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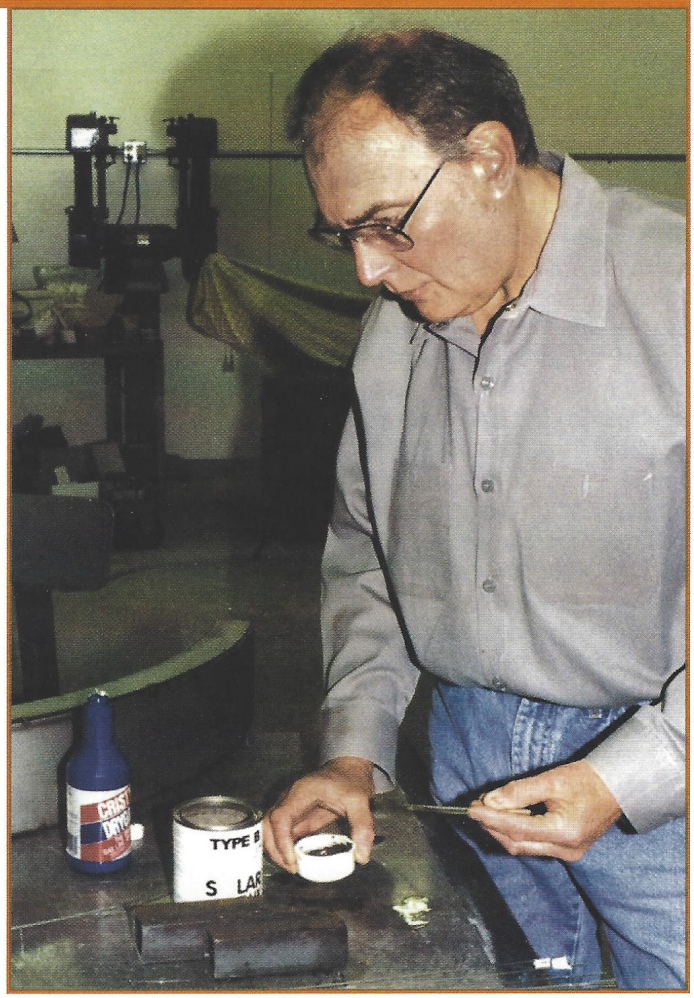
Flux Product Test

Flux Works For Stainless Steel Welding

Richard Harris, *Consulting Editor*

Tests with stainless steel show the same weld quality with flux or purging gas for certain applications. The easy-to-apply flux helps the flow of weld and base metal, without fume, smoke, or chemical hazard, while keeping the torch clean.



Bob Gardener mixes the dry Solar Flux with pure methanol alcohol to make a thick cream paste.

Welding elbows before joining them to 224 in. long, 2 x 5 in. stainless steel box tubes required joints would meet pressure tests and visual inspections.

This elbow challenge led Bob Gardner, who tests products for *Welding Design & Fabrication*, to try a flux designed for stainless steel welding after frustration with the hours of taping required for argon purging.

The channels and elbows are part of stainless steel wash racks Gardner fabricates for automatic car washing machines.

A wash rack requires a pressure test to 40 PSI. The rack holds heated water for use during cold weather. The structure also carries the wand that travels around vehicles to spray water and soap.

The 2 x 5 in., 20 in.-radius Type 304 stainless steel elbows came tack welded. The steel was cut with a plasma-arc torch, which leaves an oxide residue that was not removed.

Before using the flux, Gardner, an American Welding Society Certified Welding Inspector and Certified Welding Educator, first tried gas-metal-arc (GMAW) and tungsten-arc (GTAW) welding on the elbows with an argon purge.

"The purging method required a lot of taping and resulted in leaks — more work than necessary," says Gardener.

Because of the confined space to reach the weld joints inside the 2 x 5 in. elbow, Gardener looked for another way to achieve a high quality weld with good visual results. He tested Solar Flux, from Golden Empire Corporation, formulated to shield the back of a weld joint from oxygen.

Weld Tests

Gardner tested the Solar Flux in two stages working with Mark Demchak of Total Quality Testing, Cleveland, OH. Together they designed butt welds for destructive and non-destructive testing to establish welding procedures. Gardner used the elbows to test the application of flux and weld quality — pressure testing to 40 lb. along with visual inspection.

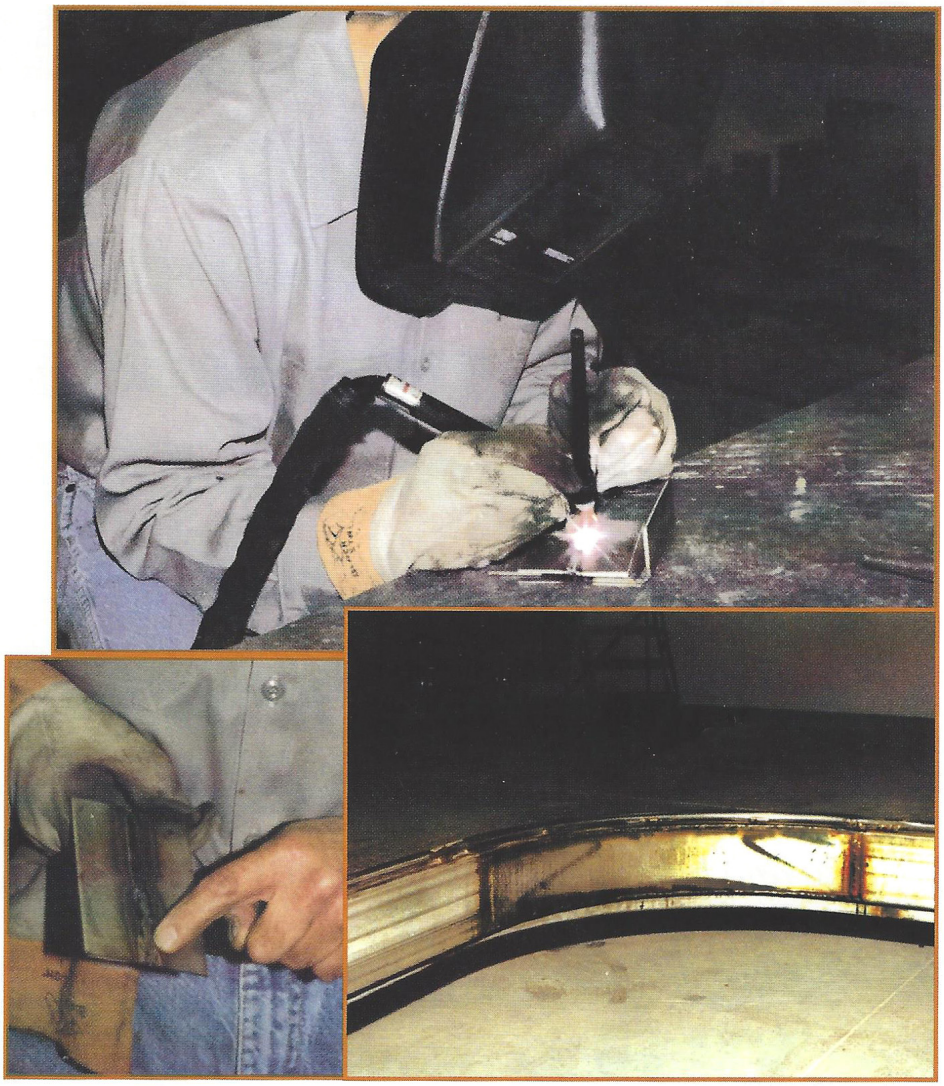
Following the directions on the flux can, Gardener mixed the dry flux with pure methanol-methyl alcohol to create a thick cream paste. Methanol alcohol is sold in autoparts stores as gasoline anti-freeze. The alcohol evaporates and leaves a dry flux attached to the workpiece surface. Gardener mixes a thicker paste for vertical joints so it will not run off.

A little flux goes a long way. For example, 2 oz. of flux covers about 80 lineal feet with a normal coat.

Gardener placed a little flux on the outside of the joint to break down the oxide layer from plasma-arc cutting. He says if the metal had been cleaned better after cutting there is no need for the flux on the outside.

Gardener reached inside the elbow with an acid brush attached to a welding rod and applied the Type B Solar Flux. The brush reached into corners and narrow spots. He used a flash light to see if he had good coverage.

The butt joints for the destructive and non-destructive tests had a 37.5° bevel on ⅛ in. thick Type 304 stainless steel. Gardener brushed the flux on the back side of the weld. He used two passes in the open root. His first pass with 3⁄32 in. thick Type 308 stainless steel filler rod matched the 1⁄16 in. gap. The cap pass, with no additional flux in the weld, had flux remaining on the back side.



(Top photo) The butt joints used for the destructive and non-destructive tests had a 37 ½° bevel and 1⁄16 in. gap. The flux was brushed on the backside of the weld. Gardener made two weld passes in the joint.

(Lower right) These elbows along with 224 in. long box tubes are part of stainless steel wash racks used in automatic car washing machines. Welding the elbows required joints that would meet pressure tests and visual inspections.

(Lower left) A thin, chemically inert glass-like residue adheres to the base metal after welding. It does not affect the quality of the weld. A stainless steel wire brush or a chemical cleaner will remove the residue.

Test Results

"We set up tests similar to procedure qualification tests per ASME with workpieces that had the flux versus those that were welded with a purge," says Mark Demchak, president, Total Quality Testing. Tests included liquid penetrant, bend, and tensile tests. "Because of the flux residue, we examined for but saw no slag inclusions in the welds either visually or in cross sections.

"The bend and tensile results were almost identical, with no discernible

SOLAR FLUX

Prior to World War II, the Solar Aircraft Company, San Diego, CA, developed Solar Flux Type B to help solve welding problems on stainless steel exhaust manifolds it was manufacturing for U.S. Navy aircraft engines. During WW II, the flux was a military secret. After the war, patents were obtained and Solar Flux was marketed internationally. In 1973, Golden Empire Corporation, Los Angeles, bought the Flux Division from the Solar Company.

Solar Flux, a complex chemical compound, comes as a fine powder — finer even than a lady's face powder. The powder is mixed with methanol and brushed on the back of the weld joint. The firm formulates the flux to shield the back of the weld joint from oxygen, dissipate heat, and unwanted oxides, clean the surface of the metal to aid in the flow of filler metal over base metal, and form a protective barrier to prevent re-oxidation and heat scale.

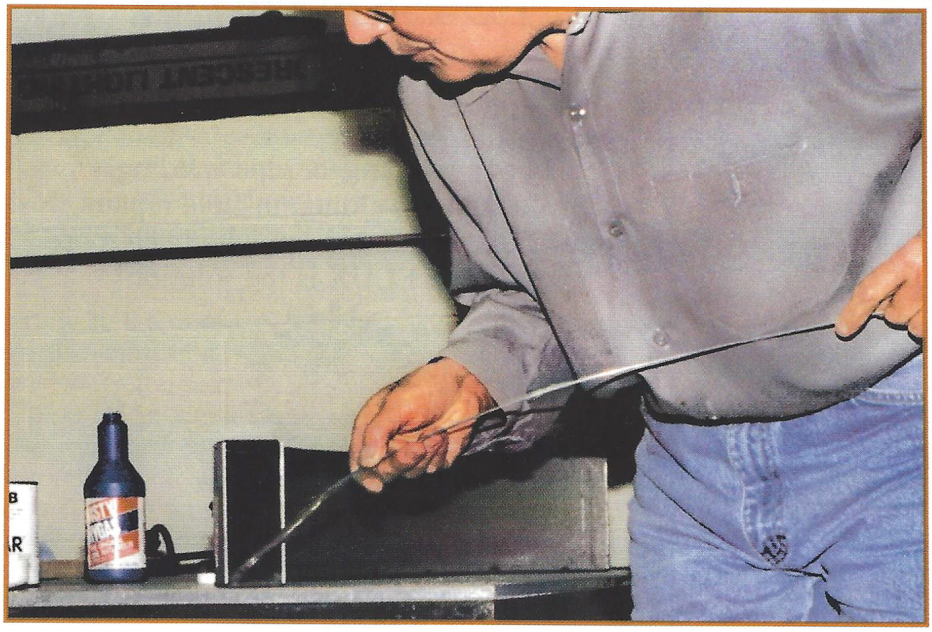
Solar Flux type B is formulated for welding stainless steel and alloy steels and type I for welding high nickel super alloys. Type B meets United States Military Specification MIL-F-7516B, Classes 2 and 4. Type I conforms to the requirements of United States Military Specification MIL-F-7516B, Classes 1, 2, 3 and 4.

The flux is inert, non-flammable, and non-explosive. It can be shipped safely in any quantity by any means of transportation.

Applications include:

- Pipe and tube welding (except in those few cases that require removal of the thin, glass-like residue)
- Maintenance welding
- In-field welding
- One-of-a-kind welds
- Unusual shapes and configurations
- Large diameter pipes and ducts
- Certain specified aircraft airframe and jet engine repairs
- High performance engine exhausts

Most welding supply distributors stock the flux or you can order directly from the factory with no minimum order: Golden Empire Corporation, P.O. Box 2129 Morehead City, NC 2855, phone: 888-211-3511, *www.solarflux.com.*



Gardner reaches inside the elbow with an acid brush attached to a welding rod to apply the Type B Solar Flux. He uses a flashlight to check for good coverage.

difference," states Demchak. "We made a point of looking for differences."

Gardener set a Square Wave TIG-355 welding machine from Lincoln Electric Company at 150 A, DC negative. He picked a Type 309 welding rod because it works for stainless steel to stainless steel or stainless steel to carbon steel. During installation at the car wash he welds the wash rack to carbon steel hangers.

He welds in "back step" sequence, working from the first tack weld on an edge of an elbow to the end, then the second to the first. When one edge is welded, he begins the some sequence on another edge.

He says the torch tip remains clean because there is no bubbling from the flux.

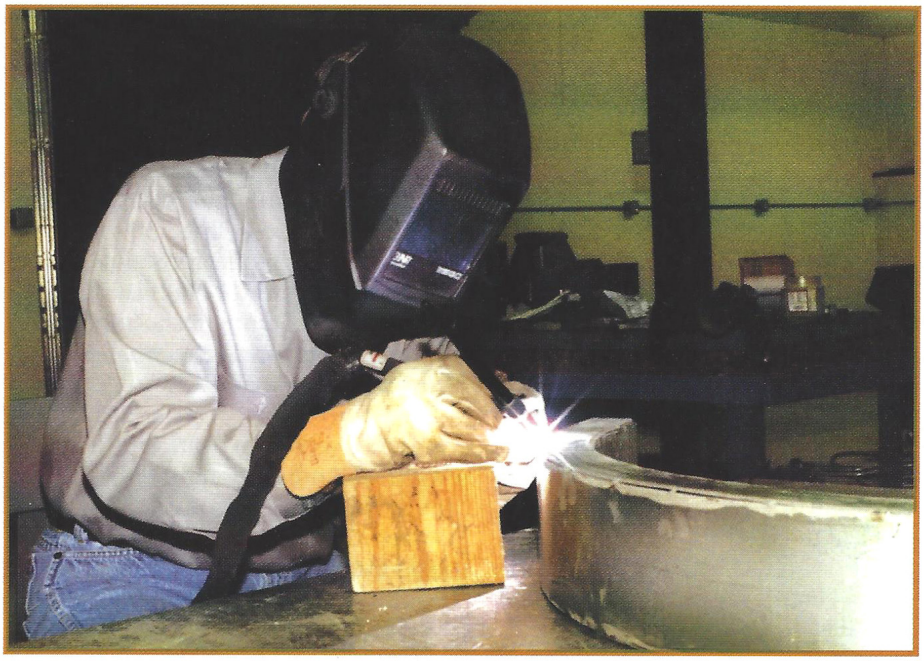
"Because it is more difficult to see on a butt weld, the flux can limit control of the puddle, so I used a bevel joint," states Gardener. "On the elbow with a 90°angle I could see both sides of the corners."

"On the back side of the weld the flux stops 'sugaring' from oxygen in the air," says Gardener.

Cleaning

The thin glass-like residue is chemically inert after welding and adheres to the base metal. While this residue may be unattractive, it does not affect the quality of the weld and usually is not removed. Depending on access to the inside of the weld joint and degree of cleaning required after welding, a stainless steel wire brush or a chemical cleaner removes the residue. The people at Solar Flux can offer suggestions for cleaning methods to meet specific requirements.

Some pipe or tube welding applications require absolute purity and a polished inside surface. These include food or beverage lines where subse-



Gardner uses a Type 309 filler metal because it can be used for stainless steel to stainless steel or stainless steel to carbon steel. He welds the wash rack to carbon steel hangers during installation at the car wash.

quent product refining will not take place, medical oxygen lines, computer chip manufacturing air lines, and steam lines above 1,000° F. In these situations, the firm recommends purging instead of Solar Flux to avoid a chemical cleaning process.

"From our tests, the weld quality is the same with the flux or purging gas," says Gardener. "In addition, the flux is simple to apply, so it is easy to improve the products coming out of my shop."

Gardener concludes flux helps the flow of weld and base metal, keeps the torch clean, and eliminates fume and smoke.

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