



# NF Wire Forum



Deutsches  
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# Copper Wire Rod – Wire Break Types

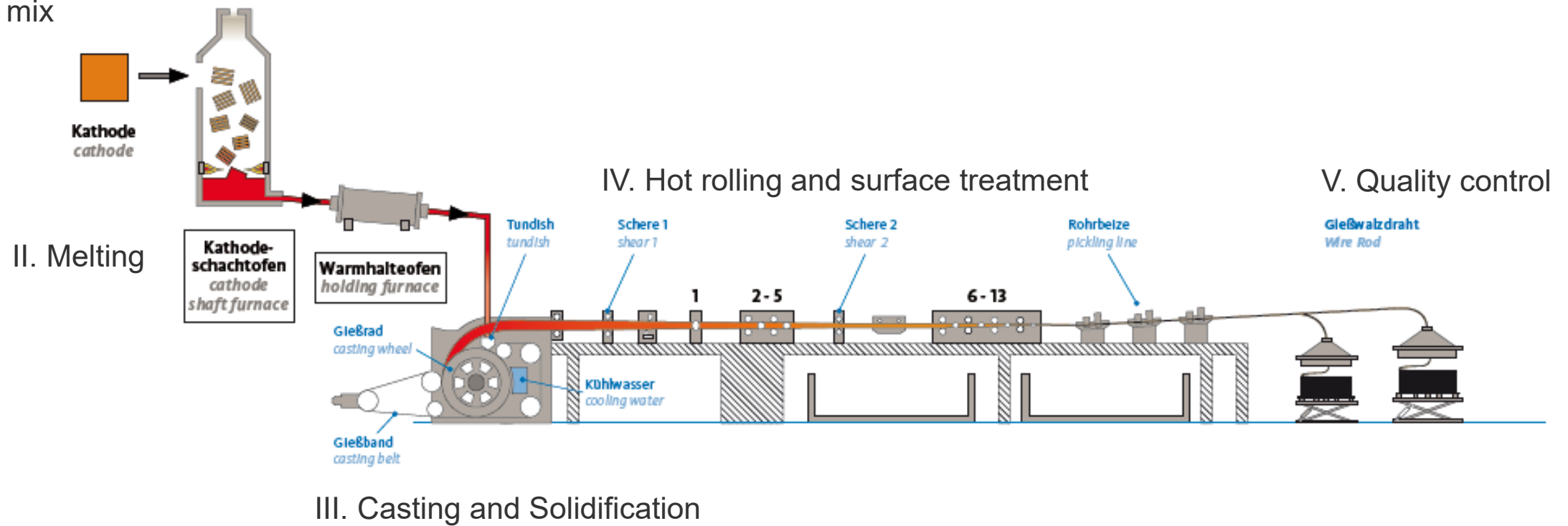
**NF WIRE FORUM ONLINE EVENT**

**October 20th, 2020**

Aurubis AG, Dr. Cornel Abratis

# Influencing factors on good drawability of Copper Wire Rod

I. Feed mix

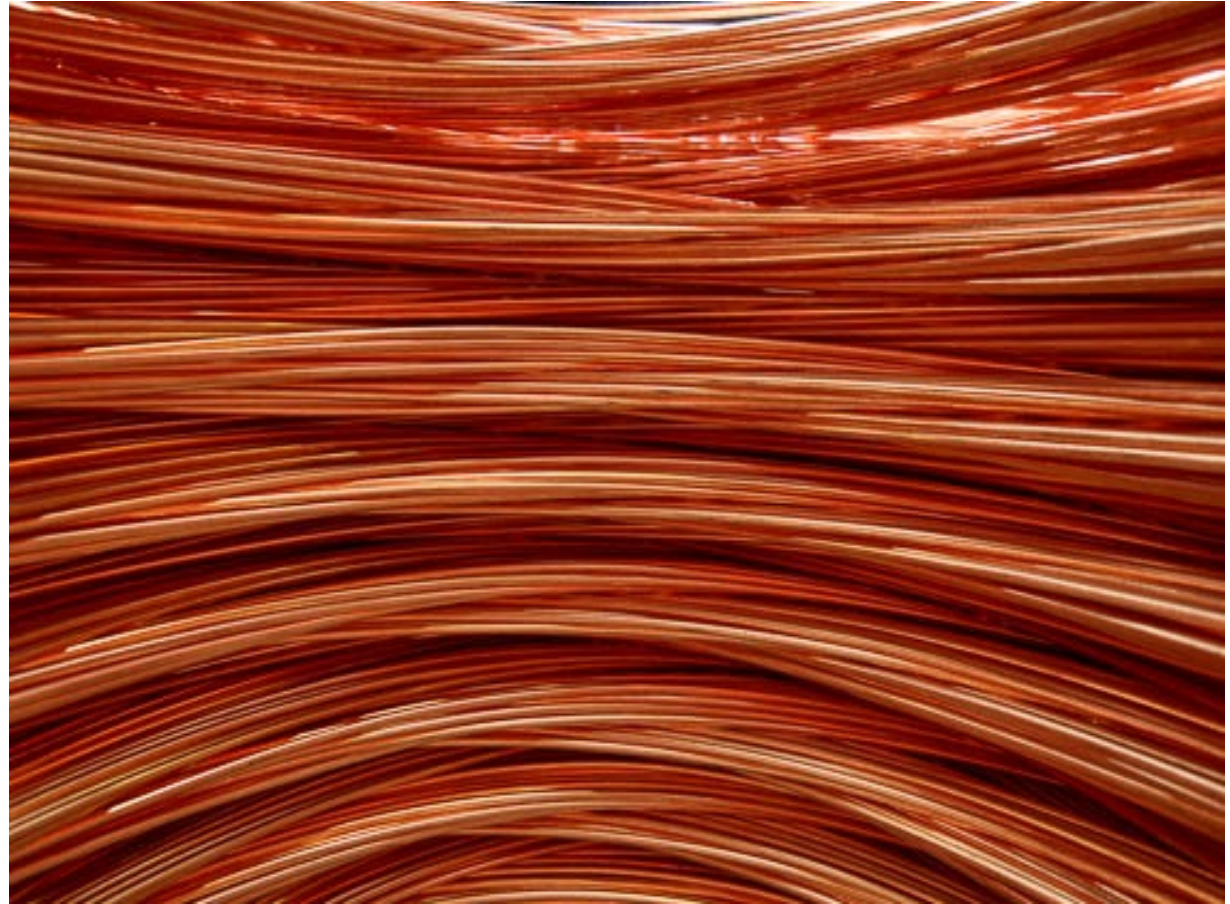


# Selection criteria for good drawability copper wire rod

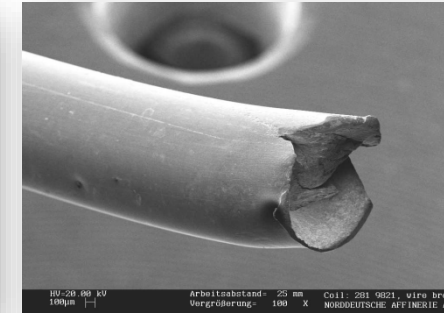
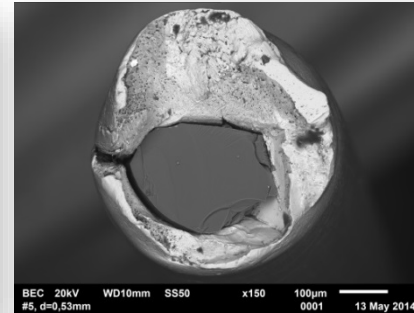
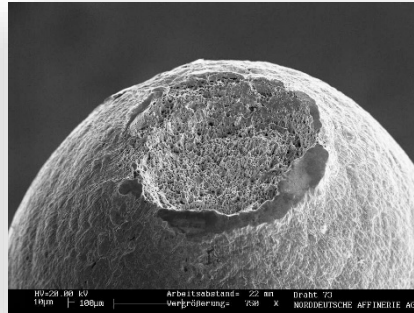
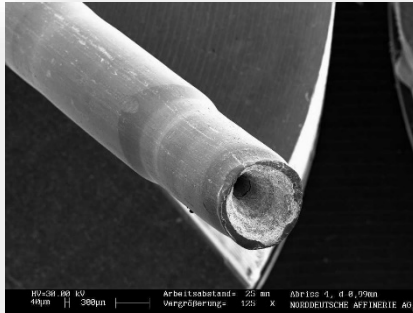


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- » “best” feed mix with grade A cathodes
- » Oxygen content < 250 ppm
- »  $\Delta$  temperature  $T_{\text{Copper melt}} > T_{\text{Copper solidus}}$
- » Cooling water
- » Rolling current at rolling stands
- » Low defectomat and ferromat signals
- » Good twist test result
- » Low residual oxide layer

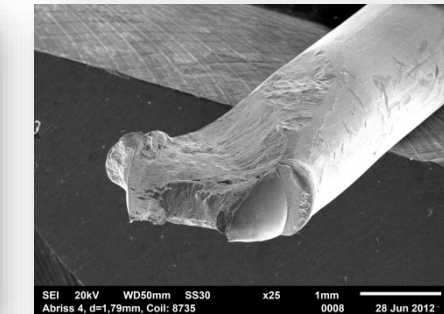
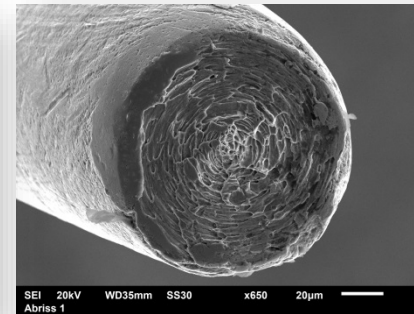
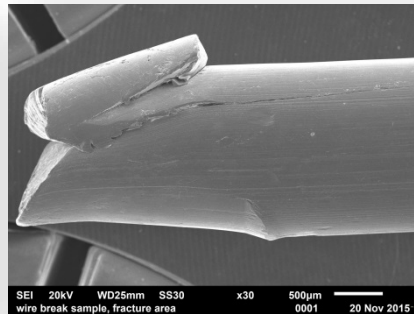
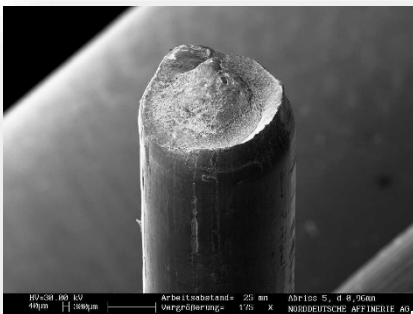


# Introduction



## Wire Breaks

... are the undesired result of unfavorable interactions of adjacent forces, tensions and metallic/physical processes in the material exceeding beyond the material's stress limit.





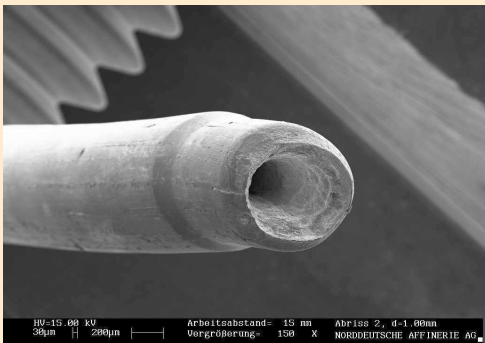
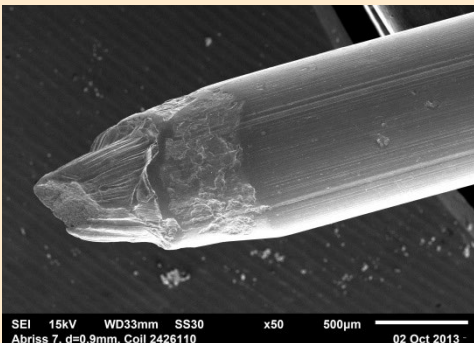
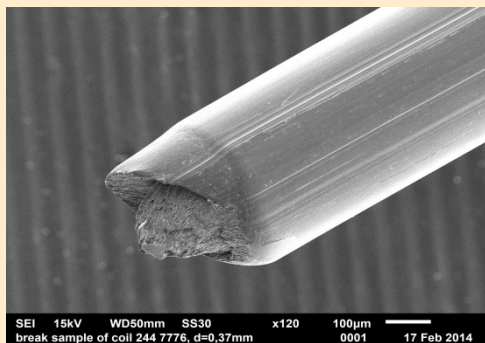
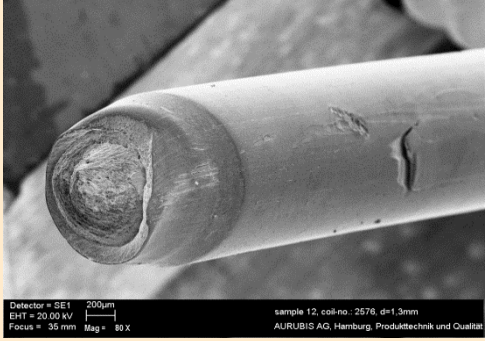
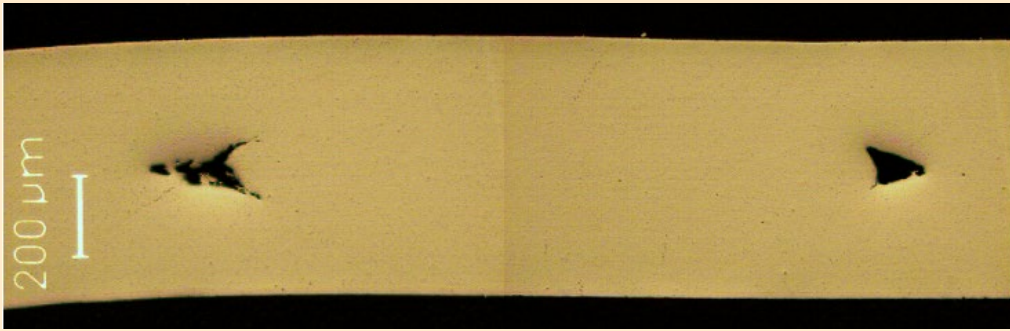
# Typical Wire Breaks

- Cup- and Cone break I (drawing conditions)
- Cup- and Cone break II (Cuprous enrichments)
- Ductile force break / strain break
- Inclusion break
- Force break by rolled-in or pressed-in chip / mech. surface damage (surface break)
- Weld break
- Annealing break

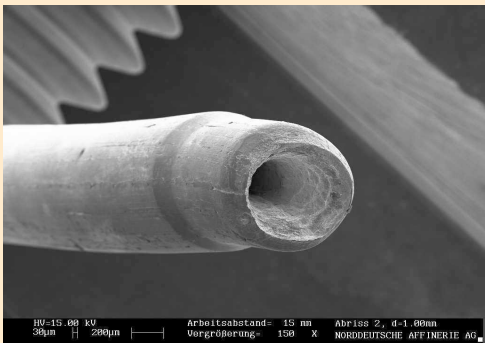
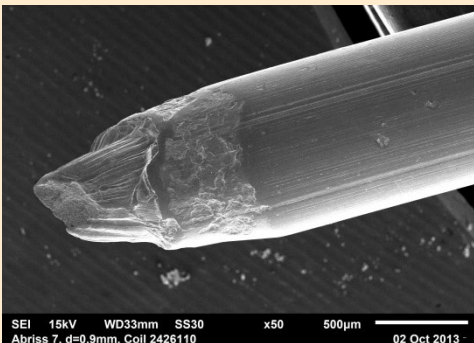
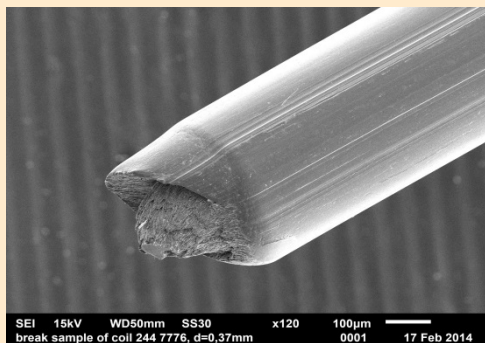
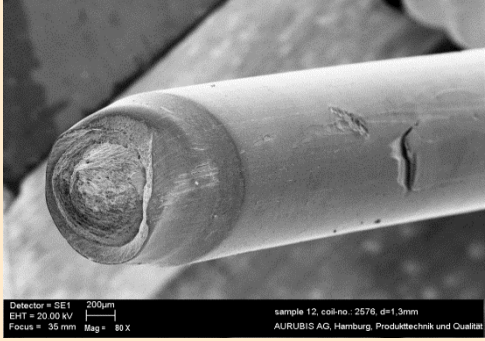
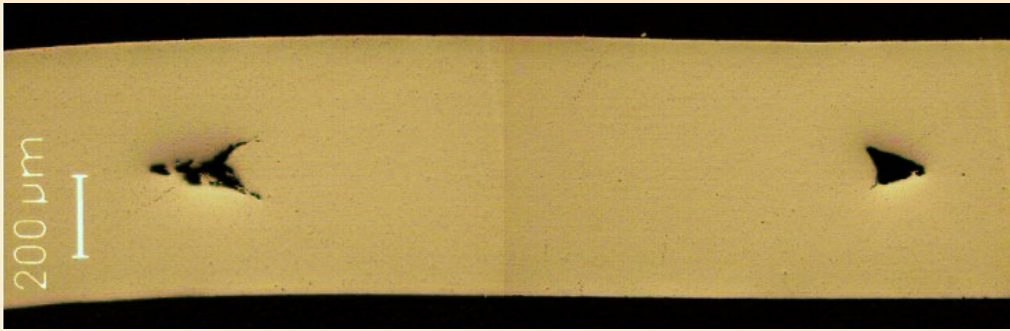


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Break type	Cup- and Cone-break I (drawing conditions)
Examples	    
Features	<ul style="list-style-type: none"> <li>- Cup side with a deep whole in the middle of the wire or</li> <li>- Cone side with a symmetrical necking and a tip</li> <li>- surface defects (draw marks, etc.) aside of the breakage area</li> <li>- Inner cracks so called “craw feet” in longitudinal cross sections</li> <li>- no impurity phase agglomeration in the copper wire matrix</li> </ul>



Break type	Cup- and Cone-break I (drawing conditions)
Examples	    
Damage mechanism	<ul style="list-style-type: none"> <li>- high shear stresses between wire surface and neutral line induce local material failures where the max. material stress level is exceeded (inner cracks “craw feet”)</li> <li>- the tip of the “craw feet” is orientated in drawing direction</li> <li>- with additional strain, these cracks grow and reduce the load-bearing cross-section of the wire until the material fails or breaks</li> </ul>