

# 400c 不锈钢和 Ti-6Al-4V 粉末

行 业:	Metallurgy
进料尺寸:	< 50 µm
最终精度:	d50 < 100 nm (d50 < 408 nm reached)
样 品 量:	5-10 g
研磨建议:	Some samples use to be too ductile to get properly ground. In this case, sample 440C remained quite large, even after longer grinding time. With Ti-Al-V powder, we achieved a fineness of d50 < 408 nm, but observed formation of gas pressure when particles got fine ground. To achieve smallest possible results, we recommend using a Planetary Micro Mill PULVERISETTE 7 premium line.



## PLANETARY MICRO MILL PULVERISETTE 7 PREMIUM LINE

main disk speed: 1100 rpm (220 V power supply)

20 ml grinding bowls made of zirconium oxide (ZrO<sub>2</sub>)  
+ 30 g of 3 mm Ø zirconium oxide grinding balls

Material attributes:	sample: 440 C
Feed quantity:	5 g
Feed Size:	< 50 µm
Additive:	+ 10,5 ml IPA (isopropyl alcohol)
Grinding time:	90 min
Final fineness:	d50 < 2,65 µm
Comments:	First sample 440 C got ground with this trail.

Because start size is mentioned to be < 50 µm, we used 3 mm Ø grinding balls for pre grinding. When particles use to be ground to < 5 µm, size can be changed to 0,1 mm Ø for a maximum fineness.

To avoid over pressure, we ground the sample in steps of 3 minutes, followed by a programmed pausing time of 10 minutes. After several cycles, the outside temperature of the bowl should be checked (remain below 80 °C); grinding time or programmed pausing time might be readjusted afterwards.

This is counting for all further grinding trials in suspension too.

We checked the size of particles by optical microscopy after 30 and 60 minutes of grinding, but each time, still particles up to 30  $\mu\text{m}$  had been spotted. We interrupted the grinding process after a total grinding time of 90 minutes were still up to 30  $\mu\text{m}$  particles had been spotted under the microscope.

Also such particles could be found with our Laser Particle Sizer ANALYSETTE 22 NanoTec plus (measurement attached).

We are guessing that this sample contains particles which use to be too ductile for a grinding with a planetary mill.

No other machine in our portfolio will be capable to achieve the desired grinding result.



## PLANETARY MICRO MILL PULVERISETTE 7 PREMIUM LINE

main disk speed: 1100 rpm (220 V power supply)

20 ml grinding bowls made of zirconium oxide ( $\text{ZrO}_2$ )

+ 30 g of 3 mm  $\varnothing$  zirconium oxide grinding balls

Material attributes: sample: Ti-Al6-V4 alloy powder

Feed quantity: 5 g

Feed Size: < 50  $\mu\text{m}$

Additive: + 7 ml IPA

Grinding time: 60 min

Final fineness: < 10  $\mu\text{m}$

Comments: This grinding trial has been performed analogue result 1.

To achieve a motor oil like viscosity (for an optimum grinding result), we added about 7 ml of isopropyl alcohol.

With sample Ti-Al6-V4 alloy powder, we also checked the size of particles during the grinding process by optical microscopy. After 60 minutes of grinding, no more particles > 10  $\mu\text{m}$  have been spotted.



## PLANETARY MICRO MILL PULVERISETTE 7 PREMIUM LINE

main disk speed: 1100 rpm (220 V power supply)

20 ml grinding bowls made of zirconium oxide (ZrO<sub>2</sub>)

+ 30 g of 0,5 mm Ø zirconium oxide grinding balls

Material attributes:	sample: Ti-Al6-V4 alloy powder
Feed quantity:	5 g
Feed Size:	< 10 µm (see result 2)
Additive:	+ 2 ml IPA (Σ: 9 ml)
Grinding time:	+ 60 min (Σ: 120 min)
Final fineness:	d50 < 408 nm
Comments:	After sample got pre ground in result 2, we changed the grinding balls to 0,5 mm Ø for finer grinding results. We checked the present fineness of sample after 90 minutes of grinding with our Laser Particle Sizer ANALYSETTE 22 NanoTec plus and found d50 < 1,1 µm. After 120 minutes, fineness has been checked again. Now the d50 sunk to < 408 nm. To determine the fineness after 2 hours of grinding, we used Mie parameters of n=1,53 and l 1,6. If refractive index and absorption coefficient of this substance will be given, it is possible to recalculate a more precise result after 2 hours of grinding.

We tried to proceed grinding after 2 hours of total grinding time, but after about 10 minutes of grinding, pressure inside the bowl rose to the point that gasket will sample allow to be pressed out (usually about 15 bar of pressure might be inside the grinding bowl). That might come with the additional oxygen we allowed to enter the bowl when we checked the fineness after 90 minutes. It is also possible that fine ground particles start to react with the isopropyl alcohol which we used for grinding.

Even after cleaning the gasket and running the bowl with a ratio of 1 minutes of grinding time and 7 minutes of pausing time, gasket have shown a leakage rapidly.

To proceed grinding, it might be beneficial to handle the bowl inside a glove box to keep it off of oxygen. Also the usage of a different kind of solvent might be beneficial for grinding (probably alkanes like benzene, hexane instead of alcohols).