# BFPA FOUNDATION LEVEL - HYDRAULICS

BFPA
LEARNING & DEVELOPMENT PROGRAMME

BRITISH FLUID POWER ASSOCIATION

Q19 - Version 2

# Foreword

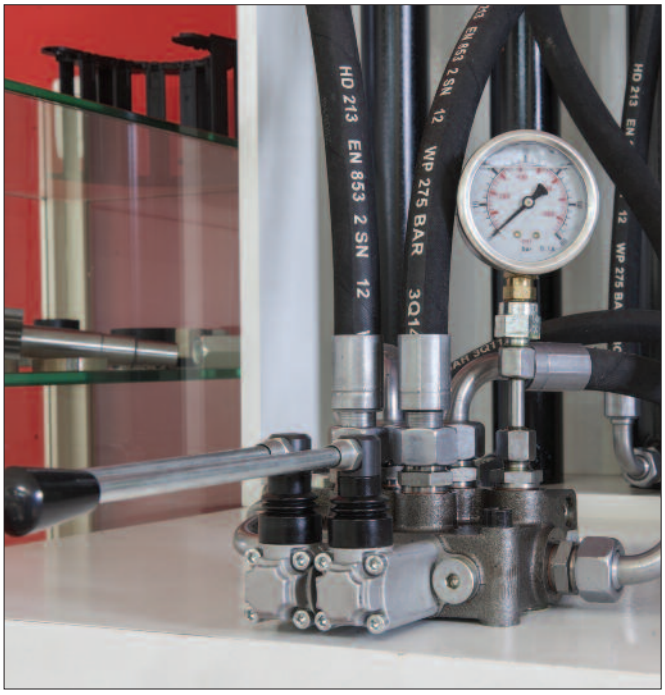
This document and its contents were developed by the British Fluid Power Association using the expertise and resources of the BFPA Education and Training Committee. It presents the consolidated view of leading representatives and experts in the Fluid Power Industry. It is the product of a dedicated initiative managed by a specially convened BFPA E&T Task-force. The BFPA and members of the task-force wish to acknowledge the valuable contributions made by other industry stakeholders including academia, representatives from other BFPA member organisations, OEM's and the wider UK engineering industry. This document is one of three publications covering, Hydraulics, Pneumatics and Electronic Control of Fluid Power Systems respectively. This particular publication addresses the recommended foundation requirements for operatives in the Hydraulics sector.

The BFPA has always taken the lead within the UK as regards the provision of educational recommendations for those involved in the maintenance and management of Fluid Power Systems and their associated control. Many of its recommendations now form the basis for competence-based qualifications which have been widely adopted by CETOP* in Europe.

The health and safety of all personnel maintaining and managing Fluid Power Systems remains the primary driver underpinning the work of the BFPA. To this extent, following a one-year investigative programme with key stakeholders, these recommendations are applicable to everyone in every sector where Fluid Power is employed.

They should be regarded as an Industry standard, forming the foundation level of knowledge and understanding necessary for practical operatives, whilst ensuring that safe working practices are followed at all times.

This guideline is formulated as a series of outcome-related statements. It is not intended to be a training course, however from these recommendations, approved education and training establishments will be able to formulate effective training programmes and modules to meet this foundation level of understanding.




Wherever possible the learning process should be supported by the development of key practical skills thus hands-on training in a practical context is also recommended.

To support these recommendations the BFPA has developed a training reference manual, an industry recognised certification process and training card.

## For whom are these recommendations intended?

These recommendations are primarily intended for those personnel involved in the maintenance and management of Fluid Power Systems – in short – anyone who is expected to operate and maintain fluid power components and systems at a practical level. However, many other related engineering professions would benefit across a range of levels from advanced apprentices to service engineers, technical representatives and project engineers. Appropriately applied, these recommendations establish a foundation upon which any individual may develop their Engineering career and become more involved in broader integrated systems engineering.

* The European Committee for the Fluid Power Industry

# BFPA Foundation Level - Hydraulics

## Introduction to the application of Fluid Power

On completion of any programme of study, candidates should know where Fluid Power (hydraulics) is used in modern society and have an appreciation of its importance in the provision of power and motion control (high profile examples should be provided.) Candidates should also be given a basic understanding of the relevant regulations governing the industry.

## Technical Recommendations

On completion of any programme of study involving these recommendations candidates should know:

## Basic Principles

1. the basic layout of a typical hydraulic circuit
2. the function and operation of the parts that are used to construct a typical circuit
3. the fundamental principles that underpin the operation of all hydraulic systems in relationship to:-
   a) Pressure and Force
   b) Flow, Displacement and Speed
   c) Pressure, Displacement and Torque
   d) Power in with reference to the prime mover
   e) Power out with reference to actuator operations
   f) Pressure drops/Power losses/Heat generation

This section should involve simple calculations, associated units and terminology.

## Hydraulic Symbols

4. Candidates should be able to recognise the Hydraulic Symbols in current use relating to ISO-1219-2012 and apply these to the various component parts within a hydraulic circuit with reference to a typical:
   a) Open circuit
   b) Closed circuit

## Hydraulic Pumps

5. Candidates should know the types of pump in common use (gear, vane and piston) with reference to:-
   a) construction and principle of operation
   b) fixed and variable displacement
   c) methods used to control displacement (pressure compensation)
   d) relationship between flow and pressure (pump performance)

## Hydraulic Fluid Oil Reservoirs

6. Candidates should know the basic layout and function of a typical hydraulic fluid oil reservoir – features and characteristics

## Pressure Control

7. Candidates should know the devices used to control and limit pressure within a working circuit with reference to;
   a) Relief valves, Pressure Reducing valves and Sequence valves
   b) Following safe setting up procedures
   c) Effects upon performance if adjustments are made

## Flow Control

8. Candidates should know the difference in construction between a Simple Throttle Valve and Pressure Compensated flow control valve with reference to:
   a) Performance and energy losses
   b) Pressure intensification through the use of flow control valves

## Direction Control

9. Candidates should know the construction, function and principle of operation of:
   a) Simple inline check valve
   b) Pilot operated check valve
   c) Spool direction control valve (Brief overview of options and control methods)

## Hydraulic Actuators

Candidates should:

10. Know the construction and operation of the types of actuators in common use

## Contamination Control

11. Candidates should know the importance of Cleanliness Management associated with hydraulic system performance with reference to:
    a) Locations where contamination can enter a system and recommended preventative measures/procedures that must be followed
    b) Effects upon performance due to ingress of contamination
    c) Filter performance and location
    d) Regular monitoring of systems to assure target cleanliness levels are maintained

## Hydraulic Fluid

Candidates should:

12. Know the function of the Hydraulic Fluid within a system
13. Know the meaning of the term VISCOSITY and how it affects overall performance
14. Outline the factors that affect the life of the hydraulic fluid in service
15. Know the importance of good storage and transfer processes

## Hydraulic Hose Technology

Candidates should:

16. Know the general construction of hydraulic hose assemblies and the concept of 'fit for purpose'

    An understanding of the acronym; 'STAMPED' should also be introduced. *(Size, Temperature, Application, Medium, Pressure, End-couplings & Delivery)*
17. Know the factors to inspect before installing a particular hose
18. Know the recommended procedures to follow to effectively install a hose
19. Know the causes of reduced hose life/failure
20. Know the safe procedures to follow when carrying out hose inspection and the signs of deterioration and actions to be taken

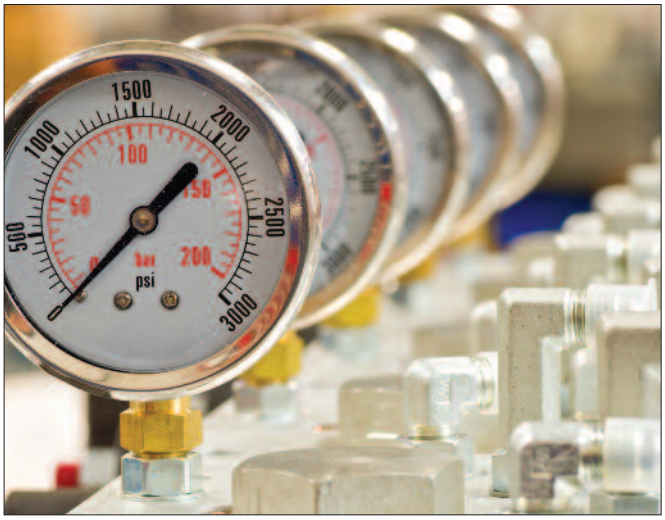
## Maintenance Procedures

Candidates should:

21. Know the main causes of failure in hydraulic systems
22. Know the importance of being able to identify normal key system performance indicators
23. Know the symptoms associated with a change in performance
24. Know the importance of a pro-active maintenance scheme and associated record keeping
25. Know the importance of following safe working procedures at all times when carrying out such activities as: installation, commissioning, servicing/testing, inspections, checking performance, and any other activities that fall within your job role specification

## Test and Measurement in Hydraulic Systems

26. Overview of test and measurement equipment in common use



## Health and Safety

Due to the nature of a working hydraulic system and the utilisation of oil under pressure to transmit power, together with that of moving parts, it is important to follow safe working practices at all times.

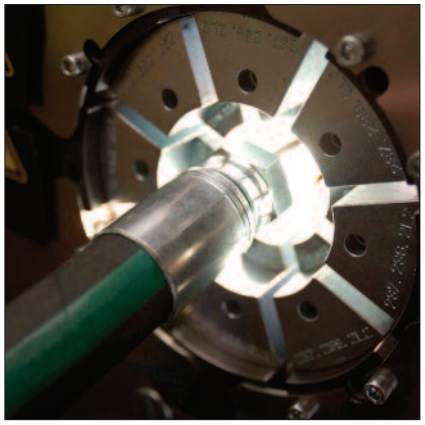
These recommendations will improve a candidate's knowledge and skills and with a greater overall understanding of the power transmission process and the components involved, their ability to identify dangers, assess the risk and to put in place the necessary control measures that will become part of their daily work.

CANDIDATES MUST:

27. Know the importance of personal protection associated with the working environment
28. Know the importance of following safe isolation procedures
29. Know the dangers of trapped and stored energy and how to deal with it (such as accumulators)
30. Know the dangers associated with hydraulic oil leakage and how to deal with it
31. Know the effects of oil injection injuries and the immediate actions to be taken
32. Know the procedures to follow before starting work on any hydraulic system
33. Know the importance of training and working within their trained capability
34. Know the importance of following all safe working procedures and rules laid down by their Employer

## Practical Recommendations

To support the implementation and effectiveness of these Recommendations, Candidates must be given the opportunity to install and commission small working systems, whilst interpreting circuit diagrams, follow safe working practices and setting up procedures.



## Contributing Organisations

- A C Hydraulics
- Bath University
- Belfast University
- Bosch Rexroth
- British Fluid Power Association
- EAL
- EnerMech
- Festo
- Fluid Power Design Solutions
- Hercules Hydraulics
- HMS Sultan
- Manuli Hydraulics
- National Fluid Power Centre
- Parker Hannifin
- Pirtek UK
- SEMTA
- Siemens
- Systems Services

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