RE 2000/01 - H/P

QUALIFICATIONS ASSOCIATED WITH FLUID POWER SYSTEMS

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1. INTRODUCTION

1.1 What is CETOP?

Founded in 1962, CETOP is the European Oil and Hydraulics Committee and represents the National Fluid Power Associations within the fourteen European countries, in-turn representing some 1000 companies throughout Europe.

CETOP supports, promotes and provides aid to the fluid power industry and prepares standards and guidelines in co-operation with the technical committees of ISO (International Organisation for Standardisation), CEH (European Committee of Standardisation) and the various National Standards Organisations.

More detailed information may be obtained by visiting the CETOP Website at www.cetop.org.

1.2 Education and Training Proposal and Harmonisation initiative for Europe

With the ever-growing need throughout Europe and the world for a COMPETENT, WELL EDUCATED WORKFORCE, able to maintain and manage fluid power systems; CETOP have taken the initiative to put forward a proposal to develop an harmonisation programme relating to the qualifications of such a workforce.

1.3 The Aim is to develop an acceptable and agreed structure of "Competence Based Qualifications" reflecting the needs of those people who fall into the categories covered by OCCUPATIONAL LEVELS 1, 2 and 3 (see appendix 1). Such a structure will reflect the needs of those people in employment or being prepared for a particular level of employment.

1.4 What are COMPETENCE BASED QUALIFICATIONS?

Historically, many people have achieved a qualification that represents a "level of academic attainment" and does not always relate to that person's ability to apply their knowledge to a "real life situation".

The real life skills associated with Maintenance and Management of fluid power systems are work related and are as follows:

- PLANNING AND PREPARING
- INSTALLING
- COMMISSIONING
- TESTING
- MAINTAINING
- FAULT DIAGNOSIS AND RECTIFICATION
- REMOVAL AND REPLACEMENT
- DISMANTLING AND REASSEMBLING

To carry out these tasks at the various "occupational levels" and achieve a level of performance and repeatability within a given time will require that person to be COMPETENT.

A "Competence Based Qualification" will therefore consist of a combination of both knowledge and application of the knowledge, supported by practical experience in the workplace or under simulated conditions.

1.5 OCCUPATIONAL LEVELS -
Vs KNOWLEDGE BASED/COMPETENCE BASED PROGRAMMES OF STUDY TO MEET THE OCCUPATIONAL NEEDS

The following provides an example to enable the reader to clearly see the difference in knowledge based levels under consideration.

A relief valve is used as the example and this ANOLOGY outlines the difference in knowledge requirements at the various levels and clearly indicates where training and experience plays its part.

RELIEF VALVE

At Level 1 - the candidate needs to know what a relief valve is, what it does and why. (Basic Function.)

At Level 2 - the candidate needs to know in addition to the above, how the relief works. (Function and Operation.)

At Level 3 - the candidate also needs to know the different applications that a relief valve can be used for (unloading, proportional control) and what can go wrong. (Function, Operation, Application and Technical Specification.)

At Level 4 - the candidate would need all level 3 and could be involved in the aspects of design, component selection and compatibility.

At Level 5 - the candidate needs all the above levels plus the skills and knowledge necessary to design or re-design the relief valve itself.

Using this example it can be seen that although a level 5 person needs to know the same as a level 1 person, there is a distinct difference in breadth and depth. Level 1 is a broad approach with very little depth, whilst level 5 is a much deeper approach covering a broader range of subjects.

- From base level to Level 1 requires only education and training, work-based activities will be repetitive, following established procedures and requires very little

experience and knowledge of other areas.

- From Level 1 to Level 2 requires education and training with an acquired level of competency allied to experience to meet Level 2 Occupational requirements.

- From Level 2 to Level 3, a greater depth and breadth of knowledge is required compared to level 2, with a knowledge of other subject areas complementary to fluid power. At level 3, the competence-based skills should clearly reflect a level of experience able to deal with the broader and more complex range of activities required to fulfil this occupational level.

- Level 4 and 5 will require experience and knowledge from other areas of engineering and will require a greater degree of core skills and knowledge. Covering such items as: materials, stress calculations, mathematics, physics, production techniques, technical specifications and available technology.

2. COMPETENCE IN FLUID POWER SYSTEMS

2.1 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 and needs 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.

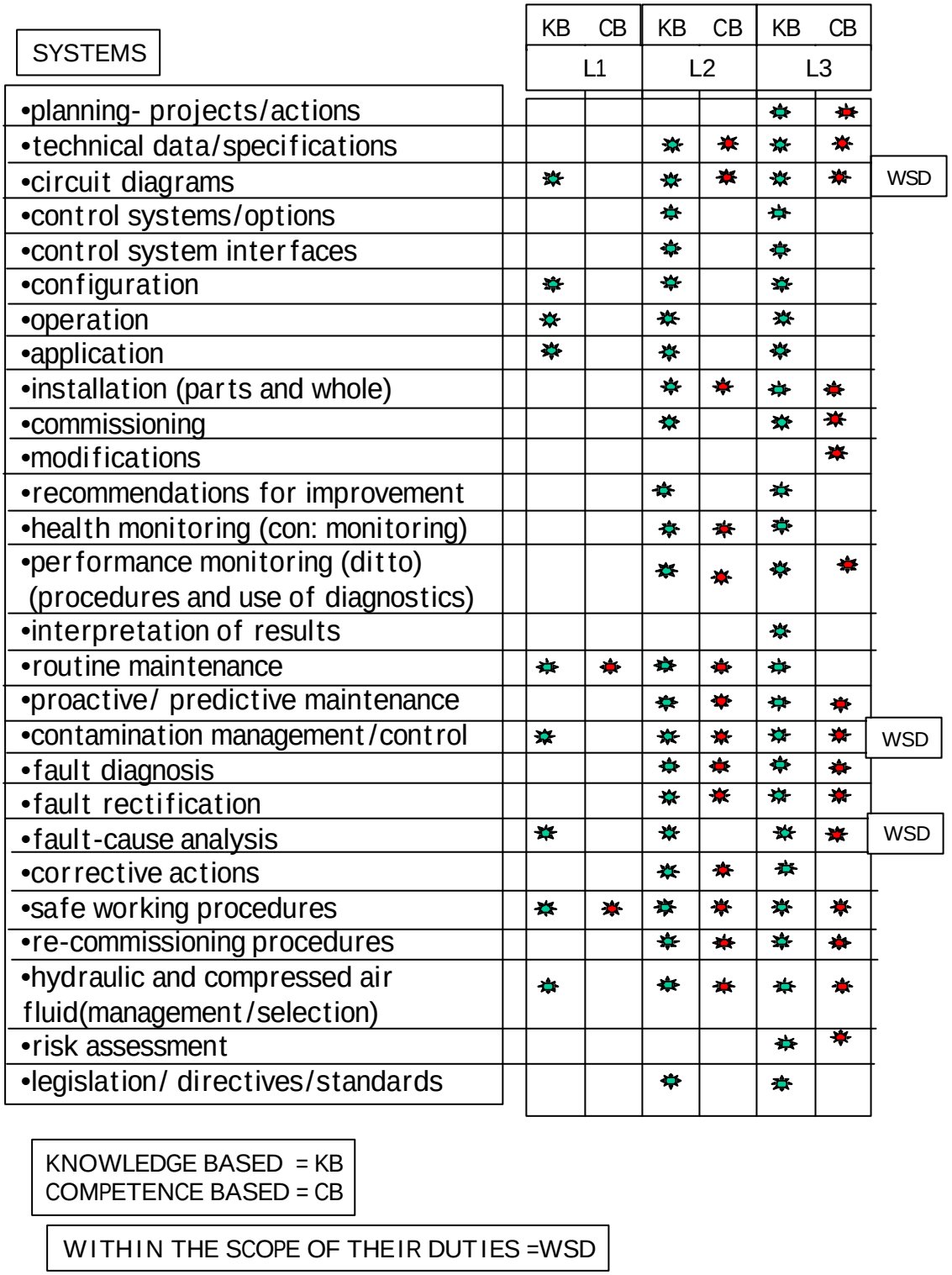
LEVEL (4) & (5) will be defined later

2.2 KNOWLEDGE BASED & COMPETENCE BASED SKILLS

COMPONENTS	KB	CB	KB	CB	KB	CB	
	L1		L2		L3		
•types	✸		✸		✸		
•construction			✸		✸		
•function	✸		✸		✸		
•operation			✸		✸		
•application			✸		✸		
•performance/ characteristics			✸		✸		
•selection/recommendations			✸	✸	✸	✸	
•sizing			✸	✸	✸	✸	
•mounting/ interface			✸	✸	✸	✸	
•control systems/interface	✸		✸		✸		WSD
•installation	✸	✸	✸	✸	✸	✸	
•commissioning/setting up	✸	✸	✸	✸	✸	✸	WSD
•malfunction and effects	✸		✸		✸		
•testing			✸	✸	✸	✸	WSD
•fault diagnosis			✸	✸	✸	✸	
•removal and replacement	✸	✸	✸	✸	✸		
•dismantle			✸	✸	✸		
•re-assemble			✸	✸	✸		
•contamination tolerance/awareness	✸		✸		✸		
•technical data			✸		✸		WSD
•use of formulae/calculations			✸		✸		
•system design/compatibility					✸		
•safety precautions/features	✸		✸		✸		
•risk assessment/use			✸		✸	✸	
•physical attributes (noise etc.)	✸		✸		✸		
•legislation/directives/standards			✸		✸		WSD

KNOWLEDGE BASED = KB
COMPETENCE BASED = CB
WITHIN THE SCOPE OF THEIR DUTIES = WSD

NOTE- although the ✸ may appear in a number of levels, the breadth and depth of the subjects differ from level to level



KNOWLEDGE BASED = KB
COMPETENCE BASED = CB

WITHIN THE SCOPE OF THEIR DUTIES =WSD

CORE SKILLS / Knowledge	KB	CB	KB	CB	KB	CB	
	L1		L2		L3		
•fundamental PRINCIPLES	✸		✸		✸		
•use of formulae and calculations			✸		✸		
•technical report writing			✸	✸	✸	✸	WSD
•communications	✸	✸	✸	✸	✸	✸	WSD
•information technology	✸	✸	✸	✸	✸	✸	WSD
•presentation skills					✸	✸	
•planning skills	✸	✸	✸	✸	✸	✸	WSD
•preparing procedures/work instructions					✸	✸	
•reading and interpretation technical data/ circuit diagrams	✸	✸	✸	✸	✸	✸	WSD
•translation of information			✸	✸	✸	✸	WSD
•analysis of facts	✸		✸		✸		
•organisational management	✸		✸		✸		
•quality management	✸		✸		✸		
•safety management	✸		✸		✸		
•power and motion control interfaces	✸		✸		✸		WSD

KNOWLEDGE BASED = KB
COMPETENCE BASED = CB

2.3 TECHNICAL TERMS USED

Relating to COMPONENTS

Type	Different components used within a system. e.g. gear pumps, vane pumps, piston pumps screw compressor, vane compressor. Lubricators, dryers, coolers e.t.c.
Construction	Individual design attributes. e.g. a pump may have a splined shaft, a relief valve may be sub-plate mounted, compressors fully packaged .cushioned cylinders
Function	Purpose or specific activity. e.g. the function of a relief valve is to limit the pressure to a particular level, 3port-2position valve to operate single acting cylinder.
Operation	Specific performance. e.g. a relief valve poppet lifts off its seat when the system pressure creates a force upwards, greater than that of the downward force of the opposing spring.
Application	Relates to the function of a component within a circuit or system. e.g. a pressure reducing valve may be used to specifically limit the pushing force on a small press cylinder.
Performance/ characteristic	Refers to the dynamic operation of a component. e.g. pressure override of a pressure control valve, slippage rate of a pump, pressure drop across a proportional directional control valve. FAD for a compressor, pressure drop in pipes.
Selection/ recommendations	Types and choice available and why a particular component would be selected in preference to another.
Sizing	Relating to range and capacity. e.g. flow and pressure range to meet a specific requirement.
Mounting/ interface	Refers to ISO /NG/CETOP SAE, pipe mounted, flange mounted, screw in e.t.c.
Control system/ interface	Pilot operation, solenoid operation, 'bang-bang' or proportional, digital or analogue .solenoid/ pilot, detent.
Installation	Procedures to be followed when fitting a component into a system or part of a system, new or replacement.

Commissioning/ setting-up	Procedures to follow to meet a required performance specification. e.g. setting up of a compensator on a pump to 150 bar. Speed of a cylinder and cushioning
Malfunction and effects	Refers to deviation in performance, possible causes and the effect on the system.
Testing	Checking the settings of a component meet a specific performance (involving diagnostic equipment).
Fault diagnosis	Following procedures to identify a fault against specific symptoms, evaluation of the facts to identify a cause and implementation of a solution to rectify and prevent a re-occurrence.
Removal/ replacement	Procedures to be followed, including safe working practices and the correct use of tools and equipment. Compliance with all specifications and manufacturer recommendations.
Dismantle	Procedures to be followed, including the correct use of tools and equipment, following safe working practices and compliance with manufactures recommendations and specifications.
Re-assemble	Procedures to be followed, including the correct use of tools and equipment, following safe working practices and compliance with manufactures recommendations and specifications.
Contamination tolerance/ awareness	Refers to manufacturers cleanliness recommendations for components to effectively perform, plus knowledge of target cleanliness levels and methods of achieving and maintaining them.
Technical data	Refers to manufacturers catalogue information and recommendations specific to a particular component.
Use of formulae/ calculations	Refers to fundamental formulae to determine information specific to component size, performance, flow rate, pressure drop e.t.c.
System design/ compatibility	Refers to a components performance characteristics, size, construction e.t.c. to meet a system specification in conjunction with other components.
Safety precautions/ features	Refers to specific component safety features and/or the safety precautions to be taken when a particular component becomes part of a system.

Risk assessment/ use	Refers to the investigation of a component within a system to identify any possible safety hazards during use and the necessary recommendations/precautions to be implemented.
Physical attributes	Refers to noise, heat generation, vibration (belonging to or caused by).
Legislation/ directives/ standards	European Standards, ISO Standards, Health & Safety requirements and directives, Machinery Directive. Specific links to component application in a particular system.

TECHNICAL TERMS USED

Relating to SYSTEMS.

Planning - projects/actions Preparing a documented plan of actions relating to a specific task involving: -

- Procurement.
- Compliance.
- Staffing/resourcing.
- Time-based action plan.
- Review/evaluation.
- Installation/commissioning.
- Hand-over/declaration of conformance.

Technical data/ specification Use of manufacturers catalogues and data sheets with reference to recommendations for 'setting up', installation and testing.

Circuit diagrams Symbolic representation of components and systems to meet the required ISO specification.

Control systems/ options Open and closed loop (continuous and discontinuous), digital and/or analogue options, pump control system options.

Control system Interfaces Digital and analogue systems (use of PLC's and bus systems, pilot control).

Configuration Open systems, closed hydrostatic transmission system. List of specific circuits relating to a particular application).

Operation Specific performance at system level (involving a number of components).

Application Specific system function (operational specification).

Installation Procedures to be followed when configuring a system from individual

components (involving planning and preparation).

Commissioning Preparing a system for 'active duty', setting up of the component parts to meet a performance specification.

Modification Procedures to be followed when alterations are made to a system for example, the need to update technical documentation and the performance specification to ensure that any modifications are in compliance with the manufacturers specification and all requirements to health and safety.

Recommendations for improvement Reports relating to system improvements specific to a particular aspect of its performance, maintenance safety and operational management.

Health (condition) monitoring Procedures set up to determine system and component performance that meets the operation of the specification with reference to: -

- Fluid condition to meet target cleanliness levels.
- Noise and vibration.
- Temperature.
- General leakage.
- Documentation & report.

Performance monitoring Procedures set up to determine that system and component performance meets the required operation specification with reference to: -

- Pumps – Q/P testing.
- Actuator speeds.
- Operational pressures.
- Documentation & report.

Interpretation of results Referring to health and performance monitoring, translating results into an action plan with clear 'outcome objectives' as part of the pro-active maintenance programme.

Routine maintenance Maintenance activities that are time based – daily, weekly, monthly etc and follow a 'set checklist' approach.

Pro-active/ predictive maintenance Maintenance activities carried out as part of a plan for continued improvement and/or relating to specific condition monitoring.

Contamination management/ control	Refers to that of maintaining cleanliness levels that meet the TARGET CLEANLINESS LEVEL and ensuring that procedures are in place to achieve and maintain this at all times. Where a non-compliance is identified, procedures should be in place to enable remedial action to be taken and cause to be evaluated.
sFault diagnosis	Procedures to be followed, to effectively diagnose a fault within a system.
Fault rectification	Procedures to be followed, to effectively rectify a fault with a system and to re-establish the system to a fully operational status.
Fault – Cause - Analysis	Management procedures in place to investigate the cause of a fault and the necessary steps to implement preventative measures against a re-occurrence.
Corrective actions	A report outlining actions to be taken to overcome and prevent the re-occurrence of a fault or that of fault prevention identified as part of the programme for continued improvement.
Re- commissioning Procedures	Plan of action inline with manufacturers recommendations and operational/technical specifications for the system to become fully operational.
Fluid Management/ Selection and Treatment	Refers to control procedures relating to : - Oil procurement , storage ,transportation ,filling and dispensing systems whilst in use in the machine to final disposal with regard to all aspects of health and safety. - Compressed air , contaminants and purity classes with regard to all aspects .
Risk assessment	Refers to the investigation of a system by a competent person to identify any possible hazards during use and the necessary recommendations/precautions to be implemented to prevent danger to all persons involved with that system.
Legislation/ directives/	European Standards, ISO Standards, Health & Safety requirements and directives, Machinery Directive. Specific

standards inks to systems and their application.