Test method to determine the characteristic rate of discharge for plumbing fixtures and devices

Beach, R. K.

Publisher's version / Version de l'éditeur:
https://doi.org/10.4224/40000558
Building Research Note, 1980-02

ISSN 0701-5232

BUILDING RESEARCH NOTE

TEST METHOD TO DETERMINE THE CHARACTERISTIC RATE OF DISCHARGE FOR PLUMBING FIXTURES AND DEVICES

by

R.K. Beach

Division of Building Research, National Research Council of Canada

Ottawa, February 1980

TEST METHOD TO DETERMINE THE CHARACTERISTIC RATE OF DISCHARGE FOR PLUMBING FIXTURES AND DEVICES

by

R.K. Beach

SCOPE

This test method describes a procedure to determine the characteristic rate of discharge for plumbing fixtures and devices.

APPARATUS

Tests may be carried out using the apparatus and piping shown in Figures 1 and 2. An arrangement other than that shown in Figure 1 may be used if it can be proven that the change will not influence the results.

This procedure assumes that the strip chart record will be processed manually to produce the characteristic rate of discharge curve for the fixture or device. To facilitate this the total deflection should exceed 50 per cent of the chart width and the combination of the chart speed and the full scale deflection chosen should be such that the strip chart record has a maximum slope of about 45°. As the expected maximum rate of discharge is 4 L/s, the product of the strip chart's scale factor and chart speed should also be 4 L/s. A clear plastic rate of discharge template, shown in Figure 3, is used to process the strip chart record. Users will find it more convenient to replace the slope scale with a rate of discharge scale so that the rate of discharge can be read off directly. The rate of discharge scale is the product of the slope times the scale factor in L/mm times the chart speed in mm/s.

The fixture piping shown in Figure 2 should be plastic and should conform to the appropriate standard in the Canadian Standards Association B181 series of standards. Dimensions not specified should be the minimum practical. Piping need not be solvent welded but should be sealed.

The pressure in the water supply system under no flow conditions should be adjusted to fall within the 275 to 425 KPa (40 to 60 psi) range. The pressure in the water supply line during the testing of a fixture that requires a supply of water for its normal and proper functioning should conform to the requirements of the Canadian Plumbing Code except that, where a manufacturer specifies that a higher pressure is required, the higher flow pressure should be used.

CALIBRATION

The complete test set up should be tested for a straight line relationship and, where necessary, modifications should be made to ensure that the variation between the actual capacity of the tank and that recorded by the strip chart does not vary by more than ± 2 per cent.

At the beginning of each series of tests and whenever the range of the strip chart record is changed, the strip chart recorder should be calibrated by first zeroing the pen then adding a measured quantity of water to the tank and adjusting the scale reading.

TEST LOADS

(a) A fixture with an overflow should be filled to the overflow.

(b) A fixture without an overflow should be filled to a height equal to 75 per cent of the vertical distance between the bottom of the fixture and its flood level rim.

(c) A flush tank type fixture should have the refill mechanism adjusted to fill the tank to the level mark indicated by the manufacturer and, where applicable, the fixture should be filled by operating the flushing mechanism.

(d) Any other device or appliance should be filled to a level that represents a large but not improbable load.

NUMBER OF TESTS

(a) A fixture that has an overflow should have its rate of discharge determined with the overflow open and again with it sealed.

(b) A fixture that has two or more compartments should have its rate of discharge determined using the compartment that experience or preliminary testing indicates will produce the highest peak rate of discharge and determined again by discharging all compartments together.

(c) A fixture that is provided with a removable strainer (e.g., the crumb cup of a kitchen sink) should have its rated discharge determined without the strainer and again by opening it in place.

(d) A fixture that requires a flushometer for its proper functioning should have its rate of discharge determined under two conditions: with the flushometer as received from the manufacturer and again as adjusted to discharge the maximum amount of water. The flushometer should be supplied with the fixture.

(e) Each test should be repeated three times except that for those fixtures that are provided with a flushing mechanism or that discharge less than 10 litres of water, each test should be repeated five times.

TEST PROCEDURE

Install the fixture or device using the appropriate piping arrangement. Adjust the Pressure Reducing Valve and flow resistor to provide the correct water pressures. Prepare the fixture or device for testing by filling or flushing it. Drain the receiving tank if required. Adjust the strip chart recorder to the required deflection scale and speed and zero the pen.

Start the strip chart recorder and discharge the fixture or device by operating the mechanism or removing the stopper. The stopper should be pulled straight up each time in order to avoid giving the water a swirl as this affects the rate of discharge.

In the case of a fixture whose functioning requires the trap to be refilled, the strip chart recorder may be stopped after the main flush has finished and be restarted briefly when the supply of water to the fixture has stopped and thus record the actual amount of water that was discharged.

PROCESSING OF THE STRIP CHART RECORD

Draw a smooth curve through each of the strip chart records to average out the rapid fluctuations in pressure picked up by the transducer. Establish the zero point for time when the water first begins to accumulate in the receiving tank.

Starting from this zero time, read off and tabulate for the same selected times the total amount of water discharged during each test run. The selected time interval should normally be 1 second, but shorter intervals are necessary at the beginning of the period and may be needed when the rate of discharge changes rapidly.

Determine the average quantity of water discharged and the time of discharge by averaging the quantity discharged and the times when discharge ceased. In the case of water-closets and devices with trap refill mechanisms, the average discharge time and the average quantity discharge refer to the main flush. Record also the total discharge time and the total quantity of water discharged. The difference in the quanitities discharged is the trap refill loss. Average the amounts discharged for the selected times and tabulate. Plot the results and draw a smooth curve fairing it in to terminate horizontally at the discharge time.

By means of the clear plastic template shown in Figure 3 determine the rate of discharge and corresponding time of discharge for several points and tabulate. Plot the results and draw in a smooth curve which is the characteristic rate of discharge curve for the fixture or device. The discharge curve of a fixture whose normal function requires refilling of the trap does not include any subsequent trap refill loss.

Calculate the mean rate of flow equal to the quantity discharged divided by the time of discharge. Determine the peak two-second mean rate of discharge which is the highest average rate of discharge of any two-second period. The accuracy of the characteristic discharge curve can be checked by comparing the measured quantity of water discharged with the area under the curve.

Complete the Characteristic Discharge Rate Report.

CHARACTERISTIC RATE OF DISCHARGE REPORT

(1) Device Tested (2) Mfr's Name

(3) Manufacturer

(4) Water pressure (a) Static KPa; (b) Flowing KPa

(5) No. of Tests

(6) Period of Discharge sec. (7) Quantity Discharged L

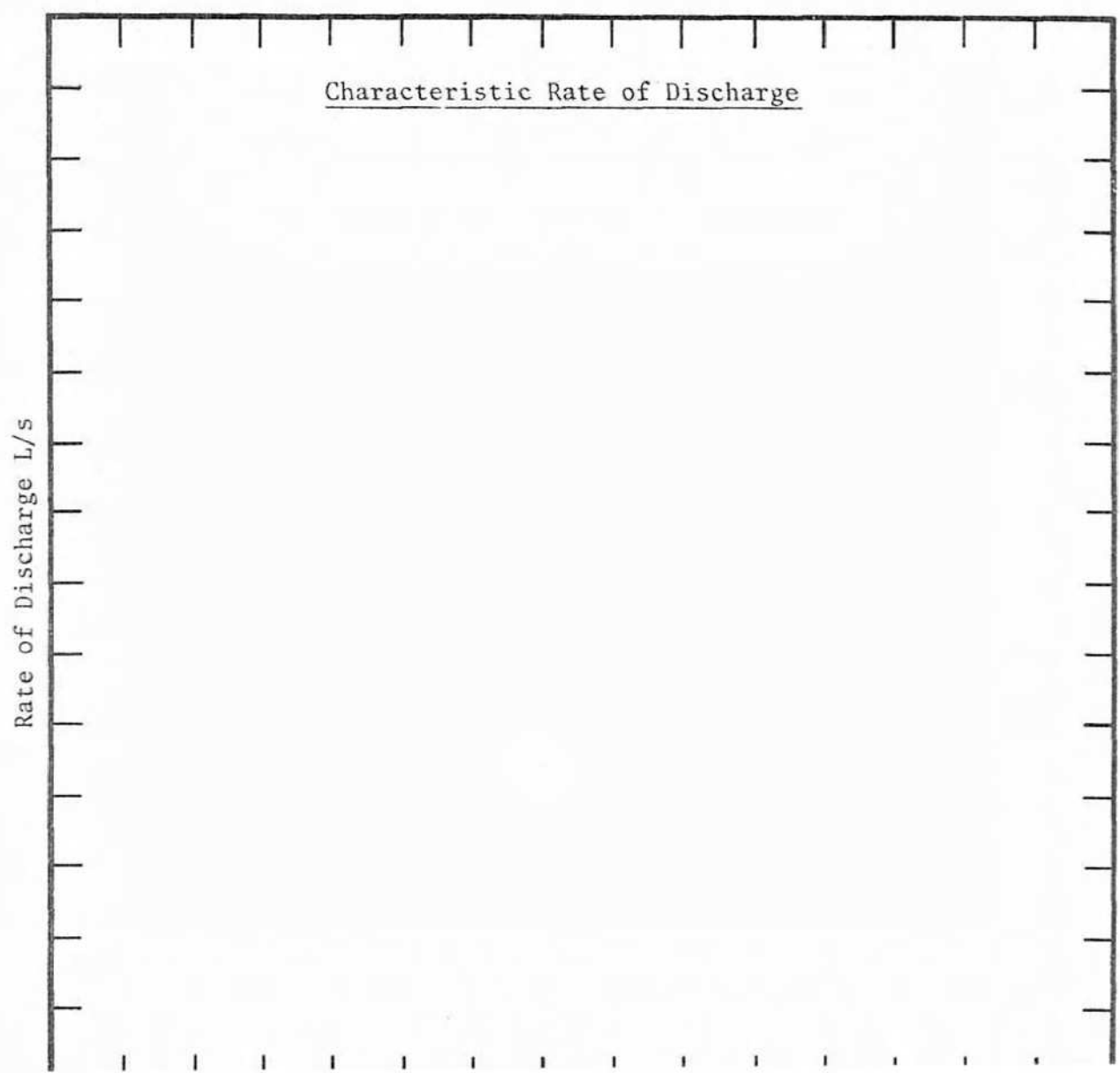
(8) Mean rate of discharge L

(9) Peak 2 sec. mean rate of discharge L/s

(10) Period of Total Discharge sec

(11) Total quantity discharged L

(12) Trap refill loss



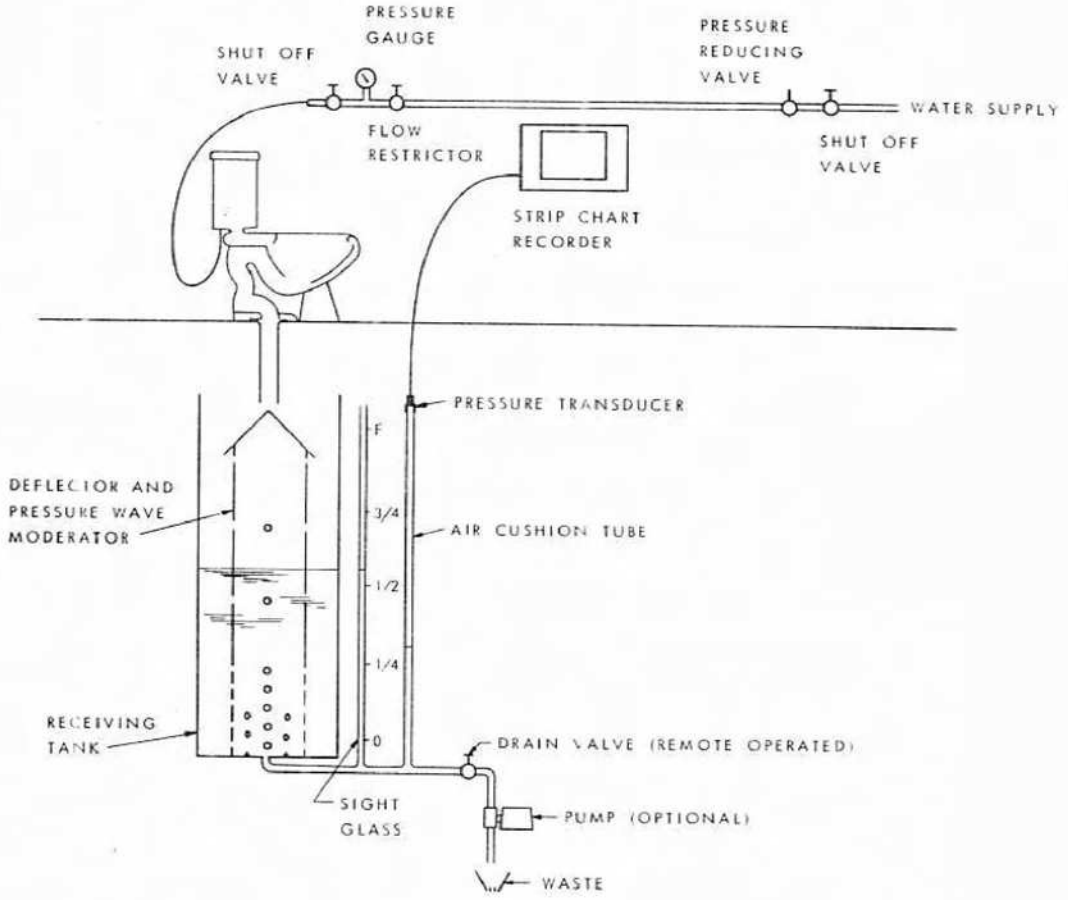
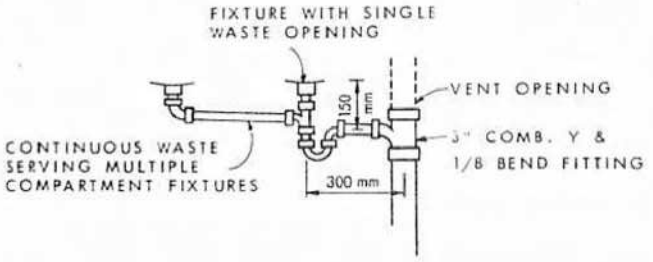
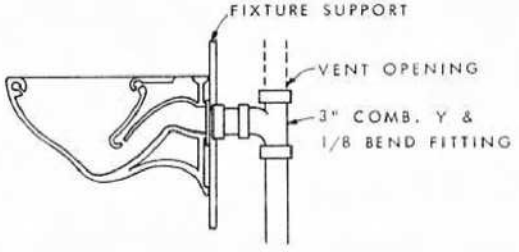


FIGURE 1

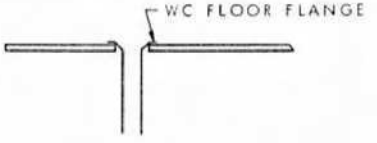
APPARATUS FOR DETERMINING THE CHARACTERISTIC RATE OF DISCHARGE OF A PLUMBING FIXTURE OR DEVICE



(A) TYPICAL VERTICAL OUTLET TYPE FIXTURES (FLOOR OUTLET WC'S EXCEPTED)



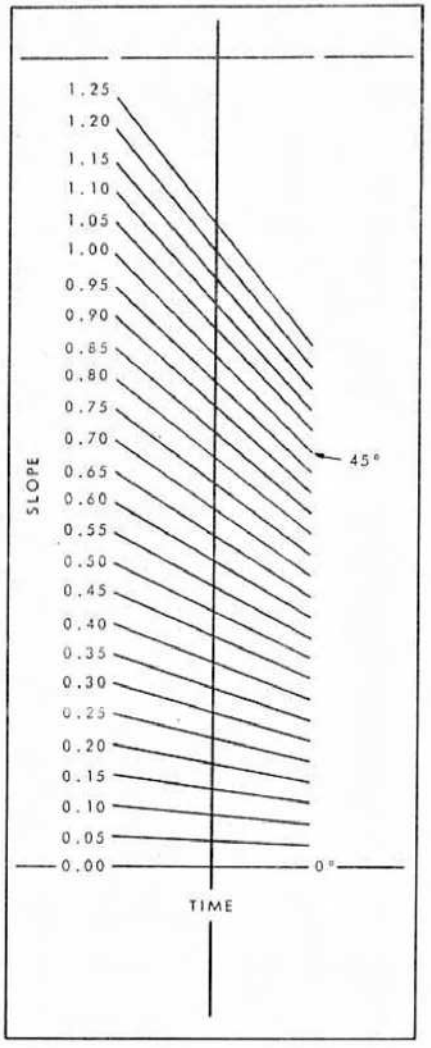
(B) TYPICAL BACK OUTLET, INTEGRAL TRAP TYPE FIXTURES



(C) FOR FLOOR OUTLET WC'S AND OTHER DEVICES

FIGURE 2

FIXTURE PIPING



NOTE: Actual Rate of Discharge (L/s) = Slope x Scale Factor (L/mm) x Chart Speed (mm/s)

FIGURE 3

CLEAR PLASTIC RATE-OF-DISCHARGE TEMPLATE