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A NEW FORM OF BARBED ATTACHMENT DEVICE FOR SHORT TERM SPEAR TAGGING OF FISH BY DIVERS AT SEA

by

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Summary

The "tank adapted" and "wild" fish are considered as subjects for behaviour experiments with ultrasonic tags at sea and it is suggested that in order to preserve the "wild" state, fish must either be caught, tagged and immediately released at the point of capture or tags must be attached without capture.

A diver held device; made from easily available materials; is described. This allows attachment of tags to fish for short term behaviour observation and the recommended procedure avoids handling and capture of the fish.

Introduction

There is a growing use of ultrasonic tags for short-term continuous monitoring of a fish's location in the sea both in the vicinity of fishing gears and in other behaviour studies. Because these experiments make use of elaborate and sophisticated detection and plotting devices, it is common practice to take back to sea a laboratory tank adapted fish. A fish in good physical condition is selected, a tag is attached and the behaviour of the released fish is thus followed. This practice of using tank adapted fish has been forced on the experimenter by the serious drawbacks inherent in fish caught at sea, which suffer physical and physiological setbacks that may last for days or even weeks when kept in captivity.

Detailed physiological studies have shown that marine fish undergo extreme long-term physiological changes when transferred from the wild to the captive environment (reviewed by Wardle 1972a and b). These changes are not necessarily reactions to alterations in the physical properties or chemical composition of the water in which the fish is placed as these can be matched. It is important to realise that internal physiological changes can result from activity of the nervous system triggered by sensory inputs generated by the changes in the situation of the individual. These internal upsets can be considered as chains of physiological regulatory activity set off by the complex stimuli of capture and captivity and are not avoided by careful control of the physical conditions of the new environment. Tank adaptation is a slow recovery from such a chain of upsets and results in a final stable state. However, it is not clearly understood what difference remains between the "tank adapted" and "wild" fish. It can be argued that the difference will be corrected by the release of the fish. In contrast there is a growing indication that the enforced change of environment causes disturbances that might be particularly relevant in the behaviour study and that continuity of the "home" environment is more important in the context of a behaviour study.

It has been shown that attachment of an ultrasonic tag does not alter the behaviour of tank adapted cod that were trained during tank adaptation to race between feeding lights (Wardle and Kanwisher in press). The importance of the continuous "home" was indicated in this experiment where the cod were adapted to the "home" tank and trained to come to flashing lights for food. After training, the cod were caught, anaesthetised, tagged and then released back to their "home" tank and immediately on recovery from the anaesthetic, they responded to the feeding light. The few experiments with transferred cod fitted with locating transmitters have shown that the fish move back to the location from where they were caught (A. D. Hawkins, personal communication). Similar experimental results have long been known for salmon and trout. Experiments in the 10m circular tank at Aberdeen have also demonstrated the sense of familiarity shown by cod for their own part of the tank compared to an extreme nervous awareness when introduced to an unexplored but otherwise identical part of the same tank (Wardle and Anthony 1973).

To take a tank adapted fish and release it to some random spot in the open sea with which it is quite unfamiliar is likely to lead to a type of behaviour associated with readaptation that will not be typical of a wild fish. Behaviour much nearer to that of the wild fish might be expected from either a fish caught, tagged and immediately and carefully returned to the place of capture, or better still by a fish tagged without capture.

A clear advantage of the fish tagged without capture over one caught and then returned immediately is that however carefully a fish is handled it will, during capture, always exercise its white (anaerobic) muscle in its frantic efforts to escape hook or codend. We now know that 2-5 minutes of this type of muscular work will leave this fish with an oxygen debt, an inability to perform escape reactions and a behaviour pattern dominated by rest and seek shelter behaviour that will certainly last 10 hours and possibly up to 24 hours after release depending on the severity of the exertions (Wardle 1967, 1971). The released local fish is likely to be better off than a released laboratory tank adapted fish in that the local fish can seek shelter within its familiar "home" territory during recovery while the tank fish has the added nervous stress of being in unfamiliar territory and might have an induced behaviour urging it to move to its own home territory.

With these unresolved observations in mind the technique described below was developed so that fish might have ultrasonic transmitters attached with as little disturbance to their natural behaviour as possible.

Design and Construction

The structure of the tag attachment device with its components and dimensions labelled is shown in Figure 1. The metal parts were shaped (while wetted with water) by use of a dental drill with various standard dental grinding wheels, cutting discs, burrs and drills. The main shaft is cut from a number 14 gauge stainless steel hypodermic needle. A groove is ground through one side to allow the entrance of a length of number 18 gauge hypodermic needle shaped as shown to form the barb and made to lie in the groove of the 14 gauge needle, with its point protruding, to activate the barb. The inner end of the barb is drilled from one side through the other side and is thus made to hinge on a piece of monofilament nylon (0.2-0.4mm OD) that also passes through two aligned holes drilled in the 18 gauge shaft as shown (Fig 1). The hinge is sealed by heating the outer ends of the nylon and pressing so that they become flush with the outside walls of the shaft. A thicker (0.9mm OD) monofilament nylon crossbar is fitted to act as a stop to prevent further penetration and a knotted thread (Ethicon Mersilk Braided R 836/2) is passed in through the squared end and pulled out through the lateral hole. Both ends of the shaft are filled with quickset resin to prevent clogging with tissue and to seal in the crossbar and cord (the hinge area is kept clear of resin).

The applicator (Fig 2) is a stainless steel rod 60 cm long and 8 mm diameter machined to a useful fine point at one end and squared at the other end. A piece of PVC sleeving 3 cm long (Radio Spares, London, 8 mm sleeving) fits tightly over the squared end and is made to protrude 1 cm beyond the end of the rod so that a cylindrical cavity is formed 1 cm long and 8 mm in diameter. A split portion of the same sleeving 1 cm long is coiled and fitted into this cavity so its outer edge is flush with the end, thus forming a PVC spring (Fig 2). The shaft of the tag attachment device is easily pushed into the end of the sleeving on the rod so that the shaft meets the end of the rod and is held firmly in place by the PVC spring (Fig 2).

The diver spears the fish (in the lateral muscle at normal tagging positions) with the attachment device. The crossbar limits penetration of the shaft and on withdrawing the rod, the barb on the device opens and the shaft of the device remaining in the fish is pulled from the plastic socket. The label or sonic transmitter previously tied to the cord is thus attached to the fish with no handling and the minimum of disturbance.

The fish can be accumulated in an area before diving by feeding or they can be tagged by chance encounter. The pointed end of the applicator rod can be used to recover the tagged fish. A 10 cm length of sleeving can be slid along the rod to 20 cm from the inner end of the socket to act as a scale in photographs. It is clearly useful if a second diver can make photographs at the time of tagging including the scale on the applicator rod to indicate the size of fish and the position of attachment.

Results

In the field test a 30 cm plaice, encountered at sea, was speared with the device while resting on the sand. The immediate reaction of the plaice was to bury deeper into the sand, and it was reluctant to move off. However, after chivvying the fish swam away and could be followed and identified and was later speared and the tag examined. The attachment was so firm that the barb had to be broken at the hinge in order to remove it. Tests on the feasability of spear tagging and development of the practical technique were made previously at sea using straightened fish hooks and further wastage of attachment devices was not thought necessary. Tests on the attachment device were made while optimising its dimensions using plaice held in tanks on the research ship and the device proved reliable for periods up to two weeks. Longer tests were not performed.

Future developments

In experiments with roundfish it will be exceedingly difficult to tag by encounter or by baiting and it is expected that capture by line or by codend followed by tagging on the bottom might prove successful. In this case the device does avoid the handling and pressure changes but not the inevitable exhaustion generated during capture.

A pair of electrodes can quite simply be threaded into the shaft and barb respectively of the attachment device for metering electrical activities when using ultrasonic tags designed to transmit physiological information such as heart rate (Wardle and Kanwisher in press). The device would then be inserted at the monitoring point and would serve both as bipolar electrode and attachment device.

References

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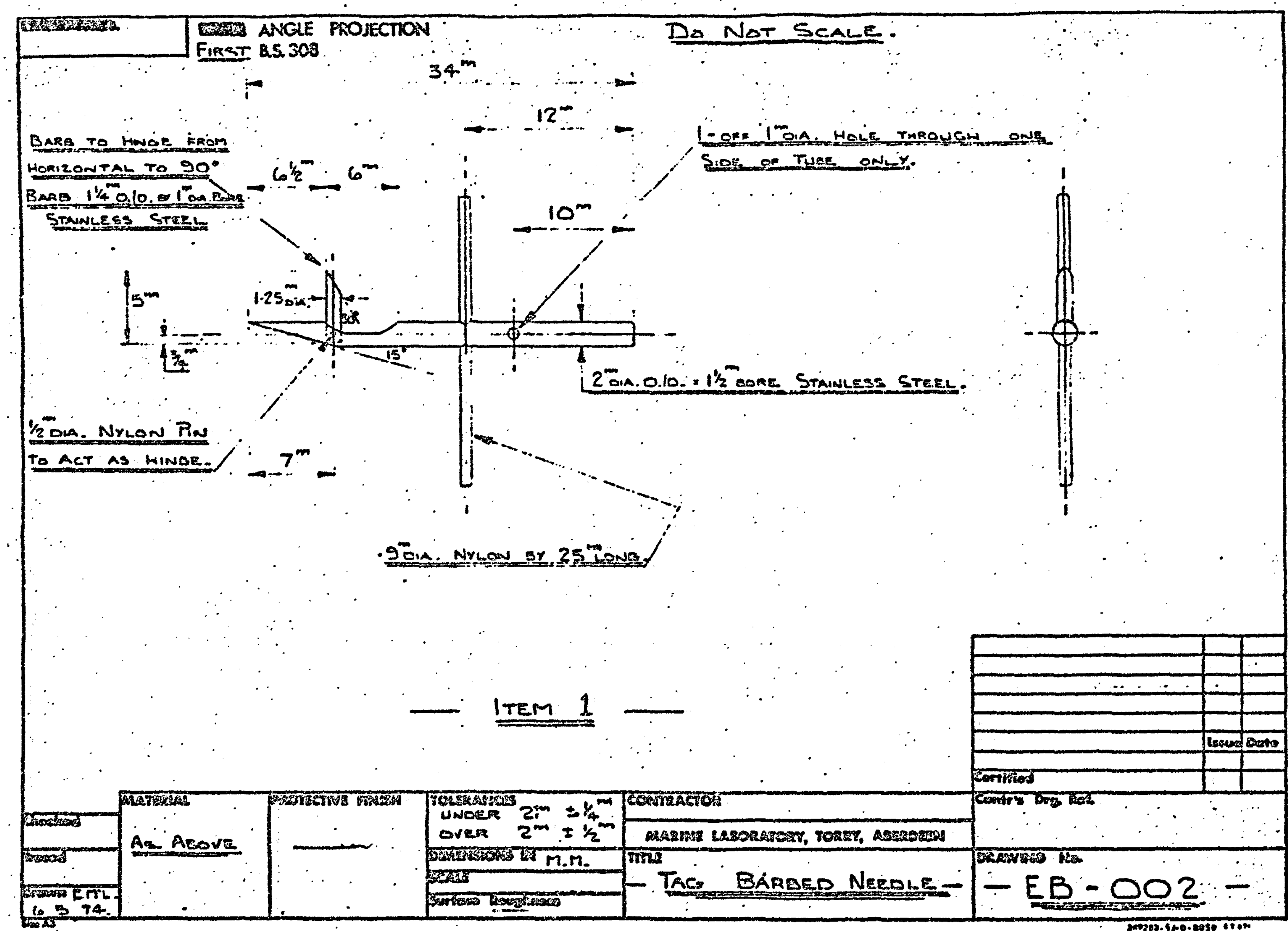
ANGLE PROJECTION
FIRST B.S. 308
DO NOT SCALE.
34 mm
12 mm
BARB TO HINGE FROM HORIZONTAL TO 90°
BARB 1¼ O/D. & 1 mm DIA. BORE STAINLESS STEEL
6½ mm
6 mm
1-OFF 1 mm DIA. HOLE THROUGH ONE SIDE OF TUBE ONLY.
10 mm
5 mm
1·25 DIA.
30°
15°
¾ mm
2 mm DIA. O/D. × 1½ mm BORE STAINLESS STEEL.
½ mm DIA. NYLON PIN TO ACT AS HINGE.
7 mm
·9 mm DIA. NYLON BY 25 mm LONG.
ITEM 1
Issue Date
Certified
Checked
Traced
Drawn E.M.L. 6.5.74.
MATERIAL
AS ABOVE
PROTECTIVE FINISH
TOLERANCES UNDER 2 mm ± ¼ mm OVER 2 mm ± ½ mm
DIMENSIONS IN M.M.
SCALE
Surface Roughness
CONTRACTOR
MARINE LABORATORY, TORRY, ABERDEEN
TITLE
TAG BARBED NEEDLE
Contr's Drg. Ref.
DRAWING No.
EB - 002

Fig 1

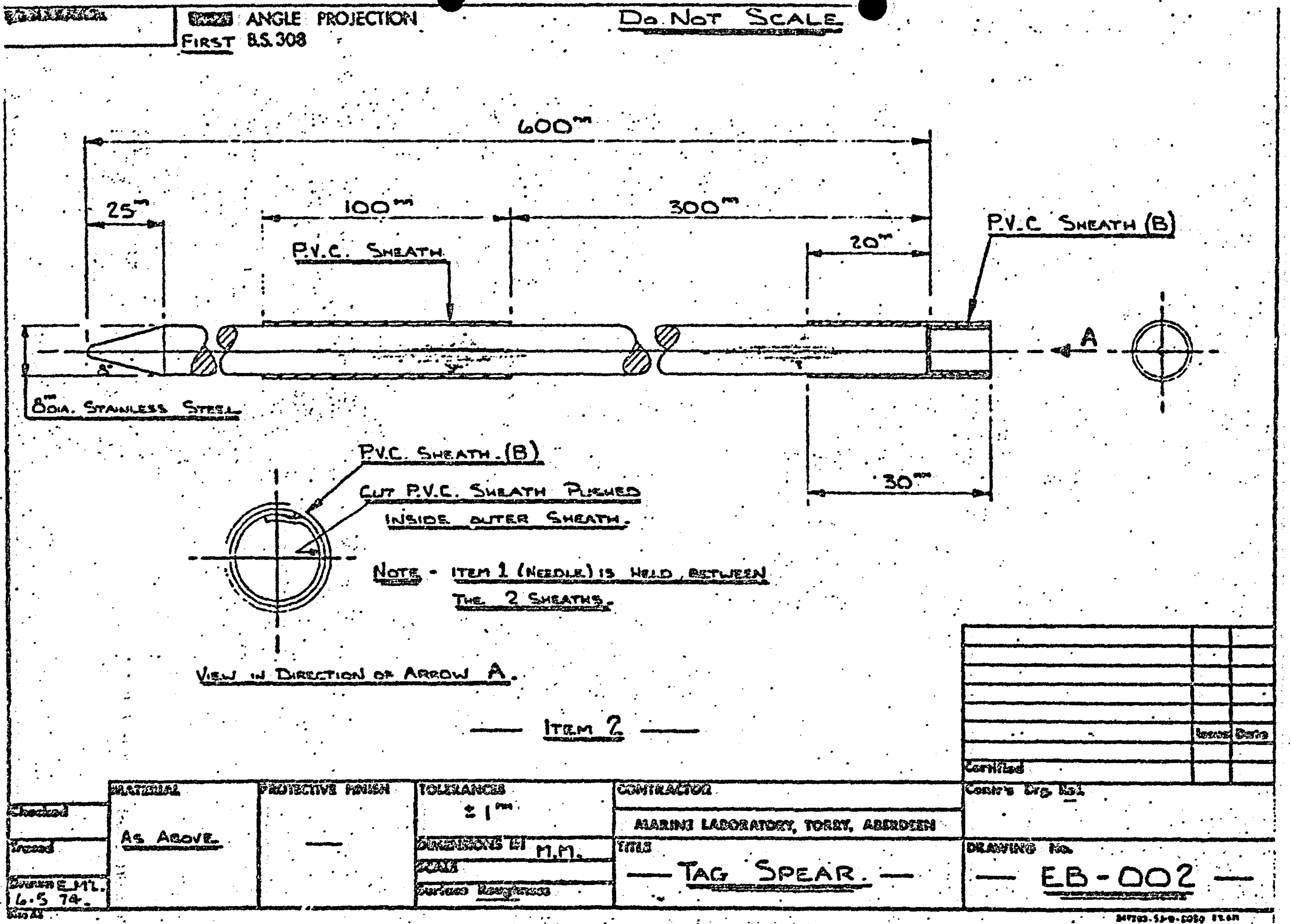
ANGLE PROJECTION
FIRST B.S. 308
DO NOT SCALE
600mm
25mm
100mm
300mm
20mm
P.V.C. SHEATH
P.V.C. SHEATH (B)
A
8°
8mm DIA. STAINLESS STEEL
30mm
P.V.C. SHEATH. (B)
CUT P.V.C. SHEATH PUSHED INSIDE OUTER SHEATH.
NOTE - ITEM 1 (NEEDLE) IS HELD BETWEEN THE 2 SHEATHS.
VIEW IN DIRECTION OF ARROW A.
— ITEM 2 —
MATERIAL
AS ABOVE.
PROTECTIVE FINISH
—
TOLERANCES
± 1mm
DIMENSIONS IN M.M.
SCALE
Surface Roughness
CONTRACTOR
MARINE LABORATORY, TORRY, ABERDEEN
TITLE
— TAG SPEAR. —
Contr's Drg. No.
DRAWING No.
— EB-002 —
Certified
Issue Date
Checked
Traced
Drawn E.M.L.
6.5.74.

Fig 2