U.S. MOTORS® Brand Products

PRODUCT SERVICE MANUAL

Table of Contents

Bearing Insulation Instructions

Spring Loaded Thrust Bearings

Accessory Leads

Winding Temperature Detectors

Alarm and Trip Temperature Settings

Temperature Rise

Motor Frame Surface Temperature

Technical Service / Start-Up Service

Bearing Housing Vibration

Machine Mounting

Limits of Bearing Housing Vibration

Standard Machines and Vibration

Vibration Banding

Testing Vibration

Obtaining Parts

Connection Diagrams

TITAN® Motor Failure Sheet

Nidec

All for dreams

NIDEC MOTOR CORPORATION

Quality Policy

Nidec Motor Corporation is dedicated to exceeding customer expectations through a 3Q6S culture that drives continuous improvement providing the highest quality products, services, and solutions

Quality
Cost
Delivery
Service
Speed
Specialization
(customization)

Nidec Way... Passion *(Challenge for Excellence)*, ***Enthusiasm*** *(Customer Centric)*, ***and Tenacity*** *(Work Hard and Smart)*

3Q6S | Driving Continuous Improvement
Quality Workers, Quality Company, Quality Products

Kei Pang

Kei Pang
Chief Executive Officer
Revision August 24th, 2017

Product Service Mission Statement

Provide timely, courteous, and efficient response as primary contact for technical support and training for internal and external customers on proper maintenance, application and evaluation of products. Develop and maintain interface with service network by diligent communication and evaluation to provide analysis and resolution of quality problems within stated warranty policy. Identify quality problems and feedback through appropriate channels within Nidec Motor Corporation to develop corrective actions.

PRODUCT SERVICE / WARRANTY ADMINISTRATION -- INTRODUCTION

Our warranty service philosophy is to provide our customers and product users prompt and efficient action to resolve product warranty issues at reasonable expense. In addition, we will obtain as much information as possible about the conditions and cause of the issue, thus allowing appropriate corrective actions to avoid similar future product issues. This Product Service Manual defines Warranty Policy, Procedures, and Product Service Contacts for U.S. MOTORS® brand products, which must be utilized when carrying out product warranty repairs and replacements. Product Service and Warranty Administration for US MOTORS® brand products are handled out of the Corporate Headquarters Location in St. Louis, MO. This manual contains a listing of product service / warranty contacts, addresses, and telephone / fax numbers.

WARRANTY POLICY

NIDEC MOTOR CORPORATION

TERMS AND CONDITIONS OF SALE

Nidec Motor Corporation, referred to herein as the "Seller" and the customer or person or entity purchasing goods ("Goods") from Seller is referred to as the "Buyer." These Terms and Conditions, any price list or schedule, quotation, acknowledgment or invoice from Seller relevant to the sale of the Goods and all documents incorporated by specific reference herein or therein, constitute the complete and exclusive statement of the terms of the agreement governing the sale of Goods by Seller to Buyer. Seller's acceptance of Buyer's purchase order is expressly conditional on Buyer's assent to all of Seller's terms and conditions of sale, including terms and conditions that are different from or additional to the terms and conditions of Buyer's purchase order. Buyer's acceptance of or payment for the Goods will manifest Buyer's assent to these Terms and Conditions. Seller reserves the right in its sole discretion to refuse orders.

1. **PRICES**: Prices for Goods, whether specified in Seller's price list or schedule, acknowledgment or written quotation, are subject to change without notice. Such prices shall be adjusted to reflect Seller's prices for Goods as in effect at the time of requested shipment date, and each shipment will be invoiced at such prices**.** All prices are exclusive of taxes, transportation and insurance, which are to be borne by Buyer.

2. **TAXES**: Any current or future tax or governmental charge (or increase in same) affecting Seller's costs of production, sale, or delivery or shipment, or which Seller is otherwise required to pay or collect in connection with the sale, purchase, delivery, storage, processing, use or consumption of Goods, shall be for Buyer's account and shall be added to the price or billed to Buyer separately, at Seller's election.

3. **TERMS OF PAYMENT**: Unless otherwise specified by Seller, terms are net thirty (30) days from date of Seller's invoice in U.S. currency. Seller shall have the right, among other remedies, either to terminate this agreement or to suspend further performance under this and/or other agreements with Buyer in the event Buyer fails to make any payment when due, which other agreements Buyer and Seller hereby amend accordingly. Buyer shall be liable for all expenses, including attorneys' fees, relating to the collection of past due amounts. If any payment owed to Seller is not paid when due, it shall bear interest, at a rate to be determined by Seller, which shall not exceed the maximum rate permitted by law, from the date on which it is due until it is paid. Should Buyer's financial responsibility become unsatisfactory to Seller, cash payments or security satisfactory to Seller may be required by Seller for future deliveries and for the Goods theretofore delivered. If such cash payment or security is not provided, in addition to Seller's other rights and remedies, Seller may discontinue deliveries. Buyer hereby grants Seller a security interest in all Goods sold to Buyer by Seller, which security interest shall continue until all such Goods are fully paid for in cash, and Buyer, upon Seller's demand, will execute and deliver to Seller such instruments as Seller requests to protect and perfect such security interest.

4. **SHIPMENT AND DELIVERY**: While Seller will use all reasonable commercial efforts to maintain the delivery date(s) acknowledged or quoted by Seller, all shipping dates are approximate and not guaranteed. Seller reserves the right to make partial shipments. Seller, at its option, shall not be bound to tender delivery of any Goods for which Buyer has not provided shipping instructions and other required information. If the shipment of the Goods is postponed or delayed by Buyer for any reason, Buyer agrees to reimburse Seller for any and all storage costs and other additional expenses resulting therefrom. Risk of loss and legal title to the Goods shall transfer to Buyer for sales in which the end destination of the Goods is outside of the United States immediately after the Goods have passed beyond the territorial limits of the United States. For all other shipments, risk of loss for damage and responsibility shall pass from Seller to Buyer upon delivery to and receipt by carrier at Seller's shipping point. All shipments are F.O.B. Seller's shipping point. Any claims for shortages or damages suffered in transit are the

responsibility of Buyer and shall be submitted by Buyer directly to the carrier. Shortages or damages must be identified and signed for at the time of delivery.

5. **LIMITED WARRANTY**: Subject to the limitations of Section 6, Seller warrants that the Goods manufactured by Seller, other than those specifically identified below, will be free from defects in material and workmanship and meet Seller's published specifications at the time of shipment under normal use and regular service and maintenance for a period of twelve (12) months from the date of shipment of the Goods by Seller or eighteen (18) months from the date of manufacture, whichever occurs sooner, unless otherwise specified by Seller in writing. Partial Motors of any kind not fully assembled by Seller shall carry no warranty of any kind, express or implied. Products purchased by Seller from a third party for resale to Buyer ("Resale Products") shall carry only the warranty extended by the original manufacturer. **THE WARRANTY SET FORTH IN THIS SECTION 5 AND THE WARRANTY SET FORTH IN SECTION 7, ARE THE SOLE AND EXCLUSIVE WARRANTIES GIVEN BY SELLER WITH RESPECT TO THE GOODS AND ARE IN LIEU OF AND EXCLUDE ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, ARISING BY OPERATION OF LAW OR OTHERWISE, INCLUDING WITHOUT LIMITATION, MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE WHETHER OR NOT THE PURPOSE OR USE HAS BEEN DISCLOSED TO SELLER IN SPECIFICATIONS, DRAWINGS OR OTHERWISE, AND WHETHER OR NOT SELLER'S PRODUCTS ARE SPECIFICALLY DESIGNED AND/OR MANUFACTURED BY SELLER FOR BUYER'S USE OR PURPOSE.**

This warranty does not extend to any losses or damages due to misuse, accident, abuse, neglect, normal wear and tear, negligence (other than Seller's), unauthorized modification or alteration, use beyond rated capacity, unsuitable power sources or environmental conditions, improper installation, repair, handling, maintenance or application or any other cause not the fault of Seller. To the extent that Buyer or its agents has supplied specifications, information, representation of operating conditions or other data to Seller in the selection or design of the Goods and the preparation of Seller's quotation, and in the event that actual operating conditions or other conditions differ from those represented by Buyer, any warranties or other provisions contained herein which are affected by such conditions shall be null and void.

If within thirty (30) days after Buyer's discovery of any warranty defects within the warranty period, Buyer notifies Seller thereof in writing, Seller shall, at its option and as Buyer's exclusive remedy, repair, correct or replace or refund the purchase price for, that portion of the Goods found by Seller to be defective. Failure by Buyer to give such written notice within the applicable time period shall be deemed an absolute and unconditional waiver of Buyer's claim for such defects. Seller shall have the right to require the Buyer to deliver the Goods to Seller's designated repair center or manufacturing facility. All costs associated with dismantling, reinstallation and transportation to and from Seller's designated repair center or manufacturing facility and the time and expense of Seller's personnel and representatives for site travel and diagnosis under this warranty shall be borne by the Buyer. Goods repaired or replaced during the warranty period shall be covered by the foregoing warranty for the remainder of the original warranty period or ninety (90) days from the date of shipment, whichever is longer. Buyer assumes all other responsibility for any loss, damage, or injury to persons or property arising out of, connected with, or resulting from the use of Goods, either alone or in combination with other products/components.

Section 5 applies to any entity or person who may buy, acquire or use the Goods, including any entity or person who obtains the Goods from Buyer, and shall be bound by the limitations therein, including Section 6. Buyer agrees to provide such subsequent transferee conspicuous, written notice of the provisions of Sections 5 and 6.

6. **LIMITATION OF REMEDY AND LIABILITY**: **THE SOLE AND EXCLUSIVE REMEDY FOR BREACH OF ANY WARRANTY HEREUNDER (OTHER THAN THE WARRANTY PROVIDED UNDER SECTION 7) SHALL BE LIMITED TO REPAIR, CORRECTION OR REPLACEMENT, OR REFUND OF THE PURCHASE PRICE UNDER SECTION 5.**

SELLER SHALL NOT BE LIABLE FOR DAMAGES CAUSED BY DELAY IN PERFORMANCE AND THE REMEDIES OF BUYER SET FORTH IN THIS AGREEMENT ARE EXCLUSIVE. IN NO EVENT, REGARDLESS OF THE FORM OF THE CLAIM OR CAUSE OF ACTION (WHETHER BASED IN CONTRACT, INFRINGEMENT, NEGLIGENCE, STRICT LIABILITY, OTHER TORT OR OTHERWISE), SHALL SELLER'S LIABILITY TO BUYER AND/OR ITS CUSTOMERS EXCEED THE

PRICE PAID BY BUYER FOR THE SPECIFIC GOODS PROVIDED BY SELLER GIVING RISE TO THE CLAIM OR CAUSE OF ACTION. BUYER AGREES THAT IN NO EVENT SHALL SELLER'S LIABILITY TO BUYER AND/OR ITS CUSTOMERS EXTEND TO INCLUDE INCIDENTAL, CONSEQUENTIAL OR PUNITIVE DAMAGES. The term "consequential damages" shall include, but not be limited to, loss of anticipated profits, business interruption, loss of use, revenue, reputation and data, costs incurred, including without limitation, for capital, fuel, power and loss or damage to property or equipment.

It is expressly understood that any technical advice furnished by Seller with respect to the use of the Goods is given without charge, and Seller assumes no obligation or liability for the advice given, or results obtained, all such advice being given and accepted at Buyer's risk.

7. **PATENTS AND COPYRIGHTS**: Subject to the limitations of the second paragraph of Section 6, Seller warrants that the Goods sold, except as are made specifically for Buyer according to Buyer's specifications, do not infringe any valid U.S. patent or copyright in existence as of the date of shipment. This warranty is given upon the condition that Buyer promptly notifies Seller of any claim or suit involving Buyer in which such infringement is alleged and cooperates fully with Seller and permit Seller to control completely the defense, settlement or compromise of any such allegation of infringement. Seller's warranty as to use patents only applies to infringement arising solely out of the inherent operation according to Seller's specifications and instructions (i) of such Goods, or (ii) of any combination of Goods acquired from Seller in a system designed by Seller. In the
event such Goods are held to infringe such a U.S. patent or copyright in such suit, and the use of such Goods is enjoined, or in the case of a compromise or settlement by Seller, Seller shall have the right, at its option and expense, to procure for Buyer the right to continue using such Goods, or replace them with non-infringing Goods, or modify same to become non-infringing, or grant Buyer a credit for the depreciated value of such Goods and accept return of them. In the event of the foregoing, Seller may also, at its option, cancel the agreement as to future deliveries of such Goods, without liability. No license or rights in any of Seller's intellectual property associated with the Goods is granted hereby.

8. **EXCUSE OF PERFORMANCE**: Seller shall not be liable for delays in performance or for non-performance due to acts of God; acts of Buyer; war; fire; flood; weather; sabotage; strikes or labor disputes; civil disturbances or riots; governmental requests, restrictions, allocations, laws, regulations, orders or actions; unavailability of or delays in transportation; default of suppliers; or unforeseen circumstances or any events or causes beyond Seller's reasonable control. Deliveries or other performance may be suspended for an appropriate period of time or canceled by Seller upon notice to Buyer in the event of any of the foregoing, but the balance of the agreement shall otherwise remain unaffected as a result of the foregoing.

If Seller determines that its ability to supply the total demand for the Goods, or to obtain material used directly or indirectly in the manufacture of the Goods, is hindered, limited or made impracticable due to causes set forth in the preceding paragraph, Seller may allocate its available supply of the Goods or such material (without obligation to acquire other supplies of any such Goods or material) among itself and its purchasers on such basis as Seller determines to be equitable without liability for any failure of performance which may result therefrom.

9. **CANCELLATION**: Buyer may cancel orders only upon reasonable advance written notice and upon payment to Seller of Seller's cancellation charges which include, among other things, all costs and expenses incurred, and, to cover commitments made, by the Seller and a reasonable profit thereon. Seller's determination of such termination charges shall be conclusive.

10. **CHANGES**: Buyer may request changes or additions to the Goods consistent with Seller's specifications and criteria. In the event such changes or additions are accepted by Seller, Seller may revise the price and dates of delivery. Seller reserves the right to change designs and specifications for the Goods without prior notice to Buyer, except with respect to Goods being made-to-order for Buyer. Seller shall have no obligation to install or make such change in any Goods manufactured prior to the date of such change.

11. **NUCLEAR/MEDICAL**. GOODS SOLD HEREUNDER ARE NOT FOR USE IN CONNECTION WITH ANY NUCLEAR, MEDICAL, LIFE-SUPPORT AND RELATED APPLICATIONS. Buyer accepts Goods with the foregoing understanding, agrees to communicate the same in writing to any subsequent purchasers or users and to defend, indemnify and hold harmless Seller from any claims, losses, suits, judgments and damages, including incidental and consequential damages, arising from such use, whether the cause of action be based in tort, contract or otherwise, including allegations that the Seller's liability is based on negligence or strict liability.

12. **ASSIGNMENT**: Buyer shall not assign its rights or delegate its duties hereunder or any interest herein without the prior written consent of Seller, and any such assignment, without such consent, shall be void.

13. **QUANTITY**: Buyer agrees to accept overruns of up to ten percent (10%) of the order on "made-to-order" goods, including parts. Any such additional items shall be priced at the price per item charged for the specific quantity ordered.

14. **REPLACEMENT / SERVICE GOODS:** Upon the cancellation or fulfillment of this order, Seller will have no obligation to sell and Buyer will have no obligation to purchase the Goods sold hereunder, including, but not limited to, the supply of replacement parts for Goods or Goods for Buyer's consumer service division. Seller is not obligated to sell Buyer or its consumer service divisions Goods: (i) for any fixed period of time after production of the Goods supplied hereunder ceases or after the last date of shipment made under this order: or (ii) at any pre-established price to fulfill Buyer's or its consumer service divisions requirements during or after production of the Goods ceases or after the last date of shipment under this order. Seller shall have the absolute right to revise the price of Goods and the terms of sale and to modify or discontinue the sale of the Goods, and such action shall not form the basis of any claim by Buyer against Seller.

15. **TOOLING**: Tool, die, and pattern charges, if any, are in addition to the price of the Goods and are due and payable upon completion of the tooling. All such tools, dies and patterns shall be and remain the property of Seller. Charges for tools, dies, and patterns do not convey to Buyer, title, ownership interest in, or rights to possession or removal, or prevent their use by Seller for other purchasers, except as otherwise expressly provided by Seller and Buyer in writing with reference to this provision.

16. **INSPECTION/TESTING**: Buyer, at its option and expense, may inspect and observe the testing by Seller of the Goods for compliance with Seller's standard test procedures prior to shipment, which inspection and testing shall be conducted at Seller's plant at such reasonable time as is specified by Seller. Any rejection of the Goods must be made promptly by Buyer before shipment. Tests shall be deemed to be satisfactorily completed and the test fully met when the Goods meet Seller's criteria for such procedures.

17. **DRAWINGS**: Seller's prints and drawings (including without limitation, the underlying technology) furnished by Seller to Buyer in connection with this agreement are the property of Seller and Seller retains all rights, including without limitation, exclusive rights of use, licensing and sale. Possession of such prints or drawings does not convey to Buyer any rights or license, and Buyer shall return all copies (in whatever medium) of such prints or drawings to Seller immediately upon request therefor.

18. **EXPORT/IMPORT**: Buyer agrees that all applicable import and export control laws, regulations, orders and requirements, including without limitation those of the United States and the European Union, and the jurisdictions in which the Seller and Buyer are established or from which Goods may be supplied, will apply to their receipt and use. In no event shall Buyer use, transfer, release, import, export, Goods in violation of such applicable laws, regulations, orders or requirements.

19. **GENERAL PROVISIONS**: These terms and conditions supersede all other communications, negotiations and prior oral or written statements regarding the subject matter of these terms and conditions. No change, modification, rescission, discharge, abandonment, or waiver of these terms and

conditions shall be binding upon the Seller unless made in writing and signed on its behalf by a duly authorized representative of Seller. No conditions, usage of trade, course of dealing or performance, understanding or agreement purporting to modify, vary, explain, or supplement these terms and conditions shall be binding unless hereafter made in writing and signed by the party to be bound, and no modification or additional terms shall be applicable to this agreement by Seller's receipt, acknowledgment, or acceptance of purchase orders, shipping instruction forms, or other documentation containing terms at variance with or in addition to those set forth herein. Any such modifications or additional terms are specifically rejected and deemed a material alteration hereof. If this document shall be deemed an acceptance of a prior offer by Buyer, such acceptance is expressly conditional upon Buyer's assent to any additional or different terms set forth herein. No waiver by either party with respect to any breach or default or of any right or remedy, and no course of dealing, shall be deemed to constitute a continuing waiver of any other breach or default or of any other right or remedy, unless such waiver be expressed in writing and signed by the party to be bound. All typographical or clerical errors made by Seller in any quotation, acknowledgment or publication are subject to correction.

The validity, performance, and all other matters relating to the interpretation and effect of this agreement shall be governed by the law of the state of Missouri without regard to its conflicts of laws principles. Buyer and Seller agree that the proper venue for all actions arising in connection herewith shall be only in Missouri and the parties agree to submit to such jurisdiction. No action, regardless of form, arising out of transactions relating to this contract, may be brought by either party more than two (2) years after the cause of action has accrued. The U.N. Convention on Contracts for the International Sales of Goods shall not apply to this agreement.

Rev 1/1/2013

WARRANTY PROCEDURE

1. The product to be considered for warranty repair or replacement should be delivered to an Authorized Service Station for inspection and warranty evaluation. Warranty policy coverage does not include the pick-up of units or on-site inspections, unless authorized by the Product Service Department with a log (authorization) number.

2. Check the unit's date code to determine if the unit is within the warranty period per policy. Any deviation from this policy must be authorized by a Product Service Department issued log number.

3. Inspect the unit for both the cause of failure and repair requirements. Determine whether the product failure was caused by a defect in materials or workmanship, and thus warrantable under policy definition.

4. If the customer disputes your warranty decision, contact the Product Service Department to reach a resolution.

5. If the product failure is determined to be caused by a warrantable defect, and the product date code indicates the unit is within the warranty period, proceed as follows:

- ***a.)*** Minor repairs should be carried out at reasonable prevailing market rates. Any excessive deviation must be authorized by the Product Service Department.
- ***b.)*** Major repairs (rewinds) or unit replacements should be carried out at reasonable prevailing market rates. Generally, Standard Open Dripproof motors through 320 frame ratings, and Standard TEFC motors through 280 frame ratings, should be replaced rather than rewound when stock is available. This will vary depending upon motor RPM, special features, explosion proof, etc. Refer to the Product Service Department if you have any questions.
- ***c.)*** Invoice and Warranty Repair Report for warranty replacement units must be accompanied by the nameplate from the failed unit.
- ***d.)*** Any warranty repair expense that is anticipated to be in excess of $2,000.00 requires pre-authorization by the Product Service Department (log number authorization).
- ***e.)*** Contact the Product Service Department prior to replacing thrust bearing(s) in vertical pump motors larger than 360 frame. We may wish to provide the replacement bearing(s).

WARRANTY REPORT FORMS

ALL WARRANTY CLAIMS MUST BE MAILED TO OUR ST. LOUIS LOCATION FOR TIMELY PROCESSING.

THE CORRECT MAILING ADDRESS IS:

NIDEC MOTOR CORPORATION
P.O. BOX 36916
ST. LOUIS, MO 63136
ATTN.: PRODUCT SERVICE

Warranty claims should consist of an invoice from your service station to **NIDEC MOTOR CORPORATION** and a warranty report complete with the information available on the motor nameplate and the results of your repair.

Please note the following items as they correspond to the shaded areas on the example warranty report on page 14:

1.) CUSTOMER NAME AND ADDRESS.
2.) COMPLETE UNIT ID NUMBER FROM NAMEPLATE ON MOTOR.
3.) REASON FOR FAILURE, WITH ANY ADDITIONAL DETAILS LOGGED IN AREA PROVIDED. (See inspection report requirements and special TITAN product data sheet available on our web site *usmotors.com)*
4.) TOTAL BILLING LISTING PARTS / LABOR CHARGES IN DETAIL. (LIST PARTS SEPARATE FROM LABOR CHARGES.)
5.) SERVICE STATION NAME AND ADDRESS.

IN THE EVENT OF MOTOR REPLACEMENT, THE NAMEPLATE MUST BE REMOVED FROM THE MOTOR AND RETURNED ALONG WITH YOUR INVOICE AND WARRANTY REPORT.

NOTE: ***Warranty invoices / claims for products with a date code indicating the date of failure was beyond the warranty period will be rejected, unless prior authorization is indicated by a log number from the Product Service Department.***

Failure to provide any of the above information will result in a delay in processing your invoice. If you have any questions, please contact the Product Service Department at **800-566-1418**. Warranty report forms may be obtained by visiting out web site, ***usmotors.com/servicestation.***

Nidec
All for dreams

WARRANTY REPAIR REPORT

No.

CUSTOMER						USEM No.	INVOICE No.
ADDRESS						MFG. PLANT	INVOICE DATE
CITY			STATE		ZIP	DATE PUT IN SERVICE	DATE OF FAILURE
TYPE	FRAME	HP	POLES	VOLTS	CYCLE	PHASE	MFG. OF DRIVEN MACHINE
MOTOR RPM	OUTPUT RPM	IDENTIFICATION/MODEL No./SERIAL No.					TYPE OF DRIVEN MACHINE

COMPLAINT:

NOTE: REPORT MUST BE SUBMITTED WITHIN 30 DAYS AFTER REPAIRS ARE COMPLETED

PROVIDE ADDITIONAL EXPLANATION AS REQUIRED IN REMARKS SECTION
O - CIRCLE ONE CONDITION RESPONSIBLE FOR FAILURE
P - CHECK OTHER CONDITIONS EXISTING

REMARKS AND/OR REPAIRS MADE INCLUDING APPLICATION INFORMATION (DUTY CYCLE, HOURS IN SERVICE, ETC.):

WINDING FAILURE

2010	HIGH AMPS	
2020	LOW AMPS	
2030	UNBALANCED AMPS	
2110	EXCESSIVE VARNISH	
2111	NO VARNISH	
2112	VARNISH NOT CURED	
2114	HIGH PHASE PAPER	
2100	DAMAGED LEADS	
2121	STRING TIES	
2140	DAMAGED WINDING	
2150	LEAD FAILURE	
2159	SHORTED	
2161	SHORTED PHASES - OCE	
2162	SHORTED PHASES - CE	
2165	COIL TO COIL	
2171	SHORTED TURNS - OCE	
2172	SHORTED TURNS - CE	
2180	INSULATION FAILURE	
2190	GROUNDED	
2191	SHORTED ONE PHASE	
2200	CELL WALL FAILURE	
2201	TOPSTICK FAILURE	
2202	FAILED IN SLOT	
2230	INTERNAL CONNECTION	
2231	FAULTY SLEEVING	
2232	INCORRECT RESISTANCE	
2240	LEAD MARKERS	
2241	LUGS	
2250	GROUNDED TO BRACKET	
2251	GROUNDED TO FRAME	
2252	GROUNDED TO AIR BAFFLE	
2260	CORE TURNED IN FRAME	
2280	OPEN WINDING	
2330	THERMAL PROTECTOR N.G.	
2400	WRONG TYPE WIRE	
2500	FOREIGN MATTER IN WINDING (DESCRIBE)	

BEARINGS

5010	NOISY	
5020	FAILED	
5060	GRIT OR METAL SHAVINGS	

GEARS

5210	KNOCKS	
5220	NOISY	
5230	FAILED	

SINGLE PHASE UNITS

7010	SWITCH	
7020	CAPACITOR	
7030	THERMAL PROTECTOR	

FAULTY PARTS

1020	FRAMES	
1030	FRAME CASE	
1040	GEARCASE	
1041	FAN GUARD	
1061	BRACKET FACE RUNOUT	
1062	BRACKET REGISTER CONCENTRICITY	
1063	BEARING BORE OVERSIZE	
1062	BEARING JOURNAL UNDERSIZE	
1063	BEARING JOURNAL OVERSIZE	
1070	REMOTE CONTROLS	
1122	HEATERS	
1123	THERMISTORS	
1124	THERMA SENTRY	
1126	BRAKE	
1140	ELECTRIC REMOTE SPEED INDICATOR	
1160	NON-REVERSE RATCHET	

ROTOR

1211	WRONG ROTOR
1220	OPEN BARS
1230	RUBS
1240	MISALIGNMENT
1250	LOOSE CORE
1260	LOOSE BALANCE WEIGHTS
1290	DAMAGED ROTOR

OTHER

PLEASE EXPLAIN IN DETAIL IN REMARKS SECTION

QUANTITY	PARTS USED PART No.	NET PRICE
	XXXX	$0.00
LABOR XXXX	HOURS @ XXXX	$0.00
FLAT RATE		
TRANSPORTATION IF ALLOWED - ATTACH RECEIPT		
TOTAL BILLING		$0.00

SERVICE STATION

FOR WARRANTY ADMINISTRATION USE ONLY

12		14	
13		15	

Nidec
–All for dreams

WARRANTY REPAIR REPORT

No.

CUSTOMER							USEM LOG NO.	INVOICE NO.
ADDRESS							MFG. PLANT	INVOICE DATE
CITY				STATE	ZIP		DATE PUT IN SERVICE	DATE OF FAILURE
TYPE	FRAME	HP	POLES	VOLTS	CYCLE	PHASE	MFG. OF DRIVEN MACHINE	
MOTOR RPM	OUTPUT RPM	IDENTIFICATION/MODEL No./SERIAL No.					TYPE OF DRIVEN MACHINE	

CUSTOMER CLAIM/WARRANTY REASON:

NOTE: REPORT MUST BE SUBMITTED WITHIN 30 DAYS AFTER REPAIRS ARE COMPLETED

PROVIDE ADDITIONAL EXPLANATION AS REQUIRED IN REMARKS SECTION

○ - **CIRCLE ONE CONDITION RESPONSIBLE FOR FAILURE**

✓ - **CHECK OTHER CONDITIONS EXISTING**

WINDING FAILURE

2010 HIGH AMPS
2020 LOW AMPS
2050 UNBALANCED AMPS
2100 DAMAGED LEADS
2110 EXCESSIVE VARNISH
2111 NO VARNISH
2112 VARNISH NOT CURED
2114 HIGH PHASE PAPER
2121 STRING TIES
2140 DAMAGED WINDING
2150 LEAD FAILURE
2159 SHORTED
2161 SHORTED PHASES - OCE
2162 SHORTED PHASES - CE
2165 COIL TO COIL
2171 SHORTED TURNS - OCE
2172 SHORTED TURNS - CE
2190 GROUNDED
2202 FAILED IN SLOT
2230 INTERNAL CONNECTION
2231 FAULTY SLEEVING
2232 INCORRECT RESISTANCE
2240 LEAD MARKERS
2241 LUGS
2250 GROUNDED TO BRACKET
2251 GROUNDED TO FRAME
2252 GROUNDED TO AIR BAFFLE
2260 CORE TURNED IN FRAME
2280 OPEN WINDING
2500 OBJECT IN WINDING (DESCRIBE)

ROTOR

1211 WRONG ROTOR
1220 OPEN BARS
1230 RUBS
1240 MISALIGNMENT
1241 INCORRECT SKEW
1250 LOOSE CORE
1260 LOOSE BALANCE WEIGHTS
1290 DAMAGED ROTOR
1300 NOT PROPERLY BALANCED
1310 EXCESSIVE VIBRATION

BEARINGS

1053 BEARING BORE OVERSIZE
1062 BEARING JOURNAL UNDERSIZE
1063 BEARING JOURNAL OVERSIZE
5010 NOISY
5020 FAILED
5060 GRIT OR METAL SHAVINGS

FAULTY PARTS

1020 FRAME
1041 FAN GUARD
1051 BRACKET FACE RUNOUT
1052 BRACKET REGISTER CONC.
1060 SHAFT
1122 HEATERS
1123 THERMOSTATS/THERMISTERS
1124 THERMASENTRY
1126 BRAKE
1150 NON-REVERSE RATCHET
1160 FAN

MISCELLANEOUS

3010 IMPROPER ASSEMBLY
3410 OIL LEAKS
4015 PAINT UNSATISFACTORY
4510 PACKAGING/DAMAGED UNIT

DC MOTORS

9610 FIELD OPEN
9611 FIELD SHORTED
9612 FIELD GROUNDED
9630 ARMATURE COMMUTATOR
9631 ARMATURE OPEN
9632 ARMATURE SHORTED
9633 ARMATURE GROUNDED
9634 ARMATURE BURNOUT

OTHER

PLEASE EXPLAIN IN DETAIL IN REMARKS SECTION

REMARKS AND/OR REPAIRS MADE INCLUDING APPLICATION INFORMATION (DUTY CYCLE, HOURS IN SERVICE, ETC.):

QUANTITY	PARTS USED PART No.	NET PRICE
LABOR _____ HOURS @ _____		
FLAT RATE		
TRANSPORTATION IF ALLOWED - ATTACH RECEIPT		
TOTAL BILLING		

SERVICE STATION

FOR WARRANTY ADMINISTRATION USE ONLY

12		14	
13		15	

AP-490 REV. 11/97

OK-133762 (K71287) Reynolds + Reynolds LITHO IN U.S.A.

INSPECTION REPORT REQUIREMENT

Purpose

The purpose of this requirement is to develop a comprehensive and systematic approach to collecting data from service stations performing warranty repairs on US MOTORS® brand products.

Scope

This requirement will standardize the reporting procedure for all service shops performing warranty repairs on U.S. MOTORS® brand products. Sufficient data will be provided in these reports so that when compiled, the data will give meaningful statistics to identify field problems. First hand analysis of failure can provide vital information to aid in refinements which produce a better, more trouble free product. We rely on Authorized Service Stations to provide this vital data from the field.

Repeat problems on the same or similar applications should be brought to the immediate attention of the Product Service Department in St. Louis. In these cases, the unit should remain intact until it is determined if failure analysis is required.

Repairs expected to cost in excess of $2000 must be brought to the attention of the Product Service Department. Prior authorization **(LOG NO.)** is required to proceed.

Application details on the Repair Report Form should be filled out. Of particular interest are part winding start, soft start, variable frequency drive, high inertia load, frequent starts, or any other special application considerations. The customer block should include both the name and address of the company, and the name and phone number of a contact who is familiar with details of application and the problem experienced with the unit. See the TITAN® Motor Failure Sheet (449 frame and larger) included in this manual.

Motor repairs can be generally categorized as winding, bearing, or other problems. Each of these categories will require specific data on the warranty repair report as indicated below.

Winding

1. The **type of winding failure** should be specified. These include, but are not limited to, phase-to-phase short, turn-to-turn short, coil-to-coil short, or grounded. Descriptions and/or photographs of the fault area will greatly aid in the collection of data.

2. The **location of the fault** should be given with as much detail as possible. If the fault is in the end turns, clock position is not particularly useful. More meaningful is the position relative to the terminal coil of a phase. If the fault is in the slot, how much damage was done to the stator iron? What is the condition of the coils from that slot in the end turn? If the fault is at the edge of the slot, what is the condition or position of the cell wall liner? In short, what does the mechanic observe that might have contributed to the winding failure?

3. Is there **evidence of abuse** such as **overloading or single phasing**? Are any contaminants such as water or dirt present in the winding?

Bearings

1. Does the bearing appear to have had sufficient lubrication?
2. Are any contaminants such as water or dirt present in the bearing?
3. Are there signs of spinning in the bore or on the shaft? If so, what are the dimensions of the bearing, bore, and shaft journal?
4. What was the customer's complaint about the bearing, and how was it confirmed that the bearing was bad?
5. On vertical motors, is the end play set properly? Does the bearing appear to have excessive thrust?
6. Is there evidence of circulating current (shaft current)?

If there are questions about these or other observations, consult the Product Service Department. Bearing failure analysis and lubricant analysis are available when appropriate.

Other

As complete a summary as is possible should be included in the report. Descriptions of cosmetic defects, missing or broken parts, improper assembly, oil leaks, or machining geometry defects should be detailed.

Vibration problems should include as complete an analysis as is available. The minimum data should be the amplitude of vibration on the application which was deemed to be a problem, the amplitude of vibration of the motor removed and completely isolated from the application, and the amplitude of the vibration in both of these conditions after the corrective action is taken.

In all cases, Digital Photographs of the problem area, would be appreciated

Conclusion

The Product Service Department is anxious to assist in providing to our customers the quality product they expect. Complete, accurate, and timely reporting of warranty repairs will significantly aid this effort.

UNIT IDENTIFICATION / DATE CODE INFORMATION

INTEGRAL HORSEPOWER DESIGNS

SAMPLE UNIT ID NUMBER: J1212345678-100R-1

[J12]	**[12345678-100]** or **[A123]**	**[R*]**
Date Code (3 Characters)	*Order Number (11 Characters) or Model Number (4 Characters)*	*Plant Code*

Date Code Abbreviations

Year Code			Month Code		
P	=	2009	01	=	January
R	=	2010	02	=	February
S	=	2011	03	=	March
T	=	2012	04	=	April
U	=	2013	05	=	May
V	=	2014	06	=	June
W	=	2015	07	=	July
X	=	2016	08	=	August
Y	=	2017	09	=	September
Z	=	2018	10	=	October
A	=	2019	11	=	November
B	=	2020	12	=	December
C	=	2021			
D	=	2022			
E	=	2023			
F	=	2024			
G	=	2025			
H	=	2026			
J	=	2027			
K	=	2028			
L	=	2029			
M	=	2030			
N	=	2031			

Plant Codes

* R = Mena, AR
M = Mont., MX
GT = Southaven Conversion

* Mena plant serializes units on orders with multiple quantities, i.e. R-1, R-2, etc.

UNIT IDENTIFICATION / DATE CODE INFORMATION

FRACTIONAL HORSEPOWER DESIGNS

MFG#: [A] [09] [C]

Month Year Plant Code

Date Code Abbreviations

Month Code

A	=	January
B	=	February
C	=	March
D	=	April
E	=	May
F	=	June
G	=	July
H	=	August
J	=	September
K	=	October
L	=	November
M	=	December

Year Code

10	=	2010
11	=	2011
12	=	2012
13	=	2013
14	=	2014
15	=	2015
16	=	2016
17	=	2017
18	=	2018
19	=	2019
20	=	2020
21	=	2021
22	=	2022
23	=	2023
24	=	2024
25	=	2025
26	=	2026
27	=	2027
28	=	2028
29	=	2029
30	=	2030
31	=	2031

Plant Codes

C	=	CMD, MX
KM	=	KMM, China

Product Service Department
Fax 314-595-8922

Department Phone
800.566.1418

=

Mailing Address:
NIDEC MOTOR CORPORATION
PO Box 36916
St. Louis MO 63136
Attn: Product Service

Shipping Address:
NIDEC MOTOR CORPORATION
8050 West Florissant Avenue
St. Louis MO 63136
Attn: Product Service

Frequently Asked Questions and Answers

Motor Inspection Procedure After Storage

Question: After storing my motor for an extended period of time, I am now ready to install it. Is there any specific inspection procedure that must be followed?

Answer: Yes. Following storage, an extensive inspection must be performed on a motor by one of our authorized service stations. This inspection must include the following elements:

1) Render an external inspection of the motor to assure the unit is clean, ventilation openings are free of obstructions, and no damage has occurred.

2) Perform a megger test of motor windings to insure satisfactory insulation resistance.

3) Rotate the shaft to check for roughness in bearings or interference between rotating and stationary parts.

4) Perform a bench test on the unit to check for excessive amp. draw, noise, or vibration.

5) Regrease the motor bearings (as applicable) in accordance with the unit's operating instruction folder.

6) The authorized service station must install a plate/tag indicating the date of inspection. Make any corrections which inspection shows to be needed.

Class "B" vs. Class "F" Insulation

Question: After requesting a motor equipped with class "F" insulation, I received a unit on which the insulation class is labeled "B." Was there a mix-up in my order?

Answer: No, there was not a mix-up. We build all of our motors with class "F" insulation or better. When the nameplate indicates class "B", this means the motor is designed to operate within class "B" temperature rise limits. These limits are 80 degrees centigrade at 1.0 service factor, and 90 degrees centigrade at 1.15 service factor. For many years, it has been our policy to nameplate open dripproof motors that meet this temperature rise criteria with the insulation class "B", regardless of the actual insulation type. This gives the end user the information that the motor has a 90 degrees centigrade, or less, temperature rise at 1.15 service factor.

Rewinding U.S MOTORS® Brand Inverter Duty Motors

Question: Is there a specific procedure which should be followed when rewinding US MOTORS® brand inverter duty motors? If so, could you please explain it.

Answer: Following are guidelines to use when rewinding US MOTORS® brand inverter duty motors:

1) Use inverter grade magnet wire. If not available, triple build wire may substitute.
2) Avoid loose windings - use slot fillers as required.
3) Insulate between phases, center of each coil group, both end turns and in slots.
4) Secure end turns - tie or band both winding ends.
5) Be especially careful to avoid damaging winding magnet wire.

6) Recommend two cycles of VPI treatment for all rewinds.

Space Heaters

Question: What is the importance of a space heater and what affect does it have on warranty?

Answer: Electric motors frequently have space heaters installed, at the customer's request, to prevent moisture condensation in the motor when it is not running. In applications where the possibility of condensation is not a factor, or where continuous operation of the motor prevents the formation of condensation, space heaters are not necessary.
Our warranty policy covers manufacturing defects, and allows for repair or replacement to remedy any situations which may arise within the warrantable period. The failure of a motor due to condensation does not fall into this category, and is, therefore, not considered for warranty coverage. If the project plans and specifications do not require space heaters, then the space heaters present in the unit may be left unconnected and the space heater warranty nameplate may be removed. However, as previously stated, motor failure due to condensation is not warrantable.

Trickle Voltage Heating

Question: Is it true that there are advantages to using trickle voltage heating rather than conventional space heaters? If so, what are these advantages?

Answer: Yes, trickle voltage heating has some distinct advantages, especially when applied in the field after the motor is built. Trickle voltage heating does not require removal and dismantling of the motor. In addition, it compares favorably in cost, provides improved heat distribution, and does not require additional wiring to the motor. Specifications for adding trickle voltage heating are available from the Product Service Department.

Reversing Direction of Rotation on TEFC Motors

Question: What is the procedure to follow when changing the direction of rotation on TEFC motors?

Answer: US MOTORS® brand TEFC motors are equipped with one of three types of external cooling fans:

1. **Propeller type** (most two pole and some smaller motors)
2. **Sirocco type** (most four pole motors)
3. **Radial type** (some two and four pole motors; all six pole and slower motors)

Radial type fans are bi-directional. However, **propeller** and **sirocco** types are uni-directional. Although changing the rotational direction of a motor equipped with a **propeller** type requires a different fan, the **sirocco** type can be reversed in the field by performing the following steps:

1) Remove the fan cover guard in order to gain access to the fan.
2) Remove the fan from the shaft. This may require heating the fan hub to expand it loose from the shaft.
3) Remove the "baffle plate" from the fan casting and mount it on the opposite side. This will require drilling and tapping new mounting holes (use the "baffle plate" as a template).
4) Re-balance the reworked fan assembly.
5) Install the fan back onto the shaft with the "baffle plate" toward the motor.
6) Reinstall the fan cover guard.
7) Remove any direction of rotation arrow(s), turn 180 degrees and reinstall.
8) Reverse the leads if required to obtain the desired direction of rotation.

NOTE: Be sure the power is off and steps are taken to prevent accidental restarting of the motor before attempting to do any of the above procedures.

Part-Winding Start of a 12 Lead Y-Δ Motor

Question: My motor has a connection plate which says Dual Voltage Wye Start, Delta Run with PWS on the Low Voltage. How should I hook it up?

Answer: This motor has very good versatility and may be used in several power supply applications. It is a dual voltage machine and may be used on either voltage as defined on the connection plate. It is designed for use on a Wye Start, Delta Run starter. This is a special motor contactor which starts the motor on its Wye connection to limit the inrush and then switches to Delta for running. **The motor must not be run on the Wye connection for more than 30 seconds as severe winding damage may occur.** This motor may also be started across the line and run on the Delta connection. In addition, the motor may be used on the low voltage connection as a part-winding start motor, also to limit the inrush required. After a brief period, it is switched to the full winding.

Identifying Leads of a Nine Lead Three Phase Motor

Question: I have lost track of the leads of a nine lead three phase motor. How can I re-identify these leads?

Answer: For the purpose of this test, a lantern battery of six or nine volts works best. Use a DC volt-ohm meter with a 20K ohms per volt DC scale. Battery and voltmeter leads should be properly identified. Alligator clips should be used on both. The motor must be completely assembled. Test the nine leads for continuity with the ohmmeter to determine whether the motor is star (wye) or delta connected. The delta connected motor will possess three sets of three leads with continuity between them. On the other hand, the star connected motor will have only one set of three leads with continuity between them, and three sets of two leads with continuity. Following are specific steps to take when identifying leads of both a star connected and a delta connected motor. Refer to the diagrams on the following page for further details.

Delta Connected Motor:

Using an ohmmeter, identify the three groups of three leads. Separate these groups by tying them with tape. Attach leads to a pair of wires in a group, and observe the voltage drop from each pair of energized leads to the third lead in that group. Continue until a combination is found that gives a voltage drop from each of the energized leads to the third lead equal to one half of the battery voltage. The lead located halfway between the other two will thus be the corner lead of the delta. Repeat this for each group of leads, marking the corner leads #1, #2, and #3.

Next, use the inductive kick test method to identify the proper markings for the other two leads of each group. The two coils #3 & #6 and 3 & #8, acting in parallel, will produce the effect of a coil positioned halfway between the actual position of the two coils. The flux produced by #3 & #6 and #3 & #8 combined, will be perpendicular to the axis of #1 & #4 and #2 & #7. Opening and closing a switch in this circuit will produce a kick in coils #1 & #9 and #2 & #5, but no kick in #1 & #4 and #2 & #7.

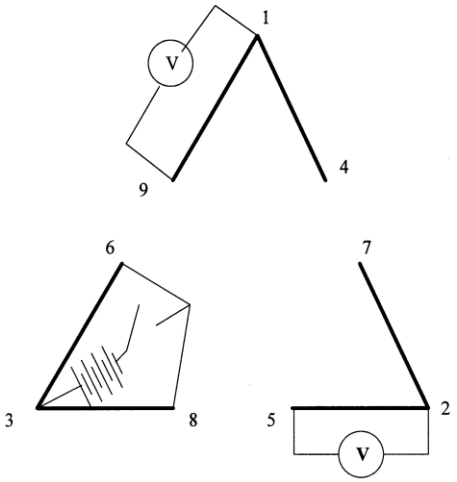
Therefore, if the battery is connected from #3 & #6 and #3 & #8 as shown, opening and closing the battery circuit, the voltmeter will identify leads #1, #4, and #9 and can be distinguished by noting the magnitude rather than the polarity. The voltmeter can then be connected to terminal #2 for determination of the leads #5 & #7. Leads #2 to #7 will give little or no deflection, and leads #2 to #5 will give a substantial deflection.

In succession, the battery is then transferred to the corner of #1. Tie the battery between leads #1 & #4 & #9. Making and breaking the circuit will be perpendicular to #3 & #8 and #2 & #5, resulting in no deflection. However, there will be a deflection from leads #2 & #7 and #3 & #6. Placing the battery next on the #2 & #5 and #2 & #7 leads will be perpendicular to #1 & #9 and #3 & #6 leads, therefore creating no deflection. Leads #1 & #4 and #3 & #8 would then have a deflection, thus concluding the lead testing of the nine lead delta connected motor.

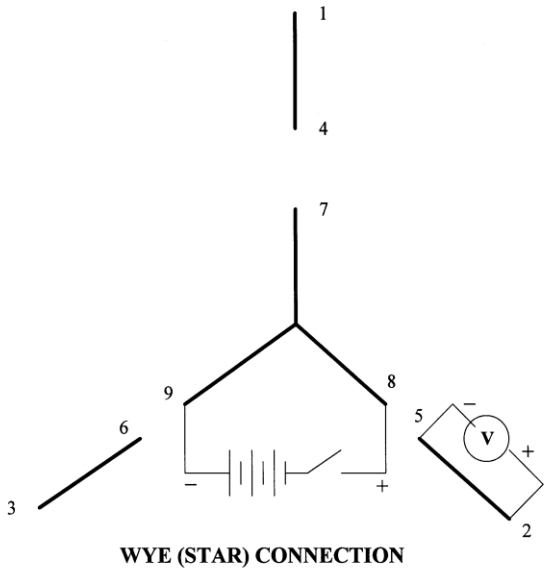
Star Connected Motor:

Mark the three leads with continuity, #7, #8, and #9. Clip the battery to the #8 & #9 pair, clipping onto one and flashing the other. Clip the voltmeter to each pair of leads with continuity between them, until a pair is found that produces little to no "kick" or deflection. This pair of leads consists of the #1 & #4 leads. Next, move the battery to the #7 & #8 combination, with the positive lead on the #7 lead and the negative lead to be used for flashing the #8 lead. The voltmeter is so placed on the #1 & #4 pair that an upscale deflection is observed on the "make" of the negative #8 lead. The voltmeter positive lead is then the #1 motor lead, and the negative voltmeter is the #4 motor lead.

Next, move the battery to #7 & #9 leads with the positive lead on the #9 motor lead, and the negative to flash the #7 lead. Identification of the #3 motor lead is then determined by an upscale kick. The positive voltmeter lead should be on this lead, and the negative lead should be on the #6 motor lead. Shift the battery to the #8 & #9 pair, with the positive battery lead on the #8 lead and the negative used for the flashing. An upscale kick will identify the #2 motor lead. The positive voltmeter lead will be found on the #2 lead, and the negative voltmeter lead will be the #5 lead. This concludes the lead testing of the nine lead star connected motor.



DELTA CONNECTION



WYE (STAR) CONNECTION

Adjusting End Play

Question: After disassembling and reassembling a motor, what is the proper method for adjusting the rotor end play?

Answer: Should a motor be disassembled for any reason, the rotor end play must be adjusted. Use one of the following procedures, depending upon the type of thrust bearing:

I. Spherical Roller Thrust Bearings and Angular Contact Bearings (With Springs)

On spherical roller or angular contact thrust bearings with springs, setting the correct end play for preload requires a controlled assembly method, due to various deflections internal to the motor and friction of locknut threads from spring force. An end play setting of .005 to .008 inches is required to allow the lower guide bearing to return to an unload position when external thrust is applied to the motor (see Figure 5). End play can be properly adjusted by the following recommended procedure:

A. Place spring retainer, without springs and lower thrust washer of bearing, into upper bracket bearing bore.

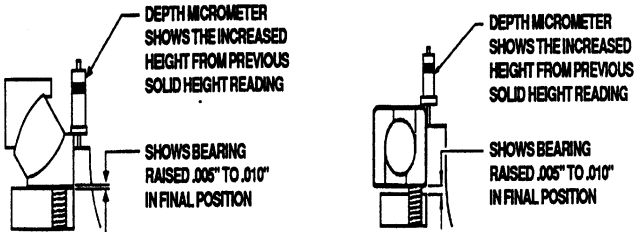
B. Using a depth micrometer, measure the distance between the top of the lower thrust washer and the faced surface on top of the bearing housing. Record this dimension to three decimal places.

C. Add .005 and .008 inches to the recorded dimension to obtain the correct minimum and maximum settings range for the unit.

D. Reassemble bearing with springs; motor is now ready to set end play.

NOTE: Certain motor builds require removal of the fabricated steel or cast aluminum oil baffle to provide access for depth micrometer measurements.

FIGURE 5



Motors built with spherical roller thrust or angular contact bearings with springs require a minimum external thrust load, sufficient to compress upper die springs and unload lower guide bearing from axial spring thrust. Refer to the motor's spring thrust plate for required minimum thrust.

NOTE: Do not run motor without load for more than fifteen minutes, as lower bearing damage may occur and improper seating of thrust bearing may cause vibration.

2. Angular Contact Ball Bearings (Without Springs)

A. No preliminary measurements are required to set end play. End play may be set by any of the following methods described in this section.

B. To correctly adjust the rotor end play setting on units with angular contact ball bearings, a dial indicator should be positioned to read the shaft axial movement. (See figure 7 for location of dial indicator.) The rotor adjusting locknut should be turned until no further upward movement of the shaft is indicated. The locknut is then loosened until .005 to .008 end play is obtained, lock the locknut with the lockwasher.

C. Motors that have two opposed angular contact bearings, locked on the mount for up and down thrust, do not require rotor end play adjustment. The shaft, however, must be set to original "AH" (shaft extension) to prevent the guide bearing in the lower bracket from taking external thrust.

End Play Adjustment Methods

Method 1 *(refer to Figures 6 & 7)*
This method requires the user to install a bolted chain from the bearing mount back to a lifting lug, and rotate the locknut with a spanner wrench and 8 foot long bar until the dial indicator shows no movement on the end of the shaft. The locknut should then be loosened until .005 to .008 end play is obtained. Lock the locknut with the lockwasher. (See figure 7 for location of dial indicator.)

NOTE: This is the lowest cost of the three methods and requires the least amount of equipment. This method, however, may be less desirable than Method 2, as considerable locknut torque may be encountered on units with die springs.

Special equipment required includes:
* Locking bolts
* 3/4" chain
* Spanner wrench with extension
* Dial indicator
* Depth micrometer

FIGURE 6 (METHOD 1)

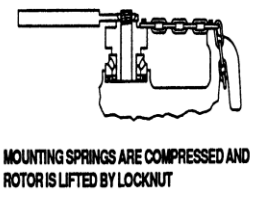
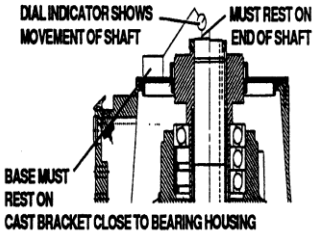


FIGURE 7 (METHOD 1 & 3)

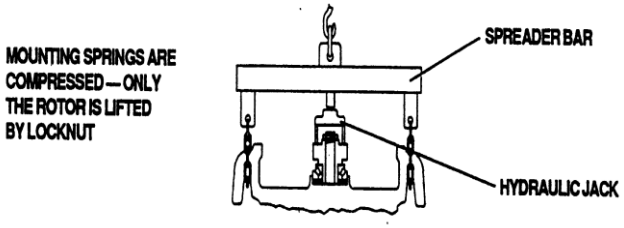


Method 2 *(refer to Figure 8 - Utilized on Spring Loaded Bearings Only)*
This method utilizes a spreader bar and chains to wrap around lifting lugs, a hydraulic jack (five ton), and a crane to lift the spreader bar. The hydraulic jack is supported by two steel blocks of equal thickness on top of the bearing mounting, with the jack pushing against the spreader bar. On very heavy solid shaft rotors, the rotor can be lifted by placing a second jack below the motor to allow the locknut to be turned easily. After correct range (recorded earlier) is obtained, lock the locknut with the lock washer.

NOTE: This method utilizes usual shop equipment and tools. End play settings can be checked quickly on larger vertical motor products. The locknut lifts rotor weight only.

Special equipment required includes:
* Large spreader bar with chains and locking bolts
* Overhead crane
* Spanner wrench
* Hydraulic jack (five ton)
* Depth micrometer
* Metal blocks
* Dial indicator

FIGURE 8 (METHOD 2)



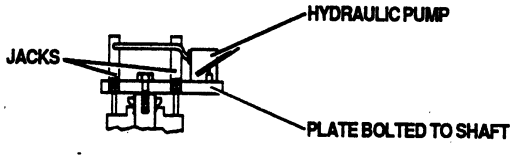
Method 3 *(refer to Figure 9)*
This method uses a one inch thick steel disc, with center hole for shaft end bolt, and two threaded hydraulic jacks connected to a single pump. Apply load to the hydraulic jack until the dial indicator shows no movement on the end of the shaft. (See figure 7 for location of dial indicator.) Pressure from the hydraulic jack should be relieved until .005 to .008 end play is obtained. Lock the locknut with the lock washer.

CAUTION - Excessive hydraulic pressure should not be used when setting end play, or bearing damage may occur.

NOTE: This method is directly usable on solid shaft motors, and can be utilized on some HOLLOSHAFT motors with the use of a long threaded rod and plate. It is very easy to apply and settings can be checked quickly, especially in field service. The locknut does not see rotor weight or spring force and can be turned easily.

Special equipment required includes:
* Fixture with hydraulic jacks (five ton)
* Dial indicator or depth micrometer
* Spanner wrench

FIGURE 9 (METHOD 3)



MOUNTING SPRINGS ARE COMPRESSED AND ROTOR IS LIFTED BY FIXTURE - LOCKNUT IS MERELY TURNED FOR ADJUSTMENT

CAUTION: ***After setting end play by any of the above methods, run unit for fifteen minutes and recheck end play setting. If not within range, end play must be reset. All loosened or removed parts must be reassembled and tightened to original specifications. Keep all tools, chains, equipment, etc. clear of unit before energizing motor.***

3. NEMA Frame Verticals with Thrust Bearing in Lower Housing

End-play setting on NEMA frame vertical motors with the thrust bearing at the lower end of the motor is accomplished by the use of shims on the outboard side of the upper guide bearing. The endplay should be determined before disassembly by using a dial indicator on the end of the shaft. After repairs are completed, the motor should be reassembled and with the original shims. The end play should be checked to insure the original setting remains. If unable to determine original endplay due to damage or other reasons, contact Product Service for values.

Oil Foaming

Question: What causes the lubricating oil in my vertical motor to foam?

Answer: Oil foaming is generally caused from moisture contamination, cleaning solvents etc. that get into the oil. The contaminants tend to discolor the oil giving it a milky appearance and the bubbles will dissipate very slowly after the motor has stopped.

The primary method of correcting foaming is to have the oil reservoir and associated parts thoroughly steam cleaned and baked dry. The main emphasis is to make sure all contaminates have been removed and the reservoir is completely free of moisture. If the issue still persists, anti-foaming agents are available as an additive to stop the foaming

Rewind Data

Question: Whom should I contact in order to obtain rewind data for a particular motor?

Answer: If you are one of our authorized service shops, you can obtain rewind data by contacting our Southaven distribution center at 662-342-7373**.** -However, if you are not an authorized service shop, you must contact a part stocking distributor in order to obtain this information. A complete part stocking distributor list is included in this manual.

Across the line connection of multi-lead motors

Question: Is it possible to connect a multi-lead motor across the line? If so, what is the procedure for doing this?

Answer: Yes, this is possible. In order to connect a multi-lead motor across the line, you must use the "RUN" connection for the appropriate voltage on the connection plate. For example, the diagram below shows the "RUN" connection as Full Winding connection. Motor leads T1 & T7 are combined and connected to line 1. Leads T2 & T8 are combined and connected to line 2. Leads T3 & T9 are combined and connected to line 3. Refer to the following diagram and table for further information.

Double Delta Connection

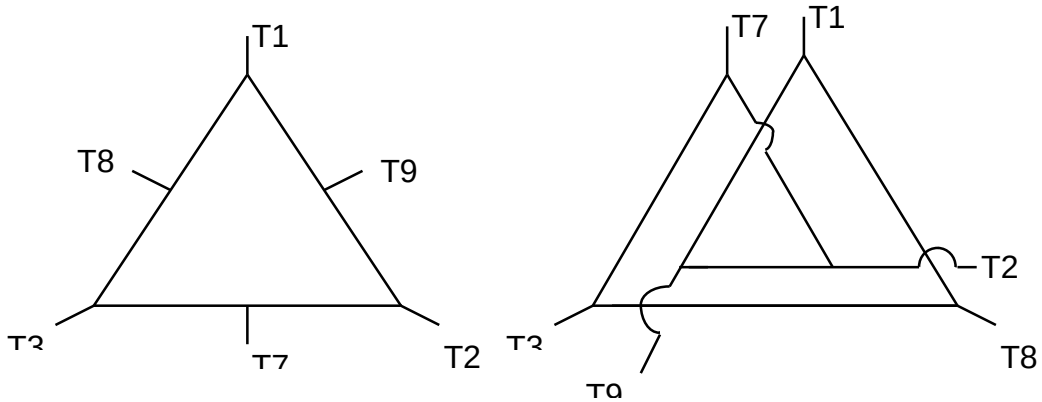


Table 4

Voltage	L1	L2	L3	OPEN
Full Winding	**(T1, T7)**	**(T2, T8)**	**(T3, T9)**	**---------**
Part Winding	**T1**	**T2**	**T3**	**(T7) (T8) (T9)**

Note: To reverse the direction of rotation, interchange connections L1 and L2.
Each lead may have one or more cables comprising that lead.
In such case, each cable will be marked with the appropriate lead number.

Bearing Types

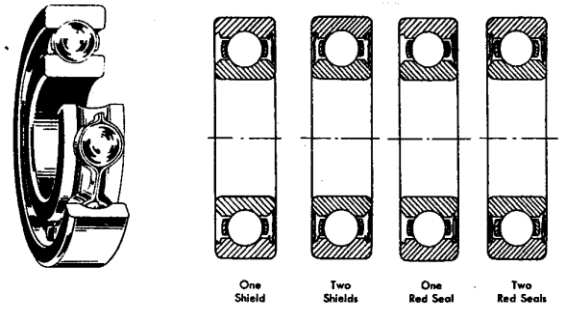
Question: What types of bearings are most frequently used on U.S. MOTORS® brand products?

Answer: We most frequently use **anti-friction / rolling element bearings**. These bearings are characterized by rolling elements which separate the stationary part from the rotating part. Specific types of these bearings include:

- Deep Groove (Conrad) Ball Bearings
- CARB Toroidal Roller Bearing
- Double Row Angular Ball Bearings
- Cylindrical Roller Bearings
- Spherical Roller Radial Bearings
- Angular Contact Ball Bearings
- Spherical Roller Thrust Bearings

Following is a brief description of each bearing type listed:

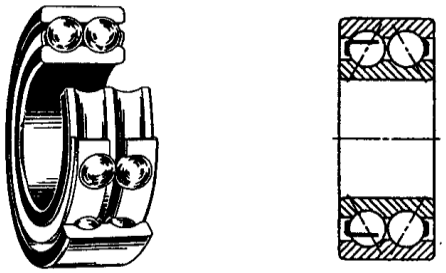
Deep Groove (Conrad) Ball Bearings



Typical bearing manufacturing series numbers used range from **6200** to **6400**.

Deep groove ball bearings are available in open type bearings, shielded bearings (single or double), and sealed bearings. Open type conrad bearings, which are supplied on explosion proof 180 frames and higher and ODP/TEFC 400 frames and higher, require bearing caps to contain grease in the housing. Shielded bearings, supplied on all 140 frames (ODP/TEFC through 360 frame and on all automotive duty), can be used on motors without bearing caps. Sealed bearings, which are "lubed for life", possess a reduced speed limit due to seal friction. These sealed bearings are supplied for customer specials only.

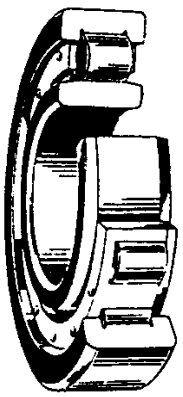
Double Row Angular Ball Bearings



Deep groove ball bearings are the most common type of bearing for electrical motor use. These bearings are good for moderate radial and axial loads. They are used in vertical high thrust motors as a guide bearing for momentary upthrust.

Typical bearing manufacturing series numbers used range from **5200** to **5400**.
Double row angular ball bearings are very similar to single row conrad bearings, with the addition of an extra row of balls. Because of this addition, these double row bearings can handle larger radial and axial loads than conrad bearings. Double row angular ball bearings, available open, shielded, or sealed, are provided on both horizontal and vertical close-coupled pumps, and on larger normal thrust motors as thrust bearings. Sizes larger than 5316 are not readily available.

Cylindrical Roller Bearings

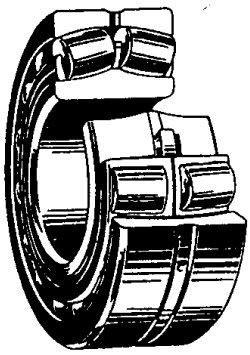


Typical bearing manufacturing series numbers used are preceded by an "N". For example: N2XX or NU2XX.

Cylindrical roller bearings are used on horizontal motors where high radial loads are present. Although equivalent in size to conrad ball bearings, cylindrical bearings have a lower speed limit and are only available as open type bearings. These bearings are not available for

direct connected motors, and are provided upon special order only on motors with an overhung load.

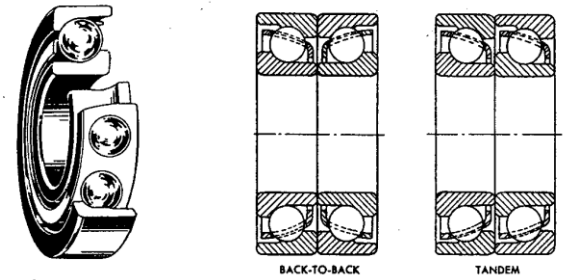
Spherical Roller Radial Bearings



Typical bearing manufacturing series numbers used range from **22,000** to **24,500**.

Spherical roller radial bearings are used on horizontal motors which possess an extremely high radial load, or on motors which require an extended bearing life. Typically, these bearings are wider than conrad ball bearings, thus making special engineering more difficult. In addition, they have a lower speed limit than cylindrical roller bearings. Spherical roller radial bearings can not withstand axial loading.

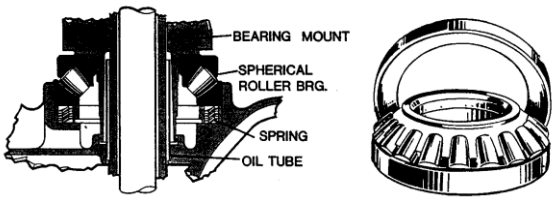
Angular Contact Ball Bearings



Typical bearing manufacturing series numbers used range from **7200** to **7400.**

Angular contact ball bearings are supplied on vertical motors only. High thrust vertical motors using single angular contact bearings are capable of continuous thrust in only one direction. Multiple angular contact ball bearings can be mounted either back-to-back for up/down thrust, or in tandem sets of two or more bearings for extra high thrust loading.

Spherical Roller Thrust Bearings



Typical bearing manufacturing series numbers used range from **29,300** to **29,400**.

Spherical roller thrust bearings are supplied on vertical motors only. These bearings can support extremely high thrust loads (up to 300% of standard thrust capacity) and moderate radial loads. Preload springs are required to supply minimum downthrust to bearings at start up in order to prevent bearing skidding. In addition, the motor requires minimum downthrust at all times to compress preload springs and unload the lower guide bearing for maximum life. Water cooling is generally required.

Lubrication Instructions

Question: How can motors in service be re-lubricated?

Answer Units are pre-lubricated at the factory and do not require initial lubrication. Re-lubricating interval depends upon speed, type of bearing and service. Refer to table in the Operating and Instruction Manual provided with motor for suggested re-greasing intervals and recommended greases. Operating conditions may dictate more frequent lubrication. Motor must be at rest and electrical controls should be locked open to prevent energizing while motor is being serviced (refer to section on Safety). If motor is being taken out of storage, refer to storage procedures.

To re-lubricate bearings, remove the drain plug. Inspect grease drain and remove any blockage with a mechanical probe taking care not to damage bearing. *Under no circumstances should a mechanical probe be used while the motor is in operation.* Add new grease at the grease inlet. New grease must be compatible with grease already in the motor (refer to Table 1 in Operating & Maintenance Manual for replenishment quantities). Run the motor for 15 to 30 minutes with the drain plug removed to allow purging of any excess grease. Shut off unit and replace the drain plug. Return motor to service.

CAUTION

Over greasing can cause excessive bearing temperatures, premature lubricant breakdown and bearing failure. Care should be exercised against over greasing.

CAUTION

Greases of different bases (lithium, polyurea, clay, etc.) may not be compatible when mixed. Mixing such greases can result in reduced lubricant life and premature bearing failure. Prevent such intermixing by disassembling the motor, removing all old grease from bearings and housings (including all grease fill and drain holes). Inspect and replace damaged bearings. Fill bearing housings and bearing approximately 30% full of new grease. Remove any excess grease extending beyond the edges of the bearing races and retainers. Refer to Table 2 in Operating & Maintenance Manual for recommended greases.

Bearing Temperature by RTD

Question: The bearings on my unit are too hot to touch, and I am worried there may be a problem. What is a normal/safe bearing temperature?

Answer: It is not abnormal for bearings to be "too hot to touch." Following is a list of standard temperatures for both mineral-oil-lubricated and synthetic-oil-lubricated bearings.

Mineral-oil-lubricated bearings:
run temperature: 80° centigrade
alarm temperature: 90° centigrade
shutdown temperature: 100° centigrade

Synthetic-oil-lubricated bearings:
run temperature: 110° centigrade
alarm temperature: 120° centigrade
shutdown temperature: 130° centigrade

These temperatures apply to grease-lubricated as well as oil-lubricated bearings. In addition, new bearings often require a break-in period of up to 100 hours. During this time, temperatures and noise levels can be slightly elevated. However, these levels should decrease somewhat after this break-in period.

Insulated Bearings

Question: What is the purpose of bearing insulation?

Answer: Bearing insulation is required to prevent circulating rotor currents which can damage bearings. Our practice is to insulate the non-drive end shaft bearing journal with a ceramic (aluminum oxide) or Belzona #1111 coating. Insulated sleeve bearings are purchased with the outer diameter insulated by the bearing manufacturer. Insulated bearings are provided as standard on the following TITAN® products:

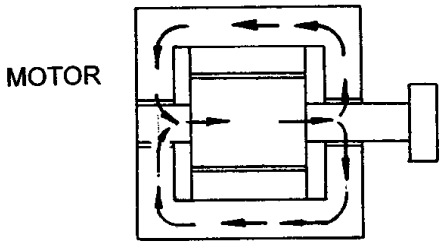
- All 6-pole motors
- Vertical motors 5800 frame and larger
- Horizontal motors 6800 frame and larger
- Motors for inverter duty applications
- Sleeve bearing motors

Any product by customer request - TITAN® or NEMA size (at additional cost to customer).

Insulated Bearing Location

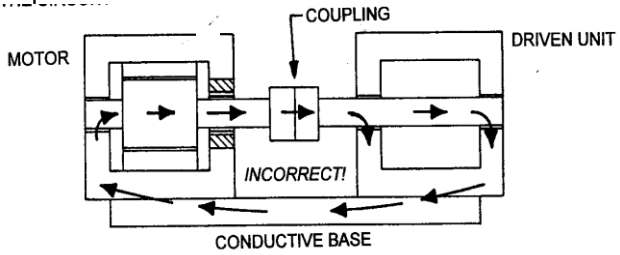
Question: Is it necessary to insulate both the drive end and the non-drive end bearings in order to eliminate circulating currents?

Answer: In the diagram below, arrows represent the direction of current flow through the rotor and motor frame. Insulating either bearing is sufficient for elimination of circulating currents, so long as the motor is not attached to driven equipment.

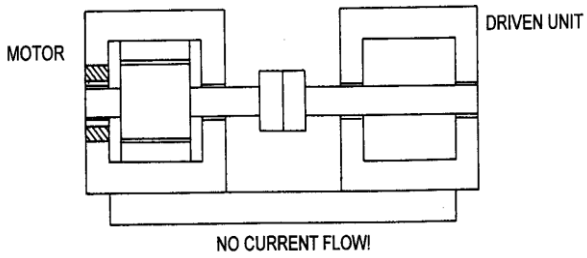


If only the drive end bearing is insulated and the motor is connected to driven equipment via a conductive base and coupling, circulating currents can still cause bearing damage by

including the driven equipment in the circuit. An insulated base or coupling would also be required to break the circuit.



Common practice is to insulate only the non-drive end bearing. This is sufficient to eliminate any current flow.



Bearing Insulation Instructions

Question: Is there a specific procedure to follow when insulating bearings? If so, what is this procedure?

Answer: Following are some guidelines to follow when insulating bearings. Apply sufficient alumina oxide coating to allow for finished grinding to original bearing journal dimensions with a 63 RMS, or better, surface finish. A phenolic sealer must be applied after the initial machining, but before the finish grind.

Suggested insulation materials:

* Alumina oxide (Metaceram® 25010 or equivalent) - P/N 936521.
* Bonding material (Metaceram® 21021 or equivalent) - P/N 936520
+ Sealer (Metcoseal® AP from "Metco") - P/N 936557.

OR

BELZONA® 1111 (Super Metal)

Vendors:

***for Metaceram® materials**:

Eutectic Castolin TD
3000 Torch Downers Grove, IL
(800) 323-4845

+for Metcoseal® sealer:

Metco Seal (800) 826-3826

For Belzona:

BELZONA , INC.
2088 N.W. COURT
MIAMI, FL 33172
WWW.BELZONA.COM

Spring Loaded Thrust Bearings

Question: Why are there minimum external down thrust requirements for motors built with spring loaded thrust bearings? What are these requirements?

Answer: Motors equipped with a spring loaded thrust bearing require a minimum external thrust load, sufficient to compress upper die springs and unload the lower guide bearing from the axial spring thrust. Refer to Table 5 for required minimum thrust values corresponding to bearing part numbers.

Table 5: Minimum Continuous External Down Thrust

Manufacturer's Basic Bearing Number	*Minimum Continuous External Downthrust*
7226BCB	2000 LBS.
7322 BEAMCB - QTY 2	4000 LBS.
29328 EJ	4000 LBS.
29330 EJ	6500 LBS.
29334 EJ	6000 LBS.
29338 EJ	8000 LBS.
29344 EJ	8000 LBS.
29422 EJ	4000 LBS.
29426 EJ	3800 LBS.
29428 EJ	4500 LBS.
29430 EJ	4500 LBS.
29438 EJ	12500 LBS.

NOTE: Do not run motor with no load for more than fifteen minutes, as lower bearing damage may occur and improper seating of the thrust bearing may cause vibration.

Accessory Leads

Question: What types of accessory leads can be found on U.S. MOTORS® brand products?

Answer: Accessory leads used include space heaters, bearing detectors, and winding detectors. Refer to the next question for brief descriptions of some of these.

Winding Temperature Detectors

Question: What types of winding temperature detectors are utilized on U.S. MOTORS® brand products?

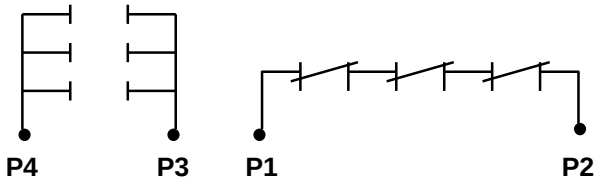
Answer: Specific types of winding temperature detectors include thermostats, RTD's, thermistors, and thermocouples. Following is a brief description of each.

Winding Thermostats

Winding thermostats are snap action, bi-metallic, temperature actuated switches. Their purpose is to activate a warning device, or simply shut down the motor upon excessive winding temperatures, when wired into the motor control circuit.

Thermostats are made either with contacts that are normally closed (open at high temperatures) or contacts that are normally open (closed at high temperatures). The thermostat temperature switch point is pre-calibrated by the manufacturer and is not adjustable. Reset is automatic after a decrease in temperature. Thermostats are normally installed in the connection end turns of the motor winding. Standard procedure is to wire three thermostats together in a set, with one thermostat embedded in each phase of the winding. Open thermostats are normally wired in parallel, while closed thermostats are wired in series. Refer to the figure below for further explanation.

Thermostat Connections



As seen in the figure above, only two leads come out to the motor outlet box. The leads of a normally closed (N.C. thermostat) are marked **P1** and **P2**. Those of a normally open thermostat are marked **P3** and **P4**.

Refer to the table below (Table 6) for thermostat alarm and shutdown temperatures.

Table 6: Thermostat Temperature Chart

Temperatures shown in °C

Service Factor		***1.00***						***1.15 and up***					
Purpose		***Alarm***			***Shutdown***			***Alarm***			***Shutdown***		
Temp. Rise Class		***A***	***B***	***F***	***A***	***B***	***F***	***A***	***B***	***F***	***A***	***B***	***F***
Open Motors Without Ducts:	***N.O.***	95	118	140	106	132	150	106	132	150	118	140	160
	N.C.	100	120	140	110	130	150	110	130	150	120	140	160
	N.C. (R&T)	100	120	140	110	130	150	110	130	150	120	140	160
Open Motors With Ducts & TEFC Motors:	***N.O.***	106	132	150	118	140	160	118	140	150	132	150	160
	N.C.	110	130	150	120	140	160	120	140	150	130	150	160
	N.C. (R&T)	110	130	150	120	140	160	120	140	150	130	150	160

Winding RTD's

RTD's (Resistance Temperature Detectors) are precision, wire-wound resistors, with a known temperature resistance characteristic. We use flat, molded strip type RTD's that are only .030 inch thick. RTD's are installed in the slot portion of form wound motors, and in either the slot or end turns of mush wound motors.

RTD's used in motor windings are either 10 ohm, 100 ohm, or 120 ohm. Each type of RTD has its own specific resistance characteristic. The basic detectors are listed below in Table 7.

Table 7: Winding RTD's

OHMS	*ELEMENT*	*# LEADS*
10 Ohms at 25°C	Copper Wire	3
100 Ohms at 0°C	Platinum Wire	3
120 Ohms at 0°C	Nickel Wire	2*

* Also available with 3 leads.

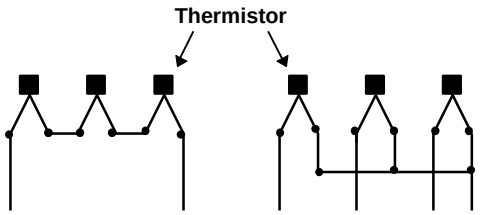
All the RTD leads are brought out to a motor outlet box. RTD's leads are identified in sets, using **C1**, **T1**, **T1**, and **C11**, **T11**, **T11** for the same phase. Since leads are always brought to terminal strips, the leads are terminated with fork-tongue terminals.

See page 32 for alarm and trip temperatures based on the motor service factor, HP rating, and class of temperature rise.

Winding Thermistors

A thermistor is a non-linear resistance temperature detector, made from semi-conducting material. We utilize positive temperature coefficient (PTC) type thermistors, which have a resistance that increases with increasing temperature. Each individual thermistor has its own unique resistance vs. temperature characteristic. Thermistors are normally installed in the end turns of the motor. Depending upon the controller, they are wired either in series or in a 'common lead circuit'. Both circuits are shown below.

Thermistor Connections



Series Circuit **Common Lead Circuit**

The following is a brief description of the controllers and thermistors supplied by various companies:

Power Control Corporation (PCC): In the past, we supplied PCC 600, 900, 8000, and 9000 series thermistors. We now use only the 8000 series thermistors. A maximum of three PCC 8000 series thermistors are installed in the common lead circuit configuration. Do not install them in series, or false tripping will result. PCC makes numerous controllers, including a special controller for the therma-sentry system. The PCC controller brand name is 'MOTOGUARD'. For non-therma-sentry PCC thermistors, the thermistors are internally wired in the common lead configurations with the leads marked **TM5**, **TM6**, **TM7**, and **TM8**. Lead **TM5** is the common lead.

Texas Instrument (TI): TI currently uses 4BA and 7BA series, PTC thermistors. The 4BA series thermistors are normally used on new and rewound motors and contain a copper heat collector for a fast response time. The 7BA series is normally used on existing motors, and contains only a small thermistor bead to ease installation. TI thermistors are wired in series. Three thermistors may be installed in series without false tripping the controller. Our procedure is to bring out all six leads and make the series connection in the outlet box. The thermistor lead pairs are marked **TM1**, **TM2**, and **TM3**. The standard TI controller is a 50AA control module. These TI products are no longer utilized.

Siemens: We presently use a Siemens Q63100-P, PTC thermistor. Siemens thermistors must be wired in series. Six thermistors may be wired in series without false tripping the controller. Our standard procedure

is to install three thermistors in series and bring all six leads out, making the series connection in the outlet box. The thermistor lead pairs are marked **TM1**, **TM2**, and **TM3**. The Siemens standard controller is a 3UN tripping unit control module, which has an N.O. and an N.C. contact. The following table (Table 8) shows alarm and shutdown temperatures (in °C) for 1.0 and 1.15 SF thermistors, based on the required class of temperature rise.

The new Thermasentry® system utilizes Siemens B59100M thermistors connected in series and a Siemens 3RN1010 controller.

Table 8: Thermistor Temperature Setting Chart

Temperatures shown in °C

Service Factor	*1.0*						*1.15 - UP*					
Purpose	*ALARM*			*SHUTDOWN*			*ALARM*			*SHUTDOWN*		
Class of Temp. Rise	*A*	*B*	*F*	*A*	*B*	*F*	*A*	*B*	*F*	*A*	*B*	*F*
Open Motors w/o Ducts												
PCC, PTC 8000	105	115	145	115	125	155	105	125	155	115	135	165
TI, 4BA Series	105	115	145	115	125	155	105	125	155	115	135	165
TI, 7BA Series	105	115	145	115	125	155	105	125	155	115	135	165
Siemens	100	120	140	110	130	155	110	130	155	120	140	160
Open w/Ducts and TEFC Motors												
PCC, PTC 8000	105	125	155	115	135	165	115	135	155	125	145	165
TI, 4BA Series	105	125	155	115	135	165	115	135	155	125	145	165
TI, 7BA Series	105	125	155	115	135	165	115	135	155	125	145	165
Siemens	110	130	150	120	140	160	120	140	155	130	150	160

Thermocouples

A thermocouple is a pair of dissimilar conductors joined at one point, in a way that causes an electromotive force (EMF) to develop due to the thermoelectric effects. Any given set of thermocouple wires has a known EMF vs. temperature characteristic. Thermocouples are only able to generate a low-voltage, low-power signal in the millivolt range. There are many types of thermocouples. Our standard types include copper-constantan, chromel-constantan, and iron-constantan. Thermocouples are normally installed in the slot between coil sides, on both mush wound and form wound motors. However, if necessary, they can also be installed in the end turns. The standard quantity of thermocouples is six, installed two per phase. If quantity-3 thermocouples are specified, leads are marked **TC1**, **TC2**, and **TC3**. If quantity-6 are specified, leads are marked **TC1**, **TC2**, **TC3**, and **TC11**, **TC22**, **TC33**, such that **TC1** and **TC11**, etc. are in the same phase.

See Table 8 (above) for alarm and trip temperatures based on the motor service factor, HP rating, and class of temperature rise.

Alarm and Trip Temperature Settings

Question: What do you recommend as alarm and shut-down temperature settings for winding RTD's?

Answer: The following tables (Tables 1 and 2) show alarm and shut-down temperatures based on the motor service factor, HP rating, and class of temperature rise. These temperatures apply to both ***winding RTD's*** and ***thermocouples***. See pages 32 and 34 for alarm/shut-down temperatures of thermostats and thermistors.

Table 1: Monitors With Alarm and Shutdown

TEMPERATURE IN °C						
Insulation Rating	CLASS A		CLASS B		CLASS F	
	Alarm	Trip	Alarm	Trip	Alarm	Trip
1.0SF≤1500HP	110	120	130	140	155	165
1.0SF>1500HP	105	115	125	135	150	160
1.15SF≤1500HP	120	130	140	150	160	165
1.15SF>1500HP	115	125	135	145	160	165

Table 2: Monitors With Shutdown Only

INSULATION RATING	TEMPERATURE IN °C		
	CLASS A	CLASS B	CLASS F
1.0SF≤1500HP	110	130	155
1.0SF>1500HP	105	125	150
1.15SF≤1500HP	120	140	160
1.15SF>1500HP	115	135	160

Temperature Rise

Question: How does the motor insulation system class relate to the winding temperature rise?

Answer: According to NEMA MG1 12.15-16, the winding temperature rise above the temperature of the cooling medium (ambient temperature), shall not exceed the values given in the following table (Table 3). See also "Class 'B' vs. Class 'F' Insulation" on page 19 of this manual.

Table 3: Average Winding Temperature Rise

(Based on maximum ambient temperature of 40°C; Temperatures given in Degrees C)

Insulation Class	A	B	F	H
Motors with 1.0 service factor other than those listed below	60	80	105	125
All motors with 1.15 or higher service factor	70	90	115	-----
Totally-enclosed non-ventilated motors with 1.0 service factor	65	85	110	130
Motors with encapsulated windings and with 1.0 service factor, all enclosures	65	85	110	-----

Motor Frame Surface Temperatures

Question: What is considered an average motor frame surface temperature?

Answer: Table 3 (above) gives average winding temperature rises for various motors. Frame surface temperatures are typically 15 - 20 degrees centigrade less than the average winding temperature, depending on the size and type of motor along with standard manufacturing variation. For example, a motor designated class F with a 1.15 service factor has an allowable average winding temperature rise of 115 degrees centigrade. This motor has a total temperature of 155 degrees centigrade with the inclusion of the 40 degrees centigrade maximum allowable ambient temperature. Therefore, this motor frame surface temperature could reach 135 - 140 degrees centigrade, as affected by ambient and load conditions.

Technical Service / Start-Up Service

Question: What are your technical service / start-up service rates?

Answer: Refer to the following table (Table 9) for specific rates and conditions. Following are various stipulations pertaining to these rates.

1) Purchase of technical service / start-up service at the rates listed below entitles the customer to the services of a start-up engineer to:

   A) Visually inspect all equipment furnished on the covered purchase order to assure all such equipment is in proper condition to start and operate.

   B) Monitor the performance of the equipment to assure all U.S. MOTORS® brand equipment is operating within specs and is free from electrical and mechanical defects.

   C) Provide training on proper maintenance, lubrication, and operation of US MOTORS® brand equipment.

2) The customer is to provide two (2) weeks notice when requesting start-up. In the event that the start-up cannot be completed due to any equipment not being ready for start-up, the customer will be charged for the entire trip, and additional authorization or a new purchase order will be required if subsequent trips are necessary.

3) In the event that technical service/start-up service cannot be completed due to warranty problems with U.S. MOTORS® brand equipment, the customer will not be charged for the time required to make corrections to such equipment. Should additional trips be required due to such warranty problems, the additional trips will be at our expense.

4) As a result of this purchase of technical service/start-up service, we assume no responsibility for work performed or equipment furnished by others, and extends no additional warranty

Table 9: Technical Service / Start-Up Service

The price basis for outside field service by technical service personnel is time and material plus travel expense. Listed below are the prevailing rates and conditions that establish this price basis.

POLICY	RATE	CONDITIONS
Hourly service rate	$1,280.00 per day	Up to 8 hours in any one normal work day between the hours of 7 A.M. and 6 P.M., Monday - Friday; includes incidental living expenses - except overnight.
Premium service rate	$240.00 per hour	Overtime (excess of 8 hours/day) and work between 6 P.M. and 7 A.M. - up to 6 P.M. Saturday.
	$320.00 per hour	Sundays, holidays, and after 6 P.M. Saturday.
Overnight rate	$240.00 per night	Cover expenses associated with remaining in job-site area overnight - except travel.
Travel via company or personal vehicle	$.47 auto/pickup charge per mile	Does not include travel time or overnight expense.
Travel via public transportation	At cost+10%	Includes air, railway, charter, car rentals, buses and taxis for personnel and equipment. Does not cover travel time.
Time en route	$66.00 per hour	Total time en route from point of origin to job-site and return. Conditions same as those above for 'hourly service rate'.
Standby time	$132.00 per hour	Includes "waiting" or "on call" at job-site. Conditions same as those above for 'hourly service rate'.
Holdover time	Same as service rates without premium additions	Covers time (other than service and standby) spent in job-site area in lieu of return to point of origin. This rate applies for any time and day of the week.
Parts, material, subcontracted service	At cost	Price per manufacturer's list price and applicable discount.
International service	Same as domestic rates listed above plus all applicable extensions of transportation, travel time, and expenses from the contiguous USA to the job-site. Payment for services shall be in US dollars. Refer to office for terms of payment when contracts are made directly with international customers.	

NOTE: Minimum billing for technical outside service work is $300.00 net. (DOES NOT INCLUDE EXPENSES.)

Bearing Housing Vibration

Question: How do you determine a machine's vibration?

Answer: The criteria utilized to determine bearing housing vibration is the peak value of the unfiltered vibration velocity in inches per second. The greatest value measured at the set measuring points identifies the vibration of the machine.

Machine Mounting

Question: Does a machine's mounting style affect its vibration?

Answer: Yes. When evaluating the vibration of electrical machines, it is important to understand the machine's mounting because mounting and vibration are closely linked. Two passive (admit insignificant external disturbances to the machine) methods of mounting a motor are resilient mounting and rigid mounting. Following is a brief description of each, and an explanation of their affect on vibration.

Resilient Mounting: Resilient mounting entails suspending the machine on a spring, or mounting it on some type of elastic support (rubber, springs, etc.). Natural oscillation frequencies of the suspension system and machine should be less than 25 percent of the frequency corresponding to the lowest speed of the machine under test. The effective mass of the elastic support should be no greater than 10 percent of that of the machine, in order to reduce the influence of the mass and the moments of inertia of these parts on the vibration level.

Rigid Mounting: Rigid mounting entails fastening the machine directly to a relatively massive foundation. According to NEMA MG1-7.06, a relatively massive foundation is one that has a vibration which is limited, during testing, to 0.02 in/s peak (0.5 mm/s peak) above any background vibrations. The horizontal and vertical natural frequencies of the complete test arrangement shall not coincide within $\pm$10 percent of the rotational frequency of the machine, within $\pm$5 percent of two times the rotational frequency, or within $\pm$5 percent of one- and two- times the electrical-line frequency.

Limits of Bearing Housing Vibration

Question: Please explain the limits of bearing housing vibration.

Answer: The following limits of vibration pertain to uncoupled, resiliently mounted machines, running at no load. For machines tested with rigid mounting, the values given should be multiplied by 0.8. Vibration levels given here refer to internally excited vibration only. Motors as installed (in situ) may exhibit higher levels.

Figures 10a and 10b, taken from NEMA MG1-7.08, show limits for bearing housing vibration levels of machines resiliently mounted for both unfiltered and filtered measurements.

For unfiltered vibration, the measured velocity level shall not exceed the limit for the appropriate curve in figure 10a corresponding to the rotational frequency. For filtered vibration, the velocity level at each component frequency of the spectrum analysis shall not exceed the value for the appropriate curve in figure 10a at that frequency.

Figure 10: Machine Vibration Limits

Figure 10a

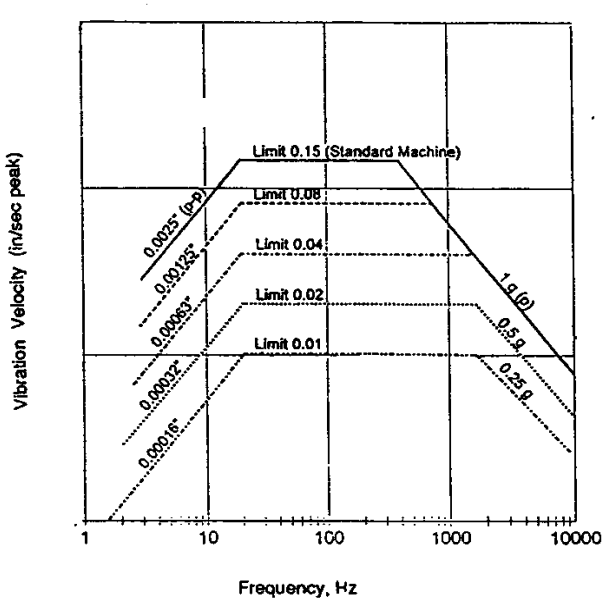


Figure 10b

Vibration Limit	*Machine Type - General Examples*
0.15	Standard industrial motors; motors for commercial or residential use
0.08	Machine tool motors; medium/large motors with special requirements
0.04	Grinding wheel motors; small motors with special requirements
0.02	Precision spindle and grinder motors
0.01	Precision motors with special requirements

Standard Machines

Question: Please explain the unfiltered vibration limits for standard machines.

Answer: For standard machines mounted resiliently, unfiltered vibration should not exceed the velocity levels shown in the top curve of figure 10a. For example, the limits at rotational frequency are shown in Table 11:

Table 11: Unfiltered Vibration Limits

Speed, rpm	*Rotational Frequency, Hz*	*Velocity, in/s peak (mm/s)*
3600	60	0.15 (3.8)
1800	30	0.15 (3.8)
1200	20	0.15 (3.8)
900	15	0.12 (3.0)
720	12	0.09 (2.3)
600	10	0.08 (2.0)

Vibration Banding

Question: What is vibration banding?

Answer: Banding is a method of dividing the frequency range into frequency bands and applying a vibration limit to each individual band. Banding recognizes that the vibration level at various frequencies is a function of the source of excitation and is grouped, or banded, in multiples of rotational frequency.

Testing Vibration

Question: Is there a standard method for testing a motor's vibration? If so, please explain it.

Answer: Yes, there is a standard method for testing vibration. The following diagrams illustrate this procedure for both horizontal (figure 1) and vertical (figure 2) motors.

Figure 1: Horizontal Motors

(over-head view of motor)

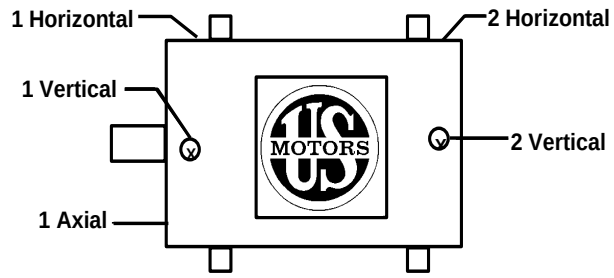
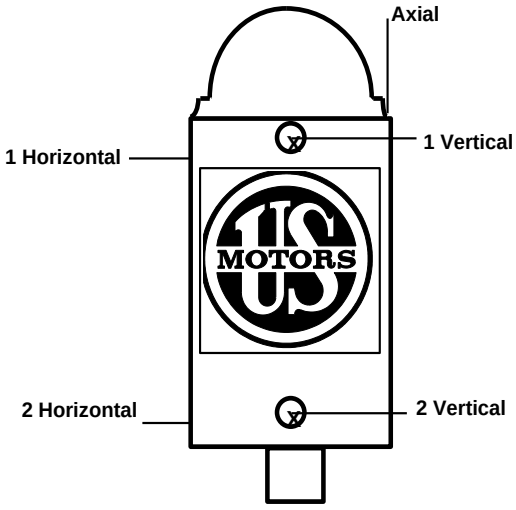


Figure 2: Vertical Motors

(front view of motor)



Obtaining Parts

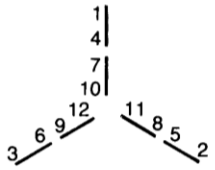
Question: How do I go about obtaining parts for old U.S. MOTORS® brand motors, or motors still under warranty?

Answer: In order to obtain parts for your old US MOTORS® brand motors, or those still under warranty, you must contact one of our part stocking distributors.

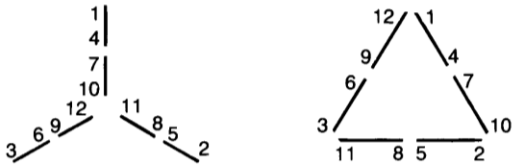
Connection Diagrams
Three-Phase Motors

Single-Speed 12 Leads

DUAL VOLTAGE EXTERNAL Y-CONNECTION



VOLTAGE	L1	L2	L3	JOIN
LOW	1,7	2,8	3,9	4&5&6,10&11&12
HIGH	1	2	3	4&7,5&8,6&9, 10&11&12

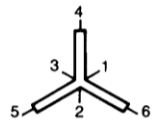


DUAL VOLTAGE Y-CONNECTED START DELTA-CONNECTED RUN

		L1	L2	L3	JOIN
LOW VOLTAGE	START	1,7	2,8	3,9	4&5&6,10&11 &12
	RUN	1,6,7, 12	2,4,8, 10	3,5,9, 11	—
HIGH VOLTAGE	START	1	2	3	4&7,5&8,6&9, 10&11&12
	RUN	1,12	2,10	3,11	4&7,5&8,6&9

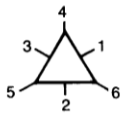
Two-Speed Single Winding With 6 Leads

CONSTANT TORQUE CONNECTION
Low-speed horsepower is half of high-speed horsepower.



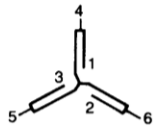
SPEED	L1	L2	L3		TYPICAL CONNECTION
HIGH	6	4	5	1&2&3 JOIN	2Y
LOW	1	2	3	4-5-6 OPEN	1 DELTA

CONSTANT HORSEPOWER CONNECTION
Horsepower is the same at both speeds.



SPEED	L1	L2	L3		TYPICAL CONNECTION
HIGH	6	4	5	1-2-3 OPEN	1 DELTA
LOW	1	2	3	4&5&6 JOIN	2 Y

VARIABLE TORQUE CONNECTION
Low-speed horsepower is one fourth of high-speed horsepower.



SPEED	L1	L2	L3		TYPICAL CONNECTION
HIGH	6	4	5	1&2&3 JOIN	2 Y
LOW	1	2	3	4-5-6 OPEN	1 Y

CAUTION: On European motors horsepower variance with speed may not be the same as shown above.

TITAN® Motor Failure Sheet
(449 FRAME AND LARGER)

Nameplate and Customer Data

Customer Name_____

Street Address_____

City_____ State/Province_____ Country_____

H.P._____ Speed_____ Frame_____ Type_____

Volts_____ Phase_____ Hertz_____ Serial No._____

Date Unit Put In Service_____ Date of Unit Failure_____

Customer Complaint_____

Incoming Inspection / Condition of Motor

Rust?_____ Oil?_____ Deposits?_____ Bearings?_____

Physical Damage?_____ Winding Grounded?_____

Describe Condition_____

Before working on motor, contact the Warranty/Product Service Department.
Endplay adjustment to be recorded prior to disassembly on vertical motors.

Rotors

Rotor turning when failure occurred?_____ Rotor shows signs of overheating?

Was rotor checked for open bars?_____ If yes, describe findings_____

_____

Evidence of tooth failure?_____ If yes, describe location and evidence_____

Did rotor rub stator bore?_____ If yes, describe condition of rotor surface_____

_____

Was shaft damaged in any way?_____ Any rubs?_____ Describe_____

_____

Windings

Describe location of failure relative to drive end and connection end_____

_____

_____

Describe location of failure relative to terminal coils, leads, and phase insulation. Give clock position of failure looking into motor from failure end_____

_____

Megger winding to ground results_____

Describe condition of winding. Topsticks, bracing, phase connections, varnish, etc. _____

_____

Describe any tracking or heating patterns (ex. single phase heating)_____

_____

Describe failure (coil-coil, coil-ground, etc..)_____

_____

Any sign of rotor rub stator bore?_____ Describe_____

Winding Condition: Rust?_____ Contaminants?_____ Deposits_____

Air ducts plugged?_____ Further describe winding problems_____

_____

Leads

Number of coil lead connections melted?_____ Are connections soldered?_____

Brazed?_____ Crimped?_____

Number of failures between: Coil leads?_____ Coil leads and end turns?_____

Motor leads and coils?_____ Number of motor lead connections melted?_____

Number of melted or burnt motor lead lugs?_____

Bearings and Housings

Condition of bearings?_____ Bearing Temperature?_____

Position(s) of failed bearings?_____ Oil Sump Temperature?_____

Bearings turned in housing?_____ On shaft?_____

Bearing heat discoloration: None_____ Straw_____ Blue_____

Wear pattern: Balls_____

Inner race_____

Outer race_____

If vertical motor, does guide bearing show signs of running in upthrust?_____

Describe_____

Condition of lubricant?_____

Type of lubricant?_____ Percent fill?_____

Relube schedule?_____ Moisture?_____ Brinelling?_____

Application and System Data

Note: Please fill out all data which may have a bearing on the ultimate cause of failure. In addition, please include descriptions of when the unit failed.

Start up: After_____ hours running Service?_____

Environment:

Outdoor-exposed?_____ Outdoor-Sheltered?_____ Indoor?_____

Ambient Temperature Range?_____ to _____ High humidity?_____

Spray from leaks, rotating parts, hose down, etc..?_____

Direct rain?_____ Blowing dust?_____ Water borne chemicals?_____

Liquid chemicals?_____ Gas or fumes?_____

Types of chemicals, gas, or fumes?_____

Physical Contaminant?_____ Type?_____ Degree?_____

Application Mounting:

Type of driven equipment (fan, crusher, etc..)_____

Direct coupled?_____ Coupling type?_____ Belt driven?_____

Hub location on shaft?_____ Center distance?_____ Diameter: Driver?_____

Driven?_____ Number of belts?_____ Type and size of belts?_____

Clutch between motor and load?_____ Type?_____

Vertical Pump_____ External Thrust_____ Down_____ Up_____

Other connection_____

Duty Cycle:

Starts per day_____ Run time per start_____ Off time between starts_____

Load fluctuations_____ Length of time unit stored prior to initial start-up_____

Describe method of mounting motor to bedplate_____

Electrical System:

Note: This section must be filled out on units which have experienced failure of terminal coils.

Supply System: Grounded_____ Ungrounded_____ Local Utility_____

Generates own power_____ Both utility and generate own_____

Bus transfers_____ Automatic reclosures_____

Switch Gear: Type_____ Manufacturer_____ Model_____

Power at motor terminals: Line 1_____ Line 2_____ Line 3_____

Amps: Line 1_____ Line 2_____ Line 3_____

Inverter Duty Speed Range_____

Other Comments / Analysis of Failure (for more room, use additional sheet of paper)

_____

_____

_____

_____

Signed_____

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

Rev. 02/13

NIDEC MOTOR CORPORATION

8050 W. Florissant Avenue | St. Louis, MO 63136
Phone: 800-566-1418 | Fax: 314-595-8922
www.usmotors.com