cetop

The Voice of the European Fluid Power Industry

EDUCATION RECOMMENDATIONS

★ ***HYDRAULICS PROGRAMME IH2***
CETOP Passport Occupational Level 2

RE 2025/01.01 - IH2

HYDRAULICS & ASSOCIATED CONTROL PROGRAMME (IH2): RE 2025/01.01 - IH2

CETOP (Passport) Occupational Level 2

INTRODUCTION

This is a LEVEL 2 Hydraulics Programme, forming the start of a series of competence-based qualifications designed around CETOP occupational levels.

It combines the necessary knowledge and competence-based skills for those people on route to a higher-level qualification at level 3, involving the maintenance and management of both Industrial and Mobile hydraulic systems.

Note: In all cases, each programme represents a "stand-alone" qualification but can also be a progressive route to a higher level.

CETOP OCCUPATIONAL LEVEL 2

LEVEL (2) This person will perform a variety of activities needing some understanding of the technical factors involved. The activities may require the interpretation and application of varied and non-routine specifications. Activities will involve the use of simple diagnostic checks and ability to make a positive response to deviations. Co-operation with others in team or work groups may be required.

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 ranging from that of short courses to distance learning and centre-based modules. The time scale can also be flexibly managed by the Approved Centres.

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 via a written examination of a minimum of 2 hours duration. This will be prepared initially once per year and offered at Approved Centres. The pass mark for the written examination will be 60%.

The expected completion time for this competence-based programme is 1-2 years but this does depend upon previous experience and the learning mode devised by the centre and will require a high level of personal commitment to study and re-search the subjects within the syllabus.

Successful completion of both the knowledge-based and competence-based units will result in the award of a CETOP Level 2 Industrial Hydraulics Qualification Certificate. (Candidates successfully completing only one unit might receive a CETOP Unit Certificate).

PRACTICAL TASK ASSESSMENT (IH2)

When assessing competence, the following processes must be followed:

- Relating to the occupational level, a series of Assessed Abilities are identified. These represent the" DOING PART" of a person's job and requires a combination of both practical skills and applied knowledge.
- For each Assessed Ability, evidence of performance is then established and shown as EVIDENCE REQUIRED (sometimes termed performance criteria).

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.

During practical task assessment, the ASSESSOR will agree the" type of evidence" to be obtained and this can range from:

- Direct Observation
- Verbal Questioning/Candidate Commentary
- Written Report and may include all types.

- ***Assessment Requirements***

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

Assessed Ability

IH2.1 Interpret hydraulic circuit diagrams applicable to selected systems.

Evidence Required

IH 2.1.1 Machine function and operation correctly identified.
IH 2.1.2 Components named, and function identified.
IH2.1.3 Component control methods identified.

Assessed Ability

IH2.2 Assemble a hydraulic system from given information and carry out effective fault diagnosis.

Evidence Required

IH 2.2.1 Components selected and checked against specification.
IH 2.2.2 Installation plan prepared (order of actions to be taken).
IH 2.2.3 Safe working practices followed at all times.
IH 2.2.4 Components commissioned by following prescribed procedures.
IH 2.2.5 Startup procedures followed.
IH 2.2.6 System operational checks carried out and results recorded.
IH 2.2.7 System operates according to specification.
IH 2.2.8 System fails to operate according to specification –" Fault, Cause, Remedy" Approach to fault diagnosis is effectively applied to re-establish 2.2.7.

Assessed Ability

IH2.3 Pump performance test carried out to assess Q/P relationship under load conditions.

Evidence Required

IH 2.3.1 Correct diagnostic equipment selected.
IH 2.3.2 Establish test procedures followed.
IH 2.3.3 Safe working practices followed at all times.
IH 2.3.4 Pump specification checked.
IH 2.3.5 Performance results recorded, and written report completed covering all actions taken.

Assessed Ability

IH 2.4 System contamination levels assessed against established target cleanliness levels.

Evidence Required

IH 2.4.1 Established oil sampling procedures followed.
IH 2.4.2 Cleanliness control procedures followed to ensure representative sample is taken.
IH 2.4.3 Sample identification procedures followed.
IH 2.4.4 Safe working practices followed at all times.
IH 2.4.5 Sample analysis procedures followed, and comparison checks made to determine cleanliness level.
IH 2.4.6 Written report completed.

INDUSTRIAL HYDRAULICS PROGRAMME KNOWLEDGE BASED UNIT (IH2)

CONTENTS

KNOWLEDGE BASED UNIT – WRITTEN EXAMINATION SPECIFICATION

The examination paper will contain questions from all sections of the programme.

- Examination minimum duration 2 consecutive hours
- Pass mark 60%
- Question style may be single subject, multiple subjects, short answer, multiple choice
- All questions will carry equal marks

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

INDUSTRIAL HYDRAULICS PROGRAMME - (Knowledge Based Unit)

IH 2.5.1 Fundamental Hydraulic Principles

State and use the fundamental principles underpinning the operation of Hydraulic systems and know how they affect performance:

a) Pascal's Law (static and dynamic pressure).

b) Know the cause and effect of pressure generation, pressure losses, heat generation, fluid leakage, cavitation, aeration, noise and vibration.

c) State and use the relationship between:
- pressure, area, and the force transmitted by a cylinder
- flow rate, cylinder dimensions and cylinder velocity
- pressure, displacement, and hydraulic motor torque
- flow rate, displacement, and motor speed
- pump displacement, shaft speed and fl ow rate
- pump flow rate, operating pressure and hydraulic power
- volumetric efficiency, mechanical efficiency and overall efficiency of pumps and motors
- pipe diameters, flow rates, fluid viscosity and pressure losses

IH 2.5.2 Hydraulic System Components

Describe the function and operation of control valves and recognize their graphical symbols on associated circuitry.

a) Flow control:
- flow control devices both fixed and adjustable
- pressure and temperature compensated fl ow control devices
- flow dividers – spool, rotary, and priority

b) Pressure control:
- relief valves – single and two stage
- vented vent control and unloading principles
- pressure reducing – single and two stage (two way and three-way operations)
- counterbalance with remote pilot
- sequence valves

c) Directional Control devices and methods of control:
- check valves
- pilot operated check valves
- spool valves – including two stages
- poppet valves
- rotary valves
- manual/pilot/on-off solenoid operation
- introduction to proportional control

IH 2.5.3 Pumps and Associated Control Systems

Describe the function and operation of Hydraulic pumps and listed control systems, plus set up procedures as prescribed.

a) Pumps:
- external gear
- internal gear
- gerotor
- vane (fixed and variable)
- axial piston (fixed and variable)
- bent axis (fixed and variable)
- radial piston (fixed and variable)

b) Control features:
- fixed pumps with relief valve involving vent control
- unloading (two pump system)
- pressure compensation with and without load sensing
- manual displacement control

c) Pump relationship between pressure and flow (Q/P) characteristics.

d) Compensator setting up procedures involving standby and pressure limiting compensators.

IH 2.5.4 Hydraulic Actuators

Describe function and operation of hydraulic actuators.

a) Motor types:
- gear
- gerotor/orbit
- vane
- radial piston – single and two speed
- axial piston – fixed and variable displacement
- bent axis – fixed and variable displacement

b) Motor performance:
- series circuitry
- parallel circuitry

c) Cylinders, types, construction, sealing and mounting arrangements:
- single acting
- double acting
- through rod
- sealing
- mounting arrangements
- cushioning

d) Semi-rotary actuators:
- rack and pinion type
- vane type
- others

IH 2.5.5 Circuitry and Control Features

Interpret listed circuitry, including basic electrical symbols and circuits.

- counterbalance
- regenerative circuit
- two pump (Hi-Lo) circuits
- sequence valve circuitry
- P O checks. (Load holding, pre-fill/decompression)
- closed hydrostatic circuitry

a) Electrical symbols and associated circuitry:
- NO and NC contacts
- solenoids (AC and DC)
- relays

IH 2.5.6 Hydraulic Fluids

Describe the functions and characteristics of hydraulic fluids.

a) Functions:
- power transmission
- lubrication
- cooling
- sealing
- carrier for contaminants

b) Characteristics and properties and their effect on system performance:
- viscosity
- viscosity index
- lubricity
- oxidation
- pour point
- demulsibility
- material compatibility

c) Oil types and application:
- mineral oil
- emulsions
- glycols
- bio-degradable fluids

d) Storage, handling, and transfer:
- explain the need for correct storage, handling, transfer systems and associated cleanliness control
- regulations and requirements relating to safe handling and disposal

IH 2.5.7 Reservoirs and Auxiliary Equipment

Describe the function of a reservoir and associated fluid conditioning equipment and auxiliary components.

a) Describe a typical reservoir with respect to:
- size (relate to pump capacity)
- general construction
- return line arrangements
- filling arrangements
- level/temperature indication
- contamination control

b) Describe methods of fluid cooling:
- reservoir (size, siting)
- air blast coolers
- water cooled coolers

c) Describe function, operation, and typical applications of accumulators:
- bladder type
- piston type
- diaphragm type
- safety and control features
- pre-charge procedures

IH 2.5.8 Hydraulic pressure equipment and safety components

Describe function, operation, and typical applications of accumulator installation.

Describe:
- bladder type
- piston type
- diaphragm type
- safety components
- safety and control features to PED
- pre-charge procedures

ELECTRONICS *PROGRAMME - (Knowledge Based Unit)*

IH 2.6.1 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

IH 2.6.2 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

IH 2.6.3 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

IH 2.6.4 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

IH 2.6.5 Awareness of current Safety requirements of an integrated system

Overview of relevant regulations

IH 2.6.6 Safe working practices for an integrated system

- Utilities 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 workplace
- Use the correct personal protection equipment (PPE)

IH 2.6.7 Safety related components

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

- Personal safety
- Machine safety

IH 2.6.8 Circuit and Control Features (Recognition and use of component symbols)

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

MAINTENANCE, MONITORING AND FAULTFINDING PROCEDURES (knowledge based unit)

IH 2.7.1 Maintenance, Monitoring and Faultfinding Procedures

Describe maintenance, Monitoring, and faultfinding procedures.

a) Know the importance of RISK MANAGEMENT:
- safe working practices (risk assessment)
- following established procedures
- regular use of diagnostic and test equipment
- analysis of results
- record keeping

b) List common faults and possible causes and effects on system performance:
- high noise level
- vibration
- system/component temperature high
- erratic operations (stick-slip, air inclusion, cavitation, aeration, dieseling)
- incorrect pressure
- incorrect actuator speed
- failing to work within component manufacturers' recommendations
- failure to hold position/load
- leakage

c) Describe procedures that should be followed when carrying out fault diagnosis and rectification:
- safe working practices and associated risk assessments
- identifying the nature of the fault
- identify and remove the cause of the fault and take steps to prevent re- occurrence
- identify information required for effective fault diagnosis and rectification
- use of test equipment and diagnostic techniques
- use of FCR (fault, cause, remedy) procedures
- importance of accurate record keeping
- establishing system restart procedures
- re-establishing the workplace" fi t for purpose"
- preventive versus corrective action

IH 2.7.2 Contamination Control

Describe contamination control methods.

- origins of contamination
- cleanliness targets – achieving and maintaining
- monitoring fluid condition (sampling and measurement)
- preventive/correction actions
- filter performance and ratings
- filter types
- locations and performance