TECHNICAL TRAINING SOLUTIONS

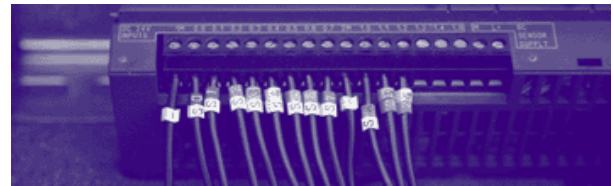| ELECTRICAL COURSES	INSTRUMENTATION COURSES	MECHANICAL COURSES

PLC PROGRAMMING

COURSE 530: 5 DAYS: Max 8 Candidates

Modern PLC-based control and automation systems often have improvements and modifications made, resulting in changes needing to be made to the PLC program. This course provides the skills necessary to understand how typical modern industrial PLC programs work, how to make changes to existing programs and how to create small programs from scratch.

PARTICIPANTS

The course is designed for those who have an electrical background (for example maintenance electricians) who have successfully completed course 520 (PLC Fault Finding). Candidates who subsequently attend more advanced manufacturer-specific programming courses will find that their progress is enhanced by this foundation in PLC programming.

COURSE PRESENTATION

The course is presented using a wide range of industrial PLCs so that candidates learn how different manufacturers employ the programming languages involved. Allen Bradley, Siemens, Mitsubishi and Omron PLCs are used to control a complex training rig incorporating conveyors, solenoids, motors and industrial sensors as a 'target' system to gain the necessary programming skills. Comprehensive course notes are provided.
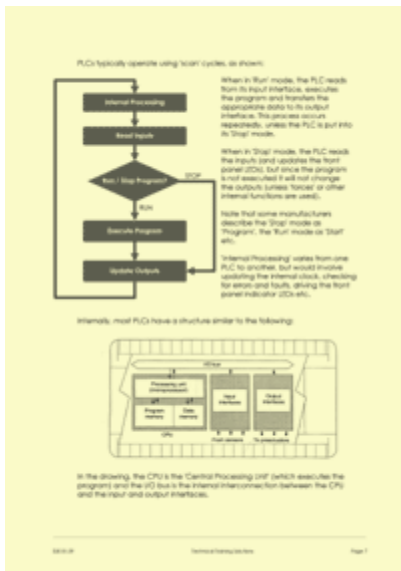
COURSE OBJECTIVES

On completion of the course, participants will be able to

- state the dangers of modifying PLC programs
- use subroutines to structure programs
- use labels and comments correctly
- employ logical commands
- select appropriate types of timers and program them
- select appropriate types of counters and program them
- program mathematical operations (greater than, equal to etc)
- create a PLC program to control a complex machine incorporating several motors, solenoids and sensors, using logical functions, timers and counters etc
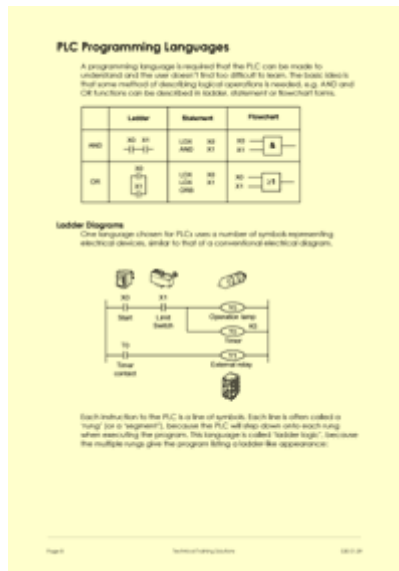- create programs on several different manufacturers' PLCs.

Successful completion of the course leads to the award of the Technical Training Solutions Certificate of Competence 530: PLC Programming.

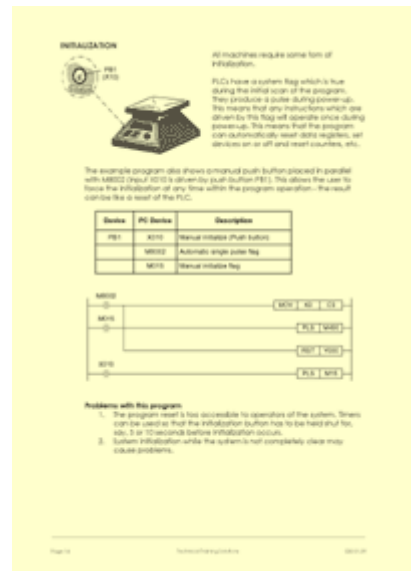# What do candidates on the PLC Programming course actually do?

The PLC Programming course begins by looking at the ways in which PLCs typically work. We study the Scan Cycle used to fetch the input values, execute the program and write the outputs. Our candidates find this useful when progressing further into the course. We also look at the ways in which inputs and outputs are commonly configured in a ladder program to produce a simple outcome, and how this might relate to real-world events. We then analyse various example applications with their respective programs, checking how the suggested programs relate to the applications in question. This is a useful way of highlighting some of the subtle workings of PLCs, like for example the system flags used for initializing the PLC.

Page 7 of the course notes for the PLC Programming course, describing the common PLC Scan Cycle and the typical internal architecture of PLCs

Page 8 of the course notes for the PLC Programming course, explaining the languages used on PLCs and how ladder programs are executed by the PLC

Page 14 of the course notes for the PLC Programming course, which is part of a section where we discuss various PLC applications and how a PLC would be programmed to control them. This particular example is explaining how system flags are often used to initialize programs, by setting counters and other registers to a default state when the program is initiated

We then look at the dangers involved when modifying PLC programs and clarify the legal situation with regard to the competence issues, the various relevant legislative documents etc. We also analyse the root causes of control system failures, using this as a way of reminding the candidates about the safety implications of PLC programming. We also mention the various relevant British Standards, Codes of Practice and typical employers' working procedures to ensure that the candidates understand this.
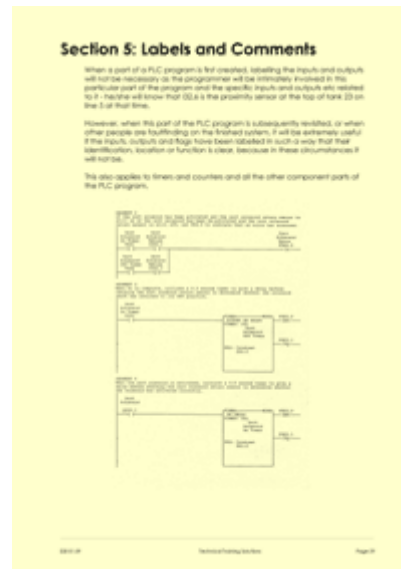
Candidates learn the importance of structuring programs using subroutines and labelling and commenting the program so that they are easily understood by others. We insist that our candidates take a professional approach to the creation of PLC programs and the subsequent practical exercises on the course provide practice at creating and calling their own subroutines and labelling and commenting their own programs professionally.

Page 21 of the course notes for the PLC Programming course, analysing the dangers of programming PLCs and the root causes of control system failures that lead to accidents
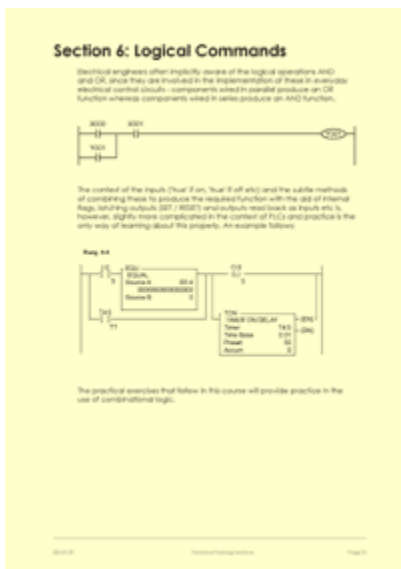
Page 27 of the course notes for the PLC Programming course, explaining the importance of using subroutines to structure programs professionally and how this would typically be achieved in an industrial program
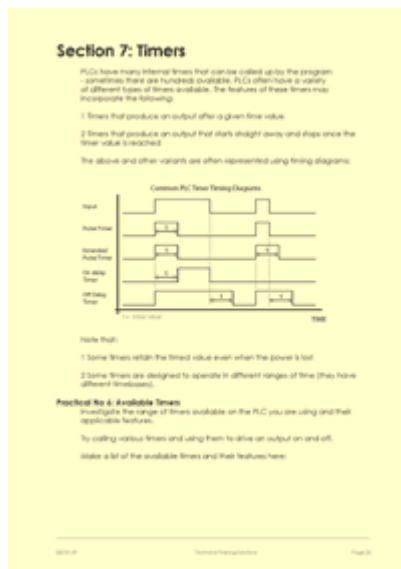
Page 29 of the course notes for the PLC Programming course, explaining the importance of using labels and comments to structure programs professionally and how this would typically be achieved in an industrial program
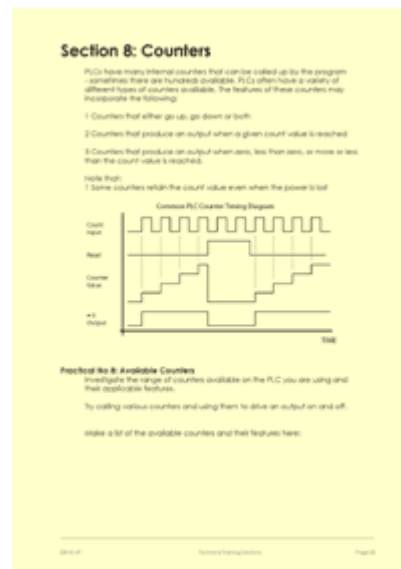
Candidates are shown the ways in which logical expressions (AND, OR, SET, RESET etc) are achieved in PLCs, and how the timers and counters inside the various PLC manufacturers' PLCs typically operate.

Page 31 of the course notes for the PLC Programming course, showing how logical expressions (AND, OR, SET, RESET etc) are achieved in PLCs
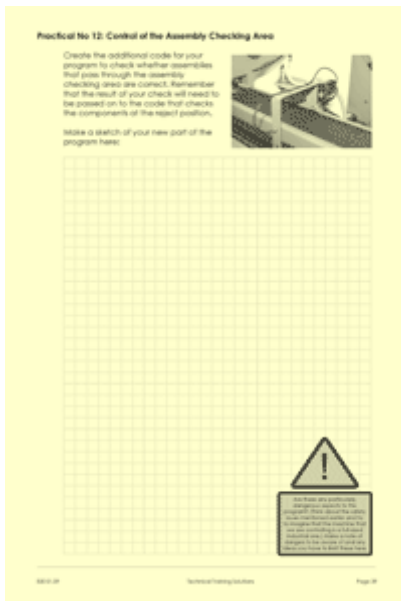
Page 33 of the course notes for the PLC Programming course, describing how PLC timers typically operate

Page 35 of the course notes for the PLC Programming course, describing how PLC counters typically operate

Practical exercises are interspersed in the theoretical part of the PLC programming course. For example, in the exercises shown in the above pictures, as well as learning about the theoretical issues the candidates are also practicing calling subroutines to implement some basic logic functions and exploring how labels and comments are added to their program. They also find out what timers and counters are available on the PLC that they are using and create some basic code to make their PLC generate timing delays and counting functions.

A series of structured exercises follow, where the candidates are given the opportunity to create their own programs to solve various control problems. These consist of getting the PLC to start and stop two conveyor motors correctly, reading several sensors to detect the presence of different targets at a sorting point on a machine and driving an electric solenoid reliably and counting components down a loading chute, using the count value to drive an electrical rotary solenoid which loads a hopper.
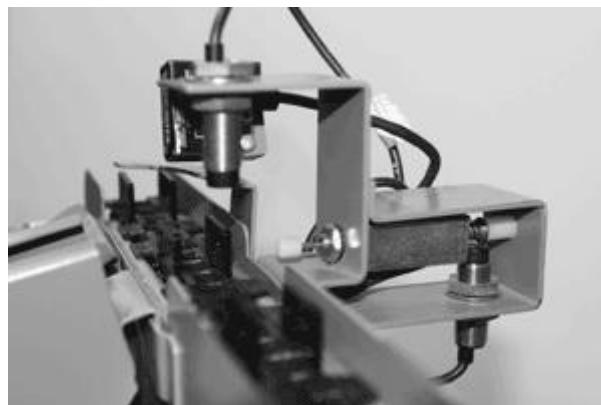

The practical exercises give candidates the opportunity to try out various methods of achieving the required objectives of each of the structured exercises.

Candidates draw their solutions to the practical exercises in their course notes. The page shown here is for one of these exercises.

One of the practical exercises on the PLC Programming course - writing the program that uses the start/stop buttons to control the conveyor motors correctly and safely
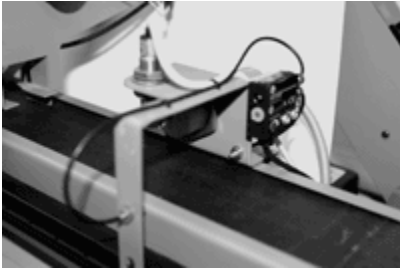
One of the practical exercises on the PLC Programming course - writing the program that sorts components one from another and sending the correct components down an assembly chute
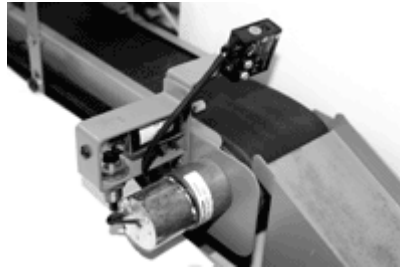
One of the practical exercises on the PLC Programming course - writing the program that loads a hopper at the end of the assembly chute
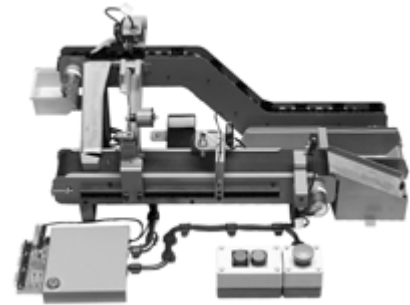
The structured exercises continue (in fact they consume on average 3 out of the 4 days of the course) with a PLC program required to detect if assembled components are correct and rejecting incorrectly assembled components. This can become quite involved since the assembly-checking area is some way along the conveyor from the reject position so often a series of shift registers and other complex programming techniques are required to ensure that the PLC program operates well.

One of the practical exercises on the PLC Programming course - writing the program that checks whether the assembled components are correct or incorrect

One of the practical exercises on the PLC Programming course - writing the program that rejects incorrectly assembled components

The complete conveyor control rig that candidates on the PLC programming course use

On this course we use Allen Bradley PLCs controlled by Rockwell software, Siemens S7 214 PLCs controlled by Step 7 software, Mitsubishi FX0n PLCs controlled by FX-GP WIN software and Omron CP1E PLCs controlled by Sysmac software. We expect candidates to program at least three of these PLCs and we find that the experience of learning about a range of PLCs helps to ensure that they gain a holistic understanding of the subject so that subsequent to the course they could attempt to re-program any type of PLC.

Candidates on the PLC programming course are encouraged to explore other more advanced commands available in the PLCs that they are using and the course also places them in a very strong position for attending manufacturer-specific PLC training courses where the sound foundations achieved in this course would ensure that they gained the maximum benefit from attending more advanced courses.

If you would like to see some of the equipment used on the PLC Programming 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.

CONTACT US

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