

FLOW-RATE DIVERSION - AN ALTERNATIVE TO VOLUME DIVERSION

In 1993 SafeRain was invented. SafeRain is a first flush water diverter which combines what is called a “differential volume” action with an extensible member. There have been many “differential volume” first flush diverters but none appear to have had much success. Briefly “differential volume” device intercepts a portion of the rain inside a body (sphere or cylinder), which is balanced by a counter-weight.



When the combined weight of the intercepted water and the valve body exceed the counter-weight then the body will move in one motion to seal a valve seat causing diversion sometimes called the “pilot” principle. Instead of a counter-weight, SafeRain suspends the valve body (ball) from a shaft with a length of special water-proof elastic.

The shaft enables the ball position relative to the seat to be adjusted. This changes the flow-rate at which the ball closes the seat. SafeRain was the first to employ “an extensible member” (elastic). Above this shaft is a flat plate with holes in it (baffle plate). This attenuates the flow of incoming water into the ball. It also prevents premature closure when there is a recent surge of water.

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HOW SAFERAIN WORKS

When rain starts it will either go around the sides of the baffle or hit it (Figure 1). Some of this rain will go through the holes in the baffle and some of this will enter the ball. Typically about 0.0005 of the rain enters the ball and if this entry rate into the ball is faster than the drain rate then the ball will begin to descend eventually closing the valve seat. The water will then divert to the cistern (Figure 2).

Figure 1

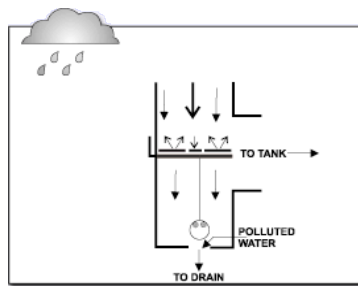
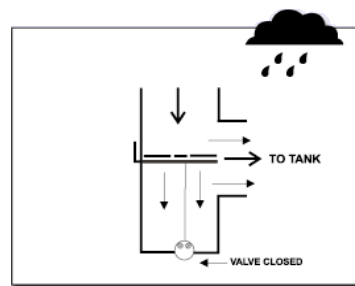


Figure 2



When rain ceases the water in the unit will slowly drain out of the ball (Figure 3). When it is empty the elastic will pull it back to its original position (Figure 4).

Figure 3

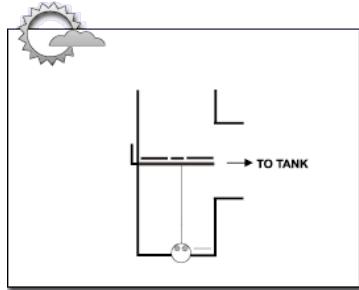
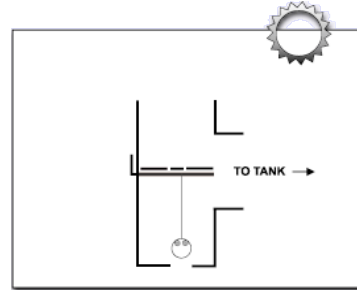


Figure 4



By winding the ball up or down the flow rate at which the ball closes can be adjusted. The standard model has a closing range between 1.32 gallons/minute – 9.25 gallons/minute (5 litres/minute and 35 litres/minute). The "normal" setting is about 2.64 gallons/minute – 3.96 gallons/minute (10 litres/minute - 15 litres/minute). Of course it can be closed or opened manually. The leakage rate for the ball when closed is about 1.69 – 3.38 ounces/minute (50-100 ml/minute).

In drizzle conditions the unit will not work automatically. This is desirable since the roof would not be swept of adhering materials. A sudden rain-burst would not fill the ball immediately since the ball floats and the baffle plate attenuates the immediate impact of the incoming water. This enables the furthestmost debris etc to reach the downspout before closure.

The above description is schematic only. There is other design features not mentioned that are included for smooth operation. The design can be adopted for inflow from any direction. The lifespan of the elastic is 7+ years. The pressure drop across the unit is minimal. This is important in tropical and monsoonal areas. SafeRain is not a leaf filter although it does have an internal ½ inch mesh stainless steel screen.

For urban use rain must fall firstly to clear the air of smog etc, and then go to clean the roof. The efficiency with which it does the former depends on the intensity while the latter depends on the momentum of the moving rainwater across a surface (roof). Ignoring roof pitch we can equate this with flow rate.

The realization that the first flush of water needs to be separated from a cistern if that cistern is being used for consumption has been acknowledged since the 1920's. The technology of these first flush systems since then has never strayed from the

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container/volume idea. SafeRain has designed a flow-rate first flush diverter that has taken rainwater harvesting out of the 20th century and into the 21st.