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This report is: ☐ INTERIM ☒ FINAL and mainly: ☒ NEW ☐ REVIEW

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DESCRIPTIVE SUMMARY WITH CONCLUSIONS:

Databooks: 22320, 22705, 22992, 23323, 23670, 24025, 25088, 24091, 24091, 24806, 22319, 22704, 23083, 23322,

PURPOSE

The purpose of this investigation was to develop a high quality, long life diaphragm.

SUMMARY

With improvements such as metal anodes and new cell design, the diaphragm is the weakest link in Dow's chlorine cell. In an effort to improve diaphragm quality, an intensive study was conducted on caustic drawn, Kynar® bonded, and Teflon® bonded diaphragms.

Some physical properties of the asbestos and diaphragms were identified and measured to aid in selecting the optimum diaphragm.

Various wetting agents were tried with the bonded diaphragms to aid in plant start up of the cells.

The TFE Teflon (Product 30) bonded diaphragm was selected as the optimum diaphragm for Dow's use.

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I. PURPOSE

The purpose of this study was to develop a high quality long life diaphragm for the Dow Chlorine Cells.

II. SUMMARY

To improve diaphragm quality, an intensive study was conducted on caustic drawn, Kynar bonded, and Teflon bonded diaphragms. Various physical properties were identified and measured in an attempt to optomize the diaphragms. The final selection of the optimum diaphragm was made based on data gathered from operating chlorine cells. The cell data was gathered from laboratory, intermediate, M-63, M-82, M-83 and M-121 chlorine cells. The diaphragm selected was a TFE Teflon bonded, blue/white asbestos diaphragm drawn from a 75 to 100 gpl aqueous sodium carbonate solution. The best diaphragms contained 1.08 to 1.16 grams per $in.^2$ asbestos and from 10% to 15% Teflon, Product 30. The most efficient had a relatively high permability and started up in the plant with 50 to 60 gpl caustic strength.

III. CONCLUSIONS

1. The optimum diaphragm for the Dow chlorine cell is a TFE Teflon bonded asbestos diaphragm.

2. The optimum weight for such a diaphragm should be 1.08 to 1.16 grams per square inch of cathode area or 375 to 400 pounds of asbestos for an M-82 cathode.

3. A 75 to 100 gpl aqueous solution of sodium carbonate was used to slurry the asbestos. This produces a homogeneous slurry and a diaphragm which will wet out easily in the cell.

4. Caustic drawn diaphragms lose their strength and dimensional stability in the first five days of cell operation.

5. Kynar bonded diaphragms lose their strength and dimensional stability progressively over a sixty day period.

6. After a diaphragm loses its strength and dimensional stability, it is prone to develop holes and tends to swell into the brine gap, causing poor brine circulation and low efficiencies. In the case of graphite anodes, the reduction in brine circulation increases the graphite wear rate.

7. The TFE Teflon bonded diaphragms retain their dimensional stability and 80% to 90% of their initial strength for more than eleven months in cell operation.

8. The FEP Teflon, Product 120, bonded diaphragms proved to be extremely hard to wet and usually required an alcohol or acetone soak prior to start up. This process was effective on diaphragms with less 10% FEP.

9. The sodium carbonate acts as the wetting agent for the Teflon bonded diaphragms.

10. The Triton DF-12 was found to be better than Triton X-100 or Triton X-114 wetting agents for the Kynar bonded diaphragms.

11. When sodium carbonate was used with Kynar, the Kynar latex emulsion was broken. The Kynar then sheets on the diaphragms and the walls of any containers associated with the drawing operation.

IV. INTRODUCTION

With the advent of metal anodes, new cell designs, and a higher cost for energy, the need for a more uniform diaphragm with greater dimensional stability, efficiency, and longer life was apparent.

To determine what this would be, three types of diaphragms were studied. They were caustic drawn, Kynar bonded and Teflon TFE bonded.

Some of the tests used to classify the diaphragms were:

1. The Franks Freeness Test, which measures the drain rate of the refined asbestos slurry.

2. A chemical resistance test, which soaked diaphragms in various liquids at elevated temperatures.

3. Gurley Air Flow Test, which measured the air permability of the diaphragms.

4. Mullen Burst Test, to determine the diaphragms resistance to rupture.

5. Diaphragm weights were used to optomize cell efficiencies.

6. Diaphragm thickness measurements were used to determine diaphragm uniformity.

A diaphragm screening program was conducted using a step-wise progression of laboratory mini-cells, ranging in size from 36 sq. in., 18 amp, to 1143 sq. in., 500 amp cells. The preferred diaphragms were then tested in M-82 cells on the test skid at chlorine 1. From the data gathered in the various test locations, diaphragms were drawn for production cells.

V. EXPERIMENTAL

A. Materials

The chrysotile, white, asbestoses used were: Bell 3T-700 and Bell 4T-800, Hooker 1 and Hooker 2. The crocidolite, blue, asbestos was Bell 713.

The TFE Teflon, Product 30 and FEP Teflon, Product 120 were obtained from E. I. DuPont De Nemours and Co.

The Kynar PVDF was obtained from Pennwalt Corp.

The surfactants used were Triton X-100, Trition X-114 and Triton DF-12 all obtained from Rohmand Haas Company.

The anti foam used was DB-31 obtained from Dow Corning Co.

The sodium carbonate was obtained from McKesson Chemical Co.

Product data sheets may be seen in Appendix A.

B. Apparatus

1. Refiners
   a. A Hydropulper was used for the small laboratory cell diaphragms.
   b. A Beloit-Jones Wood pulp refiner was used to refine the slurries for the production size diaphragms.

2. Franks Freeness Tester
   This was used to determine the drain rate of both types of refined asbestos slurries.

3. Ovens
   a. The laboratory and intermediate diaphragms were dried and bonded in electric ovens.
   b. The production size diaphragms were dried in a steam heated oven and bonded in a gas fired oven.

4. Cells
   a. The laboratory and intermediate cells were fitted with coated titanium anodes and matching punched plate cathodes.
   b. The M-63, M-82 and M-121 production cells used graphite anodes and the M-83 cells were fitted with coated titanium anodes.

5. Temperature Control
   The laboratory and intermediate cells used internal heaters to maintain production cell temperatures of about 70°C.

6. Gurley Hill Air Flow Tester
   This test was used to determine the air permeability of the laboratory diaphragms.

7. Mullen Burst Tester
   This test was used to determine the rupture resistance of the various diaphragms.

For information on the various equipment see Appendix B.

VI. PROCEDURE

1. Caustic drawn diaphragms were produced by mixing the asbestos with cell effluent. The asbestos concentration in the slurry was kept in the 12 to 15 gram per kilogram range. No mechanical refineing of the asbestos fiber was used to break up the fiber bundles. The asbestos was mixed into the cell effluent and the caustic chemically refines the fiber bundles. Then the diaphragms were drawn in an 8" x 9" or 9" x 33" drawing vat. The diaphragms produced in this manner contained 1.0 to 1.20 grams of asbestos per square inch of diaphragm area. This yields an M-82 equivalent weight of 344 lbs to 413 lbs.

   The diaphragms were dried at 100°C and baked at about 200°C for an hour. From this point they were tested either in a cell or some other prescribed test procedure.

2. The Kynar bonded diaphragms were produced by mixing asbestos in water to produce a 40 gram per liter slurry. This slurry was mechanically refined for a predetermined period to break up the asbestos fiber bundles. At this point a Frank Freeness measurement was taken on the slurry. This is done by taking a 2 g sample of the asbestos in a sized dipper, diluting the sample to one liter with water, draining the sample through the tester. The Frank Freeness test is run at 20°C. For further information on the specific Frank Freeness test method see Appendix B. When the desired Frank Freeness number was obtained the 40 gram per liter slurry was diluted to 12 to 15 gpl with water, Kynar, antifoam and a wetting agent were added. This slurry was mixed and drawn into diaphragms just as the caustic drawn diaphragms were. The diaphragms were dried at 100°C and bonded at 170°C for an hour.

3. The Teflon bonded diaphragms were produced much in the same manner as the Kynar bonded diaphragms. The differences were that TFE Teflon, Product 30, was used in place of the Kynar, 100 gpl sodium carbonate was used in place of the water and no other addatives were required. The diaphragms were drawn in the same vats as the caustic drawn and Kynar bonded diaphragms. The Teflon bonded diaphragms were dried at 100°C and bonded at 370°C for 30 minutes to 1 hour.

   The various test were conducted on these diaphragms.

VII. DISCUSSION OF THE TESTS

A. Frank Freeness Test

The Frank Freeness Test was the earliest test run in a diaphragm drawing operation. This was a test used in all of the Dow facilities where mechanical refining of the asbestos is used. However, it was found that this is a very subjective test and depends on many variables. The type and blend of asbestos used affect the freeness number as well as the type of refiner used to work the asbestos. A test of this type used on a daily basis in a plant using specific blends of asbestos and a single refiner may be a valuable correlation tool. However, the data generated in one plant does not translate to another operation.

Trends that can be seen with a Frank Freeness Tester are related to the type and amount of work applied to the asbestos. Generally, the higher the Frank Freeness number, a range of 0-100, the tighter the diaphragm of a given slurry will be. The high Frank Freeness number usually indicates more work and/or more asbestos fines in the slurry. If an excessive amount of fines are deposited in a diaphragm it will be light in weight, thin, and blister during cell operation.

For test results see Graph 1, this shows the different Freeness numbers generated from different types of asbestos.

B. Chemical Resistance at Constant Elevated Temperature

This was a test devised to further determine the diaphragm stability. It consisted of a series of one liter beakers with the various test solutions held at a constant temperature for several days. The results of this test may be seen in Table I.

All samples were stable in water, brine and cell effluent; in acid brine the Teflon, even at a low concentration seems to protect the white asbestos better than the Kynar. The Kynar bonded samples containing 25% blue asbestos also retained their strength in acid brine. The cell effluent containing 5% hypochlorite was particularly destructive to the 5% TFE Teflon dispersion bonded diaphragm. However, the 10% TFE Teflon dispersion bonded all white diaphragm held up very well.

C. Gurley-Hill SPS Tester

The Gurley-Hill SPS Tester is a device used to measure air permability or the porosity of the diaphragm. The specific information for this piece of equipment may be found in Appendix B

The air permeability of a diaphragm may be related directly to the initial brine flow and start up gpl caustic strength of that diaphragm. See Graph 2.

D. The Mullen Burst Tester
This piece of equipment was used to determine the burst strength of the diaphragms. It measures the rupture resistance of the diaphragm piece in per square inch (psi). Specific information on this piece of equipment may be found in Appendix B.

This test was used to determine diaphragm strength for caustic drawn, Kynar bonded and Teflon bonded diaphragms. It was very usefull in determing the bond life of both Kynar and Teflon in a cell which had been operated for a given length of time. See Graph 3.

E. Diaphragm Weights
Various weight ranges of diaphragms were prepared and run in the chlorine cells. The efficiencies of the different diaphragms were measured and correlated to the weights. These correlations may be seen in Graph 4. This shows that the optimum weight for an M-82 diaphragm is 375 to 400 pounds.

It was also determined that at higher current densities a lighter weight diaphragm was desireable.

F. Diaphragm Uniformity
Diaphragm uniformity is another of the physical properties that is essential to high quality diaphragm production. Observations of many production and small intermediate pocket type diaphragms lead to the disassembly of two M-82 cathodes with diaphragms on them. In each case the production units had rated the diaphragms as top quality. Four samples were taken from each side of each pocket and weight determinations made. From this information it was shown that the best diaphragms were not uniform and there was a vast weight variation from the edge of the pockets to the backscreen as well as from pocket to pocket. See Graphs 5 and 6.

Further observations of the drawing vats seemed to indicate that the asbestos slurries in sodium carbonate solutions were more homogenous than those in water. A homogenous slurry is essential to produce a uniform diaphragm.

G. Wet Out Study

A wet out study was conducted on Triton X-114 and Triton DF-12. Earlier work has shown Triton X-114 superior to Triton X-100. To conduct the test eight diaphragms were drawn from 100% white asbestos and containing 15% Kynar. The surfactant levels were as follows:

a) No surfactant — 2 diaphragms
b) 0.25% Triton X-114 — "
c) 0.25% Triton DF-12 — "
d) 0.125% Triton DF-12 — "

The wet out time was the time required for a 4" square piece of diaphragm to sink after being floated in tap water.

See Table II for the results of this test.

H. Kynar Bonded Diaphragms

Kynar bonded diaphragms drawn from sodium carbonate solutions were set up and run in the mini cells. These diaphragms wet-out readily and ran satisfactorily when 50 gpl to 275 gpl sodium carbonate solution was used.

When low levels of sodium carbonate, below 10 gpl, were used the Kynar forms a sheet over the surface of the diaphragm during the drawing procedure. When these diaphragms were bonded the Kynar sheet was hydrophobic and the diaphragms were very difficult to wet-out.

Very little work was done with the sodium carbonate drawn Kynar bonded diaphragms because of the superior quality of the Teflon counterpart.

Ref: TCL-011-L.R.

TABLE I

Stability Study of Asbestos Diaphragms

Formulation	days	water	brine	acid brine	cell effluent	cell effluent with hypochlorite
25 Blue/75 White Kynar bond Initial strength 75psi	3	45psi	40psi	35psi	40psi	40psi
	7	45	30	25	35	30
	14	45	30	25	35	35
	21	40	35	30	35	30
	28	40	35	25	35	30
	42	40	35	30	35	20
100%white 15%Kynar bond Initial strength 90psi	3	45psi	50psi	35psi	45psi	45psi
	7	40	40	25	35	35
	14	40	40	25	35	40
	21	45	40	25	35	35
	28	45	40	20	35	30
	42	45	40	20	35	20
100%white 5%TFE fiber 5%TFE dis Initial strength 45psi	3	40psi	45psi	40psi	45psi	30psi
	7	35	40	30	35	Disintegrated
	14	40	40	30	40	"
	21	40	35	30	35	"
	28	40	35	35	35	"
	42	40	35	35	40	"
100%white 5%TFE fiber 10%TFE disp. Initial strength 55psi	3					45psi
	7					40
	14					40
	21					40
	28					35
	42					35

WETOUT STUDY FOR KYNAR BONDED DIAPHRAGMS

CONDITIONS	UNBONDED	170 C remove	170 C 5 min bond	170 C 10 min bond	170 C 20 min bond
NO TRITON	2 min	-------DID NOT WETOUT OVER NIGHT-------			
0.25% X-114	30 sec	4 min 9 sec	4 min 20 sec	18 min 28 sec	30 min
0.25% DF-12	20 sec	26 sec	43 sec	45 sec	53 sec
0.125% DF-12	20 sec	38 sec	42 sec	55 sec	29 sec

TABLE II

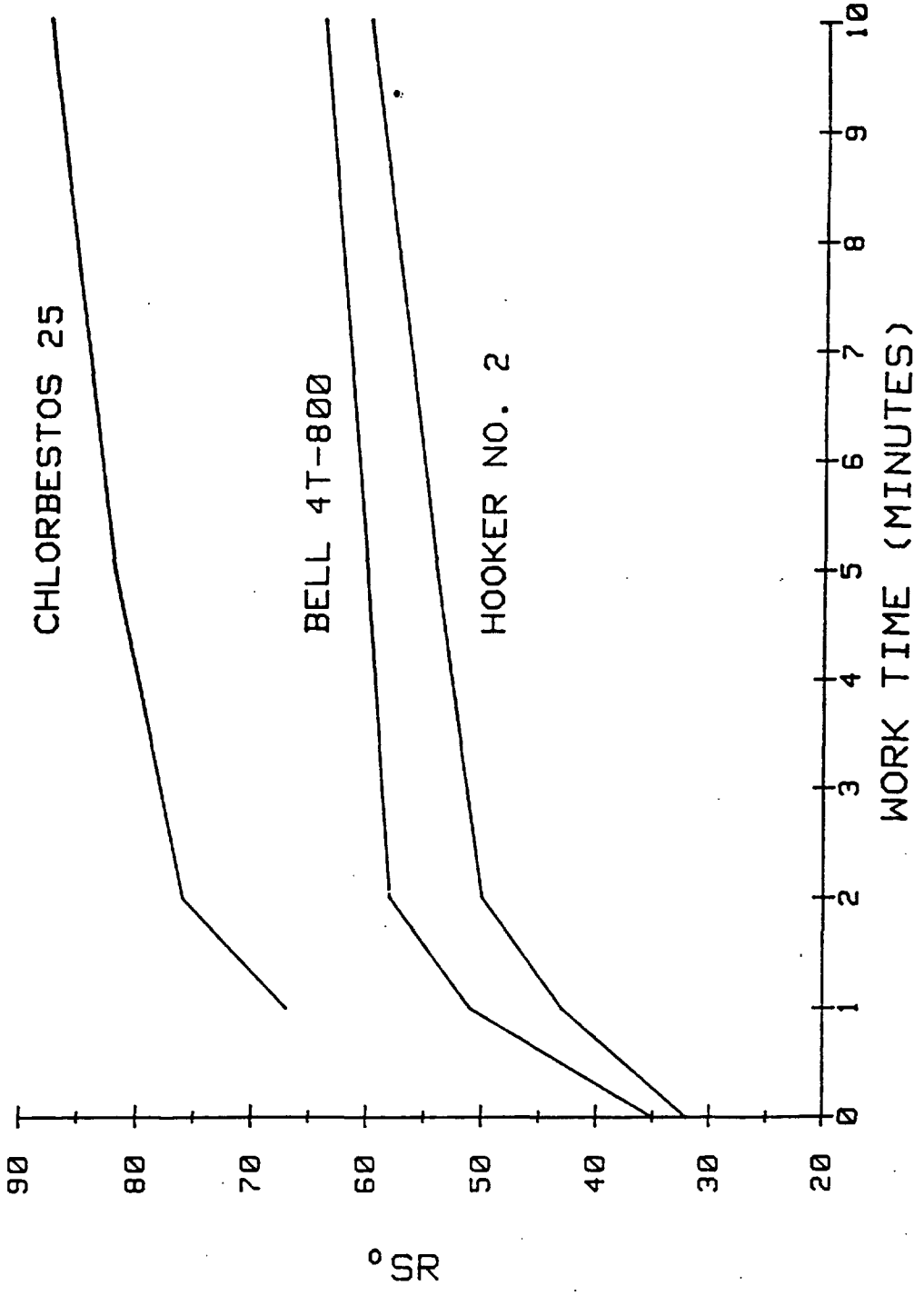
TABLE III

KYNAR BONDED DIAPHRAGMS DRAWN FROM SODIUM CARBONATE

GPL Na_2CO_3	BLUE/WHITE ASBESTOS	24 hr DATA		7 day DATA	
		VOLTS	GPL	VOLTS	GPL
50	100% white	2.732	54.0	2.801	80.0
50	100% white	2.689	61.2	2.657	76.0
275	25%/75%	2.911	93.2	2.921	98.8
275	25%/75%	2.882	98.8	2.967	114.0
275	25%/75%	2.932	102.8	2.936	104.8

GRAPH 1

FRANKS FREENESS VS WORK TIME
(HYDROPULPER)



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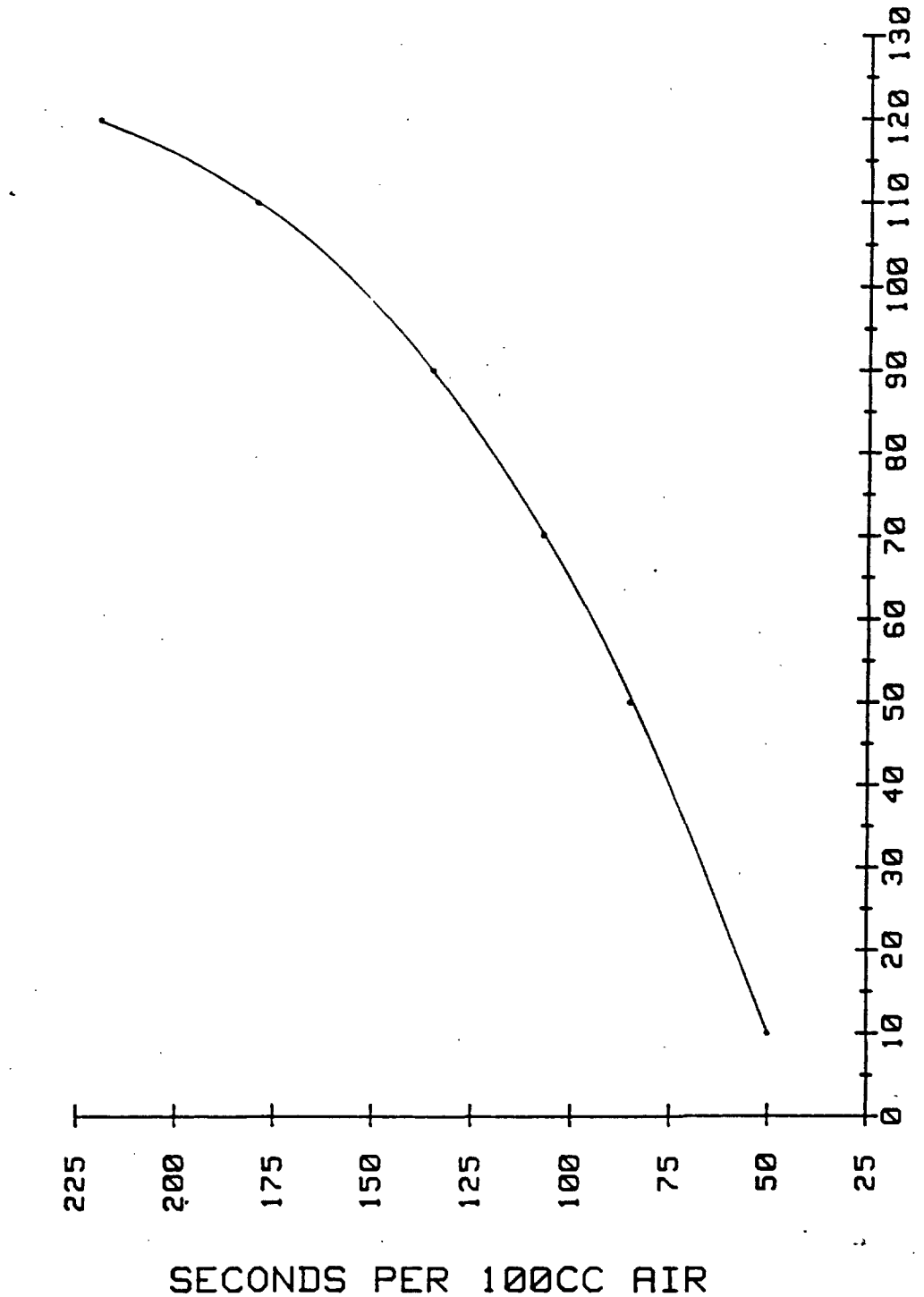
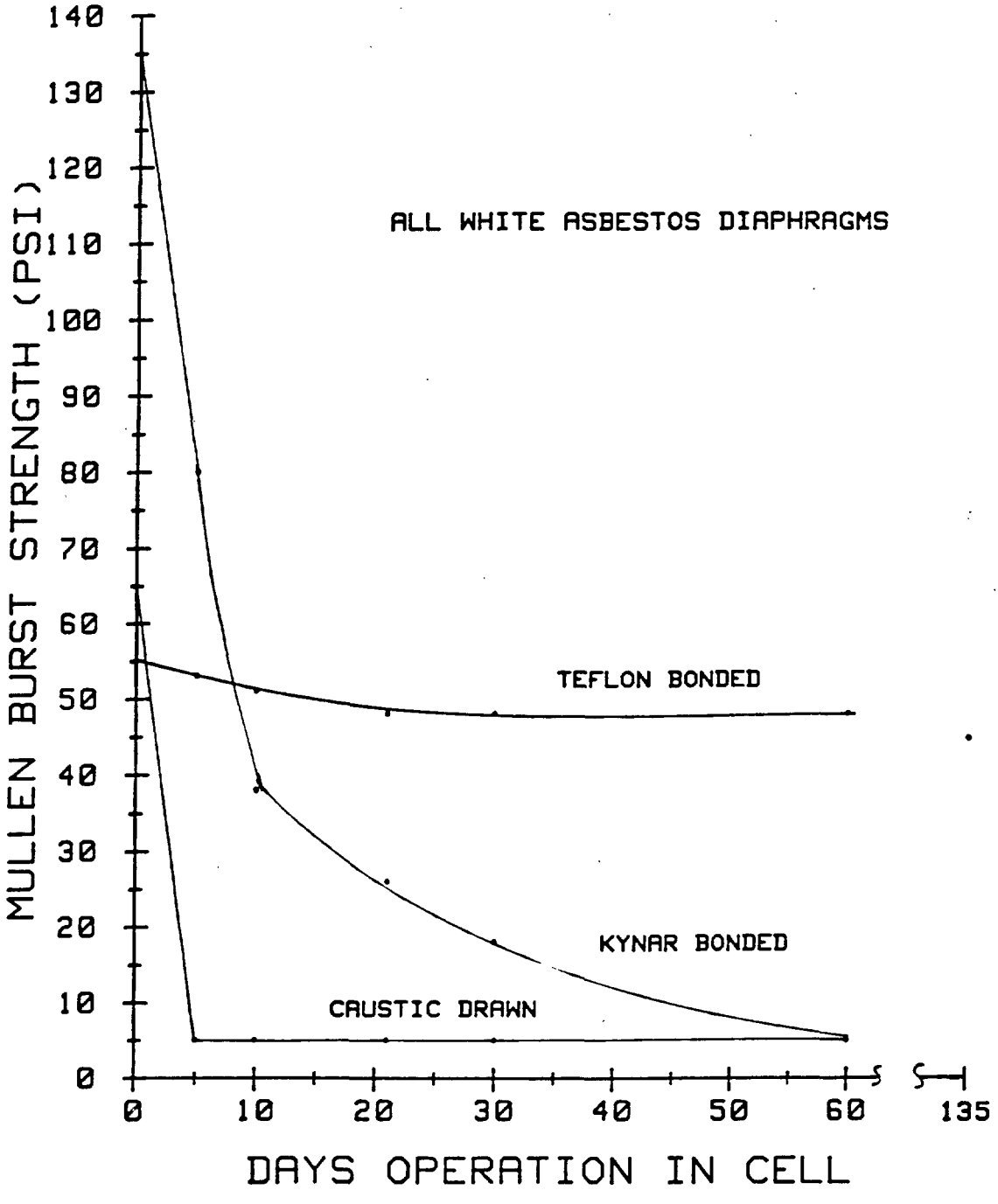
GRAPH 2

GURLEY AIR FLOW VS START-UP GPL



GRAPH 3

BOND STRENGTH VS OPERATING TIME



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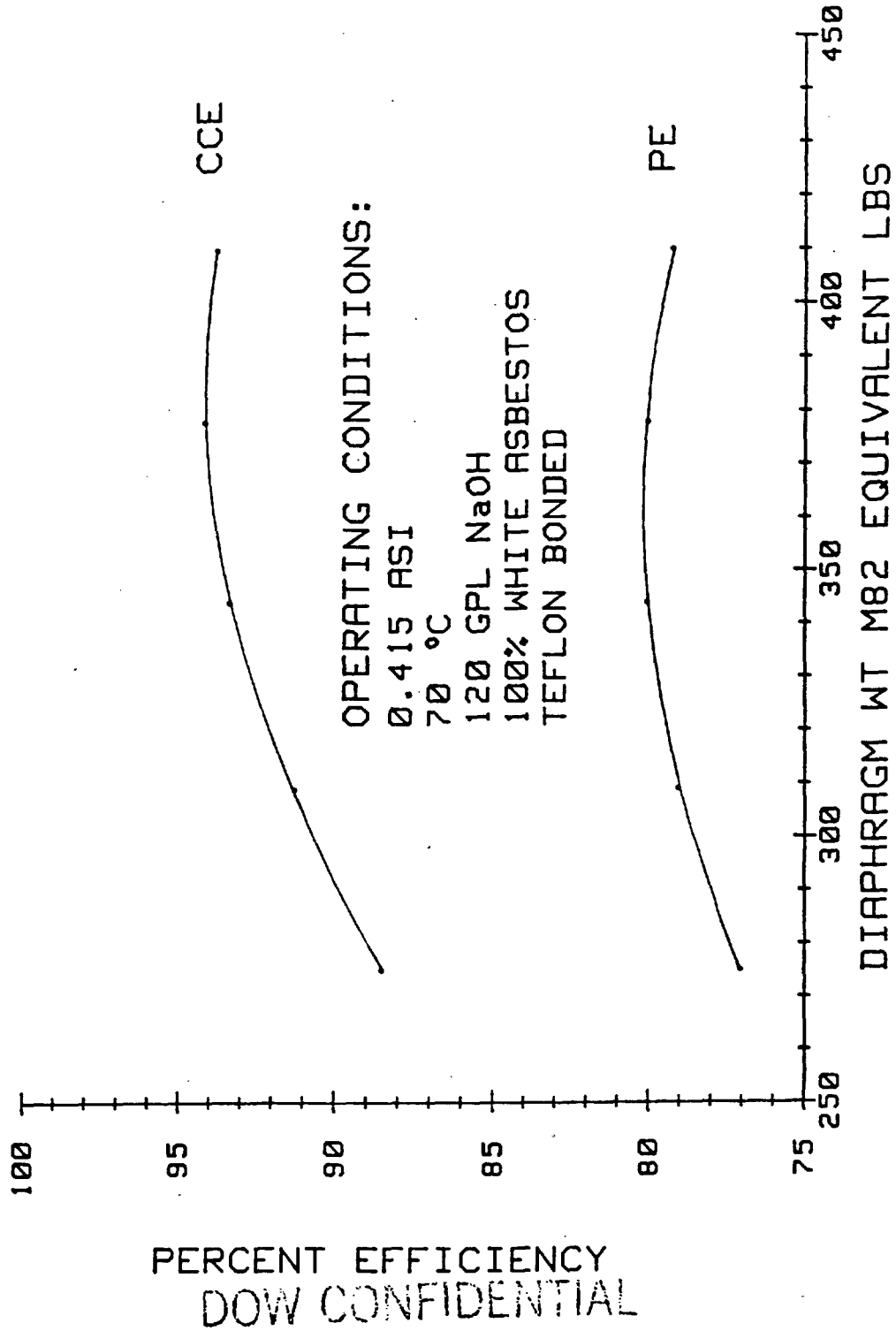
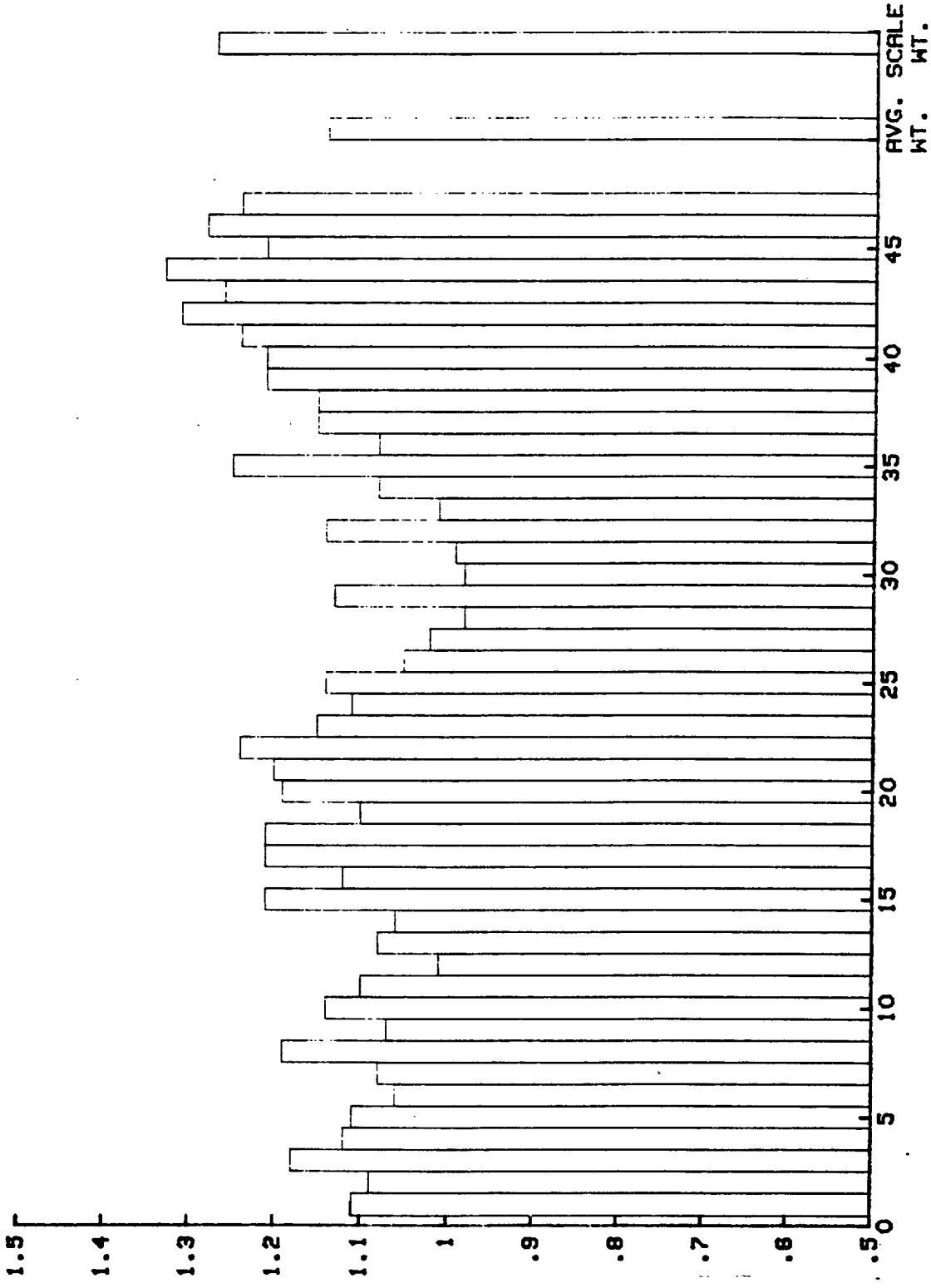
GRAPH 4

DIAPHRAGM WT VS CCE & PE



GRAPH 5

STADE DIVISION M82 DIAPHRAGM STUDY



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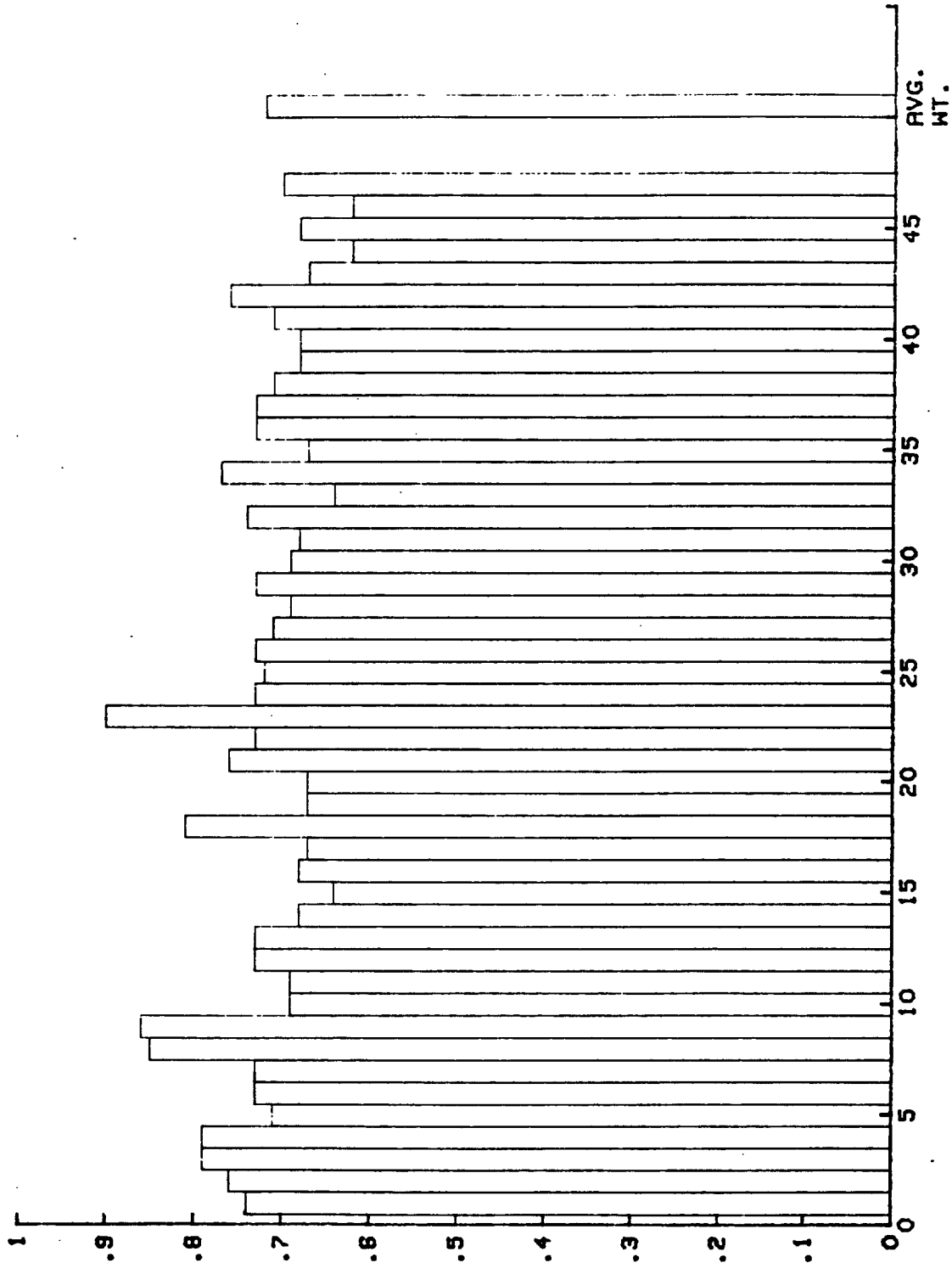
GRAPH 6

TEXAS DIVISION M82 DIAPHRAGM STUDY



Appendix A

CORPORATION
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RC-9332

RC-9332 is a polyvinylidene fluoride homopolymer in latex form containing a minimum of 15% NVM.

Tentative properties of the latex are:

Odor	:	None
pH of Latex	:	3-6 when shipped
Solids Content	:	20±5% NVM minimum
Freeze-Thaw Stability	:	Not stable to freezing
Latex Viscosity	:	4±2 cps (#1 spindle @ 60 RPM)
Density of Latex	:	1.10±.1 gm/cc
Density of Polymer	:	1.76 gm/cc
Shelf Stability	:	Unknown
Weight per Gallon	:	9.4 lbs.

RC-9332 latex possesses some resistance to coagulation when under shear.

The latex should be kept from freezing at all times. The latex is harmful if taken internally. Prolonged contact with skin and inhalation of a spray mist should be avoided. In case of contact with eyes, wash gently with copious quantities of water and seek medical attention.

Name	Composition	Percent Active Ingredient and Form	Activity	Principal Uses
Triton X-15	Octyl phenoxy ethanol	100%, liquid	nonionic	Oil-soluble emulsifier and coupling agent
Triton X-35	Octyl phenoxy diethoxy ethanol	100%, liquid	nonionic	Oil-soluble emulsifier and coupling agent
Triton X-45	Octyl phenoxy polyethoxy ethanol	100%, liquid	nonionic	Biodegradable oil-soluble detergent, emulsifier – water dispersible
Triton X-100	Octyl phenoxy polyethoxy ethanol	100%, liquid	nonionic	Biodegradable household and industrial detergents, emulsifier
Triton X-102	Octyl phenoxy polyethoxy ethanol	100%, liquid	nonionic	Biodegradable liquid household detergents with increased water solubility, high-temperature detergent
Triton X-114	Octyl phenoxy polyethoxy ethanol	100%, liquid	nonionic	Biodegradable controlled sudsing laundry detergent, emulsifier
Triton X-165	Octyl phenoxy polyethoxy ethanol	70%, aqueous solution	nonionic	High-temperature detergent
Triton X-305	Octyl phenoxy polyethoxy ethanol	70%, aqueous solution	nonionic	High-temperature detergent
Triton X-405	Octyl phenoxy polyethoxy ethanol	70%, aqueous solution	nonionic	High-temperature detergent
Triton N-40	Nonylphenoxyethanol	100%, liquid	nonionic	Emulsifier and dispersant. Emulsification of aliphatic solvents.
Triton N-42	Nonylphenoxyethanol	100%, liquid	nonionic	Emulsifier and dispersant. Emulsification of aliphatic solvents.
Triton N-57	Nonyl phenoxy polyethoxy ethanol	100%, liquid	nonionic	Oil-soluble detergent, emulsifier – water dispersible
Triton N-60	Nonylphenoxyethanol	100%, liquid	nonionic	Emulsifier and dispersant. Emulsification of aliphatic solvents.
Triton N-101	Nonyl phenoxy polyethoxy ethanol	100%, liquid	nonionic	Biodegradable water-soluble detergent, emulsifier
Triton N-111	Nonylphenoxyethanol	100%, liquid	nonionic	Emulsifier and dispersant. More water-soluble than Triton N-10
Triton N-150	Nonylphenoxyethanol	100%, liquid	nonionic	Wetting agent, water-soluble detergent, emulsifier
Triton CF-10	Alkyl aryl ether	100%, liquid	nonionic	Low-foam household and industrial detergents, dish rinse
Triton CF-21	Alkyl aryl polyether	100%, liquid	nonionic	Low-foam household and industrial detergents, dish rinse
Triton CF-32	Amine polyglycol condensate	95%, liquid	nonionic	Low-foam detergent, dishwashing
Triton CF-54	Modified polyethoxy adduct	100%, liquid	nonionic	Low-foam household and industrial detergents, dish rinse
Triton CF-76	Modified polyethoxy adduct	100%, liquid	nonionic	Low-foam machine dishwashing detergent
Triton CF-87	Modified terminated alkyl aryl ether	90%, liquid	nonionic	Rinse-aids; powdered alkaline detergent formulations
Triton DF-12	Modified polyethoxylated straight chain alcohol	100%, liquid	nonionic	Biodegradable, low-foam household and industrial detergents, rinse aids
Triton DF-16	Terminated ethoxylate of linear primary alcohols	100%, liquid	nonionic	Low-foam detergent; particularly suitable for rinse aids and stable in acid formulations
Triton DF-18	Modified polyethoxylate alcohol	90%, liquid	nonionic	Biodegradable, low foam detergent designed for use in mechanical dishwashing detergents, food processing machinery, spray metal cleaners.
Triton DF-20	Biodegradable, modified ethoxylate	100%, liquid	anionic	Biodegradable, low foam detergent

Information about Silicone Defoamers

DOW CORNING

DOW CORNING® DB-31 ANTIFOAM EMULSION

Type	Silicone emulsion
Physical Form	Creamy liquid
Special Properties	Excellent longterm antifoaming performance even in alkaline solutions
Primary Use	Control of aqueous foamers
Benefits	Immediate defoaming action combined with longterm foam prevention; water dilutable; 30 percent active defoamer

DESCRIPTION

Dow Corning DB-31 antifoam emulsion is a water-dilutable 30-percent silicone defoamer offering:

- Immediate defoaming action
- Longterm foam prevention
- Good stability, as supplied and when diluted with water
- Defoaming and antifoaming action in alkaline solutions

In laboratory tests, Dow Corning DB-31 antifoam emulsion outperforms other defoamers in almost every case, under a wide variety of conditions, including hot, cool, alkaline, and non-alkaline systems. Less antifoam is needed than with previous antifoams, resulting in cost savings.

During storage, Dow Corning DB-31 antifoam emulsion will not break or oil even under warehouse conditions as hot as 130 F (54 C). If creaming should occur, only gentle agitation is necessary to completely redisperse the emulsion. This emulsion is also stable through several freeze-thaw cycles.

USES

Dow Corning DB-31 antifoam emulsion controls aqueous foamers over a wide range of industrial processes and products. However, it is not intended for use in food or drug processing.

HOW TO USE

1. Dow Corning DB-31 antifoam emulsion should be stirred or agitated before removing it from the shipping container.

2. Between 5 and 50 parts of Dow Corning DB-31 antifoam emulsion per million parts of foamer are required in most systems.

3. Dilute the antifoam emulsion with at least 3 parts of water or of the aqueous foamer, before adding it to the system.

4. Add the diluted antifoam either directly to the system or to one of the foamer components.

PACKAGING

Dow Corning DB-31 antifoam emulsion is supplied in containers of 40 pounds, 360 pounds and 440 pounds, net weight.

TYPICAL PROPERTIES

These values are not intended for use in preparing specifications

Chemical Type	Silicone emulsion
Color	White
Specific Gravity at 77 F (25 C)	1.0
Consistency at 77 F (25 C)	Creamy liquid
pH	4 to 5
Active Defoamer, percent	30
Type of Emulsifier	Nonionic
Suitable Diluent	Water

DOW CORNING CORPORATION, MIDLAND, MICHIGAN 48640

Atlanta Boston Brussels Chicago Cleveland Dallas Greensboro Honolulu
Los Angeles New York San Francisco Sydney Tokyo Toronto

Printed in U.S.A.

Form No. 22-030A-76

Samples bulletins technical information. suggestions on formulation. and advice on labeling will be promptly supplied if you will write or phone one of these offices

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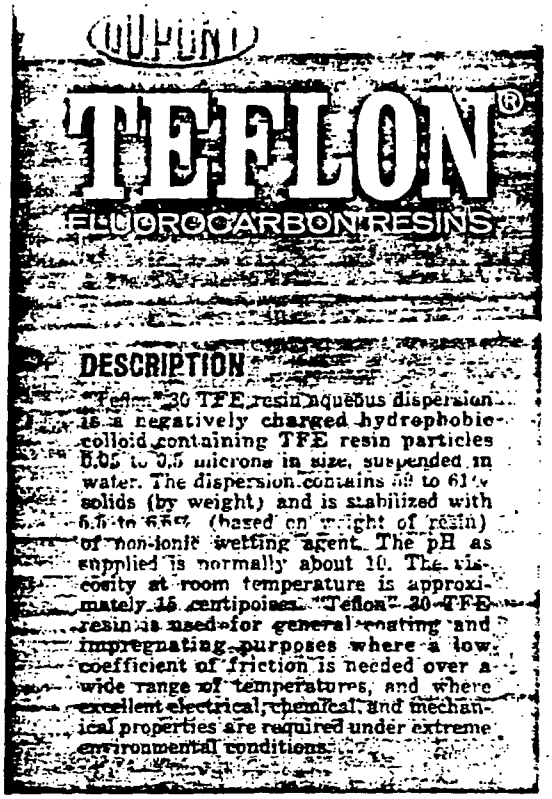


TFE-FLUOROCARBON RESIN

STORAGE AND HANDLING

"Teflon" 30 TFE dispersion will settle on prolonged standing or on heating above 150°F. It can be redispersed by mild agitation. Stock being stored for an indefinite period should be redispersed at least every two weeks by inverting or gently rolling the container. High-speed stirring or violent agitation should be avoided and the product should be protected against freezing since these conditions will cause irreversible coagulation. The dispersion should also be protected from the atmosphere to prevent coagulation by drying. The optimum storage temperature range is from 45 to 75°F. The product should be rolled or stirred gently just prior to use.

TYPICAL PROPERTIES

Property	Units	ASTM Method	Value
Specific gravity of dispersion (60% solids)	—	Hydrometer	1.50
Resin weight (60% solids)	lb./gal.	—	7.5
Melting point	°C.	ASTM D-1457-62T	327 ± 10
Specific gravity (sintered resin)	—	ASTM D-1457-62T	2.18-2.26
Color	—	—	White

PROCESSING

"Teflon" 30 TFE resin dispersions are applied as coatings, cast as film, or impregnated into a variety of porous structures by conventional dipping or flowing procedures. After application, the dispersion is heated to about 250°F. to remove the water. Water-repellent structures with useful properties can be obtained by simply applying pressure to the coated materials, such as by calendering or molding. If a strong, continuous film is to be obtained, however, the deposited polymer must be sintered after drying. Sintering is usually done at 680° to 700°F.

The pH of the dispersion can be reduced by adding organic or inorganic acids. Care must be taken in adding these reagents since excessive acidity will cause irreversible coagulation. The viscosity and wetting power of the dispersion can be increased by adding wetting agents such as anionic or non-ionic dispersants. Non-ionic dispersants are usually preferred since they are more volatile and thus can be removed by heat. (Cationic reagents should ordinarily be avoided since they coagulate the dispersion). The techniques outlined above are described in more detail in Plastics Department Bulletin X-50c.

PACKAGING

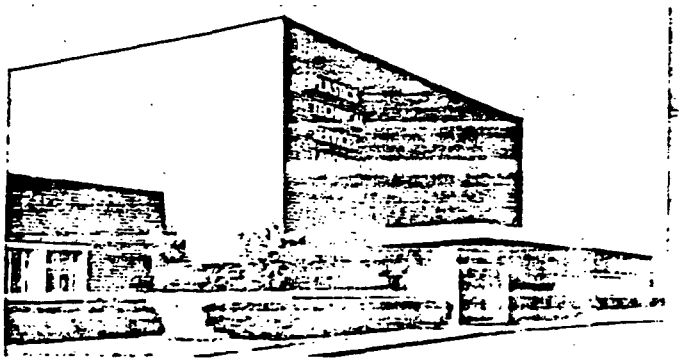
"Teflon" 30 TFE resin dispersion is packaged in 1-gallon, cube-shaped polyethylene containers in fiberboard boxes, and in 5- and 30-gallon nonreturnable drums.

FREIGHT CLASSIFICATION

"Teflon" 30 TFE resin dispersion is shipped by rail classified as "Synthetic Resins NOIBN without filler", by truck as "Plastic Material

from Plastics Technical Services Laboratory about

processing techniques



. . . designed to keep field representatives of the Marketing Section abreast of the information rapidly being accumulated, in advance of conclusive research findings. This information is subject to change as further development work is completed, and is not to be considered final.

PROPERTIES AND PROCESSING TECHNIQUES FOR "TEFLON" 120 FEP-FLUOROCARBON RESIN DISPERSION

"Teflon" 120 FEP-fluorocarbon dispersion is a new member of the expanding family of "Teflon" fluorocarbon products. It combines the processing advantages of both a low fluid viscosity and a low melt viscosity together with the well-known chemical, electrical, and mechanical properties of "Teflon" FEP-fluorocarbon resin. This union of dispersion, melt flow, and end-product virtues is expected to lead to many uses as a surface coating and impregnant, particularly in the wire and cable field. This preliminary information bulletin describes its properties in dispersion and end-use form, provides recommended processing conditions, and indicates end-use markets where we feel it is useful. Since much of this information parallels similar matter given in greater detail in Information Bulletin X-50d, "'Teflon' 30 Aqueous Dispersion - Properties and Processing Techniques", we suggest that both bulletins be studied.

Composition

"Teflon" 120 FEP-fluorocarbon dispersion is a water based dispersion of hexafluoropropylene-tetrafluoroethylene copolymer particles and compares with "Teflon" 30 TFE-fluorocarbon dispersion as shown in Table I.

Appendix B

TELEDYNE GURLEY

Troy, N. Y. 12181

INSTRUCTIONS FOR USING GURLEY-HILL S-P-S TESTER

1. Set on level surface. Remove the inner cylinder and fill the outer cylinder with oil to depth indicated by a ring cut about halfway up on the inner surface (about half full).

2. Raise the inner cylinder until the spring pointer engages it under its flange. (Never raise the inner cylinder while the sample is clamped between the orifice plates — to do so will suck oil into the air tube).

POROSITY (AIR RESISTANCE) TESTS

3. An Adapter Plate is furnished with new instruments. The Adapter Plate has synthetic elastic gaskets (see Note) on its upper and lower faces, and a hollow stem, which centers and supports it, when pushed up into the central air tube which leads to the upper clamping plate. The purpose of the Adapter Plate is to enable the Gurley-Hill S-P-S Tester to make porosity tests under the same conditions now prescribed for Air Resistance Tests under TAPPI and ASTM Standard Methods Nos. D460-m49 and D726-58. These methods require that Gurley Densometers be fitted with an elastic gasket between the paper surface and the source of air pressure, and were so modified because it was found impossible to prevent all lateral leakage of air between the paper sample and the flat smooth metal plate. The Adapter Plate is to be used only when making Porosity tests. It must be removed when making a Smoothness or Softness test.

4. Remove the perforated lower test plate from the central pin which supports it. Push the tube of the Adapter Plate up into the central air tube as far as it will go, so that the top gasket is in good contact with the upper clamping plate. Replace the perforated lower plate.

5. Insert paper sample between the orifice plates. Clamp it by turning the capstan handle clockwise (or equally well, by using the lever arm with the 2 lb. weight in position).

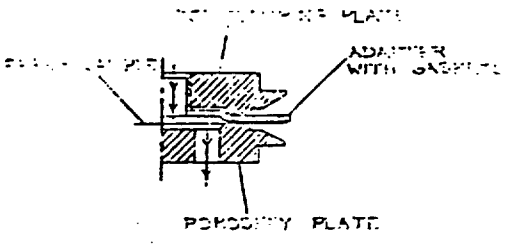
6. Disengage the spring support from under the flange of the inner cylinder, lower the inner cylinder gently until it floats in the oil, and allow it to settle under its own weight.

7. Enough oil must be added so that the inner cylinder will have a steady motion by the time the zero line reaches the edge of the top ring of the outer cylinder.

8. Start stop watch or timer when the zero line reaches the edge of the top ring of the outer cylinder. Stop it when one of the engraved lines reaches the edge. This may be the 25 cc or 50 cc line for a very impermeable sample, or any other line up to the 300 cc line for very porous samples. Where any volume other than 100 cc is used, the reading is usually converted into the elapsed time in seconds for 100 cc.

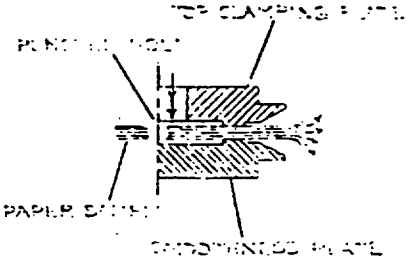
The grooves are concentric with the aperture in the opposing orifice plates, and are 0.020 inch deep. The gasket protrudes about 0.011 inch above the metal plate. The inside diameter of the groove is 1.128 inches, and the gasket has an area of approximately 0.48 sq. inch. The addition of the gasket does not change the standard orifice area. Gaskets should be replaced when they become frayed, scratched, or otherwise damaged, and replacement gaskets are obtainable from the Factory. Only moderate, even clamping pressure is needed to give air resistance tests free from surface leakage.

Principles of Tests with S-P-S Tester



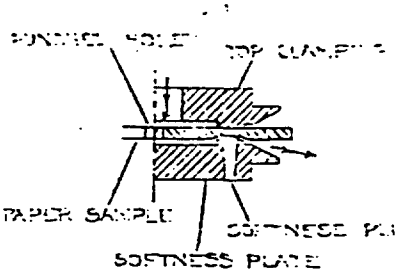
Porosity Test

One square inch of paper is exposed to the air pressure exerted by the inner cylinder floating in oil. The rate of air flow through the paper is its porosity. Air escapes through holes in the bottom clamping plate. Elastic gaskets on the adapter plate prevent leakage over the surface.



Smoothness Test

The rate of lateral air flow between several sheets of paper depends upon the smoothness or roughness of their surfaces. By taking the time for 50 cc. of air to escape, as measured on the inner cylinder, the smoothness is measured. The test can be adapted for paper boards and other materials.



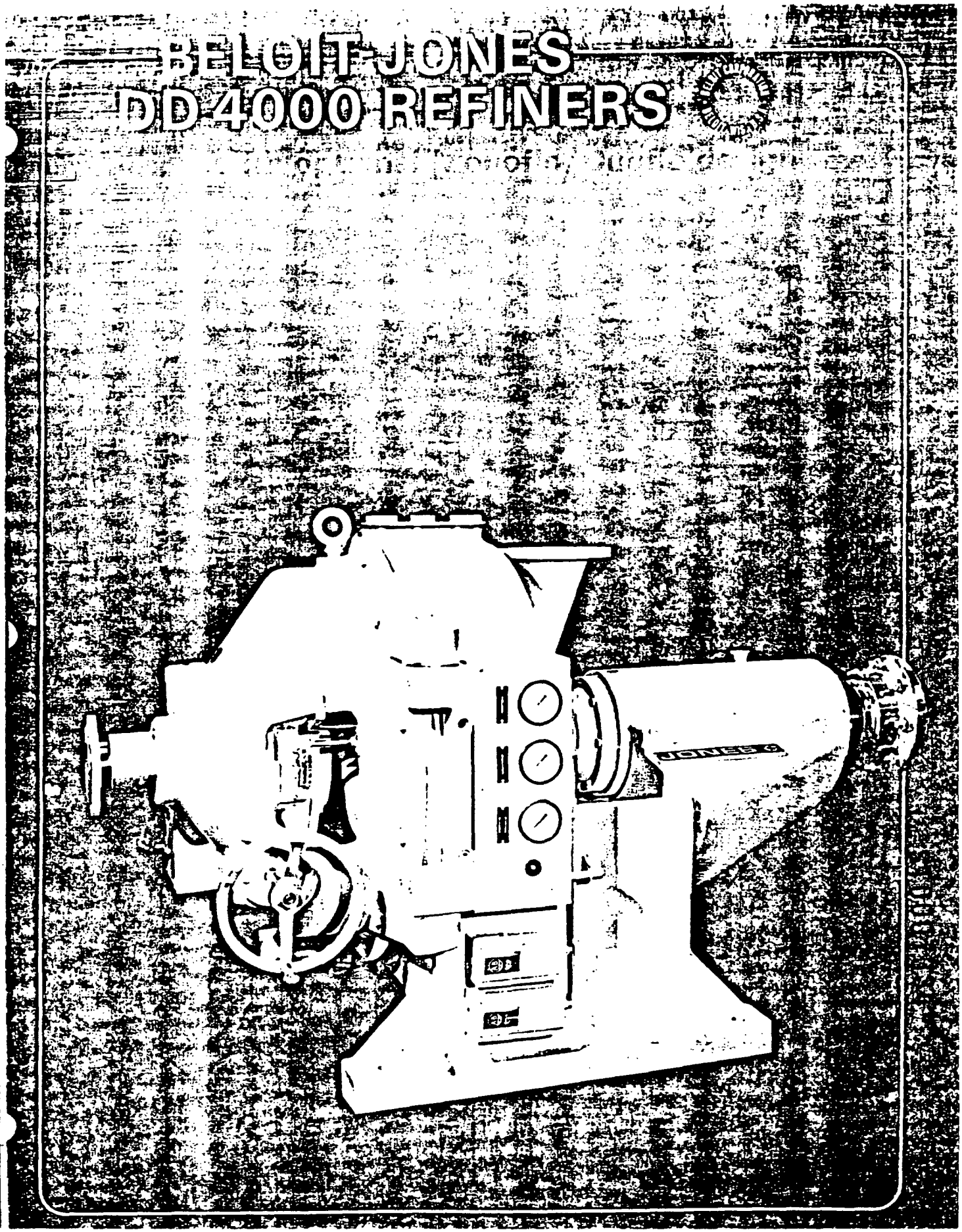
Softness Test

Four softness plugs, forced into the paper sample by the weight and lever arm, consti the space for air-escape, d pending upon how deeply th plugs compress the paper. T resulting rate of air flow is measure of the paper's softness, or compressibility.

Parts for S-P-S Testers

Part No.	Model No.		Part No.	Model No.	
22182	4102	Inner cylinder, 20 oz.	23857		Weight, 0.34 lb.
22249		Cylinder stop	23883		Paper punch
23875		Upper clamping plate, no gasket, 1 sq. in. orifice	23884		Paper punch spring
			B1871		Oil, Velocity E, quart
23877		Lower clamping plate, porosity test		4130	Automatic timing attachment, complete
23876		Lower clamping plate, smoothness test	22317		Upper shutter
			22318		Lower shutter
23878		Lower clamping plate, softness test	X-1		Screw, shutter to frame
			22316		Frame
23868		Lifter pin, lower plate	X-16		Screw, frame to cylinder
27966	4195	Adapter plate with gaskets, porosity test	21074		Rollers, pair
				4109	Electric stop timer 110V 60 cycle
23856		Weight, 2 lb.			

BELOIT-JONES
DD-4000 REFINERS



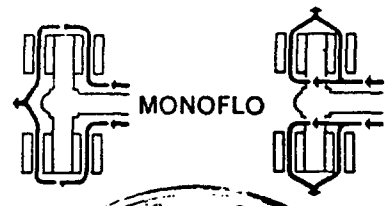
BELOIT-JONES DD 4000 REFINERS

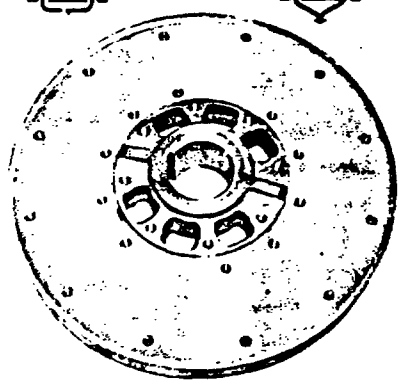
Beloit-Jones DD 4000 refiners are manufactured specifically for pulp or paper mill operation. They are equipped with an electromechanical positive-action disk positioning system which is the most accurate, dependable, and stable system available for uniform processing of stock. Beloit-Jones DD 4000 refiners offer maximum versatility for present and future needs.

OPTIONAL MONOFLO/DUOFLO INSTALLATION

In Monoflo, the machine is in two-pass operation with the stock being refined in series as it passes first over one set of disks, followed by a pass over the second set — a feature unique to Beloit-Jones — offering you two units in one machine. Duoflo applications employ a rotor* that permits half of the incoming stock to pass through to the eye of the second set of disks. Stock passes in parallel across both sets of disks, rejoins, and leaves the unit through a single outlet. Duoflo operation requires only that the covers over the spoked rotor be removed, and that the opening in the sliding head be capped.** Again unique from Beloit-Jones is the requirement of only two pipes — inlet and outlet — for Duoflo operation, with the optional advantage that pipe disconnects are unnecessary during disk inspection and maintenance.

**Duoflo refining disks also are required to complete the conversion.





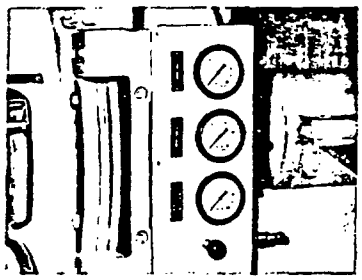
UNIQUE SPOKED ROTOR

Beloit-Jones patented spoked rotor provides Duoflo operation with only one inlet and one outlet pipe. Flow is split inside the refiner!

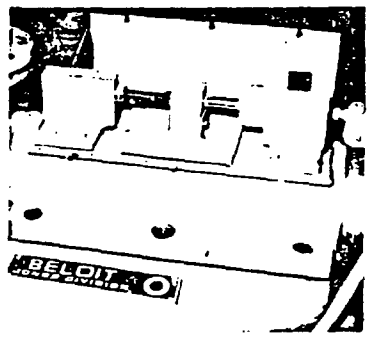
An optional cover plate can be provided to convert from Duoflo to Monoflo operation.

*U.S. Pat. No. 3438586

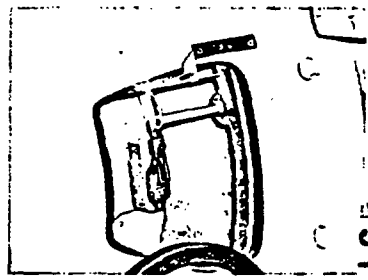
Instrument panel — Mounted on the side of the refiner. Complete with inlet and outlet stock pressure gauges, a gland water gauge, and a gland water pressure control valve. All connections are brought to a single point at the bottom of the panel and are tagged for easy mill connections.



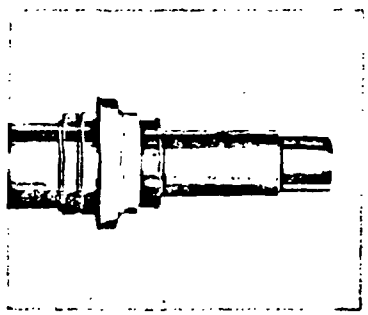
Available options — Include the optional rotor centering device for controlled startup and shutdown, and optional back inlet for greater flexibility in piping design.



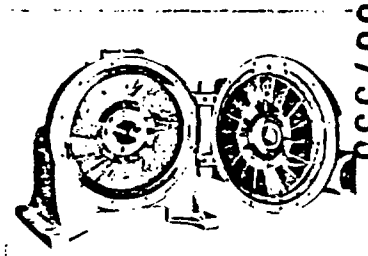
Limit switch and position indicator — Mounted in the end housing, limits the travel of the sliding head. An adjustable rod actuates the limit switch and can be adjusted to compensate for disk wear. A pointer indicates the position of the sliding head on a graduated scale.



Packing box features — The packing box located on the base is stationary —requiring no flexible connections. It is equipped with teflon-impregnated asbestos packing and is lubricated by pressurized water through a lantern ring located between the packing rings.



Packing sleeve — The packing sleeve is centrifugally cast Type 316 coated with ceramic and given a precision polish. Alternate sleeve materials are available.



Hinged end housing — Disk access is by way of a hinged end housing containing the adjusting mechanism and sliding head assembly. Disks shown are the one-piece type. Segmented disks also are available.

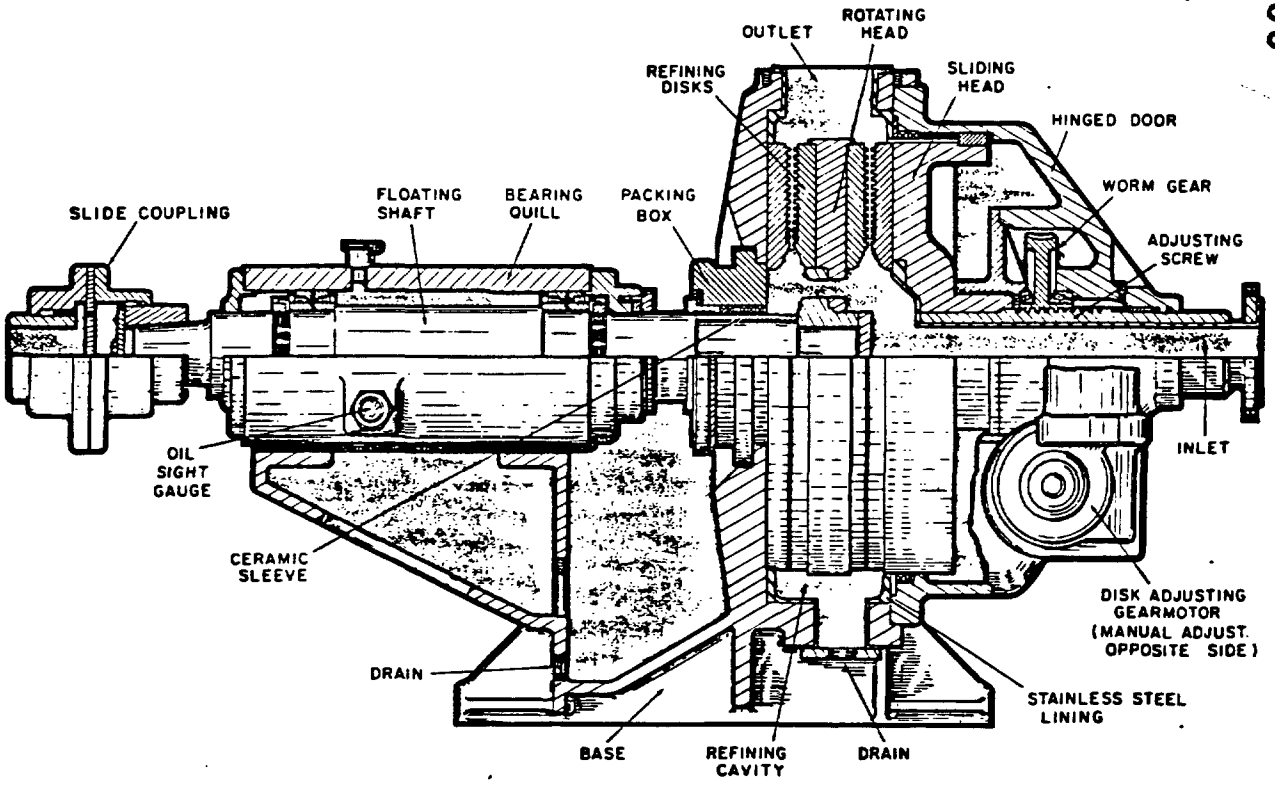
FEATURES

- Simplicity of design for ease of operation, maintenance, and installation.
- Hinged end housing for easy access to disks.
- Disk diameters available from 13" to 60".
- Disk material — Standard Ni-hard (Nickel Alloy), cast SS, and milled SS.
- Unique two-pipe Duoflo* with single stock inlet.
- Optional automatic rotor centering device for controlled startup and shutdown protecting disks for longer disk life.
- Cutting, fibrillation, or brushing — all done with one unit by correct choice of disks, speed, and operating consistency.
- Ceramic-coated sleeve — for longer packing life.**
- All units may be run Monoflo (disks in series) or Duoflo (disks in parallel).
- Optional automatic "J" Series refiner control.

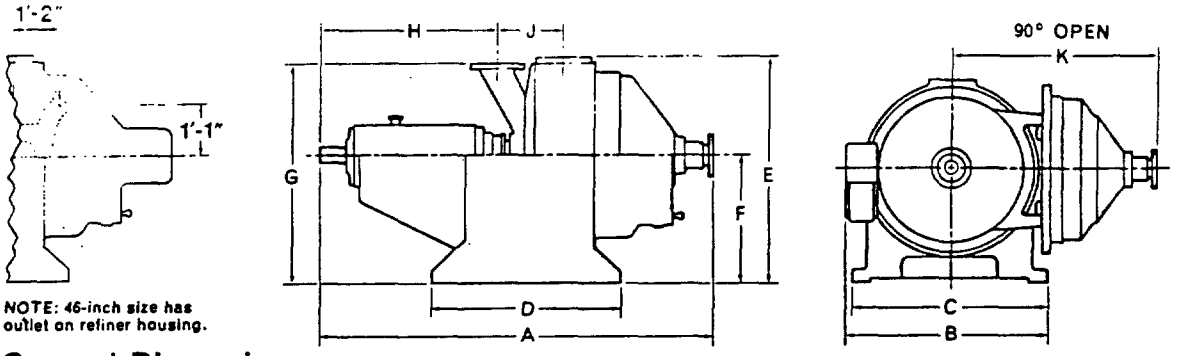
*Patented

**Alternate sleeve materials are available for specific applications

BELOIT-JONES DD 4000 DUOFLO WITH FRONT INLET



BELOIT-JONES DD 4000 REFINERS



NOTE: 46-inch size has outlet on refiner housing.

General Dimensions

(Inches. Not to be used for construction.)

SIZE	INLET	OUTLET	CENTER	A	B	C	D	E	F	G	H	J	K
16	3	3	3	54	32	26.5	24	26.8	15	21.4	24.2	7.8	32
24	4	4	4	70	42.8	38	30	39	22	29	32.8	11	40
30	6	6	4	80	48.2	45	38	46.5	26	44.2	39.4	12.8	52
38	6	6	6	90.3	56	53	42	56.5	32	55.5	42.3	12.8	52.8
46	8	8	8	117	65	63	48	65	36	63.5	54	15.8	71

Specifications

SIZE		16	24	30	38	46
Nominal Capacity—Monoflo	T/D	5—30	25—100	35—125	65—250	125—440
Range —Duoflo	T/D	10—50	25—125	35—200	65—500	125—600
Connected Power Range	HP	75—200	150—400	250—600	350—1000	700—2000
Speed Range	RPM	1200—1800	720—1200	720—900	514—720	450—514
Floor Space Required (CxD)	IN.	24 x 25	38.5 x 28	45 x 38	58 x 42	63 x 48
Shipping Weight	LB	2,100	5,300	6,900	13,800	16,000
Floor Loading	PSF	500	700	575	810	760
Maximum Stock Pressure	PSIG	100	100	100	100	100

Each model includes the complete machine as specified below, less motor and disks.

MODEL	4100 STANDARD	4200 CORROSION RESISTANT	4300 SPECIAL CORROSION RESISTANT
Sliding Head	304 S/S Lined	304 S/S Lined	316 S/S Lined
Inlet Connection	Ductile Iron	304 S/S	316 S/S
Packing Box Water Lubricated	Ductile Iron Ceramic sleeves on shaft	304 S/S Ceramic sleeves on shaft	316 S/S Ceramic sleeves on shaft
Outlet Connection	304 S/S	304 S/S	316 S/S
Internal Construction	304 S/S Where exposed to turbulent stock	304 S/S Where exposed to turbulent stock	316 S/S Where exposed to turbulent stock
Main Shaft Bearings	Tapered roller		
Coupling	Gear Tooth Slide		
Adjustment	2-speed gearmotor complete with drive and limit switch		
Main Bearing Lubrication	Oil Bath		
Integral Panel	3 pressure gauges for inlet and outlet stock and packing box water Includes seal water control valve and pressure switch		
Grease Fittings	Pressure Type		
Gauge Connections	Brought to a panel on the side of the unit		
Operator Controls	Remote manual operation cabinet, suitable for pipestand mount, complete with indicator, pushbuttons and lights. Switchgear, relays and control components in separate cabinet for mounting in main motor control center		

BELOIT
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BELOIT CORPORATION
DALTON, MASS., U.S.A. 01226
In Canada
Jones Division Beloit Canada Ltée/Ltd
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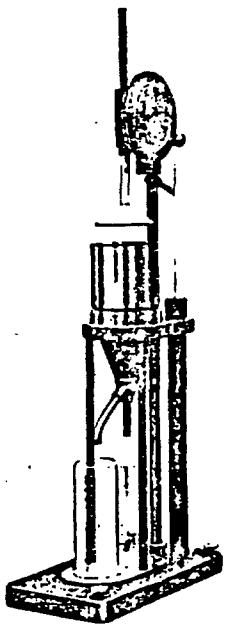
Beating and Freeness Tester



Beating and Freeness Tester No. 850 - 95850

For determining the beating degree of pulp, by utilising the change in water permeability caused by beating.

In accordance with FAK 107 and the recommendations contained in the investigations carried out in 1960 by the British Paper and Board Makers Industry Research Association.

Removable orifice to ensure cleaning and speedy replacement.

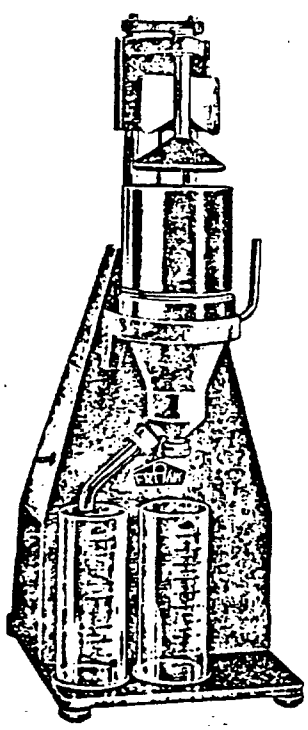
Semi automatic valve lifting device.

Circular section rubber „O" valve sealing rings, which are easily fitted.

The instrument is equipped with graduated measuring cylinders.

Available Extras and Accessories

cylinder of special glass with 1 ltr. mark, cylinder of plexiglass with 1 ltr. mark, graduated cylinder of special glass, graduation: cm^3 and SR°, graduated cylinder of plexiglass, graduation: cm^3 and SR°,
spare sieve, wrench, packing ring, device for quick drainage, plastic cover, dippers for 2 % till 10 % pulp consist.



Freeness Tester No. 885 - 95885

motordriven model, for ascertaining the fineness and the beating degree of fibre stock according to FAK 107.

A stock dilution of 2 g per litre is poured into the container, the sealing cone is lifted at a constant speed rate, the stock is drained through a screen plate.

Stock which drains faster than 220 ml p.m. passes through side orifice, reading the draining capacity.

Constant lifting speed 10 cm/sec ± 1 cm/sec.

Gear motor assures fast and reproducible acceleration.

KARL FRANK GMBH

Angebot - Offer - Offre Nr. P 35-62

vom 24.06.60

Pos. DM

001 FRANK BEATING AND FREENESS TESTER 95850

Design according to notice Fak 107 and SCAN-C 19:65 for the determination of the draining speed of pulp, wood pulp and mechanical wood pulp

Base plate with frame
to take up the cylindric filling chamber
and the cone-shaped separator with outlet and nozzles

Mechanical lifting and lowering device
for manual operation

Finish: grey RAL 7030

Standard Equipment:
2 measuring cylinders, made of special glass, with graduations in ccm and SR-units
2 hook spanners
1 operating instructions 2.615,--

We have this ordered one with accessories has Kogure in Slade Delivery Note

002 FRANK BEATING AND FREENESS TESTER 95885

Design according to notice FAK 107 and SCAN-C 19:65 for the determination of the draining speed of pulp, wood pulp and mechanical wood pulp

Base plate with holding appliance for the gear motor,
cylindrical filling chamber and
the cone-shaped separator with outlet and nozzles

Mechanical lifting and lowering device
driven by an electric motor
to obtain unvarying stroke intervals and
stroke speed of the sealing cone

Stroke interval: 5 s
Stroke speed: 100 ± 10 mm/s

separate switches for the upward and return stroke

Finish: grey RAL 7030

Standard Equipment:
2 measuring cylinders, made of special glass, with graduations in ccm and SR-units
2 hook spanners
1 operating instructions 6,660,--

003 CONNECTION TO A.C. 220 V, 50 CYCLES -

004 CONNECTION TO A.C. 220 V, 60 CYCLES 95,--

BLUE M

INSTRUCTION NO I-206-1R1

BLUE M MAX-SET

OVERTEMPERATURE PROTECTION SYSTEM (OTP)

I. INTRODUCTION

System consists of a temperature sensing thermostat, external time delay and reset circuit. Design of circuit allows unit to re-start automatically if overtemperature condition is momentary (ie., power surge to unit); in case of interrupted power to unit, manual reset is not required.

II. CALIBRATION

OTP is supplied with dial calibrated in reference numbers of degrees (F or C). Each reference number represents approximately 10°C. (20°F.). Generally, OTP should be set 10°C. (one reference number) higher than desired operating temperature. To set OTP, proceed as follows:

A. Turn OTP control fully clockwise.
B. Turn unit ON, set to desired operating temperature and allow unit to stabilize.
C. Slowly rotate OTP control counterclockwise until control trips shutting unit OFF. Observe temperature or reference number at which OTP trips.
D. On units with reference numbers, rotate control one reference number higher than number obtained in step C above. Press RESET BUTTON; unit should now operate normally.
E. On units calibrated in degrees, set OTP control 10°C. higher than temperature obtained in step C, above. Press RESET BUTTON; unit should operate normally.

More precise calibration may be achieved by following directions in Memory Ring Instructions, enclosed.

If temperature within work chamber rises to OTP setpoint, device will trip, and shut unit down. As unit cools below OTP setpoint, Max-Set circuitry will restart unit automatically. This cycle should repeat three times, if overtemperature condition is not rectified. If unit continues to cycle on and off, resistor mounted behind RESET BUTTON (thermally activated time delay) is positioned too far from Re-Set switch; if unit trips and shuts unit down completely without cycling, resistor is too close to re-set switch. Average spacing between resistor and re-set switch is approximately 3/16". OTP must be manually reset after unit completely shuts off.

NOTE: Cause of overtemperature condition should be corrected before unit is reset.

III. MAINTAINENCE

A. Periodically, turn temperature control above OTP setpoint to verify proper operation of OTP system.
B. If OTP should malfunction, check OTP thermostat; contacts should be closed when OTP control is set above unit operating temperature; open when control is set below operating temperature.

IV. PROTECTION OF LIVE ELECTRICAL TEST LOADS

When testing live electrical loads, damage to load may occur if load power supply is not interlocked with OTP. In event of overtemperature condition, power to unit will be shut off; however, heat generated by test load may be sufficient to cause damage to load and unit. It is suggested that test load power supply be interlocked with OTP to insure power to load will be cut when OTP trips. Suggested practice is to connect safety interlock coil in parallel with OTP contactor coil.

TCL-514

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