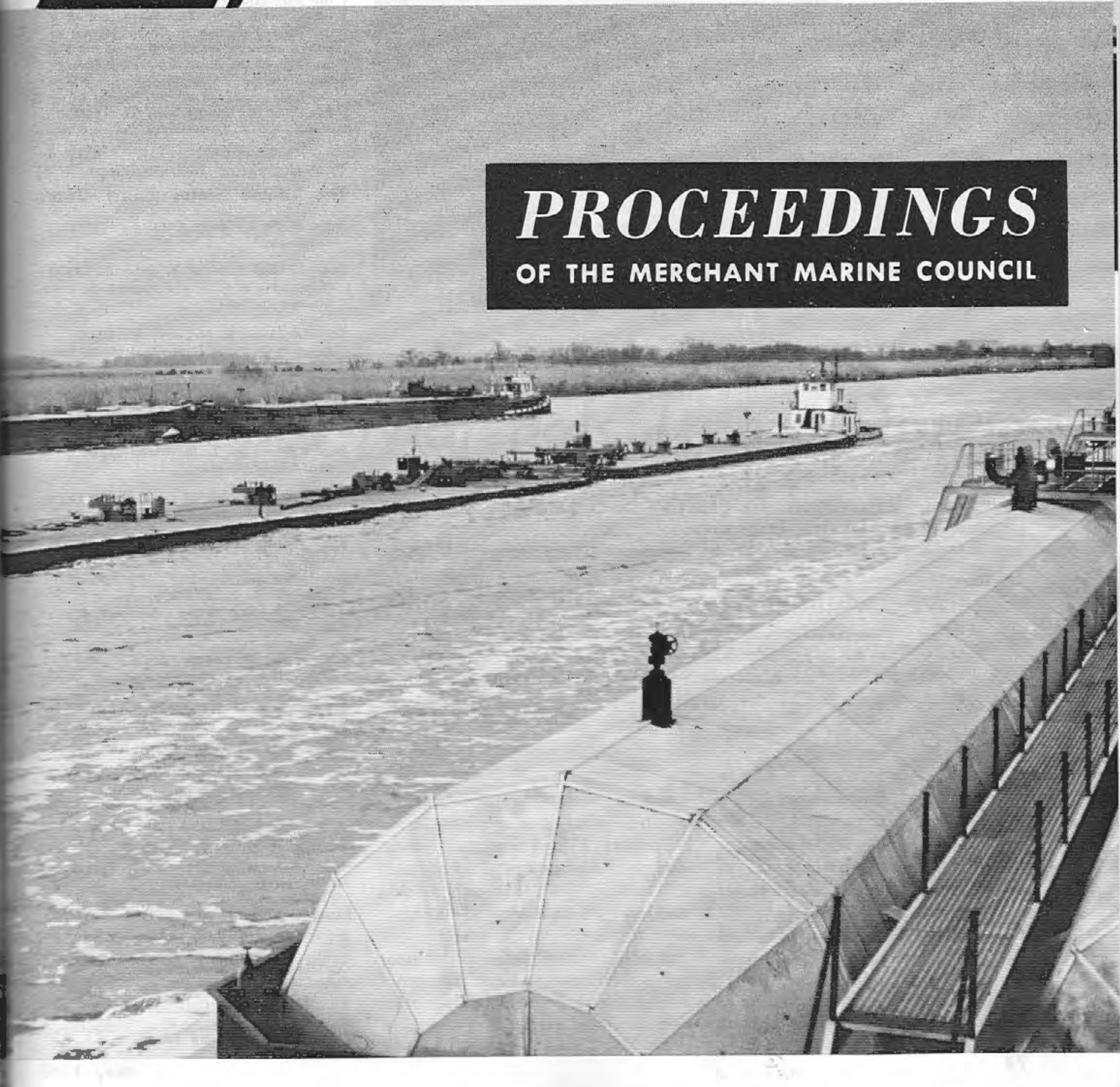
COAST GUARD



PROCEEDINGS
OF THE MERCHANT MARINE COUNCIL

Vol. 27, No. 5 CG-129 May 1970

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COVERS

FRONT COVER: Barges carrying hazardous materials on the Gulf Intracoastal Waterway, bound from Houston to New Orleans.

BACK COVER: Topside View of Modern "Drug Store" Tanker Carrying Hazardous Materials Such As Ethylene Oxide, Anhydrous Ammonia, Vinyl Chloride, Butadiene, etc.

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PROCEEDINGS

OF THE

MERCHANT MARINE COUNCIL

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Towboat Captain's View of 1,600,000 Gallons of Refrigerated Anhydrous Ammonia in Two Barges.

This article is extracted from an address by Commander Welsh delivered at the Marine Section of the National Safety Congress and Exposition in Chicago 1969.

Hazardous Materials Transportation

With the rapid growth in the size and variety of shipments it is essential that hazard evaluations be based on a good understanding of properties, hazards and disaster potential.

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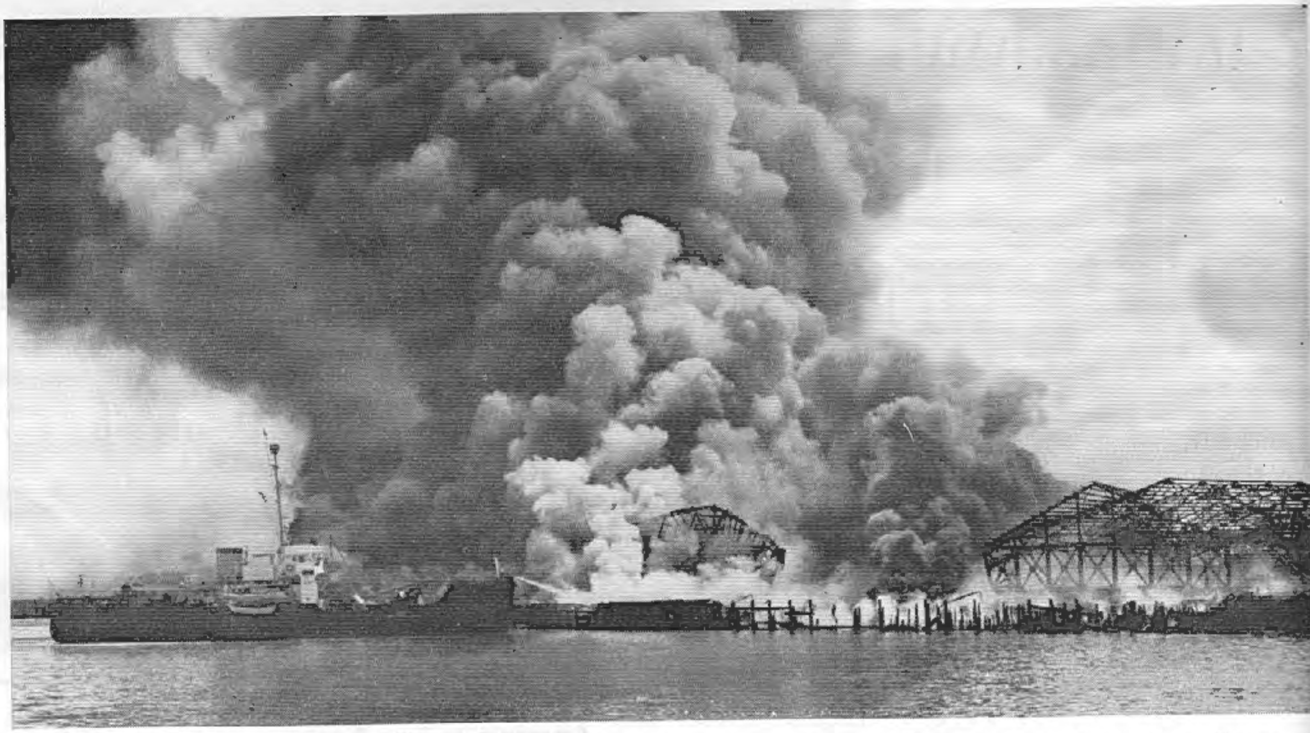
MEASURES TO PROTECT operating personnel and the public during the bulk transportation of hazardous materials are becoming more and more complex as chemical production increases and the size and variety of chemical shipments grows. Because of this, existing classification systems and accident statistics are no longer sufficient as a basis for developing safety regulations and standards. Thus, if chemical transportation disasters are to be reduced to a minimum, hazard evaluation must become a comprehensive, reliable science.

As can be seen from *Figure 1,* the production of organic chemicals more than doubled from 1958 to 1968, and inorganic chemical production almost doubled during this same period. By comparison, there has been only a 15% increase in population despite the population explosion.

Between 1964 and 1967, the growth in chemical loadings was 25%, or about 7%/yr., while during the years 1965 to 1968 growth in the combined total of chemical imports and exports was 33%, or 8%/yr.,

The greater absolute quantity of chemicals being shipped in more individual movements means there is



The Coast Guard Cutter *Iris* is shown here fighting an ammonium nitrate fire at Texas City, Texas.

a greater chance of an accident, and growing population centers means there is a greater probability that it will involve the public.

Hazard evaluation seeks to minimize the probability of such disasters, and, failing that, to minimize the effects of those that do occur. To be useful, the hazard evaluation system should contain a minimum number of categories and still be comprehensible; reflect multiple inherent hazards; specify degrees of hazards; and be somewhat quantifiable.

Inherent hazards are determined by the physical, chemical, and toxicological properties of the cargoes. For instance, the toxicity hazard is related to vapor pressure, water solubility, LC_{50}, and LD_{50}, among others. Having identified and evaluated the degrees of various hazards associated with a cargo, the next step is to correlate the hazards with the engineering and operational aspects of the transportation mode so that adequate controls can be provided. For example, with highly flammable or toxic liquid commodities, the design of pressure relief systems and the choice of construction materials are important because tank integrity will largely determine how well the evolved vapors are contained.

Identification of hazards

The first step in the hazard evaluation process is the identification of the types of potential hazard that a given commodity presents to life and property. To make this determination the following questions should be answered satisfactorily:

1. Is the commodity a gas, a liquid, or a solid?
2. Who, or what, would be injured by release of the commodity?
3. What kind of injury would it sustain?
4. If the commodity is toxic to humans, is the effect cumulative, delayed, and acute?
5. How does the agent enter the body?
6. What are the critical dosages and concentrations?
7. What organs are attacked?
8. What kind of property damage can the commodity cause and how can it cause this damage?
9. Can the commodity react with something else?
10. Are the reaction products dangerous?

These hazards are identified without regard to the method of containment or handling. At this stage we are not concerned with how much damage the commodity can do, but rather with the properties of a commodity and their relationship to hazards.

To be more specific, what is the nature of some of the hazards? First, let us consider gases, or liquids that emit vapors irritating to the skin or to the mucous membranes of the eyes, nose, throat, and lungs. Since chemical vapors vary in degree of toleration, an evaluation of this health hazard would be based upon the likelihood that the vapor would cause an injury, and the severity and permanence of that injury. Nonvolatile chemicals, or those which produce vapors not irritating to the eyes and throat, would be rated as nonhazardous. Chemicals with the highest hazard rating would include severe irritants that cannot be tolerated even at low concentrations without causing eye or lung damage.

Another health hazard involves the tendency of some chemicals in the liquid or solid state to "burn" or irritate human skin. In this respect, some chemicals are practically harmless. At the opposite end of the hazard rating scale are the severe irritants which cause second and third degree burns on short contact and serious injury if splashed into the eyes.

The possibility of poisoning through inhalation, ingestion, or absorption is yet another hazard. Some chemicals offer little or no likelihood of producing an injury in this way, but others with threshold limits below 10 ppm can be extremely dangerous. Volatile chemicals producing toxic effects by inhalation are of most concern in bulk water transportation, while toxic chemicals absorbed through the skin are considered less hazardous because of the lower probability of exposure. Chemicals which are toxic only by ingestion generally present a relatively small danger.

Chemicals are rated as health hazards if they are anesthetics, narcotics, have a cumulative toxic effect, or are acutely toxic. The Coast Guard's primary concern has been with acute rather than chronic or cumulative toxicity, and the same holds true for the evaluation process.

Water pollution hazards

In addition to the health hazard, the water pollution characteristics of chemicals must also be considered. Hazard ratings should reflect the concern that arises when chemicals are spilled or dumped into waterways. A wide variety of problems may arise from such occurrences: water for municipal systems may be made unfit for human consumption; fish and other aquatic life may be killed; waters in streams or on beaches may be contaminated by oily, sticky, dark-colored, or malodorous materials which make them unfit for recreational purposes; and noxious odors or vapors may evolve from polluted water to contaminate the atmosphere in areas nearby. See *Figure 2*. Thus, the water pollution characteristics of chemicals should be evaluated on the basis of their toxicity to human and marine life as well as the threat they pose to the aesthetics of the environment.

To arrive at a human toxicity evaluation for water pollution the basic guide is the LD_{50} value. For a more practical assessment of the real hazard involved, however, other factors need to be considered. For instance, ratings should be reduced below that indicated by LD_{50} values for compounds that have low water solubility (and accordingly cannot reach a high concentration in water), for compounds of high volatility (that vaporize in a short time from the surface), and for compounds that have a pronounced taste or odor which will serve as a warning to prevent human consumption.

In most cases, the toxicity of particular chemicals to aquatic life can be determined from published data. In some instances, these ratings can be modified for chemicals with low water solubility or high volatility, which, accordingly, will not normally pollute waters.

Chemicals should also be evaluated with regard to the aesthetic problems

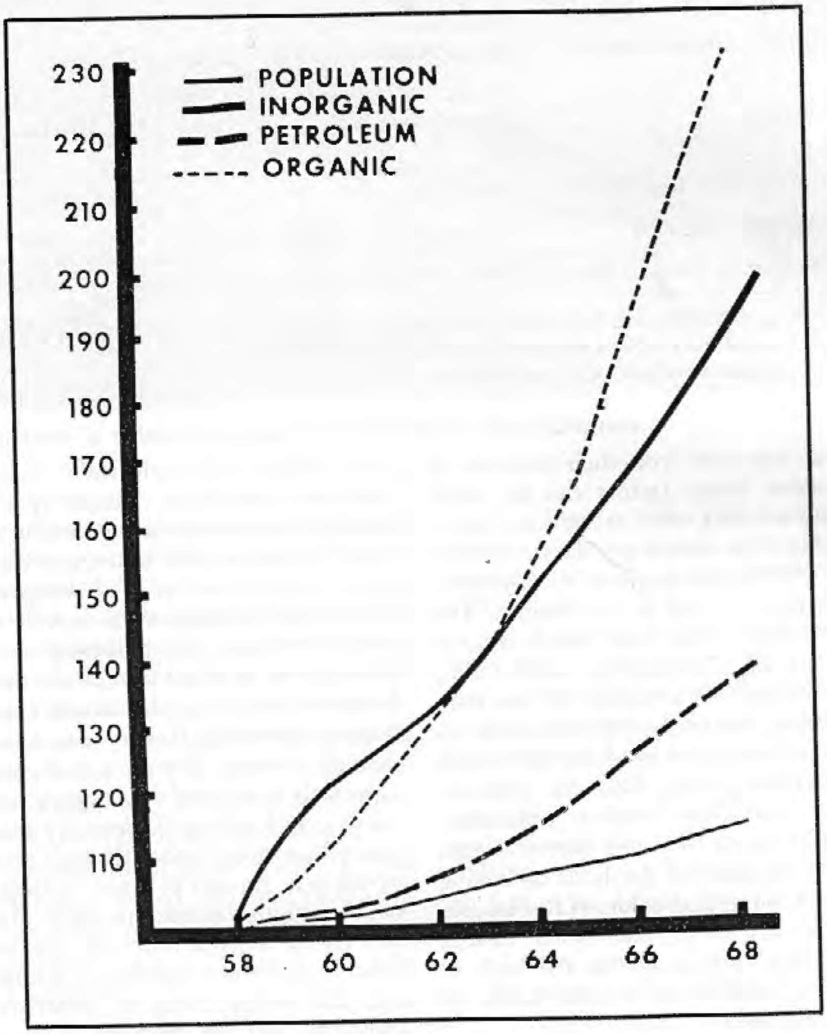


Figure 1. Growth in population and chemical production, 1958–68 (1958=100%).

Table 1. Hazard evaluation ratings and classifications for selected commodities.

		Fire	Health			Water Pollution			Reactivity		
		(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)	(x)
			Vapor Irritant	Liquid or Solid Irritant	Poisons	Human Toxicity	Aquatic Toxicity	Aesthetic Effect	Other Chemicals	Water	Self-Reaction
Acetone	(C Flam. Liq.)	3	1	0	0	1	1	1	2	0	1
Acrylonitrile	(C Flam. Liq.)	3	3	1	3	4	3	2	3	0	3
Ethyleneimine	(B Flam. Liq.)	3*	3	2	4	4	3	3	3	1	3
Allyl Alcohol	(B Pois.)	3	3	2	3	2	3	2	2	0	1
Ammonia, Anhydrous	(Non-Flam. Compr. Gas)	1*	4	2	2	2	2	2	3	2	0
Chlorine	(Non-Flam. Compr. Gas)	0	4	2	4	2	3	2	4	1	0
Dichlorodifloromethane	(Non-Flam. Compr. Gas)	0	0	0	1	0	0	0	1	0	0
Propane	(Flam. Compr. Gas)	4	0	0	0	0	0	0	0	0	0
Hydrochloric Acid, 28-35%	(Corr. Liq.)	0	3	3	2	2	2	2	3	0	0
Chlorosulfonic Acid	(Corr. Liq.)	0	4	4	4	2	3	2	4	4	0
Phosphoric Acid, 75-85%	(Haz. Art.)	0	0	3	1	2	3	2	3	0	0

Ratings are from 0 to 4 in order of increasing severity.
*Indicates fire hazards are unlike those of hydrocarbons.
( ) Indicates current DOT classification.

that may arise from their pollution of waters. Many factors can be taken into account, such as the water solubility of the chemical; that is, whether it will float on water as an oily layer, dissolve, or sink to the bottom. The volatility (how long the substance will remain in or on the water) odor, taste, and color should be also considered. Normally, gaseous chemicals which are water insoluble and which volatilize quickly from the area are not considered water pollutants. Other water insoluble chemicals can be evaluated on the basis of boiling point, odor, and color. Water soluble compounds can have their ratings modified principally on the basis of odor; with some weight given to persistence.

In addition, chemical reactivity must be considered since this hazard often arises under bulk water transportation conditions. Reactivity includes the reaction of a chemical with other chemicals, with water, and with itself (polymerization or decomposition). An evaluation of reactivity should consider the tendency of a chemical to undergo a vigorous and hazardous reaction with another industrial chemical if they are accidentally mixed. The fact that two chemicals react is of no concern unless it may lead to a hazardous situation. This may arise through the overflow or rupture of tanks, ignition, or the evolution of noxious gases. The severity of the reaction will depend upon temperature, the degree of mixing, the weight ratio of water or chemical, and the presence of trace impurities that may catalyze the reaction.

Self-reactivity evaluations rate chemicals with regard to their tendency to undergo a hazardous self-reaction, usually polymerization. Most organic chemicals are incapable of such a reaction, but for those that are, the evaluation should be based on the ease of initiation, the vigor with which it occurs, and the hazard that may arise during transportation.

Chemicals can be classified as a fire hazard if their properties are such that they may ignite or spread a fire during bulk water transportation. Evaluation can be based principally on flash points; however, other factors may be considered and the rating raised or lowered accordingly, if the chemical presents a hazard unlike the one presented by hydrocarbons. They include:

1. Chemicals such as halogen-,

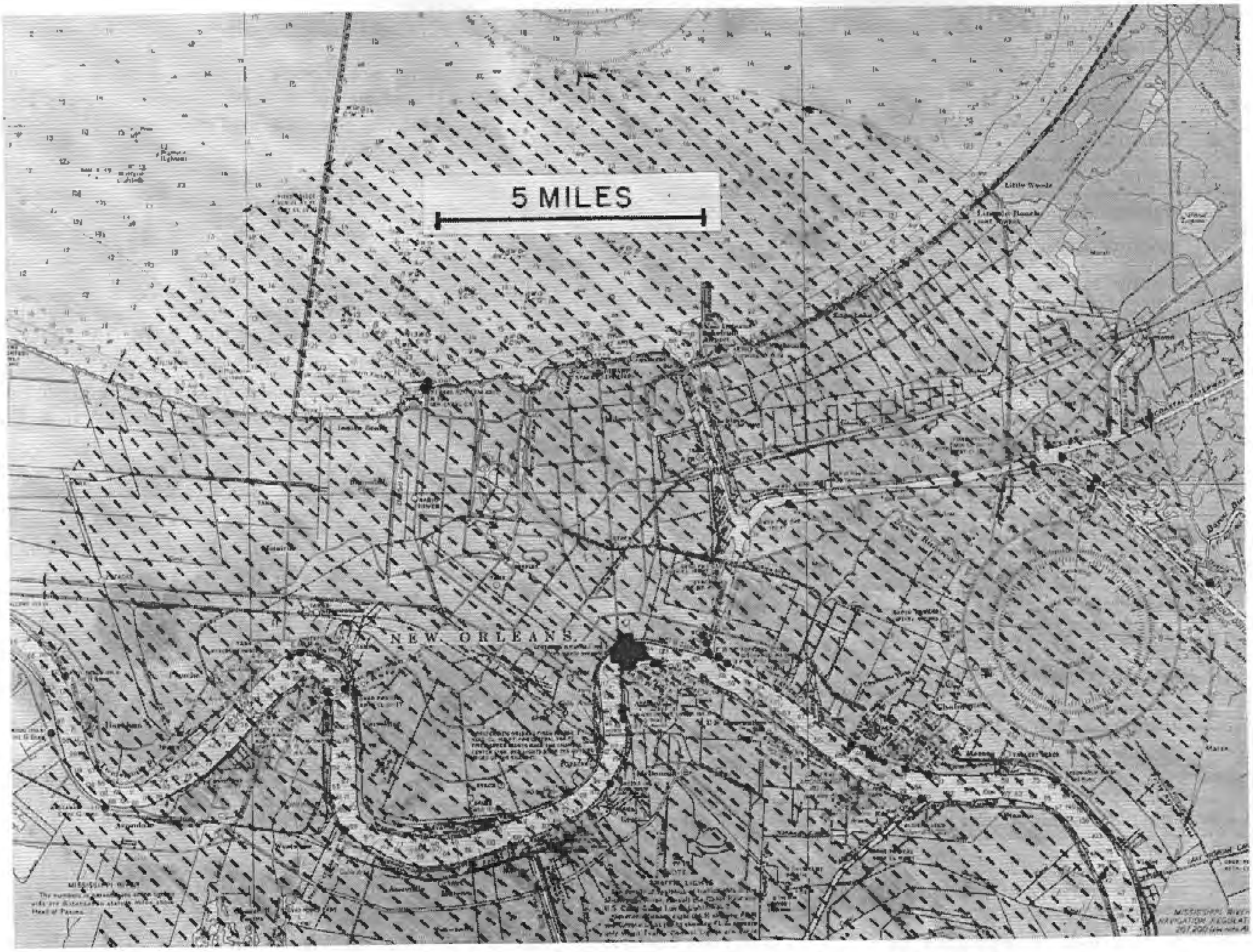


Figure 2. Hazard area from a chlorine barge tank rupture in New Orleans.

nitrogen-, and sulfur-containing compounds that produce noxious gases in burning.

2. Chemicals having exceptionally high or low ignition temperatures.

3. Chemicals that ignite spontaneously on contact with air or water.

Classification systems

The factors described above are those we feel must be present in any hazard evaluation system. The older, traditional classification systems are clearly insufficient for they only recognize a single hazard which may or may not be the most important one.

How does this new approach to hazard evaluation compare with the traditional classification system used in this country? Let us consider a few examples:

1. Liquid oxygen is presently an unregulated commodity when transported at a pressure of less than 25 psig. But for purposes of marine transportation, this concept of hazard based only on a criterion of pressure is inadequate. What would happen if a tank full of liquefied oxygen at a temperature of about −297° F were suddenly spilled onto the deck of a ship? The possibilities are numerous, including the likelihood of hull fracture.

2. Chlorine, as it is now classed, falls into the same category as compressed air.

3. Chlorine trifluoride is classified as a corrosive liquid. There is no indication that it is violently reactive with water.

4. Kerosene in less than bulk quantities is unregulated, and is frequently identified as a nonflammable.

The International Maritime Dangerous Goods Code is a hybrid; combining elements of both the classification theory and the hazard evaluation theory. It has nine basic classifications, as stipulated in Chapter VII of the International Convention on Safety of Life at Sea, 1960:

1. Explosives
2. Gases
3. Inflammable liquids
4. Inflammable solids
5. Oxidizing substances

Table 2. A guide to compatibility of chemicals for adjacent bulk loading.

1	Inorganic Acids	1																							
2	Organic Acids	X	2																						
3	Caustics	X	X	3																					
4	Amines & Alkanolamines	X	X		4																				
5	Halogenated Compounds	X		X	X	5																			
6	Alcohols, Glycols & Glycol Ethers	X					6																		
7	Aldehydes	X	X	X	X		X	7																	
8	Ketones	X		X	X			X	8																
9	Saturated Hydrocarbons									9															
10	Aromatic Hydrocarbons	X									10														
11	Olefins	X				X						11													
12	Petroleum Oils												12												
13	Esters	X		X	X									13											
14	Monomers & Polymerizable Esters	X	X	X	X	X	X								14										
15	Phenols			X	X			X							X	15									
16	Alkylene Oxides	X	X	X	X		X	X							X	X	16								
17	Cyanohydrins	X	X	X	X	X		X									X	17							
18	Nitriles	X	X	X	X												X		18						
19	Ammonia	X	X					X	X					X	X	X	X	X		19					
20	Halogens			X			X		X	X	X	X	X	X	X	X				X	20				
21	Ethers	X													X						X	21			
22	Phosphorus, Elemental	X	X	X																	X		22		
23	Sulfur, Molten									X	X	X	X				X						X	23	
24	Acid Anhydrides	X		X	X		X	X							X		X	X	X	X					24

X Represents unsafe combination for adjacent loading. Table 1 lists the chemicals by chemical and reactivity groups. Obtain the group for the chemical and then read chart, first from left to right, then down.

Chemicals Not on Chart

Carbon bisulfide should not be carried adjacent to reactivity groups 1, 4, 19, 20, and epichlorohydrin.

Epichlorohydrin should not be carried adjacent to reactivity groups 1, 2, 3, 4, 14, 15, 19, 20, 22, 23, 24, and carbon bisulfide.

Motor fuel antiknock compounds should not be carried adjacent to reactivity groups 1, 4, 5, 6, 7, 15, 19, and 20.

6. Toxic substances
7. Radioactive substances
8. Corrosives
9. Miscellaneous dangerous substances

There are gradations within classifications that reflect degrees of hazards, as in the case of explosives and inflammable liquids. Other gradations, such as those applied to gases, inflammable solids, oxidizing and toxic substances, describe the nature of the hazard. Inflammable solids, for example, are subdivided into three categories, one of which covers those substances which are spontaneously combustible. Another category covers substances emitting inflammable gases when wet.

The International Maritime Dangerous Goods Code further provides that each hazard be identified by a separate label. Chlorine, for example, requires a label as a poison gas and as an oxidizing agent. Methyl cyanide (acetonitrile) is labeled as a poison and as an inflammable liquid. Some other compounds may require as many as three labels.

There are a number of new hazard evaluation systems that consider the problems of multiple hazards and graded hazard levels. One of these, the National Academy of Sciences System, is based upon principles discussed earlier in this article. Developed by the Advisory Committee on Hazardous Materials for the Coast Guard, it is used principally to evaluate the bulk transportation of dangerous cargoes. The NAS System starts off with four broad hazard categories:

1. Fire hazard
2. Health hazard
3. Water pollution hazard
4. Reactivity hazard

These are further broken down into ten specific hazards:

1. Fire hazard
2. Vapor irritant health hazard
3. Liquid, solid irritant health hazard
4. Poison health hazard
5. Human toxicity water pollution hazard
6. Aquatic toxicity water pollution hazard
7. Aesthetic effect water pollution hazard
8. Reactivity hazard with other chemicals
9. Water reactivity hazard

Table 3. Partial list of compatibility groups.

Group 1. Inorganic Acids

hydrogen chloride (anhydrous)
hydrogen fluoride (anhydrous)
oleum
sulfuric acid
phosphoric acid
hydrochloric acid (aqueous)
hydrofluoric acid (aqueous)

Group 2. Organic Acids

acetic acid
butyric acid *(n-)*
formic acid
propionic acid
tall oil
rosin oil

Group 3. Caustics

caustic potash solution
caustic soda solution

Group 4. Amines and Alkanolamines

aminoethylethanolamine
aniline
diethanolamine
diethylamine
diethylenetriamine
diisopropanolamine
dimethylamine
ethylenediamine
2-methyl-5-ethyl pyridine
monoethanolamine
monoisopropanolamine
morpholine
pyridine
triethanolamine

Group 5. Halogenated Compounds

allyl chloride
carbon tetrachloride
chlorobenzene
chloroform
chlorohydrins, crude
triethylenetetramine
dichlorobenzene *(o-)*
dichloroethyl ether
dichloropropane
dichloropropene
ethyl chloride
ethylene dibromide
ethylene dichloride
methyl bromide
methyl chloride
methylene chloride
perchloroethylene
propylene dichloride
1,2,4-trichlorobenzene
1,1,1-trichloroethane
trichloroethylene

Group 6. Alcohols, Glycols and Glycol Ethers

allyl alcohol
amyl alcohol
butyl alcohols *(iso-, n-, tert-)*
butylene glycol
corn syrup
cyclohexyl alcohol
decyl alcohols (n,iso)
dextrose solution
diacetone alcohol
diethylene glycol
diethylene glycol monobutyl ether
diethylene glycol monoethyl ether
diethylene glycol monomethyl ether
diisobutyl carbinol
dipropylene glycol
ethoxytriglycol
ethyl alcohol
2-ethylbutyl alcohol
2-ethylhexyl alcohol
ethylene glycol
ethylene glycol monobutyl ether
ethylene glycol monoethyl ether
ethylene glycol monomethyl ether
furfuryl alcohol
glycerine
hexylene glycol

10. Self-Reactivity hazard

So far our Advisory Committee under the National Academy of Sciences has evaluated the hazard potential of 209 commodities with this system. Table 1 shows the hazard ratings for some representative cargoes along with their classifications under the Dept. of Transportation (DOT) classification system.

The American Society for Testing and Materials is also working on a multiple graded hazard system. The ASTM committee, in cooperation with the Coast Guard, is attempting to develop standardized techniques for determining the hazard of individual chemicals. Toxicity and compatibility are not included in this system, however.

Another hazard evaluation is the commodity-oriented National Academy of Sciences Sulfur Study initiated as a result of the loss of the S.S. Sulphur Queen in the Gulf of Mexico in 1963. This accident made us realize that we have an inadequate understanding of the hazards and properties of commercial molten sulfur. We have asked the National Academy of Sciences to determine the types of gases evolved, and the rate of gas evolution, as a function of composition, temperature, and agitation. We are especially interested in the presence of carbon bisulfide in the gas, in determining the flammable limits of carbon bisulfide and hydrogen sulfide, and in developing a procedure for identifying commercial sulfur in terms of its gas evolution properties.

Binary chemical compatibility

The "reactivity with other chemicals" hazard is a potential source of difficulty in the evaluation process because the possible combinations of chemicals of significant commercial value is overwhelming. Much data is available, but it is voluminous, scattered, and requires evaluation. To overcome this, the Advisory Committee on Hazardous Materials is developing a chemical compatibility chart that indicates the behavior of binary chemical systems.

Chemicals are first grouped by families (aldehydes, ketones, alcohols, monomers, etc.). Specific cargoes are assigned to a family, and each family compared with every other one. There are three possible conditions for each combination; a hazardous reaction is possible, a hazardous reaction is not possible, or there is insufficient data to make a determination of the hazard potential for the reactions.

Although the NAS work is still at an early stage, the Coast Guard has prepared a chart, based, in part, on their work. Table 2 shows this chart as we are now using it for guidance—not for rigid regulation. It is intentionally conservative (all questionable combinations are included as unsafe) and we expect considerable change as we learn more. However, the changes are expected to be relaxa-

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tions based on new technical knowledge rather than additional restrictions based on casualties.

As indicated by Tables 2 and 3, the Binary Compatibility Chart can answer some very practical questions, such as the feasibility of using common piping or venting systems, but it does not indicate the nature of the hazard. The design engineer cannot tell if toxic gases are evolved, if heat is generated, or if polymerization is likely to occur. To provide a systematic technique for determining compatibility, the Coast Guard recently let a contract, through the National Academy of Sciences Hazardous Materials Committee, to develop standardized procedures for the determination of the chemical compatibility of binary systems. Various procedures are under study including computational techniques based on enthalpy, heat of solution, free energies, heat of formation, etc. Various experimental techniques are also included, to supplement computational techniques where they are impractical or inconclusive.

So far we have been talking about the properties of chemicals and the qualitative aspects of hazards. The second step in hazard evaluation is the extent of the hazard. At present, the most important use of this step is in the evaluation of commercial nuclear reactor sites. Here, the off-site damage potential of the proposed reactor must be demonstrated. This is accomplished by assuming a complete failure of all of the safety systems, leading to the worst possible accident, a core melt-down.

This is the concept of the "maximum credible accident" which is arrived at by considering only the laws of physics and chemistry. The relevant item is the greatest level of damage that can happen. The laws of statistics are ignored. No matter how improbable an accident is, if it doesn't violate the laws of physics and chemistry, it is a credible accident. There have been other studies of the maximum credible accident, such as one by the AEC in conjunction with the Price-Anderson Act. Here, a series of studies were conducted for the space program but, as far as we know, our work is the first "maximum credible accident" analysis of a private activity. This effort is being conducted in the form of projects carried on by the Bureau of Mines and the National Academy of Sciences.

The Cargo Size Limitations Panel of the National Academy of Sciences Advisory Committee on Hazardous Materials is approaching the problem by assuming the worst possible accident for a given quantity of cargo and then determining such factors as the downwind hazard of toxic and explosive vapors, the downstream spread of flammable and toxic liquids, and the radius of blast damage. The information they are supplying is a correlation between cargo size and damage areas for a given cargo.

The contract with the Bureau of Mines is sponsoring an investigation into the behavior of liquefied gases, such as nitrogen, liquefied natural gas, and chlorine, when massive amounts of them are suddenly released into the water. While their work is still far from complete, it appears that liquefied natural gas forms a lattice with the ice. This ice results from the heat of evaporation absorbed from the surrounding water by the LNG. However, a solid ice layer is not formed and vaporization rates are much higher than anticipated.

Uses of hazard evaluation

Hazard evaluation permeates all phases of the Coast Guard's hazardous materials work on both a national and international scale. For instance, the NAS Hazard Evaluation System has provided basic guidance in the development of major new U.S. regulations for bulk dangerous cargo barges (i.e., "Subchapter O") and in U.S. participation in the development of international standards through IMCO (Intergovernmental Maritime Consultative Organization). Overall ratings for a cargo are used to guide decisions on whether it has unconventional hazards and warrants special precautions in transportation. Selected ratings are used to guide detailed decisions. For instance, if the cargo has high hazard ratings for health as a poison or vapor irritant, closed gaging and venting of tanks is required for liquids. If the cargo has a high hazard rating for water pollution as a human toxicant, a double skin tank is required to minimize accidental release to the waterway.

The hazards associated with compatibility are, in the main, evolution of heat and/or gas, and the evolution of dangerous products. The Chemical Compatibility Chart, Table 2, and the Hazard Evaluation Ratings, Table 1, show which cargoes may have to be separated from each other, or from the water if a reactivity problem is present. Accordingly, a double skin tank is required where the cargo reacts dangerously with the water, and a cofferdam or void is required around cargoes that react with other cargoes. Separate and independent cargo piping and pressure relieving lines are required for tanks carrying reactive cargoes and inert padding is required for those that react with air.

The results of massive cargo spill studies mentioned earlier will provide a hazard evaluation technique for guiding decisions on ship and barge design and operation requirements. The studies are already providing a better understanding of transportation hazards.

In conclusion

Two things should be noted about any hazard evaluation system and ratings mentioned in this article. First, they are *guides* to regulatory decision making and not rigid rules. Second, and a corollary, other information is used whenever available to supplement or override ratings. Thus, there is a real distinction between the classification of hazardous materials and an evaluation of their hazards. ⚓

HANDLING OF INTERMODAL FREIGHT CONTAINERS

Containerization, generally speaking, has greatly decreased the exposure of longshoremen to the hazards of cargo suspended from cargo gear. With gantry cranes working over cellular containership holds, it is not necessary for men to physically guide and shove the cargo drafts into place as with break-bulk stowage.

Nevertheless, containerization creates some special safety problems in longshoring, especially where conventional cargo gear must be used to lift containers. This is because of the heavy weights involved and the strength limitations of the containers themselves. It is possible to break even a properly loaded container by lifting it improperly.

With the kind permission of the Swedish standards organization, Sveriges Standardiseringskommission, we print below a paper prepared by Sweden for the International Organization for Standardization (ISO) Technical Committee on intermodal containers (TC–104). It should be noted that the recommendations are still under development within the ISO and are not to be considered complete.

In the United States a related work is being drafted by the M4–5 committee of the American National Standards Institute.

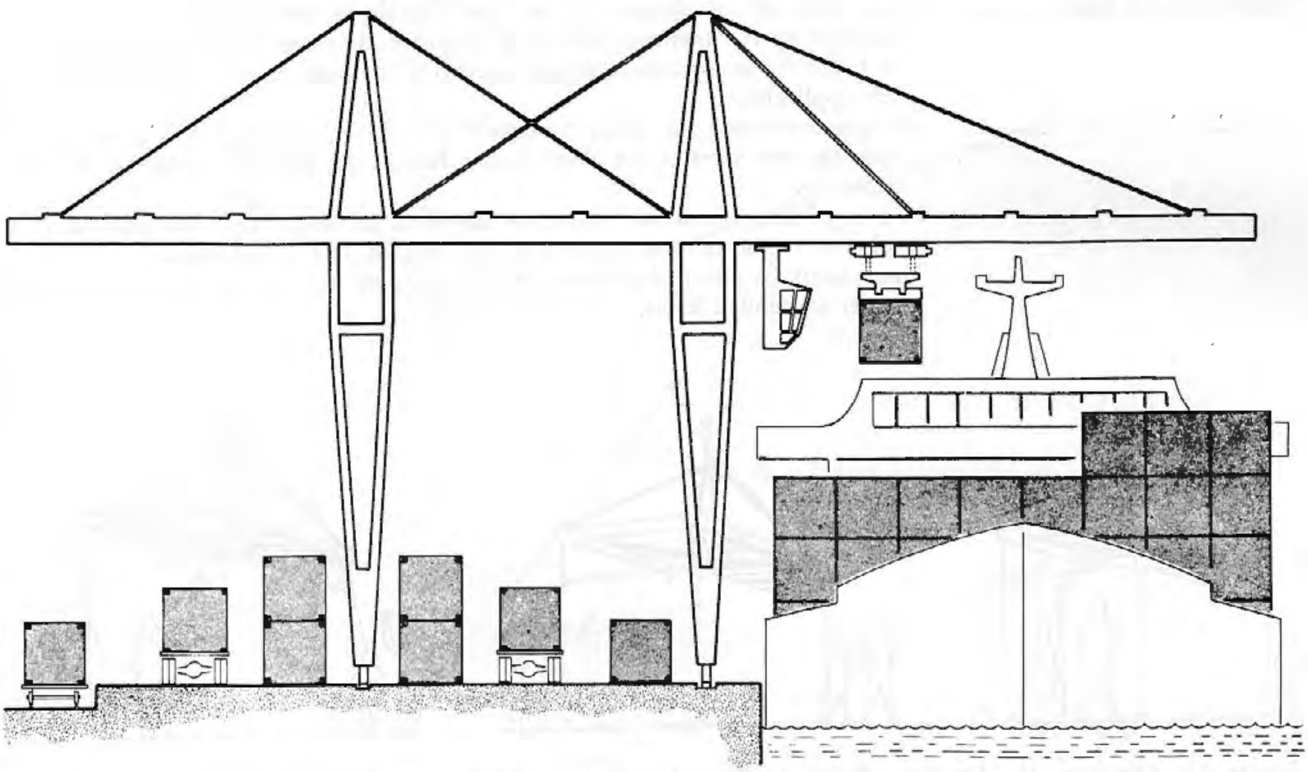


Figure 1. Principles of container handling.

Handling of freight containers

1 General

This recommendation prescribes methods of handling containers in accordance with ISO Recommendations or Draft ISO Recommendations.

The purpose of this recommendation is to set forth the basic rules that must be observed in order to avoid accidents and damages to freight containers, and other property.

1.1 Containers of standard size

Designation as in ISO/R 668	Length m	Length ft	Width m	Width ft	Height m	Height ft	Maximum gross weight[1] kg
1 A	12	40					30 480
1 B	9	30					25 400
1 C	6	20					20 320
			2, 4	8	2, 4	8	
1 D	3	10					10 160
1 E	2	7					7 110
1 F	1. 5	5					5 080

[1] By maximum gross weight is understood the tare weight plus the maximum weight of the payload.

1.2 Containers of other sizes

The recommendation is applicable to containers of other sizes provided they are constructed in accordance with the same principles as the standard containers. They are to be handled as though they were standard containers of the next largest size.

1.3 Containers of other types and container flats

Other types of containers, such as open containers, and container flats, can be handled by the methods indicated, provided they are shown by strength tests to fulfill the international requirements for standard containers as far as these are applicable.

2 Lifting by crane

All equipment used for lifting containers shall have been inspected in accordance with the directives of the Work Safety Board, the Board of Shipping or other authority.

In every lifting operation care must be taken to ensure that the equipment is suitable for the purpose and is securely attached to the container.

There must be strict observance of the accepted rule never to walk or stand under suspended loads.

Figure 2a. Attaching the lifting equipment.

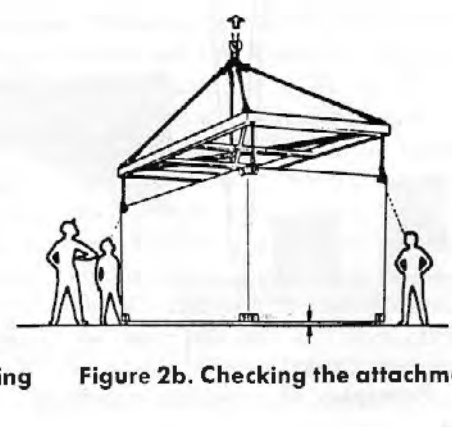


Figure 2b. Checking the attachment.

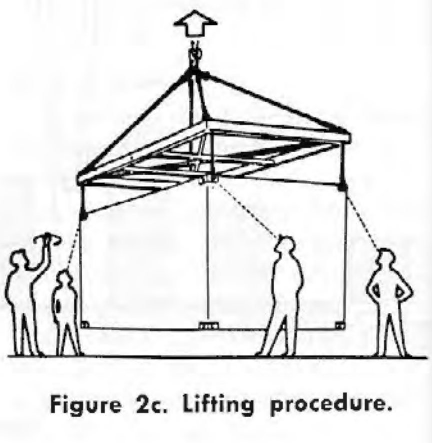
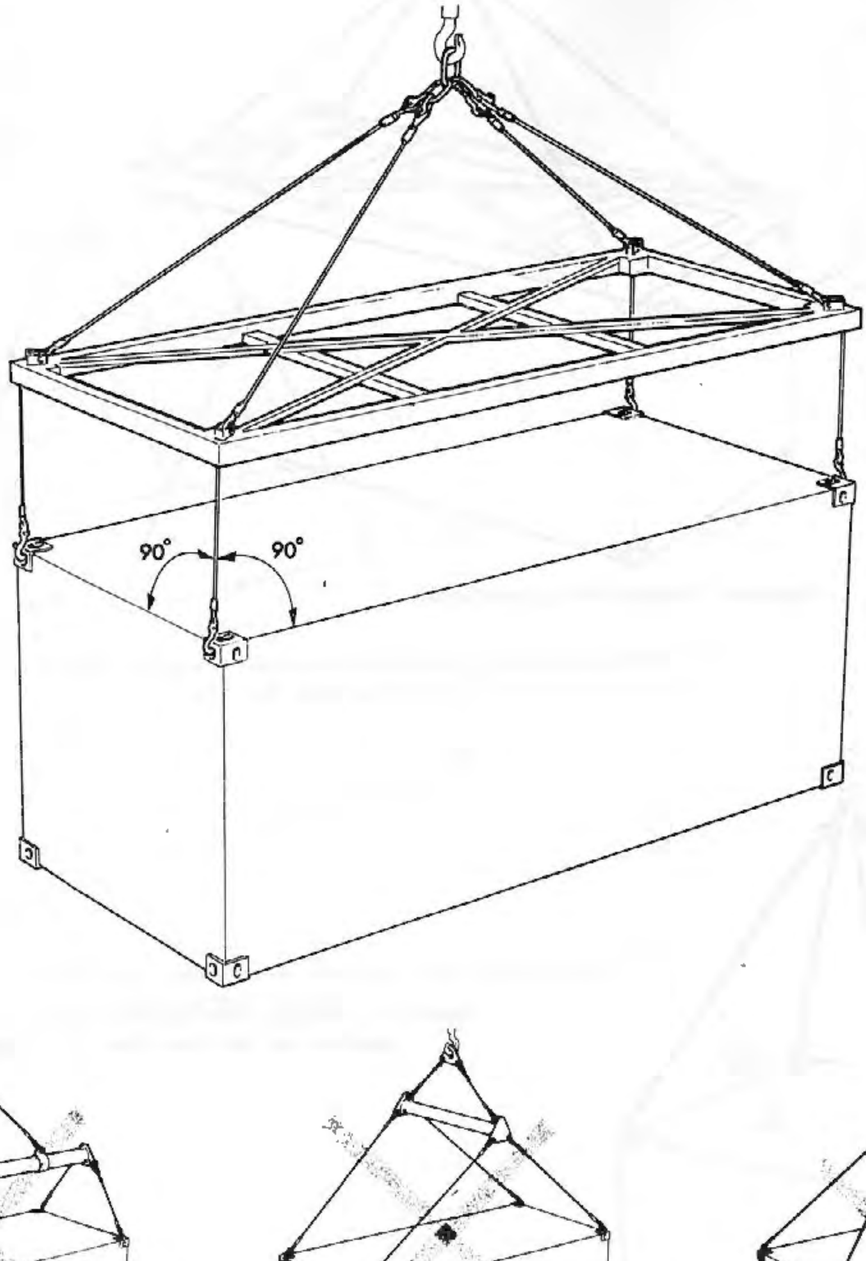


Figure 2c. Lifting procedure.

2.1 Lifting by top corners___ The top corner fittings are the only obligatory lifting points for all types of containers. The equipment should therefore be designed for lifting from these fittings, and should be attached to them.

Container sizes A, B, and C___ When lifting from the top corner fittings of containers of sizes A, B, and C, the lifting forces must always be applied vertically. See Figs. 3 and 4.



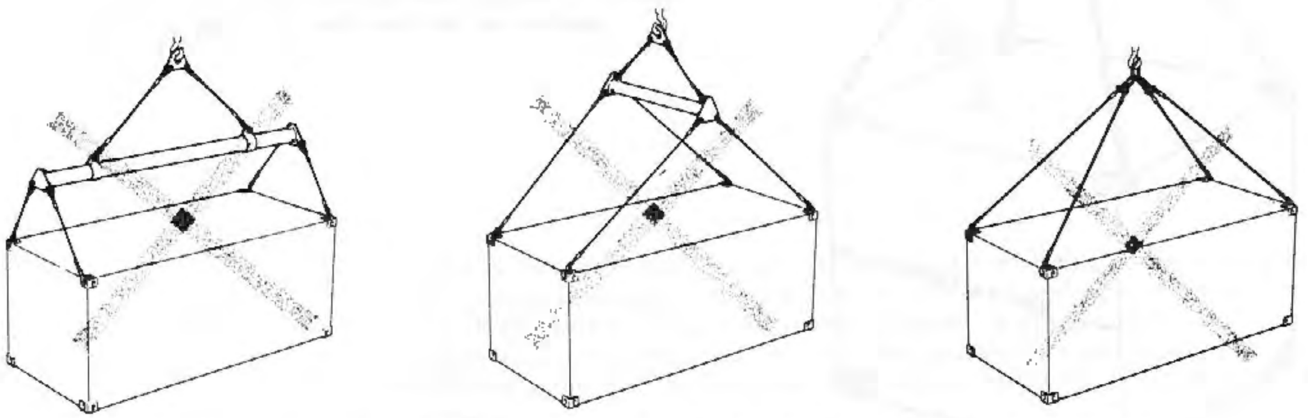


Figure 3. Only vertical lifting forces are permissible when lifting containers of sizes A, B, and C.

The equipment may be attached by hooks or shackles, provided they can be applied without causing breakage either of the corner fittings or of the equipment. See Figs. 5 and 6.

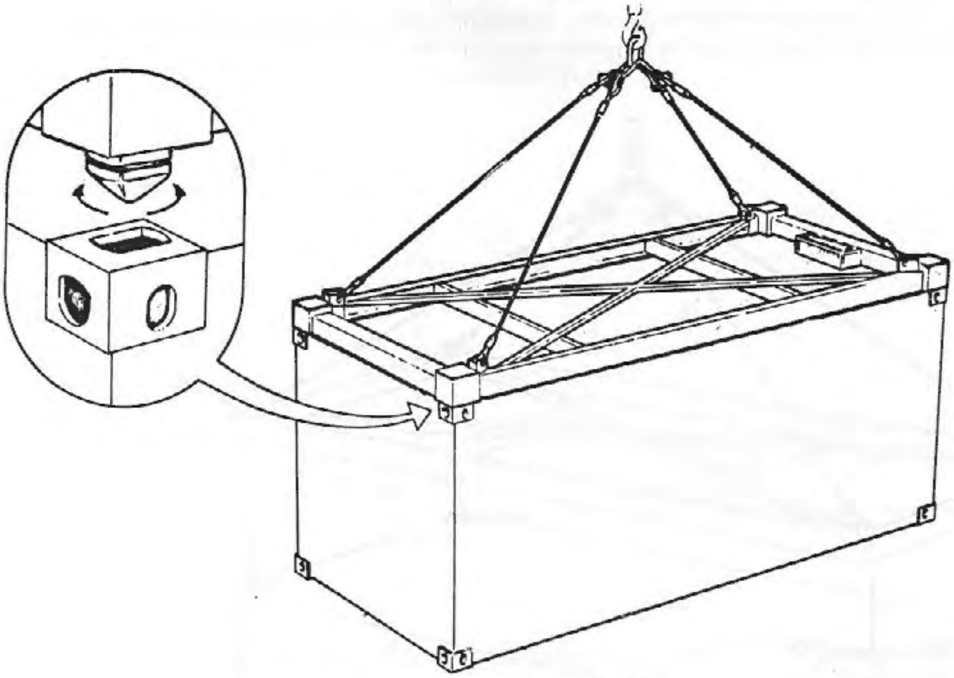


Figure 4. Vertical lift by twist locks.

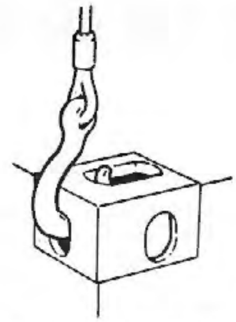


Figure 5. Hook attachment.

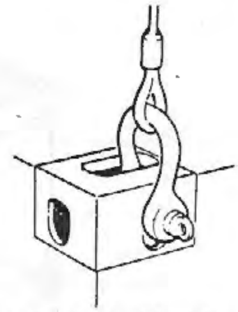


Figure 6. Shackle.

Sizes D, E, F______________ For sizes D, E, and F the lifting forces may be applied at an angle. The angle should not be less than 60° to horizontal. See Fig. 7.

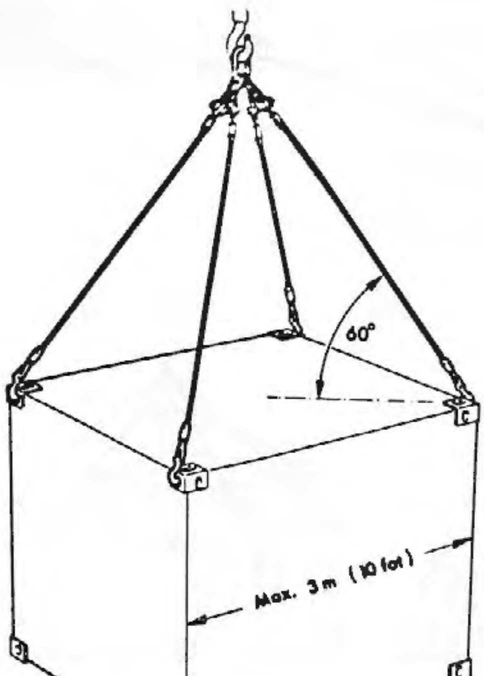


Figure 7. Lifting container of smaller type: forces applied at not less than 60° angle.

2.2 Lifting by bottom corners — If lifting by the bottom corners cannot be avoided, equipment must be used that is specially designed for the purpose. See Fig. 8.

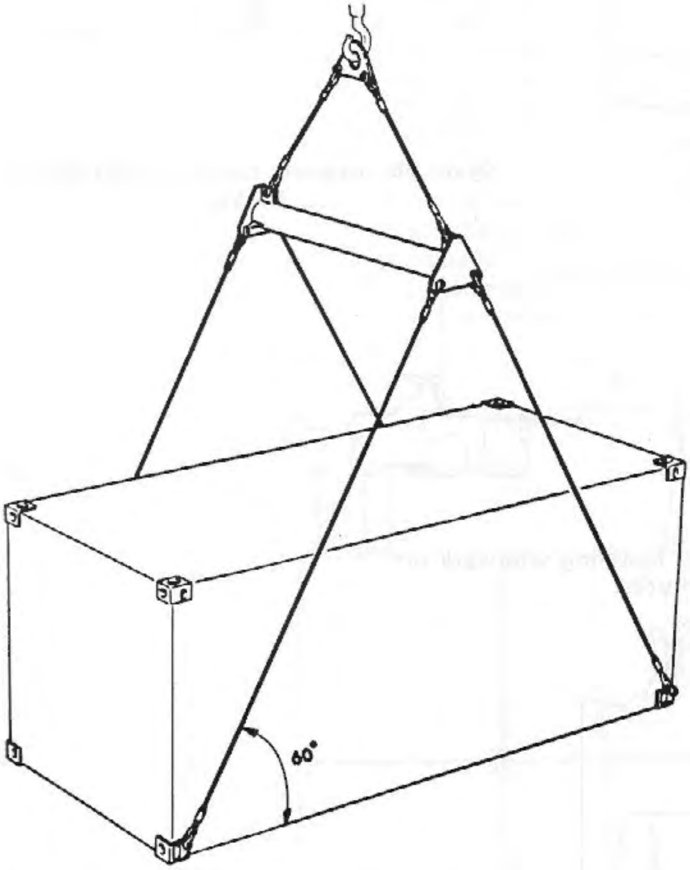


Figure 8. Lifting from bottom corners—a method that should only be used exceptionally.

2.3 Other methods of handling — Containers that are handled by any other method than lifting by the top corner fittings shall be designed for such handling and fitted with special devices such as fork lift pockets, recesses for straddle carriers, or grapple holds.

Handling shall always be carried out with the appropriate equipment.

All engaged in the handling operations shall receive instructions as to the permitted methods.

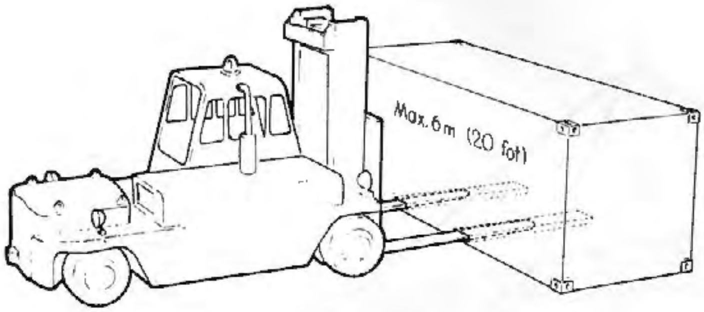


Figure 9a. Example of correct handling with fork lift trucks.

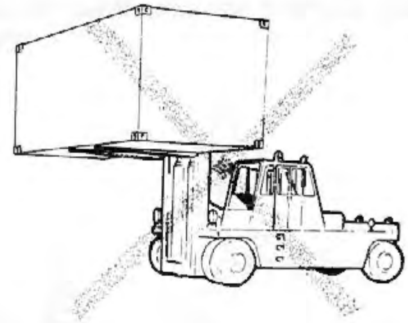


Figure 9b. Incorrect handling with fork lift trucks.

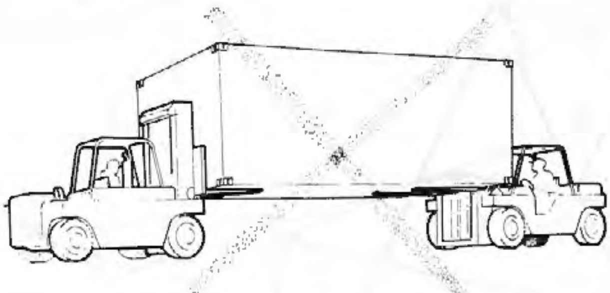


Figure 9c. Incorrect handling with fork lift trucks.

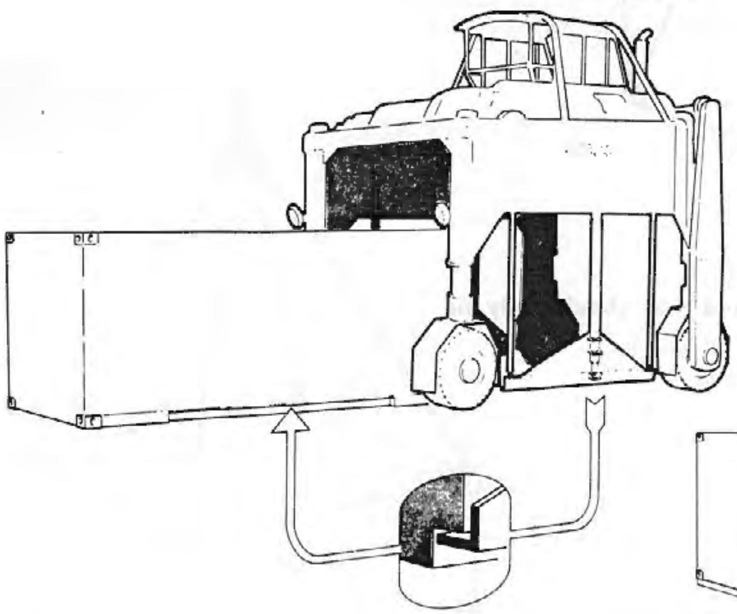


Figure 10a. Correct handling of container with straddle carrier.

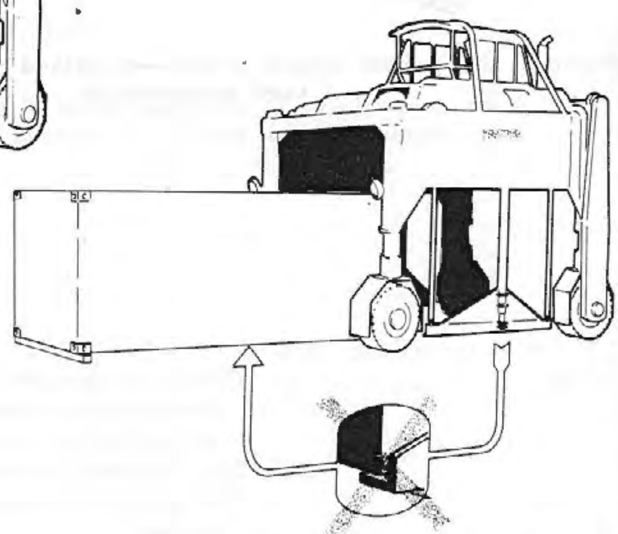


Figure 10b. Incorrect handling with straddle carrier.

3 Putting down	Containers are so designed that when put down, they rest only on their bottom corner fittings. The ground or other surface should be so level that the container can be placed on it without damage to the bottom. If it is not, packing must be laid under the corner fittings.
4 Stacking	The directions for stacking apply to assembly areas on shore. For stacking aboard ship, special directives must be worked out by the shipowners in consultation with the proper authorities. When stacking, the bottom layer of containers shall be laid horizontally, and the containers in each succeeding layer placed with their bottom corner fittings on the top corner fittings of the containers in the layer below. When stacking several containers on top of each other, caution must be observed with regard to the ground and wind conditions.
5 Working on top of containers	Workmen are not to be allowed on top of containers unless adequate precautions have been taken for their safety. Nor should they be allowed to stand near—without reason—containers on top of which work is being done. If they do, they may be struck by falling pieces of equipment or other objects.

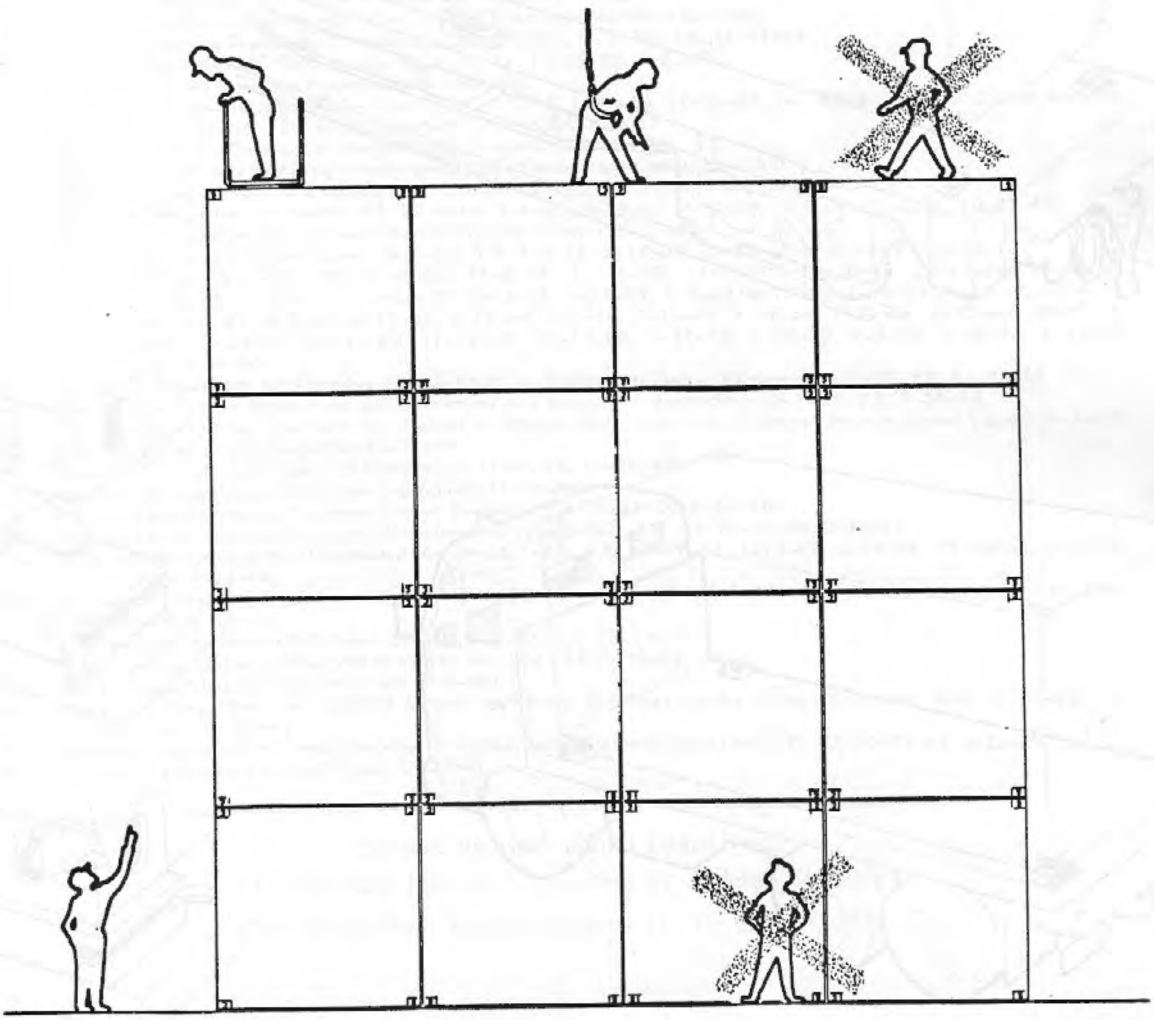


Figure 11. Workmen are not to be allowed on top of containers unless adequate precautions have been taken for their safety.

6 Making fast............ When making containers fast, either on vehicles or aboard ship, they shall be held by as many of the corner fittings as may be necessary to prevent movement.

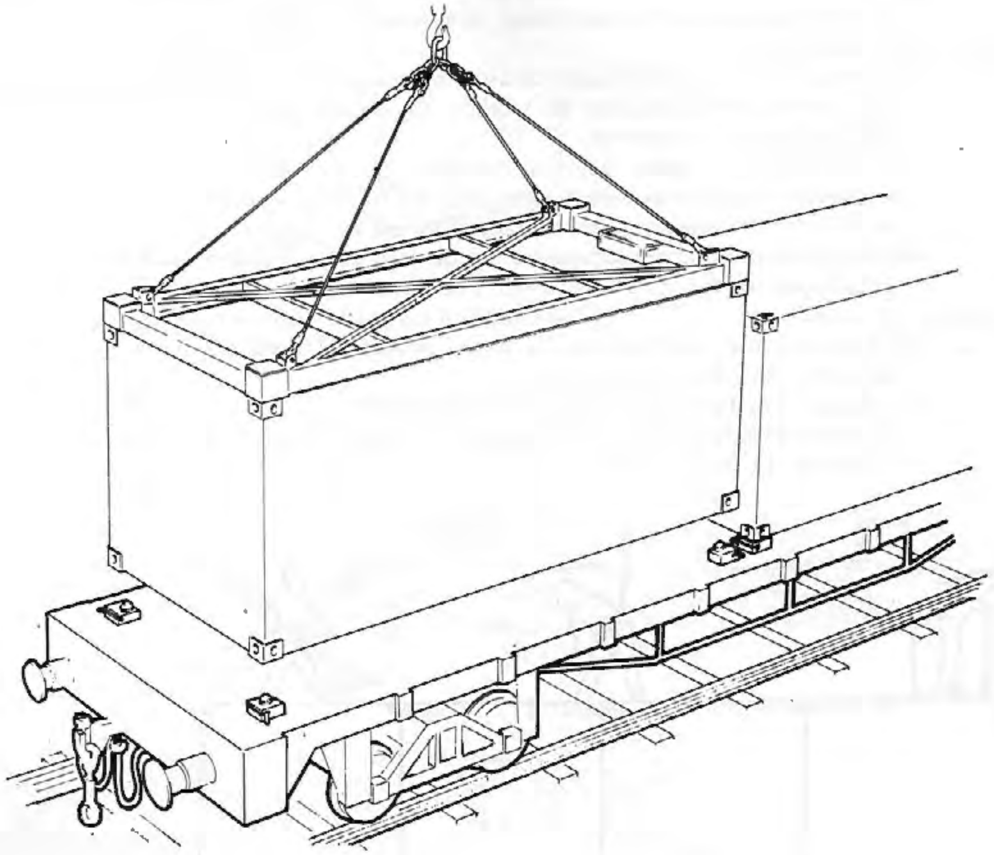


Figure 12. Example of the way containers may be made fast to a railway car.

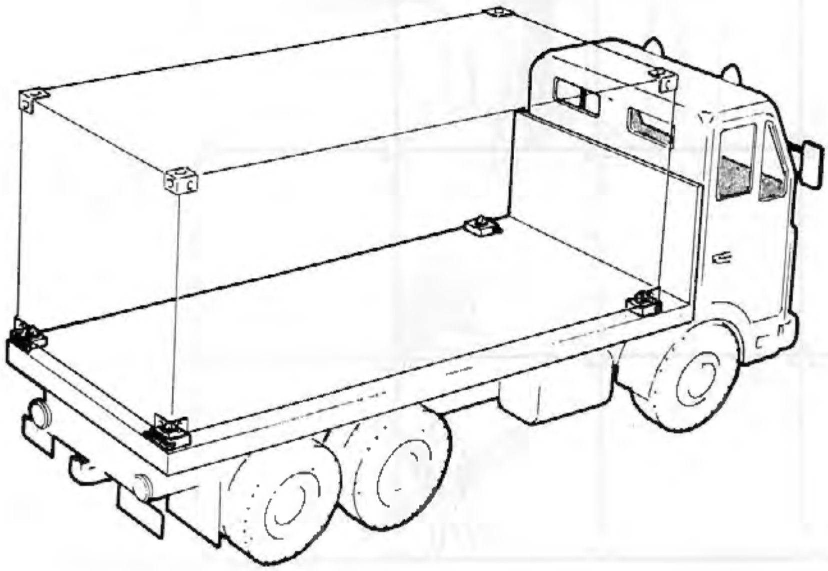


Figure 13. Method of making fast to a highway truck.

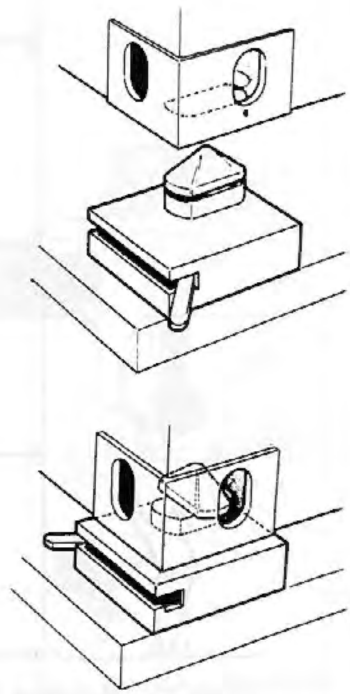


Figure 14. Locking fixtures.

MERCHANT MARINE SAFETY PUBLICATIONS

The following publications of marine safety rules and regulations may be obtained from the nearest marine inspection office of the U.S. Coast Guard. Because changes to the rules and regulations are made from time to time, these publications, between revisions, must be kept current by the individual consulting the latest applicable Federal Register. (Official changes to all Federal rules and regulations are published in the Federal Register, printed daily except Sunday, Monday, and days following holidays.) The date of each Coast Guard publication in the table below is indicated in parentheses following its title. The dates of the Federal Registers affecting each publication are noted after the date of each edition.

The Federal Register will be furnished by mail to subscribers, free of postage, for $2.50 per month or $25 per year, payable in advance. The charge for individual copies is 20 cents for each issue, or 20 cents for each group of pages as actually bound. Remit check or money order, made payable to the Superintendent of Documents, U.S. Government Printing Office. Washington, D.C. 20402. Regulations for Dangerous Cargoes, 46 CFR 146 and 147 (Subchapter N), dated January 1, 1970 are now available from the Superintendent of Documents price: $3.75.

CG No.	TITLE OF PUBLICATION
101	Specimen Examination for Merchant Marine Deck Officers (7–1–63).
108	Rules and Regulations for Military Explosives and Hazardous Munitions (5–1–68).
115	Marine Engineering Regulations and Material Specifications (3–1–66). F.R. 12–18–68.
123	Rules and Regulations for Tank Vessels (5–1–69). F.R. 10–29–69, 2–25–70.
129	Proceedings of the Merchant Marine Council (Monthly).
169	Rules of the Road—International—Inland (9–1–65). F.R. 12–8–65, 12–22–65, 2–5–66, 3–15–66, 7–30–66, 8–2–66, 9–7–66, 10–22–66, 12–23–67, 6–4–68, 10–29–69, 11–29–69.
172	Rules of the Road—Great Lakes (9–1–66). F.R. 7–4–69.
174	A Manual for the Safe Handling of Inflammable and Combustible Liquids (3–2–64).
175	Manual for Lifeboatmen, Able Seamen, and Qualified Members of Engine Department (3–1–65).
176	Load Line Regulations (1–3–66). F.R. 12–6–66, 1–6–67, 9–27–67, 7–12–68, 6–5–69, 7–26–69, 10–29–69.
182	Specimen Examinations for Merchant Marine Engineer Licenses (7–1–63).
184	Rules of the Road—Western Rivers (9–1–66). F.R. 9–7–66, 5–11–67, 12–23–67, 6–4–68, 11–29–69.
190	Equipment Lists (8–1–68). F.R. 11–7–68, 11–8–68, 11–16–68, 11–19–68, 11–20–68, 12–11–68, 12–18–68. 2–11–69, 2–18–69, 2–21–69, 2–26–69, 3–15–69, 3–27–69, 4–4–69, 4–12–69, 4–19–69, 4–25–69, 4–26–69, 4–28–69, 5–3–69, 5–9–69, 6–18–69, 6–19–69, 7–1–69, 7–15–69, 7–17–69, 9–12–69, 9–25–69, 10–10–69, 10–11–69, 10–22–69, 10–31–69, 11–19–69, 12–13–69, 1–27–70, 1–30–70, 2–3–70, 2–26–70, 3–11–70, 3–14–70, 3–25–70.
191	Rules and Regulations for Licensing and Certificating of Merchant Marine Personnel (5–1–68). F.R. 11–28–68.
200	Marine Investigation Regulations and Suspension and Revocation Proceedings (5–1–67) F.R. 3–30–68.
220	Specimen Examination Questions for Licenses as Master, Mate, and Pilot of Central Western Rivers Vessels (4–1–57).
227	Laws Governing Marine Inspection (3–1–65).
239	Security of Vessels and Waterfront Facilities (5–1–68). F.R. 10–29–69.
249	Merchant Marine Council Public Hearing Agenda (Annually).
256	Rules and Regulations for Passenger Vessels (5–1–69). F.R. 10–29–69, 2–25–70.
257	Rules and Regulations for Cargo and Miscellaneous Vessels (8–1–69). F.R. 10–29–69, 2–25–70.
258	Rules and Regulations for Uninspected Vessels (3–1–67). F.R. 12–27–67, 1–27–68, 4–12–68, 12–28–68, 3–27–69, 10–29–69, 2–25–70.
259	Electrical Engineering Regulations (3–1–67). F.R. 12–20–67, 12–27–67, 1–27–68, 4–12–68, 12–18–68, 12–28–68, 10–29–69, 2–25–70.
266	Rules and Regulations for Bulk Grain Cargoes (5–1–68). F.R. 12–4–69.
268	Rules and Regulations for Manning of Vessels (5–1–67). F.R. 4–12–68.
293	Miscellaneous Electrical Equipment List (9–3–68).
320	Rules and Regulations for Artificial Islands and Fixed Structures on the Outer Continental Shelf (11–1–68). F.R. 12–17–68, 10–29–69.
323	Rules and Regulations for Small Passenger Vessels (Under 100 Gross Tons) (7–1–69). F.R. 10–29–69, 2–25–70.
329	Fire Fighting Manual for Tank Vessels (7–1–68).

CHANGES PUBLISHED DURING MARCH 1970

The following have been modified by Federal Registers:

CG-190, Federal Register, March 11, 14, and 25, 1970.

U.S. GOVERNMENT PRINTING OFFICE: 1970


National Transportation Week
May 10-16
National Maritime Day May 22