



Electric Motor Drive

Electric motors, direct connected through a flexible coupling can be utilized to drive Ariel compressors. Electric motors are available at various speed depending upon the frequency of the power supply and the number of motor poles.

When the selection permits, it can be beneficial to match an electric driver with the compressor frame that will provide a lower piston speed. Slower piston speeds can provide higher efficiencies and a longer time between scheduled maintenance. For example, if a JGC or a JGD frame could be used for an application where 60Hz electricity is available, an electric driver could run the JGD at 1200 RPM for a piston speed of 1100 fpm, or run the JGC at 900 RPM for a piston speed of 975 fpm. The JGC selection would be more efficient and would have longer times between scheduled maintenance due to the slower piston speed. The JGC will also have slightly larger cylinders. Common motor speeds:

- Synchronous rpm = Power Frequency (hz) x 120 / number of motor poles
- Induction motor rpm = synchronous rpm x 0.985 (accounts for 1.5% slip)
- Induction motors will operate at less than the rated synchronous speed because of “slip”. A typical motor slip is 1.5%. This must be accounted for in the compressor selection.

Number of Motor Poles	Synch	Induction	Synch	Induction
	50 hz	50 hz	60 hz	60 hz
4	1500	1475	1800	1775
6	1000	985	1200	1185
8	750	740	900	885
10	600	590	720	710
12	500	492	600	590
14	428	422	514	506

Electric motor drives will require a review of [Starting Torque](#) to ensure the motor has enough torque to start the rotation of the compressor. This will most often require a full bypass for start-up and may require special motor torques. Variable speed drivers have other details to consider, see [Rated Speed \(Minimum Allowable Rotating Speed\)](#) topic.

Refer to the Ariel [Packager Standards](#) Section 5 for more details on the drive system.

Common Project information for motor driven applications include:

Quotation

- Start up torque curve (at highest suction pressure) with estimated bypass line pressure losses
- Full horsepower torque effort curve

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- Part load torque effort curves (highest power of each single acting step)
- +10% of max horsepower for nameplate power (may be inclusive of service factor)
- The motor stub shaft and the section through the drive end bearing should equal or exceed the compressor drive stub diameter. JGE:K:T/6 and KBB:V frames have flanged drive end connections on the crankshaft, use the crankshaft journal diameter for the minimum motor shaft diameter. Crankshaft diameters can be found in ER-83, Frame Data Sheets and Torsional Supporting Documents.

Purchase (confirming quotation data)

- *Start up torque curve (at highest suction pressure) with actual bypass line pressure losses
- Full horsepower torque effort curve
- Part load torque effort curves (highest power of each single acting step)
- +10% of max horsepower for nameplate power (may be inclusive of service factor)
- The motor stub shaft and the section through the drive end bearing should equal or exceed the compressor drive stub diameter. JGE:K:T/6 and KBB:V frames have flanged drive end connections on the crankshaft, use the crankshaft journal diameter for the minimum motor shaft diameter. Crankshaft diameters can be found in ER-83, Frame Data Sheets and Torsional Supporting Documents.

Studies necessary

- Motor start up analysis - Does the motor have enough torque to reach full speed fast (before the high inrush current overheats the motor)
 - This is done by the motor supplier and requires the compressor inertia value from the start up curve or mass elastic data, the coupling inertia, inertia from any added flywheel or crankshaft detuner
- Current pulsation analysis (66% or less for induction motors, per NEMA MG-1) (by motor supplier)
- Torsional analysis
- Lateral analysis may be necessary depending upon lengths

Data necessary for Torsional from Motor Supplier

- Mass elastic data (inertia and shaft stiffness)
- Shaft detail drawing for vibratory stress calculations
- Minimum additional inertia (flywheel) to limit current pulsations (66% or less)

*Generating Final Start Up Torque Curve

- Run start up curve at highest suction pressure (or settle out pressure) and default pressure loss settings of 25 psi times the number of stages
- Load cylinders if manual capacity devices are used, and unload cylinders if pneumatic capacity devices are used (suction valve unloaders and pneumatic pockets)

- Apply the "flow at startup" value from the start up torque data to size the bypass line
- Calculate the bypass line pressure drop at the "flow at startup" (from final stage cylinder discharge flange through vessels, coolers, bypass line, bypass valve, suction scrubber, suction vessel to first stage cylinder suction flange)
- Provide the final flywheel inertia from the torsional analysis and current pulsation analysis for the final start up torque calculation
- Rerun the start up curve with the calculated bypass line losses

Start up torque is used to determine if an engine starter, or electric motor driver has enough torque to start a compressor. Refer to [Starting Torque](#) topic for more specific information on starting torque curves and data.