



High Voltage Induction Motors



LS LAURENCE
SCOTT Technology in Motion

The Company

Since 1883 Laurence Scott Ltd has been a leading designer and manufacturer of electrical rotating machines and control gear, pioneering the application of electrical power in many fields.

In June 2007, the former Laurence, Scott & Electromotors Ltd, was purchased by A-Tec Industries, through their ATB Group and now becomes ATB Laurence Scott Ltd. This adds the company to an already illustrious stable of international electric motor manufacturing companies including Schorch, Morley Motors and Brook Crompton Parkinson Motors.

The Company has accumulated extensive experience and skill in a broad spectrum of industries world wide including: processing and manufacturing, petrochemical, power generation, mining, marine, offshore (oil and gas exploration and production), desalination, nuclear and defence.

The Norwich facility is now the Centre of Excellence for the manufacture of MV and HV Induction Motors. The product range has been enhanced by the integration of the Brush ranges of induction motors, which are now manufactured at Norwich.

The Products

Our motors are distinguished by performance characteristics configured to suit individual application needs, leading to excellent product reliability and long in-service life. The Norwich factory can offer standard induction machines or slip ring machines, either as direct repeats of original designs from ATB Laurence Scott and BEM or as more modern developments based on technological improvements generated by these well-respected design teams.

All application-specific machines are developed from standard base designs, allowing us to provide excellent and competitive prices. The complexity of variations available means that this brochure only describes the basic features of our machines, with detailed information about specific aspects or particular applications being available against your enquiry/tender documents. Please feel free to contact our sales department directly.

Quality Assurance

The design and manufacturing processes are administered by the Company quality management system that has been assessed and certified to meet the requirements of ISO9001.



Precision Rotor Balancing Shop



Automated Lamination Production Line



High Voltage Core Winding Shop



Extensive CNC Machine Shop

Facilities

Company resources include Computer Aided Design and Manufacture based on an extensive NT network. High precision machining is ensured by Computer Numerically Controlled machine tools, providing rapid setting-up and accurate repeatability.

Design and development work is enhanced by the use of 3D finite element analysis software and an extensive suite of other computer based analysis systems for use in rotor dynamics, noise, thermal, stress analysis and electromagnetic studies.

Our test bed facilities are among the most comprehensive available with capabilities for testing up to and including 13,800 volts for both 50Hz and 60Hz supplies, with direct loading of machines up to 7500kW. Other test facilities include motor test rigs and controlled environments for ageing and humidity testing insulation systems.

These resources are regularly updated and maintained at the forefront of their respective technologies. The Company has selected, attracted and trained a team of highly qualified electrical and mechanical engineers, many of them experts of international standing in their own fields.

This combination of resources, expertise and experience enables a 'conception to commissioning and take over' approach to customer requirements and maintains constant updates in the design and manufacture of electrical equipment of high reliability and quality for demanding and sophisticated applications throughout the world.

Product Ranges

More than a century of experience has supported the development of the range of AC Induction motors. The product ranges cover ratings from 100 kW to 20 MW, from 3.3kV up to 13.8kV for all industrial and marine applications. The rationalised but versatile ranges allow rapid adaptation to meet customers' specific requirements. They include Norac/Puma series heat exchanger motors, M series TEFC and E series flame proof motors. The machines are of simple and robust construction having proven reliability and cost effective operation in a wide variety of industries and environments. In addition, The Company has gained a particular and highly regarded reputation for the design and application of low starting current motors and large 2 pole motors.

Specification

In standard form, the machines are manufactured to EN60034. Where specified, however, machines can be supplied to meet other national and international standards, as well as contractors' and end users' specifications such as;

- NEMA
- CSA
- API541
- EEMUA 132
- Shell DEP

Hazardous Areas

Hazardous area electrical machines are a speciality, and we have been responsible for many advances in design for use on offshore platforms and petrochemical plants. our product ranges are suitable for operating in hazardous areas in all types of Ex enclosure;

- Ex n – EN60079-15
- Ex e – EN60079-7
- Ex p – EN60079-2
- EEx d – EN60079-1

All products are independently certified to European Norm and incorporate the latest ATEX requirements. Certification to IEC and other national standards also available.

Supply

The product ranges are designed for voltages from 3.3kV to 13.8kV, appropriate to the required output and are available for 50 or 60Hz supplies on fixed speed drives. Variable speed machines and drives are designed to satisfy the particular requirements of individual applications.

Poles

From 2 poles to in excess of 20 are available. Multi-speed designs are available using PAM (Pole Amplitude Modulated) windings or alternatively machines with separate windings for each of the speeds can be specified.





Starting

All motors are designed to withstand the stresses associated with direct-on-line (DOL) starting. Where appropriate other starting methods such as auto-transformer, capacitor and reactor start or AC frequency converter can be employed. As a viable alternative to the above we can offer reduced current starting designs, with extensive references down to 270% of full load current. Employment of such designs has helped eliminate the associated cost and maintenance requirements of soft starters.

Ambient Conditions

Unless otherwise stated, air cooled motors are designed for operation in a maximum air temperature of 40°C and an altitude not exceeding 1000 metres. We are experienced in designing motors for operation in extreme ambient conditions from -50°C to +60°C.

Noise

The reduction of environmental pollution by noise has been given special attention during the development of present product ranges. Therefore the noise requirements of EN60034-9 can be met without difficulty. Further noise reduction is possible by means of various special provisions, dependent upon machine type, operating speed and the degree of attenuation required.

Transient and Surge Conditions

Stator winding insulation systems have been designed and developed to withstand both the electrical and mechanical forces generated under transient conditions. Such conditions include starting, supply system short circuits and rapid re-switching.

In particular the insulation systems have been developed to endure the surge withstand levels required by EN60034-15.



Product Range - Construction

Frame and Enclosure

Ranges include fin-cooled frames manufactured from grey cast iron, spheroidal graphite iron or fabricated carbon steel. CACA and CACW box frame motors and larger motors employing unit construction on a base plate with pedestal-mounted bearings are all fabricated from carbon steel.

Stator Winding

The standard stator winding insulation is the NORFAST Vacuum Pressure Impregnation Class F system using Class H materials. The insulation system is based on mica tape and employs a split resin impregnation technique that gives a low viscosity and highly reactive system, which ensures maximum penetration with minimum drain-out characteristics. Once fully impregnated, the system provides a consolidated winding which exceeds the requirements of NEMA MG. 1-20.18 for sealed windings.

Stator windings consist of coils all having the same level of turn insulation. Each coil is formed from pre-insulated rectangular copper conductor and insulated with mica tape. For higher voltages, the slot portion includes a resistive corona shield to reduce voltage stress on the edges of core laminations. An additional semi-conducting layer is applied at the slot ends for the purpose of grading surface voltage stress.

Once coils are assembled into the open slots of the core, the end windings are securely blocked and braced for excellent mechanical strength against electrical starts and short circuit. The whole assembly is consolidated through impregnation under vacuum. The wound stator is finally baked at high temperature, whilst being continuously rotated on rollers to cure and fully consolidate the insulation system.

Stator Core Pack

The stator core is assembled from varnish insulated laminations produced at the same time as rotor laminations on an automated lamination precision punching and notching line, thus ensuring the best electrical and mechanical compatibility for rotor/stator packs. Lamination packs with the endplates are assembled onto a mandrel and consolidated before welding/fixing to produce a high integrity core pack.



Rotor

The rotor core pack is shrunk onto the shaft assembly while clamped under pressure to ensure maximum integrity. Cage-type rotors have copper or copper alloy bars brazed to jointless short-circuiting endrings of material appropriate to the electrical and mechanical requirements. Alternatives include various copper alloy bars, non-standard bar profiles or slip-ring rotors, which are available for individual applications.



Shafts are normally manufactured from either normalised carbon steel bar or carbon steel forgings. Various shaft ends are available including parallel shaft end with keyway, tapered shaft end or integral flange.

All rotors are dynamically balanced to ISO 1940/1. All rotors have at least two-balance planes. On larger and higher speed rotors, a third balance plane may be utilised.

Motors are normally fitted with shaft mounted uni-directional fans to minimise energy losses.

Bearings

Bearings are dependent on application and machine type but typically rolling element bearings are endshield mounted and grease lubricated. Some high speed arrangements may utilise a circulating oil bath arrangement. Rolling element bearings are designed to have an L10 life greater than 40,000 hours. Where required, bearings are electrically insulated to prevent damage from circulating shaft currents.

Where appropriate to suit output, duty, ambient conditions or customer-requested, oil lubricated sleeve bearings may be specified either as self-contained or force lubricated. Depending on frame size, sleeve bearings may be either endshield mounted or pedestal mounted. All sleeve bearings are supplied with oil rings, sight glasses and insulation between the bearing shell and housing; the drive end bearing is supplied with a shorting strap for normal operation. On sleeve bearings for force lubrication the oil rings provide a run down facility in the event of oil supply failure.

Single bearing machines with solid couplings, forged integrally with the drive shaft, are available on request.

For vertical machines, there are several bearing arrangements available to suit the application. These can range from angular contact rolling element bearings, which could be either grease lubricated or oil bath lubricated, to white metal and tilting pad bearing arrangements.

Cable Terminations

Various forms of cable terminations are available including fault rated, pressure-relieved terminal boxes. A selection of available terminal boxes includes:

- Air insulated
- Phase insulated
- Phase segregated
- BEAMA/CEGB
- Elastomeric type bushings

Terminal enclosures to house Lightning Arrestors, Surge Capacitors and Current Transformers are also available.

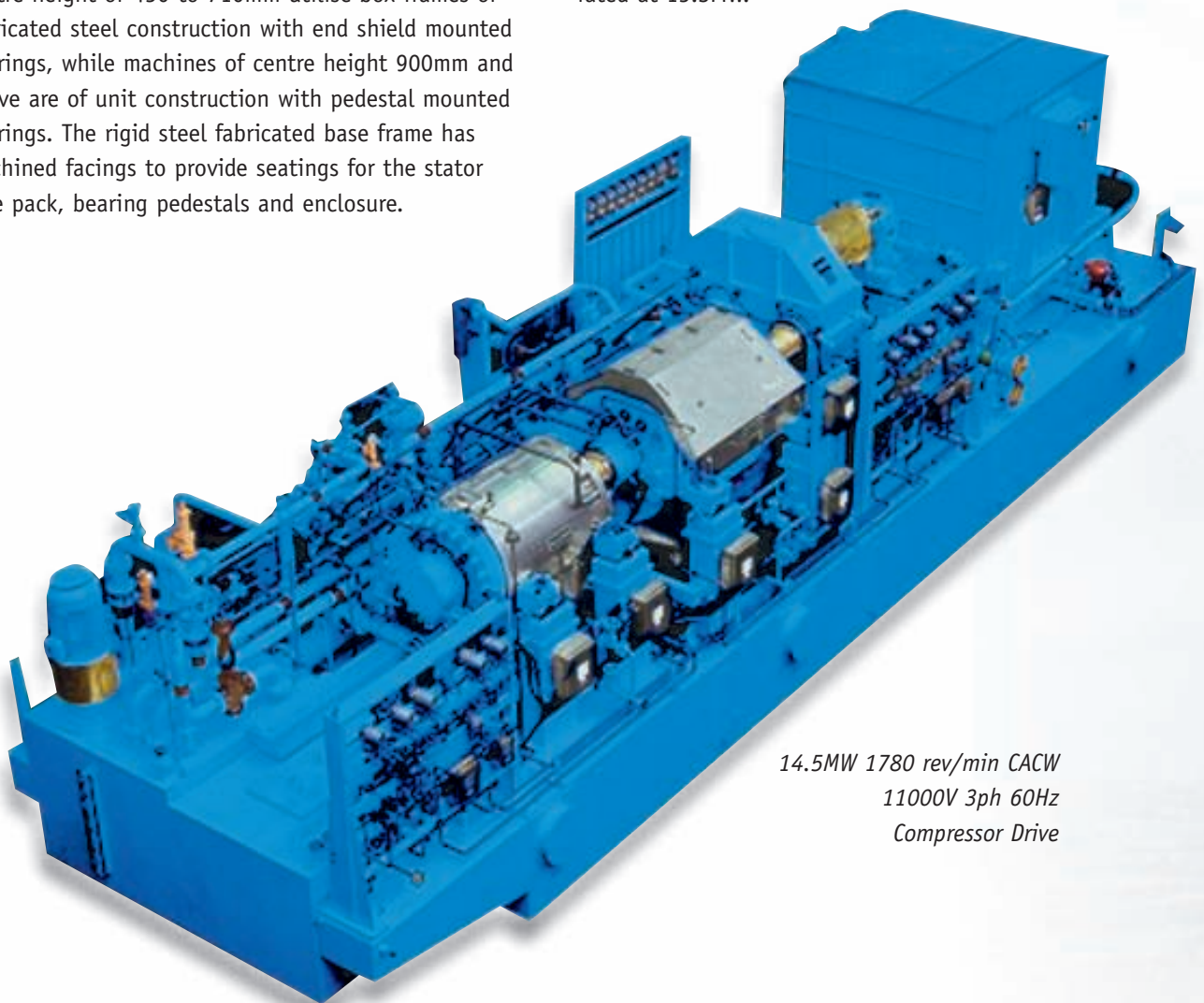
P-Series

An extension of Laurence Scott's long established and acclaimed NORAC range, the P-Series maintains the strengths of the NORAC and the flexibility to adapt but now incorporates fabricated steel "Box" frame construction for the smaller frame sizes. With proven reliability and cost effective operations in a wide variety of industries and environments, the P-Series continues the concept of satisfying the need of individual users with a rationalised but versatile range of machines.

The range covers ratings up to 20MW for supply voltages from 3.3kV to 13.8kV at 50Hz or 60Hz. Machines with a centre height of 450 to 710mm utilise box frames of fabricated steel construction with end shield mounted bearings, while machines of centre height 900mm and above are of unit construction with pedestal mounted bearings. The rigid steel fabricated base frame has machined facings to provide seatings for the stator core pack, bearing pedestals and enclosure.

The range is designed to accommodate top mounted enclosures or heat exchangers. As such, the IP code can range from IP22 for simple open ventilated motors to IP55 or IP56 with air or water cooled heat exchanger. NEMA I or NEMA II enclosures are also available.

The strength and versatility of the range has allowed us to design and apply its technology in many arduous and difficult environments, including as examples the two largest off-shore induction motors currently in operation, one on a North Sea Oil Production Platform, rated at 14.5MW and the other in the Caspian area rated at 15.3MW.



*14.5MW 1780 rev/min CACW
11000V 3ph 60Hz
Compressor Drive*

2 Pole Applications

The proven design has allowed The Company to record an enviable reference list for large 2 pole motors. One of the largest 2 pole motors in operation is an 8.5MW motor driving an air blower on a North Sea platform.

Our ability to supply large two pole motors has proven to be beneficial to the pumping industry whereby gearboxes for large P-Series drives can be omitted and the pump driven directly by the motor. Over the years we have supplied many 2 pole motors for pumps and compressors ranging up to 7.5MW for both 50Hz and 60Hz supply.



*4100kW 3550 rev/min CACA
11000V 3ph 60Hz
300% FLC-Water Injection Pump Drive*

Low Starting Current Applications

With the flexible and effective ventilation system of this range, we have designed and manufactured some of the world's largest motors with reduced starting current. Low starting current designs have been installed on many offshore platforms and FPSO's, where the power generation is limited and in onshore facilities fed from low capacity lines. Use of DOL low starting current designs can provide a cost-effective solution, removing the need for expensive electronic variable frequency starters or other forms of soft starters.

In conjunction with the system designer and the driven equipment designer, motors with starting currents down to 270% of full load current (FLC) have been produced. These designs minimise the impact on the line during starting of the motors but have sufficient torque to accelerate the driven equipment up to full speed. Typically most applications are in the region of 300 to 350% which provides an acceptable value of pull out torque, allowing sufficient margin for the motor to ride through momentary voltage depression. Designs with starting current as low as 240% have been produced but are generally not offered due to the associated unacceptably low value of pull out torque.

We have supplied nearly 350 motors with starting current of 450% FLC or less, which have been commissioned for operation around the world. The ratings range from 500kW to 15.3MW. One of the lowest starting current designs was a 10.6MW motor driving a gas compressor for a FPSO. The starting current of this motor was 270% of full load current.



*9500kW 1478 rev/min CACW
11000V 3ph 50Hz
290% FLC-Compressor Drive*

P-Series



10750kW 1770 rev/min CACW
13800V 3ph 60Hz
LP/IP Compressor Drive Motor
320% FLC



925kW 425 rev/min CACA
3300V 3ph 60Hz
Reciprocating Compressor Drive Motor
500% FLC



7060kW 2970 rev/min CACW
11000V 3ph 50Hz
Main Oil Pump Motor
320% FLC



2635kW 1480 rev/min CACA
6600V 3ph 50Hz
Water Injection Pump Motor
300% FLC



3000kW 890 rev/min CACW
6600V 3ph 60Hz
Vertical Thruster Motor
500% FLC



4300kW 1772 rev/min CACA
1100V 3ph 60Hz
Low Noise Compressor Motor
300% FLC



P-Series Specification

	Standard	Option
Type	Cage Induction	Slip Ring
Frame Sizes	450 to 1400	
Output	Up to 20000kW @ 4 Pole speed	
Voltage	3150 to 13800V	Others
Mounting	Horizontal or Vertical	
Frequency	50Hz or 60Hz	Variable Frequency Supply
Poles	2 to 16	Others, Multiple-pole
Cooling	CACA (TEAAC) CACW (TEWAC)	Open Ventilated NEMA I or II
Ingress Protection	IP55	IP22 to IP 56
Mounting (EN60034-7)	IM1001, IM7011 and IM7211 IM3011	Others
Temperature Rise	Class B	Class F
Duty	S1	Others
Insulation	Class F, VPI	Class H, VPI
Bearings	Grease Lubricated Rolling Element Bearings	Oil – Lubricated Sleeve Bearings (Standard on some sizes)
Main Terminal Box	Air Insulated for fused supplies Or Elastomeric termination	Phase Insulated Phase Segregated BEAMA/CEGB Others
Ambient Temperature	-20°C to +40°C	-50°C to +60°C
Starting	Design N	Design D Low Starting Current High Starting Torque
Starting Method	DOL	Others
Noise Level Mean Sound Pressure Level @ 1m, No Load	81 dB(A)	Refer to LSE for lower noise level.
Vibration	Grade A to EN60034-14	API 541
Standards	EN60034-1 IEC 72: Pt 2	NEMA MG1 Customer Specific
Area Classification	Safe Area	Ex n to EN60079-15 Ex e to EN60079-7 Ex p to EN60079-2

M-Series

A new range of high voltage, high efficiency TEFC cage induction motors. The range covers ratings from 125kW to 1500kW, 50Hz (200 to 1800kW, 60Hz) in frame sizes 355, 400, 450 and 500 and supply voltages 3.3kV to 13.8kV, 50 or 60Hz. The M-Series is available with standard designs for 2 to 8 pole, in either horizontal or vertical mounting configurations with IP56 enclosure protection. Renowned expertise in low starting current design is also available with the M-series range.

The robust construction includes cast iron frames and endshields with form-wound stator coils and copper or copper alloy rotor cage providing a design life of 20 years.

The use of the Laurence Scott NORFAST insulation system, providing high thermal conductivity combined with low loss shaft mounted external fan and a novel back of core internal air circuit delivering highly effective cooling, ensure exceptional in-service running hours.

Lead-time for this range of machines has been reduced through a deliberate rationalisation of production methods and component procurement, whilst still retaining the flexibility to offer application-specific motors.



550kW 2980 rev/min
11000V 3ph 50Hz
Low Noise Pump Drive Motor



850kW 1480 rev/min
6000V 3ph 50Hz
Pump Drive Motor (400% FLC)



340kW 1480 rev/min
3300V 3ph 50Hz
Vertical Pump Drive Motor



1380kW 2980 rev/min
6600V 3ph 50Hz
Treated Water Pump Motor

M-Series Specification

	Standard	Option
Type	Cage Induction	-
Frame Sizes	355 to 500	-
Output	125 – 1500kW @ 4 Pole speed	
Voltage	3300, 4160, 6600	Other voltages to 13.8kV
Mounting	Horizontal or Vertical	-
Frequency	50Hz or 60Hz	Variable Frequency Supply
Poles	2 to 8	Others, Multiple-pole
Cooling	Air Cooled, TEFC, IC4A1A1	-
Ingress Protection	IP56	-
Mounting (EN60034-7)	IM2001 – Horizontal Foot IM3011 – Vertical Flange	IM2001 – Horz. Foot and Flange IM3811 – Vertical Skirt
Temperature Rise	Class B	Class F
Duty	S1	Others
Insulation	Class F, VPI	Class H, VPI
Bearings	Grease Lubricated Rolling Element Bearings	Oil – Lubricated Sleeve Bearings (standard on 500 2 Pole)
Main Terminal Box	Air Insulated for fused supplies	Phase Insulated Phase Segregated BEAMA/CEGB Elastomeric termination
Ambient Temperature	-20°C to +40°C	-50°C to +60°C
Starting	Design N	Design D Low Starting Current High Starting Torque
Starting Method	DOL	Others
Noise Level Mean Sound Pressure Level @ 1m, No Load	2 Pole: 81 dB(A) 4 Pole and up: 80 dB(A) (60Hz +3dB)	Refer to LSE for lower noise level.
Vibration	Grade A to EN60034-14	API 541
Standards	EN60034-1 IEC 72: Pt 2	NEMA MG1 Customer Specific
Area Classification	Safe Area	Ex n to EN60079-15 Ex e to EN60079-7 Ex p to EN60079-2

Series 'E' Flameproof Motors

The E series of flameproof motors is an established range designed to meet the needs of modern industry with the flexibility to satisfy most applications over a wide range of outputs, speeds and voltages. Output ratings range from 75kW to 2500kW for voltage supply from 3.3kV to 11kV at 50Hz and 60Hz and cover certification for group IIA, IIB and IIC gases.

The motor enclosure is designed to withstand the increased pressure that results from the ignition of a flammable gas or vapour within the machine and to do so without transmitting the flame through enclosure joints to the external hazardous atmosphere.

The robust construction features fabricated steel stator frame and steel or cast endshields. For frame sizes from 315 to 450, motors are of surface cooled ribbed frame design. For frame sizes 560 and 630, the range utilises a frame with integral tube air to air heat exchanger.

Bearings are grease lubricated rolling element type with grease escape facility. Larger 2 pole units have rolling element bearings with an oil circulation system. A phase insulated Ex e terminal box is normally provided. Fault containing, phase segregated EEx d and Ex e Elastomeric type terminations are available as options.



300kW 2979 rev/min
3300V 3ph 50Hz
Water Pump Drive



648kW 3129 rev/min
3460V 3ph 52Hz
Variable Speed Drive
Crude Oil Transit Pump

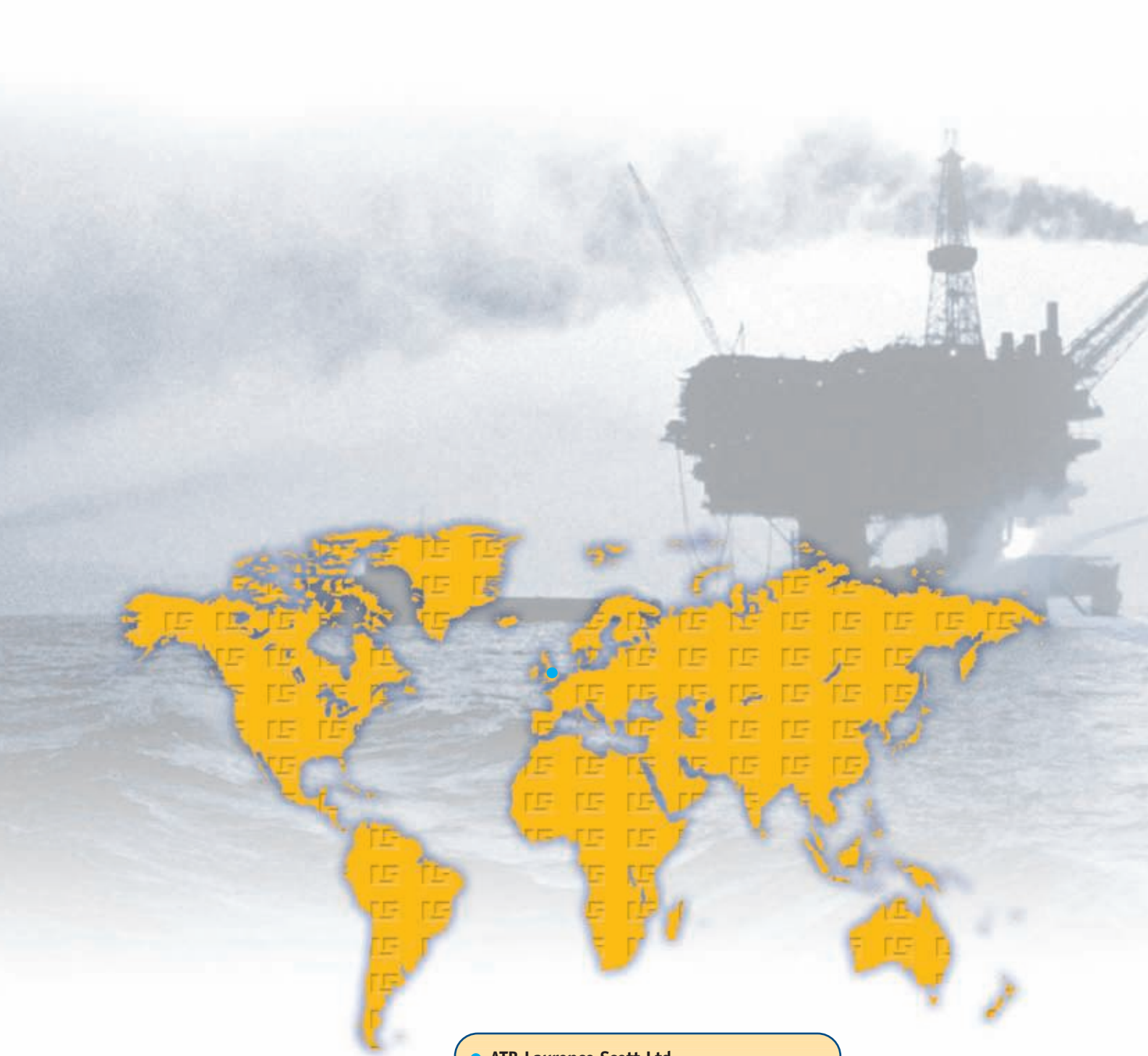


1120kW 3084 rev/min
3410V 3ph 52Hz
Variable Speed Drive
Crude Oil Transit Pump



E-Series Specification

	Standard	Option
Type	Cage Induction	-
Frame Sizes	315 to 630	-
Output	75 – 2500kW @ 4 Pole speed	
Voltage	3300, 4160, 6600	Other voltages to 11kV
Mounting	Horizontal or Vertical	-
Frequency	50Hz or 60Hz	Variable Frequency Supply
Poles	2 to 8	Others, Multiple-pole
Cooling	Air Cooled	-
Ingress Protection	IP44	IP56
Mounting (EN60034-7)	IM2001 – Horizontal Foot IM3011 – Vertical Flange	IM2001 – Horz. Foot and Flange IM3811 – Vertical Skirt
Temperature Rise	Class B	Class F
Duty	S1	Others
Insulation	Class F, VPI	Class H, VPI
Bearings	Grease Lubricated Rolling Element Bearings	Oil – Lubricated Rolling Element Bearings
Main Terminal Box	Phase Insulated (Ex e)	Phase Segregated (EEx d) Elastomeric termination (Ex e)
Ambient Temperature	-30°C to +55°C	Please refer to LSE.
Starting	Design N	Design D Low Starting Current High Starting Torque
Starting Method	DOL	Others
Noise Level Mean Sound Pressure Level @ 1m, No Load	85 dB(A)	Refer to LSE for lower noise level.
Vibration	Grade A to EN60034-14	API 541
Standards	EN60034-1 IEC 72: Pt 2	NEMA MG1 Customer Specific
Area Classification	Ex d to EN60079-1 for group IIA and IIB.	Group IIC Gases Australian standards AS2380: Pt 1 AS2380: Pt 2



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- *Cage induction motors up to 20,000kW, 20 poles*
- *Flameproof motors*
- *Range of Power Transmission Products*



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