

# **INFORMATIONAL LEAFLET NO. 172**

## **THE USE OF THE CODED WIRE TAG INJECTOR UNDER REMOTE FIELD CONDITIONS**

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## INTRODUCTION

During the summer of 1976 the coho salmon research project of the Alaska Department of Fish and Game's Commercial Fisheries Division, Region I coded wire tagged 45,514 wild juvenile coho salmon under remote field conditions in Southeastern Alaska. This report will cover some techniques and instructions in the use of the Northwest Marine Technology (NMT) a/ coded wire tag injector that should be useful to biologists attempting to use the machine under similar conditions b/. Although the company supplies an operator's manual with all its tag injectors, there are certain things that were experienced under field conditions that are not covered in that manual. Also included in this report are diagrams of the various machine parts that should make maintenance and trouble shooting easier for the inexperienced machine operator.

## METHODS AND TECHNIQUES

### The Tagging Procedure

Due to the remoteness of our field operations our equipment had to be as portable as possible, hence the decision was made not to use the large quality control device for magnetizing and checking for untagged fish. Instead we used the ring magnet assembly from the quality control device mounted to a board. The tagged fish were dropped head first through the magnet and into a bucket. The fish were then passed through a NMT field sampling detector to check for the presence of a magnetized tag. Using this technique we were able to tag over 500 fish per hour. A discussion of the operation and maintenance of the NMT field sampling detector is outlined in Appendix A.

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a/ Northwest Marine Technology, Inc. Shaw Island, Washington 98286.

b/ Commercial products mentioned in this report are not necessarily being endorsed by the Alaska Department of Fish and Game.

During all of our field tagging operations the coded wire tag injector was powered by two small 12 volt aircraft batteries that were wired in series to produce 24 volts. The positive and negative leads from the batteries were plugged into a small adaptor box containing a slow blowing 5 amp fuse. The main power cable was plugged into the adaptor box and the opposite end into the tag injector (Figure 1). If the batteries are accidentally wired wrong the fuse in the adaptor box will blow and the tag injector will not be damaged. A supply of MDL 5 amp slow blowing fuses were always carried during the field tagging operations.

All the juvenile coho that we tagged were captured using "Gee" minnow traps baited with borax-preserved salmon eggs <sup>c/</sup>. The best trapping locations were beaver ponds, warm side sloughs and weedy lake shores. The fish were held in holding pens near the trapping areas. Every effort was made to take the tagging equipment to the fish capturing sites to reduce stress to the fish from transportation. No attempt was made to transfer fish over long distances to the tagging equipment. When a sufficient number of juvenile coho had been trapped the tagging equipment was transported to the holding pens. The tag injector was placed on a 4' x 8' collapsible table usually under a 12' x 12' screened wall tent. The batteries and adaptor box were placed under the table and all the electrical connections were made. We found it easier under these conditions to place the "touch" switch on the table and actuate it by hand rather than using it as a foot pedal. The following is a list of the necessary steps to be performed to assemble the tag injector for operation. It should be noted that our machine is a NMT MK2 "200 series" tag injector which differs from the older machines only in the appearance of the outside case, and the program interrupt switch. All of the necessary machine tools and items used for assembling the tag injector, maintenance and trouble shooting are listed in Appendix B.

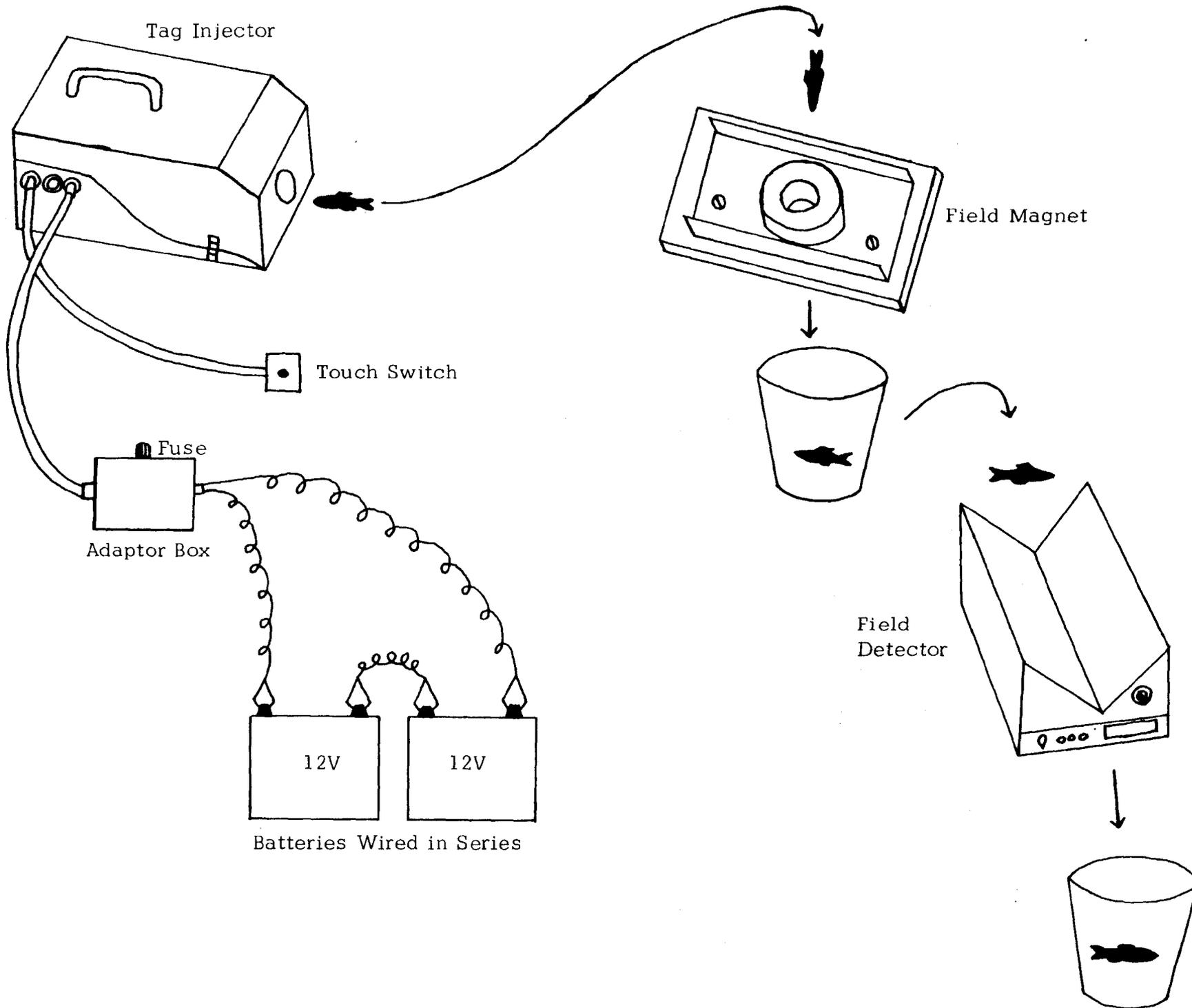
#### Assembling the Tag Injector

1. Remove the blank head mold base which protects the needle. This is accomplished by loosening the two socket head set screws on the holder using the small Allen wrench.
2. The wire can now be threaded through the machine. With the power switch turned off, feed the wire through the rear wire guide and into the drive rollers. Advance the wire into the front wire guide by rotating the upper drive roller with your finger. It may be necessary

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<sup>c/</sup> Cuba Specialty Manufacturing Co., P.O. Box 38, Houghton, New York, 14744.

Figure 1. The tag injector power supply and tagging procedure.



to help the wire into the guide using a pair of tweezers or the end of the small Allen wrench. Make sure that the needle carrier is in its full retracted position against the cutter. The needle carrier can be adjusted manually with the power off by reaching under the needle carrier motor and rotating the crank by hand. Rotate the upper drive roller and bring the wire out through the needle until it extends approximately 1/2" from the end of the needle. If resistance is met it may be necessary to turn the knob on the cutter assembly motor a few degrees to the right or left in order to line up the holes in the cutter.

3. With the wire now threaded through the needle turn the power on and cycle the machine twice. The cutter will cut two long uneven lengths of wire which will be expelled. There is now a tag of the proper length in the cutter assembly. The next step is to set the tag implantation depth.
4. Turn the program interrupt switch to the "on" position. By actuating the touch switch the machine can be run through the seven steps that occur during a machine cycle one step at a time. These seven steps are diagrammed in Figures 2a, 2b and 2c. In step No. 1 the needle carrier travels forward. Actuate the touch switch again and the drive rollers will push the wire through the cutter, expelling the tag from the end of the needle. In this position the needle and the wire are fully extended. Inspect the needle point using the jeweler's loupe. The end of the wire should be visible but should not extend beyond the tip of the needle. The insert on Figure 2b shows the proper position of the wire in relationship to the needle at the end of step No. 2. If the position of the wire is not satisfactory it can be changed using the control switches next to the program interrupt switch. The first switch is marked in tens and the second switch in units. One unit is equal to 1/2 of a tag length so an increase or decrease in the "tens" switch will move the wire 5 tag lengths. If one wants to shorten the length of the wire by 1 tag length reduce the units count by two. For instance if it was set on 48 reduce it to 46. If the control number is reduced the excess wire will be cut off and expelled as a long tag on the next cycle. But if the count has been increased the machine will have to be cycled once for every two numbers of increase in the control number. With the proper tag implantation depth now set the last step is to adjust the needle penetration depth.
5. This step also requires the use of the program interrupt switch. Turn the switch to the "on" position and actuate the touch switch. The needle will travel forward and you can now slip the desired head mold into place in the holder. Adjust the head mold to the desired

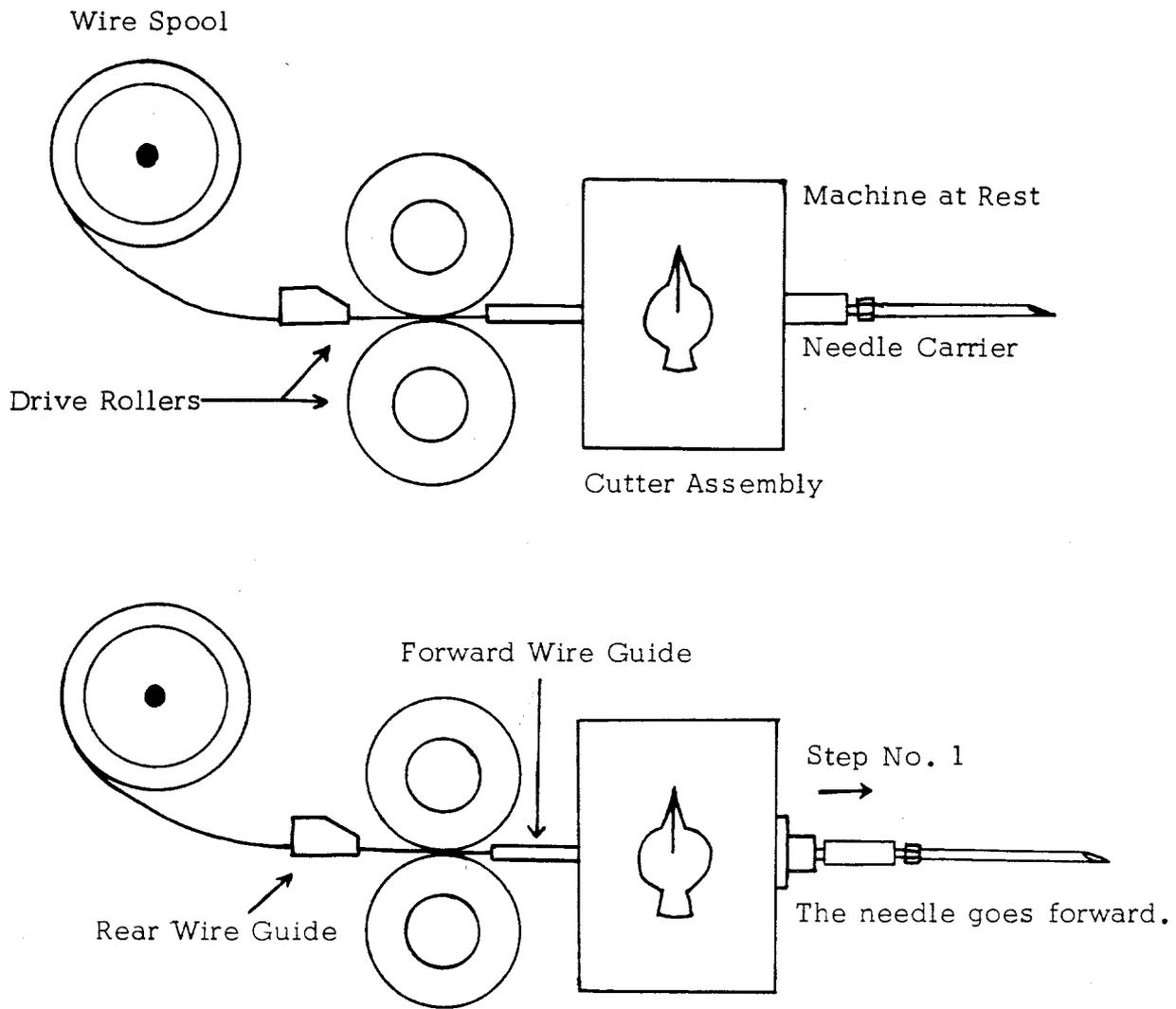


Figure 2a. The seven steps in one machine cycle (Step 1).

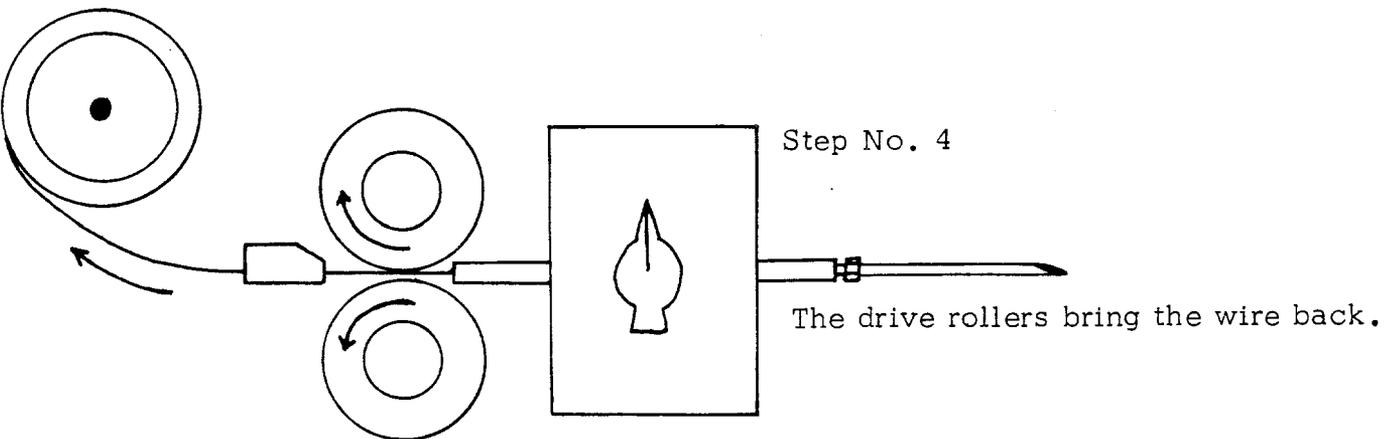
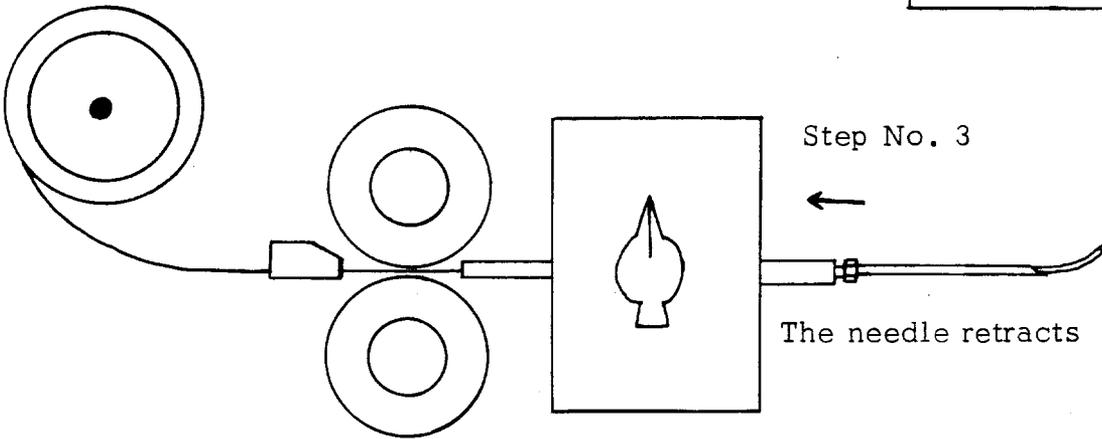
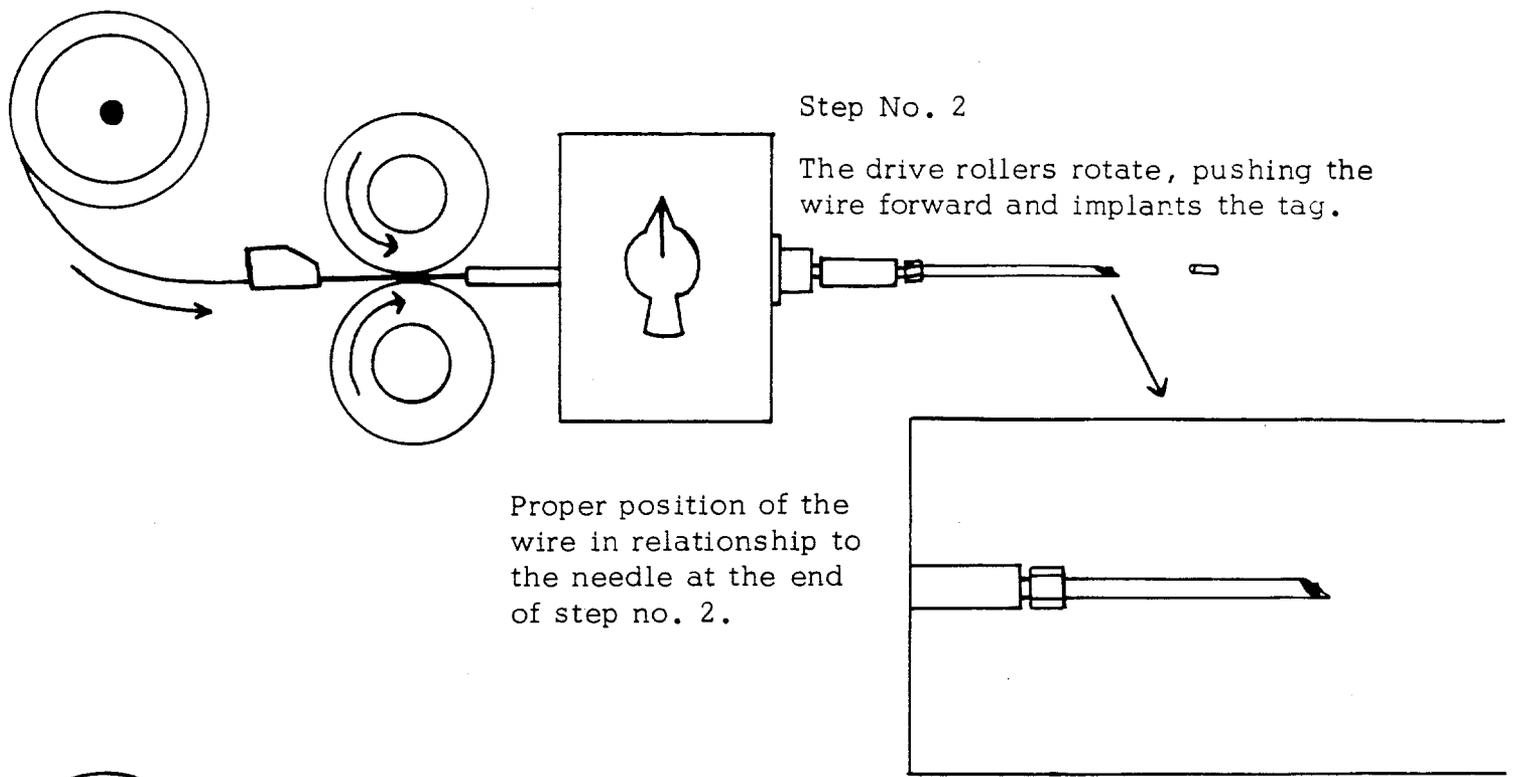


Figure 2b. The seven steps in one machine cycle (Steps 2-4).

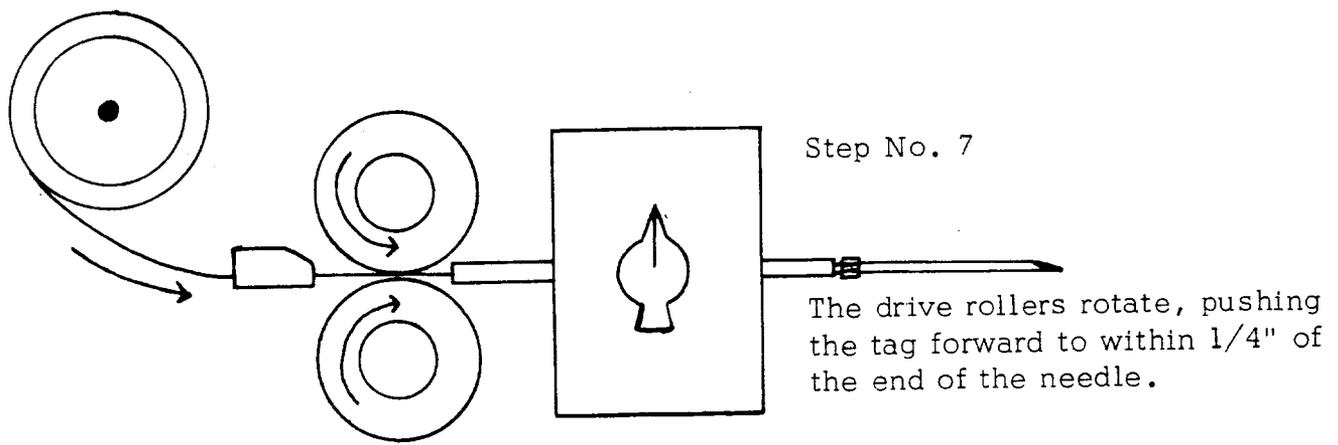
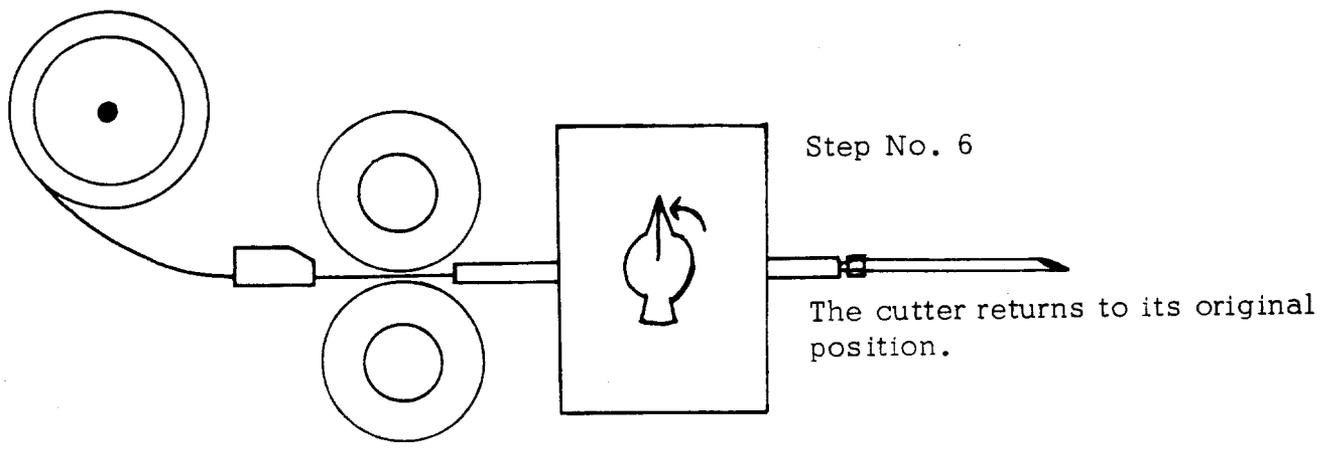
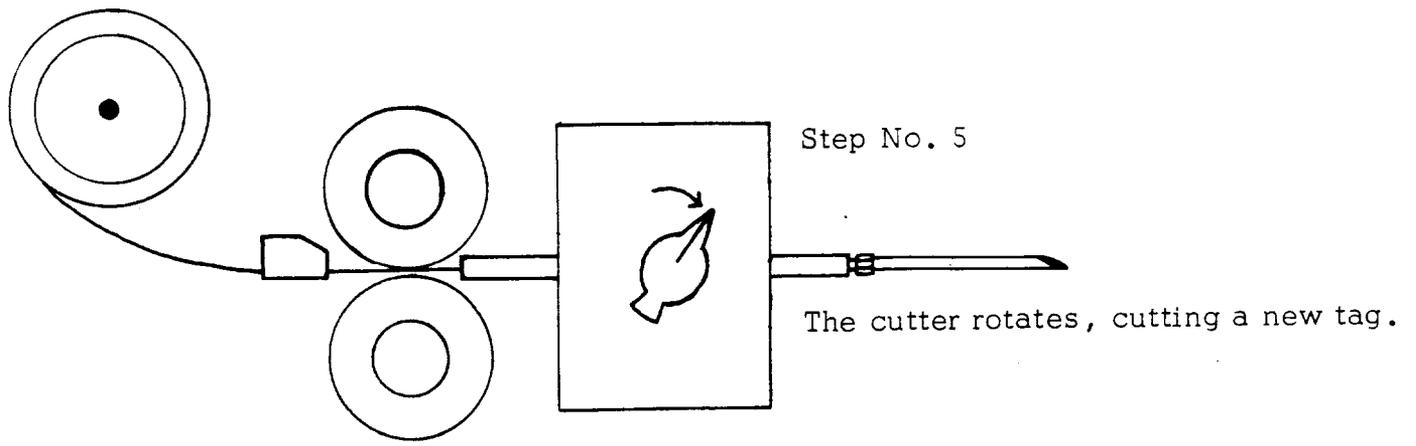


Figure 2c. The seven steps in one machine cycle (Steps 5-7).

position in relationship to the size of the fish you are tagging. Tighten the head mold in place with the small Allen wrench. A few fish should then be checked for proper tag placement.

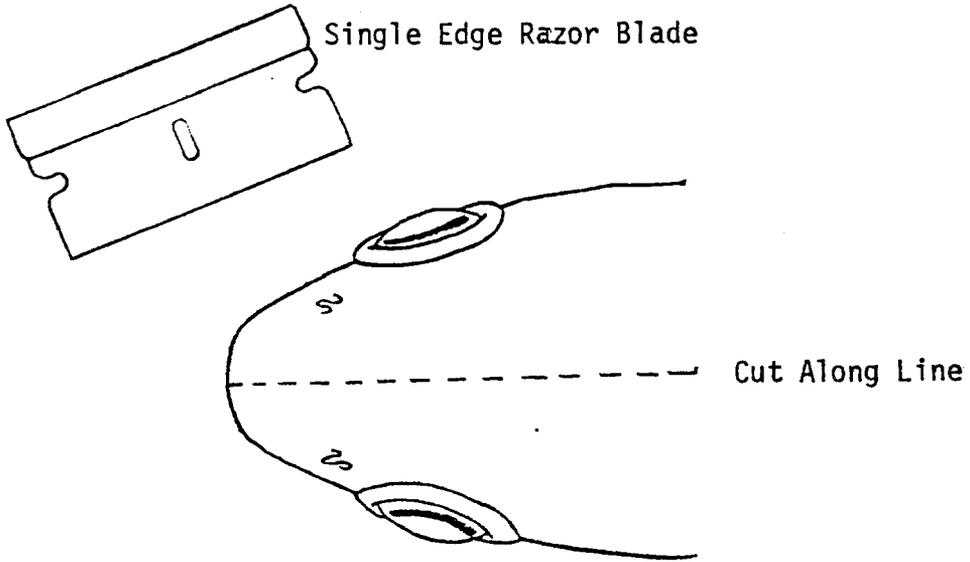
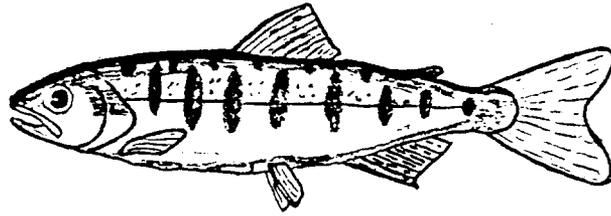
6. In order to obtain maximum tag retention the tag should be implanted in the cartilaginous wedge in the fish's nose (Figure 3). To check for proper tag placement, tag a fish, and using a single edged razor blade or a sharp scalpel, bisect the skull along the median plane. The tag should then be readily visible in the fish's nose. If the tag is too shallow or deep adjust the head mold accordingly and check a few more fish. In our tagging of wild juvenile coho we tagged fish ranging in size from 55 to 150 mm fork length. This required sorting our fish into different size groups; different head mold settings were used accordingly. We felt we could tag up to a 35 mm range in lengths with one head mold setting and still have good tag placement. We used three different head molds during our tagging operations: a 65/lb. head mold for fish 55 to 80 mm in fork length; a 30/lb. head mold for 80 to 120 mm fish; and a 15/lb. head mold for 120 to 150 mm fish.

## MAINTENANCE

### The Tag Injector

At the end of each tagging day we found it easier to clean and work on the machine if the tagging assembly was first removed from the outside case. This is accomplished by first turning the power switch off and then unsnapping the two wire clips from the electronics package. Then remove the four screws from the base plate. The tagging assembly can then be lifted out and set on a dry, level table. The cleaning of all the tag injector parts was accomplished using cotton swabs, pipe cleaners and liberal amounts of 70% ethyl alcohol (ethanol). No oil of any kind should ever be used on the tag injector components. The following are the basic steps for cleaning the needle and the cutter assembly.

1. Rotating the drive rollers by hand, back the wire out of the cutter assembly.
2. Remove the head mold by loosening the two socket head set screws with a small Allen wrench. Flush the head mold out with alcohol and run a piece of blank wire through the hole.
3. Remove the four screws in the head mold flange and slide it out. Flush with alcohol and clean with a cotton swab.



Proper Tag Placement in Cartilage

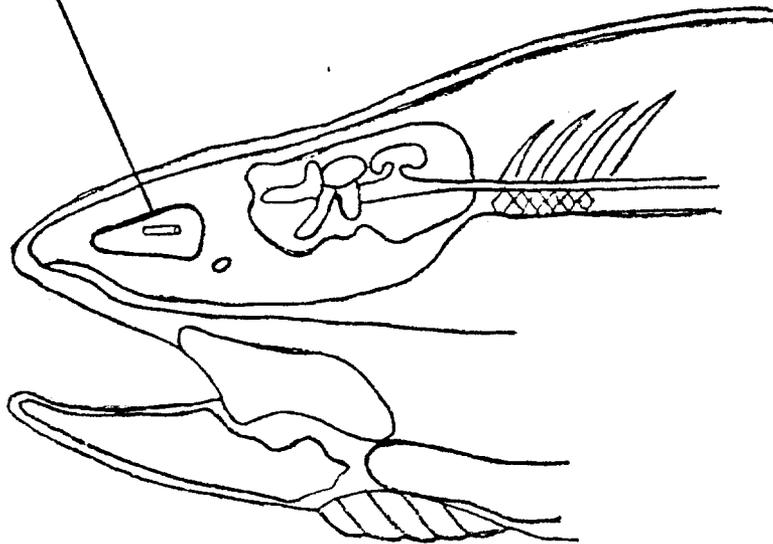


Figure 3. Checking for proper tag placement.

4. Remove the shoulder screw from the end of the gold needle-actuating linkage, releasing it from the black face plate. The gold linkage arm holds the needle carrier in front of the cutter assembly.
5. Swing the needle-actuating linkage backwards and it will slip free from the hole in the side of the needle carrier. Remove the needle carrier and flush with alcohol (Figure 4). Using the hex nut tool provided in the tool kit, loosen the hex nut on the needle carrier and gently slide the needle backwards in the carrier and carefully clean around the funnel with alcohol and pipe cleaner. Run a piece of blank wire through the needle and flush again with alcohol.
6. It was found that the easiest way to disassemble and clean the cutter was to first remove the black face plate from the front of the machine. This is done by removing the three small screws along the bottom and the two larger screws that hold it to the cutter motor assembly block. The face plate can then be laid flat in front of the machine, but caution must be taken not to break the small black wire that connects to the pilot lamp.
7. Swing the needle-actuating linkage out of the way of the cutter face plate.
8. Remove the two knurled Allen screws from the front of the cutter face plate with the wrench provided. Do this carefully as there is a tension spring behind the cutter (Figure 5).
9. Carefully remove the cutter face plate and slide the cutter out of the sleeve.
10. Mark the cutter with a pencil so that when it is replaced the same cutting edge will be retained. The cutter and the cutter sleeve are made from tungsten carbide alloy and should be handled with care. They can be damaged and easily broken if dropped.
11. Flush the cutter and the cutter sleeve with alcohol and clean with a pipe cleaner or cotton swab. Run a piece of blank wire through the holes in the cutter and in the cutter sleeve. Flush again with alcohol.
12. Using a pipe cleaner and alcohol clean the needle carrier hole on the front of the cutter motor housing. The hole on the top of the cutter motor housing and the hole where the cutter rests should both be cleaned with alcohol and a cotton swab.

When reassembling the machine all the screws and the screw holes should be cleaned with alcohol. It is not necessary to tighten the

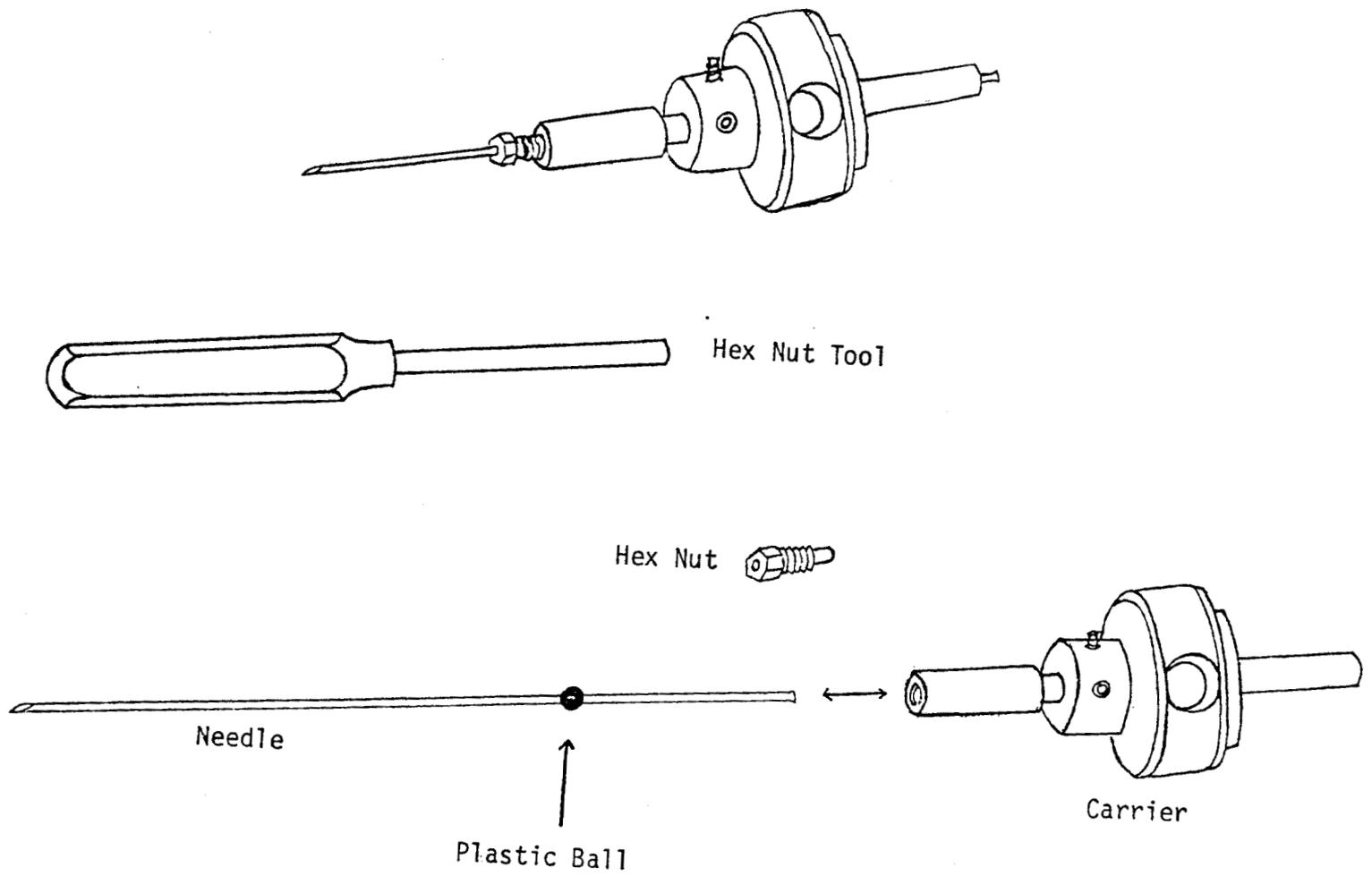
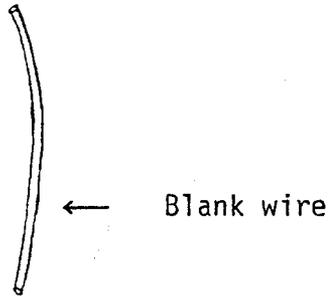
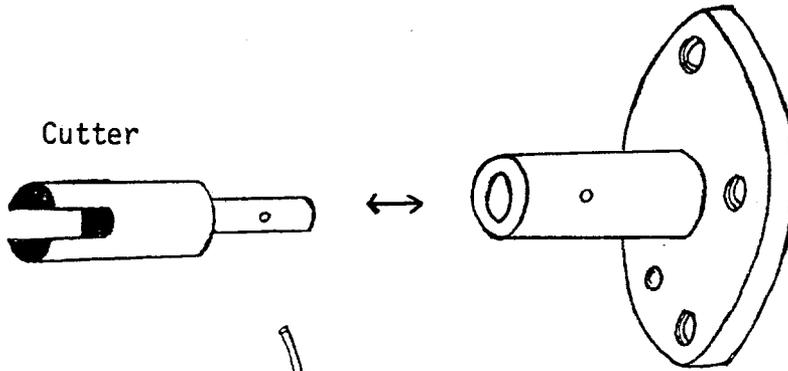
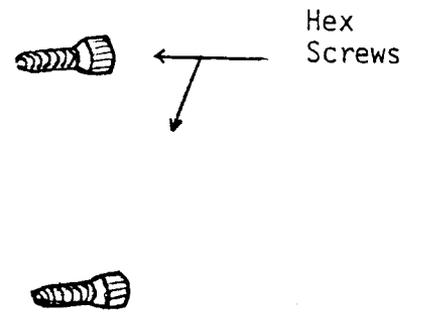
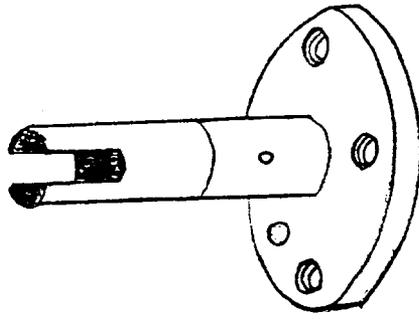
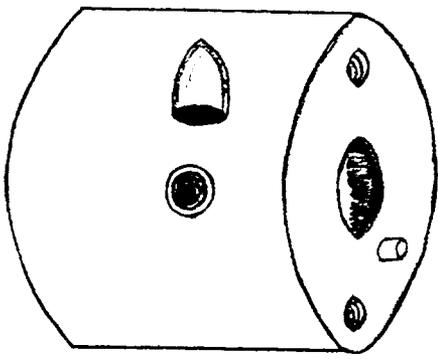


Figure 4. The needle carrier.



70% Ethanol

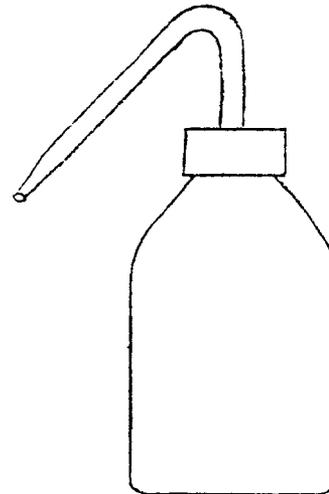


Figure 5. The cutter assembly.

screws down excessively hard; finger tight plus one-half turn is sufficient.

13. Reassemble the cutter assuring that the cutter is replaced the same way it was removed in order to maintain the same cutting surface. There is a pin on the face of the cutter motor housing face and a corresponding hole in the cutter face plate. Slide the cutter into the cutter sleeve and then slide the whole unit into the cutter motor housing. Replace the knurled screws and tighten them down until the face plate is flush with the cutter motor housing.

The cutter face plate is also equipped with two other threaded holes. If, after removing the two knurled screws, the cutter face plate cannot be easily pulled free by hand, these holes can be used. First make sure that there is not a piece of wire in the cutter. Sometimes a piece of wire can become stuck in the cutter and protrude into the cutter motor housing making it impossible to pull the cutter and the cutter face plate free. Check this by rotating the drive rollers by hand and run the wire through the cutter. The end of the wire will force any pieces of wire out of the cutter. If after doing this the cutter face plate still cannot be removed take the two knurled screws and screw them into the two threaded holes. By tightening them down the face plate will be forced away from the cutter assembly housing and the face plate should come free. This is a drastic measure to have to take and the problem should never be encountered except from extreme neglect in cleaning or damage to the machine.

14. Swing the needle-actuating linkage arm back and then replace the black face plate. Clean all the holes and the screws with alcohol before tightening them down.
15. Replace the needle carrier back in the hole in the cutter motor housing and connect the needle-actuating linkage. Clean the linkage shoulder screw with alcohol and replace it. In its rearmost position the back of the needle should have a gap of from 0" - .005" from the outside of the cutter assembly. To set the correct needle position tighten the hex screw down only finger tight with the needle in its fully extended position. Bring the needle carrier back to its rearmost position by turning the crank on the needle carrier motor by hand. This motion will push the needle back through the carrier and set the proper needle position. The hex nut should now be tightened sufficiently to hold the needle firmly in the carrier (do not over-tighten).
16. Replace the head mold flange.
17. Replace the needle guard.

18. In order to reduce the jarring effects of transportation and to keep the tag injector as dry as possible, a heavy plywood waterproof carrying box was constructed for storing the machine after being cleaned at the end of each day's use.

#### The Touch Switch

At the end of each day's tagging the touch switch should be thoroughly dried with paper towels and the electrical connector should be cleaned with alcohol and a cotton swab.

#### The Power Cable

After each use the power cable should be dried with paper towels, and the electrical connectors cleaned with alcohol and a cotton swab. The power cable and the touch switch should be stored together in the machine's tool box.

#### The Adaptor Box

The battery adaptor box requires very little maintenance. It should be dried with paper towels, cleaned and stored after each use. The power cable receptor should be cleaned with alcohol and a cotton swab. The battery wire receptors should be cleaned with a cotton swab and a light application of a lightweight oil such as LPS #2 or WD-40 to keep the receptors from corroding.

#### The Batteries

The battery drain of the tag injector is about 1.5 amperes. The two 30 ampere-hour batteries that we used provided approximately 24 hours of machine operation before they had to be recharged. Recharging the batteries was accomplished using a portable 400 watt Honda generator. The batteries were recharged at the base camp after two or three days of tagging in the field. Usually only 2 or 3 hours of recharging was necessary to bring the batteries back to full charge. All the battery wire connectors should be dried after each use and given a light application of oil to prevent corrosion.

### TROUBLE SHOOTING

#### The Tag Injector

1. Machine Jams

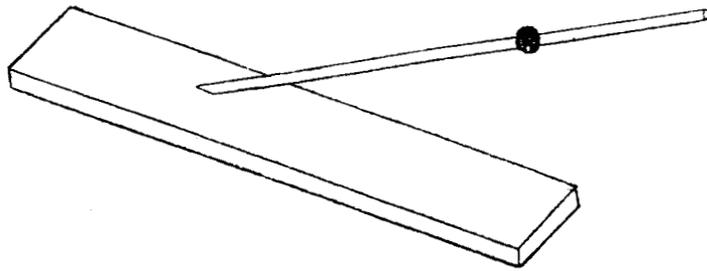
The number one cause of machine jams is a dirty cutter assembly. The problem arises from fish slime and dirt particles in the cutter assembly which obstruct the cutter hole. The drive rollers force the wire against the obstruction causing a kink in the wire, and the machine jams. Our project personnel tagged over 45,000 juvenile coho without one jam that was attributed to a dirty cutter assembly. Our success was due to the fact that after each day of tagging the machine was stripped down and all parts were thoroughly cleaned with alcohol. This should eliminate what has become known as the "Monday Morning Phenomenon" that some agencies have experienced. It seems that a tag injector in active use, if shut down on a Friday afternoon, can be expected to malfunction on Monday morning. The problem stems from dried fish slime in the cutter assembly. The problem can be eliminated by cleaning the machine at the end of each tagging day.

If the machine jams, first turn off the power switch and, using the wire cutters provided, cut the wire behind the kink and pull it out of the cutter assembly. Actuate the drive rollers by hand and pull the rest of the wire out. Trim off any bent wire and reload the machine.

## 2. Repeated Jams

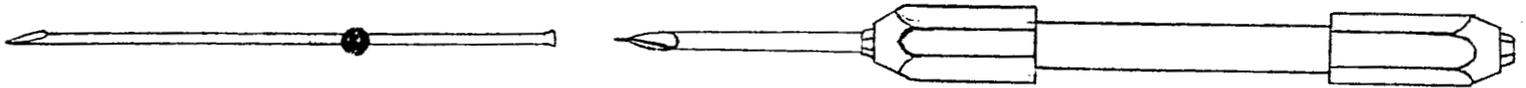
If the tag injector continues to jam inspect the needle first. It may be inspected, cleaned and refinished by removing the needle, or more easily by removing the entire needle carrier (Figure 4). The needle is held in place in the carrier by a compressed plastic ball slipped over it. To remove the needle, slip off the head mold and manually rotate the crank on the needle carrier motor until the needle is in its fully extended position. With the wrench provided, remove the 1/8" hex fitting on the end of the needle carrier through which the needle extends. The needle may then be pulled out from the front complete with its plastic ball. We found it easier to remove the head mold flange and the shoulder screw from the actuating linkage and then remove the needle carrier assembly through the front of the machine. The hex nut was then loosened and the needle slipped backward in order to inspect the funnel more easily.

Using the jeweler's loupe, inspect the funnel which is cut into the base of the needle. When the machine jams, a piece of wire will frequently be bent over on the outside of the cutter assembly. As the machine is cycled the needle funnel will be forced up against the bent wire and will damage the funnel (Figure 6). If the funnel has been damaged it can be reshaped using the needle reamer provided in the tool kit. The point of the needle reamer is inserted into the funnel. Four or five turns using light pressure should be enough to restore the proper shape of the funnel. Check it with the jeweler's loupe to see if additional reaming is necessary.

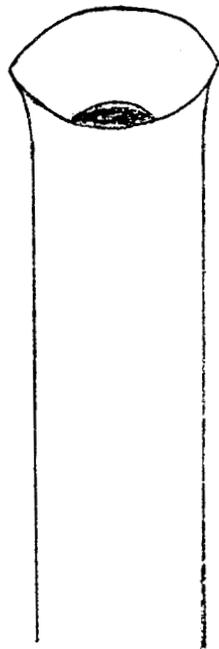


Sharpen needle with hard Arkansas slip stone

Needle Reamer



Good Funnel



Damaged Funnel

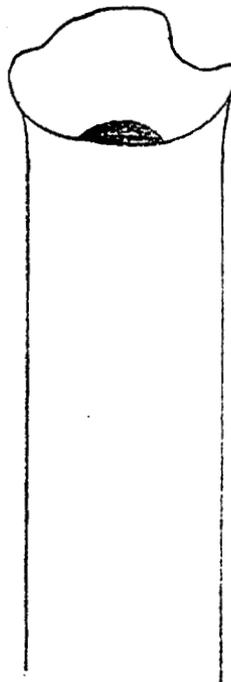


Figure 6. Needle maintenance.

After reaming out the funnel it may be necessary to hone down the rim of the funnel in order to replace the needle in the carrier. This can be done with the hard Arkansas slip stone provided in the tool kit. The stone used with light oil can quickly make a new point on the needle. The tag injector operator will notice when the needle is getting dull. As the needle goes forward to inject the tag into a fish a dull needle will push the fish's head slightly out of the mold and probably result in a shallow tag placement. When sharpening the needle (Figure 6) it is necessary to retain the same point angle on the needle. After sharpening you can compare it with a new needle to check the bevel on the point. The needle should be cleaned with alcohol to remove any oil after sharpening. Keith Jefferts claims that he has cut over 100,000 tags using only one needle and that it showed very little wear.

If the needle is damaged beyond repair it can be replaced by simply removing the hex nut and sliding the needle out of the carrier. Place the hex nut on the new needle very carefully, being cautious to avoid dulling the sharp point. Insert the new needle in the carrier and tighten the hex fitting finger tight. Replace the needle carrier and set the proper needle position. Remember that after reaming the funnel, sharpening the point, or inserting a new needle, be sure to check the needle penetration and implantation depth before proceeding, as reaming and sharpening shortens the needle (new needles also vary slightly in length).

### 3. Worn or Damaged Cutter

If the tag injector continues to jam check the cut tags under a microscope for quality. Badly worn or damaged cutters will produce tags with bent ends to the extent that the tags cannot pass through the needle, causing the machine to jam. There are four available cutting edges on the cutter which rotate within the cutter sleeve. Cutting is performed by the rotation of the cutter within the sleeve which shears off the end of the wire. Rotation can take place in either direction and can be changed using the switch on the control box. Also the cutter may be rotated 180° to provide a fresh pair of cutting edges on the opposite side of the cutter. This is done by turning the power off and then manually rotating the knob on the end of the cutter motor by 180°. Each cutting edge is capable of cutting over 75,000 tags. Worn out cutters that have been returned to Northwest Marine Technology Inc. by various fisheries agencies had an average life of over 400,000 cuts. It appears that their practice of removing and cleaning the cutters after every day of operation was important to obtain this length of cutter life. Remember when cleaning the cutter assembly to mark the cutter so that the same cutting edge is used upon reassembly. The cutting edge should be changed when the tag quality becomes poor and jams are frequent.

#### 4. The Electronics Package

Some agencies have experienced malfunctions in the electronics package which have caused repeated jams and abnormal machine operation. The electronics package in the tag injector is a sealed unit and is not field serviceable. Northwest Marine Technology can exchange units if necessary.

#### 5. Magnetization

During the field tagging operations we had to be extremely careful to keep the tag injector and the machine tools away from the field magnet. Magnetized wire, needle and tools can cause the machine to jam. If the needle or the wire becomes magnetized, loose tags can be picked up and drawn back into the needle where on the next cycle, the cutter will cut a new tag and also cut the end off one of the other tags, producing a small chip of wire which may jam the machine. A demagnetizer is a useful accessory to have on hand. The wire, needle and all the machine tools should be periodically demagnetized.

#### The Touch Switch

Most problems encountered with the touch switch result from an accumulation of dirt and water inside the rubber plunger receptacle, causing the switch to stick in the "down" position. This can be prevented during tagging operations by placing the switch inside a small plastic sandwich bag and sealing it tight (Figure 7). To clean the touch switch the cable should be disconnected from the tag injector. The rubber plunger can be taken out by removing the screw on the side of the base and sliding out the plunger pin. The rubber plunger and the plunger spring can now be lifted out of the receptacle. Clean out the receptacle with a cotton swab and a light application of oil. Clean the rubber plunger and spray the spring with oil. To reassemble, place the plunger and spring back into the receptacle. After lining up the holes replace the plunger pin and the screw. The receptor at the end of the cable should be cleaned with alcohol and a cotton swab. Care should be taken when handling the receptor as it can be damaged. A spare touch switch should be carried during field tagging operations.

### SUMMARY AND CONCLUSIONS

The coded wire tagging of 45,500 wild juvenile coho salmon by the Alaska Department of Fish and Game's Coho Research Project was the first program of its type to be conducted in Alaska. It has shown that the coded

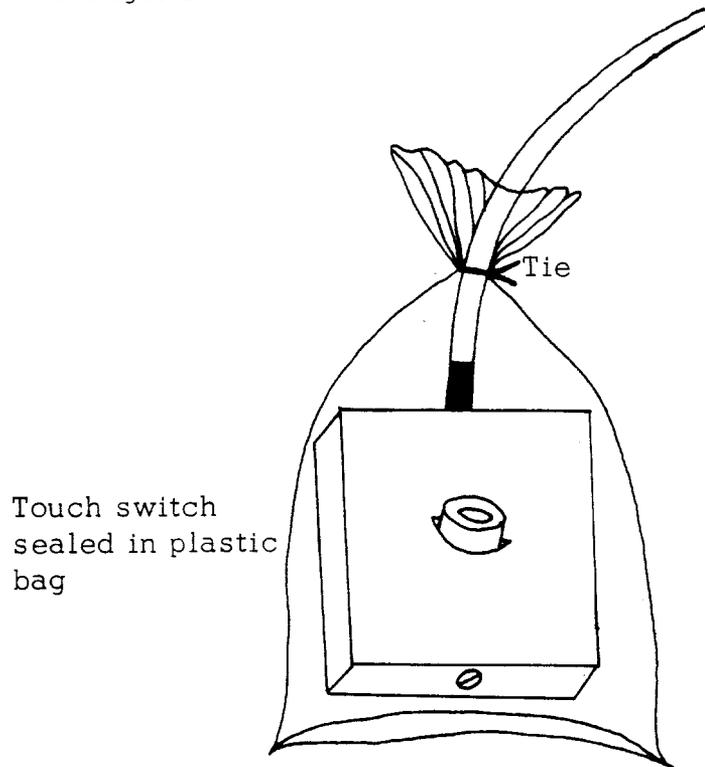
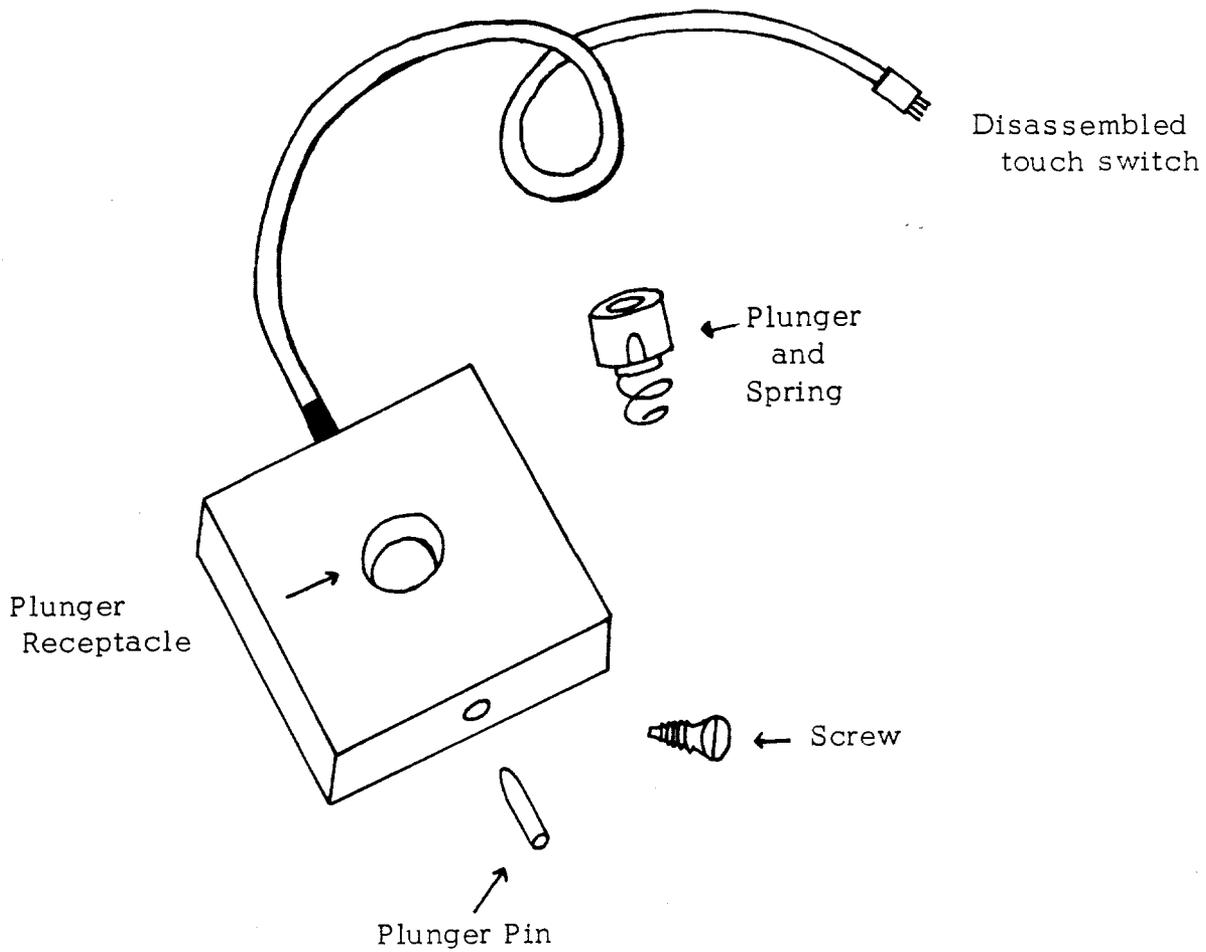


Figure 7. Touch switch maintenance.

wire tag injector can be used satisfactorily under remote field conditions to tag large numbers of juvenile salmon. Very few problems with the tag injector were experienced which we attribute to the daily cleaning of the vital parts of the tagging assembly and care to not submit the machine to jarring effects. Experience and common sense alleviated most of the problems with the tag injector. To other biologists attempting to use the machine under similar field conditions we do not recommend the use of the large quality control device. As access to most of our trapping and tagging areas was by floatplane and riverboats, our equipment had to be as portable as possible. The use of the QCD requires an additional power supply, water pumps, a level piece of ground and considerable time to get the instrument into operation. The use of the magnet and the field sampling detector proved to be an efficient and suitable method for magnetizing the tags and checking for untagged fish.

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## APPENDIX A

### Notes on the Field Use of the Magnetic Wire Tag Detector

An NMT Field Sampling Detector was used throughout our field season instead of the quality control device to check for the presence of untagged fish. The field detector operates by detecting the small changes in a magnetic field caused by moving a tagged fish through the gap between the detector's magnets. The unit is light, rugged and adequately protected to tolerate the usual wet environment encountered during field operations in S.E. Alaska.

#### A. Operation

To place the instrument into operation turn the power switch on and check the battery condition by pressing the battery check button, making sure that the lamp indicates a satisfactory battery charge. To set the gain control wave a magnetized tag taped or glued to the end of a small piece of wooden dowel through the magnetic field and adjust the gain control until the audio indicator gives a proper response.

The field detector should be placed on a solid base out of the wind, as movement of the detector and wind currents will cause false signals. The operator should remember to remove all rings, watches and metallic buttons from his person before using the detector. It is advisable to pass your hand through the magnetic field a few times to make sure the detector is not picking up any other metallic objects. We found that if the detector was set too close to the tag injector the field detector would beep every time the machine was cycled. This can be very confusing to the field detector operator while checking the fish. The problem is solved by placing the detector 6 to 8 feet from the tag injector.

Our field detector operator found that he obtained the best results by holding the anesthetized fish upside down in his hand, leaving the head exposed. He then passed the fish sideways through the detector so that the tag was in a perpendicular position to the sides of the V-shaped trough. If the hand is held over the fish's head, or if the fish is passed through the field detector so that the tag is parallel to the sides of the V, the detector will often not beep even though the tag is properly magnetized. When a fish was passed through the field detector three or four times and no signal occurred the fish was dropped through the field magnet again and checked once more. On occasion a fish had to be passed through the magnet three times before the tag was properly magnetized.

## B. Maintenance

1. **Batteries:** The field detector uses two Burgess #2N6 or equivalent transistor radio batteries. The expected battery life is about 200 hours; an extra set should be carried along during all field tagging operations. To change the batteries, first make sure that the power switch is turned off, as operating it with only one battery connected can damage the instrument. Remove the battery box cover and slide out the batteries. Using extreme care, gently pry the wire snap connectors loose from the batteries using a small screwdriver. The connectors are easily broken if forced by hand. Connect the new batteries, slide them back into the detector, and replace the cover. If the field detector is to be stored for long periods of time remove the batteries before storage.
2. **Accidental Immersion:** The field detector will survive an accidental immersion if properly cared for soon after the incident. With the power turned off, remove the batteries, and then remove the electronic subassembly by removing the screws holding the control panel in place. The panel must be lifted approximately 1/2 inch to release the circuit board from its connector. If it is immersed in saltwater, flush the inside of the detector and the subassembly with clean fresh water. Shake all water possible out of the detector case and place it in a warm place to dry. The subassembly can be dried using cotton swabs with subsequent placement in a warm spot. When all components are thoroughly dry, reassemble, being careful to seat the printed circuit board of the subassembly properly in its socket.

In order to reduce the jarring effects of transportation and to minimize the chance of accidental immersion of the field detector a heavy plywood waterproof carrying box was constructed for the unit. After each day's use the detector was thoroughly dried with paper towels and stored in the box.

## APPENDIX B

### Tag Injector Machine Tools

#### 1. Spare Parts

- |                      |                        |
|----------------------|------------------------|
| a. power cable       | 65/lb Head mold        |
| b. cutter and sleeve | 30/lb Head mold        |
| c. needle hex nut    | 15/lb Head mold        |
| d. needles           | Numerous needle guards |
| e. drive rollers     |                        |
| f. touch switch      |                        |

#### 2. Tools supplied with the Machine

- a. jeweler's loupe
- b. hex nut tool (for the needle carrier)
- c. Allen wrench (for the cutter screws) large
- d. Allen wrench (head mold screws) medium
- e. Allen wrench (drive roller screws) small
- f. wire cutters
- g. needle reamer (spare reamers)
- h. hard Arkansas slip stone
- i. BDL 5 amp fuses

#### 3. Additional Items Purchased

- |                    |  |
|--------------------|--|
| a. 3 screw drivers | g. wash bottle & 70% ethanol           |
| b. pipe cleaners   | h. single edged razor blades           |
| c. cotton swabs    | i. sandwich bags & ties (touch switch) |
| d. demagnetizer    | j. paper towels                        |
| e. hemostat        | k. lightweight oil                     |
| f. tweezers        |  |

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