



NAVAL RESEARCH LABORATORY

WASHINGTON, D.C. 20375

IN REPLY REFER TO:

6180-289:HBP:gs
NRL Prob. C05-19

1 Jul 75

From: Director, Naval Research Laboratory, Washington, D. C. 20375
To: Commander, Naval Ship Engineering Center (6101F)
Subj: New draft on Proposed Revision of AFFF Specification MIL-F-24385;
forwarding of

Ref: (a) NRL ltr 6180-313:HBP:bh of 16 Aug 1974

Encl: (1) 1 June 1975 draft of Proposed Revision of MIL-F-24385

1. Additional work done on AFFF materials subsequent to the results contained in reference (a) has led to the preparation of another draft of the subject revision. It is forwarded herewith as enclosure (1) for action toward adoption.

D. E. Fagan

Copy to (w/1 copy encl (1)):
NAVSEC 6154F (Mr. R. B. McCann)
NAVMAT 00F (Mr. L. Duhrkoop)

1 June Draft of Proposed Revision

of MIL-F-24385

1. Several drafts of a revision to the AFFF Specification, MIL-F-24385, have been prepared. The most recent one, dated 4 August 1974, resulted from action by a conference of all concerned Navy personnel convened at NRL on 2 August. No action has been taken toward implementation or coordination of the 4 August document which was prepared by NRL.
2. In the time since the issuance of the 4 August draft, qualification tests have been completed on AFFF from a third manufacturing source, The Ansul Co. A number of additional tests were conducted on the Ansul material not required for current qualification in order to observe its performance under the proposed revised specification. These tests were discontinued after it became apparent that the concentrate would not conform to current requirements and a reformulation would be likely. The costs of these tests were not borne by the manufacturer but by existing R&D funds.
3. A new draft of the revision, dated 1 June 1975, is appended to the report as Appendix A. The latest changes made subsequent to the 4 August draft have been denoted by left-hand margin marking.
4. One of the major changes is the introduction of a minimum value for the refractive index of the concentrate in paragraph 3.3. In the 4 August version only a reporting on refractive index and maximum deviation in production lots were required. This change first became desirable during the tests of the Ansul product when it was found that its refractive index was 1.3451. This low value is too close to that of water to permit solution concentration analysis with the hand refractometer. Requiring a minimum refractive index of 1.3590 will enable continued use of the refractometer for operational checks on shipboard proportioners.
5. The second major change is the introduction of requirements related to the environmental impact of AFFF, paragraph 3.1.6. Limits on toxicity toward marine life, Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), and biodegradability are set forth. This section of the specification should be referred to NAVSEC, Code 6159, for comment and suggestions. The limits essentially describe the product most desirable from an environmental standpoint (FC-206) and will ensure that future materials will at least be no worse.
6. Appendix B is a tabulation of the proposed specification requirements and the test results on the three presently qualified products (3M's FC-200, FC-206 and National Foam's Aer-o-water 6) plus the Ansul product. The FC-206 exhibited the best performance and the requirements originally proposed in the 2 August 1974 draft were built around these values. As a result of the 4 August 1974 conference with the representatives of NAVMAT,

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NAVSEC, NAVSEA and NRL, some of the performance levels in the proposed specification were lowered to more nearly accommodate the other existing QPL products. A review of the test results in Appendix B will show that some areas of non-conformance or marginal conformance still exist. It is believed that the recent changes National Foam has made in their product line would enable them to meet the requirements of the 1 June 1975 draft. The Ansul Co. material does not meet the current requirements and will have to be reformulated to meet any specification.

7. Although it would be desirable to maintain at least two manufacturers on the QPL from a purely economic point of view, it must be remembered that the basic objective is to extinguish fires in the most expeditious manner possible. If the proposed requirements are lowered to meet the minimum performing product, it can be certain that the manufacturer of the best product will cut back his performance in order to place himself in the best competitive position price-wise. Such a step, of course, would not be to the best interest of Navy field activities and other users.

8. In the data on compatibility between mixed products plotted in Appendix B, the points within or beyond the shaded areas indicate non-conformance with the proposed requirements of Appendix A. In some instances it will be seen that the precipitation values in premix sea water solution exceed the allowable 0.05%. This is attributed to the precipitation which results from mixing the sea salt mixture. The procedure has now been revised to require filtration of the synthetic sea water before the samples are prepared and this should bring all samples to the minimum or below.

9. It is recommended that Appendix A coordination be initiated at an early date with industry and other concerned services, as a preliminary step to final adoption of the revision and before any new products are submitted. NRL is prepared to discuss the test procedures and the test results on the individual products with their manufacturer.

A handwritten signature in black ink, appearing to read "H. B. Peterson", with a large, stylized initial "H" and "P".

H. B. PETERSON, Head
Fire Suppression Section
Chemical Dynamics Branch
Chemistry Division

MIL-F-24385A (NAVY)

SUPERSEDING
MIL-F-24385 (NAVY)
21 Nov. 69

with Amendment 8
20 June 74

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MILITARY SPECIFICATION
FIRE EXTINGUISHING AGENT, AQUEOUS FILM FORMING
FOAM (AFFF) LIQUID CONCENTRATE, SIX PERCENT,
FOR FRESH AND SEA WATER

This specification has been concurred in by interested commands of the Navy Department and the Marine Corps.

1. SCOPE

1.1 This specification covers the requirements for aqueous film forming foam (AFFF) liquid concentrate fire extinguishing agent, consisting of fluorocarbon surfactants and foam stabilizers. The liquid concentrate will be diluted for use in concentrations of six parts concentrate to ninety-four parts fresh or sea water by volume.

2. APPLICABLE DOCUMENTS

2.1 The following documents, of the issue in effect on date of invitation for bids or request for proposal, form a part of the specification to the extent specified herein:

SPECIFICATIONS

FEDERAL

TT-E-489 - Enamel, Alkyd, Gloss (For Exterior and Interior Surfaces).

"PPP-C-1337 - Containers, Metal, With Polyethylene Inserts."

VV-G-76 - Gasoline, automotive

O-D-1407 - Dry Chemical, Fire Extinguishing, Potassium Bicarbonate

RR-S-366 - Sieve, test

MILITARY

MIL-P-116 - Preservation, Methods of.

MIL-G-5572 - Gasoline, Aviation, Grades 80/87, 100/130, 115/145.

STANDARDS

FEDERAL

FED-STD-595 - Colors.

MILITARY

MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes.

MIL-STD-129 - Marking for Shipment and Storage.

MIL-STD-130 - Identification Marking of U.S. Military Property.

MIL-STD-147 - Palletized and Containerized Unit Loads, 40" x 48" Pallets, Skids, Runners, or Pallet-Type Base.

(Copies of specifications, standards, drawings, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

AMERICAN SOCIETY FOR TESTING AND MATERIALS

ASTM A279-63 - Total Immersion Corrosion Test of Stainless Steels.

ASTM D445-65 - Test for Viscosity of Transparent and Opaque Liquids (Kinematic Viscosities).

ASTM D1141-52 (1965) - Substitute Ocean Water, Specification for.

ASTM D1298-67 - Test for Specific Gravity of Petroleum Liquids, Hydrometer Method.

ASTM D1331-56 - Tests for Surface and Interfacial Tension of Solutions of Surface Active Agents.

ASTM D 96 Test for Water and Sediment in Crude Oils

"ASTM D1821-63 - Inorganic Chlorides in Asphalts, Test for."

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(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.)

(Technical society and technical association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal agencies.)

UNIFORM CLASSIFICATION COMMITTEE

Uniform Freight Classification Rules

(Application for copies should be addressed to the Uniform Classification Committee, 202 Union Station, 516 West Jackson Blvd., Chicago, Illinois 60606.)

NATIONAL CLASSIFICATION BOARD

National Motor Freight Classification Rules.

(Application for copies should be addressed to National Motor Freight Traffic Association, Inc., 1616 P Street, N.W., Washington, D.C. 20036.)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA No. 412 - Suggested Standard Test Procedures for Aircraft Rescue and Fire Fighting Vehicles Utilizing Foam (1969 Edition)

(Application for copies should be addressed to National Fire Protection Association, 60 Batterymarch Street, Boston, Mass. 02110).

"DEPARTMENT OF TRANSPORTATION

"49 CFR 171-1790 - Department of Transportation Rules and Regulations for Transportation of Explosives and Other Dangerous Articles.

"(Application for copies should be addressed to the United States of America Standards Institute, 10 East 40th Street, New York, New York 10016.)"

Standard Methods for the Examination of Water and Waste Water, 13th ed., 1971

3. REQUIREMENTS

3.1 Qualification. Liquid concentrate fire extinguishing agents furnished under this specification shall be products which are qualified for listing on the applicable Qualified Products List at the time set for opening of bids (see 4.3 and 6.3).

3.2 Material. The concentrate shall consist of fluorocarbon surfactants plus other compounds as required to conform to the requirements specified hereinafter. The material shall have no adverse effect on the health of personnel when used for its intended purpose.

3.3 Refractive index. The concentrate shall have a minimum refractive index of 1.3590 when determined as specified in 4.7.1.

3.4 Viscosity. The concentrate shall have a maximum viscosity of 25 centistokes (cs) at $40 \pm 0.1^\circ\text{F}$ and a minimum of $2.0 \text{ at } 77 \pm 0.1^\circ\text{F}$ when tested as specified in 4.7.2.

3.5 pH Value. The concentrate shall have a pH value between 7.0 and 8.5 at $77 \pm 0.1^\circ\text{F}$ when tested as specified in 4.7.3.

3.6 Spreading coefficient. A ^{6% distilled} fresh water solution shall have a minimum spreading coefficient of ~~plus 3 (+3)~~ ^{+3.00} when tested as specified in 4.7.4.

3.7 Foamability. 6% solutions (by volume) of fresh water and sea water shall produce foams with a minimum expansion of 6.0 and a 25% drainage time of 2.5 minutes when tested as specified in 4.7.5.

3.8 Film formation and sealability. A film produced by a foam shall spread over the surface of the fuel and prevent sustained burning of fuel vapors when tested as specified in 4.7.6.

3.9 Fire performance.

3.9.1 General. There shall be 3 sizes of fire tests based on the extent of the fueled areas: 28, 50, and 1260 square feet. Extinguishment shall be by application of foams generated from 3, 6, and 50% solutions prepared from the concentrate and fresh and/or sea water.

3.9.2 28 square-foot test. A minimum of one fire each with fresh water and sea water shall be conducted with concentrations of 3 and 6% and a minimum of one fire with sea water shall be conducted with a concentration of 50% as specified in 4.7.7.

3.9.2.1 3% solutions. The fire shall be extinguished with an application time of ~~60~~ ⁶⁵ seconds and shall exhibit a burnback time of at least ~~30~~ ²⁴⁰ seconds. |

3.9.2.2 6% solutions. The fire shall be extinguished within an application time of 45 seconds and shall exhibit a burnback time of at least 320 seconds. |

3.9.2.3 50% solutions. The fire shall be extinguished within an application time of 55 seconds and shall exhibit a burnback time of at least ~~100~~ ¹⁰⁰ seconds. |

3.9.3 50 square-foot test. This test is used only for quality conformance purposes. A minimum of one fire with a 6% sea water solution is required for each lot under test. When tested as specified in 4.7.8, at least 85% of the fire shall be extinguished within an application time of 40 seconds, the summation of the "percent of fire area extinguished" values at 10, 20, 30, and 40 seconds shall be a minimum of ~~325~~ ²²⁵, and the burnback time shall be at least 240 seconds.

3.9.4 1260 square-foot test. A minimum of one fire each with fresh water and sea water shall be conducted with concentrations of ~~3 and~~ 6% and a minimum of one fire with sea water shall be conducted with a concentration of 50% as specified in 4.7.9. The two criteria used in this test are: the time required to extinguish 85% of the fire area and the summation of the percentages of fire area extinguished after 10, 20, 30, and 40 seconds of foam application. ³⁴

3.9.4.1 3% solutions. The 85% extinguished time shall not exceed 40 seconds. The summation of percentages shall be a minimum of 285. |

3.9.4.2 6% solutions. The 85% extinguished time shall not exceed 30 seconds. The summation of percentages shall be a minimum of 285. |

3.9.4.3 50% solution. The 85% extinguished time shall not exceed 55 seconds. The summation of percentages shall be a minimum of 225. |

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3.10 General corrosion. When tested in accordance with 4.7.10 the corrosion rates shall not exceed 5.0 milli-inches per year (mpy) for cold rolled steel; 3.0 mpy for 90-10 copper-nickel; 1.5 mpy for monel and 300 milligrams for 905 bronze.

3.11 Localized corrosion. When tested in accordance with 4.7.11 the CEES 304 specimens shall show no evidence of pitting.

3.12 Stability. The concentrate, ^{6%} fresh water premix solution, and ^{6%} sea water premix solution shall be tested after ^{150°F} ~~high temperature~~ storage as specified in 4.7.12.

3.12.1 Stratification. The samples shall show no stratification when tested as specified in 4.7.12.1.

3.12.2 Precipitation. The amount of precipitation in the concentrate and fresh water solution shall not exceed 6.05% and the sea water solution 0.2% by volume when tested as specified in 4.7.12.2.

3.12.3 Spreading Coefficient. A ^{6%} solution prepared from the aged concentrate, and both aged premix solutions shall have a minimum spreading coefficient of 3.00 when tested as specified in 4.7.12.3.

3.12.4 Foamability. The aged premix solutions and freshly prepared solutions from aged concentrate shall meet the requirements for foamability as stated in 3.7.

(Exp > 6, DT > 2.5)
3.12.5 Film formation and sealability. The aged premix solutions and freshly prepared solutions from aged concentrate shall meet the requirements for film formation and sealability as stated in 3.8.

3.12.6 Fire performance. The aged premix solutions shall meet the requirements of 3.9.2.2. Freshly prepared ^{6%} 3% fresh water and sea water solutions from aged concentrate shall meet the requirements of 3.9.2.1. ($L_x < 65$, $L_b > 240$)

3.13 Total halides. When tested in accordance with 4.7.13, the total halide content of the concentrate shall not exceed 100 ppm (parts per million).

3.14 Dry chemical compatibility. The foam shall exhibit a minimum burnback time of ~~240~~ seconds in the presence of potassium bicarbonate dry chemical agent (P-K-P) in accordance with 4.7.14.

3.15 Compatibility. A candidate concentrate shall be compatible with other concentrates previously approved under this specification as defined by Commander, Naval Ship Engineering Center, Hyattsville, MD at the time the concentrate is submitted for approval. Testing shall be done in conformance with 4.7.15.

3.15.1 Viscosity. The viscosity of admixtures of the concentrates shall not be greater than the more/most viscous of the constituents and shall not be less than the lesser/least viscous when tested in accordance with 4.7.2.

3.15.2 Spreading Coefficient. ^{6%} solutions prepared from the mixtures of aged concentrates and fresh water and sea water aged premix solutions shall have a minimum spreading coefficient of 3.00 when tested as specified in 4.7.4.

3.15.3 Foamability. The foams produced from fresh and sea water solutions freshly prepared from aged admixtures of concentrates and from aged fresh and sea water premixed solutions prepared from admixtures of concentrates shall have a minimum expansion of 6.0 and a minimum drainage time of 2.5 minutes when tested in accordance with 4.7.5.

3.15.4 Film formation. Foams from all samples shall meet the requirements of 3.8 when tested in accordance with 4.7.6.

3.15.5 Fire performance. Foams from all samples shall meet the requirements of the 28 ft² fire test in 3.9.2.2 when tested in accordance with 4.7.7.

3.15.6 Stratification and precipitation. No sample shall show stratification when tested in accordance with 4.7.12.1. No sample shall show precipitation in excess of 0.5% when tested in accordance with 4.7.12.2.

3.16 Environmental impact

3.16.1 Toxicity. The concentrate shall have a TL₅₀ of not less than 2500 ppm when tested as specified in 4.7.16.

3.16.2 BOD₂₀. The concentrate 20-day Biological Oxygen Demand (BOD₂₀) shall not exceed 500,000 mg/l when tested as specified in 4.7.16.

3.16.3 COD. The concentrate Chemical Oxygen Demand (COD) shall not exceed 500,000 mg/l when tested as specified in 4.7.16.

3.16.4 Biodegradability. The concentrate shall be biodegradable when tested as specified in 4.7.16.

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3.17

Marking.

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3.17.1

Identification marking shall be in accordance with MIL-STD-130. In addition, the marking on the containers (see 5.3) shall be in white characters against a blue background (see 5.1.1.3).

3.17.2

No identical markings conforming to figure 1 shall be applied to containers so that the markings are located diametrically opposite. The markings shall be applied on the containers in such a manner that water immersion, contact with the contents of the containers, or normal handling will not impair the legibility of the marking. No paper labels shall be used.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or order, the supplier may use his own or any other facilities suitable for the performance of the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.2 Classification of tests. The inspection of the fire extinguishing agent shall be classified as follows:

- (a) Qualification tests.
- (b) Quality conformance inspection.
 - (1) Examination of filled containers.
 - (2) Quality conformance tests.
 - (3) Production check tests.

4.3 Qualification tests. ^{1/}Qualification tests shall be conducted at a laboratory satisfactory to the Naval Ship Engineering Center. Qualification tests shall consist of examination and qualification tests shown in table I.

4.3.1 Samples for qualification tests. ^{2/}Five filled 5-gallon containers are required for the qualification tests.

^{2/}Application for qualification tests shall be made in accordance with "Provisions Governing Qualification SD-6" (see 6.3 and 6.3.1).

4.4 The examination and tests applicable to each classification shall be as shown in table I:

Table I - Categories of Inspection

Reference		Qualification	Quality conformance	Production check ^{1/}
3.3,	4.7.1	Refractive index	X	
3.4,	4.7.2	Viscosity	X	
3.5,	4.7.3	pH value	X	
3.6,	4.7.4	Spreading coefficient	X	
3.7,	4.7.5	Foamability	X	
3.8,	4.7.6	Film formation and seal	X	
3.9.2,	4.7.7	28 ft ² fire test	X	I
3.9.3,	4.7.8	50 ft ² fire test	X	
3.9.4,	4.7.9	1260 ft ² fire test	X	
3.10,	4.7.10	General corrosion	X	
3.11,	4.7.11	Localized corrosion	X	
3.12,	4.7.12	Stability	X	
3.13,	4.7.13	Total halides	X	
3.14,	4.7.14	Dry chemical compatibility	X	
3.15,	4.7.15	Compatibility	X	
3.16,	4.17.16	Environmental impact		X
4.5.2		Examination of filled containers		

^{1/}Tests of this specification, in addition to the fire performance test, will be performed as necessary to insure that the sample is essentially identical to the product upon which qualification approval has been granted.

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4.5 Sampling for quality conformance inspection.

4.5.1 Inspection lot. For purposes of sampling, a lot shall consist of all material manufactured as one batch and transferred from one mixing tank to the shipping container.

4.5.2 Sampling for examination of filled containers. A random sample of filled containers shall be selected in accordance with MIL-STD-105 at inspection level I. The acceptable quality level = 2.5 percent defective to verify compliance with all requirements regarding fill, closure, marking, and other requirements not requiring tests, as specified in 4.6.1, 5.1.1.1, and 5.1.1.2.

4.5.3 Sampling for quality conformance tests. Three filled 5-gallon containers shall be selected at random from each lot and used as one composite sample for the tests specified in 4.6.2, or three 5-gallon containers of the product shall be withdrawn from an agitated mixing tank prior to packaging. The results of the tests required by 4.6.2 shall be submitted to the Naval Ship Engineering Center or the designated Laboratory.

4.5.4 Sampling for production check tests. In addition to the sample selected for quality conformance tests, one additional 5-gallon container from the first lot offered for delivery under a contract or order, and thereafter from any one lot in each group of ten successive lots shall be selected and forwarded to a laboratory designated by the Naval Ship Engineering Center for the tests specified in 4.6.3. If the same lot is being offered on more than one contract, one sample will suffice.

4.6 Quality conformance inspection.

4.6.1 Examination of filled containers. Each sample filled container shall be examined for defects of construction of the container and the closure, for evidence of leakage, and for unsatisfactory markings. Each filled container shall also be weighed to determine the amount of contents. Any container in the sample having one or more defects or less than required fill, shall not be offered for delivery, and if the number of defective containers in any sample exceeds the acceptance number for the appropriate sampling plan of MIL-STD-105, this shall be cause for rejection of the lot represented by the sample.

4.6.2 Quality conformance tests. The samples selected in accordance with 4.5.3 shall be subjected to the tests of table I, as applicable.

4.6.2.1 Action in case of failure. If the sample tested is found to be not in conformance with any requirement of this specification, the lot represented by the sample shall be rejected.

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THIS END UP

U.S.

AQUEOUS FILM FORMING FOAM (AFFF) LIQUID CONCENTRATE

In accordance with

MILITARY SPECIFICATION MIL-F-24385

THIS FIRE EXTINGUISHING CONCENTRATE IS FOR USE BY DILUTION WITH WATER IN FIXED OR MOBILE SYSTEMS. IT MAY BE USED ALONE OR IN COMBINATION WITH "TWINNED" DRY CHEMICAL EQUIPMENT. THE CONCENTRATE MAY BE DILUTED FOR USE IN FLOW PROPORTIONING EQUIPMENT WITH SEA WATER OR FRESH WATER AT VOLUME PROPORTIONS OF SIX GALLONS CONCENTRATE TO 94 GALLONS WATER. IT MAY ALSO BE DILUTED FOR READY-USE STORAGE AS A SIX-PERCENT PREMIX SOLUTION WITH FRESH WATER ONLY.

FOR READY USE DO NOT STORE BELOW 32°F. AVOID PROLONGED STORAGE ABOVE 120°F. DO NOT MIX WITH OTHER THAN LIQUID CONCENTRATE APPROVED UNDER SPECIFICATION MIL-F-24385 OR WATER.

MANUFACTURER'S NAME
ADDRESS
BATCH NO.
DATE OF MANUFACTURE.

Figure 1 - Container markings.

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4.6.3 Production check tests. The samples selected as specified in 4.5.4 shall be subjected to the fire performance test specified in 4.7.8. In addition, the sample shall be subjected to such other tests of this specification as are necessary to determine that the sample is essentially identical to the product upon which qualification approval has been granted.

4.6.3.1 Action in case of failure. Acceptance of the first lot offered for delivery under a contract or order shall be withheld until a satisfactory report is received on the composite production check test sample. Thenceforth, except as hereinafter specified, acceptance and rejection of lots shall normally be on the basis of the sampling, examination, and tests specified in 4.5, 4.6, and 4.7 and acceptance shall not be withheld pending receipt of test reports on production check test samples. However, upon receipt of an unsatisfactory test report on a production check test sample, additional samples shall be selected from every subsequent lot offered for delivery. The samples so selected shall be submitted to a laboratory designated by the Naval Ship Engineering Center and shall there be subjected to the examination and tests specified in 4.6 and 4.7. Lots shall then be accepted only upon receipt of a satisfactory test report on the samples so selected. Additional testing shall be discontinued and lot acceptance returned to the normal basis when two successive lots have been accepted. The contractor shall not be permitted to submit more than three separate samples for production check tests (see 4.6.3) in the event of failure.

4.7 Test procedures.

NOTE: Where sea water is required for tests, synthetic sea water in accordance with ASTM D1141-52 shall be used.

A sea-salt mixture conforming to ASTM D-1142 may be purchased from Lake Products Co Inc, St Louis, MO 63125.

4.7.1 Refractive index. The refractive index shall be determined at 77°F using sodium "d" line illumination.

4.7.2 Viscosity. The viscosity shall be determined at temperatures of $40 \pm 0.1^\circ\text{F}$ and $77 \pm 0.1^\circ\text{F}$ in accordance with ASTM Method D-445-65 using capillary viscometers of the appropriate size.

4.7.3 pH Value. The pH value shall be determined potentiometrically, using a pH meter with a glass electrode and a reference electrode.

4.7.4 Spreading coefficient. The spreading coefficient shall be determined with reference to reagent grade cyclohexane in accordance with the following relationship:

$$S_{a/b} = \gamma_b - \gamma_a - \gamma_i$$

where $S_{a/b}$ = spreading coefficient

γ_b = surface tension of cyclohexane as determined in 4.7.4.1

γ_a = surface tension of APFF solution as determined in 4.7.4.1

γ_i = interfacial tension between liquids as determined in 4.7.4.2

4.7.4.1 Surface tension. The surface tension of a $6 \pm 0.1\%$ by volume solution of the concentrate in distilled water and of reagent grade cyclohexane shall be determined in a DuNoy tensiometer at $77 \pm 1.0^\circ\text{F}$ in accordance with ASTM D1331-56.

4.7.4.2 Interfacial tension. The interfacial tension between reagent grade cyclohexane and a $6 \pm 0.1\%$ by volume of the concentrate in distilled water shall be determined in a DuNoy tensiometer at $77 \pm 1.0^\circ\text{F}$ in accordance with ASTM D 1331-56 and until the readings come to equilibrium.

4.7.5 Foamability. The foam shall be generated by means of a special 2 gpm test nozzle. The basic nozzle as manufactured by National Foam System, Inc., Lionville, PA shall be modified by shortening the length of the tip (foam barrel) from $2\frac{1}{2}$ " to $1\frac{1}{4}$ " and by adding a "wing-tip" spreader to the outlet. The spreader shall have a $1/8$ " wide, circular arc orifice $1\frac{7}{8}$ " in length; it may be made by slightly squashing a Bernz-o-matic TX-1527 flame spreader. (A print of the nozzle construction is available at the Naval Research Laboratory, Code 6180, Washington, DC 20375.) During foam sample collection the nozzle butt pressure shall be maintained at 100 psi and the solution temperature at $70 \pm 2^\circ\text{F}$. The nozzle shall be held at hip height and directed onto the collection backboard from a distance of 4-6 ft. The methods and procedures used shall be in accordance with National Fire Protection Association Standard No. 412.

4.7.6 Film formation and sealability. The test shall determine the ability of a fire-extinguishing agent of the foam-forming type to develop a vapor-sealing film on a hydrocarbon fuel surface. As the foam drains, a small percentage of the liquid drop-out remains surface-borne and spreads to provide protection against re-ignition of exposed fuel.

4.7.6.1 Test equipment. A corrosion-resisting steel Graduated Measure of 1000 ml capacity (4-1/2 inches in diameter, 5 inches deep) (Cole-Parmer Co., Chicago, Illinois, or similar) shall be fitted at the top edge with two small metal clips protruding $1/8$ inch into the opening. They shall serve to restrain an 80-mesh conical screen of corrosion-resisting steel (5 inches in height by 4-3/4 inches in diameter) from floating out of the container during the test.

A 2 gpm foam maker as described in 4.7.5 above shall be used as the foam source.

4.7.6.2 Test procedure. After placing 600 ml of 98% cyclohexane in the Graduated Measure, 200 ml of foam freshly made from a 6% by volume, fresh water solution in the 2 gpm nozzle shall be poured onto the fuel surface. The conical screen shall then be inserted into the Measure to create a foam-free surface within the screen and the screen clipped into place and a stop-watch started.

After 1 minute of elapsed time, a small flame shall be passed six times around the fuel surface at a height of $1/2$ inch ($\pm 1/8$ inch). A small flash may occur but no sustained ignition shall result if an effective vapor-seal is present. This flame can be readily provided using a hand-held propane tank fitted with a capillary tubing outlet and adjusted with the valve to give about a 1-inch long pilot flame.

4.7.7 Fire performance (28-square-foot test).

4.7.7.1 Test site. The 28-square-foot fire performance test shall be conducted in a level circular pan 6 feet in diameter (28 square feet), fabricated from $1/4$ -inch thick steel and having sides 4 inches high, resulting in a freeboard of approximately $3\frac{1}{2}$ inches during tests. The pan shall be without leaks so as to contain gasoline on a substrate of water. The water depth shall be held to a minimum, and shall be used only to ensure complete coverage of the pan with fuel.

4.7.7.2 Test equipment. The nozzle used for application of agent shall be the 2 gpm device described in 4.7.5.

4.7.7.3 Test materials. Foams shall be generated from $3.0 \pm 0.05\%$, $6.0 \pm 0.1\%$, and $50 \pm 1\%$ solutions made with fresh and sea water at $70 \pm 10^\circ\text{F}$. The fuel shall be 10 gallons of motor gasoline conforming to VV-G-76B or aviation gasoline conforming to MIL-G-5572.

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4.7.7.4 Test procedure. No tests shall be conducted with wind speeds in excess of 10 miles per hour. The complete fuel charge shall be dumped into the diked area within a 60-second time period.

~~The fuel shall be ignited within 60 seconds after completion of fueling and shall be permitted to burn freely for 10 seconds before the application of the extinguishing agent.~~

4.7.7.4.1 The fire shall be extinguished as rapidly as possible and in the most effective and expeditious manner. This shall be achieved by maintaining the nozzle 3-1/2 to 4 feet above the ground and angled ~~upward~~ ^{half} at a distance that permits the closest edge of the foam pattern to fall on the nearest ~~edge~~ of the fire. The nozzle shall be moved slowly from side to side to permit the foam pattern to fall from edge to edge of the fire. The operator shall move forward and around the area as the fire front recedes, ~~and shall stop when the fire is extinguished.~~ When the fire is extinguished, the time-for-extinguishment shall be recorded continuing distribution of the agent over the test area ~~with exactly 60 seconds of agent being applied (60 second application time)~~ ^{for 60 90 sec}

4.7.7.4.2 Burnback. The burnback test shall start within 60 seconds after the 90-second solution application. A weighted 1-foot diameter pan having 2-inch side walls and charged with 1 quart of gasoline shall be placed in the center of the area. (An eyebolt with an 8-inch shaft attached to the center of the pan and a 10-foot pole with a hook on the end will facilitate the placement of the pan.) The fuel in the pan shall be ignited ~~just prior to placement.~~ Burnback time shall commence at the time of this placement and terminate when 25 percent of the fuel area (7 square feet), (36-inch diameter), originally covered with foam is aflame. After the large test pan area will sustain burning, the small pan shall be removed.

NOTE:

Intermittent "flash-overs" occur occasionally and are characterized by creeping blue flames consuming the uppermost layer of the foam blanket. They usually self-extinguish. They shall not be considered part of the burn-back area unless sustained burning occurs. However, "flicker-fires" which are characterized as a series of sustained scattered fires burning freely above the foam blanket shall be judged independently and their cumulative areas used to determine 25% burn-back time.

4.7.8 Fire performance (50-square-foot test)

4.7.8.1 Test site. The fire test shall be conducted in a level circular area 8 feet in diameter (50 square feet). The base and surrounding dike shall be of material suitable for the containment of fuel on a substrate of water. The water depth shall be the minimum required to ensure complete coverage of the diked area with fuel.

4.7.8.2 Test equipment. The nozzle used for applying the agent shall be the 2 gpm device described in 4.7.5. operated at 100 psi (application rate 0.04 gpm per square foot).

4.7.8.3 Test materials. The solution used shall be sea water at 70±10 F containing 6.0±0.1% by volume of AFFF concentrate. The fuel shall be 15 gallons of gasoline meeting MIL-G-5572 or VV-G-76B.

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4.7.8.4 Test procedure. One fire test is required for each quality conformance test. Tests shall not be conducted when wind speeds are in excess of 10 mph. The entire fuel charge shall be dumped into the diked area within 150 seconds. Before fueling all extinguishing agent from previous runs shall be removed from the diked area. The fuel shall be ignited within 60 seconds of dumping and shall be permitted to burn freely for 10 seconds before starting agent application.

4.7.8.4.1 The fire shall be extinguished as rapidly as possible and in the most effective and expeditious manner. The nozzle shall be moved slowly from side to side to permit the foam pattern to fall from edge to edge of the fire. The operator shall move forward and around the area as the fire front recedes. Foam shall be applied continuously for 90 seconds to provide a constant cover for the burnback test. The fire shall be completely extinguished within the 90 second application.

4.7.8.5 Burnback. At the conclusion of the extinguishing portion of the fire test a burnback test shall be conducted as described in 4.7.7.4.2, except that the 25% area shall be 12.5 square feet (4 feet in diameter).

4.7.9 Fire performance (1260-square-foot test).

4.7.9.1 Test site. The fire test shall be conducted in a level circular area 40 feet in diameter (1260 square feet). The base and surrounding dike shall be of nonporous material for the containment of fuel on a substrate of water. The water depth shall be the minimum required to ensure complete coverage of the diked area with fuel.

4.7.9.2 Test equipment. The nozzle used for applying agent shall be the Elkhart model "SFL" set to discharge at a rate of 60 gpm and shall be operated with a nozzle pressure of 100 psi.

4.7.9.3 Test materials. The solution in fresh water and sea water shall be $70^{\circ} \pm 10^{\circ}\text{F.}$, and shall contain 6.0 ± 0.1 percent AFFF concentrate. The fuel shall be 25 gallons of gasoline conforming to MIL-G-5572.

4.7.9.4 Test procedure. No tests shall be conducted with wind speeds in excess of 10 miles per hour. The complete fuel charge shall be dumped into the diked area as rapidly as possible. Before fueling for any test run, all extinguishing agent from the previous test runs shall be removed from the diked area.

4.7.9.4.1 The fuel shall be ignited within ^{2 min.} 60 seconds after completion of fueling, and shall be permitted to burn freely for 10 seconds before the application of the extinguishing agent.

4.7.9.4.2 The fire shall be extinguished as rapidly as possible, and in the most effective and expeditious manner. This shall be achieved by maintaining the nozzle 3-1/2 to 4 feet above the ground and angled ~~upward~~ at a distance that permits the closest edge of the foam pattern to fall on the nearest ~~side~~ edge of the fire. The nozzle shall be moved slowly from side to side to permit the foam pattern to fall from edge to edge of the fire. The operator shall move forward and around the area as the fire front recedes, and shall always maintain the nozzle in the same attitude. edge

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4.7.10 General corrosion.

4.7.10.1 Test medium. The metal specimens shall be exposed in a medium of concentrate diluted with 10% by volume of sea water.

4.7.10.2 Test specimens. The test specimens shall consist of cold rolled steel (SAE 1010), 90-10 copper-nickel alloy, monel (400), and 905 bronze (Copper Development Assn (CDA) designation). The bronze specimen shall have sand-cast faces and shall be approximately 3/16-inch thick, 1/2-inch wide, and 3-inches long. All other specimens shall be approximately 1/16-inch thick and milled to a finished dimension of 1/2-inch by 3-inches. (Prepared specimens may be conveniently obtained from The Metaspec Co., Box 28125, San Antonio, TX 78228.) All specimens shall be degreased in acetone, rinsed well with distilled water, and air dried before exposure.

4.7.10.3 Test procedure. ^{Five} specimens of each metal shall be fully immersed in the test medium in a 600 ml beaker and held at room temperature for a period of 60 days. A watch-glass cover shall be used to retard evaporation. At the end of the exposure period the weight-loss shall be determined and the corrosion rate calculated as required.

4.7.11 Localized corrosion.

4.7.11.1 Test medium. See 4.7.10.1

4.7.11.2 Test specimens. The test specimens shall be CRES 304 approximately 1/16-inch thick, 1/2-inch wide, and 3-inches long. After degreasing with acetone and rinsing with water, the specimens shall be pretreated by immersion in a 1:9 concentrated nitric acid-water solution (~~20-25%~~) for a period of 5 minutes.

4.7.11.3 Test procedure. Ten specimens shall be girdled lengthwise with a clean 1/16 to 1/8 inch wide band of a good grade of gum rubber of a size such that the band is taut during the test. Because of the poor quality of most commercial rubber bands, it is recommended that the bands for this test be cut from 1-3/4-inch flat width pure gum amber tubing; Gooch type (Preiser Scientific Rubber tubing, Pure Gum, Gooch Type, 1/32-inch thin wall, pure gum amber tubing, very elastic, especially made for Gooch crucibles, Stock No. 139080 or equivalent). This tubing is most easily cut into uniform strips with a blade-type papercutter, but can also be cut with sharp shears. The specimens with their rubber bands shall be placed in a beaker so that no contact is made between individual specimens. A 1/4-inch layer of glass beads shall be introduced into the beaker to aid in stabilizing specimen position. Enough liquid shall be added to completely immerse the specimens, and a watch glass shall be placed over the beaker to retard evaporation (but allow air access) and act as a dust cover, and the assemblies allowed to stand at room temperature for 60 days,

4.7.11.4 Results. ^{the} The specimens shall be monitored daily over a 60-day period to ascertain the presence or absence of pitting. These daily examinations shall be made without disturbing the test (other than removing the cover). Corrosion is customarily signaled by the appearance of a dark spot which, if removed after sufficient exposure, discloses underneath what is readily recognizable as a corrosion pit. If the suspected area cannot be positively identified by the naked eye, it can be at a magnification of 10X. At the end of the test, each specimen shall be inspected carefully with particular attention being given to the edges of the specimens and those areas of the specimens under, or adjacent to the rubber bands. 10 X magnification shall be used, if necessary."

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4.7.12 Stability. One sample each of concentrate and 6% solutions of fresh and sea water shall be stored in cylindrical glass containers of 1000 ml capacity (approximately 2-inches in diameter and 19-inches in height). The containers shall be stoppered to prevent evaporation and placed in an oven at 150³°F for a period of 10 days. Additional samples of concentrate and solutions should be stored under the same conditions and of sufficient volume to enable testing as specified under 4.7.5 (foamability), 4.7.6 (film formation and sealability), and 4.7.7 (28 ft² fire test).

NOTE: When using sea-salt in the preparation of the samples for the precipitation test, the resultant synthetic sea water shall be filtered or decanted after a settling period in order to eliminate solids introduced from this source.

4.7.12.1 Stratification. Stratification shall be determined by visual examination.

4.7.12.2 Precipitation. After thorough agitation the precipitate in each sample shall be determined by centrifuge by ASTM method D 96 (Method 4) using the cone-shaped tube, except that benzene shall not be added.

4.7.12.3 Spreading Coefficient. The spreading coefficients shall be determined in accordance with the procedure in 4.7.4, except that the age premix solutions are run as they are and not diluted with distilled water.

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4.7.12.4 Foamability. The foamability shall be determined as specified in 4.7.5.

4.7.12.5 Film formation and sealability. The film formation and sealability shall be determined as specified in 4.7.6.

4.7.12.6 28 ft² fire test. The fire tests shall be conducted in accordance with 4.7.7 using the following materials:

- 3% sea water solution prepared from aged concentrate
- 3% fresh water solution prepared from aged concentrate
- 6% sea water solution aged as a premixed solution
- 6% fresh water solution aged as a premixed solution

4.7.13 Total halides. The halide content shall be determined in accordance with ASTM 1821, except for the following modifications:

(a) Procedure

- (1) Weigh 2.0 ± 0.1 grams or add 2.0 ± 0.1 ml of concentrate into a clean 250 ml beaker.
- (2) Add 75 ml of acetone measured by graduated cylinder. Add 2 ml of dilute nitric acid (1 volume of concentrated nitric acid to 60 volumes of water).

(b) The calculation shall be modified as follows: halide content,
 $\text{ppm} = 44.4(A - B)$.

4.7.14 Dry chemical compatibility. The foam's compatibility with potassium bicarbonate is tested by measuring the burnback time after the addition of dry chemical agent.

4.7.14.1 Test materials. The fuel used shall be gasoline conforming to VV-G-76 or MIL-G-5572. The dry chemical used shall conform to O-D-1407. The sieve used shall be an 8-inch diameter, 40 mesh standard sieve conforming to Type I, style A of RR-S-336.

4.7.14.2 Test procedure. ^{6%} Perform a 28-ft² fire extinguishing test as described in 4.7.7 using a sea water solution. Before the burnback test is started distribute evenly over the foam blanket one pound of dry chemical agent by means of a 40 mesh screen on a long handle. This shall be accomplished within a period of 30 seconds so that the total time from end of foam application to placement of the burning pan will be no longer than 90 seconds. Determine the burnback time in the normal manner described in 4.7.7.4.2.

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4.7.15 Compatibility. The compatibility of concentrates shall be determined by preparing admixtures of the concentrates and 6% premix solutions from these admixtures and testing their performance after an accelerated aging period. The percentage ratios of the components in the admixture shall be determined by the testing activity. The testing activity shall supply the necessary quantities of qualified products in order that prospective suppliers may conduct their own compatibility tests prior to submission for qualification.

4.7.15.1 Sample preparation. After the necessary samples of concentrates and 6% solutions of fresh and sea water have been prepared they shall be stored at 150[±]5°F for a period of 10 days. At the conclusion of the aging period the samples shall meet the requirements as follows:

stated set forth in Section 3

4.17.16 Environmental impact. All environmental tests shall be made in accordance with the procedures cited in Standard Methods for the Examination of Water and Waste Water, 13th Edition.

4.3 Inspection for preparation for delivery. Samples items and packages shall be selected in accordance with MIL-P-116 and inspected to verify conformance with the requirements of section 5.

5. PREPARATION FOR DELIVERY

"(The preparation for delivery requirements specified herein apply only for direct Government procurements. For the extent of applicability of the preparation for delivery requirements of referenced documents listed in Section 2, see 6.4).

"5.1 Preservation packaging. Preservation packaging for levels A and C shall be as specified hereinafter.

"5.1.1 The APFF liquid concentrate shall be furnished in a 5-gallon plastic or in a 55-gallon composite container as specified (see 6.2).

"5.1.1.1 Five-gallon plastic container. The container shall be ~~of polyethylene~~ molded polyethylene as specified herein. The container shall be as follows:

Capacity	5-gallon (min.)
Height, body (overall)	14-1/4 inches (approximate)
Diameter, body (overall)	11 inches (approximate)
Pour opening (inside dim.)	1-1/2 inches (min.)

"5.1.1.1.1 The container shall meet the requirements of Department of Transportation Specification Number 34. Containers shall be:

- (a) Stackable and self-supporting.
- (b) Provided with a tamperproof lock or seal and an NPT threaded-type plastic cap fitted with a gasket for the pour opening.
- (c) May be provided with a vent opening having an easily punctured membrane. When furnished, vent opening shall be provided with an NPT threaded type plastic cap. ~~Veressable~~
- (d) ~~As specified in 5.1.1.1.1~~ handle.
- (e) A blue color conforming to 5.1.1.3.
- (f) The torque required to remove the cap shall not exceed 50 inch-lbs.
- (g) The magnetic permeability shall not exceed 2.0.

"5.1.1.2 Fifty-five gallon container. The 55-gallon container shall be a composite comprised of a plastic insert and a steel drum overpack. The composite container shall conform to the requirements of type II, class 4 of PPP-C-1337, and the following:

- (a) Insert. The insert shall contain two protruding openings in the top head - one 3/4-inch and one 2-inch. Openings shall be so designed that when positioned in the steel drum cover there will be no strain on the protruding openings. The protruding plastic openings shall be secured to the drum cover by means of lock or retaining rings and gaskets. Openings shall be closed by use of NPT threaded plastic plugs and gaskets.
- (b) Covers. The steel drum cover shall be provided with two openings to accommodate the protruding insert openings. Covers shall be fully removable and provided with gaskets. Covers shall be secured to the steel drum with minimum 16 gage bolt or lever lock type locking rings.

(16)

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"5.1.1.3 Exterior color and coatings. Color shall be blue and shall be an approximate match to color number 15123 of Federal Standard 595. Exterior coating for fiber and steel drum overpacks shall conform to TT-E-489. In case of question or dispute, a color chip shall be submitted to NAVSEC for resolution.

"5.2 Packing. For levels A, B, and C, no further packing is required.

"5.2.1 Method of shipment shall comply with Uniform Freight Classification Rules or other carrier rules as applicable to the mode of transportation.

"5.2.2 Palletization. When specified (see 6.2), 5-gallon plastic containers shall be palletized for shipment in accordance with MIL-STD-147.

"5.3 Marking. In addition to the marking specified in 3.14 and any special marking required (see 6.2), containers and palletized unit loads shall be marked in accordance with MIL-STD-129."

6. NOTES

6.1 Intended use. The concentrate is intended for use in mechanical foam generating equipment such as fire-fighting trucks or foam sprinkler systems for extinguishing fires in flammable liquids such as gasoline or fuel oils.

"6.2 Ordering data. Procurement documents should specify the following:

- (a) Title, number, and date of this specification.
- (b) Size of container required (see 5.1.1).
- (c) Whether palletizing is required (see 5.2.2).
- (d) Special marking required (see 5.3)."

6.3 With respect to products requiring qualification, awards will be made only for such products as have, prior to the time set for opening of bids, been tested and approved for inclusion in Qualified Products List QPL-24385 whether or not such products have actually been so listed by that date. The attention of the suppliers is called to this requirement, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification, in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. The activity responsible for the qualified products list is the Naval Ship Engineering Center, Department of the Navy, Center Building, Prince Georges Center, Hyattsville, Maryland, 20782 and information pertaining to qualification of products may be obtained from that activity. Application for Qualification tests shall be made in accordance with "Provisions Governing Qualification SD-6" (see 6.3.1).

6.3.1 Copies of "Provisions Governing Qualification" may be obtained upon application to Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, Pennsylvania 19120.

6.4 Sub-contracted material and parts. The preparation for delivery requirements of referenced documents listed in section 2 do not apply when material and parts are procured by the supplier for incorporation into the equipment and lose their separate identity when the equipment is shipped.

Review activities:

AS

User activities:

OS, YD, XC

Preparing activity:

Navy - SH

(Project 4210-N051)

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SPECIFICATION ANALYSIS SHEET		Form Approved Budget Bureau No. 119-R004
<u>INSTRUCTIONS</u> This sheet is to be filled out by personnel either Government or contractor, involved in the use of the specification in procurement of products for ultimate use by the Department of Defense. This sheet is provided for obtaining information on the use of this specification which will insure that suitable products can be procured with a minimum amount of delay and at the least cost. Comments and the return of this form will be appreciated. Fold on lines on reverse side, staple in corner, and send to preparing activity (as indicated on reverse hereof).		
SPECIFICATION		
ORGANIZATION (of submitter)		CITY AND STATE
CONTRACT NO.	QUANTITY OF ITEMS PROCURED	DOLLAR AMOUNT \$
MATERIAL PROCURED UNDER A		
☐ DIRECT GOVERNMENT CONTRACT ☐ SUBCONTRACT		
1. HAS ANY PART OF THE SPECIFICATION CREATED PROBLEMS OR REQUIRED INTERPRETATION IN PROCUREMENT USE?		
A. GIVE PARAGRAPH NUMBER AND WORDING.		
B. RECOMMENDATIONS FOR CORRECTING THE DEFICIENCIES.		
2. COMMENTS ON ANY SPECIFICATION REQUIREMENT CONSIDERED TOO RIGID		
3. IS THE SPECIFICATION RESTRICTIVE?		
☐ YES ☐ NO IF "YES", IN WHAT WAY?		
4. REMARKS (Attach any pertinent data which may be of use in improving this specification. If there are additional papers, attach to form and place both in an envelope addressed to preparing activity)		
SUBMITTED BY (Printed or typed name and activity)		DATE

DD FORM 1426
1 APR 63

REPLACES NAVSHIPS FORM 4863, WHICH IS OBSOLETE

0101-807-2000

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Naval Ship Engineering Center
Center Building
Prince George's Center
Hyattsville, Maryland 20782

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Center Building
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Hyattsville, Maryland 20782

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US00000089

TEST DATA FOR MIL-F-24385A

				206	200	NATL	Ansul
3.3	Refract Index	> 1.3590		1.3595	1.3760	1.3650	1.3451
3.4	Viscosity	> 2.0 cs	77°F	2.5	4.4	2.5	1.6
		> 25.0	40	5.0	10.0	12	2.9
3.5	pH	> 7.0		8.2	7.5	8.0	7.4
		< 8.5					
3.6	Spread Coeff	> +3.00		3.96	3.32	5.3	5.27
3.7	Foam	exp	> 6.0 fresh	11.2	10.1	9.5	10.4
		drain	> 2.5 mm sea	11.4	9.3	8.2	6.1
				4.5	5.5	2.9	3.8
				4.0	5.7	3.3	3.2
3.8	Film & Seal	No Ignit		none	none	none	none
3.9	Flux						
3.9.2	28 ft ²						
3.9.2.1	3% fresh						
	t _x	< 65 sec		33	59	71	—
				47	40	63	
	t _{bb}	> 240 sec		366	528	204	—
					510	186	
	3% sea						
	t _x	< 65		58	43	72	85
				48	42	68	67
	t _{bb}	> 240		372	510	300	296
				373	516	259	336

NAVAL RESEARCH LABORATORY
FIRE SUPPRESSION SECTION
WASHINGTON, D.C. 20375

1 JUNE 75

SHEET _____

MTL-F-24385A

					206	200	NATL	ANSOL
3 ft ² Fire	6% fresh							
3.9.2.2 (cont'd)	$t_x < 45 \text{ sec}$				29	24 (ave)	40	31
	$t_{bb} > 320$				498	554	404	379
	6% sea							
	$t_x < 45$				37	34 (ave)	38	32
	$t_{bb} > 320$				371	376	312	454
3.9.2.3	50% sea							
	$t_x < 55$				31	37 30	37 54	—
	$t_{bb} > 100$				210	132 222	150 102	—
3.9.3	50 ft ² fire							
	$t_{85} < 40$				16	25	32	
	$\Sigma_{40} > 225$				360	318	270	
	$t_{bb} > 240$				357	312	315	
3.9.4	1260 ft ² fire							
3.9.4.1	3% sea							
	$t_{85} < 40$				20	26	30	25
	$\Sigma_{40} > 285$				313	295	285	310
3.9.4.2	6% fresh							
	$t_{85} < 30$				14		30	—
	$\Sigma_{40} > 285$				334	340	270	—

SHEET 1 of 1

NAVAL RESEARCH LABORATORY
FIRE SUPPRESSION SECTION
WASHINGTON, D.C. 20375

1 JUNE 75

SHEET _____

MIL-F-24385A

					206	200	NATL	ANSUL
3.12 Stability								
3.12.1	Stratification		None					
	Conc				none	none	none	none
	6% fresh premix				none	none	none	none
	6% sea "				none	none	none	none
3.12.2 Precipitation								
	Conc		<0.05		none	none	0.05	<0.05
	6% fresh premix		<0.05		none	none	none	<0.05
	6% sea	"	<0.05	*	0.20	0.10	0.075	.05
	* these values obtained with unfiltered sea water							
3.12.3 Spread coeff								
	fresh water from conc		>3.0		3.96	3.22	5.72	5.78
	6% aged FW premix		>3.0		5.15	4.12	5.37	3.74
	6% " SW		>3.0		5.75	-	5.26	4.38
3.12.4 Foamability								
	fresh exp		Exp > 6					
	fresh drain		Drain > 2.5					
	fresh exp				10.8	11.1	7.7	10.2
	fresh drain				4.8	5.0	3.2	3.8
	sea exp				11.0	8.6	7.8	7.4
	sea drain				4.5	5.7	3.1	3.7
	fresh premix exp				10.2	9.9	8.8	4.0
	fresh premix drain				4.7	4.9	3.0	2.9
	sea premix exp				7.1		8.3	4.3
	sea premix drain				4.0		3.1	2.8

MIL-F-24385A

				206	200	NATL	ANSUL
3.12.5	Film & Seal	No Ignit					
	fresh water			none	none	none	none
	sea "			none	none	none	none
	fresh premix			none	none	none	none
	sea "			none	none	none	none
3.12.6	Fire						
	3% fresh	t_x	< 65	35 34	35 54	49 73	—
		t_{bb}	> 240	396 378	474 432	252 174	—
	sea	t_x		35 38	52 56	65 75	—
		t_{bb}		420 384	504 480	396 336	—
	6% fresh premix	t_x	< 45	36 28	35	40	46
		t_{bb}	> 320	392 436	592	348	—
	6% sea premix	t_x		26 29	25	47	37 50
		t_{bb}		520 524	576	300	576 528
3.13	Total Halides						
			< 100 ppm	58	42	78	20
3.14	Dry Chem Compat						
			> 320 sec	474	348		414

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SHEET

MIL-F-24385A

DATA PAPER (8 COLUMN) NDW-GEN-5900 3 (10-65)

6

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NAVAL RESEARCH LABORATORY
FIRE SUPPRESSION SECTION
WASHINGTON, D.C. 20375

PRECIPITATION - %

.05 .10 .15 .20 .30

0% 206
100 ANSOL

50

100% 206
0 ANS

PRECIPITATION

3.15.6

AGED AS CONC

none

none

none

none

none

STRATIFICATION

3.15.6

no ignit

no ignit

no ignit

no ignit

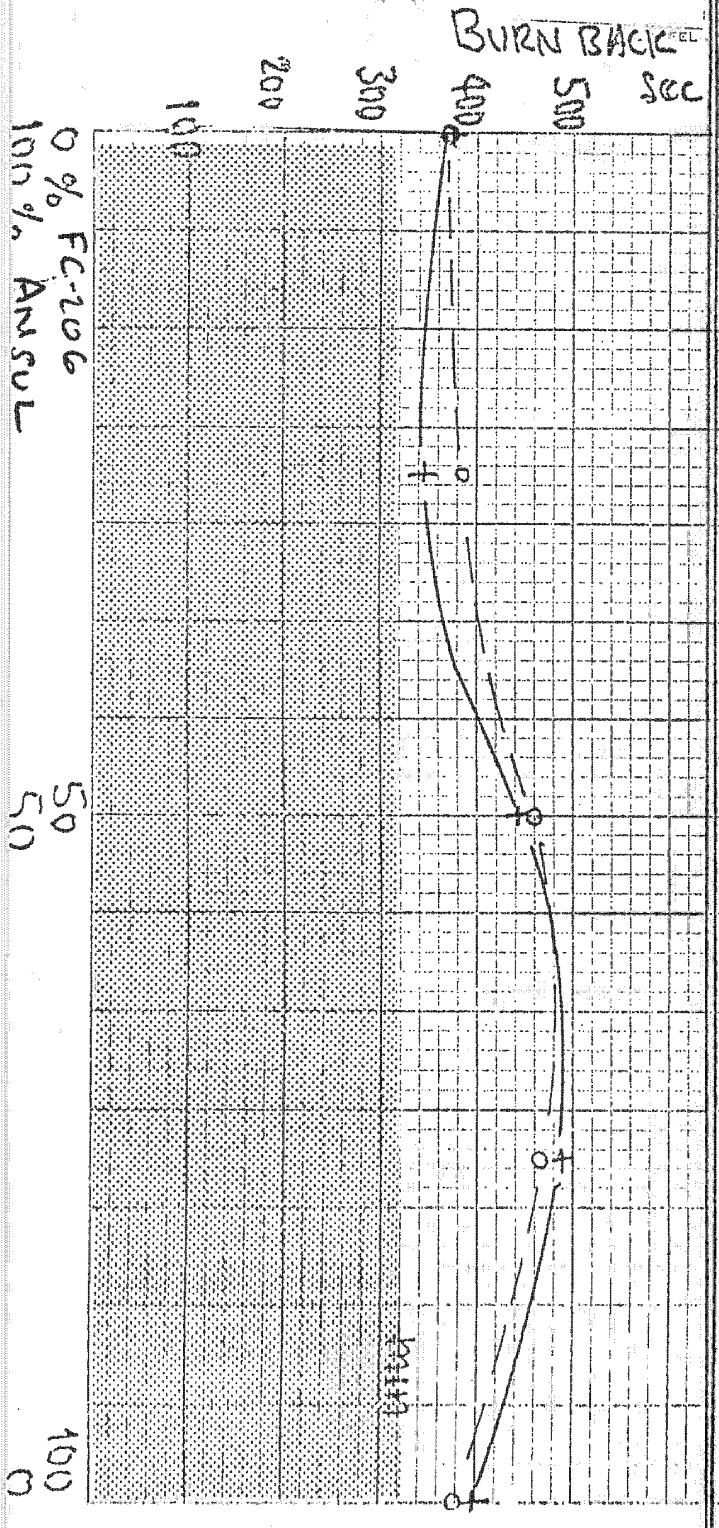
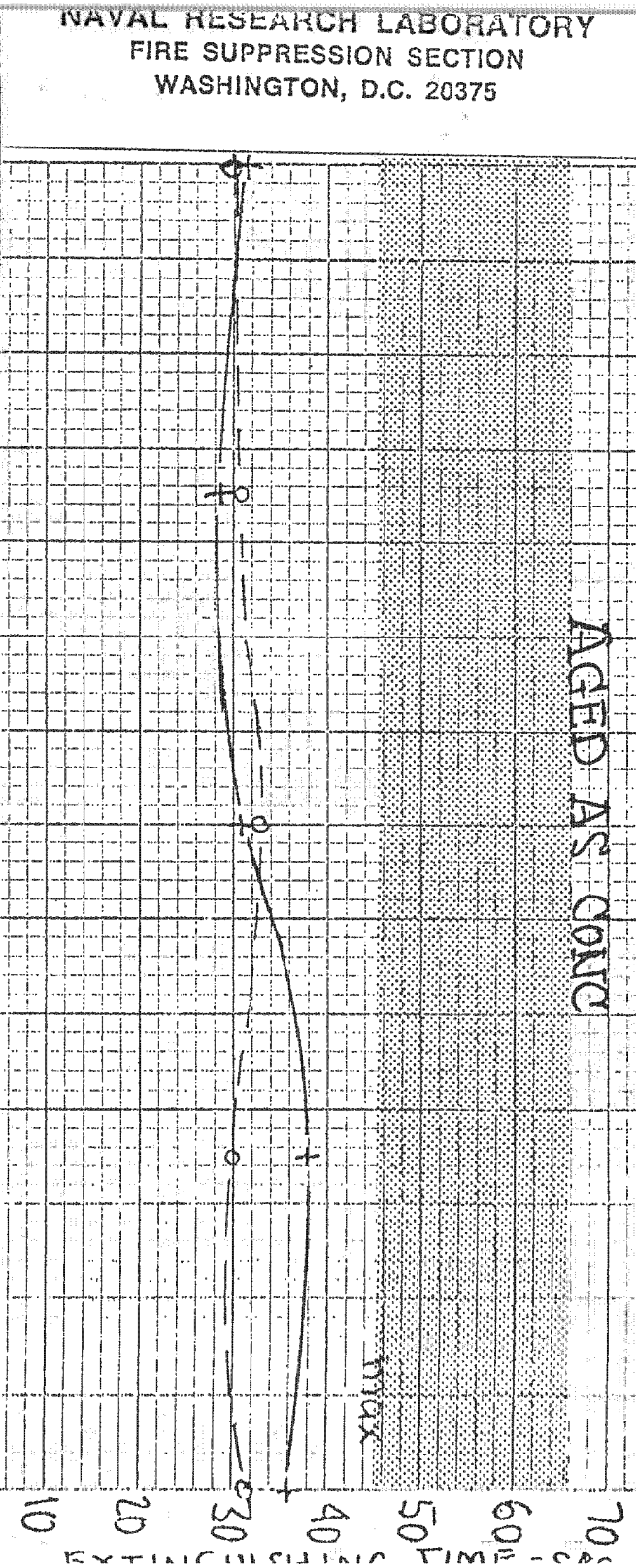
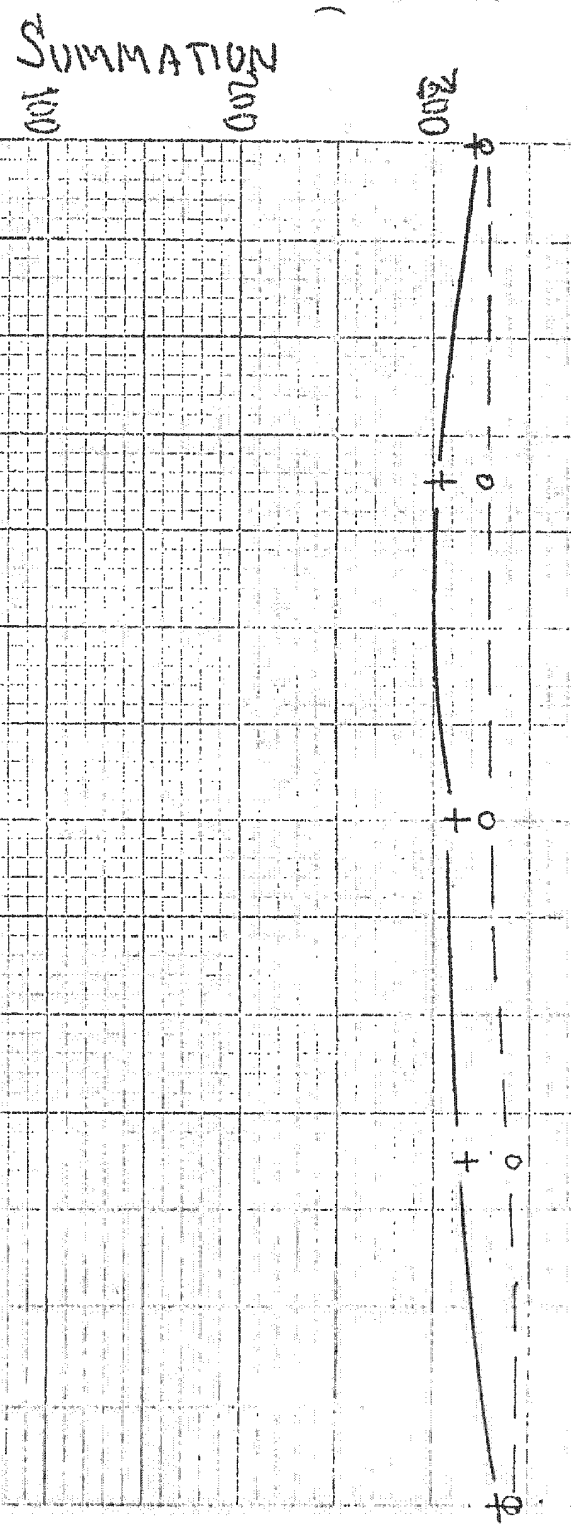
no ignit

FILM FORMATION 3.15.4

COMPATIBILITY BY

ANSOL/FC-206

3.13.3 COMPATIBILITY BY FIRE PERFORMANCE ANSUL/206



3.15.1

ANSUL/FC-206

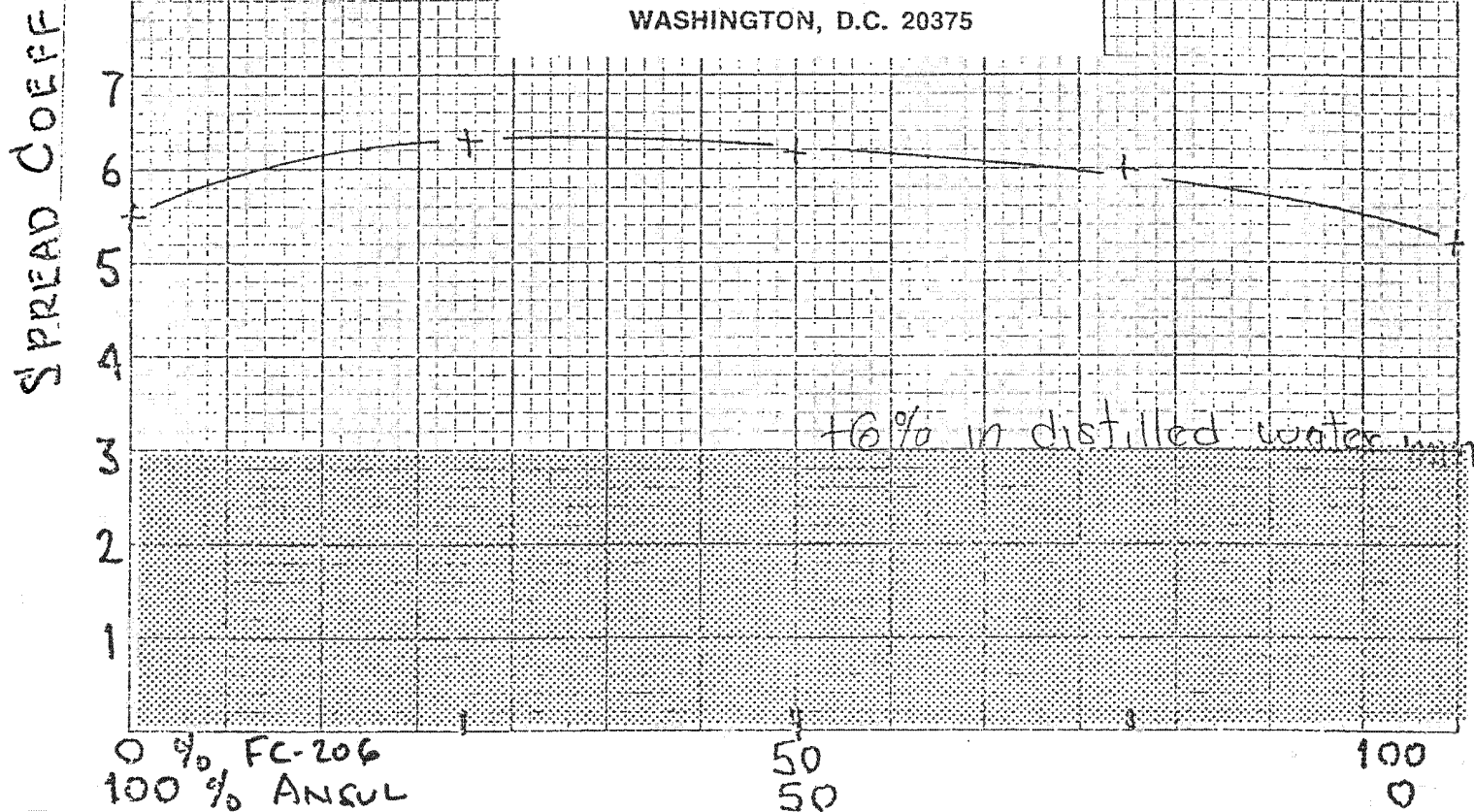
COMPATIBILITY BY VISCOSITY



3.15.2

COMPATIBILITY BY SPREAD COEFF

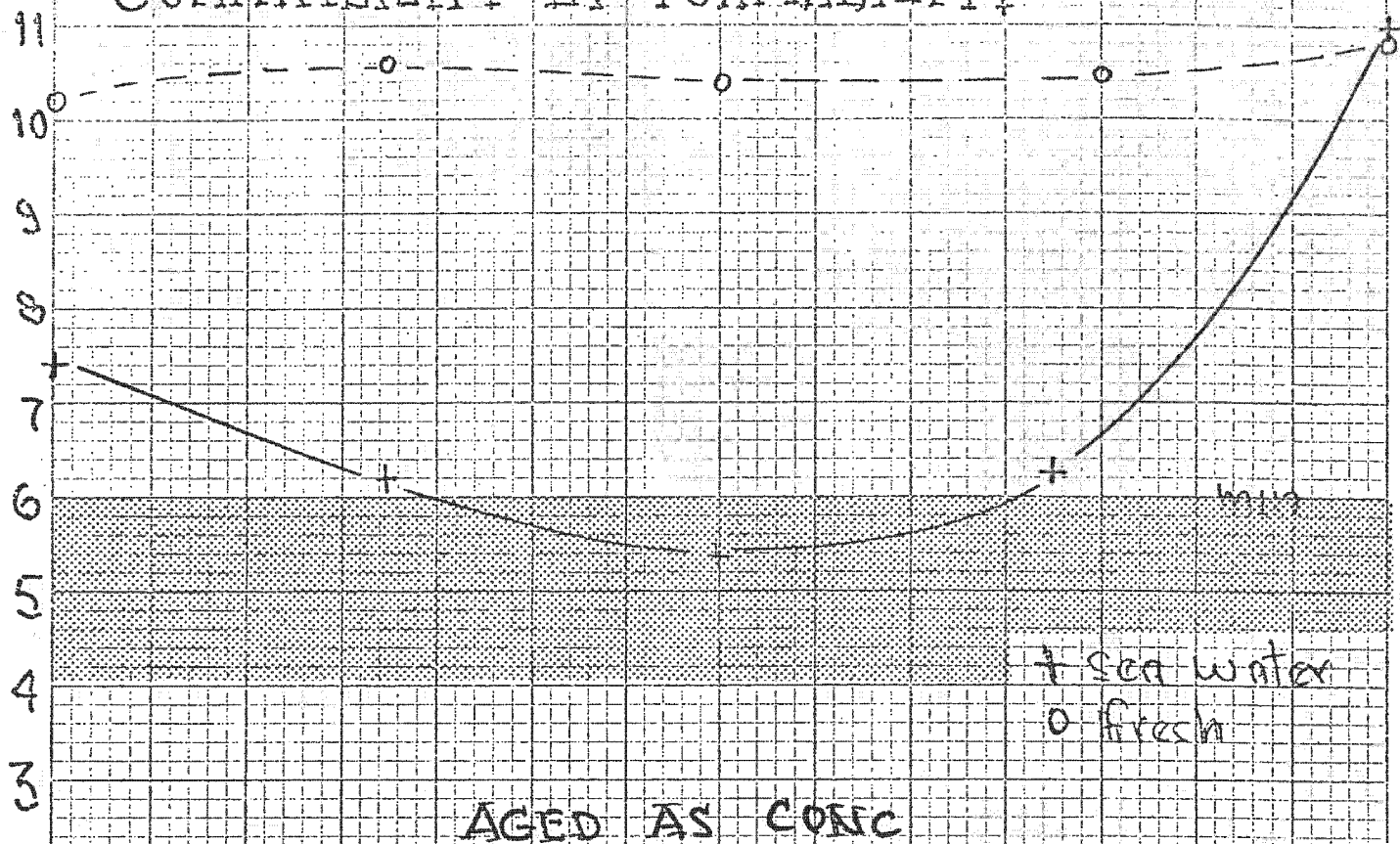
NAVAL RESEARCH LABORATORY
FIRE SUPPRESSION SECTION
WASHINGTON, D.C. 20375



3.15.3

COMPATIBILITY BY FOAMABILITY

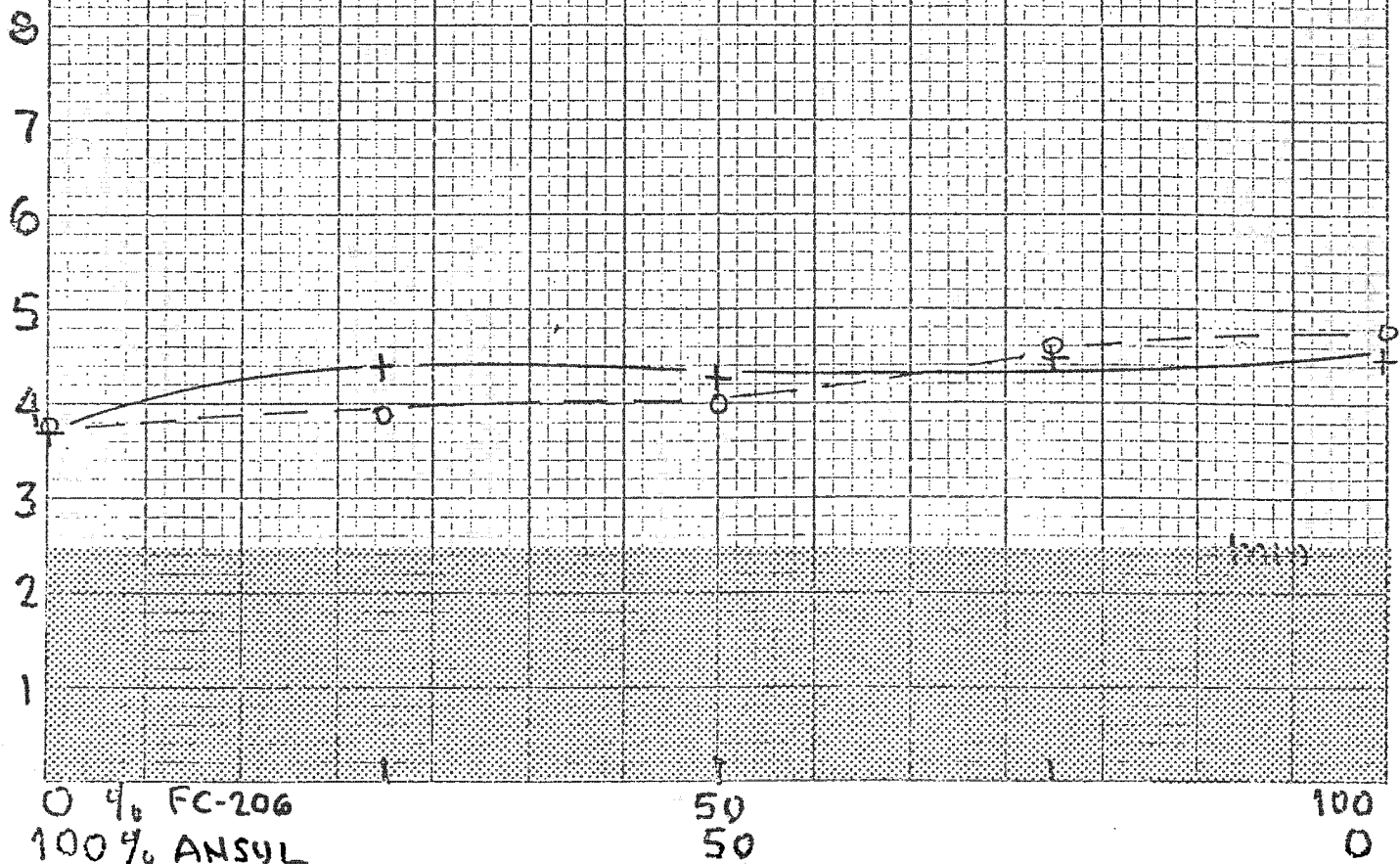
EXPANSION



AGED AS CONC

NAVAL RESEARCH LABORATORY
FIRE SUPPRESSION SECTION
WASHINGTON, D.C. 20375

DRAIN TIME - MIN



0 % FC-206
100 % ANSUL

50
50

100
0

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FIRE SUPPRESSION SECTION
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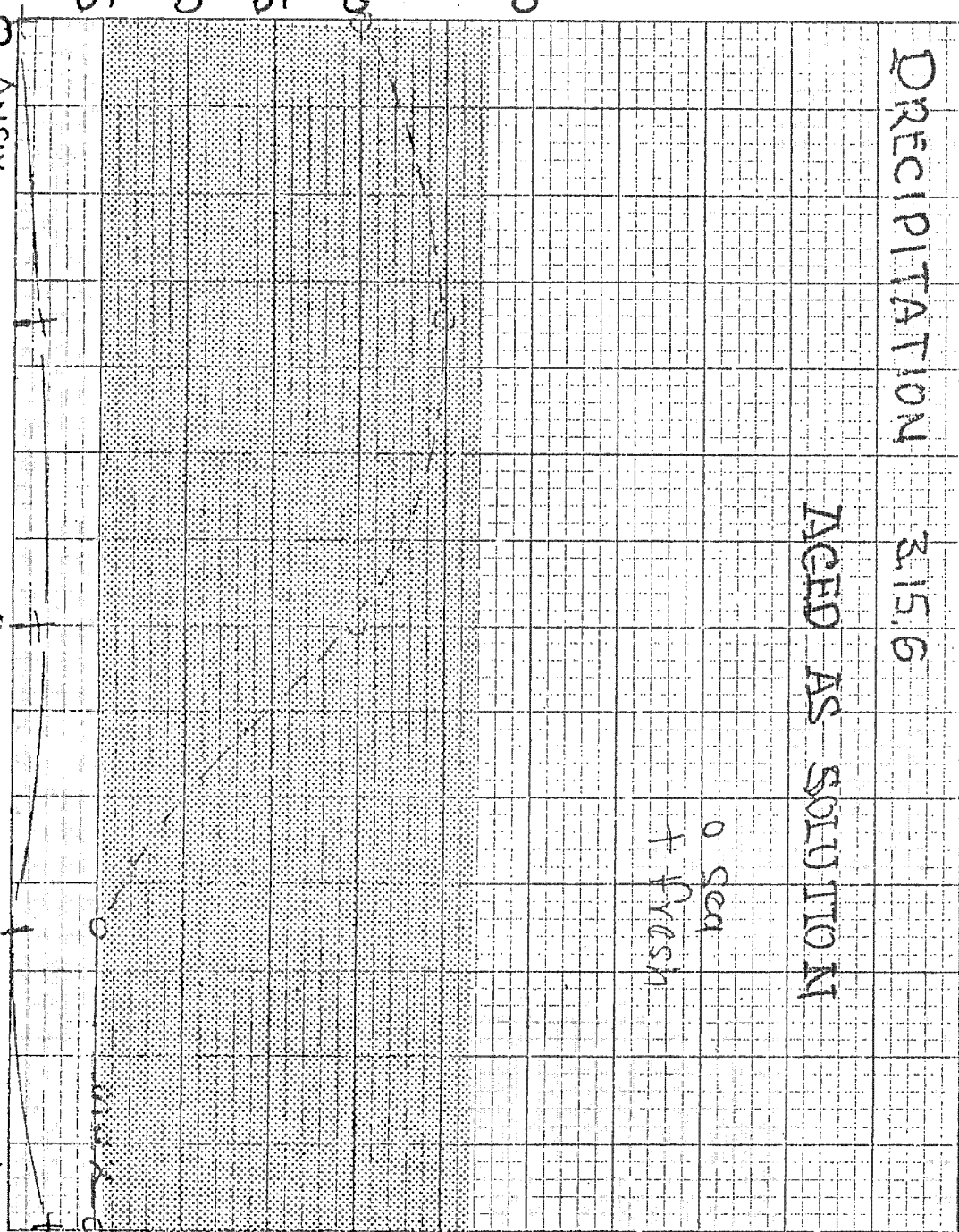
PRECIPITATION - %

.05 .10 .15 .20 .30

0 ANSUL
100% FC-206

50
50

100 ANSUL
0% FC-206



none

none

none

none

none

STRATIFICATION

3.15.6

no ignit

no ignit

no ignit

no ignit

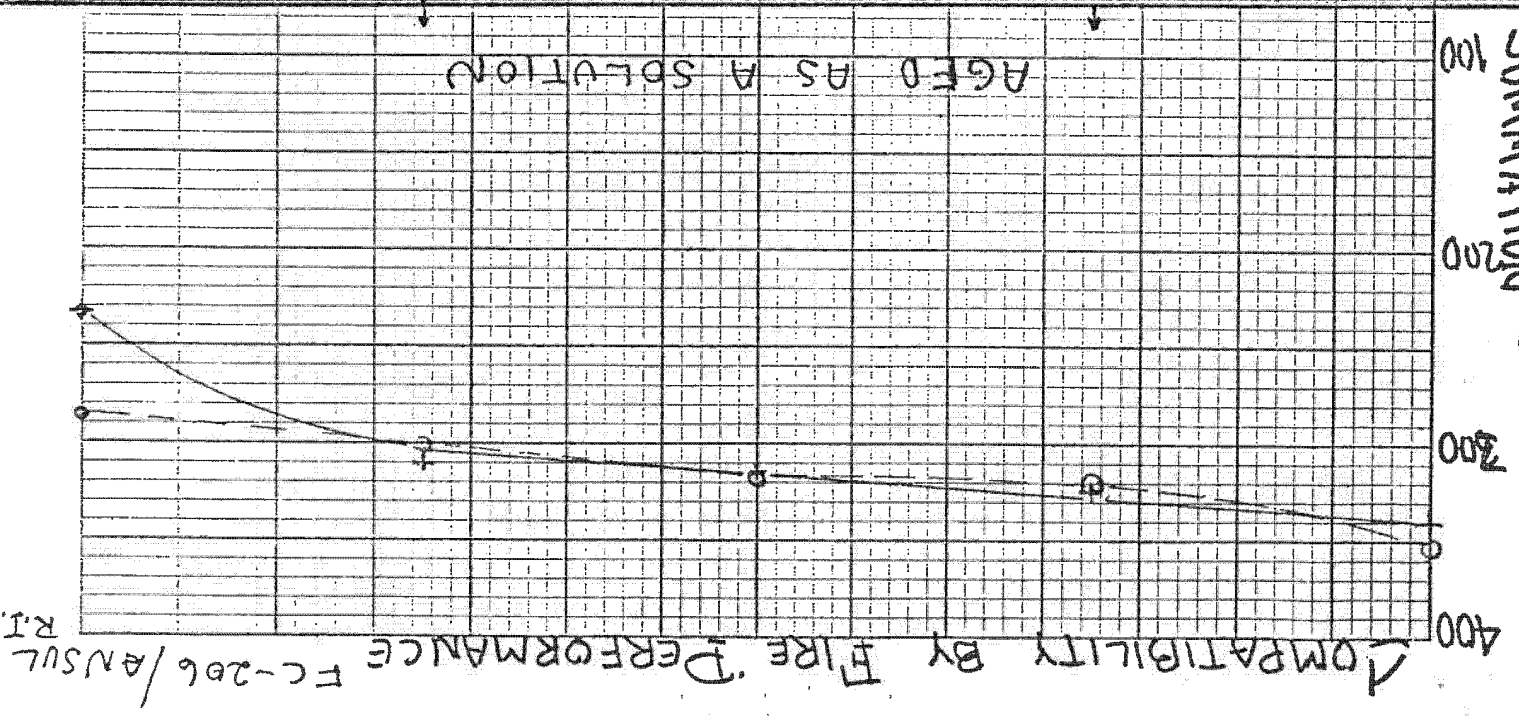
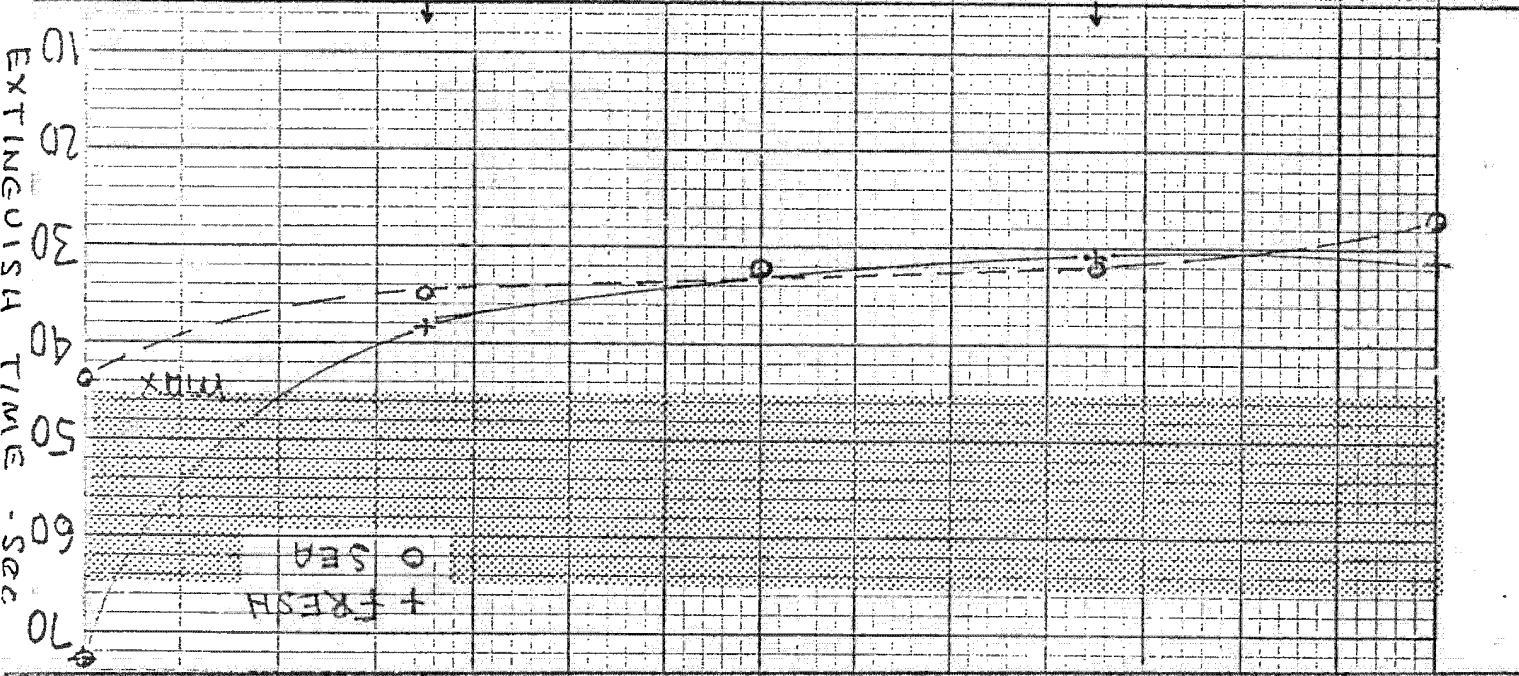
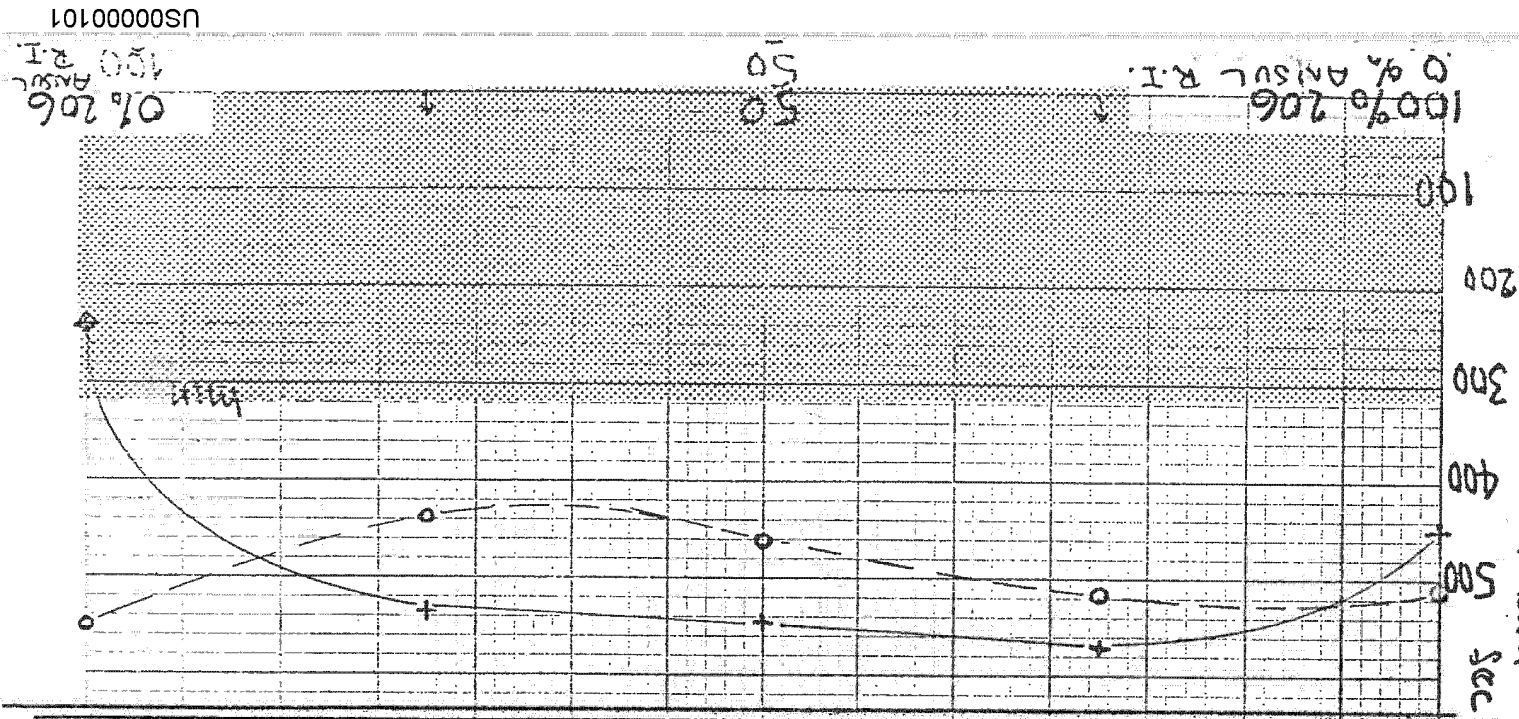
no ignit

FILM FORMATION 3.15.4

COMPATIBILITY BY

FC-206 / ANSUL

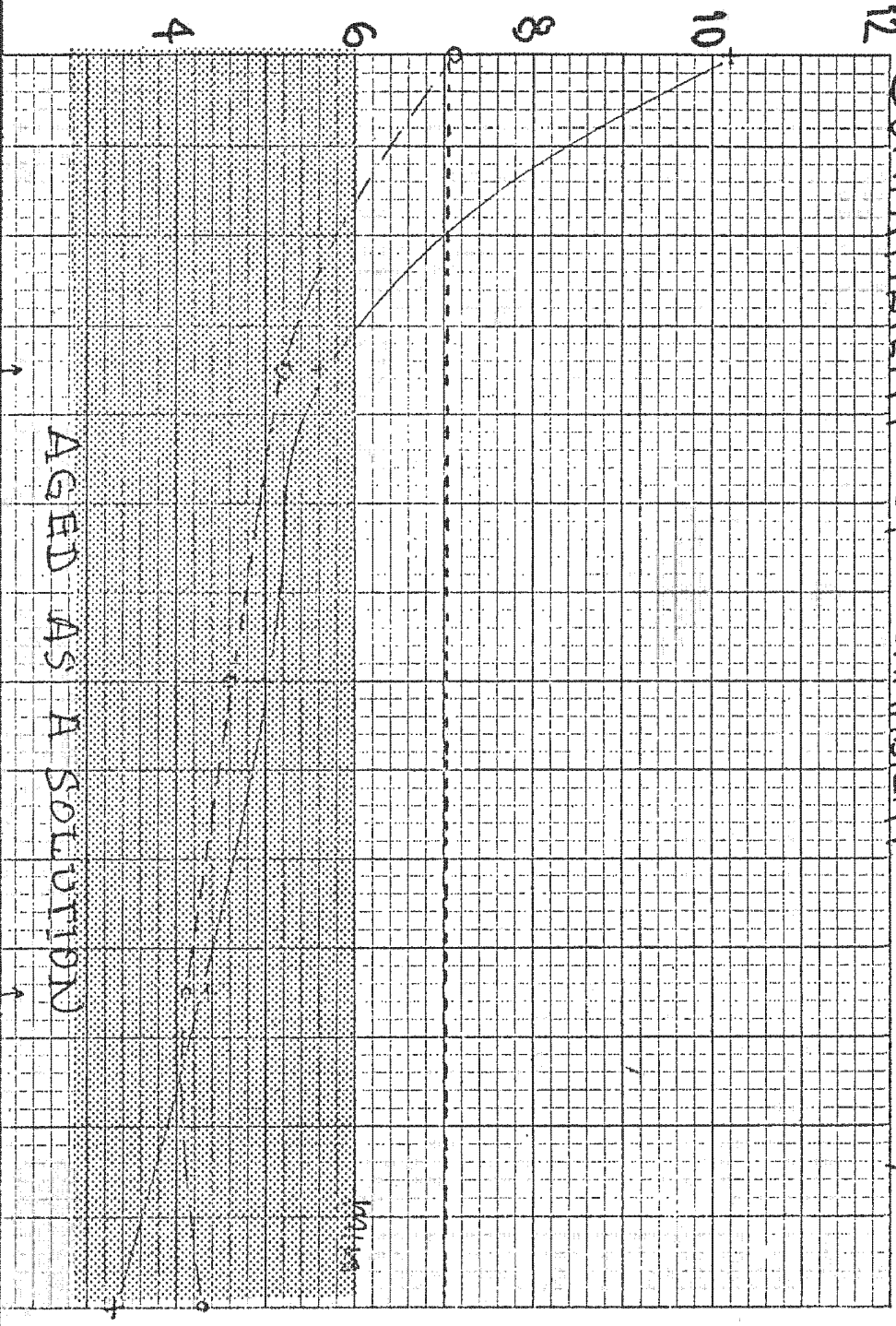
BURN BACK
K+Σ 5 X 5 TO 1/2 INCH
7 X 10 INCHES
46 0860
MADE IN U.S.A.



US00000101

COMPATIBILITY BY FOAMABILITY FC-206 / ANSWER

EXPANSION

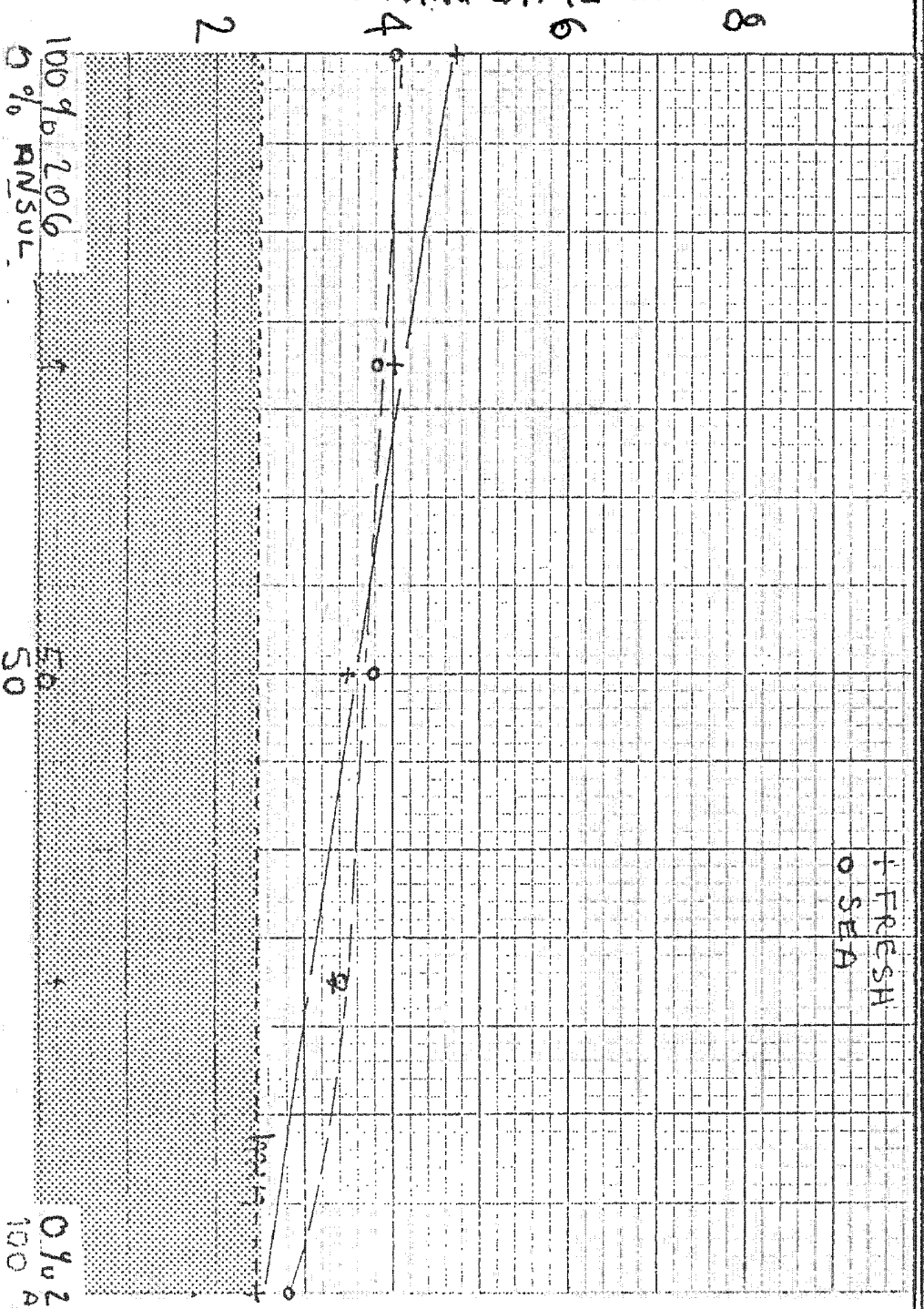


AGED AS A SOLUTION

+ FRESH
o SEA

K&E 5 X 5 TO 1/2 INCH 46 0860
7 X 10 INCHES
KEUFFEL & ESSER CO.
MADE IN U.S.A.

DRAIN TIME-min



100% 206
0% ANSWER

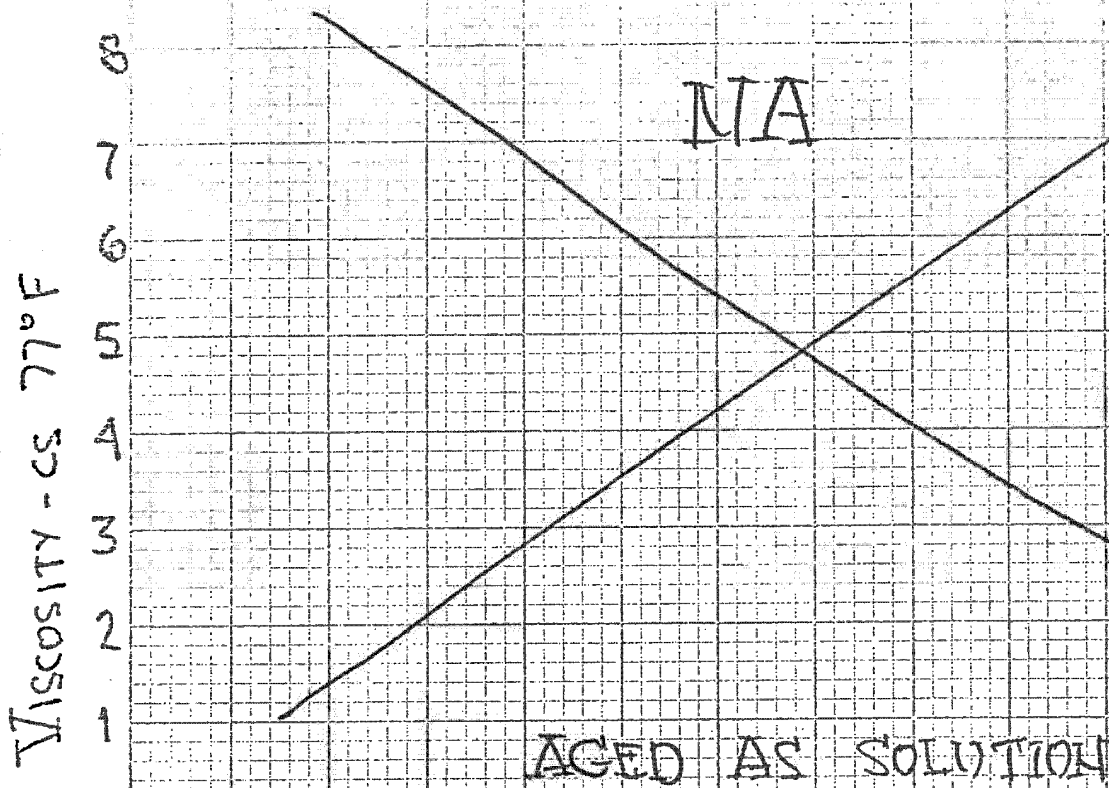
50

0% 206
100 ANSWER

3.15.1

FC-206/ANSUL

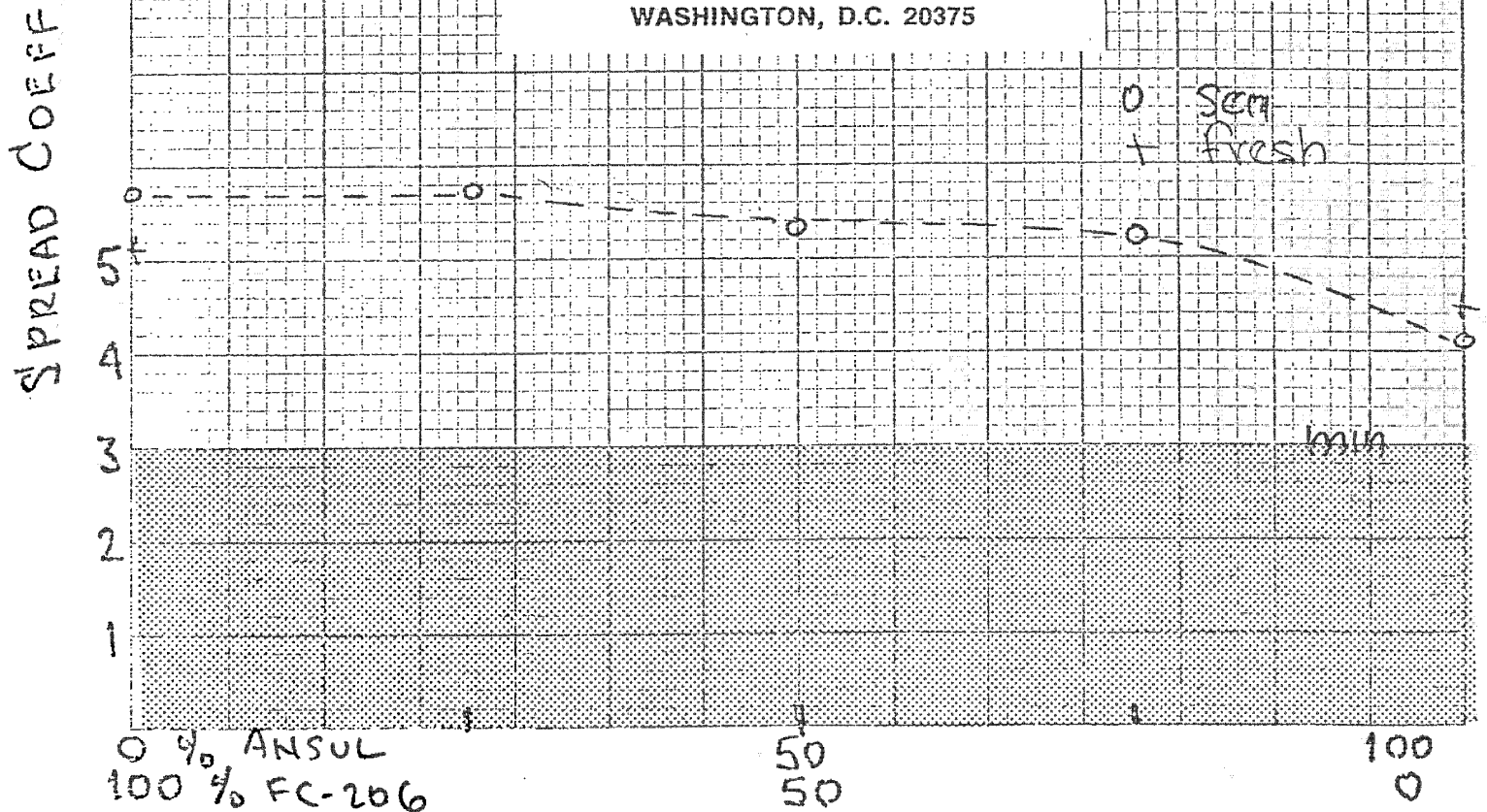
COMPATIBILITY BY VISCOSITY



3.15.2

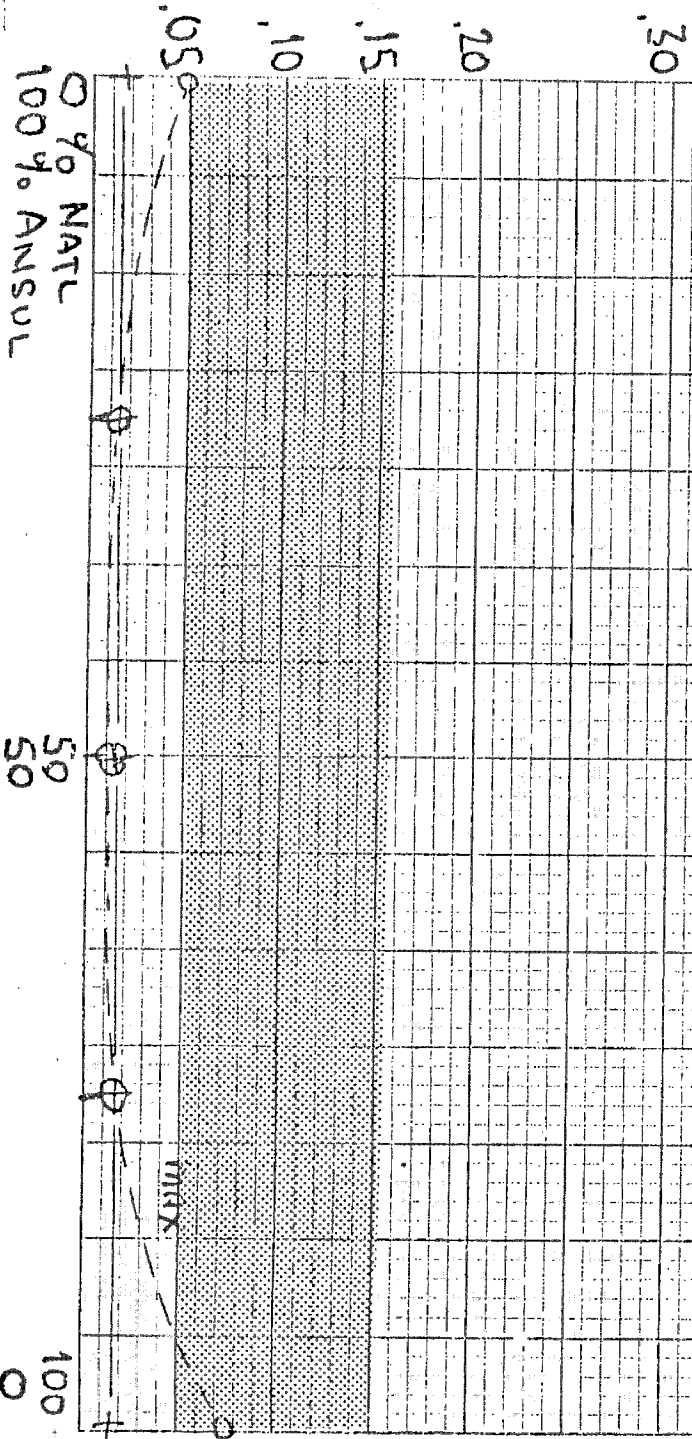
COMPATIBILITY BY SPREAD COEFF

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PRECIPITATION - %



COMPARABILITY BY

ANSUL/NATL

FILM FORMATION 3.15.4

no ignit

no ignit

no ignit

no ignit

no ignit

STRATIFICATION

3.15.6

none

none

none

none

none

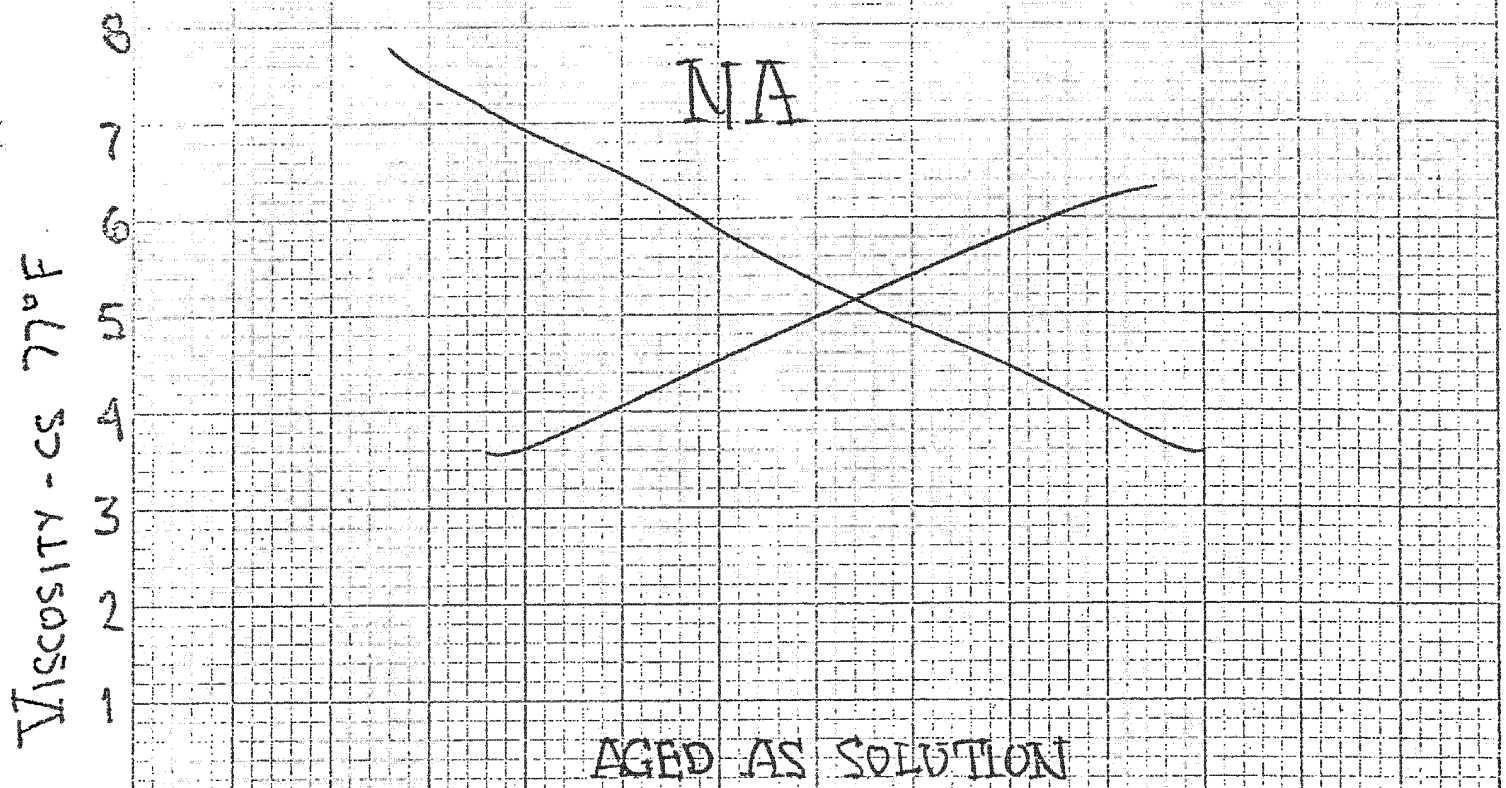
PRECIPITATION

3.15.6

3.15.1

ANSOL/NATL

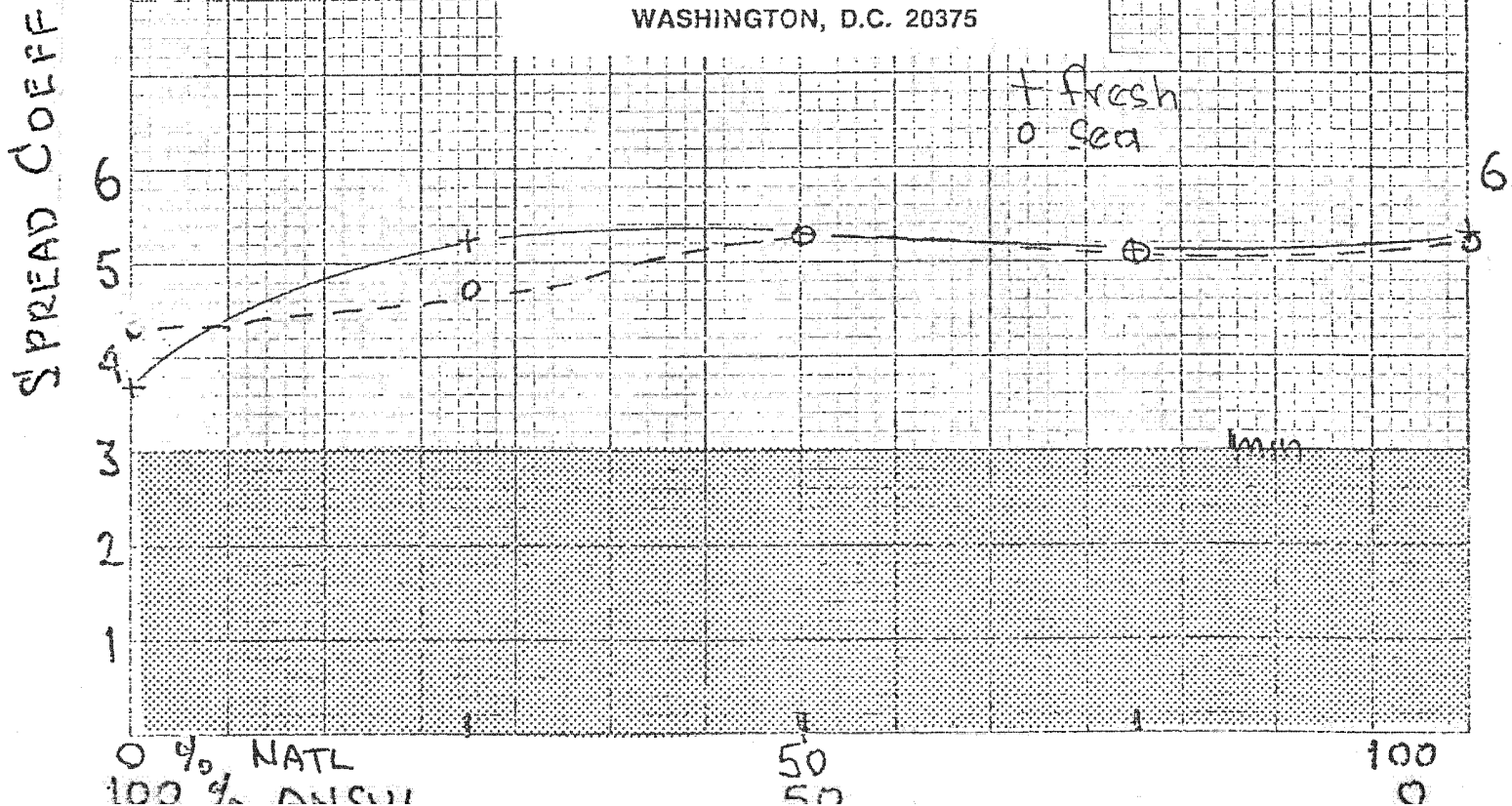
COMPATIBILITY BY VISCOSITY



3.15.2

COMPATIBILITY BY SPREAD COEFF

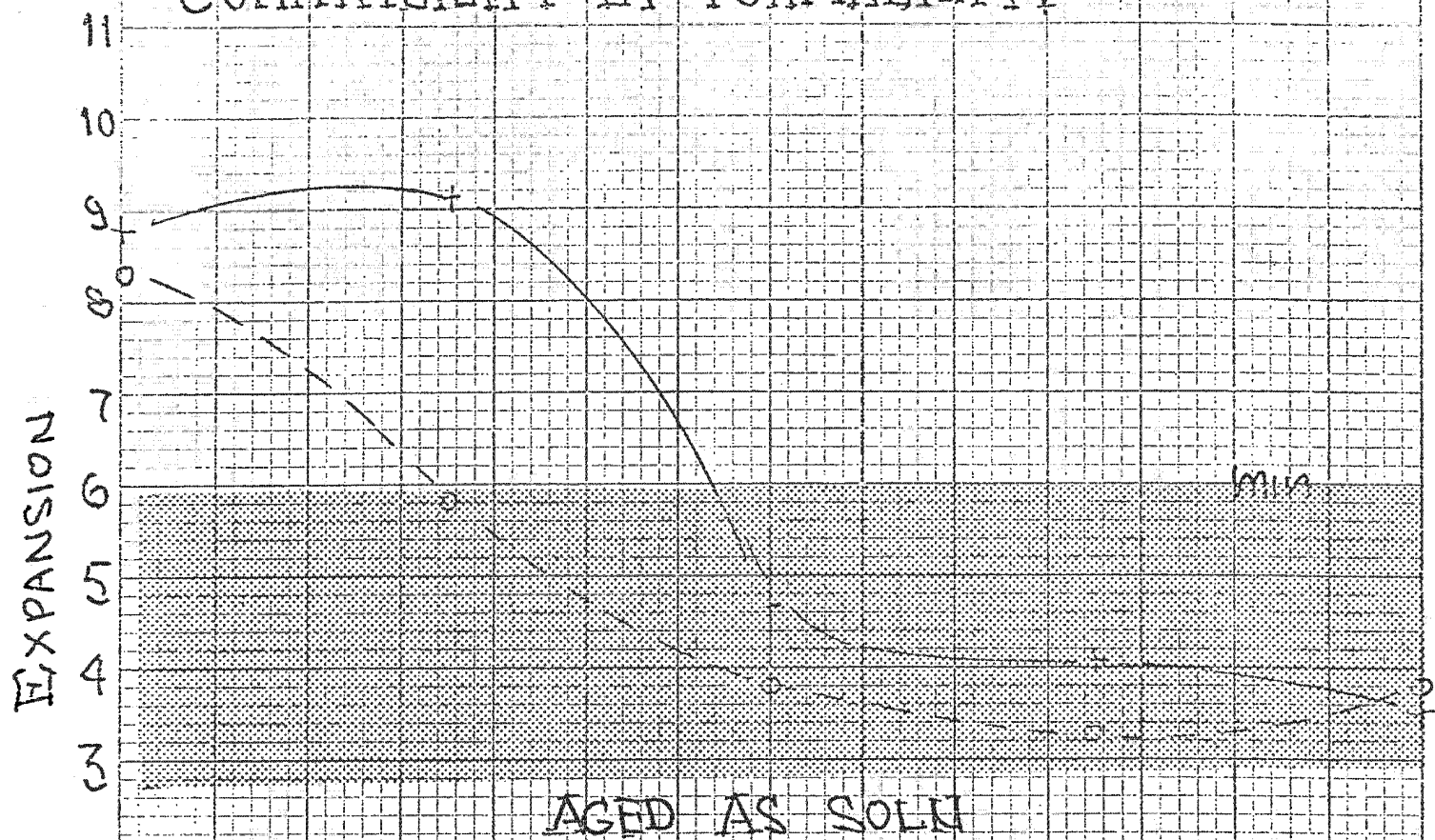
NAVAL RESEARCH LABORATORY
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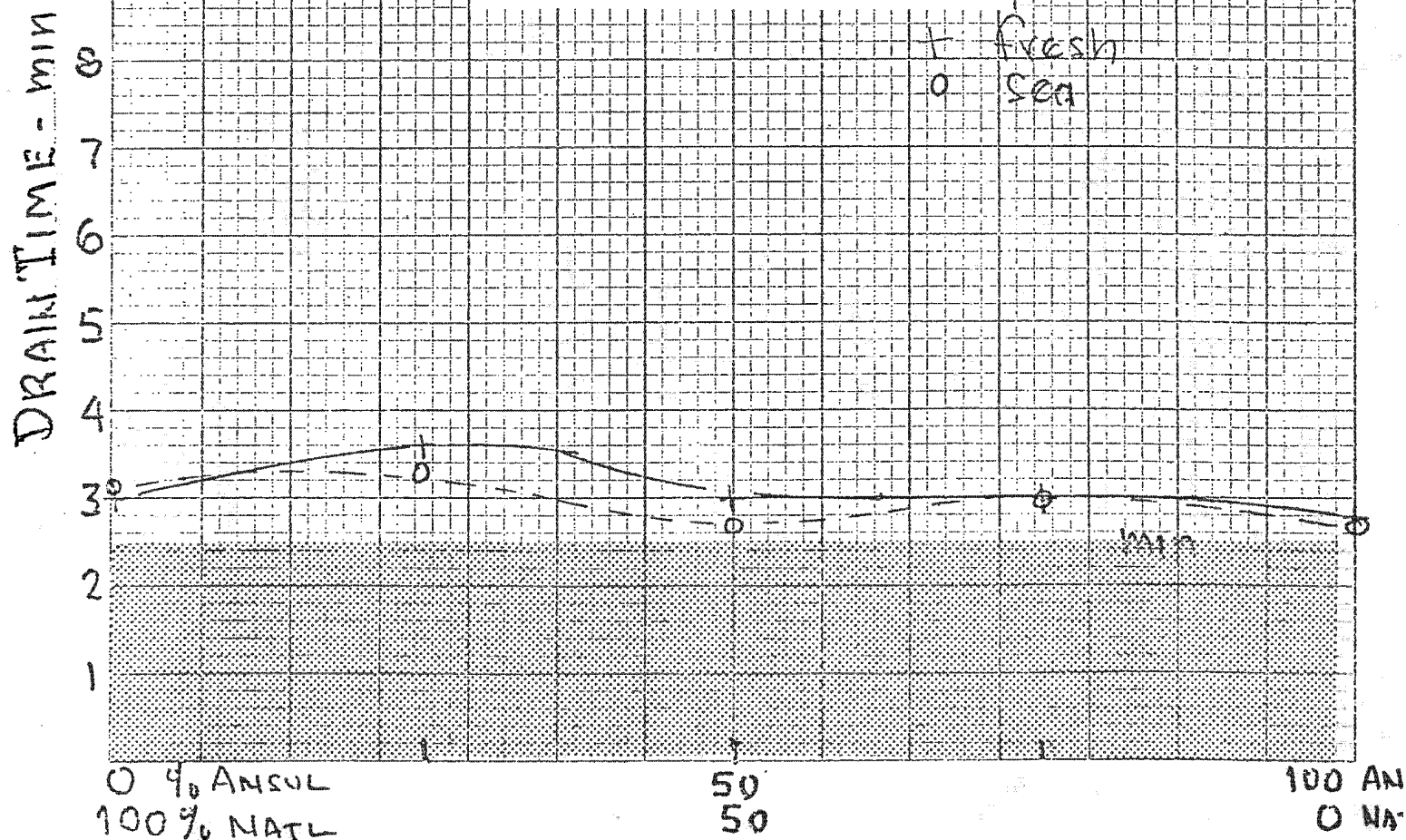
3.15.3

ANSOL/NATL

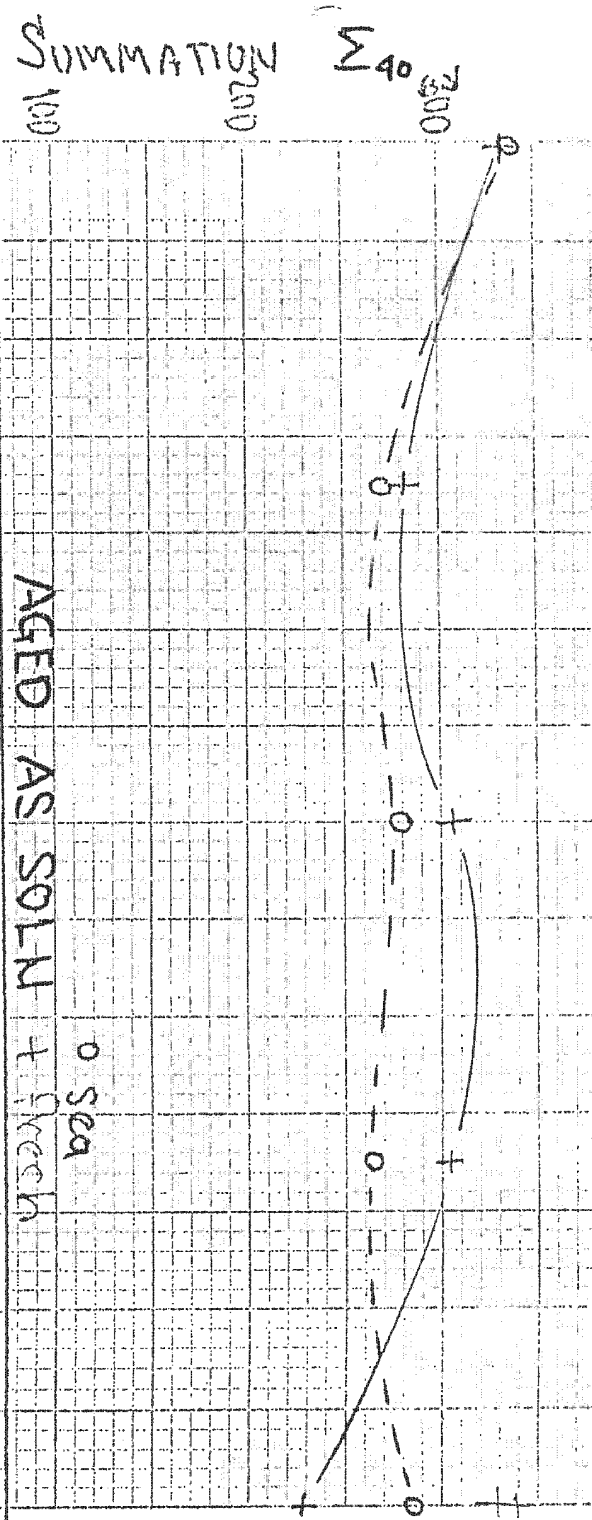
COMPATIBILITY BY FOAMABILITY



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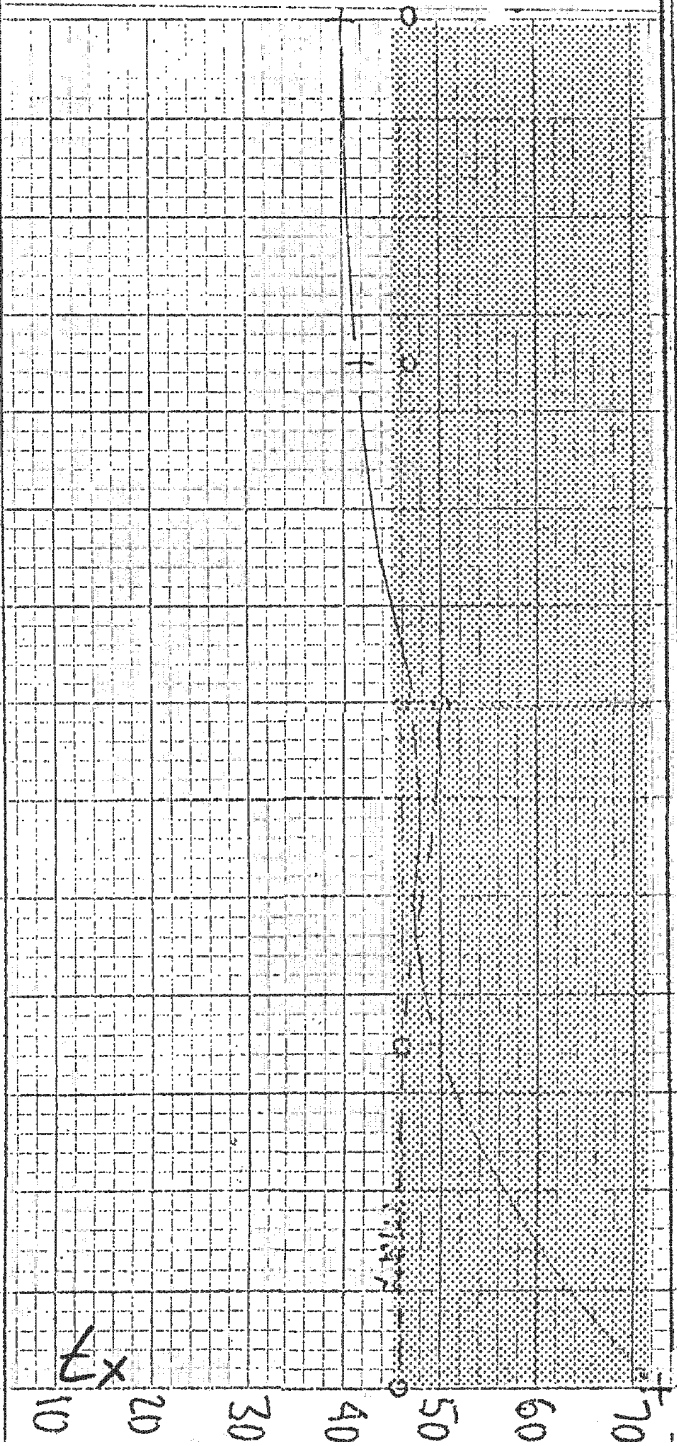


COMPATIBILITY BY FIRE PERFORMANCE ANSUL/NATL

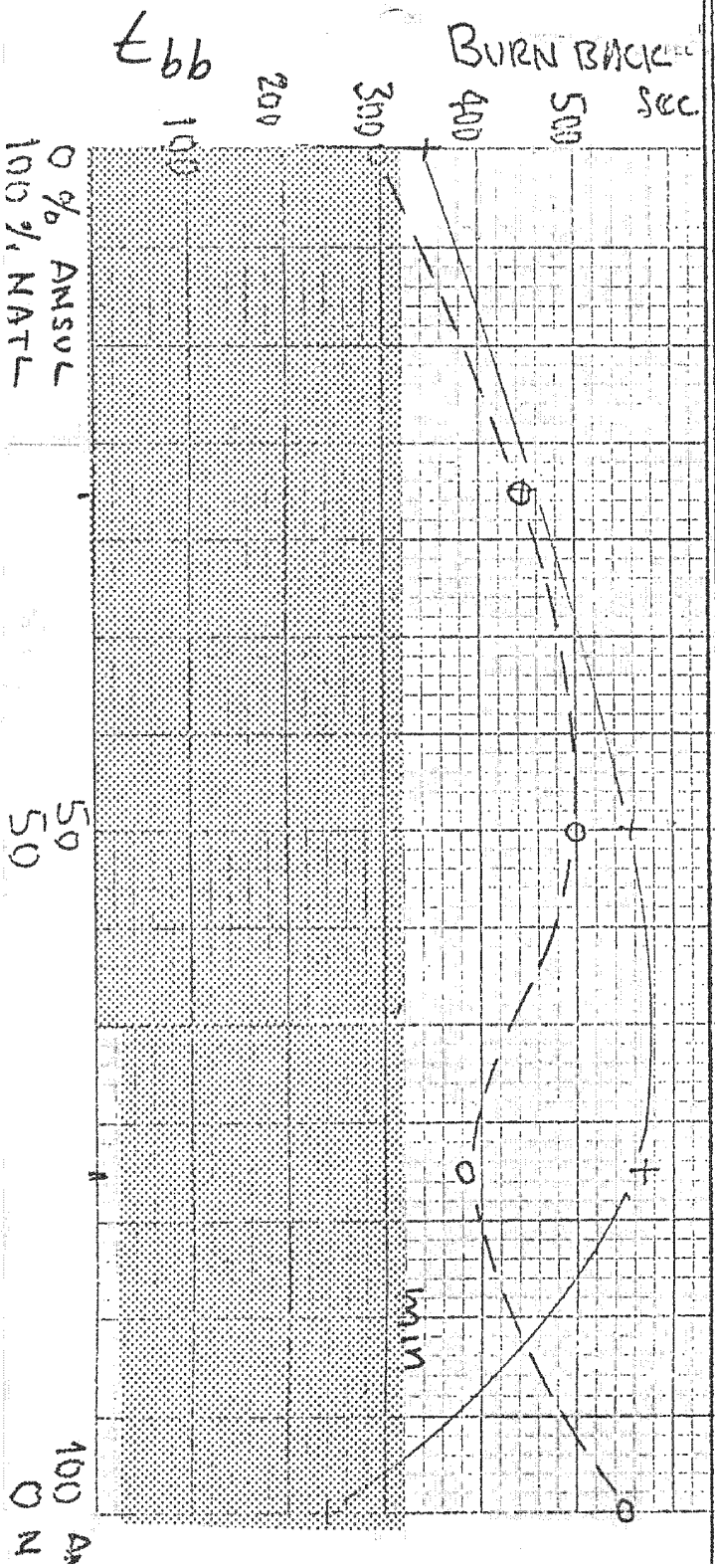


AGED AS SOLN + Fresh

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FIRE SUPPRESSION SECTION
WASHINGTON, D.C. 20375



Σ



0% ANSUL
100% NATL

50

100 AN
0 N

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FIRE SUPPRESSION SECTION
WASHINGTON, D.C. 20375

PRECIPITATION - %

.05 .10 .15 .20 .30

0 NATL
100% ANSUL

50

100 NAT
0 ANSUL

AGED AS CONC

PRECIPITATION 3.15.6

none

none

none

none

none

STRATIFICATION 3.15.6

no ignit

no ignit

no ignit

no ignit

no ignit

FILM FORMATION 3.15.4

0 NATL 100% ANSUL

0 NATL 100% ANSUL

3.15.1

ANSUL/NATL

COMPATIBILITY BY VISCOSITY

Viscosity - cs 77°F

8
7
6
5
4
3
2
1

AGED AS CONC

max
min

3.15.2

COMPATIBILITY BY SPREAD COEFF

NAVAL RESEARCH LABORATORY
FIRE SUPPRESSION SECTION
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SPREAD COEFF

6
5
4
3
2
1

max + 6% in distilled water

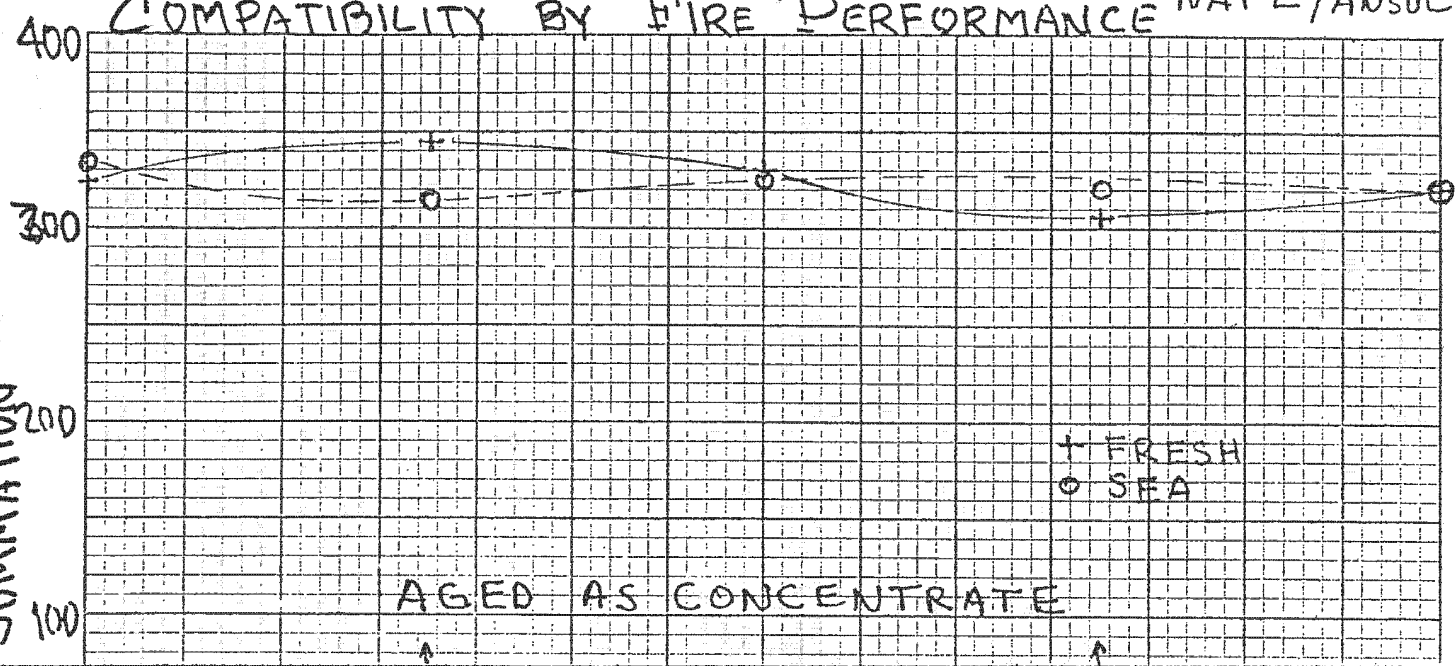
0 % NATL
100 % ANSUL

50
50

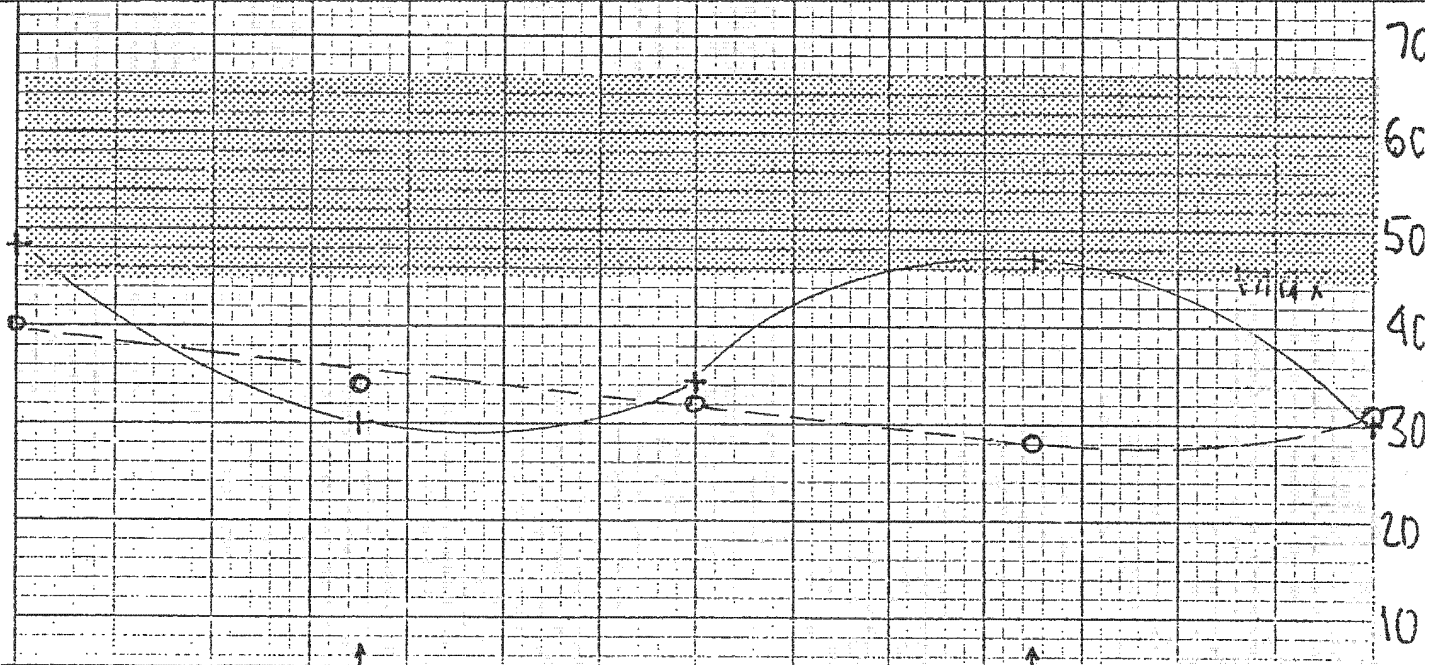
100
0

COMPATIBILITY BY FIRE PERFORMANCE NAT'L/ANSUL R

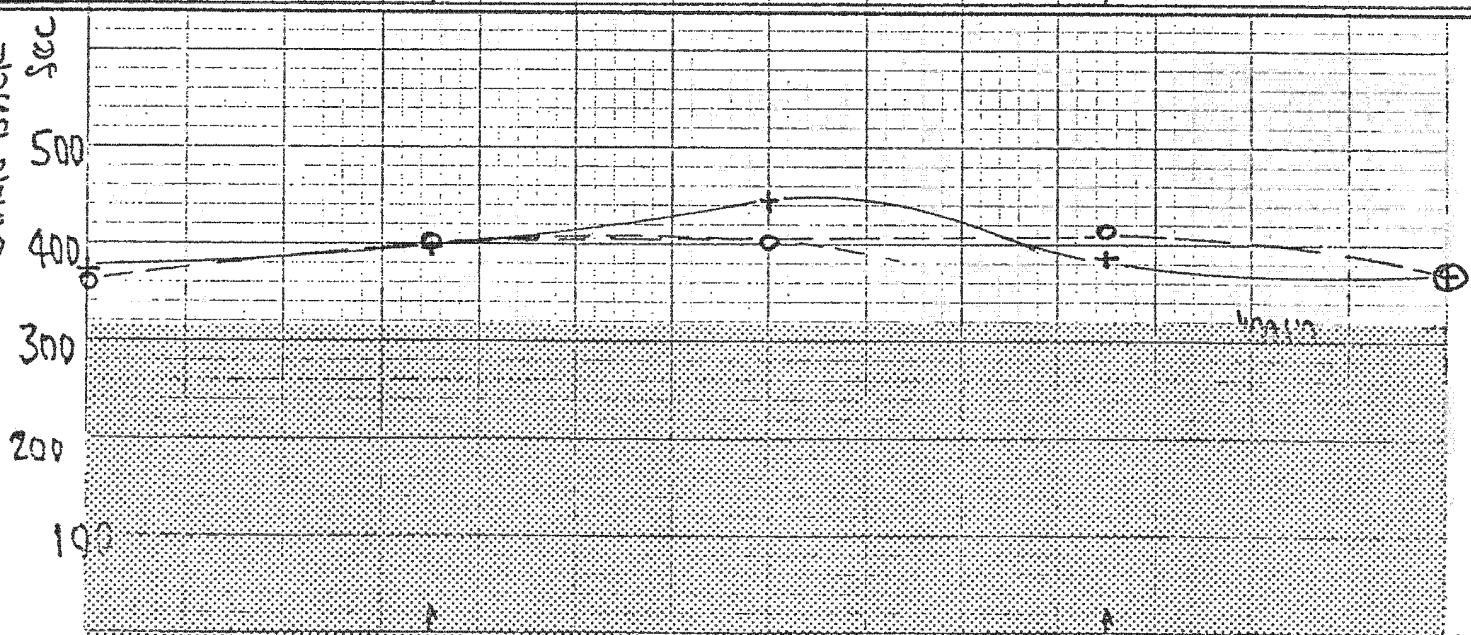
SUMMATION



INCH 4G OUGO
MADE IN U.S.A.
LOGSIL CO.



BURN BACK
sec



0% ANSUL R.I.
100% NAT'L

50
50

100 ANS
R.I.

COMPATIBILITY BY FOAMABILITY NAT'L / ANSUL R.I.

EXPANSION

+ FRESH
O SEA

AGED AS CONCENTRATE

1 1/2" x 5 x 5 TO 1/2" INCH 4G OUGO
MADE IN U.S.A.
KROFTEL & HUBER CO.

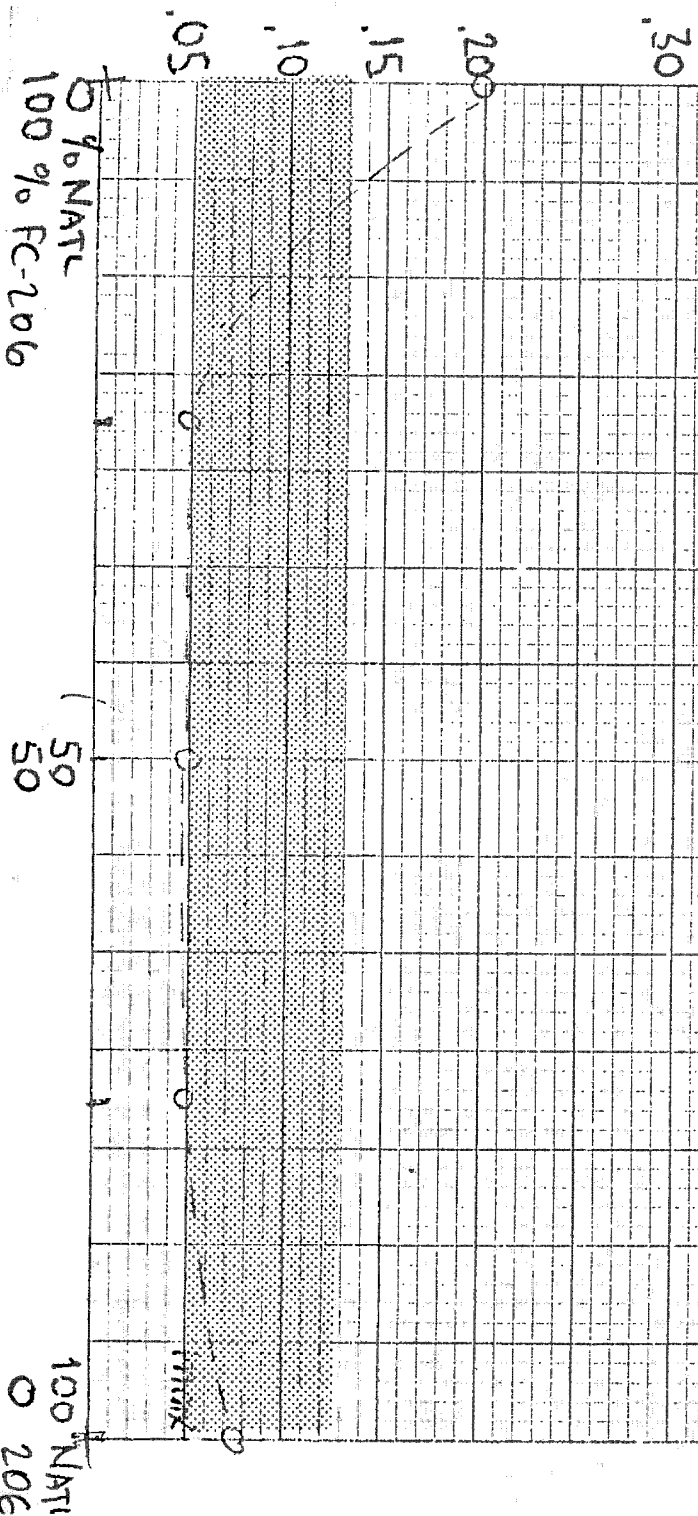
DRAIN TIME-min

100 NATL
0 % ANSUL R.I.

50

0 NATL
100 ANSUL R.I.

PRECIPITATION - %



COMPATIBILITY 87

HC-206/NATL

FILM FORMATION 3.15.4

no sign

no light

no ignit

no ignit

no ignit

STRATIFICATION

۱۷۹

hope

NONE

none

NONE

None

PRECIPITATION

৭৫৩

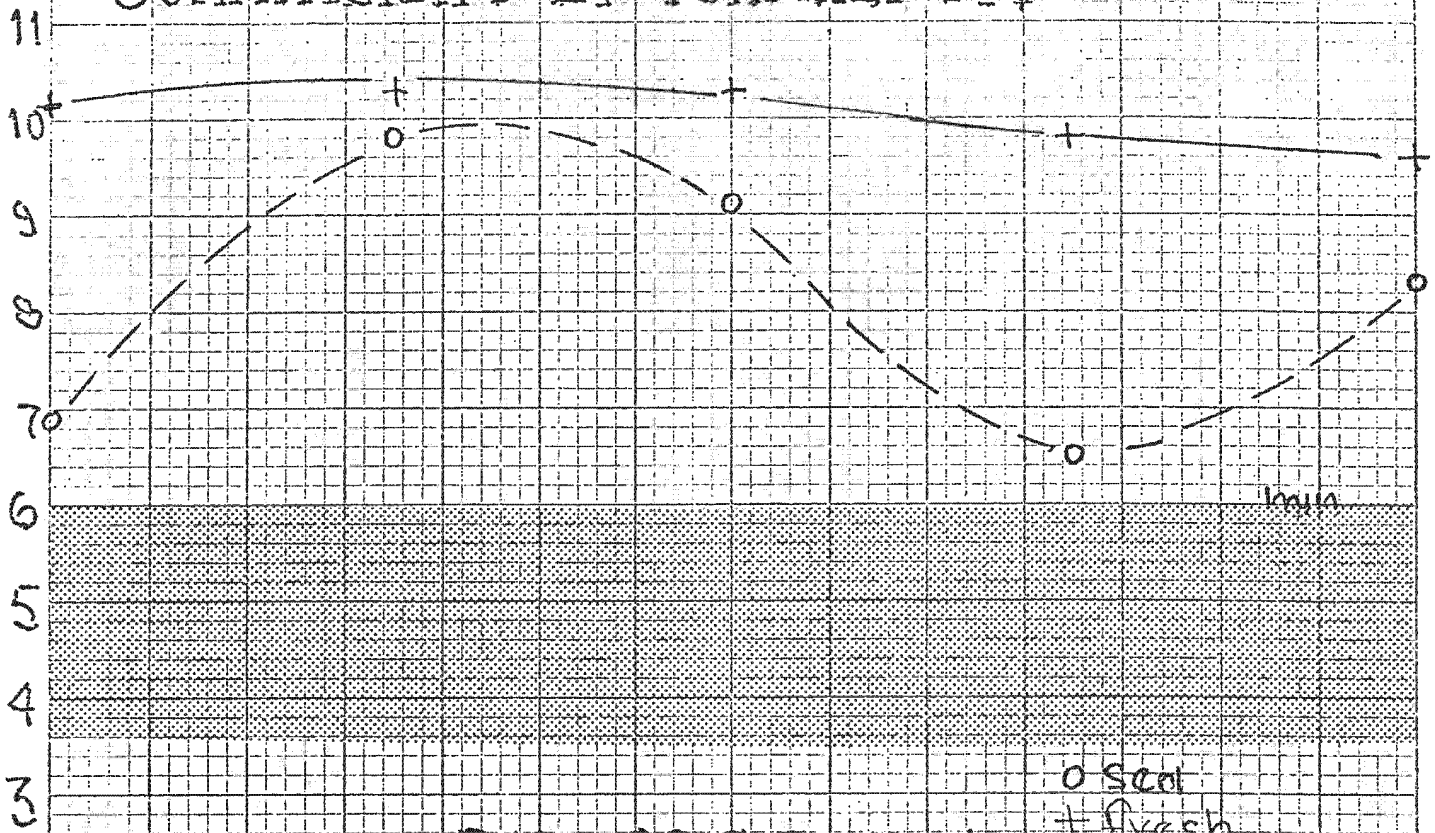
AGED AS SOUTH

fresh
0509

3.15.3

COMPATIBILITY BY FOAMABILITY

EXPANSION

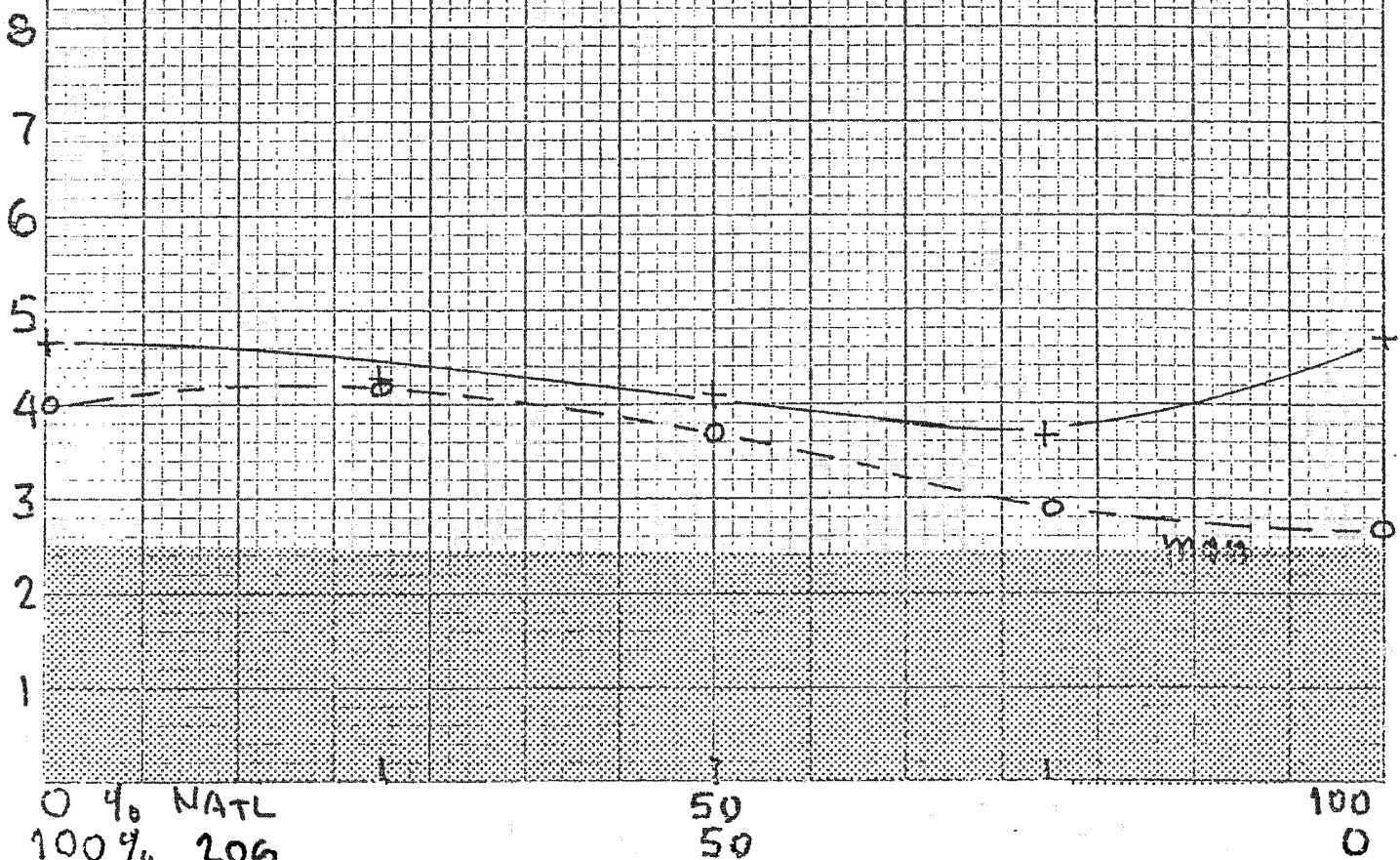


AGED AS SOLUTION

O Seal
+ Fresh

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DRAIN TIME - min



O 4, NATL
100% 206

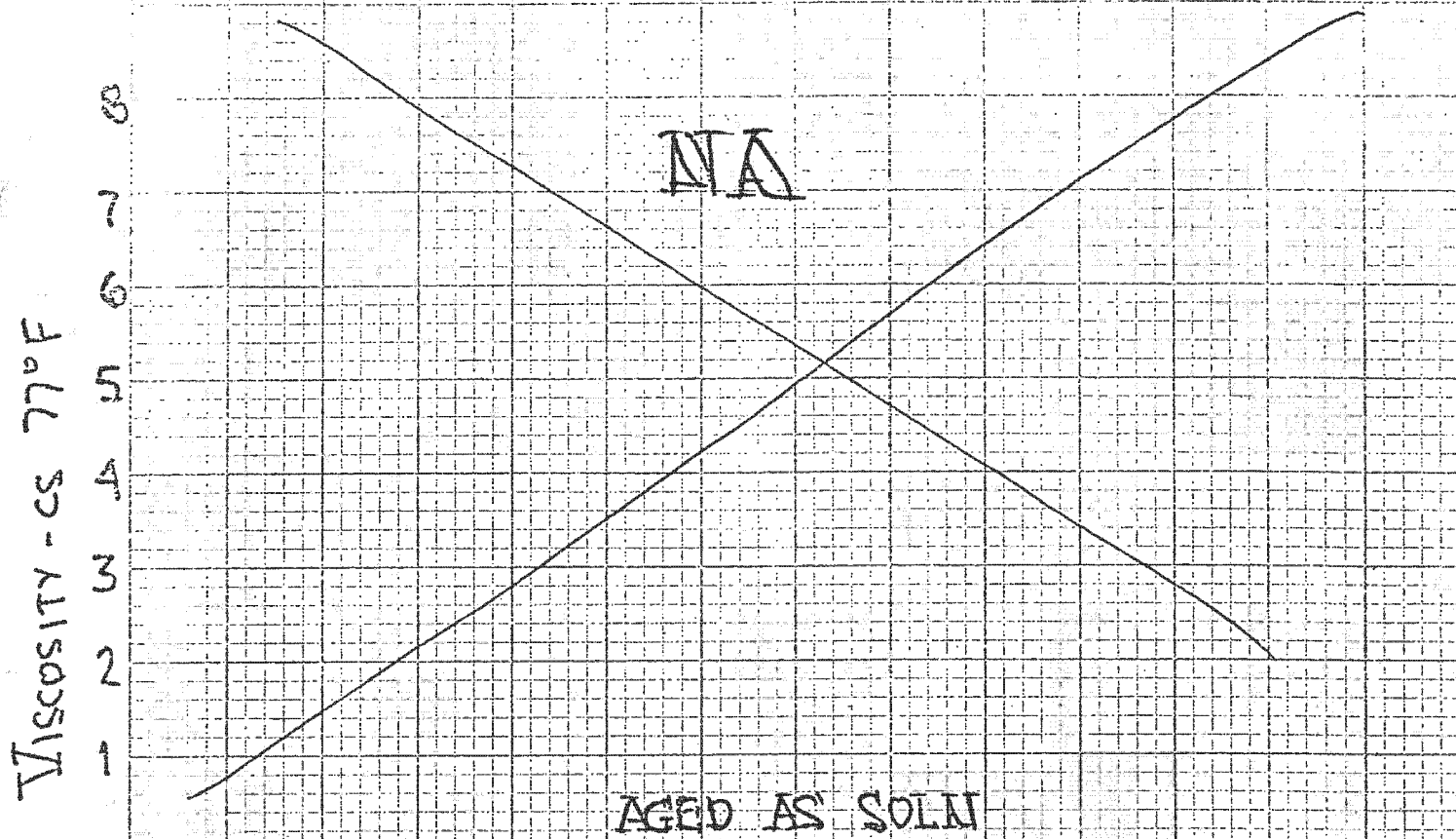
50
50

100
0

3.15.1

EC-206 / NATL

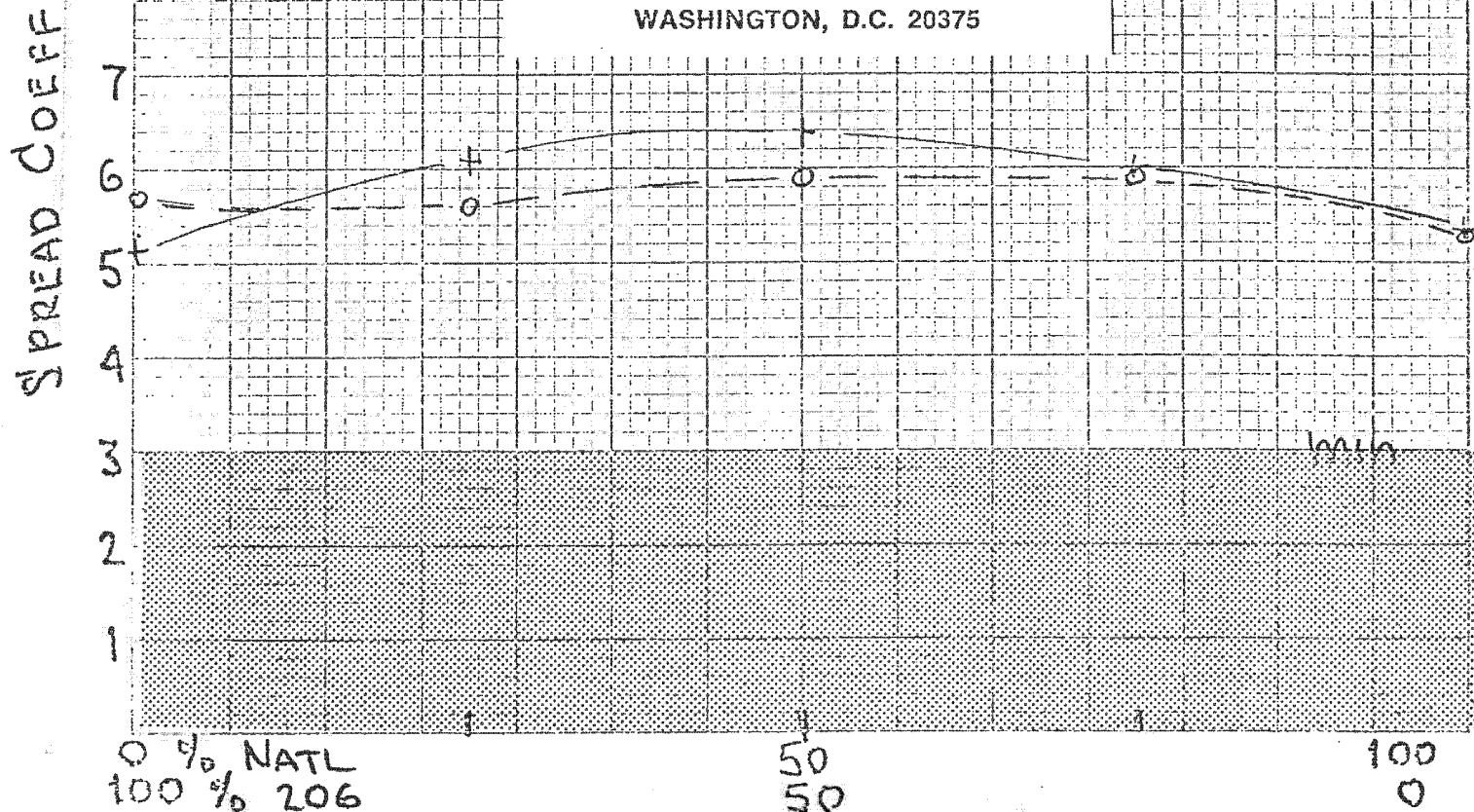
COMPATIBILITY BY VISCOSITY



3.15.2

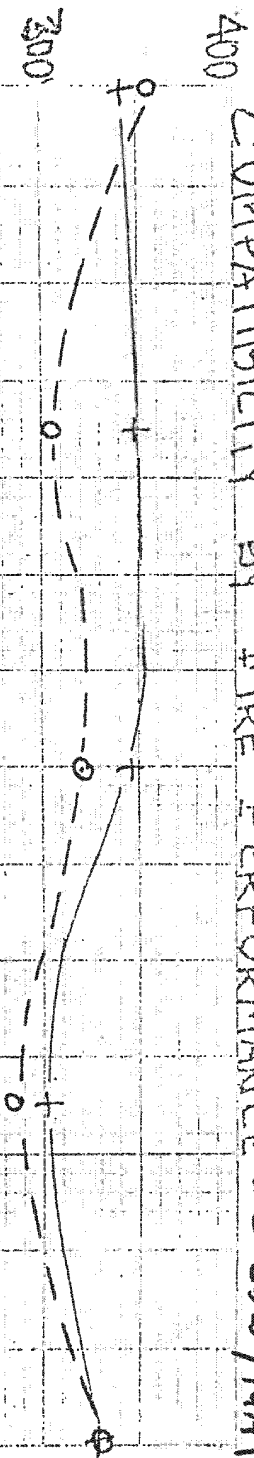
COMPATIBILITY BY SPREAD COEFF

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FIRE SUPPRESSION SECTION
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COMPATIBILITY BY FIRE PERFORMANCE HC-206/NATL

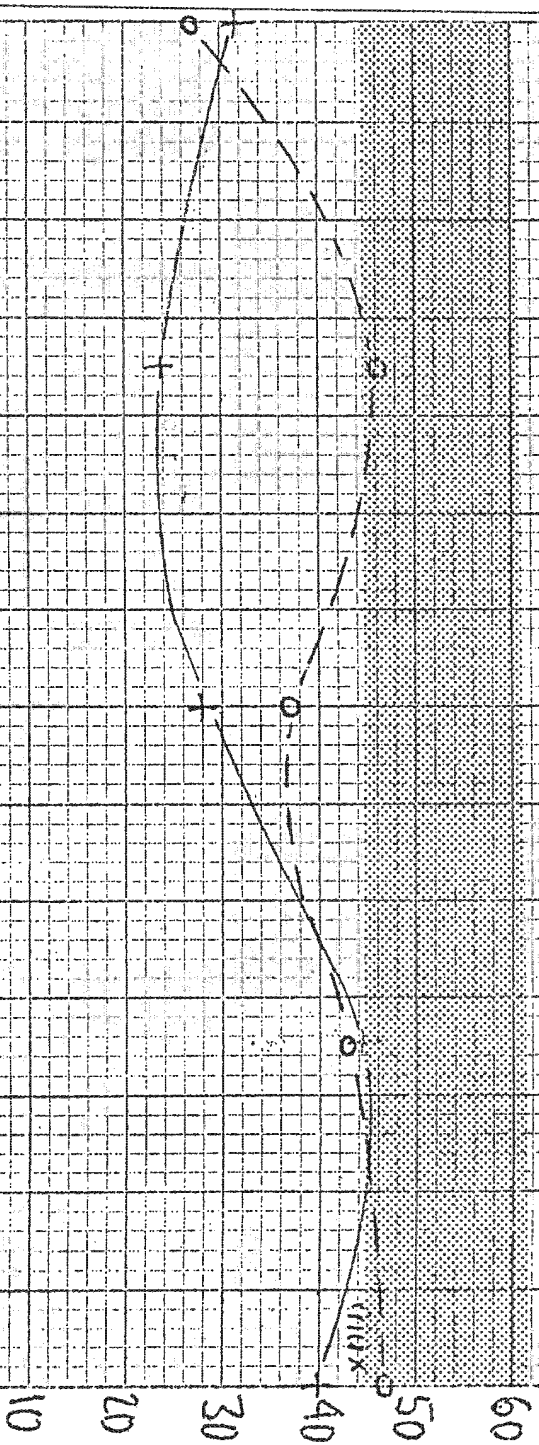
SUMMATION



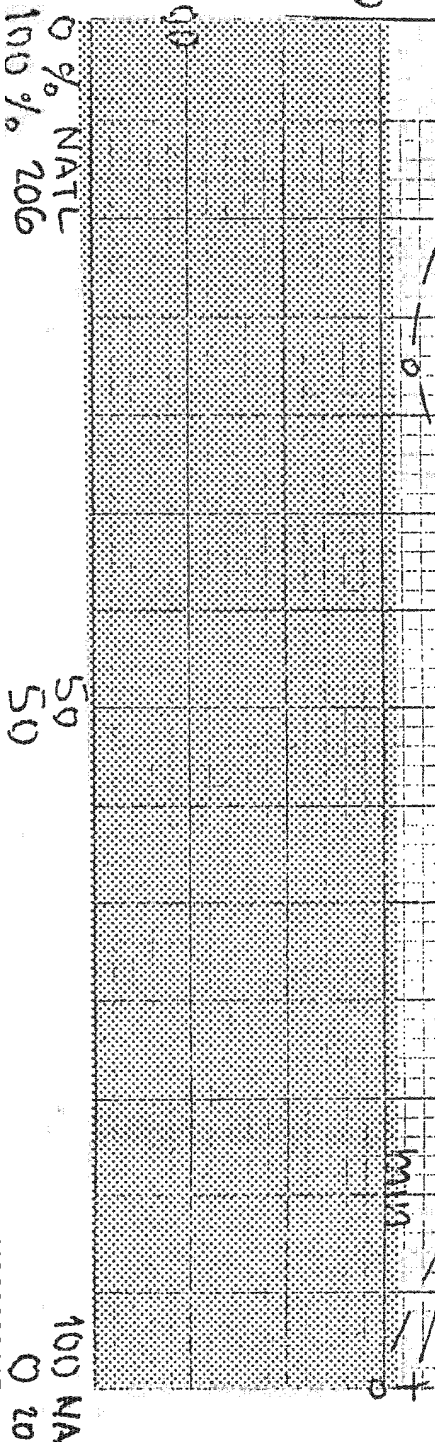
NAVAL RESEARCH LABORATORY
FIRE SUPPRESSION SECTION
WASHINGTON, D.C. 20375

AGED AS SOLID

0 Sec
+ fresh



BURN BACK Sec



COMPATIBILITY BY

FC-206/NATL

FILM FORMATION 3.15.4

no ignit

no ignit

no ignit

no ignit

no ignit

STRATIFICATION 3.15.6

none

none

none

none

none

DRECIPIRATION 3.15.6

AGED AS CONC

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FIRE SUPPRESSION SECTION
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DRECIPIRATION - %

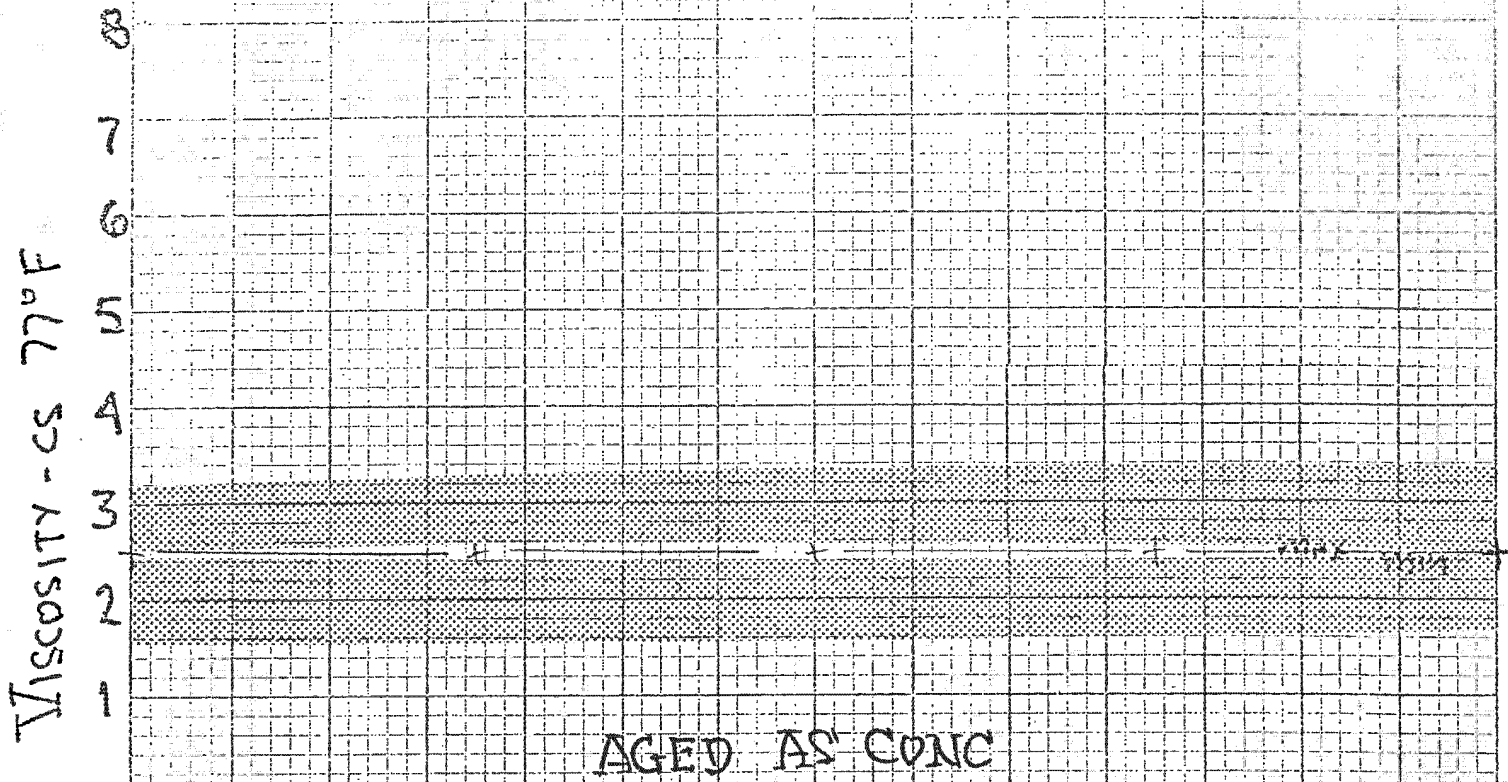
0% NATL
100 206

50
50

100 NATL
0 206

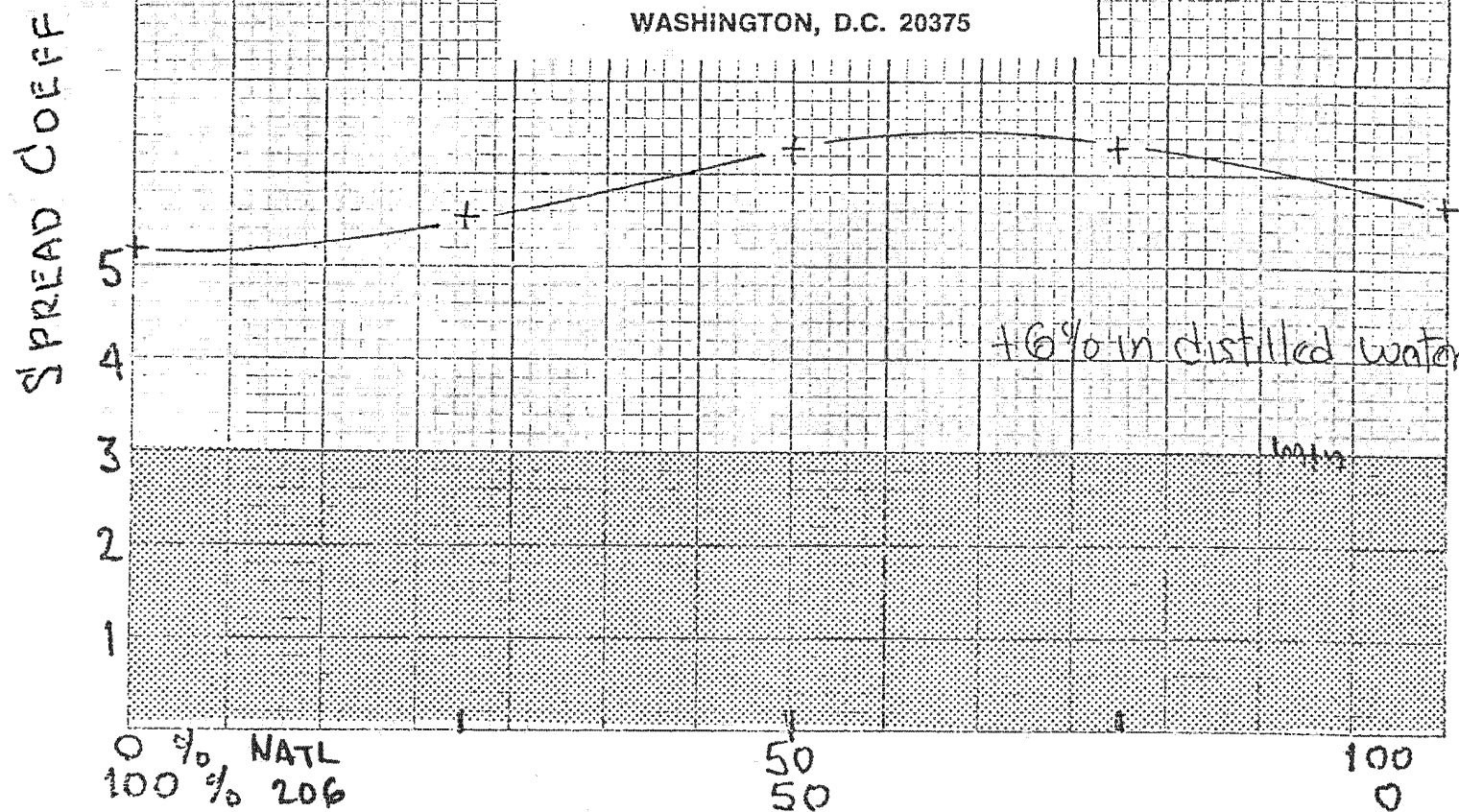
3.15.1 COMPATIBILITY BY VISCOSITY

EC-206/NATL



3.15.2 COMPATIBILITY BY SPREAD COEFF

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FIRE SUPPRESSION SECTION
WASHINGTON, D.C. 20375



3.15.3

COMPATIBILITY BY FOAMABILITY

EXPANSION

min

AGED AS CONC

o sea
+ fresh

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FIRE SUPPRESSION SECTION
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DRAIN TIME - min

min

0 4% NATL
100 4 206

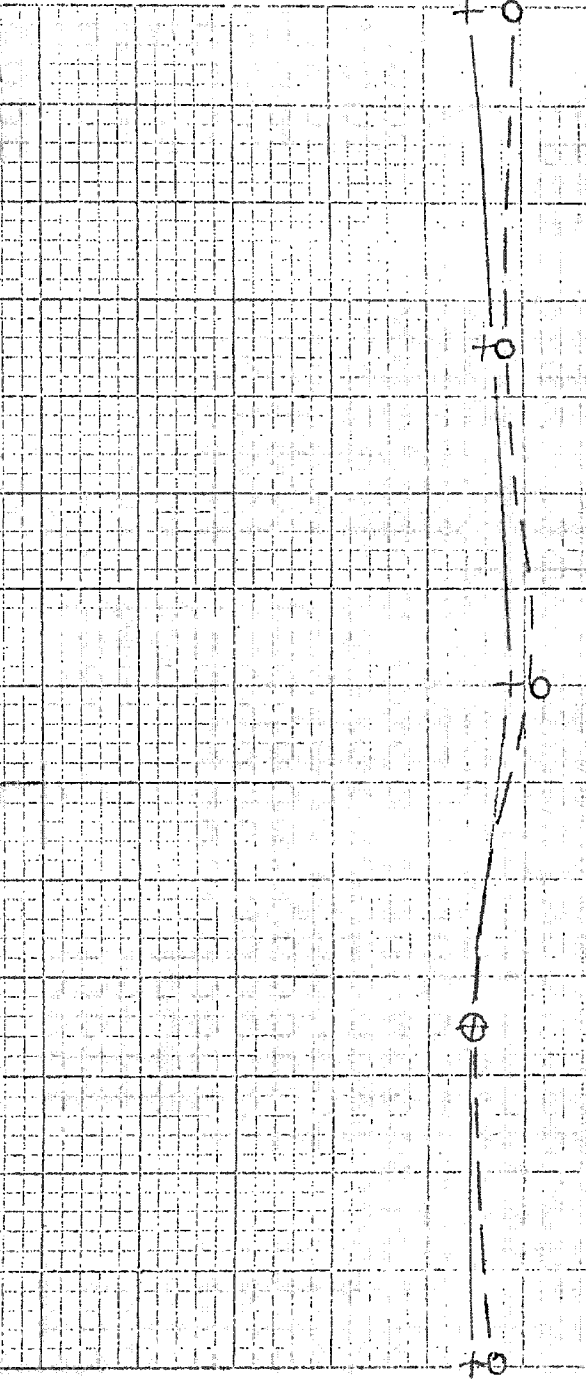
50
50

100
0

NAVAL RESEARCH LABORATORY
FIRE SUPPRESSION SECTION
WASHINGTON, D.C. 20375

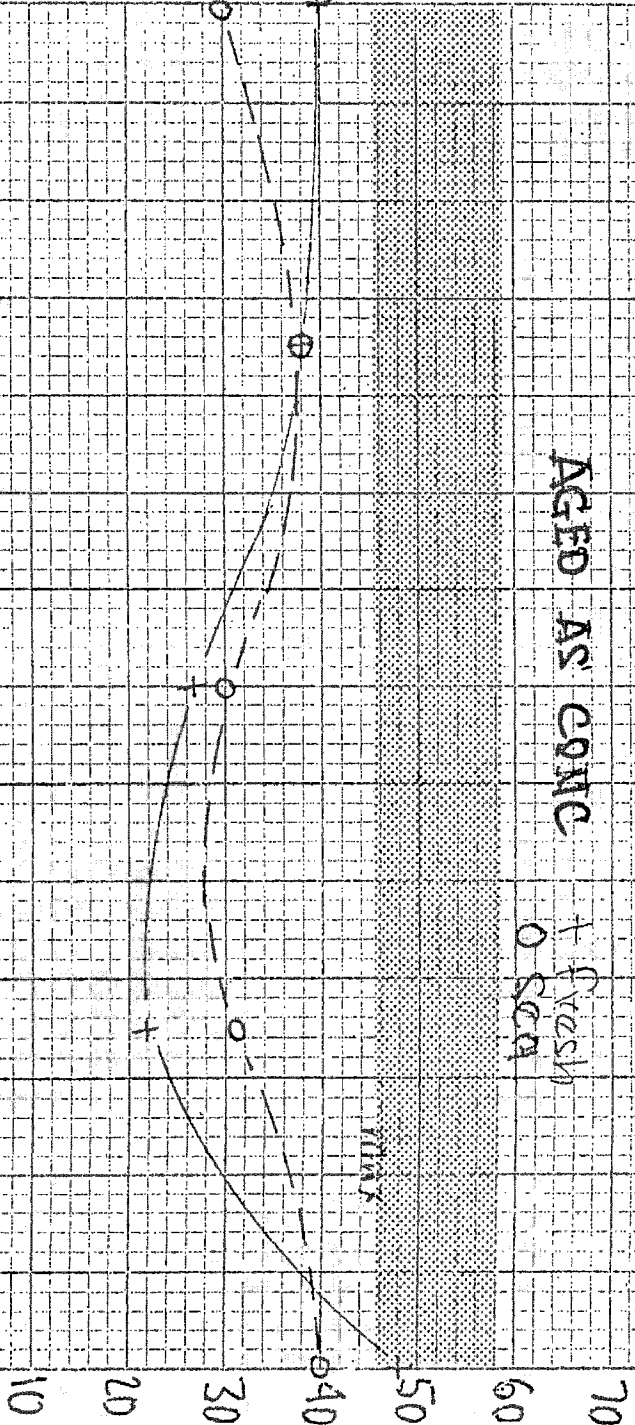
SUMMATION

COMPATIBILITY BY FIRE PERFORMANCE LVO/NATL

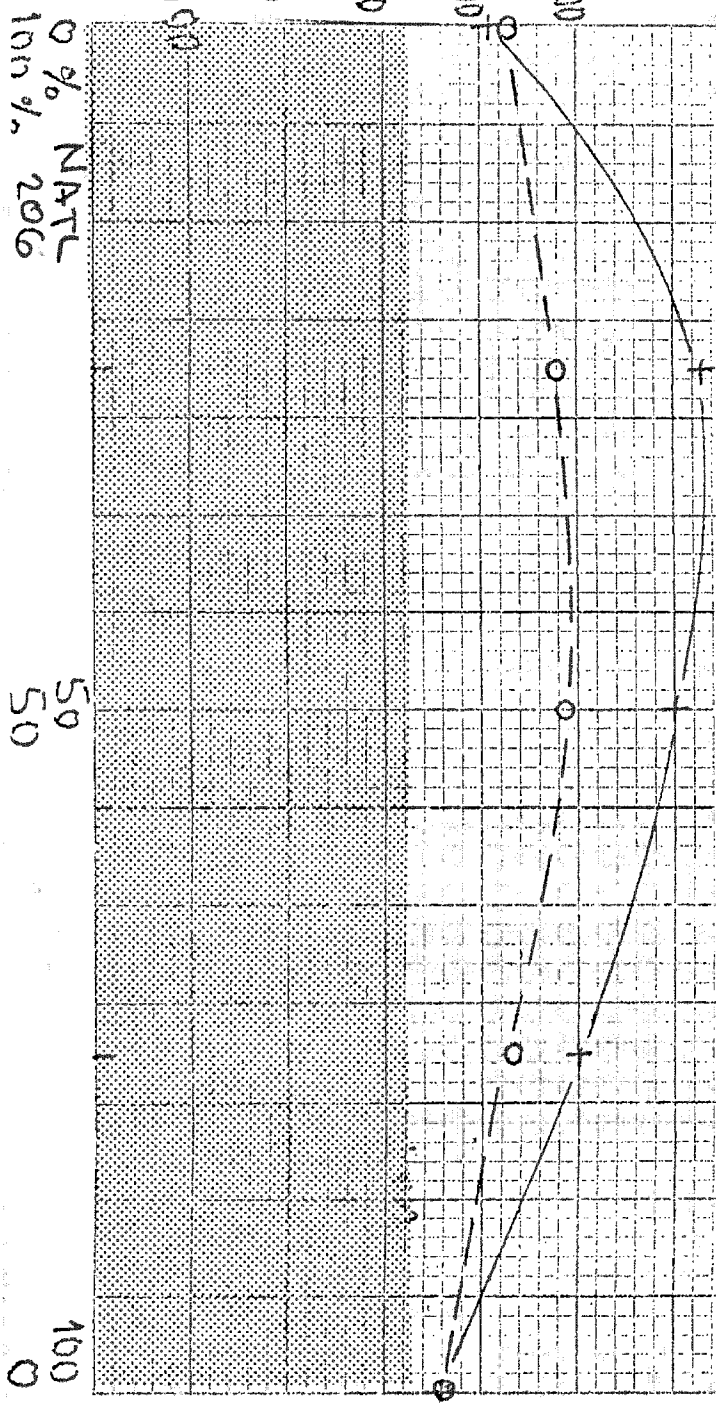


AGED AS CONC

+ fresh
o aged



BURN BACK
400 500 sec



0% NATL
100% 200

50
50

100
0