Drivers

A driver selection review is required to provide enough power for the desired compression, with several variables that require consideration. The driver selection is a joint review between the packager and the end user. Ariel does not provide driver analyses. Ariel provides predicted performance with a +/-3% to +/-6% tolerance on flow and power. Drivers are impacted by the fuel or electrical power supply and also have prediction tolerances.

Ariel's prediction for power and flow is subject to small variations due to manufacturing tolerances, wider or narrower compression ratios, gas compositions, speeds, etc. External factors can affect power and flow predictions, such as acoustical pulsation effects and vessel or gas piping sizing. The difference between predicted and actual can be +/-3% to +/-6% for the compressor.

Driver available power may have similar differences in predicted versus actual draw on fuel gas or electrical amperage. Engine available power can be impacted by air density (temperature and elevation) and fuel quality (BTU content). Electric motor available power can be impacted by the quality of the power supply and the consistency of power drawn by the motor. The compressor torque effort can cause rpm fluctuations in the driver, resulting in reduced power factor at the electrical source and having a direct impact on the actual amperage draw.

Driver Power Rating

Drivers should be selected to provide enough power to meet the compression requirements. Best Practice and industry standard is to apply a 10% margin over the greatest compressor power demand for the driver selection. For electric motor drivers, this 10% margin can be applied to the motor-rated horsepower or to the Service Factor. If applied to the Service Factor, a specific review is required with the motor and motor controller suppliers to ensure continuous operation within Service Factor can be allowed. End users must also be aware of and accept operations within Service Factor.

This 10% margin is a selection criterion to account for the variables affecting power demand and power supply. This is not meant to limit the use of the available driver power. Once installed, the full power rating may be used.

For proper sizing of a variable frequency drive (VFD), consult motor and motor controller suppliers, especially if considering use above motor nameplate horsepower.

There are two main types of motors: synchronous and induction. To calculate a general maximum speed of a synchronous motor, you can apply the following formula:

Synchronous Motor Speed (RPM) = **Power Frequency** (Hz) x 120 / **Number of Motor Poles**

Induction, or asynchronous, motors will operate at less than the rated synchronous speed because of slip. A typical motor slip is 1%. This 1% slip is applied by default in the Ariel Performance Software but can be edited. To calculate a general maximum speed of an induction motor, you can apply the following formula:

Induction Motor Speed (RPM) = **Synchronous Motor Speed** (RPM) x 0.99*

* 0.99 value accounts for 1% slip.

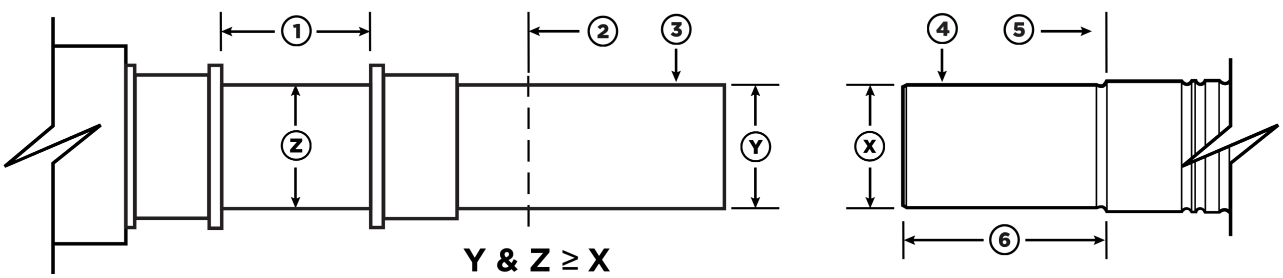
Table: Common Motor Speeds

Number of Motor Poles	Synchronous Speed (RPM)	Induction Speed (RPM)	Synchronous Speed (RPM)	Induction Speed (RPM)
	50 Hz	*50 Hz*	*60 Hz*	*60 Hz*
4	1500	1485	1800	1782
6	1000	990	1200	1188
8	750	743	900	891
10	600	594	720	713
12	500	495	600	594
14	428	424	514	509

For motor driven compressors, it can be beneficial to match an electric driver with the compressor frame that will provide a lower piston speed when the selection allows. Slower piston speeds can provide higher efficiencies and a longer time between scheduled maintenance. For example, if a KBC or a KBD frame could be used for an application where 60 Hz power is available, an electric driver could run the KBD at 1200 RPM, or it could run the KBC at 900 RPM for a lower piston speed. The KBC selection would be more efficient and could have longer times between scheduled maintenance due to the slower piston speed. The KBC will have slightly larger cylinders.

To avoid complications in the torsional analysis, Ariel recommends a motor stub shaft of comparable strength and stiffness to the compressor crankshaft. Using a motor shaft with a keyway, low tensile strength material, or small diameter may make the driveline design difficult, resulting in exotic coupling selections, speed restrictions, or requiring a larger motor. Ariel recommends the motor stub shaft and the section thru the drive end bearing equal or exceed the compressor drive stub diameter. For flanged crankshafts (JGE:K:T/6 and KBB:V/4/6), use the main bearing diameter for the compressor shaft size (x). See ER-83 for frame shaft diameters. Coupling hubs should be fully engaged on the motor shaft.

Figure: Motor Shaft to Drive Stub Coupling



1 Bearing Journal
2 Coupling Hub Engagement
3 Typical Motor Shaft
4 Compressor Drive Stub
5 Coupling Shoulder Stop
6 Full Coupling Hub Engagement

Ariel Performance Software provides the necessary information for driver sizing:

- Startup torque
- Torque effort curve and data
- Compressor inertia
- Power demand
- Compressor shaft diameter
- Crosshead pin reversal review for variable speed drives

Drivers require several system reviews:

- Startup torque analysis
- Torsional analysis
- Lateral analysis may be necessary depending upon lengths
- Current Pulsation analysis for motor driven units

Select motor drivers for severe duty, or reciprocating compressor duty. Reciprocating compressor torques vary considerably within one revolution. Drive end flywheels and dampers are effective to reduce vibratory torque on the motor. Ariel offers custom drive end flywheels to meet driveline requirements. Contact Ariel Applications Engineering for more information.

Startup torque review is required. Consideration for starting pressure inside the cylinders should include a review of highest pressure at start up; this may include a blocked in settle out pressure. A gas recycle line or bypass for startup is required.

Refer to the Ariel Packager Standards Section 5 for more details on the drive system and ER-83 for torsional analysis guidelines and limits.