

Starting Torque

Start up torque is used to determine if an engine starter, or electric motor driver has enough torque to start a compressor.

Start up torque is characterized by two main components, break away torque and speed up torque. The break away torque is the static friction and gas load on the piston rod area at zero rpm. The speed up torque is the dynamic friction and the pressure load on the cylinders as the unit speeds up toward full speed.

Ariel provides start up torque data within the Ariel Performance Program. All start up torque calculations provided assume that a bypass or gas recirculation line is installed and open, sized to bypass 100% of the compressor flow.

The break away torque is dependent on the pressure on the unit when the start button is pushed. Higher start up pressures will result in higher break away torque. If the break away torque must be reduced for starting, the pressure on the unit must be reduced. Six throw units are mostly exempt from this as the phasing of the six throws offers a cancellation of the individual throw torques from the pressure on the piston rod.

The speed up torque can be impacted by both the starting pressure, as well as the bypass line pressure loss. Smaller bypass lines will have higher pressure losses, resulting in higher torques as the unit approaches full speed.

Start Up Torque Calculations:

- Use the highest suction pressure that the unit will see when the start button is pushed. This may be a normal (max) suction pressure, or a settle out pressure.
- Load all manual capacity devices (close WCP's, remove spacers, double act cylinders if valves are removed manually for single acting cases).
- Unload all panel controlled capacity devices (open FVCP's, single act if SVU's are provided)
- Consider and calculate the bypass line pressure losses for a more accurate torque curve.
- Apply the final flywheel inertia from the torsional analysis and current pulsation analysis for the final start up torque calculation

Bypass Line Pressure Losses:

- Ariel provides an entry for the bypass line pressure loss. This is a value multiplied by the number of stages, for a total pressure loss.
- The default value is 25 psi times the number of stages. This is only a rough value for a beginning assumption.
- The start up torque calculation will include a "flow at Start up". Apply this value when calculating the bypass line pressure loss. At the lower ratios of start up (bypass line open) the flow can be much higher than the compressor design flow.

For electric motor drives, please also refer to Driver Power Rating topic.

Typical Starting Torque Data and Curves provided within the Ariel Performance Software:



Break away torque

- Static friction
- · Equalized gas pressure
- Gas pressure on piston rod area

Pull-up torque

- Dynamic friction
- Gas compression due to increased discharge pressure as flow increases on bypass

