MECHANICAL COMPONENT ASSEMBLY INFORMATION SHEETS MEL02INF2387

HEALTH & SAFETY REQUIREMENTS

RECORDING REQUIREMENTS: Record the results of your work on Task Worksheet MET02TWS15

REFERENCES: This document relates in part to the requirements of Unit Standard 2387

ASSOCIATION OF MECHANICAL COMPONENTS;

Mechanical engineering often requires the preparation and assembly of mechanical components, as well as the test, inspection and storage of completed assemblies.

Written or verbal instructions are usually provided, and this may include worksite safety procedures, equipment operating procedures, job procedures, procedures for handling and disposal of materials, assembly drawings and specifications.

Typical components for simple assemblies often include combinations of items such as shafts, seals, bearings, pulleys, sprockets, motors, chains, belts, levers, frames, fasteners and keys.

Typical tools often include screw drivers, spanners, pliers, torque wrench, Allen keys, and may also involve the use of specialised tools or jigs.

Personal Appearance and Protective Equipment

Normal street and office clothing is not usually adequate for protecting people while working in a mechanical engineering assembly environment. Items such as ties, jewellery, loose fitting clothing or even long hair may become caught in machinery or equipment, leading to serious harm or loss.

- Overalls should be worn to protect and confine exposed skin and personal clothing
- Jewellery should be removed to prevent amputation of body parts
- Hair ties or a hair net should be used to confine long hair

To remain safe when assembling mechanical components, the correct personnel protective equipment (PPE) must be worn. Some items of PPE are mandatory, while other types need to be used to ensure protection during specific activities.

- **Safety Boots** are mandatory in most mechanical assembly environments and usually offer toe protection from crushing or falling objects. Most safety boots have heavy-duty construction, and a choice of non-skid, chemical resistant and/or electrically insulated soles.
- **Overalls** are mandatory in most mechanical assembly environments, and usually provide arm as well as leg and body protection from dirt, dust and oil contamination, and light abrasion.
- **Safety Glasses** are mandatory in most mechanical assembly environments to protect the wearer from eye injury and impact caused by low velocity, low mass flying objects.
- **Visors** are designed to offer protection from impact caused by low velocity, low mass flying objects in the assembly environment. Visors are usually constructed from light-weight, heavy-duty plastics and incorporate a head band with a clear flip-down face shield.
- **Ear Muffs** are designed to provide hearing protection from workplace noise. Hearing protection is required for exposures above 85 decibels (dBA) over an 8 hour working day, but as a general rule, hearing protection should be used where any discomfort is experienced.
- **Leather Gloves** are used to provide hand protection from abrasion, as well as minor impact and variations in temperature.
- **Dust and particle masks** are designed and rated to provide protection by filtering fine solids or liquid particles from inhaled air.
- **Hard Hats** are designed to prevent head injury due to impact from flying, falling or suspended objects. Some types of hard hat can be modified by adding face-shields, visors, chin-straps and hearing protection.

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COMMON TYPES OF ASSEMBLY TOOLS

**Hammers and Mallets** are used to apply impact force to drive punches which are used to insert pins, dowels and keys into mechanical assemblies.

**Screwdrivers** are used to tighten or loosen machine screw fasteners. Blade sizes and types vary to match a wide range of screw heads.

**Torque Wrenches** can be fitted with detachable sockets and are used to tighten fasteners to a selected torque setting. They require careful use and frequent calibration to maintain their accuracy.

**Soft-Face Hammers** are used to prevent or minimize impact damage to components during assembly. The soft face inserts are commonly made of raw-hide, plastic, or soft metals such as copper or aluminum, and are removable for quick and easy replacement.

**Sockets** and **Socket Wrenches** are used to tighten and loosen hexagonal head nuts and bolts. They are manufactured in a variety of metric and imperial sizes to suit a wide range of hexagonal head fasteners.

**Adjustable Wrenches** are used to tighten and loosen hexagonal head nuts and bolts and can be adjusted to suit a range of nut and bolt sizes.

**Spanners and Socket Wrenches** are used to tighten and loosen hexagonal head nuts and bolts. They are manufactured in a variety of metric and imperial sizes to suit a wide range of hexagonal head fasteners.

**Combination Pliers** and **Vice Grips** are manufactured in a wide range of sizes and types, and can be used for temporarily holding components during assembly.

**Pliers and Vice-Grips** are manufactured in a wide range of sizes and types, and can be used for temporarily holding components during assembly.

**Soft-Face Hammers** are used to prevent or minimize impact damage to components during assembly. The soft face inserts are commonly made of raw-hide, plastic, or soft metals such as copper or aluminum, and are removable for quick and easy replacement.

**Allen keys** are used to tighten or loosen hexagonal socket machine screw fasteners. They are manufactured in a variety of metric and imperial sizes. The ends of the Allen keys can be plain or "ball-end" to allow for access in tight spaces.

**Screwdrivers** are used to tighten or loosen machine screw fasteners. Blade sizes and types vary to match a wide range of screw heads.

**Socket Sets** are manufactured in a variety of metric and imperial sizes to suit a range of different hexagonal head fastener sizes and types. Sockets are used to tighten or loosen hexagonal heads fasteners using a reversible ratchet mechanism.
**Tidy-as-you-go** should be practiced whenever possible. This applies to both individual and shared work benches and assembly work areas. Tools and equipment should be returned to their storage area, tool box or shadow-board as soon as possible after use. Waste material clean-up, segregation and recycling procedures should be implemented where possible. Raw, in-process and waste materials should be stored safely when not in use. Personal items, food, or drink should not to be taken into workshop, storage or assembly areas, unless a clean work-free area has been set aside for this purpose.

**HANDY HINT:**
Good housekeeping is fundamental to workshop safety. Time allocated to an assembly job should include an opportunity for cleaning up.

Avoiding injury or damage can be as simple as choosing the right tool for the job, and using it correctly.

- Don't use damaged or worn tools
- Don't use oversize or undersize tools
- Don't use a tool that is designed for a different job
- Always work carefully and methodically

If you don't know which tool to use, or how to use a tool properly; STOP and ASK!

**Assembly Tool Safety Checks**
Check the tool handles are secure and in good condition and are not split, chipped or cut.
Check the clamping faces for excessive bruising or embedded foreign objects.
Check tool surfaces, edges and teeth for any sign of chipping, splitting cracking, bruising or damage.
Clean the surfaces with a dry rag to remove any excess oil or grease.
Lubricate the tool (if required) to achieve smooth operation.
Check the tool mechanism for full and free movement.
Check for a secure fit on the heads of fasteners.

**Component Cleaning**: Most components will have traces of dirt or oil on their surfaces due to the manufacturing processes or to prevent them from rusting during transport or storage. Excessive amounts of oil or grease on the surfaces of the assembly may cause a build-up of dirt or debris on critical moving parts. This in turn can cause the assembly mechanisms to fail, or the working environment to become dangerously contaminated.

Component cleaning can be done simply and effectively in a variety of ways including;

- Rag-wipe (clean, dry and lint-free)
- Detergent wash
- Solvent cleaning
- Compressed Air
- Ultrasonic bath
- Steam clean

**HANDY HINT:**
An ultrasonic bath can be used to clean multiple batches of complex small parts.
Selection and Checking of Components
Components can come from a wide range of sources including the original equipment manufacturer (OEM), engineering subcontractors or via in-house manufacture.

The components should be checked against one or more of the following documents to ensure the correct components types, part numbers, and quantities are available;

- Assembly procedures or checklists
- Design specifications
- Engineering drawing
- Bill-of-materials (BOM)
- Works-order or job card

The sizes of important components should be measured to ensure they are the correct size and that the assembly will fit together. The measurements should be recorded on the assembly documentation.

Corrective Actions; Where the finishing quality is poor or the size of a component is incorrect, or it will not fit into the assembly, corrective action such as adjustment or rework may be required. Common types of rework are;

- Filing or sanding
- Buffing or polishing
- Grinding or finishing
- Turning or milling

HANDY HINT:
Before assembly, use a measuring checklist to record the sizes of critical components.

Assembly Process Instructions are used describe the steps taken to integrate the components into a completed assembly. Assembly instructions typically follow a logical sequence and can come from a wide range of sources, such as;

- Engineering drawings and specifications
- Verbal instructions from a supervisor
- Manufacturers instruction manuals
- Company procedures manuals
- Schematics and diagrams
- Illustrations and photographs

Documentation is usually required to record the successful completion of a mechanical assembly. Completion records usually include forms relating to the assembly process, such as;

- An assembly checklist
- Quality assurance records
- Company work-order or job cards

HANDY HINT:
Use an Assembly Checklist to plan and record the assembly process.
EXAMPLE ASSEMBLY PROCESSES

The following process is a typical example of how to assemble a simple item, in this case a fishing reel spool. The assembled fishing reel spool is made up of some machined parts, as well as two original equipment manufacturer (OEM) roller bearings and two types of fasteners.

A Tool and Materials Checklist for this assembly process may look like this:

### Components
- Spool Plate: Part No MEL02-PRI23-03, QTY 2 required
- Spool: Part No MEL02-PRI23-09, QTY 1 required
- Handle: Part No MEL02-PRI23-011, QTY 2 required
- Bearing: Part No NTN 608-LU, QTY 2 required

### Fasteners
- M3 x 10 mm long Countersunk stainless steel screws, QTY 12 required
- M5 x 35 mm long Countersunk stainless steel screws, QTY 1 required
- M5 Nylock nut, Stainless steel, QTY 1 required

### Tools
- Phillips Screwdriver set (small), QTY 1 required
- Allen Key Set (small), QTY 1 required
- Needle-nose Pliers (small), QTY 1 required

### Step 1: Gently hand-press the two NTN 608-LU roller bearings into the Spool Body part No MEL02-PRI23-09.

### Step 2: Attach each Spool Plate to the Spool using six M3 x 10 mm long countersunk stainless steel screws.

### Step 3: Fit the Handle to the spool plate using the 35 mm long M5 countersunk socket head cap screw and Nylock nut.

### Step 4: Ensure the Spool Handle has minimal end-play, rotates freely, but does not wobble excessively.

### Step 5: Attach the second Spool Plate to the Spool using six M3 x 10 mm long countersunk stainless steel screws.

An Assembly Checklist for this assembly process may look like this:

An Engineering Assembly Drawing of the spool assembly may look like this:

**Note:** This is a 3-S Solid Model engineering drawing.

Illustrated instructions for an Assembly Procedures Manual may look like this:

**Step-1:** Gently hand-press the two NTN 608-LU roller bearings into the Spool Body part No MEL02-PRI23-09.

**Step-2:** Attach each Spool Plate to the Spool using six M3 x 10 mm long countersunk stainless steel screws.

**Step-3:** Fit the Handle to the spool plate using the 35 mm long M5 countersunk socket head cap screw and Nylock nut.

**SMART TIP**

Engineering drawings usually include a detailed Bill-of-Materials which lists all of the components and fasteners that are required in the competed assembly.
Adjustment During Assembly usually includes actions such as:

- Removal or burrs or sharp edges
- Drilling-out holes to allow fasteners to fit
- Cleaning and checking threads and tapped holes
- Checking and setting the alignment of components
- Using a torque wrench to correctly tighten fasteners
- Checking and setting the tension of chains and belts
- Polishing and lubricating shafts and bushings to ensure smooth and free movement
- Modifying, swapping or exchanging fasteners and components to improve their fit

TESTING OF COMPLETED ASSEMBLIES

Completed assemblies should be tested to check they operate correctly and are fit for service. There are a number of simple tools and instruments that can be used to carry out checks on completed assemblies, such as,

- **Straight Edges** for alignment of chains and sprockets, belts and pulleys
- **Sensory Checks** for smooth-meshing of chains, sprockets and gears
- **Dial Gauge** for true-running of shafts in bushings and bearings
- **Sensory Checks** for full and free movement of levers
- **Feeler Gauges** for the snug-fit of mating faces
- **Torque Wrenches** for correctly tightened fasteners
- **Infrared Thermometers** for cool, free-running shaft seals

HANDY HINT; If the shaft nut is sticking, use a die to clean the shaft threads.

HANDY HINT; A feeler gauge can be used to check the mating faces of a completed assembly.

HANDY HINT; When finished, return any unused fasteners to the correct storage bin.

SMART TIP! When finished, return any unused fasteners to the correct storage bin.

Storage of Components and Assemblies

To prevent damage or deterioration before use or installation, components, fasteners and completed assemblies can be stored in a variety of different sizes and types of containers including;

- Bins
- Bags
- Trays
- Boxes
- Trolleys
- Shelves

Storage Guidelines:

Plastic is the preferred material for storage trays, bins and boxes, as it is strong and tough, but will not damage metal components.

Small components can be wrapped in brown paper or cardboard, before being place in a storage container.

Plastic bags can be used to store small quantities of small items. Larger quantities of small items can be stored in bins, boxes or trays.

Clean, dry wood should be placed under large or heavy assemblies to prevent damage.

Large or bulky items can be covered in plastic wrap, which should be secured in place using adhesive tape.

As system of coded bins, boxes and shelves should be used to manage the location of stored items.

HANDY HINT; When finished, return any unused fasteners to the correct storage bin.

HANDY HINT; To prevent small metal components from rusting or corroding, wrap them in brown paper that has been sprayed with light oil.