

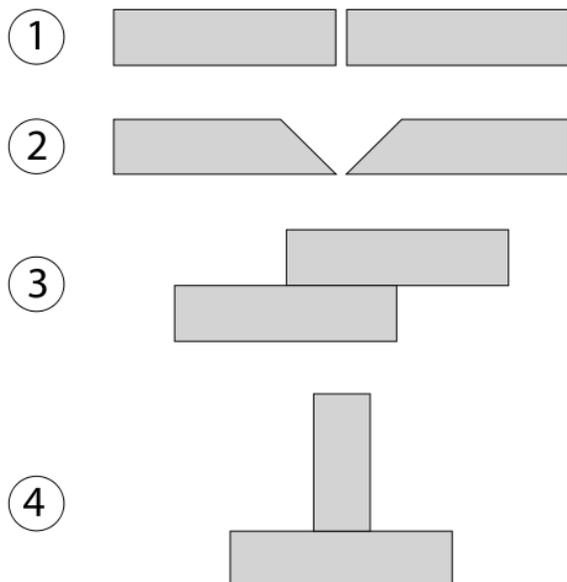
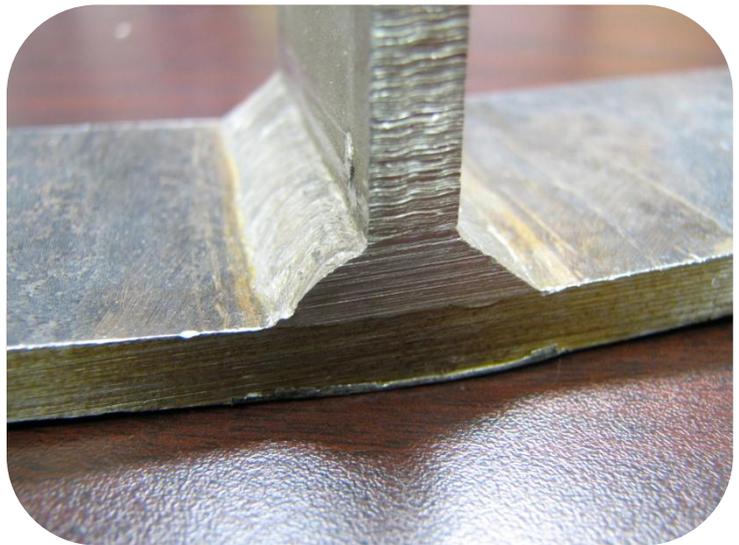
Metkon Application Note

SAMPLE: Preperation of Micro Welded Steel Sheet

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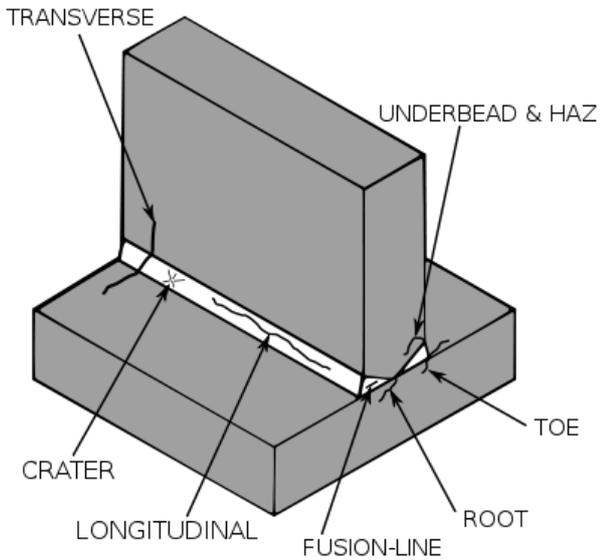
- 1. INTRODUCTION**
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Welding is a fabrication or sculptural process that joins materials, usually metals or thermoplastics, by causing coalescence. This is often done by melting the workpieces and adding a filler material to form a pool of molten material (the weld pool) that cools to become a strong joint, with pressure sometimes used in conjunction with heat, or by itself, to produce the weld. This is in contrast with soldering and brazing, which involve melting a lower-melting-point material between the workpieces to form a bond between them, without melting the workpieces.



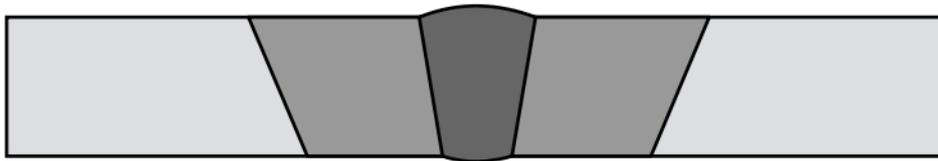
Welds can be geometrically prepared in many different ways. The five basic types of weld joints are the butt joint, lap joint, corner joint, edge joint, and T-joint. Other variations exist as well—for example, double-V preparation joints are characterized by the two pieces of material each tapering to a single center point at one-half their height. Single-U and double-U preparation joints are also fairly common—instead of having straight edges like the single-V and double-V preparation joints, they are curved, forming the shape of a U. Lap joints are also commonly more than two pieces thick—depending on the process used and the thickness of the material, many pieces can be welded together in a lap joint geometry.

Common welding joint types – (1) Square butt joint, (2) V butt joint, (3) Lap joint, (4) T-joint



After welding, a number of distinct regions can be identified in the weld area. The weld itself is called the fusion zone—more specifically, it is where the filler metal was laid during the welding process.

The properties of the fusion zone depend primarily on the filler metal used, and its compatibility with the base materials. It is surrounded by the heat-affected zone, the area that had its microstructure and properties altered by the weld. These properties depend on the base material's behavior when subjected to heat. The metal in this area is often weaker than both the base material and the fusion zone, and is also where residual stresses are found.



The cross-section of a welded butt joint, with the darkest gray representing the weld or fusion zone, the medium gray the heat-affected zone, and the lightest gray the base material.

In this application, welded steel sheet samples were used which they shown in the picture below.



Requested cutting line

A. SECTIONING



	Order Code	Description
Equipment Used	17 06	MICRACUT 201, PRECISION CUTTER
Clamping Device	GR 0825	Manual X-axis positioning unit
	GR 0400	Universal specimen vise
Cutting Fluid	19-902	Metcool, Nature Friendly Soluble Oil, 5lt.
Cutting Disc	18-201	Treno-MP, Ø 200 mm, for Medium Hard Steels

MICRACUT 201 is built on precisely manufactured heavy duty aluminium frame providing stable and vibration resistant base for precision components and linear bearings. The cutting compartment is fully enclosed.

The transparent hood is equipped with interlocking safety switch. Powerfull cutting motor has variable cut-off wheel speeds from 400 up to 5000 rpm allowing both high speed and low speed cutting.

By moving the cutting table, MICRACUT 201 can cut larger and deeper samples. Wide range of clamping tools can be used on the T-slotted moving table. Optional X - axis table with motorized drive mechanism positions the specimen with 5 microns positioning accuracy

B. GRINDING & POLISHING



	Order Code	Description
Equipment Used	36 09-250	FORCIPOL 2V Polishing machine
Equipment Accessories	31 21	PVC Wheel, 250 mm
	31 63	Splash Guard, 250 mm
	31 24	Paper Ring, 250 mm

The FORCIPOL Series of grinding and polishing machines offer practical and economical solutions to your metallographic sample preparation needs.

FORCIMAT is a microprocessor controlled sample mover designed to be used with FORCIPOL grinder / polishers. It is ideal for medium size labs where consistent result is desired.

FORCIPOL instruments can be used for grinding, lapping and polishing with magnetic backed discs and cloths or by quick and simple exchange of wheels. When the number of specimens to be prepared increases, FORCIPOL instruments can be fitted with FORCIMAT automatic head for automation.

FORCIMAT automatic head provides high rate sample preparation and frees the operator from the grinding and polishing procedures.

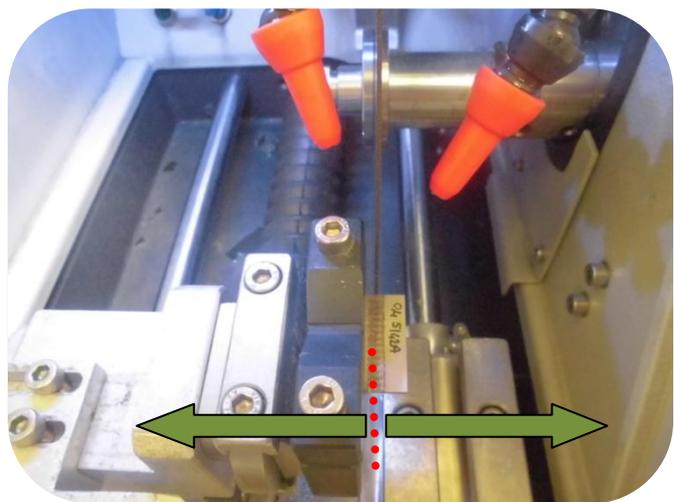
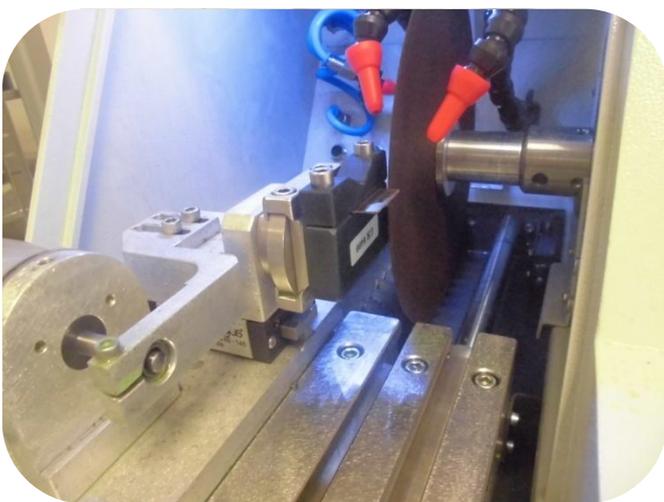
SAMPLE PREPARATION PROCESSES



First of all samples cut from the both sides to provide proper holding with specimen holder.



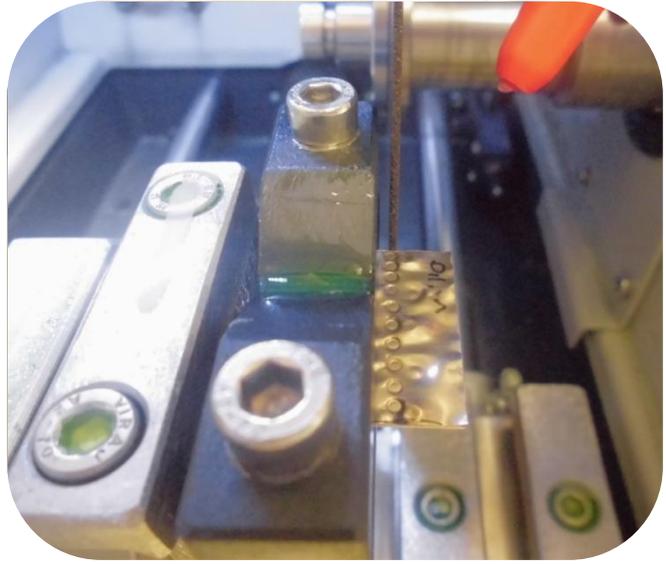
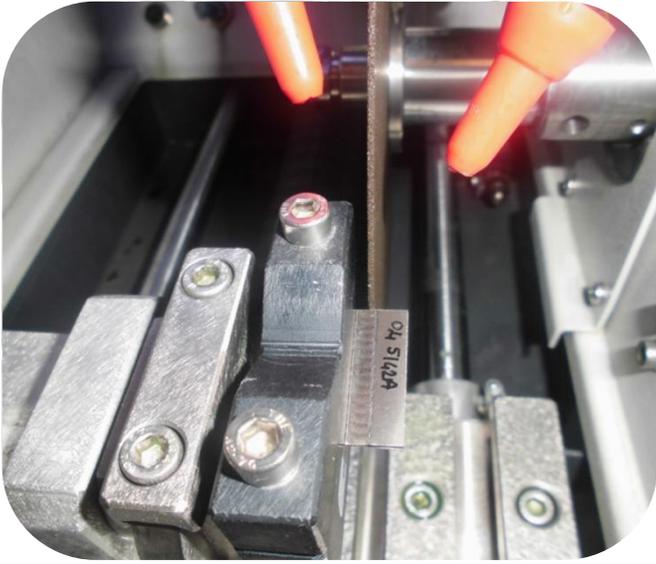
Then samples are attached as it shown in the above photo with the GR 0400 vise.



By the help of Manual X-axis unit suitable sample position can be adjusted according to cutting line.

Operation parameters are following;

Feed rate: 200 μ /sec - Rpm: 2500 - Travel: 40 mm - Force: 3A



Specimens divided from the welding area.



After that divided specimens mounted with cold mounting products. Hot mounting is not recommended.



After that specimen grinded & polished with FORCIPOL 2V + FORCIMAT equipment.
Operation parameters are following;

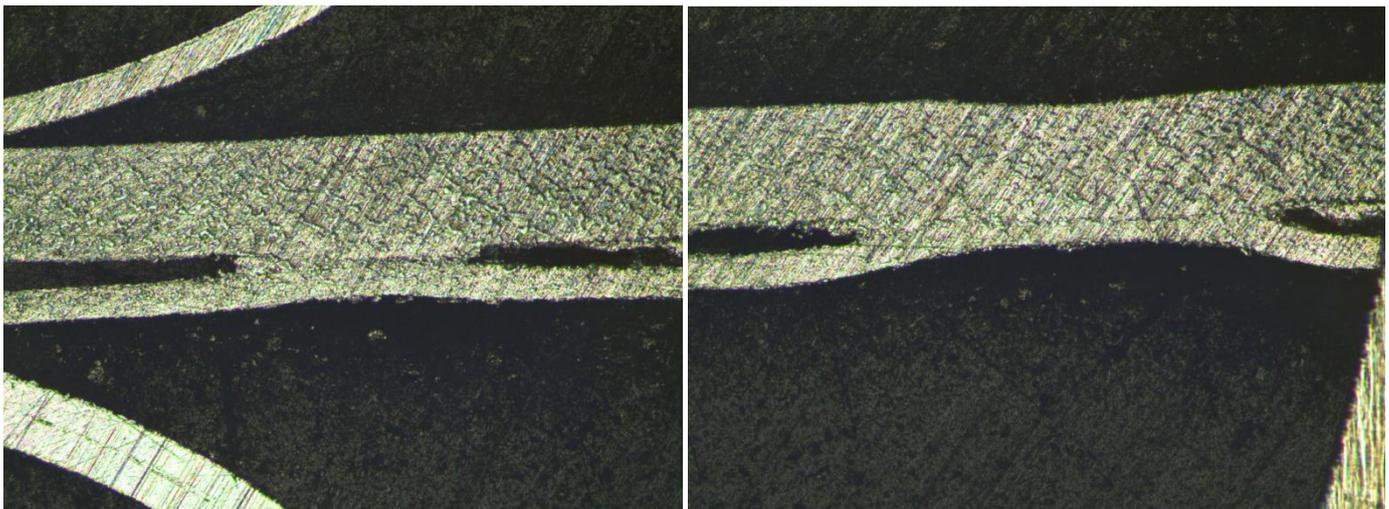
	<i>Surface</i>	<i>Abrasive</i>	<i>Lubricant</i>	<i>Force per Sample, (N)</i>	<i>Time (min.)</i>	<i>Disc speed (rpm) Rotation</i>	<i>Head Speed (rpm) Rotation</i>
Planar Grinding	<i>MAGNETO I</i> [38-040-54]	54μ Diamond	Water	25 N	Until plane	200 CCW	50 CW
Final Grinding	<i>MAGNETO II</i> [38-040-018]	18μ Diamond	Water	25 N	1 min.	200 CCW	50 CW
Polishing Step	<i>FEDO-3</i> [39-025-250]	<i>DIAPAT-M 3μ</i> [39-420-M]	<i>DIAPAT</i> [39-502]	25 N	3 min.	200 CCW	50 CW

After polishing operation the sample etched 3% Nital solution to see heat-affected zone.

RESULT

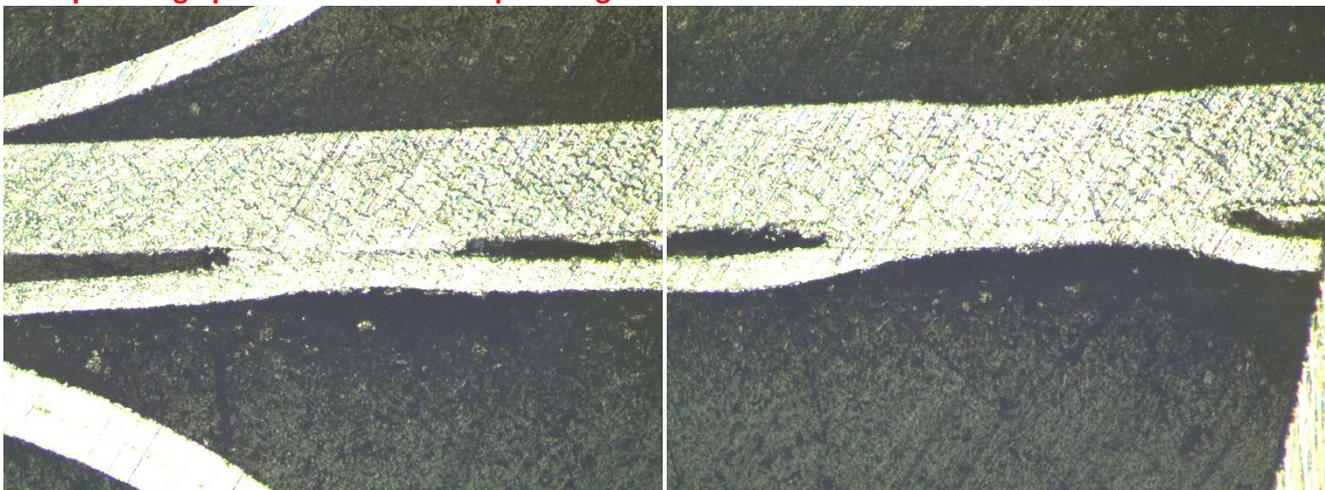
Microstructure images of specimens following for each steps;

After grinding operation with MAGNETO diamond discs



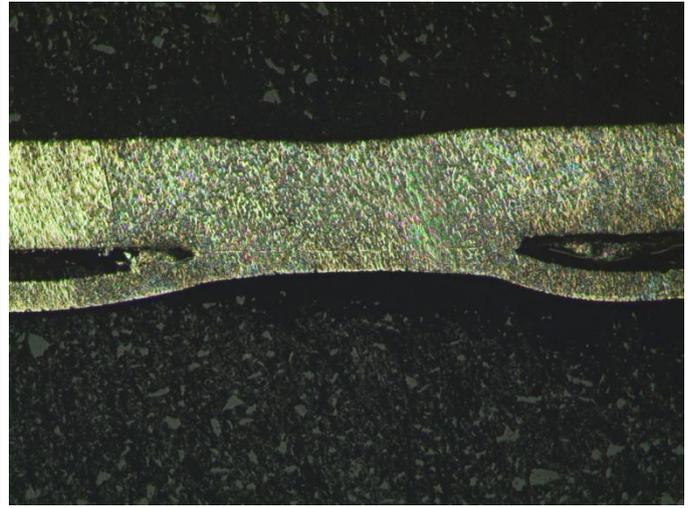
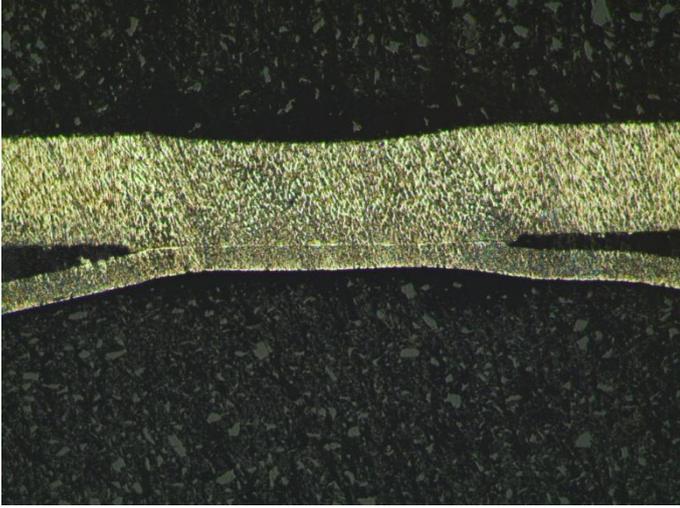
Magnification: 50x

After polishing operation with FEDO-3 polishing clothes

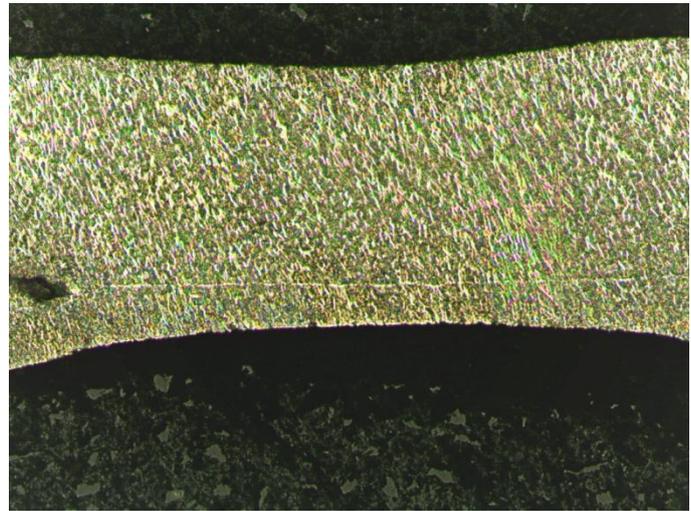
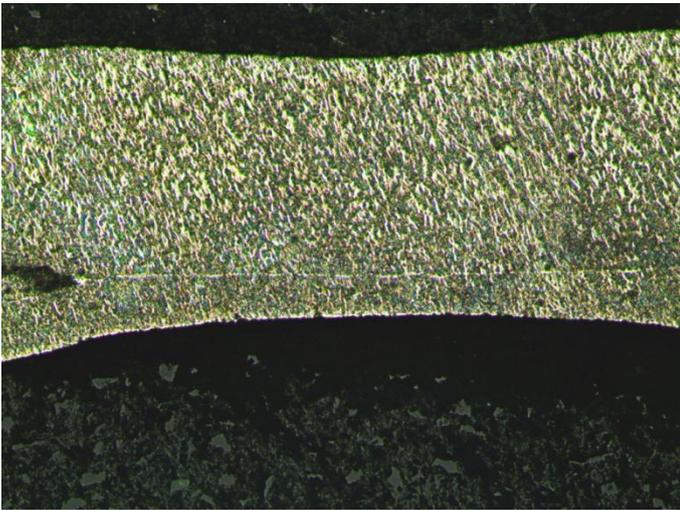


Magnification: 50x

After etching operation with Nital solution



Magnification: 50x



Magnification: 100x

As a result welded steel sheet samples were subjected to the following operations;

Cutting → Grinding → Polishing → Etching

After the macro analysis the samples examined in IMM 901 Metallurgical Microscope (*Order No: 60 01*)
Welding area, heat-affected zone and base material microstructure can be seen above images.

02.08.2013