

Fire Pump Starting Type Characteristics
- for -
Electric Fire Pump Motors and Controllers

Starting Characteristics (at Stall) -- Typical Values -for- Fully Load Pump (1)

<u>Starting Type</u>	<u>Motor Type Note</u>	<u>Motor Contactors Note (3)</u>	<u>Closed Transition</u>	<u>Starting Amps & KVA % LRA</u>	<u>Starting Amps & KVA % FLA</u>	<u>Starting Power Factor</u>	<u>Starting Power % F.L. Note (4)</u>	<u>Starting Torque % ATL</u>	<u>Accelerate Full Load to Full Speed</u>	<u>Notes</u>
Across-the-Line	Any	1	N/A	100%	600%	40%	240%	100%	Yes	(a)
Part Winding	Special (2)	2	Yes	65	390	40	156	48	Usually	(b)
Primary Resistor	Any	2	Yes	65	390	80	314	42	Yes	(c)
Primary Reactor	Any	2	Yes	65	390	28	111	42	Yes	(c)
Neutral Reactor	6/12 Lead	2	Yes	65	390	28	111	42	Yes	(c)
Wye-Delta Open	6/12 Lead	3	No	33/100	200/600	40	80/240	33	No	(d)
Wye-Delta Closed	6/12 Lead	4	Yes	33/100	200/600	40	80/240	33	No	(d)(e)
Soft Start/Stop	Any	1/2	Yes	40/67	240/400	Varies	Ramps	16/44	Yes	(f)
Autotransformer	Any	3	Yes	46	276	40	110	42	Yes	(c)(g)

Notes

- (1) Refer to Factory details.
- (2) Part Winding Motors must be wound specifically for this service. Some motors may not accelerate to full speed in the starting mode. See Note (b).
- (3) Units with two or more contactors have two basic steps (Accelerate & Run) with steps three and four being for transitions.
- (4) Starting KW Power as a percent of motor full load power requirement.
- (a) Also called "A-T-L" or Direct-On-Line. Motor Power Factor taken as 40%. Other values shown are due to the effects of the controller.
- (b) Part Winding Parameters vary with the motor. Starting Amps & KVA vary from around 60% to 70%, Starting Torque from around 45% to 50%. The motor can start a fully loaded pump if it has no large torque dip or cusp. See the text discussion on Part Winding Starting for details.
- (c) Figures are for tap set at 65% which yields a motor voltage of 65% of line (mains) voltage.
- (d) The Dual Figures are for Starting and Transition. The transition values are to finish accelerating a fully loaded pump. Examples include deluge or open systems, re-starting a fully loaded pump after a power failure or interruption, and failure of another pump feeding the same system.
- (e) Ignores the momentary transition resistor loads.
- (f) Varies with pump load and particular Soft Starter used. Values shown are initial and maximum for a typical fully loaded pump. MCS uses the second (Start) contactor for isolation. Others use only the Bypass contactor.
- (g) The 46% Starting Amps & KVA figures include the Autotransformer exciting current.

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The table is a listing of the main starting parameters of the nine starting methods (starting types) discussed above. The table shows the main starting parameters which are starting current, starting power (Kw power) and starting torques among the nine starting types discussed. However two of the nine have the same electrical and torque parameters; namely, Primary Reactor and Neutral Reactor. Only the motor type varies between these two. Likewise, the electrical and torque values are the same for Wye-Delta Open and Closed transition starting since these two vary only by being either open or closed transition. This leaves seven basic sets of starting characteristics.

The table first lists the nine starting types. The second column gives the Motor Types which can be used with each of the nine starting types. The third column lists the number of Starting Steps while the fourth column shows whether the starting type is Closed Transition or not. Note that only Wye-Delta Open is of the open transition type. The 5th column of the table gives the Starting current (Amps) and KVA (Kilovolt-amperes) as a per cent of the full voltage A-T-L *starting current* (LRA). The Amps and KVA percentages are the same since the Apparent Power (KVAs) is the product of the current times the voltage with the voltage being a constant for any given case. The 6th column gives the starting current and KVA (Kilovolt-amperes) as a per cent of that of the motor's FLA (Full Load Amperes) rating. These are six times the values of the 5th column since the LRA values are taken as six times the FLA values for the typical fire pump motor. The 7th column gives Starting Power Factor for each starting type. These are used to calculate starting KW (Kilowatt) power which is important on Gen-Set applications. The 8th column gives said Starting Power as a percent of motor full load power. This is the product of Starting KVA times the Power Factor. The 9th column shows the Starting Torque values as a percent of full voltage (A-T-L) starting. The next column shows whether the starting type can always accelerate a fully loaded pump to full speed during the accelerate period. This is based on torque-speed curves for typical fire pumps as well as field experience. The last column list the notes that give further details on the data and values.

Where the Wye-Delta rows show dual values, these are for the Wye starting configuration first and for the Delta starting currents second assuming the pump is fully loaded and is not up to speed during the accelerate period. Some of the values in the Soft Start / Soft Stop row are not numeric since they vary through out the starting or stopping periods because the voltage is ramping up or down during these times. The 67% and the 400% starting amperes and KVA as well as the 56% starting torque values are based on typical and expected values when starting a fully loaded fire pump.