

**CHAPTER 4**

**MARKING OF METALS AND ALLOYS**

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**General**

1. The marking of part numbers, etc. on components of aircraft and aero-engines is a matter that requires careful consideration and the operations entailed in the various processes must be undertaken with extreme care and under competent supervision; this applies in particular to highly stressed components constructed from metals and alloys. In many instances it has been found that the depressions made by engraving processes, metal stamps, centre punches, etc., and in the case of light alloys, etching reagent, have caused damage to the material which has formed the origin of fatigue cracks and consequent early failure of the component concerned. The damage usually takes the form of minute fractures which are seldom visible unless examined under a microscope or traced by a method of crack detection.

2. When aircraft and aero-engine components require marking the process employed and the actual position of the mark must be carefully selected to suit the material and the construction of the component. This chapter describes permissible processes suitable for service requirements, but the correct process to employ will depend upon the circumstances. A useful guide in this direction and an indication of the correct area to mark will be found by an examination of similar components that have been marked by the manufacturers. In instances where a specified area is called for, instructions and a sketch will be issued in Vol. II leaflets.

3. The fatigue resisting properties of light alloys may be dangerously impaired by the application of a chemical reagent during etching or pickling processes, and the use of metal stamps is undesirable for the reasons previously mentioned. When dealing with these materials the electric etching pencil described in this chapter should be employed. Light alloys must not in any circumstances be chemically etched, washed or pickled in solutions containing caustic potash, caustic soda, washing soda or acids. Etching or stamping must on no account be adopted for marking springs of any description. Springs which require marking should be marked with an approved paint or enamel, or labelled.

**METAL STAMPS**

4. The use of metal stamps for any marking purposes must be undertaken with due consideration and under competent supervision. The size and depth of the impression and the form of stamp is important. When impressions surrounded by a border are called for, the border should be of circular or oval formation; square or triangular borders with sharp angles or corners are undesirable. Prior to stamping an item a test should if possible be made on a piece of similar material which can afterwards be examined to ascertain that the correct impressions have been made and that the material has not been damaged. This test particularly applies at the commencement of repetition work where a number of articles may be ruined by incorrect stamping. After using metal stamps or making a mark of a similar nature by other means, a suitable authorised corrosion preventative should be applied to the affected area.

## CHEMICAL ETCHING

5. Chemical etching has a general application for marking purposes but, as previously mentioned is not permissible for service use when dealing with items constructed from light alloys. Briefly, this process consists of making the desired marks by dissolving the material locally with a chemical reagent which is applied by means of an acid-resisting stencil. The reagent is strongly corrosive and it is therefore of the greatest importance when employing this process to take precautions to prevent the reagent from coming into contact with the skin, clothing or any article with the exception of the actual work in hand (*see* para. 8). On completion of the chemical etching process immediate anti-corrosion action must be applied to the item concerned.

### Chemical etching—general procedure

6. The general procedure for marking by the chemical etching process is given in the following sub-paragraphs, and the appropriate reagent to use in conjunction with a particular metal or alloy will be found in para. 7. The procedure is as follows:—

- (i) Thoroughly clean the surface to be marked until it is perfectly free from oil or moisture. In instances where an anti-corrosive protective has been applied to the material only sufficient area should be carefully removed to allow the work to proceed.
- (ii) Apply a thin coating of acid-resisting material over the surface to be marked, at the same time forming a lip round the edges to act as a container for any excess of the etching reagent. The material usually employed for this purpose is beeswax or paraffin wax which can be applied by first melting and then brushing it on the desired area; transfers are also employed by various manufacturers for this purpose. The correct application of the wax is of the greatest importance; it should be applied as thinly as possible to prevent the formation of air-locks. To facilitate an even flow when making the application there should only be a slight difference in temperature between the molten wax and the item to be etched.
- (iii) Allow the acid-resisting material to set hard; this is important, as it is impossible to make clean cuts in the material if it is in a plastic state.
- (iv) Cut the required letters, figures etc., in the acid-resisting material with a fine-pointed scriber, in such a manner that the metal or alloy is bared, but not scratched.
- (v) Apply an appropriate etching reagent to the markings by means of a glass rod. The reagent should be allowed to fall in drops from the glass rod until the surface of the metal exposed has been completely covered; the glass rod should not touch the work during this operation and care must be taken not to apply an excess of the reagent.
- (vi) Allow the etching reagent to remain on the work for a sufficient period to make the marks clear and permanent. The period will depend on the metal or alloy being worked on and also the depth of indentation required. If there is any doubt with regard to the period, the operator should experiment on a piece of similar material prior to applying the reagent to the work in hand.
- (vii) Remove the reagent by thoroughly washing in hot water. A stiff brush will greatly assist in this operation and at the same time the acid resisting material will be removed. If necessary the last traces of the acid-resisting material may be removed by petrol.
- (viii) The metal or alloy that has been etched should now be dried and examined. If certain areas necessitate re-etching, it is advisable to re-coat the surrounding area with acid-resisting material and repeat the process.
- (ix) Treat the area that has been etched with a thin coating of oil or an approved corrosion preventative.

### Chemical etching reagents

7. For all general purposes when chemically etching metal and alloys, but not light alloys, a suitable reagent can be made by adding concentrated nitric acid to an equal volume of water; the mixture must be well stirred before using, and it is important for several reasons when mixing acids and water invariably to add the acid to the water. Copper sulphate, commonly known as "bluestone" can be successfully employed for marking steel tools; the copper sulphate crystals should be crushed into powder form, a pinch of common salt added and then moistened with a small quantity of water so that a small amount of saturated solution is obtained. The appropriate acid or liquid to use in conjunction with a particular metal or alloy is given below (all parts are by volume except where otherwise stated). No attempt should be made to speed up the chemical etching process by using a concentrated reagent where a dilute reagent is stipulated.

<i>Metal or Alloy</i>	<i>Reagent</i>
Brass ... ..	Concentrated nitric acid.
Copper ... ..	Mixture of nitric acid (2 parts) and sulphuric acid (1 part)
Lead ... ..	Concentrated nitric acid.
Zinc ... ..	Mixture of equal parts of hydrochloric acid and water.
Carbon steel ... ..	Mixture of nitric acid (1 part) and water (3 parts).
Hard steel ... ..	Mixture of nitric acid (2 parts) and acetic acid (1 part).
Nickel steel ... ..	Mixture of nitric acid (1 part) and hydrochloric acid (4 parts)
High speed steel ... ..	
High chromium steel ... ..	
High speed steel ... ..	Concentrated hydrochloric acid.

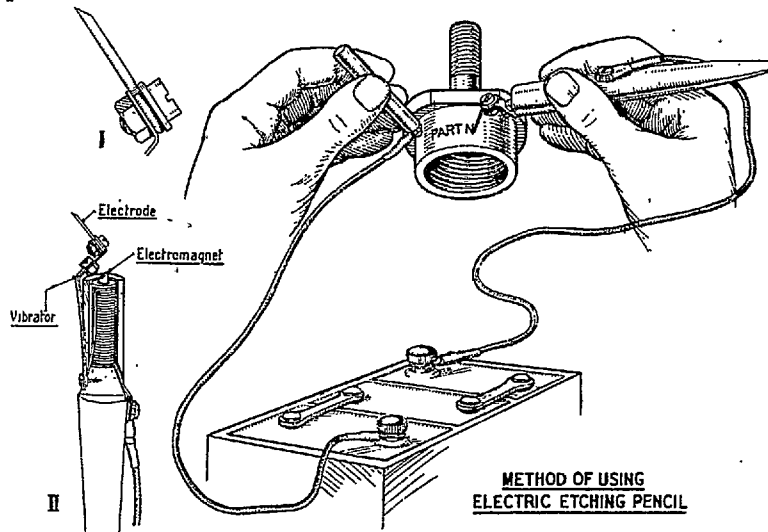
**Precautions—acids**

8. The acids used as the medium for chemical etching are very powerful corrosives and it is of the utmost importance that extreme care is exercised during handling and storing. Precautions must be taken to protect personnel and equipment during the chemical etching procedure. The acids must always be stored in glass bottles or containers having ground glass stoppers. The bottles or containers must be suitably labelled to denote their content and reasonable precautions taken to prevent the acids from being used in error or ignorance. The stoppers should always be replaced after using the bottles. There should always be a plentiful supply of cold water available for immediate use in washing off any acid accidentally split on the skin. Oil or petroleum jelly should be to hand for immediate application, *after washing in water*, in the event of acid burns. Common washing soda, or ammonia if available, can be used for neutralising acid spilled on clothes, benches, floors, etc., but precautions should be taken to avoid splashing or spilling of any description.

**ELECTRICAL ETCHING**

**General**

9. The electrical etching process can be very widely applied for marking purposes, but can only be employed when dealing with material that is a conductor of electricity. An electric etching pencil (Stores Ref. 1B/4247) is available to all units for re-marking and re-numbering engine parts etc. This pencil can be operated by a 6-volt accumulator of similar capacity to that of the standard ground purpose accumulator (Stores Ref. 5A/1901) which is normally held by units. This process of marking may be employed on any grade of metal or alloy, but due consideration must be given when dealing with components of a highly stressed nature or material of thin section, as the marks produced by the etching pencil (if carelessly used) can have a similar damaging effect to those mentioned in para. 1.



**Fig. 1.—Electric etching pencil**

10. The process is a very simple one consisting of placing the section of the item to be marked in a low voltage electrical circuit, in such a manner that the circuit is open until contact is made at the marking point by means of the etching pencil, when an arc is formed which fuses the metal and

so produces a mark. On gently pressing the point (electrode) of the pencil on to the work a vibrator is brought into operation which causes the point to make a succession of rapid contacts and so forming a, more or less, continuous arc which in turn produces corresponding fuse marks on the work. If the pencil is guided, as in normal wiring, these fuse marks will become an apparently continuous line which can be formed to make any desired mark.

### **Electrical etching—general procedure**

11. Fig. 1 clearly illustrates the method of using the electric etching pencil. It will be seen that the pencil is connected by flexible wire to one pole of a 6-volt accumulator, and a hand-contact is connected to the other pole. The procedure for marking is in the first place to make a good electrical contact between the item to be marked and the hand-contact as shown in the illustration, and then to apply the etching pencil as desired. The pencil should be applied with a gentle pressure and guided at a rate to suit requirements. The depth of mark is dependent on the rate of movement and the grade of material being worked upon, and can readily be determined by experiment on a piece of similar material. It is important that the area to be marked is thoroughly cleaned and free from grease, rust, paint, etc. For the sake of neatness it is desirable to space out all lettering in pencil before using the etching pencil.

### **Electric etching pencil**

12. Fig. 1, sketch II, gives a sectional view of the etching pencil which is of simple construction comprising a small electro-magnet and vibrator; embodied in the holder, with an electrode (point) consisting of a short length of hard drawn copper wire attached to the spring of the vibrator by a small brass screw and nut. Apart from sharpening and renewing the electrode the pencil requires no other attention. The electrode should be sharpened by filing the point to an angle approximately equal to that shown in sketch I of the illustration. To prevent overheating the winding of the electro-magnet, the pencil should not be used for long periods at a time, but when felt by the hand to be producing excessive heat it should be allowed to cool off before continuing with the work.

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