Additional Guidelines to Marking and Coded Wire Tagging of Juvenile Salmon

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ABSTRACT

Jenkinson, D. W., and H. T. Bilton. 1981. Additional guidelines to marking and coded wire tagging of juvenile salmon. Can. Tech. Rep. Fish. Aquat. Sci. 1051: iv + 24 p.

This report is intended mainly for those individuals who may for the first time become involved in salmonid tagging programs using the Jefferts binary-coded-wire-tagging machines. Most aspects of the tagging procedures, ranging from anaesthetics, handling of fish, design of tagging units, tagging problems and solutions, maintenance of tagging machines and quality control units, making of head moulds, to recovery and storage of tags from returning adults, are covered.

Key words: Guidelines, coded wire tagging juvenile salmonids.

RÉSUMÉ

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Ce rapport est une initiation aux programmes d'étiquetage du saumon pour lesquels sont utilisés des instruments Jefferts d'étiquetage avec fil métallique portant un code binaire. On y traite des principaux aspects de la procédure d'étiquetage, dont l'anesthésie, la manipulation du poisson, le type des éléments d'étiquetage, les problèmes d'étiquetage et leurs solutions, l'entretien des instruments d'étiquetage, et le contrôle de la qualité, la fabrication des moules de tête ainsi que la récupération et l'entreposage des étiquettes récupérées des adultes retournant au cours d'eau natal.

Mots-clés: directives, étiquetage avec fil métallique codé, saumons juvéniles.

ADDITIONAL GUIDELINES TO MARKING AND CODED WIRE TAGGING OF JUVENILE SALMON

D. W. Jenkinson and H. T. Bilton

INTRODUCTION

Use of the micro-pin tag is increasing in studies about the distribution, survival, growth, etc. of the various salmon stocks. As well, more people are becoming involved in salmon culture and there is an increasing need to know the most efficient techniques of tag implantation and extraction. The new Jefferts binary coded wire tagging system, now used almost exclusively, comes with good pertinent instructions which should be followed closely. However, those instructions were not meant to cover all aspects involved in tagging juvenile salmon. A review of the auxilliary technology has been put together in this micro-pin-tagging manual, which covers a broad range of topics from the preparation of the fish to storage of recovered tags.

A. ANAESTHETICS

It suffices to briefly summarize the properties, characteristics and uses of some general anaesthetics for fish as described in a guide by Bell (1964).

Among the eleven anaesthetics referred to in the guide, there are two that are most commonly used. They are:

Tricaine methanesulfonate	MS 222
2-phenoxyethanol	2 phenoxy

The following are some properties of these two listed in the guide.

Stability		Concentration time to: (minutes)			
Undiluted	Solution	Immobilize	Recover	Precautions	Remarks
MS 222 Good. Keep cool and dry	Slowly decomposes Slowly inactivated by fish	0.5-1.0 g/4.55 L		Use fresh solution for best results, or freeze stock. May be toxic when used in water colder than that from which fish taken	If fish immobilized in less than 2-3 min sln. probably too strong -- dilute or remove fish quickly. Use for transportation limited by instability of solution
		2-4	3-5		
2 Phenoxy Stable	Stable can be reused	0.5-1.0 mL/4.55 L		Usually best to dissolve or emulsify in an aliquot of warm water before adding to main container KEEP OUT OF EYES	Adult sockeye Effective dose M/L 100 Imp Gal 4°C 11°C 25 43
		2-4	3-6		

MS 222 is reported to have a clogging effect on tagging machines and its use appears to be giving way to 2 phenoxyethanol.

B. CONDITION AND HANDLING OF FISH DURING TAGGING

It is advisable to cease feeding juvenile salmon at least 24 h prior to immersion in an anaesthetic. Juvenile salmon are hardier in March and April, prior to smolting, than they are in May or June when they are in the process of smolting at a time when ambient water temperatures are rising. Thus early tagging is preferrable to tagging just before release. At any time, it is desirable to pass the fish through the marking and tagging process as quickly as possible to minimize stress.

Transfer of fish from rearing to the marking and tagging locations should be done with minimum stress to the fish. If the transfer is made by dip nets, scale loss can be extensive. Much of this can be alleviated by transferring fish in 45-L containers partially filled with aereated water. In the marking unit, adequate sized holding pens or tanks and adequate water exchange must be available to provide the most favourable conditions for fish recovering from the anaesthetic. It is important that only small numbers of fish are immersed in the anaesthetic baths at any one time. This will result in a shorter immersion time, quicker recovery,

easier handling, less scale loss, reduction in stress, and lower mortality. Where fish are discharged through a pipe from the tagging unit to the desired rearing location, as large a flow of water as possible should be used. This will prevent fish from skimming along the bottom of the pipe and reduce the possibility of eye injury or scale loss.

C. THE TAGGING UNIT AND PROCEDURES INVOLVED

There are as many marking and tagging unit designs as there are people involved in such operations, each with its own particularly notable advantage, suited to its own peculiar situation. Nevertheless, in each, the route of the fish is through the same essential stages of anaesthetic baths, fin clipping (in most instances), pin tagging, malachite bath (decreasing in popularity), recovery pen or box, and final release. The marking and tagging unit described in this manual is designed for the use of the coded wire tagging machines, quality control equipment, and for grading fish into various size categories.

The holding tank, or the first station in the tagging unit (Fig. 1), provides a supply of fish ready at hand for the fin clipper. This holding tank can be made either from 3/4-inch plywood, sealed and painted, or fibreglass, approximately 15 x 48 x 12 inches deep. The in-flow water should be from the same source as the fish culture water or, at least, be at the same temperature. The out-flow water can be piped into the tagged fish release pipe thereby adding to the flow needed to transport the fish from the marking and tagging unit. When being transferred to the holding tank, fish should be in moderate density in 13.6-22.7-L buckets, i.e. not exceeding several hundred, to minimize stress and scale loss. Should the rearing ponds and tagging unit be close together, it may be possible to eliminate intermediate transfer by supplying fish directly to the fin clipping tray in small volumes (Fig. 1/1a).

The next station is for anaesthetizing the fish. It consists in two parts, one for anaesthetizing the fish in preparation for fin clipping, and one for tagging. The first consists of one plastic tray (Fig. 1/FC) 20 x 8 x 3 inches deep in size holding two marquessette nets, each 10 x 8 x 2 inches deep in size. The first is for preliminary anaesthetizing of the fish (Fig. 1 1/FCa), and the second (Fig. 1 1/FCb), which is a little shallower, holds the fish to be fin clipped. This arrangement assures that fish are available constantly at the right level of anaesthesia while it prevents fish from being in the bath too long, the batches being processed in their entirety in sequence. The second area also consists of a plastic tray of the same dimensions with two shallow nets (Fig. 1/T). The fish are narcotized in the first net, and then tipped into the second from which they are tagged by hand. Depending on operator's timing and special arrangement, it may be feasible to eliminate one stage of handling here. The fin clipper can place anaesthetized clipped fish directly into the tagger's net (Fig. 1/2), providing that only a few fish are in this net at one time (this is to prevent fish from being ignored in the tray and remaining there whilst other newcomers are processed. This reduces handling by about 30% and greatly reduces the time of immersion in the anaesthetic bath.

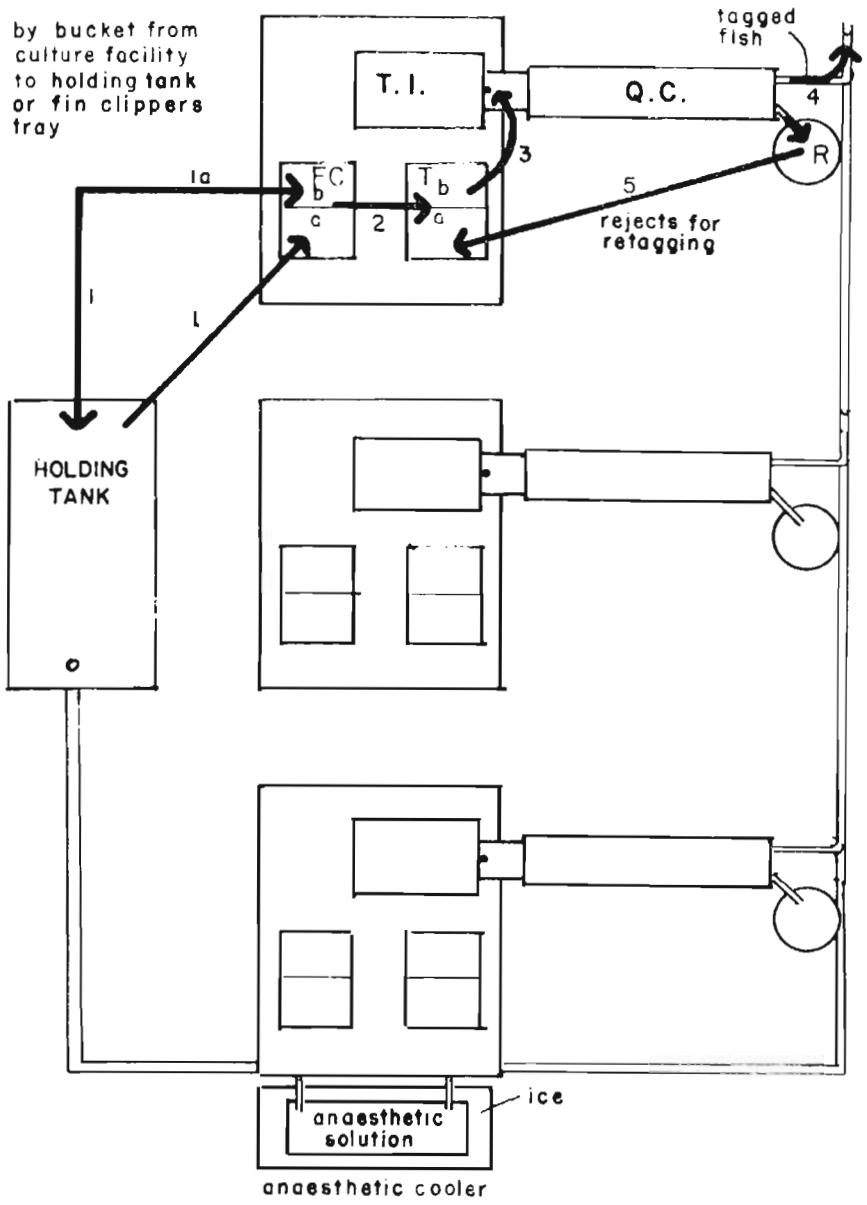

Fig. 1. Basic layout for a three-unit fin-clipping and tagging facility.

At this point (Tb) the fish are then tagged by placing the head firmly in the hard mould (Fig. 1/3) and pressing the button to initiate one tagging cycle (Fig. 1/T1). The tagged fish are then dropped into the chute of the Quality Control separator unit (Q.C.) and pass through it (Fig. 1/QC). Fish with a tag leave the Q.C. via a transparent plastic discharge pipe (Fig. 1/4). This discharge pipe is supplied with ample water from both the first station (holding tank) and the last station (the Q.C.). This can be supplemented, if necessary, with water from a direct suppy into the discharge pipe. Fish not having a tag pass out of the Q.C. into the reject bucket net (Fig. 1/R). Periodically these are removed (Fig. 1/5) and returned to the first tagging tray net (Ta) for retagging.

Another means to cut down fish handling is to assign both the fin clipping and the tagging operations to one operator. Fish are placed into net (Ta) for the first stages of anaesthetization and are then tipped into net (Tb), from which the operator takes the fish, removes the fin (Fig. 2/2) and while still holding it in the same hand the fish is tagged and then placed into the Q.C. chute (Fig. 2/3), thus eliminating two stages.

For reduction of stress, the last method is the most preferrable. A noticeable reduction of machine/day output will result by combining the two functions, but these would be an overall labour cost-saving. If however, the disengaged fin clipper were to operate a second unit the combined output would substantially increase over the sequential clipper/tagger combination.

Any head mould is efficient only over a limited size range of fish. When there is a wide range of sizes in a population of fish and where only part of these need to be tagged, it may be advisable to reject pronouncedly undersized or oversized fish. This reduction in the size range improves the rate of satisfactory tag implantation. If all the members of a population must be tagged, the average quality of the tag implantation inevitably will be lower. Even when the fish pass through the Q.C. as tagged, tag rejection by oversized or undersized fish may follow later.

Undersized fish may not survive the deep penetration of the tag, or the injector needle may pass through the roof of the mouth depositing the tag in the mouth. Oversized fish snouts may not completely fill the mould cavity, and thus would result in only partial penetration of the tag, possibly just under the skin (Fig. 3) and the tag would eventually be lost.

Experimental releases may require three graded size groups, whereas two size groups are usually sufficient to ensure a good implantation to meet the needs of most production releases. A length frequency sample (Fig. 4) of the population to be tagged should be made in order to select head mould sizes for the upper and lower fish size ranges.

Since there is a wide overlap of sizes possible, as indicated in Fig. 4, fin clippers need select only the obviously large or small individuals to grade, passing these to the appropriate tagger's tray. The large middle group is divided as needed over both trays.

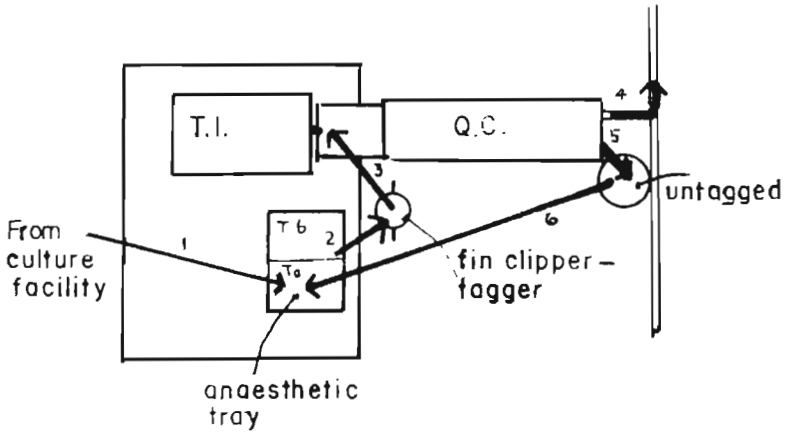

Fig. 2. Single unit layout for a combined fin-clipping and tagging system.

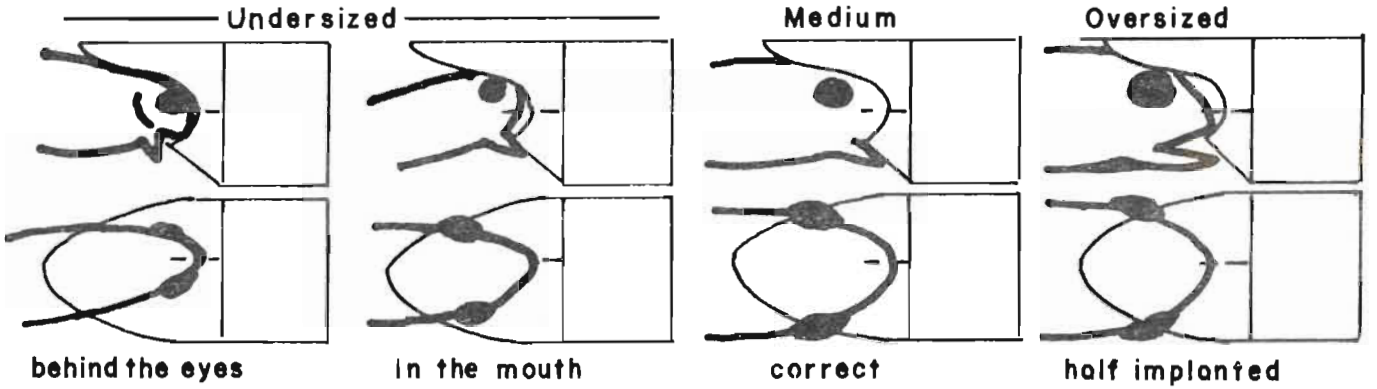

Fig. 3. An illustration of some tag implant effects, from the use of one head-mould size with a population for fish having a wide size range.

When size ranges are processed a dual marking and tagging unit similar to Fig. 5 is required enabling two fin clippers to pass fish to either the lower or upper size tagging machine operators anaesthetic tray (Fig. 5/3, 3a). To this can be added the alternative of either a holding tank for incoming fish (Fig. 5), or the use of plastic buckets to transport the fish directly from the source to the marker trays (Fig. 5/1a). A third alternative is the use of a combination of a fin-clipper-tagger as described in Fig. 2.

D. FIN CLIPPING

By convention the adipose fin is removed to identify fish with a coded wire tag. This is a delicate operation carried out best by people with good eyesight, small and sensitive hands, and circled by adequate illumination. Salmonid fry marking requires magnifier illuminators. A regular monitoring of clip quality on the basis of percent of fin removal must be carried out (see Bams and Crabtree 1976). The fin-clipping anaesthetic solution can be recycled through a filtering, aerating, and cooling system in any of the marking and tagging set-ups previously described.

There are a variety of scissors and clippers available for fin clipping, ranging from simple clinical type scissors with one blunted point, to costly spring handle cornea scissors, obtainable from surgical instrument suppliers only. All are satisfactory, but operators are known to prefer one type above another. Most of these scissors must be sharpened professionally.

Since the adipose fin does not have rays it is easier to remove than the other fins. Because it tends to regenerate more often than the ventral fins (Bams 1979), at least on young fry, care must be taken to remove it clearly, while at the same time not cutting into the body of the fish, leaving an open wound prone to fungoid or bacterial infection. After clipping and tagging, a treatment of tetracycline medicated OMP is a safeguard against various infections: 2-phenoxyethanol itself has a certain amount of antiseptic value.

E. BINARY-CODED-WIRE TAG INJECTOR

The tagging machine operation instructions issued by Northwest Marine Technology Inc. should be followed closely. Most operators will stress certain phases of maintenance more than others, and adherence to additional recommendations to keep the machines in good operating condition. One important fact, not stressed in the manual, is that these electronic units are not constructed to operate in unusually wet conditions. Some locations are extremely humid, or have been badly plumbed, and the layout is such that water constantly comes into contact with the cables and the machine themselves. Water seems to be everywhere, and the

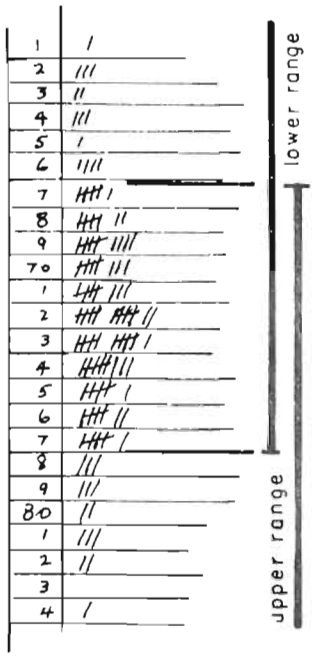

Fig. 4. A frequency of fish length ranges to determine mould sizes for coarse grading.

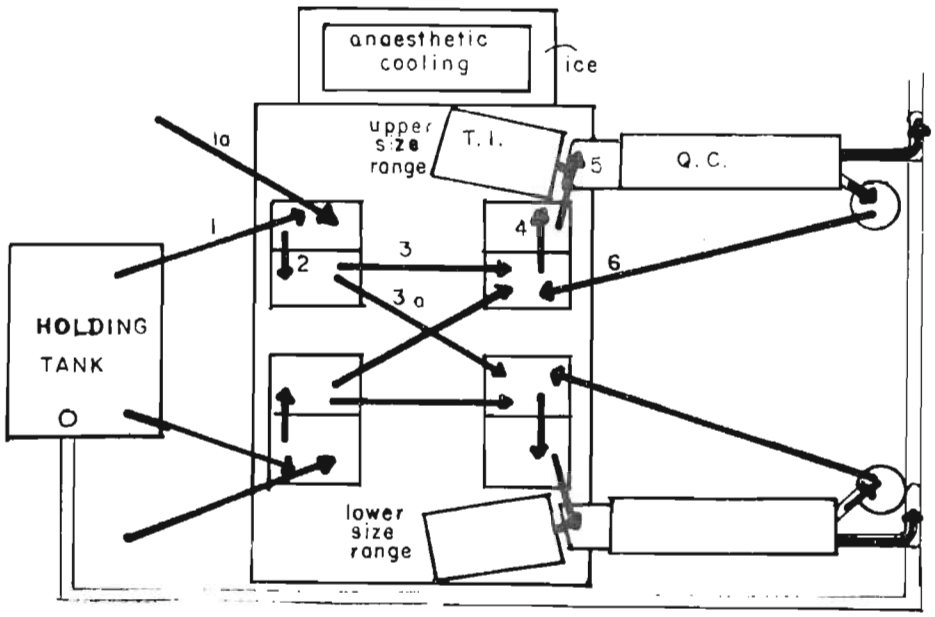

Fig. 5. Layout of a two-size graded, fin-clipping and tagging system.

operators may wear waterproof clothing because of it. Under such conditions water runs down eventually into the "water proof" multiple plugs, seeps into electronic control boxes of the tag injector and the Q.C., and gets into the manual switches and many stoppages may result. The only remedy is to improve on the plumbing and drainage system, rearranging the marking and tagging areas to reduce the frequency of transfer of fish, by nets. Pipes should overflow from tanks into a drain instead of onto the floor, or outgoing water can be piped into the fish release pipe, adding to the outflow. A relatively dry marking and tagging area will help ensure that the electronic equipment remains dry and warm and functions without mysterious and exasperating breakdowns. It is good practice to leave the equipment switched on from the start to finish of a tagging program, thus keeping it warmed up and dry internally.

1. Routine care of the tag injector

As a general rule, when a tagging machine is operating trouble free it is advisable to leave well enough alone. Only a daily start-up routine is required. This involves:

a) Turn the machine off momentarily, and revolve the green drive roller until the wire is projecting from the head mould. This will ensure the wire is running freely, and not seized-up from minute amounts of dried slime from the previous day's operation.

b) Revolve the drive roller backward until the wire is out of the cutter. Turn the knob at the end of the cutter motor to ensure that the cutter core is free. If time permits, a better practice is to remove the cutter completely. Check it with a lens, and clean it up with alcohol before replacing it. If the cutter is free, turn the drive roller forward until the wire projects 1/2" beyond the needle. Switch on, and operate the machine a couple of times. This daily routine involving a few minutes is often all that is needed for a smooth, continuous, and trouble free machine operation for days on end.

2. Problems and solutions

Kinking of the wire. Kinking of the wire between the guide tube and the drive roller, indicates a blockage somewhere between the roller and the point of the needle. There may be various causes, some of which are noted below.

(a)	A worn cutter edge, resulting in a burred or bent tag jamming in the cutter core or the needle.	Requires a cutter edge change, or maybe a new cutter. Examine the cutter edges with a microscope. See the manual instructions.
(b)	Build up of deposits at the entrance to the guide tube following the drive roller, at the entrance to the cutter, or at the rear of the needle.	Removal and examination of the part involved, clean with alcohol.

(c) A worn flare at the base of the needle, or even a broken flare. A small fragment of the metal from the flare, or a minute fragment from the cutter also will jam a tag in a needle quite firmly.

A reamer is supplied with each machine to bevel or flare the entrance to the back of the needle. If reamed out too drastically too wide a flare will form, which has a very thin wall. The end of the wire may strike this edge and break off a small segment. The cutters are extremely brittle and minute fragments may chip off the sharp edge of a new cutter, not causing any immediate cutting problem, but each piece may be carried on the wire into the cutter hole. Flush out the offending fragment with alcohol. If the needle base is reamed out, the needle will require resetting. Refer to the manufacturers instructions.

(d) The space between the base of the needle and the cutter may be too wide.

See the instructions regarding needle setting.

(e) Infrequently a tag may be drawn back out of the fish, at times because the wire or the needle has become magnetizied. Such a tag may remain on the point of the needle, and become dislodged when the needle point retracts behind the head mould base, finally the tag settles across the entrance to the mould base and blocks the entrance of the needle.

After removal of the mould an examination of the inside of the base sometimes reveals a stray tag or two around the bevelled hole through which the needle must pass. If a tag is found across the hole, its removal may be the solution to the problem. After removing the stray tag examine the needle point with a loup to check for damage caused to it by coming into contact with the stray tag. There is a demagnetizer mentioned in the NWMT Technical Bulletin #1, available for about $40. Local jewellers may be able to help; they demagnetize watches and could demagnetize the wire or needle.

(f) A loose needle advance arm screw.

If this mechanism was removed and replaced earlier, it may have picked up some fragment that prevented a complete tightening of the screw, which eventually works loose. An over-tight screw also can cause problems, resulting in an incomplete needle advance.

Electronic malfunctioning of the tag injector. This is rare and when it occurs it is advisable to contact the manufacturers. Replacement

parts are sometimes the best
and only remedy.

3. Maintenance after tagging session completed

- Disassemble the needle carrier, cutter, drive rollers, and needle advance. Clean with alcohol.
- Check the needle for angle, sharpness, setting, damage, and need for reaming.
- Check the cutter with the aid of a microscope for chipping and wear.
- Check the drive rollers for channelling.
- Check the guide tube for position and cleanliness.
- Ensure that the set screws are all tight.
- Keep the manual switch dry at all times. The button may seize up when water enters the well and prevents passage of air, like a piston with both ports closed.

4. Achieving correct tag implantation

The tagging injector units are designed to deliver .254 dia by 1.067 mm long pieces of stainless steel coded-wire tags to a set distance from the point of a projected hypodermic needle. To achieve a satisfactory implantation of the tag into the snout of the fish requires skill, experience, craftsmanship, and even art. Three major concerns are:

a) The sharpness and angle of the hypodermic needle point.

b) The extent of projection of the uncut wire past the needle point.

c) The shape and size of the plastic mold that holds the fish head.

(a) Needle angle and sharpness

Too acute a needle point angle will tend to deflect the needle toward the longest side and allow the tag to angle before it is sufficiently imbedded (Fig. 6/a).

A needle point of 45°-50° will give an adequate cutting edge, will not cause deflection, and will allow the tag to be controlled until more than half the tag is extended (Fig. 6/b).

(b) Projection of uncut wire

The extent of the projection of the uncut wire beyond the needle must be closely checked. Insufficient projection (Fig. 7/a) may allow the tag to be drawn back into the needle by suction as the wire recedes, or be left half exposed. Over-projection can place the tag more deeply than required (Fig. 7/b), or force the tag to angle, and possibly enter the nostril or the mouth and be rejected in the Q.C. and fall out later (Fig. 7/c). The correct projection will set the tag just beyond the needle point by about 1/4 mm (Fig. 7/d). (See the manufacturer's instructions). Revolving the needle so that the angle of the point faces the dorsal side of

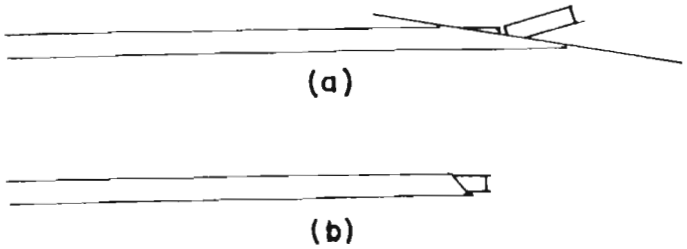

Fig. 6. Illustrating the importance of a correct angle to the point of the injector needle.

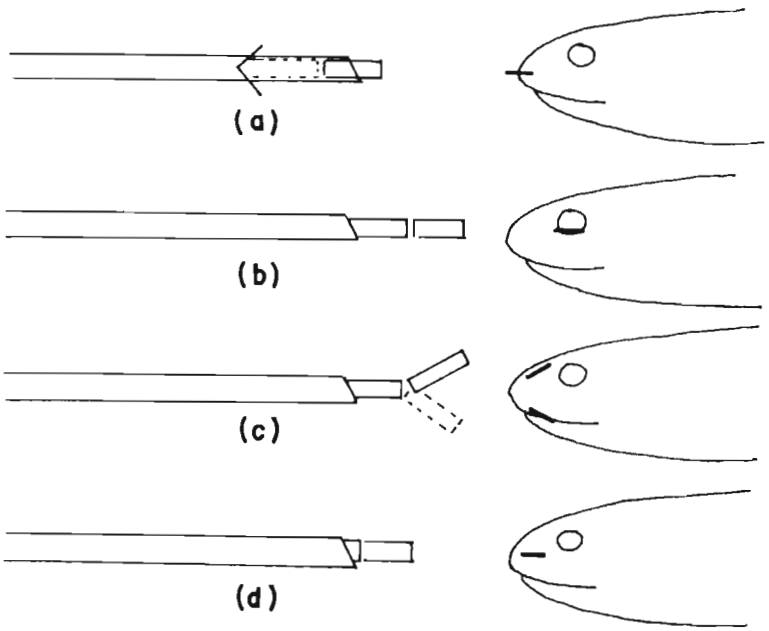

Fig. 7. Illustrating the effect of: (a) unsufficient projection from the needle of the uncut wire; (b,c) excessive projection and; (d) correct projection.

the fish's nose sometimes can help in the initial penetration of the skin (Fig. 8/a, b). There may be, however, a problem with the larger fish, in that the point of the needle will come into contact with the upper jaw bone first and will not penetrate.

F. HEAD MOULDS

The injector manufacturers supply well made, coloured head moulds. However, many users prefer to make their own, either owing to for considerations of cost, or because of greater confidence in the hand made variety, which may be better adopted to local stocks and/or sizes.

1. Materials for making your own

Fibreglass resins are used in making the moulds. These following items are needed:

Fibreglass resin and catalyst
Small mixing container
Tagging needle, or straight pin of same diameter as needle (thickest end).
Kraft gummed paper tape 1 1/2" wide
Small ball of putty or wax
Wood or metal support with centre hole for pin
Aluminum mould base

2. Method of making moulds one at a time

a) 11 centre channels at side of base with putty or wax (Fig. 9/a).

b) Make a sleeve around the base with 1 1/2" Kraft paper (Fig. 9/b).

c) Cut the head off a pin or use the needle and insert it into the snout of an average sized, freshly killed fish, above the top jaw bone, and in the centre of the snout, parallel with the fish (Fig. 9/c).

d) Remove the lower jaw of the fish with scissors (Fig. 9/c).

e) Place the needle (or cut-off head end of the pin) into the needle hole in the mould base inside the sleeve, allowing 1/16"-1/8" between the snout and the base (Fig. 9/d).

f) Place the pin protruding below the mould base into the support pin hole so the sleeve is vertical (Fig. 9/d).

g) Pour the resin into the tube, and allow to set. Remove tape, fish, and pin. An unfinished mould attached to the base will result.

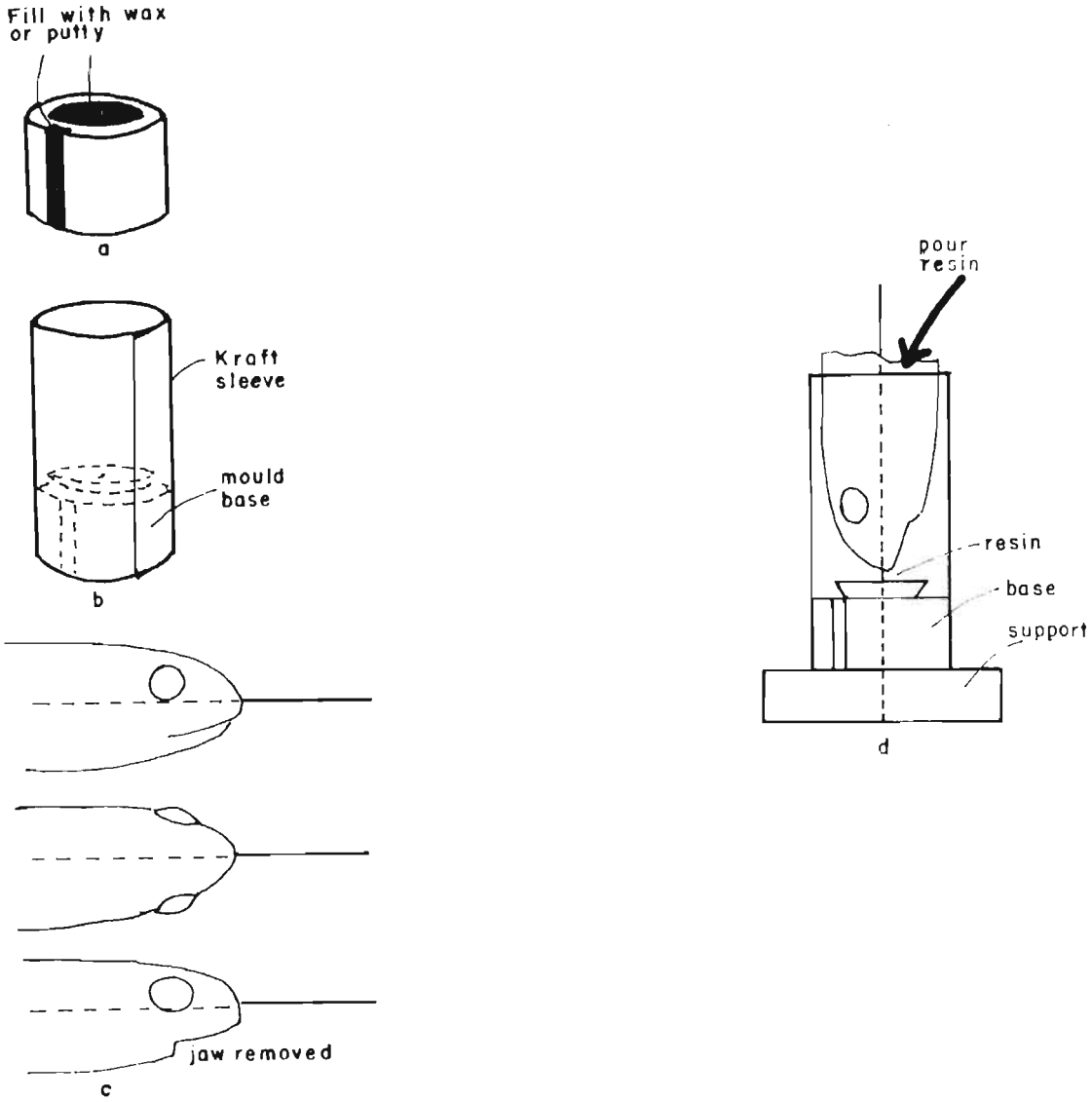

Fig. 9. The four preparation stages before pouring the resin for a head-mould.

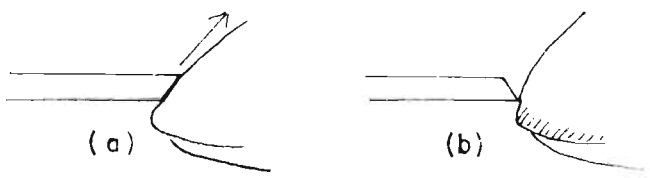

Fig. 8. Illustrating the possible effect of the needle point angle on contact with the fish snout.

h) With a hacksaw blade, a round, and a flat file shape the mould as shown, with space for the fish eyes and a bar for the jaw (Fig. 10/a-c).

i) The jaw bar should be bevelled to the base, starting from the ridge caused by the removal of the lower jaw of the fish. Curve the jaw bar slightly so that smaller fish with shorter jaw and narrower heads fit into the lower curve of the bar. Use a "fine" round file to shape the eye cut-out. The mould can be polished, if desired, by rubbing with felt buffing, and polishing with chamois leather.

3. Using a master to make more than one mould at a time

If it is desired to duplicate a mould, a metal form can be made in little more than double the time it takes to make a single mould. This master form can be used to cast as many moulds as required, and is available when fish are not.

Additional to the items required to make moulds from individual fish (Sect. 6-2) are a small quantity of dentists plaster and a small quantity of optical, low melting point alloy such as Cerrlow Alloy #136. Such alloy can be melted in a container, over low heat or even in boiling water.

Method:

a) Repeat 2a-f above

b) Mix a small amount of dental plaster by adding cold water until just able to pour. Pour the plaster around the fish in the sleeve and allow it to set (about 1/2 h)

c) Remove the paper sleeve, fish, and pin

d) Shape the plaster cast to the same design as the finished mould above (Fig. 11).

e) Replace the paper sleeve to 1/8" above the top of the plaster cast. Replace the pin to protrude above the Kraft paper sleeve (Fig. 11/a).

f) If the paper sleeve fits tightly around the plaster cast, pour in the melted alloy to the top of the sleeve (Fig. 11/a). Allow alloy to set (2-3 min)

g) Remove the sleeve and separate the plaster cast from the alloy.

The permanent fish head form (Fig. 11/b) can now be used as often as required to duplicate fibreglass head moulds. Proceed as follows.

h) Coat the alloy form with a thin wax coat. (Clear wax floor polish, spray wax, car wax, anything easily applied).

i) Make a final Kraft sleeve around the alloy form and seal it with melted paraffin wax (Fig. 11/c)

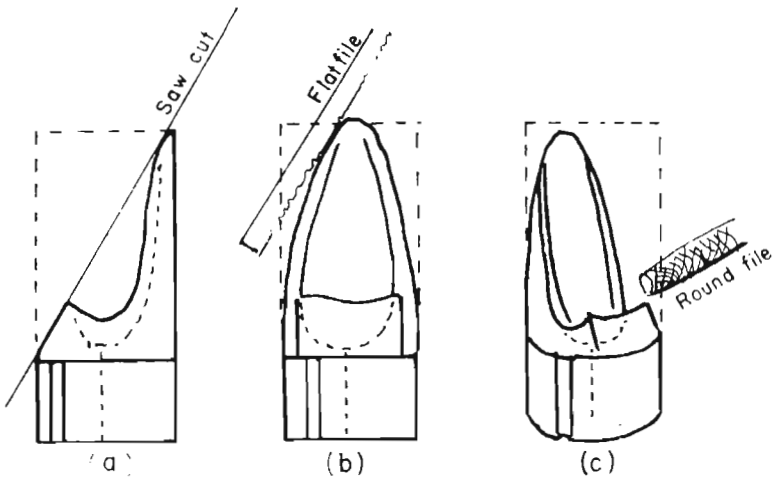

Fig. 10. Shaping the head mould.

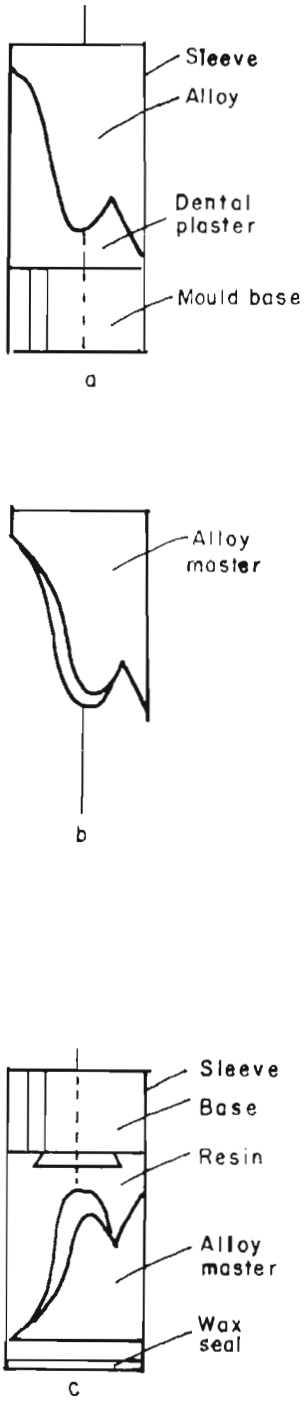

Fig. 11. Method of making an alloy master for finished head moulds.

j) Invert the sleeve and pour in the fibreglass resin to 1/4" above the alloy form. Push an aluminum base down to the alloy form leaving 1/8" space between the base and the forms (Fig. 11/c). The pin should pass through the base, and the base should be inserted flange side down.

k) Allow to set for 8 hrs. Remove the sleeve, and the alloy form. A complete mould will have been formed to the aluminum base. Repeat i-k for each head mould of the same design that is required.

l) Buffing and polishing can be done as in previous methods. Mould forms for various species and sizes of fish, can be permanently available by this method even when fish are not available, and killing fish for mold making is confined to that for the initial plaster cast.

4. Making copies of existing moulds

From moulds such as those supplied by NWMT copies can also be easily produced, using RTV silicone liquid rubber and any fibreglass and casting resin.

The method requires pouring the liquid rubber compound into a dixie cup to cover the head mould with needle in place, which is standing on its base at the bottom of the cup (Fig. 12a). When the compound is set, remove the form from the cup, remove the master head mould and base from the form, leaving the needle in place in the form. Pour the resin into the mould cavity up to the base line (making sure no bubbles are trapped), insert a base flange down to the base line (Fig. 12/b), and allow to set. A copy of the original is thus produced. This method is described in more detail by Robert Livel in Progress Report #40 St. Wash. Dept. of Fisheries 1978.

G. THE QUALITY CONTROL UNIT

1. Operating environment

The Q.C. functions best when dry. A very humid atmosphere may cause condensation to form in the electronic control box and around the chute. Avoid water getting into the Q.C. unit by keeping the lid shut. The metal lid can be replaced with plexiglass to see the seperator window without the need to raise the lid. An excess of moisture inside the Q.C. may invade the multipoint plugs and the control box resulting in inevitable functional problems.

If incoming water is not filtered it may be necessary to install a filter before the Q.C. Even with a steady flow of water through the solenoid valve, solids can build up, or grit become lodged internally, causing switching of jets to fail. When this happens dismantle the solenoid valve and clean with a bottle brush. Be careful not to lose the "o" ring, or the spring.

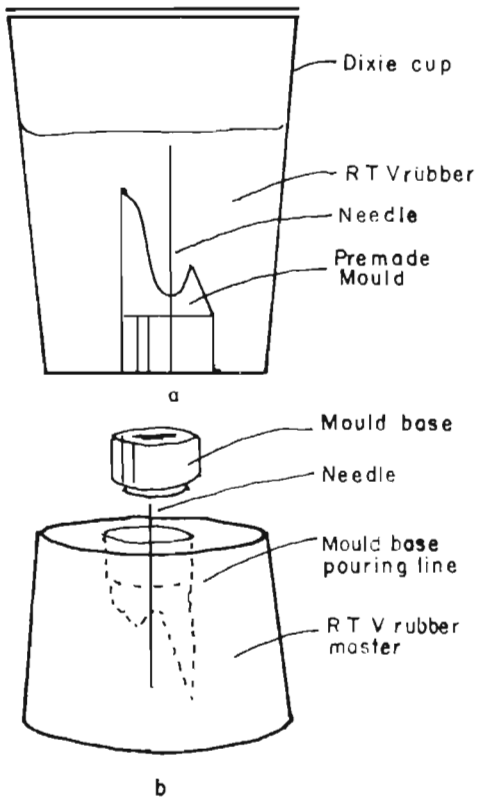

Fig. 12. Method of making a master mould of R.T.V. silicone liquid-rubber compound, from a pre-made head mould.

2. Problems and solutions

Adjustment of the Q.C. delay[a] and gain[b] controls is necessary to ensure the fish reach the deflecting jets at the right moment. As a first requirement the flow of water down the chute must be adequate. Insufficient flow of water, or slope of the Q.C. unit will extend the time required for the fish to travel down the chute, and beyond the adjustment limits. Conversely, too great a slope or flow may have the reverse effect, and an active fish increasing its speed down the chute arrives at the deflecting jets in advance of their functioning. Whilst it is not desirable for the fish to be too heavily anaesthetized, it is necessary for them to be sufficiently sedated to prevent thrashing and jumping through the Q.C. which could lead to loss of scales, injury and stress, as well as flipping into the wrong outlet. This would result in tagged fish falling into the rejects bin and untagged fish passing into the tagged population, causing a higher percentage of untagged fish to be released than estimated.

For ease of handling, reduced stress and injury, better tagging and quality control, and shorter time in the anaesthetic it is preferrable that the fish are inactive to a sufficient degree. Where fish are too far advanced into smolting, and thus at a delicate stage, problems may be encountered in adjusting the depth of sedation necessary to arrive at that degree of inactivity. The remarks in the first paragraph under the heading "Conditions and Handling" apply.

To ensure satisfactory separation of tagged and untagged fish, 20 psi water pressure should be available, the correct Q.C. slope and the electronic settings must be selected, and further Q.C. adjustment must be made. This requires direct observation of the fish as they pass out of the chute into range of the deflector jets below the viewing window. The jets may need to be adjusted according to the size of the fish so that they are struck by the stream of water correctly and deflected into the appropriate outlet pipe. Small fish may go beneath a jet set too high, and large fish over a jet set too low. Both jets must be set to push the fish aside until it has passed the "V" shaped guide in the centre of the separator box. It is worthwhile to check these jets regularly and thoroughly because much time can be consumed checking reject fish that prove to be tagged, but were not passing into the correct pipe because of an incorrect jet angle.

A more serious problem than tagged fish arriving in the untagged bucket is the often unknown incidence of untagged fish passing into the tagged fish outlet, and becoming included in the tagged fish population, leading to incorrect estimates of number of tags applied. As noted before, fish that are not sufficiently anaesthetized and are active while passing through the Q.C. will present a problem at this point, frequently flipping

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[a]Delay--actuates the separator gate when a tag passes through the detector level.

[b]Gain--detects the presence of a tag.

into the wrong outlet pipe. Occasional checks on actual tag content should be carried out throughout a season.

A thin stream of water is sufficient to carry the fish down the chute. An excess of water hampers the deflecting jets and prevents the fish from being pushed aside by the jets. When all adjustments are correct, fish travelling head first down the chute will be deflected as intended. Those travelling tail first, may travel slower down the tube and not arrive at the jet in time to be deflected into the correct outlet. These are further points in favour of adequate anaesthetization, for active fish frequently flip upside down when dropped head first into the chute, and large fish may even succeed in positioning themselves across the mouth of the chute.

H. RECOVERY NET

Anaesthetized fish discharged after tagging into a holding pond can be protected in a shallow net from which they can easily rise and escape when recovered from the anaesthetic. Without such a net swimming fish are liable to pick at their immobile counterparts. A net measuring 4 x 8 feet and 18 inches deep or less according to the pond depth, will enable observation of the fish discharged into it to allow a check on overcrowding in an area of the net.

I. MAINTAINING ACCURATE COUNTS OF FISH TAGGED

To obtain a final tally on a group of tagged fish the following records are needed:

date of tagging
location
stock tagged
code number used
tagged fish counter setting at start
tagged fish counter setting at completion
deduct number at start from number at completion

The record may be completed by recording the final number tagged, and attaching a wire sample on a form with the above data, such as illustrated below.

Tagging data

Species: Location:

		Q.C. numbers tagged					
Date	Code used	Finish	Start	Finish minus start	Minus	Total tags	Wire sample

Both the binary tagging machine and the quality control device are provided with counters. The counter in the tagging machine records the number of times the tagging cycle has functioned. The Quality Control Unit contains two counters, the first records the number of times a magnetized tag is detected as it passes down the chute, the other, the reject counter, records the number of times the tagging cycle has functioned without a tag being detected. Several things can go wrong with this system. A tag on the outer surface of the fish, in the mouth, or just carried by the water will be recorded on the "tag detected" counter. A fish held up in the mouth of the chute not having passed through the detecting section of the chute will be recorded on the reject counter when the button is pressed to initiate the next tagging cycle even though it may be tagged. If dislodged by the next fish dropped into the chute and passing the detector section in close proximity with the second fish, it will most likely not be recorded on the "tag detected" counter. The extent of these errors may be difficult to assess.

By noting down the starting number on the Q.C. "tag detected" counter and subtracting that from the number shown at the finish, the total number of tags detected during the session is recorded. Should a fish with a tag be passed through the Q.C. a second time for any reason (such as when checking rejects), it must be deducted from the recorded tagged total to arrive at the appropriate figure for the session's total. A hand tally counter kept close by is useful for keeping a tab on all deductions.

J. RECOVERY OF TAGS FROM ADULTS

Recovery of tags from whole heads or snouts of adult salmon is largely a matter of skill and good eyesight, plus a high degree of cleanliness. The process is aided by a magnetic tag detector and a microscope for decoding.

The electronic tag detector produced by the manufacturers of the tag injectors and currently in use will indicate the presence of magnetized tags in the fish snout when one is passed through the "V" shaped detector space. Infrequently a tag may not have become magnetized or may have lost its magnetism after tagging of the fish. By passing the entire snout section through a ring magnetic field, it is possible to remagnetize the tag

which then becomes electronically detectable. If, after splitting the snout section (part of the head in front of the eyes) down the middle with a scalpel the tag is not visible, the detector will indicate in which half of the snout the tag is located. By repeating this test with the halves of each successive cut the tag can eventually be detected and recovered with the unaided eye or with the aid of a magnifier or dissecting microscope.

Ultrasonic cleaning of the recovered tags enable the code on the tag to be read without confusing the etched dots on the four sides with any small particles adhering to it. Inexpensive ultrasonic cleaners of 1/3 amp can be obtained from laboratory supply firms.

A clean, spacious table on which to work, covered in white paper or card will ensure that a tag which has flipped away will be more easily observed and recovered for decoding.

There are a number of tag holders, varying from a simple one constructed from a block of styrofoam through which a blunted and magnetized dissecting needle is passed, to the more sophisticated brass mounted tag holders produced by the manufacturers of the injector and Q.C. For tag code reading and decoding, see the latest "Instruction booklet" issued by the injector manufacturers.

K. STORAGE OF TAGS

A space saving storage technique for extracted tags is in polyethelene-type coin envelopes, which can be used for individual or bulk storage. Stapled to a filing card they can be filed neatly with appropriate information for future reference.

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