

# TAYLOR STUDWELDING SYSTEMS LIMITED

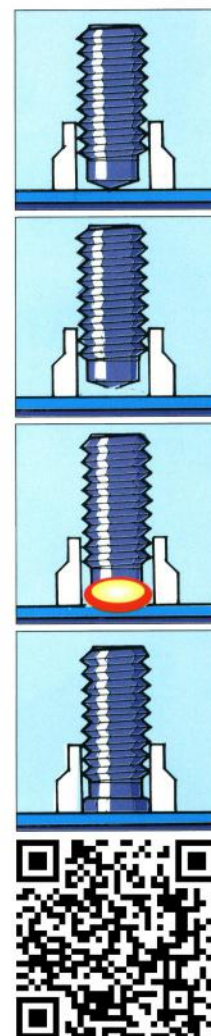


## OPERATING GUIDE

FOR

# TYPE i12

## DRAWN ARC CONTROLLER



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# **USEFUL INFORMATION**

## **MANUFACTURERS DETAILS**

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You may wish to record the details of your controller below as this information will help with any technical assistance you may require:

<b>CONTROLLER SERIAL No.</b>	
<b>DATE PURCHASED.</b>	

## **PURPOSE AND CONTENT OF THIS GUIDE**

This guide has been written for :

- The personnel of the end-user responsible for the installation and maintenance of the controller.
- The operator of the welding controller.

This guide contains information relating to :

- Installation and connection.
- Operation.
- Technical specifications and parameters.
- Spare parts.

# **USEFUL INFORMATION**

## **FURTHER INFORMATION**

Should you require additional technical information, please contact us directly (details on previous page) or our local agent / distributor (details of agents etc. can be obtained from us).

This guide contains important information which is a pre-requisite for safe Operation of the equipment. The operating personnel must be able to consult this guide when necessary. In the interests of safety, make this guide available to your personnel in good time.

If the equipment is sold / passed on, please hand over this manual to the new owner and if possible please inform us of the name and address of the new owner, in case we need to contact him regarding the safety of the machine.



PLEASE READ THIS GUIDE CAREFULLY BEFORE INSTALLING OR OPERATING THE CONTROLLER.



PLEASE OBSERVE CAREFULLY ALL SAFETY PROCEDURES/INSTRUCTIONS.



DUE TO THE POWER REQUIREMENTS AND ELECTROMAGNETIC EMISSIONS PRODUCED DURING NORMAL USE, THIS MACHINE MUST ONLY BE OPERATED IN AN INDUSTRIAL ENVIRONMENT.



THIS MACHINE OPERATES FROM A MAINS SUPPLY OF 400V AC @ 50Hz



NEVER REMOVE ANY PORTION OF THE UNIT HOUSING WITHOUT FIRST ISOLATING THE CONTROLLER FROM THE MAINS ELECTRICAL SUPPLY.



NEVER OBSTRUCT THE UNDERSIDE, FRONT OR REAR PANELS AS THIS MAY CAUSE THE UNIT TO OVERHEAT DURING OPERATION.



DO NOT USE THIS WELDING POWER SOURCE FOR PIPE THAWING OR IN CONDITIONS OF RAIN OR SNOWFALL.



THIS EQUIPMENT HAS BEEN EMC TESTED AND APPROVED IN ACCORDANCE WITH BS EN 60974-10 (CATEGORY 2).

# **IMPORTANT SAFETY INFORMATION !**

## **PROTECT YOURSELF AND OTHERS !**

Read and understand these safety notes.

### **1. ELECTRICAL**

No portion of the outer cover of the welding controller should be removed by anyone other than suitably qualified personnel and never whilst mains power is connected.

ALWAYS DISCONNECT THE MAINS LEAD BEFORE ATTEMPTING ANY MAINTENANCE.



BEWARE - RISK OF ELECTRIC SHOCK !

Do not use any fluids to clean electrical components as these may penetrate into the electrical system.

Installation must be according to the setting up procedure detailed on page 11 of this guide and must be in line with national, regional and local safety codes.

### **2. FIRE**

During welding small particles of very hot metal are expelled. Ensure that no combustible materials can be ignited by these.

### **3. PERSONNEL SAFETY**

Arc rays can burn your eyes and skin and noise can damage your hearing. Operators and personnel working in close proximity must wear suitable eye, ear and body protection.

Fumes and gases can seriously harm your health. Use the equipment only in a suitably ventilated area. If ventilation is inadequate, then appropriate fume extraction equipment must be used.

Hot metal spatter can cause fire and burns. Appropriate clothing must be worn. Clothing made from, or soiled with, combustible materials must NOT be worn.

Have a fire extinguisher nearby and know how to use it.

Magnetic fields from high currents can affect heart pacemakers or other electronically controlled medical devices. It is imperative that all personnel likely to come into the vicinity of any welding plant are warned of the possible risks before entering the area.

### **4. MAINTENANCE**

All cables must be inspected regularly to ensure that no danger exists from worn or damaged insulation or from unsound electrical connections. Special note should be made of the cables close to the pistol, where maximum wear occurs. As well as producing inconsistent welds, worn cables can overheat or spark, giving rise to the risk of fire.

# **IMPORTANT SAFETY INFORMATION !**

## **5. TRAINING**

Use of the equipment must be limited to authorised personnel only who must be suitably trained and must have read and understood this manual. This manual must be made available to all operators at all times. Further copies of this manual may be purchased from the manufacturer. Measures must be taken to prevent the use of this equipment by unauthorised personnel.

## **6. LIMITATIONS OF USE**

The mass of the welding controller is under 22kg and is suitable for man lifting. It is fitted with an appropriate carrying handle to allow lifting by hand. The controller is suitable for use in an environment with increased risk of electric shock.

## **6. INSTALLATION**

Ensure that the site chosen for the equipment is able to support the weight of the equipment and that it will not fall or cause a danger in the course of its normal operation. Do not hang connecting cables over sharp edges and do not install connecting cables near heat sources or via traffic routes where people may trip over them or they may be damaged by the passage of vehicles (forklifts etc).

## **7. INTERFERENCE**

During welding operations, intense magnetic and electrical fields are unavoidably produced which may interfere with other sensitive Electronic equipment.

All Taylor Studwelding equipment is designed, manufactured and tested to conform the current appropriate European standards and directives regarding electromagnetic emissions and immunity and as such is safe to use in any normal environment.

## **8. DISPOSAL**

The equipment either wholly or any of its component parts may be disposed of as part of general industrial waste or passed to a scrap merchant. None of the components used in the manufacture are toxic, carcinogenic or harmful to health in their "as supplied" condition.

## **INTRODUCTION TO STUDWELDING**

The Taylor Studwelding i12 Drawn Arc controller when matched with an appropriate pistol and earth cables is intended for precision stud welding up to 12 mm diameter reduced base studs. The controller is easily transportable and has been designed to operate with a minimum amount of maintenance.

The energy required to carry out the welding operation is derived from a fully micro-processor controlled power inverter inside the controller.

Taylor Studwelding Systems Ltd pistols are modern, ergonomically designed and offer maximum comfort in handling with minimum operator fatigue.

### **THE PROCESS**

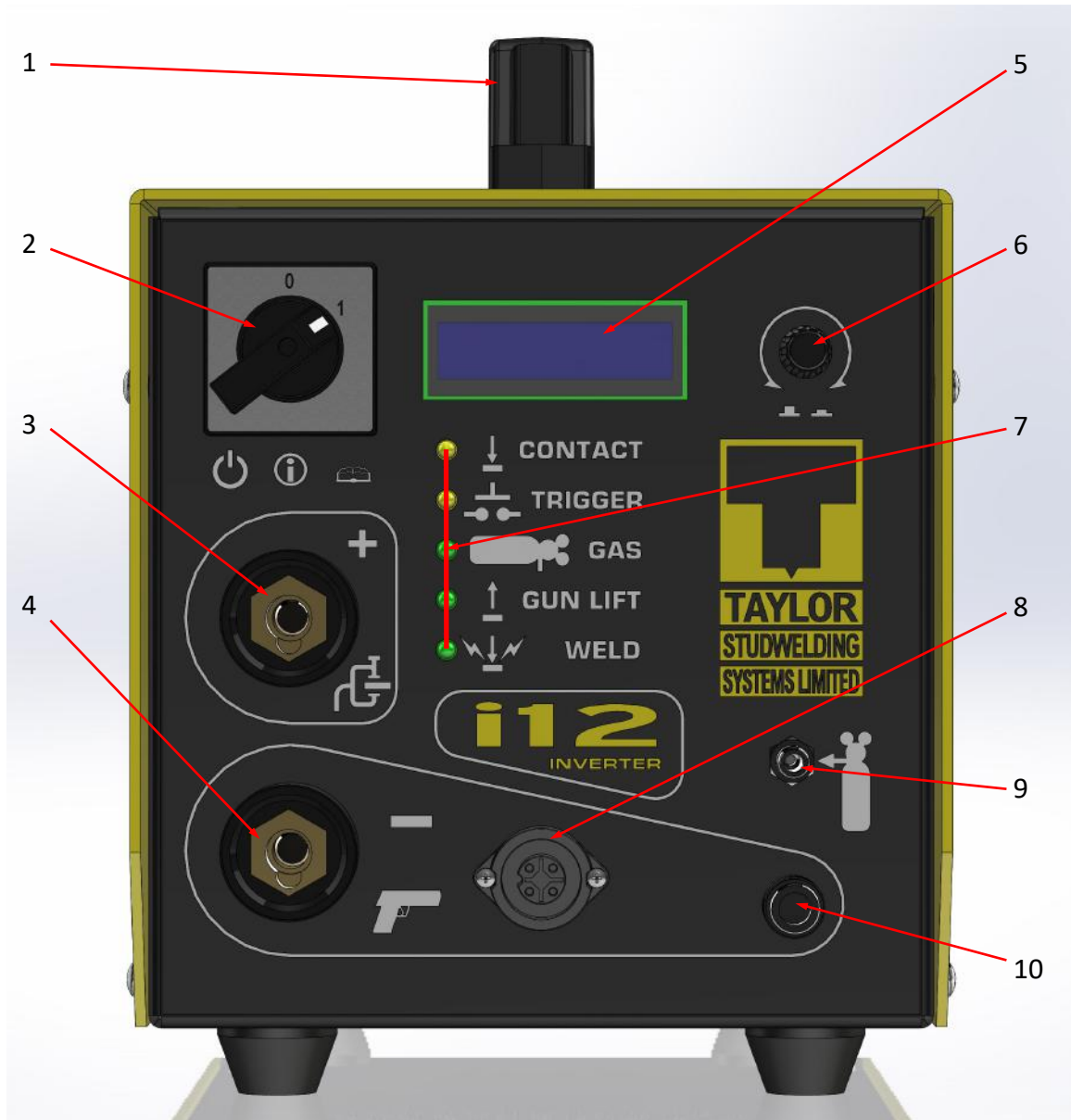
The process of drawn arc studwelding is long established and well proven. The basic steps are as follows :

- A measured amount of weld stud protrusion is set at the welding pistol.
- Once in position, the pistol lifts the stud away from the work-piece, simultaneously striking an arc between the two.
- Both the tip of the weld stud and the surface of the work-piece melt as the arc is sustained for a pre-determined interval.
- At the completion of the pre-determined interval, the pistol returns the weld stud to the molten pool on the work-piece, thus forming a weld.

The most common and traditional drawn arc welds have a weld duration greater than 100ms and employ the use of a single use ceramic arc shield, commonly referred to as a ferrule. This ferrule helps to protect the arc during the weld and assists in formation of the final fillet. Post welding the ferrule is removed and disposed of.

It is possible to stud weld without a ferrule. This method is more commonly employed with welds having a duration of less than 100 ms and this type of weld is referred to as short cycle stud welding. Although no ferrule is employed, it is recommended practice in short cycle welding to employ a suitable shielding gas to reduce the amount of porosity in the completed weld and improve weld quality.

## GUIDE TO EXTERNAL FEATURES

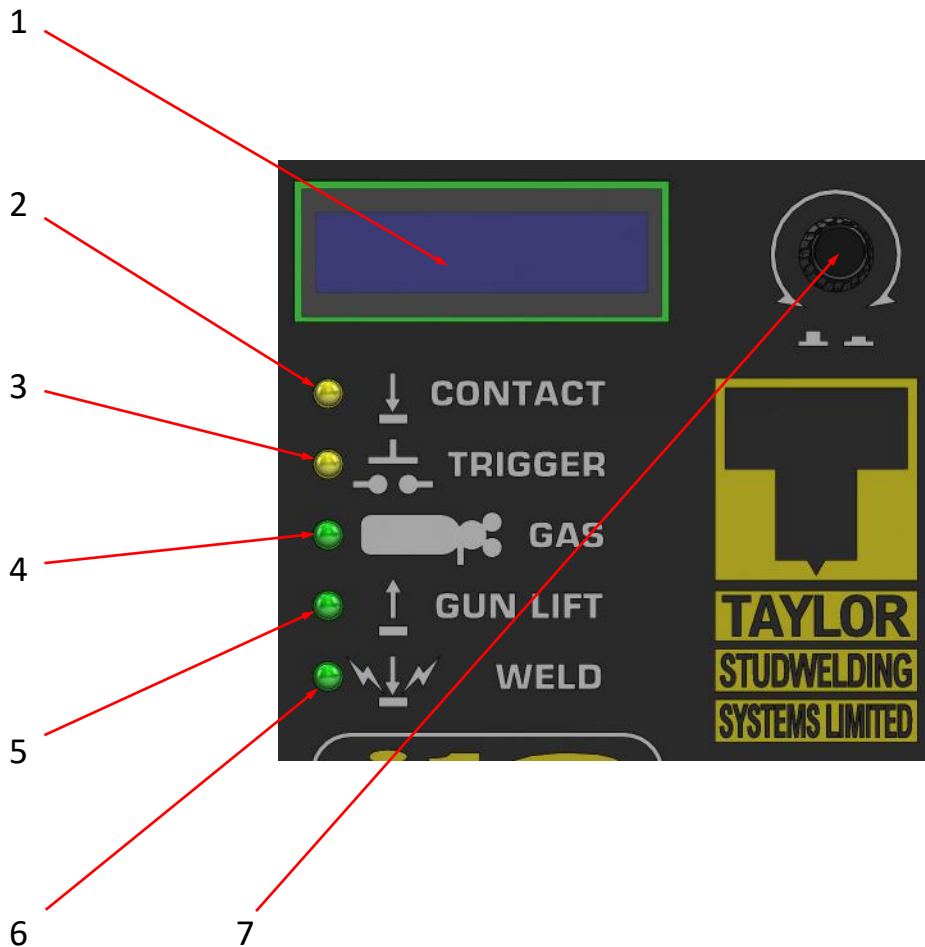


### FRONT PANEL

- |                           |                                |
|---------------------------|--------------------------------|
| 1. CARRYING HANDLE        | 6. CONTROL KNOB                |
| 2. ON/OFF SWITCH          | 7. INDICATOR LEDS (SEE PAGE 9) |
| 3. WELDING EARTH SOCKET   | 8. PISTOL CONTROL SOCKET       |
| 4. WELDING PISTOL SOCKET  | 9. SHIELDING GAS INLET         |
| 5. MULTI-FUNCTION DISPLAY | 10. SHIELDING GAS OUTLET       |



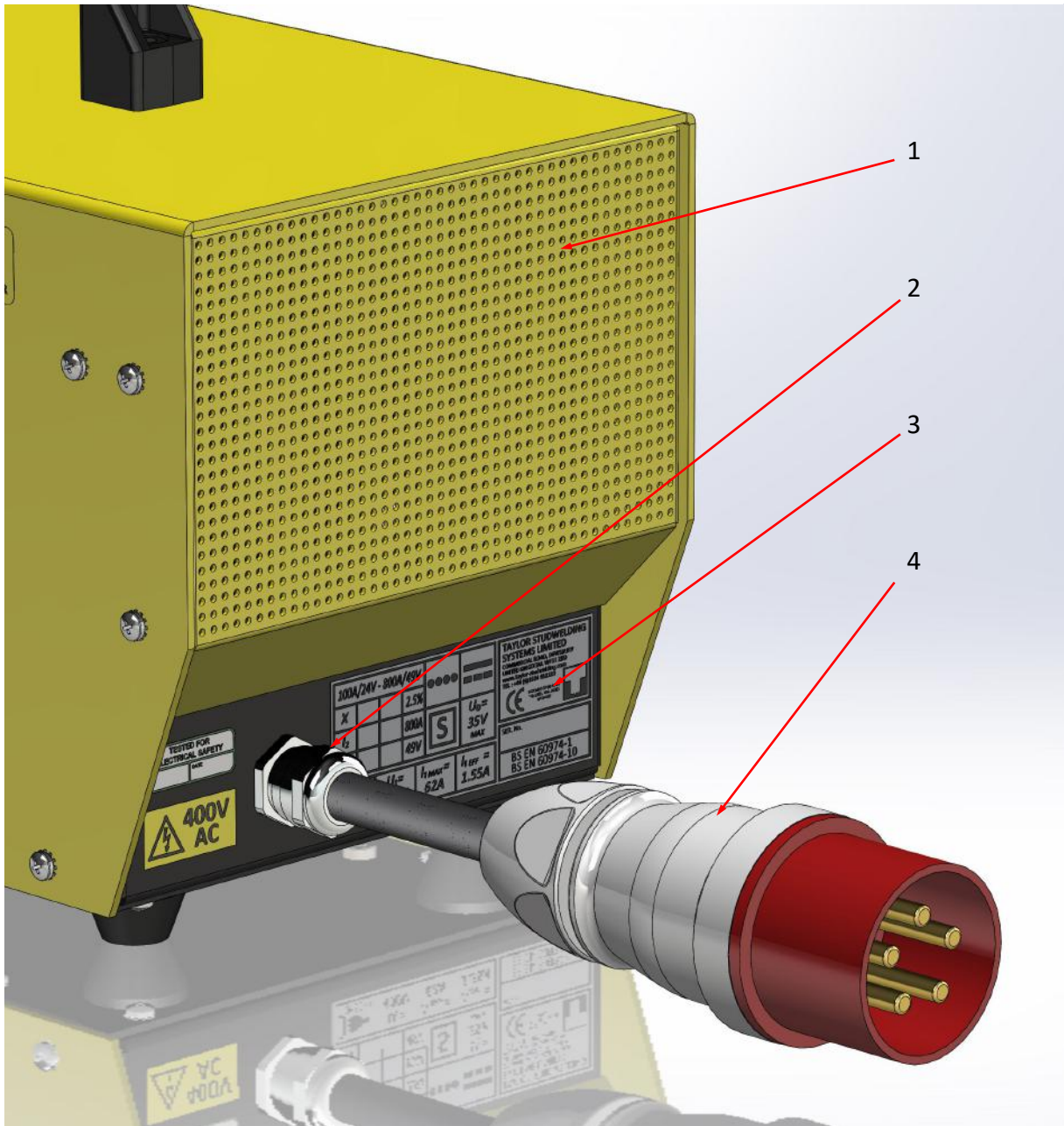
## GUIDE TO EXTERNAL FEATURES



### CONTROL PANEL

1. MULTI-FUNCTION DISPLAY UNIT - USED TO SELECT OPERATIONAL PARAMETERS ETC. AND REPORT BACK INFORMATION
2. CONTACT LED - INDICATES STUD TO PLATE CONTACT WITHOUT WHICH A WELD CANNOT TAKE PLACE
3. TRIGGER LED - INDICATES THAT PISTOL TRIGGER HAS BEEN ACTIVATED
4. GAS LED - INDICATES THAT SHIELDING GAS FLOW IS ACTIVATED
5. GUN LIFT LED - INDICATES THAT THE GUN LIFT HAS BEEN ACTIVATED
6. WELD LED - INDICATES THAT THE WELD CURRENT HAS BEEN ACTIVATED
7. CONTROL KNOB - INCORPORATING PUSH BUTTON FUNCTION - USED FOR INTERACTION WITH MULTI-FUNCTION DISPLAY

# GUIDE TO EXTERNAL FEATURES



## BACK PANEL

1. VENTILLATION GRILLE **! DO NOT OBSTRUCT !**
2. 3 Ph MAINS CABLE INLET GLAND
3. RATING/SERIAL PLATE
4. 4m CABLE WITH 3 Ph MAINS CONNECTOR

## SETTING UP AND WELDING

Set up the control unit at the place of work, ensuring that the mains switch is in the **OFF** position.



Plug the controller into a suitable three phase AC supply with a 32A motor rated fuse/breaker.

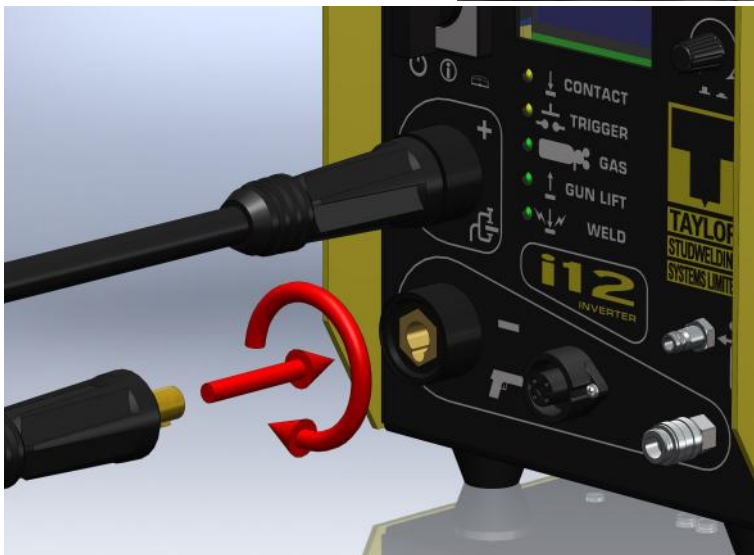
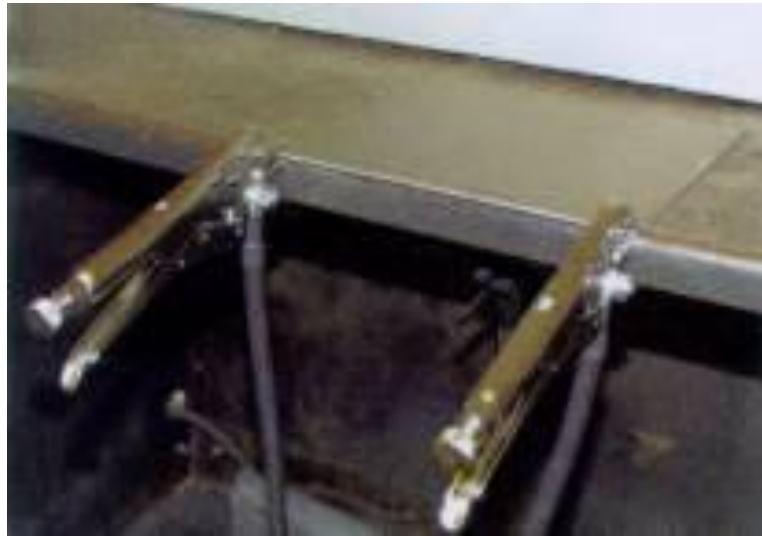
Plug the welding earth cables into the controller. Note that the cable end weld plug has a peg which mates with the key slot in the panel mounted socket.

**IMPORTANT!** Secure the connectors with a clockwise turn until they lock. Failure to do this may result in damage to the connectors during welding.



## SETTING UP AND WELDING

Attach the welding earth clamps to the work piece at approximately 180° to each other; this will help prevent "arc-blow" when welding takes place. Prior to fitting the clamps, ensure that the contact area of the work piece is free from rust, paint, grease etc., as this will result in a poor welding connection. Surface grind the workpiece if necessary.

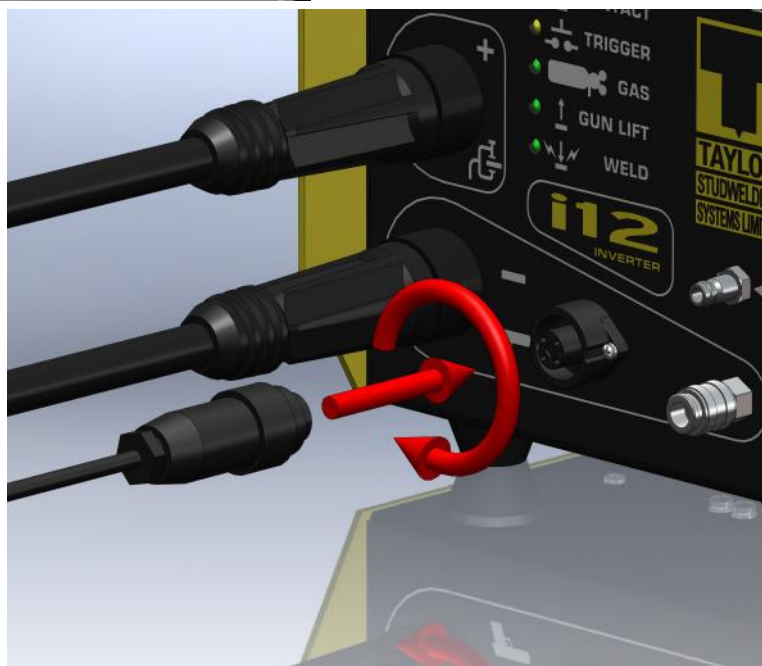


Plug the welding pistol cable into the controller. Note that the cable end weld plug has a peg which mates with the key slot in the panel mounted socket.

**IMPORTANT!** Secure the connectors with a clockwise turn until they lock. Failure to do this may result in damage to the connectors during welding.

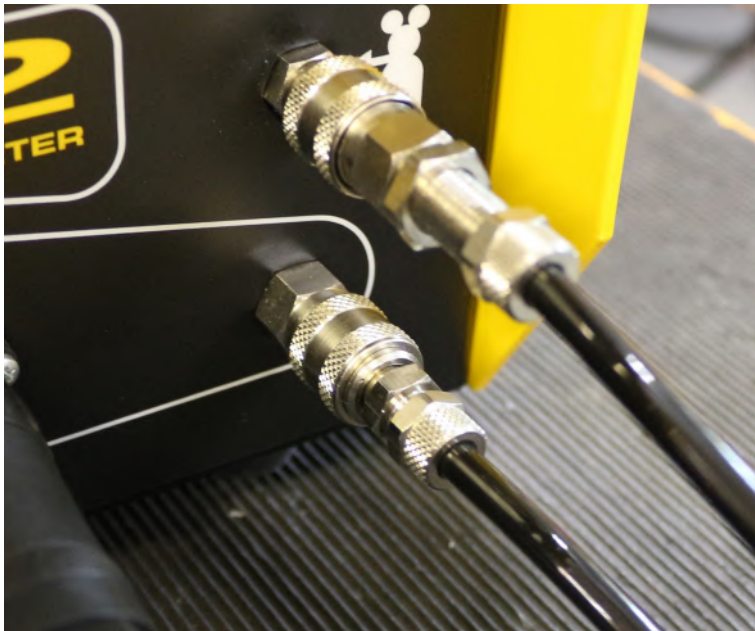
Plug the pistol control cable into the controller. Note that the cable end plug and panel-mounting socket are keyed to prevent incorrect fitting. Push the plug firmly home and twist the locking ring to secure the plug in position.

Set up the welding pistol according to the instructions in the operating guide supplied with the pistol.



## SETTING UP AND WELDING

If optional shielding gas is to be used during welding. Attach the bottle supply to the controller via the front panel using a suitable self-sealing push-on socket.



Connect the gas pipe from the pistol to the output socket on the front panel (optional).

If the mains supply is switched. Turn **ON** the mains supply.



## SETTING UP AND WELDING

Turn **ON** the controller using the switch on the front panel. The controller will cycle through a start-up self-test during which the various indicators etc. on the front panel will flash, before settling to a display showing the last used setup.

**IMPORTANT NOTE!** The control knob on the controller front panel is also a push-button. The control knob is used to interface with the control system in the controller.



To adjust the welding parameters. **PRESS & RELEASE** the control knob and the display will change to show 2 options:

-> **Change**  
**Load**

With the indicator (->) aligned with the word **Change**.

From this menu. You can elect to either “Change” the in-use welding parameters by adjusting the individual welding

parameters or “Load” a previously saved parameter set from the controller memory.

**NOTE!** The controller does not come with any pre-saved parameter sets. The controller memory is there for you to add your own parameter sets (up to 25 different sets) to speed up future operations.

**ROTATE** the control knob, select either:

-> **Change**    or    **Change**  
**Load**                    **-> Load**

**PRESS & RELEASE** the control knob to confirm selection.

For “**Change**” see next page.

For “**Load**” see page 17.



## SETTING UP AND WELDING

Selecting **Change** will take you through the following series of manual weld parameter setting screens:

The first screen is for the welding current. The value is shown in Amps (A) and is adjustable between 10A and 800A in 5A steps.

**NOTE!** The adjustment knob features an accelerator. Slowly turning the knob will advance/retard the display slowly and turning the knob quickly will accelerate the rate of change in the display.



**TURN** the knob to set the required welding current. Once the desired number is reached. **PRESS & RELEASE** the knob to move on to the next parameter screen.



The next screen is to set the welding time (duration). The value is shown in milliseconds (mS) and is adjustable between 1mS and 1000mS.

**NOTE!** Between 1 & 20mS the value is adjustable in 1mS steps. Between 20 & 100mS the value is adjustable in 5mS steps and between 100 & 1000mS the value is adjustable in 10mS steps.

**TURN** the knob to set the required welding time. Once the desired number is reached. **PRESS & RELEASE** the knob to move on to the next parameter screen.

The next screen is to set the time duration of the shielding gas purge. If shielding gas is being used the gas purge will continue throughout the weld time duration. The gas purge time sets a duration of gas purging which occurs before the weld commences to help purge normal atmosphere from the welding zone.

**NOTE! If shielding gas is not being used. Leave this value at 0.0S which disables the gas function.**

The gas purge is adjustable between 0.0S and 5.0S in 0.1S steps.



**TURN** the knob to set the required purging time. Once the desired number is reached. **PRESS & RELEASE** the knob to move on to the next parameter screen.

## SETTING UP AND WELDING

The next screen is the last of the parameter setting screens and is to set the Start Current (Pilot Current). This is used to initialise the weld prior to the main current. The value is shown in Amps (A) and is adjustable between 50A & 200A in 1A steps.

**TURN** the knob to set the required Start Current.



If you wish to go around the 4 parameter setting screens again **PRESS & RELEASE** the control knob to skip to the first screen (Current)

or

if you wish to save the parameters you have set to one of the 25 locations in the controller memory. **PRESS & HOLD** the control knob until the “Save to” screen appears.

**TURN** the control knob to set the number on screen to a value between 1 & 25. Then **PRESS & RELEASE** the control knob. The controller will save your parameter set to that location and return to the original user screen (now displaying your parameters which have become the current operational parameters).



**NOTE!** It is not necessary to cycle through all 4 setting screens when making adjustments. If you wish to alter only one parameter. Cycle to the parameter screen you wish to adjust. Change it, then **PRESS & HOLD** the control knob to activate the “Save to” screen and follow the instruction above to save the settings to memory.

Conversantly, it is also not necessary to save the parameters you have set to a memory location. Once you have changed the parameters to those you desire. Do nothing else and begin welding. The controller will use the parameters you have set and will even remember them if you switch off the controller and switch it back on again. However, if another parameter change is executed. They will become the current operational parameters and to return to your original parameters will require manual re-entry using this procedure.



## SETTING UP AND WELDING

Selecting **Load** will take you to the parameter load screen.

If you have previously saved a parameter set to one of the 25 memory locations in the controller memory. You can recall those parameters using this screen.

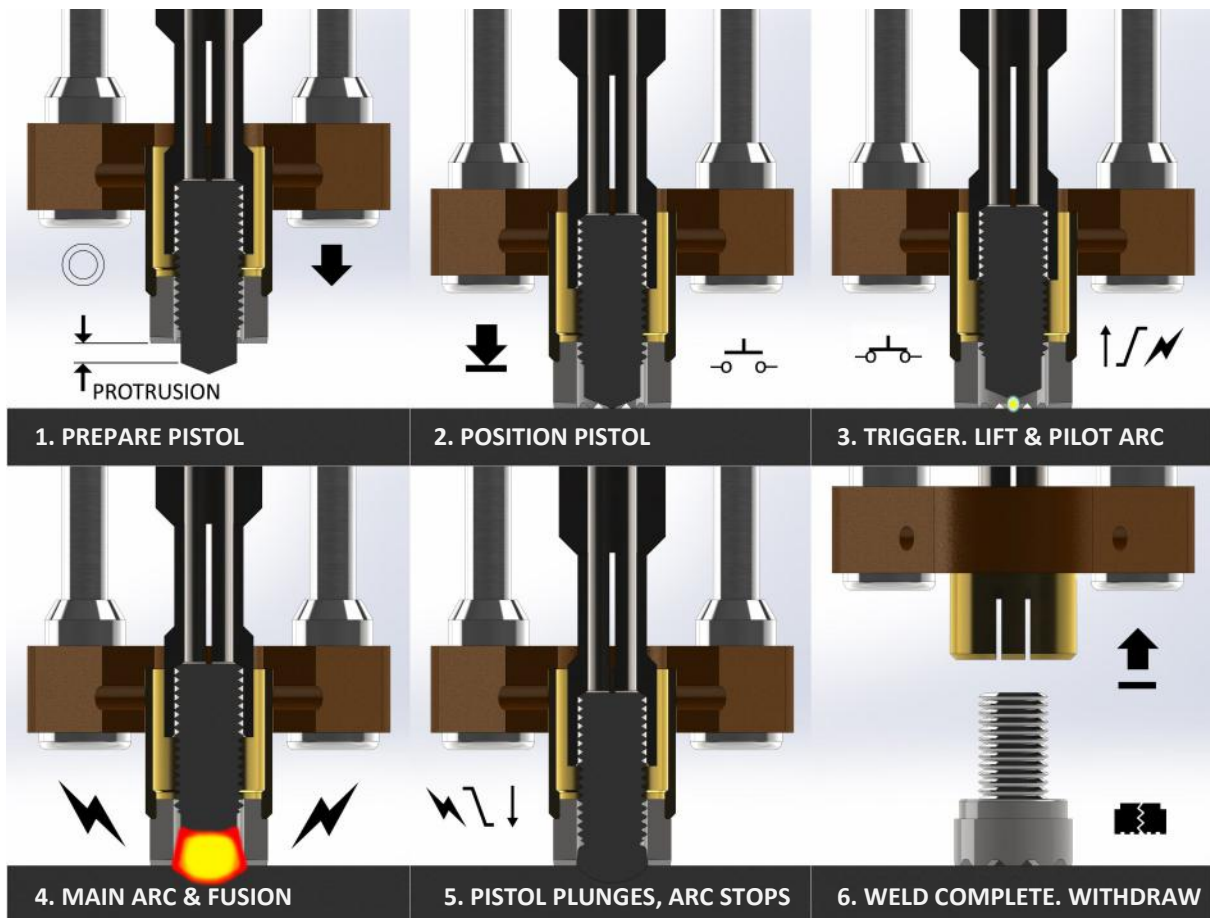
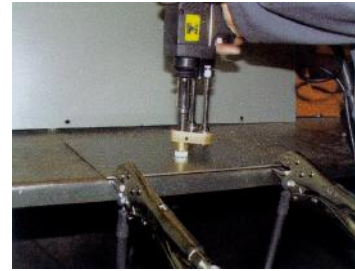
Simply **TURN** the control knob to select the appropriate memory location (numbered 1 to 25).

Then **PRESS & RELEASE** the control knob. This will load the saved parameter set into the current operating parameters and return to the operating screen.



## SETTING UP AND WELDING

Set up the welding pistol in-line with the operating guide supplied with the pistol. Ensuring that there is sufficient stud protrusion and that the stud is centred in the ferrule/foot assembly. Place the pistol perpendicular to the work piece with the stud touching down at the desired location to be welded. Press down on the pistol until the ceramic ferrule rests firmly on the work piece. Press the trigger to initiate the weld sequence (see graphic below). See the section on **STUDWELDING TECHNIQUES** for further advice.

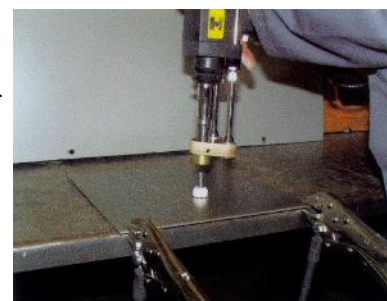


Having welded the stud, draw the pistol vertically off the stud. Failure to do this may cause the split tines of the chuck to splay out. This will result in the chuck and stud arcing together during subsequent welds.



Finally, remove the ferrule by lightly tapping until it shatters and visually inspect the weld.

For a guide to the inspection of the welded stud see the sections on **VISUAL WELD INSPECTION** and **WELD TESTING**.



# WELDING TIME AND CURRENT SETTINGS

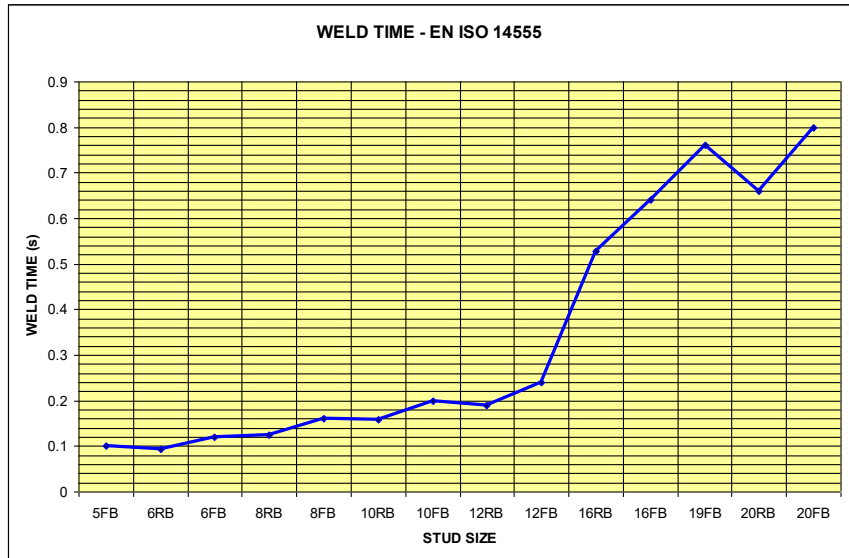
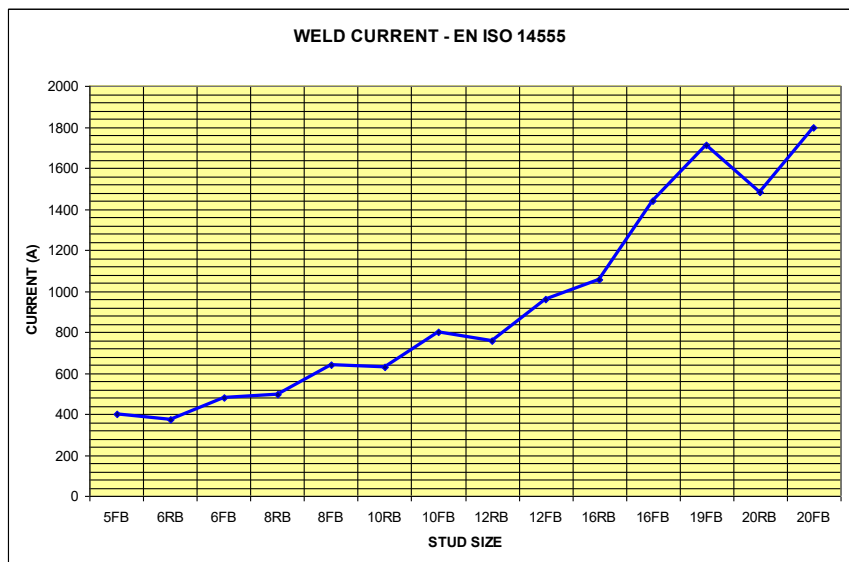
This page is intended as a guide to setting your machine.

A set of basic formulae as defined by the British Standard BS EN ISO 14555:2014 (European Standard EN ISO 14555:2014) Annex A.2.7.2.2 and Annex A.2.7.2.4 may be used to calculate the current and time settings to weld any stud.

These formulae when applied to standard studs give results shown in the table on this page. A graphical representation of the data is also illustrated below.

STUD TYPE	ACTUAL DIAMETER (mm)	WELD CURRENT (A)	WELD TIME (ms)
5FB	5	400	100
6RB	4.7	376	94
6FB	6	480	120
8RB	6.2	496	124
8FB	8	640	160
10RB	7.9	632	158
10FB	10	800	200
12RB	9.5	760	190

The settings generated in the table are only intended as a starting point. It is possible that the settings will give satisfactory results without adjustment, but in reality the quality of the welding results is governed by many variable factors. These include, most obviously, the welding time, current and arc-gap (pistol lift) as covered in the table, but can also include factors such as stud and work-piece material type and condition, ambient temperature, relative humidity, quality of supply etc. All of these factors can act on the weld to change the outcome. It is recommended that in all instances, you need to carry out sample welds in your actual conditions and environment. This will enable you to alter the settings, where necessary, to achieve welds that are most acceptable to you.



# VISUAL WELD INSPECTION

This page will help you to recognise a poor weld when you see one and give some of the possible explanations as to how it may have occurred. Your test welds should look like the first example diagram in the series and once you transfer to the actual job, periodic checks should be made to ensure that your welding is consistently good.

## **POINTS TO LOOK FOR IRRESPECTIVE OF PROCESS USED.**

- L.A.W. (Length After Welding). This should be correct to within + 0 / - 1 mm.
- The base fillet of the welded stud is complete.
- The welded stud is perpendicular to the work-piece.

## **WHEN USING A CERAMIC FERRULE.**

This diagram is an example of a good normal weld, fulfilling the criteria above i.e. The LAW is correct, the stud has a complete, well formed and even fillet and is also perpendicular to the work-piece.

The following examples will help you to recognise the most common types of poor weld, explain the possible causes of these problems and how to remedy them.

### **EXAMPLE 1**

**PROBLEM :** Insufficient heat, causing the L.A.W. to be too long and the fillet to be underdeveloped and/or incomplete.

**REMEDY :** Increase the welding time (see page 13).

### **EXAMPLE 2**

**PROBLEM :** Excessive heat, causing the L.A.W. to be too short and the fillet to be too large and messy, spreading out under the ferrule and/or splashing up the threads.

**REMEDY :** Reduce the welding time (see page 13).

### **EXAMPLE 3**

**PROBLEM :** The ferrule is not being held firmly against the work-piece and/or the stud is binding against the ferrule.

**REMEDY :** Hold the pistol firmly down to the work-piece (see page 14) and reset the alignment of the stud and ferrule (refer to your pistol setup guide).

### **EXAMPLE 4**

**PROBLEM :** Insufficient stud protrusion set on the pistol and/or the stud is binding against the ferrule.

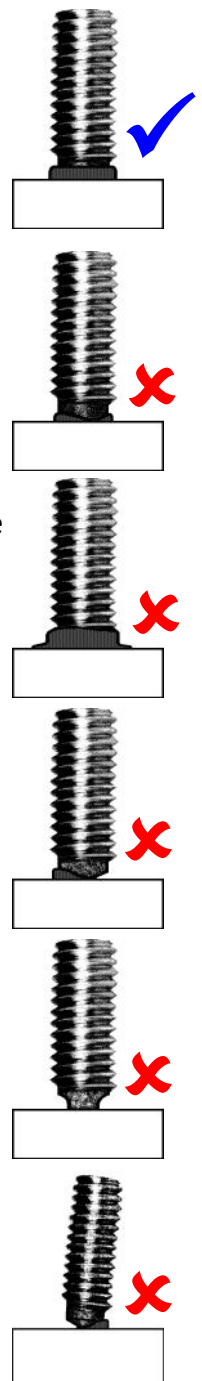
**REMEDY :** Adjust stud protrusion to correct setting (refer to your pistol setup guide).

### **EXAMPLE 5**

**PROBLEM :** Poor alignment i.e. stud is not perpendicular to the work-piece.

**REMEDY :** Hold the pistol perpendicular to the work-piece (see page 14).

**NOTE :** If the misalignment is only slight and in all other aspects the weld is good, then the weld may be salvaged by tapping straight with a soft mallet.



## **WELD TESTING**

There are two factors which should receive special attention in establishing visually whether or not a stud weld is sound. These are :

- The length after weld (L.A.W.) of the stud should be correct. That is to say that a stud which is intended to be 50 mm long after welding, should be correct within +0/-1 mm. A word of explanation is perhaps needed on this point. All studs produced include a "weld allowance". This allowance is so arranged for the different diameters of stud, that it will be completely melted during the welding process, provided of course that the correct conditions have been established and the correct values of current and time are used.
- The fillet of metal formed around the base of the stud should be well formed, reasonably evenly distributed, completely free from blow holes and of a silver blue colour.

These two factors combined form the basis of all visual stud weld examination. It should be the aim of every operator to produce these results.

Under normal conditions a stud welded to clean mild steel plate of adequate thickness having the correct L.A.W. and fillet formation, as described above, will be a satisfactory weld.

It should be remembered, however, that different applications or conditions will produce slightly different visual results, particularly in the appearance of the fillet, i.e.. Slightly rusty, dirty or oily plate will produce blow holes in the fillet, in proportion to the degree of plate contamination. Welding close to some magnetic obstruction may produce uneven fillet distribution. Too much power will produce a fillet that flows too easily and is lost either up in the threads of the stud or out through the ferrule vents, while too little power may not melt sufficient material to form a complete fillet.

It is important, therefore, to judge the degree to which these possible variations will affect the weld strength, but in general, provided that the L.A.W. is correct and the fillet formation is not unsightly, a visual examination is all that is required.

Further testing may be carried out on a "percentage of production" basis, and the methods used fall into the classes outlined below.

### **1. DESTRUCTIVE TESTING.**

Should only be used on studs welded to samples and test pieces.

- Hammering a stud over may look spectacular, but it is not a satisfactory test, as the direction and force behind the blows is uncontrolled, as also is the point at which the impact takes place. The length, diameter and type of stud also have an effect on the results obtained.
- Bending the stud over by using a tube of approximately the same bore as the stud diameter. This method is preferred to hammering, but again no conclusive evidence as to the strength of the weld is obtained.
- Loading the stud by the use of washers / spacer and a nut until the stud breaks. This method is much more conclusive and should show that the weld is in fact stronger than the stud. Use of a suitably calibrated torque wrench for this test will give an indication of the U.T.S. developed by the stud material under test.

# WELD TESTING

## 2. NON DESTRUCTIVE TESTING.

Generally the most practical way of testing threaded stud welds, without destroying the stud, is with the use of proof tests. A torque wrench is particularly useful for this purpose.

Below and overleaf are some tables which you may find useful. However, it must be noted that :

- Formulas & data shown are intended for guidance only.
- In applications where control of preload is important, the torque - tension relationship should be determined experimentally on the actual parts involved including any lubricants.
- The coefficient of friction (k) varies with material, surface finish and lubricity of threads and bearing areas of fastened parts.
- For standard steel screws it is 0.19 to 0.25 and 0.13 to 0.17 for plated screws. Anti-seize materials and lubricants can lower k to 0.05. For some stainless steel threads and parts not coated or lubricated k may be as high as 0.33
- All the figures are approximate and do not form part of any specification.
- Designers and specifiers must satisfy themselves that the studs and materials chosen are suitable for their particular application.

Material properties:	(N/mm <sup>2</sup> )	(N/mm <sup>2</sup> )	(N/mm <sup>2</sup> )
	UTS	Yield	Safe
Mild Steel (4.8)	420	340	272
Stainless Steel (1.4301)	540	350	280
Note: safe loads are 80% of the yield			

All torque figures are calculated by the formula :  $T = kDP$

Where :  $T = \text{Torque (Nm)}$   
 $D = \text{Effective Stud Diameter (m)}$   
 $k = \text{Coefficient of Friction (0.2 used for calculations)}$

## **WELD TESTING**

Stud loads - Full Base Drawn Arc Studs (kN)

	Mild Steel	Mild Steel	Mild Steel	Stainless Steel	Stainless Steel	Stainless Steel
Thread	UTS	Yield	Safe	UTS	Yield	Safe
M5 x 0.8	5.8	4.7	3.7	7.4	4.8	3.8
M6 x 1.0	8.2	6.6	5.3	10.6	6.8	5.4
M8 x 1.25	15.2	12.3	9.8	19.6	12.7	10.1
M10 x 1.5	23.8	19.2	15.4	30.6	19.8	15.8
M12 x 1.75	34.6	28.0	22.4	44.5	28.8	23.1

Torque required to reach the loads above (Nm)

	Mild Steel	Mild Steel	Mild Steel	Stainless Steel	Stainless Steel	Stainless Steel
Thread	UTS	Yield	Safe	UTS	Yield	Safe
M5 x 0.8	4.9	4.0	3.2	6.3	4.1	3.3
M6 x 1.0	8.2	6.7	5.3	10.6	6.9	5.5
M8 x 1.25	20.7	16.8	13.4	26.7	17.3	13.8
M10 x 1.5	40.5	32.8	26.2	52.1	33.8	27.0
M12 x 1.75	71.0	57.5	46.0	91.3	59.2	47.4

Stud loads - Reduced Base drawn Arc Studs (kN)

	Mild Steel	Mild Steel	Mild Steel	Stainless Steel	Stainless Steel	Stainless Steel
Thread	UTS	Yield	Safe	UTS	Yield	Safe
M6 x 1.0	7.2	5.8	4.7	9.3	6.0	4.8
M8 x 1.25	12.6	10.2	8.2	16.3	10.5	8.4
M10 x 1.5	20.5	16.6	13.3	26.4	17.1	13.7
M12 x 1.75	29.7	24.0	19.2	38.2	24.8	19.8

Torque required to reach the loads above (Nm)

	Mild Steel	Mild Steel	Mild Steel	Stainless Steel	Stainless Steel	Stainless Steel
Thread	UTS	Yield	Safe	UTS	Yield	Safe
M6 x 1.0	6.8	5.5	4.4	8.8	5.7	4.6
M8 x 1.25	15.7	12.7	10.2	20.2	13.1	10.5
M10 x 1.5	32.5	26.3	21.1	41.8	27.1	21.7
M12 x 1.75	56.6	45.8	36.6	72.7	47.1	37.7

# **STUDWELDING TECHNIQUES**

The operating instructions given previously in this guide apply to the majority of general applications where it is possible to use the pistol in the down hand position and with standard cable lengths. For many applications these conditions do not apply and the following notes will give some guidance as to the methods used to obtain satisfactory results for a variety of applications.

## **1. WELDING TO A PLATE IN THE HORIZONTAL POSITION.**

In this position there is a tendency for the weld metal to run to the underside of the stud during welding, due to the action of gravity, resulting in an uneven fillet. The effect is more noticeable as stud diameter increases and generally speaking it is not recommended that studs of 12 mm diameter and over be welded to vertical plates for this reason. The essential requirement to obtain satisfactory fillet formation is to use the shortest weld time possible with increased welding current. Welding to a vertical surface reduces the maximum size of the stud a given power source will weld. It must be remembered, that greater care is required to ensure that the stud is perpendicular to the work piece. A special tripod foot attachment can be supplied if required. Take particular care to keep the ferrule grip, foot adapter and chuck clean.

## **2. WELDING TO A PLATE IN THE OVERHEAD POSITION.**

**IMPORTANT !** You must protect your face and shoulders with a helmet and cape before carrying out overhead welding operations. Weld spatter can do a lot of damage !

Firstly, obtain satisfactory weld settings in the down hand position before making attempts in the overhead position. Since the weld metal is transferred from stud to plate in small particles in the down hand position, it follows that, when welding overhead, the transfer takes place against gravity. As with vertical welding the best results will be achieved using the shortest possible weld time with increased welding current.

It is important that the ferrule grip, foot adapter and chuck are kept free from spatter build up as this can cause stud return problems or possibly short out/bridge out the weld.

## **3. PISTOL ADJUSTMENTS WHEN WELDING IN THE VERTICAL OR OVERHEAD POSITIONS.**

Problems may be encountered when welding in the vertical or overhead positions with a damped pistol. To prevent problems occurring, where it is possible to do so, the damping effect should be removed or turned off.

Welding can then continue as outlined in sections 1. and 2.

## **4. USING LONG CABLE LENGTHS.**

Frequently the pistol must be used some distance from the nearest available mains supply, for instance on board ship, in power stations and building construction, in workshops building large pre-fabricated structures etc. In these cases long lengths of welding cable are used and it must be realised at the outset that, the longer the cables the smaller the maximum diameter of stud which can be welded with a given power source.

To help get over this problem, if larger diameter studs are to be welded with long lengths of cable, increase the welding cable conductor size.

Try to avoid running the pistol cables and the earth cables alongside each other as this can cause a choking effect, reducing power. Also avoid coiling any excess cable as this will have the same effect.



# **STUDWELDING TECHNIQUES**

## **5. WELDING STUDS LESS THAN 25 mm LONG USING FERRULES.**

As we have seen previously, the stud is held in a recess in the chuck and must be long enough to allow us to set the correct protrusion. A standard chuck has a recess 12 mm deep and ferrules vary in length up to 13.5 mm high. Thus if a stud is much less than 25 mm LAW we shall not be able to obtain the correct protrusion, i.e.. The chuck may hit the ferrule on the return stroke and prevent the stud returning to the plate correctly.

This problem may be overcome by using "shallow recess" chucks (the recess depth is only 6 mm) or if the studs are required to be very short, by using a special type of stud known as a "break-off" type. These studs have an overall LAW of 30 mm and are welded using a standard chuck and ferrule. The stud is "grooved" at the required length from the welding end. After welding, the surplus portion of the stud is broken off with a pair of pliers. By these means, very short studs can easily be welded.

## **6. USING TEMPLATES TO ENSURE POSITIONAL ACCURACY.**

When welding studs around the periphery of a flange, i.e. for cover plates, inspection doors etc., positioning of the studs in relation to each other becomes most important. A simple template made from 2 mm sheet, shaped to suit the component and provided with clamps is usually the answer to this problem. The position of the studs is accurately marked and holes drilled in these positions to accept either the ferrule of the stud to be welded or, if using short cycle, the pistol gas shroud. The size of the holes should be the outside diameter of the ferrule / shroud +0.4 mm. It is also advisable to provide 2 mm thick pads underneath the template so that there is a space between the component and template, this space will allow the gases developed during welding to vent properly from the ferrule / shroud. For any further advice or help in the design of jiggging or templates contact your local field sales engineer.

## **7. MINIMUM PLATE THICKNESSES WHEN STUD WELDING.**

When using standard Drawn Arc with ceramic ferrules, the minimum ratio of stud diameter to plate thickness is 4 : 1 for plate thickness greater than 3 mm and 3 : 1 for plate thickness between 1.5 mm and 3 mm. When using the short cycle system with or without gas purging it is possible to weld equivalent size studs onto slightly thinner sections, due to the short weld duration. These ratios ensure that the strength of the plate is sufficient to support a stud of a given size when it is loaded, without there being a tendency for the plate to distort.

Occasionally, however, it may be necessary to weld a stud outside of these ratios. This can sometimes be accomplished without distortion by "heat sinking" the component, by using a flat copper or water cooled backing piece behind the weld area, to support the plate and assist in dissipating heat quickly.

## **8. WELDING STAINLESS STEEL.**

Austenitic stainless steel studs of the 18/8 g/N : weld decay proof type can be supplied for welding to similar parent material or mild steel. The technique does not differ from that used for mild steel stud welding. There is a tendency with larger diameters of stainless steel studs for metal transfer across the arc to take the form of large particles. If short circuits occur then the arc can be heard to splutter. This may occur with any diameter of stainless steel stud if the lift of the hand tool is not correct. Due to this tendency to transfer in large particles increased lift may be required and time settings should be kept as low as possible.

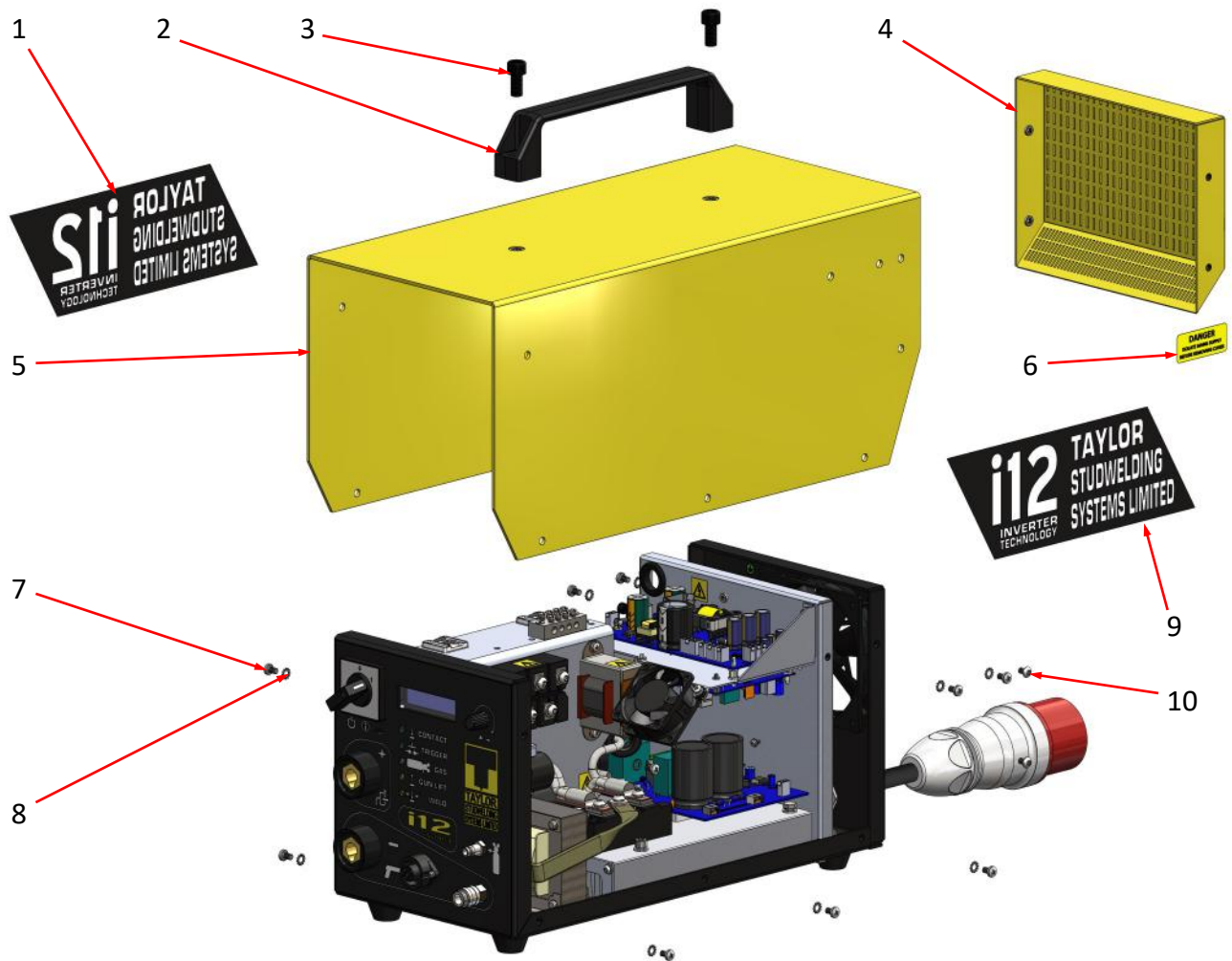
# **STUDWELDING TECHNIQUES**

## **9. WELDING CLOSE TO CORNERS, FLANGES AND OTHER OBSTACLES.**

When welding close to the edge of a plate, in / on a corner, on long strips of narrow plate etc. An effect known as "arc-blow" occasionally will produce an uneven fillet, in such a fillet, most of the material is blown to one side of the stud. "Arc-blow" is caused by the magnetic forces surrounding the arc being intensified in one direction, due to the presence of an air gap or the proximity of a large mass of magnetic material. It is dependant on a number of factors, size of stud, shape of component, position of earth connection, current density etc. No hard and fast rules can be applied to correct it. The following methods are generally helpful, but if satisfactory results cannot be obtained, our field staff will be pleased to advise you. Check that no other fault is present by welding a few studs on to a test piece and inspecting the fillet formation, before deciding that "arc-blow" is causing the uneven fillet.

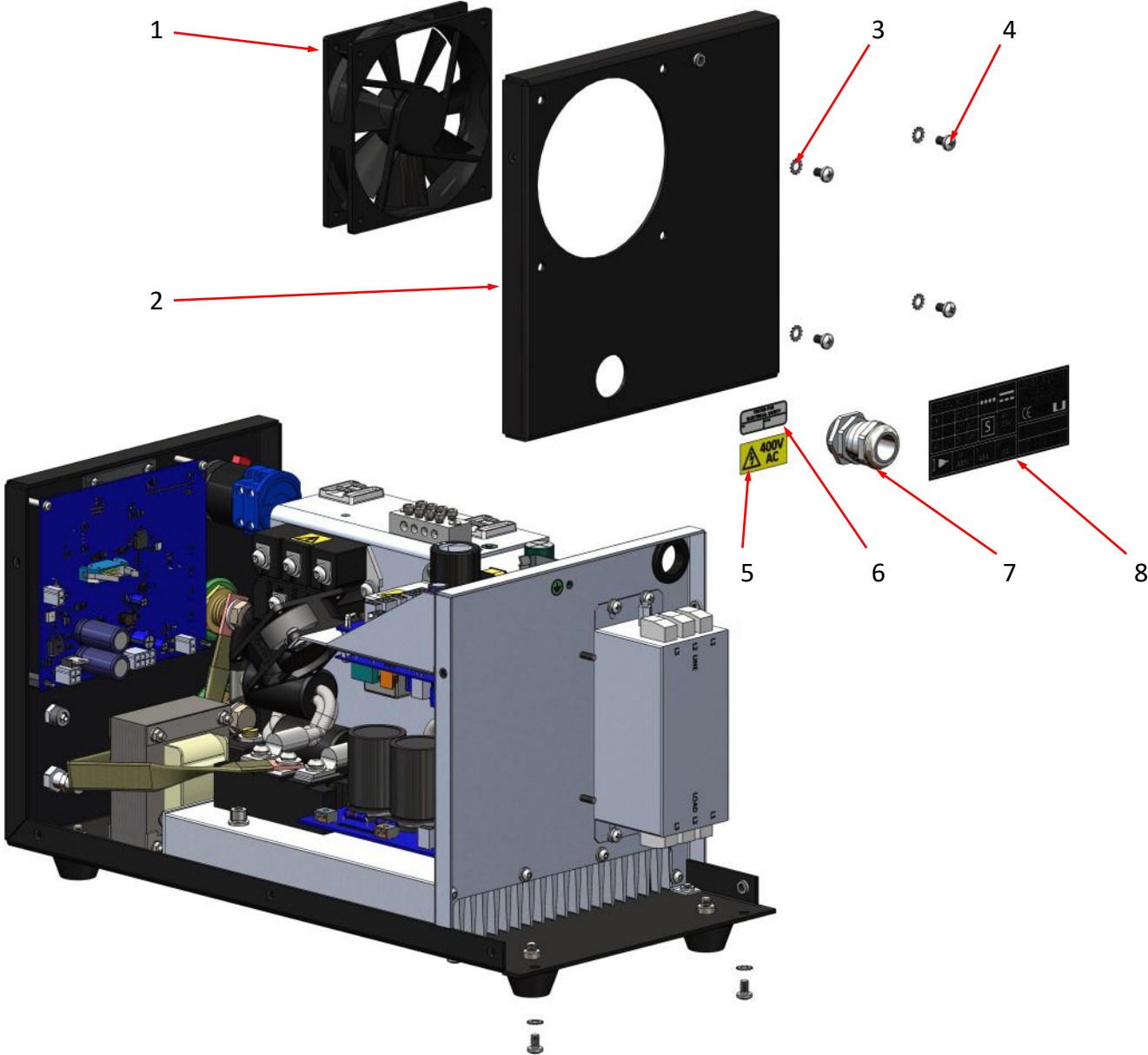
"Arc-blow" can sometimes be corrected by placing a block of steel near the position of the weld area, on the opposite side to that at which the fillet has blown. When welding near the edge of a plate, the fillet will be blown towards the general mass of material, i.e.. away from the edge. The block in this case should therefore be placed at the edge the plate, touching it, thus providing a more evenly distributed magnetic field. The earth connection can be located immediately below the position of the stud weld, this latter is not always practicable, since it requires the earth connections to be moved frequently. The use of two earth connections, spaced evenly across the welding area, is also advisable.

## PARTS LIST & EXPLODED DIAGRAM



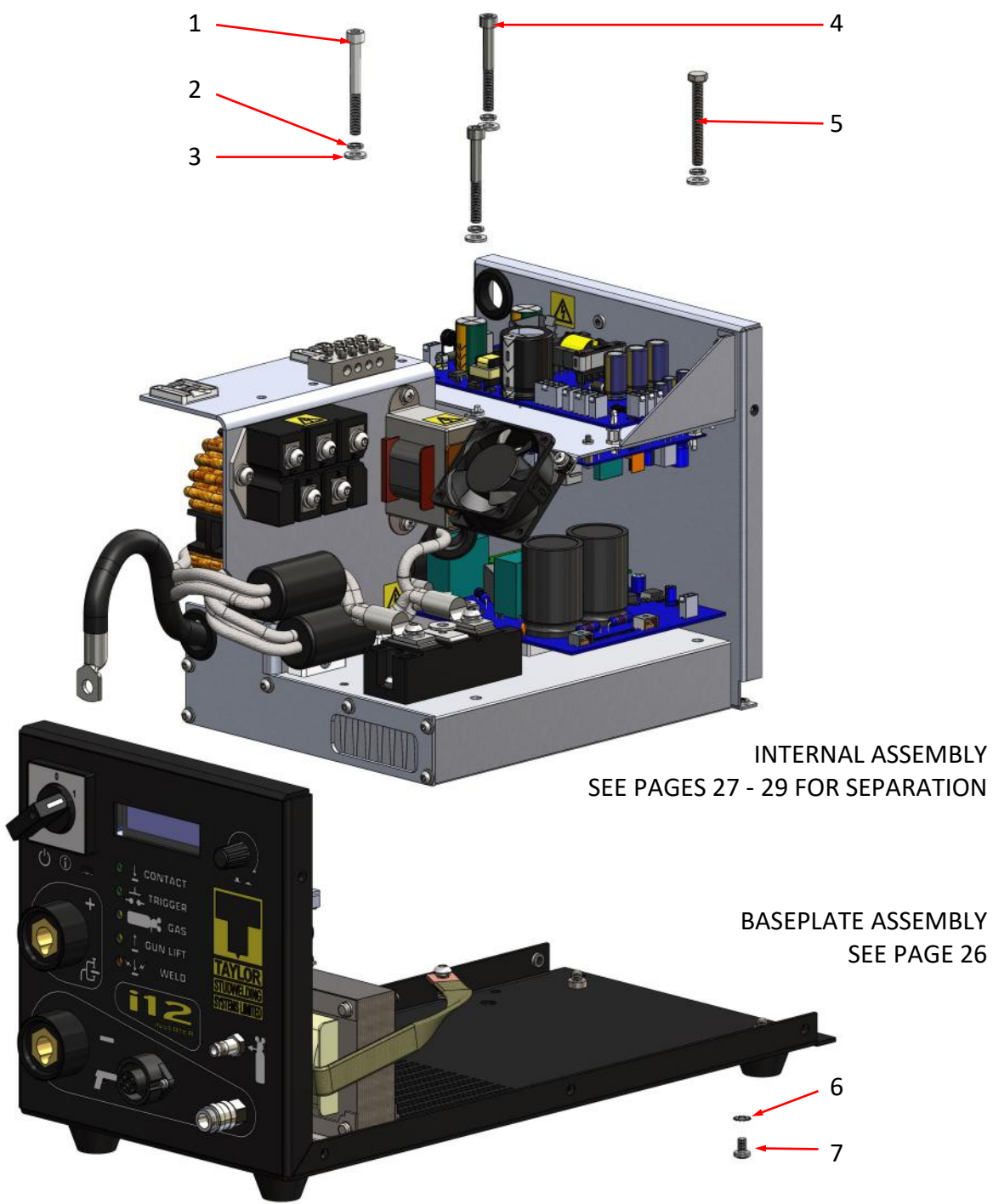
ITEM	No. OFF	PART No.	DESCRIPTION
1	1	81-300-040	SIDE STICKER
2	1	81-1120-011	HANDLE
3	2	Z100-10-020	SCREW
4	1	81-300-036	VENT PANEL
5	1	81-300-037	HOUSING COVER
6	2	98-103-050	WARNING LABEL
7	12	Z200-05-008	SCREW
8	12	Z620-05-000	WASHER
9	1	81-300-039	SIDE STICKER
10	4	Z115-05-008	SCREW

# PARTS LIST & EXPLODED DIAGRAM



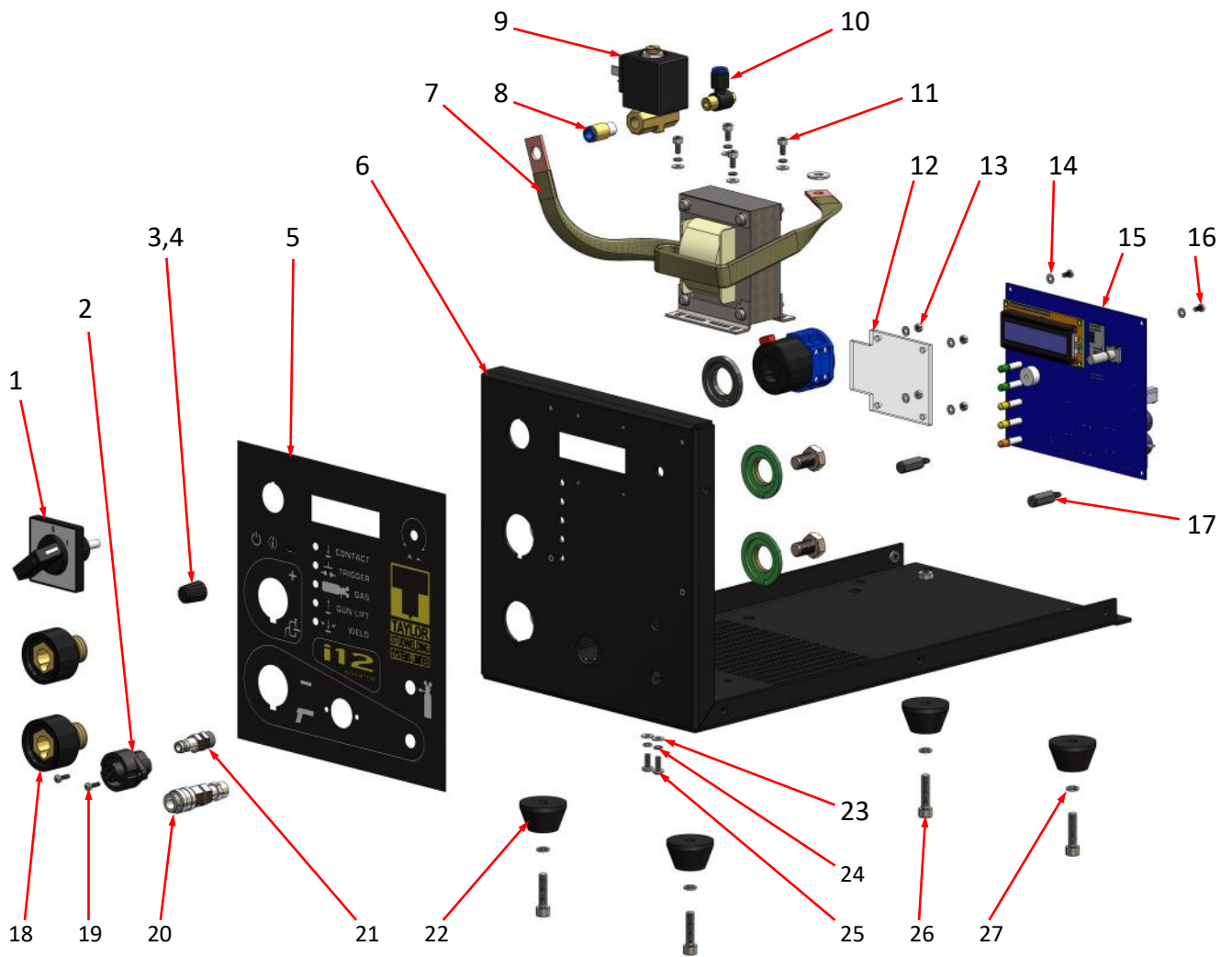
ITEM	No. OFF	PART No.	DESCRIPTION
1	1	70-105-233	FAN
2	1	81-300-035	BACK PANEL
3	6	Z620-05-000	WASHER
4	6	Z200-05-008	SCREW
5	1	98-103-057	WARNING LABEL
6	1	98-103-055	TEST LABEL
7	1	81-108-019	CABLE GLAND
8	1	81-300-026	SERIAL/DATA LABEL

# PARTS LIST & EXPLODED DIAGRAM



ITEM	QTY.	PART No.	DESCRIPTION
1	1	Z105-06-055	BOLT
2	4	Z615-06-000	WASHER
3	4	Z600-06-000	WASHER
4	2	Z105-06-050	BOLT
5	1	Z305-06-050	SCREW
6	2	Z620-05-000	WASHER
7	2	Z200-05-008	SCREW

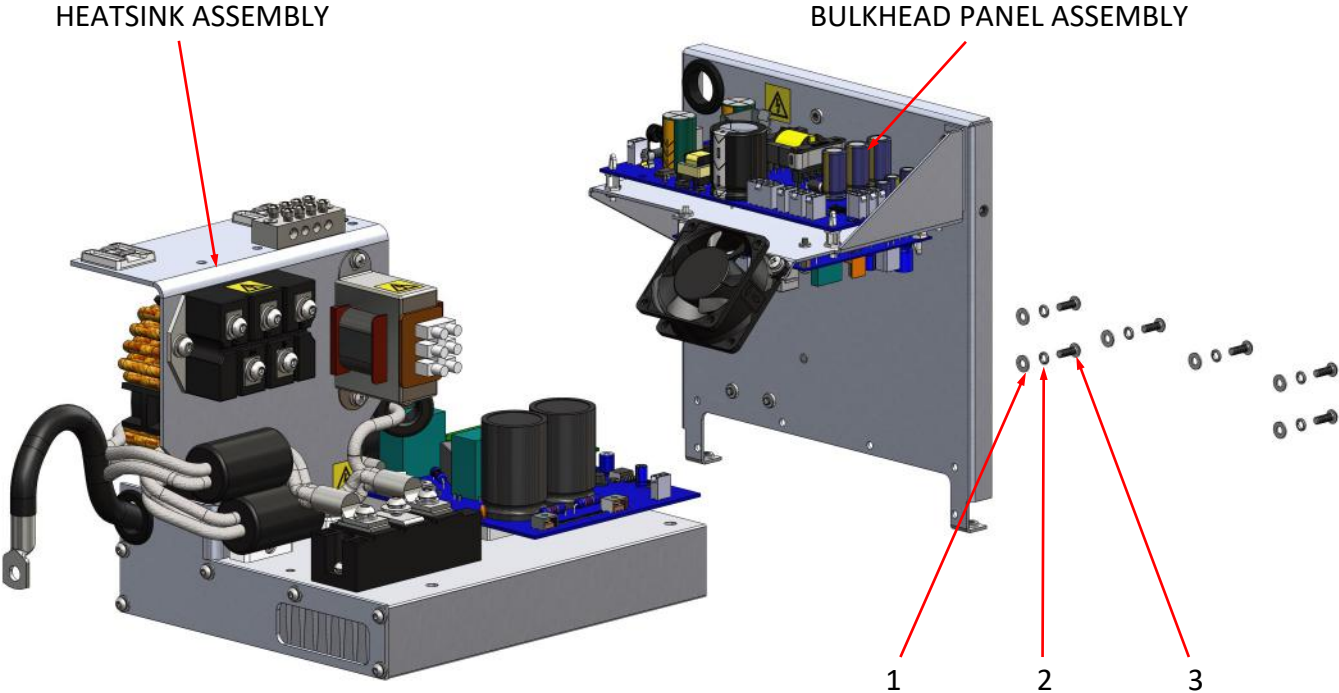
# PARTS LIST & EXPLODED DIAGRAM



ITEM	QTY.	PART No.	DESCRIPTION
1	1	81-108-067	ON/OFF SWITCH
2	1	70-102-025	SOCKET
3	1	81-300-027	KNOB
4	1	81-300-028	CAP
5	1	81-300-031	PANEL OVERLAY
6	1	81-300-030	BASEPLATE
7	1	81-300-008	OUTPUT INDUCTOR
8	1	PFS-P06-U1M-INT	GAS FITTING
9	1	81-108-071	GAS VALVE
10	1	PFE-P06-U1M	GAS FITTING
11	4	Z105-04-010	SCREW
12	1	81-300-025	WINDOW
13	4	Z505-03-000	NUT
14	6	Z600-03-000	WASHER

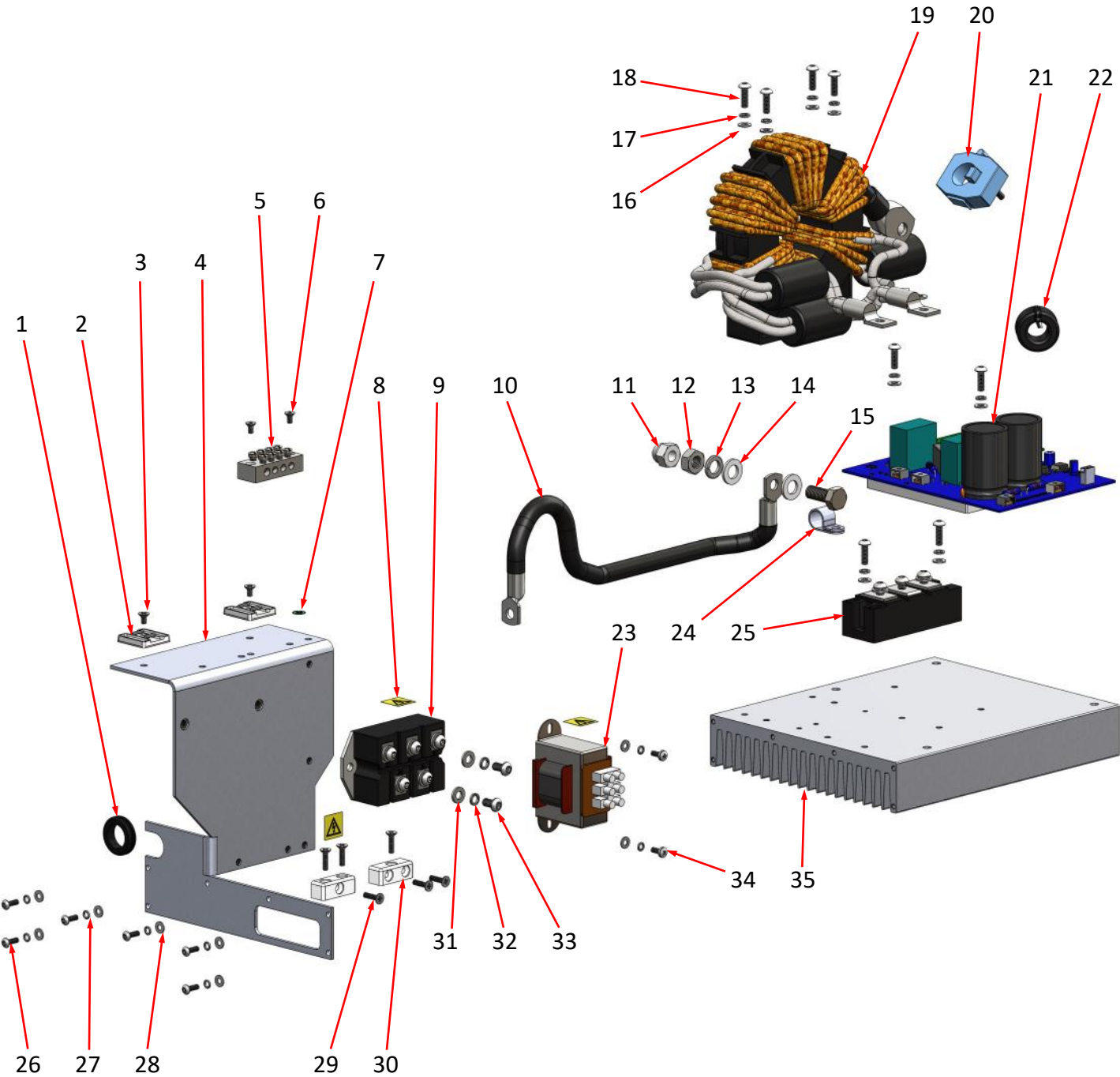
ITEM	QTY.	PART No.	DESCRIPTION
15	1	81-300-087	DISPLAY PCB
16	2	Z200-03-006	SCREW
17	2	81-300-093	MOUNT PILLAR
18	2	81-106-031	WELD SOCKET
19	2	Z200-03-010	SCREW
20	1	PFX-CSS-B06-BUL	GAS SOCKET
21	1	71-200-067	GAS INLET
22	4	81-113-024	FOOT
23	6	Z600-04-000	WASHER
24	6	Z615-04-000	WASHER
25	2	Z200-04-010	SCREW
26	4	Z100-06-020	SCREW
27	4	Z620-06-000	WASHER

# PARTS LIST & EXPLODED DIAGRAM



ITEM	No. OFF	PART No.	DESCRIPTION
1	6	Z600-04-000	WASHER
2	6	Z615-04-000	WASHER
3	4	Z115-04-012	SCREW

# PARTS LIST & EXPLODED DIAGRAM

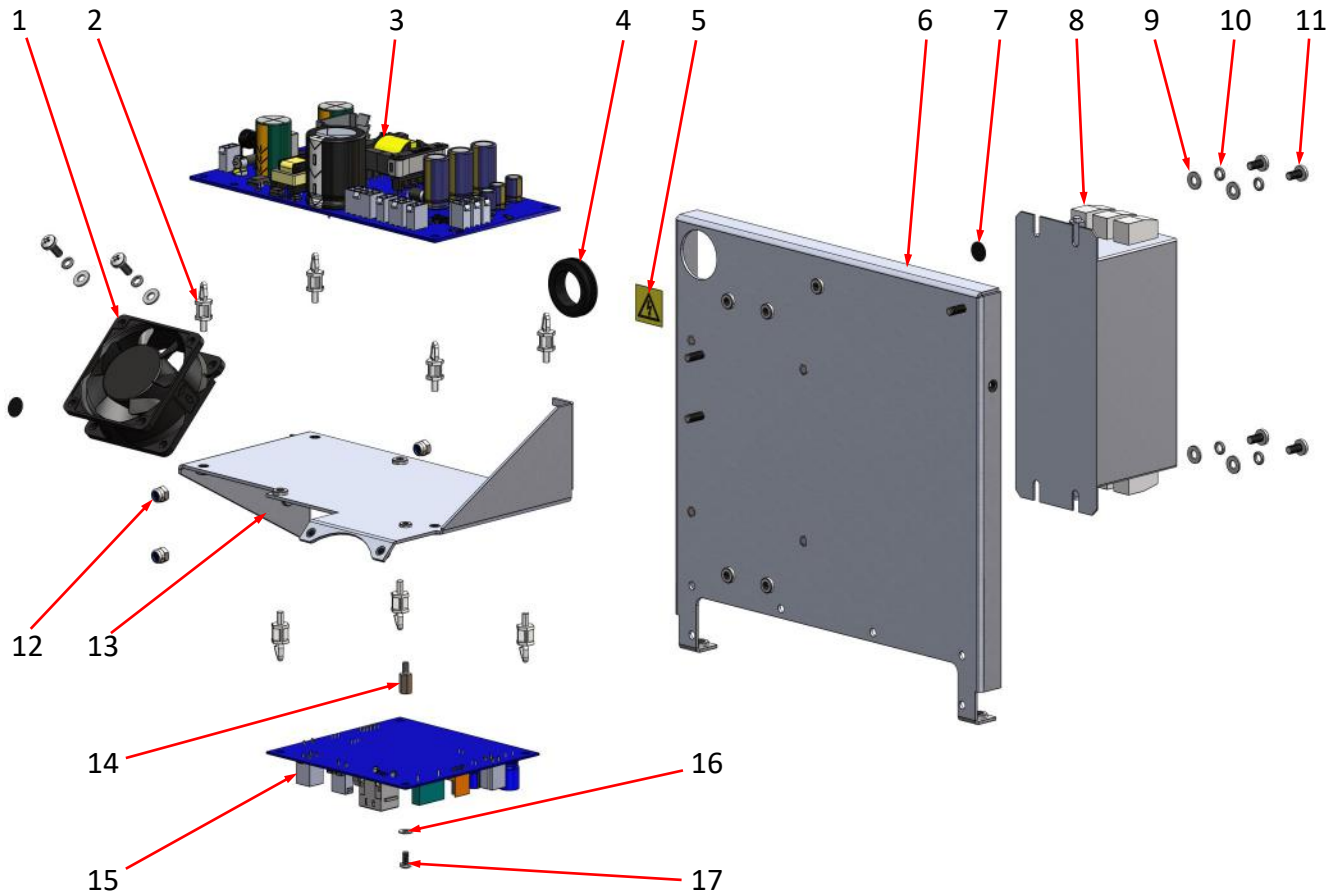




## **PARTS LIST & EXPLODED DIAGRAM**

ITEM	QTY.	PART No.	DESCRIPTION
1	1	81-106-257	GROMMET
2	2	81-300-022	CABLE TIE MOUNT
3	2	Z205-04-008	SCREW
4	1	81-300-032	TRANSFORMER SCREEN
5	1	70-105-190	EARTH BLOCK
6	2	Z120-04-018	SCREW
7	1	81-106-262	EARTH LABEL
8	3	98-103-052	WARNING LABEL
9	1	81-300-011	INPUT RECTIFIER
10	1	81-300-044	CONNECTION CABLE
11	1	Z650-10-000	NUT
12	1	Z515-10-000	NUT
13	1	Z615-10-000	WASHER
14	2	Z605-10-000	WASHER
15	1	Z305-10-025	SCREW
16	8	Z600-05-000	WASHER
17	8	Z615-05-000	WASHER
18	8	Z115-05-016	SCREW
19	1	81-300-009	800A WELD TRANSFORMER
20	1	81-300-014	LEM TRANSDUCER
21	1	81-300-091	IGBT PCB
22	1	81-300-015	CURRENT TRANSDUCER
23	1	81-300-013	AUTO TRANSFORMER
24	1	81-300-045	P CLIP
25	1	81-300-010	OUTPUT DIODE
26	6	Z200-04-012	SCREW
27	8	Z615-04-000	WASHER
28	8	Z600-04-000	WASHER
29	6	Z205-04-016	SCREW
30	2	70-105-234	FIXIT BLOCK
31	2	Z600-06-000	WASHER
32	2	Z615-06-000	WASHER
33	2	Z200-06-016	SCREW
34	2	Z200-04-010	SCREW
35	1	81-300-018	HEATSINK

# PARTS LIST & EXPLODED DIAGRAM



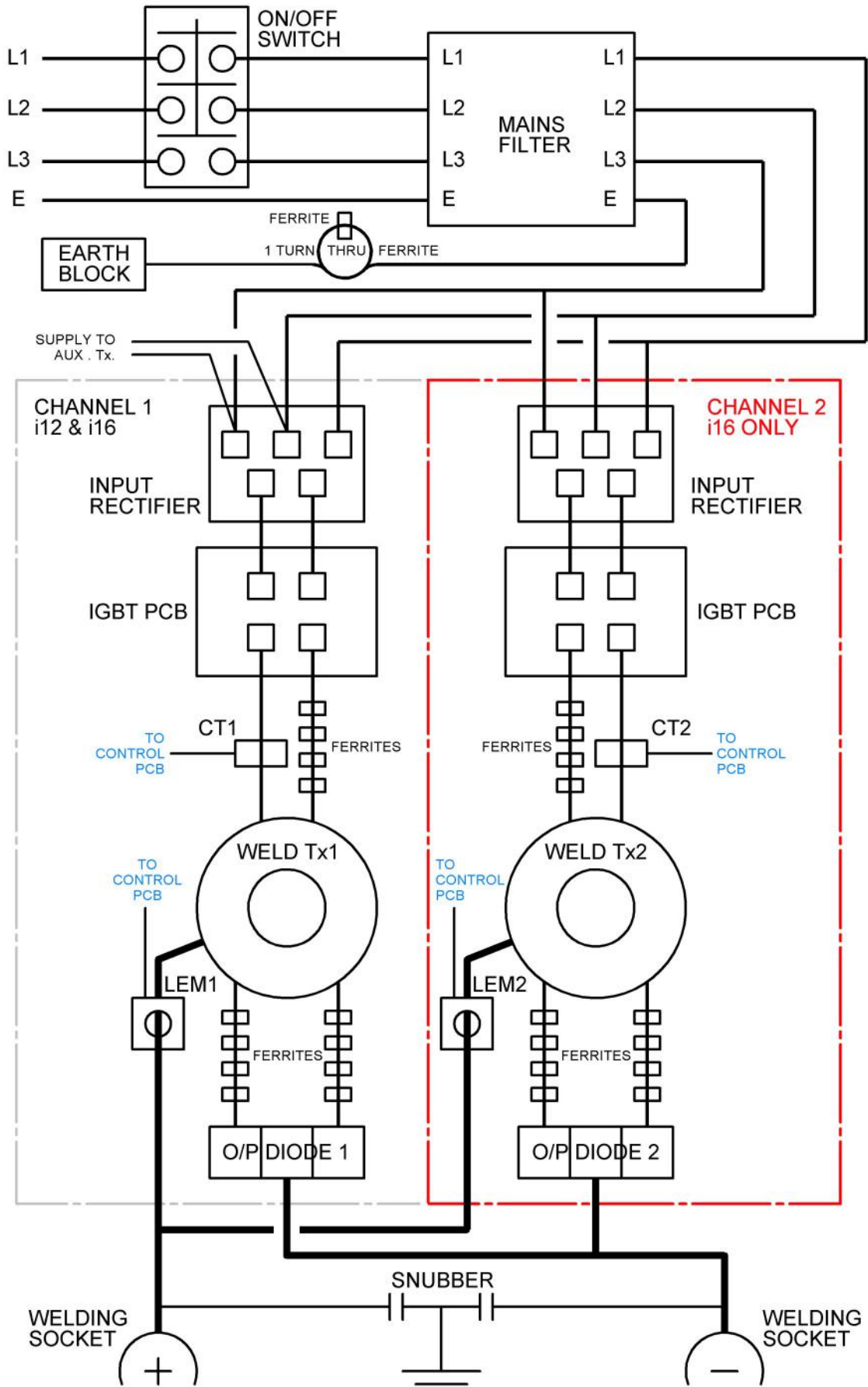
ITEM	QTY.	PART No.	DESCRIPTION	ITEM	QTY.	PART No.	DESCRIPTION
1	1	70-105-053	FAN	10	6	Z615-05-000	WASHER
2	7	81-300-092	PCB SUPPORT	11	6	Z200-05-008	SCREW
3	1	81-300-088	PSU PCB	12	3	Z520-04-000	NUT
4	1	81-106-257	GROMMET	13	1	81-300-034	BRACKET
5	1	98-103-052	WARNING LABEL	14	1	70-105-228	SPACER
6	1	81-300-033	BULKHEAD PANEL	15	1	81-300-089	CONTROL PCB
7	1	81-106-262	EARTH LABEL	16	1	Z600-03-000	WASHER
8	1	81-300-079	MAINS FILTER	17	1	Z200-03-006	SCREW
9	6	Z600-05-000	WASHER				

ITEMS NOT SHOWN & MAINS PLUGS AVAILABLE FROM STOCK

No. OFF	PART No.	DESCRIPTION
1	81-300-094	i12 WIRING HARNESS
1	81-300-099	IGBT DATA CABLE - YELLOW - i12
1	81-108-066	3 PHASE, 380/415V AC, 32A, 4 PIN MAINS PLUG

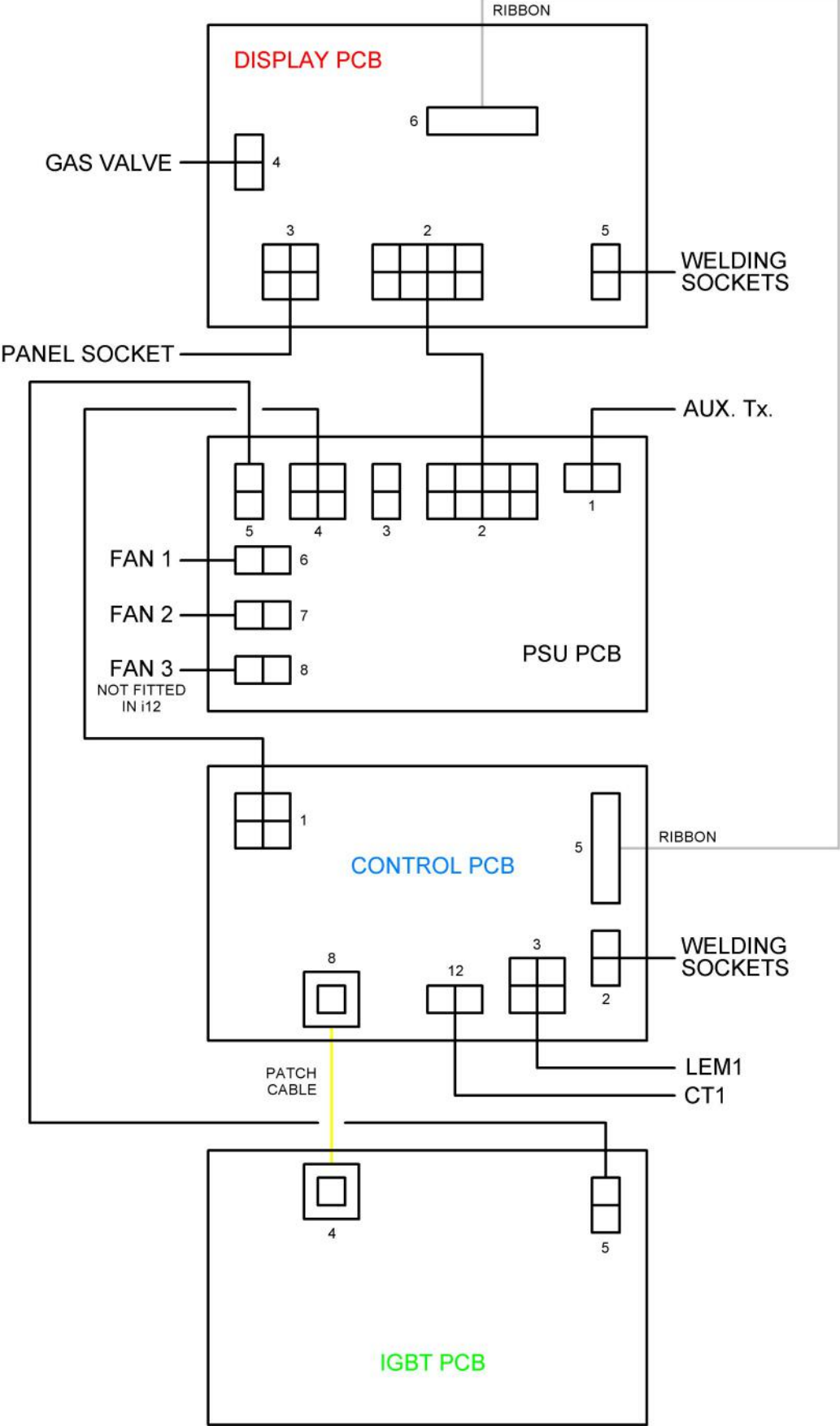
# CIRCUIT SCHEMATIC

## i12 & i16 POWER



# CIRCUIT SCHEMATIC

## i12 CONTROL



## **ACCESSORIES**

Both the earth connection sockets on the controller are bussed on the same internal bus-bar. It is possible to weld with only one earth connection but where possible connect 2 earth cables to every workpiece (see page 11. Setting up and Welding) as this gives better results. An earth cable must be connected to the controller in this user guide. A pair of cables comprises 2 off the standard cable assembly part number listed below.

STANDARD EARTH CABLE ASSEMBLY FOR SYSTEM i12

**99-101-090**

Spare parts for the maintenance of earth cables are listed below:

WELD PLUG	81-101-051
CABLE/m	71-300-004
EARTH CLAMP	81-101-135
CRIMP TERMINAL	Z700-08-060

# DECLARATION OF CONFORMITY

Responsible Party Name : **Taylor Studwelding Systems Ltd**

Address : **Commercial Road  
Dewsbury  
West Yorkshire  
UK  
WF13 2BD**



In accordance with the following directives :

93/68/EEC                      The CE Marking Directive  
2014/35/EU                    The Low Voltage Directive  
2014/30/EC                    The Electromagnetic Compatibility Directive

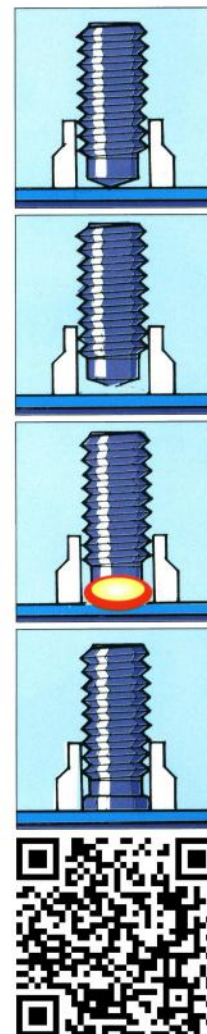
Hereby declares that the product :

Equipment Name :              Drawn Arc Studwelding Equipment  
Model No :                        i12

Conforms to the applicable requirements of the following standards :

Safety :                            BS EN 60974-1:2012  
EMC Testing :                    BS EN 60974-10:2014

I hereby declare that the equipment named above has been designed to comply with the relevant sections of the above referenced specifications. The unit complies with all applicable essential requirements of the directives.



SIGNED

A handwritten signature in black ink, appearing to read 'D Taylor'.

DAVID TAYLOR  
MANAGING DIRECTOR