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Monthly Informative Application Guidelines, with respect to *Motors & Drives* to keep you better INFORMED.

APPLICATION GUIDELINE #34

(BRIEF OVERVIEW OF API-541 MOTOR SPECIFICATION)

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An often referred to specification for large HP induction motors is the API 541 specification. The following is intended to help explain what this specification covers, comments regarding it's proper use and to describe Toshiba's compliance on the more important aspects, keep in mind that to fully comply with the intent of API 541, the purchaser's data sheets (4 pages) MUST be filled out.

The API specification is a lengthy 77 page booklet that covers detailed aspects of the construction, performance, specification and testing of large form wound squirrel cage induction motors. Sections mentioned in the 'Table of Contents" include:

Section 1--General,
Section 2--Basic Design: Electrical, Insulation and Mechanical
Section 3--Accessories: Terminal Boxes, Temperature Detectors, Space Heaters, Screens & Filters, Alarms & Control Devices for Motor Protection, Ground Connectors, and Vibration Detectors
Section 4--Inspection Testing & Preparation for Shipment,
Section 5--Guarantee & Warranty
Section 6--Vendor's Data.
Appendix, **Tables** and **Figures** Section summary.

The following are comments describing the scope and details, taken directly from the API 541 std:

- The API (American Petroleum Institute) specification covers the minimum requirements for all FORM WOUND SCIM above NEMA 440 Frame sizes (nominally 250HP and larger) for use in the petroleum industry services. The scope of the specification indicates that the specification may be applied to adjustable speed motors and induction generators with appropriate attention to the specific requirement of such applications. For adjustable speed applications, proper selection of the motor and drive are required to avoid many conditions (as listed in the spec).

- Throughout the specification at the beginning of some paragraphs, their will be either one of the following:
  (?)- Round Bullets: Indicates either a decision is required or further information is to be provided by the purchaser. All bulleted paragraphs are summarized on the data sheets. Therefore, the 'purchasing request' information should be indicated on the data sheets, otherwise it should be stated in the quotation request or in the order.
  (¦)- Square Bullets: Indicates additional requirements for 'special purpose' motors. Special purpose motors are motors that drive high inertia loads, vertical motors that support high thrust loads, motors that are part of a complete train requiring vibration sensitivity criteria, motors that operate in abnormally hostile environments, or motors that drive critical unspared equipment. When the motor is specified as 'special purpose' on the Purchaser's Induction Motor Data Sheets, the paragraphs that are marked with 'square bullets' shall also apply. As indicated above all bulleted paragraphs are summarized on the data sheets.

- The API-541 standard requires the purchaser to specify certain details and features. In order for this standard to be meaningful as an aid to procurement, the purchaser must complete the data sheets in Appendix A of the specification. (See below for a scanned image of page 1 of the Purchaser's Induction motor data sheet).

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PURCHASER'S INDUCTION MOTOR DATA SHEET

JOB NO. _____ ITEM NO. _____
PAGE 1 OF 4 BY _____
DATE _____ REVISION _____

APPLICABLE TO: O PROPOSAL O PURCHASE O AS BUILT
FOR _____
SITE _____
SERVICE _____
VENDOR _____

MODEL _____
UNIT _____
DRIVEN EQUIPMENT _____
NO. REQUIRED _____
SERIAL NO. _____

NOTE: IN CASE OF CONFLICTS, THE ORDER OF PRECEDENCE SHALL BE THE PO, THESE DATA SHEETS AND THEN API541.

MOTOR DESIGN DATA

BASIC DATA:

TYPE OF MOTOR (1.1.2) O GENERAL PURPOSE O SPECIAL PURPOSE
O VOLTS _____ PHASE _____ HERTZ _____
O NAMEPLATE HP (2.2.1.1) _____ SERVICE FACTOR (2.2.1.3) _____
O SYNCHRONOUS RPM _____
O INSULATION CLASS AND TYPE _____
O TEMPERATURE RISE (2.2.1.3): _____ °C ABOVE _____ °C AMBIENT
AT _____ SF BY O RESISTANCE O RTD
O MIN % OVERSPEED (2.1.4, 2.4.5.2.7) _____
O BEARING TYPE: O HYDRODYNAMIC (2.4.7.1) O ANTIFRICTION (2.4.7.2)
O MAX DRIVEN-EQUIPMENT VERTICAL THRUST (2.4.7.2) (2.4.7.10) _____
_____
O DIFFERENTIAL PROTECTION TO BE APPLIED (2.2.2.1)

SITE DATA (2.1.2)

AREA CLASSIFICATION (2.1.7):
O CLASS _____ GROUP _____ DIVISION _____ O NONCLASSIFIED
O IGNITION TEMPERATURE _____ TEMP. ID NO. _____
O ELEVATION, FT _____
O AMBIENT TEMPERATURE MAX, °F _ MIN, °F _____
O RELATIVE HUMIDITY: MAX, % _____ MIN, % _____
O INDOOR O OUTDOOR O HEATED O UNHEATED
O ROOF OVER MOTOR O NO ROOF OVER MOTOR
O NONMASSIVE FOUNDATION (2.4.6.1.2), DESCRIPTION _____
_____
O MAX SOUND PRESSURE LEVEL (2.1.3) _____ DBA _____

UNUSUAL CONDITIONS:

O ABRASIVE DUST (2.4.1.2.2, ITEM c) _____
O EXTERNAL FORCES AND MOMENTS (2.4.4) _____
O SEISMIC LOADING (2.4.2.2) _____
O CORROSIVE AGENTS (2.4.10.1.2) _____
O OTHER _____

ELECTRIC SYSTEM CONDITIONS:

O MAX S.C. KVA AT MOTOR BUS (3.1.2) _____
O I^2t LET-THROUGH ENERGY (3.1.2) _____
O MIN S.C. KVA AT MOTOR BUS (2.2.5.2, ITEM b) _____
O X/R RATIO (2.2.5.2, ITEM b) _____
O TYPE OF SYSTEM GROUNDING O RESISTANCE O REACTANCE
O UNGROUNDED OSOLID
GROUND FAULT AMPERES _____

STARTING (2.2.3, 2.2.5.2):

O TORQUES IN EXCESS OF NEMA MG 1-20.41 (2.2.7 ITEM C) _____
O FULL VOLTAGE O % REDUCED VOLTAGE AND TYPE _____
O LOADED (100%) O PARTIALLY LOADED (%) _____
O OTHER _____

STARTING (2.2.3, 2.2.5.2) (CONTINUED):

O LOAD CURVE 2.2.3.2, ITEM a _____
O VOLTAGE AT LOCKED ROTOR (2.2.5.2, ITEM a)(MIN % OF RATED): _____
O NUMBER OF FULL-VOLTAGE STARTS, IF NOT 5000 (2.4.5.1.1): _____
O CAPABILITY IN EXCESS OF TABLE 2 (2.2.6.2)
SPECIFY _____

MOUNTING (2.4.2):

O HORIZONTAL O VERTICAL O SHAFT UP O SHAFT DOWN
O FOOT MOUNTED O FLANGE MOUNTED, NEMA TYPE _____
O BASEPLATE FURNISHED BY (2.4.2.6) _____
O SOLEPLATE FURNISHED BY (2.4.2.6) _____

ENCLOSURE (2.4.1):

O OPEN--DRIPPROOF
O WEATHER PROTECTED (2.4.1.2.2) O TYPE I O TYPE II
O TEFC (2.4.1.2.3) O TEWAC (2.4.1.2.4) O TEPV
O EXPLOSION PROOF O OTHER TYPE _____
O TEAAC-TUBES (2.4.10.8, ITEM a): O COPPER O COPPER ALLOY
O ALUMINUM O STAINLESS STEEL O ALUMINUM ALLOY
O AISI 300 SERIES HARDWARE (2.4.1.1, ITEM c) _____

TEWAC HEAT EXCHANGER:

O TUBE MATERIAL (2.4.10.8, ITEM b) _____
O TUBE CONSTRUCTION (2.4.1.2.4, ITEM d) O DOUBLE TUBE O SINGLE TUBE
O AIR TEMPERATURE SENSOR (2.4.1.2.4, ITEM g) O YES O NO
O RTD TYPE _____ O TC TYPE _____
O COOLING WATER CONDITIONS PER 2.4.1.2.4, ITEM a? O YES O NO
IF NO, SPECIFY DIFFERENCES _____
_____
O FLOW SENSOR LOCAL INDICATOR (2.4.1.2.4, ITEM f)
O OUTER TUBE ON DOUBLE TUBE COOLERS LEAK DETECTION
(2.4.1.2.4, ITEM b): TYPE _____

DRIVE SYSTEM:

O DIRECT CONNECTED O GEAR (2.2.3.2, ITEM c)
O TYPE OF COUPLING (2.4.9.4) _____
FURNISHED BY _____
O ROTATION REQ'D BY DRIVEN EQUIPMENT WHEN FACING MOTOR
OPPOSITE DRIVE END: O CLOCKWISE O COUNTERCLOCKWISE
O DRIVEN-EQUIPMENT Wk^2(2.2.3.2, ITEM c) _____ LB-FT^2@ _____ RPM
O LOAD REACCELERATION REQUIRED (2.2.3.2, ITEM b)? O YES O NO
IF YES, PROVIDE:
MAX VOLTAGE INTERRUPTION, (CYCLES) _____
VOLTAGE AT MOTOR TERMINALS ON RECLOSURE _____
LOAD SPEED-TORQUE REFERENCE CURVE NO. _____
O OTHER _____
_____

As an aid to help describe how Toshiba motors meet some of the API 541 (third edition) motor requirements, some Toshiba API 541 features include:

Rotor & Bearing Construction

- ✓ Copper bar rotors with phosphorous free brazing of end rings or proven die cast aluminum**. (2.4.5.2.2)**
- ✓ Precision two (or more) plane balancing to limit residual unbalance**. (2.4.6.2.1)**
- ✓ Steel-backed Sleeve Bearings with split oil guards and Trico Oilers when specified or grease lubricated Anti-Friction bearings where applicable. **(2.4.7.1) (2.4.7.3)**
- ✓ Insulated non-drive end bearing. **(2.4.7.8)**
- ✓ High strength hot rolled steel shaft material. **(2.4.5.1.2)**
- ✓ Vibration levels which meet or exceed requirements **(2.4.5.1.3)**
- ✓ Bearing temperature rise lower than API requirements **(2.4.7.3)**

Stator Construction

- ✓ Sealed epoxy based Class F VPI insulation (Toshtight II). Mica wrapped coils. **(2.3.1.1)**
- ✓ Maximum 650% Inrush. **(2.2.7)**
- ✓ Heavy duty coil bracing. **(2.2.2.2)**
- ✓ C5 core plate electrical steel. **(2.4.10.7)**
- ✓ 2 hot, 3 cold Starts, subject to application. **(2.2.6)**
- ✓ 2/phase 100 ohm Platinum Stator RTD's. **(3.2.1)**

Enclosures

- ✓ Mounting surface machined to 250 micro-inches. **(2.4.2.10)**
- ✓ Provision for measuring air gap in 3 positions. **(2.4.10.6)**
- ✓ Grounding pads on the motor frame, opposite side 2-position. **(3.7)**
- ✓ Resonant response peaks removed from operating speed. **(2.4.6.1.1)**
- ✓ Corrosion resistant hardware. **(2.4.1.1c**)
- ✓ Low temperature space heaters with separate terminal box as required. **(3.4.3)**
- ✓ Vertical Jacking screws. **(2.4.2.7.11)**
- ✓ Permanent end play indicator on sleeve bearing motors **(2.4.9.3)**
- ✓ Louvers over air openings on Weather Protected Type II (WP2) **(2.4.1)**
- ✓ Epoxy coated aluminum heat exchanger tubes on Totally Enclosed Air to Air Cooled (TEAAC) **(2.4.10.8)**
- ✓ Max. 85 dBA, no load sound pressure level (3600 Rpm).

Testing

- ✓ No-load vibration test.
- ✓ Shaft voltage. **(4.3.2.L)**
- ✓ Polarization Index. **(4.3.2.e)**
- ✓ Standard Factory Routine Test (Nema MG1)
- ✓ Noise Measurement **(4.3.5.1.1.g)**

Other auxiliaries and additional testing available as required.

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