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USER GUIDE

UGE059-1223

Sure Cut Rotary Knife Cutter

SC-5 Servo Model

Please record your equipment's model and serial number(s) and the date you received it in the spaces provided.

It's a good idea to record the model and serial number(s) of your equipment and the date you received it in the User Guide. Our service department uses this information, along with the manual number, to provide help for the specific equipment you installed.

Please keep this User Guide and all manuals, engineering prints, and parts lists together for documentation of your equipment.

Date:

Manual Number: UGE059-1223

Serial Number(s):

Model Number(s):

DISCLAIMER: Neither Conair nor its employees shall be liable for errors contained in this User Guide or for incidental, consequential damages in connection with the furnishing, performance or use of this information. Conair makes no warranty of any kind with regard to this information, including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose.

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Introduction

Purpose of the User Guide

This User Guide describes the Conair SC-5 Sure Cut Servo Knife Cutter and explains step-by-step how to install, operate, maintain and repair this equipment.

Before installing this product, please take a few moments to read the User Guide and review the diagrams and safety information in the instruction packet. You should also review manuals covering associated equipment in your system. This review won't take long, and it could save you valuable installation and operating time later.

How the Guide Is Organized

Symbols have been used to help organize the User Guide and call your attention to important information regarding safe installation and operation.

 Symbols within triangles warn of conditions that could be hazardous to users or could damage equipment. Read and take precautions before proceeding.

1 Numbers indicate tasks or steps to be performed by the user.

◆ A diamond indicates the equipment's response to an action performed by the user or a situation.

❒ An open box marks items in a checklist.

- A circle marks items in a list.

Indicates a tip. A tip is used to provide you with a suggestion that will help you with the maintenance and the operation of this equipment.

 Indicates a note. A note is used to provide additional information about the steps you are following throughout the manual.

Your Responsibility as a User

You must be familiar with all safety procedures concerning installation, operation, and maintenance of this equipment. Responsible safety procedures include:

- Thorough review of this User Guide, paying particular attention to hazard warnings, appendices, and related diagrams.
- Thorough review of the equipment itself, with careful attention to voltage sources, intended use, and warning labels.
- Thorough review of instruction manuals for associated equipment.
- Step-by-step adherence to instructions outlined in this User Guide.

ATTENTION:
Read This So No One Gets Hurt

We design equipment with the user's safety in mind. You can avoid the potential hazards identified on this machine by following the procedures outlined below and elsewhere in the User Guide.

DANGER: Sharp blades!

Most injuries caused by knife blades occur when the cutter has been turned off. Handle blades with care at all times.

- Always lock out the cutter before opening the cutting chamber.
- Always wear cut-resistant gloves when the cutting chamber is open and when handling blades.

SC-5 cutters are equipped with several safety devices to ensure safe operation. Never remove or disable these devices to sustain production. Operating without these devices can cause severe injury.

- When the knife guard is opened, the knife guard switch stops the cutter.
- Two proximity-type safety switches prevent operation unless the cutter bushings are in place.
- The STOP button activates a circuit that stops the knife. (Do not attempt to change a blade or work in the cutting chamber without locking out the power.

WARNING: Improper installation, operation, or servicing may result in equipment damage or personal injury.

This equipment should be installed, adjusted, and serviced by qualified technical personnel who are familiar with the construction, operation, and potential hazards of this type of machine.

All wiring, disconnects, and fuses should be installed by qualified electrical technicians in accordance with electrical codes in your region. Always maintain a safe ground. Do not operate the equipment at power levels other than what is specified on the machine serial tag and data plate.

WARNING: Voltage hazard

This equipment is powered by three-phase alternating current, as specified on the machine serial tag and data plate.

A properly-sized conductive ground wire from the incoming power supply must be connected to the chassis ground terminal inside the electrical enclosure. Improper grounding can result in sever personal injury and erratic machine operation.

Always disconnect and lockout power before opening the electrical enclosure or performing non-routine procedures such as maintenance.

CAUTION: It is always recommended that the main power cord be disconnected and placed in clear view of the operator or service personnel while changing blades or servicing the cutter in any capacity.

In order to protect the operator from possible harm from the rotating blade wheel, several safety features are built into this cutter. They include:

Two electric switches make a contact between the side and the clear polycarbonate sliding blade observation windows such that the windows MUST BE CLOSED in order to enable the blade wheel to spin.

- This prevents someone from opening the windows and having the blade wheel spin which can cause serious injury. Tampering with this safety feature will VOID ANY responsibility for safety.

A proximity switch is positioned on both the upstream and downstream side of the bushing holder. If there are no bushings in either side, the blade will not spin.

- This prevents someone from inserting their hands or fingers in the cutting mechanism while the blade wheel is spinning. Tampering with this feature will also VOID ANY responsibility for safety.

A safety switch is positioned on the bushing holder flip up guard to prevent operation unless fully closed.

This prevents someone from inserting their hands or fingers in the cutting mechanism while the blade wheel is spinning. Tampering with this feature will also VOID ANY responsibility for safety.

A lockable main power disconnect is provided to prevent the possibility of hazardous electrical shock while servicing the main electrical enclosure. (See How to use the Lockout Device, in Section 1)

How to Use the Lockout Device

CAUTION:

Before performing maintenance or repairs on this product, you should disconnect and lockout electrical power sources to prevent injury from unexpected energization or start-up. A lockable device may be provided to isolate this product from potentially hazardous electricity.

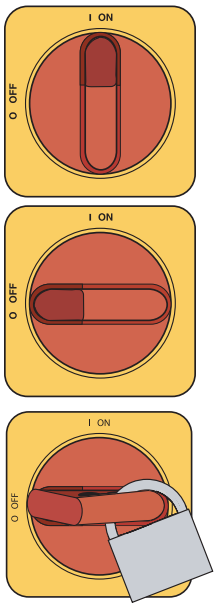
WARNING:

Before removing lockout devices and returning switches to the ON position, make sure that all personnel are clear of the machine, tools have been removed and all safety guards reinstalled.

Lockout is the preferred method of isolating machines or equipment from energy sources. Your Conair product may be equipped with a lockout device. To use the lockout device:

1. **Stop or turn off the equipment.**
2. **Isolate the equipment from the electric power.**
3. **Turn the rotary disconnect switch to the OFF, or "O" position**
4. **Secure the device** with an assigned lock or tag.
5. The equipment is now locked out.

If the equipment has no included lockout device, perform the same procedure upstream of the device as part of premises electrical system.



NOTE: Your lockout device may appear different than the one shown here.

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Description

What is the SC-5 Sure Cut Rotary Knife Cutter?

The Conair SC-5 Sure Cut Series rotary knife cutter has been designed to be “The most versatile cutter of the industry”.

With both capacity to cut small parts at high speeds or large tubes or profiles at low speeds this cutter can eliminate the need for moving cutters in and out of a line per application.

Today with custom profile houses potentially running 2-3 different profiles on one line in a given day, time is at a premium. Having to move different cutters in and out of line is no longer acceptable when time is money.

Mechanical Features

This series of servo rotary knife cutters use a 24-inch diameter flywheel optimizing surface speed and power. This is in fact the largest diameter wheel which could be used while still allowing it’s mounting under the bushing holder.

Flywheel

With a 24-inch diameter flywheel which is 1-inch thick, many benefits become available.

Planetary Gear Reducer

A 10:1 in-line servo motor rated planetary gear reducer with 7 arc-minutes maximum backlash is mounted directly to a 3000 rpm brushless servo motor. A top flywheel speed of 300 rpm is realized. Even though the flywheel appears to be moving slowly, the actual surface speed at the blade at only 300 RPM’s is over 0.438 inch per millisecond. That’s twice the surface speed of a typical clutch brake cutter.

Instead of mounting the cutter head directly to the servo motor shaft, which is generally not designed for high radial load or axial load due to small shaft diameters, the 24-inch flywheel is mounted to the planetary gear reducer shaft which is designed for just this type of application. At the gear ratio and output speeds which this cutter was designed, radial load on the output shaft of the reducer is in excess of 1000 lbs where the servo motor shaft may only be 100 lbs or less. Potential wear on the servo motor shaft bearings is minimized.

The high speed\low torque power of the servo motor is efficiently converted into a low RPM \ high surface speed \ high torque power more suitable for cutting applications.

What is the SC-5 Sure Cut? (Cont'd)

Two opposing belts pull the extrusion through the line based on the speed set at the puller's speed reference potentiometer. The optional footage counter displays linear speed (ft/min) or motor rpm in English or metric units, depending on customer preference.

The larger diameter flywheel used on the servo cutter offers the potential of higher surface speeds at dramatically lower blade rpm's with high cutting torque. The typical grey area between on-demand cutting and flywheel cutting (150 cpm on-demand up to 300 cpm flywheel), typically seen in DC driven clutch\brake cutter is eliminated.

It should not be necessary to cut in on demand mode in excess of 150 cuts-per-minute which will greatly save on premature wear to the system. Not only does this cutter offer optimum blade surface speed throughout an extremely wide cuts per minute range, but extreme accuracy throughout.

The added benefit of the 24 inch diameter by one inch thick aluminum wheel is the stored inertia which adds power for cutting larger profiles and tubes. The size of the wheel actually adds horsepower to the system. Due to the use of 10:1 gear reduction, the servo motor is made extremely efficient and easily able to handle this weight with out detrimental effects.

Typical Applications

Cutting from Below the Bushing Holder

The SC-5 Sure Cut Servo Cutter housing maximizes versatility and operational ease. Due to the size of the flywheel it was determined best to mount it directly below the bushing holder keeping the center of gravity low and offering the following benefits:

- Accessibility of the flywheel for ease of blade changes.
- Built in blade lubrication tray can be integral to the design of the cutting chamber.
- An optional blade heating system can be added to give optimum versatility to this cutter.
- With the bushing holder above the flywheel tremendous cutting capacity is available without extreme blade length.
- Ease of discharge conveyor interface for part support and automatic ejection systems is made simple with this layout.
- The optional slide system can enable the use of rigids and flexibles.

To get the full benefit from the servo cutter, Conair has provided several cutting modes, *see Cutter Control, Section 4*. The Conair SC-5 Sure Cut servo rotary knife cutter is a truly innovative cutter. Loaded with features and backed up by the most extensive service support system in the industry.

How the SC-5 Sure Cut Works

Extruded material that has been sized and cooled enters the cutter from the upstream side *(See How the SC-5 Sure Cut Works, Section 2, step 1)*. Typically, a puller is placed just before the cutter; the puller pulls the extrudate through the sizing and/or cooling tanks and feeds it into the cutter.

The positional servo motor, is direct coupled to the cutter head, or an in-line planetary gear reducer that drives the cutter head. The planetary gear reducer arrangement increases cutting torque, improves servo motor efficiency, and offers improved bearing load ratings.

The cutting knife, attached to the cutter head, is driven by the servo motor *(See How the SC-5 Sure Cut Works, Section 2, step 2)*. Two cutter bushings guide and support both the extrudate and the cutting knife. The cutter head is mounted directly to the in-line planetary gear reducer shaft using a B-Loc coupling device, and may have as many as four optional blade positions. *See Installation and Removal of B-Loc, Section 5.*

Two types of cutting modes are available. On-demand cutting modes (Timer, Encoder, Auto and Product) provide a single rotation cut cycle. However, in continuous cutting modes (Flywheel and Optional Follower) the cutting mechanism rotates continuously.

The knife guard includes a stainless steel lower tray, which can be used for blade lubrication. The upper knife guard includes a clear polycarbonate window. This allows you to watch the cutting blade during operation.

Cut pieces are collected or carried on to further processing by an optional conveyor *(See How the SC-5 Sure Cut Works, Section 2, step 3)*.

How the SC-5 Sure Cut Works (Cont'd)

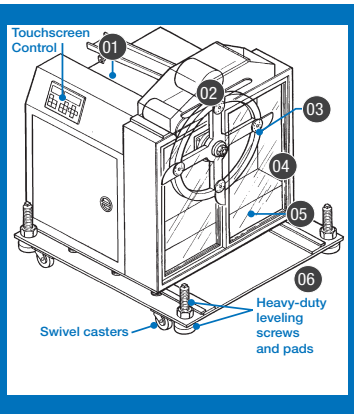
3 Cut pieces are collected or carried away on a conveyor.

1 Extruded material enters the cutter from the upstream side.

2 The cutter head holds the blade(s) as they rotate and pass between the bushings, cutting the extrudate.

Specifications

Overview



01
Parts discharge chute or optional discharge conveyor.

02
Wide range of cutter bushing capacities

03
24-inch {610 mm} diameter flywheel with multiple blade mounting system

04
Polycarbonate blade observation window

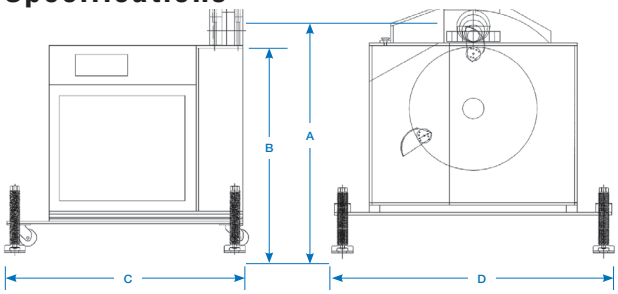
05
Optional blade lubrication system

06
Optional slide base assembly with position locking mechanism

Controls

The Sure Cut features a full-color touchscreen control. Switch cutting modes, adjust blade speed, customize operation, save recipes, and create unique user privileges all from a touchscreen control that allows for easy communication to other devices. All Conair controls are designed with the same style icon/button operation, making learning a new piece of equipment easy and comfortable.

Specifications



Models	SC-5	SC-8
Performance characteristics		
Extrusion capacity inches {mm}		
Tube diameters	2.25 - 4.75 {57 - 121}	2.25 - 7.25 {57 - 184}
Profile dimensions	2 x 4 - 2 x 10, 4 x 7 {51 x 102 - 51 x 254, 102 x 178}	2.25 x 26.6 - 6.25 x 12.25 {57 x 676 - 159 x 311}
Blade drive motor	4.6 Hp {3.4 kW}	10.0 Hp {7.5 kW}
Feed direction	right to left	
Dimensions inches {mm}		
A - Overall height	47 {1193.8}	70 {1778}
B - Height to centerline (± 2)	42 {50.8}	43 ±3 {1092 ±76.2}
C - Length	37 {939.8}	43 {1092}
D - Width	52.0 {1321}	61 {1549}
Voltage Full load amps *		
460 V/3/60 Hz		

* FLA data for reference purposes only. Does not include any options or accessories on equipment. For full FLA detail for power circuit design of specific machines and systems, refer to the electrical diagrams of the equipment order and the nameplate applied to the machine.
Specifications may change without notice Consult with a Conair representative for the most current information.

Features

- Surface speeds to 0.438 inches {11.1 mm} per millisecond
- Heavy-duty positional AC brushless servo drive
- 10:1 planetary gear head reducer as standard
- 3,000 pulse bi-directional encoder

Options

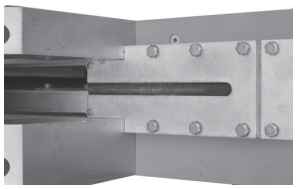
- Custom paint
- Left to right operation
- Custom round bushing holder sizes available: 3.25, 4.25, 5.25 inch
- Blade lubrication system including large capacity stainless steel blade lubrication tray and blade wipe with replaceable felt pads
- Slide base assembly with position locking mechanism for 12 inches of movement
- Timer mode
- CE certification
- UL certification

Optional Equipment

Slide Base

This option is highly recommended for cutting flexible extrudates. While the cutter base is fixed and aligned with the puller, the cutter itself is mounted on a set of linear slides that allow as much as 12 inches of movement. The cutter can be moved away from the puller for startup, then moved close to the puller to enhance delivery to the cutter bushings.

Blade Wipe



The blade wipe system keeps the cutting blade clean by removing lubricant and particles from the blade. A felt pad sandwiched between two pieces of stainless steel and mounted next to the bushing wipes the knife before each cut.

Custom Bushing Holder Sizes Available:

Round	Profile
2.25 inch (standard)	2 x 4 inch
3.25 inch	2 x 6 inch
4.25 inch	2 x 8 inch
5.25 inch	2 x 10 inch
	3 x 6 inch
	4 x 7 inch

Heavy Duty Blade Positions

- One blade position standard
- Optional 2 or 4 blade positions available
- Optional simitare blade available (see parts list for optional blades.)

Discharge Conveyor

A discharge conveyor facilitates the removal of cut parts. Discharge conveyors are available in the following sizes:

- 6 inches wide by 6 feet long
- 6 inches wide by 10 feet long
- 6 inches wide by 16 feet long

Isolation Transformer

The isolation transformer protects sensitive electronics from incoming power, which helps prevent errors caused by electrical noise. It also protects equipment from electrical noise generated by the servo motor and associated amplifier.

✎ **NOTE:** An isolation transformer will not compensate for a ground that does not meet code requirements.

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SECTION
3

Installation

Unpacking the Boxes

The SC-5 Sure Cut Series Servo Knife Cutter comes fully assembled in a single crate.

⚠ **CAUTION: Lifting**

To avoid personal injury or damage to the cutter, lift the cutter using a forklift or hoist with straps that have been positioned at the cutter's center of gravity.

1. **Carefully uncrate the puller and its components.**
2. **Remove all packing material, protective paper, tape, and plastic.** Compare contents to the shipping papers to ensure that you have all the parts.
3. **Carefully inspect all components** to make sure no damage occurred during shipping. Check all wire terminal connections, bolts, and any other electrical connections, which may have come loose during shipping.
4. **Record serial numbers and specifications** in the blanks provided on the back of the User Guide's title page. This information will be helpful if you ever need service or parts.
5. **You are now ready to begin installation.**
   Complete the preparation steps in *Preparing for Installation, Section 3.*

Preparing for Installation

⚠ **WARNING: Improper installation, operation, or servicing may result in equipment damage or personal injury.**

This equipment should be installed, adjusted, and serviced by qualified technical personnel who are familiar with the construction, operation, and potential hazards of this type of machine.

All wiring, disconnects, and fuses should be installed by qualified electrical technicians in accordance with electrical codes in your region. Always maintain a safe ground. Do not operate the equipment at power levels other than what is specified on the machine serial tag and data plate.

1 You need these tools for installation:

- ❒ wire strain relief
- ❒ 16- or 18- inch adjustable wrench
- ❒ set of Allen wrenches
- ❒ set of feeler gauges
- ❒ 1/2 inch open or box end wrench
- ❒ flashlight

2 Plan the location.
Make sure the area where the servo cutter is installed has the following:

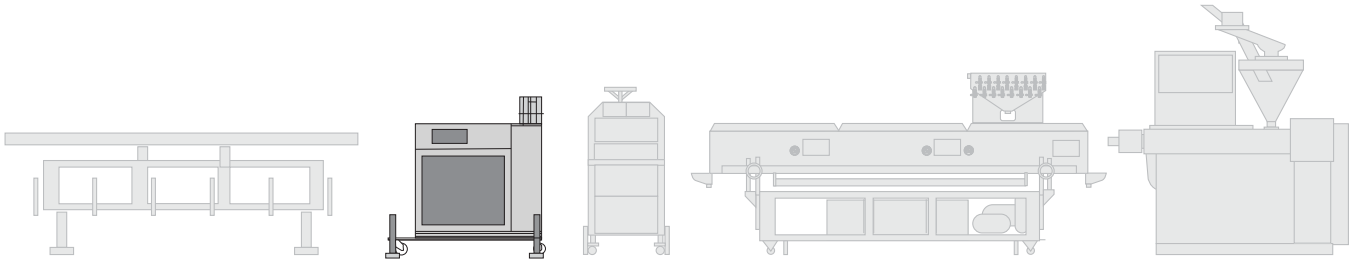
- **A grounded power source.**
  Check the cutter's serial tag for the correct amps, voltage, phase, and cycles. All wiring should be completed by qualified personnel and should comply with your region's electrical codes.
- **Clearance for safe operation and maintenance.**
  Make sure there is enough clearance around the servo cutter for maintenance and servicing. If the servo cutter has the optional slide base, be sure to check for clearance by extending the slide system in both directions.

Positioning the Servo Cutter

CAUTION: Lifting

To avoid personal injury or damage to the cutter, lift the cutter using a forklift or hoist with straps that have been positioned at the cutter's center of gravity.

1 **Move the servo cutter into position.** Place the servo cutter in position downstream of the belt puller.



SC-5 Cutter

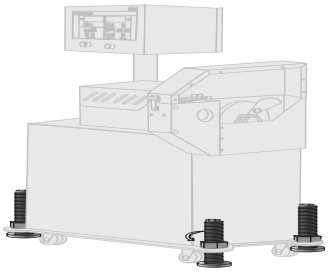
2 **Determine the best distance** from the belt puller to the SC-5 Sure Cut cutter.

- **For flexible products,** the cutter should be located as close to the puller as possible to insure a minimum amount of space for the product between the point of exit of the puller and the inlet to the cutter bushing for most flexible products.
- **For rigid products,** allow some deflection space between the puller and cutter. This will minimize product sag or excessive deflection during cutting which could affect the cut length accuracy. As a general rule, place the cutter such that you feel no shock from the cut with your fingernail placed on the extrudate on the entrance of the puller. If you feel shock form the cut, simply allow more space between the cutter and puller.

✎ **NOTE:** If the slide base option was purchased, the cutting chamber can be slid back from the frame to allow ease of the string up procedure.

3 **Align the cutter with the extrusion line.**

4 **Measure the centerline height** of the extrudate as it exits the extrusion die. Adjust all equipment on the extrusion line (sizing tank, cooling tanks, belt puller, and cutter) to this height.



5 **Adjust the cutter's floorlock/caster assembly** to the center height of the extrusion

line using a 16- or 18-inch adjustable wrench. Once the correct height is reached, adjust the pad assembly to remove the weight from the casters for operation. This minimizes machine vibration during the cutting cycle.

6 **Use a plumb line or laser to check for a straight line** from the extrusion die through each line component to the cutter bushings. Adjust as necessary.

Connecting the Main Power Source

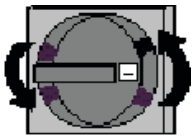
WARNING: Electrical hazard

Before performing maintenance or repairs on this product, you should disconnect and lockout electrical power sources to prevent injury from unexpected energization or start-up. A lockable device has been provided to isolate this product from potentially hazardous electricity.

⚠ **WARNING: Improper installation, operation, or servicing may result in equipment damage or personal injury.**

This equipment should be installed, adjusted, and serviced by qualified technical personnel who are familiar with the construction, operation, and potential hazards of this type of machine.

All wiring, disconnects, and fuses should be installed by qualified electrical technicians in accordance with electrical codes in your region. Always maintain a safe ground. Do not operate the equipment at power levels other than what is specified on the machine serial tag and data plate.



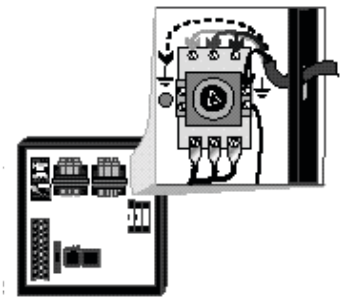
1 **Open the servo cutter's electrical enclosure.** Turn the disconnect dial on the door to the OFF or O position and open the door.

2 **Insert the main power wire** through the knockout in the side of the enclosure. Secure the wire with a rubber compression fitting or strain relief.

3 **Connect the power wires** to the terminals indicated on the wiring diagram that came with your machine.

4 **Check every terminal screw** to make sure wires are secure. Gently tug each wire. If a wire is loose, use a screwdriver to tighten the terminal.

5 **Connect the ground wire** to either grounding point shown in the diagram.



⚠ **IMPORTANT:** Always refer to the wiring diagrams that came with your belt puller before making electrical connections. The diagrams show the minimum size main power cable required for your puller, and the most accurate electrical component information.

Installing the Encoder

CAUTION: Handle with care.

The encoder is a delicate piece of equipment and must be handled gently.

Conair uses bi-directional encoders to ensure that only product that moves forward is counted. Installing the encoder consists of several parts:

- the encoder
- the measuring wheel
- the connecting cable

The encoder is fitted with a one foot circumference wheel which rides on either the upper belt of the belt puller or (for rigid profiles and pipe) on the extrudate itself upstream of the puller.

The encoder is supplied with an integral mounting bracket. How and where you attach the encoder to the puller depends on your particular puller and application.

- If the wheel rides on the puller belt, make sure that its linear alignment is the same as the belt. Place the wheel near the center of the belt to minimize bouncing. Try to avoid cracks and other belt features that may effect accuracy.
- Make sure the location allows you to keep the wheel clean. Any small buildup on the wheel will effect its circumference and change the cut length.

After the encoder is installed, attach it to the cutter control using the supplied cable. The cable has been hard-wired to the control at the factory.

Installing the Cutter Blades

DANGER: Sharp blades!

Most injuries caused by knife blades occur when the cutter has been turned off. Handle blades with care at all times.

- Always lock out power to the cutter before opening the cutting chamber.
- Always wear cut-resistant gloves when the cutting chamber is open and when handling blades.
- Always wait until the cutter head has completely stopped before opening the knife guard.

SC-5 Sure Cut cutters are equipped with several safety devices to ensure safe operation. Never remove or disable these devices to sustain production. Operating without these devices can cause severe injury.

Never attempt to change or work on Blades without first locking out power to the machine.

- When the knife guard is opened, the knife guard switch stops the cutter.
- Two proximity-type safety switches prevent operation unless the cutter bushings are in place.
- The STOP button activates a circuit that stops the cutter head.

1 **Shut off the main power disconnect and unplug the main power cord** when entering the cutter housing. There is a safety interlock on the cutter blade housing that will deactivate the servo amplifier and control system.

2 **Remove the screws holding the blades, remove the old blades and insert the new blades.** The blade, or blades as the case may be, will fit onto a roll pin or in a machined slot with a blade clamp to squeeze or tighten. Secure the blade.

For more information about choosing the appropriate blade for your material, *see the Appendix B.*

Installing the Cutter Blades (Cont'd)

TIP: We recommend that you:

- **Apply some protective cover on the portion of the blade you are handling**, such as masking tape to help prevent getting cut during installation and to leave it on until such time that you will start and check the cutting operation.
- **Check the length that the blade extends out of the cutter blade wheel**. The blade needs to be carefully checked to insure that the entire blade will pass completely through the product.

This is especially important with the very first installation and can be accomplished by rotating the wheel with the blade installed manually though the bushing and visually check to see that it will completely cover the entire bore of the bushing.

CAUTION: Never attempt to change or work on blades without first locking out power to the machine.

CAUTION: Use extreme caution as the blades will be very sharp. With the power off, the blade wheel can spin freely.

Mounting the Cutter Bushings

DANGER: Sharp blades!

Always wear cut-resistant gloves when the cutting chamber is open and when handling blades. Never open cutting chamber without locking out the cutter power and waiting until the cutter head stops spinning.

The Bushings

Generally, the bushing will be in two parts, an inlet and an outlet with the inlet bushing being tapered or otherwise contoured to assist in guiding the product into the cutter mechanism. It is extremely crucial to the success of the cutting process that bushing bores be exact and in perfect alignment with each half. They should be polished smoothed, burr free and generally several thousands oversized for optimum performance.

Installation of the Bushing

1. **Open the top hinged cover (yellow) to expose the top of the bushing holder.**
2. **Use the two set screws positioned on top of the bushing holder and turn them counterclockwise to loosen and remove the bushings.**
3. **Replace the desired bushings and tighten up the two set screws just enough to barely be able to move the bushings.**
4. **Rotate the blade wheel until the blade enters the space between the two bushings.**
5. **Move the outlet bushing in until you can barely feel the blade scrape along the inside of the bushing.**

Mounting the Cutter Bushings (Cont'd)

6 **Move the inlet bushing inward until there is about 0.001 to 0.003 inch clearance between the blade and the outlet bushing.**

7 **Tighten the two screws in the housing to lock in the bushings.**

8 **Rotate the blade wheel** by hand so that the blade passes through the space between the two bushings to insure that it will clear without hitting either bushing and passes through the space with little effort.

Checking the Alignment of the Bushings

Checking the Alignment of Bushing to Blade

Once you are sure that the blade will easily clear the bushings as it goes through the space you should then make some test cuts to insure quality.

1 **Close the safety cover.**

2 **Turn on the Power (Rotary main disconnect).**

3 **Press the Green start button.**

4 **Do several test cuts by pressing the manual cut button.**

5 **Check the quality of the cuts. Adjust the bushing if necessary**

For more information about setting and adjusting the gap for the bushings, see About Cutter Bushings in the Appendix C.

Checking Repeatability

Before any Conair SC-5's are shipped, they are tested for cut time repeatability to be sure they are within performance specifications. The repeatability test checks the performance of the rotary knife cutter to return to the home park position after a complete cut. Acceptable repeatability times allowed for each cutter model prior to shipping are:

Type of Cutter	Repeatability Time
AC Pneumatic Cutter	Less than 1 millisecond
DC Pneumatic Cutter	Less than 1.5 millisecond
Positional Servo	Less than 0.1 millisecond

✎ **NOTE:** 1-millisecond at 60 feet per minute is equal to 0.012 inches.

The repeatability mode is built into the Conair cutter controls and allows you to perform similar tests, without any external test equipment. It is recommended that you check repeatability on a regular basis. *Refer to Operation Section 4, Control Instructions Test to run repeatability tests.* Acceleration/deceleration delays of the servo do not contribute to repeatability error; any error is attributed solely to motor stability, couplings, assembly, power, and proximity sensor alignment.

Use any blade speed and line speed. The line speed is only seen while in the Encoder or Product modes. It is recommended that the tests be performed at cut intervals between 0.5 and 5-seconds. Do not change the blade speed or the line speed after starting the test.

Preparing for Testing

1. **Make sure all components** are installed according to assembly drawings. Make sure that all bolts on the cutter have been tightened.
2. **Check that cutter is firmly locked** into position with the anchoring screws.
3. **Check that all wiring conforms to electrical codes,** and all wiring covers are in place.

Testing the Installation

1. **Locate the main disconnect switch on the front of the control cabinet.** Turn it on. You should see the Redlion interface illuminate and start communications and the yellow power light should now be on.
2. **Make sure the bushings and the blade doors are in place and secure.** Check that the bushing access door is closed and the threaded knob is tight and the E-stop is in the out position.
3. **Press the green start button.** If the guard circuit is ready the green start button will now be illuminated.
4. **Do a test cut, by pressing the black manual cut button.** You should have caused the flywheel to complete on test cut.
5. **To enable the cutter, push the center arrow key.**

If for any reason any of these steps could not be achieved please *refer to the troubleshooting section of the manual.*

SECTION
4

Operation

SC-5 Cutter Control

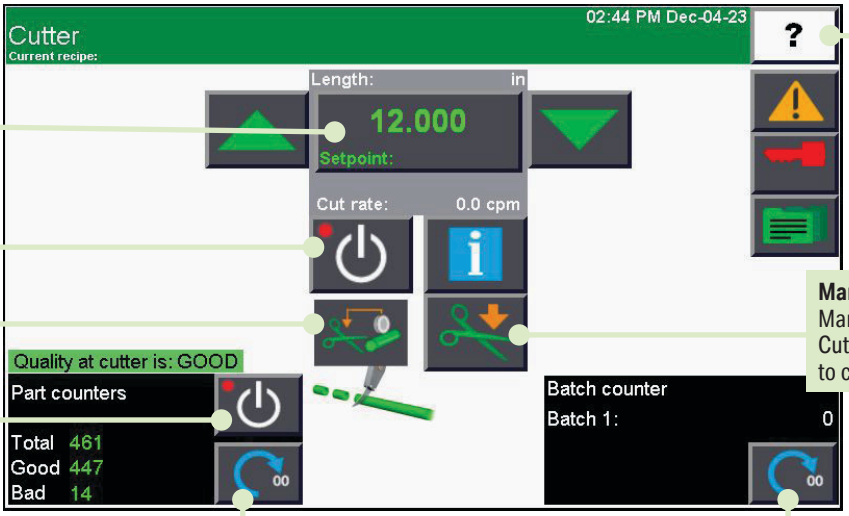
About/Calibration
Displays control info and calibration function.

Cut Length
Displays a numeric keypad to enter a new value. The range displays on the bottom of the keypad.

On/Off
Turns the Cutter on or off.

Mode Select
Displays the cutter mode selection options.

On/Off
Turns the Part Counter on or off.



Manual Cut
Manual cut of the part. Cutter must be "on" to cut.

Part Count
Press to open the part counter screen showing the good/bad parts and reset option.

Batch Warning
Illuminates when end of a batch is near (not shown).

Batch Counter
Opens the Batch Counter screen.

Navigating the Control Screens

Home - Return to Home (Main) Screen.

Menu - Access set up and settings options.

Scroll Up/Scroll Down on current screen or adjust values up or down.

Recipes - Navigate to Recipes screen.

Security Options - Navigate to security set up and settings, logon/logoff functions.

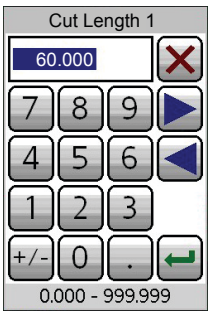
About - Information about the control and access to calibration function.

Alarms - Navigate to the Alarms screen.

Power - Intiate Start/Stop functions for the Cutter and Part Counter.

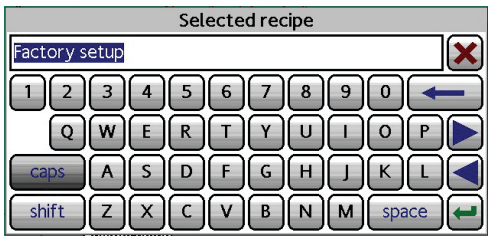
Select Units - Set units of measure to English or Metric.

Language - Set and control the lanugage displayed on the control screens.



Fields requiring numeric entry display a number keypad in a popup with the acceptable range at the bottom

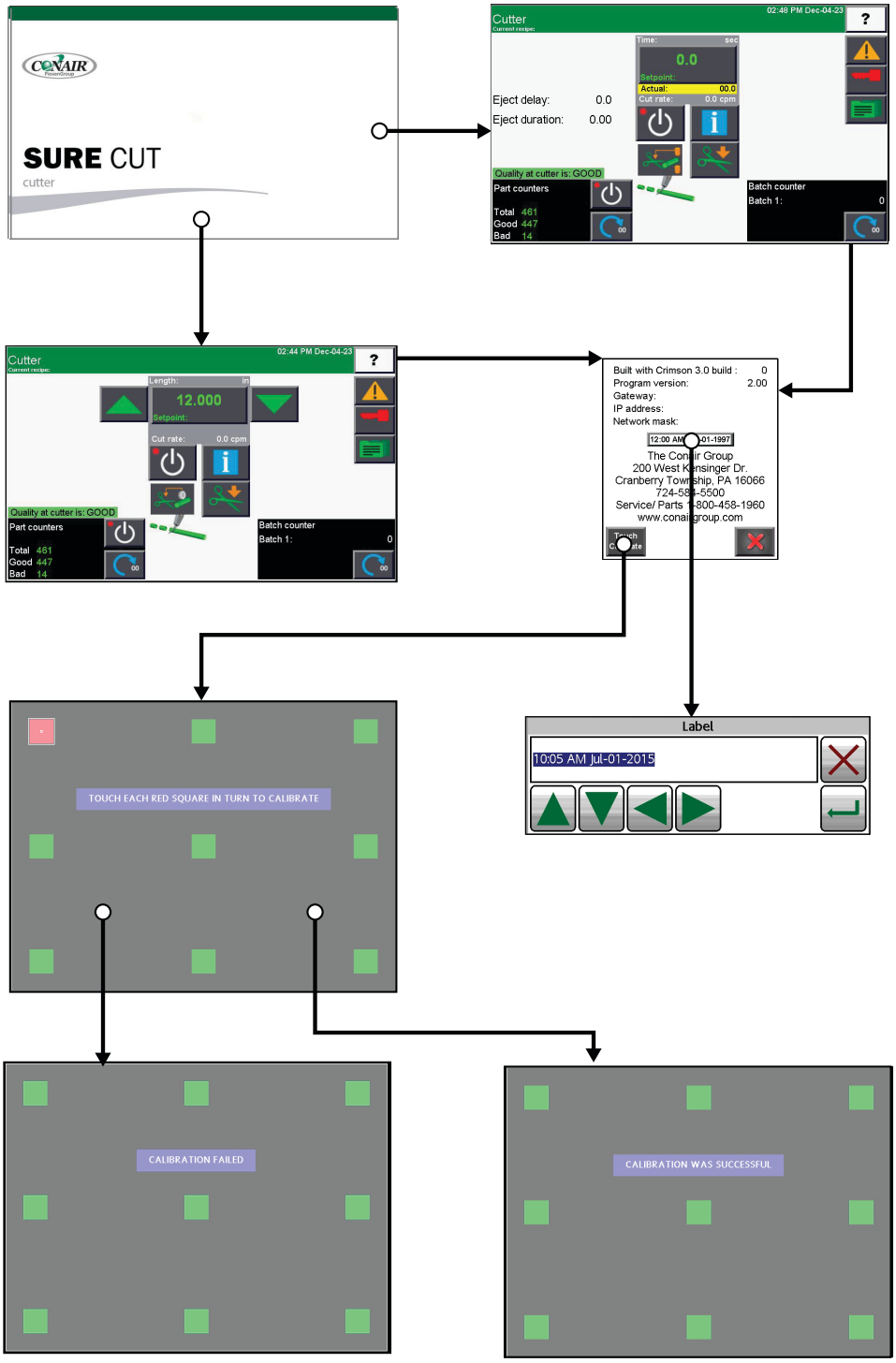
Fields requiring data entry display a keyboard in a popup



Control Function Flow Charts

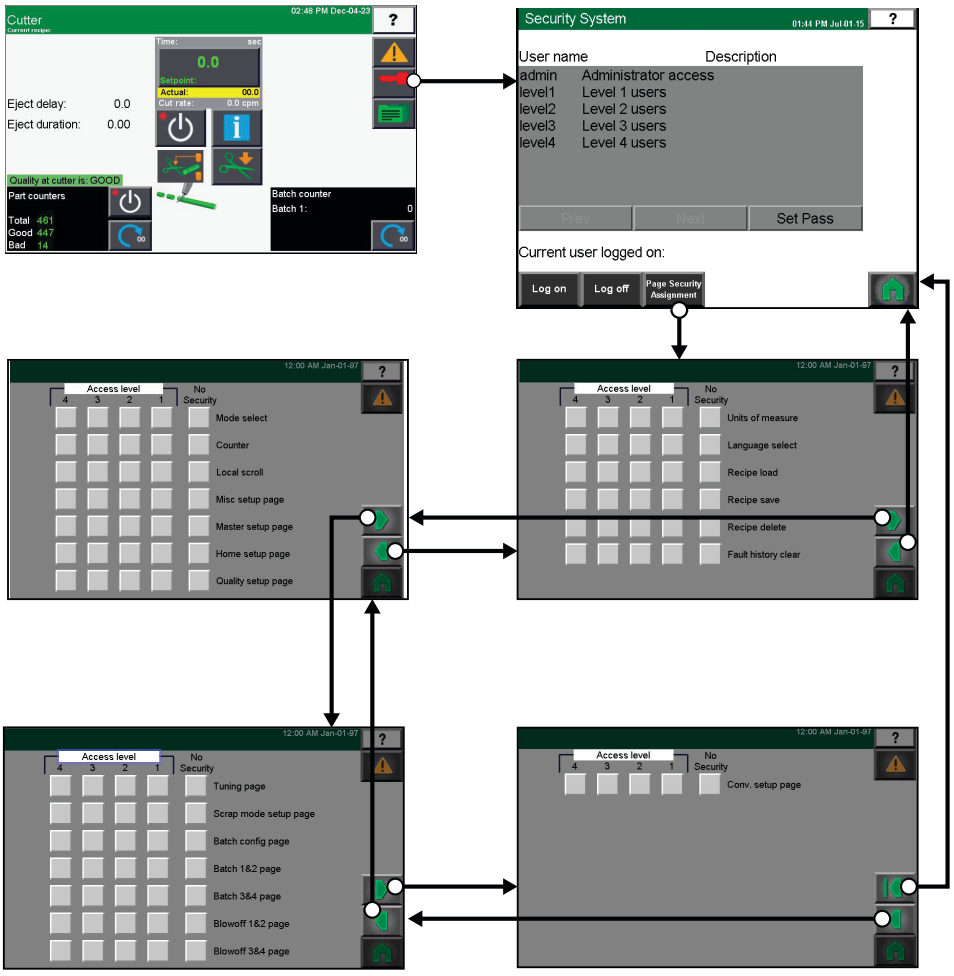
✎ **NOTE:** Depending on the mode settings Encoder, End Sense, Timer, Flywheel, or Follower, the Main screen will vary slightly.

Startup and Calibration Screens



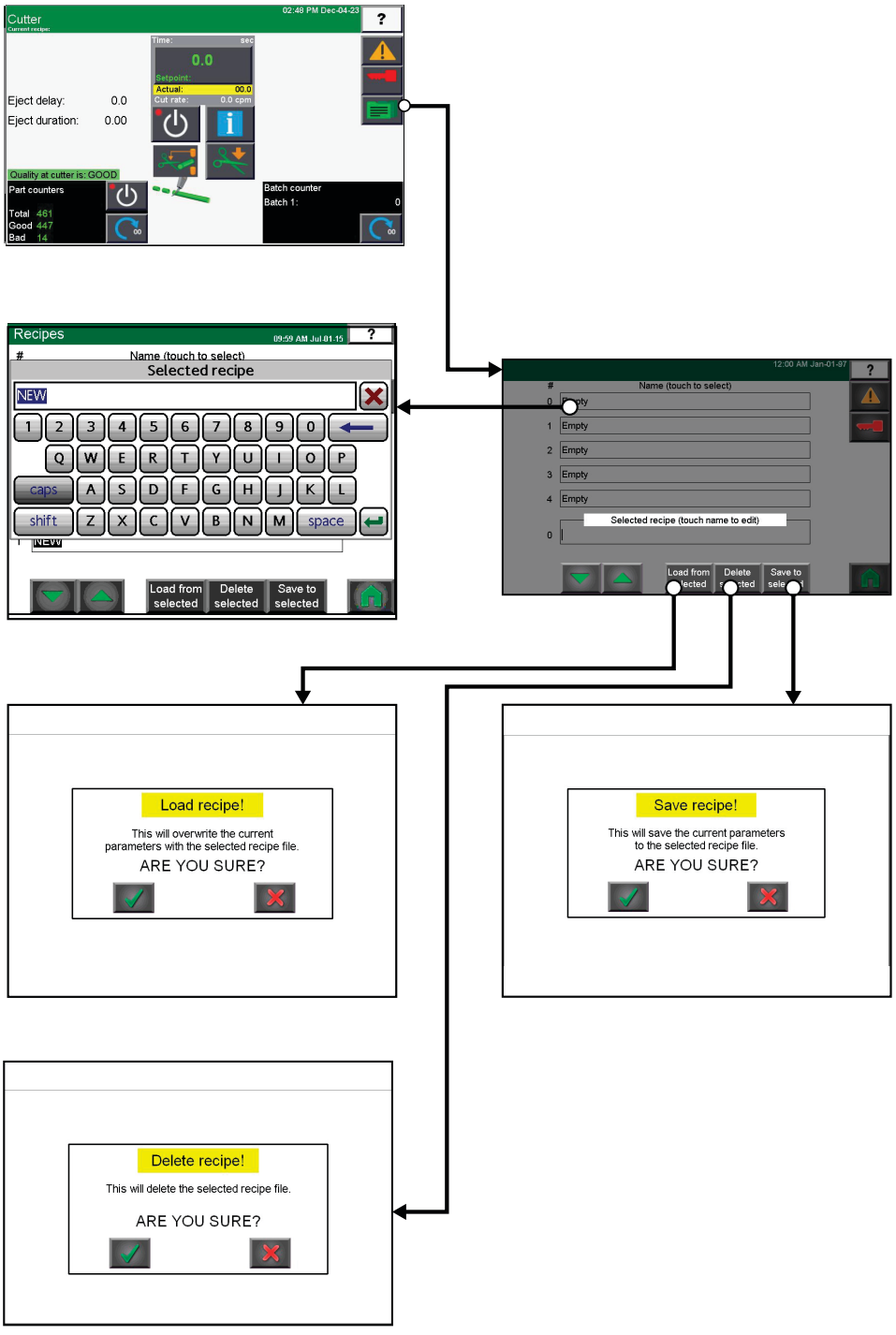
Control Function Flow Charts (Cont'd)

Security Screens



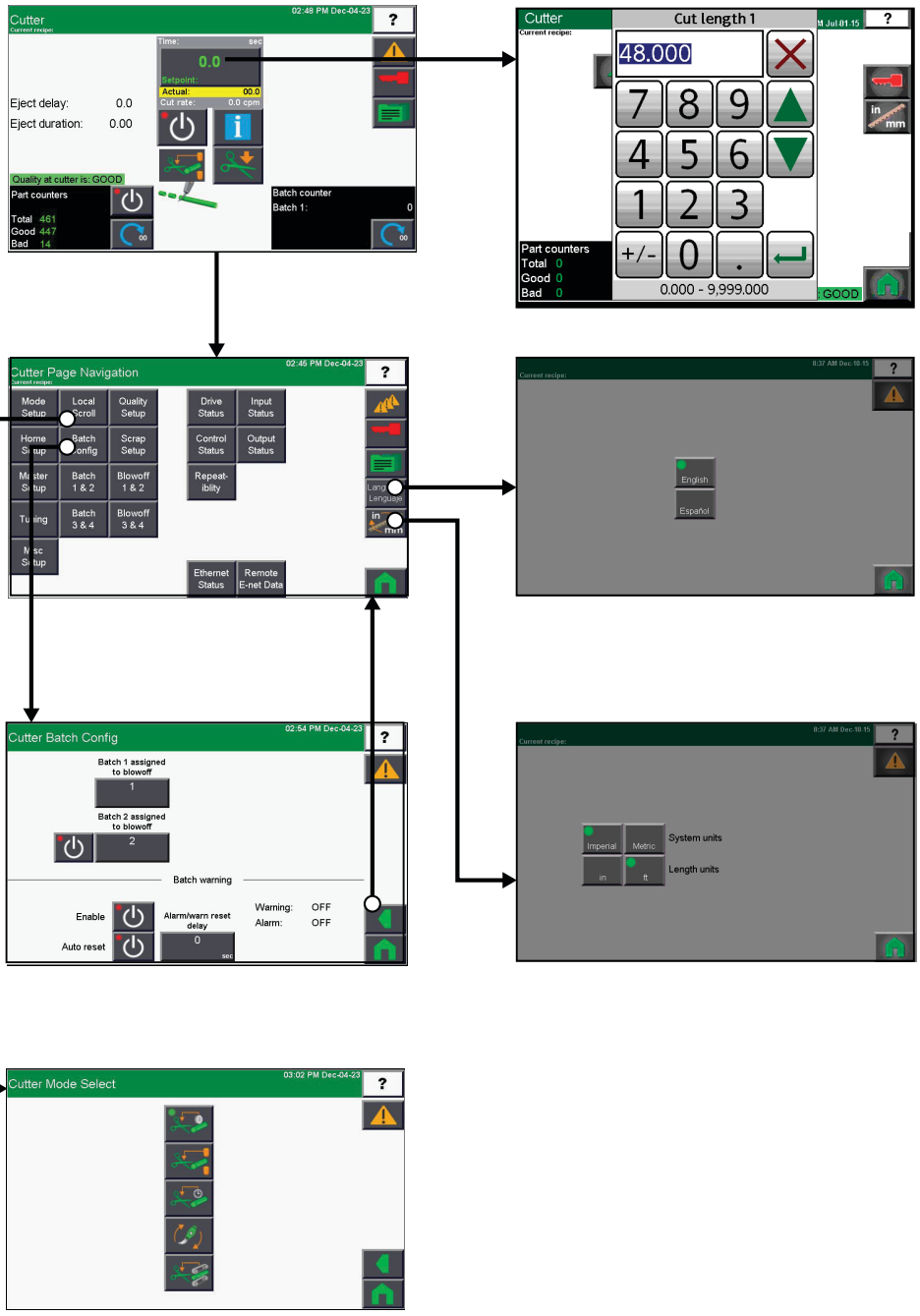
Control Function Flow Charts (Cont'd)

Recipe Screens



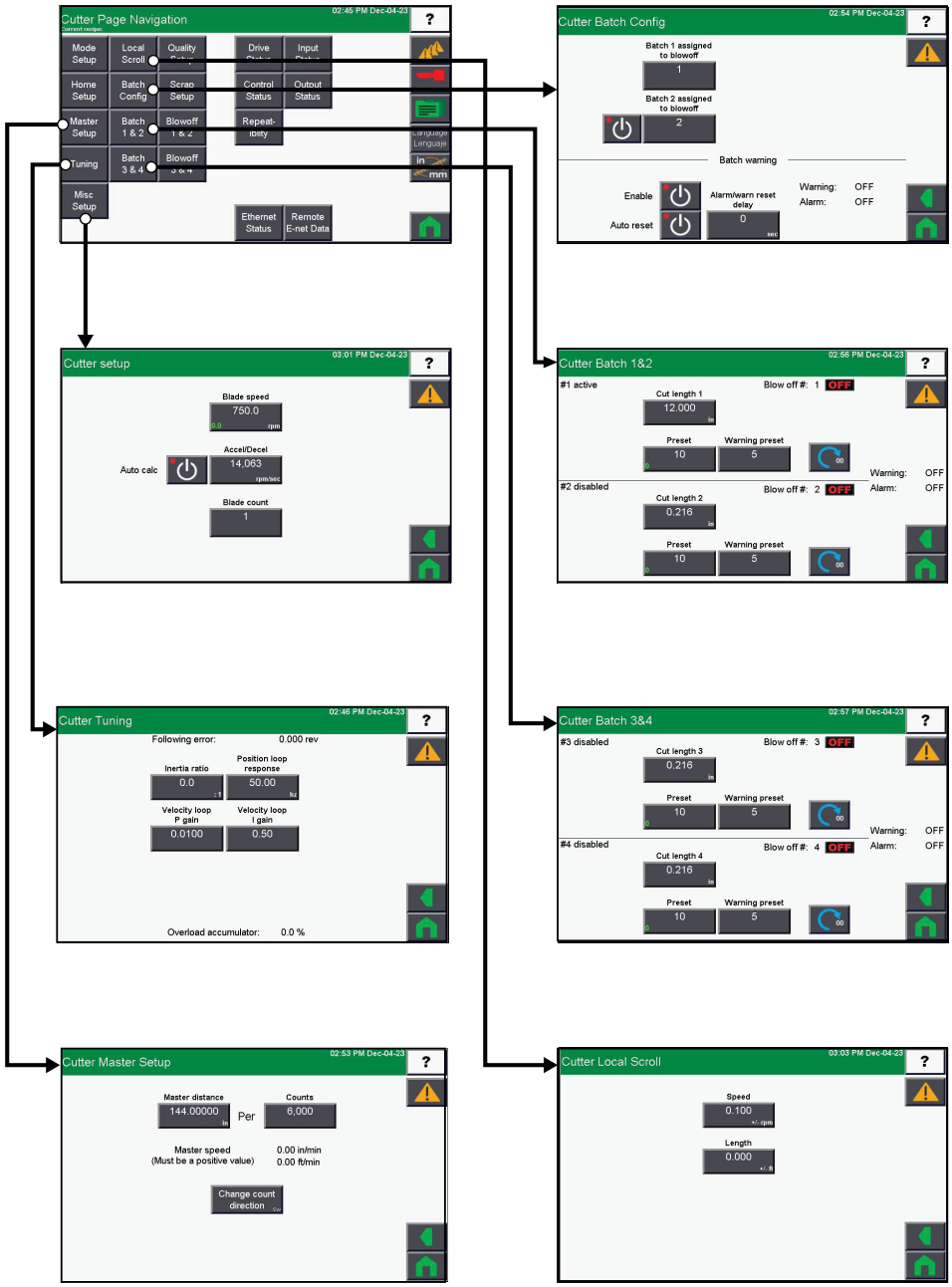
Control Function Flow Charts (Cont'd)

Setup Screens



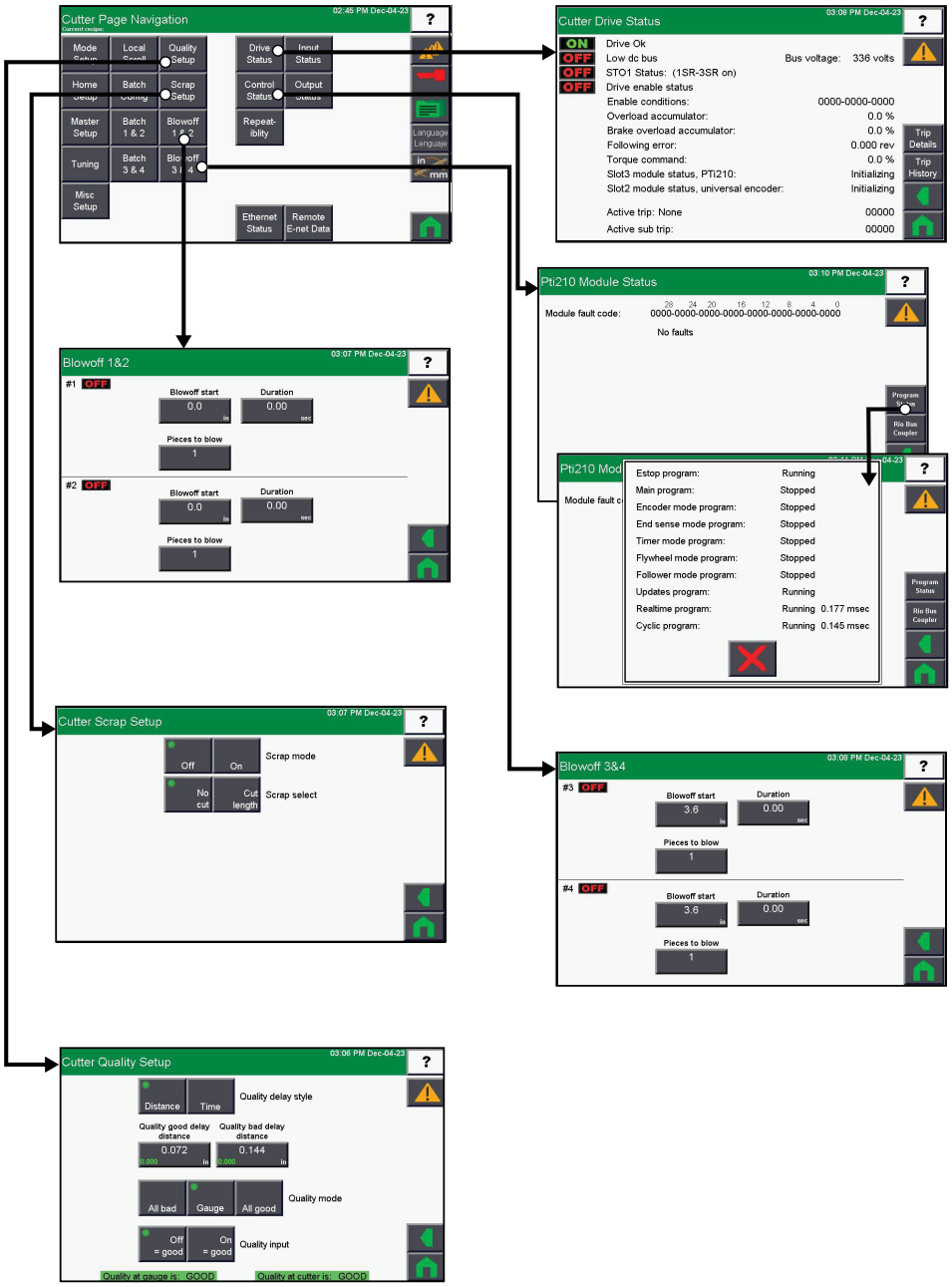
Control Function Flow Charts (Cont'd)

Setup Screens



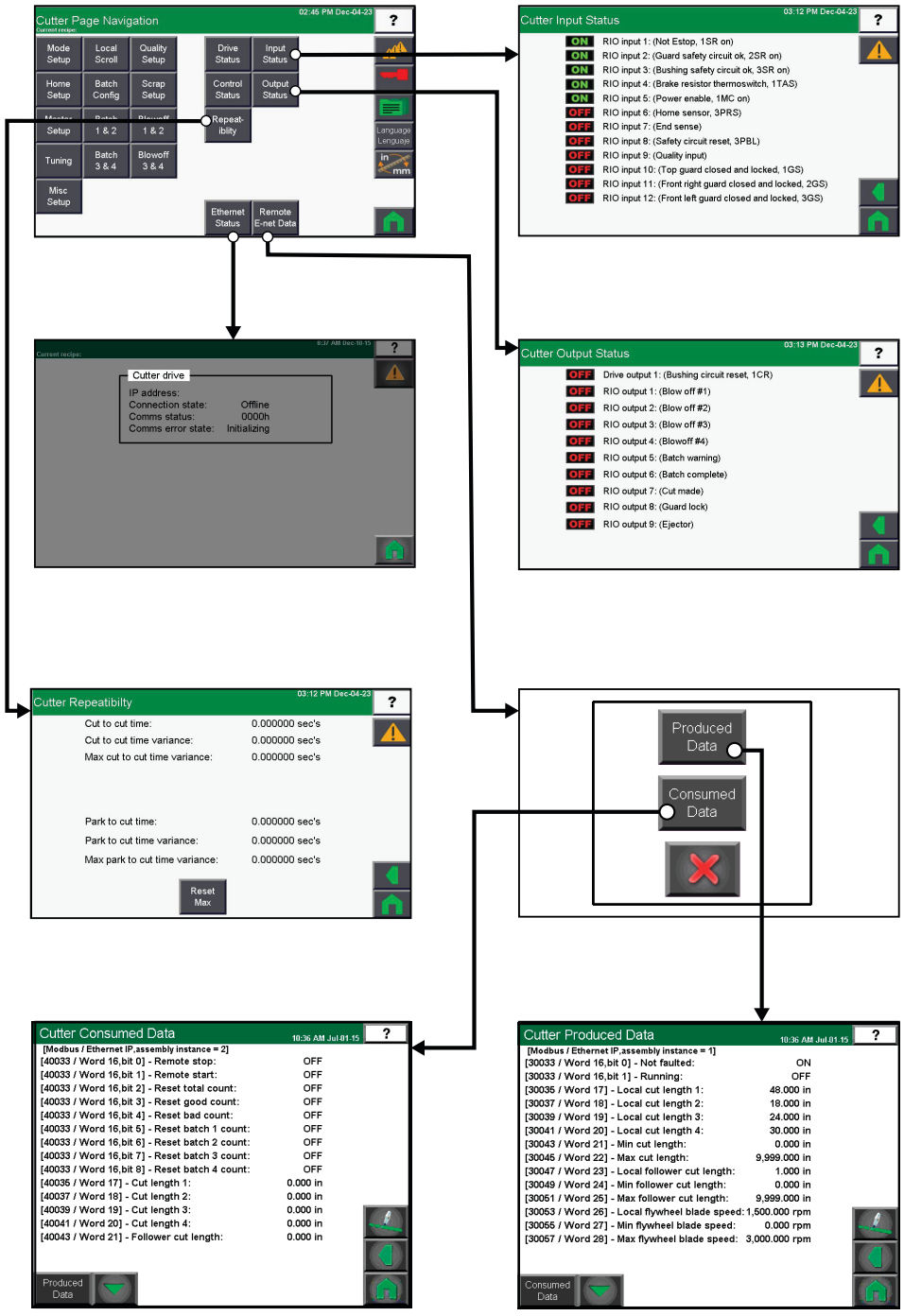
Control Function Flow Charts (Cont'd)

Setup Screens



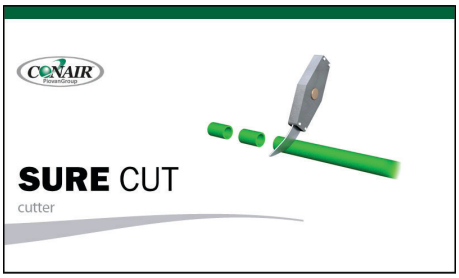
Control Function Flow Charts (Cont'd)

Setup Screens



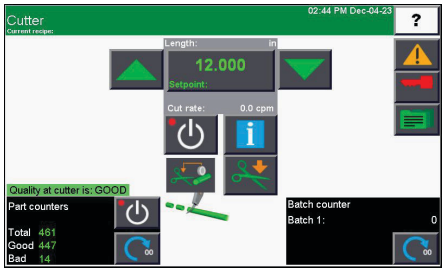
Control Screen Descriptions

Splash Screen



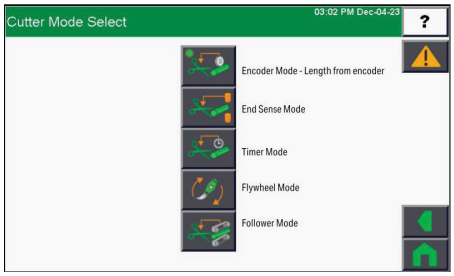
The first screen that appeas when the power to the unit is turned.

Home



The Home (main) screen is displayed automatically upon power up after the system is done initializing. The main page is where most machine control functions are performed. *See "SC-5 Cutter Control" on page 4-2 for feature details.*

Home > Mode Select



This screen allows the changing of the cutter to the various modes.

Encoder A signal is obtained from the puller to control the cuts.

Flywheel The blade holder/flywheel will turn at a consistent RPM. The RPM will be entered on the main operating screen and can be changed to change the resulting cut length. This page shows the blade holder/flywheel will turn at a consistent RPM. The RPM will be entered on the main operating screen and can be changed to vary the resulting cut length. The acceptable range 0.000 - 750.000 is displayed at the bottom of the popup keypad window. Blade speed may need adjusted depending on your application (product density/hardness).

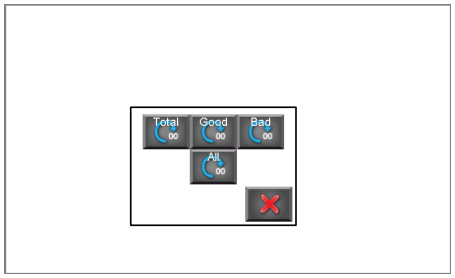
End Sense this mode uses a proximity switch, mechanical switch, or some type of sensing device that triggers the cut. This page uses a proximity switch, mechanical switch, or some type of sensing device that triggers the cut. Delay time that must expire after a cut is made before end sense device can trigger another cut.

Follower This mode is similar to flywheel mode, except that the operator will enter a desired length and the cutter program will do the calculations of how fast the blade holder/flywheel must turn to get the desired part length with current observed master belt speed. The program will constantly try to correct part length with any motor variations. This screen is similar to flywheel mode, except that the operator will enter a desired length and the cutter program will do the calculations of how fast the blade holder/flywheel must turn to get the desired part length with current observed master belt speed. The program will constantly try to correct part length with any motor variations. The acceptable range 0.000 - 999.999 is displayed at the bottom of the popup keypad window.

Timer This mode will allow the cutting to occur on a timed basis not a length basis. This mode will allow the cutting to occur on a timed basis not a length basis. This page will allow the cutting to occur on a timed basis rather than a length basis.

Control Screen Descriptions (Cont'd)

Home > Part Counter

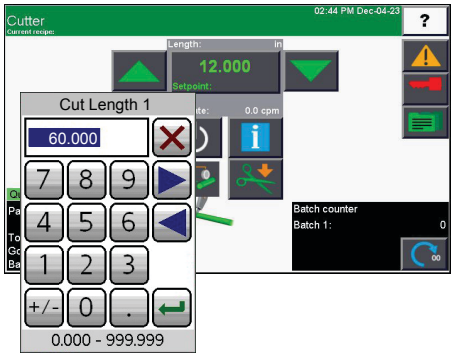


Displays when the part counter icon is pressed is pushed on the Home (main) screen. Shows the counted good and bad parts if a signal is being sent from a laser gauge system. The counter can be turned on/off or reset here.

Home > Batch Counter

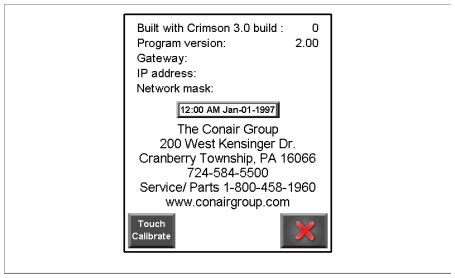
Displays when the batch counter icon is pressed is pushed on the Home (main) screen.

Home > Main Cut Length



The cut length number will open a keypad that will allow the entry of a desired length. At the bottom of the keypad, there will be a set of 2 numbers. Those numbers are the range of cut lengths that can be entered at the current puller speed.

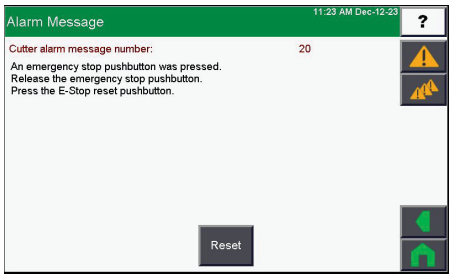
? About / Calibration



This screen displays the software usage, Conair contact information, and allows for Touch Screen Calibration. *See "Startup and Calibration Screens" on page 4-3 and "Calibration Screens" on page 4-23*.

Control Screen Descriptions (Cont'd)

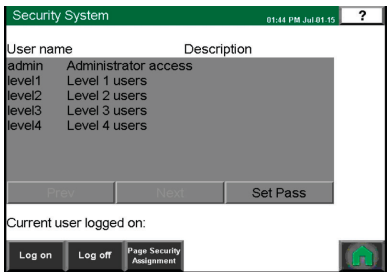
Home > Alarms



This screen shows the current and acknowledged (but not cleared) list of alarms. Pressing Silence, Acknowledge or the Acknowledge All icons will silence the alarms. Some alarms will shut down the machine operation until the condition is cleared.

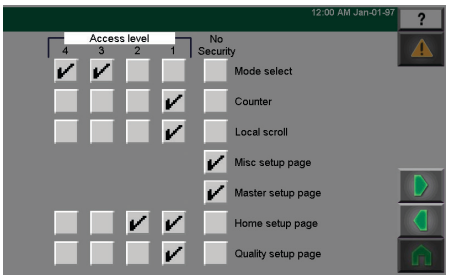
Security Screens

Home > Security



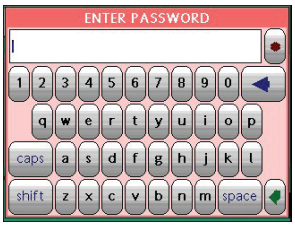
User can log into or out of the system. There are five different User choices. Each User ID can be set up with specific passwords to create different levels of permission to access the programs pages. Setting the accessibility of each User to the various pages can be done by pressing Page Security Assignment.

Security > Page Security Assignment #1



Initially No Security is active. Check/touch the boxes to enable or disable permissions for each security level and page. *See "Security Screens" on page 4-4*.

Home > Security > Login



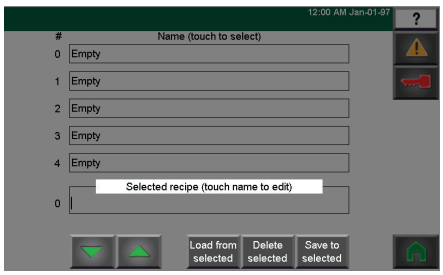
Enter username on the keypad.

After you have entered your user name, this key pad pops up to enter your password

Control Screen Descriptions (Cont'd)

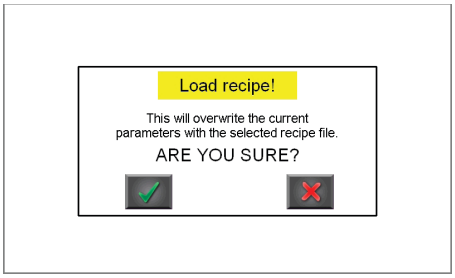
Recipe Screens

Home > Recipes



The recipe screen allows access to the recipe storage/retrieval system. Up to 100 recipe files are available and are numbered 1 thru 100. Each recipe file can be given a name up to 40 characters. Five recipe file numbers/names are displayed at once. To view other recipe file names touch the "Pg Up" or "Pg Dn" buttons. Recipes can only be loaded when the machine is in the stopped condition. *See "Recipe Screens" on page 4-5*.

Home > Recipes > Load from Selected

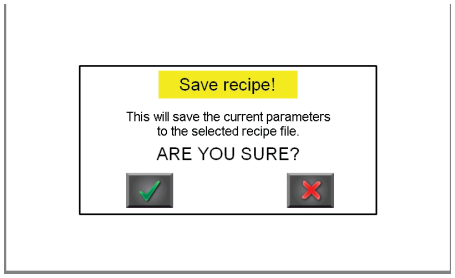


The "Load from selected" function is only available when the cutter is stopped. This function will load the parameters from the recipe file into the active parameters.

Home > Recipes > Renaming Recipe

Touching the selected recipe name will allow you to change the name using the pop up key pad.

Home > Recipes > Save to Selected



Individual recipes can be saved on this screen. Up to 99 different recipes can be saved. A saved recipe will collect all set points of the current conditions of the puller and cutter when it is saved. Recipes can be saved at any time. Recipes can only be loaded when the machine is in the stopped condition. This function will save the active parameters to the selected recipe file.

Control Screen Descriptions (Cont'd)

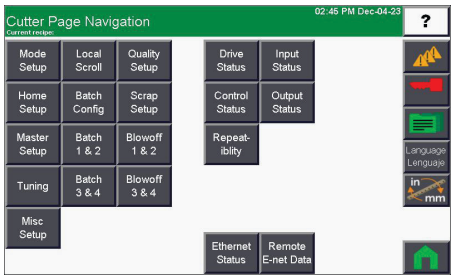
Recipe Screens (Cont'd)

Home > Recipes > Delete Selected

The "Delete selected" function is available anytime. This function will set the name of the selected recipe file to "Empty". The actual parameter values in the recipe file are not deleted.

Screens Accessible from (Setup) Menu

Home > Menu

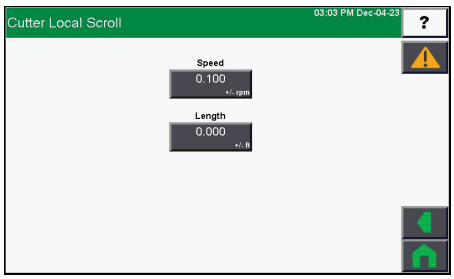


The Menu screen is the root page for screen navigation. Provides access to setup and settings screens.

Home > Menu > Mode Setup

The Mode setup options are accessed from the Menu screen.

Home > Menu > Local Scroll

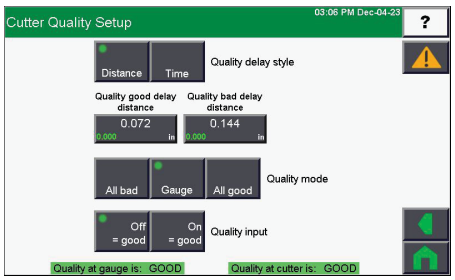


The Local Scroll options are accessed from the Menu screen.

Control Screen Descriptions (Cont'd)

Screens Accessible from (Setup) Menu (Cont'd)

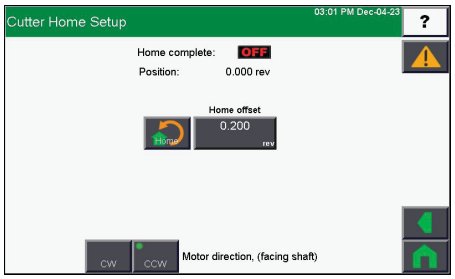
Home > Menu > Quality Setup



This screen allows the selection of which parts to blow off of the conveyor. This is used when the blow-off is tied to an optional laser gauging system for quality. The laser will send a signal of a good or bad part to the cutter. The blow-off sequences can be turned on/off here also. This screen allows the configuration of the input quality signal. The laser gauge will send a signal to the cutter.

Quality good delay	This is a timer for how long of time is desired for the system to run after the laser gauge has given a "good" signal. The length of time should be sufficient for all off-spec parts to clear the conveyor . This is the amount of time that will pass after the gauge system indicates that the part is good before the cutter starts treating the parts as good parts. This allows the clearing of bad parts from the system.
Quality input	The selection of whether the part is good or bad when gauging systems signal is observed.
Quality Mode	Select here whether the blow-off and counters treat the part as always bad, always good, or if it follows the signal from the laser gauge.

Home > Menu > Home Setup

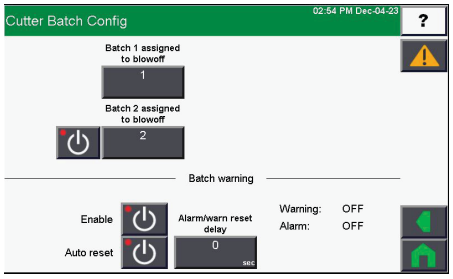


This screen allows access to the cutter flywheel homing parameters. When the cutter is first powered up a zero (home) position needs to be established for the flywheel. When the emergency stop circuit is reset and no faults exist, the cutter will automatically home. Cutters that have a gear reducer attached to the motor will use a proximity sensor as the home input. Cutters that do not have a gear reducer will use the motor encoder marker pulse as the home input. When the homing procedure begins the flywheel will turn at a slow speed until the home sensor is detected. After finding the home sensor the flywheel will move an "offset" distance and stop. This offset distance from the home sensor is the zero, or park position of the flywheel. The cutter remembers this zero position until powered down.

Control Screen Descriptions (Cont'd)

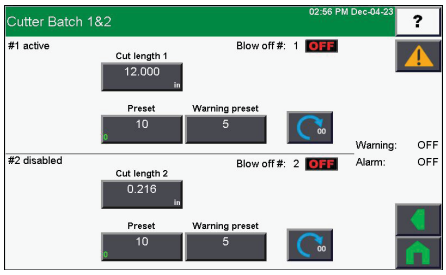
Screens Accessible from (Setup) Menu (Cont'd)

Home > Menu > Batch Config



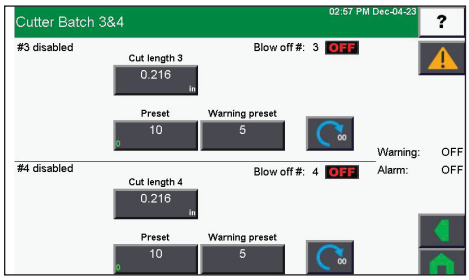
This screen allows access to the cutter batch configuration parameters. The cutter provides part batch counting and blowoff control. Up to four batches and four blowoffs are available. One batch counter is always enabled. The other three (3) can be enable/disabled from this page. Each batch counter can be assigned to any one blowoff.

Home > Menu > Batch 1 & 2



This screen allows access to the cutter batch counters 1 & 2 parameters. Each batch counter has an associated cut length. If more than one batch counter is enabled, the cutter switches to the next batch counter enabled and switches the cut length. This allows cutting batches of different length products automatically. Each batch counter has a preset and warning preset parameter.

Home > Menu > Batch 3 & 4

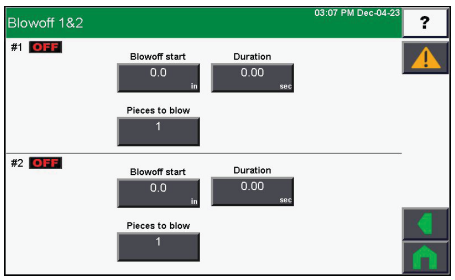


This screen allows access to the cutter batch counters 3 & 4 parameters. Each batch counter has an associated cut length. If more than one batch counter is enabled, the cutter switches to the next batch counter enabled and switches the cut length. This allows cutting batches of different length products automatically. Each batch counter has a preset and warning preset parameter.

Control Screen Descriptions (Cont'd)

Screens Accessible from (Setup) Menu (Cont'd)

Home > Menu > Blowoff 1 & 2



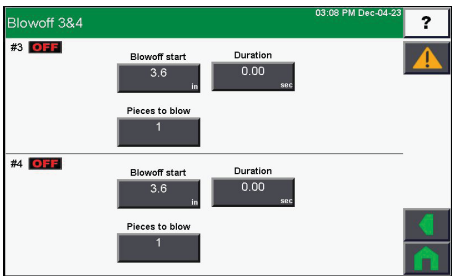
This screen allows configuration of different blow-off set-ups. Different blow-off conditions may be needed for the removal of parts when batch sequences are being used. This page allows access to the blowoff 1 & 2 parameters. The blowoff outputs can operate in either "On demand" or "Continuous" mode. "On demand" mode is active whenever the cutter is in either "Encoder", "Timer" or "End Sense" mode. "Continuous" mode is active whenever the cutter is in "Flywheel" or "Follower" mode. The blowoff's work in conjunction with the quality input. This allows good and bad product to be separated at the take away conveyor.

Blowoff 1 & 2 Blow on Distance	Blow on distance- the length of product that travels through the cutter before the blow-off turns on. This is distance traveled through the puller which may be independent of the distance traveled on the conveyor depending on conveyor speed set and length set
Blowoff 1 & 2 Duration	The amount of time that the blow-off air is on.
Blowoff 1 & 2 Pieces to Blow	Pieces to blow- this is how many pieces will be cut during each blow-off sequence. After this many parts are cut, the blow on distance will be activated for the proper blow-off. This is used when the parts are small and several are to be blown off at a time.

Control Screen Descriptions (Cont'd)

Screens Accessible from (Setup) Menu (Cont'd)

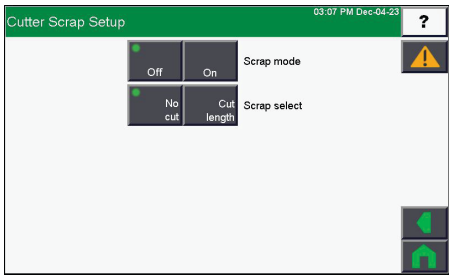
Home > Menu > Blowoff 3 & 4



This screen allows access to the Blowoff 3 & 4 parameters. The blowoff outputs can operate in either "On demand" or "Continuous" mode. "On demand" mode is active whenever the cutter is in either "Encoder", "Timer" or "End Sense" mode. "Continuous" mode is active whenever the cutter is in "Flywheel" or "Follower" mode. The Blowoff's work in conjunction with the quality input. This allows good and bad product to be separated at the take away conveyor.

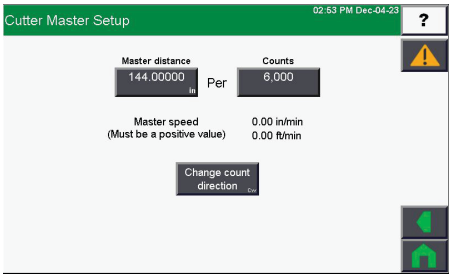
Blowoff 3 & 4 Blow on Distance	Blow on distance- the length of product that travels through the cutter before the blow-off turns on. This is distance traveled through the puller which may be independent of the distance traveled on the conveyor depending on conveyor speed set and length set.
Blowoff 3 & 4 Duration	The amount of time that the blow-off air is on.
Blowoff 3 & 4 Pieces to Blow	Pieces to blow- this is how many pieces will be cut during each blow-off sequence. After this many parts are cut, the blow on distance will be activated for the proper blow-off. This is used when the parts are small and several are to be blown off at a time.

Home > Menu > Scrap Setup



This screen allows access to the scrap mode setup parameters. Scrap mode works in conjunction with the quality input. Scrap mode allows the cutter to make bad (scrap) product a different length than good product. The cutter can be configured to stop cutting or to cut a scrap length. Scrap mode can be turned on or off.

Home > Menu > Master Setup

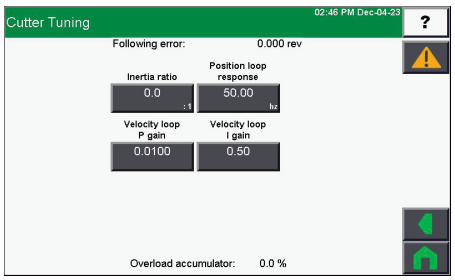


This screen allows access to the master encoder input scaling parameters. The cutter uses a quadrature encoder input signal to measure product length. These parameters scale encoder pulses to product length.

Control Screen Descriptions (Cont'd)

Screens Accessible from (Setup) Menu (Cont'd)

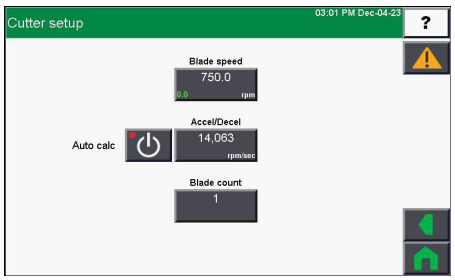
Home > Menu > Tuning



This screen allows access to the cutter servo tuning parameters. These parameters will affect how tightly the cutter servo controls the speed and position of the servo motor. These parameters are adjusted at the factory and generally do not need to be adjusted by the customer.

Tuning Inertia Ratio	The inertia ratio specifies the load to motor inertia ratio and has a range of 0.0 - 10.0. If the exact inertia is unknown, a conservative approximate value should be used. If you enter an inertia value higher than the actual inertia, the resultant motor response will tend to be more
Tuning Friction	This parameter is characterized in terms of friction increase per 100 motor RPM. If estimated, always use a conservative (less than or equal to actual) estimate. If the friction is completely unknown, a value of zero should be used. A typical value used here is less than one percent.
Tuning Integral Time	This is set at the factory and should not be changed. Contact Conair Customer Services if adjustments or replacements are necessary.
Tuning Response	The Response adjusts the velocity loop bandwidth with a range of 0 to 150 Hz. In general, it affects how quickly the drive will respond to commands, load disturbances and velocity corrections. A good value to start with (the default) is 50 Hz. The maximum value recommended is 80 Hz.

Home > Menu > Misc Setup



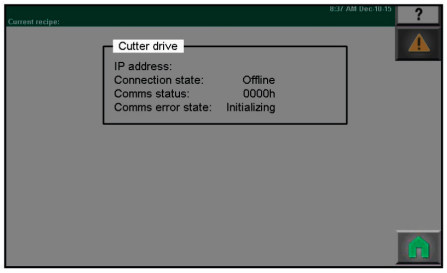
This screen displays when the Misc Setup option is selected on the Menu screen.

Blade Speed	The number in this box will be in RPM for when the cutter is in Encoder, End Sense, or Timed mode. It will be in CPM when the cutter is in Follower or Flywheel mode. This determines how fast the blade will rotate when cutting. The acceptable range 0.0 - 750.0 is displayed at the bottom of the popup keypad window for current settings.
Accel/Decel	How fast the blade will ramp up or down when it is in flywheel or follower mode. The acceptable range 0 - 14090 is displayed at the bottom of the popup keypad window for current settings.
Blade Count	The number of blades being used.
Conveyor Speed	This is where the speed of the conveyor is entered when it is being controlled by an analog output of the cutter. The acceptable range 0.00 - 500.00 is displayed at the bottom of the popup keypad window for current settings.

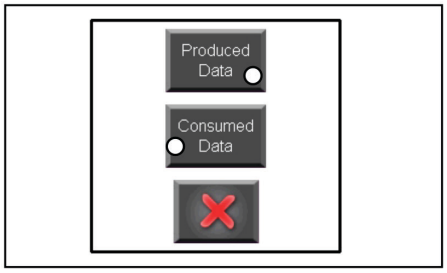
Control Screen Descriptions (Cont'd)

Screens Accessible from (Setup) Menu (Cont'd)

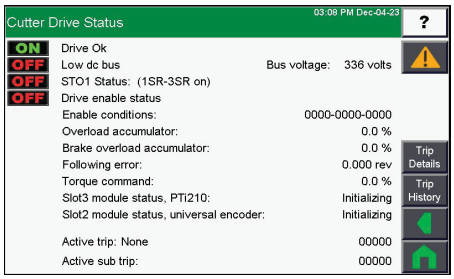
Home > Menu > Ethernet Status



Home > Menu > Remote E-net Data

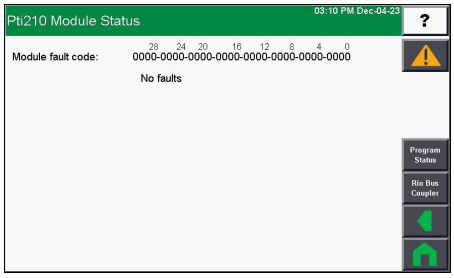


Home > Menu > Drive Status



This screen allows access to the cutter servo drive module status. The status of various drive conditions and power for the cutter are shown. The information displayed on this page is used to help troubleshoot problems encountered with the cutter.

Home > Menu > Cutter Control Status

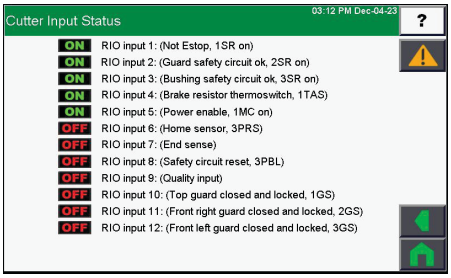


This screen allows access to the cutter servo control module status. The current status of each control program is displayed as "running" or "stopped." The information displayed on this page is used to help troubleshoot problems encountered with the cutter.

Control Screen Descriptions (Cont'd)

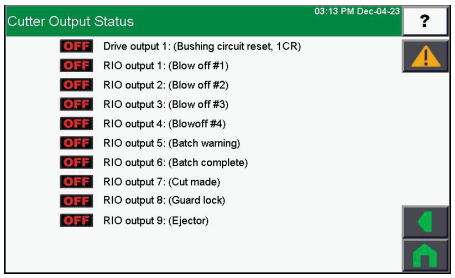
Screens Accessible from (Setup) Menu (Cont'd)

Home > Menu > Cutter Input Status



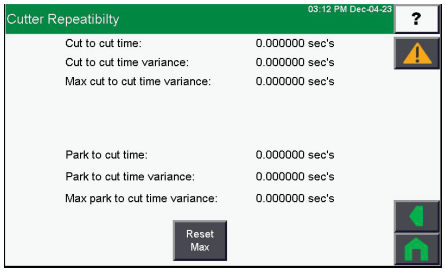
This screen allows access to cutter servo control digital input status. The information displayed on this screen is used to help troubleshoot problems encountered with the cutter.

Home > Menu > Cutter Output Status



This screen allows access to the cutter servo control digital output status. The boxes will change to "on" when the output is triggered. Some changes will occur quickly when switching between "off" and "on." The information displayed on this screen is used to help troubleshoot problems encountered with the cutter.

Home > Menu > Repeatability

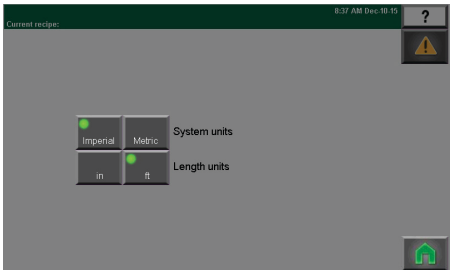


This screen is used for diagnostic purposes. It is used to determine the repeatability and subsequently the accuracy of the cutting process.

Control Screen Descriptions (Cont'd)

Screens Accessible from (Setup) Menu (Cont'd)

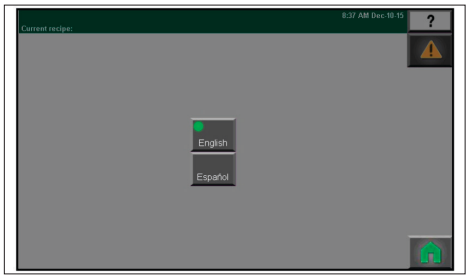
Home > Menu > Units



Select between standard units and metric units.

Selecting "inches" sets length units to inches and speed units to feet/min, (FPM). Selecting "centimeters" sets length units to centimeters and speed units to meter/min, (MPM)

Home > Menu > Language

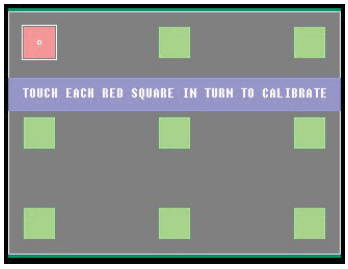


Set the language on the control screens.

Control Screen Descriptions (Cont'd)

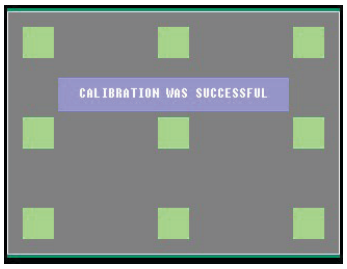
Calibration Screens

Touch Calibrate



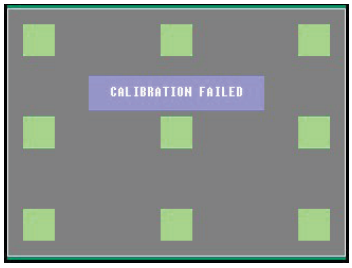
This is the screen used to calibrate the touch locations of the HMI screen. Several squares will appear that you must touch in to align the touches with the functions for the proper operating of the HMI.

Touch Calibrate Successful



This screen displays when calibration is successful.

Touch Calibration Failed



This screen displays when the calibration has failed. Attempt calibration again. If still unsuccessful, contact Conair Customer Services.

Before Starting

WARNING: Electrical hazard

Be sure that power to the servo cutter is OFF when doing any maintenance on the servo cutter. Follow all safety rules when performing any maintenance on this equipment.

Before you start daily operation of the servo cutter, you need to perform preventative maintenance. Necessary maintenance is described in the Maintenance section.
See Preventative Maintenance of this User Guide.

Daily maintenance includes:

- Inspecting the cutter blades
- Inspecting the blade mounting hardware
- Making sure the cutter bushings are properly secured
- Inspecting the closure latch on the knife guard
- Checking cutter alignment with extrusion line
- Performing any floor lock adjustments as needed

These items and weekly, monthly, and semi-annual maintenance procedures are detailed in the Preventive Maintenance Schedule of the Maintenance section of this User Guide.
See Preventative Maintenance Schedule of this User Guide.

Powering Up

1. **Plug in the power cord** to restore power after any required maintenance.
2. **Turn on the main power.** The cutter control will bootup. If there are no faults, the cutter head will automatically make one revolution until it finds the home position.
3. **Make sure the E-Stop button is in the out, extended position.**
4. **Make sure that the cutter guard is in place,** and that all bushings are in place.
5. **Press the E-Stop Reset button.** The safety circuits should reset and cutter will automatically home.

✎ **NOTE:** If "Home Runtime Failed" message is displayed. Check for malfunctions or misadjusted sensor.

If the cutter is not working properly at any time, turn it off immediately. *See the Trouble-shooting section of this User Guide.*

If you do not encounter any problems, proceed to the Operation section.

Power Up Sequence

At power up, a splash screen will briefly appear. If there are no communications problems, the Conair Servo Cutter program will begin to run.

Checking Cut Quality

1 **Press the manual cut button** and observe the movement of the cutter blade. The cutter head makes a single rotation and the blade moves through the cutter bushings without interference.

2 **Insert a piece of extrudate through the cutter bushings.**

3 **Press the manual cut button.** A single cut is made at the preset blade speed. (This works even if Cut On/Off is off.)

4 **Inspect the cut.** If necessary, adjust the blade design or blade speed. *See All About Cutter Blades, Appendix B.*

Starting the SC-5 Cutter

1 If you have not already done so, **check the cutter hardware, power up the cutter, select cutting mode and blade speed, and make a test cut to check cut quality.**

2 When you are satisfied with cut quality, **press the Cut On/Off soft key.** Automatic operation will begin.

TIP: When the extrudate is running within tolerance, cut it with a knife or saw and feed it through the cutter bushings.

Making Adjustments During Operation

There are several adjustments you can make during normal cutting. These adjustments include:

- **In Timer mode,** adjust the time between cuts.
- **In Encoder and Follower modes,** adjust the length.
- **In End Sense mode,** adjust the hold-off time.
- **In Flywheel mode,** adjust blade speed.
- **Adjust blade speed in all modes except Follower.**
- **Perform a manual cut and reset the length** by pressing the manual cut button at any time during on-demand cutting. Pressing Manual Cut has no effect during continuous cutting.
- **Count the total number of cuts** by pressing the Total Part Count display field. Use the Reset button to return the count to zero. This feature is useful for collecting samples during a production run.
- **Count the batches of cuts** by selecting one of the two Batch Counter pages. Use the Reset button to return the count to zero. This feature is useful for collecting samples during a production run.
- **Stop cutting temporarily** by setting Cut On/Off to off. This allows you to view the cutting blade (through the window) or perform other tasks without shutting down the cutter.

✎ **NOTE:** Control does not allow switching modes during operation, cutter must be stopped.

Stopping the SC-5 Cutter

WARNING: Never stop the SC-5 cutter by opening the knife guard.

This can cause damage to the equipment and injury to personnel.

Use this procedure to safely stop the SC-5 cutter:

1. **Press Cutter Stop button on the main page** to stop cutting.
2. **Wait until flywheel comes to a stop.**
3. **Turn the rotary disconnect to the off position.**

WARNING: Never turn off the rotary disconnect first.

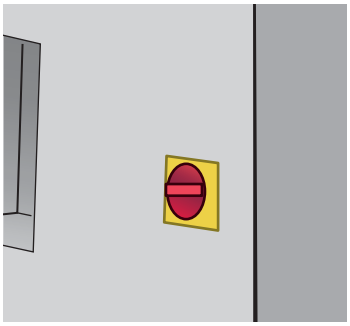
Doing so will turn off all power to the unit, and the cutter will not be brought to a controlled stop. For safe stopping, always follow the sequence given above.

4. **Disconnect the power cord** if it is equipped with a plug on the end.
5. **Lock out the rotary disconnect.**
6. **Clean the lubricant reservoir** if you are shutting the servo cutter down for the day.

Emergency Stops

In an Emergency:

1. **Press the E-stop Button** to stop the SC-5 immediately.
2. **Use the rotary disconnect to turn the power of the machine off.**



SECTION
5

Maintenance

Maintenance Overview

This section describes the daily, weekly, monthly and semi-annual maintenance schedules that should be performed when changing materials or lines, or when changing equipment, as well as the maintenance procedures to follow.

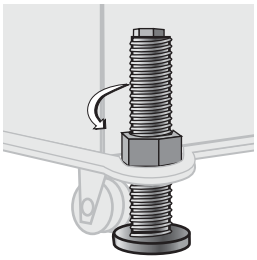
Cutting either flexible or rigid materials generates tremendous shock and vibration to the entire unit. Anything that can loosen, will over time.

To maintain the best performance, follow this maintenance schedule and develop an effective preventative maintenance program.

Preventative Maintenance Schedule

Daily

- ❒ **Checking cutter blade(s) -** Clean, sharpen or replace as needed *(see Checking the Blades, Section 5).*
- ❒ **Inspecting the blade mounting hardware -** The blade securing bolt should use both a lock washer and flat washer, and be tightened enough to fully compress the lock washer. Replace the holding pins if they appear worn.
- ❒ **Inspecting the cutter bushing screws -** Check that the cutter bushing screws are secure *(see Inspecting Cutter Bushing Screws, Section 5).*
- ❒ **Checking the closure latch on the knife guard -** *See Checking the Closure Latch, Section 5.*
- ❒ **Inspecting cutter alignment -** Proper cutter alignment is critical for optimum performance. Use a plumb line or laser to check for a straight line from the extrusion die to the cutter bushings.
- ❒ **Check floor locks -** It is always recommended that the weight be removed from the casters for optimum stability during cutting cycles. Check to see if the floor locking mechanism is properly adjusted.



Weekly

- ❒ **Cleaning the blade lubrication tray (if the cutter has this option).** *See Cleaning the Blade Tray, Section 5.*
- ❒ **Lubricating shafts on optional slide rail system.** *See Cleaning the Blade Tray, Section 5.*

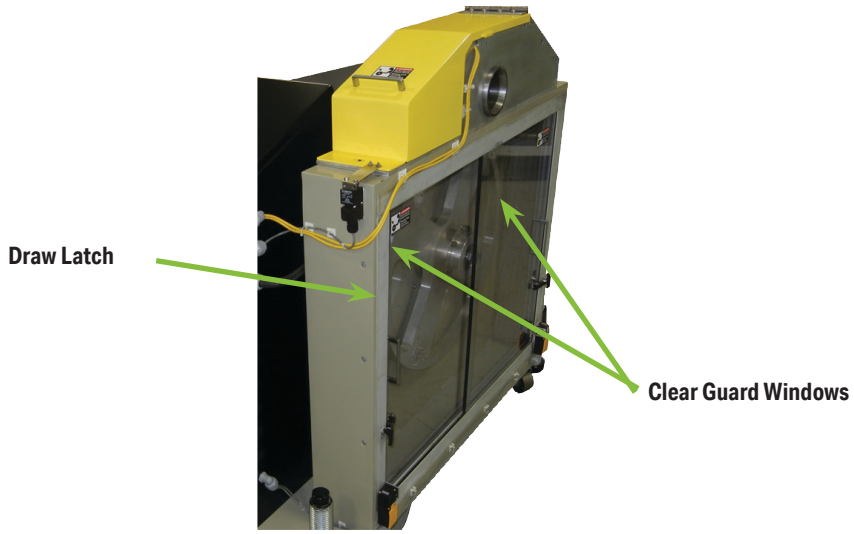
Preventative Maintenance Schedule (Cont'd)

Monthly

❒ **Checking hardware on the knife guard**
Inspect the hardware on the knife guard (fasteners on hinge and the clear blade guard window). Tighten as needed.

❒ **Checking bushing holder proximity switches**
Inspect the sets screws which retain the bushing holder proximity switches for tightness. Adjust as needed. *See Adjusting the Proximity Switches, Section 5.*

❒ **Checking the draw latch**
Inspect the latch on knife guard windows for wear and proper tension. Readjust or replace as needed.



❒ **Clean the clear blade guard window**
Clean using glass cleaner or plain water. Other materials may cause premature loss of clarity or crazing.

Semi-annual (every 6 months)

❒ **Inspecting electrical terminals**
Check all electrical terminals for tightness; adjust as needed. *See Checking Electrical Connections, Section 5.*

❒ **Checking torque on Trantorque coupling device**
Check the tightness (torque) of the Trantorque coupling device with a torque gauge. This device connects the cutter head to the Micron reducer shaft. *See Checking Torque, Section 5.*

❒ **Checking all electrical cables**
Inspect all electrical cables for cuts and abrasions. Replace as needed.

❒ **Inspecting control panel lights**
Check to make sure no LEDs or lights are burned out on the control panel. Replace as needed.

Checking Blades

Blades become dull over time depending on the material being cut, cut rate, blade speed, and blade material and thickness. Check blades regularly for sharpness as well as scratches, nicks, burrs, and material buildup. Clean, sharpen or replace as needed *(see Installing Cutter Blades, Section 3).*

DANGER: Sharp blades!

Most injuries caused by knife blades occur when the cutter has been turned off. Handle blades with care at all times.

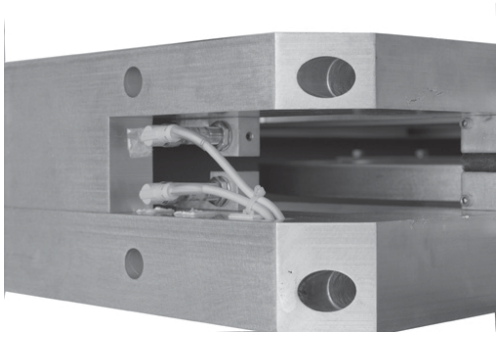
- Always wear cut-resistant gloves when the cutting chamber is open and when handling blades.
- Always lock out the cutter before opening the cutting chamber. (See Lockout/tagout above)
- Always wait until the cutter head has stopped completely before opening the knife guard.

SC-5 cutters are equipped with several safety devices to ensure safe operation. Never remove or disable these devices to sustain production. Operating without these devices can cause severe injury.

- When the knife guard is opened, the knife guard switch stops the cutter.
- Two proximity-type safety switches prevent operation unless the cutter bushings are in place.
- The STOP button activates a circuit that stops the knife.

Inspecting Cutter Bushing Screws

Check the set screws that secure the cutter bushings. If bushings move during cutting, cutting blades and possibly the drive chain could be damaged.

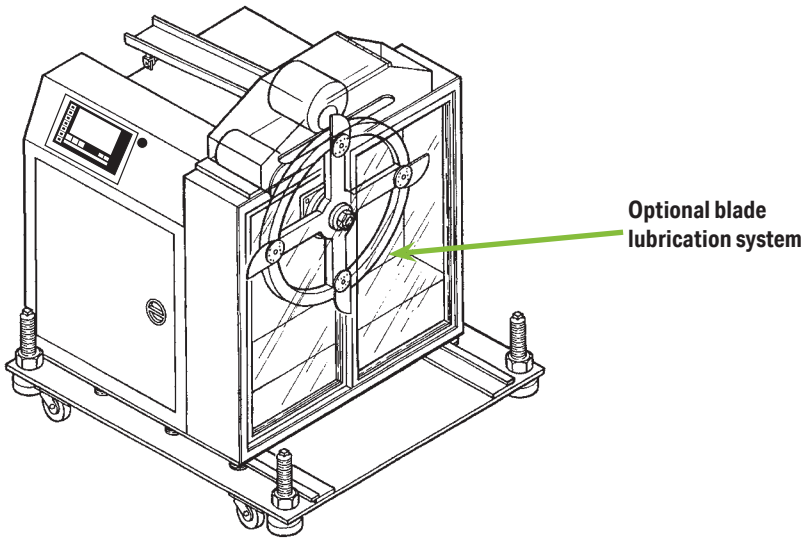


Checking the Knife Guard

Check the hand knob and tighten it so the knife guard closes completely. This prevents false triggering of the safety switch.

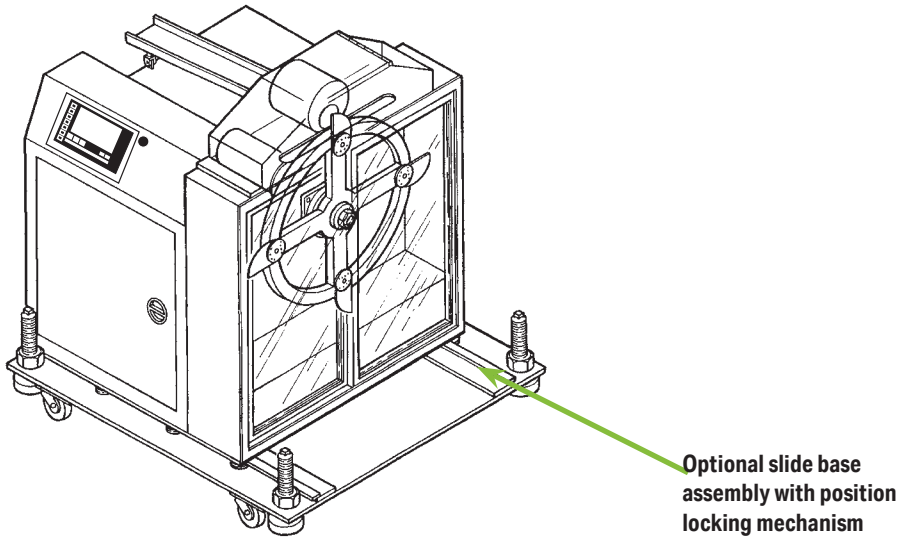
Cleaning the Blade Tray (Optional)

This tray is built into the cutter assembly as a simple method of applying lubrication to your blade during cutting cycles. Depending on cut rate and type of material and lubrication, the area will need to be cleaned on a regular basis and the lubricant replaced. Open the clear guard windows and, using a shop vac or other similar equipment, remove all liquid and solids from the cutting chamber and around the bushings. Replace the lubricant. For more information, *see Blade and Bushing Lubrication, Appendix D.*



Lubricating the Slide Rail System (Optional)

Check the shafts on the slide rail system. Even though these shafts are stainless steel, it is recommended that a light oil (WD-40 or similar) be applied to the shafts as needed. Wipe off any excess.



Adjusting the Proximity Switches

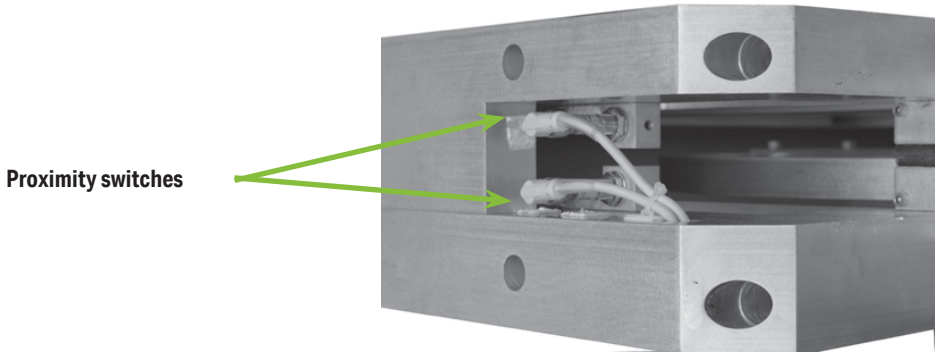
Follow all warnings and cautions listed at the beginning of the Maintenance section of this User Guide.

1 **Be sure the main power is disconnected** and the cutter is locked out.

2 **Loosen the set screws** that hold the cutter bushings.

3 **Remove the cutter bushings.**

4 **Check the depth of the proximity switch face for each bushing**. It should be recessed no more than 0.010 inches, but should not interfere with the bushings themselves.



5 **Check the tightness of each proximity switch's retaining screw.** Use an Allen wrench to perform this task.

IMPORTANT: You can damage the proximity switch if you over-tighten the retaining screw.

6 **Replace cutter bushings** and check for proper cutting blade alignment. *See Mounting the Cutter Bushings, Section 3 and the Appendix A and C.*

7 **Plug in the power cord** and turn the main power disconnect to the on position if all other maintenance is completed.

Checking Electrical Connections

WARNING: Voltage hazard

Before performing any work on this product, disconnect and lock out electrical power sources to prevent injury from unexpected energization or start-up. A lockable device has been provided to isolate this product from potentially hazardous electricity.

WARNING: Improper installation, operation, or servicing may result in equipment damage or personal injury.

This equipment should only be installed, adjusted, and serviced by qualified technical personnel who are familiar with the construction, operation, and potential hazards of this type of machine.

All wiring, disconnects, and fuses should be installed by qualified electrical technicians in accordance with electrical codes in your region.

1. **Be sure the main power is disconnected and the cutter is locked out.** Always disconnect and lock out the main power source before opening the unit or servicing.
2. **Turn the main power disconnect to the off position** before opening the electrical enclosure on the back of the cutter, or the back of the control. This is a safety device to prevent you from opening the doors if the power is still on.
3. **Open the electrical enclosure.**
4. **Inspect all wires and connections.** Look for loose wires, burned contacts, and signs of over-heated wires. Have a qualified electrician make any necessary repairs or replacements.
5. **Close the electrical enclosure door.**
6. **Inspect the exterior power cords.** Cords should not be crimped, exposed, or rubbing against the frame. If the main power cord runs along the floor, make sure it is not positioned where it could rest in pooling water or could be run over and cut by wheels or casters.

SECTION
6

Troubleshooting

Before Beginning

You can avoid most problems by following the recommended installation, operation and maintenance procedures outlined in this User Guide. If you have a problem, this section will help you determine the cause and tell you how to fix it.

Before you begin troubleshooting:

- ❒ **Find any wiring, parts, and assembly diagrams that were shipped with your equipment.** These are the best reference for correcting a problem. The diagrams will note any custom features or options not covered in this User Guide.
- ❒ **Verify that you have all instructional materials related to the puller.** Additional details about troubleshooting and repairing specific components are found in these materials.
- ❒ **Check that you have manuals for other equipment connected in the system.** Troubleshooting may require investigating other equipment attached to, or connected with the control.

A Few Words of Caution

WARNING: Improper installation, operation, or servicing may result in equipment damage or personal injury.

This equipment should only be installed, adjusted, and serviced by qualified technical personnel who are familiar with the construction, operation, and potential hazards of this type of machine.

All wiring, disconnects, and fuses should be installed and adjusted by qualified electrical technicians in accordance with electrical codes in your region. Always maintain a safe ground. Do not operate the equipment at power levels other than what is specified on the machine serial tag and data plate.

WARNING: Electrical hazard

Before performing maintenance or repairs on this product, disconnect and lock out electrical power sources to prevent injury from unexpected energization or start-up. A lockable device has been provided to isolate this product from potentially hazardous electricity.

A Few Words of Caution (Cont'd)

DANGER: Sharp blades!

Most injuries caused by knife blades occur when the cutter has been turned off. Handle blades with care at all times.

- Always wear cut-resistant gloves when the cutting chamber is open and when handling blades.
- Always lock out the cutter before opening the cutting chamber. (See Lockout/ tagout above)
- Always wait until the cutter head has stopped completely before opening the knife guard.

SC-5 cutters are equipped with several safety devices to ensure safe operation. Never remove or disable these devices to sustain production. Operating without these devices can cause severe injury.

- When the knife guard is opened, the knife guard switch stops the cutter.
- Two proximity-type safety switches prevent operation unless the cutter bushings are in place.
- The STOP button activates a circuit that stops the knife.

Identifying the Cause of a Problem

The Troubleshooting section covers problems directly related to the operation and maintenance of the servo cutter. This section does not provide solutions to problems that originate with other equipment. Additional troubleshooting help can be found in manuals supplied with the other equipment.

The main problems you will see with the servo cutter are:

- **Cutter operation problems,** which focus on problems that are clearly related to the operation of the cutter's electrical control systems.
- **Plastic product quality concerns,** which deal with product characteristics that may be related to cutter operation. Of course, other sections of the extrusion line also influence the quality of the extruded product. This section does not provide solutions to problems originating with other equipment on the extrusion line.

Additional troubleshooting help can be found in the manufacturer's manuals included with this User Guide.

Electrical Problems

Look in this section when you have problems such as lights on the control that are working improperly, buttons that do not execute the function properly, and when information input is not executed properly.

Warning	Possible Cause	Solution
The blue reset button does not extinguish when pressed.	The E-stop button is pushed in.	Pull out the E-stop button.
	Blade guard is open	**Check to see if:**
	Front guards are open	The blade guard is closed.
	Bushing sensors do not detect bushing.	
	A safety switch has failed.	Check connections and replace if needed.
	The relay is bad. Loose wiring connection	Replace the relay.
After power up, the cutter head rotates slowly but does not stop.	The Blade home proximity switch failed or the connection to it is loose.	Check connections and replace switch if needed.
While in Encoder mode, no count is displayed.	Input from encoder failed.	Check encoder cable for continuity. Connect any loose wires.
	Encoder failed.	Replace encoder.
	There is a problem with the servo amplifier.	*See Checking the Servo Amplifier.*
	There is a loose connection.	Check wiring for loose connections.
Cutter stops and nothing is displayed.		**Check for:** ❒ Loose connection on cutter control or servo amplifier. ❒ Fault on amplifier preventing cut cycle. ❒ Blade is stuck in extrudate/bushings. ❒ Look at the drive and record the fault code and call the Conair Service Department. ❒ Look at HMI status screens take pictures and call the Conair Service Department
	There is a problem with the home proximity switch.	*See Adjusting the Proximity Switches, Section 5.*

(Continued)

Electrical Problems (Cont'd)

Look in this section when you have problems such as lights on the control that are working improperly, buttons that do not execute the function properly, and when information input is not executed properly.

Warning	Possible Cause	Solution
Cutter does not respond to HMI buttons or numeric valves show ----.	There is a communication failure between the control and drive.	Check for wiring for loose connections and tighten.
The park (home) position is drifting, i.e. the blade parks further away from the original park site.	The coupling between the servo motor and the Micron reducer has slipped.	*See Checking the Motor/ Reducer Assembly, Section 6.*
	The Trantorque coupling has slipped.	*Refer to the Trantorque instructions, Section 5.*
Cutter does not respond to HMI buttons or numeric valves show ----.	There is a communication failure between the control and drive.	Check for wiring for loose connections and tighten.
The park (home) position is drifting, i.e. the blade parks further away from the original park site.	The coupling between the servo motor and the Micron reducer has slipped.	*See Checking the Motor/ Reducer Assembly, Section 6.*
	The Trantorque coupling has slipped.	*Refer to the Trantorque instructions, Section 5.*

(Continued)

Product Quality Problems

Look in this section when the final product does not meet standards: has strings, burrs, cracks, or is misshaped.

Warning	Possible Cause	Solution
Hairs or strings.	Blade speed is too low.	Increase the blade speed or decrease the blade cut path area (blade width).
	The blade is too thick.	Excessive blade thickness can cause frictional heat. Use a thinner blade.
	The blade is wrong for the application.	Change angle of the blade attack or the blade style to decrease the cut path area.
	Material is building up on the blade and wiping off on the cut site.	Use blade lubrication (water, etc.) or change lubricants. Consider a blade wiping system.
	There are imperfections on the blade.	The cutting edge should not have grind marks, burrs or other imperfections. Check the blade and replace if necessary.
	A hole or slot in the blade cut path is causing a 'cheese grater' effect.	Change blade design.
	The extrudate is too cold.	If the extrudate is too cold, it can fracture during cutting. Raise the extrudate's temperature,
Burrs at cut site.	The bushings are not providing enough support during cutting.	Change bushing design to make them more supportive.
	The bushing gap is too wide.	The bushing gap should be no more than .001-.003 inch larger than the blade. Check and adjust if necessary.
	The blade is wrong for the application.	Change angle of the blade attack or the blade style to decrease the cut path area.
	The blade speed is too low.	Low blade speeds can cause excessive blade interruption. Increase blade speed or decrease the blade cut path area.

(Continued)

Product Quality Problems (Cont'd)

Look in this section when the final product does not meet standards: has strings, burrs, cracks, or is misshaped.

Warning	Possible Cause	Solution
Cracks at cut site.	The extrudate is too cold.	If the extrudate is too cold, it can fracture or whiten during cutting. Raise the extrudate's temperature.
	The blade speed is too high.	High blade speeds can cause too much impact. Lower the blade speed.
	The bushings are not providing enough support during cutting.	Change the bushing design to make them more supportive.
	The cutting blade is too sharp.	A blade that is too sharp can fracture some materials, especially rigid PVC and nylons. Slightly dull the blade.
	If using Nylon, it may be cooling too quickly.	If nylon is cooled too quickly, its molecular structure may become unstable, leading to poor physical properties. Try more gradual cooling.
Cut is not square.	The blade speed is too low.	Low blade speeds can cause excessive blade interruption. Increase blade speed or decrease the blade cut path area.
	The blade is misaligned.	Check that blade is 90 degrees relative to the bushing holder.
	The cutter bushings are not properly gapped.	If the cutter bushings are not properly gapped, the blade may be free to move with the extrudate. Check and adjust if necessary. *See Appendix A.*
	The knife bevel is not symmetric.	If the knife bevel is asymmetric, the blade will tend to move in the direction of the smaller bevel. Be sure that the bevel is symmetric. ✎ **NOTE:** You can use this to your advantage with some rigid products.
	For rigid products the puller is too close to the cutter.	There must be enough space between the puller and cutter to allow for extrudate stoppage that occurs during cutting. Allow enough space so no cut shock is detectable at the input to the belt puller with your fingernail.

Replacing Safety and Proximity Switches

Safety switches are included in SC-5 Sure Cut cutters: a keyed safety switch on the knife guard, front guards, and a proximity switch on each cutter bushing. A failure in any of these switches will prevent the cutter from running.

- **Safety Switch**

If you suspect a problem with the keyed safety switch on the knife guard, check for loose or damaged wires. Replace the switch if wires appear to be undamaged.

- **Proximity Switches**

The proximity switches on the cutter bushings have LEDs that light when the bushing is sensed. If an LED does not light when the bushing is in place:

1. **Check for loose or damaged wires.**
2. **Remove the cutter bushing** and make sure the proximity switch is properly positioned, i.e. 0.010 inch from the bushing surface.
3. **Remove the proximity switch** by loosening the set screw. Test it by bringing some object close to the sensor when the power is turned on. If the LED does not light, replace the proximity switch.

Checking the Servo Amplifier

The servo amplifier is equipped with a digital readout that can be seen through the viewing window on the electrical enclosure. This display shows amplifier status and error messages. Refer to the supplier's documentation included with this User Guide.

✎ **NOTE:** Make sure you look for servo amplifier messages before you shut off the power.

⚠ **CAUTION**: Insure that all personnel involved in the installation, operation and maintenance of this particular cutting machine,

as well as those persons who will act as supervisory personnel, have read and fully understand these instructions and those contained in any and all accompanying suppliers manuals and instruction sheets before attempting to install, operate or perform maintenance on this machine.

Adjusting Proximity Switches

The home position proximity switch should be 0.010 inch from the 5/16 inch thread rod on the cutter head for proper operation.

1 **Open the flywheel clear guard window.**

2 **Locate the 5/16 inch thread rod on the cutter head.** It should be 0.010 inch from the proximity switch sensor when it passes that location. If necessary, loosen the jam nuts, readjust the distance, and re-tighten the jam nuts.

DANGER: Sharp blades!

Always wear cut-resistant gloves when the cutting chamber is open and when handling blades. Never open cutting chamber without locking out the cutter power.

Most injuries caused by knife blades occur when the cutter has been turned off. Handle blades with care at all times.

3 **If the proximity switch does not sense** the cutter head after this adjustment, remove the switch and test it outside the cutter. Replace if necessary.

Checking the Encoder

When the encoder is working properly, amaster speed should be shown on the HMI main page and master setup page when the encode is turning. If the speed is 0 when the encoder wheel moves:

1 **Check all connections.**

2 **Check the encoder cable for damage.** If necessary, replace.

3 **Check the connector that attaches the cable to the encoder.** Internal wiring may be shorted out if this connector is not handled properly.

4 **Check the encoder itself.** There should be no play in the shaft.

5 Check the master setup page for correct, non zero, scaling parameters.

WARNING: Delicate equipment

The encoder is a delicate piece of equipment.
Any rough handling can damage fragile parts.

6 **If all else fails,** contact Conair Customer Service. *See Appendix A.*

Contact Conair Customer Service
1-800-458 -1960
From outside of the United States,
call 814-437-6861

Checking the Encoder (Cont'd)

Encoder Mounting and General Information

The provided encoder is a precision instrument which outputs 3000 bi-directional quadrature pulses per revolution of the shaft.

Do not apply excessive axial or radial thrust on encoder shaft (rated for 30lbs. axial thrust).

Do not press or dive gears or pinions on the encoder shaft.

Encoders are an instrument containing an accurately positioned electronic system. Dropping will cause damage as the inner disc is made of glass and is easily damaged.

Parts should slide freely on the shaft prior to securing with a clamp or set screw. (.001 slide fit).

Excessive clearance in mounting hole can lead to inaccuracy.

If encoder is taken apart, the warranty is invalidated. (seal broken)

Encoder wheel should not exceed .001 TIR.

If mounting encoder and wheel assembly on belt or roller:

- Tighten bracket to facilitate no vertical movement.
- Apply encoder wheel to surface to be measured in position that will not allow slippage, but confirms to above warnings.

Alternatives to above mounting of encoder:

- Direct drive through solid (precision board) coupling to encoder on output side of any type gear box to remove error due to backlash in gears.
- Use O-ring as a drive belt from belt sheave to encoder wheel. (Items must be machined on mandrels or actual mounting shafts to facilitate precision TIR to obtain best accuracy).

Checking the Motor/Reducer Assembly

1. **Open the flywheel clear guard window.**
2. **Remove the cutter head** by loosening the Trantorque assembly. Refer to the manufacturer's guide included with this User Guide for information about the Trantorque assembly.
3. **Locate the four bolts** holding the motor/reducer assembly to the cutter. Remove them and carefully remove the assembly from the cutter.
4. **Refer to the Micron installation** and maintenance information included with this User Guide to check and adjust the motor/reducer assembly. Refer to section 5, Installation and Removal Instructions for B-Loc.

Testing Repeatability

Before any Conair puller/cutters are shipped, they are tested for cut time repeatability to be sure they are within performance specifications. The repeatability test checks the performance of the rotary knife cutter to return the home park position after a complete cut. Acceptable repeatability times allowed for each cutter model prior to shipping are:

Type of Cutter	Repeatability Time
AC Pneumatic Cutter	Less than 1 millisecond
DC Pneumatic Cutter	Less than 1.5 millisecond
Positional Servo (FX)	Less than 0.1 millisecond

✎ **NOTE:** 1-millisecond at 60 feet per minute is equal to .012 inches.

The repeatability mode is built into the Conair cutter controls and allows you to perform similar tests, without any external test equipment. It is recommended that you check repeatability on a regular basis. Acceleration/deceleration delays of the servo do not contribute to repeatability error; any error is attributed solely to motor stability, couplings, assembly, power, and proximity sensor alignment.

Use any blade speed and line speed. The line speed is only seen while in the Encoder or Product modes. It is recommended that the tests be performed at cut intervals between 0.5 and 5-seconds. Do not change the blade speed or the line speed after starting the test.

To test repeatability:

1. **Turn on the cutter.** Performing the test with the cutter off-line shows problems with the cutter; performing the test with the cutter on-line shows a problem with the puller.
2. **Place the cutter in any mode except follower** and flywheel mode.
3. Press 

to zero the readings.
4. Read the results on the display.

Repeatability valves are continuously measured while the cutter is running in an on demand mode.

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Appendix A: Warranty & Service

We're Here to Help

Conair has made the largest investment in customer support in the plastics industry. Our service experts are available to help with any problem you might have installing and operating your equipment. Your Conair sales representative also can help analyze the nature of your problem, assuring that it did not result from misapplication or improper use.

Additional manuals and prints for your Conair equipment may be ordered through the Customer Service or Parts Department for a nominal fee.

Most manuals can be downloaded free of charge from the product section of the Conair website.

www.conairgroup.com

How to Contact Customer Service

To contact Customer Service personnel, call:

✎ **NOTE:** Normal operating hours are 8:00 am - 5:00 pm EST. After hours emergency service is available at the same phone number.

From outside the United States, call: 814-437-6861

You can commission Conair service personnel to provide on-site service by contacting the Customer Service Department. Standard rates include an on-site hourly rate, with a one-day minimum plus expenses.

Before You Call...

If you do have a problem, please complete the following checklist before calling Conair:

- ❒ Make sure you have all model, control type from the serial tag, and parts list numbers for your particular equipment. Service personnel will need this information to assist you.
- ❒ Make sure power is supplied to the equipment.
- ❒ Make sure that all connectors and wires within and between control systems and related components have been installed correctly.
- ❒ Check the troubleshooting guide of this manual for a solution.
- ❒ Thoroughly examine the instruction manual(s) for associated equipment, especially controls. Each manual may have its own troubleshooting guide to help you.
- ❒ Check that the equipment has been operated as described in this manual.
- ❒ Check accompanying schematic drawings for information on special considerations.

Equipment Guarantee

Conair guarantees the machinery and equipment on this order, for a period as defined in the quotation from date of shipment, against defects in material and workmanship under the normal use and service for which it was recommended (except for parts that are typically replaced after normal usage, such as filters, liner plates, etc.). Conair's guarantee is limited to replacing, at our option, the part or parts determined by us to be defective after examination. The customer assumes the cost of transportation of the part or parts to and from the factory.

Performance Warranty

Conair warrants that this equipment will perform at or above the ratings stated in specific quotations covering the equipment or as detailed in engineering specifications, provided the equipment is applied, installed, operated, and maintained in the recommended manner as outlined in our quotation or specifications.

Should performance not meet warranted levels, Conair at its discretion will exercise one of the following options:

- Inspect the equipment and perform alterations or adjustments to satisfy performance claims. (Charges for such inspections and corrections will be waived unless failure to meet warranty is due to misapplication, improper installation, poor maintenance practices, or improper operation.)
- Replace the original equipment with other Conair equipment that will meet original performance claims at no extra cost to the customer.
- Refund the invoiced cost to the customer. Credit is subject to prior notice by the customer at which time a Return Goods Authorization Number (RGA) will be issued by Conair's Service Department. Returned equipment must be well crated and in proper operating condition, including all parts. Returns must be prepaid.

Purchaser must notify Conair in writing of any claim and provide a customer receipt and other evidence that a claim is being made.

Warranty Limitations

Except for the Equipment Guarantee and Performance Warranty stated above, Conair disclaims all other warranties with respect to the equipment, express or implied, arising by operation of law, course of dealing, usage of trade or otherwise, including but not limited to the implied warranties of merchantability and fitness for a particular purpose.

Appendix B: Cutter Blade Selection and Use

Cutter blade characteristics such as material, design, and thickness can have a large effect on cut quality.

Blade Materials

Blue tempered spring steel is most commonly used because of its cost and availability over a wide range of thicknesses (0.010-0.062 inch). It is a very tough material with an HRC value of approximately 48-51 and fair wear characteristics.

Razor blade stainless steel is becoming very popular due to its HRC value of 57-58, which leads to improved wear resistance. This material retains good toughness, but will chip or break. It is available in 0.010-0.062 inch thicknesses. Because it is non-corrosive, stainless steel is a good choice for medical cutting applications, and may even be coated with Teflon to enhance cut quality.

A-2 is a good grade of tool steel with an HRC of 60. Its minimum thickness (0.031 inch) forces the blade manufacturer to grind it down for thinner applications, which adds cost. A-2 is more wear resistant than stainless, but is also more brittle.

M-2 is an excellent grade of tool steel with an HRC of 63-66. It is one of the best materials for coating with titanium nitride for improved wear resistance. (However, coatings generally cause some slight loss of sharpness.) 0.025 inch material is available, which covers many applications without the need for secondary grinding operations.

D-2 is another excellent tool steel with an HRC range of 58-60. It is tougher than M-2 but has slightly less wear resistance. Its minimum thickness (0.035 inch) and the need for specialized grinding materials, make it a relatively expensive material. It is the material of choice for cutting Kevlar-reinforced hose.

CPM 10-V is a form of carbide developed especially for the high speed punch industry. With an HRC of 60-62 and a toughness that far exceeds D-2, it is by far the best cutting blade material. Because its minimum thickness is 0.035 inch, and it requires the use of diamond grinding wheels, CPM 10-V is the most expensive of the blade materials.

Blade Design

Straight-edge knives have a straight cutting surface. A chopping action (which has cutting forces parallel to the cut) is typically obtained with straight-edge blades.

Because the blade is mounted on a rotary arm, some slicing action (which has additional force vectors at various angles to the cutting edge) is obtained, but generally not through the entire cutting action. If a slicing action is required, the angle of attack can be modified by mounting the blade on a 30-45 degree angle as close to the cut site as possible. In many cases the bushings must be modified to allow the blade holder to have close proximity to the cut site. This offers the steepest angle of attack throughout the entire cutting process. Generally straight knives can be obtained in thicknesses from 0.004-0.060 inch depending on the application.

Blade Design (Cont'd)

Curved-edge knives offer increased slicing throughout the entire cutting action. They are generally used for cutting rubber preforms, rubber hose, flexible foams, and other materials that require slicing. Blade lubrication is often used to enhance the cut and minimize blade and bushing buildup.

As a general rule, curved-edge knives offer improved cut quality on rigid materials if additional heat can be used. However if used on cold rigid materials, curved knives have a tendency to produce wavy or angled cuts.

A curved edge knife can sometimes cut larger cross section profiles and tubing with the same horsepower as a straight edge blade. However, the use of a curved blade increases product interruption. To overcome this effect, use a variable speed rotary knife cutter to vary the blade speed to obtain the desired cut quality.

Piercing blade (bat-wing, woodpecker) knives are specifically designed for cutting thin wall tubing. Their shape minimizes penetration marks caused by the flattening action of the blade prior to penetration of the extrudate. These are the most expensive type of blade, and the most susceptible to breakage. Because the point is exposed and not fully supported by the bushings, it may deflect into the bottom of the bushing bore and break off. For these reasons, piercing blade knives are usually used as a last resort.

Some rigid materials require warming when this type of blade is used because the impact of the point can cause cracking or whitening.

Blade Thickness

Because material is displaced rather than removed in rotary knife cutting, think of the blade as a wedge. The thicker the blade, the greater the displacement. This displacement can cause fracture in rigid profiles and tubing, which is often observed as a whitening on all or a portion of the cut. You can reduce this fracturing by reducing the thickness of the blade. (This effect can also be minimized by heating the profile or tube. However, if heat is used to enhance cut quality, the bushings must be supportive enough to minimize distortion.)

If the cutting blade is too thin, it may actually deflect within the bushing bore. This can lead to "S" shaped cuts or premature blade breakage.

Optimizing Blade Speed

Flexible extrudates generally require a very fast blade speed with a slicing action for best results. This is due to the fact that even minimal interruption can cause a blade jam on a product that has little or no internal strength.

On the other hand, rigid extrudates may require different blade speeds to obtain the desired cut quality. What's needed for a particular application depends on blade style, internal heat, and blade thickness. Speeds as slow as 300 rpm may be required if a curved blade is used with little or no heat.

Improving Cut Quality by Adding Heat to Certain Materials

All rigid extrudates can have their cut quality improved by the addition of heat. A few of the most common materials and the respective temperatures are listed below:.

Rigid PVC	110°-125° F {43.33°-51.67° C}
Styrene ABS	120°-135° F {48.89°-57.22° C}
Polypropylene	160°-200° F {71.11°-93.33° C}

It is important to remember that as the temperature approaches the glassification zone, the degree of support offered by the bushing becomes more important.

Calculating Blade Interruption

Blade interruption is the length of time which the blade interrupts the extrudate during the cutting process. Knowing blade interruption allows you to optimize blade speed and design for specific applications.

You can calculate blade interruption for your application if you know:

- the cutting blade width
- blade speed (cutter rpm)
- extrudate cross section.

The rotary knife cut path circumference is fixed for each cutter model:

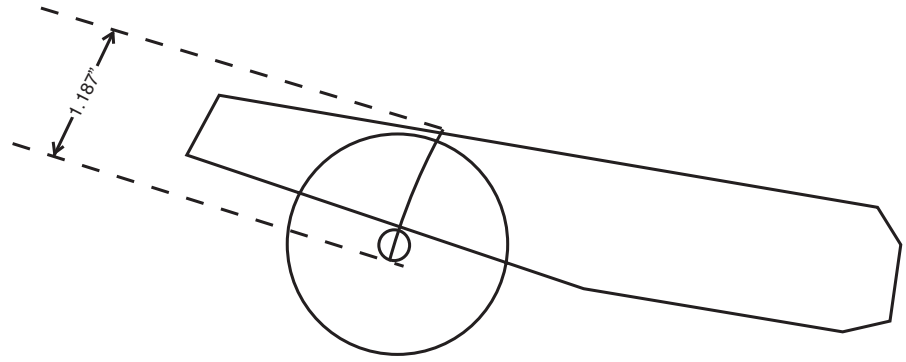
CSC Model	Bushing Diameter	Knife Cut Path Diameter	Knife Cut Path Circumference
1L	1.25″	10″	31.4″

As an example, calculate the blade interruption (in milliseconds) for an CSC1 cutter running 1/4” (0.250”) OD tubing. The blade speed is 718 rpm and the cutting blade is 15/16” (0.937”) width at the point where it passes through the extrudate, and the cut path circumference is 31.4” for the CSC1.

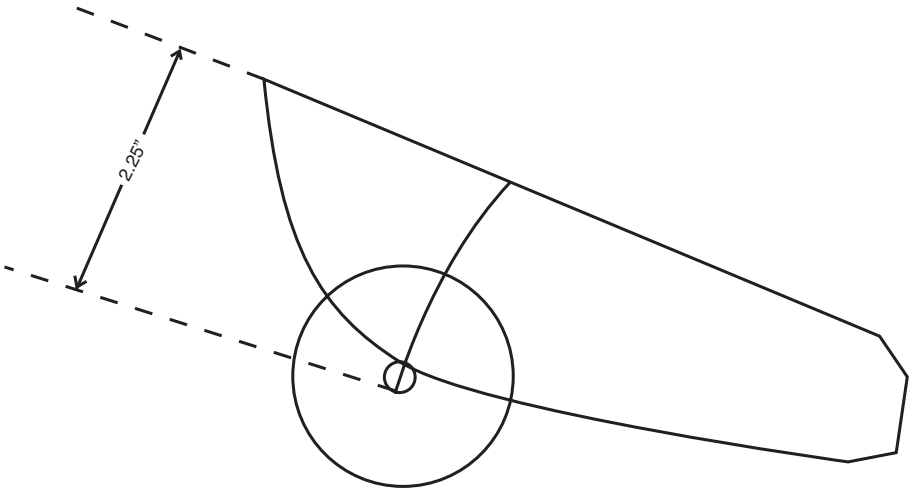
Calculate the blade interruption time. The interruption time starts when the blade makes its first contact with the extrudate and ends when the blade is totally clear of the product (i.e. no longer interrupting it). Because we know the blade travel speed, we can calculate the interruption time if we know how far the blade travels during period of interruption. This distance is equal to the sum of the extrudate outer diameter and the blade width at the point of contact.

$$\text{Blade interruption, msec} = \frac{(\text{Product OD} + \text{Blade width})}{\text{Knife circumference}} \times \frac{6000}{\text{rpm}}$$

Calculating Blade Interruption (Cont'd)



Straight blade



Curved blade

To calculate interruption time:

$$\frac{(0.937 \text{ in.} + 0.250 \text{ in.})}{31.4 \text{ in.}} \times \frac{60{,}000 \text{msec/rev}}{718 \text{ rpm}} = 3.2 \text{ msec}$$

Knowing the interruption time and the line speed, you can calculate the amount of production deflection that must be accommodated during cutting. To calculate the amount of extrudate deflection between the cutter and puller, multiply line speed by interruption time:

Blade Interruption time, msec	X Line speed, X fpm	12 60,000	Deflection, in.

3.2 msec X 60 fpm X 0.0002 = 0.038 in.

In this example the puller and cutter must be set up to allow for 0.038" of product deflection during cutting. Failure to do this can lead to puller stoppage (which can form annular rings on the product), and poor-quality cuts (hairs or fuzz and angular cuts).

Conair Cutter Blades

Use Commercial Razor Blades or contact Conair Parts for blade recommendations.

Contact Conair Customer Service
1-800-458 -1960
From outside of the United States,
call 814-437-6861

Appendix C: All About Cutter Bushings

Rotary knife cutter bushings are probably the most ignored aspect of cutting. Yet, they are probably the most important ingredient to obtaining clean, square, accurate cuts with minimal jamming and broken blades.

This appendix contains information about several aspects of cutter bushings:

- bore characteristics
- bushing length
- shear surface characteristics
- the bushing gap

Cutter Bushing Bore Size

The cutter bushing bore size affects both the cutting process and the overall extrusion process.

Bushings with relatively large bores are often used to facilitate start-up and minimize bushing inventory. While this practice is acceptable for start-up, it will lead to premature blade failure because the bushings do not properly support the blade. For optimum cut quality, make sure the bore adequately supports the tube or profile.

When the blade first makes contact with the tube or profile, it pushes the part until it assumes the size and/or shape of the bushing bore. In the case of tubes this causes two marks on the tube (penetration marks) that show where the tube flattened before the blade actually penetrated it. The tighter the bushing bore size to tube size, the closer the marks become, making them less obvious.

If the bushing bore is too tight, excessive extrudate interruption or even jamming may occur. In turn, this can cause internal air blockage in free extruded flexible materials and thus extrudate size fluctuations. In the case of rigid profiles or tubes, belt puller slippage may occur during the cutting if the bushings are improperly configured. This can cause annular rings around the extrudate and size fluctuations.

- For rigid profiles or tubes, allow 0.010-0.020 in. clearance over the OD tolerance. Anything tighter than 0.010 inch will be difficult to process. For easier startup, allow as much as 1/4 in. above a rigid profile because the blade will force the profile to the bottom of the cutting bushing where the shearing action occurs. However, if perfect squareness is required, the clearance above the profile should be minimized to prevent bowing. Supportive bushings become more important if heat is used to minimize whitening (fracturing).
- If you are cutting a square or rectangular profile, whether rigid or flexible, a round bushing bore will not offer proper support and will often lead to an “S” shaped cut. A flat bottomed bushing will offer excellent support and enhance the shearing action of the blade.
- In the case of flexible extrudates, allow 0.010-0.050 inch clearance depending on durometer and surface; the softer durometers and tacky surfaces require the most clearance. In the case of softer durometer materials, bushing lubrication may be required to minimize drag and material build-up between the cutter bushing faces.

Cutter Bushing Bore Surface Quality

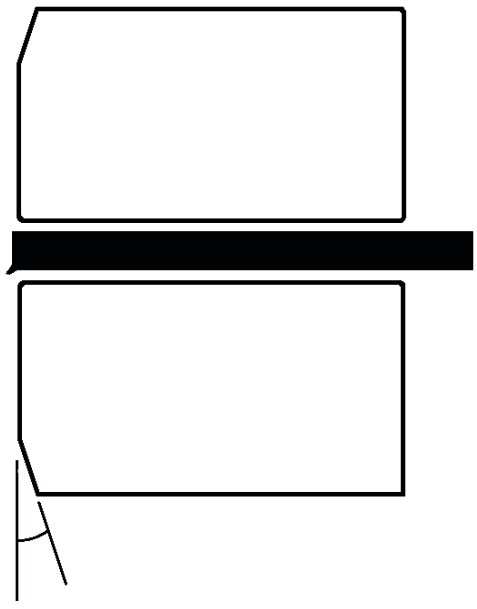
The internal surface of the cutter bushing must be smooth and glass-like when cutting flexible extrudates, otherwise excessive drag causes jamming and can lead to variations in cut-to-length accuracy.

- When cutting flexible materials, have the internal surface machined to resemble glass. In many cases, medical processors will actually have the ID of their bushings either honed or burnished for best results.
- When cutting clear extrudates, it is also very important to have a smooth internal surface to minimize scratches. In some cases it may be necessary to make a Teflon or Delrin insert to further minimize drag and/or scratching.
- Bushing lubrication can also help minimize bushing drag.
- Be sure to have a lead-in angle machined into the entrance of the upstream cutter bushing. The transition from the bore to the lead-in angle should not be abrupt as it to can cause variable drag.

Cutter Bushing Shear Surface Quality

Similar to a dull pair of scissors, if the cutter bushing shear surface is not sharp the tube or profile is not supported to the side of the blade and the cut will not be clean. In some cases, the entrance of the downstream cutter bushing is slightly radiused to minimize jamming. While this practice helps accommodate bushing bores that are not quite aligned, it has a negative effect on cut quality.

- The shear surface of both the upstream and downstream cutter bushings should be sharp and bored to the same size. NOTE: In high speed cutting applications, the downstream bushing is sometimes bored 0.005” larger than the upstream bushing to minimize jamming. Deburr the edge after the boring operation, but be careful to remove only the burr and not the edge.
- Leave a minimum land of 1/8 - 1/4 inches on the face of the cutter bushing beyond the bore. Angle the rest of the bushing face with a 10-15 degree lead-in.



Cutter Bushing Length

⚠ **WARNING: Blade hazard**

In order to comply with OSHA regulations, the distance from the sidewall of the cutter to the blade (through the bushing) must be long enough to prevent fingers from reaching the blades.

On flexible extrudates, it is important to minimize the length of the cutter bushings. It is very difficult to push flexible extrudates through since it tends to compress as it is pushed, causing a marginal increase in the tube diameter. For this reason, bushing lubrication may be necessary to minimize drag as the length of the bushings increase. A discharge conveyor may also be helpful in removing longer cut parts. The exit bushing may be funneled to allow the cut part to drop out faster while still maintaining minimal bushing length for safety.

- For flexibles, the upstream cutter bushing should offer total support to the extrudate as close to the nip point of the puller as possible. In this way the part is not able to move from side to side or bow from the weight of the tube, which can, in turn, cause variable drag. You use the strength of the tube to push itself.
- The bore length of the exit bushing should not be shorter than 1 1\2 times the diameter of the tube with the remainder of the bushing length being tapered. On sticky flexible extrudates, the parts will actually stick back together if the new part has to push the cut part out very far.

For rigid extrudates, the length of the cutter bushings can result in a square cut or an angular cut. The cutter bushings support the extrudate keeping it from moving from side to side and bowing from the weight of the profile itself. Many processors make their bushings short to minimize cost of EDM which is determined by depth of cut.

- For rigid extrudates, a general rule is to make the length of the cutting bushings equal to two times the largest outside dimension. NOTE: In the case of full profile cutter bushings where maximum support is offered, the bushing length may be shortened depending on actual clearance.
- Be sure to have a lead-in angle machined into the entrance of the upstream cutter bushing. The transition from the bore to the lead-in angle should not be abrupt as it to can cause variable drag.

Adjusting the Cutter Bushing Gap

✎ **NOTE:** Because blades are rarely perfectly flat, it is possible that a swishing sound will be heard.

✎ **NOTE:** Blade/bushing lubrication can also help to solve this problem.

If the bushing gap is too big, material is dragged down between the bushings creating a burr, especially with flexibles. This may lead to jamming within the bushings where the upstream side of the cut extrudate actually hits against the downstream bushing surface. This is especially apparent with flexibles with non-concentric walls where a slight bow is present.

- Locate the downstream bushing such that it touches the blade without deflecting it. Lock it in place and rotate the blade to check proper gap.
- Locate the upstream cutter bushing with 0.001-0.002 inch of the blade and lock it in place. Rotate the blade through the set bushings to insure proper gap.
- If hairs are present on only the upstream cut end of a tube or profile, it may be necessary to allow a 0.002-0.005 inch gap on the downstream bushing to allow the blade to slightly move with the extrudate during the cutting cycle and not cause excessive frictional heat which actually melts the extrudate.

Appendix D: Blade and Bushing Lubrication

Blade and bushing lubrication can nearly always improve the quality of cutting.

Description of the Cutting Process

Unlike sawing, a rotary knife cutter displaces material rather than removing it. When the knife blade first contacts the extrudate, it pushes it against the opposite side of the cutter bushings. If there is too much clearance the extrudate may crack or distort before cutting even begins. Tubing may develop two distinctive marks related to the compression of the tube.

Once the blade penetrates the part, material is displaced to either side of the blade. This displacement will vary in degree and visibility depending on the type of material, temperature, blade thickness, blade style, and blade speed. As the material is displaced, heat is generated and passed to the blade surface.

Flexible materials (flexible PVC, urethanes, and even LDPE) will generally compress during cutting, leaving little or no sign of displacement. The cut will appear uniformly glossy and free of fracture. However, a closer look will show very fine lines on the cut face. With flexible materials, these lines will typically show an arc or "S" pattern which can be attributed to compression of the part as the blade passed through.

Rigid materials such as rigid PVC and styrene will tend to fracture during cutting. The cut surface changes from glossy to dull, and finally becomes whitened and rough. Whitening occurs when cutting changes to fracturing: the cut begins to extend in front of the cutting blade, which acts as a wedge. At this point, you can only hope the fracture is controlled, allowing for a square cut.

Friction and Heat during Cutting

Because most rotary knife cutters don't travel with the flow of the extrusion line, forward motion is interrupted as the blade passes through the plastic tube or profile. This interruption causes friction, which generates heat in the cutting blade. As the temperature of the blade increases, plastic is melted at the cut site. This melted plastic can adhere to and coat the cutting blade, especially on the upstream side, and be transferred to the next part in the form of hairs or tissue-like film. This will be especially noticeable on the top inside of the tube or profile.

If the blade has a rough surface where the extrudate rubs against it, material will accumulate on the blade in a cheese grater fashion. This scratched material will also be passed from the blade to the next cut and be seen as hairs or flakes.

Some of the more flexible materials, such as silicones, soft urethanes and flexible PVCs, also exhibit drag against the blade during the cutting cycle. The part will actually stick to the side of the blade and drag down between the bushings. Typically a small "C" shaped tail of the tube will accumulate in the bottom of the cutting chamber. This tail actually tore off the tube rather than cut due to the excessive drag against the blade.

The generation of heat during cutting can also lead to parts that stick to each other. They may appear to be welded together, and an extra operation may be required to separate them. This can be a real problem in materials such as latex, silicone, PP, and flexible PVC.

Benefits of Using Lubricants

The primary benefit of using a cutting lubricant is reducing friction. If the cutting blade is coated with a film of lubricant, the coefficient of friction between the blade and the plastic tube or profile is reduced, reducing the generation of frictional heat.

Lubricants also minimize the tendency for material to stick to the blade, thus minimizing the potential for material to be wiped on the next cut part. The co-efficient of friction is reduced with varying degrees, depending on the type of lubricant, which in turn limits the increase in blade temperature. Over time this can lead to an increase in blade life because the cutting edge will last longer at cooler operating temperatures.

While lubricants can also help minimize problems caused by rough or poorly ground blades and cutter bushings, it is generally better to solve the problem than mask it with lubricants.

Common Cutting Lubricants

Commonly used general purpose lubricants include:

- Tap water
- Dish washing liquid (Joy, etc)
- Glycol (anti-freeze, coolant)
- Water-soluble silicone cutting oils
- Diesel fuel
- Mold release
- Mineral oil

Medical grade lubricants:

- Distilled water
- Isopropanol (isopropyl alcohol)
- Mixtures of isopropanol and water

Lubrication Systems

The most basic blade lubrication system for rotary knife cutters is using a stainless steel tray filled with the lubricant. Because the cutting blade passes through the tray during every cutting cycle, the blade is lubricated before each cut. This approach limits material buildup on blade and bushing surfaces for most applications. Care must be taken to maintain the lubricant level within the tray. Clean out accumulated cut residue on a regular basis.

Spray mist systems can be used to lubricate either the blade or the extrudate as it enters the cutter bushings. These systems allow the application of a minimum amount of lubricant with good consistency. If the mist is applied to the product as it enters the cutter bushings, the lubricant will minimize the drag between the bushing bore and the tube or profile, as well as wet the blade and bushing faces. With flexible and/or sticky materials this can improve both cut quality and cut-to-length accuracy.

The last method of blade lubrication (and the oldest) is the blade wipe system. Felt, sponge, or some other absorbent material is mounted so the rotary knife blade will pass through it, with interference, before making a cut. Typically a gravity drip or wick system is used to keep the absorbent material wet with lubricant. These systems not only lubricate the blade, but also wipe off residue before each cut. However, the operator must constantly observe the condition of the pads as they wear quickly and lose their function. Another concern (especially in medical applications) is what happens to wear particles from the pads. This material frequently ends up on the blade itself, and is then transferred to the very product it is meant to protect from contamination. Particles would be especially noticeable on the top inside of the tube or profile.

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