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This chapter is valid until superseded by a revised chapter.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.

Revised chapters will be forwarded to all subscribers to the rules. Buyers of reprints are advised to check the updated list of rule chapters printed in Pt.0 Ch.1 Sec.1 to ensure that the chapter is current.

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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 inde-pendent 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

Parameter	*Remote reading*	*Alarm*		*Comments*
		Low	*High*	
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.
— sischarge 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 hazardously 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. Misclaneousl. 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)

Name	Group No.
Acetaldehyde	19
Acetic Acid	4
Acetic Anhydride	11
Acetone	18
Acetonitrile	37
Acetophenone	18
Acetyl Tibutyl 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 Straight Run Residue	 33 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
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
Dicyclopentadine	30
Diethanolamine	8

Name	Group No.
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
Dioctyl 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 Flashed Feed Stocks	 33 33
Diundecyl Phthalate	34
Dodecane	31
Dodecanol	20
Dodecene	30
Dodecylamine, Tetradsecylamine Mixture	7
Dodecylbenzene	32
Dodecyl Diphenyl Oxide Disulphonate Solution	43
Dodecyl Pentadecyl Methacrylate	14
Epichlorohydrin	17
Epoxy Resin	18
Ethane	31
Ethanolamine	8
Ethoxylated Alcohols C_{11}-C_{15}	20
Ethoxy Triglycol	40

Name	Group No.
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 Reformates	 33 33
Gasolines: Casing head (natural) Automotive (containing over 4.23 grams lead per gallon) Aviation (containing not over 4.86 grams lead per gallon) Polymer Straight Run	 33 33 33 33 33
Glutaraldehyde Solution	19
Glycerine	34
Glyceryl Triacetate	34
Glycidyl Ester of Versatic Acid	34
Glycol Diacetate	34
Glycols, Resins, and Solvents Mixture	33
Glyoxal Solution	19

Name	Group No.
Heptane	31
Heptanoic Acid(n-)	4
Heptene, 1	30
Herbicide ($C_{12}H_{22}NO_2Cl$)	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) JP-3 JP-4 JP-5 (Kerosene, Heavy)	 33 33 33 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
Methylolureas (20% Free Formaldehyde)	19
Methyl Pyridine,2	9
Methyl Pyridine,3	9
Methyl Pyrrolidone (N-)	9
(alpha-) Methyl Styrene (inhibited)	30

Name	Group No.
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 Cracking Fraction Solvent Stoddard Solvent Varnish Markers' and Painters' (75%)	 33 33 33 33 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 (ethyoxylated)	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 Clarified Coal Oil Crude Oil Diesel Oil Oiticica Residual Road Seal Soapstock Transformer Tung White (Mineral)	 33 33 33 33 33 34 33 33 34 34 33 34 33

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
Pentenenitrile (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
Polybutene	30

Name	Group No.
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
Toluene	32
Toluenediamine	9

Name	Group No.
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 (containing 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
   - Polyethylene Polyamines
   - Propylamine

Tetraethylenepentamine
Triethylamine
Triethylenetetramine

8. *Alkanolamines*
(2-Aminoethoxy) Ethanol, 2-
Aminoethylethanolamine
Diethanolamine
Diethylethanolamine
Diisopropanolamine
Dimethylethanolamine
Ethanolamine
Propanolamine
Triethanolamine

9. *Aromatic Amines*
Aniline
Ethyl-6-Methyl-n-(1-Methyl-2-Methoxy Ethyl) Aniline, 2-
Methyl-6-Ethyl Aniline, 2-
Methyl Pyridine, 2
Methyl Pyridine, 3
Methyl Pyrrolidone (N-)
Pyridine
2-Methyl-5-Ethylpyridine
Toluenediamine
Toluidine (ortho-)

10. *Amides*
Acrylamide Solution
Dimethyl Acetamide
Dimethylformamide
Octadecenoamide (Oleamide)

11. *Organic Anhydrides*
Acetic Anhydride
Maleic Anhydride
Phthalic Anhydride
Propionic Anhydride

12. *Isocyanates*
Diphenylmethane Diisocyanate
Polyphenyl Polymethyleneisocyanate
Toluene Diisocyanate

13. *Vinyl Acetate*
Vinyl Acetate (inhibited)
Vinyl Neodecanate

14. *Acrylates*
Butyl Acrylate (inhibited)
Butyl Methacrylate, Decyl Methacrylate, Cetyl Eicosyl Methacrylate Mixture
Butyl Methacrylate (inhibited)
Decyl Acrylate (inhibited)
Dodecyl Pentadecyl Methacrylate
Ethyl Acrylate (inhibited)
2-Ethylhexyl Acrylate (inhibited)
Ethyl Methacrylate (inhibited)
Methyl Acrylate (inhibited)
Methyl Methacrylate (inhibited)

15. *Substituted Allyls*
Acrylonitrile (inhibited)
Allyl Alcohol
Allyl Chloride
Dichloropropane/ 1,3-Dichloropropene Mixture
1,3-Dichloropropene

16. *Alkylene Oxides*
Propylene Oxide
Butylene Oxide

17. *Epichlorohydrin*
Epichlorohydrin

18. *Ketones*
Acetone
Acetophenone
Butyl Heptyl Ketone (iso-)
Camphor Oil
Cyclohexanone
Diisobutyl Ketone
Epoxy Resin
Isophorone
Mesityl Oxide
Methyl iso-Amyl Ketone
Methyl Ethyl Ketone
Methyl Heptyl Ketone
Methyl Isobutyl Ketone

19. *Aldehydes*
Acetaldehyde
Acrolein (inhibited)
Butyraldehyde
Crotonaldehyde
Decaldhyde
Ethylhexaldehyde
2-Ethyl-3-Propyl Acrolein
Formaldehyde
Formaldehyde, Methanol Mixtures
Furfural
Glutaraldehyde Solution
Glyoxal Sollltioll
Methylbutyraldehyde
Methylorlureas (20% free Formaldehyde)
Octyl Aldehyde
Pentyl Aldehyde
Propionaldehyde
Valeraldehyde

20. *Alcohols, Glycols*
Alcohol Diisobutyl Carbinol
Alcohols (Mixed)
Behenyl Alcohol
Amyl Alcohol
Butyl Alcohol
1,3-Butylene Glycol
Choline Chloride Solutions
Cyclohexanol
Decyl Alcohol
Diacetone
Dimethylpropane-1-3-Diol, 2,2-
Dodecanol
Ethanol
Ethoxylated Alcohols C_{11}-C_{15}
Ethyl Alcohol
Ethylbutanol
Ethylene Chlorohydrin
Ethylene Cyanohydrin
Ethylene Glycol
2-Ethyl Hexanol
Furfuryl Alcohol
Glycerin
Hexanol
Hexylene Glycol
Methanol
Methyl Alcohol
Methylamyl Alcohol
Methyl-2-Hydroxy-3-Butyne, 2-
Methylisobutyl Carbinol
Octyl Alcohol
Nonyl Alcohol
Pentadecanol
Propyl Alcohol
Propylene Glycol
Sorbitol
Tallow Fatty Alcohol
Tetradecanol
Tridecanol
Undecanol

21. *Phenols and Cresols*
Carbolic Oil
Creosote, Coal Tar
Cresols
Cresylic Acid
Dichlorophenol, 2,4-
Nonyl Phenol
Phenol

22. *Caprolactam Solution*
Caprolactam Solution

23-29. *Unassigned*

30. *Olefins*
Butadiene (inhibited)
Butene
Butylene
Cyclopentadiene Polymers
Cyclopentadiene, Styrene, Benzene Mixture
Decene
Dicyclopentadiene
Diisobutylene
Dipentene
Dodecene
Ethylene
Ethylidene Norbornene
Heptene, 1-
Hexene
Isoprene (inhibited)
Methyl Acetylene, Propadiene Mixture (stabilized)
(alpha-) Methyl Styrene (inhibited)
Nonene
Octadecene-1
Octene
Pentadiene, 1,3-
Pentene
Pinene
Polybutene
Polypropylene
Propylene
Propylene Butylene Polymer
Propylene Tetramer
Styrene (inhibited)
Vinyl Toluene (inhibited)
Tetradecene
Tridecene
Tripropylene
Turpentine
Undecene

31. *Paraffins*
Butane
Cycloaliphatic Resins
Cyclohexane
Decane
Dodecane
Ethane
Heptane
Hexane
Methane
Nonane
Octane
Pentane
Propane

32. *Aromatic Hydrocarbons*
Benzene
Benzene, Toluene, Xylene (crude)
Cumene
Cymene
Decylbenzene
Diethylbenzene
Diisopropyl Benzene
Diisopropyl Naphthalene
Dodecylbenzene
Ethylbenzene
Methyl Naphthalene
Naphthalene
Pseudocumene (1,2,4-Trimethylbenzene)
Tetradecylbenzene
Tetrahydronaphthalene
Toluene
Tridecylbenzene
Triethylbenzene
Trimethyl Benzene, 1,2,4-
Undecylbenzene
Xylene

33. *Misc. Hydrocarbon Mixtures*
Asphalt
Asphalt Blending Stocks
Carbon Black Base
Diphenyl-Diphenyl Oxide
Distillates
Fatty Acid Amides
Gas Oil, Cracked
Gasoline Blending Stocks
Gasolines
Glycols, Resins, and Solvents Mixture
Herbicide ($C_{15}H_{22}NO_2Cl$)
Jet Fuels
Kerosene
Magnesium Nonyl Phenol Sulfide
Maleic Anhydride Copolymer
Mineral Spirits
Naphtha
Naphtha, Cracking Fraction
Naphtha, Varnish Makers' and Painters (75%)
Nonyl Phenol Sulfide
Oils, Aliphatic
Oils, Clarified
Oils, Coal
Oils, Crude
Oils, Diesel
Oils, Fuel (No. 1 through No. 6)
Oils, Miscellaneous
Oils, Residual
Oils, Road
Oils, Transformer
Oils, White (Mineral)
Petrolatum
Petroleum Naphtha

34. *Esters*
Acetyl Tributyl Citrate
Alkyl Phthalates (n-)
Amyl Acetate
Amyl Tallate
Butyl Acetate
Butyl Benzyl Phthalate
Castor Oil
Coconut Oil
Cottonseed Oil
Dibutyl Phthalate
Diethylene Glycol Monobutyl Ether Acetate
Diethyl Sulfate
Diheptyl Phthalate
Diisodecyl Phthalate
Diisononyl Phthalate
Diisooctyl Phthalate
Dimethyl Phthalate
Dimethyl Polysiloxane
Dinonyl Phthalate
Dioctyl Phthalate
Dipropylene Glycol Dibenzoate
Diundecyl Phthalate
Ethyl Acetate
Ethylene Glycol Monobutyl Ether Acetate
Ethylene Glycol Monoethyl Ether Acetate
Ethylhexyl Tallate
Fish Oil
Glyceryl Triacetate
Glycidyl Ester of Varsatic Acid
Glycol Diacetate
Lard
Methyl Acetate
Methyl Acetoacetate
Methyl Amyl Acetate
Octyl Epoxy Tallate
Oils, Edible, Babassu
Oils, Edible, Coconut, Methyl Ester
Oils, Edible Corn
Oils, Edible Cotton Seed Fatty Acid
Oils, Edible, Rapeseed
Oils, Edible, Rice Bran
Oils, Edible, Sunflower Seed
Oils Oiticica
Oils Seal
Oils, Soapstock

Oils, Tung
Olive Oil
Palm Oil
Peanut Oil
Propyl Acetate
Safflower Oil
Sodium Dimethyl Naphthalene Sulphonate, Aq. Solution
Soybean Oil
Tall Oil, Fatty Acid
Tallow
Tallow Fatty Acid
Triarylphosphate
Tributyl Phosphate
Tridecane
Triethyl Phosphate
Triisooctyl Trimellitate
Trimethyl Pentanediol-1-3-Diisobutyrate, 2,2,4-
Trimethyl-3-Pertanol-1-Isobutyrate, 2,2.4-
Tucum Oil
Vegetable Oil
Vinyl Acetate, Fumarate Copolymer

35. *Vinyl Halides*
Vinyl Chloride (inhibited)
Vinylidene Chloride (inhibited)

36. *Halogenated Hydrocarbons*
Carbon Tetrachloride
Chlorobenzene
Chlorodifluoromethane (mono-)
Chloroform
Chlorotoluene (m-, o-, p-)
Dichlorobenzene
Dichlorodifluoromethane
1,1-Dichloroethane
Dichloroisopropyl Ether
Dichloromethane
1,1-Dichloropropane
1,2-Dichloropropane
Ethyl Chloride
Ethylene Dibromide
Ethylene Dichloride
Methyl Bromide
Methyl Chloride
Pentachloroethane
Perchloroethylene
1,1,2,2-Tetrachloroethane
1,2,4-Trichlorobenzene
Trichloroethane, 1,1,1-
Trichloroethylene
Trichloro-1-2-2-Trifluoroethane, 1,1,2-

37. *Nitriles*
Acetonitrile
Adiponitrile
Pentenenitrile (crude), 3-
Propionitrile
Tallow Nitrile

38. *Carbon Disulfide*

39. *Sulpholane*

40. *Glycol Ethers*
Diethylene Glycol
Diethylene Glycol Monobutyl Ether
Diethylene Glycol Monoethyl Ether
Diethylene Glycol Monomethyl Ether
Diethylene GlYcol Monophenyl Ether
Dipropylene Glycol
Ethoxy Triglycol
Ethylene Glycol Monobutyl Ether
Ethylene Glycol Monoethyl Ether
Ethylene Glycol Monoisopropyl Ether
Ethylene Glycol Monomethyl Ether
Ethylene Glycol Phenyl Ether
Methoxy Triglycol
Nonylphenol, Ethoxylated
Oils, Edible, Soybean (epoxidized)
Polyethylene Glycols
Polypropylene Glycols
Polypropylene Glycol Methyl Ether
Soybean Oil, Epoxidized
Tetraethylene Glycol
Triethylene Glycol
Triethylene Glycol Butyl Ether Mixture
Triethylene Glycol Ether Mixture
Tripropylene Glycol

41. *Ethers*
Butyl Ether
Dichloroethylether
Diglycidyl Ether of Bisphenol A
1,4-Dioxane
Ethyl Ether
Methyl Formal (Dimethyl Formal)
Methyl tert-Butyl Ether
Propyl Ether
Tetrahydrofuran

42. *Nitrocompounds*
(mono-) Nitrobenzene
Nitrochlorobenzene, ortho-
1- or 2-Nitropropane
Nitrotoluene

43. *Miscellaneous Water Solutions*
Ammonium Nitrate. Urea, Water Solu-

tions (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
Acrylonitrite	Triethanolamine
Dodecyl and Tetradecylamine mixture	Tall Oil Fatty Acid