Metkon Application Note

SAMPLE: Preperation of Welded Steel

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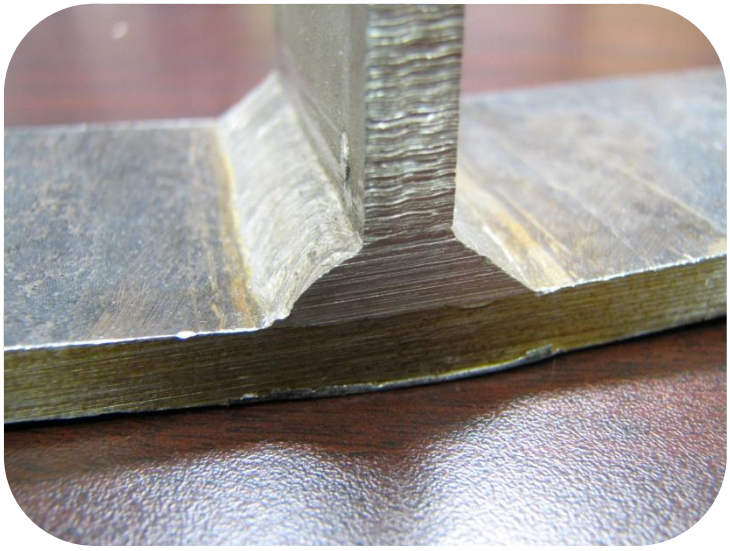
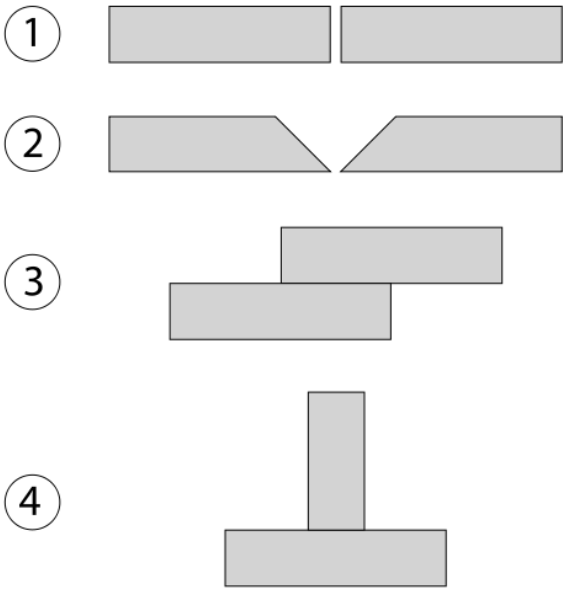
METALLOGRAPHY

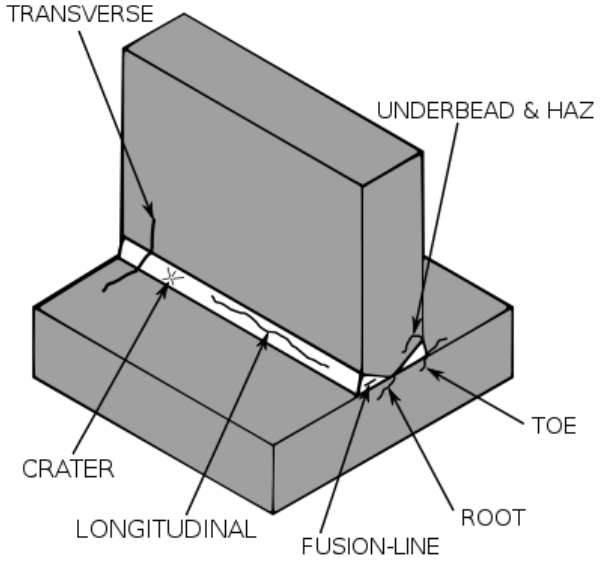
Welding is a fabrication or sculptural process that joins materials, usually metals or thermoplastics, by causing coalescence. This is often done by melting the work pieces and adding a filler material to form a pool of molten material (the weld pool) that cools to become a strong joint, with pressure 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 work pieces to form a bond between them, without melting the work pieces.





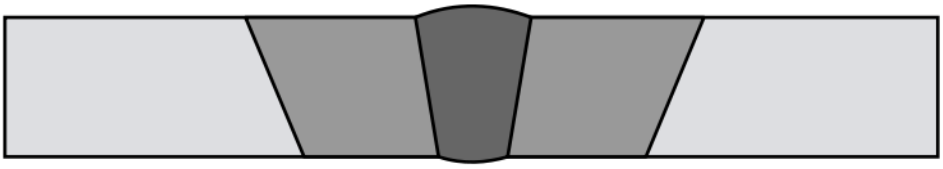
Common welding joint types – (1) Square butt joint, (2) V butt joint, (3) Lap joint, (4) T-joint

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.



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, chromium welded steel samples were used which they shown in the picture below.

Requested cutting line

A. SECTIONING

	Order Code	Description
Equipment Used	10 01	METACUT 250, ABRASIVE CUTTER
Clamping Device	GR 0013	Vise Assembly ,Left
Cutting Fluid	19-902	Metcool,Nature Friendly Soluble Oil,5lt.
Cutting Disc	19-022	Treno-M, Ø 250 mm, for Medium Hard Steels

METKON chop cutting machines METACUT series are designed for wet cutting of large and small, regularly or irregularly shaped work pieces of metallic, ceramic or composite materials.

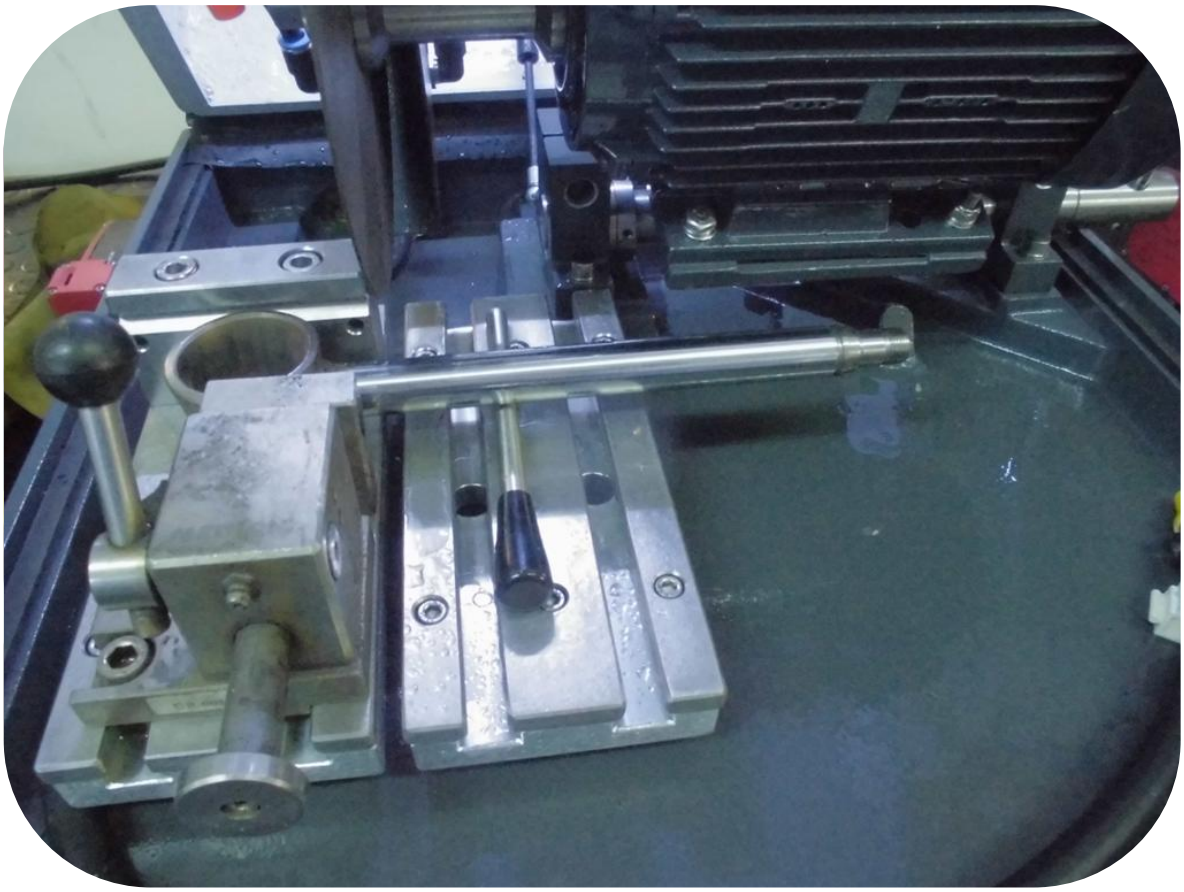
METACUT 250 has the capacity to cut solid sections up to 90 mm in diameter. The side access port permits the sectioning of extra-long work pieces, as well. The machine is equipped with a powerful motor, driving the cut-off wheel towards the work piece. The bottom part of the machine is a large robust alloy base casting. The cutting table is provided with T-Slots increasing the versatility so that different clamping sets can be mounted. The quick-clamping devices are removable to permit the installation of conventional clamping tools to hold larger or more intricate work pieces.

B. GRINDING & POLISHING

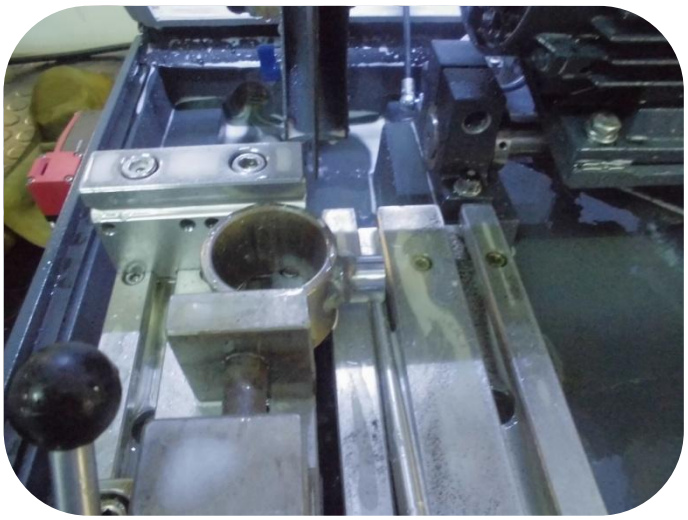
	Order Code	Description
Equipment Used	36 09-250	FORCIPOL 2V Polishing machine
Equipment Accessories	31 21	PVC Wheel, 250 mm
	31 63	Splash Guard, 250 mm
	31 24	Paper Ring, 250 mm

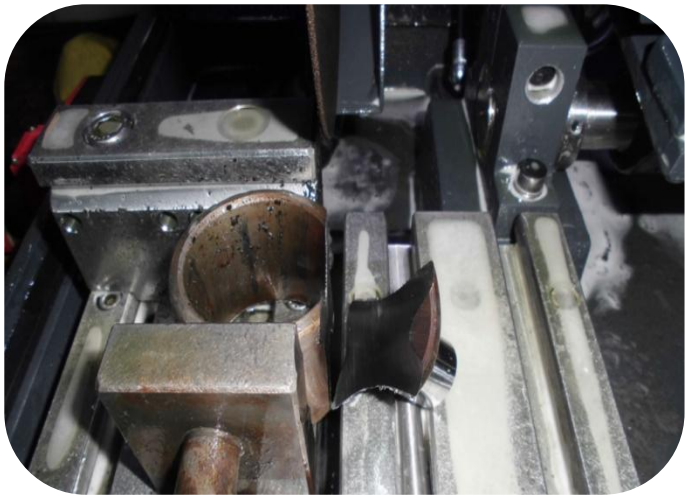
The FORCIPOL Series of grinding and polishing machines offer practical and economical solutions to your metallographic sample preparation needs. FORCIMAT is a microprocessor controlled sample mover designed to be used with FORCIPOL grinder / polishers. It is ideal for medium size labs where consistent results are desired.

Forcipol 2V Having two discs and variable speed range between 50 and 600 rpm,Forcipol 2V is the most universal grinder/polisher, especially for labs having wide veracity of materials. When coupled with Forcimat, Forcipol 2V becomes a versatile automatic sample preparation system with high operator comfort.

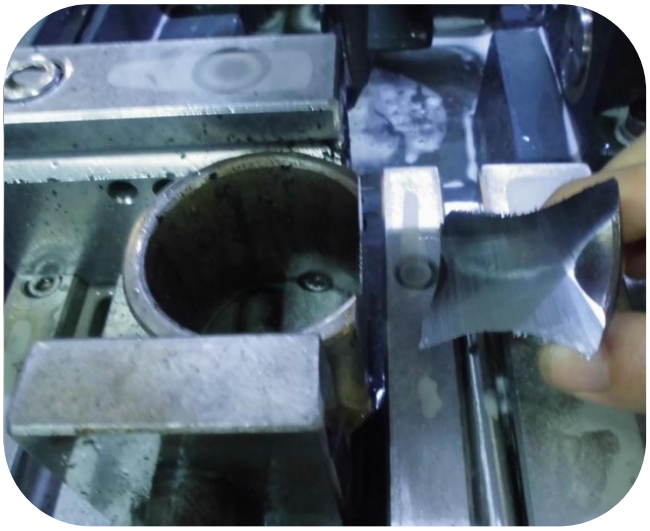


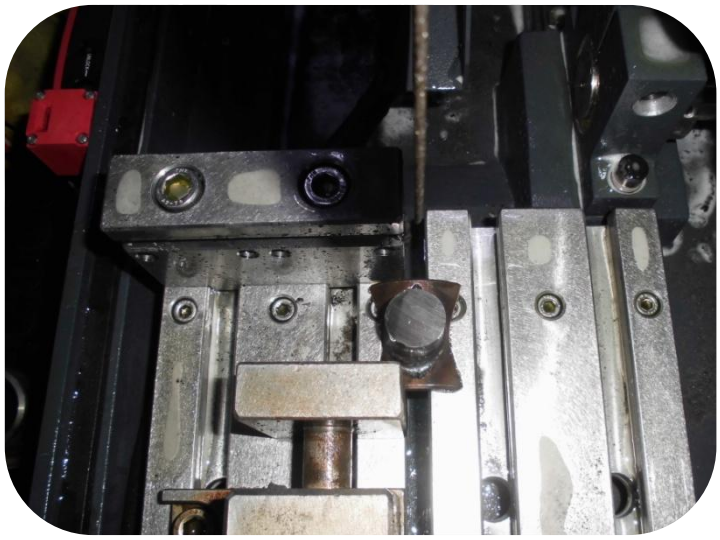
The sample is attached as it shown in the above photo with the GR 0013





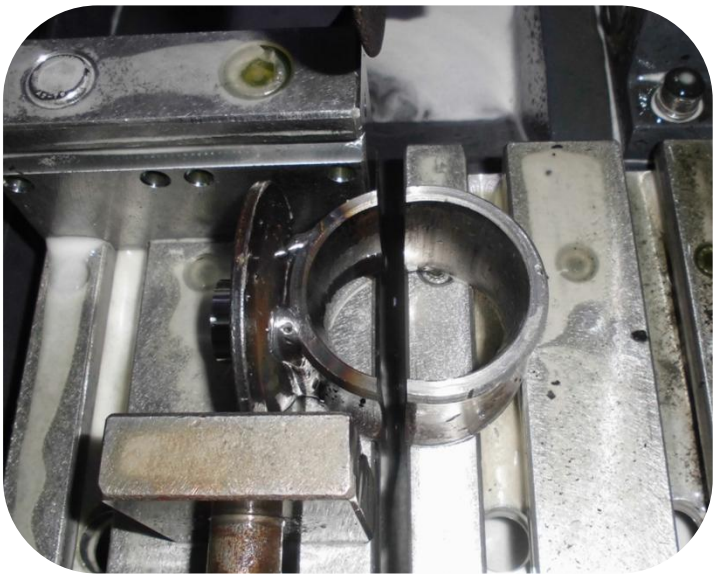
The first 2 cutting process took around 2 minutes.

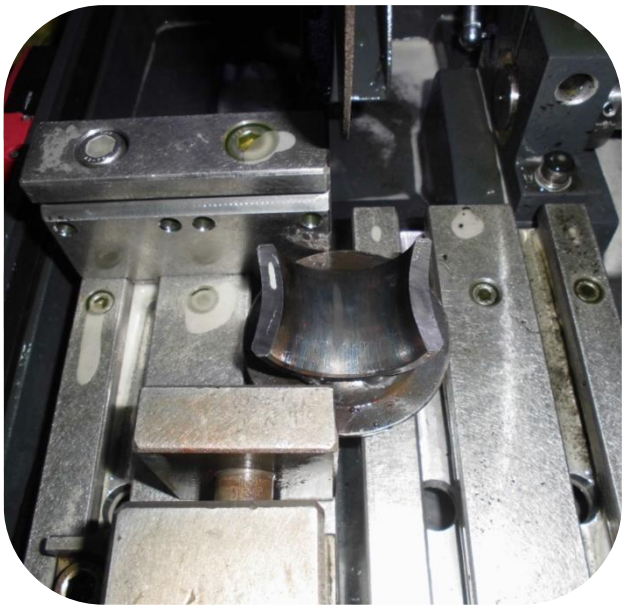




After that the sample cut from the middle (shown above pic.) as a third cutting operation.

Also we did the same operations for second sample;





After cutting operation the samples were grinded and polished with FORCIPOL 2V,

To compare differences between SiC grinding paper and Diamond disc the grinding operation made by both of them.

We used FORCIPOL 2V grinding and polishing machine to grind the samples with following parameters;

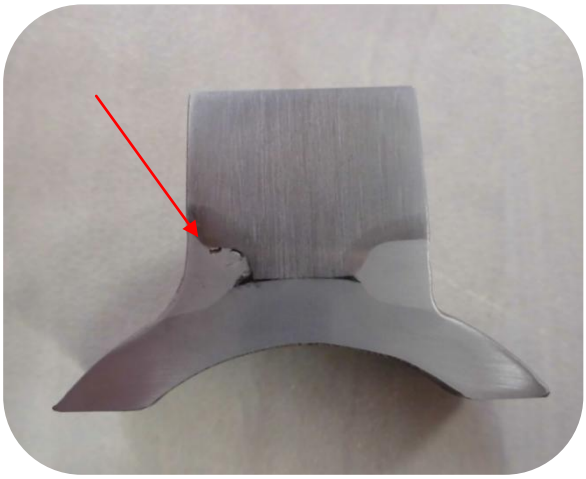
With SiC grinding paper;

Stage / Parameter	Grinding Step 1	Grinding Step 2	Grinding Step 3	Polishing Step 1	Polishing Step 2
Surface	*DEMPAX Paper Disc 38-040-400*	*DEMPAX Paper Disc 38-040-800*	*DEMPAX Paper Disc 38-040-1200*	*FEDO-3 Polishing Cloth 39-025-250*	*FEDO-1 Polishing Cloth 39-065-250*
Abrasive	*400 Grit SiC*	*800 Grit SiC*	*1200 Grit SiC*	*3 micron Diamond*	*1 micron Diamond*
Lubricant	*Water*	*Water*	*Water*	*DIAPAT [39-502] Diamond Lubr.*	*DIAPAT [39-502] Diamond Lubr.*
Time min.	*1 min.*	*2 min.*	*2 min.*	*2 min.*	*2 min.*
Disc Speed, rpm	*300*	*300*	*300*	*200*	*200*

With Diamond disc;

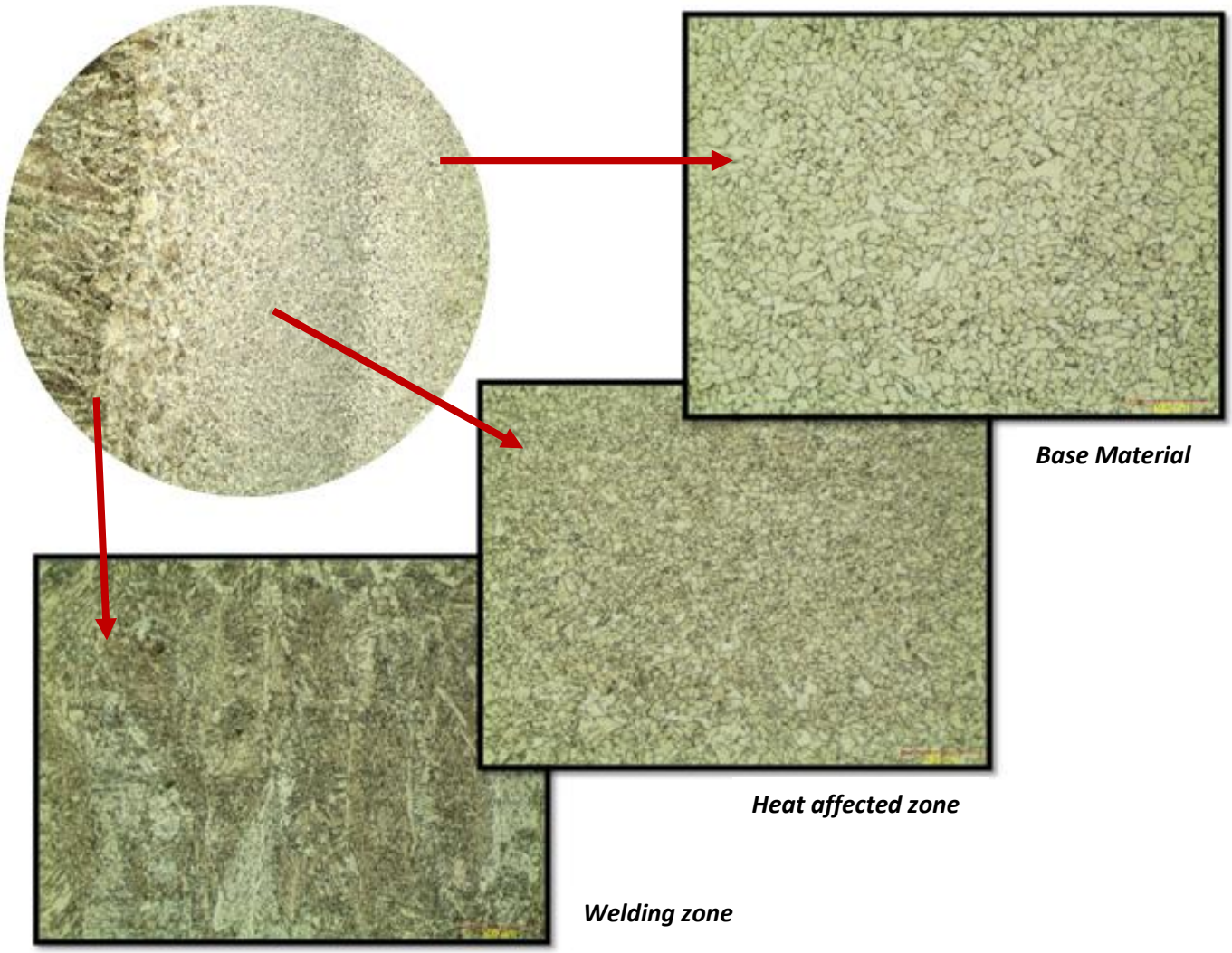
Stage / Parameter	Grinding Step 1	Grinding Step 2	Polishing Step 1	Polishing Step 2
Surface	*MAGNETO-I Diamond Disc 38-040-054*	*MAGNETO-II Diamond Disc 38-040-018*	*FEDO-3 Polishing Cloth 39-025-250*	*FEDO-1 Polishing Cloth 39-065-250*
Abrasive	*54 micron Diamond*	*18 micron Diamond*	*3 micron Diamond*	*1 micron Diamond*
Lubricant	*Water*	*Water*	*DIAPAT Diamond Lubr.*	*DIAPAT Diamond Lubr.*
Time min.	*1 min.*	*2 min.*	*2 min.*	*2 min.*
Disc Speed, rpm	*300*	*300*	*200*	*200*

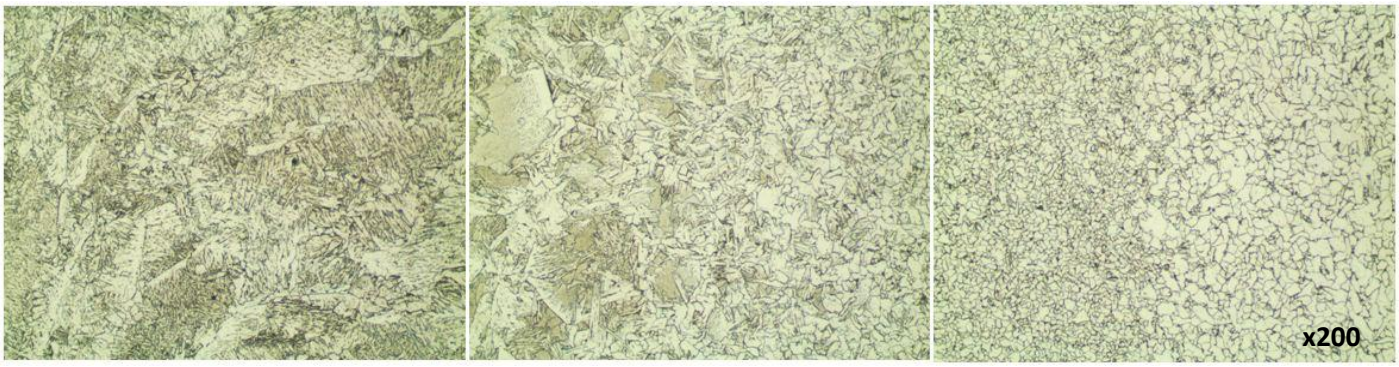
After polishing operation the sample etched 3% Nital solution and heat-affected zone can be observed.



RESULT

As a result the chromium steel 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.





Microstructre variation from the welding zone into the base material

Welding → **Base material**

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