For Added Value, Count On Allied.

Steel Tubing in a Variety of Shapes and Sizes... 1/2"-5" OD rounds...1/2" to 4" square... 22 to 7 gauge.

PRODUCT APPLICATIONS

ELECTRICAL DIVISION:

Offers a full line of Galvanized Rigid Conduit (GRC), Intermediate Metal Conduit (IMC), Electrical Metallic Tubing (EMT), and Power-Strut® Channel Raceway and Framing Systems, plus Kwik-Couple™ (GRC & IMC) and Kwik-Fit® (EMT) in large sizes.

FENCE DIVISION:

Provides a complete range of fence framework, including SS 40®, SS 20®, and SS 15™ for industrial applications, as well as galvanized tubing for residential applications. Also offers Silent Swordsman® long barbed tape for high-security applications.

FIRE PROTECTION:

Supplies a comprehensive group of products to the fire protection industry including SK 40, SK 10, Super-Flo® and Allied XL™ galvanized sprinkler pipe.

MECHANICAL DIVISION:

Offers galvanized steel tubing in a wide assortment of shapes & sizes, using our patented Flo-Coat® process. Superior coatings such as Gatorshield® and Gold-Coat® provide the ultimate in corrosion resistance and lasting durability.

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TUBE & CONDUIT
16100 South Lathrop Ave
Harvey, Illinois 60426
(708) 339-1610
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Welding/Painting GUIDELINES For Allied's Galvanized Steel Tube

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DISCLAIMER

The specifications, descriptions, information and illustrated material herein is not intended nor should it be relied upon to provide anyone with all of the relevant information required for welding/painting Allied Tube & Conduit Corporation's galvanized steel tubing. The material is submitted solely for evaluation by others and Allied Tube & Conduit Corporation assumes no responsibility whatsoever for its accuracy or application. Reference should be made to original or primary source data along with standard accepted industry practice. The material herein is as the date of publication and is subject to change without notice.

Welding Allied's Galvanized Steel Tubing is a very achievable operation if three key points are observed to assure consistent, quality results...

- Use of sound welding practice and procedures;
- Proper safety practices;
- Application of good weld corrosion protection methods.

Let's expand on these three areas...

WELDING PRACTICE

Tubular steel should be welded so as to develop the maximum strength at the connections. When tubes are butt welded (i.e. joined end-to-end), the weld should penetrate through the full section thickness, and the reinforcement should not exceed 3/32". For fillet welds and other configurations, the Engineering Drawing should specify the weld design, including fillet weld sizes. If fillet weld sizes are shown on the drawing, proceed to step number 3. If the fillet weld sizes are not shown, they have to be determined. This is, in fact, quite simple:

1. Determine the thickness of the tube.

2. Using the following table, determine the size of the fillet weld needed to develop full strength at any weld:

Tube Wall Thickness(in.)	Minimum Fillet Weld Size	Tube Wall Thickness(in.)	Minimum Fillet Weld Size
0.035	0.063 (1/16")	0.113	0.160 (3/16")
0.049	0.069 (3/32")	0.133	0.186 (3/16")
0.065	0.092 (3/32")	0.140	0.198 (7/32")
0.072	0.102 (1/8")	0.145	0.205 (7/32")
0.083	0.117 (1/8")	0.154	0.217 (7/32")
0.095	0.134 (5/32")	0.180	0.250 (1/4")
0.109	0.134 (5/32")	any wall thickness (t)	1.414 X (t)

The numbers in parentheses are the nearest fraction. Fillet weld gauges can be purchased from your local welding supplier or manufactured for the specific sizes by a machine shop.

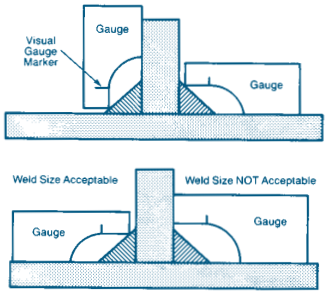
When tubes of two different wall thicknesses are joined, the minimum fillet weld size should be based on the thinner of the two members. There is no maximum fillet weld size: however, welds which are significantly oversized are a waste of money... Welding is expensive, and extra weld metal does not improve the quality of the structure.

These fillet sizes are suitable for connections where the tube end is trimmed to match the curvature of the mating tube or where the end is flattened and welded to the top of the joining member.

3. Visually inspect the weld for soundness, smooth, even contour and freedom from undercutting and arc strikes.

4. Using a fillet weld gauge, measure the weld size in both directions and determine that there is the minimum fillet weld size present around the entire joint. It is important that there not be any gaps or unwelded areas between the members being joined. Such spots will lower the overall strength of the joint, provide a site for corrosion, and concentrate the stresses that lead to fatigue failure. A fillet weld gauge is used in the following manner:

Measure fillet weld in two directions



Gauge must touch fillet before touching base metal

Where it is difficult to actually measure the entire weld due to the geometry of the members, measure the weld at one location, then visually check it as it proceeds around the tube to be sure that it is at least the same size all around.

WELDING PROCESSES

SHIELDED METAL ARC (STICK) WELDING

Welding of thinner gauge galvanized steel can be done using E6013 electrode and the following initial parameters using direct current and electrode positive (reverse polarity) or alternating current, downhill progression:

Gauge	Thickness (inches)	Electrode Size	Amps for Groves	Amps for Fillets
10	0.135	3/32	65/90	55/95
12	0.105	3/32	62/84	85/88
14	0.075	3/32	58/76	75/80
16	0.059	3/32	54/68	66/69
18	0.047	3/32	50/60	55/60
20	0.035	3/32	46/52	50/55
20	0.035	5/64 (alt.)	42/48	50/55
22	0.028	5/64	40/45	45/50

If burn-through cannot be controlled, reduce the amperage slightly, especially if using AC. The welding power source should not exceed 250 amps maximum rating.

Welding of thicker galvanized steel can be done using E6010 electrode and the following initial parameters using direct current and electrode positive (reverse polarity). Use downhill progression for the first 1/4 inch of weld deposit and uphill progression for greater thicknesses.

Thickness (inches)	Electrode Size	Amps for Groves	Amps for Fillets
3/16	3/32	40/80	70/80
1/4 and over	1/8	75/125	115/125

GAS METAL ARC (MIG) WELDING

Welding of thinner gauge galvanized steel can be done using GMAW in the short circuiting transfer mode.

This is the best process to use for economical, high production, high quality welding.

The power source should be rated at 150 to 200 amps, and it should have "inductance" control. The welding gun should be rated for 200 amps, and the wire should be ER70S-2 or ER70S-3, 0.035 inches diameter. The welding gun contact tip should extend beyond the shielding gas cup 1/8 to 1/4 inch. The contact-tip-to-work distance (stickout) should be 3/16 to 1/4 inch. The preferred shielding gas is 92% Argon/8% CO^2. Set the inductance to maximum and the slope control (if any) between mid-range and maximum slope. The initial parameters should be as follows:

Gauge	Thickness (inches)	Voltage	Amps	Wire Feed Speed (ipm)
7	0.180	18	125/140	170/210
10	0.135	18	125	170
12	0.105	17	115	160
14	0.075	17	110	155
16	0.059	17	100	140
18	0.047	16	90	130
20	0.035	16	60	70
22	0.028	15	65	55

For 20 gauge and thinner, switch to 98% Argon/2% Oxygen gas mixture and reduce the voltage by 2 to 3 volts. Use of Argon/Oxygen mixtures is not recommended for thicknesses over 3/16 inch.

If the welder has difficulty keeping the stickout constant, switch to 0.030 inch diameter wire and adjust the wire feed speed to use approximately the amperage shown above.

Excessive voltage is the main cause of spatter in GMAW when using short circuiting transfer. The welder should adjust the voltage in small increments to achieve a rapid, regular, consistent crackling sound. For maximum productivity, the welder should increase the wire feed speed and his forward travel speed to the maximum that he can handle while making a quality weld.

For thicknesses over 7 gauge, GMAW in the Spray Transfer mode may be used. Use 0.035 inch diameter wire, 92% Argon/8% CO^2 shielding gas, 420 to 500 ipm wire feed speed (225 to 280 amps), 27 to 28 volts, 1/2 to 5/8 inch stickout, a welding gun rated at 400 amps and a power source rated at 400 amps. Travel speed will be very high, and deposition rates (i.e. production rate) will be very high.

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GAS TUNGSTEN ARC (TIG OR HELIARC) WELDING

Welding of thinner gauge galvanized steel can be done using GTAW, direct current, electrode negative (straight polarity), 1/16" diameter EWTh-2 classification tungsten pencil-sharpened to a 1/32" flat end, ER70S-2 or ER70S-3 filler metal, argon shielding gas and the following parameters:

Gauge	Thickness (inches)	Amps for Grooves	Amps for Fillets	Filler Metal Size
10	0.135	70/100	125/130	3/32
12	0.105	63/90	105/110	3/32
14	0.075	57/81	86/91	3/32
16	0.059	51/73	68/73	1/16
18	0.047	45/65	50/55	1/16
20	0.035	40/60	45/50	1/16
22	0.028	35/50	40/45	1/16

GTAW is the slowest and costliest of the welding processes, and it should be used only where visual appearance is critical and mechanical surface treatment for appearance is not possible.

PROPER SAFETY PRACTICES

When a manufacturer uses welding, he needs to be aware of safety hazards associated with welding. These include Welding Smoke and Fumes, Electrical Shock, Electromagnetic Radiation.

WELDING SMOKE AND FUMES

Welding produces smoke and fumes which come up from the weld zone in what is referred to as a plume. Obviously, the smoke and fumes which result from welding are not especially healthy to breathe!

The most-cost effective thing a company can do related to welding fumes and smoke is to teach its welders to keep their heads out of the welding plume. Supervisory personnel should be instructed to watch for welders whose heads are in the plume and advise them to change positions. Welders should set up their work so that air flows from one side to the other, rather than towards or from behind the welder. This will keep the plume (and its contents) away from the welder's breathing zone.

When there is a ceiling height of 16 feet or more, and a space of 10,000 cubic feet per welder, and no confined spaces, natural ventilation is considered adequate. When these criteria are not met, forced ventilation must be provided, according to American National Standards Institute (ANSI) standard Z49.1.* This may be done by using a mobile hood or exhaust hose which can be placed in the vicinity of welding, or by using a fixed enclosure which will provide an air flow rate of 100 feet per minute (1 to 2 MPH) in the vicinity of welding. Ventilation can also be in the form of open grid work tables with uniform downdraft ventilation providing at least 150 cubic feet of air per minute per square foot of table surface. Finally, a low volume, high-velocity fume eductor may be attached to the welding gun to provide local fume removal.

The USFDA recognizes that at least 15 mg/day of zinc is essential for proper health in humans. Zinc is also a necessary micronutrient for plant and animal life. Too much zinc, however, can cause temporary illness known as "metal fume fever." Inhaling the white zinc oxide fumes which are produced when welding over zinc may cause temporary symptoms of influenza, including fever and chills. No permanent or long-term effects are known to occur. It is important that the welding plume containing the zinc oxide be carried away from the welder. ANSI Z49.I requires that zinc fume removal be done by local exhaust ventilation when zinc is welded indoors. Welders should also be taught not to stand or work downwind from another welder who is welding on zinc coated materials. In addition to local or general ventilation, personal breathing filters are recommended. Light-weight, disposable, half-face filters such as the Dust/Fume/Mist filter (#9920) made by 3M (800-328-1667) are convenient for the welder, and no maintenance is required. Half-face mask cartridge filters, using filter elements designed for metal fume removal, are also acceptable and available from 3M. Powered air purifying systems and supplied air systems are also available from RACAL Airstream, Inc. (301-695-8200). These systems provide combined respiratory, head, eye and face protection for situations in which fume exposure cannot be avoided.

*This Standard is available from the American Welding Society, Miami, Florida, or from The American National Standards Institute (ANSI), New York, NY.

ELECTRICAL SHOCK

Welders and those who work around welding need to be aware that there is sufficient voltage in a welding circuit to cause severe injury. When using a standard arc welding machine, there is 80 volts of difference between the welding electrode and the surrounding work piece and building; when using a continuous wire process, such as MIG or Fluxcore, this difference is around 40 volts. Welders are usually aware of the potential hazard, but others who work around welding are frequently unaware of this danger. This situation should be regularly addressed during safety meetings.

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ELECTROMAGNETIC RADIATION

When using any arc welding process, an electrical arc is generated which emits various forms of radiation energy. The most harmful of this radiation is ultraviolet, which can cause blindness. Welders normally wear adequate protection from radiation when they are welding. Those who work around welding must also protect themselves. This is usually done by placing either opaque or transparent ultraviolet absorbing barriers around the area where welding is being done. Additional protection can be provided by having those who work around welding wear safety glasses with side shields made of polycarbonate. This plastic absorbs the most harmful ultraviolet radiation, preventing eye damage. In addition, this practice will prevent "Welding Flash Burn" (sunburn of the white of the eyeball), which is usually caused by reflection of the welding arc light off surrounding objects rather than by direct exposure to the arc. This radiation can also cause burning of skin similar to sunburn, so the welder and those who are around welding should wear protective clothing to avoid the hazard.

ALLIED'S TRIPLE COATING DESCRIPTION

ZINC COATING

Zinc melts at 787°F, then boils at 1665°F, becoming a vapor and, as it mixes with oxygen in the air, changes to zinc oxide. Zinc oxide is normally visible as about 30% of the white plume rising from the welding point. As has been already stated, proper safety precautions should be followed when welding with any zinc coated tube product.

CONVERSION COATING

In Allied's process, the conversion coating on the zinc substrate is particularly thin, and as it relates to the welding process, may be considered negligible.

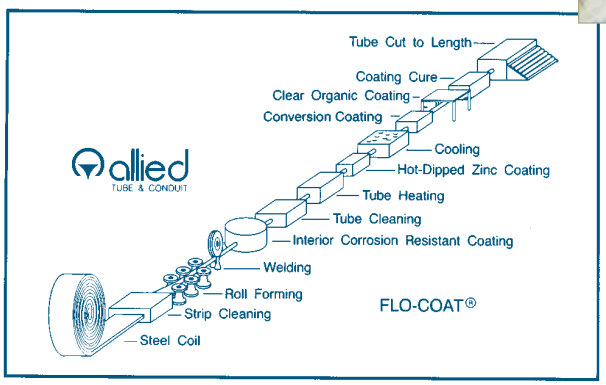
ORGANIC COATING

Allied tube is additionally protected by a clear organic top coat. In welding, this organic top coat could generate fumes irritating to the welder if proper ventilation procedures are not followed. Removal of this coating is recommended and easily accomplished.

The tube should be cleaned back from the end to be welded: a minimum of 2" for arc welding, 4" for gas welding.

Sand with flapper wheel or by hand (3M "Scotch-Brite" or Norton "Beartex" unitized abrasive wheels suggested). Personal breathing filters are recommended to avoid inhalation of dust and related coating particulate. Wire brushing and grinding wheels are not effective.

THE ALLIED FLO-COAT PROCESS



Material Safety Data Sheets on Allied's galvanized tubular products are available on request from your local Allied Sales Representative.

CORROSION PROTECTION METHODS

When welding galvanized tubing, it is important to restore the corrosion resistance of the weld zone to that of the surrounding parent surface areas. This can be accomplished in a few easy steps...

1. Clean the weld area using a wire brush to remove slag and loose particulate...wipe away dust with clean, dry rag. Surface must be clean and oil-free.
2. It is recommended that the weld zone be treated with one or two coats of a cold galvanizing compound. Follow the manufacturer's label directions for best results.
3. **If the welded assembly will be powder coated,** follow through step 2, making sure a **heat-resistant** cold galvanizing compound is used to withstand the baking temperature and cycle time. For more information on how to obtain a heat-resistant cold galvanizing compound that also acts as a primer for powder coating, contact your local Allied Sales Representative or Allied's Mechanical Tube Division for more specific information.
4. **If the welded assembly is to be liquid painted,** follow through step 2; then we suggest that a high quality urethane-based top-coat paint be used for superior corrosion protection.
5. **If the assembly will not be painted,** follow through step 2 above. Then, in the weld zone, use a corrosion resistant touch up paint, as available from Allied, to tone match this area with the surrounding galvanized surfaces, again following label directions. (See following section for details.)

CORROSION RESISTANT TOUCH-UP PAINT

Allied has available a corrosion resistant, color matching touch-up paint for our zinc product varieties.

Here are the facts about this touch up paint:

1. Excellent color match to Allied's zinc finish

2. Superior adhesion

3. Available in aerosol spray cans

- Dry time: 10 minutes
- Shelf life: 2 years

Material safety Data Sheets for aerosol spray cans are available from your Allied representative upon request.

PAINTING OVER ALLIED'S GALVANIZED STEEL TUBING

It's easy to paint or powder coat over our galvanized steel tubing.

Simple surface cleaning of the tube is required due to normal transportation and storage related accumulated soils. Merely wipe off such soils with a mild cleaning solution.

Our galvanized steel tube coatings will also withstand in-line chemical cleaning baths and rinses. At the same time, our coatings will not damage or contaminate any part of your cleaning system.

Allied's galvanized tube products are protected by a clear organic top coating which provides excellent adhesion properties to most thermo-set powder coatings, as well as to the following air dry and bake topcoats:

- High-bake thermoset acrylic
- High-bake alkyd
- High-bake polyester
- Two-part urethane or epoxy
- Solvent-based paints for metals
- Solvent-based paints for wood
- Solvent-based high-solids paints
- Oil-based paints
- Paints for car bodies or appliances

As you can see, almost all powder or liquid paints will work well over our clear topcoat. If the paint/powder coating you are using does not fall into one of the above categories, or you have any questions, please contact Allied's Mechanical Tube Division for more specific information.

WELDING PROCESS GLOSSARY

Arc welding is the most widely used form of welding. In arc welding, heat is created by an electric arc between an electrode and the material to be welded. The heat melts the metal which must be shielded from the atmosphere. If unwanted gases mix with the molten metal, oxides and porosity form, decreasing the metal's soundness and strength.

The five common arc-welding processes and several others are listed below. Each processes is distinguished by its own means of shielding the weld pool and adding filler metal.

Gas Metal Arc Welding (GMAW), also called MIG welding, uses equipment which pushes wire and shielding gas through a welding gun. Mixtures of argon and carbon dioxide are used to shield steels while argon is used to shield nonferrous metals. This process is widely used for welding Allied's tube.

Flux Cored Arc Welding (FCAW) is exactly the same as GMAW, except that it uses a tubular electrode containing flux instead of solid wire. This process produces a fast and clean weld with excellent properties.

Shielded Metal Arc Welding (SMAW) is entirely controlled by hand. A consumable, coated electrode gives off a gas which forms a shield around the molten weld metal. This welding is suitable for steels, iron and many nonferrous metals.

Gas Tungsten Arc Welding (GTAW), also know as TIG and Heli-arc welding, uses a tungsten electrode to carry the arc. The weld pool is shielded by helium or argon gas. This process is used mainly on thinner metals, but it can be used for welding all metals.

Plasma Arc Welding (PAW) is very much like GTAW, except that the arc is forced through a small nozzle, where it forms a stiff plasma column. This welding process gives a deep, narrow and more uniform weld than GTAW, and is faster than GTAW.

Submerged Arc Welding (SAW) uses a flux in the form of a coarse, granular mixture of minerals which is placed on the workpiece ahead of the welding electrode. The arc is completely covered by the flux during welding. Submerged arc welding is usually used for welding of thick materials.

Resistance Welding (RW) welds material by passing current through overlapping work pieces. The interface between the faying surfaces provides the greatest resistance to current flow, resulting in heat concentration and welding at that point. The work pieces must be clamped together, so access to both sides of the parts to be joined is necessary. This process is usually automated. Spot welding and seam welding are two types of resistance welding.

Oxy-fuel Welding (OFW) is done by burning oxygen and acetylene to make a flame. Gas welding is slow compared to arc welding.

Laser-Beam Welding (LBW) produces a weld using a high-intensity beam of coherent light. The result is a narrow, smooth and clean weld with a small heat-affected zone. Laser-beam welding works well on steels.

Electron-Beam Welding (EBW) uses a beam of electrons to make a clean, deep weld between closely-fitted parts. The beam itself melts the metal, and welding is usually done in a deep vacuum.

Stud Welding (SW) is done by placing a stud in a welding gun, placing the gun at the desired location and pulling the trigger. An arc is initiated between the end of the stud and the surface, and in less than a second, the stud is attached. Studs are usually less than 3/8 inch in diameter.

Electroslag Welding (ESW) generates heat using current from a consumable electrode that passes through a molten bath of welding flux. This process is used for welding sections over an inch thick. It deposits weld metal faster than any other arc welding process. Two-sided access is necessary.

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