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Chapter 2 Referenced Publications

2.1 General.

The documents or portions thereof listed in this chapter are referenced within this recommended practice and should be considered part of the recommendations of this document.

2.2 NFPA Publications.

National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471.

NFPA 30, *Flammable and Combustible Liquids Code,* 2015 edition.

NFPA 33, *Standard for Spray Application Using Flammable or Combustible Materials,* ~~2015~~ 2016 edition.

NFPA 34, *Standard for Dipping, Coating, and Printing Processes Using Flammable or Combustible Liquids,* 2015 edition.

NFPA 35, *Standard for the Manufacture of Organic Coatings,* 2016 edition.

NFPA 36, *Standard for Solvent Extraction Plants,* 2013 edition.

NFPA 45, *Standard on Fire Protection for Laboratories Using Chemicals,* 2015 edition.

NFPA 55, *Compressed Gases and Cryogenic Fluids Code,* 2016 edition.

NFPA 58, *Liquefied Petroleum Gas Code,* 2017 edition.

NFPA 59A, *Standard for the Production, Storage, and Handling of Liquefied Natural Gas (LNG),* 2016 edition.

NFPA 70®, *National Electrical Code®*, 2017 edition.

2.3 Other Publications.

2.3.1 API Publications.

American Petroleum Institute, 1220 L Street, NW, Washington, DC 20005-4070.

API RP 500, *Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class I, Division 1 and Division 2*, 3rd edition, 2008.

API RP 505, *Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class I, Zone 0, Zone 1, and Zone 2*, 2002, reaffirmed 2013.

2.3.2 ASHRAE Publications.

~~American Society of Heating, Refrigeration and Air-Conditioning Engineers~~ ASHRAE , Inc., 1791 Tullie Circle NE, Atlanta, GA 30329-2305.

~~ASHRAE 15~~ ASHRAE STD 15 , *Safety Standard for Refrigeration Systems*, 2013.

ASHRAE STD 34, *Designation and Classification of Refrigerants,* 2013.

2.3.3 ASTM Publications.

ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959.

ASTM D323, *Standard Method of Test for Vapor Pressure of Petroleum Products (Reid Method)*, 2008, ~~(~~ reaffirmed 2014~~)~~ .

2.3.4 CGA Publications.

Compressed Gas Association, 14501 George Carter Way, Suite 103, Chantilly, VA 20151-2923.

CGA G2.1, *Safety Requirements for the Storage and Handling of Anhydrous Ammonia*, ~~1999~~ 6th edition, 2014 .

2.3.5 IEC Publications.

International Electrotechnical Commission, 3, rue de Varembé, P.O. Box 131, CH-1211 Geneva 20, Switzerland.

IEC 60079-20-1, *Explosive atmospheres — Part 20-1: Material characteristics for gas and vapor classification — Test methods and data*, 2012.

2.3.6 ISA Publications.

The International Society of Automation, 67 T.W. Alexander Drive, P.O. Box 12277, Research Triangle Park, NC 27709.

ISA-RP12.12.03, *Standard for Portable Electronic Products Suitable for Use in Class I and II, Division 2, Class I Zone 2 and Class III, ~~Division~~ Division 1 and 2 Hazardous (Classified) Locations,* 2011.

2.3.7 Other Publications.

Merriam-Webster's Collegiate Dictionary, 11th edition, Merriam-Webster, Inc., Springfield, MA, 2003.

2.4 References for Extracts in Recommendations Sections.

NFPA 30, *Flammable and Combustible Liquids Code,* 2015 edition.

NFPA 59A, *Standard for the Production, Storage, and Handling of Liquefied Natural Gas (LNG),* ~~2013~~ 2016 edition.

NFPA 70®, *National Electrical Code®*, ~~2014~~ 2017 edition.

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Second Revision No. 5-NFPA 497-2015 [Section No. 4.4.2 [Excluding any Sub-Sections]]

An alphabetical listing of selected combustible materials, with their group classification and relevant physical properties, is provided in Table 4.4.2.

Table 4.4.2 Selected Chemicals

Chemical	CAS No.	Class I Division Group	Type[a]	Flash Point (°C)	AIT (°C)	%LFL	%UFL	Vapor Density (Air = 1)	Vapor Pressure[b] (mm Hg)	Class I Zone Group[c]	MIE (mJ)	MIC Ratio	MESG (mm)
Acetaldehyde	75-07-0	C[d]	I	-38	175	4.0	60.0	1.5	874.9	IIA	0.37	0.98	0.92
Acetic Acid	64-19-7	D[d]	II	39	426		19.9	2.1	15.6	IIA		2.67	1.76
Acetic Acid- tert-Butyl Ester	540-88-5	D	II			1.7	9.8	4.0	40.6				
Acetic Anhydride	108-24-7	D	II	49	316	2.7	10.3	3.5	4.9	IIA			1.23
Acetone	67-64-1	D[d]	I	-20	465	2.5	12.8	2.0	230.7	IIA	1.15	1.00	1.02
Acetone Cyanohydrin	75-86-5	D	IIIA	74	688	2.2	12.0	2.9	0.3				
Acetonitrile	75-05-8	D	I	6	524	3.0	16.0	1.4	91.1	IIA			1.50
Acetylene	74-86-2	A[d]	GAS		305	2.5	100	0.9	36600	IIC	0.017	0.28	0.25
Acrolein (Inhibited)	107-02-8	B(C)[d]	I		235	2.8	31.0	1.9	274.1	IIB	0.13		
Acrylic Acid	79-10-7	D	II	54	438	2.4	8.0	2.5	4.3	IIB			0.86
Acrylonitrile	107-13-1	D[d]	I	0	481	3	17	1.8	108.5	IIB	0.16	0.78	0.87
Adiponitrile	111-69-3	D	IIIA	93	550			1.0	0.002				
Allyl Alcohol	107-18-6	C[d]	I	22	378	2.5	18.0	2.0	25.4	IIB			0.84
Allyl Chloride	107-05-1	D	I	-32	485	2.9	11.1	2.6	366	IIA		1.33	1.17
Allyl Glycidyl Ether	106-92-3	B(C)[e]	II		57			3.9					
Alpha-Methyl Styrene	98-83-9	D	II		574	0.8	11.0	4.1	2.7				
n-Amyl Acetate	628-63-7	D	I	25	360	1.1	7.5	4.5	4.2	IIA			1.02
sec-Amyl Acetate	626-38-0	D	I	23		1.1	7.5	4.5		IIA			
Ammonia	7664-41-7	D[d,f]	GAS		651	15	28	0.6	7498.0	IIA	680	6.85	3.17
Aniline	62-53-3	D	IIIA	70	615	1.2	8.3	3.2	0.7	IIA			
Benzene	71-43-2	D[d]	I	-11	498	1.2	7.8	2.8	94.8	IIA	0.20	1.00	0.99
Benzyl Chloride	98-87-3	D	IIIA		585	1.1		4.4	0.5				
Bromopropyne	106-96-7	D	I	10	324	3.0							
n-Butane	106-97-8	D[d,g]	GAS		288	1.9	8.5	2.0		IIA	0.25	0.94	1.07
1,3-Butadiene	106-99-0	B(D)[d,e]	GAS		420	2.0	11.5	1.9		IIB	0.13	0.76	0.79
1-Butanol	71-36-3	D[d]	I	36	343	1.4	11.2	2.6	7.0	IIA			0.91
Butyl alcohol (s) (butanol-2)	78-92-2	D[d]	I	23.8	405	1.7	9.8	2.6		IIA			
Butylamine	109-73-9	D	GAS	-12	312	1.7	9.8	2.5	92.9	IIA		1.13	
Butylene	25167-67-3	D	I		385	1.6	10.0	1.9	2214.6	IIA			0.94
n-Butyraldehyde	123-72-8	C[d]	I	-12	218	1.9	12.5	2.5	112.2	IIA			0.92
n-Butyl Acetate	123-86-4	D[d]	I	22	421	1.7	7.6	4.0	11.5	IIA		1.08	1.04
sec-Butyl Acetate	105-46-4	D	II	-8		1.7	9.8	4.0	22.2				
tert-Butyl Acetate	540-88-5	D	II			1.7	9.8	4.0	40.6				
n-Butyl Acrylate (Inhibited)	141-32-2	D	II	49	293	1.7	9.9	4.4	5.5	IIB			0.88
n-Butyl Glycidyl Ether	2426-08-6	B(C)[e]	II										
n-Butyl Formal	110-62-3	C	IIIA						34.3				
Butyl Mercaptan	109-79-5	C	I	2				3.1	46.4				
Butyl-2-Propenoate	141-32-2	D	II	49		1.7	9.9	4.4	5.5				
para tert-Butyl Toluene	98-51-1	D	IIIA										

Chemical	CAS No.	Class I Division Group	Type[a]	Flash Point (°C)	AIT (°C)	%LFL	%UFL	Vapor Density (Air = 1)	Vapor Pressure[b] (mm Hg)	Class I Zone Group[c]	MIE (mJ)	MIC Ratio	MESG (mm)
n-Butyric Acid	107−92−6	D[d]	IIIA	72	443	2.0	10.0	3.0	0.8				
Carbon Disulfide	75−15−0	d,h	I	−30	90	1.3	50.0	2.6	358.8	IIC	0.009	0.39	0.20
Carbon Monoxide	630−08−0	C[d]	GAS		609	12.5	74	0.97		IIB			0.54
Chloroacetaldehyde	107−20−0	C	IIIA	88					63.1				
Chlorobenzene	108−90−7	D	I	29	593	1.3	9.6	3.9	11.9				
1-Chloro-1-Nitropropane	2425−66−3	C	IIIA										
Chloroprene	126−99−8	D	GAS	−20		4.0	20.0	3.0					
Cresol	1319−77−3	D	IIIA	81	559	1.1		3.7					
Crotonaldehyde	4170−30−3	C[d]	I	13	232	2.1	15.5	2.4	33.1	IIB			0.81
Cumene	98−82−8	D	I	36	424	0.9	6.5	4.1	4.6	IIA			1.05
Cyclohexane	110−82−7	D	I	−17	245	1.3	8.0	2.9	98.8	IIA	0.22	1.0	0.94
Cyclohexanol	108−93−0	D	IIIA	68	300			3.5	0.7	IIA			
Cyclohexanone	108−94−1	D	II	44	420	1.1	9.4	3.4	4.3	IIA			0.98
Cyclohexene	110−83−8	D	I	−6	244	1.2		2.8	89.4	IIA		0.97	
Cyclopropane	75−19−4	D[d]	I		503	2.4	10.4	1.5	5430	IIA	0.17	0.84	0.91
p-Cymene	99−87−6	D	II	47	436	0.7	5.6	4.6	1.5	IIA			
Decene	872−05−9	D	II		235			4.8	1.7				
n-Decaldehyde	112−31−2	C	IIIA						0.09				
n-Decanol	112−30−1	D	IIIA	82	288			5.3	0.008				
Decyl Alcohol	112−30−1	D	IIIA	82	288			5.3	0.008				
Diacetone Alcohol	123−42−2	D	IIIA	64	603	1.8	6.9	4.0	1.4				
Di-Isobutylene	25167−70−8	D[d]	I	2	391	0.8	4.8	3.8			0.96		
Di-Isobutyl Ketone	108−83−8	D	II	60	396	0.8	7.1	4.9	1.7				
o-Dichlorobenzene	955−50−1	D	IIIA	66	647	2.2	9.2	5.1		IIA			
1,4-Dichloro-2,3 Epoxybutane	3583−47−9	D[d]	I			1.9	8.5	2.0		IIA	0.25	0.98	1.07
1,1-Dichloroethane	1300−21−6	D	I		438	6.2	16.0	3.4	227	IIA			1.82
1,2-Dichloroethylene	156−59−2	D	I	97	460	5.6	12.8	3.4	204	IIA			3.91
1,1-Dichloro-1-Nitroethane	594−72−9	C	IIIA	76				5.0					
1,3-Dichloropropene	10061−02−6	D	I	35		5.3	14.5	3.8					
Dicyclopentadiene	77−73−6	C	I	32	503				2.8	IIA			0.91
Diethylamine	109−87−9	C[d]	I	−28	312	1.8	10.1	2.5		IIA			1.15
Diethylaminoethanol	100−37−8	C	IIIA	60	320			4.0	1.6	IIA			
Diethyl Benzene	25340−17−4	D	II	57	395			4.6					
Diethyl Ether (Ethyl Ether)	60−29−7	C[d]	I	−45	160	1.9	36	2.6	538	IIB	0.19	0.88	0.83
Diethylene Glycol Monobutyl Ether	112−34−5	C	IIIA	78	228	0.9	24.6	5.6	0.02				
Diethylene Glycol Monomethyl Ether	111−77−3	C	IIIA	93	241				0.2				
n-n-Dimethyl Aniline	121−69−7	C	IIIA	63	371	1.0		4.2	0.7				
Dimethyl Formamide	68−12−2	D	II	58	455	2.2	15.2	2.5	4.1	IIA			1.08
Dimethyl Sulfate	77−78−1	D	IIIA	83	188			4.4	0.7				
Dimethylamine	124−40−3	C	GAS		400	2.8	14.4	1.6		IIA			
2,2-Dimethylbutane	75−83−2	D[g]	I	−48	405				319.3				
2,3-Dimethylbutane	78−29−8	D[g]	I		396								

Chemical	CAS No.	Class I Division Group	Type[a]	Flash Point (°C)	AIT (°C)	%LFL	%UFL	Vapor Density (Air = 1)	Vapor Pressure[b] (mm Hg)	Class I Zone Group[c]	MIE (mJ)	MIC Ratio	MESG (mm)
3,3-Dimethylheptane	1071-26-7	D[g]	I		325				10.8				
2,3-Dimethylhexane	31394-54-4	D[g]	I		438								
2,3-Dimethylpentane	107-83-5	D[g]	I		335				211.7				
Di-N-Propylamine	142-84-7	C	I	17	299				27.1	IIA			0.95
1,4-Dioxane	123-91-1	C[d]	I	12	180	2.0	22.0	3.0	38.2	IIB	0.19		0.70
Dipentene	138-86-3	D	II	45	237	0.7	6.1	4.7		IIA			1.18
Dipropylene Glycol Methyl Ether	34590-94-8	C	IIIA	85		1.1	3.0	5.1	0.5				
Diisopropylamine	108-18-9	C	GAS	-6	316	1.1	7.1	3.5		IIA			1.02
Dodecene	6842-15-5	D	IIIA	100	255								
Epichlorohydrin	3132-64-7	C[d]	I	33	411	3.8	21.0	3.2	13.0				
Ethane	74-84-0	D[d]	GAS	~~-29~~ 135	472	3.0	12.5	1.0		IIA	0.24	0.82	0.91
Ethanol	64-17-5	D[d]	I	13	363	3.3	19.0	1.6	59.5	IIA		0.88	0.89
Ethylamine	75-04-7	D[d]	I	-18	385	3.5	14.0	1.6	1048		2.4		
Ethylene	74-85-1	C[d]	GAS		490	2.7	36.0	1.0		IIB	0.070	0.53	0.65
Ethylenediamine	107-15-3	D[d]	I	33	385	2.5	12.0	2.1	12.5				
Ethylenimine	151-56-4	C[d]	I	-11	320	3.3	54.8	1.5	211		0.48		
Ethylene Chlorohydrin	107-07-3	D	IIIA	59	425	4.9	15.9	2.8	7.2				
Ethylene Dichloride	107-06-2	D[d]	I	13	413	6.2	16.0	3.4	79.7				
Ethylene Glycol Monoethyl Ether Acetate	111-15-9	C	II	47	379	1.7		4.7	2.3	IIA		0.53	0.97
Ethylene Glycol Monobutyl Ether Acetate	112-07-2	C	IIIA		340	0.9	8.5		0.9				
Ethylene Glycol Monobutyl Ether	111-76-2	C	IIIA		238	1.1	12.7	4.1	1.0				
Ethylene Glycol Monoethyl Ether	110-80-5	C	II		235	1.7	15.6	3.0	5.4				0.84
Ethylene Glycol Monomethyl Ether	109-86-4	D	II		285	1.8	14.0	2.6	9.2				0.85
Ethylene Oxide	75-21-8	B(C)[d,e]	I	-20	429	3	100	1.5	1314	IIB	0.065	0.47	0.59
2-Ethylhexaldehyde	123-05-7	C	II	52	191	0.8	7.2	4.4	1.9				
2-Ethylhexanol	104-76-7	D	IIIA	81		0.9	9.7	4.5	0.2				
2-Ethylhexyl Acrylate	103-09-3	D	IIIA	88	252				0.3				
Ethyl Acetate	141-78-6	D[d]	I	-4	427	2.0	11.5	3.0	93.2	IIA	0.46		0.99
Ethyl Acrylate (Inhibited)	140-88-5	D[d]	I	9	372	1.4	14.0	3.5	37.5	IIA			0.86
Ethyl Alcohol	64-17-5	D[d]	I	13	363	3.3	19.0	1.6	59.5	IIA		0.88	0.89
Ethyl Sec-Amyl Ketone	541-85-5	D	II	59									
Ethyl Benzene	100-41-4	D	I	15	432	0.8	6.7	3.7	9.6				
Ethyl Butanol	97-95-0	D	II	57		1.2	7.7	3.5	1.5				
Ethyl Butyl Ketone	106-35-4	D	II	46				4.0	3.6				
Ethyl Chloride	75-00-3	D	GAS	-50	519	3.8	15.4	2.2					
Ethyl Formate	109-94-4	D	GAS	-20	455	2.8	16.0	2.6		IIA			0.94
Ethyl Mercaptan	75-08-1	C[d]	I	-18	300	2.8	18.0	2.1	527.4	IIB		0.90	0.90
n-Ethyl Morpholine	100-74-3	C	I	32				4.0					

Chemical	CAS No.	Class I Division Group	Type[a]	Flash Point (°C)	AIT (°C)	%LFL	%UFL	Vapor Density (Air = 1)	Vapor Pressure[b] (mm Hg)	Class I Zone Group[c]	MIE (mJ)	MIC Ratio	MESG (mm)
2-Ethyl-3-Propyl Acrolein	645−62−5	C	IIIA	68				4.4					
Ethyl Silicate	78−10−4	D	II					7.2					
Formaldehyde (Gas)	50−00−0	B	GAS		430	7	73	1.0		IIB			0.57
Formic Acid	64−18−6	D	II	50	434	18.0	57.0	1.6	42.7	IIA			1.86
Fuel Oil 1	8008−20−6	D	II or IIIA[k]	38−72[k]	210	0.7	5.0						
Fuel Oil 2			II or IIIA[k]	52−96[k]	257								
Fuel Oil 6			IIIA or IIIB[k]	66–132[k]									
Furfural	98−01−1	C	IIIA	60	316	2.1	19.3	3.3	2.3				0.94
Furfuryl Alcohol	98−00−0	C	IIIA	75	490	1.8	16.3	3.4	0.6				
Gasoline	8006−61−9	D[d]	I	−46	280	1.4	7.6	3.0					
n-Heptane	142−82−5	D[d]	I	−4	204	1.0	6.7	3.5	45.5	IIA	0.24	0.88	0.91
n-Heptene	81624−04−6	D[g]	I	−1	204			3.4					0.97
n-Hexane	110−54−3	D[d,g]	I	−23	225	1.1	7.5	3.0	152	IIA	0.24	0.88	0.93
Hexanol	111−27−3	D	IIIA	63				3.5	0.8	IIA			0.98
2-Hexanone	591−78−6	D	I	35	424	1.2	8.0	3.5	10.6				
Hexene	592−41−6	D	I	−26	245	1.2	6.9		186				
sec-Hexyl Acetate	108−84−9	D	II	45				5.0					
Hydrazine	302−01−2	C	II	38	23		98.0	1.1	14.4				
Hydrogen	1333−74−0	B[d]	GAS		500	4	75	0.1		IIC	0.019	0.25	0.28
Hydrogen Cyanide	74−90−8	C[d]	GAS	−18	538	5.6	40.0	0.9		IIB			0.80
Hydrogen Selenide	7783−07−5	C	I						7793				
Hydrogen Sulfide	7783−06−4	C[d]	GAS		260	4.0	44.0	1.2		IIB	0.068		0.90
Isoamyl Acetate	123−92−2	D	I	25	360	1.0	7.5	4.5	6.1				
Isoamyl Alcohol	123−51−3	D	II	43	350	1.2	9.0	3.0	3.2	IIA			1.02
Isobutane	75−28−5	D[g]	GAS		460	1.8	8.4	2.0		IIA			0.95
Isobutyl Acetate	110−19−0	D[d]	I	18	421	2.4	10.5	4.0	17.8				
Isobutyl Acrylate	106−63−8	D	I		427			4.4	7.1				
Isobutyl Alcohol	78−83−1	D[d]	I	−40	416	1.2	10.9	2.5	10.5	IIA		0.92	0.98
Isobutyraldehyde	78−84−2	C	GAS	−40	196	1.6	10.6	2.5		IIA			0.92
Isodecaldehyde	112−31−2	C	IIIA					5.4	0.09				
Isohexane	107−83−5	D[g]			264				211.7	IIA		1.00	
Isopentane	78−78−4	D[g]			420				688.6				
Isooctyl Aldehyde	123−05−7	C	II		197				1.9				
Isophorone	78−59−1	D		84	460	0.8	3.8	4.8	0.4				
Isoprene	78−79−5	D[d]	I	−54	220	1.5	8.9	2.4	550.6				
Isopropyl Acetate	108−21−4	D	I		460	1.8	8.0	3.5	60.4				
Isopropyl Ether	108−20−3	D[d]	I	−28	443	1.4	7.9	3.5	148.7	IIA	1.14		0.94
Isopropyl Glycidyl Ether	4016−14−2	C	I										
Isopropylamine	75−31−0	D	GAS	−26	402	2.3	10.4	2.0			2.0		
Kerosene	8008−20−6	D	II	72	210	0.7	5.0			IIA			

Chemical	CAS No.	Class I Division Group	Type[a]	Flash Point (°C)	AIT (°C)	%LFL	%UFL	Vapor Density (Air = 1)	Vapor Pressure[b] (mm Hg)	Class I Zone Group[c]	MIE (mJ)	MIC Ratio	MESG (mm)
Liquefied Petroleum Gas	68476-8-7	D	I		405								
Mesityl Oxide	141-97-9	D[d]	I	31	344	1.4	7.2	3.4	47.6				
Methane	74-82-8	D[d]	GAS		600	5	15	0.6		IIA	0.28	1.00	1.12
Methanol	67-56-1	D[d]	I	12	385	6.0	36.0	1.1	126.3	IIA	0.14	0.82	0.92
Methyl Acetate	79-20-9	D	GAS	-10	454	3.1	16.0	2.6		IIA		1.08	0.99
Methyl Acrylate	96-33-3	D	GAS	-3	468	2.8	25.0	3.0		IIB		0.98	0.85
Methyl Alcohol	67-56-1	D[d]	I		385	6.0	36	1.1	126.3	IIA			0.91
Methyl Amyl Alcohol	108-11-2	D	II	41		1.0	5.5	3.5	5.3	IIA			1.01
Methyl Chloride	74-87-3	D	GAS	-46	632	8.1	17.4	1.7		IIA			1.00
Methyl Ether	115-10-6	C[d]	GAS	-41	350	3.4	27.0	1.6		IIB		0.85	0.84
Methyl Ethyl Ketone	78-93-3	D[d]	I	-6	404	1.4	11.4	2.5	92.4	IIB	0.53	0.92	0.84
Methyl Formal	534-15-6	C[d]	I	1	238			3.1					
Methyl Formate	107-31-3	D	GAS	-19	449	4.5	23.0	2.1		IIA			0.94
2-Methylhexane	31394-54-4	D[g]	I		280								
Methyl Isobutyl Ketone	108-10-1	D[d]	I	13	440	1.2	8.0	3.5	11				
Methyl Isocyanate	624-83-9	D	GAS	-15	534	5.3	26.0	2.0		IIA			1.21
Methyl Mercaptan	74-93-1	C	GAS	-18		3.9	21.8	1.7					
Methyl Methacrylate	80-62-6	D	I	10	422	1.7	8.2	3.6	37.2	IIA			0.95
Methyl N-Amyl Ketone	110-43-0	D	II	49	393	1.1	7.9	3.9	3.8				
Methyl Tertiary Butyl Ether	1634-04-4	D	I	-80	435	1.6	8.4	0.2	250.1				
2-Methyloctane	3221-61-2				220				6.3				
2-Methylpropane	75-28-5	D[g]	I		460				2639				
Methyl-1-Propanol	78-83-1	D[d]	I	-40	416	1.2	10.9	2.5	10.1	IIA			0.98
Methyl-2-Propanol	75-65-0	D[d]	I	10	360	2.4	8.0	2.6	42.2				
2-Methyl-5-Ethyl Pyridine	104-90-5	D		74		1.1	6.6	4.2					
Methylacetylene	74-99-7	C[d]	I			1.7		1.4	4306		0.11		
Methylacetylene-Propadiene	27846-30-6	C	I							IIB			0.74
Methylal	109-87-5	C	I	-18	237	1.6	17.6	2.6	398				
Methylamine	74-89-5	D	GAS		430	4.9	20.7	1.0		IIA			1.10
2-Methylbutane	78-78-4	D[g]		-56	420	1.4	8.3	2.6	688.6				
Methylcyclohexane	208-87-2	D	I	-4	250	1.2	6.7	3.4			0.27		
Methylcyclohexanol	25630-42-3	D		68	296			3.9					
2-Methycyclohexanone	583-60-8	D	II					3.9					
2-Methylheptane		D[g]			420								
3-Methylhexane	589-34-4	D[g]			280				61.5				
3-Methylpentane	94-14-0	D[g]			278								
2-Methylpropane	75-28-5	D[g]	I		460				2639				
2-Methyl-1-Propanol	78-83-1	D[d]	I	-40	223	1.2	10.9	2.5	10.5				
2-Methyl-2-Propanol	75-65-0	D[d]	I		478	2.4	8.0	2.6	42.2				
2-Methyloctane	2216-32-2	D[g]			220								
3-Methyloctane	2216-33-3	D[g]			220				6.3				

Chemical	CAS No.	Class I Division Group	Type[a]	Flash Point (°C)	AIT (°C)	%LFL	%UFL	Vapor Density (Air = 1)	Vapor Pressure[b] (mm Hg)	Class I Zone Group[c]	MIE (mJ)	MIC Ratio	MESG (mm)
4-Methyloctane	2216-34-4	D[g]			225				6.8				
Monoethanolamine	141-43-5	D		85	410			2.1	0.4	IIA			
Monoisopropanolamine	78-96-6	D		77	374			2.6	1.1				
Monomethyl Aniline	100-61-8	C			482				0.5				
Monomethyl Hydrazine	60-34-4	C	I	23	194	2.5	92.0	1.6					
Morpholine	110-91-8	C[d]	II	35	310	1.4	11.2	3.0	10.1	IIA			0.95
Naphtha (Coal Tar)	8030-30-6	D	II	42	277					IIA			
Naphtha (Petroleum)	8030-30-6	D[d,i]	I	42	288	1.1	5.9	2.5		IIA			
Neopentane	463-82-1	D[g]		-65	450	1.4	8.3	2.6	1286				
Nitrobenzene	98-95-3	D		88	482	1.8		4.3	0.3	IIA			0.94
Nitroethane	79-24-3	C	I	28	414	3.4		2.6	20.7	IIB			0.87
Nitromethane	75-52-5	C	I	35	418	7.3		2.1	36.1	IIA		0.92	1.17
1-Nitropropane	108-03-2	C	I	34	421	2.2		3.1	10.1	IIB			0.84
2-Nitropropane	79-46-9	C[d]	I	28	428	2.6	11.0	3.1	17.1				
n-Nonane	111-84-2	D[g]	I	31	205	0.8	2.9	4.4	4.4	IIA			
Nonene	27214-95-8	D	I			0.8		4.4					
Nonyl Alcohol	143-08-8	D				0.8	6.1	5.0	0.02	IIA			
n-Octane	111-65-9	D[d,g]	I	13	206	1.0	6.5	3.9	14.0	IIA			0.94
Octene	25377-83-7	D	I	8	230	0.9		3.9					
n-Octyl Alcohol	111-87-5	D						4.5	0.08	IIA			1.05
n-Pentane	109-66-0	D[d,g]	I	-40	243	1.5	7.8	2.5	513	IIA	0.28	0.97	0.93
1-Pentanol	71-41-0	D[d]	I	33	300	1.2	10.0	3.0	2.5	IIA			1.30
2-Pentanone	107-87-9	D	I	7	452	1.5	8.2	3.0	35.6	IIA			0.99
1-Pentene	109-67-1	D	I	-18	275	1.5	8.7	2.4	639.7				
2-Pentene	109-68-2	D	I	-18				2.4					
2-Pentyl Acetate	626-38-0	D	I	23		1.1	7.5	4.5					
Phenylhydrazine	100-63-0	D		89				3.7	0.03				
Process Gas > 30% H_2		B[j]	GAS		520	4.0	75.0	0.1			0.019	0.45	
Propane	74-98-6	D[d]	GAS		450	2.1	9.5	1.6		IIA	0.25	0.82	0.97
1-Propanol	71-23-8	D[d]	I	15	413	2.2	13.7	2.1	20.7	IIA			0.89
2-Propanol	67-63-0	D[d]	I	12	399	2.0	12.7	2.1	45.4	IIA	0.65		1.00
Propiolactone	57-57-8	D				2.9		2.5	2.2				
Propionaldehyde	123-38-6	C	I	-9	207	2.6	17.0	2.0	318.5	IIB			0.86
Propionic Acid	79-09-4	D	II	54	466	2.9	12.1	2.5	3.7	IIA			1.10
Propionic Anhydride	123-62-6	D		74	285	1.3	9.5	4.5	1.4				
n-Propyl Acetate	109-60-4	D	I	14	450	1.7	8.0	3.5	33.4	IIA			1.05
n-Propyl Ether	111-43-3	C[d]	I	21	215	1.3	7.0	3.5	62.3				
Propyl Nitrate	627-13-4	B[d]	I	20	175	2.0	100.0						
Propylene	115-07-1	D[d]	GAS		460	2.4	10.3	1.5		IIA	0.28		0.91
Propylene Dichloride	78-87-5	D	I	16	557	3.4	14.5	3.9	51.7	IIA			1.32
Propylene Oxide	75-56-9	B(C)[d,e]	I	-37	449	2.3	36.0	2.0	534.4	IIB	0.13		0.70
Pyridine	110-86-1	D[d]	I	20	482	1.8	12.4	2.7	20.8	IIA			
Styrene	100-42-5	D[d]	I	31	490	0.9	6.8	3.6	6.1	IIA		1.21	

Chemical	CAS No.	Class I Division Group	Type[a]	Flash Point (°C)	AIT (°C)	%LFL	%UFL	Vapor Density (Air = 1)	Vapor Pressure[b] (mm Hg)	Class I Zone Group[c]	MIE (mJ)	MIC Ratio	MESG (mm)
Tetrahydrofuran	109−99−9	C[d]	I	−14	321	2.0	11.8	2.5	161.6	IIB	0.54		0.87
Tetrahydronaphthalene	119−64−2	D	IIIA		385	0.8	5.0	4.6	0.4				
Tetramethyl Lead	75−74−1	C	II	38				9.2					
Toluene	108−88−3	D[d]	I	4	480	1.1	7.1	3.1	28.53	IIA	0.24		
n-Tridecene	2437−56−1	D	IIIA			0.6		6.4	593.4				
Triethylamine	121−44−8	C[d]	I	−9	249	1.2	8.0	3.5	68.5	IIA	0.75		1.05
Triethylbenzene	25340−18−5	D		83			56.0	5.6					
2,2,3-Trimethylbutane		D[g]			442								
2,2,4-Trimethylbutane		D[g]			407								
2,2,3-Trimethylpentane		D[g]			396								
2,2,4-Trimethylpentane		D[g]			415					IIA			1.04
2,3,3-Trimethylpentane		D[g]			425								
Tripropylamine	102−69−2	D	II	41				4.9	1.5	IIA			1.13
Turpentine	8006−64−2	D	I	35	253	0.8			4.8				
n-Undecene	28761−27−5	D	IIIA			0.7		5.5					
Unsymmetrical Dimethyl Hydrazine	57−14−7	C[d]	I	−15	249	2.0	95.0	1.9		IIB			0.85
Valeraldehyde	110−62−3	C	I	280	222			3.0	34.3				
Vinyl Acetate	108−05−4	D[d]	I	−6	402	2.6	13.4	3.0	113.4	IIA	0.70		0.94
Vinyl Chloride	75−01−4	D[d]	GAS	−78	472	3.6	33.0	2.2		IIA			0.96
Vinyl Toluene	25013−15−4	D		52	494	0.8	11.0	4.1					
Vinylidene Chloride	75−35−4	D	I		570	6.5	15.5	3.4	599.4	IIA			3.91
Xylene	1330−20-7	D[d]	I	25	464	0.9	7.0	3.7		IIA	0.2		1.09
Xylidine	121−69−7	C	IIIA	63	371	1.0		4.2	0.7				

[a]Type is used to designate if the material is a gas, flammable liquid, or combustible liquid. *(See 4.2.6 and 4.2.7.)*

[b]Vapor pressure reflected in units of mm Hg at 77°F (25°C) unless stated otherwise.

[c]Class I, Zone Groups are based on IEC 60079-20-1, 1996 IEC TR3 60079-20-*1, Explosive atmospheres — Part 20-1:Material characteristics for gas and vapor classification — Test methods and data*, which contains additional data on MESG and group classifications.

[d]Material has been classified by test.

[e]Where all conduit runs into explosionproof equipment ~~are~~ , the conduit is provided with explosionproof seals installed within 18 in. (450 mm) of the enclosure, equipment for the group classification shown in parentheses is permitted.

[f]For classification of areas involving ammonia, see ASHRAE 15, *Safety Standard for Refrigeration Systems*, and CGA G2.1, *Safety Requirements for the Storage and Handling of Anhydrous Ammonia*.

[g]Commercial grades of aliphatic hydrocarbon solvents are mixtures of several isomers of the same chemical formula (or molecular weight). The autoignition temperatures (AIT) of the individual isomers are significantly different. The electrical equipment should be suitable for the AIT of the solvent mixture. *(See A.4.4.2.)*

[h]Certain chemicals have characteristics that ~~require~~ need safeguards beyond those ~~required~~ necessary for any of the above groups. Carbon disulfide is one of these chemicals because of its low autoignition temperature and the small joint clearance necessary to arrest its flame propagation.

[i]Petroleum naphtha is a saturated hydrocarbon mixture whose boiling range is 68°F to 275°F (20°C to 135°C). It is also known as benzine, ligroin, petroleum ether, and naphtha.

[j]Fuel and process gas mixtures found by test not to present hazards similar to those of hydrogen ~~may~~ can be grouped based on the test results.

[k] Liquid type and flash point vary due to regional blending differences.

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Committee Statement

Committee Statement: Updated Table 4.4.2 note c by updating reference to IEC 60079-20-1. The flashpoint for Ethane has been updated to the correct value of -135 instead of -29 as shown in SDS.
Response Message:

Public Comment No. 2-NFPA 497-2015 [Section No. 4.4.2 [Excluding any Sub-Sections]]

Second Revision No. 4-NFPA 497-2015 [Section No. 5.10]

5.10 Classification Diagrams for Class I, Divisions.

Most diagrams in Section 5.10 and Section 5.11 include tables of "suggested applicability" and use check marks to show the ranges of process equipment size, pressure, and flow rates. *(See Table 5.8.4.)* Unless otherwise stated, these diagrams assume that the material being handled is a flammable liquid. Table 5.10 provides a summary of where each diagram is intended to apply. Class I, Division diagrams include Figure 5.10.1(a) through Figure 5.10.14.

Table 5.10 Matrix of Diagrams Versus Material/Property/Application

Figure Number for Class I		Special Condition	VD > 1	VD ≤ 1	Cryogenic	Indoor	Indoor, Poor Ventilation	Outdoor	Above Grade	At Grade	Refer to Table 5.7.4		
Division	Zone										Size	Pressure	Flow
5.9 10.1(a)	5.10 11.1(a)		X					X		X	S/M	S/M	S/M
5.9 10.1(b)	5.10 11.1(b)		X					X	X		S/M	S/M	S/M
5.9 10.1(c)	5.10 11.1(c)		X			X				X	S/M	S/M	S/M
5.9 10.1(d)	5.10 11.1(d)		X			X			X		S/M	S/M	S/M
5.9 10.1(e)	5.10 11.1(e)		X			X				X	S/M	S/M	S/M
5.9 10.1(f)	5.10 11.1(f)		X				X			X	S/M	S/M	S/M
5.9 10.1(g)	5.10 11.1(g)		X					X		X	L	M/L	L
5.9 10.1(h)	5.10 11.1(h)		X					X	X		L	M/L	L
5.9 10.1(i)	5.10 11.1(i)		X				X		X		M/L	L	M/L
5.9 10.1(j)	5.10 11.1(j)		X			X			X		M/L	L	M/L
5.9 10.1(k)	5.10 11.1(k)		X					X	X	X	S/M	S/M	S/M
5.9 10.1(l)	5.10 11.1(l)		X					X	X	X	M/L	M/L	M/L
5.9 10.1(m)	5.10 11.1(m)		X					X	X	X	S/M	S/M	S/M
5.9 10.1(n)	5.10 11.1(n)		X			X			X	X	S/M	S/M	S/M
5.9 10.2(a)	5.10 11.2(a)		X		X			X		X	S/M	M/H	S/M
5.9 10.2(b)	5.10 11.2(b)		X		X			X	X		S/M	M/H	S/M
5.9 10.3(a)	5.10 11.3(a)	Product dryer	FL			X		X	X				
5.9 10.3(b)	5.10 11.3(b)	Filter press	FL			X			X				
5.9 10.4(a)	5.10 11.4(a)	Storage tank	FL					X		X	M/L	L	M/L
5.9 10.4(b)	5.10 11.4(b)	Tank car loading	FL					X	X				
5.9 10.4(c)	5.10 11.4(c)	Tank car loading	FL					X	X	X			
5.9 10.4(d)	5.10 11.4(d)	Tank truck loading	FL					X	X	X			
5.9 10.4(e)	5.10 11.4(e)	Tank car loading/tank truck loading	FL					X	X	X			
5.9 10.5	5.10 11.5	Tank car loading/tank truck loading	FL		X			X	X				
5.9 10.6	5.10 11.6	Drum filling station	FL			X		X	X				
5.9 10.7	5.10 11.7	Emergency basin	FL					X	X	X			
5.9 10.8(a)	5.10 11.8(a)	Liquid H_2 storage		X	X	X		X	X	X			
5.9 10.8(b)	5.10 11.8(b)	Gaseous H_2 storage		X		X		X	X	X			
5.10.8(c)	5.11.8(c)	Liquid Hydrogen Storage – Tank and		X	X			X		X			

Figure Number for Class I		Special Condition	VD > 1	VD < 1	Cryogenic	Indoor	Indoor, Poor Ventilation	Outdoor	Above Grade	At Grade	Refer to Table 5.7.4		
Division	Zone										Size	Pressure	Flow
		Vaporizer (parts of system containing liquid hydrogen)											
5.10.8(d)	5.11.8(d)	Gaseous Hydrogen Vent Stack		X				X	X				
5.10.8(e)	5.11.8(e)	Gaseous Hydrogen Receivers		X				X		X			
5.9 10 .9(a)	5.~~10~~ 11 .9(a)	Compressor shelter		X		X			X	X			
5.9 10 .9(b)	5.~~10~~ 11 .9(b)	Compressor shelter		X			X		X	X			
5.9 10 .10(a)	5.~~10~~ 11 .10(a)	Cryogenic storage			X			X	X	X			
5.9 10 .10(b)	5.~~10~~ 11 .10(b)	Cryogenic storage			X			X	X	X			
5.9 10 .10(c)	5.~~10~~ 11 .10(c)	Cryogenic storage			X			X	X	X			
5.9 10 .11	5.~~10~~ 11 .11		LNG					X	X	X			
5.9 10 .12	5.~~10~~ 11 .12		LNG			X			X	X			
5.9 10 .13	5.~~10~~ 11 .13		LNG						X				
5.9 10 .14	5.~~10~~ 11 .14	Marine terminal	FL/LFG			X		X	X				
5.10.15	5.11.15	Compressed Gas Cylinders lighter than or equal to air, including hydrogen)		X		X		X		X			
5.10.16	5.11.16	Compressed Gas Cylinders (heavier than air)	X			X		X		X			

FL: Flammable liquid. LFG: Liquefied flammable gas. LNG: Liquefied natural gas. X: Diagram applies.

L: Large. M: Moderate. S: Small. H: High.

5.10.1 Indoor and Outdoor Process-Flammable Liquids.

[See Figure 5.10.1(a) through Figure 5.10.1(n).]

Figure 5.10.1(a) Leakage Located Outdoors, at Grade. The material being handled is a flammable liquid.

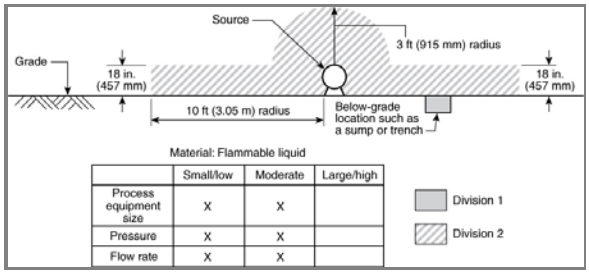


Figure 5.10.1(b) Leakage Located Outdoors, Above Grade. The material being handled is a flammable liquid.

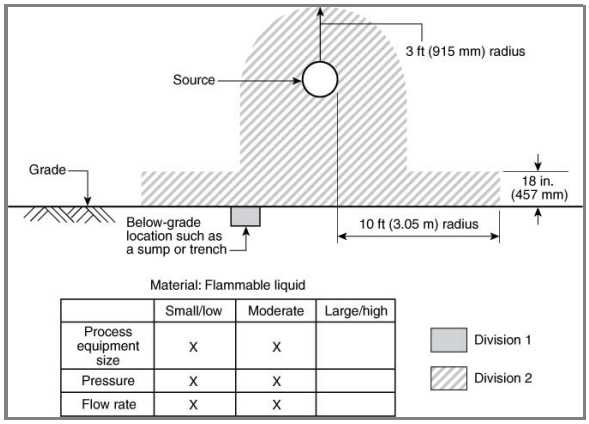


Figure 5.10.1(c) Leakage Located Indoors, at Floor Level. Adequate ventilation is provided. The material being handled is a flammable liquid.

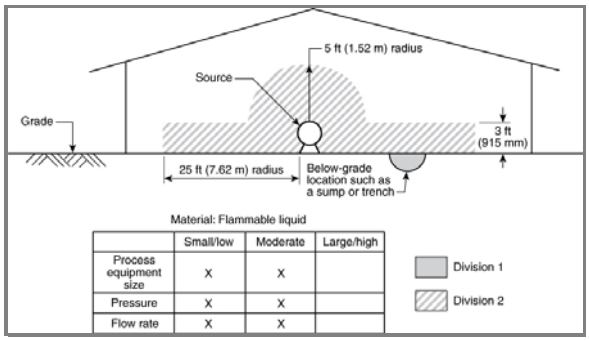


Figure 5.10.1(d) Leakage Located Indoors, Above Floor Level. Adequate ventilation is provided. The material being handled is a flammable liquid.

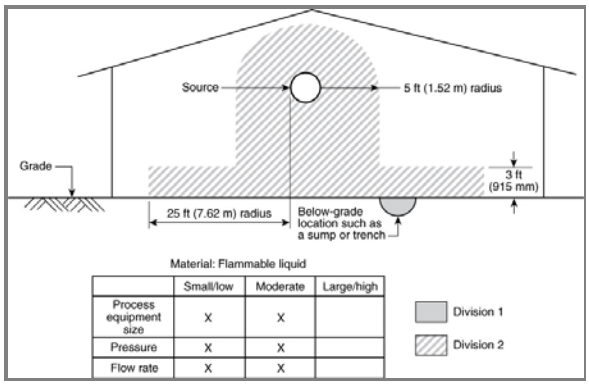


Figure 5.10.1(e) Leakage Located Indoors, at Floor Level, Adjacent to an Opening in an Exterior Wall. Adequate ventilation is provided. The material being handled is a flammable liquid.

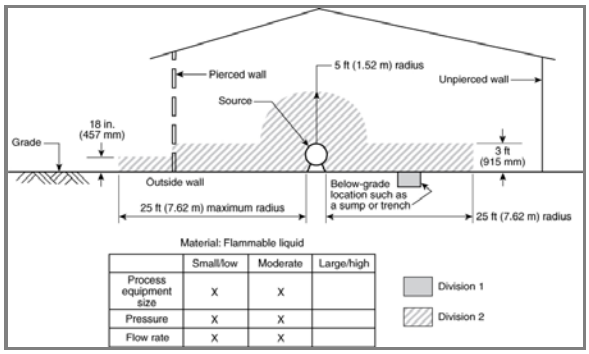


Figure 5.10.1(f) Leakage Located Indoors, at Floor Level, Adjacent to an Opening in an Exterior Wall. Ventilation is not adequate. The material being handled is a flammable liquid.

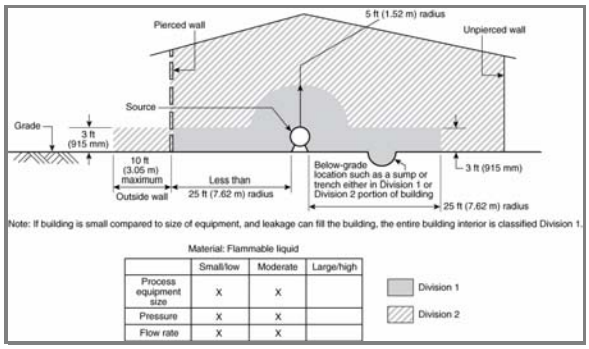


Figure 5.10.1(g) Leakage Located Outdoors, at Grade. The material being handled is a flammable liquid.

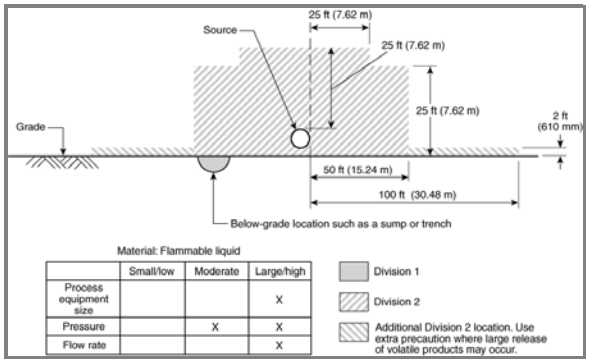


Figure 5.10.1(h) Leakage Located Outdoors, Above Grade. The material being handled is a flammable liquid.

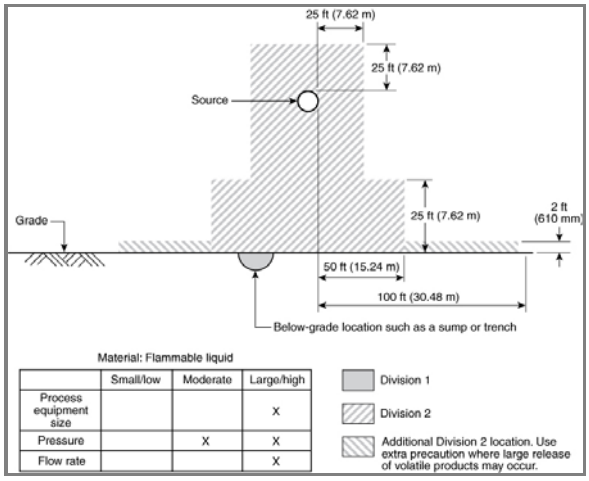


Figure 5.10.1(i) Leakage Located Indoors, Adjacent to an Opening in an Exterior Wall. Ventilation is not adequate. The material being handled is a flammable liquid.

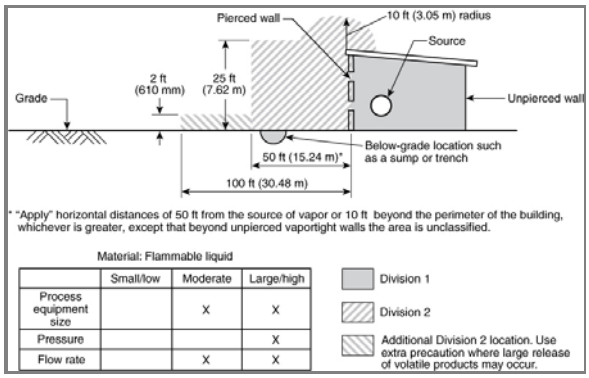


Figure 5.10.1(j) Leakage Located Indoors, Adjacent to an Opening in an Exterior Wall. Adequate ventilation is provided. The material being handled is a flammable liquid.

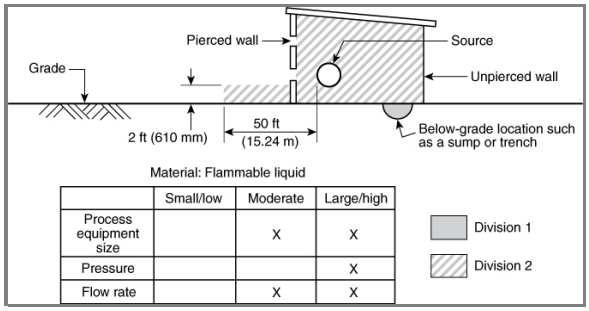


Figure 5.10.1(k) Leakage, Located Both at Grade and Above Grade, in an Outdoor Process Area. The material being handled is a flammable liquid.

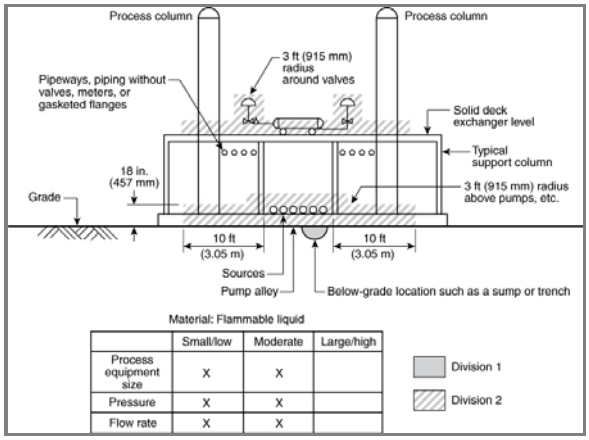


Figure 5.10.1(l) Multiple Sources of Leakage, Located Both at Grade and Above Grade, in an Outdoor Process Area. The material being handled is a flammable liquid.

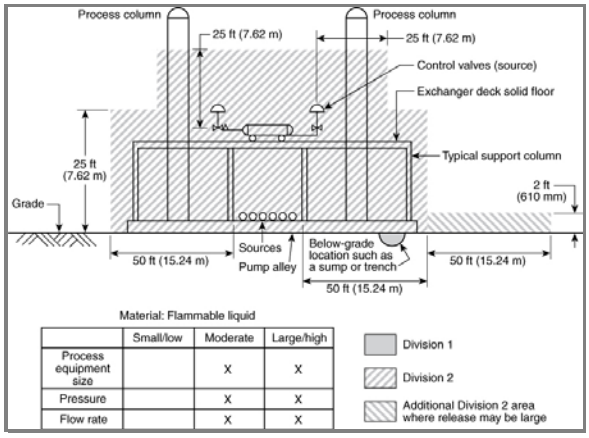


Figure 5.10.1(m) Multiple Sources of Leakage, Located Both at and Above Grade, in an Outdoor Process Area. The material being handled is a flammable liquid.

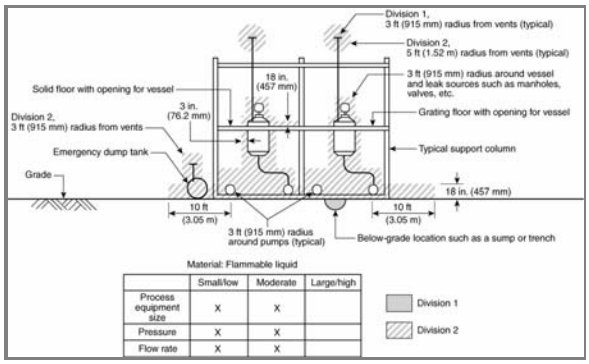
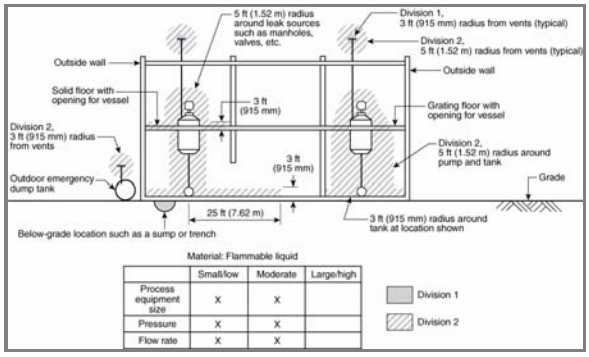


Figure 5.10.1(n) Multiple Sources of Leakage, Located Both at and Above Floor Level, in an Adequately Ventilated Building. The material being handled is a flammable liquid.



5.10.2 Outdoor Process — Flammable Liquid, Flammable Gas, Compressed Flammable Gas, or Cryogenic Liquid.

[See Figure 5.10.2(a) and Figure 5.10.2(b).]

Figure 5.10.2(a) Leakage Located Outdoors, at Grade. The material being handled could be a flammable liquid, a liquefied or compressed flammable gas, or a flammable cryogenic liquid.

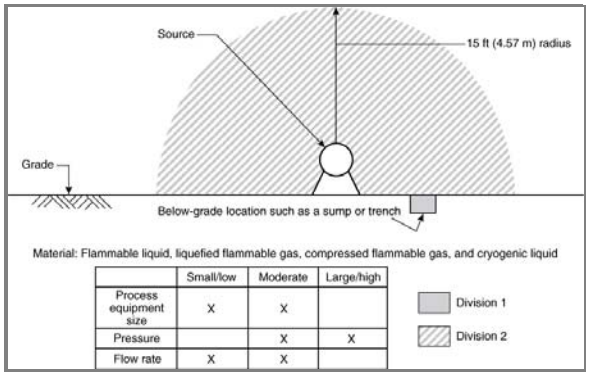
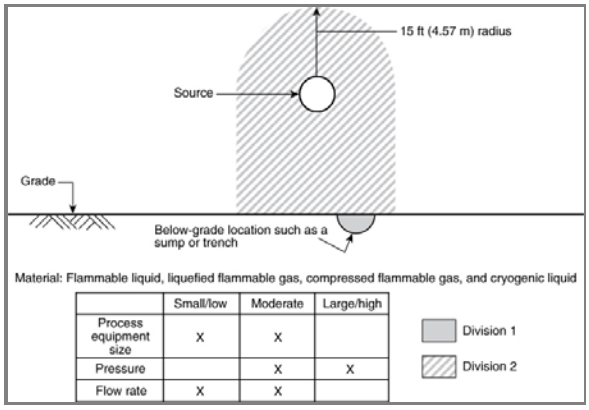


Figure 5.10.2(b) Leakage Located Outdoors, Above Grade. The material being handled could be a flammable liquid, a liquefied or compressed flammable gas, or a flammable cryogenic liquid.



5.10.3 Product Dryer and Plate and Frame Filter Press — Solids Wet with Flammable Liquids.

[See Figure 5.10.3(a) and Figure 5.10.3(b).]

Figure 5.10.3(a) Product Dryer Located in an Adequately Ventilated Building. The product dryer system is totally enclosed. The material being handled is a solid wet with a flammable liquid.

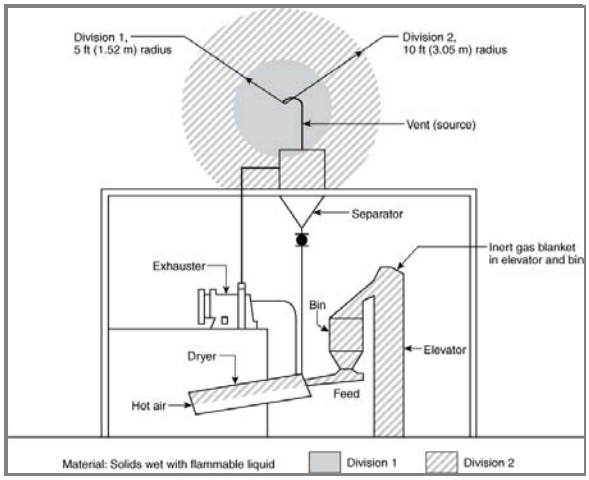
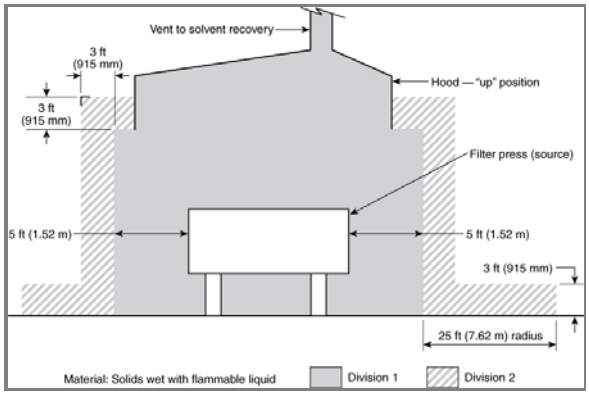


Figure 5.10.3(b) Plate and Frame Filter Press. Adequate ventilation is provided. The material being handled is a solid wet with a flammable liquid.



5.10.4 Storage Tanks and Tank Vehicles — Flammable Liquids.

[See Figure 5.10.4(a) through Figure 5.10.4(e).]

Figure 5.10.4(a) Product Storage Tank Located Outdoors, at Grade. The material that is being stored is a flammable liquid.

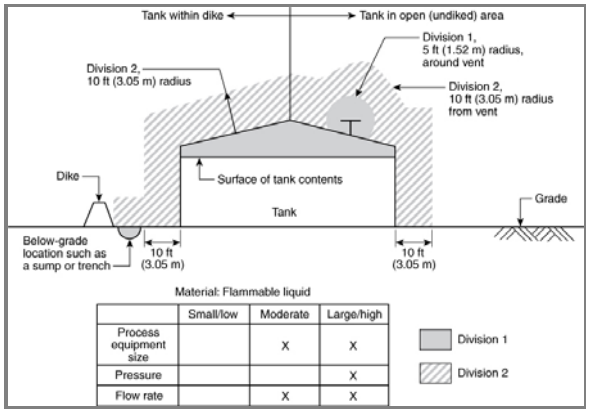


Figure 5.10.4(b) Tank Car Loading and Unloading via a Closed Transfer System. Material is transferred only through the dome. The material being transferred is a flammable liquid.

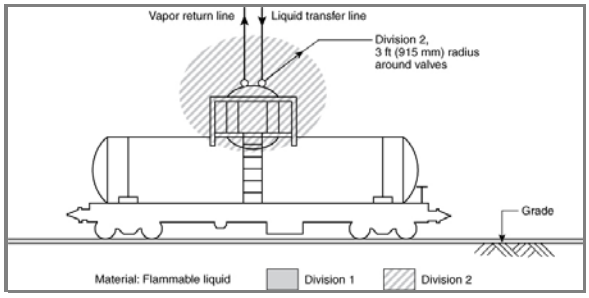


Figure 5.10.4(c) Tank Car Loading and Unloading via a Closed Transfer System. Material is transferred through the bottom fittings. The material being transferred is a flammable liquid.

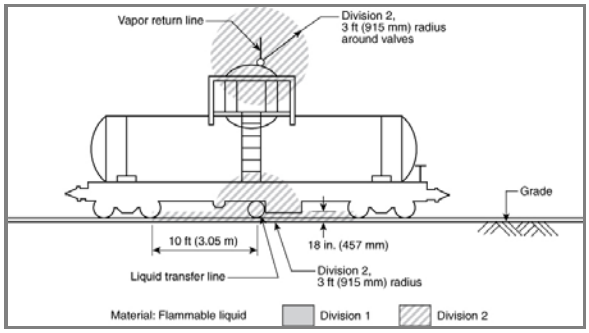


Figure 5.10.4(d) Tank Truck Loading and Unloading via a Closed Transfer System. Material is transferred through the bottom fittings. The material being transferred is a flammable liquid.

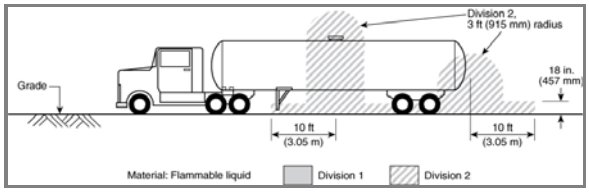
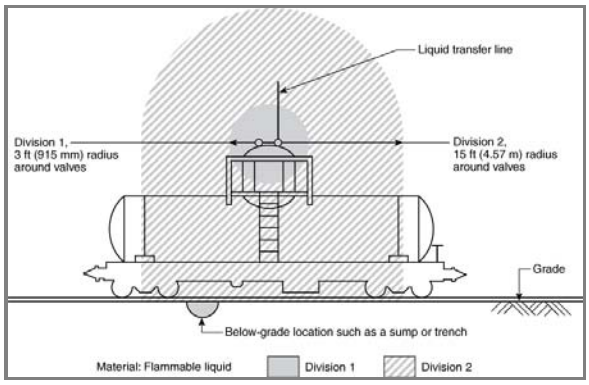


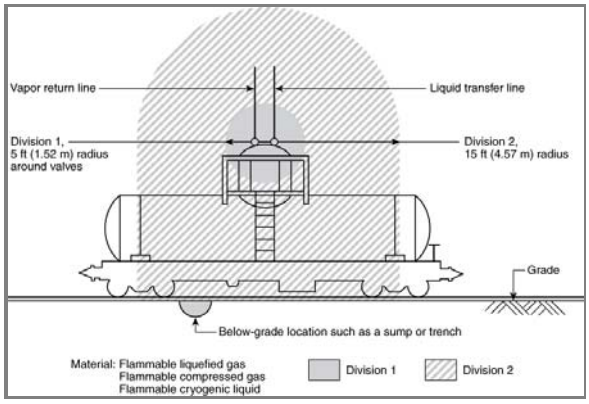
Figure 5.10.4(e) Tank Car (or Tank Truck) Loading and Unloading via an Open Transfer System. Material is transferred either through the dome or the bottom fittings. The material being transferred is a flammable liquid.



5.10.5 Tank Vehicle — Flammable Liquefied Gas, Flammable Compressed Gas, or Flammable Cryogenic Liquid.

(See Figure 5.10.5.)

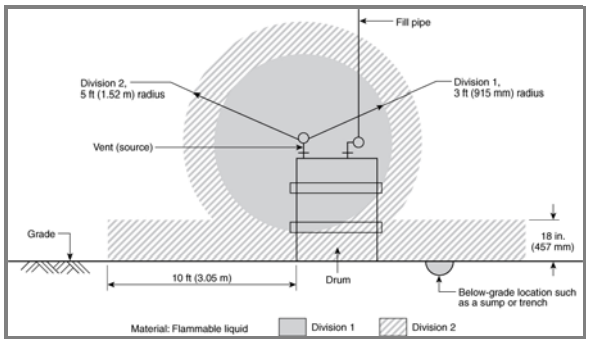
Figure 5.10.5 Tank Car (or Tank Truck) Loading and Unloading via a Closed Transfer System. Material is transferred only through the dome. The material being transferred may be a liquefied or compressed flammable gas or a flammable cryogenic liquid.



5.10.6 Indoor or Outdoor Drum Filling Station — Flammable Liquids.

(See Figure 5.10.6.)

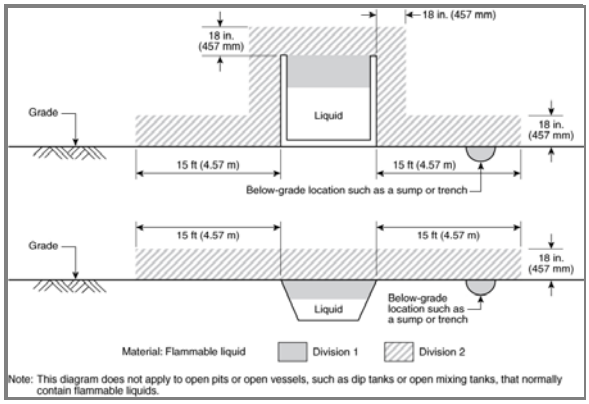
Figure 5.10.6 Drum Filling Station Located Either Outdoors or Indoors in an Adequately Ventilated Building. The material being handled is a flammable liquid.



5.10.7 Emergency Impounding Basins, Emergency Drainage Ditches, or Oil–Water Separators — Flammable Liquids.

(See Figure 5.10.7.)

Figure 5.10.7 Emergency Impounding Basin or Oil–Water Separator and an Emergency or Temporary Drainage Ditch or Oil–Water Separator. The material being handled is a flammable liquid.



5.10.8 Storage of Liquid or Gaseous Hydrogen.

[See Figure 5.10.8(a) and Figure 5.10.8(b).]

Figure 5.10.8(a) Liquid Hydrogen Storage Located Outdoors or Indoors in an Adequately Ventilated Building. This diagram applies to liquid hydrogen only.

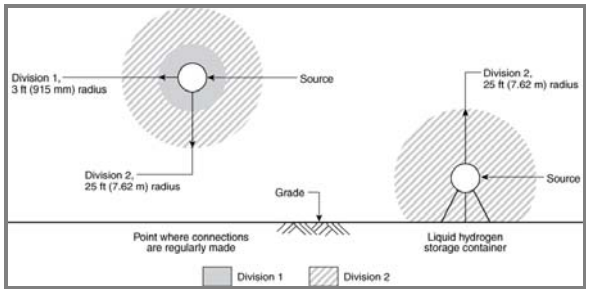


Figure 5.10.8(b) Gaseous Hydrogen Storage Located Outdoors or Indoors in an Adequately Ventilated Building. This diagram applies to gaseous hydrogen only.

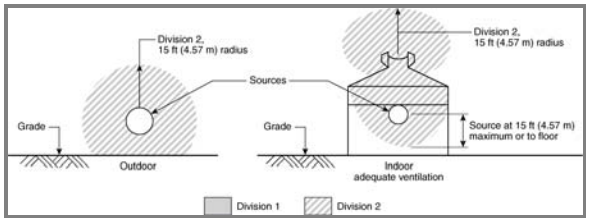


Figure 5.10.8(c) Liquid Hydrogen Storage — Tank and Vaporizer (parts of system containing liquid hydrogen).

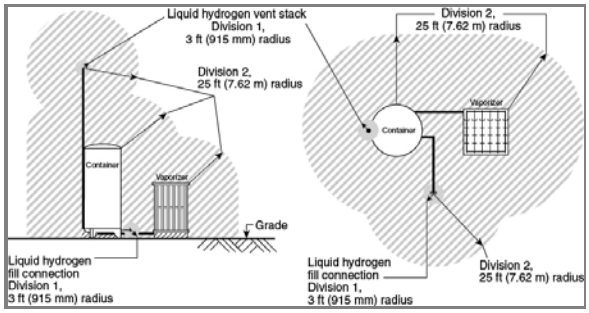


Figure 5.10.8(d) Gaseous Hydrogen Vent Stack.

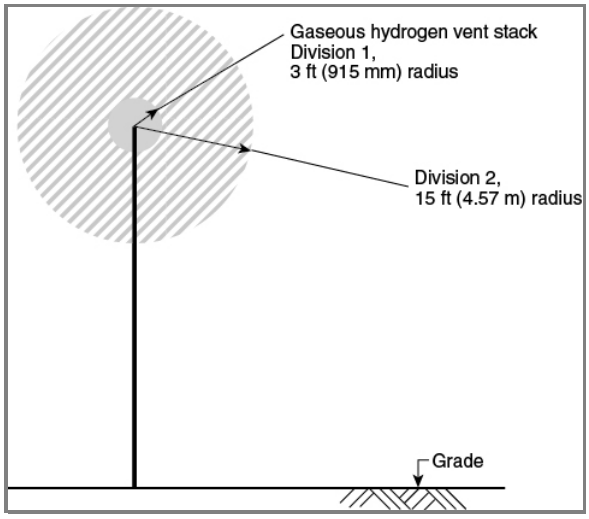
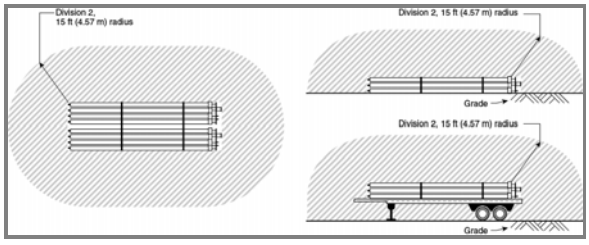


Figure 5.10.8(e) Gaseous Hydrogen Receivers



5.10.9 Compressor Shelters — Lighter-than-Air Gas.

[See Figure 5.10.9(a) and Figure 5.10.9(b).]

Figure 5.10.9(a) Adequately Ventilated Compressor Shelter. The material being handled is a lighter-than-air gas.

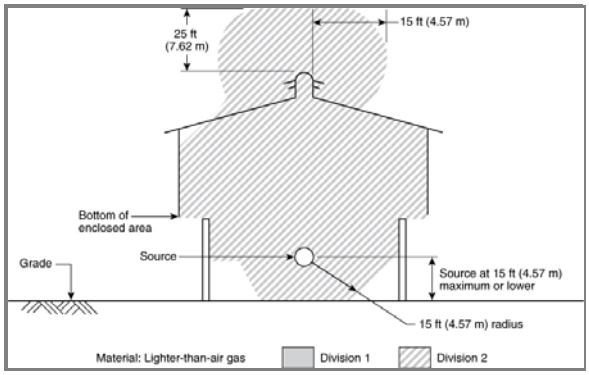
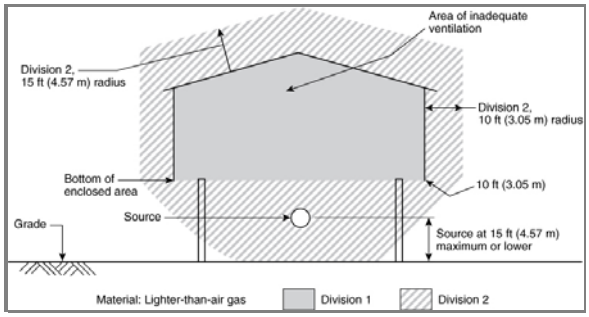


Figure 5.10.9(b) Inadequately Ventilated Compressor Shelter. The material being handled is a lighter-than-air gas.



5.10.10 Storage Tanks for Cryogenic Liquids.

[See Figure 5.10.10(a), Figure 5.10.10(b), and Figure 5.10.10(c).]

Figure 5.10.10(a) Tank for the Storage of Cryogenic and Other Cold Liquefied Flammable Gases. Dike height less than distance from container to dike (*H* < *x*). [59A: Figure 10.7.2(b).]

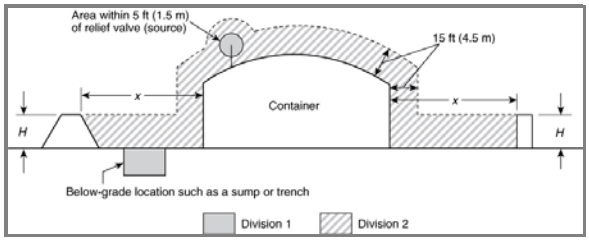


Figure 5.10.10(b) Tank for the Storage of Cryogenic and Other Cold Liquefied Flammable Gases. Dike height greater than distance from container to dike (*H* > *x*). [59A: Figure 10.7.2(c)]

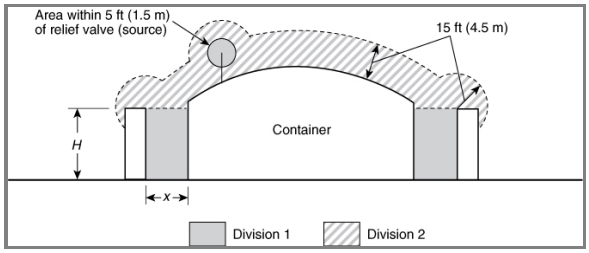
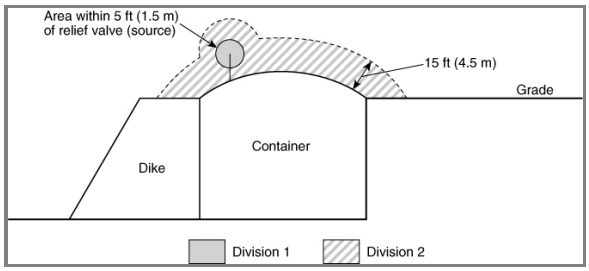


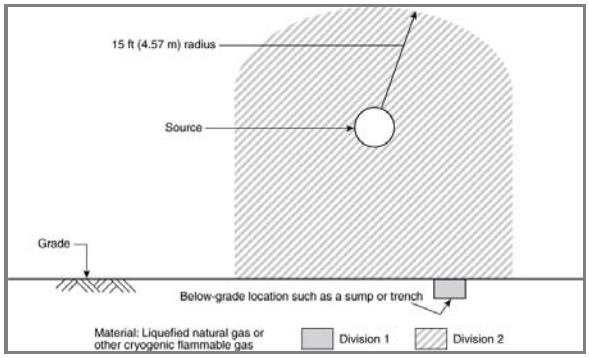
Figure 5.10.10(c) Tank for the Storage of Cryogenic and Other Cold Liquefied Flammable Gases. Container with liquid level below grade or top of dike. [59A: Figure 10.7.2(d).]



5.10.11 Outdoor Handling — Liquefied Natural Gas or Other Cryogenic Flammable Gas.

(See Figure 5.10.11.)

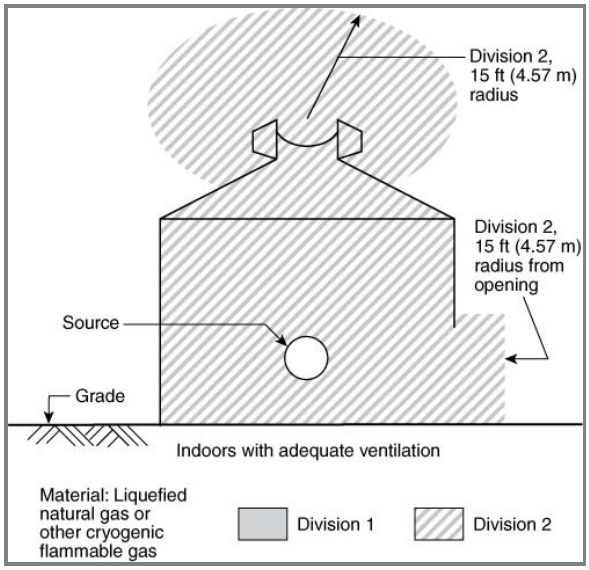
Figure 5.10.11 Source of Leakage from Equipment Handling Liquefied Natural Gas or Other Cold Liquefied Flammable Gas and Located Outdoors, at or Above Grade.



5.10.12 Indoor Handling — Liquefied Natural Gas or Other Cryogenic Flammable Gas.

(See Figure 5.10.12.)

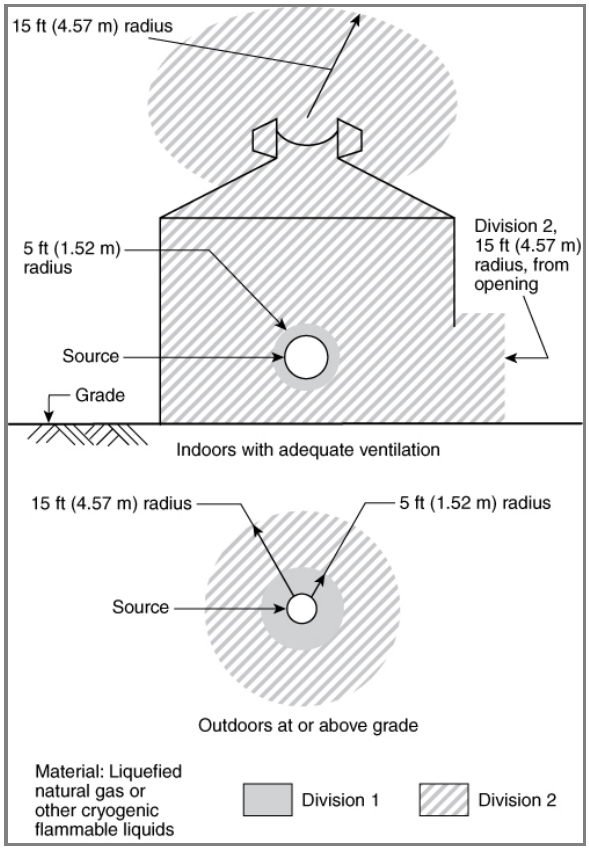
Figure 5.10.12 Source of Leakage from Equipment Handling Liquefied Natural Gas or Other Cold Liquefied Flammable Gas and Located Indoors in an Adequately Ventilated Building.



5.10.13 Routinely Operating Bleeds — Liquefied Natural Gas or Other Cryogenic Flammable Gas.

(See Figure 5.10.13.)

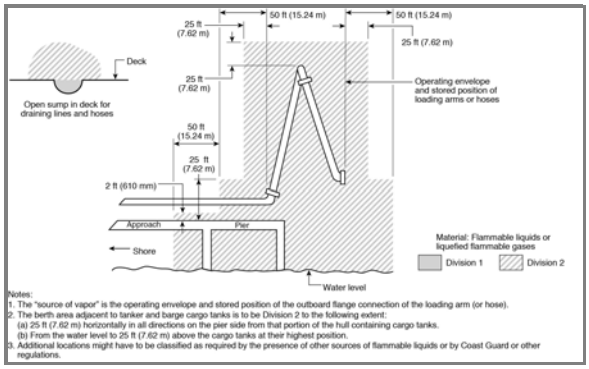
Figure 5.10.13 Classified Zones around Liquefied Natural Gas Routinely Operating Bleeds, Drips, Vents, and Drains Both Outdoors, at or Above Grade, and Indoors, in an Adequately Ventilated Building. This diagram also applies to other cold liquefied flammable gases. (*Source:* Table 10.7.2 of NFPA 59A.)



5.10.14 Marine Terminal — Flammable Liquids.

(See Figure 5.10.14.)

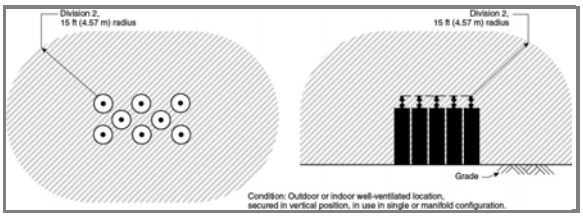
Figure 5.10.14 Classified Locations at a Marine Terminal Handling Flammable Liquids or Liquefied Flammable Gases; Includes the Area Around the Stored Position of Loading Arms and Hoses.



5.10.15 Compressed Gas Cylinders (Lighter than or Equal to Air, including hydrogen).

(See Figure 5.10.15 .)

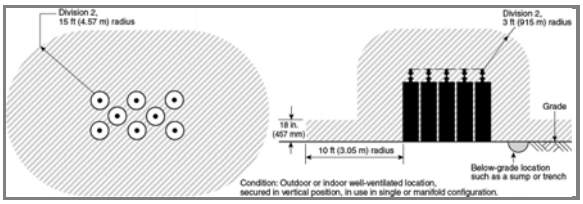
Figure 5.10.15 Compressed Gas Cylinders (lighter than or equal to air, including hydrogen).



5.10.16 Compressed Gas Cylinders (Heavier Than Air).

(See Figure 5.10.16 .)

Figure 5.10.16 Compressed Gas Cylinders (heavier than air).



Supplemental Information

File Name	Description
NFPA_497_Figure_Updates_per_NFPA_55-2016_EN_10.2.15.pptx	New Figures as attached in Presentation. Please note numbering has changed from the old edition 5.9 is now 5.10 and 5.10 is now 5.11.
Figures_for_497_SR-4_EN_11.10.15.docx	the figures have been extracted from the ppt file into a word file.

Submitter Information Verification

Submitter Full Name: Eric Nette
Organization: [Not Specified]
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City:
State:
Zip:
Submittal Date: Fri Oct 02 13:23:50 EDT 2015

Committee Statement

Committee Statement:	An update to the figures has been added for Hydrogen and compressed gases by the 497 task group to be in line with the recent update to NFPA 55.
Response Message:	

Task Group Report on NFPA 497 Figure Updates per NFPA 55-2016 and Gas Cylinders

David Wechsler, Jack Jamison, Jonathan Cadd, Erdem Ural,

Rob Early

Comparison of Editions (H_2 Gas)

Table 10.3.1.2 Electrical Area Classification

Location	Classification	Extent of Classified Area
Storage equipment excluding the piping system downstream of the source valve	Class I, Division 2	Between 0 ft (0 m) and 15 ft (4.6 m)

2016 edition adds a Div 1 location around vent outlets

Table 10.4.2.1.2.1 Electrical Area Classification

Location	Classification	Extent of Classified Area
Within 3 ft (1 m) of any vent outlet and any points where hydrogen is vented to the atmosphere under normal operations	Class 1, Division 1	Between 0 ft (0 m) and 3 ft (0.9 m) and measured spherically from the outlet.
Between 3 ft (1 m) and 15 ft (4.6 m) of any vent outlet and any points where hydrogen is vented to the atmosphere under normal operations	Class I, Division 2	Between 3 ft (0.9 m) and 15 ft (4.6 m) and measured spherically from the vent outlet.
Storage equipment excluding the piping system downstream of the source valve	Class I, Division 2	Between 0 ft (0 m) and 15 ft (4.6 m) and measured spherically from the source.

2016 Edition

Table 6.3.1.1 Maximum Allowable Quantity (MAQ) of Hazardous Materials per Control Area

			Storage			Use — Closed Systems			Use — Open Systems	
Material	Class	High Hazard Protection Level	Solid Pounds	Liquid Gallons	Gas[a] scf (lb)	Solid Pounds	Liquid Gallons	Gas[a] scf (lb)	Solid Pounds	Liquid Gallons
Cryogenic fluid	Flammable	2	NA	45[b,c]	NA	NA	45[b,c]	NA	NA	45[b,c]
	Oxidizing	3	NA	45[d,e]	NA	NA	45[d,e]	NA	NA	45[d,e]
	Inert	NA	NA	NL	NA	NA	NL	NA	NA	NL
Flammable, gas[f]	Gaseous	2	NA	NA	1000[d,e]	NA	NA	1000[d,e]	NA	NA
	Liquefied	2	NA	NA	(150)[d,e]	NA	NA	(150)[d,e]	NA	NA
	LP	2	NA	NA	(300)[g,h,j]	NA	NA	(300)[g]	NA	NA
Inert gas	Gaseous	NA	NA	NA	NL	NA	NA	NL	NA	NA
	Liquefied	NA	NA	NA	NL	NA	NA	NL	NA	NA
Oxidizing gas	Gaseous	3	NA	NA	1500[d,e]	NA	NA	1500[d,e]	NA	NA
	Liquefied	3	NA	NA	(150)[d,e]	NA	NA	(150)[d,e]	NA	NA
Pyrophoric gas	Gaseous	2	NA	NA	50[d,j]	NA	NA	50[d,j]	NA	NA
	Liquefied	2	NA	NA	(4)[d,j]	NA	NA	(4)[d,j]	NA	NA
Unstable (reactive) gas	Gaseous									
	4 or 3 detonable	1	NA	NA	10[d,j]	NA	NA	10[d,j]	NA	NA
	3 nondetonable	2	NA	NA	50[d,e]	NA	NA	50[d,e]	NA	NA
	2	3	NA	NA	750[d,e]	NA	NA	750[d,e]	NA	NA
	1	NA	NA	NA	NL	NA	NA	NL	NA	NA
Unstable (reactive) gas	Liquefied									
	4 or 3 detonable	1	NA	NA	(1)[d,j]	NA	NA	(1)[d,j]	NA	NA
	3 nondetonable	2	NA	NA	(2)[d,e]	NA	NA	(2)[d,e]	NA	NA
	2	3	NA	NA	(150)[d,e]	NA	NA	(150)[d,e]	NA	NA
	1	NA	NA	NA	NL	NA	NA	NL	NA	NA
Corrosive gas	Gaseous	4	NA	NA	810[d,e]	NA	NA	810[d,e]	NA	NA
	Liquefied		NA	NA	(150)[d,e]	NA	NA	(150)[d,e]	NA	NA
Highly toxic gas	Gaseous	4	NA	NA	20[e,k]	NA	NA	20[e,k]	NA	NA
	Liquefied		NA	NA	(4)[e,k]	NA	NA	(4)[e,k]	NA	NA
Toxic gas	Gaseous	4	NA	NA	810[d,e]	NA	NA	810[d,e]	NA	NA
	Liquefied		NA	NA	(150)[d,e]	NA	NA	(150)[d,e]	NA	NA

Comparison of Editions (H_2 Liq)

Table 11.2.6 Electrical Area Classification

Location	Division	Extent of Classified Area
The bulk liquefied hydrogen system fill connection, pressure relief vent outlets, or other points on the system where hydrogen is vented to the atmosphere under the designed operating conditions	1	Within 3 ft (1 m) of the system fill connection, system pressure relief vent outlets or, other points of release when the system is operating as designed
	2	Between 3 ft (1 m) and 25 ft (7.6 m) from the system fill connection, system pressure relief vent outlets, or other points of release when the system is operating as designed

Table 11.2.6.2 Electrical Area Classification

Location	Division	Extent of Classified Area
The bulk liquefied hydrogen system fill connection, pressure relief vent outlets, or other points on the system where hydrogen is vented to the atmosphere under the designed operating conditions	1	Within 3 ft (1 m) measured spherically from system fill connection, system pressure relief vent outlets, or other points of release when the system is operating as designed.
	2	Between 3 ft (1 m) and 25 ft (7.6 m) measured spherically from the system fill connection, any vent outlet, and within 25 ft (7.6 m) of any portion of the bulk supply system that contains liquefied hydrogen.

2016 Edition

2016 edition clarifies that the locations are evaluated spherically around a leak point and extends PRV vent to include any vents. It also clarifies the area extends from the surface of the equipment all around.

Current 5.9.8(a)/5.10.8(a)

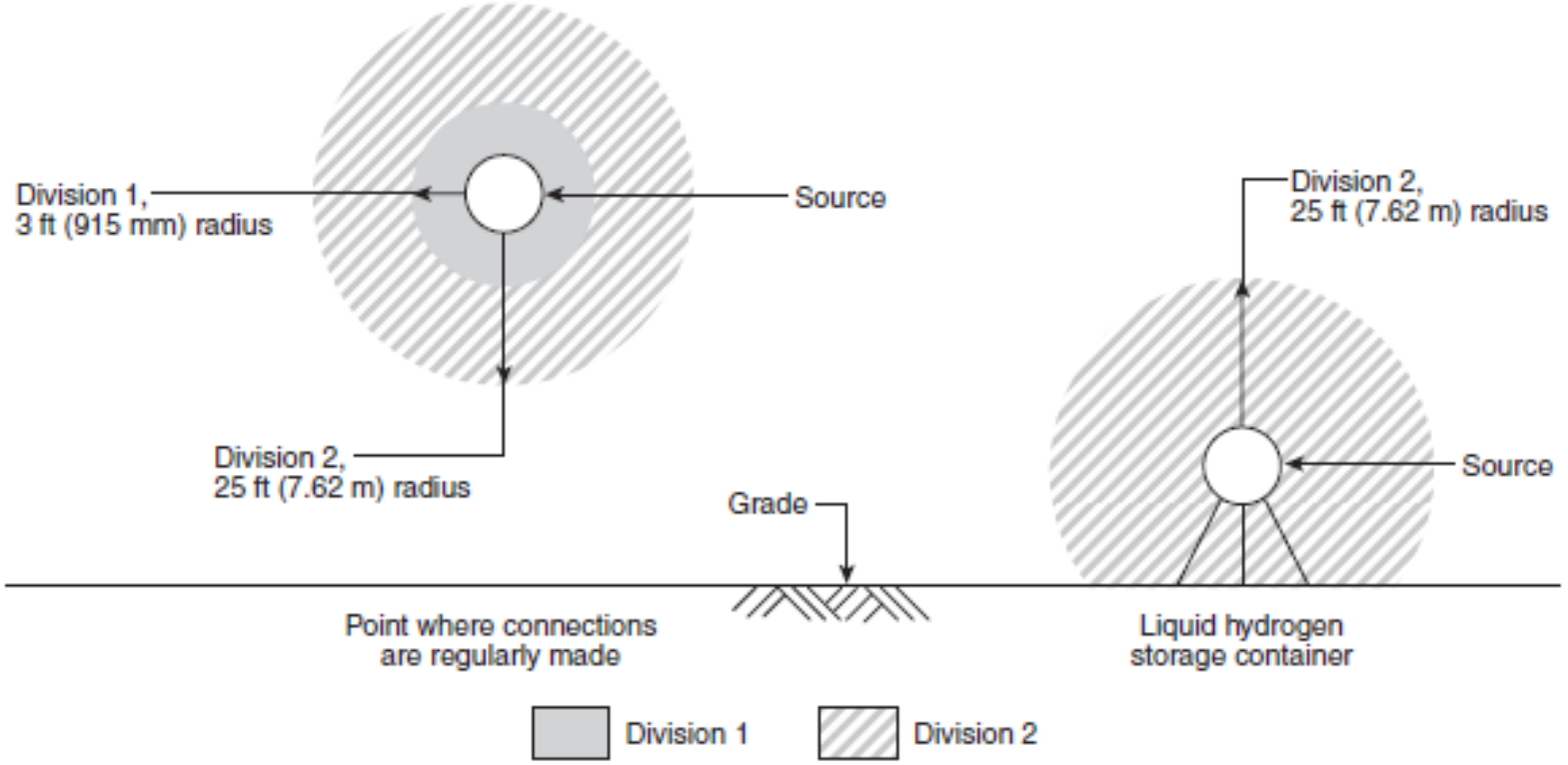


FIGURE 5.9.8(a) Liquid Hydrogen Storage Located Outdoors or Indoors in an Adequately Ventilated Building. This diagram applies to liquid hydrogen only.

Current figure is more general and does not specifically include the PRV vent or the fill connection

Current 5.9.8(b)/5.10.8(b)

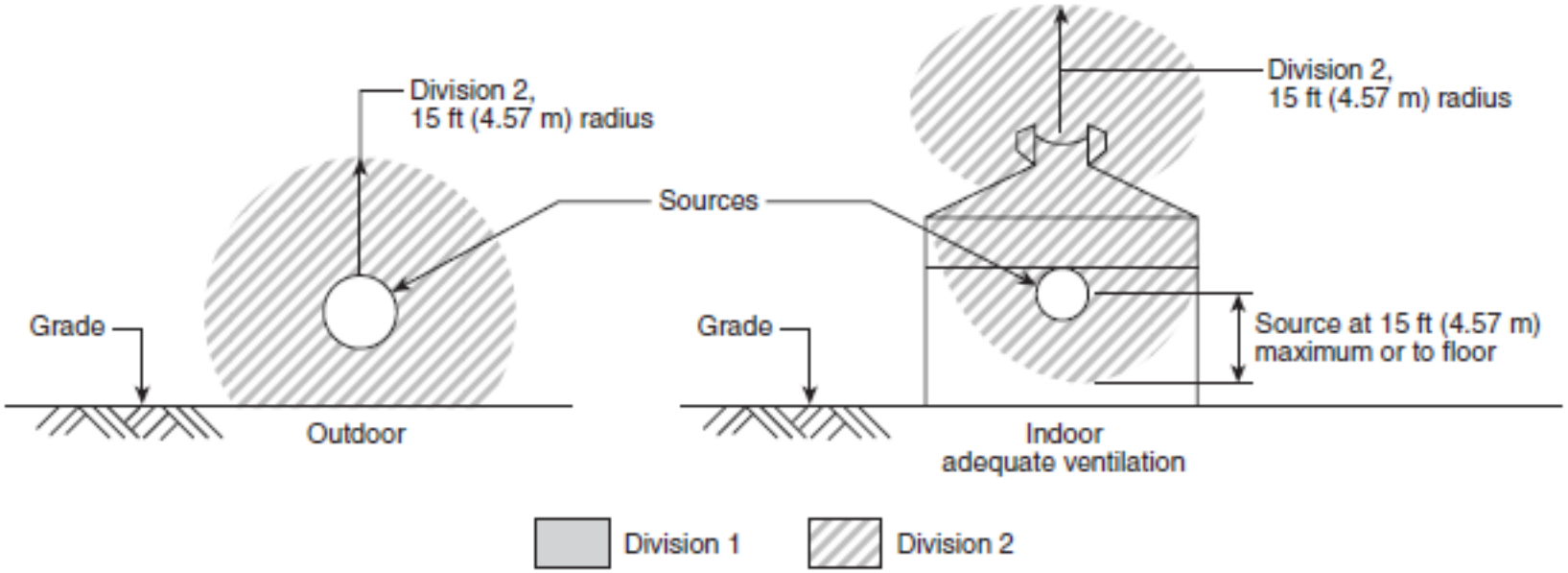


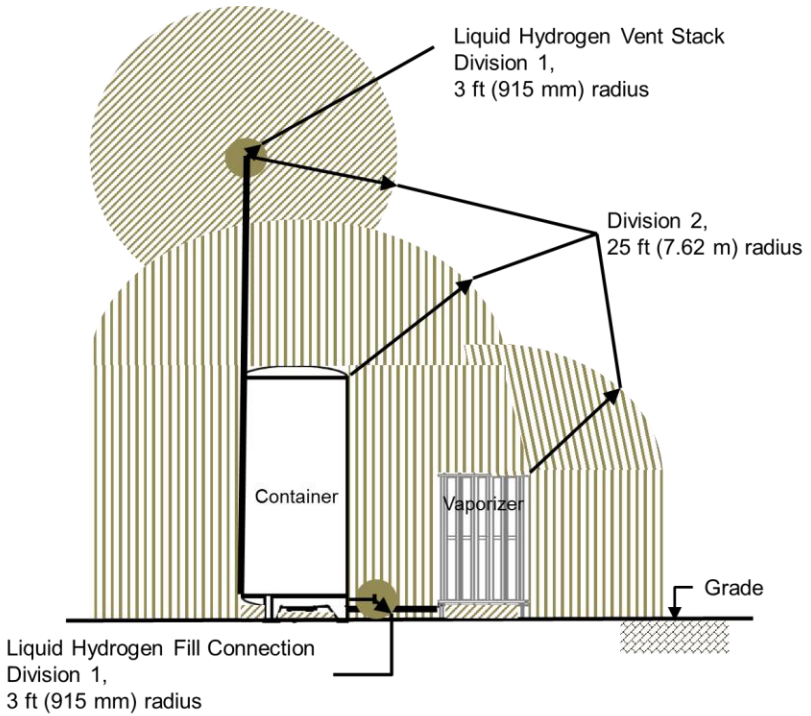
FIGURE 5.9.8(b) Gaseous Hydrogen Storage Located Outdoors or Indoors in an Adequately Ventilated Building. This diagram applies to gaseous hydrogen only.

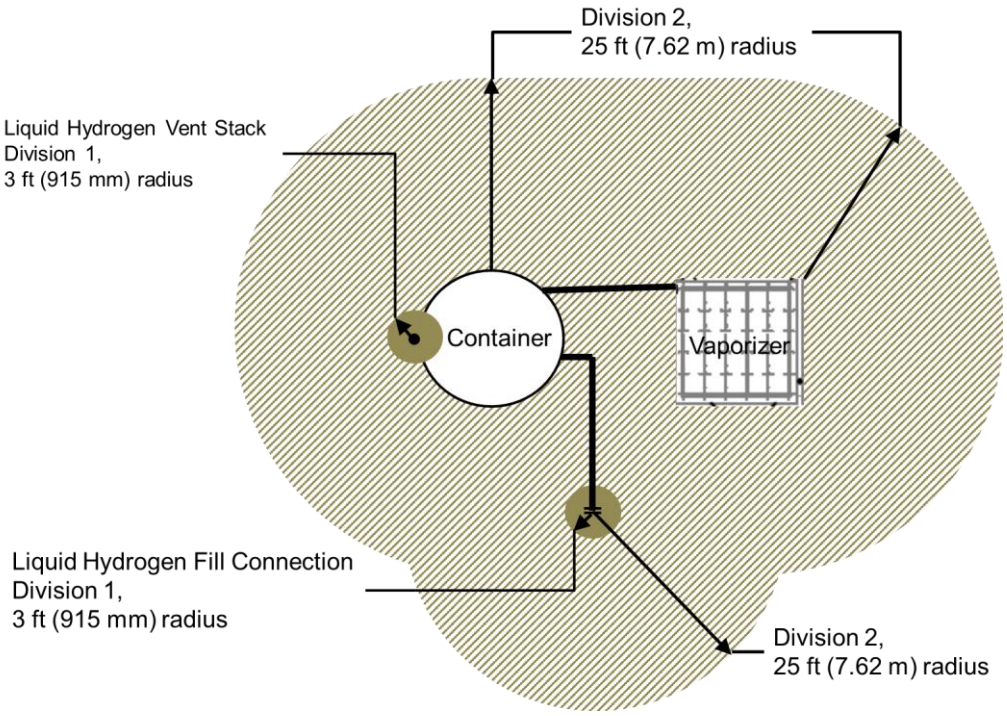
Current figure is more general and does not specifically include an area around the closed container or vents from the closed container as in the latest edition

Recommendation

- Retain current 5.9.8/5.10.8 (a), (b) as general source locations using the 497 understanding of source as any potential leak point
- Add new 5.9.8/5.10.8(c) Liquid Hydrogen Storage – Tank and Vaporizer (parts of system containing liquid hydrogen)
- Add new 5.9.8/5.10.8 (d) Gaseous Hydrogen Vent Stack
- Add new 5.9.8/5.10.8(e) Gaseous Hydrogen Receivers
- Add new 5.9.x/5.10.x Compressed Gas Cylinders (Lighter than or Equal to Air, including Hydrogen)
- Add new 5.9.y/5.10.y Compressed Gas Cylinders (Heavier than Air)

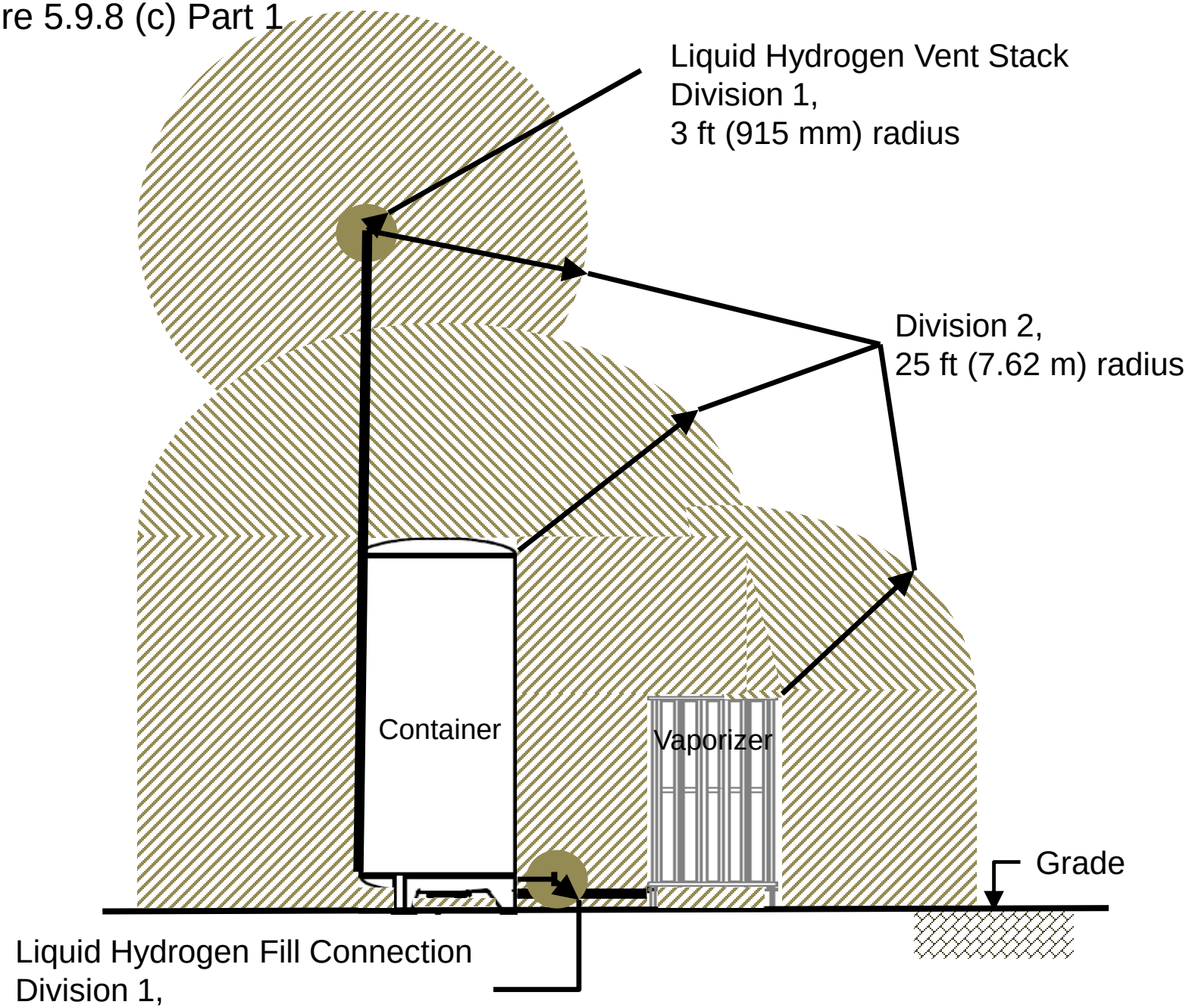
5.9.8(c) Liquid Hydrogen Storage – Tank and Vaporizer (parts of system containing liquid hydrogen)

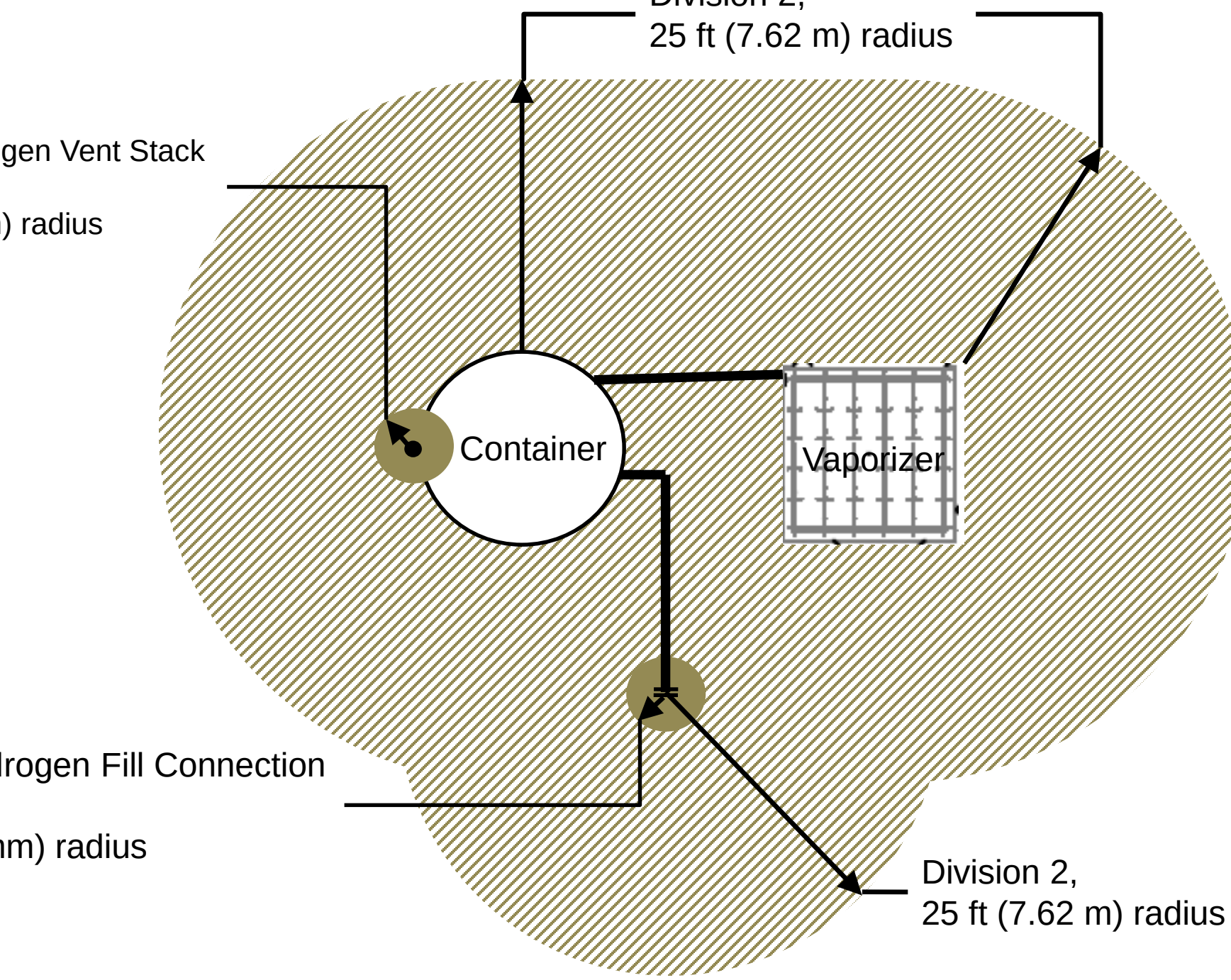




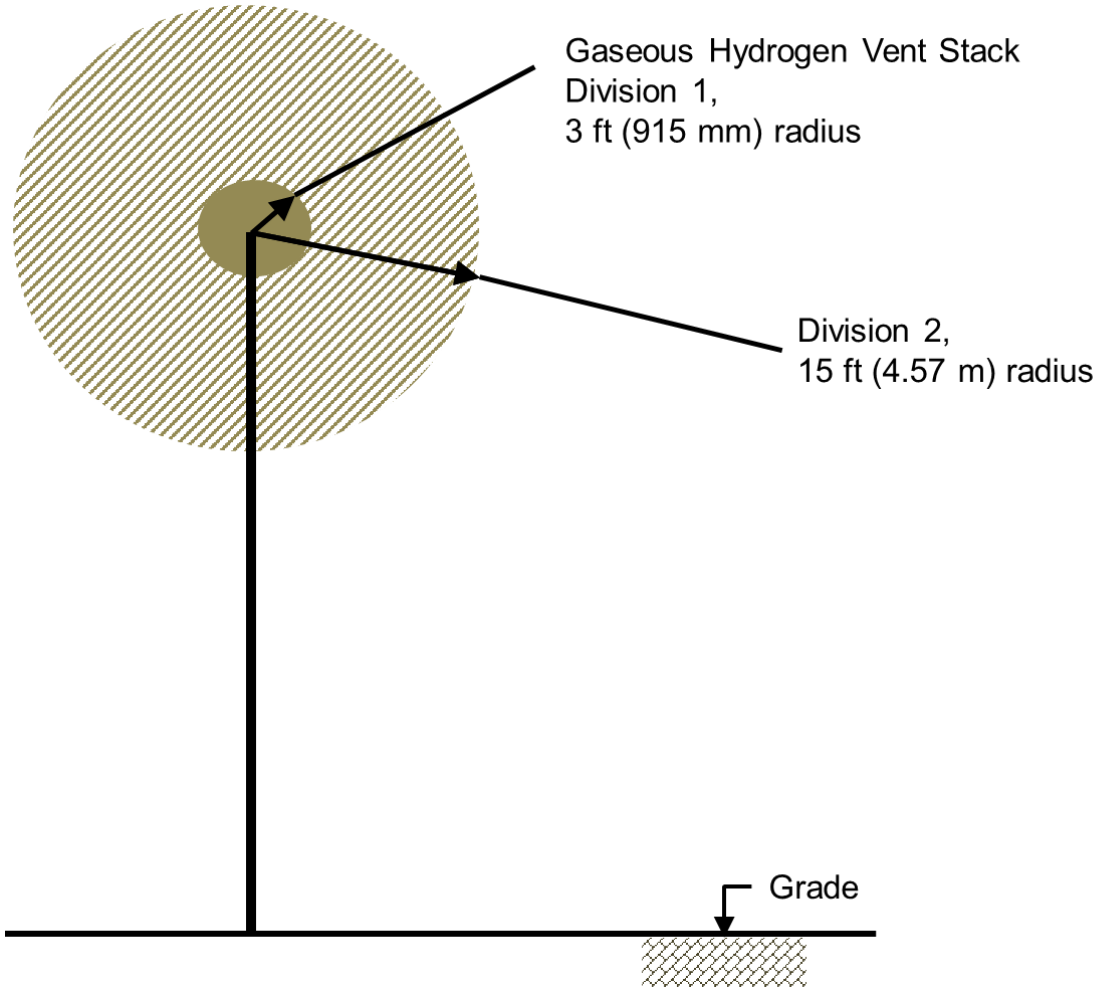
For 5.10.8(c) replace “Division” with “Zone”

Figure 5.9.8 (c) Part 1

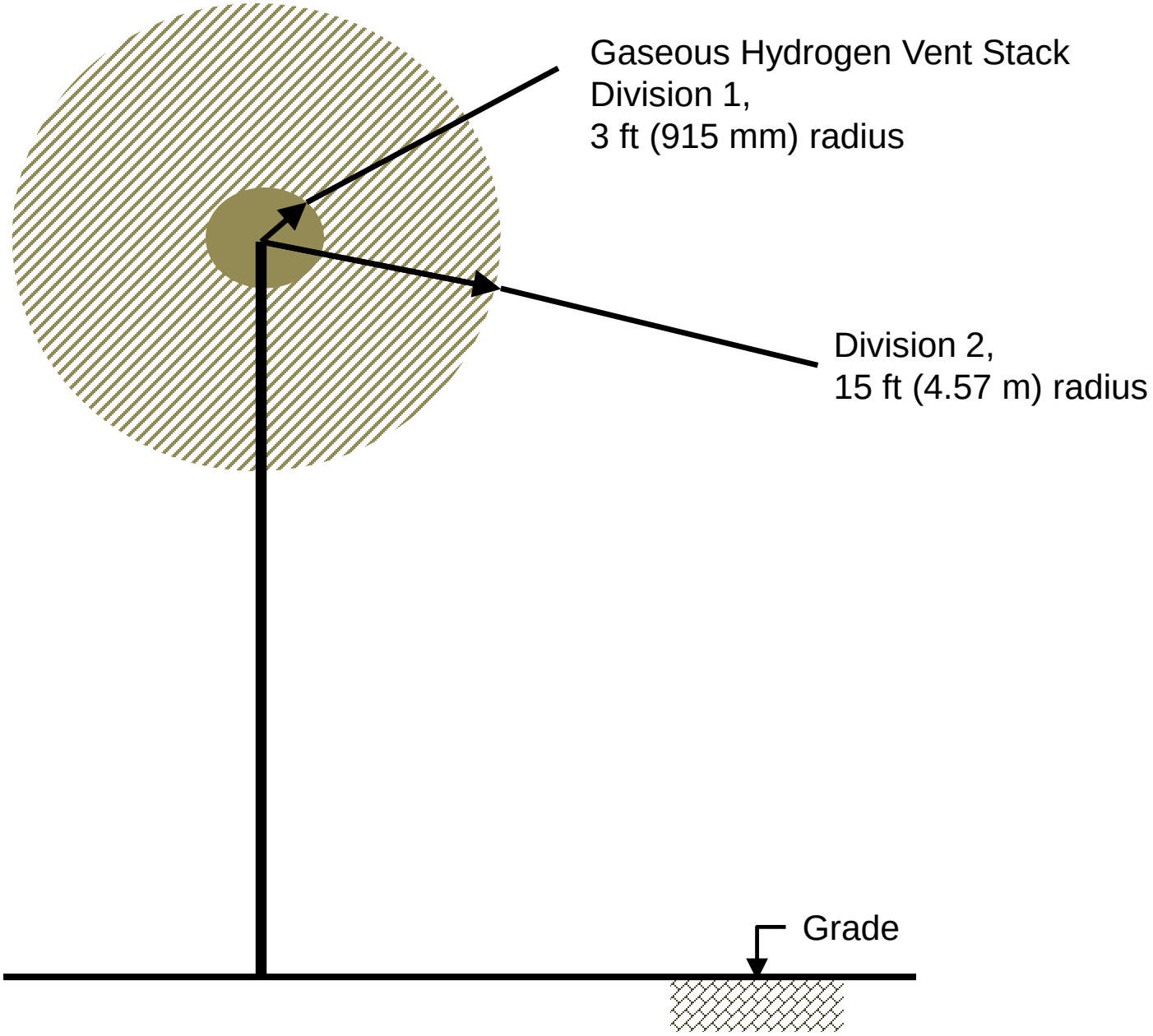



Division 2,
25 ft (7.62 m) radius
gen Vent Stack
) radius
Container
Vaporizer
lrogen Fill Connection
nm) radius
Division 2,
25 ft (7.62 m) radius

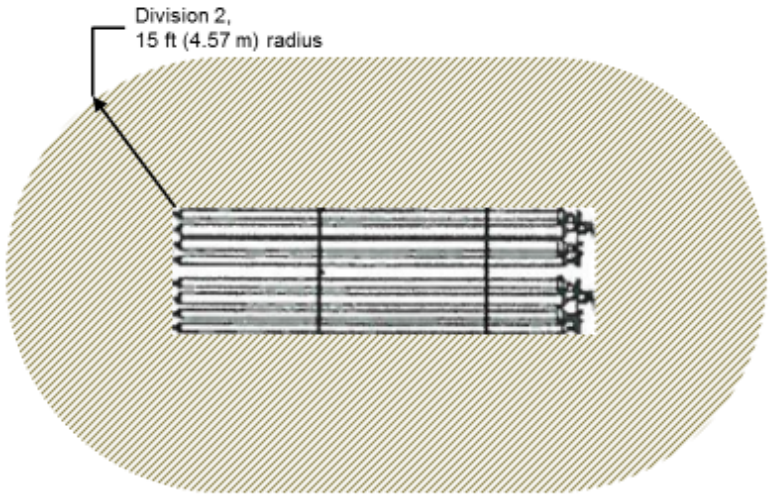
5.9.8(d) Gaseous Hydrogen Vent Stack

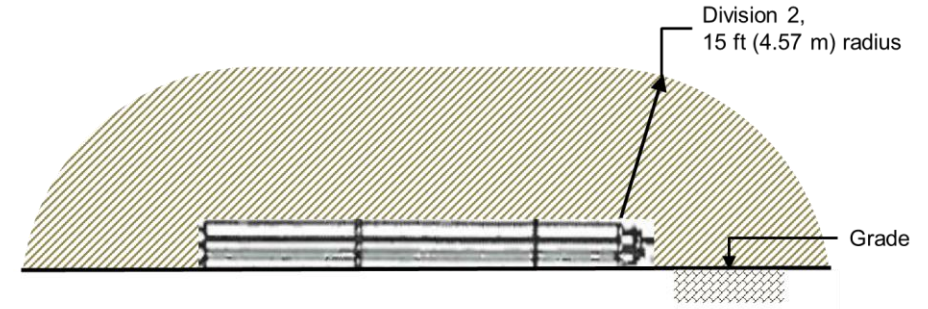


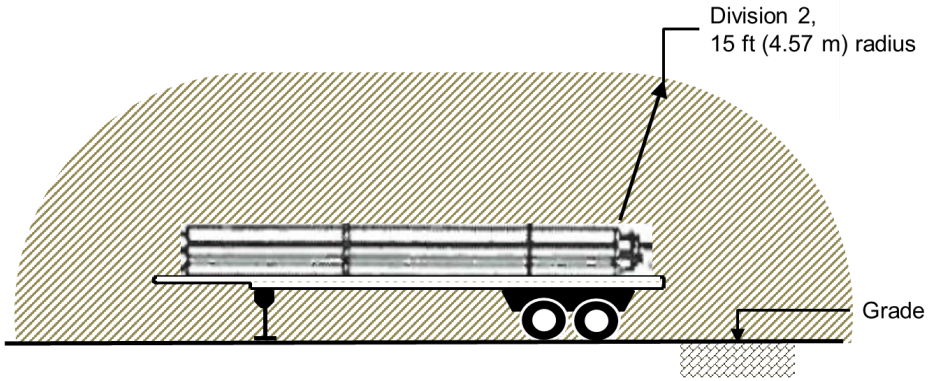
For 5.10.8(d) replace “Division” with “Zone”


Gaseous Hydrogen Vent Stack
Division 1,
3 ft (915 mm) radius
Division 2,
15 ft (4.57 m) radius
Grade

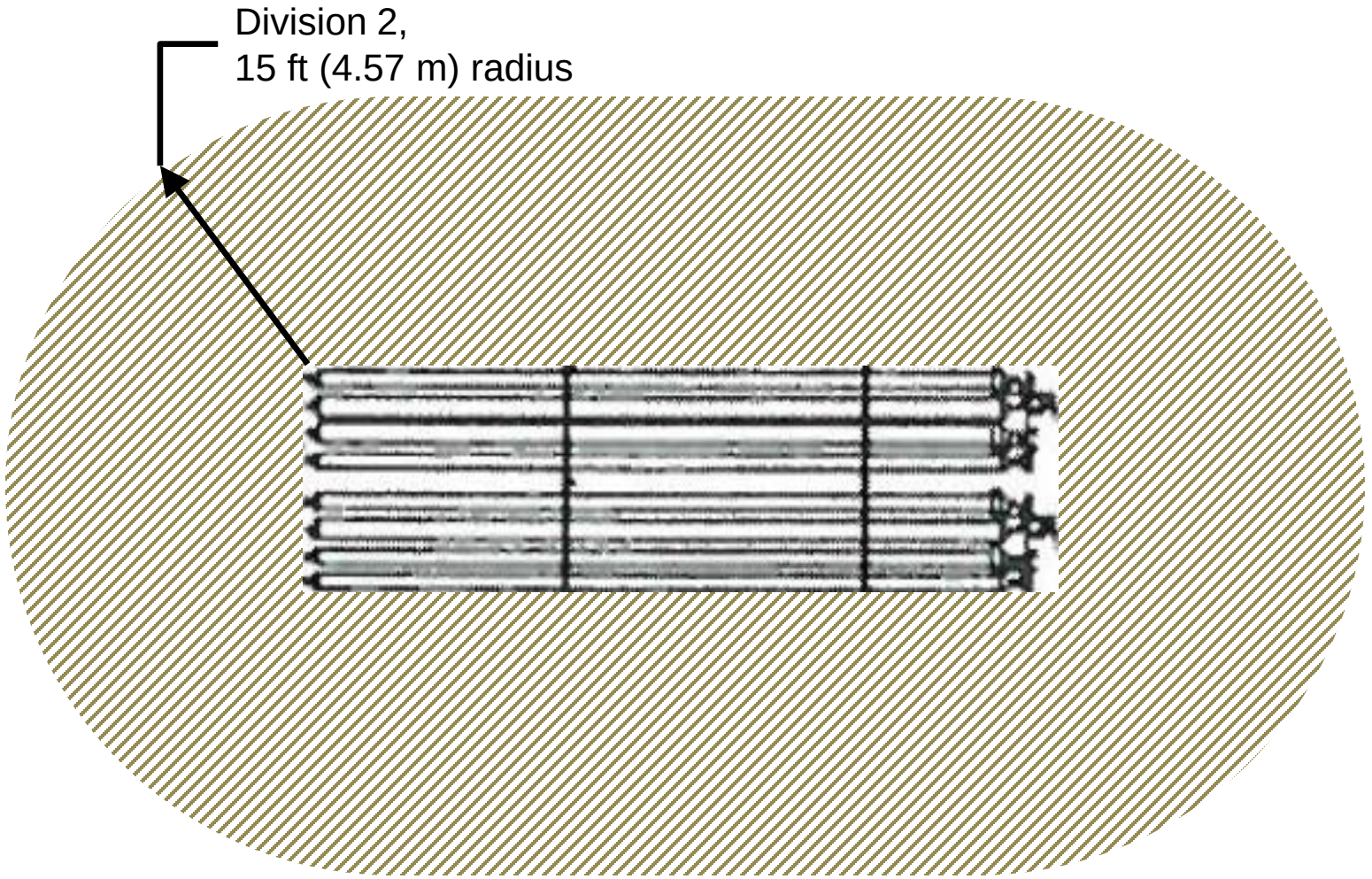
5.9.8(e) Gaseous Hydrogen Receivers

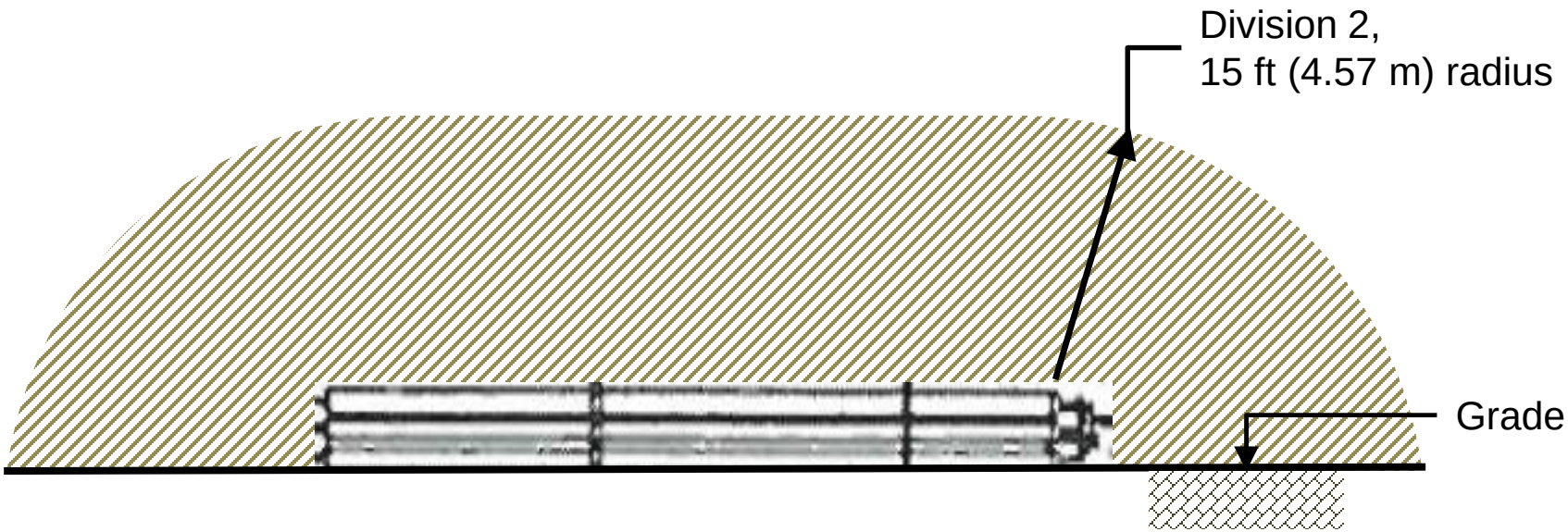


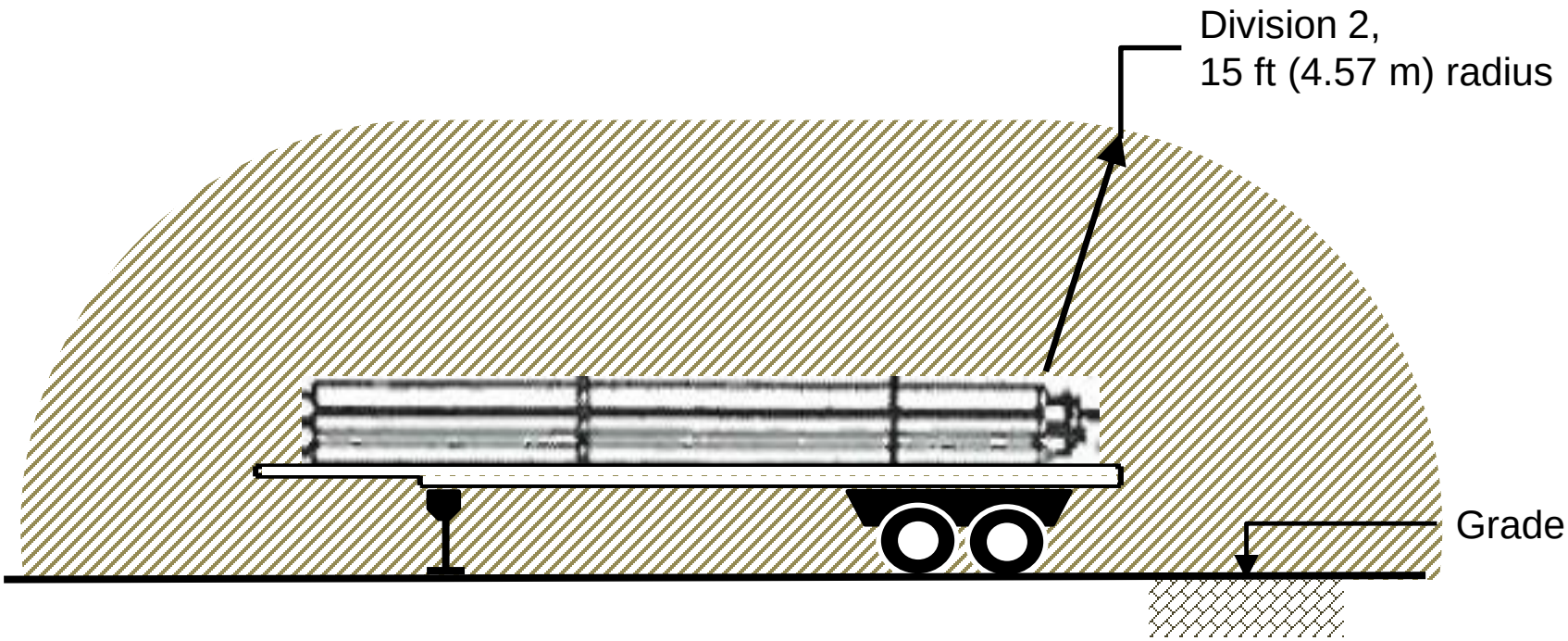




For 5.10.8(e) replace “Division” with “Zone”


Division 2,
15 ft (4.57 m) radius

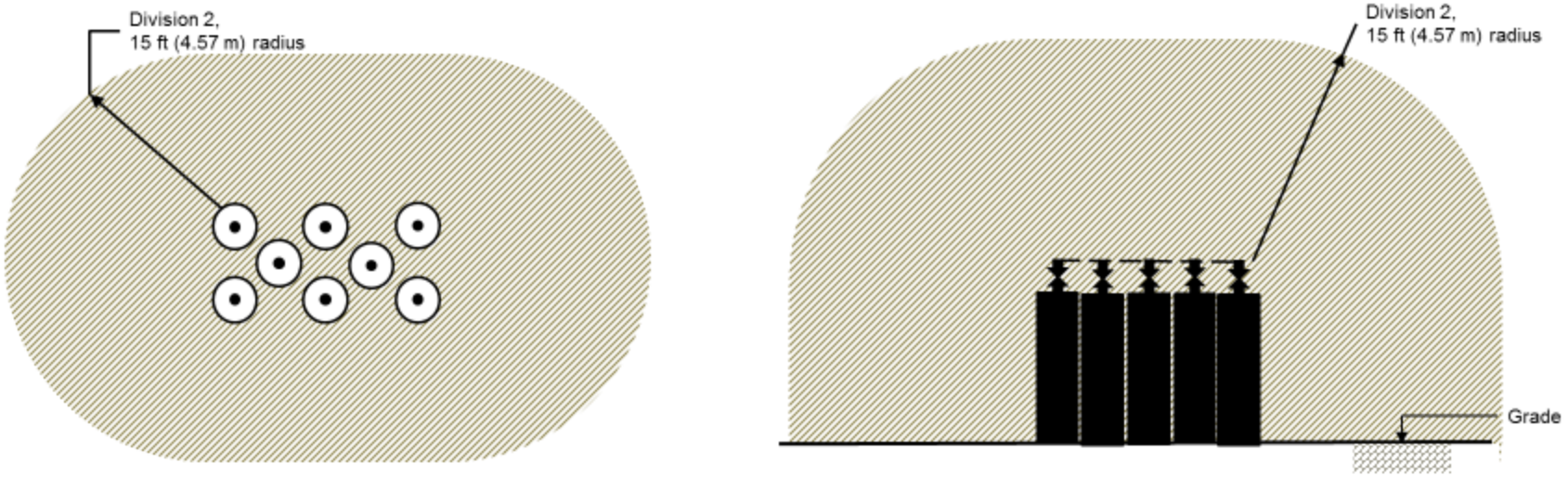

Division 2,
15 ft (4.57 m) radius
Grade


Division 2,
15 ft (4.57 m) radius
Grade

Compressed Gas Cylinders

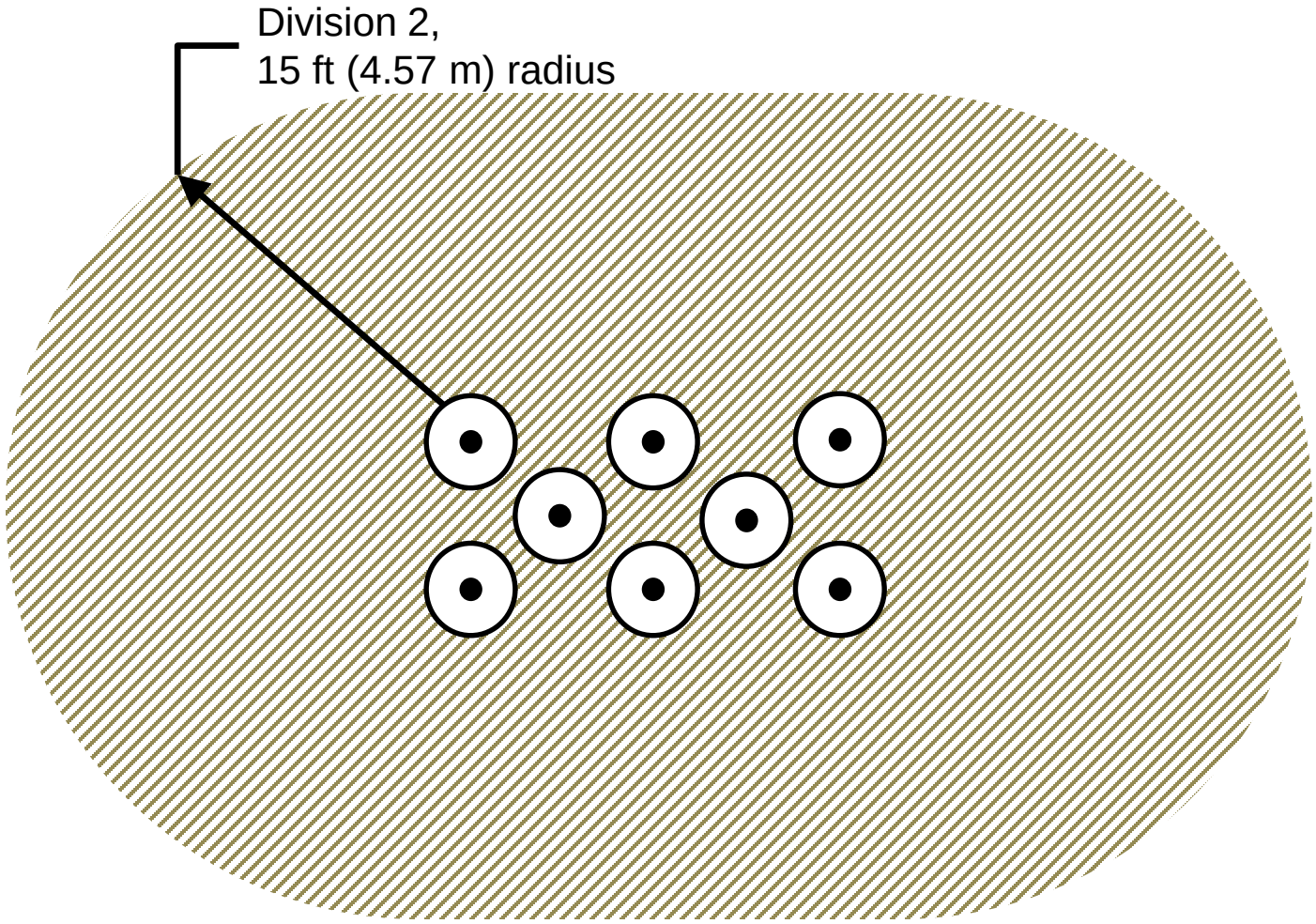
- Low volume cylinder storage also applies to gaseous hydrogen cylinders
- Cylinders conventionally stored vertically and restrained.
- Lighter than air cylinder storage leaks are buoyant
- Heavier than air cylinder storage leaks are jet leaks under significant pressure, so entrainment quickly reduces concentration

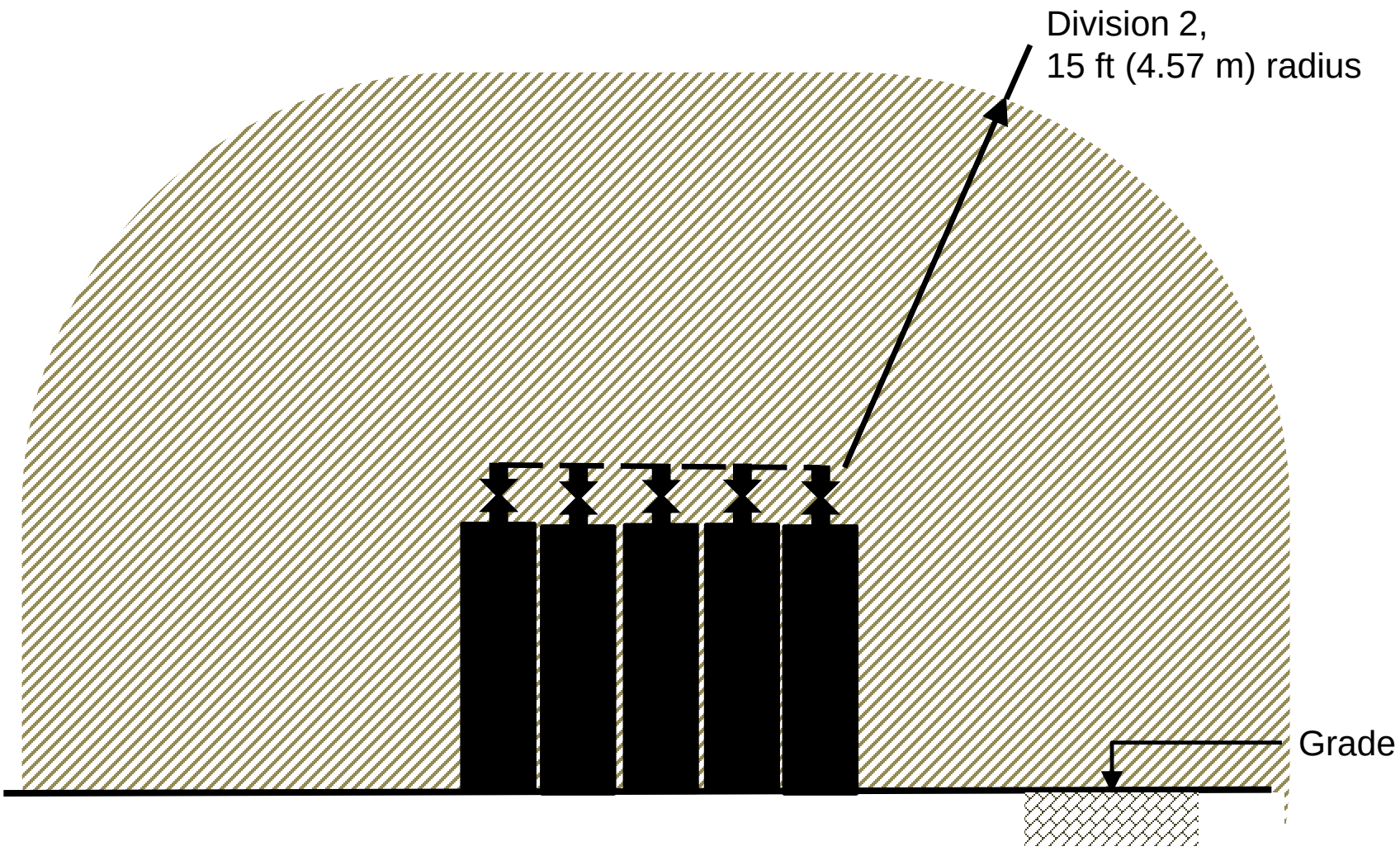
5.9.x(a) Compressed Gas Cylinders (Lighter than or Equal to Air, including Hydrogen)



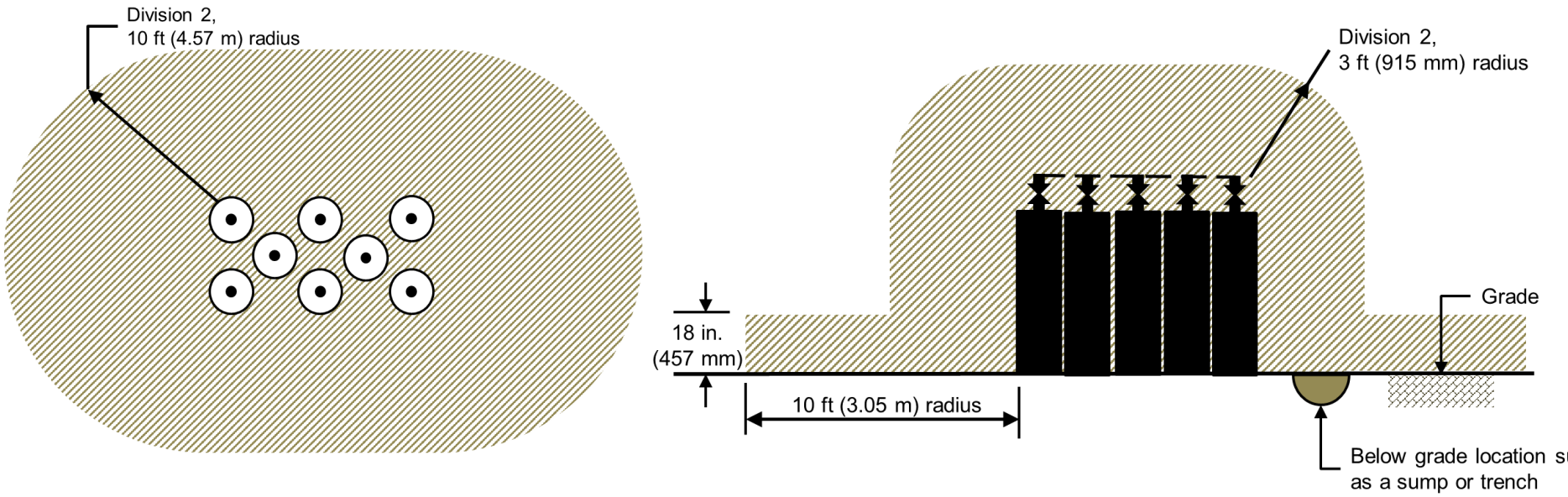
Condition: Outdoor or Indoor well-ventilated location, secured in vertical position, in-use in single or manifolded configuration

For 5.10.x(a) replace “Division” with “Zone”


Division 2,
15 ft (4.57 m) radius

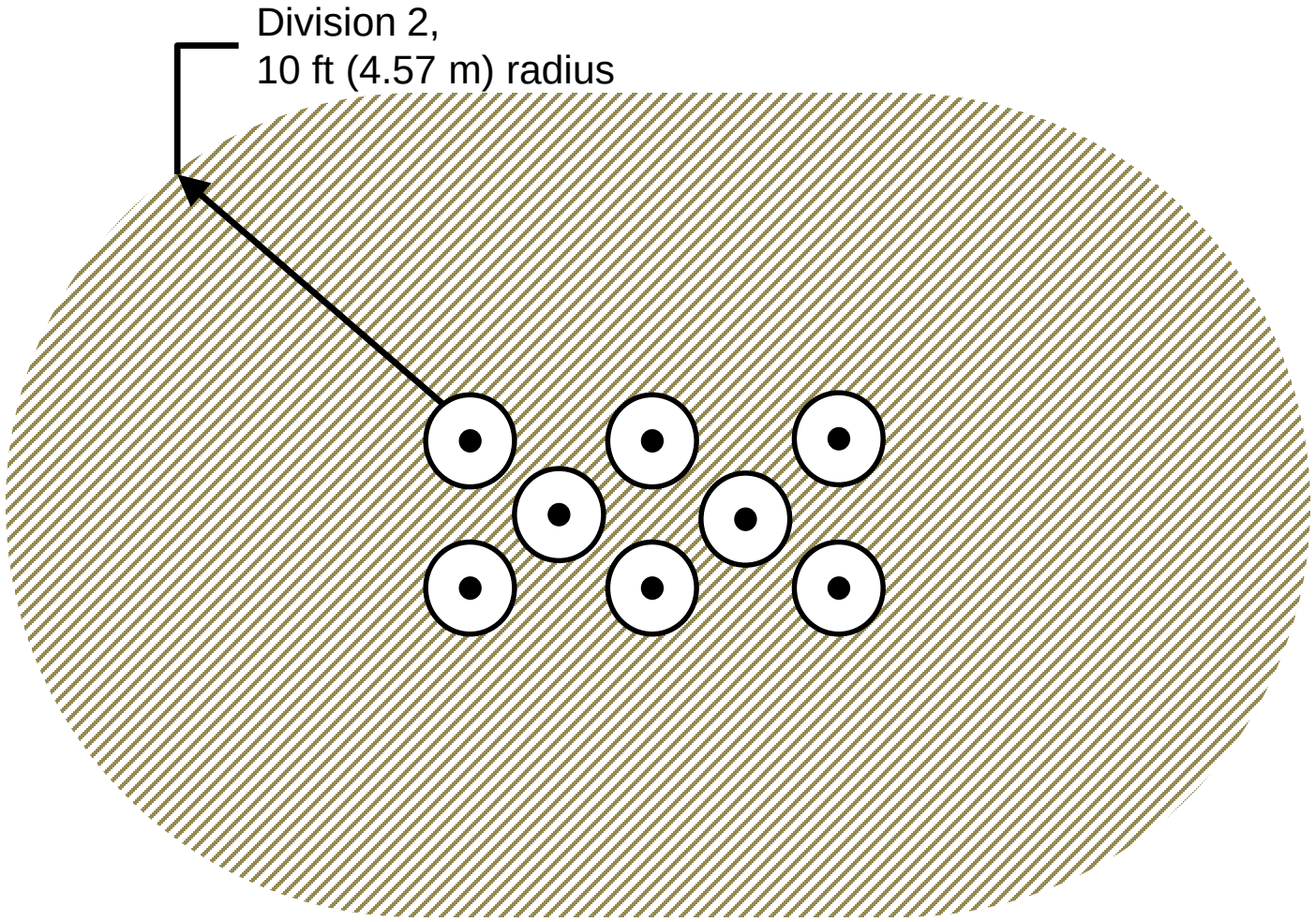

Division 2,
15 ft (4.57 m) radius
Grade

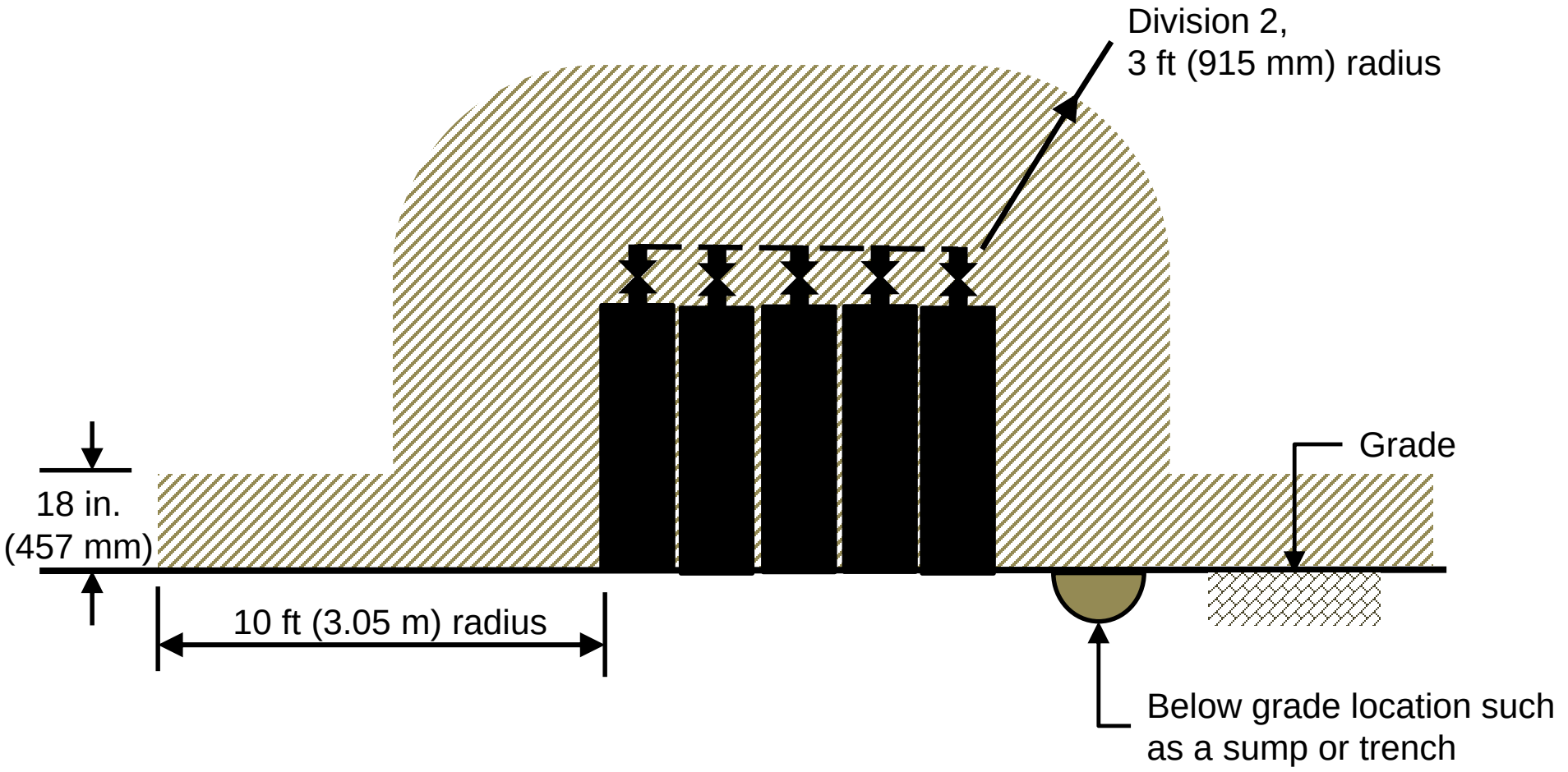
5.9.x(b) Compressed Gas Cylinders (Heavier than Air)



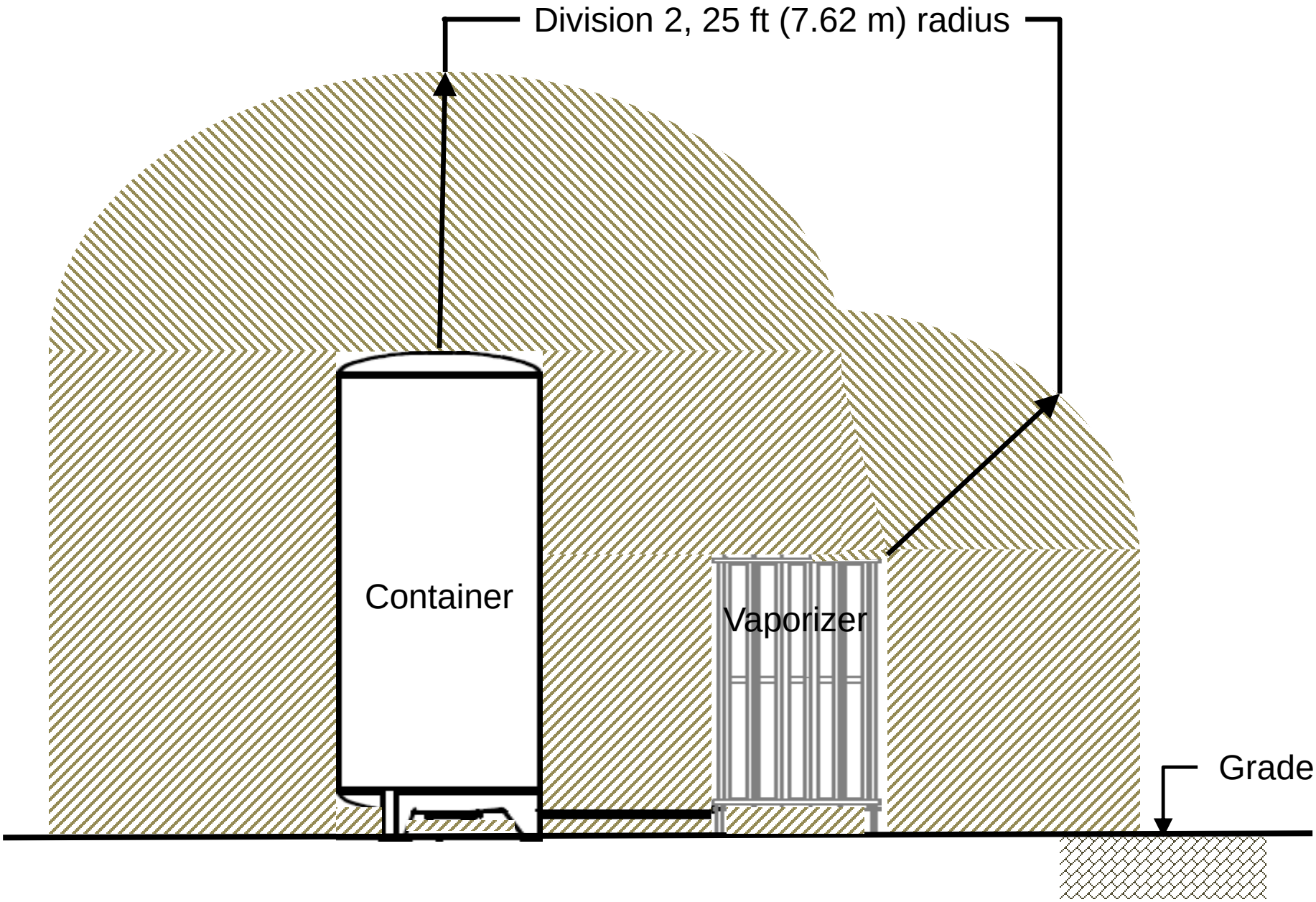
Condition: Outdoor or Indoor well-ventilated location, secured in vertical position, in-use in single or manifolded configuration

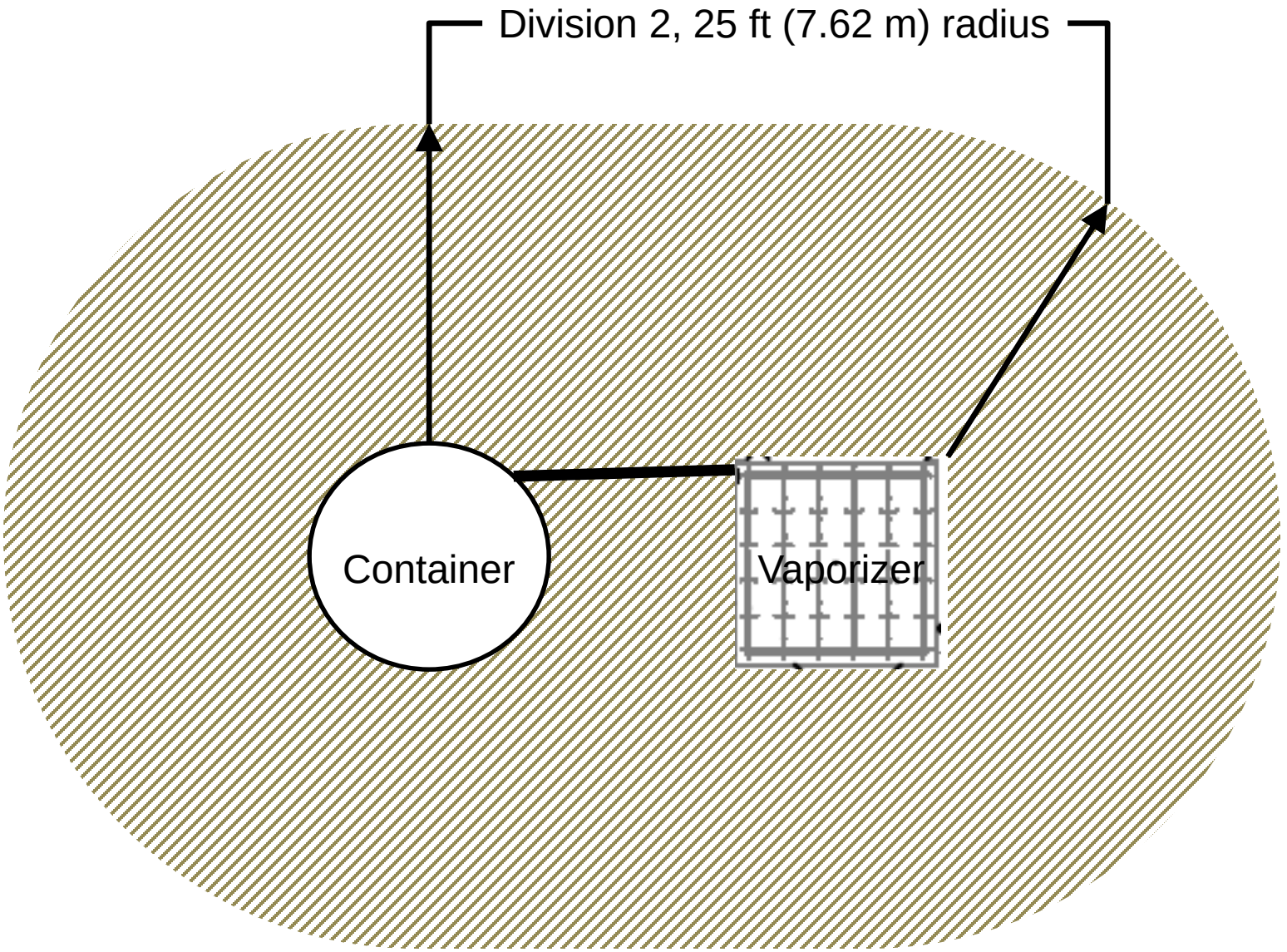
For 5.10.x(b) replace “Division” with “Zone”


Division 2,
10 ft (4.57 m) radius

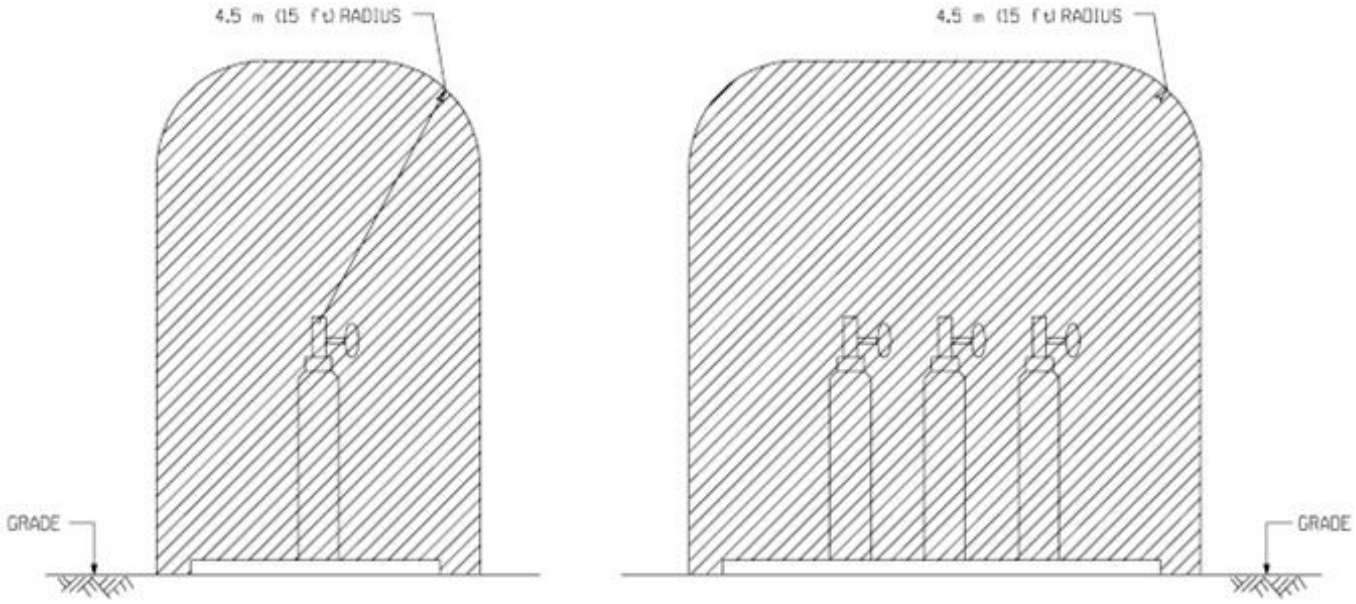

Division 2,
3 ft (915 mm) radius
Grade
18 in.
(457 mm)
10 ft (3.05 m) radius
Below grade location such
as a sump or trench

Backup


Division 2, 25 ft (7.62 m) radius
Container
Vaporizer
Grade


Division 2, 25 ft (7.62 m) radius
Container
Vaporizer

Lighter than Air

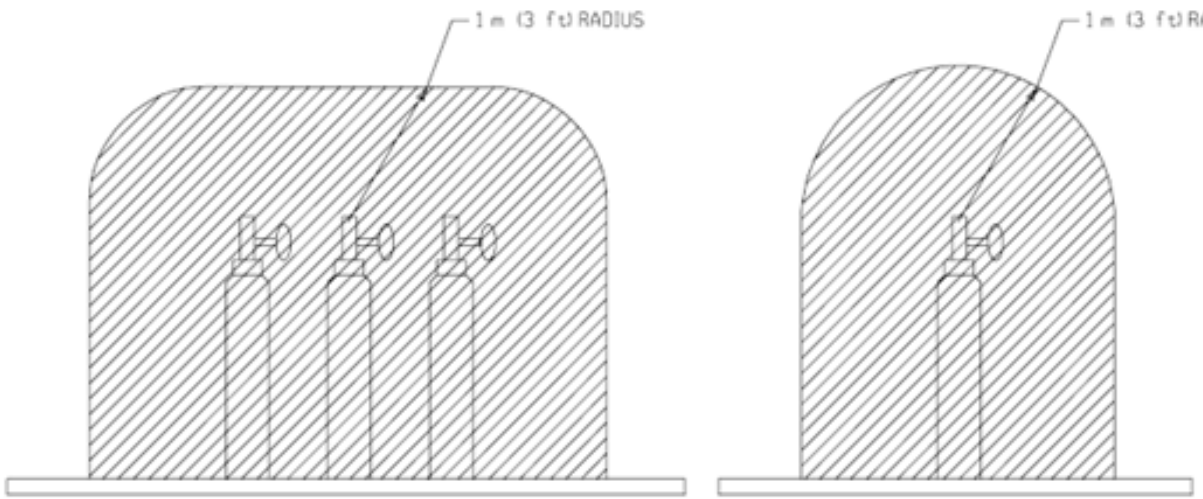


CONDITION: ACTIVE APPLICATION OF A WELL MAINTAINED INSTALLATION IN AN OUTDOOR VENTILATED LOCATION. CYLINDERS ARE SECURED AND ARE CONNECTED USING STAINLESS STEEL TUBING WITH MINIMUM NUMBER OF COMPRESSION FITTINGS.

ZONE 2
CLASS I, DIVISION 2

IN-USE CYLINDERS WITH COMPRESSED LIGHTER-THAN-AIR OR EQUAL-TO-AIR FLAMMABLE GAS

Heavier than Air

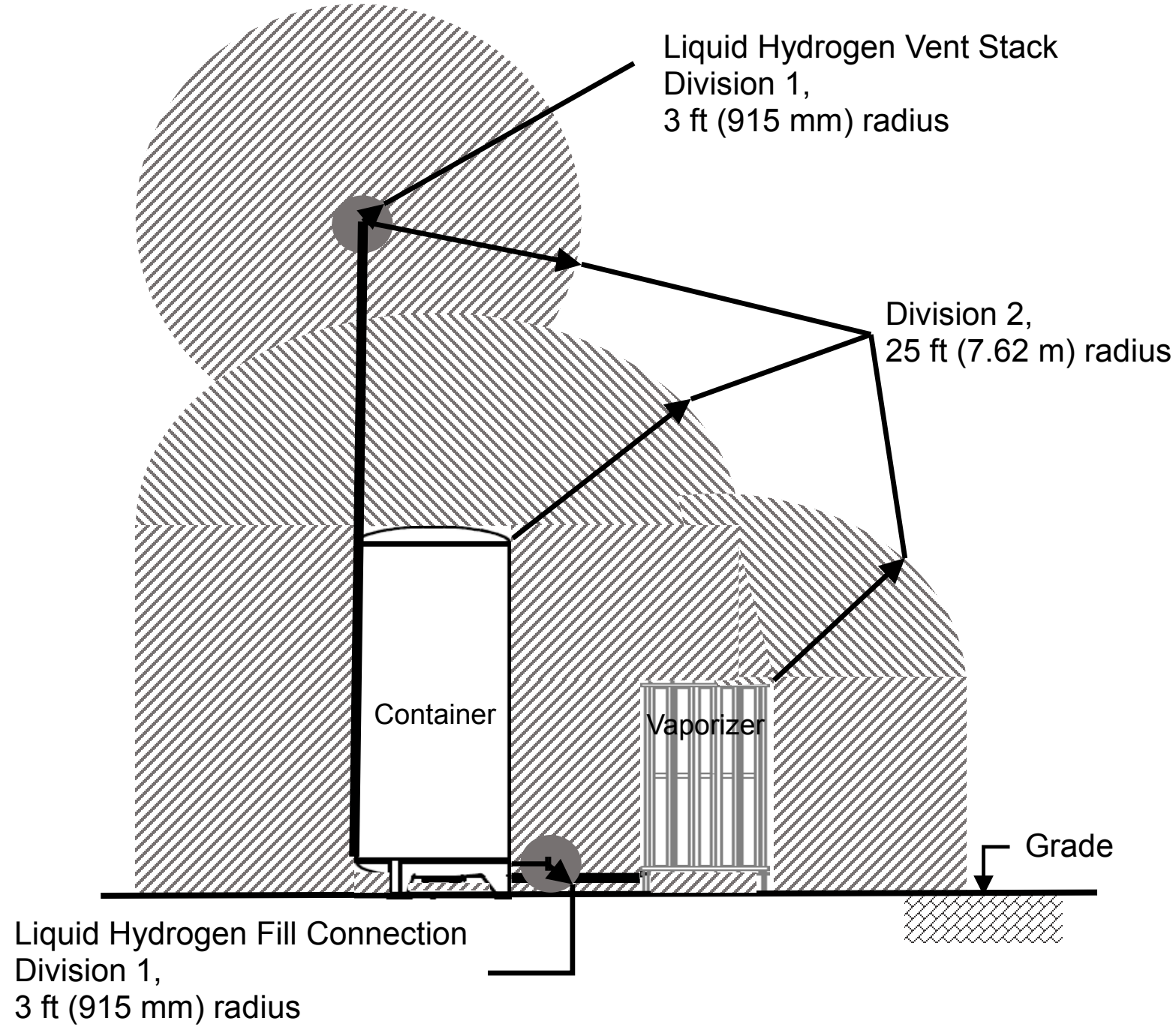


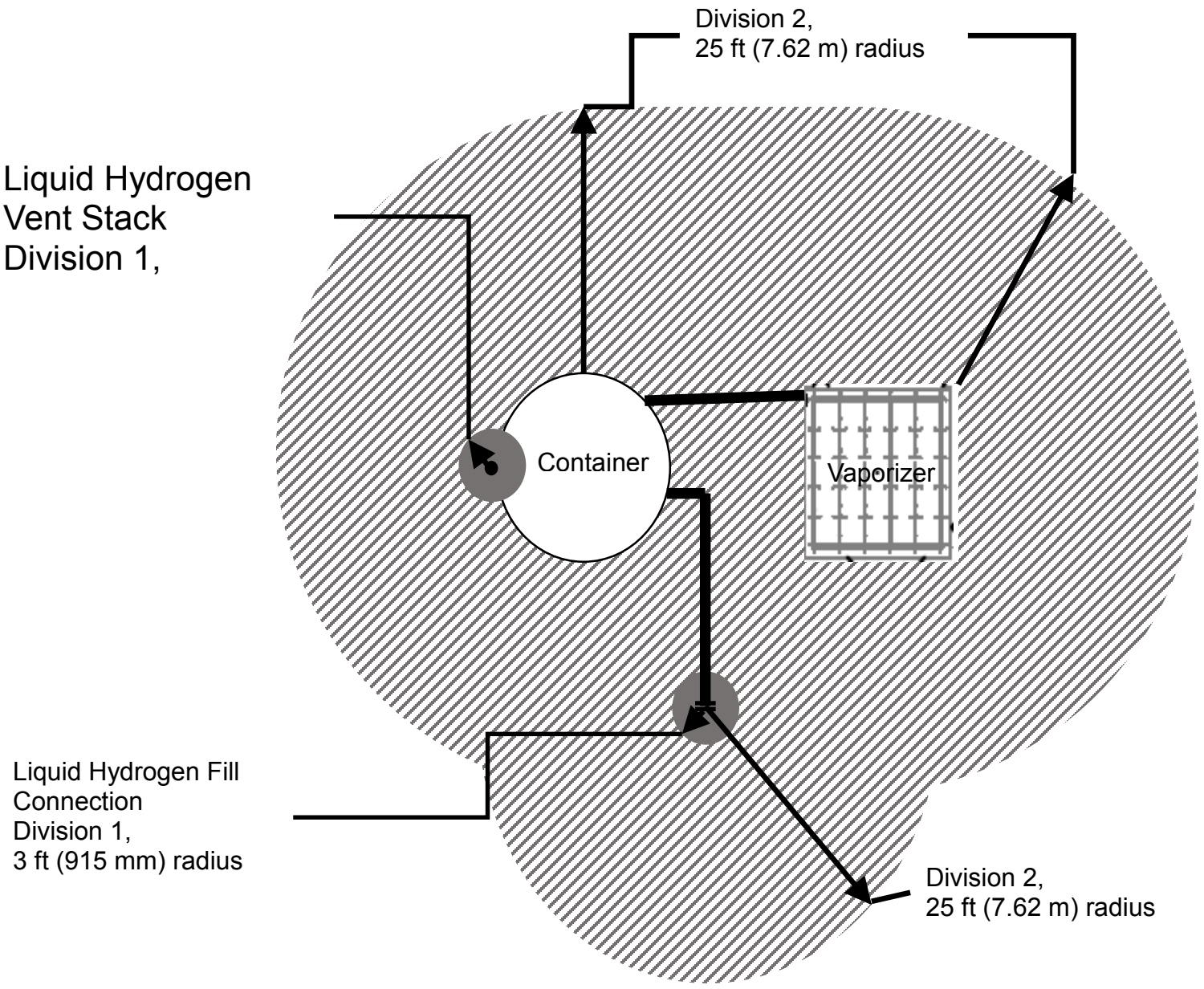
CONDITION: ACTIVE APPLICATION OF A WELL MAINTAINED INSTALLATION IN AN OUTDOOR VENTILATED LOCATION. CYLINDER IS SECURED AND IS CONNECTED USING STAINLESS STEEL TUBING WITH MINIMUM NUMBER OF COMPRESSION FITTINGS.

ZONE 2
CLASS I, DIVISION 2

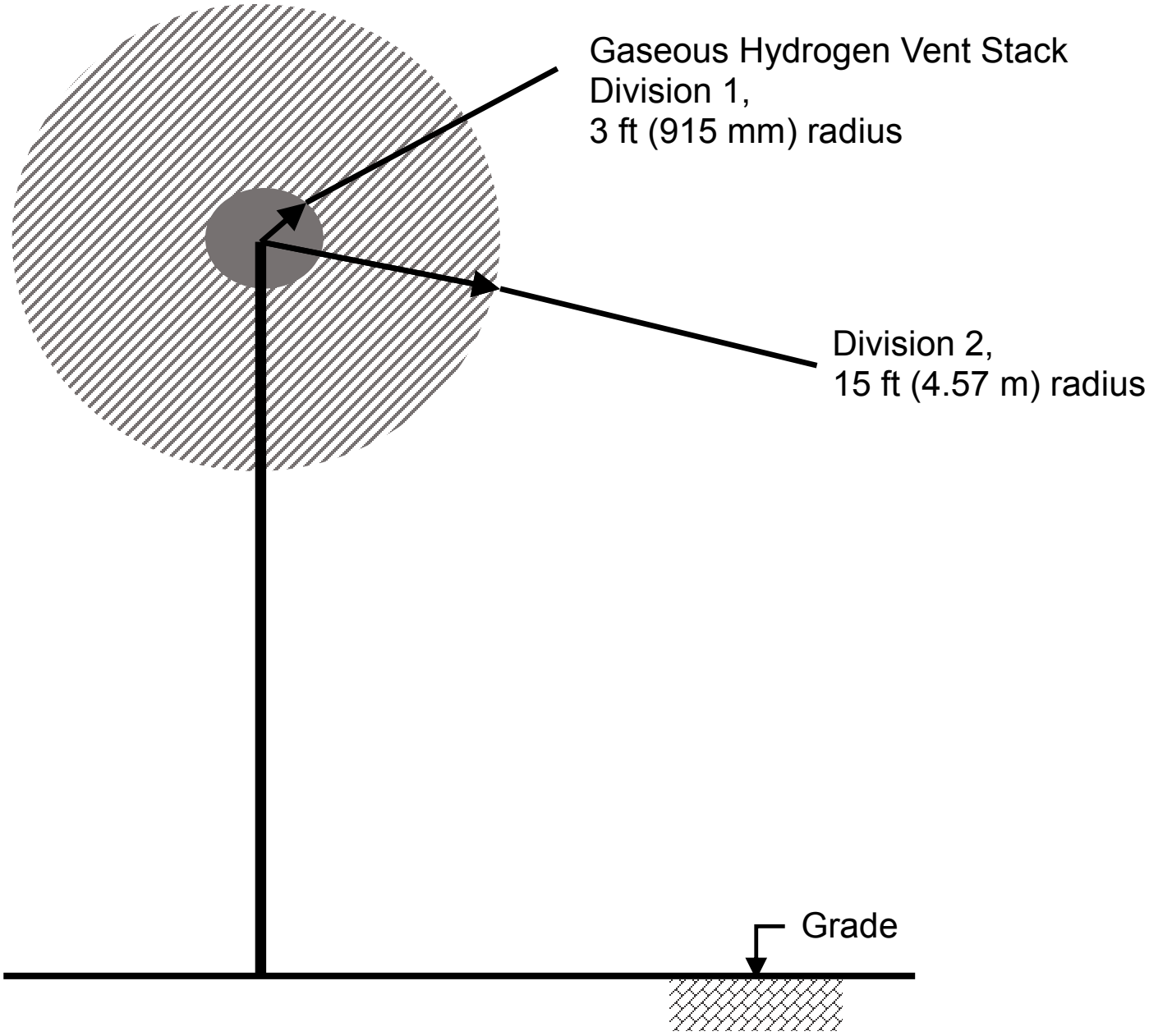
IN-USE CYLINDER WITH COMPRESSED HEAVIER-THAN-AIR FLAMMABLE GAS

New 5.10.8(c) Liquid Hydrogen Storage – Tank and Vaporizer (parts of system containing liquid hydrogen)

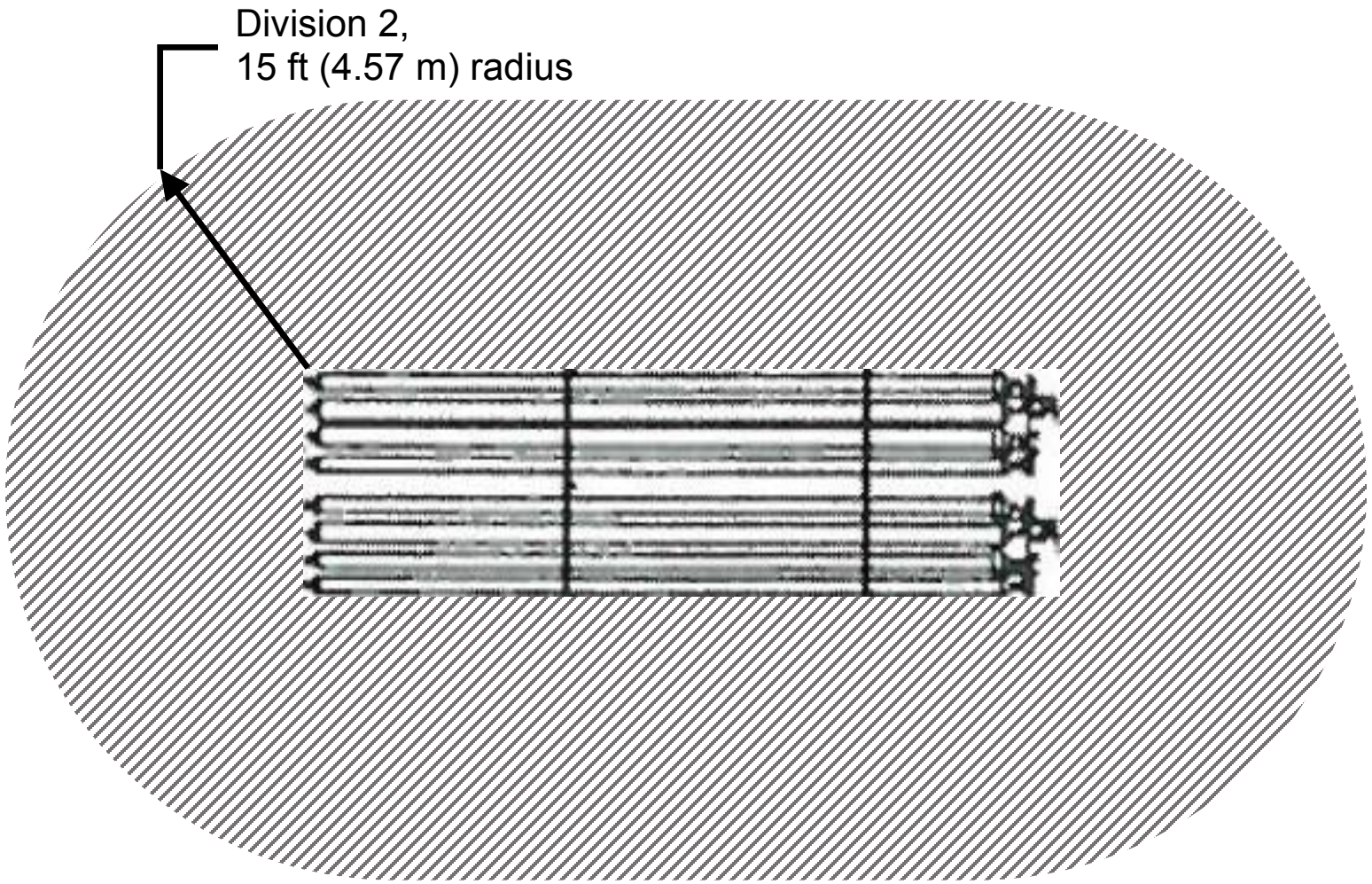


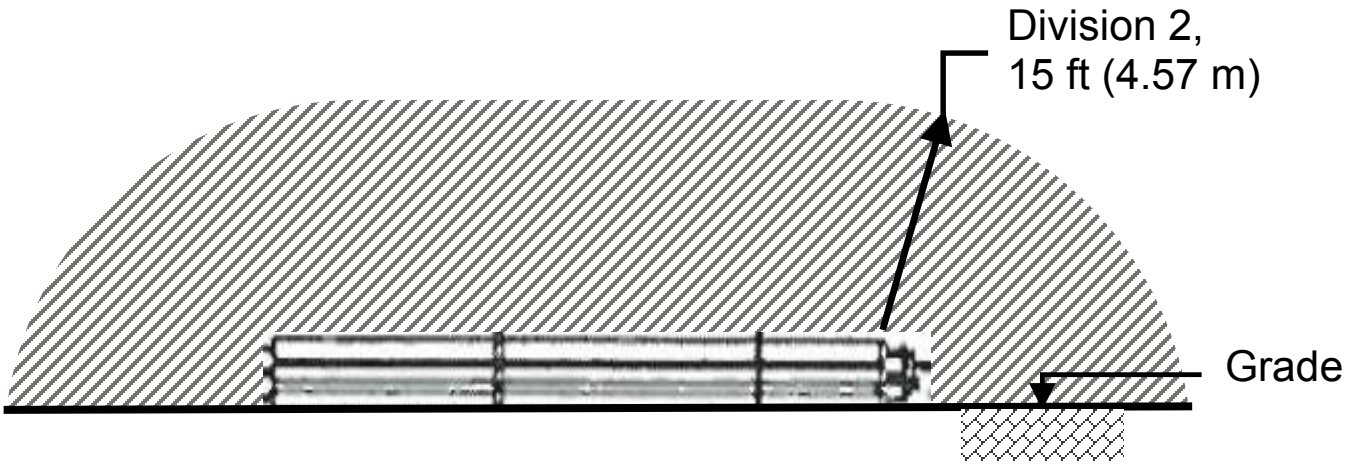

Division 2,
25 ft (7.62 m) radius
Liquid Hydrogen
Vent Stack
Division 1,
Container
Vaporizer
Liquid Hydrogen Fill
Connection
Division 1,
3 ft (915 mm) radius
Division 2,
25 ft (7.62 m) radius

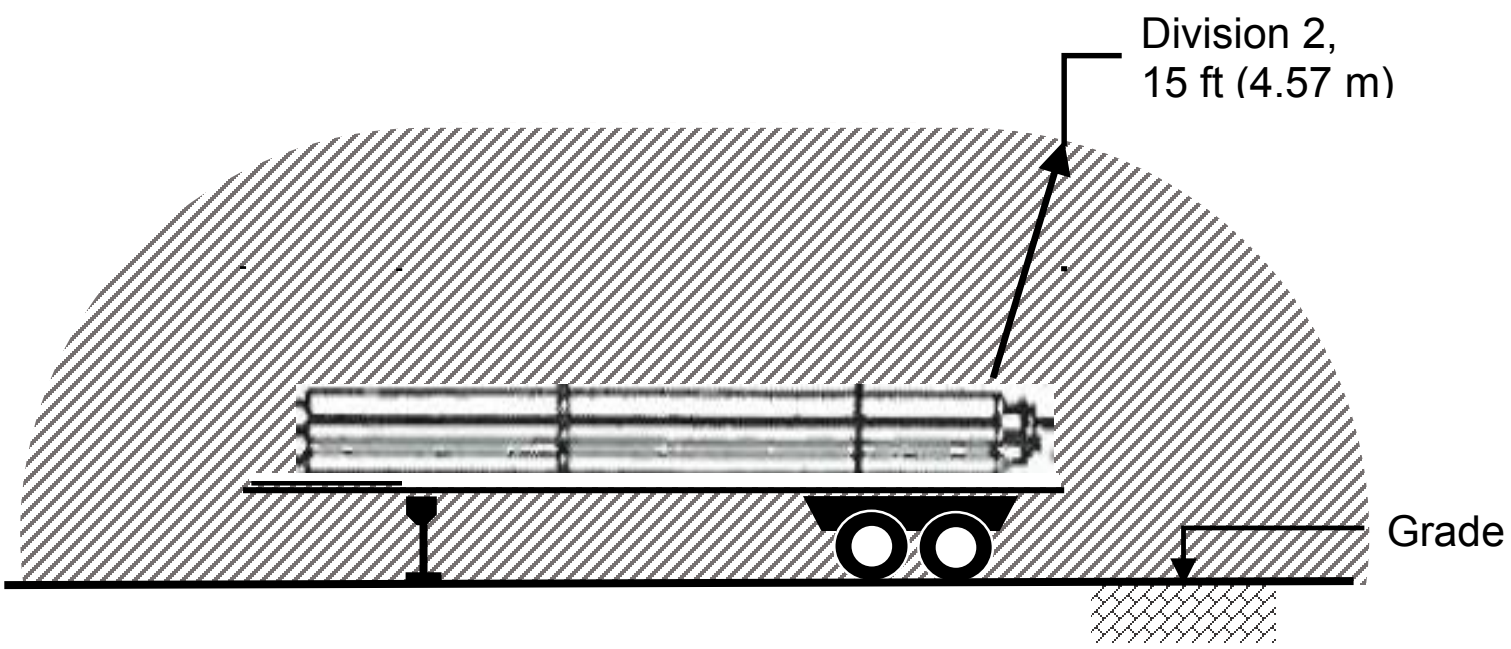
New 5.10.8(d) Gaseous Hydrogen Vent Stack



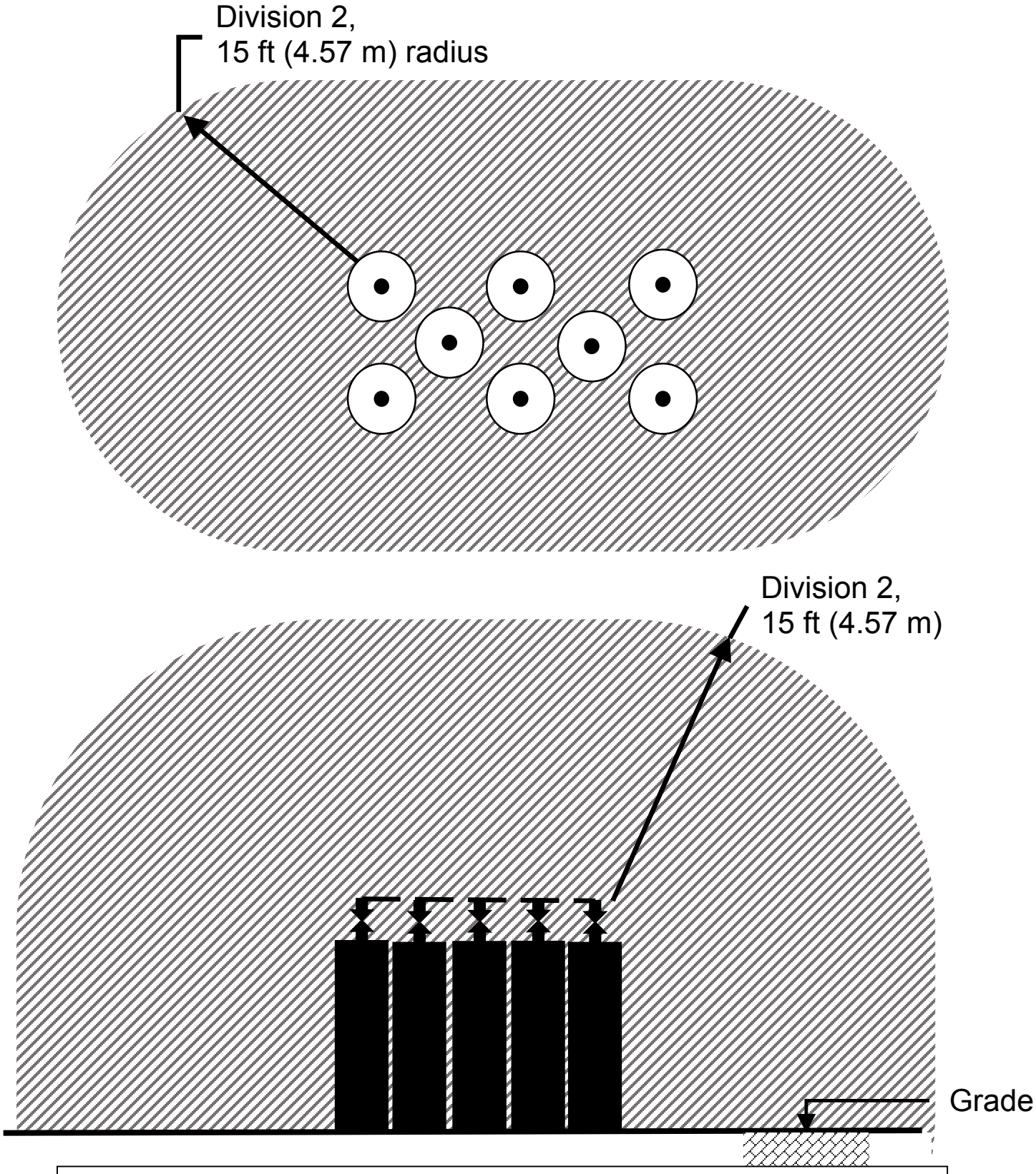
New 5.10.8(e) Gaseous Hydrogen Receivers




Division 2,
15 ft (4.57 m)
Grade

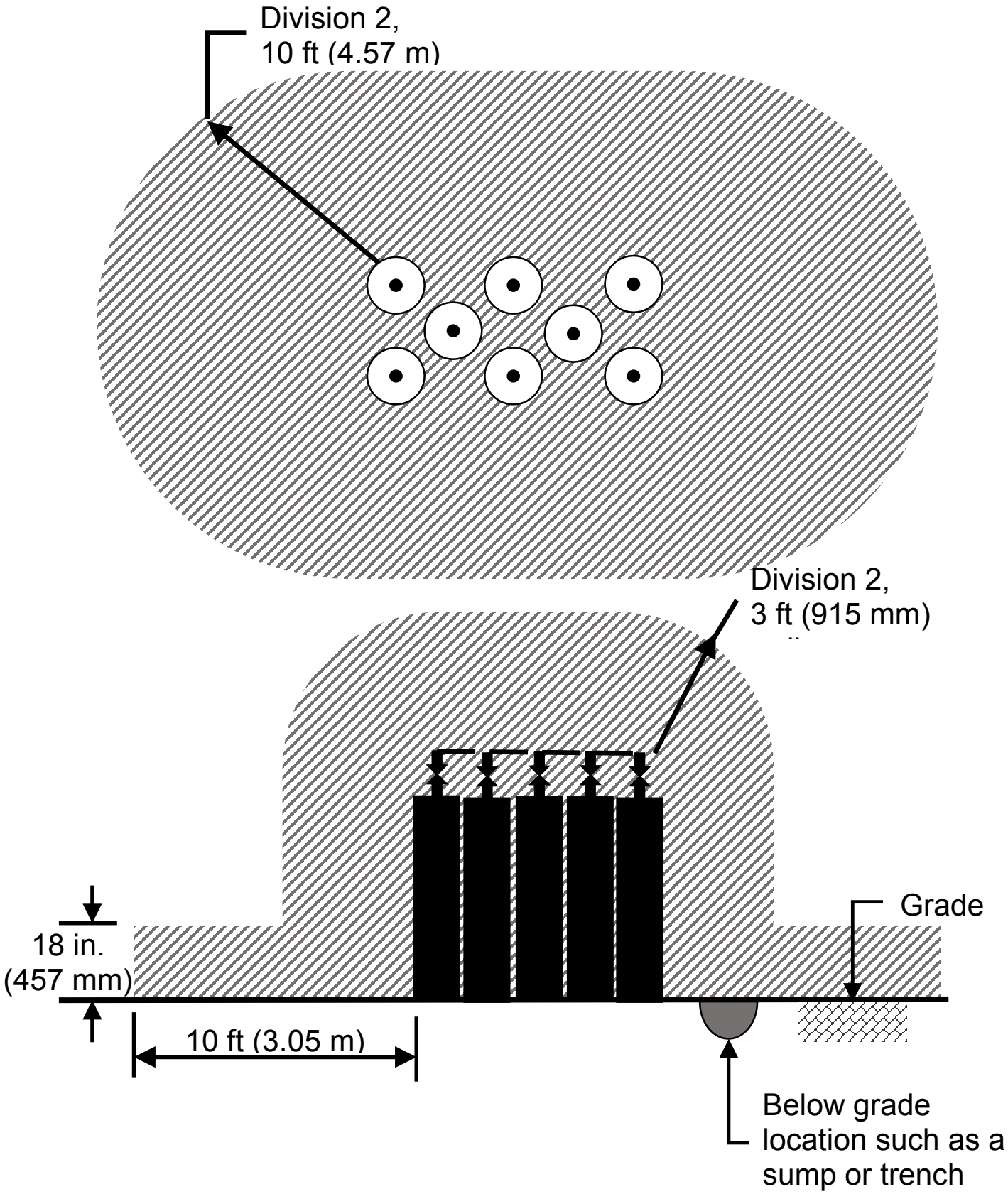

Division 2,
15 ft (4.57 m)
Grade

New 5.10.15 Compressed Gas Cylinders (Lighter than or Equal to Air, including Hydrogen)



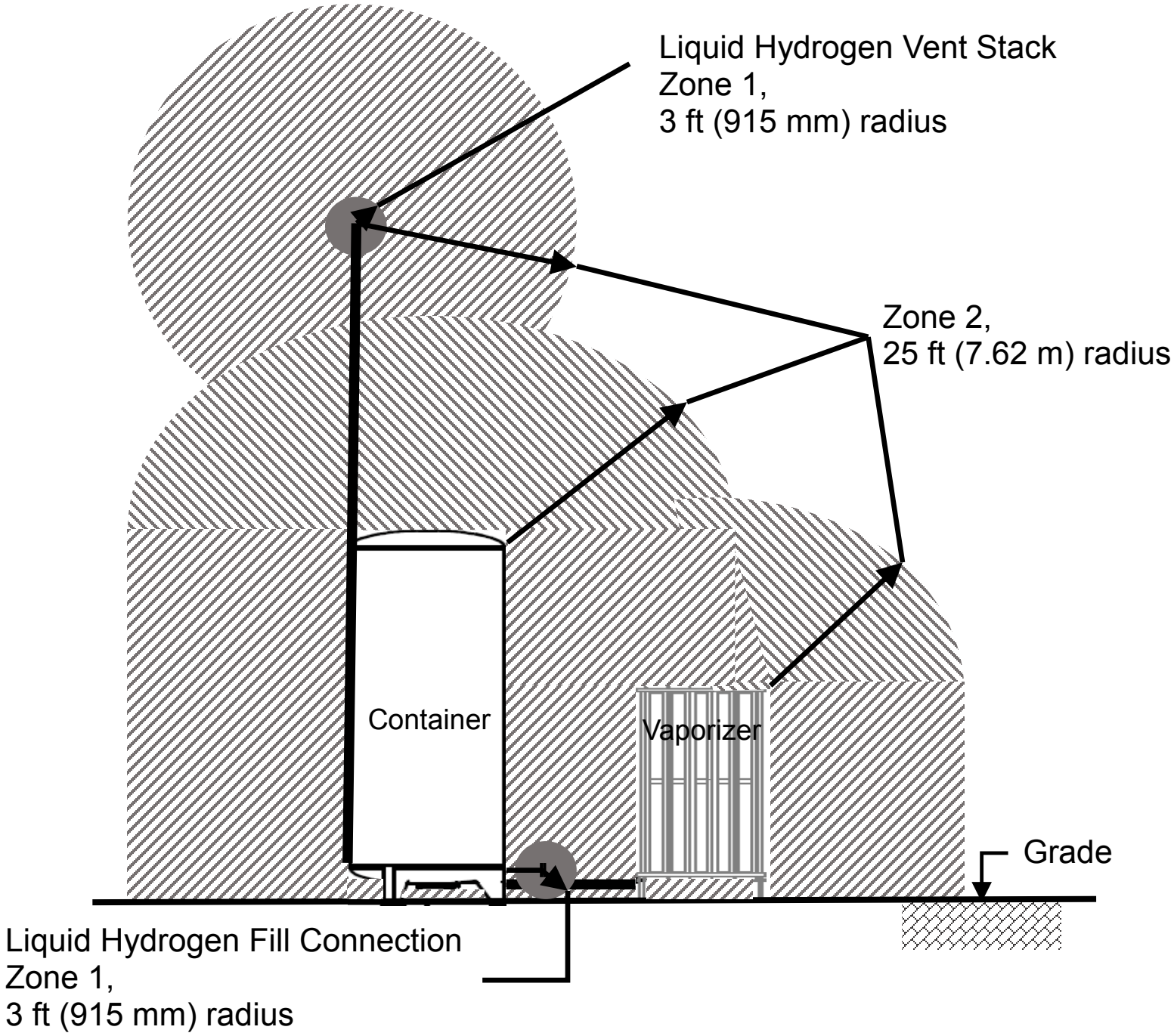
Condition: Outdoor or Indoor well-ventilated location, secured in vertical position, in-use in single or manifolded configuration

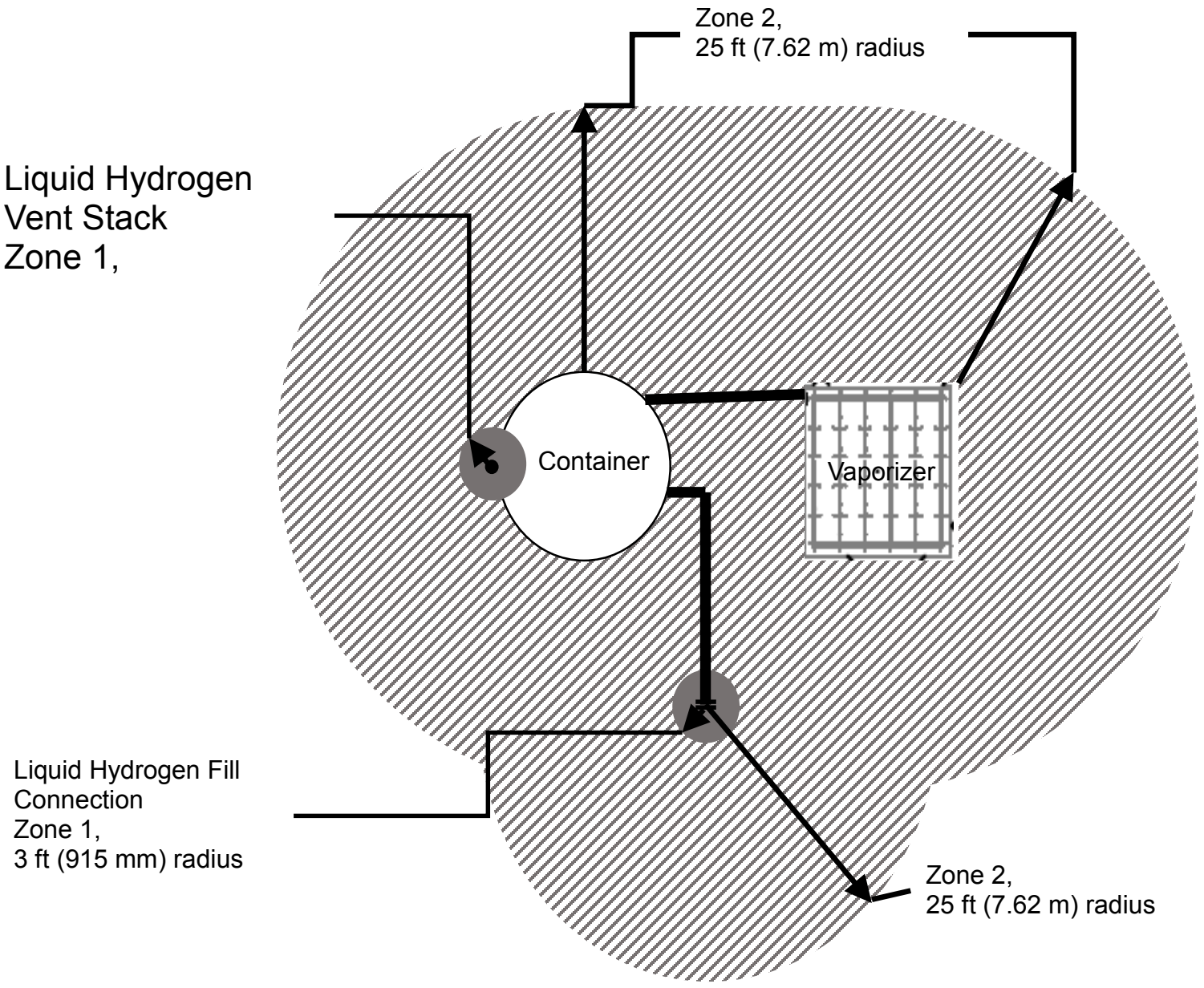
New 5.10.16 Compressed Gas Cylinders (Heavier than Air)



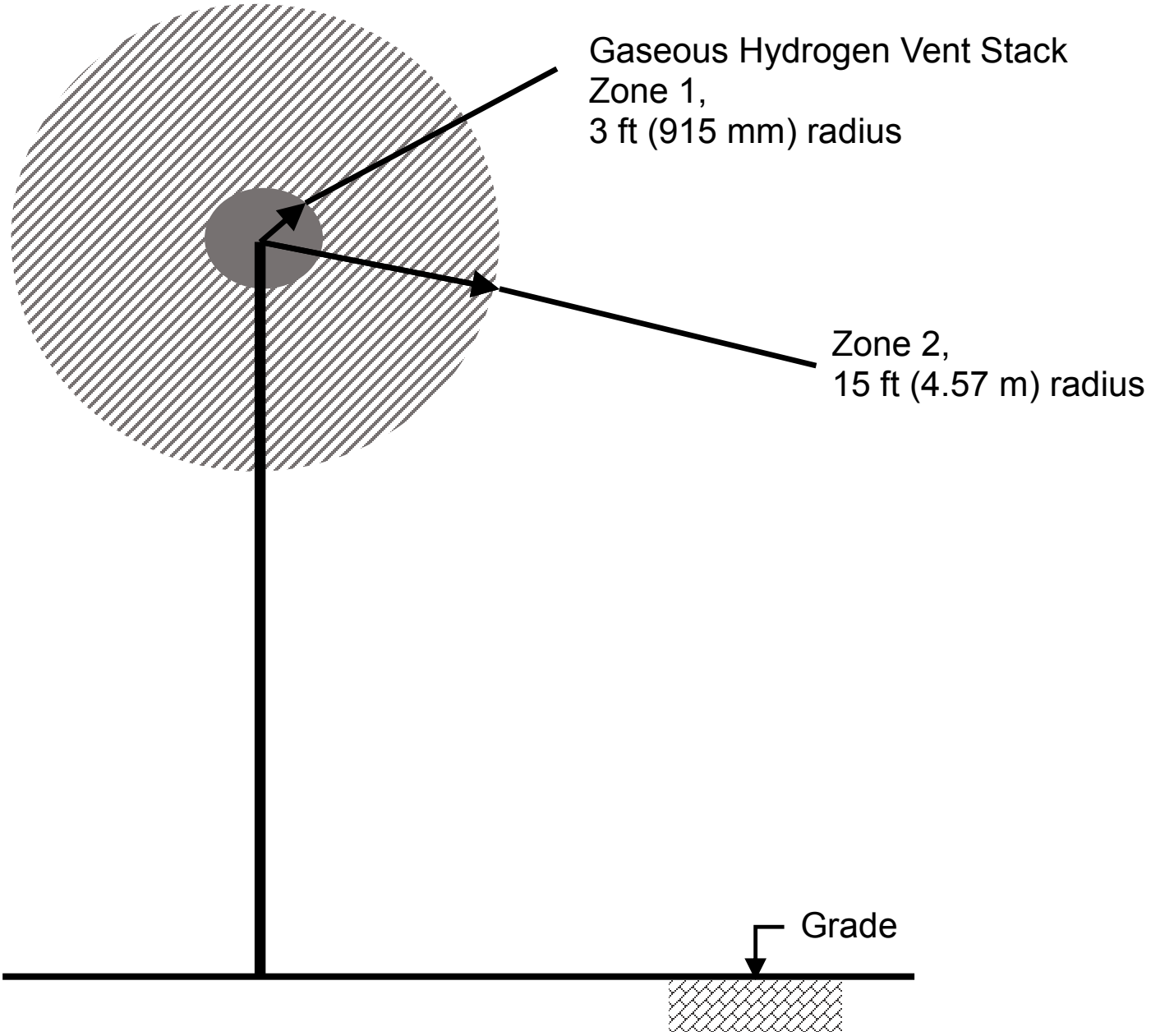
Condition: Outdoor or Indoor well-ventilated location, secured in vertical position, in-use in single or manifolded configuration

new 5.11.8(c) Liquid Hydrogen Storage – Tank and Vaporizer (parts of system containing liquid hydrogen)

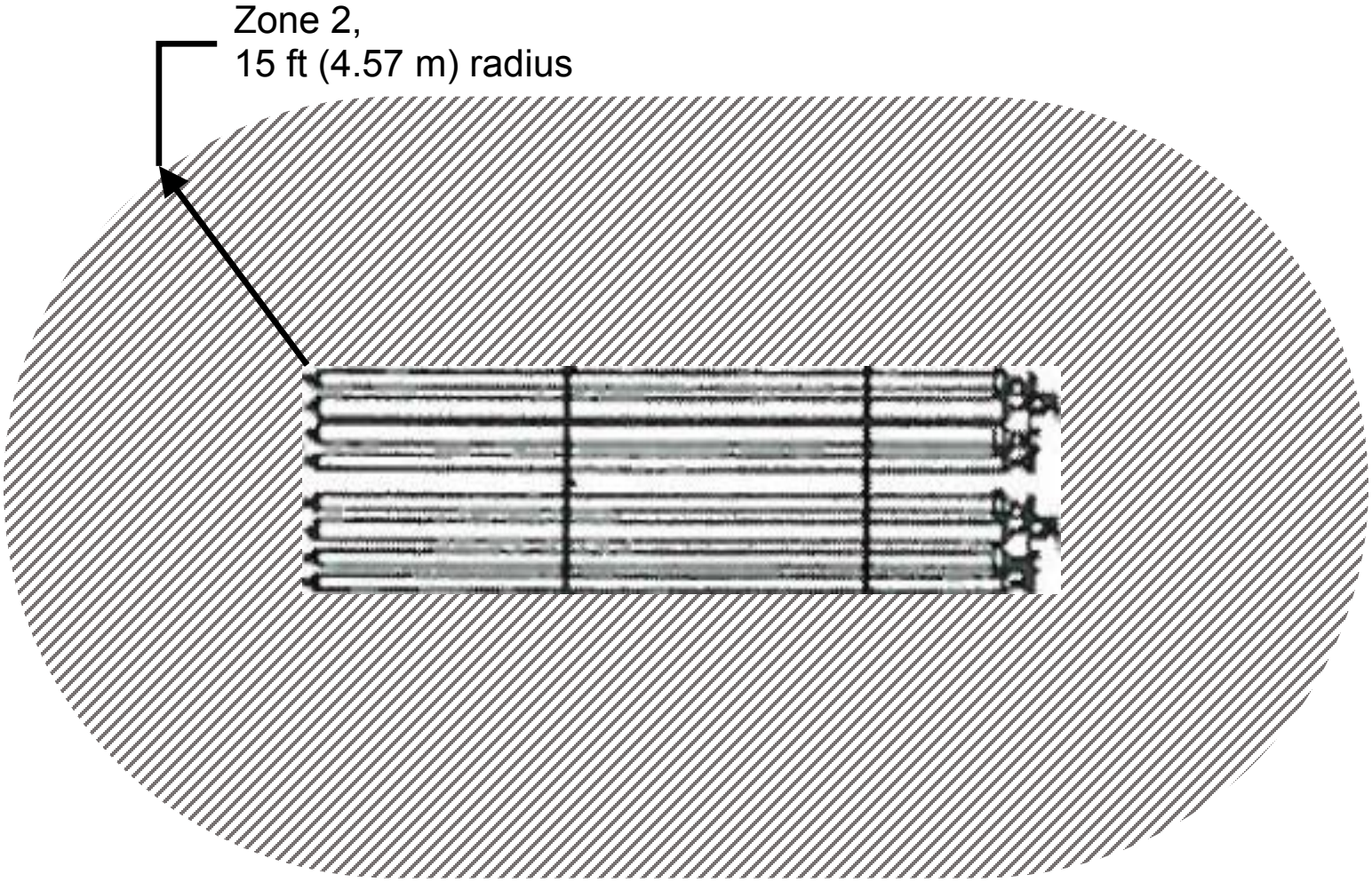


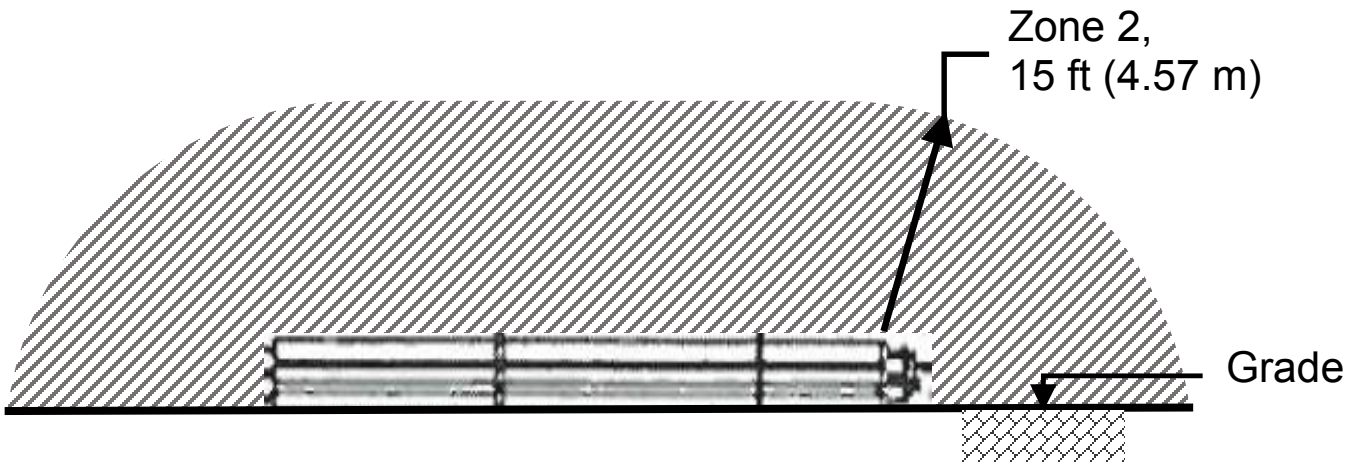

Zone 2,
25 ft (7.62 m) radius
Liquid Hydrogen
Vent Stack
Zone 1,
Container
Vaporizer
Liquid Hydrogen Fill
Connection
Zone 1,
3 ft (915 mm) radius
Zone 2,
25 ft (7.62 m) radius

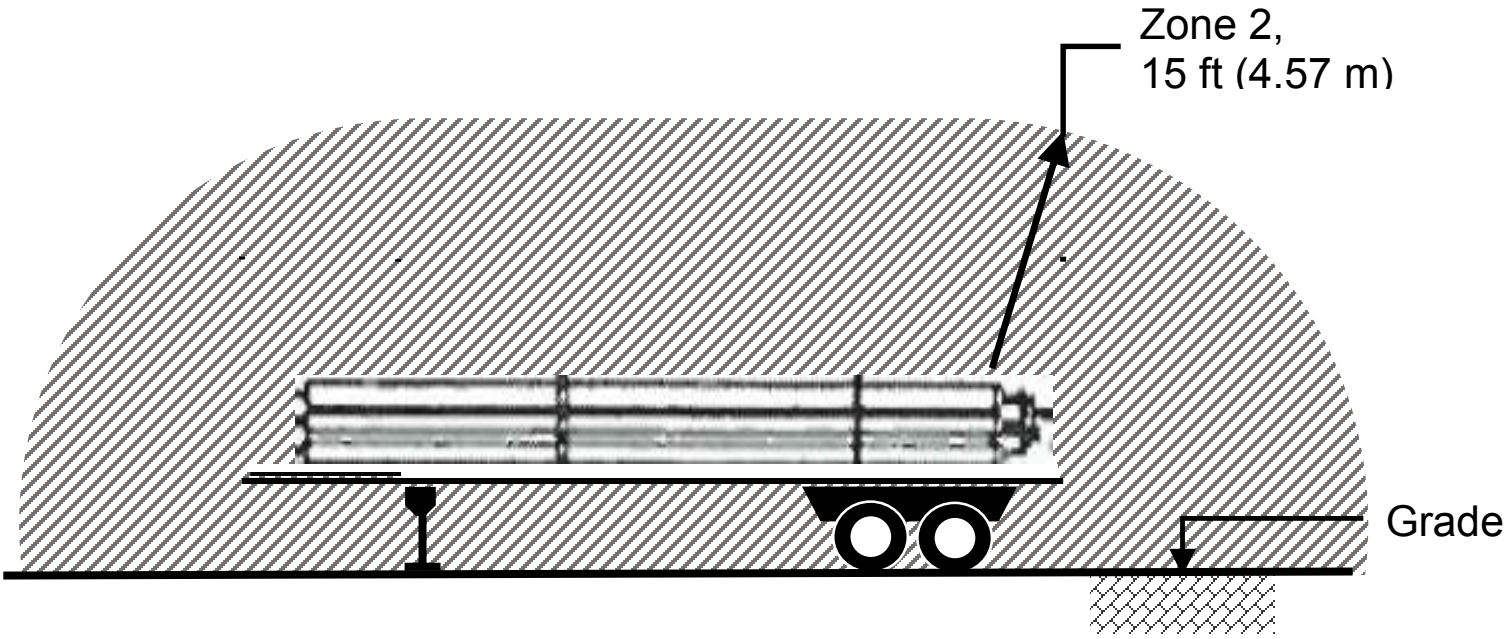
5.11.8(d) Gaseous Hydrogen Vent Stack



5.11.8(e) Gaseous Hydrogen Receivers




Zone 2,
15 ft (4.57 m)
Grade

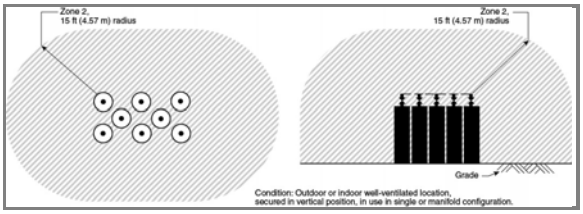

Zone 2,
15 ft (4.57 m)
Grade

Second Revision No. 6-NFPA 497-2015 [New Section after 5.11.14]

5.11.15

Compressed Gas Cylinders (Lighter Than or Equal to Air, Including Hydrogen). *(See Figure 5.11.15 .)*

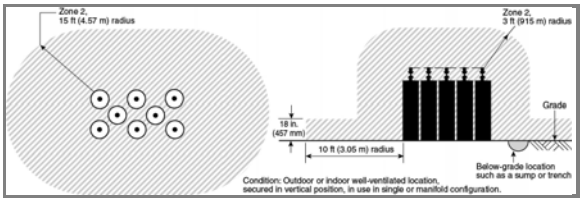
Figure 5.11.15 Compressed Gas Cylinders (lighter than or equal to air, including hydrogen).



5.11.16

Compressed Gas Cylinders (Heavier than Air). *(See Figure 5.11.16 .)*

Figure 5.11.16 Compressed Gas Cylinders (heavier than air).



Supplemental Information

File Name	Description
NFPA_497_Figure_Updates_per_NFPA_55-2016_EN_10.2.15.pptx	New Figures as attached in Presentation. Please note numbering has changed from the old edition 5.9 is now 5.10 and 5.10 is now 5.11.
Figures_for_497_SR-6_EN_11.10.15.docx	I extracted both figures from the powerpoint file into a word file.

Submitter Information Verification

Submitter Full Name: Eric Nette
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Fri Oct 02 14:26:36 EDT 2015

Committee Statement

Committee Statement: An update to the figures has been added for Hydrogen and compressed gases by the 497 task group to be in line with the recent update to NFPA 55.
Response Message:

Second Revision No. 3-NFPA 497-2015 [Chapter C]

Annex C Informational References

C.1 Reference Publications.

The documents or portions thereof listed in this annex are referenced within the informational sections of this recommended practice and are not part of the recommendations of this document unless also listed in Chapter 2 for other reasons.

C.1.1 NFPA Publications.

National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471.

~~NFPA~~ *NFPA 70*®, *National Electrical Code*®,~~2014~~ 2017 edition.

NFPA Fire Protection Guide to Hazardous Materials, 2010 edition.

C.1.2 Other Publications.

C.1.2.1 ASTM Publications.

ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428–2959.

ASTM E659, *Standard Test Method for Autoignition Temperature of Liquid Chemicals*, 2014.

C.1.2.2 IEC Publications.

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C.2 Informational References.

The following documents or portions thereof are listed here as informational resources only. They are not a part of the recommendations of this document.

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C.3 References for Extracts in Informational Sections. (Reserved)

~~**(Reserved)**~~

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Committee Statement

Committee Statement: IEC 60079-1-1 superseded by IEC 60079-20-1. UL TR 58 has been withdrawn. Other standards have been updated.
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