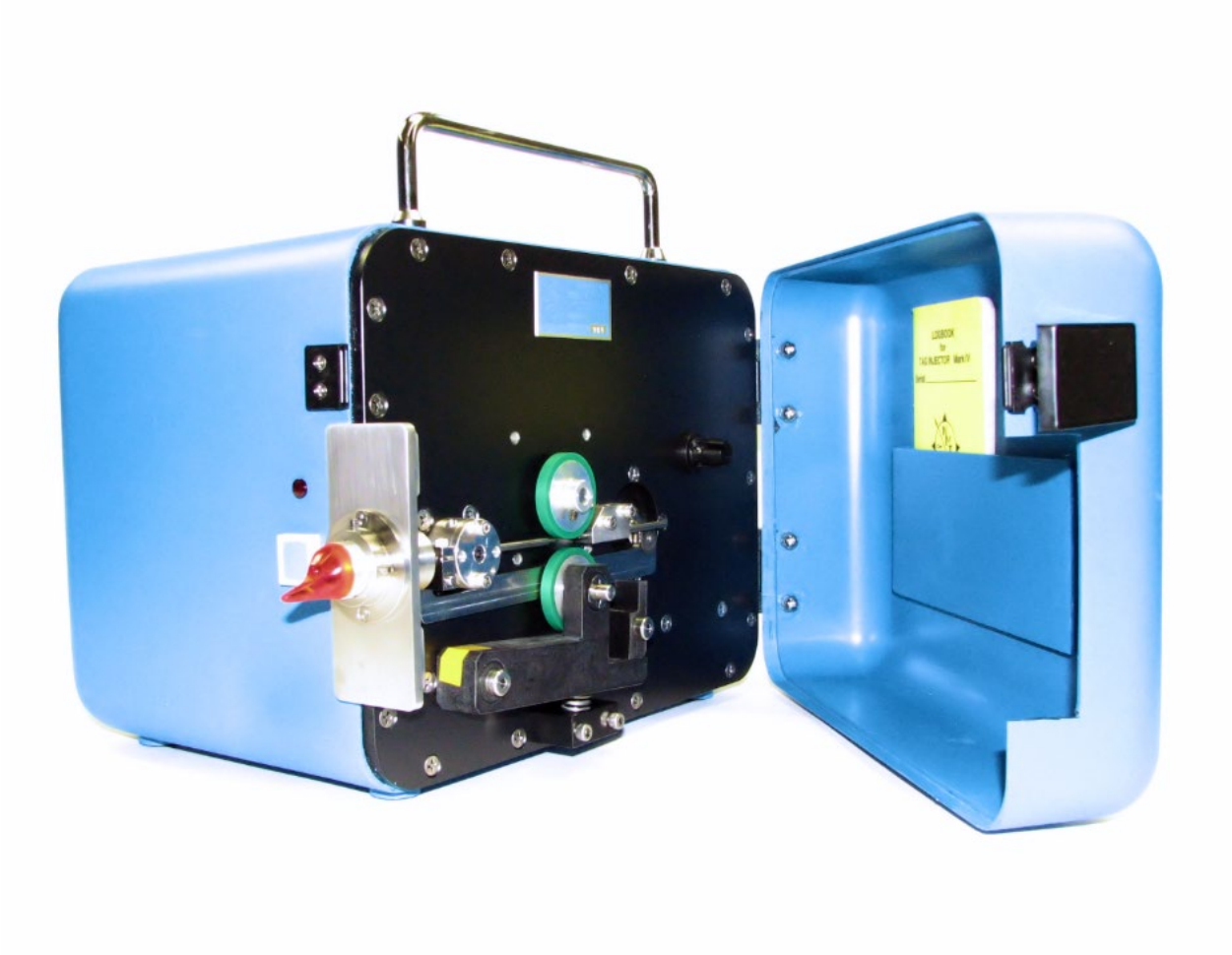
MKIV Coded Wire Tag Injector
Instruction Manual



Northwest Marine Technology, Inc.
4003 Airport Road, Anacortes, WA 98221, USA
Phone: +1 (360) 764-8850 Email: office@nmt.us
www.nmt.us

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1 Introduction

Northwest Marine Technology (NMT) designs and manufactures Coded Wire Tags and their associated injection and detection equipment. The Coded Wire Tag (CWT) identification system is an accurate and versatile method for assessing and studying natural and hatchery-reared fish populations. Coded Wire Tags have been implanted in hundreds of different marine and freshwater species. Reliability of the equipment and data allow for application in many areas of fisheries research and management.

The MKIV Tag Injector is designed to give years of reliable performance. Please read and understand the operating and maintenance instructions so you can obtain the maximum service from this product. The most up-to-date version of this manual is available on our website (www.nmt.us; NMT User Manuals). Our CWT Project Manual gives a comprehensive overview for implementing CWT projects.

The MKIV Injector comes in various configurations:

1. MKIV Tag Injector only (a V-detector or T-Wand for quality control is recommended).
2. MKIV Tag Injector with a Quality Control Device (QCD), Figure 1.
3. MKIV Tag Injector in an AutoFish trailer (Figure 1) - refer to the AutoFish SCT Operator Manual).

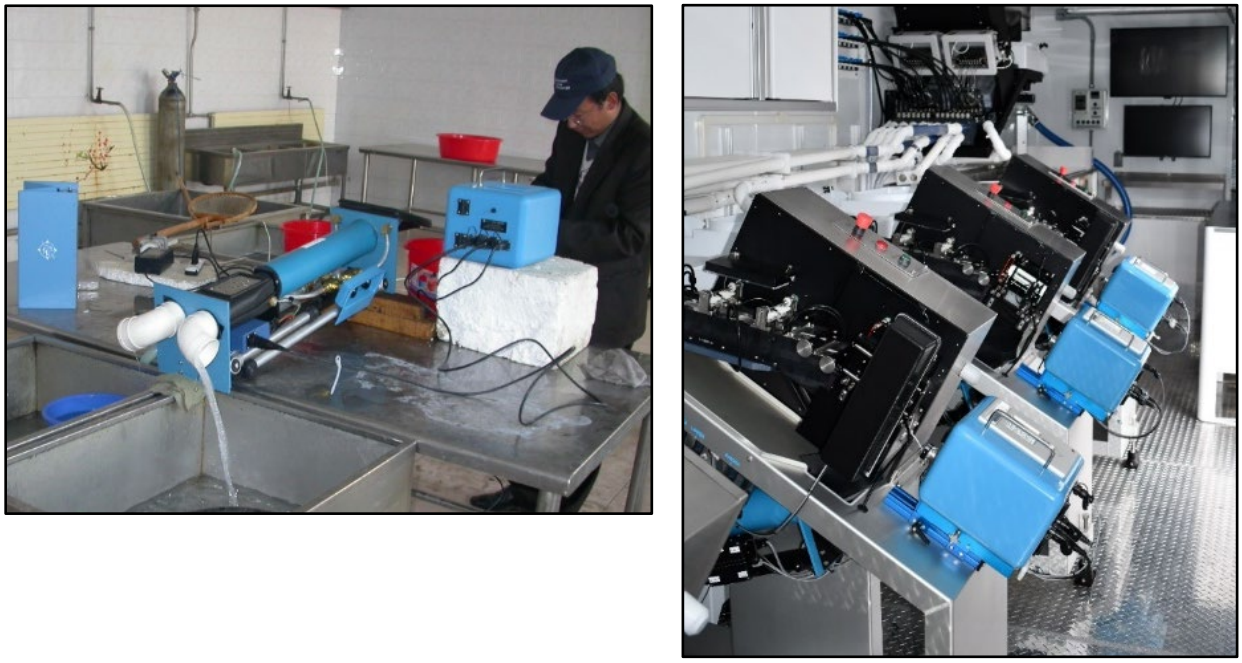


Figure 1: MKIV with QCD for manual tagging (left) and installed in AutoFish System (right) for automated tagging.

2 Setup

2.1 Contents Checklist

A MKIV Tag Injector is shipped with the following items in a transit case:

- MKIV Tag Injector
- Power Supply
- Touch Switch or Foot Switch
- 3 non-custom head molds
- 3,000 tag spool of test wire
- Tool Kit (see Appendix A: Tool Kit Components)
- Instruction Manual

A MKIV Tagging Unit includes these additional items:

- Quality Control Device (QCD)
- Interconnect Cable
- Funnel
- Legs
- Quick disconnect with a water filter.

Remove all items from the boxes and make sure nothing has been left in the packing materials.

2.2 Assembly

1. Place the Injector on a stable, flat surface near the power source. The tagging equipment operates on 12-28 volts DC (about 50 watts). The Injector comes with a power supply which converts 110-240 volts AC to 24 volts DC. Plug the power supply into a grounded AC power outlet.

2. Alternate DC power sources such as a 12 V automobile battery can also be used when AC power isn't available. Adapters for use with alternate power sources are available from NMT.

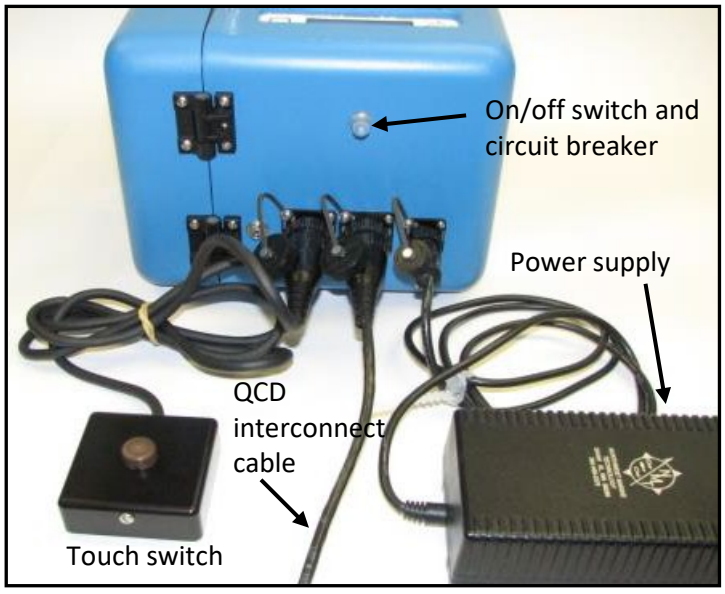


Figure 2: Back view of the MKIV Injector

3. Connect the cable from the power supply to the 4-pin connector on the back of the Injector.

4. Attach the cable from your touch switch or foot switch to either of the two large connectors on the back of the Injector.

5. If you are using a QCD, connect it to the other large connector on the back of the injector (Figure 3). See (Quality Control Device (QCD), page 37) for more information about setting up your QCD.

The two large connectors on the back of the Injector are interchangeable. Keep the protective caps closed on any unused connector(s).

WARNING! To avoid damaging the electronics, do not connect the QCD while the Injector is turned on.

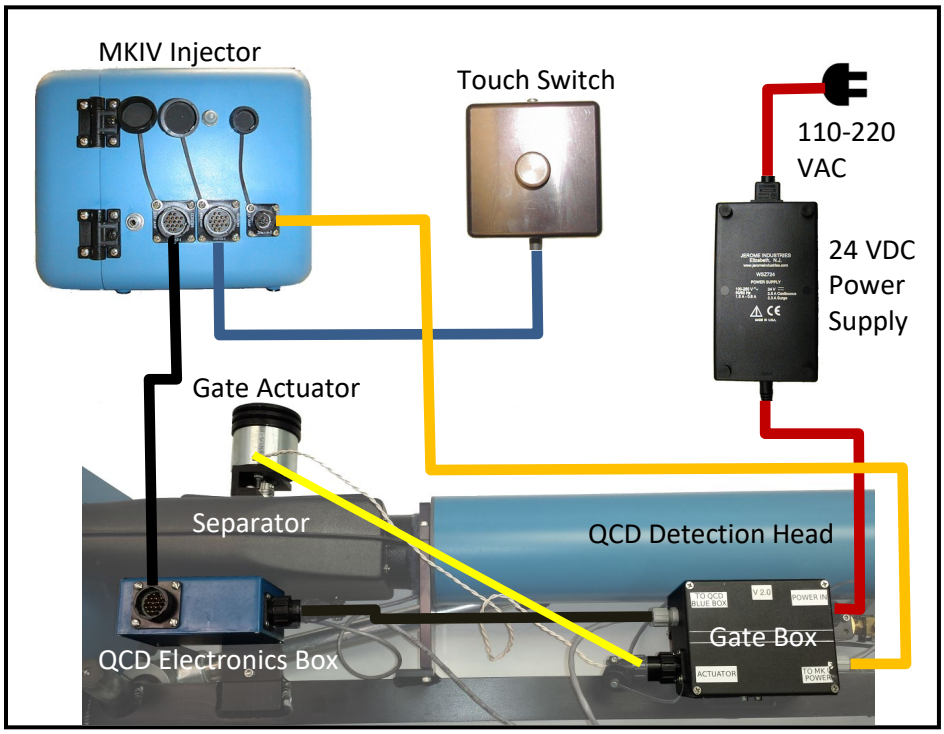


Figure 3: Cable connections for a mechanical gate QCD.

3 Quick Start

After the equipment is assembled, follow the steps on the next pages for initial testing and familiarization. These steps confirm that the equipment is operating and ready for the remaining adjustments. Completing these steps does not mean that everything is ready for tagging.

Figure 4: MKIV Injector main plate. shows the parts on the Injector main plate with the door open.

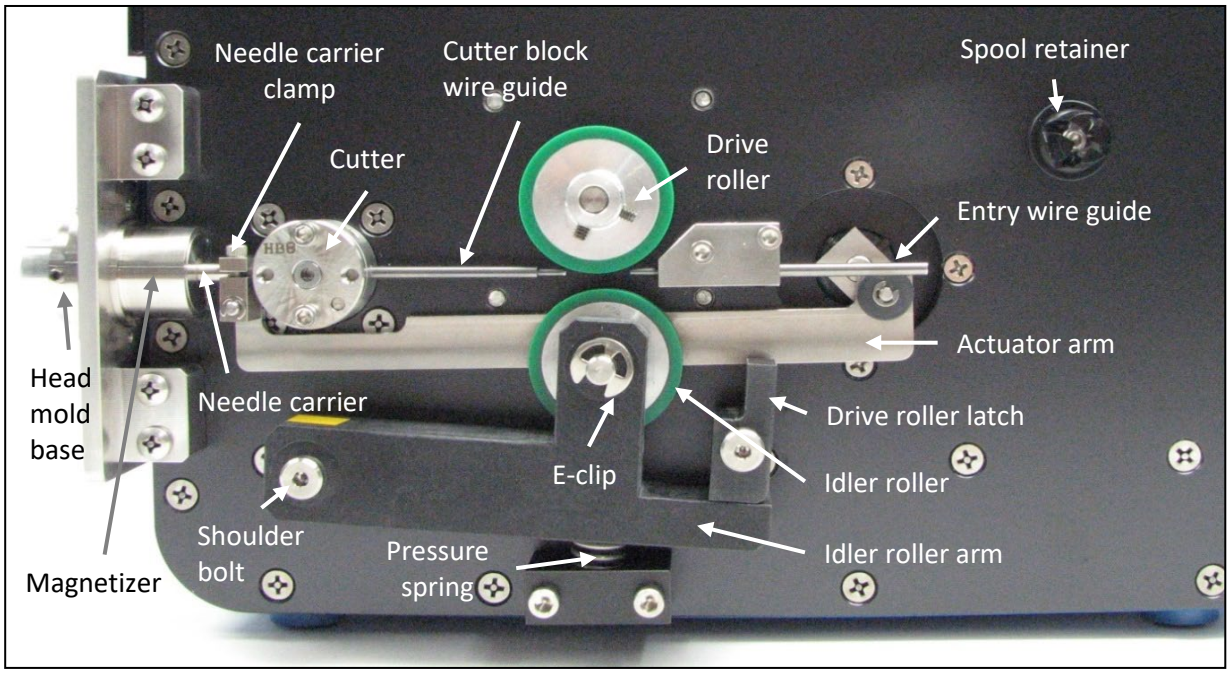
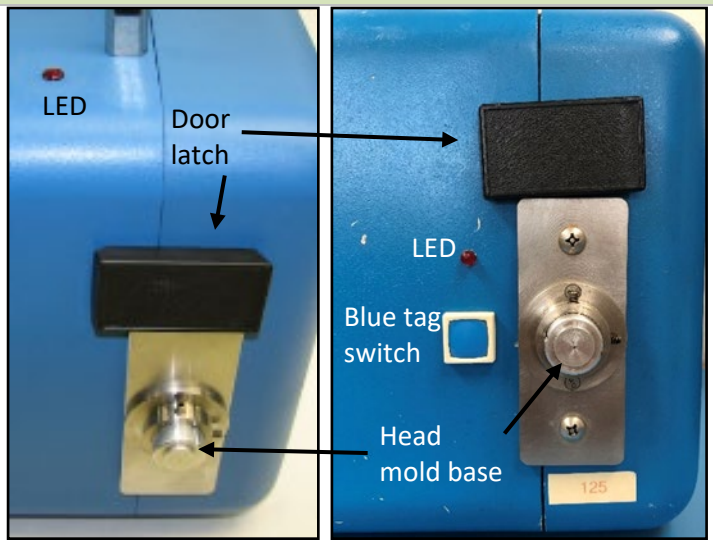


Figure 4: MKIV Injector main plate.

Step 1		
Open the latch on the front of the Injector (Figure 5) and swing the door open.	 **Figure 5: Front of MKIV Injector, AutoFish version left, standard version, right.**	
Step 2		
Turn on system power by pressing the rubber-covered On/Off button on the back of the Injector (Figure 2). A self-test sequence will take place and the display will show a "READY VX.X" message where “X.X” is the firmware version.	If the display shows the message "NO QCD OK?" and: (1) If a QCD is connected, check to make sure the QCD Interconnect Cable is properly installed. Or: (2) If you are not using a QCD, press any key on the keyboard to confirm this status and clear the message.	The Injector has a built-in circuit breaker and protective fuse. If the circuit breaker is tripped, the Injector will shut off. The circuit breaker will automatically reset after about 1 minute. If the circuit breaker does not reset, the internal protective fuse is most likely blown and the Injector must be returned to NMT for servicing.
Step 3		
The Injector is shipped with a spool of test wire installed. If there is not a spool of wire on the machine, install one on the spool retainer before proceeding.	The MKIV Injector ships with a 2.5 inch needle installed which is protected by a head mold base. If a needle is not installed or a 3.5 inch needle is required, see Needle Installation, page 54.	

Step 4

Locate the idler roller arm and move the drive roller latch so that the rollers are engaged (Figure 6).

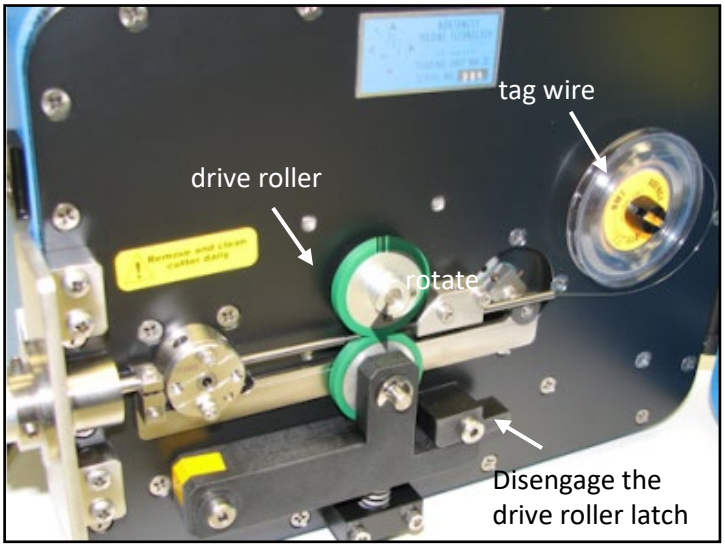


Figure 6: Loading tag wire.

Step 5

Load the tag-wire by pressing [LOAD] (page 25) on the keyboard. The display will show “LOAD 100" and the drive rollers can be rotated easily by hand. The Injector may make a hissing sound -this is normal.

Step 6

Insert the tag-wire into the entry wire guide and push it forward until it reaches the drive rollers.	Turn the top roller clockwise to feed the wire into the cutter block wire guide (Figure 6) until the tag wire extends slightly past the needle tip.

Step 7

Press the **[OK]** key. The Injector will retract and cut the tag wire. Press the Touch Switch button, the **[TAG]** key, or the blue tag switch on the front of the Injector if equipped (Figure 5, page 12) to cycle the injector once. The first piece of wire ejected will be longer than a standard tag. Cycle the injector a few times to see how it operates and confirm the Injector is making the proper length tags. Each cycle will produce one tag.	If a QCD is attached, the red error light and tone will be activated as determined by the Item: TAG CREDIT value (page 35). This indicates that tagged specimens are not being detected by the QCD, and is normal for this sequence.

4 Getting Ready to Tag

Before tagging, please read NMT's Coded Wire Tag Project Manual, available at www.nmt.us for a comprehensive overview of coded wire tagging projects and appropriate setups for a variety of species and environments.

The following MKIV Tag Injector adjustments need to be checked before tagging:

- Needle selection (page 15)
- Needle positioning jig selection (for example a head mold) (page 16)
- Tag Length (page 17)
- Common Menu Settings (page 19)
- Needle Penetration (page 19)
- Tag Placement Depth (page 20)

If you are using a Quality Control Device (QCD) you will also check or adjust:

- Water flow and General Assembly (Mechanical and Water Jet Versions) (page 39)
- Separator (Water) Jet Adjustments (water jet version only) (page 44)
  or
- Mechanical Diverter Gate Assembly (mechanical gate version only) (page 41)
- Item: QCD DELAY (page 33)
- Item: QCD THRESHold (page 31)

4.1 Needle Selection

Four needle styles (Figure 7) are offered for the MKIV Tag Injector:

- 2.5 inch (63.5 mm), etched or non-etched
- 3.5 inch (89 mm), etched or non-etched

Non-etched needles do not have a reduced outside diameter near their tip, making them better suited for larger animals or tagging into tougher tissue because of their added strength. Etched needles have a reduced outside diameter near the tip, making them better suited for smaller animals, where a smaller incision is required or for tagging into soft tissue. The trade-off with etched needles is reduced strength in the tip.

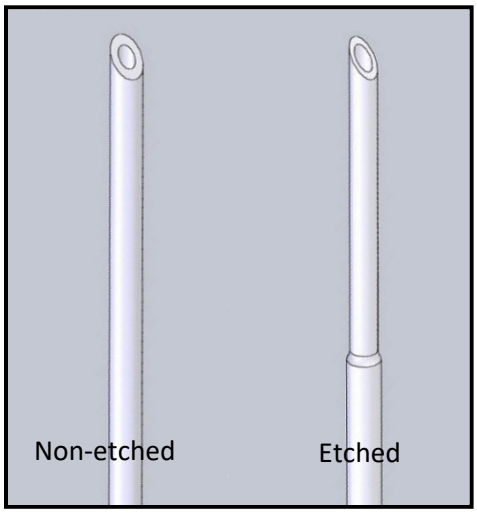


Figure 7: Needle styles

4.2 Needle Positioning Jig Selection

The most common type of positioning jig used with a MKIV Tag Injector is the head mold (Figure 8). NMT sells head molds for a wide variety of size and species fish (see Table 1). A custom head-mold kit is also available from NMT to allow the end user to create unique head molds.

Table 1: NMT stock head mold sizes.

Species	Head Mold Size (fish/lb); *CMS=Closed Mouth Style*
Coho/Chinook	5, 10, 15, 20, 30, 45, 65, 90, 120, 200, 300 (*CMS*), 550, 1100
Steelhead (Rainbow)	2(5), 3(8), 5(12), 7(18), 11(27), 20(50), 36(90), 80(200)
Pink	2000 (*CMS*)
Atlantic Salmon	7, 9, 11, 15, 25, 30, 50, 100, 120
Lake Trout	5, 8, 12, 18, 27, 50, 90
Chum	700
	Head Mold Size (length in mm); *CMS=Closed Mouth Style*
Sockeye	60 (*CMS*), 90
Walleye	55, 65, 125
Mullet	60-70, 70-80, 100, 120, 140
Paddlefish	Not size designated, but for ~ 6 inch fish

Tagging can be done without a positioning jig. Many fishes, crustaceans, and other animals have tag locations which don't need or aren't conducive to, the use of a positioning jig. The operator would manually impale the specimen on a non-moving needle (see Item: NEEDLE MOVe, page 32) and then inject the tag. Without a jig, is still desirable to have some depth control so that you know how much of the needle has penetrated the specimen. The needle support tube (available as an accessory) makes a good depth stop.

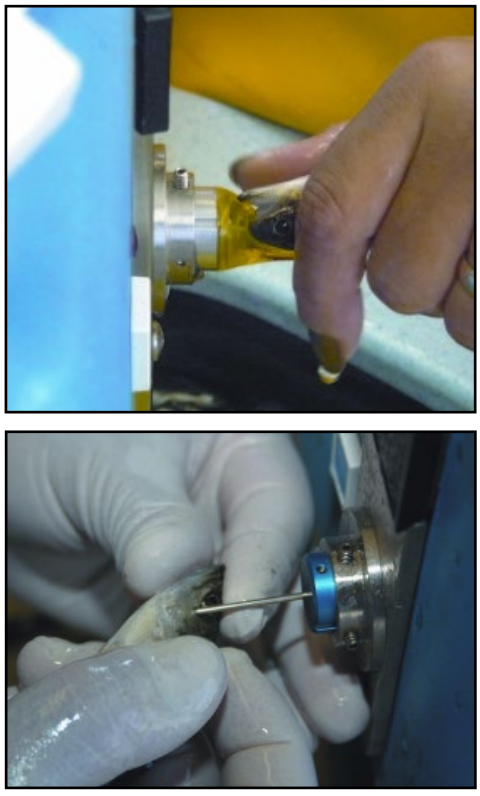


Figure 8: Positioning jigs – tagging with a head mold (top) and with a needle support tube (bottom).

4.3 Tag Length

There are two ways to set the tag length of the Injector:

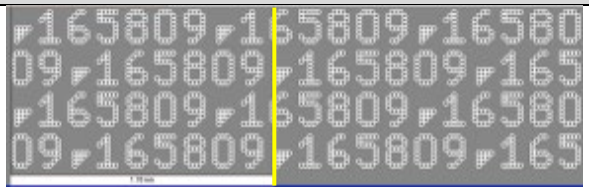
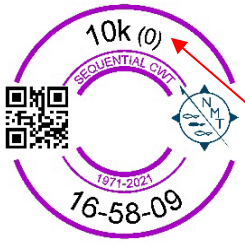
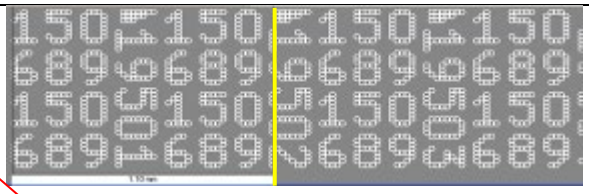
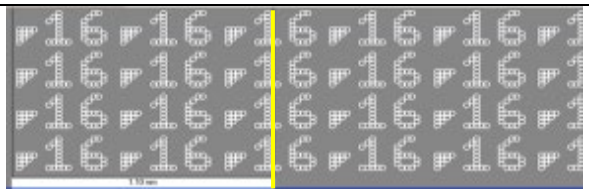
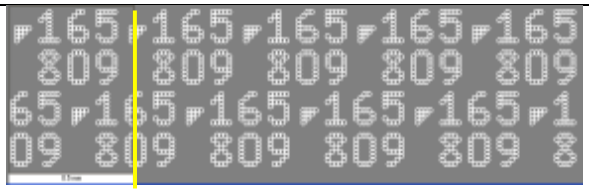
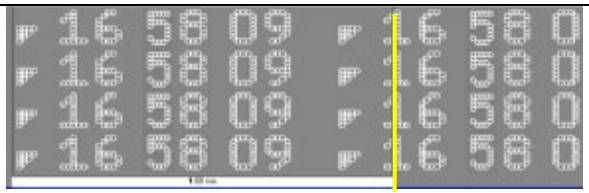
1) Under Item: SETUP (page30) in the Adjustment menu (ADJ), select *Standard* (otherwise known as single length tags), *Half, 1 ½,* or *Double*.

Using the TagLength option will automatically display Special if other options, for example Needle Move, are changed in the Adjustment menu. You can also store 2 different adjustment settings using Custom1 and Custom2.

2) Choose the appropriate tag length in the Adjustment menu under the option Item: TAG LENgth (page 30).

If the MKIV Tag Injector is set up to cut tags SHORTER than that specified on the spool, then the code(s) will be unreadable.

Table 2: Coded Wire Tag formats

CWT format and MKIV Injector setting	Spool label	Layout: If a 2 mm piece of wire were unrolled and magnified, it would look like this. The yellow bars show where tags of each format might be cut by the injector.
Standard CWT: TAG LEN [SGL] **or** SETUP [STANDARD]		 The top number indicates the number of tags on this spool (10,000 in this example).
Sequential CWT: TAG LEN [SGL] **or** SETUP [STANDARD]		 Starting sequence number is in brackets
Agency CWT: TAG LEN [SGL] **or** SETUP [STANDARD]		
½ Length CWT: TAG LEN[1/2] **or** SETUP[HALF]		
1 ½ Length CWT: TAG LEN[1 1/2] **or** SETUP[1 1/2]		

4.4 Common Menu Settings

4.4.1 Using a head mold and 2.5 inch needle

- Item: SETUP [STANDARD/HALF/1 1/2] (page 30)
- Key: [SHOW] [96] (page 26)

4.4.2 Using a needle support tube and a 3.5 inch needle

- Item: SETUP [SPECIAL/CUSTOM 1/CUSTOM 2] (page 30)
- Item: NEEDLE MOVe [NO] (page 32)
- Item: STOP [1] (page 31)
- Key: [SHOW] [171] (page 26)

4.4.3 Using a needle support tube and a 3.5 inch needle (alternate)

This setup is recommended over no Needle Move (section 4.4.2) and Stop 1 if poor tag retention is an issue.

- Item: SETUP [SPECIAL/CUSTOM 1/CUSTOM 2] (page 30)
- Item: NEEDLE MOVe [S5-S23] (page 32)
- Item: STOP [2], the needle starts in the extended position (page 31)
- Item: MIN. TIME [0-255] (page 33)
- Key: [SHOW] [172-180], dependent on the amount of Needle Move (page 26)

4.5 Needle Penetration

Needle penetration refers to the depth the needle will penetrate the specimen. Proper penetration depth is very important for tag retention and depends on the size and species of the specimen being tagged. Penetration depth is controlled with a head mold or positioning jig.

To set the needle penetration depth, put the Injector in SHOW mode to move the needle to its fully extended position. Loosen the set screws in the head-mold holder and slide the appropriate head mold or needle positioning jig in or out to adjust the distance the needle will extend into the specimen. Gently tighten the set screws to hold the head mold in place.

4.6 Tag Placement Depth

Tag placement depth refers to the position of the tag with respect to the tip of the needle. Tag placement depth can be estimated by measuring the distance from the end of the wire to the surface of the head mold while the Injector is in *SHOW* mode (see Key: [SHOW], page 26). In all cases correct tag placement depth must be confirmed by dissection of tagged test specimens. Figure 9 shows the preferred placement for Coded Wire Tags in salmonids.

There are instances when the tag must be extended beyond the tip of the needle, and other cases when the tag should not be extended beyond the tip of the needle. Examples of these cases are given below.

Tag placement depth beyond the tip of the needle: If the tag implantation site does not lend itself to the use of a head mold, you may wish to manually impale the specimen on a non-moving needle. Since the needle will not be retracting to leave the tag in the specimen, the tag must be pushed past the tip of the needle. The approximate SHOW value using a standard length needle with "NEEDLE MOVe (NO)" is 78.

In SHOW mode, the tip of the uncut tag wire will move to the same position as the leading end of the tag at implantation. Thus, the end of the uncut tag wire represents the tag's deepest point of penetration.

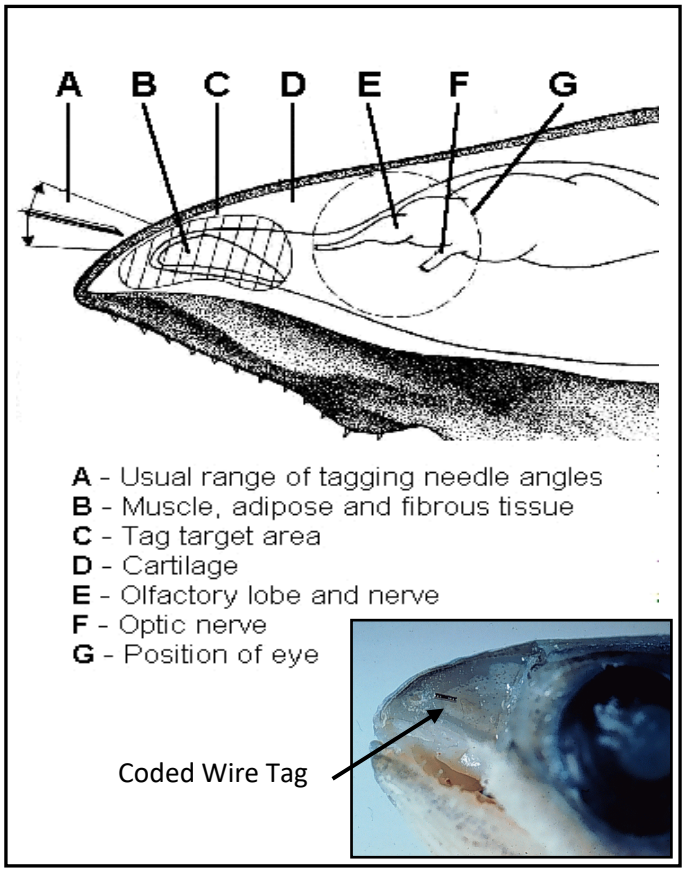


Figure 9: Typical Coded Wire Tag placement for salmonids.

Tag placement depth behind the tip of the needle: Whenever the target area is very hard (e.g., the head of steelhead trout), trying to inject the tag into tissue which has not been penetrated by the needle will cause a wire jam or slippage of the drive rollers. In this case, use a tag placement depth which does not extend any part of the tag beyond the tip of the needle. This way the needle can penetrate the hard tissue and, upon retracting, leave the tag in the target area.

NMT's Coded Wire Tag Project Manual (available for download at www.nmt.us) has more details about correct tag placement.

4.7 Final Check

As a review, see that the following items have been considered and checked before tagging.

- Proper spool of wire is loaded.
- Tag length set corresponds to tag format (Table 2: Coded Wire Tag formats).
- Tag target chosen for specimen.
- Head mold or positioning fixture and injection technique determined.
- Needle penetration and tag placement depth set and tested.
- QCD water flow and mechanical gate (or jet position) adjusted.

5 Configuration

5.1 Keyboard

The keyboard is used to make nearly all operating adjustments and to obtain system information (Figure 10). All items displayed when using the keyboard are kept in circular lists. After the last item is displayed, the first item is displayed again. This section describes each key, its function, and corresponding displays/options.

Explanations of the keyboard and its functions use the following conventions:

[ ]	Names of keys are shown in square brackets.
" "	Display messages are shown in quotes.
( )	Changeable values are shown in parentheses.

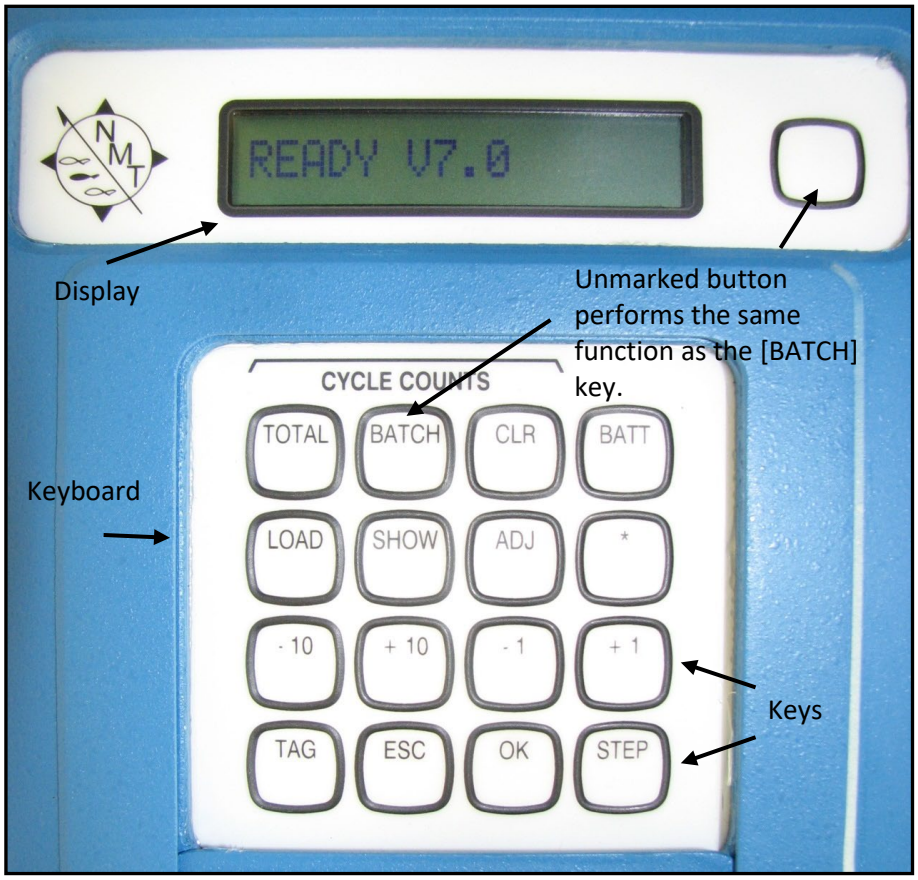


Figure 10: Display and keyboard.

5.1.1 Key: [TOTAL]

Purpose	Operation	
Display the non-resettable counts of Injector cycles and QCD activations. These counts are retained for the life of the Injector, even with the power off. They are useful for maintenance records on items such as cutters, drive rollers, and needles.	Press **[TOTAL]** to toggle between:	"T INJ x" where x is the total Injector cycles ⇩ “T QCD x” where x is the total QCD activations

5.1.2 Key: [BATCH]

Purpose	Operation	
Display the resettable counts of Injector cycles, QCD activations, and the net difference, called rejects, between the two. Batch may be used to keep track of items such as tags per hour, day, group, etc. The unlabeled key next to the display functions identically to the [BATCH] key, and can be used with the keyboard cover closed. To reset the batch counts, use the [CLEAR] key.	Press [**BATCH**] to toggle between:	"T INJ x" where x is the number of Injector cycles ⇩ “QCD x” where x is the number of QCD activations ⇩ "REJ x" where x is the number of rejects (“INJ x” – “QCD x”).

5.1.3 Key: [CLeaR]

Purpose	Operation	
Reset all batch counts to zero. The CLEAR function only operates when the BATCH counts are displayed.	Press **[BATCH]**	displays the batch counts.
	Press **[CLEAR]**	displays "OK TO CLR CNTS?”
	Press **[OK]** **or** Press **[ESC]**	clears the batch counts **or** cancel clearing the counts

Pressing [OK] to affirm a choice or pressing [ESC] to decline is common throughout the MKIV menu system.

5.1.4 Key: [BATTery]

Purpose	Operation	
Displays the approximate DC input voltage at the Injector. This function can be used to monitor the performance of the power source. Input voltage should be between 12 and 28 VDC when the injector is idle.	Press **[BATT]**	displays 'BATT XX.X" which is the input voltage If the voltage drops below 11.5 Volts a “POWER LOW” error message will appear.

5.1.5 Key: [LOAD]

Purpose	Operation	
Sets the Injector into position for loading tag wire and installingthe needle carrier, actuator arm or needle. Pressing **[LOAD]** aligns the cutter, retracts the actuator arm and releases the drive rollers so they can be turned by hand. The Injector may make a hissing sound when in *LOAD* mode. This is normal.	Press **[LOAD]**	displays "LOAD 100" and the Injector is ready for loading tag wire or installing the needle carrier and needle.
	Press **[ESC]** **or** Press **[OK]**	exits the *LOAD* mode without moving the tag wire **or** exits the *LOAD* mode, retracts and cuts the tag wire to prepare for tagging

When **[OK]** is used to exit *LOAD* mode, the Injector assumes the wire is extended to the tip of the needle and retracts and cuts the tag wire. The Injector must be cycled once by pressing the **[TAG]** key to eject the first piece of wire because it is longer than a normal tag.

When **[ESC]** is used to exit *LOAD* mode, the Injector assumes the position of the tag wire should not be changed and so the tag wire is not moved. A common use for **[ESC]** instead of **[OK]** to exit *LOAD* is when installing a new needle/needle carrier in an Injector with wire already loaded.

Using [OK] to exit the LOAD mode if the wire is not at the tip of the needle will cause the wire to retract too far resulting in a “NO WIRE OR STUCK” message.

5.1.6 Key: [SHOW]

Purpose	Operation	
Allows the operator to set the position of the tag with respect to the tip of the injection needle. In *SHOW* mode, the tip of the uncut tag wire will move to the same position as the leading end of the tag during injection. Thus, the end of the uncut tag wire represents the tag's deepest point of penetration.	Press **[SHOW]**	displays "SHOW (XX)" and the Injector cycles to extend the tag wire to represent the tag's deepest point of penetration
	Press **[OK]**	opens the brackets on the value
	Press **[+1]** or **[-1]** **or** Press **[+10]** or **[-10]**	increases or decreases the tag placement depth by 1 unit **or** by 10 units 1 unit = 0.01 inches (0.25 mm)
	Press **[OK]** **or** Press **[ESC]**	saves the new SHOW value discards new SHOW value
	Press **[ESC]**	if pressed after [OK] exits the SHOW mode

While in SHOW mode, the [TAG] and [STEP] keys can be used to activate the QCD so that the mechanical gate or water jets in the separator can be observed and/or adjusted. Pressing [TAG] activates the actuator or solenoid one time by turning it on and off. Pressing [STEP] toggles the actuator or solenoid between on and off.

5.1.7 Key: [*]

Purpose
(1) Clear serious error messages before resuming operation of the Injector. (2) Store settings for CUSTOM 1 and CUSTOM 2 (see Item: SETUP, page 30).

5.1.8 Key: [-10], [+10], [-1], [+1]

Purpose	Operation
Select different menu options and set values for operating parameters.	Press **[+1]**or**[-1]** to select different menu options and make small changes in numerical values **or** Press **[+10]** or **[-10]** **or** to make large changes to numerical values

5.1.9 Key: [TAG]

Purpose
(1) Cycles the Injector when the Injector is on and not in either SHOW or LOAD mode. You can also cycle the Injector by pressing a touch switch, foot switch, or the blue button on the front of a manual Injector. (2) Activates the QCD actuator or solenoid as if a tagged specimen had been detected when the Injector is in the SHOW mode. For more information refer to Key: [SHOW] (page 26).

5.1.10 Key: [ESCape]

Purpose
(1) Pressing **[ESC]** reapplies the brackets and reinstates the previously stored value when making changes to a menu item. (2) When a menu item or value is displayed with the brackets in place, pressing [**ESC]** will return the Injector to the READY to tag mode.

5.1.11 **Key: [OK]**

Purpose	Operation	
Store a menu choice or value selected by the operator, or instruct the Injector to proceed. The effect of the **[OK]** key depends on when it is used.		
1. Use the **[OK]** key to clear batch counts	Press **[CLEAR]**	displays "OK TO CLR CNTS?"
	Press **[OK]**	clears the batch count
2. Use the **[OK]** key to exit *LOAD* mode	Press **[LOAD]**	displays "LOAD 100" and the Injector is ready for loading tag wire or installing the needle carrier and/or needle
	Press **[OK]**	exits LOAD mode, retracts the tag wire 6.5 cm and cuts the wire
3. Use the **[OK]** key to select menu items	Press **[ADJ]**	displays menu choices
	Press [**+1**]or**[-1]**	selects menu item
	Press **[OK]**	removes brackets from item
	Press **[+1]**or**[-1]**	changes item or value
	Press **[OK]**	restores brackets and stores new value

5.1.12 **Key: [STEP]**

Purpose	Operation	
1. Execute, in order, the steps of a complete injection cycle. Use the **[STEP]** key to observe which action takes place at each point and for diagnostic purposes.	Press **[STEP]**	the Injector will proceed to the next step in the tag injection cycle
	Press **[TAG]** at any time	exit STEP mode
2. Activate and deactivate the QCD actuator or solenoid when the Injector is in SHOW mode. This is useful in adjusting the mechanical gate or water jets.	Press **[SHOW]**	displays "SHOW **[XX]**"
	Press **[STEP]**	turns the QCD solenoid on and holds it on
	Press **[STEP]**	turns the QCD solenoid off
	Press **[ESC]**	exits SHOW mode

5.1.13 **Key: [ADJustment]**

Purpose	Operation	
View and adjust a number of operating parameters for the MKIV Tag Injector. The procedure for viewing, selecting, and storing values is the same for all items. Each menu item is initially displayed as a caption at the left of the display, and a description or value in brackets at the right. Items in the *ADJustment* menu follow. See Appendix C: Adjustment Menu, page 91 for a summary.	Press **[ADJ]**	displays "[SETUP (STANDARD)]" The brackets signify that the item is closed and the value cannot yet be changed.
	Press **[+1]** or **[-1]**	moves one menu item up or down the list to find the desired item
	Press **[OK]**	removes the brackets and open the item for changes
	Press **[+1]**,**[-1]**,**[+10]**, or **[-10]**	selects alternative operating parameters or values
	Press **[OK]** or Press **[ESC]**	saves changes or discards changes
	Press **[ESC]**	exits the *ADJustment* menu
	Example:	
	Press **[ADJ]**	displays "SETUP (STANDARD)"
	Press **[-1]**	displays "US-EUR (X,XXX.X)"
	Press **[-1]**	displays "TAG CREDIT (X)"
	Press **[-1]**	displays "CUT EDGE (1)"
	Press **[OK]**	displays "CUT EDGE 1", brackets removed, item open.
	Press **[+1]**	displays "CUT EDGE 2"
	Press **[OK]** **or** Press **[ESC]**	displays "CUT EDGE 2", brackets restored, new value saved or displays “CUT EDGE (1)” brackets restored, old value restored
	Press **[ESC]**	exits the *ADJust*ment menu

5.2 Adjustment Menu

5.2.1 Item: SETUP

Options: STANDARD, 1½, DOUBLE, CUSTOM 1, CUSTOM 2, SPECIAL, HALF EZ, HALF.	
Purpose	Operation
Selects a pre-defined set of operating parameters, or is used to set and save a customized set of operating parameters. Selecting a different SETUP does not change the settings for QCD BEEP, QCD DELAY, CUT EDGE, TAG CREDIT and US-EUR.	STANDARD, 1½, DOUBLE, HALF EZ, HALF: Selecting one of these pre-defined setups automatically sets TAG LENgth, WIRE, QCD THRESHold, NEEDLE MOVe and MIN. TIME to the values shown in Appendix D: Setups (page 87). An * is displayed to the left of these menu items as a reminder that they are changed when selecting a different SETUP option. CUSTOM 1, CUSTOM 2: These options are used to select and save a set of customized parameters. To define a custom setup: 1) Set the desired values for each operating parameter in the SETUP function (those items which have a * to the left on the display). 2) Select the SETUP menu item, press **[OK]** to open it, and use **[+1]** or **[-1]** to choose CUSTOM 1. 3) Press the **[*]** key. The display will show "NEW CUSTOM 1?" 4) Press **[OK]** to save the current adjustment values as CUSTOM 1. CUSTOM 2 is set up in the same way. SPECIAL: Any change made to the *ADJustment* menu items used by the predefined setups, without using the predefined setups, will automatically show as "SETUP(SPECIAL)".

5.2.2 Item: TAGLENgth

Options: 1/2, SGL, 1 ½, DBL	
Purpose	Operation
Sets the tag length. A standard/single ("SGL") length tag is 1.1 mm (0.042 in) long. All other tags lengths are described with respect to a standard tag. Thus, a ½ length tag is 0.5 mm (0.021 in) long and a 1 ½ length tag is 1.7 mm (0.063 in) long.	Which tag length to use is based on specimen size, tag code format, and recovery detection method. The standard (SGL) length tag is suitable for most applications. Longer tags are easier to read and easier to detect magnetically, but may be too large for small animals. HALF tags, which are used in the smallest animals, are not as easy to detect and not all coding formats (e.g. sequential) are available in the half-length format. If the tag length of the MKIV Injector is set to cut tags SHORTER than the format specified on the spool, then the tag code will be unreadable.

5.2.3 Item: Wire

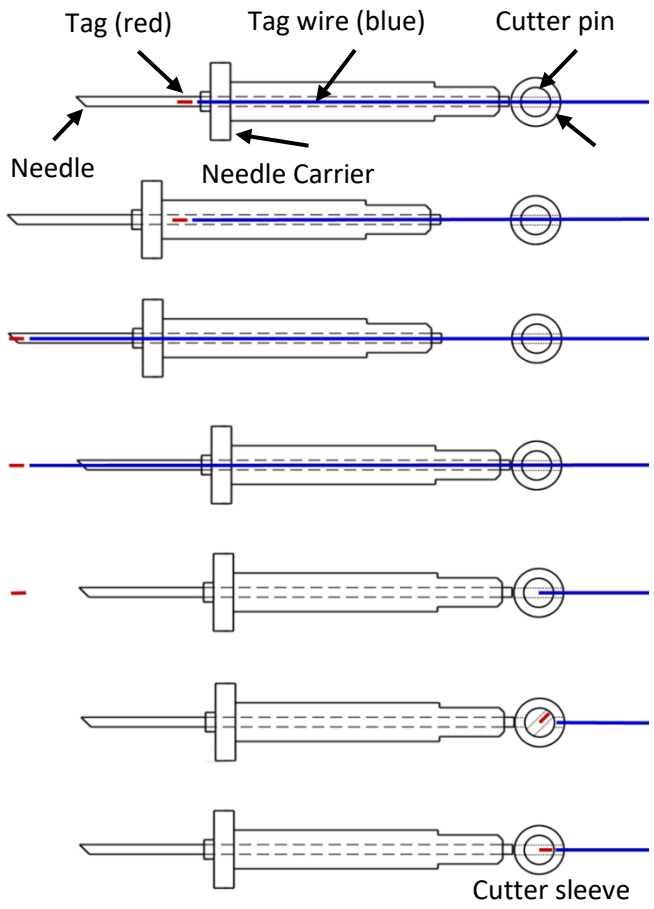
Options: NORMAL, EZ-FIND, NON STD, MAG OFF	
Purpose	Operation
Controls the electronic magnetizer.	This item should **always be set to NORMAL**. EZ-FIND and NON STD are reserved for future use. MAG OFF turns off the electronic magnetizer and is not recommended. If you turn off the magnetizer, the tags will NOT be electronically detectable in the specimen.

5.2.4 Item: QCD THRESHold

Options: 0 through 255	
Purpose	Operation
Sets the detection sensitivity of the Quality Control Device (QCD). The lower the value, the smaller the magnetic signal required to activate the QCD. Since a half-length tag generates a smaller magnetic signal than a standard or longer tag, a lower THRESHOLD value is necessary to detect half-length tags.	The default QCD threshold setting is 50 for a standard length tag and 20 for a half-length tag. Tags in the transverse orientation are harder to detect, so a threshold of 15-20 is recommended for standard length tags. Setting the THRESHOLD too high will miss tags. Setting the THRESHOLD too low may cause the QCD to be activated by tags that are weakly magnetized and will be difficult to detect during tag recovery, or by external sources of magnetic interference. When setting THRESHOLD, you can leave the brackets open while trying different values. The value displayed is active. Restore the brackets by pressing [OK] to retain changes or [ESC] to discard changes.

5.2.5 Item: STOP

Options: 0 through 7	
Purpose	Operation
A complete cycle of the MKIV Tag Injector has seven sequential “stops”. By changing the STOP number, the operator can select any point in the cycle as the place where the Injector will start and finish each time a tag is injected.	STOP [1] - The needle begins at the “Stop 1” position shown in Figure 11. When **[TAG]** is pressed, the needle moves forward into the specimen and the tag is inserted. STOP [2] - The needle begins at the “Stop 2” position shown in Figure 11. The specimen has the needle inserted into it, **[TAG]** is pressed, the tag is placed, and then the needle retracts out of the specimen. Use the MIN TIME option to adjust the time that the needle stays retracted. STOP (0, 3-7) – These stops are for diagnostic purposes and not recommended for tagging. "STOP (0)" cycles the injector continuously until the **[TAG]** key is pressed again.



Stop 1: The needle/needle carrier is back and tag is magnetized and ready for insertion.

Stop 2: The needle/needle carrier goes forward to a distance set by NEEDLE MOVe.

Stop 3: The tag is pushed forward to a distance set by SHOW.

Stop 4: The needle/needle carrier is retracted.

Stop 5: The uncut tag wire (blue) is retracted leaving the tag behind.

Stop 6: The cutter pin rotates up or down as set by CUT EDGE. A new tag is cut.

Stop 7: Cutter pin rotates back and the new tag is ready to be moved forward by the tag wire.

Figure 11: Stops of a MKIV Tag Injector cycle

5.2.6 Item: NEEDLE MOVe

Options: MAX, NO, S1 - S49	
Purpose	Operation
This item sets how much the Injector needle moves during the tagging cycle. The show value (Key: [SHOW]; page 25) must be changed when the NEEDLE MOVe is changed.	NEEDLE MOV(MAX) – The needle travels to its full extent (Stop 2). Most common when using a head mold. NEEDLE MOV**(**NO) – The needle does not move during the tagging cycle. Most common when no head mold or jig is being used. NEEDLE MOV(S1-S49) - Adjusts the amount of needle movement in 0.1 mm increments. For example, setting this option to S12 would result in the needle moving forward about 1.2 mm.

Table 3: Common Show values

2.5" needles		3.5" needles	
Needle Move	SHOW	Needle Move	SHOW
No	78	No	171
MAX	96	MAX	193

5.2.7 Item: MIN. TIME

Options: 0 through 255	
Purpose	Operation
Allows the operator extra time to remove the specimen before the needle returns to the extended position while using a **STOP [2]** item setting.	This function introduces a delay into the injection cycle between Stop 1 and Stop 2. Each unit is equal to 0.01 second (10 msec).

5.2.8 Item: QCD BEEP

Options: 0 through 5
Purpose
To select the alarm tone for the Injector and QCD.

5.2.9 Item: QCD DELAY

Options: 20 through 150	
Purpose	Operation
To set the amount of time the QCD gate actuator or water jet solenoid remains on. The QCD DELAY setting does not determine when the water jet comes on, only how long it stays on after a tag is detected.	Each unit is equal to one hundredth of a second (10 msec). The value should be high enough to sort the largest specimen while allowing the water jets or mechanical gate to turn off/close before the next specimen arrives at the separator.

5.2.10 **Item: CUT EDGE**

Options: 1 through 4 Purpose	Operation
Sets which of the four available edges on the cutter to use (Figure 12, see also Figure 33). Use CUT EDGE to select a new cutting surface when the existing edge is worn and no longer makes a clean cut.	**You do not need to remove the cutter to change the cut edge.** When changing between edges 1 or 2 and 3 or 4, the cutter must rotate 180 degrees. This rotation takes place during the next injection cycle. When removing the cutter, note the position of the index notch and replace it in the same orientation.

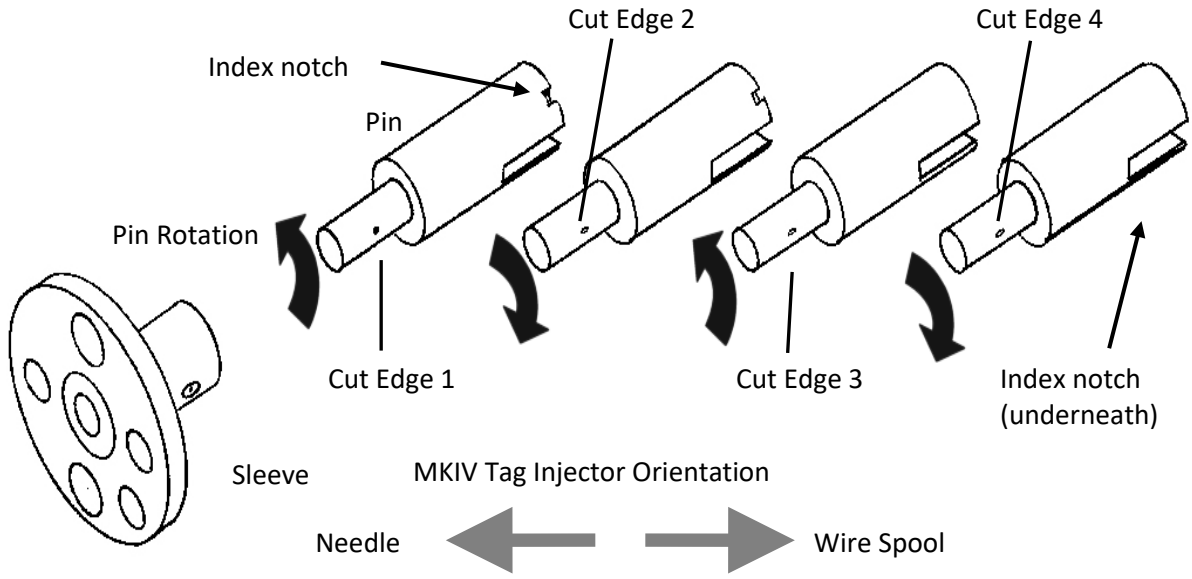


Figure 12: Cutter edges.

5.2.11 **Item: TAG CREDIT**

Options: 1 through 5	
Purpose	Operation
Sets the number of Injector cycles allowed without a corresponding QCD cycle before the missed tag alarm sounds. The TAG CREDIT setting does not change the QCD's detection and sorting performance. Increasing the TAG CREDIT value simply allows the operator to choose how many tags can be missed before the alarm sounds.	The default TAG CREDIT is (2). Reasons to set the TAG CREDIT to a larger value are: 1. You expect to have more than two specimens tagged before the first of those reach the QCD. 2. You prefer not to be alerted until more than a few tags have been missed.

5.2.12 **Item: US-EURopean**

Options: 0,000.0 or 0.000,0
Purpose
Sets the 1000 and decimal separator format according to the convention used in the United States or Europe. For example, 1 million = 1,000,000 (US) = 1.000.000 (EUR). This item does not affect performance.

6 Quality Control Device (QCD)

6.1 Overview

The QCD automatically detects and separates tagged from untagged fish. When connected to the MKIV, the QCD performs the following operations:

- Detects the magnetized tag.
- Separates tagged from untagged fish using a mechanical gate or water jets.
- The Injector counts tagged and untagged fish.
- Sounds the alarm when untagged fish are diverted (see Item: TAG CREDIT, page 35).

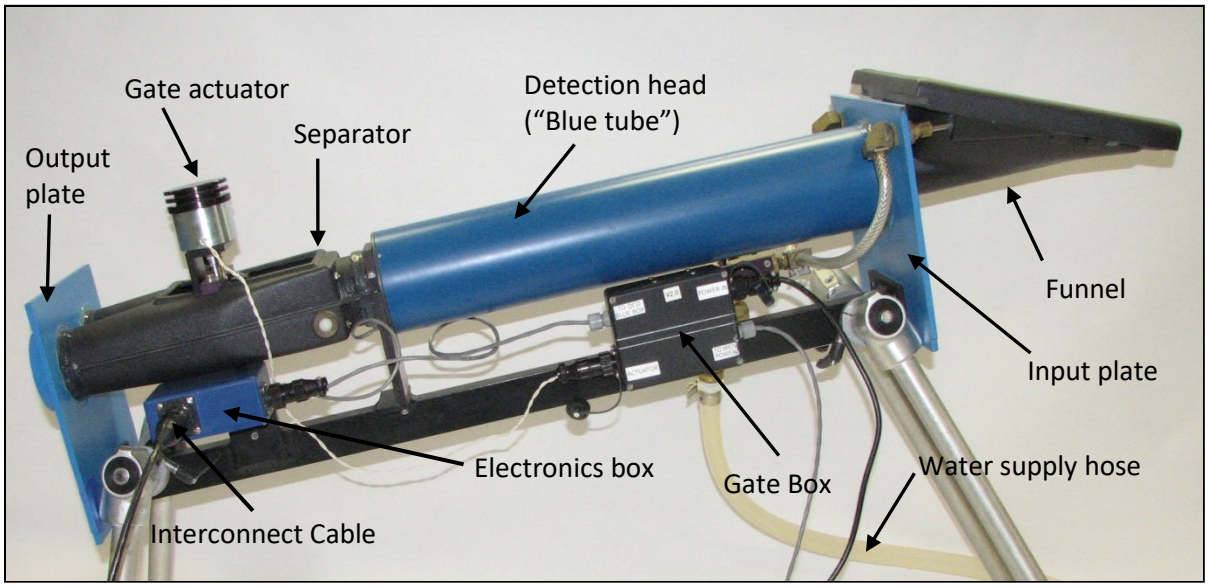


Figure 13: Quality Control Device (mechanical gate version, electronics box side).

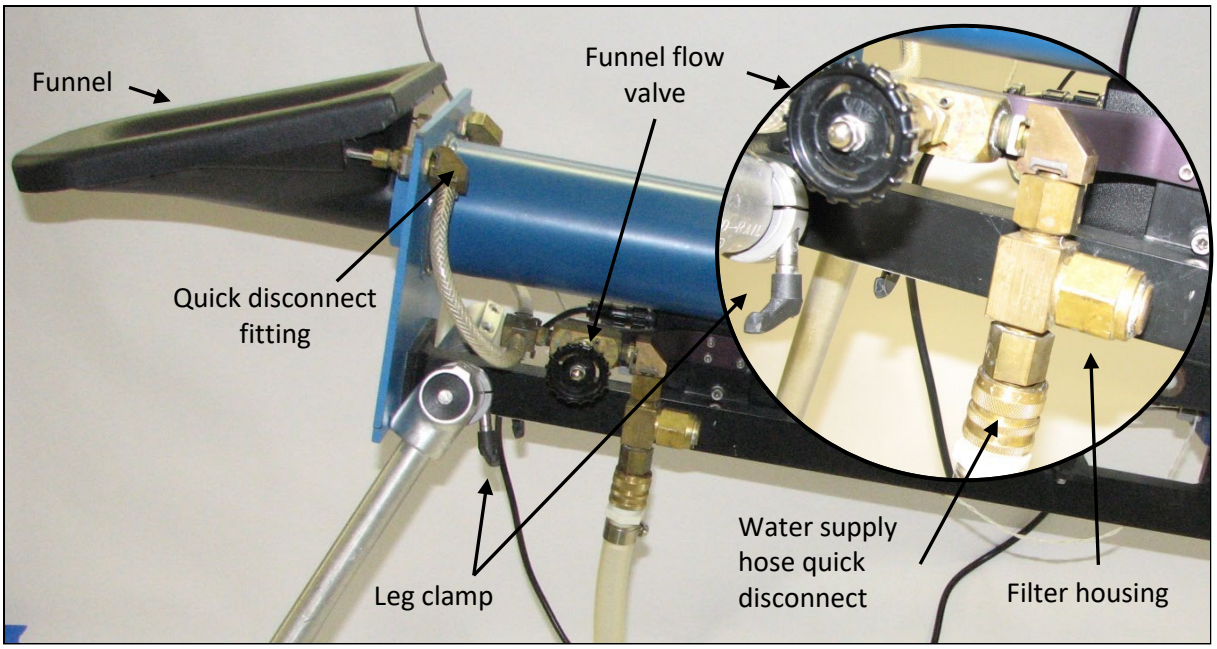


Figure 14: Quality Control Device (mechanical gate version, filter side).

Water flows into the funnel to carry fish through the QCD detector. Water jets or a mechanical gate in the separator are used to direct the fish to either the tagged or untagged outlet. When a tag is detected, the solenoid is activated and the gate actuator turns the gate-fin (or in the jet version, water flow is directed to the opposite water jet), directing the fish to the tagged outlet.

The QCD detects a magnetized tag in the fish as it passes through the detection head. Since untagged fish don't create a signal, the QCD cannot detect an untagged fish. Instead, the QCD and Injector work together to decide when an untagged fish has passed through the QCD. This is done by having each Injector cycle added to a memory buffer, and each tag detected by the QCD subtracted from the same buffer. When the net buffer value limit, as set by Item: TAG CREDIT (page 35) is exceeded, it is assumed that a tag was missed and the alarm sounds.

The QCD detects extremely small changes in the magnetic field that are caused when a tagged fish passes through the detector head. To prevent false signals, the QCD should not be moved or jarred during operation and should not be operated near sources of strong magnetic fields such as motors or generators.

> The effect of known sources of magnetic interference can be minimized by positioning the QCD detection head perpendicular to the source of the interference.

6.2 General Assembly (Mechanical and Water Jet Versions)

There are two versions of QCD's. The "Mechanical version" uses a fin with an actuator to divert tagged fish (Figure 13 and Figure 14). The "Water jet" version uses water jets with a solenoid to divert tagged fish in the separator (Figure 20 and Figure 21).

Step 1

Set up the legs:

1. Position the QCD upside down(open side of the cover facing up) on the floor or other flat surface.
2. Loosen the leg clamps (Figure 14) by turning the small black lever-style handle at the rotating joint between the legs and the QCD frame. Space is tight so the handles cannot always make a full turn. To help in this situation the handles have built-in clutches. Pull the handle out for free turning, allow the spring to pull it back in and it will operate the clamp.
3. Unfold the short legs and position them so they are about 2 mm (1/16 in) from the output plate (Figure 14) of the QCD. Unfold the long legs and position them so they are approximately 2 mm (1/16 in) from the input plate of the QCD. Tighten the leg clamps.
4. Turn the QCD upright and stand it on a level surface.

Step 2

Attach the QCD funnel to the corresponding connectors at the input end of the QCD (Figure 15). One of the two female quick disconnect fittings is loose in the input plate to make alignment of the funnel easier. Secure the funnel's fittings in place with the retainer clips. The top edge of the funnel should be approximately level. Adjust the legs if necessary.

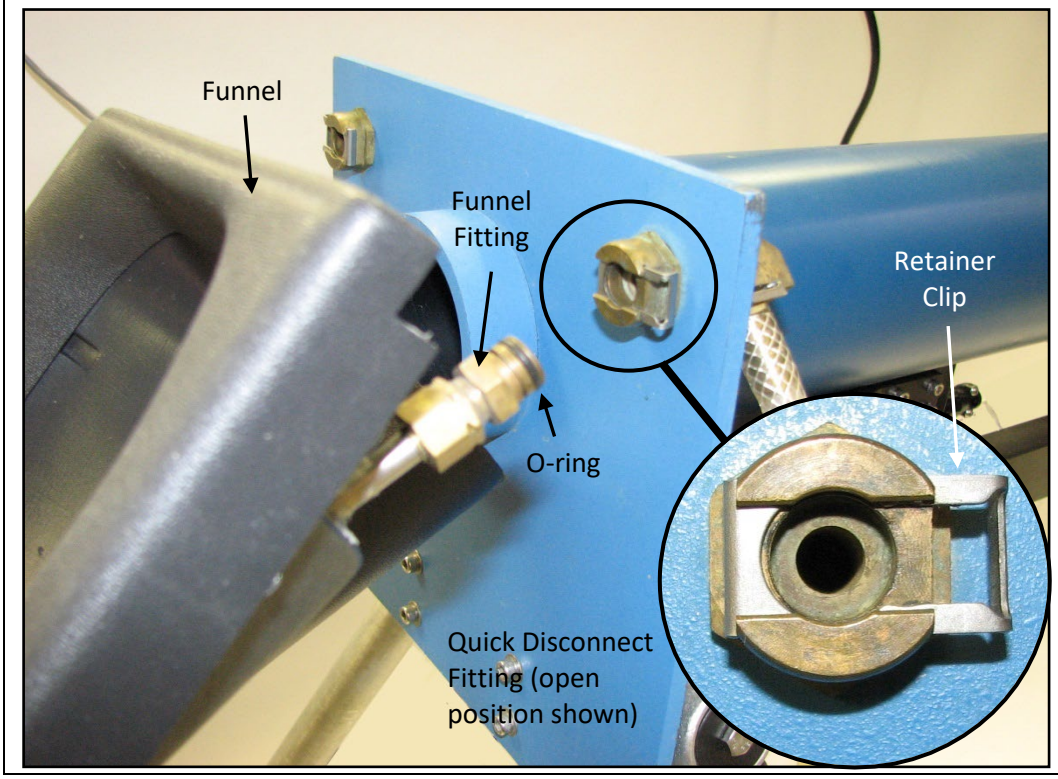


Figure 15: QCD quick disconnects.

Step 3

Find the water supply hose quick disconnect. Screw the threaded end of the connector onto a standard garden hose or other water supply. The other end has a sliding collar which connects to the QCD Filter Assembly (Figure 14 and Figure 46, page 65). The water supply should provide a flow of about 2 gal/minute (7.5 L/min) at 40 psi (3 kg/cm).

Many plumbing connections on the QCD use quick disconnect fittings held in place by a sliding retainer clip (Figure 15). Sliding the retainer in one direction allows the fitting to be taken apart and sliding the retainer in the opposite direction locks the fittings together. The fittings will go together more easily if the "O" ring is lubricated with water or another lubricant before assembly.

Step 4

The Interconnect Cable is 10 feet (3 m) long and has the same style connector at each end. Attach the Interconnect Cable from the QCD electronics box to either of the two large connectors on the back of the Injector.

To avoid damaging the electronics, do not connect the QCD while the Injector is turned on.

Step 5

The QCD is equipped with a filter, but it is a fine mesh and will quickly clog if the water contains much debris. We recommend that you filter the water before it reaches the QCD. This can be done with any of the commercially available products designed for larger volumes of water and easy cleaning. Contact NMT if you need assistance selecting one of these filters.

6.4 Mechanical Diverter Gate Assembly

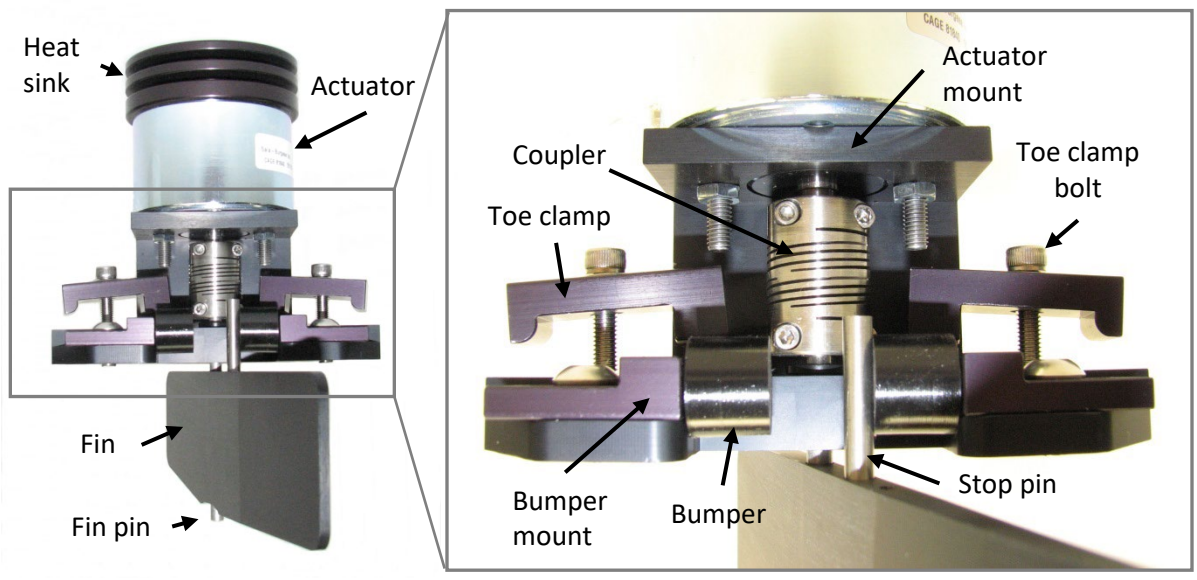


Figure 16: Mechanical gate parts.

Step 1
With the Toe Clamp bolts loose, rotate the fin over to one side or the other as far as it will go. Tip the long end of the fin down and put it into the separator section first. Slide the Toe clamp over the separator and line-up the Fin pin on the diverter assembly with the Fin bearing of the separator (Figure 17).

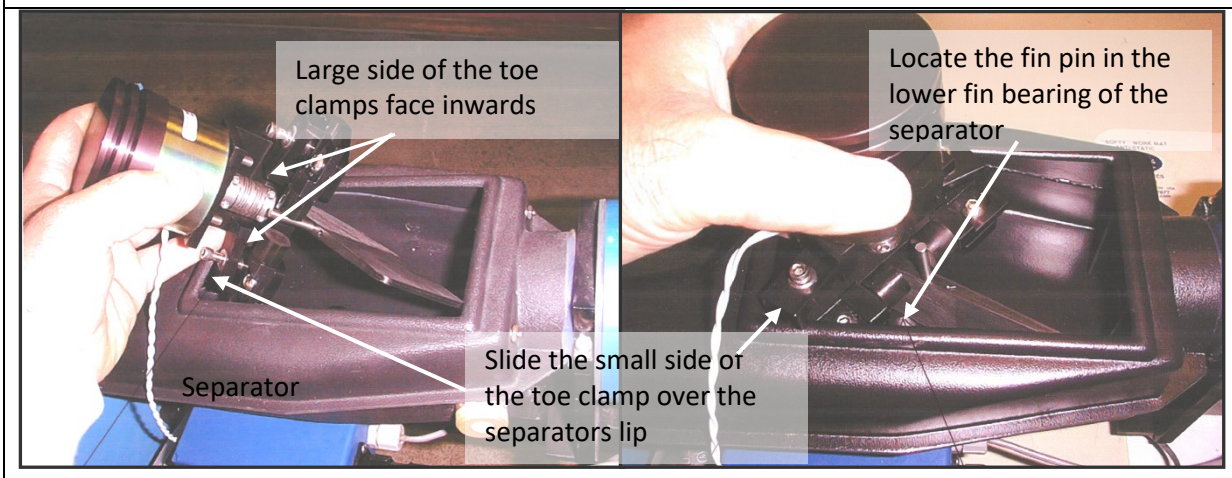


Figure 17: Assemble the mechanical diverter gate.

Step 2

Rotate the other toe-clamp end into position. The diverter assembly should now have both of the toe-clamps over the plastic, and the mount under the plastic. Ensure that the “small” end of the toe clamp goes all the way over the separator’s lip. Tighten one side’s toe clamp bolt a little followed by the opposite side’s toe clamp bolt a little. Keep repeating until the diverter gate assembly feels secure (Figure 18).

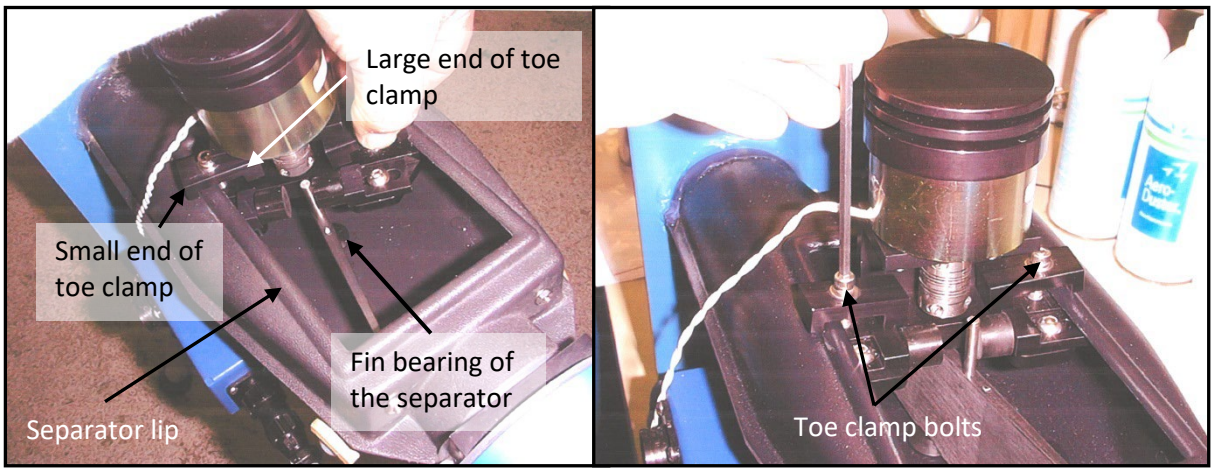


Figure 18: Secure the mechanical diverter gate.

Step 3

Ensure the fin moves freely (Figure 19A). If not, adjust the position of the diverter assembly. Set the right-hand bumper stop so that the fin tip is flush with the fin shields (Figure 19B & C). Hold the fin in position while tightening the bumper. This will be the at rest position (no tag present). Move the fin to the other (tag present) side and adjust the left bumper so the fin's tip is flush with its fin shield (Figure 19D).

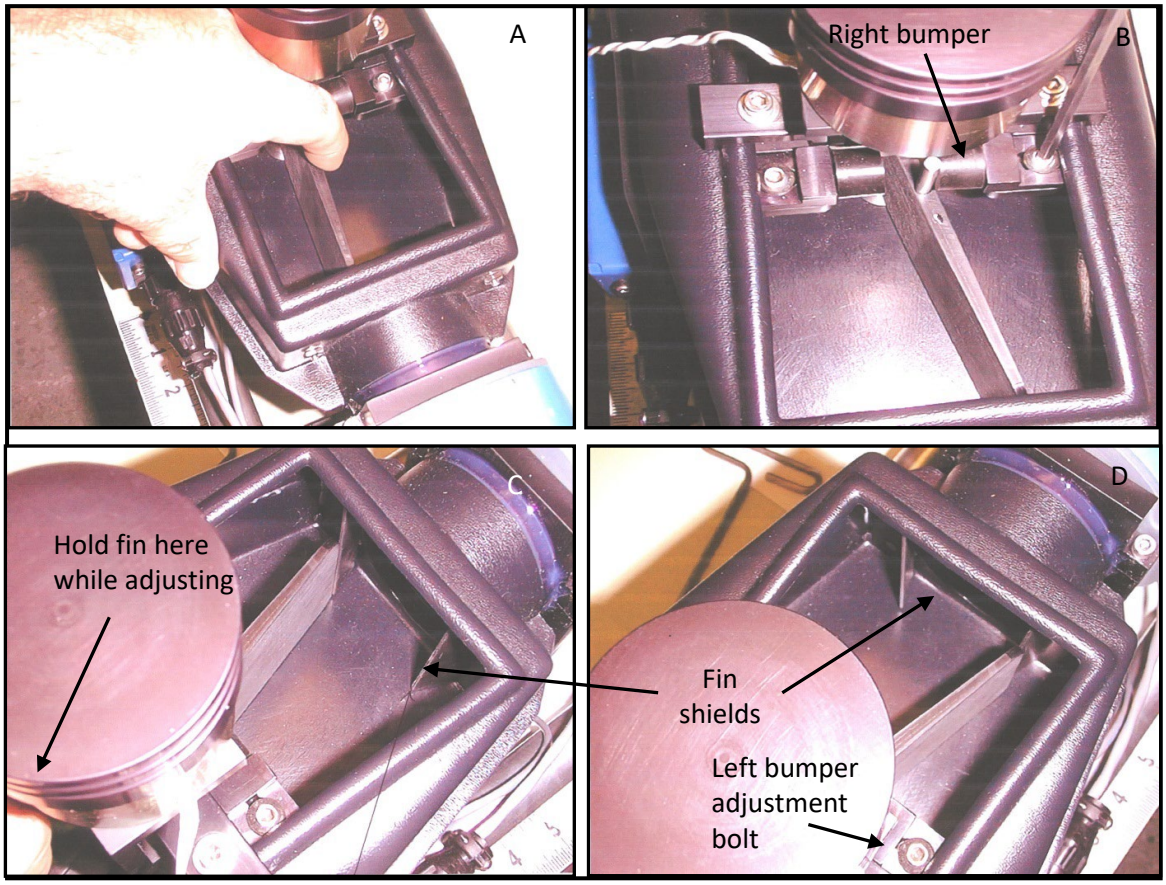


Figure 19: Adjust fin position.

Step 4

Plug the actuator into the QCD's gate box (Figure 13, page 34). Plug the power supply to the Gate Box (**NOTE: it must be a 24VDC power supply**). Plug the gate box to the QCD electronics box and the MKIV Tag Injector.

Step 5

To test that the QCD Diverter gate and the fin are properly adjusted, turn on the injector, press [SHOW], and then press [STEP] several times (see pg. 26).

6.5 Separator (Water) Jet Adjustments

Many QCD's use a water jet system, rather than a mechanical gate in the separator to divert tagged fish. The two valves on the side of the QCD are used to control the flow of water to the funnel and the separator.

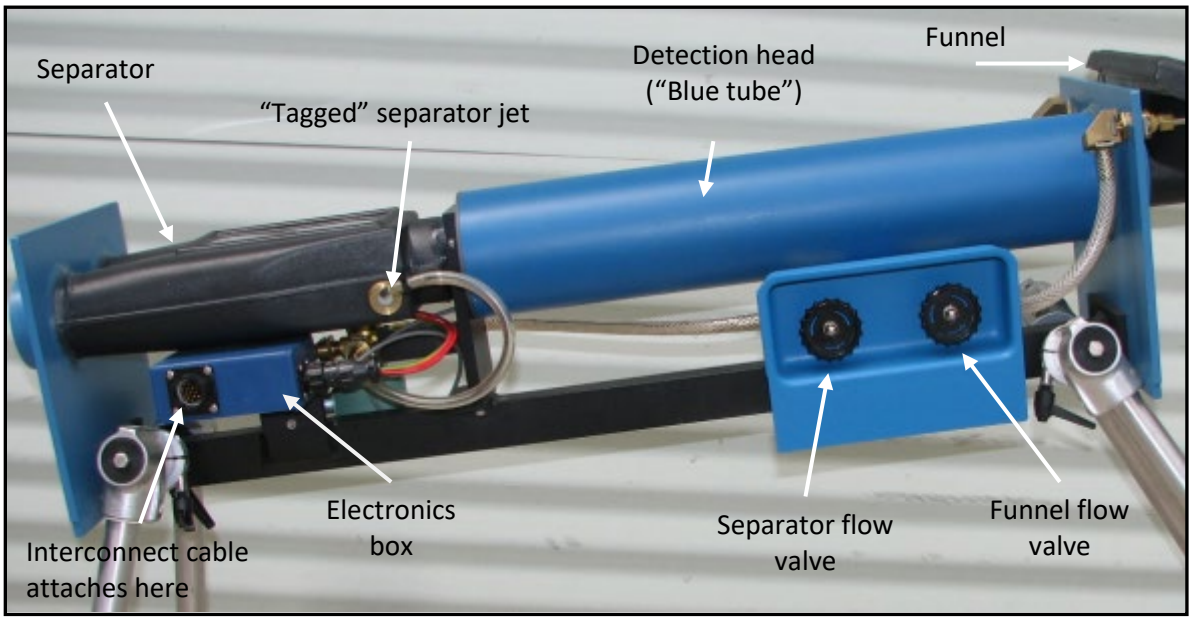


Figure 20: Quality Control Device (water jet version, valve side).

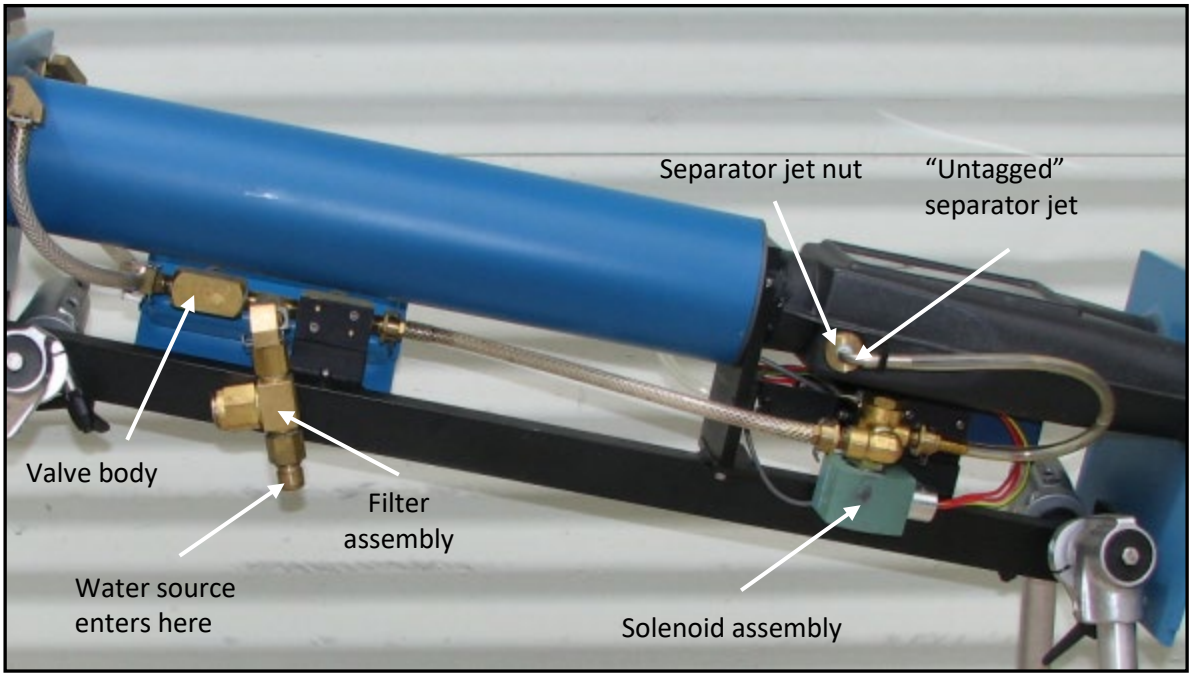


Figure 21: Quality Control Device (water jet version, solenoid side).

Step 1

Turn on the water supply to the QCD. Adjust the water flow from the funnel using the funnel flow valve (Figure 20). The funnel water flow should be sufficient to keep the fish moving through the QCD, but not so great that the separator jets are ineffective.

Step 2

Adjust the water flow to the separator jets using the separator flow valve (Figure 20). The flow should be sufficient to move the fish to the proper side of the separator, but not so great that the fish is subjected to excessive forces. Since the water will always be diverted to one jet or the other, the flow to the two separator jets should be equal.

Step 3

Adjust the position of the separator jets. The jets used in the system work with a wide range of fish sizes; however, very small or very large fish require some jet adjustment. Water normally flows from the "untagged" separator jet down one side of the separator, leaving the QCD from only one of the two exits (Figure 22: Separator jets.). To activate the solenoid so that you can adjust the jet for tagged fish, use the **[TAG]** and **[STEP]** keys as explained in the section for the Key: [SHOW] (page 26).

To adjust the jet position, loosen the knurled nuts which hold the jet in the separator housing and position the jets as desired. When the solenoid is activated almost all the water should be leaving the QCD from the opposite exit.

The flow and jet position settings should be checked when specimen size changes significantly, water pressure changes, or sorting accuracy decreases.

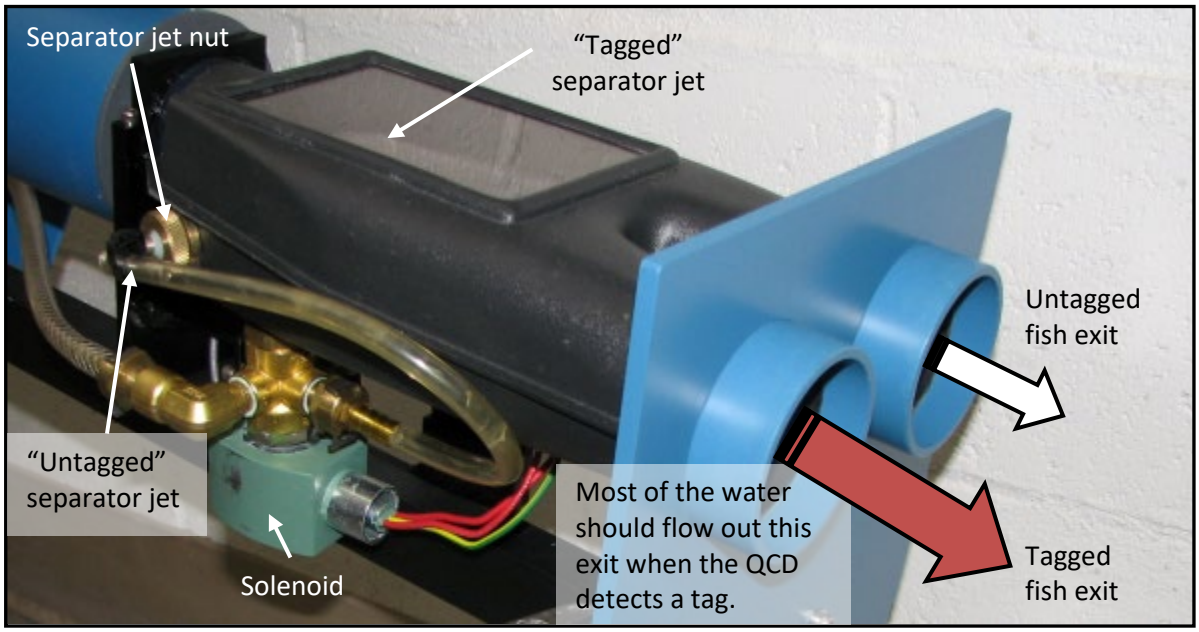


Figure 22: Separator jets.

Step 4	
Adjust the separator jets for the frequency of fish. Use the Item: QCD DELAY (page 33) in the MKIV Tag Injector's adjustment menu to increase or decrease the amount of time the "tagged" water jet stays on.	 The nuts on the separator jets should be only finger-tight. Over-tightening may cause the whole jet assembly to turn in the housing.

7 Maintenance

This chapter describes how to completely disassemble the outer parts, reassemble the outer parts, and inspect key parts of the MKIV Tag Injector.

The frequency of maintenance depends on the water environment (fresh vs. salt), species being tagged, and quantity being tagged. Some components, especially the cutter, require daily maintenance during tagging. The frequency of maintenance for other components is more dependent on the species and/or target area for the tag. For example, the harder the target location for the tag, the quicker the needle will become dull, and the more frequently it will need to be replaced. It is recommended that you fully service your Injector before storage to ensure it is ready for the next tagging session.

7.1 Injector Disassembly

Step 1
Remove any tag wire from the Injector.
Step 2
Remove the head mold or needle support tube, the cutter, the brass needle nut and the needle.
Step 3
Loosen the needle carrier clamp screw.

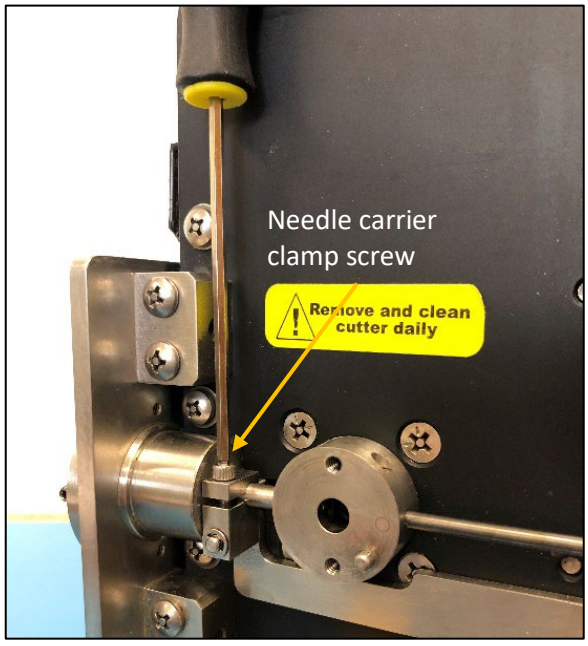


Figure 23: Loosen the needle carrier clamp screw.

Step 4

Remove the needle carrier using the 6-32 x ¾ inch socket head cap screw found in the tool kit (see Appendix A: Tool Kit Components, pg. 87).

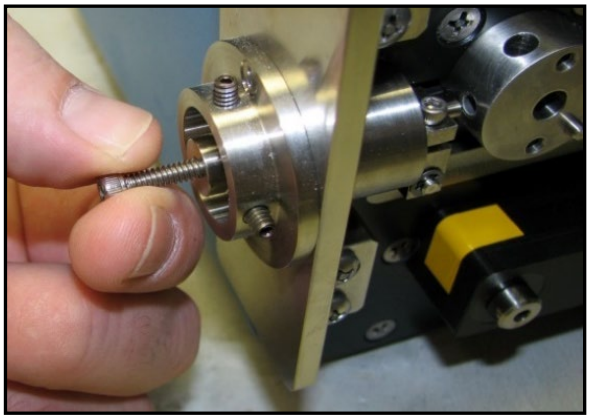


Figure 24: Remove the needle carrier.

Step 5

Push the latch up to disengage the drive roller and remove the idler roller arm.

Hold the idler roller arm with your fingers to keep it from popping up once the bolt is loose.

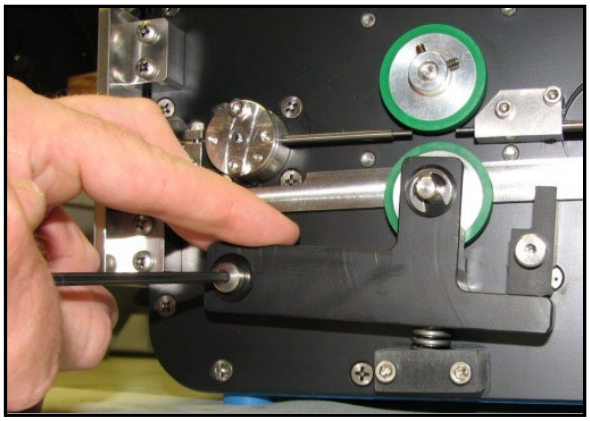


Figure 25: Remove the idler roller arm.

Step 6

Loosen the set screws to remove the drive roller.

Figure 26: Remove the drive roller.

If the drive roller is seized to the shaft, use the drive roller puller in the MKIV tool kit to gently remove the drive roller.

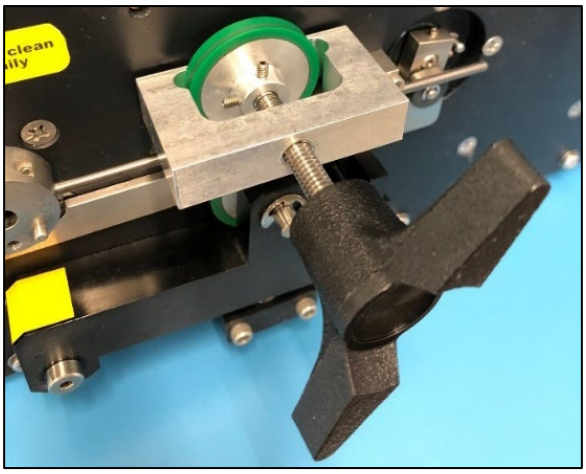


Figure 27: Using the drive roller puller.

Step 7

Loosen the entry wire guide's set-screw and remove the wire guide.

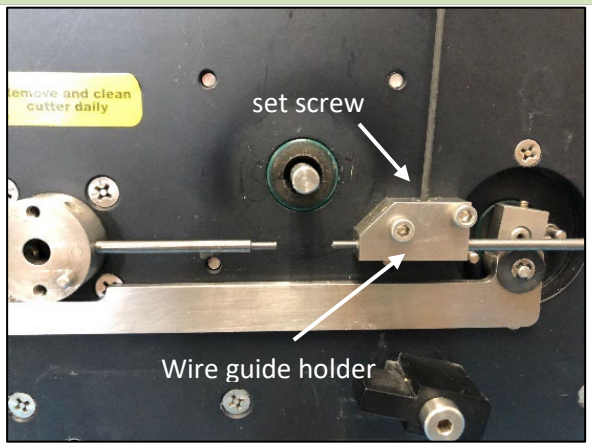


Figure 28: Loosen wire guide set screw.

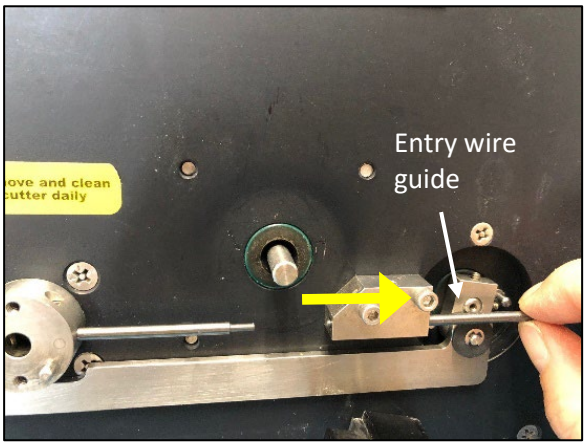


Figure 29: Remove wire guide.

Step 8

Loosen the set screws in the offset arm using the modified .050" hex wrench in the tool kit.

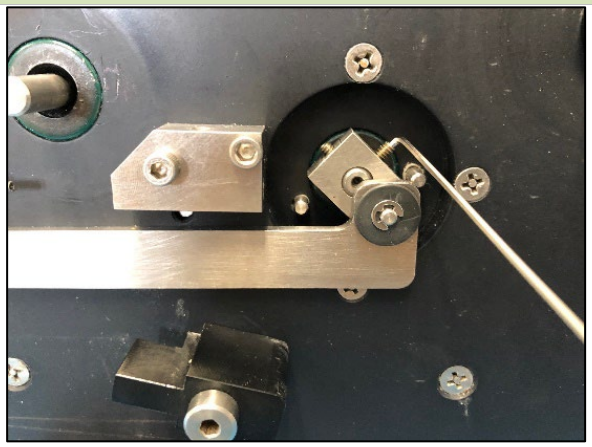


Figure 30: Loosen set screw to remove actuator arm.

Step 9

Remove the actuator arm.

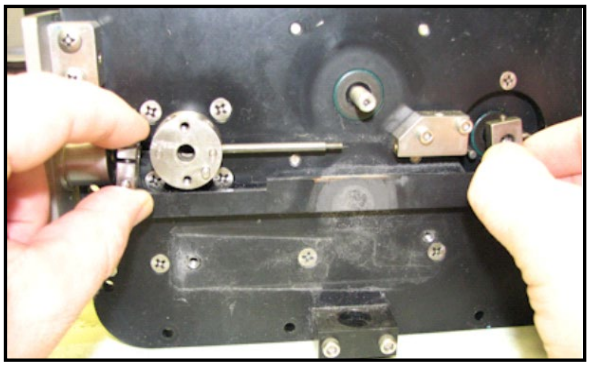


Figure 31: Remove actuator arm.

Step 10

Loosen the set-screw and remove the cutter block wire guide.

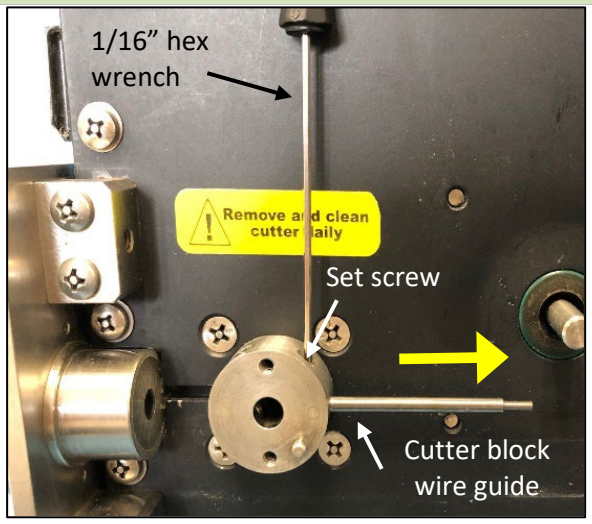


Figure 32: Remove cutter block wire guide.

If the cutter block wire guide is stuck, insert the 7/64 inch hex wrench through the cutter block until it is against the cutter block wire guide. GENTLY tap the wrench handle to push the wire guide free.

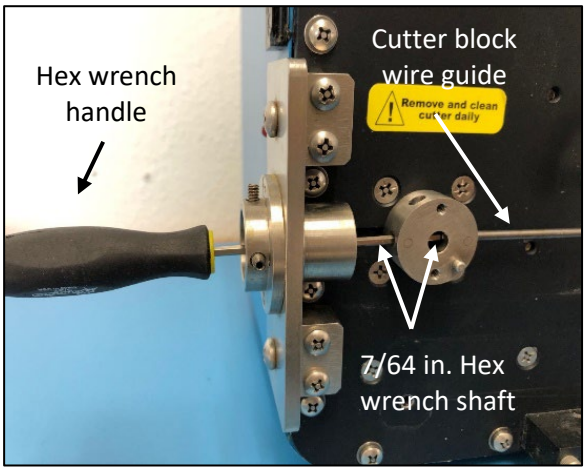


Figure 33: Removing a stuck cutter block wire guide.

7.2 Injector Assembly

This section assumes that you have completely disassembled and cleaned (see Cleaning and Disinfection page 67) the outside components of a MKIV Tag Injector and are now ready to reassemble them.

Step 1

Insert cutter pin and sleeve. Hold the cutter towards the Injector, compressing the spring while tightening the screws using a 7/64 inch hex wrench.

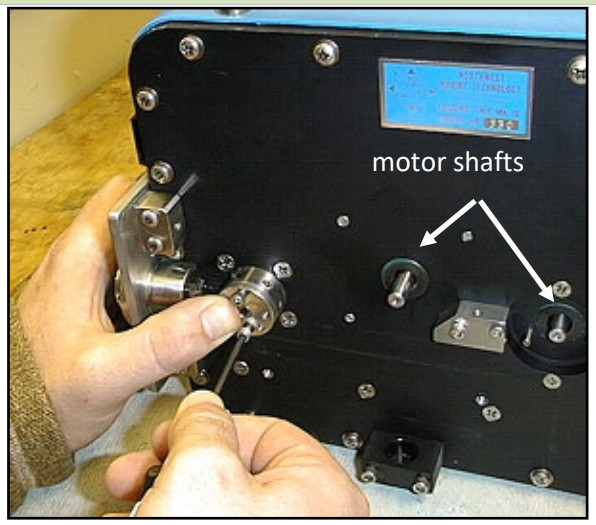


Figure 34: Install the cutter.

Step 2

Lightly lubricate the motor shafts (Figure 34) with silicone-based grease and attach the actuator arm assembly but do NOT tighten yet.

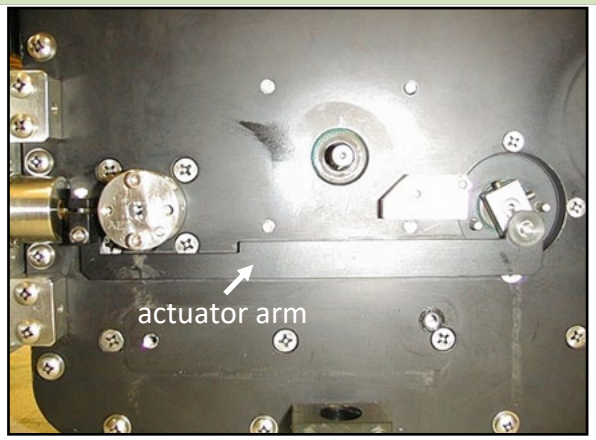


Figure 35: Install actuator arm.

7.2.1 Needle Carrier Installation

Step 3

Insert the needle carrier so that the back lip of the needle carrier is flush with the back of the needle carrier clamp.

Using a 3/32 inch hex driver, tighten the needle carrier clamp just enough so as the needle carrier will not slip in the clamp.

Do not over tighten the needle carrier clamp. Doing so may cause irreparable damage to the needle carrier clamp and the needle carrier!

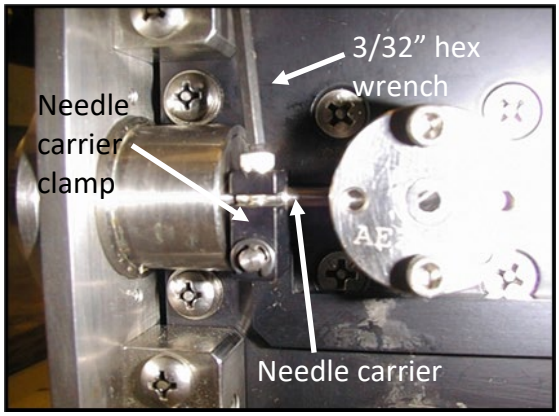


Figure 36: Install needle carrier.

Step 4

Slide the cutter block wire guide into its hole until it touches the cutter.

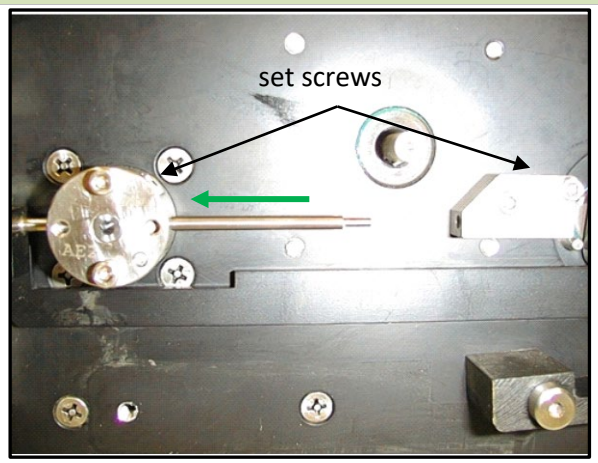


Figure 37: Install cutter block wire guide.

Step 5

Slide the entry wire guide into its mounting block until the lip of the wire guide is flush with the front of the holder and tighten their set screws.

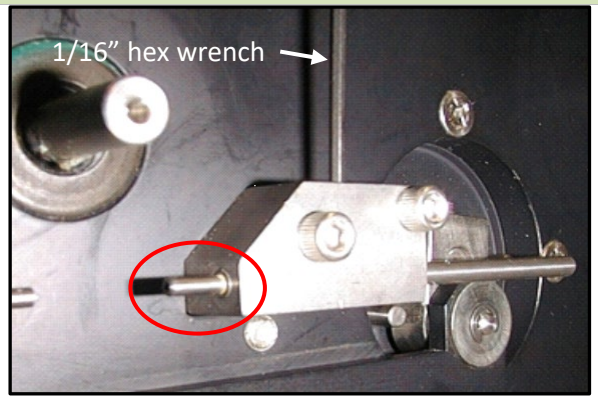


Figure 38: Install entry wire guide.

Step 6

Slip the drive roller onto its motor shaft but do NOT tighten its set-screws yet. Fasten the idler roller arm. As you compress the spring while positioning idler roller arm and shoulder bolt, turn the latch to the disengaged position (down). Turning the latch down will help align the shoulder bolt, and prevent the spring slamming the idler roller into the wire-guides.

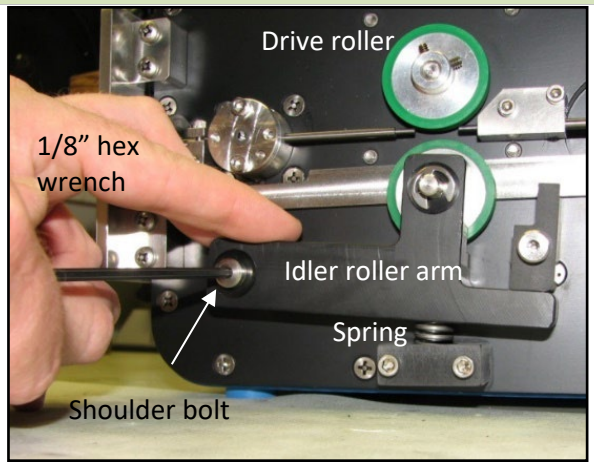


Figure 39: Install idler roller arm.

Step 7

Engage and line up the drive roller with the idler roller. Tighten the set-screws.

Disengage the drive rollers.

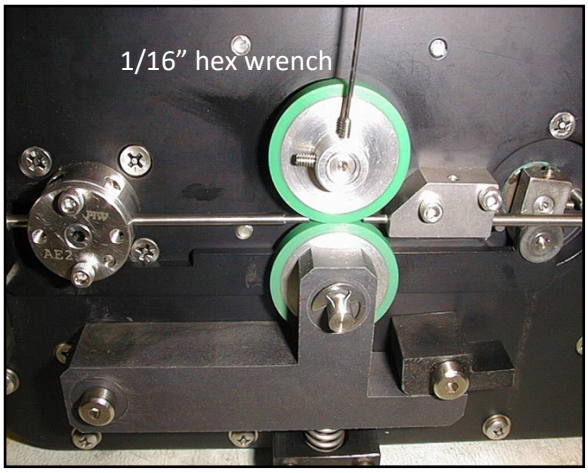


Figure 40: Tighten drive roller.

Step 8

Turn the Injector on and enter *LOAD* mode by pressing the **[LOAD]** key.

Push on the front of the needle carrier until it is up against the inside of the head mold holder/magnetizer.

Use the modified 0.050 inch L-shaped hex wrench from the MKIV toolkit to tighten the setscrews of the actuator arm assembly.

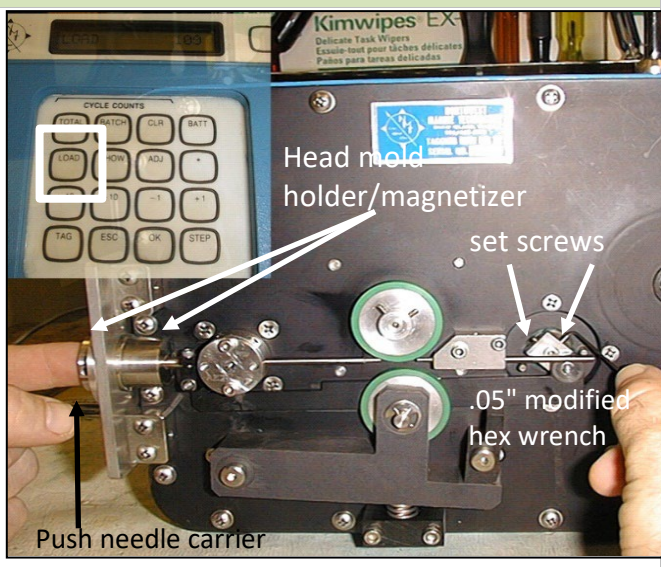


Figure 41: Tighten actuator arm.

7.2.2 Needle Installation

Step 9

The needle is held in the needle carrier by a compressed nylon ball slipped over the needle. The ball and needle are retained by a brass clamping nut.

With the Injector still in *LOAD* mode, insert the needle until it contacts the cutter, and tighten the needle nut.

A piece of paper or something bright below the vertical inspection hole helps to see. Press the **[ESC]** key.

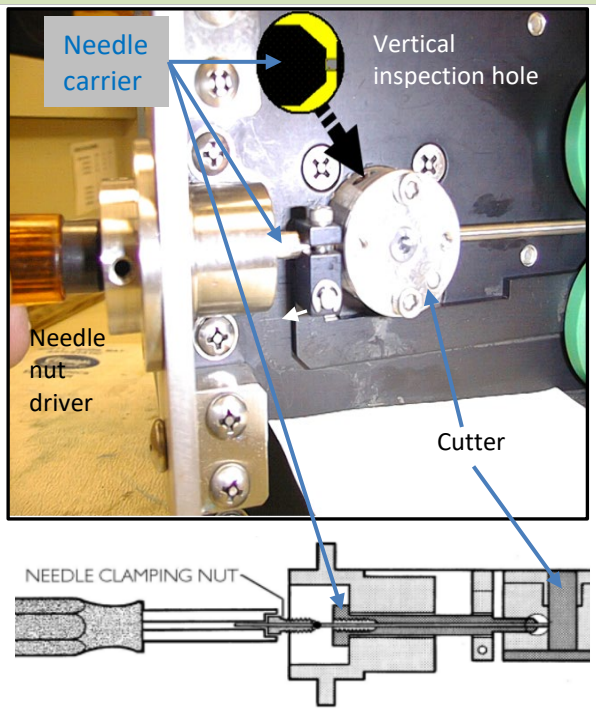


Figure 42: Use the vertical inspection hole to verify correct installation of the needle.

Step 10

To be certain that there is the proper gap between the needle and the cutter, follow the steps below:

Step 10-1

Loosen the needle carrier clamp using the 3/32 inch hex wrench.

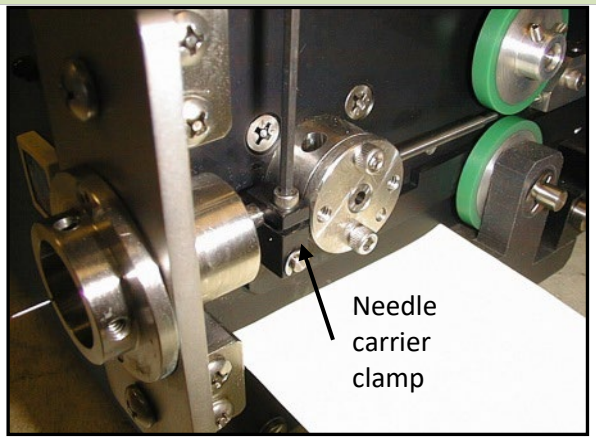


Figure 43: Loosen clamp.

Step 10-2

With the needle carrier clamp still loose, push the needle/needle carrier assembly towards the cutter until you see the funnel end of the needle touch the cutter.

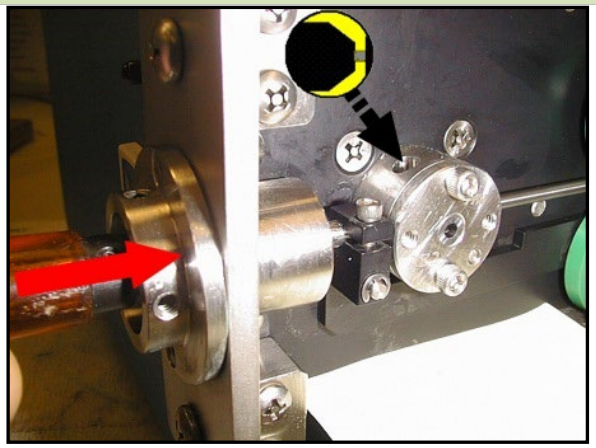


Figure 44: Position needle.

Step 10-3

Press the **[LOAD]** key, while still holding the needle against the cutter, and then tighten the needle carrier clamp just enough so that the needle carrier will not move. Press **[ESC]**.

Do not over tighten the needle carrier clamp. Doing so may cause irreparable damage to the needle carrier clamp and the needle carrier!

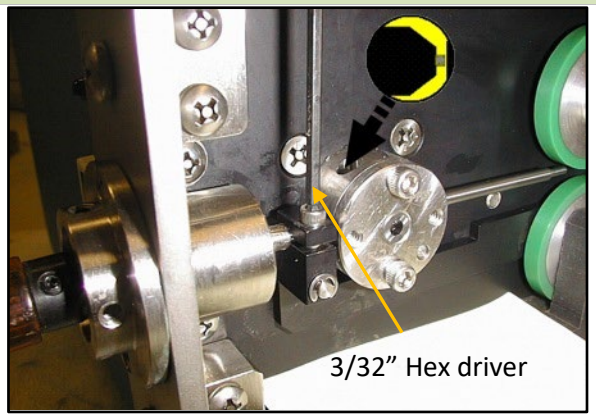


Figure 45: Tighten clamp.

The MKIV is now assembled. Install the head mold, positioning jig or needle support tube and set up the MKIV's needle penetration and tag placement depth (page 19).

7.3 Parts Inspection

7.3.1 **Needle Inspection and Maintenance**

The needle should be kept clean and sharp. A dirty needle may cause tag jamming, improper tag placement, or pathogenic contamination. Clean the needle with detergent and water, then rinse with alcohol.

Inspect the beveled end of the needle to see that it is smooth and sharp. A sharp needle is required to repeatedly penetrate the fish and deliver the tag to the target site. A dull needle makes penetration difficult and tends to push the specimen away during tagging, causing shallow implantation of the tag. Dull MKIV needles cannot be sharpened and must be replaced.

Inspect the needle to make certain it is straight. Bent needles must be replaced.

Inspect the slight "funnel" at the back end of the needle with the magnifying loupe (Figure 46). The funnel helps guide the tag into the needle and can be damaged if the tag wire jams in the Injector.

The funnel can be reshaped using the needle reamer and the Arkansas stone in the tool kit. To reshape the funnel, insert the point of the reamer into the funnel and turn it a few times with **light pressure** to restore the proper shape. The rim of the funnel must be smoothed with the Arkansas stone to remove the external flare caused by reaming.

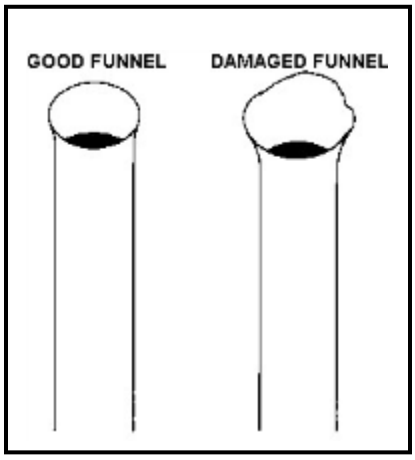


Figure 46: Needle funnels.

The needle carrier and needle can be removed as a unit for easier needle maintenance. When removing them together, pull it out by the brass clamping nut so you don't damage the needle carrier. The needle carrier is an expensive part compared to the clamping nut. Also be careful not to bend the needle. When reinstalling the needle/needle carrier unit, make sure the Injector is in LOAD.

Need help? Call +1 (360) 764-8850 or email office@nmt.us

7.3.2 Cutter

The cutter consists of an inner "pin", a "sleeve" and a "flange" (Figure 47). The tag wire passes through holes in the sleeve and pin. Cutting is performed by rotating the pin within the sleeve, thus shearing off the tag at the point where the wire enters the pin.

Each cutter has four cut edges (see Figure 12, page 34, Figure 47, and Figure 48). The “cut edge” refers to the side of the pin hole doing the work cutting the tag wire.

> ⚠ Remove and clean the cutter at the end of each day’s tagging. Avoid letting the pin and sleeve dry while assembled.

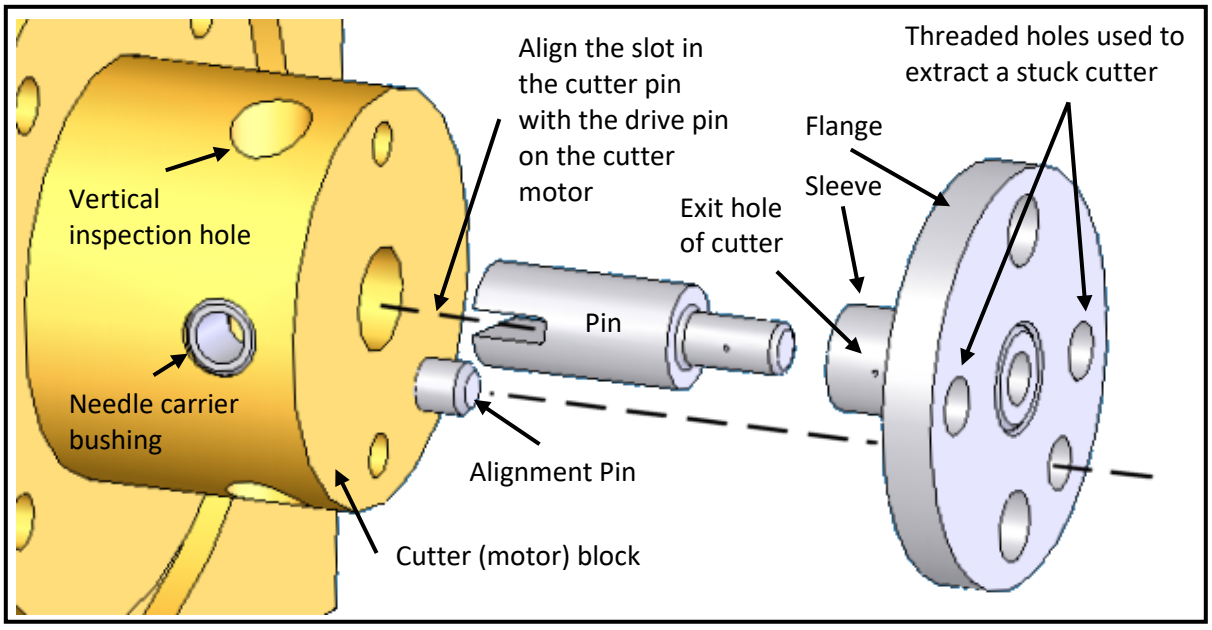


Figure 47: Cutter parts.

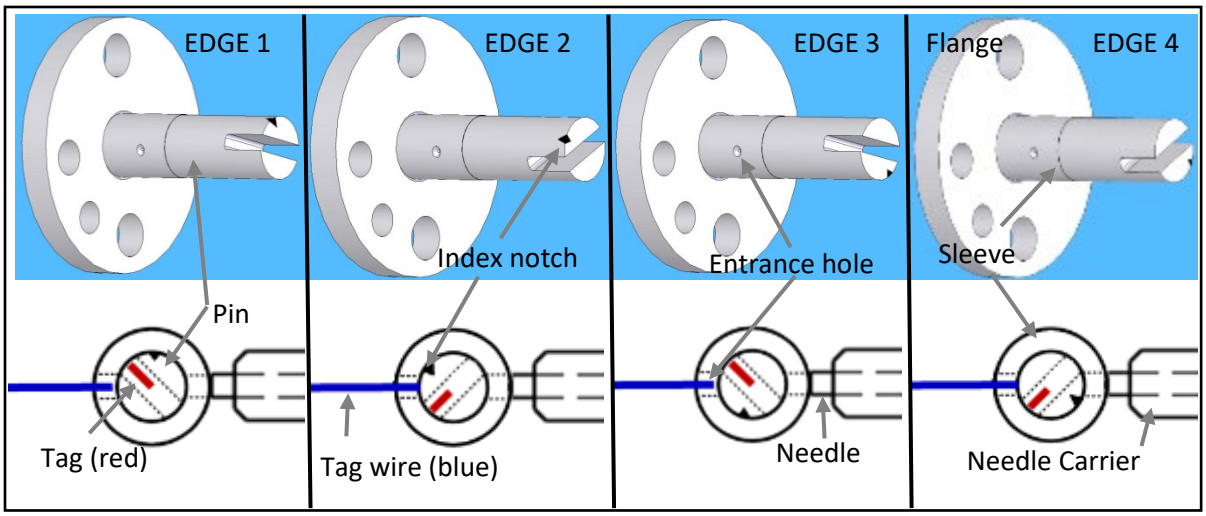


Figure 48: Cut edges shown from inside the MKIV injector looking out.

During normal operation, the cutter does not have to be removed to select a different cut edge; however, a tag will not be cut on the newly selected edge until the Injector is cycled once. A new cut edge can be selected using the Item: CUT EDGE (page 34) in the *ADJustment* menu (**[ADJ]**). Also, look at the *CUT EDGE* item setting when installing the cutter to make sure the pin is in the correct orientation using the index notch as a reference (Figure 48).

Keeping the cutter clean will result in the best performance, longest wear and avoids the problem of a seized cutter. Never use tools to disassemble a stuck cutter – this is almost certain to damage the cutter. If the pin cannot be removed from the sleeve after the cutter is removed from the Injector, put the cutter in an ultrasonic cleaner (most jewelers have these) with tri-sodium phosphate (TSP) based detergent solution for one hour. This usually allows the pin to be removed from the sleeve by hand. If you have any questions, please contact NMT.

Record the cut edge change in the log book along with the Injector total ("INJ T"). Keeping track of the number of cuts on a cut edge is useful in determining approximately when the cut edge or cutter needs to be changed.

7.3.2.1 Cutter Inspection

Tag quality can be a key indicator of the condition of a cutter or cut edge. Badly worn or damaged cutters can produce tags that are bent or with a large tail (Figure 49). Damaged tags may not pass through the needle, causing the Injector to jam. If half-length tags are being cut then the condition of the cut edge becomes more critical. Using a worn cutter can also damage the end of the tag making subsequent reading difficult. Occasionally inspect a tag with the magnifying loupe, Magniviewer, or on a piece of tape under a microscope to determine that the tag ends are square.

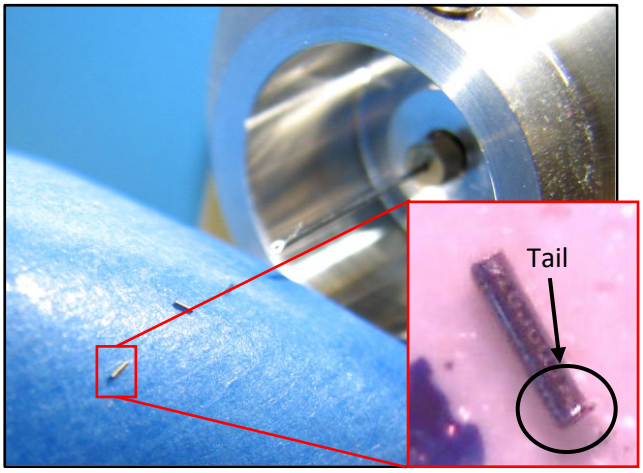


Figure 49: Inspect tags to evaluate your cutter.

Inspect the flange, cutter block surface, and cutter holes for stray tags or wire (Figure 50). This can cause wire jams or make it hard to load wire and possibly damage the cutter. The Arkansas stone found in the MKIV tool kit can be used to take down any high spots from dents created by tags caught between the flange and cutter block surfaces.

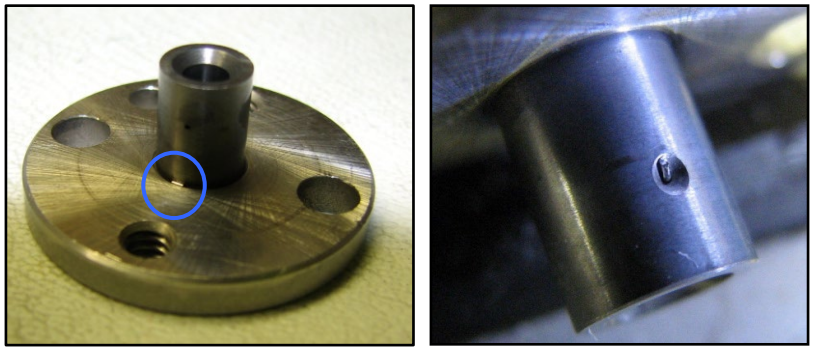


Figure 50: Stray tag at base of cutter sleeve (left) and in the cutter hole (right).

Check the outside surfaces of the flange and sleeve. These two surfaces should be flush. Figure 51 shows a cutter's flange and sleeve whose outside surfaces are not flush. Wire would either not load or load with difficulty through this cutter because the wire path would be partially blocked. If you notice this problem with your cutter, it should be returned to NMT for attempted repair.

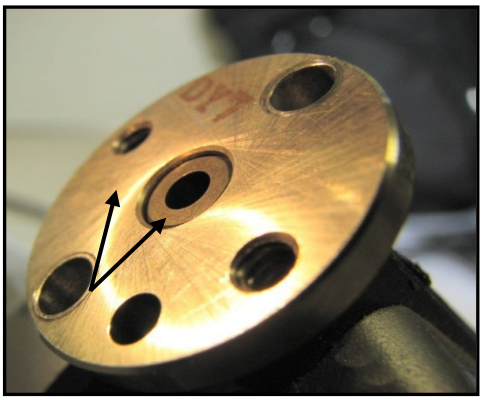


Figure 51: An example of a cutter with a flange and sleeve that are not flush.

The cut edges of the pin and sleeve should be checked for wear. The pin has four cut edges because it can rotate 180 degrees, while the cutter sleeve only has two cutting surfaces (Figure 52).

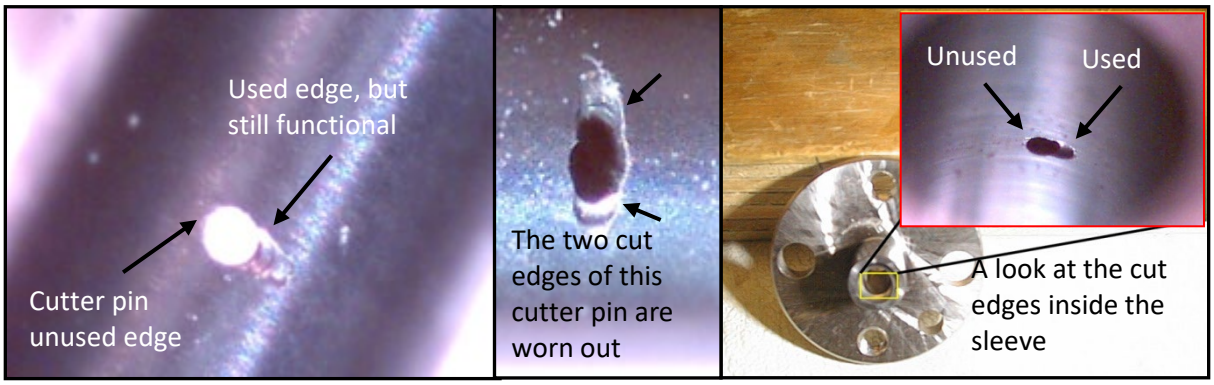


Figure 52: Inspecting the cutter edges.

7.3.3 Needle Carrier

The needle carrier holds the needle in place and is a critical part of the electronic tag magnetization process. Correct installation of the needle carrier is critical to proper system performance (see Needle Carrier Installation, page 53). When inspecting the needle carrier, pay close attention for stray tags in, on, and around the needle carrier (Figure 53).

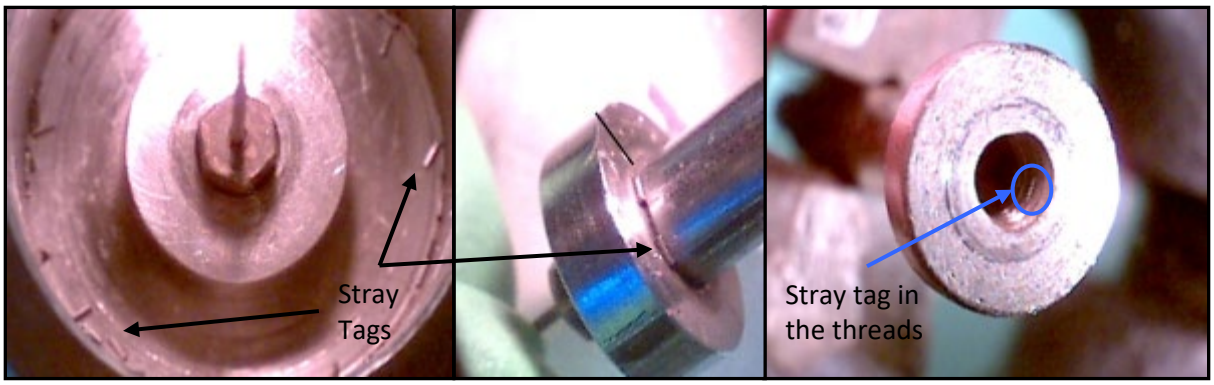


Figure 53: Inspecting the needle carrier for stray tags.

7.3.4 Drive Rollers

The drive roller is used to transfer the action of the wire drive motor to the tag wire. Since accurate positioning of the tag wire is critical to tag length, magnetization and tag placement depth, you should always be certain that the drive roller and its idler roller are in good working condition and free from contamination by dirt or oils. Oil from certain species can be transferred to the rollers by the action of the tag wire, causing the wire to slip and subsequently cut short tags. Use soap and water to keep the drive rollers clean. Over time, a groove in the drive roller will develop which can also cause the wire to slip.

7.3.5 Touch Switch

The Touch Switch (Figure 38) is a hand switch that can be operated hundreds of times per hour without causing operator fatigue. When the Touch Switch button is pressed, a magnet in the button closes a reed switch in the base and the Injector is cycled.

Cleaning

Other than cleaning, the Touch Switch rarely needs maintenance. The Touch Switch can be cleaned by removing the screw in the side of the block, tipping the block to allow the pin which restrains the push button to slide out, and then lifting out the push button and spring underneath (Figure 54). The cavity can then be cleaned and the switch reassembled. Dry the Touch Switch and its connector before storing.

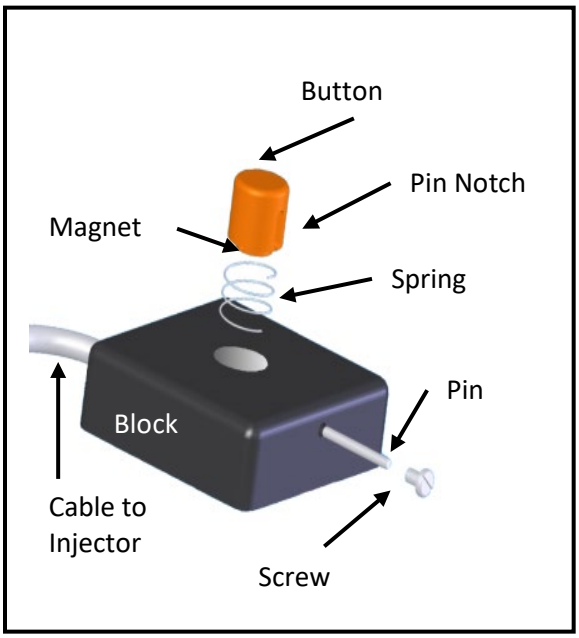
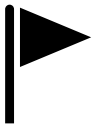


Figure 54: Touch switch.



Some operators place the Touch Switch in a small plastic bag during use to keep it clean and dry.

7.3.6 QCD Solenoid Valve (Water jet version QCD only)

The QCD solenoid valve (Figure 21, page 44) diverts the flow of water to either of the two water jets in the QCD separator. In the inactive position, water is diverted to the separator gate for untagged specimens. When a magnetized tag passes through the QCD, a signal is sent to the solenoid, diverting the water flow to the separator for tagged specimens.

7.3.6.1 Removal and Installation

The solenoid does not require any routine maintenance; but you may need to remove it if it becomes plugged by debris or otherwise fails.

Follow these steps to remove the solenoid:

Step 1
Note the position of the three water tubes and disconnect them at the quick disconnect fittings.
Step 2
Disconnect the electrical connector for the solenoid where it enters the QCD electronics box.
Step 3
Remove the wing screw which holds the solenoid bracket to the QCD frame.
Step 4
If you are replacing the solenoid use the 9/64" hex wrench to remove the two cap screws which hold it to the solenoid bracket. It is not necessary to remove the solenoid from the bracket for normal servicing.
Step 5
Reinstall the solenoid using the opposite procedure.

When storing the QCD, remove and drain the solenoid. If water freezes inside the solenoid it may be damaged.

7.3.7 Solenoid Valve Cleaning

The QCD filter has been chosen so that anything that passes through the filter will also pass through the solenoid. If the filter has been removed, the solenoid can become blocked. The solenoid can usually be cleaned by disconnecting it as explained above and removing the debris from the water passages at the quick disconnect fittings. If the debris is inside the solenoid then it will have to be disassembled as follows:

Step 1
Remove the plastic retaining cap and slip the housing, spring washer, coil and base-plate off the solenoid base sub-assembly.
Step 2
Unscrew the solenoid base sub-assembly from the valve body. This requires a large wrench which is not included in the tool kit.  Once disassembled, the two sides of the valve body (Figure 39a) are identical so before disassembly, mark the side of the valve body into which the end cap fits.
Step 3
Remove the core assembly, core spring and solenoid base gasket. Note that the rubber end of the core assembly goes toward the valve body.
Step 4
Unscrew the end cap and remove the disc holder spring disc holder sub-assembly and end cap gasket. Note that the disc holder sub-assembly has three legs which only fit the valve body one way.
Step 5
All parts are now accessible to clean. Inspect the components and remove any debris. Replacement solenoids are available from NMT.
Step 6
Reassemble in reverse order of disassembly (Figure 56). • The coil should be installed so the larger end faces the base plate (Figure 16, page 41). • Lubricate the gaskets with silicone grease. • Torque the solenoid base sub-assembly and end cap to about 125 inch pounds.

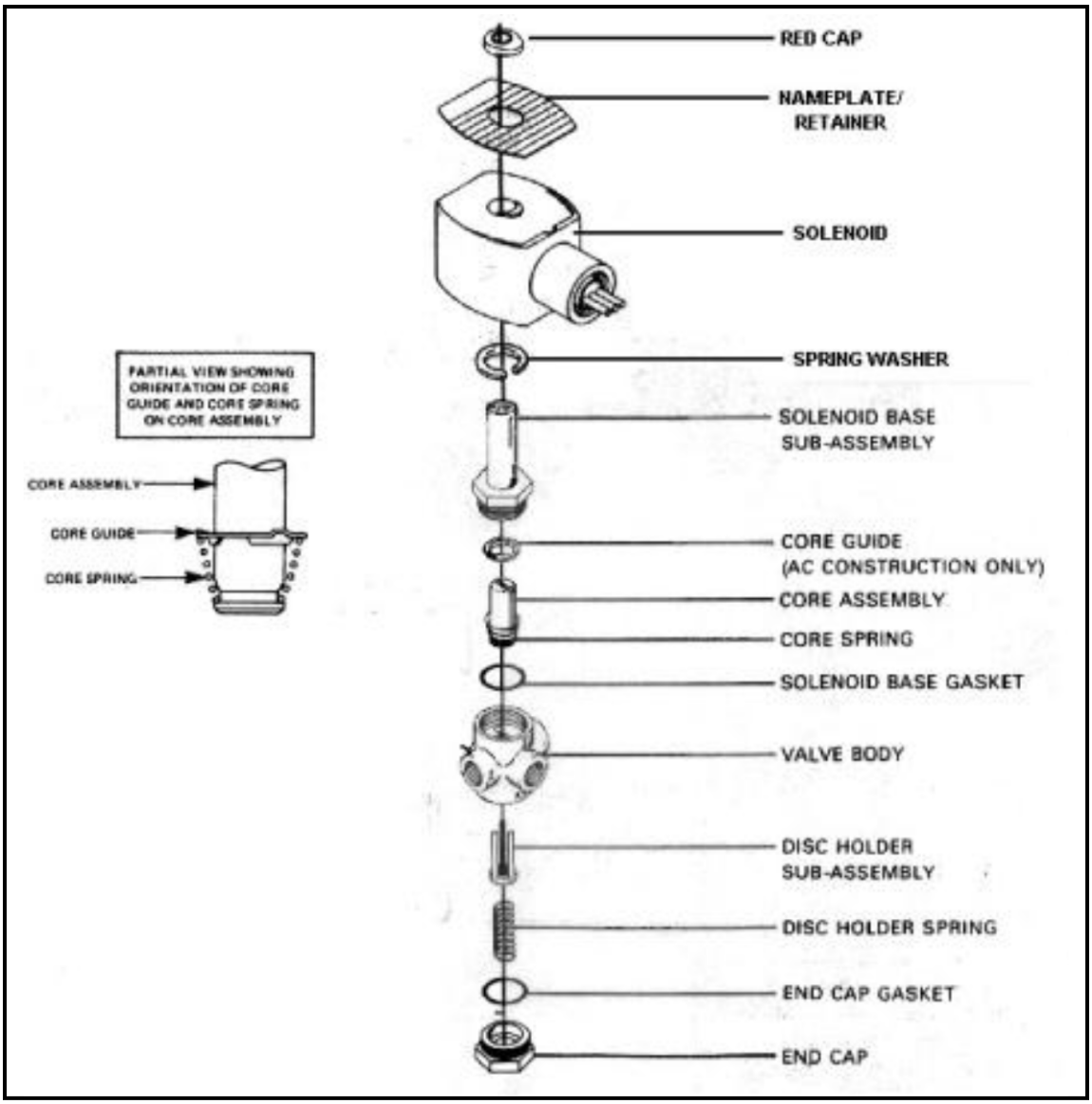


Figure 56: QCD solenoid valve.

7.3.8 QCD Filter Assembly (Both QCD versions)

The filter housing (Figure and Figure 13, page 34) is between the water supply hose adapter and the QCD valves. The filter housing contains a stainless steel 440 micron filter. The filter is designed to prevent debris from clogging the solenoid valve.

7.3.8.1 Filter Cleaning

Two methods are available for cleaning the filter. The easiest and fastest is by back flushing with water. To back flush the filter, remove the water supply hose from the filter assembly and disconnect the filter assembly from the valve body. Run water through the filter in the direction opposite to the normal flow (so water flows opposite the direction of the arrows on

the filter assembly). This will usually force most of the loose debris out of the filter.

If the filter must be removed for cleaning or replacement, follow these steps:

1. Remove the filter assembly from the QCD.

2. With a large wrench, unscrew the housing which contains the filter. The filter can now be removed for cleaning or replacement. ***Be careful not to lose the gasket***.

Before reinserting the filter inspect the gasket which seals the filter housing. The factory supplied gasket is metal and will eventually wear out. If the gasket is worn it will be evident by water leaking from the small hole in the side of the filter housing. Non-metal replacement gaskets are available from NMT.

> The replacement (non-metal) gasket is recommended for saltwater use.

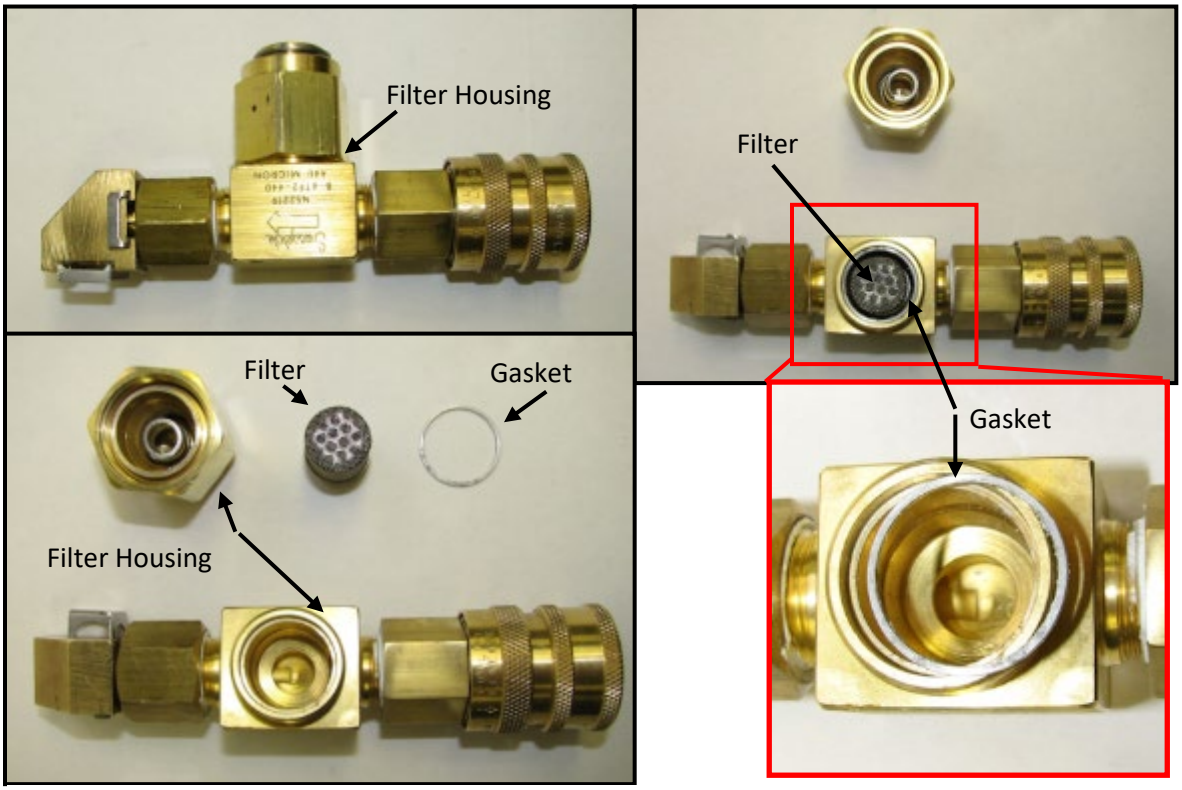


Figure 55: Cleaning the QCD filter.

7.4 Cleaning and Disinfection

The possibility of spreading fish diseases between culture facilities and watersheds is of concern to both our customers and Northwest Marine Technology. Although we are unaware of a case of coded wire tagging equipment, moved between locations, as having served as a vector in spreading a disease, the potential consequences of such occurrences call for stringent preventative measures. Disinfection procedures should also be implemented between groups of fish, within a facility, when signs of disease exist. **Do not tag during a severe outbreak of disease.**

Chlorine solutions are recommended as disinfectants on tagging equipment. Commonly used sources of chlorine are calcium hypochlorite ("HTH") and solutions of sodium hypochlorite ("bleach"). Household bleach comes in a concentration of about 5% so that to achieve the desired concentration one would dilute to a ratio of 1:250 (1 oz of bleach per 2 gallons water). Stronger solutions may be available at fish rearing facilities so that a lesser proportion of material would be required to achieve the desired concentration (200 ppm) of active ingredient. To reduce corrosion, alcohol (70 - 90%) is recommended as the disinfectant and cleaning agent for the interior mechanisms of the MKIV.

Calcium hypochlorite and sodium hypochlorite solutions are highly toxic to fish but can be neutralized by adding sodium thiosulfate or sodium sulfite to the solution. As a "rule of thumb", if a five percent solution of these chlorine compounds is used as a disinfectant, they can be neutralized by adding an equal weight of either chemical. For example, 1 ounce (29.6 mL) of 5% bleach added to 2 gallons (7.57 L) of water would be neutralized by 1 ounce (28.4 g) dry weight of either sodium sulfite or sodium thiosulfate. If the chlorine solution is stronger, the weight of the neutralizing agent should proportionately increase. Do not pour "neutralized" disinfectant into water containing fish.

Before using any disinfectant, read and understand the Material Safety Data Sheets (MSDS) for each product.

7.4.1 Equipment and Supplies

In addition to the disinfectants indicated above, the following equipment and supplies are recommended:

- Two spray bottles for dispensing alcohol and chlorine solutions
- Tap (pathogen free) water
- 50 ml syringe with 20 gauge needle
- Wiping sponge/cloth
- Cotton tipped applicators made of wood (available from medical supply stores)
- Cotton balls
- A 2 - 3 inch length of blank/excess coded wire
- DCWT tool kit
- MKIV Tag Injector instruction manual (this manual)
- Paper towels
- An open container for soaking parts
- A pump and appropriate fittings for circulating disinfectant through a QCD
- A large open container for holding and catching disinfectant pumped through a QCD
- Material Safety Data Sheets
- Rubber gloves
- Eye protection
- Particle masks or respirator

7.4.2 Injector

Using tap water and sponge, wipe down the exterior surfaces of the Injector taking care to remove extraneous material. Repeat this procedure with the touch switch, power supply and attendant cords.

Choose a well-ventilated work location free from hazards that could ignite alcohol. Place the Injector on a clean surface that has been disinfected with the chlorine solution. Secure the MKIV Tag Injector's electrical outlet caps and wipe all the exterior surfaces with the chlorine solution. Without wetting the electrical connections with the disinfectant, thoroughly wipe the touch switch, power supply and attendant cords.

Remove the head mold and clean with the chlorine disinfectant. DO NOT use alcohol on the head molds because it may damage the surface material.

Open the Injector and remove the tagging needle, needle carrier, clamping nut, and dismantled cutter. Immerse these parts into a container of chlorine disinfectant.

Remove the screws that hold the head mold (positioning jig) and immerse them in the chlorine disinfectant. Immerse tools, and other contents of the kit including the case, in the disinfectant.

Remove the idler roller arm and the rear wire guide. There is an E clip holding the needle arm on the drive cam. Remove it and the needle arm. Spray the alcohol solution onto the exposed interior surfaces (including the case) taking care to include drive rollers, wire guides, tension spring, drive roller latch (in both up and down positions), hinges, lower drive roller arm, and all screws.

With alcohol wetted cotton tipped applicators, thoroughly clean all surfaces and orifices/tubes of the head mold holder, needle carrier, needle carrier clamp, vertical inspection hole, cutter motor drive pin, cutter motor block including hole for cutter pin, and alignment pin. Shift the

moving parts to and fro during the process to ensure that all surfaces are exposed to the alcohol.

Remove the caps from the electrical outlets and spray with the alcohol solution. Allow the alcohol to evaporate before replacing the caps. Similarly spray the electrical connections of the power supply and touch switch.

Rinse the soaking Injector parts, tools, and case in tap water. Remove any debris adhering to the cutter parts. Using a length of tagging wire dipped in alcohol, probe the holes in the cutter sleeve and cutter pin to clear them of any material. Insert the tagging needle into the 20 gauge barrel of an alcohol-loaded syringe and force a stream through the tagging needle. After removing the hypodermic needle from the loaded syringe, force alcohol through the needle carrier.

Remove the soaking parts and tools, spray with alcohol, and reassemble the parts using disinfected tools. After replacing the 20 gauge hypodermic needle onto the loaded syringe, fit it over the refitted tagging needle and force alcohol through the needle, toward the interior of the Injector, until a steady stream reaches through to the drive rollers. Using the same syringe, insert it into the wire guide leading to the drive rollers, and force alcohol through until a steady stream reaches the drive rollers. Allow the equipment to dry in sunlight if possible.

7.4.3 **Quality Control Device (QCD)**

Attach the QCD to the MKIV Injector, power source, and tap water, allowing the water to run through the device for several minutes. During this period, divert the flow through both water jets by activating the solenoid valve by pressing [STEP] on the control panel of the MKIV. Using tap water and sponge, wipe down the exterior surfaces of the QCD taking care to remove extraneous material.

Choose a well-ventilated work location. Place the QCD on a clean surface that has been disinfected with a chlorine solution or other suitable disinfectant.

With the QCD attached to the MKIV and power, spray and wipe down the exposed surfaces of the QCD with a chlorine solution including all surfaces of the legs. Remove the cover and repeat the process on the exposed surfaces, including inside the cover, taking care to reach all of the nooks and crannies.

The most practical, and recommended, procedure that follows requires the use of a pump to recirculate chlorine solution through the QCD. Prepare enough solution to operate the pump and place the container in a position to catch the solution exiting the discharged ports as it is pumped/recirculated through the machine for several minutes. Divert the flow through both water jets by activating the solenoid valve.

Let the equipment stand for 15 minutes, then rinse the surfaces with tap water. Run tap water through the QCD while again activating the solenoid valve. Allow the QCD, with cover removed, to dry in sunlight if possible.

8 System Messages

The system will display different messages to confirm its operating status. These messages and their meaning are explained below.

BAD DRIVE XY	Indicates an internal failure of the motor or motor drive circuitry. When Y=0 the Wire motor has failed, Y=1 the Needle motor has failed and Y=2 the Cutter motor has failed. The Injector must be returned to NMT for servicing.
BAD MEMORY	The system has a memory which retains menu settings and cycle counts even with the power off. If this memory fails or resets the Injector will display "BAD MEMORY". Press the **[*]**key to clear this message which will prompt the "CHECK ALL ADJ" message. If the message cannot be cleared, the Injector must be returned to NMT for servicing.
CHECK ALL ADJ	The stored settings have been lost and all values have reverted to the standard factory settings. All adjustments should be checked and reset if necessary.
CHECK NEXT TAG	If the wire does not extend to its proper position, the Injector will complete its cycle, then stall and display this message. (pg. 74)
CUTTER STUCK	The cutter can't complete its cycle. (pg. 75)
INT ERROR	Indicates an internal failure. (pg. 74)
NEEDLE STUCK	The needle actuator (drive) arm is unable to extend or return all the way. (pg. 77)
NO QCD OK	This message appears if the Injector is turned on and a QCD is not attached. Press **[OK]** if there is no QCD attached.
NO WIRE OR STUCK	At the end of each cycle, the Injector cuts and magnetizes a tag for injection during the next cycle, and verifies that a magnetized tag is actually present in the needle. This test is skipped if the WIRE menu item is set to "(MAG OFF)".
POWER LOW	This message appears if the power supply voltage to the Injector drops below about 11.5 volts. When the power supply voltage is low the Injector will run slower than normal. You can display the actual voltage by pressing the **[BATT]** key. (pg. 81)
READY VX.X	The power-on message identifies the firmware version "X.X" installed on the Injector. This message also indicates that the equipment has passed the power on self-test. On a MKIVb this message will say **"MK4B V X.X"**.
***RELOAD WIRE**	MK4**b** V X.X only. The Injector has lost the position of the wire due to an improper shutdown.
WEAK MEMORY	After many years this memory will begin to wear out and will give the warning WEAK MEMORY. After this message is displayed you can safely finish out the tagging season but should return the equipment to NMT at the earliest convenient time.

9 Troubleshooting the MKIV Injector

9.1 Injector displays “NO WIRE OR STUCK”

Cause	Solution
Tag wire has run out or the drive rollers are not engaged.	Install a new spool of tag wire. Make sure the drive rollers are in operating position.
The needle carrier is improperly installed.	Make sure the needle and needle carrier are properly installed. See Needle Carrier Installation (page 53) and Needle Installation (page 55).
The drive roller is loose or not making firm contact with the wire.	Confirm that the drive roller is secure to the motor shaft. Confirm that the idler roller can rotate freely. Confirm that the wire guides are NOT touching the drive rollers. Inspect both the idler and drive roller for grooves. Sometimes the drive roller can be adjusted on its motor shaft to avoid any grooves in its tread.
[OK] was used to exit LOAD mode but the wire was not at the tip of the needle causing the wire to be retracted too far.	Return to *LOAD* mode, turn the drive rollers clockwise by hand to advance the wire to the tip of the needle and press **[OK]**.
[SHOW] is not set properly. Too low of a *SHOW* value may cause cut tags not to be expelled from the needle and to build up or may cause the tag wire to be retracted too far and not be cut at all. Too high of a *SHOW* value causes the wire to be extended too far and not cut because the Injector cannot find the end of the wire.	Adjust **[SHOW]** so that the cut tags are pushed to the end of the needle and are expelled each machine cycle (see Key: [SHOW], page 26).
The Injector’s magnetizer and/or associated detector electronics may not be operating properly.	Return Injector to NMT with a repair request form (available at www.nmt.us).

9.2 Injector displays “INT ERROR”

Cause	Solution
The Injector has lost track of its motor position.	Turn the Injector off and remove any wire still loaded. Turn on the Injector. Press the **[OK]** key if the display says “No QCD OK?”. Next press the **[LOAD]** key followed by the **[OK]** key ***([ESC]*** *will not work)*. The Injector should now be ready to load wire and resume tagging.
The Injector’s internal circuitry has suffered an unrecoverable failure.	Return Injector to NMT with a repair request form (available at www.nmt.us).

9.3 Injector displays “CHK NEXT TAG”

Cause	Solution
The forward progress of the wire is blocked.	Check the wire path (head mold, needle, cutter, and wire guides) for burrs, debris or leftover tag wire that could be hindering the movement of the wire. Inspect the needle’s funnel and see if the needle itself is bent (see Needle Inspection and Maintenance, page 57).
The forward progress of the wire is not being driven properly (drive roller).	Confirm that the upper drive roller is tightened to its motor shaft, the idler roller can move freely when not engaged, and that the wire guides are not touching the drive roller.
The current cut edge is worn out and cutting inconsistent tags.	Inspect the cut edge being used (see Cutter Inspection, page 60) and if needed change cut edges (see Figure 12, page 34) or replace the cutter.
The tag location in the specimen is too hard.	If the message persists re-examine the biological structure of the specimen for a tag target which is not as hard. Proper needle penetration is important to tag retention. Contact NMT for recommendations of possible tag location options.

9.4 Tag wire unthreads and backs out when leaving LOAD mode.

Cause	Solution
The *SHOW* value is too small.	This can happen after the tag wire has seemed to advance normally, when switching from 2.5 inch needles to 3.5 inch needles without changing the *SHOW* value too. Increase the *SHOW* value to about where you think it should be (Table 3: Common Show values, page 33). Then load the tag wire and fine tune the SHOW (see Key: [SHOW], page 26)

9.5 Tag length varies.

Cause	Solution
Drive rollers are loose, wearing out, or dirty so that the tag wire slips or rides in a groove on the rollers.	Tighten, replace, or clean the rollers respectively.
A wire guide is rubbing against the drive rollers.	Readjust the wire guide(s) (page53).
[SHOW] value is too low.	Adjust [SHOW] so that cut tags are pushed to the end of needle (see Key: [SHOW], page 26).
Cut edge is worn out	Inspect the cut edge being used (see Cutter Inspection, page 60) and if needed change cut edges (see Figure 12, page 34) or replace the cutter.
Cutter is misaligned from a foreign substance, preventing the cutter from being fully seated on the cutter block.	Check for stray tags or debris on mating surfaces of cutter flange and cutter block.

9.6 Injector indicates “CUTTER STUCK”

Cause	Solution
The cutter is jammed with tag wire and cannot complete its cycle.	See section 9.10 The tag wire jams. (page 78).
The cutter pin and sleeve are seized together from dried foreign matter or corrosion.	Great care must be used when attempting to separate a seized pin from its sleeve. These two parts are made of carbide. Carbide is very hard but also very brittle and susceptible to breaking. Separate at your own risk. Feel free to send the cutter to NMT if you would like us to attempt to separate the pin from the sleeve for you. Using a screwdriver, pliers or putting the cutter in a vise is almost certain to cause misalignment or breakage. If the pin cannot be removed from the sleeve after the cutter is removed from the Injector, put the cutter in an ultrasonic cleaner (most jewelers have these) with tri-sodium phosphate (TSP) based detergent solution for one hour. This usually allows the pin to be removed from the sleeve by hand. If you have any questions, please contact NMT.
The cutter motor or its associated circuitry has failed.	Return Injector to NMT with a repair request form (available at www.nmt.us).

9.7 A tag is not ejected from the needle.

Once the injector is set up, it is customary to cycle it through a few injections without tagging an animal to ensure it is working as expected. Sometimes during this testing, the tag will not be ejected from the needle each time the injector is cycled.	
Cause	Solution
There is moisture in the needle.	The hydrostatic force of the water combined with the size of the tags can be enough to make the tags stick together. This is normal. When the tag is injected into the specimen, the force of the tissue on the tag should be enough to overcome the hydrostatic force on the tag.
The *SHOW* is too small.	Increase the *SHOW* value to about where you think it should be (Table 3: Common Show values, page 33). Then load the tag wire and fine tune the SHOW (see Key: [SHOW], page 26).
The needle carrier is out of adjustment.	Check the needle carrier's installation/adjustment (Needle Carrier Installation page 53). Inspect the needle carrier and inside of the head mold holder for stray tags or other items which could be interfering with proper operation (see Needle Carrier, page 61).
The firmware needs to be upgraded.	Contact NMT to see if you have the latest firmware.
Internal circuitry controlling the magnetizer has failed.	Return Injector to NMT with a repair request form (available at www.nmt.us).

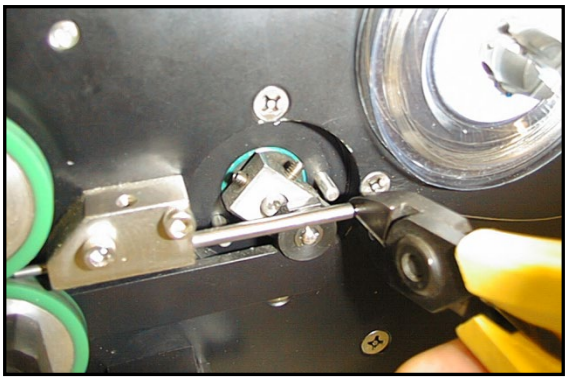
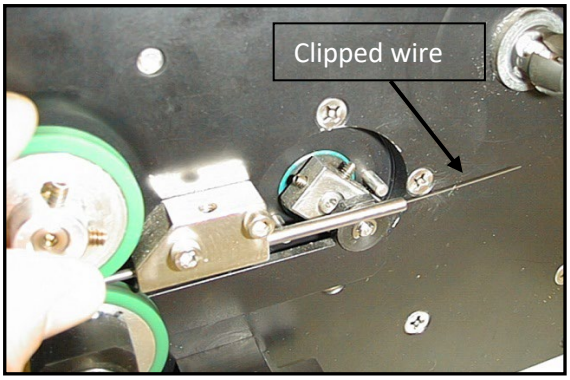
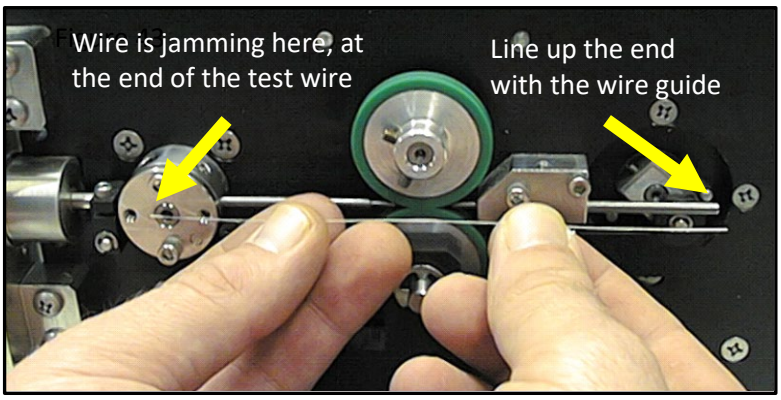
9.8 Injector cycles continuously.

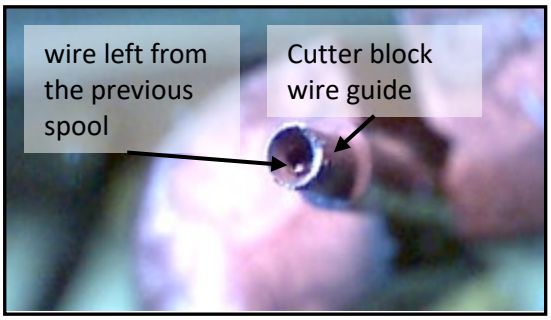
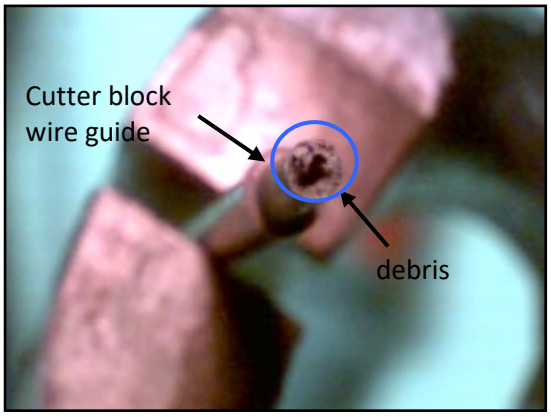
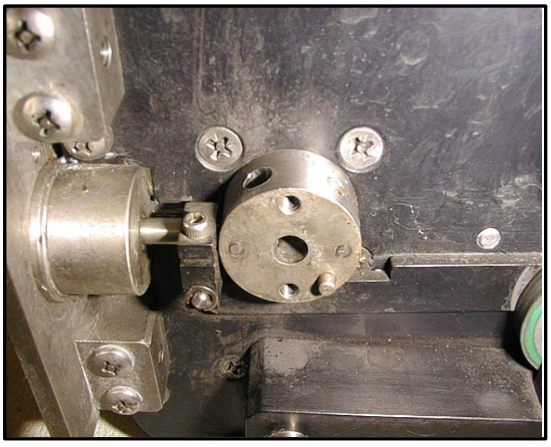
Cause	Solution
The *STOP* item in the [ADJ]ustment menu is set to 0 (see Item: STOP, page 31).	Press [TAG}], then set "STOP (0)" to a value other than zero (default is 1).
The blue tag button, on the front of the Injector (if equipped) or the touch switch has failed.	Disconnect the touch switch from the Injector. If the problem goes away, check the touch switch for a stuck button or damaged cable. Clean the touch switch (see Touch Switch , page 62). If the problem persists after removing the touch switch, return the Injector to NMT with a repair request form (available at www.nmt.us).

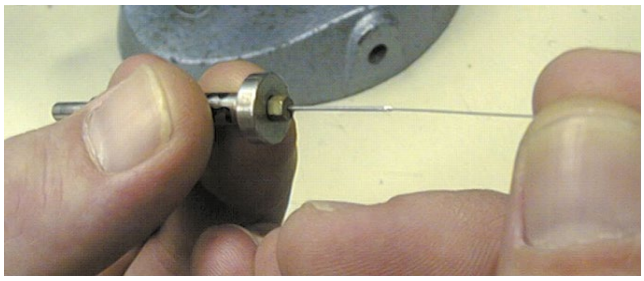
9.9 Injector cycles indicates “NEEDLE STUCK”.

The MKIV Tag Injector will sound an alarm and give the “Needle Stuck” error message if the actuator arm can’t complete its forward or return stroke.	
9.9.1 Needle stuck on the return stroke	
Cause	Solution
If the “Needle Stuck” message happens on the return stroke or when turning on the Injector, try the following to correct the problem:	1. Turn off the Injector. 2. Loosen the needle carrier clamp. 3. Turn on the Injector. 4. Follow the steps below.
If the problem went away	Remove the needle and needle carrier. Inspect for debris, stray tags or any other foreign objects in the head mold holder or stuck to the needle/needle carrier (pg. 61). Clean these areas. Install the needle and needle carrier (see Needle Carrier Installation, page 53 and Needle Installation, page 55).
If the problem did not go away, the clamp is probably hitting the cutter block.	1. Turn off the Injector. 2. With the clamp still loose, push the actuator arm forward so the clamp is approximately halfway between the cutter block and magnetizer. 3. Turn on the Injector. The clamp and arm will locate themselves to the proper position. 4. Press Load, push the needle carrier/needle all the way towards the cutter and tighten the clamp.
If the problem persists, then the actuator arm may be out of adjustment.	Readjust the actuator arm by following steps 2, 3, 7, 8 and 9, Injector Assembly , page 52.
9.9.2 Needle stuck on the forward stroke	
Cause	Solution
The head-mold is too far back and the needle carrier is hitting it.	Reinstall the head-mold slightly further out in the head-mold holder.
There’s debris on the inside of the head-mold that blocks the needle carrier.	Remove and thoroughly clean the head-mold.
The needle carrier clamp is broken, so does not hold the needle carrier.	Replace the needle carrier clamp.  Figure 57: Broken needle carrier clamp.
The end of the needle is running into something it can’t penetrate.	Try switching to non-etched needles if you are using etched needles. You may also need to consider a different tagging location.

9.10 The tag wire jams.

Determine where the MKIV Injector is jamming	
Figure 58: Turn on the injector and load the wire as far as it will go. Clip the wire evenly with the back of the wire guide.	
Figure 59: Turn off the injector and use the drive rollers to back the cut wire out.	
Figure 60: Hold the cut wire in front of the wire guide. Align the cut wire with the end of the wire guide, where you clipped it. The other end of the wire shows where the wire is jamming. In this case the wire is jamming at the entrance of the needle, just after passing through the cutter. Save this wire as it may be useful later.	

Cause	Solution
Wire is jamming between the front wire guide and the cutter	Sometimes the last piece of wire from the end of a spool will be forgotten in the wire guide (Figure 62) and needs to be removed. Check for wire in the front wire guide and that the wire guides are clear of debris (Figure 63).  **Figure 61: Inspect the front wire guides for leftover wire.**  **Figure 62: Inspect the front wire guides for debris.**
	Check the cutter and cutter block for excessive dirt and debris (Figure 64), stray tags (Figure 50, page 60) and damage (eg Figure 51, page 60.  **Figure 63: Excessive dirt on the cutter block will cause jamming**.

	Check the cutter for wire (Figure 50, page 60). If wire is found use the piece of tag wire cut earlier (the “measuring stick”) to push the stray wire out of the cutter.
Wire is jamming entering the needle	Clear any wire left in the wire path. Inspect the cut edge being used (see Cutter Inspection, page 60) and if needed change cut edges (see Figure 12, page 34) or replace the cutter.
	Check the needle carrier and needle for any wire (Figure 65), debris build up or stray tags.  **Figure 64: Wire left in the needle carrier (left) and debris on the needle carrier (right).** The piece of wire used to determine where the Injector is jamming, the “measuring stick”, is a useful tool to clear any wire out of the needle (Figure 66).  **Figure 65: Use a spare piece of tag wire to clean inside the needle.**
	Make sure the needle is straight and that the needle funnel is not damaged (Figure 46).
	Check that the needle carrier clamp is not broken (Figure 58, page 77).
	Make sure the needle carrier and needle are properly installed (see Needle Carrier Installation, page 53 and Needle Installation, page 55).

Wire is jamming in the cutter	Clear any wire left in the wire path. Inspect the cut edge being used (see Cutter Inspection, page 60) and if needed change cut edges (see Figure 12, page 34) or replace the cutter.
	Verify that the cutter sleeve is flush in its flange (Figure 51).
	Check that the spring behind the cutter motor drive pin is not stuck and that no debris is trapped there.
	Check for stray tags in the cutter block and on the cutter block-flange mating surfaces. Use the Arkansas stone in the MKIV tool kit to take down any high spots on the cutter block or inside of the flange.

9.11 Injector indicates "POWER LOW".

Cause	Solution
The DC voltage from the power supply to the Injector is too low.	Check the AC line voltage with a voltmeter if available. Check the DC voltage from the power supply at the 4 pin connector, between pins 2 (+VDC) and 4 (ground) that plugs into the MKIV Injector. This voltage should be at least 12 VDC for an Injector without a QCD or using a QCD with a water jet (solenoid) diverter. Press [BATT] on the key pad and confirm that the voltage, with the Injector and QCD at idle, is above 11.8 VDC (as read from the Injector's display). *If the Injector is using a QCD with a mechanical (actuator gate) diverter the voltage needs to be at least 24 VDC*.
The Injector is a MK4b and using a power supply whose output is not 24 VDC.	Verify that the Injector is a MK4b by observing the power-on message. If the power on message, following "NO QCD OK?" (if applicable), reads "MK4B V X.X" the Injector is a MK4b. If the Injector is a MK4b connect it to a power supply with an output of 24 VDC.

9.12 Nothing happens when Injector is turned on.

Cause	Solution
The Injector's circuit breaker is tripped or the internal fuse is blown.	The On/Off switch contains a circuit breaker. If circuit breaker has tripped it will automatically reset within about 1 minute. If the internal fuse has blown, return the Injector to NMT with a repair request form (available at www.nmt.us).
Power source or supply is faulty.	Verify there is power to the power supply (AC) or the batteries are charged (DC). Inspect for damaged pins or cable. Try another power supply if one is available.

9.13 The display reads “* RELOAD WIRE”.

Cause	Solution
MK4b only. The Injector shut down improperly and has lost the position of the wire.	Press the [LOAD] key. Clear the Injector of any tags by running the wire all the way out of the tip of the needle and wiping off the end of the wire. Press the [OK] key and cycle the Injector once by pressing the [TAG] key, thus ejecting the initial large piece of wire out of the Injector. The MK4b is now ready to continue tagging specimens.

10 Troubleshooting the QCD

10.1 The QCD is not detecting tags.

Cause	Solution
Specimen does not contain a tag.	Check insertion technique, tag placement depth, suitability of tag target area, head mold or positioning fixture suitability, drive roller condition and needle condition.
QCD threshold setting too high (see 31).	Check threshold setting. Setting should be about 50 for standard tags and 20 for a half-length tags that are horizontal to the tunnel, 15-20 for standard tags that are vertical to the tunnel.
Tag is not properly magnetized.	Check to make sure the Injector has not accidentally been set to "WIRE (MAG OFF)", see Item: WIRE (page 31). Confirm that the needle carrier is properly installed (see Needle Carrier Installation, page 53).
QCD Interconnect Cable is faulty or the connection is poor.	Reconnect or replace cable.

10.2 The QCD detects a tag but the tagged fish is not diverted.

Cause	Solution
The actuator/solenoid is not activating when the QCD detects a tag. Test the actuator/solenoid by pressing [SHOW] then [TAG]).	Unplug and plug back in the electrical connection to actuator/solenoid from the QCD gate box (Figure 3, page 10) and retry. Clean the solenoid if it is still not working. If it is a mechanical gate check if the gate fin is moving freely in the separator.

10.3 The QCD is sorting fish to the opposite side from before.

Cause	Solution
Hoses from the solenoid to the separator jets are reversed or the solenoid has been reassembled with the solenoid base subassembly and end cap on opposite sides.	Check that hoses from the solenoid are connected to the correct ports. Check that the end cap is in the correct port of the solenoid valve body (Figure 55, page 65).

10.4 The QCD diverter is working, but fish are not sorted properly.

Cause	Solution
Incorrect water pressure.	Check the water pressure to the QCD. Recommended flow is 2 gallons per minute at 40 psi. Check the amount of water that is diverted to the funnel and solenoid. If the funnel flow is excessive and the flow to the solenoid is restricted, the jets may not be able to influence the direction of the specimen. Check the QCD filter. A dirty filter can restrict the water flow.
The separator jets are not adjusted properly.	Alternate between each water jet by pressing [SHOW] then [STEP]. If necessary, a more direct stream of water can be obtained by bending back the deflector at the tip of the water jet.
The QCD DELAY is incorrect.	Check the QCD DELAY in the adjustment menu (Item: QCD DELAY, page 33). Larger specimens require more delay so that the water jet will stay on longer.
Solenoid will not turn off or water flows from both separator jets at the same time.	The rubber seal inside solenoid is stuck or damaged. Debris could be restricting the movement of the valve mechanism or excessive water pressure can damage the rubber seal. Disassemble and clean the solenoid, and replace the seal if necessary.
The mechanical gate is not properly attached to the separator.	Readjust the toe clamps (Figure 17, page 41).

10.5 The QCD activates erratically, even with no tagged fish present.

Cause	Solution
QCD threshold set too low.	Check threshold setting. If setting is lower than 10 change to 20 and retry. If erratic operation stops, retest to make sure tags can be detected at new setting.
Loose tags have fallen out of the fish into the detection head and are moved by a passing specimen or flowing water, causing the solenoid to activate.	Make sure tag placement depth is sufficient to avoid lost tags. Inspect the QCD for any loose tags near the entry funnel and where the entry funnel connects to the detection head. Use water to flush inside of the detection head to remove any stray tags.
QCD Interconnect Cable is faulty.	Replace cable.
Interference from magnetic sources or power supply is being picked up by QCD.	Check for sources of outside magnetic interference such as motors, generators, pumps etc. in the area. Position sources of interference farther from QCD if possible. If sources of interference must be close to QCD then position them perpendicular to the detection head rather than at the funnel or exit end. Check quality of power to Injector. Line noise on an AC line or voltage fluctuations from a generator can cause false QCD activations. Try increasing QCD threshold setting but be careful not to increase the threshold so high that tags can no longer be detected.
Electrical noise is being generated by improper AC power to Injector power supply.	In some instances we have found line power to be incorrectly supplied to a facility or tagging trailer. Usually problems have to do with incorrect grounding and wiring of the system. Improper installation of the U (3rd wire) ground has been a particular concern. A simple wire inspector trouble light can verify correct hook-up of the power outlet sockets. A voltmeter check to see if a potential difference exists between the wall outlet ground and nearby water pipe can also show if this is a problem.
Water may have gotten into the detector tube or its Electronics Box.	Substitute a known-working QCD; if problem goes away return faulty QCD to NMT for repair with a repair request form (available at www.nmt.us).

10.6 Water leaks from the QCD's filter housing.

Cause	Solution
The filter housing is not tightened down or the gasket seal is damaged.	Tighten the filter housing. If it's still leaking, remove the housing and inspect its gasket for wear. Replace the gasket if necessary.

10.7 QCD reject count is negative.

Cause	Solution
The number of QCD activations has exceeded the number of Injector cycles (see Key: [BATCH], page 24).	Remember, the QCD does not count missed tags but rather determines this number by subtracting QCD activations from Injector cycles. If the QCD has additional activations either from rechecking tagged specimens or by false activations from interference, then the QCD activations may exceed the number of Injector cycles and the reject count will be negative. For the same reason, if the Injector is intentionally cycled without tagging a specimen (for example during testing or setup) the number of rejects will be overstated. If you are using the QCD to recheck tagged specimens ignore the reject count as it will not be accurate. If the QCD has false activations from interference correct the problem or ignore the reject count. Always reset the BATCH counts after setup or testing so that the beginning values are zero.

11 Appendix A: Tool Kit Components

Tool Kit components and their identifying names are shown below. Since the contents are modified from time to time the exact appearance of the components may vary slightly.

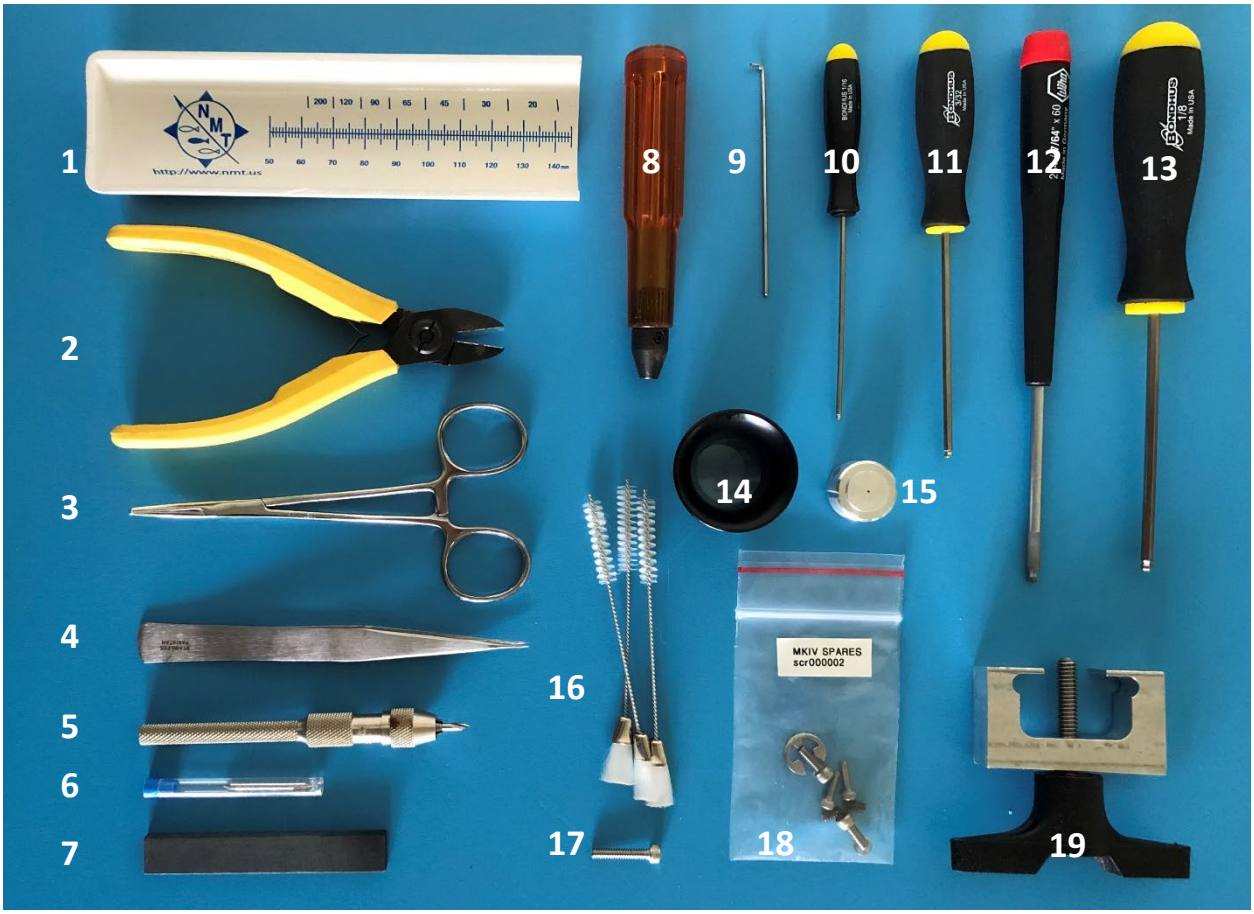


Figure 66: Tool kit components.

1. Fish sizer (1FISH00001)
2. Hard wire cutters (1CUT004720)
3. Hemostat (1HEM007530)
4. Forceps (1FOR006420)
5. Needle reamer (pin vise) (1PIN011680)
6. Needle reamer bit (1REA012120)
7. Arkansas stone (1SLI016880
8. 1/8 inch nut driver (1HEX007670)
9. 0.050 inch hex wrench (modified) (1HEX007535)
10. 1/16 inch hex driver (1HEX0075355)
11. 3/32 inch hex driver (1HEX007537)
12. 7/64 inch hex driver (1HEX007540)
13. 1/8 inch hex driver (1HEX007545)
14. 5X Magnifying loupe (1LOU009760)
15. Head mold base (to protect the needle) (1HEA00720)
16. Shaver brushes (1BRU001480)
17. 6-32 x ¾ inch screw for removing needle carrier (1SCR015180)
18. Spare screws and clips (1SCR00002)
19. Drive roller puller (1DRI000005)

12 Appendix B: Main-Plate Parts List

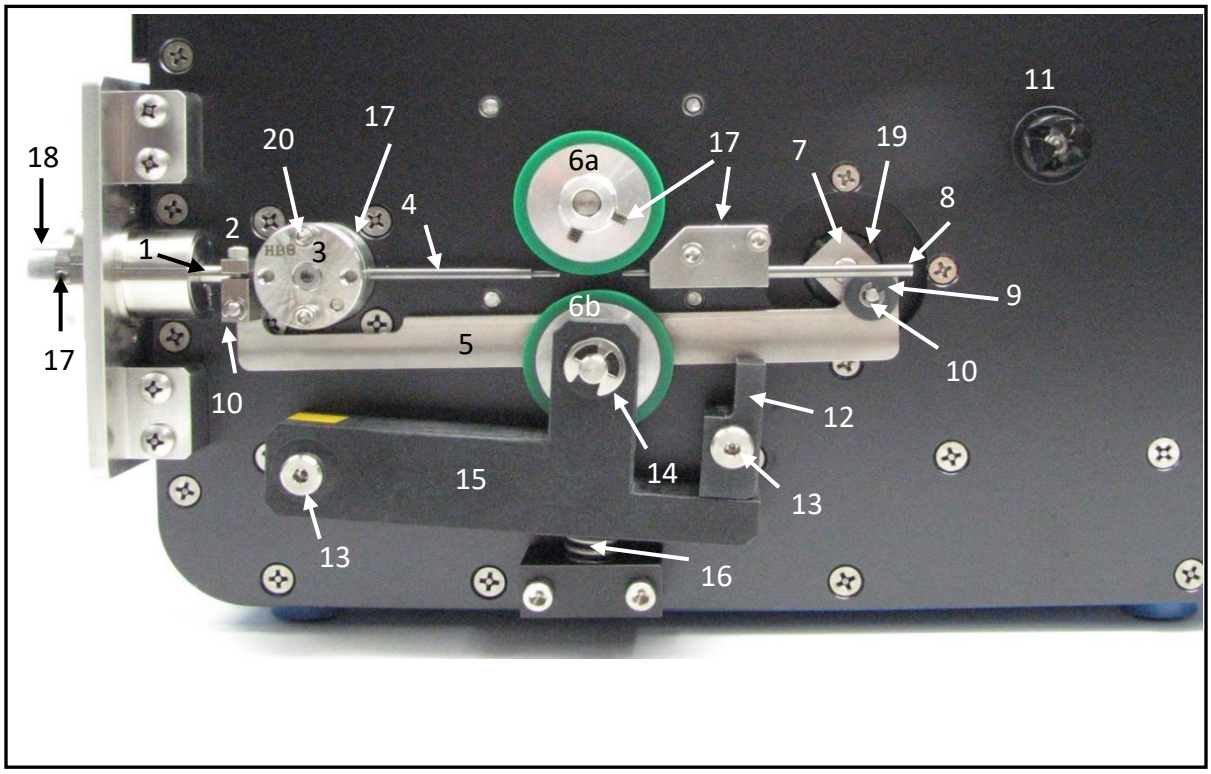


Figure 67: Injector main-plate.

This is a list of replaceable parts on the main-plate of a MKIV Injector. The name of the part is listed followed by the NMT part number in italics.

1. Needle carrier (with nut) - *NEE000009*
2. Needle carrier clamp – *NEE000008*
3. Cutter – *CUT000002*
4. Cutter block wire guide – *WIR020740*
5. Actuator arm – *NEE010661*
6. Drive roller set – *DRI000002*
7. Offset arm – *NEE010680*
8. Entry wire guide – *WIR020760*
9. Pin bushing – *NEE010740*
10. Small e-clip (2 places) – *RET014260*
11. Spool retainer – *SPO017180*
12. Drive roller latch – *PRE011980*
13. Shoulder bolt (2 places) – *SCR015780*
14. Large e-clip – *RET014280*
15. Idler roller arm – *PRE012000*
16. Pressure spring – *SPR017240*
17. 6-32 Ag tip set screw (6 places) – *SET016640*
18. Head mold base – *HEA007420*
19. 4-40 Ag tip set screw (2 places) – *SET016620*
20. 6-32 x 3/8 SS cap screw (2 places) – *SCR015140*

13 Appendix C: Adjustment Menu

Item	Options	Remarks
SETUP	See Appendix D, Setups	Sets certain parameters to pre-defined values
TAG LENgth	HALF, SINGLE, 1 ½, DOUBLE	Selects tag length
WIRE	NORMAL, EZ-FIND, NON-STD, MAG OFF	Magnetizer control
QCD THRESHold	0 through 255	Detection sensitivity - lower values are more sensitive
STOP	0 though 7	0 is free run. 1 through 7 select other stops in the injector cycle
NEEDLE MOVe	MAX, NO, S1 through S49	Activates, deactivates or mini-steps the needle move
MIN. TIME	0 through 255	Injector cycle time in hundredths of a second
QCD BEEP	0 through 5	Selects alarm tone
QCD DELAY	20 through 150	Solenoid valve “on” time in hundredths of a second
CUT EDGE	1 through 4	Selects cutter edge
TAG CREDIT	1 through 5	Number of injector cycles remembered against QCD activations
US-EUR	0,000.0 or 0.000,0	US or European punctuation

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14 Appendix D: Setups

Setup Name	Tag Length	Wire	QCD Thresh	Stop	Needle Move	Min. Time	Typical Use
Standard	Single	Normal	50	1	Yes	0	Most tagging
1 ½	1 ½	Normal	50	1	Yes	0	Large specimen, easier to detect
Double	Double	Normal	50	1	Yes	0	Large specimen, easier to detect
Custom 1	Single	Normal	50	1	Yes	0	Special operator setup[1]
Custom 2	Single	Normal	50	1	Yes	0	Special operator setup[1]
SPECIAL	X	X	X	X	X	X	Note [2]
HALF EZ	Half	EZ-Find	50	1	Yes	0	Not used
HALF	Half	Normal	20	1	Yes	0	Small specimen, harder to detect.

[1]As delivered, the Injector will have the values shown above for CUSTOM 1 and CUSTOM 2. The operator may change these values as described in the section covering the adjustment menu (page 30).

[2]Any set of adjustment values which does not correspond to the currently active setup (either pre-defined or custom) will show as SPECIAL. This alerts you that non-standard values are active so that unintentional changes do not take place.

15 Appendix E: Size Conversion Table for Salmonids

Size conversion table for salmonids based upon measurements of Chinook salmon. NMT stock Coho\Chinook head mold sizes are highlighted in yellow.

Numbers per pound	Grams per fish	Fork Lengths	
		Inches	Centimeters
1200	0.33	1.32	3.35
1100	Conversion not available		
1000	0.45	1.40	3.56
800	0.57	1.52	3.86
700	0.65	1.58	4.01
600	0.76	1.67	4.24
550	0.82	1.71	4.34
500	0.91	1.77	4.50
475	0.96	1.80	4.57
425	1.07	1.87	4.75
400	1.14	1.91	4.85
380	1.19	1.94	4.92
360	1.26	1.97	5.00
340	1.35	2.02	5.13
320	1.48	2.08	5.28
300	1.52	2.10	5.33
290	1.57	2.13	5.41
280	1.62	2.15	5.46
270	1.68	2.17	5.51
260	1.75	2.20	5.58
250	1.82	2.23	5.66
240	1.89	2.26	5.74
230	1.98	2.28	5.81
220	2.07	2.32	5.94
210	2.16	2.36	6.00

Numbers per pound	Grams per fish	Fork Lengths	
		Inches	Centimeters
200	2.27	2.40	6.10
190	2.39	2.44	6.20
180	2.52	2.49	6.30
170	2.69	2.53	6.40
160	2.84	2.59	6.60
150	3.03	2.64	6.70
140	3.24	2.69	6.83
130	3.49	2.80	7.08
120	3.78	2.85	7.20
110	4.13	2.95	7.45
100	4.54	3.03	7.70
90	5.04	3.13	7.95
80	5.67	3.26	8.30
70	6.48	3.41	8.66
65	Conversion not available		
60	7.56	3.56	9.10
50	9.08	3.81	9.70
45	Conversion not available		
40	11.54	4.13	10.50
30	15.12	4.51	11.46
20	22.68	5.17	13.13
15	Conversion not available		
10	45.36	6.52	16.56
9	50.00	6.73	17.10
5	Conversion not available		

16 Appendix F: Spare Parts and Accessories

The following items are recommended spare parts to have on hand. The operator should evaluate spare parts availability and delivery time when determining which spare parts to maintain for a particular operation. Most parts are available from stock with overnight delivery. However, any tagging operation which cannot tolerate 48 hours down time should maintain an adequate supply of critical spares. Customers outside the U.S. must remember that shipping time and customs clearance can substantially increase the amount of time required to obtain ugent spares.

- 1 Cutter
- 1 Needle Package
- 1 Interconnect Cable
- 1 QCD Solenoid
- 1 Set Drive Rollers
- 1 QCD Filter Screen with Gasket

17 Equipment Specifications

17.1 MKIV Tag Injector

Dimensions:	11” (28 cm) x 10” (25 cm) x 8” (22 cm) (l x w x h)
Weight:	17 lb. (8 kg)
Power requirement:	12 to 28 VDC, 50 watts maximum (with Separator Jet QCD). Power supplied from QCD Gate Box for units with a Mechanical Gate QCD.
Temperature range:	Operating 32 ºF to 122 ºF (0 ºC to 50 ºC)

17.2 Quality Control Device

Dimensions:	35”(81 cm) x 9”(24 cm) x 9”(24 cm) (l x w x h) w/o funnel, legs folded
Weight:	39 lb (18 kg)
Power requirement:	Separator Jet QCD - Power supplied through the Injector 24 V DC, 50 W maximum (mechanical Gate QCD)
Temperature range:	Operating 32 ºF to 122º F (0 ºC to 50 ºC)

17.3 Power Supply

Dimensions:	6.5” (165 mm) x 4” (102 mm) x 2” (51 mm) (l x w x h)
Weight:	2.6 lb
Input:	100-250 VAC, 50/60 hz
Output:	24 VDC

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