A Field Method for Measurement of Infiltration

GEOLOGICAL SURVEY WATER-SUPPLY PAPER 1544-F

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By A. I. JOHNSON

GENERAL GROUND-WATER TECHNIQUES

GEOLOGICAL SURVEY WATER-SUPPLY PAPER 1544-F

UNITED STATES GOVERNMENT PRINTING OFFICE, WASHINGTON : 1963

U.S. DEPARTMENT OF THE INTERIOR

MANUEL LUJAN, Jr., *Secretary*

U.S. GEOLOGICAL SURVEY

Dallas L. Peck, *Director*

First Printing 1963
Second Printing 1991

For sale by the Books and Open-File Reports Section, U.S. Geological Survey, Federal Center, Box 25425, Denver, CO 80225

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ABSTRACT

The determination of infiltration—the downward entry of water into a soil (or sediment)—is receiving increasing attention in hydrologic studies because of the need for more quantitative data on all phases of the hydrologic cycle. A measure of infiltration, the infiltration rate, is usually determined in the field by flooding basins or furrows, sprinkling, or measuring water entry from cylinders (infiltrometer rings). Rates determined by ponding in large areas are considered most reliable, but the high cost usually dictates that infiltrometer rings, preferably 2 feet in diameter or larger, be used.

The hydrology of subsurface materials is critical in the study of infiltration. The zone controlling the rate of infiltration is usually the least permeable zone. Many other factors affect infiltration rate—the sediment (soil) structure, the condition of the sediment surface, the distribution of soil moisture or soil-moisture tension, the chemical and physical nature of the sediments, the head of applied water, the depth to ground water, the chemical quality and the turbidity of the applied water, the temperature of the water and the sediments, the percentage of entrapped air in the sediments, the atmospheric pressure, the length of time of application of water, the biological activity in the sediments, and the type of equipment or method used. It is concluded that specific values of the infiltration rate for a particular type of sediment are probably nonexistent and that measured rates are primarily for comparative use.

A standard field-test method for determining infiltration rates by means of single- or double-ring infiltrometers is described and the construction, installation, and operation of the infiltrometers are discussed in detail.

INTRODUCTION

The complexity of the problems confronting the water-resources investigator today has caused an increasing need for more quantitative data for all phases of the hydrologic cycle (fig. 1) and an analysis of the complete hydrologic problem. A balanced investigation calls for a better understanding of infiltration—defined by the Soil Science Society of America (1956, p. 434) as "the downward entry of water

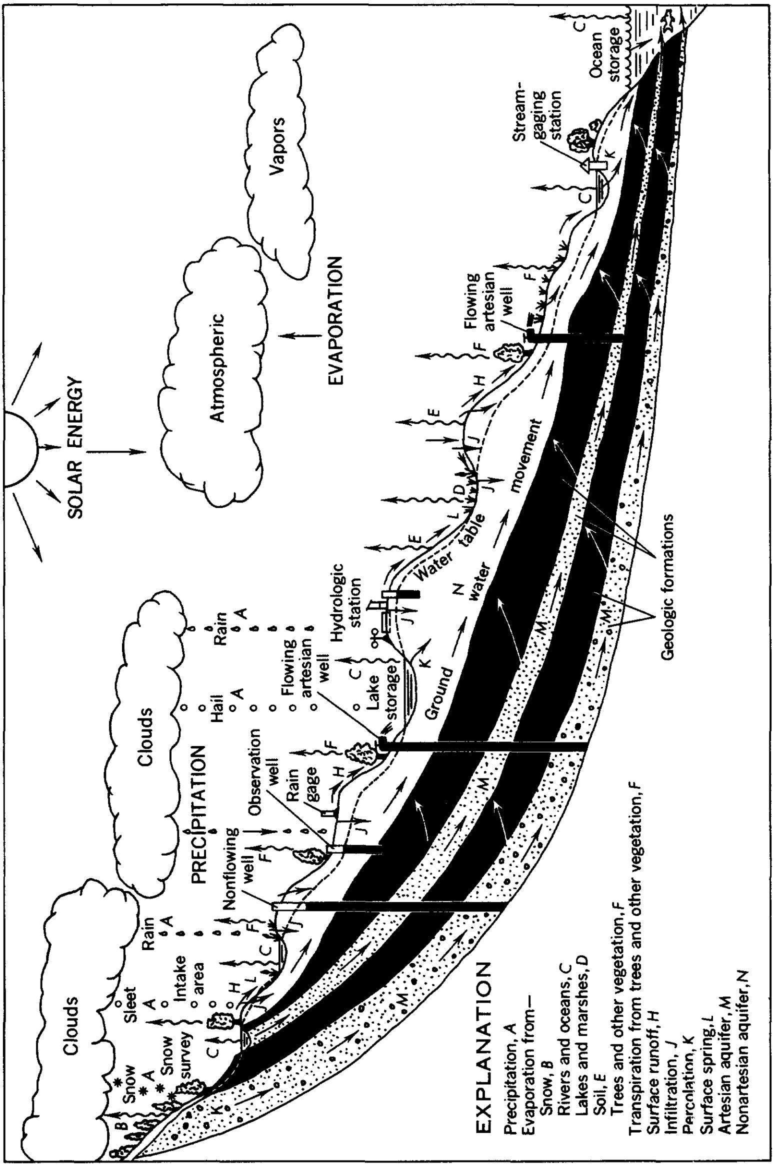

FIGURE 1.—Hydrologic cycle.

into soil"—and a knowledge of how this hydrologic property may be determined. This report discusses the factors affecting infiltration and describes a method for determining infiltration data. A list of references on infiltration is included for the investigator interested in pursuing the subject in more detail. It is hoped that this report will be particularly helpful to those investigators who will be making infiltration tests and also to all who are interested in water-resources investigations in general.

TERMINOLOGY AND DEFINITIONS

Terminology relating to infiltration was thoroughly reviewed by Richards (1952) and by the Soil Science Society of America (1956).

They defined infiltration as the downward entry of water into soil, and infiltration rate (infiltration capacity) as the maximum rate at which a soil will absorb water impounded on the surface at a shallow depth when adequate precautions are taken regarding border, or fringe, effects. Defined as the volume of water passing into the soil per unit of area per unit of time, infiltration rate has the dimensions of velocity, LT^{-1}, where L=length and T=time. Some divergence of flow may occur as the wetting front moves downward through the soil; and, under some conditions, even with large rings or basins, divergent flow cannot be neglected.

Infiltration velocity, known also as intake rate, has been defined (Soil Science Society of America, 1956, p. 434) as the volume of water moving downward into the soil surface per unit of area per unit of time and has the dimensions of velocity. The maximum infiltration velocity is equivalent to the infiltration rate. Because this definition involves no restrictions on area of application or divergence of flow in the soil, a description of the measuring method should be specified.

In soils work, infiltration rate or velocity is usually reported in inches per hour or centimeters per hour. Occasionally they are reported in feet per year or feet per day.

METHODS AND EQUIPMENT

Infiltration rate usually is determined from field data. Many different methods and types of equipment have been used for measuring infiltration rate, but the principal methods are flooding of basins or furrows, sprinkling (to simulate rain), and measuring water entry from cylinders (infiltrometer rings). The rate of subsidence of the water surface, or the rate of flow required to maintain a constant level in a large basin, or a very large ring infiltrometer is taken as a measure of the infiltration rate. If smaller infiltrometer rings are used, the rate of flow or subsidence for the period during which the wetting front is moving downward through the enclosed part of the soil column is taken as the infiltration rate.

No single method is satisfactory for all field conditions. The problem to be solved, the funds available, and the availability of the appropriate supplies and equipment dictate the method to be used. Judgment based largely on experience is an important requirement in evaluating infiltration-rate data—especially where conditions are nonuniform.

Robinson and Rohwer (1957) studied infiltration in relation to canal seepage and used a variety of equipment installed under field conditions. They concluded that large-diameter rings—as much as 6 feet for the inner ring and 18 feet for the outer ring—provided more accurate measurements than the more commonly used rings 1 to 2 feet in diameter.

Ring infiltrometers of large diameter, such as those used by Robinson and Rohwer, or infiltration pits or ponds, such as those discussed by Mitchelson and Muckel (1937), probably are the most accurate field methods for obtaining data on infiltration rates. Rates determined by ponding in large areas probably are the most reliable, but problems of cost usually require the use of smaller and cheaper equipment. Therefore, the use of the ring infiltrometer, especially if 2 feet or larger in diameter, probably provides the best alternate method for obtaining data economically. Large rings determine the average rate of infiltration for a larger area and are especially necessary in areas of gravel-sized materials, where all particles are large in comparison to the size of the ring or basin.

In 1956, after working with a uniform soil profile having no layers restricting the movement of water, Burgy and Luthin (1956) concluded that 6 infiltrometers gave an average rate that was within 30 percent of the true mean when compared with infiltration rates obtained by flooding large areas or basins. To be truly representative, the general location of the infiltration tests should be based on the geology or soils pattern of an area.

FACTORS AFFECTING INFILTRATION RATE

The principles of infiltration and the factors affecting the process are imperfectly understood even after many years of investigation. Early studies by Muntz (1908) were followed by evaluation studies by many investigators, among which were Kohnke (1938), Free, Browning, and Musgrave (1940), Nelson and Muckenhirn (1941), and Klute (1952). The most recent general research on the subject of infiltration is the study by Robinson and Rohwer (1957), under field conditions, and by Aronovici (1955), under laboratory conditions.

Many factors affect the infiltration rate. Infiltration depends upon the chemical-physical condition of the sediments and the chemical-hydraulic characteristics of the water in those sediments, both of which may change with time. The infiltration rate is affected by the sediment (soil) texture and structure, the condition of the sediment surface, the distribution of soil moisture or soil-moisture tension, the chemical and physical nature of the water, the head of the applied water, the depth to ground water, the length of time of application of water, biological activity, the temperature of the water and the sediments, the percentage of entrapped air in the sediments, the atmospheric pressure, and the type of equipment or method used.

Studies of saturated and unsaturated flow of water through soils have been made by Colman and Bodman (1944), Kirkham and Feng (1949), Marshall and Stirk (1949), and Miller and Richard (1952), but very little information is available concerning water flow from infiltrometers under conditions of low initial moisture content. Marshall and Stirk (1949) utilized tensiometers to observe the movement of the water below infiltrometers, and Haise (1949) studied flow patterns in coarse-textured soils. Possibly the most complete study of water-flow patterns below infiltrometers was that of Aronovici (1955), who illustrated the significance of surface and subsurface conditions on observed infiltration rates. His study suggested also that pressure head is the dominant factor involved in infiltration rates in initially dry or damp soils, and emphasized the influence of the differential hydraulic head in causing a decrease of infiltration rate with time.

The rate of infiltration is affected greatly by the permeability of the sediments. Usually the sediments are unsaturated when an infiltration test is started, and the infiltration rate would not correspond, even under ideal field conditions, with the permeability as normally determined in the laboratory. That is, the standard laboratory permeability equals the infiltration rate only when the sediments are saturated. On the first application of water in the infiltration tests, the rate is generally great. As water application continues and the uppermost sediments become saturated, the infiltration rate gradually decreases and reaches a nearly constant rate, generally within a few hours. If all the sediments are uniform or the deeper ones are more permeable than those near the surface, and the water table is a considerable distance below the surface, the infiltration rate is controlled by the sediments near the surface. However, when the deeper sedi-

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ments are less permeable than the shallow ones, the shallow sediments soon become saturated and the resultant infiltration is controlled by the less permeable sediments at greater depth. Thus, the critical zone controlling the rate of infiltration is the least permeable zone, and, as Musgrave (1935a) pointed out, infiltration rings set only a few inches into the sediments may not indicate the permeability of the underlying materials. This fact indicates that the bottom of the infiltrometer basin or ring should be installed at the top of the least permeable zone.

The definition of infiltration requires that the downward flow into and through the sediments be nondivergent. The U.S. Salinity Laboratory Staff (1954) pointed out that the effect of divergent flow increases as infiltration area decreases and becomes pronounced where the permeability decreases with depth. The proportion of lateral flow to vertical flow becomes higher as the permeability of the sediments beneath an infiltrometer decreases. Flow may move laterally as well as vertically beneath small infiltrometers, especially if the rings are set only a short distance into the soil, and the rate determined will apply to large areas only if the sediments are very uniform and the underdrainage is not limiting. Divergence may be minimized for cylinders or small plots by the ponding of water in a guard ring or border area surrounding the cylinder or plot. Lewis (1937) found that, at least for uniform soils, the use of cylinders set 6 inches into the soil gave reliable results and that buffer rings were not needed if the infiltrometer was at least 18 inches in diameter. Burgy and Luthin (1956) also found that the difference between rates obtained with the single-ring and double-ring infiltrometers for uniform soils that had been previously wetted above field capacity was not significant. However, Schiff (1953) obtained the opposite effect in the use of the two types of rings where soils were not uniform and contained subsurface zones of low permeability. He suggested that piezometers would be helpful in determining lateral flow in the vicinity of an infiltrometer.

Free, Browning, and Musgrave (1940) found that the infiltration rate decreases with increasing clay content and increases with increasing noncapillary porosity (approximately equivalent to specific yield). These investigators made infiltrometer tests on many different soil types at 68 field sites throughout the United States. Their data have been used to prepare table 1.

The infiltration rate can be considerably decreased by disturbance of the softened surface of the sediments as the water is poured into the infiltrometer ring. Thus, care must be taken in the first filling of the apparatus. The effect of rainfall on bare soil also may exert considerable influence on infiltration rate. Wisler and Brater (1949) pointed

TABLE 1.—*Infiltration rates for different type soils as measured by infiltrometer rings in third hour of a wet run*

[After Free, Browning, and Musgrave, (1940)]

Soil type	Porosity (percent)		Infiltration rate		
	Total	Non-capillary (specific yield)	Inches per hour	Feet per day	Centimeters per hour
Gravelly silt loam	54. 9	28. 1	4. 96	9. 92	12. 60
Clay loam	61. 1	36. 3	3. 98	7. 96	10. 11
Silt loam	57. 0	32. 0	2. 09	4. 18	5. 31
Sandy loam	49. 6	26. 3	1. 93	3. 86	4. 90
Clay (eroded)	54. 3	28. 7	1. 78	3. 56	4. 52
Sandy clay loam	48. 8	27. 7	1. 42	2. 84	3. 61
Silty clay loam	50. 8	24. 3	. 72	1. 44	1. 83
Stony silt loam	59. 7	32. 6	. 55	1. 10	1. 40
Fine sandy loam	41. 5	24. 2	. 55	1. 10	1. 40
Very fine sandy loam	49. 6	23. 4	. 51	1. 02	1. 29
Loam	45. 7	17. 2	. 50	1. 00	1. 27
Sandy clay	42. 9	16. 9	. 05	. 10	. 13
Heavy clay	57. 8	27. 0	. 02	. 04	. 05
Light clay	47. 0	19. 8	. 00	. 00	. 00
Clayey silt loam	49. 4	17. 6	. 00	. 00	. 00

out that the rain beats down on the unprotected soil, compacts it, washes fine debris into the pores of the surface strata, and thereby reduces the permeability.

Lewis (1937) and Musgrave and Free (1937) concluded that an increase in initial moisture content in the tested sediments correlated with a decrease in infiltration rate. They stated that this is probably due to the unavailability of the smallest interstitial spaces for the percolation of water after the initial supply is received. In fine-textured materials part of the rate reduction is due to the swelling of clay and the resultant choking of the small pores.

Musgrave and Free (1937) found that even slight water turbidity caused a considerable decrease in infiltration rate. According to the U.S. Salinity Laboratory (1954), water having the same quality as that to be used later in actual infiltration should be used for the infiltration test.

Schiff (1953) found that infiltration rates increase as driving head increases. The depth of water to be applied during a test depends on the information desired. For example, in determination of rates of infiltration from waste-disposal pits, it may be desirable to apply the full head. According to Lewis (1937), the duration of testing also depends upon the information desired. Most infiltration tests are of short duration to simulate the effects of rainfall or the application of irrigation water. Even then, the rate usually decreases with time of application.

It seems to be the opinion of investigators that when the rate of infiltration is low a correction must be made for the evaporation rate during the test, or the evaporation must be minimized by covering the water surface with a film of oil or a monomolecular film of a waxy alcohol, such as hexadecanol or octadecanol. If infiltrometer rings are used, a cover may be installed to reduce evaporation virtually to zero.

The infiltration rate is influenced also by plant and animal action in the sediments. Decaying roots leave channels throughout the root zone. Roots extend to considerable depths, some reaching 10 feet or more, according to the type of vegetation. Certain animals, such as gophers and earthworms, may considerably increase the permeability of the soil and, hence, the infiltration rate. However, the converse may be true, especially above a depth of 2 to 3 feet in the soil zone, where some decrease in infiltration rate may result from the growth of micro-organisms. To overcome growth of micro-organisms, 20 ppm (parts per million) of mercuric chloride is sometimes added to the water used for the test. The amount of activity by micro-organisms is not great in arid regions.

Desiccation structure in the sediments of arid regions may cause difficulties in determining the infiltration rate. Heavy clay soil may crack during drying, and considerable penetration may result upon the first application of water. As the soil adjoining the cracks is wetted, however, it swells and closes the cracks, so that infiltration becomes very slow.

Musgrave and Free (1937) and Free, Browning, and Musgrave (1940) observed a tendency toward an increase in rate of infiltration with an increase in sediment temperature. This is due to a decrease in water viscosity caused by the increase in temperature. Theoretically, in the ordinary range of temperatures, the infiltration rate should approximately double for a 50°F increase in water temperature. The rate, however, does not always increase this much because of some soil-water reactions that are affected by these temperature changes, especially during longer test runs. Infiltration data should all be corrected and reported to some standard temperature, such as 60°F.

In 1934, Powers reported that entrapped air may have a considerable effect on infiltration rate. As the wetting front moves downward below the infiltrometer ring or basin, air is trapped in the pore space and compressed by the increasing pressure. As the test run proceeds, the air is apparently flushed out—at least in part—and the infiltration rate may tend to increase; however, the general trend is for the entrapped air to cause a decrease in infiltration rate. A change in atmospheric pressure also may affect the infiltration rate because of its effect on the expansion and contraction of the entrapped air.

The investigations discussed above show that to interpret infiltration data properly the investigator must know the hydrology of the deep sediments as well as that of the shallow ones. Adequate subsurface exploration always should accompany infiltration tests.

SUGGESTED METHOD FOR DETERMINING INFILTRATION RATE

No generally accepted method is applicable to all field conditions or problems in spite of all the studies that have been made of the measurement of infiltration rate. As already discussed, the large-pond method is the best for determining accurate infiltration data but is usually not feasible because of economic considerations. A method utilizing a ring infiltrometer is probably the most versatile of all available methods; thus, such a method is described in detail to provide a simple standard that can be used by all investigators.

APPARATUS AND SUPPLIES

Infiltrometer rings.—Cylinders 20 inches high and of different diameters—12, 18, and 24 inches. (See fig. 2.) Cylinders made of 1/8-inch hard-alloy aluminum sheet with the bottom edge beveled from the outside to the inside.

Driving cap.—Disks of 1/2-inch aluminum alloy, with centering pins around edge, of a diameter slightly larger than the infiltrometer rings.

Depth gage.—A hook gage, staff gage, or length of heavy wire, pointed on one end, for use in measuring and controlling a definite depth of water (head) in the infiltrometer ring.

Driving equipment.—A 12-pound mall or sledge and a 2- or 3-foot length of wood (2×4 or 4×4 in.).

Splash guard.—Six-inch-square pieces of sheet rubber or burlap.

Rule or tape.—Six-foot steel tape or 1-foot steel rule.

Metal tamp.—Round pipe 14 inches long with 6-inch length of 1-inch-wide by 1/4-inch-thick steel strap welded to end.

Shovels.—One long-handled shovel and 1 trenching spade.

Hand auger.—Orchard-type auger with 3-inch-diameter by 9-inch-long barrel, and rubber-headed tire hammer for knocking sample out of auger.

Water containers.—One 50-gallon barrel for main water supply; one graduated cylinder of 1,000-ml or 1-quart capacity, or a graduated Mariotté tube, for measurement of water and used during the test; a 12-quart pail for the initial filling of the infiltrometer; a length of rubber hose to siphon water from the barrel.

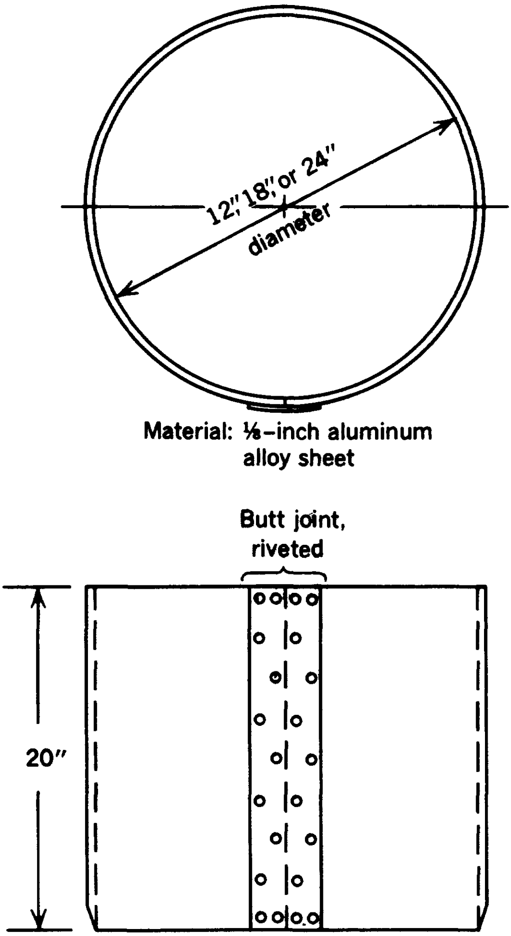


FIGURE 2.—Ring-infiltrometer construction.

Water supply.—Preferably water of the same quality as that involved in the problem being examined.

Stopwatch.—Pocket-type.

Level.—A carpenter's level or bull's-eye level.

Recording materials.—Record books and graph paper (20×20 divisions per inch), or special forms with graph section, and pencils.

PROCEDURE

If a single-ring infiltrometer is desired, a ring of any one of the different sizes may be used. However, because divergent flow increases as the infiltration area decreases, the largest ring practicable for the water supply available is preferable. If a double-ring infiltrometer is desired, a small ring is installed, centered inside a larger ring. The 12- and 24-inch rings are suggested for a double-ring infiltrometer installation. The sides of the infiltrometer rings should be kept vertical, and undue disturbance of the soil surface from driving of the ring or from excessive trampling over the surface should be avoided.

The infiltrometer rings should be driven 6 to 8 inches into the soil. Where the infiltration rate for a shallow subsurface layer is desired, a pit shoud be excavated to the desired depth before the rings are installed. An infiltration ring is driven by means of a driving cap (½-in.-thick plate), which has been centered on the ring and on the edge of which has been placed a heavy wood block (2×4 or 4×4 in., 2 or 3 ft. long). Blows of the heavy sledge on the block should be of medium force to prevent undue fracturing of the soil surface. The wood block should be moved around the edge of the driving cap every one or two blows, so the cylinder will penetrate the soil surface uniformly, without the tilting back and forth that results in a disturbance of the soil. If a double-ring infiltrometer is used, both rings are installed to the same depth.

The rings may be jacked into the soil surface if a truck and heavy jack are readily available. The jack should be centered upon a wood block that has been centered across the driving cap of the ring. The top of the jack then can be placed under the end of the truck body and force applied to the jack. In heavy-textured soils it may be necessary to add additional weight to the truck in order to obtain sufficient force.

After the driving is completed and the rings are level, the disturbed soil adjacent to the ring on the inside should be tamped firm by means of the metal tamp (1in. wide × ¼ in. thick × 20 in. long). If the soil is disturbed more than one-eighth of an inch from the wall of its ring, an attempt should be made to reset the infiltrometer ring with less disturbance of the surface.

Some type of depth gage should be installed on the infiltrometer ring (fig. 3), or on both rings if a double-ring infiltrometer is used, to assist the investigator visually in maintaining a given water level (head). A staff gage is satisfactory if the infiltration rate is high, but a more accurate device should be used for low rates. A hook gage may be used, or a simple point gage may be constructed. The latter consists merely of a length of heavy wire, pointed on both ends, inserted into the soil and left at a height above the soil surface equivalent to the desired depth of water. All these gages, except the staff gage (which is installed on the ring wall), should be installed near the center of

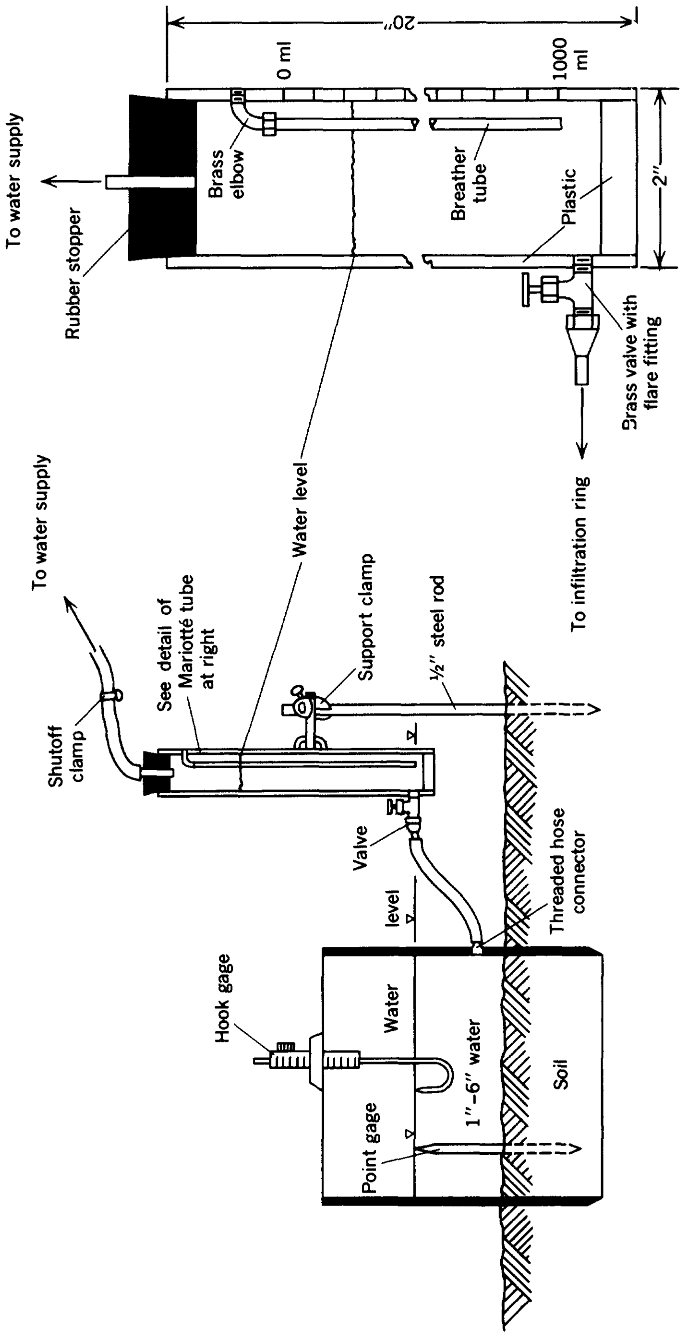


FIGURE 3.—Ring installation and Mariotté tube details.

the center ring and in the middle of the annular space between the two rings. The water is at the proper depth when the point of the wire or hook barely makes a small pimple on the surface of the water. A minimum water level of 1 inch and a maximum of 6 inches is usually maintained.

A Mariotté tube can be utilized for maintaining the water level and for measuring the quantity of water. (See fig. 3.) The small quantities of water required for low infiltration rates may require measurement by small-diameter Mariotté tubes, or merely graduated cylinders. For higher rates or longer test runs, the water level may be held constant by means of a float valve connected to the ring and supplied from a large water-storage tank or trailer. (See fig. 4.) A recording level

FIGURE 4.—Ring infiltrometer with float-valve control.

gage may be installed on the supply tank to record the amount of water used for the test.

To dissipate the force of the applied water and to prevent disturbance of the soil, the soil surface within the infiltrometer rings should be covered with a splash guard (pieces of burlap or rubber sheet). The initial amount of water poured into the rings need not be measured, but any water added to maintain the desired depth of water, after the start of the timing interval, should be recorded. This process is followed for both rings in a double-ring infiltrometer. For comparison, infiltration rate is usually calculated for the outer as well as inner ring.

The water level should be maintained as near the desired depth as possible. For average materials the amount of water used should be recorded at intervals of 15 minutes for the first hour, 30 minutes for the second hour, and 60 minutes during the remainder of a period of at least 6 hours. Permeable materials may require more frequent early readings. A longer test may be desirable if the soil has a low permeability or if a long-range infiltration rate is more applicable to the problem being studied. To prevent evaporation, the driving cap or some other type of covering should be placed on the infiltrometer rings during the time intervals between water measurements. A small hole should be drilled in the center of the driving cap to permit air to enter.

Upon completion of the infiltration test, the infiltrometer rings are removed from the soil by light hammering on the sides, (the rings should be hammered only with a rubber hammer to prevent denting), by moving the ring back and forth, and by lifting. A trench then should be dug. One wall of the trench should pass along the centerline of the former location of the infiltrometer rings and be so oriented that it will be illuminated by the rays of the sun. If feasible, the trench should be large enough to include all the moist area. If the soil was moist before the start of the infiltration test, the use of dyes may assist in delineating the newly moistened areas (Tamm and Troedsson, 1957). If the soil is sandy, sodium fluorescein or indigo carmine may be used, but a portable black-light lamp will be needed to detect the fluorescein dye. The use of dyes in clay soils commonly is unsatisfactory because the clay may absorb the dye. If preferred, an auger (the Orchard barrel-type auger is suggested) may be used to determine the approximate outline of the moist area. Determination of the moisture content of samples obtained from different locations in the moist area commonly provides useful information in interpreting the movement of water through any particular soil profile. The moist area should be plotted on the cross-section part of the report form. Contours of different moisture contents also may be plotted.

CALCULATIONS AND DATA REPORT

The volume of water used during each measured time interval should be converted into depth of water per unit of time (inches per hour or centimeters per hour). If the Mariotté tube is used, these calculations may be made by use of tables 2 and 3. For double-ring infiltrometers, these calculations usually are made for the inner ring, the outer ring, and both rings combined.

TABLE 2.—*Data for single-ring infiltrometers*

Diameter of ring (inches)	Area of ring (sq in)	Area of ring (sq cm)	Volume of water, in ml, providing 1 in. depth	Multiply volume of water used in ml by (A) or (B) to obtain depth of water	
				(A) Inches	(B) Centimeters
12	113. 1	729. 7	1, 854	5.39×10^{-4}	13.70×10^{-4}
18	254. 5	1, 642. 0	4, 176	2.39×10^{-4}	6.09×10^{-4}
24	452. 4	2, 918. 9	7, 415	1.35×10^{-4}	3.43×10^{-4}

TABLE 3.—*Data for double-ring infiltrometers*

Diameter of rings (inches)	Area of annular space (sq in)	Area of annular space (sq cm)	Volume of water, in ml, providing 1 in. depth	Multiply volume of water used in ml by (A) or (B) to obtain depth of water	
				(A) Inches	(B) Centimeters
12 and 18	141. 4	912. 3	2, 318	4.31×10^{-4}	10.96×10^{-4}
12 and 24	339. 3	2, 189. 2	5, 561	1.80×10^{-4}	4.57×10^{-4}
18 and 24	197. 9	1, 276. 9	3, 244	3.08×10^{-4}	7.83×10^{-4}

All test data, as well as the infiltration rates calculated during the progress of the test, are recorded in a record book or on a report form. (See fig. 5.) The data are plotted also on the cross-sectioned part of the report form.

SUMMARY

Most of the investigation of infiltrometer rings or basins has been made by scientists interested in their use for evaluation of agricultural soils. Because of this, the infiltration rates were usually determined for the upper foot of surface soils, the heads applied were low to simulate rainfall or the application of irrigation water, the time of application was approximately 3 to 6 hours, and the maximum rates were usually the ones used and reported. These items must be considered in evaluating infiltration data or in considering the use of the infiltrometer for other applications. For example, in the design of infiltration pits for waste disposal, all the above items would be different; the infiltration rates must be representative of the deeper sediments, the head applied may be several feet, the time of application would be long, and the minimum rather than the maximum rate of infiltration probably would be the one used.

Considering all factors, Musgrave and Free (1937) concluded that a specific infiltration rate for a particular type of sediment is virtually nonexistent and that measured rates are primarily of comparative value. The rates do have sufficient value, however, to warrant presentation of the discussion and test method in this report.

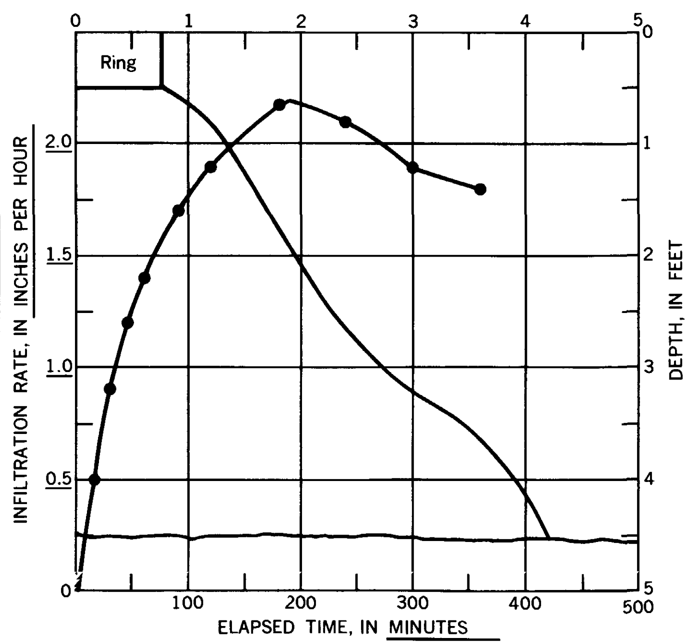
PROJECT NRTS INFILT., IDAHO

INFILTRATION RATE

DATE: Oct. 14, 1955 TECHNICIAN: Joe Smith METHOD: 18-in ring infiltrometer (single)

ELAPSED TIME (min)	QUANTITY OF WATER (ml)	INFILTRATION (in. per hr)
15	522	0.5
30	940	0.9
45	1252	1.2
60	1461	1.4
90	3549	1.7
120	3967	1.9
180	9187	2.2
240	8670	2.1
300	7934	1.9
360	7517	1.8

CROSS SECTION OF MOIST AREA AND GRAPH OF INFILTRATION RATE



SOIL PROFILE DESCRIPTION

- Soil, sand, thin grass stand
- Sand, very fine to fine, dry, loose
- Basalt, dense surface

FIGURE 5.—Report form for infiltration test with sample data.

Infiltration is presently the subject of a model study in the U.S. Geological Survey's Hydrologic Laboratory at Denver, Colo. (Palmquist and Johnson, 1960). Because of the restrictions and expense involved in infiltration fieldwork, it would be useful if it could be shown that field infiltration rates could be correlated with permeability measurements made in the laboratory. However, with the information available at present, it would be extremely fortuitous if such a correlation were found.

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