How to Design Spray Nozzle Headers

Keeping the liquid distribution consistent

In many cases, covering an area with spray requires more than one nozzle. If so, you should start to give the nozzle positions some thought using a few simple guidelines.

There are two main approaches: Full cone and flat fan arrays. Each has its purpose and primary applications. In this section we'll discuss the latter. In the next section we'll discuss full cones.

Flat fan headers

When the object is to wash a moving target, a flat fan header is typically the first choice. This includes:

- Washing a product on a conveyor.
- Washing the conveyor belt itself.
- Rinsing cake on a filter belt.
- Spraying a web or large sheet.

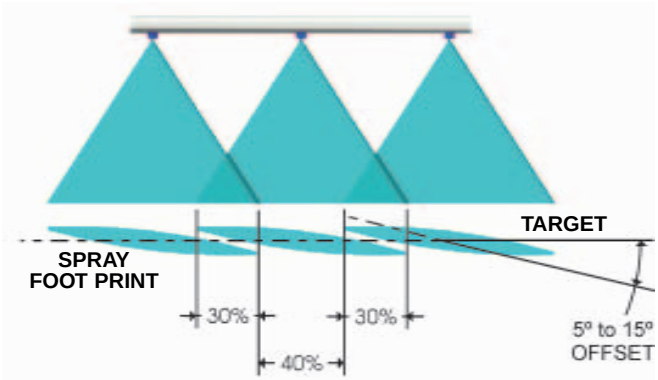
The common element is that the product is moving past the nozzles and a narrow spray line (sort of a curtain) is desirable. The typical configuration is a group of flat fan nozzles arranged on a header pipe positioned across the target. While this is not a difficult setup, a few moments of analysis can help you determine the nozzle selection and arrangement to keep the liquid and impact distribution even across the full width.

When making the design, there are several elements to consider:

Flow Rate and Pressure — Your process and available equipment will decide these parameters. Ultimately the total flow will have to be divided among the number of nozzles selected.

Header Position — Frequently the final location of the header is determined by equipment constraints. There is only so much space and you have to work within that. Otherwise, if you have a choice, the height can be an element you use to optimize the process.

At this point, look at the optimal spray overlap diagram below.

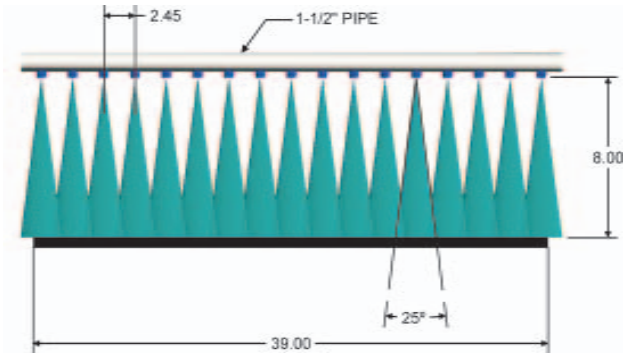


This illustration makes a few assumptions: Many flat fan nozzle designs have "tapered" or "parabolic" distribution. It means that more of the spray is concentrated in the middle of the fan than the edges. This is deliberate and for just this type of application. (Lechler's catalog indicates which of our product lines have this feature. With other manufacturers you may have to ask.) The idea is that when the sprays are overlapped by 30%, the liquid will be distributed evenly across the full width.

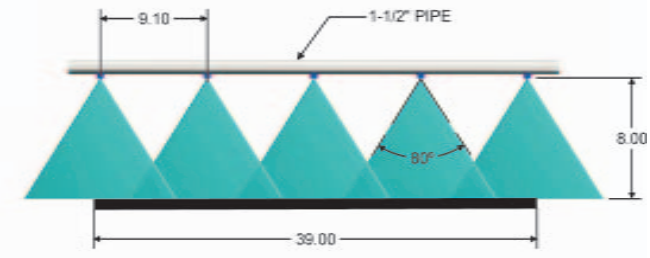
The sprays need to be offset slightly so the droplets do not collide in mid air. Since they are coming from different directions, providing a little extra space allows them to follow their path without impinging on each other.

That in mind, look at the two examples on the next page. Both have the header in the same position (8" above the target) and use the 30% overlap suggested. Both have the same combined flow rate and operate at the same pressure (10 GPM at 40 PSI), but the effect of the two will be different. Here are the details:

Header A uses 17 Lechler nozzle (632.512.16.BC; .59 GPM at 40 PSI, 25° spray angle) spaced 2.45" apart. This is a large number of small capacity narrow angle sprays.



Header B uses 5 Lechler nozzles (632.726.16.BC; 1.95 GPM at 40 PSI, 80° spray angle) spaced 9.10" apart. This is a smaller number of larger capacity wide angle sprays.



Header A would cost more and be more work with 12 more mounts to fabricate, so why would somebody do that? It depends on what the spray is supposed to do. While both headers would distribute the liquid evenly, **Header A** would also distribute the impact much more evenly. Look at the vectors of the droplets on **Header A**. They are much more perpendicular to the surface they strike.

With **Header B**, the impact is concentrated directly below each nozzle in 5 bands across the spray width. Contrast that with the areas where the nozzles overlap. There the droplets are hitting at almost a 45° angle after traveling a longer path from the nozzle. The impact would be much lower. However, if impact uniformity is not the concern, this would be a more economical choice. Additionally, by using larger capacity nozzles, **Header B** would be harder to clog.

The key is determining which characteristics are most important to you. Impact? Header simplicity? Clog resistance? Mounting constraints? Fortunately, Lechler offers a wide enough line of flat fan nozzle capacities and configurations to handle just about any job. Ask for a copy of our latest catalog if you don't have one. What's more, we can design and fabricate custom headers for your application. Let us know the details of your application, and we will design it to maximize the effectiveness you're looking for.

Making calculations such as this is easier with our Spray Nozzle Calculator. This FREE handy slide chart is available at your request. See the back page for details.

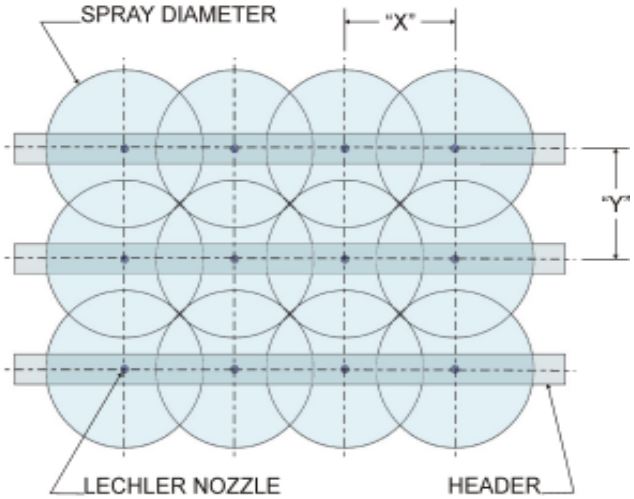
Full cone headers
Covering a large area evenly

In the previous section we discussed the process of laying out headers using flat fan nozzles. These are especially useful when trying to spray a moving target such as something carried on a conveyor.

There are other types of applications where it is necessary to cover a large area without either the nozzles or the target moving. Examples could be distributing liquid over packing in a tower or washing mist eliminator panels. These applications call for a large array of full cone nozzles distributed over the surface. If you spend a few minutes making a sketch of the installation and doing a few calculations, you can generate a nozzle layout that will make the liquid distribution very consistent over the surface.

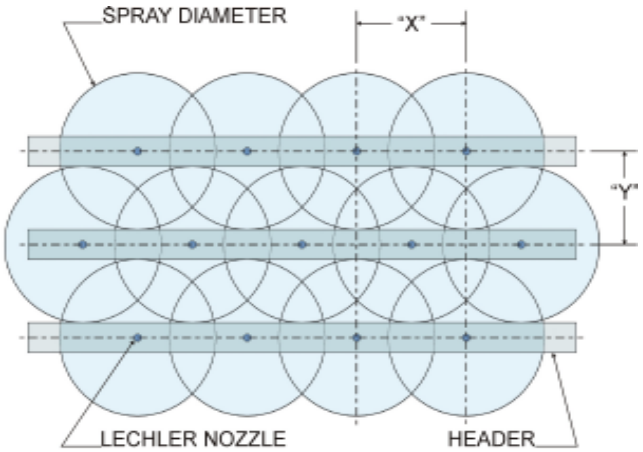
Looking at the two diagrams below and on the next page, you will see that there are two typical layouts, the *square* layout and *offset* layout. Either method works, but they have their own characteristics.

Square layout is easiest with minimal overlap. If coverage is not highly critical, this can be the most cost effective approach. However, if the nozzles are too narrow or the header is too low, the intersections at the corners can open into voids. If the opposite is the case, the corners can become heavy spots with overlap from four nozzles.



SQUARE LAYOUT DIAGRAM

Offset layout requires a few more nozzles, but is frequently preferred as more forgiving of slight variations in nozzle spray angle and header height position. There is little chance that holes can form in the spray and the maximum possible layering at any point is three. This security also comes at the cost of about 15% more headers.



OFFSET LAYOUT DIAGRAM

Full cone nozzles are available in both narrow and wide spray angles. When impact is not a major concern, using the widest spray angle possible, 120°, will minimize the number of nozzles and headers. However, droplets at the edges of the individual spray circles hit the target at only 30° above horizontal. If a more perpendicular spray is required, a narrower nozzle will accomplish that. Unfortunately, that will increase the number of nozzles and headers.

Making the position calculation is not complicated. Once you have chosen the spray angle nozzle that you want to use, calculate the diameter of the spray circle at the appropriate distance.

For square arrangements, multiply the spray diameter by 0.7 which will give 30% overlap between the sprays. This measure then becomes the distance between the nozzles on the headers “X” and the distance between the header center lines”Y”.

For offset arrangements, use the same calculation for the distance between the nozzles on the header, however the headers need to be closer together and offset by half the distance between the nozzles. Multiply the nozzle spacing distance “X” by 0.85 for the header spacing “Y”.

These calculations are easier using our handy Spray Nozzle Calculator. This FREE slide chart is available at your request. See the back cover for details.

In addition to making individual nozzles, Lechler can design and build headers for many applications. Give us your dimensions, flow rates and so forth, and we can lay out the configuration for whatever spray attributes you need. Just ask for help.

Height Considerations for Headers using Flat Fan Nozzles

Distance A
Insufficient height from surface to allow full coverage
Either move nozzles closer together or raise header.

Distance B
Optimum height level for this spacing of nozzles.
Flat fan nozzles overlap by 30%, giving complete coverage.

Distance C
Acceptable overlap for rinsing.
Greater distances from nozzles will reduce wash impact effectiveness.

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