

TECHNICAL MANUAL

INSPECTION AND MAINTENANCE

MACHINERY AND SHOP EQUIPMENT

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1 INSPECTION AND MAINTENANCE.

This Technical Order (TO) provides general policy for the inspection and maintenance of commercial type shop machinery and equipment installed in organizational, intermediate, and depot maintenance facilities and other United States Air Force (USAF) industrial facilities. This TO applies to general machinery and shop equipment as defined in the following paragraph. It does not apply to Aerospace Ground Equipment (AGE), Depot Maintenance Equipment (other than as outlined in [Paragraph 1.1.4](#)), test equipment, or specialized shop equipment for which specific inspection and maintenance requirements are published in the TO series applicable to the equipment. Machinery and shop equipment as defined in this TO includes all powered machinery and shop equipment which does not have specific instructions for inspection.

1.1 Inspection and Maintenance Requirements. The inspection and maintenance requirements for machinery and shop equipment will be determined by applicable technical data. Technical data will be obtained in accordance with TO 00-5-1. When technical data does not exist, the work center supervisor and the supporting quality control agency shall use the criteria in this TO as general guidelines to aid in the inspection of equipment which does not have specific instructions for inspection. (Reference [Paragraph 1.2](#) through [Paragraph 1.21](#).) The guidelines must incorporate common sense, and in all cases sound judgment when not involving specific tolerances. There are two methods of documenting maintenance on machinery and shop equipment. The method used depends upon the complexity of equipment and the nature of the inspection or maintenance requirements as follows:

1.1.1 Machinery and industrial equipment for which there is no periodic recurring inspection will be categorized as on-condition maintenance equipment. Examples of this type of equipment include small bench grinders or buffers, drill presses, or other equipment that may require the user to make an adjustment or replace a part. Items that the user would replace rather than repair do not require any tag. Fully serviceable equipment does not require a tag. Serviceable equipment with user correctable discrepancies and unserviceable equipment will be tagged with a Department of Defense (DoD) Form 1574, DoD Form 1577, or DoD Form 1577-2 and the delayed discrepancy and/or supply document numbers, if applicable, listed on the back. Include enough information on the tag to clearly identify who inspected it, the equipment, and the discrepancy. The inspector does not need to be a 7-level or on a special certification roster. After the equipment is made serviceable, the tags are removed. If the equipment will be turned in to supply, follow the guidance in Air Force Instruction (AFI) 23-101 when filling out the tag.

1.1.2 Work center supervisors and the supporting Quality Assurance Agency shall be given the authority to change or adjust lubrication and inspection intervals for commercial-type shop machinery and equipment that is infrequently used by organizational units.

1.1.3 Machinery and shop equipment for which recurring inspection and maintenance requirements have been determined necessary, the Air Force Technical Order (AFTO) Form 244, INDUSTRIAL/SUPPORT EQUIPMENT RECORD, [Figure 1](#) through [Figure 4](#), will be used to document inspection and maintenance action requirements and accomplishments. The maintenance of machinery and shop equipment in this category includes preventative maintenance (inspection and minor maintenance) and major repair actions. Schedule and document equipment maintenance and inspections in the Aviation

TO 34-1-3

Support Equipment Maintenance Information System (AvSE MIS), i.e. Enterprise Logistics Management System (ELMS M&U) in accordance with TO 00-20-1.

1.1.3.1 Preventative maintenance consists of scheduled maintenance, cleaning, lubrication, minor adjustments and repairs of items such as belts, wiring connections and safety guards. The above is only an example. Refer to the specific TO for each individual end item of Industrial Plant Equipment (IPE) for the manufacturer's preventative maintenance recommendations. Preventative maintenance requirements will be recorded on AFTO Form 244, Section III, scheduled inspection. Maintenance actions resulting from scheduled preventative maintenance are recorded in Section V, Maintenance/Delayed Discrepancy of AFTO Form 244. The work center or activity supervisor will ensure that Preventative Maintenance Actions are accomplished at the prescribed intervals. When required, a separate AFTO Form 244 will be used for each item of equipment.

1.1.3.2 Major repair consists of maintenance actions caused by equipment breakdown or failure that required repair beyond that accomplished during normal preventative maintenance. Major repair actions within the maintenance capability of the owning activity will be accomplished by that activity. Required repairs that are beyond the capabilities of the owning activity may be repaired by contract maintenance (AFM 70-4). However, coordination with and approval by the inventory manager for the specific item is required to preclude contractual repair of items that may be in long supply. When the required repairs exceed the limitations for contractual maintenance, the repair requirements will be referred to the major command for resolution. Delayed discrepancies will be entered in Section V of the AFTO Form 244. The replacement of accessories such as grinding wheels, saw blades, and cutting tools on milling machines and lathes requires only a visual inspection by the operators.

1.1.3.3 Machinery and shop equipment that pose safety concerns will also be tagged in accordance with the HAZARDOUS ENERGY CONTROL (LOCKOUT AND TAGOUT) chapter of AFMAN91-203.

1.1.4 Depot machinery and shop equipment for which recurring inspection and maintenance requirements have been determined as necessary by applicable technical data, equipment manuals or engineering data will utilize the AFTO Form 244/245 to document inspection and maintenance action requirements and accomplishments. The use of automated computer systems is optional. Air Force Material Command (AFMC) Air Logistic Centers that utilize the Facility and Equipment Maintenance (FEM) system or similar automated data systems for scheduling preventative maintenance on machinery, shop equipment and IPE are exempt from this TO. Procedures for this equipment type are outlined in AFMCI 21-100, Depot Maintenance Management.

1.1.5 Depot machinery and shop equipment which have no periodic recurring inspections will be considered as on-condition maintenance. Production engineering functions in conjunction with shop supervisors will review and document which equipment items require only on-condition maintenance. Machinery and shop equipment categorized as on-condition maintenance will not require documentation unless equipment condition becomes unserviceable. If equipment becomes unserviceable, discrepancies will be documented on DoD Form 1577-1 or DoD Form 1577-2. Once equipment has been made serviceable, the DoD Form 1577-1 or DoD Form 1577-2 will be removed. Machinery and shop equipment may utilize the AFTO Form 244/245 instead of the DoD Form 1577-1 or DoD Form 1577-2. Machinery and shop equipment that pose safety concerns will also be tagged in accordance with AFMAN91-203.

1.2 Suggested Maintenance Criteria.

WARNING

- Energy sources shall be locked out prior to the start of inspections, maintenance, or servicing actions which require the removal of guards or panels and will remain locked out until all activities are complete. Failure to comply could result in injury to, or death of, personnel or long term health hazards.
 - Machines shall not be operated unless all guards are securely in place and operational. Failure to comply could result in injury to, or death of, personnel or long-term health hazards.
- a. Ventilation screens and filters shall be free of any accumulated dust or impediment to flow of air.
 - b. Riveted joints shall be tight, without joined parts being damaged.
 - c. Welded joints shall not be cracked or broken.

NOTE

Where tack or spot welds are employed to secure parts permanently, sufficient number of welds shall be made to provide adequate strength.

- d. Frameworks, cabinets, and mechanical assemblies will conform to equipment specifications and will not have broken, cracked, or distorted members.
 - (1) Removable assemblies will fit securely in their proper places and will be easily removable without sticking or binding.
 - (2) Attaching hardware will be installed and secured.

1.3 Mounting of Parts.

- a. Parts will be securely mounted. All missing hardware and components shall be replaced.
- b. Mounting screws, nuts, bolts, and rivets will be tight.
- c. Knurled surfaces will not be worn smooth. Threaded parts will not be stripped or crossed.

NOTE

Guards will comply with AFMAN91-203, Volume I and/or Occupational Safety and Health Administration (OSHA) Standards 1910.2111910.219.

1.4 Mechanical Parts. Mechanical parts will operate freely without binding or excessive looseness. Gears, sprockets, and claws will operate properly and will be free of bent, broken or burred teeth.

1.5 Hardware.

- a. Latches will not bind or stick, will snap firmly in place and will hold latched parts tightly together.
- b. Hinged parts will operate freely, without binding.

1.6 Plastic, Ceramic and Glass.

- a. Plastic parts will be free of cracks, breaks, severe chipping, or scratches that would impair their functioning.
- b. Ceramic material will be free of surface cracks or glazing. Minor chips will be permissible, provided the electrical insulating properties and functioning are not impaired.
- c. Glass parts shall be free of cracks, breaks, severe chipping, or scratches that may impair their functioning or present a possible personnel hazard. Damaged surfaces resulting in exposed sharp edges shall be replaced.

1.7 Dials and Pointers. Dials and pointers will be clearly and completely marked. They shall be aligned to indicate correct value or settings. Moveable dials and pointers shall have free movement throughout their entire range and shall not bind or stick in any position.

1.8 Gaskets. Gaskets will be live and have no breaks, cracks, or chips that would impair making a tight seal. Replace any gasket that shows evidence of a permanent leak. Gaskets installed on equipment will meet mating edge or surface evenly and will have no high spots.

1.9 Rubber Parts. Rubber parts will be in a live condition to ensure their proper functioning. Parts will not be cut, torn, crushed, or worn to the extent that they will not function.

1.10 Controls and Moving Parts or Switches and Rheostats. Controls and moving parts or switches and rheostats will operate smoothly at all points without dead spots, binding, or excessive back lash. Contacts will make reliable mechanical and electrical contact.

TO 34-1-3

1.11 Cords and Cables. Cords and cables will be free from severe cuts, tears, gouges, crushed sections, or kinks. A severe cut is defined as one that goes deeper than one third of the thickness of the jacket.

1.12 Wire and Cable Runs. Wire and cable runs shall not be sharply bent around corners or edges that might cut or abrade insulation or where they enter ceramic, plastic or other insulation material. Where wires run through holes in sheet metal, insulation shall be protected with suitable grommets if sheet metal is less than 1/8 inch thick. If sheet metal is 1/8 inch or more in thickness, either suitable grommets will be used or edges shall be rounded to a radius equal to one-half the thickness of the sheet metal. Wiring and cables shall be properly supported to prevent undue stress on conductors and terminals.

1.13 Sockets and Plug-in Devices. Sockets and plug-in devices will make reliable electrical contact in their sockets. Sockets will not be cracked or badly chipped. Terminals and prongs shall be free of corrosion and shall not be bent, loose, broken, or burned. Contacts shall be properly positioned in accordance with the connector design.

1.14 Fuses and Fuse Holders. Fuses and fuse holders shall be free of corrosion and cracks and there shall be no evidence of having been overheated.

- a. Screw-type fuses shall be tightened to a snug fit.
- b. The tension of the fuse holders shall be sufficient to ensure good electrical contact.



The use of oversize fuses can severely damage circuits or equipment. Failure to comply could result in damage to, or destruction of, equipment or loss of mission effectiveness.

- c. Check the current rating of the fuses to ensure the proper rating.

1.15 Motors, Generators, Blowers, and Fans. Motors, generators, blowers, and fans shall be securely mounted and operate without excessive vibration or beating noise. They shall be properly lubricated and show no evidence of overheating. See machine specific owner's and/or equipment manuals for detailed instruction.

- a. Brushes shall be properly seated.
- b. Blades shall move freely without contacting enclosures or other stationary parts.
- c. Pulley belts shall be free from cuts, fraying, or excessive worn areas.

1.16 Shock Mounts. Shock mounts shall be in good condition and shall cushion equipment properly.

1.17 Interlock Safety Switches.



Plates for manually operated interlock bypass switches shall not be removed. Failure to comply could result in damage to, or destruction of, equipment or loss of mission effectiveness.

Interlock safety switches will operate with a positive action on opening or closing doors or panels of equipment. Slow acting interlock safety switches shall be replaced.

1.18 Lubrication Requirements.

- a. Commercial data approved by the Equipment Specialist (ES) or Item Manager (IM) in accordance with TO 00-5-1 shall be used when Air Force (AF) directives are not available.

WARNING

Hands will not be used to probe for high pressure leaks. Failure to comply could result in injury to, or death of, personnel or long term health hazards.

- b. In the absence of pertinent directives, mechanically operated parts such as door mechanisms, hinges, latches, locks, gears, and bearings shall be lubricated to prevent binding or overheating, provided it does not interfere with the normal mechanical or electrical operation of equipment. See machine specific owner's and/or equipment manuals for detailed instruction.
- c. Air, coolant, and lubrication lines and fitting will be free from leaks, looseness and chafing.
- d. Oil or fog type lubricator bowls will be free of cracks and breaks.
- e. Oil level sight gauges will be clean to allow clear visible sighting of oil levels.
- f. On equipment with no tech data or low hourly use with lubrication adjusted by Quality Assurance Agency, gear oil and filter change shall be three years or sooner. Hydraulic oil and filter change shall be two years or sooner. Grease shall be added one year or sooner. Document in accordance with [Paragraph 1.1.3.1](#) and also use a tag or decal that cannot be easily removed or lost and not effected by fluids or cleaning solutions used on the machines. Also, an external oil filter decal can be used instead of a tag.

1.19 Degreasers. Type of fluid in use will be identified on the degreaser tank. Covers will be protected by a fusible link to ensure closing in the event of overheating or fire.

1.20 Calibration. Components requiring calibration will be calibrated in accordance with TO 33K1-4-1000-1 Section 3 (Maintenance Data Collection Codes and Calibration Measurement Summaries), or applicable technical data.

NOTE

Voltage interruption protection will be installed on all electrical machines to prevent automatic restart upon restoration of power. Comply with AFMAN91-203, OSHA Standard 29 1910.213 (b) (3) and National Fluid Power Association (NFPA) 79 7.5.3.

1.21 Low-Voltage Protection of Motors. All motors so employed or arranged that an unexpected starting of the motor is a personnel hazard, shall be equipped with low-voltage protection. This shall automatically cause and maintain the interruption of the motor circuit when the voltage falls below an operation value. This rule does not apply to those motors with an emergency use and where the opening of the circuit may cause less safe conditions. Reference the National Electric Safety Code.

2 EQUIPMENT PAINTING.

The term painting includes any refinishing of machinery or equipment, from touch-up of the existing finish to complete repainting of the item. The repainting of new machines or equipment solely for the purpose of matching shop color schemes is not authorized.

- a. When complete repainting is to be accomplished, surfaces to be painted will be of the original color when possible.
- b. The finish on equipment may be touched up. Determination of the extent of allowable touch-up without complete painting will be made by responsible personnel of using agency.

NOTE

Exception: Shop machinery and other items of equipment such as instrument repair benches that are not Federal Stock Group (FSG) 3400 items will be refinished as prescribed by the applicable specification or directive for the equipment.

- c. Surface preparation for previously painted machinery.

- (1) A chemically clean surface is necessary for successful paint application. Surfaces may appear clean and still be unfit to paint, since a thin film of oil may prevent adhesion, and seriously slow up the drying of the finish coats.
- (2) The surfaces to be painted should be clean, dry, and free from dust, grease, oil, rust, and dirt. Glossy surfaces should be sanded to dull the gloss to ensure adhesion. Remove all rust and scale by scraping or wire brushing.

WARNING

Sanding operations are hazardous to the eyes. Eye protection is required. Failure to comply could result in injury to, or death of, personnel or long term health hazards.



SOLVENT, DEGREASING, MIL-PRF-680, TYPE II

1

Degreasing solvent is flammable and may contain the following hazardous chemicals: Naphtha (petroleum), Alkanes and/or C9 - C12 hydrocarbons which are skin and eye irritants and respiratory depressants. Exposure can occur through inhalation, ingestion, or skin and eye contact. May be fatal if swallowed. Avoid repeated and prolonged contact. Use with adequate ventilation. Do not ingest. Appropriate skin and eye protection must be worn.



ALCOHOL, ISOPROPYL, TT-I-735

2

Isopropyl alcohol is flammable, and an eye, skin and respiratory irritant. It may be harmful if swallowed. Avoid contact with skin and eyes, and avoid breathing vapors. Do not ingest. Keep away from heat, sparks and flame. Appropriate skin and eye protection must be worn. Use in a well ventilated area. Half mask respirator required in poorly ventilated areas.

- (3) The approved method for cleaning machinery surfaces for painting is to first clean the affected surfaces thoroughly with degreasing solvent, MIL-PRF-680, Type II or other approved solvent to remove visible oil or grease deposits and then clean the area with isopropyl alcohol, TT-I-735 until it is grease free.
- d. Bare spots resulting from scraping or chipping should be sanded to a feather edge and spot primed with lacquer proof primer. (Machines will not be operated during the painting operation.) Allow priming coats to dry thoroughly and apply two coats of paint in the required color set forth in [Step a](#). Allow each coat to dry thoroughly before applying the succeeding coat.
- e. Safety color coding of new and old machines in accordance with the steps below will clarify OSHA Standard 20 CFR 1910.144 Machinery and machine guarding, American National Standards Institute (ANSI) Z535.1 Color coding Machines and Machine Guards, AFMAN91-203, Color Coding and other safety agencies. These protective color codes are mandatory by Federal OSHA.
 - (1) Use of color is a visual signal that communicates important information quickly. Defined safety color codes: red for danger or stop, yellow for caution, orange for warning, green for safety, blue for information, magenta or purple for radiation, and black with white or yellow for directions or bounders.
 - (a) Safety red will be the basic color for identifying stop, off, or hot. Emergency stop bars on hazardous machines shall be red. Stop buttons or electrical switches used for emergency stopping of machinery shall be safety red only. Items that get 140 Degrees Fahrenheit (°F) or greater shall be painted safety red.
 - (b) Safety yellow will be used as the basic color for designating physical hazards such as strike against, stumbling, falling, tripping and/or caught in between. Yellow will be the basic color for designating other cautions and can be used for hand levers, cranks, knobs, locks, and access doors.

- (c) Safety orange will be used as the basic color for designating dangerous parts, energizing equipment which may cut, crush, shock, or otherwise injure. To emphasize such hazards when enclosed doors are open and/or movable guards are off the exposed parts of pulleys, gears, rollers, cutting devices, and/or power jaws shall be painted safety orange (edges only if parts were fully painted in the past, they do not need repainting). Moving equipment guards or energizing foot or hand devices shall also be safety orange.
 - (d) Safety green will be used as the basic color for designating safety related components on machinery.
 - (e) Safety blue will be used as the basic color for designating safety information on machinery.
 - (f) Safety magenta or purple will be used as the basic color for designating safety information related to radiation on machinery.
 - (g) A combination of safety black with white or yellow shall be used to indicate the direction of pulleys, gears, rollers, and/or shafts rotations and shall be marked at least 1-1/2 inch by 3/4 inch using an arrow with color(s) of best contrast.
 - (h) Metal-mesh guards can be painted black to improve operator's visibility, but the border or edge of the guard will be painted their respective safety code color. Doors of guards need not be fully painted, their borders or edges could be painted a solid safety color code, black and safety color code or existing/factory finish and safety color code. A combination of stripped or checkered pattern can be used, use the combination that attracts most attention. The border or edge coating will be less than 3/4 inch wide.
 - (i) White should be used for lettering on red, orange, green, blue, magenta, and purple. Color black should be used on yellow.
- (2) Transparent shields designed to afford a clear view of operation should not be painted. Non-movable guards that do not present any hazard also need not be painted.
 - (3) Items shall be painted only with a material that will not be affected by any fluids or cleaning solution used on the machine.

3 EXCESS OR IDLE EQUIPMENT.

In accordance with AFI 23-101, any excess machinery/shop equipment shall be processed for turn in. Equipment items that are authorized for use, but are idle for long periods of time, shall be properly maintained per this technical instruction, or applicable technical data and stored accordingly. Refer to MIL-STD-2073 for instructions on preparation and handling of machinery/shop equipment for shipment and/or storage. Copy of the current Military Standard can be found at the web site <http://quicksearch.dla.mil/qsSearch.aspx>.

[illegible]

Figure 1. Front Side, AFTO Form 244, System/Equipment Status Record

[illegible]

AFTO FORM 244, 20130529

Figure 2. Reverse Side, AFTO Form 244, System/Equipment Status Record

TO-34-1-3-003

Figure 3. Front Side, AFTO Form 245, System/Equipment Status Record

TO-34-1-3-004

Figure 4. Reverse Side, AFTO Form 245, System/Equipment Status Record

THE END

