BRAKE REMOVAL AND INSTALLATION
Practical Guide to Master Cylinder Repair

RATIONALE

This short course was developed as a resource material for trainers in the non-formal sector to train men, women and youth in the communities of Papua New Guinea. The course developed is demand oriented and aims to provide opportunities for participants to acquire relevant knowledge and skills in the brake system of a motor vehicle. This module covers the practical skills and procedures of brake master cylinder removal, installation and service. The course is part of a bridging program between the non-formal and formal sector to fill up the gap and create linkages into motor mechanic tradesman skills, and to provide lower income earners to save cost and be able to fix the brake master cylinder and perform to a skill level where they will do it themselves in repair and maintenance of the brake system.

The trainee will be specialized skilled and while he/she does at home brake system work the benefit comes from labour charge to make money for a living or opportunity into starting a small scale repair shop.

The development of this short course was sponsored by the ADB-PNG EMPLOYMENT ORIENTED SKILLS DEVELOPMENT PROJECT (EOSDP) and produced by curriculum officers at the SKILLS TRAINING RESOURCES UNIT (STRU)
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Program: MOTOR VEHICLE MECHANIC
Course: BREAK REMOVAL AND INSTALLATION
Module Code: T017iii
Module Name: A practical guide to master cylinder repair

Module 1: Brake system basic
Operating principles

Module 2: Brake light switch

Module 3: Master cylinder

Module 4: Power Booster

Module 5: Brake hoses and lines

Module 6: Bleeding the brake system
# COMPETENCY PROFILE: Master cylinder

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Curriculum Guide

Program: MOTOR VEHICLE MECHANIC
Course: Brake removal and installation
Module code: T017iii
Module name: Practical guide to master cylinder repair

Duration: 14 hour course/2 hour theory test/3 hour practical test
Purpose: After successful completion of this module participants should be able to identify and explain the functions and components of the master cylinder, and demonstrate removal and installation procedures

Content: C1. Identify components of the master cylinder
• Name components of the master cylinder
• Identify the diagram of each component
• Locate master cylinder and components assembly

C2. Remove the master cylinder
• Explain safety procedure of removal of the master cylinder
• Identify procedure of removal of the master cylinder
• Select and use hand tools
• Follow procedure and demonstrate removal of the master cylinder

C3. Install the master cylinder
• Identify removal procedure
• Explain safety procedure of installing the master cylinder
• Follow procedure and demonstrate installing the master cylinder

Prerequisite: The participant of this course should have completed or have experience in the competencies of basic operating principles and break light switch repair of the brake system from module 1, & 2.

Suggested delivery methods: This module should be delivered using the following teaching methods:
• Lecture
• Demonstration
• Discussion
• Practical project

Instructor: The ideal instructor will have a trades certificate in Automotive mechanic. New instructors wish to refer to the STRU publication “Trainer Guide” (available free of charge)

Assessment method: A holistic approach is to be taken with assessment of the learning outcome using one or more of the following:
• Questioning (oral, multiple or matching answers)
• Demonstration of practical tasks

Assessment condition: Assessment will be conducted in a workshop environment. The condition of assessment includes;
Model of motor vehicle engine brake system master cylinder and removal and installation hand tools (refer to specific learning outcome).

Reference: 1. TITLE: Master cylinder removal and installation
Overview of elements of competence and performance criteria

<table>
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<th>Element</th>
<th>Performance Criteria</th>
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<tr>
<td>1. Identify components of the master cylinder</td>
<td>1.1 Identify components of the master cylinder.</td>
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<td></td>
<td>1.2 Name each component of the master cylinder.</td>
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<td>1.3 Verify each component assembly and the position of attachment.</td>
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<td>2. Remove the master cylinder</td>
<td>2.1 Identify and explain safety procedure of removal of the master cylinder.</td>
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<td>2.2 Describe the procedure of removing the master cylinder.</td>
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<td>2.3 Select and use the removal hand tools.</td>
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<td>2.4 Demonstrate procedure of removing the master cylinder.</td>
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<tr>
<td>3. Install the master cylinder</td>
<td>3.1 Describe the removal procedure of installing the master cylinder.</td>
</tr>
<tr>
<td></td>
<td>3.2 Demonstrate the removal procedure installing the master cylinder.</td>
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<td>3.3 Explain safety precaution of installing the master cylinder.</td>
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Instruction for the Trainer/Instructor

Setup all the training aids on a workstation. The trainees must have access to:
1. Protective clothing and equipment - gloves, boots and overall
2. Hand tools - spanner (ring and open end, adjustable wrench).
3. Practical model of motor vehicle brake system master cylinder

Part one of this module is the curriculum guide. Learning activities for the trainees relates to three elements of competence in column one (1) of the overview table. In column two (2) the performance criteria show the required level of performance expected as resultant of each element. In delivery of the module the instructor follows the appendix training and assessment guide below.

Part two of this module consists of the training resource kit or instructional materials. In line with the elements of competence resource information on the skills and knowledge informed have been compiled. The additional support material is provided for both, the instructor to use in discussion and explanation, and the trainee to have additional hand out notes to read or write in exercise books.
APPENDIX 1: Training and Assessment Guide
Element 1.

Task C1: **Identify components of the master cylinder.**
Suggested minimal instructional time: **2 hours**

Learning outcome C1:
Identify and locate components of the master cylinder.

Teaching strategy:
Learning activities for the trainee must include the instructor to:
1.1 Identify components of the master cylinder.
1.2 Name each component of the master cylinder.
1.3 Verify each component assembly and the position of attachment.

Assessment methods:
Written verbal questioning and observation

Assessment condition:
Given diagram to identify the components of the master cylinder and verify components of a model master cylinder of the brake system.

Assessment criteria:
The trainee has correctly:
- identified components of the master cylinder;
- named each component of the master cylinder;
- verified each component assembly and the position of attachment.

APPENDIX 2: Training and Assessment Guide
Element 2.

Task C2: **Remove the master cylinder.**
Suggested minimal instructional time: **2 hours**

Learning outcome C2:
List and demonstrate procedure of removal of the master cylinder.

Teaching strategy:
Learning activities for the trainee must include the instructor to;
2.1 Identify and explain safe procedure of removing the master cylinder.
2.2 Describe the procedure of removing the master cylinder.
2.3 Identify the procedure of removing the master cylinder.
2.4 Select and use the removal hand tools.
2.5 Demonstrate removal procedure of the master cylinder and components.

Assessment methods:
Written verbal questioning and observation

Assessment condition:
- given diagram to identify the components of the master cylinder and verify components of a model master cylinder of the brake system;
- given task to demonstrate procedure of removing the master cylinder and components.

Assessment criteria:
The trainee has correctly:
- described the procedure of installing the master cylinder;
- demonstrated procedure of installing the master cylinder;

APPENDIX 3: Training and Assessment Guide.
Element 3.

Task C3: **Install the master cylinder.**
Suggested minimal instructional time: **2 hours**

Learning outcome C3:
List and demonstrate procedure of installation of the master cylinder.

Teaching strategy:
Learning activities for the trainee must include the instructor to;
3.1 Describe the removal procedure.
3.2 Demonstrate the removal procedure.

Assessment methods:
Written verbal questioning and observation

Assessment condition:
- given diagram to identify the components of the master cylinder and verify components of a model master cylinder of the brake system;
- given task to demonstrate procedure of removing the master cylinder and components.

Assessment criteria:
The trainee has correctly:
- described procedure of installing the master cylinder;
- demonstrated procedure of installing the master cylinder;
Assessment procedure

1. Do interval testing on each element of competence at the end of one topic session to find out the trainee progress in learning. Test knowledge orally or written. Test skills for mastery of performance standard in a demonstration performing a range of task.

2. Do a summary test of all lessons covered at the end of the course. Practical test at the end of the short course must be conducted to corroborate a trainee competent of the skills trained.

3. Learning Outcome. You attend a training course to learn new information and gain new skills that you can use in your workplace or community.

For this course a set assessment guide evidently supports your learning of the skills in training. Find in the assessment guide the topic elements have one learning outcome. The core-learning outcome is a resultant of one-element performance criteria. To measure your learning the core learning outcome becomes the mastery test of skills and objectives of the performance criteria. Participants upon successful completion of each element performance criteria should demonstrate the task of each learning outcome of the element.

In this topic there are three elements and each has a core-learning outcome. These three core-learning outcomes make up a checkpoint or summary test to be conduct on completion of training of the topic brake light switch removal and installation

Do interval testing on each element of competence at the end of one topic session to find out the trainee progress in learning. Test knowledge orally or written. Test skills for mastery of performance standard in a demonstration performing a range of task.

Do a summary test of all lessons covered at the end of the course. Practical test at the end of the short course must be conducted to corroborate a trainee competent of the skills trained.

To test participants conduct a summary test of the three core learning outcomes written below.

Learning Outcomes C-1, 2, 3.

C1 Identify and locate the components of the master cylinder.

C2 List and demonstrate procedure of removal of the master cylinder.

C3 List and demonstrate procedure of installation of the master cylinder.

Assessing your learning

When you attend a training course, you expect to learn many things. You want to know about your learning and your mind is full of questions like:

- do I really understand what I am being told?
- will I be able to use this new knowledge when I return to my place of work or my community?
- am I doing this new skill correctly?

Assessing your self is about answering these questions. It shows you and your facilitator about your progress. It also tells the facilitator about their teaching. If all participants find a topic difficult, then the facilitators know that they must teach it again or try something new to support the teaching.

Recognized Training

The Employment Oriented Skill Development Project recognizes the training and you will receive a certificate when you have successfully completed this training.

APPENDIX 4: INSTRUCTIONAL NOTES

C1: Identify components of the master cylinder

1. Identify components of the Master Cylinder.

The diagram shows the different components and assembly of the master cylinder of a motor vehicle. Study the different parts labelled and their position of attachment to get a clear understanding before you will carry out the actual practical exercise installation and removal of the master cylinder.
2. Master cylinder removal

2.1 Safety warning

**WARNING**

Vehicles with 4-wheel anti-lock brakes require an Anti-lock Brake Adapter (T90P-50-ALA) and Jumper (T93T-50-ALA) in order to bleed the master cylinder and the Hydraulic Control Unit (HCU). Failure to do so will trap air in the HCU unit, eventually causing a spongy pedal.

Before performing this procedure, ensure that you have the tools necessary to bleed the master cylinder and the HCU unit. If the tools are not available, you can still perform the procedure. However, you will need to tow the vehicle to a professional garage capable of bleeding the ABS system.

2.2 Removal procedure

1. With the engine turned off, push the brake pedal down to expel vacuum from the brake booster system.
2. Disconnect the brake fluid level sensor wire from the reservoir.
3. Disconnect the hydraulic lines (use correct tool, a Line Wrench) from the brake master cylinder.
4. Remove the brake booster-to-master cylinder retaining nuts and lock washers. Remove the master cylinder from the brake booster.
3. **Master cylinder installation**

5. Before installing the master cylinder, check the distance from the outer end of the booster assembly push rod to the front face of the brake booster assembly. Turn the push rod adjusting screw in or out as required to obtain the length shown. Refer to illustration in this Section.

6. Position the master cylinder assembly over the booster push rod and onto the studs on the booster assembly. Install the attaching nuts and lock washers and tighten to 13-15 ft. lbs.

7. Connect the hydraulic brake system lines to the master cylinder.

8. Bleed the hydraulic brake system (refer to procedure in this Section). Centralize the differential valve. Then, fill the dual master cylinder reservoirs with DOT 3 brake fluid to within 1/4 in. (6mm) of the top. Install the gasket and reservoir cover. Road test the vehicle for proper operation.

When replacing the master cylinder it is best to BENCH BLEED the master cylinder before installing it to the vehicle. Mount the master cylinder into a vise or suitable equivalent (do not damage the cylinder). Fill the cylinder to the correct level with the specified fluid. Block off all the outer brake line holes but one, then, using a long tool such as rod position it in the cylinder to actuate the brake master cylinder. Pump (push tool in and out) the brake master cylinder 3 or 4 times till brake fluid is release out and no air is in the brake fluid. Repeat this procedure until all brake fluid is released out of every hole and no air is expelled.
Glossary of Terms and definitions.

1. Competency profile
2. Curriculum guide
3. Appendix 1
4. Appendix 2
5. Appendix 3
6. Appendix 4
7. Brake booster assembly
8. Bleed the master cylinder
9. HCU unit
10. Anti lock brake adapter
11. ABS system
12. T90P-50-ALA
13. Expel vacuum
14. Srake fluid level sensor
15. Master cylinder
16. Brake booster
17. Brake actuating rod
18. Differential valve
19. Dual master cylinder
20. Reservoir

Note: The trainer/instructor before or during training should explain clearly the definition of each term to the students.
METHODOLOGY

This short course module, developed in Papua New Guinea, based on the competency-standard training model. The program was developed by a STRU curriculum officer, assisted by an international curriculum specialist and validated by a group of experience practitioners.

Their names are:

<table>
<thead>
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<th>NAME</th>
<th>ORGANIZATION</th>
<th>LOCATION</th>
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<td>Niu Ford</td>
<td>Waigani</td>
</tr>
<tr>
<td>Tau Kalogo</td>
<td>Boroko Motor</td>
<td>Waigani</td>
</tr>
<tr>
<td>Allan Hebei</td>
<td>Ela Motors</td>
<td>Badili</td>
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<tr>
<td>Allan Kauri</td>
<td>Koki Vocational</td>
<td>Koki</td>
</tr>
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