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Mazak

General Information Manual

(Classbook)

```
|M3488   T78     M3715   M5584
*--|  |----|/|-*--|/|----|  |-*
|58MX    CHAB.T|CKCLX   CKAASM|
|4892    4895   |7054    18048 |
|M58     M5142  |M3715   M5578 |
*--|  |-*--|  |-*--|  |----|  |-*
|58M     |AB.P    CKCLX   CKASWM
|                7054    18005
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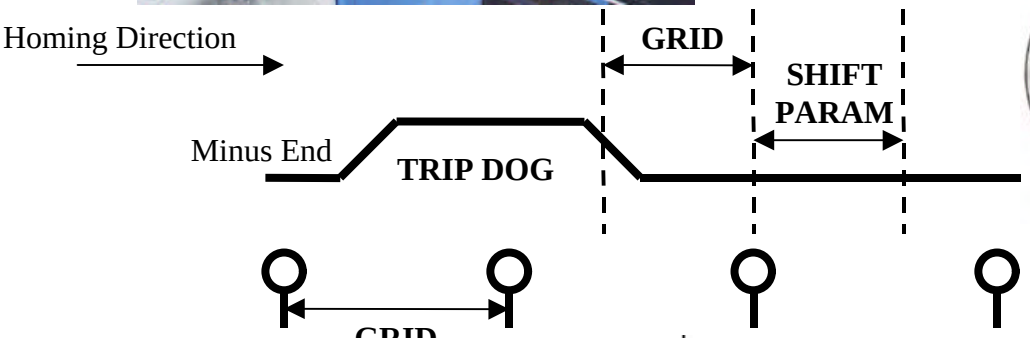

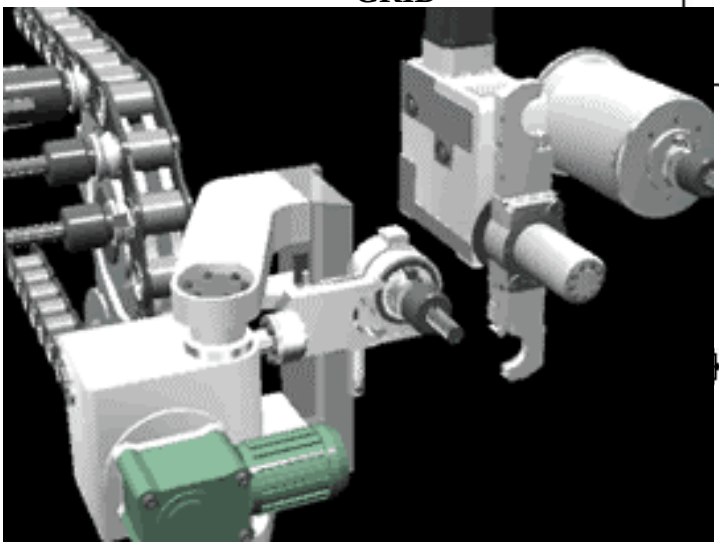

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SAFETY PRECAUTIONS

The machine is provided with a number of safety devices to protect personnel and equipment from injury and damage. Operators should not, however, rely solely upon these safety devices, but should operate the machine only after fully understanding what special precautions to take by reading the following documentation thoroughly.

• BASIC OPERATING PRACTICES

DANGER:

1) Some control panels, transformers, motors, junction boxes and other parts have high voltage terminals. These should not be touched or a severe electric shock may be sustained.
2) Do not touch any switches with wet hands. This too, can produce an electric shock.

WARNING:

1) The emergency stop pushbutton switch location should be well known, so that it can be operated at any time without having to look for it.
2) Before replacing a fuse, turn off the main incoming power switch to the machine.
3) Provide sufficient working space to avoid hazardous falls.
4) Water or oil can make floors slippery and hazardous. All floors should be clean and dry to prevent accidents
5) Do not operated any switch without a thorough understanding of the actions about to be taken.
6) Avoid accidental operation of switches.
7) Work benches near the machine must be strong enough to hold materials placed on them to prevent accidents. Articles should be prevented from slipping off the bench surface.
8) If a job is to be done by two or more persons, coordinating signals should be given at each step of the operation. The next step should not be taken unless a signal is given and acknowledged.

CAUTION:

1) In the event of power failure, turn off the main circuit breaker immediately.
2) Use the recommended hydraulic oils, lubricants and grease or acceptable equivalents.
3) Replacement fuses should have the proper current ratings.
4) Protect the NC unit, operating panel, electric control panel, etc. from shocks, since this could cause a failure or malfunction.
5) Do not change parameters or electrical settings. If changes are unavoidable, record the values prior to the change so that they can be returned to their original settings, if necessary.
6) Do not deface, scratch or remove any caution plate. Should it become illegible or missing, order another caution plate from the supplier, specifying the part number shown at the lower right corner of the plate.

• BEFORE POWERING UP

DANGER:

Cables, cords or electric wires whose insulation is damaged can produce current leaks and electric shocks. Before using, check their condition.

WARNING:

1) Be sure the instruction manual and the programming manual are fully understood before operating the machine. Every function and operating procedure should be completely clear.
2) Use approved oil resistant safety shoes, safety goggles with side covers, safe clothes, and other safety protection required.
3) Close all NC unit, operating panel, electric control panel doors and covers.

CAUTION:

1) The power cable from the factory feeder switch to the machine main circuit breaker should have a sufficient sectional area to handle the electric power used.
2) Cables which must be laid on the floor must be protected from hot chips, by using rigid or other approved conduit, so that short-circuits will not occur.
3) Before first time operation of the machine after unpacking it or from being idle for a long period of time (several days or more), each sliding part must be sufficiently lubricated. To do so, push and release the pump button several times until the oil seeps out on the sliding parts. The pump button has a return spring, so do not force it to return.
4) Oil reservoirs should be filled to indicated levels. Check and add oil, if needed.
5) For lubrication points, oil specification and appropriate levels, see the various instruction plates.
6) Switches and levers should operate smoothly. Check that they do.
7) When powering the machine on, turn on the switches in the following order: first the factory feeder switch, then the machine main circuit breaker, and then the control power on switch located on the operating panel.
8) Check the coolant level, and add coolant, if needed.

• **AFTER CONTROL POWER IS TURNED ON**

CAUTION:

When the control power “ON” switch on the operating panel is on, the "READY" lamp on the operating panel should also be on (check to see that it is).

• **ROUTINE INSPECTIONS**

WARNING:

When checking belt tensions, do not get your fingers caught between the belt and pulley.

CAUTION:

1) Check pressure gages for proper readings.
2) Check motors, gear boxes and other parts for abnormal noises.
3) Check the motor lubrication, and sliding parts for evidence of proper lubrication.
4) Check safety covers and safety devices for proper operation.
5) Check belt tensions. Replace any set of belts that have become stretched with a fresh matching set.

• **WARM UP**

CAUTION:

1) Warm up the machine, especially the spindle and feed shaft, by running the machine for 10 to 20 minutes at about one-half or one-third the maximum speed in the automatic operation mode.
2) The automatic operation program should cause each machine component to operate. At the same time, check their operations.
3) Be particularly careful to warm up the spindle which can turn above 4000 rpm.

   If the machine is used for actual machining immediately after being started up following a long idle period, the sliding parts may be worn due to the lack of oil. Also, thermal expansion of the machine components can jeopardize machining accuracy. To prevent this condition, always make sure that the machine is warmed up.

• **PREPARATIONS**

WARNING:

1) Tooling should conform to the machine specifications, dimensions and types.
2) Replace all seriously worn tools with new ones to prevent injuries.
3) The work area should be adequately lighted to facilitate safety checks.
4) Tools and other items around the machine or equipment should be stored to ensure good footing and clear aisles.
5) Do not place tools or any other items on the headstock, turret, covers and similar places (For T/M).

CAUTION:

1) Tool lengths should be within specified tolerances to prevent interference.
2) After installing a tool, make a trial run.

• **OPERATION**

WARNING:

1) Do not work with long hair that can be caught by the machine. Tie it back, out of the way.
2) Do not operate switches with gloves on. This could cause mis-operation.
3) Whenever a heavy workpiece must be moved, if there is any risk involved, two or more people should work together.
4) Only trained, qualified workers should operate forklift trucks, cranes or similar equipment and apply slings.
5) Whenever operating a forklift truck, crane or similar equipment, special care should be taken to prevent collisions and damage to the surroundings.
6) Wire ropes or slings should be strong enough to handle the loads to be lifted and should conform to the mandatory provisions.
7) Grip workpieces securely.
8) Stop the machine before adjusting the coolant nozzle at the tip.
9) Never touch a turning workpiece in the spindle with bare hands, or in any other way.
10) To remove a workpiece from the machine other than by a pallet changer, stop the tool and provide plenty of distance between the workpiece and the tool (for M/C).
11) While a workpiece or tool is turning, do not wipe it off or remove chips with a cloth or by hand. Always stop the machine first and then use a brush and a sweeper.
12) Do not operate the machine with the chuck and front safety covers removed (For T/M).
13) Use a brush to remove chips from the tool tip, do not use bare hands .
14) Stop the machine whenever installing or removing a tool.
15) Whenever machining magnesium alloy parts, wear a protective mask.

CAUTION:

1) During automatic operation, never open the machine door. Machines equipped with the door interlock will set the program to single step.
2) When performing heavy-duty machining, carefully prevent chips from being accumulated since hot chips from certain materials can cause a fire.

• TO INTERRUPT MACHINING

WARNING:

When leaving the machine temporarily after completing a job, turn off the power switch on the operation panel, and also the main circuit breaker.

• COMPLETING A JOB

CAUTION:

1) Always clean the machine or equipment. Remove and dispose of chips and clean cover windows, etc.
2) Make sure the machine has stopped running, before cleaning.
3) Return each machine component to its initial condition.
4) Check the wipers for breakage. Replace broken wipers.
5) Check the coolant, hydraulic oils and lubricants for contamination. Change them if they are seriously contaminated.
6) Check the coolant, hydraulic oil and lubricant levels. Add if necessary.
7) Clean the oil pan filter.
8) Before leaving the machine at the end of the shift, turn off the power switch on the operating panel, machine main circuit breaker and factory feeder switch in that order.

• SAFETY DEVICES

1) Front cover, rear cover and coolant cover.
2) Chuck barrier, tail barrier and tool barrier (NC software).
3) Stored stroke limit (NC software).
4) Emergency stop pushbutton switch.

• MAINTENANCE OPERATION PREPARATIONS

1) Do not proceed to do any maintenance operation unless instructed to do so by the foreman.
2) Replacement parts, consumables (packing, oil seals, O rings, bearing, oil and grease, etc.) Should be arranged in advance.
3) Prepare preventive maintenance and record maintenance programs.

CAUTION:

1) Thoroughly read and understand the safety precautions in the instruction manual.
2) Thoroughly read the whole maintenance manual and fully understand the principles, construction and precautions involved.

• MAINTENANCE OPERATION

DANGER:

1) Those not engaged in the maintenance work should not operate the main circuit breaker or the control power "ON" switch on the operating panel. For this purpose, "Do not Touch the Switch, Maintenance Operation in Progress!" or similar warning should be indicated on such switches and at any other appropriate locations. Such indication should be secured by a semi-permanent means in the reading direction.
2) With the machine turned on, any maintenance operation can be dangerous. In principle, the main circuit breaker should be turned off throughout the maintenance operation.

WARNING:

1) The electrical maintenance should be done by a qualified person or by others competent to do the job. Keep close contact with the responsible person. Do not proceed alone.
2) Overtravel limit and proximity switches and interlock mechanisms including functional parts should not be removed or modified.
3) When working at a height, use steps or ladders which are maintained and controlled daily for safety.
4) Fuses, cables, etc. made by qualified manufacturers should be employed.

• BEFORE OPERATION & MAINTENANCE BEGINS

WARNING:

1) Arrange things in order around the section to receive the maintenance, including working environments. Wipe water and oil off parts and provide safe working environments.
2) All parts and waste oils should be removed by the operator and placed far enough away from the machine to be safe.

CAUTION:

1) The maintenance person should check that the machine operates safely.
2) Maintenance and inspection data should be recorded and kept for reference.

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WARNING

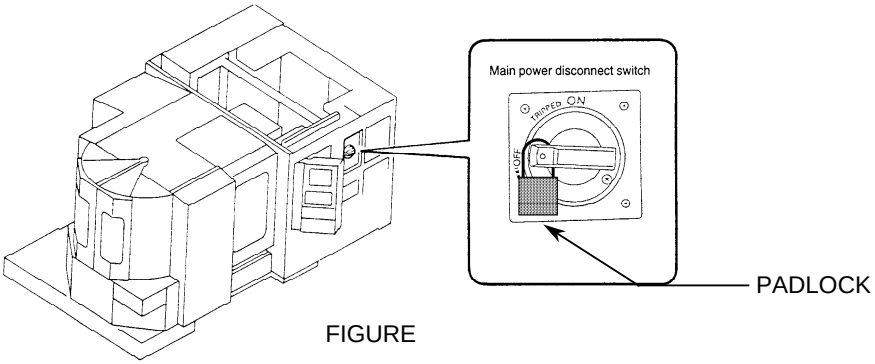
ALWAYS TURN THE MAIN CIRCUIT BREAKER TO THE "OFF" POSITION & USE AN APPROVED LOCKOUT DEVICE WHEN COMPLETING MAINTENANCE OR REPAIRS.

THE LOCKOUT PROCEDURE THAT FOLLOWS IS INTENDED TO SAFEGUARD PERSONNEL & EQUIPMENT DURING MAINTENANCE OPERATIONS, AND, REPRESENTS THE MINIMUM REQUIREMENTS. ANY ACTION SHOULD BE PRECEDED BY A "HAZARD ANALYSIS" TO DETERMINE ANY ADDITIONAL SAFETY PRECAUTIONS THAT MAY BE NECESSARY TO ENSURE THE SAFETY OF PERSONNEL AND EQUIPMENT.

***NOTE*: USE OF THE FOLLOWING LOCKOUT PROCEDURE IS MANDATORY WHEN COMPLETING MAINTENANCE OR REPAIRS.**

LOCKOUT PROCEDURE

1) THE LOCKOUT PROCESS MUST BE PERFORMED BY AUTHORIZED PERSONNEL ONLY.
2) INFORM ALL EFFECTED PERSONNEL OF YOUR INTENT TO LOCKOUT AND SERVICE THE SPECIFIED MACHINE.
3) SHUT OFF MACHINE POWER USING NORMAL SHUT DOWN PROCEDURES.
4) TURN OFF THE MACHINE AND INDIVIDUAL BUILDING CIRCUIT BREAKERS. MAKE SURE ALL STORED ELECTRICAL ENERGY IS RELIEVED. (EG: SPINDLE & AXIS SERVO CONTROLLERS)
5) CONNECT THE LOCKOUT DEVICE AS SHOWN IN FIGURE 1, AND ATTACH THE APPROPRIATE TAG AT THE MACHINE CIRCUIT BREAKER. THE TAG MUST IDENTIFY THE PERSON RESPONSIBLE FOR THE LOCKOUT. THIS WILL ENSURE THAT POWER CANNOT BE RESTORED BY ANYONE ELSE.
6) TEST THE MACHINE TO VERIFY THAT MACHINE SYSTEMS DO NOT OPERATE IN ANY WAY. ONCE TESTING IS COMPLETE, MAKE SURE ALL SWITCHES ARE IN THE "OFF" POSITION. CONFIRM THAT THE LOCKOUT DEVICES REMAIN PROPERLY INSTALLED.
7) COMPLETE THE REQUIRED MAINTENANCE OPERATIONS.
8) MAKE SURE ALL PERSONNEL ARE CLEAR OF THE MACHINE.
9) REMOVE THE LOCKOUT DEVICE. MAKE SURE ALL PERSONNEL ARE AT A SAFE LOCATION BEFORE RESTORING MACHINE POWER.



FIGURE

INSTALLATION PRECAUTIONS

The following subjects outline the items that directly affect the machine installation and start-up. To ensure an efficient and timely installation, please follow these recommendations before calling to schedule a service engineer.

• ENVIRONMENTAL REQUIREMENTS

Avoid the following places for installing the machine:

1) Avoid exposure to direct sunlight and/or near a heat source, etc. Ambient temperature during operation: 0° thru 45°C (32°F to 113°F).
2) Avoid areas where the humidity fluctuates greatly and/or if high humidity is present; normally 75% and below in relative humidity. A higher humidity deteriorates insulation and might accelerate the deterioration of parts.
3) Avoid areas that are especially dusty and/or where acid fumes, corrosive gases and salt are present.
4) Avoid areas of high vibration.
5) Avoid soft or weak ground **(minimum load bearing capacity of 1025 lbs./ft^2)**

• FOUNDATION REQUIREMENTS

For high machining accuracy, the foundation must be firm and rigid. This is typically accomplished by securely fastening the machine to the foundation with anchor bolts. In addition, the depth of concrete should be as deep as possible (minimum 6 - 8 inches). Note the following:

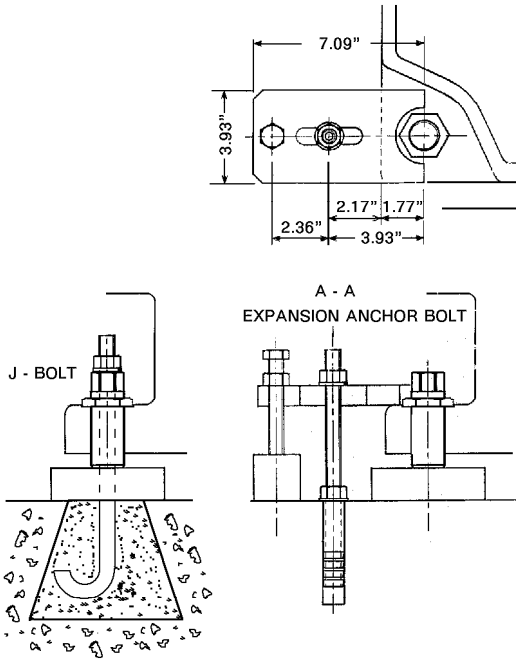
1) There can be no cracks in the foundation concrete or surrounding area.
2) Vibration proofing material (such as asphalt) should be put all around the concrete pad.
3) Form a “cone” in the foundation for J-bolt anchors, or use expansion anchors.
4) With the foundation anchor bolt holes open pour the primary **concrete at a minimum thickness of 6 - 8 inches.** Typically, the concrete must have a **minimum compression rating of 2500 lbs. @ 250 lbs. compression** and strengthened with reinforcing rods. When the concrete has cured, rough level the machine, and install the J-bolts, leveling blocks, etc., and pour grout into foundation bolt holes.
5) Mix an anti-shrinkage agent such as Denka CSA with concrete, or use Embeco grout to fill the foundation bolt holes.
6) In pouring grout, fasten the leveling block base plates with the collar retaining screws to prevent the base plates from dropping. When the grout has completely hardened, level the machine properly, and tighten M24 nuts to secure the machine to the foundation.

Note:

The machine must be anchored to the foundation with J-bolts, expansion bolts or other suitable method.

The machine accuracy and alignment specifications quoted by Mazak can usually be obtained when the minimum foundation requirements are met. However, production of close tolerance parts requires the use of an appropriate certified foundation. Foundations that do not meet certified specifications may require more frequent machine re-leveling and re-alignment, which can not be provided under terms of warranty.

If any of these conditions cannot be met, contact the nearest Mazak service office immediately.



TYPICAL MACHINE HOLD DOWN OPTIONS

• **WIRING**

1) Use only electrical conductors with performance ratings equivalent or superior.
2) Do not connect any power cables for devices which can cause line noise to the power distribution panel, such as arc welders and high frequency machinery.
3) Arrange for a qualified electrician to connect the power lines.
4) Incoming supply voltage should not deviate more than ±10% of specified supply voltage.
5) Source frequency should be±2 Hz of nominal frequency.

[CAUTION]

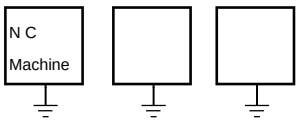
VERIFY THE ACTUAL MACHINE ELECTRICAL POWER REQUIREMENT AND THE MAIN TRANSFORMER RATING (IF APPLICABLE), AS WELL AS THE LOCAL ELECTRICAL CODE BEFORE SIZING AND INSTALLING THE INCOMING POWER WIRING.

PLEASE SEE THE ADDITIONAL CAUTIONS ON THE FOLLOWING PAGE.

• **GROUNDING**

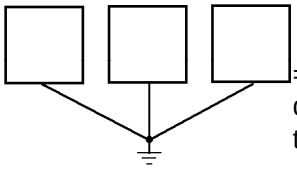
1) An isolated earth ground with a resistance to ground of less than 100 ohms is required. Typically, a 5/8" copper rod, 8 feet long, and no more than 5 feet from the machine, is sufficient. Building grounds or multiple machines grounded to the same ground rod, are not acceptable.
2) The wire size should be greater than AWG (American Wire Gauge) No. 5 and SWG (British Legal Standard Wire Gauge) No. 6.

Desirable Independent Grounding:



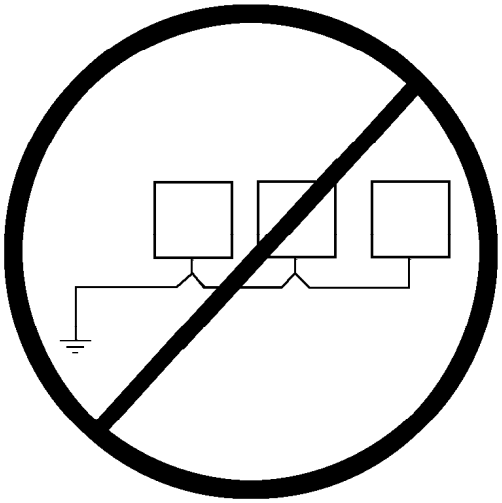
Earth resistance:
Less than 100 ohms

Common Grounds:



Resistance to ground = 100 ÷ the number of devices connected to the grounding (ohms)

Note: Never ground equipment as shown below:



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CAUTION

A step-down transformer is *optional* on some machine models. Be certain to verify the transformer Kva rating (where applicable), as well as local electrical code requirements *before* sizing and installing the incoming power wiring.

Machines not equipped with a main transformer are wired for 230 VAC, 3 phase. The end user must supply a step-down transformer where factory electrical power varies more than ± 10% of the 230 VAC rating.

NOTE:

Step-down or voltage regulating transformers are external (peripheral) to the machine tool and are considered the primary input line (source) for the machine. Local electrical code or practice may require a circuit breaker or other switching device for the isolation of electrical power when this type of transformer is used. In such cases, the machine tool end user is required to supply the necessary circuit breaker or switching device.

FAILURE TO COMPLY CAN RESULT IN PERSONAL INJURY AND DAMAGE TO THE MACHINE. IF ANY QUESTION EXISTS, CONTACT THE NEAREST MAZAK SERVICE CENTER FOR ASSISTANCE.

WARNING

MAZATROL CNC CONTROLLERS PROVIDE PARAMETER SETTINGS TO LIMIT SPINDLE RPM. THESE SETTINGS ARE BASED ON THE MAXIMUM SPEED SPECIFIED BY THE CHUCK/ACTUATOR MANUFACTURER.

MAKE SURE TO SET THESE PARAMETERS ACCORDING TO CHUCK SPECIFICATION WHEN INSTALLING A CHUCKING PACKAGE. ALSO, STAMP THE MAXIMUM SPINDLE RPM ON THE CHUCK IDENTIFICATION PLATE LOCATED ON THE MACHINE TOOL COVERS.

REFERENCE THE CNC PARAMETER MANUAL SUPPLIED WITH THE SPECIFIC MACHINE TOOL TO IDENTIFY THE REQUIRED PARAMETERS TO CHANGE.

FAILURE TO COMPLY WITH THESE INSTRUCTIONS COULD RESULT IN DAMAGE TO THE MACHINE, SERIOUS INJURY OR DEATH.

IF ANY QUESTIONS EXIST, CONTACT THE NEAREST MAZAK SERVICE CENTER FOR ASSISTANCE.

WARNING

MAZAK MACHINES ARE ENGINEERED WITH A NUMBER OF SAFETY DEVICES TO PROTECT PERSONNEL AND EQUIPMENT FROM INJURY AND DAMAGE.

DO NOT REMOVE, DISCONNECT, BYPASS OR MODIFY ANY LIMIT SWITCH, INTERLOCK, COVER, OR OTHER SAFETY FEATURE IN ANY WAY, EITHER MECHANICALLY OR ELECTRICALLY.

FAILURE TO COMPLY WITH THESE INSTRUCTIONS COULD RESULT IN DAMAGE TO THE MACHINE, SERIOUS INJURY OR DEATH.

IF ANY QUESTIONS EXIST, CONTACT THE NEAREST MAZAK SERVICE CENTER FOR ASSISTANCE.

WARNING

MAZAK MACHINES ARE ENGINEERED WITH A NUMBER OF SAFETY DEVICES TO PROTECT PERSONNEL AND EQUIPMENT FROM INJURY AND DAMAGE.

MACHINE OPERATOR DOORS AND COVERS ARE DESIGNED TO WITHSTAND ACCIDENTAL IMPACT OF A BROKEN INSERT WHERE A MAXIMUM WEIGHT INSERT AT MAXIMUM TOOL DIAMETER IS RUNNING AT MAXIMUM SPINDLE RPM

NEVER USE A CUTTING TOOL OR TOOL INSERT THAT EXCEEDS MACHINE SPECIFICATIONS OR THAT OF A SPECIFIC TOOL HOLDER ITSELF, WHICHEVER IS LESS. THIS RESTRICTION APPLIES TO DIAMETER, WEIGHT, MAXIMUM SPINDLE RPM, MAXIMUM CUTTING TOOL ROTATION SPEED, ETC.

FOR COMPLETE SPECIFICATIONS, MAKE SURE TO REFERENCE OPERATION, MAINTENANCE AND DETAIL SPECIFICATION DOCUMENTATION SUPPLIED WITH THE MACHINE AND BY THE TOOLING MANUFACTURER.

NOTE: THE MAXIMUM INSERT WEIGHT FOR MAZAK MACHINES IS 20 gf. (0.04 lbs.).

FAILURE TO COMPLY WITH THESE INSTRUCTIONS COULD RESULT IN DAMAGE TO THE MACHINE, SERIOUS INJURY OR DEATH.

IF ANY QUESTIONS EXIST, CONTACT THE NEAREST MAZAK SERVICE CENTER FOR ASSISTANCE.

WARNING

BEFORE STARTING OPERATION, CHECK THAT THE WORKPIECE IS SECURELY MOUNTED IN A VISE OR A SUITABLE FIXTURE. BE CERTAIN THAT THE MOUNTING IS SUFFICIENT TO WITHSTAND CUTTING FORCES DURING WORKPIECE MACHINING.

FAILURE TO COMPLY WITH THESE INSTRUCTIONS COULD RESULT IN DAMAGE TO THE MACHINE, SERIOUS INJURY OR DEATH.

IF ANY QUESTIONS EXIST, CONTACT THE NEAREST MAZAK SERVICE CENTER FOR ASSISTANCE.

WARNING

CONFIRM PROPER WORKPIECE FIXTURING/CLAMPING, TOOL SETUP AND THAT THE MACHINE DOOR IS SECURELY CLOSED BEFORE THE START OF MACHINING.

VERIFY ALL SAFETY PRECAUTIONS OUTLINED IN THIS MANUAL BEFORE USING THE FOLLOWING CUTTING CONDITIONS:

- CUTTING CONDITIONS THAT ARE THE RESULT OF THE MAZATROL FUSION 640 AUTOMATIC CUTTING DETERMINATION FUNCTION
- CUTTING CONDITIONS SUGGESTED BY THE MACHINING NAVAGATION FUNCTION
- CUTTING CONDITIONS FOR TOOLS THAT ARE SUGGESTED TO BE USED BY THE MACHINING NAVAGATION FUNCTION

FAILURE TO COMPLY WITH THESE INSTRUCTIONS COULD RESULT IN DAMAGE TO THE MACHINE, SERIOUS INJURY OR DEATH.

IF ANY QUESTIONS EXIST, CONTACT THE NEAREST MAZAK SERVICE CENTER FOR ASSISTANCE.

DOOR INTERLOCK SAFTY SPEC.

Determined by YMW Eng. H.Q. '99/9/1
Revised by YMC Prod. Eng. '99.10.28

MACHINING CENTER

DOOR	MODE	SET UP SWITCH	
		O (OFF)	**I** (ON)
OPEN	MANUAL	Prohibit to move axis. Prohibit to start spindle running. Prohibit to operate manual ATC. Prohibit to operate manual Pallet Changer. Prohibit to run chip spiral conveyor.	Limit the rapid override. Max is 12%. Prohibit to run chip spiral conveyor. Can run spindle JOG. Can run spindle Orient. Can operate manual ATC.
	AUTO	Prohibit cycle start. Prohibit to run chip spiral conveyor.	Prohibit cycle start. Prohibit to run chip spiral conveyor.
CLOSE I V OPEN	MANUAL	Door is always locked. Door lock can be released by pushing "DOOR UNLOCK SW" on operator panel. But, it can not release in operating ATC/Pallet changer/Axis/Spindle.	
		Prohibit to move axis. Prohibit to start spindle running. Prohibit to operate manual ATC. Prohibit to operate manual Pallet Changer. Prohibit to run chip spiral conveyor.	Limit the rapid override. Max is 12%. Chip spiral conveyor would stop. Can run spindle JOG. Can run spindle Orient. Can operate manual ATC.
	AUTO	Door is always locked. Door lock can be released by pushing "DOOR UNLOCK SW" on operator panel. But, it can not release in auto operation running except single block stop or feed hold stop or M00 program stop or M01 optional stop and spindle stop. If not, Alarm displayed "Door open invalid".	
		If release the lock by note(*1), Alarm will occur then stop the all motion. Chip spiral conveyor would stop.	Prohibit cycle start. Chip spiral conveyor would stop.
CLOSE	MANUAL	No Limitation.	No Limitation.
	AUTO	No Limitation.	Can not run auto operation.

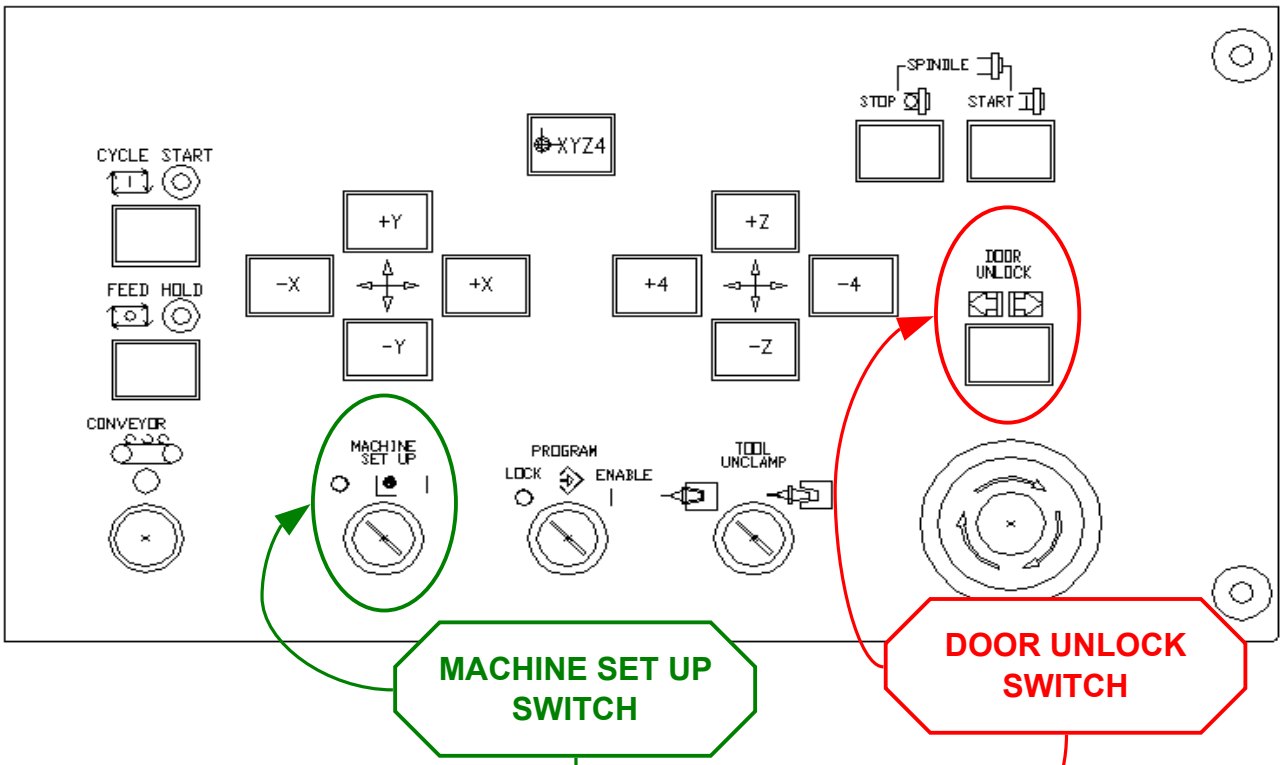
TURNING CENTER

DOOR	MODE	SET UP SWITCH	
		O (OFF)	**I** (ON)
OPEN	MANUAL	Can operate CHUCK, TAILSLEEVE , STEADY REST for Loading workpiece. Can NOT operate Spindle, Axis, Turret, Coolant, ToolEye, Partscatcher, Chip Conveyor.	Can operate CHUCK, TAILSLEEVE , STEADY REST for Loading workpiece. Can not operate Spindle running, but Can operate Spindle JOG and Spindle Orient. Limitation of speed for axis movement . (Override is 10% max.) 1 step index only for turret.
	AUTO	Can operate CHUCK, TAILSLEEVE , STEADY REST for Loading workpiece. Can not run Auto-operation.	Can operate CHUCK, TAILSLEEVE , STEADY REST for Loading workpiece. Can not run Auto-operation.
CLOSE -> OPEN	MANUAL & AUTO	Can not open the front door in Spindle running, Axis moving, Auto-running(Cycle start, Feed hold) due to Mechanical locking system. (Except Single Block Stop or M00 program stop or M01 optional stop) But, if release the lock by note(*1), Alarm will occur then stop the all motion.	
CLOSE	MANUAL	No Limitation.	No Limitation.
	AUTO	No Limitation.	Can not run Auto-operation.

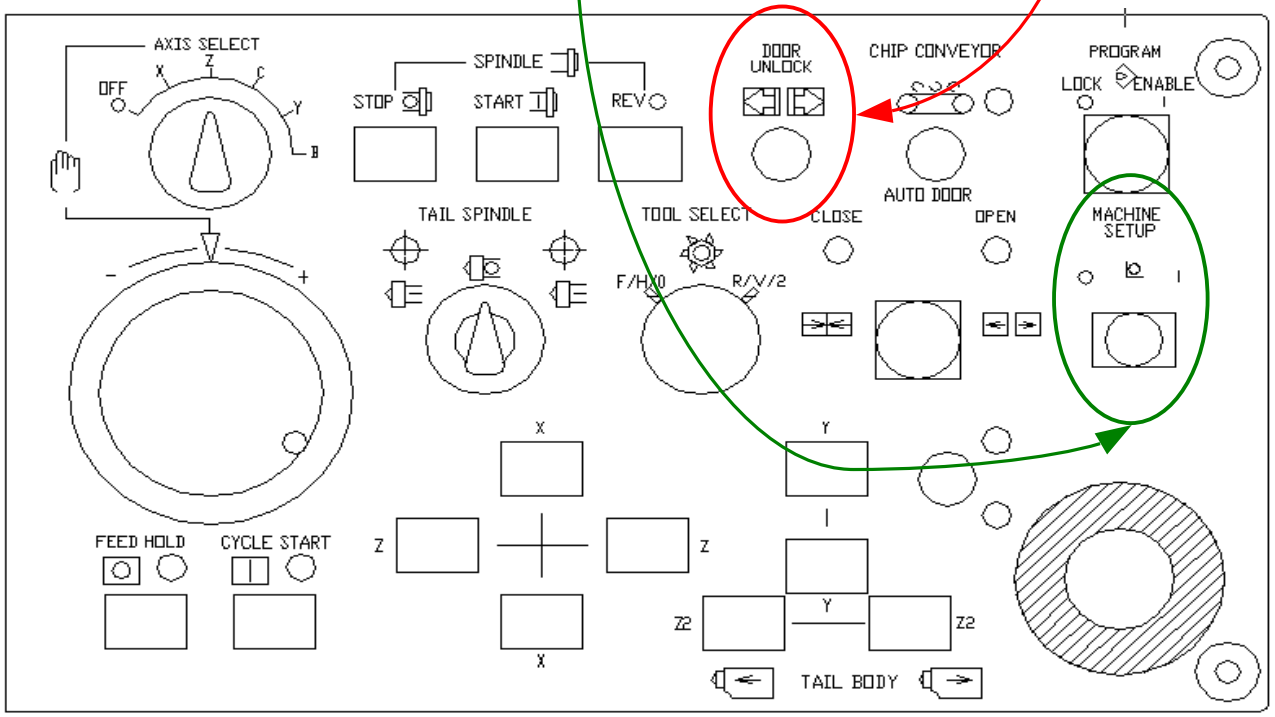
*1 : Door lock mechanism can not be released in machine stop by NC power OFF.
If it is necessary to release the lock such as emergencies, the lock can be released by operating the supplementary lock release mechanism of the main body of the safety door lock switch.
*2 : Override Limitation of Rapid speed of AXIS
Machining Center : 12%. Turning Center : 10%.
*3 : Chip Conveyor and Coolant should stop in the door open.

APPENDIX

SWITCH PANEL for M640M (Machining Center)



SWITCH PANEL for M640MT/T (Turning Center)



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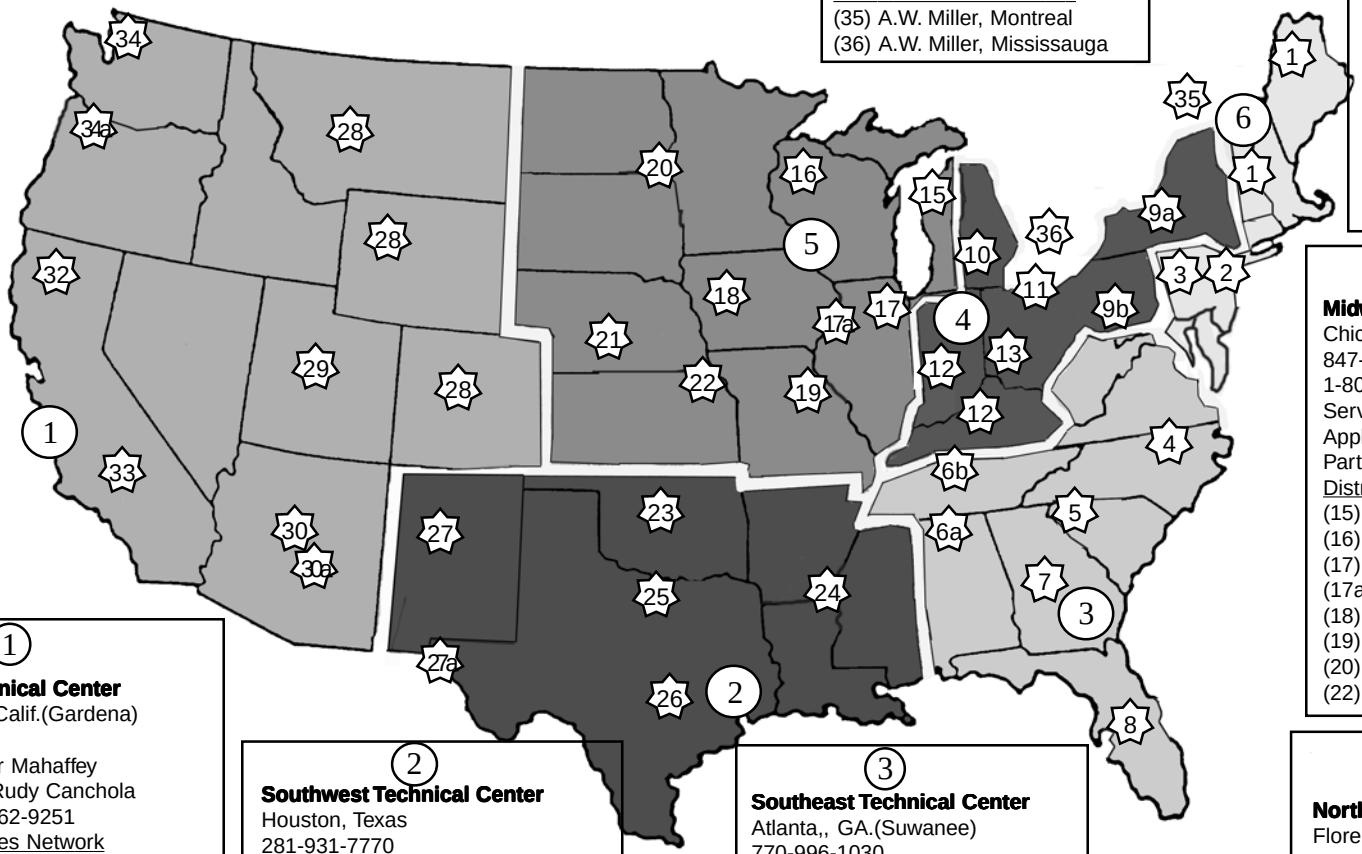
Mazak Regional Support Facilities

Canada West Support
Distributor Sales Network
(34) Machine Toolworks, Kent

Canada East Support Center
Mississauga, Canada
905-501-9555
Service: Richard Szczepko
Distributor Sales Network
(35) A.W. Miller, Montreal
(36) A.W. Miller, Mississauga



6
Eastern Technical Center
Hartford, Ct. (South Windsor)
860-528-9511
Service: Joe Civitollo
Applications: Rick Collins
Parts: 1-888-462-9251
Mazak Direct Sales Offices
(1) Mazak - Hartford
(2) Mazak - New Jersey
(3) Mazak - Lancaster

5
Midwest Technical Center
Chicago, Ill. (Schaumburg)
847-885-8311
1-800-677-8311
Service: James Jackson
Applications: Bryan Young
Parts: 1-888-462-9251
Distributor Sales Network
(15) Interface - Grand Rapids
(16) MSI - Brookfield
(17) MSI - Schaumburg
(17a) MSI - Rockford
(18) Morton - Morton
(19) Municipal - Maryland Hts
(20) Northwest - Maple Grove
(22) Concept - Lenexa

1
Western Technical Center
Los Angeles, Calif.(Gardena)
310-327-7172
Service: Roger Mahaffey
Applications: Rudy Canchola
Parts: 1-888-462-9251
Distributor Sales Network
(28) Smith - Denver
(29) Smith - Salt Lake City
(30) Reid Machine - Fountain Hills
(30a) Reid Machine - Phoenix
(34) Machine Toolworks - Kent
(34a) Machine Toolworks - Milwaukie
Mazak Direct Sales Offices
(32) Mazak - San Francisco
(33) Mazak - Los Angeles

2
Southwest Technical Center
Houston, Texas
281-931-7770
Service: Ramiro Casas
Applications - Terry Esfeller
Parts: 1-888-462-9251
Distributor Sales Network
(21) Industrial Systems - Columbus
(23) Machinery Resources - Tulsa
(24) Dixie Mill - New Orleans
(25) Intertech - Grand Prairie
(27) Magnum - Albuquerque
(27a) Magnum - El Paso
Mazak Direct Sales Offices
(26) Mazak Houston

3
Southeast Technical Center
Atlanta,, GA.(Suwanee)
770-996-1030
Service: Jim Gough
Parts: 1-888-462-9251
Distributor Sales Network
(4) Alliance - Charlotte
(5) MachineTech - Greer
(6a) Pinnacle - Meridianville
(6b) Pinnacle - Nashville
(7) Premier Eng. - Norcross
(8) Premier Mach.- Alta Monte Sp.

4
North Central Support Center
Florence, Ky.
859-342-1700
Service: JN Johnson
Applications: Paul Roberts
Parts: 1-888-462-9251
Distributor Sales Network
(9a) A.W. Miller - Buffalo
(9b) A.W. Miller - Harmony
(10) Addy-Morand - Clinton Township
(11) Numerequip - Cleveland
(12) Shelton - Indianapolis
Mazak Direct Sales Offices
(13) Mazak - Dayton

Mazak Corporation ***After Hours Service HOTLINE***
Phone ***1-800-231-1456***

Form 234 (1/2001)
Technical Publications
(File location Shared/Training/Maps

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SECTION 1

ABOUT MAZAK

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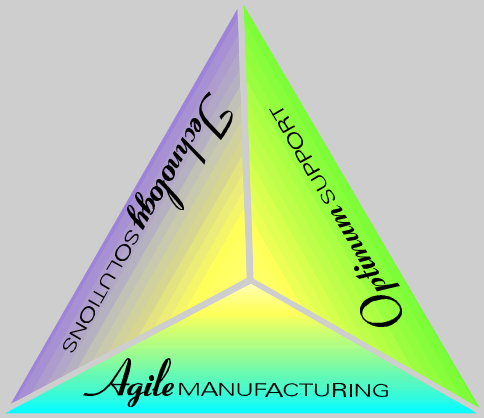
Mazak



MAZAK'S INTEGRATED SOLUTIONS

Mazak

MAZAK KY CAMPUS

Agile MANUFACTURING

Technology SOLUTIONS

Optimum SUPPORT

- Three Principle Businesses
- Each Has a Dedicated Facility with Its Own Clear Focus
- Yet the Three Are Integrated to Achieve Each Customer's Specific Goals

Return to Main Menu

Mazak

Agile
MANUFACTURING

Mazak

Agile
MANUFACTURING

FLORENCE, KY

Agile Manufacturing Facility

Return to Main Menu

Mazak

Agile MANUFACTURING

CONTINUING COMMITMENT

1974	• Begins Assembly in Florence, Kentucky
1983	• Implements Mazak's Own FMS Technology into Kentucky Plant
1988	• Receives Best Ten Plants Award from Society of Manufacturing Engineering
1990	• Implements Computer Integrated Manufacturing System
1995	• Agility Forum Citation for Best Agile Practices
	• Phillip B. Crosby Global Competition Award from the American Society of Competitiveness
1996	• Distinguished Supplier Award by Emerson Electric
	• Grand Opening of National Technology Center and National Customer Service and Support Center on KY Campus

Mazak

Agile MANUFACTURING

MANUFACTURING GOALS

- Constant Innovation of Products
- High Performance & Quality
- Best Value
- Timely Delivery

Return to Main Menu

Mazak

Agile MANUFACTURING

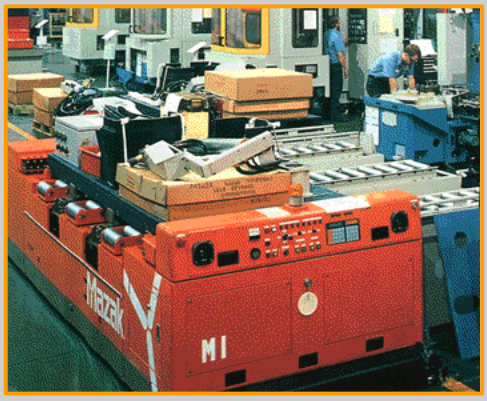
AGILE MANUFACTURING PRINCIPLES

- Use New Technology Concepts
- Shorten Lead Times
- Flexibility to Vary Product Mix
- Adjust Production Volumes Quickly in Response to Demands
- Be Globally Competitive
- Continuously Improve Quality and Manufacturing Operations

Mazak

Agile MANUFACTURING

AUTOMATED GUIDED VEHICLES



- 1.5 Ton AGV – 3 Units
- 2 Ton AGV – 1 Unit
- 6 Ton AGV – 1 Unit

Return to Main Menu

Mazak

Agile MANUFACTURING

AUTOMATED STORAGE AND RETRIEVAL SYSTEM

- 17,000 Locations
- Kitting for Unit and Final Assembly

Mazak

Agile MANUFACTURING

SHEET METAL FMS

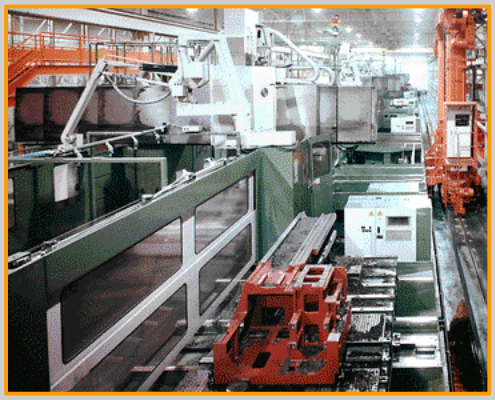
- 2 – 1KW Lasers
- 2 – 2KW Lasers
- 6 – Press Brakes
- 2 – Welding Robots
- 2 – Sand Grinding Robots
- 350 – Storage Rack Locations
- 5' x 10' Sheet Metal 11, 13, 16 Gauges

Return to Main Menu

Mazak

FRAME FMS LINE

Agile MANUFACTURING

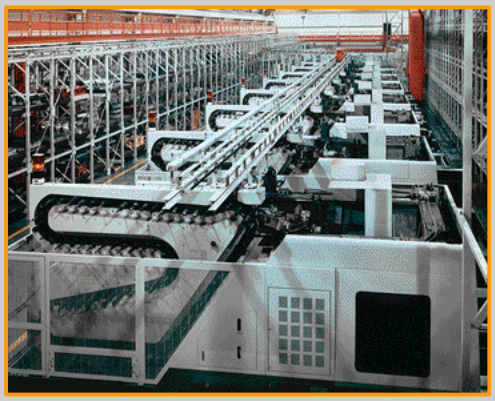


- 6 – V100 Five Face M/C 80 Tool, 2PC
- 84 – Pallet Stockers
- 1 – Loading Station
- 1 – Part Washer

Mazak

GEAR BOX FMS LINE

Agile MANUFACTURING



- 8 – H800 M/C 80 Tool, 2PC
- 140 – Pallet Stockers
- 3 – Loading Stations
- 1 – Part Washer
- 300 – Raw Material Pallet Stockers

Return to Main Menu

Mazak

SPINDLE FMS LINE

Agile MANUFACTURING

- 3 – Integrex 40 60 Tools, 60 Sets Jaws
- 54 – Pallet Stockers
- 1 – Loading Station
- 1 – Gantry Loader

Mazak

PALLETECH MANUFACTURING CELL

Agile MANUFACTURING

- 3 Ultra 650's
  - 120 tool magazine
- 30 Pallets
- 4 Load / Unload Stations

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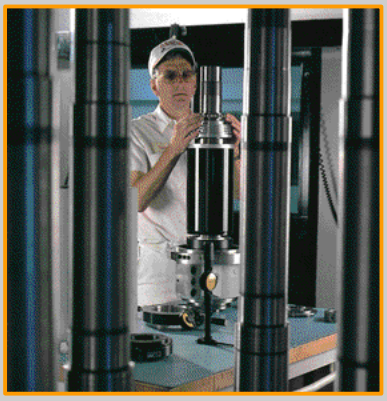
Mazak

QUALITY ASSURANCE

Agile MANUFACTURING



- Environmentally Controlled Plant
- Clean Room for Spindle Assembly
- Every Component Unit Tested Prior to Final Assembly
- Runoff Test on Each Machine
- 40 Quality Circles

Mazak

PRODUCTS FROM KENTUCKY

Agile MANUFACTURING

Super Quick Turn Lathe

VTC Vertical M/C

Quick Turn Lathe

HTC Horizontal M/C

Mazak

Technology
SOLUTIONS

Mazak

MAZAK NATIONAL TECHNOLOGY CENTER

MAZAK
TECHNOLOGY CENTER

Mission

The Mazak Commitment:

To Develop Technological Solutions for Manufacturing. We Strive to Produce These Solutions in Concert with Our Partners – Our Customers – Our Suppliers. Together We Produce Leadership in Manufacturing.

MAZAK
NATIONAL TECHNOLOGY CENTER

"Providing Innovative Solutions Through Partnership"

Return to Main Menu

Mazak

Technology SOLUTIONS

PARTNERSHIPS

Partnership with Suppliers
(SANDVIK Coromant)

Partnerships with Customers
(Dresser Industries Inc.)

Mazak

Technology SOLUTIONS

Manufacturing Solutions

Mazak Technology Center

- Advanced Machine Tool Technology
- CAD/CAM Engineering
- Process Development
- Turnkey/Runoff

Customer

- Manufacturing Objective
- Part Drawings
- Special Tooling and Fixturing
- Material Knowledge

Suppliers

- Workholding
- Material Handling
- Cutting Tools
- Chip Disposal
- Gauging
- Coolant/Hydraulic Unit
- Software

Return to Main Menu

Mazak

Technology SOLUTIONS

MAZAK TECHNOLOGY CENTER PURSUES ADDED VALUE SOLUTIONS

- Reduce Setups
- Shorten Cycle Times
- Shorten Lead Times
- Increase Throughput
- Reduce Manpower Requirements
- Provide Consistency in Part Accuracy
- Develop Concepts of Tooling and Fixturing
- Implement Production Flexibility
- Reduce Inventory Level
- Increase Machine Uptime/Utilization
- Optimize Production Capacity

Mazak

Technology SOLUTIONS

INDUSTRY FOCUSED SOLUTIONS

Automotive

Energy

Aerospace

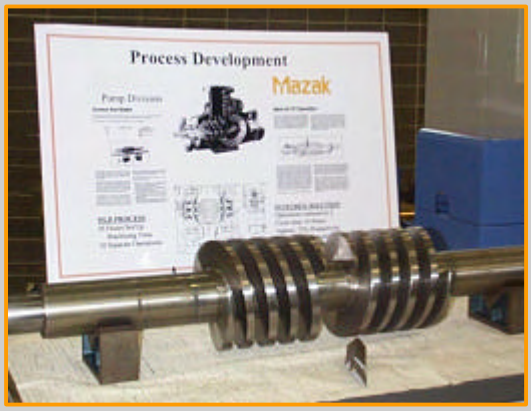
Construction

Return to Main Menu

Mazak

Technology SOLUTIONS

Process Development



Old Process

- 45 Hours Set-up and Machining Time
- 10 Separate Operations

Innovative Solution

- Integrex 50
- Operations Reduced to 2
- 10 Hour Cycle time
- 75% productivity Improvement
- Special Tool Development

Mazak

Technology SOLUTIONS

RESEARCH AND DEVELOPMENT

CAD/CAM Engineering

Process Verification

Systems Integration

High Speed Machining

Mazak

Technology SOLUTIONS

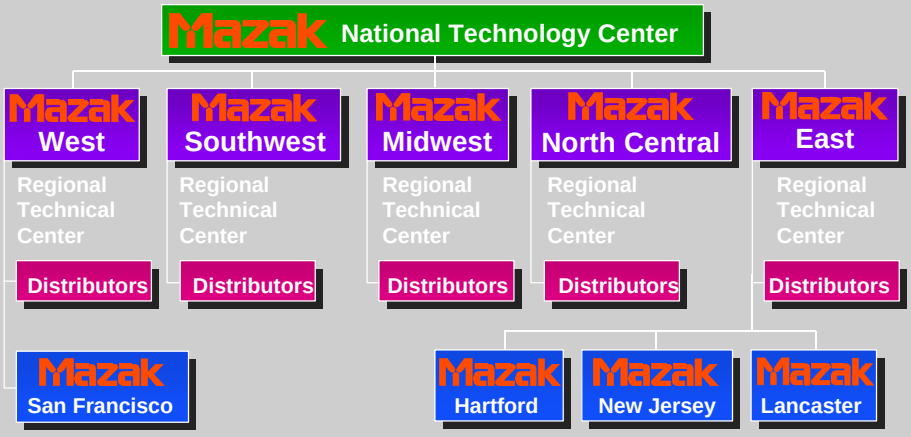
MAZAK TECHNOLOGY CENTER IMPLEMENTS INNOVATIVE TECHNOLOGIES

- CNC Control Technology
- Multi–Tasking Processing Technology
- High Speed Machining Technology
- Cellular Manufacturing Technology

Mazak

Technology SOLUTIONS

TECHNOLOGY NETWORK



Mazak

Optimum
SUPPORT

Mazak

MAZAK NATIONAL CUSTOMER SERVICE & SUPPORT CENTER

Mazak

Optimum SUPPORT

MAZAK NATIONAL CUSTOMER SERVICE & SUPPORT CENTER

Mission

The Mazak Commitment to Assure Optimum Equipment Productivity Through the Best Training, 24 Hours/Day, 7 Days/Week Service Response, Highly Skilled – Factory Trained Service Technicians, Parts Shipment Within 24 Hours and Continued Mazak Support Throughout the Life of the Machine.

Mazak

Optimum SUPPORT

MAZAK OPTIMUM SUPPORT NETWORK

Mazak National Services & Support Center

- Customer Training
- Centralized Parts Center
- Remanufacturing
- Spindle Rebuilt
- Mazatrol Support
- Technical Publications

Mazak Regional Technical Center

- 24 Hr Service Support
- Installation
- Customer Training
- Parts Order Processing

Distributors

- Installation
- Customer Training

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Mazak

Optimum SUPPORT

CUSTOMER TRAINING

- Over 3,500 Customers per year
- Programming Classes
  - Hands-On Simulation
  - Mazatrol, EIA, Macro Languages
- Hands-on Maintenance Classes
  - Individualized by model type
  - Mechanical and Electrical combined
  - Emphasizes trouble shooting
  - Advanced Classes Available
  - Customized On-Site program available

Mazak

Optimum SUPPORT

DOCUMENTATION

- Local Documentation Support
  - Kentucky Based Technical Publications Group
  - Specialized US Machine documentation
- Digital Documentation
  - OPTIMIZER Technical Library - Interactive CD Machine Manuals
  - Enhanced Service Support CD-ROM's
- Interactive Computer Training System
  - CAMWARE Interactive Learning System
  - Ethernet Communications Installation, Setup & Operation Tutorial

Mazak

Optimum SUPPORT

SERVICE SUPPORT

- Single Source Service
- 24 Hour Service Response, 7 Days/Week – (800)231-1456
- 275 Factory-Trained Service Personnel
- Mazatrol Software and Electronic Support

Mazak

Optimum SUPPORT

REPLACEMENT PARTS SUPPORT

- $44 Million Inventory
- 35,000 Different Parts
- 24 Hour Parts Shipment
  - 7 days per week
  - 96% Within 24 Hours
- Parts Available for the Life of the Machine

Mazak

REMANUFACTURING

Optimum SUPPORT

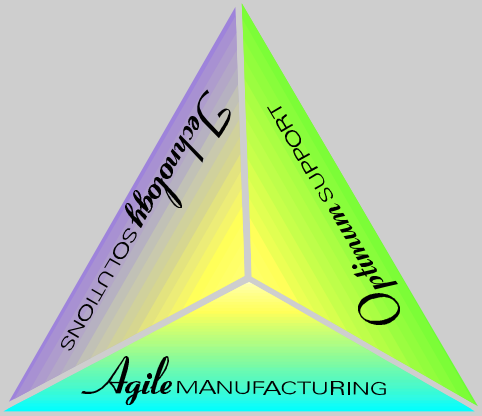
Before

- Reconditioning
- Retrofitting
- Rebuilding
- Exchange Headstock
- Clean Room for Spindle Repair

After

Remanufacturing Team

Mazak



MAZAK... COMMITTED TO YOUR SUCCESS

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SECTION 2

CROSS REFERENCES

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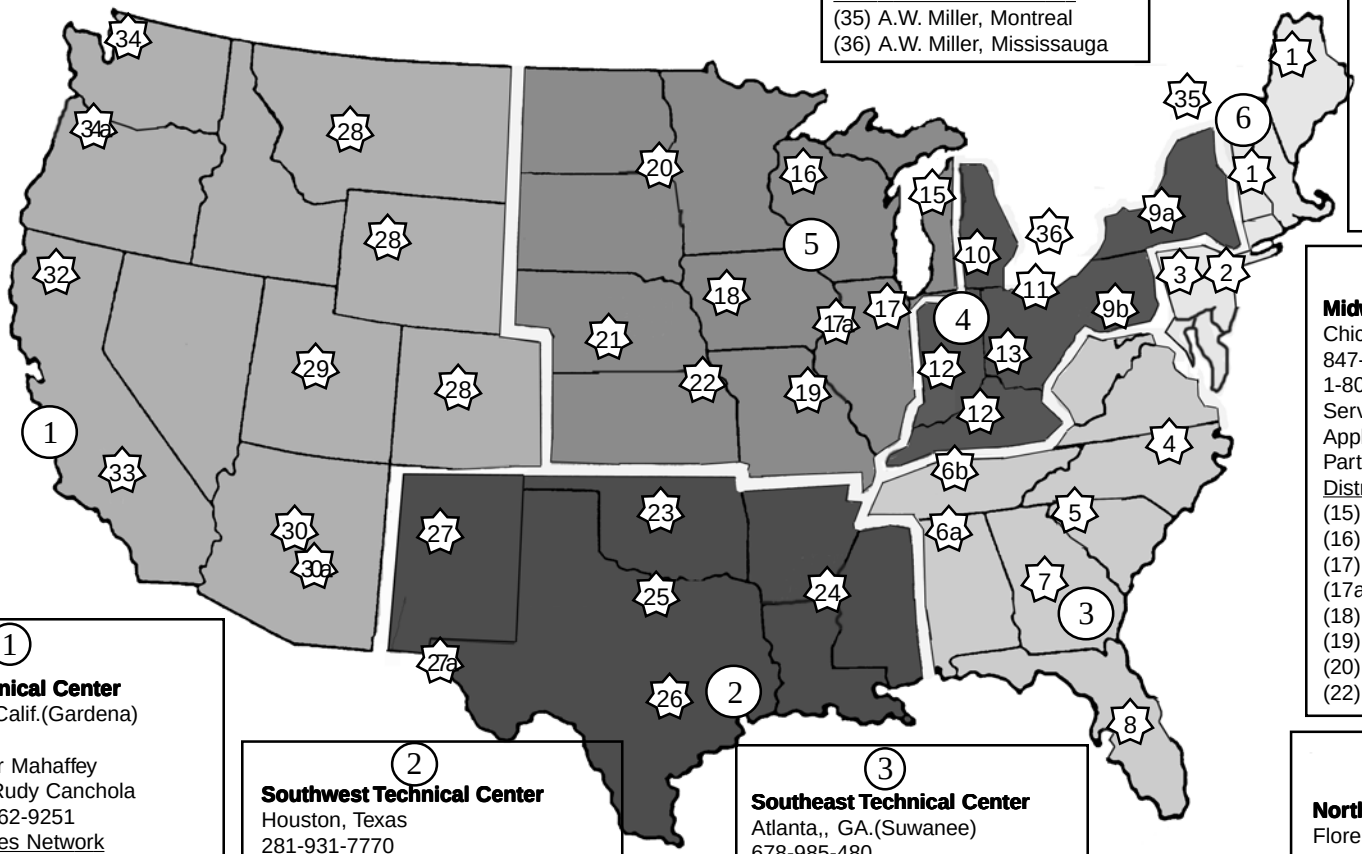
Mazak Regional Support Facilities

Canada West Support
Distributor Sales Network
(34) Machine Toolworks, Kent

Canada East Support Center
Mississauga, Canada
905-501-9555
Service: Richard Szczepko
Distributor Sales Network
(35) A.W. Miller, Montreal
(36) A.W. Miller, Mississauga



6
Eastern Technical Center
Hartford, Ct. (South Windsor)
860-528-9511
Service: Joe Civitollo
Applications: Rick Collins
Parts: 1-888-462-9251
Mazak Direct Sales Offices
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(2) Mazak - New Jersey
(3) Mazak - Lancaster

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Midwest Technical Center
Chicago, Ill. (Schaumburg)
847-885-8311
1-800-677-8311
Service: James Jackson
Applications: Mark Yasich
Parts: 1-888-462-9251
Distributor Sales Network
(15) Interface - Grand Rapids
(16) MSI - Brookfield
(17) MSI - Schaumburg
(17a) MSI - Rockford
(18) Morton - Morton
(19) Municipal - Maryland Hts
(20) Northwest - Maple Grove
(22) Concept - Lenexa

1
Western Technical Center
Los Angeles, Calif.(Gardena)
310-327-7172
Service: Roger Mahaffey
Applications: Rudy Canchola
Parts: 1-888-462-9251
Distributor Sales Network
(28) Smith - Denver
(29) Smith - Salt Lake City
(30) Reid Machine - Fountain Hills
(30a) Reid Machine - Phoenix
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(34a) Machine Toolworks - Milwaukie
Mazak Direct Sales Offices
(32) Mazak - San Francisco
(33) Mazak - Los Angeles

2
Southwest Technical Center
Houston, Texas
281-931-7770
Service: Ramiro Casas
Applications - Terry Esfeller
Parts: 1-888-462-9251
Distributor Sales Network
(21) Industrial Systems - Columbus
(23) Machinery Resources - Tulsa
(24) Dixie Mill - New Orleans
(25) Intertech - Grand Prairie
(27) Magnum - Albuquerque
(27a) Magnum - El Paso
Mazak Direct Sales Offices
(26) Mazak Houston

3
Southeast Technical Center
Atlanta,, GA.(Suwanee)
678-985-480
Service: Jim Gough
Parts: 1-888-462-9251
Distributor Sales Network
(4) Alliance - Charlotte
(5) MachineTech - Greer
(6a) Pinnacle - Meridianville
(6b) Pinnacle - Nashville
(7) Premier Eng. - Norcross
(8) Premier Mach.- Alta Monte Sp.

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(9b) A.W. Miller - Harmony
(10) Addy-Morand - Clinton Township
(11) Numerequip - Cleveland
(12) Shelton - Indianapolis
Mazak Direct Sales Offices
(13) Mazak - Dayton

Mazak Corporation ***After Hours Service HOTLINE***
Phone ***1-800-231-1456***

Form 234 (4/2002)
Technical Publications
(File location Shared/Training/Maps

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MACHINE MODEL CODE LIST (MAZAK2000/AS400)

EIA CONTROL(ADVANTEC)

Model	M2000	AS400
QT6GP (SINP)	1301-SIN	1301
QT6GXP(SING)	1303-SIN	1303
QT200KY	3251-KY	3251
IMP30HA	5513-J	5513
IMP30HB	5514-J	5514
IMP30HC	5515-J	5515

M640 CONTROL(ADVANTEC)

Model	M2000	AS400
M4NR	114B-J	114B
M5NR	111B-J	111B
PMNCR	115E-J	115E
PMNMR	115F-J	115F
PMNR	115D-J	115D
QT6PRP	1315-SIN	1315
QTN10R	147D-J	147D
QT200RK	3253-KY	3253
QT250HPK	341U-KY	341U
QT250K	341T-KY	341T
QT25LRK	342P-KY	342P
QT280CRK	341N-KY	341N
QT280LRK	341P-KY	341P
QT300K	342Q-KY	342Q
QT350RK	342M-KY	342M
QT35XSRK	342N-KY	342N
QTC300K	341Q-KY	341Q
QTN30HRK	342T-KY	342T
QTN30RKY	342L-KY	342L
QTN40R	148H-J	148H
S200MSKY	321U-KY	321U
S200MSRK	320Y-KY	320Y
S200MYK	321V-KY	321V
S250MSRK	320Z-KY	320Z
S250MSYK	321W-KY	321W
S250MYK	321X-KY	321X
SQ200MRK	320W-KY	320W
SQ200RKY	320U-KY	320U
SQ200SRK	321Y-KY	321Y
SQ250MRK	320X-KY	320X
SQ250RKY	320V-KY	320V
SQ250SRK	321Z-KY	321Z
SQT100	3100-J	3100
SQT100M	3102-J	3102
SQT100MS	3104-J	3104
SQT100MSY	3108-J	3108
SQT100MY	3106-J	3106
SQT10MR	352C-J	352C
SQT10MSR	354D-J	354D
SQR200	3241-J	3241
SQR200M	3240-J	3240
SQR250	3243-J	3243
SQR250M	3242-J	3242

M640 CONTROL(ADVANTEC)

Model	M2000	AS400
SQT28MR	382C-J	382C
SQT28MSR	384C-J	384C
SQT300	3300-J	3300
SQT300M	3302-J	3302
SQT300MY	3306-J	3306
SQT30MR	382D-J	382D
SQT30MSR	384D-J	384D
ST450	3770-J	3770
ST50NR	175B-J	175B
ST60NR	166B-J	166B
ST80NR	169B-J	169B
VTC160AK	5561-KY	5561
VTC160BK	5563-KY	5563
VTC16ARK	430H-KY	430H
VTC16BRK	430G-KY	430G
VTC20050	5576-KY	5576
VTC200BK	5571-KY	5571
VTC200CK	5573-KY	5573
VTC200GK	5578-KY	5578
VTC20BRK	439C-KY	439C
VTC20CRK	439D-KY	439D
VTC20GRK	439E-KY	439E
VTC25050	5577-KY	5577
VTC300CK	5581-KY	5581
VTC30CRK	439F-KY	439F
V41422R	521C-J	521C
V41432R	521D-J	521D
V51540ND	5392-J	5392
V51540NR	5391-J	5391
V65560NR	5402-J	5402
V65580NR	5403-J	5403
HTC400RK	2405-C	2405

EIA CONTROL(CYBERTEC)

Model	M2000	AS400
FF510	2510-J	2510
FF660	2610-J	2610
V815125X	5482-J	5482
V815805X	5480-J	5480
VRTX1412	5470-J	5470
VRTX1416	5471-J	5471
FH8805X	4470-J	4470
H12505X	4460-J	4460

M640 CONTROL(CYBERTEC)

Model	M2000	AS400
A12NMCR	196B-J	196B
A12NR	193D-J	193D
A16NMCR	197B-J	197B
A16NR	194B-J	194B
FH1080R	2371-J	2371
FH4000(JPN)	2500-J	2500
FH4000K	2501-KY	2501
FH4800	2520-J	2520
FH5800	2530-J	2530
FH6000	2540-J	2540
FH6800	2550-J	2550
FH680R	245C-J	245C
FH7800	2552-J	2552
FH8800	2560-J	2560
FH880R	2361-J	2361
H1250QR	438D-J	438D
H1250R	438C-J	438C
H630N5XR	445B-J	445B
HV630R	442B-J	442B
HV800R	441B-J	441B
ULTRA55R	234D-J	234D
ULTRA65R	235D-J	235D

M640 CONTROL(CYBERTEC)

Model	M2000	AS400
INTE100Y	1320-J	1320
INTE100SY	1321-J	1321
INTE200Y	1350-J	1350
INTE200SY	1360-J	1360
INT30R	1257-J	1257
INT30YR	1256-J	1256
INT35R	1267-J	1267
INT35YR	1266-J	1266
INTE300Y	1330-J	1330
INTE300SY	1340-J	1340
INTE400Y	1331-J	1331
INTE400SY	1341-J	1341
INTE50R	1824-J	1824
INTE50YR	1823-J	1823
INTE50YB	1450-J	1450
INTE70R	1623-J	1623
INTE70YR	1622-J	1622
INTE70YB	1490-J	1490
DT20R	3371-J	3371
MP410R	356E-J	356E
MP4200	3273-J	3273
MP430R	348C-J	348C
MP6100	3261-J	3261
MP6100Y	3260-J	3260
MP610R	356G-J	356G
MP6200R	3272-J	3272
MP6200Y	3170-J	3170
MP6250	3271-J	3271
MP6300	3281-J	3281
MP6300Y	3280-J	3280
MP630R	348D-J	348D
MP650R	3601-J	3601

M640 CONTROL(CYBERTEC)

Model	M2000	AS400
SMM2500	5292-J	5292
VRX200	5490-J	5490
FJV200	5280-J	5280
FJV200UH	5281-J	5281
FJV250	5290-J	5290
FJV250UH	5291-J	5291
FJV3560R	5353-J	5353
FJV3580R	5354-J	5354
FJ35120R	5355-J	5355
FJV5080R	5362-J	5362
FJ50120R	5363-J	5363
FJV6080R	5373-J	5373
FJ60120R	5374-J	5374
FJ60160R	5375-J	5375
V40R	5441-J	5441
V60R	5461-J	5461
V80	5450-J	5450
V100R	4201-J	4201
V120R	4202-J	4202
V81580R	5383-J	5383
V815120R	5385-J	5385

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MAZAK MACHINES AND THEIR FACTORY LOCATION

KENTUCKY MACHINES		
QT15NX	QT25CX	SQ18S2
QT20	QT25LX	HTC400
QT18NX	SQ152	VTC16AX
QT20HP	SQ15M2	VTC16BX
QT28NX	SQ15MS2	VTC20BX
QTN30	SQ15S2	VTC20CX
QT30NX	SQ182	VTC30CX
QTN30HP	SQ18MS	
QT35NX	SQ18MS2	

SEIKO MACHINES		
MTV41422X	MTV41432X	MTV51540X
MTV51540N	MTV65560X	MTV65580X
FJV20X	FJV25X	FJV35/60
VTC16CX		

MINOKAMO MACHINES		
QT6G	QT6TE	QT6T
QT35NX	QTN40	QT40NX
SQ10	SQ10M	SQ10MS
SQ15A	SQ15AM	SQ15AMS
SQ152	SQ15M2	SQ15MS2
SQ15MSY	SQ15MY	SQ15MY2
SQ182	SQ18M2	SQ18MS2
SQ18MSY	SQ18MSY2	SQ18MY
SQ28	SQ28M	SQ28MS
SQ30	SQ30M	INTEG35
INTEG50Y	INTEG50	INTEG70Y
INTEG70	ST50NX	ST60NX
ST80NX	DUAL TURN	MULTIPLEX

SINGAPORE MACHINES		
QT6GP	QTTEP	QT6TP

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OGUCHI MACHINES		
ST40NX	A10NX	A12NX
A16NX	A12NXMC	A16NXMC
M4NX	M5NX	PMNX
PMNMX	H800X	H1000X
H1250X	H1000Q	H1250Q
H630N5X	ULTRA55X	ULTRA65X
FH480X	FH680X	FH580/40
FH880		

UNITED KINGDOM		
QT8NX	SQ10	SQ10M
SQ10MS		

***NOTE: THIS LIST REFLECTS ONLY MACHINES WITH THE M-PLUS AND T-PLUS CONTROLS.**

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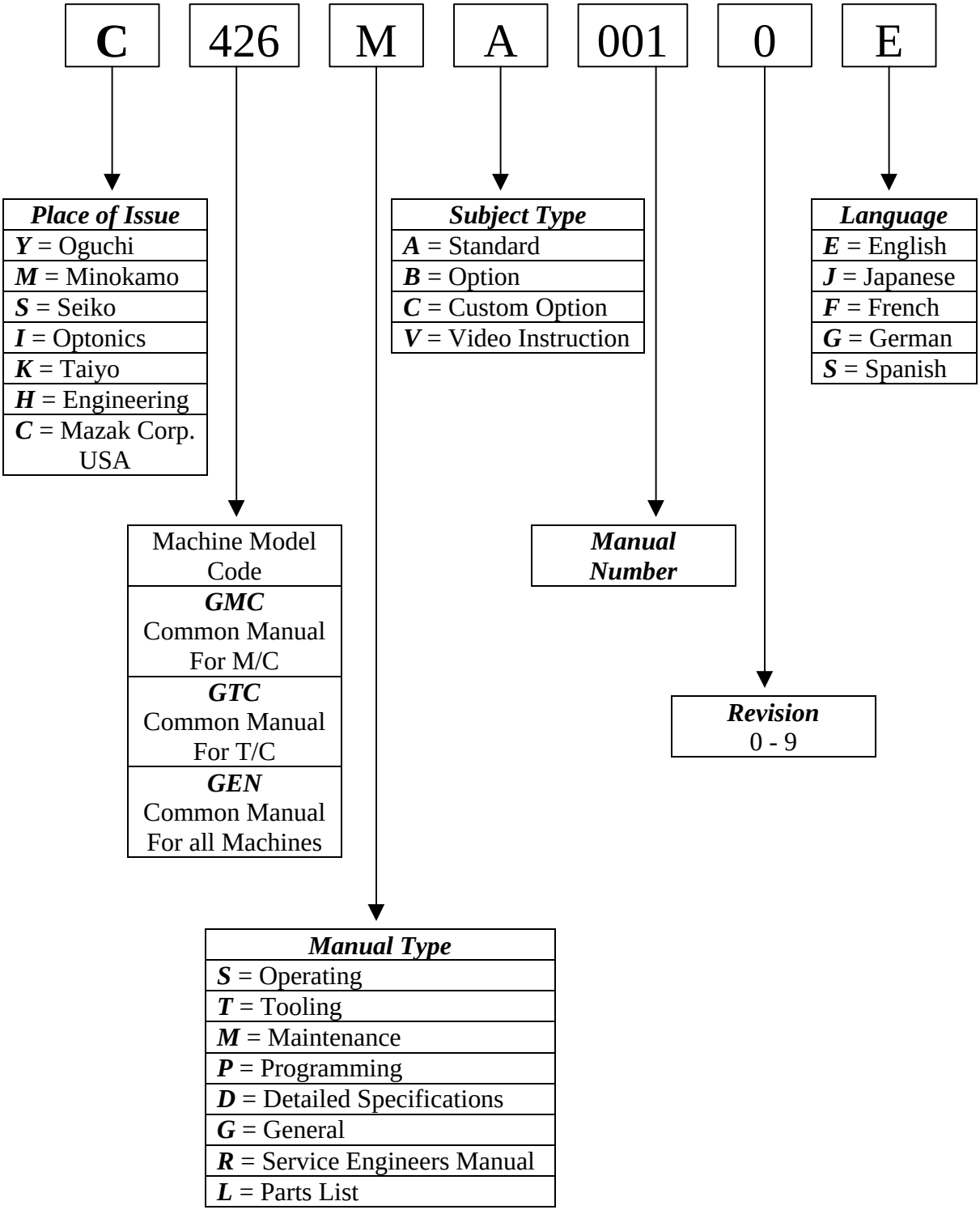
Publication Designation Number Reference



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METRIC CONVERSIONS

1 Horsepower	=	750 watts or .75kw	1kw	=	1.33hp
1 Ampre at 460v	=	.8kva	1kva	=	1.25 Ampres at 460v
1 Ampre at 230v	=	.4kva	1kva	=	2.5 Ampres at 230v
1mm	=	.0394 in.	1in.	=	25.4mm
1µm	=	.00004 in.	1in.	=	25,400µm
1kg	=	2.2lbs.	1lbs.	=	.45kg
1kg / cm^2	=	14.2psi	1psi	=	.071kg / cm^2
1kg – cm	=	.866in.-lbs	1in.-lb	=	1.15kg-cm
1 liter	=	.264 gal	1 gal	=	3.785 liters
1 gram	=	.035oz	1oz	=	28.35

TO FIND:	Alternating Current	
	Single-Phase	Three-Phase
Ampers when Kilowatts is known	$\frac{KW \times 1000}{Volts \times p.f.}$	$\frac{KW \times 1000}{1.73 \times Volts \times p.f.}$
Ampers when Horsepower is known	$\frac{H.P. \times 746}{Volts \times eff. \times p.f.}$	$\frac{H.P. \times 746}{1.73 \times Volts \times eff. \times p.f.}$
Ampers when KVA is known	$\frac{KVA \times 1000}{Volts}$	$\frac{KVA \times 1000}{1.73 \times Volts}$
Kilowatts	$\frac{Amperes \times Volts \times p.f.}{1000}$	$\frac{Amperes \times Volts \times 1.73 \times p.f.}{1000}$
KVA	$\frac{Volts \times Amperes}{1000}$	$\frac{Volts \times Amperes \times 1.73}{1000}$
Horsepower (Output)	$\frac{Amp. \times Volts \times eff. \times p.f.}{746}$	$\frac{Amp. \times Volts \times 1.73 \times eff. \times p.f.}{746}$

AWG	mm^2	A@60°C
# 24	0.2	
# 22	0.3	
# 20	0.52	
# 18	0.82	
# 16	1.31	
# 14	2.08	15
# 12	3.31	20
# 10	5.26	30
# 8	8.37	40
# 6	13.30	55
# 4	21.15	70
# 2	33.63	95
# 1	42.41	110
# 1/0	53.48	125
# 2/0	67.43	
# 3/0	87.98	
# 4/0	111.24	

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Torque Specifications for Metric Bolts

Bolt Grade 8.8		
Metric Bolt Size	Inch Pounds	Foot Pounds
3		
4		
5	24	2
6	72	6
8	192	16
10	480	40
12	648	54
14	1068	89
16		132
18		182
20		233
22		284

Bolt Grade 10.9		
Metric Bolt Size	Inch Pounds	Foot Pounds
3	12	1
4	24	2
5	60	5
6	96	8
8	264	22
10	540	45
12	840	70
14	1404	117
16	2100	175
18	2832	236
20	3780	315
22	4728	394

Bolt Grade 12.9		
Metric Bolt Size	Inch Pounds	Foot Pounds
3	12	1
4	36	3
5	72	6
6	120	10
8	324	27
10	588	49
12	1032	86
14	1644	137
16	2496	208
18	3396	283
20	4476	373
22	5568	464

The above torque values are approximate and should not be used as absolute limits. Indeterminate factors such as surface finish, type of thread, material and lubrication preclude the use of a universal chart for all applications. When servicing equipment the primary concern should be torque sequence as well as equal torque on all bolts. Do not use this chart for gasket joints or for soft materials.

POWER-LOCK COUPLING

POWER-LOCK shaft dia. mm	Tightening bolt size	Tightening torque	
		Nm	Ft-lbs
19~40	M6	16.7	12.3
42~65	M8	40.2	29.7
70~120	M10	81.3	60.1
130~150	M12	142	105

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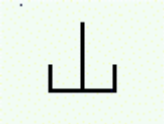
MAINTENANCE PARAMETERS FOR MAZATROL CNC UNIT'S							
CNC UNIT	BACKLASH RAPID G00	BACKLASH FEED G01	#1 HOME SHIFT	#2 HOME SHIFT	SOFT LIMIT +/-	TOOL MEASURE	SP ORIENT
MATRIX	N12	N13	M16	M5	M8 +/ M9 -	BA95 X WIDTH BA96 Z WIDTH BA97 X POSITION BA98 Z POSITION	SA96
MPRO	N12	N13	M16	M5	M8 +/ M9 -	L22 XWIDTH L23 ZWIDTH L24 XPOSITION L26 ZPOSITION	SP07
640M	N12	N13	N11	M5	M8 +/ M9 -	R2392 Z R2396 Y R2398 X	SP07
MPLUS	N12	N13	N11	M5	M8 +/ M9 -	R2392 Z R2396 Y R2398 X	SP07
M32	N12	N13	N11	M5	M8 +/ M9 -	R2392 Z R2396 Y R2398 X	J87
M1/M2	BL1 X BL2 Y BL3 Z BL4 4	MD1 X MD2 Y MD3 Z MD4 4	ZS1 X ZS2 Y ZS3 Z ZS4 4	RP1 X RP2 Y RP3 Z	X+ LX1 / X- LX2 Y+ LY1 / Y- LY2 Z+ LZ1 / Z- LZ2	TM2 Z POSITION	Determined By Spindle controller
MTPRO	BS14	BS15	BS13	A5	A9 +/ A10 -	B61 X WIDTH B62 Z WIDTH B63 X POSITION B64 Z POSITION	SP07
640T	BS14	BS15	BS13	A5	A9 +/ A10 -	B61 X WIDTH B62 Z WIDTH B63 X POSITION B64 Z POSITION	SP07
TPLUS	BS14	BS15	BS13	A5	A9 +/ A10 -	B61 X WIDTH B62 Z WIDTH B63 X POSITION B64 Z POSITION	SP07
T32	S14	S15	S13	A5	A9 +/ A10 -	B61 X WIDTH B62 Z WIDTH B63 X POSITION B64 Z POSITION	R33 #1 R34 #2
T4	BLX1 BLZ1	BLX2 BLZ2	ZPX1 ZPZ1	ZPX2 ZPZ2	X+ BA1 / X- BA3 Z+ BA2 / Z- BA4 X2+ BB1 / X2- BB3 Z2+ BB2 / Z2- BB4	U63 XW / U64 ZW U53 XP / U54 ZP B23 XW2 / B24 ZW2 B21 XP2 / B22 ZP2	Determined By Spindle controller
T2/T3	BLX BLZ BLC	SAME AS G00	ZPX ZPZ ZPC	NONE	X+ B1 Z+ B2 X- B3 Z- B4	M33 X WIDTH M34 Z WIDTH M39 X POSITION M43 Z POSITION	Determined By Spindle controller
T1	BLX BLZ	SAME AS G00	ZPX ZPZ	NONE	STROKE LIMITS CAN BE IN TOOL SET	NONE	Determined By Spindle controller
NOTE: ON MPX / DT MACHINES HD2 TOOL EYE PARAM ARE C61, C62, C63 AND C64							

Hydraulic Symbols

Hydraulic Tank (fluid reservoir)



All hydraulic systems must have some form of a reservoir to hold the fluid in the system. Most systems have vented tanks, however aircraft are one application where a closed tank is appropriate. The symbol shown here is a vented tank, a box with the line in the center would indicate a closed system. The line could also not go to the bottom of the tank, that would mean that the line stops above the fluid level in the tank and the fluid falls in. It is better to stop the line below the fluid level; otherwise the falling fluid may cause bubbles in the fluid.

Hydraulic Pump

A pump displaces fluid, which creates flow. There are fixed displacement pumps and variable displacement pumps. The pump symbol is very similar to a hydraulic motor symbol, the difference is that the pump has the small triangle pointing out and a motor has the small triangle pointing in to the center. An angled arrow typically indicates that a device is variable, thus this is a variable volume pump. Fixed displacement pumps provide the same output volume with the same input RPM. Variable displacement pumps can change the output volume while maintaining the same input RPM. Hydraulic pumps are precision components and have very close tolerances; they must be treated with care.

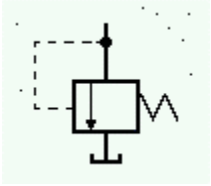
Hydraulic Line

Hydraulic lines carry the fluid from the pump throughout the system. There are two basic types, rigid and flexible. Rigid lines are used to connect items that will not move in relation to each other. Manifolds connected with rigid lines are the most reliable transfer method. The dots at the end of the line show a connection point, if two lines cross and this dot isn't shown, then the lines are not connected.

Hydraulic Hose (flexible line)

A flexible line is used to carry fluid to items that have a lot of vibration or movement in relation to each other.

Pressure Relief Valve

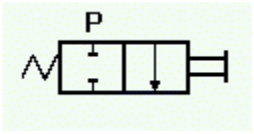


Hydraulic fluid is virtually non compressible, if the fluid can't go anywhere the pump will stall, and damage to the pump and motor can result. All hydraulic systems must have a pressure relief valve in line with the pump. The pressure relief will drain into the tank. The dashed line indicates a pilot line; this is a small line that only flows enough fluid to control other valves. The pressure of this pilot line acts against the spring on the other side of this valve. When the pilot pressure exceeds the spring force then the valve spool shifts over and opens the valve, this allows flow to the tank. This causes a drop in the pressure on the pump side, which also reduces the pilot pressure. When the pilot pressure is less than the spring force the spring closes the valve. The relief valve in the position described above will control the maximum pressure in the hydraulic system.

Directional Valves

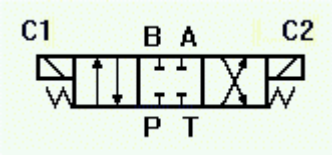
A directional valve will control which device the fluid will flow to. These valves are the primary devices used to sequence the motion of equipment. There are many different types of directional control valves. The valve is generally specified by number of positions and number of ways (ports). The valve is made up of two parts, the body and the spool. When valves shift the spool is moved in relation to the body, this opens and closes passages that the fluid flows through. Remember that the valve actuator always pushes the spool, this will help you read the drawings. You read the operation of a valve in a circuit in the following manner. The box(s) with arrows in it show the flow of fluid when the valve is shifted. The box without arrows and/or away from the actuator shows the flow, if any, in the neutral position. This is also the box you use to count the number of ports the valve has.

Two (2) Position, Two (2) way



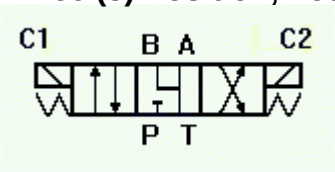
This valve has two positions (2 boxes) and 2 ways (ports); thus 2 position, 2 way. It is shown with a manual actuator (on the right) and has a spring return too neutral. This valve is called normally closed because both ports are blocked when in neutral. It could be used on a safety device like a safety gate, if the gate isn't closed, actuating the valve, then the flow will be stopped, preventing movement of the connected device.

Three (3) Position, Four (4) way



This valve has three positions (3 boxes) and 4 ways (ports); thus 3 position, 4 way. It is shown with a closed center, when the valve is neutral all ports are blocked. The small boxes on each end with diagonal lines through them, C1 and C2, are electrical coils, this is an electrically actuated valve. The port marked P is Pressure and the port marked T drains to tank. The ports marked A and B connect to an external device, like a cylinder. When C1 is energized the valve will shift, putting pressure to the B port and draining the A port to the tank. Likewise when C2 is energized the pressure port connects to the A port and the B port drains to the tank.

Three (3) Position, Four (4) Way



This valve has three positions (3 boxes) and 4 ways (ports); thus 3 position, 4 way. It also is electrically actuated. The jagged lines next to the coil indicates springs, when the coil is de-energized the opposite spring will force the spool back to the center position. This valve also drains to tank when in neutral; this is a standard valve on molding machines. They drain to tank when de-energized for safety.

Cylinder

A cylinder is one of the devices that create movement. When pressure is applied to a port it causes that side of the cylinder to fill with fluid. If the fluid pressure and area of the cylinder are greater than the load that is attached then the load will move. Cylinders are generally specified by bore and stroke, they can also have options like cushions installed. Cushions slow down the cylinder at the end of the stroke to prevent slamming. If the pressure remains constant a larger diameter cylinder will provide more force because it has more surface area for the pressure to act on.

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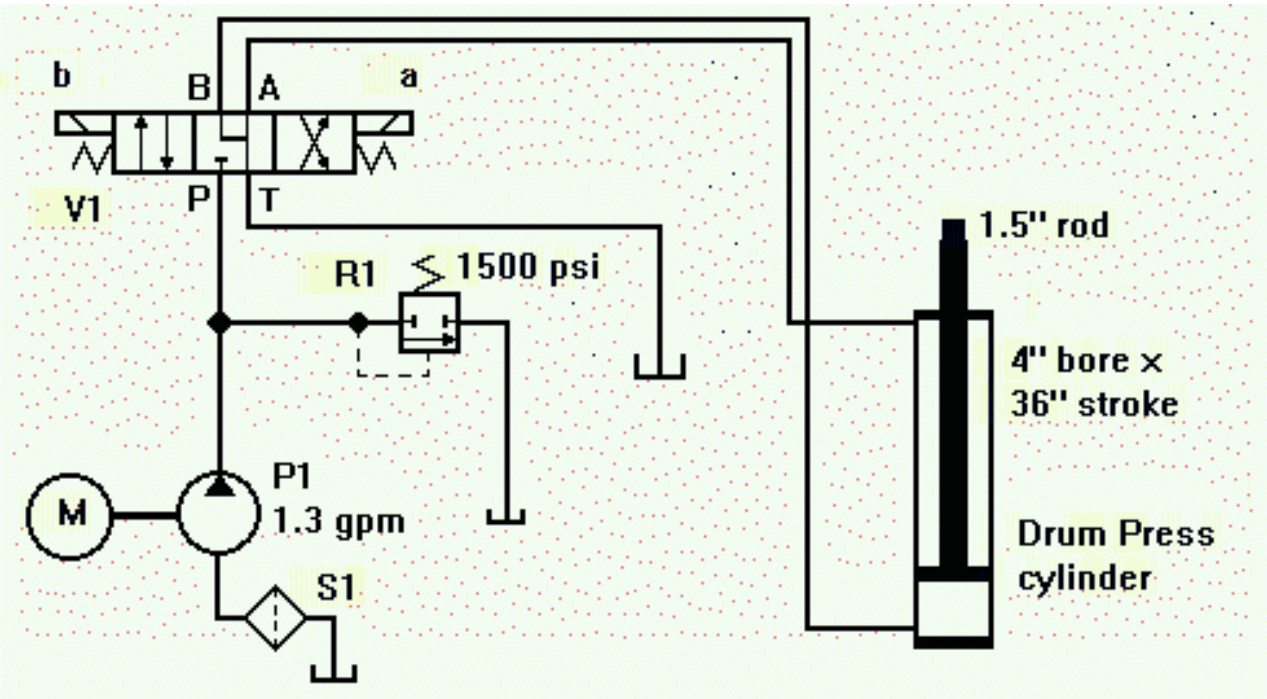
A Complete Circuit



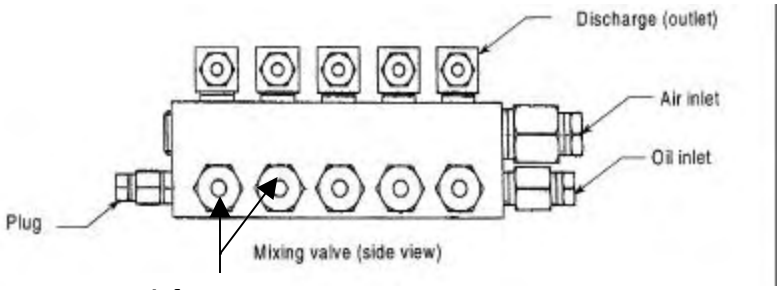
Oil/Air Lubrication
AIR FLOW

With the introduction of faster spindles and faster feed rates, it has become necessary for machining centers to utilize oil/air lubrication system. These lubrication systems are a steady flow of air that is mixed with a measured amount of oil at a predetermined interval. The oil/air systems have become a vital part of preventative maintenance and must be checked periodically or at the time of unit repair. The following is the recommended procedure for checking the airflow and the oil volume.

Procedure

The system air pressure for the machine tool must be maintained and must be kept free of all moisture. Most Mazak machines require 80-lbs. psi. (The air regulator for each machine should be checked for system pressure. **NOTE:** The air pressure gages are marked with a green arrow.) The machine specifications will also list the required air pressured. Since the air pressure is pre set.
There are two mixing blocks used, block one has **BRASS SLOTTED** needle valves, and block two has **BLACK CAP** adjusters on the needle valves. **These valves can be adjusted for air flow only.** The slotted valve adjustment is 3 to 3 ½ turns from the closed possession. The black cap type valve adjusts only 1 turn from the closed possession.

Fig. 1



Adjuster

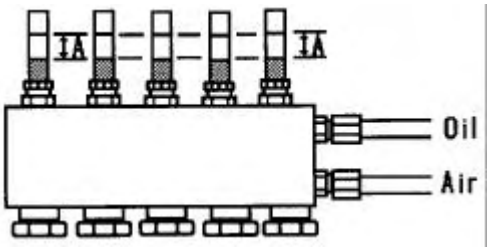


Fig.2

Oil Requirements

Oil lines used on these systems allow for both visual and physical inspection. Since the size of the tube is known (4mmOD X 2.5mmID) the volume of oil flowing to each lubrication point can be determined. Using the formula:

Injector size / .04909 = A in cm (A cm x 10 = A mm)

The distance that the oil travels in the tube, during each cycle, can be measured. (Fig.2 – A Dim.)

To measure the oil you must:

1. Close the needle valves to each oil port or disconnect the air line that feeds the mixing block (Fig 2)
2. Some machines require the spindle to be turning. If this is the case, rotate the spindle at a slow RPM manually or use MDI. The spindle rate should be 100 RPM or less. This allows the PLC to cycle the pump at the correct intervals.

Use the quick reference chart below to determine the distance of oil flow for the ejector being tested

Injector	A dim.
.01 cm^3	2 mm
.02 cm^3	4 mm
.03 cm^3	6 mm
.04 cm^3	8 mm
.05 cm^3	10 mm

(1 cm = 10 mm)

Note: If you want to shorten the oil/air cycle time. You must change the OFF time parameter only.
Note: Do not run the oil/air pump continually! The injectors must have both high and low pressure to work correctly. **The minimum OFF time should not be less then 30 sec.**

MACHINE REQUIREMENT LIST

(ELECTRICAL, HYDRAULIC, LUBRICATION & PNEUMATIC)

Technical Notes:

1. Items shown are for standard machines only. Please consult with the regional Mazak Technical Center, service center or Mazak Engineering Dept. in Florence, Ky. for additional information about machines with optional equipment such as powerful coolant, air blast, large capacity tool magazine, multiple pallet changers, etc. ,or concerning any item not listed.
2. Due to manufacturing and supplier specification changes, the main transformer may have a higher KVA rating than required by the standard machine. The wire sizes shown represent the wiring requirements for standard machines with a matching transformer.

CAUTION!

Table 1 (Transformer & Wire Size Cross Reference) lists the standard transformer KVA rating and wire sizes under generally accepted electrical codes. However, end users must verify the machine's actual transformer size (KVA), as well as local electrical code requirements before sizing and installing incoming power wiring.

NOTE:

Step-down or voltage regulating transformers are external (peripheral) to the machine tool and are considered the primary input line (source) for the machine. Local electrical code or practice may require a circuit breaker or other switching device for the isolation of electrical power when this type of transformer is used. In such cases, the machine tool end user is required to supply the necessary circuit breaker or switching device.

WARNING!

FAILURE TO COMPLY CAN RESULT IN PERSONAL INJURY AND DAMAGE TO THE MACHINE. IF ANY QUESTION EXISTS, CONTACT THE NEAREST MAZAK SERVICE CENTER FOR ASSISTANCE.

3. The amperage is calculated by the formula shown below. When a voltage other than 230 or 460 is applied, use the following formula to determine current draw in amps: [KVA] x 1,000 / [V] x 1.73
4. The customer fuse box or circuit breaker should have a rating 20% to 25% higher than the machine requirement (depending on local electrical code).
5. The wire size is selected based on 90 Deg. C rated wire. Please contact Mazak if 60 Deg. C rated wire is used.
6. Air volume indicates the minimum requirement where "Cfm"= cubic feet per minute. Convert to gallons per minute, by multiplying by 7.48.
7. The coolant capacity varies according to the options such as niagara coolant, high power coolant, chip conveyor, etc.
8. The transformer sizes for Japan machines fall into six Kva ratings: 28, 35, 48, 53, 75 & 96

   Kentucky machine transformers fall into two Kva ratings: 28 & 49.

NOTE: This information was considered complete and accurate at the time of publication, however, due to our desire to constantly improve the quality and specification of all Mazak products, if is subject to change or modification. If any question exists, contact the nearest Mazak service center for assistance.

Attachment B
(Publication #CGENGA0026E Issued 11/14/2000)

MACHINE	TRANSFORMER (KVA)	Air Pressure	Air Volume	Coolant Capacity	HYDRAULIC UNIT	HEADSTOCK	SLIDEWAYS LINEAR GUIDES	OTHER
QT-6G	28	71 Min.	3.53 Min.	26	8.45 gal UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	NONE	.47 gal FEBIS K68 (ESSO) VACTRA 2 (MOBIL) TONNA T68 (SHELL)	
QT-6T	28	71 Min.	3.53 Min.	26	8.45 gal UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	NONE	.47 gal FEBIS K68 (ESSO) VACTRA 2 (MOBIL) TONNA T68 (SHELL)	
QT-12C w/GL50	28	71 Min.	3.53 Min.	26	8.45 gal UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	NONE	.47 gal FEBIS K68 (ESSO) VACTRA 2 (MOBIL) TONNA T68 (SHELL)	
QTN-10	28	71 Min.	3.53 Min.	26	8.45 gal UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	NONE	.47 gal FEBIS K68 (ESSO) VACTRA 2 (MOBIL) TONNA T68 (SHELL)	
QT-200/200C	28	71 Min.	3.53 Min.	26	10 gal UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	NONE	.32 gal FEBIS K68 (ESSO) VACTRA 2 (MOBIL) TONNA T68 (SHELL)	
QTN-20/20HP QTN-30/30HP QT-25C & 25L, 35XS	49	71 Min.	3.53 Min.	26	10 gal UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	NONE	.32 gal FEBIS K68 (ESSO) VACTRA 2 (MOBIL) TONNA T68 (SHELL)	
QT-250/250HP QT-300/300HP/S QT-280L/280C & QT-350	49	71 Min.	3.53 Min.	26	10 gal UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	NONE	.32 gal FEBIS K68 (ESSO) VACTRA 2 (MOBIL) TONNA T68 (SHELL)	
QTN-40	49	71 Min.	3.53 Min.	26	16.6 gal UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	NONE	.26 gal. Ball screws FEBIS K68 (ESSO) VACTRA 2 (MOBIL) TONNA T68 (SHELL)	.26 gal. Turret FEBIS K68 (ESSO) VACTRA 2 (MOBIL) TONNA T68 (SHELL)

NOTE: Consult local electrical code to determine correct wire size for the transformer KVA rating.

Attachment B
(Publication #CGENGA0026E Issued 11/14/2000)

MACHINE	TRANSFORMER (KVA)	Air Pressure	Air Volume	Coolant Capacity	HYDRAULIC UNIT	HEADSTOCK	SLIDEWAYS LINEAR GUIDES	OTHER
M-4 Series	49	71 Min.	3.53 Min.	26	UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	NONE	FEBIS K68 (ESSO) VACTRA 2 (MOBIL) TONNA T68 (SHELL)	.26 gal. Turret FEBIS K68 (ESSO) VACTRA 2 (MOBIL) TONNA T68 (SHELL)
POWER-MASTER (ALL)	96	71 Min.	3.53 Min.	26	UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	NONE	FEBIS K68 (ESSO) VACTRA 2 (MOBIL) TONNA T68 (SHELL)	.26 gal. Turret FEBIS K68 (ESSO) VACTRA 2 (MOBIL) TONNA T68 (SHELL)
M-5 Series	49	71 Min.	3.53 Min.	26	UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	NONE	FEBIS K68 (ESSO) VACTRA 2 (MOBIL) TONNA T68 (SHELL)	.26 gal. Turret FEBIS K68 (ESSO) VACTRA 2 (MOBIL) TONNA T68 (SHELL)
DUAL TURN 20	75	71 Min.	3.53 Min.	26	21.1 gal. UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	15.85 gal. LONG LIFE COOLANT (50%)	.79 gal. FEBIS K68 (ESSO) Vaculine1409 (MOBIL) TONNA T68 (SHELL)	
MULTIPLEX 410N / 610N, MkII	75	71 Min. 142 max.	14 Min.	67	21.7 gal. UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	11.9 gal. LONG LIFE COOLANT (50%)	.34 gal. FEBIS K68 (ESSO) VACTRA 2 (MOBIL) TONNA T68 (SHELL)	Turret index motor gear lubricated by same pump as the ballscrews.
MULTIPLEX 420N / 620N, 4200/6200, 6100Y	95	71 Min. 142 max.	14 Min.	67	21.7 gal. UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	13.2 gal. LONG LIFE COOLANT (50%)	.34 gal. FEBIS K68 (ESSO) VACTRA 2 (MOBIL) TONNA T68 (SHELL)	Turret index motor gear lubricated by same pump as the ballscrews.
MULTIPLEX 425N / 625N, MkII	95	71 Min. 142 max.	14 Min.	67	21.7 gal. UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	13.2 gal. LONG LIFE COOLANT (50%)	.34 gal. FEBIS K68 (ESSO) VACTRA 2 (MOBIL) TONNA T68 (SHELL)	Turret index motor gear lubricated by same pump as the ballscrews.
MULTIPLEX 430N / 630N 4300 / 6300/6300Y	95	71 Min. 142 max.	14 Min.	67	21.7 gal. UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	13.2 gal. LONG LIFE COOLANT (50%)	.34 gal. FEBIS K68 (ESSO) VACTRA 2 (MOBIL) TONNA T68 (SHELL)	Turret index motor gear lubricated by same pump as the ballscrews.

NOTE: Consult local electrical code to determine correct wire size for the transformer KVA rating.

Attachment B
(Publication #CGENGA0026E Issued 11/14/2000)

MACHINE	TRANSFORMER (KVA)	Air Pressure	Air Volume	Coolant Capacity	HYDRAULIC UNIT	HEADSTOCK	SLIDEWAYS LINEAR GUIDES	OTHER
MULTIPLEX 650	95	71 Min. 142 max.	14 Min.	67	21.7 gal. UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	13.2 gal. LONG LIFE COOLANT (50%)	.34 gal. FEBIS K68 (ESSO) VACTRA 2 (MOBIL) TONNA T68 (SHELL)	Turret index motor gear lubricated by same pump as the ballscrews.
ST-40N SL-450	53	71 Min. 142 max.	14 Min.	42	16.6 gal. UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	6.6 gal. SPINESSO 10 (ESSO) VELOCITE #6 (MOBIL) TELLUS C10 (SHELL)	2.6 gal. Slideways & Z axis ballscrew .24 gal. Tailstock FEBIS K68 (ESSO) VACTRA 2 (MOBIL) TONNA T68 (SHELL)	.48 gal. X Ballscrew UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)
ST-50N	64.5	71 Min. 142 max.	14 Min.	42	16.6 gal. UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	13.2 gal. SPINESSO 10 (ESSO) VELOCITE #6 (MOBIL) TELLUS C10 (SHELL)	2.6 gal. Slideways & Z axis ballscrew .24 gal. Tailstock FEBIS K68 (ESSO) VACTRA 2 (MOBIL) TONNA T68 (SHELL)	.48 gal. X Ballscrew UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)
ST-60N	75	71 Min. 142 max.	14 Min.	71	16.6 gal. UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	13.2 gal. SPINESSO 10 (ESSO) VELOCITE #6 (MOBIL) TELLUS C10 (SHELL)	2.6 gal. Slideways & Z axis ballscrew .24 gal. Tailstock FEBIS K68 (ESSO) VACTRA 2 (MOBIL) TONNA T68 (SHELL)	.48 gal. X Ballscrew UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)
ST-80N	100.5	71 Min. 142 max.	14 Min.	42	16.6 gal. UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	13.2 gal. SPINESSO 10 (ESSO) VELOCITE #6 (MOBIL) TELLUS C10 (SHELL)	2.6 gal. Slideways & Z axis ballscrew .24 gal. Tailstock FEBIS K68 (ESSO) VACTRA 2 (MOBIL) TONNA T68 (SHELL)	.48 gal. X Ballscrew UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)
INTEGREX 30 / 35	75	71 Min.	3.53 Min.		39.6 gal UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	11.7 gal. SPINESSO 10 (ESSO) D.T.E. 21 (MOBIL) TELLUS C10 (SHELL)	.89 gal. FEBIS K68 (ESSO) VACTRA 2 (MOBIL) TONNA T68 (SHELL)	1.66 gal. C axis .39 gal. ATC FEBIS K68 (ESSO) VACTRA 2 (MOBIL) TONNA T68 (SHELL)
INTEGREX 30Y / 35Y	75	71 Min.	3.53 Min.		39.6 gal UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	11.7 gal. SPINESSO 10 (ESSO) D.T.E. 21 (MOBIL) TELLUS C10 (SHELL)	.89 gal. FEBIS K68 (ESSO) Vacuoline 1409 (MOBIL) TONNA T68 (SHELL)	1.66 gal. C axis .39 gal. ATC FEBIS K68 (ESSO) VACTRA 2 (MOBIL) TONNA T68 (SHELL)

NOTE: Consult local electrical code to determine correct wire size for the transformer KVA rating.

Attachment B
(Publication #CGENGA0026E Issued 11/14/2000)

MACHINE	TRANSFORMER (KVA)	Air Pressure	Air Volume	Coolant Capacity	HYDRAULIC UNIT	HEADSTOCK	SLIDEWAYS LINEAR GUIDES	OTHER
INTEGREX 50/50Y	75	71 Min.	3.53 Min.	73	39.6 gal UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	11.7 gal. SPINESSO 10 (ESSO) D.T.E. 21 (MOBIL) TELLUS C10 (SHELL)	.89 gal. FEBIS K68 (ESSO) Vacuoline 1409 (MOBIL) TONNA T68 (SHELL)	1.66 gal. C axis .39 gal. ATC FEBIS K68 (ESSO) VACTRA 2 (MOBIL) TONNA T68 (SHELL)
INTEGREX 70, 70Y	77	71 Min.	3.53 Min.	95	39.6 gal UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	11.7 gal. SPINESSO 10 (ESSO) D.T.E. 21 (MOBIL) TELLUS C10 (SHELL)	.89 gal. FEBIS K68 (ESSO) VACTRA 2 (MOBIL) TONNA T68 (SHELL)	1.66 gal. C axis .39 gal. ATC FEBIS K68 (ESSO) VACTRA 2 (MOBIL) TONNA T68 (SHELL)
INTEGREX 100Y & SY	48	71 Min.	3.53 Min.	53/66	6.6 gal UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	.89 gal. LONG LIFE COOLANT (50%)	1.05 gal. FEBIS K68 (ESSO) Vacuoline1409 (MOBIL) TONNA T68 (SHELL)	.4 gal. ATC FEBIS K68 (ESSO) Vacuoline 1409 (MOBIL) TONNA T68 (SHELL)
INTEGREX 200Y & SY	48	71 Min.	3.53 Min.	53/66	7.9 gal UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	1.32 gal. LONG LIFE COOLANT (50%)	1.05 gal. FEBIS K68 (ESSO) Vacuoline1409 (MOBIL) TONNA T68 (SHELL)	.7 gal. ATC FEBIS K68 (ESSO) Vacuoline 1409 (MOBIL) TONNA T68 (SHELL)
INTEGREX-300Y/SY 400Y/SY	48	71 Min.	3.53 Min.	48.9	7.9 gal UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	1.32 gal. LONG LIFE COOLANT (50%)	1.05 gal. FEBIS K68 (ESSO) Vacuoline1409 (MOBIL) TONNA T68 (SHELL)	.7 gal. ATC FEBIS K68 (ESSO) Vacuoline 1409 (MOBIL) TONNA T68 (SHELL)
SUPER QUADREX	48	71 Min.	3.53 Min.		6.6 gal UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	1.32 gal. LONG LIFE COOLANT (50%)	.89 gal. FEBIS K68 (ESSO) VACTRA 2 (MOBIL) TONNA T68 (SHELL)	
SQT-10M	53	71 Min.	3.53 Min.	29	11.89 gal UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	7.93 gal. LONG LIFE COOLANT (50%)	.39 gal. UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	
SQT-10MS	53	71 Min.	3.53 Min.	37	11.89 gal UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	7.93 gal. LONG LIFE COOLANT (50%)	.39 gal. UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	

NOTE: Consult local electrical code to determine correct wire size for the transformer KVA rating.

Attachment B
(Publication #CGENGA0026E Issued 11/14/2000)

MACHINE	TRANSFORMER (KVA)	Air Pressure	Air Volume	Coolant Capacity	HYDRAULIC UNIT	HEADSTOCK	SLIDEWAYS LINEAR GUIDES	OTHER
SQT-15/18, M, MS, MSY, S MkII	49	71 Min.	3.53 Min.		11.89 gal UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	7.93 gal. LONG LIFE COOLANT (50%)	.39 gal. UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	
SQT-15/18, M, MS, S MkII (KY)	49	71 Min.	3.53 Min.		11.89 gal UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	7.93 gal. LONG LIFE COOLANT (50%)	.39 gal. UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	
SQT-28/30 SERIES, MkII	75	71 Min.	3.53 Min.		17.17 gal UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	11.88 gal. LONG LIFE COOLANT (50%)	.48 gal. x 2 FEBIS K68 (ESSO) Vacuoline 1409 (MOBIL) TONNA T68 (SHELL)	
SQT-100 Series 2axis, M,MS,Y & S (KY)	53	71 Min.	3.53 Min.	29	11.89 gal UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	7.93 gal. LONG LIFE COOLANT (50%)	.39 gal. UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	
SQT-200/250 Series 2axis, M,MS,Y & S (KY)	49	71 Min.	3.53 Min.		11.89 gal UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	7.93 gal. LONG LIFE COOLANT (50%)	.39 gal. UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	
SQT-300 Series	49	71 Min.	3.53 Min.		7.93 gal UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	1.32 gal. LONG LIFE COOLANT (50%)	1.1 gal. FEBIS K68 (ESSO) VACTRA 2 (MOBIL) TONNA T68 (SHELL)	
VTC-16/20/30 (All)	28	71 Min.	6.4 Min.	37		4 gal. VELOCITE #3 (MOBIL)	.8 gal. FEBIS K68 (ESSO) D.T.E. 26 (MOBIL) TONNA T68 (SHELL)	AIR LUBRICATOR UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)

NOTE: Consult local electrical code to determine correct wire size for the transformer KVA rating.

Attachment B
(Publication #CGENGA0026E Issued 11/14/2000)

MACHINE	TRANSFORMER (KVA)	Air Pressure	Air Volume	Coolant Capacity	HYDRAULIC UNIT	HEADSTOCK	SLIDEWAYS LINEAR GUIDES	OTHER
VTC-160/200B/200C VTC200G/300C	28	71 Min.	4.9 Min.	37	2.64 gal UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	5.28 gal. VELOCITE #3 (MOBIL)	.53 gal. FEBIS K68 (ESSO) D.T.E. 26 (MOBIL) TONNA T68 (SHELL)	.53 gal. ATC Cam Box FEBIS K68 (ESSO) VACTRA 2 (MOBIL) TONNA T68 (SHELL)
VTC-200 50 Taper VTC-250 50 Taper	49	71 Min.	4.9 Min.	37	2.64 gal UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	5.28 gal. VELOCITE #3 (MOBIL)	.53 gal. FEBIS K68 (ESSO) D.T.E. 26 (MOBIL) TONNA T68 (SHELL)	.53 gal. ATC Cam Box FEBIS K68 (ESSO) VACTRA 2 (MOBIL) TONNA T68 (SHELL)
HTC-400	28	71 Min.	6.4 Min.	37	UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	4 gal. VELOCITE #3 (MOBIL)	.8 gal. FEBIS K68 (ESSO) D.T.E. 26 (MOBIL) TONNA T68 (SHELL)	AIR LUBRICATOR UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)
AJV-25 404 / 405	53	71 Min.	3.53 Min.		16.6 gal UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	6.6 gal. SPINESSO 10 (ESSO) D.T.E. 21 (MOBIL) TELLUS C10 (SHELL)	.8 gal. FEBIS K68 (ESSO) VACTRA 2 (MOBIL) TONNA T68 (SHELL)	
AJV-32 404 / 405	53	71 Min.	3.53 Min.		16.6 gal UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	6.6 gal. SPINESSO 10 (ESSO) D.T.E. 21 (MOBIL) TELLUS C10 (SHELL)	.8 gal. FEBIS K68 (ESSO) VACTRA 2 (MOBIL) TONNA T68 (SHELL)	
AJV-32 604 / 605	53	71 Min.	3.53 Min.		16.6 gal UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	6.6 gal. SPINESSO 10 (ESSO) D.T.E. 21 (MOBIL) TELLUS C10 (SHELL)	.8 gal. FEBIS K68 (ESSO) VACTRA 2 (MOBIL) TONNA T68 (SHELL)	
AJV-35 60/80/120	75	71 Min.	3.53 Min.		16.6 gal UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	6.6 gal. SPINESSO 10 (ESSO) D.T.E. 21 (MOBIL) TELLUS C10 (SHELL)	.8 gal. FEBIS K68 (ESSO) VACTRA 2 (MOBIL) TONNA T68 (SHELL)	

NOTE: Consult local electrical code to determine correct wire size for the transformer KVA rating.

Attachment B
(Publication #CGENGA0026E Issued 11/14/2000)

MACHINE	TRANSFORMER (KVA)	Air Pressure	Air Volume	Coolant Capacity	HYDRAULIC UNIT	HEADSTOCK	SLIDEWAYS LINEAR GUIDES	OTHER
AJV-50	75	71 Min.	3.53 Min.		16.6 gal UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	6.6 gal. SPINESSO 10 (ESSO) D.T.E. 21 (MOBIL) TELLUS C10 (SHELL)	.8 gal. FEBIS K68 (ESSO) VACTRA 2 (MOBIL) TONNA T68 (SHELL)	
AJV-60	65	71 Min.	3.53 Min.		16.6 gal UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	6.6 gal. SPINESSO 10 (ESSO) D.T.E. 21 (MOBIL) TELLUS C10 (SHELL)	.8 gal. FEBIS K68 (ESSO) VACTRA 2 (MOBIL) TONNA T68 (SHELL)	
FJV-20 & 25	53	71 Min.	3.53 Min.	21		.76 gal. (Spindle Lube) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	.8 gal. FEBIS K68 (ESSO) VACTRA 2 (MOBIL) TONNA T68 (SHELL)	4 gal. (Chiller unit) VELOCITE #3 (MOBIL)
V-414	35	71 Min.	3.53 Min.	39	16.6 gal UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	10.6 gal. LONG LIFE COOLANT (50%)	.8 gal. FEBIS K68 (ESSO) VACTRA 2 (MOBIL) TONNA T68 (SHELL)	
FJV-35/ 60	75	71 Min.	3.53 Min.	39	7.93 gal UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	9.25 gal (Spindle Head) DTE-22 (MOBIL)	.8 gal. FEBIS K68 (ESSO) VACTRA 2 (MOBIL) TONNA T68 (SHELL)	
FJV-50/80 & FJV-50/120	75	71 Min.	3.53 Min.	118.9	7.93 gal UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	9.25 gal (Spindle Head) DTE-22 (MOBIL)	.8 gal. FEBIS K68 (ESSO) VACTRA 2 (MOBIL) TONNA T68 (SHELL)	
FJV-60	75	71 Min.	3.53 Min.	118.9	7.93 gal UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	9.25 gal (Spindle Head) DTE-22 (MOBIL)	.8 gal. FEBIS K68 (ESSO) VACTRA 2 (MOBIL) TONNA T68 (SHELL)	

NOTE: Consult local electrical code to determine correct wire size for the transformer KVA rating.

Attachment B
(Publication #CGENGA0026E Issued 11/14/2000)

MACHINE	TRANSFORMER (KVA)	Air Pressure	Air Volume	Coolant Capacity	HYDRAULIC UNIT	HEADSTOCK	SLIDEWAYS LINEAR GUIDES	OTHER
V-515	53	71 Min.	3.53 Min.	66	16.6 gal UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	10.6 gal. LONG LIFE COOLANT (50%)	.8 gal. FEBIS K68 (ESSO) VACTRA 2 (MOBIL) TONNA T68 (SHELL)	
V-515/40N	53	71 Min. (7cfm) (15 cfm w/air blast)	3.53 Min.	66	16.6 gal UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	10.6 gal. LONG LIFE COOLANT (50%)	.8 gal. FEBIS K68 (ESSO) VACTRA 2 (MOBIL) TONNA T68 (SHELL)	
V-655	48	71 Min.	25 Min.	78.9	16.6 gal UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	10.6 gal. LONG LIFE COOLANT (50%)	.8 gal. FEBIS K68 (ESSO) VACTRA 2 (MOBIL) TONNA T68 (SHELL)	
V-40	75	71 Min.	28 Min.	132	26.4 gal UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	9.2 gal. x 2 VELOCITE #6 (MOBIL) TELLUS C10 (SHELL)	.8 gal. FEBIS K68 (ESSO) VACTRA 2 (MOBIL) TONNA T68 (SHELL)	
V-60	75	71 Min.	28 Min.	132	26.4 gal UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	9.2 gal. x 2 VELOCITE #6 (MOBIL) TELLUS C10 (SHELL)	.8 gal. FEBIS K68 (ESSO) VACTRA 2 (MOBIL) TONNA T68 (SHELL)	
ULTRA-550	75	71 Min.	23.7 Min.	79	26.4 gal UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	7.9 gal. (CHILLER) SPINESSO 10 (ESSO) D.T.E. 21 (MOBIL) TELLUS C10 (SHELL) .8 gal. (Spindle Lube) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	.8 gal. FEBIS K68 (ESSO) VACTRA 2 (MOBIL) TONNA T68 (SHELL)	.8 gal. Table gear box .3 gal. Magazine gear box TERESSO 68 (ESSO) D.T.E. 26 (MOBIL) TONNA T68 (SHELL)

NOTE: Consult local electrical code to determine correct wire size for the transformer KVA rating.

Attachment B
(Publication #CGENGA0026E Issued 11/14/2000)

MACHINE	TRANSFORMER (KVA)	Air Pressure	Air Volume	Coolant Capacity	HYDRAULIC UNIT	HEADSTOCK	SLIDEWAYS LINEAR GUIDES	OTHER
ULTRA-650	75	71 Min.	24.7 Min.	171.7	26.4 gal UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	7.9 gal. (CHILLER) SPINESSO 10 (ESSO) D.T.E. 21 (MOBIL) TELLUS C10 (SHELL) .8 gal. (Spindle Lube) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	.8 gal. FEBIS K68 (ESSO) VACTRA 2 (MOBIL) TONNA T68 (SHELL)	.8 gal. Table gear box .3 gal. Magazine gear box TERESSO 68 (ESSO) D.T.E. 26 (MOBIL) TONNA T68 (SHELL)
FH-4000	28	71 Min.	6.4 Min.	37	UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	4 gal. VELOCITE #3 (MOBIL)	.8 gal. FEBIS K68 (ESSO) D.T.E. 26 (MOBIL) TONNA T68 (SHELL)	AIR LUBRICATOR UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)
FH - 480/4800	75	71 Min.	19.4 Min.	132	16.6 gal. (Hyd. unit) .8 gal. (Spindle bearings) UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	10.6 gal. (CHILLER) LONG LIFE COOLANT (50%) .8 gal. (Spindle Lube) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	.8 gal. FEBIS K68 (ESSO) D.T.E. 26 (MOBIL) TONNA T68 (SHELL)	.4 gal. Index table gear FEBIS K68 (ESSO) D.T.E. 26 (MOBIL) TONNA T68 (SHELL)
FH - 580/5800	75	71 Min.	19.4 Min.	132	16.6 gal. (Hyd. unit) .8 gal. (Spindle bearings) UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	7.9 gal. (CHILLER) SPINESSO 10 (ESSO) D.T.E. 21 (MOBIL) TELLUS C10 (SHELL) .8 gal. (Spindle Lube) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	.8 gal. FEBIS K68 (ESSO) D.T.E. 26 (MOBIL) TONNA T68 (SHELL)	.4 gal. Index table gear FEBIS K68 (ESSO) D.T.E. 26 (MOBIL) TONNA T68 (SHELL)

NOTE: Consult local electrical code to determine correct wire size for the transformer KVA rating.

Attachment B
(Publication #CGENGA0026E Issued 11/14/2000)

MACHINE	TRANSFORMER (KVA)	Air Pressure	Air Volume	Coolant Capacity	HYDRAULIC UNIT	HEADSTOCK	SLIDEWAYS LINEAR GUIDES	OTHER
FH-6000	75	71 Min.	19.4 Min.	132	16.6 gal. (Hyd. unit) .8 gal. (Spindle bearings) UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	7.9 gal. (CHILLER) SPINESSO 10 (ESSO) D.T.E. 21 (MOBIL) TELLUS C10 (SHELL) .8 gal. (Spindle Lube) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	.8 gal. FEBIS K68 (ESSO) D.T.E. 26 (MOBIL) TONNA T68 (SHELL)	.4 gal. Index table gear FEBIS K68 (ESSO) D.T.E. 26 (MOBIL) TONNA T68 (SHELL)
FH - 680/6800	96	71 Min.	19.4 Min.		16.6 gal. (Hyd. unit) .8 gal. (Spindle bearings) UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	7.9 gal. (CHILLER) SPINESSO 10 (ESSO) D.T.E. 21 (MOBIL) TELLUS C10 (SHELL) .8 gal. (Spindle Lube) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	.8 gal. FEBIS K68 (ESSO) D.T.E. 26 (MOBIL) TONNA T68 (SHELL)	.4 gal. Index table gear FEBIS K68 (ESSO) D.T.E. 26 (MOBIL) TONNA T68 (SHELL)
FH - 880/8800	96	71 Min.	19.4 Min.	221	26.4 gal. (Hyd. unit) .8 gal. (Spindle bearings) UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	7.9 gal. (CHILLER) SPINESSO 10 (ESSO) D.T.E. 21 (MOBIL) TELLUS C10 (SHELL) .8 gal. (Spindle Lube) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	.8 gal. FEBIS K68 (ESSO) D.T.E. 26 (MOBIL) TONNA T68 (SHELL)	.4 gal. Index table gear FEBIS K68 (ESSO) D.T.E. 26 (MOBIL) TONNA T68 (SHELL)
FH-1080	96	71 Min.	23.7 Min.	211	42.2 gal. UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	13.2 gal. SPINESSO 10 (ESSO) VELOCITE #6 (MOBIL) TELLUS C10 (SHELL)	.8 gal. (Ballscrew) SPINESSO 22 (ESSO) VELOCITE #10 (MOBIL) TELLUS C22 (SHELL) 2.1 gal. (Slideway) TERESSO 68 (ESSO) D.T.E. 26 (MOBIL) TONNA T68 (SHELL)	3.4 gal. Table gear box .3 gal. Magazine gear box TERESSO 68 (ESSO) D.T.E. 26 (MOBIL) TONNA T68 (SHELL)

NOTE: Consult local electrical code to determine correct wire size for the transformer KVA rating.

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(Publication #CGENGA0026E Issued 11/14/2000)

MACHINE	TRANSFORMER (KVA)	Air Pressure	Air Volume	Coolant Capacity	HYDRAULIC UNIT	HEADSTOCK	SLIDEWAYS LINEAR GUIDES	OTHER
FF - 510	53	71 Min.	19.4 Min.	132	16.6 gal. (Hyd. unit) .8 gal. (Spindle bearings) UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	10.6 gal. (CHILLER) LONG LIFE COOLANT (50%) .8 gal. (Spindle Lube) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	.8 gal. FEBIS K68 (ESSO) D.T.E. 26 (MOBIL) TONNA T68 (SHELL)	.4 gal. Index table gear FEBIS K68 (ESSO) D.T.E. 26 (MOBIL) TONNA T68 (SHELL)
FF -660	53	71 Min.	19.4 Min.	132	16.6 gal. (Hyd. unit) .8 gal. (Spindle bearings) UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	10.6 gal. (CHILLER) LONG LIFE COOLANT (50%) .8 gal. (Spindle Lube) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	.8 gal. FEBIS K68 (ESSO) D.T.E. 26 (MOBIL) TONNA T68 (SHELL)	.4 gal. Index table gear FEBIS K68 (ESSO) D.T.E. 26 (MOBIL) TONNA T68 (SHELL)
H - 630 5 AXIS	75	71 Min.	23.7 Min.	106	26.4 gal. UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	7.9 gal. (CHILLER) SPINESSO 10 (ESSO) VELOCITE #6 (MOBIL) TELLUS C10 (SHELL) .8 gal. (Spindle Lube) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	.8 gal. SPINESSO 22 (ESSO) VELOCITE #10 (MOBIL) TELLUS C22 (SHELL)	.8 gal. Table gear box .3 gal. Magazine gear box TERESSO 68 (ESSO) D.T.E. 26 (MOBIL) TONNA T68 (SHELL)
H - 800	75	71 Min.	23.7 Min.	106	42.2 gal. UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	13.2 gal. SPINESSO 10 (ESSO) VELOCITE #6 (MOBIL) TELLUS C10 (SHELL)	.8 gal. (Ballscrew) SPINESSO 22 (ESSO) VELOCITE #10 (MOBIL) TELLUS C22 (SHELL) 2.1 gal. (Slideway) TERESSO 68 (ESSO) D.T.E. 26 (MOBIL) TONNA T68 (SHELL)	3.4 gal. Table gear box .3 gal. Magazine gear box TERESSO 68 (ESSO) D.T.E. 26 (MOBIL) TONNA T68 (SHELL)

NOTE: Consult local electrical code to determine correct wire size for the transformer KVA rating.

Attachment B
(Publication #CGENGA0026E Issued 11/14/2000)

MACHINE	TRANSFORMER (KVA)	Air Pressure	Air Volume	Coolant Capacity	HYDRAULIC UNIT	HEADSTOCK	SLIDEWAYS LINEAR GUIDES	OTHER
H - 1000 & 1000Q	75	71 Min.	23.7 Min.	211	42.2 gal. UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	13.2 gal. SPINESSO 10 (ESSO) VELOCITE #6 (MOBIL) TELLUS C10 (SHELL)	.8 gal. (Ballscrew) SPINESSO 22 (ESSO) VELOCITE #10 (MOBIL) TELLUS C22 (SHELL) 2.1 gal. (Slideway) TERESSO 68 (ESSO) D.T.E. 26 (MOBIL) TONNA T68 (SHELL)	3.4 gal. Table gear box .3 gal. Magazine gear box TERESSO 68 (ESSO) D.T.E. 26 (MOBIL) TONNA T68 (SHELL)
H - 1250	96	71 Min.	23.7 Min.	211	42.2 gal. UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	13.2 gal. SPINESSO 10 (ESSO) VELOCITE #6 (MOBIL) TELLUS C10 (SHELL)	.8 gal. (Ballscrew) SPINESSO 22 (ESSO) VELOCITE #10 (MOBIL) TELLUS C22 (SHELL) 2.1 gal. (Slideway) TERESSO 68 (ESSO) D.T.E. 26 (MOBIL) TONNA T68 (SHELL)	3.4 gal. Table gear box .3 gal. Magazine gear box TERESSO 68 (ESSO) D.T.E. 26 (MOBIL) TONNA T68 (SHELL)
H - 1250Q	96	71 Min.	23.7 Min.	211	42.2 gal. UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	13.2 gal. SPINESSO 10 (ESSO) VELOCITE #6 (MOBIL) TELLUS C10 (SHELL)	.8 gal. (Ballscrew) SPINESSO 22 (ESSO) VELOCITE #10 (MOBIL) TELLUS C22 (SHELL) 2.1 gal. (Slideway) TERESSO 68 (ESSO) D.T.E. 26 (MOBIL) TONNA T68 (SHELL)	3.4 gal. Table gear box .3 gal. Magazine gear box TERESSO 68 (ESSO) D.T.E. 26 (MOBIL) TONNA T68 (SHELL)
MTV-815 5 Axis	75	71 Min.	23.7 Min.	106	42.2 gal. Hydraulic Unit UNIPOWER 32 (ESSO) TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL)	.87 gal. Spindle Lubrication TERESSO 32 (ESSO) D.T.E. 24 (MOBIL) TELLUS 32 (SHELL) 19.8 GAL. Spindle Cooling SPINESSO 10 (ESSO) TELLUS C150 (SHELL) DTE 21 (MOBIL)	.8 gal. FEBIS K68 (ESSO) VACTRA 2 (MOBIL) TONNA T68 (SHELL)	3.96 gal. A / B Axis NUTO 150 (ESSO) TELLUS C150 (ESSO) EXTRA HEAVY 150 (MOBIL) 1.3 gal. ATC Unit TONNA T68 (SHELL) FEBIS K68 (ESSO) Vacuoline 1409 (MOBIL)

NOTE: Consult local electrical code to determine correct wire size for the transformer KVA rating.

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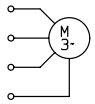
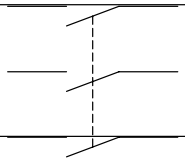
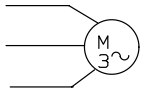
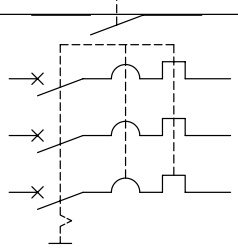
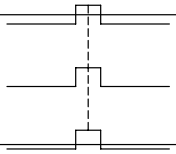
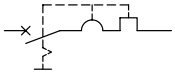
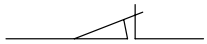
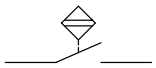
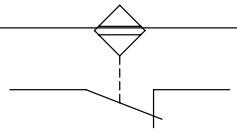
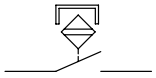
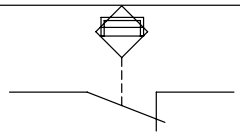
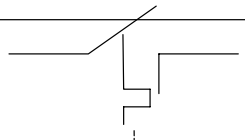
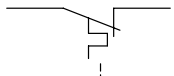
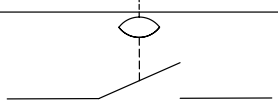
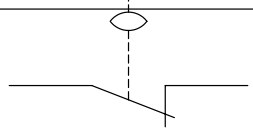
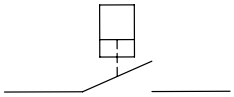
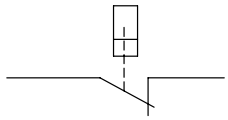
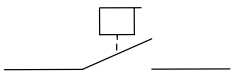
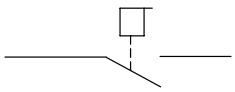
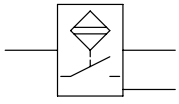
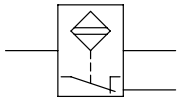
ABBREVIATION	INTERNATIONAL SYMBOL	ABBREVIATION	INTERNATIONAL SYMBOL
Three Phase Motor (M)		Electro-Magnet Contactor KM	
Three Phase Motor (M)		3 Phase Breaker (QF)	
Thermal Relay (FR)			
Breaker (QF)			
Limit Switch Make Contact (SQ)		Limit Switch Break Contact (SQ)	
Proximity Switch (SQ)		Proximity Switch (SQ)	
Reed Switch (SQ)		Reed Switch (SQ)	
Thermal Switch (ST)		Thermal Switch (ST)	
Float Switch (SL)		Float Switch (SL)	
Pressure Switch (SP)		Pressure Switch (SP)	
Flow Switch (SL)		Flow Switch (SL)	
Proximity Switch (SQ)		Proximity Switch (SQ)	

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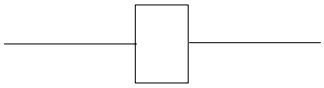
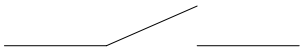
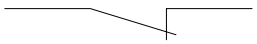
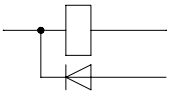
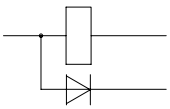
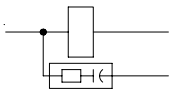
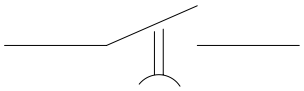
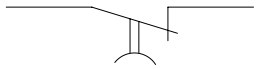
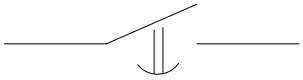
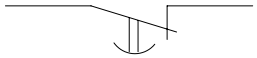
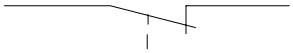
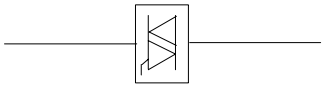
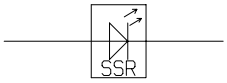
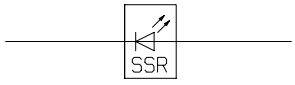
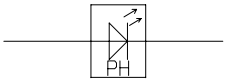
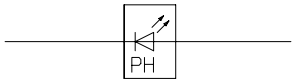
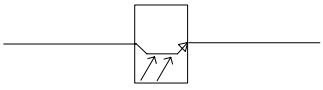
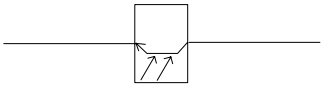
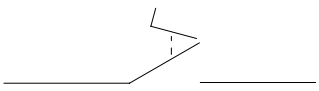
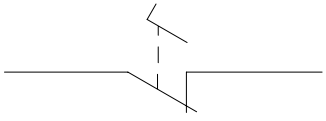
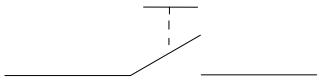
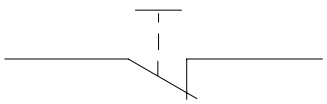
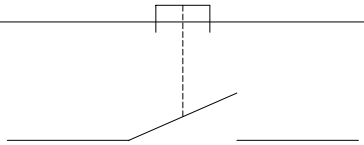
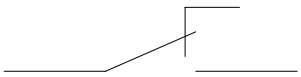
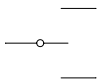
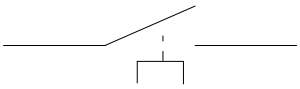
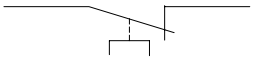
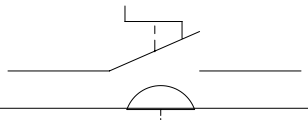
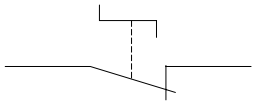
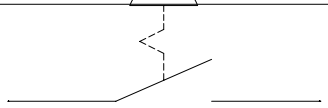
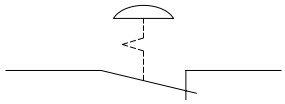
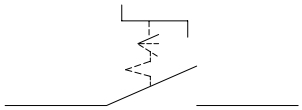
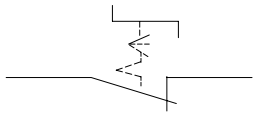
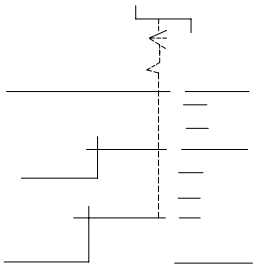
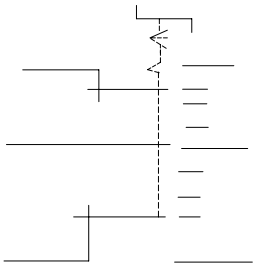
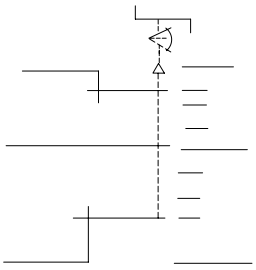
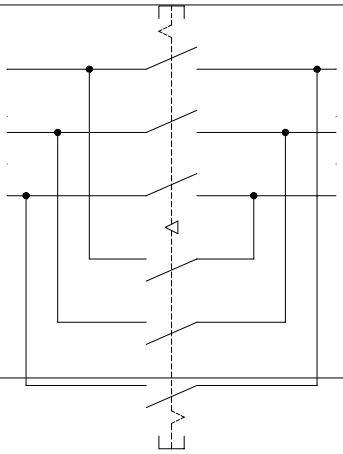
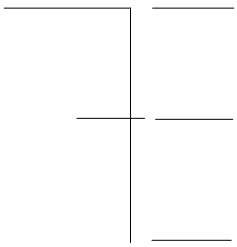
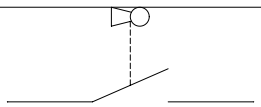
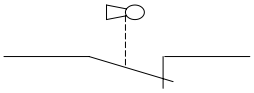
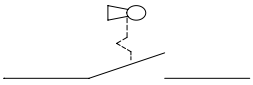
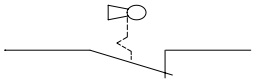
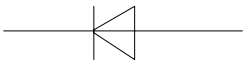
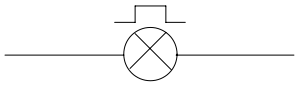
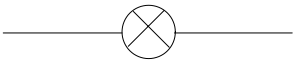
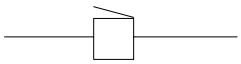
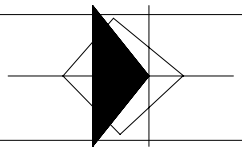
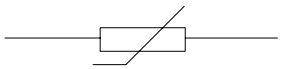
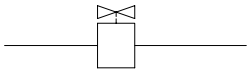
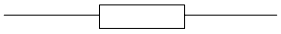
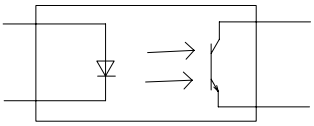
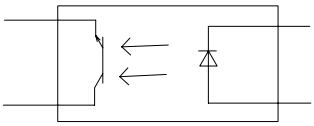
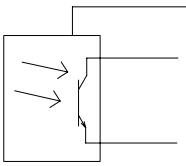
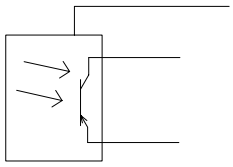
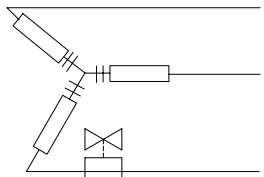
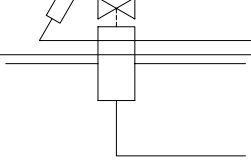
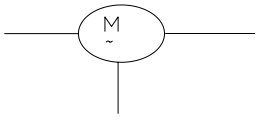
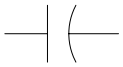
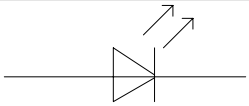
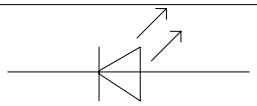
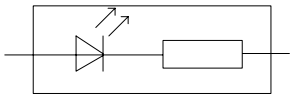
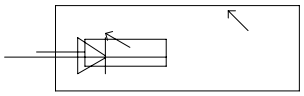
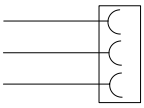
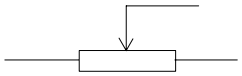
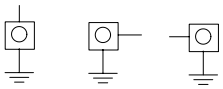
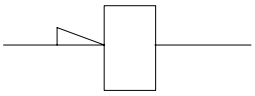
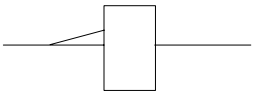
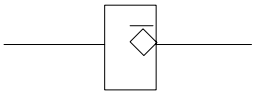
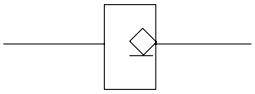
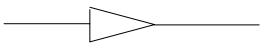
ABBREVIATION	INTERNATIONAL SYMBOL	ABBREVIATION	INTERNATIONAL SYMBOL
Relay Coil (K,KA,KT,KM)			
Make Contact (K,KA,KT,KM)		Break Contact (K,KA,KT,KM)	
Relay Coil With Diode (K,KA,KT,KM)		Relay Coil With Diode (K,KA,KT,KM)	
AC Relay (K,KA,KT,KM)		Circuit Breaker (QF)	
Contact Delayed When Closing (KT)		Contact Delayed When Reclosing (KT)	
Contact Delayed When Reclosing (KT)		Contact Delayed When Closing (KT)	
Thermal Contact (FR)		Thermal Contact (FR)	
Thermal Contact (FR)		SSR Make Contact (V)	
SSR Coil (V)		SSR Coil (V)	
Photo Coupler Coil (V)		Photo Coupler Coil (V)	
Photo Coupler Make Contact (V)		Photo Coupler Make Contact (V)	
Pedal Switch (SF)		Pedal Switch (SF)	
Manual Operated Switch (SA)		Manual Operated Switch (SA)	
Push Switch (SB)		Push Switch (SB)	

Return to Main Menu

ABBREVIATION	INTERNATIONAL SYMBOL	ABBREVIATION	INTERNATIONAL SYMBOL
Toggle Switch (SA)		Toggle Switch (SA)	
Pull Switch (SA)		Pull Switch (SA)	
Turn Switch (SA)		Turn Switch (SA)	
Push Switch (SB)		Push Switch (SB)	
Select Switch (SA)		Select Switch (SA)	
Select Switch (SA)		Select Switch (SA)	
Select Switch (SA)			
Switch (SB)		Rotary Switch (SA)	

ABBREVIATION	INTERNATIONAL SYMBOL	ABBREVIATION	INTERNATIONAL SYMBOL
Key Switch (SA)		Key Switch (SA)	
Key Switch (Manual Return) (SA)		Key Switch Manual Return (SA)	
Diode (V)		Spark Killer (Z)	
Flashing Light (HL)		Light (HL)	
Buzzer (HA)		Diode (Bridge) (V)	
Varistor (RV)		Solenoid Valve (YV)	
Resistor (R)			
AC Motor (M)		DC Motor (M)	
Photo Coupler (V)		Photo Coupler (V)	
Photo Switch (NPN) (SQ)		Photo Switch (PNP) (SQ)	
Three Phase Spark Killer (Z)			
Selenoid Valve With Grd (YV)		AC Motor With Grd (M)	

ABBREVIATION	INTERNATIONAL SYMBOL	ABBREVIATION	INTERNATIONAL SYMBOL
SSR (V)		Capacitor (C)	
LED (HL)		LED (HL)	
LED Register (HL)		LED Register (HL)	
Outlet (X)		Volume (VR)	
Earth With Earth Bar (E)		Frame Earth	
Earth (Protective Earth) (PE)		Protective Earth (PE)	
PLC Input (X)		PLC Input (X)	
PLC Output (Y)		PLC Output (Y)	
Analog Output (Y)			

MECHANICAL PARTS LISTS

1. DOCUMENTATION QUALITY & CUSTOMER SATISFACTION

MAZAK is committed to the highest levels of customer service and support. If a machine problem is encountered, contact the nearby service office of the *OPTIMUM Customer Support Network* (See page P-4) for assistance. Please use the documentation evaluation form (See page P-4) for any comments and suggestions for improvement. The purpose of the mechanical parts list is to provide unit assembly drawings and service parts identification for MAZAK machine tools when servicing a machine or ordering parts.

2. DESCRIPTION

To find the desired unit assembly number:

The first pages of the mechanical parts list gives a listing of unit assembly descriptions and numbers. The pages that follow include a table of contents, giving a detailed listing of each unit assembly.

Example :

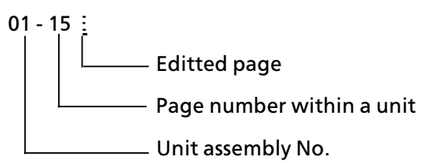
MECHANICAL PARTS LIST

SUPER QUICK TURN
15/M/MS/18/M/MS

INDEX

UNIT - NAME	UNIT
HEAD 1	01
TURRET 1	15
X DRIVE 1	25
Z DRIVE 1	30
B DRIVE 1	33
CARRIAGE	

The page number is comprised of two or three parts. The first number refers to the unit assembly number. The second number denotes the sequential page number within each unit. “E” is marked an editted page.



A third number may be added if additional pages are necessary.

Example: 02-10-1

*** * CAUTION * ***

TO ENSURE PROPER SHIPMENT OF REPLACEMENT PARTS

Mazak machines are manufactured at several international production facilities. Each location uses components supplied by local vendors. On items such as lubrication, hydraulic & pneumatic components, please obtain the vendor part information from the actual machine part before ordering.

The following parts lists include vendor parts used by all of these manufacturing locations, therefore, it is critical to match the specific part on your machine with the appropriate list.

Note: Mazak part numbers for vendor supplied items begin with *alpha* characters. Example: G06MPH00010.

3. HOW TO ORDER REPLACEMENT PARTS.

When ordering replacement parts, call the nearest MAZAK service center with the following machine information: (Please reference the *Mazak Customer Support Network* map on page P-4)

① Your machine model and type.
② Machine serial number.
③ Mechanical parts list publication number you are using.
④ Page number where the parts references are shown.
⑤ Mazak part number (11 digits).
⑥ Part name and manufacturer’s part number.
⑦ Vendor part identifier (taken from the actual part)
⑧ Quantity to order.

4. COMPOSITION

The mechanical parts list of each unit assembly is comprised of the mechanical assembly drawings and the applicable parts lists.

4-1 Unit Assembly Drawings

The unit assembly drawings show “balloon” numbers, “①”, referencing parts to an index number in the parts lists.

4-2 Parts List Descriptions

The following notations are shown in the parts list:

① INDEX No.	④ REMARKS.	⑦ RANK.
② PARTS No.	⑤ MAKER.	⑧ LIST No.
③ PARTS NAME.	⑥ Q’TY.	

SAMPLE PARTS LIST:

① IND NO.	② PART-NO.	③ PART-NAME	④ REMARKS	⑤ MAKER	⑥ Q’TY A	B	- - -	P	Q	⑦ RANK	⑧ LIST-NO.
1	A06CB100500	HEX HEAD SCREW	M10x50		8						935215B0102
2	J2600P10200	O RING	P102		1						

4-2-1 ① INDEX No.

This number corresponds to a “balloon” number in the parts assembly drawings. The index numbers are listed sequentially starting from No.1 in the parts list of each unit.

4-2-2 ② PART No.

There are two types of Mazak 11 digit part numbers, Mazak produced and vendor supplied parts.

These parts are classified as follows.

a) Mazak produced parts.

The parts designed and made by MAZAK.

b) Purchase parts number.

The parts which MAZAK defined specifications and are made by a vendor.

c) COMMENTS IN A PARTS NUMBER SPACE.(in the column)

- The parts with index number on it,yet the parts which not to be used for the time being or deleted parts,written word of NOT USED or DELETED.
- In case of use purchased parts,written word of “COMM’L. also “NO NUMBER” if it’s no parts number.

4-2-3 ③ PARTS NAME

Parts description as defined by the MAZAK engineering department.

4-2-4 ④ REMARKS

Information regarding to the parts.(supplement)

a) To identify parts composition.

(USED WITH - - -)

Noted as above if a part is used with other parts additional parts name is followed by above a words *“USED WITH”*.

b) Manufacturer's part number

c) Hardware description (eg.: bolt size)

d) Similar part numbers may be identified as an eleven digit number in parentheses.

4-2-5 ⑤ MAKER

The Manufacturer of the parts. This is typically shown under the remarks heading in parentheses.

4-2-6 ⑥ Q’TY

The number of items used in this unit assembly.

Quantity requirements for specification variations, such as machines with optional equipment, are listed under identifying alphabet characters, “ A B C ····”, which correspond to the specific option

4-2-7 ⑦ RANK

Classifications according to duration of the parts, for example, an “A” item has a shorter service life than a Rank B item and so forth. This information may be supplied as a spare parts guide.

4-2-8 ⑧ LIST No. (shown in the parts list header box)

Parts list number applicable for the assembly drawing. (For MAZAK internal use .)

5. HOW TO USE THE MECHANICAL PARTS LISTS.

To find the desired part numbers, follow the procedures outlined below.

Example :

MECHANICAL PARTS LIST

SUPER QUICK TURN
15/M/MS/18/M/MS

INDEX

UNIT - NAME	UNIT
HEAD 1	01
TURRET 1	15
X DRIVE 1	25
Z DRIVE 1	30
B DRIVE 1	33
CARRIAGE	

(1) Identify the desired machine unit assembly shown in the master index (the first pages of each parts list).

(2) Open the manual to the unit assembly drawings and locate the desired parts. (see section 4-1)

(3) Using the “balloon” numbers associated with the parts, open the manual to the parts list and make note of the Mazak eleven digit part codes,part names, remarks and quantities used.

6. ABBREVIATIONS

6-1 Following abbreviations are used in assembly drawing numbering.

ABBREVIATION	DESCRIPTION
HCD (HD)	Hydraulic circuit diagram
ACD (HD)	Air circuit diagram
CCD (CD)	Coolant circuit diagram
LCD (LD)	Lubrication circuit diagram
SCD (SD)	Spindle Cooling system diagram

6-2 The following abbreviations are used in the mechanical parts list for part descriptions.

ABB’N	DESCRIPTION
ASSY	Assembly
BRKDN	Breakdown
BRG	Bearing
COML	Commercial
DWG	Drawing
EFF	Effectivity
HEX	Hexagon
HD	Head
IDX	Index
LK	Lock
NHA	Next Higher Assembly
Q’TY	Quantity
SCR	Screw
SEC	Section
SKT	Socket

MACHINE DOCUMENTATION CUSTOMER EVALUATION

Mazak

The Other Thoroughbred From Kentucky

Your opinion is important to enable us to issue documentation that will fit your needs.
Thank you for taking the time to supply this information.

Date: _____

Machine Type: _____ Machine Serial#: _____ NC Type: _____

Customer: _____ Reported By: _____

Address: _____ Position: _____

_____ Telephone#: _____

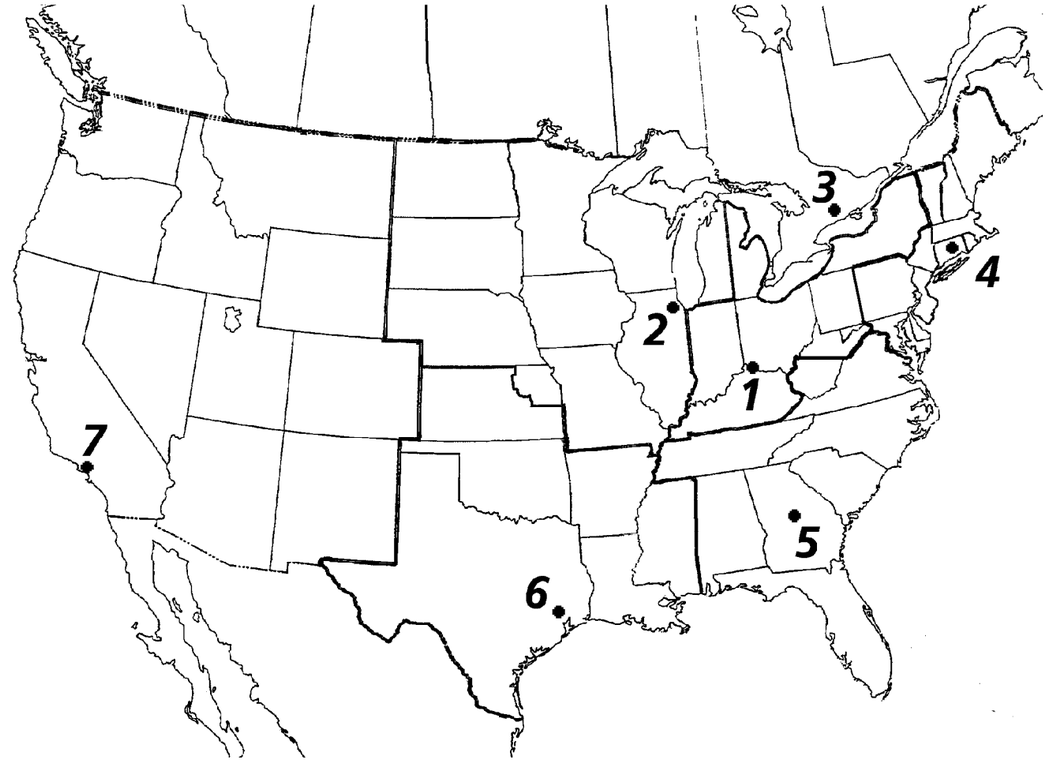
Manual Publication #: _____

	Excellent	Good	Adequate	Fair	Poor
How well is the documentation suited to your needs?	☐	☐	☐	☐	☐
Were you able to find the necessary information easily?	☐	☐	☐	☐	☐
How well are the manuals organized?	☐	☐	☐	☐	☐
How easy are the manuals to understand?	☐	☐	☐	☐	☐
Are the illustrations helpful?	☐	☐	☐	☐	☐
Overall, how do you rate the documentation?	☐	☐	☐	☐	☐

What did you like about the documentation? How can it be improved?

RETURN TO: MAZAK Corporation
Technical Publication Dept.
8025 Production Drive
Florence, Kentucky 41042

OPTIMUM CUSTOMER SUPPORT NETWORK



1	North Central Technical Center (Florence, Ky.)	(606) 342-1775
	Technical Education & Training Center (Florence, Ky.)	(606) 342-1482
2	Midwest Technical Center (Chicago, Ill.)	(847) 885-8311
3	Canada Service Center (Mississauga, Ont.)	(905) 670-0201
4	East Technical Center (Hartford, Ct.)	(860) 528-9511
5	Southeast Technical Center (Atlanta, Ga.)	(770) 996-1030
6	Southwest Technical Center (Houston, Tx.)	(281) 931-7770
7	West Technical Center (Los Angeles, Ca.)	(310) 327-7172

MAZAK After Hours Customer Service Hotline . . . . . (800) 231-1456

OUR 3RD DECADE OF MANUFACTURING IN KENTUCKY

NOTES:

NOTES:

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SECTION 3

TURNING MACHINE CENTERS

Return to Main Menu

Machine Tool Building Concept

- Machine building concept is to build a machine to a certain optimum geometric alignment, to gain accuracy and finish of part. When these alignments are achieved the assemblies are ***shimmed, scraped in, or pinned to the specific tolerance range*** and documented. Through many sub-assembly stations and final run-off of the machine building process, these alignments are checked repeatedly by different inspection personnel and applications.

- However, there are give points engineered into the machine, this allows movement on certain units in the case of an unexpected impact. These give points have ***adjustment bolts / slip couplings*** at locations to allow movement of the unit back to it's specific geometric alignment.

- ***Qualify the level first, before attempting alignment of the machine. In most cases the machines level is used to bring the tolerance in.***

- Periodic inspection of the machine alignments should be preformed (annually). This allows time for the maintenance department to inspect the machine for wear and mis-alignment. This is called preventive maintenance. There should be a copy of an accuracy test chart inside the electrical cabinet from when the machine was first received.

Note: Before making any adjustments on the machine be certain that the machine has good levels.

Lathe Leveling Procedure

- Calibrate a precision level by laying the level on a somewhat known level surface. Note the measurement on the level, and then rotate the level 180 degrees to verify that both directions repeat.

- Achieve an earth level to allow the proper coolant run-off. While leveling the machine keep in mind that there will be coolant pans and so on that will need the proper amount of clearance. Once leveling has began try not to back off the jack-bolts.

- Bring the x-axis and the z-axis to the center of their stroke. Mount the leveling plate that came with the machine to the turret. Make sure all jack-bolts are touching the ground, except the two outside corners located on the headstock side and any supports under electrical cabinets and so on. Using a ball of clay under both ends of the level, place one level on the plate in the z-axis direction and one level in the x-axis direction. Compress both levels into the clay until both levels read level.

- While monitoring the levels move the z-axis to the plus/home side of its stroke. The level in the z-axis direction will display if there is a crown in the axis movement. The level in the x-axis direction will display if there is a twist in the axis movement. Make adjustments with the jack-bolts, attempting to bring the levels back to the starting point that you began with in the center of the stroke. After making adjustments on the plus/home side, now move the z-axis to the minus/end of stroke. Also adjust the jack-bolts, attempting to bring the levels back to the starting point that you began with in the center of the stroke (Note: at this time don't use the two outside corners located on the headstock side).

- Next check the taper of the spindle. Take a piece of average size bar-stock and clamp it in the chuck. Take a few finish cuts until the bar-stock cleans up. Using a Mic measure the diameter of the bar-stock at both ends. On average the taper of the spindle should be within .0004"/12." If the taper is not within this tolerance, adjustments will need to be made.

- Last without removing the good taper cut bar-stock, place an indicator from the turret to the top of the bar-stock. Using z-axis run the indicator across the top of the bar-stock, the tolerance is the same as the taper cut .0004"/12." At this point an adjustment will normally need to be made. Adjusting is done by increasing the pressure on the two outside corners located on the headstock side.

- After completing leveling recheck all the jack-bolts for contact to the leveling pad. Also support the electrical cabinet and so on.

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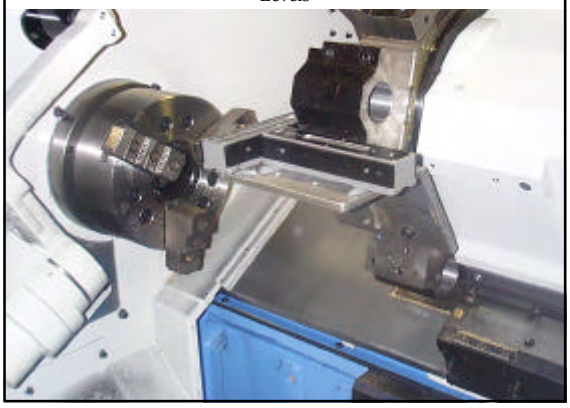
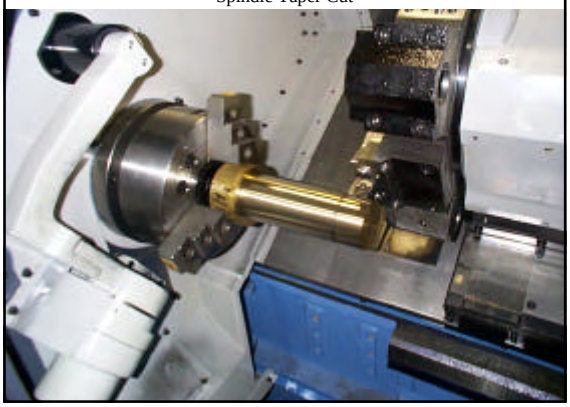
Levels

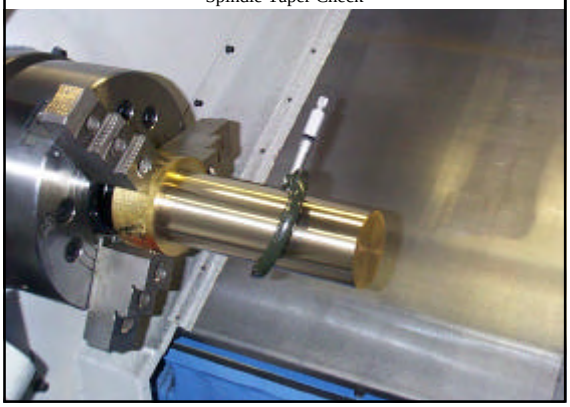


Notes

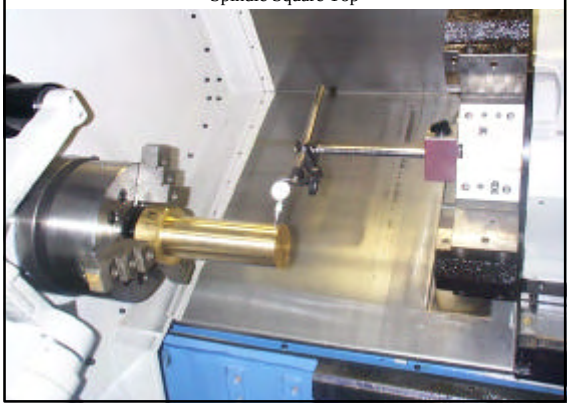
Spindle Taper Cut



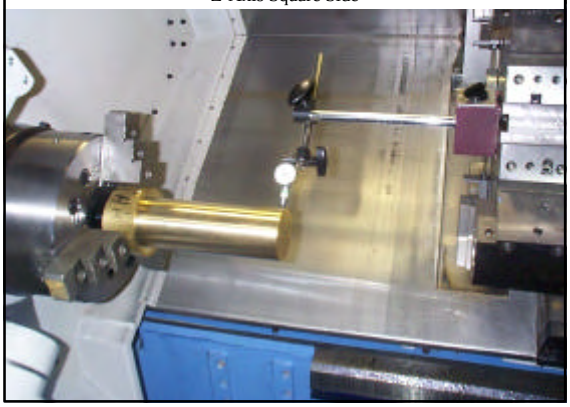
Spindle Taper Check



Spindle Square Top



Z-Axis Square Side



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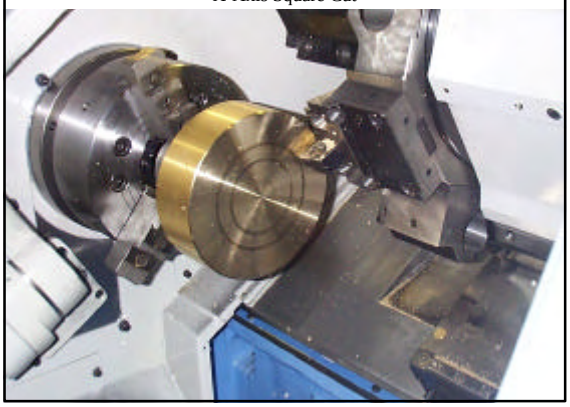
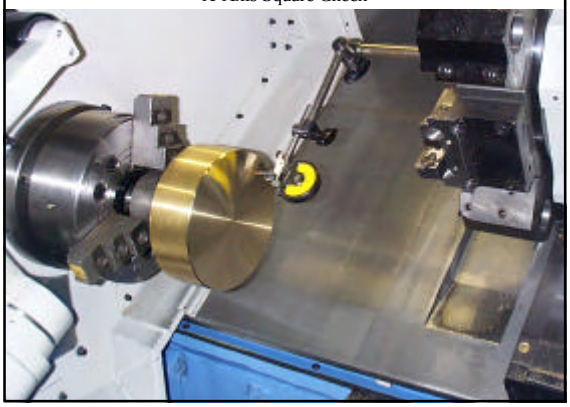
X-Axis Square Cut



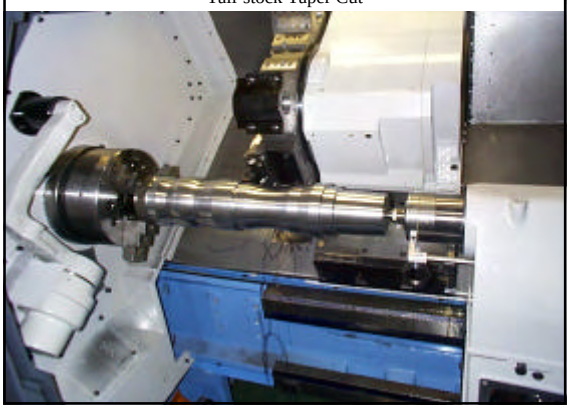
X-Axis Square Check



Tail-stock Square Top

Tail-stock Square Side

Tail-stock Taper Cut



Tail-stock Taper Check

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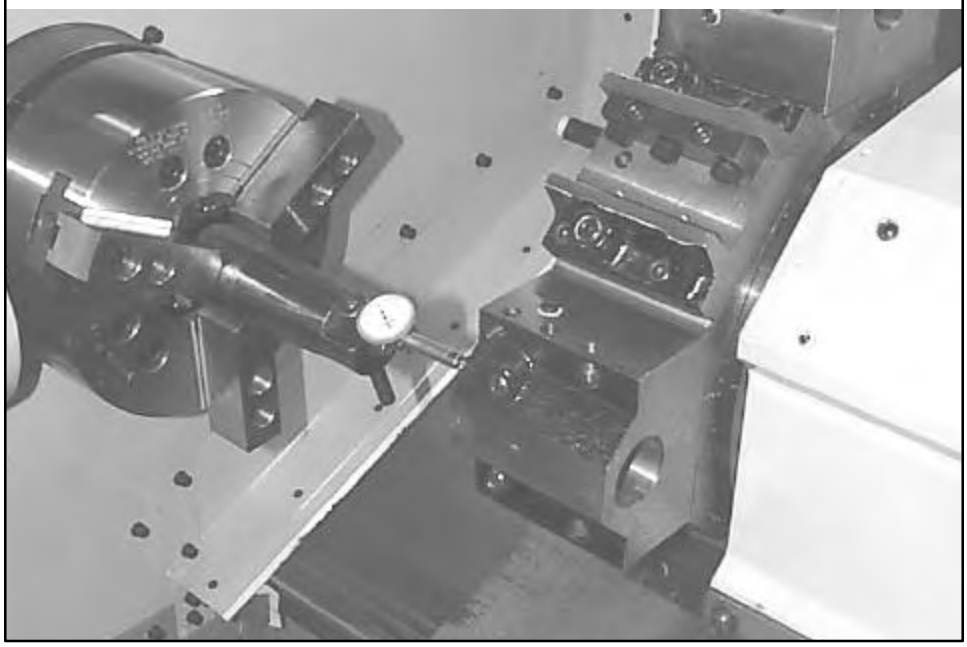
Z-Axis Home

X-Axis Home



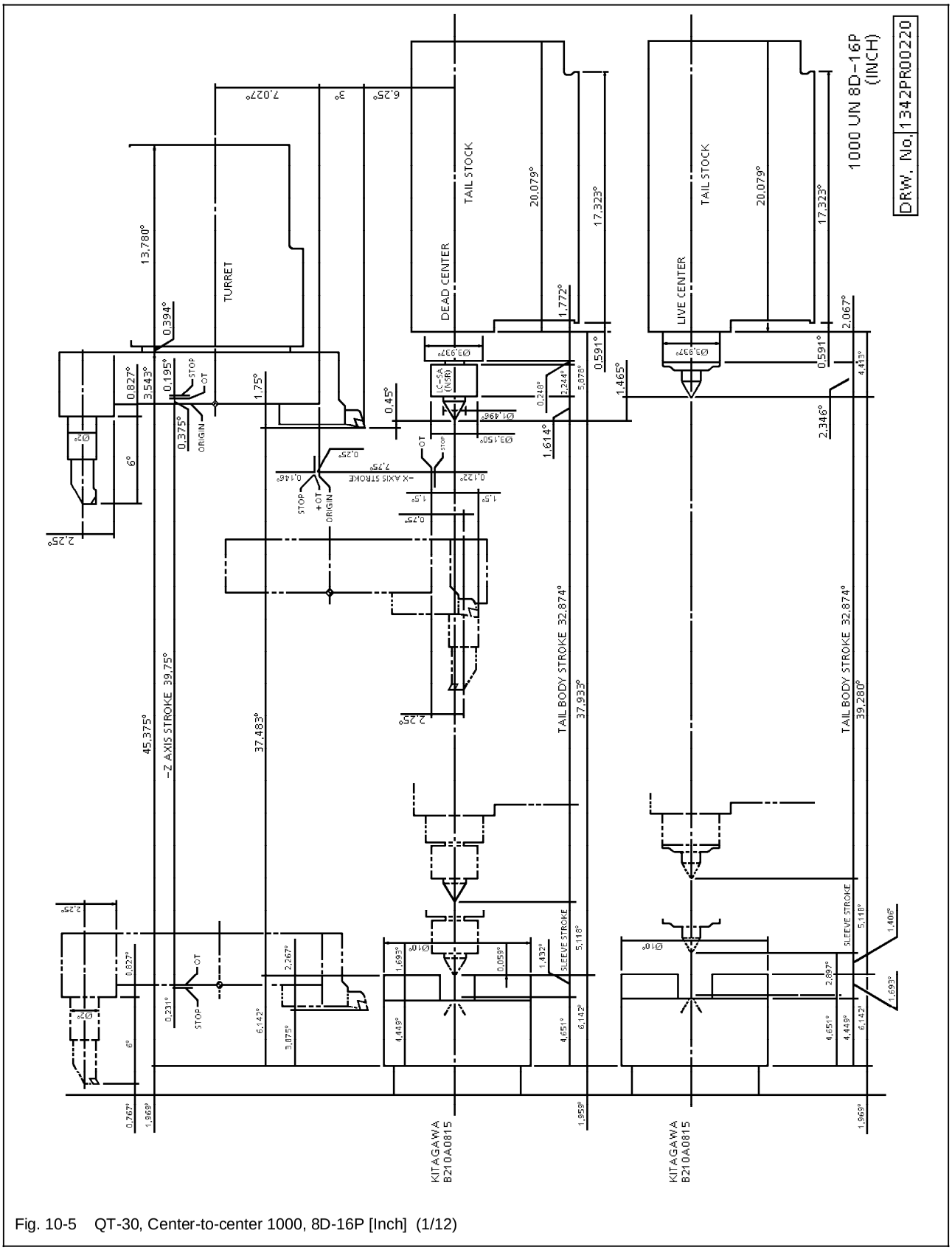


Fig. 10-5 QT-30, Center-to-center 1000, 8D-16P [Inch] (1/12)

Return to Main Menu

Tool-eye Calibration

*Adjust the tool-eye height until the tip of the insert is at the center of the sensor. Adjustment is achieved by rotating the eccentric pin.

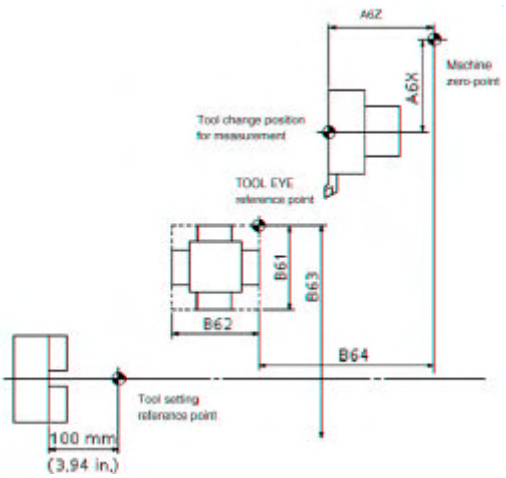
*Adjust the parallelism of the two machined surfaces on the sensor to be parallel to the x-axis within (0.000079 in.).

*Parameter (B61) -The measurement of the distance from sensor contacts (X1)-(X2). Using the machine as a measuring device, select a boring tool. In manual mode using the shaft of the tool, move the tool toward the sensor (X1) until sensor beeps. On the position page change x-axis to (0.0000). Now move the tool toward the sensor (X2). Take the new # that now appears on the position page under the x-axis. Divide the position by two, then subtract the diameter of the tool shaft. The remaining value is the new parameter.

*Parameter (B62)-The measurement of the distance from sensor contacts (Z1)-(Z2). Using the machine as a measuring device, clamp a boring tool shaft to the turret pointing in the x-axis direction. In manual mode move the tool shaft toward the sensor (Z1) until sensor beeps. On the position page change z-axis to (0.0000). Now move the tool shaft toward the sensor (Z2). Take the new # that now appears on the position page under the z-axis and subtract the diameter of the tool shaft, the remaining value is the new parameter.

*Parameter (B63)-The measurement of the distance from sensor contact (X1) to spindle center line. Lightly turn a piece of bar stock and measure the diameter of the bar after the cut. (Note: after turning the stock don't back the x-axis off of the stock.). Go to tool data page. Cursor down in tool set column x to tool that is being used. Press menu button teach, then input the diameter of stock. Record the value that appears in the tool-set column. Next teach the same tool using the tool eye. Compare the previous value to the new value in the tool set column and add or subtract half the difference to the parameter (B63).

*Parameter (B64)-The measurement of the distance from sensor contact (Z1) to the face of the chuck. Using a turning tool , move the tip of the tool toward the sensor (Z1) until it beeps. On the position page change z-axis to (0.0000). Using a 100mm gauge block, move the tool tip toward face of chuck until the tip is 100mm away from chuck. Take the value that is now displayed under the z-axis and subtract it from the value in parameter (A8), this is the new value for (B64).



NOTES:

NOTES:

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SECTION 4

HORIZONTAL MACHINE CENTERS

Return to Main Menu

Machine Tool Building Concept

- Machine building concept is to build a machine to a certain optimum geometric alignment, to gain accuracy and finish of part. When these alignments are achieved the assemblies are ***shimmed, scraped in, or pinned to the specific tolerance range*** and documented. Through many sub-assembly stations and final run-off of the machine building process, these alignments are checked repeatedly by different inspection personnel and applications.

- However, there are give points engineered into the machine, this allows movement on certain units in the case of an unexpected impact. These give points have ***adjustment bolts / slip couplings*** at locations to allow movement of the unit back to it's specific geometric alignment.

- ***Qualify the level first, before attempting alignment of the machine. In most cases the machines level is used to bring the tolerance in.***

- Periodic inspection of the machine alignments should be preformed (annually). This allows time for the maintenance department to inspect the machine for wear and mis-alignment. This is called preventive maintenance. There should be a copy of an accuracy test chart inside the electrical cabinet from when the machine was first received.

Note: Before making any adjustments on the machine be certain that the machine has good levels.

Horizontal Leveling Procedure

- Calibrate a precision level by laying the level on a somewhat known level surface. Note the measurement on the level, and then rotate the level 180 degrees to verify that both directions repeat.

- Achieve an earth level to allow the proper coolant run-off. While leveling the machine keep in mind that there will be coolant pans and so on that will need the proper amount of clearance. Once leveling has began try not to back off the jack-bolts.

- Bring all axis to the center of their stroke. Place two precision levels on the pallet. One level parallel to the axis stroke and one level perpendicular to axis stroke. The level parallel to axis stroke is considered the crown. The level perpendicular to axis stroke is considered the twist.

- While monitoring the levels move the pallet to the plus/home side of its stroke. Make adjustments with the jack-bolts, attempting to bring the levels back to the starting point that you began with in the center of the stroke. After making adjustments on the plus/home side, now move the pallet to the minus/end of stroke. Also adjust the jack-bolts, attempting to bring the levels back to the starting point that you began with in the center of the stroke.

- Return all axis to the center of their stroke again. Place two precision levels on a bracket mounted to the headstock or in the back of the column depending on the machine. Using a ball of clay under both ends of the level, place one level parallel to the axis stroke and one level perpendicular to axis stroke. The level parallel to axis stroke is considered the crown. The level perpendicular to axis stroke is considered the twist. Compress both levels into the clay until both levels read level.

- While monitoring the levels move the headstock to the plus/home side of its stroke. Make adjustments with the jack-bolts, attempting to bring the levels back to the starting point that you began with in the center of the stroke. After making adjustments on the plus/home side, now move the haedstock to the minus/end of stroke. Also adjust the jack-bolts, attempting to bring the levels back to the starting point that you began with in the center of the stroke.

- After completing leveling recheck all the jack-bolts for contact to the leveling pad; as well as, electrical cabinets, magazine, pallet changer, ect.

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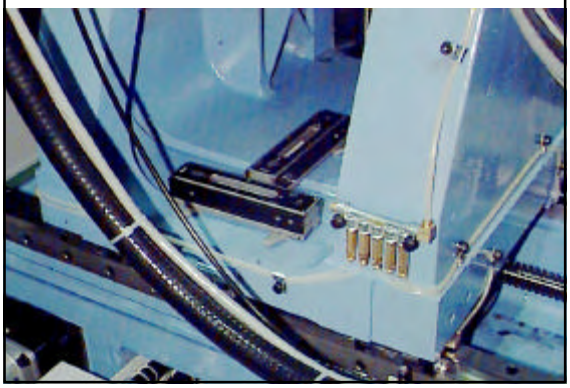
Levels

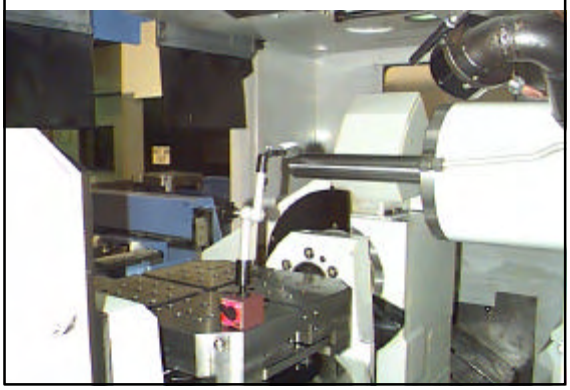
Levels



Pallet Flatness

Squares

Spindle Alignment



Tool Knock-out

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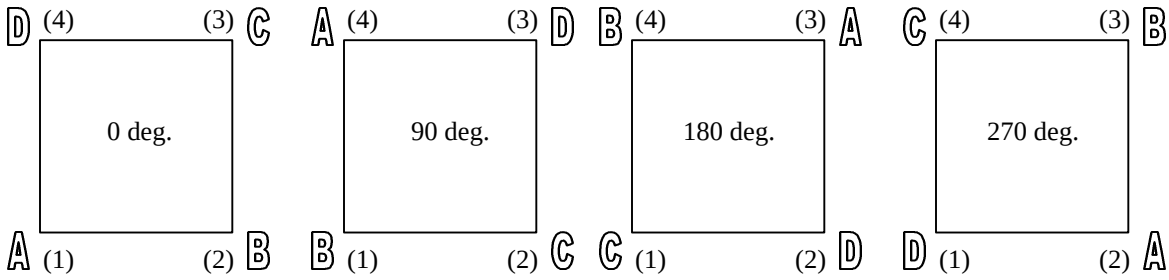
PALLET # 1



A ☐ + ☐ + ☐ + ☐ = ☐ /4 = ☐

B ☐ + ☐ + ☐ + ☐ = ☐ /4 = ☐

C ☐ + ☐ + ☐ + ☐ = ☐ /4 = ☐

D ☐ + ☐ + ☐ + ☐ = ☐ /4 = ☐

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(2) ☐ + ☐ + ☐ + ☐ = ☐ /4 = ☐

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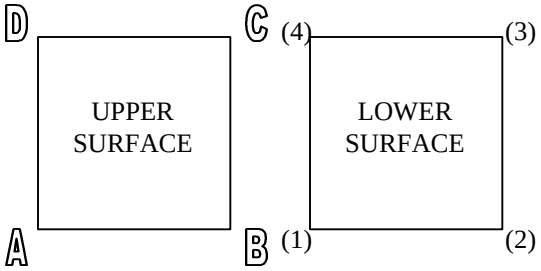
PALLET # 1



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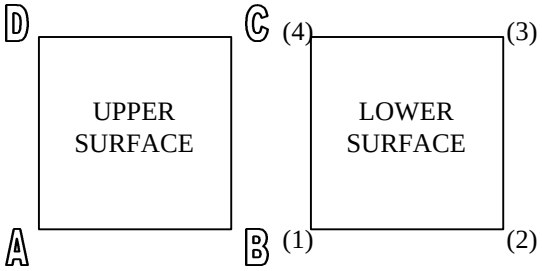
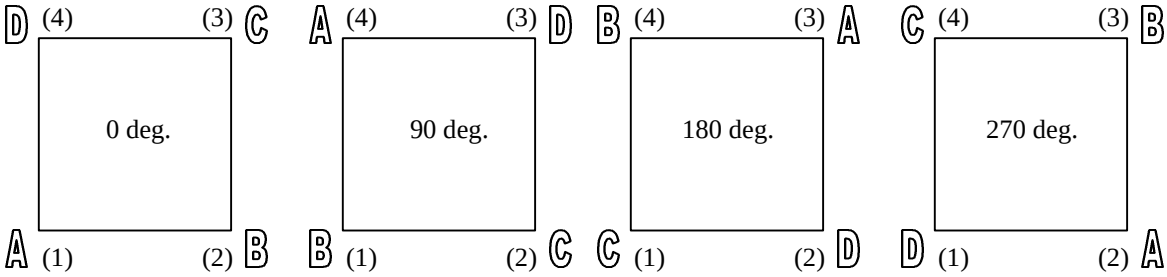


PALLET # 2



A ☐ + ☐ + ☐ + ☐ = ☐ /4 = ☐

B ☐ + ☐ + ☐ + ☐ = ☐ /4 = ☐

C ☐ + ☐ + ☐ + ☐ = ☐ /4 = ☐

D ☐ + ☐ + ☐ + ☐ = ☐ /4 = ☐

(1) ☐ + ☐ + ☐ + ☐ = ☐ /4 = ☐

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(3) ☐ + ☐ + ☐ + ☐ = ☐ /4 = ☐

(4) ☐ + ☐ + ☐ + ☐ = ☐ /4 = ☐

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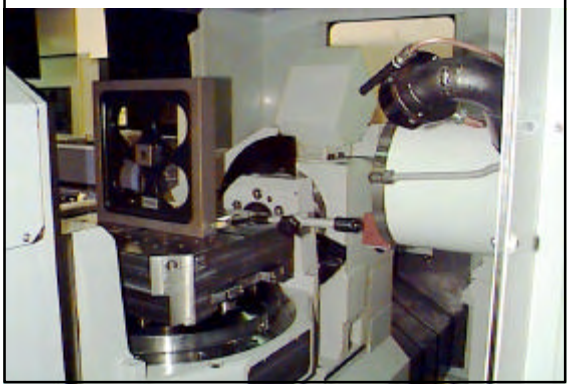
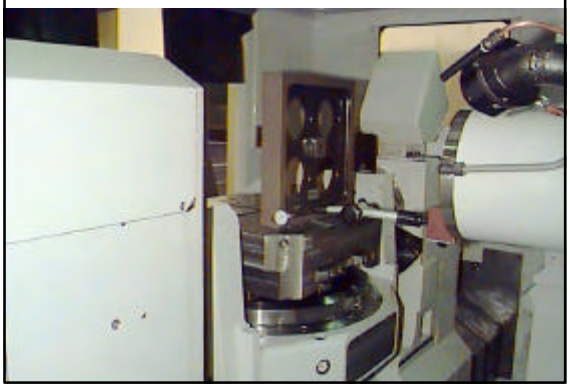
YZ Square

YZ Square



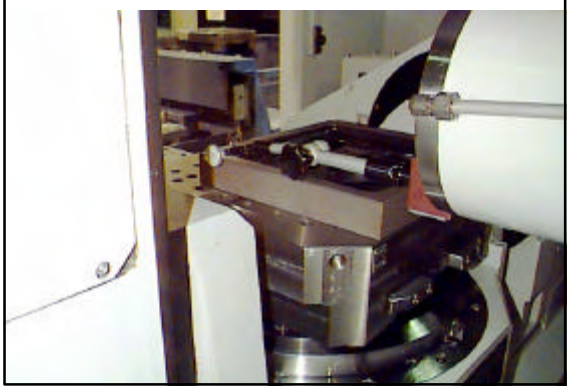
XY Square

XY Square



XZ Square

XZ Square



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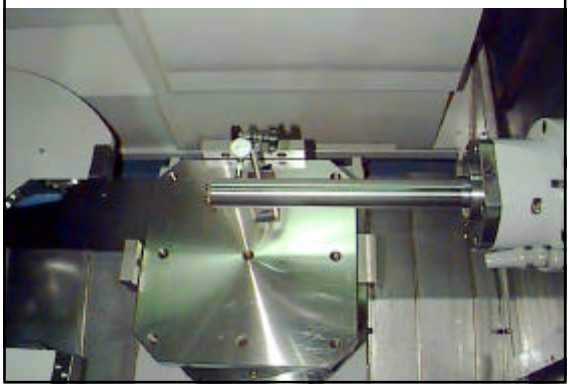
X Home

X Home



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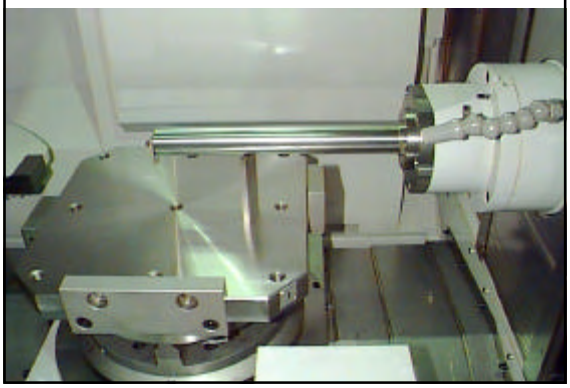

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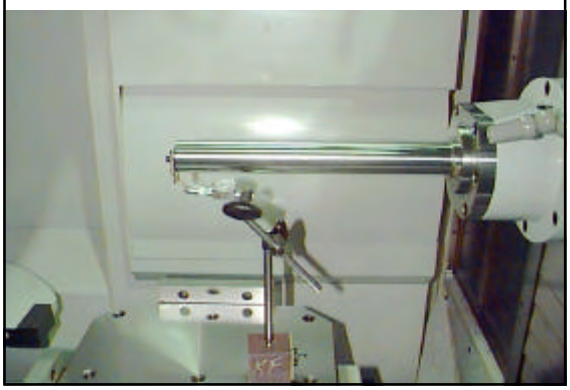
Z Home



Stroke Diagram

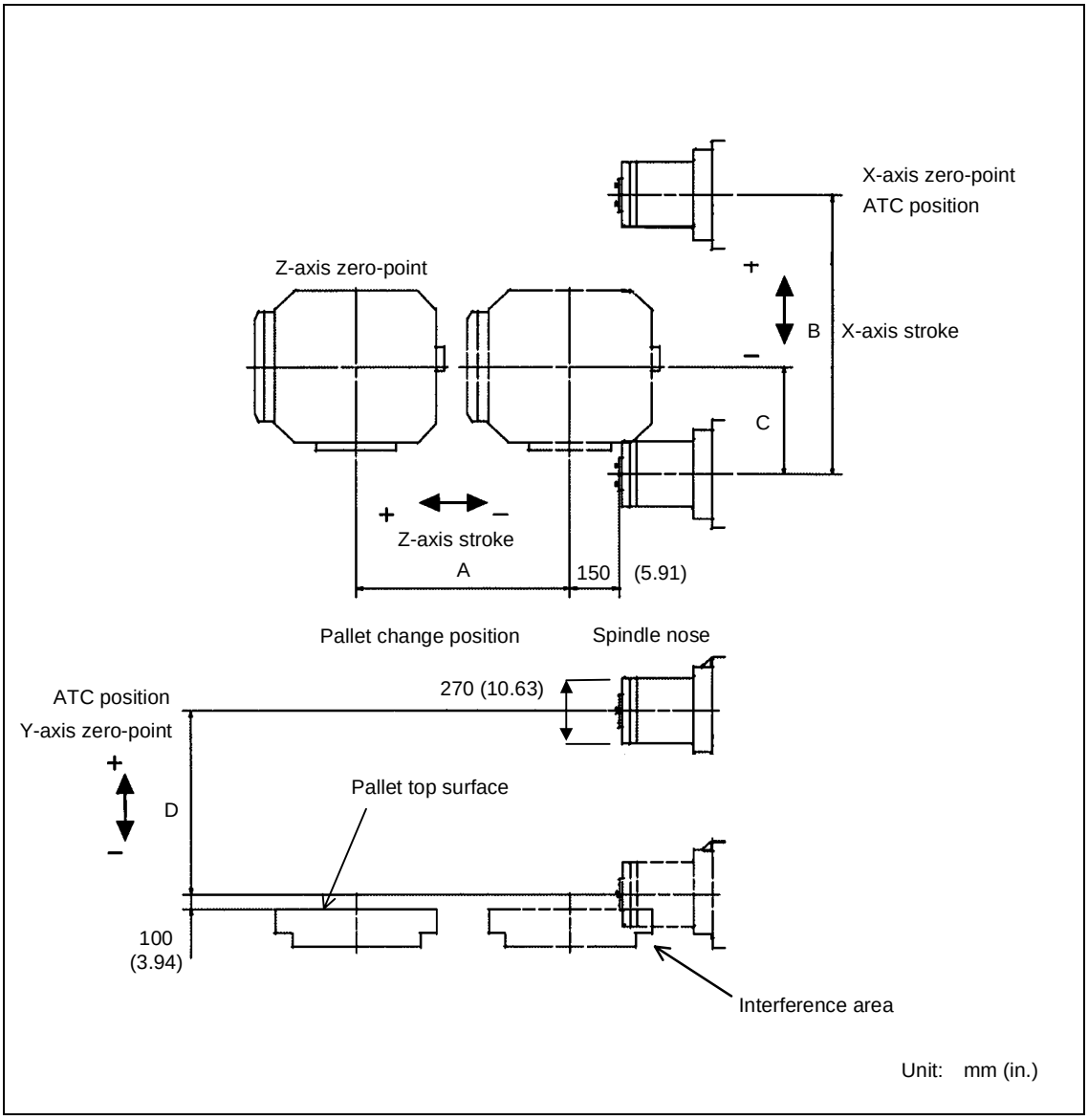


Fig. 1-1 Stroke Diagram

Unit: mm (in.)

Stroke	FH-6800
A	880 (34.65)
B	1050 (41.34)
C	525 (20.67)
D	800 (31.50)

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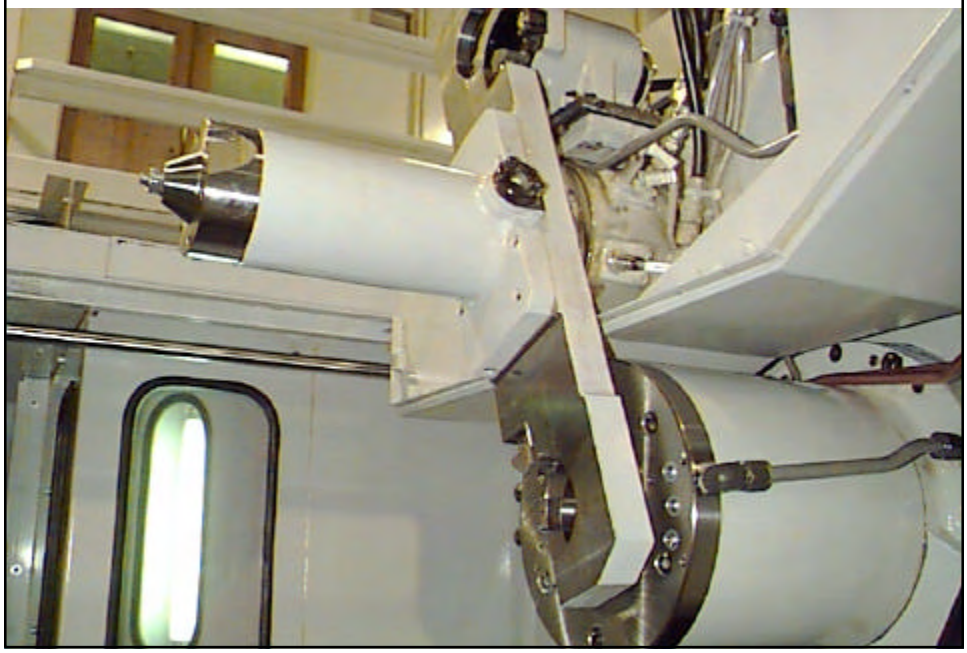
Auto Tool Changer Alignments



Auto Tool Measure

Auto Tool Length Measure Calibration

- Adjust the parallelism of the machined surface on the shaft to be parallel to the x and y-axis within (0.0015 in.).

- Parameter (R2390)-The measurement of the distance between the deceleration sensor to the skip sensor. This distance will not normally need to be adjusted unless the sensors have been replaced. After replacing the sensor load any tool into the spindle. In manual mode move the tip of the tool to the tip of the measure unit until the input address for the deceleration sensor is made (input address can be located in the PLC or Electrical Circuit Diagrams). At this point change the z-axis position to (0.0000). Now move the z-axis more in the minus direction until the skip sensor is made or it sounds a beep. Now compare the new # displayed for z-axis position to the value written in parameter R2390. The result should be within (± .008”). If not within move the replaced sensor and recheck.

- Parameter (R2392)-The measurement of the z-axis Skip position. This parameter is often adjusted if the measure unit has been moved. To properly adjust you must first find the actual length of a tool while in the spindle. With any tool place an indicator set at zero on the tip of the tool. Now zero the value in the z-axis position on the display screen. Next in a manual mode move the indicator away from the tool, and then move the tip of the indicator to the face of the spindle until the indicator reads zero again. Record the new value now displayed on the position page. You are now ready to do an auto tool measure. (Note: The parameters R2396 and R2398 must have already been set correctly) In the MDI mode select Auto Tool Measure from the menu buttons and input the tool # that you just manually measured. Next cycle start (you may choose to slow the rapid feed down the first time). After the tool has been measured go to the tool data page and compare the actual tool length to the auto tool measured length. If there are any differences adjust R2392 by the difference.

- Parameter (R2396)-The y-axis start position of tool length measure. This parameter is often adjusted if the measure unit has been moved. To properly adjust you must first select a tool. In manual mode move the tool to the measure unit until the center line of both are matched. The new value now displayed on the position screen under machine y-axis is the new value of R2396.

- Parameter (R2398)-The x-axis start position of tool length measure. This parameter is often adjusted if the measure unit has been moved. To properly adjust you must first select a tool. In manual mode move the tool to the measure unit until the center line of both are matched. The new value now displayed on the position screen under machine x-axis is the new value of R2398.

Note: The control has to be powered off and on to make these parameters active.

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SECTION 5

VERTICAL MACHINE CENTERS

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Machine Tool Building Concept

- Machine building concept is to build a machine to a certain optimum geometric alignment, to gain accuracy and finish of part. When these alignments are achieved the assemblies are ***shimmed, scraped in, or pinned to the specific tolerance range*** and documented. Through many sub-assembly stations and final run-off of the machine building process, these alignments are checked repeatedly by different inspection personnel and applications.

- However, there are give points engineered into the machine, this allows movement on certain units in the case of an unexpected impact. These give points have ***adjustment bolts / slip couplings*** at locations to allow movement of the unit back to it's specific geometric alignment.

- ***Qualify the level first, before attempting alignment of the machine. In most cases the machines level is used to bring the tolerance in.***

- Periodic inspection of the machine alignments should be preformed (annually). This allows time for the maintenance department to inspect the machine for wear and mis-alignment. This is called preventive maintenance. There should be a copy of an accuracy test chart inside the electrical cabinet from when the machine was first received.

Note: Before making any adjustments on the machine be certain that the machine has good levels.

Vertical Leveling Procedure

- Calibrate a precision level by laying the level on a somewhat known level surface. Note the measurement on the level, and then rotate the level 180 degrees to verify that both directions repeat.

- Achieve an earth level to allow the proper coolant run-off. While leveling the machine keep in mind that there will be coolant pans and so on that will need the proper amount of clearance. Once leveling has began try not to back off the jack-bolts.

- Bring all axis to the center of their stroke. Place two precision levels on the table. One level parallel to the axis stroke and one level perpendicular to axis stroke. The level parallel to axis stroke is considered the crown. The level perpendicular to axis stroke is considered the twist.

- While monitoring the levels move the table to the plus/home side of its stroke. Make adjustments with the jack-bolts, attempting to bring the levels back to the starting point that you began with in the center of the stroke. After making adjustments on the plus/home side, now move the table to the minus/end of stroke. Also adjust the jack-bolts, attempting to bring the levels back to the starting point that you began with in the center of the stroke.

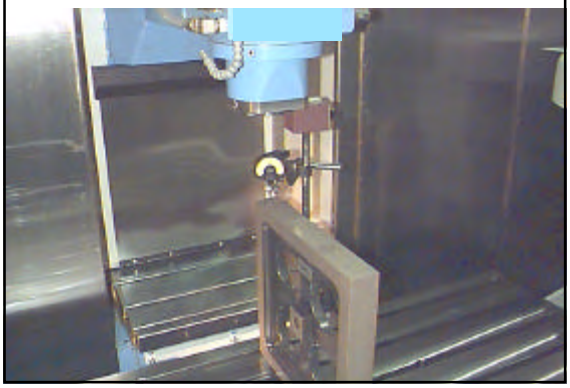
- Return all axis to the center of their stroke again. Place two precision levels in the back of the column. Using a ball of clay under both ends of the level, place one level parallel to the axis stroke and one level perpendicular to axis stroke. The level parallel to axis stroke is considered the crown. The level perpendicular to axis stroke is considered the twist. Compress both levels into the clay until both levels read level.

- While monitoring the levels move the column to the plus/home side of its stroke. Make adjustments with the jack-bolts, attempting to bring the levels back to the starting point that you began with in the center of the stroke. After making adjustments on the plus/home side, now move the column to the minus/end of stroke. Also adjust the jack-bolts, attempting to bring the levels back to the starting point that you began with in the center of the stroke.

- After completing leveling recheck all the jack-bolts for contact to the leveling pad; as well as, electrical cabinets, magazine, pallet changer, ect.

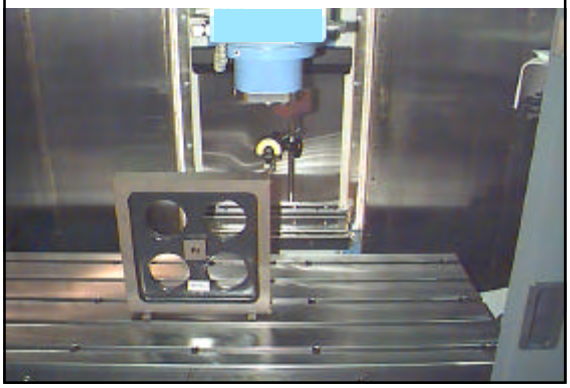
Return to Main Menu

YZ Square



YZ Square

XZ Square



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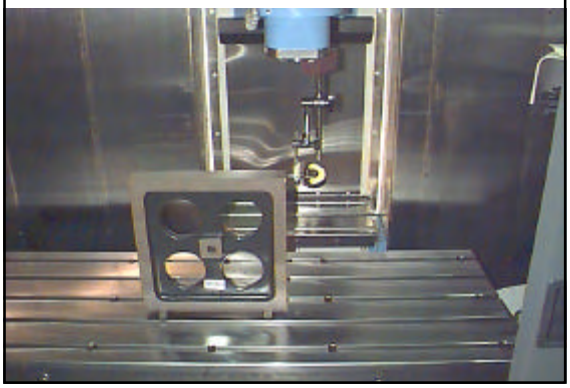

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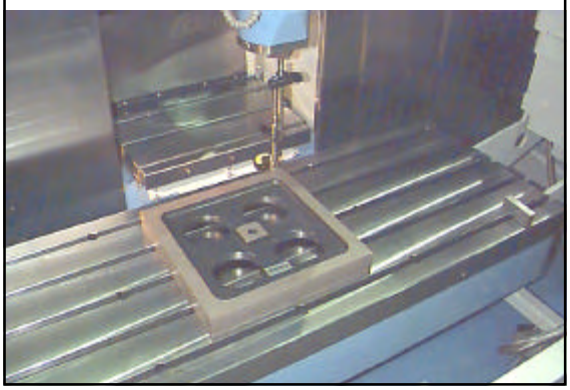
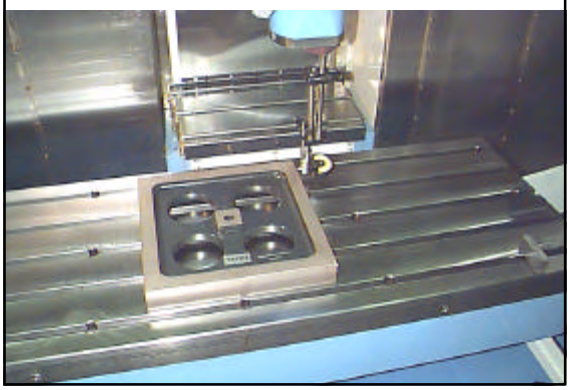


XY Square



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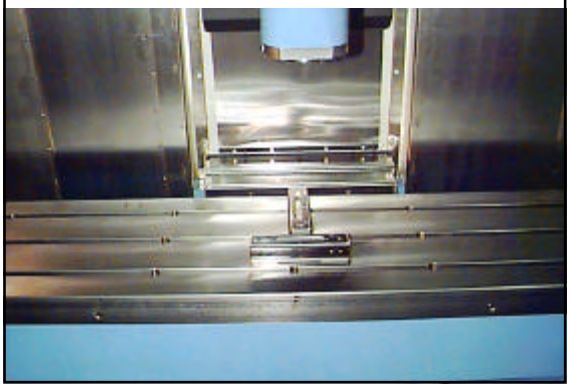
Levels



Levels

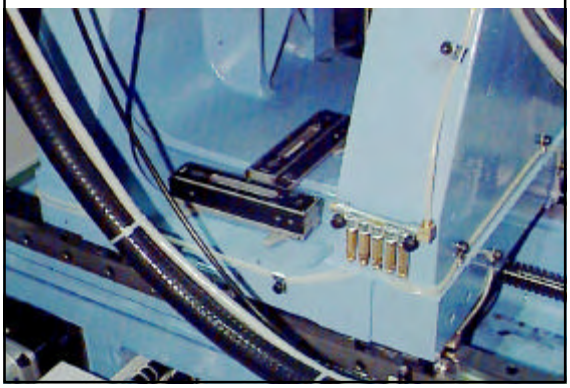
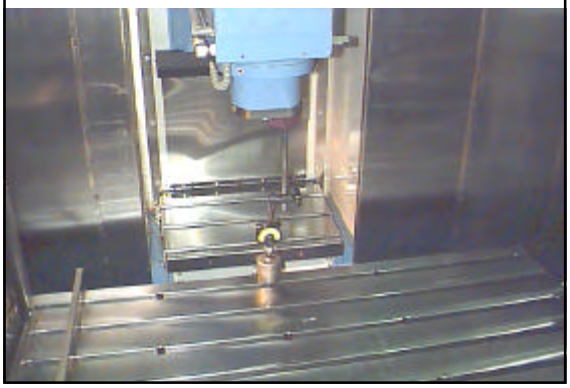
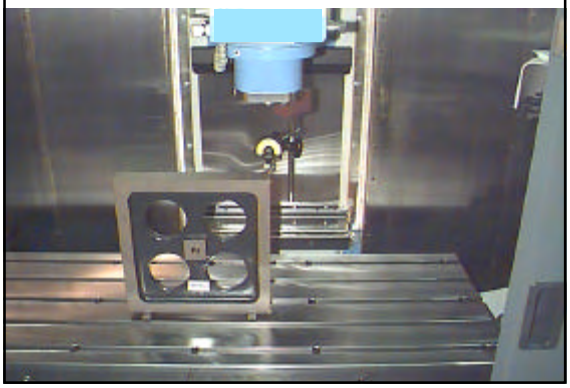


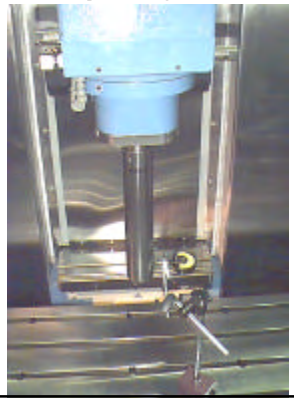
Table Flatness



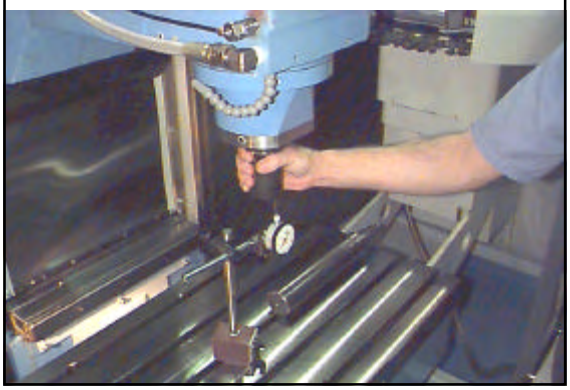
Squares



Spindle Alignment



Tool Knock-out



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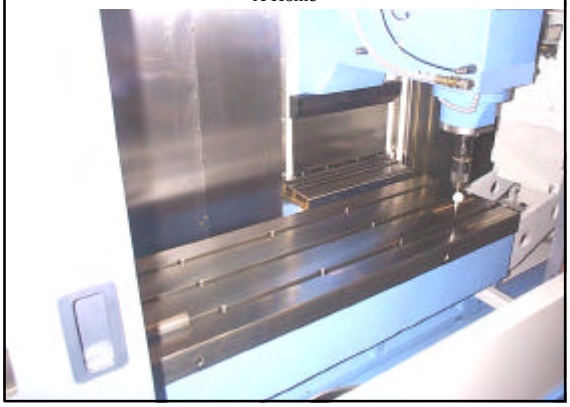
X Home



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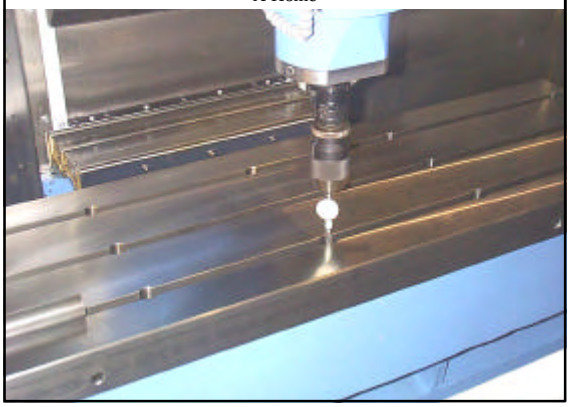

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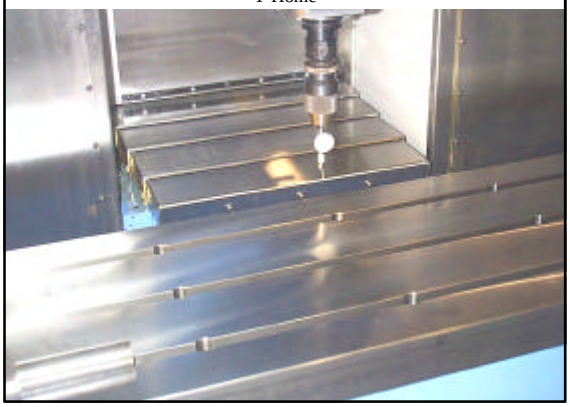

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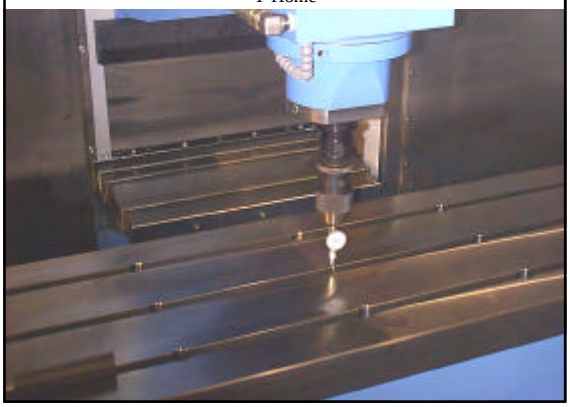

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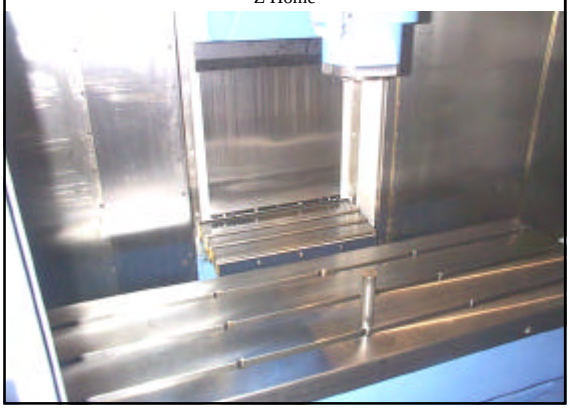

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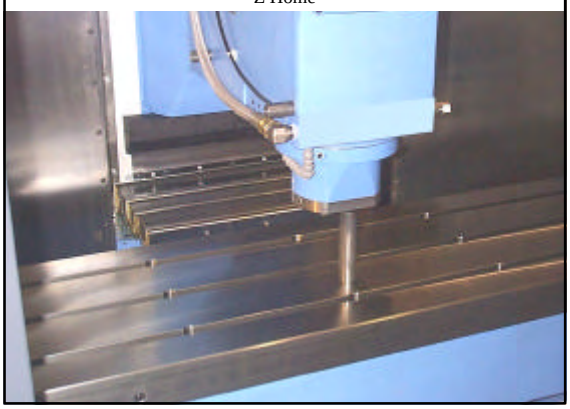

Stroke Diagram

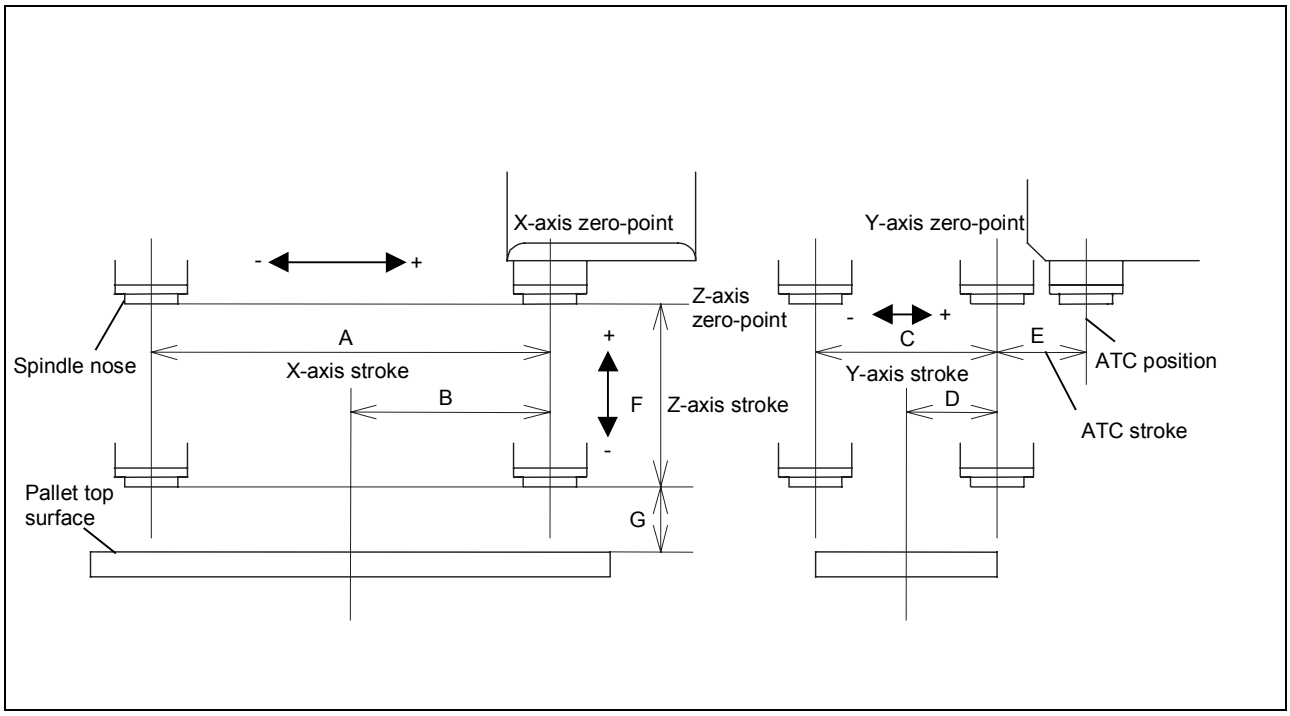

Fig. 1-1 Stroke Diagram

Unit: mm (in.)

Stroke	VTC-200B
A	1120 (44.09)
B	560 (22.05)
C	510 (20.08)
D	255 (10.04)
E	250 (9.84)
F	510 (20.08)
G	180 (7.09)

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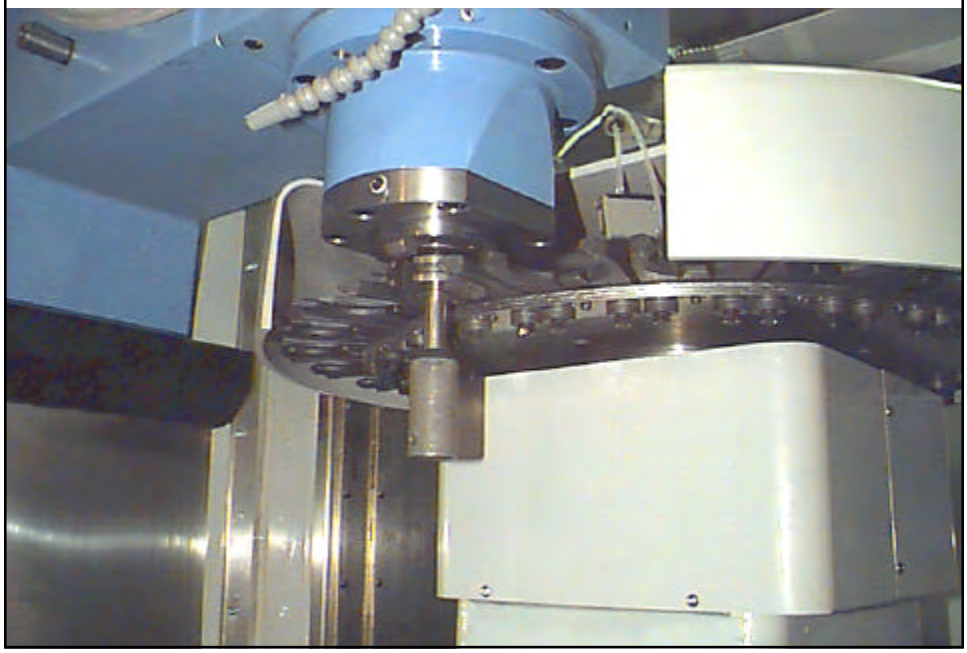
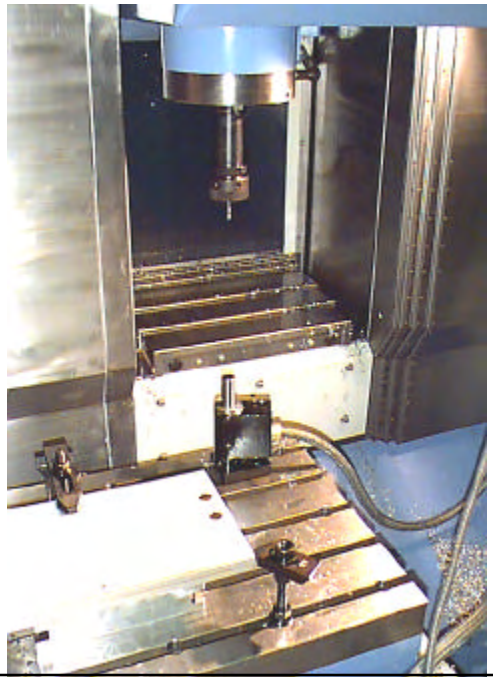
Auto Tool Changer Alignments



Auto Tool Measure



Auto Tool Length Measure Calibration

- Adjust the parallelism of the machined surface on the shaft to be parallel to the x and y-axis within (0.0015 in.).

- Parameter (R2390)-The measurement of the distance between the deceleration sensor to the skip sensor. This distance will not normally need to be adjusted unless the sensors have been replaced. After replacing the sensor load any tool into the spindle. In manual mode move the tip of the tool to the tip of the measure unit until the input address for the deceleration sensor is made (input address can be located in the PLC or Electrical Circuit Diagrams). At this point change the z-axis position to (0.0000). Now move the z-axis more in the minus direction until the skip sensor is made or it sounds a beep. Now compare the new # displayed for z-axis position to the value written in parameter R2390. The result should be within (± .008”). If not within move the replaced sensor and recheck.

- Parameter (R2392)-The measurement of the z-axis Skip position. This parameter is often adjusted if the measure unit has been moved. To properly adjust you must first find the actual length of a tool while in the spindle. With any tool place an indicator set at zero on the tip of the tool. Now zero the value in the z-axis position on the display screen. Next in a manual mode move the indicator away from the tool, and then move the tip of the indicator to the face of the spindle until the indicator reads zero again. Record the new value now displayed on the position page. You are now ready to do an auto tool measure. (Note: The parameters R2396 and R2398 must have already been set correctly) In the MDI mode select Auto Tool Measure from the menu buttons and input the tool # that you just manually measured. Next cycle start (you may choose to slow the rapid feed down the first time). After the tool has been measured go to the tool data page and compare the actual tool length to the auto tool measured length. If there are any differences adjust R2392 by the difference.

- Parameter (R2396)-The y-axis start position of tool length measure. This parameter is often adjusted if the measure unit has been moved. To properly adjust you must first select a tool. In manual mode move the tool to the measure unit until the center line of both are matched. The new value now displayed on the position screen under machine y-axis is the new value of R2396.

- Parameter (R2398)-The x-axis start position of tool length measure. This parameter is often adjusted if the measure unit has been moved. To properly adjust you must first select a tool. In manual mode move the tool to the measure unit until the center line of both are matched. The new value now displayed on the position screen under machine x-axis is the new value of R2398.

Note: The control has to be powered off and on to make these parameters active.

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SECTION 6

BEARING INFORMATION

Return to Main Menu

Types of Bearings

- Rolling bearings
  - Ball bearings
    - Radial ball bearings
      -  Single row deep groove ball bearings
      -  Maximum capacity type ball bearings
      -  Single row angular contact ball bearings
      -  Duplex angular contact ball bearings
      -  Double row angular contact ball bearings
      -  Four-point contact ball bearings
      -  Self-aligning ball bearings
    - Thrust ball bearings
      -  Single direction thrust ball bearings with flat back face
      -  Single direction thrust ball bearings with seating ring
      -  Double direction thrust ball bearings with flat back face
      -  Double direction thrust ball bearings with seating rings
      -  Double direction angular contact thrust ball bearings
  - Roller bearings
    - Radial roller bearings
      -  Single row cylindrical roller bearings
      -  Double row cylindrical roller bearings
      -  Single row tapered roller bearings
      -  Double row tapered roller bearings
      -  Spherical roller bearings
      -  Needle roller bearings
    - Thrust roller bearings
      -  Cylindrical roller thrust bearings
      -  Needle roller thrust bearings
      -  Tapered roller thrust bearings
      -  Spherical roller thrust bearings

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Bearing Load Direction

Bearing type	Magnitude and direction of load
Deep groove ball bearings 	
Maximum capacity type ball bearings 	
Single row angular contact ball bearings 	
Precision grade angular contact ball bearings 	
Four-point contact ball bearings 	
Double row angular contact ball bearings 	
Self-aligning ball bearings 	
Single row cylindrical roller bearings, type NU and N 	
Single row cylindrical roller bearings, type NJ and NF 	
Single row cylindrical roller bearings, type NUP, NP and NH 	
Double row cylindrical roller bearings, type NNU and NN 	
Single row tapered roller bearings 	
Double row tapered roller bearings 	
Spherical roller bearings 	

Bearing type	Magnitude and direction of load
Single direction thrust ball bearings with flat back face 	
Single direction thrust ball bearings with seating ring 	
Double direction thrust ball bearings with flat back face 	
Double direction thrust ball bearings with seating rings 	
Double direction angular contact thrust ball bearings 	
Spherical roller thrust bearings 	

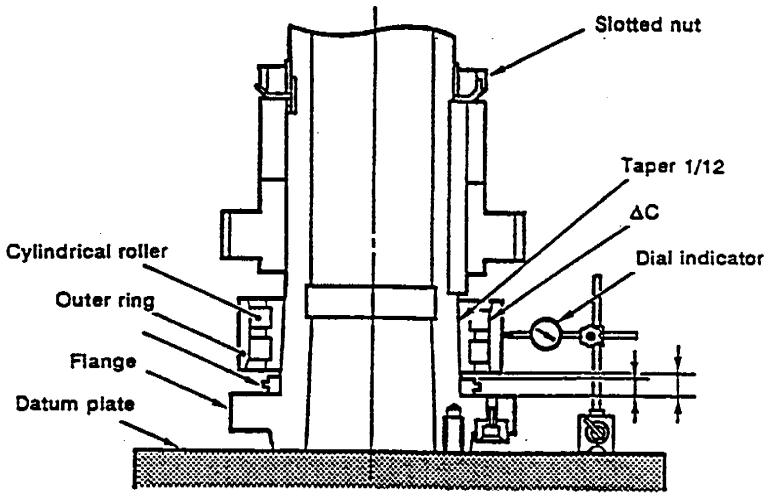
Roller Bearing Preload

The spindle bearings are lubricated with grease and sealed by labyrinth packing without any surface contact. The amount of grease scaled in the bearing is designed to be strictly controlled because it greatly affects the spindle temperature and service life.

Note: Recommended brand of grease is ISO FLEX NBU-15, NOK KLUBER or equivalent.

Adjustment of spindle bearings

When replacing the bearings, their pre-load adjustment is required. However, no pre-load adjustment is necessary for the duplex radial ball bearing at the middle because a constant pre-load is maintained by the inner ring and the outer ring.



How to measure radial clearance of bearing

Adjustment of the double-row cylindrical roller bearing at the front is by determining the thickness "A" of spacer. To determine the thickness "A", proceed as follows;

a) Set the spindle upright on the surface plate.

b) Slowly mounting the bearing down on the tapered portion of the spindle, measure the gap "ℓ" between the bearing and the flange.

c) Put a dial gage on the outer bearing ring and manually push the ring back and forth to determine the clearance, ΔC, between the outer ring and the cylindrical roller.

d) Measure the housing inner diameter and the outer diameter of the outer rings. Suppose "ΔD" represents the difference between the two diameters. ΔC – ΔD equals the actual clearance when the bearing is incorporated in the housing. To make this clearance zero, shift down the bearing axially. This distance "Δb" to be shifted is calculated as follows:
$\Delta b = 17 \times (\Delta C - \Delta D)$

e) The specified radial clearance with this bearing should be -10μ (–0.0004") when it is incorporated in the housing in normal condition. This means that the radial clearance should be less than zero by shifting down the bearing further. The axial shifting distance is calculated as follows:
$-10 \times 17 = -170\mu$ or $-0.0004" \times 17 = -0.0068"$

Bearing Combinations

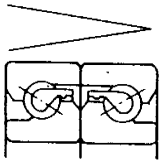
Angular-contact ball screw support bearings are usually used as preloaded combinations as shown below. The standard preload designation in a bearing combination is C10 for metric series and C11 for inch series. With the standard preload, the axial spring constants and starting torques are given in the tables on Page B7 for 2-, 3-, and 4-row combinations.

The most popular configuration is the face-to-face type, since the moment loads caused by any misalignment of the ball screw nut can be more easily relieved with this mounting arrangement. Where the ball screw shaft is mounted with a tensile preload, the bearings are often used as tandem sets.

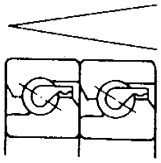
The faces of .ball screw support bearings are precisely ground to achieve a specified preload when the set is axially tightened. The bore and outside diameters of bearings within a set are selectively matched to much less than tolerance class PN7A so that bearing loads are distributed evenly. As shown here, a "V" is marked on the periphery on each set to ensure correct installation.

If universal ground types (SU) are used, no "V" mark is shown since they can be mounted in any direction. Tolerance class PN7B is specified to reduce the bore and outside diameter variations within any resulting set.

2-Row Combinations

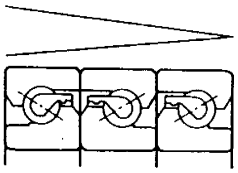


Type DF



Type DT

3-Row Combinations



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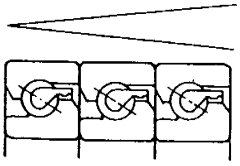
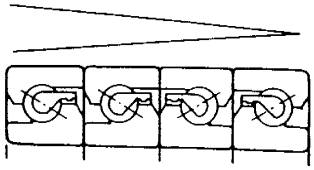


Type DTD

4-Row Combinations



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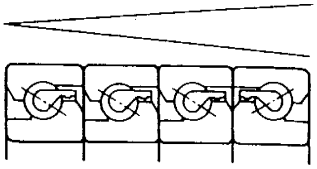
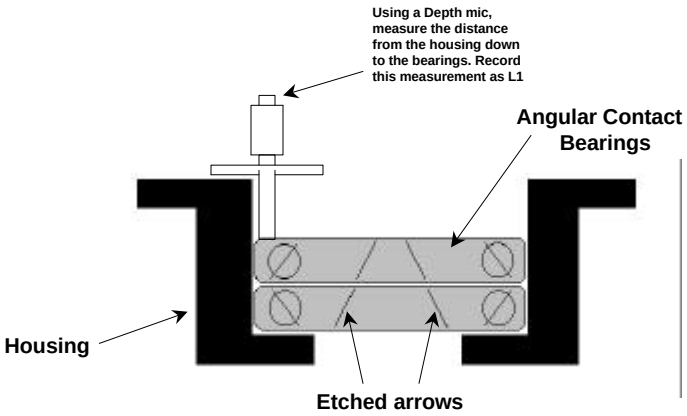


Type DFT

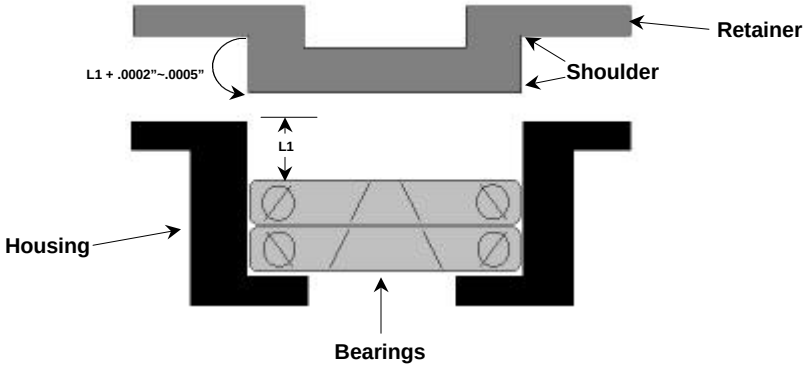
Angular Contact Bearings



Be sure to line up etched arrows when installing bearings!

Angular Contact Bearings

Now take the measurement of L1 and add .0002”~.0005” and call this L2. This is what you will grind the shoulder on the retainer to. This will properly preload bearings.



Guide Layout Methods

Typical layouts of linear guides are shown. A pair of linear guides are usually used with the rail and ball slide fixed on the reference side fixed and those on the adjust side aligned.
as shown in Fig. 34.
For the machine's mounting surface and the Linear Guide side mounting surface, it is necessary to limit the interdifferences of W_2 or W_3 and H dimensions among several slides. (Refer to Fig. 15 and Fig. 16) The rail of the side for which dimensional interdifference is limited is called "Reference side rail" or master rail and has "KL mark" on the surface opposite to the lined mark.

(A) General layout

Fig. 35 shows the simplest way. Fig. 36 shows an example of installing the linear guide horizontally to a vertical plane. It is also possible to arrange the slide as a bed and the rail placed on the table, which is the layout of Fig. 35 upside down.

(B) Opposed slide arrangement

The layout in Fig. 38 is slightly difficult as compared with (A). This layout may decrease the height of the table top surface.

(C) Other methods

The layout in Fig. 37 is also employed, but suffers in respect that the table construction becomes rather difficult and that two reference surfaces for rail mounting can hardly be gotten parallel to each other.

(D) With the method shown in Fig. 39, both rails become Reference side rail. In such a case, please consult beforehand.

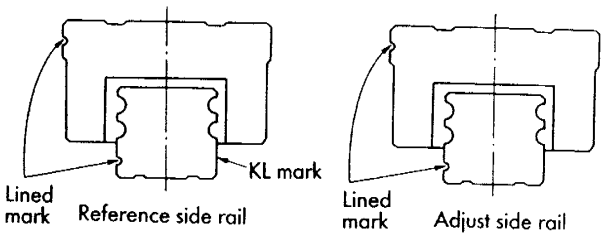


Fig. 34

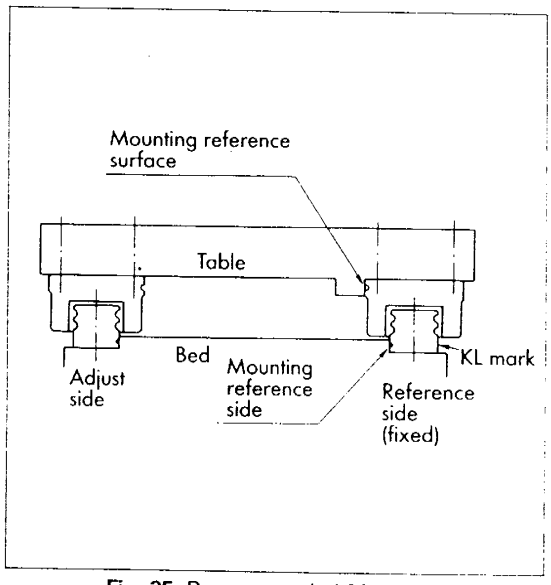


Fig. 35 Recommended Mounting

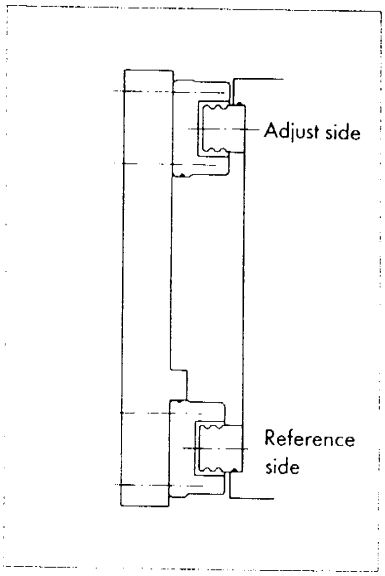


Fig. 36

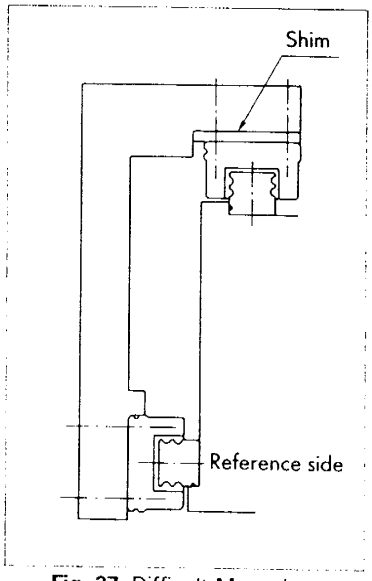


Fig. 37 Difficult Mounting

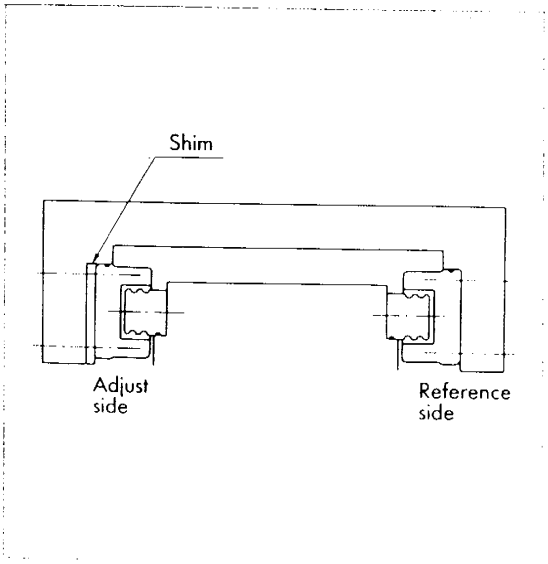


Fig. 38

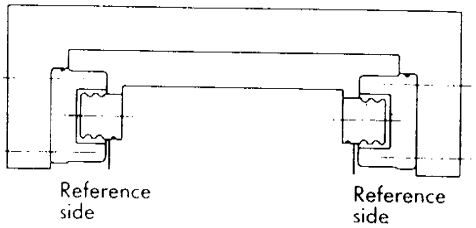


Fig. 39

Linear Guide Side Pressing Methods

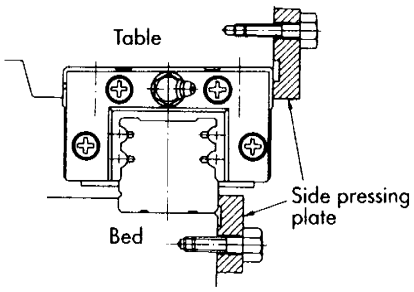


Fig. 51

- Fig. 51; This is the most widely employed method used. Slide and rail should be slightly extended outside from the table and bed. Provide the side plate with a relief, as shown.

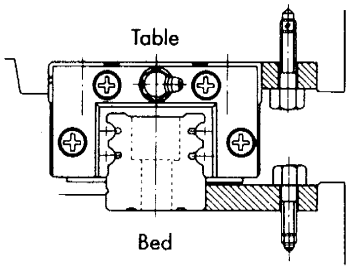


Fig. 52

- Fig. 52; Starting with a side plate slightly wider than needed, file off the ends to ensure a tight fit.

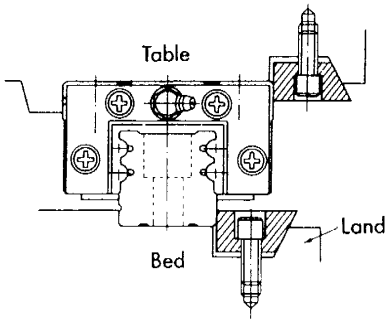


Fig. 53

- Fig. 53; Fasten a tapered block as shown. Note that excessive tightening of the bolts may cause deformation or land warping to the right of the rail, as shown.

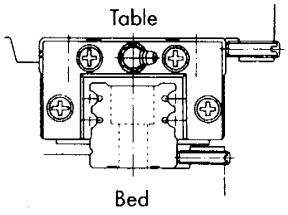


Fig. 54

- Fig. 54; Use a small bolt as the press plate, for units have limited space.

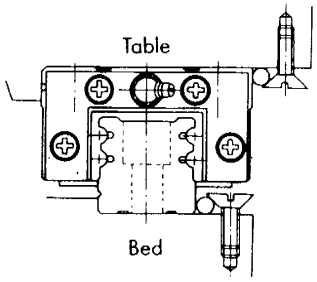


Fig. 55

- Fig. 55; This method consists of pressing a needle roller with the taper of a flat head screw. Positioning the screws is most important.

Guide Installation Examples

Depending on the degree of vibrations and impacts onto the blocks and the required running accuracy, setting of the mounting method or the mounting surface accuracy may be required for guides. The following method is recommended when two pieces are to be used in parallel in the same plane.

1. Installation example for a machine subjected to vibrations and impacts, when rigidity and a high accuracy are required

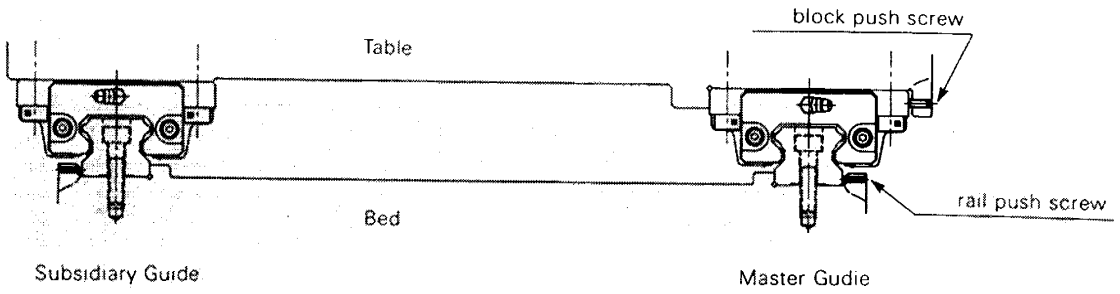


Fig. 13 When the machine is subjectd to vibration and impacts

rail installation

1) Burr, dents, dirt, etc. must be removed in advance from the mounting surface of the machine where an guide is to be installed. (Fig. 14)

   Note: **As anti corrosion oil has been applied to LM guides, the datum plane must be wiped with washing oil before use. As the datum plane rusts easily after removal of the anti corrosion oil, spindle oil with low viscosity etc. should be applied.**

2) Place the rail quietly onto the bed, and tighten the mounting bolts temporarily so that the rail just is brought to close contact with the mounting surface. (Match the side datum plane of the bed with the line mark of the rail. (Fig. 15)

   Note: **Use clean mounting bolts for fixing of guides. When inserting a bolt into the mounting hole of an rail, check for correct thread engagement. (Fig. 16) Forcible tightening of a bolt without correct thread engagement can cause decreased accuracy.**

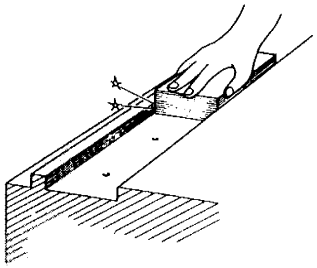


Fig. 14 Check of the mounting surface

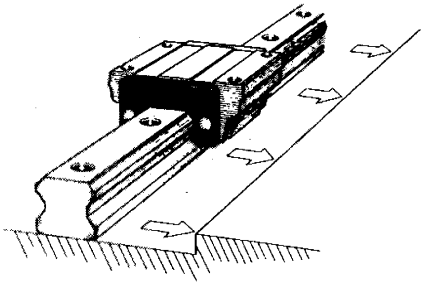


Fig. 15 Matching of the Datum plane

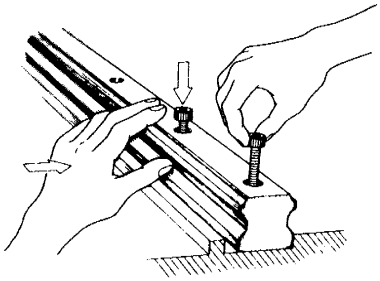


Fig. 16 Bolt play check

3) Tighten the rail push screws sequentially so that close contact with the side mounting surface is obtained. (Fig. 17)

4) Tighten the mounting bolts with a torque wrench to the specified torque. (Refer to table 3 and Fig. 18.)
Note: Stable accuracy is obtained when the rail mounting bolts are tightened sequentially from the center to the ends.

5) Complete the rail installation by installing the remaining rails in the same way.

block installation

I) Place the table quietly onto the blocks, and tighten the mounting bolts temporarily.

2) Push the blocks on the master guide side with the push screws against the datum plane of the table and position the table.

3) Complete the installation by tightening the mounting bolts on master guide side and subsidiary guide side completely.

Note: The table can be fixed uniformly by tightening the mounting bolts in diagonal sequence as shown in Fig. 19.

This method requires not much time for obtaining of the straightness of the rails, and as machining of dowel pins for fixing also is not required, the number of installation work steps can be reduced widely.

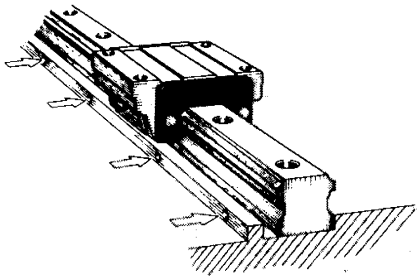


Fig. 17 Push screw tightening

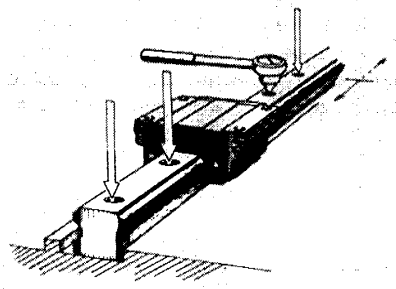


Fig. 18 Complete mounting bolt tightening

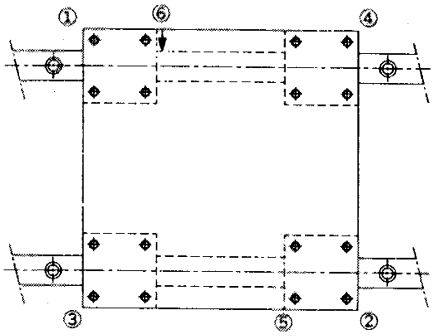


Fig. 19 block tightening sequence

2. Installation example for the case when the rail on the master guide side has no push screws

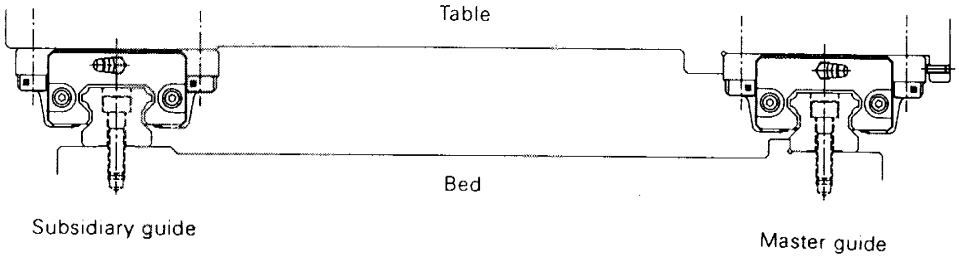


Fig. 20 When the rail on the master guide side has no push screws

Installation of the rail on the master guide side

○ After temporary tightening of the mounting bolts, use a small vice etc. to push the rail at the position of the mounting bolt against the side datum plane, and then tighten the mounting bolt securely. Repeat this procedure in sequence for each mounting bolt. (Fig. 21)

Installation of the rail on the subsidiary guide side

The following procedure is recommended for installation of the rail on the subsidiary guide side parallel to the correctly installed rail on the master guide side.

○ **Method with use of a straight edge**
Use a dial gauge to set a straight edge between the rails parallel to the side datum plane of the rail on the master guide side, and then use the dial gauge to obtain straight alignment of the rail on the subsidiary guide side with the straightedge as reference, and then tighten the mounting bolts in sequence from one end of the rail. (Fig. 22)

○ **Method using the table run**
Fix two blocks on the master guide side to the table (or to a temporary table for measuring, and temporarily fix the rail and one block on the subsidiary guide side to the bed and the table. Attach a dial gauge to a dial gauge stand fixed on the table surface, bring it into contact with the side of the LM block on the subsidiary guide side, move the table from one end of the rail to the other, align the rail on the subsidiary side parallel to the rail on the master guide side, and tighten the bolts in sequence. (Fig. 23)

○ **Method following the rail on the master guide side**
Place a table onto the blocks on the correctly tightened rail on the master guide side and the provisionally tightened rail on the subsidiary guide side, and tighten the two blocks on the master guide side and one of the two blocks on the subsidiary guide side completely. Tighten the remaining block on the subsidiary guide side provisionally. Then move the table while confirming the rolling resistance, and tighten the mounting bolts on the subsidiary guide side one after the other completely. (Fig. 24)

○ **Method with a jig**
Use a jig as shown in Fig. 25 a) or b) to confirm the parallelism of the datum plane on the subsidiary guide side to the side datum plane on the master guide side from one end to the other end at each mounting bolt position in sequence, and tighten the mounting bolts one after the other completely.

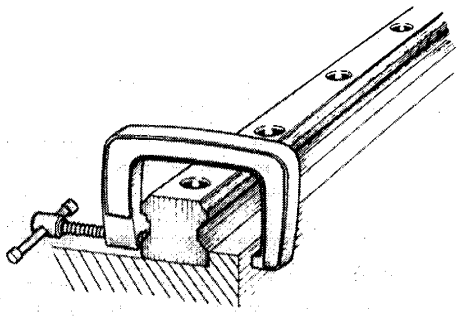


Fig. 21

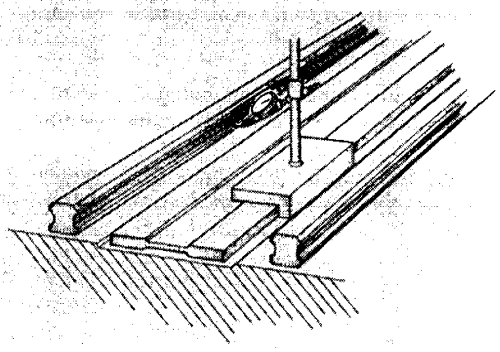


Fig. 22

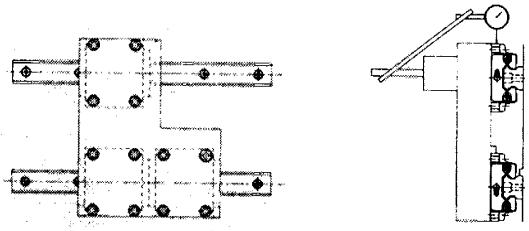


Fig. 23

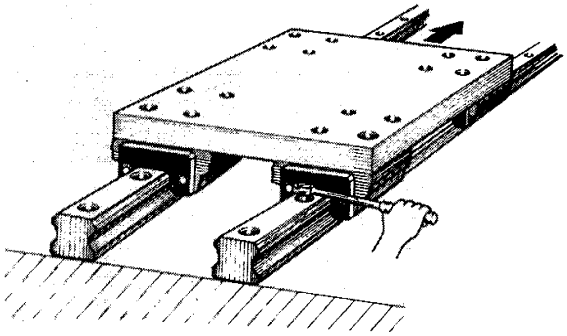
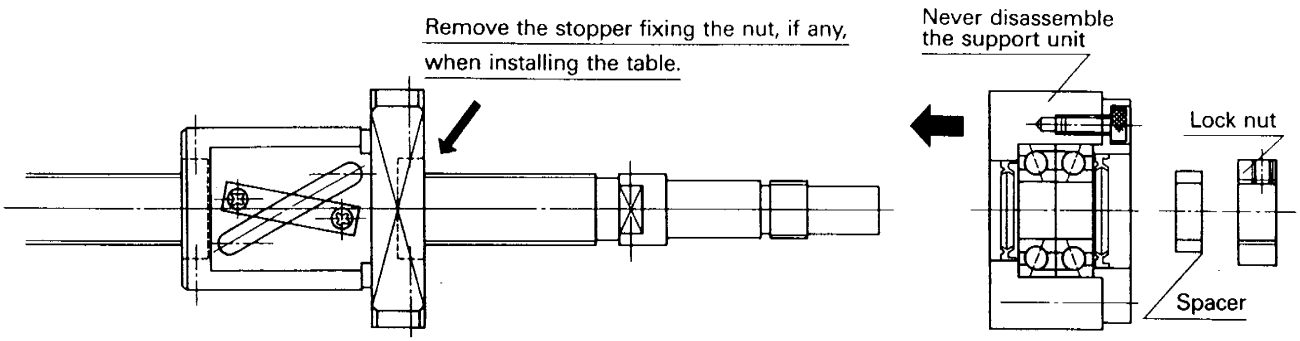


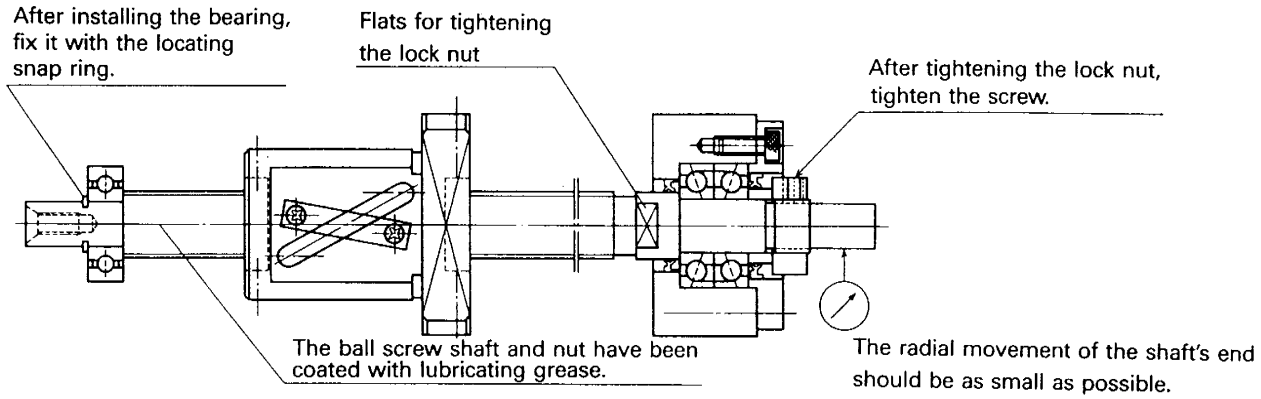
Fig. 24

Ball Screw Layout Methods

1. Assembly of Ball Screw and Support Unit



- Use care to prevent deforming the oil seal.
- Apply grease before installing the support unit on the shaft.

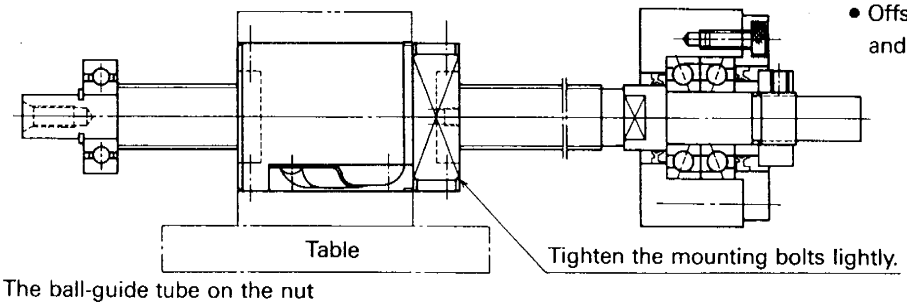


2. Assembly of Table and Ball Screw Nut

Note: This assembly may be easier with the table on the bottom.

Accuracy of table

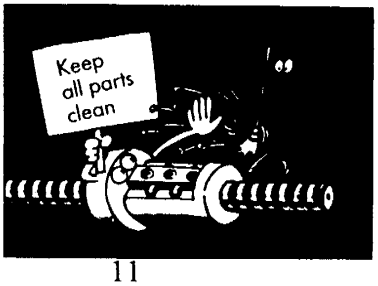
- Squareness of nut mounting face
- Offset and parallelism of table center and guide bearings

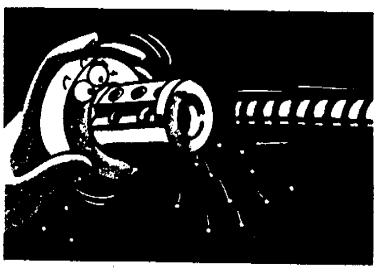


The ball-guide tube on the nut should be facing the table.

Handling Precautions

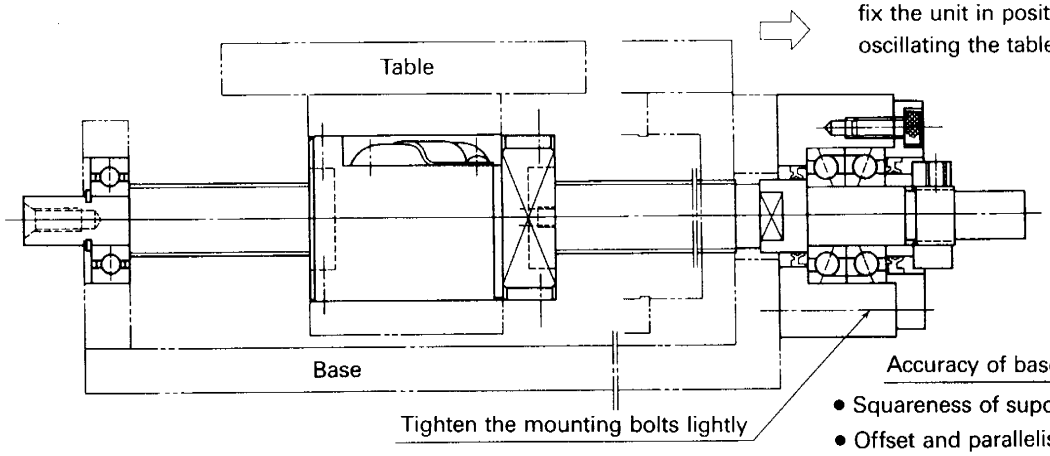
- Warning! Never remove the nut from the shaft.
- Hold the shaft horizontally so the nut will not slide off.
- Never disassemble the nut.
- Keep them clean and free of chips, dust, and moisture.





3. Mounting of Support Unit on Base

Move the ball screw nut close to the suppoort unit and carefully and lightly fix the unit in position while slightly oscillating the table's position

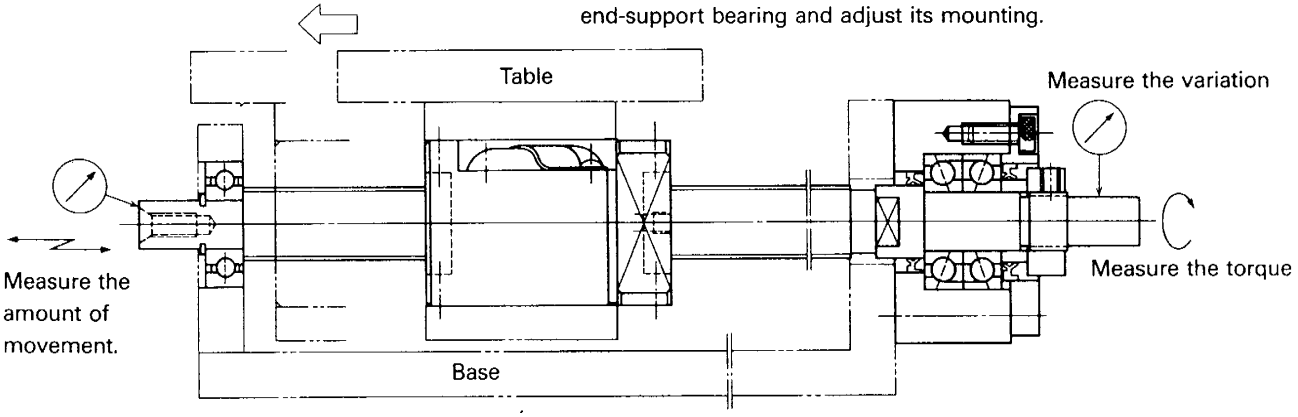


Accuracy of base

- Squareness of suport unit mounting face
- Offset and parallelism of bearing bore against base center line

4. Tightening Assembly and Checking Accuracy

Move the ball screw nut close to the shaft's end-support bearing and adjust its mounting.

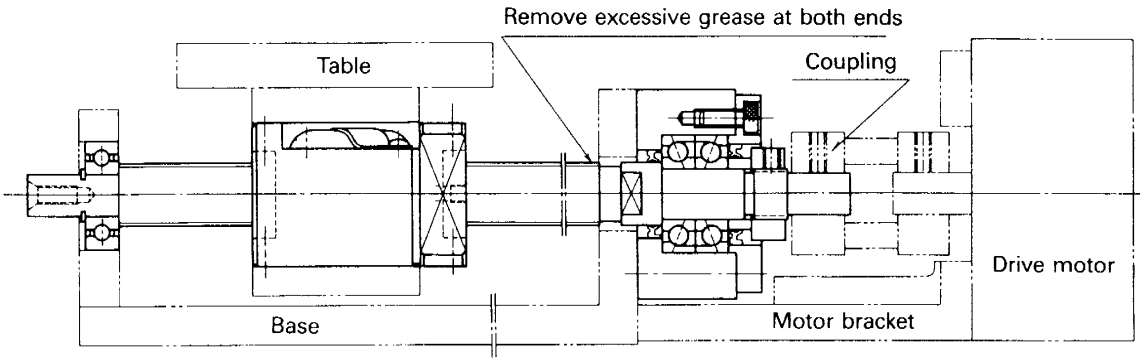


Slowly tighten the mounting bolts while oscillating the table's position and checking the accuracy of the installation and smoothness of operation. If unsatisfactory, loosen the bolts, check the installation, and repeat this procedure.

5. Completion of Assembly

- Motor bracket/Motor/Coupling

After finishing the installation, sufficiently run-in the ball screw



Since the installation accuracy of the motor bracket and coupling affects the overall performance and table positioning accuracy, the same care should be used as when mounting the ball screw.

Positioning Accuracy

Factors for feed accuracy error

Feed accuracy error factor includes lead accuracy and system stiffness. Thermal displacement due to heat generation and positional error of the guide system are also important factors.

Selection of lead accuracy

(1) Accuracy grade

Table 7.1 shows the typical accuracy grades for purposes based on extensive experience. Select the accuracy grade appropriate to the required positional accuracy.

(2) How to determine the cumulative basic lead

The basic lead of a ball screw is same as the nominal lead. The basic lead may often be set to either the minus or plus side in order to compensate elongation due to temperature rise or elongation of screw shaft under external load. In such an event, specify the target value (T) of the cumulative lead.

Table 7.2 shows the target value of cumulative lead of representative NC machine tool.

Table 7.2 Example of Specified Travel by NC Machine Tools

Unit: mm

Type of NC Machine	Shaft	Set Points of Specified Travel (Per m)
NC Lathing Machine	X	−0.02 ~ −0.05
	Z	−0.02 ~ −0.03
Machining Center	X, Y	−0.03 ~ −0.04
	Z	Varies depending on the structure

Pre-tensioning may be given to the screw shaft during assembly to compensate for elongation. Generally pre-tensioning equivalent to temperature rise of 2–3°C is given. Typical pre-tensioning bearing support structures are shown in Fig. 7.13.

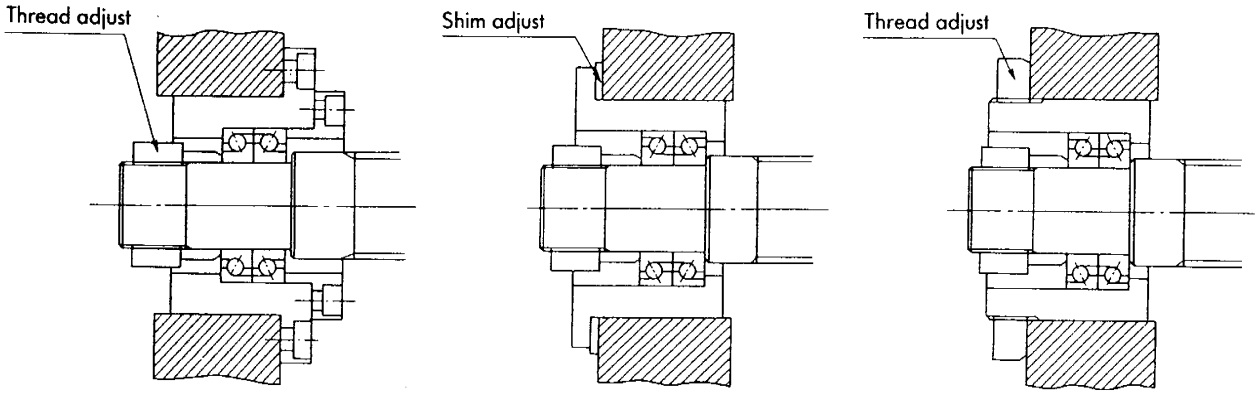
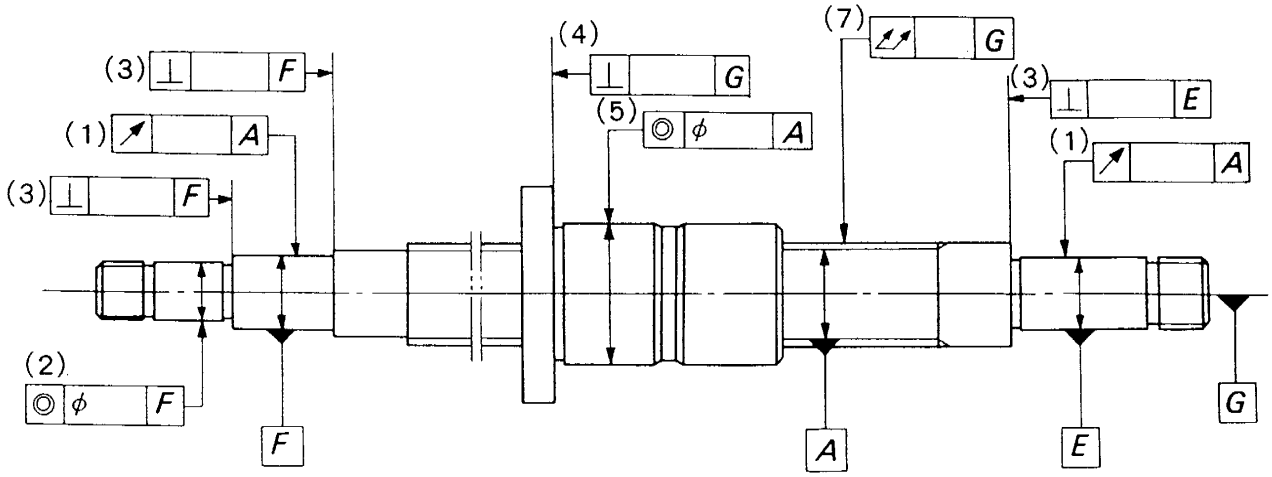


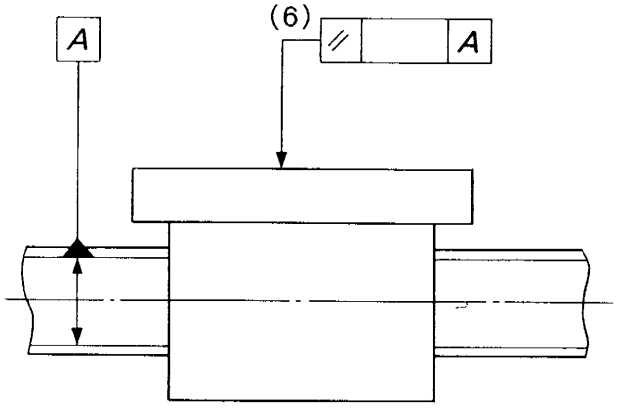
Fig. 7.13 Support Bearing Construction Giving Pre-tension

Mounting Accuracy and Tolerances

To use a ball screw properly dimensional accuracy and tolerances are most important.

(1) Periphery run-out of the supporting part of the screw shaft to the screw groove.
(2) Concentricity of a mounting portion of the shaft to the adjacent ground portion of the screw shaft.
(3) Perpendicularity of the shoulders to the adjacent ground portion of the screw shaft.
(4) Perpendicularity of the nut flange to the axis of the screw shaft.
(5) Concentricity of the ball nut diameter to the screw groove.
(6) Parallelism of the mounting surface of a ball nut to the screw groove.
(7) Total run-out of the screw shaft to the axis of the screw shaft.





Inspection and Adjustment of Gibs and Wipers

On standard flat surface boxed way systems there will be three tapered gibs. The clearance on the guide-way can be adjusted with the tapered gibs.

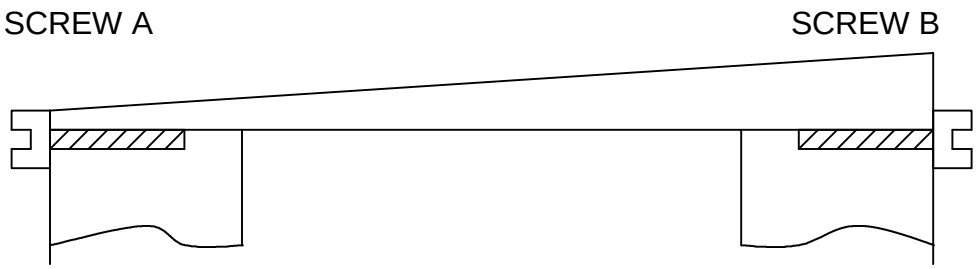
Dovetail or Vee style ways may have one, two or three gibs.

Gib adjustment greatly influences the lost motion (backlash), response characteristics to pulses, axis load characteristics, positioning accuracy and surface finish.

Gibs should be removed and examined for uneven wear patterns and re-scraped if necessary.

Gib adjustment must be made carefully.

Gib screws must remain tight during operation of the machine



Adjustment of Gibs

A. Remove the wipers
B. Turn adjustment screw A to loosen it approximately 4 turns, then fully tighten screw B. The clearance is now at zero and screw B must be loosened ¼ to ½ of a turn.
C. Tighten screw A until you feel it contact the gib and be sure it “pushes” the gib back ¼ to ½ turn and makes both screws tight.
D. Carefully operate the axis and look for abnormal loadmeter readings. Properly adjusted gibs should add no more than 5 to 10% additional load to the axis reading. Over tightening will cause excessive wear and tear, resulting in poor positioning.
E. Program the axis to run full stroke @ 10ipm. After 20 minutes the gibs should be seated and you can confirm the backlash accuarcy.

Inspection of wipers

The wipers on the slide-ways serve to prevent entry of chips and contamination into the slideways mating sections. They also keep the lubricant film contained and of a constant thickness. Inspect the wiper for wear and replace if damaged.

Glossary of Bearing Terms

A.B.E.C.
Annular Bearing Engineering Committee. Used as prefix for tolerance grades of bearings as set up by this committee.
A.B.E.C. 1-3-5-7-9
Annular Bearing Engineers Committee classes or grades of ball bearing precision.
A.F.B.M.A.
The Anti-Friction Bearing Manufacturers Association. They have set up standards for the bearing industry.
Adapter Assembly
Assembly consisting of adapter sleeve, locknut and lockwasher.
Adapter Sleeve
Axially slotted sleeve with cylindrical bore, tapered outside surface and male screw thread at small end used with locknut and lockwasher for mounting of bearings with tapered bore on cylindrical outside surface of shaft. Also called pull-type sleeve.
Aircraft Bearing
A term applied generally to bearings used by the aircraft industry or the Air Force.
Airframe Bearing
A bearing designed for use in the control systems and surfaces of aircraft.
Angular Contact Bearing
A type of ball bearing whose internal clearances and ball race locations are such as to result in a definite contact angle between the races and the balls when the bearing is in use.
Annular Ball Bearing
A rolling element bearing designed primarily to support a load perpendicular to the shaft axis. *Also: Radial Type Bearing*.
Anti-friction Bearing
Commonly used term for rolling element bearing.
Axial
In the same direction as the axis of the shaft.
Axial Internal Clearance
In ball or roller bearing assembly, total maximum possible movement parallel to bearing axis of inner ring in relation to outer ring. Also called bearing end play.
Axial Load
Load exerted parallel to the axis of the shaft on which the bearing is mounted, also called thrust load.
Axis
An imaginary line running through the center of a shaft on which a bearing is mounted.
Ball
A spherical rolling element.
Ball Bearing
A bearing using balls as the rolling elements.
Ball Cage
A device which partly surrounds the balls and travels with them, the main purpose of which is to space the balls. *Also Separator: Retainer: Ball Spacer*.
Ball Complement
Number of balls used in a ball bearing.
Ball Contact
Area of contact between raceway and ball.
Ball Diameter
The dimension measured across the ball center.
Ball Pocket
A drilled, stamped, or molded receptacle that holds the ball in a cage.

Basic Dynamic Load Rating
Basic dynamic load rating, Cr, is the calculated constant radial load (thrust load for thrust bearings) which a group of identical bearings with stationary outer rings can theoretically endure for rating life of 1 million revolutions of inner ring.
Bore
The smallest internal dimension of inner or outer ring or separator. Also, the surface of the inner ring that fits against the shaft.
Boundary Dimensions
Dimensions for bore, width, outside diameter and corner radius.
Cage
See Ball Cage.
Cam Follower
See Track roller
Cartridge Bearing
An extra wide double shielded or sealed bearing designed to increase grease capacity of bearing.
Concentric
Having the same center.
Cone
Inner ring of tapered roller bearing.
Conrad
Standard single row deep-groove bearing named for the inventor of its assembly method, Joseph Conrad.
Contact Angle
Formed by a line drawn between the areas of ball and ring contact and a line perpendicular to the bearing axis.
Counterbored Ball Bearing
Portion of one race shoulder turned and ground away to facilitate assembly with a greater number of balls. A non-separable ball bearing with one side of the raceway removed from either or both rings to facilitate manufacturing assembly. Normally the outer ring is counterbored.
Double Row Bearing
A bearing with two rows of rolling elements.
Double Row Maximum Capacity
A bearing that has a solid inner and outer with two raceways and filling notches to permit the maximum number of balls to be inserted.
Drawn Cup Needle Roller Bearing
Needle roller radial bearing with thin pressed steel outer ring (drawn cup), which may have one closed end or both ends open. Usually employed without inner ring.
Duplex Bearing
A duplex bearing is a bearing with controlled axial location of faces of inner and outer rings which makes this bearing suitable for mounting in various combinations with one or more bearings controlled in the same manner.
Dynamic Load
A load exerted on a bearing in motion.
Eccentric
Not having the same center.
End Play
The axial play of the outer ring in a bearing. The measured maximum possible movement parallel to bearing axis of the inner ring in relation to outer ring.
External Race
The ball path on an inner ring. *Also - Inner Raceway, Inner Ring Raceway.*
Face
The side surface of a bearing. *See also Thrust Face*.
Fillet Radius
The corner dimension in a bearing housing that the bearing external corner radius or chamfer must clear.

Filling Notch
A slot or notch cut in the shoulder of a ring to allow the loading of the maximum number of balls. *Also Filling Notch; Loading Groove*.
Finish
A term usually applied to the last machining operation on any surface of a bearing, such as "Finish O.D., " "Finish bore, " etc.

Fit
The amount of internal clearance in a bearing. Fit can also be used to describe shaft and housing size and how they relate to the bore or outside diameter.
Fixed Bearing
Bearing which positions shaft against axial movement in both directions.
Floating Bearing
Bearing designed or mounted so as to permit axial displacement between shaft and housing.
Full Complement Bearing
Rolling bearing without cage in which sum of clearances between rolling elements in each row is less than the diameter of rolling elements and small enough to give satisfactory function of bearing.
Hardening
Process of heating parts to a high temperature and then quenching in oil, water, air, or solution.
Heading Rivets
Process of hitting rivets in a press to form the heads.
Housing, Bearing
The opening in which a bearing is contained in a machine. The part of a machine that contains this opening.
Housing Fit
Amount of interference or clearance between bearing outside surface and housing bearing seat.
Hydraulic Nut
Collar temporarily fixed to shaft which incorporates hydraulic annular piston to transmit axial mounting or dismounting force to bearing inner ring.
ISO
International Standards Organization.
Inch Dimension Bearing
A bearing having boundary dimensions made to integral or/and fractional inch figures rather than metric figures.
Inner
See Inner Ring
Inner Ring
The inner part of a bearing that fits on a shaft and contains the external raceway for the rolling elements. Sometimes the shaft is stationary and the housing rotates.
Inner Ring Raceway
See External Race.
Internal Clearance
See Radial Clearance.
Internal Race
The ball or roller path on the bore of the outer ring. Outer Ring Raceway. Outer Raceway.
Land
Commonly called the O.D. of the inner and the I.D. of the outer.
Lapping
An abrading process for refining the surface finish and the geometrical accuracy of a surface.
Life
"Life" of individual rolling bearing is the number of revolutions (or hours at some given constant speed) which bearing runs before first evidence of fatigue develops in the material of either ring or washer or any of rolling elements.

Limits
Maximum and minimum allowable dimensions, resulting from the application of predetermined tolerances to a specified dimension.
Lock Nut
A nut used in combination with a lock washer to hold a bearing in place on a shaft.
Lock Washer
A washer with tongue and prongs to hold a lock nut in place.
Locking Collar, Concentric
Ring fitting over extended inner ring of insert bearing and having setscrews which pass through holes in inner ring to make contact with shaft.
Locking Collar, Self
Ring having recess on one side which is eccentric in relation to bore and fits over equally eccentric extension of inner ring insert bearing. Collar is turned in relation to inner ring until it locks and then secured to shaft by tightening of setscrews.
Loose Fit
A fit or fit up of inner ring, balls, and outer ring which results in the existence of appreciable radial clearance.
Maximum Capacity Bearing
A bearing with filling notches to allow the loading of the maximum number of balls.
Misalignment
Lack of parallelism between axis of rotating memeber and stationary member.
Needle Roller
Cylindrical roller of small diameter with large ration of length to diameter. Generally accepted that length is between three and ten times diameter which is usually less than 5 mm.
O.D.
Outer Diameter; Outside Diameter.
Outer
See Outer Ring.
Outer Raceway
See Internal Race.
Outer Ring
The outer part of a bearing that fits into the housing and contains the internal raceway for the rolling elements.
Outer Ring Raceway
See Internal Race.
Pocket
The portion of a cage shaped to hold the ball or roller. *Also Ball Pocket; Roller Pocket.*
Preload
An internal loading characteristic in a bearing which is independent of any external radial and/or axial load carried by the bearing.
Prelubricated Bearing
A shielded, sealed, or open bearing originally lubricated by the manufacturer.
RBEC-1, -5
Class or degree of precision of anti-friction roller bearings.
Raceway
The ball or roller path; cut in the inner and outer ring in which the balls or rollers ride. *Also Guide Path; Race; Ball Path; Roller Path.*
Raceway Diameter
Inner Ring -- the outer dimension across the diameter from raceway bottom to raceway bottom.
Outer Ring -- the inner dimension across the diameter from raceway bottom to raceway bottom.
Radial Clearance
The radial internal clearance of a single row radial contact ball bearing is the average outer ring race diameter, minus the average inner ring race diameter, minus twice the ball diameter.
Radial Load
A load exerted perpendicular to the axis.

Radial Play
See Radial Clearance.
Radial Type Bearing
In general, a rolling element bearing primarily designed to support load perpendicular to the axis. *Also: Annular Bearing.*
Rating Life
L10 of group of apparently identical bearings is the life in millions of revolutions that 90% of the group will complete or exceed.
Relieved End Roller
Roller with slight modification of diameter at ends of outside surface to reduce stress concentrationat contacts between rollers and raceways.
Retainer
See Ball Cage.
Riveted Type Ball Cage
A type of cage in which the two halves are riveted together around the balls after the balls have been assembled in the rings.
Runout, of Assembled Bearing
Displacement of surface of bearing relative to fixed point when one raceway is rotated with respect to other raceway.
Seal
A soft synthetic rubber washer with a steel core fixed in the outer ring (in the seal groove) in contact with the inner ring to retain lubricant and keep out contamination.
Self Aligning Ball Bearing
Spherical outside diameter ball bearing which can accommodate initial angular misalignment between the outer ring and its mating spherical aligning ring or housing seat.
Separable
A bearing that may be separated completely or partially into its component parts.
Separator
See Ball Cage.
Shaft Fit
Amount of interference or clearance between bearing inside diameter and shaft bearing seat outside diameter.
Shield
A metal formed washer attached to the outer ring and set so it rides close to, but not contacting, the inner ring, to retain lubricant and prevent contamination.
Shoulder
The side of a ball race, also a surface in a bearing application or shaft which axially positions a bearing and takes the thrust load.
Single Row
Bearing with one row of rolling elements.
Snap Ring
A removable ring used to axially position a bearing or outer ring in a housing. Also used as a means of fastening a shield or seal in a bearing.
Solid Cage
A solid ring type separator used in a radial or angular contact type bearings.
Spacer
Sleeve or sleeves serving to space different bearings on same shaft or different rows of rolling elements in multi-roll bearing.
Spherical Roller Bearing
Self-aligning, radial rolling bearing with convex rollers or concave rollers as rolling elements. With convex rollers outer ring has spherical raceway, with concave rollers inner ring has spherical raceway.
Standard Bearing
Bearing which conforms to the basic plan for boundary dimensions of metric or inch dimensions.
Static Load
A load exerted on a bearing not in motion.

Stay Rod
A flat elongated rivet used in the cages of maximum capacity bearings.
Stay Rod Type Ball Cage
Type cage in which the two halves are held together with special stay rod rivets.
Thrust Load
See Axial Load.
Thrust Bearing
A bearing designed primarily for thrust loads.
Thrust Face
Face of thrust bearing against which housing or shaft shoulder pushes.
Tolerance
The range between two limiting sizes as a means of specifying the degree of accuracy.
The amount a given bearing dimension may vary from specifications.
The difference between the upper and lower limits of a dimension or a specification.
A means of specifying the degree of accuracy.
Track Roller
Radial roller bearing with heavy section outer ring, intended to roll on track, a.k.a. cam follower.
Wide Inner Ring Bearing
Bearing with inner ring extended on one or both sides in order to achieve greter shaft support and permit addition of locking device and provide additional space for sealing devices.
Withdrawal Sleeve
Axial slotted sleeve with cylindrical bore, tapered outside surface and male screw thread at large end. Used for mounting and dismounting (by means of nut) of bearing with tapered bore on cylindrical outside surface of shaft. Also called push-type sleeve.

NOTES:

NOTES:

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SECTION 7

BACKLASH AND HOME ADJUSTMENTS

Return to Main Menu

Checking Backlash

Machining Centers

Checking Backlash

- Warm up the machine before checking backlash.

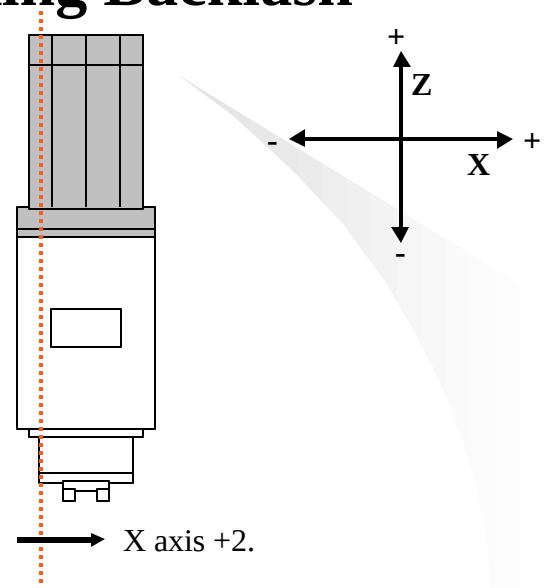
- Backlash testing should be taken in three different locations and averaged.

- Do Not use the manual pulse generator for testing.
  One test should be conducted at 10inch/min.cutting feed (G01) and the second test at 100% rapid feed rate (G00).

- Backlash parameters can be set back to zero.
  Parameters input in micron increments. A value of 10 will compensate for about .0004", a value of 20 will compensate for about .0008".

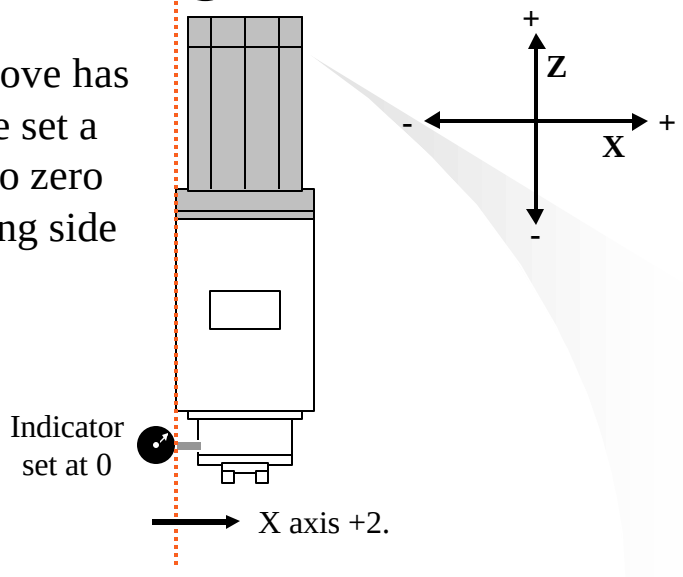
Checking Backlash

Make one move in any direction at least the pitch of the ball screw. A common distance for any machine is 2.” or (50.mm)



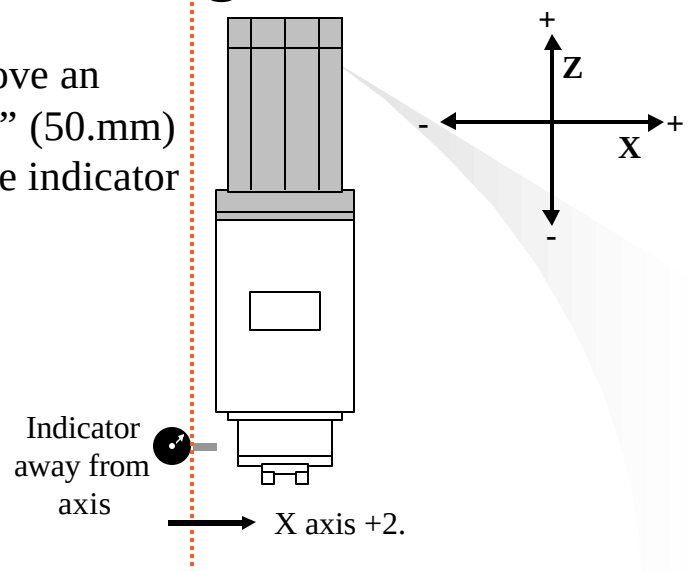
Checking Backlash

Once the move has been made set a indicator to zero on the trailing side



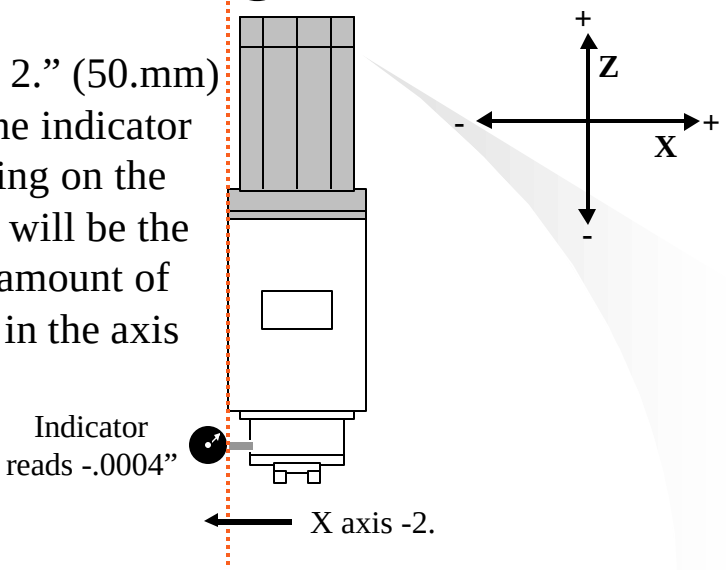
Checking Backlash

Now move an additional 2.” (50.mm) away from the indicator



Checking Backlash

Now move 2.” (50.mm) back to the indicator the reading on the indicator will be the current amount of backlash in the axis



Checking Backlash

- In order to use a auto mode instead of the manual pause generator, select MDI mode. The auto mode is needed due to having two parameters to compensate for backlash.The following is a example of a cutting and rapid feed rate command.

Rapid Feed

G00X2.;X2.;X-2.;M99

Axis

Repeat

G-Code

End of Block

Direction

Cutting Feed

G01X2.F10.;X2.;X-2.;M99

Feed Rate

Checking Backlash

- The control doesn't have to be powered off & on for the new parameter value to be active.

- Again the parameters input in micron values if the machine has an inch or metric display.

- Example: .001" * 25.4= .0254mm or 25microns
  .017mm or 17microns

Inch * 25.4 = mm mm / 25.4 = Inch

Return to Main Menu

Checking Backlash

Turning Centers

Checking Backlash

- Warm up the machine before checking backlash.

- Backlash testing should be taken in three different locations and averaged.

- Do Not use the manual pulse generator for testing.
  One test should be conducted at 10inch/min.cutting feed (G01) and the second test at 100% rapid feed rate (G00).

- Backlash parameters can be set back to zero.
  Parameters input in micron increments. A value of 10 will compensate for about .0004”, a value of 20 will compensate for about .0008”.

Checking Backlash

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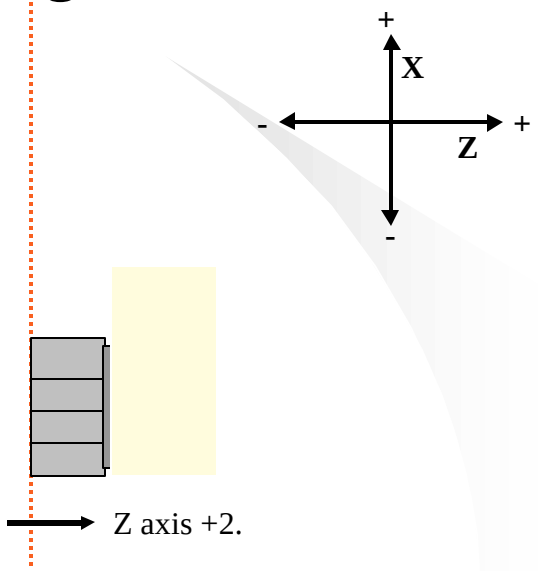
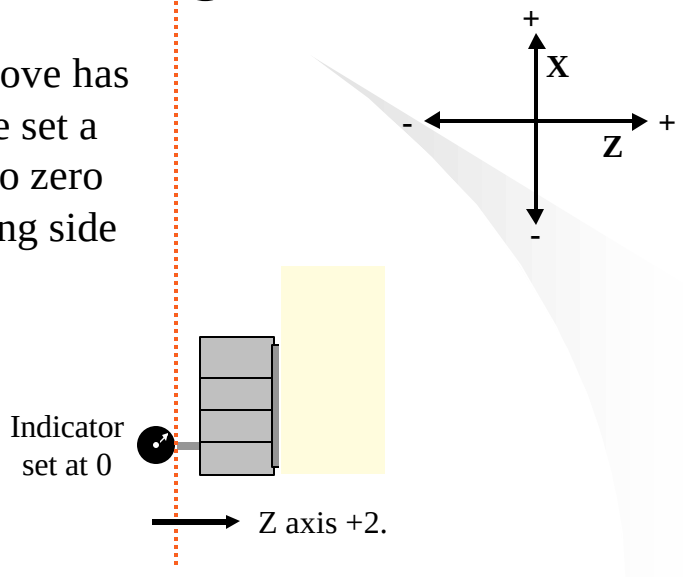


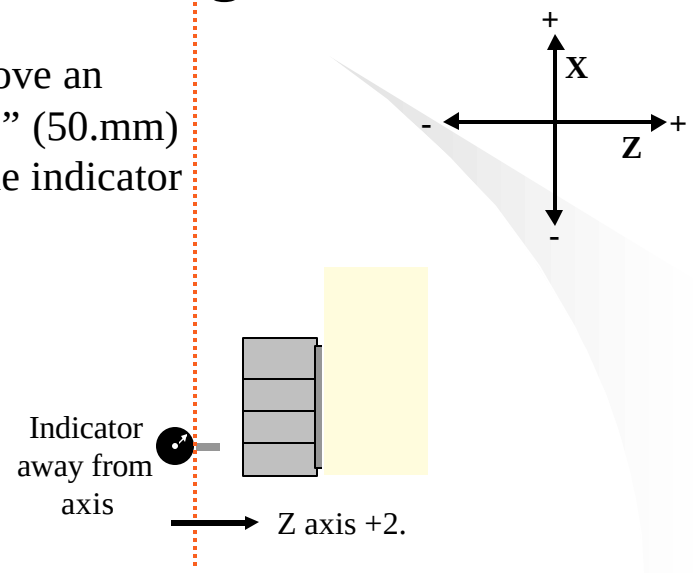
Checking Backlash

Once the move has been made set a indicator to zero on the trailing side



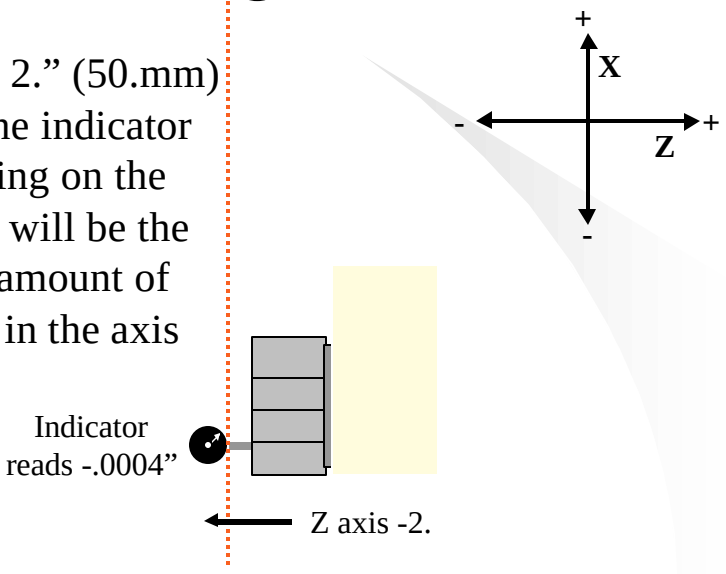
Checking Backlash

Now move an additional 2.” (50.mm) away from the indicator



Checking Backlash

Now move 2.” (50.mm) back to the indicator the reading on the indicator will be the current amount of backlash in the axis



Checking Backlash

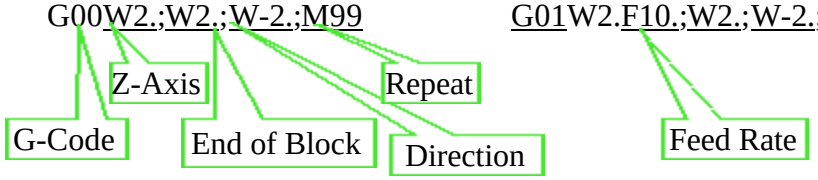
- In order to use a auto mode instead of the manual pause generator, select MDI mode. The auto mode is needed due to having two parameters to compensate for backlash.The following is a example of a cutting and rapid feed rate command.

Rapid Feed

G00W2.;W2.;W-2.;M99

Cutting Feed

G01W2.F10.;W2.;W-2.;M99



Checking Backlash

- The control doesn't have to be powered off & on for the new parameter value to be active.

- Again the parameters input in micron values if the machine has an inch or metric display.

- Example: .001" * 25.4= .0254mm or 25microns
  .017mm or 17microns

Inch * 25.4 = mm mm / 25.4 = Inch

Home Return Process

- Target Dimension for axis home position

  Target Dimension for machining centers can be identified by using the stroke diagram tag on the machine.Turning centers identified by using the tooling manual.

- Grid Spacing

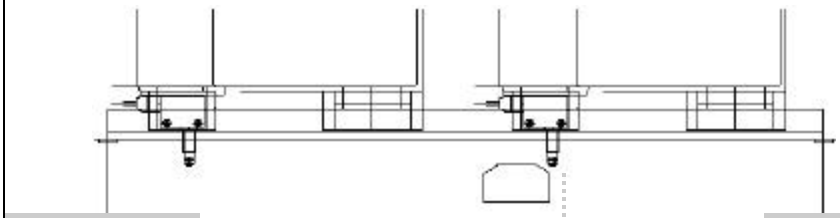
  Grid spacing is the amount of Z phase outputs per revolution. Grid spacing can be found on the Servo Monitor Screen under **GRDSP** displayed in mm.

- Grid Shift Parameter

  Grid shift parameter is a machine parameter (**N11** Machining Centers) or (**BS13** Turning Centers)

Home Return Process

- Home returning a machine beginning from home position, the axis must first move in the negative direction engaging then disengaging with the trip dog.



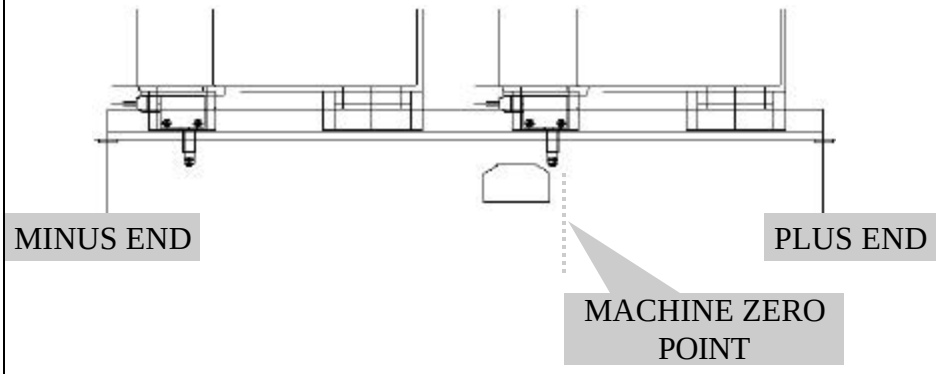
MINUS END

PLUS END

MACHINE ZERO POINT

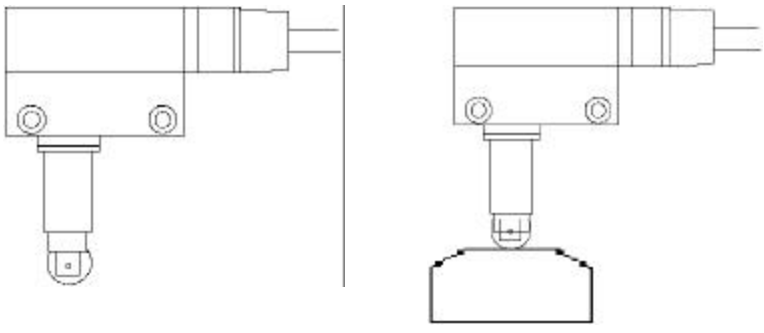
Home Return Process

•Home returning a machine beginning from other positions, the axis must still first move in the negative direction then move in the positive direction until the switch engages with the trip dog.

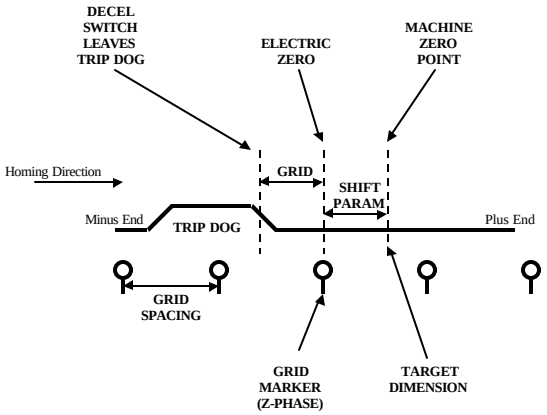


Home Return Process

Adjust vertical position of switch until center of the roller is at the bottom of the barrel.



Home Return Process



Home Return Process

SERVO MONITOR

		[X]	[Z]	[C]	[4]	[5]
GAIN	(1/sec)	0	0	0	0	0
DROOP	(i)	0	0	0	0	0
SPEED	(min-1)	0	0	0	0	0
CURRENT	(%)		0	0	0	0
MAX CUR1	(%)		0	0	0	0
MAX CUR2	(%)	0	0	0	0	0
OVER LOAD	(%)	0	0	0	0	0
OVER REG	(%	0	0	0	0	0
AMP DISP		00	00	00	00	00
ALARM		00 00 00	00 00 00	00 00 00	00 00 00	00 00 00
CYC CNT	(P)	0	0	0	0	0
GRDSP	(mm)	6.	10.	360.	6.	50.
GRID	(mm)	0.	0.	0.	0.	0.
MAC POS		-22.228	-18.788	0.	2.98685	0.
MOT POS		0.	0.	0.	0.	0.
SCA FB		0.	0.	0.	0.	0.
FB ERROR	(i)			0	0	0
DFB COMP	(i)			0	0	0

Grid Spacing

Grid Distance Should = 1/2 of GRDSP

NOTE: ON A LATHE DUE TO MACHINING TO A DIAMETER VALUE ON X-AXIS , GRID DISTANCE SHOULD EQUAL THE SAME AS GRDSP

NOTES:

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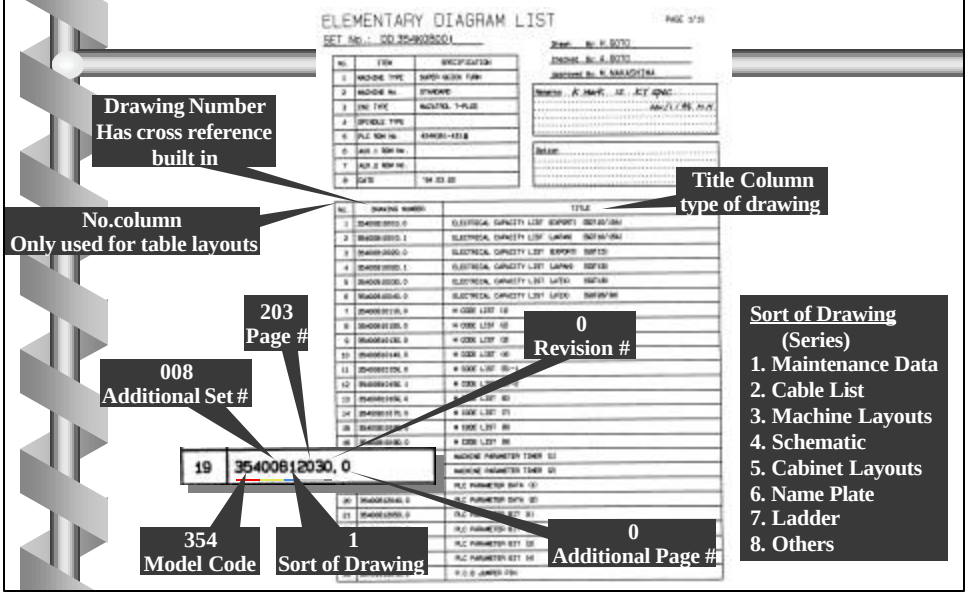
Return to Main Menu

SECTION 8

ELECTRICAL INFORMATION

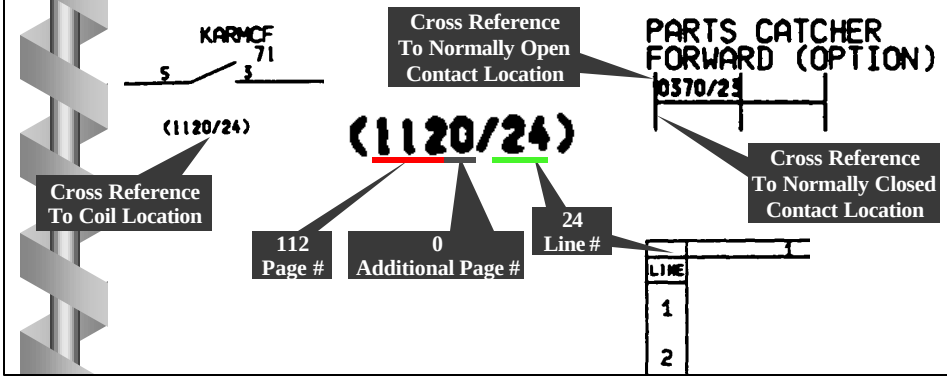
Return to Main Menu

Electrical Circuit Diagrams



Electrical Circuit Diagrams

Cross Reference will be found through out the manual.
Normally they cross reference to a coil or contact location.
All cross referencing is to the (4 Sort of Drawing) section.

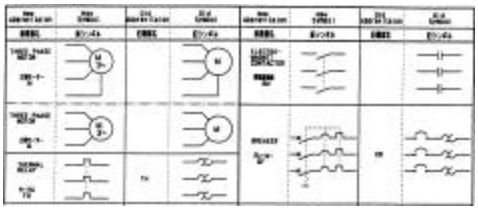


Electrical Circuit Diagrams

An explanation of the drawing number and cross reference will also be located in the front section of the Electrical Circuit Diagrams.

Electrical Circuit Diagrams

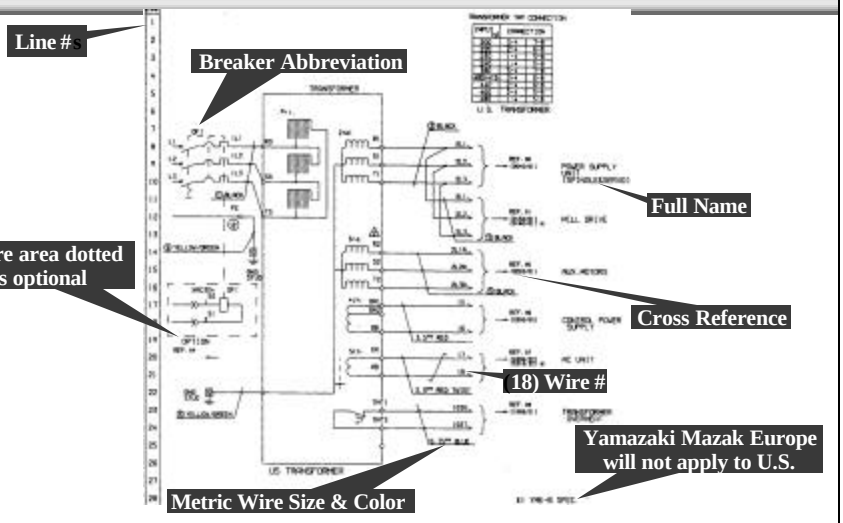
International Electrical Codes



Abbreviation Comparison List

A list of the I.E.C. and abbreviations used to write this manual can be located in the front section of the Electrical Circuit Diagrams.

Electrical Circuit Diagrams



Electrical Circuit Diagrams

- **The 60 Hz machines manufactured in the U.S. are designed for 230V ± 10% (thus a range of 207~253VAC).**
- **The 253VAC upper limit is to be considered an important factor and every effort to avoid exceeding this limit should be made. The best continuos voltage range for machine operation is 208~230VAC.**
- **Normal acceleration & deceleration of spindles generate 3.5% ~ 7.0% regenerative line voltage.**
- **When using a transformer, the 210VAC secondary is the appropriate target for machine operation, selecting a supply voltage on the low range allows for positive variances without adversely affecting the machine.**

Electrical Circuit Diagrams

- When a problem develops on a machine, more than likely the problem will be on the hardwired side.
- Before assuming that the problem is definitely on the machine side, trace the problem back to the PLC input or output.
- After identifying PLC address, view the state of the address on the Diagnosis Monitor Screen.

Electrical Circuit Diagrams

How to locate the PLC address.

Example: The coolant pump motor is not turning on.

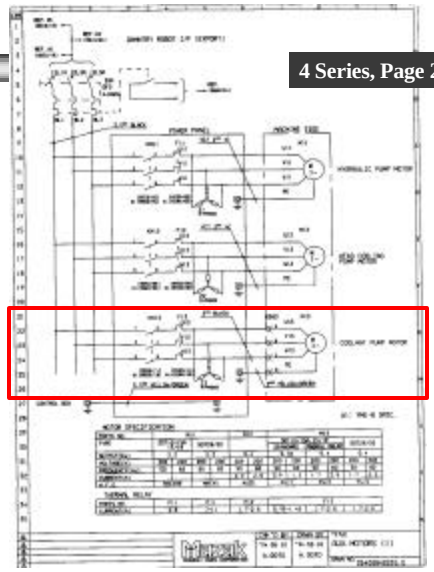
Step 1. With the Elementary Diagram List search for the drawing numbers with the (4 series) included. Once the 4 series is located, read through the title column for a related item and then view the drawing.

Examples:

146	35400840220,0	AUX. MOTORS (1)
167	35400840550,0	POWER PANEL CONTACTORS
222	35400841140,0	AC-PCB PC OUTPUT RELAY

Return to Main Menu

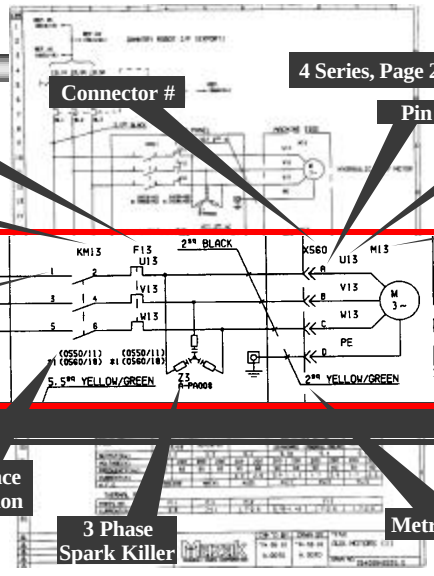
Electrical Circuit Diagrams



This drawing has the coolant pumps 3 phase motor.

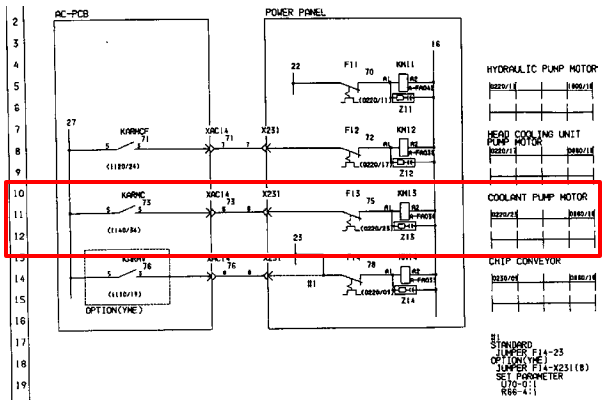
Now for step 2 locate the coil that will engage the contactor.

Electrical Circuit Diagrams



Return to Main Menu

Electrical Circuit Diagrams

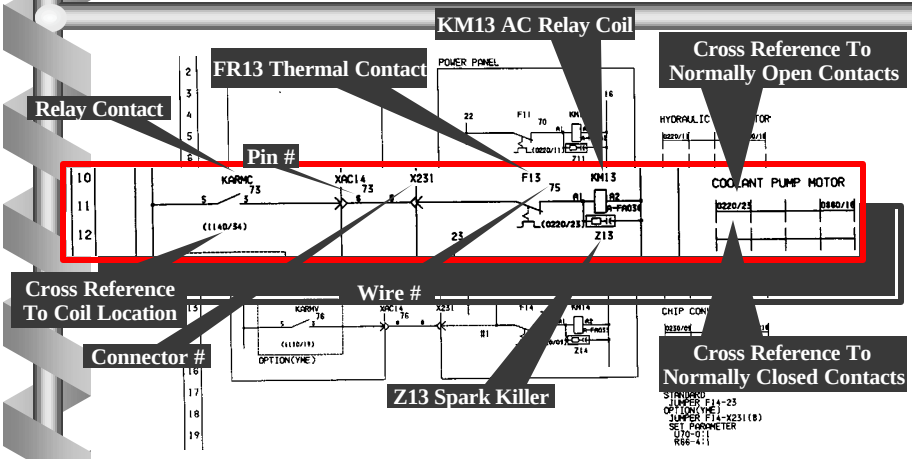


This drawing has the coolant pumps motor starter coil.

Now for step 3 locate the relay coil that will engage the relay contact.

4 Series, Page 55, Additional Page 0

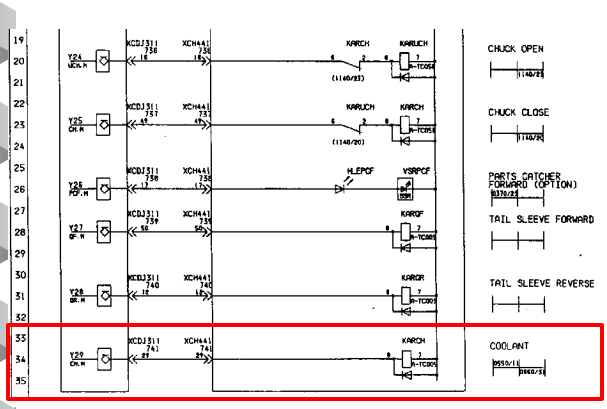
Electrical Circuit Diagrams



4 Series, Page 55, Additional Page 0

Return to Main Menu

Electrical Circuit Diagrams

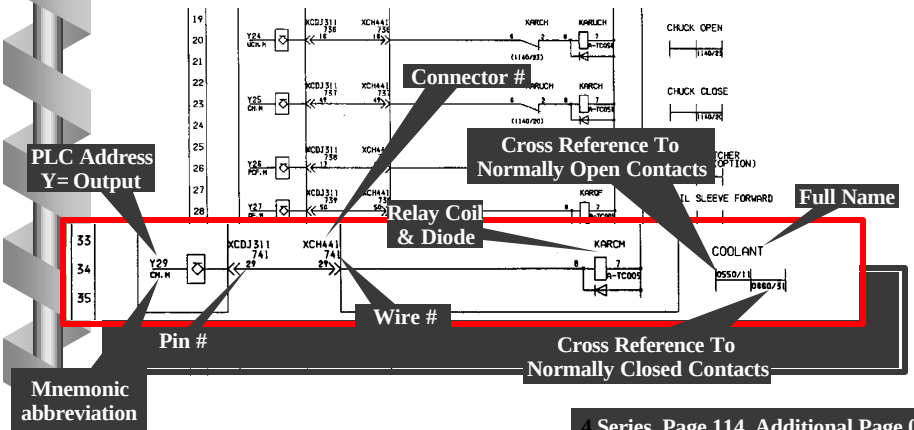


This drawing has the coolant pumps PLC output address.

Now for step 4 locate the PLC address on the Diagnosis Monitor Screen.

4 Series, Page 114, Additional Page 0

Electrical Circuit Diagrams



4 Series, Page 114, Additional Page 0

The Diagnosis Monitor Screen

- **Use the following keystrokes to display the Diagnosis Monitor Screen:**

> Diagnos
> Version
> Diagnos Monitor

The Diagnosis Monitor Screen

- **The first column is the Memory Monitor column.**
  Typically, you will not use this column.

- **The second and third are I/O monitor columns**
  - **Use the cursor keys to move to any address column.**
  - **Enter the desired address. It will display on the top line with the next three lines below it.**
  - **The second and third each have three rows of definable addresses.**
  - **A total of six separate address areas can be selected.**

Return to Main Menu

The Diagnosis Monitor Screen

- When monitoring X and Y addresses, locate the correct address line, then read across to the bit location.

- Example: Location of <u>X15</u>

I/O MONITOR

ADDRESS	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0	HEX
X 0000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0000
X 0010	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0000
X 0020	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0000
X 0030	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0000

The Diagnosis Monitor Screen

- When monitoring D and R addresses, the address line contains the complete device name.

Example: File register R0002 is the entire line.The first column is the address, the middle column is a 16 bit display of the data, and the last column is the 4 digit hex value of the address line.

ADDRESS	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0	HEX
R 0000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0000
R 0001	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0000
R 0002	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0000
R 0003	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0000

The Diagnosis Monitor Screen

- **When monitoring T, Q or C addresses, the address line contains 16 addresses.**

Example: **Timer T44 will be located in address line T0032.The first column is the address, the middle column is the display of 16 devices, and the last column is the 4 digit hex value of the line.**

ADDRESS	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0	HEX
T0000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0000
T0016	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0000
T0032	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0000
T0048	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0000

The Diagnosis Monitor Screen

- **The I/O write function is located at the the bottom of the second column.**
  - **Input the address you intend to write.**
  - **Cursor right to the "HEX" column.**
  - **Input the 4 digit hex word which will change the address to the new value.**
- **The I/O write function is a "pulse" of the address, and will not "override" the logic of the PLC ladder program.**

The Diagnosis Monitor Screen

- This system uses single characters, 0~F to represent a 4 digit binary number.

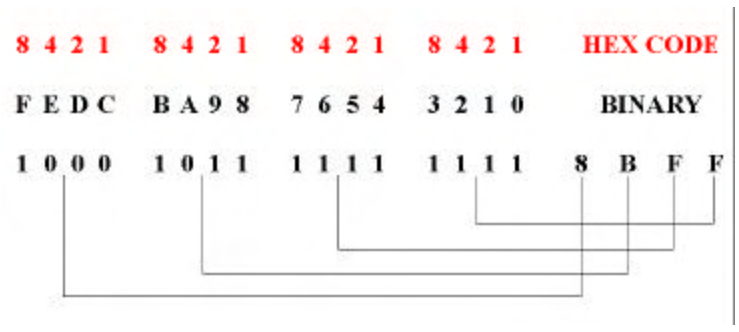
- In order to express all possible numbers with a single character, we assign a letter to represent 10 through 15 as shown below.

  10=A 11=B 12=C 13=D 14=E 15=F

- Each 4 digit binary number set has a coded HEX value.

8 4 2 1	8 4 2 1	8 4 2 1	8 4 2 1	HEX CODE
F E D C	B A 9 8	7 6 5 4	3 2 1 0	BINARY

The Diagnosis Monitor Screen



Each 4 digit binary number set is controlled by the coded HEX value for that set.

The Diagnosis Monitor Screen

- Use the diagnosis monitor as a quick check of the status of an input or output address.
- Use the ladder monitor function to view an address and the other contacts which logically relate to it.

Return to Main Menu

CONVERT FROM 16 BIT BINARY TO 4 DIGIT HEX

	8 4 2 1	8 4 2 1	8 4 2 1	8 4 2 1	HEX
1.	F E D C	B A 9 8	7 6 5 4	3 2 1 0	
	0 0 0 1	0 0 1 0	0 1 0 0	1 0 0 0	__ __ __ __
2.	F E D C	B A 9 8	7 6 5 4	3 2 1 0	
	0 0 0 1	1 0 0 0	0 0 0 0	0 0 1 0	__ __ __ __
3.	F E D C	B A 9 8	7 6 5 4	3 2 1 0	
	1 1 1 0	0 0 1 1	0 1 0 0	1 1 1 1	__ __ __ __
4.	F E D C	B A 9 8	7 6 5 4	3 2 1 0	
	0 0 1 0	1 1 1 1	1 1 0 0	1 0 1 0	__ __ __ __
5.	F E D C	B A 9 8	7 6 5 4	3 2 1 0	
	1 0 0 0	1 0 1 0	1 0 0 1	1 0 0 0	__ __ __ __
6.	F E D C	B A 9 8	7 6 5 4	3 2 1 0	
	1 1 0 0	1 0 1 1	0 1 1 1	1 0 0 1	__ __ __ __
7.	F E D C	B A 9 8	7 6 5 4	3 2 1 0	
	0 0 0 1	0 0 0 1	1 1 1 1	1 1 1 1	__ __ __ __
8.	F E D C	B A 9 8	7 6 5 4	3 2 1 0	
	1 0 1 1	1 0 1 0	1 1 0 1	0 0 0 1	__ __ __ __

Return to Main Menu

MODIFY THE 16 BIT ADDRESS FOR EACH

1.

8	4	2	1	8	4	2	1	8	4	2	1	8	4	2	1	HEX			
F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0				
0	0	0	1	0	0	1	0	0	1	0	0	1	0	0	0	1	2	4	8

Change bit **7** to a "1" and write the results below.

_____ _____ _____ _____ — — — —

2.

8	4	2	1	8	4	2	1	8	4	2	1	8	4	2	1	HEX			
F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0				
0	0	0	1	1	0	0	0	0	0	0	0	0	0	1	0	1	8	0	2

Change bit **E** to a "1" and write the new results below.

_____ _____ _____ _____ — — — —

3.

8	4	2	1	8	4	2	1	8	4	2	1	8	4	2	1	HEX			
F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0				
1	1	1	0	0	0	1	1	0	1	0	0	1	1	1	1	E	3	4	F

Change bits **B** and **4** to a "1" and write the new results below.

_____ _____ _____ _____ — — — —

4.

8	4	2	1	8	4	2	1	8	4	2	1	8	4	2	1	HEX			
F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0				
0	0	1	0	1	1	1	0	1	1	0	0	1	0	1	0	2	E	C	A

Change bits **F**, **C**, **0** and **4** to a "1" and write the new results below.

_____ _____ _____ _____ — — — —

The Ladder Monitor Function

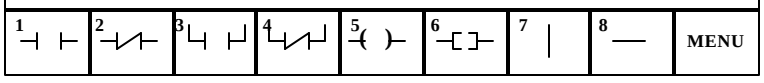
•Use the following keystrokes to view the Ladder Monitor.

> Diagnos
> Version
> Ladder Monitor
> Ladder
> 2 Circuit
> 6 Monit

The Ladder Monitor Function

Pressing any of the MND keys 1 ~ 6 will <u>RESTRICT</u> your search to that specific type of address.

Press the <u>MENU</u> key to change the choices to an alternate display.



The Ladder Monitor Function

The 9SET key will allow you to search by sequence number.

In order to resume normal searching you must press the MENU key twice and re-enter monitor mode.

9 SET								MENU

The Ladder Monitor Function

- **There are three methods of searching for addresses in the Ladder Monitor.**

1. **Unrestricted search, all locations.**
2. **Direct coil location search.**
3. **Sequence number search using the set function.**

The Ladder Monitor Function

- **Unrestricted search, all locations.**
  - **Type in the address and press input, this will display the first location found in the ladder. Press the input again for the next location.**
- **Direct coil location search.**
  - **Select the coil symbol "--( )--" and input the address to be searched. If there is a coil it will be displayed.**
- **Set number search.**
  - **Select "MENU" then "9 SET" and input the sequence number.**

The Ladder Monitor Function

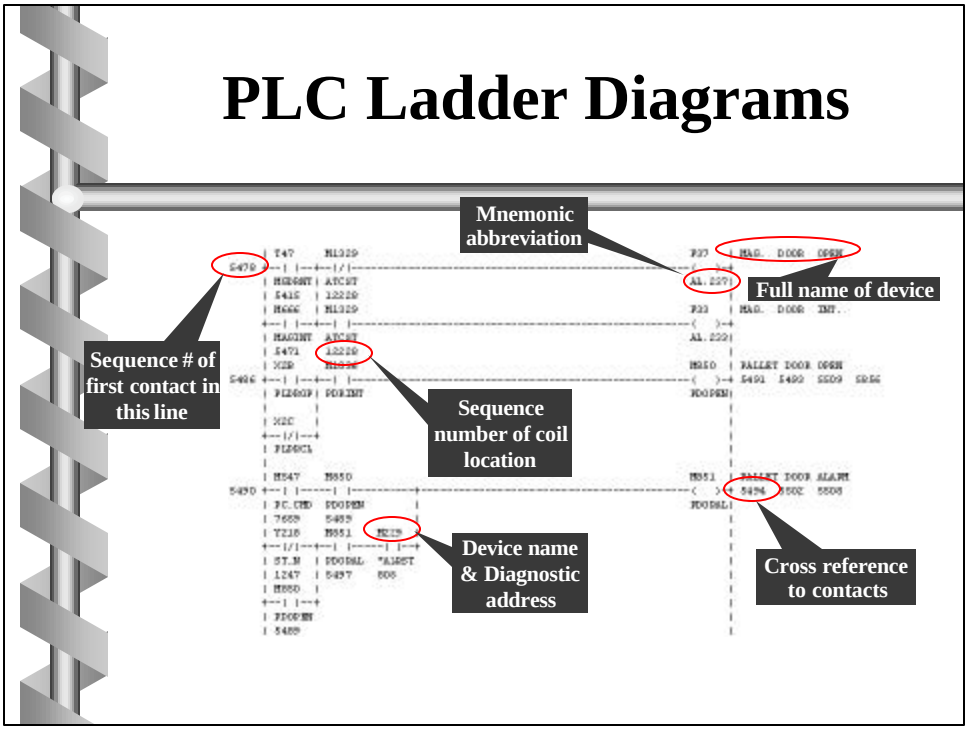
- **The ladder monitor function must be used in conjunction with the printed hard copy of the ladders.**

Use the sequence number from the display to reference the pages in the manual.

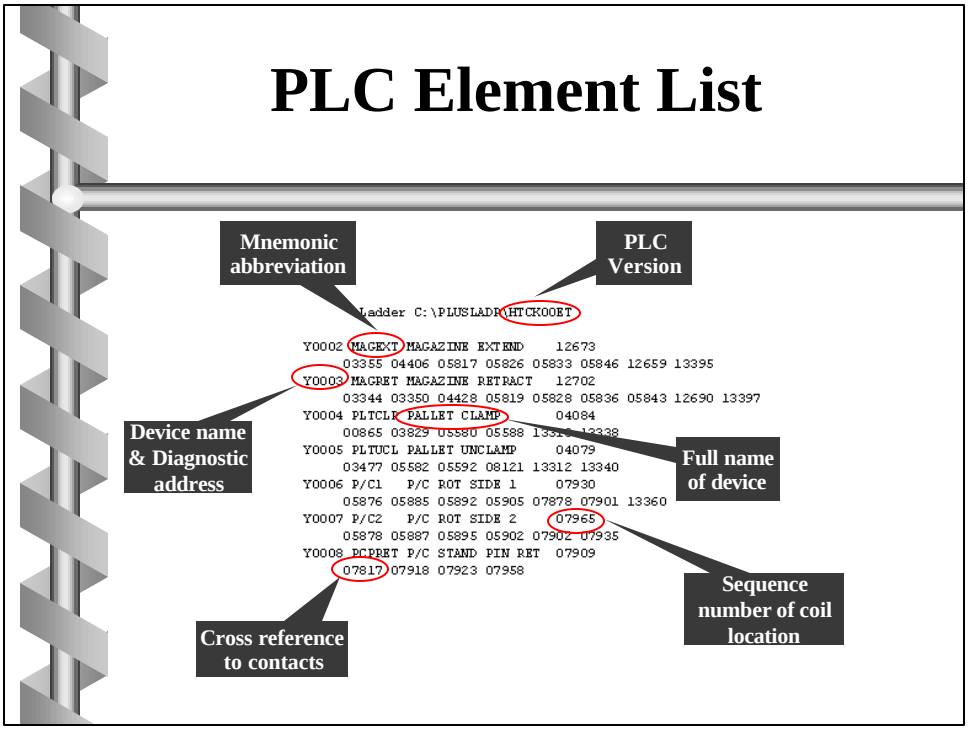
Use the mnemonic abbreviations and cross references in the manual for more detail.

Return to Main Menu

PLC Ladder Diagrams



PLC Element List



The Ladder Monitor Function

- Most machine failures or alarms will be caused by an input or output which is connected to the hardwiring.

- Look for addresses from the machine side range before considering other device conditions.

Return to Main Menu

List of Commonly Used Abbreviations for Mazatrol PLC Devices

PRS	=	Proximity Switch	*(xxx)	=	*denotes active low
SS	=	Select Switch			
RS	=	Reed Switch			
SW	=	Switch			
PB	=	Push Button			
.M	=	Machine Side			
PS	=	Pressure Switch			
LS	=	Limit Switch			
CD	=	Command			
INT	=	Interlock			
.B	=	Button (typically on operation panel)			
.N	=	Signal *to* or *from* the NC			
.L	=	Lamp (indicator lamps on operation panel)			
.P	=	Parameter related			
CL	=	Clamped or Closed			
UCL	=	Unclamped			
OP	=	Open			
EXT	=	Extend			
RET	=	Retract	S	=	Solenoid
ST	=	Start	T	=	Timer
FIN	=	Finish	R	=	Relay

Return to Main Menu

PLC Ladder Problem Solving

The operator screen displays the following message:

Find the following information:

1. What is the PLC coil (device) for this alarm?

   _____

2. What page # is the PLC coil located on in the ladders?

   _____

3. What is the step number or sequence number for the alarm coil?

   _____

4. What PLC inputs could have triggered this alarm?

   _____

5. What other PLC device could cause this alarm?

   _____

6. What type of device(s) generate the signal(s)?

   _____

7. What are the wire numbers associated with the I/O devices?

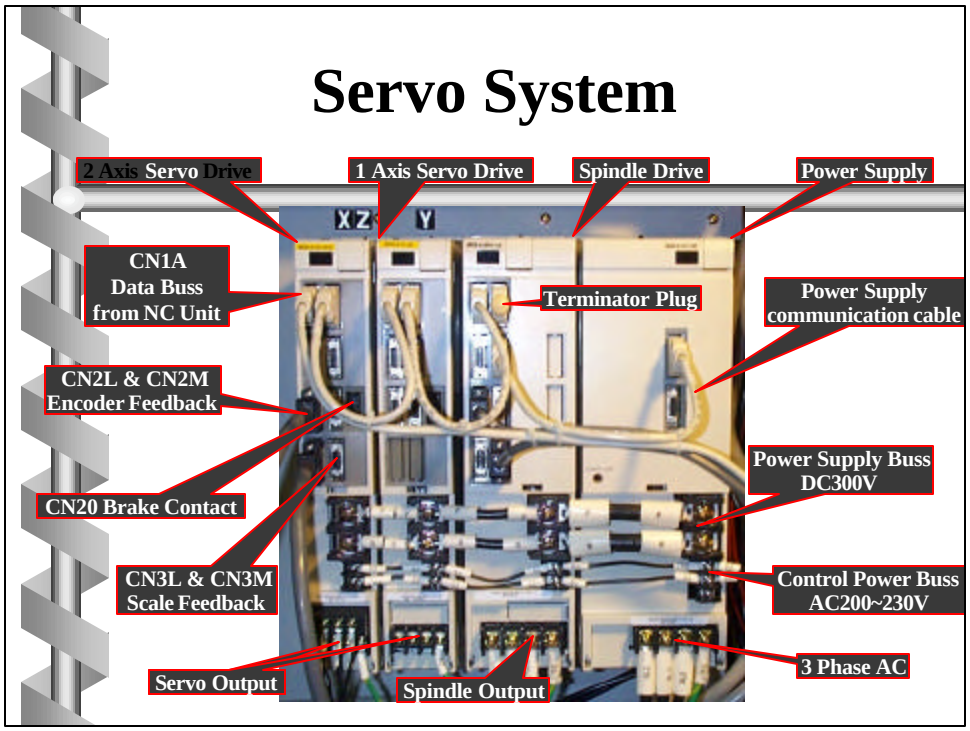
   _____

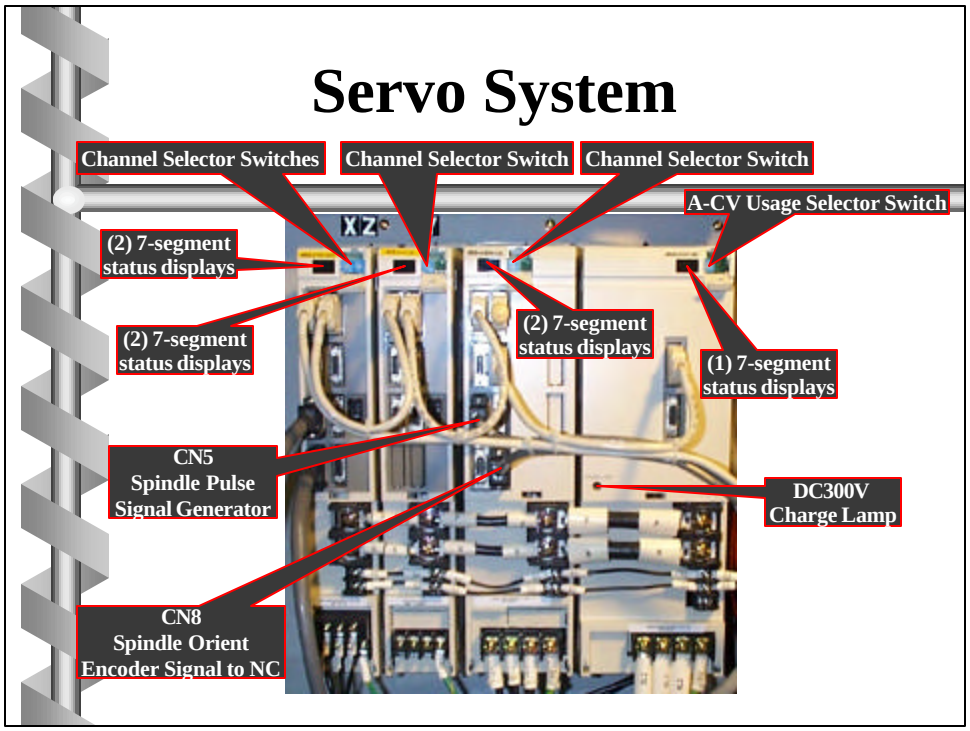
8. What page # is the device located on in the electrical schematics?

   _____

9. What could have happened to cause a loss of these signals?

   _____

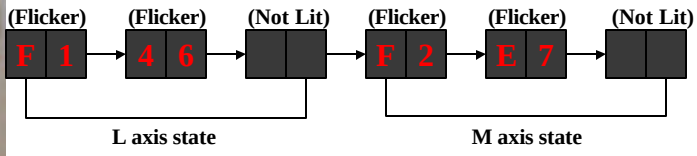

Servo System
2 Axis Servo Drive
1 Axis Servo Drive
Spindle Drive
Power Supply
CN1A
Data Buss
from NC Unit
Terminator Plug
Power Supply
communication cable
CN2L & CN2M
Encoder Feedback
CN20 Brake Contact
Power Supply Buss
DC300V
CN3L & CN3M
Scale Feedback
Control Power Buss
AC200~230V
Servo Output
Spindle Output
3 Phase AC


Servo System
Channel Selector Switches
Channel Selector Switch
Channel Selector Switch
A-CV Usage Selector Switch
(2) 7-segment
status displays
(2) 7-segment
status displays
(2) 7-segment
status displays
(1) 7-segment
status displays
CN5
Spindle Pulse
Signal Generator
DC300V
Charge Lamp
CN8
Spindle Orient
Encoder Signal to NC

Servo System

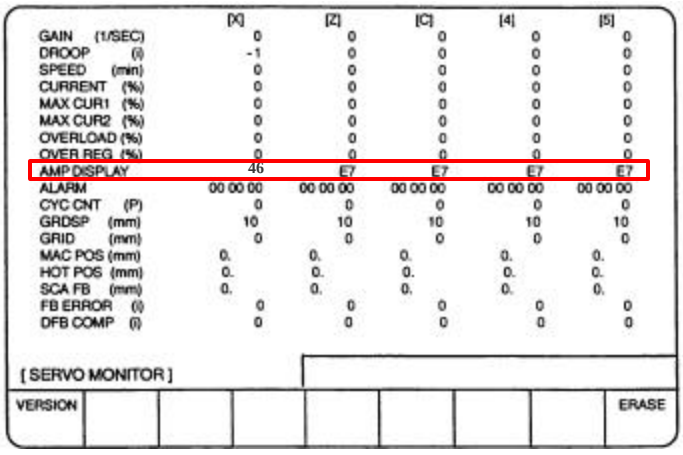
- Each axis will display its current status on the drive and the servo monitor screen.

Example: If an alarm has accrued on the L axis such as a motor overheat (# 46) and the M axis went into emergency stop (#E7) the display will read as follows.



Servo System

Servo Monitor Screen



Servo System

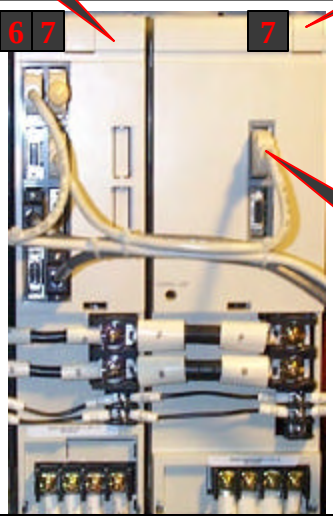
Once the state of the amplifier has been determined cross reference the alarm number in the servo manual for more details.

Most servo alarms require power off for the system to be reset.

Servo System

- **The Power Supply will display its current status on the supply using the last digit of the status only. The alarm will be fully displayed on the drive the power supply communication cable is connected to. The alarm can also be located on either the servo or spindle monitor screens under AMP DISPLAY.**

Servo System



Example: If an alarm has accrued on the Power Supply such as a open phase (# 67) and the other drives went into emergency stop (#E7) the display will read as follows.

Since the power supply communication cable is connected to the spindle drive,the status will also be displayed on the spindle monitor screen.

Servo System

Spindle Monitor Screen

GAIN (1/SEC)	0	0	0	0
DROOP (i)	-1	0	0	0
SPEED (min)	0	0	0	0
LOAD (%)	0	0	0	0
AMP DISP	46	E7	E7	E7
ALARM	00 00 00	00 00 00	00 00 00	00 00 00
CYC SNT (P)	0	0	0	0
CMD1	0000000000000000	0000000000000000	0000000000000000	0000000000000000
CMD2	0000000000000000	0000000000000000	0000000000000000	0000000000000000
CMD3	0000000000000000	0000000000000000	0000000000000000	0000000000000000
CMD4	0000000000000000	0000000000000000	0000000000000000	0000000000000000
STS1	0000000000000000	0000000000000000	0000000000000000	0000000000000000
STS2	0000000000000000	0000000000000000	0000000000000000	0000000000000000
STS3	0000000000000000	0000000000000000	0000000000000000	0000000000000000
STS4	0000000000000000	0000000000000000	0000000000000000	0000000000000000

[SPINDLE MONTOR]

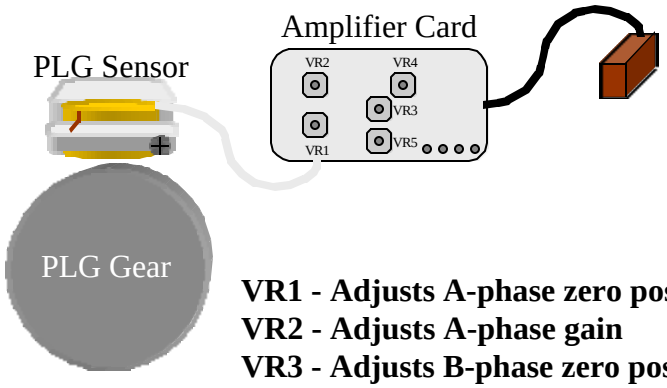
VERSION | ERASE

Servo System

Once the state of the power supply has been determined cross reference the alarm number in the servo manual for more details.

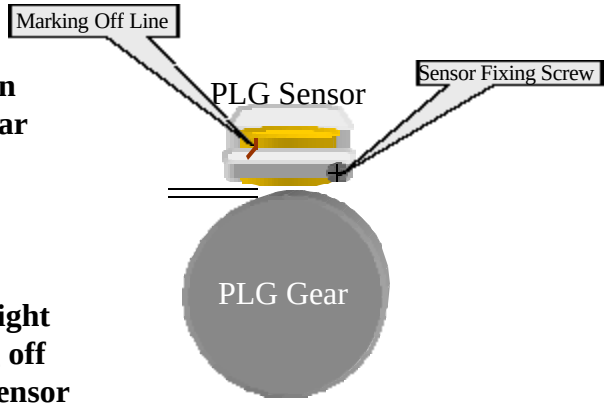
Most power supply alarms require power off for the system to be reset.

PLG Adjustment



VR1 - Adjusts A-phase zero position
VR2 - Adjusts A-phase gain
VR3 - Adjusts B-phase zero position
VR4 - Adjusts B-phase gain
VR5 - Adjusts Z-phase pulse width (Adjusted before shipment)

PLG Adjustment

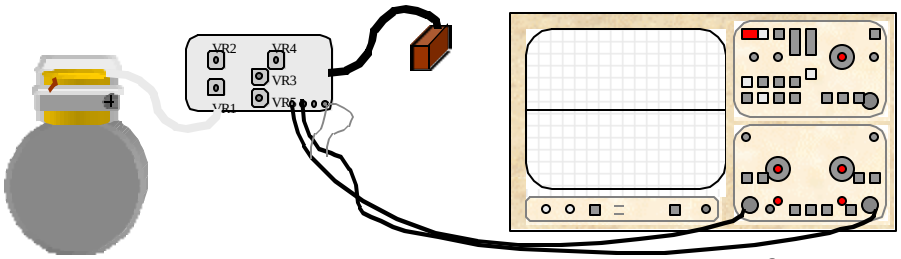


The Gap between the sensor and gear is to be set at .006±.0004" or 0.15±0.01mm.

When adjusting height keep the (marking off line) lined up from sensor to mounting bracket.

PLG Adjustment

How to check and adjust the A and B phase output signals

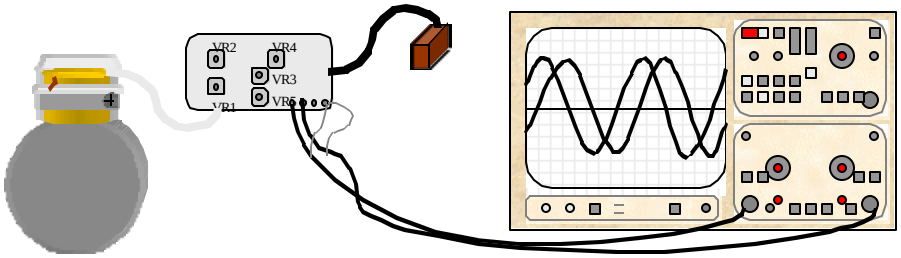


With an oscilloscope in a DC range connect to the following test pins on the amplifier card.

A-Phase output signal	Pin A & Pin G
B-Phase output signal	Pin B & Pin G

PLG Adjustment

How to check and adjust the A and B phase output signals

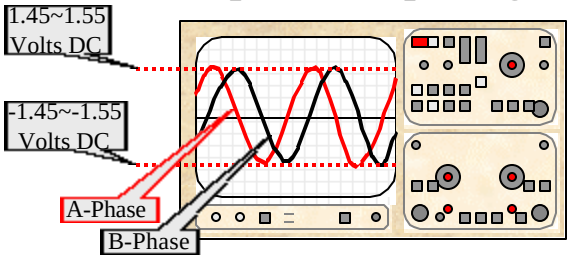


Normal signal pulses generated when motor runs at a reference speed, depending on PLG gear size.

128 Teeth Gear	Reference Speed 3600rpm
256 Teeth Gear	Reference Speed 1800rpm

PLG Adjustment

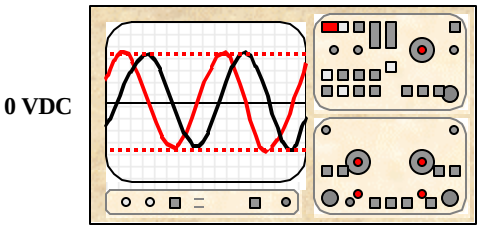
How to check and adjust the A and B phase output signals



Normal signal pulses generated when motor runs at a reference speed, is to be maintained between 2.9VDC ~ 3.1VDC.

PLG Adjustment

How to check and adjust the A and B phase output signals



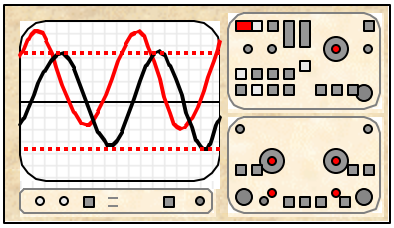
Adjustment of phase zero position - adjust the entire signal up or down.

PLG Adjustment

How to check and adjust the A and B phase output signals

A-Phase Zero Position Needs Adjustment

0 VDC

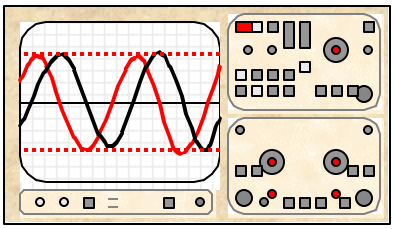


Adjustment of phase zero position - adjust the entire signal up or down.

PLG Adjustment

How to check and adjust the A and B phase output signals

0 VDC



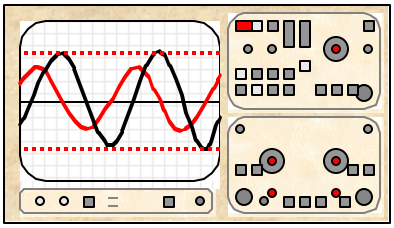
Adjustment of phase gain - adjust the voltage of the signal up or down.

PLG Adjustment

How to check and adjust the A and B phase output signals

A-Phase Gain Needs Adjustment

0 VDC



Adjustment of phase gain - adjust the voltage of the signal up or down.

PLG Adjustment

How to check and adjust the A and B phase output signals

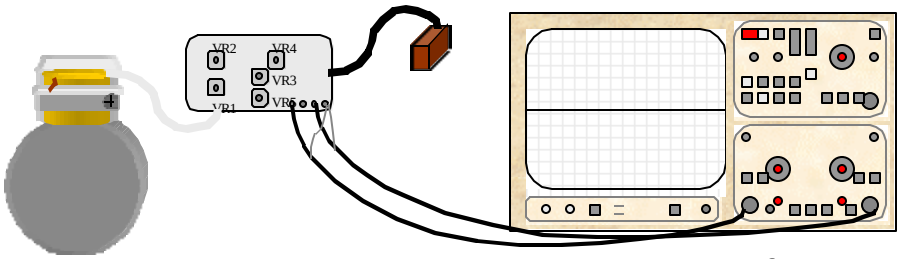
Before adjusting any of the potentiometers, change the parameter to operate the system in open loop.

Open loop - Spindle doesn't respond to PLG feedback.

Spindle Drive	Parameter	Open loop	Closed loop
FR-SF	**00**	**1**	**0**
FR-SFJ	**00**	**1**	**0**
MDS-A	**SP38 Bit F**	**1**	**0**

PLG Adjustment

How to check and adjust the Z phase output signals

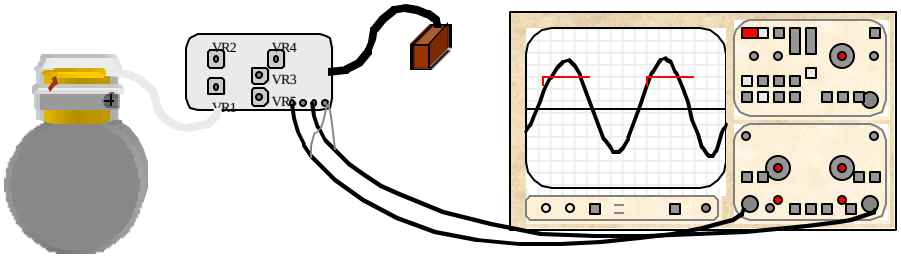


With an oscilloscope in a DC range connect to the following test pins on the amplifier card.

A-Phase output signal	Pin A & Pin G
Z-Phase output signal	Pin Z & Pin G

PLG Adjustment

How to check and adjust the Z phase output signal

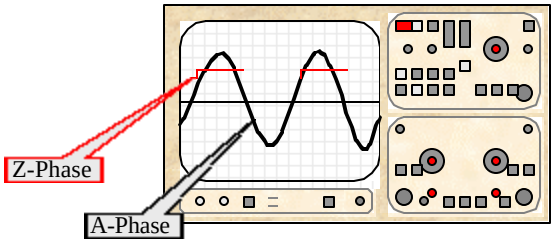


Normal signal pulses generated when motor runs at a reference speed, depending on PLG gear size.

128 Teeth Gear	Reference Speed 3600rpm
256 Teeth Gear	Reference Speed 1800rpm

PLG Adjustment

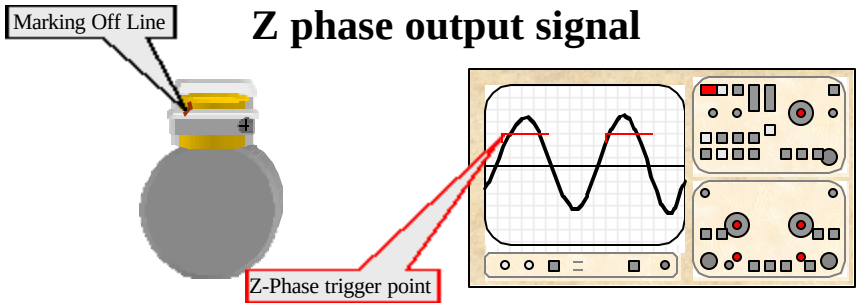
How to check and adjust the Z phase output signal



Normal signal pulses generated when motor runs at a reference speed, is one pulse per revolution. Reference voltage +15VDC

PLG Adjustment

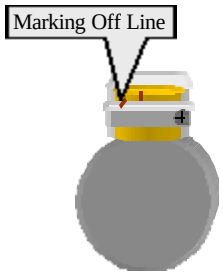
How to check and adjust the Z phase output signal



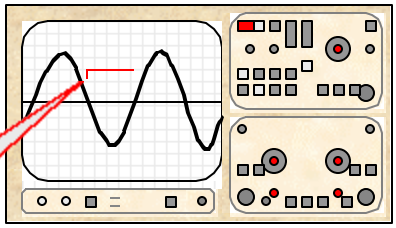
Adjustment of phase trigger point or phase difference between A & Z phases is accomplished by rotating the sensor to the marking off line. The trigger point allowable phase difference between A and Z is 25% of A-phase 0VDC.

PLG Adjustment

How to check and adjust the Z phase output signal



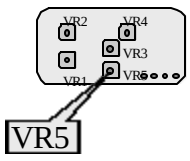
Z-Phase Difference Needs Adjustment

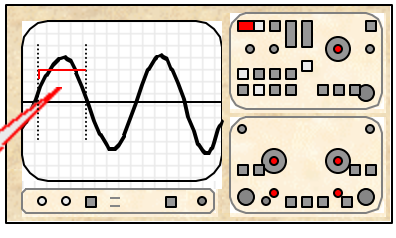


Adjustment of phase trigger point or phase difference between A & Z phases is accomplished by rotating the sensor to the marking off line. The trigger point allowable phase difference between A and Z is 25% of A-phase 0VDC.

PLG Adjustment

How to check and adjust the Z phase output signal

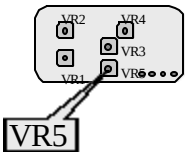




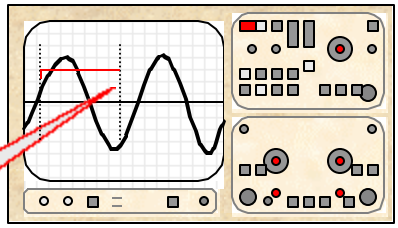
Adjustment of Z-phase pulse width is accomplished by adjusting VR5. The pulse width allowable difference between A and Z is 40~60% of A-phase full cycle.

PLG Adjustment

How to check and adjust the Z phase output signal

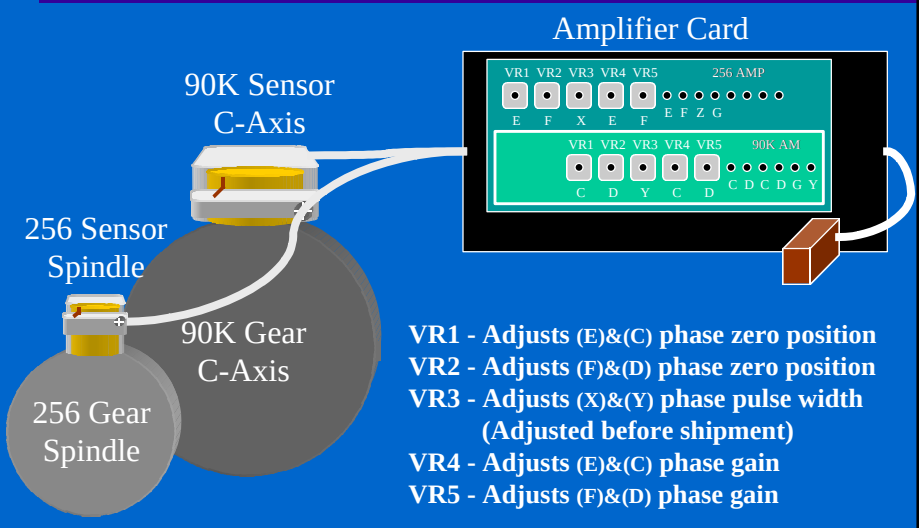


Z-Phase Pulse Width Needs Adjustment



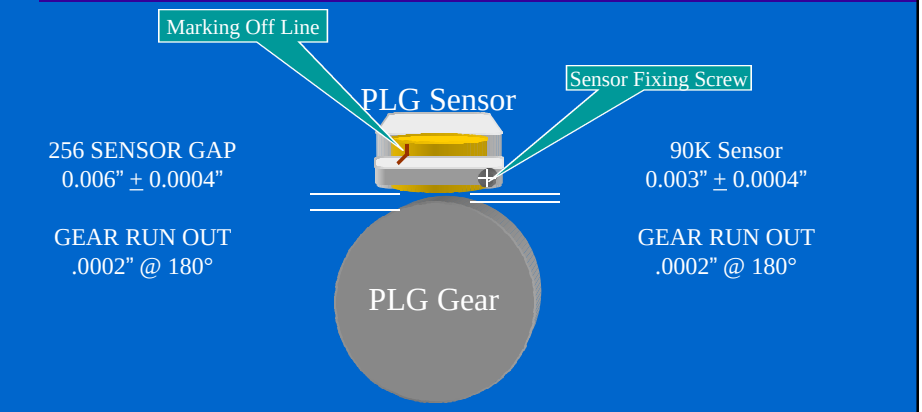
Adjustment of Z-phase pulse width is accomplished by adjusting VR5. The pulse width allowable difference between A and Z is 40~60% of A-phase full cycle.

90K & 256 PLG Adjustment



VR1 - Adjusts (E)&(C) phase zero position
VR2 - Adjusts (F)&(D) phase zero position
VR3 - Adjusts (X)&(Y) phase pulse width
(Adjusted before shipment)
VR4 - Adjusts (E)&(C) phase gain
VR5 - Adjusts (F)&(D) phase gain

90K & 256 PLG Adjustment



When adjusting:

- **Keep the (marking off line) lined up from sensor to mounting bracket.**
- **Use nylon bar to adjust run out.**

90K & 256 PLG Adjustment

How to check and adjust the E and F phase output signals for 256 Spindle Sensor.

Before adjusting any of the potentiometers, change the parameter to operate the system in open loop.

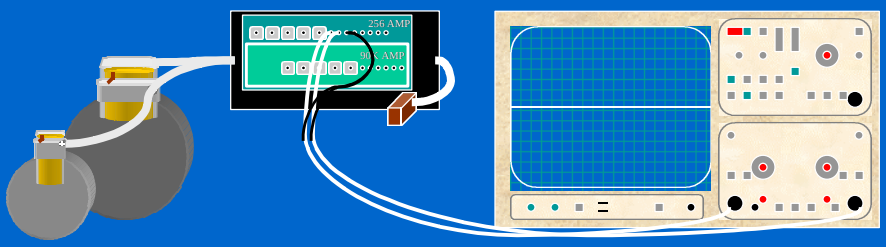
Open loop - Spindle doesn't respond to PLG feedback.

Spindle Drive	Parameter	Open loop	Closed loop
FR-SF	**00**	**1**	**0**
FR-SFJ	**00**	**1**	**0**
MDS	**SP38 Bit F**	**1**	**0**

Note: To fine tune may need final adjustment in closed loop.

90K & 256 PLG Adjustment

How to check and adjust the E and F phase output signals for 256 Spindle Sensor.



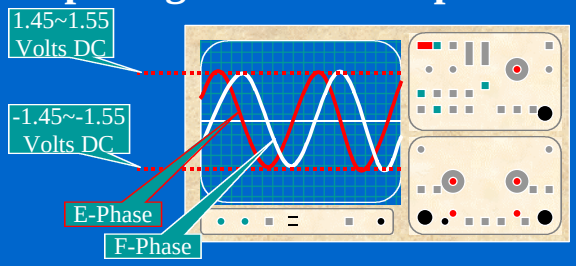
With an oscilloscope in a DC range connect to the following test pins on the amplifier card.

E-Phase output signal **Pin E & Pin G**
F-Phase output signal **Pin F & Pin G**

Return to Main Menu

90K & 256 PLG Adjustment

How to check and adjust the E and F phase output signals for 256 Spindle Sensor.



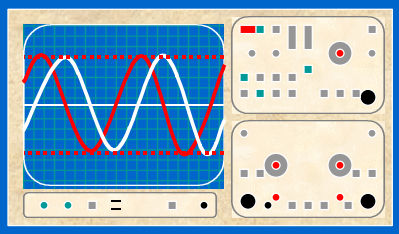
Normal signal pulses generated when motor runs at a reference speed, is to be maintained between 2.9VDC ~ 3.1VDC.

256 Teeth Gear Reference Speed 1800rpm

90K & 256 PLG Adjustment

How to check and adjust the E and F phase output signals for 256 Spindle Sensor.

0 VDC



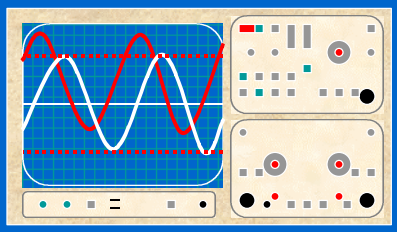
Adjustment of phase zero position - adjust the entire signal up or down.

90K & 256 PLG Adjustment

How to check and adjust the E and F phase output signals for 256 Spindle Sensor.

E-Phase Zero Position Needs Adjustment

0 VDC

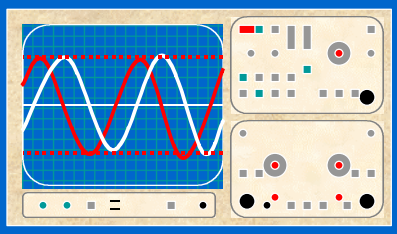


Adjustment of phase zero position - adjust the entire signal up or down.

90K & 256 PLG Adjustment

How to check and adjust the E and F phase output signals for 256 Spindle Sensor.

0 VDC



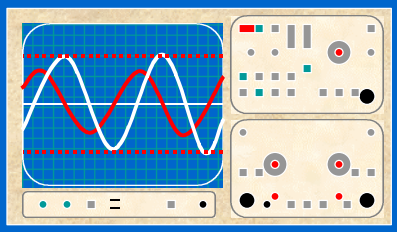
Adjustment of phase gain - adjust the voltage of the signal up or down.

90K & 256 PLG Adjustment

How to check and adjust the E and F phase output signals for 256 Spindle Sensor.

E-Phase Gain Needs Adjustment

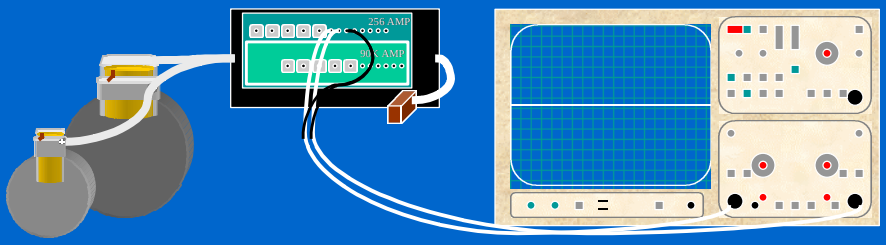
0 VDC



Adjustment of phase gain - adjust the voltage of the signal up or down.

90K & 256 PLG Adjustment

How to check and adjust the X phase output signal for 256 Spindle Sensor.

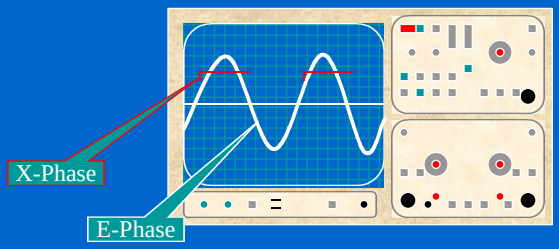


With an oscilloscope in a DC range connect to the following test pins on the amplifier card.

E-Phase output signal — Pin E & Pin G
X-Phase output signal — Pin X & Pin G

90K & 256 PLG Adjustment

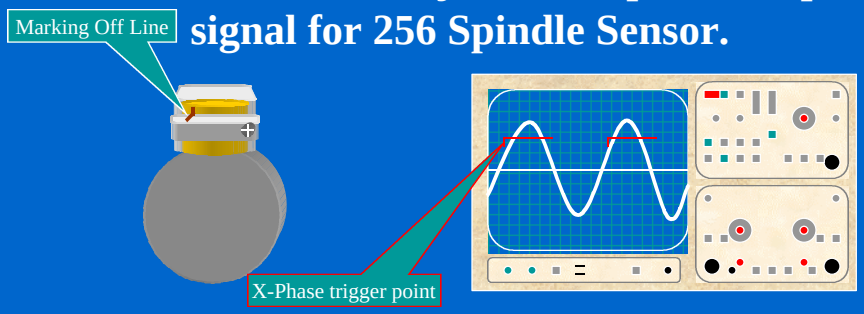
How to check and adjust the X phase output signal for 256 Spindle Sensor.



Normal signal pulses generated when motor runs at a reference speed, is one pulse per revolution.
Reference voltage +15VDC
256 Teeth Gear Reference Speed 1800rpm

90K & 256 PLG Adjustment

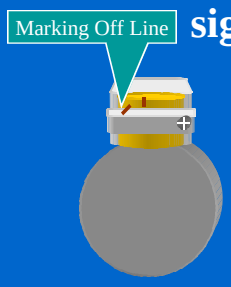
How to check and adjust the X phase output signal for 256 Spindle Sensor.



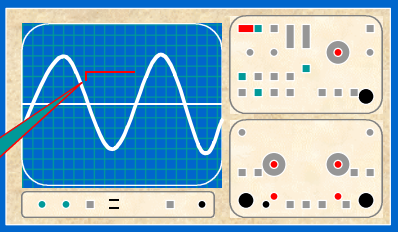
Adjustment of phase trigger point or phase difference between E & X phases is accomplished by rotating the sensor to the marking off line. The trigger point allowable phase difference between E and X is 25% of E-phase 0VDC.

90K & 256 PLG Adjustment

How to check and adjust the X phase output signal for 256 Spindle Sensor.



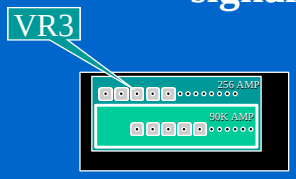
X-Phase Difference Needs Adjustment

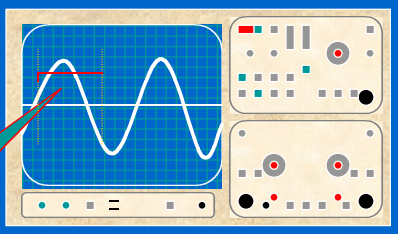


Adjustment of phase trigger point or phase difference between E & X phases is accomplished by rotating the sensor to the marking off line. The trigger point allowable phase difference between E and X is 25% of E-phase 0VDC.

90K & 256 PLG Adjustment

How to check and adjust the X phase output signal for 256 Spindle Sensor.



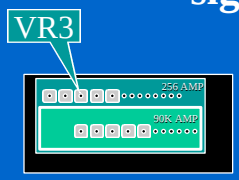


Adjustment of E-phase pulse width is accomplished by adjusting VR3. The pulse width allowable difference between E and X is 65~67% of E-phase full cycle.

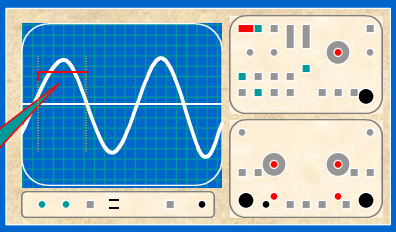
(SQT 10~200 - The pulse width allowable difference between E and X is 75%~85% of E-phase full cycle)

90K & 256 PLG Adjustment

How to check and adjust the X phase output signal for 256 Spindle Sensor.



X-Phase Pulse Width Needs Adjustment



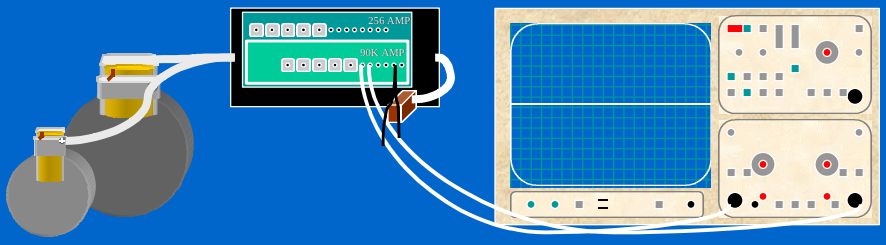
Adjustment of X-phase pulse width is accomplished by adjusting VR3. The pulse width allowable difference between E and X is 65~67% of E-phase full cycle.

(SQT 10~200 - The pulse width allowable difference between E and X is 75%~85% of E-phase full cycle.)

90K PLG Adjustment

90K & 256 PLG Adjustment

How to check and adjust the C and D phase output signals for 90K C-Axis Sensor.

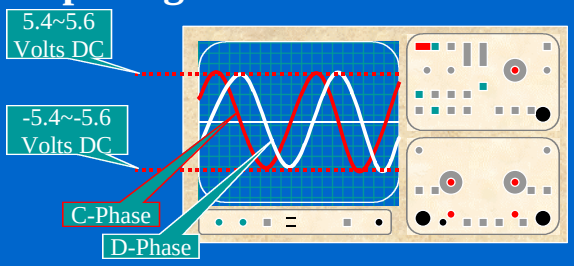


With an oscilloscope in a DC range connect to the following test pins on the amplifier card.

C-Phase output signal	Pin C & Pin G
D-Phase output signal	Pin D & Pin G

90K & 256 PLG Adjustment

How to check and adjust the C and D phase output signals for 90K C-Axis Sensor.



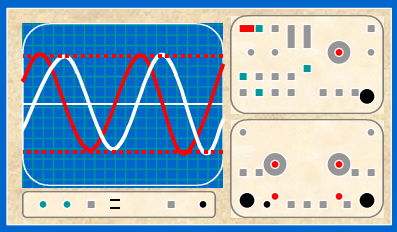
Normal signal pulses generated when motor runs at a reference speed, is to be maintained between 10.8VDC ~ 11.2VDC.

900 Teeth Gear Reference Speed 1OOrpm

90K & 256 PLG Adjustment

How to check and adjust the C and D phase output signals for 90K C-Axis Sensor.

0 VDC



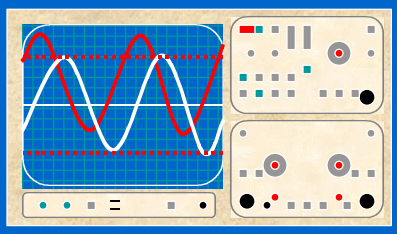
Adjustment of phase zero position - adjust the entire signal up or down.

90K & 256 PLG Adjustment

How to check and adjust the C and D phase output signals for 90K C-Axis Sensor.

C-Phase Zero Position Needs Adjustment

0 VDC

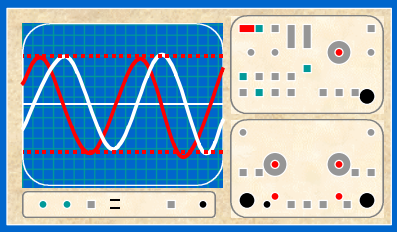


Adjustment of phase zero position - adjust the entire signal up or down.

90K & 256 PLG Adjustment

How to check and adjust the C and D phase output signals for 90K C-Axis Sensor.

0 VDC



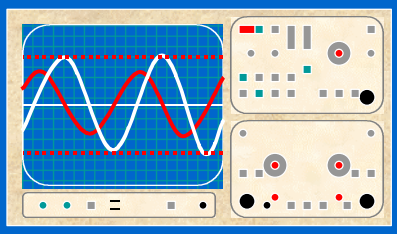
Adjustment of phase gain - adjust the voltage of the signal up or down.

90K & 256 PLG Adjustment

How to check and adjust the C and D phase output signals for 90K C-Axis Sensor.

C-Phase Gain Needs Adjustment

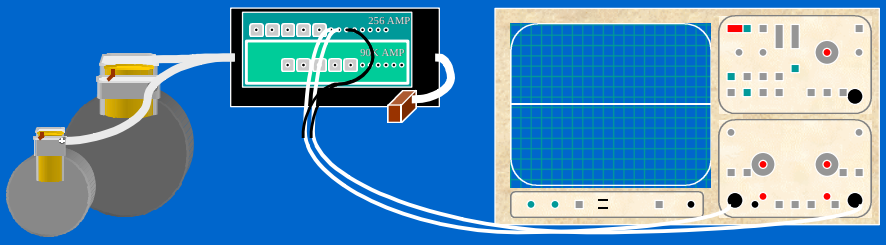
0 VDC



Adjustment of phase gain - adjust the voltage of the signal up or down.

90K & 256 PLG Adjustment

How to check and adjust the Y phase output signal for 90K C-Axis Sensor.

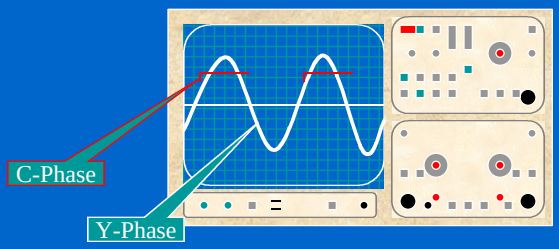


With an oscilloscope in a DC range connect to the following test pins on the amplifier card.

C-Phase output signal	Pin C & Pin G
Y-Phase output signal	Pin Y & Pin G

90K & 256 PLG Adjustment

How to check and adjust the Y phase output signal for 90K C-Axis Sensor.



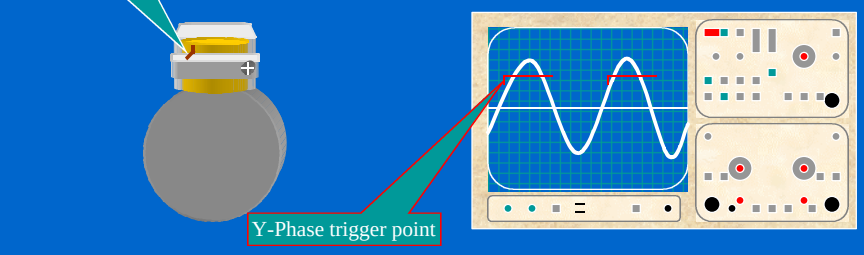
Normal signal pulses generated when motor runs at a reference speed in reverse, is one pulse per revolution.

Reference voltage +25VDC

90000 Teeth Gear Reference Speed 100rpm

90K & 256 PLG Adjustment

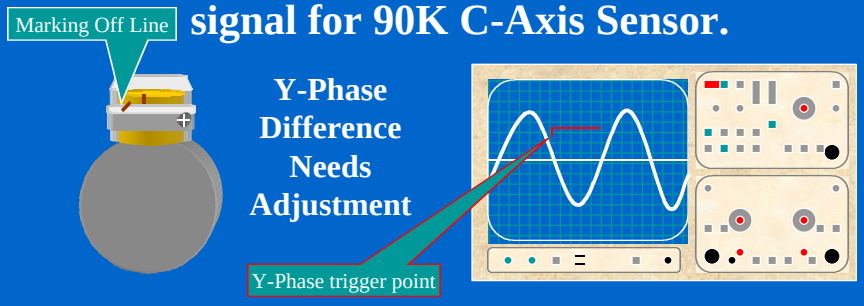
How to check and adjust the Y phase output signal for 90K C-Axis Sensor.



Adjustment of phase trigger point or phase difference between C & Y phases is accomplished by rotating the sensor to the marking off line. The trigger point allowable phase difference between C and Y is 25% of C-phase 0VDC.

90K & 256 PLG Adjustment

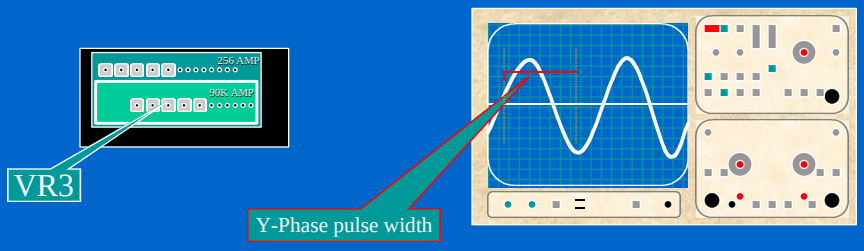
How to check and adjust the Y phase output signal for 90K C-Axis Sensor.



Adjustment of phase trigger point or phase difference between C & Y phases is accomplished by rotating the sensor to the marking off line. The trigger point allowable phase difference between C and Y is 25% of C-phase 0VDC.

90K & 256 PLG Adjustment

How to check and adjust the Y phase output signal for 90K C-Axis Sensor.



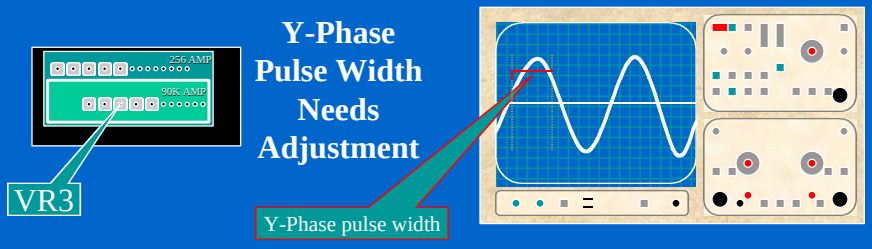
Adjustment of Y-phase pulse width is accomplished by adjusting VR3. The pulse width allowable difference between C and Y is 70~80% of C-phase full cycle.

(SQT 10~200 - The pulse width allowable difference between C and Y is 75%~85% of C-phase full cycle.)

90K & 256 PLG Adjustment

How to check and adjust the Y phase output signal for 90K C-Axis Sensor.

Y-Phase Pulse Width Needs Adjustment



Adjustment of Y-phase pulse width is accomplished by adjusting VR3. The pulse width allowable difference between C and Y is 70~80% of C-phase full cycle.

(SQT 10~200 - The pulse width allowable difference between C and Y is 75%~85% of C-phase full cycle.)

NOTES:

NOTES:

Return to Main Menu

SECTION 9

MICRO DISK INFORMATION

7 Parameter Setting

Prior to starting the unit, set the parameters to match those of the connected NC equipment.
Failure to set the parameters may lead to malfunction of the unit.

① Turn on the unit. Refer to Sec. 5, ON/OFF Switching on page 8. The initial display will show:

```
* DISK SET  1: PARAMETER  2: FORMAT
                                - - →■
```

② Put the unit in the PARAMETER SET mode.

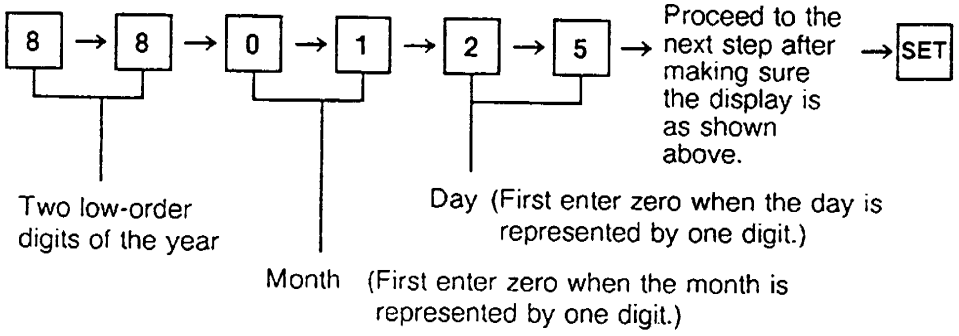
Press the [SET] key after pressing the [1] key.

When the PARAMETER SET mode has been entered, the parameters begin to appear, in the order mentioned below.
When the parameters need not be changed, press the [SET] key only. Pressing the [CLEAR] key initializes the display at any time.

③ Setting Date
Enter the year, month, and day in that order.

Example: The date to be set is January 25, 1988.

```
PARAMETER
        DATE  (88/01/25)
```

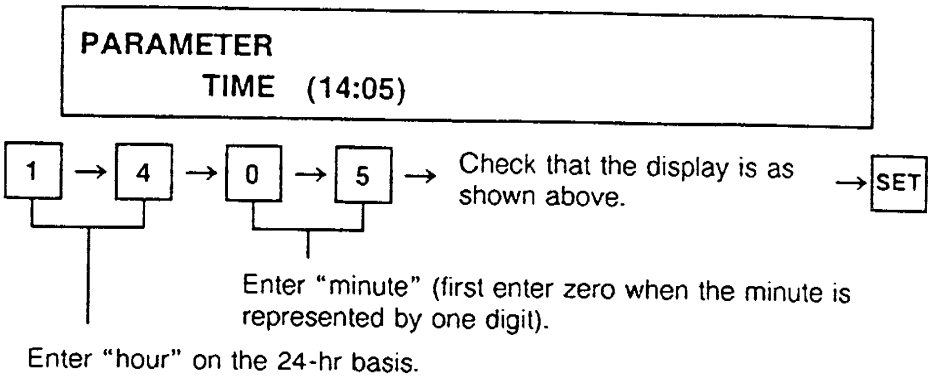


To correct an erroneous entry, move the cursor (blinking mark) to the appropriate position and re-enter the required data.

④ Setting Time of Day

Set the current time of day on a 24-hr basis.

Example: 2:05 p.m. (14:05)

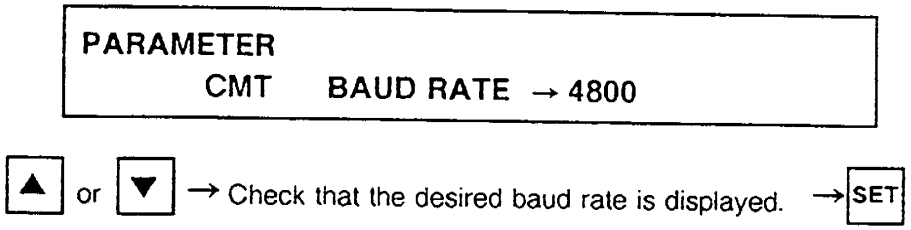


The clock starts from 00 sec when the [SET] key is pressed.

To correct an erroneous entry, move the cursor (blinking mark) to the appropriate position and re-enter the required data.

⑤ Setting the CMT Mode Baud Rate

When the unit is to be used as a cassette magnetic tape deck, select the same baud rate as is set on the connected NC equipment.



Each time the ▲ key is pressed, the baud rate shown changes in the follwing order.

110→300→600→1200→2400→4800→9600→19200

Pressing the ▼ key reverses the order of above display.

⑥ The parameter setting is now complete for a unit which is used as a cassette magnetic tape deck.

Pressing the [CLEAR] key initializes the display.

When the unit is to be used as a paper tape reader/punch, set the parameters for the EIA/ISO mode. In this case, do not press the [CLEAR] key.
When using the unit as a paper tape reader/punch, select the same parameters as set on the connected NC equipment.

⑦ Setting the EIA/ISO Mode Baud Rate
Follow the same procedure as in the CMT mode. Select the same baud rate as set on the connected NC equipment.

```
PARAMETER
        EIA/ISO     BAUD RATE → 4800
```

[▲] or [▼] → Check that the desired baud rate is displayed. → [SET]

Each time the ▲ key is pressed, the baud rate shown changes in the follwing order.
110→300→600→1200→2400→4800→9600→19200

Pressing the ▼ key reverses the order of above display.

⑧ Setting Stop Bits
Use the numerical keys.

```
PARAMETER (STOP BIT)
 P0 = 2  (0: 1  1: 1.5  2: 2)
```

[2] → [SET]

0 . . . Stop bit 1
1 . . . Stop bit 1.5
2 . . . Stop bit 2

⑨ Setting Parity Bits
Use the numerical keys.

```
PARAMETER (PARITY BIT)
 P1 = 0  (0: NON  1: ODD  2: EVEN)
```

[0] → [SET]

0 . . . No parity bit
1 . . . Odd parity
2 . . . Even parity

⑩ Setting EIA/ISO Output Code
Choose between the EIA and ISO codes for outputting purposes.

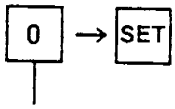
```
PARAMETER (OUTPUT CODE)
 P2 = 0  (0: EIA  1: ISO)
```

[0] → [SET]

0 . . . EIA output code
1 . . . ISO output code

⑪ Setting DC Code ENABLE/DISABLE

PARAMETER (DC CODE)
P3 = 0 (0: ENABLE 1: DISABLE)



0 . . . DC code ENABLE
1 . . . DC code DISABLE

⑫ Parameter setting is now complete.

Pressing the CLEAR key initializes the display.

When the parameter settings are to be changed, don't press the [CLEAR] key. Press the [SET] key. Pressing the [SET] key calls up the display showing the date which was set according to the procedure described in Sec. 7-③. When no change is required for a particular item, press the [SET] key.

Parameter list

Display	Contents
DATE	Date setting
TIME	Time setting
CMT BAUD RATE	Baud rate (transmission speed) in the cassette magnetic tape mode
EIA/ISO BAUD RATE	Baud rate (transmission speed) in the EIA/ISO mode
STOP BIT	Number of stop bits
PARITY BIT	Parity bit setting
OUTPUT CODE	Output code (EIA or ISO)
DC CODE	Enabling/disabling the DC code

8 Disk Formatting

After completion of parameter setting, format (initialize) the disk so that it can be used in the unit.
A nonformatted disk cannot be used in the unit. Have a commercially available 3.5-in. micro floppy disk (double-sided, double-density) on hand.
Keep in mind that formatting a previously formatted disk erases all the data stored on it.

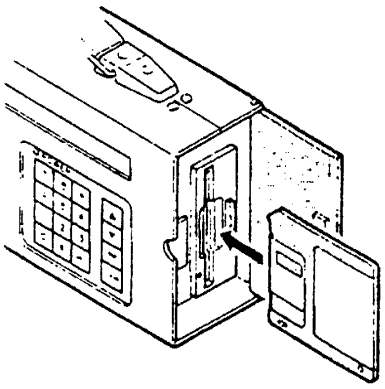
① Turn on the unit. Refer to the procedure described in Sec. 5, ON/OFF Switching, page 8. The initial display will then appear.

```
* DISK SET 1: PARAMETER 2: FORMAT
                                  - - →■
```

② Put the unit into the DISK FORMAT mode.

Press the [SET] key after pressing the [2] key.

③ Load the disk to be formatted. Refer to Sec. 6, Disk Loading and Unloading, page 10.



When the disk has been loaded, the display changes to show:

```
FORMAT PUSH (START)!!
```

A previously formatted disk can be formatted again.

If the formatted disk is formatted again, all the data stored on it will be erased.

④ Starting Disk Formatting

Press the [START] key.

The disk begins to be formatted. During formatting, a highpitched sound will be audible. Disk formatting requires approximately 80 sec.

⑤ Selecting the Mode

Upon completion of disk formatting, the display changes to the following. Decide on whether the disk is to be used in the CMT mode (as a cassette magnetic tape deck) or the EIA/ISO mode (as a paper tape reder/punch).

```
FORMAT  1: CMT(2)  2: CMT(6)  3: EIA/ISO
```

[1] → [SET]

1 . . . **Used in the standard CMT mode**
2 . . . **Used in the economy CMT mode**
3 . . . **Used in the EIA/ISO mode**

Disk formatting is now complete.
The disk cannot be used unless formatted.
It is recommended that any disk be formatted immediately after it is purchased.

[Information on the Mode]

The mode is classified into: (1) the CMT mode, in which the unit is used as a cassette magnetic tape deck and (2) the EIA/ISO mode, in which the unit is used as a paper tape reader/punch.
The CMT mode is divided into two types: standard and economy. Each is explained below.

CMT mode (standard) 319 KB × 2	Storage capacity equivalent to one roll of cassette magnetic tape is divided into two. This mode is useful when a large-volume program (about 100 KB) is to be written.
CMT mode (economy) 106 KB × 6	Storage capacity equivalent to one roll of cassette magnetic tape is divided into six. Although a large variety of programs can be entered, each program to be written should be small in volume.
EIA/ISO mode 630 KB × 1	This mode is employed when the unit is used as a paper tape reader/punch. The data equivalent to about 1,600 m of paper tape in volume can be stored.

9 Operation

■ When Used as a Cassette Magnetic Tape Deck (CMT Mode)

To write the program, have on hand a disk which was formatted for the CMT mode. Refer to Sec. 8, Disk Formatting, page 16.

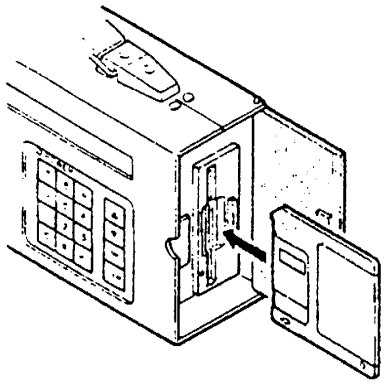
[Writing Program]

[Preparations]

① Turn on the unit. Refer to Sec. 5, ON/OFF Switching, page 8.
The initial display will appear.

```
* DISK SET  1: PARAMETER  2: FORMAT
                                - - →■
```

② Load the disk.
Use a disk which was formatted for the CMT mode.



Loading the disk causes either of the following two displays to appear.

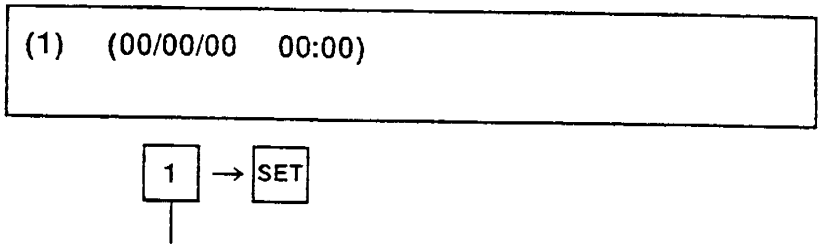
```
CMT
          (1) - (2)                - - →■
```

A disk for the standard CMT mode has been loaded.

```
CMT
          (1) - (6)                - - →■
```

A disk for the economy CMT mode has been loaded.

③ Select the track for program writing.
Select track 1 or 2 for a standard CMT mode. Select any one of trancks 1 through 6 for an economy CMT mode.



Enter the track number by pressing the appropriate numerical key.
Standard CMT mode: 1 or 2
Economy CMT mode: any number from 1 through 6

Preparations for program writing are now complete.
The unit allows the entry of comments atr the same time the program is written. Though not necessary for program writing, comments are very useful for the purpose of program management.

[How to Enter Comments]

A comment consisiting of up to 16 characaters can be entered using the numerical keys and the [*] key.
NOTE: Enter the comment before writing the program.

① Call up the comment entry display.
After making preparations for writing a program, call up the comment entry display.

Pressing the ▲ or ▼ key calls up the comment entry display, as shown above.

② Enter the comment.

```
(1) INPUT  COMMENT
    123 456 789
```

Enter the comment by pressing the appropriate numerical keys and the [*] key.
The comment can consist of up to 16 characters.
The [*] key serves as a space key.
To correct an erroneous entry, move the cursor (blinking mark) to the appropriate position and re-enter the required data.

③ Establish the comment.

Pressing the SET key establishes the comment entered.

[Writing Program]

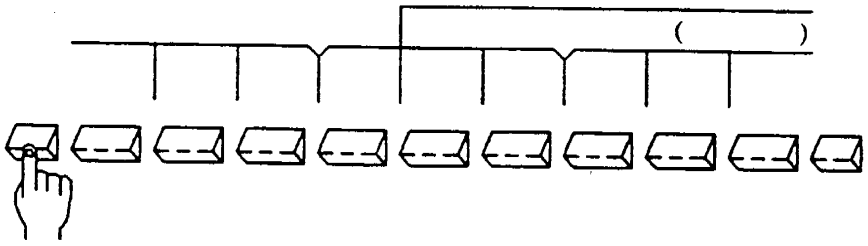
Perform the program write operation on the NC equipment.
Note that no operation is required of the unit.

① Program writing starts.

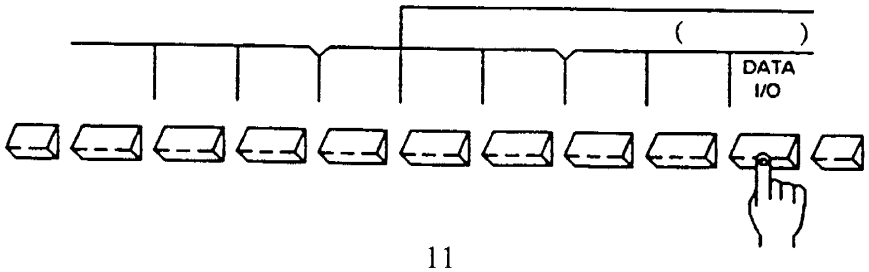
Operate the NC equipment to start program writing.

Example: MAZATROL M-32

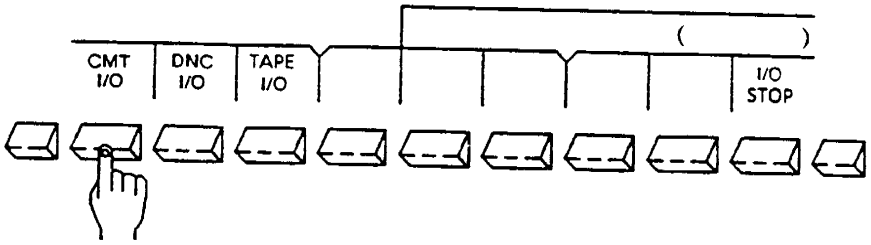
1. Press the display selector key to call up the menu containing DATA I/O.



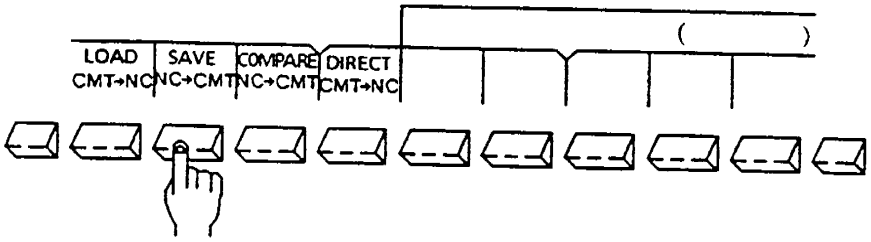
2. Press the menu key at DATA I/O.



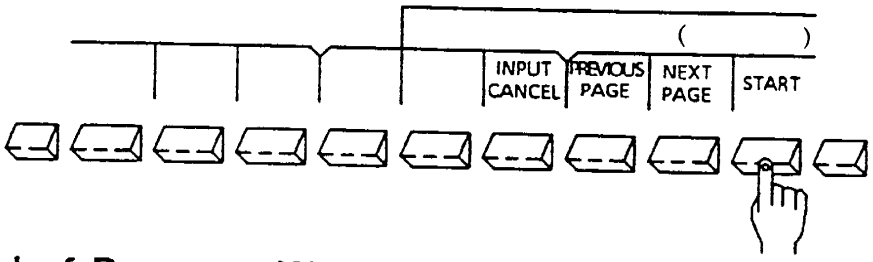
3. Press the menu key at CMT I/O.



4. Press the menu key at SAVE NC→CMT.



5. Press the menu key at START after selecting the program to be written.



[End of Program Writing]

After completion of the program writing, unload the disk, as described below.

① Press the [CLEAR] key.

Before pressing the [CLEAR] key, make sure that program has been written. Pressing this key initializes the display.

```
* DISK SET  1: PARAMETER  2: FORMAT
                                - - →■
```

Press the CLEAR key.

② Unload the disk. Refer to Sec. 6, Disk Loading and Unloading, page 10.

③ Turn off the unit. Refer to Sec. 5, ON/OFF Switching, page 8.

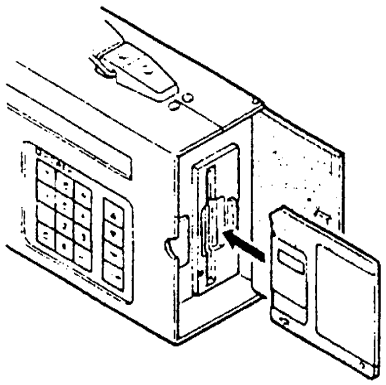
[Reading Program]

[Preparations]

① Turn on the unit. Refer to Sec. 5, ON/OFF Switching, page 8. The initial display will appear.

```
* DISK SET  1: PARAMETER  2: FORMAT
                                  - - →■
```

② Load the disk.
Load the disk storing the required program.



Loading the disk calls up either of the following two displays, depending on the kind of disk loaded.

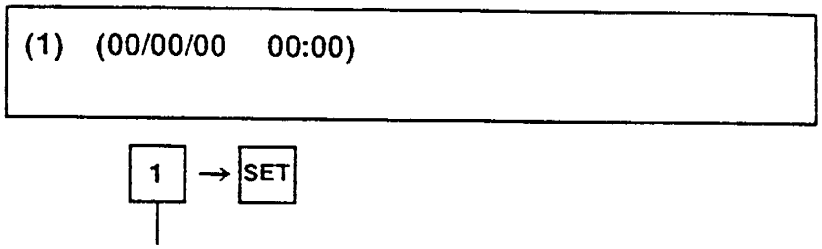
```
CMT
        (1) - (2)                 - - →■
```

A standard CMT mode disk has been loaded.

```
CMT
        (1) - (6)                 - - →■
```

An economy CMT mode disk has been loaded.

③ Select the track for program reading.
Select track 1 or 2 for a standard CMT mode. Select any one of tracks 1 through 6 for an economy CMT mode.



Press the appropriate numerical key to enter the track number of the program to be read.
Standard CMT mode: 1 or 2
Economy CMT mode: any number from 1 through 6

Preparations for program reading are now complete.

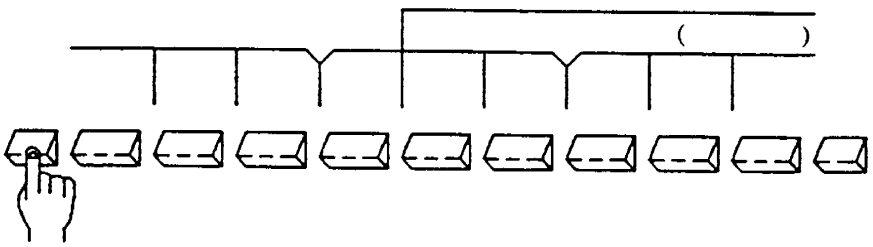
[Reading Program]

Perform the program read operation on the NC equipment. Note that no operation is required of the unit.

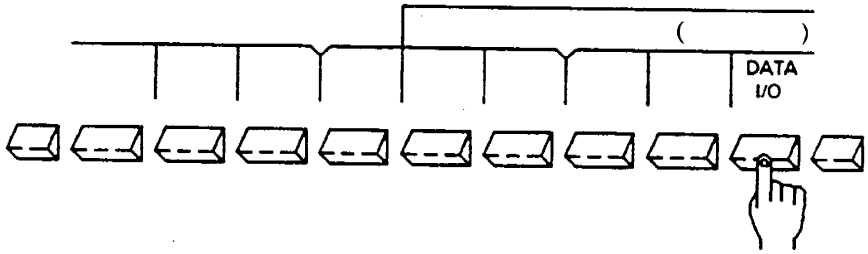
① Program reading starts.
Operate the NC equipment to start program reading.

Example: MAZATROL M-32

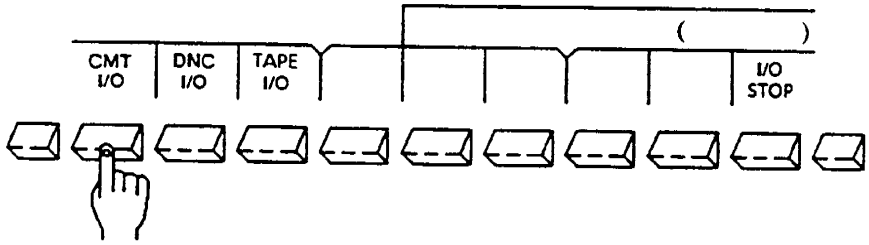
1. Press the display selector key to call up the menu containing DATA I/O.



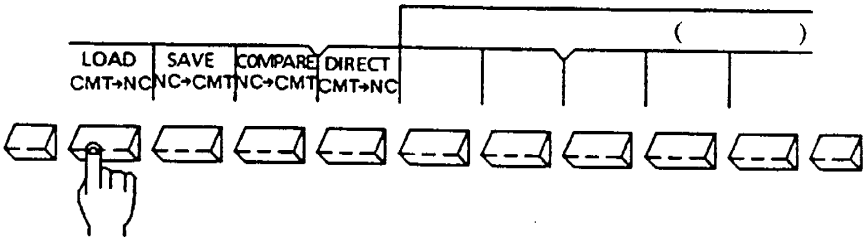
2. Press the menu key at DATA I/O.



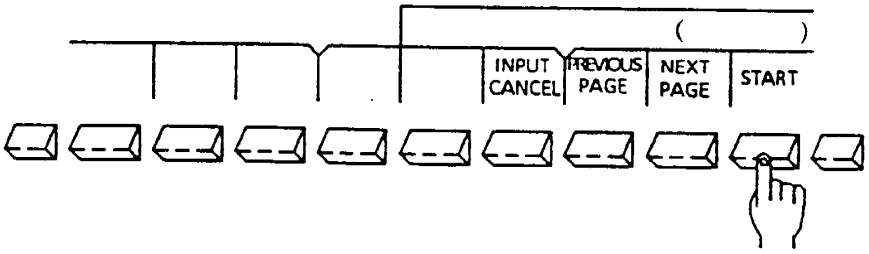
3. Press the menu key at CMT I/O.



4. Press the menu key at LOAD CMT → NC.



5. Press the menu key at START after selecting the program to be read.



[End of Program Reading]

After program reading, unload the disk following the steps described below.

① Press the [CLEAR] key.
Before pressing the [CLEAR] key, make sure that program reading is complete. Pressing the [CLEAR] key initializes the display.

Press the CLEAR key.

② Unload the disk. Refer to Sec. 6, Disk Loading and Unloading, page 10.

③ Turn off the unit. Refer to Sec. 5, ON/OFF Switching, page 8.

■ When Used as a Paper Tape Reader/ Punch (EIA/ISO Mode)

To write a program, have on hand a disk which was formatted for the EIA/ISO mode. Refer to Sec. 8, Disk Formatting, page 16.

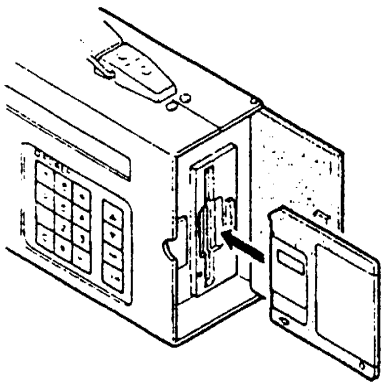
[Writing Program]

[Preparations]

① Turn on the unit. Refer to Sec. 5, ON/OFF Switching, page 8. The initial display will appear.

```
* DISK SET  1: PARAMETER  2: FORMAT
                                - - →■
```

② Load the disk.
Use a disk which was formatted for the EIA/ISO mode.



When the disk has been loaded, the display changes to show:

```
EIA/ISO  1: DIRECT.  2: IN        3: OUT
         4: DELETE   5: SEARCH    - - →■
```

③ Select the required command.

Select the operation from the list of command functions below.

To start the operation, first selecat the command using the appropriate numerical key, then press the [SET] key.

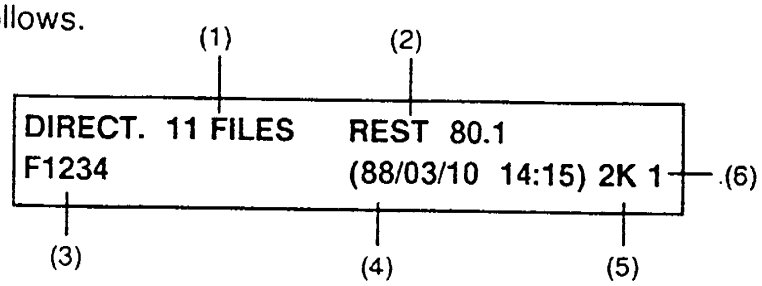
Numerical key	Command	Function
1	DIRECT.	Displays the number of stored files, the residual memory capacity, the file name, the date of registration, and the file size.
2	IN	Accepts the EIA/ISO mode data.
3	OUT	Reads the data stored on the disk.
4	DELETE	Erases a file.
5	SEARCH	Searches for a file.

Checking Files Stored on the Disk [DIRECT.]

① Execute the DIRECT. command.

[1] → [SET]

When the [SET] key is pressed, the display changes to show the information on the files stored on the disk, as follows.



(1) Number of files : indicates that 11 files are stored.
(2) Residual memory capacity : indicates that 80.1% of the disk memory capacity remains unused.
(3) File name : indicates the file name being "1234".
(4) Date of registration : indicates that the file was registered at 14:15 on March 10, 1988.
(5) File size : indicates the file capacity in KB.
(6) Order of registration : indicates that the file is the first to have been registered.

② To check other files:
Press the ▲ or ▼ key.

[▲] key: calls up the file that was registered directly before the current file.

[▼] key: calls up the file that was registered following the current file.

③ After checking the directory,

press the [CLEAR] key to initialize the display.

Writing Program on the Disk [IN]

① Execute the IN command.

[2] → [SET]

When the [SET] key is pressed, the display changes to show:

```
IN  F
```

② Entry of file name

Up to 4 digits can be used for the entry of file name. Press the appropriate numerical keys.

Example: The file is to be named 1234.

```
IN  F1234
```

[1] → [2] → [3] → [4] → [SET]

NOTE:

- Do not assign a new file the same name as any of the previously registered files.

③ Start writing the program.

When the [START] key is pressed, the display changes to show:

```
IN  F1234  Busy
    Job fin. then (SET)
```

④ Operation of NC Equipment

Operate the NC equipment to start program writing. For details, refer to the instruction manual for the NC equipment.

⑤ End of writing
Press the [SET] key after making sure that the NC equipment has completed signal transmission.

Press the [SET] key.

When the [SET] key is pressed, the display changes to show:

```
IN  F1234  End
```

⑥ When the display indicating the end of program writing appears,

press the [CLEAR] key. The display will then be initialized.

NOTE:

- To start program writing, press the [START] key on the unit before operating the NC equipment. If these steps are reversed, the program will not be properly written.

Reading the Program Stored on the Disk [OUT]

① Execute the OUT commend.

[3] → [SET]

When the [SET] is pressed, the display changes to show:

```
OUT     F
```

② Entry of file name

Using the appropriate numerical keys, enter the name of the file to be read.

Example: The file name is 4567.

```
OUT     F4567
```

[4] → [5] → [6] → [7] → [SET]

NOTE:

- Any file name which has not been registered cannot be accepted.

  When the [SET] key is pressed, the display changes to show:

```
OUT     F4567  PUSH  <START>!!
    EIA
```

③ Start reading the program

When the [START] key is pressed, the display changes to show:

```
OUT     F4567  Busy
    EIA
```

④ Operation of NC equipment
Operate the NC equipment to start program reading. For details, see the instruction manual for the NC equipment.

⑤ End of reading
When the program has been read, the display changes to show:

```
OUT     F4567   END
    EIA
```

⑥ When the display indicating the end of program reading appears,

press the CLEAR key. The display will then be initialized.

NOTE:

- To start porgram reading, press the [START] key on the unit before operating the NC equipment. If these steps are reversed, the program will not be properly read.

Erasing a File [DELETE]

① Execute the DELETE command.

[4] → [SET]

When the [SET] key is pressed, the display changes to show:

```
DELETE     F
```

② Entry of file name

Using the appropriate numerical keys, enter the name of the file to be erased.

Example: The file name is 890.

```
DELETE     F890
```

[8] → [9] → [0] → [SET]

When the [SET] key is pressed, the display changes to show:

```
DELETE     F890 Push <START>!!
```

NOTE:

- To correct an erroneous entry, first press the [CLEAR] key to initialize the display and execute the DELETE command again.

③ Starting erasure

Confirm the file name.

Press the [START] key.

NOTE:

- Be sure to confirm the file name. If the file name entered is incorrect, valuable information stored may be erased through the execution of the DELETE command, or the command itself may not be executed.

④ End of erasure
When the erasure has been completed, the display changes to show:

```
DELETE    F890    END
```

⑤ When the display indicating the end of erasure appears, press the CLEAR key. The display will then be initialized.

Searching for a Registered File [SEARCH]

① Execute the SEARCH command.

[5] → [SET]

When the [SET] keys is pressed, the display changes to show:

```
SEARCH     F
```

② Entry of file name

Using the appropriate numerical keys, enter the name of the file to be searched for. If the full name of the file does not come readily to mind, use of the [*] key is recommended.

Example: The file name is 012.

```
SEARCH     F012
```

[0] → [1] → [2] → [SET]

When the [SET] key is pressed, the display changes to show:

```
SEARCH     F012  Push  <START>!!
```

NOTE:

- If an incorrect name is entered, press the [CLEAR] key to initialize the display again, and execute the SEARCH command again.

[How to use the [*] key]

If the full name of the file does not come readily to mind before starting search operation, substitute the symbol * for the character that is uncertain.
When "*12" is entered, for example, the file name to be searched for should be any one of 10 names ranging from 012 to 912.
The symbol * can be used not only on the top of the file name, but also at the end, or in the middle of the file name.

③ Starting search operation

Press the START key.

④ To check the found file, press the ▲or ▼key, as suggested in the procedure for the DIRECT. command on page 29.

⑤ End of search operation

When the CLEAR key is pressed, the display is initialized.

NOTE:

- The file name entered for search operation is different from the WORK No. For example, when a command to punch out two or more programs continuously is entered on the NC equipment (or other equipment including an automatic programmer), they are registered on the disk as a single file. In this case, their search operation cannot be performed using any WORK No. Only the registered name of the file will be effective.

10 Alarm Messages

Display	Meaning	Corrective Action
ALREADY AVAILABLE	An attempt has been made using the IN command in the EIA/ISO Mode to enter the same name as has been previously registered.	Change the name of the file for entry.
SELECTED FILE UNAVAIL-ABLE	The file selected by the OUT or DELETE command in the EIA/ISO mode does not exist.	Change the name of the file for entry.
DISK ERROR	An error has taken place in writing data to, or reading data from the disk.	Change the disk.
WRITE INHIBIT	The write-protect tab is set in the WRITE-DISABLED position.	Change the disk or set the write-protect tab to the WRITE-ENABLED position.
MEMORY OVER	An attempt has been made to write data that exceeds the capacity of the disk in use.	Change the disk or, when in the CMT mode, use the disk in the standard mode.
TRANSFER ERROR	An error has taken place during communication with an external piece of equipment.	Replace the signal transmission cable.
BATTERY ERROR	Shortage in voltage of back-up battery	Replace the battery.

11 Troubleshooting

Symptom	Probable cause	Remedy
The unit does not turn ON.	Power cable is not properly connected.	Check for improper connections
	Power is disconnected from the NC equipment.	Press the power switch ON.
The date or time is incorrect.	The parameter settings stored have been lost due to power drain from built-in backup battery.	Replace the built-in battery.
Disk error takes place. Data cannot be read or written.	An incorrect type of disk is being used.	Use a double-sided, double-density disk.
	The disk is not formatted.	Format the disk.
	The disk has a scratched or soiled surface.	Change the disk.
	The signal transmission cable is not properly connected.	Check for improper connections.
	The signal transmission cable is incorrectly connected.	Check for improper connections. Note that the connectors used are different between the CMT and the EIA/ISO mode. Refer to Sec. 4, Connections, page 7.
	The parameters do not match those of the NC equipment.	Match the parameters.
	Electric equipment, such as a fluorescent lamp, which can cause interference is too near the unit.	Keep the unit away from any equipment that induces interference.
	The unit is incorrectly installed.	Correctly install the unit.
Data cannot be written or files cannot be erased.	The write-protect tab is set at the WRITE-DISABLED position.	Set the write-protect tab to the WRITE-ENABLED position or change the disk.
The disk cannot be loaded.	The disk is not correctly inserted.	Properly reinsert the disk.

12 Specifications

Power requirements	85 to 132 VAC or 170 to 264 VAC (See the nameplate.)
Power consumption	15 W
External dimensions	260 × 118 × 82 mm (Excluding the handle)
Weight	2.0 kg (4.41 lb.)
Applicable disk	3.5 in. micro floppy disk, Double-sided, double-density; 640 KB
Interface	RS - 232C Baud rates: 110, 300, 600, 1200, 2400, 4800, 9600, and 19200
Display	Liquid crystal display for 40 characters × 2 lines
Environmental conditions	Ambient temperature: 10°C to 50°C (50°F to 122°F) Relative humidity: 20% to 80% Avoid a dusty environment.
Connectable external equipment	NC equipment provided with the RS-232C interface, automatic programmers, etc.

Software Specifications

Storage capacity		319 KB×2 tracks in the standard CMT mode 106 KB×6 tracks in the economy CMT mode 630 KB (paper tape about 1,600 m (5250 ft) long)
Com-mands	CMT mode	Operating external equipment
	EIA/ISO mode	DIRECT., IN, OUT, DELETE, and SEARCH commands
	Parameter	Date, time of day, serial transmission format, and output code

NOTES:

NOTES:

Return to Main Menu

SECTION 10

ASSEMBLY PROCEDURES

National Training Department
8025 Production Drive
Florence, Kentucky 41042
Telephone (606) 342-1482
Fax (606) 342-1520

INSTRUCTIONS FOR:

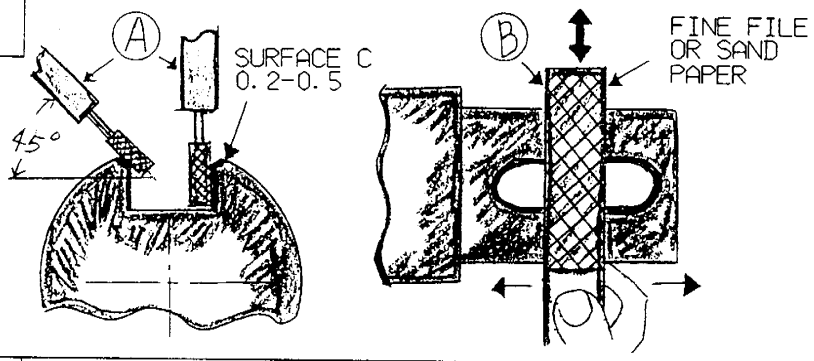
KEY ALIGNMENT

NO. 1

PROCEDURE

FOR A SINGLE KEY APPLICATION

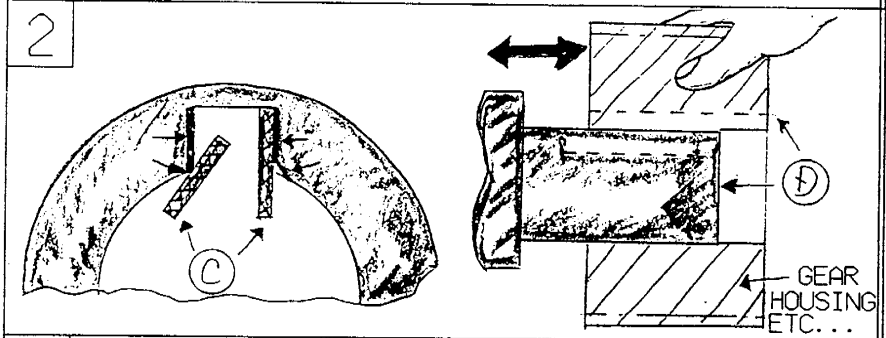
1



1. CHAMFER ALL CORNERS AND GROOVES OF THE SHAFT WITH A DIE GRINDER OR A FINE FILE (fig. A) (SURFACE C 0.2-0.5).

2. FINISH CHAMFERING BURRS WITH A FINE FILE OR SAND PAPER (#140) (fig. B).

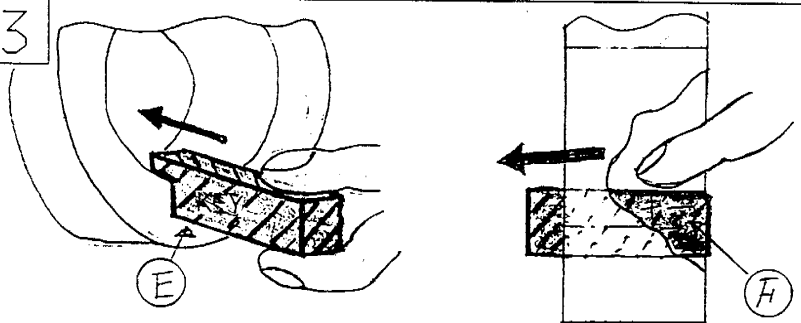
2



1. CHAMFER ALL CORNERS AND GROOVES OF THE GEAR USING A FINE FILE (fig. C).

2. AFTER FINISHING A, B AND C, CHECK THAT THE GEAR FITS SMOOTHLY (fig. D).

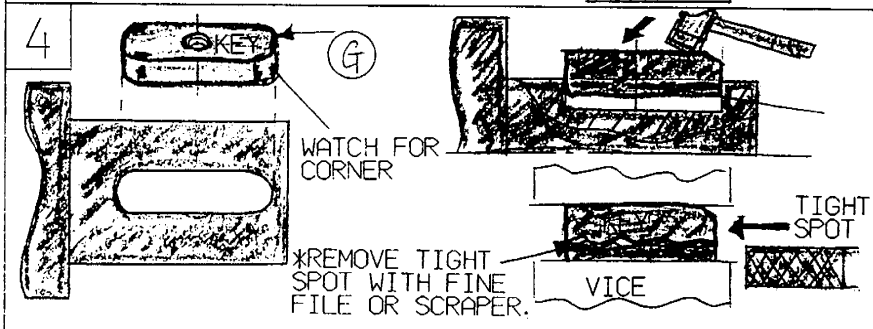
3



1. INSERT KEY AND CHECK THAT THE KEY PASSES THROUGH THE GROOVE SMOOTHLY (CAN NOT BE LOOSE).

2. IF THE FIT IS TIGHT, FIND THE TIGHT SPOT(S) AND GRADUALLY PLANE THE KEY WITH A SCRAPER OR A FINE FILE UNTIL THE PASS BECOMES SMOOTH.

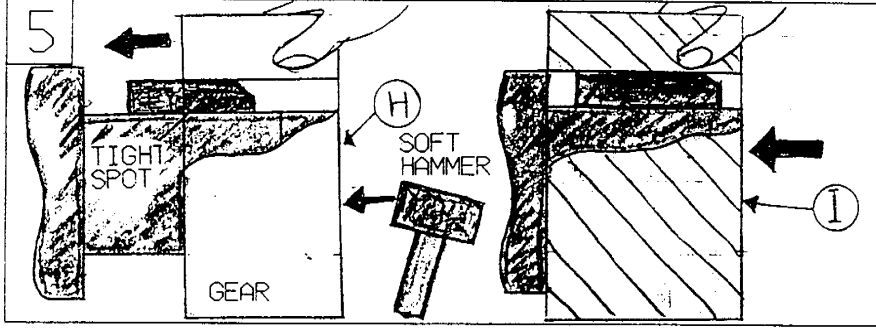
4



1. THERE IS A HIGH POSSIBILITY THAT THE CORNERS OF THE KEY WILL NOT FIT IN THE GROOVE, SO PLANE THE CORNERS WITH A FILE (fig. G).

2. REPEAT THE INSERTION AND REMOVAL OF THE KEY IN THE SHAFT, CORRECT BY REMOVING TIGHT SPOTS WITH A FINE FILE OR SCRAPER. (CAN NOT BE LOOSE)

5



1. GRADUALLY REMOVE ALL TIGHT SPOTS WITH A FINE FILE OR A SCAPER UNTIL INSERTION OF THE GEAR, BY HAND OR WITH HAMMER, BECOMES SMOOTH (fig. H).

2. CHECK THAT THE GEAR FITS SMOOTHLY AND COMPLETELY (fig. I).

zak
National Training Department
8025 Production Drive
Florence, Kentucky 41042
Telephone (606) 342-1482
Fax (606) 342-1520

INSTRUCTIONS FOR:

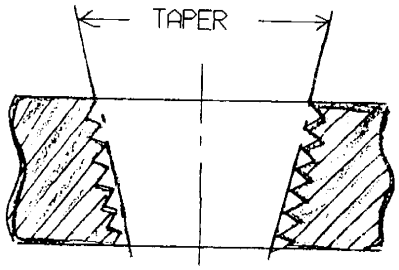
HEXAGON SOCKET HEADLESS TAPERED PIPE PLUGS

NO. 2

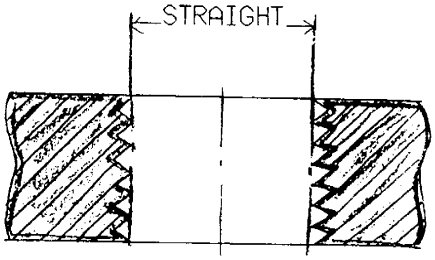
PROCEDURE

1

PRESENTLY THERE ARE TWO TYPES OF TAPERED PIPE THREADS USED IN HOUSE AND ARE ORDERED PARTS. SO, PLUGS NEED TO BE USED PROPERLY ACCORDING TO DIRECTIONS



PT TYPE



PS TYPE

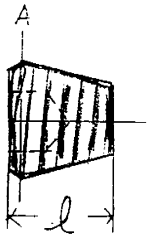
2

- GM TYPE (STANDARD) ——→ USE WITH PT PORTS
- GJ TYPE (SAME SIZE AS ABOVE BUT LONGER) ——→ USE WITH PS PORTS

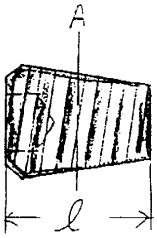
3

DIFFERENCE BETWEEN GM AND GJ PLUGS

GM



GJ

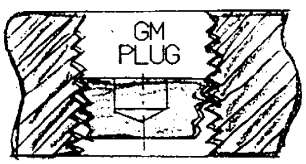


EXAMPLE - 1/8 PLUG
ℓ = 7mm

EXAMPLE - 1/8 PLUG
ℓ = 8mm

4

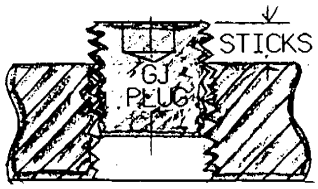
PS PORT



(CAUSES OIL LEAKAGE)

* WHEN USING GM TYPE TO PS PORT, PLUG WILL GO IN WITHOUT TIGHTENING UP.

PS PORT



(GOOD)

* APPLY GJ PLUG TO PS PORTS. HOWEVER, PLUG WILL NOT FIT COMPLETELY TO THE PS PORT. THEREFORE, TO LEVEL, CORRECT WITH PT TAP.

* AN AIM IS TO LEAVE 3 - 4 THREADS SHOWING.

National Training Department
8025 Production Drive
Florence, Kentucky 41042
Telephone (606) 342-1482
Fax (606) 342-1520

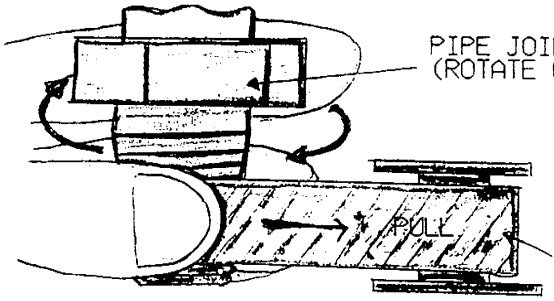
INSTRUCTIONS FOR:

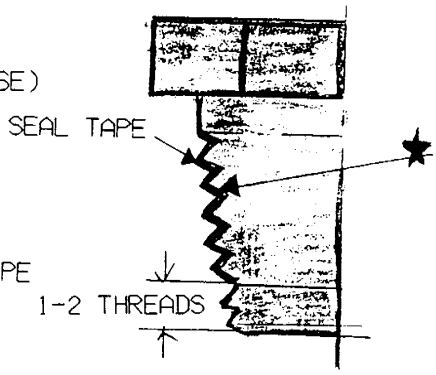
WRAPPING SEAL TAPE AND INSTALLING HEXAGON SOCKET HEADLESS TAPERED PLUG, HOSE AND PIPE JOINTS.

NO. 3

PROCEDURE

SEAL TAPE



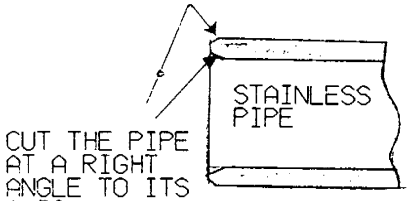


CHECK THAT THE SEAL TAPE HAS COMPLETELY FILLED THE GROOVES BETWEEN THE THREADS.

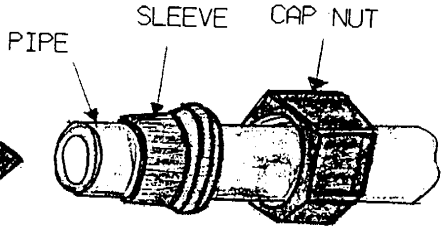
* LEAVE 1-2 THREADS UNWRAPPED

* HOLD SEAL TAPE WITH THUMB AND TIGHTLY WRAP A SEAL AROUND THE JOINT 1 1/2 - 2 TIMES.

PIPE JOINT

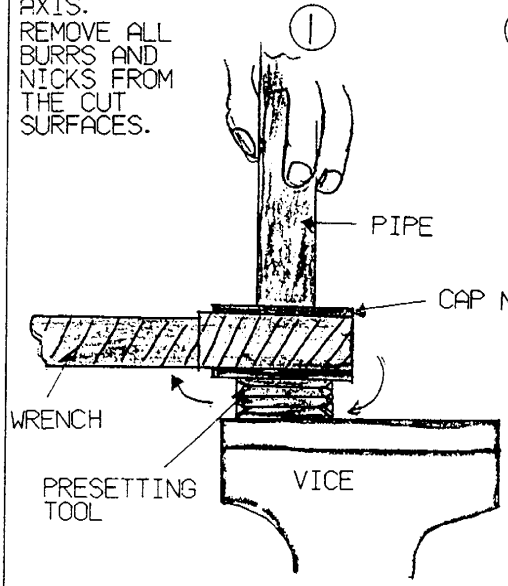


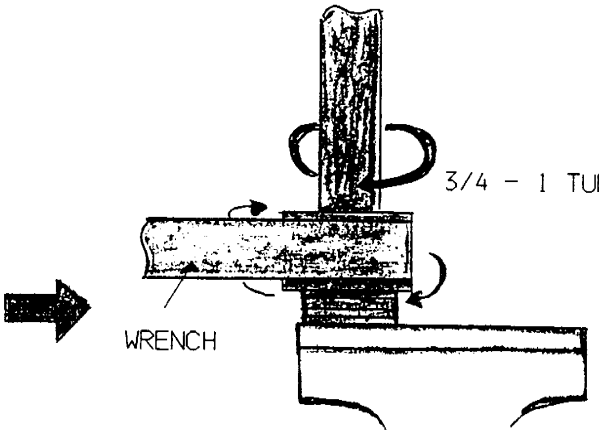
CUT THE PIPE AT A RIGHT ANGLE TO ITS AXIS.
REMOVE ALL BURRS AND NICKS FROM THE CUT SURFACES.



(2) PUT THE NUT AND THE SLEEVE OVER THE PIPE IN THIS ORDER. (BE SURE THE SLEEVE IS NOT ON BACKWARDS)

(3) APPLY OIL OR GREASE TO THE THREADS OF THE PRESETTING TOOL AND THE SLEEVE.





4. APPLY THE BOTTOM OF THE PIPE AGAINST THE SHOULDER IN THE PRESETTING TOOL, AND TIGHTEN THE NUT WITH A WRENCH UNTIL THE PIPE CAN NO LONGER BE TURNED BY HAND. THIS POSITION IS CALLED THE ZERO POINT.

5. TIGHTEN THE NUT ANOTHER 3/4 - 1 TURN FROM THE ZERO POINT. NOW THE PRETIGHTENING HAS BEEN COMPLETED.

6. AFTER REMOVAL OF THE PRESETTING TOOL, INSTALL THE JOINT TO THE BODY AND TIGHTEN THE NUT. UPON FEELING A SUDDEN INCREASE IN TORQUE, GIVE AN ADDITIONAL 1/4 TURN.

National Training Department
8025 Production Drive
Florence, Kentucky 41042
Telephone (606) 342-1482
Fax (606) 342-1520

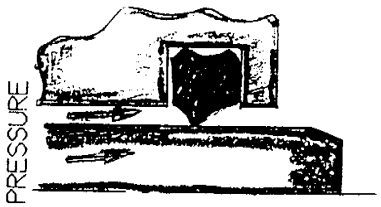
INSTRUCTIONS FOR:
GENERAL TYPES OF PACKING AND SEALS

NO. 4

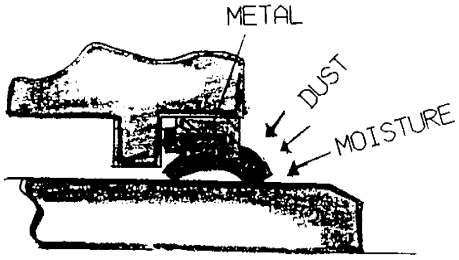
PROCEDURE

PACKING

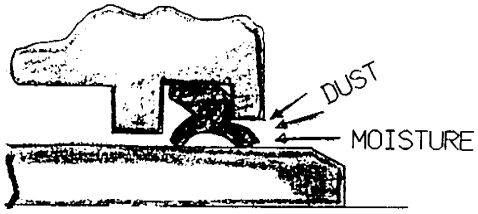
① SKY PACKING



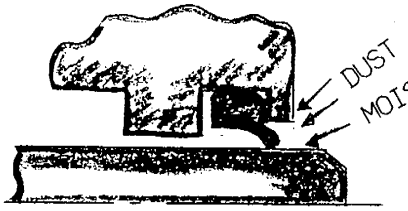
② PENTA SEAL



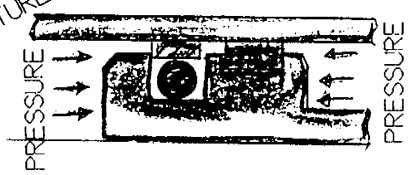
③ SCB SCRAPER



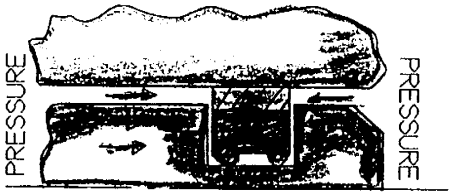
④ SDR SCRAPER



⑤ SER SCRAPER

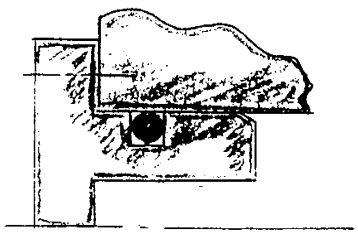


⑥ ST SEAL



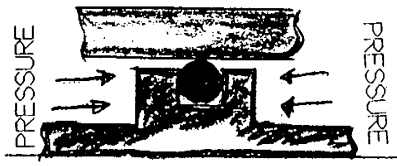
* 1 AND 7 ARE USED AT ROTOR PART OF PISTON AND CYLINDER.
* 1 AND 6 ARE USED AT CYLINDER SECTION.

⑦ SPGR PACKING



⑧ GO RING

* FOR MOVABLE PARTS SUCH AS 9, USE P TYPE.
* FOR FIXED CONDITIONS SUCH AS 8, USE G TYPE.



⑨ PO RING

National Training Department
8025 Production Drive
Florence, Kentucky 41042
Telephone (606) 342-1482
Fax (606) 342-1520

INSTRUCTIONS FOR:

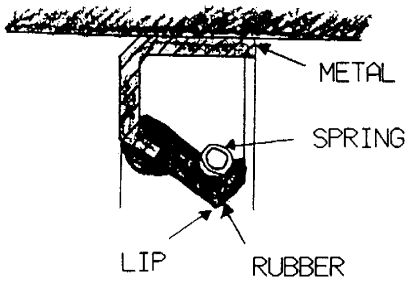
TYPES OF OIL SEALS:
APPLICATION AND INSTALLATION

NO. 5

PROCEDURE

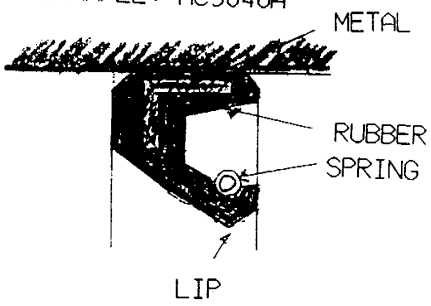
TYPES OF OIL SEALS

EXAMPLE: AB2847G



SB TYPE (AB)

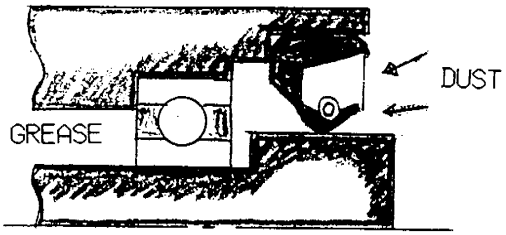
EXAMPLE: AC3040A



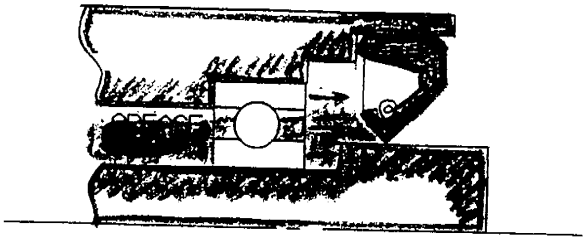
SC TYPE (AC)

* LIP DIRECTION OR INSERTING DIRECTION OF AN OIL SEAL DIFFERS WITH INDIVIDUAL PURPOSE.

EXAMPLE: IN A CASE OF PROTECTING FROM DUST, WATER, OIL, ETC.



EXAMPLE: IN A CASE OF PROTECTING GREASE AND OIL FROM LEAKING OUT. (GENERAL USAGE)



* UPON INSERTING OIL SEAL, USE DRIVING JIG WHEN NECESSARY.

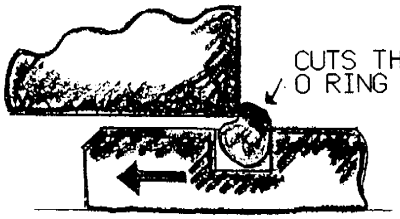
National Training Department
8025 Production Drive
Florence, Kentucky 41042
Telephone (606) 342-1482
Fax (606) 342-1520

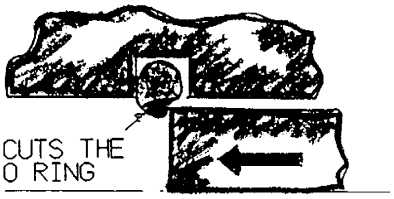
INSTRUCTIONS FOR:
HANDLING O RINGS, SKY PACKING, ETC.

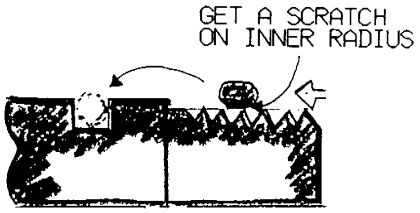
NO. 6

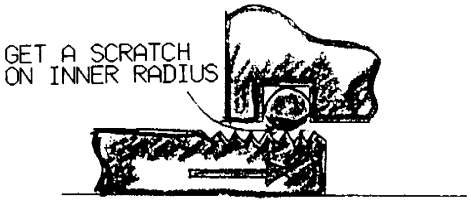
PROCEDURE

MATTERS TO CONSIDER DURING INSTALLATION





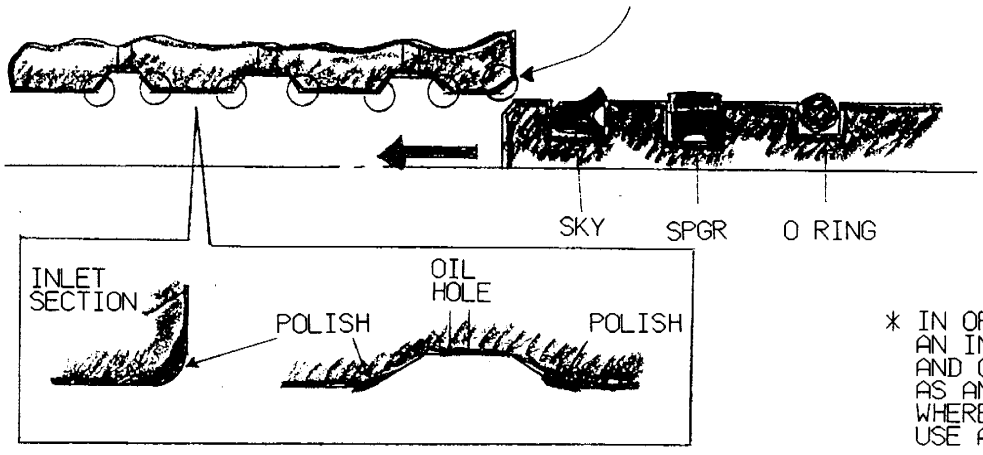




BAD EXAMPLES

* FIGURES SHOW EXAMPLES OF HOW O RINGS CAN BE DAMAGED OR CUT OFF. TO PREVENT IT FROM DAMAGING, RECEIVING SECTION AND PASSAGE WAY MUST BE CHAMFERED AT LEAST A MINIMUM OF C1. MOREOVER, CONCERNING SCREWS, COVER THREAD SECTION WITH VINYL TAPE OR USE A SPECIAL JIG TO PREVENT DAMAGING THE O RING.

NOTE: SMOOTH (POLISH) ALL EDGES WHERE SEAL PASSES WHEN INSTALLING SKY, ST, SPGR, SDR, SER, ETC.



* IN ORDER TO CHAMFER AN INLET SECTION AND GROOVES, SUCH AS AN OIL HOLE, WHERE SEAL PASSES, USE A BUFFING STONE.

IMPORTANT NOTICE

* NEGLECTING PROCESSES, SUCH AS CHAMFERING, MAY DAMAGE SEAL, O RING AND OTHER PARTS, AND WILL RESULT IN OIL LEAKAGE. THEREFORE, CORNERS MUST BE CHAMFERED WITH BUFFING STONE BEFORE ASSEMBLY.

National Training Department
8025 Production Drive
Florence, Kentucky 41042
Telephone (606) 342-1482
Fax (606) 342-1520

INSTRUCTIONS FOR:

CHARACTERISTICS OF BEARING COMBINATIONS

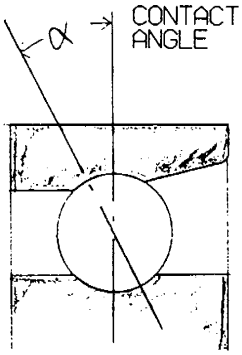
NO. 7

PROCEDURE

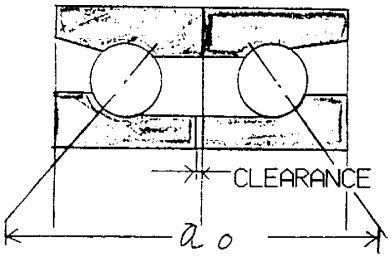
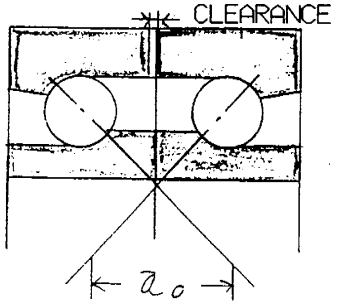
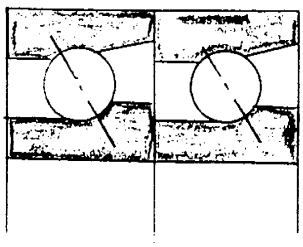
ANGULAR BALL BEARING

(COMBINATION ANGULAR BEARING)

EXAMPLE: 7020ATDB



CONTACT ANGLE	NOTATION
15°	C
25°	A5
30°	A
40°	B

FIGURE EXAMPLE	TYPE	CHARACTERISTIC
	BACK-TO-BACK COMBINATION DB EX: 7208ADB	ABLE TO ACCOMADATE RADIAL LOADS AND AXIAL LOADS IN ANY DIRECTION.
	FACE-TO-FACE COMBINATION DF EX: 7208BDF	ABLE TO ACCOMADATE RADIAL LOADS OF EITHER DIRECTION. HOWEVER, THE FACE-TO-FACE COMBINATION HAS A SMALLER LOADING CAPACITY OF MOMENT FORCE THAN THAT OF THE BACK-TO-BACK COMBINATION.
	TANDEM COMBINATION DT EX: 7208ADT	ABLE TO WITHSTAND RADIAL LOADS AND ONLY ONE DIRECTION OF AXIAL LOADS. AXIAL LOADS ARE SUPPORTED BY TWO BEARINGS, SO THIS TYPE IS USED WHEN THE LOAD OF ONE DIRECTION IS BIGGER THAN THAT OF THE OTHER.

National Training Department
8025 Production Drive
Florence, Kentucky 41042
Telephone (606) 342-1482
Fax (606) 342-1520

INSTRUCTIONS FOR:

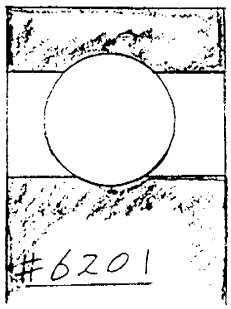
TYPES AND CHARACTERISTICS OF BEARINGS

NO. 8

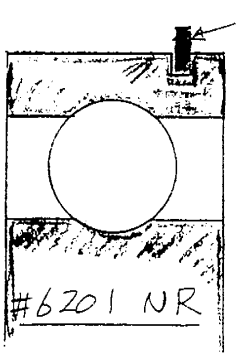
PROCEDURE

DEEP GROOVE BALL BEARING
(SINGLE ROW BALL BEARING)

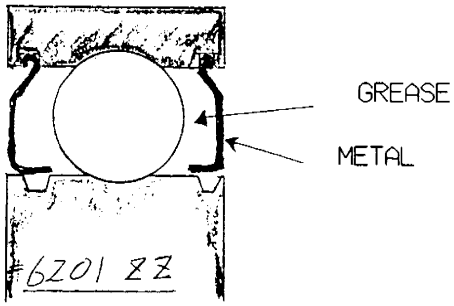
DIFFERENT TYPES OF BALL BEARINGS



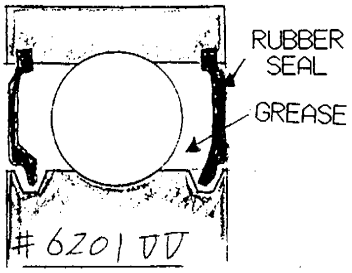
OPEN TYPE



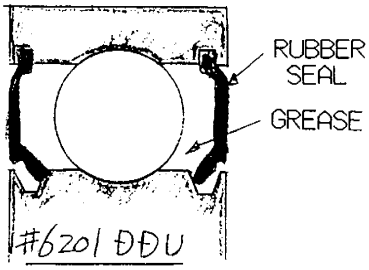
WITH A RETAINING RING



SHIELDED TYPE (ZZ TYPE)



SEALED TYPE (NON-CONTACT) (VV TYPE)



SEALED TYPE (CONTACT) (DDU TYPE)

* THERE ARE ALSO Z, V AND DU TYPES, THESE TYPES FIT ONLY ONE SIDE OF THE BEARING.

CHARACTERISTIC

TYPES	SHIELDED TYPE (ZZ TYPE)	SEALED TYPE (NON-CONTACT) (VV FORM)	SEALED TYPE (CONTACT) (DDV TYPE)
FRICTIONAL TORQUE	LOW	LOW	COMPARED WITH ZZ AND VV HIGH
HIGH-SPEED PERFORMANCE	SATISFACTORY	SATISFACTORY	HAS A LIMIT
GREASE SEALING ABILITY	SATISFACTORY	BETTER THAN ZZ FORM	A LITTLE BETTER THAN VV FORM
DUST-PROOF ABILITY	SATISFACTORY	BETTER THAN ZZ FORM	THE MOST SUPERIOR
WATER-PROOF ABILITY	UNSUITABLE	UNSUITABLE	SATISFACTORY
USABLE TEMPERATURE RANGE	-10 - 110°C	-10 - 110°C	-10 - 110°C

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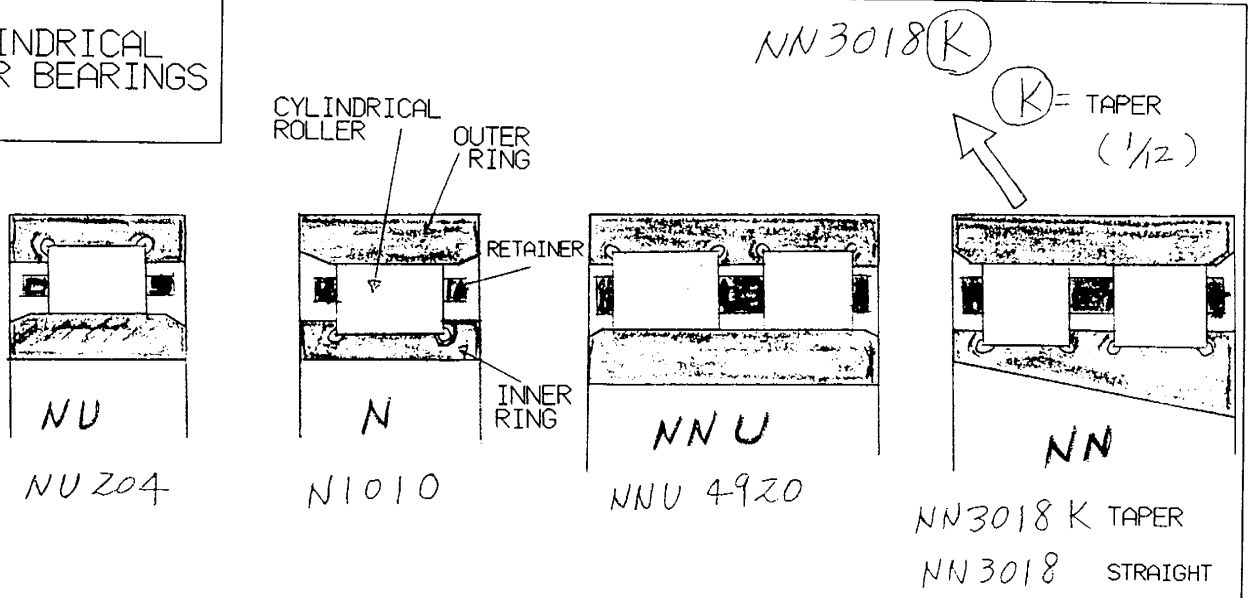
INSTRUCTIONS FOR:

TYPES OF CYLINDRICAL ROLLER BEARINGS.

NO. 9

PROCEDURE

CYLINDRICAL ROLLER BEARINGS

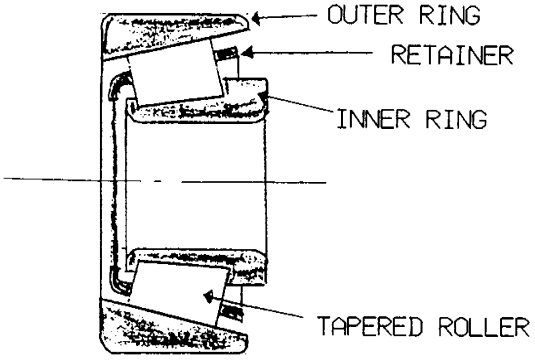


(USED AT THE HIGH-SPEED ROTATIONAL SECTION OF THE MAIN SPINDLE AND MOTOR SPINDLE)

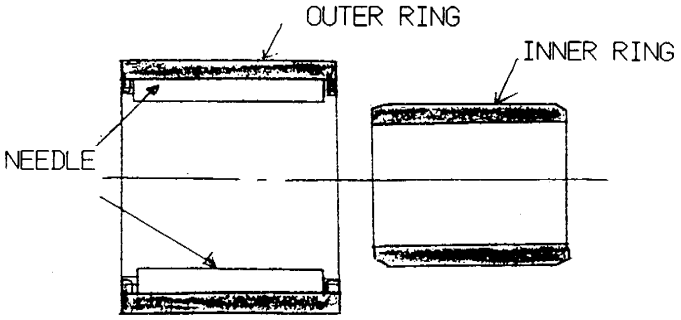
SINGLE ROW TAPERED ROLLER BEARING

CHARACTERISTIC:

WHEN A PURE RADIAL LOAD IS PLACED ON THE BEARING, AN INDUCED AXIAL LOAD IS ALSO GENERATED. SO, THESE BEARINGS ARE USED IN PAIRS OPPOSING EACH OTHER, AS A COMBINATION BEARING OR DOUBLE ROW BEARING.



(USED FOR MAIN SPINDLE WITH SLOW-SPEED ROTATION AND AT THE BEARINGS)



NEEDLE BEARING
(NEEDLE ROLLER BEARING)

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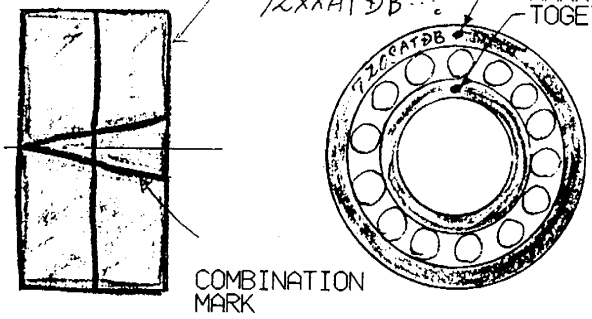
INSTRUCTIONS FOR:

COMBINATION ANGULAR BALL BEARINGS

NO. 10

PROCEDURE

1



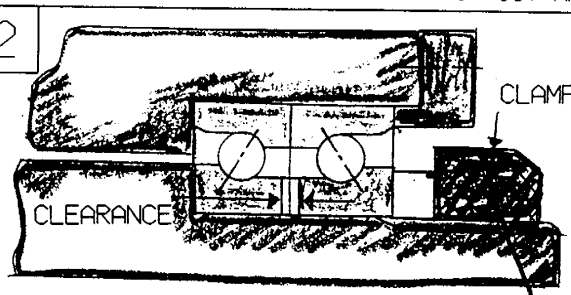
72XXDB → BACK-TO-BACK COMBINATION

72XXDF → FACE-TO-FACE COMBINATION

→THESE MARKS INDICATE WHERE THE ECCENTRICITY IS HIGH.

* WHEN A COMBINATION MARK AND A RUN-OUT MARK ARE SEALED, COMBINE THE MARKS AND THEN INSERT THEM.

2

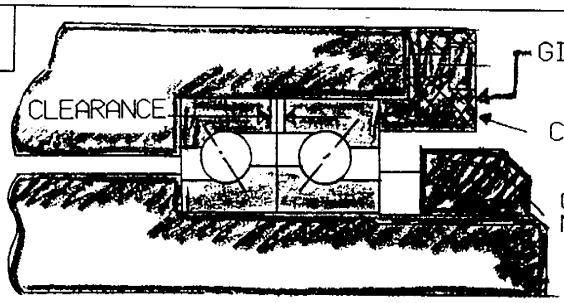


BACK-TO-BACK COMBINATION DB TYPE

GIVE PRELOAD BY PRESSING THE INNER RING.

* A METHOD TO SET PRELOAD BY TIGHTENING A CLAMPING NUT WHICH CREATES NO CLEARANCE. THIS METHOD IS CALLED A DB TYPE.

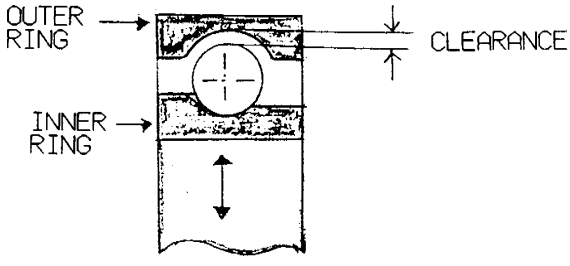
3



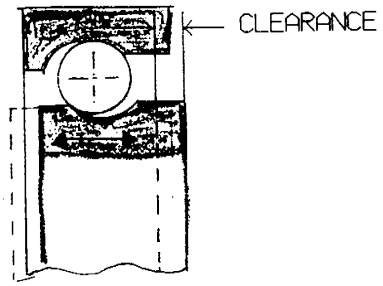
FACE-TO-FACE COMBINATION DF TYPE

* A METHOD TO SET PRELOAD BY PRESSING OUTER RING WITH COVER WHICH CREATES NO CLEARANCE. THIS METHOD IS CALLED A DF TYPE.

4 MEANING OF BEARINGS' INNER CLEARANCE, RADIAL CLEARANCE AND AXIAL CLEARANCE.



* RADIAL CLEARANCE



* AXIAL CLEARANCE

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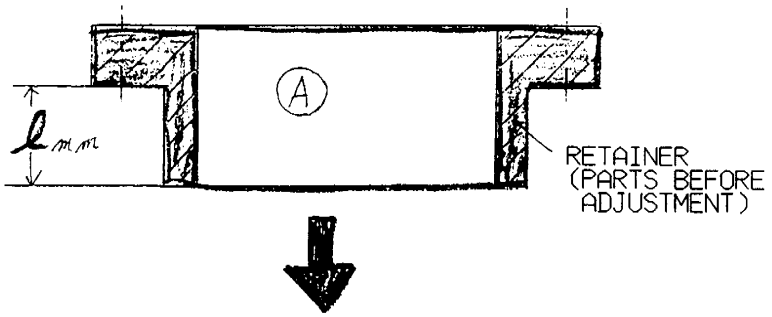
INSTRUCTIONS FOR:

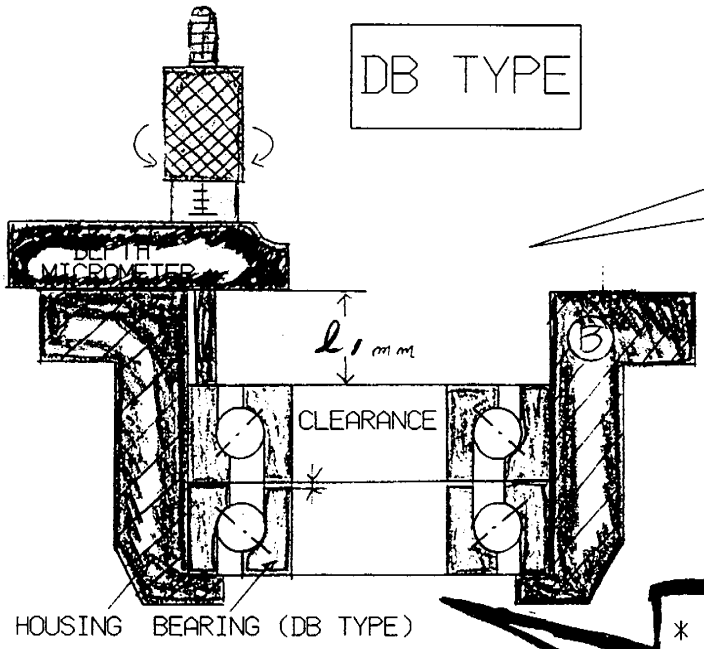
OUTER RING ADJUSTING STOCK OF COMBINATION BEARING.

NO. 11

PROCEDURE

DB TYPE BEARING





1. INSTALL THE BEARING WITH JIG AND PRETIGHTEN RETAINER A WITH BOLTS.
2. DETATCH RETAINER A AND MEASURE 2 TO 3 PLACES DIAGONALLY USING A DEPTH GAUGE.
3. FROM THE ACTUAL MEASUREMENTS OF L_1, TAKE THE LOWEST VALUE FOR DIMENSION L_1.

EXAMPLE: MEASUREMENTS OF:
5.08
5.07
5.075

SET AMOUNT OF L_1=5.07

* EQUATION TO CALCULATE ADJUSTING STOCK.

(PERMISSABLE RANGE 0.015 TO 0.025mm)

Lmm (RETAINER) = L_1mm + (0.02mm)

(ADJUSTING STOCK) (ACTUAL MEASUREMENT)

* PARALLELIZM OF L AND L_1 IS LESS THAN 0.01mm. RECHECK IF PARALLELIZM IS GREATER THAN 0.01mm.

* INCORRECT VALUES OF ADJUSTING STOCK WILL RESULT IN INCORRECT PRELOAD, A LOUD NOISE, AN UNFAMILIAR SOUND AND INFERIOR ACCURACY. THEREFORE, WATCH OUT FOR MISMEASUREMENT ON RETAINER AND OTHER PARTS.

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National Training Department
8025 Production Drive
Florence, Kentucky 41042
Telephone (606) 342-1482
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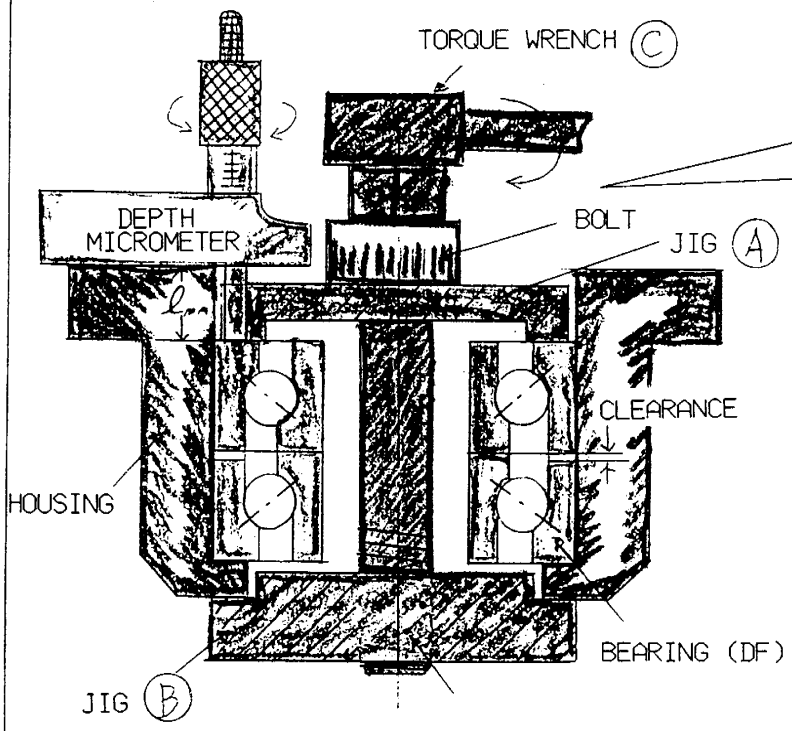
INSTRUCTIONS FOR:

OUTER RING ADJUSTING STOCK OF COMBINATION BEARING.

NO. 12

PROCEDURE

DF TYPE BEARING



1. INSTALL THE BEARING WITH JIG AND SET JIG A AND B AND BOLT AS SHOWN IN THE FIGURE TO THE LEFT.
2. TIGHTEN TO A PRESCRIBED TORQUE (KGFCM, FT-LBS, IN-LBS...) USING A TORQUE WRENCH.
3. MEASURE THE DIMENSION OF L AT A MINIMUM OF TWO PLACES DIAGONALLY WITH A DEPTH GAUGE. THEN TAKE THE LOWEST VALUE FOR DIMENSION L_1.

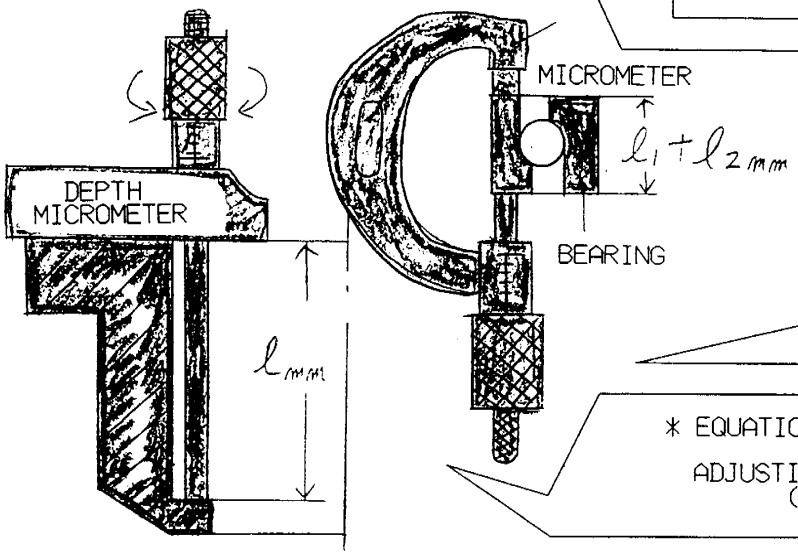
EXAMPLE: MEASUREMENTS OF:
5.08
5.07
5.075

SET AMOUNT OF L_1=5.07

* EQUATION TO CALCULATE ADJUSTING STOCK.

Lmm + (0.005 to 0.01mm)

* METHOD FOR ADJUSTING STOCK WHEN JIG IS NOT AVALIABLE.



1. MEASURE THE DIMENSION L USING A DEPTH MICROMETER.
2. MEASURE THE THICKNESS OF EACH OUTER RING OF A SINGLE BEARING RACE USING A MICROMETER.

* EQUATION TO CALCULATE ADJUSTING STOCK.

ADJUSTING STOCK FOR RETAINER L = (Lmm − (L_1 + L_2)) + 0.01mm

* IN THE CASE OF DF BEARINGS, USE JIG WHENEVER POSSIBLE BECAUSE OF HIGH POSSIBILITY OF MEASURING ERROR.

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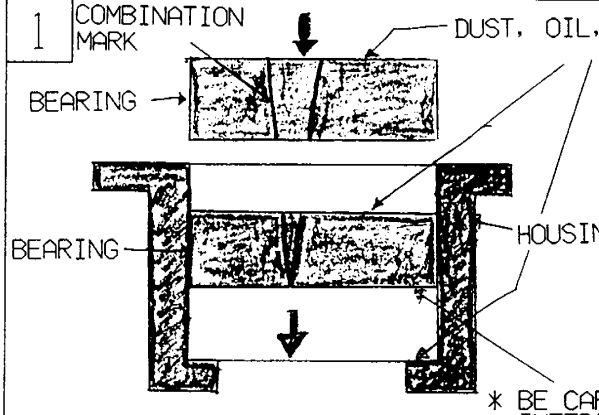
INSTRUCTIONS FOR: COMBINATION BEARINGS

NO. 13

PROCEDURE

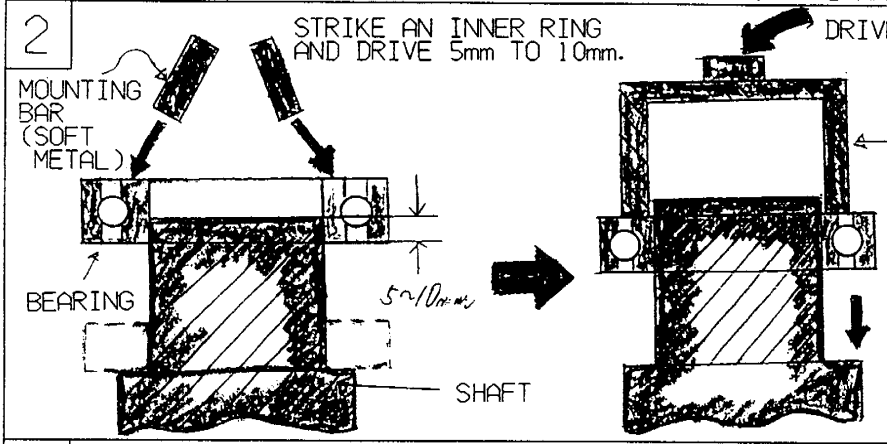
1



* DO NOT INSERT BEARINGS WHILE DUST, OIL, GREASE AND OTHER CONTAMINANTS ARE ON THE BEARING. DUST AND OTHER CONTAMINANTS BECOME EASILY ADHESABLE, ESPECIALLY WHEN USING A WASTE CLOTH.
THE BEARING SHOULD BE WIPED WITH A TISSUE OR BY HAND BEFORE INSERTING.

* BE CAREFUL SINCE THE ACCURACY MAY BECOME INFERIOR WHEN CONTAMINANTS ENTER.

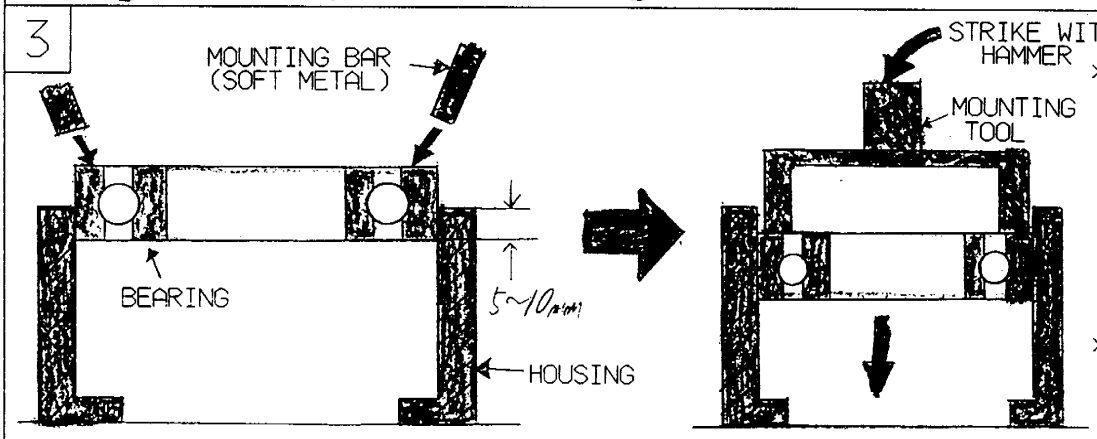
2



* DRIVE 5 - 10mm AND THEN DRIVE COMPLETELY USING A MOUNING TOOL.

* DO NOT STRIKE OUTER RING.

3



* DRIVE 5 - 10mm AND THEN DRIVE COMPLETELY USING A MOUNING TOOL.

* DO NOT STRIKE INNER RING.

NOTE: INSTRUCTIONS MAY CHANGE DEPENDING ON THE CONDITION OF ASSEMBLY, BUT AS FAR AS BASIC OPERATIONS ARE CONCERNED, USE STEPS 1 THRU 3.

BE CAREFUL NOT TO DAMAGE BALL OR RETAINER, ESPECIALLY WHEN DRIVING WITH BAR. ALSO, SINCE CONTAMINANTS CAN BADLY EFFECT THE BEARING, THE ASSEMBLY REQUIRES EXTRA CAUTION.

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National Training Department
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Florence, Kentucky 41042
Telephone (606) 342-1482
Fax (606) 342-1520

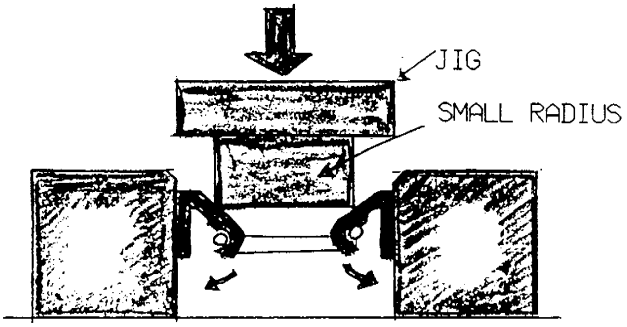
INSTRUCTIONS FOR: INSERTING OIL SEALS

NO. 14

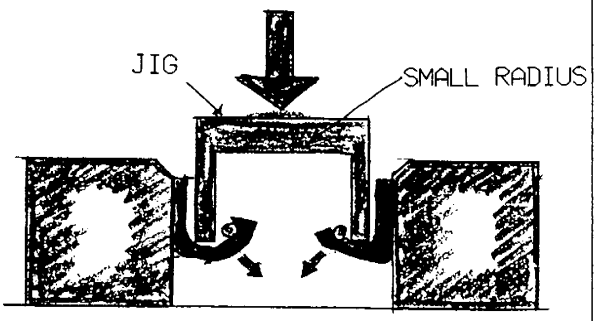
PROCEDURE

BAD EXAMPLES FOR INSERTING OIL SEALS

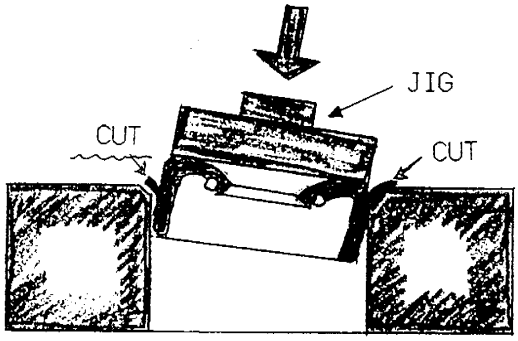
* METHODS 1 THRU 4 CAUSE UNUSUAL CHANGES TO THE SEAL SECTION WHICH RESULTS IN OIL LEAKAGE AND OTHER DAMAGES.



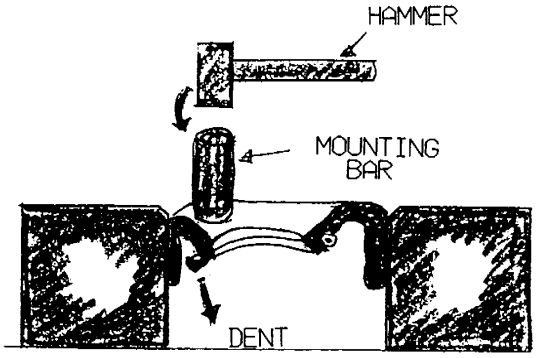
1. CHANGE AT SEAL SECTION



2. CHANGE AT SEAL SECTION

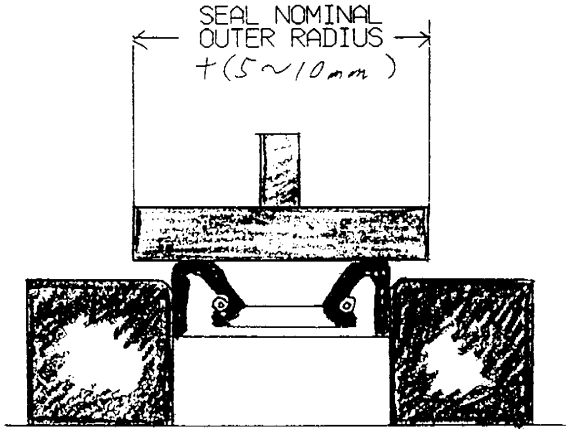


3. CUTS AT SEAL'S OUTER RADIUS

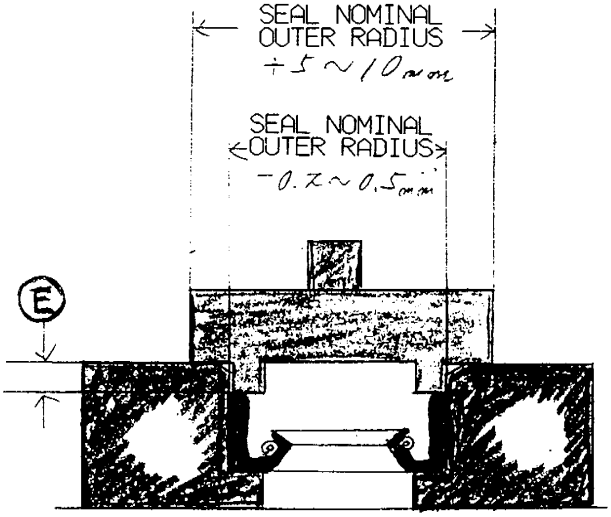


4. PARTIAL CHANGE IN SEAL

CORRECT WAYS TO INSERT OIL SEALS



* WHEN HOUSING HOLE IS AT THE END



* LENGTH OF SEAL INSERTING SECTION E IS (DEPYH OF HOUSING HOLE) - (WIDTH OF SEAL) + 0.5MM

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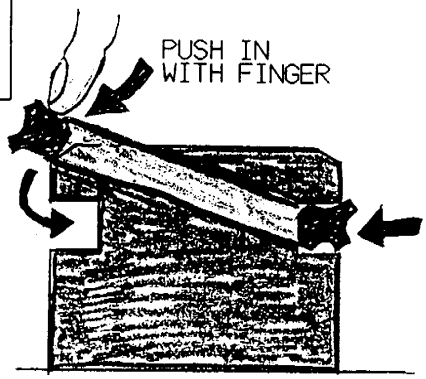
INSTRUCTIONS FOR: SKY PACKING

NO. 15

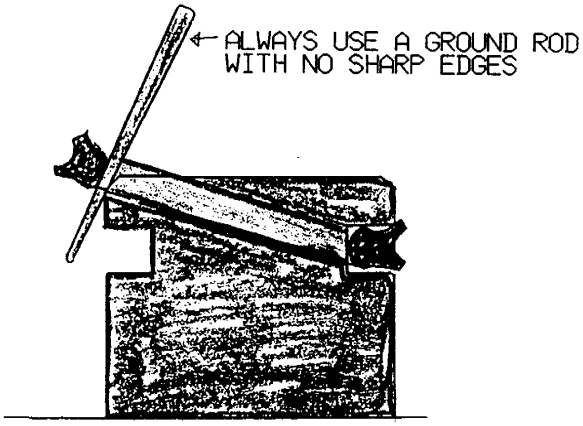
PROCEDURE

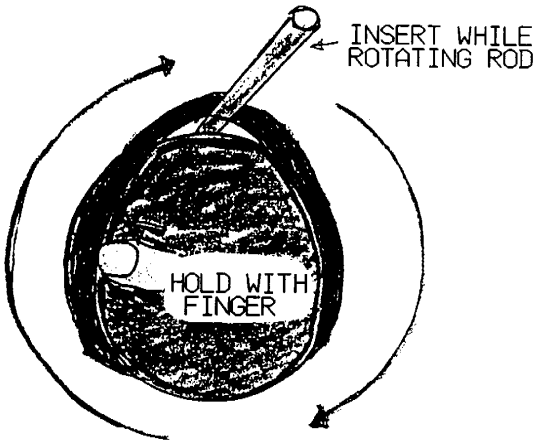
METHOD TO INSERT SEAL WITH FINGERS



WHEN USING A ROD

SKY PACKING





SKY PACKING

NOTE: IN ORDER NOT TO DAMAGE LIP SECTION, ALWAYS USE A GROUND ROD FOR INSERTION.

FOR SMOOTH INSERTION, APPLY A SMALL AMOUNT OF GREASE TO SKY PACKING.

DO NOT USE A SCREWDRIVER, BOLTS OR OTHER RELATED TOOLS IN PLACE OF ROD.

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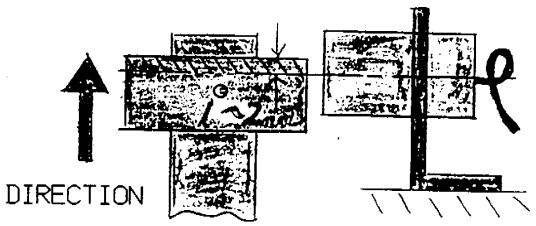
INSTRUCTIONS FOR: PROXIMITY SWITCH

NO. 16

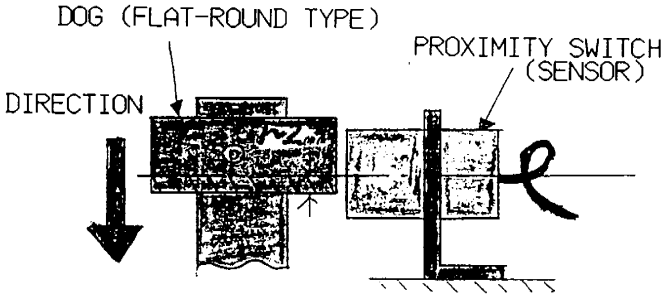
PROCEDURE

MEASURING A GAP AND ITS POSITION

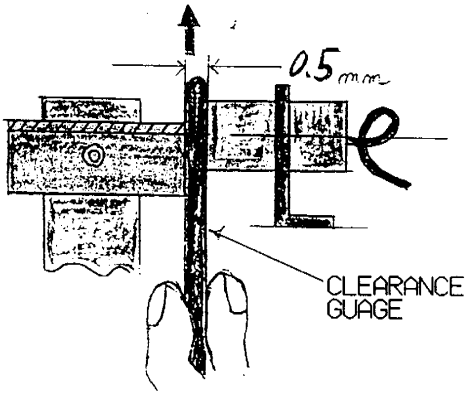
PRODUCED BY: YAMATAKE, BALLUFF



* ADJUST 1mm TO 2mm FROM THE CENTER OF THE SENSOR

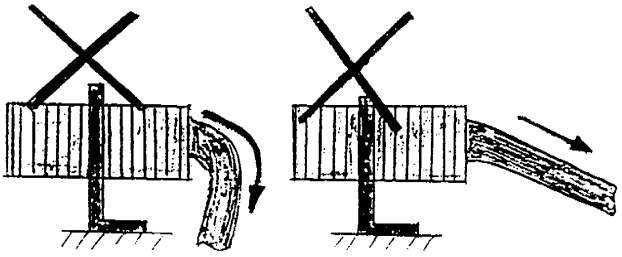


* ADJUST 1mm TO 2mm FROM THE CENTER OF THE SENSOR



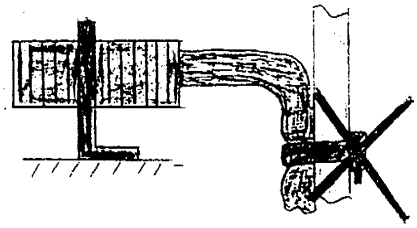
* GAP BETWEEN SENSOR AND DOG IS 0.5mm.

TREATMENT OF A CABLE

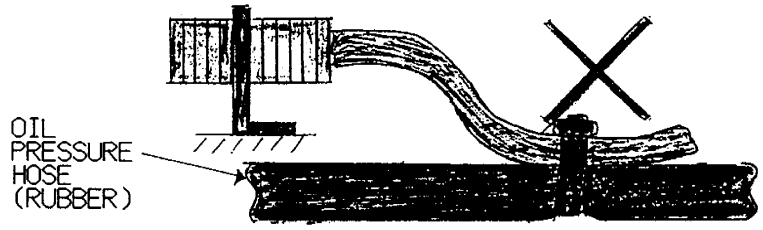


o EXCESSIVE BENDING

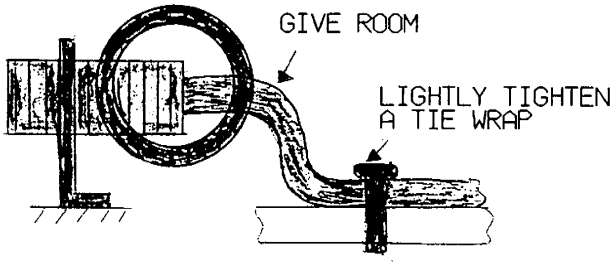
o EXCESSIVE STRECHING



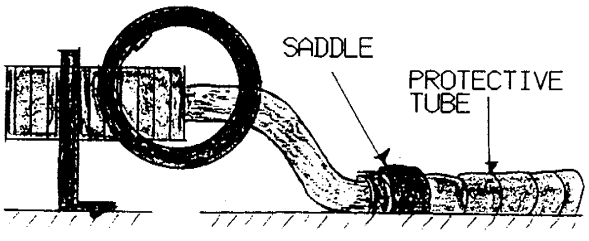
o EXCESSIVE TIGHTENING OF A TIE WRAP



o FIXING THE RUBBER SECTION OF OIL PRESSURE HOSE.



o GIVE ROOM FOR CABLE AND TIGHTEN LIGHTLY



o IF CABLE IS LONG, FIX IT WITH PROTECTIVE TUBE AND SADDLE.

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INSTRUCTIONS FOR: SOLENOID VALVES

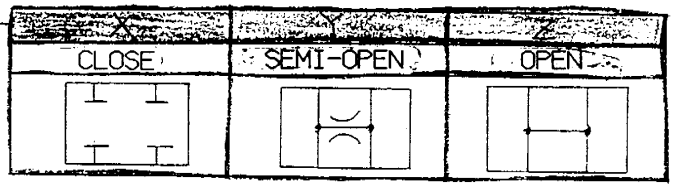
NO. 17

PROCEDURE

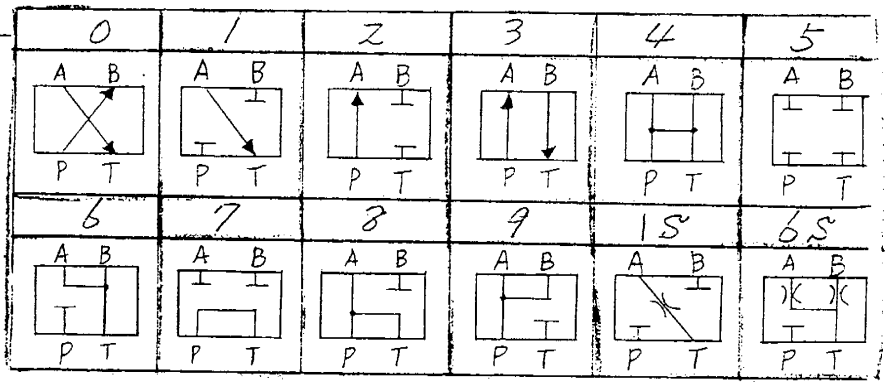
TYPE DESCRIPTION (NACHI PRODUCTION)

SA-G01-A3X-**-C2-11

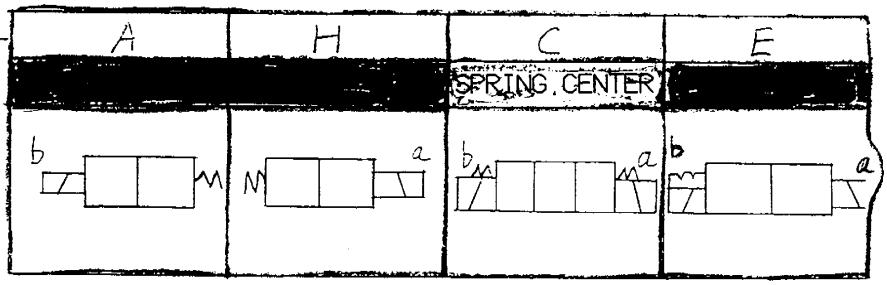
- 11 — DESIGN NUMBER
- C2 — INDICATE POWER SOURCE (C1 = AC100V, C2 = AC200V, D = DC ? V)
- ** — AUXILARY MARK
- X — CLOSE; Y — SEMI-OPEN; Z — OPEN



- 3 — NEUTRAL POSITION



- A — OPERATING METHOD



- A3 — NOMINAL TUBE RADIUS (01 SIZE, 03 SIZE)
- G — INSTALLATION METHOD (G - GASKET)
- D — DIN CONNECTOR TYPE

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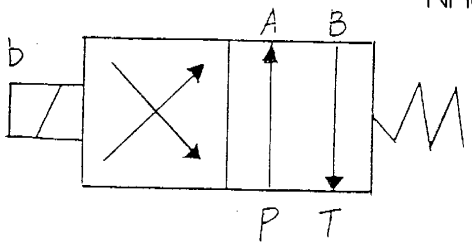
National Training Department
8025 Production Drive
Florence, Kentucky 41042
Telephone (606) 342-1482
Fax (606) 342-1520

INSTRUCTIONS FOR: SOLENOID VALVES

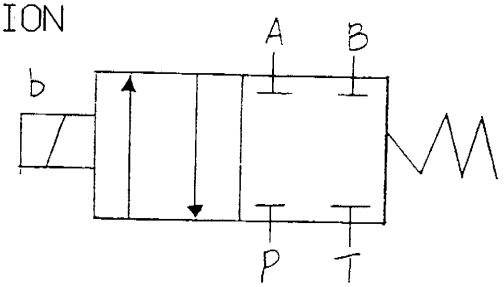
NO. 18

PROCEDURE

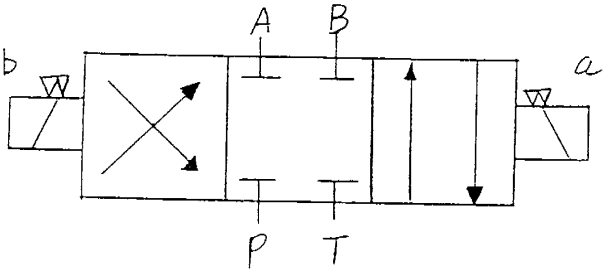
NACHI PRODUCTION



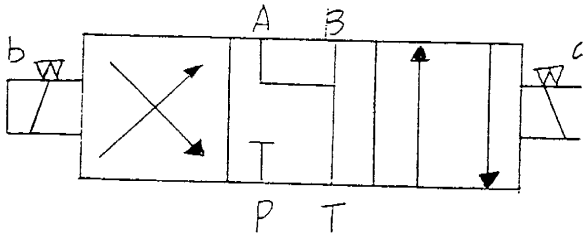
SA-G01-A3X-C1-20



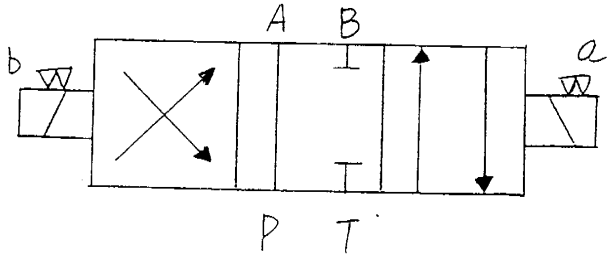
SA-G01-A5-C1-20



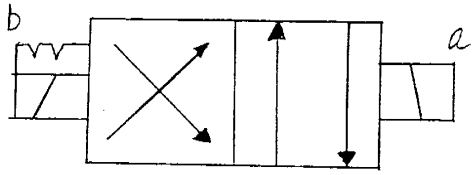
SA-G01-C5-C1-20



SA-G01-C6-C1-20

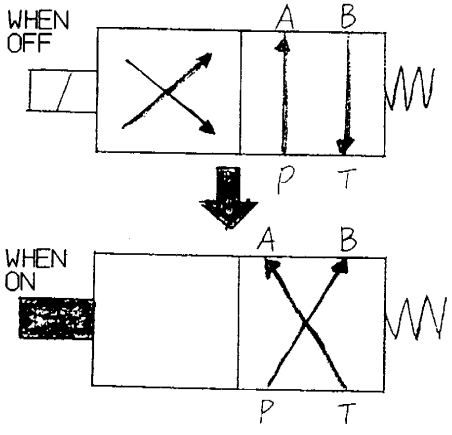


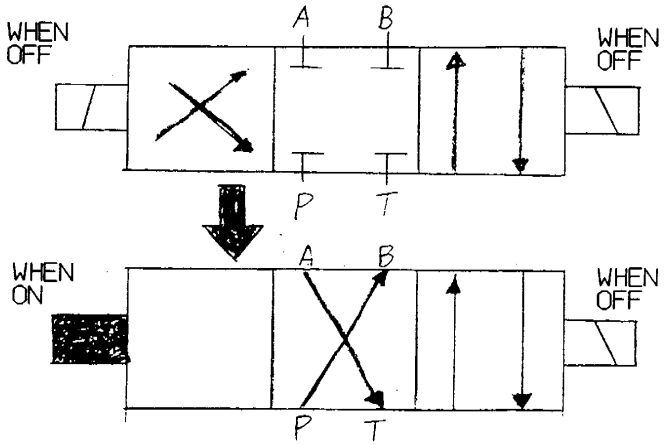
SA-G01-C2-C1-20



SA-G01-E3X-C1-20

* COMMON VALVES ARE SHOWN ABOVE





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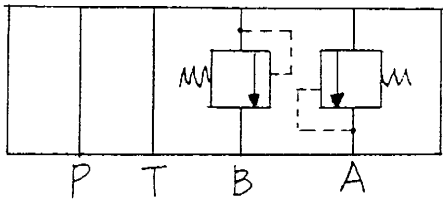
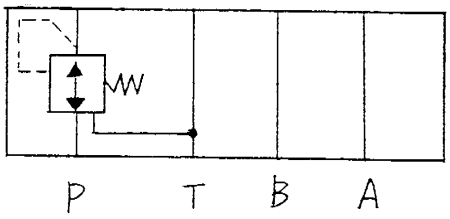
INSTRUCTIONS FOR: MODULAR VALVES

NO. 19

PROCEDURE

REDUCING VALVE (PRESSURE CONTROL VALVE)

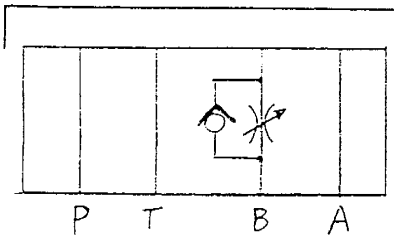


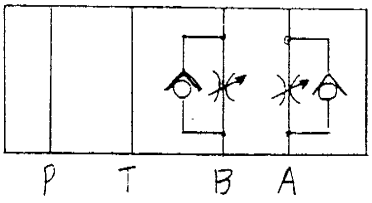


ORO-G01-W1-20

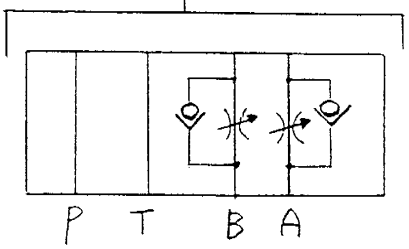
OG-G01-P1-20

METER OUT-FLOW REGULATOR VALVE (FLOW CONTROL)





METER IN-FLOW REGULATOR VALVE

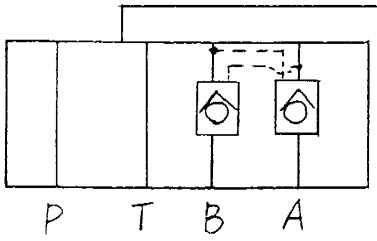


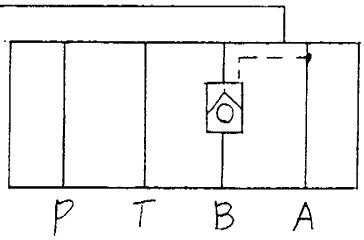
OCY-G01-B-Y-20

OCY-G01-W-Y-20

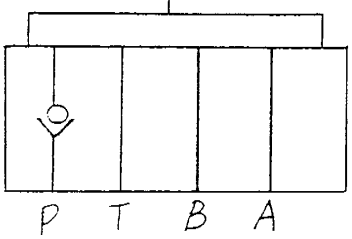
OCY-G01-W-X-20

PILOT CHECK VALVE (DIRECTION CONTROL)





CHECK VALVE (DIRECTION CONTROL)



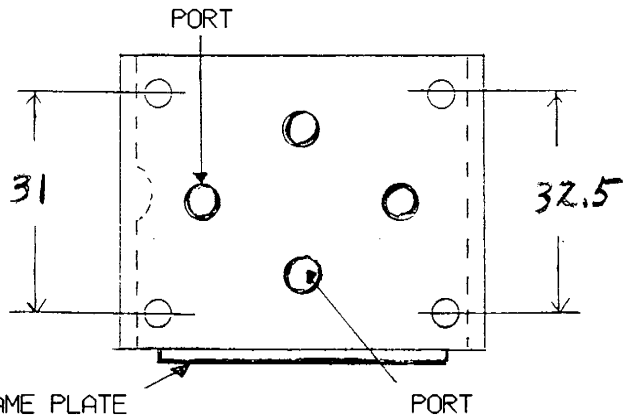
OCP-G01-W1-20

OCP-G01-B1-20

OC-G03-P1-50

CHECK VALVE

FLOW VALVE



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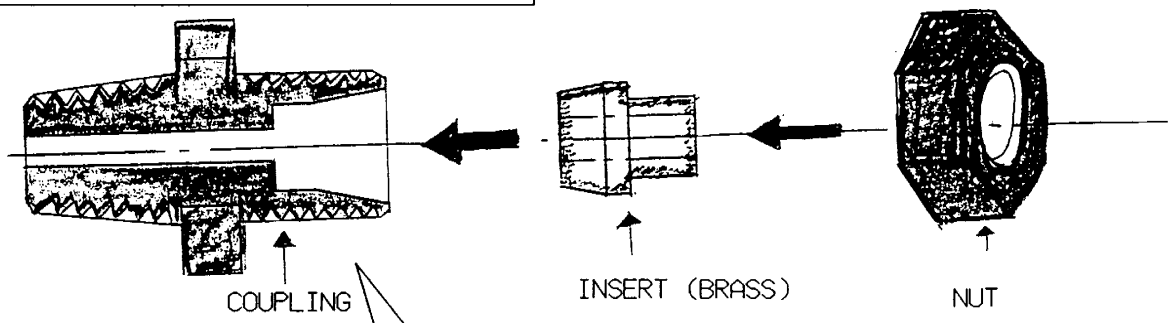
INSTRUCTIONS FOR: QUICK SEALING COUPLINGS

NO. 20

PROCEDURE

THERE ARE TWO TYPES OF QUICK SEAL COUPLINGS AND THEY EACH DIFFER IN FIXING METHODS

● INSERTLESS TYPE (0 TO 9 KG/CM²)



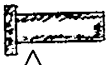
WORKING FLUID ⟶ AIR OR OIL MIXTURE
NORMAL PRESSURE ⟶ 0 TO 9.9 KGF/CM²
WORKING TEMPERATURE ⟶ -40°C TO +50°C

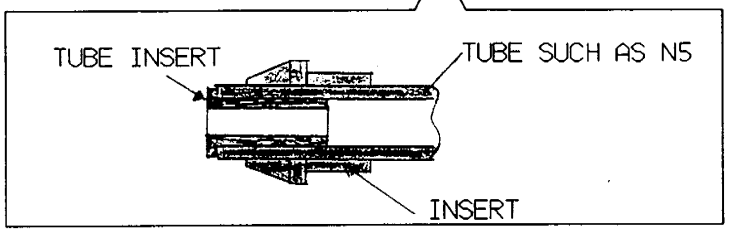
* UNFIT FOR SOFT MATERIAL SUCH AS N5 TUBE.

USED FOR HARD MATERIAL SUCH AS N2 AND N1.

* WORKING FLUID ⟶ WHEN USING FOR AIR, COOLING WATER, OPERATING OIL, ETC...

INSERTLESS TYPE + TUBE INSERT

● + 



* BY USING A TUBE INSERT, IT IS POSSIBLE TO USE A SOFT MATERIAL SUCH AS N5.

NOTE: USE OF AN INSERT PROTECTS THE TUBE FROM COMING OFF.

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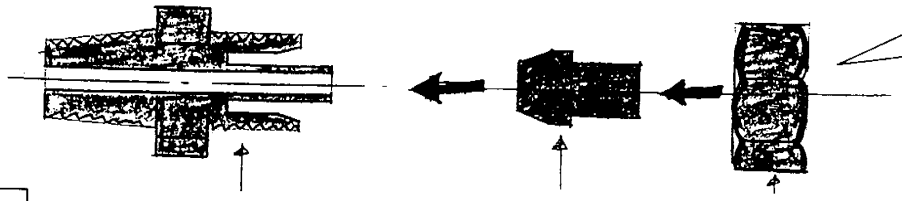
INSTRUCTIONS FOR: QUICK SEAL COUPLINGS

NO. 21

PROCEDURE

Ⓑ INSERT TYPE (0 - 25KG/CM²)



WORKING FLUID

EX: AIR, COOLING WATER, OPERATING OIL, ETC...

POINT

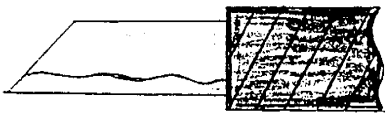
* BECAUSE THESE PARTS CLAMP THE INNER AND OUTER RADIUS OF THE TUBE, IT IS POSSIBLE TO USE N1 - N5 TUBE. THE SLEEVE DIGS INTO THE TUBE TO PREVENT THE TUBE FROM COMING OFF.

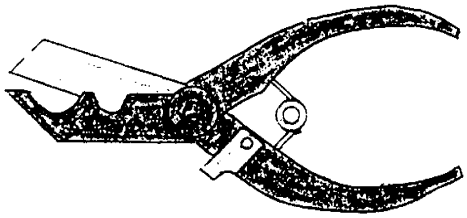
METHOD FOR CUTTING

CUTTING THE TUBE

* CUT THE TUBE PERPENDICULAR TO THE SHAFT OF THE TUBE.

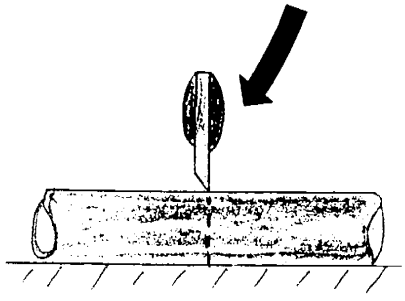
→ USE A SHARP EDGED TOOL. (CUTTER KNIFE OR EXCLUSIVE TUBE CUTTER)



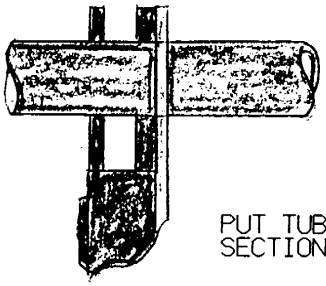


CUTTER KNIFE

TUBE CUTTER



CUT PERPENDICULAR



PUT TUBE IN GUIDE SECTION, THEN CUT.

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INSTRUCTIONS FOR: QUICK SEALING COUPLINGS

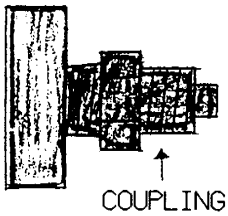
NO. 22

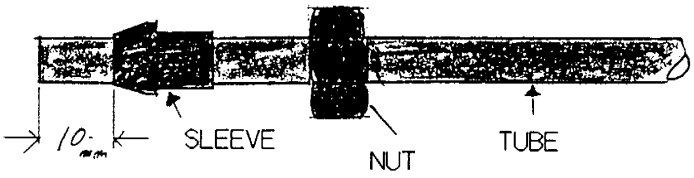
PROCEDURE

INSERTING INSTRUCTION AND CAUTION

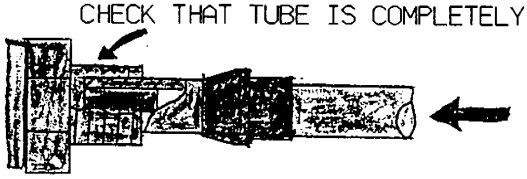
1. INSTALL COUPLING TO A BODY

PUT THE NUT AND THE SLEEVE ON THE TUBE IN THIS ORDER.

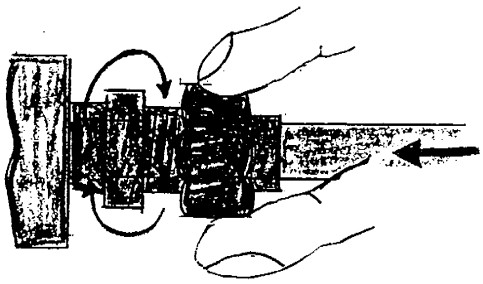




2. INSTALL TUBE TO A COUPLING.
CHECK THAT TUBE IS COMPLETELY INSERTED.



3. WITH THIS CONDITION, INSTALL SLEEVE AND NUT TO A COUPLING, AND TIGHTEN NUT FULLY BY HAND.



4. TIGHTEN NUT WITH WRENCH WHILE TUBE IS STILL INSERTED.

* TIGHTENING TORQUES ARE LISTED ON BOTTOM DIAGRAM.

(A) INSERTLESS TYPE (BRASS)

TUBE'S OUTER RADIUS (mm)	TIGHTENING TORQUE (KG/CM²)	NUMBER OF TURNS OF THE NUT
4	30-45	1-1.5
6	40-70	1-1.5
8	60-80	1-1.5
10	100-140	1.5-2
12	150-200	1.5-2

(B) INSERT TYPE (PLASTIC)

TUBE'S OUTER RADIUS (mm)	TIGHTENING TORQUE (KG/CM²)	NUMBER OF TURNS OF THE NUT
4	10-40	2-2.5
6	40-60	2-2.5
8	60-80	2-2.5
10	80-100	2-2.5
12	100-140	2-2.5
16	400-500	2-2.5

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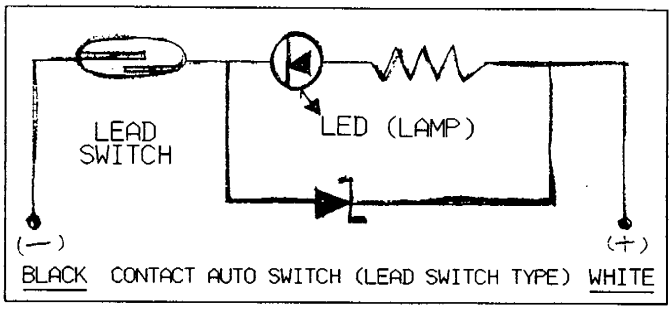
INSTRUCTIONS FOR: ADJUSTING AN AUTO SWITCH

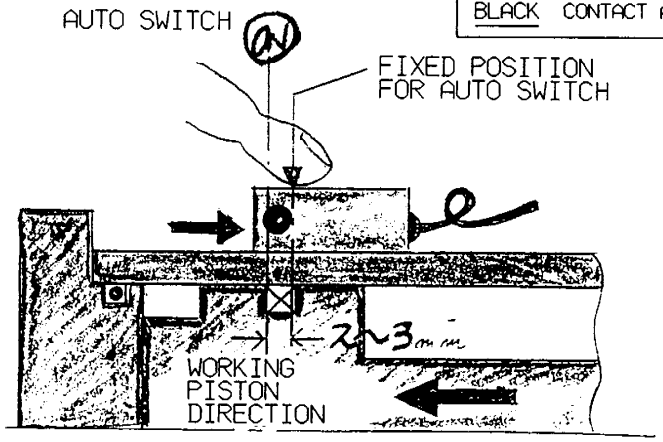
NO. 23

PROCEDURE

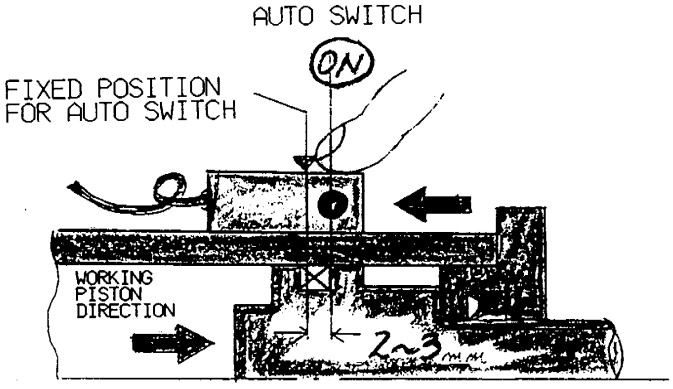
ADJUSTING METHOD FOR AN AUTO SWITCH WITH INDICATOR LIGHT

SMC AUTO SWITCH





* DURING THE CONDITION SHOWN TO THE LEFT, MOVE AUTO SWITCH TO THE LEFT AND TURN IT OFF. THEN MOVE IT TO THE RIGHT UNTIL AUTO SWITCH TURNS ON. MARK THE POSITION WHERE IT TURNED ON WITH A PEN OR MARKER. MOVE THE AUTO SWITCH ANOTHER TWO TO THREE MM TO THE RIGHT AND ATTACH IT THERE.



* DURING THE CONDITION SHOWN TO THE LEFT, MOVE AUTO SWITCH TO THE RIGHT AND TURN IT OFF. THEN MOVE IT TO THE LEFT UNTIL AUTO SWITCH TURNS ON. MARK THE POSITION WHERE IT TURNED ON WITH A PEN OR MARKER. MOVE THE AUTO SWITCH ANOTHER TWO TO THREE MM TO THE LEFT AND ATTACH IT THERE.

NOTE:

- DESPITE THE CHANGE IN MANUFACTURER, FIX THE AUTO SWITCH AT 2 - 3mm FROM THE POSITION WHERE THE SWITCH FIRST TURNS ON.
- IT IS IMPORTANT TO SET THE AUTO SWITCH AT 2 - 3mm FROM THE POSITION WHERE IT FIRST TURNS ON BECAUSE THE AUTO SWITCH DOES NOT ALWAYS COME TO STOP AT THE SAME POSITION. THIS MEANS THAT IF THE AUTO SWITCH IS FIXED AT A MARKED POSITION, IT MAY NOT REACH THE POSITION WHERE IT TURNS ON DURING ITS REPETITIVE OPERATION. THERE ARE APPROXIMITELY 2mm ALLOWANCE FOR A CONTACT AUTO SWITCH (LEAD SWITCH TYPE) AND APPROXIMITELY 1mm ALLOWANCE FOR A NON-CONTACT AUTO SWITCH (SENSOR TYPE).

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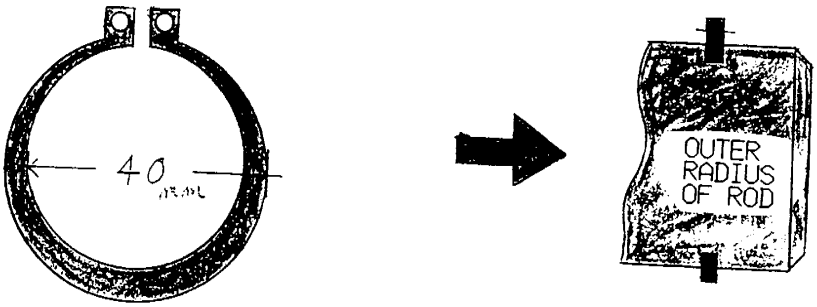
INSTRUCTIONS FOR: SNAP RINGS

NO. 24

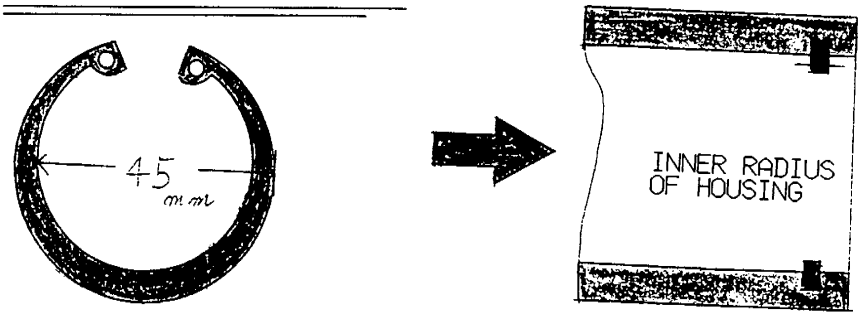
PROCEDURE

THERE ARE 4 GENERAL TYPES OF SNAP RINGS.

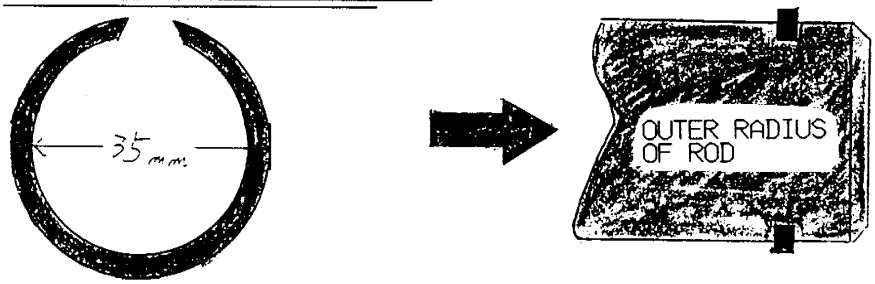
USE SNAP RING PLIERS EXCLUSIVELY FOR INSTALLING SNAP RINGS.



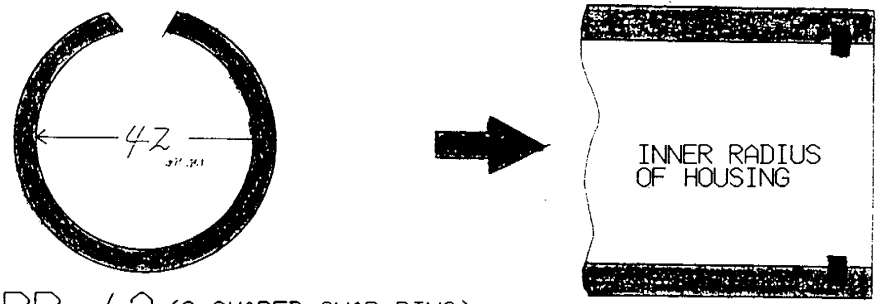
S-40 (FOR ROD)



H-45 (FOR HOUSING)



WR-35 (C-SHAPED SNAP RING)



BR-42 (C-SHAPED SNAP RING)

PRESS FIT

1 - PRESS FITTING TOOL

1. USE JIS STANDARD MATERIAL.

2. PERFORM INSPECTION ONCE A YEAR.

3. INSPECTION METHOD:

   NOTE FOR BENDING 0.3 SQ. WIRE, INSERT IT TO 1.25 TERMINAL, AND PRESS FIT SLOWLY. WHEN THE LAST RATCHET IS LOOSENED, DETATCH IT IMMEDIATLY AND PULL HARD. WIRE MUST NOT COME OFF.

4. IF THERE ARE SUB-STANDARD TOOLS IMMEDIATLY REPAIR OR REPLACE.

2 - TERMINAL SIZE

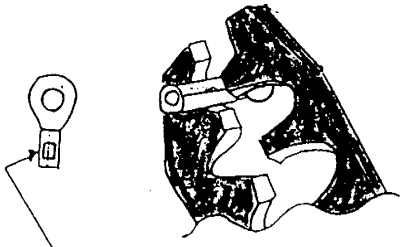
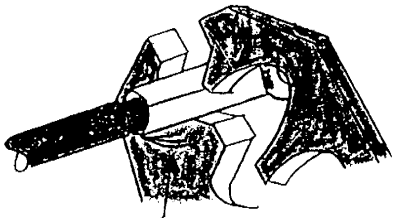
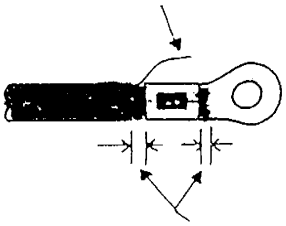
TERMINAL	CROSS SECTION AREA OF WIRE (mm)	STRIPPING LENGTH	PLACE TO PRESS FIT
1.25	0.6 - 1.3	6	1.25
2.0	1.3 - 2.6	6	2.0
3.5	2.1 - 4.1	6	5.5
5.5	2.6 - 4.6	7	5.5

EX: TO PRESS FIT 0.3 SQ. WIRE TO 1.25 TERMINAL ------ FOLD WIRE ONCE.

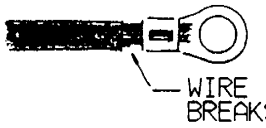
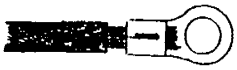
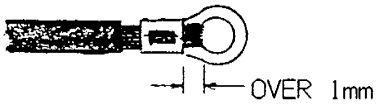
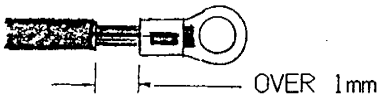
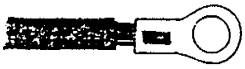
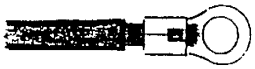
TO PRESS FIT 0.5 SQ. WIRE TO 1.25 TERMINAL ------ FOLD WIRE ONCE.

TO PRESS FIT 0.18 SQ. WIRE TO 1.25 TERMINAL ------ FOLD WIRE TWICE.

3 - METHOD TO PRESS FIT

	FIGURE	COMMENTS
1	 NO BREAKS IN WIRE	STRIP ELECTRIC WIRE COVERING IN A LENGTH SUITABLE FOR A TERMINAL.
2	 COMPRESS HERE	PUT TERMINAL BETWEEN PRESS FIT TOOL AND LIGHTLY PRESS IT SO THAT THE TERMINAL WON'T FALL OUT.
3	 WIRE MUST NOT BE STICKING OUT	INSERT CORE WIRE TO PRESS FIT TERMINAL AND HOLD LIGHTLY.
4		SQUEEZE PRESS FIT TOOL DOWN UNTIL RATCHET COMES OFF.
5	NO WIRE PROTRUDING  WIRE VISIBILITY UNDER 1mm.	CONFIRM THAT A PRESS FIT HAS TAKEN PLACE AT THE CENTER OF TERMINAL.

4 - SUB-STANDARD PRESS FIT

	EXAMPLE OF BAD PRESS FIT	REASON WHY BAD PRESS FIT
1		WIRE WITH BREAKS OR DEFECTIVE PARTS.
2		WIRE IS STICKING OUT.
3		NOT USING SUITABLE TOOL OR WRONG SLOT ON CRIMMPER.
4		WIRE TO SMALL FOR TERMINAL.
5		WIRE PROTRUDES OR INTRUDES TOO MUCH. (SHOWING PART OF WIRE SHOULD BE UNDER 1mm)
6		SPACE BETWEEN THE WIRE COVER AND TERMINAL IS TOO FAR APART OR TOO CLOSE TOGETHER. (MUST BE UNDER 1mm, BUT NOT OVERLAP)
7		PRESS FIT ON BACK SIDE.
8		PRESS FIT ALIGNMENT. (PRESS FIT SHOULD BE IN CENTER OF TERMINAL)
9		PRESS FIT DIAGONALLY. (PRESS FIT SHOULD BE IN CENTER OF TERMINAL)

5 - PRESS FIT OF A SINGLE WIRE

(TERMINAL SIZE)	(ELECTRIC WIRE SIZE)
1.25	0.57mm to 1.44mm
2	1.14mm to 1.82mm
3.5	1.82mm to 2.4mm
5.5	1.82mm to 2.89mm

EX:	SPARK KILLER	S-1205	0.75mm (0.8)
	NOISE KILLER	10K221	0.75mm
	DIODE	SRI-FM8	0.75mm (0.8)
	CARBON RESISTANCE	1/2W	0.65mm (0.7)

ABOVE EXAMPLES DO NOT NEED TO BE FOLDED, BUT PULL THEM BY HAND TO MAKE SURE THEY DON'T COME OFF.

AUTOMATIC PRESS FIT

1 - TERMINAL SIZE

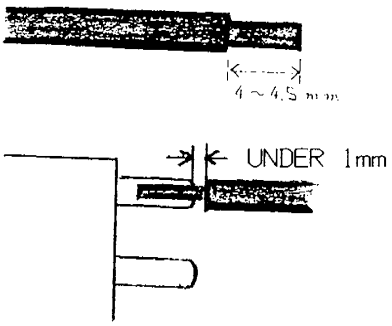
TERMINAL	TOTAL CROSS SECTIONAL AREA OF WIRE (mm^2)	SINGLE WIRE (mm)
1.25	0.25 - 1.65	0.57 - 1.44
2.0	1.04 - 2.63	1.14 - 1.82
3.5	2.63 - 4.6	1.82 - 2.4
5.5	2.63 - 6.64	1.82 - 2.89

* PULL AND CHECK THE CONNECTIONS STRENGTH ONCE A DAY AND KEEP RECORD OF RESULTS.

SOLDERING OPERATION

CONNECTOR
(HONDA, FUJITSU)

1. STRIPPED SECTION OF ELECTRIC WIRE SHOULD BE 4mm - 4.5mm.
2. POSITION FOR SOLDERING
   * AS SHOWN IN FIGURE, CLEARANCE BETWEEN CONNECTOR AND WIRE COVERING SHOULD BE UNDER 1mm AND ADHERE AT THE MIDDLE.
   * SLIP ON THE CLEAR PROTECTIVE TUBING.

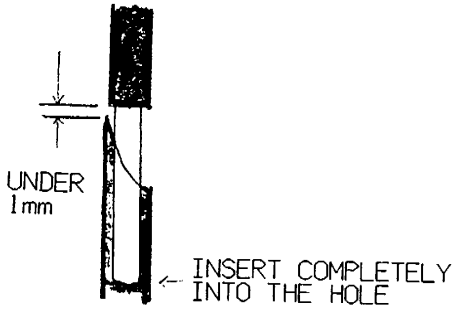


CANNON CONNECTOR

1. STRIPPED SECTION OF ELECTRIC WIRE DIFFERS WITH THE KIND OF CONNECTOR, BUT INSERT COMPLETELY INTO THE HOLE.

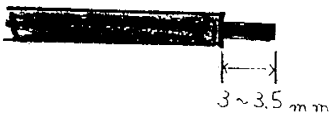
   MS3106B 28-21S.....8mm
   20-29S.....5.5mm

2. POSITION FOR SOLDERING
   * SET CLEARANCE BETWEEN CONNECTOR AND ELECTRIC WIRE COVERING TO UNDER 1mm.
   * SLIP ON THE PROTECTIVE TUBING (2.8mm CLEAR OR WHITE).



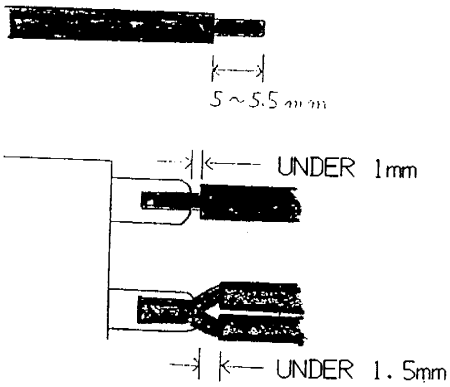
DB CONNECTOR

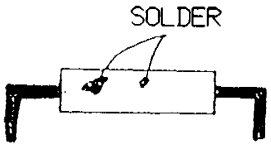
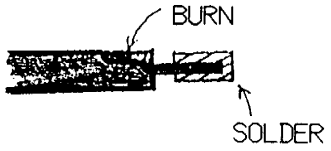
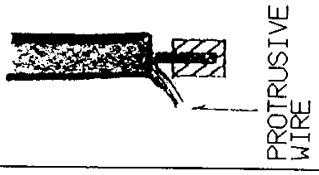
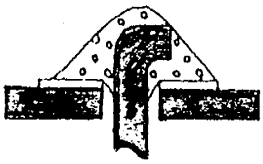
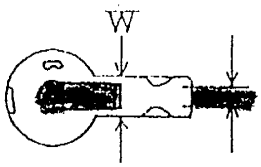
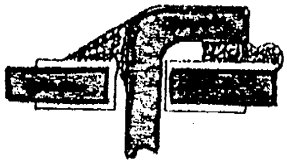
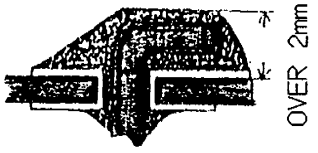
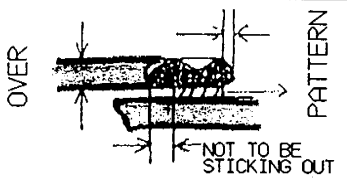
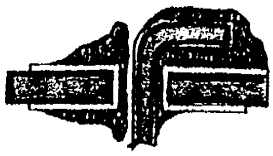
1. STRIPPED SECTION OF ELECTRIC WIRE SHOULD BE BETWEEN 3mm - 3.5mm.
2. POSITION FOR SOLDERING
   * SET CLEARANCE BETWEEN CONNECTOR AND ELECTRIC WIRE COVERING TO UNDER 1mm.
   * SLIP ON PROTECTIVE TUBING (2mm CLEAR)
   * ELECTRIC WIRE IS UNDER 0.3mm.

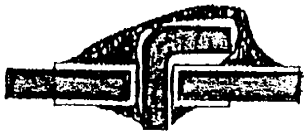
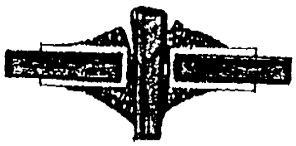
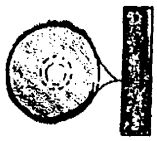
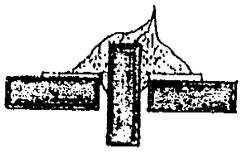
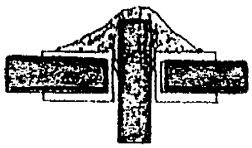
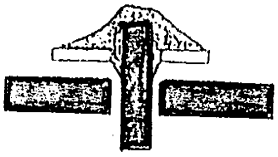
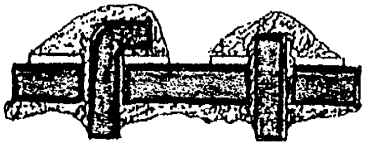
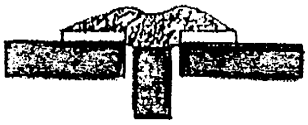
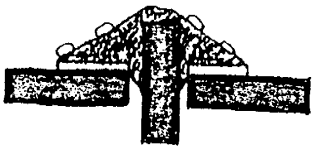


RELAY SOCKET

1. STRIPPED SECTION OF WIRE SHOULD BE 5mm - 5.5mm.
2. POSITION FOR SOLDERING
   * SET CLEARANCE BETWEEN SOCKET AND ELECTRIC WIRE COVERING TO UNDER 1mm.
   * IN CASE OF TWO ELECTRIC WIRES, SET CLEARANCE UNDER 1.5mm.
   * PUT ON PROTECTIVE TUBE WITH WIRE NUMBER.
   * WHEN SOLDERING TWO ELECTRIC WIRES, TWIST A CORE WIRE.
   * DO NOT PUT MORE THAN 3 WIRES TO A SINGLE TERMINAL.



NDARD QUALITY	FIGURE EXAMPLE	CONTENT
1. SOLDER ADHERANCE		DON'T ADHERE SOLDER TO ELECTRONIC PARTS OR A POWER SOURCE.
2. DO NOT MELT THE WIRE COVERING		ELECTRIC WIRE COVERING SHOULD NOT BE MELTED.
3. NO PROTRUSIVE WIRES		THERE MUST NOT BE ANY WIRES STICKING OUT.
4. NO COOL SOLDER		SOLDERING IN WHICH SURFACE BECOMES NOTCHED, LOOSES ITS GLOSS OR HAS NUMEROUS GAS HOLES.
5. NO INSUFFICIENT SOLDER		SOLDERING IN WHICH A SPACE EXISTS BETWEEN THE WIRE AND THE CONDUCTOR'S SURFACE. SOLDER HEIGHT SHOULD BE BELOW 0.7mm.
		IN CASE OF PATTERN, SOLDERING IN WHICH CONDUCTOR SURFACE IS EXPOSED OR THERE ARE BURS OF UNDER 0.5㎜.
6. NO OVER-SOLDER		SOLDERING WITH A SOLDER HEIGHT OVER 2mm. SOLDERING IN WHICH LEAD WIRE TERMINAL LINE IS UNKNOWN AND CAN NOT BE TRACED.
		IN CASE OF PATTERN, SOLDERING WITH SOLDER HEIGHT OVER 1mm.
7. NO OPEN SOLDER		SOLDERING IN WHICH PART OF THE LEAD WIRE INSERTING HOLE IS NOT CLOSED WITH SOLDER.

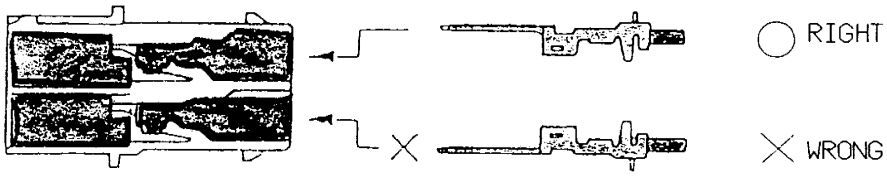
IDARD QUALITY	FIGURE EXAMPLE	CONTENT
8. NO LOOSENED SOLDER		SOLDERING IN WHICH THE SOLDER IS NOT FULLY FUSED TO THE PARTS BEING CONNECTED.
9. NO BLOW-HOLE		SOLDERING IN WHICH HOLE IS PARTIALLY OPEN AT A FUSED SOLDER CONNECTION.
10. NO BRIDGE		SOLDERING WHICH CAN CAUSE A SHORT IN A CIRCUIT
11. NO PROJECTED SOLDER		SOLDERING WITH A PROJECTION.
12. NO UNFULLY SUPPLIED SOLDER		SOLDERING IN WHICH THE SOLDER IS NOT FULLY SUPPLIED TO THE PARTS BEING CONNECTED.
13. NO BREAKING AWAY OF GROUND		SOLDERING IN WHICH GROUND BREAKS AWAY FROM CONNECTION.
14. NO COVERING OF SOLDER		SOLDERING IN WHICH SOLDER COVERS INSERTING SECTION.
15. NO BLIND SOLDER		SOLDERING IN WHICH AREA OF CONNECTION IS SCARCE.
16. NO SOLDER WITH IMPURITIES		SOLDERING IN WHICH OXIDE IS FORMING ON SOLDER.

DARD QUALITY	FIGURE EXAMPLE	CONTENT
17. NO BROKEN OR DAMAGED CIRCUIT		SOLDERING WITH INSUFFICIENT SOLDER CAN DAMAGE THE CIRCUIT.
18. NO OVER-HEATING		SOLDERING IN WHICH BASE AND TERMINAL BOARD SWELL AND WHITE SPOTS APPEAR ON THE SURFACE OF THE BASE.

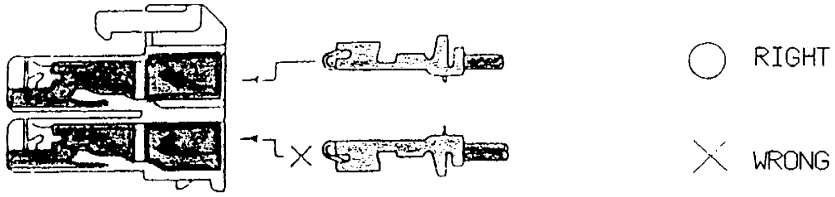
ASSEMBLY

INSERT CONTACT TO A HOUSING

1. INSERT PIN CONTACT TO A RECEPTACLE HOUSING.

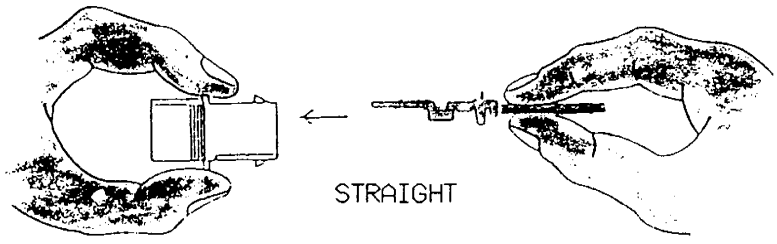


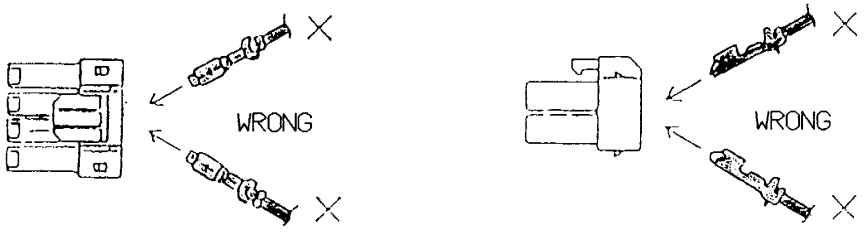
2. INSERT SOCKET CONTACT TO PLUG HOUSING.



WARNING FOR INSERTING A HOUSING

* SET CONTACT PARALLEL TO THE HOUSING AND INSERT, BUT DO NOT TWIST IT.

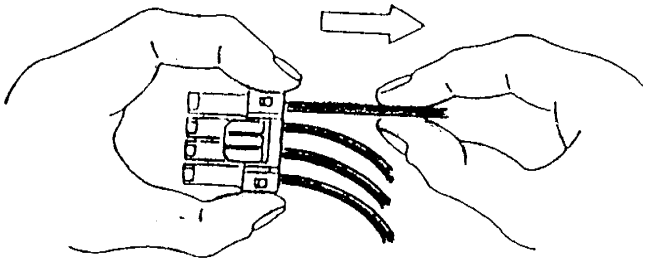




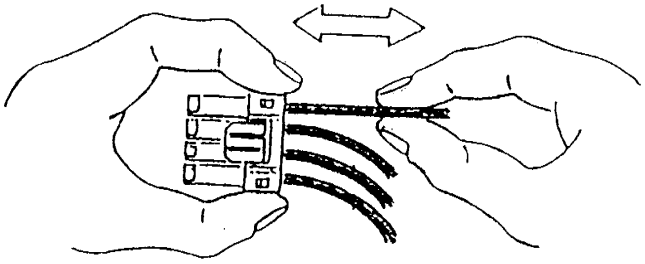
INSERTING CONTACT

* CHECK EACH TIME CONTACT IS INSERTED

1. PULL ELECTRIC WIRE WITH A FORCE OF 1 - 2 KG BY HOLDING IT WITH A THUMB AND FOREFINGER.



2. CHECK A FRONT-TO-BACK JOLT OF CONTACT WITHIN THE HOUSING.



STAYS ON --- ○

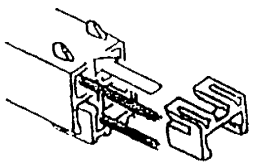
COMES OFF -- X

INSERTING RETAINER

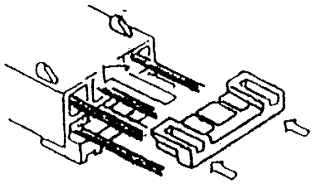
1. INSERT AFTER ALL CONTACTS ARE INSERTED IN HOUSING.

2. INSERT RETAINER UNTIL IT LOCKS (IT SHOULD MAKE A CLICKING SOUND AS IT LOCKS).

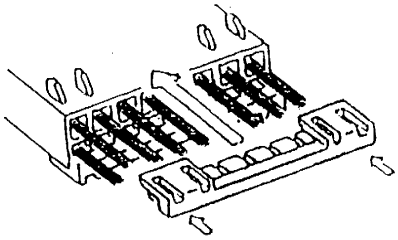
FOR 2 - 4 POLES



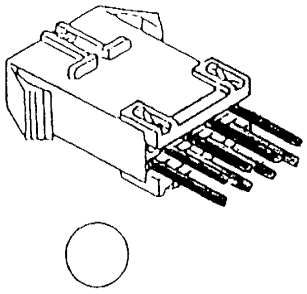
FOR 8 POLES

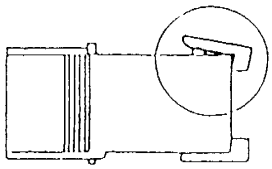


FOR 12 -16 POLES

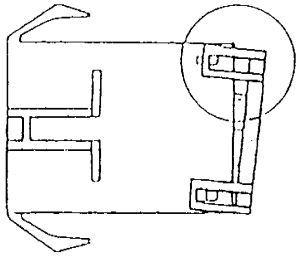


3. CONFIRMATION OF INSERTION.





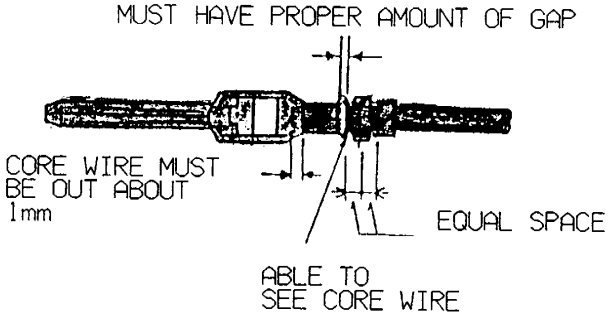
X IT IS NOT FULLY SNAPPED

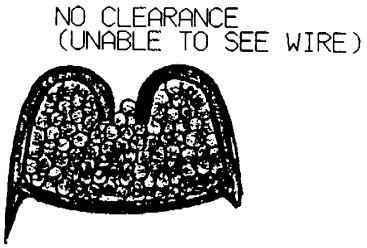


X ONLY ONE SIDE IS FULLY SNAPPED

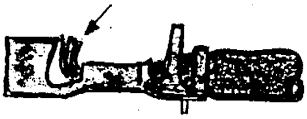
PRESS FIT APPEARANCE

CHECK TO SEE IF THE PRESS FIT IS CORRECTLY PERFORMED AND THAT THERE ARE NO EXTERNAL DAMAGES OR SHAPE ABNORMALITIES.

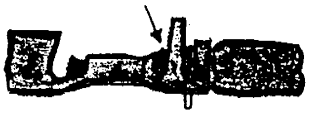




BAD EXAMPLES



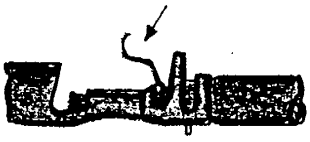
PROJECTED LENGTH IS TOO LONG



COVER IS CRIMMPED

LENGTH OF CORE WIRE IS TOO SHORT

LENGTH OF WIRE COVERING IS TOO SHORT

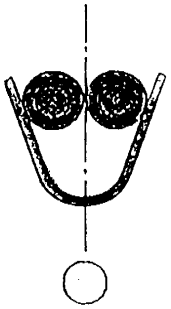


PART OF WIRE IS PROTRUDING

COVER CRIMPPED WRONG WAY

PRESS FITTING TWO ELECTRIC WIRES

1. ALIGN TWO WIRES HORIZONTALLY, THEN PRESS FIT.



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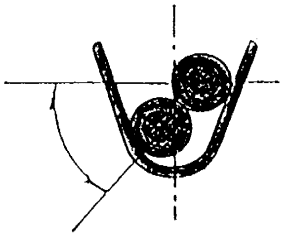
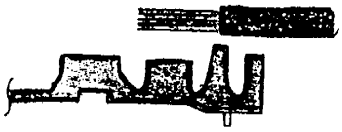


MUST NOT BE
OVER A 15° ANGLE

2. PUT CORE WIRE IN BARREL, THEN PRESS FIT.

○



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3. MAKE RIGHT AND LEFT ELECTRIC WIRES EVEN.

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INSTRUCTIONS FOR A CONTACT AFTER A PRESS FIT

1. WRAP FINISHED CONTACTS IN NEWSPAPER AND LIMIT MAXIMUM OF 100 TO EACH BUNDLE.

2. DON'T PLACE LOAD DIRECTLY ON THE FLOOR, IN A HUMID PLACE OR IN DIRECT SUNLIGHT. ALSO, DON'T SPRAY ANY INSECTICIDES AROUND LOAD.

3. DON'T STACK OBJECTS ON LOAD.

4. TO REMOVE PRESS FITTED PARTS FROM A BUNDLE, HOLD ON TO A WIRE NEAR THE PRESS FITTED SECTION AND REMOVE.

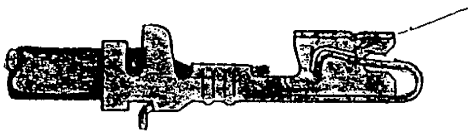
INSTRUCTIONS TO PULL OUT A CONTACT

1. AS A RULE, DO NOT REUSE A CONTACT WHICH HAS BEEN PREVIOUSLY REMOVED.

2. IN CASE OF REUSING:

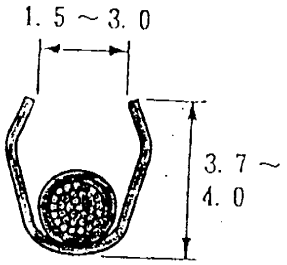
   A. REUSE HOUSING AND RETAINER ONLY ONCE.

   B. CONFIRM FULLY TO ORIGINAL SHAPE OF CONTACT AND RETAINER.



   C. CHECK, ON A STRICKTER LEVEL THAN NORMAL, THAT CONTACT HAS CONNECTED.

STANDARD DIMENSION OF STABELIZER



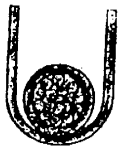
IF THE DIMENSIONS ARE OUT OF THE RANGE OF THE DIMENSIONS TO THE LEFT THESE PROBLEMS MAY OCCUR:

- CONTACT CAN NOT BE INSERTED
- RETAINER WILL NOT WORK
- ABLE TO INSERT CONTACT FROM THE WRONG SIDE

EXAMPLES OF ABNORMAL STABILIZERS

BIG DIFFERENCE IN HEIGHT

CLEARANCE AT THE TOP IS TOO SMALL

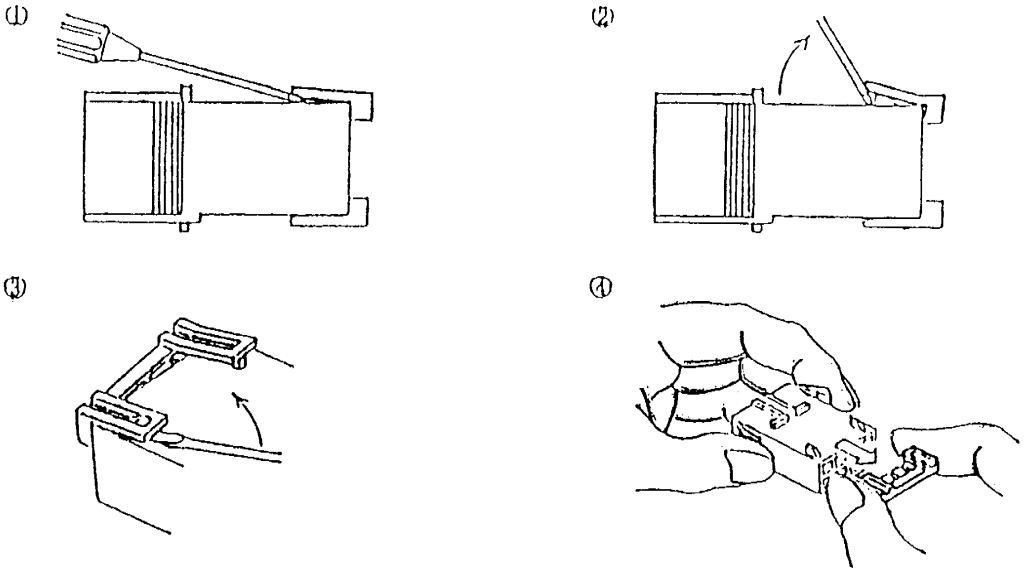


CLEARANCE AT THE TOP IS TOO BIG

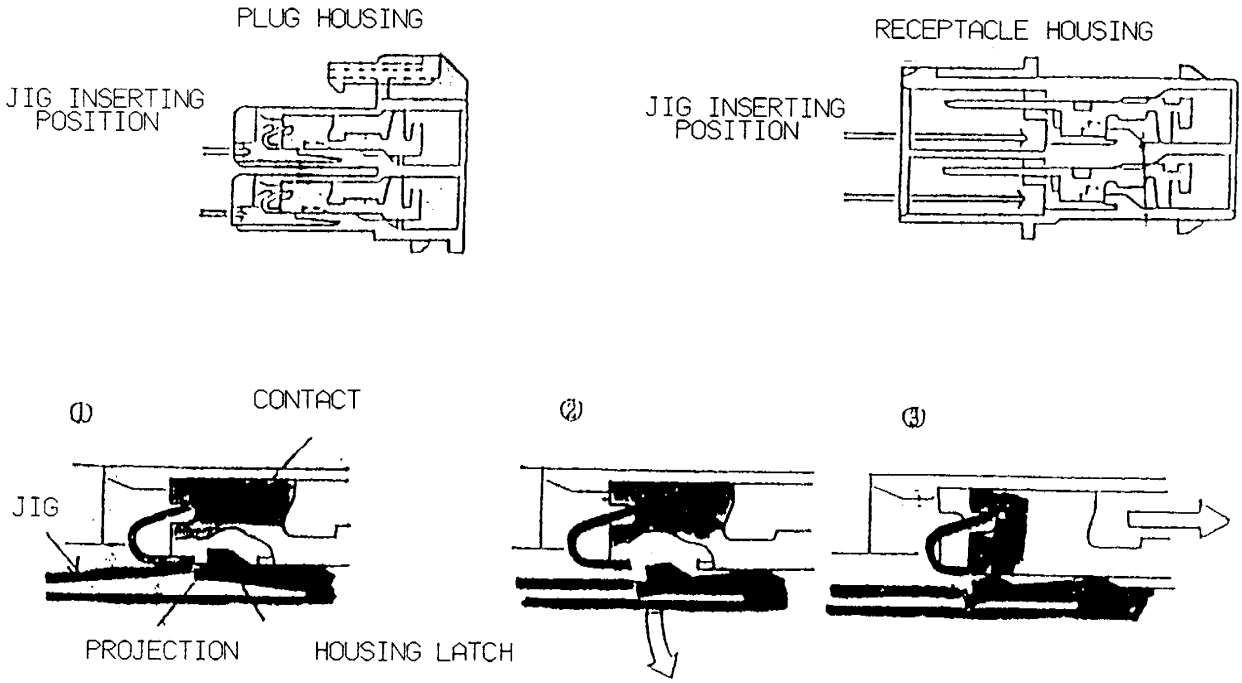
IT IS ANGLED TO ONE SIDE

BEND BREAKS OUT

1. DETATCHMENT OF RETAINER



2. DETATCHMENT OF CONTACT



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