

Contents	Page
1 Introduction	1
1.1 Gas pamphlets.....	1
1.2 Units of measure.....	1
1.3 Multipliers and metric prefixes	1
2 Scope and purpose.....	1
2.1 Scope.....	1
2.2 Purpose	1
3 Glossary of terms and acronyms	1
3.1 General	1
4 Ammonia identification and classification numbers	10
4.1 ASHRAE No. R717	10
4.2 CAS No. 7664-41-7	10
4.3 OSHA HS No. 1021	11
4.4 RTECS No. BO0875000.....	11
4.5 UN No. 1005	11
4.6 The DOT Hazard Division (Class) number	11
5 Composition, synthesis and specifications	11
5.1 Composition	11
5.2 Synthesis	11
5.3 Specifications.....	11
6 Properties	12
6.1 Physical properties	12
6.2 Chemical properties.....	13
7 Commercial uses.....	23
8 Jurisdictional authorities and general regulations.....	25
8.1 General	25
8.2 United States	26
8.3 Canada	30
8.4 Other countries	31
8.5 International transportation	31
8.6 Regulatory references	31
8.7 Shipping description and hazard class	31
8.8 Container qualification	32
8.9 Filling density	32
9 Exposure and emergency actions	33
9.1 General	33
9.2 First aid	35
9.3 Physiological effects	35
9.4 Controlling Leaks	36
9.5 Fire exposure	37
9.6 Emergency response.....	38
10 Safety, security & training.....	38
10.1 General safety	38
10.2 Safety equipment & protective clothing	38
10.3 Security	39
10.4 Training.....	40
11 Tank cars	40
11.1 Description.....	40

11.2	Fabrication	42
11.3	Stamping, stenciling and marking.....	47
11.4	Placarding and painting	48
11.5	Filling density	48
11.6	Loading and shipping.....	48
11.7	Receiving	49
11.8	Handling and unloading	50
11.9	Preparing tank car for return.....	53
11.10	Repairs	53
11.11	Leaks	53
11.12	Accidents	53
11.13	Multi-unit tank car tanks.....	54
12	Cargo tank motor vehicles	54
12.1	Description.....	54
12.2	Fabrication	55
12.3	Requalification and maintenance.....	59
12.4	Marking, placarding and painting	61
12.5	Filling density	62
12.6	Loading and shipping.....	63
12.7	Receiving and unloading	65
12.8	Repairs	66
12.9	Leaks	66
12.10	Accidents	67
13	Portable tanks.....	67
13.1	Description.....	67
13.2	Fabrication	67
13.3	Requalification and maintenance.....	69
13.4	Marking, placarding and painting	70
13.5	Filling density	71
13.6	Loading and shipping.....	72
13.7	Receiving, storage and unloading	72
13.8	Repairs	74
13.9	Leaks	75
13.10	Accidents	75
14	Containers mounted on farm wagons or farm equipment.....	75
14.1	Description.....	75
14.2	Capacity.....	76
14.3	Fabrication	76
14.4	Welding.....	76
14.5	Pressure relief devices	76
14.6	Requalification, maintenance and repairs.....	76
14.7	Painting.....	77
14.8	Filling	77
14.9	Safety.....	77
14.10	Nurse tanks	78
14.11	Farm wagons	79
14.12	Applicator tanks	79
15	Cylinders.....	80
15.1	Description.....	80
15.2	Fabrication	82
15.3	Requalification, repair and maintenance	85
15.4	Marking, labeling and painting	88
15.5	Filling density	89
15.6	Filling authorization, transfilling and filling	90
15.7	Shipping.....	91

15.8	Receiving, handling and storage	92
15.9	Ammonia withdrawal.....	93
15.10	Empty cylinders	96
15.11	Leaks	97
15.12	Accidents	97
16	Barges and ships	97
16.1	Description.....	97
16.2	Fabrication.....	98
16.3	Requalification	98
16.4	Loading	98
16.5	Unloading.....	98
17	Pipelines	99
17.1	Description.....	99
17.2	Service	99
18	Stationary containers	99
18.1	Description.....	99
18.2	Fabrication	100
18.3	Supports	101
18.4	Appurtenances.....	102
18.5	Valves	104
18.6	Piping.....	104
18.7	Manway	105
18.8	Nameplate and marking.....	105
18.9	Manufacturer's data report.....	105
18.10	Painting.....	105
18.11	Installation.....	106
18.12	Location	106
18.13	Protection of container.....	107
18.14	Maintenance and periodic inspection	107
18.15	Filling density (volume)	109
18.16	Ammonia filling	110
18.17	Ammonia withdrawal.....	111
18.18	Leaks	112
18.19	Accidents	113
18.20	Refrigerated containers	113
19	Piping and equipment.....	113
19.1	General	113
19.2	Piping	114
19.3	Gaskets.....	116
19.4	Pressure relief devices	117
19.5	Liquid level gauging devices	119
19.6	Pressure gauges.....	120
19.7	Flow indicators.....	120
19.8	Strainers	121
19.9	Pressure regulators	121
19.10	Metering devices.....	121
19.11	Automatic vacuum breakers	122
19.12	Equipment.....	122
19.13	Electrical equipment and wiring	124
20	Acknowledgments.....	124
21	References	125

Tables

Table 1-1—Multiplication factors for converting from customary to metric units of measure	2
Table 1-2—Metric prefixes	3
Table 6-1—Physical properties	20
Table 6-2—Properties of liquid ammonia at various temperatures	21
Table 6-3—Thermodynamic properties of saturated liquid and vapor ammonia.....	22
Table 8-1—Maximum permitted filling densities for ammonia shipping containers and cylinders.....	34
Table 9-1—Human physiological response to various concentrations of ammonia in air	36
Table 11-1—DOT specification pressure tank car tanks authorized for rail transportation of ammonia	41
Table 11-2—Pressure relief valve settings for DOT specification tank car tanks authorized for rail transportation of ammonia	46
Table 12-1—Requalifying periods, reinspections and retests required for MC-330 and MC-331 cargo tanks authorized for ammonia service.....	61
Table 15-1—Capacities, approximate tare weights and dimensions of commonly available ammonia cylinders.....	81
Table 15-2—Requalifying periods, reinspection and pressure retest required for typical cylinders authorized for ammonia service	85
Table 18-1—Maximum permitted filling volumes for non-refrigerated storage containers	101

Figures

Figure 6-1—Vapor pressure—temperature curve for ammonia	14
Figure 6-2—Vapor pressure - temperature curve for ammonia (SI units)	15
Figure 6-3—Density—temperature curve for liquid ammonia U.S. customary units	16
Figure 6-4—Density - temperature curve for liquid ammonia SI units.....	17
Figure 6-5—Solubility curve for ammonia in water U.S. customary units.....	18
Figure 6-6—Solubility curve for ammonia in water SI units.....	19
Figure 11-1—Tank car (80 ton capacity) DOT Specification 112S340-W	42
Figure 11-2—Tank car head shield per 49 CFR 179.100-23	43
Figure 11-3—Tank car top-and-bottom Class E shelf coupler	44
Figure 11-4—Manway and fittings arrangement for tank cars of classes DOT-105J, 112J and 112S.....	45
Figure 11-5—Piping arrangement for ammonia tank car unloading with vapor pump or compressor	52
Figure 12-1—DOT specification MC-331 tank truck.....	55
Figure 12-2—DOT specification MC-331 semitrailer transport.....	55
Figure 13-1—DOT specification 51 portable tank	67
Figure 14-1—Applicator tank.....	75
Figure 14-2—Nurse tank	76
Figure 15-1—Typical ammonia cylinders	81
Figure 15-2—Ammonia cylinder valve with CGA standard outlet connection No. 240, 3/8-18NGT-RH-INT	83
Figure 15-3—Yoke connection to an ammonia cylinder valve	84
Figure 15-4—Ammonia cylinder manifold system arrangement for supplying vapor	96
Figure 18-1—Storage tank for non-refrigerated ammonia.....	100