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Poultry Housing Tips

Direct Drive 48" Fans Vs. Belt Driven 48" Fans

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In order to maximize bird cooling in a tunnel-ventilated house, 48" exhaust fans need to operate at maximum efficiency. Dirty fan blades and shutters can reduce exhaust fan output by 30% or more. If fan screens become dusty and feather covered, fan output can be reduced as much if not more. If the belts slip, the blades turn slower and the amount of air the fans move is adversely affected as well. For instance, if the fan blades are spinning 10% slower than they should, then the fan will move 10% less air. All of these factors add together to reduce a grower's ability to provide adequate cooling during hot weather. In fact, in the average tunnel-ventilated house, a 30% reduction in air speed would reduce the air speed from 400 ft/min to approximately 280 ft/min. This loss in air speed would result in the effective temperature (taking into account windchill effect) rising between three and six degrees.

Now of course these reductions in cooling can be eliminated through proper fan maintenance. But, the problem is that proper fan maintenance can take a lot of time. When birds get older in tunnel-ventilated houses, more than a 1/4 pound of dust can collect on the fan shutters each day. After just a couple of days this accumulation of dust can have a significant effect on fan performance. As a result many producers have found that they need to clean their fan shutters every other day, if not daily. Though dust and feathers don't seem to collect quite as quickly on exhaust fan screens, they still require weekly cleaning. And then there are the loose fan belts. It takes a lot of time to find wrenches, take off the screens, loosen and retighten the motor mounts on a few dozen exhaust fans.

In an effort to maximize air flow and minimize the amount of time required to maintain exhaust fans, some growers are installing direct drive 48" fans in their tunnel-ventilated houses. Since the fan blades are directly attached to the motor, no fan belt is needed and therefore the fan always spins at the proper speed. On the surface it appears the direct drive fans are the way to go, but are they?

The downside of 48" direct drive fans is that, in general, they move less air and are less energy efficient than 48" belt driven fans. The difference can be minimal or fairly large dependent upon the fans you are comparing. Most proponents of direct drive fans concede the fact that, in general, a 48" belt driven fan will move more air. The argument about direct drive vs. belt driven fans is that belt slippage is such a serious problem and that in the real world direct drive fans move more air because a grower never has to worry about belt slippage.

Over the past year a field study has been conducted by The University of Georgia's Extension Engineering and Poultry Science Departments comparing direct drive fans to belt driven fans in tunnel-ventilated houses on a four house broiler farm in North Georgia. The curtain-sided houses are 40' X 500' and are power-ventilated year-round. Two of the houses are equipped with nine, 48" direct drive fans the other two are equipped with nine 48" belt driven fans. Shutters are located on the intake side of all exhaust fans. Exhaust fan performance test data of the fans used

is listed in Table 1 (Agricultural Ventilation Fans...Performance and Efficiencies. Bioenvironmental and Structural Systems Laboratory. Department of Agricultural Engineering, the University of Illinois)

	48" Direct Drive		48" Belt Drive	
Static Pressure	Airflow (cfm)	Efficiency (cfm/watt)	Airflow (cfm)	Efficiency (cfm/watt)
0.00"	19200	20.6	20600	21.2
0.05"	17900	18.6	19200	19.4
0.10"	16600	16.8	17500	17.4
0.15"	15100	14.9	15400	15.2
0.20"	13300	12.8	10600	12.8

Table 1. Fan Test Performance Data

Fan power usage was monitored separately in each of the four houses and recorded daily. Exhaust fan speed and tunnel air flow measurements were taken during the first and fourth growouts.

Air speed in the houses with belt driven fans was slightly higher in the houses with belt driven fans than in the houses with direct drive fans (560 ft/min vs. 500 ft/min - 10% difference). This roughly corresponds with the lab test data for the two types of fans. At a static pressure of 0.05", the belt driven fans are suppose to move about seven percent more air than the direct drive fans. There was no appreciable change in air velocity between the first and the fourth growout in any of the four houses.

Average power usage was slightly higher in the belt driven fan houses (2.2%). This was expected because even though the belt driven fans were more efficient at moving air, they required more power because they moved more air. For instance, the direct drive fan uses approximately one watt of power for every 18.6 cubic feet of air moved. The belt driven fan uses one watt of power for every 19.4 cubic feet of air moved. If the fans moved the same amount of air, the houses with the belt driven fans would have used less power. But, since the belt driven fans moved more air, more power was used.

Probably the most surprising aspect of the study was that after four growouts none of the fan belts were slipping significantly. All of the belt driven fans were spinning within two percent of their rated speed. The only exhaust fans which were spinning two percent slow were the 48" exhaust fans which were used as timer fans during cold weather. Since fan output is directly proportional to fan speed, it can be deduced that all the exhaust fans were moving within two percent of their rated output. It is important to note that the direct drive fans showed the same amount of variance in speed.

These findings agree with those of a North Carolina State University study of belt slippage in poultry houses. Fan speed was checked on 35 poultry farms. Researchers found that fans five years old or newer were spinning within 4 percent of their rated speed. Measurements of fans on various farms in Georgia have noted the same tendency.

This is not to say that belt slippage is never a problem, because sometimes it is. But, it may not be as much of a problem in tunnel-ventilated houses as people think. Producers may believe their fan shutters are not opening fully because their belts are slipping, but it may be that the shutters or blades are dirty or that house static pressure is too high.

Belt slippage experienced with relatively new fans is often the result of improper initial belt tensioning. According to fan manufacturers, new fans belt should be retensioned after a day or two of operation (24 to 48 hrs. of run time). This retensioning greatly increases the likelihood that the belts will remain tight. Furthermore, if all fan belts are replaced every other year, belt tension problems would be greatly reduced. If you have questions on what is the proper belt tension for your particular exhaust fan contact the manufacturer.

Bottom line, you may look to direct drive fans as a way to solve a maintenance problem that under the right circumstances may not be that much of a problem after all. In the process you may buy a fan that moves significantly less air and is less energy efficient. The direct drive fans used in the above study are some of the better performing direct drive fans on the market. There are others on the market that move less than 16,000 cfm. Again, this is not to say that direct drive fans are not suitable for tunnel-ventilated houses, but as with any exhaust fan, know how much air the fan moves before you buy it. It all comes down to the fact that for any fan you are planning to buy make sure you have independent tests of how the fan performs under a static pressure with shutters and guards in place.

One final note, the grower on the test farm did mention that the direct drive fans were much easier to wash than the belt driven fans. But on the other hand, the direct drive fans produced more noise and vibration than the belt driven fans. This study will continue for the next year and additional findings will be published in future *Poultry Housing Tips.*

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