



RULES FOR
CLASSIFICATION OF
SHIPS

NEWBUILDINGS

SPECIAL EQUIPMENT AND SYSTEMS
ADDITIONAL CLASS

PART 6 CHAPTER 6

CENTRALISED CARGO CONTROL FOR LIQUID CARGOES

JANUARY 2003

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CHANGES IN THE RULES

General

This booklet is a reprint of the previous edition and apart from clarifications of text and the inclusion of amendments and corrections, published in the July 2002 edition of Pt.0 Ch.1 Sec.3, no other changes have been made.

This chapter is valid until superseded by a revised chapter. Supplements will not be issued except for an updated list of minor amendments and corrections presented in Pt.0 Ch.1 Sec.3. Pt.0 Ch.1 is normally revised in January and July each year.

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Computer Typesetting (FM+SGML) by Det Norske Veritas

Printed in Norway

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SECTION 1 GENERAL REQUIREMENTS

A. Classification

A 100 Application

101 The Rules in this chapter apply to cargo handling systems, cargo related systems and ballast systems in the cargo area arranged for centralised operation and surveillance.

102 The Rules in this chapter are applicable to vessels assigned one of the following class notations:

- **Tanker for Chemicals**
- **Tanker for Oil Products**
- **Tanker for Oil.**

A 200 Class notation

201 Vessels having their cargo systems and ballast systems built and equipped, surveyed and tested in accordance with the requirements of this chapter, may be given the additional class notation **CCO**.

B. Documentation

B 100 Plans and particulars

101 The following plans and particulars are to be submitted for approval:

- arrangement of control room
- schematic diagrams showing arrangements for segregation of piping systems for various cargo loading and operational modes
- functional description of remotely controlled operations and monitoring systems
- operational procedures including emergency procedures
- description of the information systems, including user interface, logic diagrams, extent of available information, procedure for updating stored information and as applicable, interface to other instrumentation.

SECTION 2

ARRANGEMENTS FOR CENTRALISED OPERATION AND SURVEILLANCE

A. General

A 100 Extent of remote control and surveillance

101 All main operations related to cargo loading and discharging, ballasting and de-ballasting are to be arranged for centralised operation from a cargo control room.

Preparatory tasks as starting machinery, connecting loading hoses, opening of cargo manifold valves may be arranged for local control only.

Similarly, tasks to be carried out after loading/unloading is ended may be arranged for local control only.

Table A1 lists operations required to be arranged for remote control. Other solutions will be accepted if same level of operation safety is maintained.

102 Indication of parameters necessary for control and supervision of cargo handling and ballasting operations is to be provided in the cargo control room. For critical parameters alarm monitoring is to be provided.

A 200 Cargo control room

201 Controls and indications as given in 100 are to be located in a cargo control room fitted with air condition capable of maintaining a temperature between 20°C and 30°C.

202 The cargo control room is to be so located and arranged that direct visual surveillance of the cargo loading and discharge manifold area is possible.

203 Cargo control rooms located within the cargo area are to have boundaries insulated to «A-60» standard. The entrance(s) is to be located and arranged with a view to safest possible escape in a case of emergency. Three sets of emergency escape masks (breathing apparatuses) and protective clothing are to be stored in the cargo control room.

B. Arrangement of Piping Systems

B 100 General

101 The Rules of Pt.5 Ch.3 and Pt.5 Ch.4 apply in general for oil carriers or chemical carriers respectively.

B 200 Cargo tank cleaning

201 Tank cleaning machines are to be permanently installed.

202 Portable means (e.g. short hoses) for connecting individual machines to the tank washing main line may be accepted.

203 In the case of particular cargoes requiring extraordinary high cleanliness standards for commercial reasons, additional portable washing machines may be used.

B 300 Cargo tank gasfreeing

301 A fixed cargo tank gasfreeing system is to be fitted.

302 Portable means for connecting the inlet to cargo tanks to the supply main, e.g. by means of short hoses, may be accepted provided such connecting may easily be performed by one person only.

303 For smaller vessels the use of portable ventilation fans may be accepted provided the arrangement facilitates easy and quick connecting.

B 400 Segregation of piping systems

401 Segregation of cargo systems required for incompatible cargoes or between cargo systems and other systems required for safety purposes is to be achieved by means of separate piping systems. For tank cleaning systems, inert gas systems and gasfreeing/dry air systems, segregations by means of portable pipe sections or short lengths of hoses may be accepted.

Table A1 Remotely controlled operations	
Operation	Comments
Starting/stopping of cargo pumps and operation of valves	Manual start of cargo pumps in case of pump room cargo system may be accepted
Remote operation of valves in loading/unloading system	Cargo manifold valves are to be manually operable locally independent of any remote control
Cargo tank washing operations	Connecting of water supply may be carried out locally
Inerting	Connecting of actual tank(s) to i.g. main may be done locally
Ballasting/de-ballasting	
Bilge drainage for cargo pump room	
Fire extinguishing for cargo pump room	
Start of fire pump and start of cargo deck foam extinguishing system and water spray system (if provided)	

C. Monitoring and Remote Control Systems

C 100 General

101 The Rules in Pt.4 Ch.9 apply in general. In the case of computer based systems the requirements contained in Pt.4 Ch.9 Sec.4 are to be complied with.

102 Means for local manual operation of valves and machinery in the event of failure of the remote control system are to be provided.

C 200 Alarm and remote reading

201 The extent of alarm and indication are to be according to Table C1 as applicable.

C 300 Emergency stop/shut down arrangements

301 Arrangement for emergency stop of cargo pumps from the cargo loading/unloading manifold area is to be fitted.

302 Arrangements for emergency closing of valves in the cargo loading lines are to be fitted in cargo control room and at the loading manifolds.

C 400 Cargo tanks secondary ullaging system

401 In addition to the remote ullaging system required by Table C1, arrangements for closed type ullaging by means of portable equipment are to be provided. At least two sets of portable ullaging equipment are to be kept onboard

Table C1 Extent of alarm and indication				
<i>Parameter</i>	<i>Remote reading</i>	<i>Alarm</i>		<i>Comments</i>
		<i>Low</i>	<i>High</i>	
Cargo tank level	x		x	For carriage of certain chemicals an additional high-high level alarm is required
Ballast tank level	x			
Cargo temperature	x			Only for tanks with heating or cooling systems
Cargo tank ullage pressure	x	x	x	For each segregation
Cargo pressure at loading manifold	x			
Cargo pressure at pump discharge	x		x	
Cargo pump rpm	x			Not for constant speed electrically driven pumps. Alternative parameters for hydraulically driven pumps may be considered
Cargo pump housing, cargo pump shaft bearing and bulkhead shaft seal temperatures			x	Not for submerged pumps
Hydraulic and pneumatic power supply	x	x		Supply for hydraulic pump motors, cargo line stripping, valve operation etc.
Inert gas generator				Monitoring as required by Pt.5 Ch.3 Sec.11
Tank washing medium supply pressure	x	x		
Valve's positions				Open/shut indications
Status of pumps and other machinery				Running/stop indications
Oil content of wash-water discharge			x	Automatic changeover to recirculation
Bilge level in cargo pump room			x	
Explosive gas concentration in cargo pump room			x	

SECTION 3 INFORMATION SYSTEM

A. General.

A 100 Information retrieval and presentation.

101 An information system is to be provided which will enable the operation to easily retrieve and display all information needed for observing limitations and operational requirements set forth by rules and regulations for particular cargo operations.

A 200 Extent of information.

201 The information system is to contain the following information as applicable:

- physical data of the product
- pollution categorization of the product
- toxicity information
- carriage requirements and limitations stipulated by certificate
- special operational requirements mandatory for particular cargoes
- mandatory tank washing procedures, general procedures (e.g. cow or prewash for category A chemicals) and specific procedures for particular products
- cargo tank and cargo lines' stripping procedures
- cargo heating requirements/limitations
- discharge procedures for cargo tank washwater
- ship and cargo tank certification data.

202 It is recommended that information additional to that listed in 201, which may assist the operator in performing the actual operations in an efficient and correct manner be included. E.g. information such as:

- cargo tank coating compatibility guide
- recommended tank washing procedures for particular products
- synonym names/trade names' interpreter
- rules, regulations and industry standards' references for particular products.

A 300 Verification of loading conditions.

301 The information system is to enable easy checking of any loading condition and combination of products loaded or planned to be loaded with respect to strength of hull and cargo tanks and to present actual cargo tank filling limits (if any).

302 The information system is to enable easy checking of any planned loading for compatibility requirements and to provide information of any required piping segregations to be executed.

303 The information system is to enable easy checking of any planned loading conditions against applicable damage stability requirements (MARPOL Annex I and IBC- Code).

Guidance note:

- a) Appendix A contains compatibility guidelines for groups of products.
- b) It is anticipated that a computer installation will be necessary for fulfilling required functions of the information system in the case of the most sophisticated tankers (parcel chemical tankers and multi purpose product oil tankers).

For simpler single grade cargo tankers other solutions may suffice.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

APPENDIX A COMPATIBILITY GUIDE

A. General.

A 100 Definition of hazardous reaction.

101 As a first approximation, a mixture of two cargoes is considered hazardous when, under specified condition, the temperature rise of the mixture exceeds 25°C or a gas is evolved. It is possible for the reaction of two cargoes to produce a product that is significantly more flammable or toxic than the original cargoes even though the reaction is non-hazardous from temperature or pressure considerations, although no examples of such a reaction are known at this time.

A 200 Chart format

201 There are different degrees of reactivity among the various cargoes. Many of them are relatively non-reactive: for example, aromatic hydrocarbons or paraffins.

Others will form hazardous combinations with many groups: for example, the in-organic acids.

The cargo groups in the compatibility chart (see fig. 1) are separated into two categories: 1 through 22 are «Reactive Groups» and 30 through 43 are «Cargo Groups». Left unassigned and available for future expansion are groups 23 through 29 and those past 43. Reactive Groups contain products which are chemically the most reactive; dangerous combinations may result between members of different Reactive Groups and between members of Reactive Groups and Cargo Groups. Products assigned to Cargo Groups, however, are much less reactive; dangerous combinations involving these can be formed only with members of certain Reactive Groups. Cargo Groups do not react hazariously with one another.

B. Application of the Compatibility Chart.

B 100 Procedure.

101 The following procedure explains how the compatibility chart should be used to find compatibility information:

- 1) Determine the group numbers of the two cargoes by referring to the alphabetical listing of cargoes and the corresponding groups (Table I). Many cargoes are listed under their parent names; unless otherwise indicated, isomers or mixtures of isomers of a particular cargo are assigned to the same group. For example, to find the group number for Isobutyl Alcohol, look under the parent name Butyl Alcohol. Similarly, the group number for para-Xylene is found under the entry Xylene.
- 2) If both group numbers are between 30 and 43 inclusive, the products are compatible and the chart need not be used.
- 3) If both group numbers do not fall between 30 and 43 inclusive, locate one of the numbers on the left of the chart (Cargo Groups) and the other across the top (Reactive Groups). (Note that if a group number is between 30 and 43, it can only be found on the left side of the chart.) The box formed by the intersection of the column and row containing the two numbers will contain one of the following:
 - i) blank—The two cargoes are compatible
 - ii) «X»—The two cargoes are not compatible
 - iii) a letter other than «X»—Reactivity varies among the group members. Refer to the footnotes following the chart to find whether the products in question are included in the footnotes. Unless the combination is specifically mentioned in these footnotes, it is compatible.

Figure 1 Compatibility Chart

	REACTIVE GROUPS																						
	1. Non-oxidizing mineral acids	2. Sulfuric acid	3. Nitric acid	4. Organic acids	5. Caustics	6. Ammonia	7. Aliphatic amines	8. Alkanolamines	9. Aromatic amines	10. Amides	11. Organic anhydrides	12. Isocyanates	13. Vinyl acetate	14. Acrylates	15. Substituted allyls	16. Alkylene oxides	17. Epichlorohydrin	18. Ketones	19. Aldehydes	20. Alcohols, glycols	21. Phenols, cresols	22. Caprolactam solution	
REACTIVE GROUPS																							
1. Non-oxidizing mineral acids		x			x	x	x	x	x	x	x	x	x			x	x		A	E			1
2. Sulfuric acid	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	2
3. Nitric acid		x			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		3
4. Organic acids		x			x	x	x	x	C			x				x	x			F			4
5. Caustics	x	x	x	x							x	x				x	x		x	x	x	x	5
6. Ammonia	x	x	x	x						x	x	x	x			x	x		x				6
7. Aliphatic amines	x	x	x	x							x	x	x	x	x	x	x	x	x	x	x	x	7
8. Alkanolamines	x	x	x	x							x	x	x	x	x	x	x	B	x				8
9. Aromatic amines	x	x	x	C							x	x							x				9
10. Amides	x	x	x			x						x									x		10
11. Organic anhydrides	x	x	x		x	x	x	x	x														11
12. Isocyanates	x	x	x	x	x	x	x	x	x	x					D					x		x	12
13. Vinyl acetate	x	x	x			x	x	x															13
14. Acrylates		x	x				x	x															14
15. Substituted allyls		x	x				x	x				D											15
16. Alkylene oxides	x	x	x	x	x	x	x	x															16
17. Epichlorohydrin	x	x	x	x	x	x	x	x															17
18. Ketones		x	x				x	B															18
19. Aldehydes	A	x	x		x	x	x	x	x														19
20. Alcohols, glycols	E	x	x	F	x		x					x											20
21. Phenols, cresols		x	x		x		x			x													21
22. Caprolactam solution		x			x		x					x											22
CARGO GROUPS																							
30. Olefins		x	x																				30
31. Paraffins																							31
32. Aromatic hydrocarbons			x																				32
33. Miscellaneous hydrocarbon mixtures			x																				33
34. Esters		x	x																				34
35. Vinyl halides			x																			x	35
36. Halogenated hydrocarbons					H		I																36
37. Nitriles		x																					37
38. Carbon disulfide							x	x															38
39. Sulfolane																							39
40. Glycol ethers		x										x											40
41. Ethers		x	x																				41

Figure 1 Compatibility Chart (Continued)

	REACTIVE GROUPS																					
	1. Non-oxidizing mineral acids	2. Sulfuric acid	3. Nitric acid	4. Organic acids	5. Caustics	6. Ammonia	7. Aliphatic amines	8. Alkanolamines	9. Aromatic amines	10. Amides	11. Organic anhydrides	12. Isocyanates	13. Vinyl acetate	14. Acrylates	15. Substituted allyls	16. Alkylene oxides	17. Epichlorohydrin	18. Ketones	19. Aldehydes	20. Alcohols, glycols	21. Phenols, cresols	22. Caprolactam solution
42. Nitrocompounds					x	x	x	x	x													42
43. Miscellaneous water solutions		x										x										43
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
x Incompatible groups.																						
A Acrolein (19), Crotonaldehyde (19), and 2-Ethyl-3-propyl acrolein (19) are not compatible with Group 1, Non-Oxidizing Mineral Acids.																						
B Isophorone (18), and Mesityl Oxide (18) are not compatible with Group 8, Alkanolamines.																						
C Acrylic Acid (4) is not compatible with Group 9, Aromatic Amines.																						
D Allyl Alcohol (15) is not compatible with Group 12, Isocyanates.																						
E Furfuryl Alcohol (20) is not compatible with Group 1, Non-oxidizing Mineral Acids.																						
F Furfuryl Alcohol (20) is not compatible with Formic acid.																						
G (Reserved)																						
H Trichloroethylene (36) is not compatible with Group 5, Caustics.																						
I Ethylenediamine (7) is not compatible with Ethylene Dichloride (36).																						

In the accompanying Table I an alphabetic list of cargoes with reference to groups is provided. In Table II a list of cargoes within each group is given.

TABLE 1 - ALPHABETICAL LIST OF CARGOES
(See footnote at the end of the table)

Alphabetical list of cargoes	
Name	Group No.
Acetaldehyde	19
Acetic Acid	4
Acetic Anhydride	11
Acetone	18
Acetonitrile	37
Acetophenone	18
Acetyl Tributyl Citrate	34
Acrolein (inhibited)	19
Acrylamid Solution	10
Acrylic Acid (inhibited)	4
Acrylonitrile (inhibited)	15
Adiponitrile	37
Alcohols (Mixed)	20
Alkyl Phthalates (n-)	34
Allyl Alcohol	15
Allyl Chloride	15
(2-Aminoethoxy) Ethanol, 2-	8
Aminoethylethanolamine	8
Ammonia, Anhydrous	6
Ammonium Hydroxide (28% or less)	6
Ammonium Nitrate, Urea, Water Solutions (containing Ammonia)	6
Ammonium Nitrate, Urea, Water Solutions (not containing Ammonia)	43
Ammonium Polyphosphate	43
Ammonium Sulfate Solution (20% or less)	43
Amyl Acetate	34
Amyl Alcohol	20
Amyl Tallate	34
Aniline	9
Asphalt	33
Asphalt Blending Stocks:	
Roofers Flux	33
Straight Run Residue	33
Behenyl Alcohol	20
Benzene	33
Benzene, Toluene Xylene (crude)	32
Butadiene (inhibited)	30
Butane	31
Butene	30
Butyl Acrylate (inhibited)	14
Butyl Acetate	34
Butyl Alcohol	20
Butylamine	7
Butyl Benzyl Phthalate	34
Butylene	30
1,3-Butylene Glycol	20
Butylene Oxide	16
Butyl Ether	41
Butyl Heptyl Ketone (iso-)	18
Butyl Methacrylate, Decyl Methacrylate, Cetyl Eicosyl Methacrylate Mixture	14
Butyl Methacrylate (inhibited)	14

Alphabetical list of cargoes	
Name	Group No.
Butyraldehyde	19
Butyric Acid	4
Calcium Bromide Solution	43
Calcium Chloride Solutions	43
Camphor Oil (light)	18
Caprolactam Solution	22
Carbolic Oil	21
Carbon Black Base	33
Carbon Disulfide	38
Carbon Tetrachloride	36
Cashew Nut Shell Oil (untreated)	4
Caustic Potash Solution	5
Caustic Soda Solution	5
Chlorine	(1)
Chlorobenzene	36
Chloroform	36
Chloronitrobenzene, 2-See Nitrochlorobenzene, ortho- Chlorotoluene (m-, o-, p-)	36
Chlorosulphonic Acid	(1)
Choline Chloride Solutions	20
Corn Syrup	43
Creosote, Coal Tar	21
Cresols	21
Cresylate Spent Caustic Solution	5
Cresylic Acid	21
Crotonaldehyde	19
Cumene	32
Cycloaliphatic Resins	31
Cyclohexane	31
Cyclohexanol	20
Cyclohexanone	18
Cyclohexylamine	7
Cyclopentadiene Polymers	7
Cyclopentadiene, Styrene, Benzene Mixture	30
Cymene	32
Decaldehyde	19
Decane	31
Decene	30
Decyl Alcohol	20
Decyl Acrylate (inhibited)	14
Decylbenzene	32
Dextrose Solution	43
Diacetone Alcohol	20
Diammonium Salt of Zinc Ethylene Diamine Tetracetic Acid Solution	43
Dibutylamine	7
Dibutyl Phthalate	34
Dichlorobenzene	36
Dichlorodifluoromethane	36
1,1-Dichloroethane	36
Dichloroethyl Ether	41
Dichloroisopropyl Ether	36
Dichloromethane	36
Dichlorophenol, 2,4-	21
1,1-Dichloropropane	36
1,2-Dichloropropane	36
Dichloropropane/ 1,3-Dichloropropene Mixture	15
1,3-Dichloropropene	15
Dichloropropionic Acid, 2,2-	4

Alphabetical list of cargoes	
Name	Group No.
Dicyclopentadine	30
Diethanolamine	8
Diethylamine	7
Diethylbenzene	32
Diethylene Glycol	40
Diethylene Glycol Monobutyl Ether	40
Diethylene Glycol Monobutyl Ether Acetate	34
Diethylene Glycol Monoethyl Ether	40
Diethylene Glycol Monomethyl Ether	40
Diethylene Glycol Monophenyl Ether	40
Diethylenetriamine	7
Diethylethanolamine	8
Diethyl Sulfate	34
Diglycidyl Ether of Bisphenol A	41
Diheptyl Phthalate	34
Diisobutylene	30
Diisobutyl Carbinol	20
Diisobutyl Ketone	18
Diisodecyl Phthalate	34
Diisononyl Phthalate	34
Diisooctyl Phthalate	34
Diisopropanolamine	8
Diisopropylamine	7
Diisopropyl Benzene	32
Diisopropyl Naphthalene	32
Dimethyl Acetamide	10
Dimethylamine	7
Dimethylcyclohexylamine	7
Dimethylethanolamine	8
Dimethylformamide	10
Dimethyloctanoic Acid, 2,2-	4
Dimethyl Phthalate	34
Dimethyl Polysiloxane	34
Dimethylpropane-1.3-Diol, 2,2-	20
Dinonyl Phthalate	34
Diocetyl Phthalate	34
1,4-Dioxane	41
Dipentene	30
Dipropylamine	7
Dipropylene Glycol Dibenzoate	34
Diphenyl-Diphenyl Oxide	33
Diphenylmethane Diisocyanate	12
Di-n-propylamine	7
Dipropylene Glycol	40
Distillates:	
Straight Run	33
Flashed Feed Stocks	33
Diundecyl Phthalate	34
Dodecane	31
Dodecanol	20
Dodecene	30
Dodecylamine, Tetradecylamine Mixture	7
Dodecylbenzene	32
Dodecyl Diphenyl Oxide Disulphonate Solution	43
Dodecyl Pentadecyl Methacrylate	14
Epichlorohydrin	17
Epoxy Resin	18
Ethane	31

Alphabetical list of cargoes	
Name	Group No.
Ethanolamine	8
Ethoxylated Alcohols C ₁₁ -C ₁₅	20
Ethoxy Triglycol	40
Ethyl Acetate	34
Ethyl Alcohol	20
Ethyl Acrylate (inhibited)	14
Ethylamine	7
Ethyl Benzene	32
Ethyl Butanol	20
Ethylbutylamine(n-)	7
Ethyl Chloride	36
Ethylene	30
Ethylene Chlorohydrin	20
Ethylene Cyanohydrin	20
Ethylenediamine	7
Ethylene Dibromide	36
Ethylene Dichloride	36
Ethylene Glycol	20
Ethylene Glycol Monobutyl Ether	40
Ethylene Glycol Monobutyl Ether Acetate	34
Ethylene Glycol Monoethyl Ether	40
Ethylene Glycol Monoethyl Ether Acetate	34
Ethylene Glycol Monoisopropyl Ether	40
Ethylene Glycol Monomethyl Ether	40
Ethylene Glycol Phenyl Ether	40
Ethylene Oxide	(1)
Ethyl Ether	41
Ethylhexaldehyde	19
2-Ethyl Hexanol	20
Ethylhexoic Acid, 2-	4
2-Ethylhexyl Acrylate (inhibited)	14
Ethyl Hexylamine	7
Ethyl Hexyl Tallate	34
Ethylidene Norbornene	30
Ethyl Methacrylate (inhibited)	14
Ethyl-6-Methyl-n-(1-Methyl-2-Methoxy Ethyl) Aniline,2-	9
2-Ethyl-3-Propyl Acrolein	19
Fatty Acid Amides	33
Formaldehyde, Methanol Mixtures	19
Formaldehyde Solution (37-50%)	19
Formic Acid	4
Furfural	19
Furfuryl Alcohol	20
Gas Oil: Cracked	33
Gasoline Blending Stocks:	
Alkylates	33
Reformats	33
Gasolines:	
Casing head (natural)	33
Automotive (containing over 4.23 grams lead per gallon)	33
Aviation (containing not over 4.86 grams lead per gallon)	33
Polymer	33
Straight Run	33
Glutaraldehyde Solution	19
Glycerine	34
Glyceryl Triacetate	34

Alphabetical list of cargoes	
Name	Group No.
Glycidyl Ester of Versatic Acid	34
Glycol Diacetate	34
Glycols, Resins, and Solvents Mixture	33
Glyoxal Solution	19
Heptane	31
Heptanoic Acid(n-)	4
Heptene, 1	30
Herbicide (C ₁₂ H ₂₂ NO ₂ Cl)	33
Hexamethyleneimine	7
Hexane	31
Hexanol	20
Hexene	30
Hexylene Glycol	20
Hydrochloric Acid	1
Hydrofluoric Acid	1
Hydrofluorosilicic Acid	1
Isophorone	18
Isoprene (inhibited)	30
Jet Fuels:	
JP-1 (Kerosene)	33
JP-3	33
JP-4	33
JP-5 (Kerosene, Heavy)	33
Kaolin Clay Slurry	43
Kerosene	33
Latex, Liquid Synthetic	43
Lignin Liquor (Calcium Ligno-Sulphonate, Water Solution)	43
Magnesium Nonyl Phenol Sulfide	33
Maleic Anhydride	11
Maleic Anhydride Copolymer	33
Mesityl Oxide	18
Methacrylic Acid	4
Methane	31
Methoxy Triglycol	40
Methyl Acetate	34
Methyl Acetoacetate	34
Methyl Acetylene, Propadiene Mixture (Stabilized)	30
Methyl Acrylate (inhibited)	14
Methyl Alcohol	20
Methylamine	7
Methylamine Solutions	7
Methyl Amyl Acetate	34
Methyl Amyl Alcohol	20
Methyl Bromide	36
3-Methyl Butyraldehyde	19
Methyl Chloride	36
Methyl-6-Ethyl Aniline, 2-	9
Methyl Ethyl Ketone	18
2-Methyl-5-Ethyl Pyridine	9
Methyl Formal (Dimethyl Formal)	41
Methyl Heptyl Ketone	18
Methyl-2-Hydroxy-3-Butyne, 2-	20
Methyl iso-Amyl Ketone	18
Methyl Isobutyl Ketone	18
Methyl Isobutyl Carbinol	20
Methyl Methacrylate (inhibited)	14
Methyl Naphthalene	32

Alphabetical list of cargoes	
Name	Group No.
Methylolureas (20% Free Formaldehyde)	19
Methyl Pyridine,2	9
Methyl Pyridine,3	9
Methyl Pyrrolidone (N-)	9
(alpha-) Methyl Styrene (inhibited)	30
Methyl tert-Butyl Ether	41
Mineral Spirits	33
Molasses	20
Monochlorodifluoromethane	36
Morpholine	7
Motor Fuel Antiknock Compounds Containing Lead Alkyls	(1)
Naphtha:	
Coal Tar	33
Cracking Fraction	33
Solvent	33
Stoddard Solvent	33
Varnish Markers' and Painters' (75%)	33
Naphthalene (molten)	32
Naphthenic Acid	4
NHric Acid (70% or less)	3
Nitric Acid (95%)	(1)
Nitrobenzene	42
Nitrochlorobenzene, ortho-	42
1- or 2-Nitropropane	42
Nitrotoluene	42
Nonane	31
Nonene	30
Nonyl Alcohol	20
Nonyl Phenol	21
Nonyl Phenol (ethoxylated)	40
Nonyl Phenol Sulfide	33
Octadecene-1	30
Octadecenoamide (Oleamide)	10
Octane	31
Octene	30
Octyl Alcohol	20
Octyl Aldehyde	19
Octyl Epoxytallate	34
Oils:	
Aliphatic	33
Clarified	33
Coal Oil	33
Crude Oil	33
Diesel Oil	33
Oiticica	34
Residual	33
Road	33
Seal	34
Soapstock	34
Transformer	33
Tung	34
White (Mineral)	33

Alphabetical list of cargoes	
Name	Group No.
Edible Oils, including:	
Babassu	34
Castor	34
Coconut	34
Coconut, Methyl Ester	34
Corn	34
Cotton Seed	34
Cotton Seed Fatty Acid	34
Fish	34
Lard	34
Olive	34
Palm	34
Peanut	34
Rapeseed	34
Rice Bran	34
Safflower	34
Soya Bean	34
Soybean, Epoxidized	40
Sunflower Seed	34
Tucum	34
Vegetable	34
Fuel Oils:	
No. 1 (Kerosene)	33
No. 1-D	33
No. 2	33
No. 4	33
No. 2-D	33
No. 5	33
No. 6	33
Miscellaneous Oils, including:	
Absorption	33
Aromatic	33
Coal Tar	33
Heartcut Distillate	33
Linseed	33
Lubricating	33
Mineral	33
Mineral Seal	33
Motor	33
Neatsfoot	33
Penetrating	33
Range	33
Resin	33
Resinous Petroleum	33
Rosin	33
Sperm	33
Spindle	33
Spray	33
Tall	34
Tanner's	33
Turbine	33
Oleic Acid	4
Oleum	(1)
Pentadecanol	20
Pentadiene, 1,3-	30
Pentane	31
Pentene	30
Pentenitrile (crude), 3-	37
Pentyl Aldehyde	19
Perchloroethylene	36
Petrolatum	33
Petroleum Naphtha	33
Phenol	21
Pentachloroethane	36
Phosphoric Acid	1
Phosphorus	(1)
Phthalic Anhydride (molten)	11
Pinene	30

Alphabetical list of cargoes	
Name	Group No.
Polybutene	30
Polyethylene Glycols	40
Polyethylene Polyamines	7
Polymethylene Polyphenyl isocyanate	12
Polypropylene	30
Polypropylene Glycol Methyl Ether	40
Polypropylene Glycols	40
Polyvinylbenzyltrimethyl Ammonium Chloride Solution	43
Propane	31
Propanolamine	8
Propionaldehyde	19
Propionic Acid	4
Propionic Anhydride	11
Propionitrile	37
Propyl Acetate	34
Propyl Alcohol	20
Propylamine	7
Propylene	30
Propylene Butylene Polymer	30
Propylene Glycol	20
Propylene Oxide	16
Propylene Tetramer	30
Propyl Ether	41
Pseudocumene (1,2,4-Trimethylbenzene)	32
Pyridine	9
Rum	20
Sewap Sludge	43
Sodium Borohydride Solution (15% or less) / Sodium Hydroxide Solution	5
Sodium Carbonate Solutions	5
Sodium Cyanide Solution (30% or less)	5
Sodium Dimethyl Naphthalene Sulphonate, Aq. Solution	34
Sodium Hydrosulfide Solution (45% or less)	5
Sodium Hypochlorite Solution (15% or less)	5
Sodium Polyacrylate Solution	43
Sodium Silicate Solution	43
Sorbitol	20
Stearic Acid	4
Styrene (inhibited)	30
Sulpholane	39
Sulfur (molten)	(1)
Sulfuric Acid	2
Sulfuric Acid, Spent	2
Tall Oil, Fatty Acid	34
Tallow	34
Tallow Fatty Acid	34
Tallow Fatty Alcohol	20
Tallow Nitrile	37
1,1,2,2-Tetrachloroethane	36
Tetradecanol	20
Tetradecene	30
Tetradecylbenzene	32
Tetraethylene Glycol	40
Tetraethylenepentamine	7
Tetrahydrofuran	41
Tetrahydronaphthalene	32
Tetrasodium Salt of EDTA Solution	43

Alphabetical list of cargoes	
Name	Group No.
Toluene	32
Toluenediamine	9
Toluene Diisocyanate	12
Toluidine (ortho-)	9
Triarylphosphate	34
Tributyl Phosphate	34
1,2,4-Trichlorobenzene	36
Trichloroethane, 1,1,1-	36
Trichloroethylene	36
Trichloro-1 -2-2-Trifluoroethane, 1,1,2-	36
Tridecane	34
Tridecanol	20
Tridecene	30
Tridecylbenzene	32
Triethanolamine	8
Triethylamine	7
Triethyl Benzene	32
Triethylene Glycol	40
Triethylene Glycol Butyl Ether Mixture	40
Triethylene Glycol Ether Mixture	40
Triethylenetetramine	7
Triethyl Phosphate	34
Triisooctyl Trimellitate	34
Trimethyl Benzene, 1,2,4	32
Trimethyl Pentanediol-1-3-Diisobutyrate, 2,2,4-	34
Trimethyl-3-Pentanol-1-isobutyrate, 2,2,4-	34
Tripropylene	30
Tripropylene Glycol	40
Turpentine	30
Undecanol	20
Undecene	30
Undecylbenzene	32
Valeraldehyde	19
Vinyl Acetate (inhibited)	13
Vinyl Acetate, Fumarate Copolymer	34
Vinyl Chloride (inhibited)	35
Vinyl Neodecanate	13
Vinylidene Chloride (inhibited)	35
Vinyl Toluene (inhibited)	30
Xylene	32
Zinc Bromide, Calcium Bromide Solution	43
Footnote to Table I: 1) Because of very high reactivity or unusual conditions of carriage, this product is not included in the Compatibility Chart.	

TABLE II — GROUPINGS OF CARGOES

1. *Non-Oxidizing Mineral Acids*

Hydrochloric Acid
Hydrofluoric Acid
Hydrofluorosilicic Acid
Phosphoric Acid

2. *Sulfuric Acids*

Spent Sulfuric Acid
Sulfuric Acid (98% or less)

3. *Nitric Acid*

Nitric Acid (70% or less)

4. *Organic Acids*

Acetic Acid
Acrylic Acid (inhibited)
Butyric Acid
Cashew Nut Shell Oil (untreated)
Dichloropropionic Acid, 2,2-
Dimethyloctanoic Acid, 2,2-
Ethylhexoic Acid, 2-
Formic Acid
Heptanoic Acid (n-)
Methacrylic Acid
Naphthenic Acid
Oleic Acid
Propionic Acid
Stearic Acid

5. *Caustics*

Caustic Potash Solution
Caustic Soda Solution
Cresylate Spent Caustic Solution
Sodium Borohydride Solution (15% or less)
Sodium Hydroxide Solution
Sodium Carbonate Solutions
Sodium Cyanide Solution (30% or less)
Sodium Hydrosulfide Solution (45% or less)
Sodium Hypochlorite Solution (15% or less)

6. *Ammonia*

Ammonia, Anhydrous
Ammonium Hydroxide (28% or less)
Ammonium Nitrate, Urea, Water Solutions (contain-
ing Ammonia)

7. *Aliphatic Amines*

Butylamine
Cyclohexylamine
Dibutylamine
Diethylamine
Diethylenetriamine
Diisopropylamine
Dimethylamine
Dimethylcyclohexylamine
Di-n-propylamine
Dipropylamine
Dodecylamine, Tetradecylamine Mixture
Ethylamine
Ethylbutylamine (n-)
Ethylenediamine
Ethyl Hexylamine
Hexamethyleneimine
Methylamine
Methylamine Solutions

	Morpholine		Butyl Methacrylate (inhibited)
	Polyethylene Polyamines		Decyl Acrylate (inhibited)
	Propylamine		Dodecyl Pentadecyl Methacrylate
	Tetraethylenepentamine		Ethyl Acrylate (inhibited)
	Triethylamine		2-Ethylhexyl Acrylate (inhibited)
	Triethylenetetramine		Ethyl Methacrylate (inhibited)
8.	<i>Alkanolamines</i>		Methyl Acrylate (inhibited)
	(2-Aminoethoxy) Ethanol, 2-		Methyl Methacrylate (inhibited)
	Aminoethylethanolamine	15.	<i>Substituted Allyls</i>
	Diethanolamine		Acrylonitrile (inhibited)
	Diethylethanolamine		Allyl Alcohol
	Diisopropanolamine		Allyl Chloride
	Dimethylethanolamine		Dichloropropane/ 1,3-Dichloropropene Mixture
	Ethanolamine		1,3-Dichloropropene
	Propanolamine	16.	<i>Alkylene Oxides</i>
	Triethanolamine		Propylene Oxide
9.	<i>Aromatic Amines</i>		Butylene Oxide
	Aniline	17.	<i>Epichlorohydrin</i>
	Ethyl-6-Methyl-n-(1-Methyl-2-Methoxy Ethyl) Ani-		Epichlorohydrin
	line, 2-	18.	<i>Ketones</i>
	Methyl-6-Ethyl Aniline, 2-		Acetone
	Methyl Pyridine, 2		Acetophenone
	Methyl Pyridine, 3		Butyl Heptyl Ketone (iso-)
	Methyl Pyrrolidone (N-)		Camphor Oil
	Pyridine		Cyclohexanone
	2-Methyl-5-Ethylpyridine		Diisobutyl Ketone
	Toluenediamine		Epoxy Resin
	Toluidine (ortho-)		Isophorone
10.	<i>Amides</i>		Mesityl Oxide
	Acrylamide Solution		Methyl iso-Amyl Ketone
	Dimethyl Acetamide		Methyl Ethyl Ketone
	Dimethylformamide		Methyl Heptyl Ketone
	Octadecenoamide (Oleamide)		Methyl Isobutyl Ketone
11.	<i>Organic Anhydrides</i>	19.	<i>Aldehydes</i>
	Acetic Anhydride		Acetaldehyde
	Maleic Anhydride		Acrolein (inhibited)
	Phthalic Anhydride		Butyraldehyde
	Propionic Anhydride		Crotonaldehyde
12.	<i>Isocyanates</i>		Decaldehyde
	Diphenylmethane Diisocyanate		Ethylhexaldehyde
	Polyphenyl Polymethyleneisocyanate		2-Ethyl-3-Propyl Acrolein
	Toluene Diisocyanate		Formaldehyde
13.	<i>Vinyl Acetate</i>		Formaldehyde, Methanol Mixtures
	Vinyl Acetate (inhibited)		Furfural
	Vinyl Neodecanate		Glutaraldehyde Solution
14.	<i>Acrylates</i>		Glyoxal Solution
	Butyl Acrylate (inhibited)		Methylbutyraldehyde
	Butyl Methacrylate, Decyl Methacrylate, Cetyl Eico-		Methylolureas (20% free Formaldehyde)
	syl Methacrylate Mixture		Octyl Aldehyde
			Pentyl Aldehyde

	Propionaldehyde	Caprolactam Solution
	Valeraldehyde	
20.	<i>Alcohols, Glycols</i>	23-29. <i>Unassigned</i>
	Alcohol Diisobutyl Carbinol	30. <i>Olefins</i>
	Alcohols (Mixed)	Butadiene (inhibited)
	Behenyl Alcohol	Butene
	Amyl Alcohol	Butylene
	Butyl Alcohol	Cyclopentadiene Polymers
	1,3-Butylene Glycol	Cyclopentadiene, Styrene, Benzene Mixture
	Choline Chloride Solutions	Decene
	Cyclohexanol	Dicyclopentadiene
	Decyl Alcohol	Diisobutylene
	Diacetone	Dipentene
	Dimethylpropane-1-3-Diol, 2,2-	Dodecene
	Dodecanol	Ethylene
	Ethanol	Ethylidene Norbornene
	Ethoxylated Alcohols C ₁₁ -C ₁₅	Heptene, 1-
	Ethyl Alcohol	Hexene
	Ethylbutanol	Isoprene (inhibited)
	Ethylene Chlorohydrin	Methyl Acetylene, Propadiene Mixture (stabilized)
	Ethylene Cyanohydrin	(alpha-) Methyl Styrene (inhibited)
	Ethylene Glycol	Nonene
	2-Ethyl Hexanol	Octadecene-1
	Furfuryl Alcohol	Octene
	Glycerin	Pentadiene, 1,3-
	Hexanol	Pentene
	Hexylene Glycol	Pinene
	Methanol	Polybutene
	Methyl Alcohol	Polypropylene
	Methylamyl Alcohol	Propylene
	Methyl-2-Hydroxy-3-Butyne, 2-	Propylene Butylene Polymer
	Methylisobutyl Carbinol	Propylene Tetramer
	Octyl Alcohol	Styrene (inhibited)
	Nonyl Alcohol	Vinyl Toluene (inhibited)
	Pentadecanol	Tetradecene
	Propyl Alcohol	Tridecene
	Propylene Glycol	Tripropylene
	Sorbitol	Turpentine
	Tallow Fatty Alcohol	Undecene
	Tetradecanol	
	Tridecanol	31. <i>Paraffins</i>
	Undecanol	Butane
21.	<i>Phenols and Cresols</i>	Cycloaliphatic Resins
	Carbolic Oil	Cyclohexane
	Creosote, Coal Tar	Decane
	Cresols	Dodecane
	Cresylic Acid	Ethane
	Dichlorophenol, 2,4-	Heptane
	Nonyl Phenol	Hexane
	Phenol	Methane
		Nonane
22.	<i>Caprolactam Solution</i>	Octane
		Pentane

	Propane	Oils, Residual
32.	<i>Aromatic Hydrocarbons</i>	Oils, Road
	Benzene	Oils, Transformer
	Benzene, Toluene, Xylene (crude)	Oils, White (Mineral)
	Cumene	Petrolatum
	Cymene	Petroleum Naphtha
	Decylbenzene	34. <i>Esters</i>
	Diethylbenzene	Acetyl Tributyl Citrate
	Diisopropyl Benzene	Alkyl Phthalates (n-)
	Diisopropyl Naphthalene	Amyl Acetate
	Dodecylbenzene	Amyl Tallate
	Ethylbenzene	Butyl Acetate
	Methyl Naphthalene	Butyl Benzyl Phthalate
	Naphthalene	Castor Oil
	Pseudocumene (1,2,4-Trimethylbenzene)	Coconut Oil
	Tetradecylbenzene	Cottonseed Oil
	Tetrahydronaphthalene	Dibutyl Phthalate
	Toluene	Diethylene Glycol Monobutyl Ether Acetate
	Tridecylbenzene	Diethyl Sulfate
	Triethylbenzene	Diheptyl Phthalate
	Trimethyl Benzene, 1,2,4-	Diisodecyl Phthalate
	Undecylbenzene	Diisononyl Phthalate
	Xylene	Diisooctyl Phthalate
33.	<i>Misc. Hydrocarbon Mixtures</i>	Dimethyl Phthalate
	Asphalt	Dimethyl Polysiloxane
	Asphalt Blending Stocks	Dinonyl Phthalate
	Carbon Black Base	Dioctyl Phthalate
	Diphenyl-Diphenyl Oxide	Dipropylene Glycol Dibenzoate
	Distillates	Diundecyl Phthalate
	Fatty Acid Amides	Ethyl Acetate
	Gas Oil, Cracked	Ethylene Glycol Monobutyl Ether Acetate
	Gasoline Blending Stocks	Ethylene Glycol Monoethyl Ether Acetate
	Gasolines	Ethylhexyl Tallate
	Glycols, Resins, and Solvents Mixture	Fish Oil
	Herbicide (C ₁₅ H ₂₂ NO ₂ Cl)	Glyceryl Triacetate
	Jet Fuels	Glycidyl Ester of Varsatic Acid
	Kerosene	Glycol Diacetate
	Magnesium Nonyl Phenol Sulfide	Lard
	Maleic Anhydride Copolymer	Methyl Acetate
	Mineral Spirits	Methyl Acetoacetate
	Naphtha	Methyl Amyl Acetate
	Naphtha, Cracking Fraction	Octyl Epoxy Tallate
	Naphtha, Varnish Makers' and Painters (75%)	Oils, Edible, Babassu
	Nonyl Phenol Sulfide	Oils, Edible, Coconut, Methyl Ester
	Oils, Aliphatic	Oils, Edible Corn
	Oils, Clarified	Oils, Edible Cotton Seed Fatty Acid
	Oils, Coal	Oils, Edible, Rapeseed
	Oils, Crude	Oils, Edible, Rice Bran
	Oils, Diesel	Oils, Edible, Sunflower Seed
	Oils, Fuel (No. 1 through No. 6)	Oils Oiticica
	Oils, Miscellaneous	Oils Seal

Oils, Soapstock	37.	<i>Nitriles</i>
Oils, Tung		Acetonitrile
Olive Oil		Adiponitrile
Palm Oil		Pentenitrile (crude), 3-
Peanut Oil		Propionitrile
Propyl Acetate		Tallow Nitrile
Safflower Oil	38.	<i>Carbon Disulfide</i>
Sodium Dimethyl Naphthalene Sulphonate, Aq. Solution	39.	<i>Sulpholane</i>
Soybean Oil	40.	<i>Glycol Ethers</i>
Tall Oil, Fatty Acid		Diethylene Glycol
Tallow		Diethylene Glycol Monobutyl Ether
Tallow Fatty Acid		Diethylene Glycol Monoethyl Ether
Triarylphosphate		Diethylene Glycol Monomethyl Ether
Tributyl Phosphate		Diethylene Glycol Monophenyl Ether
Tridecane		Dipropylene Glycol
Triethyl Phosphate		Ethoxy Triglycol
Triisooctyl Trimellitate		Ethylene Glycol Monobutyl Ether
Trimethyl Pentanediol-1-3-Diisobutyrate, 2,2,4-		Ethylene Glycol Monoethyl Ether
Trimethyl-3-Pertanol-1-Isobutyrate, 2,2,4-		Ethylene Glycol Monoisopropyl Ether
Tucum Oil		Ethylene Glycol Monomethyl Ether
Vegetable Oil		Ethylene Glycol Phenyl Ether
Vinyl Acetate, Fumarate Copolymer		Methoxy Triglycol
35. <i>Vinyl Halides</i>		Nonylphenol, Ethoxylated
Vinyl Chloride (inhibited)		Oils, Edible, Soybean (epoxidized)
Vinylidene Chloride (inhibited)		Polyethylene Glycols
36. <i>Halogenated Hydrocarbons</i>		Polypropylene Glycols
Carbon Tetrachloride		Polypropylene Glycol Methyl Ether
Chlorobenzene		Soybean Oil, Epoxidized
Chlorodifluoromethane (mono-)		Tetraethylene Glycol
Chloroform		Triethylene Glycol
Chlorotoluene (m-, o-, p-)		Triethylene Glycol Butyl Ether Mixture
Dichlorobenzene		Triethylene Glycol Ether Mixture
Dichlorodifluoromethane		Tripropylene Glycol
1,1-Dichloroethane	41.	<i>Ethers</i>
Dichloroisopropyl Ether		Butyl Ether
Dichloromethane		Dichloroethylether
1,1-Dichloropropane		Diglycidyl Ether of Bisphenol A
1,2-Dichloropropane		1,4-Dioxane
Ethyl Chloride		Ethyl Ether
Ethylene Dibromide		Methyl Formal (Dimethyl Formal)
Ethylene Dichloride		Methyl tert-Butyl Ether
Methyl Bromide		Propyl Ether
Methyl Chloride		Tetrahydrofuran
Pentachloroethane	42.	<i>Nitrocompounds</i>
Perchloroethylene		(mono-) Nitrobenzene
1,1,2,2-Tetrachloroethane		Nitrochlorobenzene, ortho-
1,2,4-Trichlorobenzene		1- or 2-Nitropropane
Trichloroethane, 1,1,1-		Nitrotoluene
Trichloroethylene	43.	<i>Miscellaneous Water Solutions</i>
Trichloro-1-2-2-Trifluoroethane, 1,1,2-		

Ammonium Nitrate. Urea, Water Solutions (not containing Ammonia)
Ammonium Polyphosphate
Ammonium Sulfate Solution (20% or less)
Calcium Bromide Solution
Calcium Chloride Solutions
Corn Syrup
Dextrose Solution
Diammonium Salt of Zinc Ethylene Diamine Tetraacetic Acid Solution
Dodecyl Diphenyl Oxide Disulphonate Solution
Kaolin Clay Slurry
Latex Solutions
Lignin Liquor (Calcium Ligno-Sulphonate, Water Solution)

Polyvinylbenzyltrimethyl Ammonium Chloride Solution
Sewage Sludge
Sodium Polyacrylate Solution
Sodium Silicate Solution
Tetrasodium Salt of EDTA Solution
Zinc Bromide, Calcium Bromide Solution

Exceptions to the chart

The binary combinations listed below have been tested and found not to be dangerously reactive. These combinations are exceptions to the Compatibility Chart (Figure 1) and may be stowed in adjacent tanks.

Member of reactive group	Compatible with
Caustic soda 50% or less	Butyl Alcohol Diacetone Alcohol Diethylene Glycol Diethylene Glycol, Ethylene Glycol mixture Ethylene Glycol (pure) Ethyl Alcohol Ethyl Hexanol (Octyl Alcohol) Methyl Alcohol Propyl Alcohol Propyl Alcohol, Water mixture Propylene Glycol.
Ethylene Diamine	Ethyl Hexanol Isophorone Propyl Alcohol Creosole Propylene Glycol Methyl Ethyl Ketone
Sulfuric Acid, 98% or less	Choice White Grease
Acrylonitrile	Triethanolamine
Dodecyl and Tetradecylamine mixture	Tall Oil Fatty Acid

