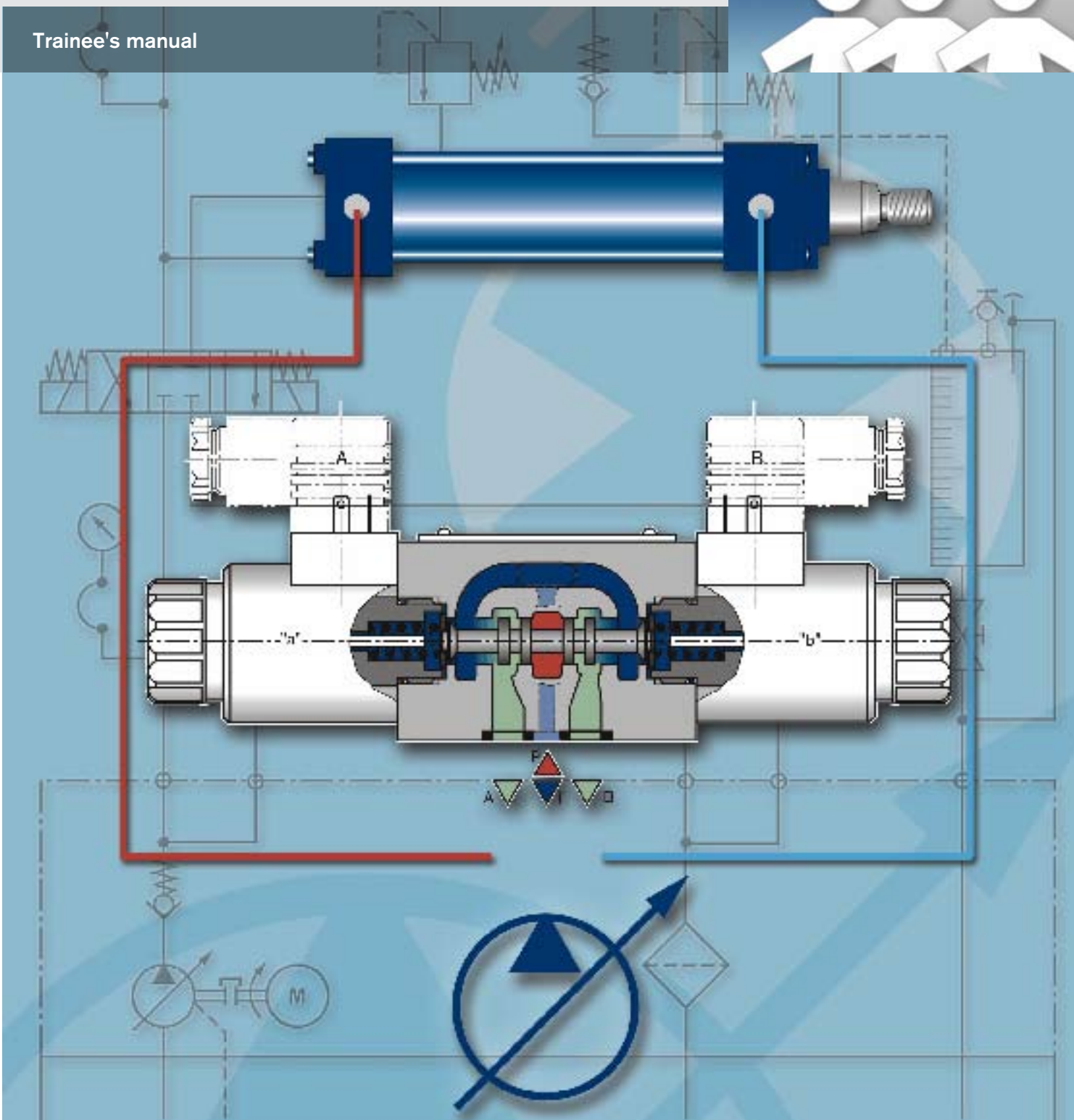
Rexroth
Bosch Group

Project Manual Industrial Hydraulics

RE 00846/04.07

Trainee's manual



A

Introduction

Imparting knowledge through project work • Project designation with short description of the industrial application • Overview of components • Safety aspects

B

Project tasks

01 Hydraulic power unit • 02 Hydraulic pump/variable displacement pump characteristic curve • 03 Single-rod cylinder/pressure intensification • 04 Single-rod cylinder/flow • 05 Hydraulic motor • 06 4/3 directional valve • 07 Check valve • 08 Check valve, pilot operated • 09 Throttle valve, adjustable • 10 Throttle check valve • 11 Flow control valve • 12 Pressure relief valve, direct operated • 13 Pressure relief valve controls • 14 Pressure reducing valve • 15 Pressure switch • 16 Pressure switch/hysteresis • 17 Hydraulic accumulator • 18 Regenerative circuit • 19 Rapid speed/creep speed control • 20 Valve circulation control • 21 Commissioning, inspection, maintenance, troubleshooting, repair

C

Annex

RE 07008 General product information about hydraulic products from Bosch Rexroth AG

Project 03: Single-rod cylinder/pressure intensification

Project definition

A workpiece is to be shifted by a horizontally installed single-rod cylinder to the working range of a simple fixture when the hydraulic pump is switched on. To this end, the extension velocity of the cylinder must be adjustable. Retracting is to be achieved by means of a 4/2 directional valve.

The customer installed a throttle valve on the piston rod side and, while adjusting the extension velocity, recognizes that the pressure upstream of the throttle becomes higher than the set system pressure. Apart from the technical documentation he wishes to get an explanation of the pressure intensification of the single-rod cylinder.

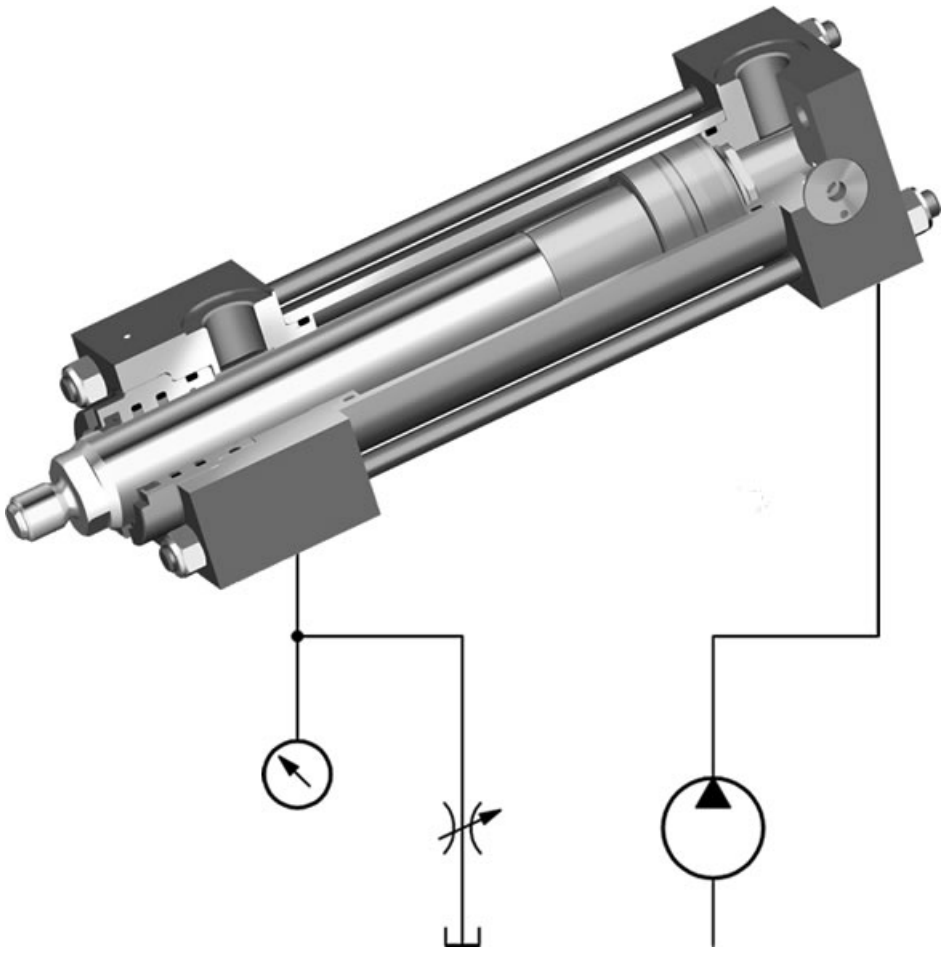


Fig. 03.1 Practical example: Hydraulic cylinder of tie rod design

Notes

Project information

If in a hydraulic system the hydraulic force, which is converted into mechanical energy, is to be transmitted to an actuator in the form of a linear (straight) movement, a **hydraulic cylinder** is used. We distinguish hydraulic cylinders by their design principles:

Plunger, **single-rod** and **double-rod cylinders**.

The hydraulic cylinder as output element forms the link between the hydraulic circuit and the working element/tool in a technological system. Lifting, lowering, locking and transporting loads are typical applications of hydraulic cylinders.
Neglecting friction, the possible maximum **cylinder force** F in kN depends on the possible maximum system pressure p and the effective piston area A of the hydraulic cylinder, i.e.

$F = p \bullet A$ in dN $\quad$ p in bar; A in cm^2

The **piston velocity** v in m/s of the hydraulic cylinder is determined by the pump flow supplied. Flow control valves are used to change, i.e. reduce, the piston velocity. When throttling, for example, the piston extension velocity, important physical laws must be taken into account.

In the following *Project 03* knowledge is to be acquired with regard to the use of single-rod cylinders as machine elements.

Project steps

- **Informing:** Accepting and understanding the order, among others, through discussions with the customer.

- **Planning:** Planning and organizing the execution of the customer order; among others, through the selection of hydraulic components from the data sheet collection (RE 17039 Hydraulic cylinders, tie rod design).

- **Deciding:** Preparation of a schematic diagram sketch and selection of components.

- **Executing:** Set-up of the hydraulic control on the training system. Working out and documenting the system parameters required by the customer and explanations with regard to pressure intensification on the basis of a calculation example.

- **Checking:** Are all customer requirements met?

- **Evaluating:** Are there further possibilities of meeting the customer requirement or simpler ways of project execution? Have unforeseeable problems occurred?

Meeting the customer requirement

The customer requirements of *Project 03* is to be met through the set-up of an electrohydraulic control.

The hydraulic components required for the order can be determined on the basis of circuit diagrams and other technical documentation. Also manufacturers' documents such as technical data sheets can be used, with modern information and communication media (Internet) being also a helpful source of information.
After **order-oriented planning** the control is to be set up observing all current safety regulations and product information. The project order should be analyzed in view of its feasibility.

Detailed **technical documentation** such as:

- Hydraulic circuit diagrams,
- Parts list of hydraulic components,
- Functional description,
- Note on possible optimizations

are essential points for fulfilling the customer order.

A **final evaluation** of work results is to be supplemented by:

- A proof of sources of technical documentation
- and a project sequence chart/documentation of the work carried out.

Note:

To recapitulate the work done and the order handling method, complete the project sequence chart at the end of the project.

Notes

Hydraulic circuit diagram

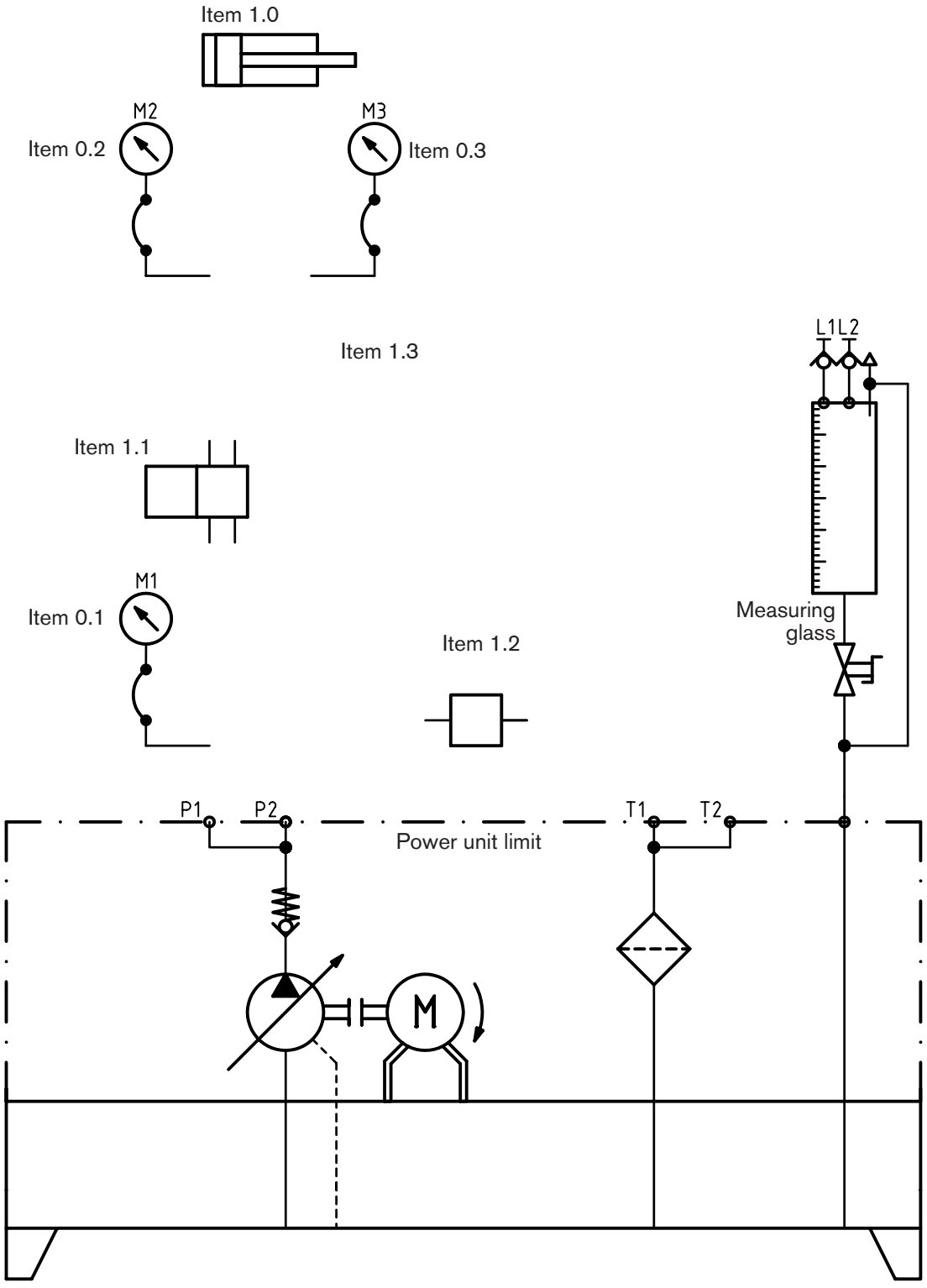


Fig. 03.2 Hydraulic circuit diagram: Feeding cylinder

Electrical circuit diagram

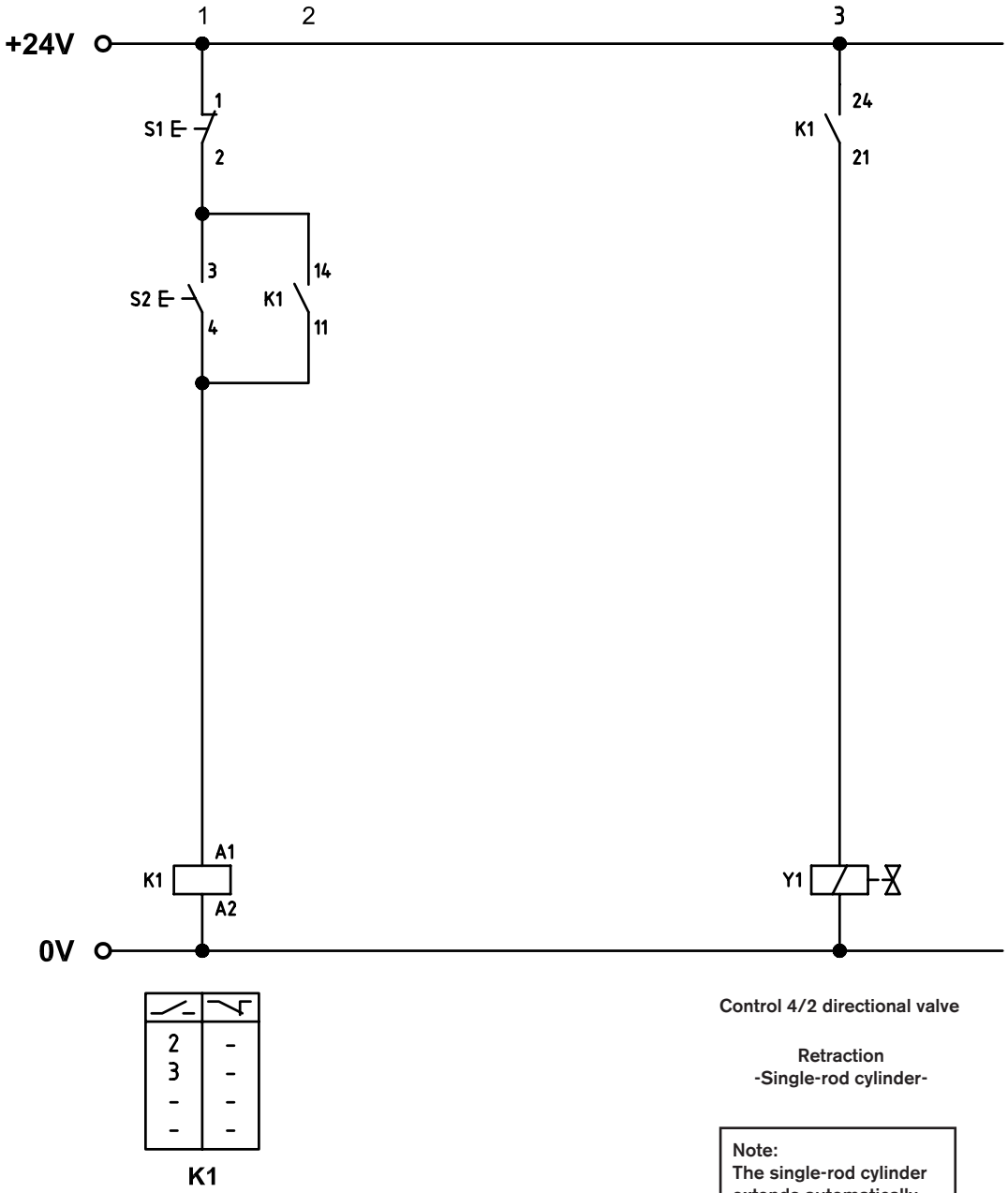


Fig. 03.3 Wiring diagram for hydraulic circuit diagram Fig. 03.2

Component selection with parts list

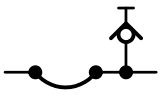
Item	Qty	Component designation	Type designation	Symbol
1.0				
1.1				
1.2				
1.3				
		Distributor plate with four ports		
0.1 - 0.3		Pressure gauge with hose and quick release coupling without check valve		
		hose with quick release coupling with check valve		
		Hose		

Table 03.1 Parts list for hydraulic circuit diagram Fig. 03.2

Safety notes

To ensure the operability of plant and machinery, and consequently to allow the recognition of potential risks, safety regulations must be observed before and during the execution of the order. Relevant sources of regulations are given in the introduction of the present manual.

Warning

If work on electrohydraulic components is carried out improperly, risks of injury and a safety risk can arise during operation of the system, including danger to life.

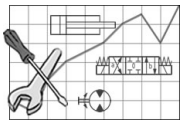
Caution

Before starting work on the training stand, check that the electrical ON/OFF switch on the hydraulic power unit is pressed in, i.e. that the system is switched off. Use the system pressure gauges to check that the system is depressurized.

Hydraulic systems can store pressure energy when at rest. It can cause injury when the system is opened.

Notes

Execution of the order



Set up the control as described below:

1. Mount the components required according to *Table 03.1* in a clearly arranged form on the training system according to the prepared circuit diagram.

   Connect the hydraulic control according to *Hydraulic circuit diagram Fig. 03.2* by means of hoses.

   For connections, to which pressure gauges with minimess line are to be connected, use hydraulic hoses. Hand-tighten the pressure gauge measuring lines at the relevant minimess connection of the hydraulic hose.

   The correct and proper fit of the component connections with hoses can be checked by slightly turning the hoses.

   
   Warning

   Make sure that pipes or hoses are connected to all connections - in this case also to minimess lines, or that the connections are plugged by means of plug screws or protective caps. Leakage oil may drip through open connections and cause a slipping risk.

   
   Caution

   Before commissioning the hydraulic control, i.e. before switching the hydraulic pump on, check, whether all pressure control valves are set to minimum pressure (spring unloaded) and all throttle valves are open.

   Wire **the electrical contr**ol ac*cording to wiring diagram Fig. 03.3*.

2. Switch the hydraulic pump on and inspect the set up control for leakage. No pressure gauge may indicate a pressure.
3. Check the pressure set on the **variable displacement pump** of the drive power unit (if required, correct to **50 bar**).
4. Set the **system pressure** on pressure relief valve **Item 1.2** to **50 bar plus one turn**; operate push-button **S2** to prevent the piston of hydraulic cylinder **Item 1.0** from extending.
5. After having adjusted the system pressure, **check** that the piston of the single-rod cylinder moves properly.
6. **Switch the hydraulic pump off** and wait until the system is **depressurized**. Close throttle valve **Item 1.3**. To this end, turn in the adjustment element counter-clockwise to the limit stop.

   Switch the hydraulic pump on and extend the piston against the meter-out throttle

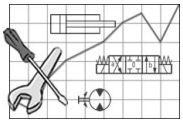
   Is this possible, or why doesn't the piston extend?

7. Measure the **pressure values** while the directional valve is not operated and the hydraulic pump is switched on, and enter the values in *Table 03.2*.

After having completed practical work on the training system switch the hydraulic pump off! Turn all pressure valves of the electrohydraulic control back to minimum pressure. Completely open throttle valves, if installed. No pressure gauge may indicate a pressure!

8. To meet the customer requirement and to explain the pressure intensification of the single-rod cylinder more clearly, make the hydraulic **calculation** below. For this, we recommend the utilization of a technical data sheet.

Measured values



Hydraulic cylinder	**Measuring point M1** System pressure *p* in bar	**M2 piston side** *p* in bar	**M3 piston rod side** *p* in bar
Extending/ Y1 not operated			

Table 03.2 Measured values of pressure intensification

Additional task in conjunction with the customer requirement:

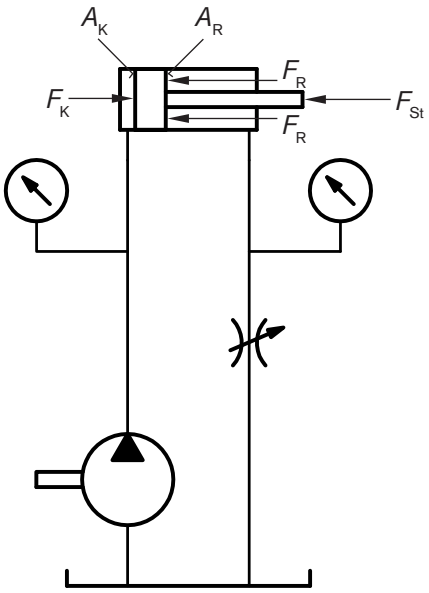
Calculation of the pressure intensification on the basis of given hydraulic cylinder values.

Hydraulic cylinder of tie rod design: **Type CD T3...25/18...200**

Bore: 25 mm A_{piston} = ... cm^2

Piston rod diameter: 18 mm A_{rod} = ... cm^2

$A_{annulus}$ = ... cm^2



..... cm^2 / ..... cm^2 = ... : 1

If the meter-out throttle is completely closed, then:

$F_K = F_R$

$p_K \cdot A_K = p_R \bullet A_R$

$p_R = \frac{.....}{.....} \bullet ..... \text{ bar} = ... \text{ bar}$

Evaluating the work results with regard to the customer requirement

- Hydraulic cylinders perform _____ and transmit the _____ in the form of _____.
- Double-acting hydraulic cylinders with _____ areas are called _____ _____.
- Single-rod cylinders are _____.
- _____ can be kept _____ over the entire stroke.

Notes

Project sequence chart: Project 03

.....
Last name, first name

Project handler

Project designation

Informing
from the project definition.

Planning steps

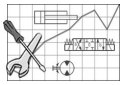
Planning
of the project objective and the proceeding.

Sources of information

Deciding

Deciding on
and selecting components; complementing the circuit diagram and parts list.

(Overleaf)



Execution of the order

Executing
Set-up of the electrohydraulic control and acquisition of required data..

Special points?

Quality check

Checking
Are all customer requirements met?

Evaluating
Optimize project steps

(If required, add supplementary sheet)

Project 03

Note of completion by confirmation of the project manager/place, date, signature