

DIESEL MECHANIC



MINING QUALIFICATIONS AUTHORITY

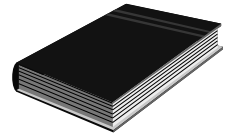
CODE: HYD - 13

DIAGNOSE AND TEST A HYDRAULIC CIRCUIT

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SOURCE REFERENCES

Demonstration by a competent person, e.g. a Training Officer.

FESTO – Basic Level Textbook

OBJECTIVE

You will be learning towards the outcome “Diagnose and Test a hydraulic circuit”. Whilst learning towards the outcome you will be required to achieve the following:

- Construct the circuit shown in the training panel.
- Use the test unit to test and record the fluid flow at the pump and in the circuit at 500 kPa pressure increments.
- Determine which components are faulty from the results given on the test sheet and by testing for leaks.
- Know the seven basic steps for trouble shooting.

On completion of this module, the learner must be able to:

- Record the fluid flow at specified increments.
- Determine which components are faulty.
- State the seven basic steps for trouble shooting.

During this process you must adhere to certain specified requirements as listed in the Module.

ASSESSMENT AND EVALUATION CRITERIA

You will be assessed, when you are confident that you may achieve the outcomes as listed, to determine your competence as measured against the required criteria. This assessment will be in line with accepted best practices regarding assessment.

- Theoretical and practical assessments will be set during the module and must be completed without using reference.
- The learner will be required to answer all the questions without any reference.
- There must not be any damage to any equipment.

HAZARD IDENTIFICATION AND CONTROL (HIAC) FORM**HYD - 13****DIAGNOSE AND TEST A
HYDRAULIC CIRCUIT**

STEPS IN OPERATION / PROCESS	POTENTIAL ACCIDENT / INCIDENT	CONTROLS (BY RESPONSIBLE PERSON)
1. Construct a hydraulic circuit.	<ul style="list-style-type: none"> Improper or careless handling of hydraulic components and pipes can lead to damage of equipment. 	<ul style="list-style-type: none"> Always handle components and pipes correctly, and with great care.
2. Use of hydraulic oil in a pressurised circuit.	<ul style="list-style-type: none"> Circuit under pressure. 	<ul style="list-style-type: none"> Wipe components and panel clean after use and store components. Ensure circuit is depressurised before removing components or pipes
3. Insure work area is safe	<ul style="list-style-type: none"> Oil in eyes and laceration of skin. Slip and fall. 	<ul style="list-style-type: none"> Wear correct PPE. Ensure working area is clean and safe. Wear correct safety boots.

NOTE: Before doing the practical work contained in this module, the learner must study the content of the above HIAC form again and then sign the statement below.

The above risks, which will be encountered in this module, are fully understood and will be controlled during the practical work.

Signature of learner:

Signature of Training Officer:

Date:

1. TROUBLE SHOOTING.

ITEM / TASK: Introduction.

DESCRIPTION:

A. A great deal of an artisan's time may be spent trouble shooting on hydraulic circuits. The following seven steps are basic to any good programme for diagnosis and testing.

B. Seven basic steps to follow when trouble shooting a hydraulic circuit:

1. *Know the system.*
2. *Ask the operator.*
3. *Operate the machine.*
4. *Inspect the machine.*
5. *List the possible causes.*
6. *Reach a conclusion.*
7. *Test your conclusion.*

The seven basic steps will be described below:

Step 1: Know the system.

Refer to the workshop manual (Fig 1) and study the schematic diagram of the hydraulic circuit. Know how the system operates, whether it is an open or a closed centre circuit, what the valve settings are, and what the pump output should be.



FIG 1.

Step 2: Ask the operator.

Get the full story from the operator. Ask him how the machine acted when it started to fail and what was unusual about it. (Fig 2)



FIG 2.

Step 3: Operate the machine.

Get on the machine and operate it, warm it up and put it through its paces. Don't completely trust the operator's story. Check it yourself. (Fig 3)



FIG 3.

Step 4: Inspect the machine.

Get off the machine and make a visual check. Use your ears, eyes and nose to spot any signs of trouble. (Fig 4)



FIG 4.

Step 5: List the possible causes.

Now you are ready to make a list of the possible causes. What were the signs you found while inspecting the machine? And what is the most likely cause? Are there other possibilities? (Fig 5)

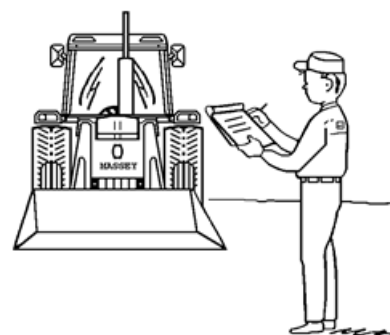


FIG 5.

Step 6: Reach a conclusion.

Check your list of possible causes and decide which are the most likely. Always verify first the faults which are easiest to detect. (Fig 6)



FIG 6.

Step 7: Test your conclusion.

Now for the final step. Before you start repairing the system, test your conclusions to see if they are correct. (Fig 7)

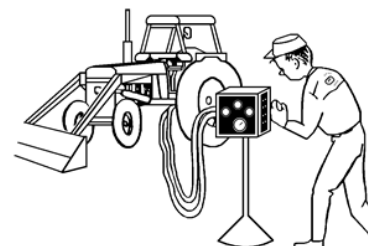


FIG 7.

2. TESTING THE HYDRAULIC COMPONENTS ON THE MACHINE

ITEM / TASK: Procedure to test components.

DESCRIPTION:

A. Testing with either pressure gauges or a hydraulic test unit are the most effective ways to pinpoint troubles in the system.

a. **Testing the pump.**

The following method may be used:

- Disconnect the control valve and cylinder. (Fig 8)
- Connect the test unit in the circuit as shown in Fig 8.
- Follow the same procedure as described in module HYD-2 to test the pump.
- Record the flow at 500 kPa increments from zero pressure to the maximum system pressure. (See table on next page)
- Use the test form given to write down your results of the pump test.

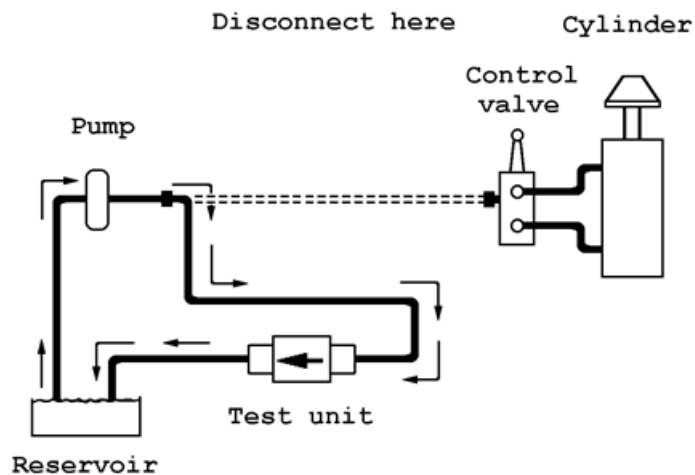


FIG 8.

		CIRCUIT TEST.			
		DIRECTION OF CYLINDER TRAVEL			
PUMP TEST		LOWER	RAISE	LOWER	RAISE
PRESSURE	ℓ / min	CIRCUIT A (ℓ / min)		CIRCUIT B (ℓ / min)	
0 kPa					
500 kPa					
1 000 kPa					
1 500 kPa					
2 000 kPa					
2 500 kPa					

b. Diagnosis of the pump test.

When the flow is measured and is less than 75% of the rated pump flow, this is an indication that the pump needs to be replaced.

If the pump flow is poor during the free flow test as well as the pressure test, the pump is not getting enough oil (cavitation). This problem could be caused by low oil supply, air leaks, a restricted pump inlet line, or a dirty filter or breather.

**DO THE SELF TEST AND PRACTICE ON THE NEXT PAGES
BEFORE CONTINUING WITH THE REST OF THE MODULE.**

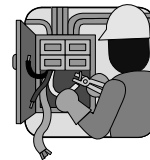


SELF TEST

Without referring to your notes give the seven basic steps for good trouble shooting:

Ask your Training Officer to check your work and if it is correct, to sign below.

LEARNER	TRAINING OFFICER
DATE :	DATE :
SIGNATURE :	SIGNATURE :



PRACTICE

- Test the pump on the trainer. Use the test sheet below to record the flow of the pump at 500kPa increments.
- From the readings on the test sheet, diagnose the faults.

		CIRCUIT TEST.			
		DIRECTION OF CYLINDER TRAVEL			
PUMP TEST		LOWER	RAISE	LOWER	RAISE
PRESSURE	ℓ / min	CIRCUIT A (ℓ / min)		CIRCUIT B (ℓ / min)	
0 kPa					
500 kPa					
1 000 kPa					
1 500 kPa					
2 000 kPa					
2 500 kPa					

Fault :

Ask your Training Officer to check your work and if it is correct, to sign below.

LEARNER	TRAINING OFFICER
DATE :	DATE :
SIGNATURE :	SIGNATURE :

c. Testing the system.

The method described below may be used:

- Install a t-piece in the line between the pump and the first control valve and attach the inlet port of the hydraulic tester to this t-piece. The return line from the hydraulic test unit must return the oil to the reservoir. (Fig 9)

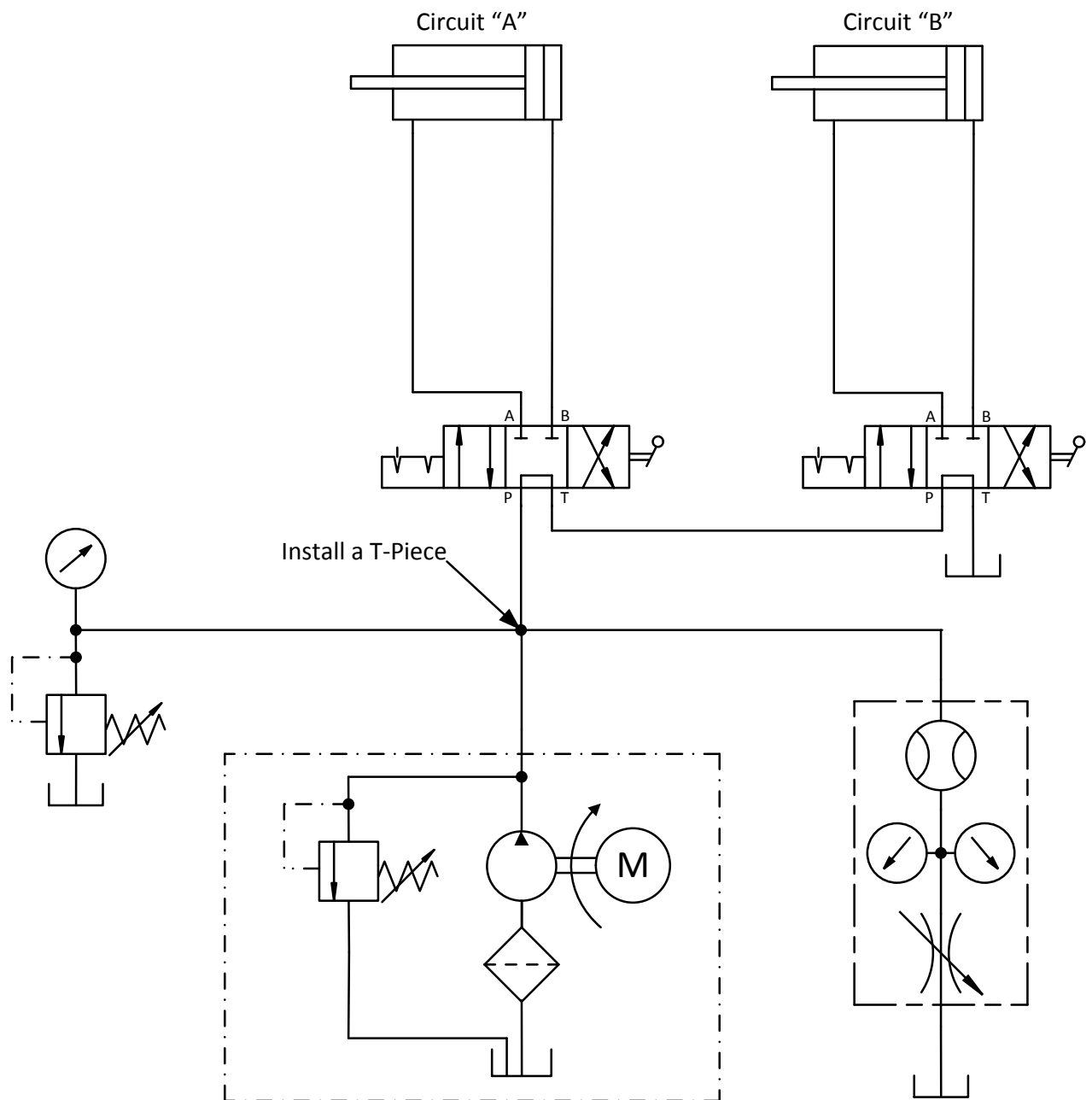


FIG 9.

- Fully open the load valve of the test unit.
- Start the pump.
- Operate the control valve of circuit B, and fully extend the cylinder. The oil will now flow through the test unit.
- Fully close the load valve on the test unit to load the system.
- Continue loading the system until normal operating temperature is reached.
- Adjust the relief valve until the rated pressure for the system is indicated on the pressure gauge.



NB:

IF THE VALVE CANNOT BE ADJUSTED TO OPEN AT THE RATED PRESSURE, IT MUST BE REPLACED.

Check the condition of circuit B as follows:

- With the control valve of circuit B still in the operating position, fully open the load valve on the test unit.
- Slowly close the load valve and record the flow in 500 kPa increments from zero pressure to maximum system pressure.
- Record your results on the circuit test sheet under the heading circuit B.
- Open the load valve until maximum flow is again at zero pressure.
- Activate the control valve of circuit A and fully extend the cylinder.
- Follow the same procedure to check the condition of circuit A and also record the flow in 500 kPa increments from zero pressure to maximum system pressure under the heading circuit A.

d. Diagnosis of the system test.

- If the flow at each pressure is the same as for the pump test, all the components are in order.
- If the flow begins to drop before full load is reached, one of the circuits is faulty.

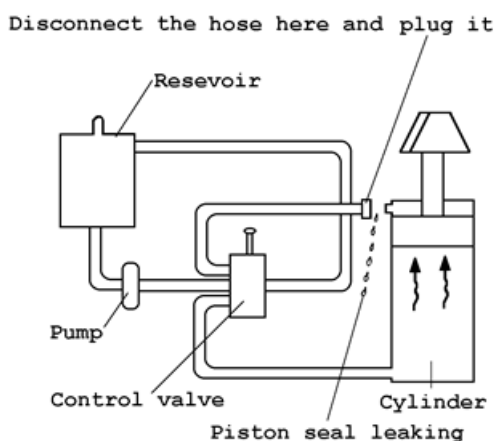
EXAMPLE:

The flow in litre/min has been recorded at 500 kPa increments on the circuit test sheet below. It will be seen that there was a drop in flow at 1 000 kPa and 1 500 kPa in circuit B. This drop in flow is due to leakage in either the cylinder, through oil leaking past the piston, or due to a faulty control valve.

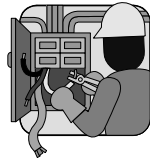
		CIRCUIT TEST.			
		DIRECTION OF CYLINDER TRAVEL			
PUMP TEST		LOWER	RAISE	LOWER	RAISE
PRESSURE	ℓ / min	CIRCUIT A (ℓ / min)		CIRCUIT B (ℓ / min)	
0 kPa	90	90	90	90	90
500 kPa	88	88	88	88	88
1 000 kPa	87.6	87.6	87.6	50.4	40.5
1 500 kPa	86	86	86	50.4	40.5

- To pinpoint the fault, do the following:
 - i. Disconnect the return line at the cylinder. Refer to Fig 10.
 - ii. Actuate the valve to raise the cylinder.

If oil leaks from the cylinder return port, the cylinder is at fault and must be repaired. If oil does not leak out, the control valve is probably at fault.

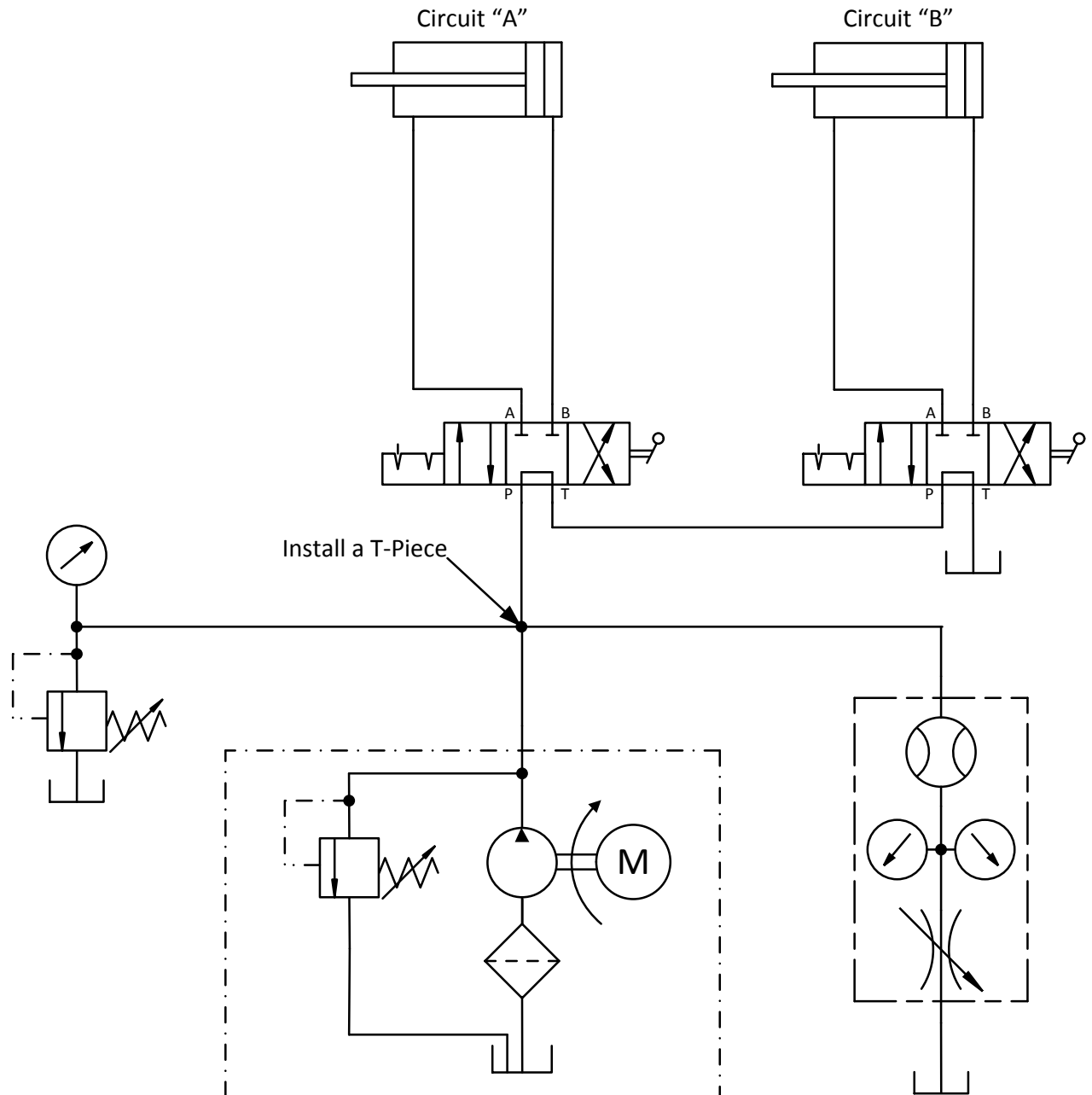
**FIG 10.**

**DO THE PRACTICE ON THE NEXT PAGE
BEFORE ATTEMPTING THE FORMATIVE ASSESSMENT**



PRACTICE

- Construct the circuit shown below on the training panel.
- Use a test unit to test the circuit.
- Record the different flows and pressures on the circuit test sheet.
- From your test results, determine and record the condition of each component.



		CIRCUIT TEST.			
		DIRECTION OF CYLINDER TRAVEL			
PUMP TEST		LOWER	RAISE	LOWER	RAISE
PRESSURE	ℓ / min	CIRCUIT A (ℓ / min)		CIRCUIT B (ℓ / min)	
0 kPa					
500 kPa					
1 000 kPa					
1 500 kPa					
2 000 kPa					
2 500 kPa					

Condition of each component:

Ask your Training Officer to check your work and if it is correct, to sign below.

LEARNER	TRAINING OFFICER
DATE :	DATE :
SIGNATURE :	SIGNATURE :



REMEMBER ALWAYS WORK SAFE

Once you have passed the entire practices, you are now at liberty to request a Formative Assessment from your Assessor.