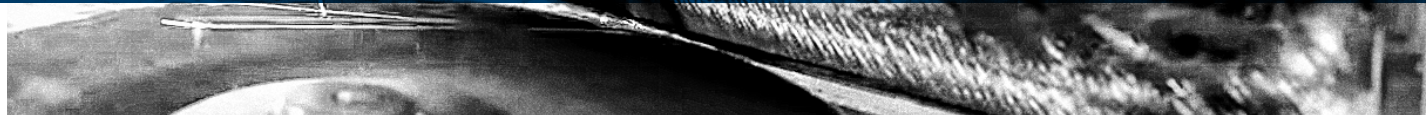


## WHITE PAPER

# 5 STEP GUIDE FOR WELD PREPARATION



The welding industry has undergone significant changes in recent years. It has been well documented that the manufacturing industry is suffering from a skilled labor shortage. According to a report released by Deloitte and The Manufacturing Institute, 2.1 million manufacturing jobs will go unfilled through 2030.

The lack of skilled workers impacts several different job roles, especially those within the assembly sectors. In 2018, the American Welding Society (AWS) calculated a welder shortage of 291,000 in 2018. The latest research by the AWS shows that number has increased to over 400,000 by 2024. They also determined that the average age of a welder is 55 and less than 20 percent of welders are under the age of 35. At both ends of the labor spectrum, manufacturing companies are experiencing a loss in the number of workers and the knowledge they possess.

As a result, several companies have turned to automation to help cover the worker gap. For example, the use of robots to perform welding passes has increased significantly. In 2019, Mikael Hedelind at Mälardalen University reported that 20 percent of all industrial robots are used for welding. The increase of robots will be a mix of industrial and collaborative robots, where humans are expected to work side by side with automated systems.

However, the knowledge of welders cannot be entirely replicated by automation. Whether the weld is performed by an automated system, a collaborative robot, or a traditional welder, the knowledge of how to perform and inspect the weld correctly is more important now than ever. While the increase in automated systems will help companies close the labor gap, the knowledge of the retiring labor force still needs to be addressed.

In the welding industry, multi-pass welds are necessary for many applications to join butt welds in the same plane with a gap or bevel, including welds used in heavy-duty structural, process pipe, pipeline, shipyard, and pressure vessel industries. In addition, adding layers of weld to thick metal joints increases the strength of critical welds where testing is often required, and weld failure could be catastrophic.

Below is a step-by-step guide to help you learn more about selecting the right abrasive products for weld preparation and some best practices to help improve product life and results. The abrasives and wire brushes used for grinding and cleaning between weld passes play an essential role in the quality of the finished weld. Knowing how to specify the correct abrasives or brushes to properly prep a weld area will help the supervising laborer ensure that either the automated system or the human welder prepare the weld correctly.



## Multi-pass Welding in 5 Simple Steps

### 1. JOINT & SURFACE PREP

### 2. ROOT PASS

### 3. HOT PASS

### 4. FILLER AND CAP PASS

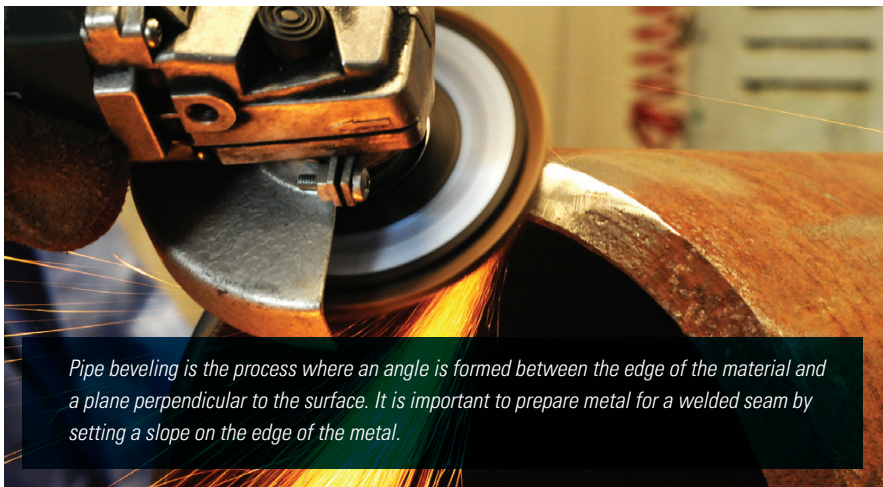
### 5. RE-COATING & FINISHING

## Multi-pass Welding in 5 Simple Steps



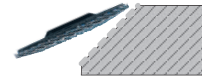
### STEP 1: JOINT & SURFACE PREP

Whether tubing, plate, or structural, any joint requires significant prep to ensure strong and consistent weld penetration. Setting the bevel is the first step, and type 27 grinding wheels and flap discs are popular choices. Type 27 grinding wheels will typically hold an edge better to keep the bevel from “rounding” and have a longer life expectancy. Weiler’s Tiger Paw flap discs are a good choice for beveling as the cut rate is fast, however the operator must use caution to hold the edge.



*Pipe beveling is the process where an angle is formed between the edge of the material and a plane perpendicular to the surface. It is important to prepare metal for a welded seam by setting a slope on the edge of the metal.*

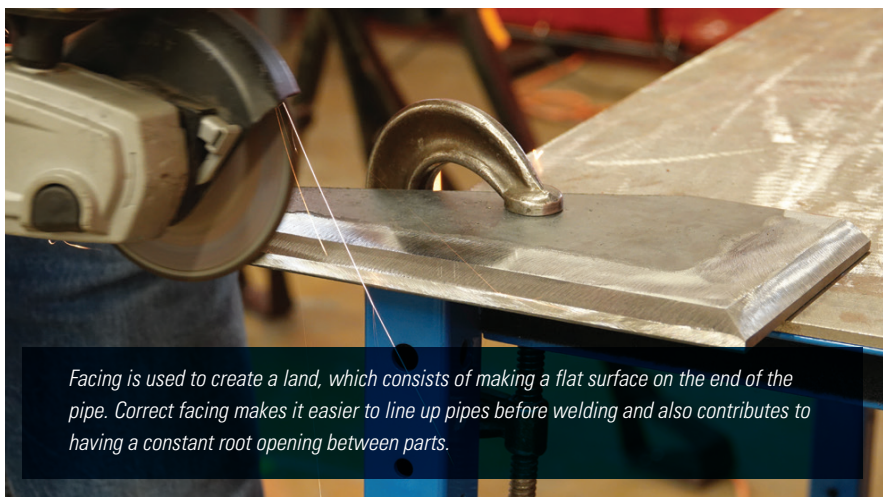
#### Beveling Process:



#### Products Used:

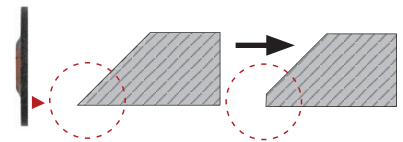


Weiler’s 1/8” type 27 pipeline wheel is designed for both flat grinding and notching, making it an excellent choice to quickly and effectively grind the bevel and set the face (land). Since it is 1/8” thick, it can be used to effectively grind the root pass.



*Facing is used to create a land, which consists of making a flat surface on the end of the pipe. Correct facing makes it easier to line up pipes before welding and also contributes to having a constant root opening between parts.*

#### Facing Process:



#### Products Used:



Finally, the bevel must be cleaned. To achieve a proper union, removing any surface residue such as oil, rust, paint, primer, corrosion, burrs, or any impurity on the steel’s surface is important. Type 29 flap discs are aggressive, easy to control, and highly effective for cleaning, removing pits, and finishing the bevel.

## Multi-pass Welding in 5 Simple Steps

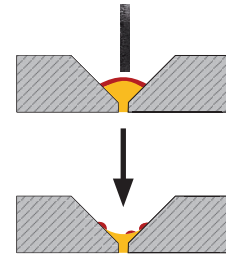
### STEP 2: ROOT PASS

With the bevel and face cleaned and set, the joint is tack-welded to prepare for the root pass. The first weld bead applied to joints is called the stringer bead or root pass. The weld must penetrate 100%. Once the root pass is finished, a "U" shaped groove is ground using a 1/8 inch notching or pipeline wheel. The objective is to prepare the base so that the next pass (hot pass) can fully penetrate the wall thickness to ensure a strong and solid joint.

The Weiler Tiger Pipeline wheel is ideal for grinding the root pass bead because it is designed to grind hot welds, bite into the bead, and quickly dig out the wagon tracks. Operators also commonly choose this wheel because it doesn't glaze over or vibrate, providing better overall grinding results for the entire life of the wheel.



#### Root Pass Weld Grinding Process:



#### Products Used:



### Mechanical Welding



For mechanical pipe welding, 3/32" Mech notching wheels are recommended for grinding starts and stops. These wheels are thinner than standard pipe notching wheels, allowing the operator to grind the bead without widening or scarring the narrow J and K bevels.

#### Products Used:



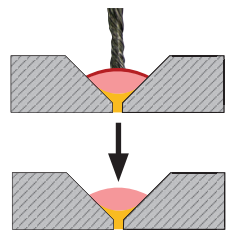
### STEP 3: HOT PASS

The next welding step is called the hot pass. The hot pass should start as soon as possible to achieve maximum penetration of the weld at the ends and to maintain a high temperature in the joint. When grinding after the root pass, slag residues are formed and exposed at the ends of the first bead. Therefore, the hot pass is performed immediately, ensuring that the residues are burned and flow out of the bead. That is why notching with a pipeline wheel and surface cleaning with a bead brush must be done quickly.

Stringer bead brushes and encapsulated brushes are excellent choices for cleaning the hot pass. Stringer bead brushes have narrow, tightly twisted knots for high-impact cleaning and aggression. In addition, the narrow profile (face) and aggressive cleaning make them popular for cleaning in narrow gaps between weld passes.

Encapsulated wheels feature a heat-stabilized encapsulation that gradually wears away to expose a consistent short trim for higher aggression, controlled brushing action, and longer life. These brushes are also ideal for cleaning hot welds.

#### Hot Pass Cleaning Process:



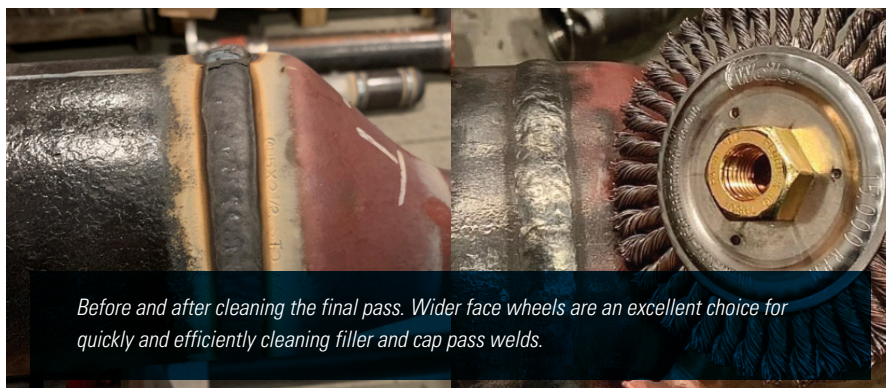
#### Products Used:



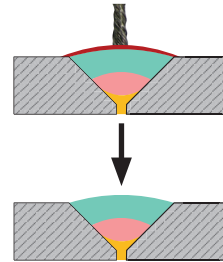
### STEP 4: FILLER AND CAP PASS

After cleaning the hot pass, the remaining gap must be filled with additional passes. The number of filler passes required will depend on the thickness of the wall and the width of the gap. To ensure optimal weld penetration before applying each bead, a perfectly clean surface is required. Root pass brushes or encapsulated brushes can be used to clean filler passes. However, a filler pass brush is a better choice for wider welds.

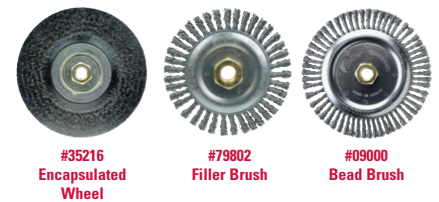
Filler Brushes have additional wire strands and a wider profile (face) for aggressive brushing and increased durability. In addition, their wider contact area makes them an excellent choice for cleaning filler passes quickly and efficiently. They are also often referred to as cable twist brushes.



Fill and Cap Cleaning Process:



Products Used:



### STEP 5: RE-COATING & FINISHING

Before applying any coating, the surface must be cleaned and prepped for optimal adhesion. Knot cup brushes provide fast, efficient cleaning and surface prep for wider surface areas. Knot wheels are also commonly used. For applying the epoxy or other protective coating, wood handle chip and oil brushes are effective and economical options.

### CONCLUSION

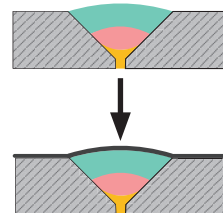
Multi-pass welds are often required in critical applications, including pipeline, ship, heavy-duty structural, and pressure vessel welds. Therefore, each pass must be thoroughly cleaned before the next pass is laid down to ensure that there are no inclusions that would cause a weld to fail inspection — or worse, fail in operation.

#### Optimize Cleaning Between Weld Passes

The role of today's welder is to ensure the process is done correctly, whether a human or machine performs it. The preceding steps help highlight the proper method of performing and inspecting multipass welds. In addition, selecting products carefully and following some best practices for product use can help optimize results when cleaning multipass welds — saving the operation time and money.

*If you would like technical assistance in selecting the best abrasives and brushes for your multi-pass welding process, Weiler Application Experts can help. Contact us today at (800) 835-9999 or visit our website at [weilerabrasives.com](http://weilerabrasives.com).*

Finishing Process:



Products Used:

