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**COOPERATIVE
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College of Agricultural and Environmental Sciences
College of Family and Consumer Sciences

Calibration of Bulk Dry Fertilizer Applicators



*Revised by Paul E. Sumner
Biological and Agricultural Engineering*

Uniform and accurate application of bulk fertilizer, lime, pesticides and other soil amendments is essential. Performance failures of agricultural materials can be directly related to improper, uneven, and/or careless application or separation of blended material due to size and density differences. Uneven distribution of lime, fertilizer and herbicides can reduce yields. Effects of uneven fertilizer or lime distribution are most notable in fields that are low in soil fertility, because response to applied nutrients is greatest on these soils.

Proper selection of application equipment and the calibration and evaluation of its performance are essential for satisfactory results. Even the best equipment needs calibration checks. This is especially important when changing from one type of material to another, to different rates of application, and when altering speeds or other operating conditions.

Calibration

Calibration checks for solid fertilizer equipment should show the type of spread pattern (including the degree of uniformity obtained across the swath), the effective swath width and the rate of application. Carry out these checks to determine any necessary adjustments to maintain or improve the characteristics of the applicator.

One practical method of calibrating fertilizer and lime spreaders requires the following supplies:

1. Nine to 15 collecting trays or pans with a grid baffle in the bottom of each (this prevents the material from bouncing out)
2. Nine to 15 test tubes (use the same amount as for #1, above)
3. Test tube rack
4. Funnel
5. 10-foot measuring tape

Make sure the sizes of the test tubes are in proportion to the rates of application being checked. All trays must be of identical size and shape. Trays should be shallow (2.5 to 4 inches deep) with a collecting area of 1.25 to 3 square feet each. The following table can be used to determine the rate of application from any size collecting tray:

Materials collected (grams/square feet)*	Rate of application (pounds/acre)
1	96.0
5	480.2
15	960.3
20	1440.5
25	2400.8

*In the example below, we use 15 plastic pans (11" x 16 3/4" x 2 1/4") with a collecting area of 1.25 square feet each. For applications up to approximately 1,100 pounds per acre, 15 test tubes (1/2" inside diameter and 6" tall) are used. The 15 trays are usually placed as shown in Figure 1.

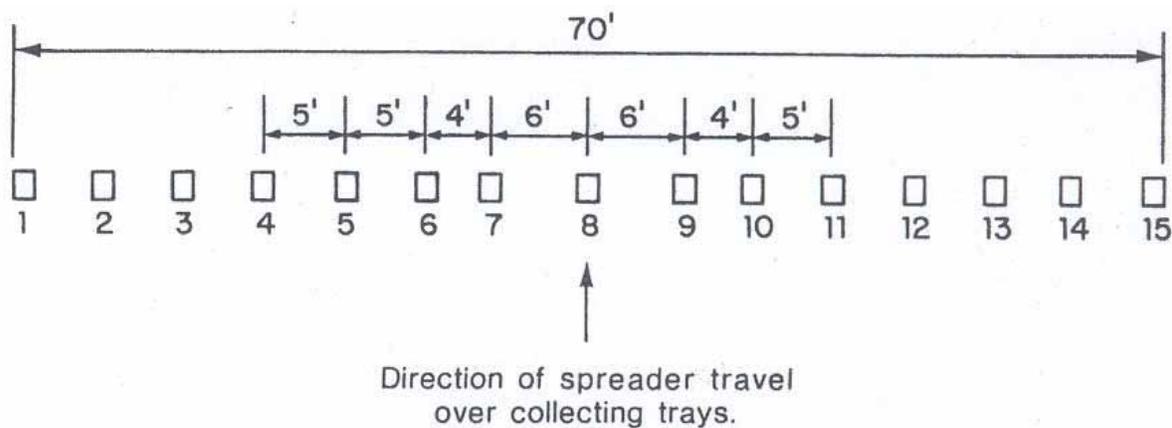


Figure 1. A field layout of collecting trays showing extra clearance on each side of center trays for spreader wheels. All trays are placed at 5-foot intervals except for trays 7 and 9, which are placed 6 feet from the center tray (number 8). The collecting tray area should be 1.25 to 1.3 square feet with grid baffles in the trays to prevent fertilizer from bouncing out.

However, the spacing interval between trays may be changed, depending on swath width. The spreader is adjusted for a given rate of application and operated at normal field speed in a direction perpendicular to the line of trays and straddling the middle tray. Material collected in each tray is then poured into the corresponding test tube in the rack.

The amount of material in the test tubes will then provide a quick visible evaluation of the spread pattern (see Figure 2). If a spread pattern is uniform across the swath, all of the center tubes will be filled to approximately the same height.

The effective swath width can be determined by locating the point on the right and left side of the swath where the tubes are filled to about one-half the height in the center tubes. The distance between these points is the effective swath width and should be used as the swath spacing.

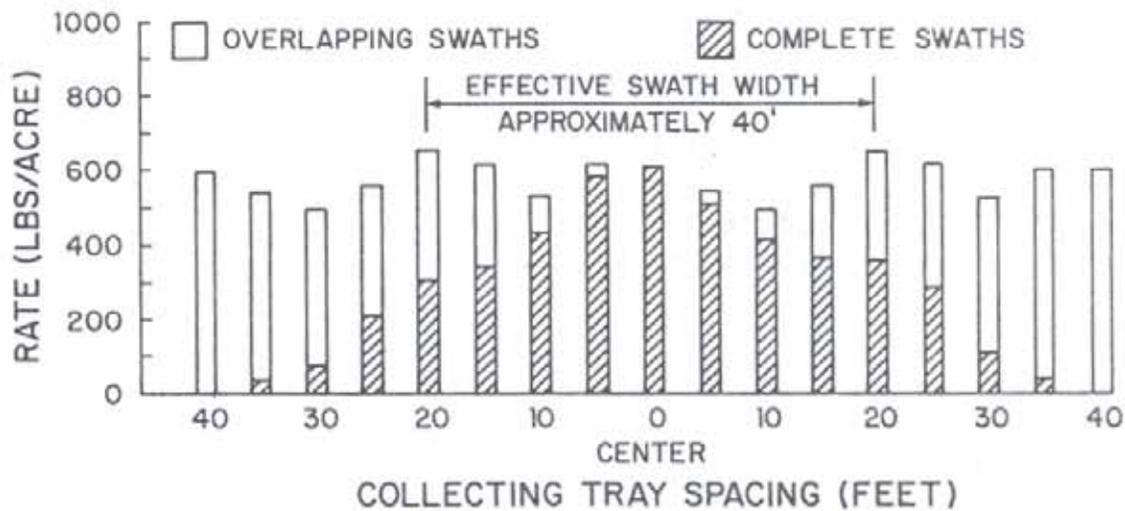


Figure 2. The spread pattern is determined by collecting the material in trays and pouring it into test tubes. Material overlap, as shown, results when swath spacing equals the effective swath width. This is a typical pattern one might expect from a double-spinner fertilizer/rock. This does not depict an ideal pattern.

Because of the way test tubes are shaped, the first 1/2 inch of material in each tube represents a rate of approximately 100 pounds per acre. Each 3/8 inch of material after the first 1/2 inch represents an additional 100 pounds per acre. This assumes the material has a density of 65 pounds per cubic foot, that the material in each tube is collected from an area of 1.25 square feet and that test tubes with an inside diameter of 1/2 inch are used. Fertilizers vary in moisture content and in size and particle density. Variations in materials will require slight adjustments in the indicated rates of application. The method given above will provide a close approximation.

Where application rates are more than 1,100 pounds per acre, larger test tubes are used with the same collecting trays. Make sure these test tubes have an inside diameter of 7/8 inch and are 8 to 10 inches tall. Once again, because of the way test tubes are shaped, the first 11/16 inch of material in these tubes represents approximately 500 pounds per acre. Each additional 1/2 inch depth indicates about 500 pounds per acre. The larger test tubes are suggested for evaluating spread patterns for rates of application between 1,000 and 6,000 pounds per acre, such as in the application of lime.

Use collecting trays with tapered sides, because they will nest together and require minimum storage space. Removable grid baffles in the trays aid in preventing the material from bouncing out. A plastic grid material (1/2" x 1/2" x 1/2") provides a satisfactory baffle. Many building suppliers stock plastic grid material (called egg crates) for recessed lights and air ducts that may be cut to size and used satisfactorily in collecting trays. The trays and grid baffles are very light weight and when nested together are easy to handle.

Adjustment in Spread Pattern

Once an evaluation of a spread pattern is made, the operator should determine what, if any, adjustments can be made to improve the pattern.

Spread patterns for a twin disk, solid fertilizer applicator can be classified into six different types (Figure 3). The flat top, oval and pyramid patterns are most desirable because they allow a more uniform overlapping of swaths.

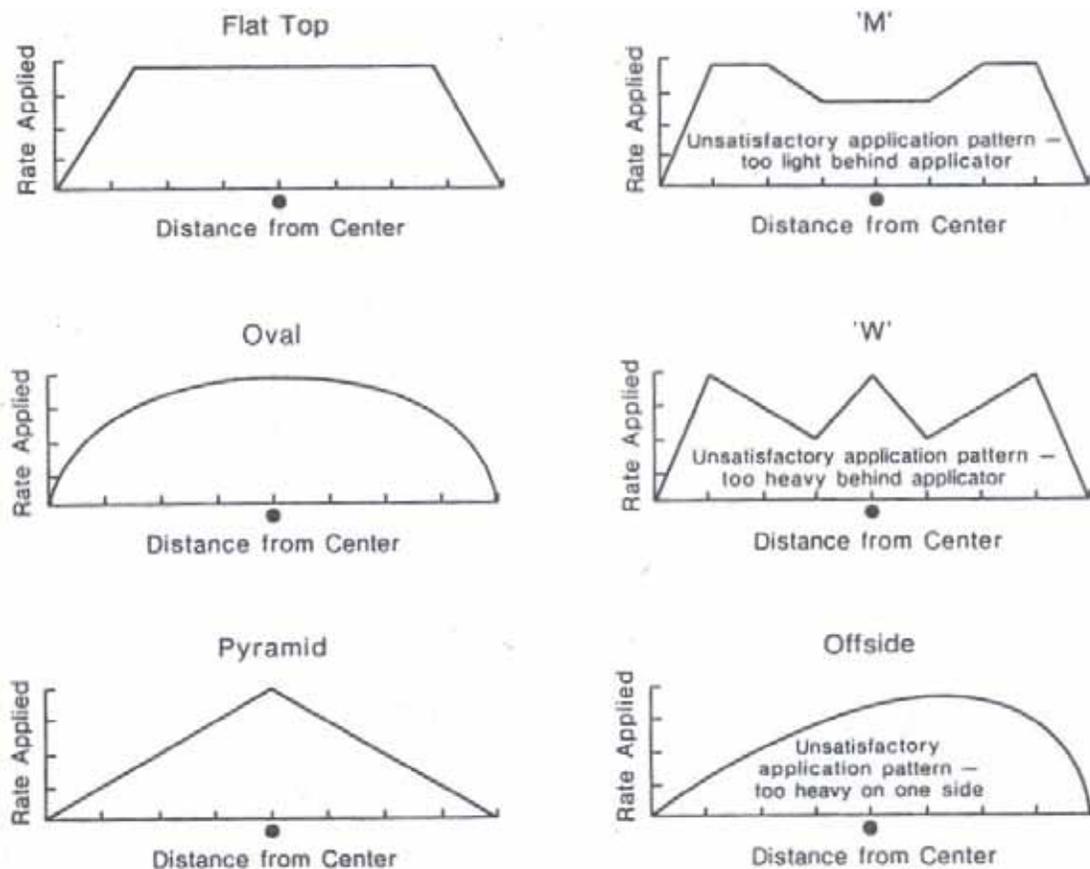


Figure 3. Typical double-spinner spreader distribution patterns. Any of the three on the left are acceptable.

The most common undesirable patterns are the M, W and offside (skewed or lopsided) patterns. You can improve the M pattern by making one or more of the following adjustments (see Figure 4):

1. Move the delivery chute toward the applicator to change the point of delivery of the material closer to the outer edge of the spinners.
2. Move spinner blades in the opposite direction of the spinner rotation.
3. Increase the spinner speed. A spinner speed of 550 to 650 RPM (revolutions per minute) is recommended. Higher spinner speeds shatter the granules and can lead to segregation and uneven distribution.

The W pattern may result from applicator conditions similar to those causing the M pattern, but have a heavy deposit at the center. The W pattern has a heavy band of material occurring in the center of the swath in addition to concentrations on both the right and left sides. The heavy center concentration may be caused by an improperly adjusted delivery chute or leaks that permit material to fall immediately behind the applicator. Also, wet material that sticks to the conveyor belt or chain can fall in the center, causing a heavy application immediately behind the spreader. Find the reason for heavy application at the center and correct it. The W pattern then becomes an M pattern. One or more changes should alter the M pattern to an acceptable flat top, oval or pyramid pattern.

Lopsided patterns, either right or left, may result from twin spinner applicators because of uneven delivery of fertilizer material to the spinners. An improperly adjusted flow divider is usually the cause. Operations on steep slopes can also produce heavier flow to the downhill side if an effective flow divider is not included in the system. This problem can be overcome, to some extent, by proper overlap between swaths and application in a circular pattern.

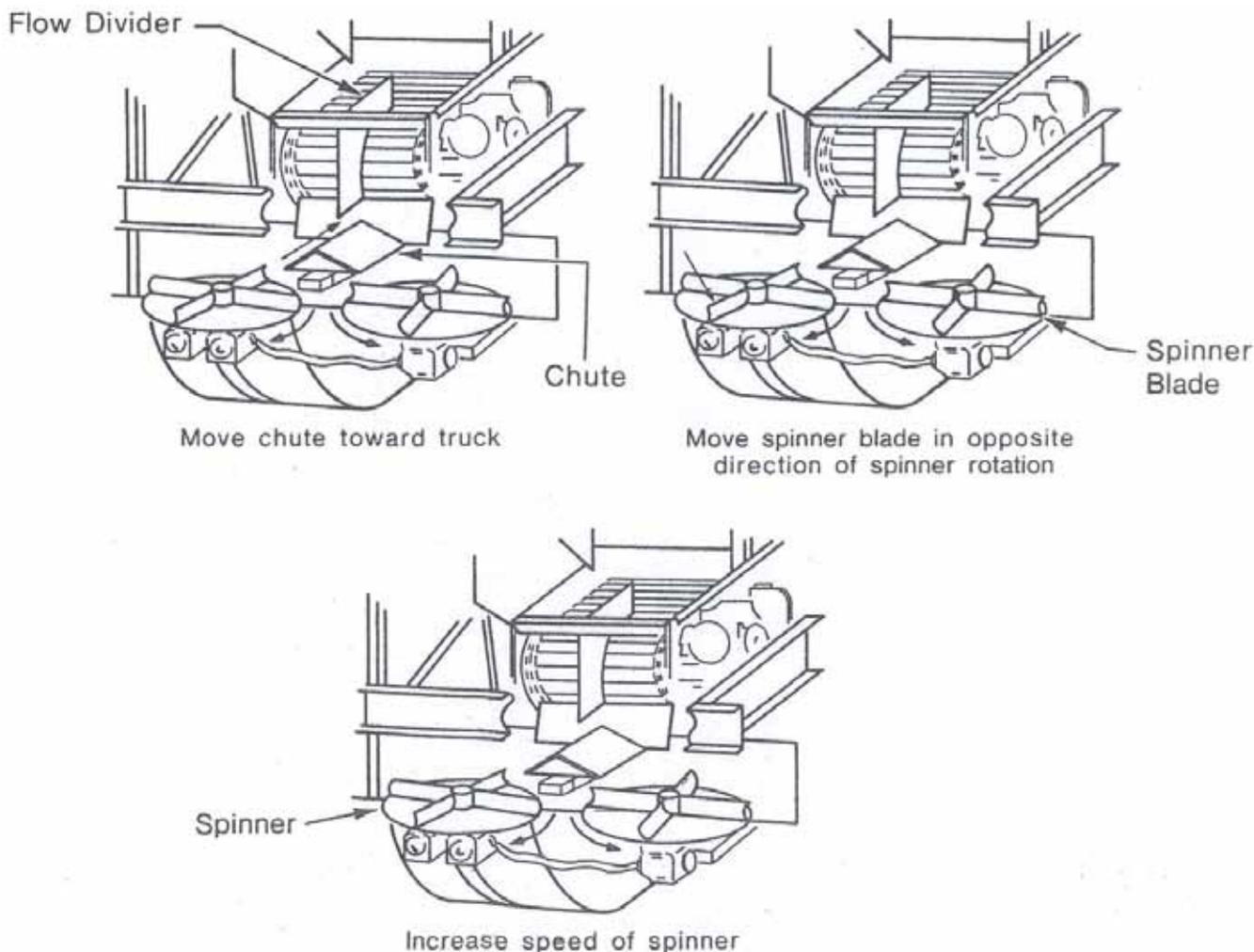


Figure 4. Dual spinner solid fertilizer applicator showing adjustments for corrections of an M distribution pattern characterized by low delivery in the center and high delivery on the edges of the swath.

Single spinner solid applicators can also produce a lopsided pattern when the delivery of the material to the spinner is not positioned properly. If the right half of the pattern from a clockwise rotating spinner is heavier than the left half, any of the following adjustments will improve the pattern by delaying the release of fertilizer from the spinner (Figure 5):

1. Adjust the delivery chute to deliver closer to the center of the spinner.
2. Move the spinner blade tips in the direction of spinner rotation.
3. Reduce spinner speed.
4. Move the delivery chute to the right or clockwise on the spinner.

Heavy applications to the left side call for adjustments in the opposite direction to those above.

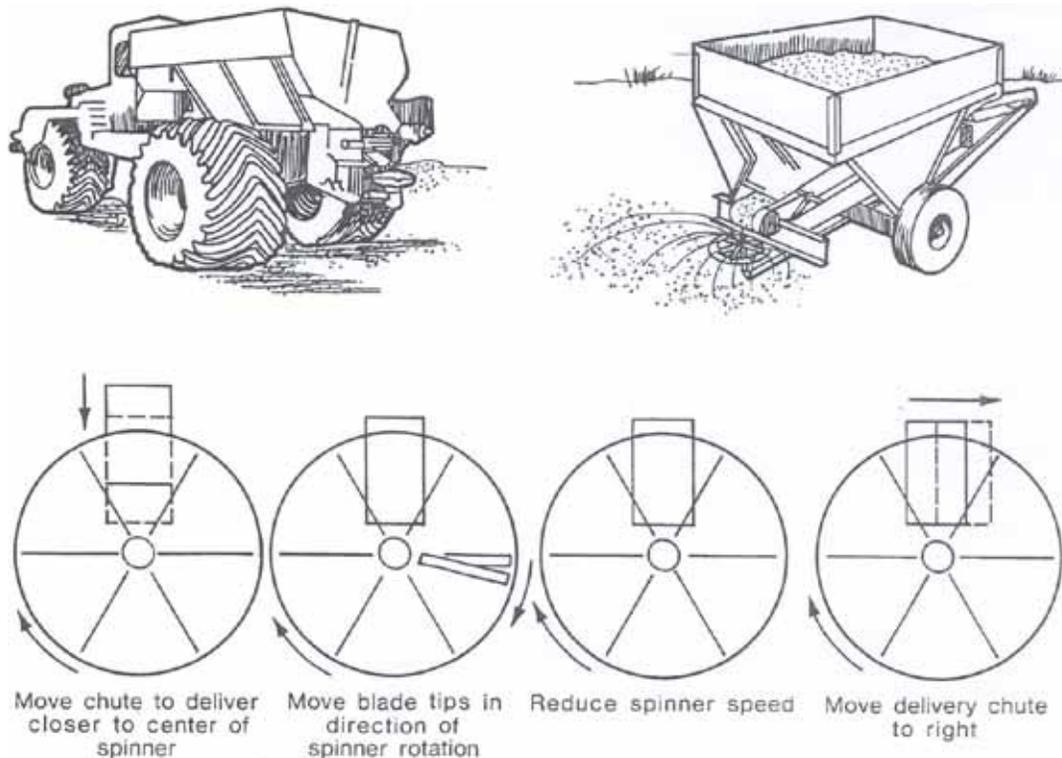


Figure 5. Four adjustments to correct "heavy right" distribution patterns from a single spinner solid fertilizer applicator. These four corrections allow material to ride the spinner further and deposit toward the left side. Corrections for "heavy left" patterns are the opposite.

Troubleshooting

In addition to evaluating spread patterns, mechanical problems will cause pattern irregularities. Some common problems include:

1. Irregular placement of slats on the center conveyor.
2. Reversing hydraulic lines to hydraulic spinner motors. This reverses the direction of spinner rotation and completely disrupts the spread pattern.
3. Worn and bent spinners and spinner blades.
4. Build-up of fertilizer and lime on spinners.
5. Lack of proper flow dividers and delivery chutes for directing material on spinners.
6. Frozen adjustment mechanisms.
7. Corroded and rusty hoppers and components.

Accurate Spreading Requirements

Accurate and uniform application depends on:

1. **Accurate metering** - Make sure graduations are present on the shear gate to aid in determining application rates for various effective swath widths. Keep a notebook showing settings from calibration tests using various material in the trucks.
2. **Proper delivery of material to the spinner or boom units** - An adequate flow divider and adjustable delivery chute (Figure 4) are necessary for uniform application, especially on hillsides and in other adverse field conditions.
3. **Uniform distribution across swath** - Spinner speed, blade pitch and delivery chute position are critical. With auger boom distributors, slide position and auger speed must be adjusted for uniform spreading at various application rates.

4. Skilled and conscientious operators - Accurate spacing of swaths is essential and requires careful driving. Swath spacing should be the same as the effective swath width. A constant ground speed is important for a uniform application with many spreaders. In addition to driving, make sure that operators study the operator's manual for their particular machine and know how to calibrate the spreader for various materials and rates of application. They should give particular attention to cleaning, adjusting, maintaining and repairing their spreaders.

Check spread pattern and make the necessary adjustments when changing the material or the rates of application. Remember, a heavy application of wet lime requires entirely different adjustments from a light application of high-analysis, free-flowing, blended material.

When it is practical, drive spreaders around fields in a perimeter pattern to minimize the effect of variations in spread patterns.

Granular or prilled materials of uniform particle size will give the most even application. It is best to select materials for blends that are approximately the same particle size, density, shape and moisture content (this prevents segregation of materials in the spreading operation). Vertical baffles in gravity bins are effective in preventing segregation.

Remember, even with proper adjustments, it is difficult to maintain a completely uniform and accurate application rate of granular fertilizer and lime if wind speeds exceed 5 miles per hour.

Making Test Kits

Test kits can be easy to make. Pans can be purchased and the grid baffles can be cut to fit the pans using a band saw or jigsaw. Test tubes of the proper size are available through various vendors. Figure 6 shows the test tube rack for the small test tubes. You can also construct them yourself at a considerable savings or purchase them directly through commercial vendors.

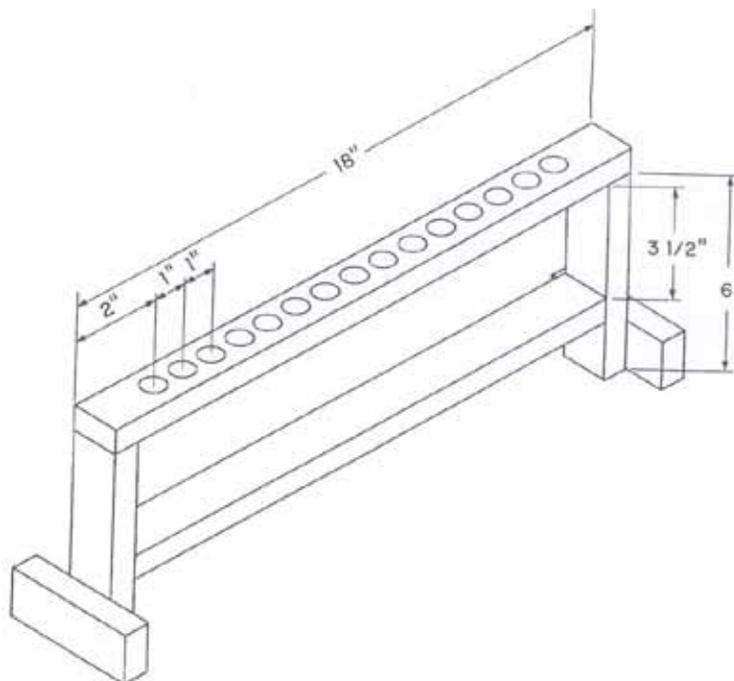


Figure 6. The test tube rack shown is made of wood and is for $\frac{1}{2}$ inch inside diameter test tubes. Holes in the top member are $\frac{5}{8}$ inch in diameter.

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