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Airflow Resistance Charts for Grain Storage Management

Airflow resistance in a grain bin is an important measure as it dictates how much airflow (cfm or cubic feet of air per minute) your fan is pushing into the grain. The target airflow for aeration (cooling) is 0.1 to 0.25 cfm per bushel while the target airflow for natural air drying is 0.5 to 1 cfm per bushel. Note that airflow rates higher than 0.25 cfm per bushel will result in faster cooling or conditioning, but it may also result in some moisture loss or removal (depending on air and grain conditions). Similarly, you may achieve some moisture removal with an airflow rate lower than 0.5 cfm per bushel, but the moisture removal will be very slow.

Airflow resistance is measured in static pressure (inches of H_20) and is dependent on grain type and depth. As grain depth increases, airflow resistance increases (and airflow rate decreases).

This handout describes two methods for using airflow resistance to know or predict airflow rate:

1. For existing fans, use static pressure and fan curves to estimate the airflow rate in the bin
2. For new bins, use the resistance-to-airflow charts to determine the fan type and size that will achieve the desired airflow rate

1. Estimating airflow rate in an existing bin:

To determine the airflow (cfm) from an existing fan, install a static pressure gauge in the aeration ducting near the fan. With the bin full (or at the target grain level), turn on the fan and take the static pressure reading on the pressure gauge. The static pressure will change based on grain depth and grain type. Use the fan manufacture's fan performance tables or curves (examples included below for Grain Guard's in-line centrifugal fans), to estimate the airflow rate based on the static pressure reading.

Example: The static pressure reading is 4.6 in. H_2O for a 5 hp in-line centrifugal Grain Guard fan (GGI-80511).

From Table 1, a 5 hp fan operating at 4 in. H_20 will generate 4790 cfm of airflow. That same fan operating at 6 in. H_20 will generate 4050 cfm. From that it is estimated the airflow is likely around 4600 cfm for this example.

Table 1. Example of airflow performance data for Grain Guard in-line centrifugal fans.

In-Line Centrifugal		Static Pressure (Inches H20)					
Model	HP	**2**	**4**	**6**	**8**	**10**	**12**
GGI-80311	3	3690	3020	2130	0	0	0
GGI-80511	5	5430	4790	4050	1600	0	0
GGI-80711	7	6550	5950	5220	4340	1560	0
GGI-81011	10	7750	7220	6550	5850	4960	3640

The other method for estimating airflow rate uses the manufacturer supplied airflow-static pressure chart (Figure 1). This chart is another way of presenting or using the same information shown in Table 1. The point where a line, drawn vertically from 4.6 (in. H_20) on the horizontal axis, intersects the GGI-80511 (5

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hp) fan curve, is the corresponding airflow rate for that fan and static pressure. Draw a line horizontally from the intersection point to the vertical axis to estimate the airflow rate (cfm), which for this example is approximately 4600 cfm (this is the same value that was estimated using Table 1).

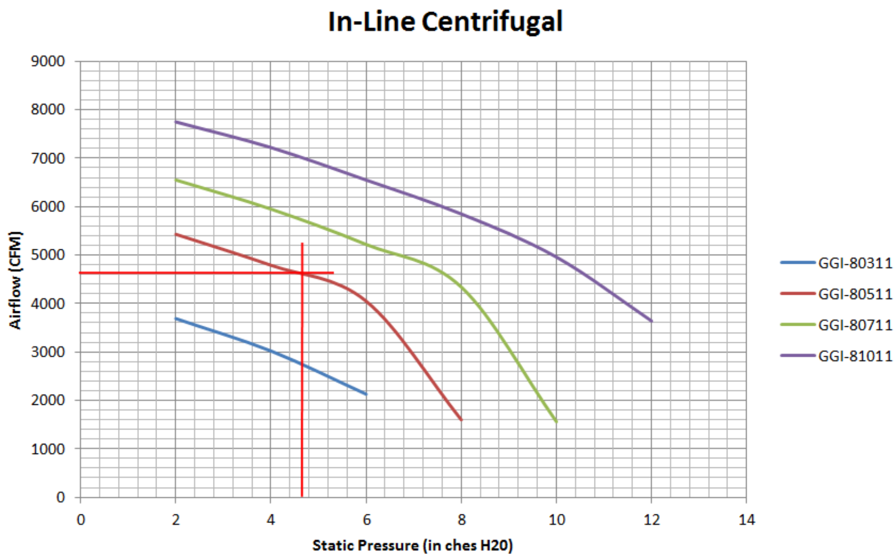


Figure 1. Example of airflow performance data for Grain Guard in-line centrifugal fans (same information shown in Table 1 shown in a different way).

To determine your airflow rate in cfm/bu, take the airflow rate value (4600 cfm in this example) and divide it by the number of bushels in the bin when the static pressure reading was taken. If there was 5000 bu in the bin, the airflow rate would be 4600 cfm/5000 bu = 0.92 cfm/bu.

2. Selecting the Correct Fan Size for a Desired Airflow Rate

Airflow resistance charts and fan performance tables/charts can be used to estimate the size of fan needed to achieve the desired airflow per volume (0.1 to 0.25 cfm/bu for aeration and 0.5 to 1 cfm/bu for natural air drying).

Example: 5000 bu of canola resulting in a grain depth of 20 ft; the desired airflow is at least 0.5 cfm/bu.

Calculate the airflow (cfm) required to achieve 0.5 cfm/bu (0.5 cfm/bu x 5000 bu = 2500 cfm). Estimate the airflow resistance using the chart in Figure 2 for canola. Once you have the estimated static pressure for a specific grain type, depth and airflow rate, use the fan performance information (similar to Table 1 and Figure 1) to estimate the required size of fan. For example, the static pressure estimation for 20 ft of canola (horizontal axis) on the 0.5 cfm/bu curve is about 8 in. H_20. Use the fan tables or charts (above) to select the appropriate fan. At 8 in. H_20, the 5 hp in-line centrifugal fan (GGI-80511) is only producing 1600 cfm, which is less than desired. The 7 hp in-line centrifugal fan (GGI-80711) however, is estimated to produce 4340 cfm which achieves the desired result with airflow of about 0.85 cfm/bu.

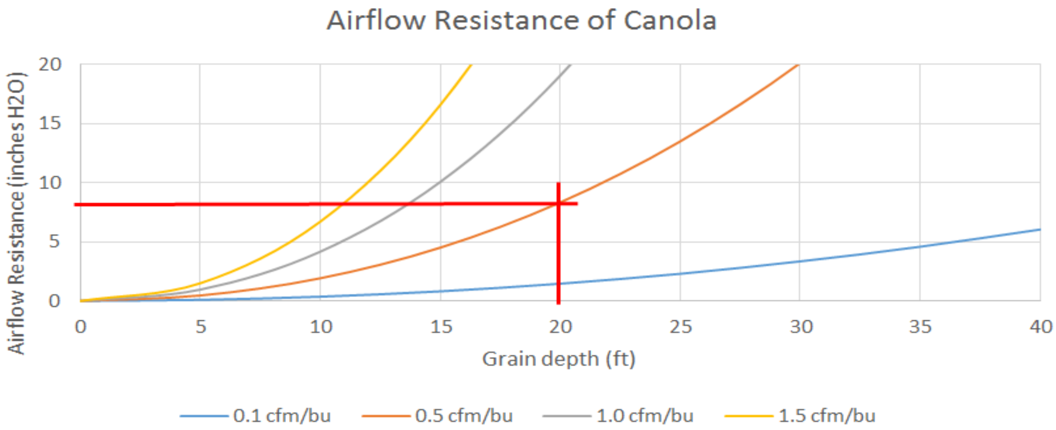
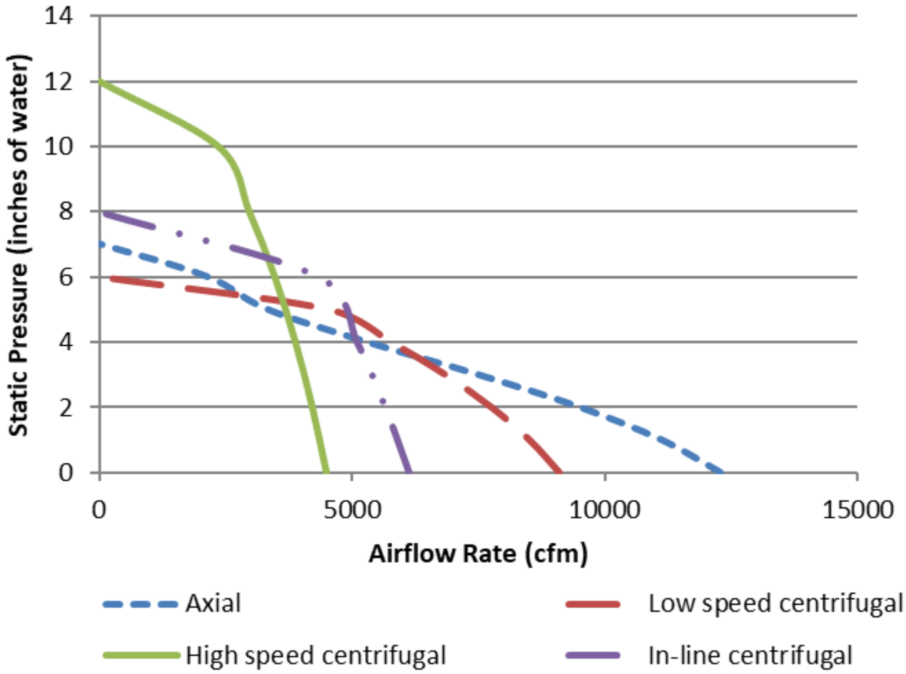


Figure 2. Estimated airflow resistance (static pressure) for canola.

The above example illustrates how fan size selection may require a few iterations through the selection process. Theoretically, the 7 hp in-line centrifugal fan (GGI 80711) will generate 4340 cfm or 0.85 cfm/bu with 20 ft of canola. But the original assumption was for 0.5 cfm/bu which was used to estimate the airflow resistance. If the fan does indeed generate 4340 cfm or 0.85 cfm/bu, the resistance to airflow for 20 ft of canola now increases to approximately 15 in. H2O (which is off the chart for all sizes of the in-line centrifugal fan). But if you use the charts backwards and say you want 2500 cfm, the 7 hp GGI 80711 will need to operate at approximately 9 in. H2O. On the airflow resistance chart at 9 inH2O and 20 ft of canola, the resulting airflow rate will be slightly above 0.5 cfm/bu. So the 7 hp in-line centrifugal fan should be sufficient for a target airflow rate of at least 0.5 cfm/bu.

Individual fan models and types have unique airflow ratings, providing the ability to achieve a variety of airflow ranges for different depths of grain. For example, the chart below shows the relationship between static pressure (vertical axis) and airflow rate (horizontal axis) for four different types of fans (all 5 hp). At low static pressures (low grain depths and/or large seed sizes), the axial fan provides the highest airflow. However, at higher static pressures (above 7 in. H2O), only the in-line and high speed centrifugal fans provide any airflow. Fan type and size must be selected carefully based on expected static pressure, so make sure you are using the static pressure charts specifically for the type and size of fan you are investigating.



The airflow resistance charts for canola, wheat, barley, peas, lentils, flax and corn are provided on the next pages and can be used to estimate the expected static pressure based on grain depth, grain type, and target airflow rate (cfm/bu). Shedd's curve and various equations were used to create the charts. These charts account for the airflow resistance of the grain only and do not account for added resistance due to chaff, fines, ductwork, or filling method (e.g.: grain spreader).

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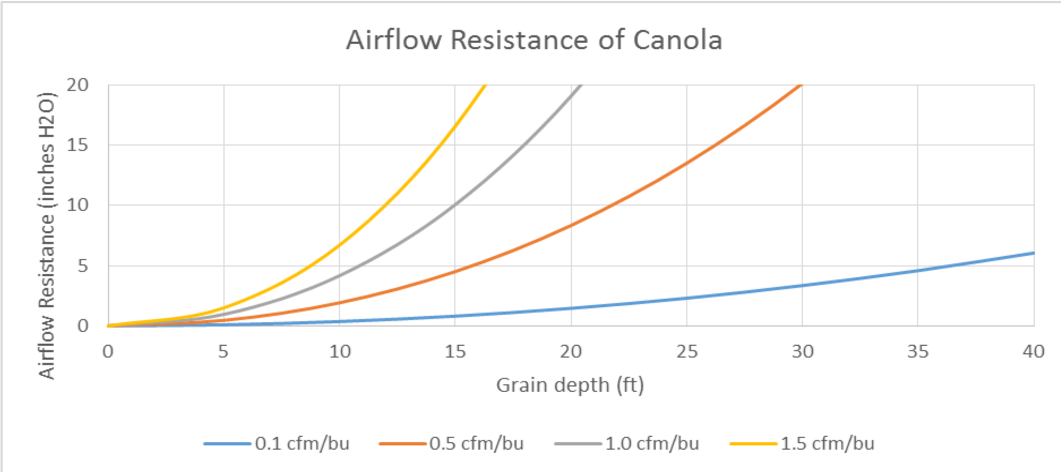

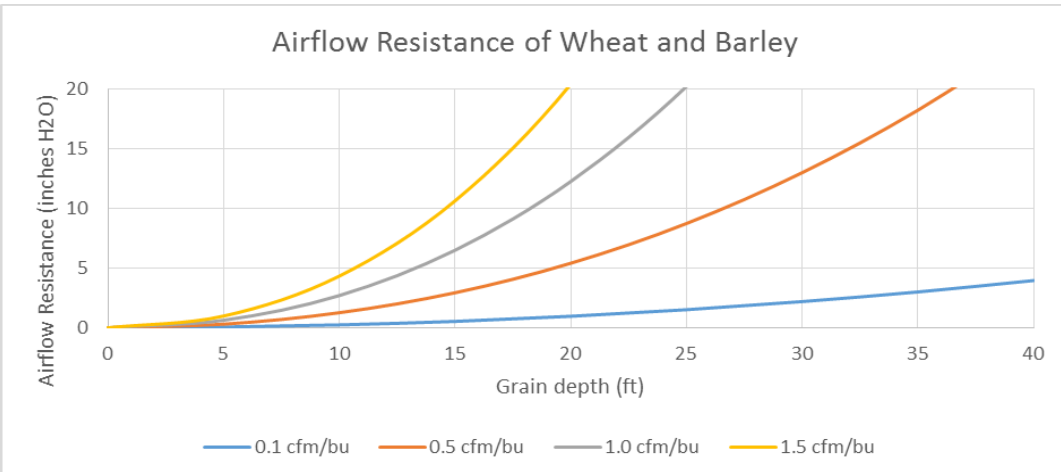

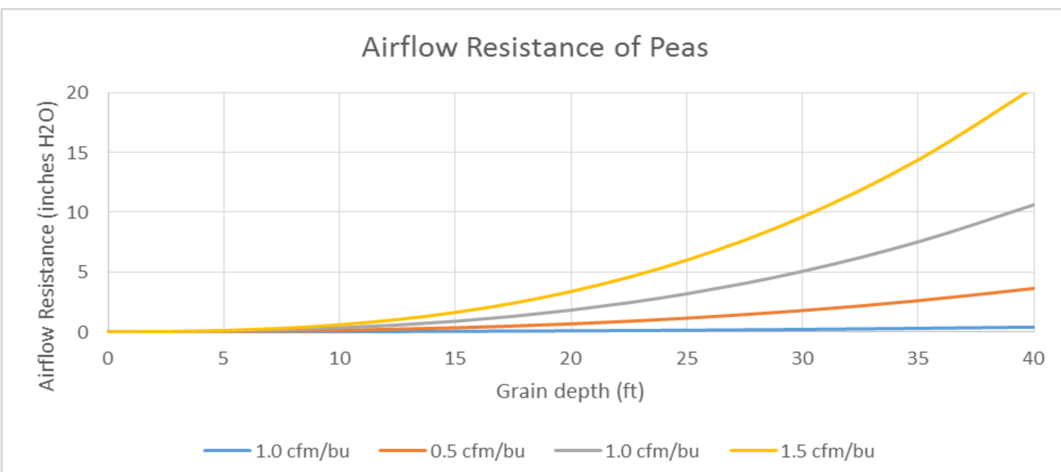

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