

# AE411060M

# AUTOMATIC TRANSMISION

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# 1. SAFETY REQUIREMENTS

# Attention:

Before using the training board, take a look at the user manual.

Training equipment may only be used for the training purposes specified in the instructions.

The staff conducting the training (lecturer, teacher, instructor and others) must be familiar with the instructions for the training equipment, know the methods and principles of use, settings, control of the equipment, be able to switch off (stop) the training equipment in an emergency.

The training staff (lecturer, teacher, instructor and others) acquaint those working and learning with the training equipment with the work safety requirements.

When working with high voltage systems (hybrid power plants and electric vehicles), it is mandatory to comply with electrical safety requirements and use personal protective equipment against electric shock.

It is forbidden to work with educational equipment for children, unqualified staff.

It is forbidden to work with training equipment for persons under the influence of alcohol or other psychotropic substances.

It is forbidden for people who do not have the appropriate qualifications to open the electrical input boxes, connect or change anything there.

It is prohibited to improve, modify or otherwise change the design of training equipment without the written consent of the manufacturer.

Do not ignore the information on possible dangers provided by the warning signs on the training equipment. Beware of the hazards indicated on the warning signs.

The training equipment must be switched off completely during cleaning work.

It is forbidden to wash the training equipment with running water or any chemical cleaning agents.

It is forbidden to clean the electronic components of the training equipment with damp cloths.

The equipment must be completely switched off during maintenance and repair work on the training equipment.

It is forbidden to disconnect the power cords of the electrical elements of the training equipment. Careless or repeated disconnection of these wires will result in damage to the connectors and loss of contact. The desired electrical measurements can be performed at specially designed and installed banana-type connectors in the training equipment. Banana type connectors are resistant to multiple joints.

#### Before working with training equipment, check that:

- Equipment is not mechanically damaged, broken;

- All protective shields are assembled;

- All components (e.g., wires, jumpers, fuses, handles, etc.) are available;

- The equipment components are free of foreign bodies;

- Undamaged power cords;

- Neat power supplies (battery or stand power supply);

- Power supplies are properly connected (e.g., battery terminals are screwed on, polarity is not mixed, proper power supply is used according to local electrical installation standards);

- The training equipment is properly constructed and locked (e.g., the equipment is placed on a sufficiently solid base, the transport wheels are locked);

- During operation, the equipment will not pose any danger to those working with it and the surrounding staff;

- There are other factors not specified in the instructions that may endanger the health of personnel working with the equipment and others.

#### **Observe during work with the equipment:**

- The noise emitted by the equipment is characteristic of such a work process (no extraneous sounds);

- Odour of glowing, burning objects;

- Power supplies are working properly;

- There are no factors or processes other than those specified in the instructions that could endanger the health of personnel working with the equipment or other persons.

## 2. GENERAL INFORMATION

#### 2.1. Purpose of training equipment

Teaching equipment for educational activities. It is a visual tool for explaining and demonstrating the structure and operation of various automotive parts, assemblies, structures, systems. The equipment is used as a teaching and learning tool for monitoring and analysis of various car systems work processes. It is possible to perform various measurements of the system installed in the training equipment, parameters of ongoing processes, to perform fault simulations, to diagnose. A variety of laboratory tasks can be performed using the training equipment. The equipment is designed and manufactured in order to provide learners with the clearest and most convenient information about the structure of the unit, the composition of the system and the principle of operation.

The training equipment is designed for demonstration, training and learning of the design and structure of the automatic transmission, the principle of operation, settings and adjustments.

#### 2.2. Training equipment parameters

Length	900 mm;
Width	600 mm;
Height	1000 mm;
Weight	85 kg;

#### **2.3.** Transport and storage conditions

Training equipment is installed in a dedicated box. Do not overturn or lay the equipment during transport. During transport, the equipment must be protected from falling, tipping, shocks, humidity, temperature, vibration.

Put the training equipment only on a suitable, solid base (table, cupboard).

Export or import procedures must take into account the legislation in force between the countries. Import export procedures and various taxes apply to various technical fluids, oils, batteries, tires and more.

Training equipment must be stored in a room with a minimum ambient temperature of at least +10 ° C. Relative humidity not more than 60 %.

Training equipment must not be exposed to direct sunlight. Equipment must be covered by protective equipment if it is stored in a place exposed to direct sunlight.

Unused training equipment is kept completely switched off. The training stands are switched off with the control key and by disconnecting the power supply.

#### 2.4. Preparation and use of equipment

The training equipment is maintained as conventional mechanical, hydraulic, pneumatic, electrical machines and systems. Training equipment requires minimal maintenance and service.

All components of the training equipment must be controlled and ensured.

Damaged, broken parts, blown fuses, damaged connecting cables and other parts are replaced with new ones.

The technical condition of the equipment, attachment of protective shields, complete set and other things are checked. For more information on safe work requirements, see the section "Occupational safety  $\rightarrow$  Before working with the training equipment, check that:".

When preparing training equipment for work, it must be properly constructed and secured. Equipment with its own stand or chassis is built on a level and solid floor. The equipment transport wheels are locked by locking the brakes.

# **3. TRAINING EQUIPMENT**

# 3.1. General overview of training equipment

A general view and structure of the training equipment is given in the illustrations below.



General view of the training stand of the automatic transmission

- 1. Hydro transformer hood
- 2. Gearbox housing
- 3. Clutch
- 4. Primary shaft
- 5. Planetary reducer
- 6. Hydro transformer
- 7. Secondary shaft
- 8. Gearbox control unit

## 4. THE PRINCIPLE OF OPERATION OF THE AUTOMATIC TRANSMISSION

#### The types of automatic transmission

Some of the most commonly used gearboxes in this category include: Automated Manual Transmission (AMT), Continuously Variable Transmission (CVT), Dual-Clutch Transmission (DCT) and Fully-Automatic Transmission.

#### **1. Automated Manual Transmission**

The automated manual transmission (AMT) or semi-automatic transmission is essentially not an automatic or clutch less transmission, but rather a manual transmission that makes it easy to change gear without having to press the clutch.

The mechanism of this type of gear unit involves the use of two key parts – a hydraulic actuator system and an electronic control unit that engages and disengages the clutch while shifting is in progress. Basically, it's just a kit that can be added to any regular manual transmission, making it a cost-effective solution for automakers.

#### 2. Continuously Variable Transmission (CVT),

The continuously variable transmission (CVT) is the most unique clutch less transmission compared to the others mentioned above. Mind you, it's not the best, it's just the most unique, and I'm saying this because while other gear units have a certain number of gears that need to be upshifted to keep accelerating, a CVT unit doesn't have any other gears like these.

Typically, the number of gears in a transmission system, also known as speed, has a finite number of gear ratios distributed across each gear. So, to go faster, you have to shift past a point. The CVT, on the other hand, has a special gear that is variable in all driving situations and can be easily changed over a continuous range of effective gear ratios.

This allows you to control the engine speed or RPM to accelerate or decelerate based on your throttle action. A CVT transmission is also primarily used in two-wheelers, especially scooters, where acceleration and braking are key. Some cars also get the paddle shifters to make things easier for drivers.

#### **3. Dual Clutch Transmission (DCT)**

A dual clutch transmission (DCT) works on similar principles to an AMT, but as the name suggests, a DCT transmission uses two clutches instead of one. One each for odd and even gear sets, which makes it more efficient than an AMT.

Simply put, a DCT transmission is more like two manual transmissions contained in a single housing. It works like this: A clutch is in an odd numbered gear while the computer works out which even numbered gear you need next. The second clutch is ready to engage that gear and simply shift the clutches at the right time.

Like every standard automatic transmission, a DCT unit also has a simple P, R, N and D gear selector and no clutch pedal. It shifts independently or can be controlled manually using a paddle shift lever or a separate gate on the gearbox.

#### 4. Automatic Transmission

As the name suggests, an automatic transmission is a fully automatic transmission that can change gear ratios while driving and frees the driver from having to shift gears manually. An automatic transmission consists of three main components: fluid / hydraulic clutch, planetary gear train and hydraulic control.

A fluid / hydraulic clutch works similarly to a clutch in a manual transmission that changes gear by locking and unlocking a planetary gear system. The torque converter is a well-known hydraulic clutch or fluid coupling that is used in number cars with powerful engines.

The second important part of an automatic transmission is the planetary gear train, a system that provides the various gear ratios and changes the speed of the output shaft depending on which planet gears are locked.

The third important component used in an automatic transmission is the hydraulic control, which is very similar to a fluid coupling but is typically a gear pump mounted between the torque converter and the planetary gear set and controls various clutches and belts that control the speed of the output depending on change the driving condition of the vehicle.

#### **Advantages of Automatic Transmission**

- Driving comfort. One of the best advantages of driving an automatic car is the convenience it offers. Thanks to the clutch-pedal-less operation and the fact that you don't have to shift gears manually.
- Good Fuel Economy. Fuel consumption has always been a major point of concern for people opting for an automatic car.
- Engineered for Versatility and Great Performance. The automatic transmission is quite responsive to driving inputs; it has sufficient power on tap to deliver quick acceleration and solid driving performance. There's a Hill Hold function as well that prevents the car from rolling backward when driving on inclines.
- Higher resale value.
- Widely available.
- Great in stop and go traffic.
- Good for beginners.

#### **Disadvantages of Automatic Transmission**

The disadvantages compared to the manual transmission are the higher space requirement and the higher weight. Compared to the automatic torque converter transmission, the worse starting comfort and the higher wear are the main drawbacks.

- Higher purchase price than manual.
- Higher repair costs.
- Historically less fuel-efficient than manual but the gap is closing.

An automatic transmission is a multi-speed transmission used in motor vehicles that do not require any driver input to change gears under normal driving conditions. The most common type of automatic transmission is the hydraulic automatic, which uses a planetary gearset, hydraulic controls, and a torque convertor.

An automatic transmission is also known as self-shifting transmission or AT or dual pedal technology, as this system operates without a clutch pedal. It is a type of motor vehicle transmission that can automatically change gear ratios as the vehicle moves, erasing the need to shift gears manually.

The automatic transmission is especially efficient in bumper-to-bumper congested traffic in cities, where a manual transmission-equipped vehicle's driver needs to constantly move the gears.

#### Parts of Automatic Transmission

Let's take a look different part of an Automatic Transmission:

- Transmission Casing.
- Torque Converter.
- Pump (aka impeller).
- Turbine.
- Stator (aka Reactor).
- Torque converter clutch.
- Planetary Gears.
- Brake Bands and Clutches.



Diagram of Automatic Transmission

## **1. Torque Converter**

The torque converter sits between the engine and transmission. It looks like a donut and is located in the large opening of the bell housing of the gearbox. This has two main functions in relation to the transmission of torque:

- Transfers power from the engine to the transmission input shaft
- Multiplies engine torque output

It performs these two functions thanks to hydraulic power provided by the transmission fluid inside your transmission.

## 2. Torque converter clutch

To avoid this loss of energy, most modern torque converters have a torque converter clutch attached to the turbine. When the car reaches a certain speed (usually 45-50 mph), the torque converter clutch engages, causing the turbine to spin at the same speed as the pump. A computer controls when the converter clutch is engaged.

## 3. Planetary Gears

On an automatic transmission, gear ratios increase and decrease automatically. And this can happen thanks to the ingenious design of planetary gear.

A planetary gear consists of three components:

- A sun gears. Sits at the center of the planetary gear set.
- The planet gears/pinions and their carrier. Three or four smaller gears surround the sun gear and are in constant mesh with the sun gear. The planet gears (or pinions) are

mounted and supported by the carrier. Each one of the planet gears spins on their own separate shafts that are connected to the carrier. Planet gears not only spin, but they also orbit the sun gear.

• The ring gears. The ring gear is the outer gear and has internal teeth. The ring gear surrounds the rest of the gear set, and its teeth are in constant mesh with the planet gears.

#### 4. Brake Bands

Brake bands are made of metal that is lined with organic friction material. The brake bands can be tightened to keep the ring or sun gear stationary, or loosened to allow them to rotate. Whether a brake band tightens or loosens is controlled by a hydraulic system.

#### 5. Oil Pump

The pump looks like a fan. It has a series of blades extending from its center. The pump is mounted directly on the torque converter housing, which in turn is bolted directly to the engine flywheel. As a result, the pump rotates at the same speed as the engine's crankshaft. The pump "pumps" transmission oil from the center to the outside.

#### How does an Automatic Transmission Work?

The most common type of automatic transmission uses hydraulic power to shift gears. This device combines a torque or fluid clutch converter with gear sets that provide the desired gear range for the vehicle. The torque converter connects the engine to the transmission and transfers the power to the gears with hydraulic fluid.

This device replaces a manual friction clutch and allows the vehicle to come to a standstill without stalling. When the engine transfers power to the torque converter pump, the pump converts that power into transmission oil that drives the torque converter turbine.

This device increases the power of the fluid and transfers even more power back to the turbine, creating a vortex force rotation that rotates the turbine and attached central shaft. The force generated by this rotation is then transmitted from the shaft to the first planetary gear set of the transmission.

This type of transmission has what is known as hydraulic control. The transmission oil is pressurized by an oil pump, which can change the speed depending on the vehicle speed, the tire revolutions per minute and other factors.

The gear pump is located between the planetary gear set and the torque converter, where it draws transmission oil from a sump and pressurizes it. The pump inlet leads directly to the torque converter housing, which is attached to the flex plate of the engine. If the engine is not running, the transmission does not have the oil pressure required to operate and therefore the vehicle cannot be started.

The planetary gear train is a mechanical system in which the gears are connected with a set of belts and clutches. When the driver changes gear, the belts hold one gear still while rotating another to transfer torque from the engine and increase or decrease gear.

The various gears are sometimes referred to as the sun gear, ring gear, and planet gear. The arrangement of the gears determines how much power flows when shifting from one gear to the other and to the vehicle's drive train.

#### Gears of an Automatic Transmission

The gears of an automatic transmission include the following:

When you switch your vehicle to drive mode, switch on all available forward gears. This means that the transmission can move between its entire gear range if necessary. Six-speed automatic transmissions are the most common number of gears, but older vehicles and entry-level compacts may still have four or five automatic transmissions.

Third gear either blocks the transmission in third gear or limits it to first, second and third gear ratios. This provides the power and traction needed to either go uphill or downhill, or to pull a boat, RV, or trailer. When the engine reaches a certain number of revolutions per minute (RPM), most vehicles automatically shift into third gear to prevent damage to the engine.

The second gear either blocks the transmission in second gear or limits it to the first and second gear ratios. This equipment is ideal for riding uphill and downhill in slippery conditions, as well as riding in ice, snow and other poor weather conditions.

First gear is used when you want to lock the transmission in first gear. However, some vehicles automatically turn this gear off to protect the engine at a certain speed. Like second and third gear, this gear is best for towing, going up or down hills, and when driving in slippery, icy conditions.

## 4. WARRANTY CONDITIONS

Our products meet modern technical standards. We guarantee that our product is perfectly constructed and manufactured. They operate reliably if used correctly and in accordance with the provided maintenance rules.

Educational training board is used for educational purposes and can be used only with the components and operating fluids that are fitted on the board.

The guarantee of \_\_\_\_\_ months is provided for the educational training board. The guarantee begins to run from the sale date of the stand.

In order to warrant the setting of the appropriate date of sale, we ask the buyer to save the relevant contract documents: purchase check, invoice, transfer-acceptance act, warranty card with a product name filled correctly and clearly, number, date of sale, store stamp, signature and the signature of the seller.

The warranty is not applied:

• if the user did not comply with the usage, transportation and storage conditions, used not appropriate operating fluids and aggressive cleaning agents;

- if the stand was damaged by the third parties, force majeure (fire, catastrophe etc.) or another side effect;
- for mechanical breakings and other breaches;
- for warn out parts of the stand, fuses and if non-original spare parts are used;

• when the stand is regulated, improved or remade by unauthorized persons who cannot carry out this work;

- for naturally worn parts such as collars, straps and filters;
- in case of the fluid spill;
- when using the incomplete kit;
- if extraneous objects or some water gets into the product;
- when operating incorrectly or plugging into a messy electric network.

Warranty conditions do not cover the costs related with dismantlement of the product and transportation to the authorized warranty service enterprise. Also, it does not cover consultation, actuation and adjustment work costs. If the elements necessary for repairing the board have to be ordered from the supplier, the repair work may be prolonged.

Warranty repair is done at technical service stations authorized by the manufacturer. During the warranty period defective product components are repaired or replaced free of charge. Technical service station has the right to make a decision about the repair or replacement of the components. The elements that are being changed become the property of the service station.

After completion of the warranty repairs, the guarantee is not extended but remains valid until the time limit provided. The manufacturer reserves the right to change the appearance, design and structure of the product. Service center has the right to suspend the guarantee if the stand was used for other purposes.

# Warranty maintenance coupon

Name	
Product number	
Date of sale	
Training equipment owner	
Trading partner / representative	

## Description of work performed

Data	Description of the fault and its elimination process	Technician / Signature
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NOTES



# CONTACTS

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