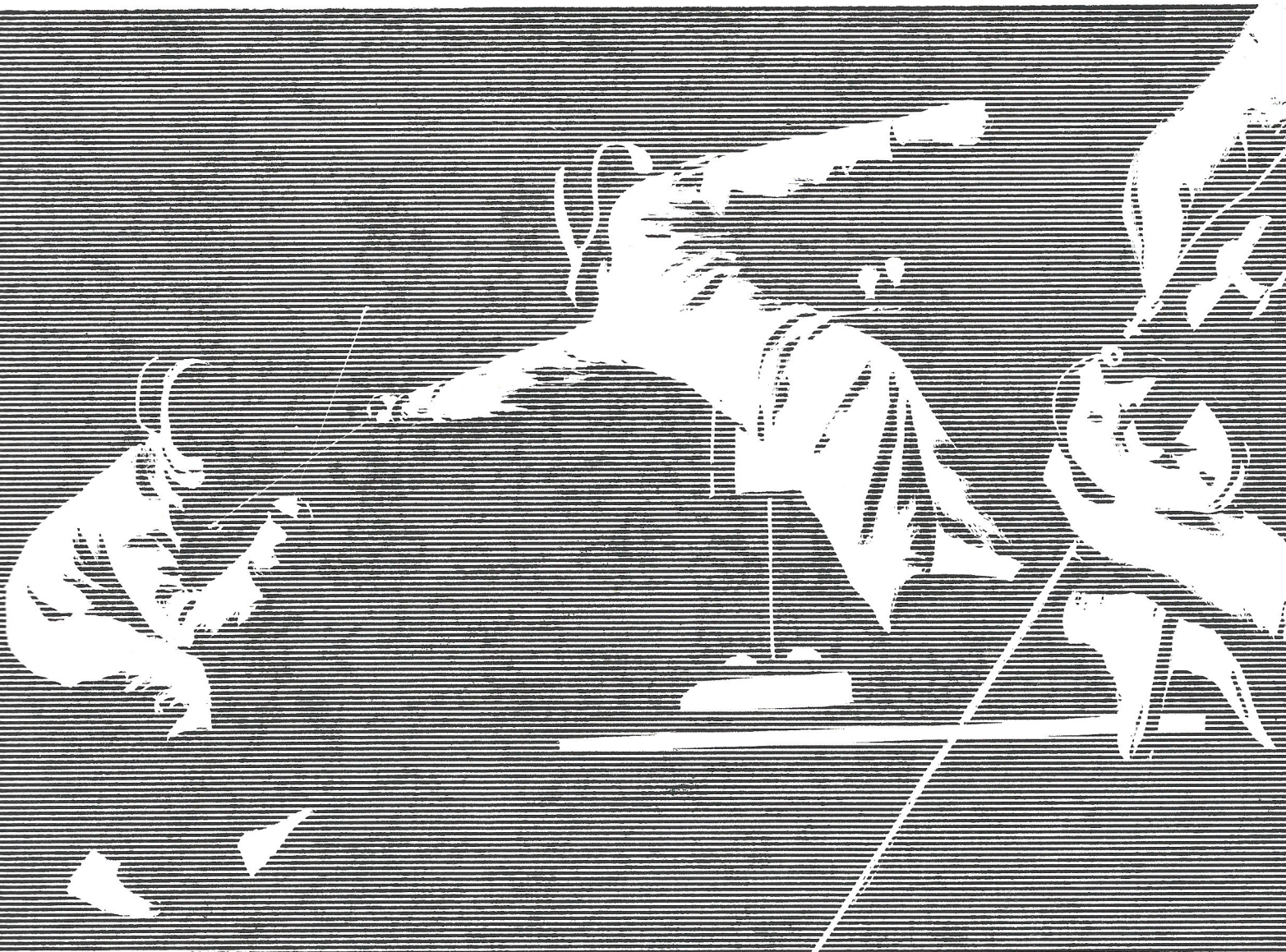


A practical guide to simple fault finding on electric foil equipment

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3/6



<i>Section</i>	1	How to use this Booklet and the special Fault Finding Kit
	2	Introduction
	3	About the Equipment
	4	The Background to Fault Finding
	5	Non-valid Hit registers Continuously
	6	Non-valid Hit registers Intermittently
	7	Valid Hit registers as Non-valid
	8	Hit fails to Register
	9	Non-valid Hit registers on the Guard
	10	Installation Checks: Faults occurring immediately after Connecting up the Equipment
	11	Unusual Faults
	12	Annulment of a Hit after a Fault

1 How to use this Booklet and the special Fault Finding Kit

First read Sections 2 and 3 so that you can identify the different parts of the equipment, and are quite familiar with the way in which they are connected together. To do this it is, of course, essential to follow the text through on an actual equipment. Next read Section 4, which provides you with background which will help you whatever fault you are trying to trace. Finally, find the Section which deals with the particular fault which you are experiencing, and carefully follow it through.

The Fault Finding Kit consists of:

One foil connecting socket

One 3-pin connecting socket

Two 3-pin connecting plugs

Note that these special items are not suitable for normal use because two of their connections are wired together for testing purposes (see Section 5 paragraphs a, c and e).

2 Introduction

Almost every fault occurring on the electric foil equipment can be found easily – if you go about it the right way.

This booklet shows the right way, which will enable you to find out in which part of the equipment the fault is. All you then have to do is to replace the faulty part (be sure spares are available) – you are not expected to repair it.

You do not need to understand what goes on inside the box – this booklet does not attempt to explain it – and all you need to know about electricity is that it is conducted by wires but not by insulators.

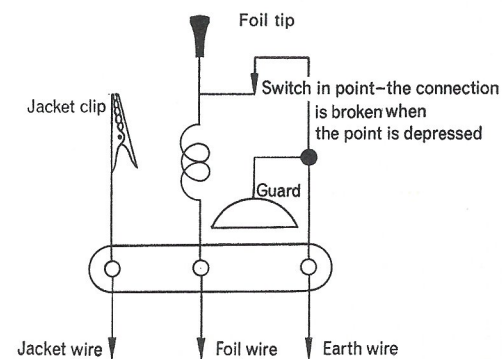
3 About the Equipment

Each fencer is connected to the box by three separate wires, which run from the box along the connecting cable to the spool, and along the spool cable to the body wire. At this point one wire is connected through a clip to the fencer's metallised jacket, and the other two run up the jacket and along the sleeve, and are connected to his foil through a plug and socket. One of these two wires is connected to the tip of the foil, and the other is connected to the guard.

Thus the three wires are the jacket wire, the foil wire, and the guard wire which is usually called the earth wire.

The foil tip contains a switch through which the foil wire is normally connected to the earth wire. When the foil tip is pushed in this connection is broken, but the tip remains connected to the foil wire. If you look at a plug or socket on the equipment (other than those which connect up the foil) you will see that two of the connections are close together and the third is spaced further away. This enables each individual wire to be identified – the outside connection of the two spaced close together carries the jacket wire, the centre connection carries the foil wire, and the connection spaced away on one side carries the guard or earth wire.

The following diagram summarises the connections:



4 The Background to Fault Finding

Fault finding is impossible without memorising which wire goes to which connection. An easy way of doing this is to note the initial letters of each wire – *Jacket, Foil, Earth*. An appropriate mnemonic is ‘*Jolly Faulty Equipment*’. There are still a few more simple things you need to know about the equipment before we can get down to tracing faults and putting them right.

Assume we call the fencer on the president’s left, fencer L, and the other fencer, on his right, fencer R. Then, in an equipment which is working normally:

- a) If the foil tip of fencer L is pushed in when in contact with the jacket of fencer R a coloured lamp will light against fencer R. This is what happens when a valid hit is scored.
- b) If the foil tip of fencer L is pushed in when in contact with anything connected to the earth wire the equipment is unaffected and no lamp will light. This is what happens when a hit is made on the guard, or on a metal piste connected to the earth wire.
- c) If the foil tip of fencer L is pushed in without being in contact with either the jacket of fencer R, his guard, or the metal piste, a white lamp will light against fencer R. This is what happens when a non-valid hit is scored, or if the point is pushed in by hand.

This is all you need to know about how the equipment works. If you have not been able to understand it, try reading it again with the equipment (and two co-operative fencers) in front of you.

Faults are always caused either by an open circuit, which is a break in a wire so that it no longer passes electricity when it should, or a short circuit, which is an electrical connection between two wires, which should be insulated from each other, so that electricity passes from one to the other when it should not. The only exception to this is a fault caused by a wrong connection which may be found when the equipment is first switched on after installation (see Section 10).

Fault finding consists of conducting tests in a logical order to determine if the open or short circuit is in the foil, body wire, cables, or box, and replacing whichever item is faulty.

To be a successful fault finder you must keep to these golden rules:

- a) Always do your tests in a logical order—ignore intuition. Always start by testing the foil, then test item by item working backwards towards the box until the faulty item is found. Trying to guess where the fault is, or taking short cuts, will waste time in the long run and will also confuse you.
- b) Make sure you are the only person testing. Do not even allow one of the fencers to change his foil until your testing shows that it is faulty. While you are testing on one side, be sure there is no interference with the equipment of the fencer on the other side – especially by the fencer himself.
- c) Before starting to trace a fault, have it demonstrated so that you are quite certain what it is. Do not accept other people’s description alone.
- d) Before starting, be sure the fault lies in the connections to the fencer you are testing, and not in the connections of the other fencer. The test procedures described in Sections 5 to 10 explain which

side you should be testing.

e) If you have conducted your fault finding logically your diagnosis of the faulty item must be correct. If you find that when this is replaced the fault persists, make sure that the replacement is not also faulty.

It is not uncommon for foils, body wires, and even spools which are already known to be faulty, to be put back into service. Alternatively, even items not already known to be faulty may in fact be so. Conversely, if you find an item faulty, try to get it marked so that it is not used again without being repaired.

f) An analysis of actual faults experienced shows that they are confined almost entirely to the foil, jacket, body wire, and spool. Faults in the connecting cable, or box, are extremely rare. Bear this in mind when you are fault finding – do not blame every fault on the box.

g) If the equipment runs from an accumulator, be sure this is charged. It may run down during a competition (see Section 11).

h) In the procedures outlined it is assumed that the box will be reset as necessary during testing. If there is some one to do this for you it will save time.

i) At those points in the fault finding procedure where you get a positive result (i.e. a lamp is lit) you should repeat the test more than once in order to be quite sure. If for any reason you should obtain a false result or interpret a result incorrectly, your fault finding procedure may be unsuccessful.

Now let us consider what the actual testing procedure is for finding the most common faults.

5 Non-valid Hit registers Continuously

A non-valid hit registers against fencer R immediately the reset button is released. Now remember that a non-valid hit would be registered against fencer R when the foil tip of fencer L is pushed in (see Section 3 paragraph c) because this breaks the connection between the foil and earth wires in the circuit of fencer L.

What has happened is that even when the foil tip of fencer L is not depressed these two wires are not connected together – in other words there is a break or open circuit in either the foil or earth wires connecting fencer L to the box.

So the first thing to note is that although the non-valid hit is registered against fencer R, the fault is somewhere in the wires connecting fencer L.

To find where the fault is, proceed as follows:

a) Disconnect fencer L from his foil, and connect the foil socket provided with the Fault Finding Kit to the end of his body wire (this socket connects the foil and earth wires together).

Note that if the Fault Finding Kit is not available, testing can be continued by connecting the foil and earth wires together in some other way, such as with a coin. But this is not recommended because such alternative means do not make a reliable connection, and so introduce a confusing element of uncertainty into the testing procedure.

b) If the non-valid hit does not re-appear, the fault is in the foil of fencer L. Replace it.

c) If the non-valid hit against fencer R persists, disconnect the body wire of fencer L from his spool wire, and plug the spool wire socket into the special plug provided (this plug connects the foil and earth wires together).

d) If the non-valid hit does not re-appear, the fault is in the body wire of fencer L. To make sure before he threads it through his jacket, connect it from his foil to his spool cable socket and check that the fault is cleared.

Note that a quick way of threading through a body wire is to tie it to the faulty body wire at the back, and gently pull the faulty wire out through the sleeve; as the faulty body wire is withdrawn, the new wire is pulled through.

e) If the non-valid hit persists, disconnect the cable connecting the box and the spool from the spool and connect it to the special fault finding socket provided (this socket connects the foil and earth wire together).

f) If the non-valid hit does not re-appear the fault is in the spool. Replace it.

g) If the fault persists, connect the special fault finding plug directly into the box.

h) If the non-valid hit does not re-appear, the fault is in the connecting cable.

Replace it.

i) If the non-valid hit persists the fault is in the box. Replace it.

6 Non-valid Hit registers Intermittently

A non-valid hit registers at intervals against fencer R without fencer L having evidently made any hit (see section 9). Note first of all that a non-valid hit might have been made by fencer L without this being apparent, so be certain that there really is a fault. If there is, it is caused by an intermittent break in the foil or earth wires connecting fencer L to the box, or a fault in the foil tip of fencer L. It is necessary to find where this intermittent break is.

Note – if while you are tracing the fault it becomes permanent, go on from the point you have reached as in Section 5.

Proceed as follows;

a) Beat the foil of fencer L with your hand or with another foil. If a non-valid hit appears against fencer R, check that the body wire plug of fencer L is properly connected to his foil, and if so replace his foil. If the plug was not properly connected this may have caused the fault.

b) Beat the new foil to check that the non-valid hit does not re-appear.

c) If the fault is not cleared by (a) or (b), check the body wire of fencer L. The most usual place for an intermittent fault is where the body wire enters the plugs at each end. Hold each plug in turn and bend the body wire from side to side and also pull it gently away from the plug.

Note — when testing the plug which goes into the foil, be sure you are not causing a non-valid hit to appear by disconnecting the plug from the socket inadvertently. If the non-valid hit re-appears replace the body wire as outlined in Section 5 paragraph (d).

d) If the intermittent non-valid hit still persists, the fault is almost certainly in the spool cable, although intermittent faults are less usually found here.

7 Valid Hit registers as Non-Valid

Place fencer L at about the same position on the piste as he was when the intermittent non-valid hit was registered, and pull the spool cable gently out of the spool a number of times, allowing it to rewind between each pull. If the non-valid hit re-appears, change the spool.

Fencer L hits fencer R on the target, but the hit registers as non-valid. Note that if fencer L is testing on fencer R at the start of a fight by making a non-valid followed by a valid hit, this fault will make it appear as if no hit is registered when fencer R is hit on the target. Do not let this deceive you as to the nature of the fault. As explained in Section 3 paragraph (a), a valid hit is registered on fencer R when the foil tip of fencer L is depressed when in contact with the jacket wire of fencer R. There must therefore be a break in the jacket wire connection to the jacket of fencer R, or his jacket is making bad contact with the foil tip of fencer L. Note that in this case the fault lies with fencer R, not fencer L.

Proceed as follows:

- a) If the fault appears when fencer R has just come on the piste at the start of a bout, he has almost certainly forgotten to connect his jacket wire clip to his metallised jacket. Check and retest.
- b) If a non-valid hit still appears it may be due to fencer R having a poor connection between the clip and the metallised jacket. Clip to another part and retest.
- c) If a non-valid hit still appears, it may be due to fencer R having a faulty metallised jacket. Check this by making hits with the foil of fencer L on various parts of the jacket of fencer R. Even if there is only one spot where a hit registers as non-valid, fencer R must replace his jacket.
- d) If a non-valid hit still persists, withdraw the spool cable socket about one-quarter inch from the plug at the end of the body wire of fencer R, taking care that the plug and socket remain connected. Place the tip of the foil of fencer L against the jacket wire pin on the plug which is

now exposed (to check which pin this is, see Section 3), and making sure the two are in contact, depress the tip by pushing on the foil blade.

If a valid hit is registered, replace the body wire of fencer R, as outlined in Section 5 paragraph (d).

e) If a non-valid hit is still registered, withdraw the connecting cable plug about one-quarter inch from the socket on the spool, and test with the tip of the foil of fencer L as described in paragraph (d) above.

If a valid hit is registered, replace the spool.

f) If a non-valid hit is still registered, withdraw the connecting cable plug about one-quarter inch from the socket on the box, and test with the tip of the foil of fencer L as described in paragraph (d) above.

If a valid hit is registered, replace the connecting cable.

g) If a non-valid hit is registered, replace the box.

8 Hit fails to Register

Fencer L cannot register either a valid or a non-valid hit. Remember that fencer L registers hits because when his foil tip is depressed the connection between his foil and earth wires is broken. If this connection is not broken when the tip is depressed, no hit will be registered. The fault is therefore a short circuit between the foil and earth wires connecting fencer L to the box.

Proceed as follows;

- a) The most common cause of this fault is that the foil tip of fencer L is stiff, and is not depressed when he makes a hit. Depress it by hand, and if a non-valid hit is registered, replace the foil.
- b) If no hit is registered, unplug the body wire of fencer L from his foil. If a non-valid hit appears, the fault is elsewhere in the foil of fencer L. Replace it.
- c) If no hit appears plug the foil in again and completely withdraw the plug on the end of the body wire from the socket on the spool cable. If a non-valid hit is registered, replace the body wire as outlined in Section 5 paragraph (d).
- d) If no hit is registered, reconnect the body wire and completely withdraw the connecting plug from the socket on the spool drum. If a non-valid hit is registered, replace the spool.
- e) If no hit is registered, reconnect the spool and completely withdraw the plug on the connecting cable from the socket on the box. If a non-valid hit is registered, replace the connecting cable. If no hit is registered, replace the box.

9 Non-valid Hit registers on the Guard

Fencer L hits fencer R on the guard, but the hit registers as non-valid. This is due to a fault in the foil of fencer R. Replace the foil.

Most usually a hit is registered only when the guard of fencer R is hit in certain spots, and is due to rust or corrosion. Even if a non-valid hit can be registered in only one spot, fencer R must change his foil.

10 Installation Checks: Faults occurring immediately after connecting up the Equipment

An electric foil equipment which has just been connected up ready for use can be tested without any fencers connected to it.

Proceed as follows;

- a) Insert the two special plugs provided with the Fault Finding Kit into the sockets on the end of each spool cable; the spool cable need not be unwound.
- b) Switch on the box. No hits should be registered. If a non-valid hit appears, see paragraph (f) below.
- c) Remove the special plug from the spool cable connecting to fencer L. A non-valid hit should be registered against fencer R. If the hit registers against fencer L, reverse the positions on the box of the two plugs at the end of the cables connecting the spools to the box.
- d) Remove the special plug from the spool cable connecting fencer R. A non-valid hit should be registered against fencer L.
- e) If when one of the special plugs is removed no hit is registered, proceed as in Section 8, starting at paragraph (d).
- f) If a non-valid hit appears when both special plugs are inserted and the box is switched on – reset. If the non-valid hit does not re-appear, proceed as in paragraph (c) above.
- g) If the non-valid hit persists, make quite sure that the spools are connected to the box the correct way round before proceeding further, otherwise you may be looking for a fault on the wrong side.
- h) Having checked the spool connections, proceed as in Section 5, starting at paragraph (e).

Besides the faults already described in this and earlier Sections, other faults may occur immediately after the equipment has been put into use, due to faulty installation. The most common of these are:

11 Unusual Faults

- i) A non-valid hit is registered on the metallised piste. This is due to there being no connection, or a faulty connection, between the piste and the earth pin on the connector cable plug connected to the spool (to check which pin this is see Section 3).
- j) When fencer L makes a hit on the piste a valid hit is registered against fencer R. The fault here is that the wire from the metallised piste has been connected to the jacket pin instead of to the earth pin on the connector cable plug connected to the spool (to check which the earth pin is see Section 3).
- k) If non-valid hits appear against both fencers and you have a dual function box, check that the switch is turned to 'Foil' and not to 'Epee'.
- l) If the lamp goes out very soon after a hit has been made, check the setting of the automatic cut-out on the box.

If the equipment is behaving oddly, perhaps allowing a non-valid hit to be registered after a valid hit on the same side when both lamps are lit on the other side, and operation is from an accumulator, check that the accumulator is adequately charged. The equipment will not work properly below about 8 volts. Some boxes incorporate a voltmeter so that the accumulator can quickly be checked. Apart from this, unusual faults, not covered in this booklet, most often occur because there are two faults at the same time. Each of them may be simple, but there can be most unusual effects due to their occurring together. This situation may arise through the replacement of some item before the logical fault finding procedure has started, and the replacement item is faulty (see Section 4 paragraph b). Double faults are difficult to locate, even for experts. But they are extremely rare, and failure to find a fault is almost always due to faulty test procedure, rather than to an obscure fault.

12 Annulment of a Hit after a fault

If a fencer who has received a valid hit has been placed at a disadvantage because of a fault which has been established before the bout has 'effectively recommenced', then he is entitled to have the last hit – but only the last hit – annulled. 'Effectively recommenced' means that although the fencers may have come back on guard before the fault was discovered, no fencing actions have taken place which might have introduced the fault after the hit was made. An exact interpretation is a matter for the president in the light of the circumstances.

Since writing "A Practical Guide to Simple Fault Finding on Electrical Foil Equipment" Mr. R. C. Winton has devised a Spring and Clip Tester which can simplify and speed up the fault finding procedure described in the Guide. It replaces two items in the Test Kit – the special foil socket and the special plug, both of which have the foil and earth wires connected together. However, the Spring and Clip Tester does not replace the two special plugs in the Test Kit which are needed to test the electric foil equipment immediately after it has been connected up. To use the Clip instead of the special foil socket, proceed as follows. Examine the plug, connected to the end of the body wire, which fits into the socket inside the foil guard. Right at the end of the plug is a screw head which is connected to the foil wire.

Immediately behind this is a raised metal washer with a small flush insulating washer behind it; immediately behind this is a metal shank which is connected to the earth wire.

Open the jaws of the clip, and holding it *at right angles* to the plug, clip it on to the plug so that one side of each jaw is touching the screw head, and the other side is touching the metal shank. The clip is then acting as a connection between the foil and earth wires.

The Spring can be used instead of the special socket in the following way. You will know from the Guide which plug in the equipment you should withdraw and plug into the special socket in order to make a test. *Do not withdraw the plug completely*, but only sufficiently for you to be able to insert the Spring into the small gap

between the plug and the socket. The two pins you must connect together are the foil pin, which is the middle pin on the plug, and the earth pin, which is the pin spaced *furthest* away from the middle pin.

You will notice that the Spring has a slight indentation on each side. Push the two sides of the Spring together sufficiently to be able to insert it into the gap between the earth and foil pins. Position it so that an indentation fits over each pin, and the Spring then connects the foil and earth pins together. Release the Spring – if correctly positioned it will hold itself in place while you continue testing.

When tests are completed and the Spring is withdrawn, do not forget to push the plug firmly back into its socket. Before using the Spring and Clip make sure that they are clean to ensure good electrical contact.