Reduced Voltage and Full Voltage

Full-Voltage, "across the line" starting is the least expensive way to start a motor, and all motors can withstand full-voltage starting. However, *reduced-voltage* starting is necessary when a power company limits the amount of current drawn from its lines or when the driven system requires a low starting torque to cushion the application of power to the load.

Type of Starter	Voltage at Motor	Line Current	Starting Torque	Advantages	Limitations
Full Voltage	100%	100%	100%	• Lowest cost • Less maintenance • Highest starting torque	• Starting inrush current may exceed limits of electrical distribution system • Starting torque may be too high for the application
Auto Transformer	80 65 50	64 42 25	64 42 25	• Provides most torque per ampere of line current • Taps on auto transformer permit adjustment of starting voltage • Suitable for long starting periods • Closed transition starting	• In lower Hp rating, is most expensive design • Heavy, physically largest type • Low power factor • Most complex of reduced voltage starters because proper sequencing of energization must be maintained
Primary Resistance	80	65	42	• Lease complex method to obtain reduced voltage starting characteristics on low capacity	• Additional power loss in resistors compared to other types of starters • Low torque efficiency (decreases as voltage

				systems because interlocking of contactors is unnecessary ● Smoothest acceleration of electromechanical types ● Improves starting power factor because voltage current lag is shortened by putting a resistance in series with the motor ● Less expensive than auto transformer starter in lower Hp ratings	is decreased) ● Starting characteristics not easily adjusted after manufacture ● Duty cycle may be limited by resistor rating ● High initial inrush current
Part Winding	100	65	42	● Starter less expensive than other types of reduced voltage control ● Closed circuit transition ● Most dual voltage motors can be started part winding on lower of two voltages ● Control smaller than other types	● Torque efficiency usually poor for 3600 RPM motors ● Possibility of motor not fully accelerating due to torque dips ● Unsuitable for high inertia, long standing loads ● Requires special motor design for voltages other than 230V
Wye Delta	100	33	33	● Low torque efficiency ● No torque dips or unusual winding stresses occur as in part winding starting	● Requires special motor design ● Starting torque is low ● Usually not suitable for high inertia loads ● Control more complex than many other starter types
Solid State	Adjust	Adjust	Adjust	● Includes constant current, ramped current, or tachometer type starting	● Specialized maintenance required ● Shorting contactor is required for NEMA 4

- Adjustable current limit and starting time
- Increased duty cycle compared to electromechanical types
- Power factor controller and line voltage limiting included
- Multiple adjustable point over wide range
- Smoothest acceleration

and 12 enclosure
- Ventilation required
- Higher priced
- Isolation contactor may be required