NVIC 11-82
21 May 1982

NAVIGATION AND VESSEL INSPECTION CIRCULAR NO. 11-82
Electronic Version for Distribution Via the World Wide Web

Subj: Deck Foam Systems for Polar Solvents

1. PURPOSE. The purpose of this Circular is to provide guidance for the design and review of deck foam firefighting systems for tank vessels carrying polar solvents.

2 BACKGROUND. Regulations 46 CFR 34.20-5(b)(2) and 46 CFR 153.460 require that tank vessels which carry polar solvents be equipped with foam systems whose application rate depends upon the vessel design, the products carried, and the foam system. Polar solvents are water miscible products such as alcohol and ketones which attack regular firefighting foam. Therefore, special "polar solvent foams" have been developed for these products. These special foams are also known as "alcohol foams" and in the IMCO Chemical Code* and Part 153 of Title 46 CFR, Systems using these foams are identified as type "A" fire protection systems. Unlike regular foams that are applied at the same rate on all hydrocarbons, the application rates necessary for polar solvent foams vary with the quality and type of foam concentrate, the characteristics of the polar solvent product, the arrangement of the hazard, and the method of application. This Circular outlines two procedures for determining acceptable application rates.

*Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk, Resolution A.212, 1980 Edition incorporating amendments 1 to 9, Intergovernmental Maritime Consultative Organization,

3. DISCUSSION.

a. If a tanker carries only regular hydrocarbons (i.e. no polar solvents), a foam system with a nominal foam application rate of 0.16 gallons per minute per square foot of protected area is adequate. The rates for designing such a shipboard system are contained in 46 CFR 34.20-5(b)(1) and 34.20-25 and are summarized in enclosure (1) of this Circular. Unfortunately different polar solvent products require different minimum foam application rates as a basis for design. Two alternatives are now being used by the Coast Guard to evaluate flow rates of foam systems protecting polar solvent products.

(1) Method 1. This method involves either restriction of the products carried or their locations aboard a vessel. Vessels using this method are considered to be dedicated (i.e. restricted) to the carriage of specific cargos and the Certificate of Inspection is endorsed to limit the vessel or a portion of the vessel based upon the capacity of the polar solvent foam system. As part of the Coast Guard polar solvent foam system approval procedure, foams are tested on various polar solvents to determine the minimum application rate for each product. Foam manufacturer's design manuals are now being approved with appendices listing minimum application rates for specific products. Enclosure (4) illustrates an example in which a manufacturer has grouped products into three appendices each requiring a different minimum application rate with his foam. Calculations similar to those used for regular hydrocarbons have been developed and are shown in enclosure (2). Since the IMCO Chemical Code allows alternative designs for "ships which

are dedicated to the carriage of specific cargos", chemical carriers can take advantage of the lower foam rates using this method and still be issued a Certificate of Fitness. Enclosure (5) is an example in which this method results in a lower foam rate.

(2) Method 2. This method is described in the ninth set of amendments to the IMCO Chemical Code. Method 2 is acceptable for tankers that carry polar solvent products as well as for tankers that carry polar solvent chemicals. Except for systems installed prior to 1975 which used less efficient foam concentrates, no cargo or loading restrictions related to the foam system are necessary for vessels with foam systems meeting these rates. The application rates are summarized in enclosure (3).

b. If the dedicated cargo calculations, Method 1, are used, the tanker's Certificate of Inspection is endorsed to reflect the limitations imposed because of the foam system.. To avoid a duplicate listing of all possible cargos on the certificate, the foam manufacturer's design manual may be cited and copies of the appropriate pages kept aboard. Typical certificate entries are:

(1) "Because of the foam system design, this vessel is dedicated to the polar solvents listed in Appendices A and B of XYZ Foam Co. approved Design Manual 00. Other flammable and combustible polar solvents shall not be carried".

(2) "For the purpose of the polar solvent foam system, the vessel is dedicated to the cargos listed in Appendices A, B and C of XYZ Foam Co. Design Manual 00 as follows:

Appendix A cargos: all tanks.
Appendix B cargos: wing tanks only
Appendix C cargos: number 1 port and starboard only".

c. If a shipper wishes to add new polar solvent cargos, the foam system manufacturer's lists may be expanded by contacting the manufacturer directly and submitting samples for testing. The foam system manufacturer then makes the appropriate submittal to the Coast Guard and after verification the Coast Guard approves the revised lists. The Certificate of Inspection may have to be revised in some cases.

d. After the designer determines the foam system application rate using one of the above methods) he should refer to 46 CFR 34.20 for additional foam system design requirements. 46 CFR 153.460 and section 3.14 of the IMCO Chemical Code should also be consulted for additional requirements for chemical carriers which are to be issued a Certificate of Fitness.

4. ACTION. New polar solvent foam systems are acceptable under 46 CFR 34.20 and 46 CFR 153.460 if designed to supply foam solution at either of the rates determined from the criteria in paragraph 3.a. of this Circular. There is no need to recalculate previously approved foam installations. However owner/operators may do so if recalculation would be to their advantage. Recalculations should be resubmitted through the foam system manufacturer.

CLYDE J. LUSK, JR.
Chief, Office of Merchant Marine Safety

Encl: (1) Calculation of Regular Foam Systems
(2) Calculation of Polar Solvent Foam systems Dedicated to Listed Cargos method 1)
(3) Calculation of Polar Solvent Foam Systems Using Method Z'
(4) Typical Appendix Lists from Foam System Approval
(5) Example Foam Rate Calculation

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List CG-12, ZTC-68

Calculation of Regular (Non-polar) Foam Systems
(Nominal recommended application
rate 0.16 gpm/sq ft of protected area)

The foam solution rate is the greater of:

(1) 0.0l6 gpm/sq ft x cargo area (sq ft)

or

(2) 0.24 gpm/sq ft x largest tank area (sq ft)

or

(3) 0.073 gpm/sq ft x area protected by largest monitor (sq ft)

Calculation of Polar Solvent Foam Systems
Dedicated to Listed Cargos (Method 1)
(Application rates are specified in foam
system manufacturer's approved design manual)

The foam solution rate is the greater of:

1. Highest foam rate[1] for vessel (gpm/sq ft) x 0.1 x cargo area (sq ft)

or

2. Highest foam rate[1] for either tank of each pair (gpm/sq ft) x area of each adjacent pair (sq ft)[2]

Exception: If both tanks in a pair are dedicated to non-polar cargos, use 0.24 gpm/sq ft x largest tank area (sq ft)

or

3. Highest foam rate[1] for area protected by monitor (gpm/sq ft) x 0.45 x area protected by monitor (sq ft)

[1] Consult the foam system manufacturer's design manual to find the rates for all cargos intended to be carried. Typical rates are 0.16, 0.20, 0.25 and 0.30 gpm/sq ft. Depending upon the restrictions for the vessel, the highest foam rate may be different for each of the three calculations. The first calculation is based upon the worst (most difficult to extinguish) cargo that the vessel is authorized to carry. The second calculation, which must be repeated for every pair of adjacent tanks on the vessel to determine the greatest solution rate, is based upon the worst cargo that can be carried in either of the two tanks being considered. The third calculation is based upon the worst cargo within the area protected by a particular monitor. The flow rate determined by calculations 1 and 2 must be available at any foam station, i.e. monitor and associated hose outlets, on the vessel.

[2] It is assumed that an opening may occur along any common tank boundary, allowing the cargo to enter both tanks. Diagonally adjacent tanks are not included in this calculation.

Calculation of Polar Solvent Foam Systems Using Method 2*
(When this method is used cargos carried are not limited by the foam system**)

The foam solution rate is the greater of:

ENGLISH	METRIC
(1) 0.05 gpm per sq ft of cargo area	2 liters/minute per square meter of cargo area
or	or
(2) 0.50 gpm per sq ft of largest tank area	20 liters/minute per square meter of largest tank area
or	or
(3) 0.25 gpm per sq ft of area protected by the largest monitor but not less than 330 gpm	10 liters/minute per square meter of area protected by the largest monitor but not less than 1250 liters/minute

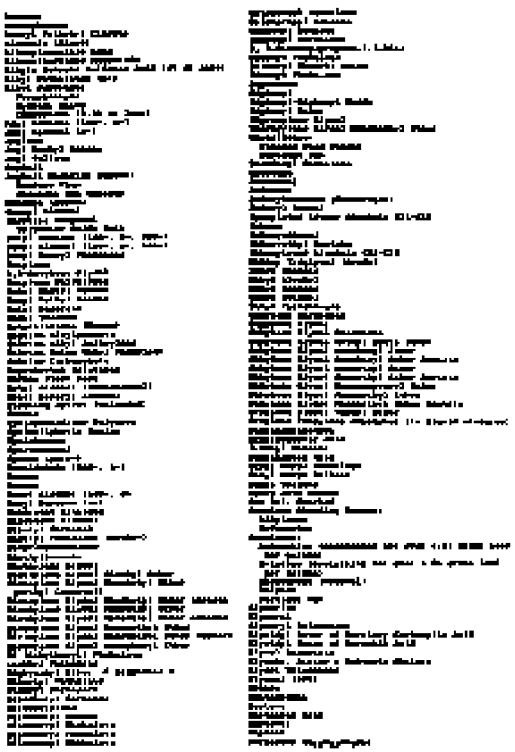
*These rates are derived from the IMCO Chemical Code but are suitable for cargos regulated under Subchapter D as well as Subchapter O.

**These rates may not be used to recalculate existing systems installed prior to 1975 which used less efficient foam concentrates.

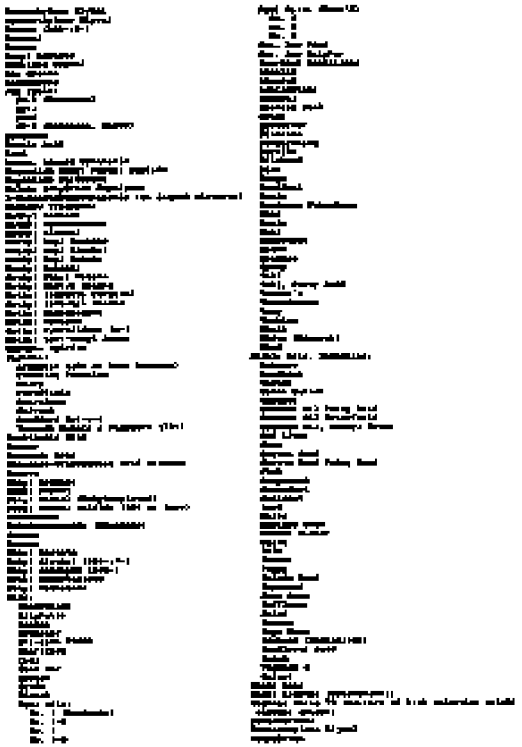
Sample of Appendices from XYZ Foam Co. Design Manual

APPENDIX A

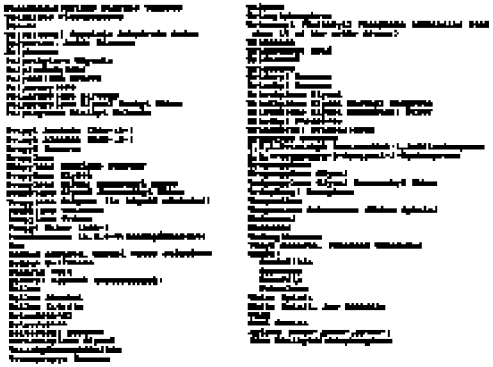
Products Requiring
0.16gpm/sq ft



Products Requiring
0.16gpm/sq ft (continued)



Products Requiring
0.16gpm/sq ft (continued)



COAST GUARD APPROVAL NUMBER
IS STAMPED ON ALL APPROVED
LISTS

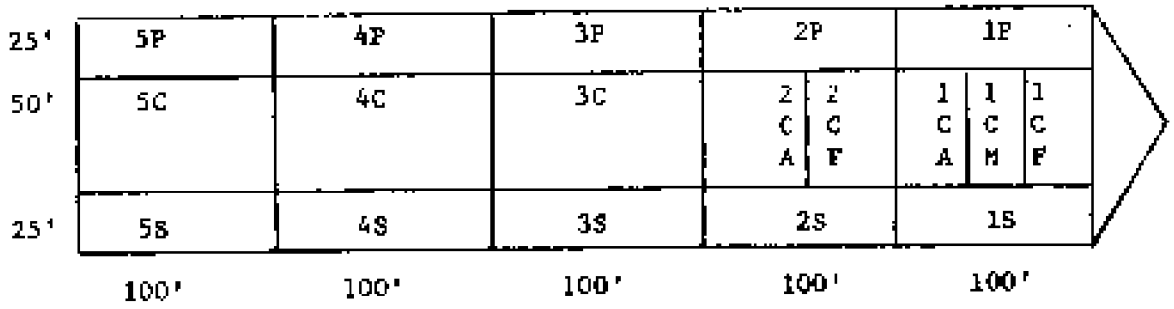
APPENDIX B

Products requiring 0.20gpm/sq ft

APPENDIX C

Products requiring 0.25gpm/sq ft

EXAMPLE: The operator of the Subchapter D tanker shown below expects to normally carry cargo which is on XYZ Foam Company's Appendix A list but in a worst case might have to carry a mix of cargo from each of the lists in Appendices A, B and C. The existing foam system pumps have a maximum capacity of 1600 gpm. Can an acceptable foam system be designed without increasing the size of the foam pump and driver?



Tank Area(sq ft)	
1 CF and CA 1 CM 1 P or S	1650 1700 2500
2 CF or CA 2 P or S	2500 2500
3 C 3 P or S	5000 2500
4 C 4 P or S	5000 2500
5 C 5 P or S	5000 2500

Total Cargo Area = 50,000 sq ft

Each Monitor Area is 10,000 sq ft
if 5 equally spaced monitors are installed

XYZ Foam Co minimum rates
from design manual

Appendix A Cargos, 0.16 gpm/sq ft
Appendix B Cargos, 0.20 gpm/sq ft
Appendix C Cargos, 0.25 gpm/sq ft

SOLUTION: First consider the rates from Method 2 because there are no limitations on cargos carried when the foam system is designed using this method. Refer to enclosure (3) for calculation procedure.

Deck Area

0.05 gpm/sq ft x 50,000 sq ft = 2500 gpm

Tank Area

0.50 gpm/sq ft x 5,000 sq ft = 2500 gpm

Monitor Area (assuming 5 monitors)

0.25 gpm/sq ft x 10,000 sq ft = 2500 gpm

The minimum foam system flow rate using this method is 2500 gpm, which exceeds the available pump capacity. Therefore) the system must be reexamined using method 1, the "dedicated" cargo method, which is described in enclosure (2). Assume that Appendix B cargos are limited to the wing tanks and tanks 1 and 2 and that Appendix C cargos are limited to tanks 1 and 2. (This assumptions was developed after several calculations showed that the rates for Appendix B and C cargos were excessive and that they must be restricted to smaller tanks.)

Deck Area

0.25 gpm/sq ft x 0.1 x 50,000 sq ft = 1250 gpm

Tank Area

Calculate for every adjacent tank pair. Several examples are listed below:

4C and 5C: 0.l6 gpm/sq ft x (5000 + 5000) sq ft = Using exception: 0.24 gpm/sq ft x 5000 sq ft = 1200 gpm

3P and 3C: 0.20 gpm/sq ft x (2500 + 5000) sq ft = 1500 gpm

lP and 2P: 0.25 gpm/sq ft x (2500 + 2500) sq ft =1250 gpm

2CA and 3C: 0.25 gpm/sq ft x (2500 + 5000) sq ft = 1875 gpm (exceeds l600 gpm)

2CA and 3C: 0.20 gpm/sq ft x (2500 +.5000) sq ft = l875 gpm

Monitor Area:

0.25 gpm/sq ft x 0.45 10,000 sq ft = 1125 gpm

ANSWER:

Yes. Using the assumed loading, the required flow rate would be 1875 gpm. By excluding Appendix C cargos from tank 2CA, however, the 1600 gpm pump would be adequate and the operator's objectives would be met. (Note that the pump capacity could be further reduced to 1600 gpm by limiting center tanks 3, 4, and 5 to non-polar cargos.)

A Certificate of Inspection entry might read:

"Because of the polar solvent foam system design, this vessel is dedicated to the cargos listed in Appendices A, B and C of XYZ Foam Co. Design Manual 00 as follows:

Appendix A Cargos: All tanks
Appendix B Cargos: All wing tanks and tanks 1 and 2 across
Appendix C Cargos: Tanks I and 2 except tank 2CA"

If this was a chemical carrier, the authorized cargos and their locations would be indicated elsewhere on the certificate.