

Application Case Study

Steel Heat Exchanger Tubing

Prepare High Quality Samples in Minutes Using the PlanarMet 300 Planar Grinder and EcoMet/AutoMet



Heat exchanger tubing - courtesy of Fine Tubes (www.finetubes.com).

Background

Metallurgical assessment, involving microstructural and hardness measurements of heat exchange tubing is important for tube manufacturers. The high volume of tube production coupled with the need to meet quality standards demand quick preparation of tubular samples for assessment with minimal or no damage.

Preparation



Specimens mounted in Central force holder.



Surface finish after PlanarMet 300.



Surface finish after 9µm diamond polishing on UltraPad cloth at 50X.

Sectioning

Equipment: AbrasiMet™ 250
Consumable: Abrasive Wheels for Ductile Materials, Ti & Ti-alloys, Zr & Zr-alloys



The tubing is first sectioned longitudinally and then cross-sectioned to fit a number of tube samples on one mount as shown above.

Mounting

Equipment: SimpliMet™ XPS1
Consumable: EpoMet™ F and PhenoCure™



The samples are mounted using a short layer of EpoMet F then filled with PhenoCure resin on a SimpliMet XPS1 fitted with a 40mm mold size.

Grinding & Polishing

Equipment: PlanarMet™ 300

PlanarMet 300 was used to grind the stainless steel and titanium tubular specimens after mounting with a target Z-axis removal of 0.5–1mm thickness. The following parameters were used:

Parameters:

Grinding setting:
Load: 40.5 lbs [180N] (for six samples)
Cycle time: 1:10
Head RPM: 150
Platen: Contra
Wheel Type: Aluminium oxide wheel, 120 [P120] grit



For a cycle time of 1min and 10sec, the average material removal was 300µm. For higher material removal rates, the cycle time was increased to 2min and 10sec. The average material removal achieved was 600µm.

Equipment: EcoMet™/AutoMet™ 300

The EcoMet/AutoMet 300 was used to polish the specimens using a 12in [305mm] platen. The mounted specimens were polished in central force mode with only two steps.



Preparation (cont'd)

3-Step Method for TSC and TBC Specimens using the PlanarMet™ 300 and EcoMet™/AutoMet™ 300

Surface	Abrasive / Size	Load - lbs [N] / Specimen	Platen Speed [rpm]	Head Speed [rpm]	Relative Rotation	Time [min:sec]
Alumina Grinding Stone	120 [P120] grit	40.5 [180]	Fixed	150		1:10
UltraPad	9µm MetaDi Supreme Diamond*	6.7 [30]	150	60		5:00
MicroFloc	3µm MetaDi Supreme Diamond*	6.7 [30]	150	60		2:00

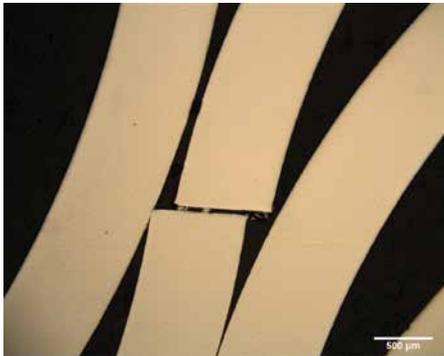
 = Platen
  = Specimen Holder
 *Plus MetaDi Fluid Extender as desired

Analysis

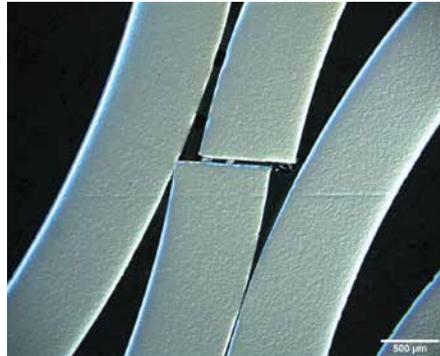
Imaging & Analysis

Equipment: Nikon LV150N Upright Microscope

The prepared specimens were inspected at magnifications between 50X and 200X at the eyepiece on a Nikon LV150 compound microscope equipped with a 3.1 MP UEye digital microscopy camera using bright field illumination (BF) and differential interference contrast (DIC).



Bright field (BF) micrographs of the surface finish after 3µm diamond polishing on Microfloc cloth.



Differential interference contrast (DIC) micrographs of the surface finish after 3µm diamond suspension polishing on UltraPad polishing cloth.

Conclusion:

A good surface finish was achieved after PlanarMet 300 grinding stage in less than 2 minutes. No additional coarse grinding steps were required and excellent flatness was achieved on the specimens. Final polishing steps involved a 2-step procedure with the resultant finish faintly showing the grain structure viewed under DIC microscopy.

Benefits:

Traditional preparation routes are arduous and take longer times. To mitigate this, Buehler has developed the PlanarMet™ 300 planar grinder enabling shorter preparation times with excellent surface finish and minimal deformation to the material.

Sectioning

AbrasiMet • AbrasiMatic • IsoMet

Mounting

SimpliMet

Grinding & Polishing

EcoMet • AutoMet • MetaServ

Imaging & Analysis

OmniMet

Hardness Testing

Wilson® Hardness



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