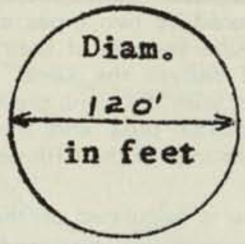
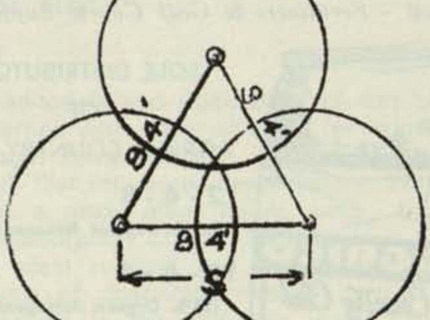


Formula for finding the precipitation in inches per hour from any sprinkler when discharge in gallons per minute and coverage in feet is known.

$$\text{Precipitation in inches per hour} = \frac{122 \times \text{g.p.m.}}{\text{Diam. squared}}$$

EXAMPLE: If a sprinkler discharges 25 g.p.m. and covers a circular area of 120 ft. in diameter the precipitation is

$$\frac{122 \times 25}{120 \times 120} = 0.21 \text{ inches per hour}$$



Formula for finding the precipitation in inches per hour from identical sprinklers located in an equalateral spacing when the discharge from any one sprinkler and distance between sprinklers in feet is known.

The precipitation in inches per hour within the triangle is: $\frac{111 \times \text{g.p.m.}}{\text{S in feet squared}}$

EXAMPLE: If each of the above sprinklers discharges 25 g.p.m. and they are spaced 96 feet apart in an equalateral position the precipitation in inches per hour **within the triangle is:**

$$\frac{111 \times 25}{96 \times 96} = 0.30 \text{ inches per hour}$$

It is frequently desired to know what number of pipes of a given size are equal in carrying capacity to one pipe of a larger size. At the same velocity of flow the volume delivered by two pipes of different sizes is proportional to the squares of their diameters; thus one 4" pipe will deliver the same volume as four 2" pipes; however, with the same pressure the velocity is less in the smaller pipe and the volume varies about as the square root of the fifth power of the pipe diameter.

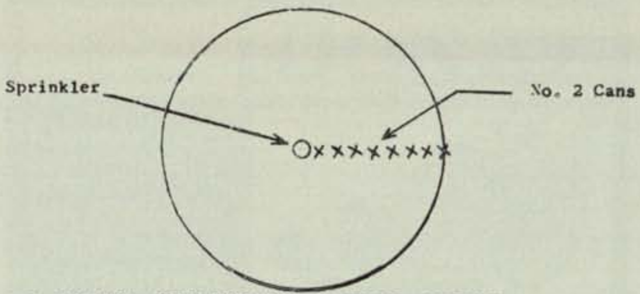
The table below is calculated on this basis.

The figures opposite the intersection of any two pipe sizes is the number of the smaller sized pipes required tto equal one of the larger sized pipe; thus one 4" pipe equals 32 one-inch pipes or 5.7 two-inch pipes or 2.1 three-inch pipes.

EQUATION OF PIPES

Diameter in inches	1"	2"	3"	4"	6"	8"
1"	I					
2"	5.7	I				
3"	15.6	2.8	I			
4"	32.0	5.7	2.1	I		
6"	88.2	15.6	5.7	2.8	I	
8"	181.0	32.0	11.7	5.7	2.1	I

NOTE: A one-inch hose will deliver slightly more water than two 3/4" hoses of the same length when connected in parallel.



C.E. STEWART, CIVIL ENGINEER, HOMEWOOD, ILLINOIS.

It has often been the desire of the golf course superintendent to obtain a cheap, easy, and accurate method for determining the exact precipitation of water in inches per hour from a sprinkler. The following suggested method fulfills this desire.

MATERIALS REQUIRED

a — A number of No. 2 cans, or any similar type of container which has a diameter of 3¼". No. 2 cans are commonly used at grocery stores to contain peas, beans, tomatoes, etc.

b — One glass or plastic cubic centimeter tube, this graduated cc tube costs about $1.00 and may be purchased at most drug stores or surgical supply stores.

METHOD TO EMPLOY

1. Place the sprinkler in its desired position.
2. Use as many of the No. 2 cans as are required to extend from the sprinkler in a straight line to the outer edge of the sprinkler coverage and at 2 to 5 feet intervals apart.
3. Set the sprinkler in operation and **RUN IT FOR EXACTLY 44 MINUTES.**
4. Shut off the sprinkler and pour the contents of any No. 2 can into the cc tube, a reading in centimeters will be obtained but each cubic centimeter will equal exactly 0.01 inches, or (1/100th inch) of sprinkler precipitation **PER HOUR.**

EXAMPLE

If a reading of 37 cubic centimeters is obtained from a can after the sprinkler has been running exactly **44 minutes** the sprinkler will, or the area where the can was located, precipitate 0.37 inches **per hour.**

By plotting the precipitation from each can on graph paper a true sprinkler precipitation curve may be obtained.

The above test should be conducted where there is water distortion by wind velocity as well as a test with NO WIND.

A SUGGESTED METHOD FOR COMPUTING PIPE SIZES FOR A GOLF COURSE IRRIGATION DISTRIBUTION SYSTEM

The selection of the correct size of pipe for a golf course water distribution system should be based on costs, i.e. the cost of the pipe, pipe fittings and all labor to install the pipe.

One example of how to arrive at the suitable size of pipe to use when the flow in g.p.m. and yearly operating time is known is given below.

EXAMPLE:

A pump is to supply water at a rate of 100 g.p.m. through a pipe line 1000 feet in length and it is assumed that the "fire to water" efficiency of the pump is 70%, i.e. the output of the pump equals 70% of the electrical energy required to drive it.

1 Size of pipe	2 Cost to instal 1000' of pipe	3 10% of pipe cost	4 Pipe friction in feet	5 KWH per year in pipe friction	6 Cost of power per year @ 1.5¢ per KWH	7 Total cost per year
2"	$1150.00	$115.00	358	11586	$173.79	$288.79
2½"	$1310.00	$131.00	120	3884	$ 58.26	$189.26
** 3"	$1630.00	$163.00	49.6	1605	$ 24.08	$187.08
4"	$2550.00	$255.00	12.2	395	$ 5.93	$260.93

** From the above analysis it will be noted that the 3" pipe is the best size to use; further, it will be noted that 100 g.p.m. flowing through a 3" pipe has a velocity of 4.54 feet per second, this indicates that a suitable size of pipe can be used when the water velocity averages between 4 and 5 feet per second.

$$\text{Velocity} = \frac{\text{G.P.M} \times 0.408}{\text{D squared}}$$

D = pipe diameter in inches.

EXPLANATION

The figure in column 2 is the cost of the pipe, pipe fittings, trenching, pipe installation and backfilling and is based on current costs for this type of work in the Chicago area.

The 10% figure in column 3 represents the following:

1. An interest rate of 5% per year on the initial investment.

2. The life of the pipe is estimated at 25 years; consequently 4% of the initial investment must be layed away each year to replace the pipe in 25 years, this comes under the heading of depreciation.

3. Minor yearly repairs in the pipe for maintenance is estimated at 1% of initial investment.

Thus a total of 5 + 4 + 1 percent, or 10% as shown in column 3 must be paid out, or layed aside, each year for the use of the pipe.

The pipe friction in column 4 is computed in the usual manner and is based on a friction factor of C – 100.

The horsepower required to drive the pump to overcome the pipe friction loss is computed and changed to kilowatt hours as shown in column 5. In this case the yearly use of the pipe is construed to be 120 days at 10 hours per day, or a total of 1200 hours per year; thus the figures in column 5 come from the following formula:

$$\text{KWH} = \frac{\text{G.P.M} \times \text{head in feet}}{3960} \times \frac{1}{0.70 \text{ efficiency}}$$

$\times\ 0.746 \times 1200$ which in reduced form is:

$$\frac{\text{G.P.M.} \times \text{head in feet}}{3.09}$$

With power costs at 1½ cents per KWH the figures in column 6 follow. The total cost for the year for pipe and power is the sum of columns 3 and 6 which is shown in column 7.

All of the irrigation information submitted by C. E. Stewart, Civil Engineer, Homewood, Illinois