Nickel-Based Superalloy

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Discover the Truth of Material

Purpose:

Observe the microstructure of nickel-based superalloys. Turbine engine blades, as one of the most critical components in aerospace engines, largely determine engine performance (higher turbine inlet temperatures result in greater thrust and thrust-to-weight ratios). Metallographic inspection of material microstructure during blade manufacturing is essential for quality control. Samples undergo cutting (TableCut200), mounting (FLEXPRESS fully automatic modular hot mounting machine), grinding/polishing (Alpha610), and etching with Marble's reagent to observe the microstructure.

Recommended parameters for different specimen size				
Sample size/ diameter (mm)	25	30	40	50
Individual force loading mode, individual sample pressure force (N)	-5	0	+(5~10)	+(5~10)

*Standard pressure: ϕ30mm (adjust according to sample size).

Recommended Equipment and Consumables (select grinding/ polishing consumables based on sample conditions):



TableCUT-200 manual/automated precision cutting machine

Cutting

Equipment	TableCUT-200 manual/automated precision cutting machine	
Cutting disc	A60 alumina abrasive cut-off wheel	Order No: 01.01.118
Cutting coolant	TJ 1410 metallographic cutting coolant	Order No: 01.07.857
Fixture	Fast lock vise and Vertical fixture	
Cutting method	Horizontal cutting (Y-axis)	
Cutting Parameters	Feed rate	0.1mm/s
	Pulse setting	No pulse cutting
	Cutting disc rotation speed	3000rmp

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FlexPRESS Automated Modular Hot Mounting Machine

Hot Mounting

Equipment	FlexPRESS Automated Modular Hot Mounting Machine
Hot mounting resin	EP2237 Epoxy Edge-Retention Hot Mounting Resin Order No：02.01.710
Heating Power	100%
Holding time	5min
Temperature	180℃
Pressure	180bar
Cooling Conditions	Cool to 40℃
Cooling rate	High
Top heating	Enabled

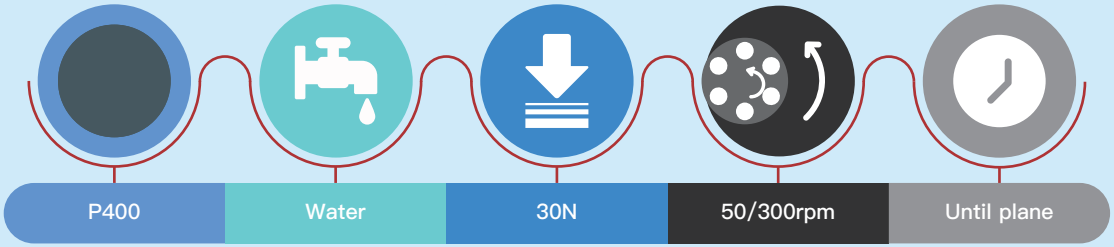
Basic Guide

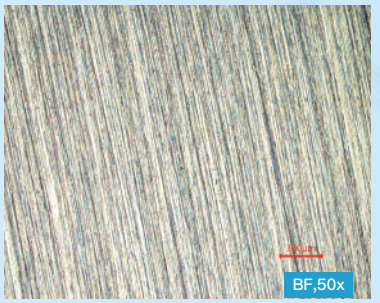
- **Cutting**
  1.Use an A60 alumina abrasive cutting wheel for nickel-based superalloys. Refer to the Trojan Cutting Guide for specific models.
  2.Select pulse mode for cutting, with a recommended maximum cutting speed ≤0.25 mm/s.
- **Mounting**
  Use high-edge-retention hot or cold mounting resin.
- **Grinding**
  1.Begin with P400 silicon carbide sandpaper/lapping films until the sample surface is flat and cutting damage is fully removed.
  2.Continue grinding with a POS disc + 9 μm polycrystalline diamond polishing suspension.
  3.Clean the sample, sample holder, and hands after each grinding step.
- **Polishing**
  1.Clean the polishing cloth, sample holder, and hands before polishing. Repeat cleaning after each step.
  2.Do not mix polishing disks with different abrasive particle sizes.
  3.Rinse the sample surface with alcohol and dry with a blower to remove water residue.
  4.After each polishing step, inspect under a metallographic microscope to ensure scratch size matches the abrasive grit and direction is random.
  5.Clean polishing cloths with running water and a soft brush after use, then air-dry.
  6.Dedicate polishing cloths used for nickel-based superalloys exclusively to such samples.

Preparation Procedure——Nickel-Based Superalloy

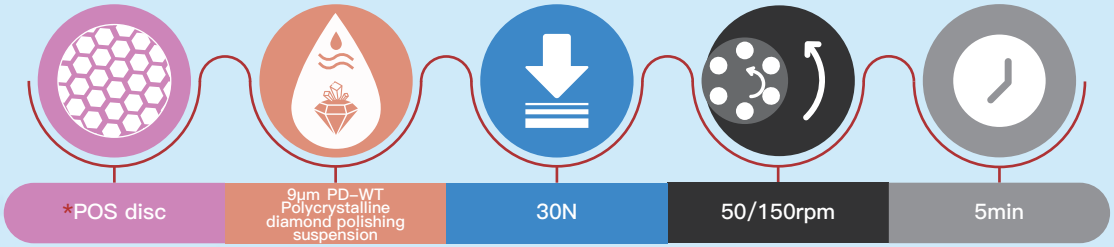
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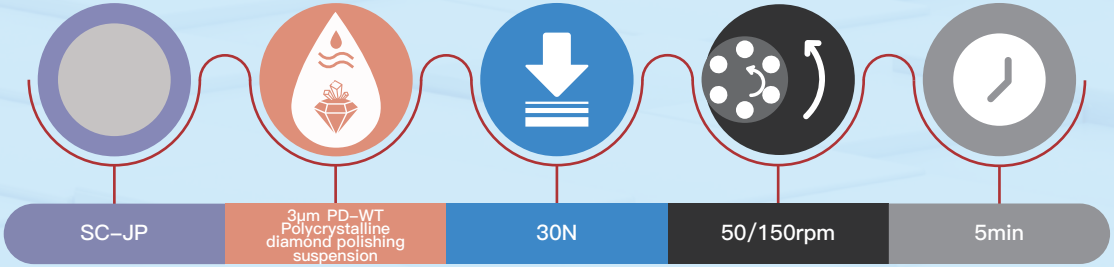
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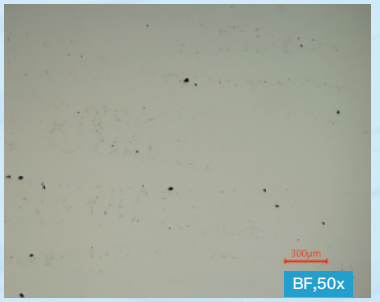




*POS discs can be replaced with P800, P2000, or P2500 sandpaper.

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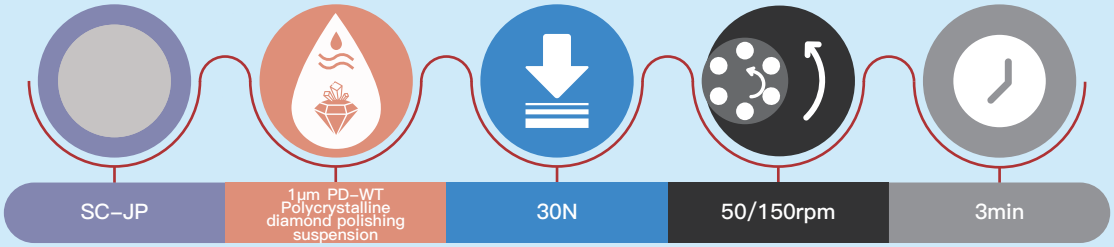




Preparation Procedure——Nickel-Based Superalloy

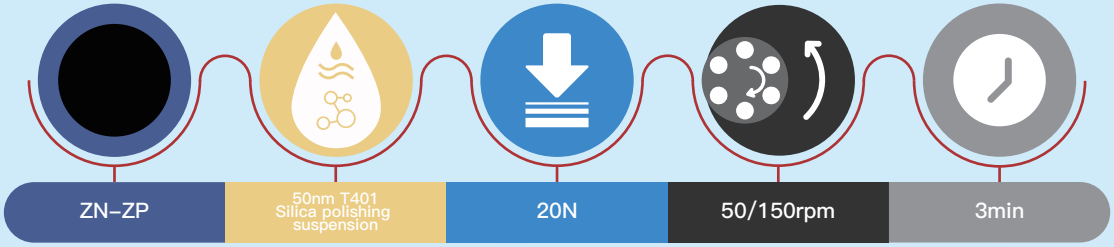
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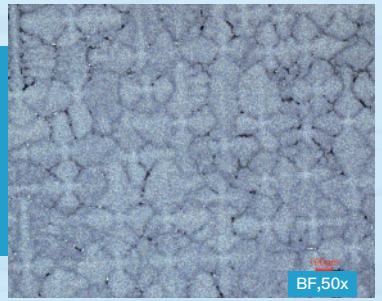


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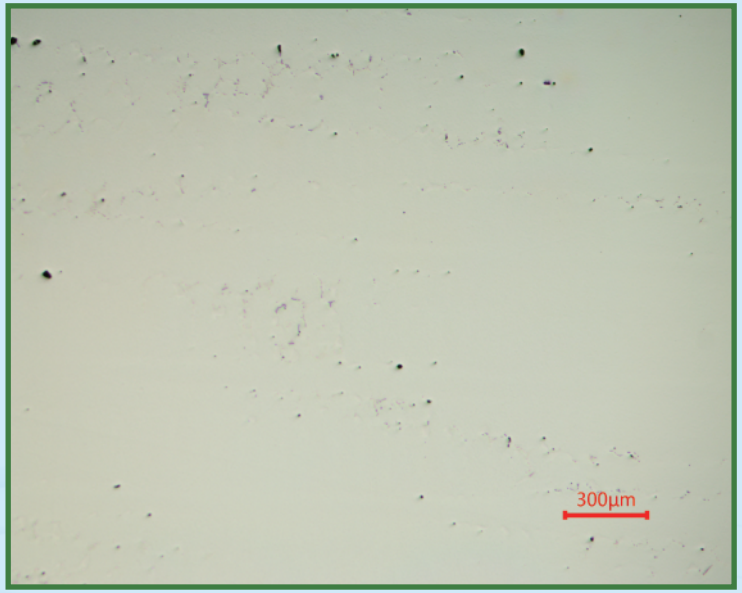
Immerse in Marble's reagent for 10—60 seconds.



Nickel-Based Superalloy-Polishing Defect Sample

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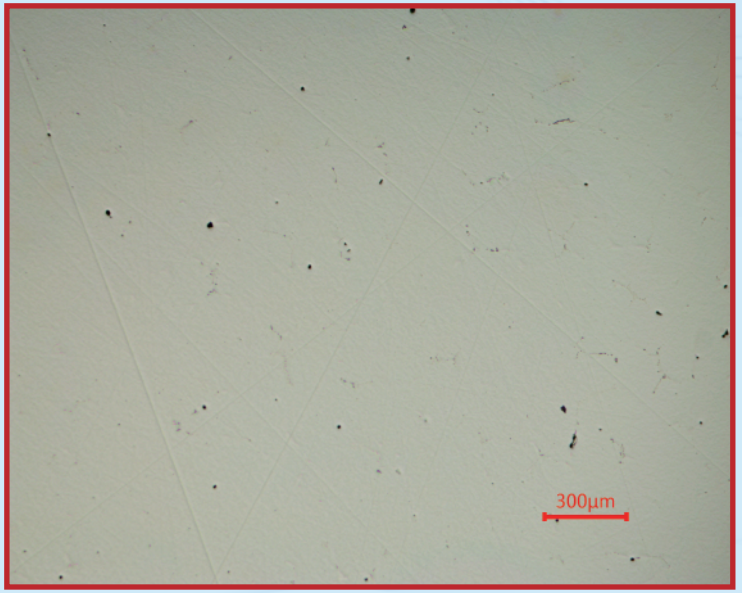
Photos of qualified polished samples



Micrograph after ZN + 50nm silica polishing suspension (50X magnification)

- Clean surface with no scratches.

Photos of unqualified polished samples



Micrograph after ZN + 50nm silica polishing suspension (50X magnification)

- Sparse polishing scratches observed on the sample surface;
- Solution: Thoroughly clean the sample, sample holder, polishing cloth, and hands. Repeat polishing steps using SC White Natural Silk Polishing Cloth + 1 μm diamond polishing suspension and ZN Black Polyurethane polishing cloth.