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## **III c 1**

**Improved technique for practical welding operators**

**Verbessere Ausbildungsmethode für Schweißer**

**Aperfeiçoamento da técnica dos soldadores**

**Perfectionnement de la technique des soudeurs**

**G. GORDON MUSTED**

**Birmingham**

### **INTRODUCTION**

With the ever increasing applications of welded steel construction, there is a demand for information concerning a more speedy method of training structural steel workers as practical welding operators in the shortest possible time for the welding of mild steel structural fabrications.

Many authorities have set forth their views on the training of welders, these have been published from time to time in most of the leading periodicals, as well as in book form, all of which are excellent works to advance the operator who has already a smattering knowledge of welding, or to present to the buyer of equipment for welding, a set of operating instructions for general purpose work.

This paper deals exclusively with the practical side only, and has no reference to laboratory methods for the making and testing of welds such as are used in most welding schools.

This improved technique for training is based on a definite programme for a series of practical exercises, which consist of making actual «mock set up» of jobs such as he will require to make when he goes on production work, this stimulates and increases his interest, and at the same time he gets as much practice in three weeks, as compared with other methods using six weeks training.

The success of any training scheme will depend largely upon the type of instructor or supervisor, and the type of individual selected for training.

The instructor or supervisor should be a first class practical welder himself, capable of demonstrating and lecturing the trainees, and should be able to determine if the selected men are likely to become suitable for welding under further supervision. A competent instructor should be

able to assess during the first three days of initial training, and so avoid any unnecessary expense of further training.

Finally, the author does not claim that this three weeks course will produce craftsmen welders, but it will give properly selected men who show willingness to learn, the way to produce sound welds and acquire (with further practice) greater skill in the art of welding under proper guidance. These men should be useful after the three weeks course to put on simple downhand production work for welded steel construction.

Training commences with preliminary lectures and practical demonstrations.

#### *Safety precautions*

Instructions for protection of eyes, skin, clothing, fire risk to property etc.

#### *Welding plant and equipment*

Preliminary instructions showing how to recognise and start up the plant for welding.

#### *Striking the arc*

Practical demonstrations showing the two methods for striking the arc, and making straight runs of weld metal deposit, explaining how to determine the slag from weld metal during welding.

#### *First practical exercise*

Each trainee is given a piece of plate not less than 8" long by 4" wide and 3/8" thick, to practise striking the arc, and making a series of straight runs of weld deposit side by side, making sure that each bead merges into each other, removing the slag after each run, using both sides of the plate for the first day's practise.

#### *Second day's practical exercise*

Each trainee is given another piece of mild steel plate, same size as was used for the first day's practise, for the deposition of bead runs until the trainee can readily strike the arc and maintain the correct arc length, and has achieved full control of the slag and weld metal deposit, and can deposit consistently beads of weld metal of correct length, width and profile, using various sizes of electrodes.

Further practise can be obtained by making superimposed bead runs over the first bead runs working across the latter.

Each trainee's test piece is marked or numbered and assessed by the instructor at the end of the second day:

- 1) uniformity of surface
- 2) degree of undercut or overlap
- 3) smoothness of merging the beads
- 4) surface cavities and slag traps
- 5) crater finish at plate edges

*Third day's practical exercise*

Practical demonstrations by the instructor showing how to make the test piece, explain to the trainees what they will be expected to do, in order that they may qualify for further training.

*Nature of final test piece for check test*

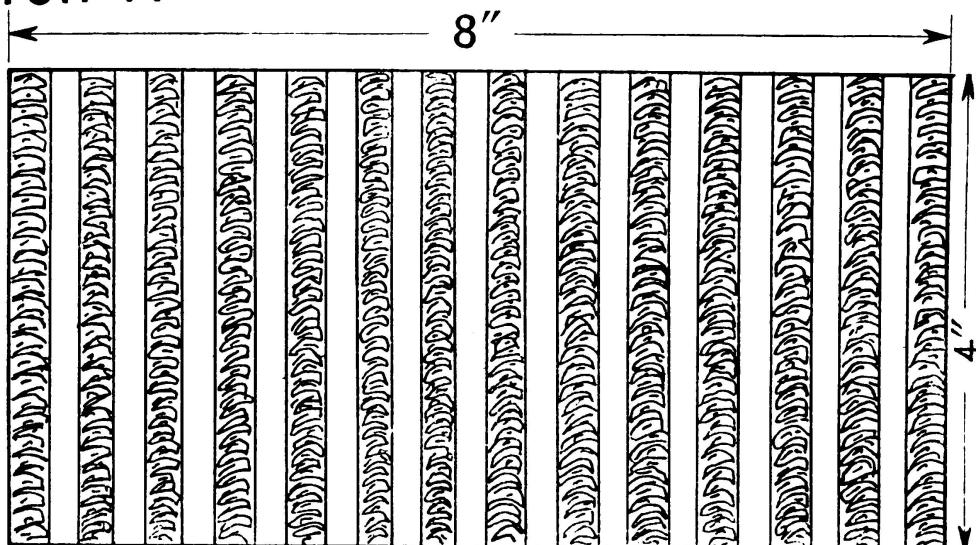
Sketch «A» illustrates the general arrangement of welds.

Fig. 1 showing a plan view of the bead and superimposed bead runs.

*Sketch «A» illustrating nature of test piece for final check test-  
-third days exercises*

**SKETCH "A"**

**FIG. 1**



**FIG. 2**



FIG. 1. plan view showing position on one side of the plate for head runs, and superimposed runs

FIG. 2. section of plate showing gaps for the final weaving runs- indicated by dotted lines from each bead run.

Both sides of the plate is reinforced in this way which gives the trainee 25ft of actual welding on one small plate 8" long by 4" wide and 1/2" thick

Fig. 2 showing section of the weld deposit, leaving a gap between for final welding by weaving runs, on a mild steel plate 8" long by 4" wide and 1/2" thickness.

Both sides of the plate is reinforced by welding, using bead runs and superimposed bead runs, weaving between the beads. The plate edges

are also reinforced by weaving, the actual amount of weld deposit on this small plate is about 25ft.

The finished test piece is then saw cut lengthwise, and then assessed by the instructor after visual examination for defects.

*Final training exercises for selected trainees*

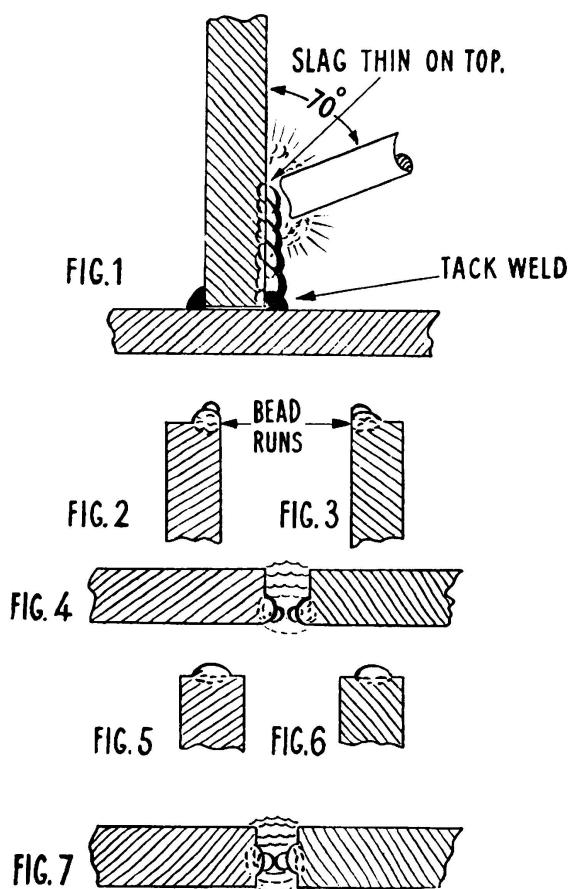
Space limitations make it impossible to discuss all the exercises used for final training.

However, the accompanying illustrations show typical examples of exercises used to give each trainee the maximum practical training, in the shortest possible time.

Similar exercises are used to give the trainee some idea of the actual welded joint he will be expected to do by using odd pieces of rolled steel sections, angle bars, channels etc.

Diagram «B» showing three exercises:

Fig. 1 illustrates briefly the technique used to deposit straight bead runs horizontally without removing the slag after each run, working from the tack weld on either side of the plate in the vertical plane.



*Diagram «B» illustrating test plate for continuous bead runs on a mild steel plate in the vertical position, by use of downhand welding with the electrode at 70° angle to the vertical plate, working from the tack weld, without removing the slag after each run. (Fig. No. 1)*

FIG. 2 & 3. shows the plate edges built up with bead runs to form a single bevel preparation (instead of cutting the plate)  
 FIG. 4. illustrates a single vee butt joint formed by placing the two plates with built up edges forming a single vee preparation

FIG. 5 & 6. show two thick plates with bead runs in the centre of the plate edges to form a double vee preparation

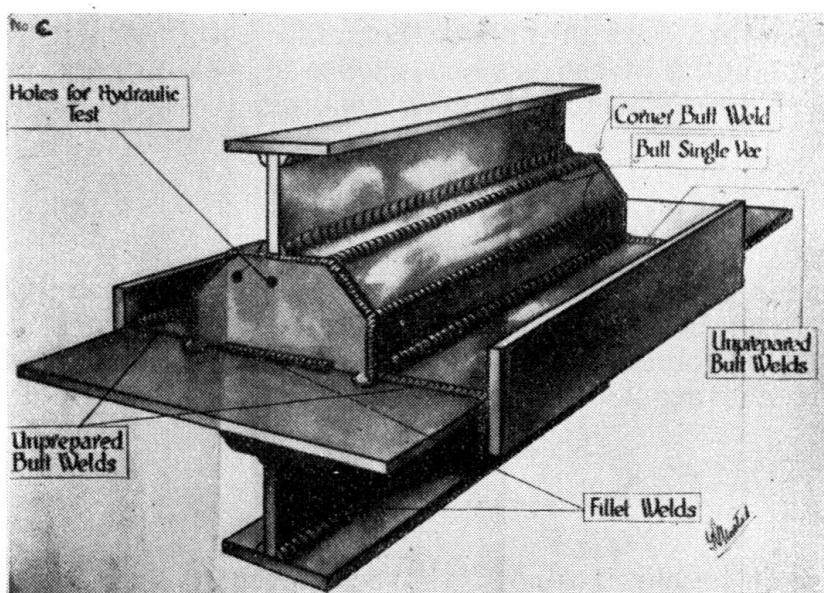
FIG. 7. shows the double vee joint obtained by built up preparation

In this way it is possible to make continuous beads, because the slag tends to fall down out of the way, leaving a thin skin of slag on the topside, which is easily removed when making subsequent superimposed runs.

Fig. 2 & Fig. 3 illustrate the technique for building the plate edges to form a single bevel, (instead of cutting a bevel) the two plates are laid flat and placed side by side to form a single vee butt joint as illustrated in Fig. 4.

Fig. 5 & Fig. 6 illustrate two thick plates with the centre of the plate edges built up to form a double bevel on each plate. The plates are laid flat and set up for a double vee butt weld as indicated in Fig. 7.

Photograph «C» shows a finished test piece which has been fabricated by welding 20 pieces of mild steel plate 14" long by  $2\frac{1}{2}$ " wide and  $5/16$ " thickness.



Photograph "C". Illustrates the final test piece fabricated from 20 pieces of mild steel plate 14" long by  $2\frac{1}{2}$ " wide and  $5/16$ " thickness

(44 welds in all) By use of natural single vee preparation for butt joints, and fillet, unprepared square butt, and corner butt welds

Test piece to be tested by hydraulic pressure for checking pressure tightness

No preparation (apart from setting up the parts) was required, for example the single vee butt joints are designed to form a natural single vee. This test piece involves 44 welds to make the following:

- 1) single vee butt welds
- 2) fillet welds
- 3) corner butt welds
- 4) unprepared square butt welds

(Finally tested by hydraulic pressure)

Each test piece is assessed by the instructor and marks given for the following:

- 1) pressure tightness
- 2) alignment
- 3) uniformity of welds
- 4) degree of undercut and overlap
- 5) surface cavities

Finally, the main object of this improved technique is to provide practical operators, and stimulate their interest in order to acquire a better understanding of the art and science of welding, and produce men who will take pleasure in doing good welding.

#### S U M M A R Y

The paper describes a three weeks course for training men and apprentices who have experience in structural steelwork. These men should be useful for simple downhand production work for welded steel construction, and acquire with further practice, greater skill in the art of welding.

#### ZUSAMMENFASSUNG

Die Arbeit beschreit einen dreiwöchentlichen Kurs zur Ausbildung von Arbeitern und Lehrlingen, die Erfahrung im Stahlbau haben. Diese Arbeitskräfte sollten für einfache Schweißarbeiten ausgebildet werden und durch weitere Praxis grössere Geschicklichkeit im Schweißen erlangen.

#### R E S U M O

O autor descreve um curso de três semanas destinado a operários e aprendizes que tenham alguma prática de construção metálica. Este pessoal torna-se útil para trabalhos simples de construção metálica soldada, e adquire com a prática, maior destreza na arte de soldar.

#### R É S U M É

L'auteur décrit un cours de trois semaines à l'usage d'ouvriers et d'apprentis ayant une certaine pratique des constructions métalliques. Ce personnel rend service pour des travaux simples de construction métallique soudée, et acquiert, avec la pratique, une plus grande habileté dans l'art de souder.