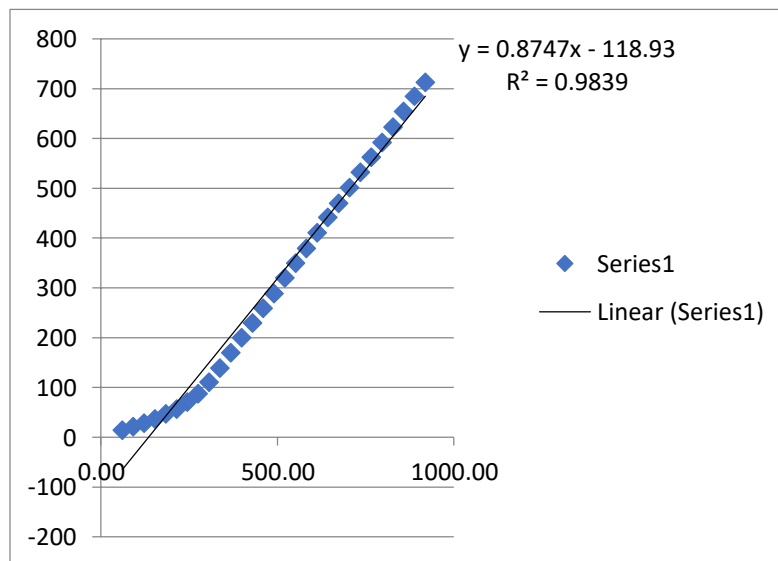
For X Values Higher than 400



## Linear Regression for Volumes greater than 713.2 cu.M. - Table A.5.5.3(b)

X	Y
61.29	14.2
91.94	21.2
122.58	28.3
153.23	36.8
183.87	46.7
214.52	56.6
245.16	70.8
275.81	87.7
306.45	110.4
337.10	138.7
367.74	169.8
398.39	199.5
429.03	229.2
459.68	258.9
490.32	288.7
520.97	319.8
551.61	349.5
582.26	379.2
612.90	410.4
643.55	441.5
674.19	469.8
704.84	500.9
735.48	532
766.13	561.8
796.77	591.5
827.42	622.6
858.06	653.7
888.71	684.9
919.35	713.2

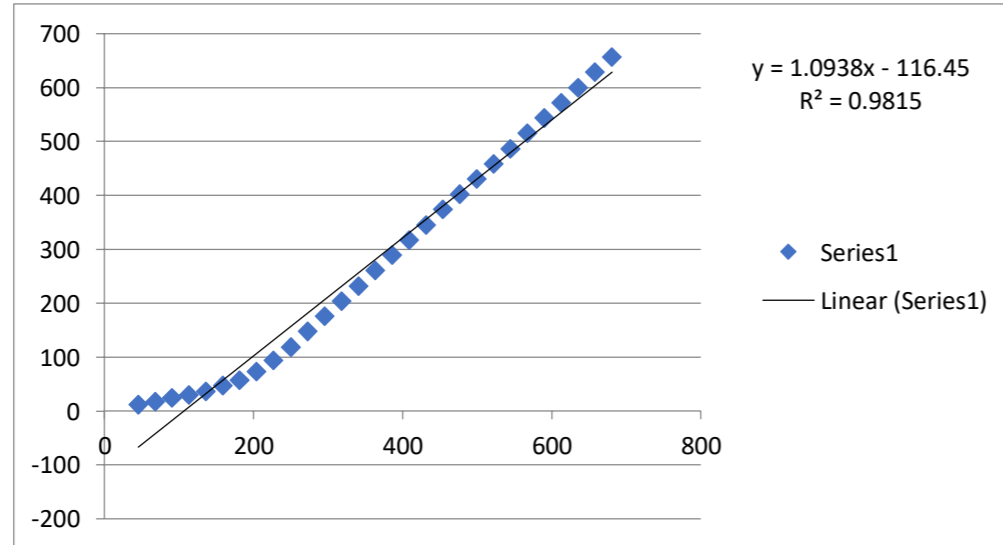
35% added for Non-Recirculating Equipment



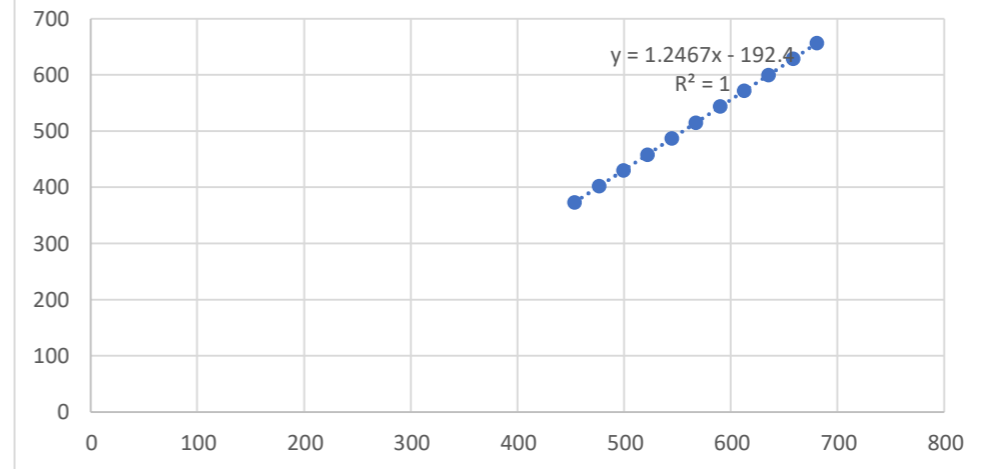
Linear Regression for Volumes greater than 656.6 cu.M. - Table A.5.5.3(b)

X	Y
45.4	11.3
68.1	17
90.8	24.1
113.5	29.7
136.2	36.8
158.9	46.7
181.6	56.6
204.3	73.6
227	93.4
249.7	118.9
272.4	147.2
295.1	175.5
317.8	203.8
340.5	232.1
363.2	260.4
385.9	288.7
408.6	317
431.3	345.3
454	373.6
476.7	401.9
499.4	430.2
522.1	458.5
544.8	486.8
567.5	515.1
590.2	543.4
612.9	571.7
635.6	600
658.3	628.3
681	656.6

For Recirculating Equipment



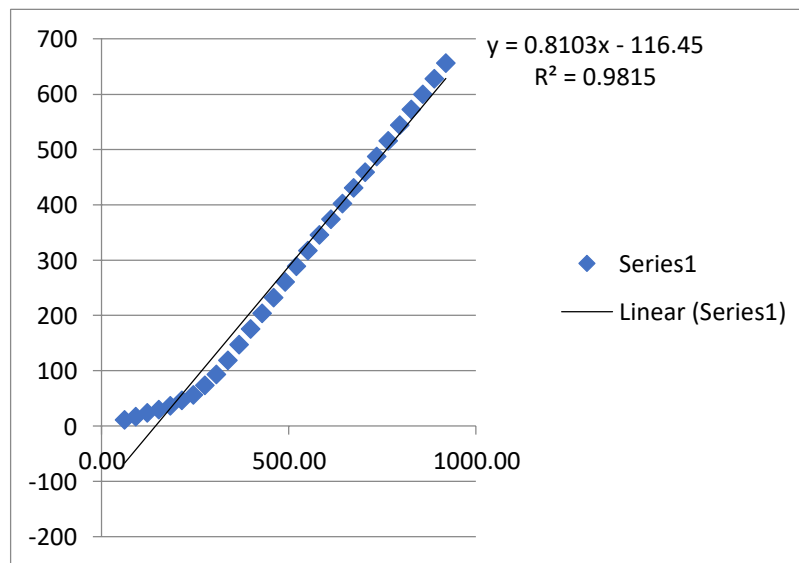
For X Values Higher than 400



## Linear Regression for Volumes greater than 656.6 cu.M. - Table A.5.5.3(b)

X	Y
61.29	11.3
91.94	17
122.58	24.1
153.23	29.7
183.87	36.8
214.52	46.7
245.16	56.6
275.81	73.6
306.45	93.4
337.10	118.9
367.74	147.2
398.39	175.5
429.03	203.8
459.68	232.1
490.32	260.4
520.97	288.7
551.61	317
582.26	345.3
612.90	373.6
643.55	401.9
674.19	430.2
704.84	458.5
735.48	486.8
766.13	515.1
796.77	543.4
827.42	571.7
858.06	600
888.71	628.3
919.35	656.6

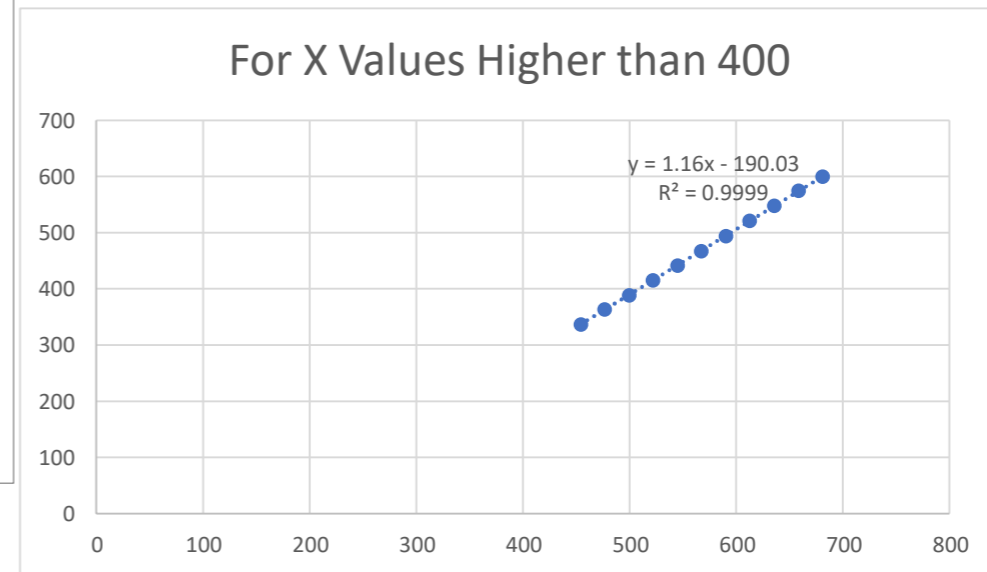
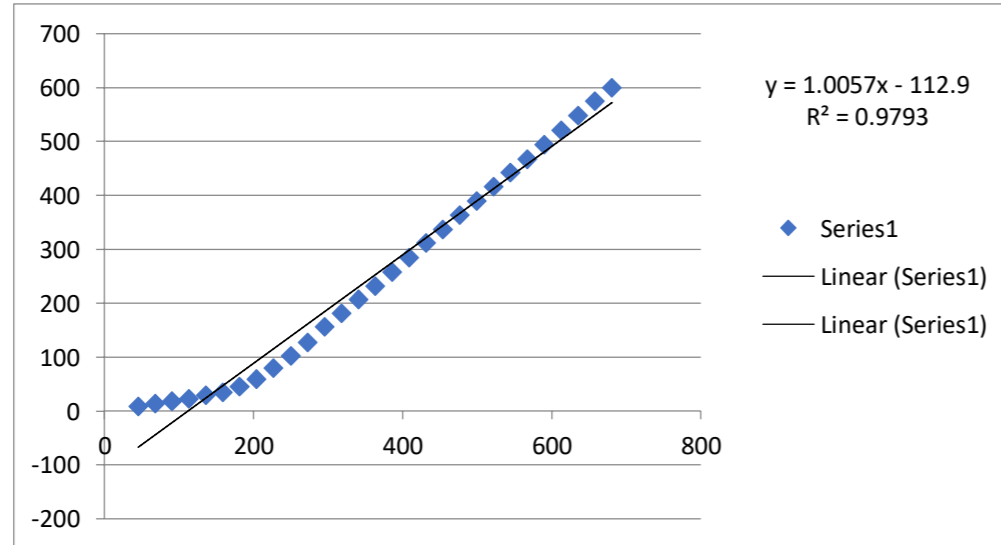
35% added for Non-Recirculating Equipment



Linear Regression for Volumes greater than 600.0 cu.M. - Table A.5.5.3(b)

X	Y
45.4	8.5
68.1	14.2
90.8	18.4
113.5	22.6
136.2	28.3
158.9	34
181.6	45.3
204.3	59.4
227	79.2
249.7	101.9
272.4	127.4
295.1	155.7
317.8	181.1
340.5	206.6
363.2	232.1
385.9	257.5
408.6	284.4
431.3	311.3
454	336.8
476.7	363.7
499.4	389.1
522.1	416
544.8	441.5
567.5	467
590.2	493.8
612.9	520.7
635.6	547.6
658.3	574.5
681	600

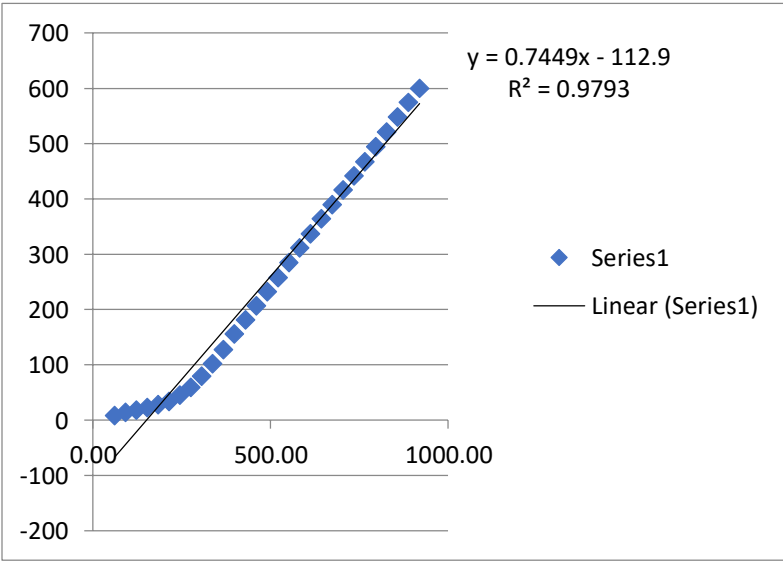
For Recirculating Equipment



Linear Regression for Volumes greater than 600.0 cu.M. - Table  
A.5.5.3(b)

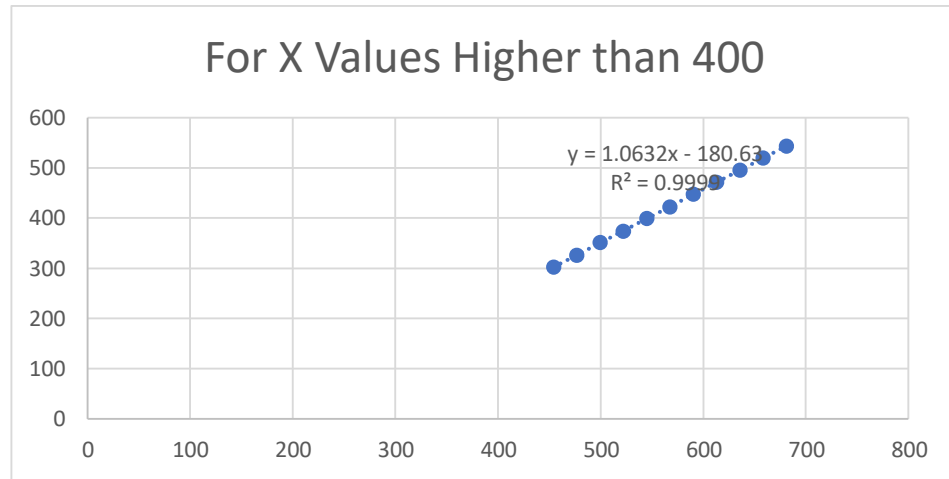
X	Y
61.29	8.5
91.94	14.2
122.58	18.4
153.23	22.6
183.87	28.3
214.52	34
245.16	45.3
275.81	59.4
306.45	79.2
337.10	101.9
367.74	127.4
398.39	155.7
429.03	181.1
459.68	206.6
490.32	232.1
520.97	257.5
551.61	284.4
582.26	311.3
612.90	336.8
643.55	363.7
674.19	389.1
704.84	416
735.48	441.5
766.13	467
796.77	493.8
827.42	520.7
858.06	547.6
888.71	574.5
919.35	600

35% added for Non-Recirculating Equipment

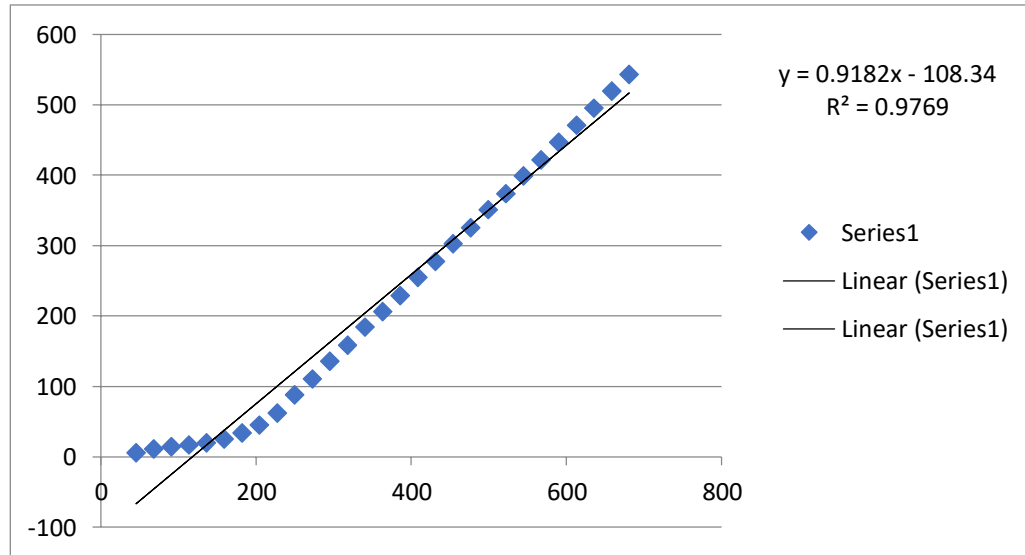


Linear Regression for Volumes greater than 600.0 cu.M. - Table A.5.5.3(b)

X	Y
45.4	5.7
68.1	11.3
90.8	14.2
113.5	17
136.2	19.8
158.9	25.5
181.6	34
204.3	45.3
227	62.3
249.7	87.7
272.4	110.4
295.1	135.8
317.8	158.5
340.5	184
363.2	206.6
385.9	229.2
408.6	254.7
431.3	277.3
454	302.8
476.7	325.5
499.4	350.9
522.1	373.6
544.8	399
567.5	421.7
590.2	447.1
612.9	471.2
635.6	495.3
658.3	519.3
681	543.4



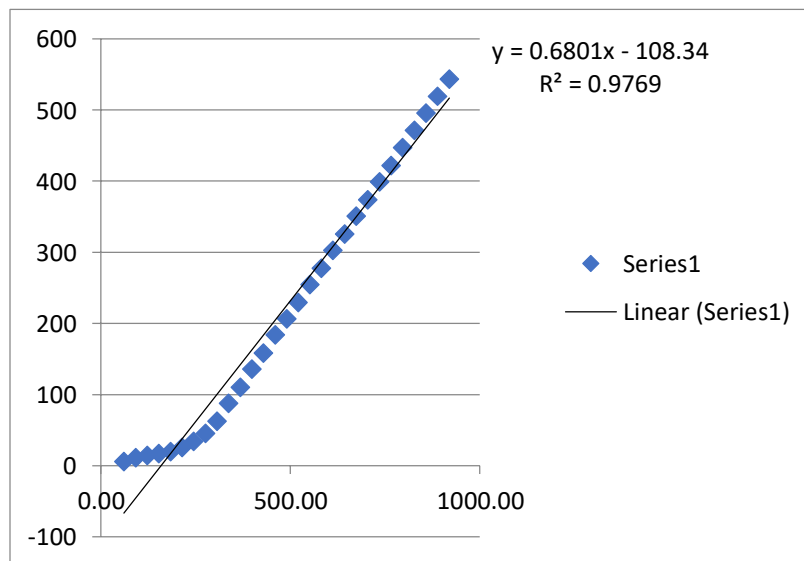
For Recirculating Equipment



## Linear Regression for Volumes greater than 543.4 cu.M. - Table A.5.5.3(b)

X	Y
61.29	5.7
91.94	11.3
122.58	14.2
153.23	17
183.87	19.8
214.52	25.5
245.16	34
275.81	45.3
306.45	62.3
337.10	87.7
367.74	110.4
398.39	135.8
429.03	158.5
459.68	184
490.32	206.6
520.97	229.2
551.61	254.7
582.26	277.3
612.90	302.8
643.55	325.5
674.19	350.9
704.84	373.6
735.48	399
766.13	421.7
796.77	447.1
827.42	471.2
858.06	495.3
888.71	519.3
919.35	543.4

35% added for Non-Recirculating Equipment





## Public Comment No. 6-NFPA 12-2023 [ Section No. 5.5.3.4 ]

### 5.5.3.4 –

For enclosed rotating electrical equipment with dampered

,

non-recirculating

-type

airflow,

the indicated quantities of carbon dioxide, as shown in Table 5.5.3.3.1(a) and Table 5.5.3.3.1(b), shall be increased by 35 percent for extended discharge protection

add 35 percent to the values given in these tables to compensate for possible leakage past the dampers .

### Statement of Problem and Substantiation for Public Comment

5.5.3.4 from the first draft was part of A.5.5.3 in the 2020 edition of the standard. The information has been in the Annex of NFPA 12 for over 70 years. It is advisory in nature pertaining to Tables A.5.5.3. The comment returns 5.5.3.4 to the Annex as part of the supporting information related to the A.5.5.3 tables. The purpose of adding 35 percent to the tabulated values is explained as compensation for possible leakage past dampers.

### Related Public Comments for This Document

<u>Related Comment</u>	<u>Relationship</u>
<u>Public Comment No. 5-NFPA 12-2023 [Section No. 5.5.3.3.1]</u>	
<u>Related Item</u>	
• PI-11 • PI-10	

### Submitter Information Verification

**Submitter Full Name:** Thomas Wysocki  
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**Street Address:**  
**City:**  
**State:**  
**Zip:**  
**Submittal Date:** Mon Dec 11 12:32:18 EST 2023  
**Committee:** GFE-AAA



## Public Comment No. 8-NFPA 12-2023 [ Section No. A.3.3.2 ]

### A.3.3.2 Deep-Seated Fire.

A characteristic of this type of combustion is the slow rate of heat ~~losses~~ loss from the reaction zone. Thus, the fuel remains hot enough to exothermically react with oxygen, even though the rate of reaction, which is controlled by diffusion processes, is extremely slow. Deep-seated fires can continue to burn for many weeks, for example, in bales of cotton and jute and heaps of sawdust. A deep-seated fire ceases to burn only when either all the available oxygen or fuel has been consumed or the fuel surface is at too low a temperature to react. [2001, 2025]

Deep-seated fires usually are extinguished by reducing the fuel temperature, either directly by application of a heat-absorbing medium, such as water, or by blanketing with an inert gas. The medium slows the reaction rate to the point where heat generated by oxidation is less than heat losses to surroundings. This causes the temperature to fall below the level necessary for reignition after removal of the inert atmosphere. [2001, 2025]

### Statement of Problem and Substantiation for Public Comment

Editorial, grammatical correction

#### Related Item

- Editorial correction

### Submitter Information Verification

**Submitter Full Name:** Thomas Wysocki

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**Zip:**

**Submittal Date:** Wed Dec 13 19:04:09 EST 2023

**Committee:** GFE-AAA



## Committee Input No. 19-NFPA 12-2023 [ Global Input ]

Remove the term "Slave cylinder" throughout the document. A task group will review and propose a new term at second draft.

### Submitter Information Verification

**Committee:** GFE-AAA

**Submittal Date:** Thu May 11 13:14:55 EDT 2023

### Committee Statement

**Committee Statement:** A task group was created to review the term "slave cylinder" and propose a new term during the second draft.

**Response Message:** CI-19-NFPA 12-2023

### Ballot Results

 This item has not been balloted



**Committee Input No. 16-NFPA 12-2023 [ Section No. 5.3.2.2 ]**

A large, empty rectangular box with a thin border, intended for the user to enter their committee input.

[Review ethyl ether and diethyl ether for accuracy, they are names for the same substance]

**5.3.2.2\***

Table 5.3.2.2 shall be used to determine the minimum carbon dioxide concentrations for the liquids and gases shown in the table.

Table 5.3.2.2 Minimum Carbon Dioxide Concentrations for Extinguishment

<u>Material</u>	<u>Theoretical</u>	<u>Minimum</u>
	<u>Minimum CO<sub>2</sub></u>	<u>Design CO<sub>2</sub></u>
	<u>Concentration</u>	<u>Concentration</u>
	<u>(%)</u>	<u>(%)</u>
Acetylene	55	66
Acetone	27*	34
Aviation gas grades		
115/145	30	36
Benzol, benzene	31	37
Butadiene	34	41
Butane	28	34
Butane-l	31	37
Carbon disulfide	60	72
Carbon monoxide	53	64
Coal or natural gas	31*	37
Cyclopropane	31	37
Diethyl ether	33	40
Dimethyl ether	33	40
Dowtherm	38*	46
Ethane	33	40
Ethyl alcohol	36	43
Ethyl ether	38*	46
Ethylene	41	49
Ethylene dichloride	21	34
Ethylene oxide	44	53
Gasoline	28	34
Higher paraffin		
hydrocarbons C <sub>n</sub> H <sub>2n+2</sub> , n≥5	28	34
Hydrogen	62	75
Hydrogen sulfide	30	36
Isobutane	30*	36
Isobutylene	26	34
Isobutyl formate	26	34
JP-4	30	36
Kerosene	28	34

<u>Material</u>	<u>Theoretical</u>	<u>Minimum</u>
	<u>Minimum CO<sub>2</sub></u>	<u>Design CO<sub>2</sub></u>
	<u>Concentration</u>	<u>Concentration</u>
	(%)	(%)
Methane	25	34
Methyl acetate	29	35
Methyl alcohol	33	40
Methyl butene-1	30	36
Methyl ethyl ketone	33	40
Methyl formate	32	39
Pentane	29	35
Propane	30	36
Propylene	30	36
Quench, lube oils	28	34

Note: The theoretical minimum extinguishing concentrations in air for the materials in the table were obtained from a compilation of Bureau of Mines, Bulletins 503 and 627.

\*Calculated from accepted residual oxygen values.

## Submitter Information Verification

**Committee:** GFE-AAA

**Submission Date:** Thu May 11 12:45:22 EDT 2023

## Committee Statement

**Committee Statement:** Table 5.3.2.2 includes different extinguishing/design concentration values for ethyl ether and diethyl ether, which are two names for the same substance. It looks like the value for ethyl ether existed first, and the value for diethyl ether was added for the 1985 edition. There is no specific committee action for this in the Technical Committee Report. The value just appeared in the 1985 draft.

The value for “ethyl ether” has an asterisk, which indicates that it was estimated from residual oxygen values. The value for “diethyl ether” is probably based on testing and was added when it became available, but since the alternative material name was used, NFPA staff probably did not realize that the old value shown with “ethyl ether” needed to be removed.

A task group was formed to determine the correct CO<sub>2</sub> concentration value, and if either needs to be removed or changed.

**Response Message:** CI-16-NFPA 12-2023

## Ballot Results

 **This item has not been balloted**



## Committee Input No. 18-NFPA 12-2023 [ Chapter 9 ]

### Chapter 9 Marine Systems

#### 9.1 Special Definitions.

The following definitions shall apply to Chapter 9:

- (1) Marine systems (See 3.4.1.)
- (2) Space
  - (a) Cargo space (See 3.4.2.1.)
  - (b) Electrical equipment space (See 3.4.2.2.)
  - (c)\* Machinery space (See 3.4.2.3.)

#### A.9.1(2)(c)

Examples include spaces containing engines used for propulsion, engines that drive electrical generators, oil filling stations, cargo pumps, or heating, ventilation, and air-conditioning machinery.

- (d)\* Vehicle space (See 3.4.2.4.)

#### A.9.1(2)(d)

Carbon dioxide systems are not recommended for vehicle spaces that are accessible to passengers.

#### 9.2 General.

##### 9.2.1\* Outline.

This chapter outlines the modifications necessary for marine systems.

#### A.9.2.1

It is intended that NFPA 12, including this chapter, would be used as a stand-alone document for the design, installation, and maintenance of marine carbon dioxide systems. Chapter 9 was added in 1998 to address marine installations. It was intended to be used in lieu of other standards such as 46 CFR 119, "Machinery Installations."

##### 9.2.2

All other requirements of this standard shall apply to marine systems except as modified by this chapter.

#### 9.3 System Requirements.

##### 9.3.1 Components.

System components shall be specifically listed or approved for carbon dioxide system marine applications.

##### 9.3.2 Operating Instructions.

### 9.3.2.1

Instructions for the operation of the system shall be located in a conspicuous place at or near all manual controls and in the carbon dioxide storage room.

### 9.3.2.2

For systems in which the carbon dioxide storage is not within the protected space, the operating instructions shall include a chart indicating the location of the emergency control to be used if the normal controls fail to operate.

### 9.3.3 Actuation.

#### 9.3.3.1\*

For spaces greater than 6000 ft<sup>3</sup> (170 m<sup>3</sup>), automatic release of the carbon dioxide system shall not be permitted.

#### A.9.3.3.1

Some internal combustion propulsion engines and generator prime movers draw combustion air from the protected space in which they are installed. Because these types of engines are required to be shut down prior to system discharge, an automatically discharged system in some cases could shut down propulsion or electricity supply when needed most. A nonautomatic system gives the ship's crew the flexibility to decide the best course of action. For example, while navigating in a high-density shipping channel, a ship's ability to maneuver can be more important than immediate system discharge.

#### 9.3.3.2\*

Automatic release shall be permitted for any space of 6000 ft<sup>3</sup> (170 m<sup>3</sup>) or less, provided the requirements of 9.3.3.2.1 through 9.3.3.2.4 are met.

#### A.9.3.3.2

On offshore platforms and on some vessels, small machinery enclosures are often located such that access by personnel at the time of a fire would be difficult and/or dangerous and cause unacceptable delay in system actuation. As long as life safety and vessel navigability are not adversely impacted, automatic actuation of systems protecting such spaces is permissible.

#### 9.3.3.2.1

Horizontal means of egress from the machinery enclosure to the open deck shall be provided.

#### 9.3.3.2.2

The enclosure shall be unmanned during any operation of the equipment.

#### 9.3.3.2.3

The system shall be locked out when persons are present within the enclosure.

#### 9.3.3.2.4

Automatic actuation of the system shall not interfere with safe navigation of the vessel.

### 9.3.3.3

For manual operation, two separate valves shall be provided for releasing carbon dioxide into any protected space.

#### 9.3.3.3.1

One valve shall control discharge from the carbon dioxide storage.

**9.3.3.3.2**

The second valve shall control carbon dioxide discharge into the protected space(s).

**9.3.3.3.3**

For systems that contain 300 lb (136 kg) of carbon dioxide storage or less, only one valve shall be required to be used for the release of the system, provided that the protected space is normally unoccupied and has horizontal egress.

**9.3.3.4\* Controls.****A.9.3.3.4**

Except for very small protected spaces noted in 9.3.3.3.3, it is the intent of this standard to require two separate manual operations to cause discharge of a marine system. Provision of a separate manually actuated control for each of the discharge control valves required by 9.3.3.3 accomplishes this intent. This requirement is an exception to the "normal manual operation" as defined in 4.5.1.2.

**9.3.3.4.1**

A separate manually operated control shall be provided to operate each valve required by 9.3.3.3.

**9.3.3.4.2**

A set of controls shall be located outside at least one of the main means of egress from each protected space.

**9.3.3.5\***

In addition to the manually operated controls required by 9.3.3.4, each of the valves required by 9.3.3.3 shall be provided with its own emergency manual control.

**A.9.3.3.5**

For a high-pressure carbon dioxide system, the emergency manual control for the supply is the manual operator on the pilot cylinder(s).

**9.3.3.6 Release Box.****9.3.3.6.1**

Controls for the valves required by 9.3.3.4 shall be located inside a release box clearly identified for the protected space.

**9.3.3.6.2**

If the box containing the controls is to be locked, a key to the box shall be provided in a break-glass-type enclosure conspicuously located adjacent to the box.

**9.3.3.7\* Source of Power.****A.9.3.3.7**

Sufficient carbon dioxide should be provided to power the alarms at their rated pressure for the required time.

**9.3.3.7.1**

In addition to the requirements of 4.3.3.2, audible predischarge alarms shall be provided that depend on no source of power other than carbon dioxide pressure.

**9.3.3.7.2**

The time delay required by 4.5.6.2.2 shall be a minimum of 20 seconds and shall depend on no source of power other than carbon dioxide pressure.

**9.3.4 Carbon Dioxide Storage.****9.3.4.1**

Carbon dioxide storage shall be permitted inside normally unoccupied protected spaces for systems that contain not more than 300 lb (136 kg) of carbon dioxide storage and are equipped for automatic actuation.

**9.3.4.2**

Low-pressure systems shall be provided with dual refrigeration units and shall be constructed in accordance with 46 CFR 58.20.

**9.3.4.3**

When the carbon dioxide containers are located outside a protected space, they shall be stored in a room that shall be situated in a safe and readily accessible location and shall be effectively ventilated so that the agent containers are not exposed to ambient temperatures outlined in 4.6.5.5.

**9.3.4.3.1**

Common bulkheads and decks located between agent container storage rooms and protected spaces shall be protected with A-60 class structural insulation as defined by 46 CFR 72.

**9.3.4.3.2**

Doors and other means of closing any opening therein that form the boundaries between such rooms and adjoining protected spaces shall be gastight.

**9.3.4.3.3**

Agent container storage rooms shall be accessible without having to pass through the space being protected.

**9.3.4.3.4**

Access doors shall open outward.

**9.3.4.3.5**

For systems that contain 300 lb (136 kg) of carbon dioxide storage or less, only one valve shall be required to be used for the release of the system, provided that the protected space is normally unoccupied and has horizontal egress.

**9.3.5 System Piping.****9.3.5.1**

Where necessary, drains shall be provided for the removal of accumulated moisture.

**9.3.5.2**

Carbon dioxide piping shall not be fitted with drains or other openings within living quarters.

**9.3.5.3**

Carbon dioxide piping shall be used for no other purpose, except that carbon dioxide piping shall be permitted to be used in an air-sampling-type smoke detection system.

**9.3.6 System Design.**

System design shall comply with Chapters 5 through 7 except as described in 9.3.6.1 through 9.3.6.4.2.

**9.3.6.1 Machinery Spaces.**

Machinery spaces shall be designed to a 34 percent concentration based on the gross volume.

**9.3.6.1.1**

Eighty-five percent of the concentration required by 9.3.6.1 shall be achieved within 2 minutes from the start of discharge.

**9.3.6.1.2**

Gross volume shall include the casing.

**9.3.6.2 Cargo Spaces.**

Cargo spaces other than vehicle spaces shall be supplied with carbon dioxide based on 1 lb/30 ft<sup>3</sup> based on the gross volume.

**9.3.6.2.1**

The initial quantity of carbon dioxide discharged shall be based on the net volume of the space as determined by the amount of cargo in the cargo space.

**9.3.6.2.2\***

Additional carbon dioxide shall be released as needed to maintain control of the fire.

**A.9.3.6.2.2**

An example of where drains would be necessary would be low points in carbon dioxide piping, which are also used by a sampling-type smoke detection system.

Fires in cargo spaces may not be completely extinguished by the carbon dioxide discharge. Whether the fire is completely extinguished or only suppressed depends on a number of factors, including the type and quantity of burning material. Some leakage of carbon dioxide-enriched atmosphere from the cargo hold is likely. Therefore, additional carbon dioxide might need to be discharged on an intermittent basis to maintain fire suppression in the cargo hold until the vessel reaches port. Once at port, before the cargo hold is opened, a properly equipped and trained fire brigade should be standing by to effect complete extinguishment of the burning material.

**9.3.6.2.3**

Clear instructions shall be posted within the carbon dioxide storage room detailing the carbon dioxide release procedure.

**9.3.6.3 Vehicle Spaces.****9.3.6.3.1**

Vehicle spaces where the vehicles contain more than 5 gal (19 L) of fuel (gasoline or diesel) shall be designed to a 34 percent concentration based on the gross volume.

**9.3.6.3.2**

Eighty-five percent of this concentration shall be achieved within 2 minutes from start of discharge.

**9.3.6.4 Vehicle Spaces.****9.3.6.4.1**

Vehicle spaces where the vehicles contain 5 gal (19 L) or less of fuel (gasoline or diesel) shall be designed to a 34 percent concentration based on the gross volume.

**9.3.6.4.2**

Two-thirds of this concentration shall be achieved within 10 minutes from start of discharge.

**9.3.7 Electrical Equipment Spaces.**

Electrical equipment spaces shall be treated as a dry electrical hazard in accordance with Chapter 5.

## 9.4 Inspection and Maintenance.

Inspection and maintenance shall comply with 4.8.3 and Section 9.4.

### 9.4.1 General.

Prior to testing or maintenance of a fixed carbon dioxide system, all personnel shall be evacuated from the protected space. (See *Section 4.3.*)

### 9.4.2 Approval of Installations.

#### 9.4.2.1

The approval test described in 9.4.2.1.1 through 9.4.2.1.4 shall be conducted prior to the tests required by 4.4.3.

##### 9.4.2.1.1

Pressure tests of the piping shall be performed to meet the requirements of 9.4.2.1.2 through 9.4.2.1.4.

##### 9.4.2.1.2

The test medium shall be a dry, noncorrosive gas such as nitrogen or carbon dioxide.

##### 9.4.2.1.3

When pressurizing the piping, pressure shall be increased in 50 psi (3.5 bar) increments.

##### 9.4.2.1.4

Once the pressure in the pipe has reached the required test pressure, the pressure source shall be shut off and disconnected from the pipe.



Pneumatic pressure testing creates a potential risk of injury to personnel in the area, as a result of airborne projectiles, if rupture of the piping system occurs. Prior to the pneumatic pressure test, the area in which the pipe is located shall be evacuated and appropriate safeguards shall be provided for test personnel.

### 9.4.2.2 High-Pressure Systems.

#### 9.4.2.2.1 Systems with Stop Valves.

##### 9.4.2.2.1.1

All piping from the carbon dioxide supply to the stop valves shall be subjected to a minimum pressure of 1000 psi (6895 kPa).

##### 9.4.2.2.1.2

The leakage during a 2-minute period shall not exceed a pressure drop of 10 percent.

##### 9.4.2.2.1.3

All piping between the stop valves and the nozzles shall be subjected to a minimum pressure of 600 psi (4137 kPa).

##### 9.4.2.2.1.4

The leakage during a 2-minute period shall not exceed a pressure drop of 10 percent.

#### 9.4.2.2.2 Systems Without Stop Valves.

##### 9.4.2.2.2.1

All piping from the carbon dioxide supply to the nozzles shall be subjected to a minimum pressure of 600 psi (4137 kPa).

##### 9.4.2.2.2.2

The leakage during a 2-minute period shall not exceed a pressure drop of 10 percent.

#### 9.4.2.3 Low-Pressure Systems.

##### 9.4.2.3.1 Normally Pressurized Piping.

###### 9.4.2.3.1.1

All piping that is normally pressurized shall be subjected to a minimum pressure test of 300 psi (2068 kPa).

###### 9.4.2.3.1.2

No leakage shall be permitted from the piping during a 2-minute test.

##### 9.4.2.3.2 Piping Between the Tank Shutoff Valve and Nozzles.

###### 9.4.2.3.2.1

All piping between the tank shutoff valve and the nozzles shall be subjected to a minimum pressure test of 300 psi (2068 kPa).

###### 9.4.2.3.2.2

The leakage during a 2-minute period shall not exceed a pressure drop of 10 percent.

#### 9.4.3 Predischarge Delays, Alarms, and Shutdowns.

##### 9.4.3.1

Predischarge delays and alarms and ventilation shutdowns shall be tested by flowing carbon dioxide into the system.

##### 9.4.3.2

Predischarge delays that are not accurate to within +20 percent/-0 percent at 70°F (21°C) of their rating shall be replaced.

#### 9.4.4 Verification.

Compliance with 9.3.2 shall be verified.

## Submitter Information Verification

**Committee:** GFE-AAA

**Submission Date:** Thu May 11 13:13:11 EDT 2023

## Committee Statement

**Committee Statement:** A task group has been formed to review chapter 9 in its entirety to update information to align with the US Coast Guard requirements. There are references that should be aligned with how they are used within the US Maritime Organization.

**Response Message:** CI-18-NFPA 12-2023

## Ballot Results

 This item has not been balloted



## Public Comment No. 1-NFPA 12A-2023 [ Section No. 6.1.4 ]

### 6.1.4\*

The agent quantity and pressure of refillable containers shall be checked. If a container shows a loss in net weight of more than 5 percent or a loss in pressure (adjusted for temperature) of more than 10 percent, it shall be refilled or replaced. ~~When the amount of agent in the container is determined by special measuring devices in lieu of weighing, these devices shall be listed.~~

### Statement of Problem and Substantiation for Public Comment

The 2004 edition added the language requiring that "when the agent in the container is determined by special measuring devices in lieu of weighing, these devices shall be listed." There does not appear to be a standard for listing such a device. A review of the 2004 edition committee ROP and ROC shows no committee deliberation on the new requirement, only that the document was re-written per the 2000 NFPA Manual of Style. This appears to have been an inadvertent change to the code in 2004.

A review of other similar standards, UL S593, US Coast Guard Regulation 46 CFR Part 147.65, US DoD UFC 3-601-02 shows that all permit alternative means, and none requires the alternative device be listed.

#### Related Item

- first draft report

### Submitter Information Verification

**Submitter Full Name:** Christopher Pragman

**Organization:** Constellation Nuclear

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**State:**

**Zip:**

**Submittal Date:** Fri Aug 25 12:40:21 EDT 2023

**Committee:** GFE-AAA



## Public Comment No. 4-NFPA 2001-2023 [ Section No. 4.4.1 ]

### 4.4.1

Before system cylinders are handled or moved, the following steps shall be taken:

- (1) Cylinder outlets shall be fitted with anti-recoil devices, cylinder caps, or both, whenever the cylinder outlet is not connected to the system pipe inlet.
- (2) Cylinder caps shall be fitted whenever the cylinder is removed from the retaining bracketing.
- (3) Actuators shall be disabled or removed before cylinders are removed from retaining bracketing.

### Statement of Problem and Substantiation for Public Comment

Adding cylinder cap requirement for NFPA 2001 to be compliant to with OSHA 1926.350(a)(1).

#### Related Item

- Public Input No. 35

### Submitter Information Verification

**Submitter Full Name:** Stefan Sekula

**Organization:** Minimax Viking R&D, GmbH

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**City:**

**State:**

**Zip:**

**Submittal Date:** Tue Dec 05 08:00:21 EST 2023

**Committee:** GFE-AAA



## Public Comment No. 1-NFPA 2001-2023 [ Section No. 5.2.2.6 ]

### 5.2.2.6

All threads used in joints and fittings shall conform to ASME B1.20.1, *Standard on Pipe Threads, General Purpose, Inch*, or ISO 7-1, *Pipe Threads Where Pressure-Tight Joints Are Made on the Threads — Part 1: Dimensions, Tolerances and Designation*. ~~Joint~~ (here, joint compound, tape, or thread lubricant shall be applied only to the male threads of the joint) or ISO228-1, Pipe Threads Where Pressure-Tight Joints Are Not Made on the Threads (here the pressure-tightness is made by pressing together two sealing surfaces being outside of the threads by using an appropriate sealant, e.g. an o-ring or a metallic flat gasket).

### Statement of Problem and Substantiation for Public Comment

More and more components (e.g. hoses, regulators, check valves, manifolds etc.) on the market used within clean agent extinguishing systems have o-ring sealings to make connections tight. Many of these components are UL and FM approved (plus have all the relevant European approvals). Some suppliers say that these kind of sealings are technically more advanced than existing pipe connections with PTFE tape or hemp).

An example could be the QUANTUM manifold and high pressure pipe system from HDT Füsser (<https://www.hdt-fuesser.de/english/systeme.html>). HDT Füsser supplies many fire suppression companies in Europe. The sealing of the QUANTUM system should never be done via the threads, as it is known that a complex installation has to be done. The system uses the threads only to create the seal via a force fit in the O-ring and the associated two sealing surfaces. This is seen as a significant advancement in the components of time and safety with the QUANTUM system, which can be installed without tools or sealant.

The connection in the QUANTUM system is tight in the external thread even without sealant. Especially since NFPA2001 4.2.2.6 only requires sealant in the male thread if it is needed. Furthermore, we are also aware that the used O-rings could require UL certification acc. UL2127.

EN ISO228-1 points out that pressure-tightness has to be achieved by pressing two sealing surfaces onto each other AND by interposing a suitable gasket.

Next to QUANTUM there are much more clever solutions and products who could make use of the adaptation of the NFPA2001 standard.

#### Related Item

- PI

### Submitter Information Verification

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**Submittal Date:** Wed Sep 06 08:32:52 EDT 2023

**Committee:** GFE-AAA



## Public Comment No. 5-NFPA 2001-2023 [ Section No. 7.1.8.2 ]

### 7.1.8.2

~~Designers~~ For calculation of enclosure vent area, designers shall consult ~~the~~ either:

- 1) The system manufacturer's recommended procedures relative to enclosure venting.
- 2) The system manufacturer's approved calculation software.
- 3) Other recognized methodologies.

*[For pressure relief vent area or equivalent leakage area, see 6.1.2.5(28).]*

### Statement of Problem and Substantiation for Public Comment

The FSSA Pressure Venting Guide is listed in Appendix A, but other Methodologies exist. Section also must allow for use of manufacturer calculations, when provided.

#### Related Item

- Public Input No. 42

### Submitter Information Verification

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**Submittal Date:** Tue Dec 05 08:58:47 EST 2023

**Committee:** GFE-AAA



## Public Comment No. 3-NFPA 2001-2023 [ New Section after 9.4.10 ]

### 9.4.10.3

The electric actuator that removed from the agent storage container discharge valve shall be secured and placed on actuator holder or solenoid pocket to prevent mechanical damage and loss of integrity.

### Additional Proposed Changes

<u>File Name</u>	<u>Description</u>	<u>Approved</u>
Solenoid_Pocket_SOKET_.png	Before and After using Solenoid Pocket	
General_Specification_SOKET.pdf	General specification for SOKET not limited to other actuator holder	

### Statement of Problem and Substantiation for Public Comment

Actuator broken is one of the major problems for functional failure of FM-200 system based on comprehensive analysis and evaluation. This condition can make liquid loss and unreadiness of FM-200 system. Mechanical damage resulted from disconnection process on FM-200 system as no bracket or pocket to hold and secure actuator while maintenance or testing process. In current situation there is no statement to secure or hold the actuator, it has not been stated on Appendix A.9.4.10.1 (NFPA 72, 14.2.6.4 requires that "Suppression system shall be secured from inadvertent actuation, including disconnection of releasing solenoids or electric actuator, closing of valves, other actions, or combinations thereof, for the specific system, for the duration of the fire alarm system testing.") how the technical procedure or process of securing the solenoid while fire alarm system testing. It's highly recommended to add additional statement to prevent similar condition in other places by adding actuator holder or solenoid pocket as the solution for this problem.

#### Related Item

- PI

### Submitter Information Verification

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**Submittal Date:** Thu Nov 16 19:41:30 EST 2023  
**Committee:** GFE-AAA

**BEFORE**



**AFTER**



# General Specification Solenoid Pocket (SOKET)

## 1.0 Scope

This Specification defines material and dimension minimum requirements for the design of Solenoid Pocket (SOKET). The specification aimed primarily at design features and at the quality of the SOKET. It specifies the general types of major material to be used in the SOKET production process.

## 2.0 References

The codes, standards and specification listed below are cited in this specification. Most of codes and standards cited in the general specifications are of Indonesian or U.S. and Europe origin. The citations are to the latest edition except where a specific edition is cited.

NFPA 72, National Fire Alarm and Signaling Code®

NFPA 1961, Standard on Fire Hose

NFPA 2001, Standard on Clean Agent Fire Extinguishing Systems

UU No. 1 / 1970 tentang Keselamatan Kerja

## 3.0 General

The materials, design, fabrication and testing of SOKET described herein shall be in accordance with the latest editions of the codes and standards referenced, and as supplemented, modified and or superseded by this specification. All components and installation procedures shall be governed by this specification in conjunction with referenced standards.

## 4.0 Material Specification

### 4.1 Waste Fire Hose :

- 100% Synthetic Rubber Fire Hose
- Easy to clean No need to dry.
- Damage is easy to repair.
- Resistant to hot weather or humid air.
- Not curved.
- Resistant to chemicals.
- Hose meets or exceeds specifications for heat and kink resistance.
- Lay-flat, lightweight and flexible ideally suited for industrial fire protection and in-plant apparatus.
- Hose designed to resist cracking, mildew, and rot. n Resists fuels, oils and a wide range of chemicals and bases.
- Underwriters Laboratories listing and Factory Mutual approval available on 1½" and 2½" diameters.
- Manufactured to meet or exceed NFPA 1961 standard.

#### 4.2 Adhesive :

- Chemical Type : Ethyl cyanoacrylate
- Appearance (uncured) : Transparent, colorless to straw
- Components : One part - requires no mixing
- Viscosity : Low
- Cure : Humidity
- Application : Bonding
- Key Substrates : Plastics, Rubbers and Metals
- Adhesive Properties
- After 24 hours @ 22 °C
- Lap Shear Strength, ISO 4587:

Steel (grit blasted)	N/mm <sup>2</sup> 14.2 (psi) (2,060)
Aluminum (grit blasted)	N/mm <sup>2</sup> 10.8 (psi) (1,570)
Zinc dichromate	N/mm <sup>2</sup> 5.9 (psi) (860)
ABS	N/mm <sup>2</sup> 7.9 (psi) (1,150)
PVC	N/mm <sup>2</sup> 8.7 * (psi) (1,260)
Polycarbonate	* N/mm <sup>2</sup> 8 * (psi) (1,160)
Phenolic	N/mm <sup>2</sup> 9.9 (psi) (1,440)
Neoprene	N/mm <sup>2</sup> 1 * (psi) (145)
Nitrile	N/mm <sup>2</sup> 1.3 * (psi) (190)
Tensile Strength, ISO 6922: Buna-N	N/mm <sup>2</sup> ≥6.0LMS (psi) (≥870)

#### 4.3 Cable Ties :

<b>Technical Specifications</b>	
Material	Nylon 66
Operating Temp	-40 to +85°C
Flammability	UL 94 V2
UV Light/Ozone Resistance	Medium
Oils & Grease Resistance	Excellent
Solvents Resistance	Good
Petrol Resistance	Excellent
Standards	UL E70062, BS EN 62275:2009 and UL1565

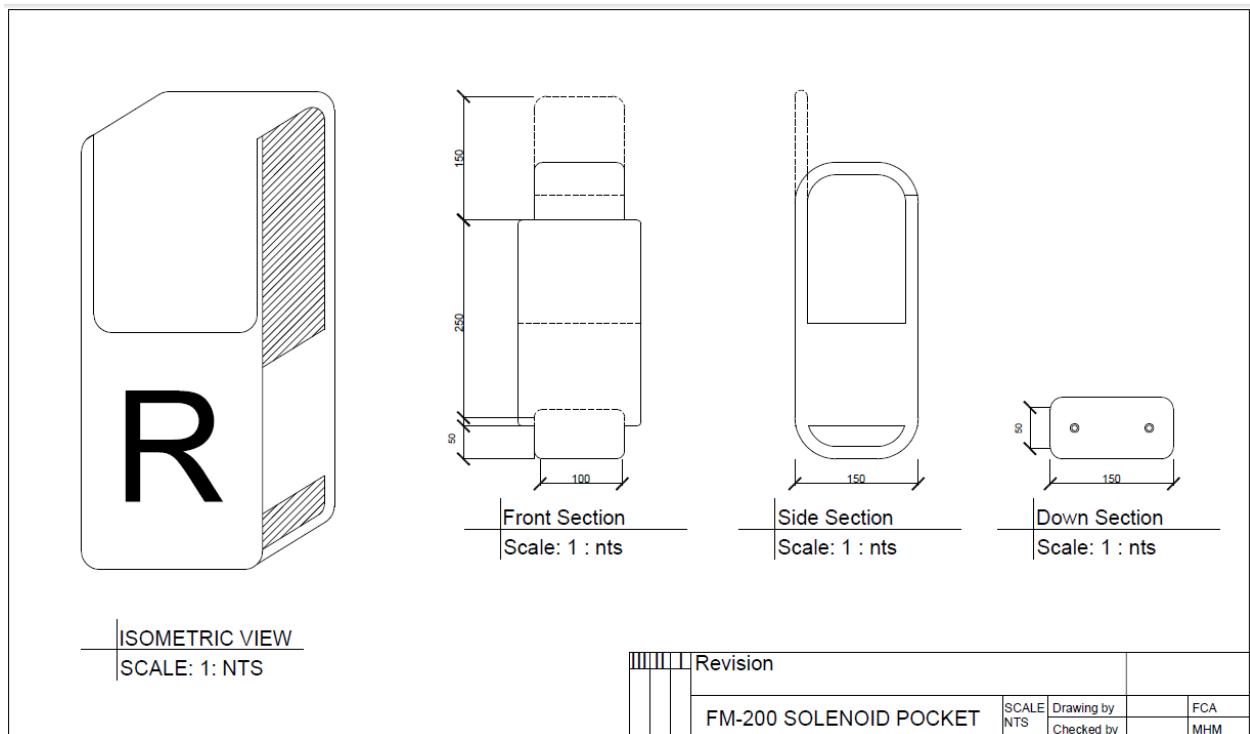
#### 4.4 Marker Sticker :

- UV Resistant
- Waterproof

#### 4.5 Safety Seal :

- 2 inch paper insulation
- 12 yards long
- Yellowish paper color
- Suitable for painting

### 5.0 Design Specification



### 6.0 Installation Specification

- Where there is a process of solenoid disconnection of total flooding or suppression system, solenoid pocket (SOKET) must be included on the installation to prevent inadvertent actuation and mechanical damage to solenoid.
- Solenoid actuator shall be secured and placed on SOKET.
- SOKET shall be placed to the nearest reel or structure on total flooding or suppression system cabinet
- SOKET shall be secured with safety seal to prevent incompetent or disinterested people from sabotage or inadvertent move.

### 7.0 Testing and Quality Check

- Each new SOKET product shall be tested with a load 3 times more than solenoid on the location where SOKET will be placed
- Adhesive strength checks need to be carried out by opening and closing the SOKET 50 times



## Public Comment No. 7-NFPA 2001-2023 [ Section No. 9.7.2 ]

### 9.7.2\*

For hazard areas subject to fast-growth fires, or where the provision of a time delay would increase the threat to life and property, a time delay shall be permitted to be eliminated.

### Statement of Problem and Substantiation for Public Comment

There are cases where a slow growing fire could still need to be addressed quickly. For instance a smoldering fire inside a dust collector could need to be addressed quickly to limit damage.

#### Related Item

- Committee Discussion

### Submitter Information Verification

**Submitter Full Name:** Brad Stilwell

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**Submittal Date:** Wed Dec 27 15:17:24 EST 2023

**Committee:** GFE-AAA



## Public Comment No. 8-NFPA 2001-2023 [ Sections 11.3.4, 11.3.5 ]

### Sections 11.3.4, 11.3.5

#### 11.3.4\*

For inert gas clean agents, if a container shows a loss in pressure (adjusted for temperature) of more than 5 percent, it shall be refilled or replaced.

#### 11.3.

~~5-~~

~~Where container pressure gauges are used to comply with 11.3.4, they 4.1~~

~~If an inert gas container pressure gauge shows any loss in pressure (adjusted for temperature) it shall be compared to a separate calibrated device at least annually pressure gauge .~~

### Statement of Problem and Substantiation for Public Comment

Pressure gauges used on inert gas systems that are Listed have shown to have a high degree of quality. The current test requires each gauge to be compared to a calibrated gauge annually. Actual field testing has shown this exercise verifies that the Listed gauges work as designed. Any cylinder that shows any leakage should be further evaluated but checking cylinders that show no leakage is a safety risk and can actually create a leak where there was not one before.

#### Related Item

- 14

### Submitter Information Verification

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**Submittal Date:** Wed Dec 27 15:40:02 EST 2023

**Committee:** GFE-AAA



## Public Comment No. 6-NFPA 2001-2023 [ Section No. A.3.3.10 ]

### A.3.3.10 Deep-Seated Fire.

A characteristic of this type of combustion is the slow rate of heat ~~losses~~ loss from the reaction zone. Thus, the fuel remains hot enough to exothermically react with oxygen, even though the rate of reaction, which is controlled by diffusion processes, is extremely slow. Deep-seated fires can continue to burn for many weeks, for example, in bales of cotton and jute and heaps of sawdust. A deep-seated fire ceases to burn only when either all the available oxygen or fuel has been consumed or the fuel surface is at too low a temperature to react.

Deep-seated fires usually are extinguished by reducing the fuel temperature, either directly by application of a heat-absorbing medium, such as water, or by blanketing with an inert gas. The medium slows the reaction rate to the point where heat generated by oxidation is less than heat losses to surroundings. This causes the temperature to fall below the level necessary for re-ignition after removal of the inert atmosphere.

## Statement of Problem and Substantiation for Public Comment

Editorial, grammatical correction

### Related Item

- Editorial

## Submitter Information Verification

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**Submittal Date:** Wed Dec 13 19:07:26 EST 2023

**Committee:** GFE-AAA



## Committee Input No. 24-NFPA 2001-2023 [ Global Input ]

Change from kPa to bar throughout the document.

### Submitter Information Verification

**Committee:** GFE-AAA

**Submission Date:** Wed May 24 10:20:40 EDT 2023

### Committee Statement

**Committee Statement:** Tables use a mix of kPa and bar in different tables

Task Group has been formed to review metric conversion and provide recommendation for Second Draft.

**Response Message:** CI-24-NFPA 2001-2023

[Public Input No. 36-NFPA 2001-2023 \[Global Input\]](#)

### Ballot Results

**This item has not been balloted**



## Committee Input No. 20-NFPA 2001-2023 [ Section No. 4.3.7 ]

### 4.3.7\* Occupiable Spaces.

Systems protecting occupiable spaces where the clean agent design concentration and egress time exceeds the design concentration and corresponding egress time approved for use in normally occupied spaces in accordance with 4.3.2 for halocarbon agents or 4.3.3 for inert gas agents shall include the following:

- (1) Supervised system lockout valves
- (2) Pneumatic pre-discharge alarms
- (3) Pneumatic time delays
- (4) Warning signs

#### A.4.3.7

In applying this provision of the standard, it is important to understand the relationship between agent concentration and egress time. The agent concentration permitted for human exposure is linked to the amount of time for which a person could be exposed to the agent concentration. For example, exposure to an HFC-227ea concentration up to and including 10.5 percent is permitted if the maximum exposure time (egress time) is limited to not more than 5 minutes, but exposure to a concentration of 11 percent would be permitted only if the exposure time could be limited to not more than 1.13 minutes. Similarly, exposure to an inert gas agent concentration up to 43 percent is permitted if the exposure time is limited to not more than 5 minutes, while exposure to a concentration up to 52 percent is permitted only if the exposure time is limited to not more than 3 minutes.

### 4.3.7.1\*

Pneumatic pre-discharge alarms shall be operated by an inert gas.

#### A.4.3.7.1

Inert gases used to operate pre-discharge alarms include inert gas clean agents, nitrogen, and carbon dioxide.

### 4.3.7.2

For an inert gas clean agent fire-extinguishing system, the quantity of inert gas discharged to operate a pneumatic pre-discharge alarm discharging into the protected space shall be considered, together with the quantity of agent discharged, when making a determination of post-discharge oxygen concentration with respect to compliance with the requirements of 4.3.3.

## Submitter Information Verification

**Committee:** GFE-AAA

**Submittal Date:** Thu May 11 13:43:17 EDT 2023

## Committee Statement

**Committee Statement:** A task group was formed to research situations where a time delay may not be appropriate.  
**Response Message:** CI-20-NFPA 2001-2023

### Ballot Results

 **This item has not been balloted**



## Committee Input No. 19-NFPA 2001-2023 [ Chapter 13 ]

### Chapter 13 Marine Systems

#### 13.1 General.

This chapter outlines the deletions, modifications, and additions that are necessary for marine applications. All other requirements of NFPA 2001 shall apply to shipboard systems except as modified by this chapter. Where the provisions of Chapter 13 conflict with the provisions of Chapter 1 through Chapter 11, the provisions of Chapter 13 shall take precedence.

##### 13.1.1 Scope.

This chapter is limited to marine applications of clean agent fire extinguishing systems on commercial and government vessels. Explosion inerting systems were not considered during development of this chapter.

#### 13.2 Use and Limitations.

##### 13.2.1\*

Total flooding clean agent fire extinguishing systems shall be used primarily to protect hazards that are in enclosures or equipment that, in itself, includes an enclosure to contain the agent.

##### A.13.2.1

Some typical hazards that could be suitable include, but are not limited to, the following:

- (1) Machinery spaces such as main machinery spaces
- (2) Emergency generator rooms
- (3) Pump rooms
- (4) Flammable liquid storage and handling areas and paint lockers
- (5) Control rooms and electronic equipment spaces

##### 13.2.2\*

In addition to the limitations given in 4.2.2, clean agent fire extinguishing systems shall not be used to protect the following:

- (1) Dry cargo holds
- (2) Bulk cargo

##### A.13.2.2

General cargo should not be protected with halocarbon agents due to the possibility of deep-seated cargo fires and due to wide variations in cargo materials. Dry cargoes, such as containerized cargoes, often comprise a wide mix of commodities that can include materials or storage arrangements not suited for protection with halocarbon agents. The volume of agent needed to protect cargo spaces varies depending on the volume of the cargo space minus the volume of the cargo carried. This quantity varies as cargo volume changes and can affect fire extinguishing effectiveness or agent toxicity.

### 13.2.3

The effects of agent decomposition products and combustion products on fire protection effectiveness and equipment shall be considered where using clean agents in hazards with high ambient temperatures (e.g., incinerator rooms, hot machinery and piping).

### 13.3 Hazards to Personnel.

#### 13.3.1

Other than the engine rooms identified in 13.3.1.1, all other main machinery spaces shall be considered normally occupied spaces.

##### 13.3.1.1

Engine rooms of 6000 ft<sup>3</sup> (170 m<sup>3</sup>) or less that are accessed for maintenance only shall not be required to comply with 13.3.1.

##### 13.3.2\*

For marine systems, electrical clearances shall be in accordance with 46 CFR, Subchapter J, "Electrical Engineering."

#### A.13.3.2

Subchapter J of 46 CFR 111.59 requires busways to comply with Article 368 of *NFPA 70*. Article 368 requires compliance with Article 300 for clearances around busways.

### 13.4 Agent Supply.

#### 13.4.1

Reserve quantities of agent shall not be required by this standard.

##### 13.4.2\*

Storage container arrangement shall be in accordance with 5.1.3.1 and 5.1.3.3 through 5.1.3.5. Where equipment is subject to extreme weather conditions, the system shall be installed in accordance with the manufacturer's design and installation instructions.

#### A.13.4.2

Agent cylinder storage spaces should be adequately ventilated. Entrances to such spaces should be from an open deck.

##### 13.4.2.1

Except in the case of systems with storage cylinders located within the protected space, pressure containers required for the storage of the agent shall be in accordance with 13.4.2.2.

##### 13.4.2.2

Where the agent containers are located outside a protected space, they shall be stored in a room that shall be situated in a safe and readily accessible location and shall be effectively ventilated so that the agent containers are not exposed to ambient temperatures in excess of 130°F (55°C). Common bulkheads and decks located between clean agent container storage rooms and protected spaces shall be protected with A-60 class structural insulation as defined by 46 CFR 72. Agent container storage rooms shall be accessible without having to pass through the space being protected. Access doors shall open outward, and bulkheads and decks, including doors and other means of closing any opening therein, that form the boundaries between such rooms and adjoining spaces shall be gastight.

##### 13.4.3

Where agent containers are stored in a dedicated space, doors at exits shall swing outward.

#### 13.4.4

Where subject to moisture, containers shall be installed such that a space of at least 2 in. (51 mm) between the deck and the bottom of the container is provided.

#### 13.4.5

In addition to the requirements of 5.1.3.4, containers shall be secured with a minimum of two brackets to prevent movement from vessel motion and vibration.

#### 13.4.6\*

For marine applications, all piping, valves, and fittings of ferrous materials shall be protected inside and out against corrosion except as permitted in 13.4.6.1.

##### A.13.4.6

Corrosion resistance is required to prevent clogging of nozzles with scale. Examples of suitable materials are hot dipped galvanized steel piping inside and out or stainless steel.

#### 13.4.6.1

Closed sections of pipe and valves and fittings within closed sections of pipe shall be required to be protected against corrosion only on the outside.

#### 13.4.6.2

Other than as permitted in 13.4.6.1, prior to acceptance testing, the inside of the piping shall be cleaned without compromising its corrosion resistance.

#### 13.4.7\*

Pipes, fittings, nozzles, and hangers, including welding filling materials, within the protected space shall have a melting temperature greater than 1600°F (871°C). Aluminum components shall not be used.

##### A.13.4.7

Fittings conforming to ASTM F1387 and fire tested with zero leakage conform to the requirements of 13.4.7.

#### 13.4.8

Piping shall extend at least 2 in. (51 mm) beyond the last nozzle in each branch line to prevent clogging.

### 13.5 Detection, Actuation, and Control Systems.

#### 13.5.1 General.

##### 13.5.1.1

Detection, actuation, alarm, and control systems shall be installed, tested, and maintained in accordance with the requirements of the authority having jurisdiction.

##### 13.5.1.2\*

For spaces greater than 6000 ft<sup>3</sup> (170 m<sup>3</sup>), automatic release of the fire extinguishing agent shall not be permitted where actuation of the system can interfere with the safe navigation of the vessel. Automatic release of the fire extinguishing agent shall be permitted for any space where actuation of the system will not interfere with the safe navigation of the vessel.

**A.13.5.1.2**

The intent of this paragraph is to ensure that a suppression system will not interfere with the safe navigation of the vessel. Many internal combustion propulsion engines and generator prime movers draw combustion air from the protected space in which they are installed. Because these types of engines are required to be shut down prior to system discharge, an automatically discharged system would shut down propulsion and electricity supply when needed most. A nonautomatic system gives the ship's crew the flexibility to decide the best course of action. For example, in a high-density shipping channel, a ship's ability to maneuver can be more important than immediate system discharge. For small vessels, the use of automatic systems is considered appropriate, taking into consideration the vessel's mass, cargo, and crew training.

**13.5.1.2.1**

Automatic release shall be permitted for any space of 6000 ft<sup>3</sup> (170 m<sup>3</sup>) or less.

**13.5.2 Automatic Detection.****13.5.2.1**

Electrical detection, signaling, control, and actuation system(s) shall have at least two sources of power. The primary source shall be from the vessel's emergency bus. For vessels with an emergency bus or battery, the backup source shall be either the vessel's general alarm battery or an internal battery within the system. Internal batteries shall be capable of operating the system for a minimum of 24 hours. All power sources shall be supervised.

**13.5.2.1.1**

For vessels without an emergency bus or battery, the primary source shall be permitted to be the main electrical supply.

**13.5.2.2**

In addition to the requirements set forth in Section 9.3, actuation circuits shall not be routed through the protected space where manual electrical actuation is used in marine systems.

**13.5.2.2.1**

For systems complying with 13.5.2.4, actuation circuits shall be permitted to be routed through the protected space.

**13.5.2.3\***

Manual actuation for systems shall not be capable of being put into operation by any single action. Other than as identified in 13.5.2.3.1, manual actuation stations shall be housed in an enclosure.

**A.13.5.2.3**

The intent is to prevent accidental or malicious system operation. Some examples of acceptable manual actuation stations are the following:

- (1) Breaking a glass enclosure and pulling a handle
- (2) Breaking a glass enclosure and opening a valve
- (3) Opening an enclosure door and flipping a switch

**13.5.2.3.1**

Manual actuation shall be permitted to be local manual actuation at the cylinder(s) location.

**13.5.2.4**

Systems protecting spaces larger than 6000 ft<sup>3</sup> (170 m<sup>3</sup>) shall have a manual actuation station located in the main egress route outside the protected space. In addition, systems protecting spaces larger than 6000 ft<sup>3</sup> (170 m<sup>3</sup>) having cylinders within the protected space and systems protecting unattended main machinery spaces shall have an actuation station in a continuously monitored control station outside the protected space.

#### **13.5.2.4.1**

Systems protecting spaces of 6000 ft<sup>3</sup> (170 m<sup>3</sup>) or less shall be permitted to have a single actuation station at either of the locations described in 13.5.2.4.

#### **13.5.2.5**

Emergency lighting shall be provided for remote actuation stations serving systems protecting main machinery spaces. All manual operating devices shall be labeled to identify the hazards they protect. In addition, the following information shall be provided:

- (1) Operating instructions
- (2) Length of time delay
- (3) Actions to take if system fails to operate
- (4) Other actions to take such as closing vents and taking a head count

#### **13.5.2.5.1**

For systems having cylinders within the protected space, a means of indicating system discharge shall be provided at the remote actuation station.

**13.6** Additional Requirements for Systems Protecting Class B Hazards Greater Than 6000 ft<sup>3</sup> (170 m<sup>3</sup>) with Stored Cylinders Within the Protected Space.

#### **13.6.1\***

An automatic fire detection system shall be installed in the protected space to provide early warning of fire to minimize potential damage to the fire extinguishing system before it can be manually actuated. The detection system shall initiate audible and visual alarms in the protected space and on the navigating bridge upon detection of fire. All detection and alarm devices shall be electrically supervised for continuity, and trouble indication shall be annunciated on the navigating bridge.

#### **A.13.6.1**

Heat detectors are typically used in machinery spaces and are sometimes combined with smoke detectors. Listed or approved optical flame detectors can also be used, provided they are in addition to the required quantity of heat and/or smoke detectors.

#### **13.6.2\***

Electrical power circuits connecting the containers shall be monitored for fault conditions and loss of power. Visual and audible alarms shall be provided to indicate this, and the alarms shall be annunciated on the navigating bridge.

#### **A.13.6.2**

This requirement is derived from SOLAS Regulation II-2/Regulation 5.3.

#### **13.6.3\***

Within the protected space, electrical circuits essential for the release of the system shall be heat resistant, such as mineral-insulated cable compliant with Article 332 of *NFPA 70*, or the equivalent. Piping systems essential for the release of systems designed to be operated hydraulically or pneumatically shall be of steel or other equivalent heat-resistant material.

**A.13.6.3**

This requirement is derived from SOLAS Regulation II-2/Regulation 5.3.

**13.6.4\***

The arrangements of containers and the electrical circuits and piping essential for the release of any system shall be such that in the event of damage to any one power release line through fire or explosion in a protected space (i.e., a single-fault concept) the entire fire extinguishing charge required for that space can still be discharged.

**A.13.6.4**

This requirement is derived from SOLAS Regulation II-2/Regulation 5.3.

**13.6.5\***

The containers shall be monitored for decrease in pressure due to leakage and discharge. Visual and audible signals in the protected area and either on the navigating bridge or in the space where the fire control equipment is centralized shall be provided to indicate a low-pressure condition.

**A.13.6.5**

This requirement is derived from SOLAS Regulation II-2/Regulation 5.3.

**13.6.6\***

Within the protected space, electrical circuits essential for the release of the system shall be Class A rated in accordance with *NFPA 72*.

**A.13.6.6**

This requirement is derived from SOLAS Regulation II-2/Regulation 5.3.

**13.7 Enclosure.****13.7.1\***

To prevent loss of agent through openings to adjacent hazards or work areas, openings shall be one of the following designs:

- (1) Permanently sealed
- (2) Equipped with automatic closures
- (3) Equipped with manual closures outfitted with an alarm circuit to indicate when these closures are not sealed upon activation of the system

**A.13.7.1**

A well-sealed enclosure is vital to proper operation of the system and subsequent extinguishment of fires in the protected space. Gastight boundaries of the protected space, such as those constructed of welded steel, offer a highly effective means for holding the fire extinguishing gas concentration. Where the space is fitted with openings, avenues for escape of the gas exist. Automatic closure of openings is the preferred method of ensuring enclosure integrity prior to discharge. Manually closed openings introduce added delay and an added human element into the chain of proper operation of the system. Failure of personnel to properly close all openings has been a recurring cause of gaseous systems not performing as intended. It is recognized that some openings in the enclosures, such as maintenance hatches and watertight doors, cannot be fitted with automatically operated closers due to personnel hazards or other limitations. In those cases, an indicator is required to alert the system operator that an opening has not been closed as required and thus the system is not ready for operation.

**13.7.1.1**

Where confinement of agent is not practical, or if the fuel can drain from one compartment to another, such as via a bilge, protection shall be extended to include the adjacent connected compartment or work areas.

**13.7.2\***

Prior to agent discharge, all ventilating systems shall be closed and isolated to preclude passage of agent to other compartments or the vessel exterior. Automatic shutdowns or manual shutdowns capable of being closed by one person from a position co-located with the agent discharge station shall be used.

**A.13.7.2**

Automatic shutdowns are the preferred method for shutting down a ventilation system. Shutdowns requiring personnel to find and manually close dampers far from the fire extinguishing system discharge station should not be permitted.

**13.8 Design Concentration Requirements.****13.8.1 Combinations of Fuels.**

For combinations of fuels, the design concentration shall be derived from the flame extinguishment value for the fuel requiring the greatest concentration.

**13.8.2 Design Concentration.**

For a particular fuel, the design concentration referred to in 13.8.3 shall be used.

**13.8.3 Flame Extinguishment.**

The minimum design concentration for Class B flammable and combustible liquids shall be as determined following the procedures described in IMO MSC/Circ. 848, *Revised Guidelines for the Approval of Equivalent Fixed Gas Fire-Extinguishing Systems as Referred to in SOLAS 74, for Machinery Spaces and Cargo Pump-Rooms*, as amended by IMO MSC.1/Circ. 1267, *Amendments to Revised Guidelines for the Approval of Equivalent Fixed Gas Fire-Extinguishing Systems, as Referred to in SOLAS 74, for Machinery Spaces and Cargo Pump-Rooms (MSC/Circ. 848)*.

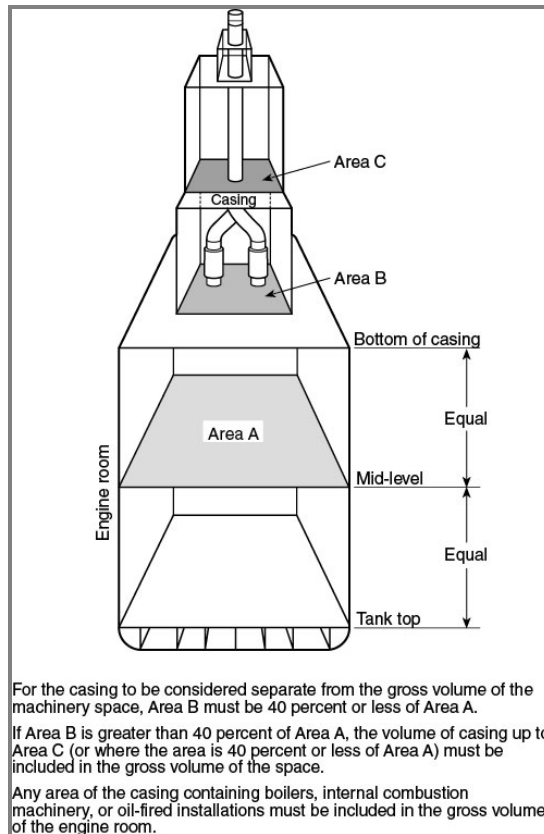
**13.8.4\* Total Flooding Quantity.**

The quantity of agent shall be based on the net volume of the space and shall be in accordance with the requirements of paragraph 5 of IMO MSC/Circular 848, *Revised Guidelines for the Approval of Equivalent Fixed Gas Fire-Extinguishing Systems as Referred to in SOLAS 74, for Machinery Spaces and Cargo Pump-Rooms*, Annex.

**A.13.8.4**

When the net volume of the machinery space is being calculated, the net volume should include the volume of the bilge and the volume of the stack uptake. The volume calculation should be permitted to exclude the portions of the stack uptake that have a horizontal cross-sectional area less than 40 percent of the horizontal cross-sectional area of the main machinery space. The horizontal cross-sectional area of the main machinery space should be measured midway between the lowest level (tank top) and the highest level (bottom of the stack casing). (See Figure A.13.8.4.)

**Figure A.13.8.4 Machinery Space and Stack Uptake.**



The objects that occupy volume in the protected space should be subtracted from the volume of the space. These objects include, but are not necessarily limited to, the following:

- (1) Auxiliary machinery
- (2) Boilers
- (3) Condensers
- (4) Evaporators
- (5) Main engines
- (6) Reduction gears
- (7) Tanks
- (8) Trunks

The Maritime Safety Committee, at its 67th session (December 2–6, 1996), approved guidelines for the approval of equivalent fixed gas fire extinguishing systems, as referred to in SOLAS 74, for machinery spaces and cargo pump rooms, as MSC/Circ. 776.

The Subcommittee on Fire Protection, at its 42nd session (December 8–12, 1997), recognized the need for technical improvement to the guidelines contained in MSC/Circ. 776 to assist in their proper implementation and, to that effect, prepared amendments to the guidelines.

The committee, at its 69th session (May 11–20, 1998), approved revised guidelines for the approval of equivalent fixed gas fire extinguishing systems, as referred to in SOLAS 74, for machinery spaces and cargo pump rooms, as set out in the annex, to supersede the guidelines attached to MSC/Circ. 776.

Member governments are invited to apply the annexed guidelines when approving equivalent fixed gas fire extinguishing systems for use in machinery spaces of category A and cargo pump rooms.

The quantity of extinguishing agent for the protected space should be calculated at the minimum expected ambient temperature using the design concentration based on the net volume of the protected space, including the casing.

The net volume of a protected space is that part of the gross volume of the space that is accessible to the free extinguishing agent gas.

In the calculation of the net volume of a protected space, the net volume should include the volume of the bilge, the volume of the casing, and the volume of free air contained in air receivers that in the event of a fire is released into the protected space.

The objects that occupy volume in the protected space should be subtracted from the gross volume of the space. They include, but are not necessarily limited to, the following:

- (1) Auxiliary machinery
- (2) Boilers
- (3) Condensers
- (4) Evaporators
- (5) Main engines
- (6) Reduction gears
- (7) Tank
- (8) Trunks

Subsequent modifications to the protected space that alter the net volume of the space require the quantity of extinguishing agent to be adjusted to meet the requirements of 13.8.4 and 13.8.5.

No fire suppression agent should be used that is carcinogenic, mutagenic, or teratogenic at concentrations expected during use. No agent should be used in concentrations greater than the cardiac sensitization NOAEL, without the use of controls as provided in SOLAS Regulation II-2/Regulations 5.2. In no case should an agent be used above its LOAEL nor approximate lethal concentration (ALC) calculated on the net volume of the protected space at the maximum expected ambient temperature.

#### **13.8.5\*** Duration of Protection.

It is important that the agent design concentration not only shall be achieved, but also shall be maintained for a sufficient period of time to allow effective emergency action by trained ship's personnel. In no case shall the hold time be less than 15 minutes.

#### **A.13.8.5**

Maintaining the design concentration is equally important in all classes of fires because a persistent ignition source, such as an electric arc, boiler front, heat source, engine exhaust, turbo charger, hot metal, or deep-seated fire, can lead to resurgence of the initial event once the clean agent has dissipated.

#### **13.9** Distribution System.

### **13.9.1 Rate of Application.**

The minimum design rate of application shall be based on the quantity of agent required for the desired concentration and the time allowed to achieve the desired concentration.

### **13.9.2 Discharge Time.**

#### **13.9.2.1**

The discharge time for halocarbon agents shall not exceed 10 seconds or as otherwise required by the authority having jurisdiction.

#### **13.9.2.2**

For halocarbon agents, the discharge time period shall be defined as the time required to discharge from the nozzles 95 percent of the agent mass [at 70°F (21°C)] necessary to achieve the minimum design concentration.

#### **13.9.2.3**

The discharge time for inert gas agents shall not exceed 120 seconds for 85 percent of the design concentration or as otherwise required by the authority having jurisdiction.

### **13.10 Nozzle Choice and Location.**

For spaces other than those identified in 13.10.1, nozzles shall be of the type listed for the intended purpose. Limitations shall be determined based on testing in accordance with IMO MSC/Circular 848, *Revised Guidelines for the Approval of Equivalent Fixed Gas Fire-Extinguishing Systems as Referred to in SOLAS 74, for Machinery Spaces and Cargo Pump-Rooms*. Nozzle spacing, area coverage, height, and alignment shall not exceed the limitations.

#### **13.10.1**

For spaces having only Class A fuels, nozzle placement shall be in accordance with the nozzles' listed limitations.

### **13.11 Inspection and Tests.**

At least annually, all systems shall be inspected and tested for proper operation by competent personnel. Discharge tests shall not be required.

#### **13.11.1**

An inspection report with recommendations shall be filed with the vessel's master and the owner's agent. The report shall be available for inspection by the authority having jurisdiction.

#### **13.11.2**

At least annually, the agent quantity of refillable containers shall be checked by competent personnel. The container pressure shall be verified and logged at least monthly by the vessel's crew.

#### **13.11.3\***

For halocarbon clean agents, if a container shows a loss in agent of more than 5 percent or a loss in pressure, adjusted for temperature, of more than 10 percent, it shall be refilled or replaced.

#### **A.13.11.3**

For determination of container pressure, the original container fill density should be obtained from the system manufacturer and the temperature/pressure relation should be obtained from tables published by the system manufacturer. For determination of container liquid level, the liquid level-temperature relationship should be obtained from the system manufacturer.

#### **13.11.3.1\***

If an inert gas clean agent container shows a loss in pressure, adjusted for temperature, of more than 5 percent, it shall be refilled or replaced. Where container pressure gauges are used for this purpose, they shall be compared to a separate calibrated device at least annually.

#### **A.13.11.3.1**

For inert gas clean agents that are not liquefied, pressure is an indication of agent quantity.

#### **13.11.4**

The installing contractor shall provide instructions for the operational features and inspection procedures specific to the clean agent system installed on the vessel.

#### **13.12 Approval of Installations.**

Prior to acceptance of the system, technical documentation, such as the system design manual, test reports, or the listing report, shall be presented to the authority having jurisdiction. This documentation shall show that the system and its individual components are compatible, employed within tested limitations, and suitable for marine use.

#### **13.12.1**

The listing organization shall perform the following functions:

- (1) Verify that fire tests were conducted in accordance with a predetermined standard
- (2) Verify that component tests were conducted in accordance with a predetermined standard
- (3) Review the component quality assurance program
- (4) Review the design and installation manual
- (5) Identify system and component limitations
- (6) Verify flow calculations
- (7) Verify the integrity and the reliability of system as a whole
- (8) Have a follow-up program
- (9) Publish a list of equipment

#### **13.13 Periodic Puff Testing.**

A test in accordance with 10.4.15 shall be performed at 24-month intervals. The periodic test program shall include a functional test of all alarms, controls, and time delays.

#### **13.14 Compliance.**

Electrical systems shall be in accordance with 46 CFR Subchapter J. For Canadian vessels, electrical installations shall be in accordance with TP 127 E, *Ship Safety Electrical Standards*.

## **Submitter Information Verification**

**Committee:** GFE-AAA

**Submittal Date:** Thu May 11 13:08:59 EDT 2023

## **Committee Statement**

**Committee Statement:** A task group has been formed to review chapter 13 in its entirety to update information to align with the US Coast Guard requirements. There are references that should be aligned with how they are used within the US Maritime Organization.

**Response** CI-19-NFPA 2001-2023  
**Message:**

### Ballot Results

 This item has not been balloted

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## Gaseous Fire Extinguishing Systems

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## Gaseous Fire Extinguishing Systems

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<b>Thomas Harris</b>	10/11/2021
<b>Staff Liaison</b>	<b>GFE-AAA</b>

National Fire Protection Association  
One Batterymarch Park  
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# NATIONAL FIRE PROTECTION ASSOCIATION

The leading information and knowledge resource on fire, electrical and related hazards

## MINUTES

### NFPA Technical Committee on Gaseous Fire Extinguishing Systems (GFE-AAA) NFPA 12/12A/2001 First Draft Meeting (F2024)

May 10-11, 2023  
8:00am – 5:00pm (Eastern)

In-Person – Hybrid via Microsoft Teams  
NFPA Headquarters  
One Batterymarch Park  
Quincy, MA 02169

1. **Call to order.** Brent Ehmke, chair, called the meeting to order at 8:00am on May 10, 2023.
2. **Introductions.** Attendees introduced themselves and identified their affiliation. NFPA staff took attendance.
3. **Chair report.** Brent Ehmke welcomed attendees and provided an overview of the meeting.
4. **Staff liaison report.** Tom Harris and Steve Kaitharath provided an overview of the standards development process and the revision cycle schedule.
5. **Previous meeting minutes.** The minutes from September/October 2020 Web/Teleconference were approved without revision.
6. **NFPA 12 First Draft.**
  - a. **Review of Public Inputs.** The Technical Committee reviewed the Public Inputs and developed First Revisions and Committee Inputs as necessary. These will be available in the First Draft Report at [www.nfpa.org/12](http://www.nfpa.org/12).
  - b. **New task groups.** The following task groups were appointed to work subsequent to the meeting:
    - i. **Secondary Cylinder Task Group.** TG Chair: Jessica Everest. Members: Jessica Hubert, Fred Penden, Scott Hill, Ray Stacy. Review terms for secondary or “slave” cylinders that are used throughout the industry to recommend a change for standardization throughout the document.
    - ii. **Maritime Task Group.** TG Chair: Dan Hubert. Members: Pock Utiskul, Blake Shugarman, Scott Hill. Review Chapter 9 in its entirety to update information to align with the US Coast Guard requirements. Align references with how they are used within the US Maritime Organization. Committee Input 18 on Chapter 9 was created as a place holder.
7. **NFPA 12A First Draft.**

- a. **Review of Public Inputs.** The Technical Committee reviewed the Public Inputs and developed First Revisions and Committee Inputs as necessary. These will be available in the First Draft Report at [www.nfpa.org/12a](http://www.nfpa.org/12a).

## 8. NFPA 2001 First Draft.

- a. **Review of Public Inputs.** The Technical Committee reviewed the Public Inputs and developed First Revisions and Committee Inputs as necessary. These will be available in the First Draft Report at [www.nfpa.org/2001](http://www.nfpa.org/2001).
- b. **Task group report.** The following task groups provided their reports and recommendations.
  - i. **Metric Conversions.** Katherine Adrian. The task group provided a report. The task group was reconstituted to continue work.
- c. **Presentation(s).** The committee heard presentations from the following individuals.
  - i. **Toxicity/Cardiac Sensitization.** Kamleshkumar Sodani.
- d. **New task groups.** The following task groups were appointed to work subsequent to the meeting:
  - i. **Metric Conversions Task Group.** TG Chair: Katherine Adrian. Members: Joe Senecal, Steve Hodges. Review all metric conversions for accuracy. Global Committee Input 24 was created as a place holder.
  - ii. **Maritime Task Group.** TG Chair: Dan Hubert. Members: Pock Utiskul, Blake Shugarman, Scott Hill. Review Chapter 13 in its entirety to update information to align with the US Coast Guard requirements. Align references with how they are used within the US Maritime Organization. Committee Input 19 on Chapter 13 was created as a place holder.
  - iii. **Insufficient Heat Task Group.** TG Chair: Jessica Hubert. Members: Jesse Cecil, Eric Forssell, Dan Hubert, Tom Wysocki, Joe Senecal, Fred Penden, Nick Johnson. Review the submitters substantiation from Public Input 1 to develop annex material to be considered at 2<sup>nd</sup> Draft.
  - iv. **Time Delay Task Group.** TG Chair: Brad Stilwell. Members: Dan Hubert, Tom Wysocki, Grant Smith, Fred Penden, Jessica Hubert. Review situations where a time delay may not be appropriate. Committee Input 20 on section 4.3.7 was created as a place holder.

## 9. Other Business.

- 10. **Future meetings.** The next committee meeting will be sometime during Q2 in 2024. A meeting notification will be posted at [www.nfpa.org/12next](http://www.nfpa.org/12next), [www.nfpa.org/12Anext](http://www.nfpa.org/12Anext), and [www.nfpa.org/2001next](http://www.nfpa.org/2001next) when the meeting is scheduled.

- 11. **Adjournment.** The meeting was adjourned at 2:00pm on May 11, 2023.

**Attendees****Committee Members:**

<b>Day 1</b>	<b>Day 2</b>	<b>Name</b>		<b>Company</b>
✓	✓	<b>Ehmke, Brent</b>	Chair	Ehmke Associates
✓*	✓*	<b>Cary, William</b>	Secretary	Aon Risk Solutions
		<b>Adrian, Katherine</b>	Principal	Johnson Controls
✓*	✓*	<b>Cecil, Jesse</b>	Principal	Fire King LLC
		<b>Chappell, Carl</b>	Principal	Hilcorp Alaska
✓*	✓*	<b>Dillon, Todd</b>	Principal	Global Asset Protection Services, LLC
✓	✓	<b>Everest, Jessica</b>	Principal	Siemens
✓	✓	<b>Faucon, Jeffrey</b>	Principal	Harrington Group, Inc.
✓*	✓*	<b>Hansen, Raymond</b>	Principal	US Department of the Air Force
✓*	✓*	<b>Hill, Scott</b>	Principal	Jensen Hughes
✓*	✓*	<b>Hodges, Steven</b>	Principal	Alion Science and Technology
✓	✓	<b>Hubert, Daniel</b>	Principal	Fire Suppression Systems Association
		<b>Indovino, Giuliano</b>	Principal	North American Fire Guardian Technology
✓*	✓*	<b>Johnson, Nick</b>	Principal	3M Company
	✓	<b>Kasiski, Robert</b>	Principal	FM Global
✓	✓*	<b>Kidd, Jeffrey</b>	Principal	The Hiller Companies
✓*	✓*	<b>Merrick, Justin</b>	Principal	Automatic Fire Alarm Association, Inc.
		<b>Miller, John</b>	Principal	US Coast Guard
✓*	✓*	<b>Minion, Joanna</b>	Principal	Honeywell
✓*	✓*	<b>Moberly, Michael</b>	Principal	BP
✓	✓	<b>Morgan, Jim</b>	Principal	Marsh USA Inc.
✓*	✓*	<b>Mushantat, Mohamed</b>	Principal	PLC Fire Safety Solutions
✓	✓*	<b>Penden, Karl</b>	Principal	Carrier/Kidde-Fenwal
✓*	✓*	<b>Pognant, Matt</b>	Principal	Liberty Mutual Property
✓*	✓*	<b>Richardson, James</b>	Principal	Lisle Woodridge Fire District
		<b>Robin, Mark</b>	Principal	Chemours

✓*	✓*	<b>Senecal, Joseph</b>	Principal	Firemetrics
✓	✓	<b>Shugarman, Blake</b>	Principal	UL Solutions
✓	✓	<b>Stilwell, Brad</b>	Principal	Fike Corporation
✓	✓	<b>VanGorder, Todd</b>	Principal	National Association of Fire Equipment
✓	✓	<b>Wysocki, Thomas</b>	Principal	Guardian Services, Inc.
✓*	✓*	<b>Sheppard, Margaret</b>	Voting Alternate	US Environmental Protection Agency
		<b>Bauroth, Charles</b>	Alternate	Liberty Mutual
		<b>Carmean, Andrew</b>	Alternate	US Department of the Air Force
✓*		<b>Downey, Thomas</b>	Alternate	Marsh USA Inc.
		<b>Espinosa, Justin</b>	Alternate	BP Alaska
✓*	✓*	<b>Fessenden, Mark</b>	Alternate	Johnson Controls
✓*	✓*	<b>Forssell, Eric</b>	Alternate	Jensen Hughes
✓*	✓*	<b>Holly, Kevin</b>	Alternate	UL Solutions
✓	✓	<b>Hubert, Jessica</b>	Alternate	Guardian Services, Inc.
		<b>Ingram, Jonathan</b>	Alternate	Carrier/Kidde-Fenwal, Inc.
		<b>Owens, John</b>	Alternate	3M Company
✓*	✓*	<b>Palumbo, Emma</b>	Alternate	North American Fire Guardian Technology
	✓	<b>Pelton, David</b>	Alternate	National Association of Fire Equipment
✓*	✓*	<b>Rivers, Paul</b>	Alternate	Sidsson LLC
		<b>Rodino, Sarah</b>	Alternate	U.S. Coast Guard
✓	✓	<b>Smith, Grant</b>	Alternate	Fire Corporation
✓	✓*	<b>Stacy, Raymond</b>	Alternate	FM Global
✓*	✓*	<b>Thornton, Alfred</b>	Alternate	The Chemours Company
✓*	✓*	<b>Zornes, Tom</b>	Alternate	Automatic Fire Alarm Association, Inc.
		<b>Schlosser, Ingeborg</b>	Nonvoting	VdS Schadencerhuetung
		<b>Vigara, Fernando</b>	Nonvoting	APICI
✓	✓	<b>Harris, Thomas</b>	Staff Liaison	National Fire Protection Association

**Guests:**

Name	Company	Day 1	Day 2
------	---------	-------	-------

Steve Kaitharath	NFPA Staff	✓	✓
Chad Duffy	NFPA Staff	✓	✓
Patrick Bakaj	NFPA Staff	✓*	✓*
Tom Goss	NFPA Staff	✓*	✓*
Pock Utiskul	US Coast Guard	✓	✓
Corey Polzin	Johnson Controls	✓	✓
Jamie McNally	Carrier	✓*	✓*
Mike Kiamanesh	Waysmos USA Inc.	✓	✓
Scott Bailey	Koorsen	✓*	✓*
Christina Thompson	US EPA	✓*	✓*
Kamleshkumar Sodani	Honeywell		✓*
Scott Panowitz	BFPE	✓*	✓*
Gary Jepson	Chemours		✓*

\*Participated by teleconference

Total number in attendance: 53



## Public Comment No. 1-NFPA 12-2023 [ Section No. 3.1.3 ]

### 3.1.3 –

~~Merriam-Webster's Collegiate Dictionary~~, 11th edition, shall be the source for the ordinarily accepted meaning.

### Statement of Problem and Substantiation for Public Comment

jdfjdsjkjfdkjfdkjfd

#### Related Item

- PI-1

### Submitter Information Verification

**Submitter Full Name:** Committee Member1

**Organization:** NEMA

**Affiliation:** fjdkjfdjfdkjfd

**Street Address:**

**City:**

**State:**

**Zip:**

**Submittal Date:** Fri Aug 11 13:47:54 EDT 2023

**Committee:** GFE-AAA



## Public Comment No. 7-NFPA 12-2023 [ Section No. 5.5.3 ]

### 5.5.3\* Enclosed Rotating Electrical Equipment.

A. 5.5.3-1 3 Enclosed rotating electrical equipment treated as “dry electrical hazards” may include generators, exciters, converters where there is potential for ignition of insulation on windings. Stationary combustion engines and gas turbines wherein the fire risk is primarily the gas used to fuel the turbine and lube and hydraulic oils are typically treated as surface fire hazards and are addressed in NFPA 37.

5.5.3.1 For enclosed rotating electrical equipment a 30% concentration of carbon dioxide shall be achieved within 2 minutes of the start of discharge and a peak concentration of not less than 50% carbon dioxide shall be achieved within 7 minutes of the start of discharge.

### 5.5.3.2

For enclosed rotating electrical equipment, a minimum concentration of 30 percent shall be maintained for the deceleration period, but not less than 20 minutes.

### A. 5.5.3.2 1

For enclosed rotating electrical equipment ~~with non-venting recirculating-type airflow~~, the initial discharge quantity ~~shall~~ should not be less than 1 lb (0.45 kg) of gas for each 10 ft<sup>3</sup> (0.28 m<sup>3</sup>) of enclosed volume up to 2000 ft<sup>3</sup> (56.6 m<sup>3</sup>).

### 5.5.3.3 –

For enclosed rotating electrical equipment

~~with non-venting recirculating-type airflow~~

, the initial discharge quantity

shall

should not be less than 1 lb (0.45 kg) of gas for each 12 ft<sup>3</sup> (0.34 m<sup>3</sup>) of enclosed volume greater than 2000 ft<sup>3</sup> (56.6 m<sup>3</sup>).

For enclosed rotating electrical equipment with dampered, non-recirculating-type airflow, the initial discharge quantity may need to be increased to compensate for possible leakage past the dampers.

**A. 5.5.3.3.4 2**

Table A. 5.5.3.3.4 2 (a) and Table A. 5.5.3.3.4 2 (b) shall may be used as a guide to estimate the quantity of gas needed for the extended discharge to maintain a minimum concentration of 30 percent for the deceleration time.

**Table 5**

For enclosed rotating electrical equipment with dampered, non-recirculating-type airflow, the indicated quantities of carbon dioxide, as shown in Table A .5. 5. 3.3.

4

2 (a) and Table A.5.5.3.3.2(b) , should be increased by 35 percent to compensate for possible leakage past the dampers.

When the manufacturer of the enclosed rotating electrical equipment specifies the quantity of carbon dioxide to be used for the extended discharge, the guidance of the manufacturer should be followed

Table A.5.5.3.3.2(a) Extended Discharge Protection for Enclosed Recirculating Rotating Electrical Equipment (Cubic Feet Protected for Deceleration Time)

<b>lb CO<sub>2</sub></b>	<b>Time (minutes)</b>							
	<b>5</b>	<b>10</b>	<b>15</b>	<b>20</b>	<b>30</b>	<b>40</b>	<b>50</b>	<b>60</b>
100	1,200	1,000	800	600	500	400	300	200
150	1,800	1,500	1,200	1,000	750	600	500	400
200	2,400	1,950	1,600	1,300	1,000	850	650	500
250	3,300	2,450	2,000	1,650	1,300	1,050	800	600
300	4,600	3,100	2,400	2,000	1,650	1,300	1,000	700
350	6,100	4,100	3,000	2,500	2,000	1,650	1,200	900
400	7,700	5,400	3,800	3,150	2,500	2,000	1,600	1,200
450	9,250	6,800	4,900	4,000	3,100	2,600	2,100	1,600
500	10,800	8,100	6,100	5,000	3,900	3,300	2,800	2,200
550	12,300	9,500	7,400	6,100	4,900	4,200	3,600	3,100
600	13,900	10,900	8,600	7,200	6,000	5,200	4,500	3,900
650	15,400	12,300	9,850	8,300	7,050	6,200	5,500	4,800
700	16,900	13,600	11,100	9,400	8,100	7,200	6,400	5,600
750	18,500	15,000	12,350	10,500	9,150	8,200	7,300	6,500
800	20,000	16,400	13,600	11,600	10,200	9,200	8,200	7,300
850	21,500	17,750	14,850	12,700	11,300	10,200	9,100	8,100
900	23,000	19,100	16,100	13,800	12,350	11,200	10,050	9,000
950	24,600	20,500	17,350	14,900	13,400	12,200	11,000	9,800
1,000	26,100	21,900	18,600	16,000	14,500	13,200	11,900	10,700
1,050	27,600	23,300	19,900	17,100	15,600	14,200	12,850	11,500
1,100	29,100	24,600	21,050	18,200	16,600	15,200	13,750	12,400
1,150	30,600	26,000	22,300	19,300	17,700	16,200	14,700	13,200
1,200	32,200	27,300	23,550	20,400	18,800	17,200	15,600	14,100
1,250	33,700	28,700	24,800	21,500	19,850	18,200	16,500	14,900
1,300	35,300	30,100	26,050	22,650	20,900	19,200	17,450	15,800
1,350	36,800	31,400	27,300	23,750	22,000	20,200	18,400	16,650
1,400	38,400	32,800	28,550	24,900	23,100	21,200	19,350	17,500
1,450	39,900	34,200	29,800	26,000	24,200	22,200	20,300	18,350
1,500	41,400	35,600	31,050	27,100	25,250	23,200	21,200	19,200

Table 5 Table A .5.5. 3.3.4 2 (b) Extended Discharge for Enclosed Recirculating Rotating Electrical Equipment (Cubic Meters Protected for Deceleration Time) (SI Units)

Time (minutes)								
kg CO <sub>2</sub>	5	10	15	20	30	40	50	60
45.4	34	28.3	22.6	17	14.2	11.3	8.5	5.7
68.1	50.9	42.5	34	28.3	21.2	17	14	11.3
90.8	67.9	55.2	45.3	36.8	28.3	24.1	18.4	14.2
113.5	93.4	69.3	56.6	46.7	36.8	29.7	22.6	17
136.2	130.2	87.7	67.9	56.6	46.7	36.8	28.3	19.8
158.9	172.6	116	84.9	70.8	56.6	46.7	34	25.5
181.6	217.9	152.8	107.5	89.1	70.8	56.6	45.3	34
204.3	261.8	192.4	138.7	113.2	87.7	73.6	59.4	45.3
227	305.6	229.2	172.6	141.5	110.4	93.4	79.2	62.3
249.7	348.1	268.9	209.4	172.6	138.7	118.9	101.9	87.7
272.4	393.4	308.5	243.4	203.8	169.8	147.2	127.4	110.4
295.1	435.8	348.1	278.8	234.9	199.5	175.5	155.7	135.8
317.8	478.3	384.9	314.1	266	229.2	203.8	181.1	158.5
340.5	523.6	424.5	349.5	297.2	258.9	232.1	206.6	184
363.2	586	464.1	384.9	328.3	288.7	260.4	232.1	206.6
385.9	608.4	502.3	420.3	359.4	319.8	288.7	257.5	229.2
408.6	650.9	540.5	455.6	390.5	349.5	317	284.4	254.7
431.3	696.2	580.2	491	421.7	379.2	345.3	311.3	277.3
454	738.6	619.8	526.4	452.8	410.4	373.6	336.8	302.8
476.7	781.1	659.4	563.2	483.9	441.5	401.9	363.7	325.5
499.4	823.5	696.2	595.7	515.1	469.8	430.2	389.1	350.9
522.1	866	735.8	631.1	546.2	500.9	458.5	416	373.6
544.8	911.3	772.6	666.5	577.3	532	486.8	441.5	399
567.5	953.7	812.2	701.8	609.4	561.8	515.1	467	421.7
590.2	999	851.8	737.2	641	591.5	543.4	493.8	447.1
612.9	1041.4	888.6	772.6	672.1	622.6	571.7	520.7	471.2
635.6	1086.7	928.2	808	704.7	653.7	600	547.6	495.3
658.3	1129.2	967.9	843.3	735.8	684.9	628.3	574.5	519.3
681	1171.6	1007.5	878.7	766.9	713.2	656.6	600	543.4

**5.5.3.4 –**

For enclosed rotating electrical equipment with dampered, non-recirculating-type airflow, the indicated quantities of carbon dioxide, as shown in Table 5.5.3.3.1(a) and Table 5.5.3.3.1(b), shall be increased by 35 percent for extended discharge protection.

**Statement of Problem and Substantiation for Public Comment**

A.5.5.3 explains the type of equipment referenced in this standard as enclosed rotating electrical equipment and differentiates stationary combustion turbines and gas turbines which are typically treated as surface fire hazards covered in NFPA 37.

5.5.3.1 provides direction for the rate of application for the initial discharge for protection of rotating electrical equipment with flooding factors recommended in the related Annex material.

Returns 5.5.3.2 and 5.5.3.3 and 5.5.3.3.1 to the Annex where they existed for over 70 years as advisory material. No new information has been provided that would justify making this advisory information mandatory.

Adds advice that when the manufacturer of the enclosed rotating electrical equipment specifies the quantity of carbon dioxide to be used for the extended discharge, the guidance of the manufacturer would be appropriately followed.

**Related Item**

- PI-10 • PI-11

**Submitter Information Verification**

**Submitter Full Name:** Thomas Wysocki  
**Organization:** Guardian Services, Inc.  
**Street Address:**  
**City:**  
**State:**  
**Zip:**  
**Submittal Date:** Wed Dec 13 14:11:31 EST 2023  
**Committee:** GFE-AAA



**Public Comment No. 9-NFPA 12-2024 [ Section No. 5.5.3.3.1 ]**

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**5.5.3.3.1**

Table Table 5.5.3.3.1(a) and Table 5.5.3.3.1(b) shall be used as a guide to estimate the quantity of gas needed for the extended discharge to maintain a minimum concentration of 30 percent for the deceleration time. (Revise Table 5.5.3.3(a) and Table 5.5.3.3(b) DJH - See attached files for revised Tables).

Table 5.5.3.3.1(a) Extended Discharge Protection for Enclosed Recirculating Rotating Electrical Equipment (Cubic Feet Protected for Deceleration Time)

<b>Time (minutes)</b>								
<b>lb CO<sub>2</sub></b>	<b>5</b>	<b>10</b>	<b>15</b>	<b>20</b>	<b>30</b>	<b>40</b>	<b>50</b>	<b>60</b>
100	1,200	1,000	800	600	500	400	300	200
150	1,800	1,500	1,200	1,000	750	600	500	400
200	2,400	1,950	1,600	1,300	1,000	850	650	500
250	3,300	2,450	2,000	1,650	1,300	1,050	800	600
300	4,600	3,100	2,400	2,000	1,650	1,300	1,000	700
350	6,100	4,100	3,000	2,500	2,000	1,650	1,200	900
400	7,700	5,400	3,800	3,150	2,500	2,000	1,600	1,200
450	9,250	6,800	4,900	4,000	3,100	2,600	2,100	1,600
500	10,800	8,100	6,100	5,000	3,900	3,300	2,800	2,200
550	12,300	9,500	7,400	6,100	4,900	4,200	3,600	3,100
600	13,900	10,900	8,600	7,200	6,000	5,200	4,500	3,900
650	15,400	12,300	9,850	8,300	7,050	6,200	5,500	4,800
700	16,900	13,600	11,100	9,400	8,100	7,200	6,400	5,600
750	18,500	15,000	12,350	10,500	9,150	8,200	7,300	6,500
800	20,000	16,400	13,600	11,600	10,200	9,200	8,200	7,300
850	21,500	17,750	14,850	12,700	11,300	10,200	9,100	8,100
900	23,000	19,100	16,100	13,800	12,350	11,200	10,050	9,000
950	24,600	20,500	17,350	14,900	13,400	12,200	11,000	9,800
1,000	26,100	21,900	18,600	16,000	14,500	13,200	11,900	10,700
1,050	27,600	23,300	19,900	17,100	15,600	14,200	12,850	11,500
1,100	29,100	24,600	21,050	18,200	16,600	15,200	13,750	12,400
1,150	30,600	26,000	22,300	19,300	17,700	16,200	14,700	13,200
1,200	32,200	27,300	23,550	20,400	18,800	17,200	15,600	14,100
1,250	33,700	28,700	24,800	21,500	19,850	18,200	16,500	14,900
1,300	35,300	30,100	26,050	22,650	20,900	19,200	17,450	15,800
1,350	36,800	31,400	27,300	23,750	22,000	20,200	18,400	16,650
1,400	38,400	32,800	28,550	24,900	23,100	21,200	19,350	17,500
1,450	39,900	34,200	29,800	26,000	24,200	22,200	20,300	18,350
1,500	41,400	35,600	31,050	27,100	25,250	23,200	21,200	19,200

Table 5.5.3.3.1(b) Extended Discharge for Enclosed Recirculating Rotating Electrical Equipment (Cubic Meters Protected for Deceleration Time) (SI Units)

<b>Time (minutes)</b>								
<b>kg CO<sub>2</sub></b>	<b>5</b>	<b>10</b>	<b>15</b>	<b>20</b>	<b>30</b>	<b>40</b>	<b>50</b>	<b>60</b>
45.4	34	28.3	22.6	17	14.2	11.3	8.5	5.7
68.1	50.9	42.5	34	28.3	21.2	17	14	11.3
90.8	67.9	55.2	45.3	36.8	28.3	24.1	18.4	14.2
113.5	93.4	69.3	56.6	46.7	36.8	29.7	22.6	17
136.2	130.2	87.7	67.9	56.6	46.7	36.8	28.3	19.8

<b>Time (minutes)</b>								
<b>kg CO<sub>2</sub></b>	<b>5</b>	<b>10</b>	<b>15</b>	<b>20</b>	<b>30</b>	<b>40</b>	<b>50</b>	<b>60</b>
158.9	172.6	116	84.9	70.8	56.6	46.7	34	25.5
181.6	217.9	152.8	107.5	89.1	70.8	56.6	45.3	34
204.3	261.8	192.4	138.7	113.2	87.7	73.6	59.4	45.3
227	305.6	229.2	172.6	141.5	110.4	93.4	79.2	62.3
249.7	348.1	268.9	209.4	172.6	138.7	118.9	101.9	87.7
272.4	393.4	308.5	243.4	203.8	169.8	147.2	127.4	110.4
295.1	435.8	348.1	278.8	234.9	199.5	175.5	155.7	135.8
317.8	478.3	384.9	314.1	266	229.2	203.8	181.1	158.5
340.5	523.6	424.5	349.5	297.2	258.9	232.1	206.6	184
363.2	586	464.1	384.9	328.3	288.7	260.4	232.1	206.6
385.9	608.4	502.3	420.3	359.4	319.8	288.7	257.5	229.2
408.6	650.9	540.5	455.6	390.5	349.5	317	284.4	254.7
431.3	696.2	580.2	491	421.7	379.2	345.3	311.3	277.3
454	738.6	619.8	526.4	452.8	410.4	373.6	336.8	302.8
476.7	781.1	659.4	563.2	483.9	441.5	401.9	363.7	325.5
499.4	823.5	696.2	595.7	515.1	469.8	430.2	389.1	350.9
522.1	866	735.8	631.1	546.2	500.9	458.5	416	373.6
544.8	911.3	772.6	666.5	577.3	532	486.8	441.5	399
567.5	953.7	812.2	701.8	609.4	561.8	515.1	467	421.7
590.2	999	851.8	737.2	641	591.5	543.4	493.8	447.1
612.9	1041.4	888.6	772.6	672.1	622.6	571.7	520.7	471.2
635.6	1086.7	928.2	808	704.7	653.7	600	547.6	495.3
658.3	1129.2	967.9	843.3	735.8	684.9	628.3	574.5	519.3
681	1171.6	1007.5	878.7	766.9	713.2	656.6	600	543.4

## Additional Proposed Changes

<u>File Name</u>	<u>Description</u>	<u>Approved</u>
For_inclusion_extend_tables_5_5_3_3_1_a_and_b.pdf		
Supporting_Tech_backup_for_with_equations_for_Extended_Table_A.5.5.3.1_a_and_b_djh.pdf		

## Statement of Problem and Substantiation for Public Comment

The purpose for extending the data in the charts is that "rotating electrical equipment" hazards have increased significantly in size (volume) since the original charts were created.

### Related Item

- FR-21

## Submitter Information Verification

**Submitter Full Name:** Daniel Hubert  
**Organization:** Janus Fire Systems  
**Affiliation:** FSSA  
**Street Address:**  
**City:**  
**State:**

**Zip:**

**Submittal Date:** Thu Jan 04 13:22:47 EST 2024

**Committee:** GFE-AAA

**Table A.5.5.3(a) Extended Discharge Protection for Enclosed Recirculating Rotating Electrical Equipment (Cubic Feet Protected for Deceleration Time)**

lb CO <sub>2</sub>	Time (minutes)								
	5	10	15	20	30	40	50	60	
100	1200	1000	800	600	500	400	300	200	
150	1800	1500	1200	1000	750	600	500	400	
200	2400	1950	1600	1300	1000	850	650	500	
250	3300	2450	2000	1650	1300	1050	800	600	
300	4600	3100	2400	2000	1650	1300	1000	700	
350	6100	4100	3000	2500	2000	1650	1200	900	
400	7700	5400	3800	3150	2500	2000	1600	1200	
450	9250	6800	4900	4000	3100	2600	2100	1600	
500	10800	8100	6100	5000	3900	3300	2800	2200	
550	12300	9500	7400	6100	4900	4200	3600	3100	
600	13900	10900	8600	7200	6000	5200	4500	3900	
650	15400	12300	9850	8300	7050	6200	5500	4800	
700	16900	13600	11100	9400	8100	7200	6400	5600	
750	18500	15000	12350	10500	9150	8200	7300	6500	
800	20000	16400	13600	11600	10200	9200	8200	7300	
850	21500	17750	14850	12700	11300	10200	9100	8100	
900	23000	19100	16100	13800	12350	11200	10050	9000	
950	24600	20500	17350	14900	13400	12200	11000	9800	
1000	26100	21900	18600	16000	14500	13200	11900	10700	
1050	27600	23300	19900	17100	15600	14200	12850	11500	
1100	29100	24600	21050	18200	16600	15200	13750	12400	
1150	30600	26000	22300	19300	17700	16200	14700	13200	
1200	32200	27300	23550	20400	18800	17200	15600	14100	
1250	33700	28700	24800	21500	19850	18200	16500	14900	
1300	35300	30100	26050	22650	20900	19200	17450	15800	
1350	36800	31400	27300	23750	22000	20200	18400	16650	
1400	38400	32800	28550	24900	23100	21200	19350	17500	
1450	39900	34200	29800	26000	24200	22200	20300	18350	
1500	41400	35600	31050	27100	25250	23200	21200	19200	
1600	44500	38300	33500	29300	27400	25200	23050	20900	
1700	47550	41000	36000	31550	29550	27200	24900	22600	
1800	50650	43750	38500	33750	31700	29200	26800	24300	
1900	53700	46500	41000	36000	33850	31200	28650	26000	
2000	56800	49200	43500	38200	36000	33200	30500	27750	
2100	59850	51950	45950	40450	38150	35200	32350	29450	
2200	62950	54700	48450	42650	40300	37200	34200	31150	
2300	66000	57400	50950	44900	42450	39200	36100	32850	
2400	69100	60150	53450	47100	44600	41200	37950	34550	
2500	72150	62900	55900	49350	46750	43200	39800	36250	
2600	75250	65600	58400	51550	48900	45200	41650	37950	
2700	78300	68350	60900	53800	51050	47200	43550	39650	
2800	81400	71050	63400	56000	53200	49200	45400	41350	
2900	84450	73800	65850	58250	55350	51200	47250	43100	
3000	87550	76550	68350	60450	57500	53200	49100	44800	
3500	102900	90200	80800	71600	68300	63200	58400	53300	
4000	118300	103850	93250	82700	79050	73200	67700	61850	
4500	133650	117550	105700	93850	89800	83200	77000	70350	
5000	149050	131200	118100	104950	100550	93200	86350	78900	

**Table A.5.5.3(b) Extended Discharge Protection for Enclosed Recirculating Rotating Electrical Equipment (Cubic Meters Protected for Deceleration Time)**

kg CO <sub>2</sub>	Time (minutes)							
	5	10	15	20	30	40	50	60
45.4	34	28.3	22.6	17	14.2	11.3	8.5	5.7
68.1	50.9	42.5	34	28.3	21.2	17	14.2	11.3
90.8	67.9	55.2	45.3	36.8	28.3	24.1	18.4	14.2
113.5	93.4	69.3	56.6	46.7	36.8	29.7	22.6	17
136.2	130.2	87.7	67.9	56.6	46.7	36.8	28.3	19.8
158.9	172.6	116	84.9	70.8	56.6	46.7	34	25.5
181.6	217.9	152.8	107.5	89.1	70.8	56.6	45.3	34
204.3	261.8	192.4	138.7	113.2	87.7	73.6	59.4	45.3
227	305.6	229.2	172.6	141.5	110.4	93.4	79.2	62.3
249.7	348.1	268.9	209.4	172.6	138.7	118.9	101.9	87.7
272.4	393.4	308.5	243.4	203.8	169.8	147.2	127.4	110.4
295.1	435.8	348.1	278.8	234.9	199.5	175.5	155.7	135.8
317.8	478.3	384.9	314.1	266	229.2	203.8	181.1	158.5
340.5	523.6	424.5	349.5	297.2	258.9	232.1	206.6	184
363.2	586	464.1	384.9	328.3	288.7	260.4	232.1	206.6
385.9	608.4	502.3	420.3	359.4	319.8	288.7	257.5	229.2
408.6	650.9	540.5	455.6	390.5	349.5	317	284.4	254.7
431.3	696.2	580.2	491	421.7	379.2	345.3	311.3	277.3
454	738.6	619.8	526.4	452.8	410.4	373.6	336.8	302.8
476.7	781.1	659.4	563.2	483.9	441.5	401.9	363.7	325.5
499.4	823.5	696.2	595.7	515.1	469.8	430.2	389.1	350.9
522.1	866	735.8	631.1	546.2	500.9	458.5	416	373.6
544.8	911.3	772.6	666.5	577.3	532	486.8	441.5	399
567.5	953.7	812.2	701.8	609.4	561.8	515.1	467	421.7
590.2	999	851.8	737.2	641	591.5	543.4	493.8	447.1
612.9	1041.4	888.6	772.6	672.1	622.6	571.7	520.7	471.2
635.6	1086.7	928.2	808	704.7	653.7	600	547.6	495.3
658.3	1129.2	967.9	843.3	735.8	684.9	628.3	574.5	519.3
681	1171.6	1007.5	878.7	766.9	713.2	656.6	600	543.4
726.4	1259.3	1083.4	948.7	829.9	774.7	713.2	652.6	591.7
771.8	1346.3	1160.8	1019.1	892.8	835.5	769.8	705.3	639.9
817.2	1433.3	1238.1	1089.5	955.8	896.3	826.4	757.9	688.2
862.6	1520.3	1315.4	1159.9	1018.7	957	883	810.6	736.5
908	1607.3	1392.8	1230.3	1081.7	1017.8	939.6	863.3	784.8
953.4	1694.3	1470.1	1300.7	1144.6	1078.6	996.2	915.9	833
998.8	1781.3	1547.4	1371.1	1207.6	1139.3	1052.8	968.6	881.3
1044.2	1868.3	1624.8	1441.6	1270.5	1200.1	1109.4	1021.2	929.6
1089.6	1955.3	1702.1	1512	1333.5	1260.9	1166	1073.9	977.8
1135	2042.3	1779.4	1582.4	1396.4	1321.6	1222.6	1126.6	1026.1
1180.4	2129.4	1856.8	1652.8	1459.4	1382.4	1279.2	1179.2	1074.4
1225.8	2216.4	1934.1	1723.2	1522.3	1443.2	1335.8	1231.9	1122.6
1271.2	2303.4	2011.4	1793.6	1585.3	1503.9	1392.4	1284.6	1170.9
1316.6	2390.4	2088.8	1864	1648.2	1564.7	1449	1337.2	1219.2
1362	2477.4	2166.1	1934.4	1711.2	1625.5	1505.6	1389.9	1267.4
1589	2912.4	2552.8	2286.5	2026	1929.3	1788.6	1653.2	1508.8
1816	3347.5	2939.4	2638.5	2340.7	2233.2	2071.6	1916.5	1750.1
2043	3782.5	3326.1	2990.6	2655.5	2537	2354.6	2179.9	1991.5
2270	4217.6	3712.8	3342.7	2970.2	2840.8	2637.6	2443.2	2232.8

**Table A.5.5.3(a) Extended Discharge Protection for Enclosed Recirculating Rotating Electrical Equipment (Cubic Feet Protected for Deceleration Time)**

lb CO <sub>2</sub>	Time (minutes)							
	5	10	15	20	30	40	50	60
100	1200	1000	800	600	500	400	300	200
150	1800	1500	1200	1000	750	600	500	400
200	2400	1950	1600	1300	1000	850	650	500
250	3300	2450	2000	1650	1300	1050	800	600
300	4600	3100	2400	2000	1650	1300	1000	700
350	6100	4100	3000	2500	2000	1650	1200	900
400	7700	5400	3800	3150	2500	2000	1600	1200
450	9250	6800	4900	4000	3100	2600	2100	1600
500	10800	8100	6100	5000	3900	3300	2800	2200
550	12300	9500	7400	6100	4900	4200	3600	3100
600	13900	10900	8600	7200	6000	5200	4500	3900
650	15400	12300	9850	8300	7050	6200	5500	4800
700	16900	13600	11100	9400	8100	7200	6400	5600
750	18500	15000	12350	10500	9150	8200	7300	6500
800	20000	16400	13600	11600	10200	9200	8200	7300
850	21500	17750	14850	12700	11300	10200	9100	8100
900	23000	19100	16100	13800	12350	11200	10050	9000
950	24600	20500	17350	14900	13400	12200	11000	9800
1000	26100	21900	18600	16000	14500	13200	11900	10700
1050	27600	23300	19900	17100	15600	14200	12850	11500
1100	29100	24600	21050	18200	16600	15200	13750	12400
1150	30600	26000	22300	19300	17700	16200	14700	13200
1200	32200	27300	23550	20400	18800	17200	15600	14100
1250	33700	28700	24800	21500	19850	18200	16500	14900
1300	35300	30100	26050	22650	20900	19200	17450	15800
1350	36800	31400	27300	23750	22000	20200	18400	16650
1400	38400	32800	28550	24900	23100	21200	19350	17500
1450	39900	34200	29800	26000	24200	22200	20300	18350
1500	41400	35600	31050	27100	25250	23200	21200	19200
1600	44500	38300	33500	29300	27400	25200	23050	20900
1700	47550	41000	36000	31550	29550	27200	24900	22600
1800	50650	43750	38500	33750	31700	29200	26800	24300
1900	53700	46500	41000	36000	33850	31200	28650	26000
2000	56800	49200	43500	38200	36000	33200	30500	27750
2100	59850	51950	45950	40450	38150	35200	32350	29450
2200	62950	54700	48450	42650	40300	37200	34200	31150
2300	66000	57400	50950	44900	42450	39200	36100	32850
2400	69100	60150	53450	47100	44600	41200	37950	34550
2500	72150	62900	55900	49350	46750	43200	39800	36250
2600	75250	65600	58400	51550	48900	45200	41650	37950
2700	78300	68350	60900	53800	51050	47200	43550	39650
2800	81400	71050	63400	56000	53200	49200	45400	41350
2900	84450	73800	65850	58250	55350	51200	47250	43100
3000	87550	76550	68350	60450	57500	53200	49100	44800
3500	102900	90200	80800	71600	68300	63200	58400	53300
4000	118300	103850	93250	82700	79050	73200	67700	61850
4500	133650	117550	105700	93850	89800	83200	77000	70350
5000	149050	131200	118100	104950	100550	93200	86350	78900

Equations for lb CO <sub>2</sub> Greater Than 1500 lb		
Time (minutes)	Equation: Volume = a*(lb CO <sub>2</sub> ) - b	
	a	b
5	30.745	4695.5
10	27.327	5440.9
15	24.882	6288.6
20	22.245	6270.5
30	21.518	7034.1
40	20	6800
50	18.609	6715.9
60	17.055	6381.8

Equations for lb CO <sub>2</sub> Greater Than 1500 lb		
Time (minutes)	Equation: lb CO <sub>2</sub> = c*Volume + d	
	c	d
5	0.03253	152.72
10	0.03659	199.10
15	0.04019	252.74
20	0.04495	281.88
30	0.04647	326.89
40	0.05000	340.00
50	0.05374	360.90
60	0.05863	374.19

\*Added using extrapolated equations shown in sheets for each column. Values are rounded to the nearest 50 to follow in line with current table values.

**Table A.5.5.3(b) Extended Discharge Protection for Enclosed Recirculating Rotating Electrical Equipment (Cubic Meters Protected for Deceleration Time)**

kg CO <sub>2</sub>	Time (minutes)							
	5	10	15	20	30	40	50	60
45.4	34	28.3	22.6	17	14.2	11.3	8.5	5.7
68.1	50.9	42.5	34	28.3	21.2	17	14.2	11.3
90.8	67.9	55.2	45.3	36.8	28.3	24.1	18.4	14.2
113.5	93.4	69.3	56.6	46.7	36.8	29.7	22.6	17
136.2	130.2	87.7	67.9	56.6	46.7	36.8	28.3	19.8
158.9	172.6	116	84.9	70.8	56.6	46.7	34	25.5
181.6	217.9	152.8	107.5	89.1	70.8	56.6	45.3	34
204.3	261.8	192.4	138.7	113.2	87.7	73.6	59.4	45.3
227	305.6	229.2	172.6	141.5	110.4	93.4	79.2	62.3
249.7	348.1	268.9	209.4	172.6	138.7	118.9	101.9	87.7
272.4	393.4	308.5	243.4	203.8	169.8	147.2	127.4	110.4
295.1	435.8	348.1	278.8	234.9	199.5	175.5	155.7	135.8
317.8	478.3	384.9	314.1	266	229.2	203.8	181.1	158.5
340.5	523.6	424.5	349.5	297.2	258.9	232.1	206.6	184
363.2	586	464.1	384.9	328.3	288.7	260.4	232.1	206.6
385.9	608.4	502.3	420.3	359.4	319.8	288.7	257.5	229.2
408.6	650.9	540.5	455.6	390.5	349.5	317	284.4	254.7
431.3	696.2	580.2	491	421.7	379.2	345.3	311.3	277.3
454	738.6	619.8	526.4	452.8	410.4	373.6	336.8	302.8
476.7	781.1	659.4	563.2	483.9	441.5	401.9	363.7	325.5
499.4	823.5	696.2	595.7	515.1	469.8	430.2	389.1	350.9
522.1	866	735.8	631.1	546.2	500.9	458.5	416	373.6
544.8	911.3	772.6	666.5	577.3	532	486.8	441.5	399
567.5	953.7	812.2	701.8	609.4	561.8	515.1	467	421.7
590.2	999	851.8	737.2	641	591.5	543.4	493.8	447.1
612.9	1041.4	888.6	772.6	672.1	622.6	571.7	520.7	471.2
635.6	1086.7	928.2	808	704.7	653.7	600	547.6	495.3
658.3	1129.2	967.9	843.3	735.8	684.9	628.3	574.5	519.3
681	1171.6	1007.5	878.7	766.9	713.2	656.6	600	543.4
726.4	1259.3	1083.4	948.7	829.9	774.7	713.2	652.6	591.7
771.8	1346.3	1160.8	1019.1	892.8	835.5	769.8	705.3	639.9
817.2	1433.3	1238.1	1089.5	955.8	896.3	826.4	757.9	688.2
862.6	1520.3	1315.4	1159.9	1018.7	957	883	810.6	736.5
908	1607.3	1392.8	1230.3	1081.7	1017.8	939.6	863.3	784.8
953.4	1694.3	1470.1	1300.7	1144.6	1078.6	996.2	915.9	833
998.8	1781.3	1547.4	1371.1	1207.6	1139.3	1052.8	968.6	881.3
1044.2	1868.3	1624.8	1441.6	1270.5	1200.1	1109.4	1021.2	929.6
1089.6	1955.3	1702.1	1512	1333.5	1260.9	1166	1073.9	977.8
1135	2042.3	1779.4	1582.4	1396.4	1321.6	1222.6	1126.6	1026.1
1180.4	2129.4	1856.8	1652.8	1459.4	1382.4	1279.2	1179.2	1074.4
1225.8	2216.4	1934.1	1723.2	1522.3	1443.2	1335.8	1231.9	1122.6
1271.2	2303.4	2011.4	1793.6	1585.3	1503.9	1392.4	1284.6	1170.9
1316.6	2390.4	2088.8	1864	1648.2	1564.7	1449	1337.2	1219.2
1362	2477.4	2166.1	1934.4	1711.2	1625.5	1505.6	1389.9	1267.4
1589	2912.4	2552.8	2286.5	2026	1929.3	1788.6	1653.2	1508.8
1816	3347.5	2939.4	2638.5	2340.7	2233.2	2071.6	1916.5	1750.1
2043	3782.5	3326.1	2990.6	2655.5	2537	2354.6	2179.9	1991.5
2270	4217.6	3712.8	3342.7	2970.2	2840.8	2637.6	2443.2	2232.8

Equations for lb CO<sub>2</sub> Greater Than 681 kg

Time (minutes)	Equation: Volume = a*(kg CO <sub>2</sub> ) - b	
	a	b
5	1.9165	132.88
10	1.7034	153.93
15	1.5509	177.89
20	1.3866	177.35
30	1.3385	197.56
40	1.2467	192.4
50	1.16	190.03
60	1.0632	180.63

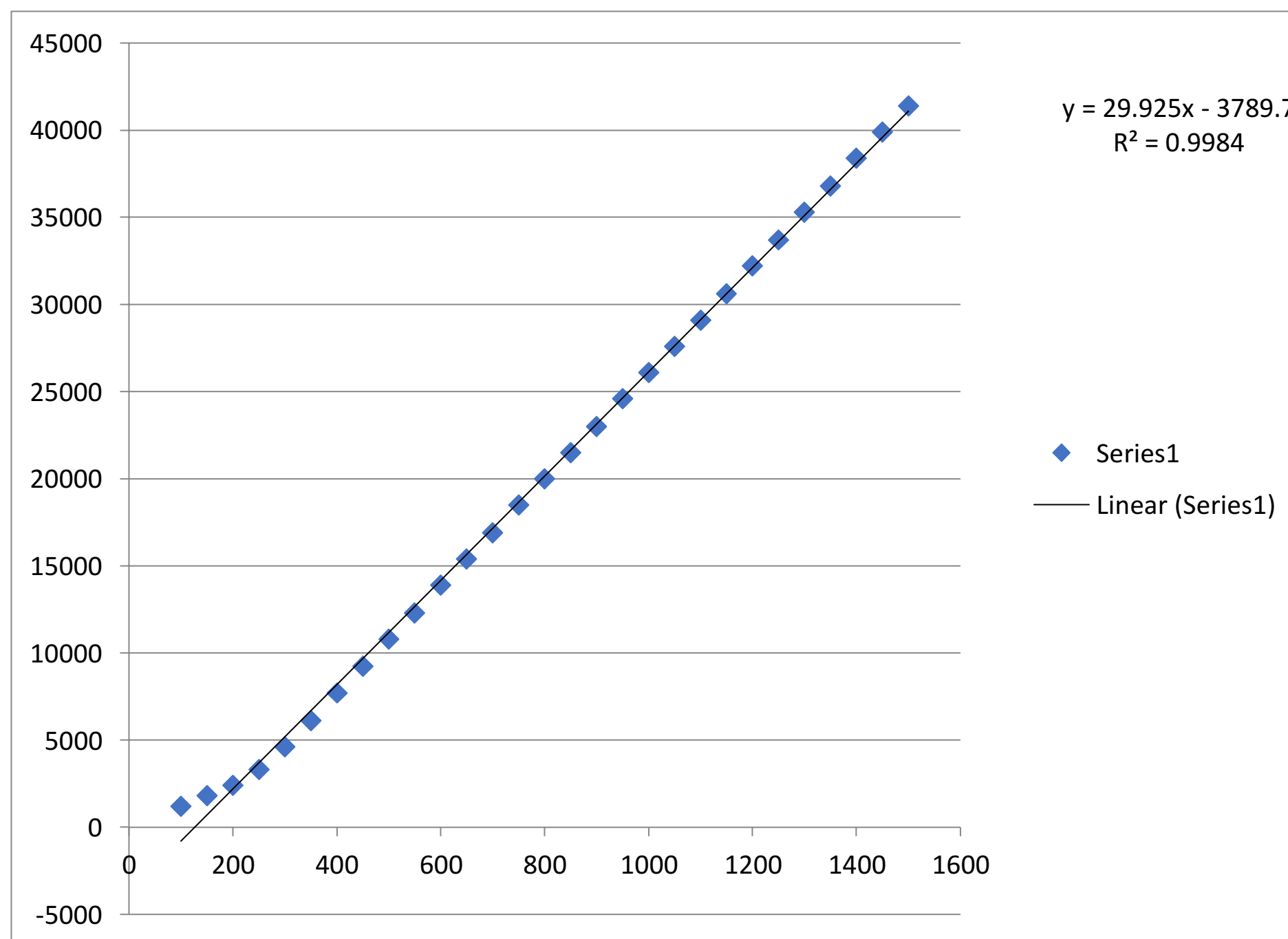
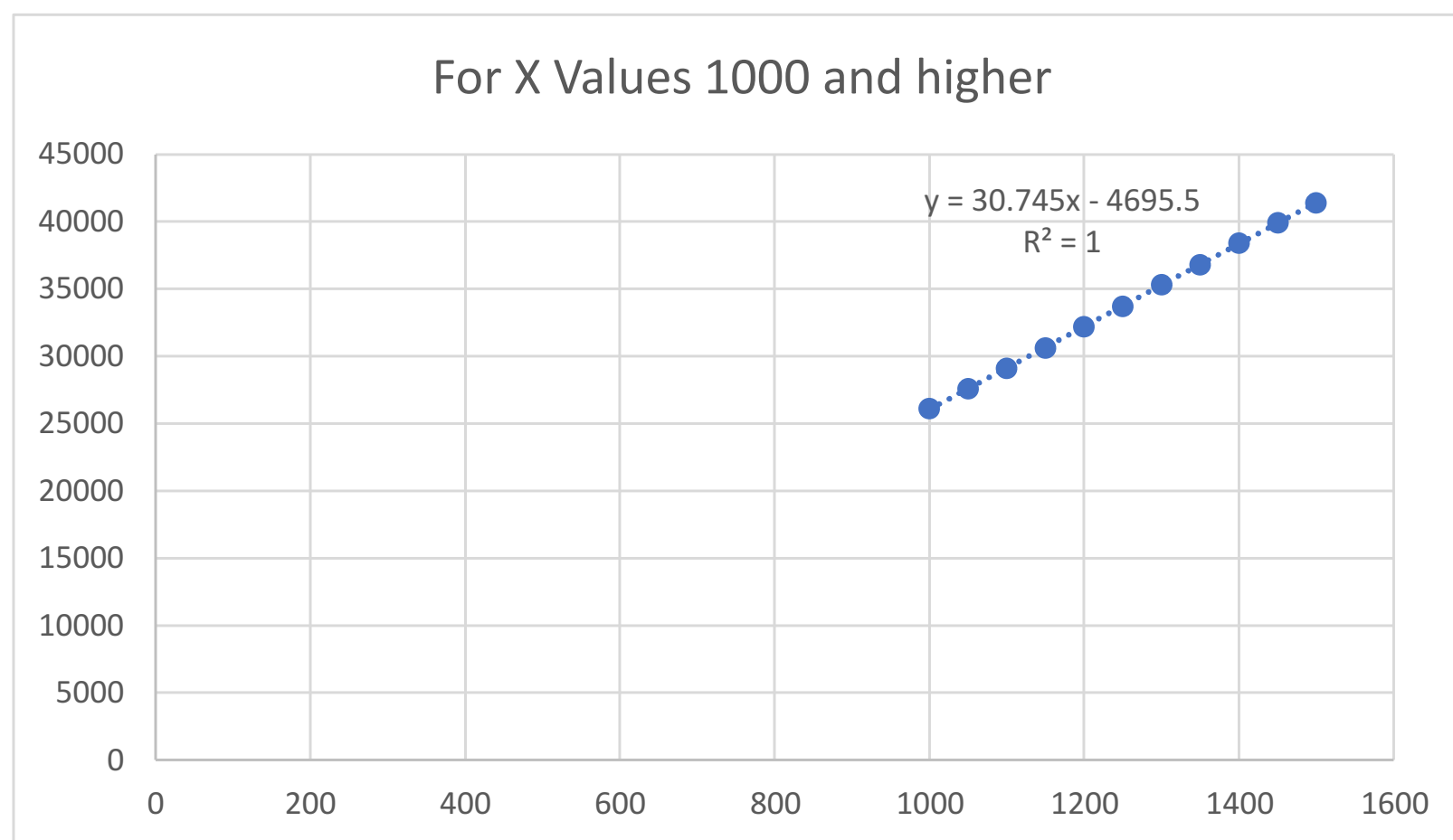
Equations for lb CO<sub>2</sub> Greater Than 681 kg

Time (minutes)	Equation: kg CO <sub>2</sub> = c*(Volume) + d	
	c	d
5	0.52178	69.33
10	0.58706	90.37
15	0.64479	114.70
20	0.72119	127.90
30	0.74710	147.60
40	0.80212	154.33
50	0.86207	163.82
60	0.94056	169.89

\*Added using extrapolated equations shown in sheets for each column. Values are rounded to the nearest 0.1 to follow in line with current table values.

Linear Regression for Volumes greater than 41,400 cu.ft. - Table  
A.5.5.3(a)

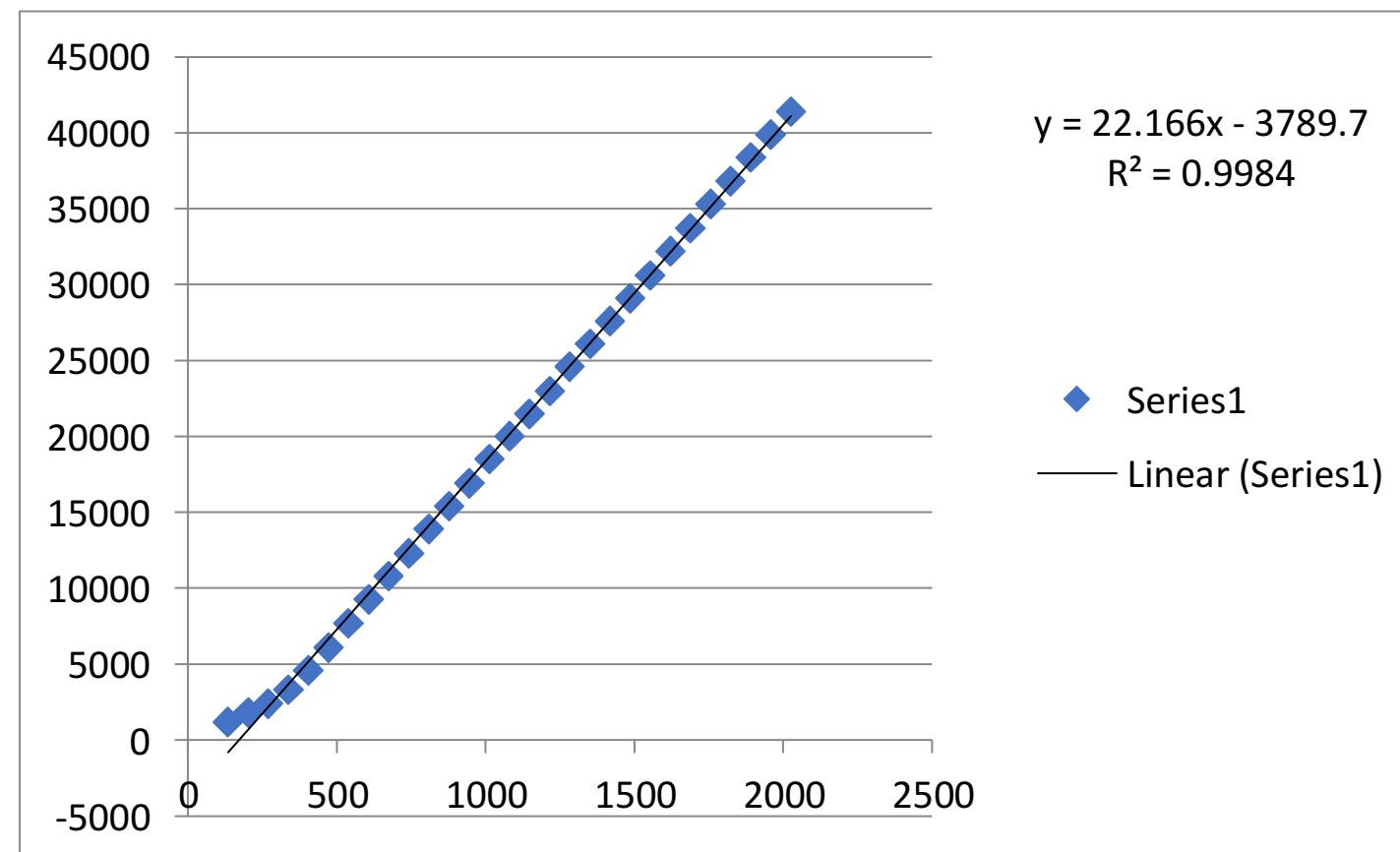
X	Y	
100	1200	X = lbs CO2
150	1800	Y = Volume covered by X
200	2400	
250	3300	
300	4600	
350	6100	
400	7700	
450	9250	
500	10800	
550	12300	
600	13900	For Recirculating Equipment
650	15400	
700	16900	
750	18500	
800	20000	
850	21500	
900	23000	
950	24600	
1000	26100	26000
1050	27600	27600
1100	29100	29100
1150	30600	30700
1200	32200	32200
1250	33700	33700
1300	35300	35300
1350	36800	36800
1400	38400	38300
1450	39900	39900
1500	41400	41400



Linear Regression for Volumes greater than 41,400 cu.ft. - Table  
A.5.5.3(a)

X	Y
135	1200
202.5	1800
270	2400
337.5	3300
405	4600
472.5	6100
540	7700
607.5	9250
675	10800
742.5	12300
810	13900
877.5	15400
945	16900
1012.5	18500
1080	20000
1147.5	21500
1215	23000
1282.5	24600
1350	26100
1417.5	27600
1485	29100
1552.5	30600
1620	32200
1687.5	33700
1755	35300
1822.5	36800
1890	38400
1957.5	39900
2025	41400

35% added for Non-Recirculating Equipment

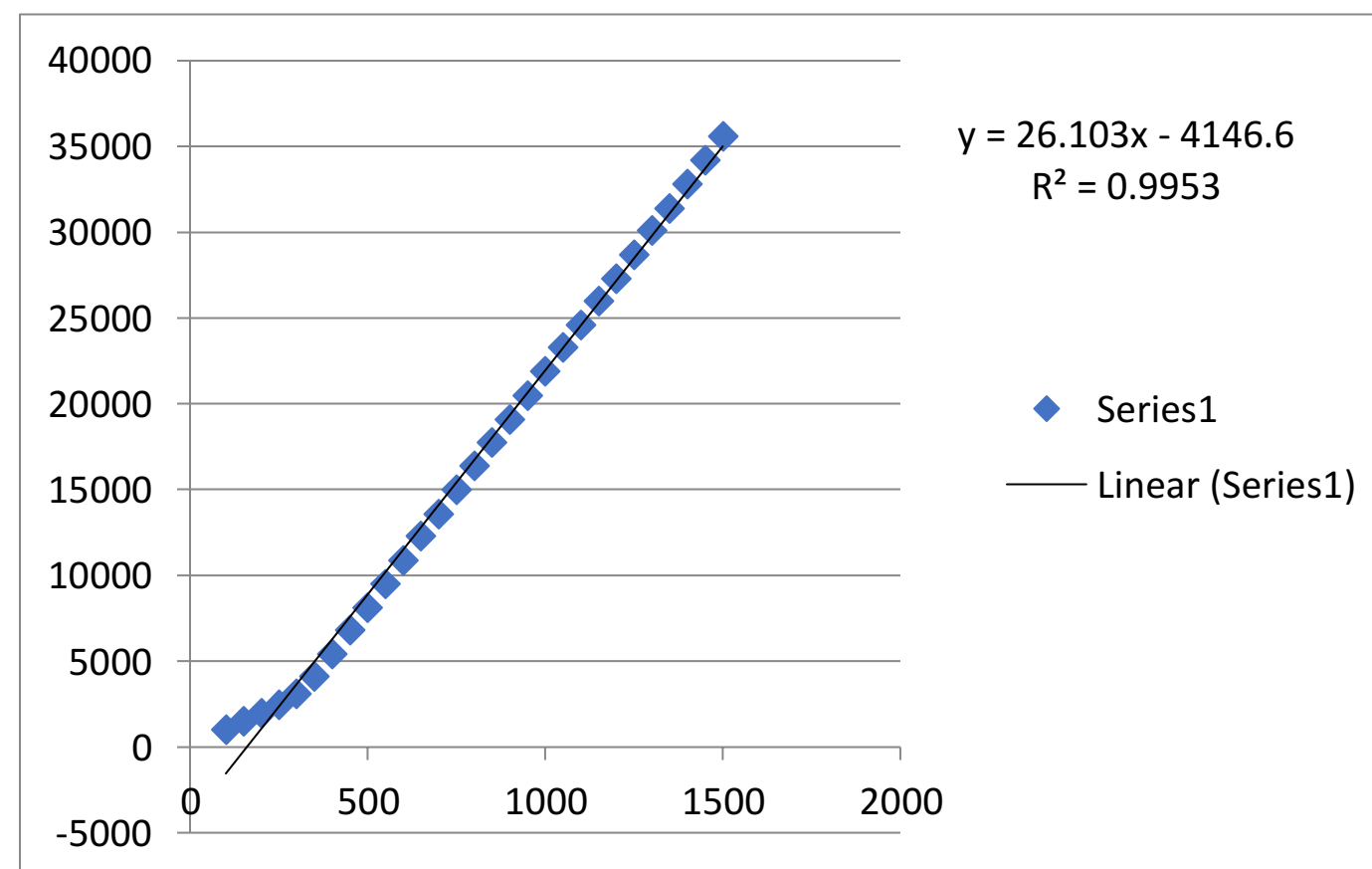


Linear Regression for Volumes greater than 35,600 cu.ft. - Table  
A.5.5.3(a)

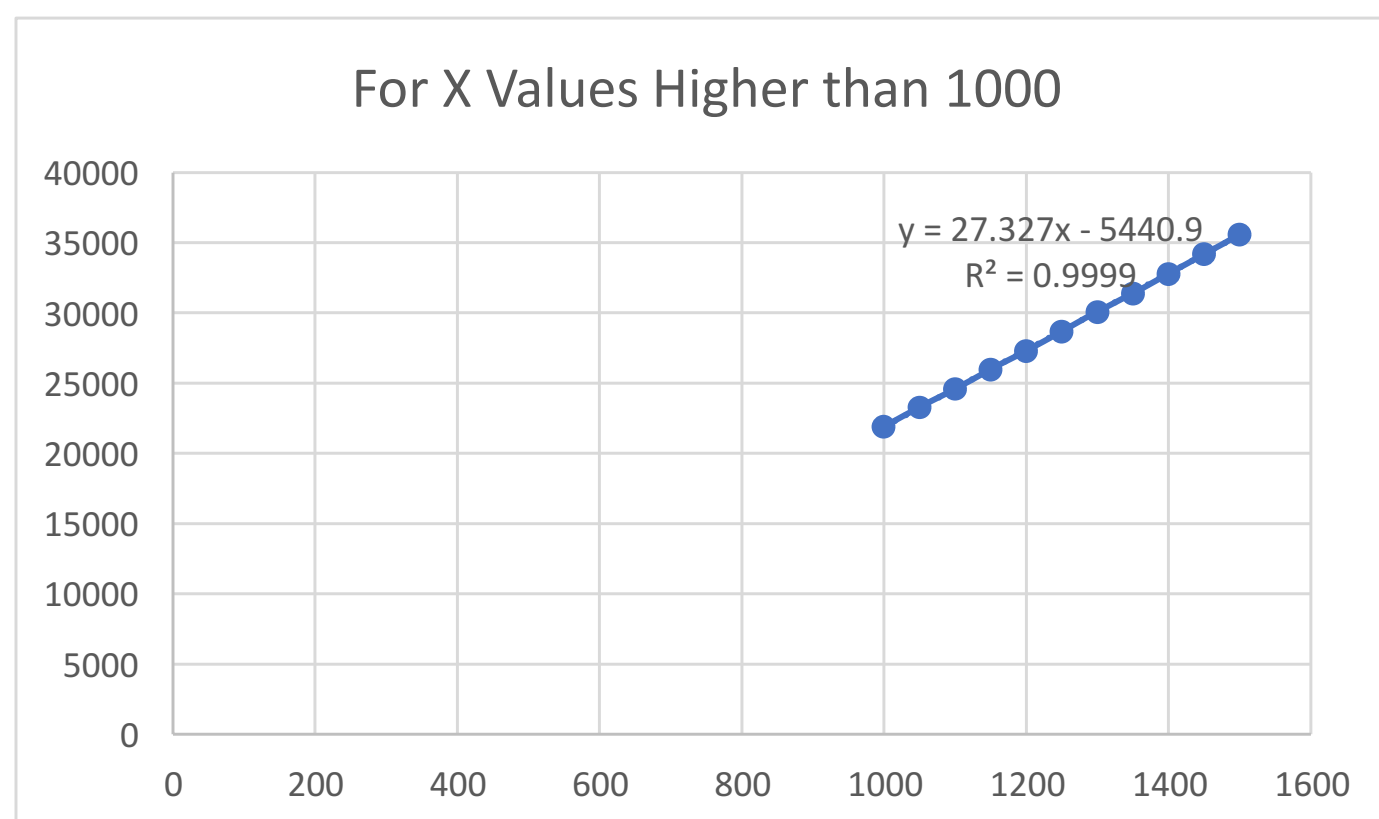
X	Y
100	1000
150	1500
200	1950
250	2450
300	3100
350	4100
400	5400
450	6800
500	8100
550	9500
600	10900
650	12300
700	13600
750	15000
800	16400
850	17750
900	19100
950	20500
1000	21900
1050	23300
1100	24600
1150	26000
1200	27300
1250	28700
1300	30100
1350	31400
1400	32800
1450	34200
1500	35600

X = lbs CO2  
Y = Volume covered by X

For Recirculating Equipment



For X Values Higher than 1000

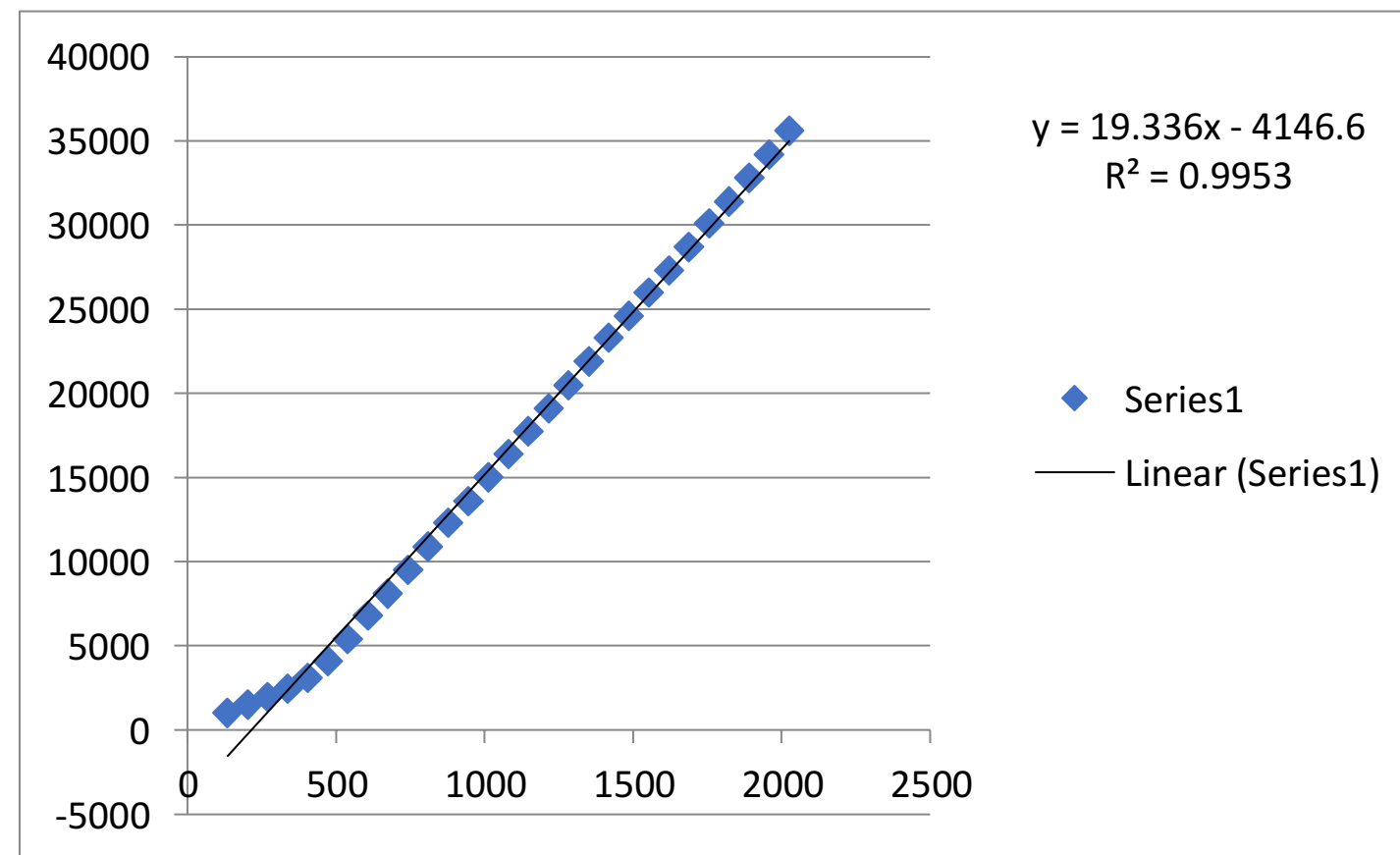


Linear Regression for Volumes greater than 35,600 cu.ft. - Table  
A.5.5.3(a)

X	Y
135	1000
202.5	1500
270	1950
337.5	2450
405	3100
472.5	4100
540	5400
607.5	6800
675	8100
742.5	9500
810	10900
877.5	12300
945	13600
1012.5	15000
1080	16400
1147.5	17750
1215	19100
1282.5	20500
1350	21900
1417.5	23300
1485	24600
1552.5	26000
1620	27300
1687.5	28700
1755	30100
1822.5	31400
1890	32800
1957.5	34200
2025	35600

X = lbs CO2  
Y = Volume covered by X

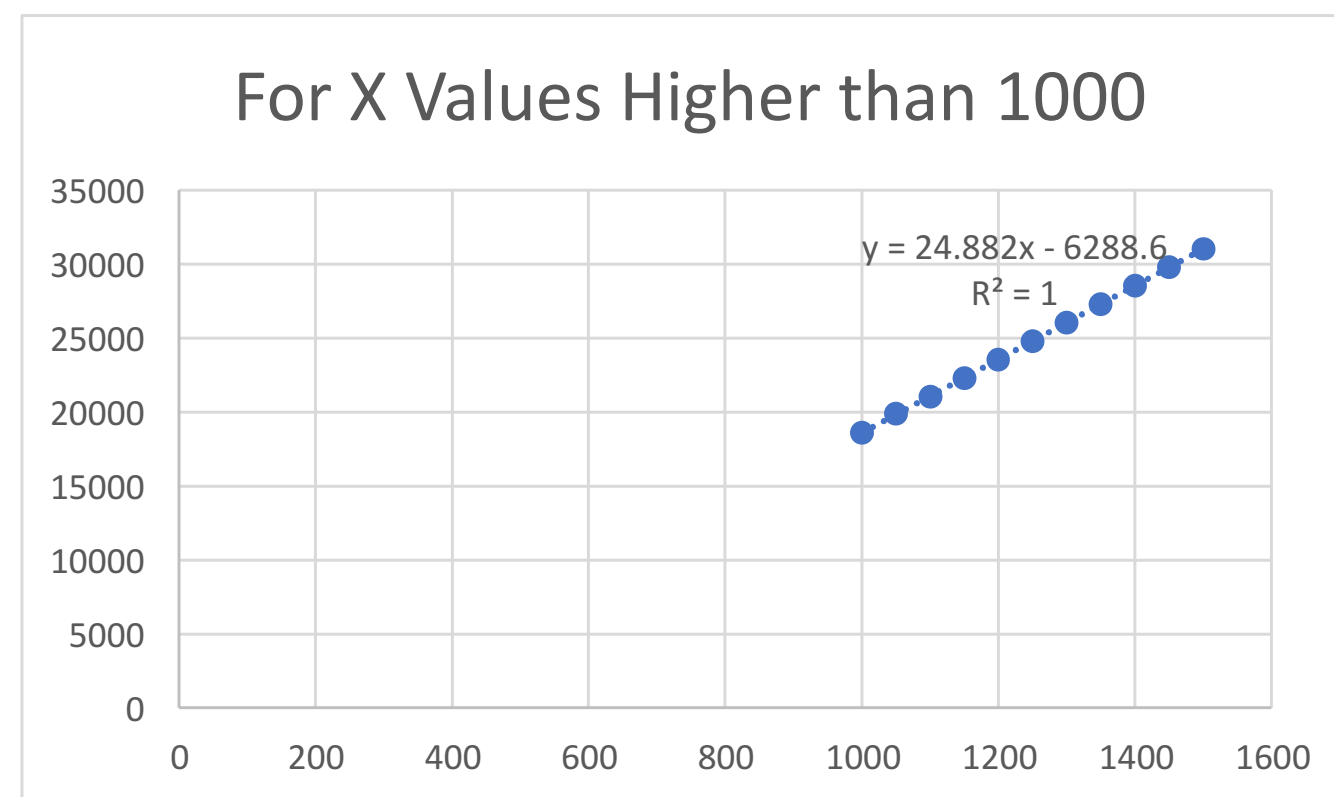
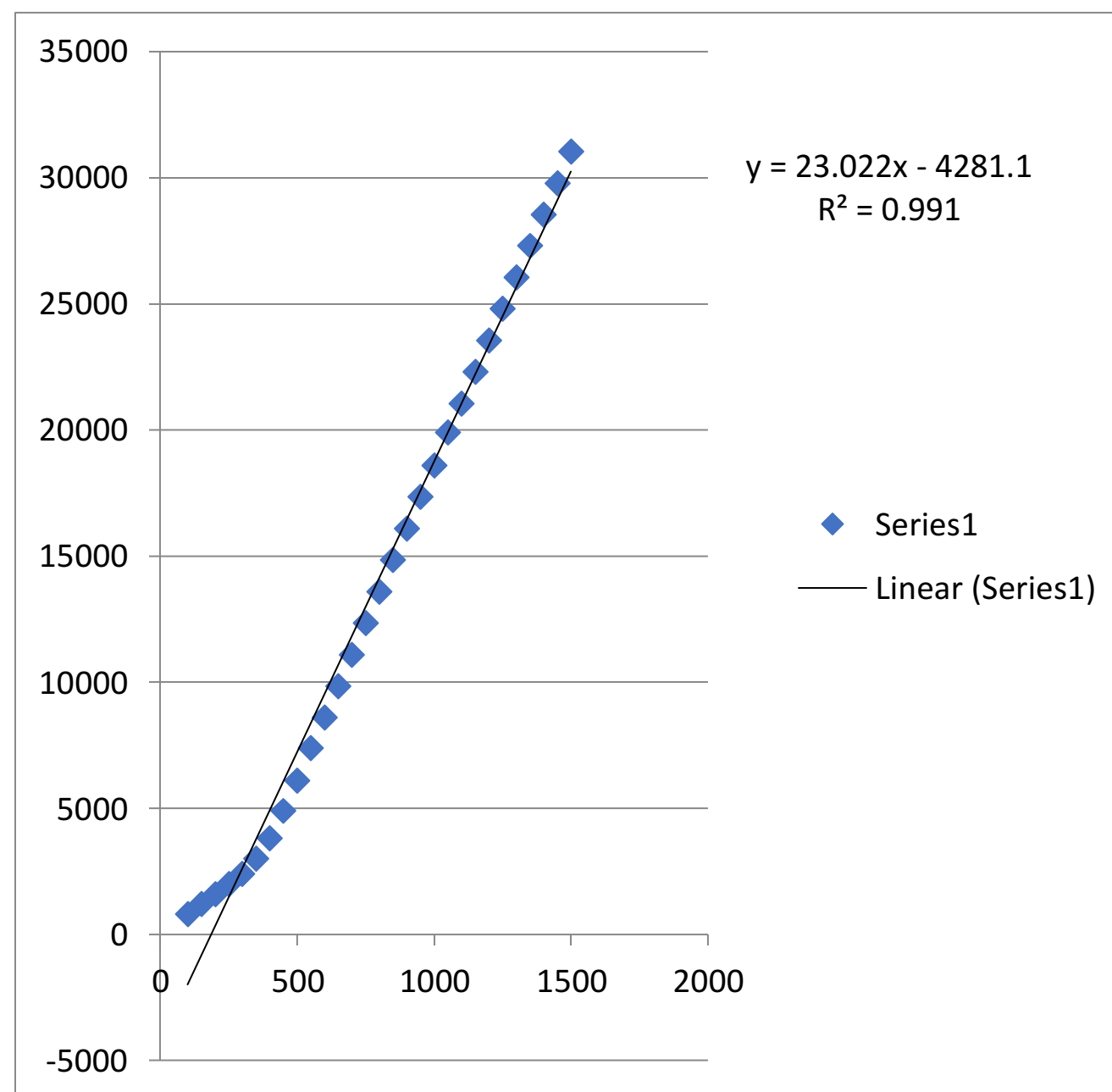
35% added for Non-Recirculating Equipment



Linear Regression for Volumes greater than 31,050 cu.ft. - Table  
A.5.5.3(a)

X	Y
100	800
150	1200
200	1600
250	2000
300	2400
350	3000
400	3800
450	4900
500	6100
550	7400
600	8600
650	9850
700	11100
750	12350
800	13600
850	14850
900	16100
950	17350
1000	18600
1050	19900
1100	21050
1150	22300
1200	23550
1250	24800
1300	26050
1350	27300
1400	28550
1450	29800
1500	31050

X = lbs CO2  
Y = Volume covered by X

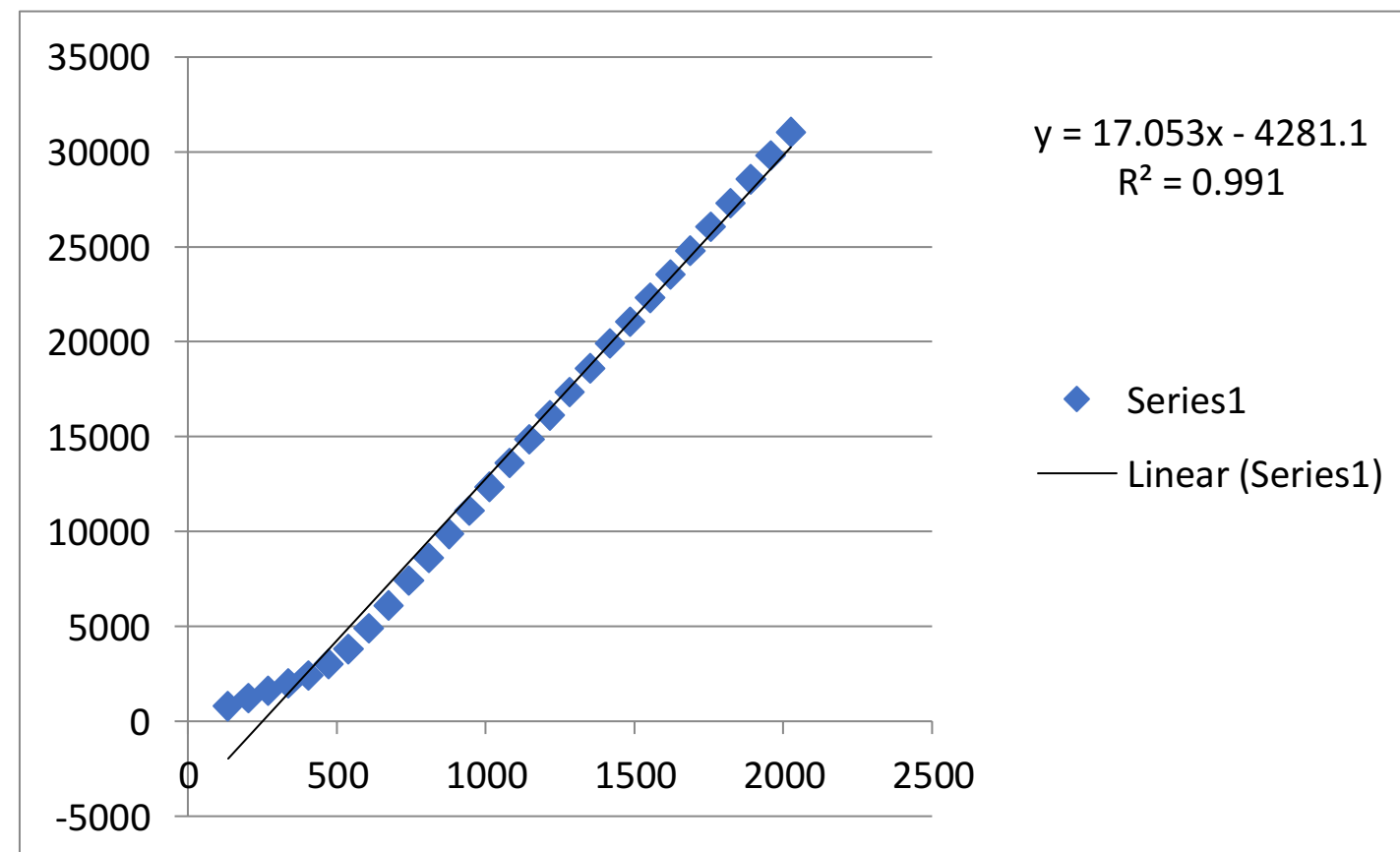


Linear Regression for Volumes greater than 31,050 cu.ft. - Table  
A.5.5.3(a)

X	Y
135	800
202.5	1200
270	1600
337.5	2000
405	2400
472.5	3000
540	3800
607.5	4900
675	6100
742.5	7400
810	8600
877.5	9850
945	11100
1012.5	12350
1080	13600
1147.5	14850
1215	16100
1282.5	17350
1350	18600
1417.5	19900
1485	21050
1552.5	22300
1620	23550
1687.5	24800
1755	26050
1822.5	27300
1890	28550
1957.5	29800
2025	31050

X = lbs CO2  
Y = Volume covered by X

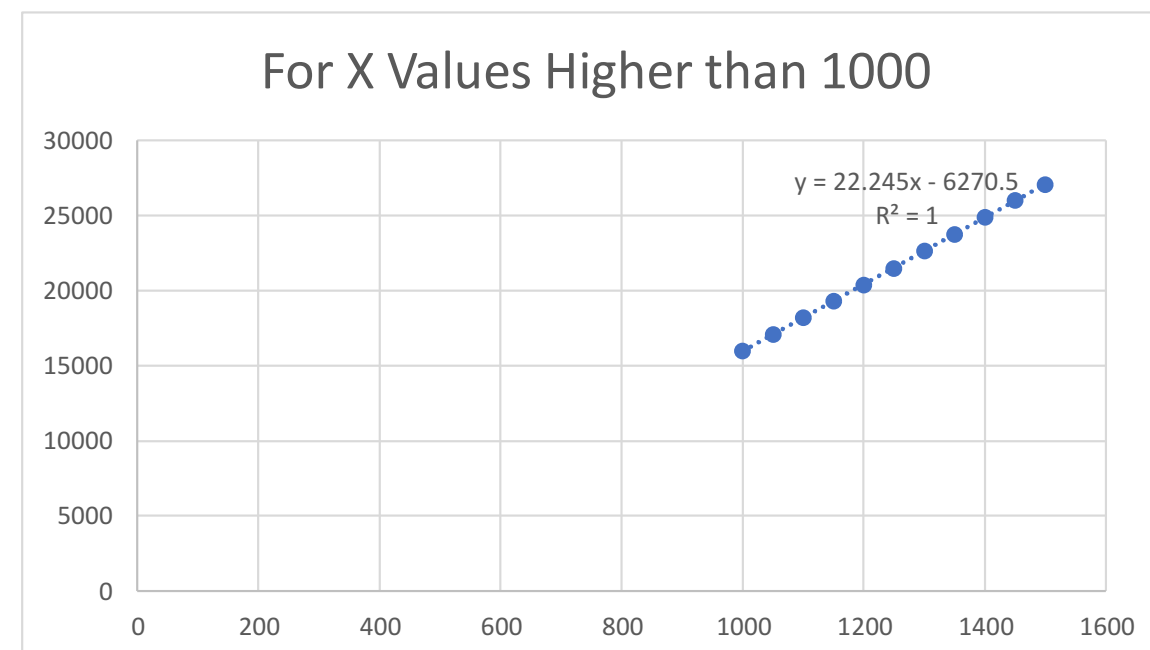
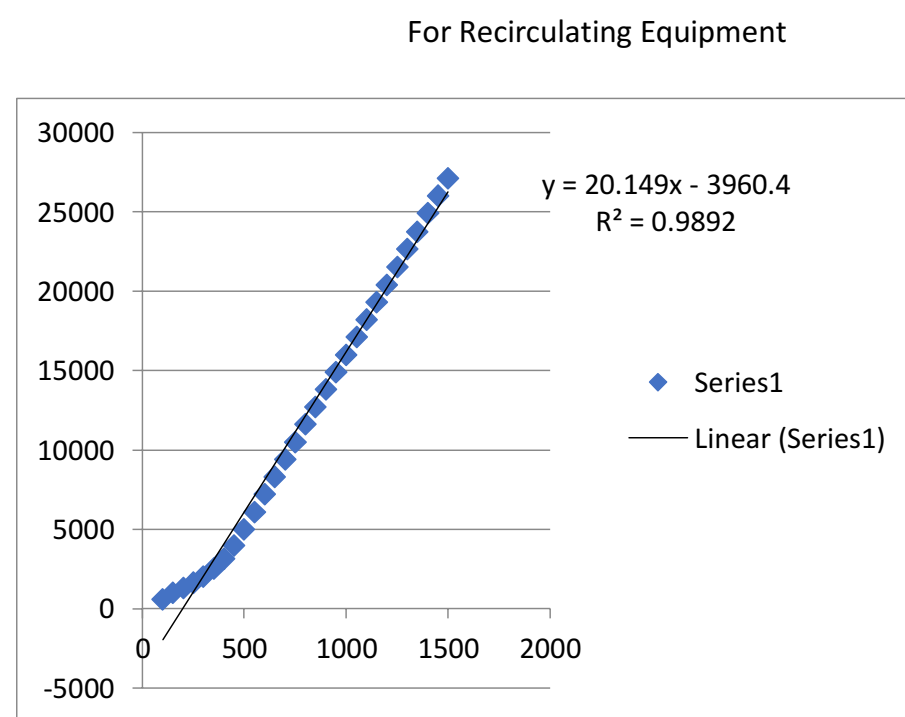
35% added for Non-Recirculating Equipment



Linear Regression for Volumes greater than 27,100 cu.ft. - Table A.5.5.3(a)

X	Y
100	600
150	1000
200	1300
250	1650
300	2000
350	2500
400	3150
450	4000
500	5000
550	6100
600	7200
650	8300
700	9400
750	10500
800	11600
850	12700
900	13800
950	14900
1000	16000
1050	17100
1100	18200
1150	19300
1200	20400
1250	21500
1300	22650
1350	23750
1400	24900
1450	26000
1500	27100

X = lbs CO2  
Y = Volume covered by X

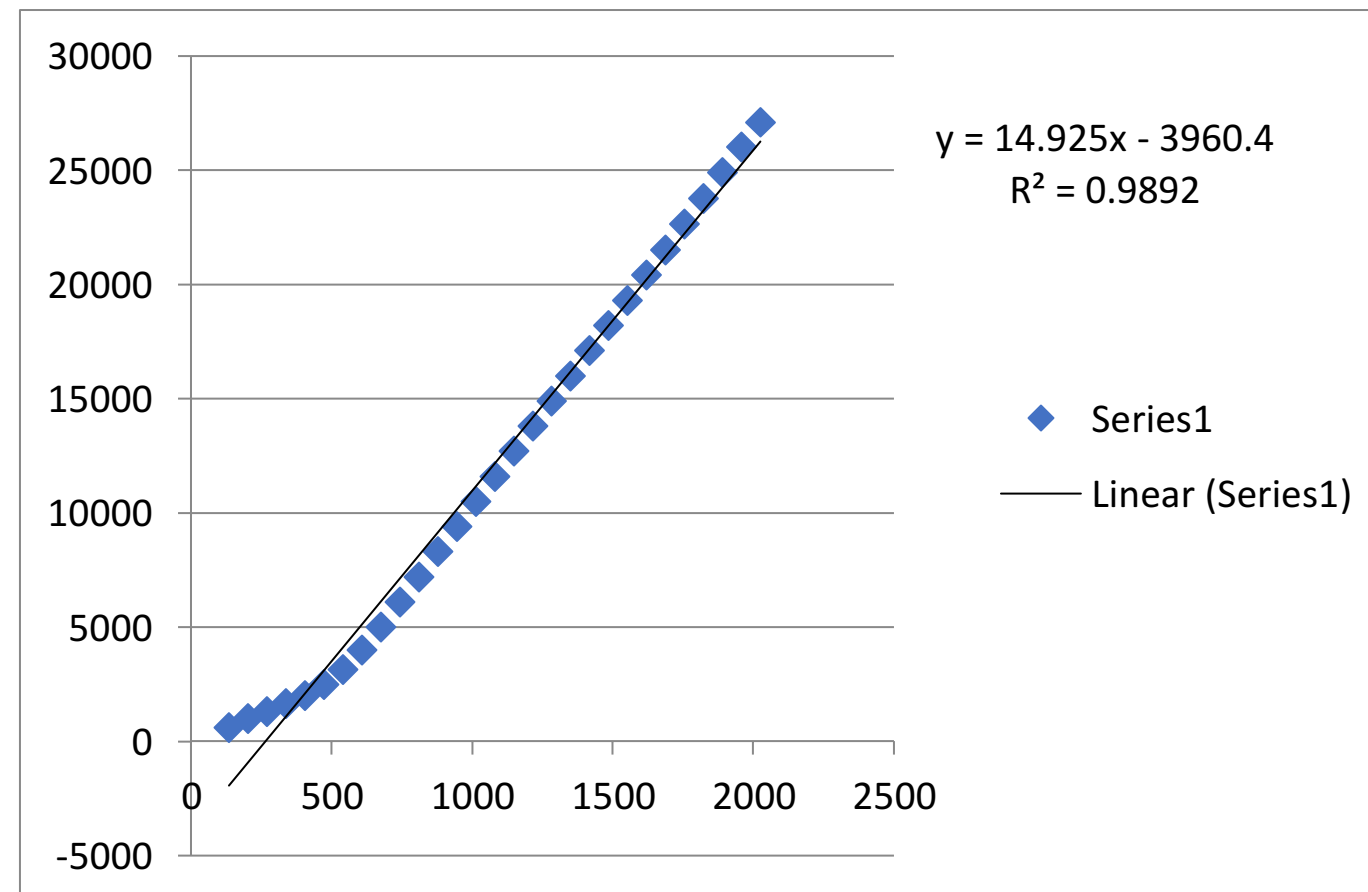


Linear Regression for Volumes greater than 27,100 cu.ft. - Table  
A.5.5.3(a)

X	Y
135	600
202.5	1000
270	1300
337.5	1650
405	2000
472.5	2500
540	3150
607.5	4000
675	5000
742.5	6100
810	7200
877.5	8300
945	9400
1012.5	10500
1080	11600
1147.5	12700
1215	13800
1282.5	14900
1350	16000
1417.5	17100
1485	18200
1552.5	19300
1620	20400
1687.5	21500
1755	22650
1822.5	23750
1890	24900
1957.5	26000
2025	27100

X = lbs CO2  
Y = Volume covered by X

35% added for Non-Recirculating Equipment

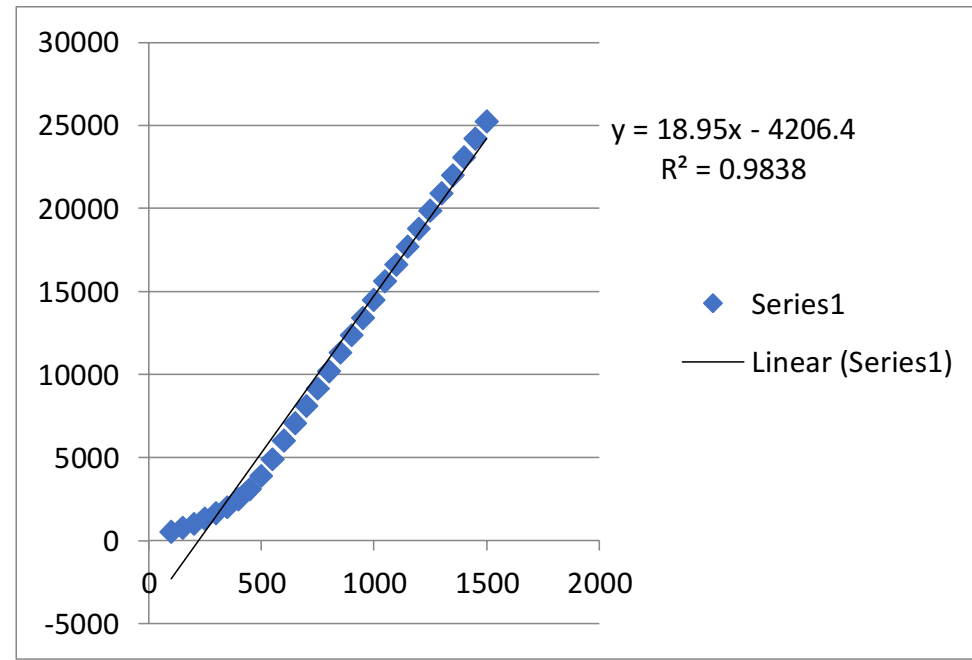


Linear Regression for Volumes greater than 25,250 cu.ft. - Table A.5.5.3(a)

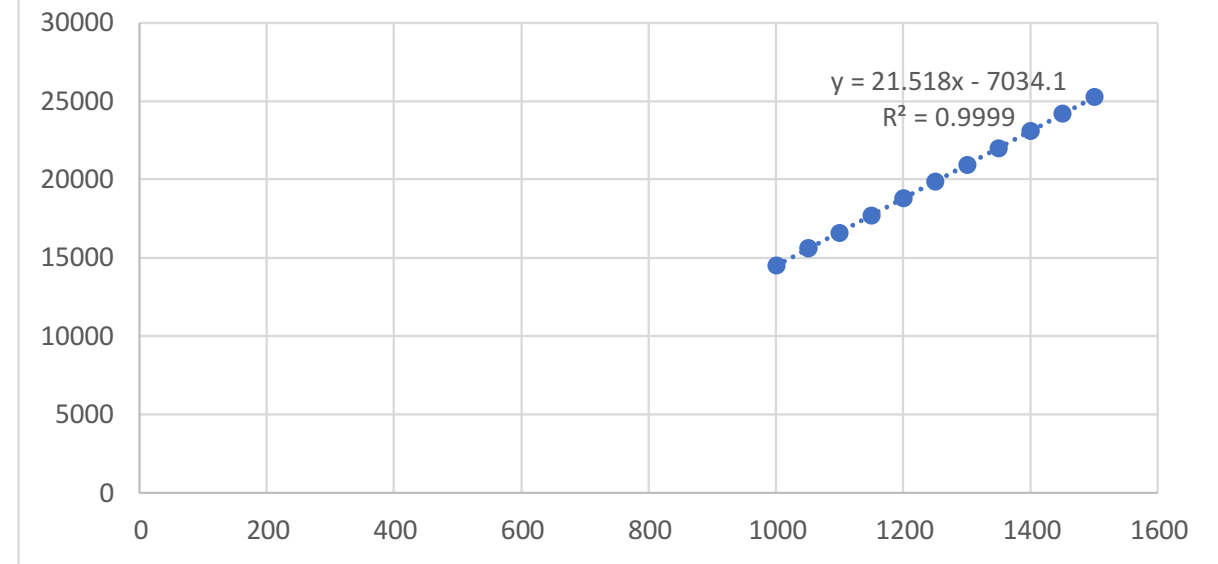
X	Y
100	500
150	750
200	1000
250	1300
300	1650
350	2000
400	2500
450	3100
500	3900
550	4900
600	6000
650	7050
700	8100
750	9150
800	10200
850	11300
900	12350
950	13400
1000	14500
1050	15600
1100	16600
1150	17700
1200	18800
1250	19850
1300	20900
1350	22000
1400	23100
1450	24200
1500	25250

X = lbs CO2  
Y = Volume covered by X

For Recirculating Equipment



For X Values Higher than 1000

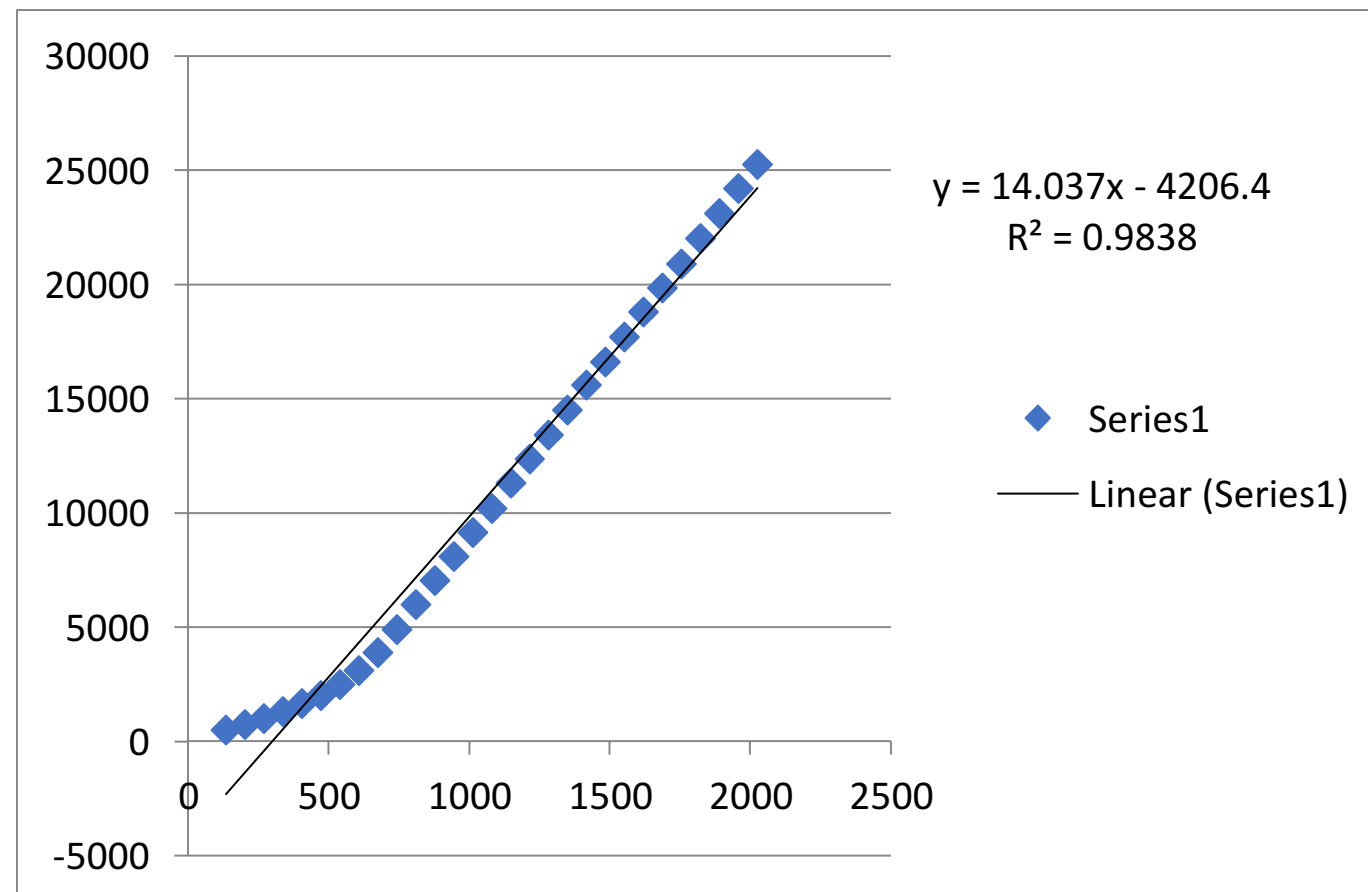


Linear Regression for Volumes greater than 25,250 cu.ft. - Table  
A.5.5.3(a)

X	Y
135	500
202.5	750
270	1000
337.5	1300
405	1650
472.5	2000
540	2500
607.5	3100
675	3900
742.5	4900
810	6000
877.5	7050
945	8100
1012.5	9150
1080	10200
1147.5	11300
1215	12350
1282.5	13400
1350	14500
1417.5	15600
1485	16600
1552.5	17700
1620	18800
1687.5	19850
1755	20900
1822.5	22000
1890	23100
1957.5	24200
2025	25250

X = lbs CO2  
Y = Volume covered by X

35% added for Non-Recirculating Equipment

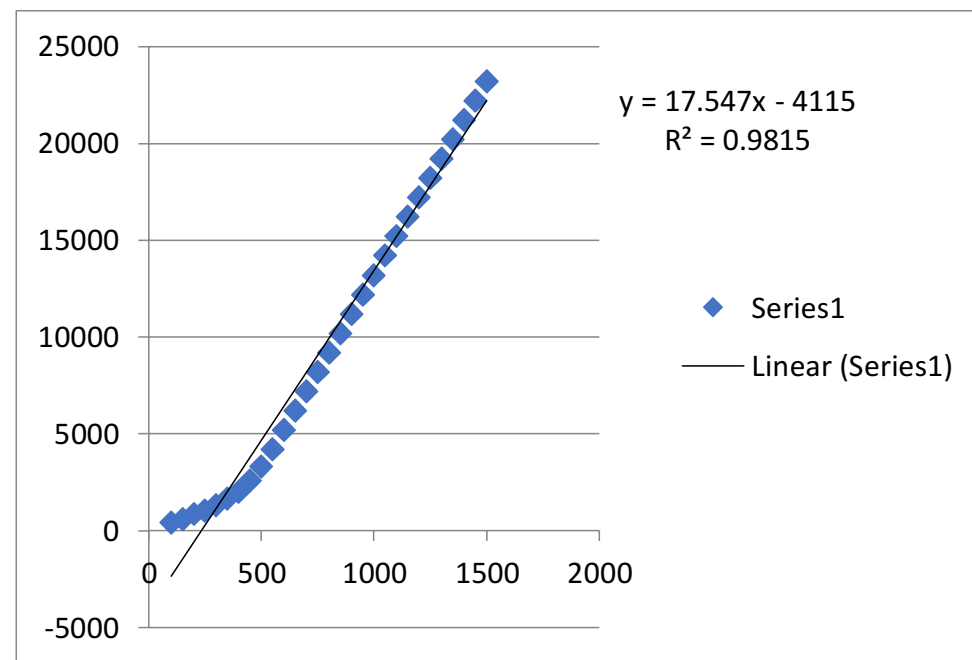


Linear Regression for Volumes greater than 23,200 cu.ft. - Table A.5.5.3(a)

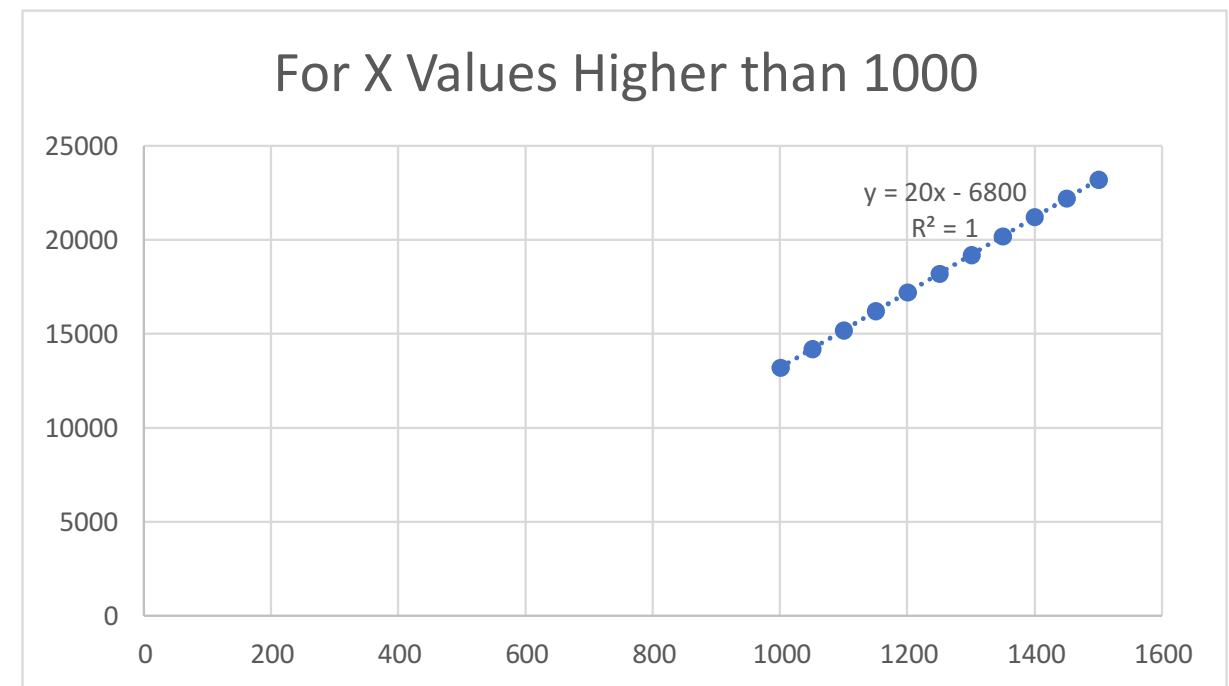
X	Y
100	400
150	600
200	850
250	1050
300	1300
350	1650
400	2000
450	2600
500	3300
550	4200
600	5200
650	6200
700	7200
750	8200
800	9200
850	10200
900	11200
950	12200
1000	13200
1050	14200
1100	15200
1150	16200
1200	17200
1250	18200
1300	19200
1350	20200
1400	21200
1450	22200
1500	23200

X = lbs CO2  
Y = Volume covered by X

For Recirculating Equipment



For X Values Higher than 1000

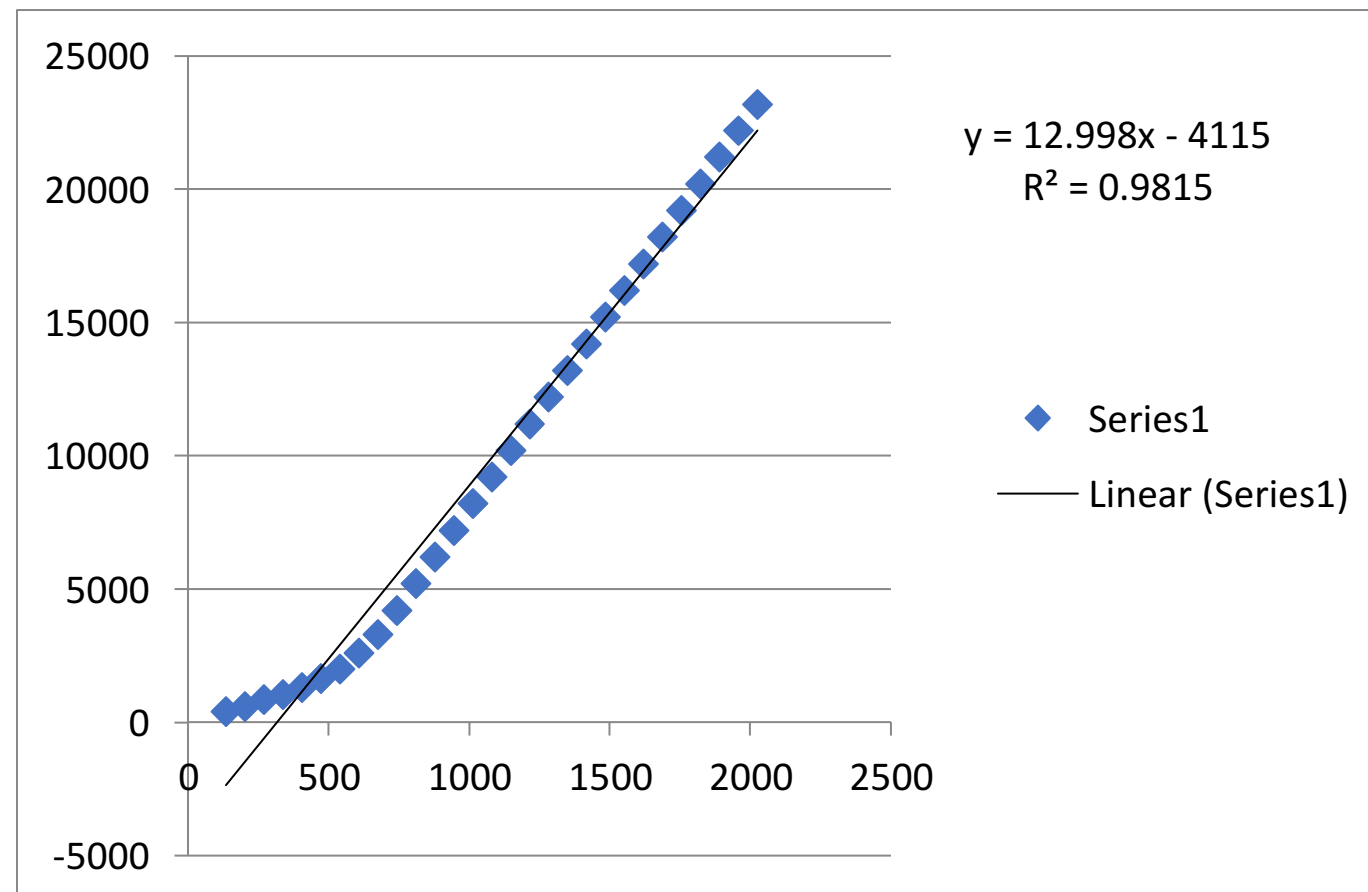


Linear Regression for Volumes greater than 23,200 cu.ft. - Table  
A.5.5.3(a)

X	Y
135	400
202.5	600
270	850
337.5	1050
405	1300
472.5	1650
540	2000
607.5	2600
675	3300
742.5	4200
810	5200
877.5	6200
945	7200
1012.5	8200
1080	9200
1147.5	10200
1215	11200
1282.5	12200
1350	13200
1417.5	14200
1485	15200
1552.5	16200
1620	17200
1687.5	18200
1755	19200
1822.5	20200
1890	21200
1957.5	22200
2025	23200

X = lbs CO2  
Y = Volume covered by X

35% added for Non-Recirculating Equipment

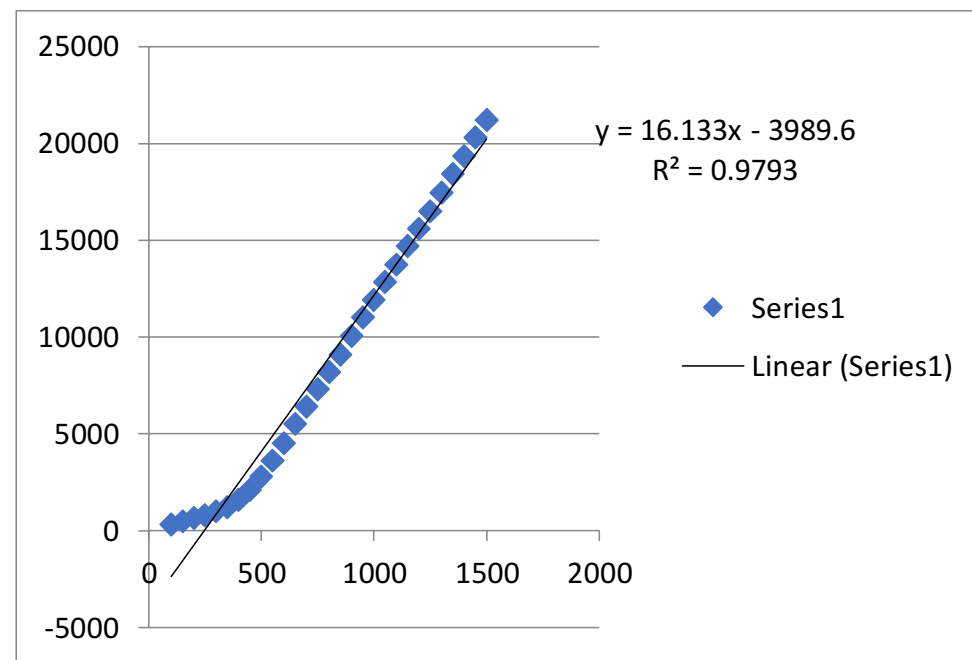


Linear Regression for Volumes greater than 21,200 cu.ft. - Table A.5.5.3(a)

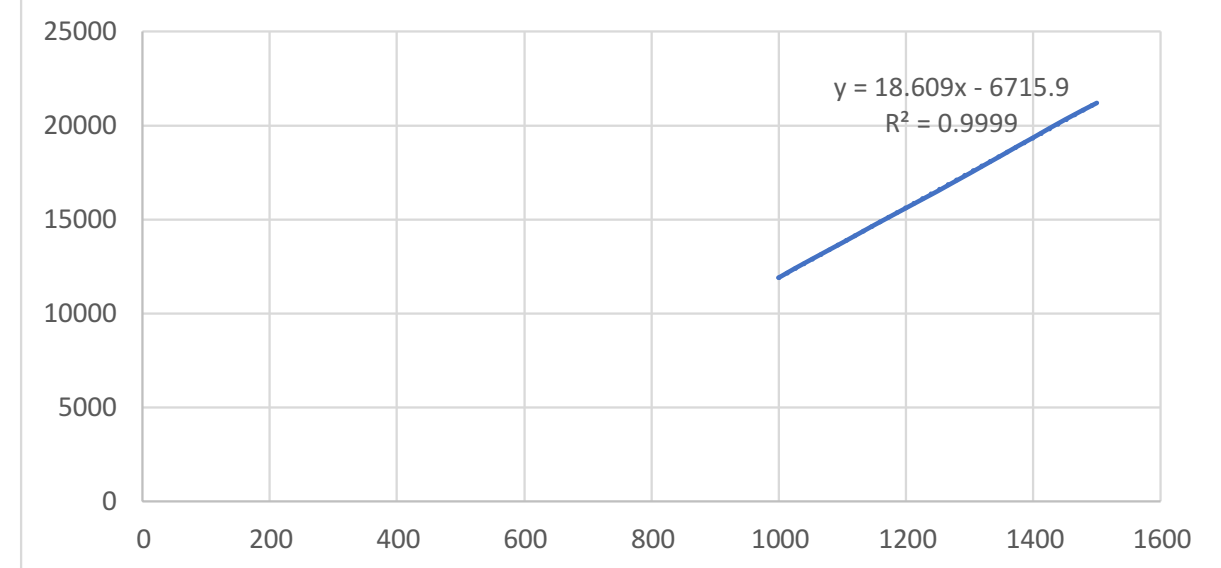
X	Y
100	300
150	500
200	650
250	800
300	1000
350	1200
400	1600
450	2100
500	2800
550	3600
600	4500
650	5500
700	6400
750	7300
800	8200
850	9100
900	10050
950	11000
1000	11900
1050	12850
1100	13750
1150	14700
1200	15600
1250	16500
1300	17450
1350	18400
1400	19350
1450	20300
1500	21200

X = lbs CO2  
Y = Volume covered by X

For Recirculating Equipment



For X Values Higher than 1000

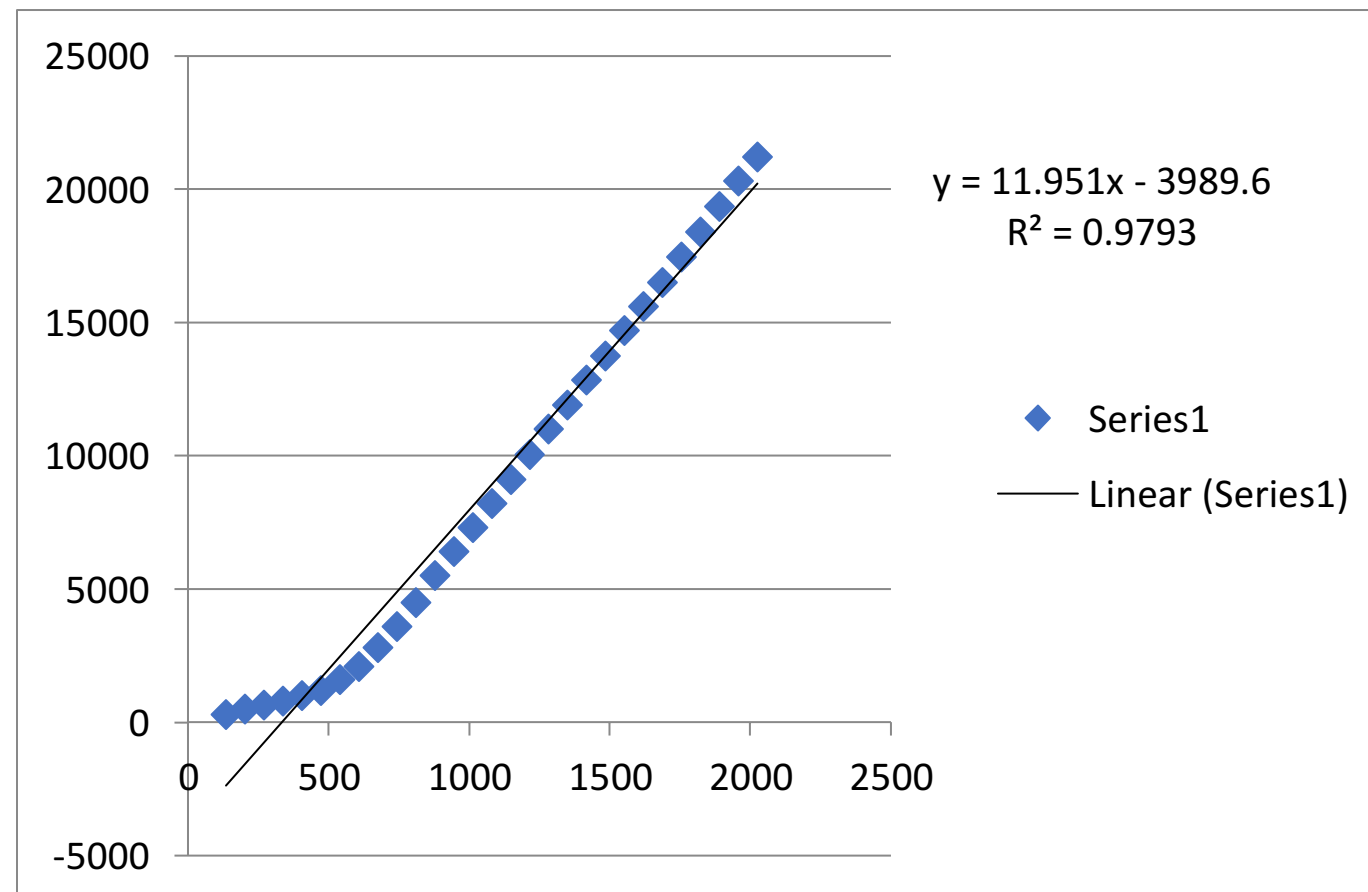


Linear Regression for Volumes greater than 21,200 cu.ft. - Table  
A.5.5.3(a)

X	Y
135	300
202.5	500
270	650
337.5	800
405	1000
472.5	1200
540	1600
607.5	2100
675	2800
742.5	3600
810	4500
877.5	5500
945	6400
1012.5	7300
1080	8200
1147.5	9100
1215	10050
1282.5	11000
1350	11900
1417.5	12850
1485	13750
1552.5	14700
1620	15600
1687.5	16500
1755	17450
1822.5	18400
1890	19350
1957.5	20300
2025	21200

X = lbs CO2  
Y = Volume covered by X

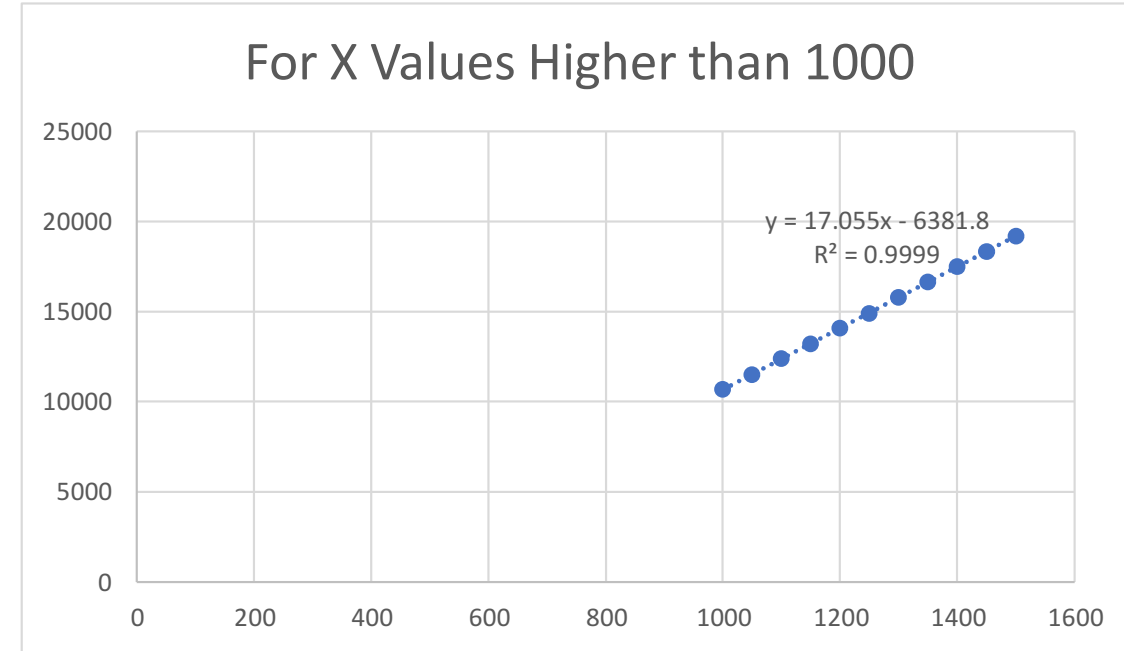
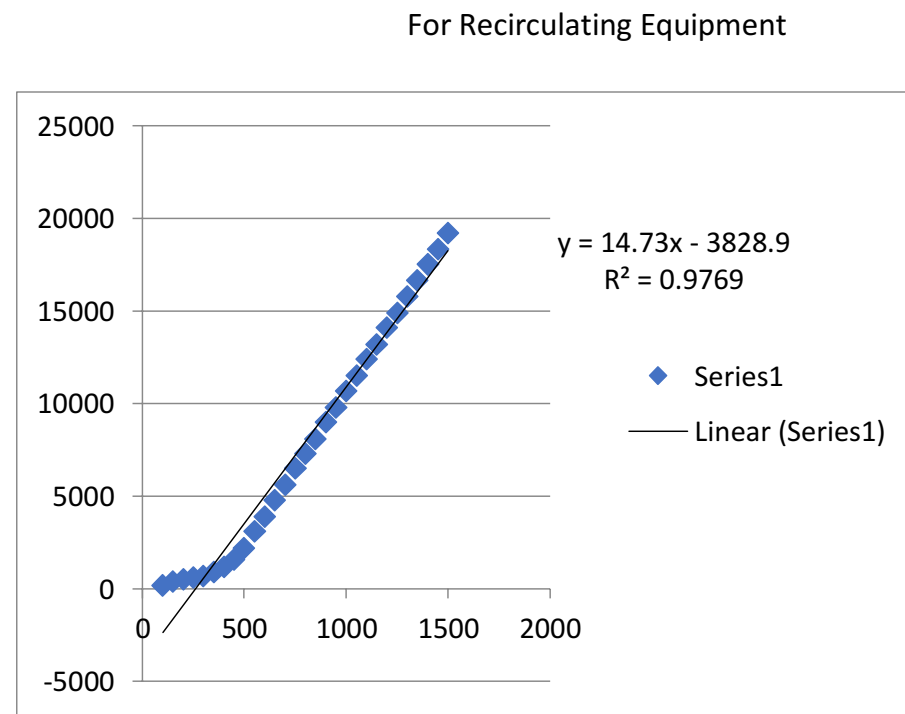
35% added for Non-Recirculating Equipment



Linear Regression for Volumes greater than 19,200 cu.ft. - Table A.5.5.3(a)

X	Y
100	200
150	400
200	500
250	600
300	700
350	900
400	1200
450	1600
500	2200
550	3100
600	3900
650	4800
700	5600
750	6500
800	7300
850	8100
900	9000
950	9800
1000	10700
1050	11500
1100	12400
1150	13200
1200	14100
1250	14900
1300	15800
1350	16650
1400	17500
1450	18350
1500	19200

X = lbs CO2  
Y = Volume covered by X

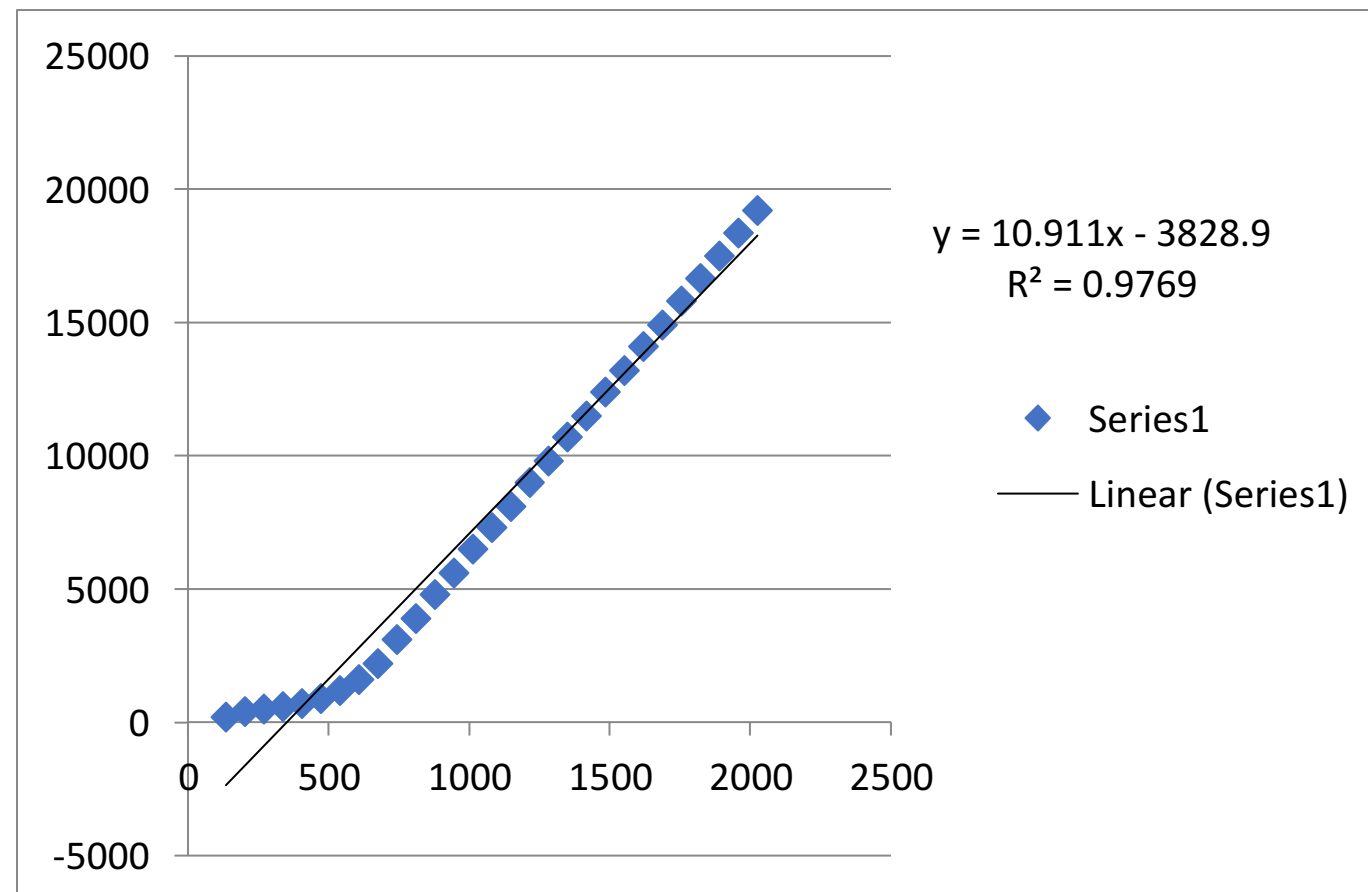


Linear Regression for Volumes greater than 19,200 cu.ft. - Table  
A.5.5.3(a)

X	Y
135	200
202.5	400
270	500
337.5	600
405	700
472.5	900
540	1200
607.5	1600
675	2200
742.5	3100
810	3900
877.5	4800
945	5600
1012.5	6500
1080	7300
1147.5	8100
1215	9000
1282.5	9800
1350	10700
1417.5	11500
1485	12400
1552.5	13200
1620	14100
1687.5	14900
1755	15800
1822.5	16650
1890	17500
1957.5	18350
2025	19200

X = lbs CO2  
Y = Volume covered by X

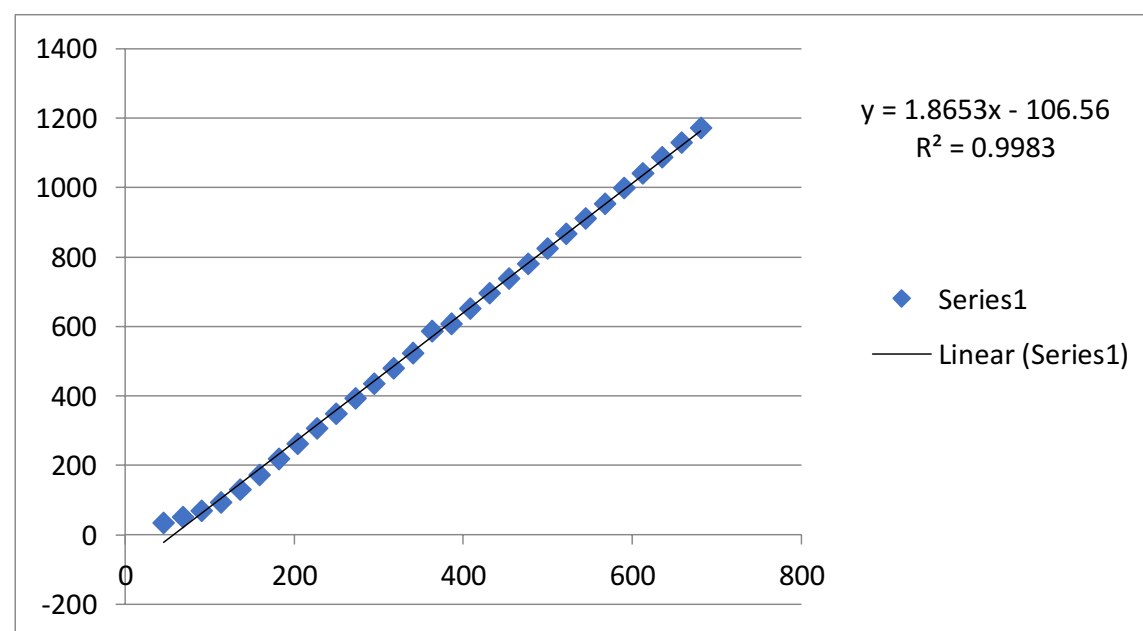
35% added for Non-Recirculating Equipment



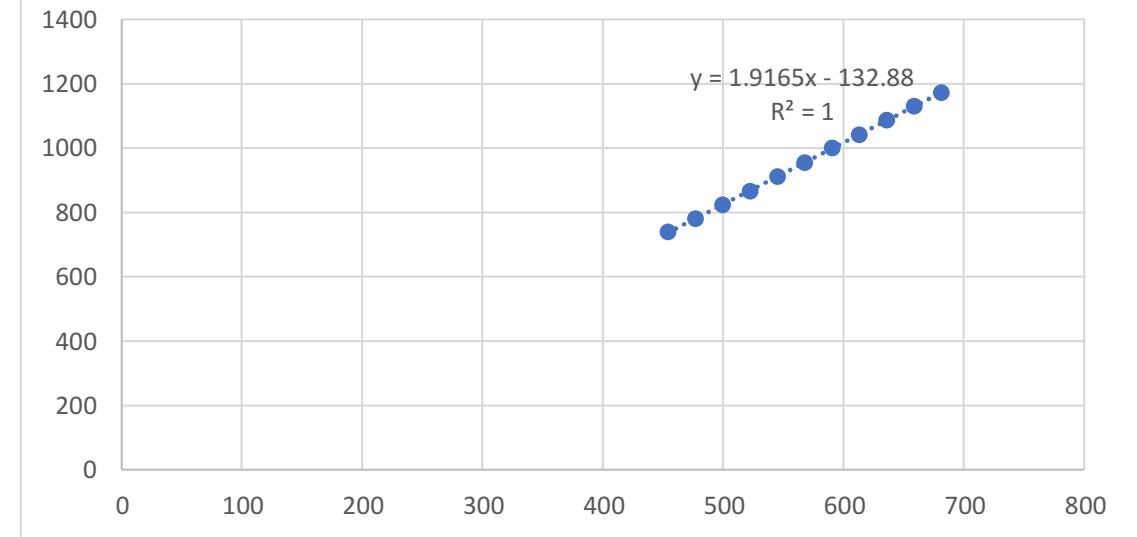
Linear Regression for Volumes greater than 1171.6cu.M. - Table A.5.5.3(b)

X	Y
45.4	34
68.1	50.9
90.8	67.9
113.5	93.4
136.2	130.2
158.9	172.6
181.6	217.9
204.3	261.8
227	305.6
249.7	348.1
272.4	393.4
295.1	435.8
317.8	478.3
340.5	523.6
363.2	586
385.9	608.4
408.6	650.9
431.3	696.2
454	738.6
476.7	781.1
499.4	823.5
522.1	866
544.8	911.3
567.5	953.7
590.2	999
612.9	1041.4
635.6	1086.7
658.3	1129.2
681	1171.6

For Recirculating Equipment



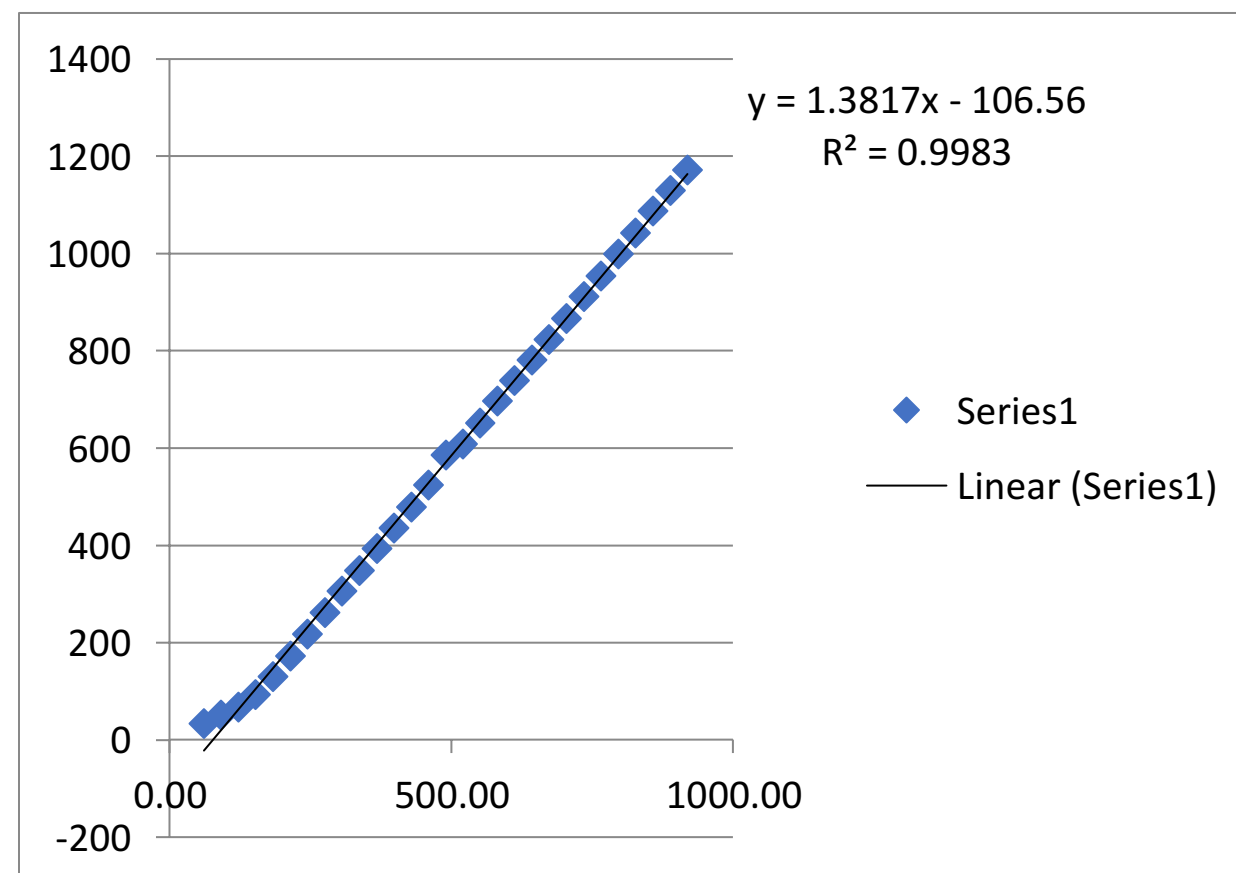
For X Values Higher than 400



Linear Regression for Volumes greater than 1171.6 cu.M. - Table  
A.5.5.3(b)

X	Y
61.29	34
91.94	50.9
122.58	67.9
153.23	93.4
183.87	130.2
214.52	172.6
245.16	217.9
275.81	261.8
306.45	305.6
337.10	348.1
367.74	393.4
398.39	435.8
429.03	478.3
459.68	523.6
490.32	586
520.97	608.4
551.61	650.9
582.26	696.2
612.90	738.6
643.55	781.1
674.19	823.5
704.84	866
735.48	911.3
766.13	953.7
796.77	999
827.42	1041.4
858.06	1086.7
888.71	1129.2
919.35	1171.6

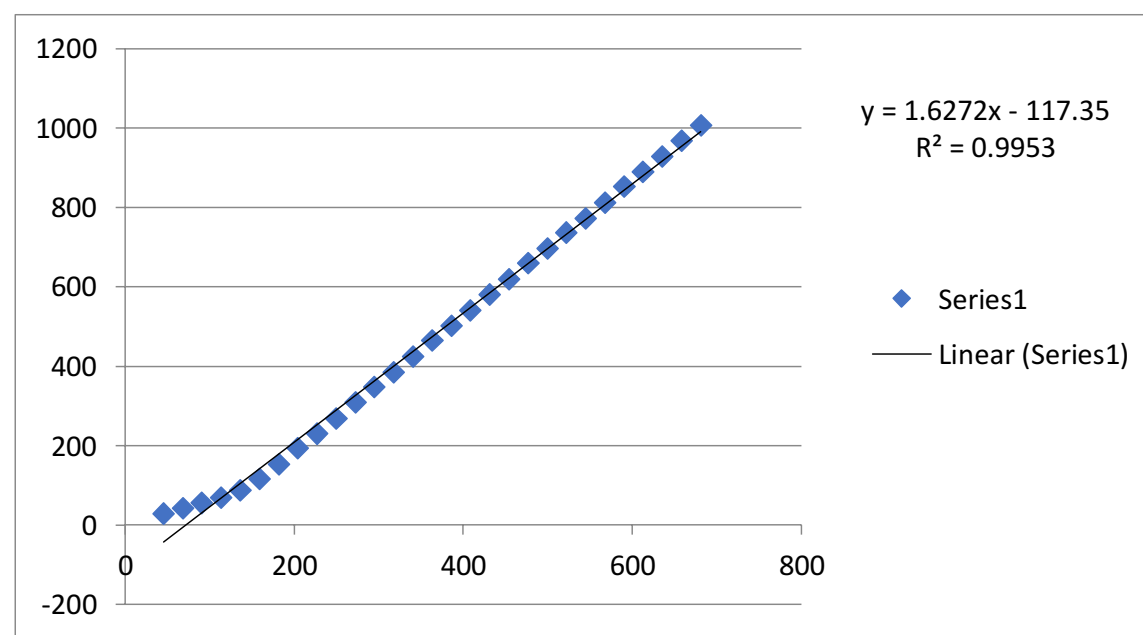
35% added for Non-Recirculating Equipment



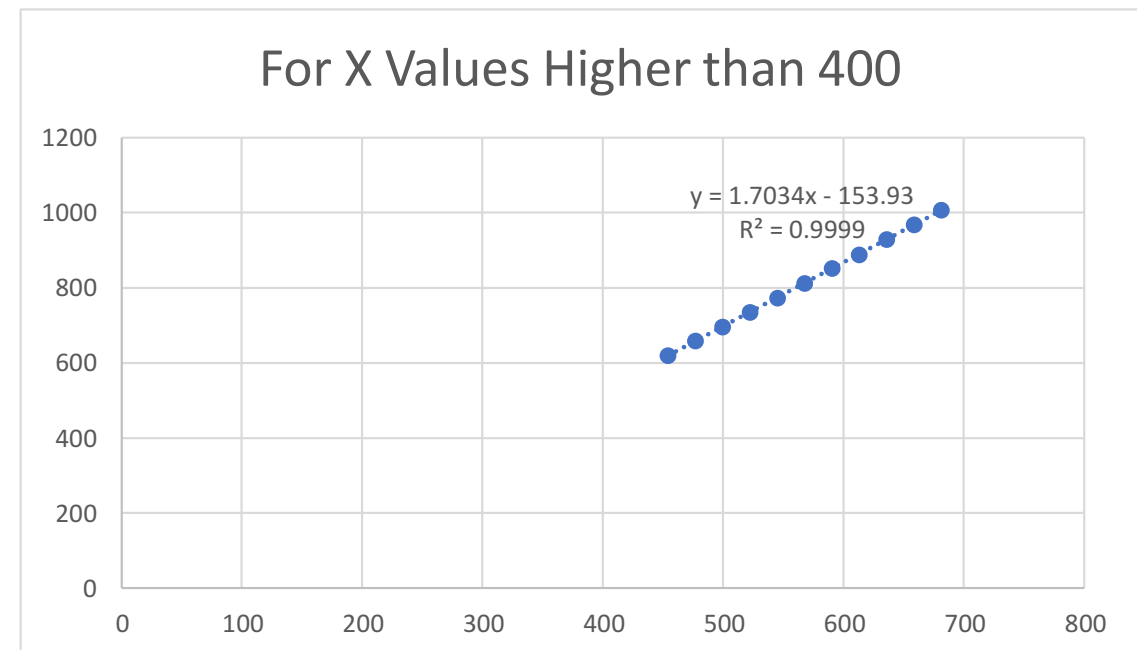
Linear Regression for Volumes greater than 1007.5cu.M. - Table A.5.5.3(b)

X	Y
45.4	28.3
68.1	42.5
90.8	55.2
113.5	69.3
136.2	87.7
158.9	116
181.6	152.8
204.3	192.4
227	229.2
249.7	268.9
272.4	308.5
295.1	348.1
317.8	384.9
340.5	424.5
363.2	464.1
385.9	502.3
408.6	540.5
431.3	580.2
454	619.8
476.7	659.4
499.4	696.2
522.1	735.8
544.8	772.6
567.5	812.2
590.2	851.8
612.9	888.6
635.6	928.2
658.3	967.9
681	1007.5

For Recirculating Equipment



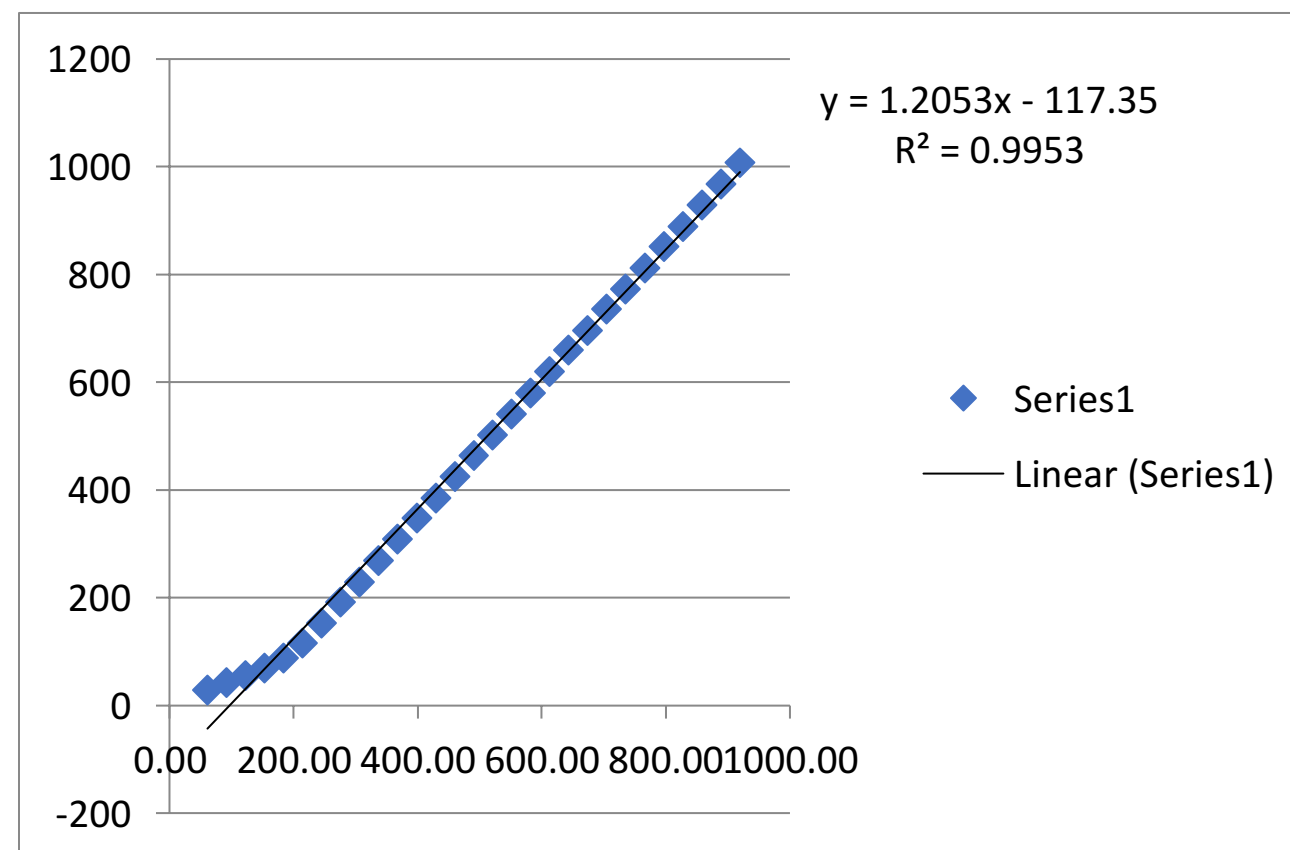
For X Values Higher than 400



Linear Regression for Volumes greater than 1007.5 cu.M. - Table  
A.5.5.3(b)

X	Y
61.29	28.3
91.94	42.5
122.58	55.2
153.23	69.3
183.87	87.7
214.52	116
245.16	152.8
275.81	192.4
306.45	229.2
337.10	268.9
367.74	308.5
398.39	348.1
429.03	384.9
459.68	424.5
490.32	464.1
520.97	502.3
551.61	540.5
582.26	580.2
612.90	619.8
643.55	659.4
674.19	696.2
704.84	735.8
735.48	772.6
766.13	812.2
796.77	851.8
827.42	888.6
858.06	928.2
888.71	967.9
919.35	1007.5

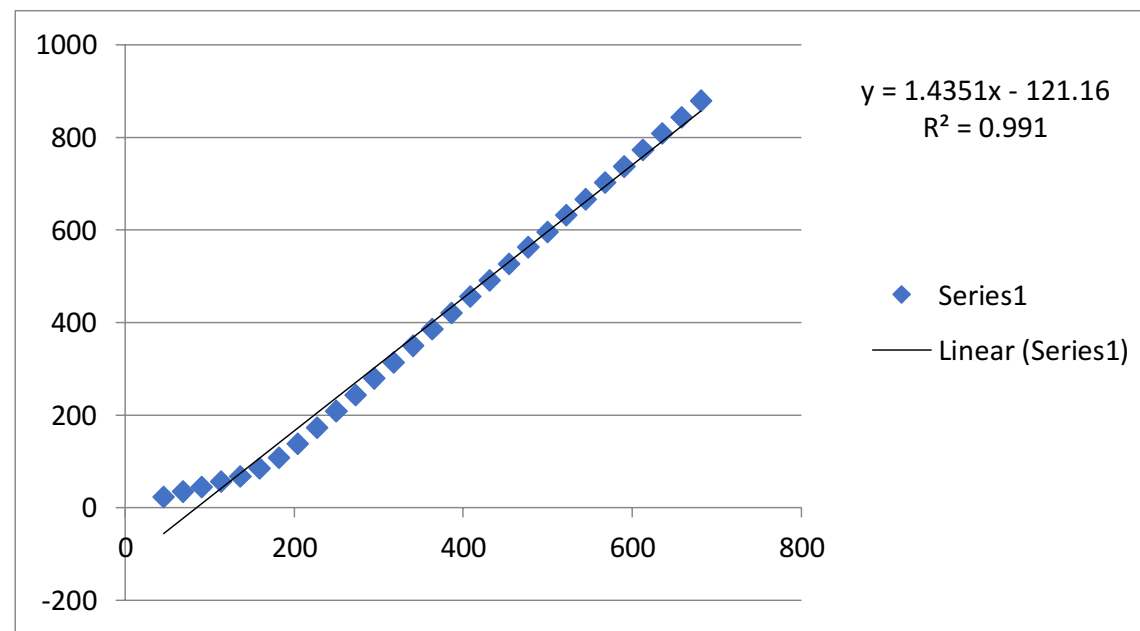
35% added for Non-Recirculating Equipment



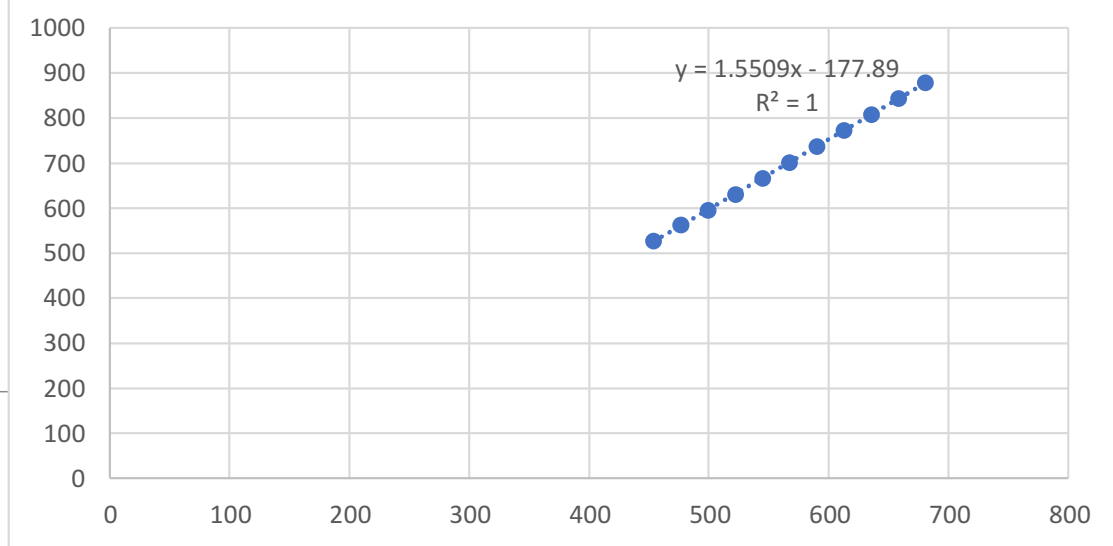
Linear Regression for Volumes greater than 878.7 cu.M. - Table A.5.5.3(b)

X	Y
45.4	22.6
68.1	34
90.8	45.3
113.5	56.6
136.2	67.9
158.9	84.9
181.6	107.5
204.3	138.7
227	172.6
249.7	209.4
272.4	243.4
295.1	278.8
317.8	314.1
340.5	349.5
363.2	384.9
385.9	420.3
408.6	455.6
431.3	491
454	526.4
476.7	563.2
499.4	595.7
522.1	631.1
544.8	666.5
567.5	701.8
590.2	737.2
612.9	772.6
635.6	808
658.3	843.3
681	878.7

For Recirculating Equipment



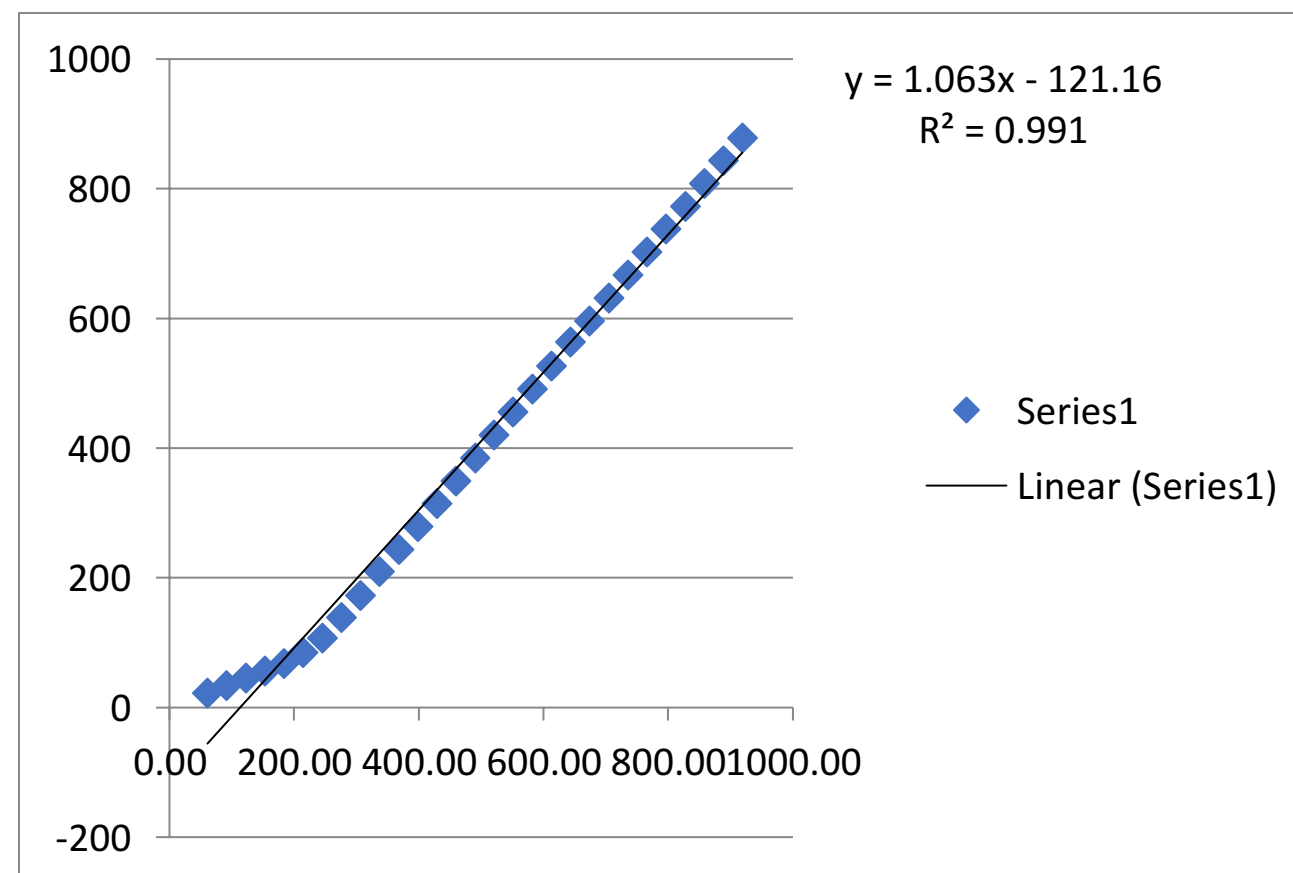
For X Values Higher than 400



Linear Regression for Volumes greater than 878.7 cu.M. - Table  
A.5.5.3(b)

X	Y
61.29	22.6
91.94	34
122.58	45.3
153.23	56.6
183.87	67.9
214.52	84.9
245.16	107.5
275.81	138.7
306.45	172.6
337.10	209.4
367.74	243.4
398.39	278.8
429.03	314.1
459.68	349.5
490.32	384.9
520.97	420.3
551.61	455.6
582.26	491
612.90	526.4
643.55	563.2
674.19	595.7
704.84	631.1
735.48	666.5
766.13	701.8
796.77	737.2
827.42	772.6
858.06	808
888.71	843.3
919.35	878.7

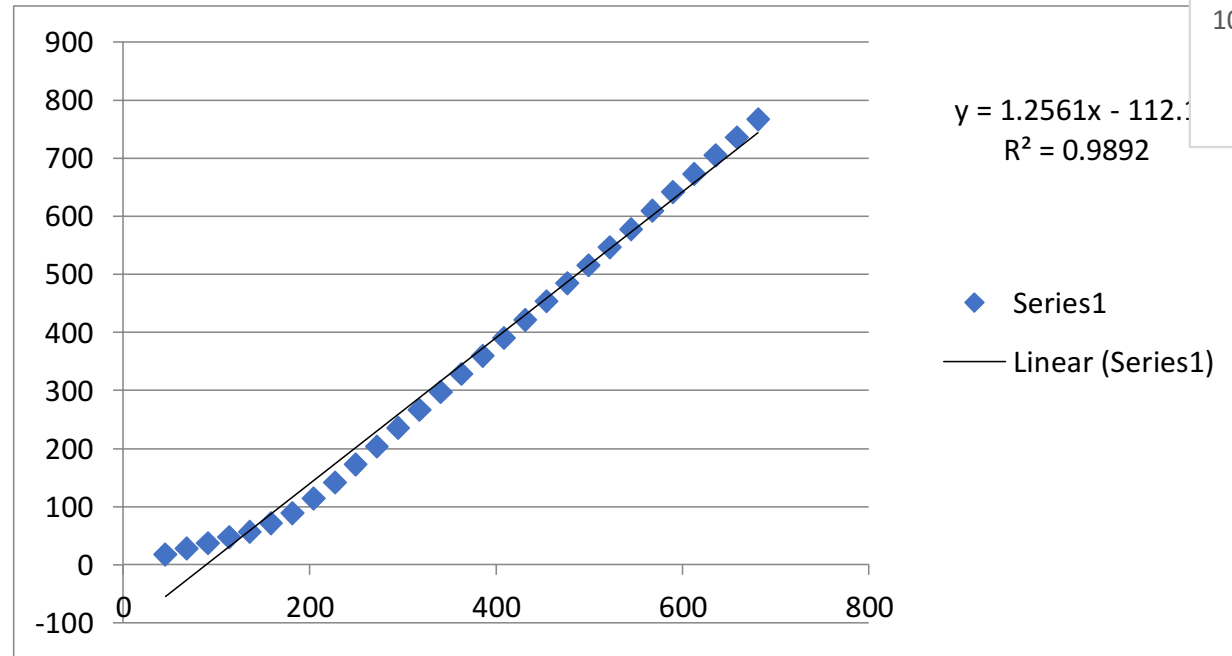
35% added for Non-Recirculating Equipment



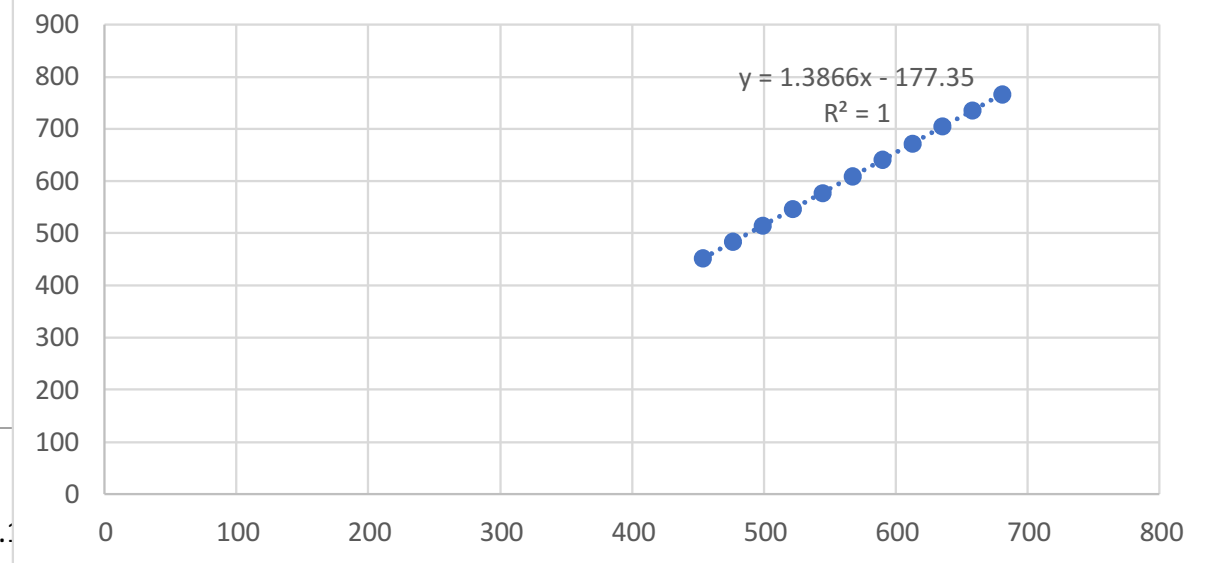
Linear Regression for Volumes greater than 766.9 cu.M. - Table A.5.5.3(b)

X	Y
45.4	17
68.1	28.3
90.8	36.8
113.5	46.7
136.2	56.6
158.9	70.8
181.6	89.1
204.3	113.2
227	141.5
249.7	172.6
272.4	203.8
295.1	234.9
317.8	266
340.5	297.2
363.2	328.3
385.9	359.4
408.6	390.5
431.3	421.7
454	452.8
476.7	483.9
499.4	515.1
522.1	546.2
544.8	577.3
567.5	609.4
590.2	641
612.9	672.1
635.6	704.7
658.3	735.8
681	766.9

For Recirculating Equipment



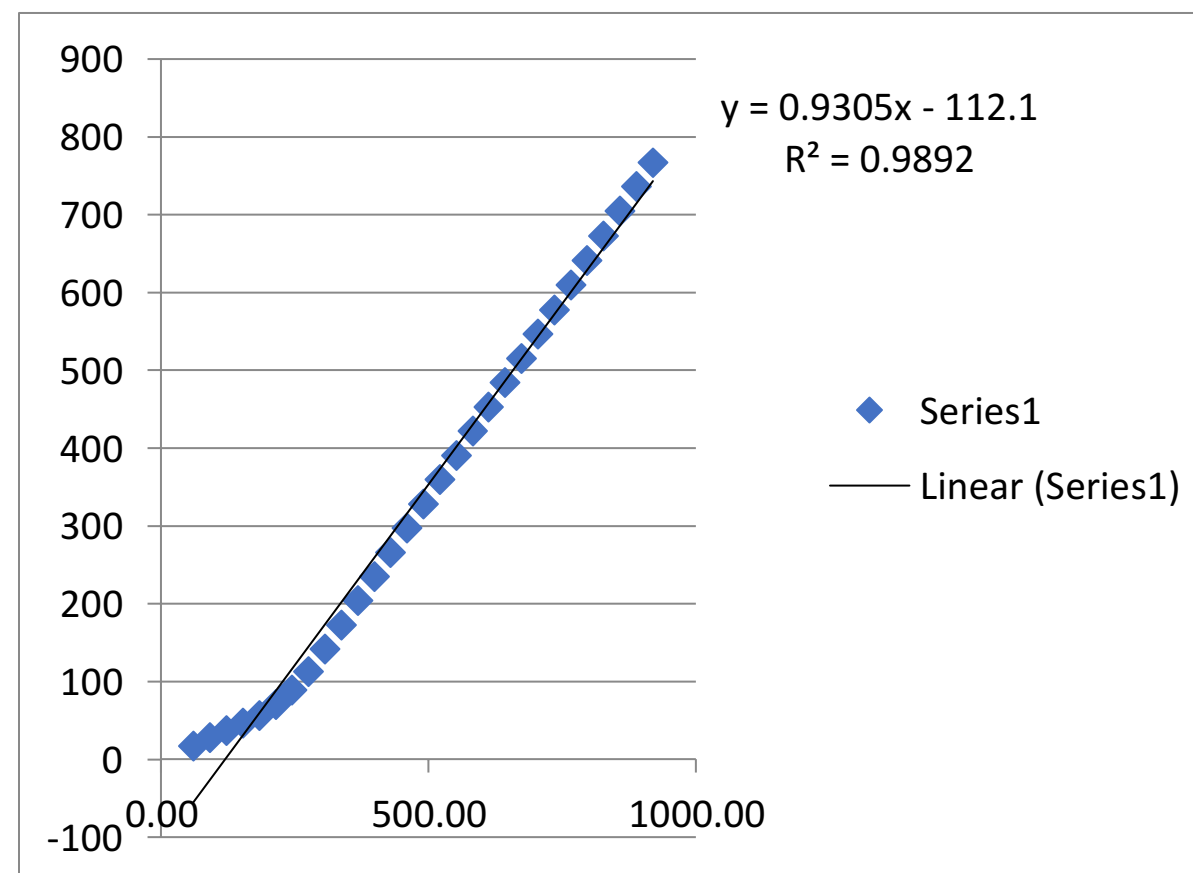
For X Values Higher than 400



Linear Regression for Volumes greater than 766.9 cu.M. - Table  
A.5.5.3(b)

X	Y
61.29	17
91.94	28.3
122.58	36.8
153.23	46.7
183.87	56.6
214.52	70.8
245.16	89.1
275.81	113.2
306.45	141.5
337.10	172.6
367.74	203.8
398.39	234.9
429.03	266
459.68	297.2
490.32	328.3
520.97	359.4
551.61	390.5
582.26	421.7
612.90	452.8
643.55	483.9
674.19	515.1
704.84	546.2
735.48	577.3
766.13	609.4
796.77	641
827.42	672.1
858.06	704.7
888.71	735.8
919.35	766.9

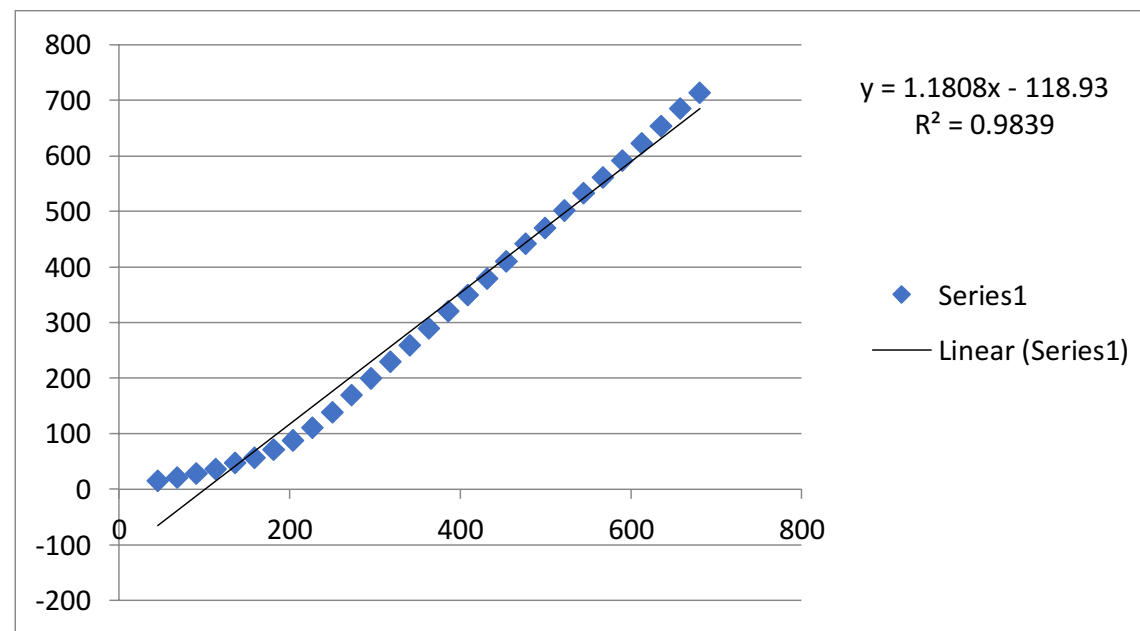
35% added for Non-Recirculating Equipment



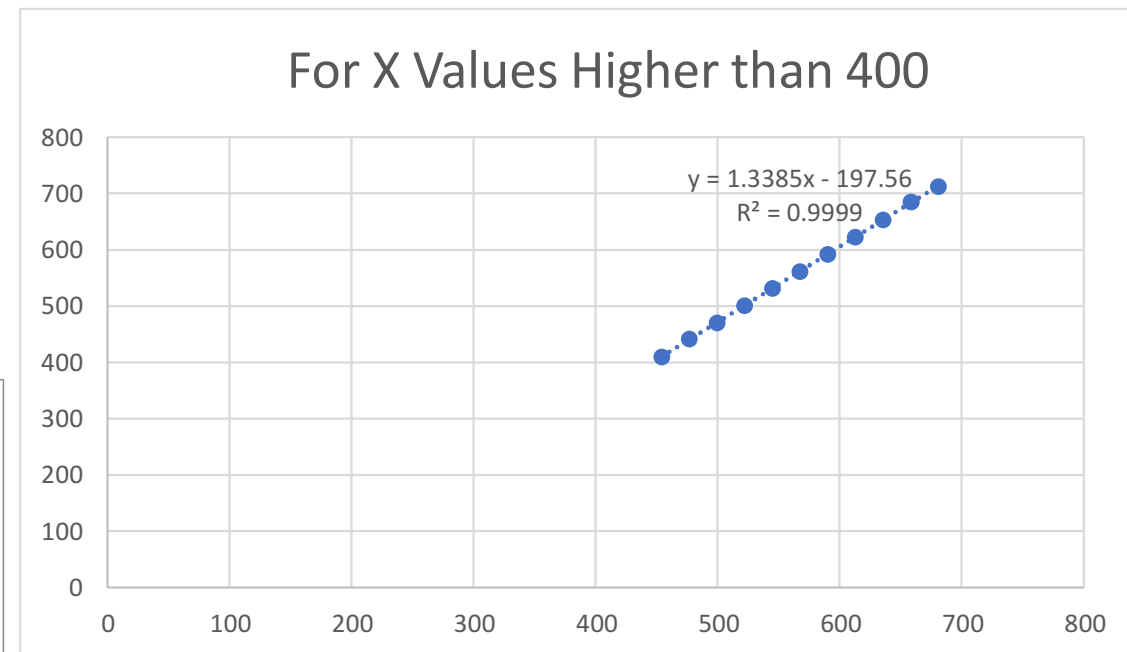
Linear Regression for Volumes greater than 713.2 cu.M. - Table A.5.5.3(b)

X	Y
45.4	14.2
68.1	21.2
90.8	28.3
113.5	36.8
136.2	46.7
158.9	56.6
181.6	70.8
204.3	87.7
227	110.4
249.7	138.7
272.4	169.8
295.1	199.5
317.8	229.2
340.5	258.9
363.2	288.7
385.9	319.8
408.6	349.5
431.3	379.2
454	410.4
476.7	441.5
499.4	469.8
522.1	500.9
544.8	532
567.5	561.8
590.2	591.5
612.9	622.6
635.6	653.7
658.3	684.9
681	713.2

For Recirculating Equipment



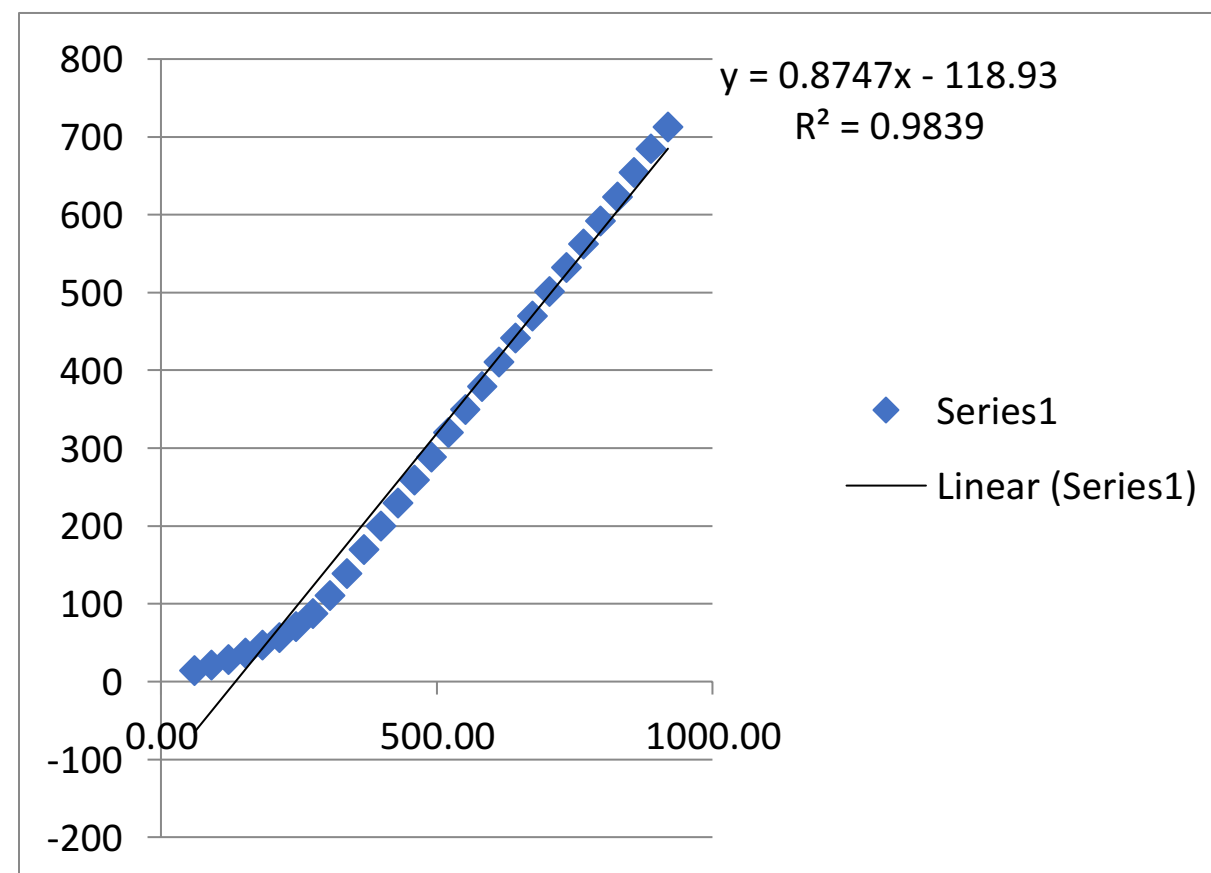
For X Values Higher than 400



Linear Regression for Volumes greater than 713.2 cu.M. - Table  
A.5.5.3(b)

X	Y
61.29	14.2
91.94	21.2
122.58	28.3
153.23	36.8
183.87	46.7
214.52	56.6
245.16	70.8
275.81	87.7
306.45	110.4
337.10	138.7
367.74	169.8
398.39	199.5
429.03	229.2
459.68	258.9
490.32	288.7
520.97	319.8
551.61	349.5
582.26	379.2
612.90	410.4
643.55	441.5
674.19	469.8
704.84	500.9
735.48	532
766.13	561.8
796.77	591.5
827.42	622.6
858.06	653.7
888.71	684.9
919.35	713.2

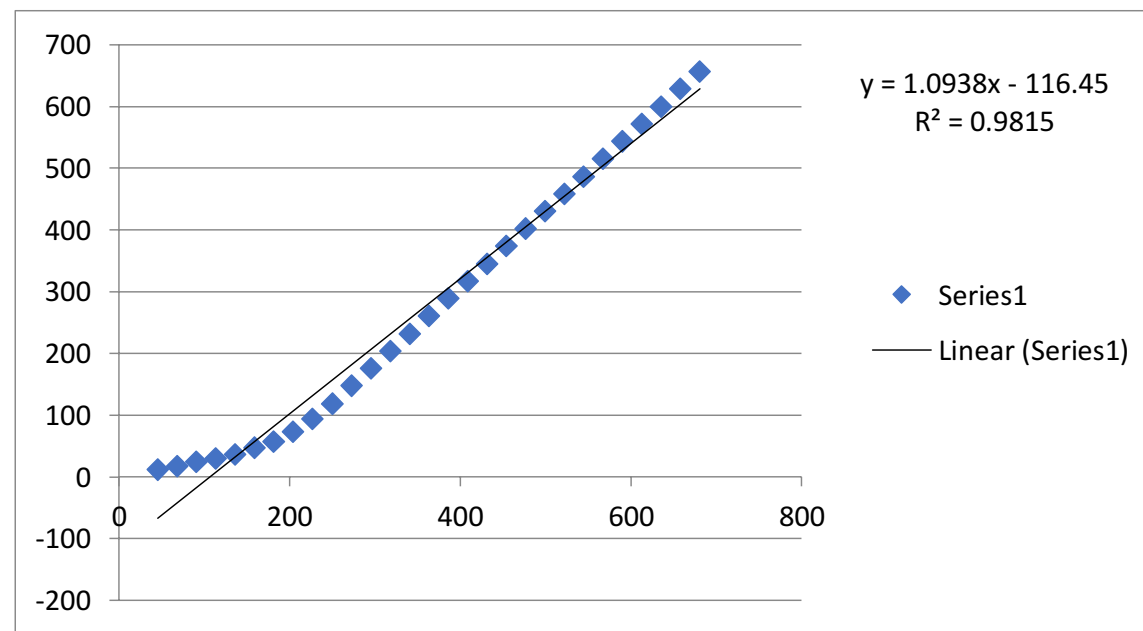
35% added for Non-Recirculating Equipment



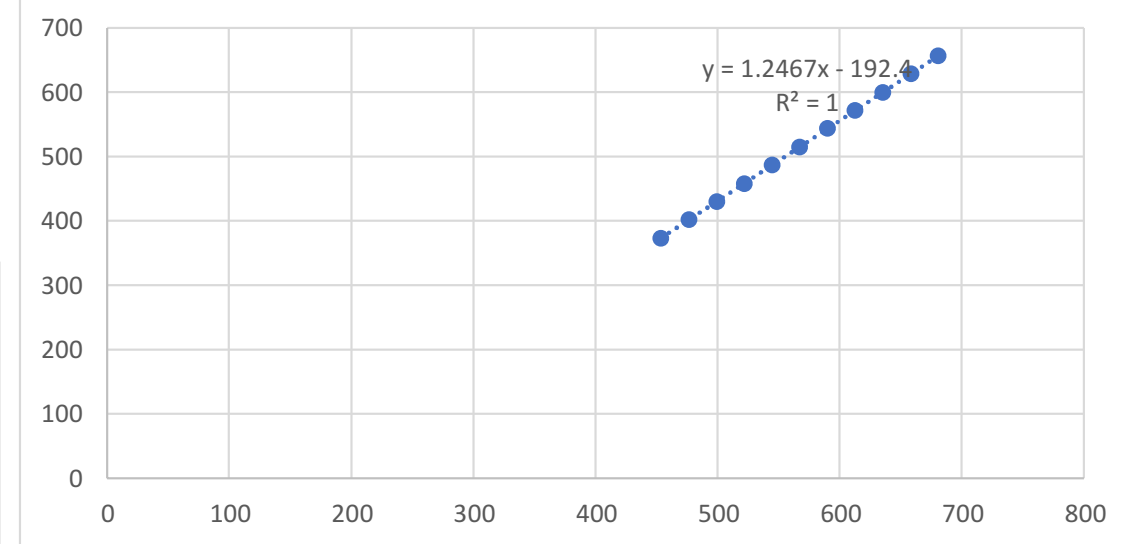
Linear Regression for Volumes greater than 656.6 cu.M. - Table A.5.5.3(b)

X	Y
45.4	11.3
68.1	17
90.8	24.1
113.5	29.7
136.2	36.8
158.9	46.7
181.6	56.6
204.3	73.6
227	93.4
249.7	118.9
272.4	147.2
295.1	175.5
317.8	203.8
340.5	232.1
363.2	260.4
385.9	288.7
408.6	317
431.3	345.3
454	373.6
476.7	401.9
499.4	430.2
522.1	458.5
544.8	486.8
567.5	515.1
590.2	543.4
612.9	571.7
635.6	600
658.3	628.3
681	656.6

For Recirculating Equipment



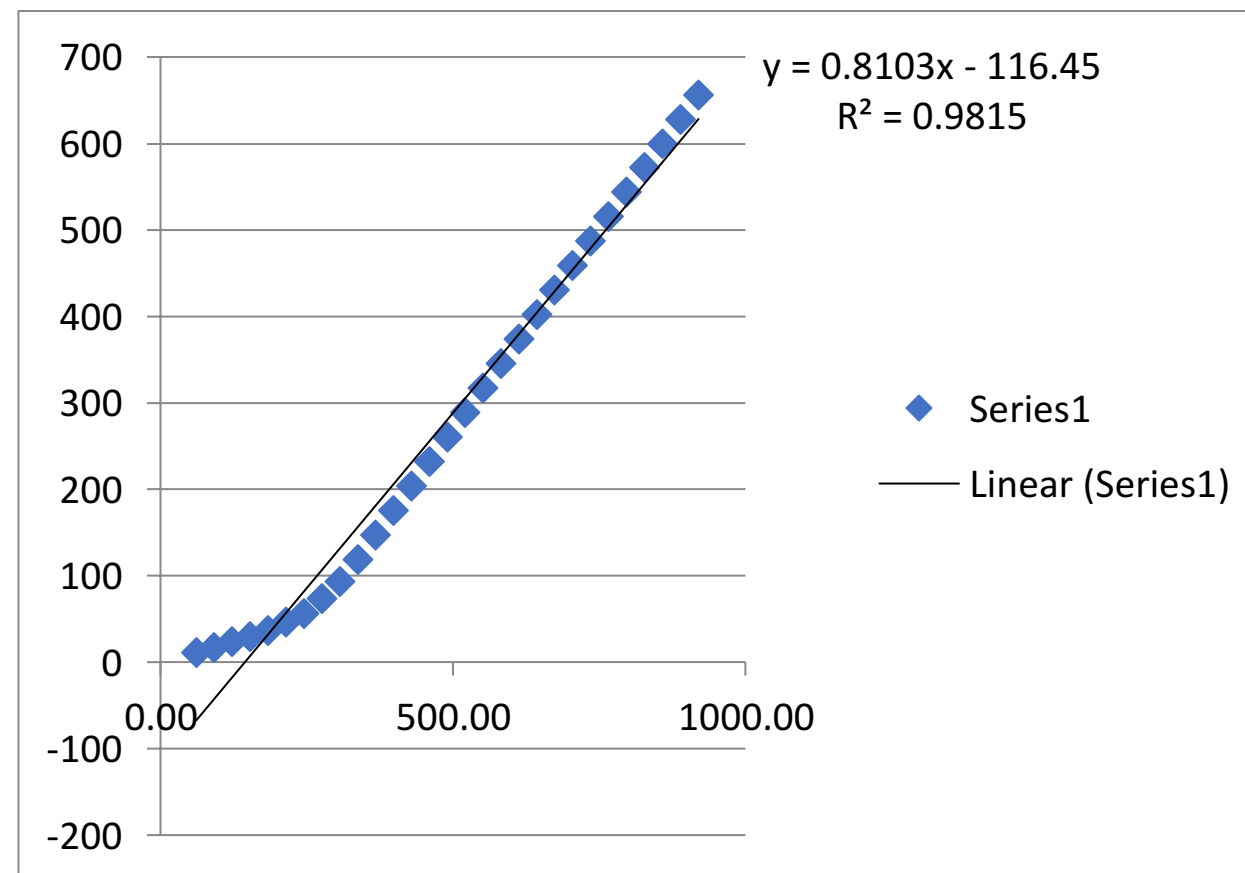
For X Values Higher than 400



Linear Regression for Volumes greater than 656.6 cu.M. - Table  
A.5.5.3(b)

X	Y
61.29	11.3
91.94	17
122.58	24.1
153.23	29.7
183.87	36.8
214.52	46.7
245.16	56.6
275.81	73.6
306.45	93.4
337.10	118.9
367.74	147.2
398.39	175.5
429.03	203.8
459.68	232.1
490.32	260.4
520.97	288.7
551.61	317
582.26	345.3
612.90	373.6
643.55	401.9
674.19	430.2
704.84	458.5
735.48	486.8
766.13	515.1
796.77	543.4
827.42	571.7
858.06	600
888.71	628.3
919.35	656.6

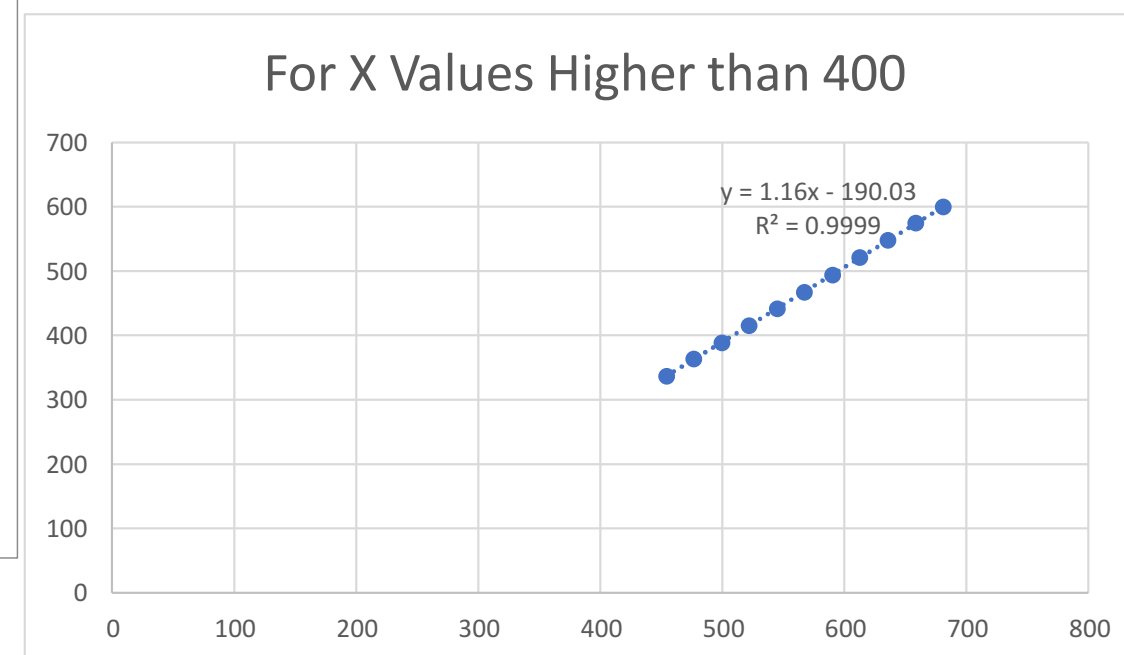
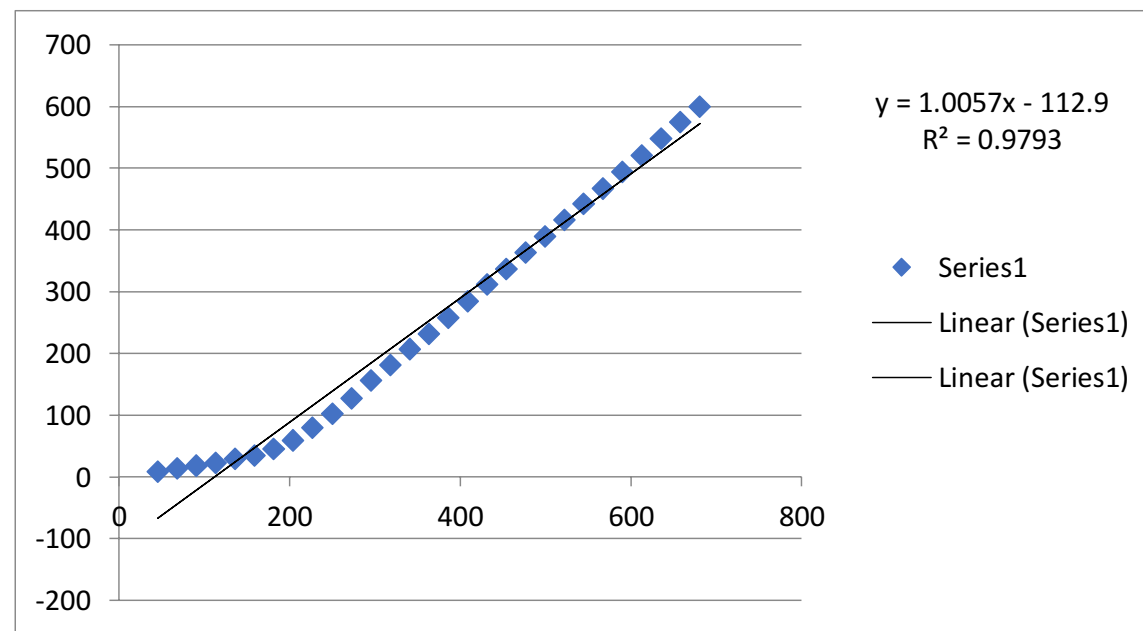
35% added for Non-Recirculating Equipment



Linear Regression for Volumes greater than 600.0 cu.M. - Table A.5.5.3(b)

X	Y
45.4	8.5
68.1	14.2
90.8	18.4
113.5	22.6
136.2	28.3
158.9	34
181.6	45.3
204.3	59.4
227	79.2
249.7	101.9
272.4	127.4
295.1	155.7
317.8	181.1
340.5	206.6
363.2	232.1
385.9	257.5
408.6	284.4
431.3	311.3
454	336.8
476.7	363.7
499.4	389.1
522.1	416
544.8	441.5
567.5	467
590.2	493.8
612.9	520.7
635.6	547.6
658.3	574.5
681	600

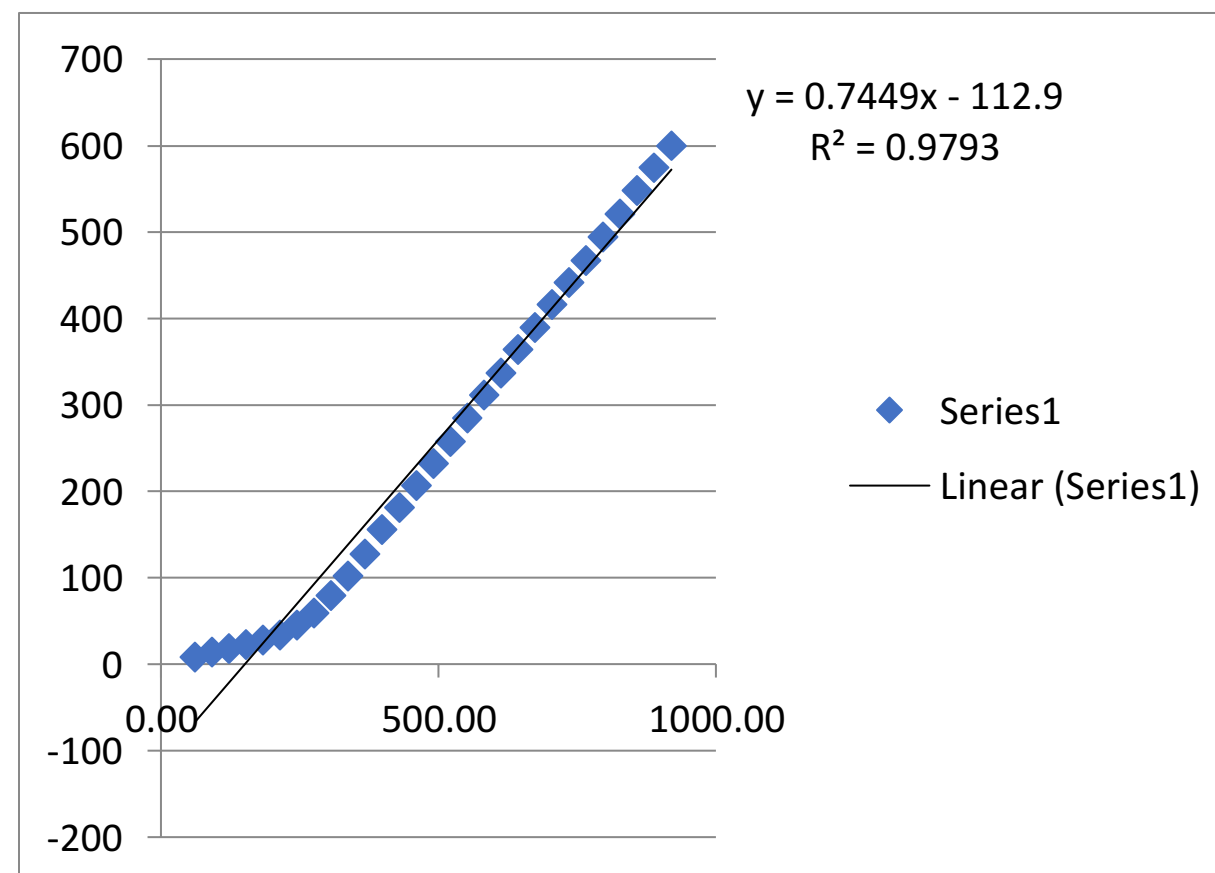
For Recirculating Equipment



Linear Regression for Volumes greater than 600.0 cu.M. - Table  
A.5.5.3(b)

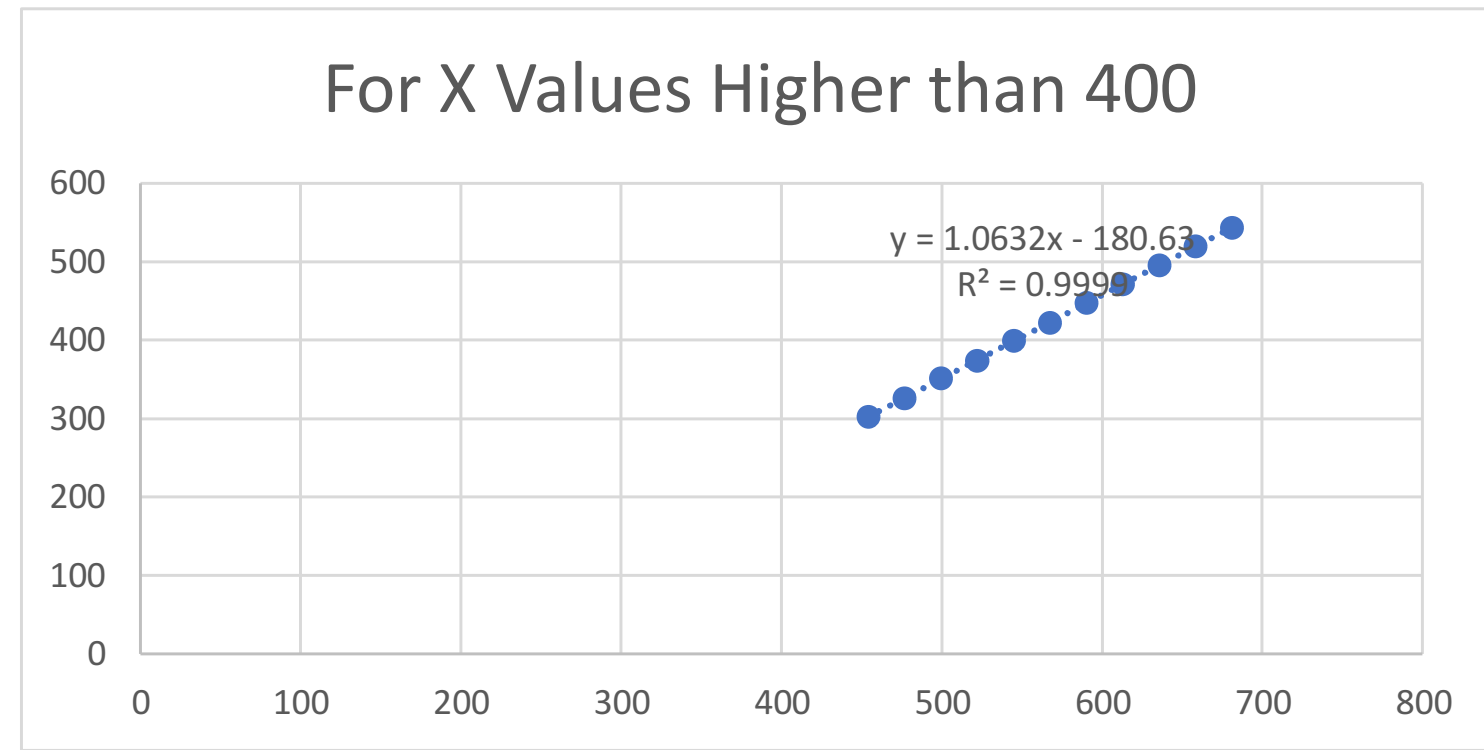
X	Y
61.29	8.5
91.94	14.2
122.58	18.4
153.23	22.6
183.87	28.3
214.52	34
245.16	45.3
275.81	59.4
306.45	79.2
337.10	101.9
367.74	127.4
398.39	155.7
429.03	181.1
459.68	206.6
490.32	232.1
520.97	257.5
551.61	284.4
582.26	311.3
612.90	336.8
643.55	363.7
674.19	389.1
704.84	416
735.48	441.5
766.13	467
796.77	493.8
827.42	520.7
858.06	547.6
888.71	574.5
919.35	600

35% added for Non-Recirculating Equipment

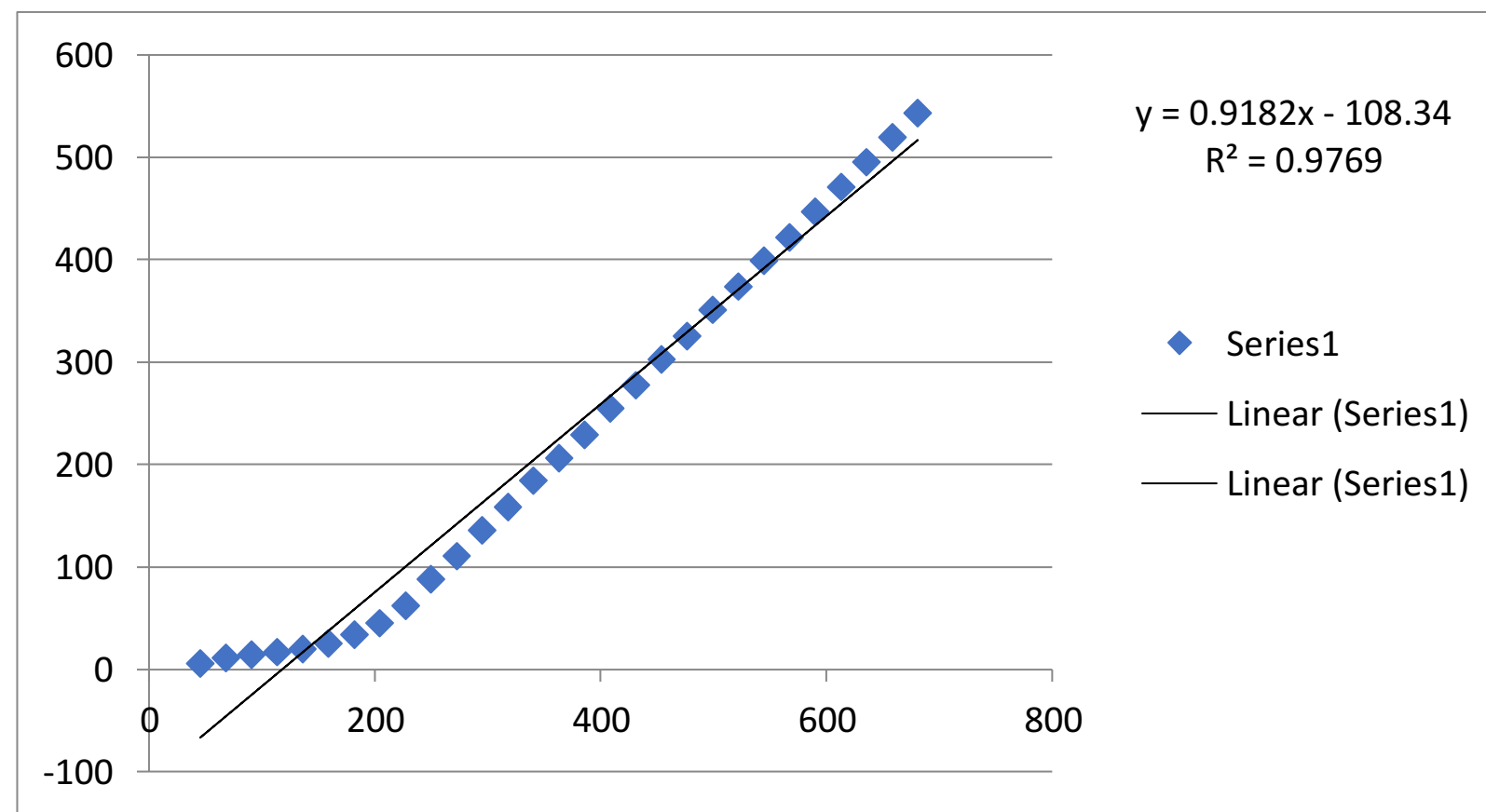


Linear Regression for Volumes greater than 600.0 cu.M. - Table A.5.5.3(b)

X	Y
45.4	5.7
68.1	11.3
90.8	14.2
113.5	17
136.2	19.8
158.9	25.5
181.6	34
204.3	45.3
227	62.3
249.7	87.7
272.4	110.4
295.1	135.8
317.8	158.5
340.5	184
363.2	206.6
385.9	229.2
408.6	254.7
431.3	277.3
454	302.8
476.7	325.5
499.4	350.9
522.1	373.6
544.8	399
567.5	421.7
590.2	447.1
612.9	471.2
635.6	495.3
658.3	519.3
681	543.4



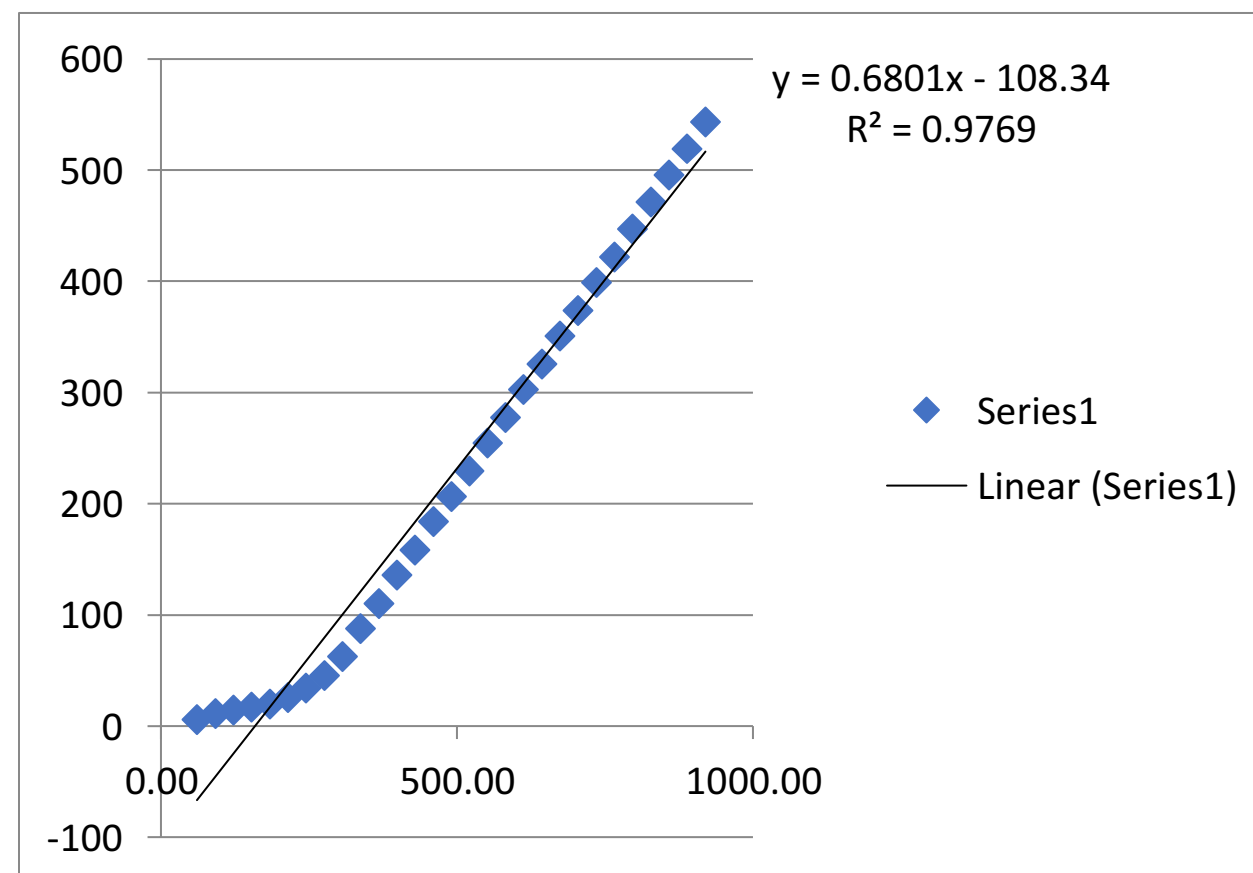
For Recirculating Equipment



Linear Regression for Volumes greater than 543.4 cu.M. - Table  
A.5.5.3(b)

X	Y
61.29	5.7
91.94	11.3
122.58	14.2
153.23	17
183.87	19.8
214.52	25.5
245.16	34
275.81	45.3
306.45	62.3
337.10	87.7
367.74	110.4
398.39	135.8
429.03	158.5
459.68	184
490.32	206.6
520.97	229.2
551.61	254.7
582.26	277.3
612.90	302.8
643.55	325.5
674.19	350.9
704.84	373.6
735.48	399
766.13	421.7
796.77	447.1
827.42	471.2
858.06	495.3
888.71	519.3
919.35	543.4

35% added for Non-Recirculating Equipment





## Public Comment No. 6-NFPA 12-2023 [ Section No. 5.5.3.4 ]

### 5.5.3.4 –

For enclosed rotating electrical equipment with dampered

;

non-recirculating

-type

airflow,

the indicated quantities of carbon dioxide, as shown in Table 5.5.3.3.1(a) and Table 5.5.3.3.1(b), shall be increased by 35 percent for extended discharge protection

add 35 percent to the values given in these tables to compensate for possible leakage past the dampers .

### Statement of Problem and Substantiation for Public Comment

5.5.3.4 from the first draft was part of A.5.5.3 in the 2020 edition of the standard. The information has been in the Annex of NFPA 12 for over 70 years. It is advisory in nature pertaining to Tables A.5.5.3. The comment returns 5.5.3.4 to the Annex as part of the supporting information related to the A.5.5.3 tables. The purpose of adding 35 percent to the tabulated values is explained as compensation for possible leakage past dampers.

### Related Public Comments for This Document

<u>Related Comment</u>	<u>Relationship</u>
<u>Public Comment No. 5-NFPA 12-2023 [Section No. 5.5.3.3.1]</u>	
<u>Related Item</u>	
• PI-11 • PI-10	

### Submitter Information Verification

**Submitter Full Name:** Thomas Wysocki  
**Organization:** Guardian Services, Inc.  
**Street Address:**  
**City:**  
**State:**  
**Zip:**  
**Submittal Date:** Mon Dec 11 12:32:18 EST 2023  
**Committee:** GFE-AAA



## Public Comment No. 8-NFPA 12-2023 [ Section No. A.3.3.2 ]

### A.3.3.2 Deep-Seated Fire.

A characteristic of this type of combustion is the slow rate of heat ~~losses~~ loss from the reaction zone. Thus, the fuel remains hot enough to exothermically react with oxygen, even though the rate of reaction, which is controlled by diffusion processes, is extremely slow. Deep-seated fires can continue to burn for many weeks, for example, in bales of cotton and jute and heaps of sawdust. A deep-seated fire ceases to burn only when either all the available oxygen or fuel has been consumed or the fuel surface is at too low a temperature to react. [2001, 2025]

Deep-seated fires usually are extinguished by reducing the fuel temperature, either directly by application of a heat-absorbing medium, such as water, or by blanketing with an inert gas. The medium slows the reaction rate to the point where heat generated by oxidation is less than heat losses to surroundings. This causes the temperature to fall below the level necessary for reignition after removal of the inert atmosphere. [2001, 2025]

### Statement of Problem and Substantiation for Public Comment

Editorial, grammatical correction

#### Related Item

- Editorial correction

### Submitter Information Verification

**Submitter Full Name:** Thomas Wysocki

**Organization:** Guardian Services, Inc.

**Street Address:**

**City:**

**State:**

**Zip:**

**Submittal Date:** Wed Dec 13 19:04:09 EST 2023

**Committee:** GFE-AAA



## Committee Input No. 19-NFPA 12-2023 [ Global Input ]

Remove the term "Slave cylinder" throughout the document. A task group will review and propose a new term at second draft.

### Submitter Information Verification

**Committee:** GFE-AAA

**Submittal Date:** Thu May 11 13:14:55 EDT 2023

### Committee Statement

**Committee Statement:** A task group was created to review the term "slave cylinder" and propose a new term during the second draft.

**Response Message:** CI-19-NFPA 12-2023

### Ballot Results

 This item has not been balloted



**Committee Input No. 16-NFPA 12-2023 [ Section No. 5.3.2.2 ]**

A large, empty rectangular box with a thin border, intended for entering committee input or comments.

[Review ethyl ether and diethyl ether for accuracy, they are names for the same substance]

**5.3.2.2\***

Table 5.3.2.2 shall be used to determine the minimum carbon dioxide concentrations for the liquids and gases shown in the table.

Table 5.3.2.2 Minimum Carbon Dioxide Concentrations for Extinguishment

<u>Material</u>	<u>Theoretical</u>	<u>Minimum</u>
	<u>Minimum CO<sub>2</sub></u>	<u>Design CO<sub>2</sub></u>
	<u>Concentration</u>	<u>Concentration</u>
	<u>(%)</u>	<u>(%)</u>
Acetylene	55	66
Acetone	27*	34
Aviation gas grades		
115/145	30	36
Benzol, benzene	31	37
Butadiene	34	41
Butane	28	34
Butane-l	31	37
Carbon disulfide	60	72
Carbon monoxide	53	64
Coal or natural gas	31*	37
Cyclopropane	31	37
Diethyl ether	33	40
Dimethyl ether	33	40
Dowtherm	38*	46
Ethane	33	40
Ethyl alcohol	36	43
Ethyl ether	38*	46
Ethylene	41	49
Ethylene dichloride	21	34
Ethylene oxide	44	53
Gasoline	28	34
Higher paraffin		
hydrocarbons C <sub>n</sub> H <sub>2n+2</sub> , n≥5	28	34
Hydrogen	62	75
Hydrogen sulfide	30	36
Isobutane	30*	36
Isobutylene	26	34
Isobutyl formate	26	34
JP-4	30	36
Kerosene	28	34

<u>Material</u>	<u>Theoretical</u>	<u>Minimum</u>
	<u>Minimum CO<sub>2</sub></u>	<u>Design CO<sub>2</sub></u>
	<u>Concentration</u>	<u>Concentration</u>
	(%)	(%)
Methane	25	34
Methyl acetate	29	35
Methyl alcohol	33	40
Methyl butene-1	30	36
Methyl ethyl ketone	33	40
Methyl formate	32	39
Pentane	29	35
Propane	30	36
Propylene	30	36
Quench, lube oils	28	34

Note: The theoretical minimum extinguishing concentrations in air for the materials in the table were obtained from a compilation of Bureau of Mines, Bulletins 503 and 627.

\*Calculated from accepted residual oxygen values.

## Submitter Information Verification

**Committee:** GFE-AAA

**Submission Date:** Thu May 11 12:45:22 EDT 2023

## Committee Statement

**Committee Statement:** Table 5.3.2.2 includes different extinguishing/design concentration values for ethyl ether and diethyl ether, which are two names for the same substance. It looks like the value for ethyl ether existed first, and the value for diethyl ether was added for the 1985 edition. There is no specific committee action for this in the Technical Committee Report. The value just appeared in the 1985 draft.

The value for “ethyl ether” has an asterisk, which indicates that it was estimated from residual oxygen values. The value for “diethyl ether” is probably based on testing and was added when it became available, but since the alternative material name was used, NFPA staff probably did not realize that the old value shown with “ethyl ether” needed to be removed.

A task group was formed to determine the correct CO<sub>2</sub> concentration value, and if either needs to be removed or changed.

**Response Message:** CI-16-NFPA 12-2023

## Ballot Results

 **This item has not been balloted**



## Committee Input No. 18-NFPA 12-2023 [ Chapter 9 ]

### Chapter 9 Marine Systems

#### 9.1 Special Definitions.

The following definitions shall apply to Chapter 9:

- (1) Marine systems (See 3.4.1.)
- (2) Space
  - (a) Cargo space (See 3.4.2.1.)
  - (b) Electrical equipment space (See 3.4.2.2.)
  - (c)\* Machinery space (See 3.4.2.3.)

#### A.9.1(2)(c)

Examples include spaces containing engines used for propulsion, engines that drive electrical generators, oil filling stations, cargo pumps, or heating, ventilation, and air-conditioning machinery.

- (d)\* Vehicle space (See 3.4.2.4.)

#### A.9.1(2)(d)

Carbon dioxide systems are not recommended for vehicle spaces that are accessible to passengers.

#### 9.2 General.

##### 9.2.1\* Outline.

This chapter outlines the modifications necessary for marine systems.

#### A.9.2.1

It is intended that NFPA 12, including this chapter, would be used as a stand-alone document for the design, installation, and maintenance of marine carbon dioxide systems. Chapter 9 was added in 1998 to address marine installations. It was intended to be used in lieu of other standards such as 46 CFR 119, "Machinery Installations."

##### 9.2.2

All other requirements of this standard shall apply to marine systems except as modified by this chapter.

#### 9.3 System Requirements.

##### 9.3.1 Components.

System components shall be specifically listed or approved for carbon dioxide system marine applications.

##### 9.3.2 Operating Instructions.

### 9.3.2.1

Instructions for the operation of the system shall be located in a conspicuous place at or near all manual controls and in the carbon dioxide storage room.

### 9.3.2.2

For systems in which the carbon dioxide storage is not within the protected space, the operating instructions shall include a chart indicating the location of the emergency control to be used if the normal controls fail to operate.

### 9.3.3 Actuation.

#### 9.3.3.1\*

For spaces greater than 6000 ft<sup>3</sup> (170 m<sup>3</sup>), automatic release of the carbon dioxide system shall not be permitted.

#### A.9.3.3.1

Some internal combustion propulsion engines and generator prime movers draw combustion air from the protected space in which they are installed. Because these types of engines are required to be shut down prior to system discharge, an automatically discharged system in some cases could shut down propulsion or electricity supply when needed most. A nonautomatic system gives the ship's crew the flexibility to decide the best course of action. For example, while navigating in a high-density shipping channel, a ship's ability to maneuver can be more important than immediate system discharge.

#### 9.3.3.2\*

Automatic release shall be permitted for any space of 6000 ft<sup>3</sup> (170 m<sup>3</sup>) or less, provided the requirements of 9.3.3.2.1 through 9.3.3.2.4 are met.

#### A.9.3.3.2

On offshore platforms and on some vessels, small machinery enclosures are often located such that access by personnel at the time of a fire would be difficult and/or dangerous and cause unacceptable delay in system actuation. As long as life safety and vessel navigability are not adversely impacted, automatic actuation of systems protecting such spaces is permissible.

#### 9.3.3.2.1

Horizontal means of egress from the machinery enclosure to the open deck shall be provided.

#### 9.3.3.2.2

The enclosure shall be unmanned during any operation of the equipment.

#### 9.3.3.2.3

The system shall be locked out when persons are present within the enclosure.

#### 9.3.3.2.4

Automatic actuation of the system shall not interfere with safe navigation of the vessel.

### 9.3.3.3

For manual operation, two separate valves shall be provided for releasing carbon dioxide into any protected space.

#### 9.3.3.3.1

One valve shall control discharge from the carbon dioxide storage.

**9.3.3.3.2**

The second valve shall control carbon dioxide discharge into the protected space(s).

**9.3.3.3.3**

For systems that contain 300 lb (136 kg) of carbon dioxide storage or less, only one valve shall be required to be used for the release of the system, provided that the protected space is normally unoccupied and has horizontal egress.

**9.3.3.4\* Controls.****A.9.3.3.4**

Except for very small protected spaces noted in 9.3.3.3.3, it is the intent of this standard to require two separate manual operations to cause discharge of a marine system. Provision of a separate manually actuated control for each of the discharge control valves required by 9.3.3.3 accomplishes this intent. This requirement is an exception to the "normal manual operation" as defined in 4.5.1.2.

**9.3.3.4.1**

A separate manually operated control shall be provided to operate each valve required by 9.3.3.3.

**9.3.3.4.2**

A set of controls shall be located outside at least one of the main means of egress from each protected space.

**9.3.3.5\***

In addition to the manually operated controls required by 9.3.3.4, each of the valves required by 9.3.3.3 shall be provided with its own emergency manual control.

**A.9.3.3.5**

For a high-pressure carbon dioxide system, the emergency manual control for the supply is the manual operator on the pilot cylinder(s).

**9.3.3.6 Release Box.****9.3.3.6.1**

Controls for the valves required by 9.3.3.4 shall be located inside a release box clearly identified for the protected space.

**9.3.3.6.2**

If the box containing the controls is to be locked, a key to the box shall be provided in a break-glass-type enclosure conspicuously located adjacent to the box.

**9.3.3.7\* Source of Power.****A.9.3.3.7**

Sufficient carbon dioxide should be provided to power the alarms at their rated pressure for the required time.

**9.3.3.7.1**

In addition to the requirements of 4.3.3.2, audible predischarge alarms shall be provided that depend on no source of power other than carbon dioxide pressure.

**9.3.3.7.2**

The time delay required by 4.5.6.2.2 shall be a minimum of 20 seconds and shall depend on no source of power other than carbon dioxide pressure.

**9.3.4 Carbon Dioxide Storage.****9.3.4.1**

Carbon dioxide storage shall be permitted inside normally unoccupied protected spaces for systems that contain not more than 300 lb (136 kg) of carbon dioxide storage and are equipped for automatic actuation.

**9.3.4.2**

Low-pressure systems shall be provided with dual refrigeration units and shall be constructed in accordance with 46 CFR 58.20.

**9.3.4.3**

When the carbon dioxide containers are located outside a protected space, they shall be stored in a room that shall be situated in a safe and readily accessible location and shall be effectively ventilated so that the agent containers are not exposed to ambient temperatures outlined in 4.6.5.5.

**9.3.4.3.1**

Common bulkheads and decks located between agent container storage rooms and protected spaces shall be protected with A-60 class structural insulation as defined by 46 CFR 72.

**9.3.4.3.2**

Doors and other means of closing any opening therein that form the boundaries between such rooms and adjoining protected spaces shall be gastight.

**9.3.4.3.3**

Agent container storage rooms shall be accessible without having to pass through the space being protected.

**9.3.4.3.4**

Access doors shall open outward.

**9.3.4.3.5**

For systems that contain 300 lb (136 kg) of carbon dioxide storage or less, only one valve shall be required to be used for the release of the system, provided that the protected space is normally unoccupied and has horizontal egress.

**9.3.5 System Piping.****9.3.5.1**

Where necessary, drains shall be provided for the removal of accumulated moisture.

**9.3.5.2**

Carbon dioxide piping shall not be fitted with drains or other openings within living quarters.

**9.3.5.3**

Carbon dioxide piping shall be used for no other purpose, except that carbon dioxide piping shall be permitted to be used in an air-sampling-type smoke detection system.

**9.3.6 System Design.**

System design shall comply with Chapters 5 through 7 except as described in 9.3.6.1 through 9.3.6.4.2.

**9.3.6.1 Machinery Spaces.**

Machinery spaces shall be designed to a 34 percent concentration based on the gross volume.

**9.3.6.1.1**

Eighty-five percent of the concentration required by 9.3.6.1 shall be achieved within 2 minutes from the start of discharge.

**9.3.6.1.2**

Gross volume shall include the casing.

**9.3.6.2 Cargo Spaces.**

Cargo spaces other than vehicle spaces shall be supplied with carbon dioxide based on 1 lb/30 ft<sup>3</sup> based on the gross volume.

**9.3.6.2.1**

The initial quantity of carbon dioxide discharged shall be based on the net volume of the space as determined by the amount of cargo in the cargo space.

**9.3.6.2.2\***

Additional carbon dioxide shall be released as needed to maintain control of the fire.

**A.9.3.6.2.2**

An example of where drains would be necessary would be low points in carbon dioxide piping, which are also used by a sampling-type smoke detection system.

Fires in cargo spaces may not be completely extinguished by the carbon dioxide discharge. Whether the fire is completely extinguished or only suppressed depends on a number of factors, including the type and quantity of burning material. Some leakage of carbon dioxide-enriched atmosphere from the cargo hold is likely. Therefore, additional carbon dioxide might need to be discharged on an intermittent basis to maintain fire suppression in the cargo hold until the vessel reaches port. Once at port, before the cargo hold is opened, a properly equipped and trained fire brigade should be standing by to effect complete extinguishment of the burning material.

**9.3.6.2.3**

Clear instructions shall be posted within the carbon dioxide storage room detailing the carbon dioxide release procedure.

**9.3.6.3 Vehicle Spaces.****9.3.6.3.1**

Vehicle spaces where the vehicles contain more than 5 gal (19 L) of fuel (gasoline or diesel) shall be designed to a 34 percent concentration based on the gross volume.

**9.3.6.3.2**

Eighty-five percent of this concentration shall be achieved within 2 minutes from start of discharge.

**9.3.6.4 Vehicle Spaces.****9.3.6.4.1**

Vehicle spaces where the vehicles contain 5 gal (19 L) or less of fuel (gasoline or diesel) shall be designed to a 34 percent concentration based on the gross volume.

**9.3.6.4.2**

Two-thirds of this concentration shall be achieved within 10 minutes from start of discharge.

**9.3.7 Electrical Equipment Spaces.**

Electrical equipment spaces shall be treated as a dry electrical hazard in accordance with Chapter 5.

## 9.4 Inspection and Maintenance.

Inspection and maintenance shall comply with 4.8.3 and Section 9.4.

### 9.4.1 General.

Prior to testing or maintenance of a fixed carbon dioxide system, all personnel shall be evacuated from the protected space. (See Section 4.3.)

### 9.4.2 Approval of Installations.

#### 9.4.2.1

The approval test described in 9.4.2.1.1 through 9.4.2.1.4 shall be conducted prior to the tests required by 4.4.3.

##### 9.4.2.1.1

Pressure tests of the piping shall be performed to meet the requirements of 9.4.2.1.2 through 9.4.2.1.4.

##### 9.4.2.1.2

The test medium shall be a dry, noncorrosive gas such as nitrogen or carbon dioxide.

##### 9.4.2.1.3

When pressurizing the piping, pressure shall be increased in 50 psi (3.5 bar) increments.

##### 9.4.2.1.4

Once the pressure in the pipe has reached the required test pressure, the pressure source shall be shut off and disconnected from the pipe.



Pneumatic pressure testing creates a potential risk of injury to personnel in the area, as a result of airborne projectiles, if rupture of the piping system occurs. Prior to the pneumatic pressure test, the area in which the pipe is located shall be evacuated and appropriate safeguards shall be provided for test personnel.

### 9.4.2.2 High-Pressure Systems.

#### 9.4.2.2.1 Systems with Stop Valves.

##### 9.4.2.2.1.1

All piping from the carbon dioxide supply to the stop valves shall be subjected to a minimum pressure of 1000 psi (6895 kPa).

##### 9.4.2.2.1.2

The leakage during a 2-minute period shall not exceed a pressure drop of 10 percent.

##### 9.4.2.2.1.3

All piping between the stop valves and the nozzles shall be subjected to a minimum pressure of 600 psi (4137 kPa).

##### 9.4.2.2.1.4

The leakage during a 2-minute period shall not exceed a pressure drop of 10 percent.

#### 9.4.2.2.2 Systems Without Stop Valves.

##### 9.4.2.2.2.1

All piping from the carbon dioxide supply to the nozzles shall be subjected to a minimum pressure of 600 psi (4137 kPa).

##### 9.4.2.2.2.2

The leakage during a 2-minute period shall not exceed a pressure drop of 10 percent.

#### 9.4.2.3 Low-Pressure Systems.

##### 9.4.2.3.1 Normally Pressurized Piping.

###### 9.4.2.3.1.1

All piping that is normally pressurized shall be subjected to a minimum pressure test of 300 psi (2068 kPa).

###### 9.4.2.3.1.2

No leakage shall be permitted from the piping during a 2-minute test.

##### 9.4.2.3.2 Piping Between the Tank Shutoff Valve and Nozzles.

###### 9.4.2.3.2.1

All piping between the tank shutoff valve and the nozzles shall be subjected to a minimum pressure test of 300 psi (2068 kPa).

###### 9.4.2.3.2.2

The leakage during a 2-minute period shall not exceed a pressure drop of 10 percent.

#### 9.4.3 Predischarge Delays, Alarms, and Shutdowns.

##### 9.4.3.1

Predischarge delays and alarms and ventilation shutdowns shall be tested by flowing carbon dioxide into the system.

##### 9.4.3.2

Predischarge delays that are not accurate to within +20 percent/-0 percent at 70°F (21°C) of their rating shall be replaced.

#### 9.4.4 Verification.

Compliance with 9.3.2 shall be verified.

## Submitter Information Verification

**Committee:** GFE-AAA

**Submission Date:** Thu May 11 13:13:11 EDT 2023

## Committee Statement

**Committee Statement:** A task group has been formed to review chapter 9 in its entirety to update information to align with the US Coast Guard requirements. There are references that should be aligned with how they are used within the US Maritime Organization.

**Response Message:** CI-18-NFPA 12-2023

## Ballot Results

 This item has not been balloted



## Public Comment No. 1-NFPA 12A-2023 [ Section No. 6.1.4 ]

### 6.1.4\*

The agent quantity and pressure of refillable containers shall be checked. If a container shows a loss in net weight of more than 5 percent or a loss in pressure (adjusted for temperature) of more than 10 percent, it shall be refilled or replaced. ~~When the amount of agent in the container is determined by special measuring devices in lieu of weighing, these devices shall be listed.~~

### Statement of Problem and Substantiation for Public Comment

The 2004 edition added the language requiring that "when the agent in the container is determined by special measuring devices in lieu of weighing, these devices shall be listed." There does not appear to be a standard for listing such a device. A review of the 2004 edition committee ROP and ROC shows no committee deliberation on the new requirement, only that the document was re-written per the 2000 NFPA Manual of Style. This appears to have been an inadvertent change to the code in 2004.

A review of other similar standards, UL S593, US Coast Guard Regulation 46 CFR Part 147.65, US DoD UFC 3-601-02 shows that all permit alternative means, and none requires the alternative device be listed.

#### Related Item

- first draft report

### Submitter Information Verification

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**Submittal Date:** Fri Aug 25 12:40:21 EDT 2023

**Committee:** GFE-AAA



## Public Comment No. 4-NFPA 2001-2023 [ Section No. 4.4.1 ]

### 4.4.1

Before system cylinders are handled or moved, the following steps shall be taken:

- (1) Cylinder outlets shall be fitted with anti-recoil devices, cylinder caps, or both, whenever the cylinder outlet is not connected to the system pipe inlet.
- (2) Cylinder caps shall be fitted whenever the cylinder is removed from the retaining bracketing.
- (3) Actuators shall be disabled or removed before cylinders are removed from retaining bracketing.

### Statement of Problem and Substantiation for Public Comment

Adding cylinder cap requirement for NFPA 2001 to be compliant to with OSHA 1926.350(a)(1).

#### Related Item

- Public Input No. 35

### Submitter Information Verification

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**Submittal Date:** Tue Dec 05 08:00:21 EST 2023

**Committee:** GFE-AAA



## Public Comment No. 1-NFPA 2001-2023 [ Section No. 5.2.2.6 ]

### 5.2.2.6

All threads used in joints and fittings shall conform to ASME B1.20.1, *Standard on Pipe Threads, General Purpose, Inch*, or ISO 7-1, *Pipe Threads Where Pressure-Tight Joints Are Made on the Threads — Part 1: Dimensions, Tolerances and Designation* ~~Joint~~ (here, joint compound, tape, or thread lubricant shall be applied only to the male threads of the joint) or ISO228-1, Pipe Threads Where Pressure-Tight Joints Are Not Made on the Threads (here the pressure-tightness is made by pressing together two sealing surfaces being outside of the threads by using an appropriate sealant, e.g. an o-ring or a metallic flat gasket).

### Statement of Problem and Substantiation for Public Comment

More and more components (e.g. hoses, regulators, check valves, manifolds etc.) on the market used within clean agent extinguishing systems have o-ring sealings to make connections tight. Many of these components are UL and FM approved (plus have all the relevant European approvals). Some suppliers say that these kind of sealings are technically more advanced than existing pipe connections with PTFE tape or hemp).

An example could be the QUANTUM manifold and high pressure pipe system from HDT Füsser (<https://www.hdt-fuesser.de/english/systeme.html>). HDT Füsser supplies many fire suppression companies in Europe. The sealing of the QUANTUM system should never be done via the threads, as it is known that a complex installation has to be done. The system uses the threads only to create the seal via a force fit in the O-ring and the associated two sealing surfaces. This is seen as a significant advancement in the components of time and safety with the QUANTUM system, which can be installed without tools or sealant.

The connection in the QUANTUM system is tight in the external thread even without sealant. Especially since NFPA2001 4.2.2.6 only requires sealant in the male thread if it is needed. Furthermore, we are also aware that the used O-rings could require UL certification acc. UL2127.

EN ISO228-1 points out that pressure-tightness has to be achieved by pressing two sealing surfaces onto each other AND by interposing a suitable gasket.

Next to QUANTUM there are much more clever solutions and products who could make use of the adaptation of the NFPA2001 standard.

#### Related Item

- PI

### Submitter Information Verification

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**Submittal Date:** Wed Sep 06 08:32:52 EDT 2023

**Committee:** GFE-AAA



## Public Comment No. 5-NFPA 2001-2023 [ Section No. 7.1.8.2 ]

### 7.1.8.2

~~Designers~~ For calculation of enclosure vent area, designers shall consult ~~the~~ either:

- 1) The system manufacturer's recommended procedures relative to enclosure venting.
- 2) The system manufacturer's approved calculation software.
- 3) Other recognized methodologies.

*[For pressure relief vent area or equivalent leakage area, see 6.1.2.5(28).]*

### Statement of Problem and Substantiation for Public Comment

The FSSA Pressure Venting Guide is listed in Appendix A, but other Methodologies exist. Section also must allow for use of manufacturer calculations, when provided.

#### Related Item

- Public Input No. 42

### Submitter Information Verification

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**Submittal Date:** Tue Dec 05 08:58:47 EST 2023

**Committee:** GFE-AAA



## Public Comment No. 3-NFPA 2001-2023 [ New Section after 9.4.10 ]

### 9.4.10.3

The electric actuator that removed from the agent storage container discharge valve shall be secured and placed on actuator holder or solenoid pocket to prevent mechanical damage and loss of integrity.

### Additional Proposed Changes

<u>File Name</u>	<u>Description</u>	<u>Approved</u>
Solenoid_Pocket_SOKET_.png	Before and After using Solenoid Pocket	
General_Specification_SOKET.pdf	General specification for SOKET not limited to other actuator holder	

### Statement of Problem and Substantiation for Public Comment

Actuator broken is one of the major problems for functional failure of FM-200 system based on comprehensive analysis and evaluation. This condition can make liquid loss and unreadiness of FM-200 system. Mechanical damage resulted from disconnection process on FM-200 system as no bracket or pocket to hold and secure actuator while maintenance or testing process. In current situation there is no statement to secure or hold the actuator, it has not been stated on Appendix A.9.4.10.1 (NFPA 72, 14.2.6.4 requires that "Suppression system shall be secured from inadvertent actuation, including disconnection of releasing solenoids or electric actuator, closing of valves, other actions, or combinations thereof, for the specific system, for the duration of the fire alarm system testing.") how the technical procedure or process of securing the solenoid while fire alarm system testing. It's highly recommended to add additional statement to prevent similar condition in other places by adding actuator holder or solenoid pocket as the solution for this problem.

#### Related Item

- PI

### Submitter Information Verification

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**Submittal Date:** Thu Nov 16 19:41:30 EST 2023  
**Committee:** GFE-AAA



# General Specification Solenoid Pocket (SOKET)

## 1.0 Scope

This Specification defines material and dimension minimum requirements for the design of Solenoid Pocket (SOKET). The specification aimed primarily at design features and at the quality of the SOKET. It specifies the general types of major material to be used in the SOKET production process.

## 2.0 References

The codes, standards and specification listed below are cited in this specification. Most of codes and standards cited in the general specifications are of Indonesian or U.S. and Europe origin. The citations are to the latest edition except where a specific edition is cited.

NFPA 72, National Fire Alarm and Signaling Code®

NFPA 1961, Standard on Fire Hose

NFPA 2001, Standard on Clean Agent Fire Extinguishing Systems

UU No. 1 / 1970 tentang Keselamatan Kerja

## 3.0 General

The materials, design, fabrication and testing of SOKET described herein shall be in accordance with the latest editions of the codes and standard referenced, and as supplemented, modified and or superseded by this specification. All components and installation procedures shall be governed by this specification in conjunction with referenced standards.

## 4.0 Material Specification

### 4.1 Waste Fire Hose :

- 100% Synthetic Rubber Fire Hose
- Easy to clean No need to dry.
- Damage is easy to repair.
- Resistant to hot weather or humid air.
- Not curved.
- Resistant to chemicals.
- Hose meets or exceeds specifications for heat and kink resistance.
- Lay-flat, lightweight and flexible ideally suited for industrial fire protection and in-plant apparatus.
- Hose designed to resist cracking, mildew, and rot. n Resists fuels, oils and a wide range of chemicals and bases.
- Underwriters Laboratories listing and Factory Mutual approval available on 1½" and 2½" diameters.
- Manufactured to meet or exceed NFPA 1961 standard.

#### 4.2 Adhesive :

- Chemical Type : Ethyl cyanoacrylate
- Appearance (uncured) : Transparent, colorless to straw
- Components : One part - requires no mixing
- Viscosity : Low
- Cure : Humidity
- Application : Bonding
- Key Substrates : Plastics, Rubbers and Metals
- Adhesive Properties
- After 24 hours @ 22 °C
- Lap Shear Strength, ISO 4587:

Steel (grit blasted)	N/mm <sup>2</sup> 14.2 (psi) (2,060)
Aluminum (grit blasted)	N/mm <sup>2</sup> 10.8 (psi) (1,570)
Zinc dichromate	N/mm <sup>2</sup> 5.9 (psi) (860)
ABS	N/mm <sup>2</sup> 7.9 (psi) (1,150)
PVC	N/mm <sup>2</sup> 8.7 * (psi) (1,260)
Polycarbonate	* N/mm <sup>2</sup> 8 * (psi) (1,160)
Phenolic	N/mm <sup>2</sup> 9.9 (psi) (1,440)
Neoprene	N/mm <sup>2</sup> 1 * (psi) (145)
Nitrile	N/mm <sup>2</sup> 1.3 * (psi) (190)
Tensile Strength, ISO 6922: Buna-N	N/mm <sup>2</sup> ≥6.0LMS (psi) (≥870)

#### 4.3 Cable Ties :

<b>Technical Specifications</b>	
Material	Nylon 66
Operating Temp	-40 to +85°C
Flammability	UL 94 V2
UV Light/Ozone Resistance	Medium
Oils & Grease Resistance	Excellent
Solvents Resistance	Good
Petrol Resistance	Excellent
Standards	UL E70062, BS EN 62275:2009 and UL1565





## Public Comment No. 7-NFPA 2001-2023 [ Section No. 9.7.2 ]

### 9.7.2\*

For hazard areas subject to fast-growth fires, or where the provision of a time delay would increase the threat to life and property, a time delay shall be permitted to be eliminated.

### Statement of Problem and Substantiation for Public Comment

There are cases where a slow growing fire could still need to be addressed quickly. For instance a smoldering fire inside a dust collector could need to be addressed quickly to limit damage.

#### Related Item

- Committee Discussion

### Submitter Information Verification

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**Submittal Date:** Wed Dec 27 15:17:24 EST 2023

**Committee:** GFE-AAA



## Public Comment No. 8-NFPA 2001-2023 [ Sections 11.3.4, 11.3.5 ]

### Sections 11.3.4, 11.3.5

#### 11.3.4\*

For inert gas clean agents, if a container shows a loss in pressure (adjusted for temperature) of more than 5 percent, it shall be refilled or replaced.

#### 11.3.

~~5-~~

~~Where container pressure gauges are used to comply with 11.3.4, they 4.1~~

~~If an inert gas container pressure gauge shows any loss in pressure (adjusted for temperature) it shall be compared to a separate calibrated device at least annually pressure gauge .~~

### Statement of Problem and Substantiation for Public Comment

Pressure gauges used on inert gas systems that are Listed have shown to have a high degree of quality. The current test requires each gauge to be compared to a calibrated gauge annually. Actual field testing has shown this exercise verifies that the Listed gauges work as designed. Any cylinder that shows any leakage should be further evaluated but checking cylinders that show no leakage is a safety risk and can actually create a leak where there was not one before.

#### Related Item

- 14

### Submitter Information Verification

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**Submittal Date:** Wed Dec 27 15:40:02 EST 2023

**Committee:** GFE-AAA



## Public Comment No. 6-NFPA 2001-2023 [ Section No. A.3.3.10 ]

### A.3.3.10 Deep-Seated Fire.

A characteristic of this type of combustion is the slow rate of heat ~~losses~~ loss from the reaction zone. Thus, the fuel remains hot enough to exothermically react with oxygen, even though the rate of reaction, which is controlled by diffusion processes, is extremely slow. Deep-seated fires can continue to burn for many weeks, for example, in bales of cotton and jute and heaps of sawdust. A deep-seated fire ceases to burn only when either all the available oxygen or fuel has been consumed or the fuel surface is at too low a temperature to react.

Deep-seated fires usually are extinguished by reducing the fuel temperature, either directly by application of a heat-absorbing medium, such as water, or by blanketing with an inert gas. The medium slows the reaction rate to the point where heat generated by oxidation is less than heat losses to surroundings. This causes the temperature to fall below the level necessary for re-ignition after removal of the inert atmosphere.

### Statement of Problem and Substantiation for Public Comment

Editorial, grammatical correction

#### Related Item

- Editorial

### Submitter Information Verification

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**Submittal Date:** Wed Dec 13 19:07:26 EST 2023

**Committee:** GFE-AAA



## Committee Input No. 24-NFPA 2001-2023 [ Global Input ]

Change from kPa to bar throughout the document.

### Submitter Information Verification

**Committee:** GFE-AAA

**Submission Date:** Wed May 24 10:20:40 EDT 2023

### Committee Statement

**Committee Statement:** Tables use a mix of kPa and bar in different tables

Task Group has been formed to review metric conversion and provide recommendation for Second Draft.

**Response Message:** CI-24-NFPA 2001-2023

[Public Input No. 36-NFPA 2001-2023 \[Global Input\]](#)

### Ballot Results

 **This item has not been balloted**



## Committee Input No. 20-NFPA 2001-2023 [ Section No. 4.3.7 ]

### 4.3.7\* Occupiable Spaces.

Systems protecting occupiable spaces where the clean agent design concentration and egress time exceeds the design concentration and corresponding egress time approved for use in normally occupied spaces in accordance with 4.3.2 for halocarbon agents or 4.3.3 for inert gas agents shall include the following:

- (1) Supervised system lockout valves
- (2) Pneumatic pre-discharge alarms
- (3) Pneumatic time delays
- (4) Warning signs

#### A.4.3.7

In applying this provision of the standard, it is important to understand the relationship between agent concentration and egress time. The agent concentration permitted for human exposure is linked to the amount of time for which a person could be exposed to the agent concentration. For example, exposure to an HFC-227ea concentration up to and including 10.5 percent is permitted if the maximum exposure time (egress time) is limited to not more than 5 minutes, but exposure to a concentration of 11 percent would be permitted only if the exposure time could be limited to not more than 1.13 minutes. Similarly, exposure to an inert gas agent concentration up to 43 percent is permitted if the exposure time is limited to not more than 5 minutes, while exposure to a concentration up to 52 percent is permitted only if the exposure time is limited to not more than 3 minutes.

### 4.3.7.1\*

Pneumatic pre-discharge alarms shall be operated by an inert gas.

#### A.4.3.7.1

Inert gases used to operate pre-discharge alarms include inert gas clean agents, nitrogen, and carbon dioxide.

### 4.3.7.2

For an inert gas clean agent fire-extinguishing system, the quantity of inert gas discharged to operate a pneumatic pre-discharge alarm discharging into the protected space shall be considered, together with the quantity of agent discharged, when making a determination of post-discharge oxygen concentration with respect to compliance with the requirements of 4.3.3.

## Submitter Information Verification

**Committee:** GFE-AAA

**Submittal Date:** Thu May 11 13:43:17 EDT 2023

## Committee Statement

**Committee Statement:** A task group was formed to research situations where a time delay may not be appropriate.  
**Response Message:** CI-20-NFPA 2001-2023

### Ballot Results

 **This item has not been balloted**



## Committee Input No. 19-NFPA 2001-2023 [ Chapter 13 ]

### Chapter 13 Marine Systems

#### 13.1 General.

This chapter outlines the deletions, modifications, and additions that are necessary for marine applications. All other requirements of NFPA 2001 shall apply to shipboard systems except as modified by this chapter. Where the provisions of Chapter 13 conflict with the provisions of Chapter 1 through Chapter 11, the provisions of Chapter 13 shall take precedence.

##### 13.1.1 Scope.

This chapter is limited to marine applications of clean agent fire extinguishing systems on commercial and government vessels. Explosion inerting systems were not considered during development of this chapter.

#### 13.2 Use and Limitations.

##### 13.2.1\*

Total flooding clean agent fire extinguishing systems shall be used primarily to protect hazards that are in enclosures or equipment that, in itself, includes an enclosure to contain the agent.

##### A.13.2.1

Some typical hazards that could be suitable include, but are not limited to, the following:

- (1) Machinery spaces such as main machinery spaces
- (2) Emergency generator rooms
- (3) Pump rooms
- (4) Flammable liquid storage and handling areas and paint lockers
- (5) Control rooms and electronic equipment spaces

##### 13.2.2\*

In addition to the limitations given in 4.2.2, clean agent fire extinguishing systems shall not be used to protect the following:

- (1) Dry cargo holds
- (2) Bulk cargo

##### A.13.2.2

General cargo should not be protected with halocarbon agents due to the possibility of deep-seated cargo fires and due to wide variations in cargo materials. Dry cargoes, such as containerized cargoes, often comprise a wide mix of commodities that can include materials or storage arrangements not suited for protection with halocarbon agents. The volume of agent needed to protect cargo spaces varies depending on the volume of the cargo space minus the volume of the cargo carried. This quantity varies as cargo volume changes and can affect fire extinguishing effectiveness or agent toxicity.

### 13.2.3

The effects of agent decomposition products and combustion products on fire protection effectiveness and equipment shall be considered where using clean agents in hazards with high ambient temperatures (e.g., incinerator rooms, hot machinery and piping).

## 13.3 Hazards to Personnel.

### 13.3.1

Other than the engine rooms identified in 13.3.1.1, all other main machinery spaces shall be considered normally occupied spaces.

#### 13.3.1.1

Engine rooms of 6000 ft<sup>3</sup> (170 m<sup>3</sup>) or less that are accessed for maintenance only shall not be required to comply with 13.3.1.

#### 13.3.2\*

For marine systems, electrical clearances shall be in accordance with 46 CFR, Subchapter J, "Electrical Engineering."

#### A.13.3.2

Subchapter J of 46 CFR 111.59 requires busways to comply with Article 368 of *NFPA 70*. Article 368 requires compliance with Article 300 for clearances around busways.

## 13.4 Agent Supply.

### 13.4.1

Reserve quantities of agent shall not be required by this standard.

#### 13.4.2\*

Storage container arrangement shall be in accordance with 5.1.3.1 and 5.1.3.3 through 5.1.3.5. Where equipment is subject to extreme weather conditions, the system shall be installed in accordance with the manufacturer's design and installation instructions.

#### A.13.4.2

Agent cylinder storage spaces should be adequately ventilated. Entrances to such spaces should be from an open deck.

#### 13.4.2.1

Except in the case of systems with storage cylinders located within the protected space, pressure containers required for the storage of the agent shall be in accordance with 13.4.2.2.

#### 13.4.2.2

Where the agent containers are located outside a protected space, they shall be stored in a room that shall be situated in a safe and readily accessible location and shall be effectively ventilated so that the agent containers are not exposed to ambient temperatures in excess of 130°F (55°C). Common bulkheads and decks located between clean agent container storage rooms and protected spaces shall be protected with A-60 class structural insulation as defined by 46 CFR 72. Agent container storage rooms shall be accessible without having to pass through the space being protected. Access doors shall open outward, and bulkheads and decks, including doors and other means of closing any opening therein, that form the boundaries between such rooms and adjoining spaces shall be gastight.

#### 13.4.3

Where agent containers are stored in a dedicated space, doors at exits shall swing outward.

#### 13.4.4

Where subject to moisture, containers shall be installed such that a space of at least 2 in. (51 mm) between the deck and the bottom of the container is provided.

#### 13.4.5

In addition to the requirements of 5.1.3.4, containers shall be secured with a minimum of two brackets to prevent movement from vessel motion and vibration.

#### 13.4.6\*

For marine applications, all piping, valves, and fittings of ferrous materials shall be protected inside and out against corrosion except as permitted in 13.4.6.1.

##### A.13.4.6

Corrosion resistance is required to prevent clogging of nozzles with scale. Examples of suitable materials are hot dipped galvanized steel piping inside and out or stainless steel.

#### 13.4.6.1

Closed sections of pipe and valves and fittings within closed sections of pipe shall be required to be protected against corrosion only on the outside.

#### 13.4.6.2

Other than as permitted in 13.4.6.1, prior to acceptance testing, the inside of the piping shall be cleaned without compromising its corrosion resistance.

#### 13.4.7\*

Pipes, fittings, nozzles, and hangers, including welding filling materials, within the protected space shall have a melting temperature greater than 1600°F (871°C). Aluminum components shall not be used.

##### A.13.4.7

Fittings conforming to ASTM F1387 and fire tested with zero leakage conform to the requirements of 13.4.7.

#### 13.4.8

Piping shall extend at least 2 in. (51 mm) beyond the last nozzle in each branch line to prevent clogging.

#### 13.5 Detection, Actuation, and Control Systems.

##### 13.5.1 General.

##### 13.5.1.1

Detection, actuation, alarm, and control systems shall be installed, tested, and maintained in accordance with the requirements of the authority having jurisdiction.

##### 13.5.1.2\*

For spaces greater than 6000 ft<sup>3</sup> (170 m<sup>3</sup>), automatic release of the fire extinguishing agent shall not be permitted where actuation of the system can interfere with the safe navigation of the vessel. Automatic release of the fire extinguishing agent shall be permitted for any space where actuation of the system will not interfere with the safe navigation of the vessel.

**A.13.5.1.2**

The intent of this paragraph is to ensure that a suppression system will not interfere with the safe navigation of the vessel. Many internal combustion propulsion engines and generator prime movers draw combustion air from the protected space in which they are installed. Because these types of engines are required to be shut down prior to system discharge, an automatically discharged system would shut down propulsion and electricity supply when needed most. A nonautomatic system gives the ship's crew the flexibility to decide the best course of action. For example, in a high-density shipping channel, a ship's ability to maneuver can be more important than immediate system discharge. For small vessels, the use of automatic systems is considered appropriate, taking into consideration the vessel's mass, cargo, and crew training.

**13.5.1.2.1**

Automatic release shall be permitted for any space of 6000 ft<sup>3</sup> (170 m<sup>3</sup>) or less.

**13.5.2 Automatic Detection.****13.5.2.1**

Electrical detection, signaling, control, and actuation system(s) shall have at least two sources of power. The primary source shall be from the vessel's emergency bus. For vessels with an emergency bus or battery, the backup source shall be either the vessel's general alarm battery or an internal battery within the system. Internal batteries shall be capable of operating the system for a minimum of 24 hours. All power sources shall be supervised.

**13.5.2.1.1**

For vessels without an emergency bus or battery, the primary source shall be permitted to be the main electrical supply.

**13.5.2.2**

In addition to the requirements set forth in Section 9.3, actuation circuits shall not be routed through the protected space where manual electrical actuation is used in marine systems.

**13.5.2.2.1**

For systems complying with 13.5.2.4, actuation circuits shall be permitted to be routed through the protected space.

**13.5.2.3\***

Manual actuation for systems shall not be capable of being put into operation by any single action. Other than as identified in 13.5.2.3.1, manual actuation stations shall be housed in an enclosure.

**A.13.5.2.3**

The intent is to prevent accidental or malicious system operation. Some examples of acceptable manual actuation stations are the following:

- (1) Breaking a glass enclosure and pulling a handle
- (2) Breaking a glass enclosure and opening a valve
- (3) Opening an enclosure door and flipping a switch

**13.5.2.3.1**

Manual actuation shall be permitted to be local manual actuation at the cylinder(s) location.

**13.5.2.4**

Systems protecting spaces larger than 6000 ft<sup>3</sup> (170 m<sup>3</sup>) shall have a manual actuation station located in the main egress route outside the protected space. In addition, systems protecting spaces larger than 6000 ft<sup>3</sup> (170 m<sup>3</sup>) having cylinders within the protected space and systems protecting unattended main machinery spaces shall have an actuation station in a continuously monitored control station outside the protected space.

#### **13.5.2.4.1**

Systems protecting spaces of 6000 ft<sup>3</sup> (170 m<sup>3</sup>) or less shall be permitted to have a single actuation station at either of the locations described in 13.5.2.4.

#### **13.5.2.5**

Emergency lighting shall be provided for remote actuation stations serving systems protecting main machinery spaces. All manual operating devices shall be labeled to identify the hazards they protect. In addition, the following information shall be provided:

- (1) Operating instructions
- (2) Length of time delay
- (3) Actions to take if system fails to operate
- (4) Other actions to take such as closing vents and taking a head count

#### **13.5.2.5.1**

For systems having cylinders within the protected space, a means of indicating system discharge shall be provided at the remote actuation station.

**13.6** Additional Requirements for Systems Protecting Class B Hazards Greater Than 6000 ft<sup>3</sup> (170 m<sup>3</sup>) with Stored Cylinders Within the Protected Space.

#### **13.6.1\***

An automatic fire detection system shall be installed in the protected space to provide early warning of fire to minimize potential damage to the fire extinguishing system before it can be manually actuated. The detection system shall initiate audible and visual alarms in the protected space and on the navigating bridge upon detection of fire. All detection and alarm devices shall be electrically supervised for continuity, and trouble indication shall be annunciated on the navigating bridge.

#### **A.13.6.1**

Heat detectors are typically used in machinery spaces and are sometimes combined with smoke detectors. Listed or approved optical flame detectors can also be used, provided they are in addition to the required quantity of heat and/or smoke detectors.

#### **13.6.2\***

Electrical power circuits connecting the containers shall be monitored for fault conditions and loss of power. Visual and audible alarms shall be provided to indicate this, and the alarms shall be annunciated on the navigating bridge.

#### **A.13.6.2**

This requirement is derived from SOLAS Regulation II-2/Regulation 5.3.

#### **13.6.3\***

Within the protected space, electrical circuits essential for the release of the system shall be heat resistant, such as mineral-insulated cable compliant with Article 332 of *NFPA 70*, or the equivalent. Piping systems essential for the release of systems designed to be operated hydraulically or pneumatically shall be of steel or other equivalent heat-resistant material.

**A.13.6.3**

This requirement is derived from SOLAS Regulation II-2/Regulation 5.3.

**13.6.4\***

The arrangements of containers and the electrical circuits and piping essential for the release of any system shall be such that in the event of damage to any one power release line through fire or explosion in a protected space (i.e., a single-fault concept) the entire fire extinguishing charge required for that space can still be discharged.

**A.13.6.4**

This requirement is derived from SOLAS Regulation II-2/Regulation 5.3.

**13.6.5\***

The containers shall be monitored for decrease in pressure due to leakage and discharge. Visual and audible signals in the protected area and either on the navigating bridge or in the space where the fire control equipment is centralized shall be provided to indicate a low-pressure condition.

**A.13.6.5**

This requirement is derived from SOLAS Regulation II-2/Regulation 5.3.

**13.6.6\***

Within the protected space, electrical circuits essential for the release of the system shall be Class A rated in accordance with *NFPA 72*.

**A.13.6.6**

This requirement is derived from SOLAS Regulation II-2/Regulation 5.3.

**13.7 Enclosure.****13.7.1\***

To prevent loss of agent through openings to adjacent hazards or work areas, openings shall be one of the following designs:

- (1) Permanently sealed
- (2) Equipped with automatic closures
- (3) Equipped with manual closures outfitted with an alarm circuit to indicate when these closures are not sealed upon activation of the system

**A.13.7.1**

A well-sealed enclosure is vital to proper operation of the system and subsequent extinguishment of fires in the protected space. Gastight boundaries of the protected space, such as those constructed of welded steel, offer a highly effective means for holding the fire extinguishing gas concentration. Where the space is fitted with openings, avenues for escape of the gas exist. Automatic closure of openings is the preferred method of ensuring enclosure integrity prior to discharge. Manually closed openings introduce added delay and an added human element into the chain of proper operation of the system. Failure of personnel to properly close all openings has been a recurring cause of gaseous systems not performing as intended. It is recognized that some openings in the enclosures, such as maintenance hatches and watertight doors, cannot be fitted with automatically operated closers due to personnel hazards or other limitations. In those cases, an indicator is required to alert the system operator that an opening has not been closed as required and thus the system is not ready for operation.

**13.7.1.1**

Where confinement of agent is not practical, or if the fuel can drain from one compartment to another, such as via a bilge, protection shall be extended to include the adjacent connected compartment or work areas.

**13.7.2\***

Prior to agent discharge, all ventilating systems shall be closed and isolated to preclude passage of agent to other compartments or the vessel exterior. Automatic shutdowns or manual shutdowns capable of being closed by one person from a position co-located with the agent discharge station shall be used.

**A.13.7.2**

Automatic shutdowns are the preferred method for shutting down a ventilation system. Shutdowns requiring personnel to find and manually close dampers far from the fire extinguishing system discharge station should not be permitted.

**13.8 Design Concentration Requirements.****13.8.1 Combinations of Fuels.**

For combinations of fuels, the design concentration shall be derived from the flame extinguishment value for the fuel requiring the greatest concentration.

**13.8.2 Design Concentration.**

For a particular fuel, the design concentration referred to in 13.8.3 shall be used.

**13.8.3 Flame Extinguishment.**

The minimum design concentration for Class B flammable and combustible liquids shall be as determined following the procedures described in IMO MSC/Circ. 848, *Revised Guidelines for the Approval of Equivalent Fixed Gas Fire-Extinguishing Systems as Referred to in SOLAS 74, for Machinery Spaces and Cargo Pump-Rooms*, as amended by IMO MSC.1/Circ. 1267, *Amendments to Revised Guidelines for the Approval of Equivalent Fixed Gas Fire-Extinguishing Systems, as Referred to in SOLAS 74, for Machinery Spaces and Cargo Pump-Rooms (MSC/Circ. 848)*.

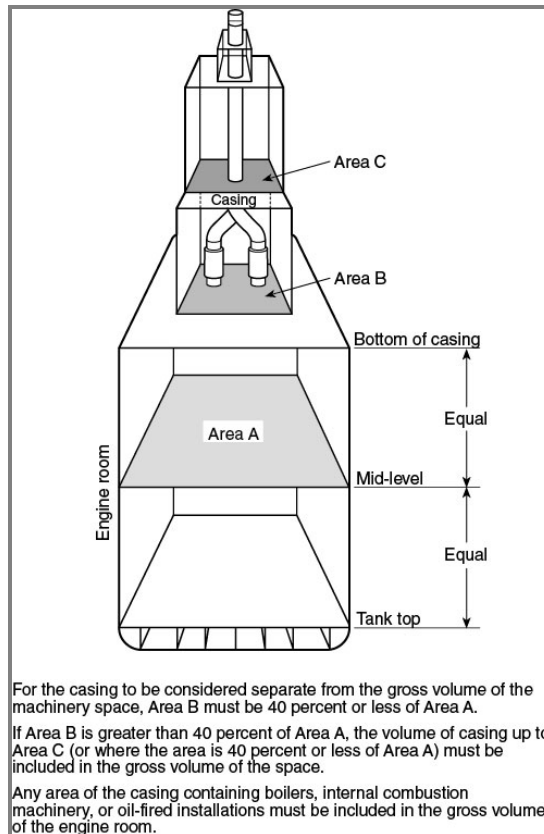
**13.8.4\* Total Flooding Quantity.**

The quantity of agent shall be based on the net volume of the space and shall be in accordance with the requirements of paragraph 5 of IMO MSC/Circular 848, *Revised Guidelines for the Approval of Equivalent Fixed Gas Fire-Extinguishing Systems as Referred to in SOLAS 74, for Machinery Spaces and Cargo Pump-Rooms*, Annex.

**A.13.8.4**

When the net volume of the machinery space is being calculated, the net volume should include the volume of the bilge and the volume of the stack uptake. The volume calculation should be permitted to exclude the portions of the stack uptake that have a horizontal cross-sectional area less than 40 percent of the horizontal cross-sectional area of the main machinery space. The horizontal cross-sectional area of the main machinery space should be measured midway between the lowest level (tank top) and the highest level (bottom of the stack casing). (See Figure A.13.8.4.)

**Figure A.13.8.4 Machinery Space and Stack Uptake.**



The objects that occupy volume in the protected space should be subtracted from the volume of the space. These objects include, but are not necessarily limited to, the following:

- (1) Auxiliary machinery
- (2) Boilers
- (3) Condensers
- (4) Evaporators
- (5) Main engines
- (6) Reduction gears
- (7) Tanks
- (8) Trunks

The Maritime Safety Committee, at its 67th session (December 2–6, 1996), approved guidelines for the approval of equivalent fixed gas fire extinguishing systems, as referred to in SOLAS 74, for machinery spaces and cargo pump rooms, as MSC/Circ. 776.

The Subcommittee on Fire Protection, at its 42nd session (December 8–12, 1997), recognized the need for technical improvement to the guidelines contained in MSC/Circ. 776 to assist in their proper implementation and, to that effect, prepared amendments to the guidelines.

The committee, at its 69th session (May 11–20, 1998), approved revised guidelines for the approval of equivalent fixed gas fire extinguishing systems, as referred to in SOLAS 74, for machinery spaces and cargo pump rooms, as set out in the annex, to supersede the guidelines attached to MSC/Circ. 776.

Member governments are invited to apply the annexed guidelines when approving equivalent fixed gas fire extinguishing systems for use in machinery spaces of category A and cargo pump rooms.

The quantity of extinguishing agent for the protected space should be calculated at the minimum expected ambient temperature using the design concentration based on the net volume of the protected space, including the casing.

The net volume of a protected space is that part of the gross volume of the space that is accessible to the free extinguishing agent gas.

In the calculation of the net volume of a protected space, the net volume should include the volume of the bilge, the volume of the casing, and the volume of free air contained in air receivers that in the event of a fire is released into the protected space.

The objects that occupy volume in the protected space should be subtracted from the gross volume of the space. They include, but are not necessarily limited to, the following:

- (1) Auxiliary machinery
- (2) Boilers
- (3) Condensers
- (4) Evaporators
- (5) Main engines
- (6) Reduction gears
- (7) Tank
- (8) Trunks

Subsequent modifications to the protected space that alter the net volume of the space require the quantity of extinguishing agent to be adjusted to meet the requirements of 13.8.4 and 13.8.5.

No fire suppression agent should be used that is carcinogenic, mutagenic, or teratogenic at concentrations expected during use. No agent should be used in concentrations greater than the cardiac sensitization NOAEL, without the use of controls as provided in SOLAS Regulation II-2/Regulations 5.2. In no case should an agent be used above its LOAEL nor approximate lethal concentration (ALC) calculated on the net volume of the protected space at the maximum expected ambient temperature.

#### **13.8.5\*** Duration of Protection.

It is important that the agent design concentration not only shall be achieved, but also shall be maintained for a sufficient period of time to allow effective emergency action by trained ship's personnel. In no case shall the hold time be less than 15 minutes.

#### **A.13.8.5**

Maintaining the design concentration is equally important in all classes of fires because a persistent ignition source, such as an electric arc, boiler front, heat source, engine exhaust, turbo charger, hot metal, or deep-seated fire, can lead to resurgence of the initial event once the clean agent has dissipated.

#### **13.9** Distribution System.

### **13.9.1 Rate of Application.**

The minimum design rate of application shall be based on the quantity of agent required for the desired concentration and the time allowed to achieve the desired concentration.

### **13.9.2 Discharge Time.**

#### **13.9.2.1**

The discharge time for halocarbon agents shall not exceed 10 seconds or as otherwise required by the authority having jurisdiction.

#### **13.9.2.2**

For halocarbon agents, the discharge time period shall be defined as the time required to discharge from the nozzles 95 percent of the agent mass [at 70°F (21°C)] necessary to achieve the minimum design concentration.

#### **13.9.2.3**

The discharge time for inert gas agents shall not exceed 120 seconds for 85 percent of the design concentration or as otherwise required by the authority having jurisdiction.

### **13.10 Nozzle Choice and Location.**

For spaces other than those identified in 13.10.1, nozzles shall be of the type listed for the intended purpose. Limitations shall be determined based on testing in accordance with IMO MSC/Circular 848, *Revised Guidelines for the Approval of Equivalent Fixed Gas Fire-Extinguishing Systems as Referred to in SOLAS 74, for Machinery Spaces and Cargo Pump-Rooms*. Nozzle spacing, area coverage, height, and alignment shall not exceed the limitations.

#### **13.10.1**

For spaces having only Class A fuels, nozzle placement shall be in accordance with the nozzles' listed limitations.

### **13.11 Inspection and Tests.**

At least annually, all systems shall be inspected and tested for proper operation by competent personnel. Discharge tests shall not be required.

#### **13.11.1**

An inspection report with recommendations shall be filed with the vessel's master and the owner's agent. The report shall be available for inspection by the authority having jurisdiction.

#### **13.11.2**

At least annually, the agent quantity of refillable containers shall be checked by competent personnel. The container pressure shall be verified and logged at least monthly by the vessel's crew.

#### **13.11.3\***

For halocarbon clean agents, if a container shows a loss in agent of more than 5 percent or a loss in pressure, adjusted for temperature, of more than 10 percent, it shall be refilled or replaced.

#### **A.13.11.3**

For determination of container pressure, the original container fill density should be obtained from the system manufacturer and the temperature/pressure relation should be obtained from tables published by the system manufacturer. For determination of container liquid level, the liquid level-temperature relationship should be obtained from the system manufacturer.

#### **13.11.3.1\***

If an inert gas clean agent container shows a loss in pressure, adjusted for temperature, of more than 5 percent, it shall be refilled or replaced. Where container pressure gauges are used for this purpose, they shall be compared to a separate calibrated device at least annually.

#### **A.13.11.3.1**

For inert gas clean agents that are not liquefied, pressure is an indication of agent quantity.

#### **13.11.4**

The installing contractor shall provide instructions for the operational features and inspection procedures specific to the clean agent system installed on the vessel.

#### **13.12 Approval of Installations.**

Prior to acceptance of the system, technical documentation, such as the system design manual, test reports, or the listing report, shall be presented to the authority having jurisdiction. This documentation shall show that the system and its individual components are compatible, employed within tested limitations, and suitable for marine use.

#### **13.12.1**

The listing organization shall perform the following functions:

- (1) Verify that fire tests were conducted in accordance with a predetermined standard
- (2) Verify that component tests were conducted in accordance with a predetermined standard
- (3) Review the component quality assurance program
- (4) Review the design and installation manual
- (5) Identify system and component limitations
- (6) Verify flow calculations
- (7) Verify the integrity and the reliability of system as a whole
- (8) Have a follow-up program
- (9) Publish a list of equipment

#### **13.13 Periodic Puff Testing.**

A test in accordance with 10.4.15 shall be performed at 24-month intervals. The periodic test program shall include a functional test of all alarms, controls, and time delays.

#### **13.14 Compliance.**

Electrical systems shall be in accordance with 46 CFR Subchapter J. For Canadian vessels, electrical installations shall be in accordance with TP 127 E, *Ship Safety Electrical Standards*.

## **Submitter Information Verification**

**Committee:** GFE-AAA

**Submittal Date:** Thu May 11 13:08:59 EDT 2023

## **Committee Statement**

**Committee Statement:** A task group has been formed to review chapter 13 in its entirety to update information to align with the US Coast Guard requirements. There are references that should be aligned with how they are used within the US Maritime Organization.

**Response** CI-19-NFPA 2001-2023  
**Message:**

### Ballot Results

 **This item has not been balloted**