

Spec. No. :	Subject :
	ENERGY INFRASTRUCTURE - L.V. MOTORS

ENERGY INFRASTRUCTURE GENERAL SPECIFICATION

SPEC. NO.

FOR:

L.V. MOTORS

P0	8/06/22	FOR BIDS	A. SHVARTSMAN	
ISSUE	DATE	REVISIONS	BY	APP. BY

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1.0 **OBJECTIVES**

This specification is issued in order to present minimum requirements for the supply of 400V Asynchronous Induction Motors, Low Loss type for non hazardous locations. The motor shall be supplied and installed in the Plants of Energy Infrastructure Ltd. The motor should be designed to operate a concentrate pump for firefighting/

2.0 **SCOPE OF SUPPLY**

- 2.1 The 400V Asynchronous Induction Motors are required for Project.
- 2.2 The scope of supply will be as shown below, and complying with the attached "General Conditions of Purchase and Contract" and inclusive of the following items, all in accordance with this specification.
 - 2.2.1 Design, supply, manufacture, and testing of complete units.
 - 2.2.2 Epoxy painting of the units in accordance with approved manufacturer standard (to be provided by vendor).
 - 2.2.3 Packing and preparation for shipment.
 - 2.2.4 Every motor ordered will be accompanied by an individual motor data sheet, which shall be completed by the supplier and returned fourteen days after the date of order.
 - 2.2.5 Supply of special tools required for installation and maintenance.
 - 2.2.6 Provision of all technical data as required - see App. C.

3.0 **GENERAL**

- 3.1 Supplier shall have complete responsibility and it shall be his duty to satisfy himself that the units supplied are suitable for the duties specified, that they conform to the design and other requirements of this specification and that most particularly the units are suitable to operate in the ambient conditions of the site without additional protection. Approval by the Engineer of drawings or other documents shall not absolve the supplier from this responsibility.
- 3.2 All materials and components used in the construction of the motors shall be new.
- 3.3 The design of the equipment shall provide for interchangeability of components to the maximum extent possible, with particular emphasis on those units for which spare parts are required.

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- 3.4 The inscriptions on rating plates, meters and other indicating instruments shall read in suitable units of the international metric system (SI).
- 3.5 All inscriptions on nameplates etc. shall be in English and/or Hebrew languages. Only symbols in line with I.E.C. recommendations may be used on equipment and on drawings.
- 3.6 Documentation shall be in the English or Hebrew language.
- 3.7 Suitable lifting facilities shall be furnished for shipment and erection for motors K32 and larger.
- 3.8 No aluminum or its alloys shall be used for the manufacture of motor parts or accessories.
- 3.9 All bolts shall be cadmium plated.

4.0 **OPERATING CONDITIONS**

- 4.1
 - a) Squirrel Cage Motors shall be suitable for direct on line starting, when the starting current of the motor shall not exceed its full load current by more than 6.5 times for the corresponding starting torques defined in the motor data sheets.
 - b) Motors up to 2.2 kW shall be 400V with 3 terminals.
 - c) Motors bigger than 2.2 kW shall be 400VD/690VY with 6 terminals.
 - d) Cable connection to the motor shall be to terminals installed on terminal plate.
- 4.2 The motors, having attained full load temperature, shall then be capable of repeated starts of the frequencies and durations stipulated in the data sheets accompanying the purchase orders, but not less than:

3 cold repeated starts
2 hot repeated starts

The tenderer, shall contain particulars of these capabilities with respect to the motors offered.

- 4.3 Squirrel Cage Motors will usually be started direct on line but occasionally, Soft Start Systems will be selected.

In these instances, particulars will be given in the motor schedules/data sheets, otherwise direct on line starting may be assumed.

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4.4 Electrical Power Supply and Earthing

- Nominal voltage 400V
- Variation from nominal voltage..... $\pm 10\%$
- Phase.....3
- Nominal frequency.....50 Hz
- Variation from nominal frequency..... $\pm 2\%$
- Fault current rating.....35kA at 400V
- Neutral.....Solid grounded
- Anti-condensation heater supply.....230VAC single phase.

4.5 Rating and Temperature Rise

- 4.5.1 The motors shall be capable of operating continuously at their nominal full load ratings, notwithstanding variations of approximately 5% and 2% from the nominal supply voltage and frequency respectively.
- 4.5.2 The motors shall be capable of operating continuously at their nominal full load ratings without reaching their temperature limit, as measured by the increase in resistance method for Class "B", as stated in the motor data sheets.

4.6 Voltage dips with standing

The power system suffers from short voltage dips several times a year due to bad weather and faults on overhead lines.

During such dips the voltage may drop to 55% of this nominal value for up to 0.6 seconds. The motors shall be so constructed as to be able to withstand, without any harm to them, the most severe occurrence of "anti-phasing" due to slow decay on the back-EMF, during such voltage dips and the subsequent recovery. The motors shall also be capable of being re-closed onto the power source without sustaining damage in the event of being disconnected for duration of greater than 0.5 seconds due to the de-energizing of the respective contactor as a result of voltage dips.

4.7 Performance Guarantee

- 4.7.1 Without limiting or restraining in any way whatever any other guarantees required by the Contract/Purchase Order the Manufacturer guarantees, to the tolerances laid down in I.E.C. 60034, the 'On Site' performances of all motors as detailed in the relevant data sheets.
- 4.7.2 Notwithstanding operational criteria specified in this document, the Supplier shall carry full responsibility for the successful operation and attainment of design capacity.
- 4.7.3 If any criteria specified herewith are at variance with what the supplier would guarantee, this should be clearly stated by the supplier on the appropriate sheet in the Form of Tender.

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5.0 **DESIGN AND CONSTRUCTION**

5.1 **General**

Motors shall be 3 phase, 400 Volts, Low Loss, 50 Hz. induction type, totally enclosed, external fan cooled, squirrel-cage, suitable for ambient conditions as specified in App. A, and use in petrochemical industry.

The motors shall be constructed to withstand:

5.1.1 The conditions defined in motor data sheets.

5.1.2 Outdoor installation and direct exposure to the sun.

5.1.3 Frames shall be cast iron with heavy walls and all surfaces (interior and exterior) shall be epoxy painted.

5.2 **Standards**

The design, construction and testing of the motor shall conform to the latest applicable editions of the following specifications, recommendations and standards, with precedence given to I.E.C. publications wherever content matter conflicts.

I.E.C. 60072 & 72A:	Dimensions and output ratings for Rotating Electrical Machines.
I.E.C. 60034 Part 1:	Rating and performance of Rotating Electrical Machines
I.E.C. 60034 Part 2:	Methods of testing for losses and efficiency of Rotating Electrical Machines
I.E.C. 60034 Part 5:	Degrees of protection for Rotating Electrical Machines.
I.E.C. 60034 Part 6:	Methods of cooling Rotating Electrical Machines.
I.E.C. 60034 Part 8:	Terminal markings and direction of rotation of Rotating Electrical Machines.
I.E.C. 60034 Part 9:	Noise limits for Rotating Electrical Machines.
I.E.C. 60034 Part 11:	Rules for protection of rating electrical machinery.
I.E.C. 60085/ B.S.I. 2757:	Classification of insulating materials for

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Electrical Machinery and Apparatus.

B.S.I. 4999 Part 111

I.E.C.

60077/22761DC Part 1:

Draft Specification

Built in thermal protection for Electrical Motors – Chapter 1

I.E.C. 60117:

Recommended graphical symbols

I.S. 1-298:

Asynchronous Squirrel Cage Motors

I.S. 1-549:

Dimensions of Electrical Motors

DIN 6885 Part 1

Center holes type R.A.B and C

NFPA 20

Standard for the installation of stationary pumps for fire protection

5.3 Efficiency

High energy efficient motors shall be preferred. The bidder shall provide - nominal efficiency values measured at 50%, 70%, 80% and 100% of motor rating power. The efficiency shall be measured to international IEC 60034 - 2. The additional investment cost of the motors will be weighed against the cost of energy saved due to reduced while the energy considered payback period shall be three years and the energy cost - 0.15 \$/kwh. 8000 hours per year for 80% loaded motor.

5.4 Vibration and Noise

5.4.1 The vibration and noise levels of the motors shall fall within the limits prescribed in I.E.C. 60034 - Parts 1 and 9 respectively.

5.4.2 If silencers or other noise reducing devices are necessary to satisfy the noise limitations imposed, their costs where applicable shall be quoted separately in the tender.

5.5 Constructional Features

5.5.1 Enclosure and Cooling

5.5.1.2 General Purpose Location Enclosures

TEFC. weatherproof, suitable for outdoor location enclosures, shall be provided for motors located in the non-classified areas.

5.5.1.3 Mounting and Enclosure Protection

Motors shall be of mounting type due to motor data

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sheet requirements, enclosed and protected in accordance with IP Code as stated in the motor data sheets.

Stator end-plates and terminal boxes shall be suitably sealed.

As a rule enclosure protection shall be (minimum) IP55.

5.5.2 Terminal Boxes

- 5.5.2.1 Terminal boxes shall satisfy Code IP56, as stated in the motor data sheet, and shall be sealed from the interior air of the motors. Gaskets shall be of Neoprene or approved equivalent.
- 5.5.2.2 The terminal boxes shall be designed to withstand, without rupture, the effects of electrical faults within the boxes.
- 5.5.2.3 The terminal boxes shall be designed to permit removal of the motors without significant disturbance of the ends of the feeder cables connected thereto. The integrity of the motor enclosure must be maintained.
- 5.5.2.4 Separate terminal boxes shall be provided for each auxiliary function (thermistors, anti-condensation heaters, etc.)
- 5.5.2.5 Terminal boxes shall be of ample size to permit interchanging of connections and a suitable earthing terminal shall be provided within each box for the connecting of the earth conductor incorporated in the supply cable, in addition to the usual earthing terminal located on the motor frame.
- 5.5.2.6 All cable entries in terminal boxes shall be drilled and tapped in accordance with the particulars that will be furnished at the purchase stage. These entries shall be suitably plugged to prevent ingress of contaminants during shipment and prior to cabling.
- 5.5.2.7 All ends of the motor winding shall be brought out into a terminal box for connection to the incoming and on the terminal plate.
- 5.5.2.8 Terminal boxes shall be completely and hermetically sealed from the stator.

5.5.3 Shafts and bearings

- 5.5.3.1 Every motor shall be equipped with a standard metric single-ended shaft, with key-way and key to metric

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standards as per DIN 6885, Sheet 1 Form A, unless otherwise specified in the accompanying motor

schedules/data sheets. The shaft will be centering hole tapped as per DIN 332, Form D - for motors 25kW and above.

- 5.5.3.2 End-shield mounted ball or roller type bearings are preferred for all motors. Pedestal mountings and sleeve bearings are to be avoided as far as practicable.
- 5.5.3.3 Antifriction deep bearings, groove ball/roller bearings of the cartridge type shall be used to permit dismantling of the machine without disturbance of the bearings.
- 5.5.3.4 The sealing of bearings shall adequately cater for the environmental conditions specified in the motor data sheet.
- 5.5.3.5 Grease relief systems shall be provided complete with grease nipples to B.S. 1486.
- 5.5.3.6 Bearing life shall be 50,000 hours at least.
- 5.5.3.7 Measures shall be taken to prevent damage to bearings during shipment. Should bearings fail or exhibit symptoms of Brinelling during the guarantee period of the motors, they shall be renewed promptly by the supplier or his appointed agent, free of charge. Costs of any removals, transportation and restoration shall also be borne by the supplier.
- 5.5.3.8 Lubrication type and interval shall be indicated on a data plate fixed to the motor.
- 5.5.3.9 Should the motor be equipped with bearings allowing axial displacement, the shaft shall be provided with a marking to indicate the correct coupling position.

5.5.4 Winding Insulation

The insulation of the motors shall be according to I.E.C. 60085 - Class "F" as specified in the motor data sheets.

- 5.5.4.1 Winding insulation phase to phase, and phase to earth, shall be thermosetting resins impregnated, rated Class F or higher; conductors will have V.P.I. impregnation.
- 5.5.4.2 The rated operating temperature rise shall be as per Class B and the limitation shall be indicated on the name-plate.

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5.5.4.3 Windings shall be suitable to resist contaminants and solvents (solid, liquid, grease) of chemical, petrochemical and petroleum industrial environments.

5.5.4.4 Connections between windings and terminals shall be insulated with materials suitable for continuous operation at the maximum temperature (measured by the resistance method) required by the Standards (see Clause 5.2) for the winding insulation class.

5.5.4.5 Connection as per Para 4.1 shall be fixed and arranged so as to withstand the short circuits and the mechanical stresses and vibrations during normal running.

5.5.5 Embedded Temperature Detectors

5.5.5.1 Embedded temperature detectors - RTD-shall be provided for 45 kW motors and larger, for winding and bearing temperature monitoring.

5.5.5.2 Temperature detectors of the thermocouple type shall be of the resistance type, non-inductive, with 100 ohm at 0 C platinum resistor and temperature coefficient of $3.85 \times 10^{-3} \text{ C}^{-1}$.- RTD DIN 43760 three conductors.

5.5.5.3 Two thermocouples shall be fitted per phase in the anticipated hottest parts of the windings according to Motor Data Sheet requirements.

5.5.5.4 Two additional thermocouples shall monitor the bearings temperature in order protect them against abnormal conditions caused by overheating or insufficient lubrication.

5.5.5.5 Thermocouple wiring shall be terminated in a separate terminal box possessing the same degree of protection as the stator terminal box.
Terminals shall be of the block type with a pressure pad between the conductor and the clamping screw.

5.5.5.6 The terminal box shall be clearly and durably labeled to quantify and define the thermocouples/ thermistors, and also to chart their positions in the windings.

5.5.6 Anti-Condensation Heaters

5.5.6.1 Anti-condensation heaters shall be provided where called for in the accompanying motor schedules/data sheets.

5.5.6.2 Heaters shall be of sufficient power rating to maintain the interior air temperature of the motor

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above dew point when the motor is not in service.
The heaters shall be suitable for connecting to a 220V 50Hz supply.

- 5.5.6.3 The leads from the heaters shall be terminated in a separate terminal box possessing the same degree of protection as the stator terminal box. Terminals shall be of the block type with a pressure pad between the conductor and the clamping screw.
- 5.5.6.4 The terminal box shall be clearly and durably labeled to define the rated voltage and power consumption of the heater and shall also bear a separate wiring label reading:
DANGER - ISOLATE HEATER BEFORE OPENING.

5.5.7 Fans and Fan Covers

Fans and Fan Covers shall be fully protected against corrosion.
Covers made of plastic shall not be used.
Fans shall be of non sparking metal.

6.0 INSPECTION AND TESTING

- 6.1 Clients representative shall be permitted to carry out, during normal working hours, periodic inspections of the motors covered by this specification, at any stage of manufacture.
- 6.2 Clients representative shall be permitted to witness the final Factory Tests of the motors covered by this specification.
- 6.3 The manufacturer, shall carry out 'Performance Tests' on one motor of each design. A 'Type Test' certificate in triplicate for every motor shall be furnished to and approved by the Engineer prior to dispatch of the motor.
- 6.4 'Routine Tests' shall be conducted on every motor and a Certificate of Routine Test in triplicate shall be furnished to and approved by the Engineer prior to dispatch of the motor.
- 6.5 The manufacturer shall give two weeks notice of readiness for final inspection and factory tests.
- 6.6 All tests shall be carried out in compliance with the relevant specification as detailed in clause 5.2 of this specification.

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7.0 **TAGGING AND PERMANENT MARKING**

- 7.1 Each motor shall bear a prominently positioned rating plate manufactured from stainless steel which shall be indelibly stamped with the information detailed in I.E.C. 60034 Part 1. Each Explosion proof motor shall have on the data plate of its classification (s.a. EEx"e", EEx"n" or others, and the relevant standard, (IEC, BS etc.).
- 7.2 In addition to the rating plate, the motor shall have a label of stainless steel bearing:
 - (a) Purchase Order Number.
 - (b) Equipment Number.
 - (c) Item Number.
 - (d) Rotation Direction (if defined).

8.0 **DRAWINGS AND DATA REQUIREMENTS**

- 8.1 Drawing and Data Requirements are detailed in attached documentation - see App. B.
- 8.2 Bidder shall furnish with his Bid a "Supplier's Data Sheet" for each type/size of motor which shall contain all the information required thereon.
- 8.3 A Data Sheet will be provided by the Engineer for each motor at the time of order. the supplier shall complete these Data Sheets as specified.
- 8.4 The manufacturer shall provide with each motor a certificate from recognized institute, which verifies the suitability of the motor to the area classification.
- 8.5 The manufacturer shall provide details of the production standard and code of manufacturing the motor (Exp. motors).
- 8.6 The supplier shall furnish the motor load curves with the motor supply.

9.0 **SPARES**

- 9.1 Spares shall be quoted by the vendor in accordance to the best of his knowledge, and shall list separately commissioning spares, initial spares, and maintenance spares required for ten years of operation.

10.0 **PAINTING & PRESERVATION**

10.1 Painting

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- 10.1.1 Stainless steel surfaces, internal surfaces, and finish machined surfaces such as flange faces, shafts, and couplings, shall not be painted.
- 10.1.2 External surfaces of machinery, baseplates, accessories and shall be epoxy painted prior to being shipped from the supplier's shop in accordance with approved suppliers standard.

10.2 Preservation

Prior to shipment all equipment shall be subjected to the following treatment:

- 10.2.1 Bearings, bearing housing, and oil systems shall be thoroughly cleaned and coated with a suitable rust preventative. Supplier shall ensure that no damage shall occur to bearings during transport.
- 10.2.2 Seal assemblies shall be fully protected from rusting and entry of moisture and dirt.
- 10.2.3 External nonpainted surfaces (except stainless steel), including bolting and flange faces, shall be coated with a suitable rust preventative.
- 10.2.4 Exposed shafts and shaft couplings and other machined surfaces shall be wrapped with waterproof moldable waxed cloth or equal.
- 10.2.5 All flanged openings shall be protected by securely fastened metal covers to prevent damage during shipment. Covers shall be installed with a suitable gasket, using a minimum of four full diameter bolts. The cover and flange shall be taped for waterproof protection. All other openings shall be plugged or covered to prevent damage during shipment.
- 10.2.6 Supplier is responsible for ensuring that no rust shall occur during shipment.

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11.0 **DATA FOR BID COMPARISON, QUANTITIES AND UNIT RATES**

In order to compare bids quickly and on an equal basis, suppliers are requested to fill in the attached "schedule of prices and data", (in addition to data sheets).

The bidder is to fill the prices and manufacturer data within the "schedule of prices and data" for various types of motors as specified in this specification.

The motor sizes and the quantities are estimated only and the final quantities and requirements shall be placed with an order.

The manufacturer technical data shall be filled within columns 3 to 11 while the prices shall be quoted within columns 12 to 15.

The delivery period (weeks) shall be quoted for each motor within column No. 16.

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APPENDIX A - SITE CONDITIONS

1. Plant Location : Ashkelon Terminal
2. Altitude of site : sea level
3. Climatic Conditions :
 - a) Barometric pressure : 960 mbara (942-972 mbara)
 - b) Ambient Temperature :
 - Summer Conditions : Maximum dry bulb: 39°C (at wet bulb of 20°C)
Maximum wet bulb: 39°C (at dry bulb of 33°C)
 - Winter Conditions : Minimum temperature for design : +5°C
Minimum temperature for fluids that may freeze : +1°C
 - c) Rainfall : average per year : 810mm (30-160mm)
 - design max. per 10 min : 70.5mm
 - design max. per 1 hr : 130mm
 - design max. per day : 320mm
 - d) Wind : basic wind velocity : 47m/sec (169km/h)
basic wind pressure : 120 kg/m²
prevailing direction : North – West (day time)

according to Israeli Standards 414, last edition
4. Earthquake standard : Israeli Standard 413, last edition (Rev. July 1991)
Alpha factor = 2
5. Earthquake standard : average (standard pan) : 2700mm / year
6. Surrounding Conditions : Highly Corrosive and Dusty Atmospheric
containing:

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APPENDIX B

VENDOR DRAWINGS AND DATA REQUIREMENTS

PLANT: PETROLEUM AND ENERGY INFRASTRUCTURE

EQUIPMENT DESCRIPTION: L.V. MOTORS

EQUIPMENT TAG. NO.: _____

R.F.O./PO _____

DATE: 27.05.15

REV. NO. 0

DESCRIPTION	Approval before Fab.	Proposal Drawings		AFTER RECEIPT OF ORDER			
		Qty. & type	Schedule	Preliminary		Final	
				Qty. & type	Schedule	Qty. & type	Schedule
1. Piping & Instrumentation Diagrams.							
2. General Arrangement / Dimensional Drwgs.		3P	TS	3P	0 + 15	S	D
3. Loads and Foundation Requirements	V			3P	0 + 15		
4. Assembly & Cross – Sectional Drwgs.				3P	0 + 15		
5. Complete Part List/Bill of Materials including Vendor & Original Mfr's Numbers.		3P	TS				
6. Fabrication Detailed Drwgs.	V			3P	0 + 15		
7. Electrical Schematics & Wiring Diagrams.	V			3P	0 + 15	S	D
8. Control & Instrument Drwgs. & Specifications.							
9. Driver Data Specifications Requirements.							
10. Piping Drwgs.							
11. Vendor Data Sheets.	V	3P	TS	3P	0 + 15	S	D
12. Test Certificates.						6P	D
13. Code/Material Certifications.	V						
14. Erection & Installations instructions.							
15. Operation & Maintenance instructions.				3P	0 + 15	6P	D
16. Lubrication Schedule: Frequency & Type.				3P	0 + 15	6P	D
17. Fabrication Schedule & Periodic Progress Report.	V						
18. Priced Recommended Spare Part list for 10 Years Operation.	V						

ABBREVIATIONS

- DRAWINGS QUANTITY & TYPE Indicated above, P=Print, S=Sepia, T=Plastic Transparency, e.g. 3S=Three Sepias.
- DRAWING SCHEDULE Indicated above, 0=Date of Order, D=Date of Despatch, A=Date of Approval, TS=Date of Tender submission, e.g. 0+30=30days after date of Order.

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APPENDIX C

CABLE SIZES AND GLANDS FOR ELECTRIC MOTORS

POWER (KW)	FULL LOAD CURRENT (A)	N2XY CABLE SIZE (MM²)	TAPPING IN MOTOR TERMINAL BOX FOR CABLE GLAND	
			PG	M
0.22	0.8	4x2.5	13	20
0.37	1.1	4x2.5	13	20
0.55	1.5	4x2.5	13	20
0.75	2.0	4x2.5	13	20
1.1	2.7	4x2.5	13	20
1.5	3.5	4x2.5	13	20
2.2	4.9	4x2.5	13	20
3	6.5	4x2.5	13	20
4	8.5	4x2.5	13	20
5.5	11.0	4x2.5	13	20
7.5	14.7	4x4	21	25
9.2	18.6	4x4	21	25
11	21.6	4x6	21	25
15	28.0	4x10	29	32
18.5	34.7	4x16	29	32
22	41.0	4x16	29	32
30	55.0	3x25/16	29	40
37	69.0	3x35/16	36	40
44	80.0	3x50/25	36	40
55	99.0	3x70/35	48	50
75	132	3x95/50	48	50
90	165	3x120/70	--	63
110	195	3x150/70	--	63
132	235	2(3x70/35)	2x48	2x50
160	285	2(3x95/50)	2x48	2x50
200	344	2(3x120/70)	--	2x63
250	438	2(3x150/70)	--	2x63
390	560	3(3x150/70)	--	3x63
430	620	3(3x150/70)	--	3x63

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APPENDIX D

MOTOR DATA SHEETS