

- 1) Precaution for use
- (1) Use the wrench within the scale range.
- (2) Do not set torque below minimum scale torque.
- (3) Make sure the torque wrench is set correctly before using.
- (4) Confirm that the torque is set according of the correct unit of measure before using (kgf.cm, kgf, N.m., etc.).
- (5) Do not lock Sup. Graduation with pliers. The lock mechanism will be damaged and will not maintain torque accuracy.
- (6) Measurement precision is affected by the grip position. A line is provided on the knurled surface to indicate effective length.
- (7) Stop tightening when you feel a click. Applying more torque beyond the click will lead to overtightening.
- (8) Loading direction. The loading direction must be at right angles to the torque wrench (tolerance: +/-15 degrees). This tolerance applies to both horizontal and vertical deviations.
- (9) Remove any dirt such as dust, mud, oil and water, etc. after each use and before storing torque wrench.
- (10) When storing the torque wrench for a long time, set at the minimum torque, apply rust proof oil, and keep in a dry place. If improperly stored, the accuracy and durability will decrease rapidly.



TTEL032



HANDLING OF STUD BOLT

If stud bolt is damaged or deformed, which may be the cause of a drop in engine power, replace or repair it.

REPLACEMENT PROCEDURE FOR STUD BOLT

(1) with use of stud bolt remover

- 1. Install stud bolt remover to stud bolt.
- 2. Be sure to insert the stopper of which circumference is a screw shape into stud bolt.
- 3. Put spinner handle into socket, then loosen stud bolt.

* It is impossible to reuse stud bolt.



TTL033

(2) without use of stud bolt remover

- 1. Prepare nut with a proper pitch for cracked or damaged stud bolt.
- 2. Fix double nut to stud bolt.
- Rotate the inside of nut to the left, then loosen it.
 * Rotate the outside of nut to the right, then tighten it.



TTL034





USAGE OF TAPS & DIES

TAPS

Function

The tap is a tool used for cutting a female screw in a hole of a work. Usually, the following three types of taps are provided as a set.

First hand tap	for rough shaping	
Second hand tap	for mid shaping	
Third hand tap	for final shaping	

TTL036

A female screw is to be cut gradually by using the first hand tap, the second hand tap and the third hand tap in this order.

These three taps are equal in diameter, but different in length of the chamfer.



REPAIR FLOW

Repair tips as follows.

- 1. Confirm a bolt hole has damaged threads (and not a broken bolt).
- 2. Measure the outer diameter of bolt with a vernier caliper.
- 3. Measure bolt pitch with a pitch gauge.
- 4. Select a tap which fits the outer pitch diameter.
- 5. Insert selected tap, turn it once or twice, then fix the tap handle.
- 6. Use each tap from step 1 to final step one by one to complete the bolt.
- 7. Blow out cuttings with compressed air.
- 8. Put in the bolt, and check if it rotates.

Explanation for the points of flow chart

- **Step 1:** Selecting an inappropriate tap may cause making a female hole too large, so be careful when selecting the tap.
- **Step 2:** Measure the outer diameter with a vernier caliper to obtain standard size for selection.
- **Step 3:** Measure the pitch of bolt with a pitch gauge, then select the tap of the same pitch as the bolt.
- Step 4: Refer to the size which is indicated on the tap for tap selection.

NNNNN ~~~~~ M8 x 1.25



• **Step 5** : Select a tap handle to fit the size of the tap.

The use of the tapping wrench makes the tapping operation easier because this wrench helps you apply a uniform turning force to the tap.

• **Step 6**: Generally, the female screw should be cut carefully by advancing the tap for one turn, and then reversing for a half turn to release the chips without applying an unreasonably strong force to the tap.

Cutting oil should be applied the tap with a brush or an oiler while the tapping operation is being carried out. This will lower high temperature during tapping work, protect the tap, and make the tapping operation easier.

Brush





How to Deal With Broken Tap

The best way is to be careful not to break taps, however, taps which are very hard and brittle can be easily broken with even a little carelessness. Confirm what caused the breakage in order to prevent its reoccurrence. Main causes which should be preventable are as follows.

- 1. Cutting oil is not used or even if the cutting oil is used, the amount is not sufficient.
- 2. The pilot hole is too small.
- 3. Neither tap maintenance nor work maintenance is perfect.
- 4. The tap is clogged with chips or other foreign particles.
- 5. The tap handle is too large to match the size of the tap.
- 6. The tap is turned too forcefully.

In any of the above cases, do not apply unnatural force on the tap.

How To Remove Broken Taps

When removing a broken tap from the hole, be careful of the chips. Remove chips clogging the tap's groove before the tap is taken out of the hole. To remove chips, use a wire or a thin chisel. If the hole is deep, blow compressed air through the hole to clean the tap.

The best way to remove a broken tap is to confirm the cause of the breakage. For example, if a pilot hole is too small, the tap will bite into the material, then be damaged. In most cases the part near the entrance of the hole may be easily broken. Do not remove the tap by knocking it in the loose direction. Select the most appropriate way according to the size of the broken tap and the quality of the material. Recommended ways are as follow:

- 1. If the broken part is comparatively shallow, place a punch or chisel on the tap and hit it with a hammer. Then turn the tap in the loosening direction and carefully remove it so as not to damage the screw thread at the entrance of the hole.
- 2. If the broken part of the tap is out of the hole, grip the tap with pliers, and remove it by turning it in the loosening direction.

3. For a large tap, use a three-footed or fourfooted tool for taking out taps according to the number of tap grooves, apply the feel to the grooves and turn the tap carefully.

- 4. Weld a handle or round bar to the broken part and remove the tap by turning it.
- 5. Pile up padding by welding on the broken part. Then remove the tap by turning the padded part with a pipe wrench.
- 6. If the above methods are no effective, slowly heat the cylindrical surface of the hole with a gas burner or torch lamp, then try to remove it. In most cases, this method will be effective.







Examples of other applications

- A broken bolt remaining in a screw hole or a bolt of which head is rounded due to crushed screw thread are hard to remove. Such bolts can be removed by drilling a hole in the bolt and applying a reverse tap designed exclusively for bolt removal.
- Crushed screw thread of a female screw can be repaired by tapping.

How To Remove Broken Bolt

The way to remove broken bolts depends on the broken conditions of the bolt.

- 1. If the bolt is broken with 2 or 3 mm outside of the surface:
- a) Pull the bolt by turning it with pliers.

- b) If impossible in the above way, try step 2.
- 2. If the bolt is broken below the surface (use of reverse tap):
- a) Make a hole at the center of bolt with a center punch.
- b) Select the drill of the same size as the reverse tap.
- c) Make a hole in the broken bolt with a drill.
- d) Pull out the bolt with the reverse tap.

In the case of no reverse tap

Make a big hole in the bolt with a drill as indicated below, insert the bolt of the same size as the hole or other tool into the hole, and then pull it out.

TTI 043

Use a drill of smaller size than the broken bolt.

Caution: Be sure to make a hole at the center of bolt, if not, the screw may be easily broken.









TTL044





DIES

Function

- A die is a tool used to cut male screw around a round bar or a pipe.
- The most widely used dies are called round open dies.

A round open die is shown below. The round split die has a chamfer which is larger in diameter than the root so that die can easily bite into the material.



TTL046

TTL047

How to use

- Screw threads of the round open die are cut off in a tapered form for 2 to 2.5 threads at its starting end so that die can easily start the screw cutting. The die should be inserted into a die holder with the starting taper of the die facing downward.
- The open die is adjustable in diameter and is widely used for cutting ordinary external threads.



REPAIR FLOW

Repair bolts as follows.

- 1. Insert a nut into a bolt, then check the hardness.
- 2. Measure the outer diameter of the bolt with a vernier caliper.
- 3. Measure the pitch with a bolt pitch gauge.
- 4. Select dies which fit the outer diameter.
- 5. Repair the bolt.
- 6. Clean cuttings with a brush.
- 7. Put the nut into the bolt, then confirm the bolt rotates.



Explanation for the points of flow chart

- Step 1 : Measure outer diameter with vernier caliper to select the standard size.
- **Step 2** : Measure the bolt pitch with a pitch gauge. Select a die with a pitch that fits the outer diameter.
- **Step 3** : Die indication code

Example



TTL048

• **Step 4:** There is a screw hole on the side of the die for installing a handle. Insert the setscrew of the die handle into the hole to prevent the die from turning unnecessarily.



TTL049

• **Step 5**: When turning the die holder handle, apply uniform force to the right and left of the handle. Generally, the screw should be cut carefully by advancing the die for one turn, and then reversing for a half turn to release the chips without applying an unreasonably strong force to the die.

Cutting oil should be applied to the die with a brush or an oiler while the screw cutting work with the die is being carried out. This will reduce the high temperature generated during the screw cutting work protect the die, make the screw cutting operation easier, and provide a clean finish of the screw.



Examples of other applications

• Bolts which are frequently used and are hard to turn when being tightened can be repaired by cutting the screw with a die again.



TTL050

APPLICATION OF TAP AND DIE

• Tap

If the handle of die is hard to use, replace the bolt.

• Pitch gauge

If there is no pitch gauge, set the bolt in use as size of tap or dies. If the bolt can be inserted into a screw thread with no trouble, the pitch is regarded as the same size.



BODY AND TRIM

SERVICING BODY INTERIOR REMOVAL OF CLIPS

The clips shown in the illustration are widely used in fastening interior trim pieces. When these clips are forced out with a screwdriver, the trim, the body panel, or the clip may be damaged.



TBT001

• Tool in this illustration ca be easily made, and will come in handy.



When pulling out the rivet-type clips with a screwdriver, the screwdriver made scratch the trim. A tool such as the one described here, which can be easily made, will come in handy.

If the trip or panel may be scratched, apply a rag underneath the fulcrum point of the tool.

- When removing the clip, carefully insert the tip of the tool between the clip and the trip, and pry it with a lever action.
- If there is a danger of scratching the trip or panel, place a rag underneath the fulcrum point of the tool.
- Replace any clips and / or fasteners which are damaged during removal or installation.
- Clips and fasteners in Service Manuals correspond to the following numbers and symbols.
- Replace any clips and / or fasteners which are damaged during removal or installation.



ENGINE FUNDAMENTALS

1. AUTOMOBILE ENGINES

Automobile engines are classified into the following types according to the type of fuel used:

(1) GASOLINE ENGINE

These engines use gasoline for fuel. Small-sized, high speed, high powered, and light weight, they are widely used in passenger cars, commercial vehicles and small trucks.

(2) DIESEL ENGINE

Diesel engines use light oil for fuel. Because they consume less fuel than gasoline engines, and light oil is cheaper than gasoline, diesel engines are often used in buses and large trucks where fuel economy becomes more important. Smaller diesel engines are used in some passenger cars, but they are inferior to gasoline engines in such aspects as maximum speed, output, weight, and noise/vibration levels.

(3) LPG ENGINE

LPG engines use LPG (Liquefied Petroleum Gas) or natural gas for fuel. Although output is lower than gasoline engines, they are widely used in taxicabs due to their superior fuel economy.



2. OPERATING PRINCIPLES OF DIESEL ENGINE

2-1. DESCRIPTION

The basic components of gasoline engine are the cylinder, in which an air-fuel mixture is sealed and combusted, and the piston, connecting rod, and crank-shaft, which act together to convert the energy created by the explosive combustion of the air-fuel mixture into rotational movement.



Basic component of the engine

The top of the <u>cylinder</u> **1** is sealed to <u>the cylinder head **2**</u> and <u>the piston **3**</u> is allowed to move freely up and down inside the cylinder. <u>The connecting rod **5**</u> connects the piston to <u>the crankshaft **4**</u> so that the crankshaft will rotate when the piston moves up / down. At the end of the crankshaft, <u>the flywheel **6**</u> is attached to make the rotation smooth and even.

On the cylinder head are attached <u>the intake valve 7</u> and <u>exhaust valve 8</u> to bring in, discharge, and seal the air-fuel mixture, and <u>the spark plug 9</u> to ignite the mixture. As the piston moves downward, air passes through <u>the carburetor 11</u>, creating a gasoline-air mixture, which is sucked into the cylinder through the <u>intake manifold 12</u>.

When the air-fuel mixture is combusted inside the sealed combustion chamber above the piston, the pressure inside rapidly increases. This forces the piston down and rotates the crankshaft through the connecting rod. The piston which has completed its downward movement is pushed back up again by the connecting rod due to the momentum of the flywheel.