PLAINTIFF'S EXHIBIT

BIR-255

TESTING PROCEDURES for CHRYSOTILE ASBESTOS FIBRE

TESTING PROCEDURES

FOR

CHRYSOTILE ASBESTOS FIBRE

SECOND EDITION 1966

ASBESTOS TEXTILE INSTITUTE

MINERAL FIBER PRODUCTS BUREAU

QUEBEC ASBESTOS MINING ASSOCIATION

Printed in U. S. A.

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TESTING PROCEDURES FOR CHRYSOTILE ASBESTOS FIBRE

PREFACE

These Testing Procedures have been prepared jointly by the Asbestos Textile Institute, the Mineral Fiber Products Bureau, and the Quebec Asbestos Mining Association, to provide standard methods for testing physical and chemical properties of chrysotile asbestos fibre.

The manual is a collection of test methods for fabricators and manufacturers of asbestos who have both the facilities to make the tests with reasonable accuracy, and the personnel with the required degree of laboratory experience.

The manual establishes authoritative procedures for testing milled chrysotile asbestos fibre. A number of tests used at various times in the industry, but which are now of little significance, have been omitted. It should be emphasized that this manual is neither a guide for placing a value on asbestos fibre, nor a specification for grading it. The intention of the sponsoring organizations is to present test procedures that will aid consumers and potential users of asbestos products throughout the world in characterising the properties of asbestos that fit their needs. These sponsors make no recommendations or suggestions for application or use of these tests and indicate only that these tests are accepted and are proven procedures for measuring specified properties.

As in any book of this type, some tests are tentative and subject to change as more information becomes available which will increase the accuracy and adaptability of the procedures. The participating associations recognize that the manual may require revision and will issue, when necessary, revised editions to include additional tests or modifications of established procedures.

The information in this publication represents the combined effort of the Fibre Testing Committee of the Asbestos Textile Institute, the Technical Committee of the Mineral Fiber Products Bureau, and the Technical Committee of the Quebec Asbestos Mining Association. The sponsors acknowledge with sincere appreciation and gratitude the help of personnel who served on these Committees for the generous contribution of their knowledge and, most important, of their time and effort in proving and compiling the procedures.

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TESTING PROCEDURES

FOR

CHRYSOTILE ASBESTOS FIBRE

NUMERICAL INDEX WITH ADOPTION AND REVISION DATES

NUMERICAL INDEX WITH ADOPTION AND REVISION DATES

SUMMARY DESCRIPTION OF TESTS

SUMMARY DESCRIPTION OF TESTS

SUMMARY DESCRIPTION OF TESTS

DEFINITIONS

Spicules: There are two types of spicules commonly found in milled asbestos.

1) Rod-like pieces of unopened asbestos.

2) Sharp pointed pieces of non-fibrous minerals such as picrolite, brucite or other mineral matter.

Pencil: Unopened asbestos of generally uniform diameter throughout its length, which can be fiberized.

Spelk: Synonymous with pencil.

Bundle: Refers to a comparatively heavy pencil which may also be partially crushed or fiberized.

Harsh: Refers to an inherent quality of a particular asbestos fibre which implies a degree of rigidity.

Brittle: The tendency to break readily when flexed.

Soft: Refers to an inherent quality of a particular asbestos fibre which implies a high degree of flexibility.

Crudy: The quality of a milled fibre containing an appreciable portion of pencils and bundles of asbestos. This is derived from the term "crude", as used in reference to unmilled asbestos.

Open: Open is a term used in referring to the quality of a milled fibre which does not contain an appreciable portion of pencils and bundles of asbestos.

Crudiness: The degree to which a fibre is crudy.

TESTING PROCEDURES

FOR

CHRYSOTILE ASBESTOS FIBRE

(Second Edition)

A-1

METHOD OF SAMPLING AND PREPARATION OF ASBESTOS FIBRE FOR TEST PURPOSES

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Revised and adopted by:

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A-1

METHOD OF SAMPLING AND PREPARATION

Scope

This method covers the procedure for obtaining and preparing composite samples from lots of fibre for testing.

1. Sampling

Sampling and preparation are equally as important as the testing. Every precaution should be taken to obtain and to prepare samples that will indicate the true character and condition of the asbestos fibre which they represent.

Equipment

One clean container of suitable size for each composite sample of fibre.

Procedure

(a) Prepare a five pound composite sample from each lot consisting of 200 bags or part thereof by selecting 20 handfuls (approximately four oz) each from a different 1/20 of the lot.

(b) When shipments exceed a lot of 200 bags, but not in excess of 2000 bags, composite samples may be combined into one master composite sample at the discretion of the tester, if agreed between vendor and buyer.

(c) Samples shall be kept in closed containers placed in covered storage for subsequent testing.

2. Sample Preparation

Equipment

Smooth, clean area.

Procedure

(a) Each individual composite sample, or group of composites, shall first be allowed to approximate average workroom temperatures

and humidity, (moisture content of sample should not exceed three per cent) and shall then be subdivided for testing in accordance with the following method.

(b) Spread each composite as obtained in Part 1 on the smooth, clean area.

(c) Condition the sample by passing the fibre through the hands with gentle rubbing in order to break up lumps and separate clots. For best results it is recommended that fibre be conditioned by means of the Johnson's Fibre Conditioner using the procedure listed in Section 3.

(d) After conditioning, mix the sample thoroughly by passing the fibre through the hands with a gentle shaking motion. When it is intimately mixed, spread it out evenly over the smooth, clean area.

(e) For master composites, quarter the sample, place aside the full thickness of two diametrically opposite quarters, and reblend the remainder. Continue this quartering until a five pound sample is obtained.

(f) This five pound composite sample will be used as the source of fibre for each individual test.

(g) For extraction of test samples, quarter the five pound sample twice, as described in 2 (e). Use two diametrically opposite quarters for Quebec Standard Test sample. Reblend remainder and spread on a smooth, clean surface by layers to form a flat pile of uniform thickness (approximately 1/2 to 1 inch thick). Select a test specimen by taking pinches from different sections of the pile until a sample is obtained which will require minimum adjustment to the desired weight.

Note 1: Step 2 (g) presupposes that the sample has already been conditioned in accordance with Step 2 (c).

Note 2: As pinches are taken, care must be exercised that each pinch contains the total cross-section of the pile from top to bottom at the point it is taken, including any grit or fines which may have segregated at the bottom.

(h) When this sampling procedure is employed in a referee test procedure acceptability shall be based on the average of the composites.

3. Johnson's Fibre Conditioner

Equipment

Laboratory Fibre Conditioner	Drawing A
Fibre Press	Drawing B
Fibre Mold	Drawing C

The Conditioner should be operated at 525 ± 25 rpm.

4. Procedure

(a) Put into the fibre mold $1\frac{1}{4}$ to $1\frac{1}{2}$ pounds of fibre, free of large lumps.

Place the mold in the fibre press and apply compressed air, pressure 85 ± 10 pounds per sq. in., for one minute.

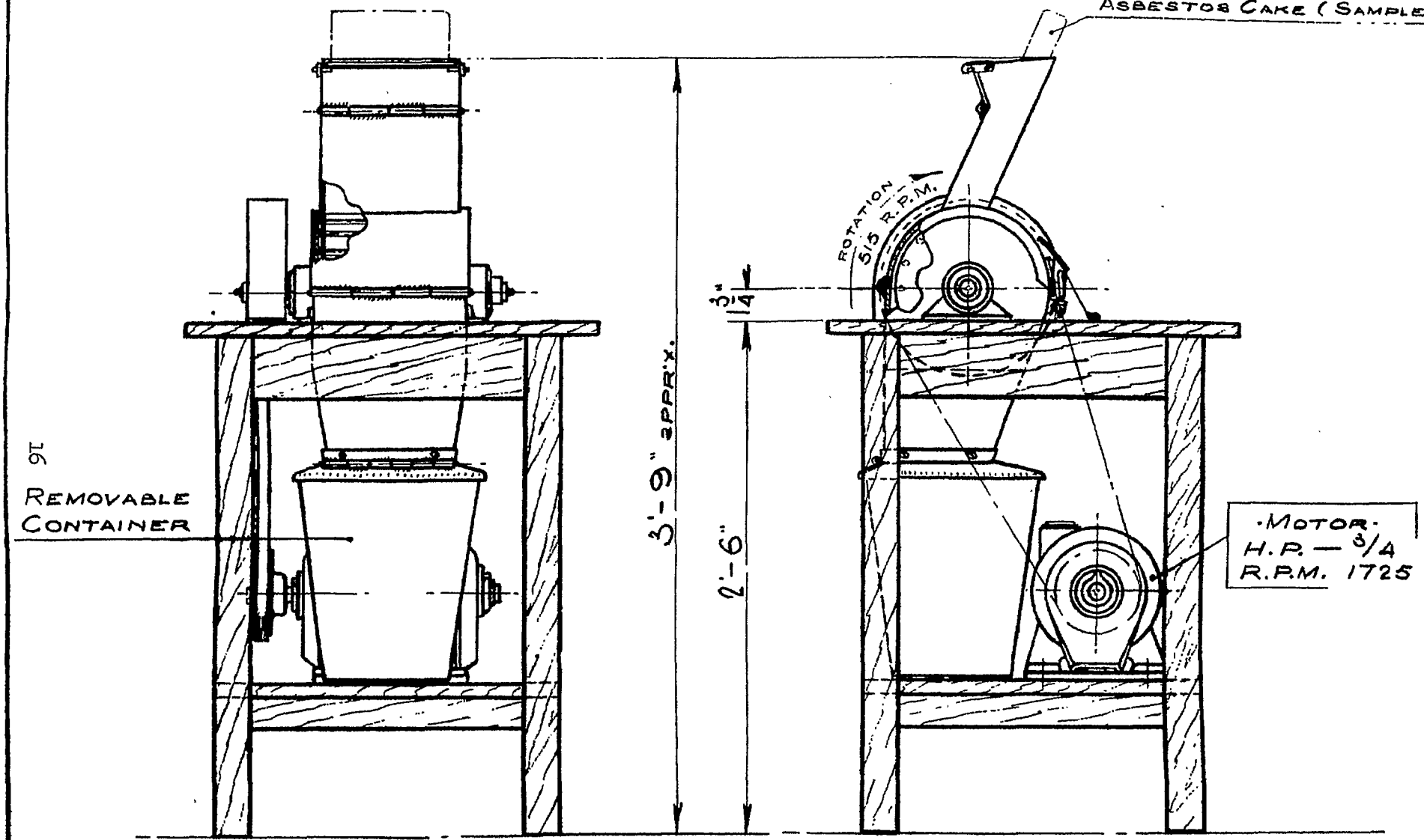
Release pressure and remove the pressed fibre cake, whole, by pushing it out with the piston of the mold.

Feed the pressed fibre cake into the laboratory fibre conditioner.

Re-feed the conditioned fibre into the laboratory fibre conditioner, using choke-feeding, to give the sample a second conditioner pass.

(b) If any lumps remain after the second conditioner pass they should be broken up by hand.

(c) The Group 3 fibre cake should be broken into three or four pieces before feeding into the conditioner, to prevent jamming.



ASBESTOS FIBER
CONDITIONER ASSEMBLY.

FIG. "A"

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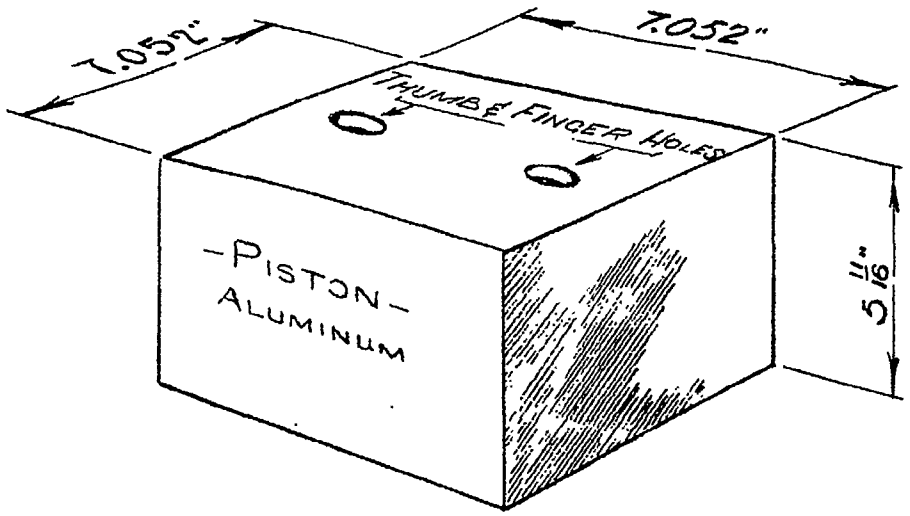
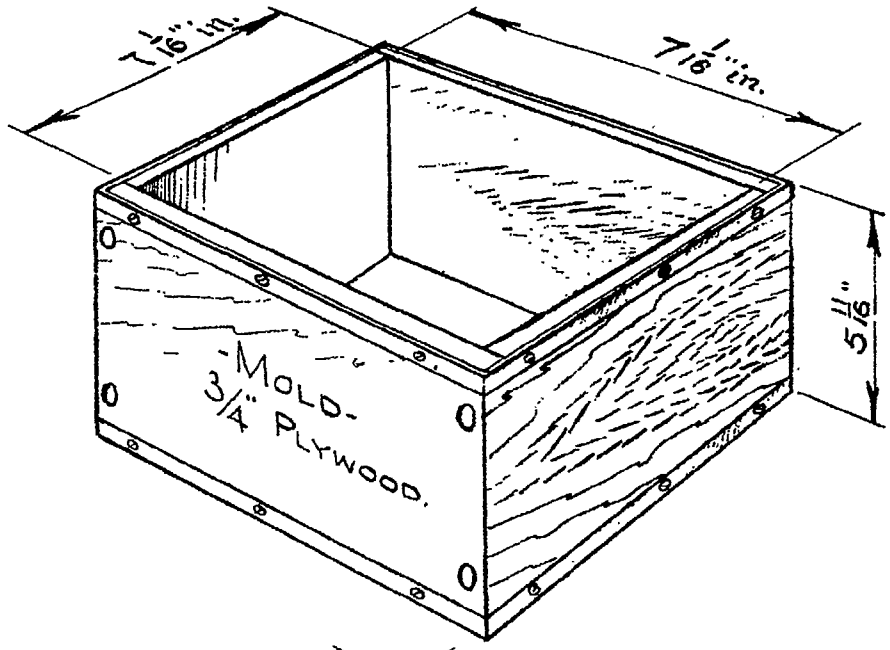
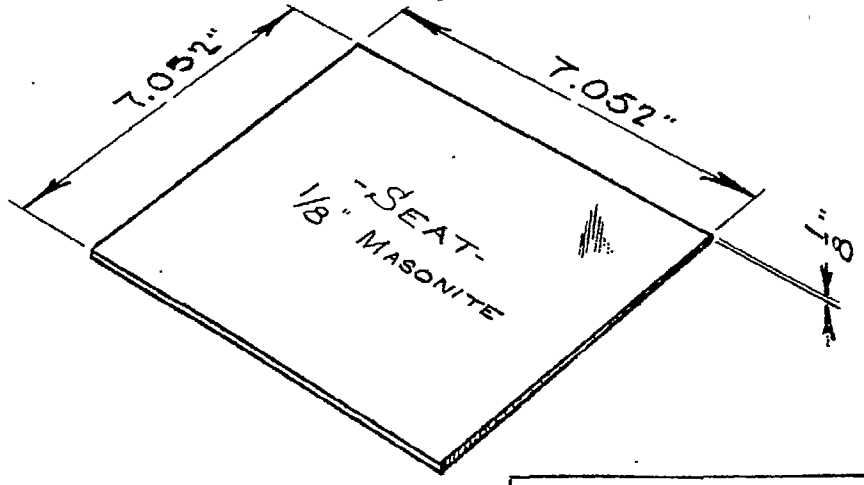
BIRD 005327



PISTON

TOP & BOTTOM MADE OF 1/2" PLY. OUT. WALLS 1/4" PLY. 3-REINFORCING 1/4" PLY INSIDE



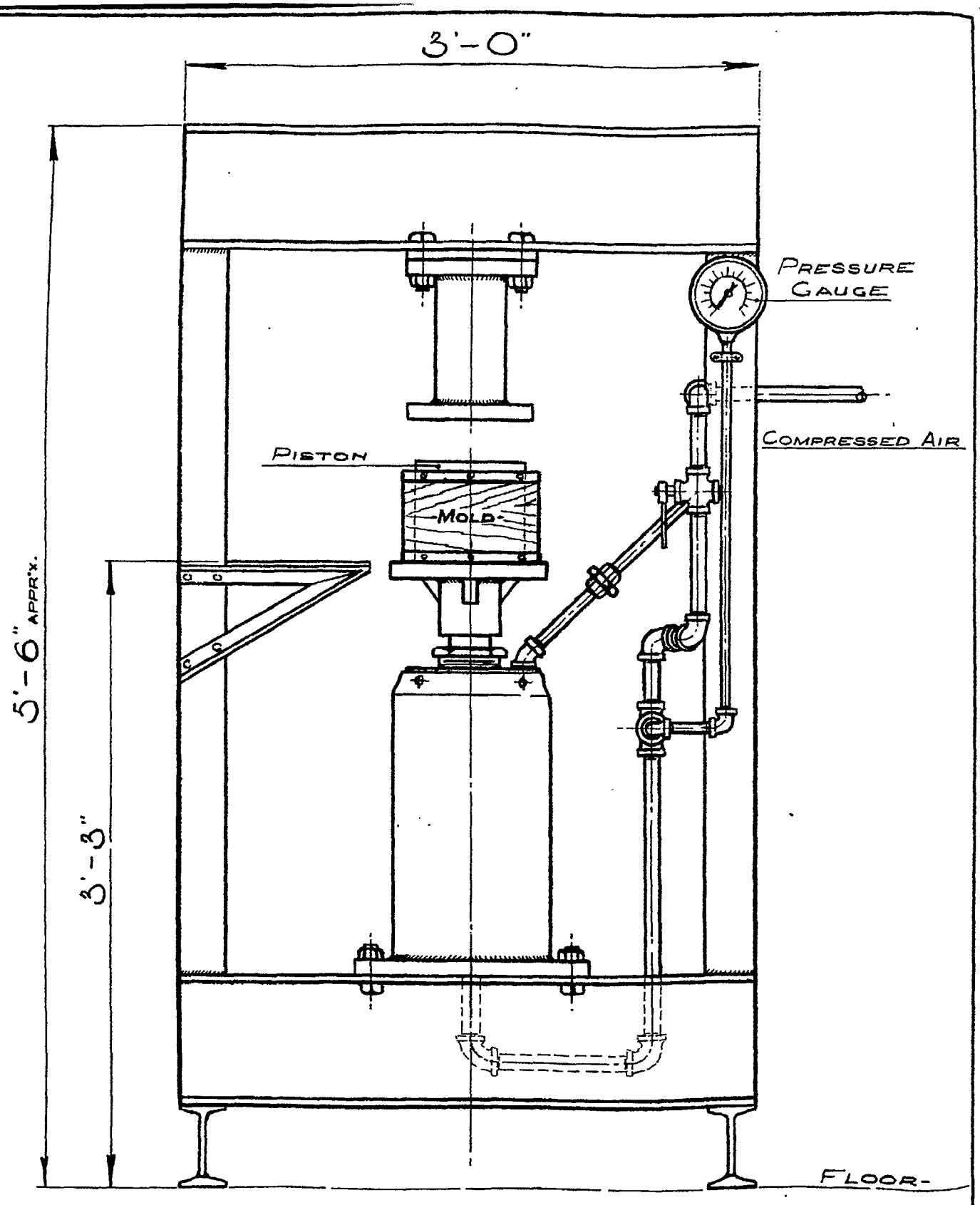


FIBRE MOLD

G.

MARCH 2ND/58

FIG. "B"



FIBER PRESS

FIG. "C" APRIL 18/58

TESTING PROCEDURES

FOR

CHRYSOTILE ASBESTOS FIBRE

(Second Edition)

B-1

CLASSIFICATION OF ASBESTOS FIBRE BY THE QUEBEC STANDARD TEST

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B-1

QUEBEC STANDARD TEST

Scope

This method of test covers a procedure for dry classification, by length distribution, of chrysotile asbestos fibres into commercial grades.

Apparatus

(1) The Quebec Standard Asbestos Testing Machine, Model No. 2.

Note: The machine shall be constructed and operated according to the specification issued by the National Research Council of Canada. (Abstract attached).

(2) A 16 oz. scoop scale with graduations of 0.2 oz. and a sensitivity of 0.1 oz.

(3) A smooth-surfaced mixing table.

Sampling and Preparation

In accordance with (A-1) "Method of Sampling and Preparation."

Procedure

Sample to be tested shall be placed on the table and conditioned to normal room temperature and humidity. Examine the sample by passing through the hands to insure that clots or lumps are broken up. The moisture content of the sample should not exceed 3 per cent (significant variations not normally encountered except when moisture content exceeds 3 per cent). Erratic results can be expected beyond 3 per cent. Mix thoroughly, weigh accurately into the scoop of the scale, a 16 oz. ± 0.1 oz. representative portion. Place the specimen in Box No. 1 of the testing machine, by letting it fall loosely from the scoop. The scoop shall be held from 6 to 10 inches above the screen cloth. Take care that when the cover of the testing machine is closed, the fibre shall not be compressed.

When setting the boxes on the machine, be sure that they are lined up true to the platform and that the ends of the boxes always face the same way each time they are used.

Start the machine and allow it to run until it automatically stops. Then, remove each tray and dump the fibre resting on each tray onto the mixing table, in individual piles, picking up and adding the loose fibre adhering to the cloth.

Weigh separately the fibre recovered from each tray; the weights in ounces of the fibre shall be recorded as the Quebec Standard Test of the fibre sample.

Report

To the nearest 0.1 oz. the fibre retained in each box. An example of test results on a long (Group 3) fibre and short (Group 7) fibre would be:

	Box 1 1/2"	Box 2 4 mesh	Box 3 10 mesh	Box 4 pan	
Long Fibre	3.2	9.4	2.8	0.6	16.0 oz.
Short Fibre	0	0	6.2	9.8	16.0 oz.

QUEBEC STANDARD ASBESTOS TESTING MACHINE, MODEL 2

General Specifications

1. The Main Frame or Base shall be in one piece of grey cast iron conforming to Drawing No. 2, item No. 1*. (See original publication for Drawings).

2. All castings shall be free of blow holes, blisters and all other faults or defects and shall be properly machined at surfaces contacting other parts of the machine moving or stationary. Other cast iron surfaces, where not machined, shall be smoothed off and painted with one coat of suitable metal paint. All castings whether aluminum or cast iron shall be finished to remove sharp edges.

3. All machine parts such as bolts, nuts, cap screws, studs, pulleys, bearings, steel springs, or any other parts, shall be used in standard engineering practice.

4. Foundations shall be of concrete, or concrete mat, allowing one inch for grouting, the surface shall be level in every direction. This foundation shall be isolated from disturbing vibration caused by extraneous forces.

5. Main Frame or Base shall be bolted by four foundation bolts, one at each corner.

6. The main shaft of the machine shall rotate at a rate of 327 rpm with a tolerance of plus or minus 1 rpm. Direction of rotation shall be counterclockwise as observed while facing machine at timing box side.

7. The automatic cut-off shall release the belt shifter after 600 revolutions. The machine shall then be stopped within two and one-half revolutions by the automatic application of the brake at the same time that the cut-off shall have released the belt shifter.

8. Each machine shall be driven by squirrel cage electric motor of not less than 2 hp, connected to it by belt, either in one stage or by medium of one countershaft. This motor shall not be used as prime mover for any machine other than a testing machine.

9. Bolts and fixtures shall be kept well tightened.

10. The transmission belting shall be kept in good condition and shall be periodically scraped and dressed, so as to prevent slippage. Endless belting with properly glued joints shall be used.

11. The moving parts shall be kept greased and oiled to ensure free movement.

12. Bearings shall be adjusted or renewed when clearance permits a perceptible knock or play.

13. The machine shall be kept in adjustment conforming to the dimensions on Assembly Drawing No. 1*. (See original publication for Drawings.) When the eccentric is in high position, the common vertical through the centres of the lower and upper rocker arm bearing shall intersect at 90 degrees, the horizontal through the centre of the main shaft.

14. A tolerance of 1/16 inch shall be allowed on the dimensions in this Drawing No. 1 except in the case of the centre distance between upper and lower rocker arm bearing, where the tolerance shall be limited to plus or minus 0.005 inch. Tolerances here refer only to adjustment dimensions. Table in any position shall be horizontal in the direction parallel to the main shaft and the two rocker arm shafts.

15. The Main Frame or Base, main shaft bearing housings and lower rocker arm bearing supports shall be cast in one piece of grey cast iron conforming to Drawing No. 2. Casting shall be machined where contacts are made with parts attached to it. Holes shall be drilled and tapped for various connecting parts, all as shown on Drawing No. 2 above-mentioned.

16. Timing Box Bracket shall be of grey cast iron as shown in Drawing No. 3, machined where contacting Main Frame and Timing Box. This bracket shall be attached to Main Frame by two 1/2 inch x 1 inch standard cap screws with hexagon head.

17. Shaking table and eccentric housings shall be of cast aluminum conforming to Drawing No. 4 all to be machined where contacting other parts. Item No. 4, eccentric housings shall be cast in two separate aluminum castings machined where contacting other part. Item No. 4 shall be bolted to item No. 3 by two standard hexagon head 5/8 inch by 7 inch long bolts. Shaking table assembly shall be connected to main shaft through eccentric adapters by two SKF bearings number 6222.

18. Clamping device shall be as per Assembly Drawing No. 21 and details per Drawings Nos. 22 and 23.

Note: * Send request to the National Research Council of Canada, Ottawa, Canada, for "Standard Specifications for Quebec Standard Asbestos Testing Machine."

Testing Boxes

A set of Testing Boxes shall consist of three boxes, a pan and cover, all of cast aluminum, as per Drawing No. 19.

Inside diameter of all boxes and pans shall be 14-3/4 x 24-1/2 inches.

Total over-all height of the four nested boxes without cover shall not be less than 14-9/16 inches nor more than 14-5/8 inches.

1st. box with 1/2 inch opening screen cloth properly attached - over-all height 3-3/4 inches.

2nd. box with a 4 mesh screen properly attached - over-all height 3-21/32 inches.

3rd. box with 10 mesh screen properly attached - over-all height 3-5/8 inches.

Pan with 20 gauge g.s. sheet attached to bottom - over-all height 3-17/32 inches.

Screen cloth to be attached to boxes with 1/8 inch flat head stove bolts and nuts, as per Drawing No. 19, using 20 gauge galvanized strips between screen cloth and bolt heads.

Specifications for Testing Screens

The screens for the Quebec Standard Testing Machine, Model 2 shall conform to the following specifications:

Dimensions

Length: 25-3/4 inches

Width: 16-1/16 inches
Mesh Opening: 1/2 inch screen = 0.500 in.; 4 mesh = 0.187 in.; 10 mesh = 0.053 in.
Wire Diameter: 1/2 inch screen = 0.105 in.; 4 mesh = 0.063 in.; 10 mesh = 0.047 in.

Note: The 1/2 inch screen shall have 42 holes formed by the 43 wires on length; 26 full holes formed by 27 wires on width.

Tolerances

On wire diameter: 0.001 inch
On mesh opening : An average tolerance of +2 per cent and -3 per cent shall be allowed, provided that a maximum tolerance of plus or minus 5 per cent shall not exceed 5 per cent of the total number of openings.

Material

The screens shall be woven from a hard drawn brass wire of the composition 80-85 per cent Cu and 20-15 per cent Zn.

Weave

The 1/2 inch screen and the 4 mesh screen shall be woven in such a manner that the warp and shute wires are securely interlocked at intersections.

The 10 mesh screen shall be woven by the "Double Crimped" process.

General

Screen cloth shall lie flat and rigid and shall be free from wrinkles.

Cloth shall be cut in such a manner that the shute wire forms the longer dimension.

The 1/2 inch screen shall be attached to the screen box in such a manner that 24 full openings are formed with 25 wires; there will then remain 1/16 of an inch on each side between the inside of the box and the last wires.

TESTING PROCEDURES

FOR

CHRYSOTILE ASBESTOS FIBRE

(Second Edition)

B-2

RO-TAP SCREEN ANALYSIS FOR ASBESTOS FIBRE

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Revised and adopted by:

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RO-TAP SCREEN ANALYSIS

Scope

This procedure covers a dry sieve analysis, by apparent length of fibre, of asbestos fibre grades other than Groups 1, 2, and 3.

Apparatus

1. Sieve Shaker - See notes

   W. S. Tyler Ro-Tap Testing Sieve Shaker for 8-in. diameter sieves. The machine shall be equipped with Sieve Supporting Plate and Cast Iron Cover fitted with a rubber plug (Specification: No. 9 Neoprene).

   Number of taps per minute shall be 154 ± 4 when operating at a speed of 285 ± 5 rpm. The shaker should be mounted on a suitable firm foundation, preferably concrete.

2. Sieves - The following Tyler Standard Mesh Sieves or U. S. equivalents shall be used for the various groups as follows:

Group 4		Group 5	
*Full height	3 mesh	Full height	4 mesh
" "	4 "	" "	6 "
" "	6 "	" "	10 "
" "	10 "	" "	20 "
" "	20 "	" "	35 "
" "	35 "	" "	65 "
" "	Pan	" "	Pan

* This 3 mesh is used as a breaker and since there is no U. S. equivalent for this screen size, a 3-1/2 mesh may be used.

Group 6 & 7D		Groups 7 & 8 except 7D	
Full height	6 mesh	Full height	6 mesh
" "	10 "	" "	14 "
" "	14 "	" "	20 "
" "	20 "	" "	28 "
" "	35 "	" "	35 "
" "	65 "	" "	65 "
" "	Pan	" "	Pan

3. Tyler Automatic Timer, Model 8063-B or equivalent with an accuracy of ± 5 seconds.

4. Scale sensitive to 0.1 gram.

Sampling

In accordance with (A-1) "Method of Sampling and Preparation."

Sample Size

Group 4	50 grams
Group 5	50 "
Group 6 including 7D	100 "
Group 7 except 7D	100 "
Group 8	100 "

Test Duration

Group 4	10 minutes
Group 5	10 "
Group 6 including 7D	10 "
Group 7 except 7D	30 "
Group 8	30 "

Procedure

The required weight of the representative sample is placed on the top sieve of the nesting. The cast iron cover is set in place and the sieve assembly is then placed in the shaker and locked in position. By means of the automatic timer the shaker is started and allowed to run for the required test period. The fibre on each screen is weighed to the nearest 0.1 gram.

Report

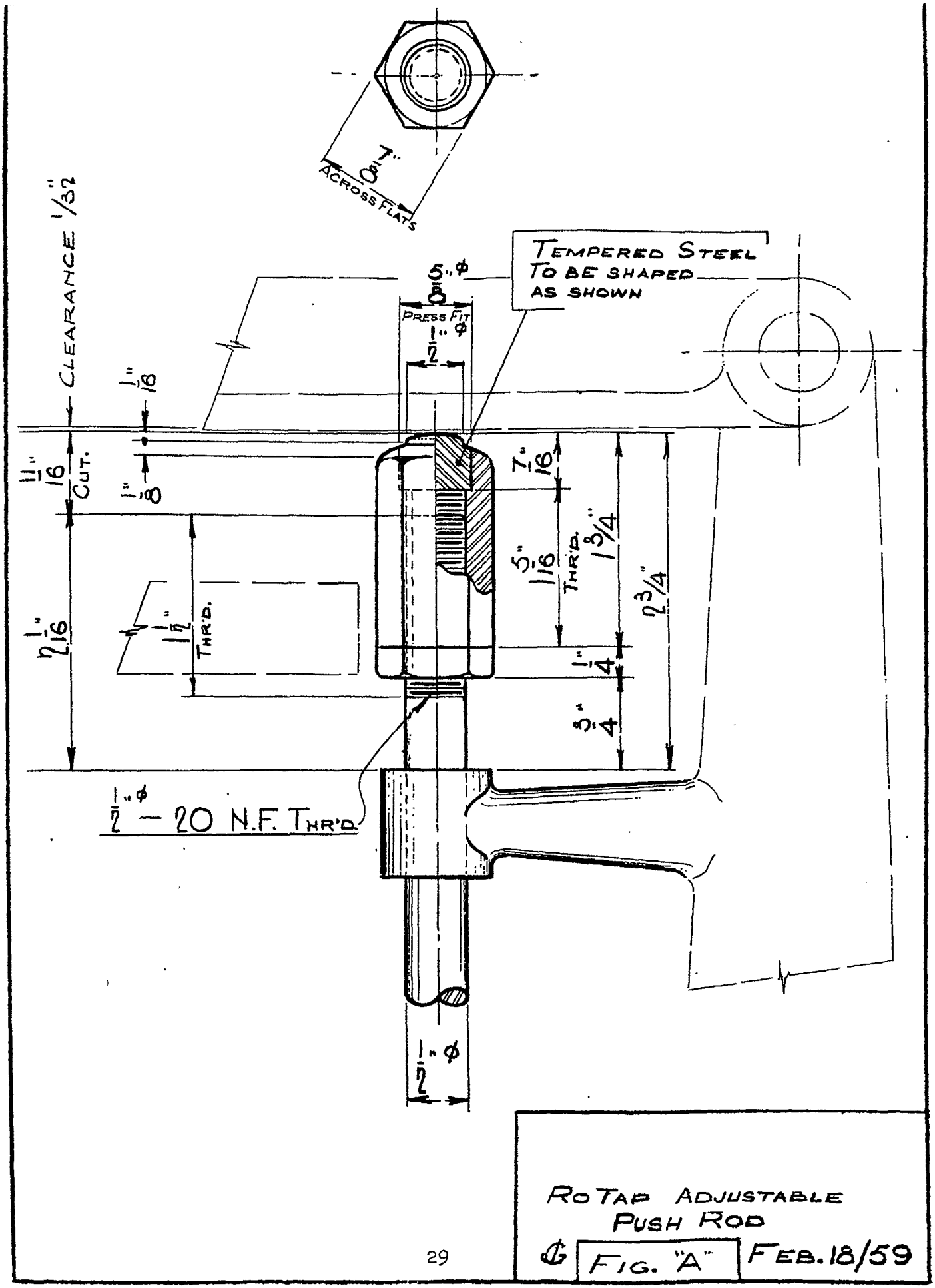
The screen analysis is recorded as the percentage of material retained on each sieve and in the pan. Allowable error in the total should not exceed ± 1.0 per cent.

Notes

1. Plate Support should be set to give a clearance of 3/32-inch ± 1/32-inch between top of cast iron cover and bottom of stops on Carrying Plate. (See A on Figure B). This clearance is sufficient to allow the screen assembly to be easily set in place and to rotate freely when shaker is in operation. It is important that this gap be checked periodically in order to maintain proper sieving action.

2. The height of the stopper above the top of the cast iron cover plate should be 1-inch ± 1/8-inch (A plus B on Figure B) measured with hammer resting on stopper. With a new stopper this measurement should be taken only after machine has been in operation for a few hours and should be set as closely as possible to the maximum setting of 1-1/8 inch.

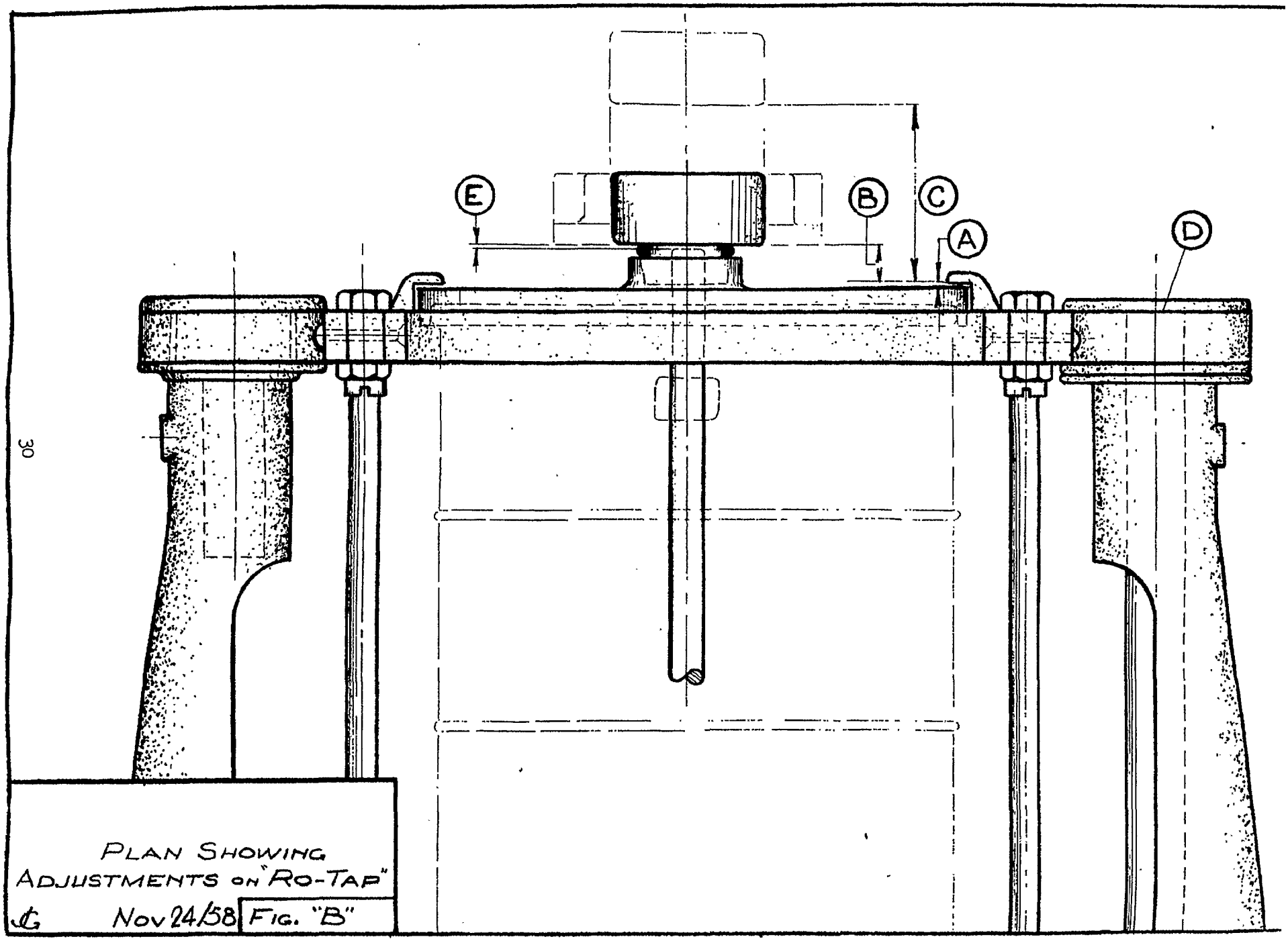
3. Clearance between push rod and hammer in lower position shown at E on Figure B should be 1/16 inch - 5/32 inch. It is necessary to make periodic adjustments to compensate for wear. This may be done by using an adjustable push rod. (See Figure A).



ROTAP ADJUSTABLE PUSH ROD

FIG. "A"

FEB. 18/59



PLAN SHOWING
ADJUSTMENTS ON "RO-TAP"

Nov 24/58 FIG. "B"

TESTING PROCEDURES

FOR

CHRYSOTILE ASBESTOS FIBRE

(Second Edition)

B-3

AIR CLASSIFICATION TEST

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B-3

AIR CLASSIFICATION

Scope

1. (a) This test indicates the relative proportions of dust (less than 40 microns), fibre, and granular material (rock) in a sample of milled asbestos fibre.

   (b) The percentage of these components in milled fibre furnish a guide to its cleanness and general degree of effectiveness when used in asbestos-cement products.

Apparatus

2. (a) Balance (sensitivity 0.01 gm).

   (b) Stop Watch.

   (c) Rectangular Metal Scoop, 1-3/4 x 7 x 1-1/2-in.

   (d) Six Inch Classifier with Mechanical Agitator and Accessories. (Refer to Figure 1, page 3). Also refer to construction details (Figure 2, Figure 3, Figure 4).

   (e) Orifice #3, 0.415-in. diameter.

   (f) Brass Tube 5 mm inside diameter, 3-in. long.

   (g) Rubber Stopper to fit small end of separator.

   (h) Wire 12-in. long (bent in hook shape at one end, see Figure 2, page 4).

   (i) Hose or Leather Strap 15-in. long.

   (j) 28 Mesh Tyler Standard Screen, 8-in. diameter.

   (k) 35 Mesh Tyler Standard Screen, 8-in. diameter.

   (l) Pan, 8-in. diameter, for above screens.

   (m) Ro-Tap Sieve Shaker.

Sampling

3. According to (A-1) "Method of Sampling and Preparation."

Procedure

4. (a)

Sample from Group	Sample Weight in gms	Air Jet Type	Test Time in Min.	Screen Mesh	*Ro-Tap Time in Min.
3	5	Tube	9	35	1
4	10	Tube	9	35	1
5	10	Tube	9	35	1
6	10	Tube	9	35	1
7	10	Tube	9	28	1

* Ro-Tap without hammer.

(b) Push the 5 mm diameter brass tube through the rubber stopper so that it does not project more than 1/8-in. beyond the small end of the stopper. Insert stopper in small end of separator and clamp firmly in place, in such a manner that this jet can rotate freely. Attach the radius arm of the agitator to the jet, and connect the jet to the flange containing the #3 orifice, by means of a 3-ft. section of 1/4-in. or 3/8-in. diameter rubber tubing.

(c) Charge the sample to the classifier by means of the rectangular scoop, then start agitator and turn on the compressed air and adjust the pressure so as to register 1.0 cm on the mercury manometer. Adjust water manometer to 8.0 cm and raise the mercury manometer to 15.5 cm. Start the stop watch. At three minute intervals shake the separator by striking it sharply with the short length of rubber hose or strap. Care must be taken to never strike the 6-in. diameter cylinder connecting the two cones.

(d) At the end of the time allotted for the fibre under test (see table) shut off the air and place screen (35 or 28 mesh) and pan under the separator. Remove the rubber stopper and let the fibre fall onto the screen. If it chokes in the opening, loosen it with the short length of wire used expressly for that purpose.

(e) Shake down the dust and rock on a section of the screen not covered by fibre, by rapping the two sides of the cone. Blow any remaining residue in the jet onto the rock laden section of the screen, using an air pressure of not more than 1.0 cm of mercury.

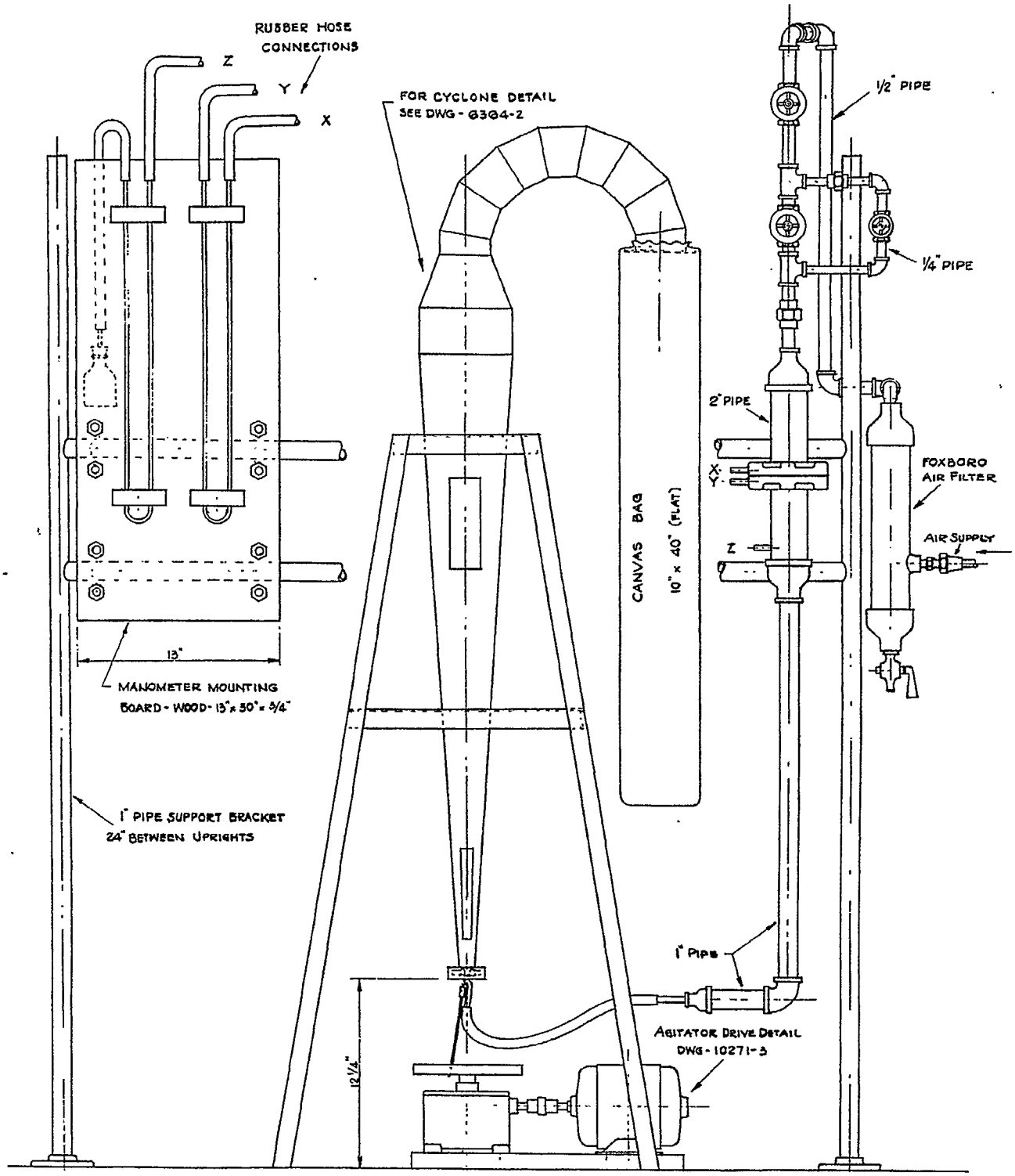
(f) Place the screen and pan in the Ro-Tap sieve shaker and run for one minute without using hammer. Weigh, to the nearest 0.01 gm, the material on the screen, and record as fibre. Weigh the contents of the pan and record as the granular content. Obtain the dust content by difference between the original sample weight and the combined weights of the fibre and granular contents.

Report

5. (a) Report the results in per cent.

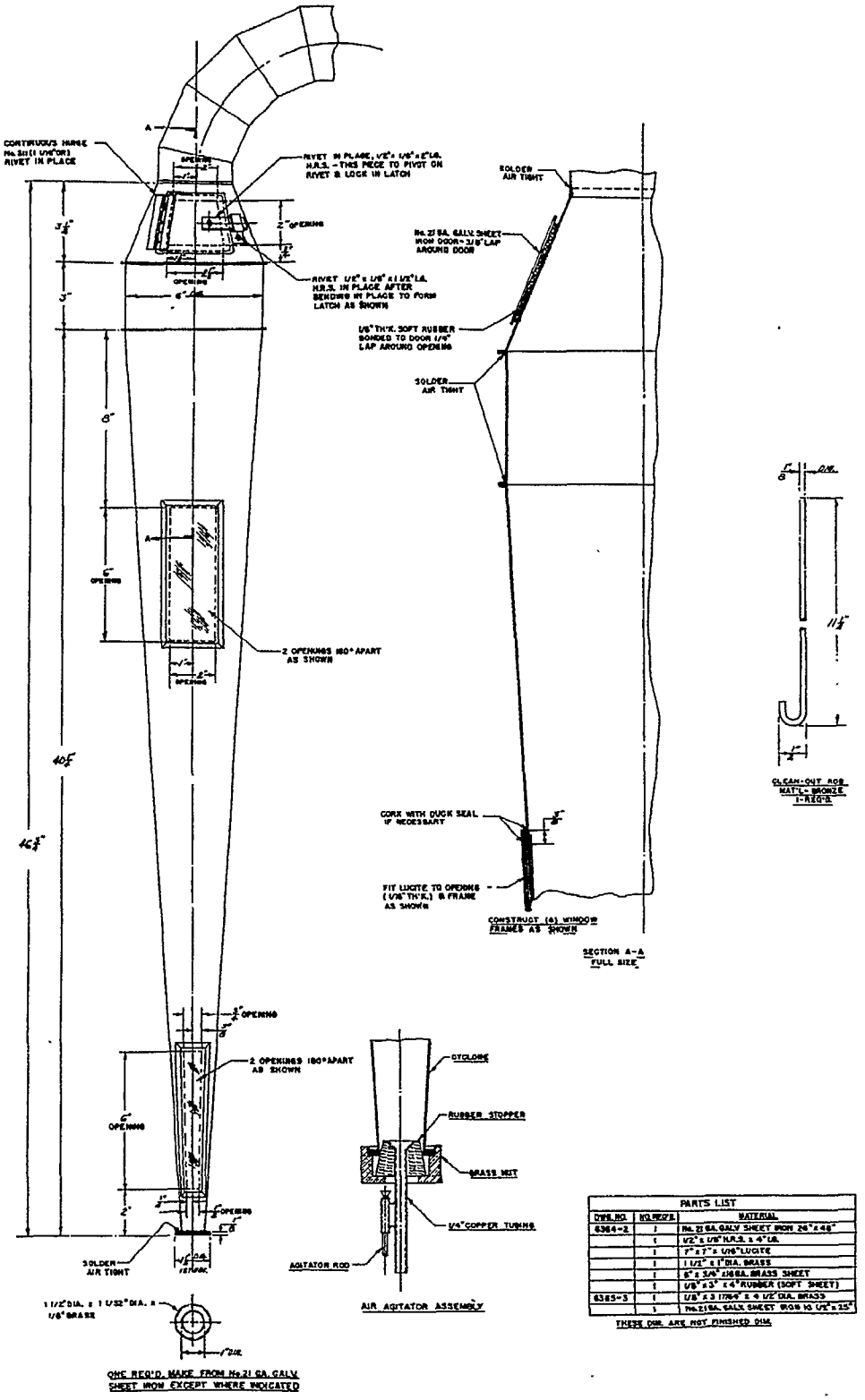
(b) An example of the test results on a 6D fibre would be as follows:

Fibre	(+40 microns)	41.6%
Dust	(-40 microns)	46.4
Granular		12.0
		100.0



AIR CLASSIFICATION APPARATUS

FIGURE 1.



PARTS LIST		
DWG. NO.	NO. REQ'D.	MATERIAL
6364-2	1	No. 21 GA. GALV. SHEET IRON 26" x 46"
	1	1/2" x 1/8" H.R.S. x 4" LG.
	1	7" x 7" x 1/16" LUCITE
	1	1 1/2" x 1" DIA. BRASS
	1	6" x 3/4" x .1668 GA. BRASS SHEET
	1	1/8" x 3" x 4" RUBBER (SOFT SHEET)
6365-3	1	1/8" x 3 17/64" x 4 1/2" DIA. BRASS
	1	No. 21 GA. GALV. SHEET IRON 10 1/2" x 35"

THESE DIM. ARE NOT FINISHED DIM.

FIGURE 2.

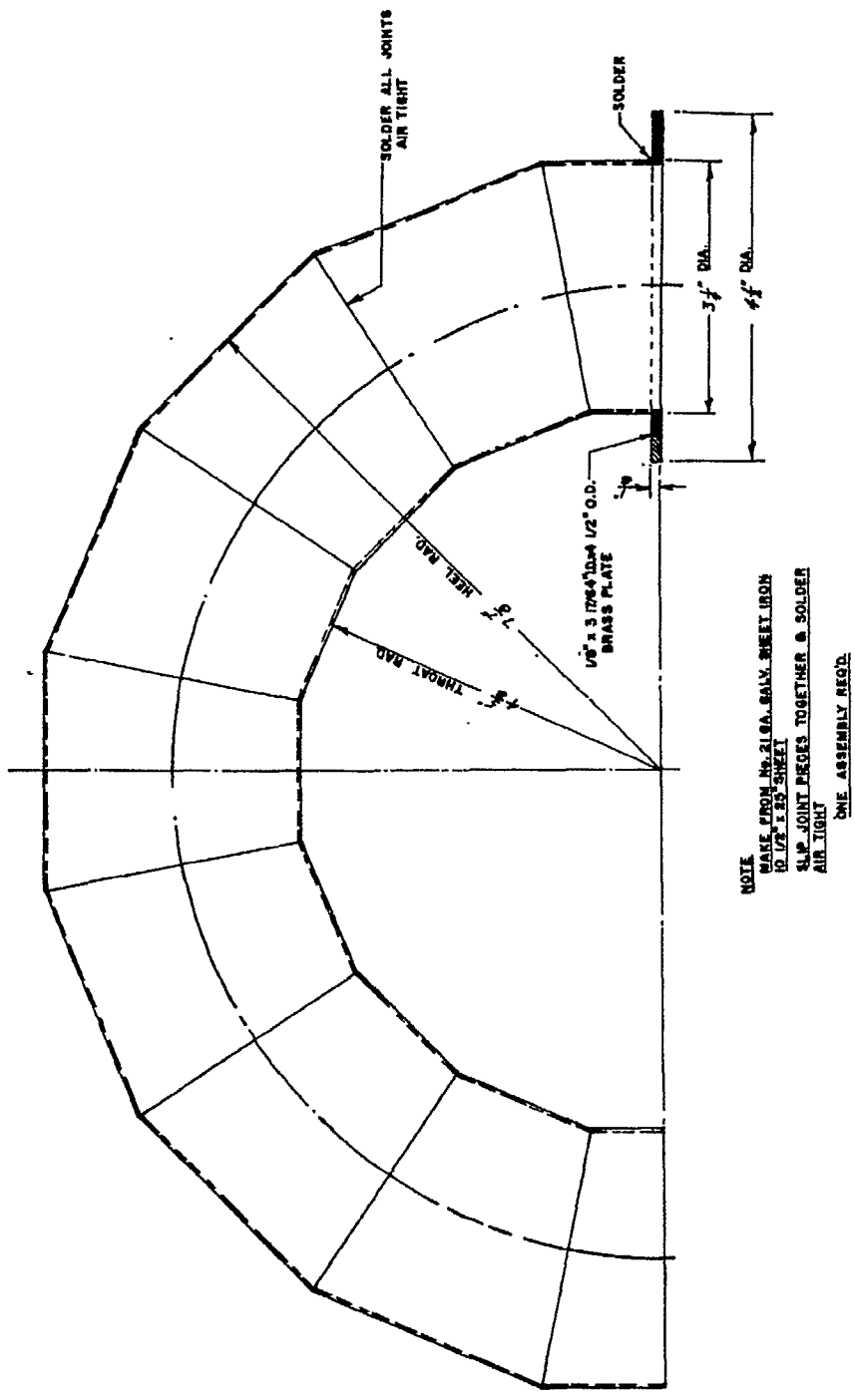

SOLDER ALL JOINTS AIR TIGHT
SOLDER
3½" DIA.
4½" DIA.
1/8" x 3 17/64" DIA. w/ 1/2" O.D. BRASS PLATE
HEEL PAD
THROAT PAD
NOTE
MAKE FROM No. 21 GA. GALV. SHEET IRON
10 1/2" x 85° SHEET
SLIP JOINT PIECES TOGETHER & SOLDER AIR TIGHT
ONE ASSEMBLY REQ'D.

FIGURE 3

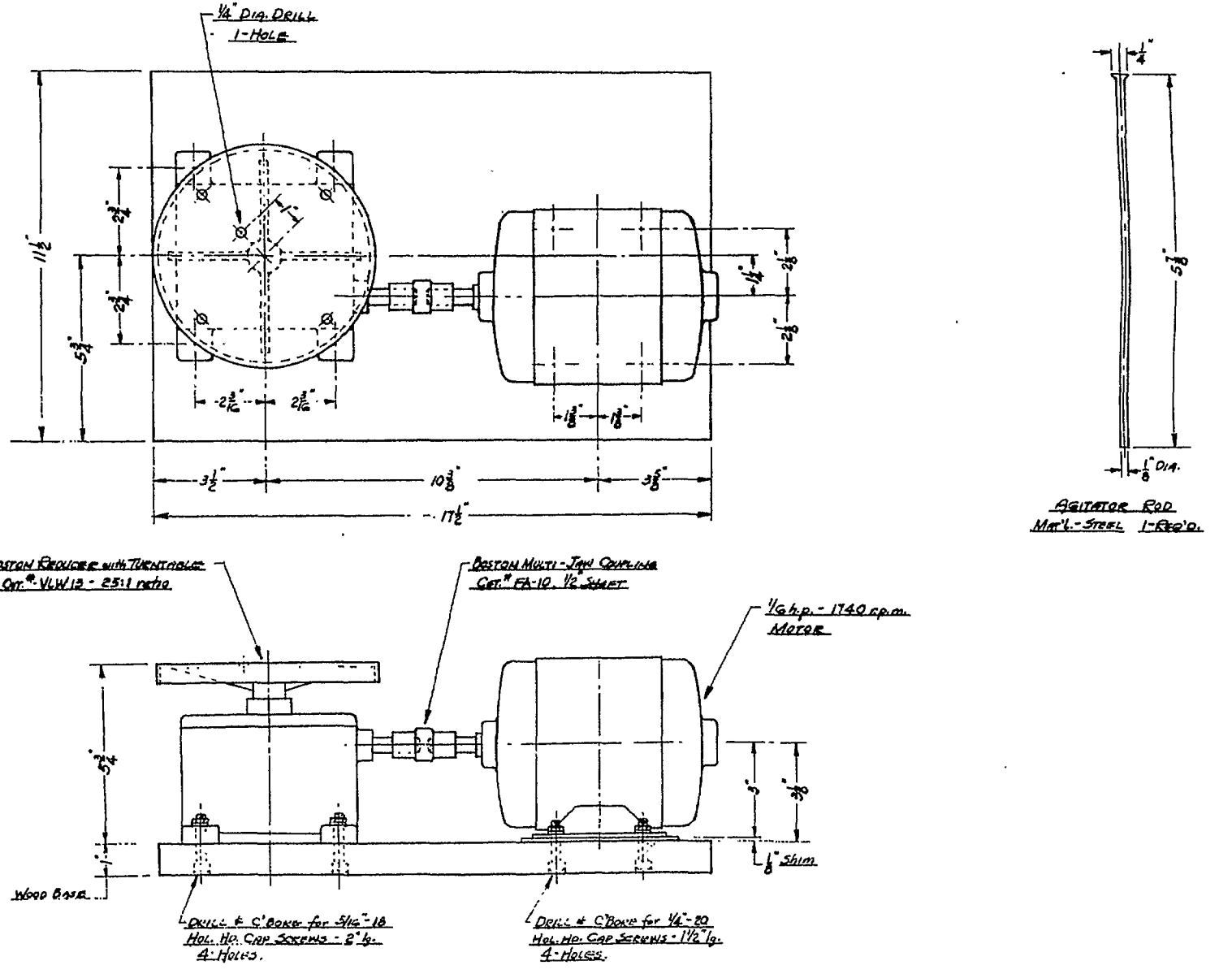


FIGURE 4

TESTING PROCEDURES

FOR

CHRYSOTILE ASBESTOS FIBRE

(Second Edition)

B-4

METHOD FOR PREPARATION OF CRUDY FIBRES
FOR THE SUTER-WEBB COMB TEST

Printed in U.S.A.

Revised and adopted by:

ASBESTOS TEXTILE INSTITUTE - 9/10/59
MINERAL FIBER PRODUCTS BUREAU -
QUEBEC ASBESTOS MINING ASSOCIATION - 4/27/61

B-4

SUTER-WEBB CRUDY FIBRE PREPARATION

Scope

1. This method covers a procedure for preparing asbestos samples containing crudy bundles of fibre to permit the taking of the representative 200-mg specimen samples required for determining the mean length and length distribution by the Suter-Webb Comb method.

Outline of Method

2. A 25-gm sample of the crudy fibre is passed through rolls to flatten and part the hard and tight crudy bundles of fibre, then placed in an air opening apparatus to fiberize and disperse the flattened bundles to produce a sample which is homogeneous in character. The surface area of the resulting fibre is to be 4000 ± 300 sq cm per gm, reasonably free of hard, crudy bundles of fibre, and suitable for taking the representative 200-mg sample for the Suter-Webb comb test. The surface area objective of 4000 ± 300 sq cm per gm is obtained by "trial and error", but Section 6, covering the procedure, will indicate a method for obtaining the objective for fibres of different character.

Description of Terms

3. (a) Fiberized - Opening crudy bundles of fibre into thinner cross-sections.

   (b) Surface Area - As measured by the air permeability method based on D'Arcy's Law.

Apparatus

4. (a) Rolls and tray as illustrated in Figure 1.

   (b) Air opening apparatus as illustrated in Figure 2.

   (c) Balance sensitive to .1-gm, and having a range of at least 0 to 25-gm.

(d) Stop Watch.

(e) Paint brush, 2-in. or equivalent.

(f) Forceps.

(g) Screen, Tyler 10-mesh or equivalent.

(h) Surface area apparatus.

Sampling

5. (a) Sample - The sample shall be the laboratory test sample as prescribed by the (A-1) "Method of Sampling and Preparation," or other asbestos fibre sample.

(b) Specimen for Preparation - The 25-gm specimen sample shall be derived from the laboratory test sample. Quarter the laboratory test sample down to approximately 25-gm as prescribed by the procedure "Sampling and Preparation of Fibre," Part 2, (a) through (g).

6. (a) For average unmilled or semi-milled crude grades of asbestos containing a large percentage of crude fibre bundles:

Note 1: Applicable only to those crude grades containing fibre bundles which are easily opened, otherwise follow procedure described in paragraph 6 (c).

(i) Spread the 25-gm specimen sample evenly on the galvanized sheet tray so that the fibre is one inch from all edges. Pass the fibre-covered tray slowly through the rolls. The pressure exerted by the rolls to be such that the fibre-free end of the tray is firmly gripped by the rolls. Any large pieces of crude which may prevent the tray from being drawn through the rolls should be fiberized by hand and replaced on the tray. Remove any fibre adhering to the tray, top roll and rubber scraper. Take the flattened fibre and by passing it through the fingers locate and open any compressed or crudy bundles of fibre. Special care should be taken to fiberize the large diameter pieces of crude by flexing or brooming the ends, thus making them amenable to air opening. At least 15 minutes should be allotted to this operation.

(ii) Shake and fluff the flattened fibre, then put loosely into the can of the air opening apparatus. Distribute the fibre evenly over the bottom of the can. Fasten the lid securely.

Attach the 1/8-in. nozzle to the bottom of the can and place the hood with the perforated plate in position on top of the 100-mesh screen. Open the air valve quickly to a pressure gauge reading of 20 psi. After two minutes, close the air valve.

(iii) Remove the fibre from the can and again place on the tray and pass it through the rolls in the same manner as before. Again pass the fibre through the fingers, pulling apart the flattened fibre. A few large diameter pieces of crude may still be present and these are to be fiberized by hand. Five minutes is to be allotted to this operation.

(iv) Shake and fluff the flattened fibre, then put loosely into the opener can and air open for two minutes at 20 psi.

(v) Remove the fibre from the can and carefully pull apart any entangled fibre. With a brush clean the air filter twill on the lid by cleaning only a small area at a time to prevent the fibre from balling. Distribute the fibre from the twill evenly over the air-opened fibre and mix thoroughly.

(vi) Test for surface area. If the surface area should be higher than 4300 sq cm per gm, reduce the air blowing schedule. Should it be lower than 3700 sq cm per gm, increase the air blowing schedule. Visually inspect the fibre for crudy bundles. An acceptable prepared fibre should be reasonably free of hard, crudy bundles of fibre.

(b) For crudy or splintery milled fibres:

(i) Proceed as in (i) of Part 6 (a).

(ii) Follow step (ii) of Part 6 (a) with the exception that the air flow is maintained at 15 psi for 1-1/2 minutes.

Note 2: When required, fibres in this class may be air-opened to a surface area of 8000 ± 500 cm^2/gm to condition any tight crudy fibre bundles present by blowing with air at 20 psi for two minutes. Any hard bundles remaining, after a surface area of 8000 ± 500 cm^2/gm has been developed, shall be sorted out and fiberized by hand or treated separately in the air-opening device. Use procedure described in Part 6 (c) for fibres containing a profusion of tight, hard bundles.

(iii) Remove the fibre from the opener can and proceed as per steps (v) and (vi) of Part 6 (a).

(c) For unmilled or semi-milled crude grades of asbestos containing a large percentage of very hard and tight crudy fibre bundles and considerable magnetite:

(i) Proceed as in (i) of Part 6 (a). Fiberize only the large crudy fibre bundles which can be hand opened without effort.

(ii) Shake and fluff the compressed specimen sample by hand, then form into a cone. Starting from the top of the cone, remove the fibre in small portions, using forceps. The remaining crudy bundles will end up at the bottom of the cone. By hand, fiberize all the crudy fibre bundles and spread over the sample.

(iii) Place the sample on a 10-mesh Tyler sieve, or equivalent, and shake for 15 seconds. Set aside the minus 10-mesh material, which will contain, besides fibre, most of the magnetite.

(iv) Place the plus 10-mesh fibre in the air opener can and air open in the same manner as step (ii) Part 6 (a) for three minutes at a pressure of 20 psi.

Note 3: Use air flow for four minutes at 20 psi for grades containing a profusion of hard crudy bundles, which are difficult to open.

(v) Proceed as in (v) Part 6 (a). A small amount of magnetite and a few crudy fibre bundles may report on the bottom of the air opener can. If so, combine with the minus 10-mesh material.

(vi) Spread the minus 10-mesh material on the tray and pass through the rolls. Pull apart and fluff any flattened or hard crudy pieces of fibre and add to sample. Mix sample thoroughly.

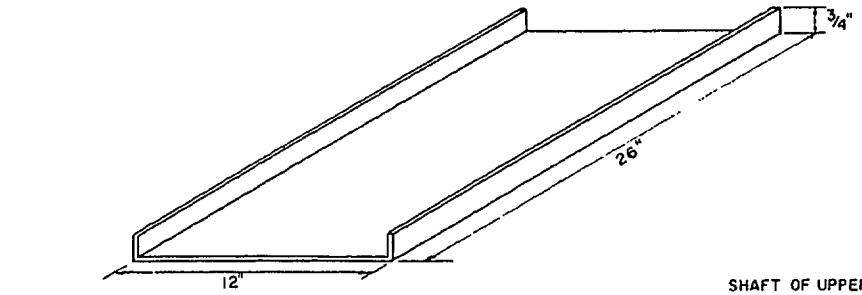
(vii) As most of the magnetite is loosely held in the sample, it is considered necessary to remove the major part of this granular material as it is likely to cause erratics in the combing results. Most of the magnetite can be eliminated by the following procedure: Thoroughly shake and fluff the prepared fibre by hand and form into a cone. With forceps starting at the top of the cone take small portions of fibre and set aside. Most of the magnetite, with a small amount of fibre, will end up on the table at the bottom of the cone. With the brush pick out the fibre and mix with the prepared sample. Discard the magnetite. Repeat the coning and fibre removal operation. A small amount of magnetite will still remain in the sample, but not

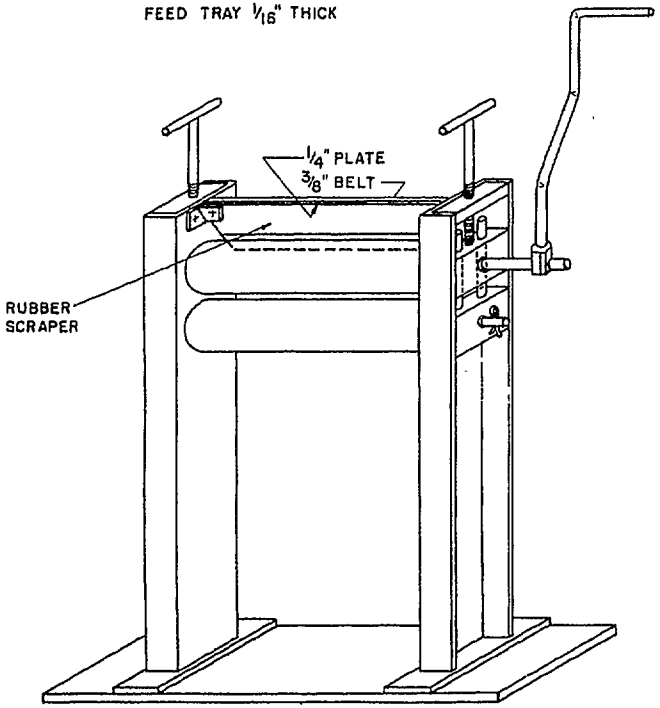
sufficient to affect the reproducibility of the Suter-Webb sorter test.

(viii) Take surface area test, then proceed as in step (vi) Part 6 (a).

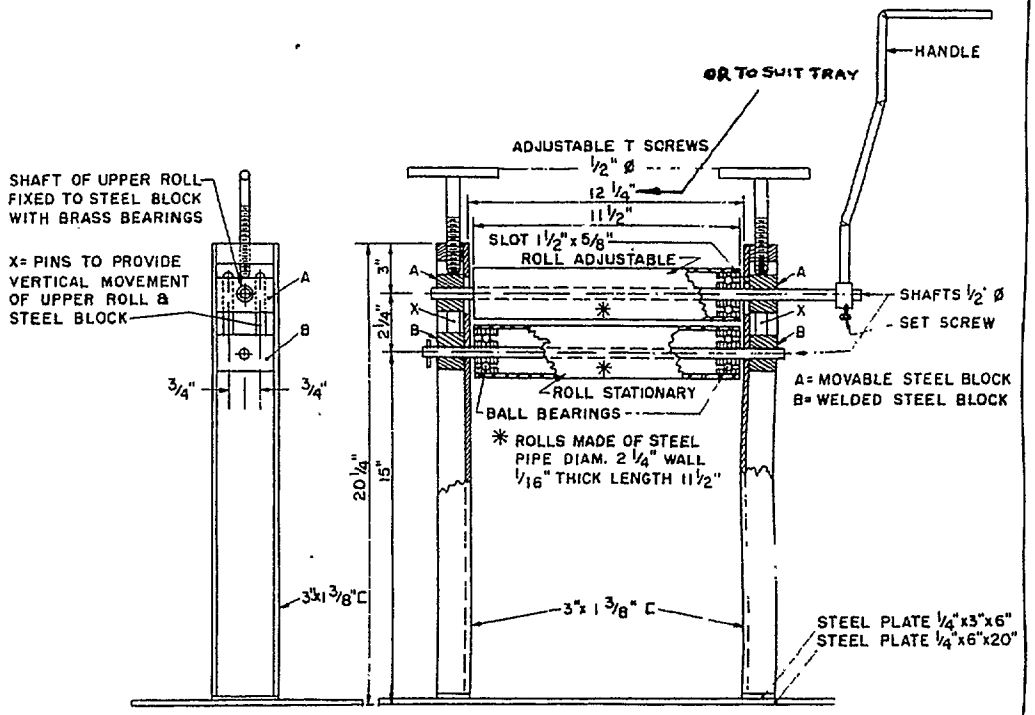
Report

7. Record the procedure finally adopted to prepare a given sample, and the surface area of the fibre tested, on the Suter-Webb report form for future reference.





ISOMETRIC VIEW



SIDE VIEW

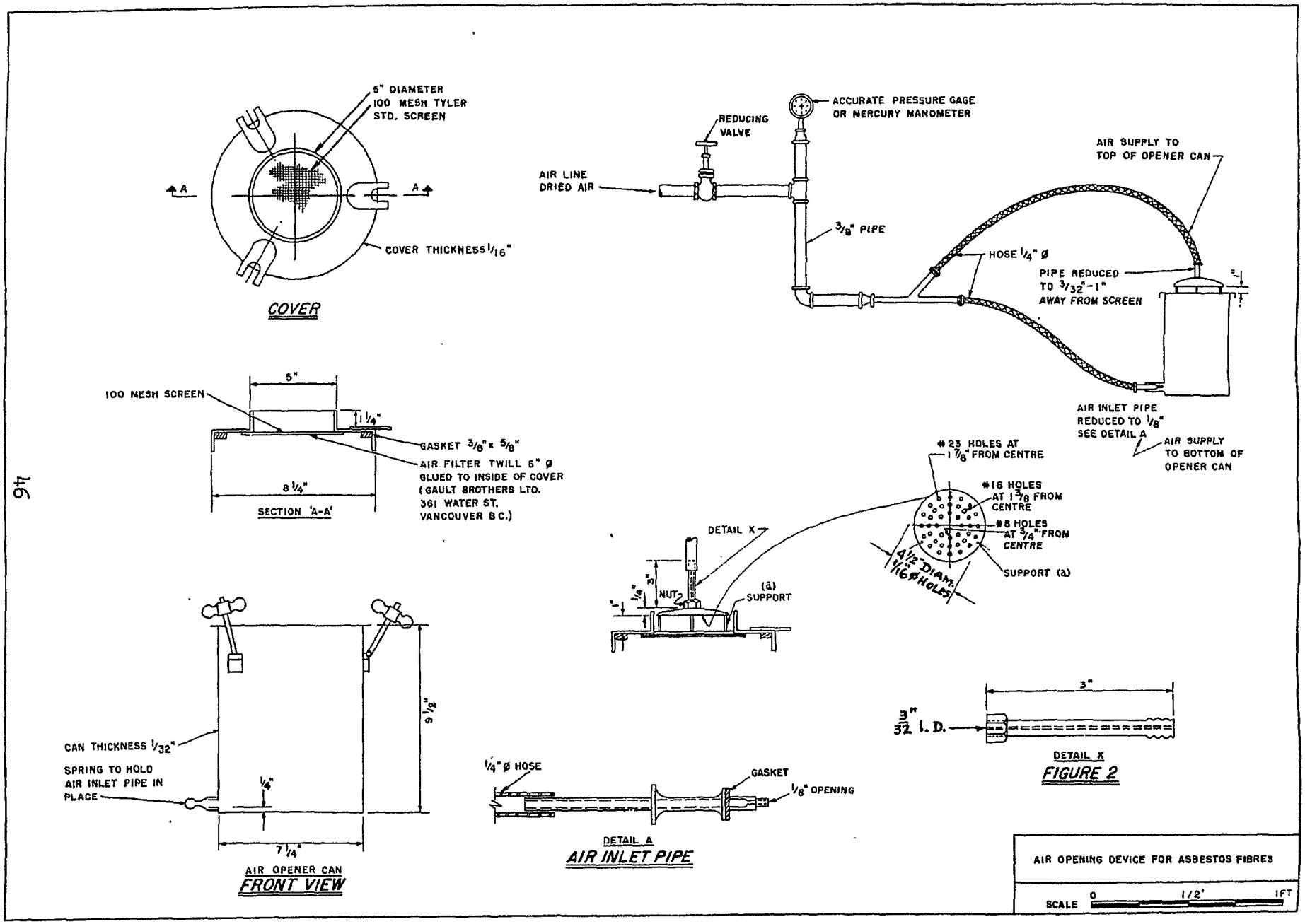
FRONT VIEW

FIGURE 1

TINSMITH ROLLS TO PREPARE CRUDY OR SPLINTERY FIBRES PREVIOUS TO AIR OPENING

SCALE 0 1/2' 1FT

45


5" DIAMETER
100 MESH TYLER
STD. SCREEN
A
A
COVER THICKNESS 1/16"
COVER
ACCURATE PRESSURE GAGE
OR MERCURY MANOMETER
REDUCING
VALVE
AIR LINE
DRIED AIR
AIR SUPPLY TO
TOP OF OPENER CAN
3/8" PIPE
HOSE 1/4" ø
PIPE REDUCED
TO 3/32"-1"
AWAY FROM SCREEN
AIR INLET PIPE
REDUCED TO 1/8"
SEE DETAIL A
AIR SUPPLY
TO BOTTOM OF
OPENER CAN
100 MESH SCREEN
5"
1 1/4"
8 1/4"
GASKET 3/8" x 5/8"
AIR FILTER TWILL 6" ø
GLUED TO INSIDE OF COVER
(GAULT BROTHERS LTD.
361 WATER ST.
VANCOUVER B.C.)
SECTION 'A-A'
#23 HOLES AT
1 7/8" FROM CENTRE
#16 HOLES
AT 1 3/8 FROM
CENTRE
#8 HOLES
AT 3/4" FROM
CENTRE
4 1/2" DIAM.
1/16 ø HOLES
SUPPORT (a)
DETAIL X
(a)
SUPPORT
NUT
1/8"
3"
1"
CAN THICKNESS 1/32"
SPRING TO HOLD
AIR INLET PIPE IN
PLACE
1/4"
9 1/2"
7 1/4"
AIR OPENER CAN
FRONT VIEW
1/4" ø HOSE
GASKET
1/8" OPENING
DETAIL A
AIR INLET PIPE
3"
3/32 I. D.
DETAIL X
FIGURE 2
AIR OPENING DEVICE FOR ASBESTOS FIBRES
SCALE
0
1/2"
1FT

TESTING PROCEDURES

FOR

CHRYSOTILE ASBESTOS FIBRE

(Second Edition)

B-5

TEST FOR MEASURING THE LENGTH AND LENGTH DISTRIBUTION OF ASBESTOS FIBRE BY THE MODIFIED SUTER-WEBB COTTON SORTER

Printed in U.S.A.

Revised and adopted by:

ASBESTOS TEXTILE INSTITUTE - 2/11/65
MINERAL FIBER PRODUCTS BUREAU -
QUEBEC ASBESTOS MINING ASSOCIATION - 3/16/65

B-5

SUTER-WEBB COMB

Scope

1. This test is intended primarily for determining the weighted mean fibre length of a sample of asbestos containing few or no crudy bundles of fibre.* In addition, the data obtained in the test can be used to calculate the percentage of fibre by weight in each 1/8-in. length group. These in turn can be used for a detailed study of length distribution. This test is usually performed only on textile grades.

Description of Terms

2. (a) Weighted Mean Fibre Length - The average length of all the fibres in the sample, based on weight-length data.

   (b) Crudy Bundles - Many fibre filaments still grouped together as hard, unopened bundles.

   * The treatment for asbestos samples containing a high percentage of crudy bundles is explained in the test method titled (B-4) "Suter-Webb Crudy Fibre Preparation."

Outline of Method

3. A sorting apparatus consisting of parallel combs spaced at 1/8-in. intervals, is used to align the fibre in a 200-mg specimen. The fibres are paralleled in the series of combs in such a manner that all fibre lengths are grouped from a base comb. The different lengths are separated by dropping combs consecutively and the fibres in each length group are collected and weighed. From these data the weighted mean length and length distribution can be calculated.

Apparatus

4. The following alternative pieces of equipment may be used:

   (a) (1) The Suter-Webb Comb Sorter modified for combing asbestos fibres, with accessories, supplied by Alfred Suter Company, 200 Fifth Avenue, New York 10, New York, U. S. A.

   (a) (2) The Turner Comb Sorter, with accessories, supplied by Turners Asbestos Fibres Limited, Faulkner House, Faulkner Street, Manchester 1, England.

(b) Fibre grippers (as supplied with Turner Comb Sorter).

(c) Hand comb (as supplied with Turner Comb Sorter).

(d) Analytical balance having a range of at least 0 to 200 mg (sensitive to 0.1 mg).

(e) Tared watch glasses or slides for weighing.

(f) Sampling board (Figure 2).

(g) Velvet covered plate (as supplied with Suter-Webb Comb).

(h) Dissecting needle.

(i) Tweezers.

Sampling

5. Test Specimen

(a) As many 25-gm comb sorter samples as are required shall be derived from the laboratory sample in accordance with (A-1) "Method of Sampling and Preparation."

(b) Only one comb sorter specimen shall be derived from each 25-gm sample.

(c) The tests specimen is then derived from the 25-gm comb sorter sample in the following manner (see also Schematic Presentation. Section 5 lettering corresponds with the Schematic lettering Figure 1).

(d) Divide the 25-gm sample into ten equal piles in two columns of five.

(e) Divide each pile in one operation into two equal parts, and discard the inner piles, the total weight remaining then being approximately 12-gm.

(f) Recombine and mix the remaining piles and again divide into ten piles in two columns of five.

(g) Divide each pile in one operation into two equal parts and discard the outer piles, the total weight remaining then being approximately 6-gm.

(h) Recombine and mix the remaining halves and divide into five piles.

(i) Divide each pile in one operation into two approximately equal parts and discard one row of piles, the total weight remaining then being approximately 3-gm.

(j) Take approximately 200-mg from each pile of the remaining piles to make a total of 1-gm.

(k) Spread the 1-gm sample in a thin layer over the area of 8-in. x 8-in. on the sampling board in such a manner that pinches can be taken from all parts. Any entangled fibre and crudy bundles should be carefully separated with dissecting needle and tweezers, and distributed over the area of the board. From each of the five marked areas take a tuft of fibre, to make a total weight of 200 ± 1-mg.

(l) All sampling and measuring should preferably be conducted at uniform temperature and humidity in accordance with (A-1) "Method of Sampling and Preparation."

Test Procedure

6. (a) Taking the whole of the 200-mg specimen, arrange the fibres in a parallel oval bundle between the finger and thumb of one hand, with the fibre ends corresponding to form an even head.

(b) Grip the fibre ends in this head with grippers. The ends of the fibre must extend into the grippers to the same extent as the leather pad on the lower jaw of the grippers.

(c) Withdraw the tuft of parallel fibres held by the grippers, lengthwise from the remainder of the specimen, and comb them with the hand comb to remove any adhering fibres which are not properly gripped.

In combing by hand, the comb is inserted alternately from above and below the tuft held in the grippers, starting near the free ends of the tuft and working progressively, in approximately 1/8-in. steps, towards the grippers. Not more than ten strokes of the comb in all should be made on any one tuft.

(d) Straighten the tuft of fibres, which finally remains in the gripper, gently with finger and thumb and lay them across the banks of combs in the sorter, with the jaw of the fibre gripper held lightly against the pins of the last comb, and gently press down the fibre tuft using the depressor, to not more than half the depth of the pins.

(e) When laying fibre across the combs, keep the grippers horizontal so that the slight downward movement required to engage the fibres with the pins of the comb does not involve tilting the grippers.

When the fibres are held in the pins of the combs the grippers can be released and removed, and the first application of the depressor should include the fringe of fibres which project from the last comb.

When so laid, the fringe of fibre should protrude 0.10 to 0.11 inches beyond the first comb.

(f) Recombine the loose fibres, separated on the hand comb, with the remainder of the specimen, and repeat steps 6 (a) and 6 (e) until the specimen has been transferred to the combs in the sorter. Fibres too short for insertion into the combs are combined with the knots in 6 (g).

(g) In the process of hand combing, small knots of fibre, caught in the comb teeth and impossible to disentangle into parallelism, may be formed. Do not place these in the comb sorter but set them aside until a later stage in the procedure.

(h) When all the fibres which can be parallelized have been placed in the comb sorter, turn the sorter around so that the combs nearest the operator are those which do not contain any fibre. Lower these combs successively until the longest fibres are seen protruding from the next comb.

(i) Using the grippers, withdraw the protruding fibres. Collect the fibres which have been withdrawn and roll them on the velvet-covered plate.

(j) Lower the next comb and withdraw the next group of fibres. Repeat this procedure until the last comb is reached. When the fibres projecting from this comb have been removed collect the fibres which remain entangled with the comb, combine them with the knots of fibre set aside earlier (Paragraph 6 (g)). Any fibres on and around the sorter are collected and also combined with the knots. The groups of fibre, with short spacing between groups, are now on the velvet-covered plate.

(k) Weigh the groups of fibre and also the short fibres that could not be placed in the combs. If the sum of the weights differs from 200-mg by more than 10-mg the test is repeated. Other weighing sequences are permissible providing there is no loss of fibre.

Calculations and Report

7. (a) The mean group length of the fibres remaining on the last comb, together with the knots and fibre that could not be placed in the combs, is taken as 1/16-in., the length of the fibres withdrawn by the grippers with one comb raised is 3/16-in., with two

combs raised is 5/16-in., and so on. The weighted mean fibre length of the whole specimen is calculated to the nearest 0.01-in., using the following formula:

$$\text{Weighted Mean Fibre Length} = \frac{(\text{Mean Group Length} \times \text{Group Weight})}{\text{Total Weight Collected}}$$

(b) For each laboratory sample make two determinations for weighted mean fibre length. If the difference between the two results is greater than ten per cent of their average value, a third test should be made. In the event of agreement with one of the first two tests, the disparate result is rejected. If the third result differs from the mean of the first two results by more than ten per cent, the whole test, including the sampling from the laboratory sample, is repeated.

(c) The mean of the two accepted results is the weighted mean fibre length of the sample. Report to 0.01-in.

(d) The percentage weight of fibres in each 1/8-in. length group may be plotted to illustrate the fibre length distribution.

FIGURE 1

PROCEDURE FOR TAKING A COMB SORTER SAMPLE

(SCHEMATIC)

A. BULK SAMPLE

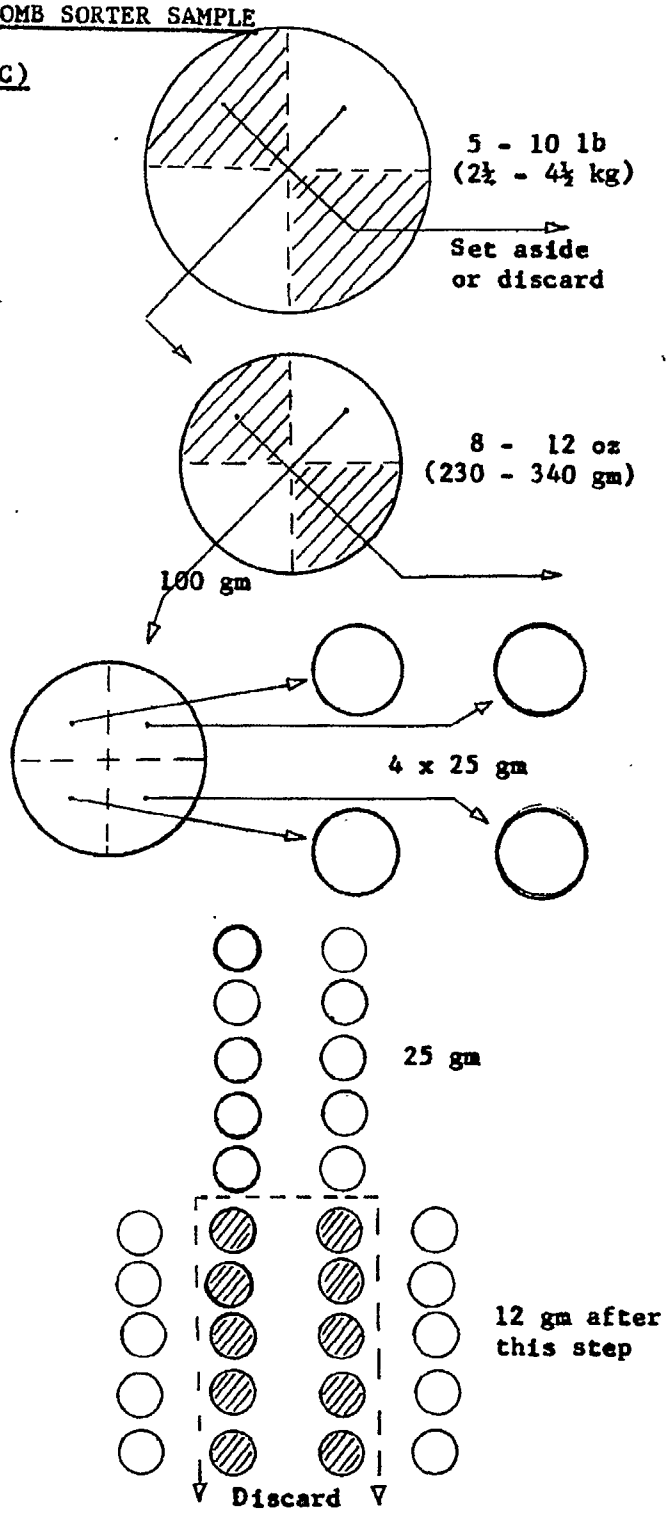
For example 5 - 10 lb
(2½ - 4½ kg)

B. Remove from the bulk sample, by coning and quartering, a test sample of 8 - 12 oz
(230 - 340 gm)

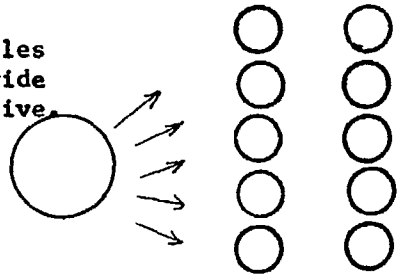
C. By further coning and quartering the test sample, remove as many 25 gm specimens as required. Each of these is to be dealt with as described in D - K below.

D. Divide the 25 gm into ten equal piles in two columns of five

E. Divide each pile in one operation into two equal parts, and discard the inner piles.

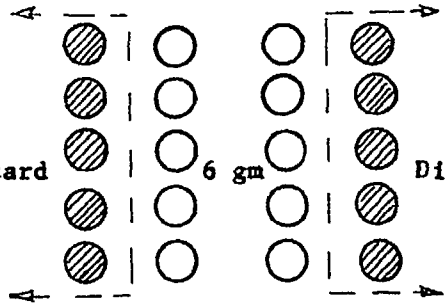


F. Recombine and mix the remaining piles (total weight 12 gm) and again divide into ten piles in two columns of five.

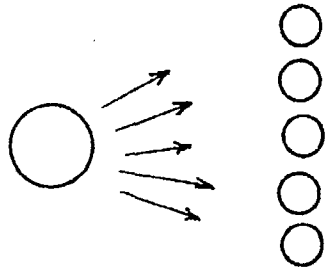


12 gm

G. Divide each pile in one operation into two equal parts and discard the <u>outer</u> piles.

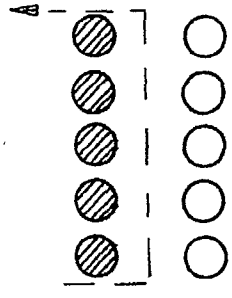


H. Recombine and mix the remaining halves and divide into five piles.



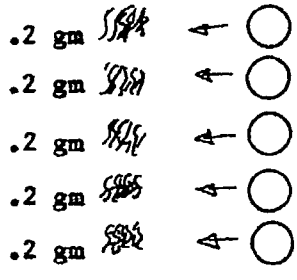
6 gm

I. Divide each pile in one operation into two equal parts and discard one row of piles.

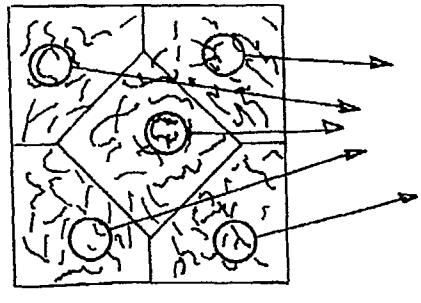


3 gm after this step

J. Take approximately 200 mg from each of the remaining piles to make a total of 1 gm.



K. Spread the 1 gm on a clean sampling board (see notes and diagram) and from each of the five marked areas take a tuft, to make a total weight of 200 mg $\pm$ 1 mg.



200 $\pm$ 1 mg

FIGURE 2

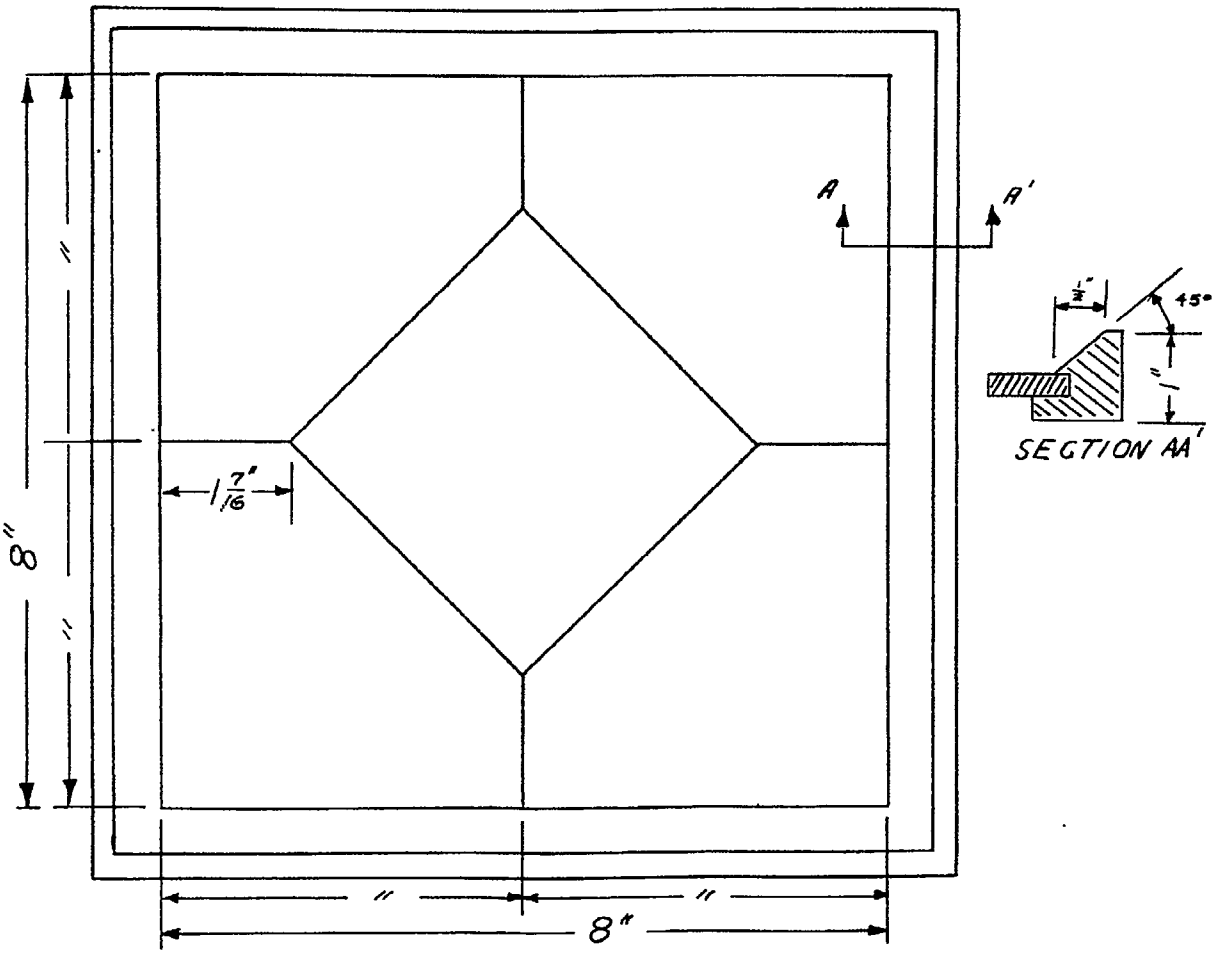
COMB SORTER TEST

SAMPLING BOARD FOR

SELECTING FIVE TUFTS FOR

FINAL 200 ±1mg TEST SPECIMEN

Board to have smooth surface, preferably black,
and marked in white as shown.
Edge moulding to be smooth and finished black.



TESTING PROCEDURES

FOR

CHRYSOTILE ASBESTOS FIBRE

(Second Edition)

C-1

BAUER-McNETT WET CLASSIFICATION TEST FOR ASBESTOS FIBRE

Printed in U.S.A.

Revised and adopted by:

ASBESTOS TEXTILE INSTITUTE - 10/7/65
MINERAL FIBER PRODUCTS BUREAU - 11/8/65
QUEBEC ASBESTOS MINING ASSOCIATION - 9/14/65

C-1

BAUER-McNETT CLASSIFIER

Scope

1. To determine the length distribution and fines content of milled asbestos fibre by wet classification employing the Bauer-McNett Fibre Classifier.

Apparatus

2. (a) Bauer-McNett Fibre Classifier 203-A or 203-C[1] preferably equipped with vacuum suction cups for drainage, similar in design to that shown in Appendix I, or on page 7 of the Service Manual 203-C[1] (See diagrams in Appendix II for identification of classifiers' parts).

Note 1: Drainage through muslin filter cloths or 200 mesh Tyler Sieve (325 Mesh for float products) is acceptable.

(b) Accessories:

(1) Balance (Sensitivity 0.01 gm).

(2) One 1000 ml. beaker and stirring rod.

(3) Filter papers, Reeve Angel No. 230[2], or equivalent, to fit suction cups on classifier.

Alternative - 325 mesh screen cloth filter mounted in a suitable metal ring may replace filter papers (See Note 5).

(4) Soft rubber scraper as shown in Appendix III.

(5) Rubber hose, 1/4-in. bore, with control valve nozzle for rinsing classifier screens and tanks with filtered water.

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[1] Currently supplied classifier Model 203-C and service manuals for the installation, operation and maintenance of Models 203-A and 203-C are available from the Bauer Brothers Company Ltd., Brantford, Ontario, Canada.

[2] Has been found satisfactory for this purpose.

(6) Drying oven (convection type, or mechanical draught), or infrared drying unit.

(7) Bell timer, or stop watch.

(8) Automatic overflow alarm as shown in Appendix IV.

(9) Optional Accessory - Automatic clearing device on the fourth tank, as shown in Appendix V (See Note 3).

(c) Water Supply - Provide a suitable filtering device on the water supply to ensure a constant flow of clean water to the classifier and rinsing hose.

Sample Weights, Screen Sizes and Test Duration

	FIBRE GROUP Q.A.M.A. NO.	SCREEN SIZES (TYLER MESH)	SAMPLE WGT (GM)	DURATION OF TEST (Mins)
3. (a)	3,4,5, 6 & 7D	4, 14, 35, 200	10	20
(b)	Other 7-Group Fibres	14, 35, 100, 200	20	20
(c)	"Floats"	80, 325	20	30

(d) For reference Tyler, U.S. and British Standard equivalent sieves are listed below:

Tyler Series		U.S. Series		British Standard	
Mesh	Opening	Mesh	Opening	Mesh	Opening
4	0.185 "	4	0.187 "		
14	0.046 "	16	0.0469"	14	0.0474"
35	0.0164"	40	0.0165"	36	0.0166"
80	0.0069"	80	0.0070"	85	0.0070"
100	0.0058"	100	0.0059"	100	0.0060"
200	0.0029"	200	0.0029"	200	0.0030"
325	0.0017"	325	0.0017"		

(e) Screen cloth must be double lock, double crimp style, with the warp in the vertical direction.

Sample Preparation

4. Select samples in accordance with (A-1) "Method of Sampling and Preparation", test duplicate samples.

Procedure

5. (a) Select screens specified for the fibre grade being tested and set in place making certain that the baffle plates are in their slots behind the screens.

(b) Insert the rubber stoppers, and fill the tanks with water.

(c) Start the agitators to rotate at 540 ± 40 rpm and adjust the water valve to give a flow slightly in excess of 3.0 U.S. gallons per minute. This rate of flow is achieved when the overflow from the constant head tank is pencil size.

(d) Add the test sample to 800 ml. of water in a 1000 ml. beaker and stir until the asbestos is thoroughly dispersed.

(e) Pour the slurry into the first tank (tank with the coarsest screen mesh) and wash out any fibre residue in the beaker with clean, filtered water. Set the timer for 20 or 30 minutes, depending upon the sample under test.

(f) During the operation, centre the filter papers, previously weighed to the nearest 0.01 gm. at room conditions, in suction cups on the supporting screen. Mark the weight of the filter paper, sample designation, classifier screen mesh, and other pertinent data around the outside edge of each filter paper with a soft black pencil before inserting into the suction cup, placing the writing against the supporting screen. Wet the filter paper and clamp into position.

(g) Close the main vacuum valve and open each vacuum cup valve.

Note 2: It is advantageous to perform the above two steps during the time in which the classifier tanks are initially being filled.

(h) Watch screens carefully during the test, and if any tank appears to overflow clean the screen surface with the soft rubber scraper shown in Appendix III.

(i) At the end of the test period, stop the impellers, shut the water, and open the main vacuum valve until a vacuum of approximately four inches water gauge is attained. Remove the drain plugs from each tank; and progressively increase the vacuum to the maximum desired. Failure to perform this operation slowly, or to remove all the drain plugs before any one tank is completely drained, may cause rupture of the filter papers.

(j) During draining, remove the screens and place them in their respective tanks. Immediately after a tank has been completely drained, carefully wash the screen and tank using the rinsing hose to ensure that all remaining fibre, including entrapped fibre and particles deposited behind the screen, are washed into the filter cup.

(k) When all the fibre in a tank is deposited into the cup, and the cup itself has drained, close the cup drain. Failure to close the cup drain after washing down and emptying the tank causes atmospheric air to enter the vacuum system and substantially lowers the vacuum of the system.

(l) After closing the cup valve, open the cup and remove the filter paper with its classified sample fraction, and dry to constant weight at 220° ± 5°F. under an infrared unit, or in a drying oven.

(m) After all the fractions are dried and allowed to return to room conditions, weigh each paper and fraction together. Obtain the net weight of the sample fraction by subtracting the initial weight of the filter paper and record as a percentage. The amount of -200 mesh (or -325 mesh) in the original sample is calculated by subtracting the cumulative weight of the fractions retained on the filter papers from the original weight of the sample (See Note 6 concerning crudy fibres).

Results and Sample Calculations

6. Below is an example of a typical 5-Group fibre Bauer-McNett classification with calculations:

Sample: 5-Group, 10 Grams, 20 Minutes

Screens (Tyler Mesh):	4	14	35	200 Mesh
Wgt. Retained (Gms)	0.5	1.3	1.9	1.4

Minus 200 Mesh $10.0 - (0.5 + 1.3 + 1.9 + 1.4) = 4.9$ Gms

Results:

Screens (Tyler Mesh)	4	14	35	200	-200 Mesh
% Retained	5.0	13.0	19.0	14.0	49.0%

Accuracy

7. (a) If the corresponding individual percentages obtained for each screen fraction differ by more than five units of percentage, make a third test. Average the results of two acceptable tests and report average.

(b) To obtain desired accuracy, the following general precautions should be observed:

(1) It is important that all material be washed from the tanks into the filter cups; and that the filter papers are handled with care.

(2) For better accuracy and reproducibility a water temperature of 70 ± 20°F is recommended.

(3) When the classifier is not in use, tanks should be kept full of water to prevent deposits from forming on screens.

(4) To obtain prescribed accuracy screens should not be cleaned during a classification, unless tanks tend to overflow. Test results may not be reproducible when screens are cleaned frequently and at irregular intervals during the test.

Note 3: At many laboratory locations, the use of an automatic clearing device on the fourth tank, similar to that shown in Appendix IV with the motor connected in series with the micro switch of the overflow alarm or on a separate switch, has been found to eliminate the necessity for cleaning the screen.

Note 4: At some laboratory locations, the use of stainless steel screen cloth has been found to give reproducible results over a longer period of time.

Note 5: When classifying very fine products, use filter papers for better accuracy.

Note 6: In the case of crudy fibres, the classified fractions may be retained for examination; and the percentage of crudy bundles and rock particles determined by an approved method.

(c) The following precautions apply to Model 203-A classifiers only:

(1) Screens should be checked regularly (at least once every operating shift) for damage, holes, warped frames, etc. Likewise, the rubber gaskets should be examined and replaced if defective as this is frequently the cause of abnormal minus 200 mesh results. The clamping screws should be turned tight enough to hold the screen plates firmly against the tank; but if turned too tight, or not uniformly, the screen frames may be permanently warped out of shape causing leakage past the gaskets.

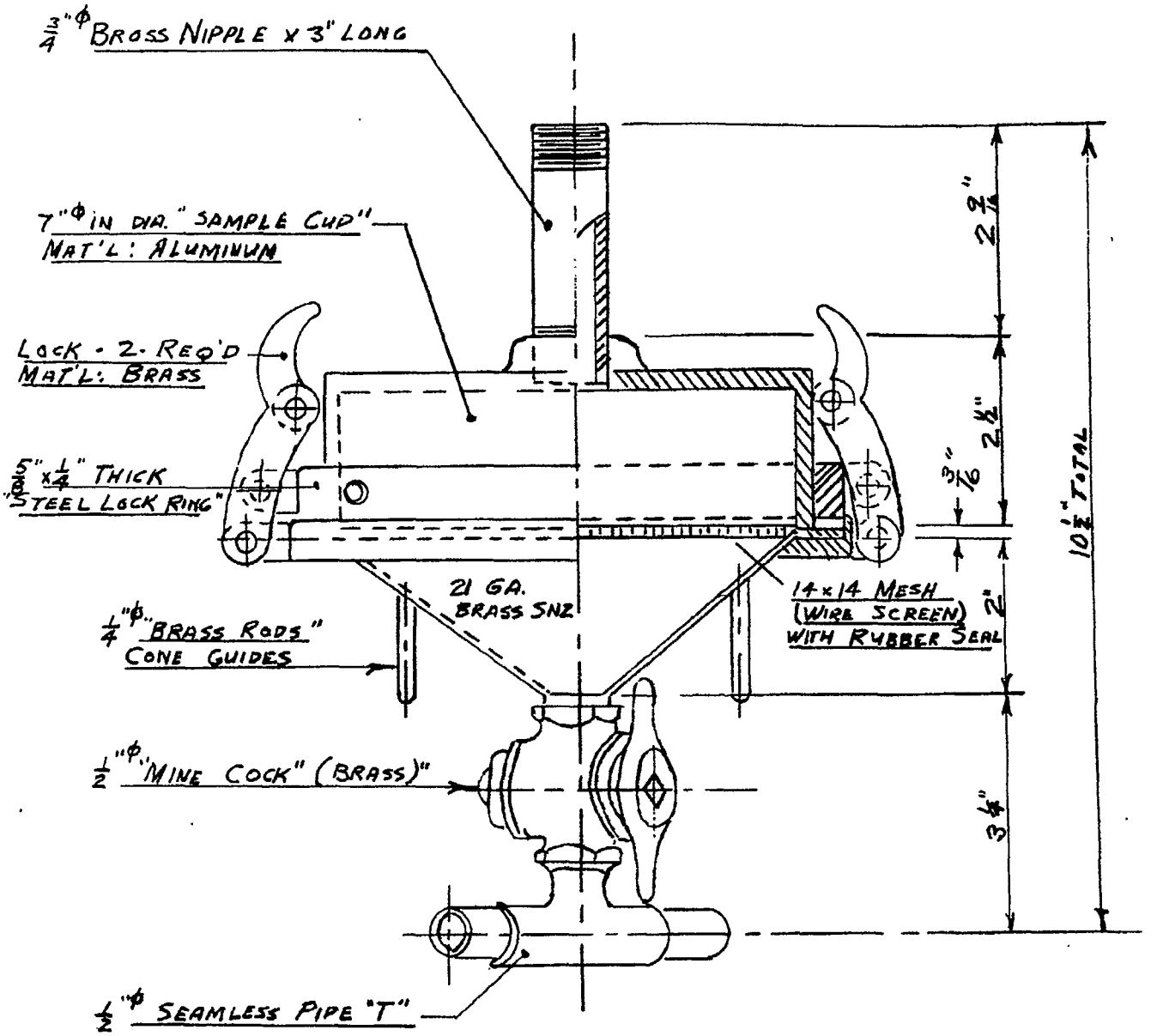
(2) The normal agitator speed (540 ± 40 rpm) should be checked daily, and the belts should be inspected to prevent slippage. The use of positive traction belts and sprockets is recommended.

(3) The equipment must be lubricated and maintained as described in Service Manual 203-A.

(d) The following precautions apply to Model 203-C classifiers only:

(1) Screens should be checked regularly (at least once per operating shift) for damage, holes, warped frames, etc.

(2) The equipment must be lubricated and maintained as described in Service Manual 203-C.

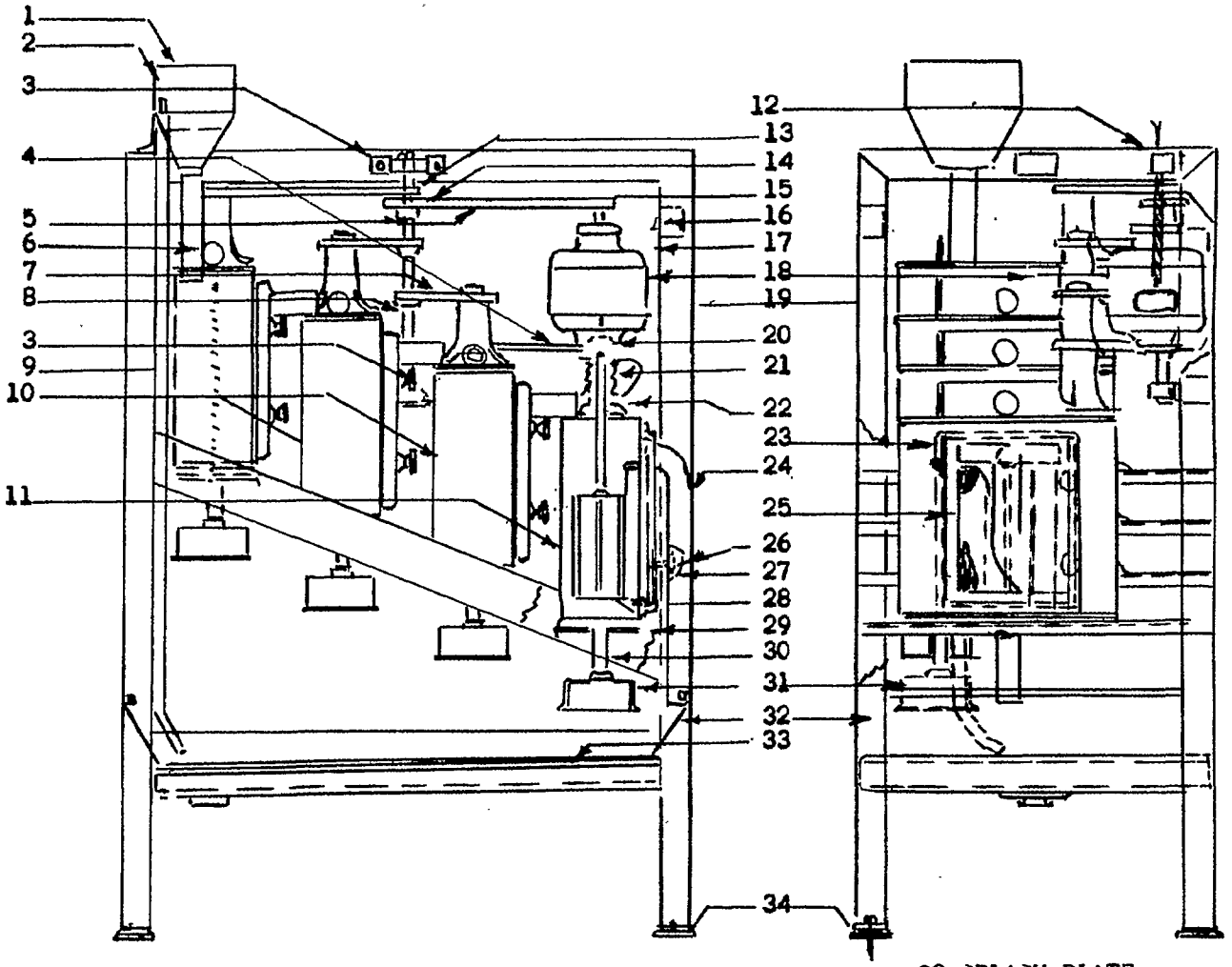


VACUUM CUP FOR 185φ CM. DIA. FILTER PAPER

BAUER-McNETT CLASSIFIER MODEL 203-A

SCALE: HALF SCALE

APPENDIX I



PARTS LIST

NO. 203A BAUER-MCNETT

FIBRE CLASSIFIER

1 TANK COVER
2 CONSTANT LEVEL TANK
3 DRIVE SHAFT BEARING
4 LONG. BELT
5 MOTOR BELT
6 STOPPER
7 SHORT BELT
8 DRIVE SHAFT
9 OVERFLOW PIPE
10 UPPER TANKS
11 LOWER TANK
12 COVER PLATE
13 SMALL PULLEY
14 DRIVE PULLEY
15 MOTOR PULLEY
16 CIRCUIT BREAKER
17 SWITCH PLATE
18 MOTOR
19 FRAME ASSEMBLY
20 SPECIAL AGITATOR PULLEY
21 AGITATOR BEARING
22 BEARING HOUSING
23 SCREEN PLATE
24 CLAMPING SCREW
25 BAFFLE PLATE
26 PACKING NUT
27 MIDFEATHER
28 SPONGE RUBBER GASKET
29 AGITATOR ASSEMBLY
30 DRAIN TUBE
31 SAMPLE CUP
32 SPLASH PLATE
33 DRIP PAN
34 FOOT

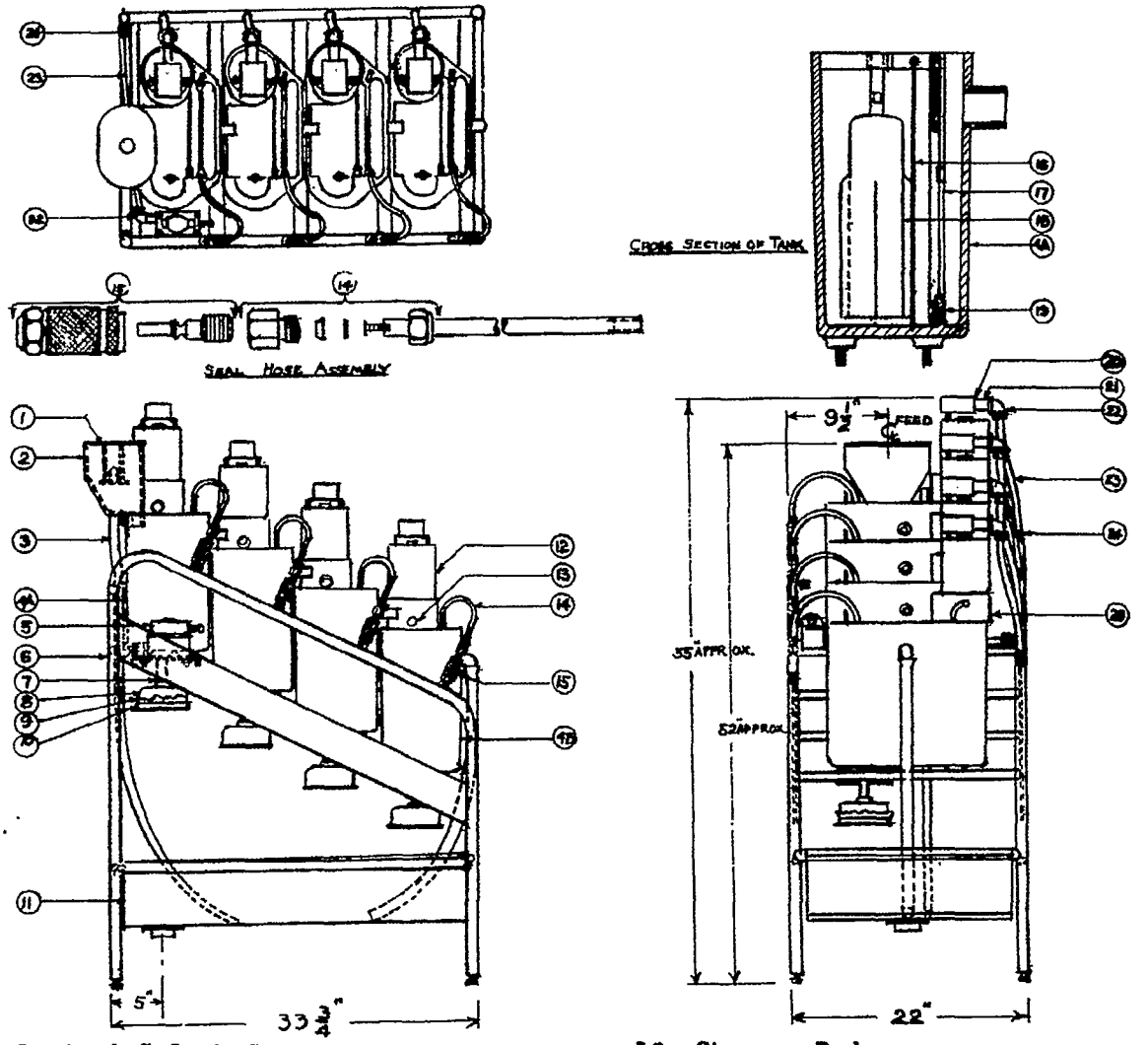
IDENTIFICATION OF CLASSIFIER PARTS MODEL 203-C

V-1. The following diagram and parts list will facilitate identification and ordering of replacement parts for the Bauer-McNett Fibre Classifier.

V-2. Ordering:

V-3. To expedite service, the following information should be supplied with your order:

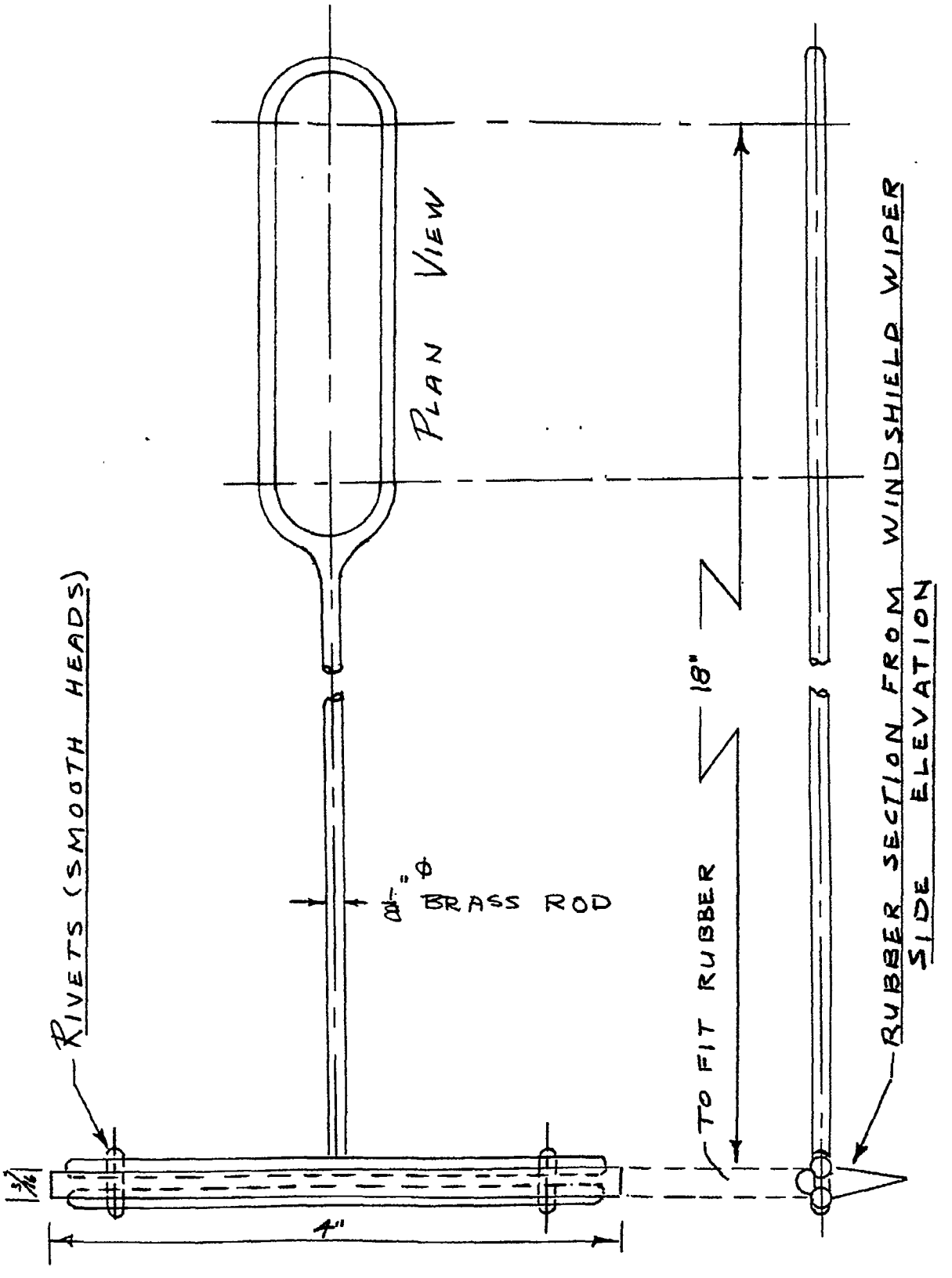
a) Serial No. and model No. of Classifier.
b) Name of part } per "parts list"
c) No. of part } diagram
d) Quantity needed

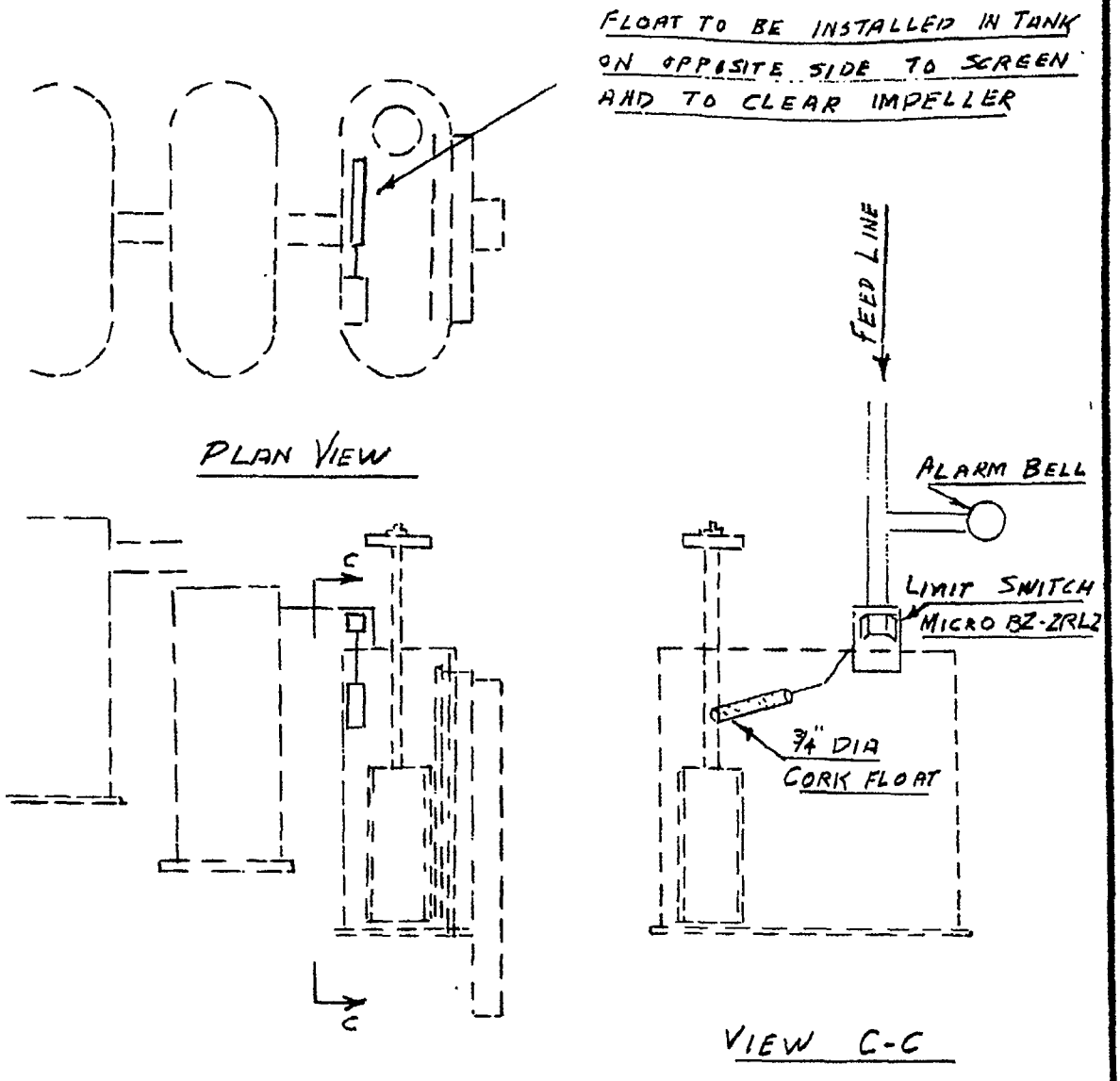


1. Anti-Splash Cover
2. Constant Level Tank
3. ⅛" I.D. x ¼" O.D. x 45" LG Tygon Tubing
4A. Tank Assembly
4B. Tank Assembly (Front)
5. Agitator Switch
6. Frame
7. Nipple Sample Cup
8. Sample Cup
9. Muslin Cloth
10. #105, Rubber Bands
11. Drip Pan
12. Motor 1/20 H.P.
13. Stopper Rod
14. Seal Hose Assembly
15. Quick Coupling
16. Midfeather
17. Baffle Plate
18. Agitator Assembly
19. Screen Plate & Screen
20. ⅛" Close Pipe Nipple
21. ⅛" Piple Coupling
22. 90" Water Tight Angle Connectors
23. 17" LG 3/8" Water Tight Flex Conduit
24. Water Tight Straight Connector
25. Gear Reduction Unit

SOFT RUBBER SCRAPER

(FULL SCALE)





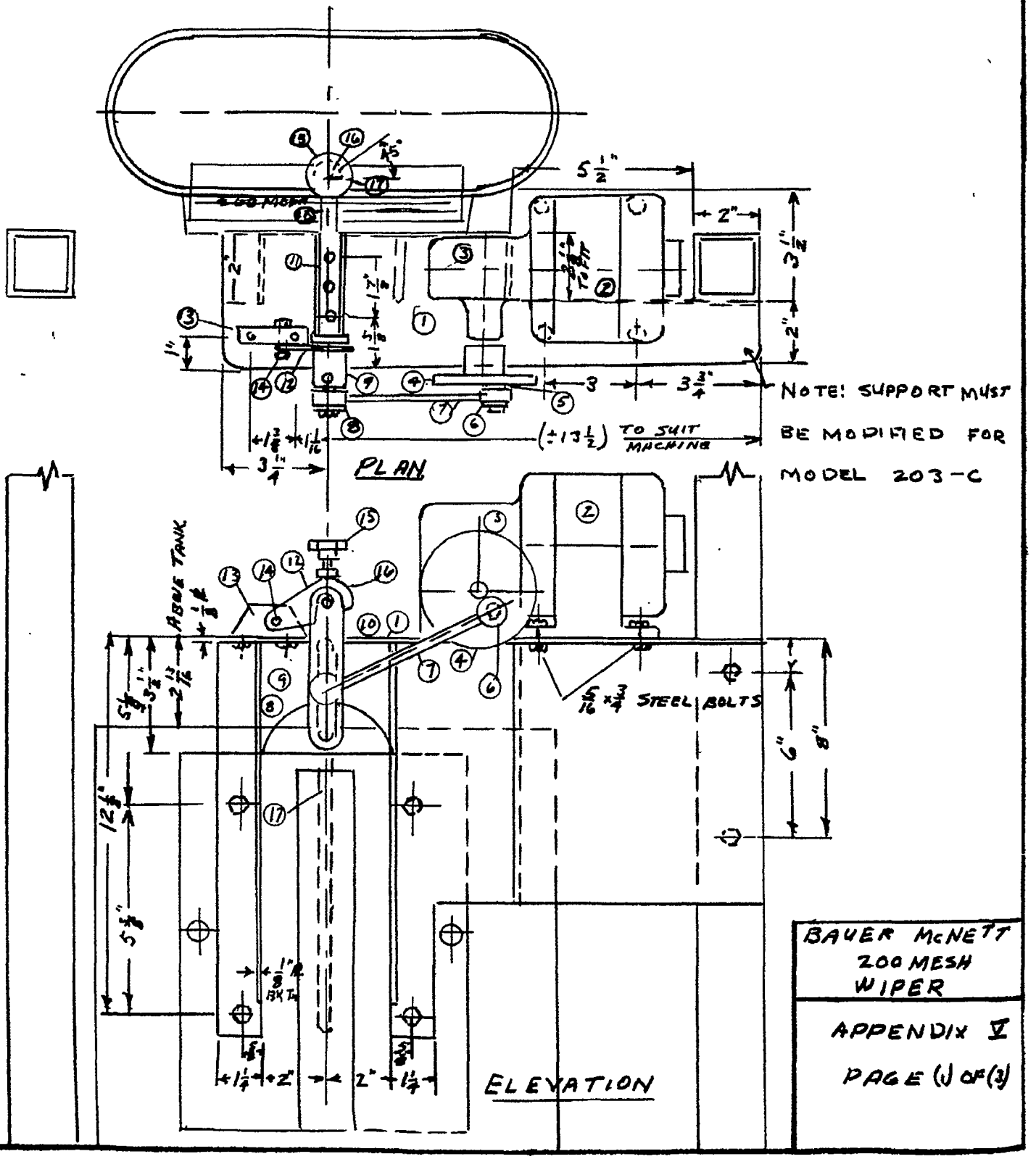
OVERFLOW ALARM BAUER McNETT CLASSIFIER

APPENDIX IV

② BOSTON GEAR MOTOR, 1/20 H.P., 115 V. A.C., 1. GAMP, 1726 R.P.M., MOTOR MODEL B1KH23AC3713

③ BOSTON GEAR MOTOR REDUCER, CAT. No, M858205 87.5 R.P.M.

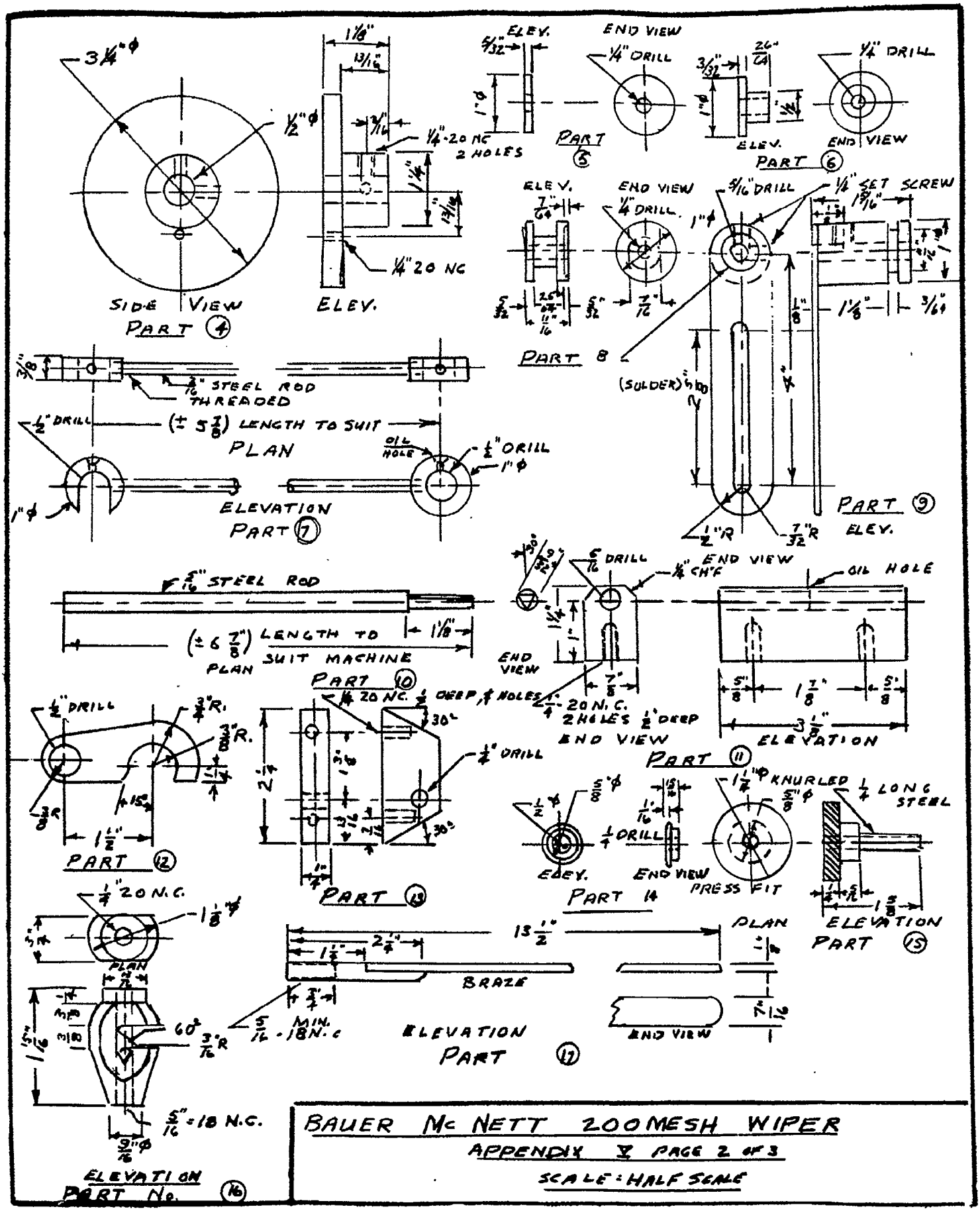
4 TO 17 FOR DETAILS OF PARTS No. 4 TO. 17 SEE DWG, "8" PAGE 2



BAUER McNETT
200 MESH
WIPER

APPENDIX V

PAGE (1 OF (3)

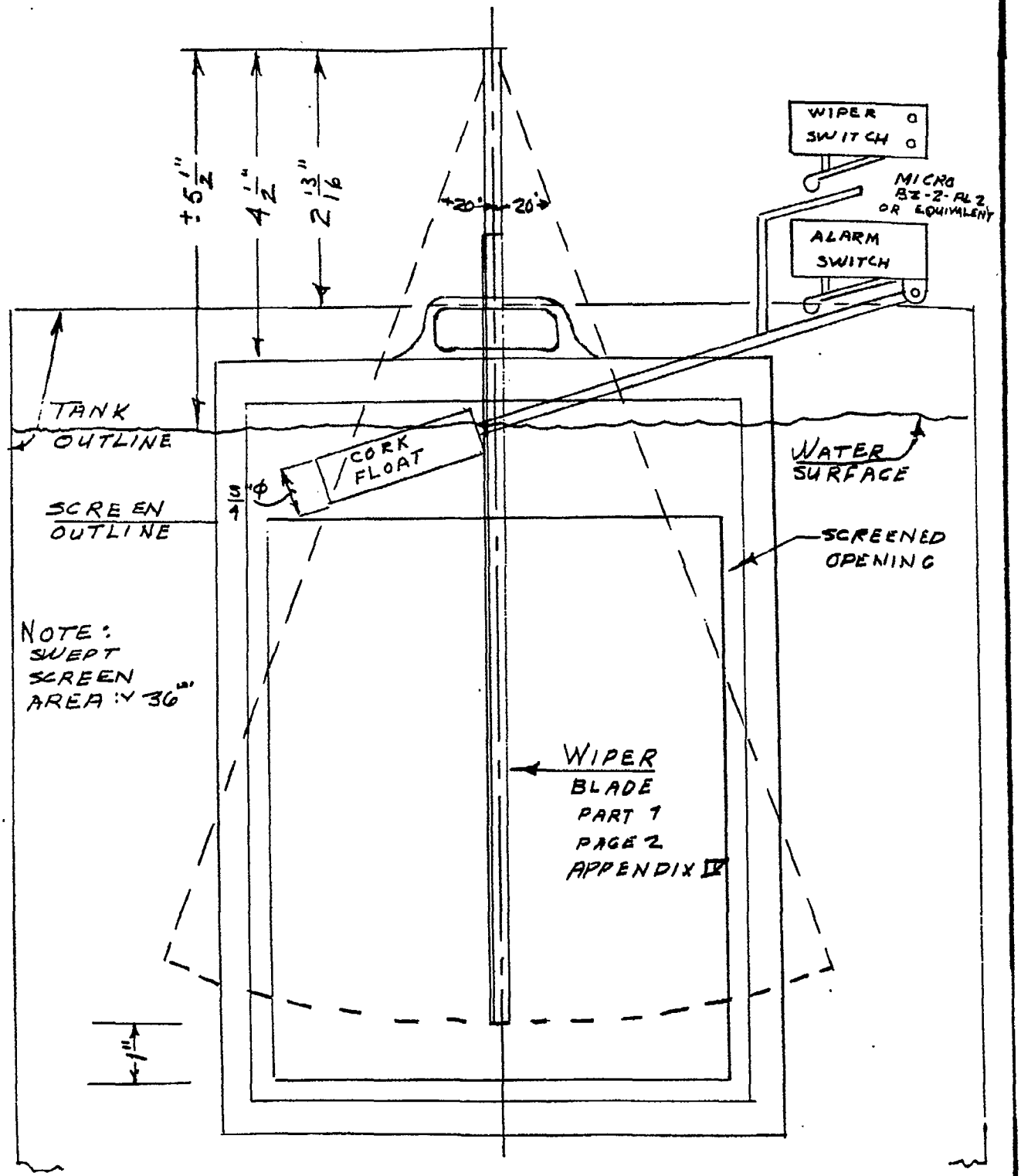


BAUER Mc NETT 200 MESH WIPER

APPENDIX V PAGE 2 OF 3

SCALE: HALF SCALE

NOTE: FLOAT TO BE INSTALLED IN TANK ON THE SIDE OPPOSITE FROM THE SCREEN AND TO CLEAR THE IMPELLER



TESTING PROCEDURES

FOR

CHRYSOTILE ASBESTOS FIBRE

(Second Edition)

C-2

LENGTH DISTRIBUTION AND DUST CONTENT OF ASBESTOS FIBRES OF 4A GRADE AND LONGER BY WET SCREENING, USING THE CLARK CLASSIFIER

Printed in U.S.A.

Revised and adopted by:

ASBESTOS TEXTILE INSTITUTE - 9/10/59
MINERAL FIBER PRODUCTS BUREAU -
QUEBEC ASBESTOS MINING ASSOCIATION - 2/23/60

C-2

CLARK CLASSIFIER

(Long Fibres)

Scope

1. This procedure covers a wet screen analysis, by apparent fibre length distribution and fines content, of asbestos fibres of Grade 4A and longer.

Apparatus

2. (a) Nature of Apparatus - The Clark Classifier consists essentially of a semicircular tub divided into four main compartments in each of which is a circular screen or perforated disc mounted on and driven by a common shaft rotated at about 48 revolutions per minute by a geared motor. The rim of each disc and screen forms a seal by rotating between the longitudinally slit edges of a piece of soft rubber tubbing mounted in a small metal channel on the inside of the tub. By means of a constant headbox, water is passed through the classifier at a chosen rate of 12.5 liters per minute. In each compartment the incoming water is directed to the bottom of the tub by means of a weir and baffle. The consequent motion of the water serves to keep the asbestos fibres from settling and to present them regularly to the rotating discs and screens. Depending on the size and the design of the disc and screen openings, a definite fibre length separation is obtained in each of the four compartments. The apparatus, illustrated in Figures 1, 2 (a), 2 (b), and 2 (c), shall consist specifically of the parts described in paragraphs (b) to (i).

   (b) Classifier - Clark Model 46, four screen pulp classifier as shown in Figure 1.

   (c) Perforated Discs - Three perforated discs fabricated of Plexiglas and conforming to the design shown in Figures 2 (a), 2 (b), and 2 (c). The disc for the first compartment shall contain 1/2 inch perforations; the disc for the second compartment shall contain 1/4 inch perforations; the disc for the third compartment shall contain 1/8 inch perforations.

(d) Screen - 30 mesh screen as supplied with the Clark Classifier. The 30 mesh screen shall be used for the fourth compartment.

(e) Balance - Balance capable of weighing five grams to the closest 0.001 gram.

(f) Drying Oven - Standard gravity convection type drying oven capable of maintaining 220°F plus or minus 5°.

(g) Beaker - Beaker of 1500 milliliter capacity.

(h) Filter Paper - Qualitative filter paper discs, 90 millimeters in diameter.

(i) Timer - Timer capable of being read to the nearest 0.5 second. The timer shall be accurate to one per cent or less.

Sampling of Asbestos Fibre

3. The sampling shall be conducted in accordance with (A-1) "Method of Sampling and Preparation."

Procedure

4. (a) Size of Sample - The weight of sample used for this test shall be 5.000 plus or minus 0.001 grams.

(b) Preparation of Equipment for Classification - A drain cup, fitted with a filter paper disc which has been weighed to the closest 0.001 gram, shall be placed on each of the four drain pipes. A No. 3 rubber stopper shall be inserted into each of the drain pipes and the drain plug shall be inserted into the outlet line of the flow box leading to the first compartment. The water rate to the compartments shall then be adjusted to 12.5 plus or minus 0.1 liters per minute and rotation of the discs and screen shall be started.

Note 1: The No. 3 rubber stoppers are used in the compartments instead of the supplied drain plugs to eliminate tangling of the fibres on the drain plug stems.

Note 2: The water rate to the compartments is adjusted by means of the metering valve located in the line from the constant headbox to the tub. Once this valve has been set, no further adjustments are necessary. Care shall be exercised in setting the water rate to the constant headbox that a continual overflow is obtained.

(c) Wet Screening Test - When overflow from the last compartment of the classifier is obtained, the fibre sample shall be placed in a 1500 milliliter beaker to which approximately one liter of water has been added and shall be stirred to give a uniform slurry. The timer shall then be started and the slurry shall be poured into the weir box of the first compartment over approximately a one minute period. Care shall be exercised that the beaker is rinsed thoroughly.

During classification, the discs and screen shall be kept free of excess fibre accumulation by periodically flushing with water and any fibre which tends to settle in the compartments shall be stirred into suspension by squirting with a small quantity of water. At 20 minutes in the time schedule, the water flow to the compartment shall be turned off and the disc and screen rotation shall be stopped.

Note 3: The water flow to the compartments can be stopped most conveniently by removing the drain plug in the outlet line of the flow box leading to the first compartment.

(d) Collection and Drying of Fractions - The rubber stoppers shall be removed from the drain pipes and the compartments allowed to empty. The discs, screen, and compartments shall be rinsed thoroughly and the excess water shall be removed from the fibre pads on the drain cups by blowing air down each drainpipe. The drain cups shall then be removed and the four filter paper discs containing the fibre pads shall be dried in a gravity convection oven for approximately two hours at 220°F plus or minus 5°. After drying, the filter paper discs containing the fibre pads shall each be weighed to the closest 0.001 gram.

Note 4: When rinsing the compartments, special care shall be exercised to remove any fibre caught in the rubber seals and to flush the drain pipes thoroughly.

Note 5: Since the fibre and the filter paper are not dried initially, the filter paper discs containing the fibre pads shall be allowed to absorb atmospheric moisture for approximately one hour after removal from the oven and prior to weighing.

Calculation and Report

5. (a) The weight of fibre in each of the four fractions shall be determined to the closest 0.001 gram. The per cent fibre in each of the four fractions shall then be calculated to the closest 0.1 per cent and the per cent dust (minus 30 mesh material) shall be determined by difference.

(b) Report the weight per cent of fibre in each of the four fractions and the weight per cent dust (Minus 30 mesh material) to the closest 0.1 per cent.

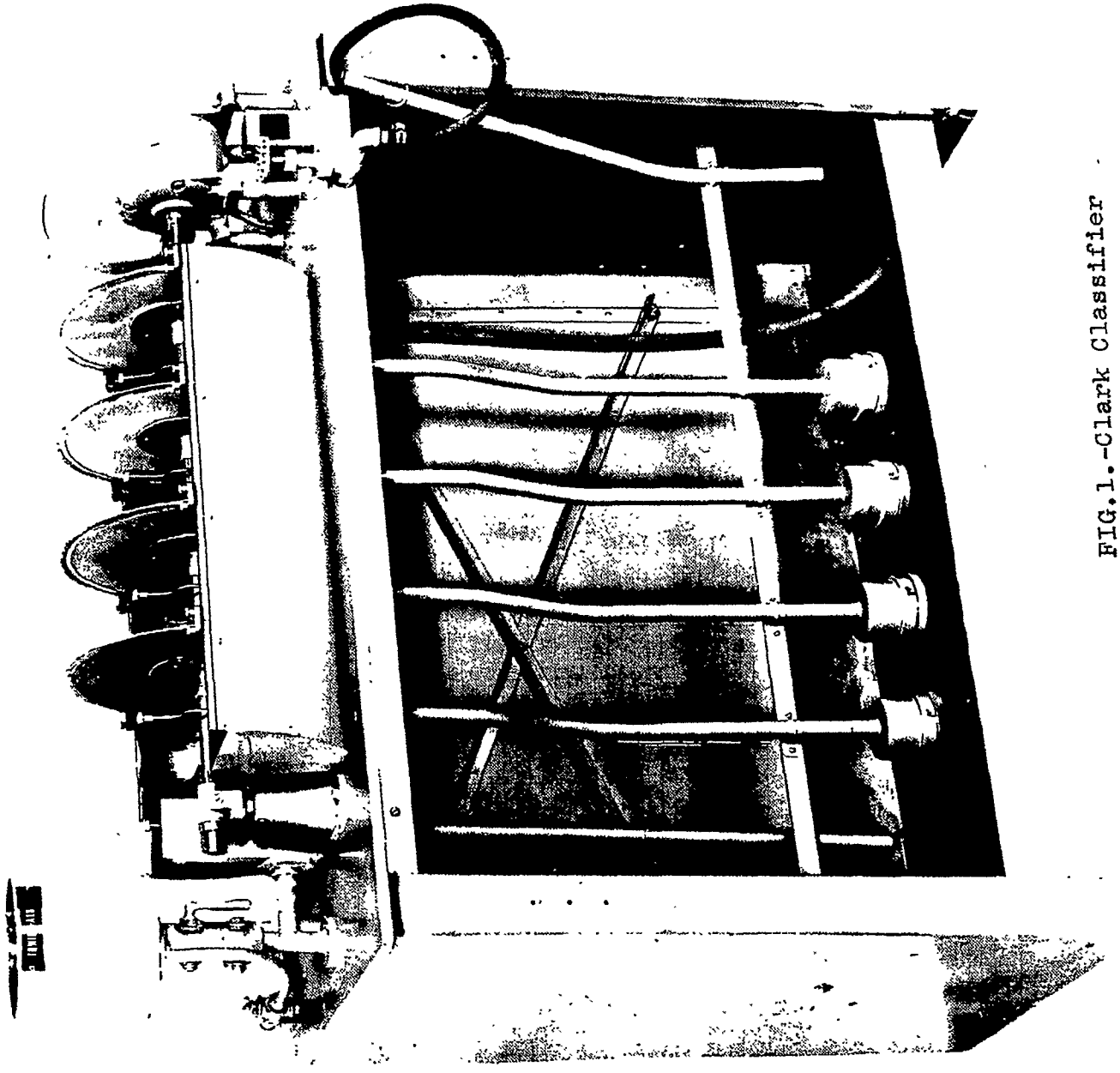
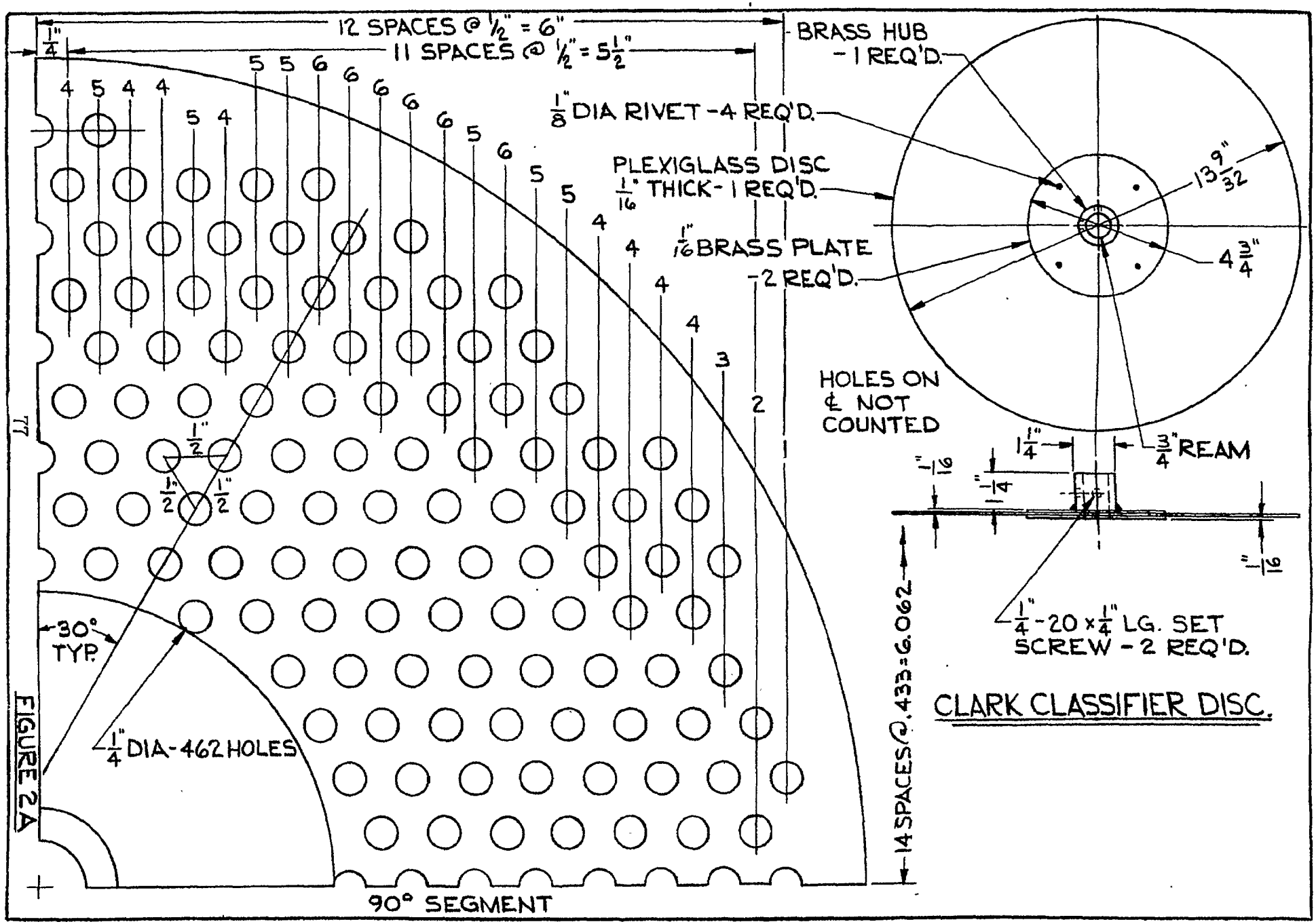


FIG.1.-Clark Classifier


12 SPACES @ 1/2" = 6"
11 SPACES @ 1/2" = 5 1/2"
1/4"
4 5 4 4
5 4
5 5 6 6 6 6 5 6 5 5 4 4 4 3 2
1/8" DIA RIVET - 4 REQ'D.
PLEXIGLASS DISC 1/16" THICK - 1 REQ'D.
1/16" BRASS PLATE - 2 REQ'D.
BRASS HUB - 1 REQ'D.
13 9/32"
4 3/4"
HOLES ON ℄ NOT COUNTED
1/2"
1/2"
1/2"
30° TYP.
1/4" DIA - 462 HOLES
FIGURE 2A
90° SEGMENT
14 SPACES @ .433 = 6.062
1 1/4"
3/4" REAM
1/16"
1/4"
1/16"
1/4" - 20 x 1/4" LG. SET SCREW - 2 REQ'D.
CLARK CLASSIFIER DISC.

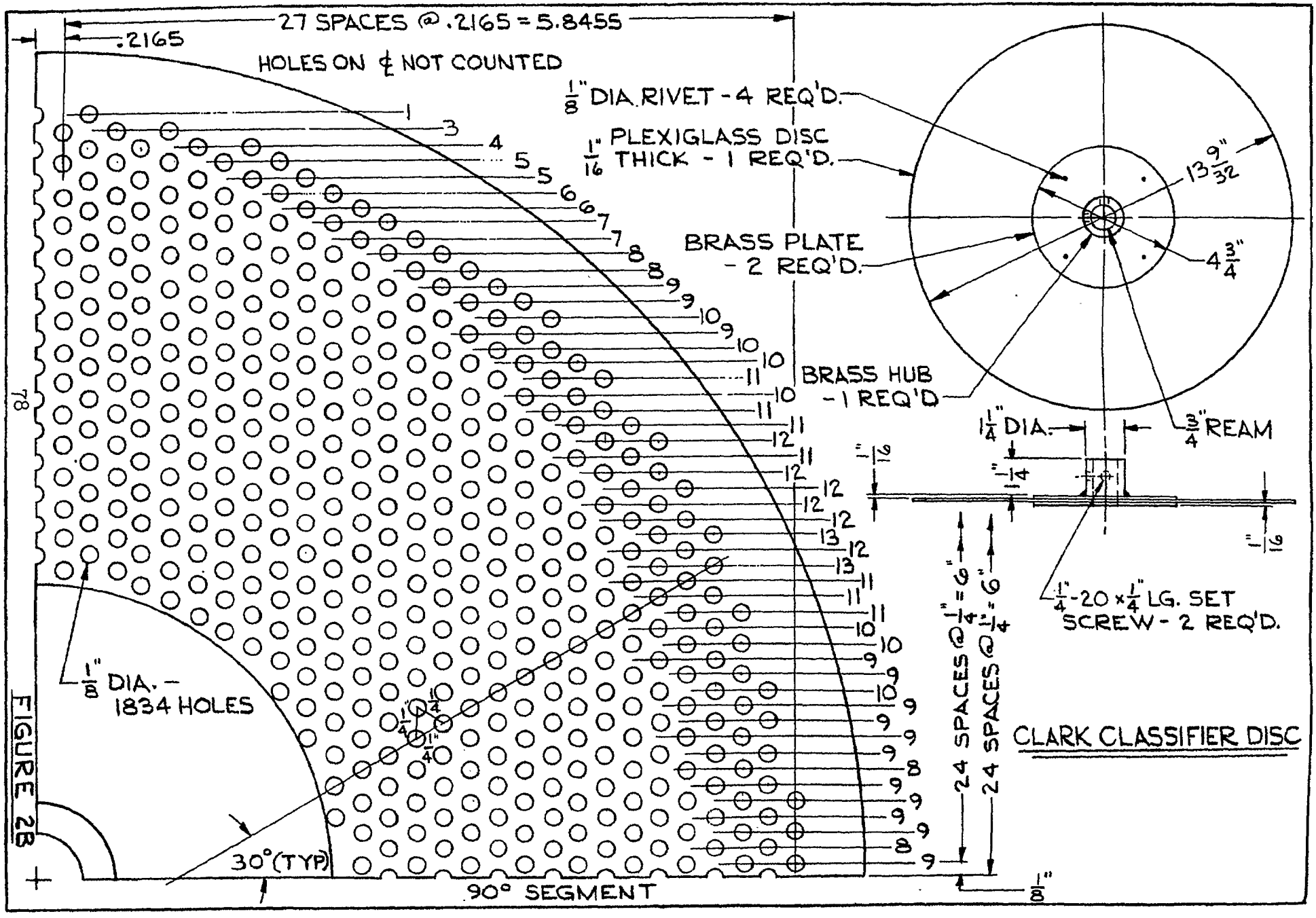
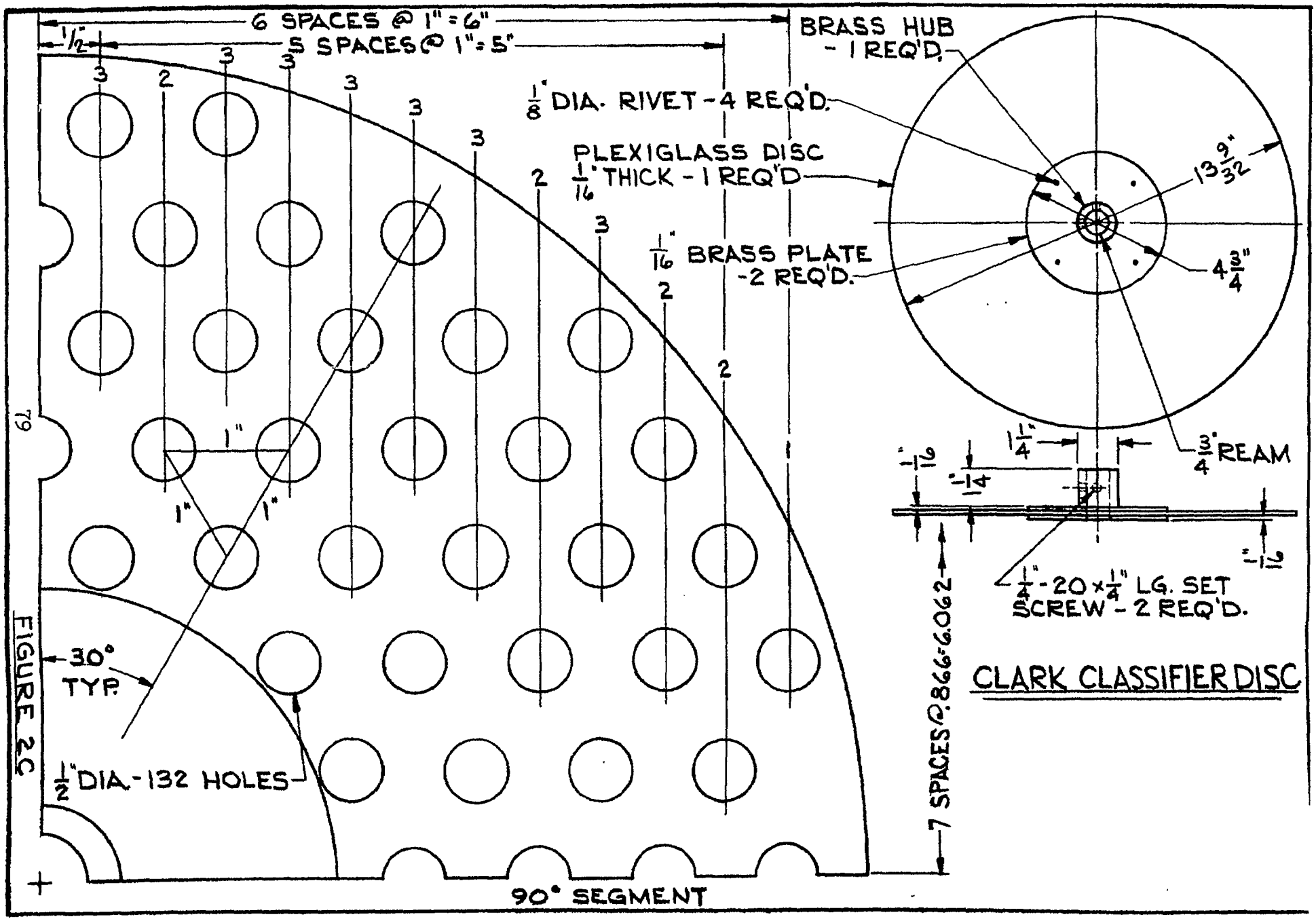


FIGURE 2B

CLARK CLASSIFIER DISC

BIRD 005389


6 SPACES @ 1" = 6"
1½"
5 SPACES @ 1" = 5"
BRASS HUB - 1 REQ'D.
⅛" DIA. RIVET - 4 REQ'D.
PLEXIGLASS DISC 1/16" THICK - 1 REQ'D
1/16" BRASS PLATE - 2 REQ'D.
13 9/32"
4 3/4"
1 1/4"
3/4" REAM
1/16"
1/14"
1/16"
1/4"-20 x 1/4" LG. SET SCREW - 2 REQ'D.
7 SPACES @ .866 = 6.062
1"
1"
1"
30° TYP.
½" DIA. - 132 HOLES
FIGURE 2C
90° SEGMENT
CLARK CLASSIFIER DISC

BIRD 005390

TESTING PROCEDURES

FOR

CHRYSOTILE ASBESTOS FIBRE

(Second Edition)

C-3

LENGTH DISBRIBUTION AND DUST CONTENT OF ASBESTOS FIBRES SHORTER THAN 4A GRADE BY WET SCREENING, USING THE CLARK CLASSIFIER

Printed in U.S.A.

Revised and adopted by:

ASBESTOS TEXTILE INSTITUTE -
MINERAL FIBER PRODUCTS BUREAU - 9/15/59
QUEBEC ASBESTOS MINING ASSOCIATION - 2/23/60

C-3

CLARK CLASSIFIER

(Medium and Short Fibres)

Scope

1. This procedure covers a wet screen analysis, by apparent fibre length distribution and fines content, of those grades of asbestos fibres used in asbestos-cement products.

Apparatus

2. (a) The apparatus, illustrated in Figures 1, 2 (a), 2 (b), 3 (a), and 3 (b), shall consist specifically of the parts described in paragraphs (b) to (c).

(b) The apparatus for classification shall consist of the following:

(1) Classifier - Clark Model 46, four screen pulp classifier as shown in Figure 1.

The Clark Classifier consists essentially of a semi-cylindrical tub divided into four main compartments in each of which is a circular screen or perforated disc mounted on and driven by a common shaft rotated at about 48 revolutions per minute by a geared motor. The rim of each disc and screen forms a seal by rotating between the longitudinally slit edges of a piece of soft rubber tubing mounted in a small metal channel on the inside of the tub. By means of a constant headbox, water is passed through the classifier at a chosen rate of 12.5 liters per minute. In each compartment, the incoming water is directed to the bottom of the tub by means of a weir and baffle. The consequent motion of the water serves to keep the asbestos fibres from settling and to present them regularly to the rotating discs and screens. Depending on the size and the design of the disc and screen openings, a definite fibre length separation is obtained in each of the four compartments.

Note 1: The Clark apparatus was designed for the classification of wood pulp. In adapting the apparatus for the classification of asbestos fibre, it was necessary to provide additional agitation in the various compartments to minimize settling of the crudier bundles.

(2) Perforated Discs - Two perforated discs fabricated of Plexiglas and conforming to the design shown in Figures 2 (a) and 2 (b). The disc for the first compartment shall contain 1/4 inch perforations; the disc for the second compartment shall contain 1/8 inch perforations.

(3) Screens - 30 and 100 mesh screens as supplied with the Clark Classifier. The 30 mesh screen shall be used for the third compartment; the 100 mesh screen shall be used for the fourth compartment.

Note 2: The 30 mesh screen has openings 0.0203 inch in width; the 100 mesh screen has openings 0.0060 inch in width.

(4) Nozzle Assembly - Nozzle assembly conforming to the basic design shown in Figures 3 (a) and 3 (b).

(5) Balance - Capable of weighing five grams to the closest 0.001 gram.

(6) Drying Oven - Standard gravity convection type drying oven capable of maintaining 220°F ± 5°.

(7) Graduate Cylinder - Stoppered graduate cylinder of 500 ml capacity.

(8) Filter Paper - Qualitative filter paper discs, 90 mm in diameter.

(9) Timer - Capable of being read to the nearest 0.5 second and accurate to one per cent or less.

(c) The equipment for projection shall consist of the following:

(1) Projector - Vu-Graph overhead projector, Catalog No. 2025, or equivalent.

(2) Screen - 70 x 70 inch Da-Lite Challenger or equivalent.

(3) Bottles - Four ounce cork stoppered glass bottles.

(4) Dishes - Three inch Petrie dishes.

(5) Compasses - Six inch compass and beam compass with two 12-inch extensions.

Sampling of Asbestos Fibre

3. The sampling shall be conducted in accordance with (A-1) "Method of Sampling and Preparation."

Procedure

4. (a) Size of Sample - The weight of sample used for this test shall be 5.000 ± 0.001 grams.

(b) Preparation of Equipment for Classification - The nozzle assembly shall be positioned on the front of the classifier such that a nozzle extends into each compartment. Each nozzle shall be so adjusted that it is directed at a point approximately 1-1/2 inches to the left of the disc or screen and approximately 7-1/2 inches (measured along the circumference of the tub) from the top front edge of the compartment. A drain cup, fitted with a filter paper disc which has been weighed to the closest 0.001 gram, shall be placed on each of the four drainpipes. A drain plug shall then be inserted into each of the drainpipes and into the outlet line of the flow box leading to the first compartment.

With the nozzles in the first three compartments closed, the water rate to the fourth nozzle shall be adjusted to 800 ± 20 mls per minute. The water rate to the compartments shall then be adjusted to 12.5 ± 0.1 liters per minute and rotation of the discs and screens shall be started.

Note 1: To eliminate tangling of the longer fibres on the drain plug stems, No. 3 rubber stoppers shall be used in the first two compartments instead of the supplied drain plugs.

Note 2: The water to the classifier and the nozzle assembly shall be filtered to remove any foreign material present in the piping.

Note 3: The water rate to the compartments is adjusted by means of the metering valve located in the line from the constant headbox to the tub. Once this valve has been set, no further adjustments are necessary. Care shall be exercised in setting the water rate to the constant headbox that a continual overflow is obtained.

(c) Wet Screening Test - When overflow from the last compartment of the classifier is obtained, the fibre sample shall be mixed with approximately 400 mls of water in a 500 ml stopper

graduate by oscillating 40 complete times in one minute. The timer shall then be started and the fibre slurry shall be poured into the weir box of the first compartment over approximately a 30 second period. Care shall be exercised that the graduate cylinder is rinsed thoroughly.

After addition of the slurry, water from the nozzle assembly shall be fed alternately at approximately 30 second intervals into compartments 1, 2, 3, and 4 with this order of agitation being observed during the entire classification cycle. During classification, the discs and screens shall be kept free of excess fibre accumulation by periodically flushing with water. At 6-1/2 minutes in the time schedule the water flow to the compartments and the nozzle assembly shall be turned off, and the disc and screen rotation shall be stopped.

Note 4: The water flow to the compartments can be stopped most conveniently by removing the drain plug in the outlet line of the flow box leading to the first compartment.

(d) Collection and Drying of Fractions - The drain plugs shall be removed from the drain pipes and the compartments allowed to empty. The discs, screens and compartments shall be rinsed thoroughly and the excess water shall be removed from the fibre pads on the drain cups by blowing air down each drain-pipe. The drain cups shall then be removed and the four filter paper discs containing the fibre pads shall be dried in a gravity convection oven for approximately two hours at 220°F ± 5°. After drying, the filter paper discs containing the fibre pads shall each be weighed to the closest 0.001 gram.

Note 5: When rinsing the compartments, special care shall be exercised to remove any fibre caught in the rubber seals and to flush the drain pipes thoroughly.

Note 6: Since the fibre and the filter paper are not dried initially, the filter paper discs containing the fibre pads shall be allowed to absorb atmospheric moisture for approximately one hour after removal from the oven and prior to weighing.

(e) Length Measurements - The fibre pads shall be removed from the filter paper discs and placed in individual four ounce bottles. The bottles shall then be filled approximately half way with filtered water and the fibre mats dispersed by shaking. Small portions of each of the fractions shall be transferred to individual Petrie dishes using a pair of tweezers. Enough water shall be added to just cover the dish bottom and the fibre shall be distributed uniformly throughout the dish.

Each of the four fractions shall then be projected onto a screen at a magnification of 20 diameters and 50 representative fibres from each fraction shall be measured for length.

Note 7: In the measurement of long and highly opened fibres, it is essential, for representative results, that a reasonable separation be obtained in the Petrie dish and that the individual fibres measured be made as straight as possible. In difficult cases the use of a 0.15 per cent solution of Aerosol OT instead of water will aid in the dispersion.

Note 8: For length measurements, it is both convenient and more accurate to span the fibres with a compass and to add the individual lengths graphically on a sheet of paper.

Note 9: Although a skilled operator can accurately select by eye typical fibres for measurement, it is preferable to use the procedure of measuring all fibres in order which touch two perpendicularly intersecting lines, centered in the projected field, until the required number of fibres has been measured.

Calculation and Report

5. (a) The weight of fibre in each of the four fractions shall be determined to the closest 0.001 gram and the arithmetical average length of each of the four fractions shall be determined to the closest 0.001 inch.

The per cent fibre in each of the four fractions shall be calculated to the closest 0.1 per cent and the per cent dust (minus 100 mesh material) shall be determined by difference. The average "dust free" length of the fibre shall then be calculated to the closest 0.001 inch using the following equation:

$$\text{Average Length} = \frac{(\%1)\ (L1) + (\%2)\ (L2) + (\%3)\ (L3) + (\%4)\ (L4)}{(\%1 + \%2 + \%3 + \%4)}$$

where:

% = weight per cent of fibre held in compartment,
L = arithmetical average length of fibre held in compartment in inches.

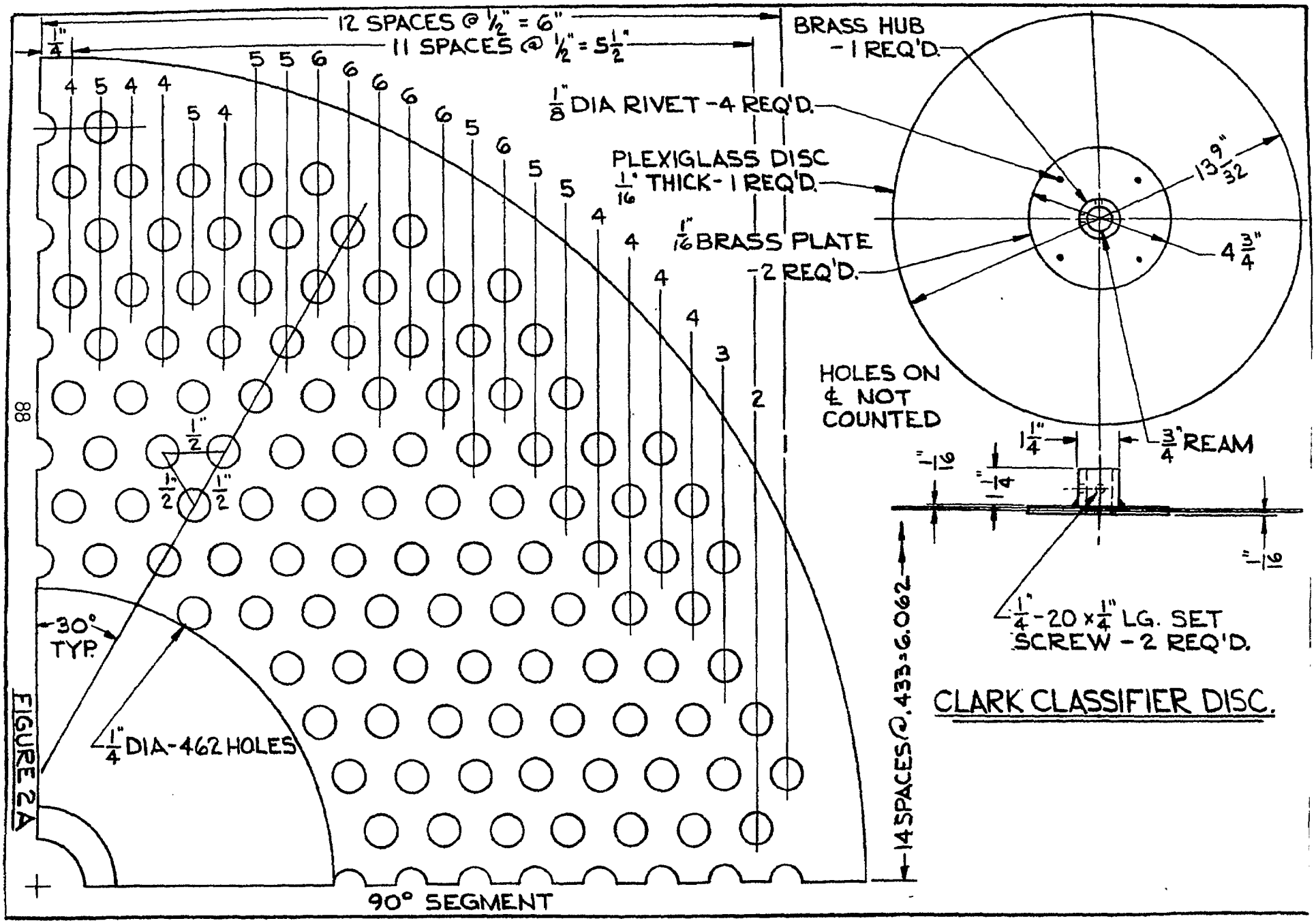
Note: For 3 and 4-grade chrysotile fibres and for blue asbestos, the following length constants may be used for the second, third and fourth compartments in the calculation of average "dust free" length:

	Chrysotile	Blue
Compartment 2	0.183	0.194
Compartment 3	0.103	0.128
Compartment 4	0.041	0.055

For 5, 6, and 7-grade chrysotile fibre the length constant for the second compartment shall not be used.

(b) Report the weight per cent of fibre in each of the four fractions and the weight per cent dust (minus 100 mesh material) to the closest 0.1 per cent. Report the average length of each of the four fractions and the average "dust free" length of the fibre to the closest 0.001 inch.

FIG. 1 - Clark Classifier


12 SPACES @ 1/2" = 6"
11 SPACES @ 1/2" = 5 1/2"
1/4"
4 5 4 4
5 4
5 5 6 6 6 6 6 5 6 5 5 4 4 4 4 3 2
88
1/2"
1/2"
1/2"
30° TYP.
1/4" DIA-462 HOLES
90° SEGMENT
FIGURE 2A
BRASS HUB - 1 REQ'D.
1/8" DIA RIVET - 4 REQ'D.
PLEXIGLASS DISC 1/16" THICK - 1 REQ'D.
1/16" BRASS PLATE - 2 REQ'D.
HOLES ON ℄ NOT COUNTED
13 9/32"
4 3/4"
1 1/4"
3/4" REAM
1/16
1/4
1/16
1/4"-20 x 1/4" LG. SET SCREW - 2 REQ'D.
14 SPACES @ 0.433 = 6.062
CLARK CLASSIFIER DISC.

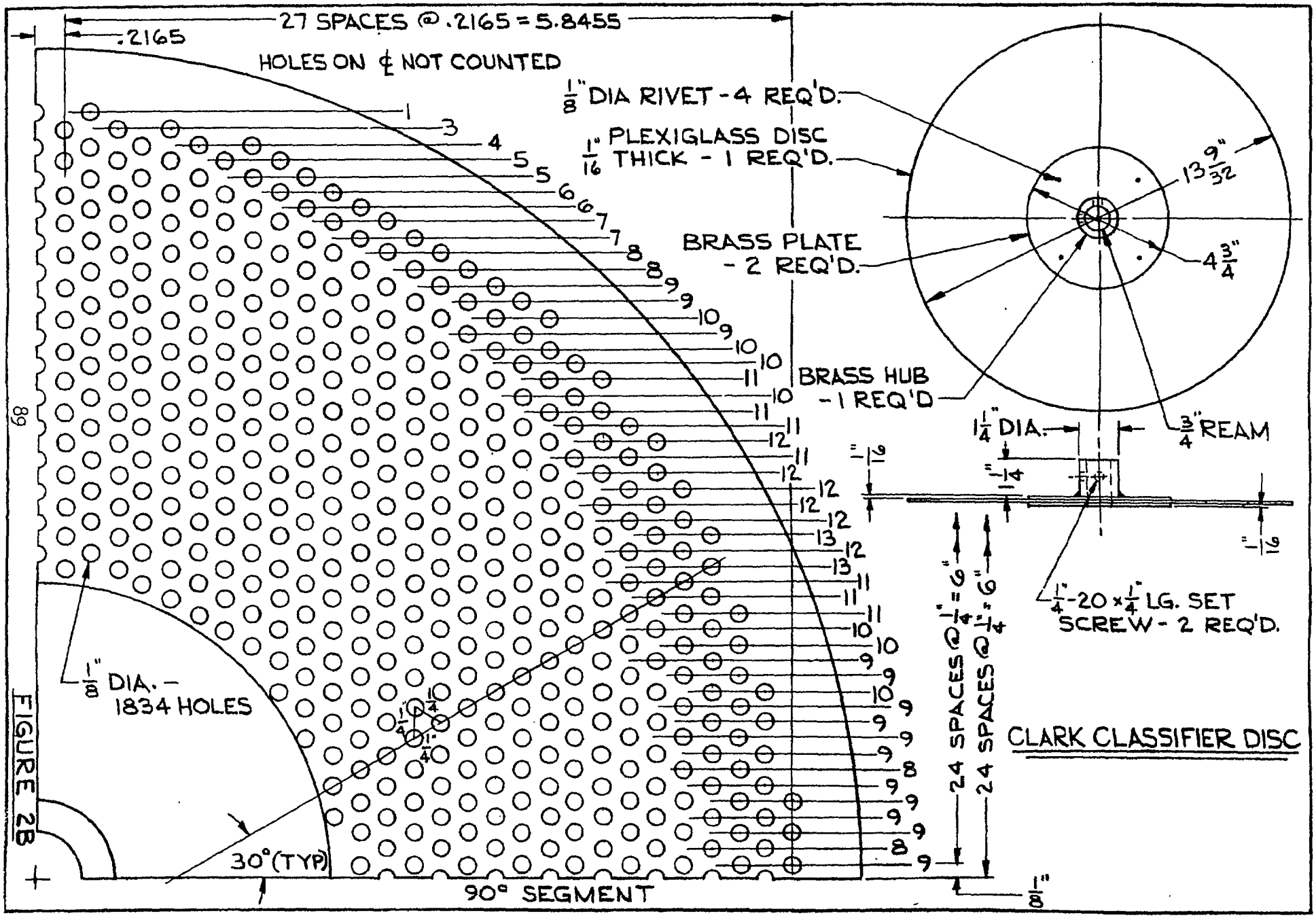
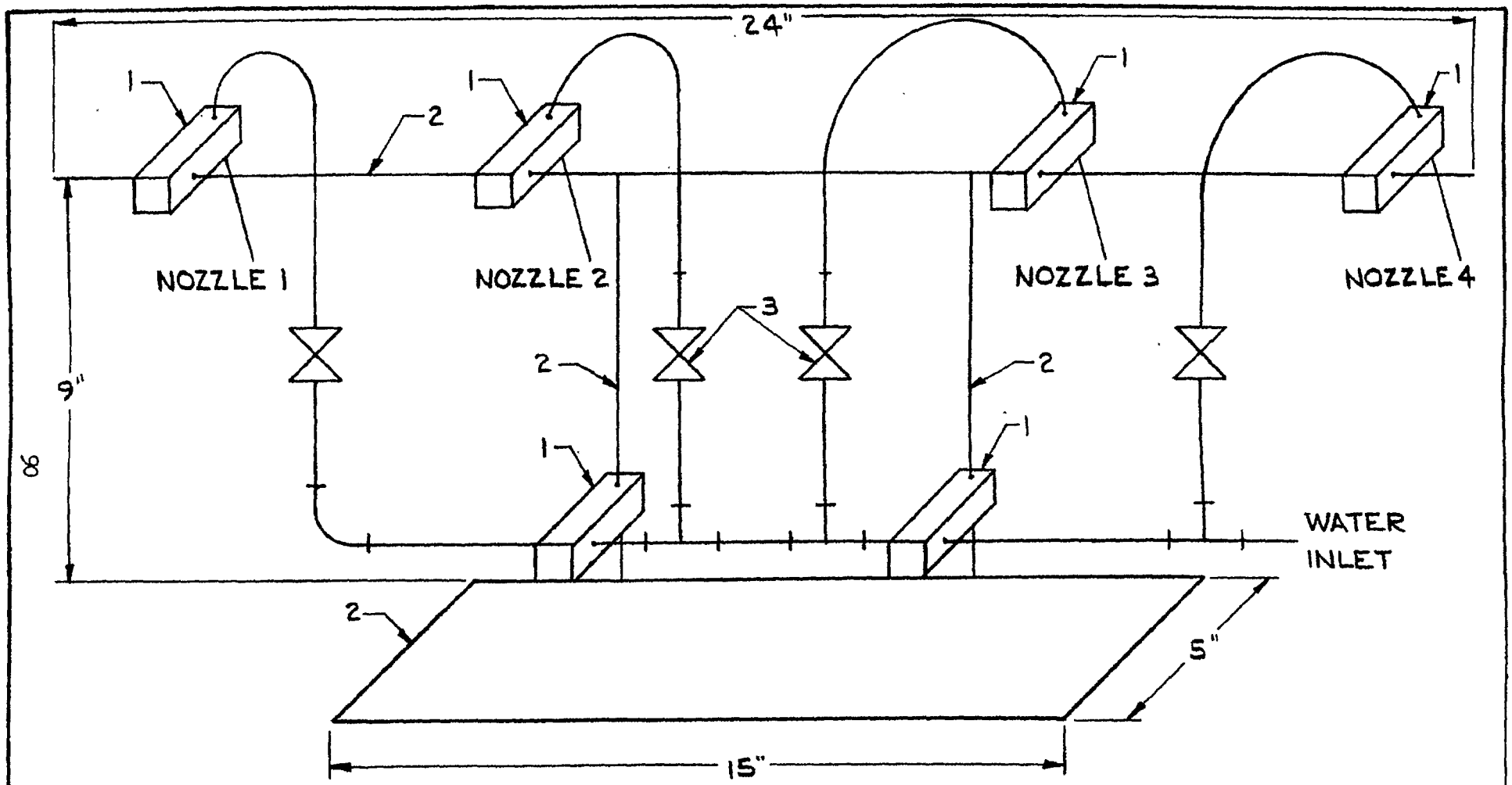


FIGURE 2B

CLARK CLASSIFIER DISC

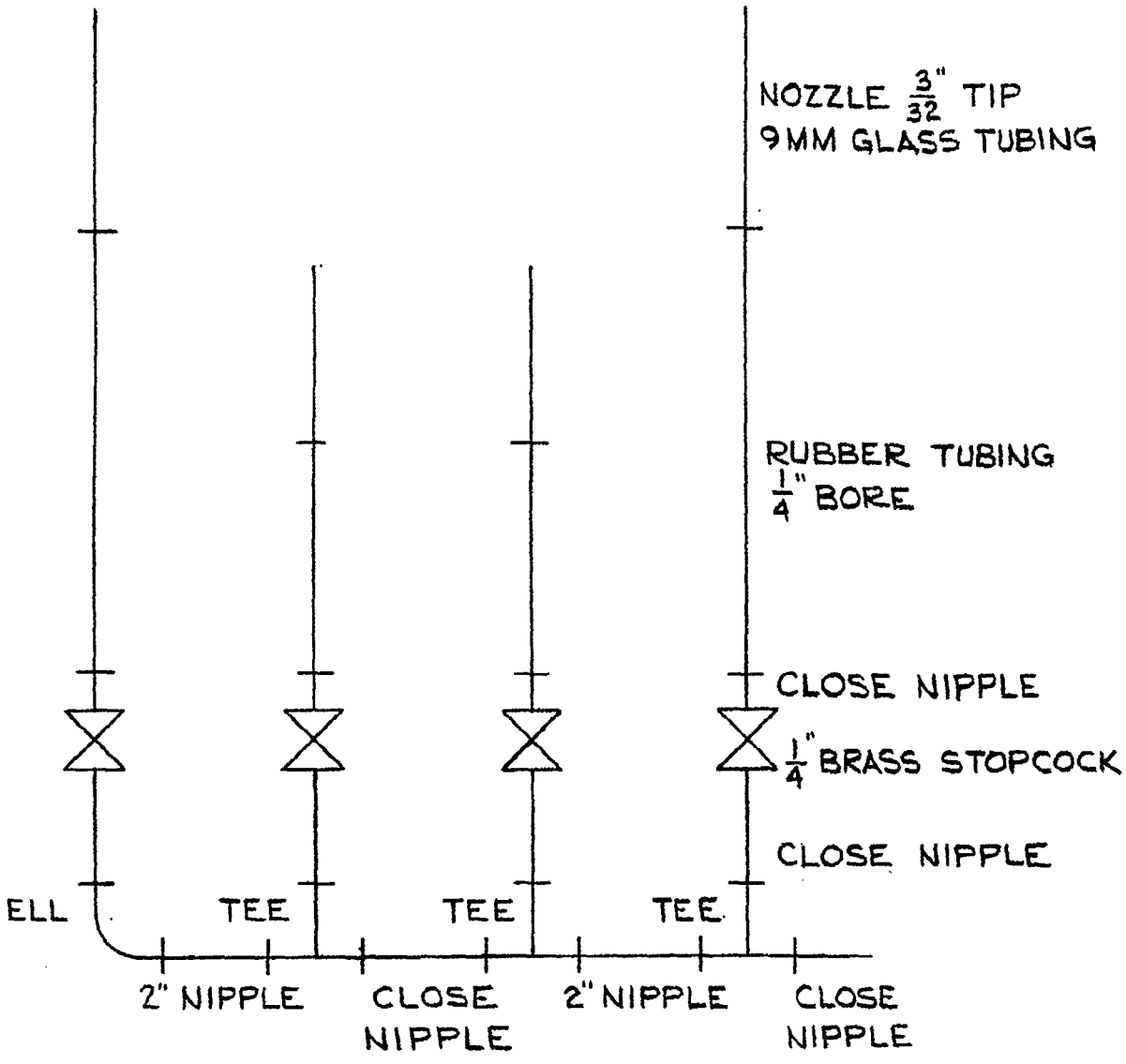
BIRD 005400



(1) CLAMP HOLDER
(2) "FLEXAFRAME" ROD
(3) CONTROL UNIT (SEE DETAIL)

FIGURE 3A

NOZZLE ASSEMBLY FOR CLARK CLASSIFIER



ALL FITTINGS 1/4" BRASS

NOZZLE ASSEMBLY FOR CLARK CLASSIFIER
CONTROL UNIT DETAIL

FIGURE 3B

TESTING PROCEDURES

FOR

CHRYSOTILE ASBESTOS FIBRE

(Second Edition)

C-4

DETERMINING THE DUST CONTENT OF ASBESTOS FIBRE BY WASHING ON A SPECIFIED SIEVE

Printed in U.S.A.

Revised and adopted by:

ASBESTOS TEXTILE INSTITUTE -
MINERAL FIBER PRODUCTS BUREAU - 11/8/65
QUEBEC ASBESTOS MINING ASSOCIATION - 9/17/63

C-4

WASH TEST

Scope

1. This procedure is for determining the fines content of asbestos fibres by washing on a specified screen.

Apparatus

2. (a) Balance accurate to 0.05 gram.

   (b) 200 mesh Tyler, 8 inch standard full height testing sieve with 10 mesh backing wire.

   (c) 325 mesh Tyler, 8 inch standard full height testing sieve with 10 mesh backing wire.

   Note 1: Sieves for this test complete with 10 mesh backing wire may be obtained from the W. S. Tyler Company, Ltd. Stainless steel is recommended for long life.

   Note 2: In order to prevent water accumulating under the sieves when washing, several drainage holes are made in the side of the frame, see Drawing No. L-551-2.

   (d) 8 inch standard height sieve frame only for splash guard, see Drawing No. L-551-2.

   (e) Wash spray nozzle, see Drawing No. L-602.

   Note 3: Design of spray nozzle taken from ASTM Designation C.430/59/T.

   (f) Suitable length of 1/4 inch to 1/2 inch inside diameter pressure hose for connecting spray to water supply.

   (g) Suitable support to maintain spray nozzle at a constant height above screen. See Drawing No. L-551-2 for suggested method.

   (h) Supply of clean water.

   (i) Needle valve to regulate water to spray nozzle.

(j) Pressure gauge capable of indicating 20 lbs per sq. in., U. S. Gauge No. 10766-1 or equivalent.

(k) Timer.

(l) Buchner funnel.

(m) Filter paper, Reeve Angel No. 230 or equivalent.

(n) Oven or Infra-Red lamp drying unit.

Calibration

3. (a) In order to detect possible blockage of orifices in nozzle it is important to periodically check the flow through the spray by filling a 2000 cc graduate; this should take from 23 to 26 seconds.

Sampling and Preparation

4. (a) In accordance with (A-1) "Method of Sampling and Preparation."

Sample Weight, Screen Sizes & Washing Time

5. (a)

Grade	Sample Weight	Screen Size	Wash Time
Groups 3, 4, 5, 6 & 7	10 grams	200	2 mins.
Floats	10 grams	325	2 mins.

Procedure

6. (a) Place the test sample in the required testing sieve which has been fitted with the splash guard.

(b) Wet the sample thoroughly with a gentle spray at approximately 2 lbs per sq. in. pressure. A few seconds is sufficient time for this operation.

(c) Adjust the pressure to 20 lbs per sq. in. ± 1 lb.

(d) Start timer and begin washing cycle.

(e) Keeping the nozzle 5 inches above the screen surface by means of the support, move the spray in a circular motion alternately in a clockwise and anti-clockwise direction so that all the fibre is thoroughly and uniformly washed.

In order to ensure a thorough washing it is advisable to occasionally change the position of the sample on the screen by directing the spray obliquely on the fibre.

This motion could possibly be described as a chasing action and is critical in the performance of the test.

Note 4: Blinding of the screen is indicated by an accumulation of water on the sieve. This condition materially reduces the effectiveness of the spray and should be corrected by tilting the sieve and directing the nozzle on the blinded areas to dislodge the small particles from the mesh.

(f) After washing for 2 minutes, the fibre is transferred to the Buchner funnel and filtered on a previously dried and weighed filter paper.

(g) The residue is dried to constant weight.

(h) After completion of the test, the seive is inverted and cleaned with the spray by backwashing.

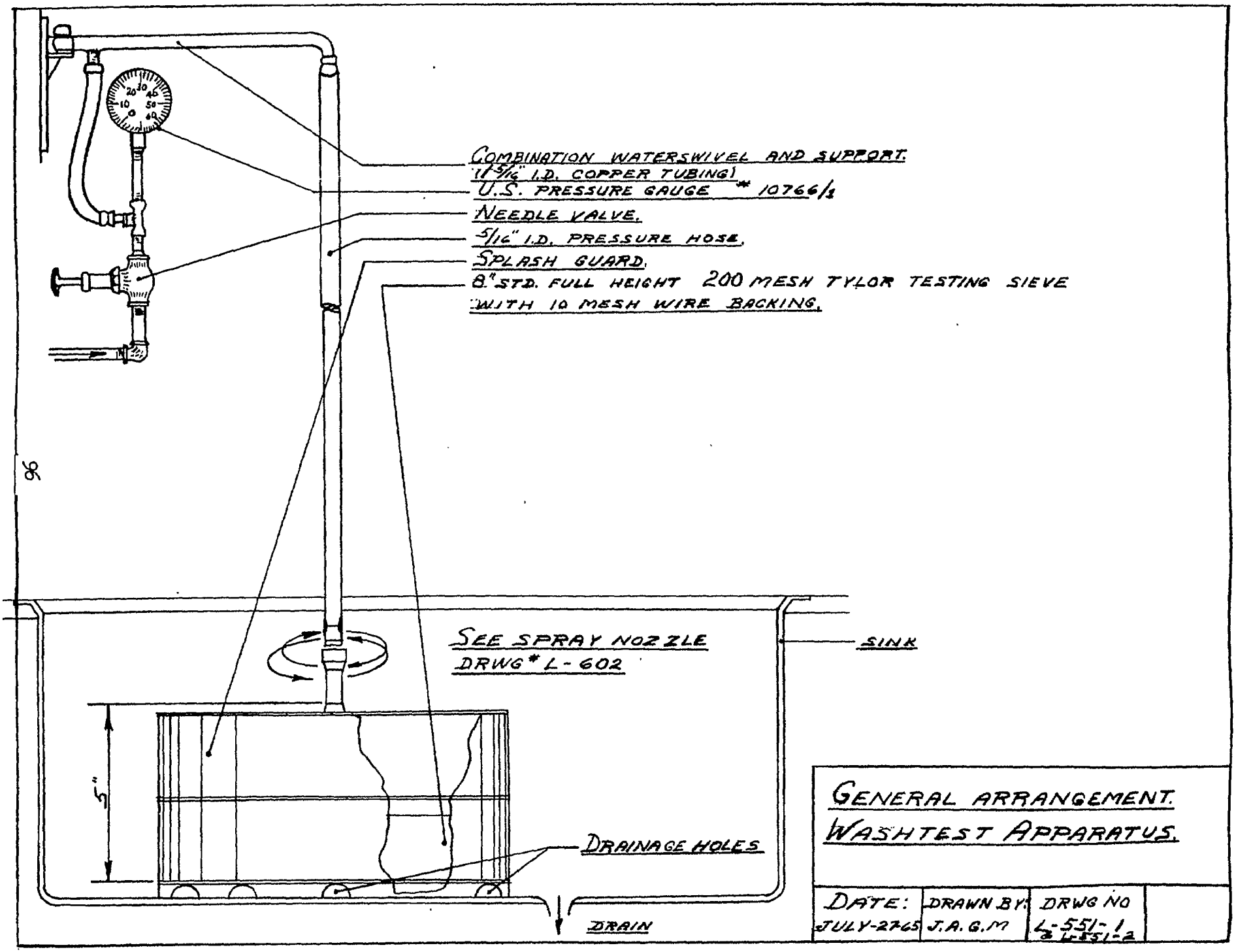
Results and Accuracy

7. (a) The loss in weight of original sample is recorded.

(b) A difference of 0.2 gram between test results is acceptable.

(c) The dust content is the average loss in weight of the test expressed as a percentage of the sample weight.

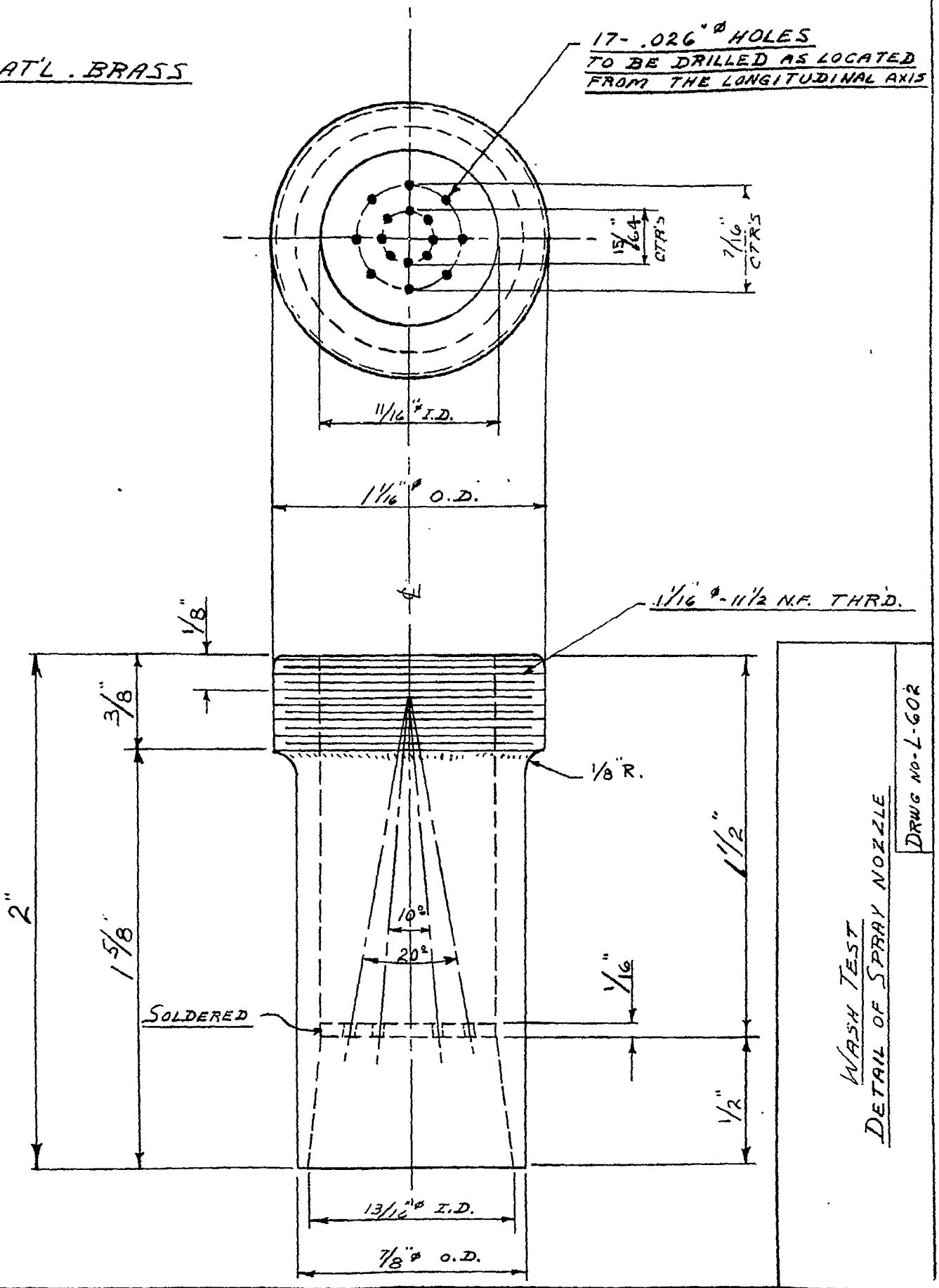
Note 5: If large pressure variations occur in the water supply line, a regulating valve will improve operating conditions.



GENERAL ARRANGEMENT. WASHTEST APPARATUS.

DATE:	DRAWN BY:	DRWG NO
JULY-2765	J.A.G.M	L-551-1 & L-551-2

MAT'L. BRASS



WASH TEST
DETAIL OF SPRAY NOZZLE
DRWG NO-L-602

TESTING PROCEDURES

FOR

CHRYSOTILE ASBESTOS FIBRE

(Second Edition)

D-1

WET VOLUME TEST

Printed in U.S.A.

Revised and adopted by:

ASBESTOS TEXTILE INSTITUTE -
MINERAL FIBER PRODUCTS BUREAU - 11/8/65
QUEBEC ASBESTOS MINING ASSOCIATION - 1/19/65

D-1

WET VOLUME

Scope

This test is designed to appraise all grades of asbestos fibre in terms of its buoyancy in water.

Apparatus

1. Balance - capacity greater than 100-grams.
   - accuracy ±0.05-grams.

2. Glass Graduated Cylinders

Capacity	- 2000 ml
Subdivisions	- 20 ml
Inside diameter	- 80 mm
Wall thickness	- 3 mm
Graduate - total length	- 482.6 ± 1.6 mm
- from bottom of base to 2000-ml mark	- 398.0 ± 6 mm
Stopper	- Type suitable for Mechanical Inversion

(Graduates - supplied by Scientific Glass Company
Bloomfield, New Jersey)

Fibre Grade	Sample Weight	Final Reading Time
3-4-5 and 6	30 gms.	2 hrs.
7	20 gms.	4 hrs.

Type of Machine - Recommend mechanically driven inverter* capable of rotating 2000-ml cylinder 30 rpm's with the axis of rotation passing through the centre of the bottle.

Sampling

According to (A-1) "Method of Sampling and Preparation".

* Illustration of one type of mechanically driven inverter which has been found satisfactory, attached hereto.

Procedure

1. Sample as per above and carefully weigh up the required fibre.

2. Add distilled or clean water (see footnote) at 77° ± 3°F to the cylinder, filling to the 1000-ml mark. Place the required sample of asbestos in the cylinder and add distilled or clean water to the 2000-ml mark.

3. Place cylinder carefully in mechanically driven inverter and rotate 30 times in one minute. After the initial shaking cycle let stand for ten minutes and then repeat the shaking cycle making 30 complete inversions in one minute.

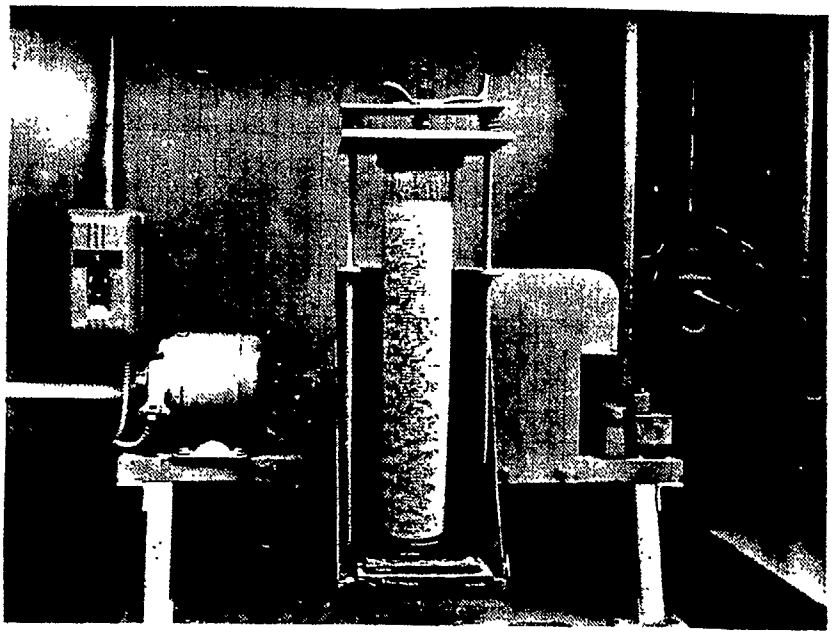
4. Place the cylinder on a vibration free table.

5. Record the wet volume of the fibre suspended in water in ml after two hours for groups 3, 4, 5 and 6 and four hours for group 7.

(A complete inversion consists of a rotation through 360° to original vertical position).

Footnote

It is recognized that clean water from different locations may affect results slightly. Therefore, when results from one laboratory are to be compared with the results of another laboratory, distilled water should be used.



Mechanically Driven Inverter
for Wet Volume Test

TESTING PROCEDURES

FOR

CHRYSOTILE ASBESTOS FIBRE

(Second Edition)

D-2

DYCKERHOFF AIR PERMEABILITY TEST

Printed in U.S.A.

Revised and adopted by:

ASBESTOS TEXTILE INSTITUTE - 6/4/65
MINERAL FIBER PRODUCTS BUREAU - 11/8/65
QUEBEC ASBESTOS MINING ASSOCIATION - 3/16/65

D-2

DYCKERHOFF AIR PERMEABILITY

Scope

1. To measure the comparative degree of openness or fiberization of milled asbestos fibre by the air permeability method.

Apparatus

2. (a) Dyckerhoff Automatic Air Permeability Tester, Blaine Design, Type LLD complete, consisting of built in electronically controlled stop watch, mechanically filled manometer, observation window in rear, inside lighting system, enclosed in a dust-proof, sheet metal case with improved cell-design and special brass cell spacer and cell clamp. (See Appendix I and II and Bulletin No. 7202 Chemisches Laboratorium fur Tonindustrie, West Berlin, Germany for further details).

(b) Additional apparatus and materials required for performance of test.

(1) Balance (Sensitivity ± 0.1 gms).

(2) Filter paper supplied by manufacturer, or equivalent.

(3) Funnel, wide mouthed.

(4) Tamping tool (supplied with instrument).

(5) Manometer fluid.

(c) Source of electrical power.

(d) Source of clean, dry compressed air at 20 psi.

Note 1: As apparatus is German made, state power requirements when ordering; and consider replacement parts on account of delivery time involved.

(e) Calibrating Standards and Capillary Tube Holder.

*(1) Low (approximately 25 ± 5 seconds);
Capillary tube, bore: ±0.31115mm
Length: ±13.0mm

(2) High (approximately 400 ± 50 seconds);
Capillary tube, bore: ±0.178mm
Length: ±39.5mm

(3) Capillary tube holder and handle as shown in Appendix III.

* Note 2: Obtainable from the Director, Quebec Asbestos Mining Association, Research Testing Laboratory, University of Sherbrooke, Sherbrooke, P. Q., Canada, with instructions for mounting, use, care and sources of supply for capillary tube holders.

Sample Weight

3. Fifty (50) grams of fibre for all grades.

Sample Preparation

4. (a) In accordance with the (A-1) "Method of Sampling and Preparation."

(b) Derive testing specimen from laboratory sample, prepared in accordance with 4(a) above, in the following manner:

(1) Spread sample on a smooth working face by layers to form a flat pile of uniform thickness (approximately 1/2-in.) and quarter.

(2) Spread reduced sample again, as described in (b) (1) above, and select a 50-gram test specimen by taking pinches from different sections of the pile until a sample is obtained which will require minimum adjustment to the desired weight.

Note 3: When pinches are taken be careful that each fraction contains the total cross-section of the pile from top to bottom at the point it is taken, including any grit or fines which may have segregated at the bottom.

(3) Perform air permeability on two (2) distinct samples thus obtained from the original laboratory sample supplied by taking at least two (2) readings on each cell loading and average results (See "Accuracy" for expected accuracy of test results).

Procedure

5. (a) Check for Air Leaks: before using or calibrating instrument check system for air leaks as follows:

(1) Seal off the top of the sample cell by removing the plunger, coating the edge of the cell with petroleum jelly, and sliding a piece of flat glass over the opening. Clamp cell firmly in position on apparatus by using a suitable spacer (rubber stopper or otherwise) of the required thickness on top of the glass.

(2) Apply vacuum to manometer through use of hand wheel.

(3) Wait five minutes until the oil drains from the sides of the manometer, then observe level of fluid. If it remains stationary there are no leaks. If it moves, examine the tubing and check-valve and correct any defects before proceeding further with test.

Note 4: Minute leaks might exist in a system, however, without having a significant effect upon the air permeability value. Changes in the manometer level of less than 0.1-in. in ten minutes may be neglected. Erratic readings can be caused by fines collecting in the rubber check-valve. This valve must be cleaned regularly.

(b) Calibration of Instrument: verify calibration daily or as required with both low and high calibrating standards in the following manner:

(1) Insert capillary tube holder, containing calibrating standard (low or high as desired), into the cell using holder handle and clamp the cell in position on the apparatus.

Note 5: For accurate results keep calibrating standards in air tight containers or in a dessicator when not in use; and clean standard capillary tube with clean, dry compressed air at 20 psi, if permanently mounted, or 5 psi, if temporarily mounted, prior to calibration.

(2) The standard cell or sample holder, modified as shown on on pages 2 and 3 of Appendix I, supplied by the manufacturer with the Dyckerhoff apparatus shall be used.

(3) The liquid level in the "U" tube at zero pressure must be at the indicated etch mark on the tube (see page 1, Appendix I).

(4) Before proceeding with the actual calibration take a minimum of two readings to determine if standard is within accuracy range specified for calibration. If not, clean capillary tube with dry compressed air.

(5) To calibrate, perform air permeability test by taking four readings on standard and average results.

(6) If average departs from standard reference by more than ±3.0 per cent, check system for leaks or defects as described in the "Instructions for Use and Care of Capillary Tube Standards," referred to in Note 2 of procedure.

(c) Weigh out a fifty ± 0.1 gram sample.

(d) Place perforated plate in bottom of cell and filter paper on top of perforated plate.

(e) Divide 50-gram sample into four approximately equal parts. Pack fibre into cell one part at a time, keeping the bed level uniform, and compress after each addition with the tamping tool provided.

Note 6: Any lumps or knots of matted fibre still remaining in sample should be disentangled before cell loading is commenced.

Note 7: Care should be taken not to compress fibre beyond final plug length or required porosity of 70.0 per cent assuming an average specific gravity of 2.55 for chrysotile asbestos.

(f) When all fibre has been added, compress and place filter paper on top of the fibre plug.

(g) Place brass spacer screen side down upon filter paper; insert plunger into sample cell and compress until plunger is seated flush with top of cell.

(h) Fasten clips on the cell to the plunger to prevent fibre spring back and clamp cell in position on apparatus. Test samples under compression.

(i) With apparatus level, turn the suction handwheel to the filling position to displace the liquid in the "U" tube leg. Then turn it to the measuring position and reset the clock to zero. This procedure starts the automatic process which will indicate on the clock the time required, and stops the test.

(j) Record time to the nearest estimated tenth second after test is completed.

Results and Accuracy

6. (a) Take four air permeability readings as described under "Procedure" on each fibre sample under test, and report average value.

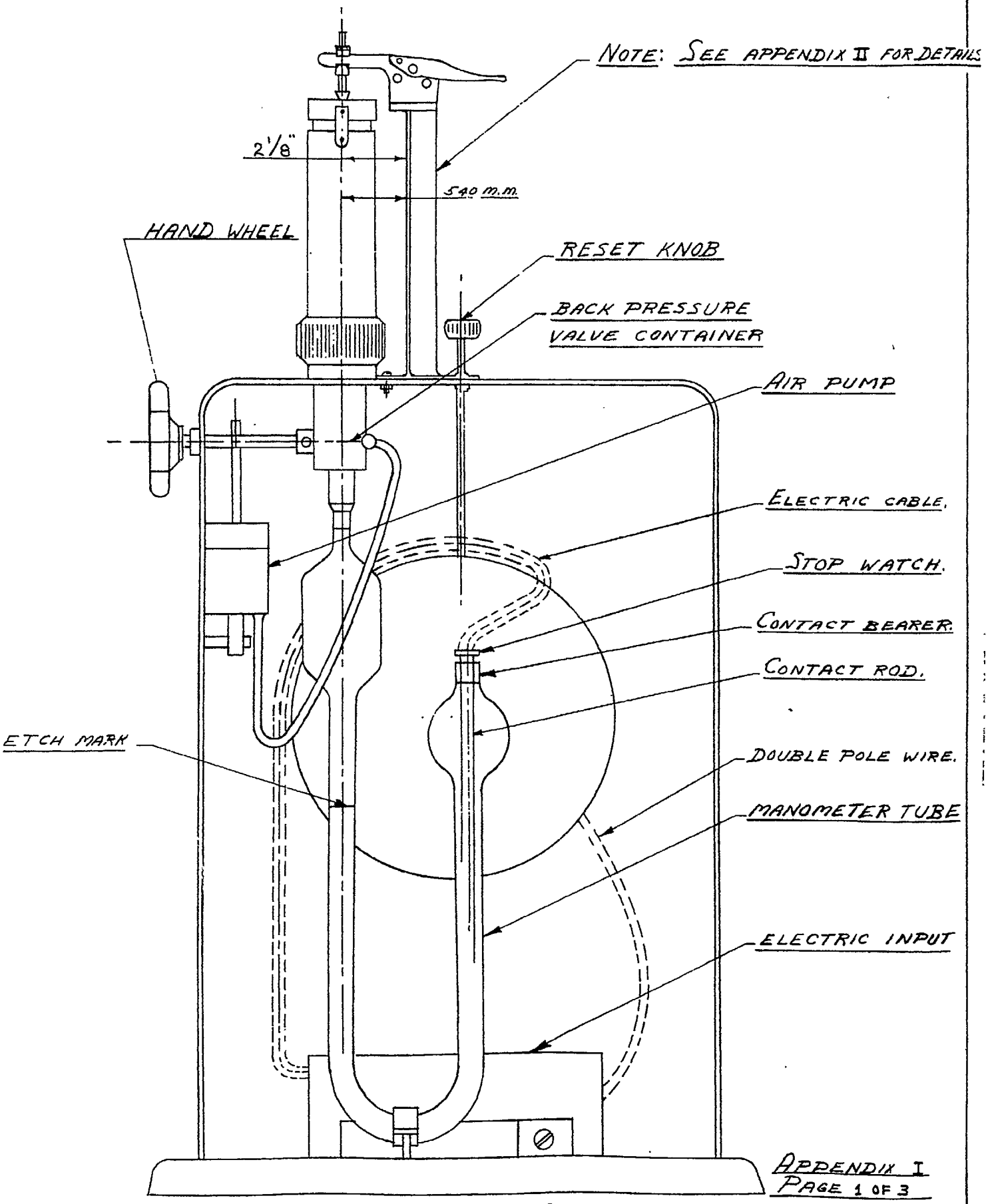
(b) The expected maximum difference between any individual reading and the average is ±3.0 per cent. When maximum difference is exceeded, repeat test by taking readings on a new cell loading.

(c) Another means of measuring the degree of openness of fiberization of milled asbestos fibre is to use the various apparatus commonly employed for surface area determinations by the air permeability method. The "effective" surface area thus obtained may be correlated with Dyckerhoff time readings.

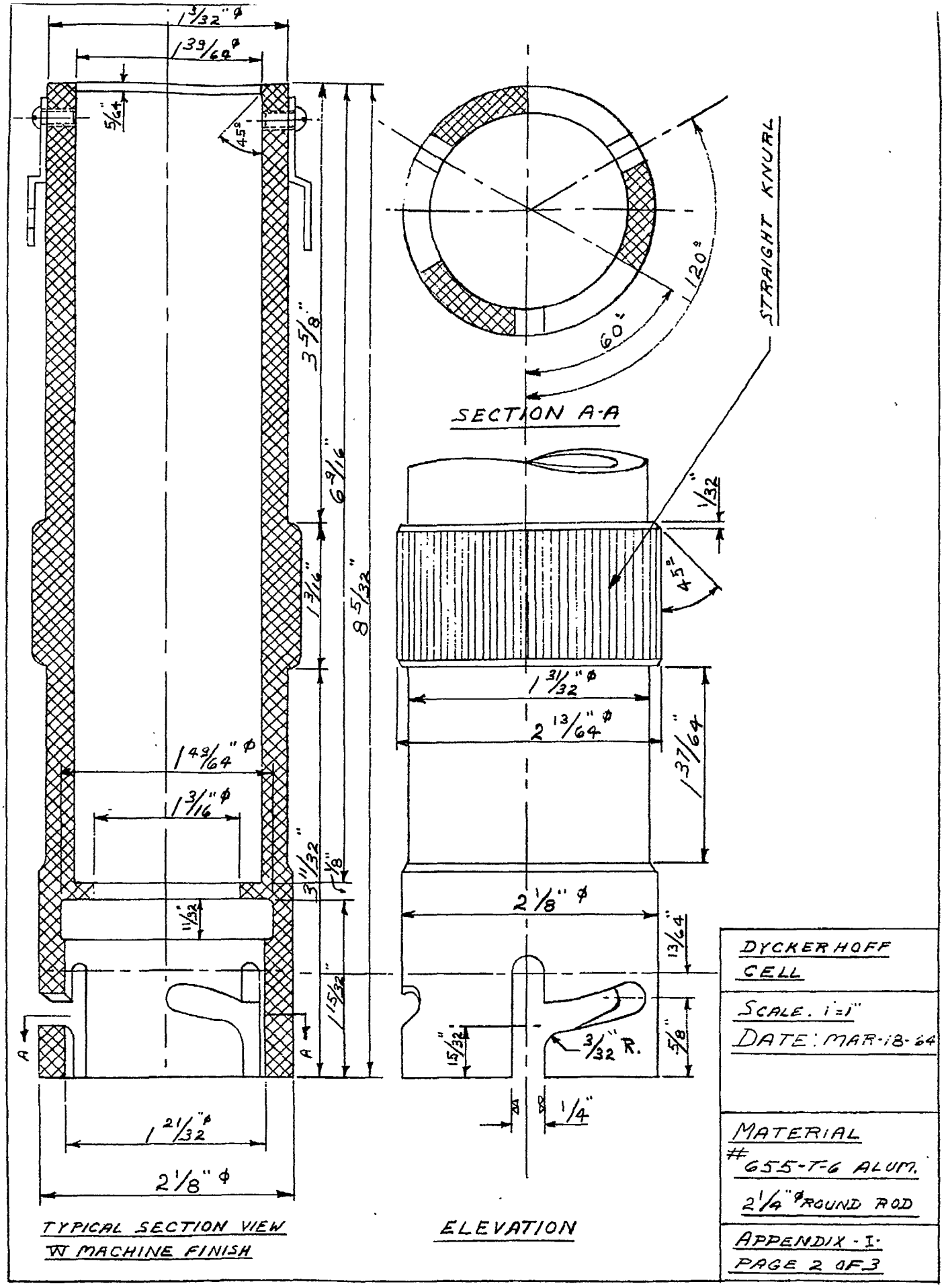
Note 8: Duplication of the atmospheric conditions of temperature and humidity used for calibration of the standards is recommended for more uniform results.

References

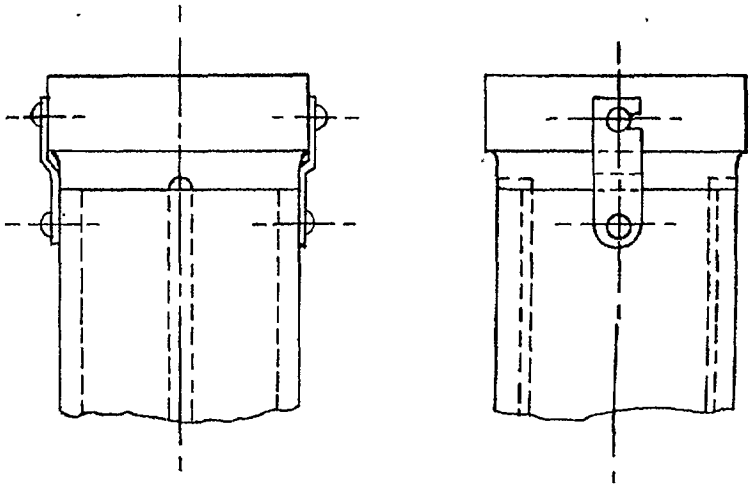
1. Kozeny: Ger. Wien. Akad, 1927, Vol. 136a, p. 271.
2. Carman: Tran. Inst. Chem. Eng., 1937, Vol. 15, p. 150 and J.S.C.I., Vol. 56.
3. Lea and Nurse: J.S.C.I., 1939, Vol. 58, p. 277.
4. Rigden: J.S.C.I., 1943, Vol. 62, p. 1.
5. J. M. Dalla Valle, C. Orr, Jr. and R. R. Cornwall, "Limitations of the Arealometer Method for the Measurement of Fibre Diameters", Textile Research Journal, 1950, Vol. 20, pp. 676-82.



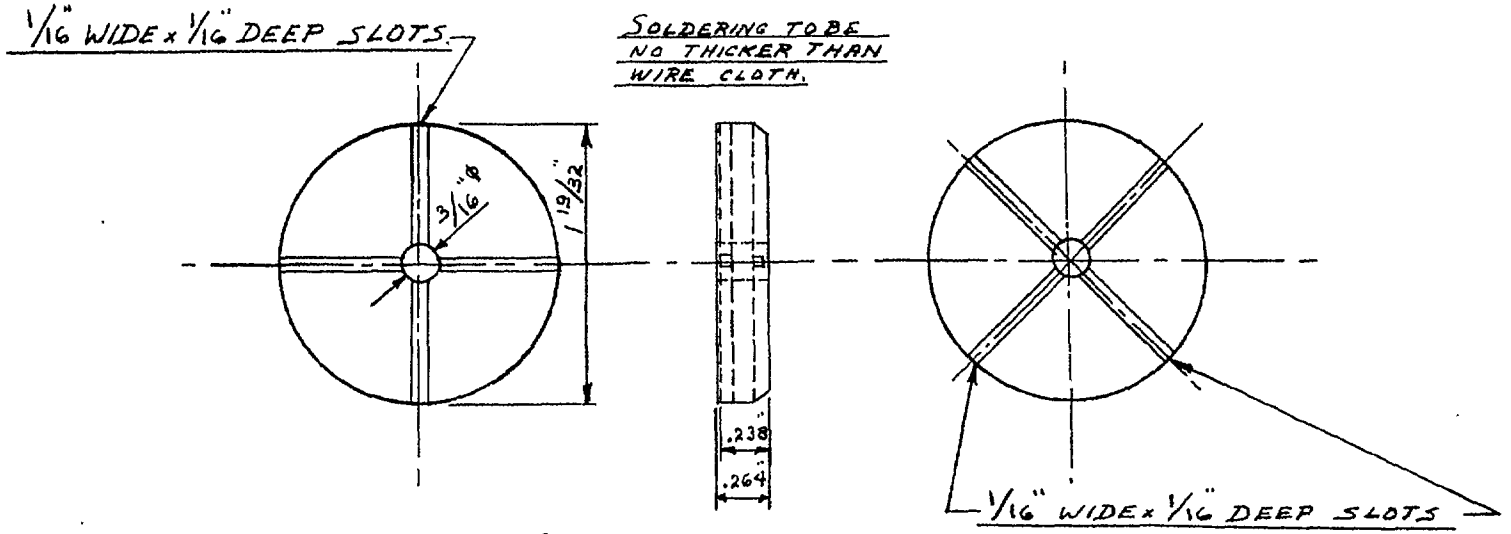
APPENDIX I
PAGE 1 OF 3


1 3/32" ϕ
1 39/64" ϕ
5/64"
45°
3 5/8"
6 9/16"
1 3/16"
8 5/32"
1 49/64" ϕ
1 3/16" ϕ
3 11/32"
1/8" R.
11/32"
1 15/32"
A
A
1 21/32" ϕ
2 1/8" ϕ
TYPICAL SECTION VIEW
W MACHINE FINISH
SECTION A-A
120°
60°
STRAIGHT KNURL
1/32"
45°
1 31/32" ϕ
2 13/64" ϕ
1 37/64"
2 1/8" ϕ
13/64"
15/32"
3/32" R.
5/8"
1/4"
ELEVATION
DYCKERHOFF
CELL
SCALE. 1=1"
DATE: MAR-18-64
MATERIAL
#655-T-6 ALUM.
2 1/4" ϕ ROUND ROD
APPENDIX - I-
PAGE 2 OF 3

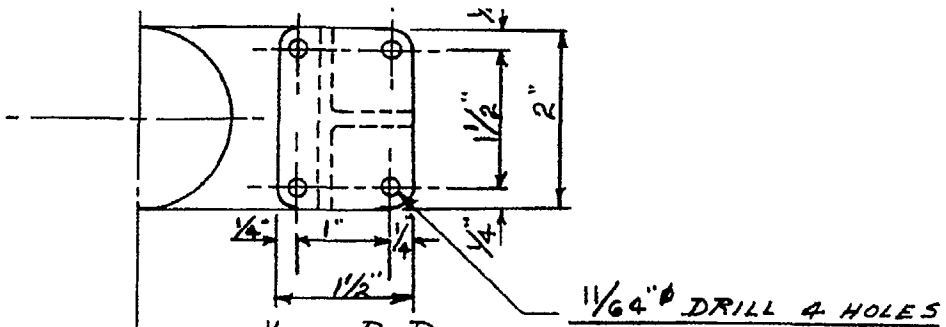
DYCKERHOFF CELL CATCHES



DYCKERHOFF SPACER

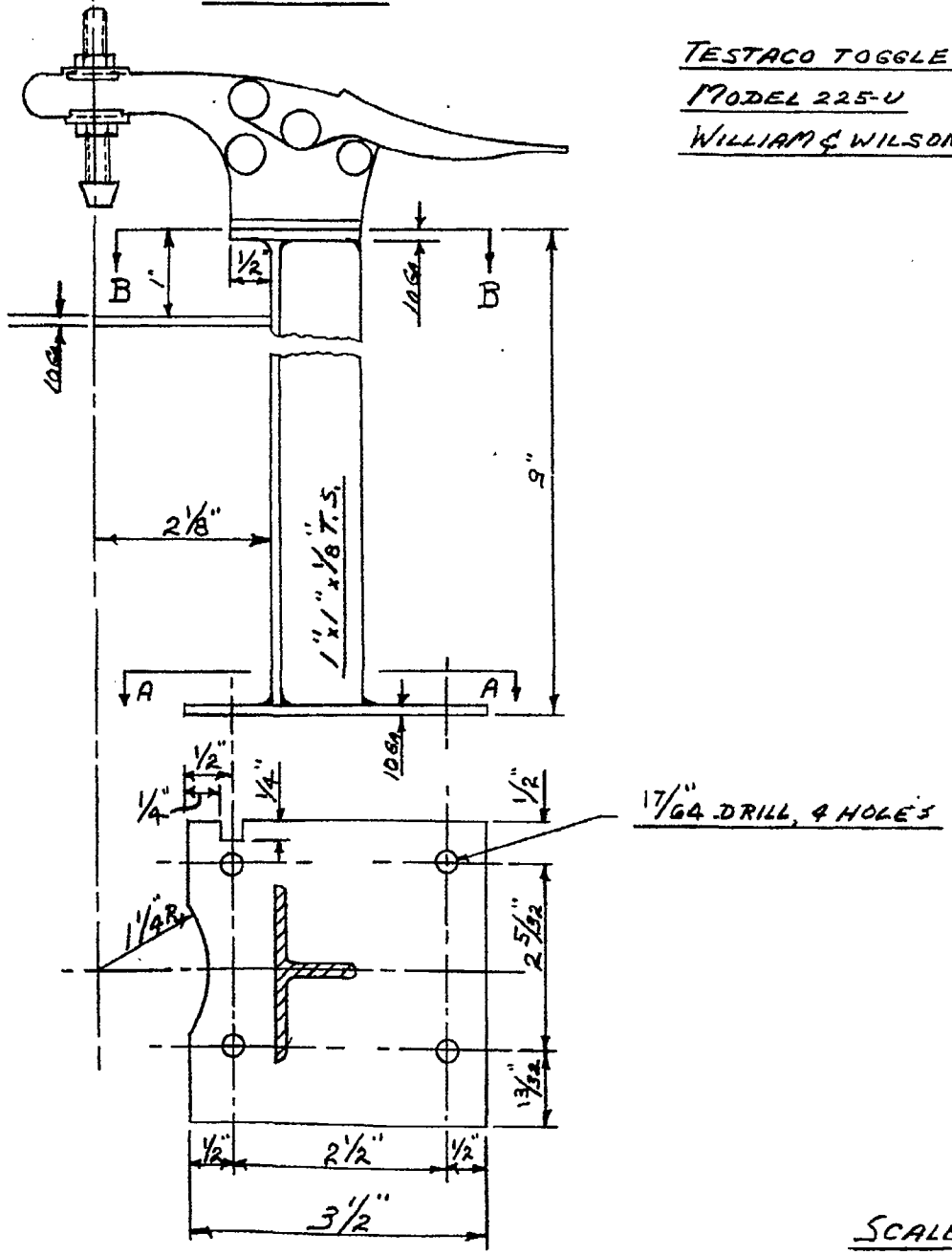


30 x 30 MESH PLAIN BRASS WIRE CLOTH 0.013" WIRE DIA.



VIEW B-B.

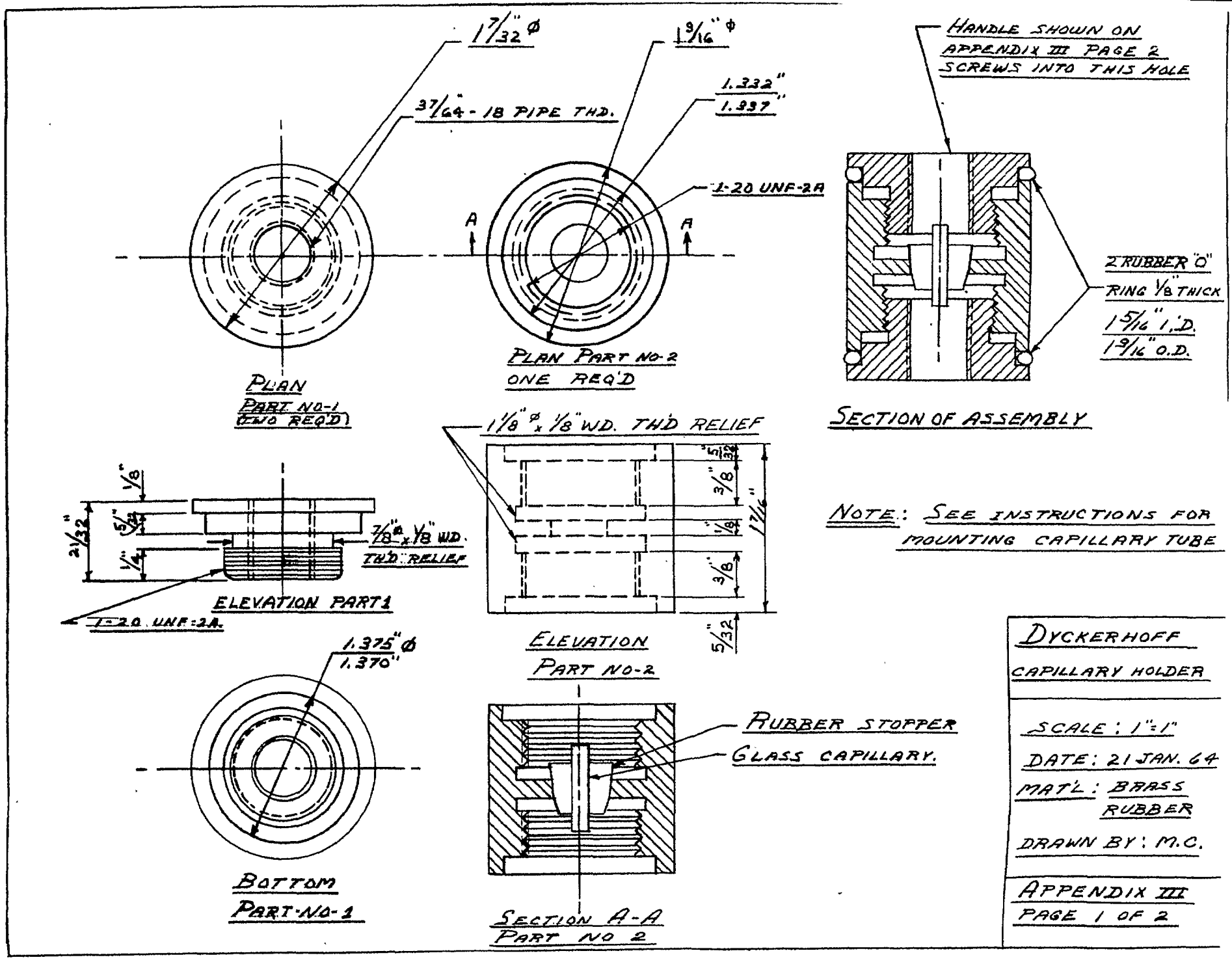
TESTACO TOGGLE CLAMP
MODEL 225-U
WILLIAM & WILSON



SECTION A-A.

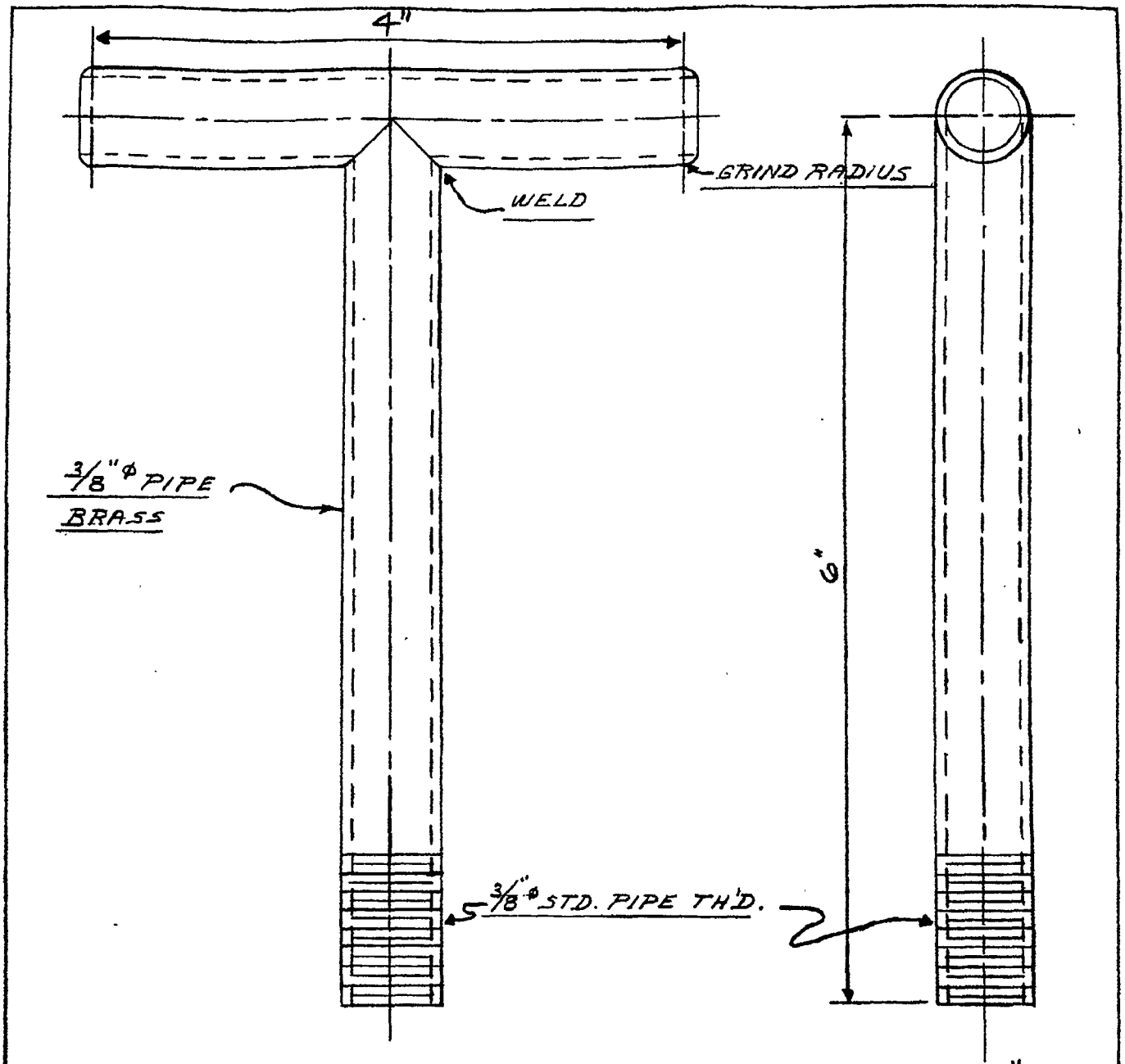
SCALE : 1" = 2

APPENDIX II



112

BIRD 005423



PART No. 3.

DYCKERHOFF CAPILLARY
TUBE HOLDER HANDLE.
SCALE : 1"=1'-0".
APPENDIX III
PAGE 2 OF 2

TESTING PROCEDURES

FOR

CHRYSOTILE ASBESTOS FIBRE

(Second Edition)

D-3

RAPID SURFACE AREA TEST

Printed in U.S.A.

Revised and adopted by:

ASBESTOS TEXTILE INSTITUTE -
MINERAL FIBER PRODUCTS BUREAU - 11/8/65
QUEBEC ASBESTOS MINING ASSOCIATION - 9/14/65

D-3

RAPID SURFACE AREA TEST[*1]

Scope

1. This test is intended to measure the relative degree of openness or fiberization of milled asbestos fibre having an "effective" surface area within the range 10 to 250 dm^2/gm, as measured by the air permeability method.

Apparatus

2. (a) Rapid Surface Area Tester including 50-gram brass sample cell, complete with perforated plate, end cap, retaining ring and base, filling funnel, tamping rod and key[*2] (See schematic diagram of apparatus in Appendix I).

   (b) Balance (Sensitivity ±0.01 gms).

   (c) Source of dry compressed air at a pressure of approximately 2 psi, with a shut-off valve.

   (d) Optional cell holder shown in Appendix II and Dyckerhoff cell.

Sample Preparation

3. Select two representative samples of 50 grams each by the "Method of Sampling and Preparation", Procedure A-1.

   Note 1: Samples containing excessive quantities of non-fibrous rock particles or contaminants will not give reliable or meaningful results.

[*1] Adopted in part from the Turner and Newall Limited Asbestos Fibre Laboratory's "Procedure T-4 - T. & N. Rapid Surface Area Tester, January 1965."

[*2] Obtainable from Turner and Newall Limited Fibre Laboratory, Trafford Park, Manchester 17, England.

Procedure

4. (a) Verification of Apparatus - Check condition of apparatus daily before using, and adjust when required, as follows:

(1) Verify zero reading of the tester daily by carrying out steps 4 (b) to 4 (e) but with the cell empty.

(2) If the manometer does not read zero, check to determine if the apparatus is out of plumb.

(3) If the water level is below zero, adjust by adding distilled water through the hole in the reservoir cap.

(4) If the level is above zero, correct it by inserting a wick through the hole in the reservoir cap to remove excess water.

(b) Ensure that the perforated disc is perfectly seated at the bottom of the sample cell.

(c) Place the filling funnel over the open end of the cell and empty one 50 gm specimen into it in stages, using the tamping rod at intervals to coax all the specimen past the neck of the funnel; avoid trapping any fibre between the rod and the funnel. When all the fibre has passed the neck of the funnel, in a single motion press the specimen into the cell, until the transverse bar touches the upper edge of the filling funnel.

Note 2: Do not compress the fibre in the cell without the filling funnel in place.

(d) Slowly withdraw the rod, rotating it slightly to ensure that the compressed fibre is not disturbed. Insert the end cap of the cell, and screw down the retaining ring using the key and base provided, until there is a positive resistance indicating that the "O" ring seal is fully compressed and that metal-to-metal contact has been established between the cell face and the end cap.

(e) Connect the cell to the rubber discharge tube of the tester and turn on the air supply. Open the control-valve on the apparatus until the water level in the front manometer tube begins to fall. When air bubbles begin to issue from the escape holes at the bottom end of the brass tube in the transparent vertical cylinder at the rear of the tester, adjust the control-valve until bubbles escape at a rate of not more than three per second.

(f) When the water level in the manometer tube appears to be stationary, note the scale reading opposite this level. Wait ten seconds, and read the level again to make sure that it is constant; if not, take another reading after a further ten seconds. Estimate the scale reading to half a division, and record this reading as the "effective" surface area in dm^2/gm.

(g) When the reading has been recorded, close the shut-off valve, and disconnect the cell from the apparatus. Do not change the setting of the control valve unless required.

(h) Repeat Steps 4 (b) to 4 (g) for the second test specimen.

(i) Procedure with Optional Cell Holder and Dyckerhoff Cell - If it is desired to compare the Rapid Surface Area Tester with the Dyckerhoff Air Permeability Tester, proceed as follows:

(1) Perform test on fibre sample or Dyckerhoff capillary calibrating standard, as desired, by the "Dyckerhoff Air Permeability Test Procedure D-2"

(2) Transfer Dyckerhoff cell to cell holder shown in Appendix II and test on Rapid Surface Area Tester, as described in Steps 4 (e) to 4 (h).

Note 3: Use of the optional cell holder and Dyckerhoff cell with the Rapid Surface Area Tester, instead of the standard 50-gram cell, will give slightly higher results.

Results and Accuracy

5. (a) If the two results obtained differ by more than two scale divisions, test a third specimen.

(b) If more than two tests are made, reject any reading that lies more than two scale divisions from the nearest of the others, and record the mean value of the remaining readings in dm^2/gm.

(c) For example:

	(a)	(b)	(c)
	46	46	46
	44 Accept	42 Reject	42 Accept
		48	44
Mean	45	47	44
Record as	45 dm^2/gm	47 dm^2/gm	44 dm^2/gm

Note 4: The Rapid Surface Area Test may be correlated with the Dyckerhoff Air Permeability Tester by taking readings as described in Step 4 (i) of the Procedure and plotting the Dyckerhoff time readings against the "effective" surface area results thus obtained. An example of a correlation graph for two given instruments is attached in Appendix III.

Maintenance of Cell

6. (a) Check the dimensions which control the internal length and diameter of the cell regularly. The dimensions of the components should be such that the effective length is within 0.002 inch (0.050 mm) of the nominal length of 2.882 inch (73.202 mm); and the nominal diameter is 1.534 ± 0.002 inch (38.964 ± 0.050 mm).

(b) The internal length may be corrected by removing material very carefully from:

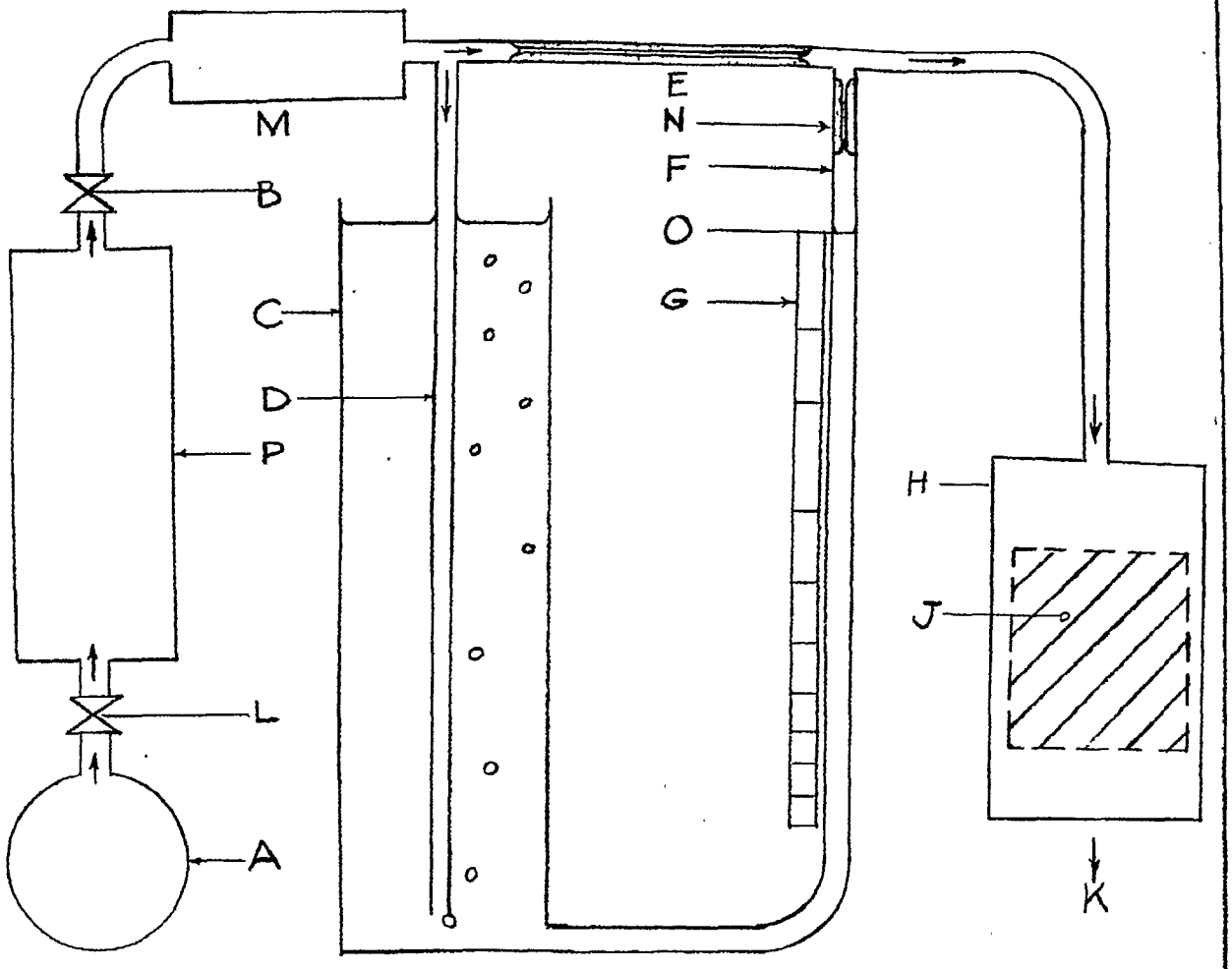
(1) The end face of the cell (to reduce the internal length).

(2) The inner face of the end cap (to increase the internal length).

(c) Record the date of any such adjustments and/or dimensional changes to the cell.

(d) If the dimensions of the internal length or diameter exceed tolerance limits and adjustments cannot be made, the complete cell should be returned to the supplier in exchange for a new cell.

APPENDIX I



LEGEND

A - SUPPLY OF DRY COMPRESSED AIR

B - CONTROL-VALVE

C - WATER RESERVOIR

D - BUBBLER TUBE

E - CAPILLARY

F - MANOMETER LEG

G - MANOMETER SCALE (EXPONENTIAL)

H - SAMPLE CELL

J - TEST SPECIMEN

K - AIR OUTLET

L - SHUT-OFF VALVE

M - DUST FILTER (FIBRE GLASS)

N - CAPILLARY SNUBBER

O - ZERO MARK ON MANOMETER

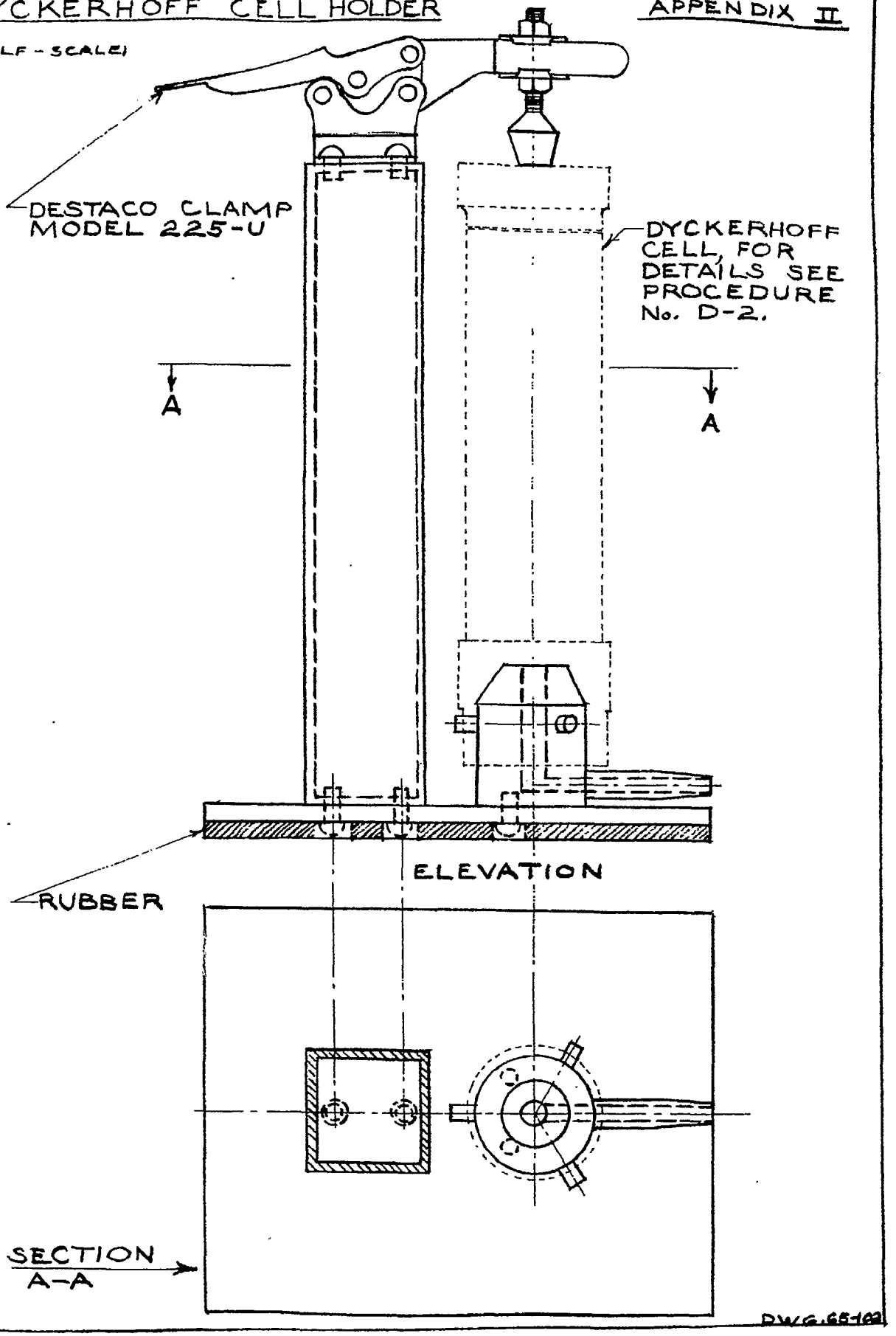
P - AIR DRYER OR DESICCATOR (DRYERITE)

DWG 65-104

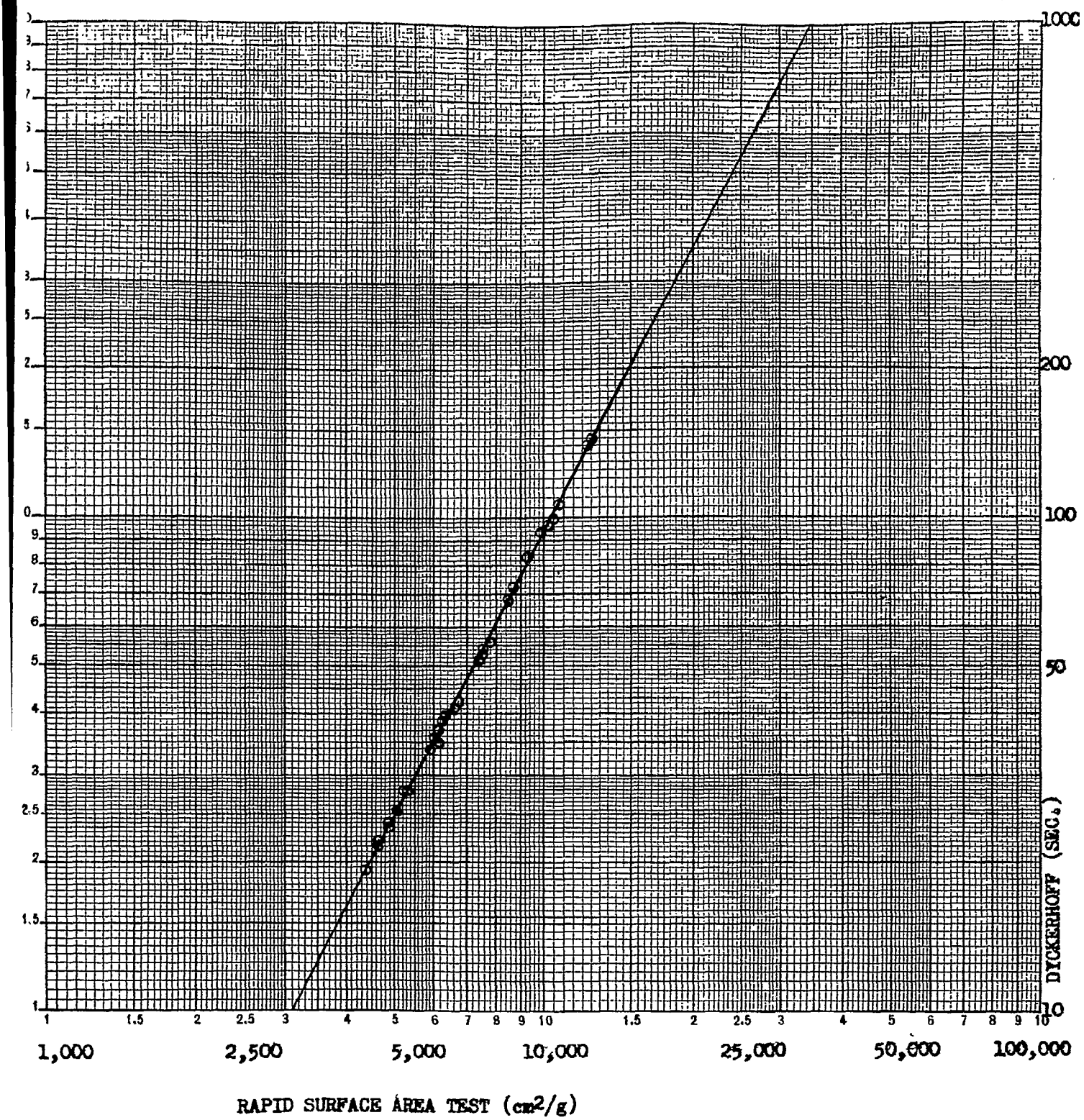
DYCKERHOFF CELL HOLDER

APPENDIX II

(HALF - SCALE)



APPENDIX III



TESTING PROCEDURES

FOR

CHRYSOTILE ASBESTOS FIBRE

(Second Edition)

D-4

COMPRESSIBILITY AND RECOVERY

Printed in U.S.A.

Revised and adopted by:

ASBESTOS TEXTILE INSTITUTE - 3/8/62
MINERAL FIBER PRODUCTS BUREAU -
QUEBEC ASBESTOS MINING ASSOCIATION -

D-4

COMPRESSIBILITY AND RECOVERY

Scope

1. This method of test covers a procedure for determining the bulking factor of spinning grade fibre.

Significance of Test

2. Fibre tested by this method will signify the compressibility and recovery of that particular fibre. Both factors are important in the processing of fibre and character of the finished product.

Apparatus

3. (a) Tube, disc, and plunger as specified in drawing "Test Unit Compressibility and Recovery of Spinning Fibre." Tube to be chrome plated on the inside.

   (b) Weight disc and plunger to weigh thirty (30) pounds. Refer to drawing "Test Unit Compressibility and Recovery of Spinning Fibre" Items 3, 5, 6, and 7.

   (c) A sixteen (16) ounce balance with graduations of 0.2 ounces and a sensitivity of 0.1 ounce.

Sample Preparation

4. In accordance with (A-1) "Method of Sampling and Preparation."

Procedure

5. (a) Size of sample; the weight of sample used for this test shall be four (4) ounces plus or minus 0.1 ounce.

   (b) Place the four (4) ounce sample in the apparatus.

   (c) Start the test. Record the fibre level under 30-pounds of weight, raise the plunger clear of the disc and record the fibre level. Repeat the cycle until no change is noted in the readings. Time to apply the weight one (1) minute, dwell to read, then release and read.

Calculation and Report

6. (a) Read and record compression directly.

(b) Read and record recovery directly.

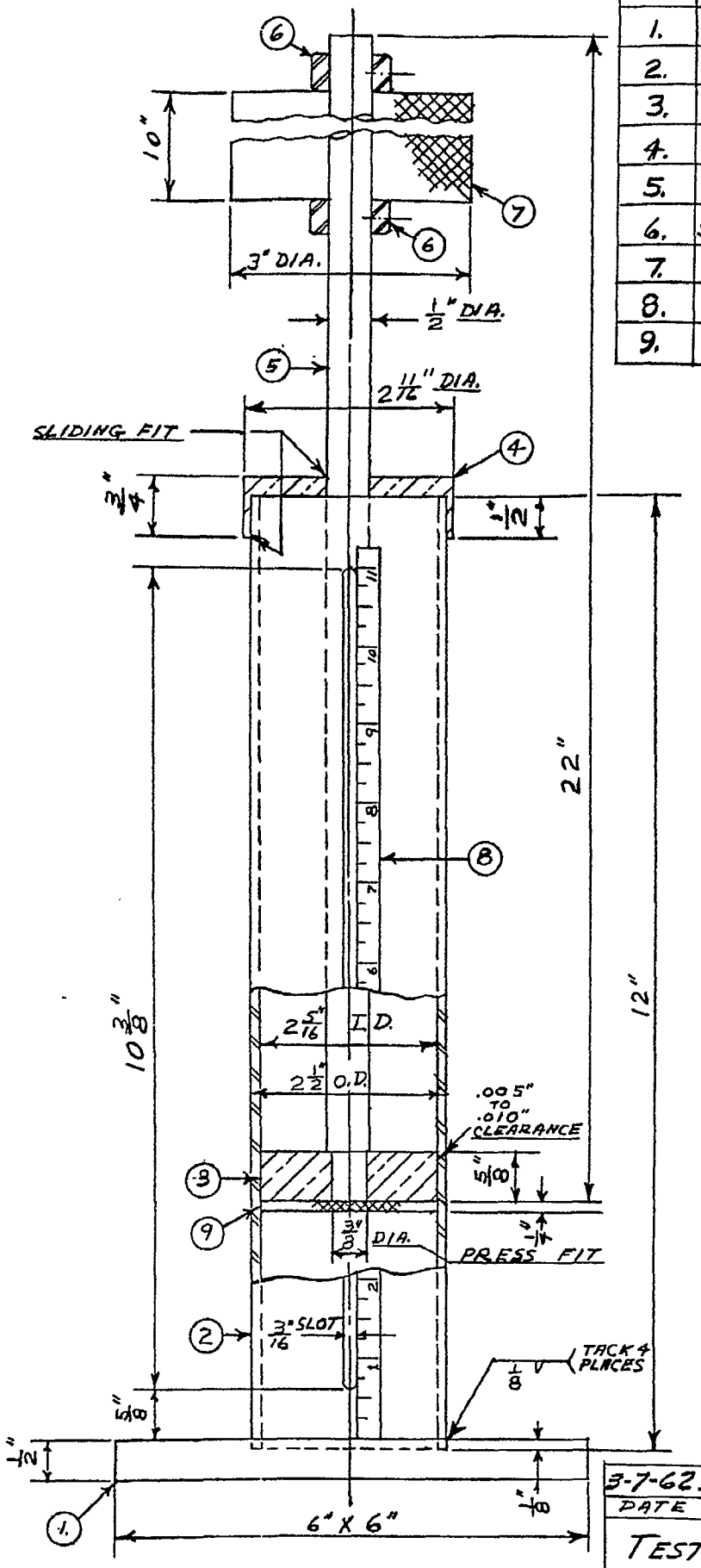
(c) Per Cent Recovery $= \frac{(\text{Recovery} - \text{Compression})}{(\text{Compression})} \times 100$

(d) Report as Compression and Per Cent Recovery.

(e) Test reproducible to plus or minus 0.5 per cent.

PC. NO.	NAME	MAT'L.
1.	BASE	C.R.S.
2.	CYLINDER	ST'L. T'B'G
3.	PLUNGER	BRONZE
4.	CAP	BRONZE
5.	ROD	C.R.S.
6.	S.S. COLLAR	ST'L
7.	WEIGHT	LEAD (28 LBS.)
8.	SCALE	LUFKIN #W2310 RULE
9.	DISC	C.R.S.

NOTE: TOTAL WEIGHT OF PCS. ③ ⑤ ⑥ ⑦ & ⑨ TO BE 30 LBS.



3-7-62.		C.J.B.	3-7-62	C.J.B.
DATE	APP'D.	DRAWN BY	DATE	CK'D.

TEST UNIT - COMPRESSIBILITY & RECOVERY OF SPINNING FIBRE T-13 DWG A-17004

D-5

DRAINAGE RATE

Scope

1. This procedure is for determining the water drainage rate from an asbestos slurry using a commercial Sheet Mould.

   Note 1: The drainage rate is understood as the speed with which the water is removed (drained) from a water-asbestos slurry.

   Re: Merriam-Webster Dictionary - To drain = to draw off
   To filter = to pass through a filter

Apparatus

2. (a) Sheet Mould - Valley Iron Works square model 8 x 8 inch with a water leg provided with a brass reduction piece screwed in after the gate valve and having an orifice of exactly 3/8 inch (0.375 inch) or an overflow box to prevent the gulping of the air by the "water leg."

   The distance between the facing wire and the water leg valve should be 40-7/16 inchs.

   (b) Facing wire 100 x 100 phos. bronze, 0.004 inch.

   (c) Three 1000 ml graduate cylinders.

   (d) Two 2000 ml beakers.

   (e) Two 400 ml beakers.

   (f) A mechanically driven inverter* capable of rotating a 1000 ml graduate cylinder at 30 rpm with the axis of rotation bisecting the axis of the cylinder at right angles.

   *Note 2: See QAMA Test Methods and Procedures and/or (D-1) "Wet Volume Test."

   (g) Two clean pails (capacity two gallons).

   (h) Balance - accurate to 0.1 gram.

(i) Supply of distilled water at 22° ± 1°C.

Sampling

3. (a) In accordance with (A-1) "Method of Sampling and Preparation."

Procedure

4. (a) Weigh two 60.0 gm samples of fibre into two 400 ml beakers.

(b) Fill three 1000 ml graduates with distilled water at 22° ± 1°C.

(c) Transfer the weighed 60 gm sample into a 2000 cc beaker, add to it 1000 ml of distilled water from the first graduate and transfer the slurry back into the same graduate.

(d) Place the graduate with the slurry into the inverter. Revolve the graduate exactly 30 times in one minute (30 rpm).

(e) Fill the sheet mould with tap water exactly to the facing wire level, wipe off any excess of water with a rubber wiper. Make sure that the air entrapped under the facing wire is removed.

(f) Remove the graduate from the inverter, transfer the slurry into a clean pail, rinse the graduate, and the 2000 ml beaker with 1000 ml of water into the same pail.

(g) In order to secure a good mixing of the water-asbestos slurry, transfer it five times from pail to pail.

(h) Immediately pour remaining 1000 ml of distilled water into sheet mould, and then the 2000 ml slurry from the pail.

(i) Immediately open the draining gate valve and start the timer.

(j) Stop the timer when at least 95 per cent of the formed sheet loses its shiny aspect.

Results and Accuracy

5. (a) The average of two results is reported in seconds as a measure of the drainage rate.

(b) The expected maximum difference between any individual reading and the average is ± 5 per cent, but not to exceed 10 seconds.

Care of the Sheet Mould

6. (a) Check before every test if the screen is thoroughly clean. After each test open the water inlet valve slightly and clean the facing screen with a long-haired brush. Be careful not to damage the screen.

(b) At the end of each series of tests close the box and wash the screen with a strong spray of water. Keep the water leg valve slightly open, and when the screen is washed, close the water leg valve, open the inlet valve and brush off fibre remaining on the facing wire. The screen shall be without white spots caused by fines blocking screen openings.

Notes on adapting this test to other models and makes of Sheet Mould:

Note 1: The present procedure may be adapted for other models and makes of commercially available Sheet Moulds.

Note 2: This procedure has been adapted and correlated for Williams 12 inch x 12 inch Sheet Mould.

The size of the sample and the amount of distilled water to be used in the Williams 12 inch x 12 inch Sheet Mould were established as follows:

(a) The true dimensions of the Valley Iron Works Sheet Mould are 8.5 inches x 8.5 inches

Screen area 8.5 inches x 8.5 inches = 72.25 sq. inches

Amount of fibre deposited per one sq. inch:

$$60.0 \text{ gms} = 0.83 \text{ gms per sq. inch}$$

The consistency of the asbestos water slurry is:

$$\frac{60.0 \times 100}{3000} = 2 \text{ per cent}$$

(b) Corresponding values for the Williams 12 inch x 12 inch Sheet Mould:

Sample size: $0.83 \times 144 = 119.5$ gm or 120.0 gms

Amount of distilled water:

$$\frac{120.0 \times 100}{2} = 6000 \text{ ml}$$

TESTING PROCEDURES

FOR

CHRYSOTILE ASBESTOS FIBRE

(Second Edition)

D-6

DETERMINING THE LOOSE DENSITY OF MILLED ASBESTOS FIBRES FOR GROUPS 5 TO 9 INCLUSIVE

Printed in U.S.A.

Revised and adopted by:

ASBESTOS TEXTILE INSTITUTE -
MINERAL FIBER PRODUCTS BUREAU - 11/8/65
QUEBEC ASBESTOS MINING ASSOCIATION - 12/11/62

D-6

LOOSE DENSITY

Scope

1. (a) This method of testing covers the procedure for determining the loose density of milled asbestos fibres for Groups 5 to 9 inclusive.

Apparatus

2. (a) Balance or scale sensitive to 0.1 ounce.

   (b) Measure, 1/16-cu. ft. (108 cu. in.) in volume, made of plastic tubing 5-1/4-in. OD, with 1/4-in. wall and 5-1/2-in. height.

   (c) Scoop to fill measure and capable of holding 1-1/2 times the volume of the measure.

   (d) Spatula or straight edge.

Sampling and Preparation

3. (a) In accordance with (A-1) "Method of Sampling and Preparation," using the Johnson's Sample Conditioner.

   (b) Sample to be 1-1/2 times the volume of the measure.

Procedure

4. (a) Using the full sample fill the measure to overflowing in one continuous shaking motion. The lip of the scoop should be held 3 to 4 inches above the measure.

   (b) With the spatula immediately level off the fibre to the top of the measure. This should be done in several passes to avoid compression of the fibre.

   (c) The weight in ounces of fibre contained in the measure is the loose density in lbs/cu. ft.

Results and Accuracy

5. (a) The loose density shall be the average of three results.

   (b) The variation in results should not be greater than plus or minus 2 per cent.

TESTING PROCEDURES

FOR

CHRYSOTILE ASBESTOS FIBRE

(Second Edition)

D-7

FREENESS TEST OF ASBESTOS FIBRE

Printed in U.S.A.

Revised and adopted by:

ASBESTOS TEXTILE INSTITUTE -
MINERAL FIBER PRODUCTS BUREAU - 11/8/65
QUEBEC ASBESTOS MINING ASSOCIATION - 9/22/64

D-7

FREENESS TEST

Scope

1. (a) To give a measure of the rate at which a water-asbestos slurry may be dewatered under standard conditions.

   (b) Grades tested: Group 4, 5, 6, and 7D.

Apparatus

2. (a) Freeness tester with suitable stand, see Drawings L-611, L-612, L-613, and L-571.

   (b) Balance accurate to 0.1 gram.

   (c) Two 1000 ml open top graduate cylinders*.

   (d) Thermometer.

   (e) Stop Watch.

   (f) Supply of F. S. U. "Prepared" water. This water shall be distilled water saturated at room temperature with chemically pure lime and gypsum. It shall be prepared by adding 2 grams of hydrated lime and 3 grams of gypsum ($CaSO_4\ 2H_2O$) per liter. It shall be allowed to stand for 24 hours (agitating water from time to time), after which it is siphoned into clean containers.

   (g) A mechanically driven inverter** capable of rotating a 1000 ml graduated cylinder at 30 rpm with the axis of rotation bisecting the axis of the cylinder at right angles.

   Note I*: A graduated cylinder as per Drawing D has been found satisfactory.

   Note II**: See "Testing Procedure for Chrysotile Asbestos Fibre" (D-1) "Wet Volume."

Sampling

3. (a) In accordance with (A-1) "Method of Sampling and Preparation."

Procedure

4. (a) Calibration and Preparation:

(1) Pour 650 ml of distilled water at 77° ± 2°F into the thoroughly cleaned tester.

(2) Open the pet-cock and drain off 50 ml into a graduated cylinder. (This removes any air pockets between the screen and the outlet pet-cock).

(3) Open the pet-cock again and measure the time in seconds to fill the same graduate from the 150 ml to the 350 ml mark without closing the pet-cock at this point.

Note III: The time measured in paragraph 4 (a) (3) should be between 8 to 10 seconds. The allowable variation for one tester is one second. A greater variation indicates fouling of the screen or pet-cock.

(4) Close the pet-cock when the level reaches the 600 ml mark in the graduate cylinder. This should set the water level slightly above the screen.

(b) Freeness test:

(1) Place an empty graduate under the freeness tester to receive the drainage water.

(2) Pour 500 ml of F. S. U. "Prepared" water at 77° ± 2°F into a 1000 ml graduate and add to it the 10 gram test sample.

(3) Place the graduate into the mechanical inverter and rotate for one minute.

(4) Immediately remove the graduate from the inverter and in one continuous motion quickly pour the slurry into the tester. This prevents an excess of material from adhering to the graduate walls and assures the uniformity of the slurry.

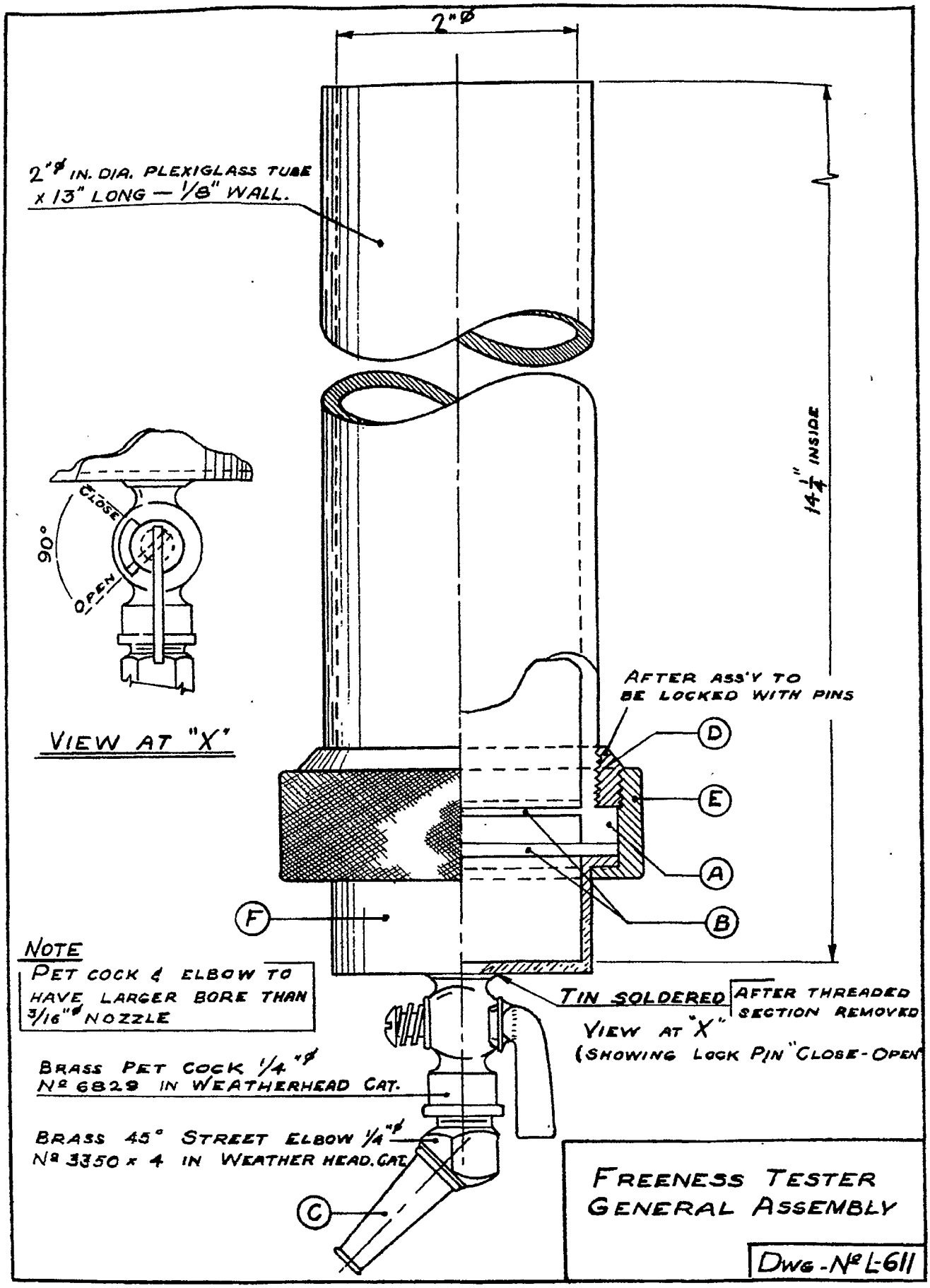
(5) Wait 5 seconds and open the pet-cock. Start timing when 50 ml has drained and measure the time interval in seconds to drain 100 ml or to reach the 150 ml mark.

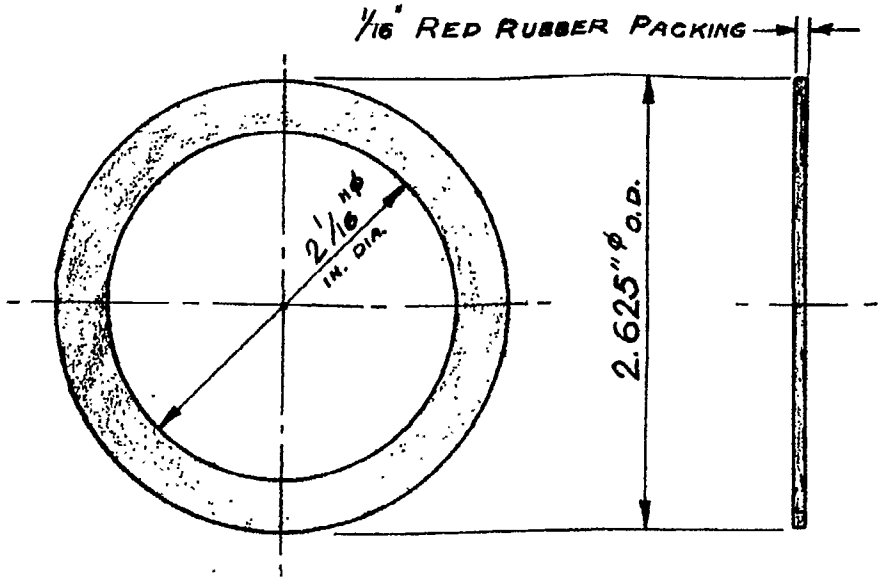
Results and Accuracy

5. (a) The average of three results is reported in seconds as a measure of freeness.

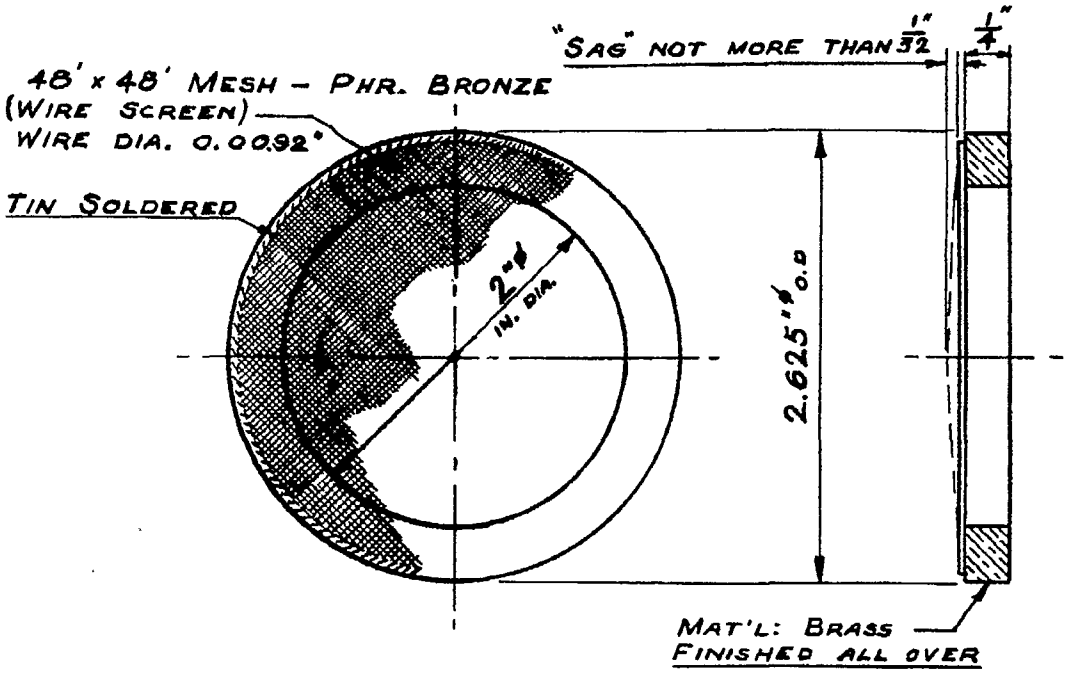
(b) The expected maximum difference between any individual reading and the average is ± 5 per cent but not to exceed 10 seconds.

Note IV: It is advisable to have reference samples to check the freeness tester periodically. If readings on the reference samples exceed the allowable tolerances, examine the screen for excessive sag. See Drawing No. L-612.


2"Ø
2"Ø IN. DIA. PLEXIGLASS TUBE
x 13" LONG — 1/8" WALL.
14 1/4" INSIDE
CLOSE
90°
OPEN
VIEW AT "X"
AFTER ASS'Y TO
BE LOCKED WITH PINS
D
E
A
B
F
C
NOTE
PET COCK & ELBOW TO
HAVE LARGER BORE THAN
3/16"Ø NOZZLE
TIN SOLDERED
AFTER THREADED
SECTION REMOVED
VIEW AT "X"
(SHOWING LOCK PIN "CLOSE-OPEN
BRASS PET COCK 1/4"Ø
Nº 6829 IN WEATHERHEAD CAT.
BRASS 45° STREET ELBOW 1/4"Ø
Nº 3350 x 4 IN WEATHER HEAD. CAT.
FREENESS TESTER
GENERAL ASSEMBLY
DWG - Nº L-611



-MARK "B"- RUBBER SEAL - 2~REQ'D-



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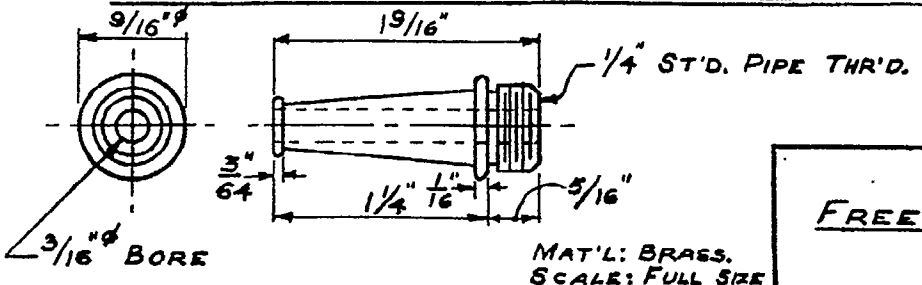
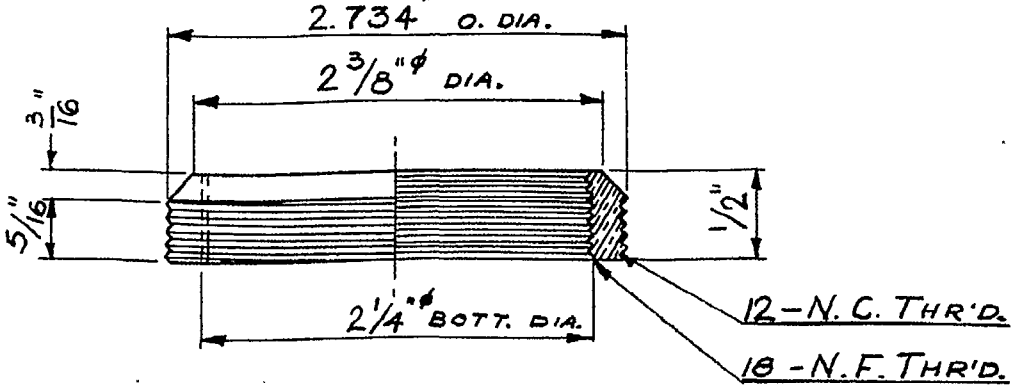


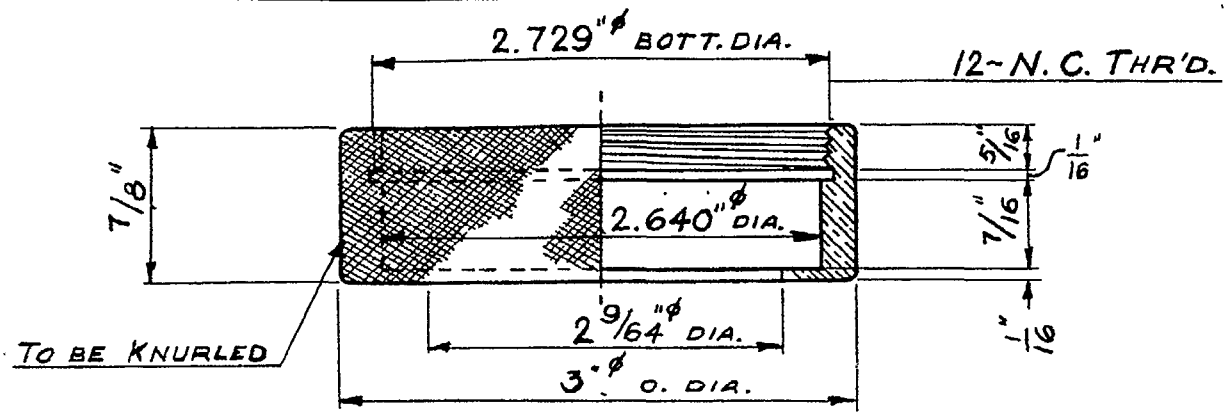
-MARK "C" - NOZZLE - ONE ~REQ'D-

FREENESS TESTER DETAILS

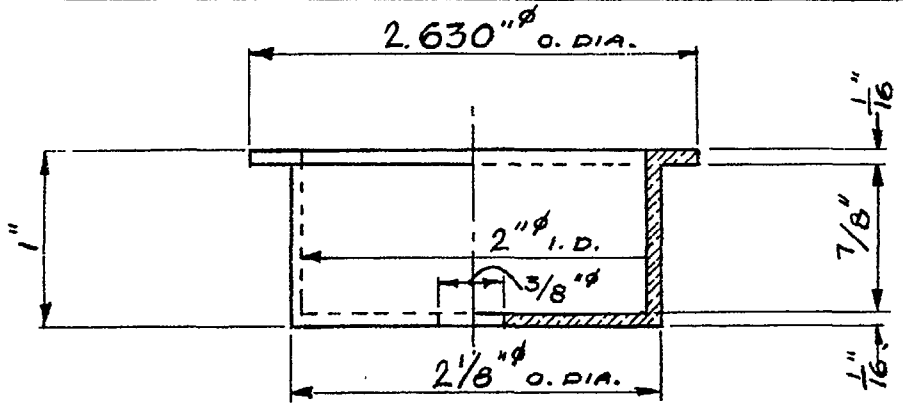
DWG. NO L-612



-MARK "D" - THR'D. BUSHING - ONE ~ REQ'D-



-MARK "E" - NUT - ONE ~ REQ'D-

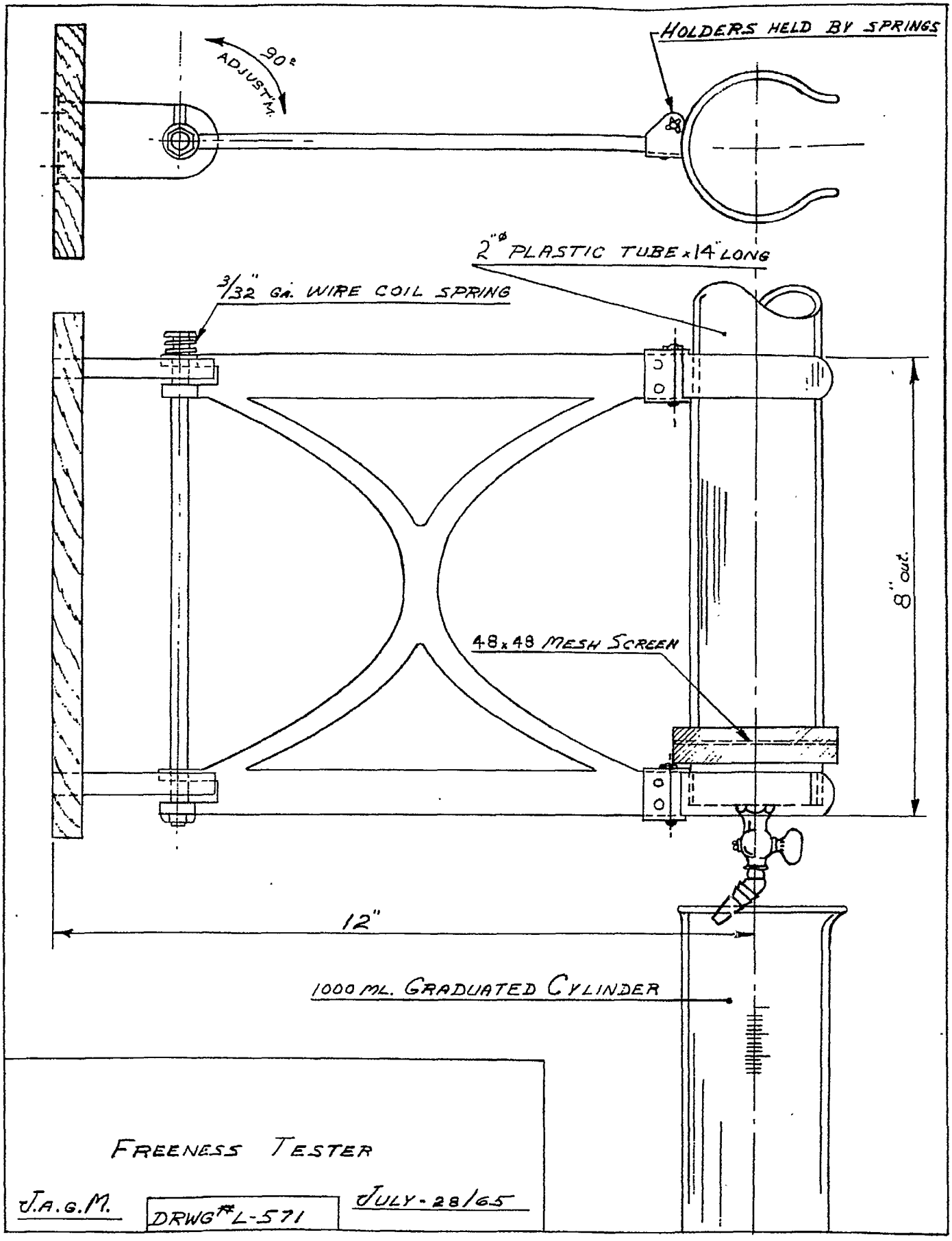


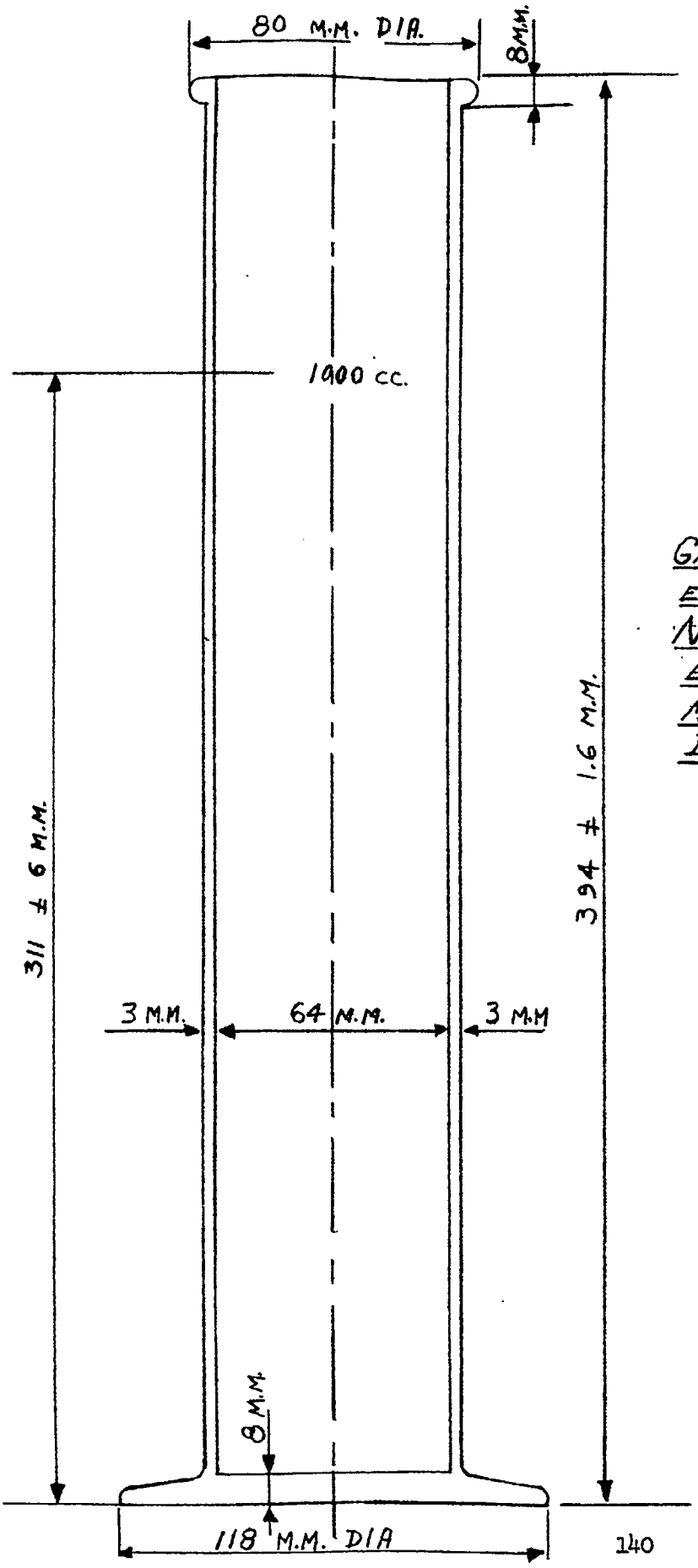
-MARK "F" - CUP - ONE - REQ'D-

-MAT'L. BRASS-

FREENESS TESTER DETAILS

DWG. Nº L-613


HOLDERS HELD BY SPRINGS
90° ADJUSTM.
2"ø PLASTIC TUBE x 14" LONG
3/32" Ga. WIRE COIL SPRING
8" out.
48 x 48 MESH SCREEN
12"
1000 ML. GRADUATED CYLINDER
FREENESS TESTER
J.A.G.M.
DRWG # L-571
JULY - 28/65



GRADUATION
EVERY 10 C.C.
NUMBERS
EVERY HUNDRED
MARK
BOTH UP AND DOWN

40 SCALE

GRADUATE CYLINDER FOR QAMA	
FREENESS TESTER	
JULY 27-65	DRWG -Nº D

TESTING PROCEDURES

FOR

CHRYSOTILE ASBESTOS FIBRE

(Second Edition)

E-1

CRUDY CONTENT DETERMINATION FOR GRADES 4D AND SHORTER

Printed in U.S.A.

Revised and adopted by:

ASBESTOS TEXTILE INSTITUTE -
MINERAL FIBER PRODUCTS BUREAU -
QUEBEC ASBESTOS MINING ASSOCIATION - 6/20/61

E-1

CRUDY CONTENT TEST

Scope

1. (a) This test is to measure by water elutriation a residue of material that indicates the crudiness and/or grit content in milled fibre.

   (b) The limitation of this test is for Q. S. grades of 4D to 7F inclusive.

Apparatus

2. (a) The apparatus as described by the drawings No. A and B.

   (b) Stop Watch.

   (c) 1000 cc beaker.

   (d) Waring blender Model No. 702 CR-W.

   (e) A balance to weigh 10 grams to an accuracy of ± 0.01 gm.

   (f) A Buchner funnel and filter or 200 mesh Tyler sieve.

   (g) Drying oven or infra-red lamp units.

Procedure

3. (a) Sample Preparation - In accordance with the "Method of Sampling and Preparing Asbestos Fibre for Testing" a laboratory sample will be taken.

   The test specimen will be selected from the above mentioned sample as follows:

   (1) Spread the sample on a smooth working surface by layers to form a flat pile approximately 1/2-in. thick and quarter.

   (2) Spread the reduced sample again and select 10 grams by taking pinches from different sections in the pile until the specimen is obtained which will require minimum adjustment to obtain the desired weight (10 grams ± 0.01 gms).

Note: Special attention must be made to ensure that each pinch of fibre picks up the full cross-section of the pile, including any grit or fines which may have segregated to the bottom.

(3) Two determinations of crudy content must be made on distinct samples thus obtained from the laboratory sample. The two results should then be averaged. (See Accuracy).

(b) Fill tube to half its height with water.

(c) Add the sample to the column from the top as a slurry in 200-400 cc of water.

(d) Bubble air through the sample for one minute to give thorough mixing.

Note: Ensure that no loss of sample takes place.

(e) Reduce the air rate to approximately 50 cc/min. and turn on the water to a 3500 cc/min. rate.

(f) After nine minutes turn off the air bubbles completely and increase the water rate to 5400 cc/min.

(g) After five minutes shut off the water.

(h) Pinch the inlet tubing, remove from the water air-line, and drain the collected crude into the beaker. The first two liters of water usually contain all the crude and the remainder of the water may be discarded.

(i) Wash down the lower end of the tube by squirting water into the inlet tube for a moment and add this to the beaker.

(j) Filter, dry, and weigh the crude and grit.

(k) If it is so desired, the grit content may be measured as follows:

Place the weighed material in a Waring blender with about 250cc of water and beat for one minute until the crude is pulpy and well fiberized.

Wash the material into a large beaker of warm (but not boiled) water, stir well and decant the fibre away from the grit.

Filter, dry, and weigh the grit (it may be necessary to hand-pick and discard some unfiberized crude).

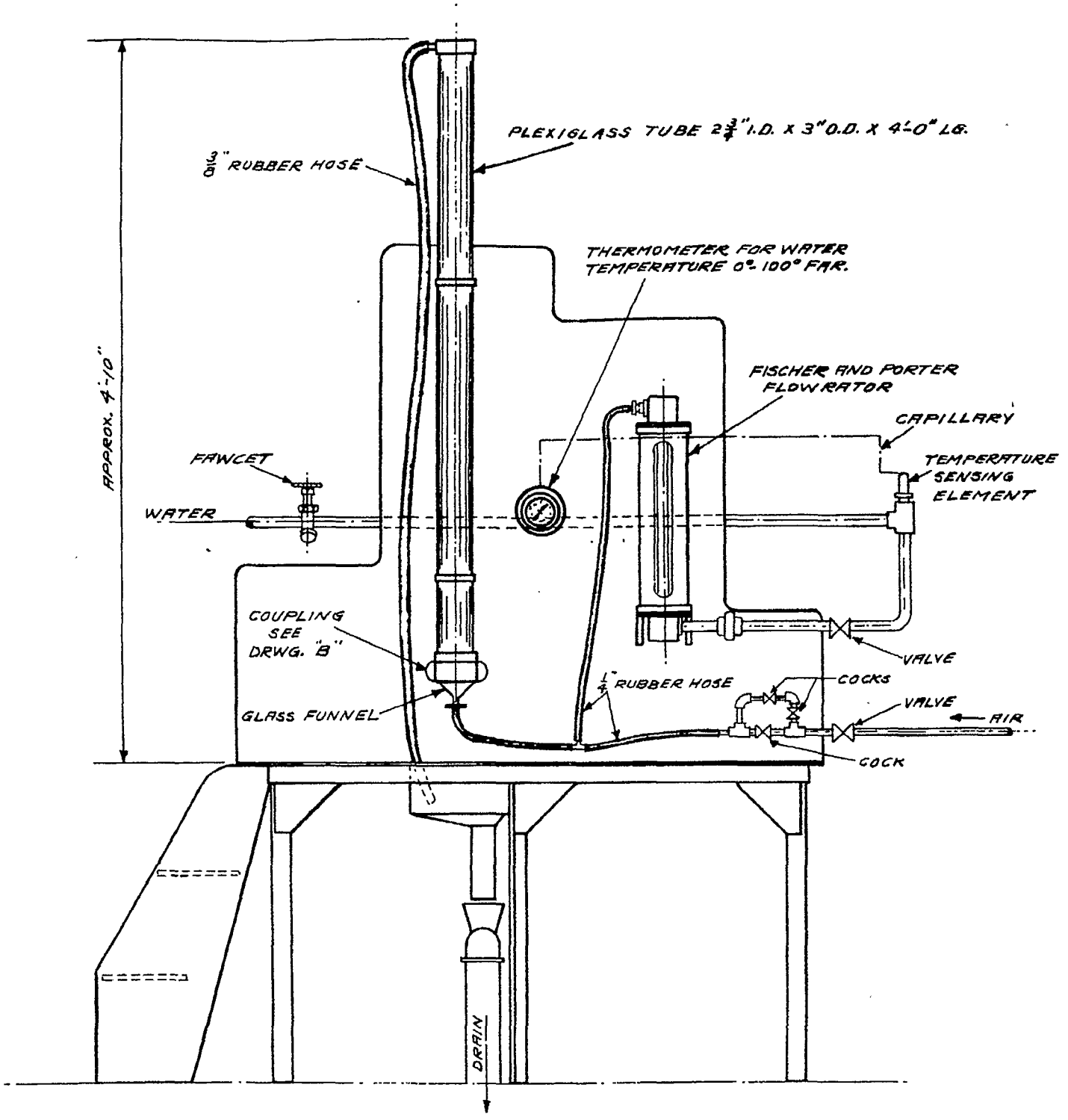
Subtract from the previous total Paragraph 3 (j) to obtain per cent crude.

Results and Accuracy

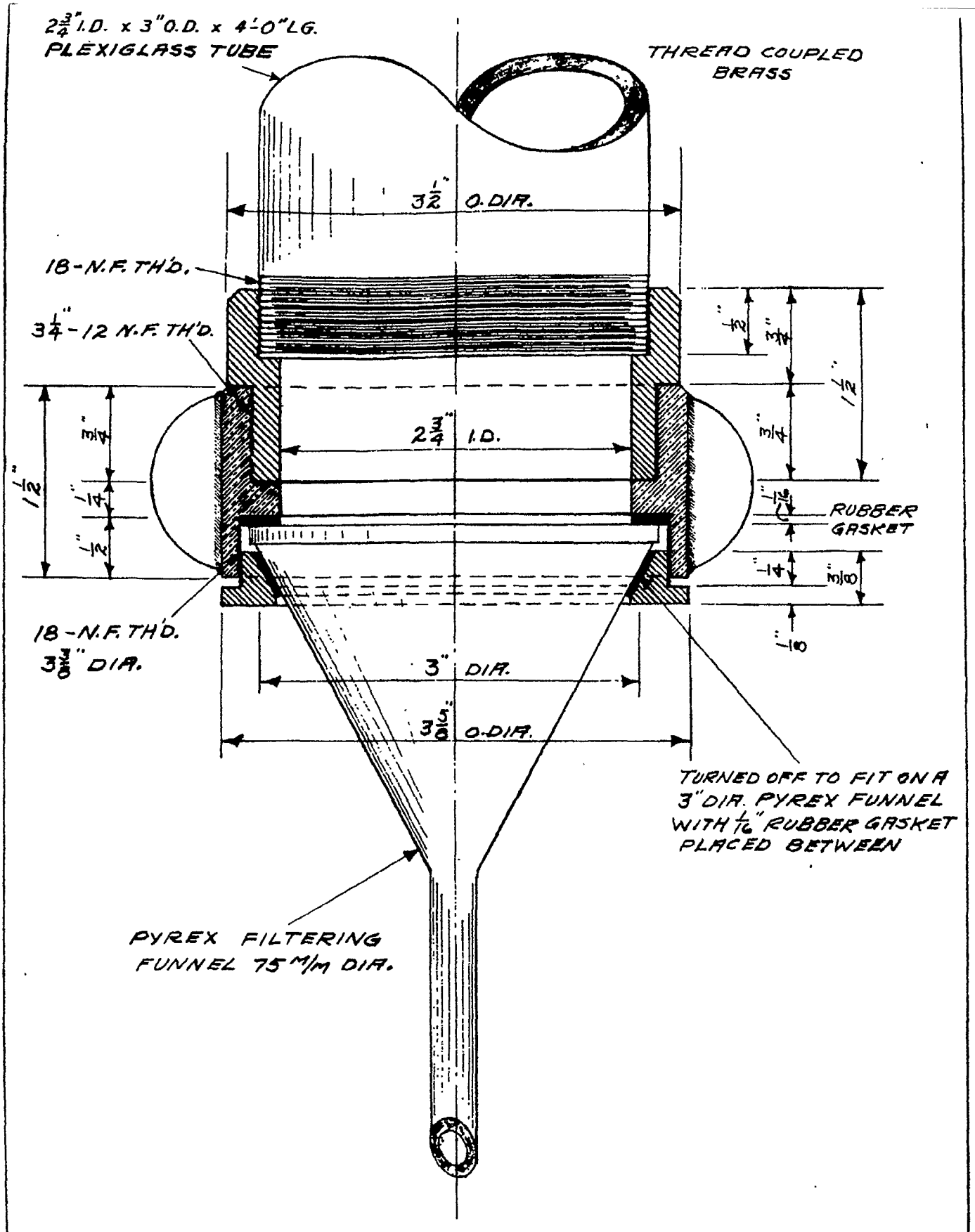
4. (a) The weighed residue described under "Procedure" paragraph 3 (j) is reported as the percentage of grit and crude. The average of two results must be reported.

(b) The weighed residue as described under "Procedure" paragraph 3 (k) is reported as the percentage of crude. The average of two results must be reported.

(c) The expected maximum difference between any individual readings and the average is ±3 per cent. When the maximum difference is exceeded, repeat the test.



CRUDY CONTENT APPARATUS
DRAWING "A"



CRUDY CONTENT APPARATUS-COUPLING
DRAWING "B"

TESTING PROCEDURES

FOR

CHRYSOTILE ASBESTOS FIBRE

(Second Edition)

E-2

GRIT AND SPICULE TEST

Printed in U.S.A.

Revised and adopted by:

ASBESTOS TEXTILE INSTITUTE -
MINERAL FIBER PRODUCTS BUREAU - 11/8/65
QUEBEC ASBESTOS MINING ASSOCIATION - 11/19/63

E-2

GRIT AND SPICULE TEST

Scope

1. (a) This test is to measure by water elutriation a residue of material that indicates the grit and spicule content in milled fibre.

   (b) The limitations of this test is for Quebec Standard grades 7H and below.

Apparatus

2. (a) Elutriation apparatus as described on drawings:

   No. L-572-A, General Arrangement
   No. L-572-B, Detail Separating Vessel
   No. L-572-C, Detail of Water Spray Tube

   (b) Fibre washing apparatus as described on drawings:

   No. L-551-1, General Arrangement
   No. L-602, Detail of Spray

   (c) Timer or Stop Watch.

   (d) Buchner Filter and filter paper. (Reeves Angel 230).

   (e) Drying oven or infra-red lamp drying units.

   (f) 35-mesh standard Tyler 8-in. sieve.

   (g) 100-mesh standard Tyler 8-in. sieve.

Sampling

3. (a) In accordance with (A-1) "Method of Sampling and Preparation," to obtain 100-gram sample.

   (b) Perform Grit and Spicule tests on triplicate samples obtained by the standard sampling procedure and average the results.

Note: Special attention must be made to ensure that each increment of fibre for the sample includes the full cross-section of the pile with any grit or fines which may have segregated to the bottom.

Procedure

4. (a) A test sample of 100 grams of fibre is ro-tapped by the standard procedure (B-2) "Ro-Tap Screen Analysis."

(b) The plus 35 mesh fraction is washed in several increments of 10 to 15 grams on 35 mesh sieve with a water spray at 20 lbs/sq. in., for 3 minutes.

The minus 35 mesh fraction is washed on 100 mesh sieve with the same spray and pressure for 3 minutes.

Note: All other techniques are outlined in wash test procedure (C-4) "Wash Test."

(c) Transfer the plus 35 mesh fraction after washing to the 4-in. diameter separating vessel.

(d) Connect to the water supply the copper spray tube so that it hangs freely in the center and the end has a half-in. clearance with the bottom of the vessel.

Note: Check the spray tube to ensure that openings are clear.

(e) Introduce the water to the separating vessel at a flow rate of 1575 cc/min.

(f) Allow the water to run for 30 minutes.

(g) After shutting off the water allow the residue to settle for 2 minutes and then decant off half the water.

(h) Pour the remaining water and residue into a Buchner funnel, making sure that the separating vessel is well washed out, and filter on a previously dried and weighed filter paper.

(i) The filtered residue from the separating vessel is then dried and weighed.

(j) The weight of the filter paper is subtracted from the weight of the filter paper plus residue to obtain the per cent of residue in the plus 35 mesh fraction.

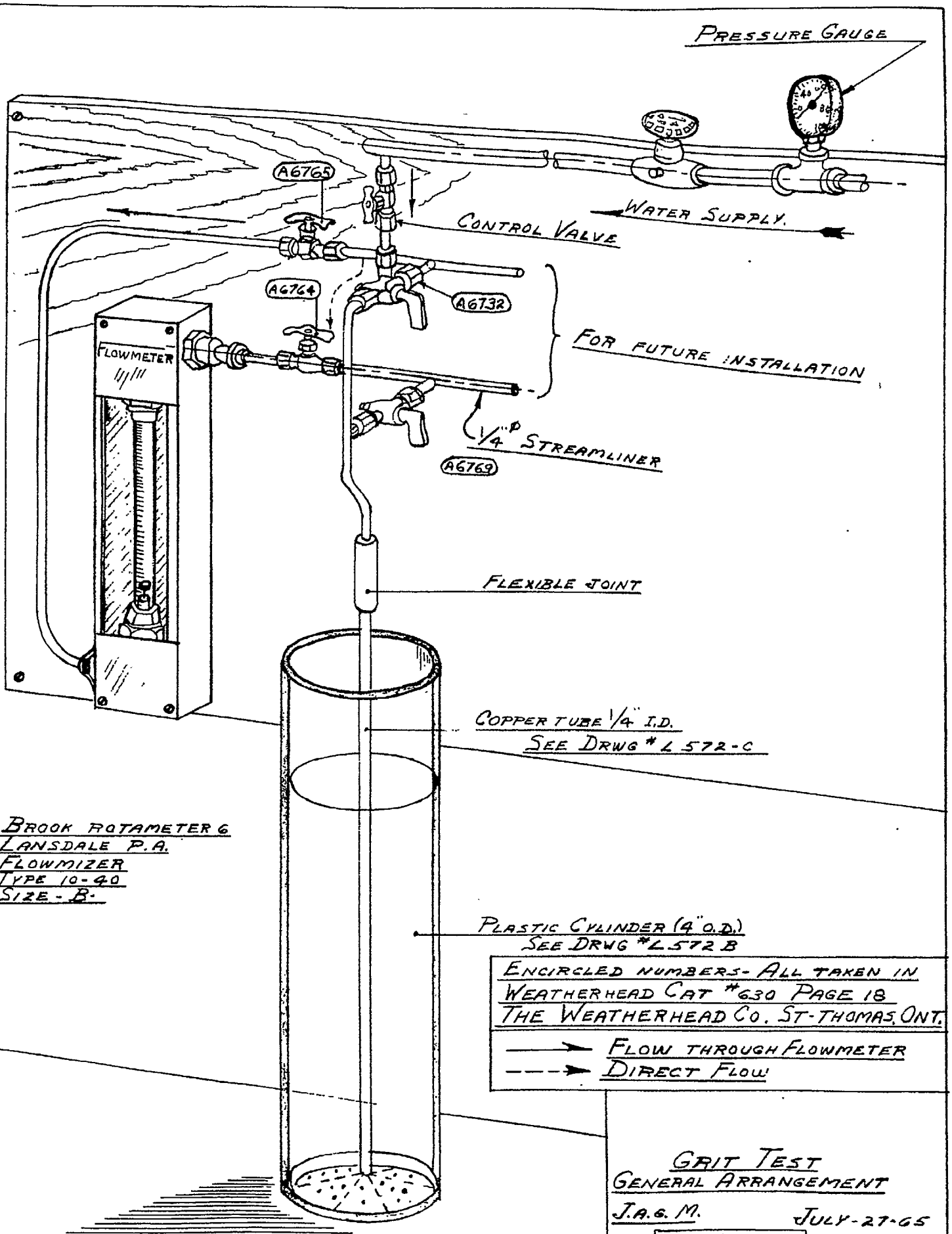
(k) The above procedure, as per paragraphs 4 (c) to 4 (j) is followed for the minus 35 mesh ro-tap fraction after washing on

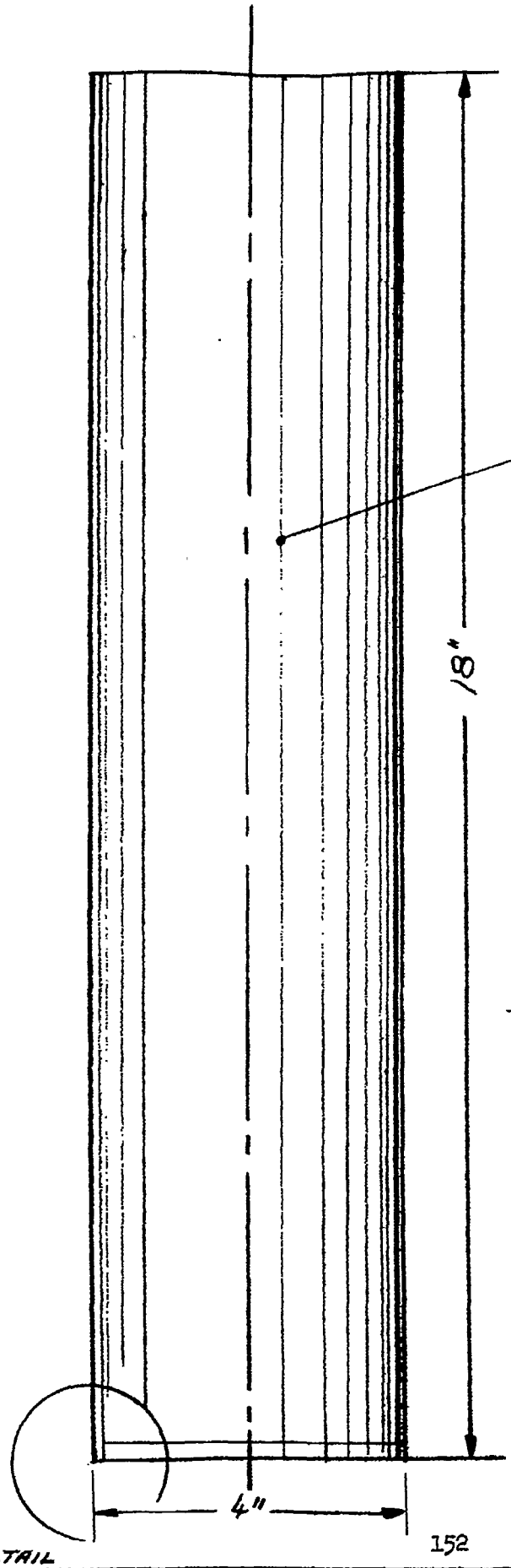
the 100 mesh to obtain the per cent of residue in the minus 35 mesh fraction.

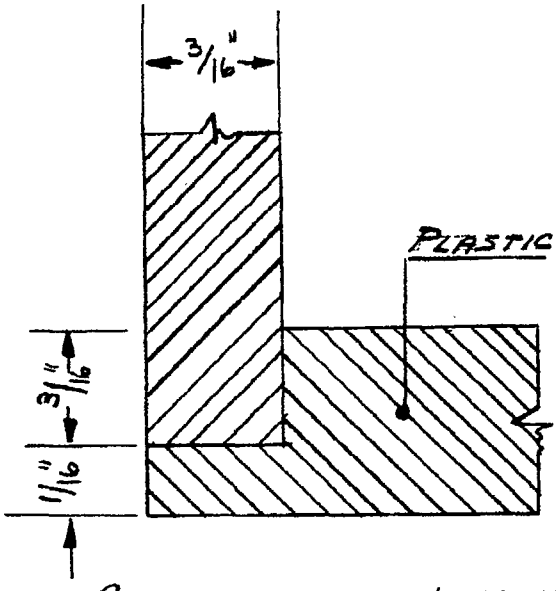
Results

5. (a) The total percentage of residue will be reported as three test results and their average.

This percentage is an indication of the grit and spicule content of the sample tested.

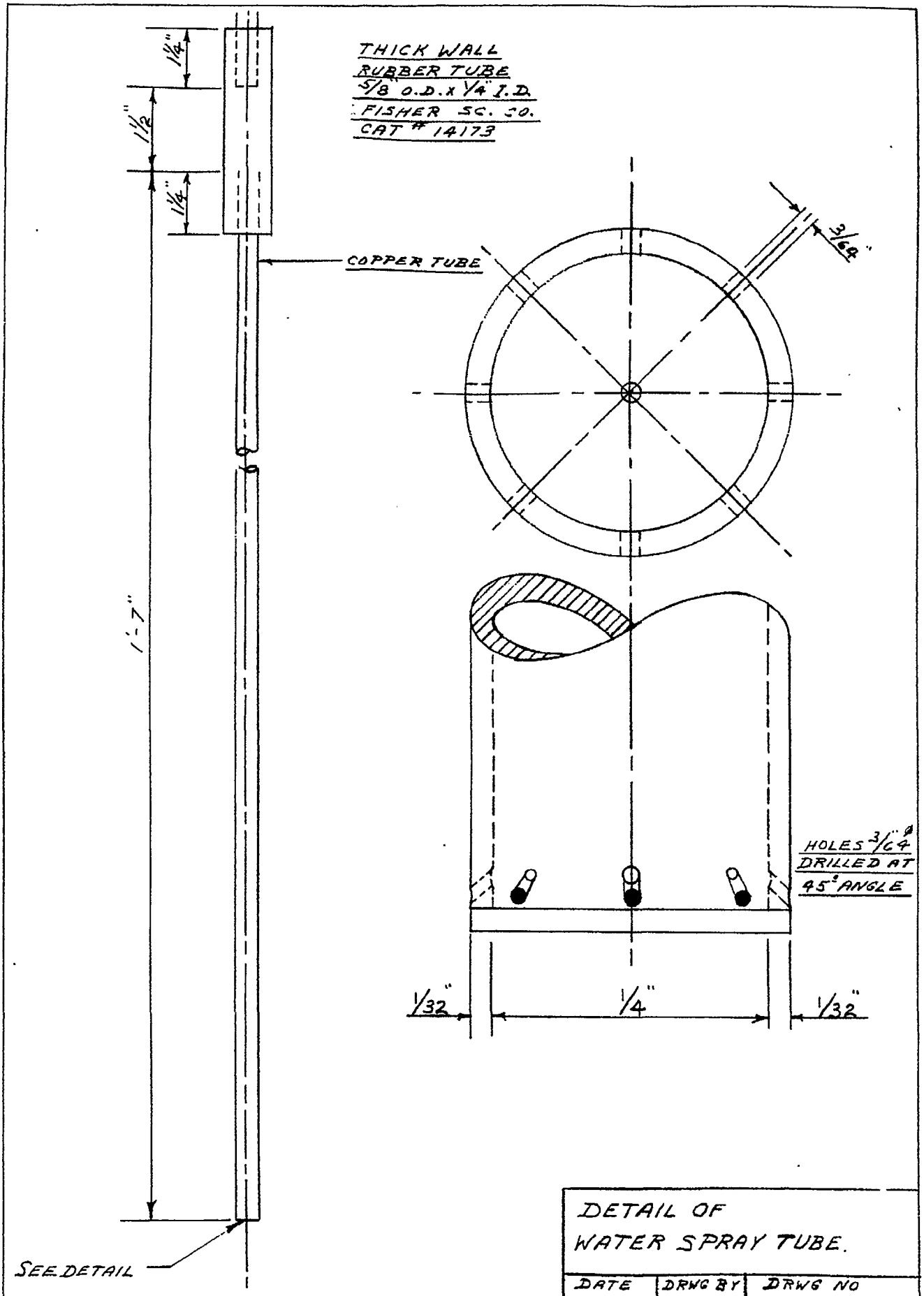

PRESSURE GAUGE
A6765
WATER SUPPLY.
CONTROL VALVE
A6764
A6732
FOR FUTURE INSTALLATION
FLOWMETER
1/4" STREAMLINER
A6769
FLEXIBLE JOINT
COPPER TUBE 1/4" I.D.
SEE DRWG # L 572-C
BROOK ROTAMETER 6
LANSDALE P.A.
FLOWMIZER
TYPE 10-40
SIZE - B.
PLASTIC CYLINDER (4" O.D.)
SEE DRWG # L 572 B
ENCIRCLED NUMBERS - ALL TAKEN IN
WEATHERHEAD CAT # 630 PAGE 18
THE WEATHERHEAD CO. ST-THOMAS, ONT.
FLOW THROUGH FLOWMETER
DIRECT FLOW
GRIT TEST
GENERAL ARRANGEMENT
J.A.G.M.
JULY-27-65
DRWG # L 572-A





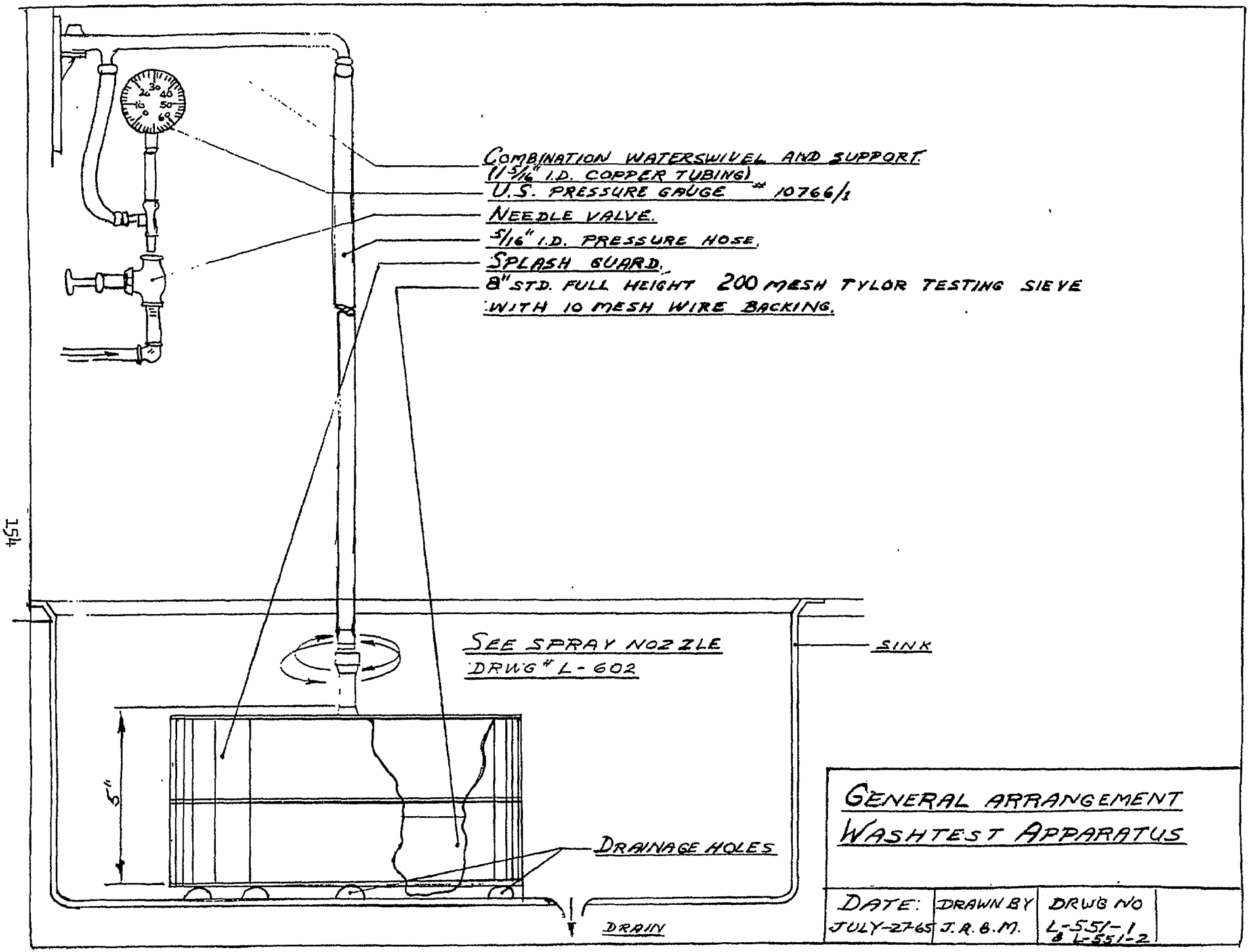
GLUED WITH TENSOL'S CEMENT
NO-7- I.C.I. WELWYN GARDEN

DETAIL SEPARATING VESSEL		
DATE	DRWG BY	DRWG NO
JULY-2446	J.A.G.M.	L-S.72-B



DETAIL OF
WATER SPRAY TUBE.

DATE	DRWG BY	DRWG NO
JULY 26-65	J.A.G.M.	L-572-C



154

GENERAL ARRANGEMENT
WASHTEST APPARATUS

DATE:	DRAWN BY	DRWG NO
JULY-27-65	J.R.B.M.	L-551-1 & L-551-2

TESTING PROCEDURES

FOR

CHRYSOTILE ASBESTOS FIBRE

(Second Edition)

F-1

DETERMINING THE TENSILE STRENGTH OF ASBESTOS FIBRE

Printed in U.S.A.

Revised and adopted by:

ASBESTOS TEXTILE INSTITUTE - 9/10/59
MINERAL FIBER PRODUCTS BUREAU -
QUEBEC ASBESTOS MINING ASSOCIATION -

F-1

TENSILE STRENGTH

Scope

1. This method of test covers a procedure for determining the tensile strength of asbestos fibre, expressed in grams per denier, where a denier is defined as the weight in grams per 9000 meters of length.

Apparatus

2. (a) The apparatus shall consist specifically of the parts described in paragraphs (b) to (i).

(b) Tensile Tester - The tensile tester shall be a vertical pendulum type with capacities of zero to ten pounds and zero to 20 pounds and shall have a constant rate of traverse of 12-inches per minute.

(c) Balance - The balance shall be capable of weighing ten milligrams to the closest 0.01 milligram.

(d) Mounting Cards - The mounting cards shall be constructed of cardboard approximately 0.01-inch thick and shall conform to the design shown in Figure 1.

(e) Cutter - The cutter shall consist of two razor blades mounted 1.00 plus or minus 0.02 centimeter apart.

(f) Scale - The scale shall be at least ten centimeters in length and shall be graduated to 0.02 centimeters or less.

(g) Cement - Epoxy resin. Mix two parts by weight of Araldite 502 resin with three parts by weight of ASP 400 clay. Blend 25 parts of this mix with one part by weight of HN 951 hardener and sufficient ASP 400 clay to give a high consistency.

Note: The Araldite 502 resin and the HN 951 hardener are supplied by CIBA Products Company, Kimberton, Pa.; the ASP 400 clay is supplied by Minerals and Chemicals Company, Menlo Park, New Jersey.

(h) Tweezers.

(i) Dissecting Needle.

Sampling of Asbestos Fibres

3. The sampling shall be conducted in accordance with the Standard Sampling and Preparation Procedure for Asbestos Fibre.

Procedure

4. (a) Size of Sample - The weight of sample used for this test shall be approximately 100 grams.

(b) Selection of Fibre Bundles for Test - The 100 gram sample shall be divided into eight equal portions and five fibre bundles shall be selected from each portion.

Note 1: In the evaluation of crudes preferably ten to 20 pieces of crude shall be selected and an equal number of fibre bundles shall be removed from each piece so that a total of 40 bundles are obtained.

Note 2: The fibre bundles shall be continuous and free of faults, as determined by visual inspection, and shall have a length of at least 1.5 centimeters and a weight of at least one milligram.

(c) Preparation of Fibre Bundles for Test - Each of the 40 fibre bundles shall be cut to a length of 1.00 plus or minus 0.02 centimeter and shall be dissected until the weight is 0.50 plus or minus 0.05 milligram. The length of each specimen shall be checked with a scale and the weight of each specimen shall be recorded to the closest 0.01 milligram.

Each specimen shall be placed on a mounting card so that it lies across the center of the slit perpendicular to the long dimension and shall be attached at the ends with cement. The cement shall be allowed to cure for a minimum of 16 hours at room conditions not in excess of 80 degrees Fahrenheit.

Note 3: The resin cure can be accelerated by heating, but the resultant wicking action causes the fibre specimens to become brittle.

(d) Tensile Strength Test - Each mounted specimen shall be placed between the grips of the tensile tester and the mounting card cut through to the slit on both sides. The tensile tester shall then be set in operation and the breaking load recorded to the closest 0.1 pound.

Calculation and Report

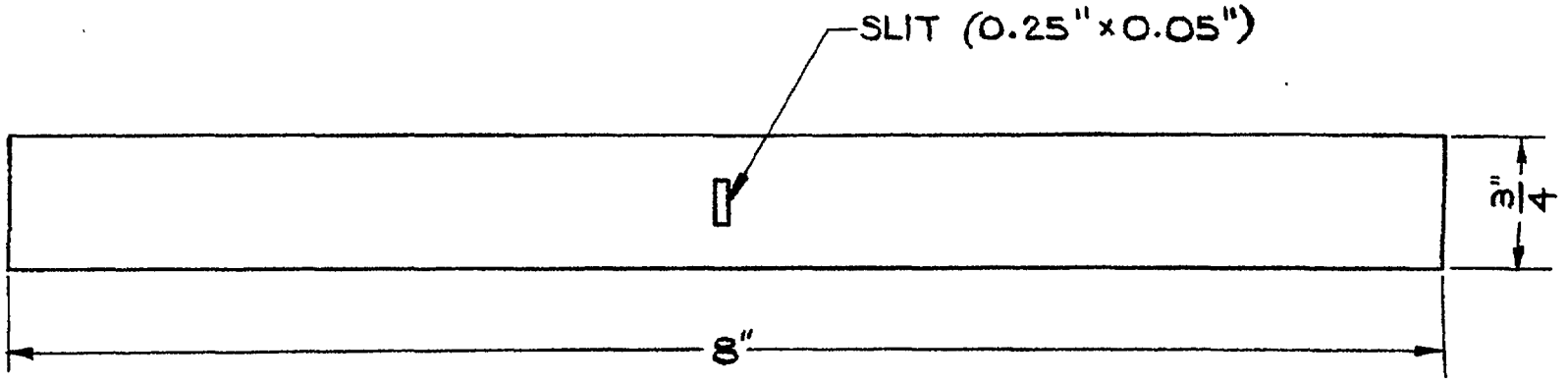
5. (a) The tensile strength of each of the 40 specimens shall be calculated to the closest 0.1 gram per denier using the following equation.

$$\text{Tensile Strength} = (\text{load}) / (1.98)\ (\text{weight})$$

where

load = breaking load of specimen in pounds
weight = weight per unit length of specimen in milligrams per centimeter.

(b) Report the average tensile strength of the 40 specimens to the closest 0.1 gram per denier.



CARDBOARD MOUNT FOR TENSILE STRENGTH

FIGURE 1

TESTING PROCEDURES

FOR

CHRYSOTILE ASBESTOS FIBRE

(Second Edition)

F-2

FIBRE STRENGTH UNIT TEST

Printed in U.S.A.

Revised and adopted by:

ASBESTOS TEXTILE INSTITUTE -
MINERAL FIBER PRODUCTS BUREAU - 2/14/61
QUEBEC ASBESTOS MINING ASSOCIATION - 2/23/60

F-2

STRENGTH UNIT

Scope

1. This procedure is for determining the strength giving properties of specific grades of asbestos fibres in asbestos-cement products.

Apparatus

2. Photographs illustrating the test apparatus are shown in Figures 1 and 2.

Fibre Preparation

3. Fibre being evaluated shall be tested in an open condition.

   (a) Opening Procedure

      (1) Ball Milling Operation - Three hundred (300) grams of fibre are placed in a procelain ball mill.

      Successive use of several sets of balls is desirable in order to enable the operator to use the ball mill continuously. The balls are removed from the ball mill with the fibre and brushed or wiped clean of fibre while a duplicate set of balls is being used in the mill.

Fibre charge	300 grams
Ball charge	6 kg
Number of balls	80 (approx.)
Speed of rotation	65 rpm
Milling time	Samples shall be ball milled for that time which ultimately gives the highest strength to the asbestos-cement cakes.*

      Balls are to be discarded and replaced when their diameter is 35 mm or less.

* For chrysotile fibre from the Jeffrey and Thetford areas, 60 min. ball milling time has been found by testing to give the highest strength to the asbestos-cement cake.

(2) Disintegrator Operation - After ball milling the fibre is passed twice in succession through the small laboratory disintegrator, as specified.

The 300 grams of ball milled fibre are fed by hand through the disintegrator. The fibre sample should be fed into the disintegrator in about 1-1/2 to 2 minutes at a reasonably steady rate so as to maintain a relatively constant disintegrator speed.

The following perforated steel plates should be used with the various fibre grades:

Fibre Grade	Diameter of Holes in Perforated Plates
3	10 mm
4	7 mm
5	5 mm
6	3 mm

After each disintegration, the apparatus should be cleaned. After the first disintegration, any bundles of fibre which have flocked together shall be separated by hand before the second disintegration. After the second disintegration the fibres which have flocked together and remain within the steel housing shall be removed and discarded.

(3) Fibre Mixing - After the second disintegration the fibre shall be mixed in a tin mixing can. The mixing can is rotated on a roll table for 10 minutes at a speed of 56 rpm.

Asbestos-Cement Sample Procedure

4. (a) Equipment - The major items of equipment are given below:

(1) Weighing - A scale or balance capable of weighing to the nearest gram is used for dry mix preparation. A scale capable of weighing to the nearest 0.1 gram is used to obtain volume and dry weights of individual asbestos-cement cakes after curing. The latter scale must be of a design to permit weight measurement of an individual cake when completely immersed in water.

(2) Dry Mixing - Dry mixing of the asbestos and cement binder constituents is done in a special mixing can. For dry mixing, a roll table or equivalent equipment for rotating the mixing cans at 78 rpm is required.

(3) Wet Mixing - Wet mixing shall be with the mixer and cone conforming to specifications. The agitator shall rotate at 600 rpm in the axis of the cone. The agitator shall be placed as closely as possible to the bottom of the cone without touching it during rotation.

(4) Pressing - The press must be capable of applying a pressure sufficient to obtain with 145 grams of dry stock (and water of hydration), a dry (cured cake) density of 1.60 gm/cm^3. Testing experience has shown that a total gauge pressure of 34,000 pounds between platens is required.

The press assembly is designed for pressing a cake to a constant thickness of 6 mm which produces a density of approximately 1.6 gm/cm^3. This is done by using stop gauge bars to maintain a constant clearance between the bottom of the top die and the base of the confining mold during forming of the cake (dwell time). The press assembly is designed for clearance of less than 6 mm to allow for the effect of "springback" and to produce a final cured cake thickness of 6 mm (of the desired constant density).

The recommended press assembly consists basically of the following parts in the order of their vertical position from the top:

(i) Device for Holding and Lowering the Confining Mold - This consists of a cylinder and piston (mounted on the upper cross-head of the press) with a yoke attached to the top of the piston. The side rods of the yoke project through the press cross-head connection to the confining mold. In addition, an L-shaped frame, pivoted centrally from the lower part of the cylinder, supports the piston and yoke during removal of the cake from the confining mold.

(ii) Top Platen - This includes the top die mounted on springs against a supporting plate (above) and gauge bars surrounding the top die, rigidly fixed to the supporting plate.

(iii) Confining Mold - The top die shall fit into the confining mold (during formation of each cake) with a clearance on four sides with a minimum of 0.051 mm to a maximum of 0.152 mm in order to allow seepage of surplus water during initial compression of the slurry.

The top inside edges of the confining mold are rounded to facilitate initial contact with the top die.

(iv) 40-mesh copper wire screen.

(v) 15-mesh brass wire screen.

(vi) Perforated steel plate.

(vii) Grooved bottom platen.

(viii) Platen base.

(5) Suction System - A suction system is used to provide a way to remove the water collected on the top of the mold during pressing. A thin tubular metal nozzle connected by rubber tubing to a receiving vessel (vacuum flask) is used to remove the water.

(6) Moist Air Cabinet - A humidity cabinet for moist curing of cakes after forming.

(7) Steam Cure Tank - An autoclave and controls required for curing cakes after moist cure.

(8) Saturating Tank - A suitable tank for saturating one day's production of cakes is required.

(9) Drying Oven.

(10) A Testing Machine for transverse center loading of the samples to destruction is required.

(11) Micrometer.

(b) Raw Materials - It is important that a large quantity of Portland cement and finely ground silica be obtained in order to provide a constant source of these materials for fibre evaluation for a minimum period of one year. It is essential that the properties of these materials remain constant in order to avoid differential effect of these materials on the ultimate strength of the asbestos-cement samples, independent of the effect of fibre on strength.

(1) Portland Cement.

(2) Silica - (Finely ground quartz).

(3) "Prepared" Water - The water used in the preparation of the samples shall be distilled water saturated with lime and gypsum (chemically pure). This water will be prepared by adding 2 grams of hydrated lime and 3 grams of gypsum ($Ca\ SO_4 \cdot 2\ H_2O$) per liter. It shall be allowed to stand for 24 hours (agitating water from time to time), after which it is siphoned off into a clean bottle.

(c) Preliminary Steps

(1) Preparation of the Perforated Plate and Screens - The screens and plate should be cleaned before the forming of each cake, using running water and a stiff bristle brush. The screens are then brush-coated with a very light machine oil (Socony-Vacuum 133B Process Oil or the equivalent; if this is not available, a mixture of 10 parts kerosene to 1 part raw linseed oil is satisfactory). The screens and plate are then placed under the confining mold on the bottom platen ready to receive the slurry.

(2) Preparation of the Mold and Die - The mold and die should be brushed with the oil or linseed oil-kerosene mixture before the forming of each cake.

(d) Cake Formation - Evaluation of one fibre sample shall consist of forming and testing of ten 206 x 76.2 x 6 mm asbestos-cement cakes.

(1) Batch Formulation - Quantity of dry mix (1700 grams) sufficient to prepare at least 11 test cakes* (145 grams per cake) is mixed according to a predetermined proportion based on empirical results and the chosen strength standard.

To calculate the quantity of each material used in the mix for each cake (145 grams of dry mix), the following formulas are used:

$F\ (fibre) = 145 \times Q_f$ = fibre weight in grams

Where Q_f = ratio of fibre weight to total dry mix weight.

* This allows sufficient dry mix for forming one more cake than the required 10 in case of accidental damage to one cake during forming.

C (cement) = 0.6 (145 - F) = cement weight in grams

S (silica) = 0.4 (145 - F) = silica weight in grams

F + C + S = 145 grams

(2) Dry Mixing - The dry stock should be mixed for 5 minutes in the specified mixing cans at 78 rpm. After mixing the stock is transferred from the mixing can to a jar or bag with as little vibration or agitation as possible so as to prevent any separation of constituents within the batch.

Prior to weighing the 145 grams of dry stock, the entire stock of 1700 grams is placed on a 3 ft x 3 ft polyethylene or similar sheet and rolled by taking opposite ends of the sheet using two rolls per end for a total of 4 rolls. Repeat this rolling technique before taking each 145 grams of stock.

(3) Slurry Preparation - After rinsing the mixing cone a rubber stopper is inserted at the bottom and 410 cc of prepared water at 74°F are poured into the cone. An additional 40 cc of the prepared water will be added to wash down the cone and stirrer after the stock has been added. 145 grams of dry stock are added and the mixer is started. The timing is continuous from this point, the time at which the mixer is started being zero.

(4) Mixing - (Time 0 to 2 minutes) The stirrer shall rotate at 600 rpm during the mixing.

(5) Transfer of Slurry - (Time 2 to 2-3/4 minutes) Initially the confining mold is resting on the screens on top of the bottom platen which is pulled forward on the platen base to facilitate transfer and distribution of the slurry. The yoke (and piston) for holding the confining mold is in the bottom position. At the end of the second minute (after mixing) the slurry is poured from the bottom of the mixing cone into the mold, using the chute. A rubber spatula and hoe are used to scrape the slurry remaining in the chute into the mold and to distribute the slurry evenly in the mold.

(6) Dewatering of the Cake - (Time 2-3/4 to 4-1/2 minutes) After removal of the chute and mixing assembly, the confining mold and the bottom platen together are pushed back beneath the top die so that the confining mold hooks contact the yoke rods between the set screw collars.

The cycle is started by opening the safety switch and closing the foot switch. The low pressure timer is activated. Timing is controlled by turning the low pressure relief valve handle counterclockwise to obtain minimum pressure. (Zero pressure reading on the gauge). The valve handle should be given one additional turn after the zero reading is obtained. At this setting the top die will contact the slurry in from 9 to 10 seconds. In other words, the rate of rise is approximately 0.2 inches per second (5mm/sec.). When the top die is in contact with the slurry, water is forced out through the screens and between the mold and the die. Water pressed from the cake is drained from the platen base into a settling tank to prevent clogging of the laboratory drain. The water between the mold and the die is drawn off through the automatic vacuum system. As a result, the operation is now automatic until the end of the dwell time cycle and the operator can now make preparations for the next sample to be pressed.

(7) Applying Forming Pressure - (Time 4-1/2 to 5 minutes) After the dewatering interval, Timer No. 1 automatically shuts off and Timer No. 2 starts building up to the required high pressure. This rate of pressure rise is controlled by adjusting the micrometer valve.

(8) Dwell Time - (Time 5 to 6 minutes) A total pressure of 34,000 pounds (gauge) is automatically maintained by Timer No. 2 for one minute. This pressure is maintained by the value set on the high pressure relief valve.

(9) Removing the Cake from the Confining Mold - At the end of the dwell time interval the motor automatically stops and the Waterman No. 2 valve opens permitting the ram to drop to the desired distance to remove the cake. This distance is controlled by closing the toggle switch. The top die is forced away from the supporting plate of the top platen by springs. At the same time since the confining mold is supported rigidly by the holding device, the top die passes through the confining mold, exposing the cake for removal. A flat asbestos-cement or Lucite plastic sheet approximately 9 x 22 cm is put on top of the screens on the bottom platen to receive the sample. Asbestos-cement sheets, if used, should be coated or partially impregnated with an alkali resistant moisture proofing compound such as an epoxy resin. The maximum recommended clearance between the bottom of the cake and the top surface of the asbestos-cement sheet should be 1/4 in. in order to minimize the distance required for the cake to drop.

If the cake does not fall of its own accord, it is carefully stripped from the die by inserting a thin spatula between the cake and the die. The asbestos-cement or plastic sheet with the cake on top is removed from the press and the rough edges smoothed by the spatula. The cake is numbered for identification. Clean the screens and the perforated plates and place on the grooved platen for the next test. The confining mold is lowered onto the screens by releasing the holding device.

After formation of each cake, remnants of the slurry should be wiped from the confining mold and the die with emphasis on the grooves on the sides of the die in order to prevent clogging of the automatic vacuum system. The water removal system must be kept clean if reproducible results are to be obtained.

The above procedure is repeated for each cake. At the end of each day's operation the equipment should be thoroughly cleaned and oiled.

(e) Cake Curing

(1) Moist Cure - Immediately after forming one set of ten the cakes on the flat asbestos-cement supports are stacked one on top of the other in groups of ten in the moist cure cabinet. The minimum period of moist cure is 16 hours. This will increase somewhat, depending upon when the sample was made.

(2) Steam Cure - After removing the asbestos-cement sheets from between the cakes, the cakes are transferred from the moist cure cabinet to a flat rack on which they are stacked side by side between pegs in groups of five. It is important to lean each cake against the cake next to it, allowing a slight space between cakes at the bottom edge. The rack is placed in the autoclave with a large asbestos-cement sheet completely covering the rack to prevent condensed water from dripping on the cakes during cure. The autoclave is sealed and the steam pressure raised immediately to curing pressure.

Cakes made on the same day should be steam cured at the same time. The actual period of steam cure is 20 hours at 7.03 kg/cm^2 (100 psi).

(3) Saturation - After steam curing the samples shall be immersed in water for 24 hours at a temperature of approximately 75°F. Cakes should be stacked on edge with the top edge approximately 25 mm or 1 in. below the water surface.

(f) Cake Testing - The order of sample testing shall be as follows:

a. Determine volume by displacement of saturated sample.
b. Determine saturated weight (in air).
c. Determine saturated transverse strength.
d. Determine specimen thickness.
e. Determine dry specimen weight.

(1) Volume - The sample volume shall be determined by weighing each saturated cake completely immersed in 75°F service water drawn fresh each day. The difference in weight between the saturated weight in air and the immersed weight equals the volume in cubic centimeters.

(2) Saturated Weight - Cakes shall be removed from the water one at a time and immediately wiped free of excess surface water by means of a slightly wet cloth, the excess water of which has been driven off by wringing, and then weighed to 0.1 gram. The cakes are now covered with a damp cloth until the transverse testing is begun. Remove one cake at a time for test, keeping the others covered by the damp cloth.

(3) Transverse Testing - Each saturated cake is then broken in flexure as a simply supported beam with the center load being applied across the entire width to the smooth (top) side. A 15.2 cm span shall be used and the loading rate shall average 36 kg/minute.

(4) Sample Dimensions

(i) Thickness shall be measured at three points across the width of the cake directly at the break. Individual thickness values shall be recorded to the nearest .01 mm.

(ii) Cake width shall be considered a constant value.

(5) Drying - After the samples are broken they shall be dried for 24 hours at 220 to 230°F.

(6) Dry Weight - The dry sample weights shall be recorded to 0.1 gram.

Calculation

5. The following theoretical calculations shall be made for each individual cake tested.

(a) Dry Density

$$\frac{\text{Dry Cake weight in grams}}{\text{Cake volume in cc}} = \text{Density in gm/cm}^3$$

Volume = Saturated Weight - Immersed Weight in Grams

(b) Transverse Strength

Modulus of Rupture

$$MR = \frac{3}{2} \frac{Pl}{b\ t^2}$$

P = breaking load in kg
b = width in centimeters = 7.62 cm
t = thickness at break in cm
l = span = 15.2 cm

$$MR_T = \frac{(3)\ (P)\ \ 15.2}{(2)\ (7.62)\ (t^2)} = \frac{(3)\ P}{t^2} \text{ kg/cm}^2 \text{ (Equation \#1)}$$

Example:

For a cake with a 40 kg breaking load and a thickness of 0.600 cm

$$MR_T = (3)\ \frac{40}{0.36} = 333 \text{ kg/cm}^2$$

(c) Correcting Modulus of Rupture (Unit Strength) to Common Density - To adjust all MR values to a common density and thus eliminate small differences in unit strength values due to differences in density, the following calculations should be performed. The common (standard) density of 1.60 gm/cm3 has been chosen as standard:

$$MR_A = \frac{(1.60)^2\ (MR_T)}{(\text{Dry density of test cake})^2} \qquad \text{(Equation \#2)}$$

where:

MR_A = MR at 1.60 gm/cm3

MR_T = MR from test results

Example:

For a dry cake density of 1.58 gm/cm3 and MR_T of 333 kg/cm2

$$MR_A = \frac{(1.60)^2}{(1.58)^2}\ (333) = 341 \text{ kg/cm}^2*$$

* Since this strength exceeds the allowable range described in Section 5, it should be rerun at a lower fibre content.

Any individual value MR_A varying from the average by more than 7.5 per cent of the average (including ten results) shall be eliminated and a new average strength calculated.**

(d) Reference Strength Level - A standard reference strength for the asbestos-cement samples has been taken as 275 kg/cm^2 at a dry cake density of 1.60 gm/cm^3.

(e) Calculating Fibre Content to Give Standard Strength - The fibre content of the mix should be chosen so that the average MR_A lies somewhere between 261-288 kg/cm^2. If the MR_A exceeds this range, a new series of test specimens should be prepared at a higher or lower fibre content as required.

The MR_A value of the test sample will usually vary somewhat from the standard reference strength, and the fibre content of the mix must be altered slightly to attain the proper strength level. Experience has shown that this correction is most easily made by assuming a linear relationship between MR_A and the ratio of fibre weight: dry mix weight - fibre weight. Mathematically this may be expressed as follows:

$$\frac{(F_T)}{(145-F_T)} \frac{(275)}{(MR_A)} = \frac{(F_A)}{(145-F_A)} \qquad \text{(Equation \#3)}$$

where the total mix weight per cake is 145 grams and

F_T = weight of fibre in grams per cake as tested

F_A = adjusted fibre weight in mix so as to give standard strength

hence:

per cent fibre required in mix to give standard strength

$$= \frac{F_A}{145} \times 100$$

** If more than three such samples vary from the average of 7.5 per cent the whole test will be repeated.

or from Equation #3

$$\text{per cent fibre required in mix} = \frac{(275\ F_T)\ \ (100)}{MR_A\ \ (145-F_T) + 275\ F_T}$$

(Equation #4)

This may of course be expressed in terms of the per cent fibre present in the original mix as tested. For example, in these terms Equation #4 becomes

$$\text{per cent fibre required in mix} = \frac{(275\ Q_f)\ \ (100)}{MR_A\ \ (1.00-Q_f) + 275\ Q_f}$$

(Equation #5)

where: Q_f = ratio of fibre weight to total dry mix weight

Either Equation #4 or Equation #5 may be used to calculate the fibre content required to give standard strength.

(f) Calculation of Strength Units - Asbestos fibre possesses the ability to impart strength to an asbestos-cement product. That is to say, every fibre grade contains a certain quantity of strength giving units. The quantity of fibre required in an asbestos-cement furnish varies inversely with the number of strength units it possesses. For example, if X amount of a fibre possessing 100 strength produces a product of a given strength, 2X would be required to produce the same product from a fibre possessing only 50 strength units.

The following definition is the basis for the strength unit test:

A fibre that gives the standard strength at the standard density when used as 10 per cent of the furnish is defined as having 100 strength units.

Therefore, by knowing the per cent fibre required in the mix to give standard strength, it is possible to calculate the strength units as follows:

$$\text{strength units} = \frac{1000}{\%\ \text{fibre required in mix}} \qquad \text{(Equation \#6)}$$

(g) Typical Analysis of Data

Mix Composition

$Q_f = .125$

F_T = fibre weight in grams/cake = (145) (.125) = 18.1 g

C_T = cement weight in grams/cake = (0.6) (145-18.1) = 76.1 g

S_T = silica weight in grams/cake = (0.4) (145-18.1) = 50.8 g

Total weight/cake in grams = 145.0

Average Strength Data

P = breaking load = 31 kg

T = thickness at break = 0.600 cm

Density = 1.58 gm/cm^3

Calculations

$$MR_T = \frac{3P}{T^2} = \frac{(3)\ (31)}{(.6)^2} = 258 \text{ kg/cm}^2 \qquad \text{(Equation \#1)}$$

$$MR_A = \frac{(1.60)^2\ (MR_T)}{\text{Density}^2} = \frac{(1.60)^2\ (258)}{(1.58)^2} = 265 \text{ kg/cm}^2 \qquad \text{(Equation \#2)}$$

$$\text{per cent fibre required} = \frac{(275)\ (FT)\ (100)}{MR_A\ (145-F_T) + 275\ F_T} \qquad \text{(Equation \#4)}$$

$$= \frac{(275)\ (18.1)\ (100)}{(265)\ (145-18.1) + (275)\ (18.1)} =$$

$$\frac{497{,}750}{33{,}600 + 4{,}980} = \frac{497{,}750}{38{,}580} = 12.9\%$$

or using (Equation #5)

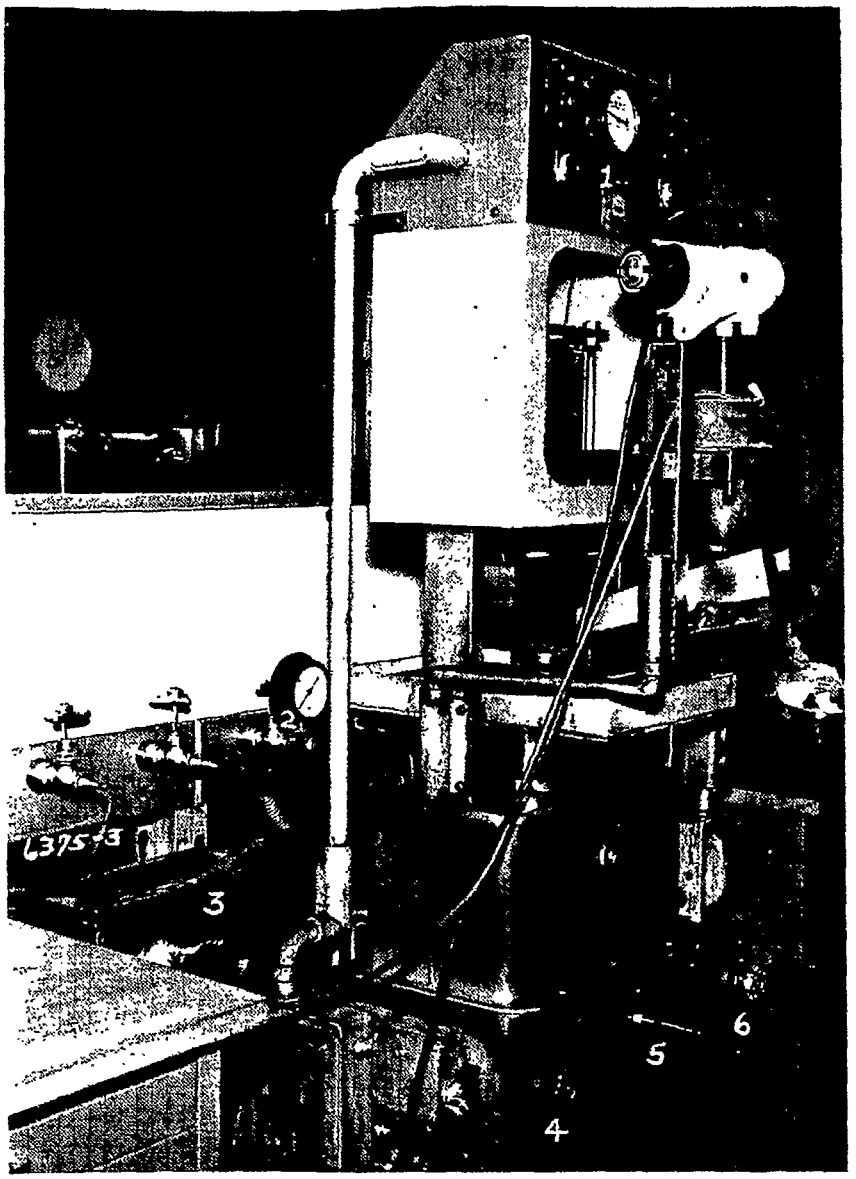
$$\text{per cent fibre required} = \frac{(275)\ (.125)\ (100)}{(265)\ (1-.125) + (275)\ (.125)}$$

$$= \frac{3437.5}{232.0 + 34.4} = \frac{3437.5}{266.4} = 12.9\%$$

$$\text{Strength Units} = \frac{1000}{12.9} = 78 \qquad \text{(Equation \#6)}$$

FIGURE 1

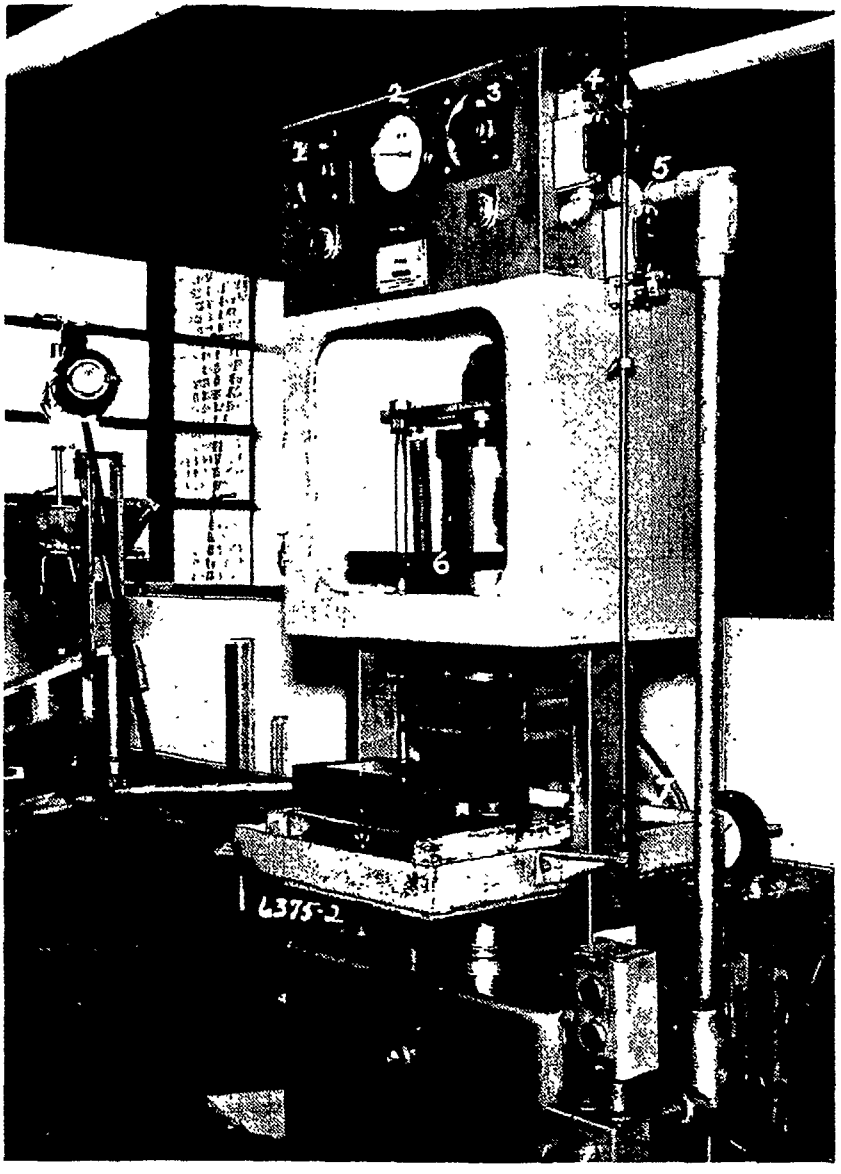
THE SEMI-AUTOMATIC PRESS



1. Toggle switch
2. Vacuum gauge
3. Settling tank
4. Low pressure control valve
5. Dump valve
6. High pressure control valve

FIGURE 2

THE SEMI-AUTOMATIC PRESS



1. Low pressure timer (No. 1)
2. High pressure gauge
3. High pressure timer (No. 2)
4. Lower limit switch
5. Top limit switch
6. Confining mold drop lever
7. Vacuum line
8. Safety switch

(The foot switch is not shown)

TESTING PROCEDURES

FOR

CHRYSOTILE ASBESTOS FIBRE

(Second Edition)

F-3

STRENGTH IN ASBESTOS-CEMENT PRODUCTS

Printed in U.S.A.

Revised and adopted by:

ASBESTOS TEXTILE INSTITUTE -
MINERAL FIBER PRODUCTS BUREAU - 9/14/60
QUEBEC ASBESTOS MINING ASSOCIATION -

F-3

STRENGTH IN ASBESTOS-CEMENT PRODUCTS

Scope

To determine the reinforcing value of asbestos fibres in asbestos-cement relative to a fibre chosen as "standard."

Apparatus

1. Mixing Equipment - Patterson-Kelley Model LB-558 laboratory blender complete with two one-quart and one two-quart plastic shells.

2. Vacuum System - As detailed in Figure No. 1.

3. Vacuum Pump - "Cenco Pressovac 4" or equivalent. An air aspirator (as detailed in Figure No. 2), connected to a compressed air line through a pressure reducing valve, may be used in place of the vacuum pump.

4. Mold Assembly - As detailed in Figure No. 3.

5. Hydraulic Press - 10-ton Carver, laboratory model.

6. Humidity Cabinet - Designed for saturated atmosphere at ambient temperature. (A Harshaw No. H-18877 Stainless Steel desiccating cabinet has been found satisfactory for this purpose).

7. Laboratory Autoclave - Capable of maintaining a saturated steam pressure of 125 pounds per square inch gauge.

8. Drying Oven - Standard gravity convection type, capable of maintaining 220 degrees Fahrenheit plus or minus 5 degrees.

9. Flexural Tester - With five inch span and capable of close readings in the zero to 300 pound range. (A 300 pound proving ring assembly with continuous reading dial, used in conjunction with a Carver press, has been found preferable to other testing devices).

10. Laboratory Balance - Capable of weighing 500 grams to 0.1 gram.

11. Graduated Cylinder - 1000 ml capacity.

12. Filter Paper - 15 cm circular, Whatman No. 40 and Whatman No. 50.

13. Beaker - 5500 ml, stainless steel.

14. Plexiglas Squares - 7 inches x 1/8 inch thick.

15. Glass Jars - Wide mouth, screw cap, 32 ounce capacity.

16. Spatula - Stainless Steel, with narrow blade.

17. Thermometer - Range minus 4 to plus 220°F in two degrees.

18. Stop Watch

Raw Materials

1. Obtain 1000 pounds each of Portland cement and 90-200 mesh pulverized silica. These materials, which will serve as standards, should be thoroughly mixed and stored in air-tight containers.

2. Obtain 250 pounds of asbestos fibre (preferably an asbestos-cement 3-grade) and prepare in an appropriate manner. This fibre, which will serve as the standard, should be thoroughly mixed before and after processing and should be stored in a dry place in clean cloth sacks.

3. For each fibre to be evaluated, obtain the sample by the "Method of Sampling and Preparation of Asbestos Fibres for Test Purposes."

Sample Preparation

1. For each evaluation, premix 1290 grams of cement and 860 grams of silica in the two-quart shell by rotating in the blender for 15 minutes. This cement-silica mixture, which will be sufficient for a 15 sample evaluation, should be stored in air-tight containers until needed.

2. Prepare three cakes each of the following compositions using the standard fibre (weigh to the closest 0.1 gram):

   3% Fibre - 4.5 grams fibre, 145.5 grams cement-silica mix
   9% Fibre - 13.5 grams fibre, 136.5 grams cement-silica mix
   15% Fibre - 22.5 grams fibre, 127.5 grams cement-silica mix

   Also prepare six cakes of the following composition using the fibre to be evaluated (weigh to the closest 0.1 gram):

   15% Fibre - 22.5 grams fibre, 127.5 grams cement-silica mix

The order of making should be staggered by preparing one cake each of 3%, 9% and 15% standard fibre followed by two cakes of the unknown, with this order being repeated until a total of 15 samples has been prepared.

3. Using the one-quart shells, dry mix the materials for each cake by rotating in the blender for five minutes and then add to 600 ml of tap water (at 77°F ± 3°) and wet mix for an additional five minute period. (It is found desirable to reserve one of the shells for dry mixing only, using the other for the wet mixing operation. Further, as a matter of convenience, the materials for one sample can be wet mixed while those for the next are being dry mixed). Be certain that both shells are thoroughly cleaned after each use.

4. During the mixing operation, fit the Buchner funnel with a sheet of Whatman No. 40 filter paper, wetting the paper to position it firmly. Then level the funnel by eye.

5. With the stopcock between the filter flask and vacuum source closed, adjust the vacuum to 16 inches of mercury.

6. When mixing is complete, swirl the shell vigorously to maintain a uniform slurry concentration and pour the material into the Buchner funnel.

7. When all of the slurry has been transferred, apply the vacuum noting the time. (A stop watch is recommended for all time schedules).

8. Rock the funnel continually during filtration to distribute the fibre.

9. As soon as the water has been drawn off (as indicated by a decrease in vacuum) again note the time. The number of seconds from vacuum application to this point is recorded as the filtering time.

10. Continue vacuum application for 30 seconds to draw off any water remaining in the bottom of the Buchner.

11. Remove the funnel from the flask, place a sheet of Whatman No. 50 filter paper on the cake, invert the funnel and remove the cake onto a tared Plexiglas square.

12. Remove the Whatman No. 40 from the cake bottom and replace it with a sheet of No. 50.

13. Then weigh the cake (to the closest 0.1 gram) on a balance tared for the Plexiglas and the two sheets of No. 50 filter paper.

14. Carefully place the mold over the cake, then invert so that the cake falls into the mold. This places the original bottom of the sample on the bottom of the mold with a sheet of Whatman No. 50 filter paper on each side.

15. Insert the plug into the mold, invert so that the plug is on the bottom, and place the assembly in the press. Apply pressure at a uniform rate such that a total load of 14,150 pounds is obtained over a 30 second period.

16. Allow the cake to compact for 30 seconds and then release the pressure.

17. Remove the mold from the press. Then remove the plug from the mold and run the spatula around the edge of the cake to free it.

18. Invert the mold on a Plexiglas square to remove the cake, peel off the upper filter paper, place the tared Plexiglas on top, invert, and peel off the bottom filter paper.

19. With the spatula smooth outwards any extruded flash from the pressing operation.

20. Then weigh the cake (to the closest 0.1 gram) on a balance tared for the Plexiglas.

Curing Cycle

1. When the series of cakes is finished, store the stack in the humidity cabinet with a Plexiglas square on the bottom and top and between each sample.

2. After 24 hours, remove the cakes from the humidity cabinet and autoclave for 20 hours using saturated steam at 125 pounds per square inch gauge. (Relative to autoclaving, the system should be purged of air prior to the start of the steaming cycle and the charging and blow-down operations should be performed slowly over approximately 15 minute periods.

3. Finally rack the cakes for free air circulation and dry in the gravity convection oven at 220°F ± 5° for 24 hours. Then obtain the dry weights to the closest 0.1 gram.

Testing Procedure

Test each cake in flexure on a five inch span. After the first break, place the two halves together, rotate the sample 90 degrees, and retest. Tests should be performed as soon as possible after removal from the oven so as to eliminate the effect of excessive moisture absorption.

Calculations

1. Record the average filtering time in seconds for the fibre being evaluated.

2. Calculate the per cent water remaining after filtration and after pressing for the unknown fibre (to the closest 0.1 per cent) as follows:

   Per cent water after filtration =
   (Average filtered weight) - 150.0 (100)/(150.0)

   Per cent water after pressing =
   (Average pressed weight - 150.0) (100)/(150.0)

3. Obtain the average breaking load in pounds for the unknown fibre and the 3%, 9%, and 15% standard cakes.

4. Using a relative strength of 20 for 3%, 60 for 9%, and 100 for 15%, calculate the least squares line of breaking load versus relative strength for the standard fibre, as illustrated in the following example:

   Assume that the average breaking loads for the 3%, 9%, and 15% standard cakes are 90.0, 171.0, and 240.0 pounds respectively. The following table is then set up, where X is the relative strength and Y is the corresponding breaking load:

	X	Y	(X)(Y)	$(X)^2$
	20	90.0	1,800.0	400
	60	171.0	10,260.0	3,600
	100	240.0	24,000.0	10,000
Total	180	501.0	36,060.0	14,000

The average X and Y values are then calculated as:

$M_x = 180/3 = 60$

$M_y = 501.0/3 = 167.0$

The slope of the least squares line is next calculated as:

$$m = \frac{36,060.0 - (60)(501.0)}{14,000 - (60)(180)} = \frac{36,060 - 30,060}{14,000 - 10,800} = \frac{6000}{3200} = 1.875$$

The Y-intercept of the least squares line is finally calculated as:

$b = 167.0 - (1.875)(60) = 167.0 - 112.5 = 54.5$

The equation for the least squares line of breaking load versus relative strength for the standard fibre is then:

$Y = 1.875\ x + 54.5$

5. From the equation for the standard, calculate the relative strength of the unknown fibre (to the closest 0.1) from its average breaking load, as illustrated in the following example:

   For an unknown fibre having an average breaking load of 210.0 pounds, the relative strength would be:

   $X = (210.0 - 54.5)/(1.875) = 155.5/1.875 = 82.9$

Results

1. Filtering Time - This time will vary with both the type of fibre used and the degree to which the fibre has been prepared. Since the end of filtration is taken as the point at which a decrease in vacuum occurs (caused by loss of the water seal around the cake edge), and is not based on the time required to remove a specified amount of water, it is dependent not only on the rate at which water is removed from the A/C slurry, but also on the water retention properties of the fibre used. Consequently, without the per cent water remaining after filtration, the filtering time has no definite meaning.

2. Filtered Weight - The filtered weight, in terms of the per cent water held after filtration, indicates the water retention properties of the fibre used and also varies with the fibre type and the degree of preparation. In conjunction with the filtering time, it has special application in the formulation of wet machine furnishes since, in wet machine operation, the water content of the asbestos-cement film on the felt is controlled by passing the film over a vacuum box.

3. Pressed Weight - The pressed weight, in terms of the per cent water held after pressing, is an indication of the resistance to water removal under pressure. The value is a guide as to the moisture content of the rolled product in wet machine operation and as to the moisture content of pressed sheets.

4. Relative Strength - The relative strength, which expresses the reinforcing characteristics of the fibre relative to the standard fibre as 100, is used in effectiveness of furnish calculations to control the strength of asbestos-cement products.

   Use of relative strength values in calculating the effectiveness

of furnish can best be illustrated by the following example:

The relative strength of a blend containing
80 pounds of Fibre A (relative strength 100),
50 pounds of Fibre B (relative strength 72), and
20 pounds of Fibre C (relative strength 32) is:

$$\frac{(80)\ (100) + (50)\ (72) + (20)\ (32)}{(150)} = 81.6$$

In a furnish containing 12.0 per cent of this blend, the effectiveness of furnish would be:

$$(81.6)\ (12.0) = 979$$

It should be emphasized that no general correlation exists between the effectiveness of furnish value and the various A/C processes. However, within any one process there is a definite relationship between the furnish calculation and product strength.

APPENDIX

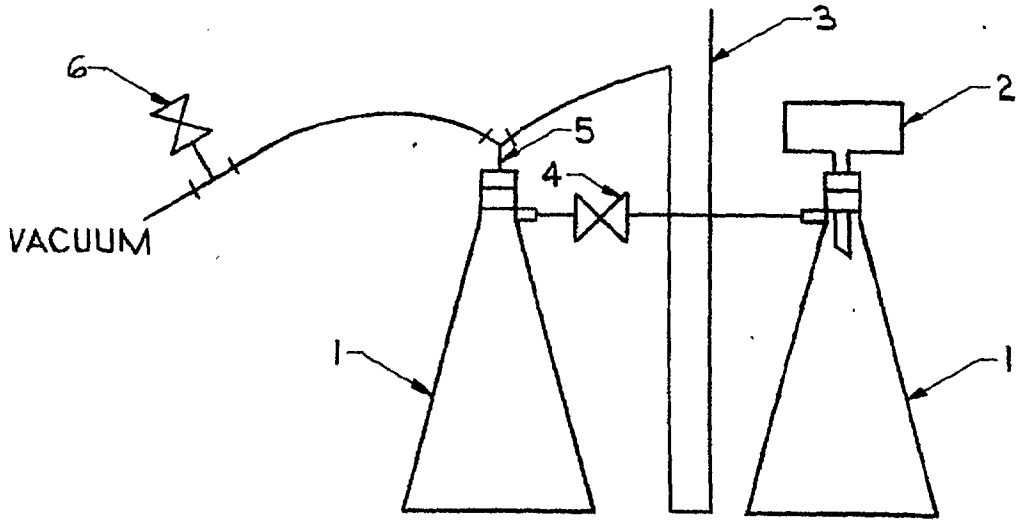
Sample Preparation

One, two or three unknown fibres can be evaluated against the same standard within any one run, the only limiting factors being time and the capacity of the two-quart shell. If more than one fibre is evaluated, it is not possible to premix the cement and silica together, but each must be premixed separately and weighed separately. For a three fibre evaluation, consisting of 27 cakes, premix 2200 grams of cement and 1500 grams of silica and weigh out as follows:

3% Fibre Cakes - 87.3 grams cement, 58.2 grams silica

9% Fibre Cakes - 81.9 grams cement, 54.6 grams silica

15% Fibre Cakes - 76.5 grams cement, 51.0 grams silica

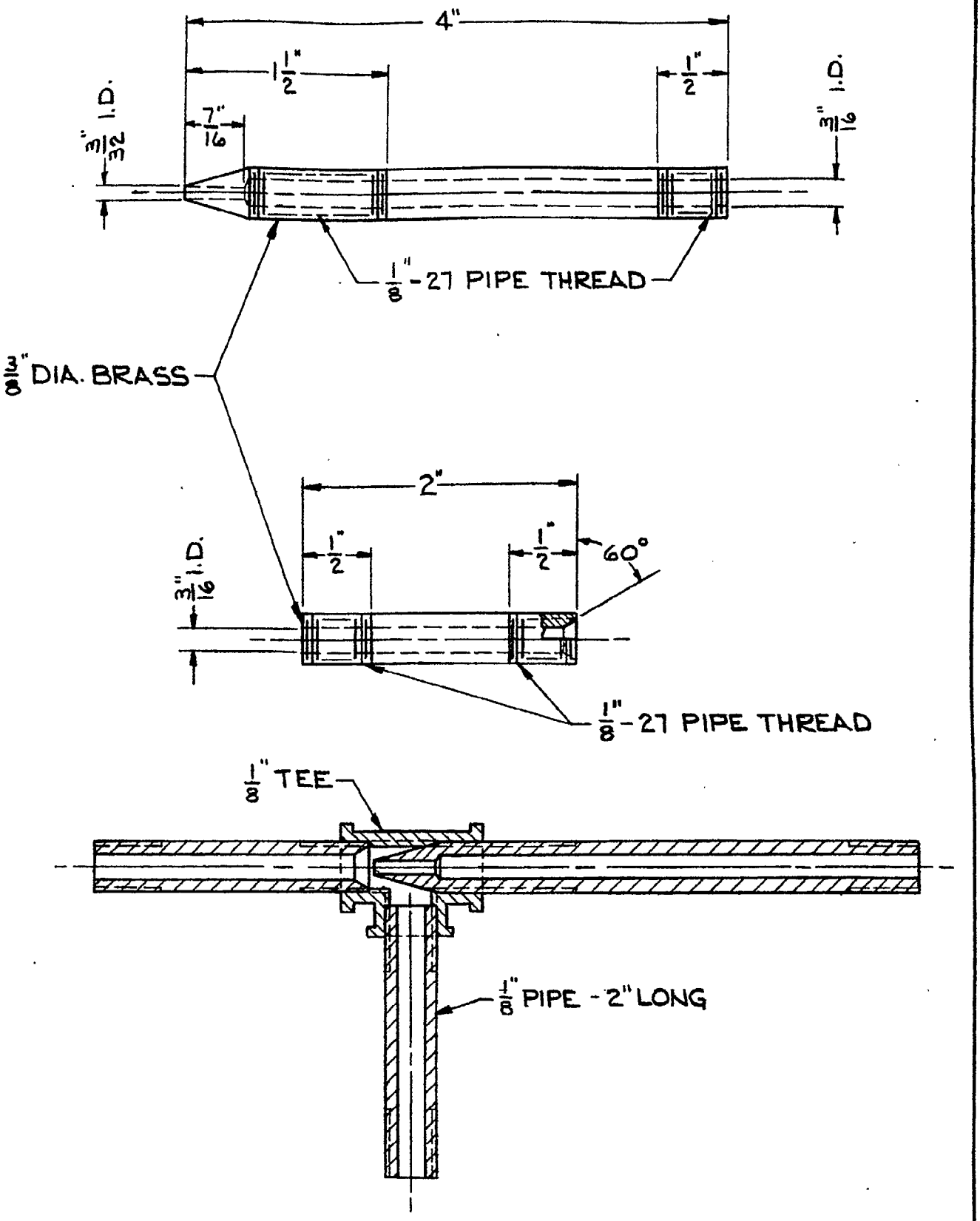


185

(1) FILTER FLASK (2000 ML.)
(2) BUCHNER FUNNEL (151 MM. I.D.)
(3) MERCURY MANOMETER
(4) BRASS STOPCOCK ($\frac{1}{4}$" BORE)
(5) BRASS Y-TUBE ($\frac{5}{16}$" BORE)
(6) NEEDLE VALVE ($\frac{1}{4}$" I.P.S.)
RUBBER TUBING ($\frac{1}{4}$" I.D. VACUUM TYPE)

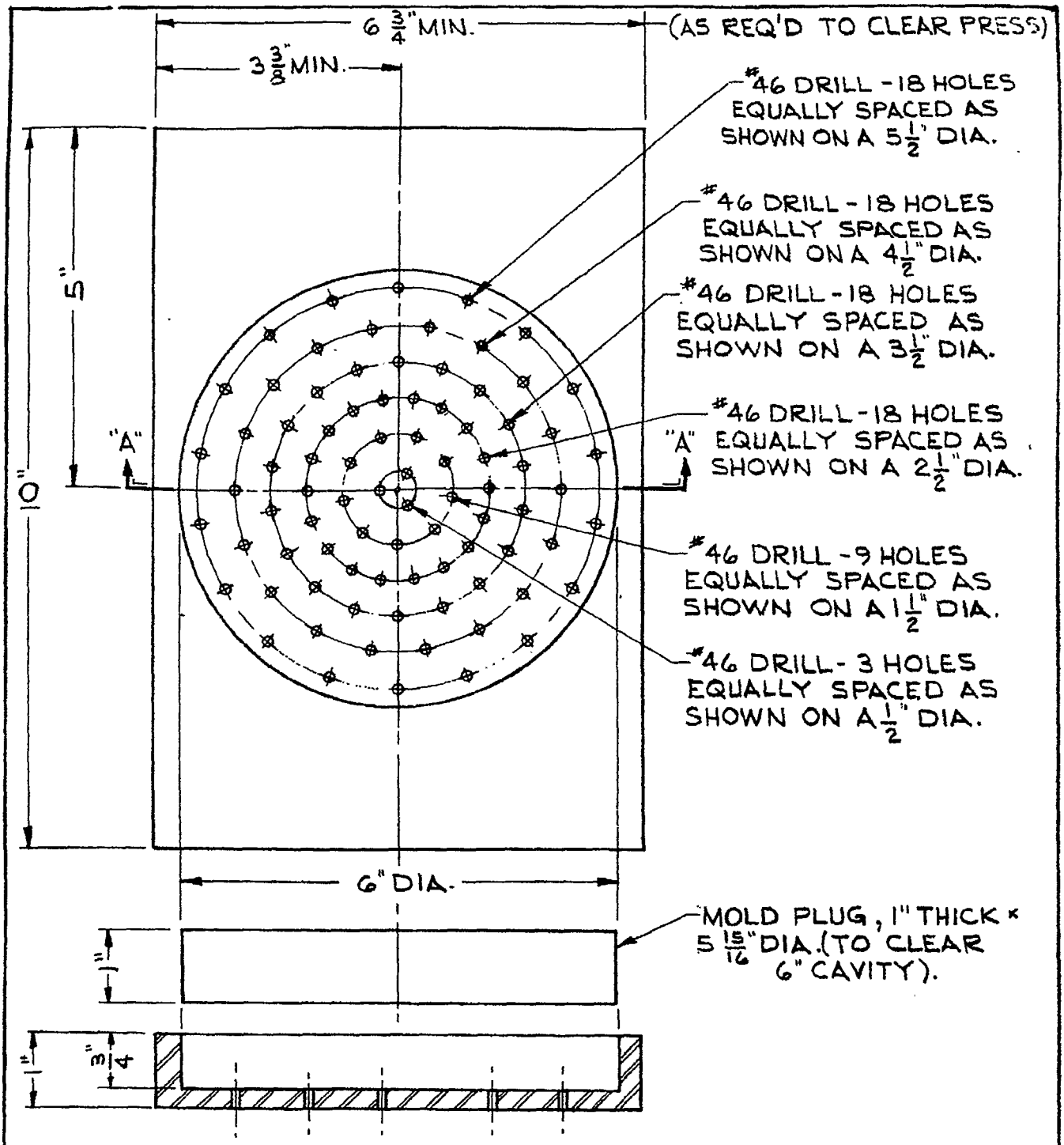
VACUUM SYSTEM

FIGURE 1



VACUUM ASPIRATOR ASSEMBLY

FIGURE 2



SECTION "A-A"

CONSTRUCTION NOTES:

1. MOLD MAY BE MADE CIRCULAR ($6\frac{3}{4}$" O.D) INSTEAD OF RECTANGULAR.
2. DRILL & TAP CENTER OF PLUG TO DEPTH OF $\frac{1}{2}$" FOR $\frac{1}{2}$-13 BOLT.
3. MATERIAL - COLD ROLLED STEEL.

PRESS MOLD

FIGURE 3

TESTING PROCEDURES

FOR

CHRYSOTILE ASBESTOS FIBRE

(Second Edition)

G-1

COLOR TEST

Printed in U.S.A.

Revised and adopted by:

ASBESTOS TEXTILE INSTITUTE - 9/8/60
MINERAL FIBER PRODUCTS BUREAU -
QUEBEC ASBESTOS MINING ASSOCIATION - 9/13/60

G-1

COLOR TEST

Scope

1. To determine the color and difference in color and shade of asbestos fibre.

Apparatus

2. (a)* Photovolt photoelectric reflection meter model No. 610.

   (b)* Search unit No. 610-T or 610-Y equipped with a green, amber and blue tristimulus filters.

   (c)* Calibrated gray working standard plaque, catalogue No. 6163 of 60 per cent reflectance.

   (d)* Calibrated dark gray working standard plaque, catalogue No. 6163 of 44 per cent reflectance.

   (e)**Hydraulic press.

   (f)**Compression cylinder with inside diameter of 1-1/8 in. which is approximately one square inch in area.

Sampling

3. In accordance with (A-1) "Method of Sampling and Preparation."

Procedure

4. (a) The details of the operation of this apparatus and the theory behind it are clearly described in the manufacturer's instructions.

* Photovolt Corporation, 95 Madison Avenue, New York, N. Y.

** F. S. Carver Inc., 1 Chatham Road, Summit, New Jersey.

(b) The procedure for running the test is as follows:

(1) Switch on the photovoltmeter and search unit and allow them to heat up for a minimum of 30 minutes.

(2) Balance the photovoltmeter against the working standard plaque for the filter being used.

(3) Weigh out 10 grams of fibre and compress to 16,000 psi on the pellet using the press and compression cylinder.

(4) Remove pellet from the compression cylinder. Be sure to test the pellet side next to the compression plunger.

(5) Place the search unit on the pellet and take readings using the blue, green and amber tristimulus filters.

(6) Place the working standard plaque back on the search unit after each sample reading and calibrate to insure proper readings.

(7) Smoking will upset the search unit readings.

(8) The 44 per cent reflectance plaque is for very dark fibre only. The 60 per cent reflectance plaque shall be used normally.

(9) A voltage regulator should be used if the voltage is variable.

Results and Sample Data

5. (a) Assuming we are checking the green spectrum, we calibrate the galvanometer using the plaque and setting the galvanometer at the reading printed on the plaque for green, i.e. 73.5.

(b) The sample is then placed on the search unit and the galvanometer reading is taken. The calibration is checked again by a second standard plaque reading.

(c) The before and after test calibration and test reading is recorded as:

		Calibration	
Filter	Reading	Before	After
Green	80.3	73.5	73.5

Accuracy

6. (a) The accuracy shall be ± 0.50 units of reflectance of the galvanometer. Readings on separate samples of the same material must be within one galvanometer unit of each other. Readings on different samples that are 1.0 or more galvanometer units different are considered significant.

TESTING PROCEDURES

FOR

CHRYSOTILE ASBESTOS FIBRE

(Second Edition)

G-2

QUANTITATIVE ANALYSIS OF ASBESTOS FIBRES

Printed in U.S.A.

Revised and adopted by:

ASBESTOS TEXTILE INSTITUTE - 9/8/60
MINERAL FIBER PRODUCTS BUREAU - 2/14/61
QUEBEC ASBESTOS MINING ASSOCIATION -

QUANTITATIVE ANALYSIS

Scope

1. These methods describe procedures for the quantitative analysis of chrysotile for (a) Silica (SiO_2), (b) Ferric Oxide (Fe_2O_3), (c) Alumina (Al_2O_3), (d) Calcium Oxide (CaO), (e) Magnesium Oxide (MgO), (f) Carbonates, (g) Water of Crystallization.

Outline of Method

2. The samples are treated as silicates not decomposed by acids and are therefore fused with Na_2CO_3 to convert to soluble sodium salts. From the hydrochloric acid solution of the melt, silica is first removed by dehydration and precipitation. The filtrate containing iron and aluminum plus calcium and magnesium is treated with bromine water to oxidize the iron to the ferric state and the latter together with the aluminum are precipitated with ammonia and ignited. To differentiate between Fe_2O_3 and Al_2O_3, the ignited residue is fused with potassium pyrosulfate and the iron in the melt determined volumetrically. Another aliquot portion of the solution of the melt is used for determination of alumina by use of 8 - hydroxy quinoline. The filtrate resulting from the Fe_2O_3 and Al_2O_3 precipitation contains calcium (if present) and magnesium. The calcium is precipitated from this filtrate, after the latter is acidified, as calcium oxalate. The latter is ignited and weighed as CaO. The filtrate after removal of the calcium is made acid with conc. HNO_3 and evaporated to dryness to insure removal of ammonium salts, as the latter will prevent complete precipitation of the magnesium. The residue is dissolved in dilute HCl and the magnesium precipitated with $(NH_4)_2HPO_4$ in ammoniacal solution. The precipitate is carefully ignited and weighed as $Mg_2P_2O_7$. The water of crystallization is determined by ignition loss and corrected for carbonate content.

Sampling

3. (a) Sample - The sample shall be the laboratory test sample in accordance with (A-1) "Method of Sampling and Preparation."

(b) Test Specimen - The 0.5 gram test specimen shall be derived from the laboratory test sample. Quarter the sample down to approximately 25 grams as prescribed in the Sampling and Preparation of Fibre, Part 2, (a) through (g). Divide the 25 gram sample into ten approximately equal portions and subdivide these portions into halves. Combine a half of each of the ten portions and mix thoroughly. Repeat this procedure until the sample weight is reduced to approximately 3 grams. On a smooth, clean area spread the 3 gram sample into a thin layer over an area of approximately 8 in. x 8 in. in such a manner that pinches may be taken from all parts. Extract with tweezers five bundles of long fibre free from rock, grit or dust, each weighing about 0.5 gram. Spread into a thin layer and extract at least five bundles of the fibre from different parts so that when these are combined and dried to constant weight at 110°C (230°F) the test specimen will weigh 0.5 ± 0.02 grams.

(c) Preparation of Sample - The test specimen is placed in a tared porcelain crucible and after being brought to constant weight at 110°C (230°F) is cooled in a desiccator and weighed on a sensitive gram balance to the fourth decimal place. This weight minus the tare is the sample weight (W) for (a) SiO_2, (b) Fe_2O_3, (c) Al_2O_3, (d) CaO and (e) MgO. (Different samples must be used for carbonates and water of crystallization). The crucible with specimen is then placed in a furnace at 927-954°C (1700-1750°F) for one hour. After cooling, the specimen is reduced to as fine a mesh as possible with an agate mortar and pestle. About 3.0 grams Na_2CO_3 are added and ground intimately with the specimen for an intimate mixture. The contents of the mortar are then transferred to a 30 ml capacity platinum crucible using a camel hair brush to sweep the last of the mixture from the mortar. Successive small amounts of additional Na_2CO_3 are then ground in the mortar and transferred in like manner to the platinum crucible, to insure removing the last trace of specimen from mortar to the crucible. Then sprinkle a little additional Na_2CO_3 on top of the intimate mix of powdered specimen and the Na_2CO_3, place a platinum lid on the crucible.

(d) Apparatus:

(1) Mortar and Pestle, 125 ml capacity. Agate.

(2) Platinum Crucible, 30 ml capacity.

(3) Oven for drying at 110°C (230°F).

(4) Muffle type electric furnace for ignition at 1700°-1750°F (927°-954°C).

(5) Sensitive chemical gram balance.

(6) Porcelain Crucible, 20 ml capacity.

(7) Camel Hair Brush.

(8) Desiccator.

(e) Reagents:

(1) Na_2CO_3, Anhydrous, C.P.

Determination of Silica

4. (a) Procedure - Heat the covered platinum crucible containing the intimate mix of powdered specimen and flux at first over a small flame to drive out any moisture present. Gradually raise the temperature until the highest heat of a good Meker burner is obtained. As soon as the mass melts quietly and there is no further evolution of carbon dioxide, the decomposition is complete. Wind a piece of platinum wire into a spiral and insert it into the fused mass. Remove the flame, allow the crucible to cool in the air somewhat and then play a stream of water upon the outside of the crucible. As soon as the crucible does not hiss when the water strikes it, quickly introduce enough water into the crucible to cover the melt. After about a minute carefully pull on the wire; usually the melt can be withdrawn from the crucible. If it does not come out easily, it can often be loosened from the crucible. If it does not come out easily, it can often be loosened by carefully heating the crucible; place the melt in a 300 ml casserole, add 25 ml of water, cover the casserole and carefully add 25 ml of 6 N. hydrochloric acid. A lively evolution of carbon dioxide at once takes place, but as the silicic acid separates, the inner part of the cake gradually becomes coated with a film of silicic acid which protects it from the further action of the acid. Consequently, it is necessary to break up the cake from time to time by means of a glass rod, until finally there is no evolution of a gas and no more hard lumps remain. After the evolution of carbon dioxide has nearly ceased, wash off the under side of the watch glass, raise it by placing a glass triangle under it, and evaporate to dryness. Heat the residue for at least an hour at 110°C to dehydrate the silica.

Moisten the dry powder with conc. hydrochloric acid and allow the covered dish to stand 10 minutes at the ordinary temperature in order that the basic salts and oxides formed during the evaporation and drying may once more be changed to chlorides. Then warm gently, dilute with 100 ml water, heat to boiling, and after the silicic acid has settled, filter

through a well-fitted ashless filter paper. Wash the residue three or four times by decantation with hot 2 N. hydrochloric acid, then transfer to the filter and wash with hot water until free from chloride. Place the precipitate in a platinum crucible and set aside for the time being. The separation of the silicic acid is not quite complete; as much as 2 mg may remain in the filtrate. To remove this, once more evaporate the solution to dryness on the water bath, and again heat at 110°C for an hour, moisten the residue with 5 ml of conc. hydrochloric acid, and allow to stand not more than 15 minutes. Warm, dilute to 100 ml, heat to gentle boiling, and filter through a new and correspondingly small, ashless filter, washing with hot 2 N. acid and with water as before. Save the filtrate and analyze it for Fe_2O_3, Al_2O_3, CaO and MgO as will be subsequently described.

Combine the latter wet filter with that one previously obtained and ignite the wet filters containing the silica in a platinum crucible. Keep the temperature low until all the carbon is consumed, and do not allow the filter to catch fire. Finally, cover the crucible and ignite over a Meker burner, cool and weigh as impure silica.

The silica thus obtained is not absolutely pure. To test its purity, moisten it with water, add a drop of conc. sulfuric acid and about 5 to 10 ml of pure hydrofluoric acid. (Do not measure this acid in a glass graduate. Do not inhale the fumes. If spilled on the hands, wash them immediately under the water tap). Place the crucible in an air bath and evaporate under a hood until no more vapors are expelled. Then remove the excess sulfuric acid by heating over a free flame. Raise the temperature gradually and finally heat the crucible over a Meker burner and again weigh. Repeat the treatment with sulfuric and hydrofluoric acids, without adding any more water, until the contents of the crucible (usually Fe_2O_3 and Al_2O_3) are at a constant weight. Deduct this amount from the weight of impure silica and add it to the precipitate obtained with the ammonia in the subsequent analysis.

(b) Calculations:

$$\frac{\text{Wt. of Silica}}{\text{Wt. of Sample (W)}} \times 100\% = \% SiO_2$$

(c) Apparatus:

(1) Platinum Crucible

(2) Platinum Wire

(3) 300 ml Casserole

(4) Glass Triangle

(5) Vented Chamber at 110°C

(6) Ashless Filter Paper (Whatman No. 41)

(7) Water Bath

(8) Meker Burner

(9) Vented Hood

(d) Reagents:

(1) 6 N. Hcl

(2) 2 N. Hcl

(3) Conc. Hcl

(4) Conc. H_2SO_4

(5) Pure HF

Determination of Ferric Oxide

5. (a) Procedure - The filtrate obtained after precipitation of the silicic acid in the last procedure should be treated as follows. Oxidize the iron back to the ferric state by adding bromine water and boiling until the excess of the latter is expelled. After this add 10 ml of 2 N. ammonium chloride solution, several drops of methyl red indicator, and precipitate the aluminum and iron from the boiling hot solution by adding dilute ammonia free from carbonate until the solution turns yellow. Allow the precipitate to settle, filter, and wash twice by decantation with hot water. Redissolve by running hot 2 N. hydrochloric acid through the filter into the beaker containing the greater part of the precipitate. Repeat the precipitation with ammonia as before, and after filtering and washing by decantation, transfer the precipitate to the filter and wash until free from chloride with water containing 2 per cent ammonium nitrate. Save the filtrate for CaO and MgO determinations.

Allow the precipitate to drain as completely as possible, and ignite wet in the crucible containing the residue obtained from the treatment of the impure silica with sulfuric and hydrofluoric acids. After igniting strongly over a Meker burner, weigh the crucible; its contents represent the sum of Al_2O_3 and Fe_2O_3.

For the determination of the Fe_2O_3, fuse the mixed oxides with potassium pyrosulfate in a silica crucible using 15 to 20 times as much $K_2S_2O_7$. Before starting the fusion, heat the $K_2S_2O_7$ in the silica crucible until fumes of sulfuric anhydride evolve. This makes it anhydrous so that steam will not come off during the fusion. Add the mixture of oxides to this and heat slowly with a small flame until complete fusion occurs. Add a small amount of additional $K_2S_2O_7$ at the last. When the fusion is complete, make a spiral from a platinum wire and insert in the melt. When solidified, remove by pulling the wire. Dissolve the melt in Hcl (1:1 by vol.) stirring until all is dissolved. Dilute this solution to a definite volume and take one half of it for the Fe_2O_3 and the other half of it for the Al_2O_3 determination.

Heat the liquid taken for the Fe_2O_3 to about 80°C and while still hot reduce the ferric iron by adding stannous chloride drop by drop from a buret until the yellow color of the $FeCl_3$ just disappears, using a white piece of paper under the beaker for a better background of color change. Cool the solution to 15°C, and while stirring add 10 ml of $HgCl_2$ solution. Formation of a light silky precipitate indicates conditions are correct. Stir the solution vigorously for one minute, add 3 drops of diphenylamine indicator solution and dilute to 150 to 200 ml with cold distilled water. Titrate with a standardized solution of $K_2Cr_2O_7$ until the blue color persists. The concentration of the $K_2Cr_2O_7$ solution should be such that one ml of the standard solution is equivalent to .006 grams Fe. From the titration, calculate the Fe to Fe_2O_3.

(b) Calculations:

$$\frac{(\text{ml } K_2Cr_2O_7 \text{ titer}) \times .006 \times \frac{2}{1} \times 1.43}{\text{Sample Wt. (W)}} \times 100\% = \% \; Fe_2O_3$$

(c) Apparatus:

(1) Meker Burner

(2) Platinum Crucible

(3) Platinum Wire

(4) Silica Crucible

(5) Two 50 ml Burets

(6) Ashless Filter Paper (Whatman No. 41)

(d) Reagents:

(1) Bromine Water

(2) 2 N. NH_4Cl

(3) 2 N. NH_4OH

(4) 2 N. HCl

(5) 2% NH_4NO_3

(6) $K_2S_2O_7$ C.P.

(7) 1:1 by Vol. HCl

(8) Stannous Chloride

Prepare by dissolving 15 grams Tin metal C.P. in 350 ml hot HCl (Sp. Gr. 1.19) and dilute to one liter.

(9) Mercuric Chloride
(Saturated Solution)

(10) Diphenylamine Indicator 1 gram dissolved in 100 ml H_2SO_4 (Sp. Gr. 1.84)

(11) Potassium Dichromate, approximately 0.1 N.

Prepare by dissolving 4.9 grams in water and diluting to one liter. Standardize against a known weight of pure iron using same method as in the procedure.

Determination of Aluminum Oxide

6. (a) Procedure - Use the other half of the solution from the last procedure made with the 1:1 HCl. Dilute to approximately 200 ml and heat to 70°C. Add an excess of the reagent 8 - Hydroxyquinoline. Slowly add 2 N. ammonium acetate until a permanent precipitate is formed, and then add 20 to 25 ml more. Allow the precipitate to settle, filter through a weighed Gooch crucible, wash with cold water, dry at 120 to 140°C, and weigh as Al $(C_9H_6ON)_3$ containing 11.1 per cent Al_2O_3.

(b) Calculations:

$$\frac{\text{Wt. of Al } (C_9H_6ON)_3 \times .111}{\text{Sample Wt. (W)}} \times 100\% = \% \ Al_2O_3$$

(c) Apparatus:

(1) Tared Gooch Crucible with asbestos mat.

(2) Filter suction flask and aspirator.

(d) Reagents:

(1) 8 - Hydroxyquinoline, prepared by dissolving 25 grams in 60 ml glacial acetic acid. Dilute with cold water to 2 liters.

(2) 2 N. CH_3COONH_4

Determination of Calcium Oxide

7. (a) Procedure - Make the filtrate, obtained from the ammonia precipitation of Fe_2O_3 and Al_2O_3 in the previous procedure, acid with HCl. Bring to a volume of 400 ml, heat to 80 to 90°C, and slowly add, while stirring, 30 ml of hot 0.5 N. ammonium oxalate solution. Slowly add NH_4OH until the solution is slightly ammoniacal and allow the precipitate to stand several hours before filtering.

If considerable magnesium is present in the solution, some magnesium oxalate will come down with the calcium oxalate. Since chrysotile contains a large amount of magnesium, it is best to redissolve the calcium oxalate precipitate and repeat the precipitation, using a filter paper for filtering off the precipitate. When all the solution has passed through the filter, wash the precipitate with about 15 ml hot water. Then rinse the precipitate back into the original beaker by holding the funnel in an inverted position and directing a stream of hot water against it. Replace the funnel in the support and wash the filter with about 25 ml of hot 3 N. hydrochloric acid. Heat the acid in a test tube, pour it upon the upper edge of the paper, and catch the liquid as it runs through the filter in the beaker containing the precipitate. Finally wash the filter with a little hot water (and with dilute ammonia if it is to be used again for filtering the next precipitate). Heat the dilute acid in the beaker and add a little more acid if necessary to dissolve the precipitate completely. Dilute the solution to about 250 ml and repeat the precipitation of the oxalate at the boiling temperature, adding ammonia and 5 ml more of the ammonium oxalate reagent. Since the solution already contains oxalic acid equivalent to the calcium, only a little more reagent is necessary.

Weighing as CaO. Use an ashless paper for collecting the precipitate. Wash the precipitate with hot water until free from chloride, and save the filtrate for the magnesium determination. Transfer the precipitate to a weighed platinum crucible. Ignite carefully with the flame at the mouth of the crucible until the precipitate is dry, and then heat with a small flame at the base of the crucible until all the paper is decomposed without letting it take fire. Then gradually raise the temperature and heat over a Meker burner for an hour with the crucible in an upright position and covered. Cool to about 100°, place in a desiccator, and weigh after 15 minutes. Repeat the heating until after cooling a constant weight is obtained. The calcium oxide is somewhat hygroscopic but is not difficult to weigh if it has been washed free from chloride. Call the weight constant if it agrees within 0.2 mg with the previous weight.

(b) Calculations:

$$\frac{\text{Wt. CaO}}{\text{Wt. Sample (W)}} \times 100\% = \% \text{ CaO}$$

(c) Apparatus:

(1) 600 ml Beaker

(2) Glass Funnel

(3) Platinum Crucible

(4) Ashless Filter Paper (Whatman No. 40)

(5) Meker Burner

(6) Desiccator

(d) Reagents:

(1) 3 N. HCl

(2) 0.5 N. Ammonium Oxalate

(3) 2 N. NH_4OH

Determination of Magnesium Oxide

8. (a) Procedure - Add 75 ml of concentrated HNO_3 to the combined filtrates and washings from the $CaC_2O_4H_2O$ precipitation, and evaporate to dryness on the steam bath or hot plate. Do not boil the solution or there will be loss by spattering. Keep

the beaker covered with a watch glass supported above the upper rim of the beaker. A glass triangle, or glass supports which are made for this purpose, should be used to support the watch glass. To the small residue obtained, add 2 ml of concentrated HCl and 25 ml of water. Heat nearly to boiling, and, after a few minutes, filter off the silica residue through a small filter. Wash the beaker, and filter thoroughly with hot water. The silica comes from the action of reagents on reagent bottles or on the beakers used in the analysis.

Dilute the solution to about 150 ml; add about 1.2 g of $(NH_4)_2HPO_4$ dissolved in a little water and a few drops of phenolphthalein indicator solution. Heat nearly to the boiling point, and then slowly add 1.5 N. ammonia water until a faint pink color is obtained and a slight precipitation takes place. Stir well for about a minute, touching the sides of the beaker as little as possible. When the precipitate has become distinctly crystalline, add more ammonia until a deep color is obtained with the phenolphthalein. Allow the solution to cool, then add one-fifth the solution's volume of concentrated ammonium hydroxide and allow to stand over night. Continue the analysis as follows:

Weighing as $Mg_2P_2O_7$

$$2MgNH_4PO_4.6H_2O \xrightarrow{\quad} 13H_2O + 2NH_3 + Mg_2P_2O_7$$

Use an ashless filter paper for filtering off the magnesium ammonium phosphate precipitate. After washing it with 1.5 N. NH_4OH, moisten with a saturated solution of ammonium nitrate in 1.5 N. NH_4OH, dry and ignite very slowly and carefully, and weigh. The precipitate contains 36.21% MgO.

(b) Calculations:

$$\frac{\text{Wt. } Mg_2P_2O_7 \times .3621}{\text{Sample Wt. (W)}} \times 100\% = \% \text{ MgO}$$

Determination of CO_2 from Carbonates (By Knorr Alkalimeter Method as Proposed in ASTM D-13 Supplement 1958)

9. (a) Sampling - The sample shall be taken in the same manner from the laboratory test sample from which specimens were taken for the preceding analyses. A specimen shall be taken, weighing approximately one gram and dried to constant weight at 110°C (230°F) weighing to the nearest 0.001 gram. Call this sample weight W.

(b) Procedure - Check the gas flow train to insure freedom from leaks. Aspirate a current of air through the system at the rate of about two bubbles per minute for a period of 10 minutes. Stop the air current and remove the absorption tubes. Place the tubes within the balance case and allow it to stand for several minutes. When ready for weighing, open the stopcock momentarily and close. Weigh and repeat the above procedure. The second weight should agree with the first to within 0.005 g. If it does not, repeat this process until the two successive weighings agree. When a constant weight is reached, replace the absorption tubes in the gas train.

Transfer about one g of the sample, weighed to the nearest 0.001 g, to the distillation flask. Wash down any adhering particles on the inside neck of the flask with distilled water. Add enough distilled water to the flask so when the apparatus is reconnected the tip of the dropping funnel will be submerged about 5 to 10 mm. Place 50 ml of HCl (1:1) in the dropping funnel and replace the guard gas-absorption tube at the top of the funnel. Start the flow of water in the condenser and open all the stopcocks except the one on the dropping funnel. Turn on the aspirator for medium suction. Adjust the stopcock on the dropping funnel so the suction will draw the acid slowly into the flask. When all the acid is in the flask, fully open the funnel stopcock and pull air through the system at the rate of two or three bubbles per second. After the reaction in the flask has subsided, warm the contents gently to boiling. When steam starts to condense in the condenser, turn off the heat. Continue to draw air through the apparatus for 30 minutes. Re-weigh the absorption bulb as before. The gain in weight represents the CO_2 in the sample.

(c) Calculations:

$$\frac{\text{Wt. of } CO_2 \text{ Absorbed}}{W_1 \text{ (Sample Weight)}} \times 100\% = \%\ CO_2 \text{ in Asbestos}$$

(d) Apparatus:

Sensitive Chemical Gram Balance
Knorr Alkalimeter, consisting of the following parts connected as shown in the appended sketch Figure No. 1.

(1) Gas Washing Bottle, A, containing concentrated H_2SO_4 which serves both to indicate the rate of flow and to prevent any water vapor entering the system from the atmosphere.

(2) Drying Tube or Cylinder, B, filled two-thirds full of soda-asbestos absorbent (Ascarite) and one-third full of a drying agent to remove all CO_2 from the air.

(3) Knorr Alkalimeter Unit, C, which consists of a dropping funnel, a distillation flask, and a condenser fitted with standard-taper joints to form a unit assembly.

(4) Gas Washing Bottle, D, containing a solution of 5 to 10 per cent by weight of Ag_2SO_4 in concentrated H_2SO_4. This serves to absorb any water vapor that escapes from the condenser and to remove any HCl from the evolved gases.

(5) Drying Tube, E, containing $CuSO_4$ to absorb any H_2S generated by the absorption of HCl.

(6) Drying Tube, F, filled with a suitable drying agent to effect complete drying.

(7) Absorption Tube, G, filled two-thirds full of soda-asbestos absorbent (Ascarite) and one-third full of a drying agent, to absorb the CO_2.

(8) Absorption Tube, H, filled with a drying agent and soda-asbestos absorbent (Ascarite) in the reverse direction to prevent CO_2 from entering the system.

(9) Trap, I, to prevent back flow of water from the aspirator.

(10) Valve or Pinched Tubing, J, to control the rate of air flow pulled through the system by the aspirator.

(e) Reagents:

(1) Conc. H_2SO_4

(2) Soda-asbestos absorbent (Ascarite)

(3) 10% by wt. Ag_2SO_4

(4) $CuSO_4$

(5) 1:1 by vol. HCl

Determination of Water of Crystallization

10. (a) The sample shall be taken in the same manner from the laboratory test sample from which specimens were taken for the preceding analyses. A specimen shall be taken, weighing about 5 grams and dried to constant weight at 230°F, (110°C), weighing to the nearest 0.001 gram. Call this sample weight W_2.

(b) Procedure - Ignite in a tared procelain crucible the sample which has been dried to constant weight, by placing the crucible and contents in an electric furnace maintained at 1700 to 1750°F (927° to 954°C) and continue the ignition for one hour. Cool in an oven at 110°C and then in a desiccator. Then re-weigh to nearest 0.001 gram.

(c) Calculations:

$$\frac{\text{Original Wt. - Oven Dry Wt.}}{\text{Original Wt.}} \times 100\% = \% \text{ Absorbed Moisture}$$

$$\frac{\text{Oven Dry Wt. - Ignited Wt.}}{\text{Oven Dry Wt.}} \times 100\% = \% \text{ Ignition Loss}$$

The equation for calculating the per cent water of crystallization provides for ignition loss due to evolution of CO_2 from carbonates even though in some cases there may be no CO_2 evolved.

$$\frac{W_2\ (100\% - \%\ CO_2) - W_2\ (100\% - \%\ \text{Ign. Loss})}{W_2\ (100\% - \%\ CO_2)} \times 100\% = \% \text{ Water Crystallization}$$

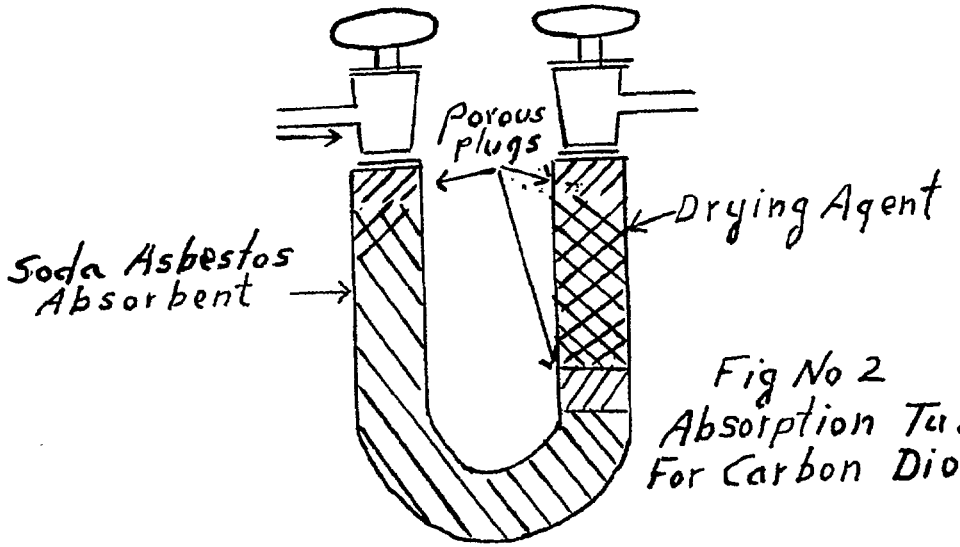


Fig No 2
Absorption Tube
For Carbon Dioxide.

Fig. No 1. Knorr Alkalimeter for Determination of Carbon Dioxide.

TESTING PROCEDURES

FOR

CHRYSOTILE ASBESTOS FIBRE

(Second Edition)

G-3

METHOD FOR MEASURING RESIN PICK-UP

Printed in U.S.A.

Revised and adopted by:

ASBESTOS TEXTILE INSTITUTE - 6/8/61
MINERAL FIBER PRODUCTS BUREAU -
QUEBEC ASBESTOS MINING ASSOCIATION -

G-3

RESIN PICK-UP

Scope

1. This method of test covers a procedure for determining resin pick-up by asbestos fibre. It is intended to provide comparative values between a sample of fibre and a standard or between two different samples of fibre when the resin is of a liquid phenolic classification.

   It has been established that the apparent surface area of the fibres, as measured by air permeability, and bulk density are major factors influencing the amount of resin picked up by the fibres.

Outline of Method

2. A weighed sample of fibre is compressed to a 6-in. x 6-in. pad by a constant applied load which is subsequently released. The pad of fibre, supported by a perforated screen, is then immersed in a low viscosity phenolic resin solution of specified solids content for a fixed time period. After removal and allowed to drain freely, the sample is dried and the resin solids content is determined by a standard ignition method for asbestos-phenolic products.

Apparatus

3. (a) Screens - Brass wire with 16 mesh openings and measuring 6-in. x 6-in.

   (b) Mold - Metal mold having a cavity measuring 6-in. x 6-in. x 4-in. deep.

   (c) Press - Shall have a capacity of at least 3600 lb total force to produce a pressure of 100 psi on an area of 36 sq. in. Daylight should be no less than 8 inches with an 8 inch ram movement.

   (d) Balance - Sensitivity of 0.01 grams and capacity of weighing 50 grams.

   (e) Stop watch.

(f) Glass tray - Size to hold 6-in. x 6-in. screen with fibre pad and capacity of 2 quarts, measuring approximately 12-in. x 7-in. x 2-in. deep.

(g) Drying oven - Standard drying oven with solvent exhaust and capable of maintaining 350°F plus or minus 5°.

(h) Muffle furnace - Capable of ignition at 1480°F plus or minus 20°F.

(i) Desiccator

(j) Resin - Phenolic varnish soluble in ethyl alcohol.

(k) Alcohol - Commercial grade ethyl.

Sampling of Asbestos Fibre

4. The sampling shall be in accordance with (A-1) "Method of Sampling and Preparation."

Procedure

5. (a) Fifty grams of fibre shall be evenly distributed in the cavity of the mold with a screen placed at the bottom of cavity.

(b) A load of 100 psi shall be applied for one minute and released.

(c) The compressed pad of fibre and supporting screen shall be removed from the mold as a unit and placed into the tray containing 1500 cc of resin solution of 20 per cent solids and 80 per cent alcohol content.

(d) Pad of fibre shall be allowed to absorb resin solution and become submersed without assistance.

(e) After five minutes of soaking the screen and fibre shall be removed and allowed to drain freely without squeezing.

(f) Upon drying to about 15 per cent solvent content either in the air or low temperature vented oven (120-140°F), the sample shall be tested for resin content by selecting three specimens of about 15 gm each from the impregnated fibre.

(g) Since resin content is based on bone dry weight, the specimens shall be dried for 30 minutes at 350°F plus or minus 5°, removed from oven and cooled to room temperature in a desiccator. Weights shall be taken to the nearest 0.01 gm and recorded.

(h) The specimens shall then be ignited for two hours in a muffle furnace at 900°F followed by one hour at 1480°F plus or minus 20°F.

(i) The specimen shall be removed from muffle and allowed to cool to room temperature before re-weighing to nearest 0.01 gram.

Calculation and Report

6. W_b = Bone dry weight after 1/2 hour at 350°F.

W_a = Ash weight after one hour at 1480°F.

$$\% \text{ resin solids} = 100 - \left[\frac{W_a}{W_b \times .86} \times 100 \right]$$

TESTING PROCEDURES

FOR

CHRYSOTILE ASBESTOS FIBRE

(Second Edition)

G-4

DETERMINING MOISTURE CONTENT

Printed in U.S.A.

Revised and adopted by:

ASBESTOS TEXTILE INSTITUTE - 3/8/62
MINERAL FIBER PRODUCTS BUREAU - 11/8/65
QUEBEC ASBESTOS MINING ASSOCIATION -

G-4

MOISTURE CONTENT

Scope

1. This method of test covers a procedure for determining the moisture content of asbestos fibre.

Outline of Method

2. A weighed specimen of fibre is dried in an oven, cooled in a desiccator and weighed. The weight loss is used to determine the per cent moisture content of the fibre.

Apparatus

3. (a) Drying oven - capable of maintaining 220°F to 230°F (105°C to 110°C).

   (b) Balance - sensitivity of 0.01 gram and capacity of at least 200 grams.

   (c) Beakers - pyrex 400 ml.

   (d) Desiccator

   (e) Timer

Sampling and Preparation

4. In accordance with (A-1) "Method of Sampling and Preparation" with three moisture content determination specimens derived from each sample.

Procedure

5. (a) Weigh 25 grams of fibre to the nearest 0.01 gram into a previously tared 400 ml pyrex beaker. Record the weight of beaker plus weight of fibre as W_1.

   (b) Dry the specimen in an oven at 220°F to 230°F (105°C to 110°C) for one hour.

(c) Remove the dried specimen from the oven and cool to room temperature in a desiccator. Weigh the beaker and dried fibre to the nearest 0.01 gram and record as W_2.

Calculation and Report

6. W_1 = weight of tared beaker + 25.00 grams fibre specimen.

W_2 = weight of tared beaker + dried fibre.

$$\% \text{ moisture} = \frac{W_1 - W_2}{25.00} \times 100$$

TESTING PROCEDURES

FOR

CHRYSOTILE ASBESTOS FIBRE

(Second Edition)

G-5

DETERMINATION OF SOLUBLE CHLORIDES IN ASBESTOS FIBRE

(Adapted to Asbestos Fibre from ASTM D512-55T)

Printed in U.S.A.

Revised and adopted by:

ASBESTOS TEXTILE INSTITUTE - 6/8/62
MINERAL FIBER PRODUCTS BUREAU -
QUEBEC ASBESTOS MINING ASSOCIATION -

G-5

SOLUBLE CHLORIDES

Scope

1. (a) The method covers the volumetric determination of the chloride ion in the leach water used in the extraction of the soluble chlorides from asbestos fiber.

Purity of Reagents

2. (a) Reagent grade chemicals shall be used in all tests. Unless otherwise indicated, it is intended that all reagents shall conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society, where such specifications are available. Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination.

(b) Unless otherwise indicated, references to water shall be understood to mean reagent water conforming to the specifications for Reagent Water (ASTM Designation D-1192). In addition, reagent water shall be free of chloride ion.

Sampling

3. (a) Sample - The sample shall be the laboratory test sample as prescribed in (A-1) "Method of Sampling and Preparation".

(b) Test Specimen - The 25 gram test specimen shall be derived from the laboratory test sample. Quarter the sample down to approximately one lb as prescribed in the Sampling and Preparation of Fibers, Part 2 (a) through (g). Divide the one lb sample into ten approximately equal portions and sub-divide these portions into halves. Combine a half of each of the ten portions and mix thoroughly. Repeat this operation until the sample weight is reduced to approximately 150 grams. On a smooth clean area spread the 150 gram sample into a thin layer over an area of approximately 20 in. x 20 in. in such manner that pinches may be taken from all parts. Extract with tweezers twenty bundles of long fiber free from rock, grit, or dust, each weighing about 2.5 grams. Spread this into a thin layer and extract at least five bundles of the fiber from different parts so that when these are combined and dried to constant weight at 110°C (230°F) the test specimen will weigh 25 grams ± 0.2 grams.

(c) Preparation of Sample - The test specimen is placed in a tared porcelain crucible and after brought to constant weight at 110°C (230°F) is cooled in a desiccator and weighed on a sensitive gram balance to the fourth decimal place. This weight minus the tare weight is the sample weight, S.

Principle of Method

4. Dilute mercuric nitrate solution is added to an acidified sample in the presence of mixed diphenyl-carbazone bromphenol blue indicator. The end point of the titration is the formation of the blue-violet mercury diphenyl-carbazone complex.

Interferences

5. Zinc, lead, nickel and ferrous and chromous ions affect solution and end-point colors, but do not reduce the accuracy of the titration when present in concentrations up to 100 PPM. Copper is tolerable up to 50 PPM. Titration in the presence of chromate ion requires indicator with extra background color (alphazurine) and prior reduction for concentrations above 100 PPM. Ferric ion above 10 PPM must be reduced before titration, and sulfite ion must be oxidized. A part of bromide ion and fluoride ion will be titrated with the chloride. Quarternary ammonium salts also interfere if present in significant amounts (one to two PPM). Deep color may also interfere.

Apparatus

6. (a) Microburet one ml or five ml, with 0.01 ml graduation intervals.

(b) Soxhlet Extraction Apparatus:

(1) 500 ml Flask 24/40 glass joint, flask to tube.

(2) Extraction Tube, thimble 123 x 43 mm with 55/50 glass joint, tube to condenser.

(3) Condenser with 55/50 glass joint to tube.

(4) Porous Thimble, sample holder.

(c) Oven for drying at 110°C (230°F).

(d) Sensitive chemical gram balance.

(e) Desiccator

(f) Electric Hot Plate, approximately 600 watts.

Reagents and Materials

7. (a) Hydrogen peroxide (30 per cent).

(b) Hydroquinone solution (10 gm per liter). Dissolve one gram of purified hydroquinone in water and dilute to 100 ml.

(c) Mercuric Nitrate Solution (0.025 N). Dissolve 4.2830 gm of $Hg(NO_3)_2.H_2O$ in 50 ml of water acidified with 0.5 ml of HNO_3 (sp. gr. 1.42). Dilute the acidified $Hg(NO_3)_2$ solution with water to one liter. Filter if necessary, and standardize against the standard NaCl solution, using the procedure described in Section 8 (See Note 1).

(d) Mercuric Nitrate Solution (0.0141 N). Dissolve 2.5200 gm of $Hg(NO_3)_2.H_2O$ in 25 ml water acidified with 0.25 ml of HNO_3 (sp. gr. 1.42). Dilute the acidified $Hg(NO_3)_2$ solution with water to one liter. Filter if necessary, and standardize against the standard NaCl solution, using the procedure described in Section 8 (See Note 1).

Note 1: Sharpness of the end point - The point, while sharp, can be improved somewhat for certain types of water by adding to the titration sample several drops of an 0.05 gm per liter solution of Xylene cyanole FF or alphazurine blue green dye (color index 714). These chemicals can be mixed with the indicator in the same proportions.

(e) Mixed Indicator - Dissolve 0.5 gm of crystalline diphenylcarbazone[6] and 0.05 gm of bromophenol blue powder in 75 ml of ethyl alcohol (95 per cent), and dilute to 100 ml with the alcohol (Note 2). Store in a brown bottle and discard after 6 months (Note 3).

Note 2: Denatured alcohol is not suitable. Methanol or isopropanol may be used if pure ethyl alcohol is not available.

Note 3: Liquid indicator generally deteriorates to the point that it yields no end-point color after 12 to 18 months of storage. High temperature (above 100°F) and exposure to bright light may shorten storage life. A dry powder mixture of the two indicator ingredients is stable for much longer periods. Both the powder mixture (capsule form) and the liquid indicator are available commercially.

(f) Nitric Acid (3:997) Dissolve three ml of HNO_3 (sp. gr. 1.42) in water and dilute to one liter.

(g) pH Indicating Paper - Long-range type, covering a pH range one to 11.[7]

(h) Standard Sodium Chloride Solution (0.025 N). Dry 1.4613 ± 0.0002 gm NaCl for one hour at 600°C, dissolve in water, and dilute to one liter at 20°C in a volumetric flask (Note 4).

Note 4: Drying for two hours at 105°C is adequate for practically all analytical work. If ultimate accuracy of standardization is desired, fuse NaCl and cool it in a desiccator.

(i) Sodium Hydroxide Solution (two gm NaOH per liter). Dissolve two gm of NaOH in water and dilute to one liter.

Procedure

8. (a) Place the sample of fiber which has been dried to constant weight and weighed on a sensitive gram balance to the fourth decimal place in the porous extraction thimble, handling as little as possible to avoid contaminating it with chlorides. Place the thimble with sample in the extraction tube, having the extraction flask a little over half full, approximately 300 ml, with pure reagent water. Start the heat on the hot plate and continue the extraction for three hours from time the water starts boiling. When cool, pour the extract water from the extraction flask into a clean 500 ml volumetric flask. Rinse out the flask thoroughly with pure reagent water and pour this also into the volumetric flask. Then add more reagent water to the 500 ml mark. After thorough mixing, take an aliquot portion of the 500 ml extract water that will not contain more than 20 mg of chloride ion, diluting this sample with reagent water to 50 ml volume if necessary. If the volume of sample contains less than 2.5 mg of chloride ion, make the final titration as described in paragraph (b), with 0.0141 N. $Hg(NO_3)_2$ solution, using a one or five ml microburet. In this latter case, determine an indicator blank on 50 ml of chloride-free water, applying the same procedure followed for the sample. If the sample contains less than 0.1 PPM chloride, concentrate an appropriate volume of sample to 50 ml.

(b) Add five to 10 drops of mixed indicator, and shake or swirl the flask. If a blue-violet or red color develops, add HNO_3 (3:997) dropwise until the color changes to yellow. Add one ml excess acid. If a yellow or orange color forms immediately on addition of the mixed indicator, add NaOH solution (two gm NaOH per liter) dropwise until the color changes to blue-violet; then add HNO_3 (3:997) dropwise until the color changes to yellow and further add one ml excess acid (Note 5).

Note 5: The prescribed acidification provides a satisfactory pH range of 3.0 to 3.5. Acidified samples on which electrometric pH measurements have been made shall not be used for chloride determinations because the use of the Calomel reference

electrode may introduce error due to chloride contamination. Instrumental pH measurements may be made on an aliquot of the sample, the chloride content determined on the balance of the sample being corrected accordingly.

(c) Titrate the solution with 0.025 N. $Hg(NO_3)_2$ solution until a blue-violet color, as viewed by transmitted light, persists throughout the solution (Note 6). Record the milliliters of $Hg(NO_3)_2$ solution added.

(d) If chromate ion is present in the absence of iron and in concentration less than 100 PPM, use the alphazurine modified mixed indicator (Note 1) and acidify the sample as described in paragraph (a) but to pH 3 as indicated by pH indicating paper. Titrate the solution as described in paragraph (b), but to an olive-purple end-point (Note 6).

Note 6: The use of indicator modifications and the presence of heavy metal ions can change solution colors without affecting accuracy of the determination. For example, solutions containing alphazurine may be bright blue when neutral, grayish purple when basic, blue-green when acidic, and blue-violet at the chloride end-point. Solutions containing about 100 PPM nickel ion and normal mixed indicator are purple when neutral, green when acid, and gray at the chloride end-point. When applying this method to samples that contain colored ions or that require modified indicator, it is recommended that the operator familiarize himself with the specific color changes involved by experimenting with solutions prepared as standards for comparison of color effects.

(e) If chromate ion is present in the absence of iron and in concentration greater than 100 PPM, add two ml of fresh hydroquinone solution and proceed as described in paragraph (c).

(f) If ferric ion is present in the absence or presence of chromate ion, use a sample of such volume as to contain no more than 2.5 mg of ferric ion or of ferric ion plus chromate ion. Add two ml of fresh hydroquinone solution, and proceed as described in paragraphs (a) and (b).

(g) If sulfite ion is present, add 0.5 ml of H_2O_2 to 50 ml of the sample in the Erlenmeyer flask and mix for one minute. Then proceed as described in paragraphs (a) and (b).

Calculations

9. Calculate the chloride ion concentration, in parts per million, in the original sample as follows:

$$\text{Chloride, PPM} = \frac{(V_1 - V_2) \times N \times 35{,}500}{S}$$

Where:

V_1 = millilters of standard $Hg(NO_3)_2$ solution required for the sample.

V_2 = milliliters of standard $Hg(NO_3)_2$ solution required for the blank.

N = normality of the standard $Hg(NO_3)_2$ solution, and

S = grams of sample.

Precision and Accuracy

10. The precision of this method is 0.1 PPM or two per cent of the chloride ion content, whichever is greater. The accuracy is approximately equal to precision in the absence of interferences.

Footnotes:

6. Eastman Kodak No. 4459S diphenyl-carbazone and No. 752 tetrabromophenolsulfonephthalein (bromophenol blue) have been found satisfactory for this purpose.

7. pH Hydrion Paper A-B has been found satisfactory for this purpose.

TESTING PROCEDURES

FOR

CHRYSOTILE ASBESTOS FIBRE

(Second Edition)

G-6

MAGNETIC RATING OF ASBESTOS USED FOR ELECTRICAL PURPOSES

Printed in U.S.A.

Revised and adopted by:

ASBESTOS TEXTILE INSTITUTE - 2/11/65
MINERAL FIBER PRODUCTS BUREAU -
QUEBEC ASBESTOS MINING ASSOCIATION - 4/23/63

G-6

MAGNETIC RATING TEST FOR ASBESTOS FIBRE[1]

Scope

1. To determine the magnetic rating of asbestos fibre by comparing the electromagnetic effect of the fibre with that of a known standard. The test provides an estimate of the quantity of magnetic iron compounds present in excess of those in the asbestos structure and is empirically expressed as magnetic rating (MR).

   Note 1: Magnetic rating is an approximate estimate only of the magnetite content, as it actually measures the magnetic effect of the iron compounds present in a given sample, which depends upon and varies with the permeability, size, shape, orientation and distribution of the particles in addition to their quantity.

Apparatus

2. (a) Magnetic Analyzer constructed in accordance with specifications outlined in "Procedure A, A.S.T.M. Designation: D1118-57, pp 332-33" attached in Appendix I (See Figure 1 in Appendix I for schematic diagram of apparatus).

   Note 2: Apparatus to be provided with two-stage resistance-coupled Class A amplifier[2], having sufficient resistance to permit the use of a low sensitivity scale of MR6. Other apparatus designed on principles of induction basically similar to the analyzer specified herein, are acceptable providing their performance can be proven to be satisfactory and equivalent.

   (b) Voltage Regulator, 115-v, 60-cycle to control voltage fluctations in power supply.

   (c) Source of 115-v, 60-cycle power.

   (d) Supply of nonmagnetic and nonmetallic test specimen holders, wooden or plastic (See Figure 2 in Appendix I for dimensions and construction details of a suitable wooden holder).

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[1] Adopted from A.S.T.M. Designation: D1118-57.

[2] Bogen Class A amplifier, manufactured by David Bogen Company Inc. New York 14, N. Y., U.S.A., has been found satisfactory for this purpose.

Note 3[1]: Specimen holder shall be slightly less than 1 inch in diameter so that it will slide easily into the secondary coil. It shall be provided with a handle at one end and a cork at the other end leaving a space 3/4 inch in diameter by 2-7/8 inches in length for the test specimen (10 gms). The handle shall be provided with a stop so positioned that the test specimen cuts all the lines of magnetic flux and is centrally located in the first secondary coil, but does not enter the second coil.

(e) Balance (Sensitivity ±0.01 gms).

(f) Supply of chemically pure zinc oxide.

(g) Calibrating and Reference Standards - Employing the U.S. National Bureau of Standards standard sample No. 29a of iron ore magnetic[3], prepare calibrating standards with MR values of 0.5, 1, 3 and 6 in the manner described below:

Note 4: As the MR values of the calibrating standards may be materially changed by tapping, dropping or excessive handling, they shall be prepared in duplicate. One set shall be used as working standards and the other as permanent reference standards.

(1) Definition of MR[1] - A calibrating standard with an MR of one is defined as containing 0.18 gms of National Bureau of Standards standard sample No. 29a of iron ore magnetite[3] uniformly distributed over the space specified for a 10-gm test specimen (3/4 inch in diameter by 2-7/8 inches in length). Calibrating standards of different values shall be prepared by varying the amount of magnetite directly with the value of the desired standard. A 10-gm test specimen has a unit magnetic rating when it produces a magnetic effect equivalent to that of 0.18 gms of standard magnetite.

Note 5[1]: As the amount of magnetite used in a calibrating standard is insufficient to fill the space specified, it shall be thoroughly mixed with enough chemically inert material, such as zinc oxide, so that it can be firmly packed and still completely fill a chamber in the calibrating standard container, having the same dimensions (3/4 inch in diameter by 2-7/8 inches in length) as the space in the test specimen holder.

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[1] (See Page 1)

[3] Standard Sample No. 29a is available from P. O. Nicodemus, General Electric Company, Lowell Plant, Lowell, Massachusetts, U. S. A.

(2) Weigh accurately the amount of standard magnetite required for each desired standard.

(3) Mix thoroughly with zinc oxide and press firmly into the chamber of the calibrating standard holder[1], similar in design to the wooden test specimen holder described in 2 (d), except a plug flush with end of the holder shall be cemented in place with nonmagnetic cement after the standard material is packed.

Note 6: The use of a nonmagnetic plastic for standard calibrating standard containers is favoured by some on account of the tendency of wooden holders to warp.

Sample Weight

3. Ten (10) grams for all test specimens.

Sample Preparation

4. In accordance with (A-1) "Method of Sampling and Preparation" both for laboratory samples and test specimens.

Note 7: Special care shall be taken in selecting 10-gram test specimens to avoid shaking out and loss of grit and magnetite particles ie., each fraction shall contain the total cross-section of the pile from top to bottom at the point where the pinch is taken, including any grit or fines which may have segregated at the bottom. Paper, board and textile samples shall be cut, chopped or broken into small pieces so they can be packed into the test specimen holder with random orientation.

Procedure

5. (a) Initial Calibration:

(1) Plug amplifier and coils into 115-v constant voltage supply. Turn on switches to energize both and permit analyzer to become stabilized by warming up for several minutes.

(2) Use the amplifier and indicating instrument to balance the secondary windings, as described under the section entitled, "Testing Solenoid", Procedure A in Appendix I.

(3) After which adjust the scale range selector switch, to give full-scale deflection on the high-sensitivity (MR) scale, when an MR1 calibrating standard is in the testing coil and the gain control "G", Figure 1 in Appendix I is near its midposition.

[1] (See Page 1)

Note 8: Before inserting calibrating standard balance secondary voltage to minimum as described in 5(a) (2) above.

(4) Switch amplifier to the low sensitivity (MR6) scale, insert the MR6 calibrating standard in testing coil and adjust shunt on input transformer to give full-scale deflection with gain control "G" at same position as used in adjusting for MR1.

(5) Recheck adjustments to make certain that sensitivities are correct.

Note 9: Calibrate the scale by adjusting the equipment to give full-scale deflection for the calibrating standard corresponding to its maximum value; and then substitute other calibrating standards and record their deflections. This shall be done for each scale. If desired, a special scale, or suitable graphs, can be prepared from these readings to correct for non-linearity, thereby eliminating the correction of subsequent analyzer readings.

(b) For each subsequent use, energize the analyzer and permit it to become stable.

Note 10: If the indicating instrument does not zero, balance the secondary coils with the balance coil.

(c) Weigh out 10 ± 0.01 grams of the sample to be tested, transfer to test specimen holder in several pinches by means of a wide-mouthed funnel; and pack each pinch into the chamber thereof.

Note 11: To obtain a maximum in random orientation, each pinch must include a complete cross-section of the test specimen and must not be sprinkled into the funnel (See Note 7). If the density of the sample is too great to fill the volume, disperse in zinc oxide, or other inert material.

(d) With the scale range selector switch in the position of MR6, insert calibrating standard MR6 into the testing coil and adjust the gain control for a meter deflection of 1.0 (Assuming the maximum reading on the dial is 1.0).

(e) Remove calibrating standard and insert test specimen holder containing sample. Note maximum reading and multiply by 6 to determine the scale range to be used e.g.

On MR6 scale range the sample gave a reading of 0.8, then $0.8 \times 6 = 4.8$ Use MR6 scale.

(f) When the proper MR scale range has been determined, select the highest calibrating standard for the range involved and insert in the testing coil. Adjust the amplifier gain control to give a full-scale deflection equal to the magnetic rating of the calibrating standard. Insert other calibrating standards for the range involved to check on the accuracy of the scale and note the readings.

(g) Remove calibrating standard and insert the specimen holder containing the sample. The dial reading of the instrument will then indicate the magnetic rating of sample.

(h) The following shall be recorded and reported:

MR range used.
Readings on calibrating standards.
Readings on sample.

Results and Accuracy

6. (a) Take three readings to two significant figures, as described under "Procedure" on each test sample and report the three results and their average. For accurate work readings shall be taken on three distinct test specimens derived from the original laboratory sample.

APPENDIX I

EXTRACT FROM A.S.T.M DESIGNATION: D1118-57[4]
"TEST FOR MAGNETIC RATING OF ASBESTOS"

PROCEDURE A

Principle of Operation of Apparatus

3. A schematic drawing of the apparatus for Procedure A is shown in Figure 1. The apparatus consists of a testing solenoid T having a primary winding M to produce a strong magnetic field, and secondary windings S and B to measure the change of flux caused by the specimen, a Class A audio amplifier, A, to increase the signal sufficiently to operate an indicating instrument I. This apparatus operates from a 115-v, 60-cycle power supply.

The secondary winding S is wound in two equal sections and connected so that their voltages oppose each other when the primary winding M is energized. Coil B is used in series with S to balance out any small voltage difference between the two sections, so that the voltage to the amplifier is zero when no specimen is in the coil. Under this condition, a small amount of magnetic material in one section of S will cause a small voltage at the input to the amplifier due to the increased magnetic flux in that section. This voltage is amplified sufficiently by A to be read by instrument I. It has been found that the readings of I are nearly directly proportional to the magnetic rating up to a magnetic rating of six. The primary and secondary windings of the testing solenoid, the amplifier gain, and the indicating instrument sensitivity can be varied as long as the over-all amplification is sufficient to give a full-scale deflection for the standard corresponding to the maximum scale value.

Testing Solenoid

4. The testing solenoid shall have a primary winding of 17 layers of 0.057-in. enameled single cotton covered copper wire (approximately 4200 turns). This coil shall be wound on a compound tube 2-1/4 in.

[4] Permission for reproduction obtained from American Society for Testing and Materials and Committee D-13 on Textile Materials.

in outside diameter with an inside diameter of 2 in., a length of 18 in., and end flanges 5 in. square by 1 in. in thickness. Inside of and concentric with the primary winding is the main secondary winding. This winding shall be in two sections on a compound tube 2 in. in outside diameter with an inside diameter of 1 in. and a length of 18 in. having two winding spaces each 3 in. in length with a diameter of 1-1/2 in. located an equal distance from the ends of the tube and 1-1/8 in. apart. Each section shall be wound with one layer of 0.010-in. enameled single silk covered copper wire (approximately 220 turns). These coils shall be electrically connected so that their voltages are opposing each other. A small sliding coil, B, Figure 1, shall be connected in series with the secondary winding and is used for fine adjustment of the secondary voltage. This coil shall be made to slide in the end of the secondary winding coil form with provision to lock it in place at any position up to 2 in. inside the form. The winding space for the sliding coil shall be 1 in. in outside diameter with an inside diameter of 7/8 in. and a length of 1/4 in. The number of turns on this coil is determined during test as follows:

Energize the primary coil from a 115-v, 60-cycle source and measure the voltages across the secondary coils. Then connect these coils in series so that their combined voltage is near zero. Then using a more sensitive indicating instrument, remove turns from the stronger section one turn at a time until it is within one turn of being exactly equal to the other section. Then wind the sliding coil with a sufficient number of turns so that the sections are exactly balanced at some point within its limits of motion and unbalanced in opposite directions at the extreme positions the sliding coil can take. This final balancing is usually made with the complete analyzer apparatus and the proper balance is indicated when the indicating instrument will show an appreciable deflection with the balance coil at one extreme of its limits of motion and then decrease to approximately zero and then increase to an approximately equal unbalance as the coil is moved to its other extreme limit.

* Test Specimen Holder

5. Test specimens shall be placed in a holder to facilitate setting them in and removing them from the testing solenoid. This specimen holder shall be slightly less than 1 in. in diameter so that it will easily slide inside the secondary coil. It shall be made with a handle at one end and a cork at the other end leaving a space

---

* Use nonmagnetic and nonmetallic material, such as wood or plastic, as specified in paragraph 2 (d) "Apparatus".

3/4 in. in diameter by 2-7/8 in. in length for the test specimen. The handle shall be made with a stop and its length shall be such that the specimen holder is centrally located under the nearest section of the secondary winding when the stop is against the solenoid.

Amplifier

6. The amplifier shall be a two-stage resistance-coupled Class A amplifier, using a pentode (type 57) for the first stage and a triode (type 56) for the second stage. The input is transformer coupled with a high secondary-to-primary-turn ratio transformer. The secondary of the input transformer is shunted by a resistance to change from the high sensitivity scale to the low sensitivity scale. This shunt circuit is controlled by a switch mounted on the amplifier panel. The amplifier gain is controlled by varying the screen grid voltage of the type 57 tube with the potentiometer G, Figure 1. The indicating instrument 1, included in the amplifier, is a d-c. miliampere meter with a sensitivity of 1 ma. for a full scale deflection. This instrument is used with a copper oxide instrument rectifier for use on alternating current. It is coupled to a 30-henry choke in the output of the type 56 tube by means of two 2-uf capacitors.

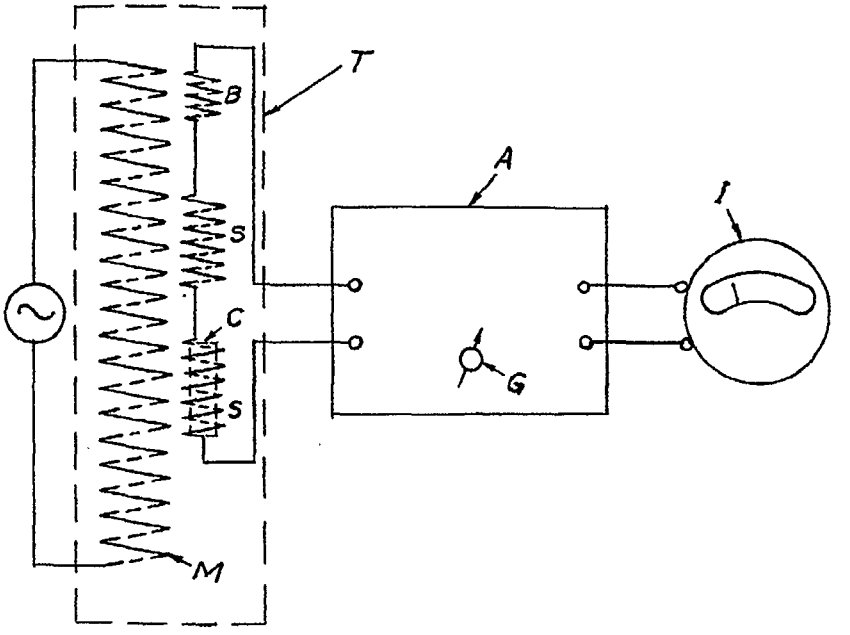


Fig. 1. - Schematic Diagram of Apparatus for Procedure A.

T - Test solenoid
M - Magnetizing coil
S - Secondary coils
B - Balancing coil
C - Test sample
~ - Alternating current source
A - Amplifier
G - Amplifier gain control
I - Indicating instrument

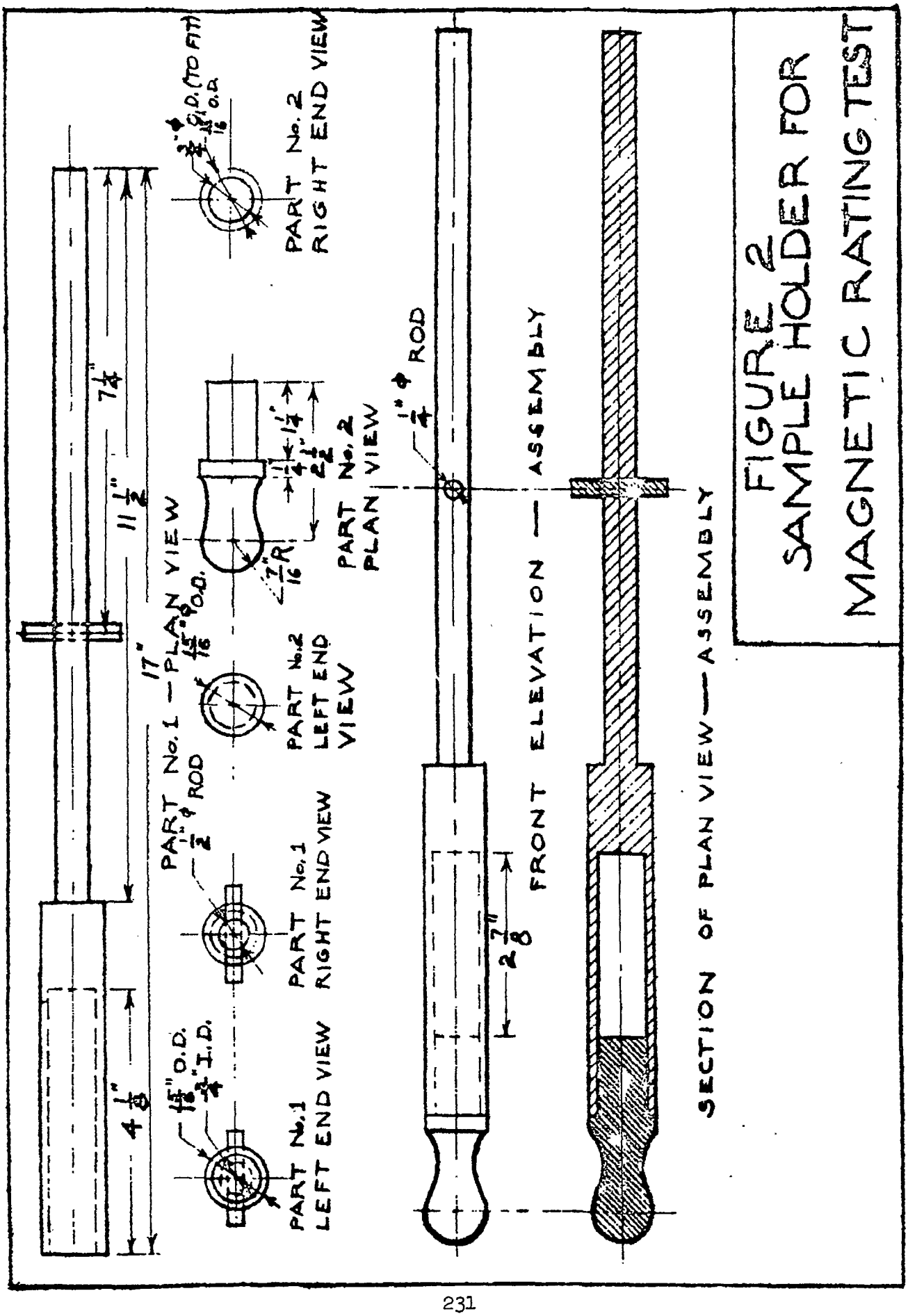


FIGURE 2
SAMPLE HOLDER FOR
MAGNETIC RATING TEST
PART No. 2
RIGHT END VIEW
PART No. 2
PLAN VIEW
PART No. 2
LEFT END
VIEW
PART No. 1 — PLAN VIEW
PART No. 1
RIGHT END VIEW
PART No. 1
LEFT END VIEW
FRONT ELEVATION — ASSEMBLY
SECTION OF PLAN VIEW — ASSEMBLY
ROD
ROD
17"
7¼"
11½"
4⅛"
2⅞"

TESTING PROCEDURES

FOR

CHRYSOTILE ASBESTOS FIBRE

(Second Edition)

G-7

KEROSENE RETENTION

Printed in U.S.A.

Revised and adopted by:

ASBESTOS TEXTILE INSTITUTE -
MINERAL FIBER PRODUCTS BUREAU -
QUEBEC ASBESTOS MINING ASSOCIATION - 1/19/65

G-7

KEROSENE RETENTION

Scope

1. This procedure is for measuring the kerosene retained by asbestos fibres of Group 7.

Apparatus

2. (a) Kerosene Retention Cylinder as per Drawings A and B.

   (b) Balance - sensitivity to 0.1 gm.

   (c) Two graduate cylinders - 250 ml.
   Two graduate cylinders - 500 ml.

   (d) Two beakers - 400 ml.

   (e) Spatula - 1/2 inch wide.

   (f) Supply of kerosene produced in accordance with following specifications:

   Canadian Government Specification Board, 3-GP-3a.
   United States of America Federal Specification, VV-K-211d, Kerosene.
   United Kingdom, Ministry of Defense Specification, DEF-2403-A.

   (g) Stop Watch.

Sampling

3. In accordance with (A-1) "Method of Sampling and Preparation."

Procedure

4. (a) Weigh two 50.0 gm samples of fibre into 400 ml beakers.

   (b) Add to the first beaker 325 ml of kerosene.

   (c) Wet with kerosene the screen of the Kerosene Retention Cylinder.

   (d) Using the 1/2 inch spatula mix the fibre and kerosene thoroughly for two minutes.

(e) Immediately transfer the slurry obtained in 4 (d) in one rapid continuous motion into the Kerosene Retention Cylinder.

(f) Start the stop watch simultaneously.

(g) Let the excess of kerosene drain into the 250 ml graduate cylinder during the period of 15 minutes.

(h) At the end of the 15 minute period read the amount of kerosene collected in the 250 ml graduated cylinder.

(i) Subtract the amount (A ml) of kerosene collected in the graduate from the initial quantity (325 ml) and multiply the results by two which will be the Kerosene Retention Value of 100 gms of asbestos fibre.

e.g. (325 ml - A ml) x 2 equals X ml/100 gms

(j) Repeat steps (b) to (i) with the fibre weighed into the second beaker.

(k) Report the average of the two results as the final result in ml of kerosene retained by a 100 gm sample of asbestos fibre.

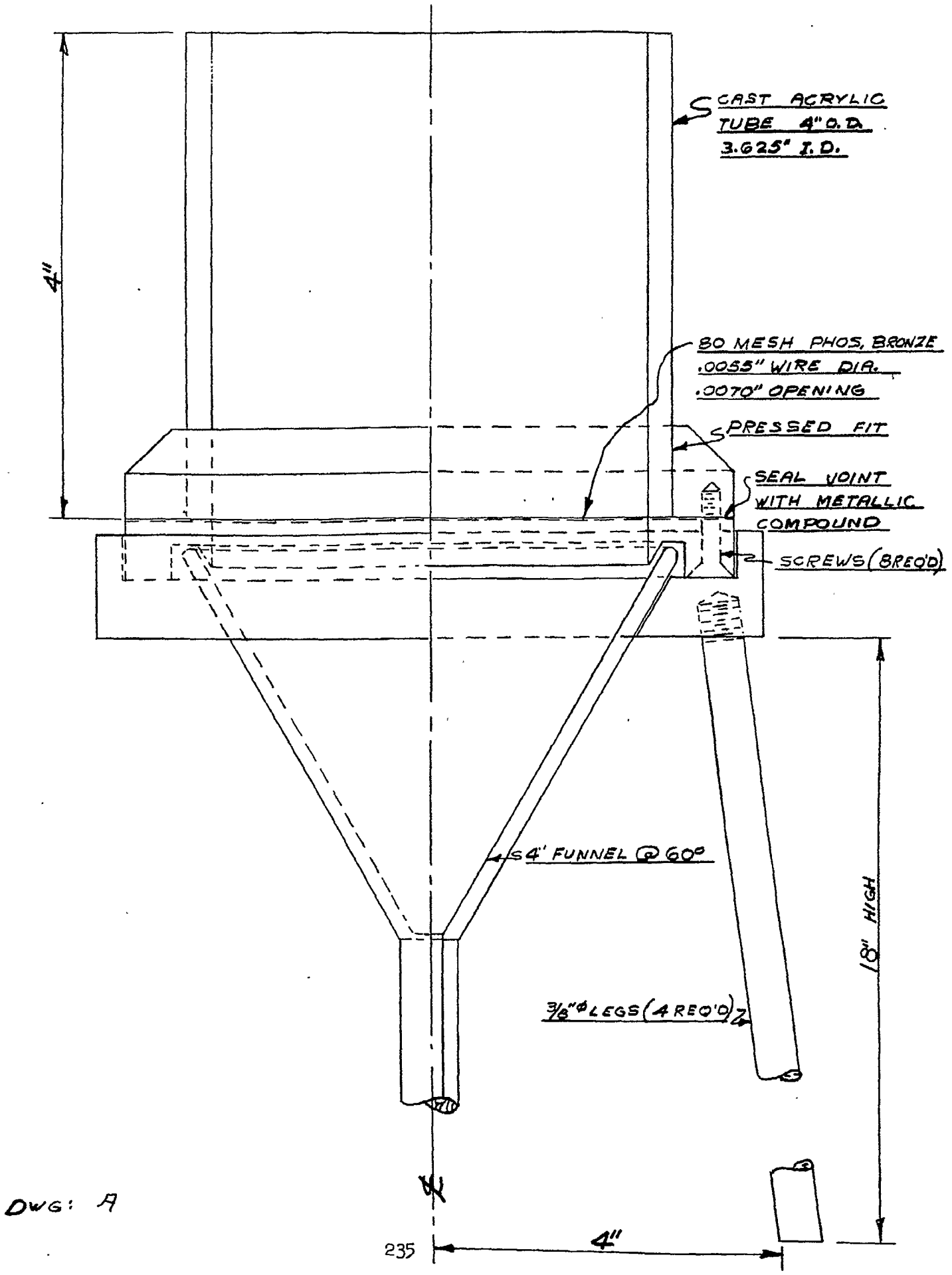
e.g. $\frac{X_1 + X_2}{2}$ = X ml/100 gm asbestos fibre

Accuracy

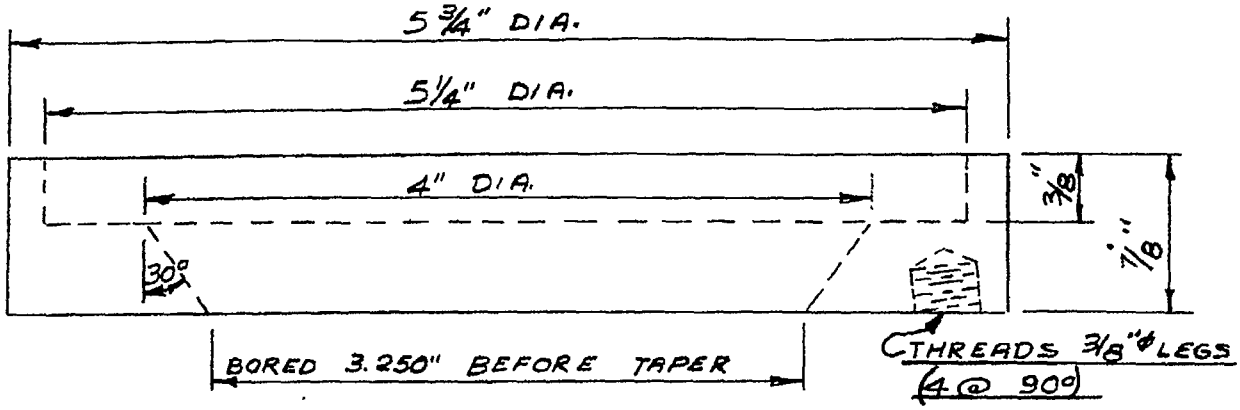
5. (a) The results obtained on the first and second sample should agree within 2 per cent.

When this is not attained the test should be repeated until two results within the required 2 per cent are obtained.

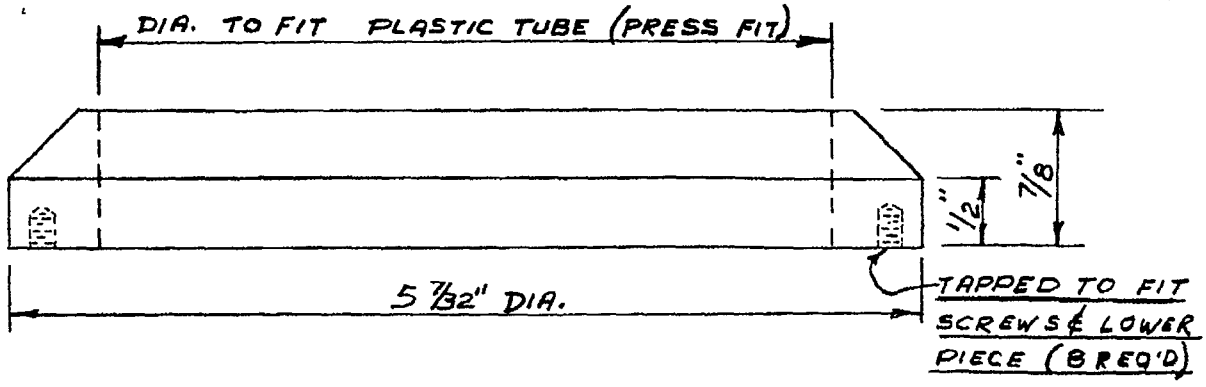
Note: The Kerosene Retention Cylinder may be adequately cleaned with tap water and dried with compressed air.



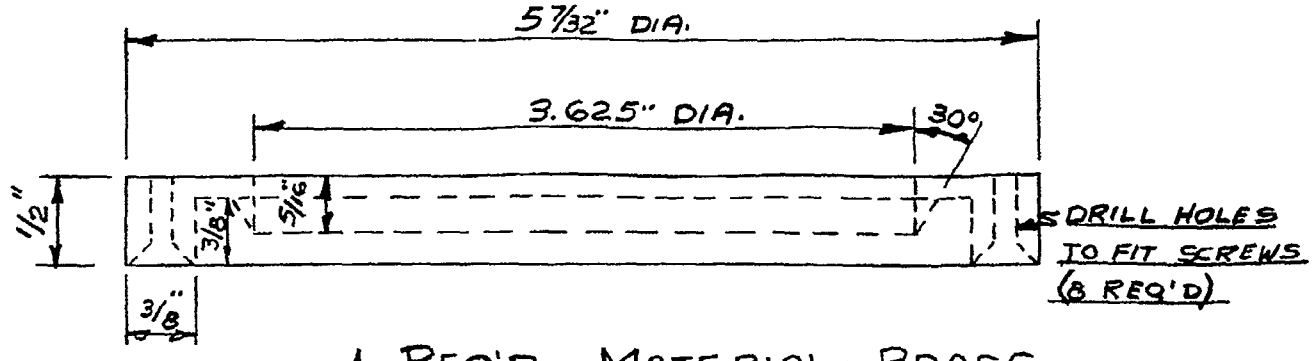
DWG: A



1 REQ'D - MATERIAL = BRASS.



1 REQ'D - MATERIAL = BRASS.



1 REQ'D - MATERIAL = BRASS.

DWG: B