11. DRAINS AND BREATHERS

Standard enclosed-frame products described in this catalog include drain holes in the low point of the bracket to prevent condensation buildup. Optional drain and breather elements are available and will be installed by Nidec Motor Corporation for the following list prices. CORRO-DUTY® and severe-duty motors include the first option as standard.

MOTOR ENCLOSURE	DESCRIPTION OF DRAIN AND BREATHER	LIST PRICE
TEFC	DRAIN HOLE-BRASS BREATHER DRAIN	$ 178
TEFC/EXPLOSIONPROOF (CLASS I, GROUP D)	STAINLESS-STEEL DRAIN	$ 270

12. EFFICIENCY

- Available on NEMA and TITAN® products
- Some other modifications listed in this catalog, when incorporated into a product with this option, will reduce published efficiency levels (altitude, ambient, extra high thrust, etc.)
- Inverter-duty motors require this option

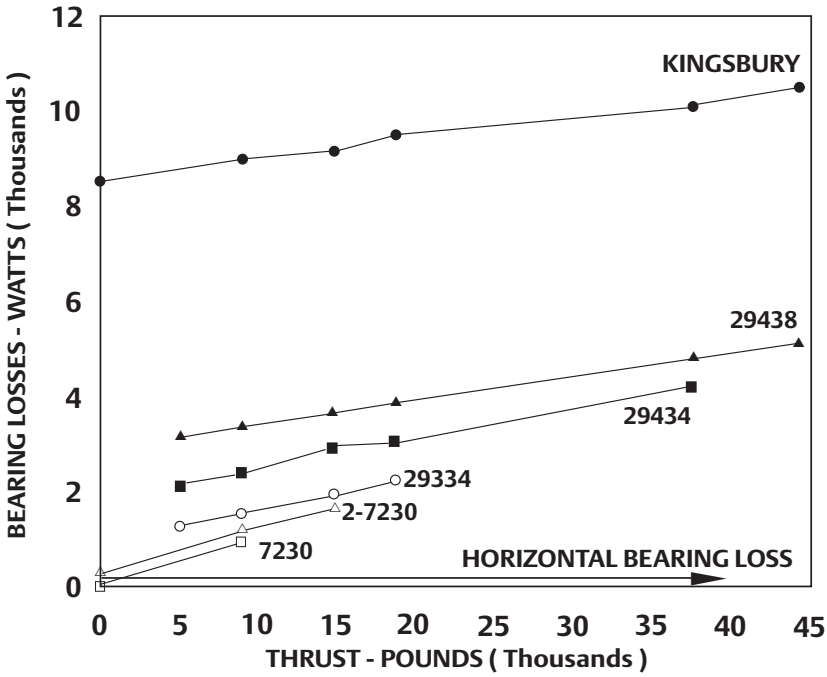
Nidec Motor Corporation offers enhanced efficiency products that feature design optimization and premium grade materials. We recognize your need for increased motor performance is driven by the potentially significant operational cost savings associated with enhanced motor efficiency. Your power costs savings are determined by a number of factors (depending on which payback method you select), including the cost of power and hours of operation. Because not all motors run 24 hours a day, 7 days a week, we offer three prepriced efficiency options for NEMA frame motors and two efficiency options for TITAN® products.

Certain modifications (high altitude, abnormal ambient temperature, 50HZ or other frequency, extra high thrust bearing arrangements lower than standard temperature rise, multispeed products, copper bar rotors, low noise designs, etc.) will cause motor performance to vary from stated values. Individual modifications that have the tendency to impact motor performance are noted in their description. Individual modifications that have the tendency to impact motor performance are noted in their description. Should any question exist, refer to the Inquiry Group.

Vertical motors are inherently different from their horizontal counterparts. Possible efficiency levels for horizontal motors do not always translate well into the vertical form. One reason for this is their ability to withstand significant thrust loads imposed on the motor by the pump. This is accomplished in the motor by the use of specialized bearing arrangements that generate additional losses. Nidec Motor Corporation factors these thrust-bearing losses into our efficiency calculations to provide the most accurate data possible.

Increasing bearing capacity reduces motor efficiency. If extra high thrust (175%, 300% or above) is selected for either actual pump thrust conditions or extended bearing life requirements, efficiency should be reduced. The following chart illustrates the additional losses associated with the use of extra high thrust angular contact, spherical roller and plate type bearings. For precise efficiency values when extra high thrust arrangements are used, refer to the Inquiry Group.

12. EFFICIENCY (continued)



VERTICAL BEARING LOSS COMPARISON

Bearing Reference:

- **7230 -- Angular Contact Bearing (2-7230 Require Quantity 2 7230)**
- **29334, 29434, 29438 -- Spherical Roller Bearing**
- **Kingsbury -- Plate Bearing**

The above illustration compares the bearing losses (in watts) of various vertical high and extra high thrust capacities to the bearing losses for a typical horizontal motor. Note that incrementally increasing thrust bearing capacity to facilitate longer bearing life or pump thrust load produces higher bearing losses. Higher bearing losses reduce motor efficiency.

PAYBACK ANALYSIS

A number of methods are available to evaluate the potential cost savings obtained by premium efficiency motors. Nidec Motor Corporation sales engineers will be happy to assist you and apply some of the more rigorous tests that include the time value of money at various yield rates. However, you may want to get a general idea of the benefits possible, and this can be accomplished by the simple payback method (shown below). This provides annual power cost savings when the following items are known: Your cost / kilowatt hour of power, actual hours of operation and the full load efficiency level of a standard vs. premium efficiency motor.

$$S = .746 \times HP \times C \times N \left[\frac{100}{SE} - \frac{100}{PE} \right]$$

Where:
- S = Energy savings / year @ 100% load
- C = Energy costs $/ KWH
- N = Hours / years running time
- SE = Standard efficiency product at full load
- PE = Premium efficiency product at full load

12. EFFICIENCY (continued)

SIMPLE PAYBACK ANALYSIS EXAMPLE

RATING:	125HP - 1800 RPM - 460V	
POWER COST:	5 cents per KW hour	
OPERATION:	Continuous duty - 8760 hours / year	
PRODUCTS:	Standard Efficient	93.0% @ F/L
	Energy Efficient	94.1% @ F/L
	Premium Efficient	95.4% @ F/L

ENERGY EFFICIENT

$$S = .746 \times 125 \times .05 \times 8760 \left[\frac{100}{93.0} - \frac{100}{94.1} \right]$$

$$S = 40843.5 \left[1.075269 - 1.062699 \right]$$

Annual power cost savings (energy efficient) = $1,205.14

- Substituting a premium efficient product with 95.4% F/L efficiency for the energy efficient motor produces an annual power cost savings of $2,594
- The difference in **LIST** price between the standard efficient (type RU) and energy efficient (type RUE) is $2,615. Payback for this **LIST** price premium is 2.17 years
- For the premium efficient (type RUS) the difference in **LIST** price is $3,270. The payback based on this **LIST** price difference is 1.26 years.
- When you compare your actual **net** cost differences to the above illustrations this becomes a very attractive option.

EFFICIENCY LIST PRICE ADDERS

NEMA® FRAME -- All three efficiency options are shown pre-priced in the modifiable motor section for your convenience.

TITAN® PRODUCTS -- Premium Efficiency motors are pre-priced in the Modifiable Motor section for your convenience.

13. ENCLOSURES

A. WEATHER PROTECTED TYPE I (NEMA WPI)

All open-type vertical motors offered by Nidec Motor Corporation feature a NEMA® WPI enclosure as standard. It is designed to minimize the entrance of rain, snow and airborne particles while protecting the internal components. It is also designed to prevent a 3/4-inch diameter rod from passing into the motor. A unique feature of Nidec Motor Corporation's WPI design is the motor's air flow pattern. Cooling air is drawn through the motor and exhausted in such a way to avoid drawing any pumped fluids into the motor, should the pumps packing seal or mechanical seal fail. Further, corrosion-resistant screens and grills cover all opening, preventing snakes, rodents, etc., from entering the motor. This is our standard product for outdoor service.

B. WEATHER PROTECTED TYPE II (NEMA WPII)

- Available only in frames sizes of 5008 through 9600
- For WPII protection in smaller frame sizes, use TEFC

The same construction features described for the WPI motor are further refined to include protection against high velocity winds, severe storms, such as hurricanes, and airborne particles from entering directly into the electrical package of the machine. The cooling air intake velocity is reduced to 600 ft/min (maximum) and must make at least three 90° right angle turns before passing into the cooling circuit. Any contaminants entering the motor (dirt, dust, abrasives, etc.) are trapped into chambers at low points in the enclosure with clean-out ports for easy maintenance.

This product is often applied to wet, corrosive, contaminated environments commonly found in heavy industries such as pulp and paper, electric utilities, petro-chem and steel mills as well as many municipal installations. Construction features include cast iron and heavy-fabricated steel, CORRO-DUTY® internal and external protective treatments and provisions for air filters. **Space heaters are also furnished at no charge if specified at order entry.** All form-wound coil machines receive two complete cycles of 100% solids epoxy VPI. For WPII enclosures, add per list price as shown on the next page.

C. CORRO-DUTY® WITH WPI OR WPII ENCLOSURES

- WPI motors -- CORRO-DUTY® paint and coatings are available (but not in all cast-iron construction) for WPI motors. Should a customer require CORRO-DUTY® internal and external protective treatments, add for Insulife 2000, 3% for paint and coatings, and for cast-iron conduit box.
- WPII enclosures -- CORRO-DUTY® treatments are standard on WPII motors.

D. AIR FILTERS

- Available only on WPII enclosures

Removable dry-type air filters are available for use only on WPII motors. These have a zinc filter media on 5008 through 5813 and polyurethane on 6800 and larger that provides a high dust holding capacity. These are easy to clean, and replacements are readily available . Disposable air filters are not recommended. Alternate filter media are not available. For air filters on WPII motors, add per list price shown on next page.

E. AIR FILTER DIFFERENTIAL PRESSURE SWITCH

- Available only for WPII enclosures

When this accessory is applied to WPII motors with air filters, it guards against clogged filters that can starve the motor from cooling air. Air filters remove a wide variety of airborne particles. The concentration of these particles can vary greatly from hour to hour, week to week, season to season. Due to these fluctuations, using a preset time schedule can be an uncertain gauge of air filter condition. A widely accepted method of determining air filter condition is to measure the pressure drop across the air filters. This is accomplished with an accessory that allows the filter to be used until its maximum dust holding capacity is reached.

13. ENCLOSURES (continued)

E. AIR FILTER DIFFERENTIAL PRESSURE SWITCH

Nidec Motor Corporation's standard air pressure differential switch is Dwyer Series 1950. This product is weather-proof and suitable for explosionproof applications (or requirements on WP-II). The electrical connection is through a single 1/2-inch NPT hub, the high/low pressure connection is through dual 1/8 inch NPT hubs. The list price shown below does not include a locally mounted air filter condition visual gauge. To include this feature, double the adder shown.

F. AIR TEMPERATURE SENSOR

- Available only in WPII enclosures

A resistance temperature detector (RTD) can be supplied in the air flow inlet of WPII motors to monitor incoming air temperature. Winding RTDs should be provided when this option is specified. The RTD monitoring the air flow should be the same rating as the winding RTD and will be wired to the same auxiliary terminal box.

WPII LIST PRICE ADDITIONS

ITEM	FRAME SIZE				
	5000	5800	6800	8000	9600
WPII ENCLOSURE	$17,606	$26,408	$33,451	$41,815	$52,230
STD AIR FILTERS	$2,507	$26,408	$2,507	$2,507	$2,507
STAINLESS STEEL	$7,242	N/A	$25,822	$28,873	$35,915
AIR PRESSURE DIFFERENTIAL SWITCH	$1,676	$1,676	$1,676	$1,676	$1,676
AIR TEMPERATURE SENSOR	$1,897	$1,897	$1,897	$1,897	$1,897

G. TOTALLY ENCLOSED FAN COOLED (TEFC)

- Available only in 182 through 5811 frame sizes
- Also used for WPII requirements in NEMA® frame (182 through 449) size motors
- Standard TEFC motors have a 1.0 service factor -- except as shown in this catalog
- 1.15 SF may not be available on maximum ratings in some frame sizes

Unlike WPI or WPII enclosures, TEFC enclosures do not allow a free exchange of air to take place between the external environment and internal motor components. Heat generated by the motor is dissipated when the external fan forces cool air over the surface of the frame and end brackets. TEFC motors are widely applied to dust laden, abrasive and corrosive environments where maximum internal component protection is required.

Since there is no free exchange of air, TEFC motors can be susceptible to internal condensation. Areas of high humidity or where great swings in day to night temperatures frequently occur can experience internal condensation. Additionally, TEFC motors applied to intermittent-duty loads can be prone to condensation as the heating (run time) and cooling (down time) cycles tend to draw moisture into the motor as it cools down and remains idle. For TEFC installations concerned with condensation buildup, Nidec Motor Corporation suggests the addition of space heaters, drain and breather elements (all Nidec Motor Corporation TEFC motors have drain holes in the low point of the motor) and on a case-by-case basis, possibly oil sump heaters. Another concern of condensation-prone areas can be overhead feed of metal conduit to the TEFC motor. It is not uncommon for condensation to build up in the metal conduit, drain into the motor conduit box, and cause a failure. Where this is a concern, Nidec Motor Corporation recommends potting of the motor leads, and a conduit box drain/ breather in the box cover. This option is not available on 182 through 286 vertical TEFC motors that are not CORRO-DUTY® or severe-duty products. Requires a cast-iron or fab-steel conduit box as well.

13. ENCLOSURES (continued)

G. TOTALLY ENCLOSED FAN COOLED (TEFC)

LIST PRICE ADDERS

FRAME	182/286	324/365	404/447	449/5800(2)
POTTED LEADS	$235(1) PLUS 10%	$352	$469	$735
CONDUIT BOX DRAIN AND BREATHER	$235	$235	$293	$441
CAST IRON CONDUIT BOX	10% (1)	$293 / $469 (360)	$587 / $704 (440)	STD
SPACE HEATER	$300	$385	$385	$1,657 / $1,819 (5800)
BRACKET DRAIN AND BREATHERS	$ 178 BRASS		$270 STAINLESS STEEL	

NOTES: (1) 10% provides C.I. construction in these frame sizes
(2) Potted leads not available on 449 Frame

H. HEAVY DUTY TEFC (182-447 FRAMES, TEFC ONLY)

Standard designs of the TEFC motors described in this catalog are supplied with a 1.0 SF except the premium efficient "S" version TEFC motor, which is Class B rise at 1.0 and Class F at 1.15. To add 1.15 SF where products are standard as 1.0 S.F., add 5% to the list price. Standard materials of construction will not change.

I. CORRO-DUTY® TEFC (182-5811 FRAMES)-- AVAILABLE WITH ALL EFFICIENCY OPTIONS

CORRO-DUTY® is the industry standard for heavy duty, corrosive environments. It consists of all cast-iron construction, 1.15 SF, specialized internal and external protective treatments, treated rotor, ground lug in double gasketed conduit box, noncorrosive drain and breather, and a stainless-steel nameplate. To include these features, add as follows:

- TEFC motors — 182-447 frame, add 10% to the standard efficient list price.
- TEFC motors — 449-5811 frame with cast-iron frame, end brackets, conduit box and heavy fabricated steel fan cover guard add 6% to the standard or premium list price. To include cast-iron fan cover guard, add 8% to the standard or premium list price.
- Explosionproof motors — 182-5811 frame, add per above, plus service factor if required.

J. EXPLOSIONPROOF

- Available only in 182 through 5811 frame sizes
- 1.0 service factor is standard
- Not all accessories and modifications are available with this enclosure
- Explosionproof pricing is shown as an adder to the basic TEFC motor in the modifiable section
- 1.15 SF may not be available on maximum HP ratings in specific frame sizes

DIVISION 1 EXPLOSIONPROOF (UL LISTED)

- Motor normally exposed to contaminated environment
- For T2D or T3C temperature code, add thermostats to explosionproof pricing

13. ENCLOSURES (continued)

J. EXPLOSIONPROOF

The explosionproof motor is a totally enclosed motor designed to withstand an explosion of a specified gas or vapor inside the motor casing and prevent the ignition outside the motor by sparks, flashing or explosion. Nidec Motor Corporation's motors are UL-approved for Class 1 (gas or vapor), Group D, which includes gasoline, hexane, naptha, benzine, butane, propane, alcohol, lacquer solvent vapors and natural gas. Ignition temperature vs. temperature marking indicates a maximum temperature for all conditions including overload, locker rotor, singled phasing and burnout. When ordering, indicate class, group and temperature code requirements. See pricing of explosionproof motor on base TEFC motor pricing pages.

HAZARDOUS LOCATION CLASSIFICATION	MAXIMUM SURFACE TEMPERATURE	TEMPERATURE CODE
CLASS I, GROUP D	260^{0}C	T2B

ENCLOSED DIVISION 2 EXPLOSIONPROOF (UL LISTED)

- Motor is abnormally or accidentally exposed to contaminated, explosive environments.

Division 2 is the abnormal situation. Material is expected to be confined within closed containers or closed systems and will be present only through accidental rupture, breakage, or unusual faulty operation. Use explosionproof list adder times 0.90 multiplier for determining Division 2 list adder. Accessories must be explosionproof for UL-listed items. Listed Division 2 is not available on open machines.

DIVISION 2 SELF-CERTIFIED (NON-UL LISTED)

The National Electrical Code Section 501-8b allows the installation of open or non-explosionproof enclosed motors without brushes, switching mechanisms or similar arc-producing devices in Class I, Division 2 locations. Nidec Motor Corporation can supply self-certified motors meeting the NEC requirements under normal operating conditions (full load). These motors are available for Class I, Group A,B,C, and D with temperature codes T1 through TC3, with some restrictions. To provide a motor meeting requirements of the NEC, add 2% of the motor's total list price.

Self-certified restrictions:

- Not applicable to explosionproof motor
- Single speed only
- 40^{0}C ambient, 3300 feet altitude
- Use explosionproof adders for all accessories. Accessories not available on Division I explosionproof motors are not available on Division 2 motors.
- Inverter duty is available with temperature codes T1 through T2B only. Motors are limited to 1.0 SF on inverter power. Hermetically sealed thermostats will be provided.

K. UL® LISTED FIRE PUMP

UL® Listed fire pump motors are designed per UL-1004A and meet the NFPA-20 "Standard for the Installation of Centrifugal Fire Pump Specifications." Nidec Motor Corporation's UL®-Listed Fire Pump motors meet the special design requirements listed below:"

- Deigned to meet NEMA Design "B" limitations per NEMA MG1
- Applies to motors rated 350 HP or less, 600 volts or less and frames 449 and less.
- Calculated Safe Stall Time must exceed 12 seconds (cold)
- Motors designated for Canada must meet CSA-390 Table 2 efficiency values.
- Add 5% of base list price for Fire Pump Service

NOTE: Motors for use on vertical turbine pumps require a NRR.

14. EXPORT BOXING (also used for domestic crating requirements)

Export packaging is available from our international warehouse in Southaven, MS. Material used to export box vertical motors is 2 x 4s for the frame and 1/2" plywood for walls. The conduit box is removed and placed in a box with the motor. Shipping marks are stenciled to the outside of the box. For other options, such as gangboxing and containerization, contact Nidec Motor Corporation.

Pricing: 6% NEMA® list
3% TITAN® list
$150 minimum NET charge each motor

15. FREQUENCY

Motors listed in this catalog are 60 cycle as standard. 50-cycle motors are available from production as follows:

- If motor has 1.15 SF and customer wants 50HZ with 1.0 SF -- no charge
- If motor has 1.15 SF which customer wants to maintain -- add 10% list
- If motor has 1.0 SF and customer wants 50HZ 1.0 SF -- add 10% list
- If motor has 1.0 SF and customer wants 50HZ 1.15 SF -- add 10% list plus 1.15 SF adder

Provisions for Wye-Delta starting are no charge if noted at time of order entry.

16. GROUNDING PROVISIONS (FRAME)

Add $352 list for a bronze bolt (GT) on the motor frame (180 through 400 frame) or $441 list for a ground pad (GP) on the motor frame (440 frame and larger). Ground pads are not available below the 440 frame.

Add $549 list for a ground pad on explosionproof motors, 440 frame and larger (includes a conduit box ground lug).

17. HORSEPOWER, NON NEMA-STANDARD RATING

A non-standard horsepower rated motor can be designed. Refer to the Inquiry Group with application details. Price using list price of next-higher horsepower rating for same motor type. Motors can be nameplated in KW units. For list price determination, divide KW by .746 to figure equivalent horsepower.

18. INSULATION CLASS

- All products described in this catalog are manufactured with copper magnet and lead wire. Aluminum wire is not available.
- All production-modified products are supplied with Class F insulation as standard.
- Inverter-duty products are supplied with a special insulation system that is described in item 19 on page 129 of this section.
- Class H insulation is an available option for inverter-duty products with our specialized insulation system.
- Temperature-rise considerations are described in item 47 on page 163 of this modification section.

INSULATION CLASS

Common designations include Class B, F, and H. These indicate the maximum thermal capability of each system based on providing a life expectancy in accordance with IEEE guidelines and industry standards. The following table illustrates the various elements and their contribution to the insulation systems.

18. INSULATION CLASS (continued)

REFERENCE TABLE
CLASSIFICATION OF INSULATION

INSULATION CLASS	A①	B	F	H
Ambient temperature (for options see item 3 on page 106)	40⁰C	40⁰C	40⁰C	40⁰C
Temperature rise at nameplate H.P. (for options see item 47 on page 163)	60⁰C	80⁰C	105⁰C	125⁰C②
Hot spot or service factor allowance (for service factor see item 38 page 150)	10⁰C	10⁰C	10⁰C	15⁰C
Thermal limit of insulation system③	105⁰C	130⁰C	155⁰C	180⁰C

NOTES:
① Class A insulation is shown for reference only and is not commercially available from Nidec Motor Corporation.
② Class H insulation is offered for special ambient conditions, life requirements, etc. Class H temperature rise is not available or used by Nidec Motor Corporation.
③ Each insulation class provides the same winding design life when operated at its thermal limit.

Any deviation from insulation class standards stated on individual pricebook pages requires the appropriate modification adder and may impact frame size and performance characteristics.

AVAILABLE INSULATION SYSTEMS

CLASS	PRODUCT APPLICATION	PRICE ADDER
B	Class F with B rise @ 1.15 SF standard on all stock ODP, WPI products in frames 182 through 445	not required
F	Class F with B rise @ 1.0 SF standard on all **stock TEFC products, Stock WPI 447 frames and larger, and all modified** WPI, WPII and TEFC production motors	not required
H	Available option on production motors in 180 through 9600 frame	25% List*
F or H (VFD)	Special INVERTER GRADE® Insulation system featuring pulse-resistant magnet wire with special end-turn lacing and phase paper treatments.	Refer to item 20 on page 132 of this section

*10% List Adder on Inverter Duty Motors

18. INSULATION CLASS (continued)

WINDING TREATMENTS

Availability of specialized insulation treatments depends upon the coil construction used in the wound stator assembly. Guidelines for random wound and form wound coil construction are:

Random wound coils are typically used on all low-voltage (600 volts and below) motors rated 700 HP and below, 5800 frame and smaller except 2-pole.

Form wound coils are used on all motors (regardless of voltage) in the 6800, 8000 and 9600 frames and on all products rated above 600 volts. Nidec Motor Corporation does not manufacture medium voltage (2300 - 7000 volts) random wound products.

- Specific applications (VFD, frequent starting duty, etc.) and other design complications may require deviation from the above guidelines. Consult the Inquiry Group if questions exist.
- Form wound coils are available for some low voltage ratings traditionally manufactured as random wound. This requires approval by the Inquiry Group; when approved, price as a 2300 volt motor.
- Nidec Motor Corporation reserves the right to modify these guidelines as required.

SELECTION TABLE

WINDING TYPE		
INSULATION CHOICE	**RANDOM WOUND**	**FORM WOUND**
Insulife 1000	STD	N/A
Insulife 2000	OPT	N/A
Insulife VPI 1000	OPT*	N/A
Insulife VPI 2000	OPT**	N/A
Abrasion Resistant	OPT	-
Insulife VPI 5000	N/A	STD
Premium Everseal	N/A	OPT
Abrasion Resistant	-	OPT

**Standard on random wound TITAN® motors in 449 frame and larger.*

*** Standard on 500 through 600 horsepower, random wound, low voltage TITAN® motors.*

18. INSULATION CLASS (continued)

DESCRIPTION OF AVAILABLE INSULATION TREATMENTS

- INSULIFE 1000 -- Standard treatment for 182 through 447 frames. Insulife 1000 utilizes 100% solid polyester resins completely impregnating slot and end turns. The standard insulation material is non-hypogrospic Class F (155ºC), suitable for WP-1 motors in a relatively dry environment or for a TEFC motor with moderate exposure to moisture. One dip and bake in polyester resin.
- INSULIFE 2000 -- An additional treatment of polyester varnish ideal for applications with high moisture content, such as tropical environments for fungus resistance. Two dips and bakes. Standard on CORRO-DUTY® motors.
- INSULIFE VPI 1000 -- One cycle of vacuum pressure impregnation of 100% solid epoxy resins. Available on 320 through 440 frames as an option. Cast-iron construction only. Standard on TITAN® motors with 600 volt maximum insulation (random wound).
- INSULIFE VPI 2000 -- Two cycles of vacuum pressure impregnation with 100% solid epoxy resins. Meets NEMA definition for moisture-resistant winding per NEMA MG1 - 1.27.1.
- INSULIFE VPI 5000 -- Two cycles of vacuum pressure impregnation. Standard process on TITAN® frame 2300 volt and up motors. Provides 7 mils Insulation Build -- 3 cycles are not available.
- PREMIUM EVERSEAL® (SEALED) -- Two cycles of VPI with the connection end receiving a special sealing treatment. Premium EVERSEAL® provides additional strength and deflection protection to winding end turns. For form wound motors only. Meets requirements for "sealed" per NEMA MG1-1.27.2, spray test per NEMA MG1-20.18, or immersion test.
- Abrasion Resistant -- Optional overcoat treatment available on any of the above systems. Protects against environments contaminated with abrasive dust such as fly ash, cement dust, etc. Highly resistant to all environmental forms of abrasion.

LIST PRICE ADDERS FOR NEMA® FRAME OPTIONS

INSULATION OPTION	182 184	213 215	254 256	284 286	324 326	364 365	404 405	444 445	447	449
INSULIFE 2000	$80	$127	$162	$270	$345	$425	$570	$742	$742	-
VPI 1000	NA	NA	NA	NA	$1,714	$2,019	$2,847	$3,887	$3,887	STD
VPI 2000	NA	NA	NA	NA	$3,427	$4,038	$5,695	$7,775	$7,775 *	$9,718
ABRASION RESISTANT	$80	$127	$162	$270	$345	$425	$570	$742	$742	1%

LIST PRICE ADDERS FOR TITAN® FRAME OPTIONS (449 TROUGH 9600 FRAME)

FRAME SIZE / INSULATON OPTION	449 5000	5800	6800	8000	9600
INSULIFE VPI 2000	3%	3%	N/A	N/A	N/A
EVERSEAL®: WPI, WPII TEFC	 5% 2.5%	 5% 3%	 5% N/A	 5% N/A	 5% N/A
ABRASION RESISTANT	1%	1%	1%	1%	1%

*No change on 300HP and larger.

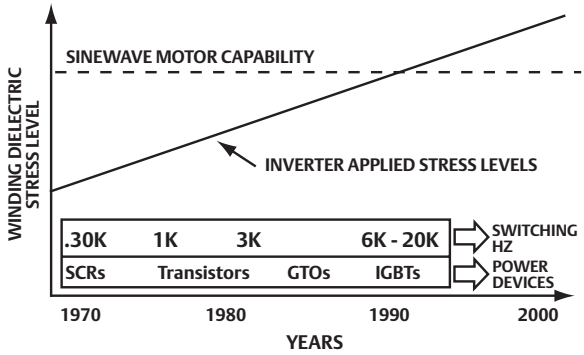
19. INVERTER DUTY

- This modification will alter published performance characteristics when motor is operated on non-sinusoidal waveforms.

The application of vertical motors to variable torque pump loads is an ideal candidate for process control through the use of a variable frequency drive (VFD). Significant operational cost savings are possible in many pumping systems.

Advances in microprocessors and power semiconductor technology have evolved to improve the performance, reliability and cost attributes of VFDs. This evolution has occurred over a 30 year period. With each power semiconductor milestone achieved, drive switching frequency increased.

WINDING DIELECTRIC STRESS VERSUS THE DEVELOPMENT OF TRANSISTORS



Increased switching frequency has created new challenges for existing insulation systems. Electric motor insulation systems have, for the most part, not changed in 30 years. It is no longer accurate to think that inverter-driven motors only have a thermal problem -- one which can be solved by using a premium efficiency motor. Today's drives produce a high rate of rise voltage waveforms that impose high impulse electrical stress on the motor insulation. Unforunately most current insulation life standards do not specify the maximum repetitive voltage transients, the switching frequency (kHz), and rate of rise that the winding should be able to withstand and still maintain normal life expectations. Standard insulation systems are not designed to operate in this new electrical environment, and when they are, unpredictable motor performance is the result.

Nidec Motor Corporation was the first motor company to recognize this by introducing the first formal INVERTER GRADE® Insulation System. This system provides protection against the effects of IGBT power devices through the use of additional phase paper end-turn bracing as well as pulse resistant magnet wire. The benefit was clear: Under inverter fed applications, a significant improvement in winding life was achieved. Nidec Motor Corporation's INVERTER GRADE® Insulation System meets the stringent requirements outlined in NEMA MG-1, Part 31.

Service factor - Sine wave vs VFD power: Motors will be rated 1.15SF on sine wave and 1.0SF on VFD power. Inverters add harmonics to the waveform, which produce additional heat. Running the motor at 1.0SF while on the inverter assures that the winding temperature limits are within the insulation temperature capabilities.

Over-speed on VFD rated units: Motors will be capable of over-speed per NEMA MG1 12.53.2. Note, even though motors are mechanically capable of over-speed, the pump will overload the motor if ran in over-speed.

You can count on Nidec Motor Corporation to continue our design efforts aimed at maintaining a compatible product in light of advancing drive technology. We will automatically upgrade our VARIDYNE® inverter-duty product offering as technology advancements become available. For more information, contact your sales representative.

19. INVERTER DUTY (continued)

PRICE ADDITIONS FOR INVERTER GRADE® MOTORS

NEMA® PRODUCTS IN 182 - 447 FRAME
VARIDYNE® Motors include:

- INVERTER GRADE® insulation system with pulse-resistant Class F magnet wire, heavy phase and special end-turn bracing techniques
- Low-loss electrical steel in rotor and stator
- Refined balance
- Additional insulation treatments -- Insulife 2000
- Premium efficiency
- Special dual-use nameplate with sine wave and VFD power characteristics shown
- N/C Thermostats, unless explosionproof

PRICING -- Price as premium efficiency motor and specify inverter duty.

TITAN® PRODUCTS IN 449 - 9600 FRAME
VARIDYNE® Motors include:

- INVERTER GRADE® Class F insulation system
- Insulife VPI 5000 -- form wound
- Insulife VPI 2000 -- random wound
- Refined balance
- Insulated thrust bearing
- Premium efficiency
- Special dual use nameplate
- N/C Thermostats unless other thermal protective devices are ordered

PRICING -- Price as premium efficiency motor and specify inverter duty.

20. LEADS

The standard length of our leads is six inches inside the conduit box. Adder $500 for up to 10 Ft. longer than stadard -- single voltage only. For dual voltage, double adder.

21. MARINE MOTORS

CORRO-DUTY® motors meet IEEE 45 specifications, both above and below deck, in both enclosed and explosionproof enclosures. Add an Inpro/Seal® for above deck service. Open motors are approved for below deck. When high-thrust motors are located onboard ship, bearing lubrication may be affected by the pitch and roll (1 degree maximum allowable) of the vessel. If motor is to be used as dockside transfer (not on ship/barge), use standard motor with CORRO-DUTY® features plus a space heater. For ship board applications and bow thruster drives, refer to the Inquiry Group.

NOTE: IEEE 45 requires that motors exposed to the weather, seas, splashing or other severe moisture conditions either be watertight or protected by watertight enclosures. Since electric motors "breathe" during operation, they cannot be constructed as watertight. Above-deck motors must be protected by suitable watertight enclosures