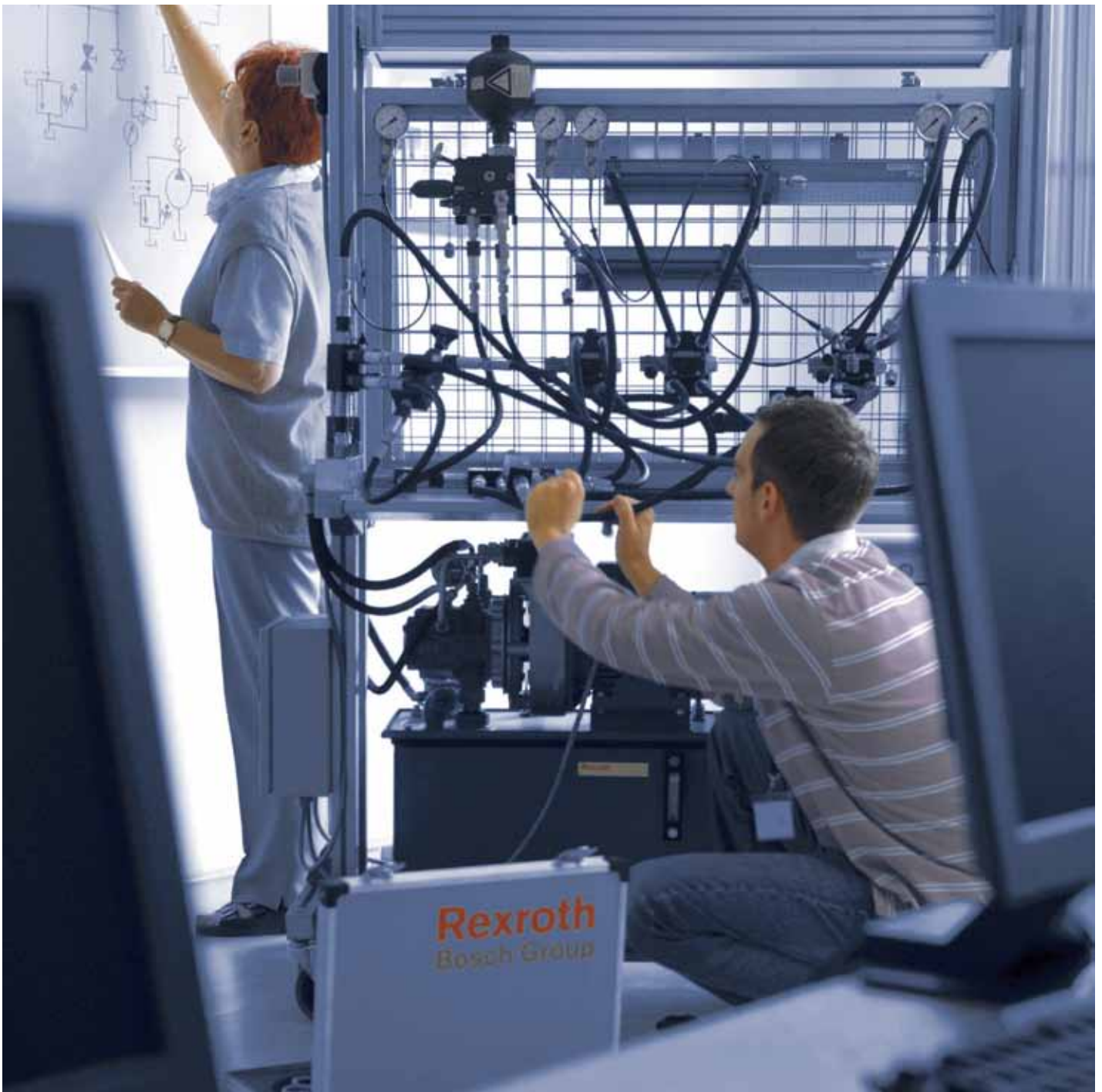
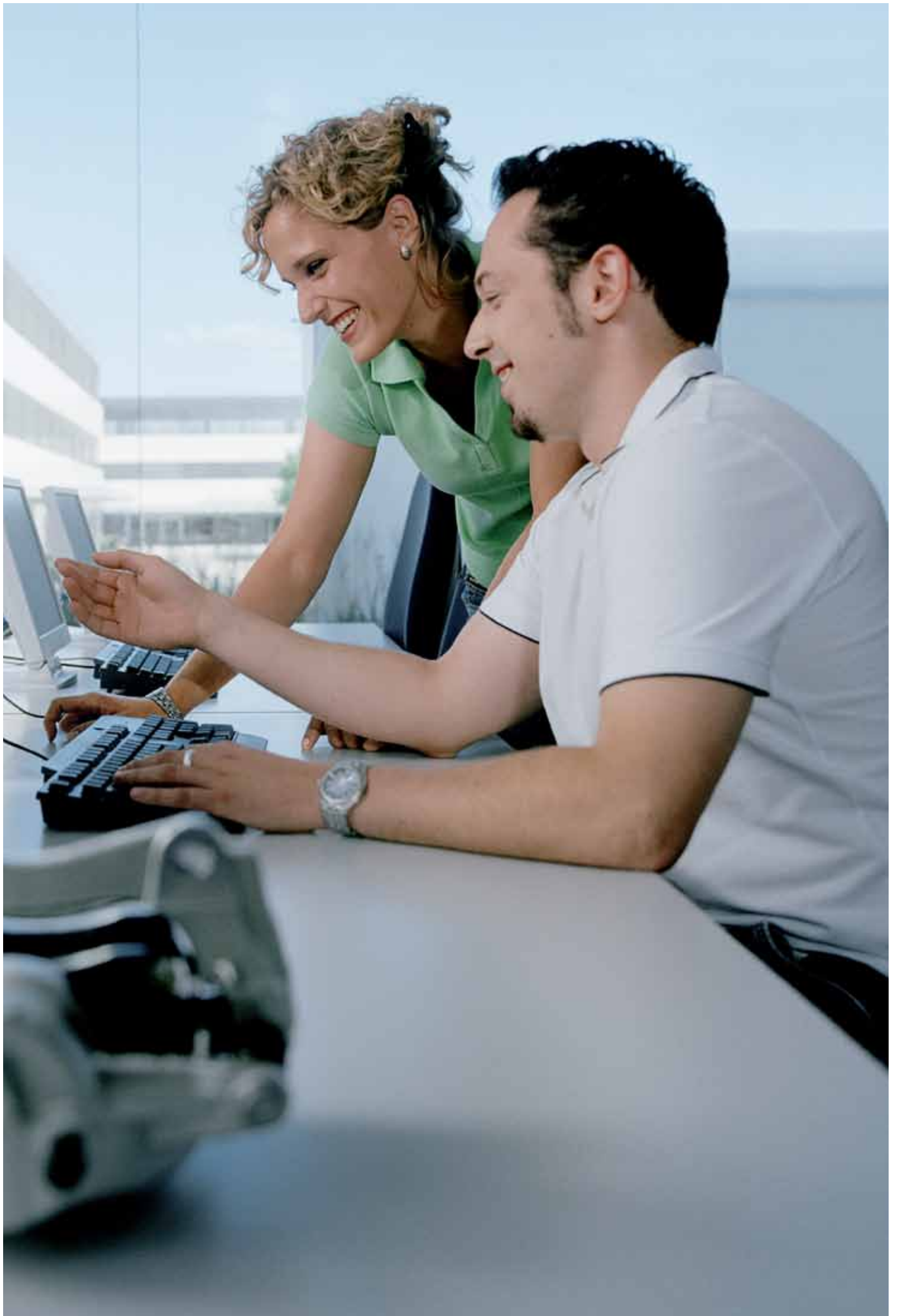


# Rexroth Hydraulics Training Schedule

## The Drive & Control Academy







## Training Centre Locations

### St Neots

UK Headquarters  
15 Cromwell Road  
St Neots  
Cambridgeshire  
PE19 2ES

### Bradford

Unit A  
Bowling Back Lane Industrial Estate  
Bowling Back Lane  
Bradford  
BD4 8SA

### Cardiff

C8 Main Avenue  
Treforest Industrial Estate  
Pontypridd  
Cardiff  
CF37 5UD

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# Professional Hydraulics Training from Rexroth The Key to Success

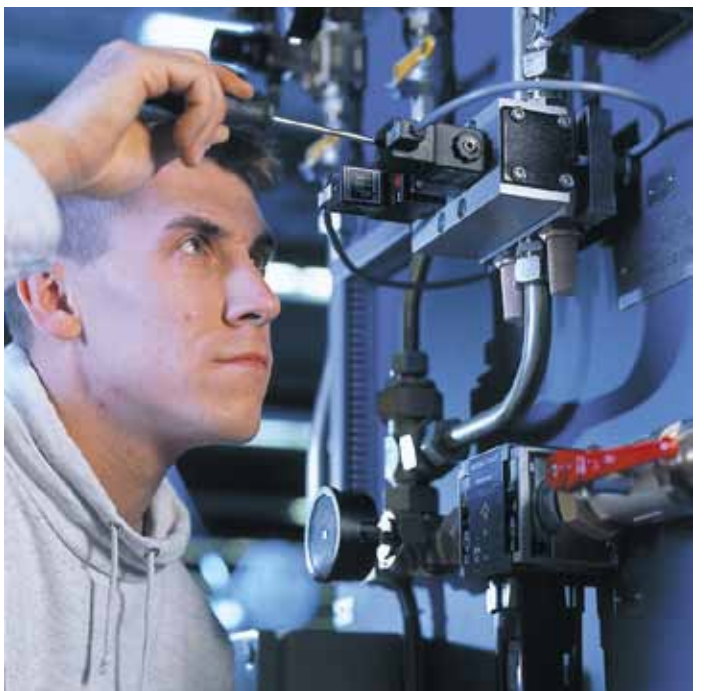
Bosch Rexroth AG is one of the world's leading specialists in the field of drive and control technologies. Supplying customers with tailored solutions for driving, controlling and moving machinery used in industrial and factory automation as well as in mobile applications. Rexroth is committed to supplying first-class customer training on our range of products.

Based on this commitment, we offer a series of courses that meet our industries' training needs. Our training is targeted toward those individuals who maintain hydraulic systems, those who design new systems and those who want to upgrade existing systems with new technology.

Course structures are formulated to represent the ideal training and learning experience for personnel working within the maintenance, repair, field service or technical support fields of hydraulic systems and are certificated by Bosch Rexroth Limited.

Rexroth training provides a perfect starting point towards an industry standard qualification such as the British Fluid Power Association Industrial Hydraulics – Level 2 Certificate.

Whether you are in maintenance or engineering, you can count on quality hydraulic training at any Rexroth Training facility you select.



# Scheduled Courses and On-site Hydraulics Training

This prospectus details our range of hydraulics training courses, offering a wide selection of basic, advanced and customer specific training for students of all abilities and levels.

## Which is best for you?

### Scheduled Courses

Regular scheduled classes in hydraulics technology offered at one of our training facilities across the UK.

- Maintenance Hydraulics
- Proportional Systems
- Basic Hydraulic Design

### On-site Training

Routinely accomplished through our on-site programmes.

We offer a full compliment of Rexroth training programmes either at customer site or at one of our training facilities. We regularly provide instruction to many students through various on-site training programmes offering training customised to your equipment and applications.

**Familiarisation Training** – for new equipment installations or an overview of current equipment, we provide on-site training seminars to train your employees in correct start-up and preventative maintenance procedures. Incorporating a mix of theory and practical work, training is delivered by a Rexroth engineer.

**Bespoke Training** – customised for your people, machines and unique challenges. Courses are designed and developed to match customer specific requirements. Delivered direct by fully competent Rexroth personnel, or one of our training partners.



# Stage 1 Training Courses

- ▶ MH Maintenance Hydraulics
- ▶ MH-s Maintenance Hydraulics 'short' course

- ▶ No previous hydraulics knowledge required
- ▶ Courses designed for non-technical staff, Maintenance Engineers, Technical and Sales personnel involved in the maintenance, management and design of hydraulic power systems
- ▶ Includes practical hands-on exercises utilising Rexroth specially designed training rigs
- ▶ MH course run from our Head Office – St Neots, Cambridgeshire.  
Course includes brief introduction to the Stage 2 course 'Proportional Systems' and factory tour.  
3.5 days
- ▶ MH-s course run from our training centres – Bradford and Treforest  
3 days



# Maintenance Hydraulics

Course Code: MH

Location: Bosch Rexroth, St Neots\*

## Aims

- ▶ To impart a basic understanding of maintenance hydraulics
- ▶ To increase the knowledge of personnel who are actively engaged in the repair and maintenance of hydraulic systems
- ▶ To allow participants to become familiar with fluid power technologies such as pump flow, cylinder speed, forces and pipe sizes
- ▶ Introduce basic hydraulic theory in a practical way
- ▶ To increase the knowledge of personnel in maintenance and fault-finding techniques associated with hydraulic systems
- ▶ To enable participants to understand their specific hydraulic installation and circuit diagrams
- ▶ To gain hands-on experience of building, fault-finding and optimising hydraulic circuits using our range of specially designed training rigs
- ▶ To introduce participants to proportional control, optimising and fault-finding



## Course Content

### Day one

- ▶ Basic hydraulic principles
- ▶ Hydraulic symbols and circuit notations
- ▶ Pressure control valves and associated circuitry
- ▶ Relief valves and pressure reducing valves
- ▶ Sequence valves and counter balance/overcentre valves
- ▶ Flow control valves and associated circuitry
- ▶ Simple throttle valves
- ▶ Pressure/temperature compensated units
- ▶ Direction control valves and associated circuitry
- ▶ Direct operated spool valves
- ▶ Two stage spool valves
- ▶ Poppet valves and logic cartridge elements

### Day two

- ▶ Check valves – type and applications
- ▶ Pump and pump control systems
- ▶ Pump types and operating principles
- ▶ Methods of control/application
- ▶ Accumulator types and application
- ▶ Hydraulic motors and actuators
- ▶ Type and operating principles
- ▶ Methods of control and application

### Day three

- ▶ Total cleanliness control
- ▶ Hydraulic fluids, good housekeeping
- ▶ Maintenance and trouble shooting techniques
- ▶ Practical hands-on exercises

### Day four

- ▶ Introduction to Proportional Control
- ▶ Factory Tour

## Maintenance Hydraulics

Course code: MH

Location: Bosch Rexroth, St Neots\*

Duration: 3.5 days / 3 days\*

### The above course is available on the following dates in 2011:

15 – 18 February  
 22 – 25 March  
 17 – 20 May  
 7 – 10 June  
 23 – 26 August  
 20 – 23 September  
 18 – 21 October

### Pre-requisites

No previous knowledge required

### Target groups

Maintenance Engineers  
 Project Engineers  
 Technical Personnel  
 Sales Personnel

\*Note: This course is also run each month on behalf of Rexroth by Sparrows Fluid Power (this is a 3 day course).

# Maintenance Hydraulics

Course Code: MH-s

Location: Bosch Rexroth, Treforest / Bradford or Customer Site\*

## Aims

- ▶ Hydraulic training at our Treforest or Bradford facility
- ▶ To impart a basic understanding of maintenance hydraulics
- ▶ To increase the knowledge of personnel who are actively engaged in the repair and maintenance of hydraulic systems
- ▶ To allow participants to become familiar with fluid power technologies such as pump flow, cylinder speed, forces and pipe sizes
- ▶ Introduce basic hydraulic theory
- ▶ To increase the knowledge of personnel in maintenance and fault-finding techniques associated with hydraulic systems
- ▶ To enable participants to understand their specific hydraulic installation and circuit diagrams
- ▶ To gain hands-on experience of building, fault-finding and optimising hydraulic circuits using our range of specially designed training rigs (Treforest/Bradford location only)

## Maintenance Hydraulics

Course code: MH-s

Location: Bosch Rexroth, Treforest / Bradford or Customer Site\*

Duration: 3 days

**The above course is available on the following dates in 2011:**

### Bradford

18 – 20 January  
13 – 16 December

### Treforest

12 – 14 April  
19 – 21 July  
15 – 17 November

### Pre-requisites

No previous knowledge required

### Target groups

Maintenance Engineers  
Project Engineers  
Technical Personnel  
Sales Personnel

\*Note: For the MH-s course carried out at customer site, no training rigs will be used. This training is adaptable to bring hydraulic training into the working environment without the need for special facilities, power supplies or rooms.

## Course Content

### Day one

- ▶ Basic hydraulic principles
- ▶ Hydraulic symbols and circuit notations
- ▶ Pressure control valves and associated circuitry
- ▶ Relief valves and pressure reducing valves
- ▶ Sequence valves and counter balance/overcentre valves
- ▶ Flow control valves and associated circuitry
- ▶ Simple throttle valves
- ▶ Pressure/temperature compensated units
- ▶ Direction control valves and associated circuitry
- ▶ Direct operated spool valves
- ▶ Two stage spool valves
- ▶ Poppet valves and logic cartridge elements

### Day two

- ▶ Check valves – type and applications
- ▶ Pump and pump control systems
- ▶ Pump types and operating principles
- ▶ Methods of control/application
- ▶ Accumulator types and application
- ▶ Hydraulic motors and actuators
- ▶ Total cleanliness control
- ▶ Hydraulic fluids, good housekeeping
- ▶ Methods of control and application

### Day three (Bradford/Treforest)

- ▶ Total cleanliness control
- ▶ Hydraulic fluids, good housekeeping
- ▶ Maintenance and trouble shooting techniques
- ▶ Practical hands-on exercises

### Day three (Customer Site)

- ▶ As no practical exercises are included in training carried out at customer site, Day 3 is devoted to analysing customer circuit diagrams in terms of maintenance requirement, testing, checkouts and faultfinding
- ▶ Explanation of circuit layout and design
- ▶ Type of components installed
- ▶ Maintenance and troubleshooting techniques

# Stage 2 Training Courses

- ▶ TPS1 Training for Proportional Systems
- ▶ BHD Basic Hydraulic Design
- ▶ PPC Pump and Pump Control

Please see below for recommended knowledge base/experience required prior to attending a Stage 2 course.

Ideally, completion of the Stage 1 course, Maintenance Hydraulics. This course is offered from our St Neots, Bradford and Treforest training centres, and also at Sparrows Fluid Power, and would encompass all of the following:

- ▶ Knowledge of basic hydraulic principles that underpin all hydraulic systems (relationship between, pressure, flow force, torque, speed, pump size, motor size & cylinder dimensions)
- ▶ Be able to read and interpret circuit diagrams using current symbols
- ▶ Know the function and operation of relief valves, sequence valves and pressure reducing valves
- ▶ Know the principle of pressure compensation relating to flow control
- ▶ Know the principle of operation of check valves and sliding spool valves
- ▶ Know the principle of operation of gear, vane and piston pumps
- ▶ Know the different characteristics of oils and the aspects of contamination control
- ▶ Know what accumulators are used for
- ▶ Have a basic understanding of proportional control and basic electrical theory

- ▶ Have a basic appreciation of pump testing and component settings up procedures
- ▶ Appreciate the requirements of risk management



# Training for Proportional Systems

Course Code: TPS1

Location: Bosch Rexroth, St Neots / Treforest / Bradford

## Aims

- ▶ To introduce students to the principles and practices of proportional control
- ▶ Introduction to the study of circuit construction and circuit components
- ▶ To introduce basic principles of design of proportional systems
- ▶ Students will gain a knowledge of both analogue and digital proportional systems
- ▶ Students will gain a knowledge of both open and closed loop proportional systems
- ▶ For students to become familiar with set-up procedures on proportional systems
- ▶ For students to become familiar with maintenance and fault-finding techniques on proportional hydraulic systems

## Training for Proportional Systems

Course Code: TPS1

Location: Bosch Rexroth, St Neots / Treforest / Bradford

Duration: 3 days

**The above course is available on the following dates in 2011:**

<b>Bradford</b>	<b>St Neots</b>	<b>Treforest</b>
22 – 24 February	21 – 23 June 6 – 8 December	13 – 15 September

### Pre-requisites

Attendance on either the MH or MH-s course.  
See Stage 2 pre-requisites (page 9).

### Target groups

Maintenance Engineers  
Project Engineers  
Technical Personnel  
Sales Personnel

Note: Practical exercises form an important part of this course, carried out using our range of specially designed training rigs. Course participants are asked to bring current circuit diagrams to these sessions where time will be devoted to their explanation.

## Course Content

### Day one

#### ▶ Valve construction and operation

- Types of proportional control devices
- Pressure relief
- Flow control
- Direction control
- Hydraulic symbols
- Spool configurations
- Selection & sizing with reference to manufacturer's data

#### ▶ Electrical operation

- Types of proportional control devices
- Basic electrical circuits and operation
- Solenoid design
- Comparison between conventional and proportional valves
- Methods of control
- Comparison between analogue and digital control

### Day two

#### ▶ Proportional Attributes

- Ramp
- Gain
- Deadband
- Dither
- Pulse width modulation

#### ▶ Amplifier cards

- Principles of operation
- Design and application
- Analogue and digital

#### ▶ Closed Loop

- Internal and external feedback devices
- Operation and application of closed loop systems

### Day three

#### ▶ Integrated Electronics Option Frequency Response

- Principles of operation
- Bode diagrams and their use in manufacturer's data
- PID control

#### ▶ Practical Exercises

#### ▶ Commissioning and set-up procedures

- Open loop circuits
- Closed loop circuits
- Interface to the control

# Basic Hydraulic Design

Course Code: BHD

Location: Bosch Rexroth, St Neots

## Aims

- ▶ The BHD course takes a more mathematical approach to the theory covered in the MH or MH-s courses. After covering basic theory and operation of hydraulic components, the emphasis moves to circuit design and basic project work
- ▶ The course is intended for design and technical personnel who are involved with machine design and the specification of hydraulic components and systems
- ▶ Although this course is not intended to fully instruct the student in proportional technology it is inevitable that this subject is covered as this technology forms an integral part of modern hydraulic systems

## Course Content

### Day one

#### ▶ **Fundamental Principles**

- Cylinders – relationship between valves
- Cylinder size, pressure, area and effective force
- Cylinder size, supply flow rate and velocity

#### ▶ **Motors**

- Motor displacement, pressure and shaft torque
- Motor displacement, supply flow rate and shaft speed
- Motor performance and effects of fluid viscosity

#### ▶ **Loads to be moved**

- Application of the laws of dynamics, with reference to mass and inertia, friction, gravity and other external forces; direct and indirect loads

#### ▶ **Pumps**

- Displacement, shaft speed and flow rate
- Flow rate, system pressure and fluid viscosity
- Pressure difference, component flow area and flow rate
- Fluid Viscosity, Renolds number, flow characteristics, recommended flow velocities
- Pressure difference, flow rates, heat generation and temperature changes

### Day two

- ▶ Step by step to follow, relating to system design

- ▶ Outline of common design faults

- ▶ Preparing outline circuitry

- ▶ Component selection to meet specification

#### ▶ **Actuators**

- Cylinder to meet force, speed and application needs
- Motors to meet torque, speed and application needs
- Pressure – Time/flow diagrams and duty cycles

#### ▶ **Pumps**

- Sizing, power requirements and Q/P requirements
- Circuitry relating to fixed and variable displacement pumps

#### ▶ **Hydraulic valves**

- Size selection, flow rates, pressure and configurations
- Proportional control valves: Overview of valve selection, sizing and application

### Day three

- ▶ Contamination control at the design stage

- ▶ Health and performance monitoring when designing

- ▶ Reservoir sizing and layout considerations

- ▶ Design exercises and practical tasks

## Basic Hydraulic Design

Course Code: BHD

Location: Bosch Rexroth, St Neots

Duration: 3 days

We aim to run this course at least once per year. We anticipate this training will take place during September/October 2011 – please contact us to register your interest.

### **Pre-requisites**

Attendance on either the MH or MH-s course. See Stage 2 pre-requisites (page 9).

### **Target groups**

Maintenance Engineers  
Project Engineers  
Technical Personnel  
Sales Personnel

# Pump and Pump Control

Course Code: PPC

Location: Please contact us for venue

## Aims

- ▶ To understand the function and operation of pumps and their controls
- ▶ To be able to make the correct pump selection for given applications
- ▶ To understand the causes of pump failure
- ▶ To understand the affects of contamination
- ▶ To understand the setting-up procedures of pump and pump control
- ▶ To understand safe working practices



## Course Content

### Day one

- ▶ Pump types
  - Function
  - Operation
- ▶ Pump selection
- ▶ Pump controls
  - Fixed displacement
  - Variable displacement
  - Relief valves
  - Flow control valves
  - Unloading valves
  - Accumulators and pressure switches
  - Pressure compensation
  - Load sensing
  - Constant power

### Day two

- ▶ Causes of pump failure
- ▶ Contamination and target cleanliness
- ▶ Manufacturers recommendations/specifications
- ▶ Setting up procedures
- ▶ Safe working practices – Dos and Don'ts

## Pump and Pump Control

Course code: PPC

Location: Please contact us for course dates/prices

Duration: 2 days

### Pre-requisites

Attendance on either the MH or MH-s course.  
See Stage 2 pre-requisites (page 9).

### Target groups

Maintenance Engineers  
Project Engineers  
Technical Personnel  
Sales Personnel

Note: Due to the nature of this training, its content is not limited to Rexroth pumps and controls.



# Additional Training from Rexroth

- ▶ FT Familiarisation Training
- ▶ BT Bespoke Training

Details of our Familiarisation and Bespoke training courses follow.

Training delivered to customer specific requirements.

## **Familiarisation Training**

A mix of theory and practical based training incorporating elements of our Maintenance Hydraulics Stage 1 course (as required) and overview of customer specific equipment (for example machine start-up, correct operating procedure, preventative maintenance etc).

## **Bespoke Training**

Bespoke training in Hydraulic Systems delivered on-site or at a Rexroth training facility.

Familiarisation and Bespoke training is delivered by fully competent Rexroth personnel or a Rexroth training partner.



# Familiarisation Training

Course Code: FT

Location: Customer site

## Aims

- ▶ Training programmes to suit your company specific needs
- ▶ A mix of theory and practical based training covering machine/equipment set up, operation and basic fault finding
- ▶ Course content and duration to customer requirements



## Development of Training

- ▶ Training will include on-site familiarisation with systems and components
- ▶ Discussion and/or site survey to gather technical and supplier information; current hydraulic circuit diagrams and operating specification of equipment to be included
- ▶ Current level of knowledge and experience of staff established
- ▶ Desired level of expertise to be attained on completion of training discussed
- ▶ Course content/programme agreed with customer
- ▶ Quotation to customer
- ▶ Course dates proposed/agreed
- ▶ Customer order placed
- ▶ Training delivered solely at customer site or a combination of training at one of our training facilities/customer site

## Familiarisation Training

Course Code: FT

Course content and duration to customer requirements.  
Please contact us for full details/pricing.

### Target groups

Maintenance Engineers  
Project Engineers  
Technical Personnel  
Sales Personnel

# Bespoke Training

Course Code: BT

Location: Bosch Rexroth, St Neots / Treforest / Bradford  
or Customer Site

## Training programmes to suit your company specific needs

- ▶ Bespoke training in Hydraulic Systems on-site or at one of our training facilities – St Neots, Treforest or Bradford
- ▶ Programmes designed to ensure training is delivered to match customer specific requirements, providing a cost effective way to guarantee staff knowledge and skills match workplace tasks
- ▶ Course content, delivery times and duration to customer specification



## This training is produced in three phases:

### Phase 1 (Information gathering)

- ▶ Site survey carried out by Rexroth personnel and/or approved Lecturer to discuss areas to be covered. Information gathering of current and expected levels of expertise to be achieved, technical data, circuit diagrams and operating specifications assessed. Estimate given for duration of Phase 2 and Phase 3 and customer quoted in accordance with Bespoke Training Pricing Structure (copy available on request).

### Phase 2 (Course Development)

- ▶ Formulation of course notes and support material; preparation of presentation to accompany course notes

### Phase 3

- ▶ Delivery of training

## Bespoke Training

Course Code: BT

Course content and duration to customer requirements.  
Please contact us for full details/pricing

### Target groups

Maintenance Engineers  
Project Engineers  
Technical Personnel  
Sales Personnel

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