ROTTLER

S85A / S86A SURFACER

MACHINE OPERATIONS MANUAL

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2. Customer number, or your billing address if you do not have a customer number
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If you are unsure which part you need to order, contact our service department, and ask to speak to one of our service consultants. They will assist you in determining which part(s) you require.

THERE IS A MINIMUM ORDER OF $25.00

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INTRODUCTION

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Introduction

READ THE SAFETY CHAPTER BEFORE INSTALLING MACHINE. THOROUGHLY UNDERSTAND ALL SAFETY ISSUES BEFORE OPERATING MACHINE.

ATTENTION OWNER/BUSINESS MANAGER

To validate the warranty on your new Rottler machine, please be sure to sign and complete the "Installation Report" located in the Installation Chapter of this manual.

We suggest that the new user of the S85A / S86A read the CONTROL DEFINITIONS to get an idea how the machine operates.

The Operating Instructions chapter should be read in order to familiarize the user with the actual button pushing sequences required to carry out a job. These chapters in the manual should be considered an introduction. As the operators of the S85A / S86A series machines gain experience with using the different functions of the machine, complicated setups and programs will make more sense.

The rest of the manual contains information and part number reference on fixtures, cutting tools, and machine maintenance. The operator should read and become familiar with these areas as well.

Description

The model S85A / S86A surfacing machine is a precision, high speed surfacing unit.

The model S85A / S86A can be equipped with tooling and accessories for surfacing most American passenger car and truck, inline, 90 and 60 degree V-type blocks as well as cylinder heads.

S85A / S86A machines may be readily tooled to resurface a wide variety of engines, including European and Asian models, as well as perform various other surfacing operations.

This machine is designed for two purposes:

1. The alignment of the deck surface to the pan rails and main bearing locations, as have been done in the original factory surfacing.
2. A considerable savings in surfacing time and operator involvement as a result of fast block clamping, and convenient controls.

Change over or resetting time required to set up V-type or in-line engines is a minimum, making this machine highly suited to the jobber shop where engines cannot be run through, in model lots.

All feeds and rapid travels are power operated and controlled from the conveniently located control panel.

Power required is 230 volt, single phase. This provides power to the variable speed AC motor controller, the horizontal S.C.R. drive, and various relays and solenoid valves that actuate mechanical controls on the machine to engage feeds and travels.

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The S85A / S86A Manual (henceforth to be referred to as the “Manual”) is proprietary to Rottler Manufacturing LLC. (“Rottler Manufacturing”) and no ownership rights are hereby transferred. No part of the Manual shall be used, reproduced, translated, converted, adapted, stored in a retrieval system, communicated or transmitted by any means, for any commercial purpose, including without limitation, sale, resale, license, rental or lease, without the prior express written consent of Rottler Manufacturing.

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Limited Warranty

Rottler Manufacturing Company Model S85A / S86A parts and equipment is warranted as to materials and workmanship. This limited warranty remains in effect for one year from the date of installation or two years from the date of the original shipment from Rottler or whichever date occurs first. This only applies is the machine is owned and operated by the original purchaser and is operated and maintained as per the instructions in the manual. A machine is warranted only if the Installation Report has been properly executed by a certified installation person and received by Rottler at the time of actual installation.

The products are warranted upon delivery to conform to their published specifications and to be free from defects in material and workmanship under normal use for a period of one year from shipment. Should a product not be as warranted, Rottler sole obligation shall be, at its option, to repair, correct or replace the product or to refund the amounts paid for the Product upon its return to a location designated by Rottler. No warranty shall extend to rapid wear Products (including tooling) or to Products which have been subject to misuse (including any use contrary to Rottler instructions), neglect, accident (including during shipment), improper handling or installation, or subject to any modification, repair or service not certified by Rottler. Rottler shall not be liable for any consequential, direct or indirect damages or for any other injury or loss. Buyer waives any right, beyond the foregoing warranty, to make a claim against Rottler. No warranty is provided for any Products not paid in full.

Merchandise cannot be returned to Rottler without prior approval. Customer must contact the Parts Department to get approval and to be issued a Return Goods Authorization number **(RGR#).** Merchandise authorized for return must be returned prepaid. If merchandise is returned with shipping charges collect, the actual amount of these charges may be deducted from any credit which may be due the customer. The **RGR #** assigned by the Parts Department should be written on the shipping label and must appear on a copy of the invoice(s) covering the original shipment. This invoice copy must be included in the box with the parts. Shipment must contain ONLY those items on the **RGR** as approved for return. Merchandise must be received within 10 days of the date of **RGR** or the **RGR** will be canceled. All returned merchandise may be subject to a 20% restocking fee on under $1,000.00 amount or 10% on any items over $1,000.00. Parts or tooling over 30 days old are considered as customer property and can only be returned with prior approval from Rottler Corporation Management.

The issuance of a **RGR DOES NOT** guarantee credit - it is only authorization for the return of the goods. Credit for return merchandise is at the sole discretion of Rottler. Credit will be issued only after inspection of returned goods.

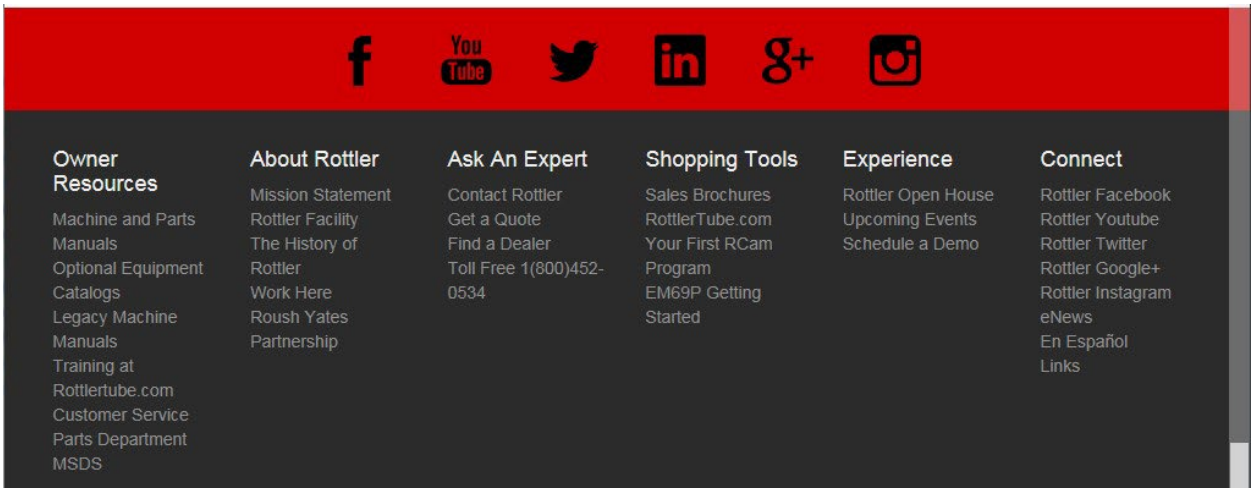
Tools proven to be defective within the warranty period will be repaired or replaced at the factory's option.

We accept no responsibility for defects caused by external damage, wear, abuse, or misuse, nor do we accept any obligation to provide compensation for direct or indirect costs in connection with cases covered by the warranty.

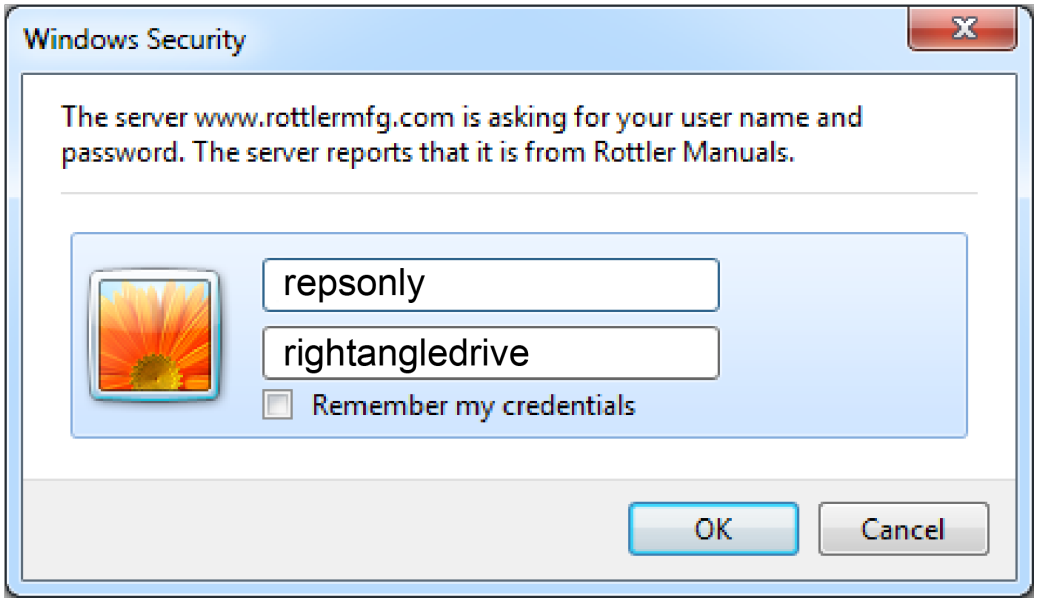
Online Documentation Access

Online documentation for machines and optional equipment can be accessed at the Rottler website. To access documentation open your browser and navigate to https://www.rottlermfg.com.

Scroll to the bottom of the page and under the Owner Resources title click the type of documentation you want to access.



If a log in window pops up asking for user name and password fill in the blanks as shown.



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SAFETY

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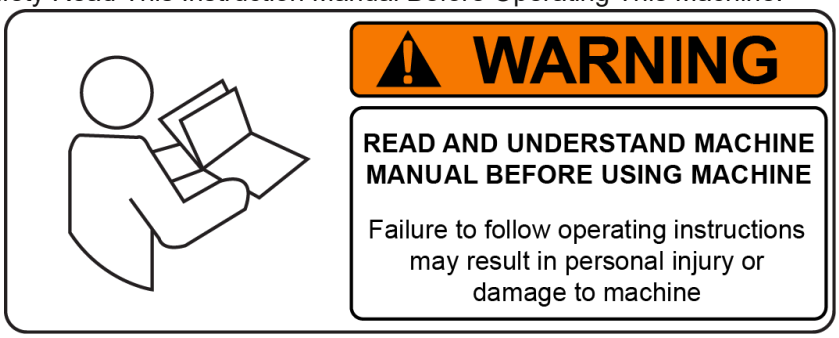
Safety Information

For Your Own Safety Read This Instruction Manual Before Operating This Machine.



This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

CAUTION used without the safety alert symbol indicates a potentially hazardous situation which, if not avoided, may result in property damage.

Safety Instructions for Machine Use

WARNING **This machine is capable of causing severe bodily injury**

ONLY A QUALIFIED, EXPERIENCED OPERATOR SHOULD OPERATE THIS MACHINE. NEVER ALLOW UNSUPERVISED OR UNTRAINED PERSONNEL TO OPERATE THE MACHINE. Make sure any instructions you give in regards to machine operation are approved, correct, safe, and clearly understood. Untrained personal present a hazard to themselves and the machine. Improper operation will void the warranty.

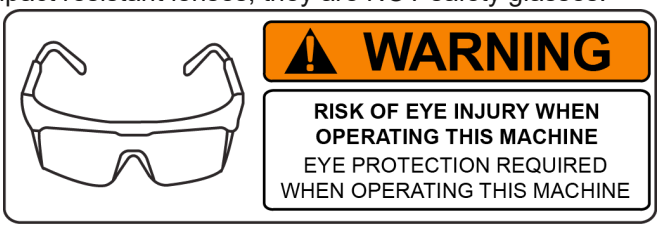
KEEP GUARDS IN PLACE and in proper working order. If equipped with doors, they must be in the closed position when the machine is in operation.

KEEP WORK AREA CLEAN. Cluttered areas and benches invite accidents.

KEEP CHILDREN AND VISITORS AWAY. All children and visitors should be kept a safe distance from work area.

WEAR THE PROPER APPAREL. DO NOT wear loose clothing, gloves, rings, bracelets, or other jewelry which may get caught in moving parts. Non-Slip foot wear is recommended. Wear protective hair covering to contain long hair.

ALWAYS USE SAFETY GLASSES. Also use face or dust mask if cutting operation is dusty. Everyday eye glasses only have impact resistant lenses, they are NOT safety glasses.



DO NOT OVER-REACH. Keep proper footing and balance at all times.

USE THE RECOMMENDED ACCESSORIES. Consult the manual for recommended accessories. The use of improper accessories may cause risk of injury.

CHECK DAMAGED PARTS. Before further use of the machine, a guard or other part that is damaged should be checked to determine that it will operate properly and perform its intended function. Check for alignment of moving parts, breakage of parts, mounting, and other conditions that may affect its operation. A guard or other part that is damaged should be properly repaired or replaced.

NEVER OPERATE A MACHINE WHEN TIRED, OR UNDER THE INFLUENCE OF DRUGS OR ALCOHOL. Full mental alertness is required at all times when running a machine.

IF AT ANY TIME YOU ARE EXPERIENCING DIFFICULTIES performing the intended operation, stop using the machine! Then contact our service department or ask a qualified expert how the operation should be performed.

DO NOT MODIFY OR ALTER THIS EQUIPMENT in any way. If modifications are deemed necessary, all such requests must be approved and/or handled by Rottler Manufacturing. Unauthorized modifications could cause injury and/or damage to machine and will void the warranty.

SAFETY DECALS SHOULD NEVER BE REMOVED. They are there to convey important safety information and warn of potential hazards.

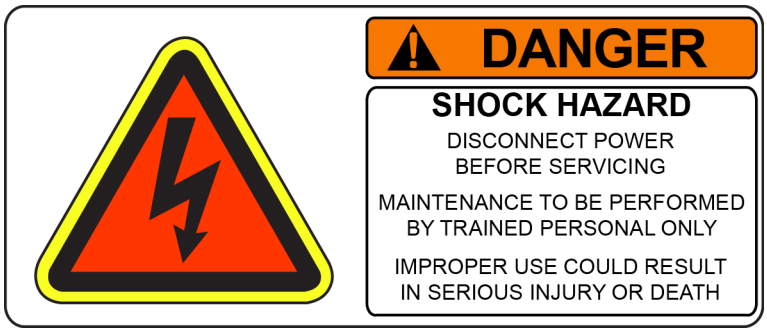
ALL LOCAL SAFETY CODES AND REGULATIONS should be followed when installing this machine.

ONLY QUALIFIED PERSONAL should perform service on the electrical and control systems.
When boring the machine is capable of throwing metal chips over 10- feet from the cutting area. Always use the guards. Eye protection must be worn at all times by the operator and all other personnel in the area of the machine.

CAUTION No list of safety guidelines can be complete. Every piece of shop environment is different. Always consider safety first, as it applies to your individual working conditions. Use this and other machinery with caution and respect. Failure to follow guidelines could result in serious personal injury, damage to equipment or poor work results.

Electrical Power

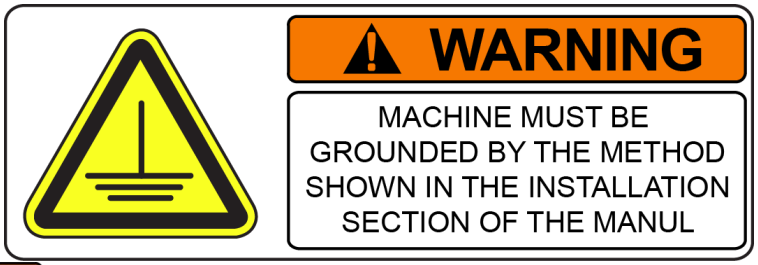
All electrical power should be removed from the machine before opening the rear electrical enclosure. It is recommended that the machine have a electrical LOCK-OUT device installed.



Make sure all electrical equipment has the proper electrical overload protection.

In the event of an electrical short, grounding reduces the risk of electric shock by providing a path of least resistance to disperse electric current.

Electrocution or a fire can result if the machine is not grounded correctly. Make sure the ground is connected in accordance with this manual. DO NOT operate the machine if it is not grounded.



CAUTION No single list of electrical guidelines can be comprehensive for all shop environments. Operating this machinery may require additional electrical upgrades specific to your shop environment. It is your responsibility to make sure your electrical system comply with all local codes and ordinances.

⚠ WARNING This machine operates under computerized control and, as with all computerized equipment, is susceptible to extraneous electrical impulses internally for externally produced. The machine may make moves out of the operator control at any time. The operator should work in and around the machine with caution at all times.

The operator and nearby personnel should be familiar with the location and operation of the Emergency Stop Button.

Make sure all electrical equipment has the proper overload protection. This machine should have ***a fully isolated*** power supply to prevent damage and uncontrolled movement of the machine. If this machine is on the same power lines that are running to other electrical equipment (grinders, welders, and other AC motors) electrical noise can be induced into this machines electrical system. Electrical noise can cause the controller to see false signals to move. Not supplying a fully isolated supply to the machine may void factory warranty. Refer to the Power supply section located in the Installation section for voltage and amperage requirements of this machine.

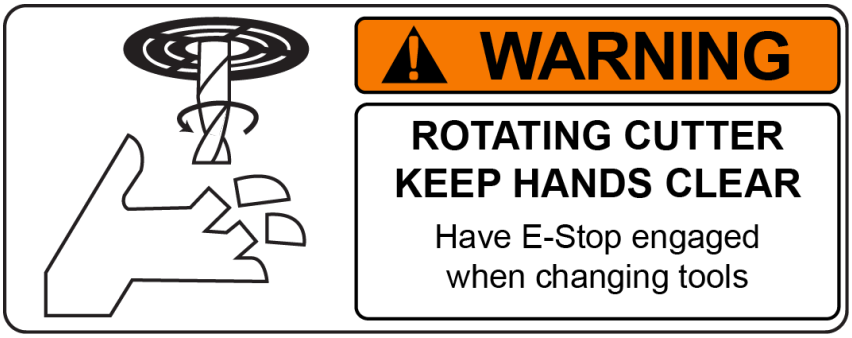
Machine Operator

The operator of this machine should be a skilled machinist craftsman who is well versed in the caution, care, and knowledge required to safely operate metal cutting tools.

If the operator is not a skilled machinist he/she must pay strict attention to the Operating Instructions outlined in this manual, and get instruction from a qualified machinist in both production and operation of this machine.

This machine has the following areas of exposed moving parts that you must train yourself to respect and stay away from when they are in motion

Cutting Tool Area – Any operation involving hands in the cutter head area, such as inspection or alignment of the cutter head or tools, changing Centering Fingers, tool insertion, and removal, cutter head changes, and size checking etc. requires the machine to be in Neutral.



Machining – Eye protection must be worn during all operations of the machine. Hands must be kept completely away from the cutter head. All chip guards must be in position during machine operations.

CAUTION **Work Loading and Unloading** – Carefully develop handling methods of loading and unloading work pieces so that no injury can result if hoist equipment or lift connection should fail. Periodically check lift components for damage that may cause failure.

CAUTION **Machine Maintenance** – Any machine adjustment, maintenance or parts replacement absolutely requires a complete power disconnection from the machine, ***this is an absolute rule.***

CONTROL DEFINITIONS

Contents

Control Definitions

The purpose of this chapter is to define the function of buttons on the front control panel. Certain button functions may not appear clear when first reading this chapter. As the operator reads through the Operating Instructions chapter of this manual, these functions will become clear.

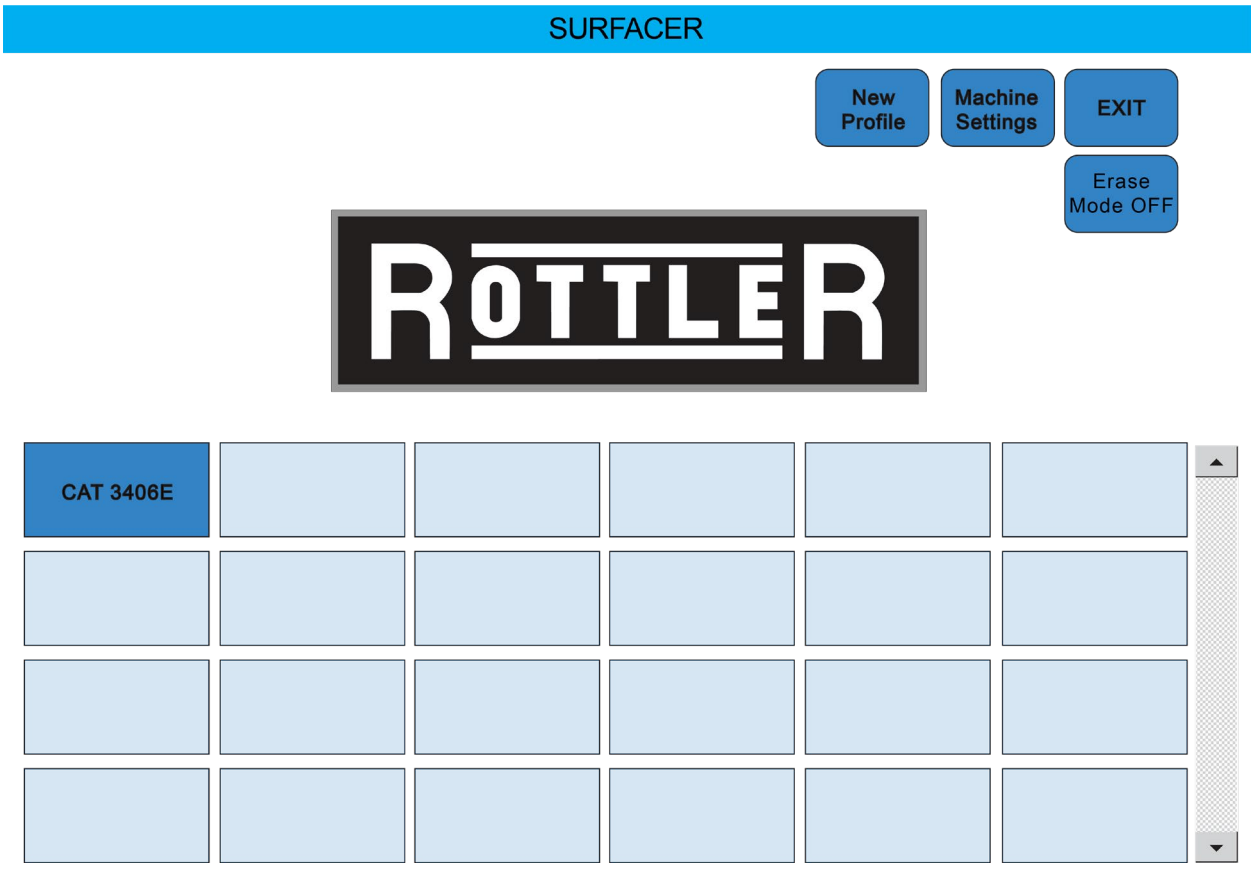
CPU Control

This machine is under control of a CPU located in the rear enclosure

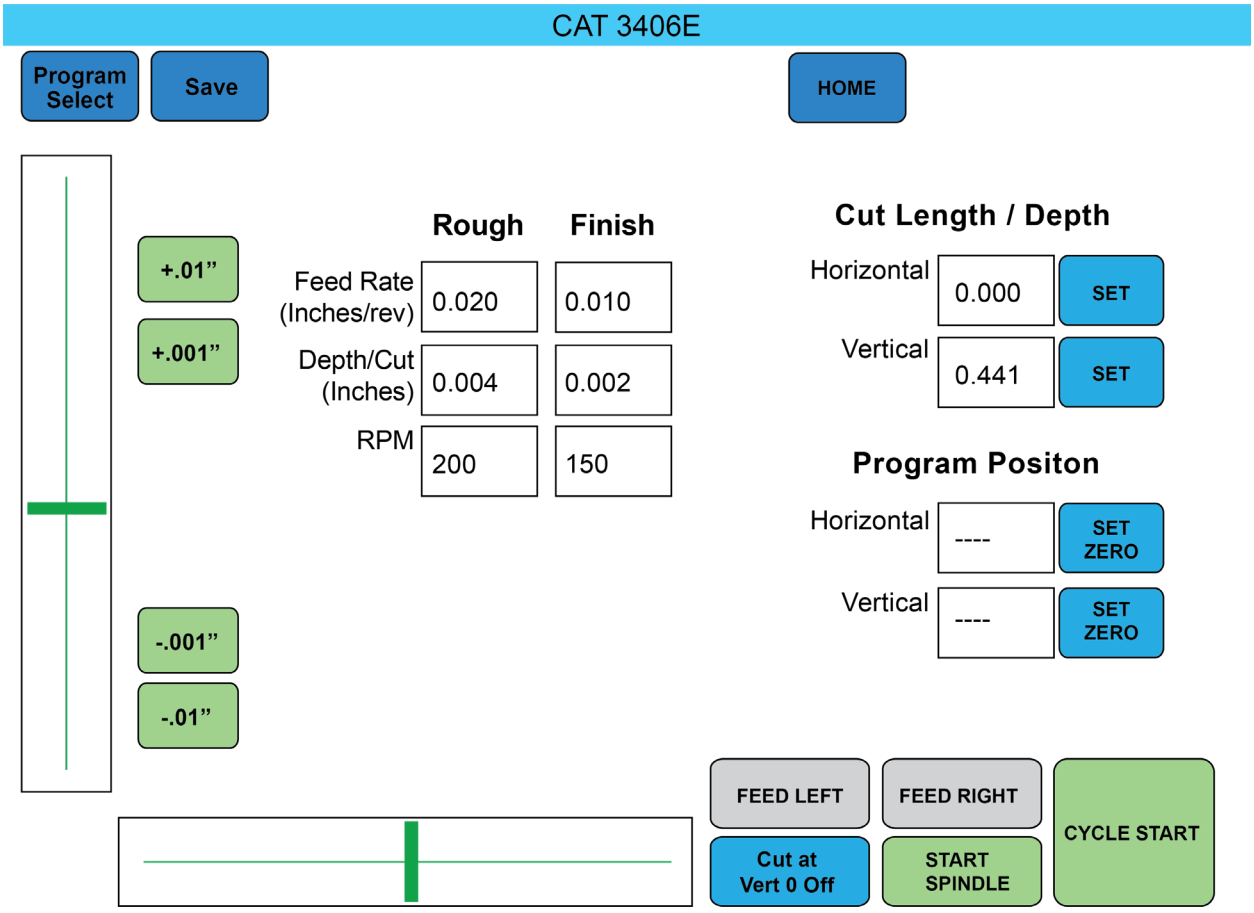
Master Power On/Off Switch

This switch is located on the upper right hand side of the rear electrical cabinet.

When first applying power to the machine it will take a short while for the system to be ready for operation. Do not press any buttons on the control panel until the display show the Profile Select screen.



Button Definition



Emergency Stop

IF the Emergency stop is pushed, all power to the spindle horizontal and vertical drive is removed. Display will still have power and will display “EMERGENCY STOP”. To release the emergency stop, turn the button to the right and it will “POP” out. Give the machine a minute to power up before pressing any buttons on the control panel.

Home Button

When the machine is powered up or cycled via the E Stop, you will have to home it so that the motors can be indexed to begin programming or running a saved program. Pressing the Home button will move the spindle to top of its travel. Then the Horizontal Position will move the carriage all the way to the right of its travel.

Rough and Finish Cut Settings

This is where the Feed Rate and Depth of Cut, along with the RPM settings for rough cut and finish cut are programed.

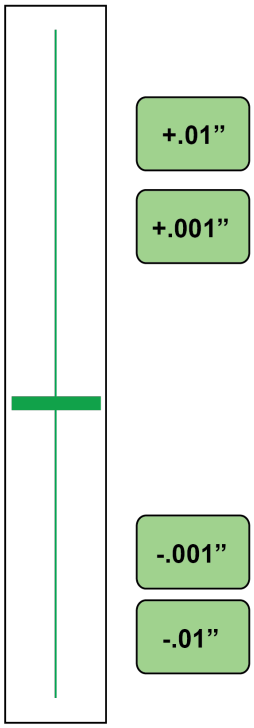
Push the value box that you want to program and a key pad will appear so that the value can be entered.

	Rough	Finish
Feed Rate (Inches/rev)	0.020	0.010
Depth/Cut (Inches)	0.004	0.002
RPM	200	150

Vertical Feed

The slider will move the spindle up or down. The further the slider is moved, the faster the spindle will travel.

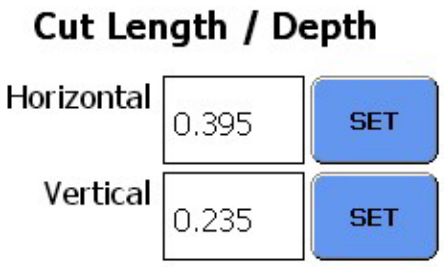
The buttons will move the spindle up or down the amount indicated. Holding the button will move the spindle in steps until the button is released.



Horizontal Feed

The slider will move the carriage to the left or right. The further the slider is moved, the faster the carriage will travel.

Cut Length and Depth Settings

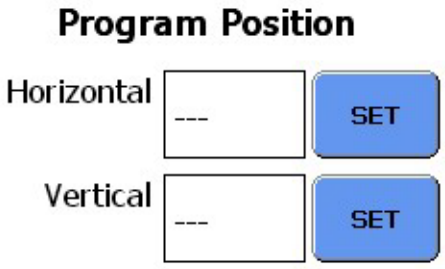


This is where the length of the horizontal travel and the depth of the vertical travel are set.

Press the value boxes to bring up the keypad and enter the values desired.

Pressing the SET buttons will set the current position.

Program Position Settings



The value boxes will show the position of the spindle and carriage when ever it is moved.

When the SET buttons is pushed the position that is shown in the value box will be zeroed.

Operation Buttons

The CYCLE START button is pressed and held for 2 seconds to begin the auto cycle process.

The START SPINDLE, FEED LEFT, and FEED RIGHT buttons are used for manual operation.

The Cut at Vert 0 button will instruct the program to cut with or without any additional stock removal. Button will show status as On or Off.

⚠ WARNING Even though the Spindle has been turned off, it will continue turning as it slows down and travels to the right. Keep all body parts away from the cutting area when in the automatic cycle.

Surface Depth Dial Indicator

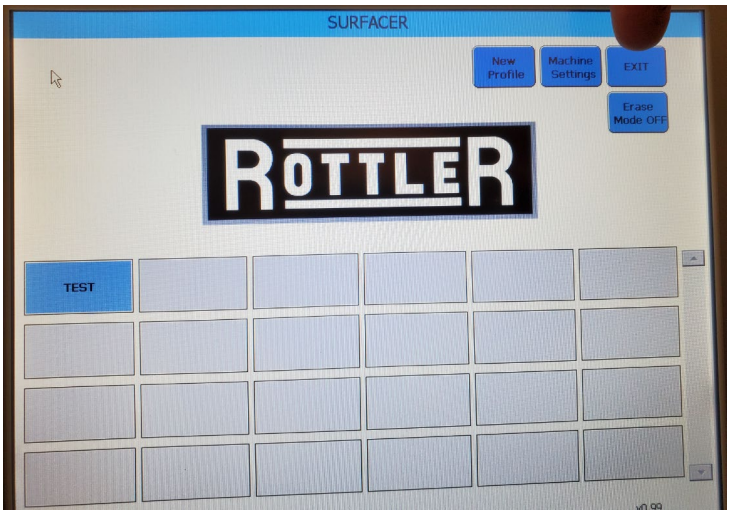
This dial indicator is mounted on the surface of the cutterhead guard. When properly adjusted this indicator will show the position of the cutting insert relative to the surface to be cut.

How to Change Measurement Units on S80 Series Machines

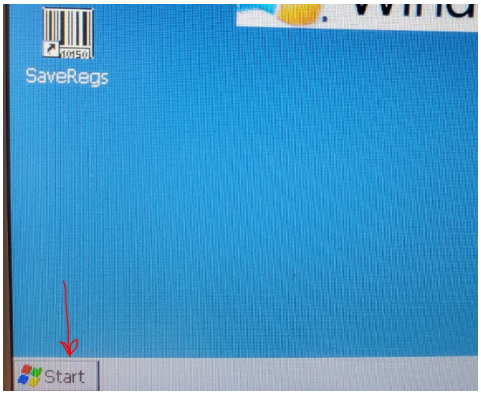
1. From the Profile Select Screen
2. Press Machine Settings
3. Press Using: inches to change to Using: mm (or reverse)
4. Press Save
5. Press Back

How to Recalibrate The Touch Screen

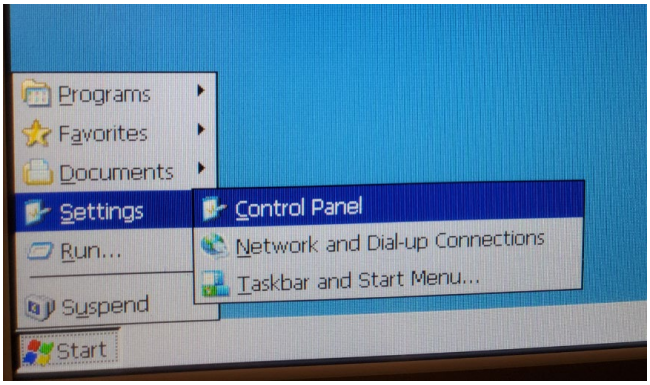
1. Exit the surfacing program.



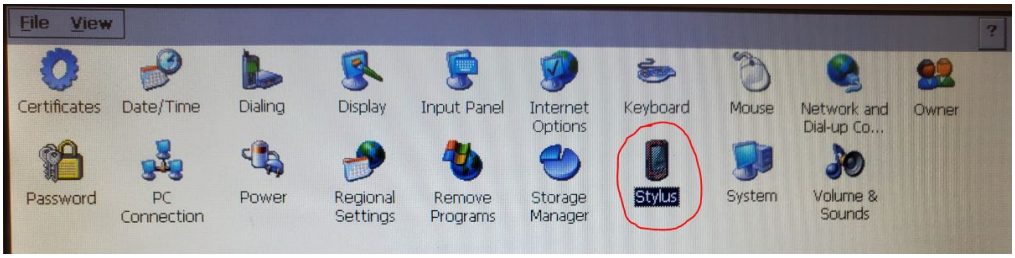
2. Click the windows start button in bottom left.



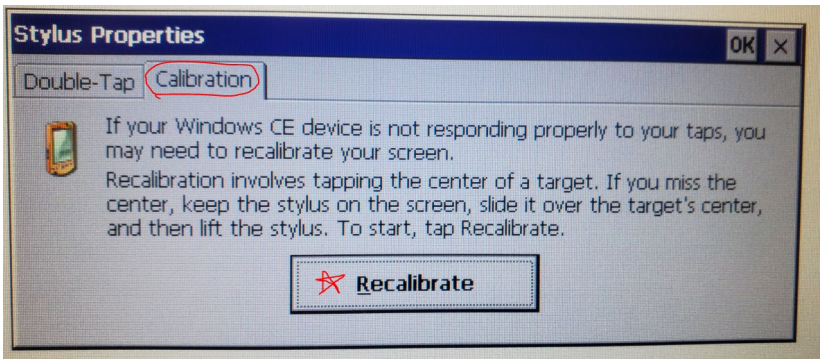
3. Select settings and control panel.



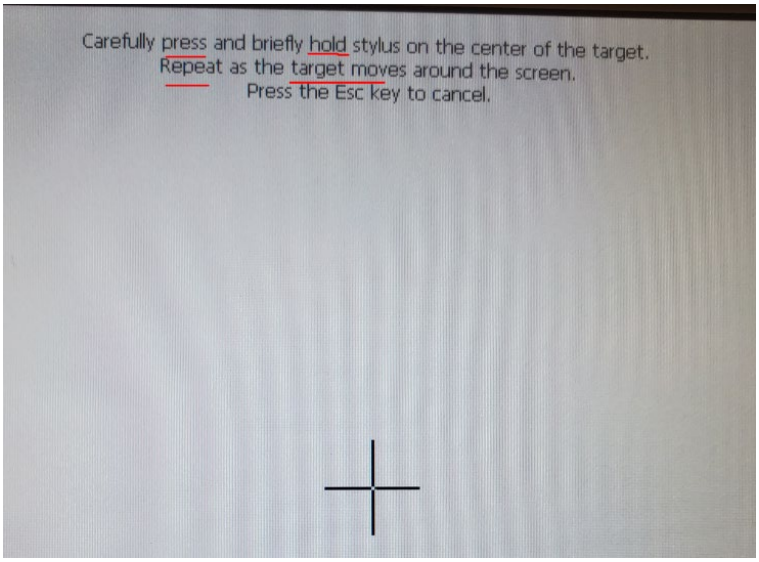
4. Double click on the “Stylus” icon.



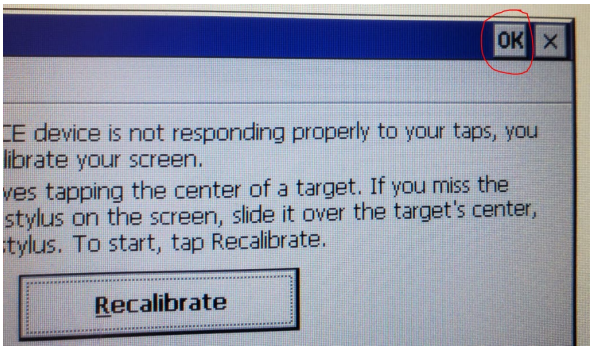
5. Select the second tab that says “Calibrate” and press the recalibrate button.



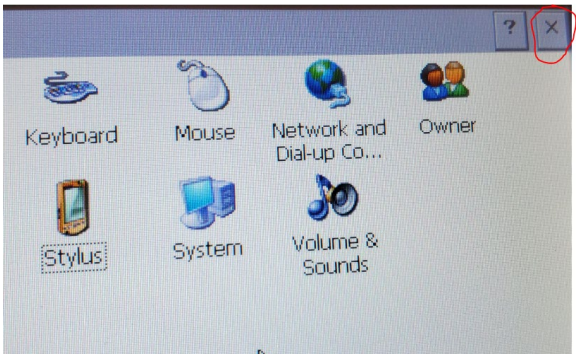
6. Press and hold gently on the cross. You will do this 5 times in different locations. When the crosses go away tap on the screen to complete the calibration.



7. Click the “OK” button to save changes.



8. Close out of the control panel.



9. Restart the machine.

Recalibration of the touch screen is completed.

OPERATING INSTRUCTIONS

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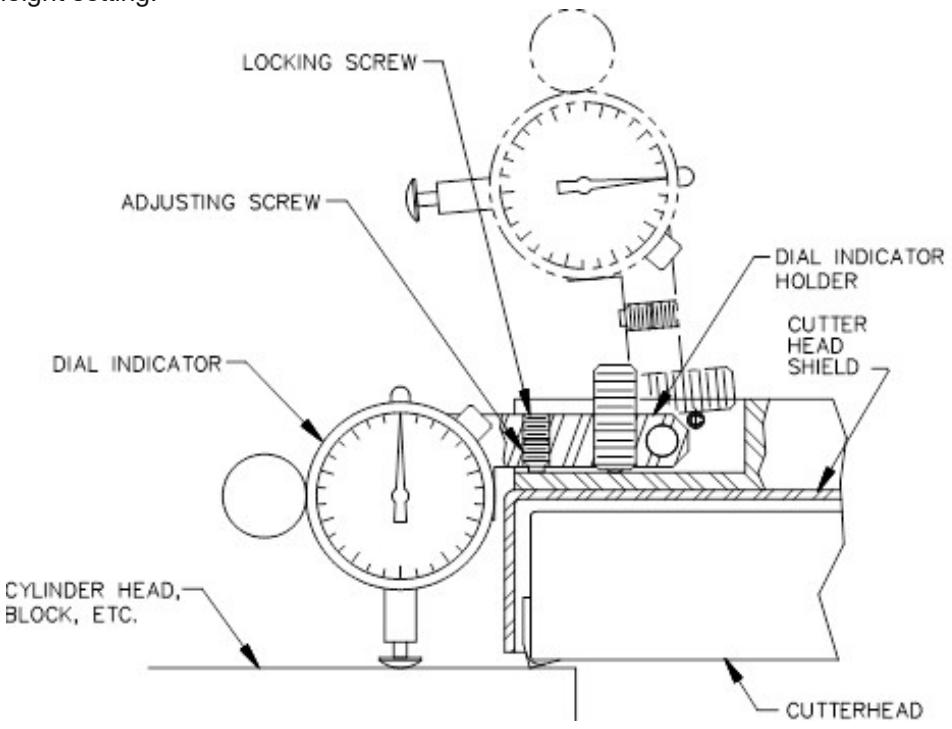
Operating Instructions

Included in this chapter is a general description of how to use this machine for surfacing, whether it cylinder head, block or other type of job. For details of operating specific fixtures available on this machine refer to the Optional Equipment Catalog located on the Rottler web site.

There are several ways to use the S85A / S86A machine cutting system depending on the type of work you do and your personal preferences. Following are some details and descriptions that will help you decide which method is best suited to your application.

Manual Operation

Use the horizontal slider to move the spindle over to the starting position. The starting position is just before the cutterhead guard passes over the work piece. Use the vertical slider and position buttons to get the cutter head close to the proper cutting position. Push the dial depth indicator, on the guard, down onto the top of the work piece. Assuming the dial indicator has been properly adjusted (see the Maintenance chapter of this manual for adjustment instructions) it will indicate the depth of the cut at your current height setting.



Press the up or down vertical move buttons to adjust the depth of the cut. Enter the Feed Rate value and Spindle RPM value for the desired finish. Press the SPINDLE START button and the FEED LEFT button. The machine will start Feeding across the work piece.

When the machine has finished cutting, press the START SPINDLE travel button to stop the machine. Use the vertical slider to raise the spindle up, then horizontal slider to move the carriage back to the home position.

Automatic Operation

To begin the carriage should be to the far right and the machine power off or the E-Stop engaged.

Install any needed fixturing and secure the work piece to be surfaced.

Turn on the power or release the E-Stop.

If power was off the Profile Select screen will be showing. Press the New Profile button and the Operation screen will appear.

If E-Stop button was released then the Operation screen will now be active.

Press the HOME button to Home the machine.

Using the sliders, move the Horizontal and Vertical until the dial indicator is in a position to make contact with the surface of the work piece.

Use the jog buttons to move the spindle up or down until you achieve a zero reading on the dial indicator.

Set the Program Position by pressing the Horizontal and Vertical SET buttons so that they both read zero.

Set the Cut Length / Depth for the length of the work piece and the amount to be removed.

Program the Rough and Finish parameters.

Press and hold the CYCLE START button until the button changes color to blue. (The spindle will move to the Program Position if it is not already in that position) The button will then change to yellow.

Press the CYCLE START button again to start the program cycle.

Feed will continue until the End of Cut is reached. The spindle will lift to the Relief Up position, Spindle rotation will be turned off and the machine will Rapid travel right to the home position.

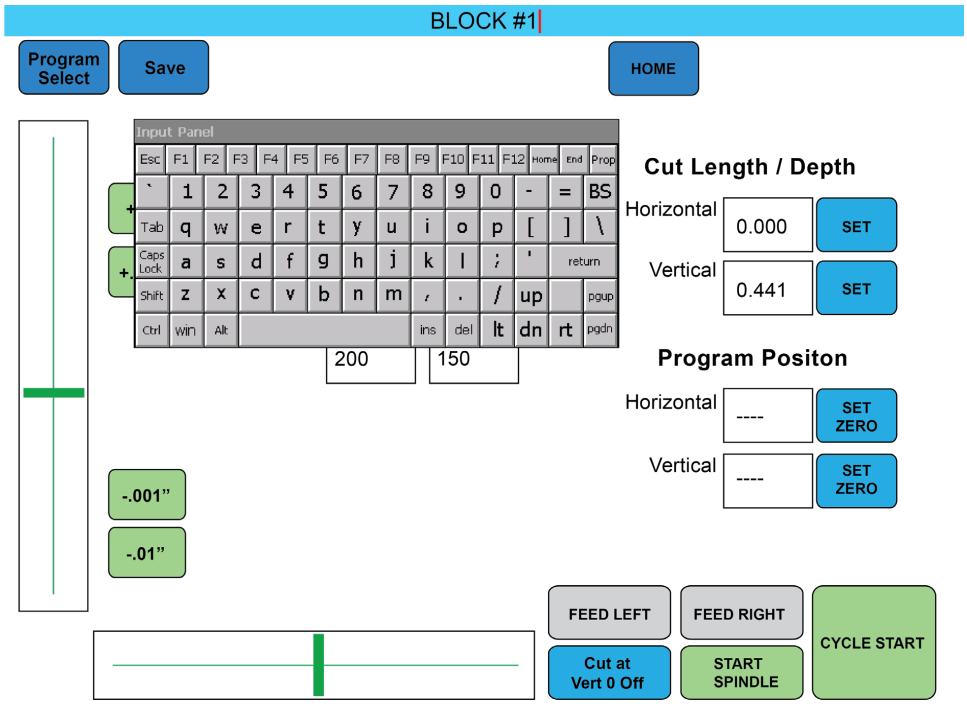
To save the settings of the completed program press the Save button. The program will be given a default name of Block #XX

To rename the program, touch the blue title bar. A keyboard will pop up on the screen. Rename the program and press Return. Press the save button again.

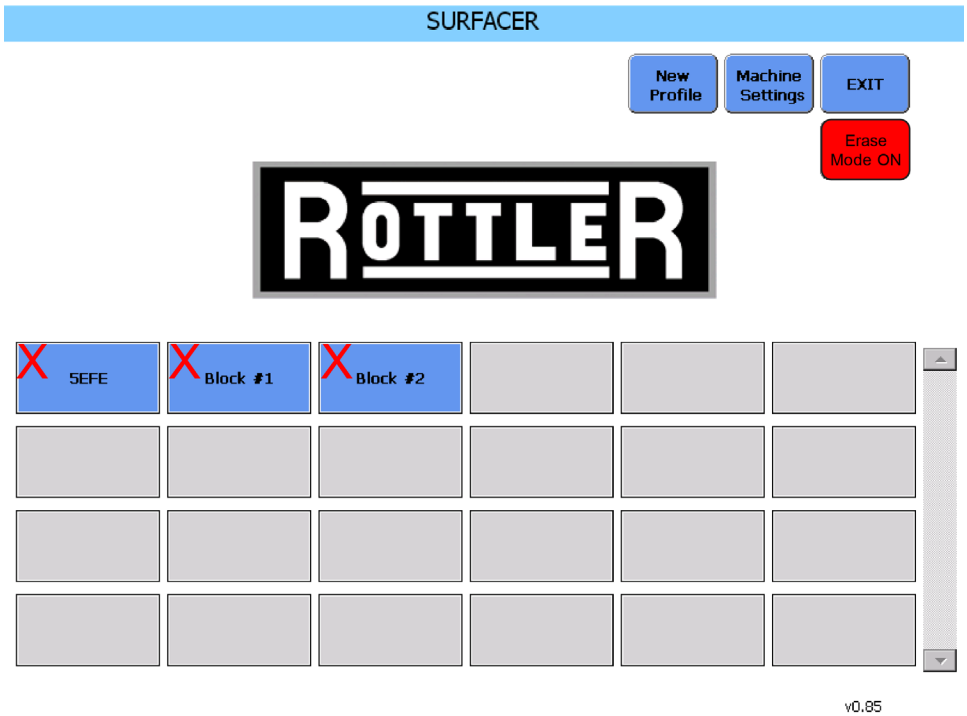
To load a different program press the Program Select button. This will bring up the Profile Select screen. Press the button of the profile you want to use.

Renaming and Deleting Block Profiles

1. To rename a block profile from the home run screen click on the title bar with the block profile name.
2. The keypad will appear.
3. Use the BS key to erase the current block profile name.
4. Type in new block profile name.
5. Tap the ins key.
6. Tap the return key.
7. Tap the Save button to save the new block profile name to the Profile Select screen.



1. To erase a block profile from the Profile Select screen tap the Erase Mode button so that it changes color to red and the button reads Erase Mode ON.
2. A red X will appear on all the saved block profiles.
3. Tap the block profiles you want to erase.
4. Tap the Erase Mode button again to change the button back to Erase Mode OFF



Cutting Inserts

Standard Inserts and Usage

Rottler offers several different 3/8” and 1/2” IC negative rake inserts for the SF machine. Below is a description of each.

6303B

A round 3/8” IC, double sided, CBN Insert. An excellent, long life insert for surfacing cast iron heads and blocks -round shape gives many cutting edges on each side of insert. When using a 14” cutterhead (SF, F65, F80) speeds range from 900-1200 RPM. When using an 18” cutterhead (F80) speeds range from 600-800 RPM.

6303M

A round 3/8” IC, single sided, PCD Insert. For use on aluminum only - heads and blocks without liners. This insert has a thin layer of PCD applied to a carbide disk. The diamond appears to be a shiny black wafer. The hardness of the diamond resists the abrasive nature of the silica in aluminum heads and blocks. RPM speeds with a 14” cutter range from 900-2000 RPM.

6303K

A round, 3/8” IC, single sided, coated carbide Insert. This is a very economical, general purpose insert for surfacing aluminum. It is advisable to use this insert for rough cutting to remove welding or contaminants before. A PCD insert should be used for the final cut to give the super fine finish required for MLS (multi layer steel) head gaskets. RPM speeds with a 14” cutterhead range from 600-1000 RPM.

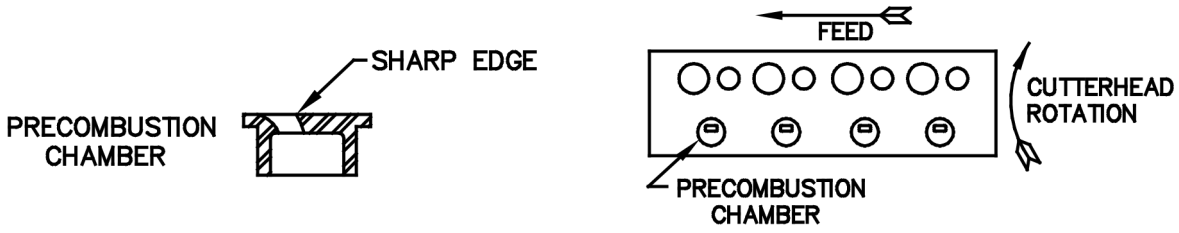
6303S

A round 3/8” IC, single sided, CBN Insert. For use on aluminum blocks with iron liners and aluminum heads with steel pre-combustion chambers. When cutting aluminum heads with pre-combustion chambers it is best to use Rottler Manufacturing’s spray mist coolant system. RPM speeds with a 14” cutter range from 650-750 RPM.

6303R

A round 3/8” IC, single sided, CBN Insert. For use on cast iron heads with steel pre-combustion chambers. RPM speed with a 14” cutter range from 600-700 RPM and with a 18” cutter range from 500600 RPM.

It is critical that the heads be mounted in the fixture correctly. If the head is not mounted in this way, the inserts will chip when they contact the sharp of the pre combustion chamber.



Note: There are at least two different materials used in the manufacture of the pre-combustion chambers. Rottler Manufacturing has experimented with only one of these materials. Rottler cannot guarantee cutting all materials.

501-29-6E R2

This is a 3/8” IC square carbide insert with a purple ceramic coating. This carbide insert is normally used for high speed boring. It works well as an economical insert for rough surfacing or heavy stock removal of cast iron. A CBN insert should be used for the final finish cut.

6301J

A square 3/8” IC, 1/16” Radius, double sided, CBN Insert. The 1/16” radius of this insert will produce a more accurate (flatter) finish than a round insert typically used for surfacing. This insert is often used on F80-Series machines when surfacing large diesel blocks which are high in nickel. The square surfacing insert is intended for F80 applications where it may encounter heavier cuts and greater interrupted cuts. When using an 18” cutter speeds range from 600-800 RPM, and with a 14” cutter speeds range from 9001200 RPM.

6303P

A round 1/2” IC, single sided, PCD Insert. For use on aluminum only - heads and blocks without liners. This insert has a thin layer of PCD applied to the top of a carbide disk. The diamond appears to be a shiny black wafer. The hardness of the diamond resists the abrasive nature of the silica in aluminum heads and blocks. RPM speeds with a 14” cutter range from 1000-2000 RPM. This insert gives the maximum productivity when cutting aluminum. Requires the purchase of 1/2” negative rake tool holders. The standard Rottler 3/8” IC tool holders will not hold this insert.

6303Q

A round 1/2” IC double sided, CBN Insert. An excellent insert for machining cast iron heads and blocks. Round shape gives many cutting edges on each side of insert. Requires the purchase of 1/2” negative rake tool holders. The standard Rottler 3/8” IC tool holders will not hold this insert.

One Insert vs. Two Inserts

Rottler SF machines can be rum effectively with either one or two inserts installed in the cutterhead.

Note: Never remove one tool holder that holds the insert and run the machine with one insert. This will create an out of balance situation.

If two inserts are installed and aligned within .0001 of an inch the feed rate can be run 2 times faster than if using only one insert.

The depth of the grooves made by the inserts for a typical finish is approximately .0003. Therefore for a second insert to be of any advantage in obtaining a smoother finish for a given feed rate or a similar finish at a higher feed rate the inserts must be aligned within .0003. Aligning them within .0001 will give you a significantly smoother finish than aligning them within .0002. Therefore for maximum quality and consistency Rottler recommends aligning the inserts within .0001 in a vertical plane, alignment of the horizontal plane within .002 is sufficient.

If aligning the inserts within .0001 is too time consuming we recommend mis-aligning them between .0003 and .0015. With the inserts mis-aligned you will get the same finish for a set RPM and feed rate that you would using one insert. The benefit on using two inserts is for stock removal. Since the one mis-aligned insert is removing some material the depth of cut can be increased up to .010 and acceptable tool life obtained.

If one insert is used (50 percent of our customers use one insert) you do not have to worry about alignment. It makes it very easy to change from CBN to coated carbide inserts. The following data assumes you are using a 3/8” diameter insert, either CBN or coated carbide.

General Information

Rottler CBN and PCD Inserts are laser marked with our part number on one side. On single sided inserts, the part number is on the back side of the insert.

Rottler surfacing insert toolholders are designated IC (inscribed circle) which means they can hold square and round inserts with the same IC, for example, a 3/8” IC round and 3/8” IC square insert will fit into the standard 3/8” IC Rottler toolholders.

Rottler SF Series machines are supplied standard with Rottler 3/8” IC toolholders fitted to our surfacing heads. Optional 1/2” tool holders are interchangeable with 3/8” toolholders.

Cutting Speed Calculation

Inserts are designed to cut within a speed range (S.F.P.M.). In order to convert from cutting speed to RPM, use the following formula:

$$RPM = \frac{S.F.P.M. \times 3.82}{DIAMETER}$$

S.F.P.M. = Surface Feet per Minute

RPM = Revolutions per Minute

DIAMETER in Inches

	One Insert	Two Inserts Set within .0015” - .0003	Two Inserts Set within .0001”
RPM 1000 Feed Rate .002” Per Rev	12 rms	12 rms	10 rms
RPM 1000 Feed Rate .005” Per Rev	20 rms	20 rms	15 rms
RPM 1000 Feed Rate .010” Per Rev	30 rms	30 rms	25 rms
RPM 1000 Feed Rate .020” Per Rev	60 rms	60 rms	40 rms
RPM 1000 Feed Rate .030” Per Rev	90 rms	90 rms	60 rms