TECHNICAL TRAINING SOLUTIONS

ELECTRICAL COURSES | INSTRUMENTATION COURSES | MECHANICAL COURSES

LEARNING BY DOING

MOTION CONTROL

COURSE 575: 3 DAYS: Max 8 Candidates

Modern motion control systems use a variety of technologies including inverters, servos, steppers etc. This course covers everything a technician needs to maintain motion control systems.

PARTICIPANTS

Suitable for anyone who is required to maintain or configure motion control systems (electricians, instrument technicians, etc). Whilst a knowledge of basic electrical principles is desirable, no prior knowledge of motor theory or electronics is necessary.

COURSE PRESENTATION

The practicalities of configuring, fault-finding and maintenance are demonstrated and then practised by participants on purpose built training rigs allowing considerable experience to be gained on a representative range of proprietary motion control systems. The course is supported by comprehensive course notes. Candidates gain experience of using Danfoss, Siemens, Mitsubishi, Omron and Allen Bradley drive systems.

COURSE OBJECTIVES

On completion of the course, participants will be able to

- apply safe working practices when working with variable speed drives
- demonstrate an understanding of the principles of operation of a range of motion control systems
- correctly configure, operate and monitor motion control systems
- identify and correct configuration errors
- differentiate between drive faults, motor faults and power faults
- differentiate between control / power circuit drive faults
- appreciate the concepts of fieldbus communications and SCADA systems.

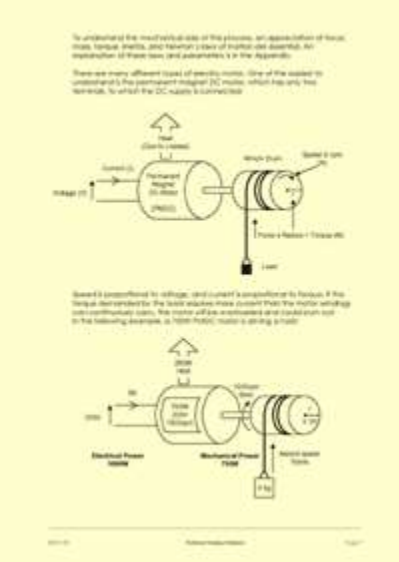
The Motion Control course is a combination of the AC Inverter Drives (580) and the Steppers & Servos (590) courses. It combines the knowledge of AC Drives and the skills associated with Steppers & Servos to ensure that candidates fully understand modern motion control systems.

Successful completion of the course leads to the award of the Technical Training Solutions Certificate of Competence 575: Motion Control.

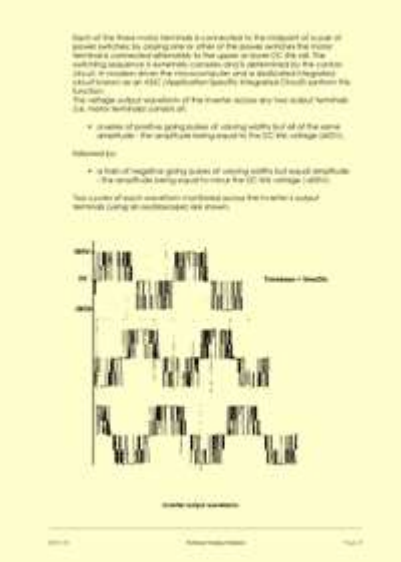
What do candidates on the Motion Control course actually do?

The course begins by looking at ac inverter drives and provides an extensive understanding of the relationships between speed and torque and voltage and frequency of industrial motors.

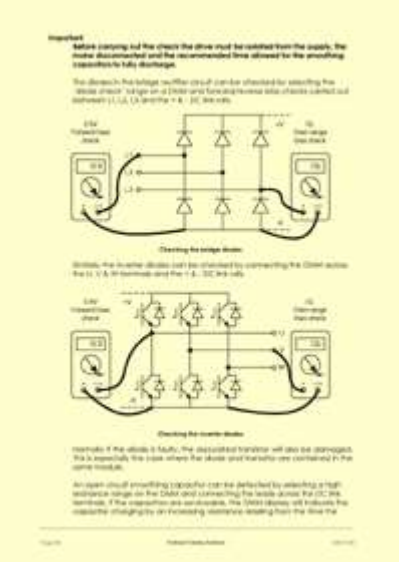
The course notes are quite extensive and explain how ac drives create the PWM output signal as a method of simulating a variable-voltage variable-frequency sinewave, without getting involved in the underlying theory. For example, we would look in detail at what signals are produced at the output of a drive, but only very briefly at how the remainder of the electronics work. Some sample pages from the course notes give an indication of this approach:



Page 7 of the notes, describing how torque and speed are related



Page 27 of the notes, showing what the PWM waveform generated by electronic motor drive units looks like



Page 48 of the notes, describing the typical faults developed in the drive output stages and how to find them

Candidates then have the opportunity to configure an industrial drive unit connected to a real three-phase motor on one of our specially-designed training rigs. Each of the major manufacturers of drive units are represented. Candidates can explore how changing the parameters of the drives alters their behaviour at start-up, while running at various speeds, and at switch-off. All of this can be done in perfect safety - an opportunity they are unlikely to have with the drives they have in their workplaces.

The Omron training rig: a real industrial drive connected to a real 3-phase motor so that candidates can explore the effects of changing parameters on the Omron drive

The Siemens training rig: a real industrial drive connected to a real 3-phase motor so that candidates can explore the effects of changing parameters on the Siemens drive

The Mitsubishi training rig: a real industrial drive connected to a real 3-phase motor so that candidates can explore the effects of changing parameters on the Mitsubishi drive

The Allen Bradley training: a real industrial drive connected to a real 3-phase motor so that candidates can explore the effects of changing parameters on the Allen Bradley drive

Candidates use various sorts of test equipment throughout the course. Standard digital multimeters are used to test the serviceability of a drive's power module (the most commonly failing part in any drive unit), tachos are used to measure the motor speed accurately, current clamp meters are used to monitor the current flow to the motor and a digital oscilloscope is used to analyse the drive's PWM output waveform.

The current probe used on the motion control course

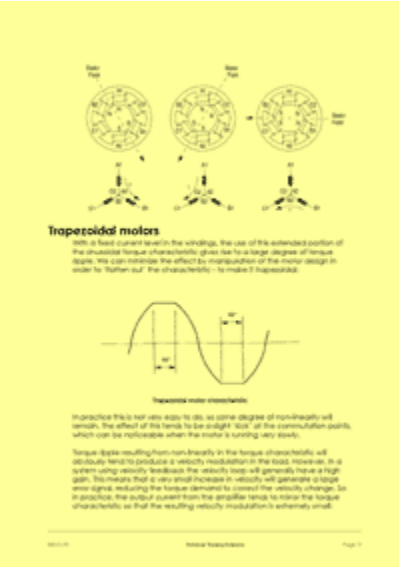
The digital storage oscilloscope used on the motion control course

The electronic tacho used on the course

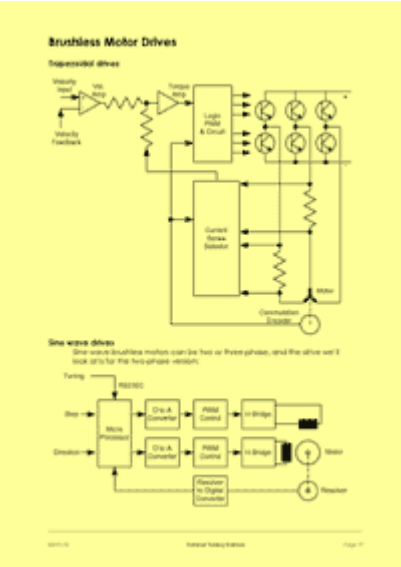
Safety issues are, of course, paramount considerations, and the dangers of incorrect parameter settings, the dangers of electric shock whilst working 'live' and making measurements (particularly with regard to the high energy capacitors found inside inverter drives), as well as the physical dangers associated with unexpected motor movement are all covered on the course, as are the important issues of EMC and installation earthing and suppression components.

On the second day of the course we move onto Steppers and Servo drives and we begin by analysing the range of motion control methods commonly used in industry - positional control, speed control and torque control. The various applications of these control methodologies are discussed, by describing the common requirements of packing machines, robots, palletizers etc. We look at how servosystems work, their maintenance issues and what typically goes wrong with them. We look at the particular problems of regeneration, causes of servomotor bearing failure, the effects of mechanical shocks on servomotors etc.

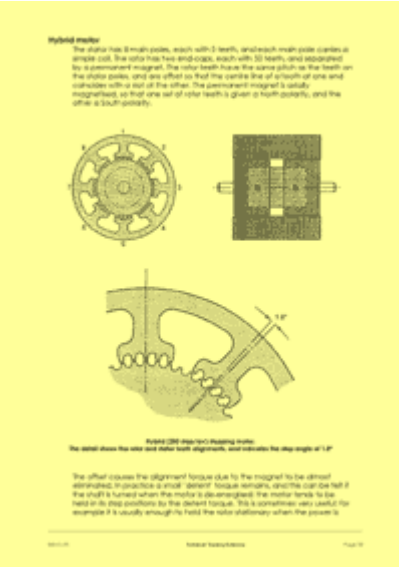
The following are some extracts from the course notes, showing how trapezoidal characteristics are designed into servomotors, how brushless motor drives work and how stepper motors work.



Page 11 of the course notes, showing how trapezoidal characteristics are designed into servomotors



Page 17 of the course notes, showing how brushless motor drives work



Page 33 of the course notes, showing how stepper motors work

The candidates practice configuring and tuning an industrial servodrive using PC-based software, programming it to respond to signals from a remote control unit, which simulates HMI or control panel inputs to the drive. Candidates then practice making the servomotor start, stop, ramp up and down and run at various speeds.

Candidates use an ac brushless servomotor to explore the operation of industrial servos

We use a remote control unit to control the servodrive on the motion control course

Candidates use an industrial servodrive to investigate the various motion control parameters that can be changed and also configure the drive's responses to inputs from the remote control unit

We then look at the range of stepper motors commonly used in industry, looking at how they work and where and why they would be used in preference to servomotors (cost factors, reliability issues etc). The various applications of stepper motors are discussed (print registration, etc). We look at how stepper drives work, the complex electrical connections required, their maintenance issues and what typically goes wrong with them. We discuss the particular issues of slewing, resonance and other problems.

The candidates use a specially designed stepper drive unit (allowing them to explore the uses of unipolar, bipolar and microstepping drive types) which can run at extremely low speeds so that they can actually see the drive signals sent to the stepper motors in the various different modes of operation (half-step, microstepping, wav etc). This aids in their understanding of stepper motors and the associated drive units.

Candidates use an industrial hybrid stepper motor to explore the operation of industrial stepper motors

We use a specially-designed stepper drive unit with unipolar, bipolar and microstepping outputs, capable of running at very low speeds so that candidates can see the signals produced by the drive in half-stop, microstepping and wav drive modes

Candidates use an optical tacho to measure the speed of the various motors used on the course

If you would like to see some of the equipment used on the motion control course for yourself, then please call us to arrange a visit to our offices in Kent. Alternatively, we can visit you anywhere in the British Isles.

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