SPRAY EQUIPMENT (NOZZLES, PUMPS, SYSTEMS)

I. COMPONENTS OF THE SPRAY SYSTEM

A. ESSENTIAL PARTS OF A SPRAY SYSTEM

1. Tank

   a) Corrosion-resistant, easy to fill and clean, shaped for mounting and agitation (openings for pump or mechanical agitation)

   b) capacity markings on side

   c) sealing lid

   d) drain at the bottom for through cleaning

   e) types: Fiberglas (durable, can crack, some solvent problems), stainless steel (expensive, heavy, high use rate), galvanized (corrosion and rust flakes), aluminum tanks (good for most products, check labels for Al corrosion warnings) and polyethylene (suited to many types, proper mounting to avoid cracks)

   f) Strainer in the tank lid.

2. Agitation devices

   a) a maintain a proper mix in the spray tank

   b) types: mechanical (paddles in tank) and hydraulic agitation (pipe or jet agitators)

      (1) With hydraulic agitation fluid circulated by the pump.
3. Pumps – (see HYPRO Sprayer Pump Handbook)

   a) Roller pumps (rolling vanes, flexible impellers, and sliding vanes) vanes come in a variety of coatings for various uses.

       (1) Sensitive to sharp object, coarse abrasives such as sand and barrel scale, use strainers to keep these out

   b) Centrifugal pumps, handles WP and abrasives well, rapid performance drop off above 30-40 PSI, no pressure relief valve necessary, may require a speed-up pulley from tractor PTO to get proper RPM.

   c) Piston pump, positive displacement pump (output is proportional to speed and independent of pressure, high-pressure constant output) can deliver very high pressure for cleaning operations. Requires a surge tank to avoid spray pulsing, also damper in pressure gauge (glycerin-filled)

   d) Diaphragm pump, positive displacement, similar to piston with regards to performance, different pump working mechanisms, available with corrosion protection coatings.

   e) Pump cost comparison:

<table>
<thead>
<tr>
<th>Type</th>
<th>Estimated Cost</th>
</tr>
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<tbody>
<tr>
<td>Roller</td>
<td>$ 92 – 313</td>
</tr>
<tr>
<td>Centrifugal</td>
<td>$ 179 - 525</td>
</tr>
<tr>
<td>Diaphragm</td>
<td>$ 256 - 1172</td>
</tr>
<tr>
<td>Piston</td>
<td>$ 188 - 1350</td>
</tr>
</tbody>
</table>

4. Regulating devices

   a) Pressure relief valves are used to return flow to the tank when spray boom is turned off. Without a pressure relief valve, pump can be damaged and hoses ruptured.

   b) Pressure gauges mounted between boom control valve and nozzle tips. Keep as close to outlets as possible to monitor changes in spray pressure. Will increase if nozzles clog and decrease if leaks develop.

   c) Unloader valve, similar to pressure relief except that when boom is shut off, flow from the outlet is directed to the pump inlet to reduce pump
working pressure., used with positive displacement pumps running above 200 psi.

5. Nozzles (go to Spraying Systems Co. Ag. Spray Products #48)

a) Types (see pages 2-8, CAT 48, “Selection Guide”)

(1) flat fan, tapered edge, primarily for broadcast application over plant/ground surface

(a) TeeJet series, XR use over a range of pressure. Low pressure large droplets, hi gallonage

(b) Standard, most broadcast operations

(c) Twinjet, double outlet to get better coverage of canopy and into crop residues.

(d) Double outlet, for directed post application

(e) Air Induction, has a venturi or hole to suck air and cause droplets with air pocket, you get larger drops for drift control but exploding drops provide small particles for improved performance.

(2) flat fan even edge, banded application, behind planter

(3) Flood jets, coarse droplets, uneven pattern, non-crop w/herbicides, can use with fertilizer in liquids.

(4) Hollow and solid cones, mostly insecticide application, some post application.

(a) full cone for higher gallonage, big drops less drift

(b) ideal for banding over rows with multiple nozzles

(5) off center, used to direct spray away from the boom end

B. NOZZLE TYPES, APPLICATION

1. NOZZLE MATERIALS

a) variety of materials, nylon, brass, aluminum and stainless steel
2. NOZZLE BODY COMPOSITION

   a) Body
   
   b) strainer, can also contain a check valve
   
   c) tip, variety of sizes
   
   d) Cap, screw on and quick disconnect.

3. NOZZLE TIP CODES

   a) Angle/gallonage description (see t-jet catalog)

      (1) First number is spray angle at 40 psi, possible tips, 35, 65, 73, 80, 95 110, 150.

      (2) Second number is a whole number value for gallons per minute at 40 psi, possible tips; 0067=.067 GPM, 1067=1.067 GPM. typical nozzles, 8004,730308, 15006

      (3) Misc designations, SS=stainless steel, E=even, OC=off center, LP=low pressure (explain), XR = EXTENDED RANGE

C. Booms sprayers and proper adjustments

1. Width of spray pattern (see page 94 CAT 48)

   a) Note that increased spray height gives wider pattern; also note theoretical spray pattern increased is with increased height. See Theoretical Coverage at Various Spray Heights.

2. Proper boom height with given nozzles

   a) note that with wider spray angle boom height is lower for proper spray over lap. (As spray width increases boom height can be lower, see page 93, CAT 48.)

   b) Note that nozzle spacing affects suggested boom height.

3. Proper spray pattern overlap based on width of spray pattern.

   a) With flat fan nozzles, you must obtain 50% overlap of nozzle spacing. Meaning that two adjacent nozzles must cover 50% of the space between nozzles. See, Example for nozzle spacing of 20 inches. See page 10 of book (in Bode and Butler).

      (1) See overhead, explain diagram
b) Nozzle spacing determination (OH of walk behind boom)

(1) Determine the width of a single nozzle at a given height. See T-Jet Catalog: “Spray Coverage Information”.

(a) Pick the nozzle angle and height of spray boom.

(b) E.G., 80° angle and spray height of 12 inch gives spray width of 20.2 inches.

(2) Recommended spray over lap is 50%, this mean that 50 percent of the area between the nozzles is covered twice by the spray from two adjacent nozzles. For flat fan tips you will always use this % overlap.

(3) Equation for determining nozzle spacing based on any desired boom height.

(a) Spray width (SW) - nozzle spacing (NS)/ (NS) = percent overlap (.5 with flat fan tips). Nozzle spacing is the value you need to determine for specialized boom applications.

(b) With an 80° angle nozzle and 20 inch nozzle spacing and 50% overlap, use the equation in (a) above to see how to see how to use the catalog values. With SW = 30.3 at 18 inches (can determine either by actual measure or see T-Jet Spray Systems book). The desired overlap is 50% or .5. Setup the equation as follows:

(i) 30.3 - 20/ 20 = .515 (X’s 100 for percent overlap)

(4) To build a custom boom for special spraying applications follow this example.

(i) for spray height = 8 inches, what is the nozzle spacing for 50 % overlap when using a 80° angle nozzle:

(a) See T-Jet book pg. 126, go to line with 80°angle nozzle, get SW value. Use equation above.
(b) 13.4 - NS/ NS = .5
(c) 13.4 - NS = .5NS
(d) 13.4 = .5NS + NS
(e) 13.4 = NS (.5 + 1)
(f) 13.4/1.5 = NS
(g) 8.9 = NS, thus nozzles are 8.9 inches apart when using an 80°angle nozzle with a spray height of 8 inches.

(h) Plug numbers into the equation to confirm, 13.4 - 8.9/8.9 = .5 (.5056), or 50.56% overlap.

(5) If you just follow T-Jet’s Spray System directions on nozzle spacing and spray width based on nozzle specs no problem, problem comes with a custom application where you want a very low boom to avoid spray drift.