JobMaster® Training Station Hydraulics

USER MANUAL

Catalog #34-8000-0004 Rev. A

intelitek

JMTS Hydraulics User Manual

Catalog No. 34-8000-0004 Rev. A

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Contents

1. Safety and Maintenance

1.1. SAFETY

For your personal safety, observe the following safety guidelines:

- Always wear safety glasses and protective clothing when working with the hydraulic components on the JMTS.
- Before activating the system, make sure the bolts which attach components to the panel are securely fastened.
- Do not attempt to disconnect or connect components when the power pack is switched on.
- Do not tamper with the power pack's pressure relief valve. Its factory setting of 60 bar should not be altered.
- Immediately clean up any oil spills.
- Never leave the power pack operating unnecessarily or unattended.
- When working with electro-pneumatic systems, ensure that the power supply module is off when connecting or disconnecting an electrical connector.

1.2. MAINTENANCE

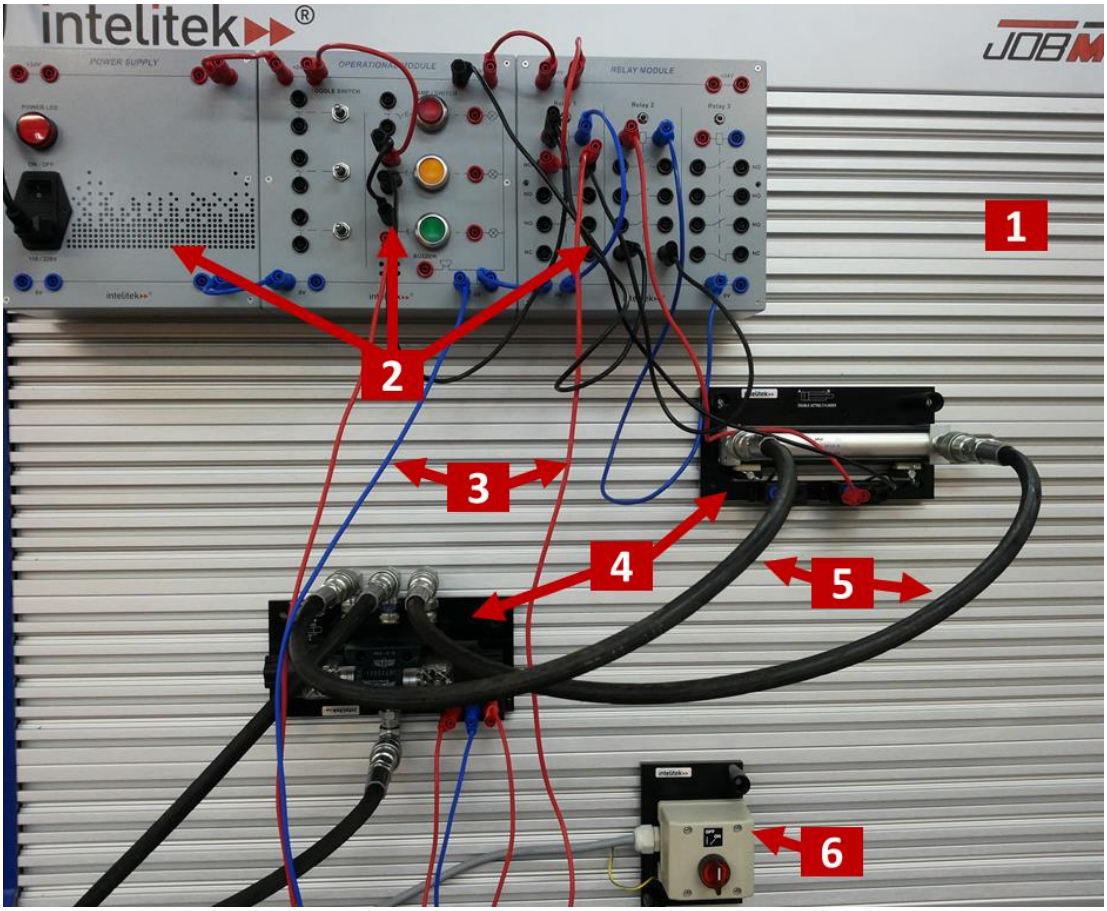
The Hydraulic components require little maintenance. However, to ensure safe and proper operation, make sure you comply with the following:

- Check hoses regularly for twisting, cracking, splitting, or leakage. Replace any hose which shows signs of damage.
- Maintain the recommended level of hydraulic fluid in the tank.
- Replace the hydraulic fluid once a year.
- Refill the tank only with hydraulic fluid of type 10W or SADOL S-300.
- Do not allow the hydraulic fluid temperature to exceed 50°C (122°F). If it does, switch off the system and allow it to cool down.

2. Installation

One of the main purposes of the JobMaster Training Station (JMTS) mounted panel is for the assembly of hydraulic circuits and systems. The station, in tandem with the hydraulic components, can be used to teach the fundamentals of hydraulics at both basic and advanced levels.

The components can easily be repositioned, coupled, and uncoupled, to form a variety of hydraulic or electro-hydraulic circuits. An example hydraulic system on the JMTS mounting panel is shown here:



1. JMTS Mounting Panel
2. Electrical modules
3. Electrical connectors (wires)
4. Hydraulic and electro-hydraulic components
5. Hydraulic connectors (hoses or pipes)
6. Hydraulic power pack (pump) On/Off switch

2.1. ATTACHING COMPONENTS TO PANEL

Hydraulic components are easily attached to the JMTS panel.

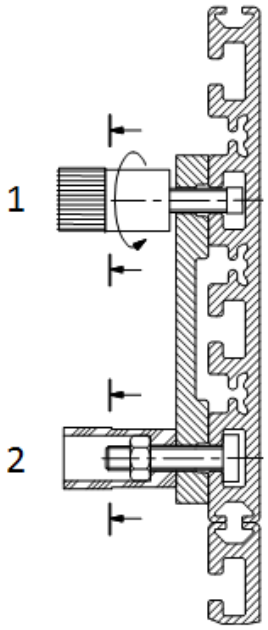
The components are mounted on special plates that can be attached to the panel. Do not remove the components from these plates.

The plates have pairs of bolts and nuts. The nuts are mounted in black plastic casings which allow them to be tightened and loosened by hand and then further tightened with a hex wrench. The heads of the bolts are shaped to fit into the slots of the panel.

ⓘ *Note: There are two types of slots on the panel. Mount the components by inserting their bolts into the thinner slots.*

To attach a component to the panel:

1. Unscrew the bolts on the mounting plate about two-thirds of the way.
2. Push the bolt head all the way into the slot at a horizontal position (1), and turn the bolt until the bolt head is positioned vertically (2).



3. Tighten the bolt by turning it clockwise until the component is held securely.
4. Further tighten the component using a hex driver.

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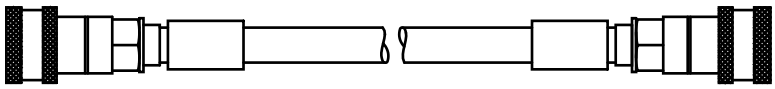
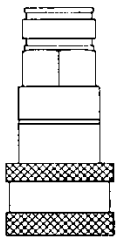
2.2. CONNECTING COMPONENTS

The hydraulic components are connected by means of 1/4" hoses provided with the system. The hoses come in three lengths: 200 cm, 80 cm and 50 cm.

Quick couplers are used for easy connection and disconnection of the hoses.

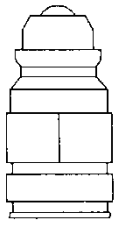


- All hoses have female couplers (sockets).
  The sockets have a spring loaded sliding collar, and an internal ball bearing ring. Retracting the collar loosens the internal ball bearings and allows the plug to be inserted or released. When the plug and socket are coupled, the female ball bearing contracts and holds the head of the male coupler, thus allowing hydraulic fluid to flow between the components.



Female coupler

- All the ports on the hydraulic components have male couplers (plugs).
  The plugs have a partially exposed ball bearing. The ball bearing is spring loaded which prevents hydraulic fluid and system pressure from leaking when the plug is not in use or not properly connected.



Male coupler

To connect a hose to a component:

- Hold the female coupler and slide back its collar.
- Fit the female coupler onto the male coupler and release the collar.

To disconnect a hose from a component, simply grasp and slide back the collar of the female coupler.

2.3. CONNECTING THE HYDRAULIC POWER PACK

The hydraulic power pack (110V, catalog #22-0004-0001 or 220V, catalog #22-0004-0002) is the hydraulic pump used for powering the components of JMTS panel. The tank has two ports for direct pipe connections. One port is for the oil pressure to the system. The other port is a return line to the tank.

Before continuing on to the sections below, and before building any hydraulic systems, read the **Hydraulic Power Pack for JMTS User Guide**, catalog #0200407, which describes the structure and setup of the hydraulic power pack.

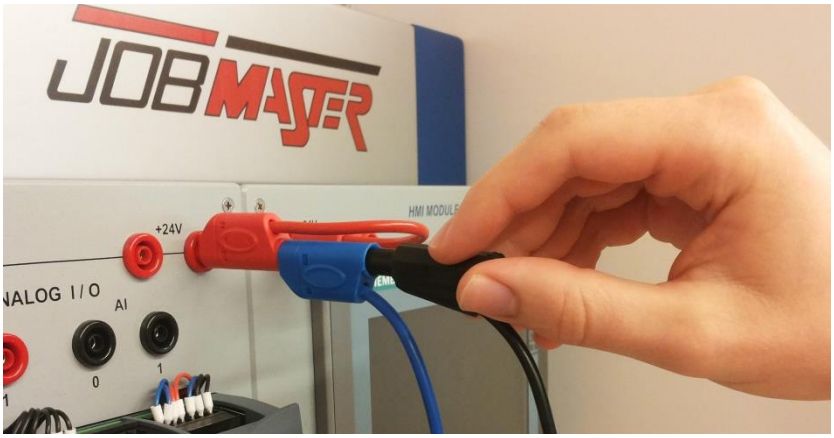
2.4. BUILDING ELECTRO-HYDRAULIC SYSTEMS

These instructions are for electro-hydraulic systems only.

The electro-hydraulic components require a power supply, supplied by the **JMTS Power Supply Module**. Power from the power supply module can be further transferred and controlled via the toggle and button switches on the **JMTS Operational Module**. These two modules, shown below, should be mounted to the JMTS panel.

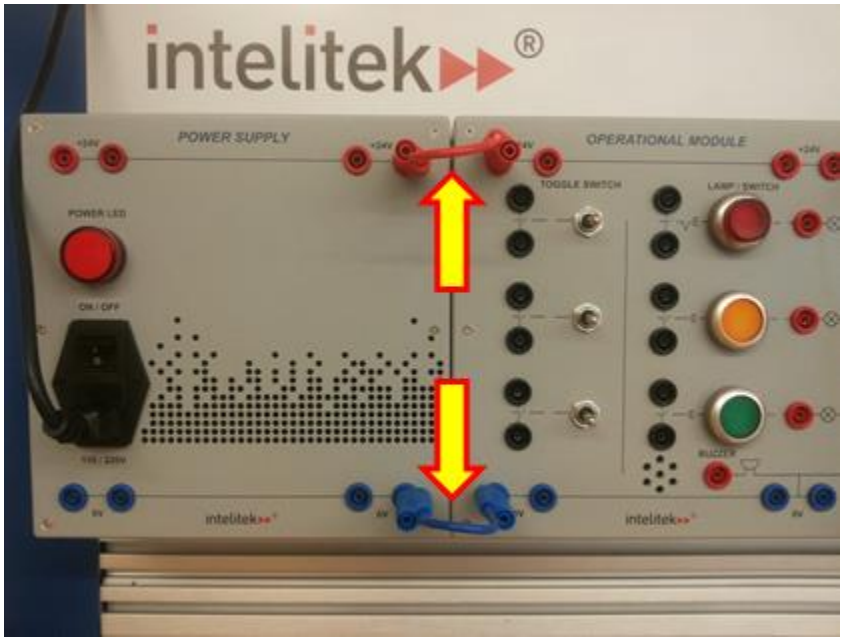
Before you make any connections, make sure the voltage rating of the power supply module matches your power supply.

All connections are by means of cables with banana plugs. The banana plugs can be stacked one into another, as shown here:



2.4.1. Wiring Connections

Wiring connections are performed by first connecting the power supply module to a grounded AC power supply outlet. The power supply module is then connected to the operational via the 24 V (red) and 0V (blue) sockets.



Connections are then made to the electro-hydraulic components from the operational module's power (red) ground (blue) and/or switch (black) sockets.

2.4.1.1. 2/2 Sol-Spring Valve Connections

To power a 2/2 sol-spring valve:

1. Connect the blue socket on the valve directly to a 0V (blue) socket on the operational panel (or the power supply module).
2. Connect the red socket on the valve to a 24V (red) socket on the operational panel (or the power supply module). This connection should not be a direct connection. Rather, it should be made via a switch on the operational module or via other another switching device such as the relay module.

2.4.1.2. 4/3 Sol-Sol Valve Connections

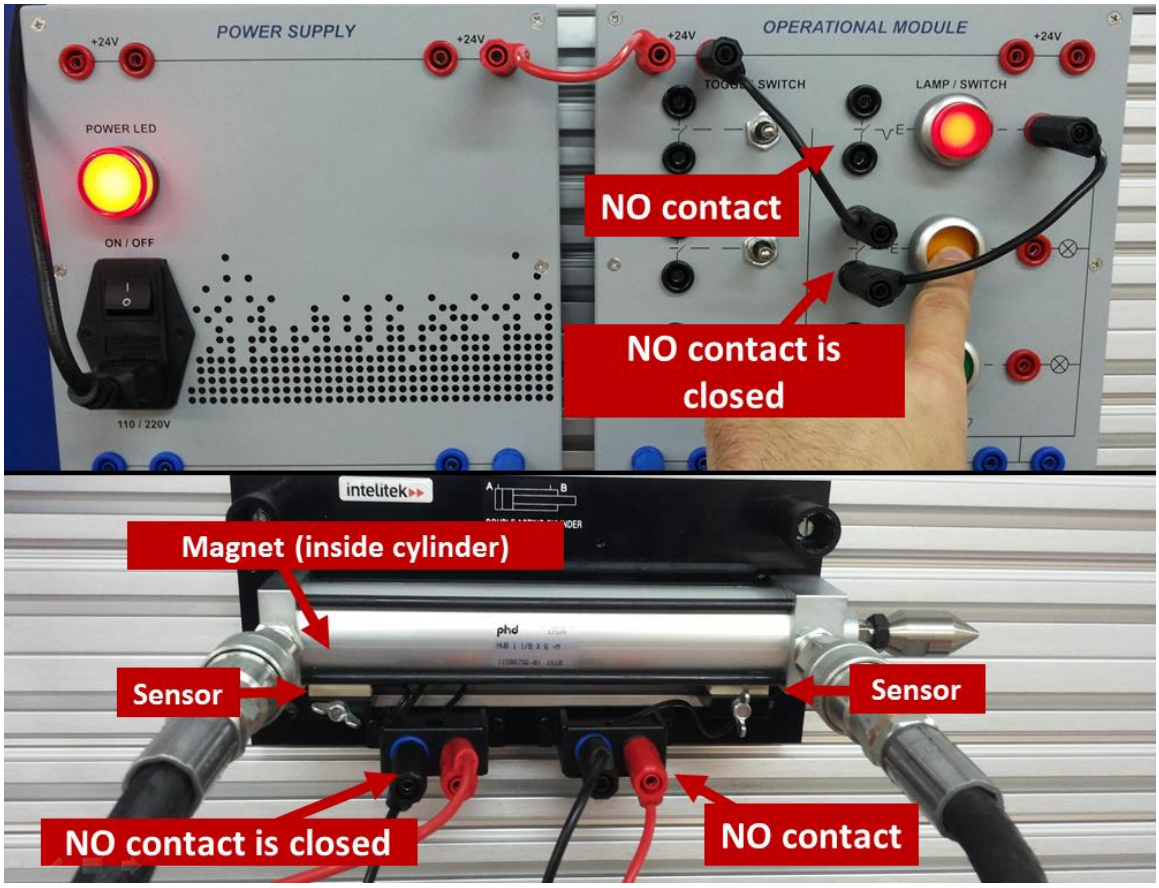
To power a 4/3 sol-sol valve to operational module:

1. Connect the blue socket on the valve directly to a 0V (blue) socket on the operational panel (or the power supply module).
2. Connect the red sockets on the valve to one or two 24V (red) sockets on the operational panel (or the power supply module). These connections should not be direct connections. Rather, they should be made via switches on the operational module or via other switching devices such as the relay module.

2.4.1.3. Magnetic Sensor/Switch Connections

2.4.1.3.1. Overview

The pair of magnetic sensors that are intended to be attached to a double-acting cylinder are actually switches. Each switch has normally open contacts only, and thus acts similar to a push button switch on the operational module. The main difference is that on the operation module, the switch requires that the push button be pressed for the contacts to close. The switches on the cylinder require that the cylinder's magnet be adjacent to the magnetic switch.



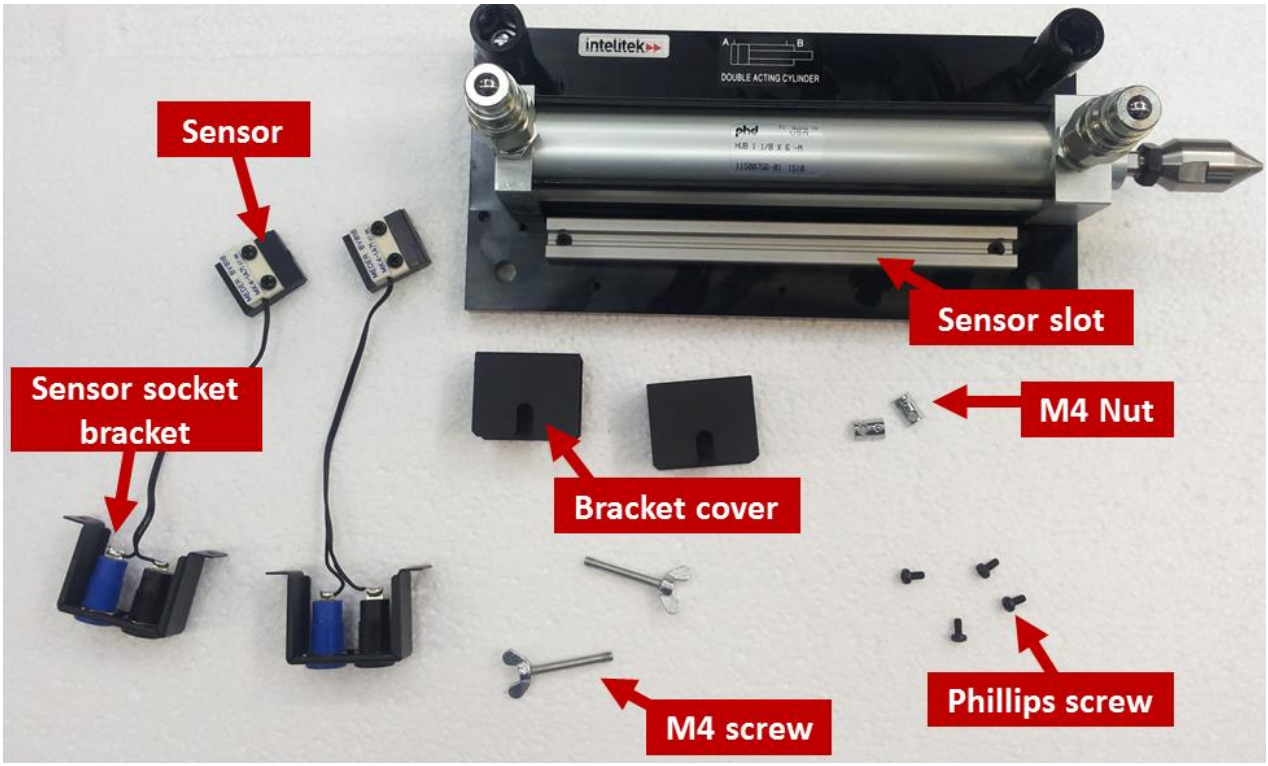
Note: You may have to adjust the sensors by moving them along the slot in order to find the exact location of the magnet when the cylinder is completely extended or retracted.

Note: If a sensor locks (i.e., the NO contacts remain closed even when the cylinder's magnet is no longer adjacent to the sensor) remove it from its slot and tap it gently with your finger. If the problem persists, the sensor should be replaced.

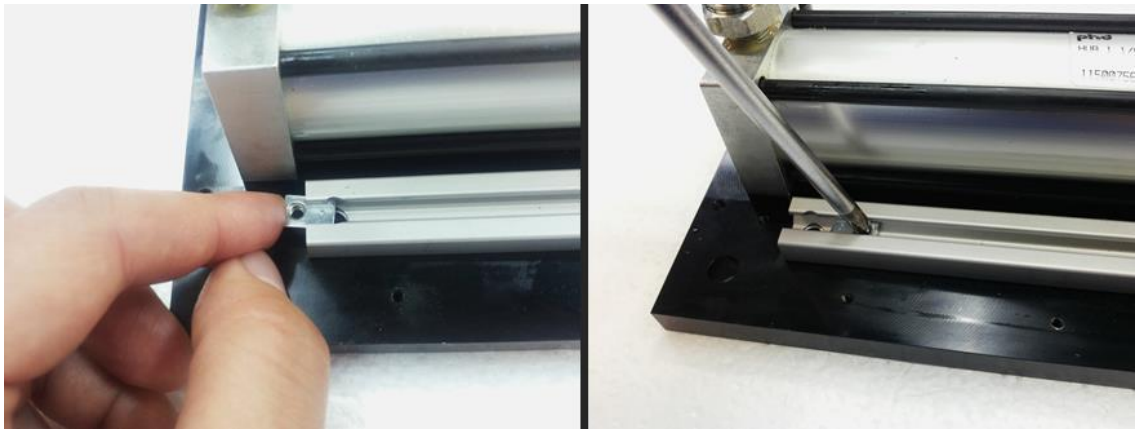
2.4.1.3.2. Sensor/Switch Assembly

To attach the magnetic sensors/switches:

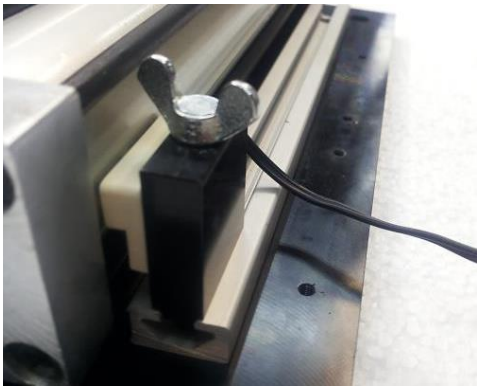
Refer to the image below.



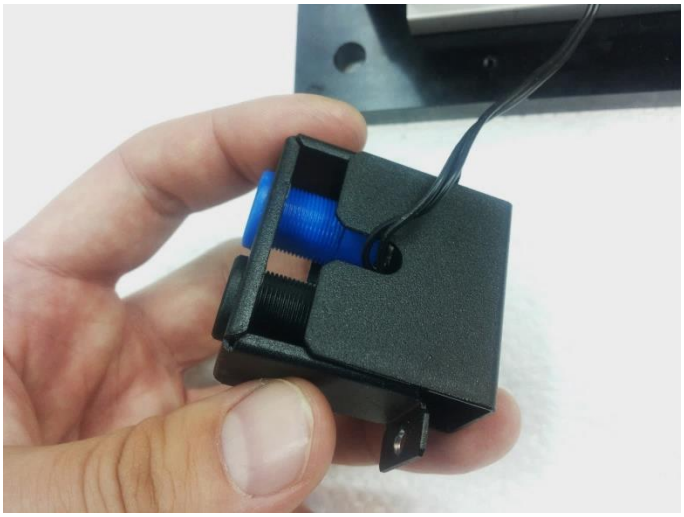
1. Insert the M4 nut into the sensor slot alongside the cylinder. You can use a Phillips-head screw driver to insert or position the nut.



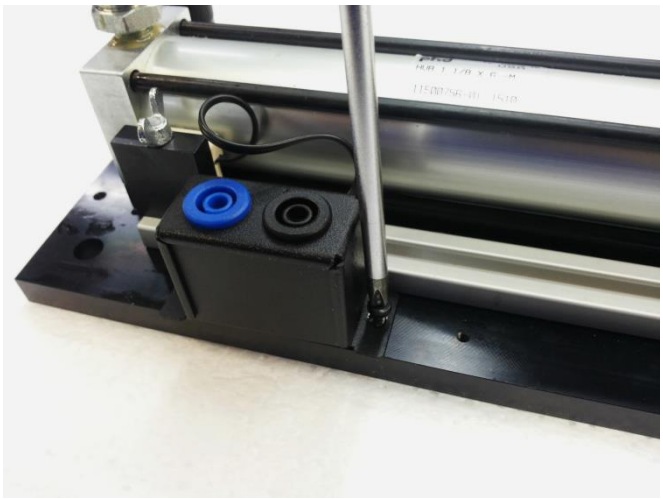
2. Fit the M4 screw through the bore in the (black) sensor housing, and attach it to the M4 nut in the slot. Position the sensor as desired (white sensor towards the cylinder), and tighten the screw.



3. Fit the bracket cover onto the sensor socket bracket.



4. Using two Phillips screws, attach the sensor socket bracket to the cylinder's mounting plate.



5. Repeat steps 1 through 4 for the second sensor.

2.4.1.3.3. Connecting the Sensors

To connect the sensor/switch:

1. Connect either socket on the switch directly or indirectly to a 24V (red) socket on the operational module (or the power supply module).
2. Connect the other socket to a consumer such as a lamp or buzzer, or to a PLC module input socket.

3. Components

3.1. TERMINOLOGY

The following are definitions of terms used in this manual as they relate to hydraulics and the JMTS training unit.

Controller — An element which controls particular function of a device. A controller can be pneumatic, hydraulic, electric, or mechanical, and may be operated manually or by a control signal.

Cylinder — A cylindrical chamber in which a piston moves.

Hydraulic Fluid — A fluid of low viscosity, such as oil, whose primary function is to transmit power in a hydraulic system.

Piston — A disk or round part which fits tightly and moves within a cylinder. The piston compresses or moves the hydraulic fluid within the cylinder, or it transforms the energy imparted by the fluid entering or expanding inside the cylinder into a mechanical force, usually by means of a connecting rod.

Port — Openings in hydraulic components which enable hydraulic fluid to flow in and out. The following codes are generally used to identify ports:
P: Pressure Input, usually connected to the pump.
T: Return Line, usually connected to the collection tank.
A, **B**: Device Connections, such as cylinder ports.

Position — A defined status of a component or valve.

Pressure — The ratio of a force to the area on which the force is exerted. Pressure is measured in bar or Pascal units.

Pump — A device which converts mechanical energy into hydraulic energy. A pump produces a flow. Pressure is the result of resistance to that flow.

Solenoid — An electric conductor wound in such a way that a magnetic field is created when electric current flows through the windings. Solenoids can be used for electric control of hydraulic valves. Abbreviated as sol.

Tank — Reservoir; stores the hydraulic fluid, and keeps it clean, free of air, and relatively cool.

Valve — A device which controls the flow or pressure of the liquid in the hydraulic system. A valve can regulate pressure, control the direction of flow, or provide a constant flow regardless of changes in pressure.

The term 4/3 (four-by-three) valve, for example, indicates that the valve has four ports and three possible positions.

3.2. HARDWARE PACKAGES

Illustrations and descriptions of the hydraulics components appear on the following pages. Items which are not designated as belonging to the Basic, Advanced, or Electro-hydraulics packages are optional components which can be purchased separately for use with JMTS.

Basic Hydraulics: Package H1 (Catalog #00-2105-1000)

Qty.	Catalog #	Part Name (Alternate Name)
1	025402	Double-Acting Cylinder ∅ 1-1/8""
1	025414	4/3 Selector Valve, Closed Center (4/3 Directional Valve [Closed Center])
1	025404	Two-Way Flow Control Valve Bi-Directional Flow Control Valve
2	025405	One-Way Flow Control Valve (Uni-Directional Flow Control Valve)
1	025437	Pressure Relief Valve
1	025408	Flow Meter
2	025409	Pressure Gauge
2	025424	T-Connector
2 4 4	025411 025412 025413	Hoses - 2 m Hoses - 80 cm Hoses - 50 cm

Not Included in Package	22-0004-0001 22-0004-0002	Hydraulic Power Pack - 110 V Hydraulic Power Pack - 220 V

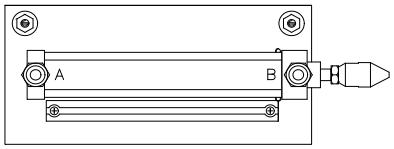
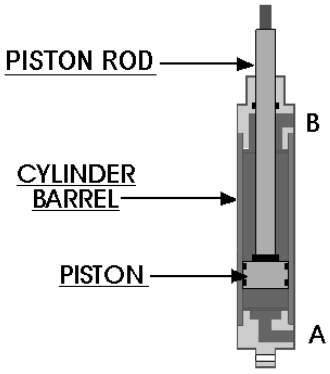
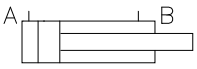
Advanced Hydraulics: Package H2 (Catalog #00-2106-1000)

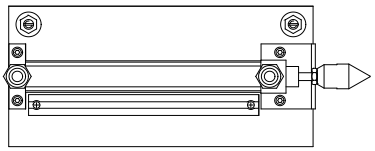
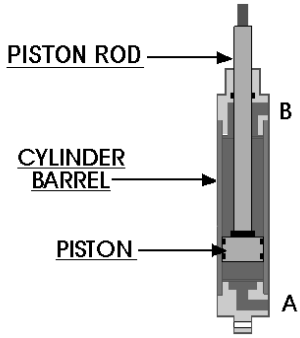
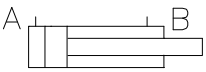
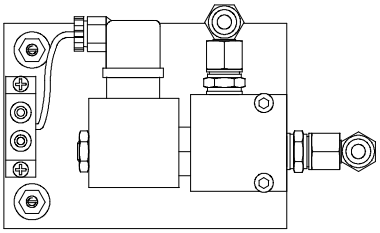
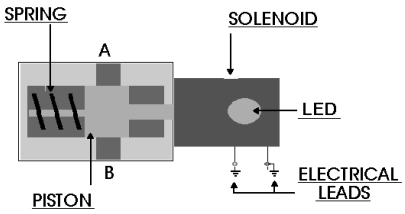
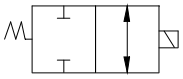
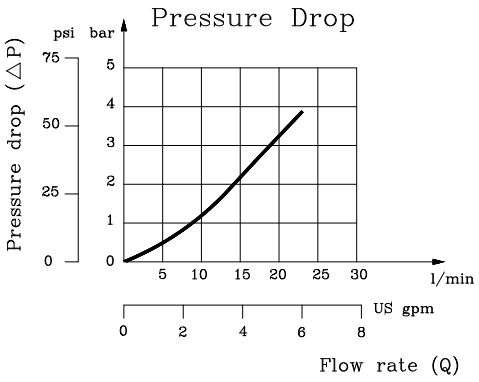
Qty.	Catalog #	Part Name (Alternate Name)
1	025431	Double-Acting Cylinder ∅ 3/4"
1	025403	4/3 Selector Valve, Open Center (4/3 Directional Valve [Open Center])
1	025415	Pressure Reducing Valve
2	025410	Manifold
1	025428	Coiled Hoses
1	025419	Temperature Gauge
2	025412	Hoses - 80 cm

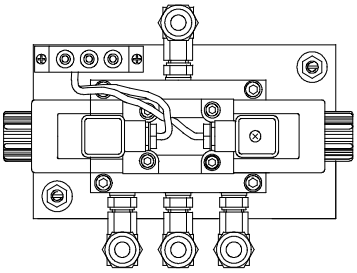
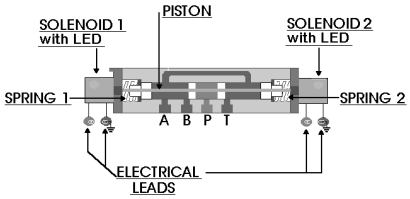
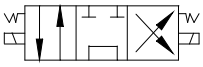
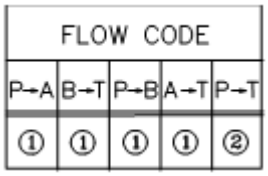
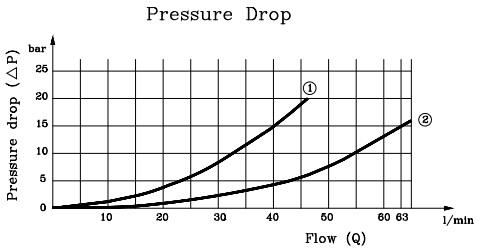
Electro-Hydraulics: Package H3 (Catalog #00-2107-1000)

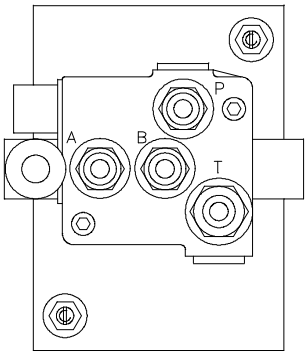
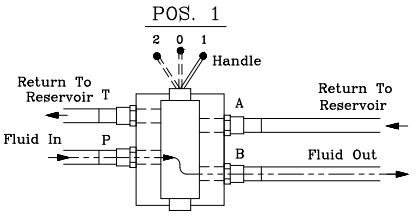
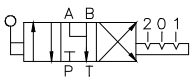
Qty.	Catalog #	Part Name (Alternate Name)
1	025421	4/3 Double Solenoid Valve (4/3 Sol-Sol Valve–Tandem Center)
1	025433	2/2 Solenoid Valve (2/2 Sol-Spring Valve)
1	025323	Magnetic Proximity Sensors (Pair)
		Banana Plug Cables:
3	411658	Red (200mm)
3	411659	Blue (200mm)
2	411661	Red (400mm)
2	411662	Blue (400mm)
2	411663	Black (400mm)
4	411664	Red (600mm)
4	411665	Blue (600mm)
4	411666	Black (600mm)
4	411667	Red (1100mm)
4	411668	Blue (1100mm)
4	411669	Black (1100mm)

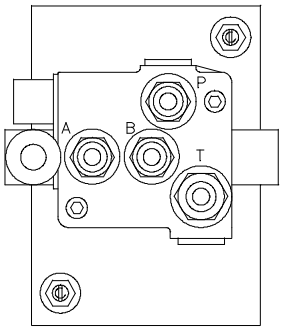
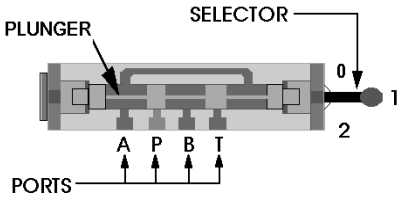
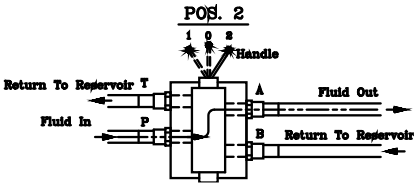
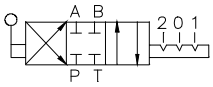
3.3. COMPONENTS

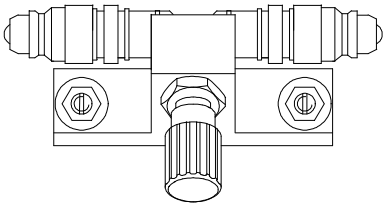
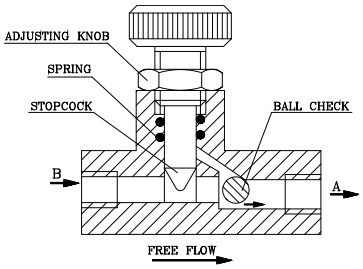
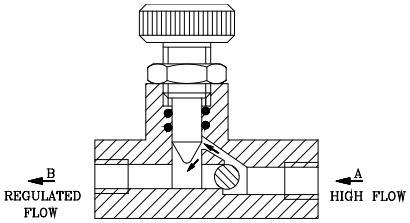
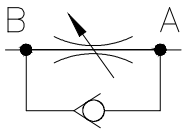
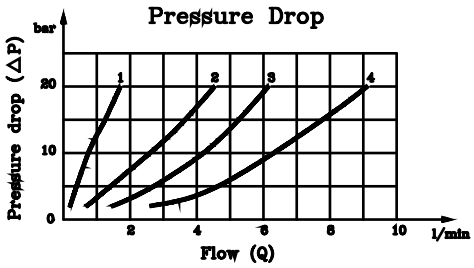
Cat #	Name	Schematic	Description
Actuators			
025402 **BASIC**	**Double-Acting Cylinder** **∅1-1/8"**   	 	Double-acting magnetic cylinder Piston ∅ 1-1/8" (28.5 mm) Piston rod ∅ 9.5 mm Stroke: 6" (152 mm) Max. pressure: 100 bar This cylinder converts potential and kinetic fluid energy into mechanical force. As a double-acting cylinder, it is both extended and retracted by hydraulic power, and both its outgoing and return movements can be used as working strokes. This component is equipped with a slot to enable the attachment of Magnetic Sensors (Cat.#025323). **Example of use:** Pressurized hydraulic fluid flows through port A into the housing on the piston side. The piston and piston rod are moved. The fluid displaced in the piston rod chamber is discharged through port B. After reversal, fluid flows through port B and pushes the piston with piston rod into the initial position (return movement). Fluid is discharged through port A.

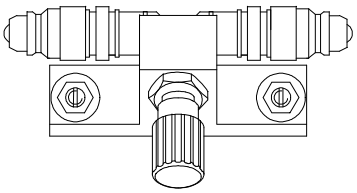
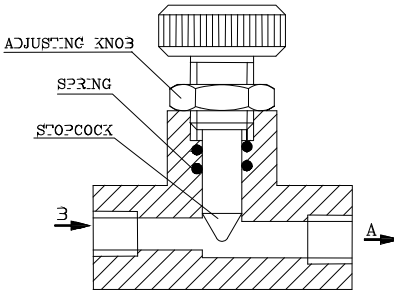
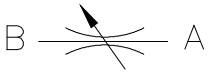
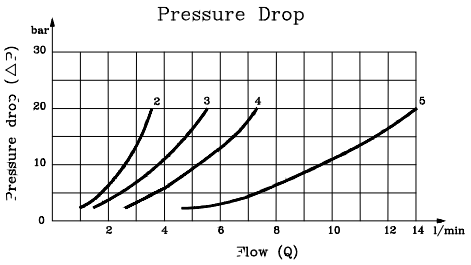
Cat #	Name	Schematic	Description
025431 **ADVANCED**	**Double-Acting Cylinder** **∅ ¾"**   	 	Double-acting magnetic cylinder Piston ∅ ¾" (19 mm) Piston rod ∅ ¼" (6.35 mm) Stroke length: 6" (152 mm) Max. pressure: 100 bar This cylinder converts potential and kinetic fluid energy into mechanical force. As a double acting cylinder, it is both extended and retracted by hydraulic power, and both its outgoing and return movements can be used as working strokes.
Electrically Activated Valves			
025433 **ELECTRO**	**2/2 Solenoid Valve** **[2/2 Sol-Spring Valve]**   		2/2 directional control valve Solenoid-actuated, spring-return Changeover contact Pressure range: 0-210 bar Flow rate: 23 l/min Operating voltage: 24 Vdc, 1A  Refer to Section 2.4.1.1 for instructions on connecting this valve.

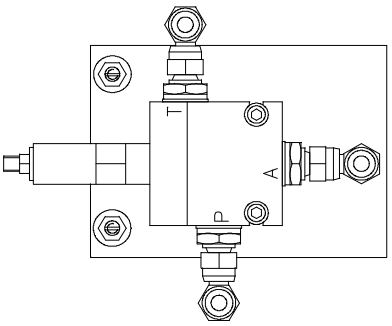
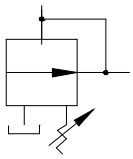
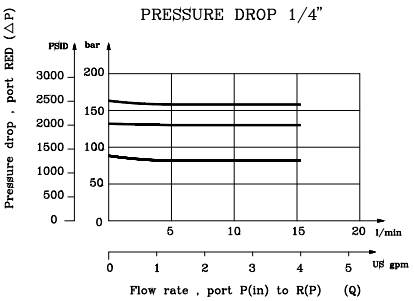
Cat #	Name	Schematic	Description
025421 **ELECTRO**	**4/3 Double Solenoid Valve** **[4/3 Sol-Sol Valve (Tandem Center)]**  		4/3 directional control valve Solenoid-actuated, both sides Spring-centered Pressure range: 0–120 bar Nominal pressure: 60 bar Flow rate: 25 l/min Operating voltage: 24 Vdc, 1.6 A   Refer to Section 2.4.1.2 for details on connecting this valve.

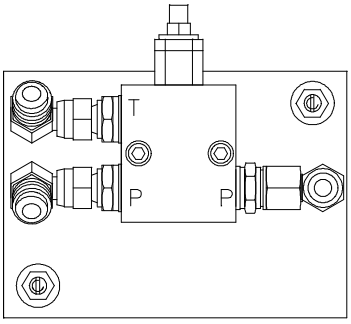
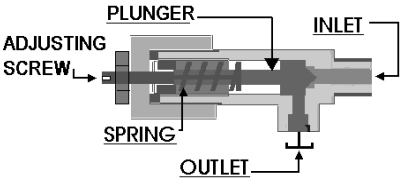
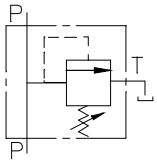
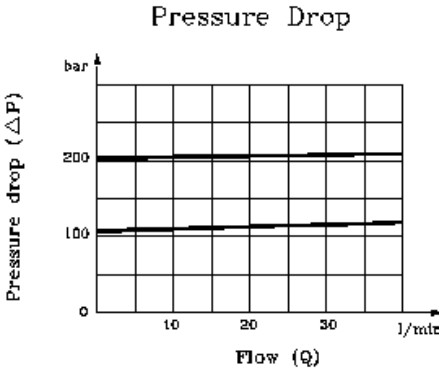
Cat #	Name	Schematic	Description
Manually and Mechanically Activated Valves			
025403 **ADVANCED**	**4/3 Selector Valve,** **Open Center** **[4/3 Directional Valve** **(Open Center)]**   	 	4/3 directional control valve Manual lever actuated Detent (operating position retained upon actuation) Valve relief in center position Nominal pressure: 60 bar Max. pressure: 210 bar POS 2 | POS 0 | POS 1 P ► A | P CLOSED | P ► B B ► T | A,B,T CONNECT. | A ► T The valve position is controlled by a manually operated lever. Pushing the lever to position 1 or position 2 moves the spool, thereby changing the path of the fluid flow from one line to another. This valve is used for operating two separate hydraulic devices.

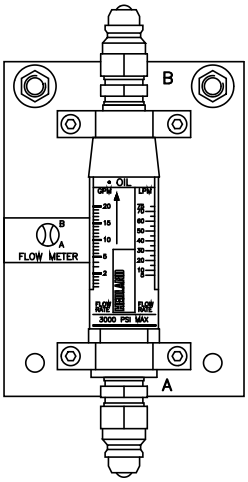
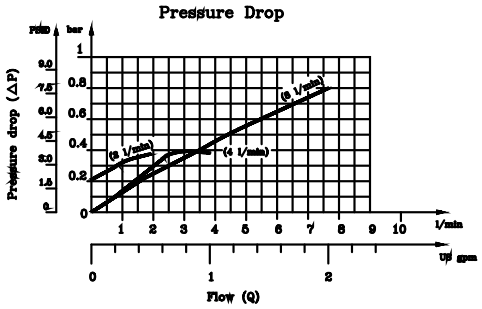
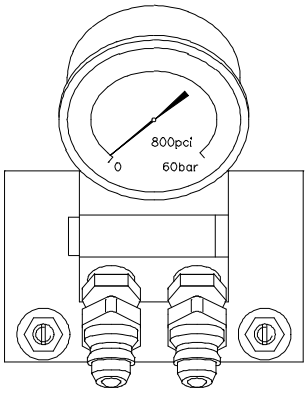
Cat #	Name	Schematic	Description
025414 **BASIC**	**4/3 Selector Valve, Closed Center** **[4/3 Directional Valve (Closed Center)]**    	 	4/3 directional control valve Manual lever actuated Detent (operating position retained upon actuation) Closed in center position Nominal pressure: 60 bar Max. pressure: 210 bar Max. flow: 20 l/min POS 1 | POS 0 | POS 2 P ► B | A–B–P–T | P ► A A ► T | CLOSED | B ► T The valve position is controlled by a manually operated lever. Pushing the lever to position 1 or position 2 moves the plunger, thereby changing the path of the fluid flow from one line to another. This valve is used when running multiple valves in series from one pump.

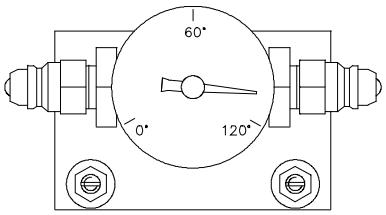
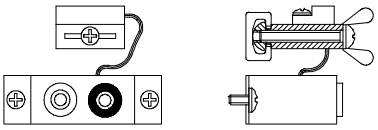
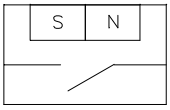
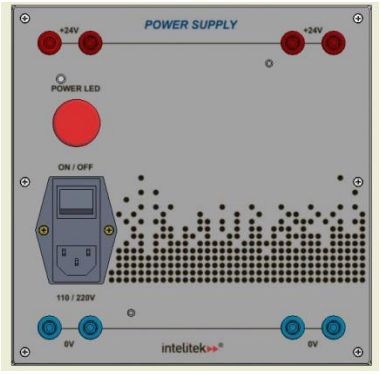
Cat #	Name	Schematic	Description
Flow, Non-Return, Regulating Valves			
025405 **BASIC**	**One-Way Flow Control Valve** **[Unidirectional Flow Control Valve]**    	 	One-way flow control valve Adjustable Opening pressure: 0.8 bar Nominal pressure: 60 bar Max. pressure: 210 bar  This manually operated control valve is used to regulate the flow of hydraulic fluid in one direction, from port A to port B. The flow rate in the other direction, from port B to port A, is not controlled by the valve. When the knob is rotated clockwise, the stopcock blocks the pipe and restricts the flow of hydraulic fluid. When the knob is rotated counter-clockwise, the stopcock retracts, and the flow of hydraulic fluid increases. Rotating the knob has no effect on the flow rate from port B to port A.

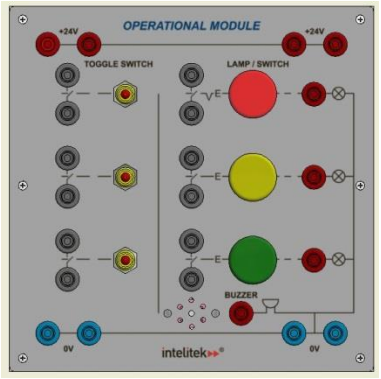
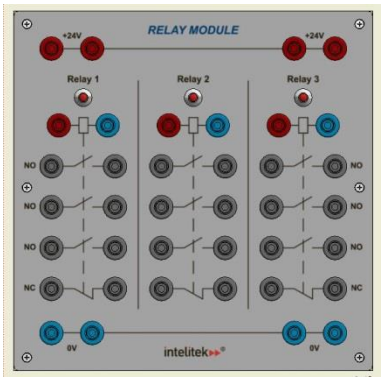
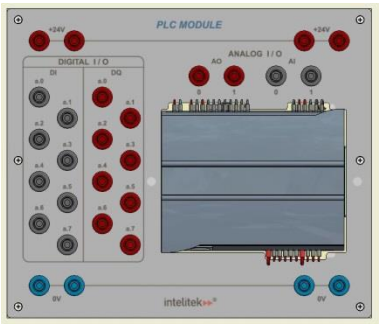
Cat #	Name	Schematic	Description
025404 **BASIC**	**Two-Way Flow Control Valve** **[Bi-Directional Flow Control Valve]**  		Two-way flow control valve Adjustable Nominal pressure: 60 bar Max. pressure: 210 bar Max. flow:20 l/min  This manually operated control valve is used to regulate the flow of hydraulic fluids. This valve regulates flow in both directions; i.e., from port A to port B, and vice versa. When the knob is rotated clockwise, the stopcock blocks the pipe and restricts the flow of hydraulic fluid. When the knob is rotated counter-clockwise, the stopcock retracts, and the flow of hydraulic fluid increases.

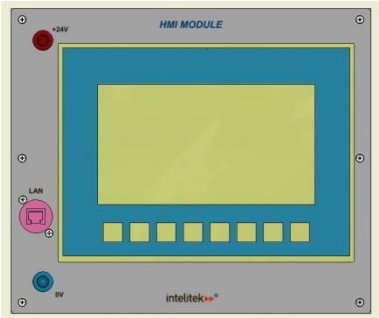
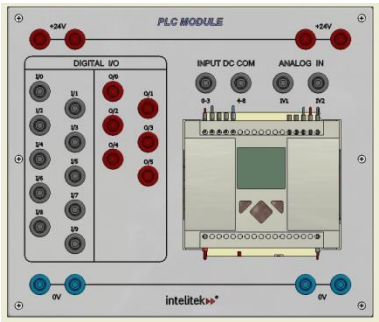
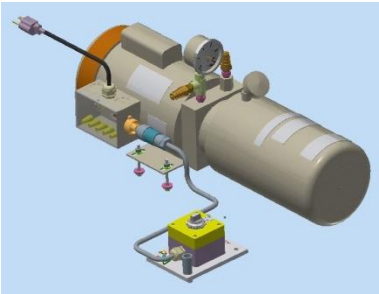
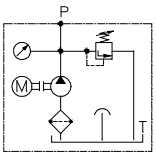
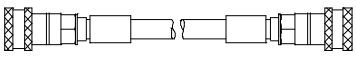
Cat #	Name	Schematic	Description
025415 **ADVANCED**	**Pressure Reducing Valve** 		Pressure reducing valve Adjustable Nominal pressure: 60 bar Max. pressure: 210 bar Max. flow: 20 l/min  This valve maintains a constant pressure at the valve outlet, port A. The valve outlet pressure can be regulated manually by means of an adjustment knob. The regulated pressure at the outlet should be set to a value which is lower than the pressure at inlet port P. **Example of use:** The valve is connected as follows: Port P is the pressure source; Port T drains the sensing line; Port A is the pressure-controlled outlet. The valve's spool is subject to a spring force on one side, and hydraulic pressure on the other. When the pressure at port A is increased, the spool moves to the right, and restricts the flow from port P to port A, thus causing a pressure drop between the two ports (pressure at A is thus reduced). When the pressure at port A is reduced, the spool moves to the left, and the rate of flow increases, thereby reducing the pressure drop between P and A (pressure at A thus increases).

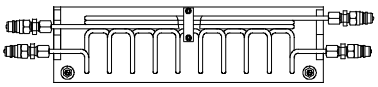
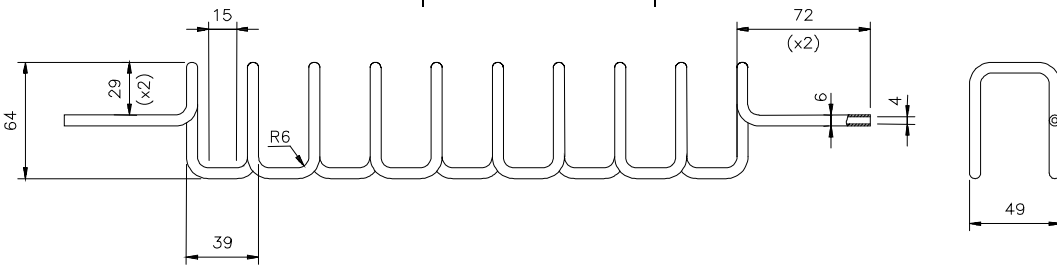
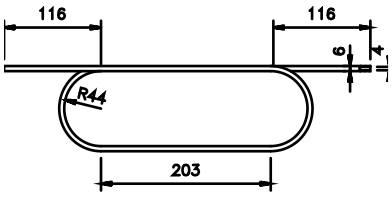
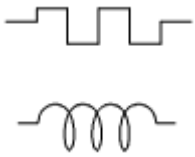
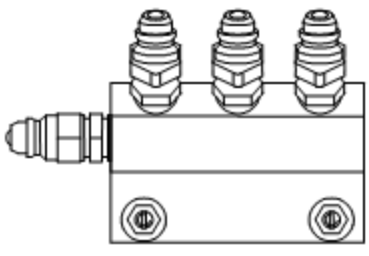
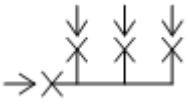
Cat #	Name	Schematic	Description
025437 **BASIC**	**Pressure Relief Valve**   	 	Pressure relief valve Adjustable Pilot actuated Pressure range: 0–250 bar Nominal pressure: 60 bar Flow rate: 0.5–40 l/min  This pressure relief valve limits the pressure in the system by releasing excess hydraulic fluid to the tank. The valve plunger is subjected to two forces: the spring force, and the force exerted by the pressure at the inlet port. The pressure required to open the valve is set manually by means of a screw which adjusts the spring tension. If the force exerted by the fluid pressure at the inlet is less than the spring force, the valve remains closed. As pressure at the inlet increases, the force exerted on the valve plunger increases. When pressure increases above the set amount, the valve opens. This valve can also be used as sequencing valve. Since pressure in the JMTS hydraulics system is limited to 60 bar, this valve will not function if it is set to a pressure greater than 60 bar. After the pressure limit has been set, the adjusting screw should be secured with the locking nut.

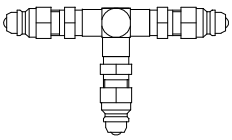
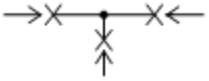
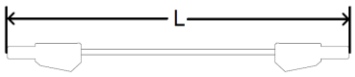
Cat #	Name	Schematic	Description
Sensors			
025408 **BASIC**	**Flow Meter** 		Flow meter Nominal pressure: 60 bar Max. pressure: 210 bar Flow rate: 0.2– 45 l /min  This flow meter is used to measure flow rate in the hydraulic system. Since this component is a rotameter, it should always be mounted vertically, with Port A at the bottom and Port B at the top.
025409 **BASIC**	**Hydraulic Pressure Gauge** 		Hydraulic pressure gauge Scale: bar/pci Pressure range: 0-100 bar / 0-1500 pci Nominal diameter: 63 mm Damping fluid: glycerin This gauge is used to measure the pressure of the hydraulic fluid at a specific point in a hydraulic system. This device is useful for the adjustment of various pressure valves.

Cat #	Name	Schematic	Description
025419 **ADVANCED**	**Temperature Gauge** 		Temperature gauge Nominal pressure: 60 bar Max. Pressure: 100 bar Flow rate: 0.5–40 l/min Temperature range: 0–120° The temperature gauge is used to measure the temperature of the hydraulic fluid at a specific point in a hydraulic system.
025323	**Magnetic Proximity Sensors** 		Magnetic proximity switch 2 magnetic sensors For attaching to cylinders Max. Rated Power: 10W (0.4A @ 24V). This pair of sensors can be attached to the barrel of the double acting cylinder (Cat. #025402 or #025431). The piston in the hydraulic cylinder has magnetic properties. Thus, when it comes near a magnetic sensor, it activates it. When positioned at each end of the cylinder, the sensors act as limit switches. Refer to Section 2.4.1.3 for details on connecting this component.
Power and Control Units (Electrical Modules)			
10-2550-1000	**Power Supply Module** 		Converts mains AC to constant 24 V necessary for operating all other modules and electrical components. ▪ Input voltage: 110-220 Vac ▪ Output voltage: 24 Vdc ▪ Output max. current: 4.5A ▪ Short circuit, overload and over voltage protected

Cat #	Name	Schematic	Description
10-2550-3000	**Operational Module** 		Provides essential switches and indicators for operating and controlling the system. Contains: ▪ Buzzer (0.7W) ▪ 3 lamps (LED 1.2W each) ▪ 2 Momentary push button switches (10A max. resistive load, 1.5A inductive load) ▪ 1 On-Off push button ▪ 3 Toggle Switches (Off-On/MOM, 10A max. each)
10-2550-2000	**Relay Module** 		3 separate relays, each with 4 changeover contacts: 3 NO, 1 NC enabling switching high power loads. Sockets (per relay): ▪ 2 coil terminals ▪ 4 contacts (2 sockets each) ▪ Operating voltage: 24 Vdc, 5A max per contact
10-2550-4000	**Siemens PLC Module** 		Industrial programmable Siemens S7-1200 controller for building and controlling advanced automated exercises and projects, using SIMATIC STEP 7 (TIA Portal) software ▪ 8 Digital Inputs (sink wiring) ▪ 8 Digital Outputs (source wiring, 2A max.) ▪ 2 Analog Inputs ▪ 2 Analog Outputs ▪ LAN cable for PC connection ▪ An additional 6 inputs and 2 outputs can be wired manually.

Cat #	Name	Schematic	Description
10-2550-5000	**HMI Module** 		Graphic-based touch screen allows friendly operating, monitoring and controlling of PLC applications. Features: ▪ Siemens SIMATIC HMI KTP700 ▪ 7" TFT high resolution touch screen ▪ LAN RJ45 Input socket ▪ LAN cable for PLC connection
10-2550-6000	**MicroLogix PLC Module** 		Programmable controller Allen-Bradley MicroLogix 1100 for building and controlling automated exercises and projects. ▪ A/B MicroLogix 1100 (1763-L16DWD) ▪ 10 Digital Inputs ▪ 6 Digital Outputs (source wiring, 1A Max.) ▪ 2 Com Inputs ▪ 2 Analog Inputs (0-10Vdc)
Hydraulic Power Supply			
22-0004-0001 **22-0004-0002**	**Hydraulic Power Pack,** 		Tank: 5.7 L capacity Gear pump: 3.5 l/min Maximum pressure: 210 bar One phase AC Motor 0.75 kW Operating voltage: #22-0004-0001: 115Vac #22-0004-0002: 230Vac Refer to the Hydraulic Power Pack for JMTS User Guide for setup and connection details.
Hoses and Connectors			
025411 **025412** **025413** **BASIC**	**Hoses** 		Hose lines with quick release couplings Diameter: 1/4" Length: #025411: 2.0 m #025412: 0.8 m #025413: 0.5 m

Cat #	Name	Schematic	Description
025428 **ADVANCED**	**Coiled Hoses**    		Circular and square coiled hoses for resistance measurements The two hoses are made of the same material. The hoses have the same diameter and the same length. The component can therefore be used to test and demonstrate how the configuration of hoses affects the flow of hydraulic fluids. Max. Pressure: 100 bar Material: Stainless Steel 304 Diameter: Inside ∅ 4 mm Outside ∅ 6 mm Length of each hose: ~ 1840 mm
025410 **ADVANCED**	**Manifold** 		Manifold, 4 ports Nominal pressure: 60 bar Max. pressure: 210 bar This manifold can be used to distribute hydraulic fluid to as many as three hydraulic consumers. It can also be used to collect fluid returning from three lines into a single line. One manifold should be used to distribute fluid from the pump. Another manifold should be used to connect return lines to the tank.

Cat #	Name	Schematic	Description
025424 **BASIC**	**T-Connector** 		T-connector Nominal pressure: 60 bar Flow rate: 0.5–40 l/min Pressure range: 0–250 bar
Didactic			
113426	**Oil Collection Tray** 		Oil collection tray for JMTS Mounting Panel.
411658 **411659** **411661** **411662** **411663** **411664** **411665** **411666** **411667** **411668** **411669** **Electro**	**Banana Safety Cables with 4mm Stacking Banana Plugs** 		#411658 Red (200mm) #411659 Blue (200mm) #411661 Red (400mm) #411662 Blue (400mm) #411663 Black (400mm) #411664 Red (600mm) #411665 Blue (600mm) #411666 Black (600mm) #411667 Red (1100mm) #411668 Blue (1100mm) #411669 Black (1100mm)
330212	**Hex Wrench** 		Tool for attaching components to slotted panel.
00-1300-007	**JMTS Hydraulic Pipes Storage Bracket** 		Bracket for separating and holding hydraulic hoses.