Nozzles And Spray Systems

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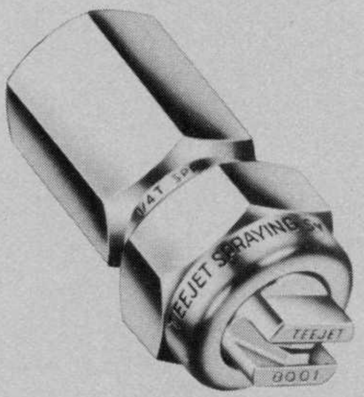
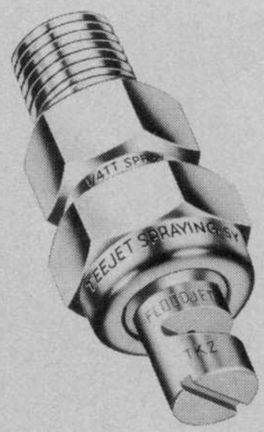
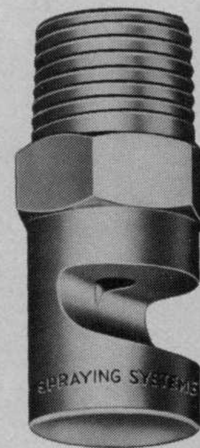


Type ¼ T Teejet nozzle with flat spray tip.



Type ¼ TTK Teejet nozzle with Floodjet tip.



Type K Floodjet nozzle.

Before delving into the nozzle varieties available and their usage, there are some physical attributes that ought to be considered. Just how accurate should one expect a nozzle to be at the time of purchase, and how long should this accuracy remain?

We feel that if we can manufacture an orifice with a tolerance of plus zero, minus 0.00″ to 0.002″ we will be able to deliver to the customer a nozzle that will meet his specifications as to gallonage, spray angle, distribution of liquid throughout the spray angle, proper particle size and particle size distribution, and from a good to a long performance life depending upon the conditions under which the nozzle is used. The reason for slightly undersizing the orifice is to give an extended wear life to it. However, if it is made too small, then the desired spray characteristics will be altered.

In order to have a rough gauge of comparison, here are results of accelerated erosion tests. The conditions of the test were: 1) finely ground quartz suspended in water under continuous agitation; 2) identical orifices made from different materials; 3) all orifices mounted on the same header; 4) the header fed from more than one location if necessary; 5) pressure held to a constant reading; 6) all orifices tested the identical length of time under the identical conditions.

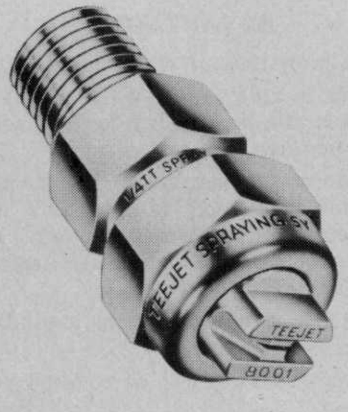
Unless such conditions are used and met, results will be incorrectly interpreted and reported. Repeated tests of orifices and nozzles showed the following relationships to be consistent: Using brass as a base and giving it a life of one (1), whether it be minute, hour, day, week, etc. we have:

Material	Life
Plastic	½ to 1
Aluminum or brass	1
Stainless Steel	3.5
Hardened Stainless Steel	10 to 15
Ceramic	90 to130
Tungsten Carbide	180 to 250

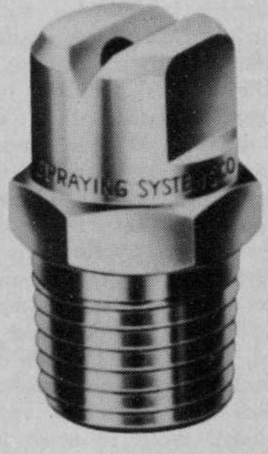
While one plastic orifice did give an extended life, it was due to a small skin burr around the orifice that tended to flap back and forth without wearing off, thus interfering with the erosion and not increasing the wear life. Upon removing this flap from other identical orifices, we found that it did not wit..stand erosion any better than orifices made from other plastics. Flow rates were inconsistent with those marked on the orifice.

There are a multitude of grades of ceramic. Some are good, all are extremely brittle, and all have been inaccurate so far. Most are placed in a brass holder that does not stand up under certain chemicals, and if cemented into stainless steel holders, some chemicals attack the cement and the tip falls out. So far it has been the brittleness and inaccuracy that has defeated these tips.

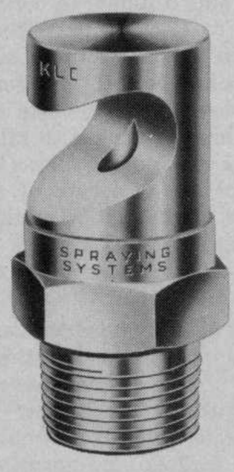
PLASTIC orifices, depending upon the material from which they are made, can vary due to absorption of liquid or loss of moisture. They are made by molding over a pin. Shrinkage must be considered in this molding process, because these pieces are literally knocked out of the molds and ejected from the orifice core pins by the t..ousands. Orifice sizes will vary due to the mold, tically matched orifices, except in



Type ¼ TT Teejet nozzle with flat spray tip.



Type H ¼ U Veejet nozzle.



Type KLC Fieldjet nozzle.

mold temperature, mold pressure, molding time, the plastic used, the plastic temperature, the skill of the operator or the skill of the set-up man. Accuracy is not one of the strong points of this type of orifice in a production run due to the aforementioned variables. Machining plastic would improve the accuracy, but results in fibers and burrs in the orifice that would require hand deburring at a great expense and possible distortion of the spray.

BRASS AND ALUMINUM are easily machined, can be made to almost any tolerance desired if the proper equipment is available, will withstand most of the ordinary agricultural chemicals used in weed and pest control, and are readily available. Aluminum does have the tendency to gall and to wire draw if hurried through the machining process. If threaded and joined aluminum to aluminum, then a lubricant, such as molybdenum disulphide is suggested so that the parts ring with the spray pattern, but may be disassembled at a future time.

STAINLESS STEEL orifices are punched, drilled or machined, depending upon the type being produced. If punched, then one must expect dulled or broken punches which will produce irregular or oversized orifices, resulting in greater capacities than those indicated on the nozzle. In addition, ridges and burrs can be found within the orifice as well as on either side of it that will interfere with the flow characteristics of the liquid and the nozzle capacity. If machined to tolerances, then the only care to be taken concerns the fibrous nature of stainless steel itself. Minute burrs or fibers can be pulled into the orifice by the dragging action caused by the drill, or cutter in forming the orifice. This occurs when the machine is pushed for time on each tip and cannot properly do the work it should, or the tools are too dull.

HARDENED STAINLESS STEEL has the same problems as stainless steel, but a much tougher grade of stainless is used and it has a tendency to chip or break off pieces as it is machined. Furthermore, the stainless qualities can be lost or greatly reduced if the heat-treating process that hardens it is done incorrectly.

CERAMIC orifices are sensitive to chipping or crumbling when made, which will result in distorted spray patterns and flow rates due to the orifice irregularities. Among new orifices, whether molded or machined, a wide variation of flow rates is found among those orifices supposed to be of the same size. The normal orifice configuration requires an extreme control of dimensions and positions that ceramic fabrication methods cannot meet. Experimental tests with ceramics, as with plastics, have resulted in great variations in the orifices of a single batch, and even wider variations in batch to batch runs. Orifices can be individually tested, selected and matched, but that would defeat the low cost supposedly possible through their use. Ceramic technology is certainly well advanced for many items, but it has not gone far enough nor adequately enough for spray nozzle orifices.

TUNGSTEN CARBIDE orifices can be manufactured with great accuracy. The corrosion resistance to various chemicals is an unknown, and even greater variation can be expected when these chemicals are mixed with local water supplies. However, one could expect a long life from these orifices due to erosive conditions that might be present, such as high pressure or entrained solids or both. Orifices of tungsten carbide are quite expensive when compared to brass or stainless steel, but if there is no violent corrosive condition present, and the erosive condition is not excessive, then one could expect the orifice to outlast the machine and still be accurate.

So far precision has been mentioned and alluded to without any figures to back it up. One way to approaching the problem in through your pocketbook. If you were spraying a chemical that costs $3.20 per gallon, and you were to mix it at a rate of 1 pint per 5 gallons of water, and apply it at a rate of 5 gallons per acre, then 1 gallon of the chemical could treat 8 acres at a chemical cost of 40 cents per acre, or $40.00 per hundred acres.

Some of the more unusual weed control applications in the central portion of the country have been:

Airplane or helicopter spraying under strict control conditions to prevent leakage and spray drift. An interesting application has been to control brush, followed by basal spot spraying from horseback to complete the kill.

Additional aerial spraying has been for brush control along power lines, pipe lines, railroad tracks, streams, etc. These are often followed in a few weeks by further application from ground driven equipment and handguns to complete the control program.

Railroad rights-of-way spraying is done either by the railroads themselves, or by contracting firms. The aim is bare ground on the ballast so that resiliency will be maintained. Decaying vegetation retains water and thus fosters compaction of the ballast. Large volumes of liquid are sprayed by tank trains moving at fairly rapid speeds. The desire is to have large drops and no drift, with complete coverage of the ballast.

Another area where complete vegetative control is desired is around, and upon, ammunition storage bunkers in the various arsenals. This is so that a grass fire will not set off the explosives. Standard weed control nozzles are used here, plus handguns to reach places where equipment is unable to enter.

We have varied an orifice for spot treatment of Johnson- or Bermudagrass clumps from a knapsack sprayer that uses gravity flow of the liquid. Our TK FloodJet tip could also be used with one of our trigger type of handguns.

There are several sectors of agriculture that can use a broadcast method of weed control. We could expect ground equipment to use the BoomJet, FloodJet, or FieldJet nozzle for these purposes along power lines, for brush control, in pasturelands, roadsides, drainage ditches, streams, ponds and other waterways to clear out choking vegetation such as water hyacinths. The process is also used to break up oil spills in Sweden and in the Gulf of Mexico.

Another use to to combine herbicides and/or insecticides with fertilizer in solution or suspension, and to broadcast apply it on fields. However, there is a problem here, a plant root will travel to a food source, whereas a given amount of herbicide must be deposited upon a plant to kill it. Therefore, one must not expect complete weed control from broadcast applications since the drops will vary in size and distribution due to pressure variations, viscosity of the liquid, speed across the field, height and attitude of nozzle in relation to the ground surface, plus any of many variables that always seem to arise at unexpected moments.

Lastly, there is the possibility of using Ultra Low Volume sprays to directly apply technical grade herbicides. The U.S.D.A. defines them as:

1. Ultra-Ultra Low Volume ....to 8 oz. per acre.
2. Ultra Low Volume ....8 oz. through 64 oz. per acre.
3. Low Volume ....65 oz. per acre to complete coverage.
4. Conventional ....to run off.

It had been proposed in 1967 that conventional be considered as all applications above 4 gallons per acre, and that low volume be from 65 oz. per acre to 4 gallons per acre.

All of you are aware of the 5 gallons per acre, and larger capacity, nozzles for weed control. We have also produced orifices that can apply less than 1 gallon per acre, but run into a series of conditions of which you might be unaware. First of all, your equipment must be scrupulously clean to continue to operate; second, pressures will have to be increased for the very small capacities in order to form the spray, and that means greater speed of the spray rig to hold down tne gallonage per acre; and last, you cannot **see** whether the nozzle is operating or not, and this is the most critical of all tne points. That which is left is a mist-type of unit using a large fan to shear and distribute the chemical over the crop area, and the obvious problems that entails when using herbicides, or the helicopter/airplane for aerial application, and this is where the spraying of technical grade chemicals originated on a large scale. Lastly, there is a method of using compressed air to atomize, impact and project technical grade chemicals onto a crop at a rate as low as 4 oz. per acre. However, 16 oz. to 32 oz. appears to be a more parctical rate to use. Fluid rates can vary with the pressure applied, degree of atomization will vary with air pressure from 7 psi to 15 psi. Experience has shown 7 - 9 psi of air is sufficient.

ADVANTAGES

1. Elimination of water hauling.
2. No mixing required—chemical is sprayed as supplied by the manufacturer.
3. More effective use of the chemical—tests indicate that ULV insecticide applications can be made on an extended spray schedule.
4. Reliable equipment is available in some areas.
5. More acreage can be covered per day.
6. More latitude is available to the chemical formulator.

DISADVANTAGES

1. Air assisted atomization creates such fine particles that wind drift will be a definite hazard.
2. Conventional equipment cannot be used. New, and more expensive controls, instruments, air compressors, pumps, etc. and other parts must be obtained to supply the accuracy needed.
3. Operators must be trained.
4. Because it is an herbicide that we are considering, absolute precission is necessary throughout the equipment and application procedures.
5. Internal cleanliness of equipment is a must.
6. If used for herbicides, the equipment cannot be used to apply insecticides or fungicides to herbicide susceptible crops. This is quite an expense to stand idle.

We are now engaged in a study of particle sizes produced by various orifices under varying conditions. So far none of this information has been published, and it may never be for its use is highly specialized. We will listen to the needs of scientists, and can often give them the information desired in short order. However, we cannot do research work for firms if it has no bearing on our needs.