35. SCREENS

Screens are standard on all WPI “P” base motors. Stainless-steel screens with 1/4 inch mesh are available for list adder below.

FRAME SIZE	182 184	213 215	254 256	284 286	324 326	364 365	404 405	444 447	449 5000	5800	6800	8000	9600
STAINLESS STEEL SCREEN	$469	$469	$469	$528	$763	$1,115	$1,115	$1,761	$1,761	$1,761	$2,200	$2,200	$2,495

36. SEALS

Shaft slingers or seals may be installed on the shaft end of vertical motors to prevent the ingress of dirt and liquid. Contact the Inquiry Group for availability on vertical HOLLOSHAFT® motors.

Shaft Slinger

Frame:	182 184	213 215	254 256	284 286	324 326	364 365	404 405	444 447	449	5000	5800	6812 (TE)	6800-8000	9600
Adder:	$141	$141	$200	$200	$270	$270	$340	$376	$469	$469	$469	$469	$469	$469

* Shaft Slinger: Installed on the shaft at the bracket face to prevent the ingress of dirt and liquid. Usually made of rubber.

Lip Seal - TEFC Only

Frame:	182 184	213 215	254 256	284 286	324 326	364 365	404 405	444 445	447	449	5000	5800	6812 (TE)	6800-8000	9600
Adder:	$141	$200	$200	$200	$270	$270	$340	$340	$376	$469	N/A	N/A	N/A	N/A	N/A

* Lip Seals: These seals provide a rubber shaft seal to exclude contaminants such as oil, water and dust from entering the bearing cavity.

INPRO/SEAL®† - TEFC 320 - 6812 & 180 - 320 with Corro-Duty® **WPI/WPII 320 Frame and Large**

Frame:	182 184	213 215	254 256	284 286	324 326	364 365	404 405	444 445	447	449	5000	5800	6812 (TE)	6800-8000	9600
Adder:	$352	$352	$587	$822	$822	$1,056	$1,291	$1,291	$1,549	$1,937	$3,815	$3,815	$3,815	$3,815	$3,815

* INPRO/SEAL®†: This is a permanent, metallic, non-contact, non-wearing, radial-axial labyrinth pattern isolator. This design permanently retains the lubricant in the bearing housing and prevents entry of foreign material into the bearing environment.

INPRO/SEAL®† Motor Grounding Seal (MGS®†) - TEFC 182-6812 **WPI/WPII 5000 Frame and Larger**

Frame:	182 184	213 215	254 256	284 286	324 326	364 365	404 405	444 445	447	449	5000	5800	6812 (TE)	6800-8000	9600
Adder:	$1,056	$1,056	$1,761	$2,466	$2,466	$3,168	$3,873	$3,873	$4,647	$5,811	$11,445	$11,445	$11,445	$11,445	$11,445

* INPRO/SEAL®† MGS®†: This is a permanent, metallic, non-contact, non-wearing, radial-axial labyrinth isolator that also includes a shaft grounding device. The seal design permanently retains the lubricant in the bearing housing, prevents entry of foreign material. The grounding device inhibits damage to bearings by diverting stray shaft currents to ground.

† All marks shown within this document are properties of their respective owners.

37. SERVICE FACTOR (OVERLOAD)

- As indicated on respective pricebook pages, many products described in this catalog include 1.15 S.F.
- Certain options (i.e., 50 Hz) can derate standard offering to 1.0 S.F. Use this adder to restore the 1.15 S.F.
- For TEFC motors (not Hazardous Location) with 1.15 S.F. refer to heavy-duty, CORRO-DUTY® and severe-duty product descriptions listed as item 13 on page M-26.
- For Hazardous Location products with 1.15 S.F., add as shown below.
- This option may influence frame size and performance characteristics. Published or guaranteed data will change when product is operated over nameplate HP.
- Contact the Inquiry Group for service factor requirements greater than 1.15 S.F.
- For slow-speed, large-frame products with 1.0 S.F. as standard, add as shown below for 1.15 S.F.

  - Premium Efficiency TEFC motors include 1.15 S.F. at no charge.

LIST PRICE ADDITIONS FOR 1.15 S.F. OPTION

FRAME SIZE	182 184	213 215	254 256	284 286	324 326	364 365	404 405	444 447	449
LIST PRICE	$352	$469	$587	$728	$939	$1,878	$2,559	$3,150	$4,432

FRAME SIZE	5000	5800	6812 (TE)	6800-8000	9600
LIST PRICE	5%	5%	6%	6%	6%

Motors will be Class B temperature rise at nameplate HP, Class F temperature rise at 1.15 S.F. For temperature rise options, refer to item 46 on page M-62 of this section. Frame and performance characteristics may change.

38. SHAFT EXTENSIONS

Vertical Solid Shaft Only, Special Shaft List Price Additions.

- Basic adder — When a non-standard shaft extension is required, this addition must be made. This addition includes standard steel material, up to 10 inches longer than standard, with one standard size runner keyway and ring keyway.
- Special material addition — If non-standard material is required, this addition must be made in conjunction with the above addition. See table. Our standard high tensile steel shaft material is 4140.
- Special feature addition — The above additions include one standard size runner keyway and ring keyway in each extension. If other special shaft features (as listed below) are required, apply addition from table for each feature required. For example: A shaft with one step, a drilled and tapped hole in the end, and a Woodruff keyway, requires three additions.

† All marks shown within this document are properties of their respective owners.

38. SHAFT EXTENSIONS (continued)

Special Features Available:

- Keyway -- sled-runner type, round end, or Woodruff
- Drilled Hole -- diametrically through shaft or in end
- Steps -- each step or reduced diameter from standard straight shaft (usually needed with thread modification)
- Threads -- right hand thread size appropriate to the shaft diameter (usually needs addition for step for thread)
- Hole drilled and tapped in end of shaft
- Squared -- milled flats on one step, four sides
- Tapered -- 1 - 1/4” or 1-1/2” per foot taper with threads, nut and lock washer

SPECIAL SHAFT ADDITIONS:

DESCRIPTION	QUANTITY OF MOTORS	FRAME SIZE - LIST PRICE										
		182 184	213 215	254 256	284 286	324 326	364 365	404 405	444 445 447	449 5000 5800	6800- 8000	9600
BASIC ADDITIONS	1-4 5 OR MORE	$904 $108	$1,085 $155	$1,164 $178	$1,317 $254	$1,427 $317	$1,681 $387	$1,969 $455	$2,265 $577	$3094 $777	$3,873 $974	$4,366 $1,092
SPECIAL MATERIAL ADDITIONS: STAINLESS STEEL* (303, 304, 416) HIGH TENSILE STEEL (4140 or 17-4H)	ANY ANY	$225 $49	$474 $178	$711 $230	$1,066 $366	$1,941 $667	$2,484 $899	$3,613 $1,244	$3,901 $1,282	$5,124 $1,678	RO $5,869	RO $6,221
SPECIAL FEATURES ADDITION (EACH)	ANY	$31	$35	$42	$52	$68	$75	$85	$99	$131	RO	RO

**Refer to the Inquiry Group for non-magnetic stainless-steel shafts on 2 pole motors (303 or 304 stainless).*
RO -- Refer to the Inquiry Group

Shaft Ground Rings

Inverters generate common mode voltage which may induce motor bearing current. A shaft ground ring helps prevent bearing damage by short-circuiting the current to ground. Inverter duty motors include a shaft ground ring on motors in the 320 frame and larger. The following list price adders can be used to add a shaft grounding ring to inverter duty motors smaller than the 320 frame or to add them to non-inverter duty motors. Nidec Motor Corporation offers shaft ground rings by AEGIS®† and INPRO/SEAL®† and shaft ground brushes by Helwig Carbon®†. For Helwig Carbon shaft ground brushes, please contact office for price & availability.

Aegis®† Shaft Ground Ring (SGR®†)

Frame:	182 184	213 215	254 256	284 286	324 326	364 365	404 405	444 447	449	5000	5800	6812 (TE)	6800- 8000	9600
Adder:	$350	$350	$510	$550	$710	$710	$1,115	$1,291	$1,937	$3,815	$3,815	$3,815	$3,815	$3,815

AEGIS®† SGR : Inhibits damage to bearings by diverting stray shaft currents to ground.

† All marks shown within this document are properties of their respective owners.

38. SHAFT EXTENSIONS (continued)

INPRO/SEAL®† Shaft Ground Ring (CDR®†)

Frame:	182 184	213 215	254 256	284 286	324 326	364 365	404 405	444 447	449	5000	5800	6812 (TE)	6800 8000	9600
Adder:	$350	$350	$510	$550	$710	$710	$1,115	$1,291	$1,937	$3,815	$3,815	$3,815	$3,815	$3,815

INPRO CDR®† : Inhibits damage to bearings by diverting stray shaft currents to ground.

39. SNOWMASTER™

Nidec Motor Corporation offers a WPI vertical motor specially designed to withstand the rigors of snowmaking applications. The SNOWMASTER™ motor utilizes proven winding treatments, a Microflow Oil system that provides proper lubrication without oil churning and optimum thrust-bearing protection via an oil bath arrangement on 400 frame & larger. In addition, inverter duty (includes normally closed thermostats 1/phase, shaft ground ring and an insulated upper thrust bearing), Class H insulation, space heaters, a 1.15 service factor on sinewave power, refined balance and corrosion-resistant paint make this product the answer to your electric motor requirements for snowmaking pumps. See pages P-63 and P-64 for pre-priced ratings. For ratings not listed, price as a premium efficiency motor and add the following list adder and note “SNOWMASTER” on the order.

FRAME SIZE	405	444, 445	5000
LIST ADDER	12.5%	12.5%	10%

40. SPACE HEATERS

We recommend low watt density space heaters be used to prevent condensation within the motor during idle periods. Space heaters are silicone rubber “strip-type” wrapped around and bonded to the end turns. Unlike cartridge-type heaters, these provide even heating with 5^0 C to 10^0 C temperature rise within the motor and exceptionally long life. Nidec Motor Corporation no longer offers cartridge-type heaters due to concern about life expectancy. Heater leads are brought out to the main conduit box on ratings, 600 volts and below. A single accessory box is included at no charge for motors rated above 600 volts.

- Standard space heaters are single phase, 50 or 60Hz and available in 115, 230, 460 or 575 volt ratings. Please specify detail at order entry.
- For hazardous location or Division 2 applications, double adder.
- For thermostatically controlled space heater -- **available on 440 through 9600 frames only** -- add $1,444 list to space heater addition shown. A calibrated (preset) thermostatic control accessory is mounted in motor conduit box. Not available on hazardous location motors.
- For pilot light located on space heater conduit box to indicate space heater operation -- **440 through 9600 frame only** -- add $3,331 list. Not available on hazardous location motors.
- For half voltage space heater (rated 240 volts operated on 120 volts), double list price adder shown below -- **available 324 and larger frames** -- nonhazardous location only.
- For space heater installed in a size 4, 5, or 6 main conduit box add $2,864 list. Includes condulet off main box with 3/4” A-A hub.
- Heaters are included at no charge (when specified at order entry) on all WPII enclosures.

† All marks shown within this document are properties of their respective owners.

40. SPACE HEATERS (continued)

LIST PRICE ADDITIONS FOR STANDARD SILICONE RUBBER, STRIP TYPE SPACE HEATERS

FRAME SIZE	182 184	213 215	254 256	284 286	324 326	364 365	404 405	444 445	447
LIST ADDER	$300	$300	$300	$300	$385	$385	$385	$385	$385
HAZARDOUS LOCATION	$601	$601	$601	$601	$770	$770	$770	$770	$770

FRAME SIZE	449/5000	5800	6800	8000	9600
LIST ADDER	$1,657	$1,819	$2,789	$2,789	$2,789
HAZARDOUS LOCATION	$3,317	$3,638	$5,575	$5,575	$5,575

Space heater watts will be:

FRAME	NOMINAL WATTAGE	
	WP-1 OR WP-2	TEFC
180	36	36
210	36	36
250	48	48
280	72	72
320	96	96
360	96	144
400	144	192
440	192	192
449/5000	288	288
5800	384	384
6800	480	-
8000	700	-
9600	900	-

41. SPEED SENSING SWITCH (ZERO SPEED SWITCH)

- Same as anti-plugging or zero speed switch
- Available only on vertical solid shaft products
- Available on 449 through 9600 frame

Nidec Motor Corporation offers a digital speed switch for precision rotation monitoring over a full range of speeds from 0.5 - 5000 RPM. Rated single phase, 115 volts with relay contact rating of 5A, SPDT includes terminal strip connections, weatherproof conduit head.

LIST PRICE ADDITION - SPEED SWITCH	
449 - 9600 (WPI, WPII, TEFC)	$9,366
Option - DPDT Relay	$660
Option - Hazardous location connection head	$915

SPDT - Single pole double throw; DPDT - Double pole double throw

† All marks shown within this document are properties of their respective owners.

42. STAINLESS-STEEL HARDWARE

Stainless-steel hardware is furnished at the prices below, including condensation drain and all machine screws required for endshields, fan cover, bearing caps, conduit box, canopy can, and fan. Standard-plated hardware is changed to 316 stainless steel. Stainless Steel hardware is not available on hazardous location motors. Reference MEC-43 on order.

FRAME SIZE	182 184	213 215	254 256	284 286	324 326	364 365	404 405	444 447	449
LIST PRICE	$282	$282	$282	$282	$528	$528	$528	$528	$547

FRAME SIZE	5000	5800	6812 (TE)	6800-8000	9600
LIST PRICE	$547	$547	$573	$735	$735

43. STARTING

- Products described in this catalog are assumed to be used with the full voltage across the line starting method.
- Some stock products feature part winding start (PWS) or Wye-Delta starting as a standard feature on 460 volts.
- Stock products rated 230/460 volts are suitable for PWS on 230 volts.
- Products supplied with either PWS or Wye-Delta winding configurations can also be used when full voltage across The line starting is required.
- Some stock products may be capable of being reconnected (by a motor repair facility) for a different starting method.
  Contact the Inquiry Group with requirements.
- Nameplate (HP) ratings assume product is applied to a power distribution system with balanced line voltage. Distribution systems using an asymmetrical transformer bank (typically open Wye, open Delta connection) almost always produce unbalanced line voltage conditions leading to premature motor failure.
- Standard products described in this catalog may be capable of alternative starting methods, provided certain basic requirements are met:

  A) Motor must be capable of accelerating the load under the specified starting method without exceeding the allowable temperature rise of the rotor or stator.

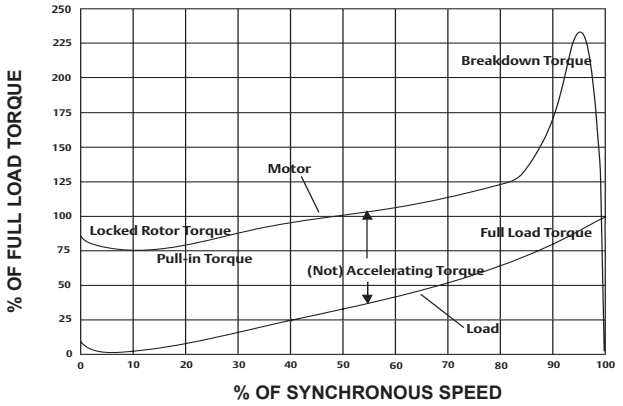
  B) Motor must produce adequate torque at all points along the driven equipment load curve so as not to stall at an intermediate load point.

Products described in this catalog can be connected directly across the line without damage to the motor. However, the typical motor draws 6 to 7 times its full load current during starting. These are situations where this starting or in-rush current can cause excessive voltage disturbance on the power supply system -- potentially causing operational problems with other equipment. Reducing voltage to the motor during starting is a common method of controlling in-rush current. Reducing voltage to the motor during starting also reduces the starting torque and breakdown torque, which increases the time it takes the motor to accelerate.

† All marks shown within this document are properties of their respective owners.

43. STARTING (continued)

TYPICAL SPEED-TORQUE CURVE



Should the staring torque be reduced at some point along the speed torque curve to where there is no longer a net accelerating torque value, the motor will stall and can be damaged if not taken offline within its safe stall time window. Comparing the pump speed -- torque curve with the motor's capabilities under reduced voltage starting conditions -- is recommended, particularly when 50% of nameplate voltage is used to start the motor (50% tap on auto transformer). Motors started by autotransformer or solid-state soft-starting methods require customer to provide speed torque curve of driven equipment, voltage tap on transformer and WR^2 of load.

Typical Comparison of Common Starting Methods (%)					
STARTING METHOD	MOTOR			LINE	NOTES
	TERMINAL VOLTAGE	STARTING TORQUE	STARTING CURRENT	STARTING CURRENT	
Full Voltage	100	100	100	100	Standard Motor
PWS (High Speed)	100	50	70	70	Special Winding[1]
PWS 514 RPM + Below	100	50	50	50	Special Winding[1]
Wye-Delta	100	33	37	33	Special Winding[1]
AUTOTRANSFORMER					
80% TAP	80	64	80	67*	*Includes Transformer magnetizing current
65% TAP	65	42	65	45*	
50% TAP	50	25	50	28*	
PRIMARY RESISTOR AND PRIMARY REACTOR ARE SIMILAR TO AUTOTRANSFORMER METHOD					

NOTE (1) - STANDARD ON SOME STOCK MOTORS

† All marks shown within this document are properties of their respective owners.

43. STARTING (continued)

A. PART WINDING START (PWS)

- Maximum timed transition from part winding to full winding should never exceed 2 to 3 seconds
- Do not attempt to accelerate load on part winding beyond 2 to 3 seconds (see note below)
- PWS motors can also be connected to the full voltage, across the line method
- Use this adder (PWS) when double delta connection is specified

Part winding start is only used to establish normal starting current in two steps rather than one. This allows the utilities automatic voltage regulators on the power distribution system time to adjust the voltage in order to compensate for the pull down due to the high initial current draw. Double Delta PWS uses all of the windings in series, then switches to two parallel delta for run mode. Starting connection produces insignificant starting torque.

SPECIAL NOTE:
When a motor is in the part winding start mode, the heating rate in the energized portion of the winding is 2.25 times the rate it is on full winding (full voltage). Two seconds on PWS is equivalent to 4.5 seconds on full winding, and the shaft may be barely turning if at all.

List Price Adders: Part Winding or Double Delta Start

FRAME SIZE	182 184	213 215	254 256	284 286	324 326	364 365	404 405	444 445	447 449
PART WINDING	NA	NA	$99	$131	$202	$291	$451	NC	NC

FRAME SIZE	5000	5800	6812 (TE)	6800-8000	9600
PART WINDING	NC	NC	NC	NC	NC

B. WYE DELTA (STAR-DELTA) STARTING

- Wye-Delta start may also be used with the full voltage or DOL (Direct On-Line) methods
- When ordered with the 50 Hz option, there is no charge for this feature

The Wye-Delta method, also known as Star-Delta, connects the motor winding to an external Wye configuration during starting, then quickly reconnects the winding to a Delta configuration for the run mode. This transition occurs internal to the starter. Open transition starters disconnect the motor momentarily; closed transition starters use resistors during this transition (Wye to Delta).

List Price Adders: Wye-Delta Start

FRAME SIZE	182 184	213 215	254 256	284 286	324 326	364 365	404 405	444 445	447 449
WYE-DELTA	$99	$99	$99	$131	$202	$291	$451	NC	NC

FRAME SIZE	5000	5800	6812 (TE)	6800-8000	9600
WYE-DELTA	NC	NC	NC	NC	NC

† All marks shown within this document are properties of their respective owners.

43. STARTING (continued)

C. ALLOWABLE NUMBER OF STARTS PER HOUR

- NEMA MG1-12.54 states a motor shall be capable of 2 cold starts (from ambient) or 1 hot start (rated load operating temperature).
- Each start is one factor in the life expectancy and reliability of a motor. As a result, some reduction in life expectancy must be accepted when a motor is applied at the upper range of the starting duty determined below.
- Qualification — Assumption for use of this table is that the motor in question is:

A. Started full voltage across the line

B. Used on sine wave power at rated frequency

C. Driven equipment BHP is less than, or equal to motor nameplate HP exclusive of service factor

D. Supply voltage is balanced and at nameplate value

E. Applied to a variable torque load (pump)

F. Consult the Inquiry Group if questions exist

Example 1:

50 HP, 4 POLE, 1800 RPM, Design B motor direct connected to a pump with a WK^2 of 20 lb•ft^2.

From the table on the following page we find:

A=6.8
B/Load Wk^2 = 232/20 = 11.6
C = Minimum off time = 72 seconds

The value of B/Load Wk^2 exceeds the maximum number of starts per hour (A =6.8). Therefore, the motor must be limited to the maximum of 6.8 starts per hour with a minimum off time between starts of 72 seconds.

Example 2:

25 HP, 2 Pole, 3600 RPM, Design B motor direct connected to pump with a Wk^2 of 7.34.lb•ft^2.

From the table on the following page we find:

A=4.4
B/Load Wk^2 = 26/7.34 = 3.5
C = Minimum off time = 115 seconds

The value of B/Load WK2 is less than the maximum number of starts per hour, and therefore, the motor must be limited to 3.5 starts per hour with a minumum off time (at rest) between starts of 115 seconds.

A list of NEMA standard WR^2 values follows this accessory section.

† All marks shown within this document are properties of their respective owners.

43. STARTING (continued)

C. ALLOWABLE NUMBER OF STARTS PER HOUR

Allowable Number of Starts and Minimum Time Between Starts for Design A and Design B Motors

HP	2 Pole			4 Pole			6 Pole		
	A	B	C	A	B	C	A	B	C
1	15	1.2	75	30	5.8	38	34	15	33
1.5	12.9	1.8	76	25.7	8.6	38	29.1	23	34
2	11.5	2.4	77	23	11	39	26.1	30	35
3	9.9	3.5	80	19.8	17	40	22.4	44	36
5	8.1	5.7	83	16.3	27	42	18.4	71	37
7.5	7.0	8.3	88	13.9	39	44	15.8	104	39
10	6.2	11	92	12.5	51	46	14.2	137	41
15	5.4	16	100	10.7	75	50	12.1	200	44
20	4.8	21	110	9.6	99	55	10.9	262	48
25	4.4	26	115	8.8	122	58	10.0	324	51
30	4.1	31	20	8.2	144	60	9.3	384	53
40	3.7	40	130	7.4	189	65	8.4	503	57
50	3.4	49	145	6.8	232	72	7.7	620	64
60	3.2	58	170	6.3	275	85	7.2	735	75
75	2.9	71	180	5.8	338	90	6.6	904	79
100	2.6	92	220	5.2	441	110	5.9	1181	97
125	2.4	113	275	4.8	542	140	5.4	1452	120
150	2.2	133	320	4.5	640	360	5.1	1719	140
200	2.0	172	600	4.0	831	300	4.5	2238	265
250	1.8	200	1000	3.7	1017	500	4.2	2744	440

How to use this table:

A = Maximum number of starts per hour.
B = Maximum product of starts per hour times load WK^2
C = Minimum rest or off time between starts in seconds.

The allowable starts per hour is the lesser of (1) A or (2) B DIVIDED BY THE LOAD WK^2.

$$\text{Starts per hour} \leq A \leq \frac{B}{\text{Load } WK^2}$$

† All marks shown within this document are properties of their respective owners.

43. STARTING (continued)

D. STARTING CURRENT

LOWER THAN STANDARD -- 210 through 440 frames -- where vertical motors are required to have starting current reduced from standard (NEMA Code G) to NEMA code F, make price additions. Note that this rule is applicable only to motors 15HP and larger. Starting torque and breakdown torque may be reduced to less than NEMA Design B limits. Efficiency will also be negatively effected. Other requirements must be referred to the Inquiry Group. Include WK^2 of driven equipment load to see if practical to manufacture.

FRAME SIZE							
182 184	213 215	254 256	284 286	324 326	364 365	404 405	444 447
N/A	$167	$167	$249	$357	$808	$1,232	$2,068

449 - 9600 frames -- Quote pending Inquiry Group approval. Adder as shown below.

Starting -- Standard starting current for Nidec Motor Corporation is 650-700%. If lower than standard is required, a price addition from the following table should be made.

Lowering of starting current results in lower starting and breakdown torque. A check of the application starting load requirements and possible voltage drop to assure satisfactory operation should be made prior to quoting.

STARTING CURRENT PERCENT	PRICE ADDITION
600-650%	7.5%
550-599%	10%
450-549%	15%

E. LOW VOLTAGE STARTING

Standard motors are capable of accelerating WK^2 loads per the published table as long as the motor terminal voltage does not drop below 80% for NEMA or 90% for TITAN® of the nominal motor voltage. For starting at lower than stated guidelines, make the following percentage additions:

STARTING CURRENT PERCENT	PRICE ADDITION
80-70%	7.5%
69-65%	12%

If the load inertia is 1/2 of the NEMA normal and load torque during acceleration does not exceed 60% of the motor rated torque, no price addition is required down to 75% voltage. Engineering verification of the motor capability is required prior to quotation. If the load inertia is greater than NEMA, both the inertia adder and the low voltage adder must be made.

NOTE: Motors designed for low-voltage starting may have higher than the standard in-rush current at full voltage.

44. STEADY BUSHING

In high-thrust pump applications, vertical HOLLOSHAFT® motors are sometimes requested with steady bushings. These are motor mounted near the P-base and the same size as the coupling bore, and center the pump head shaft to within. 002 inches TIR inside the motor shaft. When a motor is connected to the pump, the motor shaft, pump shaft and steady bushing all rotate together and have the mechanical stability of a vertical solid shaft motor.

† All marks shown within this document are properties of their respective owners.

44. STEADY BUSHING (continued)

As a general statement, all 2-pole motors and pumps with mechanical seals in their discharge head require steady bushings. Another common use is when long bearing spans exist between the stuffing box bearing and the motor coupling due to tall fabricated discharge heads or high ring bases. Here, steady bushings are used to minimize potential shaft critical speed (resonance) problems.

Steady bushings are used with either bolted couplings or motors equipped with a nonreverse ratchet (NRR). They are not recommended for use on motors with a self-release coupling (SRC) as their tight tolerance may inhibit lateral pump shaft movement should the pump shaft unscrew.

Steady bushings are typically made of SAE 660 bearing bronze (or equivalent) and are available as kits for all motors with grease-lubricated lower bearings. These replace the v-groove rubber water slinger on the bottom end of the motor shaft. They are installed on the pump headshaft below the motor before securing it to the motor shaft with setscrews. Steady bushing kits for field installation are available from 182TP through 5000P frame on WPI motors and through 405TP frame for TEFC motors. **Production motors have kit attached to shipping skid.*

Steady bushing **CANNOT BE FIELD INSTALLED ON 5008 FRAME HAZARDOUS LOCATION TYPE EU OR ON ANY 6800 FRAME MOTORS WITH OIL BATH LOWER BEARINGS**. The motor shaft does not extend beyond the lower bracket as it does in the grease lube arrangement. The oil retaining tube, which is pressed into the lower P-base, actually fits up into the lower quill of the HOLLOSHAFT® bore. The steady bushing is pressed into the HOLLOSHAFT® bore and bottoms out about 5 inches from the end of the shaft. The last machining operation on the motor shaft is to finish bore the steady bushing for concentricity and tolerance.

When reviewing specifications, look in the equipment section (usually section 11000) to determine if the pump OEM is required to provide a mechanical seal in the discharge head instead of packing. If so, include a steady bushing in your quote and point it out to your customer. This is especially important on motors with oil bath lower guide bearings. In order to retrofit these, the motor must be completely disassembled and much machining performed. It would also be prudent to quote steady bushings as an option on NEMA®† and TITAN® motors driven by inverters. This feature may be required to avoid pump shaft resonance problems, and this will serve as a reminder to check shaft critical speeds.

LIST PRICE ADDITION FOR STEADY BUSHINGS	
180-280 Frame	$202
320-447 Frame	$300
449-6812 (TE) Frame	$523
6800-8000-9600 Frame	$2,202

† All marks shown within this document are properties of their respective owners.

44. STEADY BUSHING (continued)

STEADY BUSHING PART NUMBERS

FRAME	TYPE	KIT PART NUMBER	BORE SIZE
182, 184, 213 215, TP	AU, TU, LU	365649 978141 365650	3/4” 7/8” 1”
254, 256, 284, 286 UP, TPA, TPH, UPH, TP	AU,TU	365651 978142 365657 978143 365659 365662	3/4” 7/8” 1” 1-1/16” 1-3/16” 1-1/4”
284, 286 TP, TPA, TPH	LU	978144 365663 365664 365665 978145 978146	7/8” 1” 1-3/16” 1-1/4” 1-5/16” 1-1/2”
324, 326, 364, 365 TP, TPH	RU	978147 365666 365667 978148 365668 365669	1” 1-3/16” 1-1/4” 1-5/16” 1-7/16” 1-1/2”
364, 365 TP, TPH	TU, LU	978149 365670 365671 365672 365673 978150 978151 978152 978153	1” 1-3/16” 1-1/4” 1-7/16” 1-1/2” 1-9/16” 1-5/8” 1-3/4” 1-11/16”
404, 405 TP, TPA	RU	978154 978155 365674 365675 978156 365676 918157	1-3/16” 1-1/4” 1-7/16” 1-1/2” 1-9/16” 1-11/16” 1-13/16”
404, 405, TP, TPA	LU, TU	365677 365678 978158 978159 365679 978160 978161 365680	1-7/16” 1-1/2” 1-9/16” 1-5/8” 1-11/16” 1-3/4” 1-7/8” 1-15/16”

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44. STEADY BUSHING (continued)

STEADY BUSHING PART NUMBERS

FRAME	TYPE	KIT PART NUMBER	BORE SIZE
444, 445, 447 TP, TPA	LU, TU	2070898 2070899 2070900 2070901 2070902 2070903 2070904 2070905 2070906	1-3/16” 1-7/16” 1-1/2” 1-9/16” 1-5/8” 1-11/16” 1-3/4” 1-7/8” 1-15/16”
H444, H445 447 TP, TPA	RU	978162 365677 365678 365679 978160 365680 978163 365681 365682	1-5/16” 1-7/16” 1-1/2” 1-11/16” 1-3/4” 1-15/16” 2-1/8” 2-3/16” 2-1/4”
449	HU, JU	970273* 970274* 970275* 970276* 970277* 970278* 970279*	1.688” 1.938” 2.125” 2.188” 2.375” 2.438” 2.500”
5008, 5012,+ P, PH, PA	RU	2037052 2037054 2037055* 2037056 2037057* 2037058* 2037059 2037060*	1-11/16” 1-15/16” 2-1/8” 2-3/16” 2-1/4” 2-3/8” 2-7/16” 2-1/2”
5807, 5809, 5811	JU	968595-165 968595-194 968595-000 968595-225 968596-000 993624-000	1-11/16” 1-15/16” 2-3/16” 2-1/4” 2-7/16” 2-11/16”
5812, 5813	JU,RU	2006544-219 2006544-244 2006544-269 2006544-275 2006544-294 2006544-319 2006544-344 2006544-388	2-3/16” 2-7/16” 2-11/16” 2-3/4” 2-15/16” 3-3/16” 3-7/16” 3-7/8”

** Product listed may not be available from stock*
+5012 Oil - Oil design max bore diameter of 2 1/2”

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45. SURGE PROTECTION

- Available for, WPI, WPII and TEFC enclosures in 447 through the 9600 frame as motor mounted.
- Do not use this accessory on applications where motor is driven by an inverter. Serious damage to the VFD will result. Consult your drive supplier.
- Suitable oversized main conduit box is included in price adders shown.
- Hazardous location motors require a special conduit box and mandatory approval by the Inquiry Group. When approved, add $39,366 list (for suitable conduit box only) in addition to the price adders shown on the next page.

Surge capacitors and lightning arrestors protect the motor winding from transient voltage spikes and from the incoming distribution system. Distribution system conditions likely to cause turn-to-turn or turn-to-ground winding damage include lightning strikes, capacitor switching, and opening or closing of the system circuit breaker, among others. Should the magnitude of stresses imposed on the winding from system voltage transients exceed the surge limits the motor can withstand, the insulation system will fail.

Lightning arrestors limit the magnitude of the transient voltage spike. This is achieved by the arrestor conducting to ground when the voltage reaches a given value. Surge capacitors limit the rate of rise of the voltage. This is achieved by the capacitor momentarily absorbing the steep wave front.

Surge protection is most effective when it is mounted directly from the main conduit box at the motor leads. Increasing this distance beyond 3 feet significantly reduces its effectiveness. Fusing the capacitors or arrestors is not recommended due to the difficulty in determining if or when the fuse is blown.

To provide surge protection, make the appropriate list price adder from below:

MOTOR VOLTAGE	SURGE CAPACITORS AND LIGHTNING ARRESTORS
460	$8,554
2300	$21,568
4160	$28,317
6600	$36,796

46. TEMPERATURE RISE -- STANDARD AND OPTIONAL

- This option may not be available on the maximum HP rating in a given frame size. Consult the Inquiry Group for availability.
- This option may change motor frame size and performance characteristics. Consult the Inquiry Group for confirmed data.
- Combined with other design altering modifications (high ambient, high altitude, VFD use, etc.), this option will significantly change listed product performance described in this catalog. Consult the Inquiry Group for confirmed frame size, performance data, etc.
- The description of this product feature assumes the motor is applied to sine wave power and in accordance with NEMA standards (standard ambient, altitude, balanced voltage, etc.).

The standard insulation system supplied on all Nidec Motor Corporation products described in this catalog is Class F. When our Class F system is subjected to insulation life testing as described in IEEE 275, it significantly exceeds the thermal capabilities required to classify it as capable of providing 20,000 hours of design life when operated a the Class F thermal limit of 155^{0}C. Chart 47-1 indicates the thermal capabilities of our standard insulation system, which is shown as the diagonal line slightly below Class H.

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