PENTAIR

PENTEK® AND HITACHI®
SUBMERSIBLE MOTORS (6" AND LARGER)
PERFORMANCE GUIDELINES

FOR USE ON VARIABLE FREQUENCY DRIVES (VFDs)

1). Proper, class 10, quick trip, overload protection must be used at all times.

2). Maximum Ramp-up Time: 1.0 seconds to reach 30 Hz, 4.0 seconds total to reach current limit or minimum speed/frequency.

Minimum Operating Frequency/Speed (after initial ramp-up):

- 30 Hz, 0.5 x Synchronous Speed – Pentek 6", 2 pole motors
- 30 Hz or 2400 rpm, whichever occurs first – Pentek 7" and 8", 2 pole motors; Hitachi 6" and 8", 2 pole motors
- 42 Hz or 2400 rpm, whichever occurs first – Penek 10", 2 pole motors; Hitachi 10" and larger, 2 pole motors
- 42 Hz or 1070 rpm, whichever occurs first – Hitachi 4 pole motors

NOTE: the minimum frequency for the 100-125hp, 4 pole, 10" Hitachi is 55 Hz.

3). Maximum Ramp-down Time: 4.0 seconds from minimum frequency to power shut-off.

4). Service Factor for all motors without prior factory consultation is 1.0.

5). Maximum Speed: 1.0 x Full Load Speed.

6). At the minimum operating speed and at rated ambient water temperature (77˚F/25˚C), a minimum water velocity must be maintained past the motor. See chart below. Velocity in excess of 10ft/sec (3m/sec) is not recommended without factory consultation.

MOTOR SIZE	HP	MINIMUM WATER FLOW RATE
Pentek 6"		0.5 ft/sec (0.15 m/sec)
Pentek 7"		0.66 ft/sec (0.20 m/sec
Pentek 8"	40-75	0.66 ft/sec (0.20 m/sec)
	100-125	1.64 ft/sec (0.5 m/sec)
Pentek 10"	150-250	1.64 ft/sec (0.5 m/sec)
Hitachi 6" and larger		0.5 ft/sec (0.15 m/sec)

7). The Variable Frequency Drive (VFD) must maintain a constant Volts (V) to Frequency (Hz) ratio. The controls must be rated the same as the motor nameplate.

8). The Variable Frequency Drive (VFD) carrier frequency must be set to the lowest frequency for the desired functions of the VFD. A carrier frequency above 4 kHz is not recommended. Contact the factory for other desired carrier frequencies.

9). The output of the Variable Frequency Drive (VFD) must have a filtering or line conditioning device installed to eliminate voltage waveform phenomenon that might adversely affect motor components and elements. Power at the motor leads must be clean, free of voltage reflections, transients (within the limits of MG1-31 for Definite Purpose Machines), harmonics, and within the voltage range of the motor.

10). All other requirements and restrictions apply as per:

Pentek manual PN978

Pentek manual PN979

Hitachi manual F1

These are general guidelines for the operation of the Pentek 6" and Hitachi submersible motor on AC inverters incorporating IGBT type switching devices and starting from zero rotation with a limited, immediate, hydraulic load.

When using an inverter for the 400V (volt) class motor, insert filter circuits, such as a reactor, between an inverter and a motor in order to prevent a highest value of voltage wave (peak voltage) from exceeding 1000V (volts) for surge protection. Since the motor for a deep well has the long cable, the surge voltage by reflective resonance of a cable may increase up to 2√2 times compared with the effective value of primary voltage of an inverter. Keep in mind that this makes the insulating ability of a motor fall remarkably.

Reactors and Filters

Variable frequency drives produce voltage spikes that are a function of voltage rise-time and length of motor cable. In extreme cases peak voltage may exceed three times the nominal operating voltage.

Reactors

A reactor is a resistance and inductance device that reduces voltage spikes. It does this by both increasing the voltage rise-time and improving the impedance match of the cable and motor.

Filters

A filter combines a reactor with a capacitor network. The capacitors absorb a portion of the voltage spikes. This further reduces the peak voltage seen at the motor.

When to Use a Reactor or Filter

The chart below is a general guideline when choosing between using a filter or reactor.

<table>
<tr><th rowspan="3">Motor Type</th><th colspan="6">Lead Length</th></tr>
<tr><th colspan="2">up to 50'</th><th colspan="2">50' to 150'</th><th colspan="2">150' to 1000'</th></tr>
<tr><th>230 V</th><th>460V</th><th>230V</th><th>460V</th><th>230V</th><th>460V</th></tr>
<tr><td>NEMA Above-Ground Std. Efficiency</td><td rowspan="3">-</td><td rowspan="3">-</td><td>R</td><td rowspan="2">R</td><td rowspan="3">F</td><td rowspan="3">F</td></tr>
<tr><td>NEMA Above-Ground Premium Efficiency</td><td>-</td></tr>
<tr><td>Submersible</td><td>R</td><td>R</td><td>F</td></tr>
</table>

R = Reactor F = Filter

The following list indicates a greater need for filters and reactors:

- Long motor leads are used
- Standard efficiency or submersible motors are used.
- The cost of replacing the motor is prohibitive.
- Using a submersible motor with a voltage rating greater than 230V.
- The quality and/or age of the motor is unknown.
- Condition of wiring and/or power quality is unknown.

Reactors

Open Design 230 or 460 V Model	NEMA 1 230 or 460 V Model	Rated Amps	NEMA 1 575 V Model	Rated Amps
KDRA1P	KDRA1PC1	3.4	KDRA31PC1	2.7
DDRA2P	KDRA2PC1	4.8	KDRA35PC1	3.9
KDRA3P	KDRA3PC1	7.6	KDRA33PC1	6.1
KDRA4P	KDRA4PC1	11	KDRA34PC1	9
KDRB1P	KDRB1PC1	14	KDRA36PC1	11
KDRD1P	KDRD1PC2	21	KDRD31PC2	17
KDRD2P	KDRD2PC2	27	KDRD32PC2	22
KDRD3P	KDRD3PC2	34	KDRD35PC2	27
KDRD4P	KDRD4PC2	40	KDRD33PC2	32
KDRC1P	KDRC1PC2	52	KDRD34PC2	41
KDRF1P	KDRF1PC3	65	KDRC31PC2	52
KDRF2P	KDRF2PC3	77	KDRF31PC3	62
KDRF3P	KDRF3PC4	96	KDRF32PC3	77
KDRH1P	KDRH1PC4	124	KDRF33PC4	99
KDRI1P	KDRI1PC4	156	KDRH31PC4	125
KDRI2P	KDRI2PC4	180	KDRI31PC4	144
KDRG1P	KDRG1PC4	240	KDRI32PC4	192
			KDRG31PC4	242

Filters

NEMA 1, 230, 460 or 575 V Model	NEMA 1, CUL Listed Model	Rated Amps
KLC4BE	KLCUL4BE	4
KLC6BE	KLCUL6BE	6
KLC8BE	KLCUL8BE	8
KLC12BE	KLCUL12BE	12
KLC16BE	KLCUL16BE	16
KLC25BE	KLCUL25BE	25
KLC35BE	KLCUL35BE	35
KLC45BE	KLCUL45BE	45
KLC55BE	KLCUL55BE	55
KLC80BE	KLCUL80BE	80
KLC110BE	KLCUL110BE	110
KLC130BE	KLCUL130BE	130
KLC160BE	KLCUL160BE	160
KLC200BE	KLCUL200BE	200
KLC250BE	KLCUL250BE	250

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