

NF Wire Forum

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Drawing machines and drawing processes

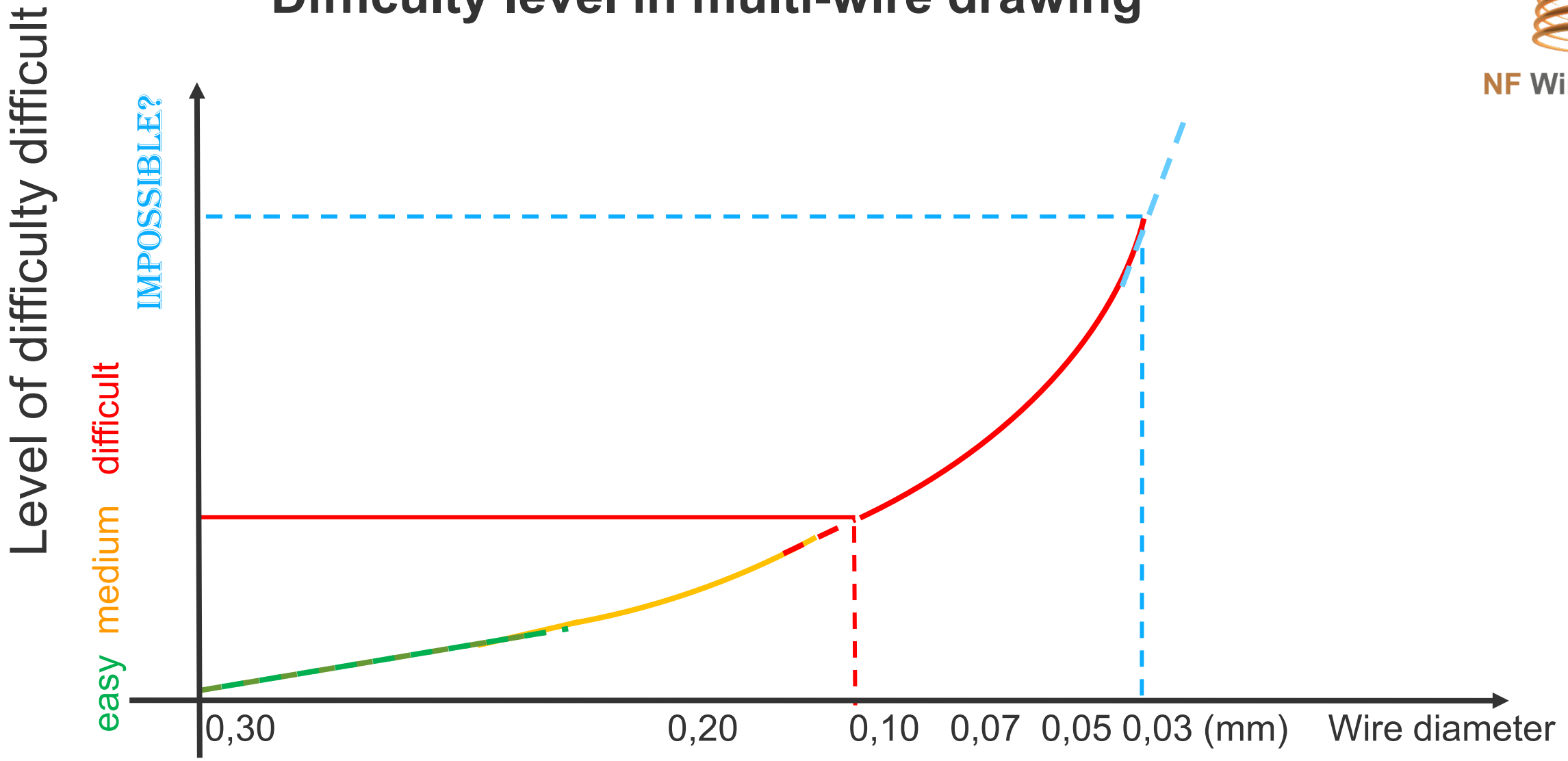
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Sources for this presentation:
NIEHOFF: Operating instructions and internal documentation
Martin Herzog: Copper wire drawing

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Difficulty level in multi-wire drawing

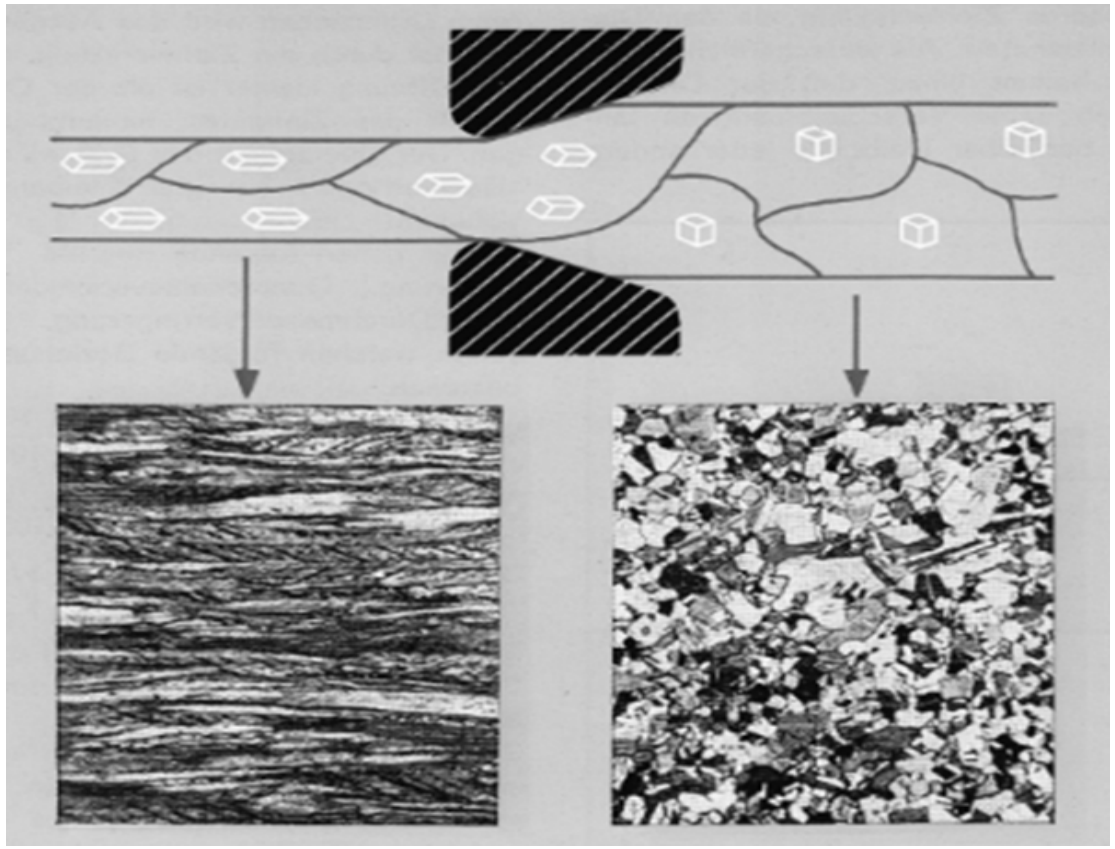
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What happens when drawing copper?

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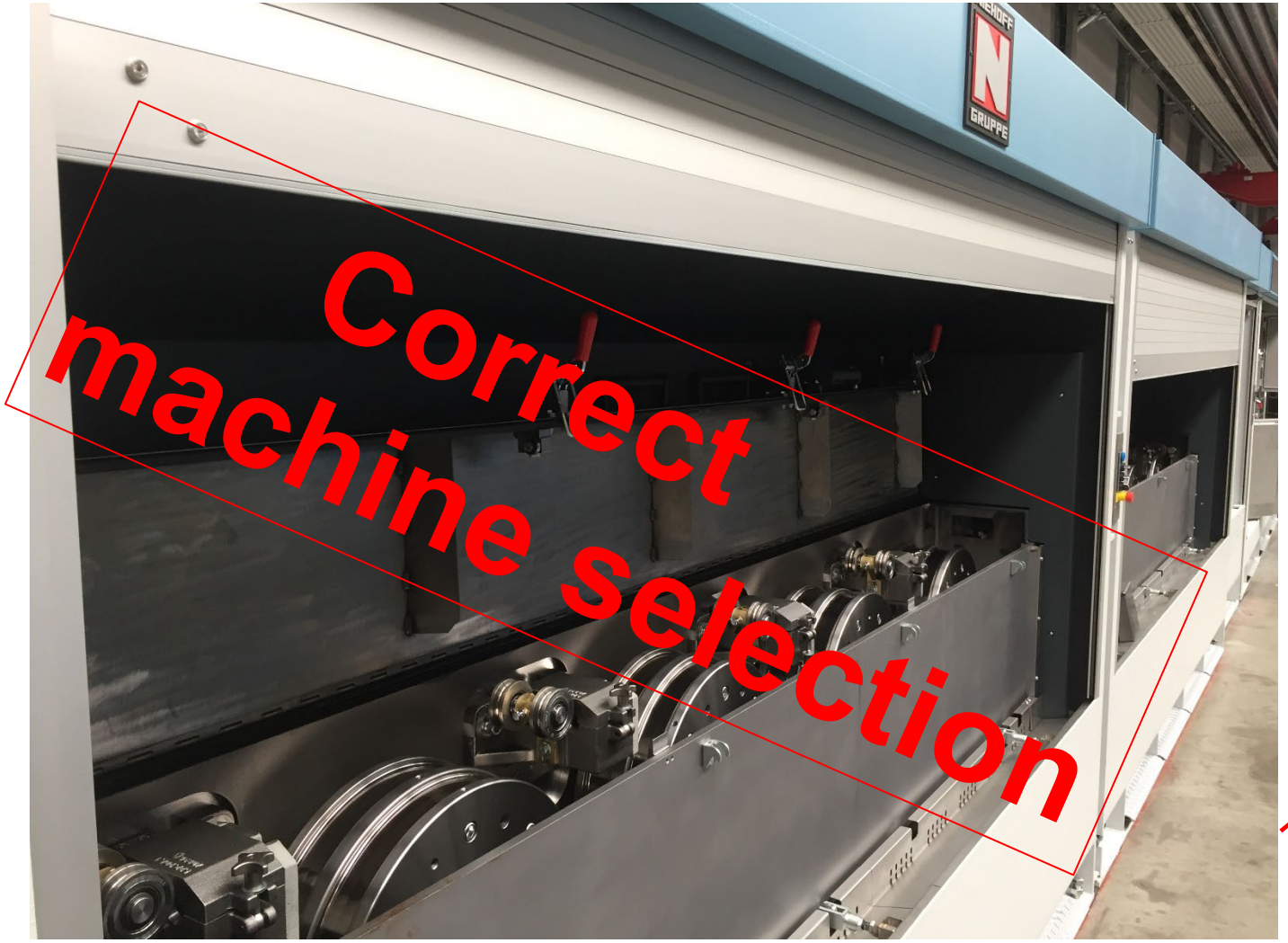


When drawing copper, the structure of the copper changes.
Soft copper becomes hard when drawing through the first two dies.

Source: copper wire drawing by Martin Herzog

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Factors influencing good quality



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Manufacturing speed

Correct gradation - wire extension

Quality of the used wire rod

annealer?? Yes / No?

State of the annealer?!

Basic setting (e.g. number of windings, slip)

Condition of equipment

Condition of the pull rings

general State of the machine

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Factors influencing good quality



Knowledge

Machine operator

Condition of equipment





Quality of the wire rod



Condition of the equipment, coolant, lubricant, drawing dies



Basic setting

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Wire elongation for pre-drawn wire, finewire and oxygen-free copper: ca. 42%

Table 1: Division of the drawing machines into groups				
Machine type	Inlet wire-ø mm	Finished wire -ø mm	wire extension %	slip ** %
Rod breakdown machine	8,00 – 6,00	4,50 – 1,00	von 55 - 25 decreasing gradation	2,5
Intermediate wire machine	3,50 – 1,80	1,50 – 0,35	25 – 30	1
Fine wire machine	2,20 – 1,00	0,50 – 0,10	15 – 25	0,5
Super fine wire machine	0,60 – 0,15	0,15 – 0,05*	11 – 18	0,3

* Finished wire diameter 0.05 - 0.03 mm only for single wire drawing machines

** for machines with central gear

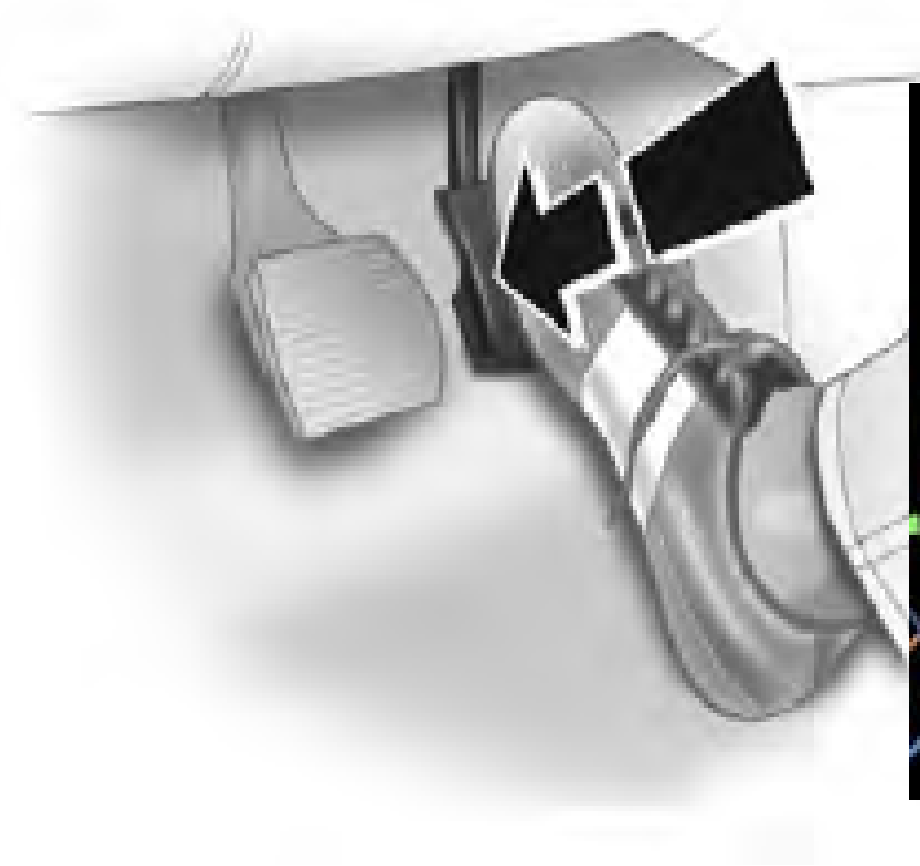
Source: copper wire drawing by Martin Herzog

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Basic setting

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Manufacturing speed





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Einlauf-ø	1.538	1.480	1.440	1.415	1.380	1.355		1.330		1.310		MS DV v [m/s]	DV Abziehsch.
	1	2	3	4	5	6	7	8	9	10	11		
2x8.00	6.451	5.303	4.419	3.715	3.162	2.717	2.334	2.024	1.755	1.533	2x1.35	35.0 *	29.0%
2x8.00	6.451	5.303	4.419	3.715	3.162	2.717	2.334	2.024	1.755		2x1.60	35.0 *	20.3%
2x8.00	6.451	5.303	4.419	3.715	3.162	2.717	2.334	2.024			2x1.80	35.0 *	26.4%
2x8.00	6.451	5.303	4.419	3.715	3.162	2.717	2.334				2x2.05	33.0 *	29.6%
2x8.00	6.451	5.303	4.419	3.715	3.162	2.717	2.420				2x2.28	26.0 *	12.7%
2x8.00	6.451	5.303	4.419	3.715	3.162	2.800					2x2.60	21.0 *	16.0%
2x8.00	6.451	5.303	4.419	3.715	3.162						2x3.00	16.0 *	11.1%
2x8.00	6.451	5.303	4.419	3.715							2x3.50	12.0 *	12.6%

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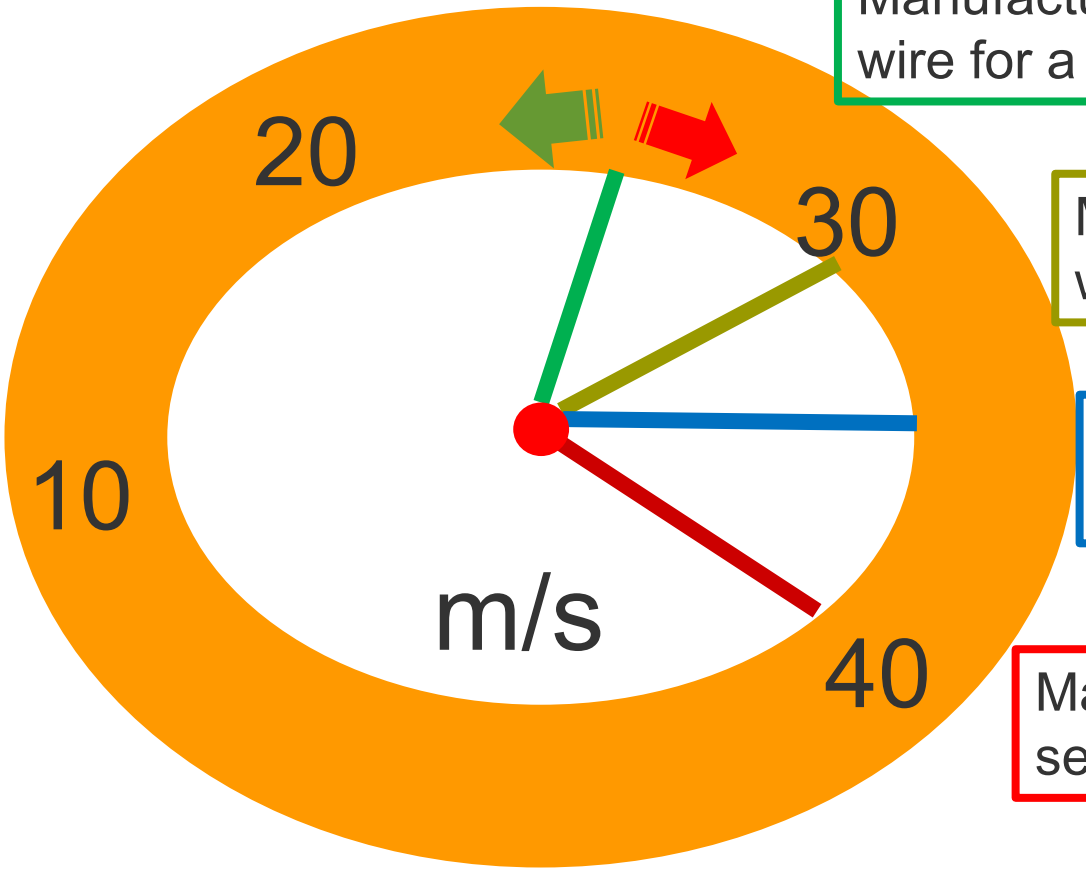
Einlauf-e	1.250				1.190												1.130													-	1.130				1.076	MS
	1.285	1.265			1.225	1.215											1.155								1.150										1.149	DV
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	v [m/s]
1.000	0.8822	0.7844	0.6974	0.6201	0.5603	0.5083	0.4611	0.4183	0.3795	0.3443	0.3124	0.2834	0.2571	0.2332	0.2116	0.1920	0.1787	0.1663	0.1547	0.1439	0.1339	0.1246	0.1159	0.1078	0.1005	0.0937	0.0874	0.0815	0.0760	0.0709	0.0661	0.0617	0.0575	0.0536	0.0500	25.0
1.000	0.8822	0.7844	0.6974	0.6201	0.5603	0.5083	0.4611	0.4183	0.3795	0.3443	0.3124	0.2834	0.2571	0.2332	0.2116	0.1920	0.1787	0.1663	0.1547	0.1439	0.1339	0.1246	0.1159	0.1078	0.1005	0.0937	0.0874	0.0815	0.0760				0.0709	0.0661	0.0620	25.0
1.000	0.8822	0.7844	0.6974	0.6201	0.5603	0.5083	0.4611	0.4183	0.3795	0.3443	0.3124	0.2834	0.2571	0.2332	0.2116	0.1920	0.1787	0.1663	0.1547	0.1439	0.1339	0.1246	0.1159	0.1078	0.1005	0.0937	0.0874	0.0815	0.0760						0.0700	25.0
1.200		1.0741	0.9569	0.8525	0.7750	0.7045	0.6405	0.5823	0.5293	0.4812	0.4375	0.3977	0.3615	0.3287	0.2988	0.2716	0.2527	0.2352	0.2188	0.2036	0.1895	0.1763	0.1640	0.1526	0.1420	0.1321	0.1230	0.1144	0.1065	0.0993	0.0926	0.0863	0.0805	0.0751	0.0700	30.0
1.200		1.0741	0.9569	0.8525	0.7750	0.7045	0.6405	0.5823	0.5293	0.4812	0.4375	0.3977	0.3615	0.3287	0.2988	0.2716	0.2527	0.2352	0.2188	0.2036	0.1895	0.1763	0.1640	0.1526	0.1420	0.1321	0.1230	0.1144	0.1065						0.1000	25.0
1.200		1.0741	0.9569	0.8525	0.7750	0.7045	0.6405	0.5823	0.5293	0.4812	0.4375	0.3977	0.3615	0.3287	0.2988	0.2716	0.2527	0.2352	0.2188	0.2036	0.1895	0.1763	0.1640	0.1526	0.1420	0.1321	0.1230								0.1150	19.0
1.200		1.0741	0.9569	0.8525	0.7750	0.7045	0.6405	0.5823	0.5293	0.4812	0.4375	0.3977	0.3615	0.3287	0.2988	0.2716	0.2527	0.2352	0.2188	0.2036	0.1895	0.1763	0.1640	0.1526	0.1420	0.1321									0.1270	16.0
1.200					1.0808	0.9785	0.8895	0.8087	0.7352	0.6683	0.6076	0.5523	0.5021	0.4565	0.4150	0.3773	0.3518	0.3280	0.3059	0.2853	0.2660	0.2480	0.2313	0.2157	0.2011	0.1876	0.1749	0.1631	0.1521	0.1418	0.1322	0.1233	0.1150	0.1072	0.1000	30.0
1.200					1.0808	0.9785	0.8895	0.8087	0.7352	0.6683	0.6076	0.5523	0.5021	0.4565	0.4150	0.3773	0.3518	0.3280	0.3059	0.2853	0.2660	0.2480	0.2313	0.2157	0.2011	0.1876	0.1749	0.1631	0.1521			0.1461	0.1362	0.1270	0.1200	30.0
1.200					1.0808	0.9785	0.8895	0.8087	0.7352	0.6683	0.6076	0.5523	0.5021	0.4565	0.4150	0.3773	0.3518	0.3280	0.3059	0.2853	0.2660	0.2480	0.2313	0.2157	0.2011	0.1876	0.1749	0.1631	0.1521				0.1461	0.1362	0.1270	28.0
1.200					1.0808	0.9785	0.8895	0.8087	0.7352	0.6683	0.6076	0.5523	0.5021	0.4565	0.4150	0.3773	0.3518	0.3280	0.3059	0.2853	0.2660	0.2480	0.2313	0.2157	0.2011	0.1876	0.1749	0.1631							0.1500	21.0

EINLAUFDURCHMESSER max. 1.20mm Cu-weich 16 Draehte (8 pro Etage)
Inlet diameter max. 1.20mm Cu-soft 16 wires (8 per level)

AC-MOTOREN 81kW/22.5kW (mit RM121/500A)
AC-Drives 81kW/22.5kW (with RM121/500A)

Basic setting

Manufacturing speed of the rod breakdown machine



Manufacturing speed for pre-drawn wire for a super fine wire process

Manufacturing speed for pre-drawn wire for a fine wire process

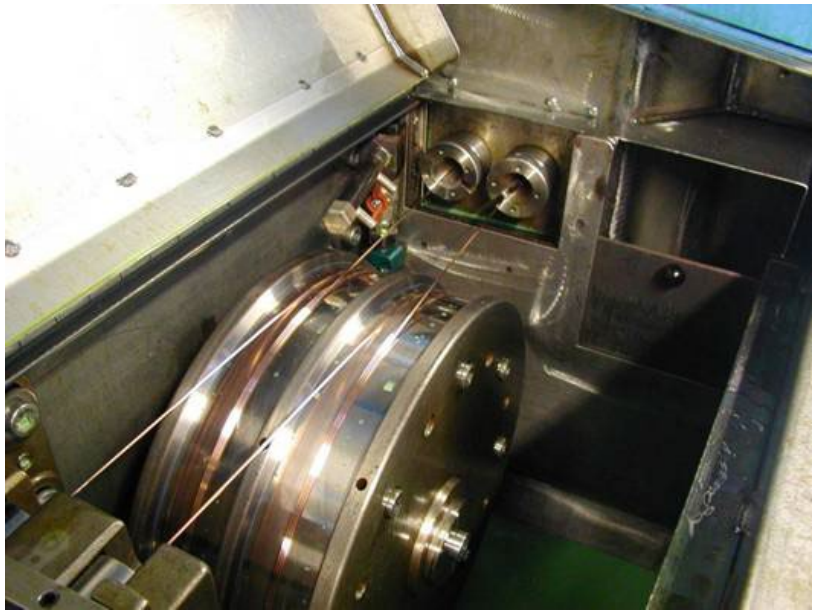
Manufacturing speed for pre-drawn wire for a intermediate wire process

Manufacturing speed for semi-finished products

Basic setting

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Number of windings





windings Rod breakdown machine:

D > (2,0 - 1,8) : 3

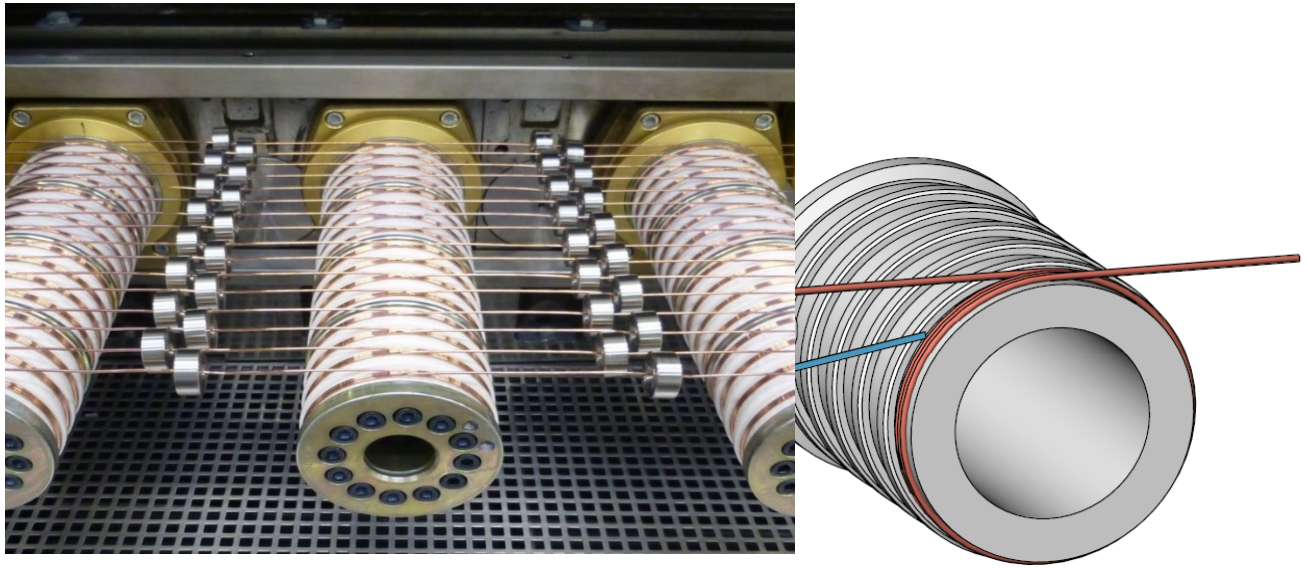
D < (2.0 - 1,8) : 2

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Basic setting

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Number of windings at the multiwire line



at the machine inlet side, the first two cones 2 windings

D > 0,4 : 3 **0,1 < D < 0,4 : 2** **D < 0,1 : 1**

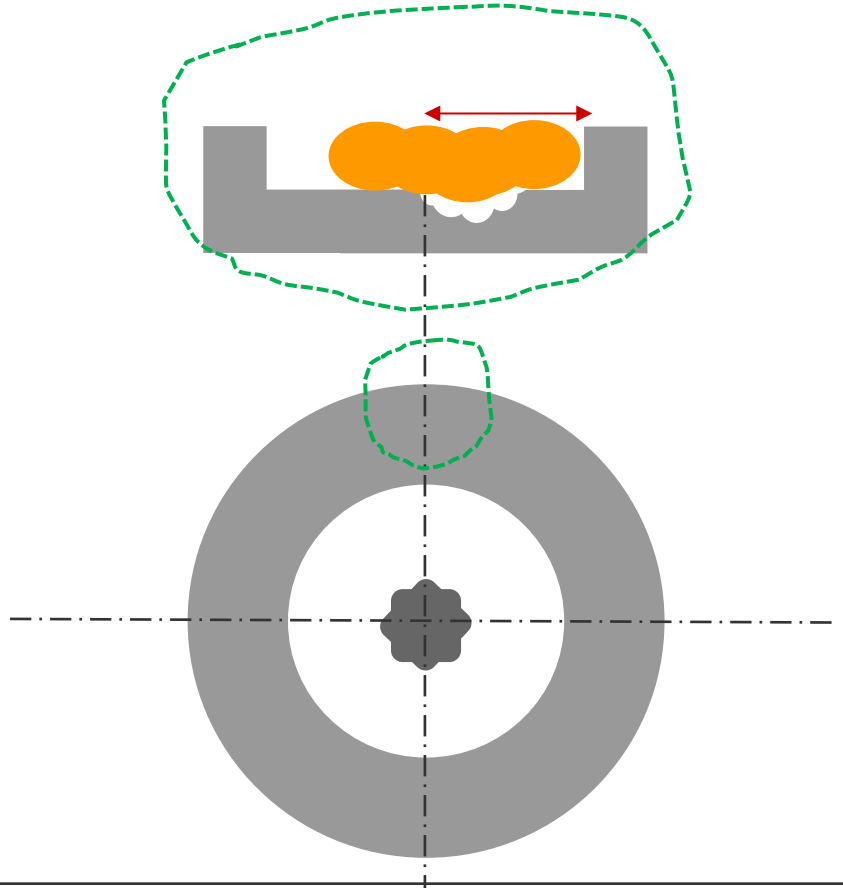
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Condition of the capstan

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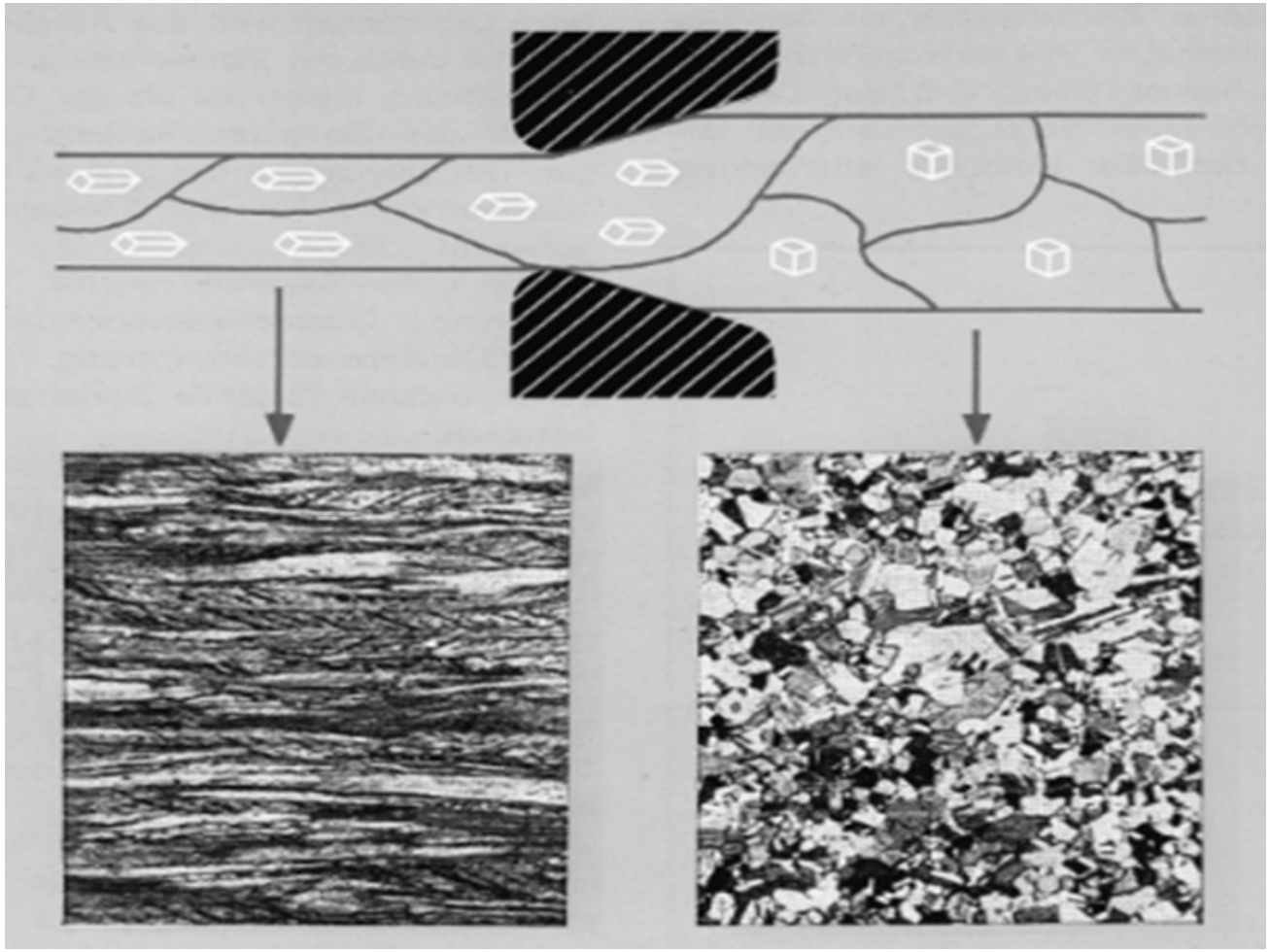


Demaged cones should be replaced.

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Annealer for the rod breakdown process

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Benefits:

- lower tensile strength, higher elongation
- This improves the flexibility of the wire
- This minimizes the risk of wirebreaks !?

annealer?? Yes / No?

State of the annealer?!

Disadvantage:

- Higher energy consumption
- Wear parts requirement for the annealer

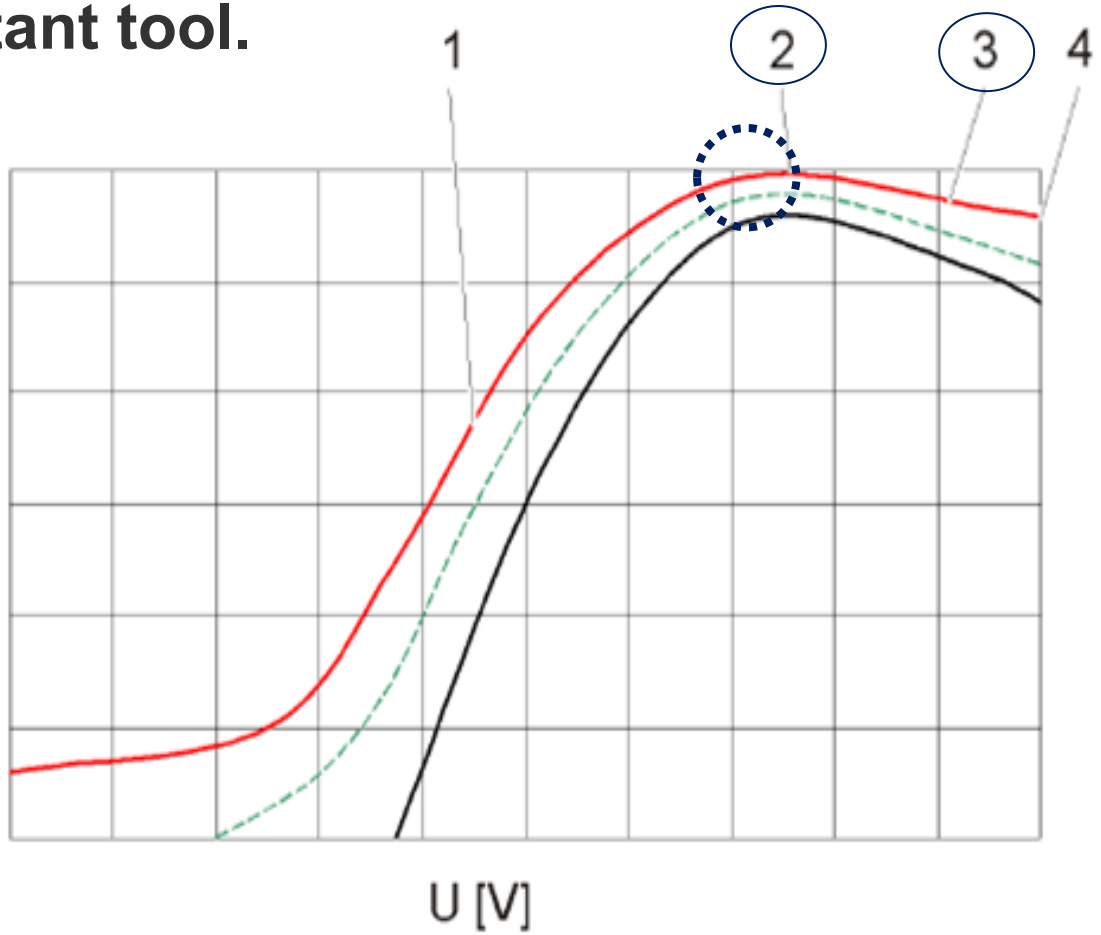
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Annealer for the rod breakdown process

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The annealing curve is our most important tool.





Choosing the operation point beyond point 2 destroys the structore of the copper.

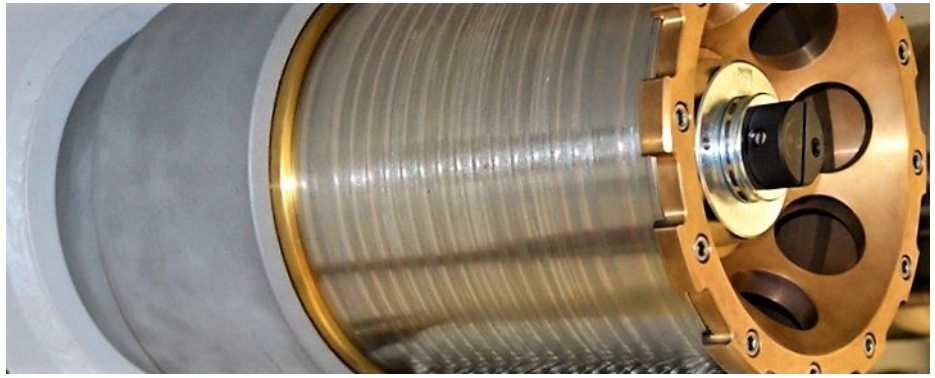
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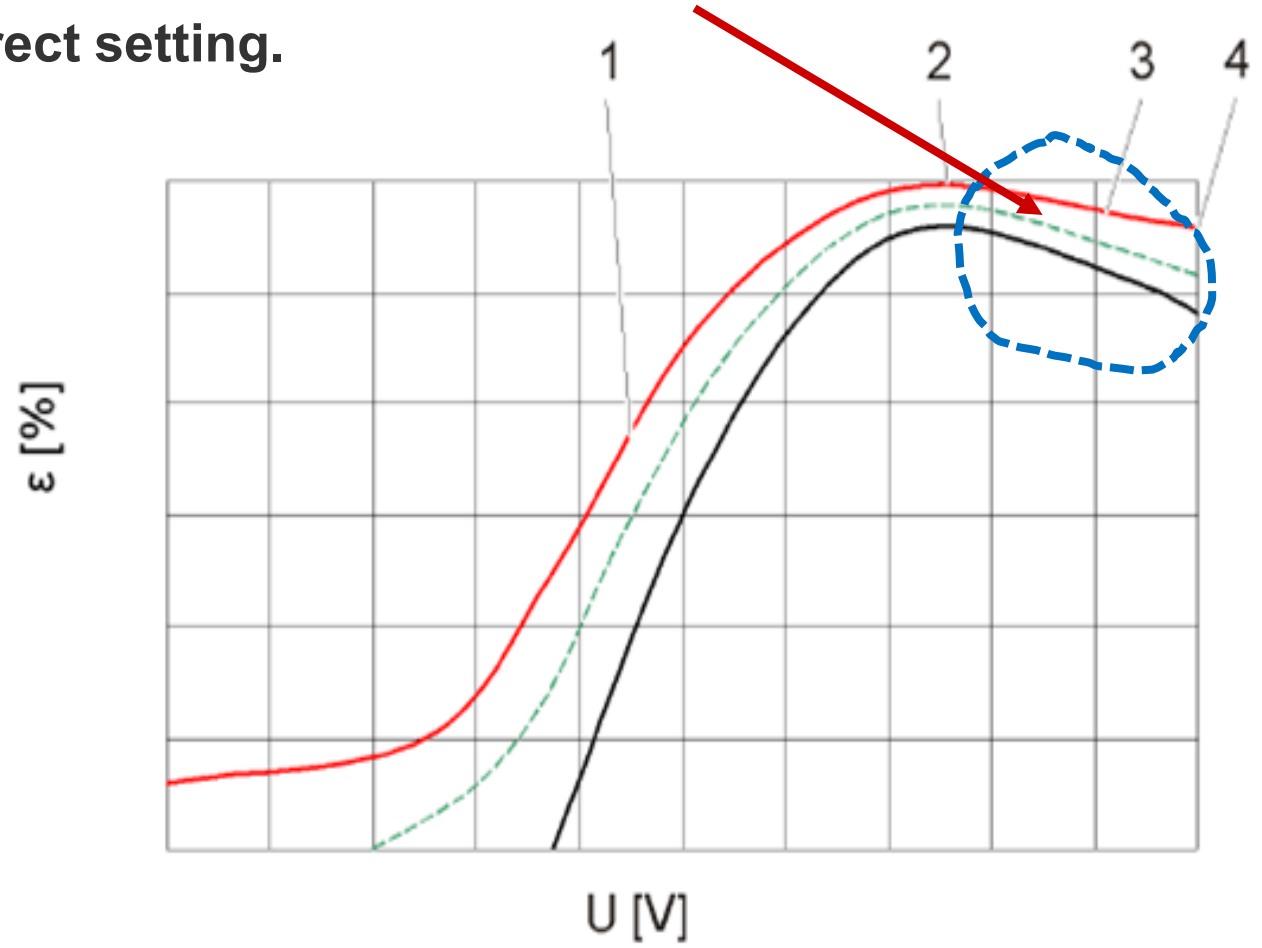
Annealer for the rod breakdown process

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The contact pullies also wear out much faster when using a incorrect setting.



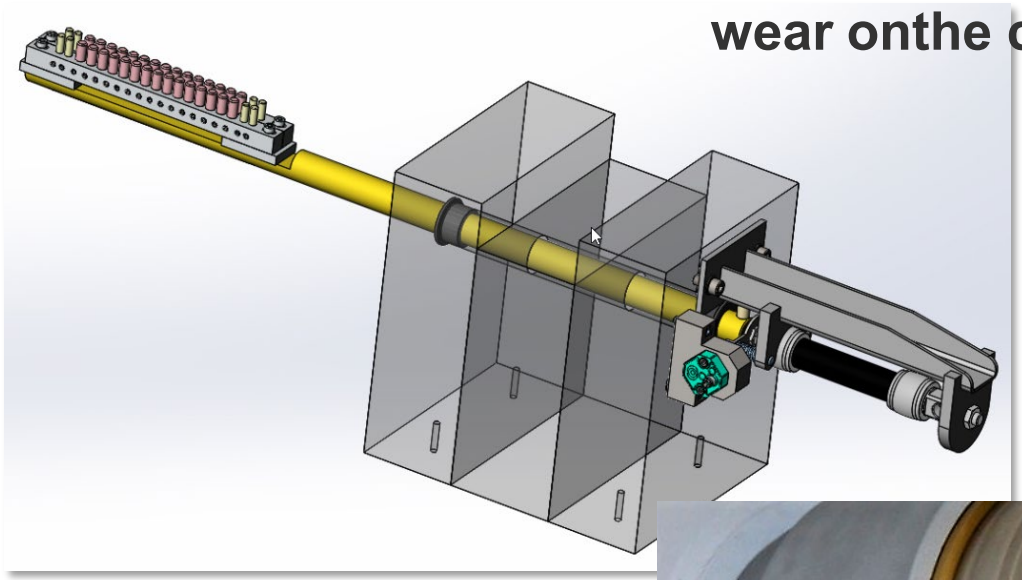


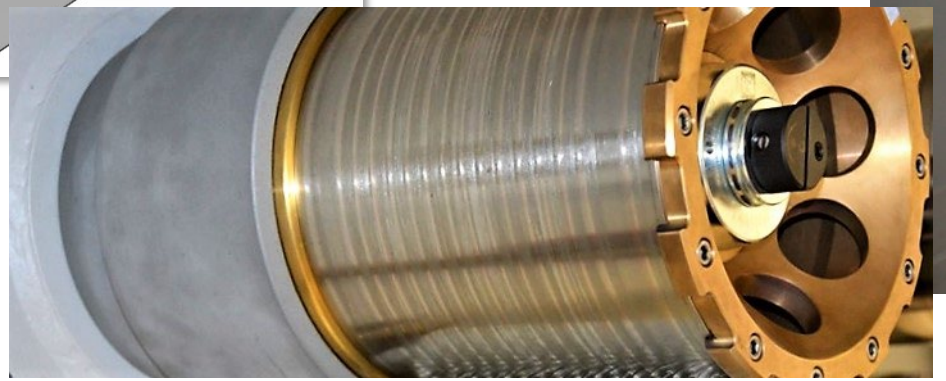
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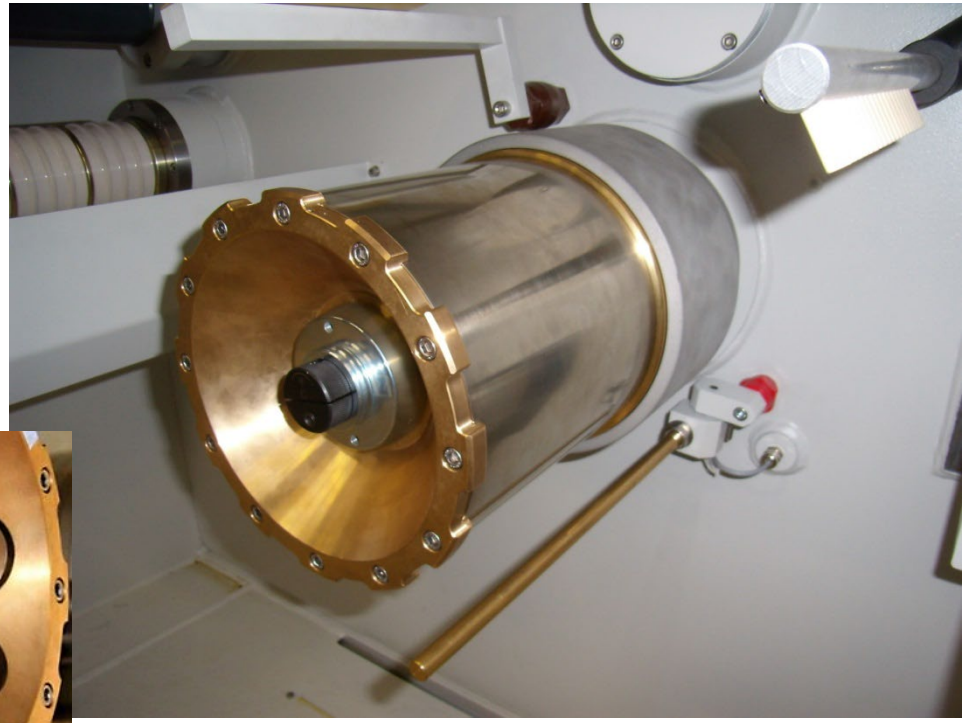
Annealer for the rod breakdown process

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A wire mooving unit can be used to reduce wear onthe contact pullies.





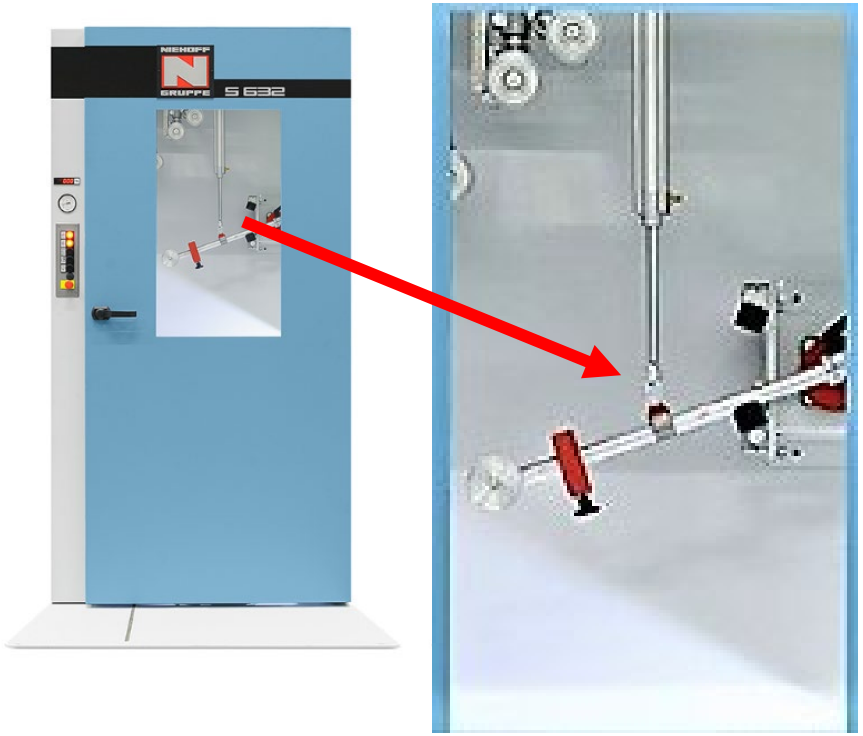


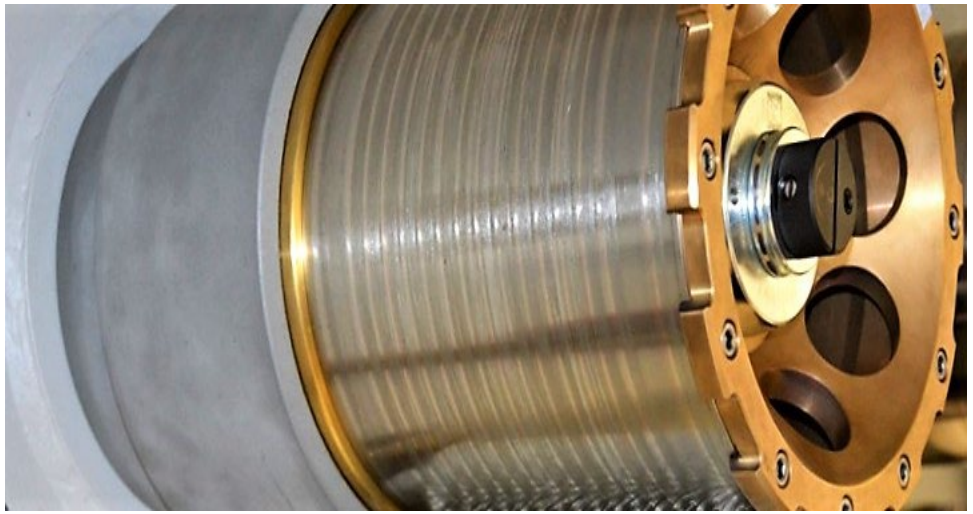
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Why is the tension setting at the dancer so important about ?

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Wire Dia-meter	cross Section Of wire	Allowed tension **	Allowed traction force
d	Ad	$\sigma_{0,2}$	$P_{0,2}$
mm	mm²	N/mm²	N
0,07	0,00385	104	0,4
0,08	0,00503	101	0,5
0,09	0,00636	99	0,6
0,10	0,00785	97	0,8
0,11	0,00950	96	0,9
0,12	0,01131	94	1,1
0,13	0,01327	93	1,2
0,14	0,01539	92	1,4
0,15	0,01767	90	1,6
0,16	0,02011	89	1,8
0,17	0,02270	88	2,0
0,18	0,02545	87	2,2
0,19	0,02835	86	2,4
0,20	0,03142	86	2,7
0,21	0,03464	85	2,9
0,22	0,03801	84	3,2
0,23	0,04155	83	3,5
0,24	0,04524	82	3,7
0,25	0,04909	82	4,0
0,26	0,05309	81	4,3
0,27	0,05726	80	4,6
0,28	0,06158	80	4,9
0,29	0,06605	79	5,2



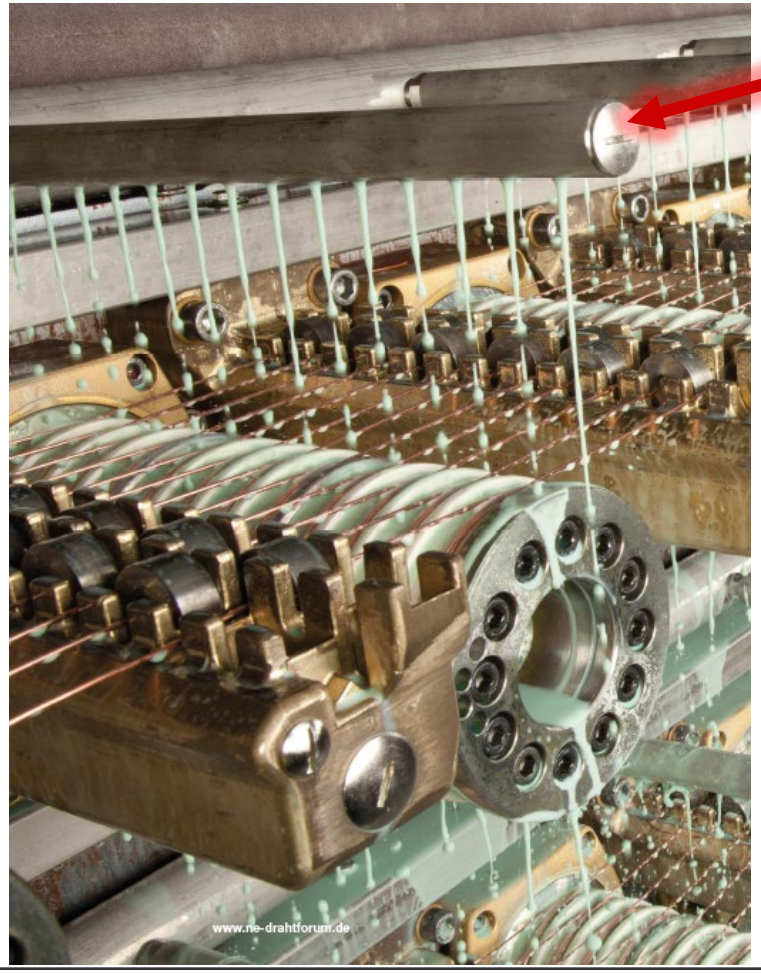


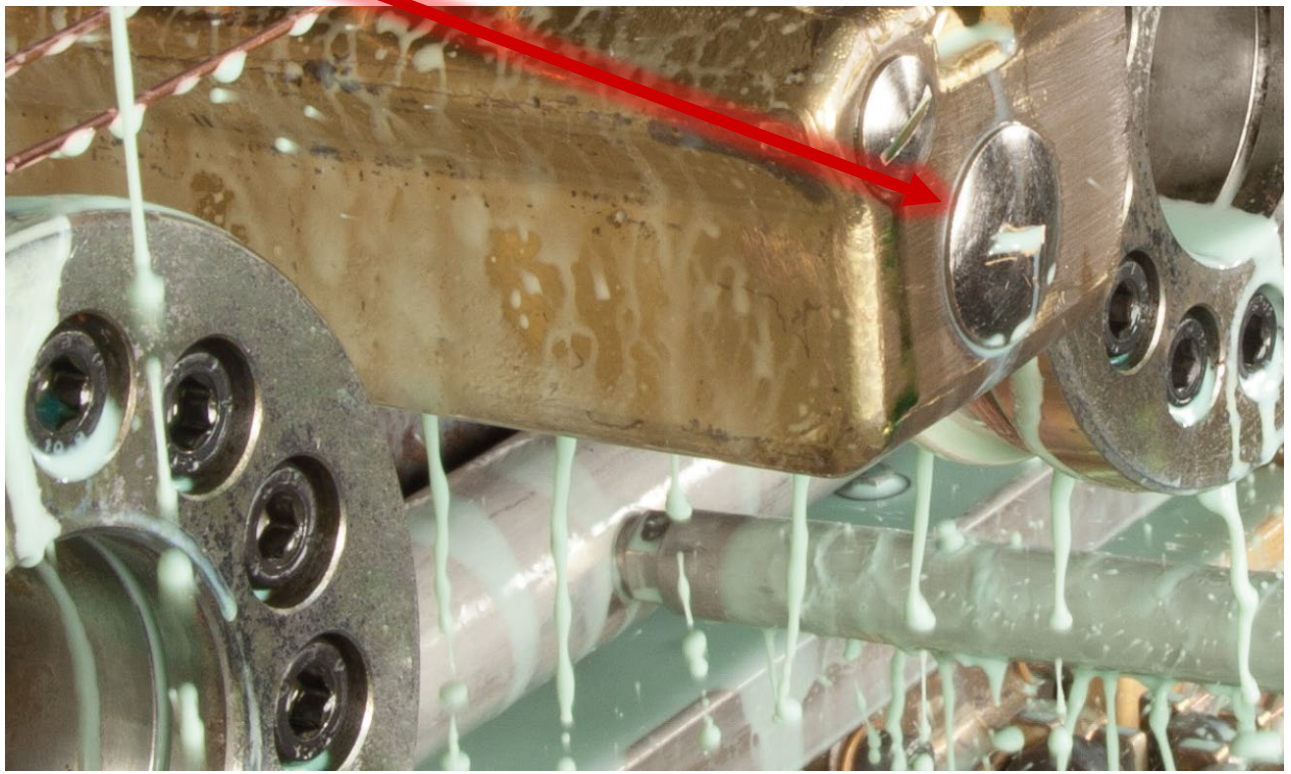
The dancer defines the contact pressure of the wire on the contact pullies.
If the contact pressure is too low, the wear on the contact pullies is very high.

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Regular maintenance and cleaning of the lubricant system is so important!

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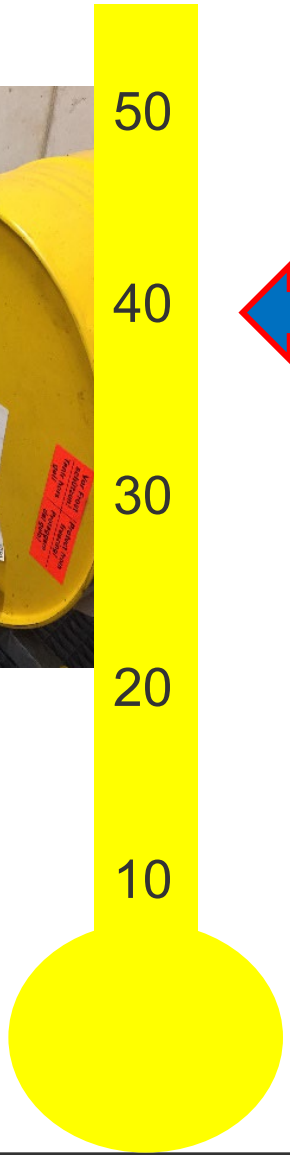
Last but not least

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Please use always the correct lubricant temperature!









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Thank you for your attention!

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