BRITISH FLUID POWER ASSOCIATION QUALIFICATIONS

INDUSTRIAL HYDRAULICS PROGRAMME (IH2)

CETOP (PASSPORT) OCCUPATIONAL LEVEL 2

Issue 1
2004

FOREWORD

Developed by the BFPA Education and Training Committee, this programme represents one of the range of new competence-based qualifications launched by BFPA.

It is intended for those personnel involved in the maintenance and management of **industrial hydraulic systems and associated controls**, who require knowledge and competence based skills to support such work based activities as: planning and preparation, interpreting and using technical information, division and following sound procedures associated with installation, commissioning, testing, fault diagnosis, rectification, maintenance, servicing and re-establishing a machine "fit for purpose".

Throughout the programme, emphasis will be 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 that of:

INSTALLATION
COMMISSIONING
PERFORMANCE TESTING
PREDICTIVE 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 and risk assessment will be emphasised 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 timescale 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 2 hours duration. This will be prepared initially once per year and offered at approved centres in June. 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 research the subjects within the syllabus.

Practical task preparation and competence based unit assessment will be carried out by arrangement with the approved centre during the year. Final assessment will be carried out on a "one to one" basis; candidate to tutor and the outcome will be pass or fail.

Successful completion of both the knowledge based and competence-based units will result in the award of a BFPA Level 2 Industrial Hydraulics and Associated Control Qualification Certificate endorsed by CETOP. Candidates successfully completing only one unit will received a BFPA Unit Certificate.

Reference should be made to the Guideline Document to Qualification BFPA/Q1 for further details.

Further copies of this document can be obtained from The British Fluid Power Association, Cromwell Park, Chipping Norton, Oxon OX7 5SR. Tel: 01608 647900. Fax: 01608 646919.

CETOP OCCUPATIONAL LEVELS

LEVEL (1) This person will perform activities that follow an established procedure. Activities will be recurring and of a short-term nature. The reaction to most problems will be to summon help or follow a predefined set of actions.

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.

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.

LEVEL (4) This person will be competent in a broad range of complex, technical or professional work activities performed in a wide variety of contexts and with a substantial degree of responsibility and autonomy. Responsibility for the work of others and allocation of resources is also involved.

PRACTICAL TASK ASSESSMENT (IH2)

When assessing competence the following processes must be followed:

1. 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.

2. For each Assessed Ability, evidence of performance is then established and shown as EVIDENCE REQUIRED (sometimes termed performance criteria).

In all cases candidates must meet the requirements of each Assessed Ability on at least two occasions.

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 carryout the following:

Assessed Ability

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

Evidence Required

IH2.1.1 Machine function and operation correctly identified.
IH2.1.2 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

IH2.2.1 Components selected and checked against specification.
IH2.2.2 Installation plan prepared (order of actions to be taken).
IH2.2.3 Safe working practices followed at all times.
IH2.2.4 Components commissioned by following prescribed procedures.
IH2.2.5 Start up procedures followed.
IH2.2.6 System operational checks carried out and results recorded.
IH2.2.7 System operates according to specification.
IH2.2.8 System fails to operate according to specification – "Fault, Cause, Remedy" Approach to fault diagnosis is effectively applied to re-establish 2.27.

Assessed Ability

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

Evidence Required

IH2.3.1 Correct diagnostic equipment selected.
IH2.3.2 Establish test procedures followed.
IH2.3.3 Safe working practices followed at all times.
IH2.3.4 Pump specification checked.
IH2.3.5 Performance results recorded and written report completed covering all actions taken.

Assessed Ability

IH2.4 System contamination levels assessed against established target cleanliness levels.

Evidence Required

IH2.4.1 Established oil sampling procedures followed.
IH2.4.2 Cleanliness control procedures followed to ensure representative sample is taken.
IH2.4.3 Sample identification procedures followed.
IH2.4.4 Safe working practices followed at all times.
IH2.4.5 Sample analysis procedures followed and comparison checks made to determine cleanliness level.
IH2.4.6 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 duration 2 consecutive hours
- Pass mark 60%
- Question style may be single subject, multiple subject, short answer
- 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)

IH2.5.1 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 flow 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

IH2.5.2 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 flow 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 stage
- poppet valves
- rotary valves
- manual/pilot/on-off solenoid operation
- introduction to proportional control

IH2.5.3 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.

IH2.5.4 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

IH2.5.5 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, prefill/decompression)
- closed hydrostatic circuitry

(a) Electrical symbols and associated circuitry:

- NO and NC contacts
- solenoids (AC and DC)
- relays

IH2.5.6 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 (Reference ISO 15380)

(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

IH2.5.7 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

IH2.5.8 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

IH2.5.9 Maintenance, Monitoring and Fault Finding Procedures

Describe maintenance, monitoring and fault finding 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 "fit for purpose"
- preventive versus corrective action