

CORESTA RECOMMENDED METHOD N° 17

STEM CONTENT OF LAMINA STRIPS

(January 1991)

A. INTRODUCTION

This CORESTA Recommended Method is concerned with the measurement of the stem content of lamina strips. The lamina strips arise from leaf threshing or hand stripping operations and can be from any tobacco type including, for example, flue-cured, burley, and cigar tobaccos.

The stem in lamina test method is to take a sample of tobacco strips and to pass it through a Cardwell type Quality Control Stem Tester. This is a small scale thresher and separating tower which threshes and classifies the residual stem from the lamina in a controlled manner.

This separated stem is collected and weighed as **Total Stem in Lamina**. If required this stem may be passed through a stack of screens on a Ro-Tap type Shaker to categorise the stem into **Over 3/32" Stem, Below 3/32" Stem less Fibre** and **Fibre Stem**.

NB : All linear measurements in this Method are given in inches; metric equivalents are included at 1" = 25.4 mm.

B. CARDWELL TYPE QUALITY CONTROL STEM TESTER

1. Introduction

The Stem Tester was originally designed by Lorne Rowell of Imperial Tobacco Co. (Canada) Ltd. in 1961 and manufactured under license by the Cardwell Machinery Co. The standard method described below for setting up the Tester was developed by Joe G. LEWIS and John D. HOOPER of Imperial Tobacco Co. (of GB & I.), Ltd. in 1965.

A diagram illustrating the main operating features of the Stem Tester is shown in Figure 1 and the test method is briefly described below.

A sample of tobacco strips is spread evenly across the feed conveyor and is thus fed into the thresher at a uniform rate. The threshed sample is pneumatically conveyed to a separating tower where the lamina is removed from the threshed material using a defined and controlled air flow and discharged into a bin. The heavies from this separation are returned to the thresher for re-threshing. This operation continues for 4 mins when the heavies discharge door automatically opens and discharges the residual stems into a container for weighing.

Different types of tobacco strip, with differing bulk densities, will require different sample weights to achieve the same volume feed into the thresher and different air flows in the separating tower to achieve the required separation of stem and lamina.

2. Modifications to the stem tester on installation

The following modifications should be made to the Stem Tester on installation and before the setting up process.

2.1. *Static Pressure Tapping and Manometer Installation*

The air velocity in the separating tower is indicated by a manometer connected to a static tapping in the tower. The tapping should be fitted 10" (254 mm) above the flange immediately above the doors of the separating tower and as flush as possible to the internal wall. This is to avoid air turbulence and thus erratic readings. The static tapping is illustrated in Figure 2.

A suitable manometer, with a full scale range of 0 to 0.20" (0 to 5 mm) wg, is fitted to the tapping and set to zero.

2.2. *Stem Deflector Plates*

Two stem deflector plates are required to stop free stem and heavies being kicked out of the thresher and lost to the test.

The first, illustrated in Figure 3, is fitted to the end of the vibratory conveyor feeding into the top of the thresher housing.

The second, illustrated in Figure 4, is fitted to the base of the thresher. Note that Damper C sited at the air flow inlet below the thresher should be removed. (See also paragraph 3.6.).

3. Setting up procedures for the stem tester

3.1. *Thresher*

- | | |
|---------------------------|---------------------------------------|
| a. Rows of thresher teeth | 4 |
| b. Teeth per row | 31 |
| c. Tooth dimensions | 3 13/16" x 1" x 1/8" (81 x 25 x 3 mm) |
| d. Teeth spacing | 1/8" (3 mm). |

See Figure 5 and Figure 6 for more detail.

3.2. *Thresher Basket*

- | | |
|----------------------|---|
| a. Hole size | 3/4" (19 mm) diameter punched holes |
| b. Hole distribution | See Figure 7 |
| c. Basket size | 18 7/8" x 10 3/8" x 1/8" (480 x 264 x 3 mm) |
| d. Outside radius | 6 1/16" (154 mm) |

See Figure 6 and Figure 7 for more detail.

3.3. *Shaft Speeds*

- | | |
|--|-------------------------|
| a. Thresher | 1150 r.p.m. ± 20 r.p.m. |
| b. Vibratory conveyor bearing | 450 r.p.m. ± 20 r.p.m. |
| c. Winnower | 950 r.p.m. ± 20 r.p.m. |
| d. Both Tangential Separator
Rotary Air Locks | 70 r.p.m. ± 5 r.p.m. |

3.4. *Tobacco Strips Conveyor*

- | | |
|-------------------------|---------------------------------------|
| a. Dimensions | 96" x 18" x 6" (2,438 x 457 x 152 mm) |
| b. Cycle time | 4 mins |
| c. Sample delivery time | 2 mins 40 secs |
| d. Belt speed | 3 ft/min (914 mm/min) |

3.5. *Air inlet Vanes Settings*

- a. Top vane 34 degrees to the horizontal
- b. Middle vane 34 degrees to the horizontal
- c. Bottom vane 29 degrees to the horizontal

The vanes must be fixed securely in these positions.

3.6. *Damper Settings*

Damper A : is sited down stream of the 14/24 tangential "lights" separator and is used to adjust the airflow through the separating tower.

Damper B : is sited downstream of the 14/18 tangential "heavies" separator and should be kept in the wide open position. This is to prevent stems building up in tangential separator.

Damper C : is sited at the air duct inlet below the thresher and should be removed. This is to prevent deposits of free stem and heavies building up behind the closed or partly closed damper. A stem deflector plate is fitted at the base of the thresher. (See also paragraph 2.2.).

If required, a large mesh screen can be fitted to the end of the air duct to trap any foreign matter picked up by the air flow. If fitted it must be kept clean.

Damper D : is sited in the air duct after the thresher and should be kept closed. These damper positions are illustrated in Figure 8.

3.7. *Separation Tower*

- a. The vibrating conveyor screen to be 20 mesh; wire diameter 0.014" (0.36 mm), open area 51%. The mesh is supported by a wire grid.
- b. The vibrating conveyor screen to have a 1" (25 mm) clearance at the point of exit from the separating tower to allow the heavies to pass through to the thresher.
- c. The winnower selvedge to clear the winnower housing by 1/4" to 3/8" (6 x 10 mm).

3.8. *Fan Performance*

The fan should be capable of giving over 4,200 cfm at a pressure of 5" (127 mm) WG but its speed may need adjusting to compensate for changes in air density at higher altitudes.

4. **Sample size and disc specification for various tobacco types**

Strips from different tobacco types can differ in their bulk density and therefore require different sample weights to ensure a constant volume feed through the Stem Tester. This avoids overloading the thresher and separating tower which would lead to variable and erratic results.

Tobacco types can also differ in the air flow required to separate the stem from the strips. The separating tower needs to be set up to a different standard air flow for these tobaccos.

The air flows are standardised by means of plastic discs which are described more fully in the Guidance Notes Section I and their design in Figure 10.

The recommended sample weight and disc specifications together with their tolerances for the three major tobacco types are detailed below.

Tobacco Sample Size and Disc Weights			
Tobacco Type	Sample Weight	Disc Weight mg	
		Light	Heavy
Flue-Cured	3 000 ± 300	328 ± 4	420 ± 4
Burley	3 000 ± 300	265 ± 4	328 ± 4
Cigar	1 000 ± 100	210 ± 4	290 ± 4

5. Setting the separator tower air flow to standard performance

- 5.1.** Ensure the Stem Tester is set up according to paragraphs 2. and 3. above.
- 5.2.** Turn the power off and set the manometer to zero.
- 5.3.** Fix and seal an aluminium plate, 18" wide, 14" high and 1/16" thick (*457 x 356 x 2 mm*), to the exit wall of the separating tower with plastic adhesive tape leaving a 1/2" (*13 mm*) clearance between the vibratory screen and the lower edge of the plate.
Fix a 2" wide, 7" long (*50 x 180 mm*) piece of plastic adhesive tape to the mesh vibratory screen; 2" (*50 mm*) from the opposite wall and in the centre of the screen. This is illustrated in Figure 9.
- 5.4.** Ensure the "heavies" discharge door is open.
- 5.5.** Open the separator tower door and place at random ten heavy and ten light discs on the plastic tape. (The discs should be selected according to tobacco type as described in Paragraph 4).
- 5.6.** Turn the power on. Start the fan and the 14/24 tangential "lights" separator airlock.
- 5.7.** Close the separator tower door.
Allow 40 secs for the airflow to stabilise and the manometer to settle and make a note of its reading.
- 5.8.** Start the vibratory conveyor and a stop clock simultaneously. The light discs should collect in the lamina hopper and the heavy discs in the heavies hopper.
- 5.9.** After precisely 30 secs, open the separating tower door. This will allow the remaining discs in the tower to discharge through the "heavies" discharge door. Ensure that no discs are lost on opening the door.
- 5.10.** Collect and count separately the discs that have collected in the lights and in the heavies hoppers.
- 5.11.** Replace the 20 discs on the plastic tape, close the tower door, and adjust damper A (sited down stream of the 14/24 tangential "lights" separator, see paragraph 3.6.) as follows:
 - a. If more than one light disc passes through the heavies door increase the static pressure by opening damper A.
 - b. If more than one heavy disc is carried over to the lights hopper reduce the static pressure by closing damper A.

- 5.12.** Repeat these instructions until at least nine heavy discs are discharged through the heavies door or at least nine light discs are collected in the lights bin.
Repeat these instructions at the same damper setting at least three times to confirm the separating performance.
- 5.13.** Note the manometer reading, tighten the damper locking nut and remove the plastic tape and aluminium blanking plate from the separating tower.
- 5.14.** Please note the following points on this procedure.
- The disc method is designed to ensure that a standard separating performance is obtained in the separating tower irrespective of changes in air density, altitude and temperature.
 - When the separating tower is set to standard air flow conditions the operator should expect to see the discs separate cleanly into ten light and ten heavy most of the time. The tolerance of one disc, given in 5.11 above, is to allow for light discs being trapped in the separating tower and for small irregularities in the air flow distribution in the tower causing heavy discs to be carried over with the lights.
 - If damper A is fully open and there is insufficient air flow to carry the light discs over, then check to see that damper B is fully open, that there is no obstruction, such as tobacco debris, in the system and that the fan is running at the appropriate speed.

6. Standard procedure for stem in lamina testing

- 6.1.** Ensure the air flow through the tower separator is set to standard according to Section 5.
- 6.2.** The nominal sample weight to be used for the different tobacco types is given in Section 4.
If a sample is taken which is outside these limits it should be discarded and a fresh sample taken.
The sample can be freshly taken or can be the recombined residue from a Lamina Strips Particle Size Test. (CORESTA Recommended Method N° 16).
- 6.3.** Weigh the sample and spread the sample evenly over the length and width of the feed conveyor.
- 6.4.** Ensure the heavies discharge door and the separating tower doors are closed.
- 6.5.** Switch the power on and then the following equipment in turn :
- the fan,
 - the 14/18 tangential "heavies" separator air lock,
 - the 14/24 tangential "lights" separator air lock,
 - the thresher,
 - the vibratory conveyor,
 - the winnower.
- 6.6.** Set the automatic timer to exactly 4 mins. (This allows 2 mins 40 secs for the sample to feed into the thresher and 1 min 20 secs for the thresher to clean the heavies.)
- 6.7.** Wait for the manometer reading to settle and check that its reading is the same as that achieved during the set up procedures. If it differs from this figure then check for possible causes such as those given in paragraphs 5.14 and 7 and then repeat the setting up procedure detailed in paragraph 5.

- 6.8.** Start the test by pressing the feed conveyor start button. This automatically starts the timer. As the last of the sample feeds into the thresher brush any residual strip particles from the feed conveyor into the thresher.
- 6.9.** After the test time of 4 mins the heavies discharge door will open automatically and stems will be discharged from the machine and collected in a bin. Allow 60 secs for the stems to discharge. Small deposits of fine stems remaining in the separating tower may be ignored.
- 6.10.** The light strips collected in the bin should be returned to the feed conveyor and spread evenly over its length and width for a second pass. The heavies discharge door is closed and the test method is repeated from paragraph 6.5. Any additional stem separated is collected and added to that from the first pass.
- 6.11.** Weigh the stem sample to within ± 1 gram.
- 6.12.** **Total Stem Content %** is calculated as follows:

$$\frac{\text{Weight of Stem Collected} \times 100}{\text{Weight of Original Strips Sample}}$$

- 6.13.** Turn the power off.
- 6.14.** When samples are tested at frequent intervals, for quality control or for other purposes, it may be more convenient to keep the machine running between tests. In this case, only the vibratory and feed conveyors need to be stopped and started between tests. Stopping the feed conveyor automatically resets the timer and re-energises the discharge door solenoid. The discharge door must be closed before each test.

7. Routine checking and cleaning procedures

- 7.1.** Check and clean daily :
1. The threshing basket. Remove any tobacco debris.
 2. The static tapping and manometer. Ensure the static tapping sensing hole is free of tobacco fines and dirt and the manometer is correctly filled and zeroed.
 3. The vibratory screen. Ensure the wire mesh screen has not become blinded with tobacco dust.
 4. The floor area surrounding the Stem Tester.
 5. Remove any stem deposits that may have built up in the:
 - a.* 14/18 tangential heavies separator.
 - b.* thresher and its surrounds.
 - c.* duct inlet below the thresher.
 - d.* the winnower shelf.
 - e.* the vibratory conveyor screen.
- 7.2.** Check weekly :
1. The threstling teeth. These are case hardened but look for excessive wear and elongation of the holes in the teeth.
 2. The air inlet guide vane settings.
- 7.3.** At least once a year all ducting should be dismantled and cleaned thoroughly.
- 7.4.** Maintain the Stem Tester according to the manufacturers manual.

C. THE RO-TAP TYPE SHAKER

1. Introduction

The stem in lamina test method can be extended by taking the stem product collected from the Cardwell type Stem in Lamina Tester and, after weighing, screening it into various size classes by means of a Ro-Tap type shaker.

A Ro-Tap type shaker reproduces the circular and tapping motion given to test screens in hand sieving but in a uniform manner.

2. Test Equipment

2.1. *The C.E. Tyler Ro-Tap Type Sieve Shaker.*

(Model RH-19, Model B or Equivalent).

Elliptical diameter approx. 32 x 25 mm

r.p.m. 280 - 290

Hammer drop 15/16" ± 1/16" (33 ± 2 mm) - 150-157 strokes per minute.

2.2. All sieves are of the standard size 8" in diameter and 2" deep. They are designed to nest together to form a stable sieve stack in the following order.

1. A 3/32" slotted plate screen made to order. (See Figure 12)

2. US N° 7 sieve. (Tyler N° 7)

3. US N° 12 sieve. (Tyler N° 10)

4. Pan.

3. Test Method

3.1. All stem product, measured as **Total Stem Content**, from the Cardwell Type Stem Tester is weighed and placed on the top screen. (This will generally range between 50 and 150 grams.)

3.2. Start the Ro-Tap type Shaker with the hammer engaged and simultaneously start a stop clock or electronic timer and run the Shaker for exactly 5 minutes. Remove the sieve stack.

3.3. Remove any lamina bullets and record the weight of stem remaining on each screen and pan.

3.4. Calculate the various categories of stem as follows :

1. *Over 3/32" Stem % =*

$$\frac{\text{Weight of Stem on 3/32" Screen} \times 100}{\text{Total Sample Weight}}$$

2. *Below 3/32" Stem less Fibre % =*

$$\frac{\text{Weight of Stem on N° 7 + N° 12 Screens} \times 100}{\text{Total Sample Weight}}$$

3. *Fibre Stem % =*

$$\frac{\text{Weight of Stem in Pan} \times 100}{\text{Total Sample Weight}}$$

D. GUIDANCE NOTES

1. Use of discs to define separating tower air flow conditions

- 1.1.** Stem varies in thickness from the butt to the vein. However only stem above a certain thickness is usually regarded as objectionable so any mechanical method of measuring stem in lamina must be set up and standardised to recognise this arbitrary criteria.

Aerodynamic separation as used in the Cardwell type Stem in Lamina tester cannot give a sharp separation by stem thickness. Any method that removes the relatively thick objectionable stem will inevitably remove some of the thinner stem. Small differences in air velocity or air distribution in the separating chamber will also affect the result.

Changes in air density affect the lift characteristics in a separating chamber and require corresponding changes in air velocity to compensate for them.

A straightforward velocity correction may not always produce a standard separating performance and may not be easily achieved across the wide variety of climates, altitudes and locations in which the Stem Tester must operate. A simple non technical method was required which would enable the Stem Tester to be easily standardised.

Polypropylene discs were introduced as a means of solving this problem. These discs can be made of varying thickness, and therefore weight, and it is easily shown that there is a linear relationship between the separating tower static pressure and the weight of a disc carried over into the air stream.

- 1.2.** Polypropylene discs, 1" (25.4 mm) in diameter, have the following characteristics :
1. Polypropylene is a relatively low density material so a disc thickness between 0.020" and 0.040" (0.5 to 1.0 mm) will cover the full static pressure range in the separating tower and is easy to machine. Denser materials would require thinner discs to cover the same range giving less control during manufacture.
 2. Polypropylene discs may be turned accurately and simply from 1" (25.4 mm) diameter bars and are virtually non-hygroscopic. Some plastic materials, such as nylon, are found to absorb moisture and therefore can gain or lose weight. This has a dramatic effect on the separating static pressure required to lift the discs.
 3. The parting-off nipple remaining on the disc after turning is only 2% of the disc weight and as the nipples appear to act as a form of aerodynamic ballast they are not removed from the discs.

- 1.3.** A drawing of the disc design is given in Figure 10.

- 1.4.** A relationship between disc weight and the static tower pressure at which:

1. All discs separate from the tower, and
2. All discs remain in the tower,

is shown in Figure 11.

This relationship enables a set of "light" discs and "heavy" discs to be specified for any required static tower pressure.

2. Subjective and objective assessment of objectionable stem

- 2.1.** Several grades of tobacco lamina, of varying stem content, should be tested over a range of separating tower static pressures and the heavies collected.
- 2.2.** The heavies product from these tests should be inspected by senior leaf and quality control personnel within a Company to determine which samples represent their view of objectionable stem.
These will lie somewhere between heavies collected at the higher static pressure range containing only the larger stems and those collected at the lower static pressure range containing these larger stems pins quantities of thinner stems and veins.
- 2.3.** The static tower pressure at which the selected samples were separated is recorded and a set of discs manufactured using the relationships between static tower pressure and the relevant light and heavy disc weights described in the Guidance Notes paragraph 1.4.
- 2.4.** The procedure described above must be repeated for each type of tobacco strips requiring testing for Stem in Lamina. The air flow characteristics of most cigar tobaccos, for example, differ markedly from most flue-cured tobaccos. The sample weights and Stem in Lamina targets are also likely to differ between tobacco types.

3. A note on sampling positions

The majority of strips sampled for stem in lamina testing are taken at the end of the threshing line as a quality control measure. These samples generally range from 16 to 20% moisture.

Tobacco strips are also, from time to time, sampled and tested from the exit of the redrier and out of the packed case or hogshead immediately after packing. Samples are also taken and tested before and after strips blending during cigarette manufacture. The sampling and handling of dry lamina must be carried out carefully to avoid degradation.

The moisture of some of these samples may range from 10 to 13 % and they will need to be reconditioned to at least 15 to 16% moisture before testing.

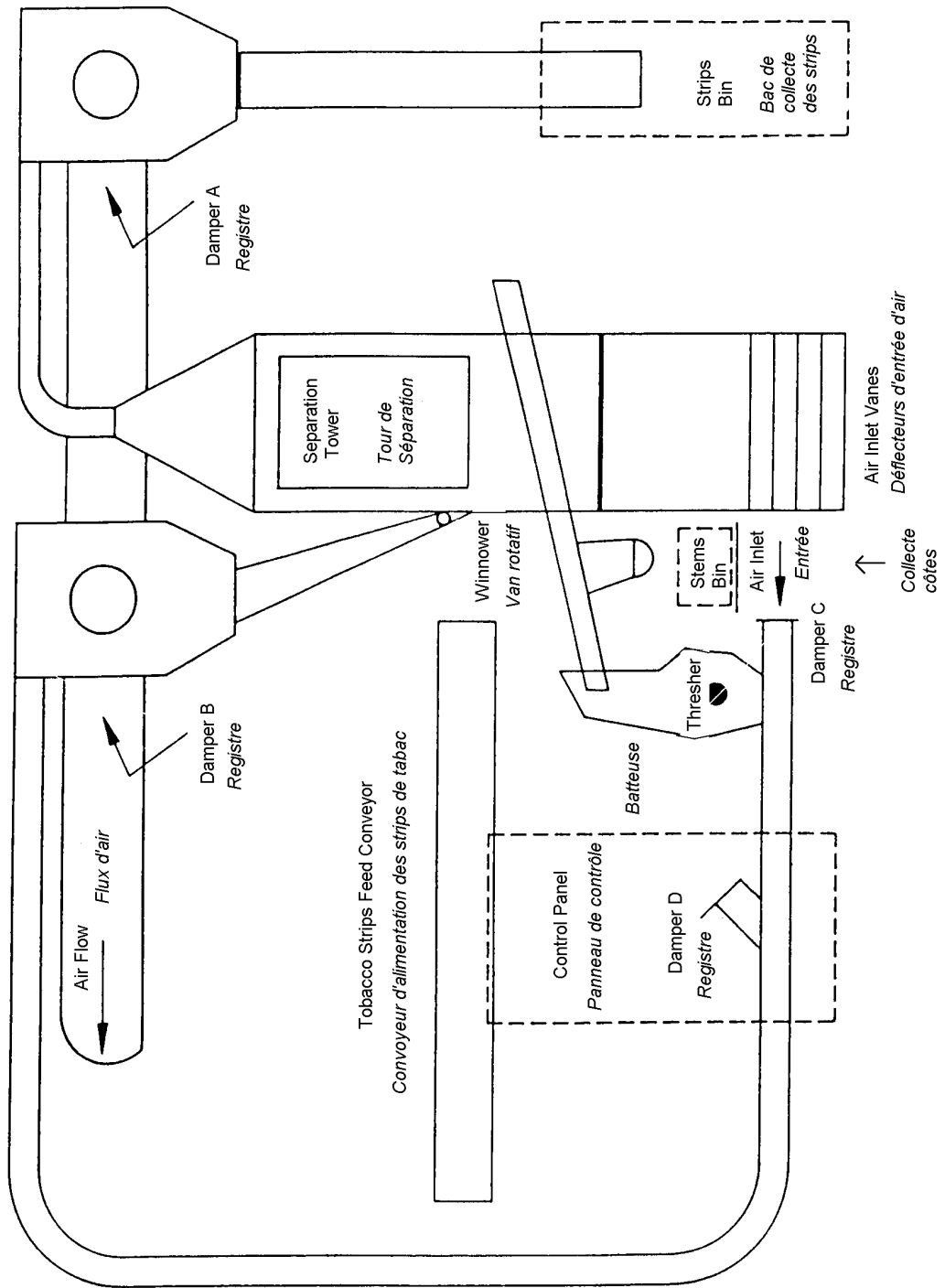
It should be recognised that although the total stem content of the lamina strips sampled from all test locations are likely to be similar, there is no guarantee of this. Test data should only be compared and ranked from within one sampling location.

It is not just differences in moisture content at the time of the test that may affect the result but also physical changes to the lamina and stem arising from their being subjected to the redrying and packing process. This may affect both the relative densities and aerodynamic properties of the sample.

Recommended Method N° 17 - Figures

RM 17 - FIGURE 1

SCHEMATIC OF STEM TESTER SCHEMA DU CONTROLEUR DE COTES

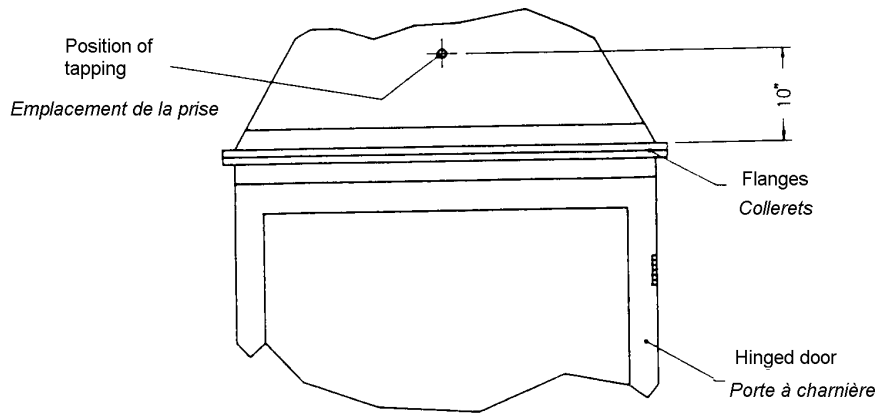
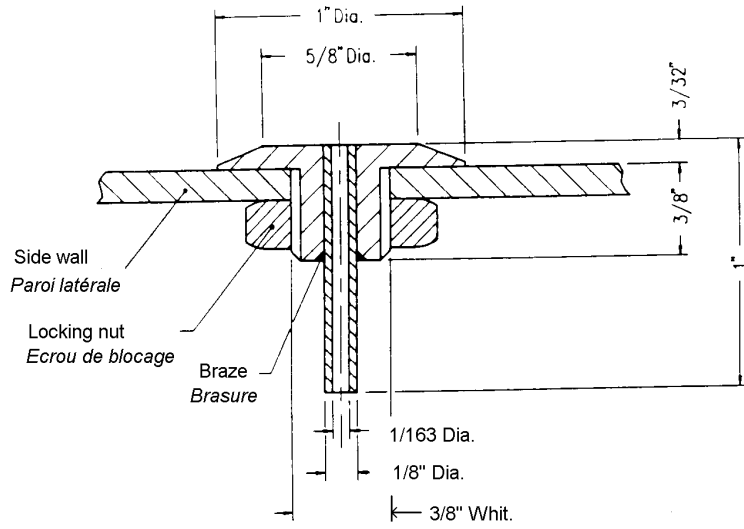


RM 17 - Figure 2

Figure 2

STANDARD STATIC TAPPING

PRISE STATIQUE STANDARD



SEPARATING TOWER

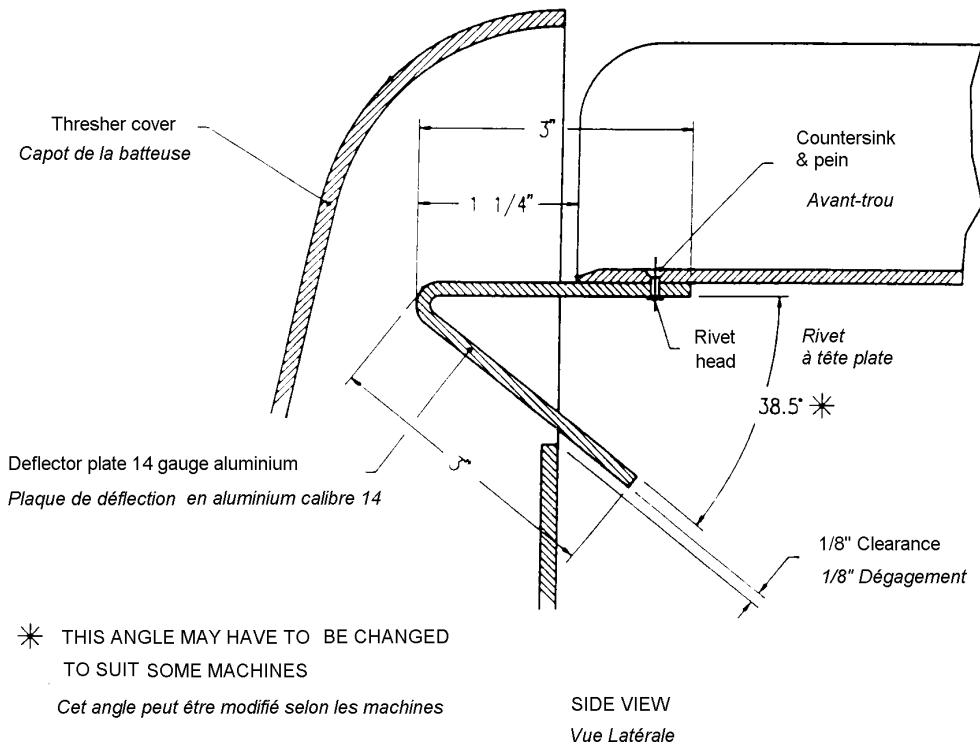
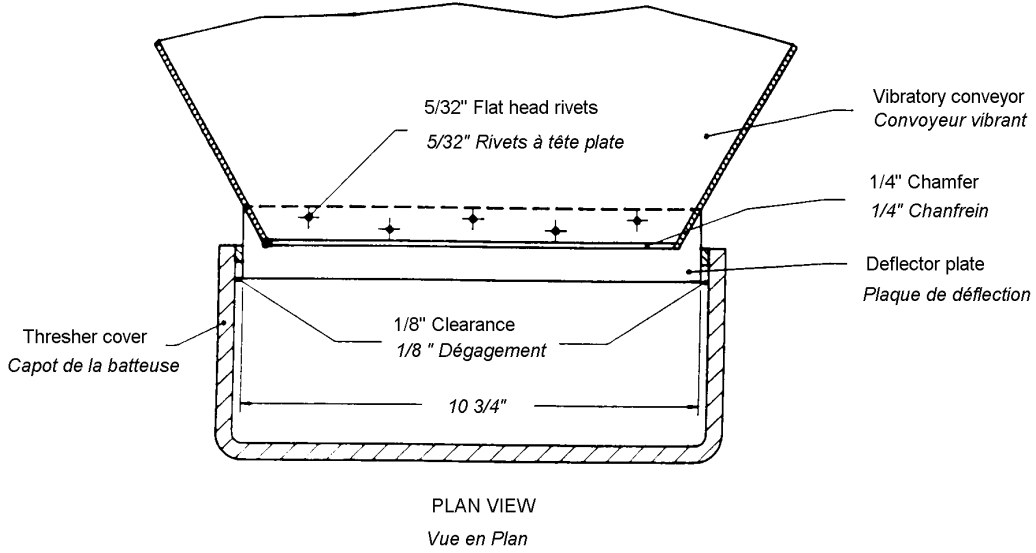
TOUR DE SEPARATION

RM 17 - Figure 3

Figure 3

STEM DEFLECTOR PLATE
THRESHER INLET

PLAQUE DE DEFLECTION DES CÔTES A
L'ENTREE DE LA BATTEUSE

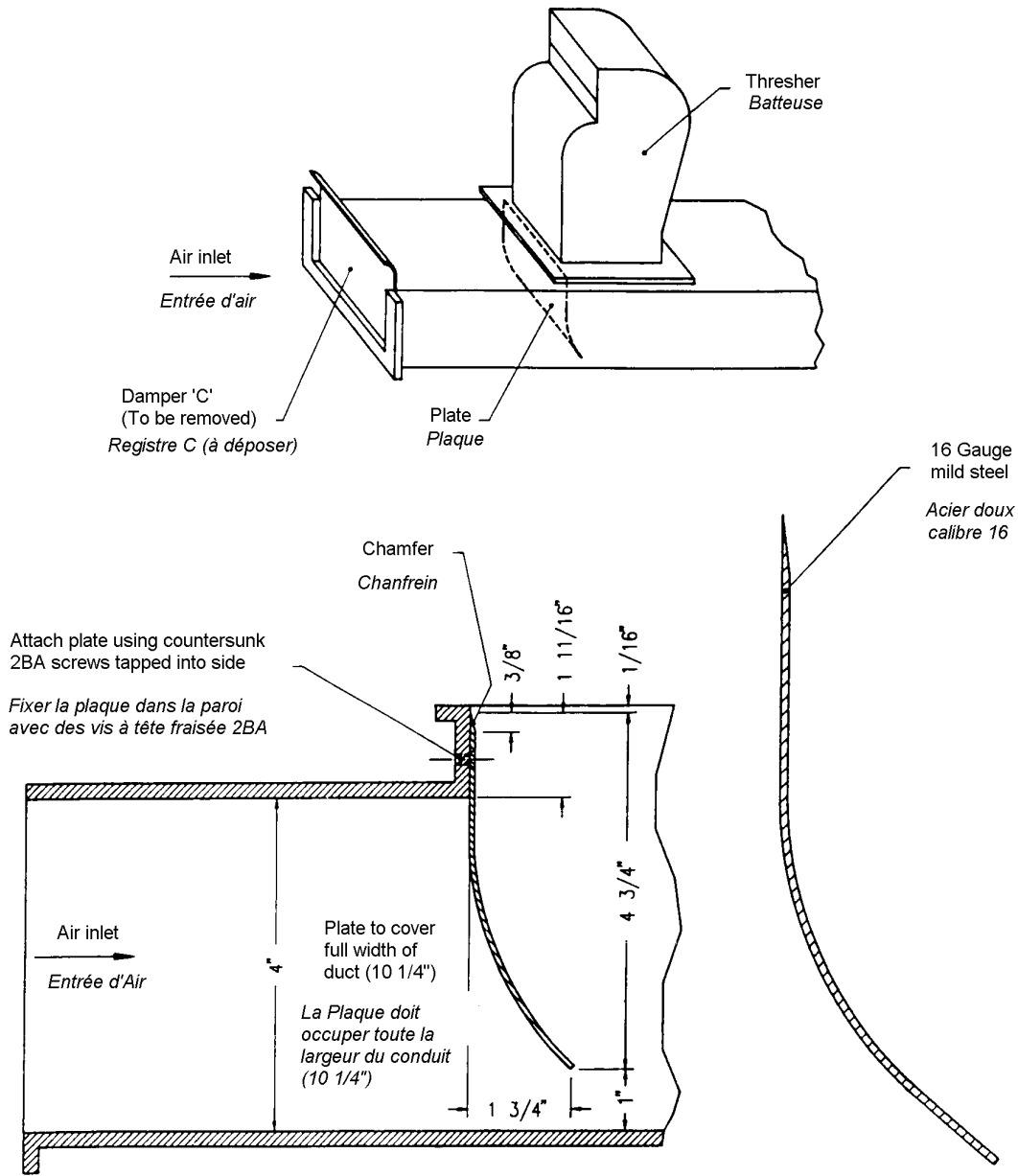


RM 17 - Figure 4

Figure 4

STEM DEFLECTOR PLATE
THRESHER OUTLET

PLAQUE DE DEFLECTION DES CÔTES
A LA SORTIE DE LA BATTEUSE



CROSS SECTIONAL SIDE VIEW
OF DUCT SHOWING POSITION OF PLATE

FULL SCALE CROSS SECTION OF PLATE
USE TEMPLATE WITH THIS CONTOUR

COUPE LATÉRALE DU CONDUIT
MONTRANT LE POSITIONNEMENT
DE LA PLAQUE

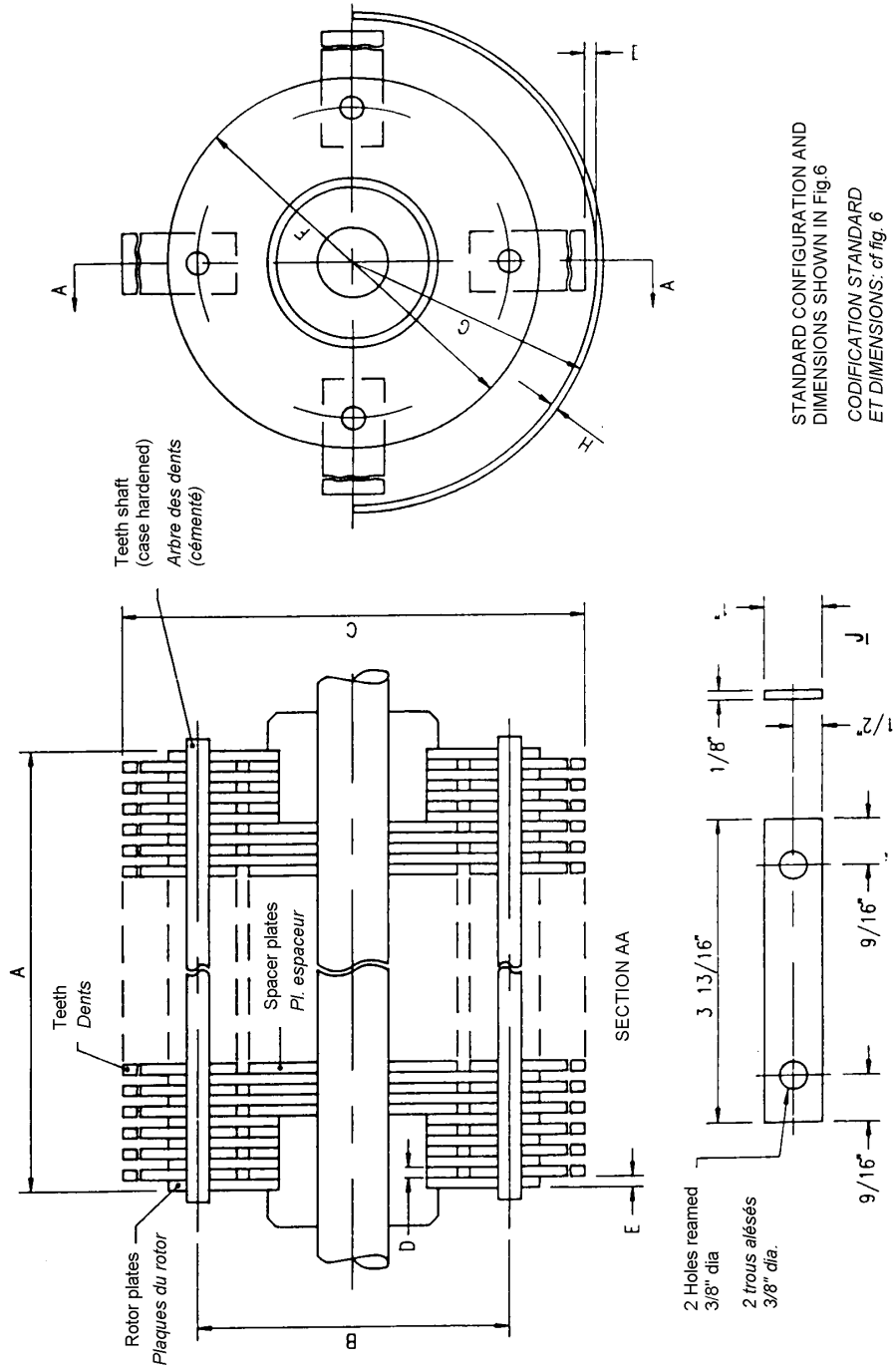
SECTION ECH.1 DE LA PLAQUE
UTILISER UN GABARIT DE CE CONTOUR

RM 17 - Figure 5

Figure 5

THRESHER ASSEMBLY

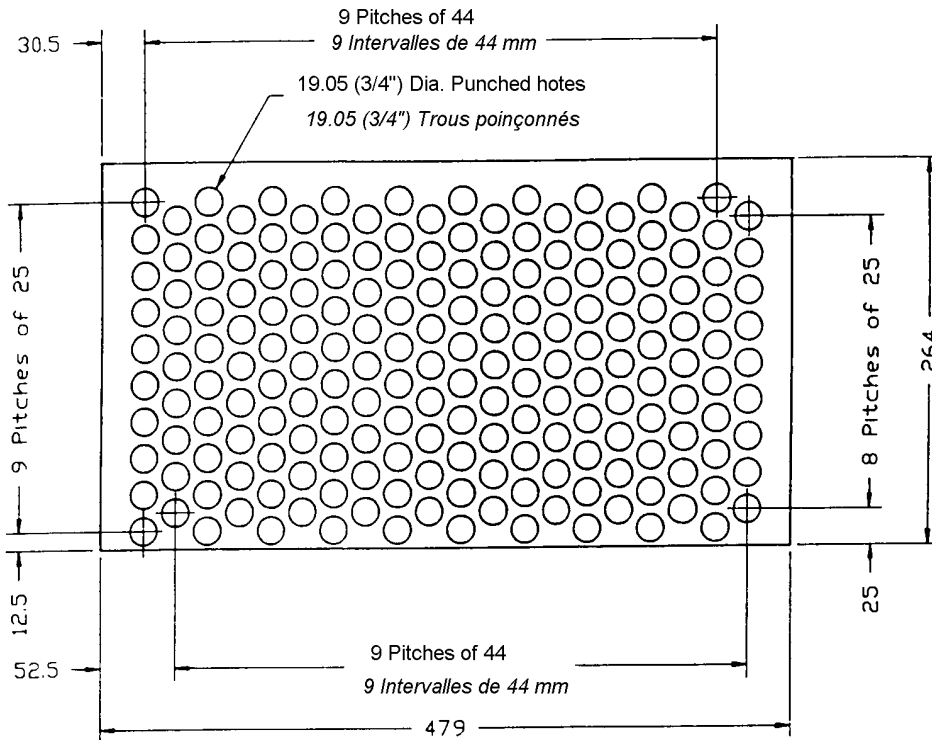
MONTAGE DE LA BATTEUSE



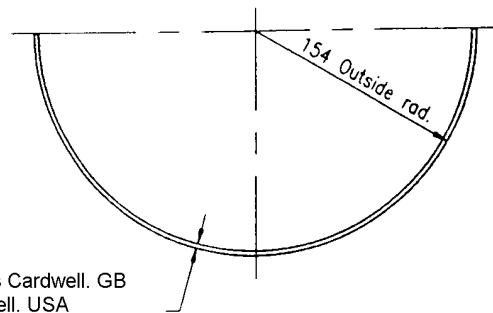
RM 17 - Figure 7

Figure 7

STANDARD THRESHER BASKET PANIER STANDARD DE BATTEUSE



BEFORE ROLLING
AVANT ROULAGE



10 SWG (MS) - Vokes Cardwell. GB
11 GA (HRS) - Cardwell. USA

AFTER ROLLING
APRES ROULAGE

- Notes:
1. All dimensions in mm unless marked otherwise.
 2. Edges of holes to be free of burrs.

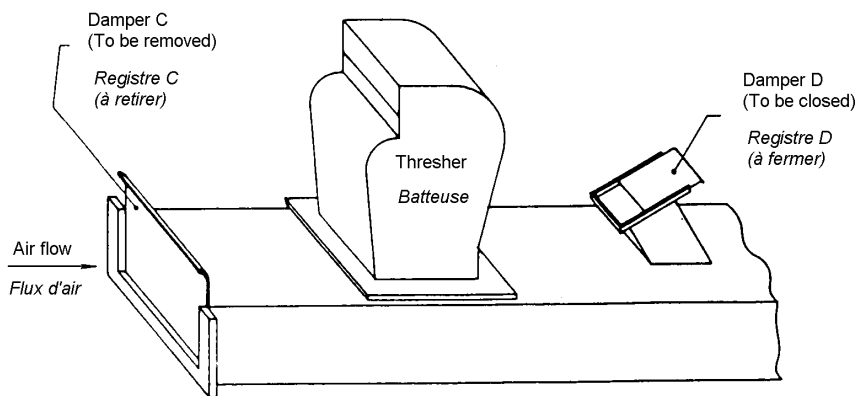
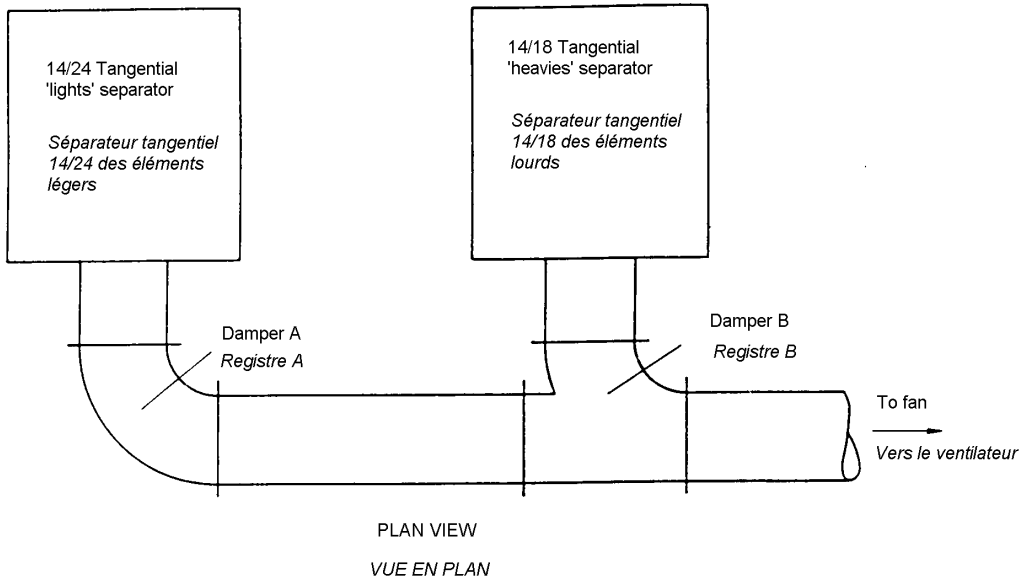
- Notes :
1. Toutes dimensions en mm sauf spécifié autrement.
 2. Les bords des trous doivent être ébarbés.

RM 17 - Figure 8

Figure 8

LOCATION OF DAMPERS

POSITION DES REGISTRES

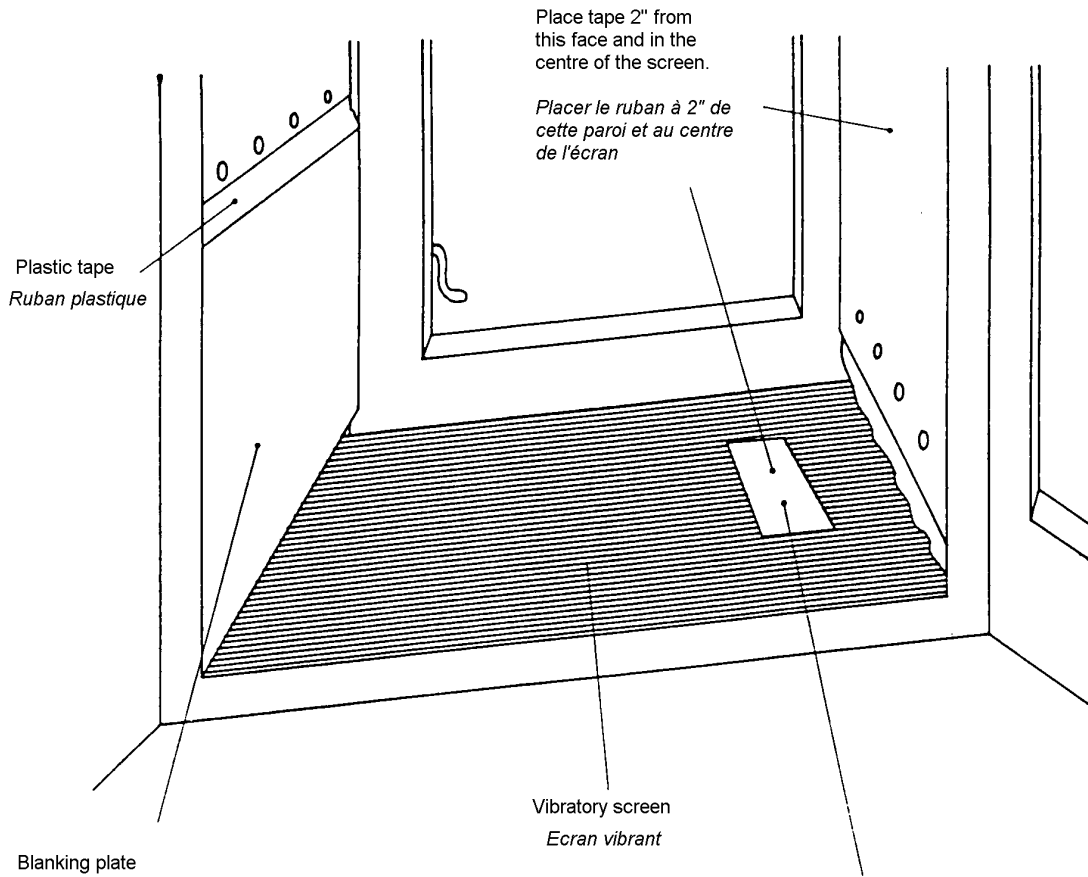


RM 17 Figure 9

SET UP TO STANDARDISE
TOWER AIR FLOW

Figure 9

DISPOSITIONS POUR STANDARDISER
LE FLUX D'AIR DANS LA TOUR



Aluminium 12SWG (0.104") plate
18" wide x 14" high, 1/2"
clearance between vibratory screen
and lower edge plate.
Plate held in position by
plastic (as shown).

Plaque

Plaque d'aluminium épaisseur 0,104"
largeur 18", hauteur 14".
Dégagement de 1/2" entre le vibrant
et le bas de la plaque.

Plaque tenue par le ruban plastique,
comme indiqué.

Std. mesh dimension :

20 Mesh per 25.4mm, Wire diameter 0.356mm,
Opening 0.91mm, 51.8% Open area.

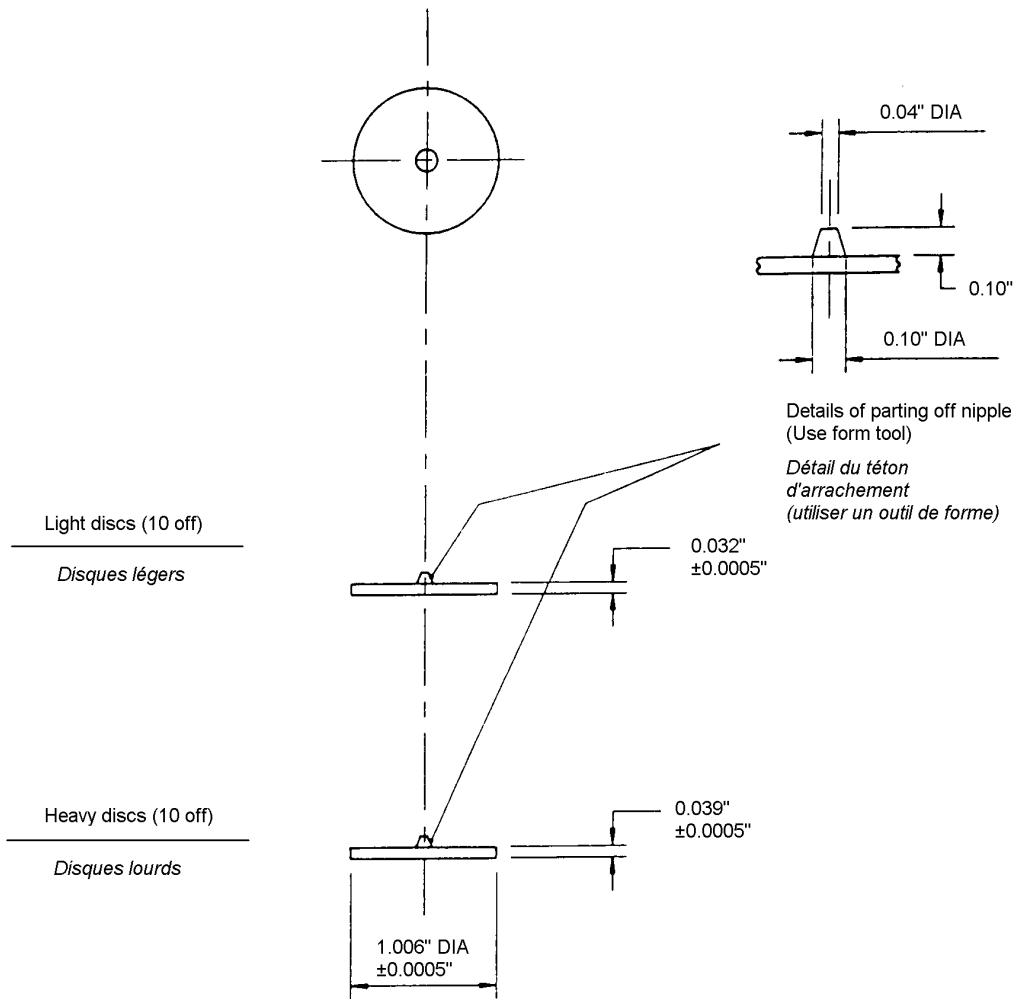
20 mailles par pouce Fil : Ø 0,356mm
Ouverture : 0,91mm, Surface ouverte : 51,8%

RM 17 Figure 10

Figure 10

DISC DESIGN

DESSIN DES DISQUES

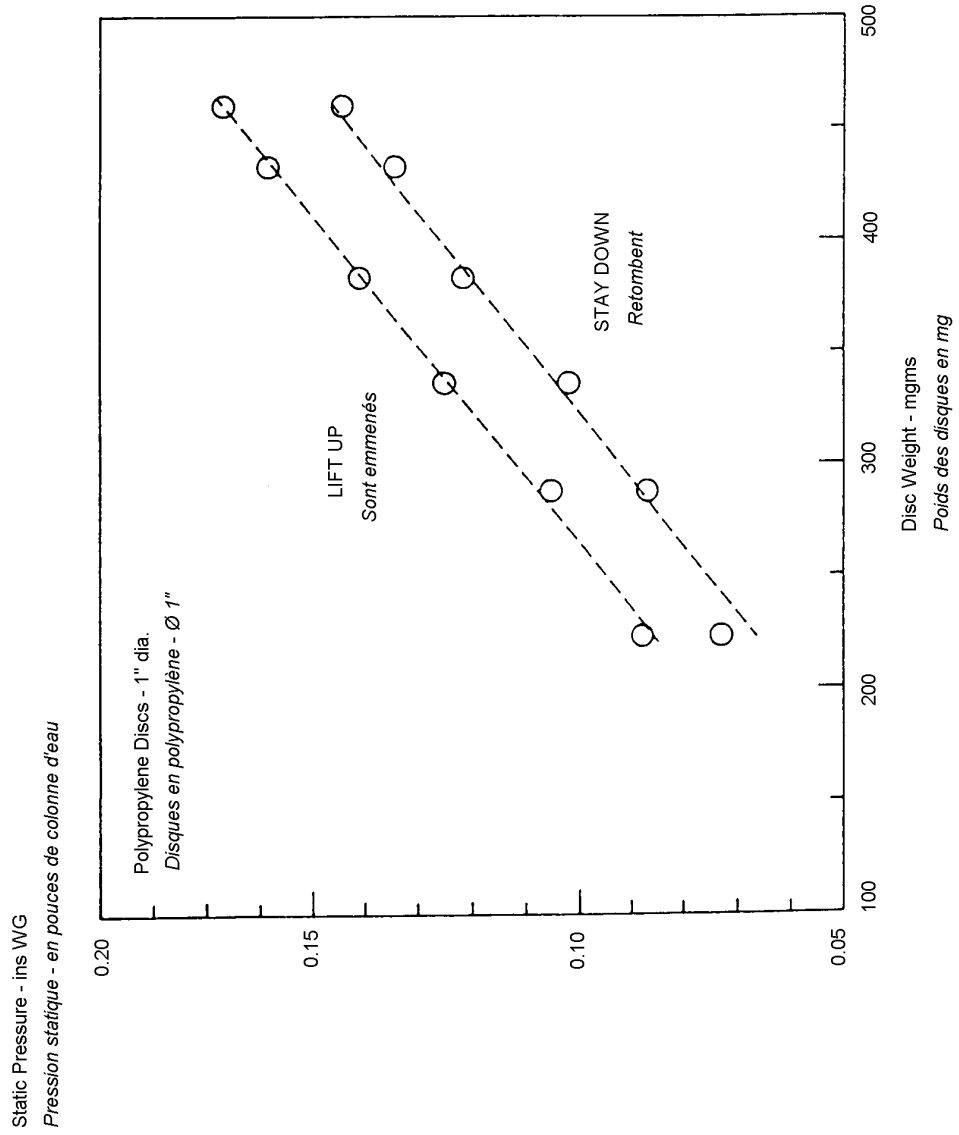


RM 17 Figure 11

Figure 11

SEPARATING TOWER CONDITIONS
AND DISC WEIGHT

PRESSION DANS LE SEPARATEUR
ET POIDS DES DISQUES

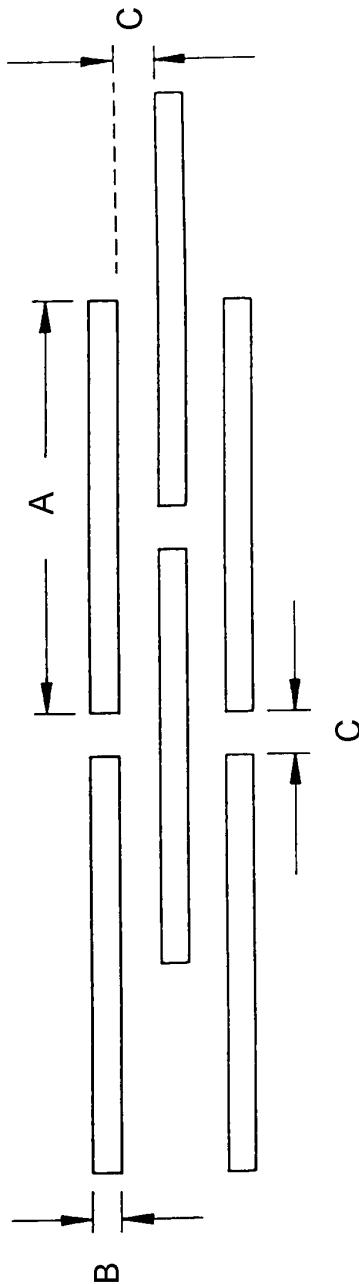


RM 17 Figure 12

Figure 12

3/32" SLOTTED PLATE
SCREEN FOR RO-TAP

PLAQUE ENTAILLEE
3/32" DU RO-TAP



This 3/32" slotted plate screen to be fitted to a standard size sieve.

8" in diameter and 2" deep.

Cette plaque entaillée doit être fixée à un tamis de taille standard de diamètre 8" et de profondeur 2".

	Imperial	Metric
A	1 1/4"	31.75 mm
B	3/32"	2.38 mm
C	7/64"	2.78 mm