3/84 TLR

PLAINTIFF'S EXHIBIT
DOW-629

BACKGROUND

A. TYPES OF ASBESTOS

NAME	TLV,* FIBER/CC	THEORETICAL FORMULA	DESCRIPTION
CHRYSOTILE	2	$3MgO\text{-}2SiO_2\text{-}H_2O$	MOST WIDELY USED FORM, KINKY FIBERS
AMOSITE	0.5	$(FeMg)SiO_3$	
CROCIDOLITE	0.2	$NaFe(SiO_3)_2\text{-}FeSiO_3\text{-}H_2O$	KNOWN AS "AFRICAN BLUE"
ANTHOPHYLLITE	2	$(MgFe)_7Si_8O_{22}(OH)_2$	
TREMOLITE	2	$Ca_2Mg_5Si_8O_{22}(OH)_2$	

B. PRODUCTION OF WORLD'S SUPPLY

CANADA	- 40%	SOUTH AFRICA	- 10%
U.S.S.R.	- 30%	UNITED STATES	- 1-2%

C. USES - ASBESTOS IS GRADED BY LENGTH. LONGEST FIBERS GO INTO TEXTILES, PACKINGS, BRAKE LININGS, AND ELECTRICAL INSULTION. SHORTEST FIBERS GO INTO INSULATION CEMENT, ROOF COATINGS, PLASTICS, AND CALKING COMPOUNDS. THE END USE OF ASBESTOS CAN HAVE A SIGNIFICANT INFLUENCE ON EXPOSURE HAZARD AND WHAT YOU SEE IN THE MICROSCOPE.

D. FIBER DIAMETERS - ALL FIBERS SEEN UNDER SIMPLE MAGNIFICATION SYSTEMS ARE ACTUALLY BUNDLES OF FIBERS. TO SEE A BASIC FIBER WOULD REQUIRE MAGNIFICATION OF ABOUT 50,000 POWER, OR THE EQUIVALENT OF AN ELECTRON MICROSCOPE. OUR COUNTING METHOD USES A MAGNIFICATION OF 400-450 POWER.

*PROPOSED STANDARD OF 0.5 F/CC TWA AND 2 F/CC STEL PENDING ON CURRENT LEGAL APPEAL.

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E. Changes in Standard

1. The odd TWA standard of 2 fibers/cc of air is currently in effect and will remain in effect until legal action against the new proposed standard is over. Current ceiling is 10 fibers/cc.

2. The proposed TWA standard is 0.5 fiber/cc with a ceiling of 5 fibers/cc.

3. 1972: TWA of 5 fibers/cc was standard
   1975: OSHA proposed TWA of 0.5 fiber/cc
   1976: NIOSH recommended TWA of 0.1 fiber/cc with 0.5 fiber/cc ceiling
   OSHA adopted TWA of 2 fibers/cc with 10 fibers/cc ceiling

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IDENTIFYING ASBESTOS

ALL METHODS BELOW RELY ON THE DEFLECTION OF LIGHT PASSING THROUGH ASBESTOS, ALSO KNOWN AS REFRACTION OR REFRACTIVE INDEX. A MICROSCOPE IS USED IN EACH METHOD.

A. PHASE CONTRAST - LIGHT FROM A BULB OR OTHER SOURCES IS CONCENTRATED (CONDENSED) INTO A SMALL BEAM WHICH PASSES THROUGH THE ASBESTOS. THE LIGHT BEAM THEN PASSES THROUGH DOUGHNUT SHAPED CONCENTRIC RINGS WHICH SEPARATE DEFLECTED AND UNDEFLECTED LIGHT WAVES, ALLOWING THE ASBESTOS TO BECOME VISIBLE. THIS IS THE CURRENT, DESIGNATED METHOD FOR COUNTING ASBESTOS FIBERS IN A SAMPLE.

B. POLARIZED LIGHT - LIGHT IS PASSED THROUGH A POLARING FILTER WHICH ORIENTS THE LIGHT WAVES INTO A SINGLE PLANE. THIS LIGHT PASSES THROUGH THE SAMPLE BEFORE PASSING THROUGH A SECOND POLARIZING FILTER. THE ORIENTATION OF THE SECOND FILTER IS APPROXIMATELY 90° TO THAT OF THE FIRST AND ESSENTIALLY BLOCKS OUT ALL THE LIGHT WAVES WHICH WERE NOT DEFLECTED BY THE ASBESTOS FIBERS.

C. DISPERSION STAINING - THE ASBESTOS SAMPLE IS STAINED AND IDENTIFIED BY CHARACTERISTIC COLORS. THE METHOD IS COMPLICATED AND TIME CONSUMING, BUT MAKES POSITIVE IDENTIFICATION AND CLASSIFICATION OF FIBERS POSSIBLE.

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SAMPLING

A. Equipment

1. Vacuum pump capable of drawing 1.7 Lpm of air against a resistance of 6 inches of water. Desired length, thick walled rubber tubing attached to pump.

2. Filter membrane 37 mm, 0.8 micron porosity, plain white cellulose ester material.

3. Open face filter holder. Millipore 37 mm field cassettes are handy and can be reused if washed in warm soapy water. Band cassettes with tape or shrinkable bands to prevent air leakage. Use Leur slip adapters to attach hose to cassette.

4. Bubble flow meter or a rotameter which has been calibrated within past year. A rubber stopper can be adapted to be connected to a flow meter and held in place against the filter holder while measuring air flow.

B. Procedure

Try to obtain an 8-hour TWA as well as excursion concentrations whenever possible. A TWA sample should monitor at least 75% of an employee's workday.

Use a sample flowrate of 1 to 2.5 lpm and check the flowrate at least at the beginning and end of the sample period. If the flowrate has changed use the average flowrate.

Minimum desired sampling times can be estimated from Figure II. An optimum sample would have about one fiber per counting field on the filter paper.

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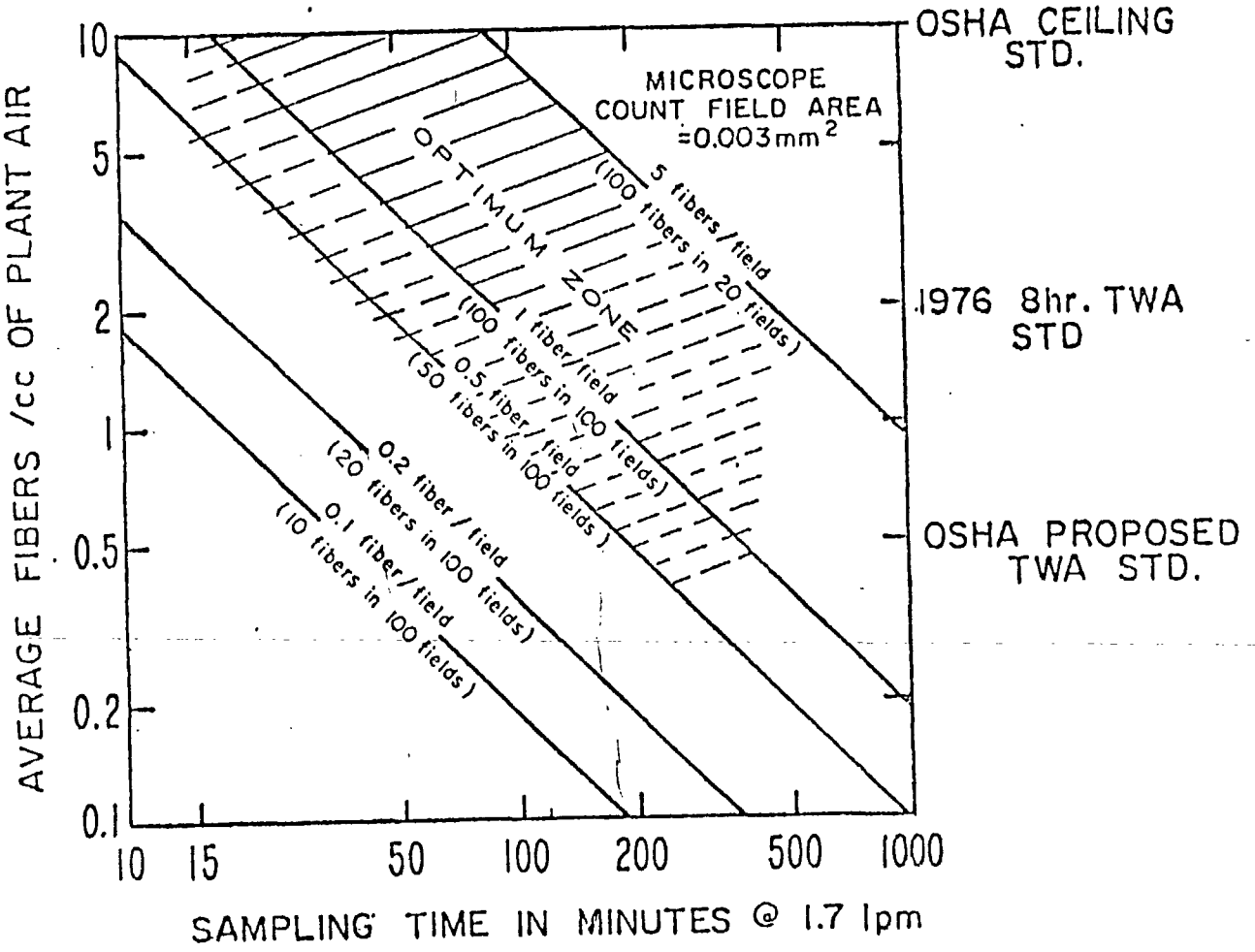

Figure 1. Optimum sampling times for airborne asbestos where microscope field area = 0.003 mm^2.

1.7 lpm

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SAMPLE MOUNTING

A. ITEMS NEEDED

GLASS SLIDES, 1 X 3 INCH OR 25 X 75 MM DIMENSIONS
SCALPEL OR RAZOR KNIFE OR RAZOR BLADE OR MICRO-SCISSORS
TWEEZERS
GLASS COVER SLIPS, #1.5 WHICH ARE 25 MM
MOUNTING SOLUTION - KEPT IN REFRIGERATOR
LINT FREE LENS TISSUE
MARKING PEN WITH FINE POINT AND PERMANENT INK
FILTER SAMPLE
GLASS CHIPS FROM BROKEN GLASS SLIDES
"BULLDOG" PAPER CLAMPS
PAPER TOWELING

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B. MOUNTING

1. CLEANLINESS IS NEXT TO IMPORTANT. WORK ON TOP OF PAPER TOWELING, WIPE GLASS SLIDE AND COVER SLIP WITH LENS TISSUE.

2. WORK ON ONE SLIDE AT A TIME UNTIL YOU ARE PROFICIENT. THE FIRST STEP IS TO LABEL THE SLIDE WITH AT LEAST YOUR NAME, SAMPLE NUMBER, AND DATE.

3. REMOVE THE SAMPLE FILTER FROM ITS HOLDER AND CUT OUT A WEDGE USING A RAZOR OR SCISSORS.

4. PLACE 1 DROP OF MOUNTING SOLUTION ON THE CENTER OF THE SLIDE IN THE FORM OF AN ELONGATED BEAD. PLACE THE FILTER WEDGE ON TOP OF THE SOLUTION.

5. OUTLINE THE PERIMETER OF THE FILTER WEDGE ON THE UNDERSIDE OF THE GLASS SLIDE. BE SURE NOT TO INCLUDE WITHIN THIS PERIMETER THE BASE OF THE WEDGE WHICH WAS HIDDEN UNDER THE FILTER HOLDER RETAINING RING DURING SAMPLING.

6. PLACE COVER SLIP ON TOP OF FILTER WEDGE AND PLACE A GLASS CHIP ON TOP OF THE COVER SLIP. APPLY PRESSURE TO THE GLASS CHIP WITH A "BULLDOG" CLAMP ON EITHER SIDE OF THE SLIDE. THIS IS THE POETTCKER PROCEDURE.

7. ALLOW APPROXIMATELY 3 HOURS FOR THE FILTER PAPER TO BECOME TRANSPARENT AND FOR THE MOUNTING SOLUTION TO HARDEN. PLACE THE MOUNTING SOLUTION BACK IN THE REFRIGERATOR.

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ASBESTOS FIBER COUNTING PROCEDURE

A. METHOD SPECIFIED BY OSHA - PHASE CONTRAST ILLUMINATION, 4 MILLIMETER OBJECTIVE, 400-450X MAGNIFICATION, BINOCULAR HEAD, 10X HUYGENIAN EYEPIECES RECOMMENDED, COUNTING FIELD AREA OF 0.003 mm^2 OR GREATER, PORTON RETICLE RECOMMENDED, ETC.

B. SET-UP, ADJUSTMENT AND FOCUS OF MICROSCOPE

1. SET-UP

POSITION ASBESTOS SLIDE ON "STAGE" (PLATFORM WHICH HOLDS SLIDE). BE SURE 40X ANNULAR DIAPHRAGM AND 40X OBJECTIVE ARE IN PROPER POSITION UNDER AND OVER SLIDE RESPECTIVELY. TURN ON MICROSCOPE ILLUMINATION. USE COARSE FOCUS TO RAISE THE STAGE UNTIL IT IS ~ 1/4 INCH BELOW THE OBJECTIVE. LOOK INTO THE EYEPIECES AND USE FINE FOCUS TO BRING THE SAMPLE INTO FOCUS.

2. ADJUSTMENTS

ADJUST DISTANCE BETWEEN EYEPIECES TO FIT YOUR EYES. DO THIS BY PULLING EYEPIECES APART AND SLIDING TOGETHER AGAIN UNTIL THE 2 ORBS OF LIGHT MERGE. THIS IS CALLED MARRIAGE OF THE ORBS. ISN'T IT ROMANTIC! SHARPEN THE IMAGE OF THE PORTON RETICLE, WHICH IS LOCATED IN ONE OF THE EYEPIECES. SWITCH THE RETICLE TO THE OTHER EYEPIECE IF YOU DESIRE. ADJUST FOR DIFFERENCES IN SIGHT BETWEEN YOUR EYES BY FOCUSING THE EYEPIECES INDEPENDENTLY. FIRST CLOSE ONE EYE AND USE THE FINE FOCUS TO SHARPEN THE IMAGE. THEN CLOSE THE OTHER EYE AND SHARPEN THE IMAGE USING THE FOCUS RING AT THE BASE OF THE RESPECTIVE EYEPIECE.

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3. FOCUS FIELD IRIS

WHILE LOOKING INTO THE EYEPIECES CLOSE THE FIELD IRIS APETURE ON THE BASE OF THE MICROSCOPE. USE THE CONDENSOR FOCUS KNOB TO BRING THE EDGES OF THE MANY-SIDED OPENING INTO AS SHARP FOCUS AS POSSIBLE. NOTICE THE INTERESTING COLOR CHANGES. ENJOY THEM, THIS IS THE HIGHLIGHT OF ASBESTOS COUNTING. OCCASIONALLY, THE MANY-SIDED OPENING WILL NEED CENTERING. DO THIS WITH THE TWO LONG-STEMMED KNOBS UNDER THE STAGE. OPEN THE IRIS JUST ENOUGH TO COMPLETELY LIGHT THE FIELD OF VIEW.

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C. COUNTING

COUNT THE NUMBER OF FIBERS INSIDE (SEE ALSO HALF-FIBERS) AT LEAST 20 DIFFERENT FIELDS. A "FIELD" IS THE AREA INSIDE THE LEFT HALF OF THE PORTON RETICLE. If you have not counted 100 fibers in the first 20 fields, see below.

KEEP COUNTING FIELDS UNTIL YOU HAVE A TOTAL OF 100 FIBERS OR 100 FIELDS (per sample), WHICHEVER COMES FIRST. ~~If you had to 4 in 20 fields~~

A FIBER IS TECHNICALLY ANY OBJECT WITH A 3:1 LENGTH-TO-WIDTH RATIO. IN REALITY FIBERS ARE FAIRLY EASY TO DIFFERENTIATE FROM BLOBS. DO NOT COUNT BLOBS, BUT DO COUNT RECTANGULAR OBJECTS WITH A 3:1 RATIO.

FIBER LENGTH MUST BE 5 MICROMETERS OR LONGER. THE DIAMETER OF CIRCLE #6 IS APPROXIMATELY 5 MICROMETERS.

DO NOT COUNT FIBERS WHICH CROSS ANY <u>TWO</u> OF THE FOUR OUTSIDE BOUNDARIES OF THE FIELD.

COUNTING CONTINUED

HALF FIBERS - COUNT AS A HALF-FIBER ANY FIBER WHICH CROSSES ONE OUTSIDE BOUNDARY OF THE COUNTING FIELD. AS AN ALTERNATIVE, PICK ANY TWO ADJACENT SIDES BEFORE STARTING AND COUNT AS WHOLE FIBERS ONLY FIBERS WHICH CROSS EITHER OF THESE TWO SIDES. IGNORE FIBERS WHICH CROSS THE OTHER 2 SIDES.

AVOID FIELDS CONTAINING BIG CLUMPS OF DEBRI WHICH MIGHT HIDE ASBESTOS FIBERS.

RECORD FIBERS COUNTED IN EACH FIELD ON THE ATTACHED SAMPLE RECORD SHEET.

CHOOSE A NEW COUNTING FIELD AS YOUR RECORD THE FIBER COUNT FROM THE LAST FIELD. DO THIS BY USING YOUR FREE HAND TO SLIGHTLY TWITCH THE MICROSCOPE'S LATERAL ADJUSTMENT KNOBS. THIS TECHNIQUE RANDOMLY SELECTS NEW FIELDS.

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(No. With >3:1 Ratio And At Least 5μ In Length)

Fields	Sample Nos.					
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
Fibers / 20 Fields						
Fibers / mm^2*						

$$\frac{\text{TOTAL FIBERS}}{(\text{TOTAL FIELDS})(0.00348)}$$

Hours:

Done By:

Date:

Checked B

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DETERMINING MONITORING RESULTS

A. Accuracy and Sources of Variation in Monitoring Procedure

1. Random Sources of Variation

Intrafilter - Differences in fiber count from one area of the sample wedge to another.

Interfilter - Variation due to random fluctuations in pump flowrate.

Environmental - Variation due to random concentration changes in time and space.

2. Systematic Sources of Variation

Intrafilter - Problem of air flow characteristics if use filter cassettes, American Industrial Hygiene Association Journal (44), July, 1983, pg. 542-546.

Intercounter - Differences primarily due to improper training, experience level, attitude, eyesight, and no quality control program. British study indicated untrained personnel obtained counts 50-70% lower than trained personnel.

Interlaboratory - Variations due to differences in microscope quality and specifications and improper microscope adjustment. A NIOSH study randomly tested 5 microscopes and found one consistently yielded counts an average of 45% higher than the other scopes.

Environmental - Systematic changes in concentration in time and space.

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B. FIELD CALCULATIONS

1. CALCULATION OF TOTAL NUMBER OF FIBERS ON A FILTER

$$\text{FIBERS/(MM}^2\text{ OF FILTER)} = \frac{\text{TOTAL FIBERS COUNTED}}{\text{(TOTAL FIELDS COUNTED) (MM}^2\text{/FIELD)}}$$

WHERE MM^2/FIELD = 0.00348 FOR THE OLYMPUS MICROSCOPE IN 1803 BUILDING

2. CONCENTRATION OF AIRBORNE ASBESTOS

TOTAL FIBERS ON FILTER = (FIBERS/MM^2)(855 MM^2, FOR 37 MM DIAFILTER)

$$\frac{\text{FIBERS}}{\text{CC}} = \frac{\text{(TOTAL FIBERS ON FILTER)}}{\text{(AIR FLOWRATE, LPM)(DURATION, MINUTES)(1000 CC/LITER)}}$$

2 lpm

C. COMPLIANCE CALCULATIONS

1. COMPLIANCE OFFICER'S TEST FOR NON-COMPLIANCE

NC = (SAMPLED AIR CONCENTRATION) - (1.645)(CV)(STANDARD)

WHERE: (A) CV DETERMINED USING FIGURE 3
(B) STANDARD TEMPORARILY 2 FIBERS/CC

IF NC EXCEEDS THE LEGAL STANDARD, THEN 95% OF SIMILAR AIR CONCENTRATIONS WOULD EXCEED THE STANDARD AND A CITATION WOULD BE ISSUED.

2. EMPLOYER'S VOLUNTARY TEST FOR COMPLIANCE

IC = (SAMPLED AIR CONCENTRATION) + (1.64)(CV)(STANDARD)

IF IC IS LESS THAN THE LEGAL STANDARD, THEN 95% OF SIMILARLY MEASURED AIR CONCENTRATIONS WOULD BE WITHIN THE STANDARD.

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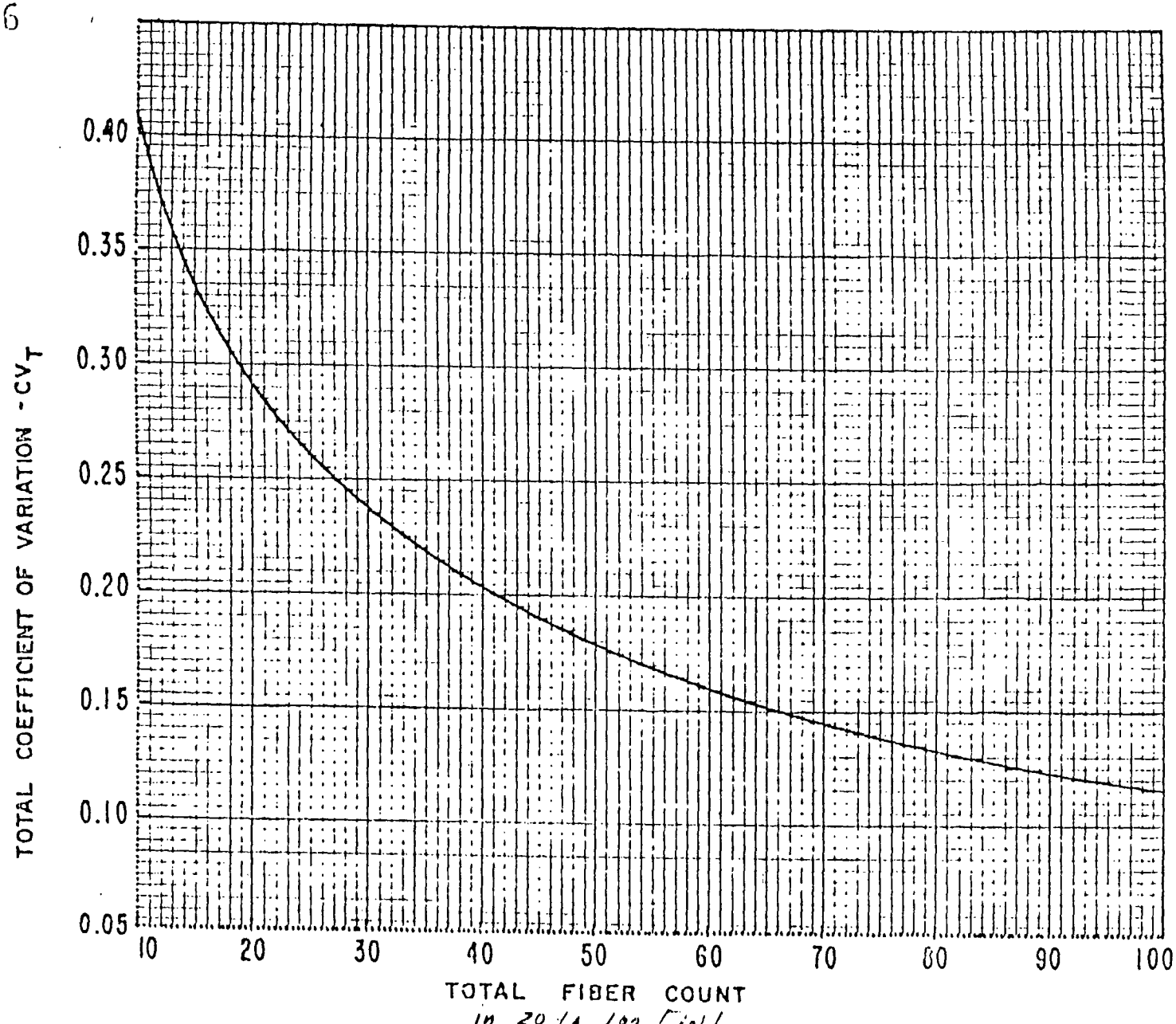

Figure 3 - Total coefficient of variation as a function of total fiber count (including pump error)

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