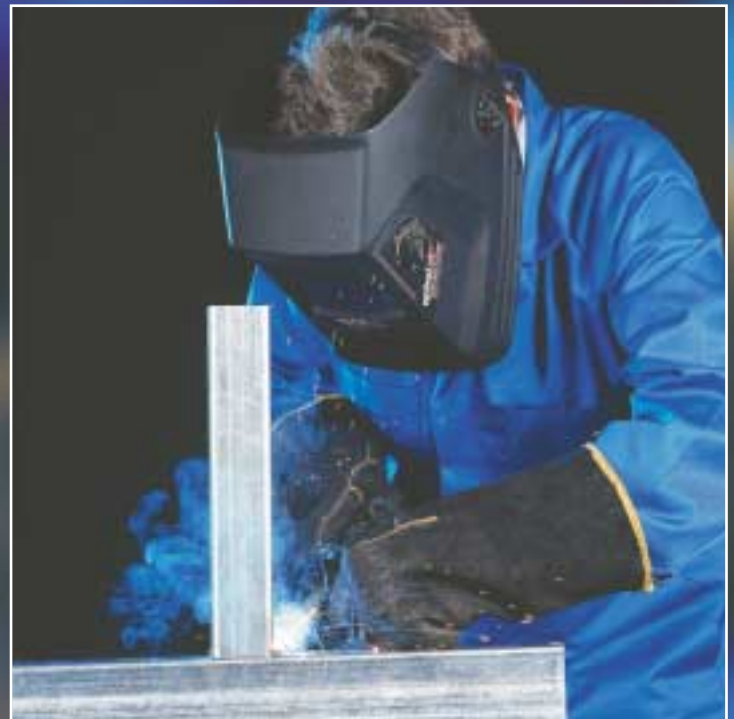


DURAGAL[®]

Easy Welding Guide

TECHNICAL INFORMATION

- welding hints
- use the right electrode
- recommended electrode size
- weld quality and handpiece angle
- recommended welder setting and consumables
- welding fume
- safety in welding



THE FAMILY OF DURAGAL PRODUCTS[®]

This guide applies to welding techniques for low carbon steel used in The Family of DuraGal Products[®]. (maximum carbon equivalent 0.39.)

These sections, with their lustrous, thin, evenly applied zinc coating can be as readily welded as black steel. Using this guide will assist in achieving the best possible appearance and the highest quality welds with the minimum of spatter and fuming.

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GLOSSARY OF TERMS

CHS	=	Circular hollow sections (pipe).
FCAW	=	Flux cored arc welding.
GMAW	=	Gas metal arc welding - commonly known as MIG welding.
H-fillet	=	Horizontal fillet - A fillet weld that has one leg on the upper side of an approximately horizontal surface and the other leg on abutting an approximately vertical surface.
ILG	=	In-line hot dip galvanized.
SMAW	=	Shielded metal arc welding - commonly known as stick welding.
Profiles	=	Steel open sections, angle, channels and flats.
RHS	=	Rectangular hollow section.
SHS	=	Square hollow section.
WIA	=	Welding Industries of Australia.
WTIA	=	Welding Technology Institute of Australia.

WELDING HINTS

The thin, even coating of zinc on The Family of DuraGal Products® means welding can be carried out safely and with minimum fuming if suitable procedures are followed.

The application of a clear polymer coat to the heavy angles and channels of The Family of DuraGal Products® not only improves weldability and increases weld metal deposition rates, but allows most spatter that does remain on the fabrication to be easily wiped off.

DuraGal's clean smooth coat allows instant grounding to complete the welding circuit. The thin clear polymer coating on the DuraGal® open profiles and Ultra Fence Tubing causes minimum disruption to the grounding.

We suggest you use the welder settings in this manual as a starting point and then tune the machine to suit your consumable and personal preferences.

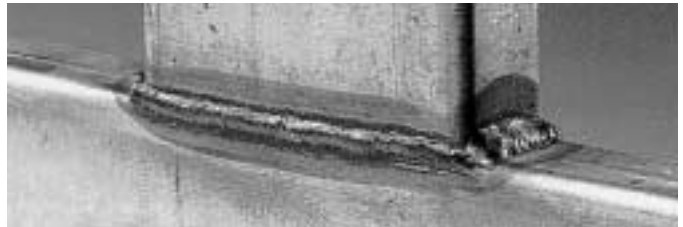
Hints

- Reduced the size of the weld to a minimum.
- Don't increase the heat (to weld The Family of DuraGal Products®).
- Preheating is unnecessary.

The most common welding issues brought to OneSteel's attention have been :-

- "Burn through" or melting holes in the thinner wall section.
- Visible ("worm holes") and internal porosity and/or unacceptable weld appearance.
- Zinc vaporization (explosions) and spatter.

Just a little extra care in preparation and slight changes in welding technique can help even the most inexperienced welder avoid these common welding problems. The following are some other hints that will help any welder to achieve excellent results when welding ILG hollow sections and Profiles.



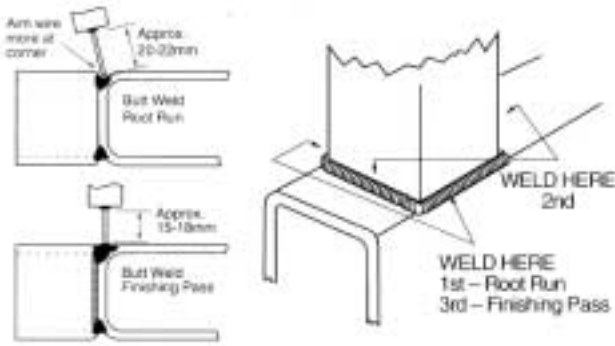
The desired weld, smooth, even, minimum spatter

Preparing joints in Rectangular and Square Hollow Sections

Careful joint fit-up, with minimum gaps, has the following advantages :-

- Reduced weld metal volumes.
- Increased welding speeds.
- Lower welding costs.
- Elimination of burn through on thinner sections.
- Reduced visible and internal porosity.
- Less zinc burn back and thus less fuming.

RHS branches welded to RHS chords of the same width require a combination butt/fillet weld to make the connection. A butt weld is used to attach the branch along the corner of the chord. For thicker section chords the larger corner radii results in a void that has to be filled with weld metal. At least two passes should be laid. Lay a small root run with the welding rod or wire aimed more at the corner of the chord than at the end of the branch. Then lay the fillet welds on the other sides of the branch. Finally lay the finishing passes on the butt welds. This procedure will minimize distortion and produce the best possible appearance at the corners.



If a MIG welder is to be used, increasing the root run wire stick out to 0.8" to 0.9" (instead of the normal 0.6" to 0.7") will reduce the chances of burn through.

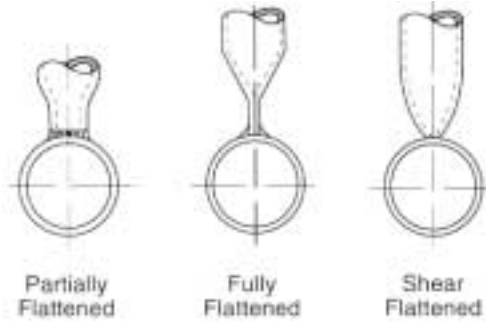
Preparing joints in Circular Hollow Sections

Fully profile the branch tube to fit the mating part. This option is the most aesthetically pleasing and structurally the strongest.



Specialized profiling machines can automate this joint preparation. Some CAD software can prepare paper templates for CHS joining.

Partially flattened, and shear flattened ends are methods of achieving good joint fit-up. All three reduce the structural capacity of the CHS to some extent.



USE THE RIGHT ELECTRODE

SHIELDED METAL ARC WELDING - STICK



Most GP rods suit The Family of DuraGal Products[®], refer to the chart on page 6.

For Superior Appearance

Use AWS/ASME-SFA A5:1: E6013 electrodes. This type of rod is "all positional" and will give a smooth weld with no visible porosity. The fluid slag and softer arc action of these rods allow the gases formed during welding to escape into the slag before the weld solidifies.

These electrodes give welds with a minimum yield strength of 50,000 PSI and will often be suitable for welding joints in 65,000 PSI DuraGal[®] fabrications because the loads to be carried are lower than the allowable capacity of the weld group. If in doubt

however it is recommended that electrode selection be in line with the required material mechanical properties (see for strength).

When these electrodes cannot give a suitable joint capacity use the electrodes suggested in the next section.

For Strength

For strength and/or impact performance use low hydrogen electrodes.

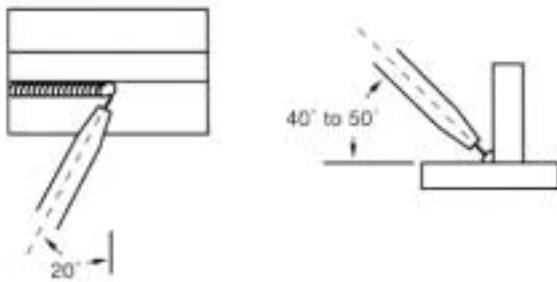
This type of rod requires the attention of a more experienced welder than the E7016 type, mentioned in the previous section, and may produce a little more spatter. Better fit up may be required.

The E6013 type electrode gives a weld metal yield strength of 66,700 PSI and tensile strength of 72,500 PSI.

HANDPIECE ANGLE (TORCH)

When MIG Welding, a Handpiece Angle of 20°, is recommended

Testing has shown that inclining the MIG handpiece 20° with the wire pointing in the direction of travel, forehand, reduces porosity and nozzle cleaning frequency. The lateral angle should be between 40° and 50°.



ROD DIAMETER

The Recommended Rod Diameter Depends on the Thickness of the DuraGal® Products

The preferred electrode diameters are set out in "Recommended Welder Settings and Consumables".

During the testing carried out in conjunction with manufacturers of electrodes to develop the recommended welder settings, 16G to 7G thick DuraGal® products were welded using 3/32" and 1/8" diameter rods at low power settings. This combination of readily available consumables and low power settings is preferred but, in the hands of an inexperienced welder of thin wall steel sections, may result in undercut which will reduce joint strength and make the slag harder to detach.

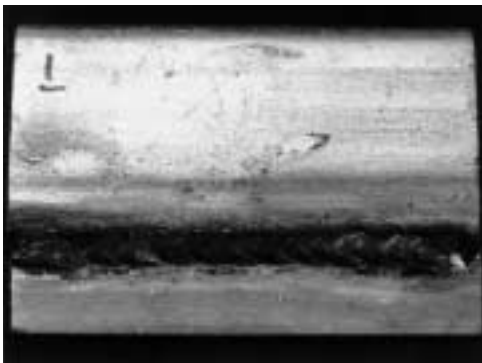
RECOMMENDED WELDER SETTINGS AND CONSUMABLES

SHIELDED METAL ARC WELDING

(STICK)

Electrode

Material Wall Thickness Gauge (inch)	Electrode inch	Amps	Electrode Type AWS Classification
7G (0.180)	1/8	120	E70XX
13G (0.095)	3/32	85	E70XX
16G (0.065)	3/32	70	E6013



Manual Arc welded 2x2x0.203"
 DuraGal[®] Angle - Lap Joint
 E7016 Electrode, 120 Amps.

easy welding guide

GAS METAL ARC WELDING - MIG

(DIP OR SHORT ARC)

Recommended Shielding Gases

Gas Type	Supplier
ARGOSHIELD 25C	BOC GASES
ARGOSHIELD UNIVERSAL	BOC GASES
ARCAL 211	AIR LIQUIDE AMERICA CORP
BLUESHIELD 23	AIR LIQUIDE AMERICA CORP
BLUESHIELD 8	AIR LIQUIDE AMERICA CORP
CO ₂	All suppliers

Solid Electrode Wire

SIZE INCHES	TYPE	AWS A5.18 CLASS (ELECTRODE TYPE)*	SHIELDING GAS
0.048	CARBON STEEL	ER70S-6 ER70S-3	ARGOSHIELD UNIVERSAL ARCAL 211
0.035	CARBON STEEL	ER70S-6 ER70S-3	ARGOSHIELD 25C BLUESHIELD 8
0.035	CARBON STEEL	ER70S-6 ER70S-3	ARGOSHIELD UNIVERSAL ARCAL 211
0.035	CARBON STEEL	ER70S-4	CO ₂

* Check with supplier for 5 number electrode type for your application

Settings

Shielding Gas	Wall Thickness G (inch)	Amps	Volts	Wire Size Inch	Wire speed ipm	Electrode Type *
CO ₂	7G (0.180)	174	24.00	0.035	307	ER70S-4
ARGOSHIELD UNIVERSAL	7G (0.180)	200	20.50	0.045	240	ER70S-6
ARCAL 211	7G (0.180)	285	28.00	0.045	240	ER70S-6
ARGOSHIELD 25C	7G (0.180)	174	24.00	0.035	307	ER70S-6
BLUESHIELD 8	7G (0.180)	174	24.00	0.035	307	ER70S-6
ARGOSHIELD UNIVERSAL	13G (0.095)	140	21.00	0.035	256	ER70S-6
BLUESHIELD 8	13G (0.095)	110	20.00	0.035	256	ER70S-6
ARGOSHIELD 25C	16G (0.065)	53	16.00	0.035	212	ER70S-6
BLUESHIELD 8	16G (0.065)	53	16.00	0.035	212	ER70S-6

* Check with supplier for 5 number electrode type for your application

FLUX CORED ARC WELDING

Flux cored arc welding is (FCAW) a very practical, high quality, welding method for people using the small low cost, 240 volt MIG welders that are becoming popular with home handymen and other low intensity users.

An advantage of FCAW is that it is less effected by drafts than gas shielded welding, and as such, is more suitable for outdoor welding.

The recommended wire for FCAW is an AWS/ASME-SFA AS.20: E71T-GS type wire. This is a purpose built flux cored wire for welding galvanized products. It is designed to give a smooth weld at lower amps, have low spatter and a slag easily removed by brushing.

This wire type is not suitable for applications where the low temperature properties of The Family of DuraGal Products® are required.

Flux Core Electrode Wire

SIZE	TYPE	CODE
0.048	Flux cored	E71T-GS
0.031	Flux cored	E71T-GS

Settings

Wall Thickness G (inch)	Amps	Volts	Wire speed ipm	Electrode Type
7G (0.180)	170	20.50	204	E71T-GS
16G (0.065)	90	17.00	177	E71T-GS
11G (0.120)	90	17.00	177	E71T-GS
16G (0.065)	84.7	17.00	157	E71T-GS

Notes:

- a) All settings use Negative Polarity.
- b) Best results achieved with DRAG method.

WELDING FUMES

The right choice of shielding gas could reduce fume emissions considerably.

All welding produces fumes. Normal welding processes generally keep these fumes to acceptable levels.

All welding can be injurious to the health unless sensible welding practices are used.

It is good welding practice to keep your head out of the welding plume.

Testing has shown that the zinc fume given off when welding DuraGal® hollow section products, provided the arc power is kept in the lower amp to volt working range, does not exceed the zinc oxide exposure standard of an 8 hour time weighted average (TWA) of 5mg/m³ and a short term exposure limit (STEL) of 10mg/m³ as recommended by the (Occupational Safety & health Administration) US Department of Labour. However, operating in high short arc or spray arc conditions, or welding DuraGal® open profiles, will require natural or forced ventilation and/or some form of air circulation or extraction.

A benefit of the zinc coating on DuraGal® is the significant reduction in free ozone formed during the welding process.

Exposure to zinc fumes should be less than the allowable limit in a normal fabrication shop environment where actual arc time is often less than a quarter of the total working time. If DuraGal® Profiles are being welded, or high arc powers are being used on DuraGal® Hollow Sections, it is recommended that some form of ventilation be used. See the recommendations by American National Standards Institute (ANSI) standard Z49.1

When using some form of ventilation the likelihood of suffering from weld fume fever, when welding DuraGal® and DuraGal® Ultra Fence Tube, is very low because the exposure will normally be well below the recommended limit.

Welding the thin, evenly zinc coated The Family of DuraGal Products® produces far less zinc fume than welding batch galvanized steel.

Therefore the problems involved with unsound weld due to weld spatter, and unsafe fume associated with batch galvanized product can be alleviated with the use of DuraGal®.

SAFETY IN WELDING

Arc radiation is a result of

Ultra-Violet (UV) & Infra-red (IR)

Rays & exposure can cause the following:

- Skin Cancer
- Thermal Skin Burns (severe sun burn)
- ARC FLASH (Welders Flash) or eye burn

Protection Required Includes:

- An approved welding helmet with correct filter & shade number.
- Safety glasses to help reflect the UV & IR rays.
- Protective clothing to shield your body from potential burns.

Electric Shock - "Prevention":

- Never touch live metal parts with bare skin or wet clothing.
- Repair any damaged or loose connections, especially bare cables, before welding.
- Never coil or loop welding cables around your body.
- Don't weld while standing on a wet surface or while standing in water.

The American Welding Society has released a publication on Safety in Welding, Cutting & Allied Processes (Z49.1-99) and you are encouraged to become familiar with it's recommendations.

YOUR CONSUMABLE SUPPLIER

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