

WIRE EDM MACHINE OPERATION
TRAINING

LN1W / LN2W CONTROL

(AQ400L, AQ600L, AD360L, All with FJ AWT)



Sodick
— Inc. —

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(AQ400L, AQ600L, AD360L, All with FJ AWT)

Sodick Inc.
Linear Motor EDMs

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WEDM Training Course Outline

Day 1:

- Read Discuss Ch. 1 Description of the EDM Process.
- Discuss EDM maintenance via powerpoint slides. Students can follow along in Ch. 3 of the manual.
- At the machine, go over machine layout from Ch. 2 of the manual.
- Perform routine maintenance including wire spool threading, guide removal, carbide contact indexing, pipe removal and resetting of the maintenance screen.
- Perform wire setup procedures including AWT jet alignment, wire vertical alignment and table to limit/lower recording using the LNTPRDAT program. Students can follow along in Ch. 4.
- Perform part setup procedures including all codeless part alignments, tilt offset and edge find using both G80 and using the ST key.

Day 2:

- Read and discuss Ch. 8 and Ch. 5 contents via powerpoint slides.
- Learn how to update the COND file in the memory and perform a condition search in NEWFILE.
- Set up a simple straight line rough cut and allow students to modify machining conditions to see how they affect cutting speed, stability and wire breakage.
- Power down machine and allow each student to perform a power up, homing and wire alignment.
- Set up a steel plate with start holes to show students how to thread automatically and manually through a small start hole.
- Perform a test cut doing a simple circular die with 5 degree taper. The program will be provided beforehand but allow students to practice file loading and saving.

Day 3:

- Discuss Taper cutting and required parameter settings on the control.
- Begin Heart NC basic instruction for importing a DXF file and creating a tool path.
- Students should do the programming examples in the manuals and confirm that the program and NC data are made correctly by having student use the Graphic function on the machines.
- Have each student set up a simple punch shape and actually cut the part. Confirm size and have students modify offset data in program in order to see how to change part size for next cut.

DESCRIPTION OF THIS MANUAL

It is the intention of this course and manual to inform beginning and experienced operators of the techniques used in programming and operating Sodick Wire EDM systems. This manual is to be used in conjunction with our class as the course text. This course provides you with good knowledge of machine operation, maintenance and programming.

For experienced operators/programmers, this manual and course should provide you with additional information and technique differences between various Sodick controls and other manufacturer's equipment. As experienced operators/programmers know, there are several ways to develop CNC programs and various successful techniques to operate the machine. You can use your own past experience and common sense to develop your own programming and operating style.

This manual is not to be used as a replacement for the manual set supplied with the machine. You should have received the following manuals with your new wire EDM:

- Operation Instructions
- Code Instruction
- Operation Instructions UTY
- Machining Condition Table
- Supply Tank
- Pipe AWT

It would be wise to familiarize yourself with the above manuals when you return to your shop.

It is our sincere hope that this course and manual gives you the information you need to begin operating, programming and maintaining your Sodick wire EDM machine.

Once you return from class and begin using your new machine, if you have questions please feel free to call us. When calling, we will need to know your name and the company name, which model machine you are working on, and also which control it has. This information will help us get you the correct information you need. For programming and operation questions ask for the applications dept. If something is not working correct, ask for the service dept.

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847-310-9000

Chapter 1 DESCRIPTION OF THE EDM PROCESS

The first key concept that you must understand is the basic principle of the EDM process.

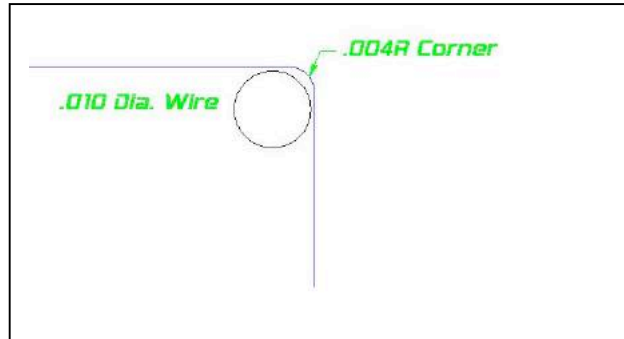
One good analogy of what occurs in the EDM process is what is constantly happening in your automobile engine. The spark plug that ignites the fuel in the combustion chamber is constantly receiving a great amount of voltage and current to form a spark. As time goes on, and the spark plug wears, you will notice a certain amount of pitting on the electrodes of a worn spark plug. This pitting is caused by exactly the same elements that work in the EDM process. The heat generated by the spark causes a small amount of the electrode to melt, and as time goes on the melted material is blown away from the electrode of the spark plug. Of course, the spark plug is designed to fight against this pitting, but in the EDM process the melting of material and the flushing away of the melted particles is desirable, and the machine is designed accordingly.

In simplified terms, this is what happens during the wire EDM process. The wire passing through the machine has an intermittent voltage applied to it. As the wire comes close to the material (but not actually touching it), an ionization channel forms and amperage flows through this channel vaporizing a tiny area of the workpiece. This channel or gap must be filled with a dielectric fluid, in this case deionized water that acts as a flushing medium to remove the vaporized particles, an insulator and a cooling medium. The electricity going to the wire is then turned off and the vaporized material will instantaneously solidify to form a small particle. The flushing will then remove the particle from the gap and the process starts over again. This process repeats thousands of times per second. It is this constant process that eventually machines the workpiece to your specifications.

GENERAL EDM FACTORS

WIRE DIAMETER AND WIRE GUIDES

The operator should give thought to the diameter of the wire used to machine the part with. Generally speaking, the larger the diameter, the faster the machining speed will be. You must look at the minimum inside radius specified on the print and use a wire diameter capable of achieving that radius. If the corner R was .004" you would have to use .008" or smaller diameter wire.



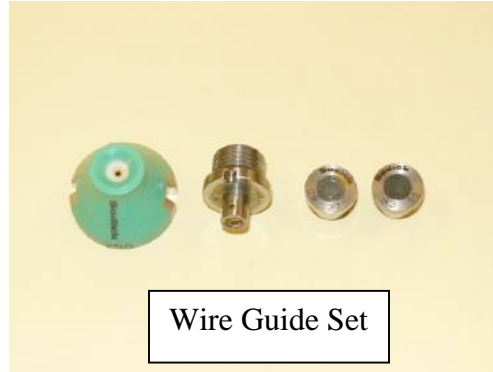
Sodick allows the following wire diameters and wire guides:

Wire Size	AWT Pre Guide (Qty2)	Lower Guide	AQ-1 Upper Guide
.004"	(.12mm) 3080211	(.11mm) 0206101	(.11mm) 3110253
.006"	(.17mm) 3080214	(.155mm) 0206103	(.155mm) 3110259
.008"	(.22mm) 3080219	(.205mm) 0206106	(.205mm) 3110258
.010"	(.27mm) 3080223	(.255mm) 0206109	(.255mm) 3110291
.012"	(.32mm) 3080225	(.31mm) 0206113	(.31mm) 1330067

NOTE:

a) The AWT pre-guide, upper, and lower wire guides must match the wire diameter you will use based on the above chart. When you change wire diameters, you must change all 4 pcs, the upper and lower wire guides as well as the 2 pre-guides above the AWT pipe.

b) .004" wire requires optional circuit (HTP Circuit).



WIRE TYPE

Sodick has developed the power supply to cut at very good speed and with very good accuracy with plain brass wire. Hard brass wire works best for all general cutting and taper cutting up to 10 degrees and for reliable AWT operation. Use half hard brass wire when taper cutting 11° to 20°, and soft brass wire when cutting 21° or greater. Also look for a wire brand that stays straight when unwound from the wire spool. This will give the best AWT operation. Spool sizes the machine uses are the P-5, 11Lb or P-10, 18Lb.

FLUSHING & NOZZLES

This is the flow of water that surrounds the wire during the EDM process. Flushing nozzles are mounted around the upper wire guide and the lower wire guide. The upper flushing nozzle screws onto the upper head while the lower flushing nozzle fits onto the lower head and slides up to about .005" below the table automatically when the flushing is turned on. Set the Z-axis position so that the upper flushing nozzle is between .004" and .006" above the top of the part. This is considered to be perfect flushing conditions.

There are several size flushing nozzles. The standard flush nozzle is 6mm I.D. and can be used to a maximum taper angle of 10°. The 10mm I.D. nozzle is for taper angles up to 20°.



6mm upper and lower nozzles. Large 10mm upper and lower nozzles.

Flushing is one of the most important factors that contribute to the EDM process. This is because the small particles created by the EDM process **MUST** be removed from the work area, otherwise double burning of these particles will occur and the insulation properties of the dielectric are eliminated resulting in unstable cutting. You will find that the better the flushing, the faster and more

stable the EDM process will occur and wire breakage will decrease. During rough cutting, you usually want high flushing pressure (T84 code) to remove the particles. During skim cuts, you want low flushing pressure (T85 code) to avoid having the pressure of the flushing deflect the wire.

When you enter the cut from the edge of a workpiece or when machining close to an internal shape, a portion of flushing is being dispersed by the wall of the part itself. When the wire is not surrounded on both sides of the wire by about 0.25" of material the flushing is not perfect and the cut may become unstable and the power may have to be reduced.

There are 2 sizes of flush nozzles that come with a new machine.

For up to 10° taper cutting use the 6mm I.D. nozzle (standard).

For up to 20° taper cutting use the 10 mm I.D. nozzle.

Once you have the proper flush nozzles for the taper angle you are about to cut, you should dry run the machine and visually verify that the wire isn't touching the I.D. of the nozzle. If it is, the nozzles with a larger I.D. opening need to be installed and verify again that the wire isn't touching the I.D. of the nozzle.

Upper Nozzles

(Size) Part No.	Note
(3mm ID) 3082997	Close edge work.
(6mm I.D.) 3081604	10° max taper, comes standard with machine
(6mm I.D.) 3081682	Extended Length. L6.5mm
(6mm ID) 3082396	Extended Length Nozzle. L26.5
(10mm I.D.) 3081606	20° max taper, comes standard with machine
(16mm I.D.) 3081868	30° max taper, available from parts dept.
(40mm I.D.) 3086875	45° max taper, Special. Mounting parts required, see below

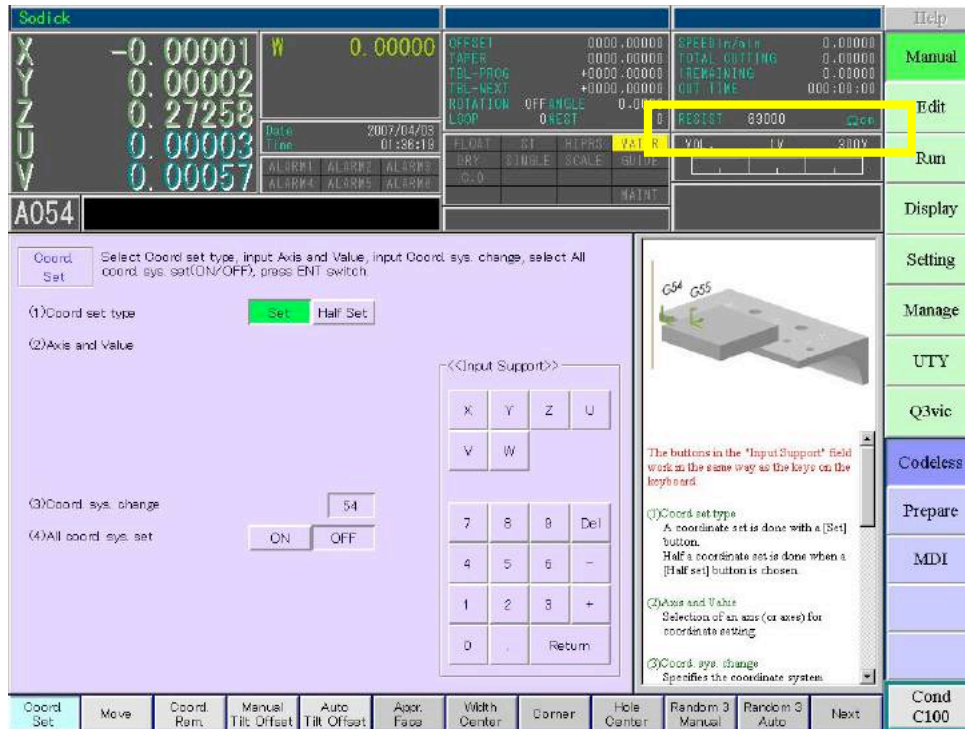
Lower Nozzles

(Size) Part No.	Note
(3mm ID) 3110508	Close edge work
(6mm ID) 3110303	10° max taper, comes standard with machine
(6mm ID) 3110463	Extended Height Nozzle. Taller by 4mm
(10mm ID) 3110461	20° max taper, comes standard with machine
(14mm ID) 3086876	45° max taper, available from parts dept.

WATER RESISTIVITY

The water resistivity affects the EDM process. The water is intended to be a dielectric, meaning that the water is an insulator to electricity. However, in real life this is impossible to achieve. There is a bottle containing deionization (DI) resin hooked up to the dielectric tank that removes the charged ions from the water thus increasing its resistivity and maintaining a set range.

High water resistivity allows a focused discharge, which allows the machine to cut fast, stable and also reduces rusting of the workpiece. Low water resistivity allows the spark discharge to leak out of the cutting area, which slows down the cut. It can also cause rusting on your work piece. This is why it is required to monitor the resistivity daily. The normal setting for water resistivity is 55000 ohms to 65000 ohms per centimeter. When the DI bottle cannot maintain the resistivity level of 55000 or HIGHER, it must be recharged with new resin.



Resitivity display at the machine.

- ✓ Clean the probe in the dielectric tank on a regular basis to maintain a valid reading.
- ✓ Resistivity range setting value is stored in the "Setting User2" screen.
- ✓ Super Pika option requires a higher setting.

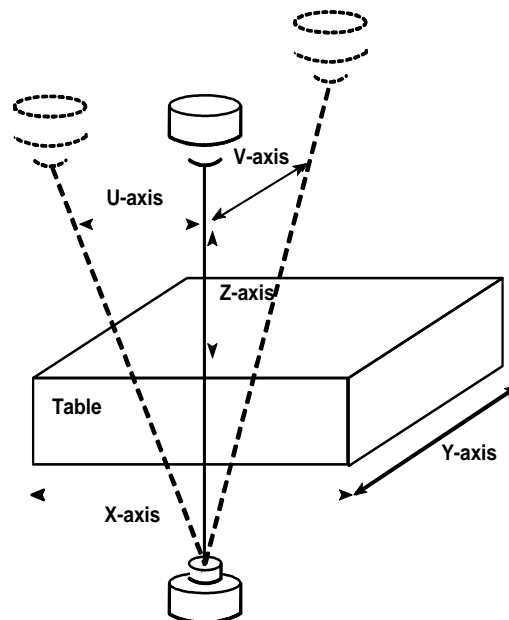
Chapter 2 MACHINE LAYOUT DESCRIPTION

Another key concept to understand is the basic makeup of the machine. Our intention first is to look at the machine from the operator's viewpoint. Later, we will look at the machine from the programmer's viewpoint.

While the configuration may change from model to model, you will find that there are many consistencies from one Sodick wire EDM machine to another. This section is intended to acquaint you with the components of the machine and control. Each machine is made up of three basic components; the machine tool, dielectric system, and control.

As the table moves from right to left and vice-versa, it is moving along the "X" axis. As the table moves in and out, it is moving along the "Y" axis. The up and down motion of the upper head is the "Z" axis.

The upper head can also move in two directions parallel to the X and Y-axis. These motion directions are primarily used to create taper. As the upper guide moves left to right, it is moving in the "U" axis. As the upper guide moves in and out, it is moving in the "V" axis.



Here is an introduction to many of the most important keys and switches on the control panel. These are important ones to be familiar with. To make it a little easier, we break them down into logical categories.



CONTROL PANEL SWITCHES

1 [SOURCE ON/OFF] switches

These switches are used to switch the power to the NC part of the power supply unit. Do not press the [SOURCE OFF] switch with the [POWER ON] switch held down; press the [SOURCE OFF] switch after pressing the [POWER OFF] switch. To protect the machine, allow at least two minutes between pressing of the [SOURCE ON] switch and [SOURCE OFF] switch and vice versa.

2 [POWER ON/OFF] switches

These switches are used to switch the power to the machine related section on and off.

Note: The [POWER ON] switch is valid when the [SOURCE ON] switch has been pressed and the system has started up. To protect the machine, allow at least two minutes between pressing of the [POWER ON] switch and [POWER OFF] switch and vice versa.

3 [EMERGENCY STOP] switch shuts off the power to the machine and the power supply unit. This large red button turns off the "POWER" and the "SOURCE" on the control. This will power down the control and machine completely.

4 [AWT CUT/THREAD] switch

These switches are used to cut and automatically thread the wire.

5 **[TENSION ON/OFF]** switches

Not Used.

6 **[WIRE STOP/RUN]** switches

These switches are used to stop and start wire running.

7 **[HIGH PRESSURE ON/OFF]** switches

These switches are used to turn high–pressure flushing on and off.

8 **[LOW PRESSURE ON/OFF]** switches

These switches are used to turn low–pressure flushing on and off.

9 **[TANK FILL ON/OFF]** switches

These switches are used to turn supply of dielectric fluid to the tank on and off.

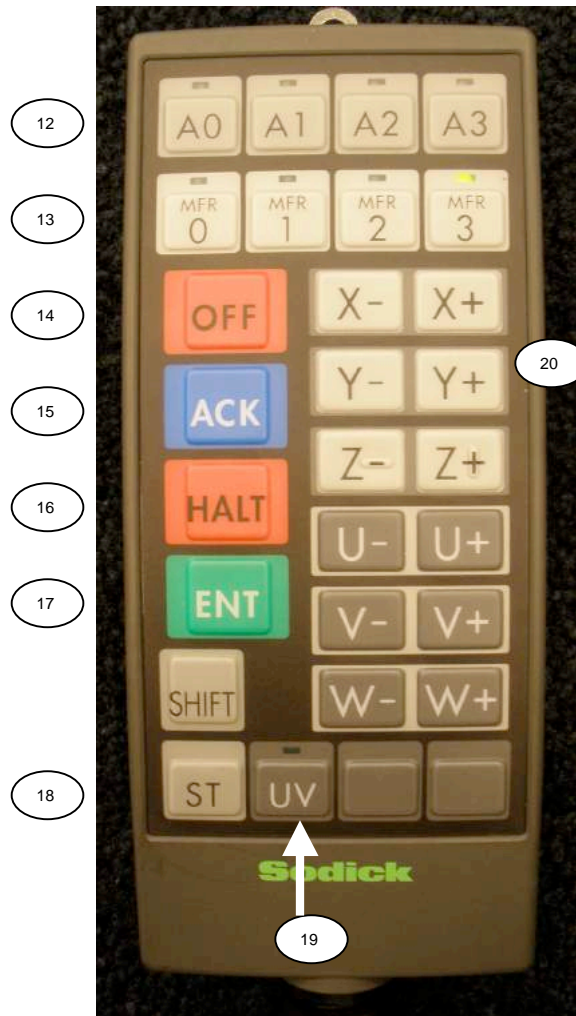
10 **[TANK DRAIN ON/OFF]** switches

These switches are used to open and close the tank drain.

11 **[TANK DOOR UP/DN]** switches

These switches are used to raise and lower the tank door.

(Note: VZ AQ750 and AQ900 models have a manual switch to raise and lower tank)



12 [A0] to [A3] Switches

These switches are used to execute program files which are stored in the NC unit. The relationship between the program file to be executed and the switches to be pressed is shown below. Using the Edit function you can customize these files. It is convenient to store programs for setup operations such as centering in these files.

Switch	File Name	Program
A0	_ZZ21	User's program
A1	_ZZ22	User's program
A2	_ZZ23	User's program
A3	_ZZ24	User's program
SHIFT+ A0	_ZZ25	User's program
SHIFT+ A1	_ZZ26	User's program
SHIFT+ A2	_ZZ27	User's program
SHIFT+ A3	_ZZ28	User's program

Note: Files from “_ZZ21” to “_ZZ28” are registered to the hard drive as blank operation programs before shipping the machine. The operator may customize and register those files according to his needs.

13 [MFR0] to [MFR3] Switches

These switches are used to select the feedrate for travel in jog and dry run operation.

MFR0: High speed travel

MFR1: Medium speed travel

MFR2: Low speed travel

MFR3: Very slow speed

✓ Jog speed located on **SET-USER3** screen

14 [OFF] switch

This key will stop the program permanently. There will be no way to continue without going back to the start point and running the program again. You must be careful when using this key, since you will not get a second chance. We recommend that you get in the habit of ALWAYS pressing the HALT key to stop the activation of a program. Then, if you still want to completely stop the program, press the OFF and ACK key.

15 [ACK] switch

Means acknowledge. Whenever the control generates an alarm message on the control screen and the buzzer goes off, this key must be pressed to acknowledge the fact that you have read the message.

16 [HALT] switch

This key can be pressed to temporarily stop the actual running of a program.

To restart operation, press the [ENT] switch.

17 [ENT] switch

Use to start a program or after halting or when the control automatically stops the program's operation maybe due to wire breakage, M00 or M01 this key allows you to continue from where the machine stopped.

18 **[ST]** switch

This switch is used to cause contact detection: Press one of the jog switches with this switch held down and contact detection will occur. "Contact detection" is the processing in which axis travel is unconditionally stopped on detection of contact between the wire and workpiece.

✓ See page37 for details about using the ST key.

19 **[UV]** switch

This switch is used to select whether the [U-], [V-], [U+], and [V+] switches are effective or ineffective.

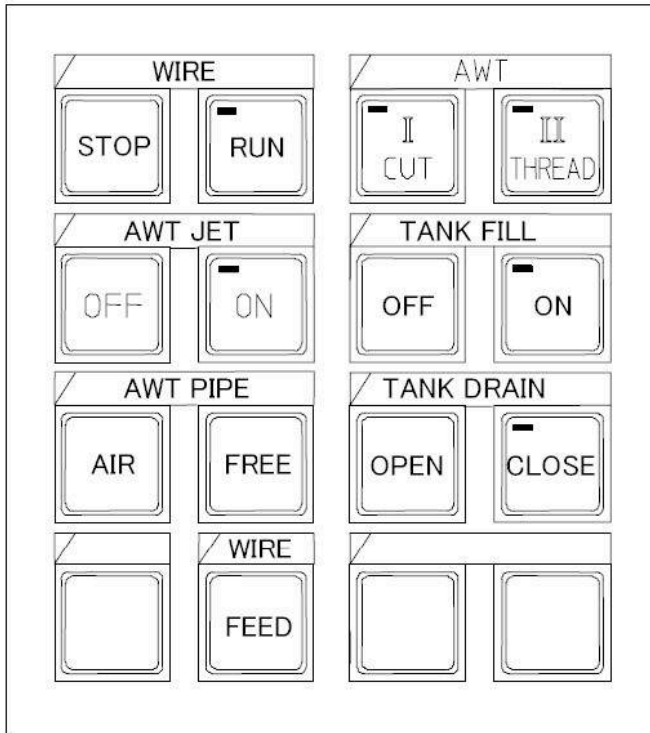
Note: The status corresponding to the switch whose lamp is on is the effective status.

20 Jog switches ([X-], [Y-], [Z-], [U-], [V-], [X+], [Y+], [Z+], [U+], [V+])

When one of these switches is pressed, the corresponding axis moves in the designated direction.

MACHINE PANEL SWITCHES

This panel is located near the flushing valves on the machine. Some of the keys on this panel are the same as the switch panel on the control.



WIRE STOP/RUN – Allows you to manually turn on and off the wire run.

AWT - Allows you to manually cut or thread the wire.

AWT JET – Allows you to manually turn on or off the AWT water jet.

TANK FILL- Turns on or off the fill pump.

AWT Pipe Air – Creates an air blow to dry the annealing unit.

AWT Pipe Free – Allows you to slide the AWT pipe up and down easily while holding down the button. Use this if threading the wire by hand.

TANK DRAIN- Open or closes the worktank drain.

WIRE FEED- Use this to unspool wire from above the AWT unit.

ADDITIONAL ITEMS

Hour Meter:

Machine usage hours can be seen on the Display – Maint screen. At the bottom of this screen is the source on time, and also cutting time.

Worktank Door UP and DOWN:

The AD360L, AQ400L and AQ600L machines have a manual drop door. The door must be up for the tank fill and flushing pumps to work and to run the machine in the submerged mode.

USB Memory Stick:

On the front side of the control there is a USB port. This port is compatible with **ONLY** Sodick memory sticks that come with the machine upon delivery. It is used for program storage and transfer to an offline computer as well as storing backup information for the machine control.



**ONLY Sodick memory sticks
can be used for data transfer!!!**



UNDERSTANDING WORK COORDINATE SCREENS

Sodick allows you to assign up to 60 different program zero points. This could be helpful when you are machining multiple parts. However, most of the time you will only be interested in one of the available work coordinate screens. You will usually start with coordinate system G54. If you are setting up more than one part at the same time or cutting multiple openings in a part, you might be being using other work coordinate systems other than G54. Prior to programming your G92 you can tell the control which coordinate system you want to work in. This means that you can include a G code in the program PRIOR to the G92 command.

Present work coordinate

G54		G55	G56	G57	G58	G59
X	0.30000	-0.00001	-0.00001	-0.00001	-0.00001	-0.00001
Y	0.40000	0.00002	0.00002	0.00002	0.00002	0.00002
Z	0.00000	0.27258	0.27258	0.27258	0.27258	0.27258
U	0.00003	0.00003	0.00003	0.00003	0.00003	0.00003
V	0.00057	0.00057	0.00057	0.00057	0.00057	0.00057
W	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

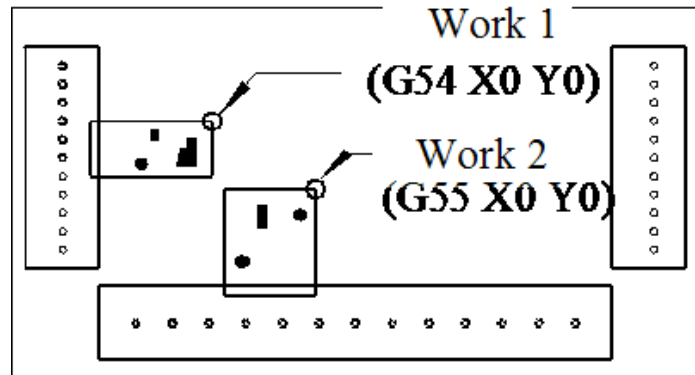
G154		G155	G156	G157	G158	G159
X	-0.00001	-0.00001	-0.00001	-0.00001	-0.00001	-0.00001
Y	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002
Z	0.27258	0.27258	0.27258	0.27258	0.27258	0.27258
U	0.00003	0.00003	0.00003	0.00003	0.00003	0.00003
V	0.00057	0.00057	0.00057	0.00057	0.00057	0.00057
W	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

Here is a list of all of the coordinate systems available:

<u>G CODE</u>	<u>Display AT MACHINE</u>
G054 to G059	= work coordinates A054 to A059
G154 to G159	= work coordinates A154 to A159
G254 to G259	= work coordinates A254 to A259
G354 to G359	= work coordinates A354 to A359
G454 to G459	= work coordinates A454 to A459
G554 to G559	= work coordinates A554 to A559
G654 to G659	= work coordinates A654 to A659
G754 to G759	= work coordinates A754 to A759
G854 to G859	= work coordinates A854 to A859
G954 to G959	= work coordinates A954 to A959

NOTE: G959 cannot be set to a new number as this is displaying the machine coordinates located from the machine home position.

There may be times when you will want to use the various coordinate systems (other than G54) for some special purposes. For example, let's say you had job #1 on the worktable, and it was already located. If a second job needed to be set up and located you probably would not want to disturb the zero set of job #1. Simply change to a second work coordinate system by entering G55, then locate your second job and set zero in this screen. Now your 1st work coordinate will not have been disturbed. Also be aware that there will always be an A (absolute) G90 or I (incremental) G91 ahead of the work coordinate screen number.



Chapter 3 MAINTENANCE

Sodick Wire EDMs are precision machine tools and should be treated as such. Preventative maintenance will eliminate unnecessary problems, downtime, and aggravation and should be performed on a regular basis religiously. Sodick Wire EDMs have a reputation in the industry to run longer in harsh conditions between maintenance intervals than their competitors. This does not mean maintenance is not as important and should be put off until you start having problems with the machine. "Don't fix it if it ain't broke" theory doesn't apply here. Ideally, the machine should be located in an environment where the air is clean (not right next to a grinder) and temperature doesn't fluctuate more than several degrees (not located in direct sunlight or by air duct) and on a vibration free surface.

Cleaning: To remove the EDM residue that accumulates on the machine and on the workpieces, we recommend a cleaner called AC-500. It is made by Rochester Midland and works well. You can get this cleaner by contacting them directly at (800-474-4762). This cleaner should be rinsed off after wiping off the dirty surface. Try not to contaminate the water as this decrease the life of the DI resin if too much of it gets into the system.

DISPLAY MAINTENANCE SCREEN

In the Display, MAINT, CONSUME screen, there is a bar graph that will turn red when the item is due for service. It can be reset after an item has been serviced, returning the bar graph to 100% and green. CUT TIME displays the actual cutting time for an item. Put a check in the box to the left of an item to highlight the icon box in the Run screen, when over the allotted time.



MAINTENANCE CHECKLIST

For additional information about maintenance items, please see the “Machine Tool” manual supplied with your machine.

Daily Inspection Items

Inspection Item	Check To Perform
Conductivity Piece	Index every 50 hrs
Water	Level
Water	Resistivity
Water Filter	Pressure
Wire Bin	Scrap Wire Level
Wire Ejection	Entangled Wire
Slide Pipe (lower arm)	Clean
Worktable	Clean
Lower Guide Pulley	Rotates Freely
Wire Terminals	Connection
Flushing Nozzle	No damage

Weekly Inspection Items

Inspection Item	Check To Perform
Wire Guides	Clean
Worktank	Clean
AWT Alignment	Adjust
AWT Annealer	Keep Clean And Dry

Monthly Inspection Items

Inspection Item	Check To Perform
Air Filters	Clean or Replace
Wire Guides	Check For Accuracy
Resistivity Probe	Clean
Floppy Disk Drive	Clean
Lower Guide Pulley	Clean
Air Hydro Unit	Oil Level
Disposal Pipe	Clean
Air Regulator	Drain

MAINTENANCE DESCRIPTIONS

DI BOTTLE

If the DI bottle needs to be recharged,

1. Turn off the circulation pump.
2. Disconnect the lines at the top of the bottle noting which one is "IN" and "OUT". Put the disconnected ends into the dielectric tank so water doesn't run onto the floor.
3. Unscrew the cap and pull the cap and the rod plugged into it out and rinse the DI resin off the screens and/or off of the small slits at the bottom of the rod with tap water.
4. Now pour out all the used DI resin from the bottle and rinse the bottle out. The old resin should be recycled to be used again, which reduces operating costs.
5. Pour in new DI resin and fill the bottle about 7/8 of the way up.
6. Push the rod attached to the cap down until the cap can be threaded back on.
7. Plug the hoses back on to the bottle and turn on the resistivity meter.
8. If there is a valve on the supply hose (where the hose is connected to) it must be open to allow water to flow into the bottle. Also make sure the hoses don't get kinked, thus blocking the flow and check for leaks around the cap.

The resistivity meter should return to its setting value in an hour or so.

WORKTANK AND WORKTABLE

Use AC-500 or equivalent and spray down the tank and table and let sit for several minutes. A toilet bowl brush works well for scrubbing out the tank and a toothbrush for the smaller areas.

If a small amount of acid is used, wipe up excess with a cloth.

If a large amount of acid is used, do not allow any to flow down the worktank drain.

Use only an Arkansas stone on the table to remove nicks and scratches. If a fine India stone is used, it will scratch the table and remove too much material.

WATER LEVEL

Confirm that the filter tank is full of water with the worktank drained. On the AG400L and AG600L type machines, confirm the level in the dirty side of the tank. The dirty side is the side that the water overflows into. The water overflowing from the clean (filter) side to the dirty side should drop 1 to 2 inches. If it is more than two inches, add water to the dielectric tank to bring the level back to 1 to 2 inches of drop on the overflow.

NOTE: If the water level gets too low, the water inside the worktank turns gray. This is an indication that the pump is sucking air.

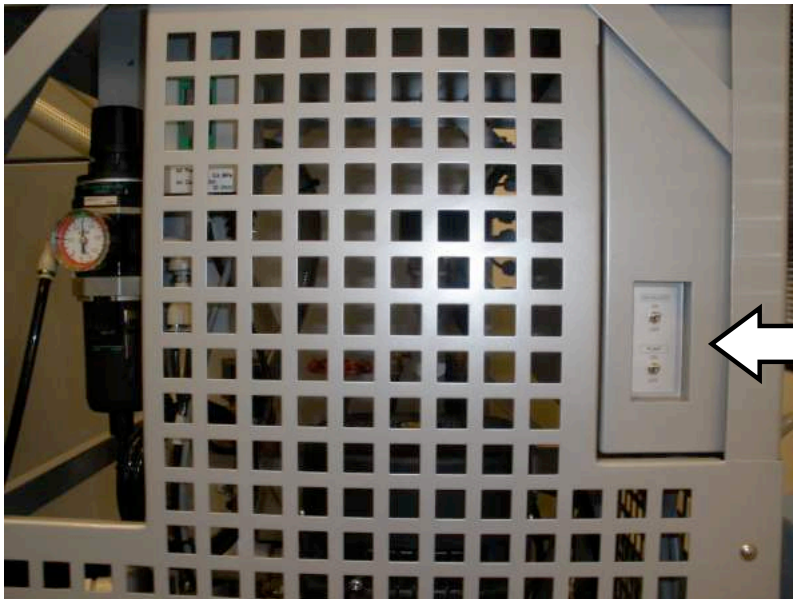
WATER FILTERS

Machine	Number of filters	Filter type
AD360L	2	SHF25E
AQ400L, AQ600L	2	SHF25E
AQ750L with LN1W	2	SHF25E
AQ750L with LN33W	4	SHF25E

Locate the filter pressure gauge on your machine. When the pressure gauge reaches the red zone, the filters need to be changed. If you do not change the filters, and the pressure in the filters continues to rise, and they could blow out. This would result in the pressure gauge going down below the red zone, giving you the illusion that the filters are still good. Water is constantly flowing through the filters and the filters catch any particle that is bigger than what the filter is rated at.



To remove the filters, locate the chrome toggle switches for the DI pump and Filter pump. Flip the switch down to turn off the circulation pump. Open the filter cover and unscrew the wing nut. Remove the old filter by sliding it out from the tank and throw it away. Install the new filter and tighten down the wing nut, then turn the circulation pump back on.



DI Pump Switch
and
Filter Pump Switch

CARBIDE POWER CONTACTS

The carbide power feeders (conductivity piece) deliver the electricity to the wire thus charging it with current. They need to be indexed when the witness line (created by the wire) is about .005"-.010" deep (maximum) or about every 40 to 50 hours (when using .008" - .012" wire). They also need to be indexed when wire diameter is changed. When using .004" diameter wire, you will be able to burn for more than 50 hours before indexing.

To adjust the contact use the provided indexing tool, or a 6" scale.

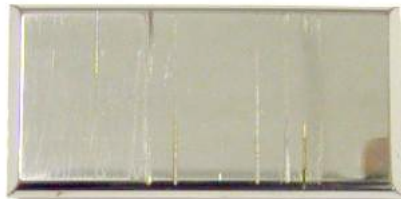
- 1) Measure the present position.
- 2) Loosen the set screw.
- 3) Remove the contact, clean and check for a wear groove.
- 4) Clean the mounting slot, which the contact came out from.
- 5) Replace the contact, and adjust it left or right by 1 index position of the tool (.040")

Upper contact: The set screw is located on the front of the upper guide assembly.

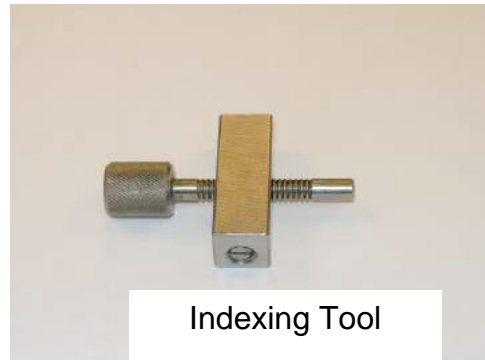
Lower contact: The set screw is located behind the head.

NOTE: Regrinding the conductivity piece is not recommended.

CAUTION: Do not let the carbide protrude more than .400" from edge of heads.



Conductivity Piece



Indexing Tool

WIRE GUIDES

The upper and lower wire guides should be cleaned weekly, and checked for roundness monthly.

Upper Guide:

- 1) Remove the nozzle assembly that carries the upper flush cup.
- 2) Use the guide tool to remove the guide and replace



Upper Guide

Lower Guide:

- 1) Remove the nozzle assembly that carries the lower flush cup.
- 2) Use the guide tool to remove the guide and replace



Lower Solid Guide



Guide Removal Tool

LOWER WIRE ROLLER ASSEMBLY

There is a white ceramic roller 2.75"O.D. located below the lower head with 2 ceramic guides surrounding it. The wire travels around the roller and through the lower arm, between the ejection rollers and drops in the wire bin. This roller must spin freely and should not feel sloppy. This roller can affect how reliable the AWT

unit is. Occasionally a piece of wire or a sliver slug will get lodged between the guides and the roller. That object must be removed to allow the roller to spin freely. It may be easier to work on this assembly if it is removed from the machine. To remove the roller assembly, first remove the cover. On the AG400L and AG600L machines, loosen and remove the metal cover held in place by 2 Phillips screws and then the 2 screws located at the top of the right side of the steel plate. Pull the entire assembly toward the front of the machine and remove it. Remove the ceramic guides and remove the object that is jammed and verify that the roller now spins freely. To attach the ceramic guides, push the guides toward the roller and tighten the screws to secure the guides. NOTE: If the small rear guide is closer to the roller than the front larger guide, there will be a step that the wire will hit when it comes around the roller. With the ceramic guides tightened in place, verify that the roller spins freely. To attach the assembly to the lower arm, note the plastic tube sticking out of the lower arm. Push the assembly onto the tube so that the hole in the rear ceramic guide plugs onto the tube. Tighten the 2 screws that secure the steel plate and install the cover. Now verify that the plastic tube is seated properly into the aspirator unit back by the wire ejection rollers. Verify that the AWT unit is reliable now by doing several cut and threads.

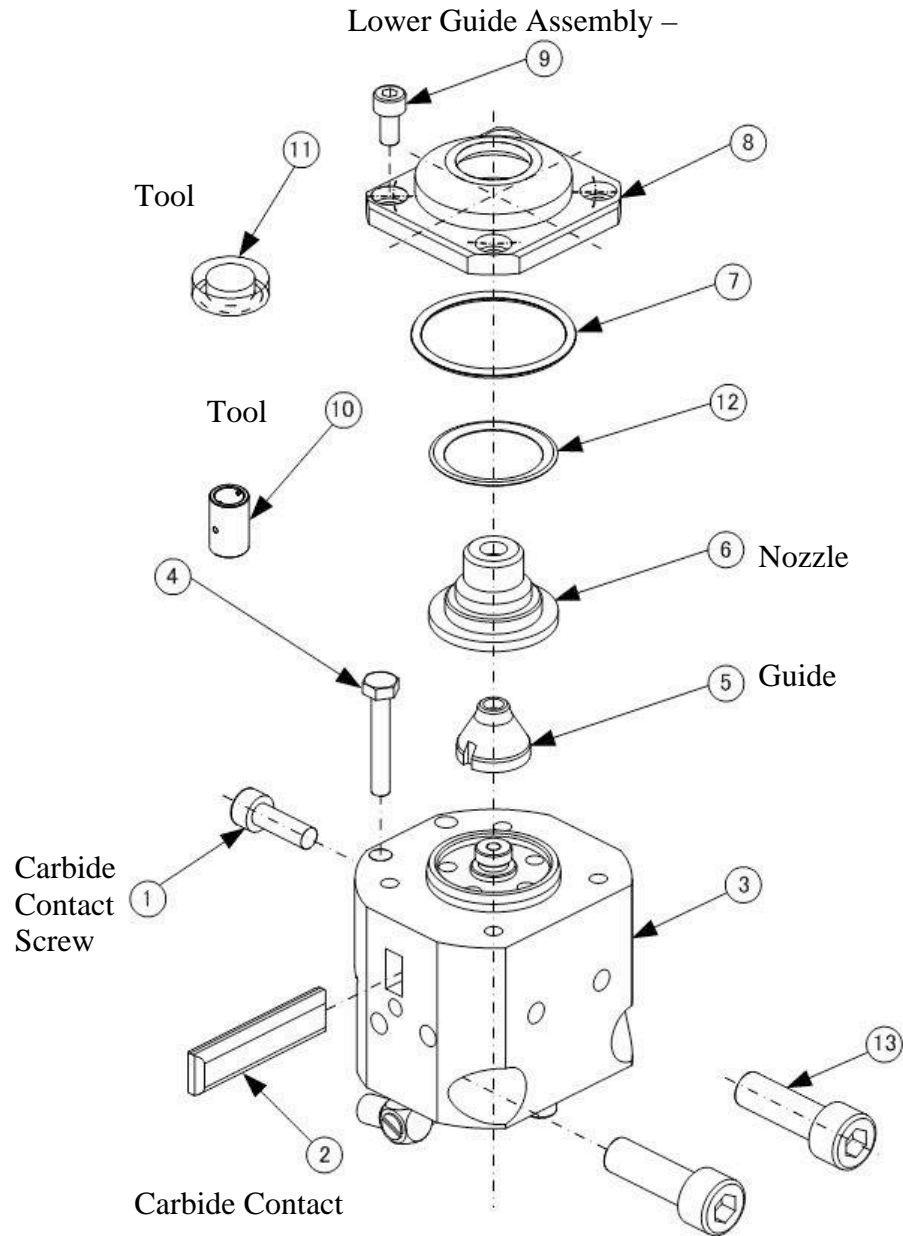
WIRE EJECTION ROLLERS

There is a set of wire ejection rollers located above the wire bin. These rollers pull the wire from the spool, through the machine and drop it in the wire bin. The pressure between these rollers affects how the wire lies in the bin. When the wire run is turned on, if the wire is not lying flat in the bin, increase the pressure by turning the adjusting bolt (located directly behind or above the rear roller) clockwise or decrease it by turning counterclockwise. There is a spacer ring located on the adjusting bolt. Turn the bolt until it bottoms out on the spacer ring. This is maximum pressure between the ejection rollers. This is the setting used for .008" and .010" wire. For .012" wire, decrease the pressure between the ejection rollers by turning the adjusting bolt several turns. This will allow the bigger diameter wire to enter the ejection rollers. Wait several minutes between adjustments. This will allow you to read how the wire is lying in the bin. CAUTION: If the pressure is decreased too much, the rollers cannot grip the wire and the wire will slip. Watch the wire spool and verify it is rotating smoothly and not jerking. You can also detect slight wire slippage, not visually detectable, by turning the wire run on so the wire is being pulled from the spool and touch the wire between the upper and lower head. CAUTION: Do not touch the wire if the generator has clicked on, which sends current to the wire. The wire should feel smooth with no detectable vibration. NOTE: If you push on the wire too hard, you will create vibration in the wire; therefore touch the wire gently. Occasionally, trying a different wire may eliminate the curling problem. Sodick also offers an optional wire chopper that chops the wire into small bits and drops them into the wire bin thus eliminating wire curling in the bin.

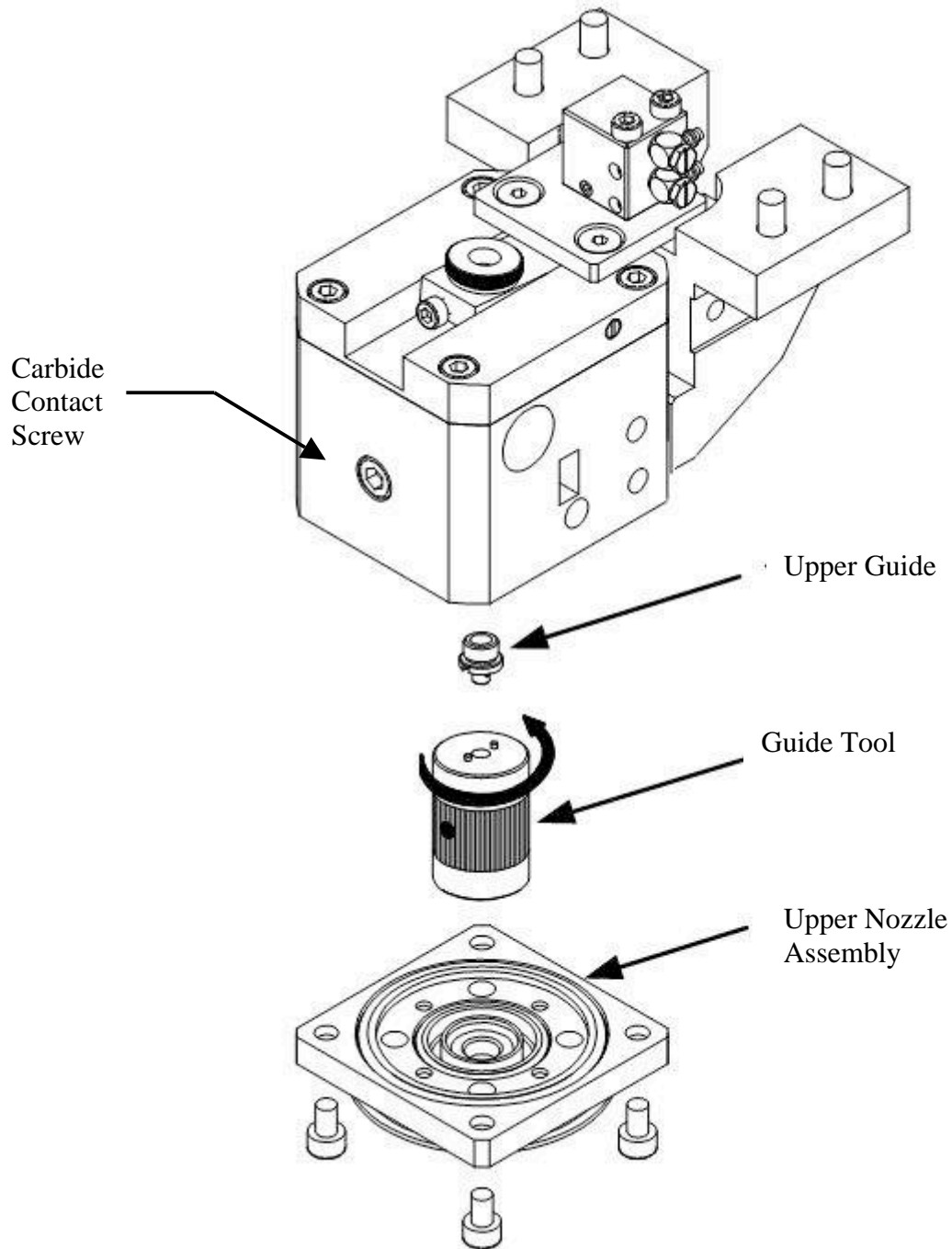
WAY LUBRICATION

AD325L, AG400L, AG600L: Grease is not required.

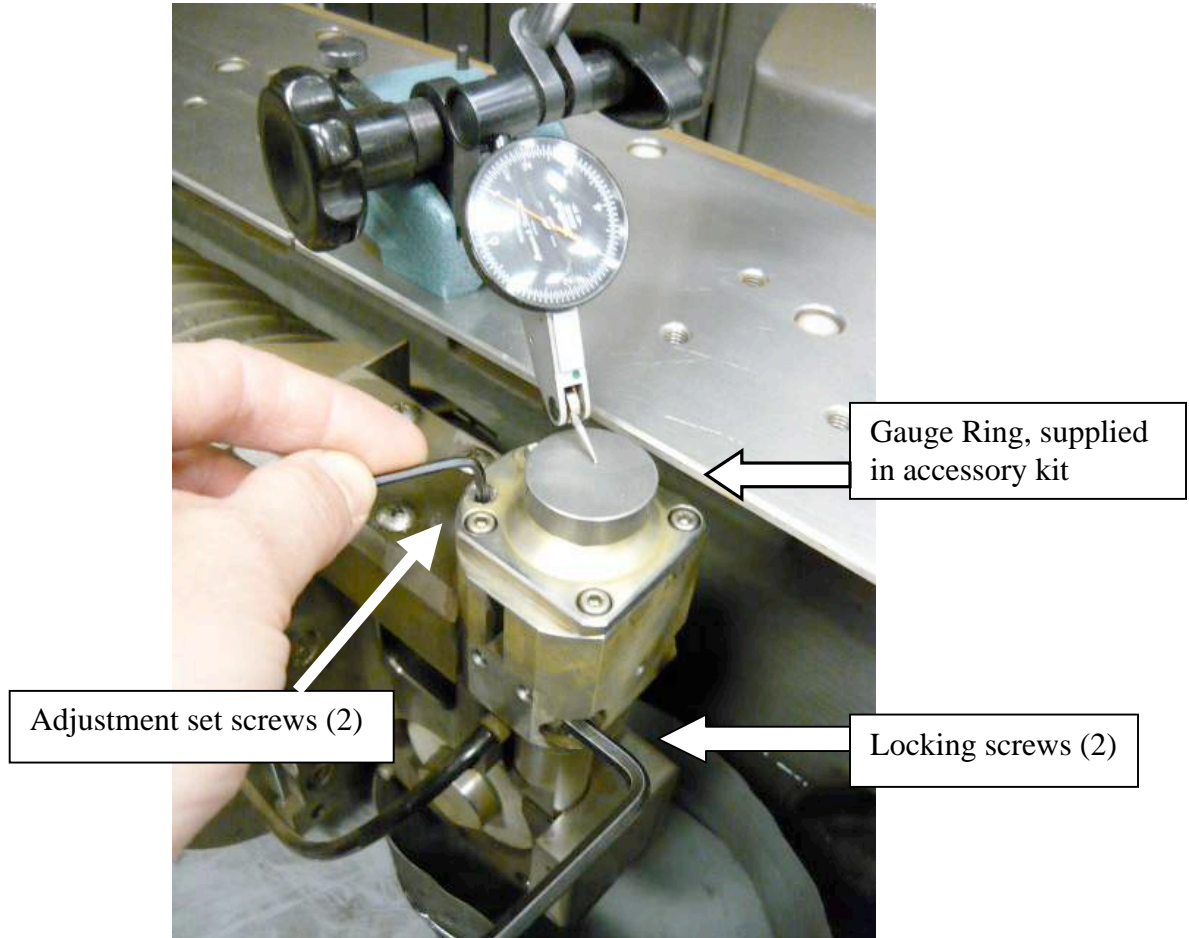
WIRE GUIDE ASSEMBLY DRAWINGS



Upper Guide Assembly: AQ400L AQ600L AD360L

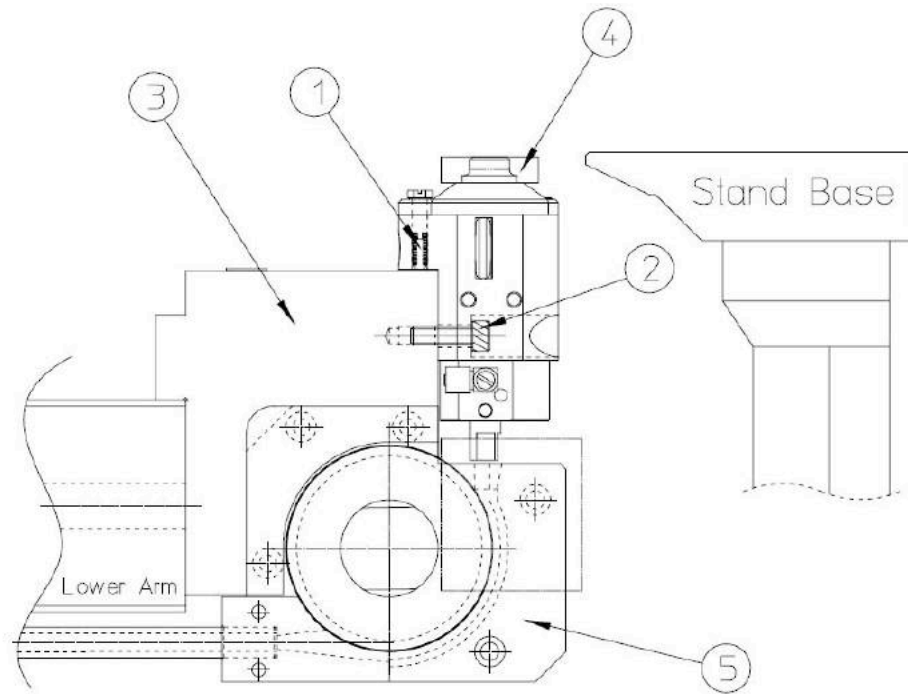


LOWER HEAD ALIGNMENT PROCEDURE



Lower Head Alignment

To check lower head alignment, use the round gauge ring (supplied with machine), a surface gauge and an indicator. Set the surface gauge on the machines worktable and zero out the dial. Swing the indicator over to the gauge ring (as shown above) and determine how far above or below the table the top of the gauge ring is. Adjust the lower head so that the top surface of the gauge ring is about .001", below the worktable and flat. Loosen the locking screws and use the adjustment set screws shown to adjust the head upwards. If it is too high to begin with, you will need to tap it down.



- 1) Adjustment Screws
- 2) Locking Screws
- 3) Lower Arm
- 4) Gauge Ring Tool (from accessories kit)

Chapter 4 WIRE AND PART SETUP PROCEDURES

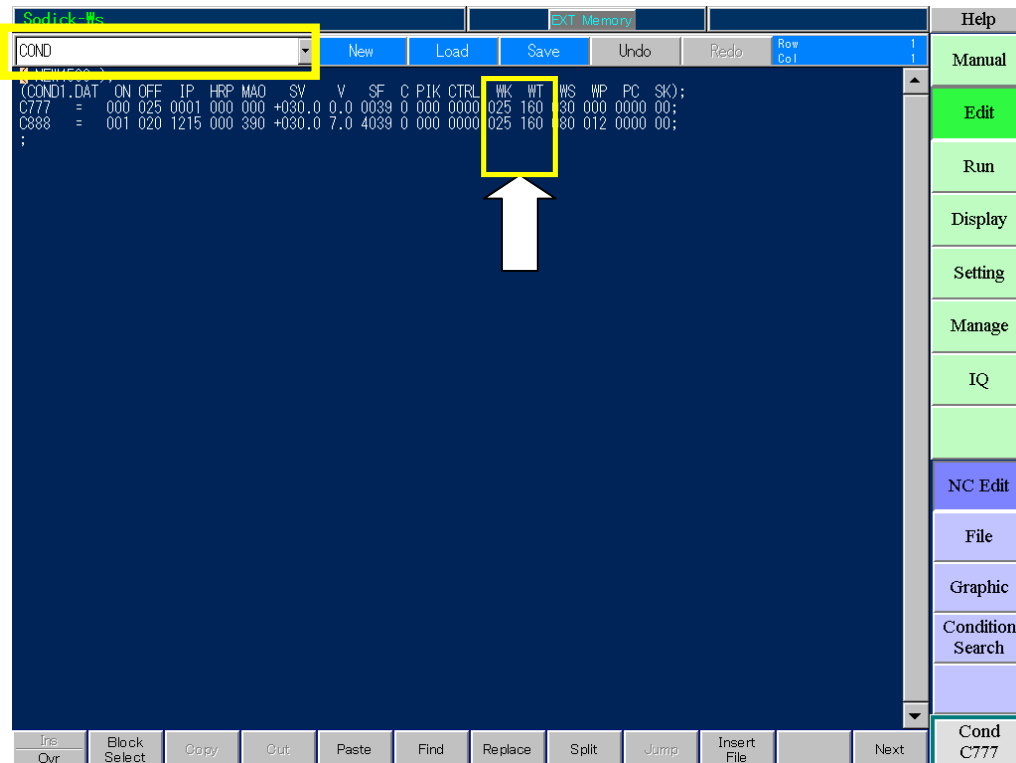
CHANGING WIRE SIZE SETTINGS ON THE MACHINE

When changing wire diameter, please confirm the following settings are correct before operating the machine.

Condition File Setting

Go to the “Edit”, NC Edit” screen and pull up the file named “COND”. Confirm that the “WK” and “WT” settings for C100, C777 and C888 all match the diameter of the wire as per the following table:

Diameter	WK	WT
.004”	010	035
.006”	015	060
.008”	020	120
.010”	025	160
.012”	030	200



After making the changes :

- 1) Press “BLUE” save button at the top of the screen.
- 2) Change to MDI screen and type C777 and press ENT key.

SPOOL WEIGHT SETTING

Note: Below information doesn't apply to models with jumbo spooler and AQ750L or AQ900L.

When changing the weight of the wire spool, please adjust these settings. These settings change the rewind motor power used on the spool. Change to the Setting, User2 screen.

Weight of wire spool	=	11Lb			18-22Lb
STANDARD AWT BACKTEN	=	80			add 10
STD. WIRE BROKEN BACKTEN	=	65			add 10
STANDARD THREAD BACKTEN	=	80			add 10

The screenshot shows the 'Setting' screen for AWT (Automatic Wire Threading) parameters. The following table summarizes the key settings shown:

Parameter	Value
STANDARD AWT BACKTEN	085
STD. WIRE BROKEN BACKTEN	075
STANDARD THREAD BACKTEN	095
FINE AWT BACKTENSION	070
FINE NORMAL BACKTENSION	051

Callout 1: ".006 wire and larger use these settings (WK15 and up)." points to the three main BACKTEN settings.

Callout 2: "If you never use .004" wire, zero out these 2 settings." points to the FINE AWT BACKTENSION and FINE NORMAL BACKTENSION settings.

Standard Awt Backten: This parameter is used when the spool is rewinding after a wire break (AWT function).

Std. Wire Broken Backten : This parameter is used for the reversing tension of the wire spool when the wire is not threaded .

Standard Thread Backten: This parameter is used for the reversing tension of the wire spool when the wire is threaded.

VERTICAL WIRE ALIGNMENT

The screenshot shows the Sodick CNC control interface. At the top, there are several data fields: X (0.00001), Y (0.00002), Z (13.85824), U (-0.00003), and V (0.00003). Below these are machine parameters like OFFSET, TAPER, TR1-PROG, TR1-NEXT, ROTATION, and LOOP. A control panel on the right side has buttons for Manual, Edit, Run, Display, Setting, Manage, UTY, Q3vic, Codeless, Prepare, MDI, and Cond C100. The main screen area is titled 'Vert. Align' and contains instructions: 'Select axis and direction, input Tension, press ENT switch. In UV Axis 0 Set, press U or V button. To remember vertical position, press U or V Axis button.' It includes a directional pad with X+, X-, Y+, and Y- buttons, a TENSION input field set to 0, and UV Axis 0 Set buttons for U and V. A diagram of the alignment block is shown on the right, with text explaining the process: 'Vertical alignment can be performed by triggering weak electrical discharge at the vertical alignment block and adjusting the U-axis and V-axis on the remote control box (for manual operation) until uniform sparks are obtained. When the alignment has been completed, press the [OFF] switch.'

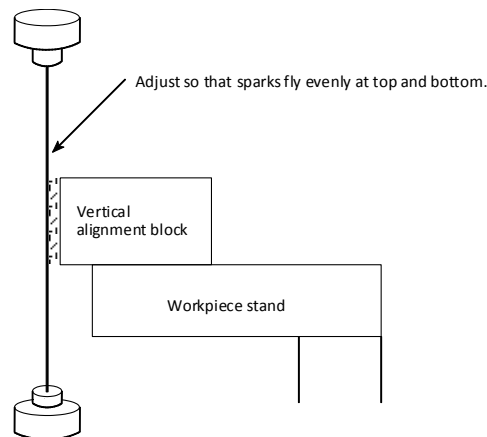
VERTICAL ALIGNMENT MANUAL PROCEDURE

- 1) Determine wire tension value for wire size to be used (pg24)
- 2) Blow-dry the AWT, Upper Guide Head Assembly, and Alignment Block.
- 3) Place the Alignment block on the worktable, and jog the wire near its edge.
- 4) Choose “Manual”, “Prepare”, “Vert. Align”, “Manual” buttons.
- 5) Choose the axis (X or Y) and direction (+ or -) which will cause the wire to travel into the block and press ENT.
- 6) Once sparking begins on the block manually jog the UV to obtain even sparking from top to bottom (UV button must be ON).
- 7) Press OFF and ACK when satisfied.
- 8) Click on the U or V “0 set” button, and press ENT.
(choose the axis you just adjusted).
- 9) Move the block so that you can do the 2ND axis and repeat the procedure.

Final Procedure to zero out all work screens

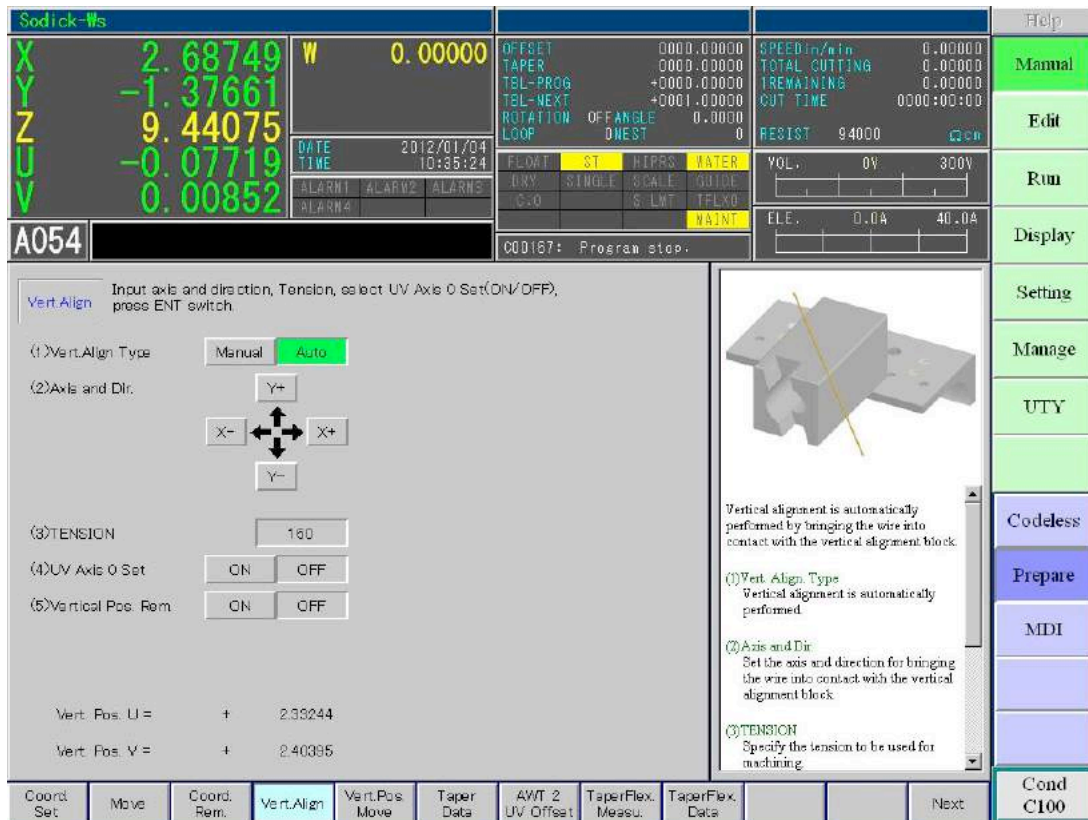
When U and V are aligned, you should zero out all the other work coordinate screens.

- 10) Press “Manual”, “MDI” buttons on the right side of the screen.
- 11) Type “G97UV” and press “ENT”.



NOTE:

- It is not necessary to perform vertical alignment for each workpiece, but it must be performed in the following cases:
 - ✓ When it has not been performed for two or three days
 - ✓ After a collision with an obstacle
 - ✓ When a wire guide has been removed
- If there is any dirt between the vertical alignment block and the workpiece stand, or there are scratches on these contacting surfaces, accurate vertical alignment will not be possible.
- DRY - DRY - DRY. If you cannot see the sparking along the side of the squaring block, you need to dry the upper head again. Unless the wire is completely free of moisture, sparks will not be generated evenly.
 - ✓ Close the flushing valves full.
 - ✓ Disconnect Upper flushing hose
 - ✓ Blow dry with an air hose, through the upper flushing hose fitting.
 - ✓ Use the button "AWT PIPE AIR" to blow dry, the AWT thread pipe.



VERTICAL ALIGNMENT AUTOMATIC PROCEDURE

- 1) Confirm that the U and V axis are aligned within .010" already.
- 2) Clamp the block and indicate it straight and level on the front table
- 3) Position the wire to the right side and the upper head about .25" above the block.
- 4) Choose "Manual", "Prepare", "Vert. Align", "Auto"
- 5) DIR setting: Click X -
- 6) Enter wire tension value for wire size to be used (pg24)
- 7) Turn ON the "U V axis zero set" button (pushed in). If left OFF the U or V will not zero out automatically when this procedure is finished.
- 8) Press "ENT" to start the alignment process.
- 9) When the cycle ends for the U axis, reposition the block to the side work table and the wire so as alignment can be performed in the Y- direction.
- 10) Repeat above steps to align the wire in the Y- axis direction. Use Y- for the "Dir" setting in step 5.

Final Procedure to zero out all work screens

When U and V are aligned, you should zero out all the other work coordinate screens.

- 11) Press "Manual", "M.D.I." buttons on the right side of the screen.
- 12) Type "G97UV" and press "ENT".

AWT ADJUSTMENTS ALIGNMENT PROCEDURE

The wire should be vertically aligned before performing this procedure. For the AWT to thread correctly, the U & V axis will need to offset to align the water jet with the lower wire guide. The U & V movement is measured by the following procedure:

- 1) Remove the lower flange and flushing nozzle
- 2) Upper split guide AWT: Move the AWT pipe down so that the end of the pipe is about .5" above the lower wire guide
- 3) Go to "Manual", "MDI" and press the "AWT water" button. (On the machine's keypad). This button turns on the water jet.
- 4) Jog the U & V axis until the jet is centralized in the funnel in the lower guide and write down the UV offset values.
- 5) Go to "Manual," "Prepare," "AWT2 UV Offset," and press the "Auto Login" button. This will store the U & V AWT offsets in the user settings automatically.
- 6) Go to "Manual, MDI" and type UV and press ENT to return the U & V axis to zero.
- 7) Press the AWT water off button, and raise the AWT pipe all the way up.
- 8) Execute an AWT to verify AWT reliability. You will now see the UV move the amount that you input, during the AWT cycle. When the cycle is done, the pipe returns to the top position and the UV returns to zero.

The screenshot displays the Sodick-We CNC control interface. The top section shows coordinate readouts (X, Y, Z, U, V) and various machine parameters. The 'AWT 2 UV Offset' screen is active, showing the following settings:

(1)SETTING	AWT 2 U OFFSET=	-	000.00784	AUTO LOGIN
	AWT 2 V OFFSET=	+	000.07483	

The interface also includes a diagram of the AWT assembly and instructions: "U- and V-axis offset data for AWT2 is registered." and "The current U- and V-axis offset data for AWT2 is indicated." Below the diagram, it states: "To re-register offset data, press the [AUTO LOGIN] button."

The bottom of the screen features a navigation bar with buttons for: Coord. Set, Move, Coord. Rem., Vert. Align, Vert. Pos. Move, Taper Data, **AWT 2 UV Offset**, TaperFlex. Measu., TaperFlex. Data, and Cond C100.

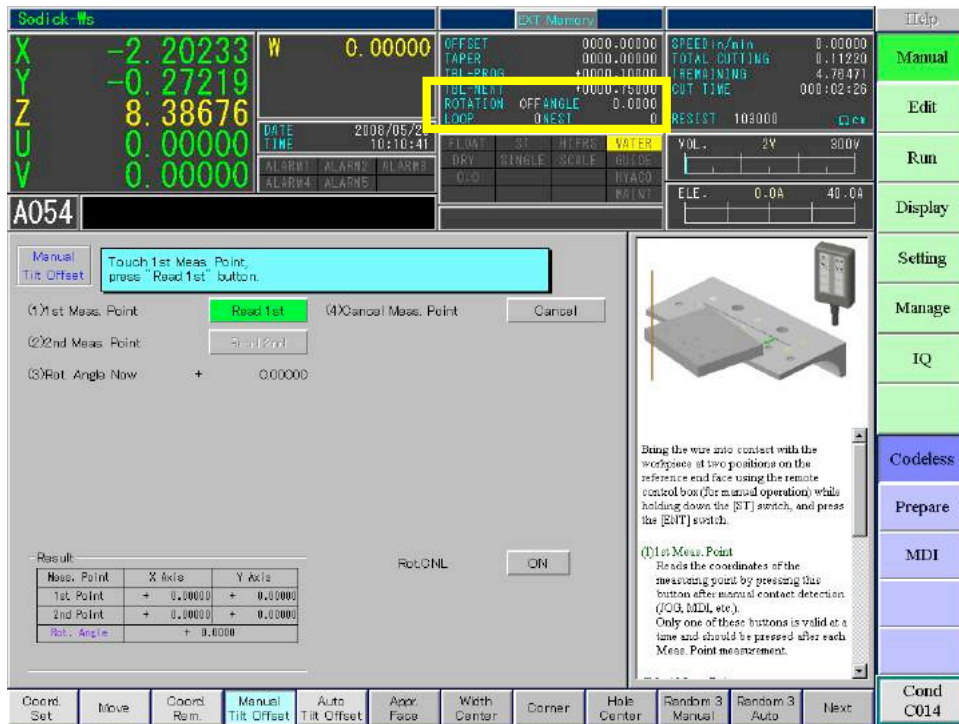
Confirm on the “Setting”, “User2” screen that the AWT offsets have been logged correctly. You can also adjust the values directly here without using the “Manual”, “Prepare” screen discussed previously.

The screenshot shows the Sodick control panel interface. At the top, the 'Sodick' logo is visible. The main display area shows coordinates (X, Y, Z, U, V) and various machine parameters. A white arrow points to the 'AWT 2 OFFSET U', 'AWT 2 OFFSET V', and 'AWT Z UP' fields, which are highlighted in yellow. The 'Setting' button on the right side of the panel is highlighted in green. The screen also displays a list of AWT settings, including 'AWT REFERENCE', 'CONNECT TYPE', 'AWT 2 OFFSET U', 'AWT 2 OFFSET V', 'AWT Z UP', 'AWT 2 RETRY COUNT', 'BUCKLING RETRY', 'WIRE BROKEN RETRY', 'WIRE REMOVE RETRY', 'CUSTOMIZE FOR FAST AWT', 'AQ-AWT WIRE S-BEND', 'ACT-AWT TYPE', 'ACT-AWT U(TIME)', 'ACT-AWT V(TIME)', 'ACT-AWT RELAX.(10ms)', 'ACTIVE_AWT_UV SPEED', 'AUTO_SHORT_ESCAPE RANGE', 'TABLE TO LIMIT', 'TABLE TO UPPER', 'TABLE TO LOWER', 'TABLE TO PROGRAM', 'TABLE TO NEXT', 'TABLE TO DRAW', 'MAX RESISTIVITY 1(OHM)', 'MIN RESISTIVITY 1(OHM)', 'MAX RESISTIVITY 2(OHM)', 'MIN RESISTIVITY 2(OHM)', 'STANDARD AWT BACKTEN', 'STD-WIRE BROKEN BACKTEN', 'STANDARD THREAD BACKTEN', 'FINE AWT BACKTENSION', 'FINE NORMAL BACKTENSION', 'F.S.C SPEED LMT 8000', 'F.S.C SPEED LMT 9000', and '[AWT REFERENCE]'. The right side of the panel has a vertical menu with buttons for 'Help', 'Manual', 'Edit', 'Run', 'Display', 'Setting', 'Manage', 'UTY', 'Q3vic', 'Flag', 'Disk', 'Run Data', and 'Cond C100'.

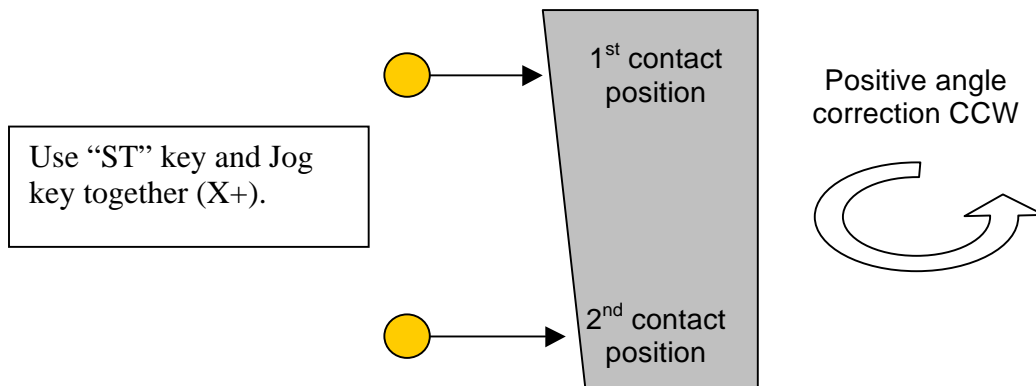
If the holes to be threaded through are very small, (approx .010” thru .030”) aligning the jet to the top of the hole in the part rather than the lower guide, may give better AWT reliability.

There are 2 AWT pipes available. They have an I.D. of .7mm or 1mm. The O.D. is .079 inches. Use the .7mm ID pipe for .004” - .008” wire, when threading through small start holes.

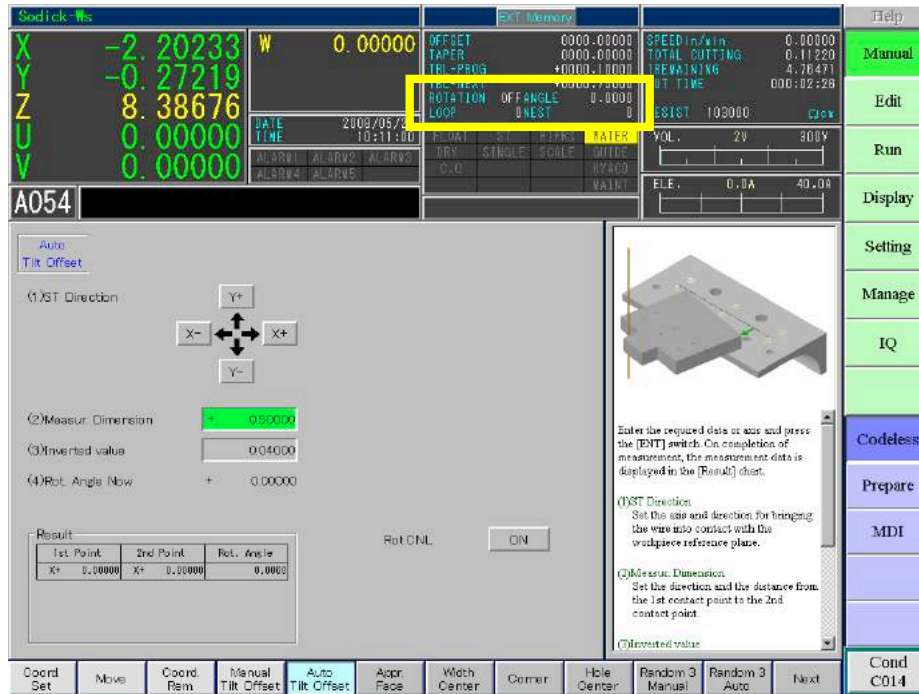
MANUAL TILT OFFSET



1. Move the wire near the first pickup location of a ground edge.
2. Set jog speed on remote to MFR = 2
3. Turn on “Wire Run” switch.
4. Press together the “ST” key and a jog key so the wire touches the ground edge.
5. After machine beeps and with the wire still in contact with the part, hit the “Read 1st” button.
6. Repeat this procedure for the 2nd contact position.
7. Press the ENT key to rotate your coordinate system by the angle between your two pickup locations.
8. To cancel the rotation, click the “Rot.CNL” button and hit “OK” to cancel rotation. You can confirm that rotation is on or off on the top of the screen above.

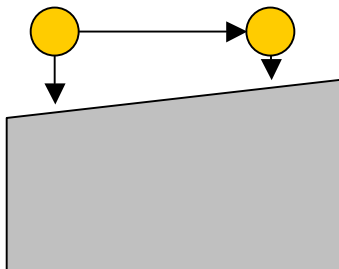


AUTO TILT OFFSET

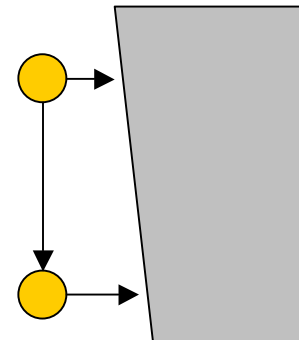


1. Move the wire in front of the first pickup location.
2. Choose your “ST Direction” as the direction you need to move the wire in order to pick up the workpiece face.
3. Set your “Measur. Dimension”. This is the distance from the first contact position to the second contact position. Make sure the sign of the dimension is correct (+ or -).
4. Enter your inverted value, which is the retract height after picking up the 2 contact positions. If you are picking up a large tilt angle, make sure that the inverted value is large enough not to hit the part as it moves from the 1st location to the 2nd location.
5. The rotation angle will automatically be calculated and input into the machine settings. To cancel rotation, pretty the “ON” button next to “Rot. CNL”.

ST Direction: Y-
 Measur. Dimension: +1.0”
 Inverted Value: 0.25”



ST Direction: X+
 Measur. Dimension: -1.0”
 Inverted Value: 0.04”

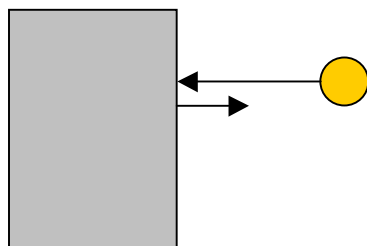


APPROACH FACE

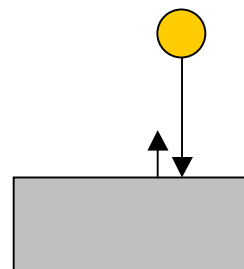
The screenshot displays the 'APPROACH FACE' screen in a CNC control system. At the top, there are coordinate readouts for X, Y, Z, U, and V axes. Below these, there are fields for 'Date' (2007/04/03) and 'Time' (01:40:01). A 'Manual' button is highlighted in green. The main area contains a 'Please Input 1 or 2 Axis and Direction for Sense Touch, and press ENT switch' instruction. Below this, there are fields for '(1) Axis and Direction', '(2) Wire Diameter' (0.00000), '(3) Inverted value' (0.04000), '(4) Coordinate 0 Set' (ON/OFF), and '(5) Movement' (AES/INC). A numeric keypad is visible. On the right, a 3D model of a workpiece is shown with a wire. A text box explains that the 'Input Support' field buttons work like keyboard keys. A legend at the bottom right defines the axis and direction selection process.

1. Choose “Manual”, “Codeless”, “Appr. Face”
2. Choose an Axis (X or Y) and direction (+ or -) you wish to pickup.
3. Enter your wire diameter = .010” (or your wire size).
4. Enter the inverted as 0.
5. Click Coordinate 0 Set = **ON**
6. Click Movement = **ABS**
7. Press “ENT” key to start pickup.
8. When completed, the wire will be flush with the edge of the workpiece, and the display will show the compensated value for the centerline of the wire.

Axis and direction: X-



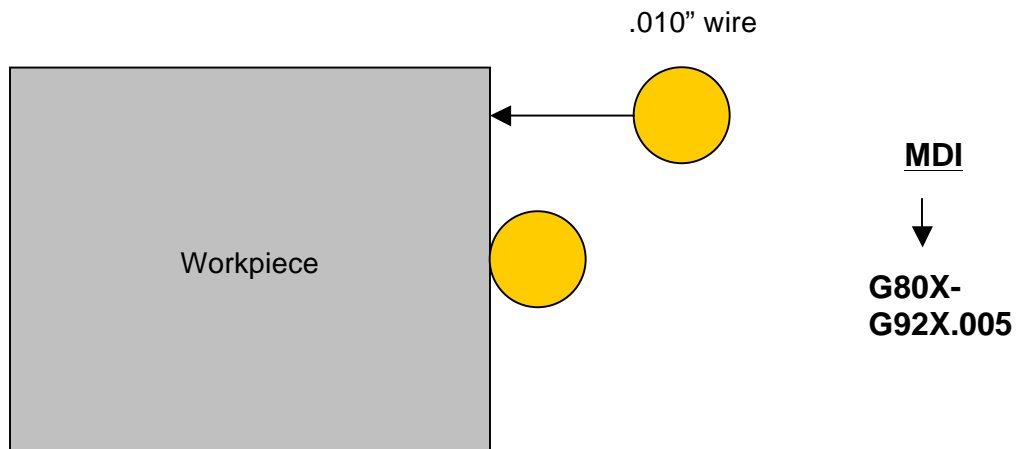
Axis and direction: Y-



EDGE FIND USING G80

The G80 code will cause wire to travel into the edge of a workpiece, and stop with the wire flush to the edge.

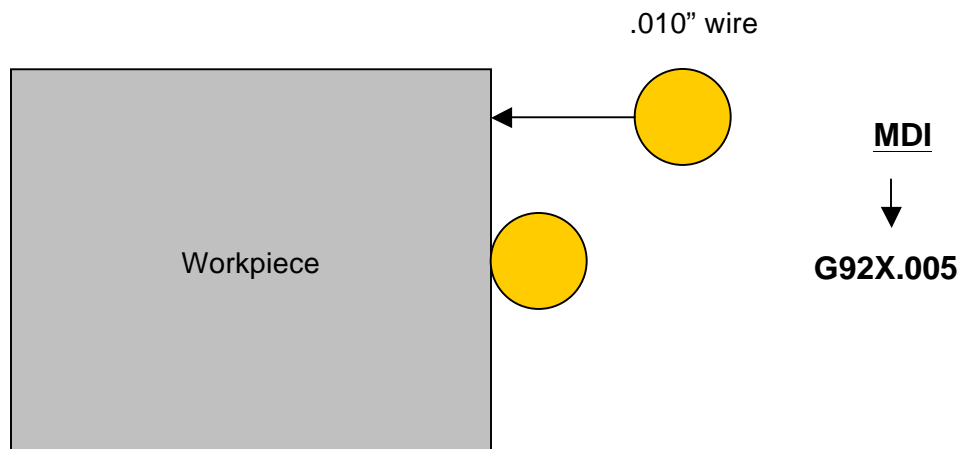
- 1) Manually jog the wire close to the surface to edge find (within about 0.1").
- 2) Choose "Manual", "MDI".
- 3) Type G80X+ or G80X- or G80Y+ or G80Y- (see table below).
- 4) Press ENT
- 5) When the edge find stops, the wire will be flush with the edge of the workpiece.
- 6) Set location by using the G92 code.
 - ✓ Remember 1/2 the wire size.
 - ✓ Always set G92 in the opposite direction of the G80 code.
 - ✓ If you used G80X- then use G92X+.005 (for .010" wire or 1/2 the wire diameter you are using).



EDGE FIND BY USING THE ST KEY

Accuracy of the ST key is about .0002". The previous 2 methods for edge finding are by using the G80 code method.

- 1) Using the X and Y jog keys, position the wire close to the edge to be picked up.
- 2) Turn wire run on manually.
- 3) Press and hold the ST key while pressing the X or Y keys to jog the wire into the edge of the part using MFR 1 or 2. MFR0 is too fast for a good pickup.
- 4) When the wire touches the part, it will automatically move back and stop. When finished, the buzzer will sound. The red alarm bar will appear along the bottom of the screen stating the wire and workpiece touched. When the red alarm bar appears, you can let go of the X or Y axis key and the ST key.
- 5) Press the "ACK" key to remove the alarm message.
- 6) The edge of the wire is now flush with the edge of the part. Press the wire stop button to turn the wire run off.
- 7) Remember to use the G92 code to set the axis position +1/2 the wire size



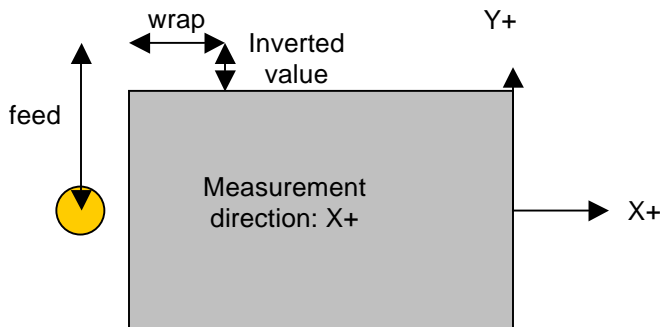
WIDTH CENTERING

The screenshot shows the 'Width Center' menu in the Sodick CNC control. The top status bar displays coordinates: X: -2.22855, Y: 5.62105, Z: 6.04265, U: 0.00000, V: 0.00000. The wire diameter is set to 0.01000. The feed amount is 0.50000, wrap amount is 0.25000, and measuring times are set to 2. The measurement results table is as follows:

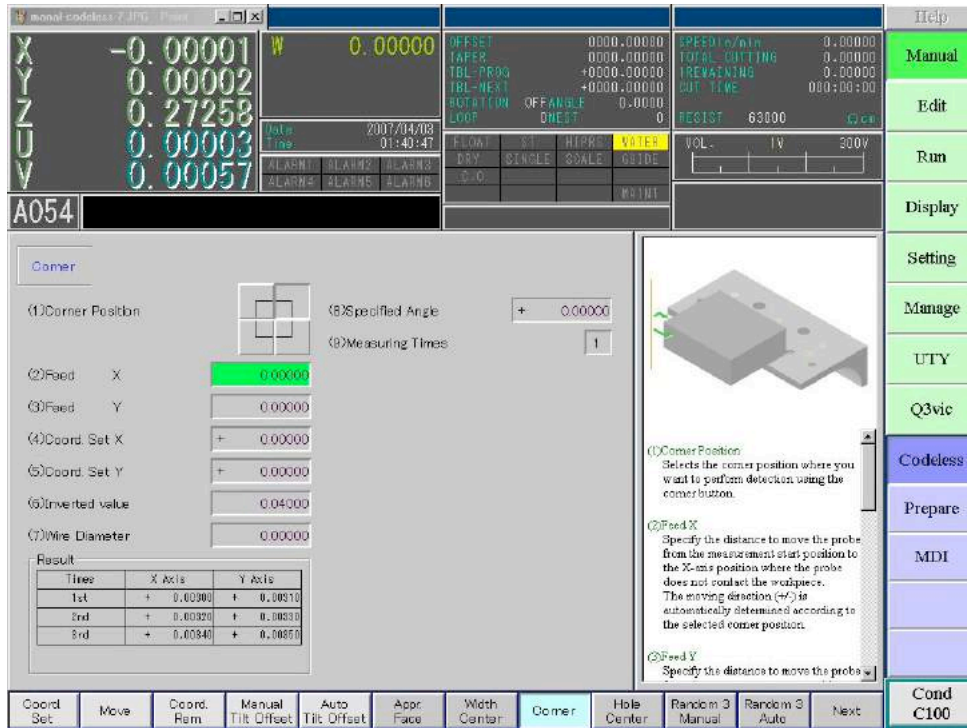
Times	Center site
1st	+ 0.00400
2nd	+ 0.00410
3rd	+ 0.00420
Dim of Measu.	0.00430

The interface also includes a diagram of a workpiece with a wire and a table of measurement results. The diagram shows a rectangular workpiece with a wire being fed from the left. The measurement direction is indicated as X+.

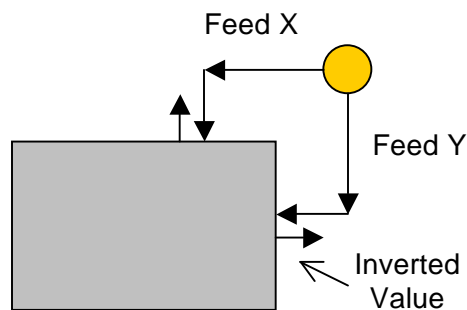
1. Position the wire near the center of the part width to be picked up.
2. Choose “Manual”, “Codeless”, “Width Center”.
3. Choose which direction to feed the wire towards the part.
4. Enter the feed amount (a value that is larger than the half width of the part).
5. Enter the wrap amount. This value is the distance the wire will travel along the length of the part.
6. Enter measurement times, inverted value and wire diameter being used.
7. Enter specified angle. This can be used to rotate the pickup if needed.
8. Your width direction (X or Y) will read zero when done. The wire is now in the center of the part width.



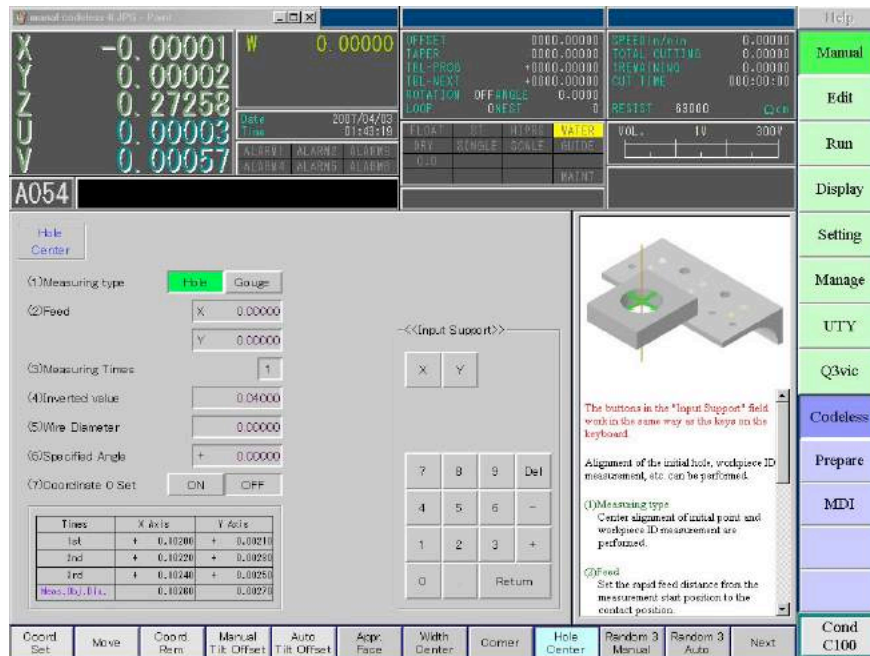
CORNER FIND



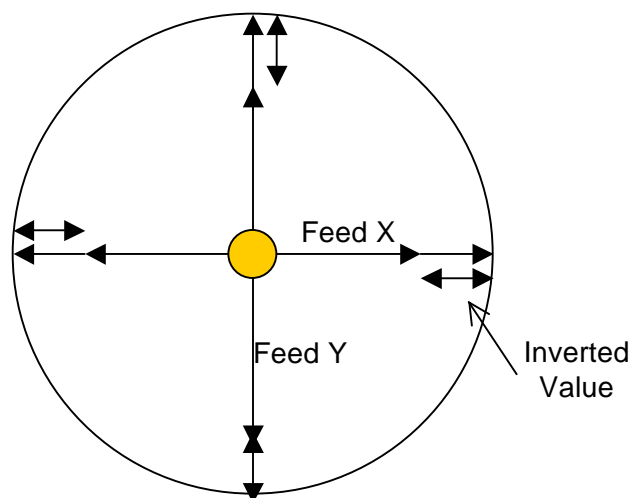
1. Choose “Manual”, “Codeless”, “Corner”
2. Click the corner position that you will be picking up.
3. Enter the feed amount as a rapid value for X and Y. They can be different amounts.
4. Enter coord. set after measurement. This will be the corner dimension on the print.
5. Enter the inverted value after picking up each face. Enter .005” or larger if needed.
6. When done, the machine will be at the location it was at when this procedure was started and the values in X and Y will be the distance from the corner to the center of the wire.



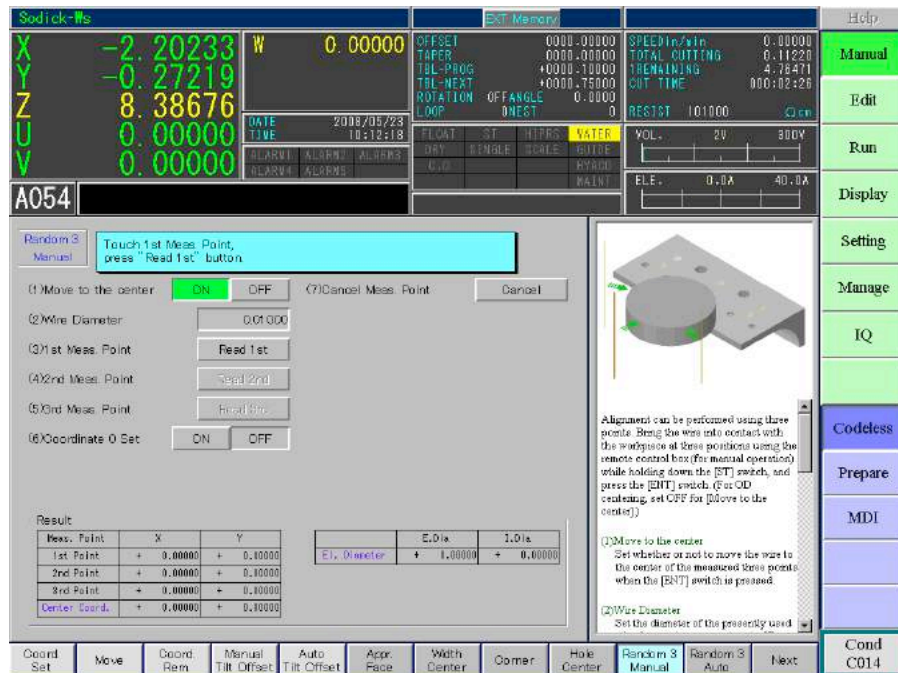
HOLE CENTERING



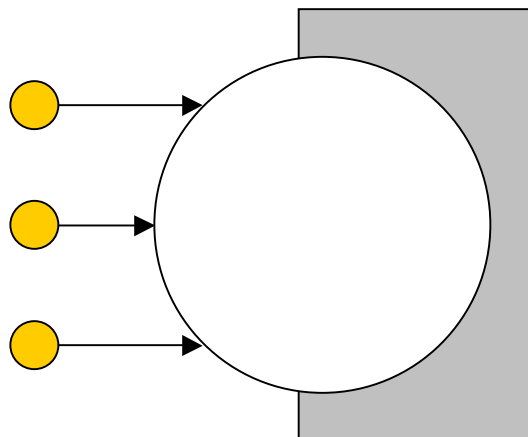
1. Position the wire near the center of the hole to be picked up.
2. Choose “Manual”, “Codeless”, “Hole Center”.
3. Choose whether you want to pick up a “Hole” or “Gouge” which allows you to pick up and center in a channel in either the X or Y direction only.
4. Feed Amount: Enter a value that is smaller than the pickup hole diameter or you can also leave it set to 0.
5. Enter measurement times as 1 time.
6. Enter inverted value of .001” (backup distance). For small diameter holes your backup distance cannot be large or the wire will hit the opposite side of the hole.
7. Enter wire diameter being used.
8. Enter specified angle as 0. This can be used to rotate the pickup if needed.
9. X and Y will read zero when done. The wire is now in the center of the hole.



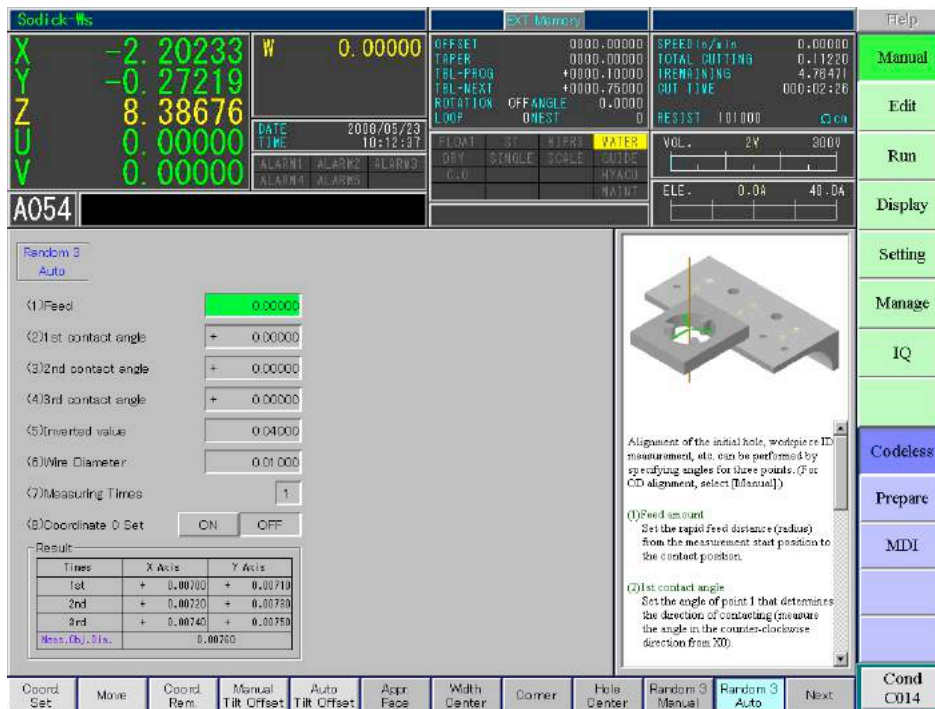
RANDOM 3 MANUAL



1. Choose whether or not you want to move to the center of your workpiece after picking up the 3 measure points. If workpiece center is outside the machines travel, you need to set this to OFF.
2. Set your wire diameter.
3. Move the machine near the 1st contact position. Use the “ST” along with the jog key until the wire contacts the edge.
4. While still in contact with the part, hit the “Read 1st” button.
5. Repeat the above 2 steps for the 2nd and 3rd locations.
6. Turn Coordinate 0 Set setting to “ON”.
7. Press ENT to set your zero location and move to that location if you activated the Move to center feature in Step 1 above.



RANDOM 3 AUTO



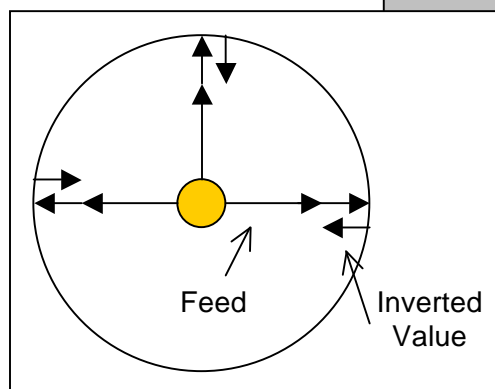
This feature is used for picking up inner diameters only.

1. Set your feed value. Enter a value that is smaller than your part diameter or just enter 0 if working with a small diameter.
2. Enter your 1st, 2nd, and 3rd contact angles (0-360 degrees).
3. Enter inverted value (backup distance). For small diameter holes your backup distance cannot be large or the wire will hit the opposite side of the hole.
4. Set your wire diameter.
5. Enter measurement times as 1.
6. Turn "Coordinate 0 Set" to "ON".

1st contact angle: 0°

2nd contact angle: 90°

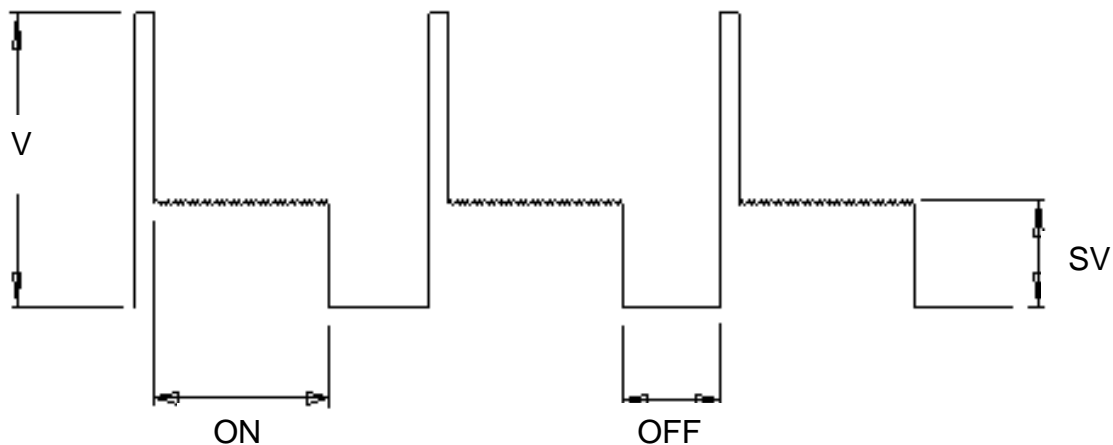
3rd contact angle: 180°



Chapter 5 EDM PROCESS PARAMETERS

Many factors called parameters control the way the EDM process occurs. What follows is an attempt to explain each of the parameters. For the beginner, remember that we are just introducing each one. Try not to become bogged down by attempting to memorize each one now. Cutting conditions developed by Sodick will usually generate the desired cutting without you having to adjust them. However, as time goes on you will want to get more familiar with each of the parameters so you can easily fine tune for desired results and even create your own cutting conditions.

Each factor directly contributes to machining speed, part finish, and accuracy. Keep in mind that as you modify the parameters that make up a cutting condition to improve one of these objectives, the other two may suffer. The following is a graph that shows 3 EDM cycles. Voltage is applied to the wire until an ionization channel forms. The voltage drops and amperage is now flowing between the wire and the workpiece for the length of time that the ON time designates. The process repeats thousands of times per second.



A typical discharge waveform of a DC pulse.

Now let's look at the specific "Sodick related" EDM parameters. If you have experience with other brands of wire EDM machines, some of these will be familiar. However, each type of EDM machine will have many things that are specific to that machine. Here we discuss how Sodick does it.

Cutting Parameters

ON	OFF	IP	HRP	MAO	SV	V	SF	C		EPA
000	015	2215	000	470	+060.0	3.0	0012	0		0
PIK	OTRL	WK	WT	WS	WP			C NO		CLOSE
000	0000	010	035	080	045			000		

ON

Parameter Range: (roughing = 000-020, skimming = 000-331)

“ON” stands for discharge ON time. This parameter controls the length of time that electricity is applied to the wire. The lower the number, the shorter the ON time will be.

ON time is a factor that can add power to the wire. As you increase the ON time, the machine will cut faster but the surface finish gets more porous and accuracy may decrease because of the increased cutting speed. Usually, the ON time for roughing is higher than the ON time for finishing. If the ON time is too great, the wire will be prone to breakage.

OFF

Parameter Range: (roughing = 000-063, skimming = 000-363)

“OFF” stands for discharge OFF time. This parameter sets the length of time that no electricity is applied to the wire.

OFF time is very important since it is during the OFF time that the particles are flushed out of the gap. Without OFF time the EDM process could not take place and the wire would eventually short out against the workpiece or break.

OFF time is a factor that takes away power from the wire. Increasing the OFF time will generally mean slower cutting, increased stability and less wire breakage. Usually ON time and OFF time are considered together for their effects. OFF cannot be adjusted so that it is less than half of the ON time.

IP

Parameter Range: (0001 - 2215)

“IP” stands for peak current. IP controls the amount of amperage (current) that is applied to the wire. IP is usually a parameter that the user does not adjust as the correct current level is always chosen from the machine database.

HRP (option)

HRP is used with the HTHP option. This setting will be 000, unless using this option. This option is for OIL dielectric and .004” wire cutting.

V

Parameter Range: (0-9)

“V” Voltage is a factor that adds power to the wire. You can think of voltage as being a crude setting for the power range and ON time as a way of fine tuning

the actual power to the wire. A higher number increases the voltage available to the wire.

While cutting, this parameter is usually not adjusted. The cutting condition file will set the value according to which pass is being made.

MAO

“MAO” sets the adaptive control circuit. The settings values control the sensitivity level and the amount of adjustment to the “ON” and “OFF” times. When the machine’s adaptive control circuitry determines that something is wrong while cutting (hard spot in material, poor flushing, etc.), it will self adjust the “on” and “off” time parameters to obtain a steady cut.

M Parameter Range (0-9)

M controls the sensitivity level. The lower that “M” is set to, the lower the sensitivity of the adaptive control system. The higher “M” is set to, the more sensitivity. This means that a low first digit for “M” (1 for example) would tell the control not to be very sensitive to “problems” in the work zone. A setting of 9 would make it very sensitive. A setting of 2 is desired when rough cutting with good flushing.

A Parameter Range (0-9)

A controls the multiplier for the “OFF time”. When the control senses that something is wrong (based on the M), it will multiply the off time by the value specified in the second digit of MAO (A) until the problem is cleared. Then it goes back to its normal setting. We must point out that you don’t actually see the off parameter change, it does this internally. To obtain maximum speed when rough cutting, lower the A until the cut becomes unstable then raise it back up one number. NOTE: The A parameter gets raised one number automatically when the wire breaks and the AWT unit rethreads the wire and then resumes machining.

O Parameter Range (0-9)

O controls the “ON time”. When the control senses that something is wrong (based on the M), it will decrease the ON time by the value specified . If nothing is wrong it increases the ON time by the value specified.

MAO adjustment examples:

To increase cutting speed for roughing, reduce “A” and/or increase “O”.

MAO 252 to MAO 243

If wire breakage is a problem, increase “A” and/or reduce “O”.

MAO 252 to MAO 261

SV

Parameter Range: (000-255)

“SV” stands for servo voltage. This sets the gap voltage between the wire and the workpiece when cutting. Lowering this setting makes this gap smaller. Setting this to low makes the cut unstable because the particles are trapped in the gap. The voltage can be read by the voltmeter on the control. This parameter controls the cutting performance and overburn. Think of this setting as the gas pedal on your car. Pushing the pedal to the floor (smaller SV) causes the machine to try to cut faster, but the engine size has not increased. So this parameter actually doesn't add power to the wire, but will make the machine try to cut faster when lowered. Setting this high will slow down the cut, making it a more stable cut.

The value set is an actual voltage target the machine will try to achieve. If it is set at 25, then the machine will try to maintain a gap voltage of 25 volts. The “SV” parameter allows for gap voltage adjustments in 1-volt increments. This method of setting the gap voltage directly allows for finer settings, which is required for fine surface finish cutting.

Fine Adjustment for Part Straightness: If you cut a punch shape and it measures bigger in the middle than top and bottom, raise the SV several numbers on the first skim cut only. Cut another punch to verify that changing the SV eliminated the bow on the part.

WP

Parameter Range: (000 - 063)

This sets the speed of the flush pump when in high-pressure mode.

WT

Parameter Range: (000-255)

“WT” sets the wire tension. The value input is 1/10 the actual amount directly in grams.

Example: 160 = 1600 Grams

WS

Parameter Range: (000-155)

“WS” sets the wire speed. The input value is directly in decimeters per minute.

Example: 120 = 12.0 meters per min.

EPA

Parameter Range: (-4 to +2)

“EPA” stands for “Easy Power Adjustment.” This setting allows you to adjust the aggressiveness of your rough pass ONLY without having to modify multiple parameters.

SF

Parameter Range: (0000-9999)

"SF" stands for Servo Feed. This parameter sets the maximum feedrate the machine moves at when there is no load on the cut. By no load, we mean the wire hasn't reached the workpiece and is not cutting yet. The SF will be set to a faster speed than what the machine will really cut at, and what happens when under load (cutting) is the SV (gap voltage feedback) setting ends up controlling the speed. The adaptive control is controlling the speed so it feeds as fast as it can with the given amount of power on the wire.

SF 0 0 2 5

↓
These digits set the feedrate when under no load.

Examples:

SF setting	No Load Speed
0005	0.050"/min
0025	0.250"/min
0100	1.00"/min

→ This digit is used when skim cutting only. The database will set its value and the user should not adjust it.

CHOOSING CUTTING CONDITIONS

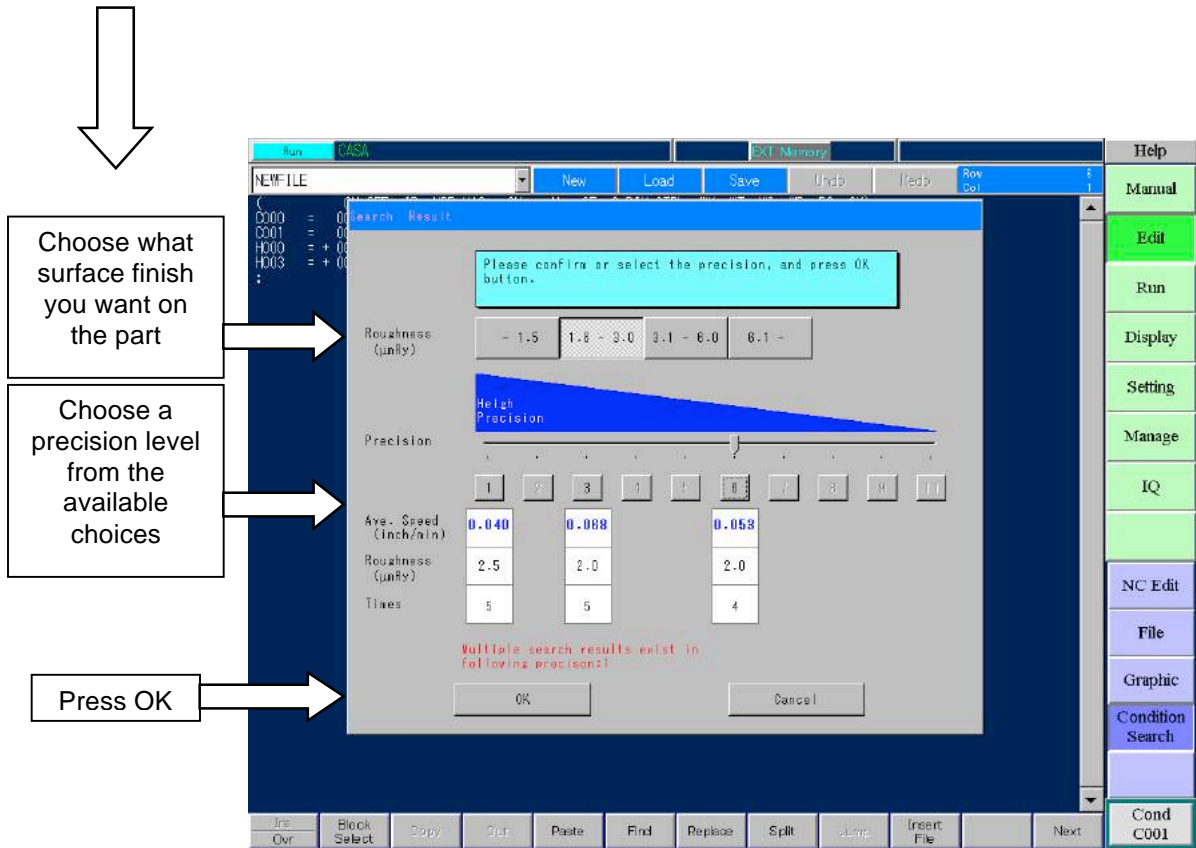
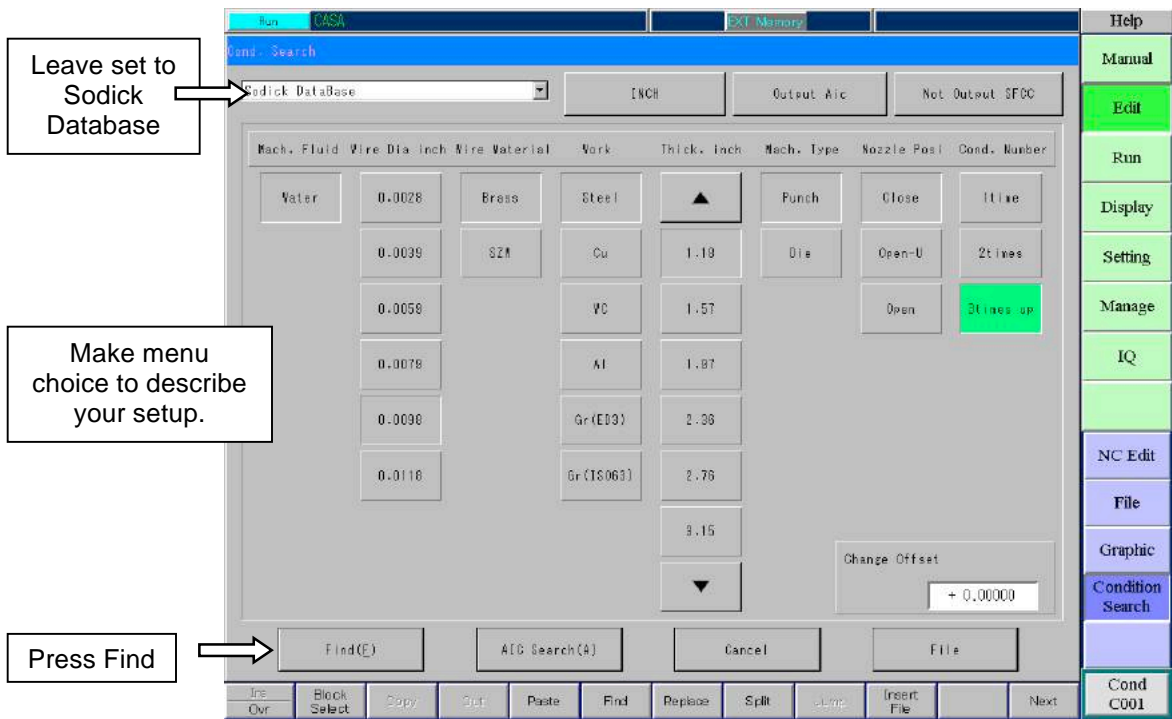
Cutting conditions and offsets can be found in the cutting condition manual, or they can be found in the machine's library as described below.

The condition search function automatically searches for the required machining condition in the condition file database in response to input of a search condition.

Procedure:

- 1) Press the "EDIT" "CONDITION SEARCH" buttons.
The condition search window, shown below, is displayed.
Note: The details displayed on the condition search window as it is now displayed are the choices input when the last search was made.
- 2) Select the items on the screen starting on the left side, which match your cutting job requirements.
- 3) When all items are selected properly, the "FIND" button is active. Press the "FIND" button.
- 4) Choose your desired surface finish and the corresponding average speeds and number of passes are displayed. Choose the desired setting and press the "OK" button.
- 5) The system will now display the cutting conditions and offsets it has found from the database file.
- 6) Press the "OK" button for the system to copy the data as a header to your NC program.

When OK is pressed, the cutting conditions, offsets and the AIC (corner control) will be added to the top of your NC program as a Header. The program will need to call out "C001 and H001" for the first cut condition and offset, then "C002 and H002" for the second condition and offset, "C903 and H003" for the third condition and offset, and "H004 and C904" for the fourth.



Results will be displayed.

Press OK

CNo.	ON	OFF	IP	HRP	MAD	SV	V	SF	C	PIK	CTRL	WK	WT	WS	WP	PC	SK	DFST	μmRy	inch/min
C000	012	013	2215	000	240	+040.0	8.0	0028	0	000	0000	025	160	130	045	0000	00	0.00039	---	---
C001	014	013	2215	000	244	+018.0	8.0	0028	0	000	0000	025	160	130	055	0000	00	0.00858	20.0	0.17-
C002	002	023	2215	000	750	+048.0	8.0	6020	0	000	0000	025	160	130	012	0000	00	0.00602	17.0	0.19-
C003	000	001	1015	000	000	+030.0	7.0	7020	0	008	0000	025	160	130	012	0000	00	0.00524	3.8	0.24-
C004	000	001	1015	000	000	+018.0	2.0	7024	0	009	0000	025	160	130	012	0000	00	0.00512	2.0	0.21-

Search Data : Water-Brass φ 0.0098inch-Punch-Close-Steel 1.18inch
Precision : 6

Approach : 4 Conds
Surface : 2.0 μmRy

Cut Length / Ave. Speed / Predicted Cut Time = 0.053inch/min =

Buttons: OK, Back, Save, Other Info. (O), User DataBase Edit (B)

Machining conditions
Offset Terms
Other data
Corner control data

```

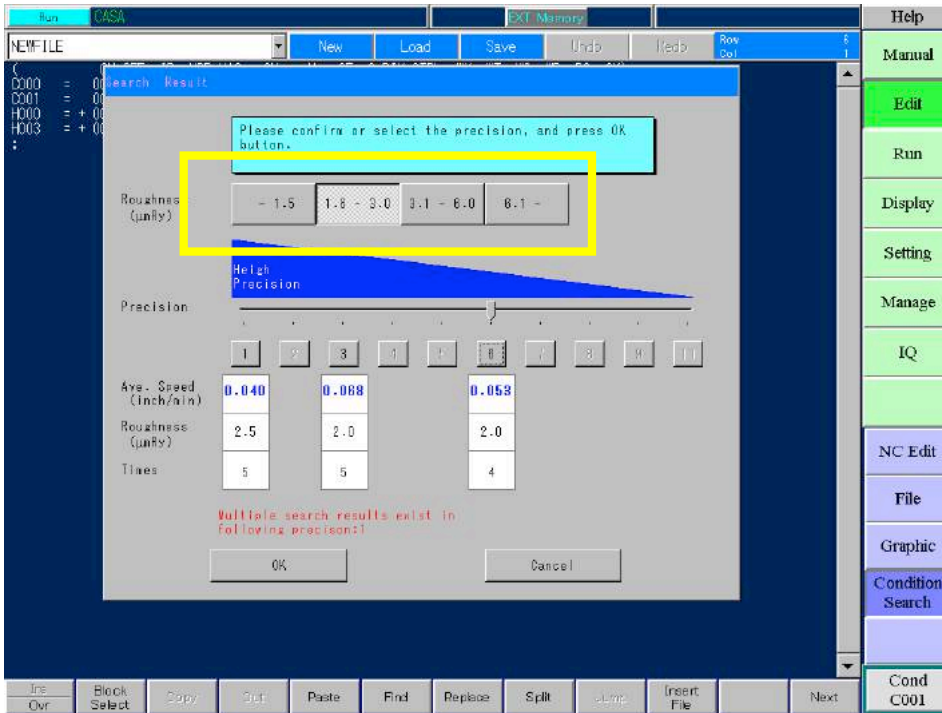
VER : S.01A Sodick DataBase ACL-W5.4.1[03] ;
Search Data : Water-Brass φ0.0098,Punch-Close-Steel,1.18inch,E=0.2,0umRy,4lines,0.00000 ;
Precision : 6 ;
-----
CNo. ON OFF IP HRP MAD SV V SF C PIK CTRL WK WT WS WP PC SK DFST μmRy inch/min
C000 = 012 013 2215 000 240 +040.0 8.0 0028 0 000 0000 025 160 130 045 0000 00 ;
C001 = 014 013 2215 000 244 +018.0 8.0 0028 0 000 0000 025 160 130 055 0000 00 ;
C002 = 002 023 2215 000 750 +048.0 8.0 6020 0 000 0000 025 160 130 012 0000 00 ;
C003 = 000 001 1015 000 000 +030.0 7.0 7020 0 008 0000 025 160 130 012 0000 00 ;
C004 = 000 001 1015 000 000 +018.0 2.0 7024 0 009 0000 025 160 130 012 0000 00 ;
H000 = + 00000.00039 (Approch.) ;
H001 = + 00000.00858 ( 1ST ) ;
H002 = + 00000.00602 ( 2ND ) ;
H003 = + 00000.00524 ( 3RD ) ;
H004 = + 00000.00512 ( 4TH ) ;
H009 = + 00000.00200 ( Taper Offset ) ;
Other Information :
UP DN ! 1st 2nd ! ;
Dices : 0.010 0.011 ! PS : 15.0 1.0 ! Rest. : 50000 ;
Nozzles : 0.24 0.24 ! UP : 8.0 1.0 ! Taper Offset : 0.0020 ;
Distances : 0.004 0.004 ! DN : 8.0 1.0 ! ;
GALC(2,1,0.00432,001,0,0.00630,0.00118,012,0.0006,0020,15,035) ;
  
```

UNDERSTANDING THE EDIT, CONDITION SCREEN

- Mach Fluid:
Water: Standard database for Water machines.
- Wire Dia.: Choose the wire diameter being used.
- Wire Material: Choose Brass or Zinc-coated.
- Workpiece material
Steel: All tool steels, mold steels, alloys, stainless, titanium
CU: Copper
WC: Carbide
AL: Aluminum
GR (ED3): Graphite similar to POCO 3
GR (ISO63): Graphite similar to POCO 200
- Thick: Choose the closest value to your part thickness.
- Mach. Type: Choose **Punch**. Die is only for 3 pass technology.
- Nozzle Position
Close: Choose this if the 2 flushing nozzles are .005” away from the part
Open U: Choose this when your upper flushing nozzle is distanced from the part.
Open: Choose this when both your upper and lower flushing nozzles are distanced from the part.
- Cond. Number: Number of passes.
 - 1 Time: 1 rough cut setting only.
 - 2 Time: 1 rough and 1 skim only
 - 3 times and up: 1 rough and 2, 3 or 4 skim passes.
 - ✓ If this is your choice, you will need to then choose your desired surface finish upon pressing the FIND button. The finish selected will determine how many skims to make.

As you can see, there are many factors that contribute to the EDM process. It would be impossible for beginners to memorize each factor. One of our goals in this class will be to teach you how to determine what cutting condition to use and what parameters are changed most often, then, you can fine-tune the previously developed conditions to your liking. If you are unsure of what settings to choose from, you can reference the Sodick condition manual or call the applications department for help.

SURFACE ROUGHNESS CONVERSION



umRz	Ra Uinch
15	90
8.0	50
5.0	32
3.8	23
2.5	15
2.0	12

Tips For Adjusting Cutting Conditions:

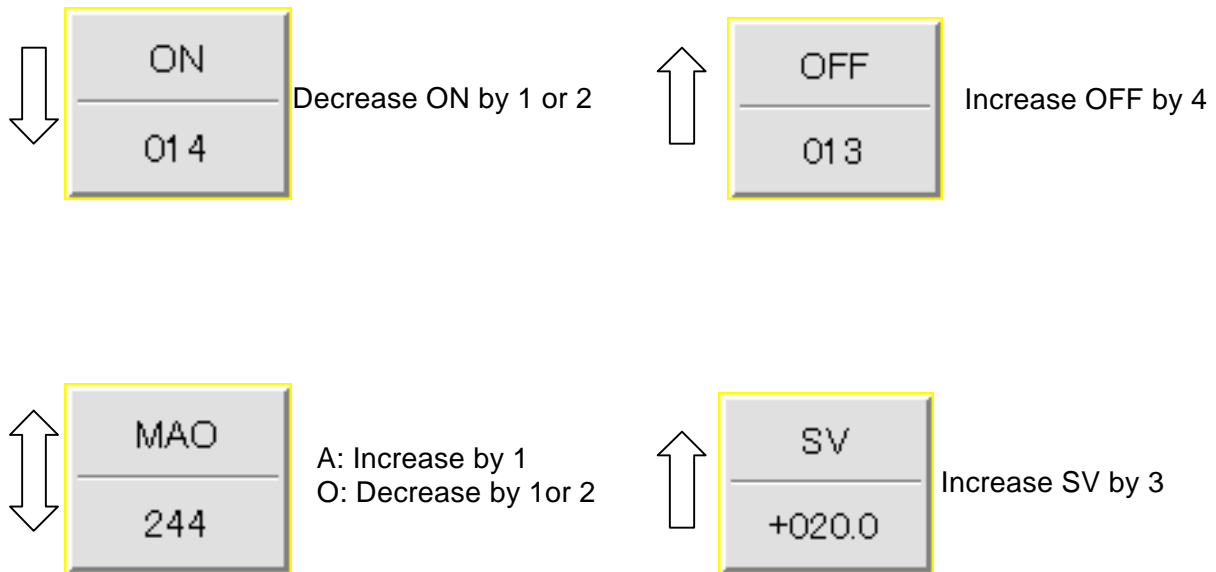
During the rough cut, there may be instances in which you would like to adjust the cutting conditions. Be sure to choose the proper nozzle position from the cutting condition menu. Proper selection of this parameter is key to the proper power range in the rough cut. To make minor changes to the power follow these guidelines.

Wire Breakage Problem Example:

ON	OFF	IP	HRP	MAO	SV	V	SF	C	EPA	MDI
014	013	2215	000	244	+020.0	8.0	0031	0	0	
PIK	CTRL	WK	WT	WS	WP			C NO	CLOSE	
000	0000	025	160	130	055			100		
DRY	SINGLE	NO MAN	SKIP	MIRR.X	MIRR.Y	XYCH	START	Back	Forward	Next
0	OFF	0	OFF	OFF	OFF	OFF	G30			Cond C100

Easy Power Adjustment: First try adjusting the EPA value by inputting -2. You are allowed to adjust this parameter from +2 to -4.

If further adjustment is necessary, you can adjust one or more of the following parameters, to remedy wire breakage problems.



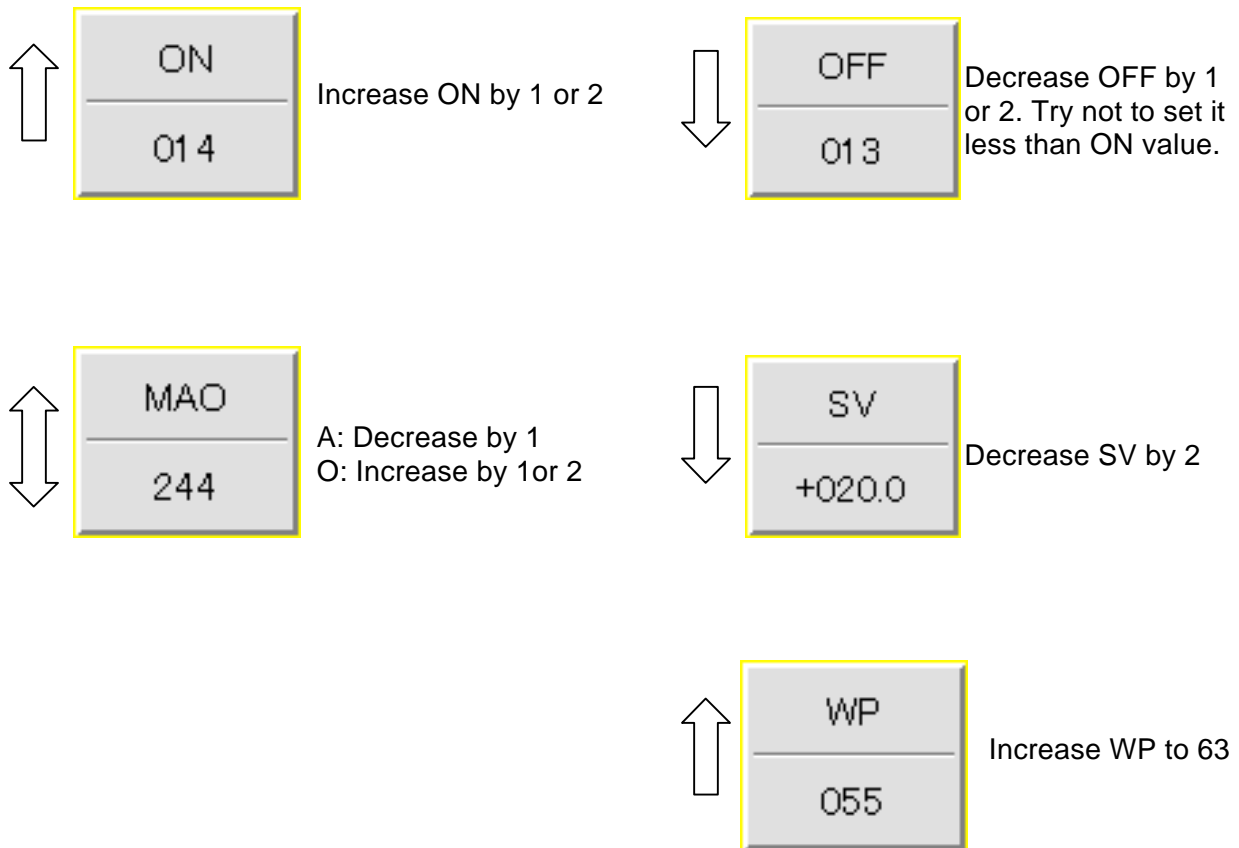
Speed Cutting Example:

ON	OFF	IP	HRP	MAO	SV	V	SF	C	EPA	MDI
014	013	2215	000	244	+020.0	8.0	0031	0	0	
PIK	CTRL	WK	WT	WS	WP			C NO	CLOSE	
000	0000	025	160	130	055			100		
DRY	SINGLE	NO MAN	SKIP	MIRR.X	MIRR.Y	XY.CH	START	Back	Forward	Next
0	OFF	0	OFF	OFF	OFF	OFF	G30			Cond C100

Easy Power Adjustment: First try adjusting the EPA value by inputting +1. You are allowed to adjust this parameter from +2 to -4.

The rough-cut library settings are not MAXIMUM speed settings. They are designed to give good speed and accuracy. If you increase the power to speed up the cut, accuracy may suffer and wire breakage may occur. If the rough-cut power is changed a lot, the following skims may not run correctly. Test cutting may need to be done before cutting the actual part.

To increase cutting speed, you can adjust one or more of the following parameters.



Chapter 6 DESCRIPTION OF PROGRAMMING CODES

This chapter will present most of the codes and words involved with programming. While there appears to be a great number of them, only a few are used on a regular basis. Try to memorize the codes used most often and what they mean, so you can understand what the program is doing.

N: Used for numbering the lines in a program. The sequence numbers can be in any order and can even repeat. When N is used for numbering subroutines, you need 4 numbers (N0000)

I: Used in circular movement commands (G02 and G03). I is defined as the incremental distance and direction in X from the starting point of a circular move to the center around which the movement takes place.

J: Used in circular movement commands (G02 and G03). J is defined as the incremental distance and direction in Y from the starting point of a circular move to the center around which the movement takes place.

H: Specifies the register in the offset file or in the header of the NC program to be used for wire offset.

A: Used to input the amount of taper angle when using G51 and G52 commands. An angle of 1 degree is input as A1.0

P: Used in the line with M98 to designate the sequence number (line number) of the beginning of the sub-routine. When the control executes the line M98 P0010 it jumps to line number N0010 in the subroutine.

L: Subprogram Looping. Used in conjunction with the M98 code. M98 P0030 L4 would execute the sub-routine at line N0030, four times.

C: Designates the three digit cutting condition number which the control will load into the generator. The three digits may be any existing combination from 000 to 999. Usually you would use C001 for the first cut, C002 for the second cut, C903 for the third cut.

R: Specifies the radius of a corner round. A radius of one inch would be written as R1.0 and a radius of 0.010" would be input as R.01

Example NC code: G01 X1.0 R.050

This would cause the intersection of the next line to be filleted by .05

RA: Specifies the amount of rotation about the G92 point of the program. Use G26 to turn it on. Think of the 3 o'clock position as 0 rotation. Rotating a program clockwise is a minus rotation and counter clockwise is a positive rotation.

```
G90
G26 RA 45.0 (rotation angle of 45 degrees)
G92 X0 Y0 (start point location)
... (rest of program here)
G27 (cancel rotation)
M02
```

Q: Designates a pre-existing routine to be executed. Stored on the user disk or hard drive is a program to pick up the center of a hole. It is stored with the numeric title 0145. To execute this program, type Q0145 in Manual, MDI and press enter and the control will load the program from the user disk or hard disk and execute it.

TP or TN: This is for inputting the taper settings Table to Program and Table to Next in the Setting screen. These codes may appear in an NC program to load the taper registers automatically with the value that appears directly after these codes. Used when you want to program the machine to cut taper, holding size at different heights for different openings.

```
Example:
G92XY
TP2.000 (Sets Table to Program at 2.000)
TN0.000 (Sets Table to Next at 0)
G90
```

LIST OF G CODES

G00 Rapid Motion
G01 Straight Line Cutting Motion
G02 Circular Cutting Motion - Clockwise (CW)
G03 Circular Cutting Motion - Counterclockwise (CCW)
G29 Reference Point Memory (for auto wire threader)
G30 Return to the Last G92 Location
G40 Wire Radius Compensation Cancel
G41 Wire Radius Compensation Left
G42 Wire Radius Compensation Right
G50 Taper Cancel
G51 Taper Left
G52 Taper Right
G80 Sensor touch
G82 Move to Half of Axis Display
G90 Set Absolute Mode
G91 Set Incremental Mode
G92 Assign Values to Axis Displays in Current Work Coordinate
G97 Assign Values to Axis Displays in ALL Work Coordinates
G131 Checking Interference = 0
G132 Checking Interference = 2
G192 Assign Half the Current Value to Axis Displays in Current Work Coordinate

LIST OF T CODES

T82 Worktank Drain Closed
T83 Worktank Drain Open
T84 High Pressure Flushing Mode On (high flush)
T85 High Pressure Flushing Mode Off (low flush)
T90 Cut Wire By Auto Wire Threader Sequence One
T91 Thread Wire By Auto Wire Threader Sequence Two
T96 Worktank Fill Pump On
T97 Worktank Fill Pump Off

LIST OF M CODES

M00 Program Stop
M01 Optional Stop
M02 End of Program
M05 Sensor Touch Off
M36 Half Tank Door Limit Set (for workpieces ~2" and smaller)
M46 Cancel Half Tank Door Limit Position

- M98 Jump to a Sub-Routine from the main program.
- M99 Return from a Sub-Routine to the main program.
- M199 End of Q-Routine (Use in place of M02 at the end of the Q routine).

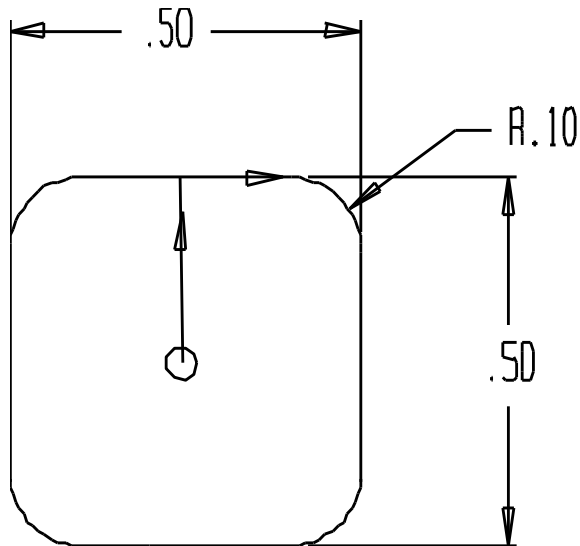
NC PROGRAM EXAMPLE

The below program is an example to make a 0.5" square, with 0.1" corners. The approach is at a right angle to the contour, and starts at X0 Y0. The cutting conditions and H registers (which make up the header of the program) have not been included in the example below.

```

G54 G90
G92 X0 Y0
G29
T91
T84
T94
C001
G42 H001
G52 A0.5 G01 Y.25
X.15
G02 X.25 Y.15 I0 J-.1
G01 Y-.15
G02 X.15 Y-.25 I-.1 J0
G01 X-.15
G02 X-.25 Y-.15 I0 J.1
G01 Y.15
G02 X-.15 Y.25 I.1 J0
G01 X-.1
M00
X0
G50 G40 Y0
T85
C002
G41 H002
G51 A0.5 G01 Y.25
X-.15
G03 X-.25 Y.15 I0 J-.1
G01 Y-.15
G03 X-.15 Y-.25 I.1 J0
G01 X.15
G03 X.25 Y-.15 I0. J.1
G01 Y.15
G03 X.15 Y.25 I-.1 J0.
G01 X0
G50 G40 Y0
M02

```



Chapter 7 WIRE OFFSET DESCRIPTION

UNDERSTANDING OFFSETS

An offset tells the control how far to keep the wire centerline away from the programmed surface to be cut for any given pass. If making only one pass to size (roughing the part right to size), the offset would be equal to the wire radius + the amount of the spark gap. If making multiple passes, the amount of offset used per pass will be slightly larger than the wire radius + spark gap. It must be large enough to leave stock on the part for the next pass.

There are three G codes related to wire offset

G40 - Cancel

G41 - Wire Left

G42 - Wire Right

THREE ADVANTAGES TO USING OFFSETS

The first advantage to using wire offset is that it allows the operator to input actual part coordinates into the program with no concern for the wire diameter in the values of the coordinates. The control will automatically keep the wire a specified distance (the offset value) away from the surfaces of the part while cutting. This generates the movements necessary to make the part to the proper size.

The second advantage to using wire offsets is that the same program that machined the first rough pass can be used for subsequent trim passes. This means you may not have to develop multiple programs for the various trim passes required to make the part to the size and finish requirements you need.

The third advantage to using wire offset is that you will be able to incorporate die clearance into your program with the same set of coordinates that machined the part to size.

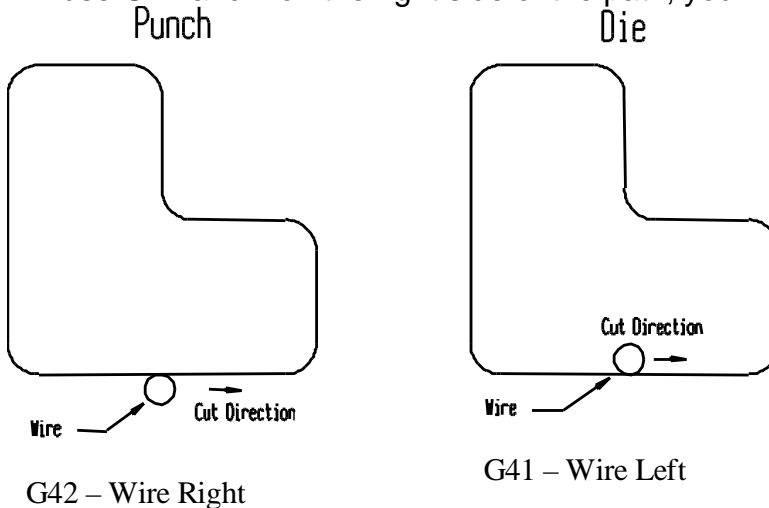
OFFSET PROGRAMMING

Now that you know some of the advantages to using wire offsets, let's look at how you use it. Wire offsetting requires three steps in the program:

- 1) Instate wire offset (G41 or G42 codes)
- 2) Drive the wire through its motions

3) When finished, you MUST cancel offset (using the G40 code during movement)

Initializing Offset: To instate offset, you will be choosing from G41 (wire left) and G42 (wire right). You must be able to decide how the wire will be related to the workpiece during the cutting motions. To evaluate this relationship, look in the direction that the wire will be moving during the cut. Looking in this direction, ask yourself, "What side of the programmed path is the wire on? Is the wire on the left side or the right side of the path? If the wire is on the left side of the path, you will use G41 and if on the right side of the path, you will use G42.



It is important to use offset PRIOR to the first cutting move so that as you begin cutting, the first piece of geometry to be cut will be on size. As the wire moves to the end point of that move, it will automatically be offset so that the edge (plus the amount of overburn) of the wire is flush with the surface you wish to be on size.

Offset Value: In the initialization block, you will include an "H" word along with the G41/G42 code. This specifies the register the control will use from the header. The value in this register tells the control how far to keep the wire away from all surfaces to be cut. Register H001 is for the 1st cut, register H002 is for the 2nd cut and so on.

```
H000 = + 00000.00000 (Approach.);
H001 = + 00000.00843 (1ST OFFSET);
H002 = + 00000.00587 (2ND OFFSET);
H003 = + 00000.00508 (3RD OFFSET);
G92X0Y0
G41H001
G01X.1
Y.1
X0
G40Y0
G41H002
G01X.1
Y.1
X0
G40Y0
```


M02

GLOBAL OFFSET CHANGING

FLAG7D:

Sometimes you may wish to add a clearance amount to all the offset values without having to add or subtract to each offset in the header. The code “FLAG7D” was designed to accomplish this. Before you attempt to use this code, please be aware of how it functions. Let’s look at an example:

```
H000 = + 00000.00000 (Approach.);  
H001 = + 00000.00843 (1ST OFFSET);  
H002 = + 00000.00587 (2ND OFFSET);  
FLAG7D.01250
```

```
G92X0Y0  
G41H001  
G01X.1  
Y.1  
X0  
G40Y0  
G41H002  
G01X.1  
Y.1  
X0  
G40Y0  
M02
```

In the above example, the code “FLAG7D.01250” was keyed in just below the offset header. This location is a good spot to input the value as each operator can see it easily. What will happen is H000, H001 and H002 will be increased by “.0125” so the part size being cut will change overall by “.025”.

Notes:

- The M02 code or the OFF key will cancel the effect of this code so the next program run will not be changed.
- FLAG7D code may be input more than once in a program
- Recommended to use parameter “Approach Pattern =1”

Chapter 8 TAPER CUTTING INFORMATION

Now we will discuss taper cutting. We will limit our discussions about taper cutting to machining die clearance angles. There are other applications for taper cutting, but we feel that if you understand how to machine taper for die clearance angles, you should be able to apply what you know to other applications.

The primary use for machining taper is for die clearance. You usually need some form of clearance angle on the die to allow the blanked slugs from the punched workpiece to fall easily through the die. There are several different ways to machine this taper, depending on your requirements for cycle time, clearance angle, and basic personal preferences.

TAPER CUTTING CONSIDERATIONS

Do you want Die Land? Die land (also called die life) is an amount of non-tapered area of the die. The purpose for die land is to allow the die to be sharpened (ground on the top surface) with absolutely no deviation to the size of the die opening. Depending on the taper angle, die land may not be necessary. Many companies machine only about .25 degrees (1/4 degree) taper as the angle. If your desired taper angle is this small, and if the part to be punched is relatively thick, the very small change in die opening size during sharpening will be minimal. For example, if machining .25 degrees as the taper angle, when you sharpen the die and remove .007 inch stock from the top surface of the die, the change in die opening size will only be .0000305 inch (per side). For all intents and purposes, this small deviation will not affect the performance of the die.

Knowing this, companies can save a great deal of cycle time by tapering right up to the top of the die, leaving absolutely no land. But remember, as the taper angle grows, the amount of deviation to the die opening during sharpening will also grow. You can easily calculate the amount of growth (per side) by applying this formula:

Growth (per side) = TAN of the taper angle times the amount of stock to be removed per sharpening:

How big do you want the taper angle to be? The taper angle in a die affects the strength of the die. Generally, you will want the taper angle to be at its smallest acceptable angle to keep the die strong. The desired taper angle will also affect the best and easiest way to machine the die.

Maximum Taper Angle

The maximum taper angle per side can be calculated for a particular workpiece thickness. To determine the maximum taper angle that can be cut at a given

thickness, use the following calculation (angle must never exceed 15° with standard guides).

$$\text{Max Angle} = \text{TAN}^{-1} [\text{U axis travel per side} / [\text{part thickness} + .800]]$$

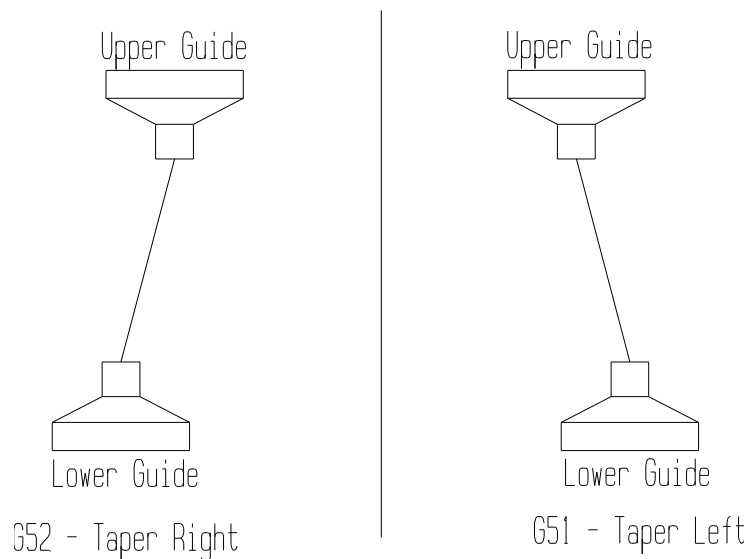
HOW TO PROGRAM TAPER

Now that you know the theory of taper cutting, you can decide for yourself which method of taper cutting is best for your particular application. We will give you the information to do it any way you wish.

As with wire radius compensation, there are three steps to programming taper:

- 1) Initialize taper (G51 for left, G52 for right)
- 2) Make machining motions
- 3) Cancel taper cutting mode (with G50)

(Notice the similarities to wire radius compensation. These commands should be easy to remember!)



Straight Wire Is G50 (Cancel)

Initializing Taper

First let's discuss initializing taper correctly. To initialize the taper cutting mode, you must look in the direction the wire will be moving during the cut (rotate print if necessary). Looking in this direction, ask yourself, "Which way does the UPPER GUIDE have to move to generate the desired taper, left or right?" If the UPPER GUIDE has to move to the left, you will use G51 to initialize taper. If the UPPER GUIDE has to move to the right, you will use G52 to initialize taper.

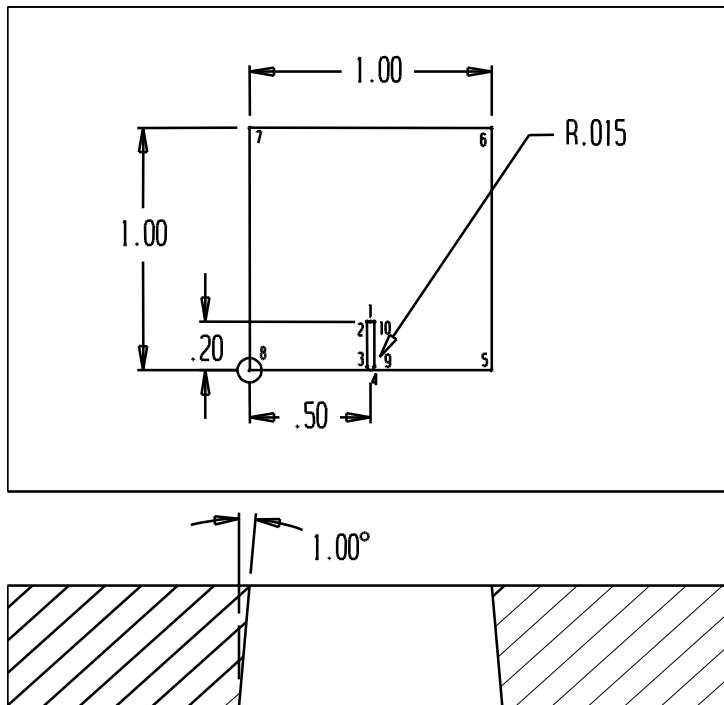
As with wire radius compensation, it is wise to set yourself a general rule to help you remember which direction you need. If you always cut dies with the top of the die UP, you will use G51 (left) whenever making counterclockwise (general direction) passes around the die and G52 (right) when making clockwise direction passes around the die. Of course, if you cut with the top of the die down, the rule will change.

Now that you can decide between right and left taper (G51 or G52), let's discuss the ANGLE you must also include in the initialization command. You will be using an "A" to command the desired taper angle. If you want to machine a half-degree taper (per side), the program needs A.5 in it. You also need to know that there is a limitation of the maximum possible taper angle on your particular machine based on part thickness. The thinner the workpiece, the greater the taper angle can be.

To initialize taper properly, you simply program the G51 (left) or G52 (right) in a command with the "A" word. Next, move to the first surface you wish to machine with taper. The control will initiate the taper DURING the movement to the first surface to cut.

After all the cutting movements have been made, you MUST remember to cancel taper cutting (with a G50 command). The control will bring the wire back to vertical during the next X and or Y movement.

TAPER PROGRAM EXAMPLE



TP1.0 (Table To Program, see next section)
 TN0.0 (Table To Next, see next section)

```

N0000 G90
N0005 G54
N0010 G92 X.5 Y.2
N0015 G29
N0020 G41 H1
N0025 G51 A1.0
N0030 C1
N0035 T84
N0040 G01 X.485
N0045 Y.015
N0050 G03 X.5 Y0 I.015
N0055 G01 X1.
N0060 Y1.
N0065 X0
N0070 Y0
N0075 X.4
N0080 M00
N0085 X.5
N0090 G03 X.515 Y.015 J.015
N0095 G01 Y.2
N1000 G40 G50 X.5
N1005 M02
  
```

At the beginning of the program, the taper registers (TP – TN) receive their values. These values may be set by this method, or they may be set manually in the “Setting” screen (see figure 8-3). We prefer to set these values by the NC program like the above example.

TAPER SETTINGS IN THE CONTROL

The screenshot shows the Sodick control interface. The top section displays coordinates (X, Y, Z, U, V) and machine status. The middle section shows various machine parameters and settings. The 'Setting' screen is highlighted in green on the right-hand side. The main display area shows parameters like AVT REFERENCE, CONNECT TYPE, and various resistivity and backtension settings. A yellow box highlights the 'TABLE TO LIMIT', 'TABLE TO UPPER', 'TABLE TO LOWER', 'TABLE TO PROGRAM', and 'TABLE TO NEXT' settings.

As you can see, there really isn't all that much to programming taper. You simply instate taper, use it, and cancel it. However, there are some machine settings that must also be made. You can find these settings in the “Setting” screen in the lower right corner. If these settings are not properly made, the resulting size of the cut will not be accurate. The control needs to know five basic things about your setup in order to form the taper correctly. They include:

- 1) Table to limit (T-Limit)
- 2) Table to upper (T-Upper)
- 3) Table to lower (T-Lower)
- 4) Table to program (T-Program)
- 5) Table to next (T-Next)

Tip: You only need to set these 2 parameters, when switching between setups.

“Table” here refers to the top surface of the pedestals. The figure below shows these relationships. A detailed description is on the following pages.

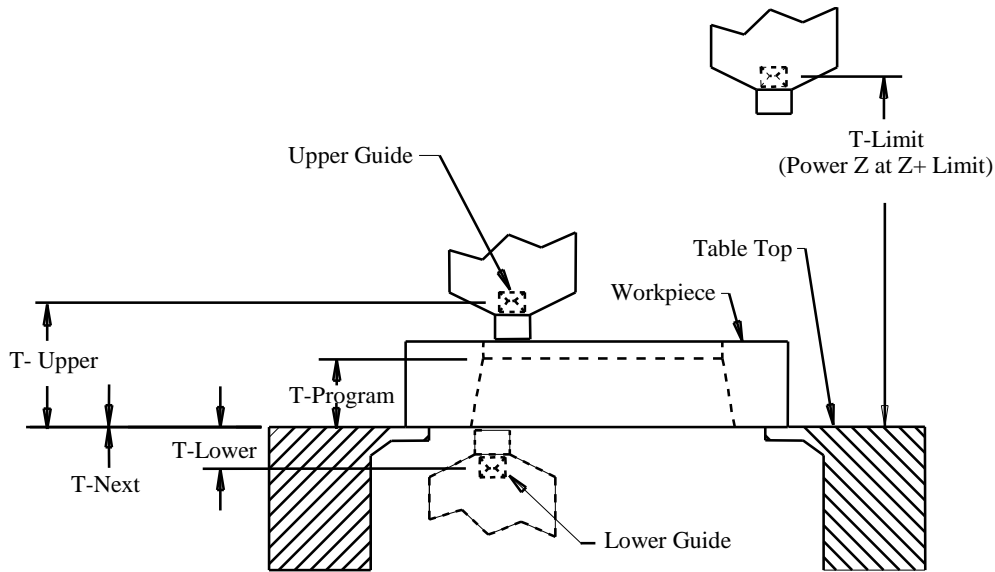


Table to Limit

Table To Limit is how far above the table the upper guide is when the head is at the upper limit switch. Table To Limit is a CONSTANT that will usually not change for the life of the machine. You will find it documented in the mechanical file printout that comes with the machine. It is wise to write down the value of Table To Limit and keep it posted on the machine for quick reference.

Table to Upper

Table to upper is the distance between the worktable and the upper wire guide. Table To Upper is automatic as the Z axis is moved up or down. The value of Table To Upper changes by itself because the machine is tracking with the Z axis.

- ✓ Make sure that “Auto T Upper” in the Manage, Parameter, Action screen is on.

Table To Lower

This is the distance from the worktable to the lower wire guide. This is a constant that will usually not change. Sodick documents this value in the list of parameters (the mechanical file) that comes with your machine.

- ✓ Table to lower is a positive number.

Table to Program

This is the distance from the tabletop to where you are holding size when taper cutting with G51 or G52.

Here are four possible situations when the workpiece is mounted directly on the table.

- 1) Cutting with the top of the die UP and you want a die land, this value will be the thickness of the part MINUS the die land.
- 2) If cutting with the top of the die UP and you do NOT want a die land, this value will be the thickness of the part.
- 3) If cutting with the top of the die DOWN and you want a die land, this value will be the die land amount.
- 4) If cutting with the top of the die DOWN and you do NOT want a die land, this value will be zero.

When 4-Axis cutting (G74)

When 4 axis cutting, this is the amount that the bottom of the part is above the worktable. Usually set to zero, as the part would be mounted on the worktable.

Table to Next

This is the distance from the tabletop to the other end of the tapered area (opposite table to program) when using G51 or G52.

When taper cutting (G51/G52)

When a die block is mounted directly on the table die face up and your holding size at the top, T- Next will be 0 and T-Program will be the die thickness. If the die face is down on the table and you are holding size there (T-Program = 0) and T-Next will be the die thickness.

When 4-Axis cutting (G74)

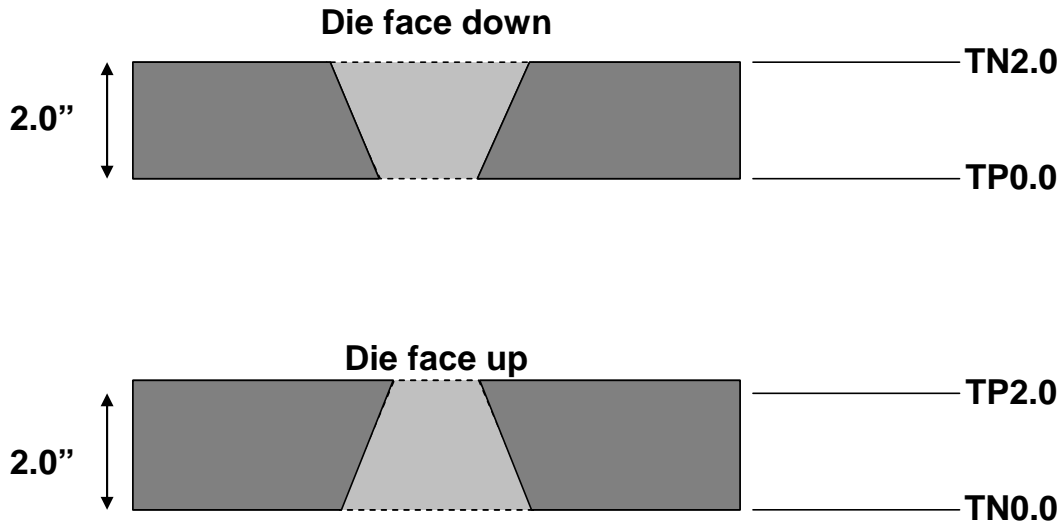
This value represents the distance from the table to the 2nd plane when you have a 4 axis (independent UV) program. When the part is on the table, Table to Program is usually 0 (1st plane) and Table to Next will usually be the workpiece thickness (2nd plane).

Note: When 4 axis cutting, it must be used. This sets the position of the u-v axis plane in your part, so set this value to the amount that the top of the part is above the table.

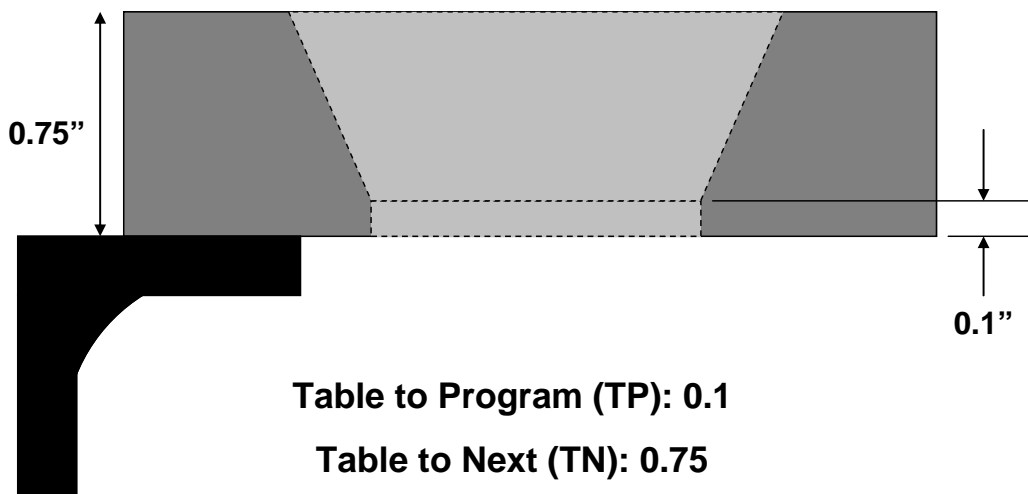
TAPER SETTING EXAMPLES

Below examples help to explain the TP and TN value setting the operator needs to input.

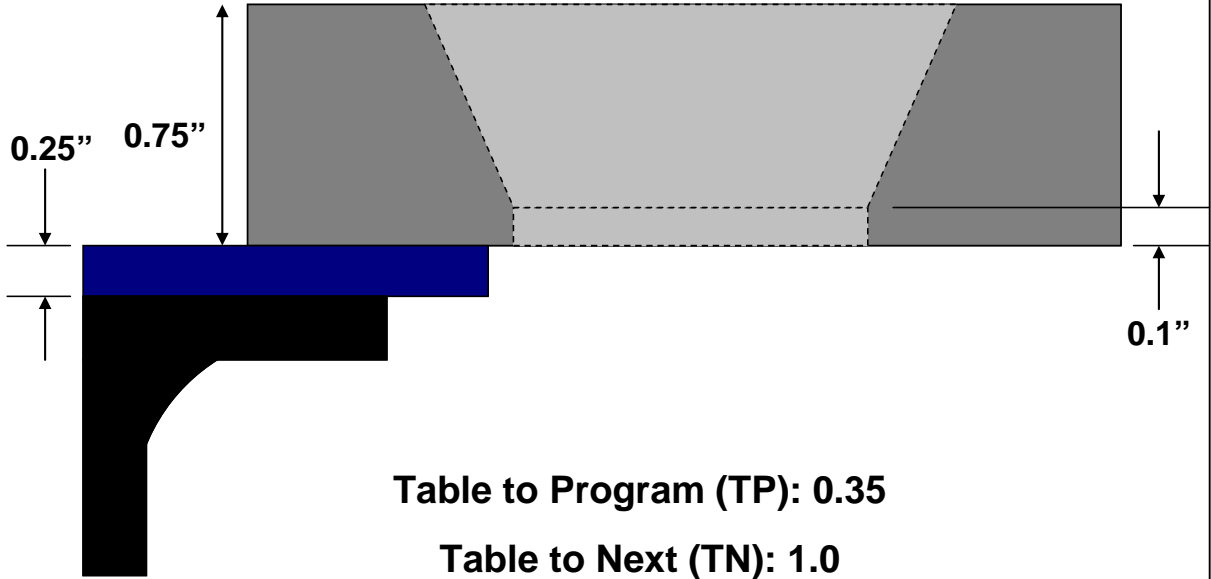
Simple taper programming scenarios:



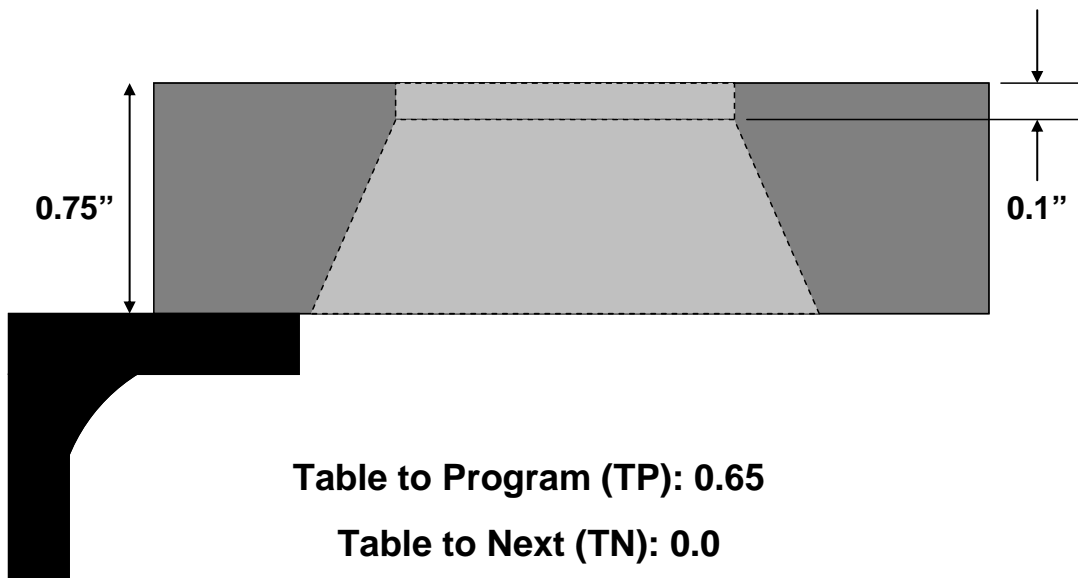
Die face down with land example:



Die face down with land and fixture example:



Die face up with land example:



TAPER SETTINGS - OPERATOR INPUT

The following is what needs to be actually input by the operator for each taper cutting job. For complete parameter definitions see prior information on pages 8-7 thru 8-9.

Taper Settings

1) Input **Table To Program** (Distance to where you are holding size from the worktable)

2) Input **Table To Next** (set to zero if T-Program is > 0)

All other settings are machine constants and should already be set.

```
(      ON OFF  IP HRP MAO SV V  SF C PIK CTRL WK WT WS WP);
C000 = 005 014 2215 000 251 040 8 0039 0 000 0000 025 160 100 040;
C001 = 012 016 2215 000 251 036 8 0039 0 000 0000 025 160 100 045;
C002 = 001 023 2215 000 750 053 7 6039 0 000 0000 025 160 090 012;
C903 = 000 001 1015 000 000 030 7 7024 0 008 0000 025 160 090 012;
H000 = + 00000.00039 (Aprch.)          ;
H001 = + 00000.00863 ( 1ST )          ;
H002 = + 00000.00600 ( 2ND )          ;
H003 = + 00000.00525 ( 3RD )          ;
H999 = + 00000.00000 ( Taper Offset ) ;
;
TP 0.0000 (ENTER MAIN PROGRAM SURFACE);
TN 0.5000 (ENTER OPPOSITE PROGRAM SURFACE HEIGHT);
;
N0010 G90;
N0015 G54;
N0020 G90 X0 Y0;
N0025 G29;
N0030 C000;
```

Insert taper settings in the NC program. Putting the values here will cause the values to go into the "SETTING" screen parameters as well as the "GRAPHIC", "FLAG" page.

TAPER SETTINGS FOR 4 AXIS CUTTING

Same as taper cutting, the TP and TN values need to be input for 4 axis cutting programs.

1) Table to Program (Distance from worktable to bottom of part)

2) Table to Next (Distance from worktable to top of part)

NOTES CONCERNING TAPER CUTTING

Calibrating T-Limit and T-Lower

If you are not cutting accurate taper angles, it is possible that the constants called Table to Limit and Table to Lower in the Setting screen need to be changed. There are programs called LNTPRDAT located on your User disk or Hard disk. This program will calculate these 2 constants. Locate this program and load it into memory, then follow the instructions at the beginning of the program. It is wise to do a test cut after this procedure is done, to verify that the machine is now cutting accurate taper angles. This is a procedure that is not done very often. Check when one of the following has occurred.

If a different wire guide is installed.

If you disassemble the upper or lower guide assembly.

If taper cutting is not accurate.

Flush Nozzles

The standard flush nozzles have a 6mm I.D. and are used when cutting up to 10° taper. If 0° to 15° is being cut, flush nozzles with a larger I.D. (10mm) should be used. If over 15°, flush nozzles with a larger I.D. should be used. Verify by dry running the machine, that the wire does not contact the I.D. of the flush nozzle. If the wire is contacting the I.D. of either flush cup, a larger flush cup is needed.

Wire Type considerations for steep angle cutting

At steep angles, if there are lines on the part from wire vibration, try using a soft wire like Gisco Mega cut W, or Gisco Berco cut 390 or 490 to eliminate the lines. These wires have more elongation and will flow through the wire guides better at taper angles of more than 10 degrees.

Converting To Decimal degrees

To convert the minutes and seconds of an angle given in degrees, minutes, seconds to the decimal equivalent (without this function on your calculator).

$$\text{Decimal equivalent} = [\text{Min} / 60] + [\text{Seconds} / 3600]$$

Graphics Colors

When drawing or viewing the graphic picture of a program with taper, the screen will show 2 colors. While running a taper program, there will also be 2 asterisks following the graphics drawing.

Green = top of workpiece

Blue = bottom of workpiece

AUTOMATIC CORNER ROUNDING

This feature was discussed during our descriptions of motion types (concept number three about G02 and G03 circular commands.) Here we will take it a little further. However, remember that these techniques may not perform the desired taper for die machining. If you use these techniques, the radius at the top of the die will match the radius at the bottom of the die. The use of G02 and G03 with the I and J is a better method for making circular movements on a die, since the radius will grow with the taper in the die. However, if you are programming shapes that do not require conical taper or no taper at all these techniques can make manual programming much simpler.

The basic idea with automatic corner rounding is that you are allowed to program directly to the intersection point of two surfaces and simply include an “R” word (for the desired radius) in the command to the intersection point. The control will automatically start rounding when it approaches the intersection point.

Taper Cutting With The R Code

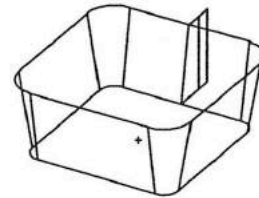
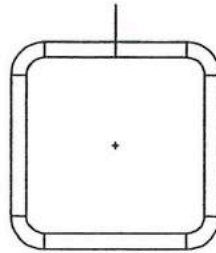
Notice with automatic corner rounding that block number N0011 included an R word to tell the control to start rounding as it approached X-.5. Also notice that the X-.5. is the intersection point to the next surface to machine. While this technique is quite simple to understand, remember the limitations related to taper cutting. You may be tempted to use this technique to program a punch (since a punch does not have any taper). But many times you will want to use the punch program to make the die program. In most cases you will have to use G02 and G03 to accomplish this.

NOTE: Offset code G41 (or G42) is required in the program for the R word to work. If you want to cut without offset, simply include the G41 (or G42) code and use H000 for the offset value.

```

"N0002 (MAIN PROGRAM);"
"N0003 G54 G90;"
"N0004 G92 X0. Y.8;"
"N0005 G29;"
"N0006 T84;"
"N0007 C511 H1=.0061;"
"N0008 G42 G52 A0 H0;"
"N0009 G01 Y.5;"
"N0010 A10.0 H1;"
"N0011 X-.4;"
"N0012 G03 X-.5 Y.4 I0. J-.1;"
"N0013 G01 Y-.4;"
"N0014 G03 X-.4 Y-.5 I.1 J0.;"
"N0015 G01 X.4;"
"N0016 G03 X.5 Y-.4 I0. J.1;"
"N0017 G01 Y.4;"
"N0018 G03 X.4 Y.5 I-.1 J0.;"
"N0019 G01 X0.;"
"N0020 A0 H0;"
"N0021 G40 G50 Y.7;"
"N0023 M02;"

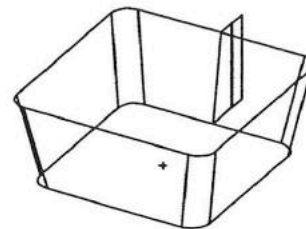
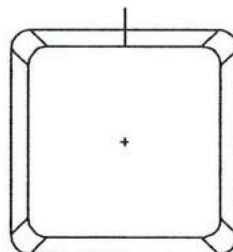
```



```

"N0002 (MAIN PROGRAM);"
"N0003 G54 G90;"
"N0004 G92 X0. Y.8;"
"N0005 G29;"
"N0006 T84;"
"N0007 C511 H1=.0061;"
"N0008 G42 G52 A0 H0;"
"N0009 G01 Y.5;"
"N0010 A10.0 H1;"
"N0011 X-.5 R.1;"
"N0012 Y-.5 R.1;"
"N0013 X.5 R.1;"
"N0014 Y.5 R.1;"
"N0015 X0.;"
"N0016 A0 H0;"
"N0017 G40 G50 Y.7;"
"N0019 M02;"

```



Chapter 9 MISCELLANEOUS OPERATING AIDS

Operating aids are available to simplify programming and operating the machine. There are more capabilities you need to know about to make running the machine easier. The following aids are what we will look at in this section of the course.

SUBROUTINES

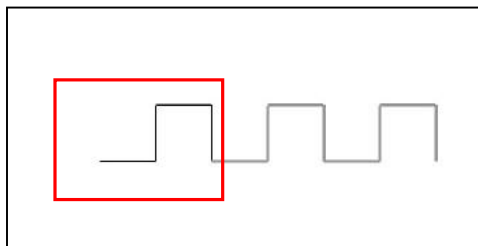
The M98 code can be used for calling up a program. Typically this command may be used to make a program shorter or if you want to loop a certain section of your program.

Subroutines involve four programming words:

- 1) M98 - Jump to a sub routine
- 2) M99 - Return to the main program
- 3) P - Sequence line number to jump to (needs 4 numbers)
- 4) L - Loop the sub routine how many times?

The M98 command will ALWAYS include a P and 4 numbers to tell the control which line number to go to. When the control reads M98P1000 for example, it jumps to sequence number N1000 in the subroutine and continues executing from there. When the control reads the M99 from the subprogram, it jumps back to the main program to the command AFTER the M98 P1000 and continues execution of the main program.

```
(Main Program)
N0000
M98P1000 L3
M02
;
N1000
G91
G01X.1
    Y.1
    X.1
    Y-.1
M99
```



- ✓ The parameter "RAM LINK" allows the control to search the entire memory for the N1000, if turned ON.

Q ROUTINE TECHNIQUES

A Q routine is an operating aid, which allows the programmer to call up another separate nc program by filename from within a main-program. The Q'ed up program will be a separate file or program, sometimes referred to as a macro. The program "Q"ed up can reside either on the hard disk or in the memory. Below is an example.

```
G54 G00X0Y0
QPROGRAM1
G55 G00X0Y0
QPROGRAM2
M02
```

The above main-program starts by moving to G54 X0Y0 and then executes the nc code with the title "Program1". Once that file ends with M199 code it returns to this main-program and moves to position G55 X0Y0 and then calls up nc code titled "Program2".

Q file ending code

A Q routine can be written similar to any other program you have seen so far with one exception. A Q routine needs to end with the code M199. If the Q file were to end with an M02, the machine would stop and say program end. Usually you would like the Q file to return back to the program which had called it up.

- ✓ File name must be 8 letters or digits maximum (no long filenames)
- ✓ The Q – macro must end with M199 code.
- ✓ Q function can also be used from the MDI screen

MIRROR IMAGE AND AXIS EXCHANGE

There are several G codes involved with these features:

G05 - Turn on X axis mirror image (X axis changes RED)

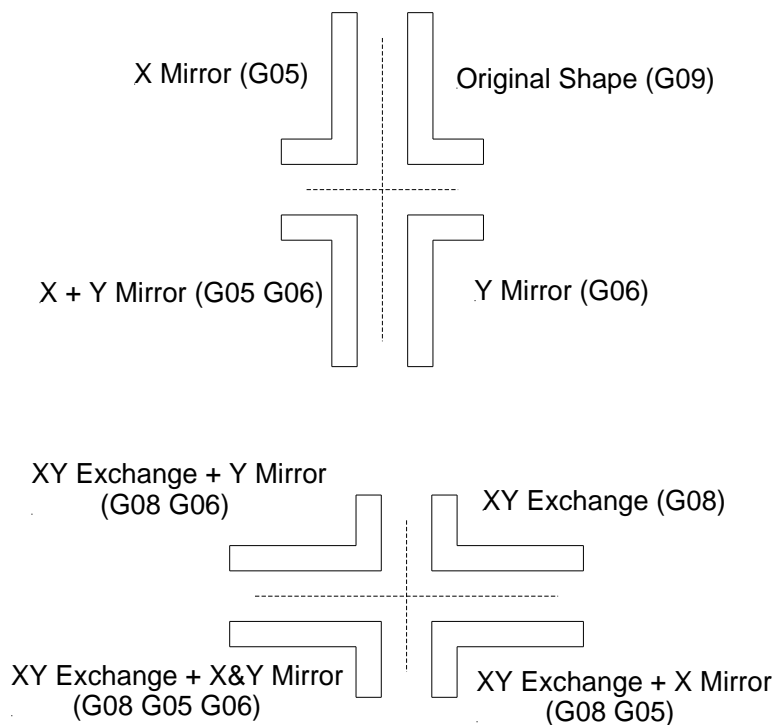
G06 - Turn on Y axis mirror image (Y axis changes RED)

G08 – Turn on X Y axis exchange (XY axis changes to lower case xy)

G09 - Cancels codes G05, G06 and G08.

When you are finished using mirror image or axis exchange in a program, you **MUST** remember to cancel them (with G09.) We recommend placing the cancellation command just prior to the M02 (end of program.) If you forget to cancel these features prior to the end of a program, you will receive no alarm, but the machine may still be under the influence of the features programmed, meaning your next job may be incorrectly run.

Mirror Image And Axis Exchange Chart



- ✓ When taper cutting, confirm the taper angle is programmed the correct direction after turning on mirror codes.

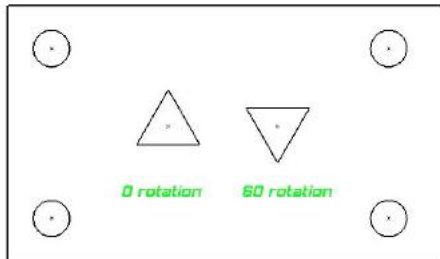
AXIS ROTATION

The machine has 2 types of rotation, Figure rotation and coordinate rotation.

FIGURE ROTATION: G26 / G27 codes.

This function is used to rotate a programmed shape about the G92 position within a coordinate system. This function is only active while the program is running. If OFF is pressed, or M02 is reached, the rotation turns to 0 automatically.

The triangle on the left below was the original program. The triangle on the right is made using the original program and adding 60 degrees rotation to it.

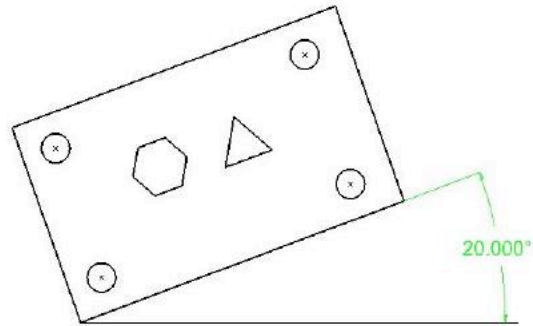


```
G26 RA60.0  
G90  
G92X4. Y2.  
...  
G27  
M02
```

- ✓ Jog keys are not rotated with this function.
- ✓ The present rotation is displayed on the "Display" "Status" screen.
- ✓ No maximum limit
- ✓ G26 code is incremental. Each time the active program reads a G26 code, the RA value is added to the present value. This used to be used for gear programming (this example is in the code instruction manual from the machine).

COORDINATE ROTATION: G126 / G127 codes.

This function is used to rotate the coordinate system. This is used in the Tilt Offset screen when you want to align the machines axis with the workpiece. This rotation stays active until the **G127** code is used.



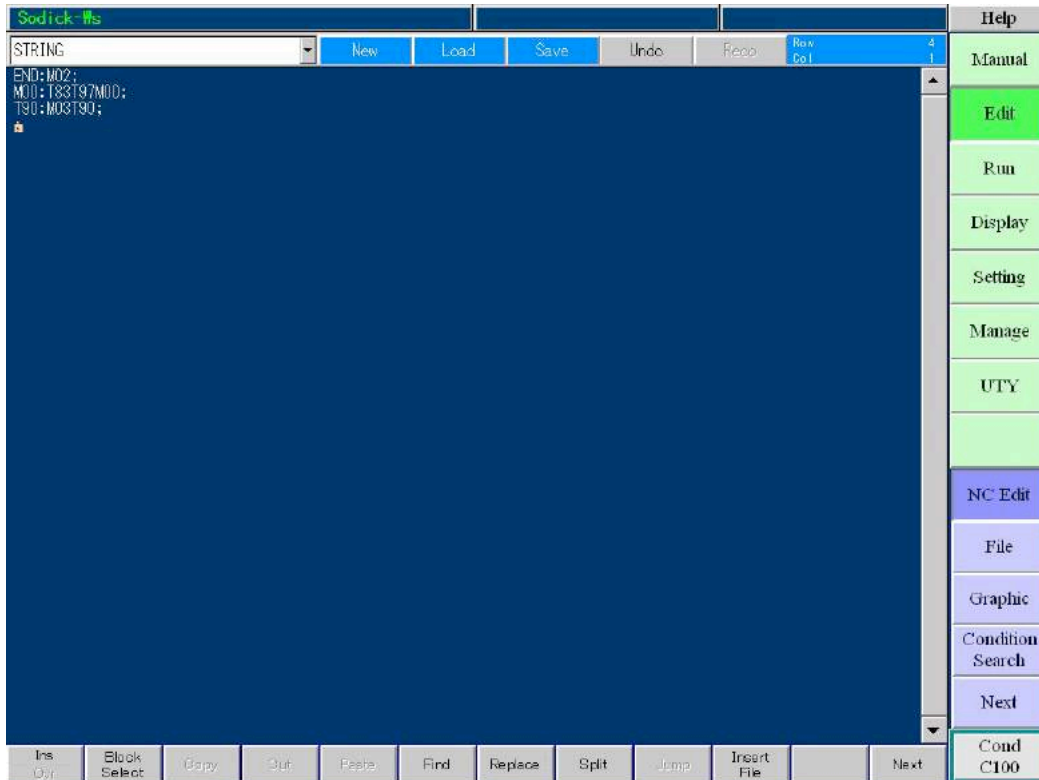
Program Code Example:

```
KA20.0  
G126  
...  
G127  
M02
```

- ✓ Jog keys are rotated when this function is used
- ✓ The present rotation is displayed at the top middle of the "RUN" screen.
- ✓ Recommended maximum value to use is 45 degrees.

STRING FILE

The string file is a converter or translation file. It lets the Sodick machine read and execute commands that it would not normally recognize.



In the above example string file, the following changes have been made.

- END: This word now equals M02 (program end)
- M00: Now M00 code will also open the drain and stop fill pump.
- T90: will also use the M03 AWT skip code.

NOTE:

- ✓ The control uses the string file, which is stored on the hard disk, not the one in memory.
- ✓ If you have to change the string file, change it in the edit screen, and then be sure to save the file back to the hard disk for the changes to take effect.
- ✓ String pattern in the Setting, User 1 screen needs to be set to 1, which activates the string file.

NOTES ABOUT DRY RUN

Always dry run the program when all axes are in the proper start point location. This is your last chance to catch any mistakes. Here is how Dry Run works in its three forms:

Dry Run Modes

- Dry Run 1: No sensor touch. If the wire hits something, it will break. Used for when you want to DRY RUN back thru an existing kerf. All axes motors run, all limit switches are checked.
- • Dry Run 2: Sensor touch enabled. If the wire or heads touches something, an alarm will sound. Used if you are trying to insure that the wire and heads will not run cut into a clamp, fixture etc. All axis motors run, all limit switches are checked.
- Dry Run 3: Table to Draw enabled. The “ z plane” being drawn by the motion of the x-y axis on the plotting table will be specified by Table to Draw in the Setting screen. Only X and Y-axes motors move in Dry Run number 3.

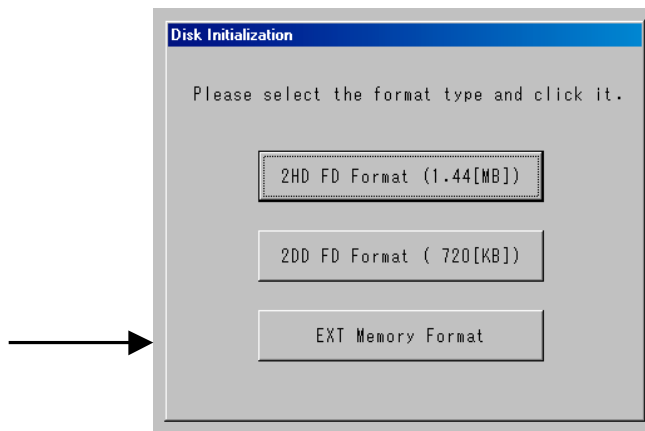
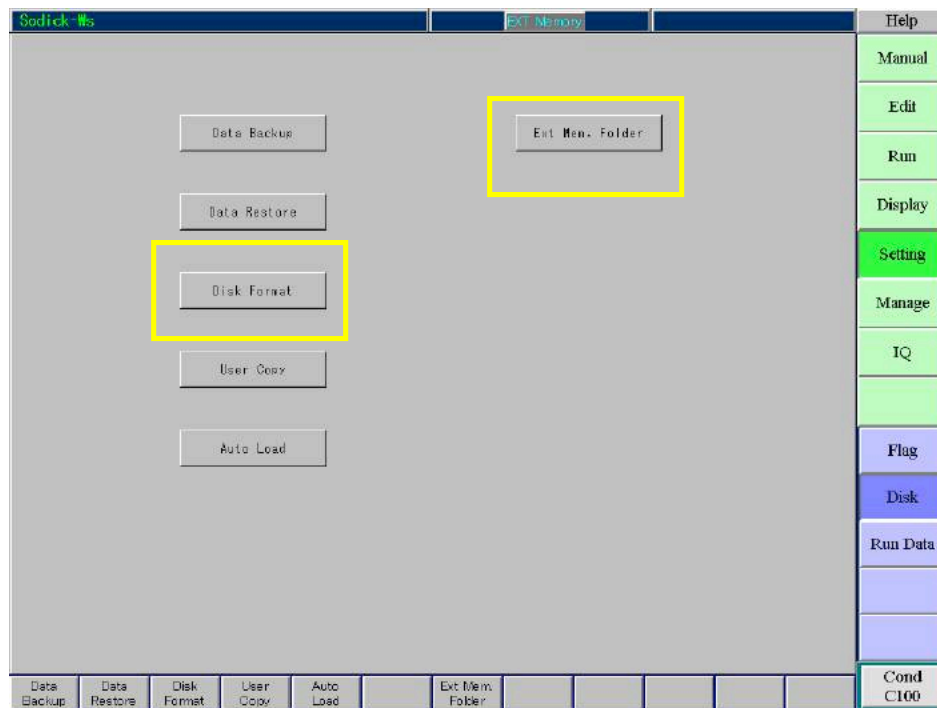
Partial Dry Run

Check setting screen “Manage” – “Parameter” – “Cutting” Block Dry Change = 1. If you need to abort your program and restart it from the beginning, sometimes it is wise to start it with dry run=1. Then once you are close to where it was aborted you can switch dry run=0. Please 1st check the parameter setting above, and then the control will allow you to use this function.

Dry Run Speed

The Dry Run speed can be controlled by the selection of the “MFR” 0 to 3 key. These keys work the same for Dry Run as they do for jogging the machine, 0 = fastest, 3 = slowest.

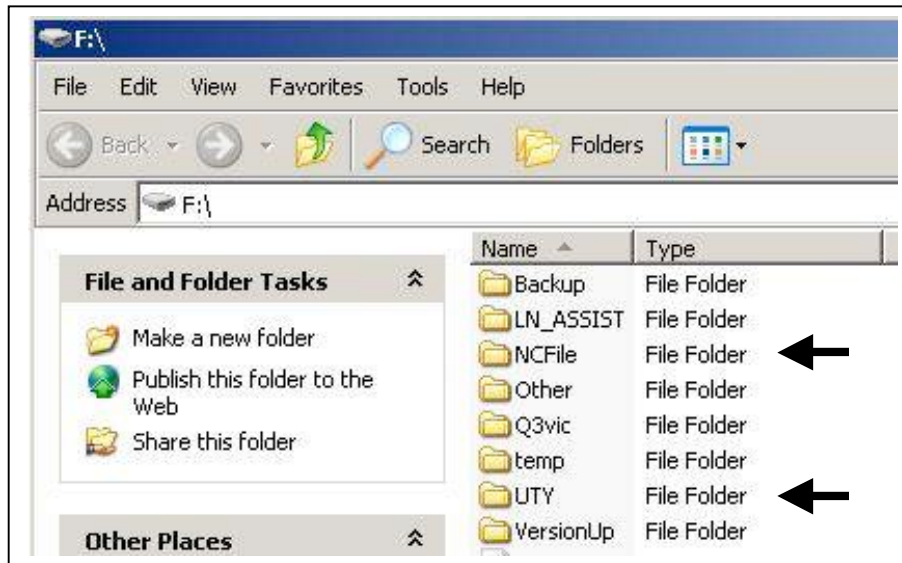
FORMATTING EXTERNAL (USB) MEMORY



1) EXT Memory Format: Formatting of the USB drive is not required unless you wish to remove all data from the drive.

2) Ext Memory Folder: After formatting the USB drive, or if you receive a new drive, you will need to create the folder structure on the drive with this button. The USB device supplied with the machine should already have the folders structure setup.

USB FOLDER STRUCTURE



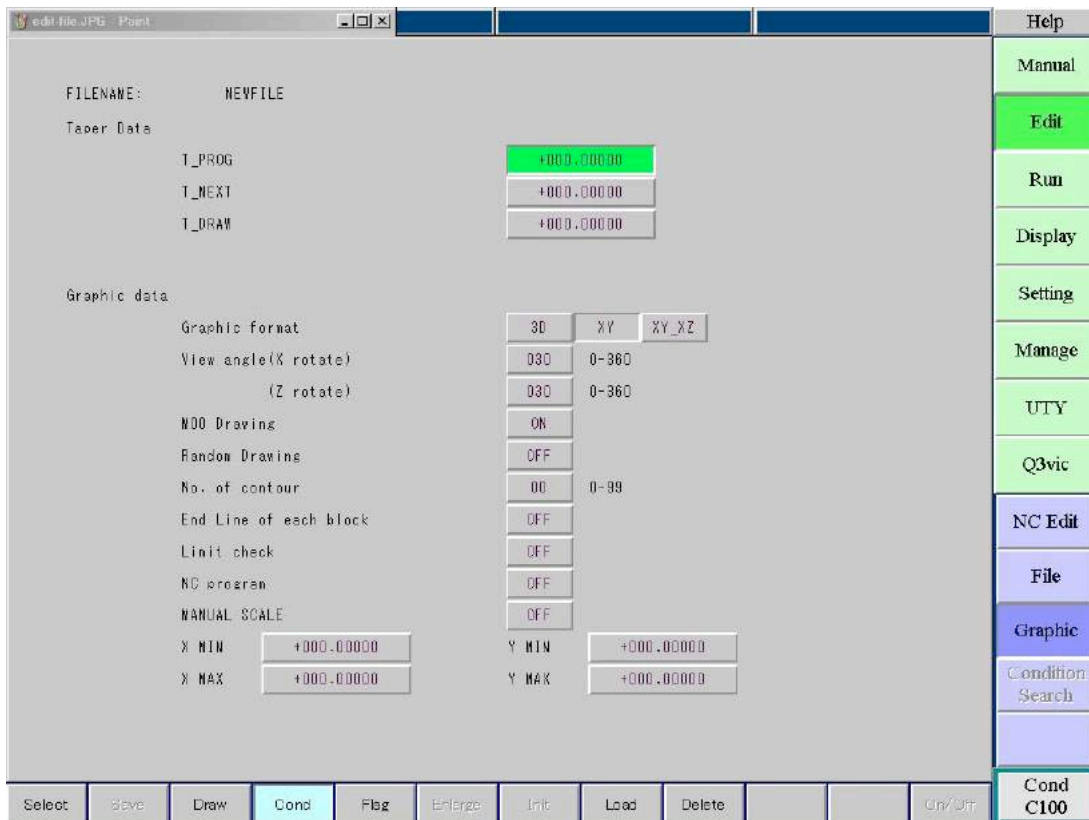
USB Folder Structure as seen in windows explorer.

When you hit the “Ext Mem Folder” button, then the system creates the folders as seen above, on the USB stick. For the AQ and AD model machines the following folders are used as described.

Backup: Parameter screen backup data.
NCFile: Storage folder location for NC cutting programs.
UTY: Used for DXF file transfer into HeartNC.

DRAWING GRAPHICS

The CNC Program must be loaded into Memory before this procedure is done.



16 Press the soft key next to **EDIT, GRAPH**

16 Set the graphic parameters the way you want.

If you are taper cutting you must enter a value for T_PROG and T_NEXT

16 You may need to press "**FLAG**" to set additional parameters like mirrors, scale factor, graphic single run, etc.

16 Choose **DRAW** from bottom menu. (graphics should be shown).

- If the alarm, same data are set in the T-P and T-N appears, go back to Edit, GRAPHIC and look at T- program and T- Next. They cannot be the same. Set them correctly and retry step 4.
- If you get the alarm, UV presently not zero, the U and or V axis display is not zero. Correct this by going to Manual, MDI and type G00UV then G92UV.

16 Once you get the picture on the screen press **SAVE** (this must be done to allow you to see the graphics while burning).

16 If needed you can use the **ENLARGE** button to zoom up on a specific section of the drawing (see below picture).

Note: If the program has a M00 or M01 at the end of the NC line, it may not appear in graphics. If on a line by themselves, they will appear.

Example:

(may not appear in graphics)

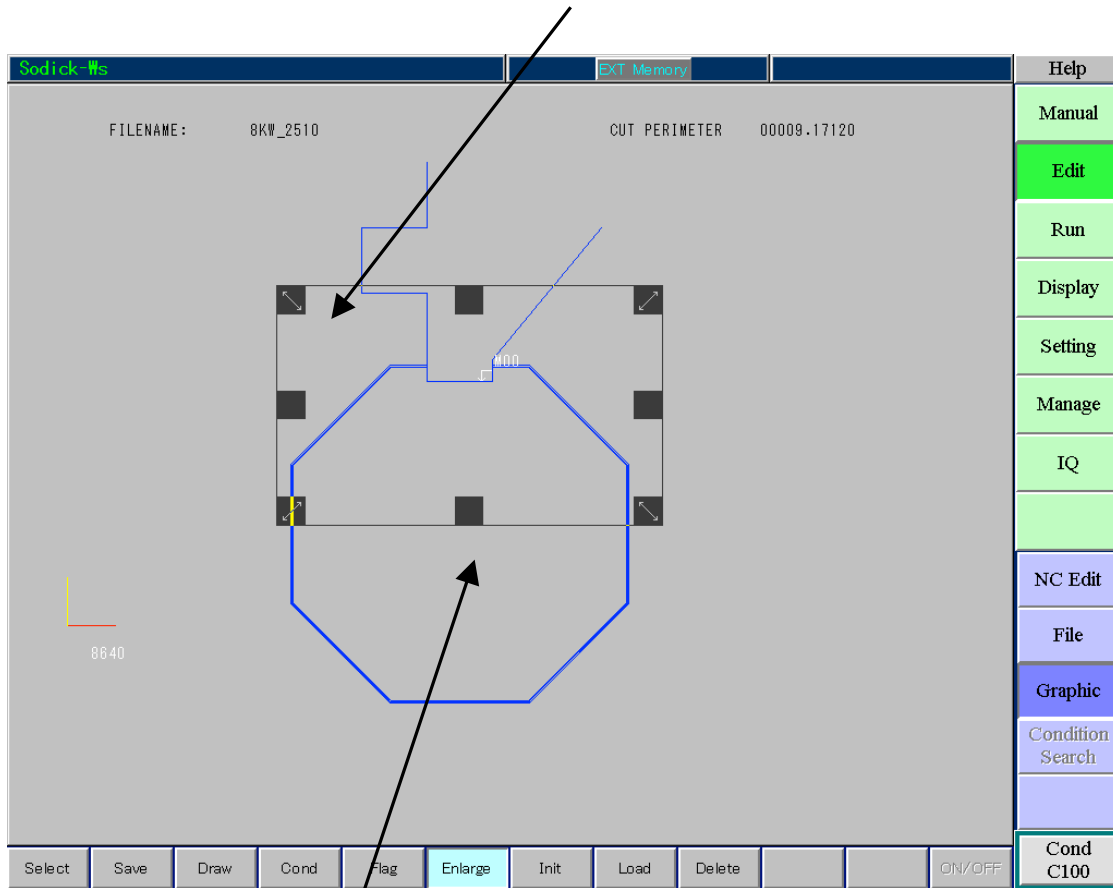
N0123 G01X12.354 M00

(will appear in graphics)

N0123 G01X12.354

N0124 M00

To enlarge the drawing, click and drag on these corner handles to indicate the new viewing area.



To enlarge a different area of the drawing, click and drag on these handles to move the enlarge box over the section you wish to zoom up on.

MANUALLY ADJUSTING FLUSHING

To set the flushing flow-rate there are 2 clear flow meters on the front of the machine with adjustment knobs. The flow meters have a scale measuring liters of flow per minute. Each meter has a float inside of it. When reading the clear flow meters, read the top of the floats position. These valves control the amount of flushing flow going to the flush nozzles. There are separate adjusters for high and low pressure. The upper 2 brass adjusters are for setting the low-pressure (T85) flow. The 2 black adjusters directly on the flow meters are for setting the high-pressure (T84) flow.

- When skim cutting, about 1.5 L/min. of flow should be used.
- When rough cutting, about 4 to 12 L/min of flow should be used.

A combination of the cutting condition parameter “WP” and the flow adjuster knobs will be used for setting the flow rate.

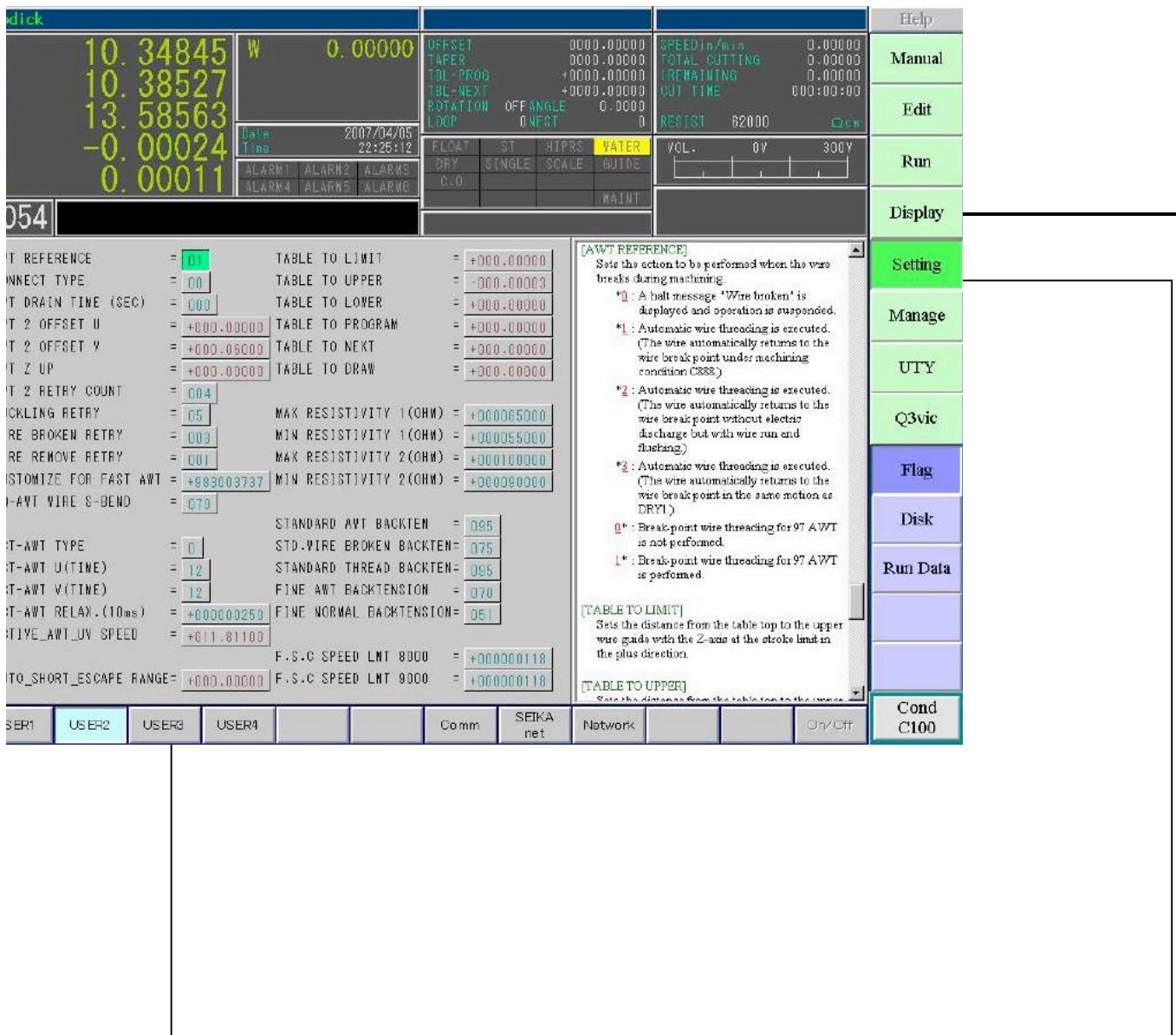
If the flushing nozzles are close to the workpiece, turn the black adjuster knobs CCW all the way open. This will give maximum flushing flow and is desirable for rough cutting. If the flushing nozzles are positioned AWAY from the workpiece =(flushing is not perfect), turn the valve knobs CW restricting the amount of flow to 8-10 L/min. on the clear flow meter. Too much flushing in this situation could create unstable cutting or splashing out of the worktank.



SETTING, USER 1 SCREEN

- SKIP - This manually turns on or off the block skip slash code in the program. This is the G11- G12 code if you want to program it.
- NOMAN - When at 1 and an M02 is read, the power is turned OFF; like pressing E Stop button. Dry Run must be 0 for this to work. At 0, the power stays on.
- N-STOP - When turned on, program runs until the line before “N DATA” number.
- N-DATA - Insert sequence line of the NC program you want to stop on. Must have “N-STOP” turned on.
- DRY RUN
 - 0 = Dry run turned off.
 - 1 = Dry run on without sensor touch.
 - 2 = Dry run on with sensor touch.
 - 3 = Dry run on with XY axis moves of “TABLE TO DRAW” in SET Screen. Use this to plot out the taper at different Z heights.
- SINGLE - When ON, the machine executes one line of NC code and stops.

- X-Y CHANGE - When ON, the X Axis becomes Y and the Y Axis becomes X:
- MIRROR X - When ON, it flips the program in the X-axis.
- MIRROR Y - When ON, it flips the program in the Y-axis.
- MIRROR Z - Not Used
- SCALE - Scale factor 1000 is full size, 0500 is half size.
- OPTIONAL STOP - When there is an M01 in the program, the machine stops there when this is turned ON and does not stop if turned OFF. If you want, program it into the NC program before the line containing the M01.
- STRING PATTERN – 1 activates the string file. Normally at 1.
- A CIRCLE POINT - When using G02 and G03, it compares the radius at the start and end points. If within the value specified in this parameter, the program will run.
- Z RETURN - Usually 0
 - 0 = When the program is stopped by HALT, M01 or M00, and the Z axis is moved and RST is pressed, Z returns to position.
 - 1 = If M01 or M00 is read and the Z axis is moved and RST is pressed, the machine cuts with Z axis moved. If HALT is pressed and Z axis is moved and RST is pressed, Z returns to position before restarting.
 - 2 = If M01 or M00 are read, and Z axis is moved and RST is pressed, Z returns to position before restarting. If HALT is pressed and the Z axis is moved and RST is pressed, it cuts with the Z axis moved.
 - 3 = Z never returns if moved from the original position.
- MACHINING HISTORY - Sets whether or not to automatically record operational history of your NC programs which were run.
 - 0: History is off.
 - 1: History of cutting time and date is recorded
 - 2: History of time, date, error, and condition modification is recorded.
- CHECKING INTERFERENCE – While cutting, if there's a smaller radius than the offset amount on an inside corner, the wire will dig into your workpiece. This is usually undesirable.
 - 0 = G131: The control ignores the situation & digs into the workpiece.
 - 1 = G136: If that situation can happen, the control will stop and tell you the offset will create interference to make you aware of it. Recommended setting
 - 2 = G132: The control decides how to correct the situation and the program continues without warning you. You must decide if the correction is acceptable.
- CONDITION CHANGE – Sets whether or not to update the active file or COND file when a called machining condition is modified in the machining condition window.
 - 0 = no update
 - 1 = update all



- **AWT REFERENCE**

- 0 = Wire break recovery turned off .If the wire breaks the machine stops.

- 1 = Wire-break rethread enabled. After threading the wire at the start hole it will return to the break point with C888 power.

- 2 = Wire-break rethread enabled. After threading the wire at the start hole it will return to the break point by dry-run. The dry run return speed is set by the parameter “Wire broken retry speed” located on the “Setting – Motor” screen.

- **AWT DRAIN TIME (SEC)**

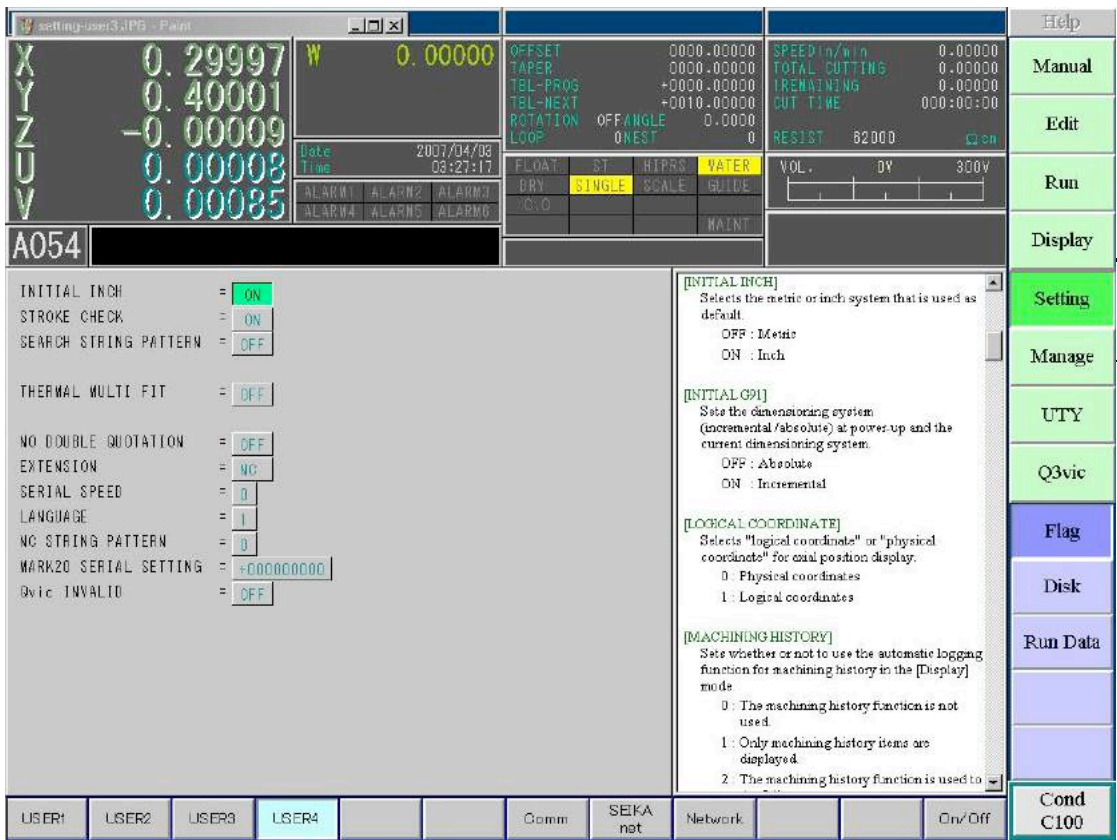
- 0: Water is not drained before threading the wire.

- Other than 0: Water is drained for the specified length of time.

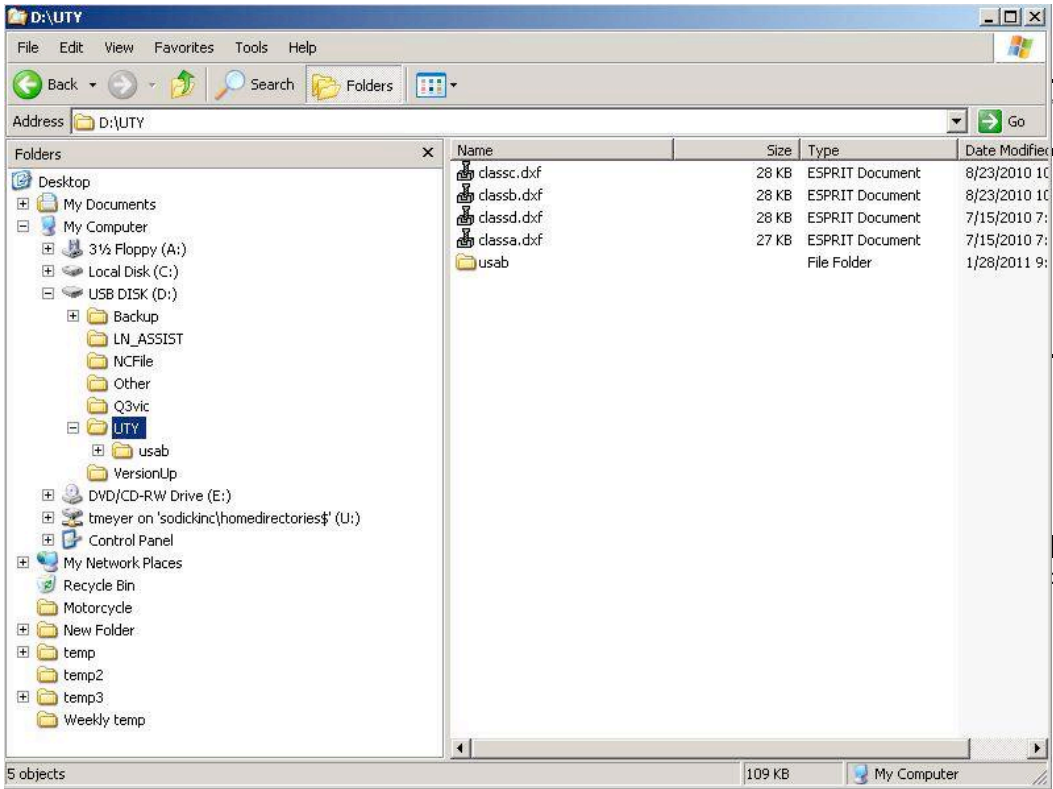
- ✓ Set to 25 seconds. Add 6sec/inch of part thickness.

- **AWT 2 OFFSET (UV):** The distance by which to offset the U/V axes for the AWT thread cycle. This offset aims the water jet at the lower guide. This needs to be set correctly for the AWT to work.

- **AWT Z UP:** This parameter is used to set the distance that the Z axis will raise if the wire breaks. If used, the Z axis raises after the wire breaks, but before the X and Y move back to the AWT rethread point. This may be used if the upper head has to clear a clamp as it travels back to the rethread point. If it is needed, enter the amount in inches (or mm) that you need the Z axis to move up. Normally set to 0
 - ✓ Not used if there is taper in the program.
- **AWT 2 RETRY COUNT**
Sets the maximum number of times automatic wire threading may be repeated after exceeding Buckling Retry value, in a single AWT operation.
- **WIRE BROKEN RETRY**
Sets the maximum number of times wire breakage may occur during the execution of one block of commands. If wire breakage occurs repeatedly, exceeding the number of times set here, the machine stops and waits for the [ENT] switch to be pressed.
- **WIRE REMOVE RETRY:** This parameter controls the number of times the wire tip remover operates after each wire break. Using this feature reconditions the end of the wire allowing a more reliable rethread operation. Normally set to 1.
 - ✓ 0: Do not execute wire tip removal operation.
 - ✓ 1 to 999: Number of times to execute the wire tip removal operation.
- **AUTO SHORT ESCAPE RANGE:** When starting a cut, the wire must not be touching the workpiece. If the wire is touching, and the setting is --
 - ✓ 0: Machine stops with yellow bar message about short circuit.
 - ✓ .0001 or higher: the machine will move within this setting range to make the wire clear the workpiece. If it cannot clear the short itself, it stops with a yellow banner for you to move the machine so the wire is clear, and press "ent" to continue.
- **MAX RESISTIVITY 1:** Water resistivity setting – usually 65000
 - ✓ Super Pika option set to 100000
- **MIN RESISTIVITY 1:** Water resistivity setting – usually 55000
 - ✓ Super Pika option set to 95000



- **INIT INCH** For Inch mode use ON. For metric mode use OFF. If you change units, you will be prompted to reboot the machine. You will need to do this reboot for the change to take affect.
- **STROKE CHECK** – When on, will allow control to determine if the input data for a position move exceeds the stroke of the machine.



C

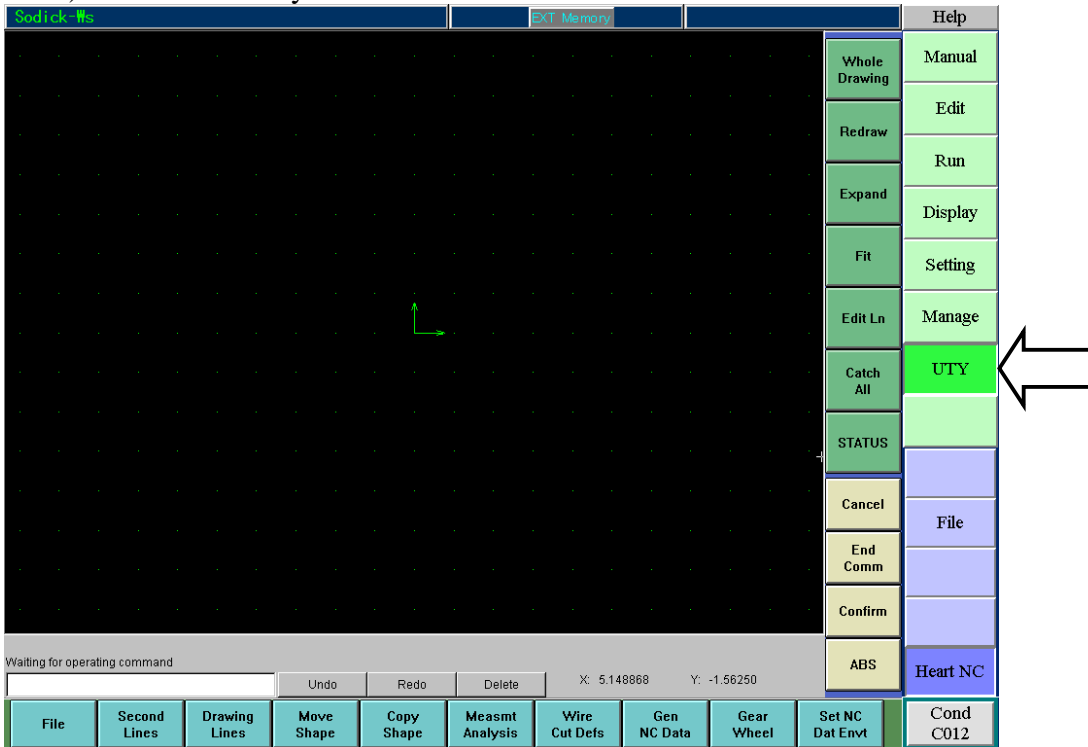
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memory stick. Your
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%\$#@)

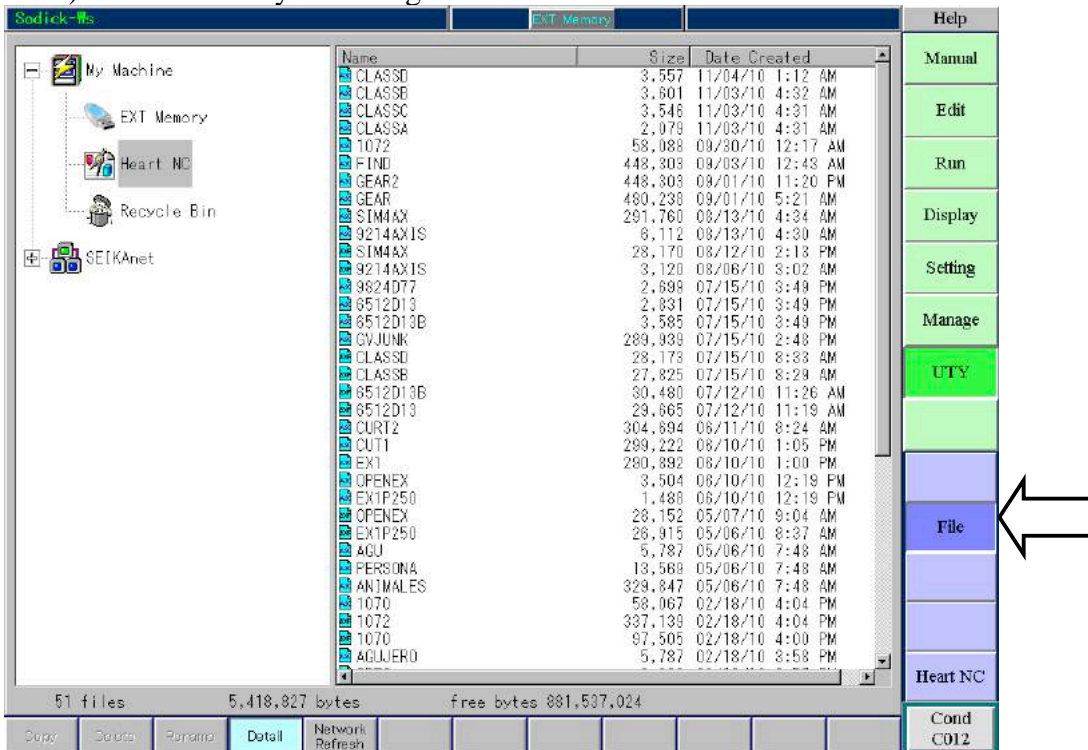


LOADING DXF FILE

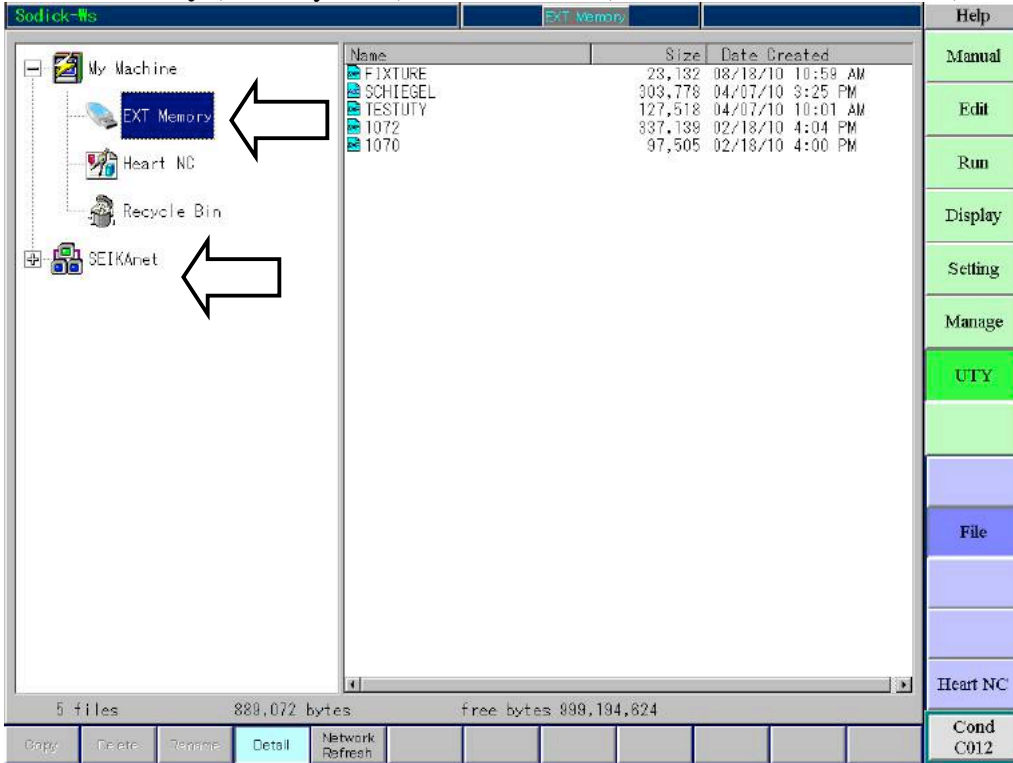
1) Click **UTY** Key



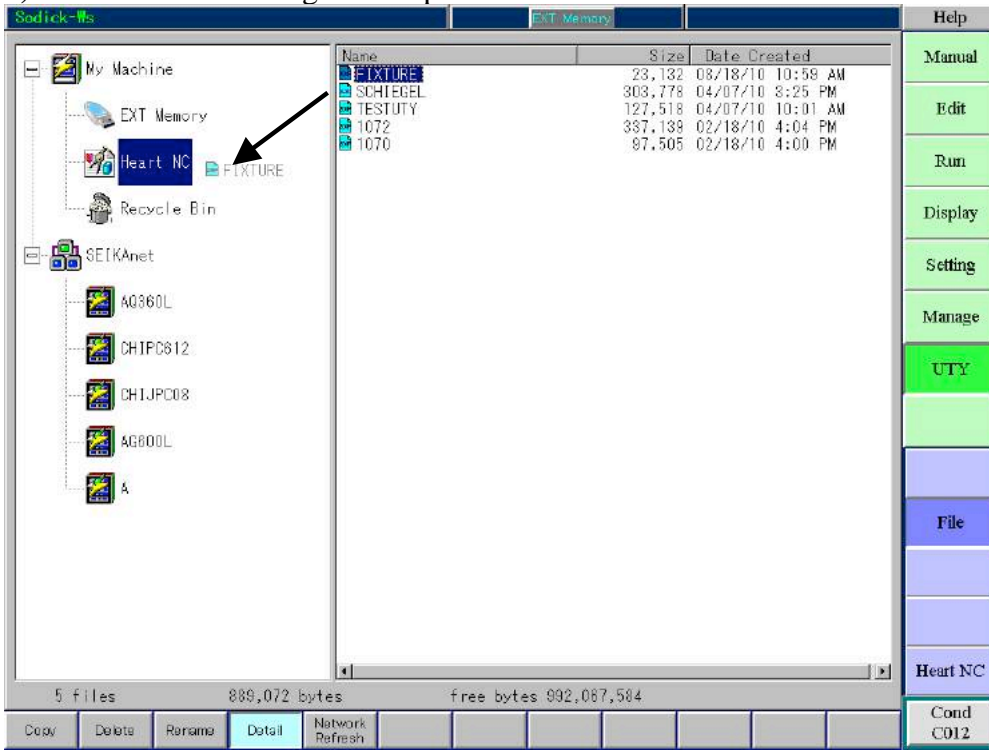
2) Click **File** Key on the right.



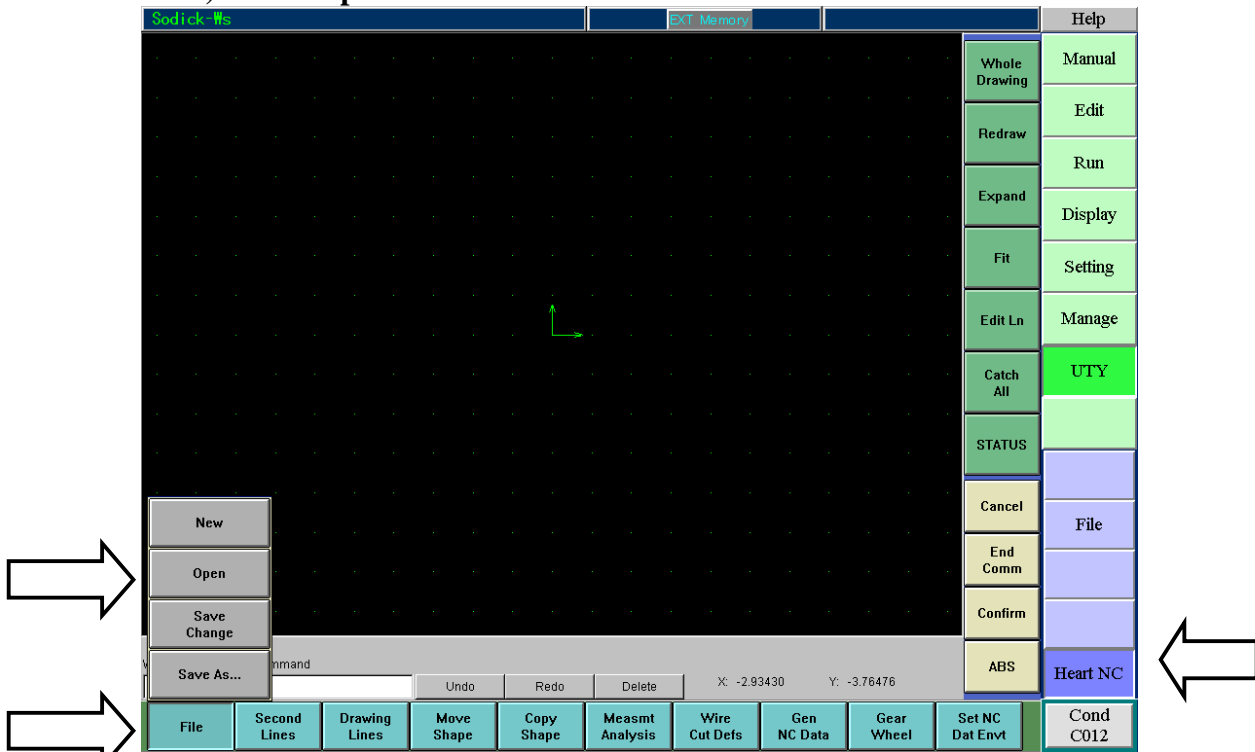
3) In the directory tree on the left, Pick where this file is originally stored
EXT. Memory (memory stick) or **SEIKAnet** (network 3D_DATA folder)



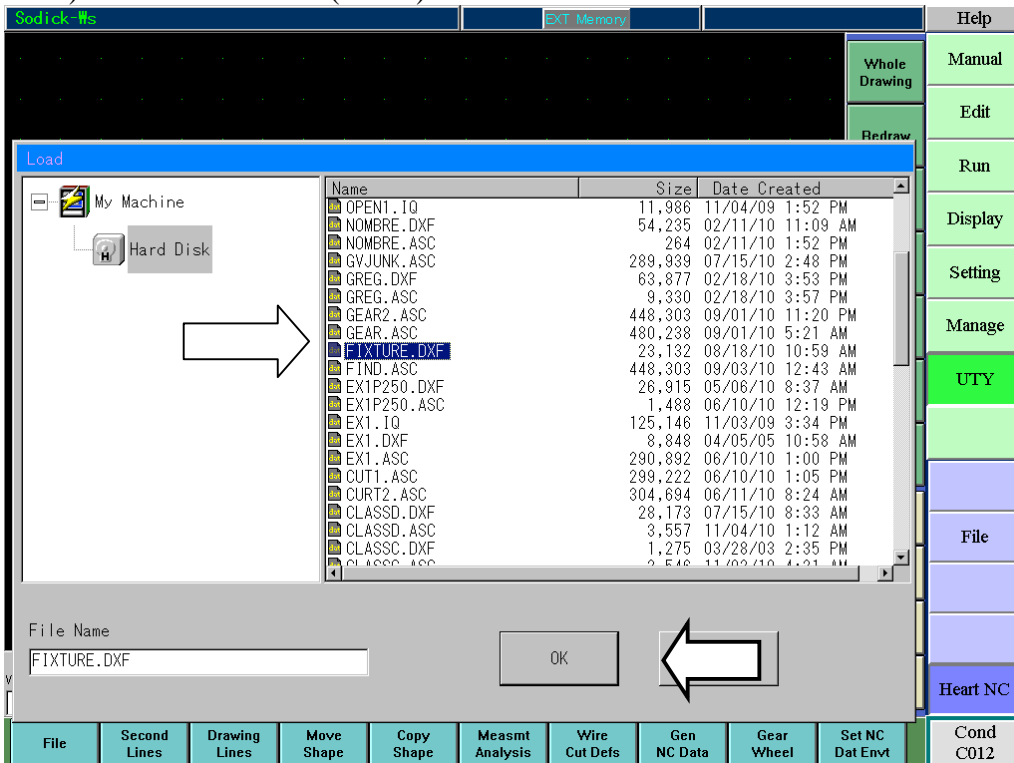
4) Choose file and drag and drop into **HeartNC**



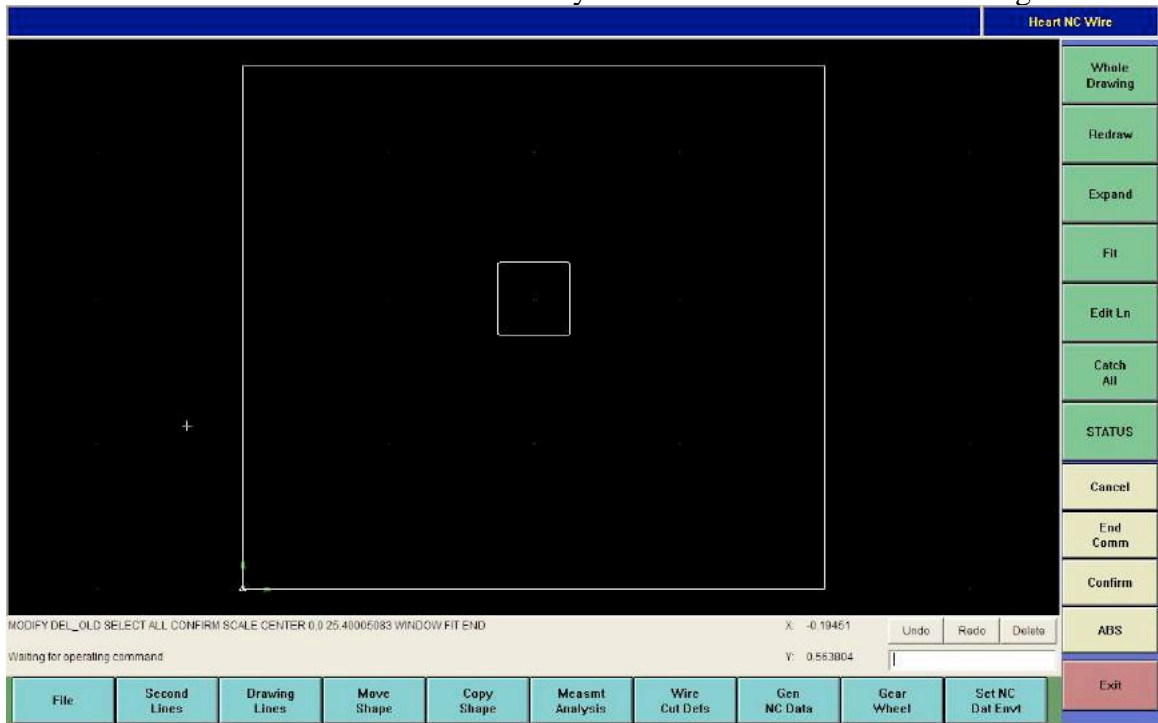
- 5) Click **Heart NC**
- 6) Click **File**
- 7) Click **Open**

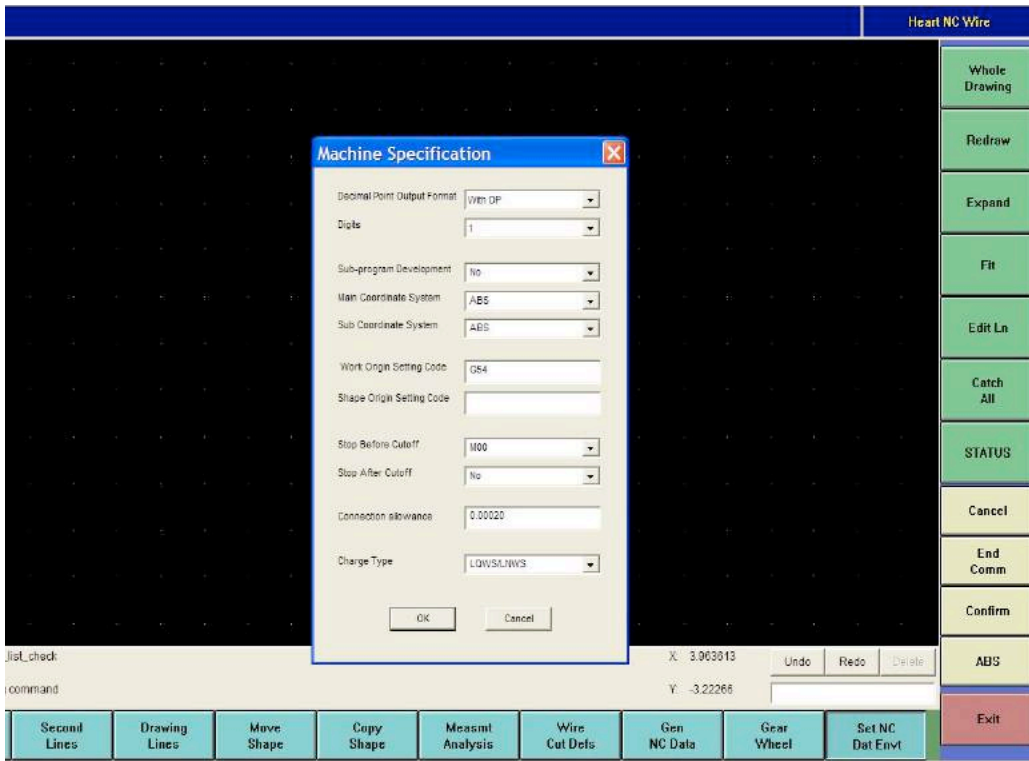


- 8) Choose **DXF file (classa)** and Click **OK**

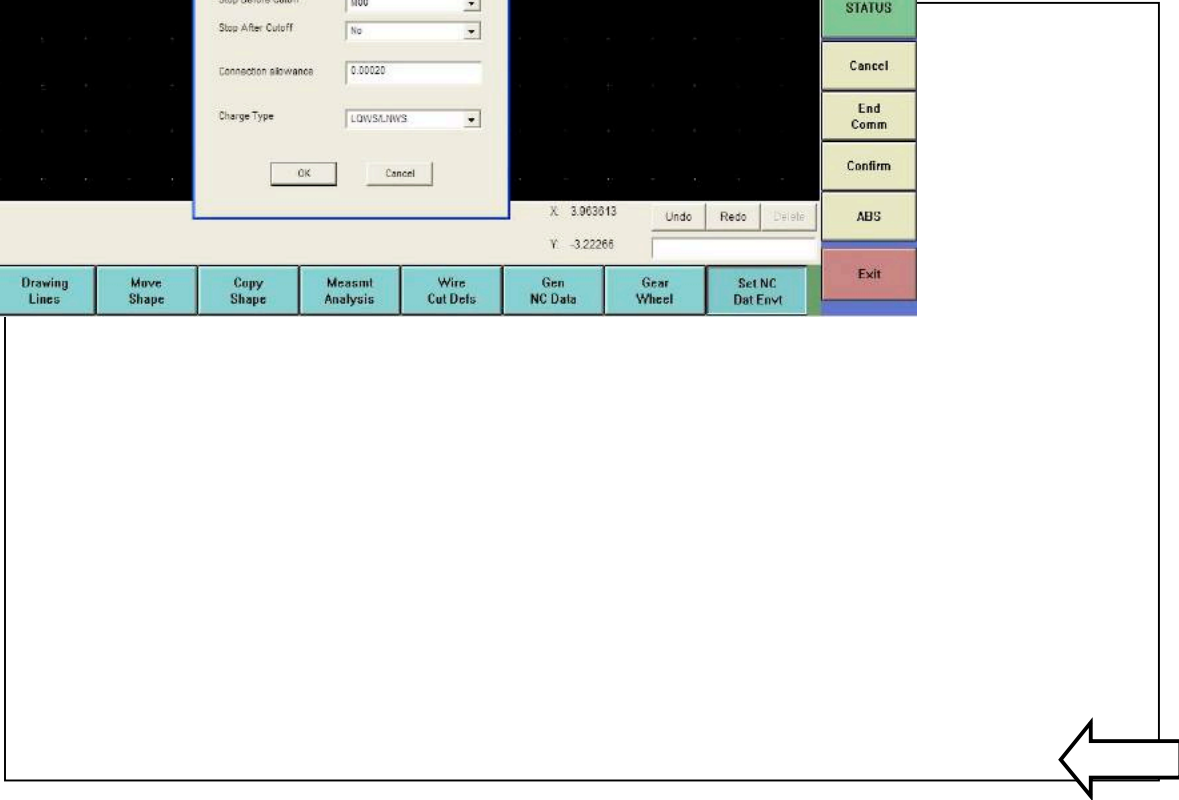


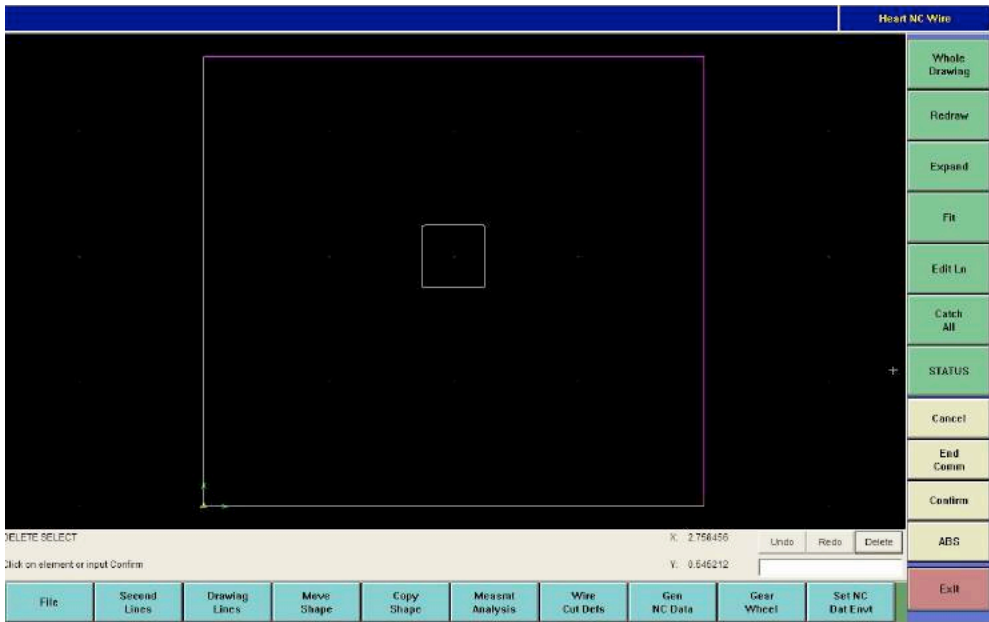
DXF has been loaded into Heart NC. When you save it the extension will change to .ASC



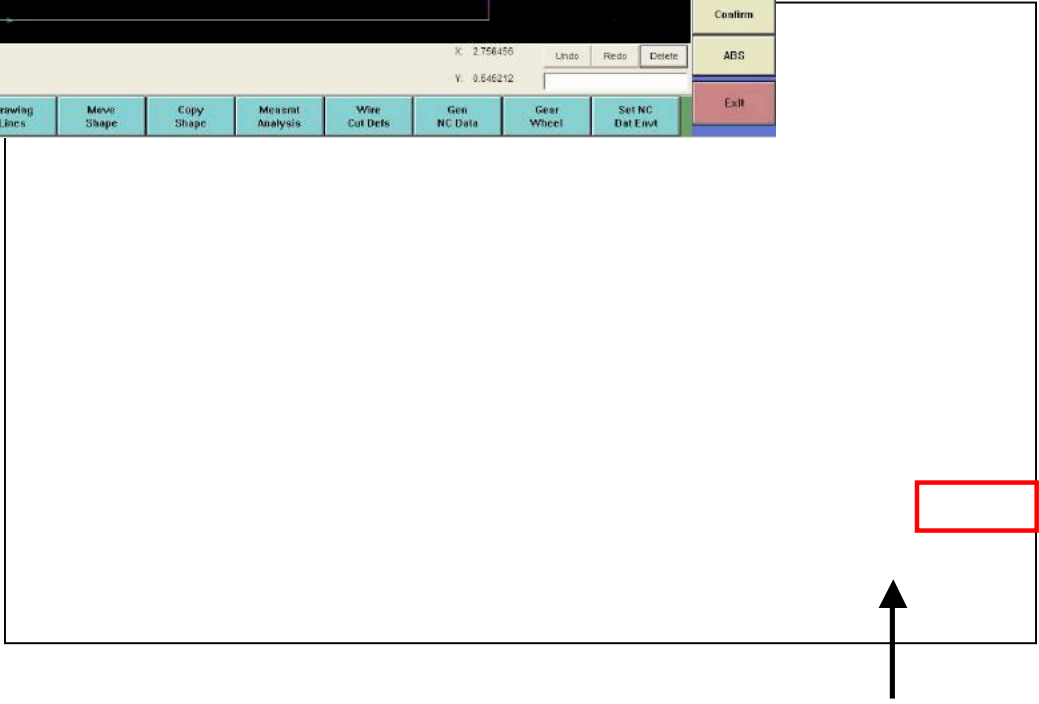


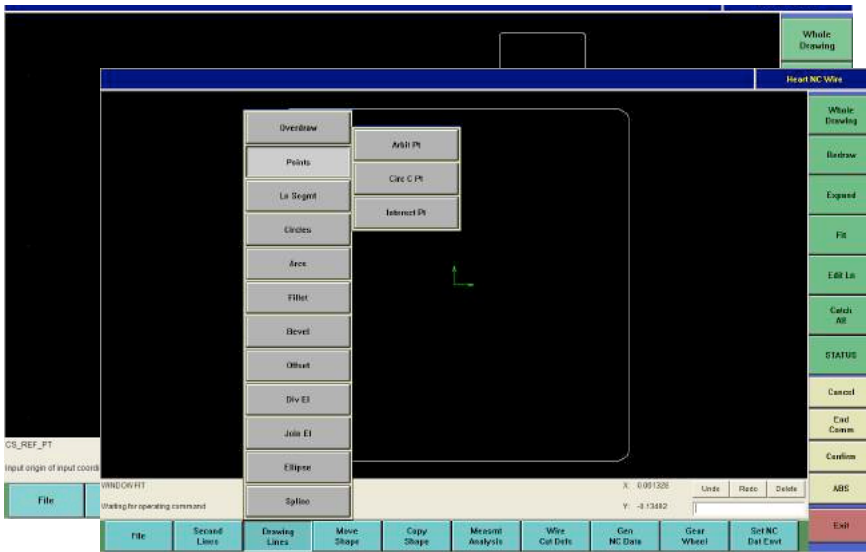
file accuracy.





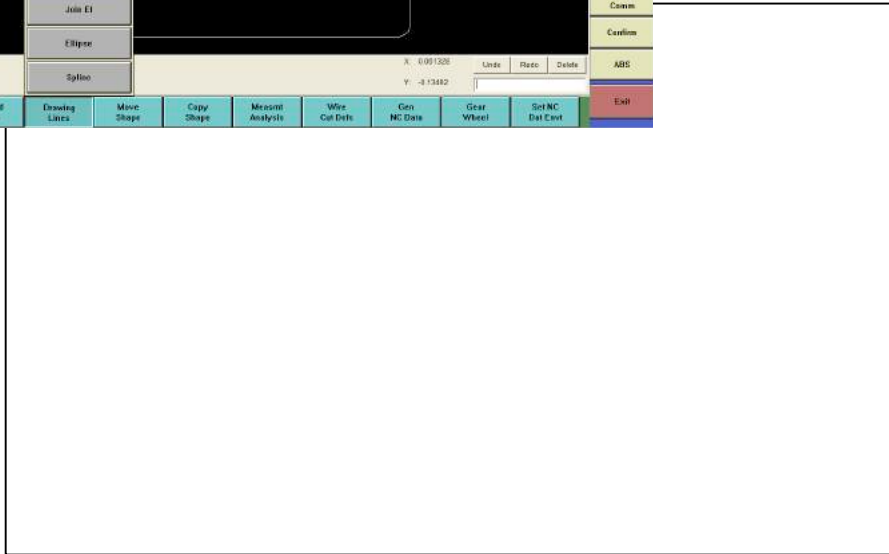
shape you want to cut. Delete shape.





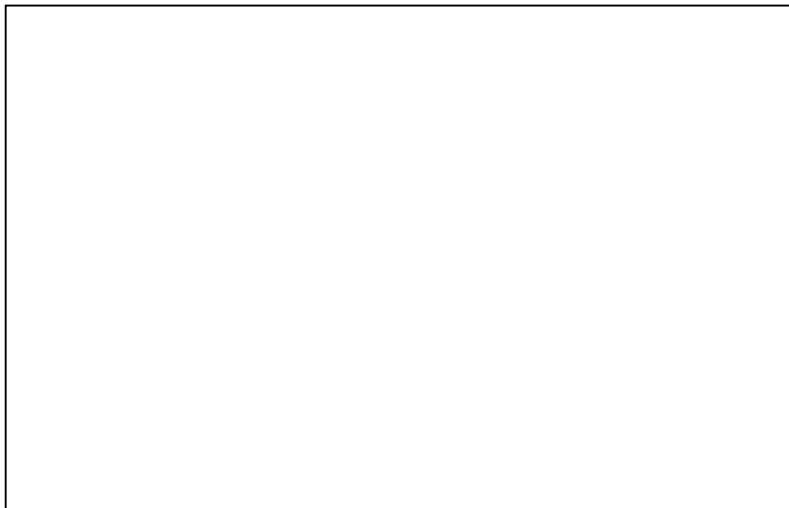
position:
 on place for this would be the center

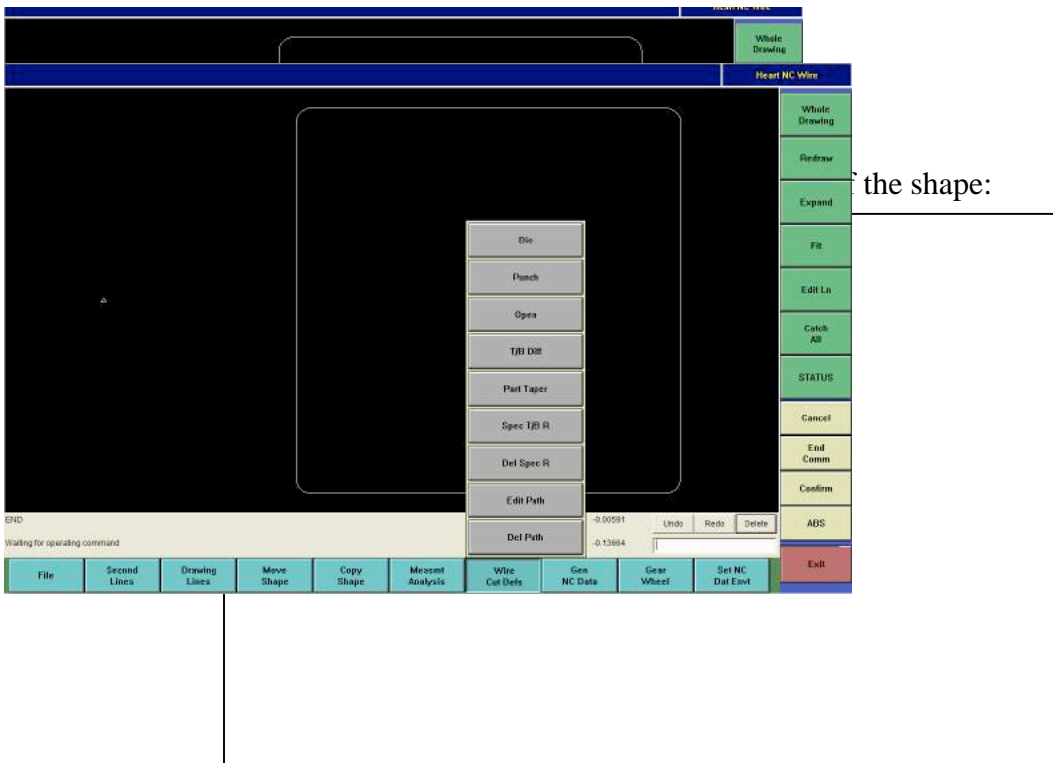
go. In this case it is the center of the



Preparation – Add start point for the wire:

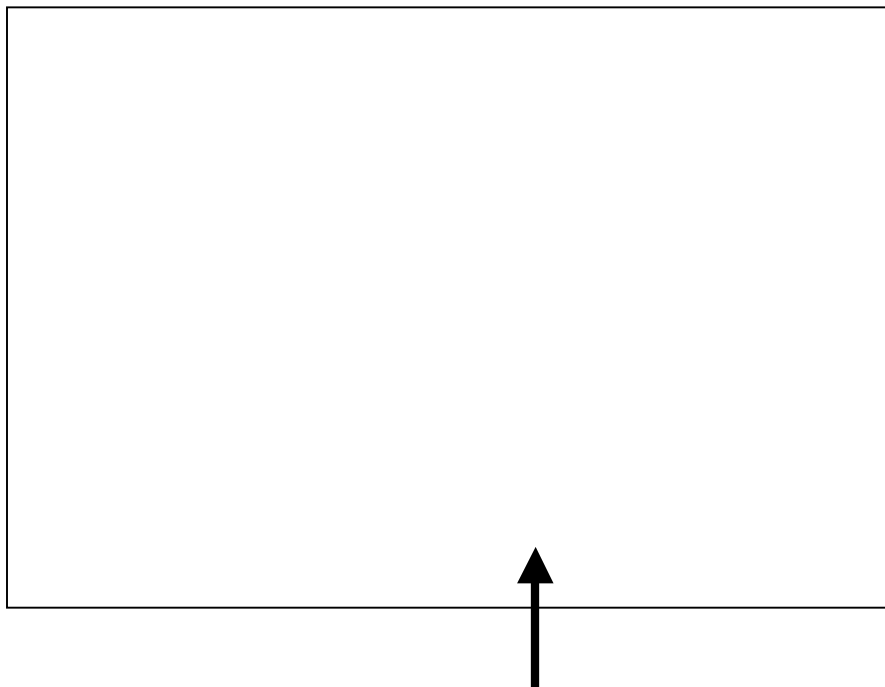
- 7) Click **Drawing Lines – Points – Arbit Pt**
- 8) Enter the X Y position for the start point, in this case we will use (-.250,0).

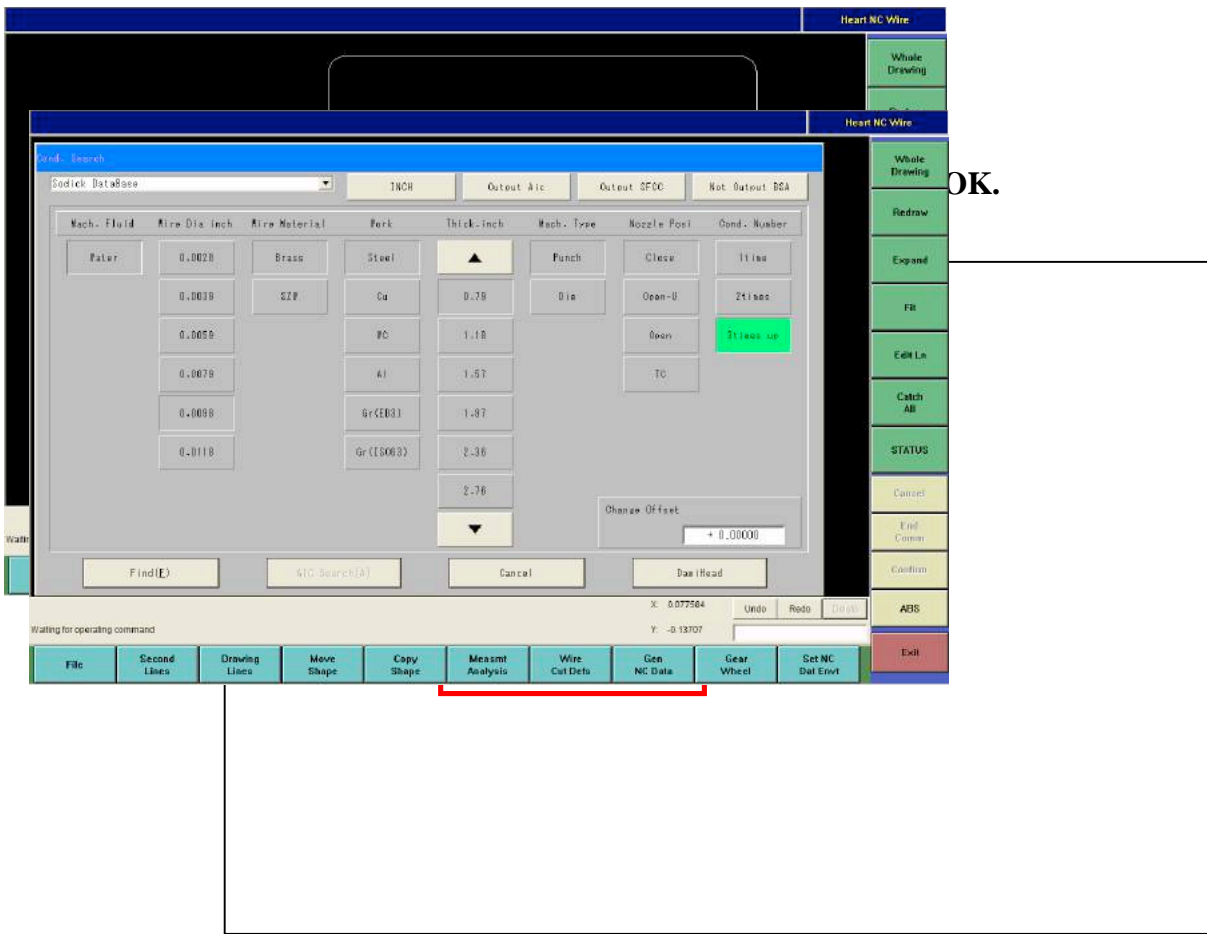




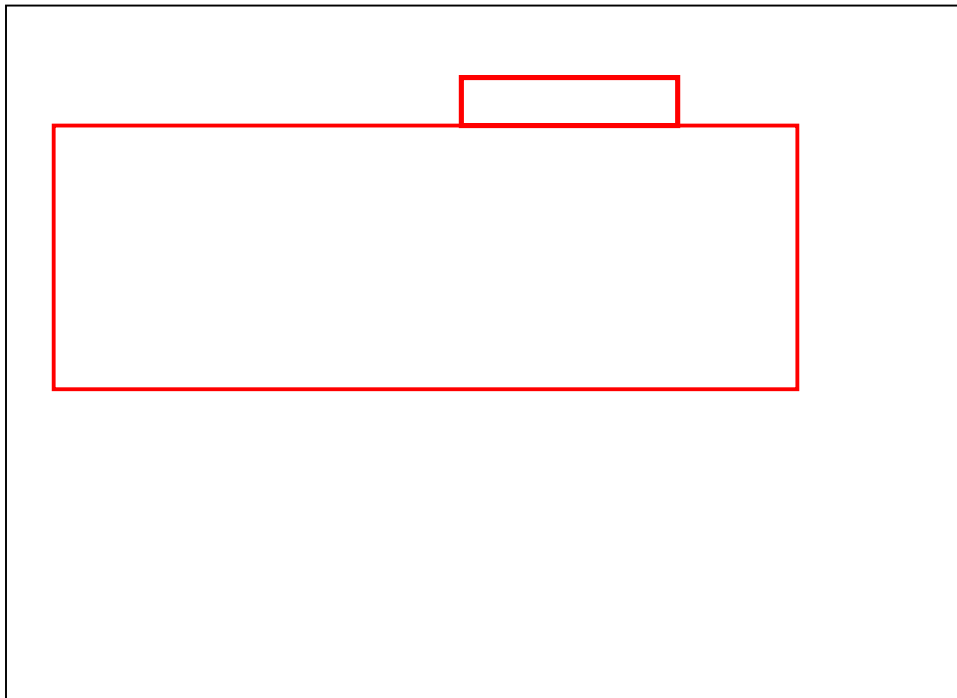
NC program Creation – Punch Example

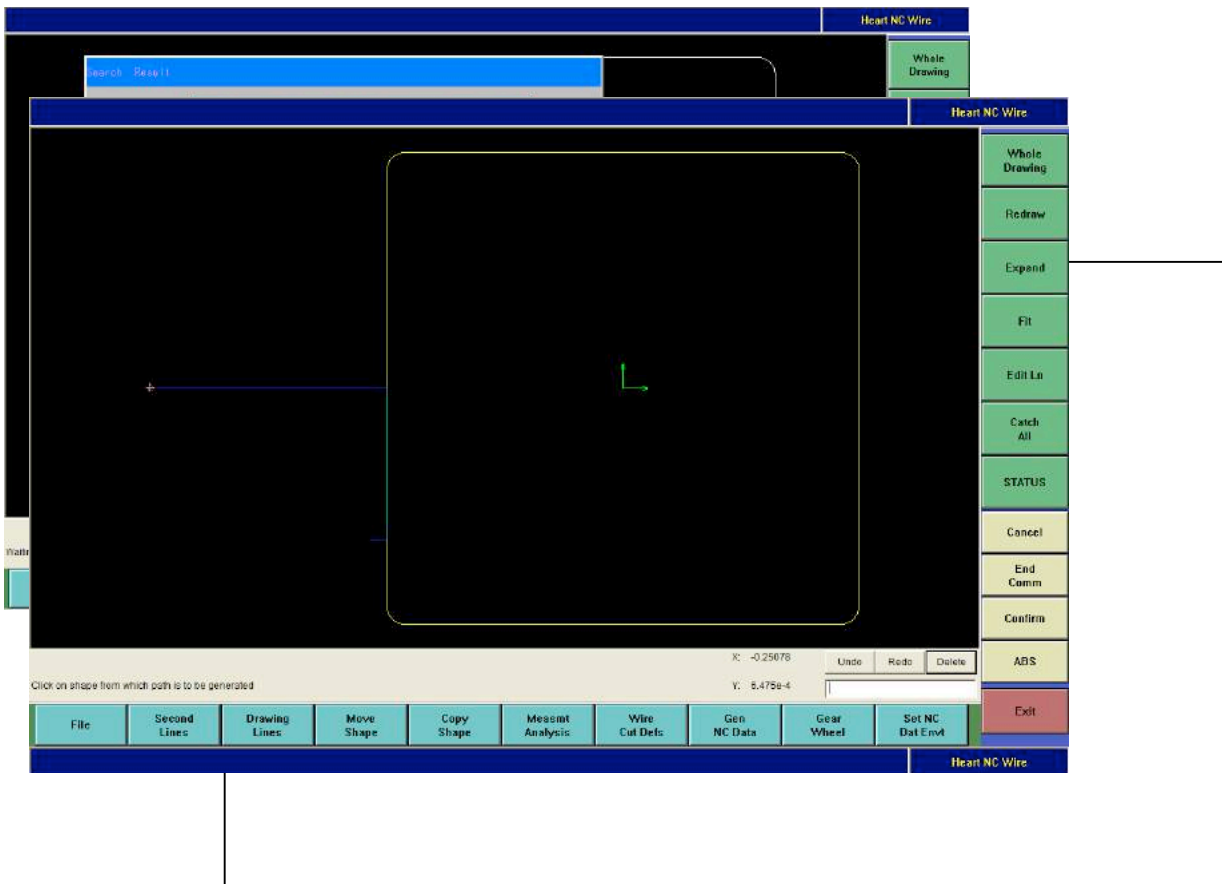
9) Click **Wire Cut Defs - Punch**



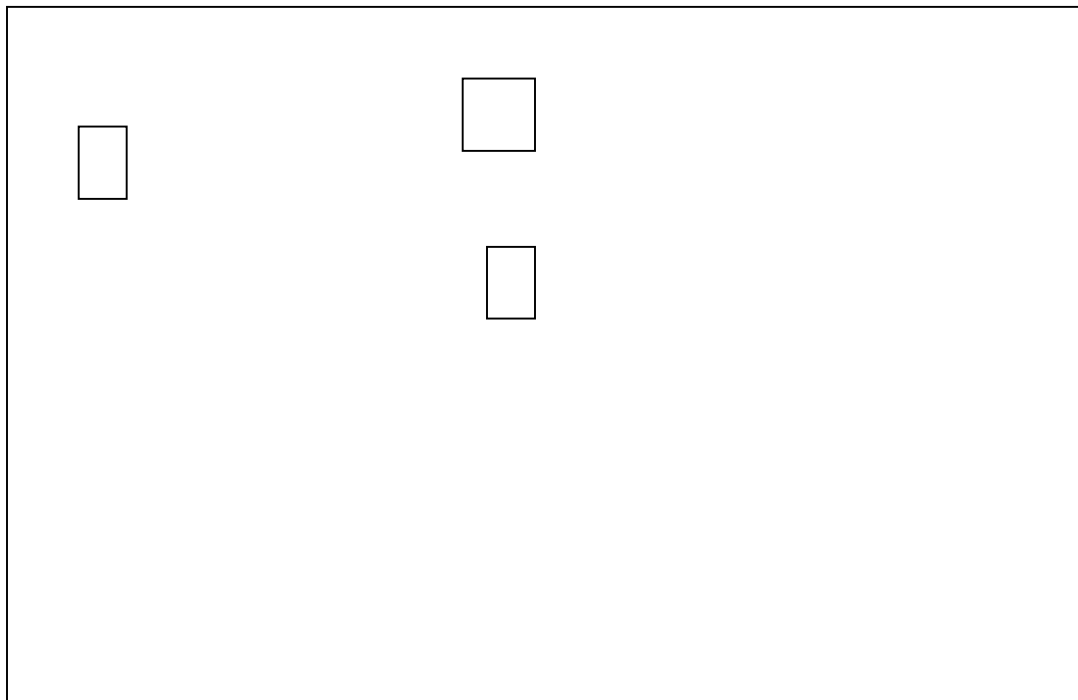


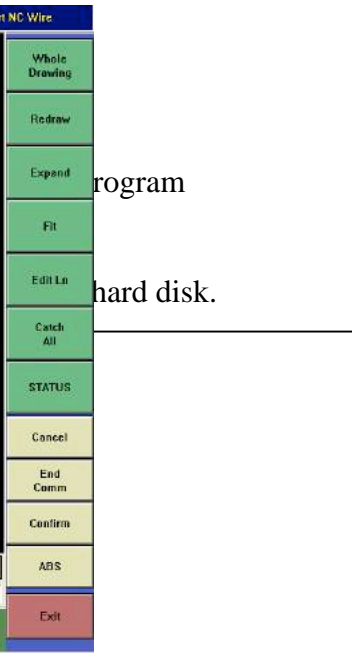
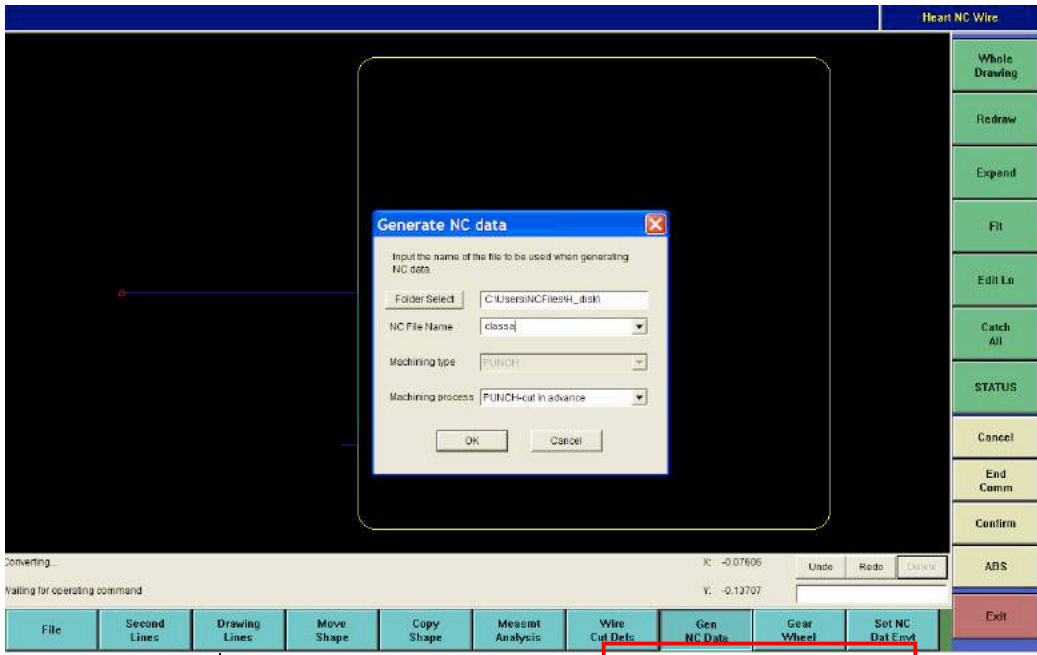
- 11) Enter cutting condition parameters as shown below
- 12) Be sure to turn on "AIC" and "SFCC" buttons.





- 15) Follow the prompts at the bottom of the screen
- A) Click on the start point
 - B) Click on the shape to cut (entire shape turns purple)
 - C) Click where to lead onto the shape





rogram

hard disk.

