cetop

The Voice of the European Fluid Power Industry

EDUCATION RECOMMENDATIONS

★ ***HYDRAULICS PROGRAMME H3***
CETOP Passport Occupational Level 3

RE 2025/01.01-H3

HYDRAULICS & ASSOCIATED CONTROL PROGRAMME (H3): RE 2025/01.01 - H3

CETOP (Passport) Occupational Level 3

INTRODUCTION

This is a LEVEL 3 Hydraulics Programme, forming the start of a series of competency-based qualifications designed around CETOP occupational levels.
It combines the necessary knowledge and competency-based skills for those people on route to this high level of qualification, involving the maintenance and management of both Industrial and Mobile hydraulic systems.

CETOP OCCUPATIONAL LEVEL 3

LEVEL (3) This person will be involved in a broad and often complex range of activities, often requiring independent decisions to be made on technical matters concerning specifications, resources, or processes. Planning of work will be a responsibility, as will the finding and rectification of faults. Responsibility for the quality of work undertaken and the required outcomes are also included.

Throughout the programme, emphasis is placed upon the development of knowledge relating to "FUNCTION"," OPERATION" and" APPLICATION".
The knowledge-based section will support the development and effective application of practical skills necessary to carry out in a safe and effective manner:

- INSTALLATION
- COMMISSIONING
- PERFORMANCE TESTING
- PROACTIVE MAINTENANCE AND MACHINE MANAGEMENT
- SERVICING
- COMPONENT REMOVAL AND REPLACEMENT

The development of planning and preparatory skills, the use of technical information and specifications and the formulation and implementation of safe working procedures will be emphasized throughout all aspects of this programme.

METHODOLOGY AND ASSESSMENT

The programme can be offered via a range of learning modes devised by the Approved Centres, but it is envisaged that distance learning supported by a series of centre-based modules will be the normal system used.

Candidates will be expected to complete a series of assignments throughout the programme of study to reinforce the learning process and attend the programme of centre-based modules.

Final assessment for the knowledge-- based units will be by means of a written examination of 2½ hours duration. These will be prepared and offered at approved centres or at an engaged external examination centre. The pass mark for the written examination will be 70%.

The expected completion time for a competency-based programme is one to three years depending on work experience within hydraulics and will require a high level of personal commitment to study and research the subjects within the syllabus.

Practical task assessments to verify competency against the agreed performance criteria will be carried out at the approved centre during the education programme period. It could be arranged on one-to-one base or in groups, candidate/ candidates to tutor.

All candidates taking a level 3 qualification should have a minimum of 2 years work-based experience involving hydraulics verified by their employer.

Alternative:
Where candidates do not have 2 years work-based experience, they can undertake the qualification but will not receive the award until they have completed two years of verified employment involving hydraulics.

Successful completion of both the knowledge based and competency-based units will result in the award of a CETOP Level 3 Hydraulics Qualification Certificate. Candidates successfully completing only one unit will receive a CETOP Unit Certificate.

PRACTICAL TASK ASSESSMENT (H3)

Assessment Requirements
In practical tasks, candidates must on at least two occasions, prove their ability to carry out the following:

Assessed Ability

H3.1 Interpret hydraulic and Electro-Hydraulic circuit diagrams applicable to selected systems (against recommended specification)
and prepare a schematic representation of the system.

Evidence Required

H3.1.1 Machine function and operating principles identified.
H 3.1.2 Components correctly identified.
H 3.1.3 Function and operation of individual sub-circuits correctly identified.
H3.1.4 Machine control inputs and outputs identified.

Assessed Ability

H3.2 Assemble a hydraulic system from given information and establish suitable maintenance procedures.

Evidence Required

H3.2.1 Components selected, and conformance checked against system specification.
H 3.2.2 Installation plan prepared.
H3.2.3 System assembled in a safe and efficient manner.
H3.2.4 Commissioning procedures followed in accordance with technical specification.
H 3.2.5 Startup procedures correctly specified and followed.
H3.2.6 System operated according to specification.
H3.2.7 Establish predictive maintenance procedures to be followed, including:
- component performance testing
- fluid sampling and assessment of contamination level against target level.
- electrical input and output signals involving on/off and proportional control systems

Assessed Ability

H3.3 Carry out effective fault diagnosis and rectification.

Evidence Required

H3.3.1 Nature of fault correctly identified.
H3.3.2 Fault, cause, remedy checklist prepared.
H3.3.3 Diagnostics used to locate fault.
H3.3.4 Safe working practices followed at all times.
H3.3.5 Faulty components replaced.
H3.3.6 Cause and effect of faults assessed.
H3.3.7 System re-commissioned in accordance with set procedures.
H3.3.8 System operated according to machine specification.

Assessed Ability

H3.4 Designated or faulty component replacement carried out in accordance with given information.

Evidence Required

H3.4 Establish documented procedures and carry out proactive maintenance and monitoring of Electro-Hydraulic systems.

Evidence Required

H 3.4.1 System assessed to determine service/maintenance schedule requirements.
H3.4.2 System assessed to determine routine monitoring requirements.
H3.4.3 Documented system established including safety requirements/risk assessment.
H3.4.4 Performance testing carried out and results recorded.
H3.4.5 Electrical input and output signals involving on-off and proportional control systems checked and recorded.
H3.4.6 Fluid sampling carried out and contamination levels assessed against target cleanliness and result recorded.
H3.4.7 Manufacturers recommendations and specifications checked against results.
H 3.4.8 Safe working practices followed at all times.
H3.4.9 Workplace re-established to required levels of tidiness and cleanliness.

Note: Preparation for practical task assessment can be a group activity or it could be carried out on a" one to one" basis between the candidate and the assessor. Evidence will be obtained by non-intrusive observation, questioning, or written and verbal reports.

KNOWLEDGE BASED SECTION (H3) CONTENTS

H 3.5.1 Fundamental and Scientific Principles
H3.5.2 Application of the Fundamental Principles
H3.5.3 Hydraulic Fluids
H 3.5.4 Valve Mounting Styles/ Configurations
H3.5.5 Control Valves
H3.5.6 Mobile multifunction Valves
H3.5.7 Hydrostatic Steering systems
H3.5.8 Slip-in Logic Cartridge Valves
H3.5.9 Fundamental Electrical Principles
H3.5.10 Proportional Valve Technology
H3.5.11 Pumps and Associated Control Systems
H 3.5.12 Hydraulic Actuators (Motors and Cylinders)
H3.5.13 Closed Hydrostatic Transmissions
H3.5.14 Reservoirs, Conditioning and Auxiliary Components
H 3.5.15 Hydraulic pressure equipment and components
H 3.5.16 Machine Circuitry and Control Features (Recognition and use of hydraulics and electrical symbols)
H 3.6.1 Electrical Components
H 3.6.2 Electronic Sensors for Control and Condition Monitoring in integrated Fluid Power Systems
H 3.6.3 Electrical/Electronic sensor signals in integrated Fluid Power Systems
H 3.6.4 Recognize and understand the application of integrated system control methods used in integrated fluid power systems.
H 3.6.5 Awareness of current Safety requirements of an integrated system
H 3.6.6 Safe working practices for an integrated system
H 3.6.7 Safety related components
H 3.6.8 Circuit and Control Features (Recognition and use of component symbols)
H 3.7.1 Pipes and Hoses – Installation and Commissioning Procedures
H 3.7.2 Contamination Control
H3.7.3 Installation and Commissioning Procedures
H 3.7.4 Maintenance, Monitoring and Fault-Finding Procedures

KNOWLEDGE BASED UNIT – WRITTEN EXAMINATION SPECIFICATION

The examination paper will contain 8 questions integrating the above 22 sections

- Examination duration will be 2½ consecutive hours
- Candidates will be expected to attempt 5 questions
- Each question will carry equal marks
- Pass mark will be 70%

Where calculations and formulae are involved, all progressive stages of the calculation together with the corresponding units must be shown

HYDRAULICS PROGRAMME (Knowledge Based Section)

In addition to demonstrating an understanding of Hydraulic Systems and Associated Control, candidates must prove ability to:

H 3.5.1 Fundamental and Scientific Principles

Describe the fundamental principles of power transmission by hydraulics and associated scientific principles underlying its use.

a) List the basic building blocks and describe their function with reference to:
prime movers, pumps, reservoirs, fluids, control valves, filters, coolers, pipe work and manifold blocks.
b) Know the cause and effect of pressure generation, pressure losses, heat generation, fluid leakage, cavitation, aeration, noise, and vibration.
c) Know the difference between laminar and turbulent flow and their effect on system performance.
d) Know the meaning of the term Reynolds Number and use the associated formula.
e) Know the difference between static and dynamic pressure.
f) Know the quantities and units:
pressure, force, area, displacement, flow rate, speed/velocity, torque, and power.
g) Know the formulae relating to:
pressure, force, area, displacement, flow rate, speed/velocity, torque, and power.
h) Know the principles of heat dissipation and temperature control:
heat sinks within a system (reservoirs, pipe work and coolers) and effects of ambient conditions and working cycle.
i) State and use the relationship between pressure, force and area for cylinders and pressure, torque and displacement per revolution for pumps and motors.
j) State and use the relationship between flow, area and velocity for cylinders, and flow, displacement per revolution and shaft speeds for pumps and motors.
k) Know the relationship between:
input and output powers of pumps and motors and the causes of volumetric and mechanical inefficiencies.

H 3.5.2 Application and Fundamental Principles

Describe the application of the fundamental principles with regard to:

a) Relationship between flow rate, pressure drop, restriction, power, and heat.

b) Control of pressure
- pressure generation
- pressure limiting
- pressure unloading
- pressure reducing
- pressure intensification

c) Control of flow
- non-compensated flow control
- pressure compensated flow control
- temperature compensated flow control
- flow dividing
- regenerative flow
- damping
- meter-in, meter-out and by-pass flow control

d) Control of movement
- acceleration and deceleration control
- stopping or preventing movement
- changing direction

H 3.5.3 Hydraulic Fluids

Describe the application and selection of fluids for use in hydraulic systems relating to:

a) Functions
- power transmission
- lubrication
- cooling

b) Characteristics and properties (behavior and effect on system performance):
- viscosity
- viscosity index
- lubrication
- thermal stability (oxidation)
- pour point
- remissibility
- shear stability
- compressibility
- material compatibility
- foaming and aeration resistance
- filterability
- specific gravity
- fire-resistance

c) Types of fluids in common use in hydraulic applications
- ISO/SAE viscosity grades
- classifications to ISO standards

d) Fluid selection for typical applications (factors to be considered):
- environmental considerations
- fire resistance
- toxicity
- water separation
- filterability

e) Fluid storage, handling, and transfer:
- explain the need for correct storage, handling, cleanliness control and transfer systems to be in place and controlled by working procedures

f) Explain the need for cleanliness control systems to be in place and associated fluid analysis procedures and monitoring

H 3.5.4 Valve Mounting Styles/Configurations

Describe valve mounting styles, standardized interfaces, sizes, flow rates, port layouts and sealing arrangements, relating to:

- pipe mounting/line mounting
- sub-plate mounting
- manifold mounting
- stack, mounting
- flange mounted valves
- screw in cartridge
- slip in cartridge
- ISO interface valves

H 3.5.5 Control Valves

Describe the function, operation and application of control valves and interpret their graphical symbols.

a) Flow control devices (fixed and adjustable:
- non-compensated flow control devices (orifice and throttle valves)
- pressure and temperature compensated flow control valves
- hydrostatics and applications with proportional controls
- priority valves
- spool flow dividers
- rotary flow dividers
    - differential lock units

b) Pressure control devices:
- pressure limiting
    - single stage, relief valves
    - two stage, pilot operated relief valves
    - unloading valves
    - control features
- vent
    - remote control (manual/proportional)
- load sensing

- pressure sensing (application of pressure switches)
- pressure reducing
- single stage and two stage pressure reducing valves
- two way and three-way configuration

c) Load Holding and Motion Control:
- pilot operated check valves
- counterbalance with internal and external pilot control (including the effect of pilot ratios)
- hose burst control devices
-

d) Direction control devices:
- check valves
- pilot operated check valves
- spool valves
- ball valves
- poppet valves
- sequence valves

e) Control features to include simple on-off and proportional control)

H 3.5.6 Mobile multifunction Valves

Describe the function, operation, application and control features of mobile multifunction control valves and interpret their graphical symbols.

a) Mobile spool direction control valves:
- layout/construction (monoblock/sandwich)
- spool configurations (single and multiple) series
- fl ow paths - parallel, series and tandem arrangements including carry-over and alternative inlet sections
- open centre, closed center, single acting, double-acting motor half motor, regeneration and fl oat arrangements

b) Inlet sections:
- pressure control/unloading facilities/priority
- load sensing connections
- pilot fluid supply

c) Controls:
- manual - spring cantered, mechanical hydraulic and electrical detent
- solenoid and solenoid pilot
- proportional control (with and without spool position monitoring)
- remote control [Joystick], (hydraulic and pneumatic)
- remote control - electrical [Joystick]
- Special features (including inlet, outlet and service ports):
- flow sharing (pre and post compensation)
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- load sensing, pressure limiting and vent control
- load holding
- anti-cavitation
- pressure limiting

d) Valve characteristics:
- valve sizes, flow rates and associated pressure drops
- operating performance (under conditions of closed, partially open, and fully open)

H 3.5.7 Hydrostatic Steering Systems

Describe the function, operation and application of hydrostatic steering systems and associated control features:

a) Rotary servo steering units:
- open center
- closed center
- reaction and non-reaction types
- load sensing systems
- steer units for electric motor applications
- steer units with 'power beyond' facilities
- flow amplifiers
- dual displacement steer units

b) Priority valves:
- non dynamic types
- dynamic types

c) Steering systems, modes:
- single ram single rod, single ram double rod, double rams' single rods
- methods of switching between steering modes

d) Emergency steering systems (manual and powered)

H 3.5.8 Slip-in Logic Cartridge Valves

Describe the function, operation, and application Slip- in (logic) cartridge elements

- construction and manifold assembly
- sizes and associated fl ow rates
- operating principles
- application for pressure, fl ow and direction control including associated control methods

H3.5.9 Fundamental Electrical Principles

Describe the fundamental principles and control, applicable to the use and application of electrical/ electronic technology.

- state and use the relationship between voltage, current, resistance and power
- state the relationship between movement, magnetism and current
- meaning of the term inductance and its effect upon DC circuits
- meaning of the term capacitance and its effect upon DC circuits• meaning of the term's amplitude, frequency, periodic time, and RMS
- define the terms digital and analogue associated with control systems
- describe the fundamental principles of open and closed loop control

H 3.5.10 Proportional Valve Technology

Describe the principles of proportional valve technology

- list the potential benefits compared to application of "on-off "operated systems
- describe the difference in performance of a proportional solenoid to that of a standard solenoid
- describe the application of proportional control to pressure, flow, and direction control (including feedback and non-feedback valves, direct and two stage versions)
- describe, in block diagram form the control components of a typical proportional valve electronic amplifier
- explain the meaning of the terms: gain adjustment, dead band compensation, ramp control, dither and pulse width modulation and demonstrate an understanding of their effects on system performance
- explain the recommended practices for installing proportional electronic control in terms of power supply requirements, enable signals, input signal generation, cable shielding, earthing and interface with PLC's

H 3.5.11 Pumps and Associated Control Systems

Describe the function and operation of hydraulic open loop pumps and associated control features:

a) Pumps:

- external gear
- internal gear
- vane (fixed and variable)
- radial piston (fixed and variable)
- axial piston (fixed and variable)
- bent axis piston (fixed and variable)
- multiple pumps

b) Know the power - torque relationship between the prime mover and pump with reference to electric motor/engine speed.

c) Control features:

- fixed pumps with integral pressure and flow control
- fixed pumps with unloaded valve systems
- mechanical/hydraulic servo displacement
- Electro-Hydraulic proportional displacement
- pressure compensation/limiting
- load sensing (constant fl ow/variable speed)
- constant power
- torque summation control, including prime mover characteristics
- pumps with frequency control of electric motor speed and features

d) Link to prime mover:

- power take off arrangements
- splitter gearbox
- step up and step-down gearbox arrangements
- belt drives and clutch arrangements

H 3.5.12 Hydraulic Actuators (Motors and Cylinders)

Describe the function, operation, and application of hydraulic actuators, including control features:

a) Motors:

- gear
- gerotor/orbit
- vane
- radial piston
  Including variable and dual displacement control features and associated torque speed characteristics
- axial piston (swash plate)
  Including variable and dual displacement control features and associated torque speed characteristics
- bent axis
  Including variable and dual displacement control features and associated torque speed characteristics
- cam/roller types
  Including variable and dual displacement control features and associated torque speed characteristics

b) Motor features:

- pressure control (pressure compensation)
- displacement (torque/speed control)
- parking brake
- dynamic braking (use of counterbalance valves)

c) Motor performance:
- series circuitry
- parallel circuitry

d) Cylinders, mounting arrangements and construction:
- telescopic
- single acting
- double acting
- sealing
- cushioning
- mounting arrangements
- position monitoring

e) Semi-rotary actuators:
- rack and pinion type
- vane type

H 3.5.13 Closed Loop Hydrostatic Transmissions

Describe the function, operation and application of hydraulic components associated with closed loop hydrostatic transmission systems:

Basic configuration:
- close coupled (motor and pump back-to-back units)

a) Over center piston pumps:
- basic construction (axial, bent axis and radial)
- control methods
- mechanical
- mechanical servo
- pilot pressure
- electronic servo
- pressure/limitation and displacement control
- automotive control

b) Charge pump:
- construction
- charge pump circuitry
- case flushing (including cooling and heating functions)

c) Control valves:
- hot oil shuttle valves
- crossline relief valves
- counterbalance valves
- free-wheel by-pass valves
- differential lock valves
- parking brake systems

d) Special control features:
- inch control
- creep speed
- brake defeat function
- hydrostatic braking

H 3.5.14 Reservoirs, Conditioning and Auxiliary Components

Describe the purpose of the system reservoir and associated fluid conditioning equipment and auxiliary components.

a) Outline a typical system reservoir in terms of:
- size, with reference to oil and air space and changes in level
- general construction (internal/external), incl. return line and port arrangements to minimize aeration)
- level/temperature indication
- filling connections
- sampling points
- level/temperature indication
- air and oil filtration
- pressurized reservoirs
- use of bladder and diaphragms separators

b) Describe the use of hydraulic fl uid systems:
- cooling
- reservoirs (size, siting, and layout)
- air blast coolers
- water coolers

H 3.5.15 Hydraulic pressure equipment and safety components

Describe the function, operation and application of hydraulic accumulators, associated safety components and associated selection process and sizing relating to application:

a) Accumulator:
- piston
- bladder
- diaphragm

b) Associated Safety component and control features Fluid side:
- pressure relief valve
- safety block
- pressure switches

Gas side:
- pressure relief valve
- temperature fuse
- burst disc
- pressure switches

Describe the pressure terms:
- pre-charge pressure (p_0) and control
- working pressure (p_1)
- max. pressure (p_2)

c) Have full knowledge about the fundamental rules of European Pressure Equipment Directive:
- PED

H 3.5.16 Machine Circuitry and Control Features (Recognition and use of hydraulics and electrical symbols)

Describe and interpret hydraulic circuits and associated methods of control, including failsafe methods:

Recognize and use current graphical hydraulic and electrical symbols relating to hydraulic systems.

FLUID POWER ELECTRONICS PROGRAMME - (Knowledge Based Unit)

H 3.6.1 Electrical Components

Describe the function, operation and application of electrical components used in integrated systems:

- Switches/Contacts: Normally Open (NO), Normally Closed (NC), Change Over (CO)
- Protective devices
- Lighting
- Relays
- Solenoids
- Limit switches
- Distance sensors
- Photo-electric sensors
- AC and DC Motors
- Electric Motor control technology

H 3.6.2 Electronic Sensors for Control and Condition Monitoring in integrated Fluid Power Systems

Identify sensors used in integrated Fluid Power Systems

- Pressure
- Flow
- Temperature
- Level
- Particle
- Humidity
- Viscosity
- Conductivity
- Noise
- Vibration

H 3.6.3 Electrical/Electronic sensor signals in integrated Fluid Power Systems

Describe the function, operation and application of electrical communication signals used in integrated systems:

- Digital (switching)
- Analog
- Bus
- Bi-directional communication
- Wire-less

H 3.6.4 Recognize and understand the application of integrated system control methods used in integrated fluid power systems.

- Relay control
- Power Amplifier control
- Analog and digital
- Open loop control
- Closed loop control
- Computer control

H 3.6.5 Awareness of current Safety requirements of an integrated system

Overview of relevant regulations

H 3.6.6 Safe working practices for an integrated system

- Utilize the safe working practices and procedures to be used when working on integrated systems
- Risk Assessments for the system and your workplace
- Utilize the safe working practices and procedures to be used when working on integrated systems
- Risk Assessments for the system and your workplace
- Comply with all Health and Safety requirements for the machine and your work- place
- Use the correct Personal Protection Equipment (PPE)

H 3.6.7 Safety related components

Describe the basic function and application of safety equipment and components used in integrated fluid power systems

- Personal safety
- Machine safety

H 3.6.8 Circuit and Control Features (Recognition and use of component symbols)

Identify symbols and describe common drawing practices in integrated fluid power systems

INSTALLATION AND COMMISSIONING PROCEDURES

H 3.7.1 Pipes and Hoses – Installation and Commissioning Procedures
H 3.7.2 Contamination Control
H 3.7.3 Installation and Commissioning Procedures
H 3.7.4 Maintenance, Monitoring and Fault-Finding Procedures

H 3.7.1 Pipes and Hoses – Installation and Commissioning Procedures

Describe installation and commissioning procedures for pipes hoses and seals, and associated selection process and sizing relating to application:

a) Determine from pipe sizing charts and manufacturers' catalogues, suitable pipe/hose diameters associated with flow rates, velocities and acceptable pressure drops.

b) Describe the types and application of seals used in hydraulic systems, with specific reference to:

- static and dynamic seals,
- cylinder seals
- pump and motor shaft seals
- seal materials, selection, and compatibility
- replacement methods and care to be taken during installation

c) State the factors that affect system pressure drop:

- pipe/hose dimensions
- pipe work/manifold block configuration flow rate
- fluid viscosity and density
- component size/ design

d) Hose types and application:

- wire braided
- 2-wire braided
- spiral wire
- thermoplastic
- high temperature and protective sleeved (abrasion resistant)
- low temperature

e) Hose/pipe fitting and assembly procedures:

- use of adapters and unions,
- use of bite compression fittings
- use of 'O-Ring' fittings
- use of flange type fittings
- use of formed fittings
- use of welded connections

f) Hydraulic hose failures relating to:

- poor installation procedures
- failure to meet required working specification
- system performance
- pipe-work installations
- layout fastenings
- leakage prevention

H 3.7.2 Contamination Control

Describe contamination control methods associated with:

- ingression of contamination and the nature of the contaminant
- preventative measures to reduce ingression to an acceptable level
- establishing a suitable cleanliness target
- achieving and maintaining a cleanliness target (ISO and AS standards)
- measuring and monitoring cleanliness levels
- remedial actions

filter types, rating, location, and performance

H 3.7.3 Installation and Commissioning Procedures

Describe installation and commissioning procedures to be followed:

- planning work to be done and listing necessary resources
- checking component conformance against technical specification
- following manufacturers' recommendations for installation of a particular component/s
- outline commissioning procedures to be followed, taking into consideration: safety/risk assessment, operational specification, technical specification, and start up procedures
- outline the procedures to be followed to ensure that system/component/s operates at a satisfactory level of performance
- outline the procedure to be followed to ensure that the work place is re-established" fit for purpose"
- completion of all necessary reports/documentation

H 3.7.4 Maintenance, Monitoring and Fault-Finding Procedures

Describe maintenance, monitoring and fault-finding procedures:

a) Outline a maintenance scheme. Involving performance and health monitoring, in terms of:

- maintaining cleanliness standard
- regular use of diagnostic and test equipment
- continuous condition monitoring systems
- analysis of results and actions to be taken
- keeping up to date records and information systems
- establishing safe working practices and step by step procedures when dealing with system breakdowns/component failures/ replacement/ re-commissioning start up and testing
- leakage detection methods

b) List the common faults encountered in hydraulic systems and associated components and state the possible causes and effects on system performance:

- excessive noise
- vibration
- high system/component temperature
- erratic operation
- leakage
- pressure too high
- pressure too low
- incorrect actuator speed
- incorrect pump flow rate
- incorrect sequence of operations
- loads lowering/failure to hold position
- hose and pipe failure (Section H3.5.18 f)
- contamination level too high

c) Describe procedures to follow when carrying out fault finding, including:

- identifying and determining the nature of the fault
- planning stages
- safe working practices to be followed and associated risk assessment
- information necessary to effectively carry out fault diagnosis and rectification process
- application of FAULT - CAUSE – REMEDY procedures
- use of diagnostic equipment and recording results
- procedures to follow to rectify problems (adjustments replacements, repair and re- commissioning)
- establishing system re-start procedures
- re-establishing workplace" fit for purpose" completion of all necessary reports/documentation.