

SmartFlex® Wire

“100% quality controlled Shape
Memory Wire for microactuators”



HIGHLIGHTS

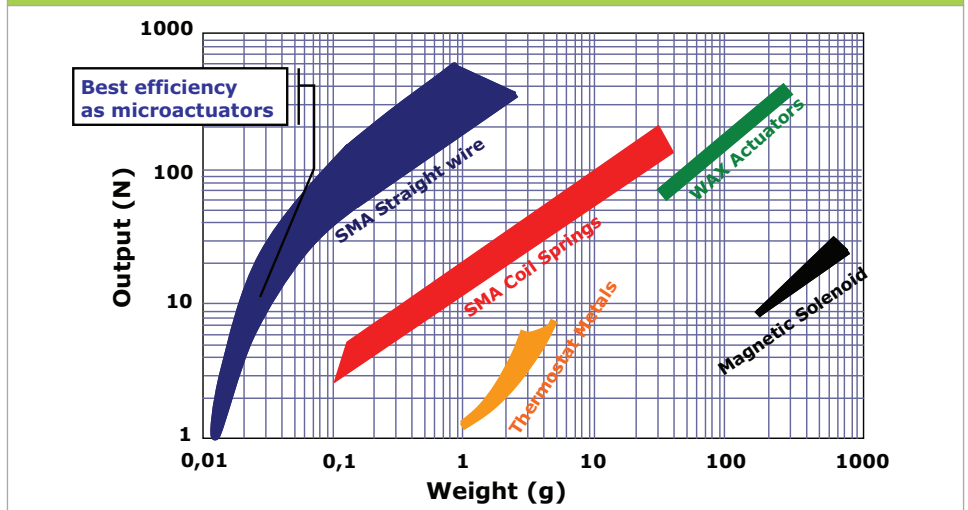
General Features

- The smallest powerful electrical actuator
- Direct linear or angular motion using a thin wire
- The simplest solution
Simple mechanism without bulky gears
- The silent solution
No noise emission during actuation
- Nature-like movement
Smooth and controlled action

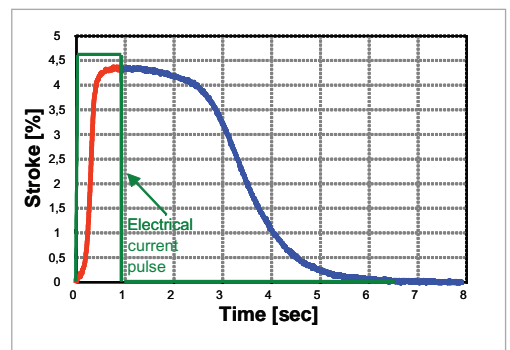
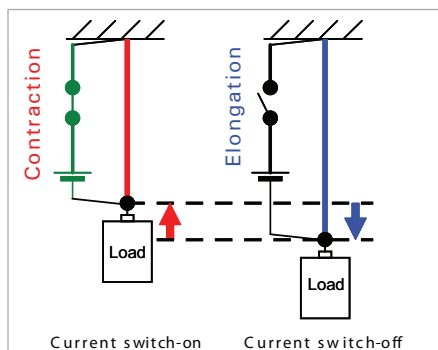
Product	Diameter [μm]	Diameter [inch]	Max Force [N]	Max Stroke	Suggested operating Force [N]	Suggested operating Stroke
SmartFlex25	25	0,001	0,3	5%	0,1	<3,5%
SmartFlex50	50	0,002	1,2		0,3	
SmartFlex76	76	0,003	2,7		0,8	
SmartFlex01	100	0,004	4,7		1,3	
SmartFlex015	150	0,006	10		2,7	
SmartFlex02	200	0,008	19		5	
SmartFlex03	300	0,012	42		12	
SmartFlex04	400	0,016	75		21	
SmartFlex05	500	0,020	118		33	

Comparison of technologies

SMA actuators present a very high specific working output confronting the other actuator's technologies



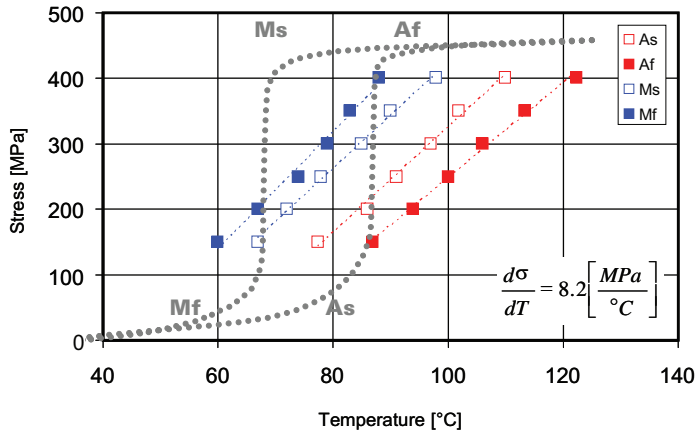
Typical electrical actuation



Transformation temperatures

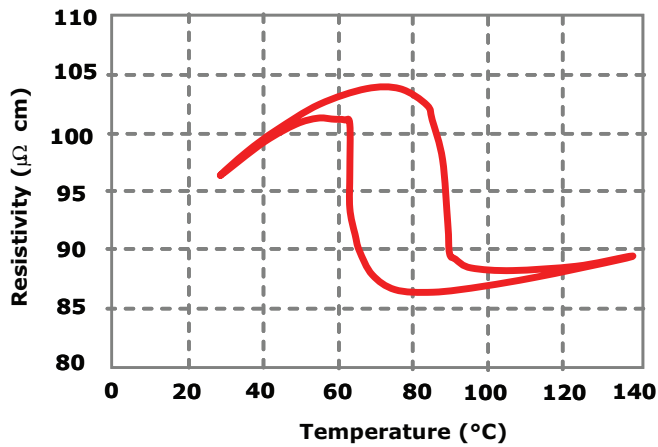
SmartFlex®
Wire

Transformation temperature of a SmartFlex wire loaded of different stress level



Resistivity

Resistivity of the material changes during martensitic transformation showing the below behaviour

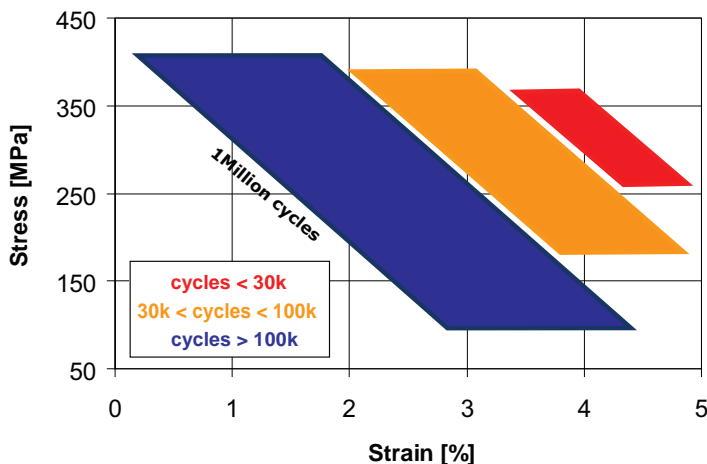


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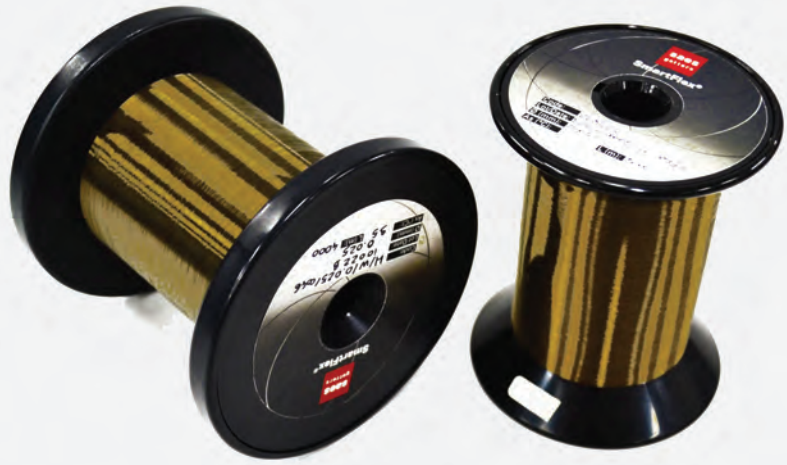
Fatigue behavior

Life cycles depend on a stress-strain trade-off.
A strain increase needs a stress decrease to achieve a good fatigue performance



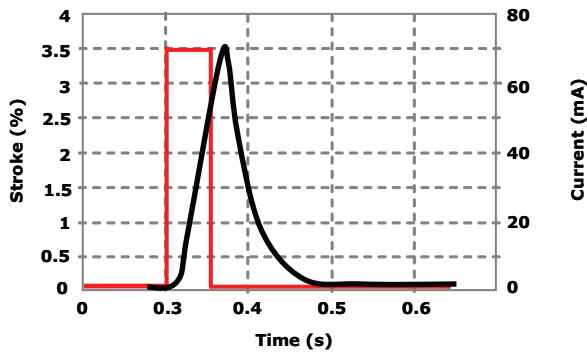
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group

SmartFlex® 25 μm



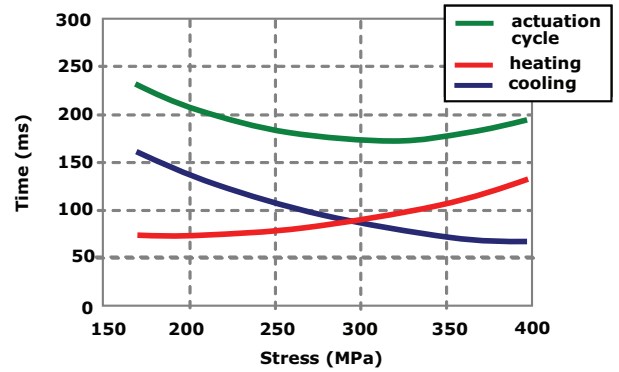
Stroke vs Time

| 1st cycle | L 100 mm | 25°C | 70 mA | 170 MPa |



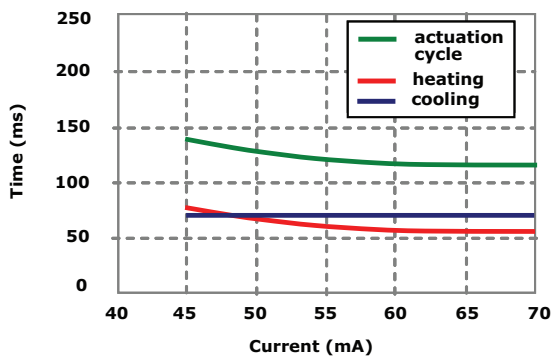
Cycle time vs Stress

| 25°C | 50 mA | 3,5% |



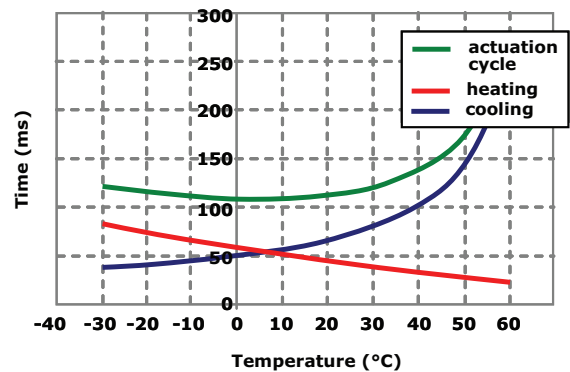
Cycle time vs Current

| 25°C | 170 MPa | 3,5% |

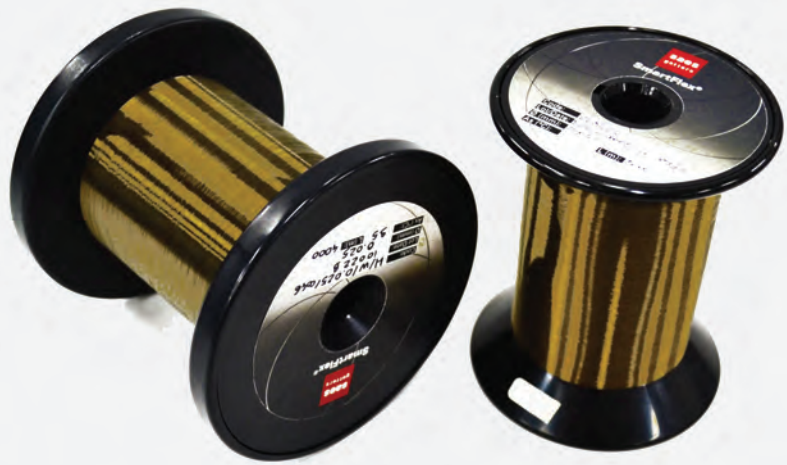


Cycle time vs Temperature

| 70 mA | 200 MPa | 3,5% |

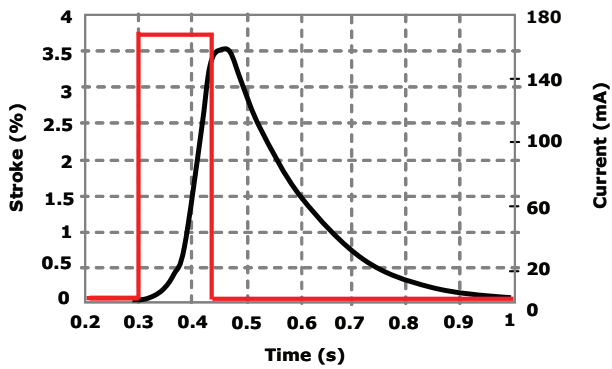


SmartFlex® 50 μm



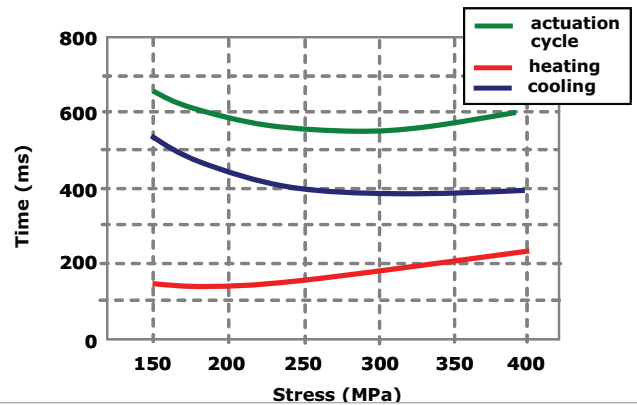
Stroke vs Time

| 1st cycle | L 100 mm | 25°C | 160 mA | 170 MPa |



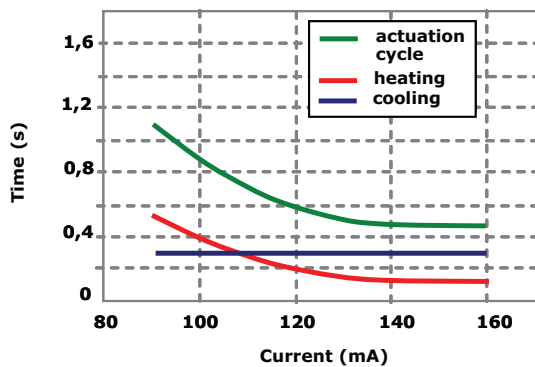
Cycle time vs Stress

| 25°C | 130 mA | 3,5% |



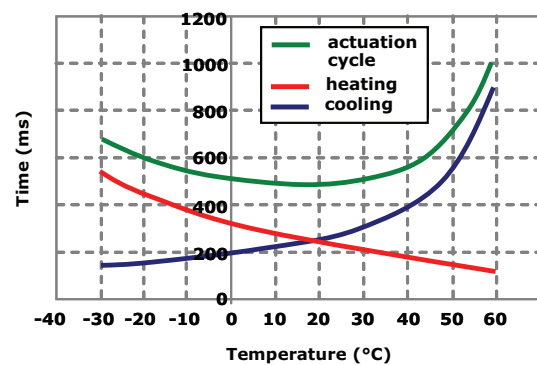
Cycle time vs Current

| 25°C | 170 MPa | 3,5% |



Cycle time vs Temperature

| 160 mA | 200 MPa | 3,5% |



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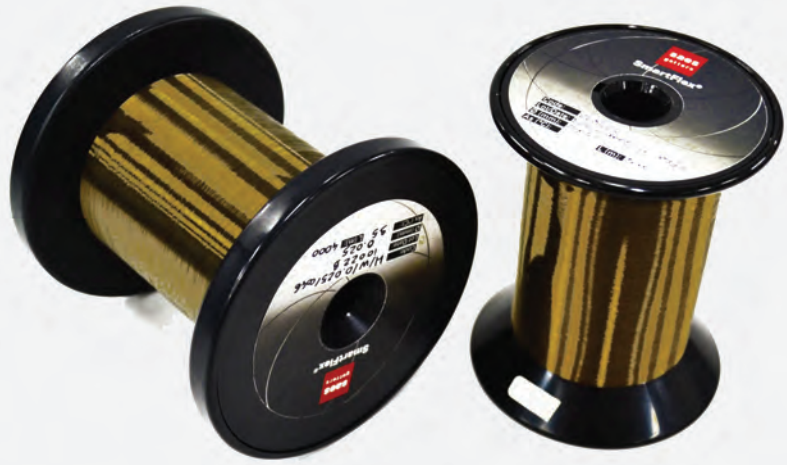
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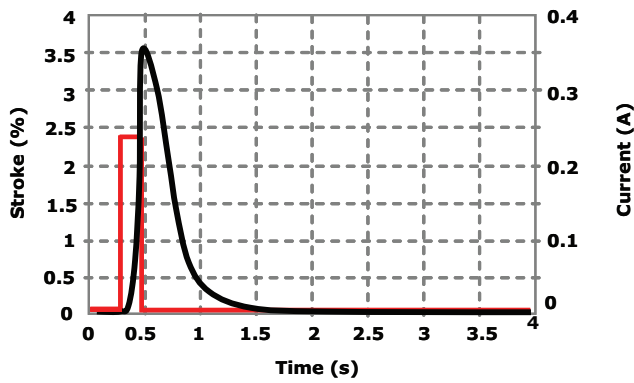
SmartFlex[®]

76 μm



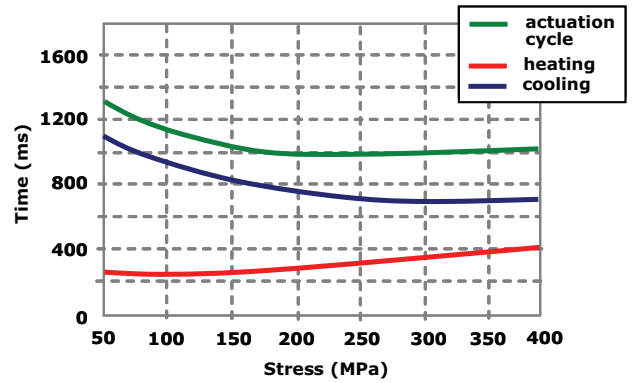
Stroke vs Time

| 1st cycle | L 100 mm | 25°C | 240mA | 170 MPa |



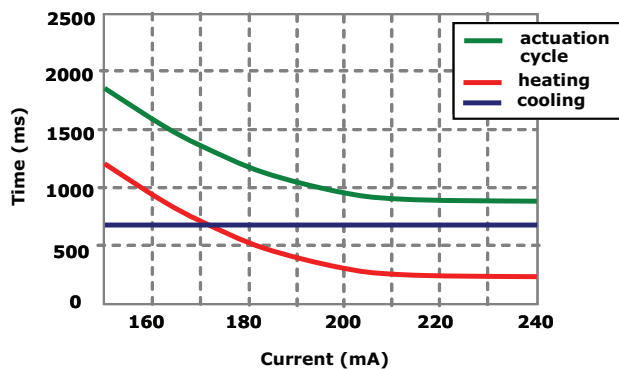
Cycle time vs Stress

| 25°C | 200 mA | 3,5% |



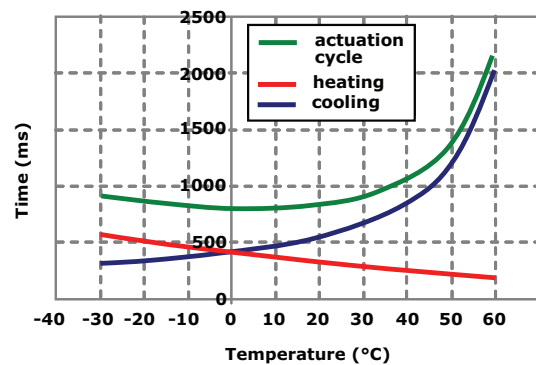
Cycle time vs Current

| 25°C | 170 MPa | 3,5% |

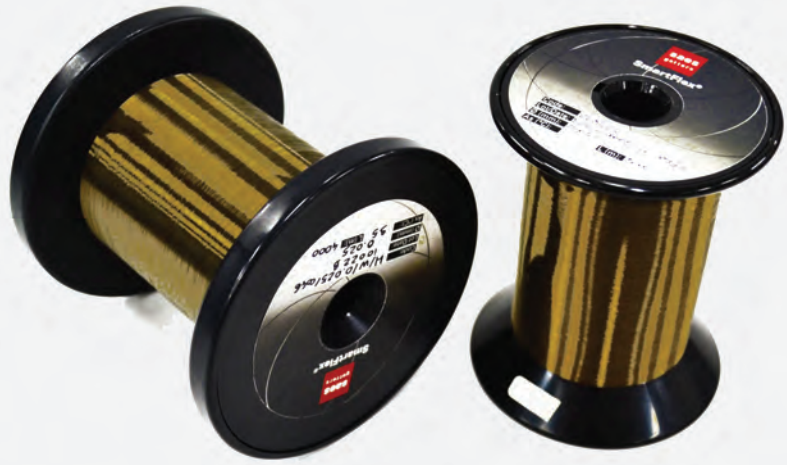


Cycle time vs Temperature

| 240 mA | 240 MPa | 3,5% |

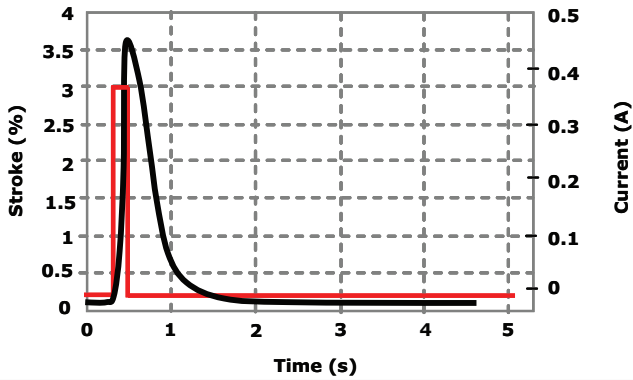


SmartFlex® 100 μm



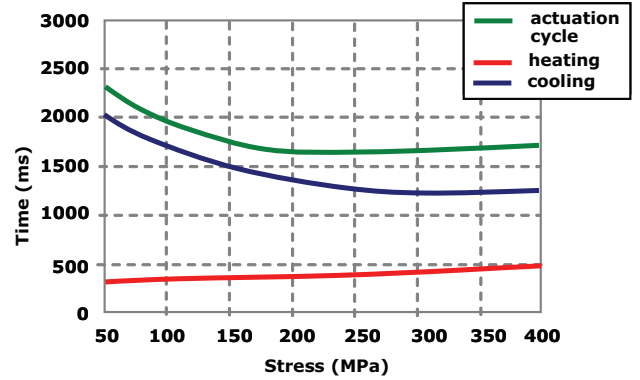
Stroke vs Time

1st cycle | L 100 mm | 25°C | 380mA | 170 MPa |



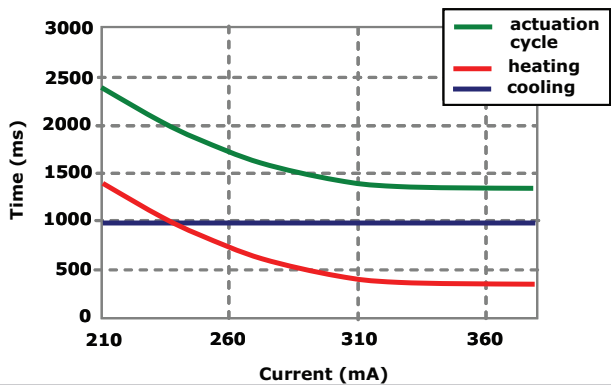
Cycle time vs Stress

25°C | 300 mA | 3,5% |



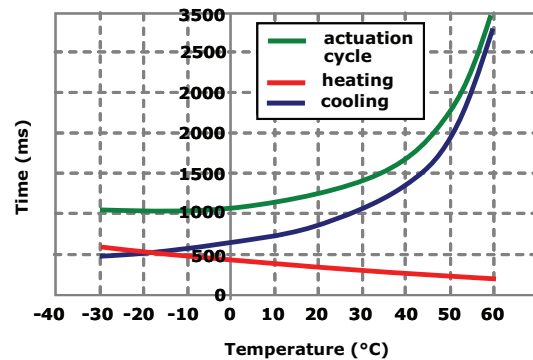
Cycle time vs Current

25°C | 170 MPa | 3,5% |



Cycle time vs Temperature

380 mA | 200 MPa | 3,5% |



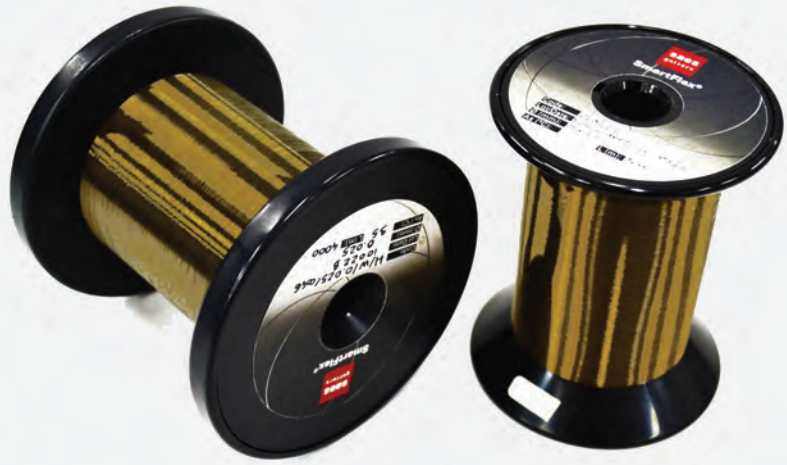
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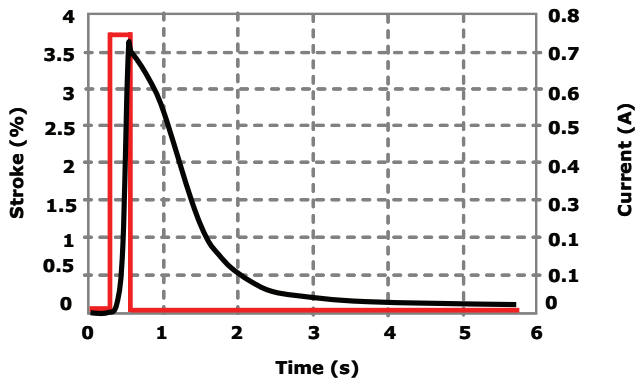
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SmartFlex[®] 150 μm



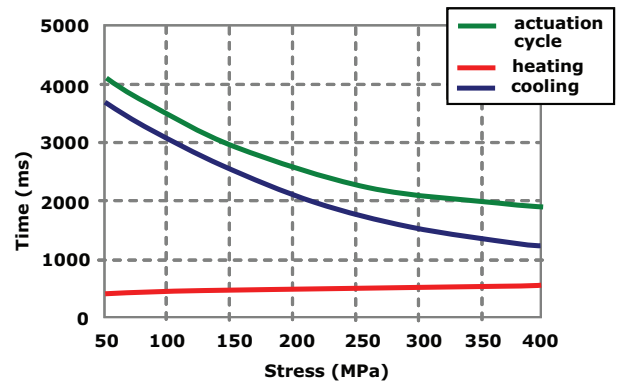
Stroke vs Time

| 1st cycle | L 100 mm | 25°C | 750mA | 170 MPa |



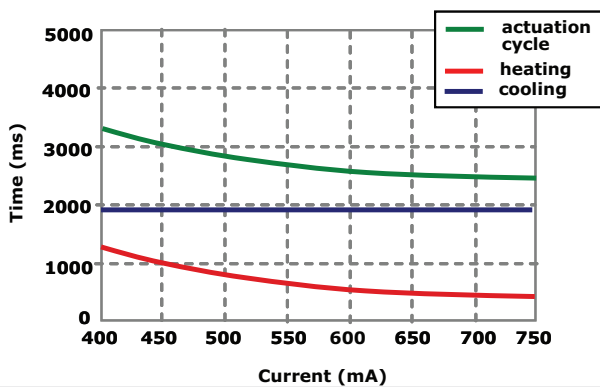
Cycle time vs Stress

| 25°C | 600 mA | 3,5% |



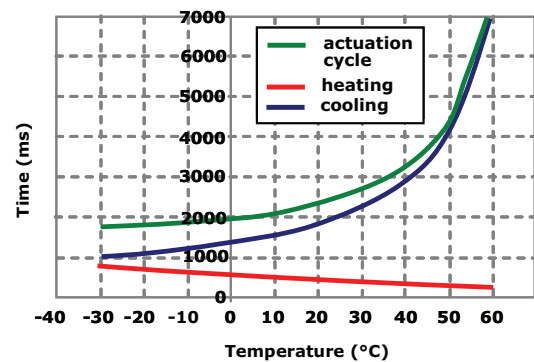
Cycle time vs Current

| 25°C | 170 MPa | 3,5% |

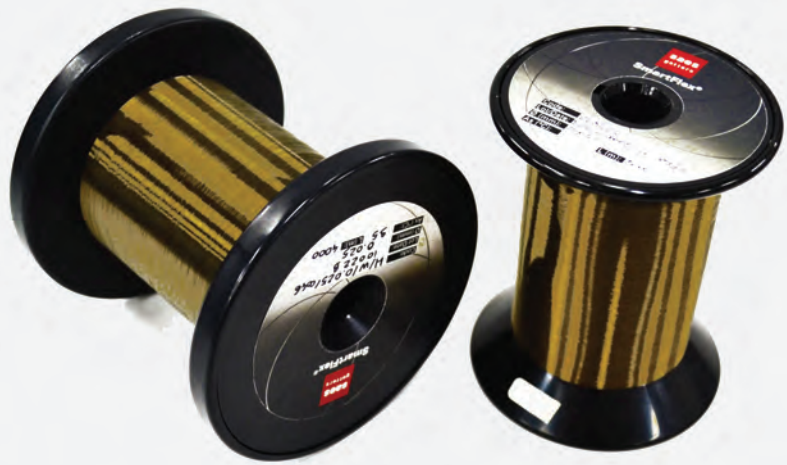


Cycle time vs Temperature

| 750 mA | 200 MPa | 3,5% |

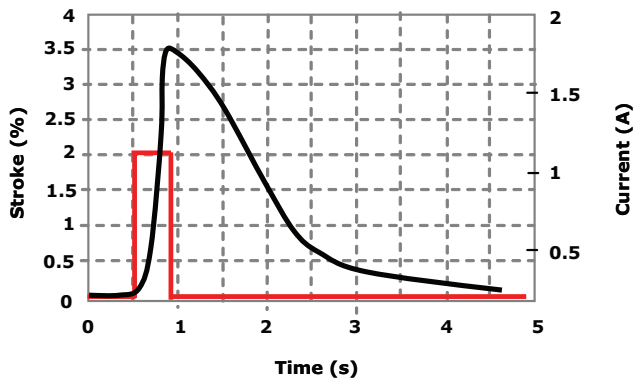


SmartFlex® 200 μm



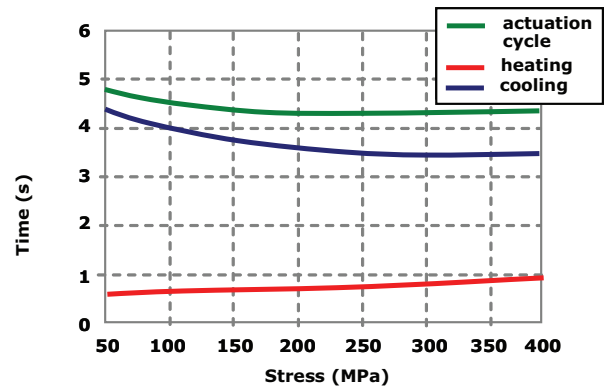
Stroke vs Time

| 1st cycle | L 100 mm | 25°C | 1.1 A | 170 MPa |



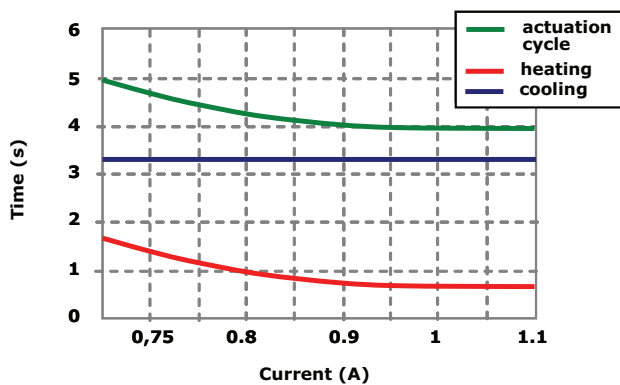
Cycle time vs Stress

| 25°C | 0.9 A | 3,5% |



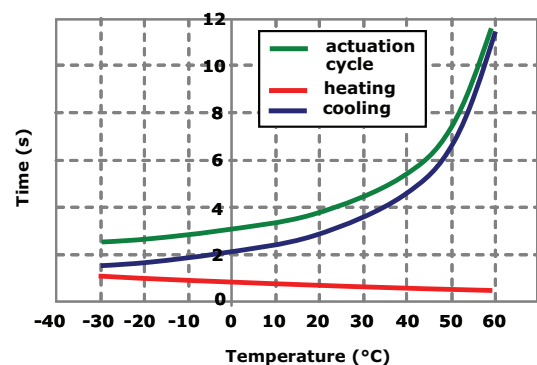
Cycle time vs Current

| 25°C | 170 MPa | 3,5% |



Cycle time vs Temperature

| 1,1 A | 200 MPa | 3,5% |



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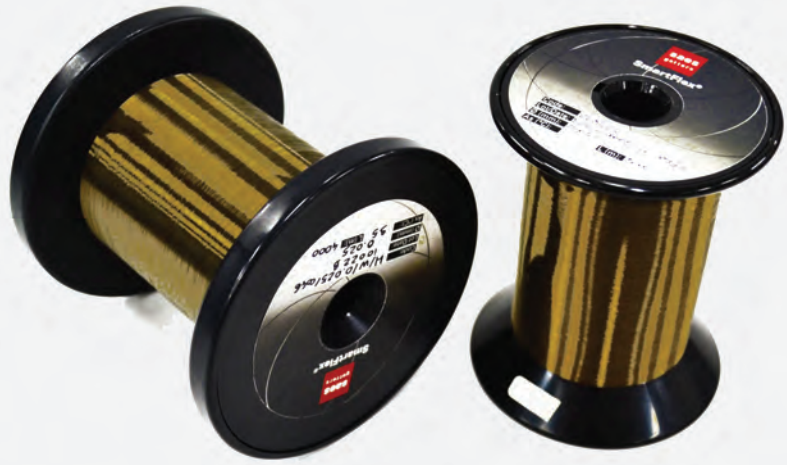
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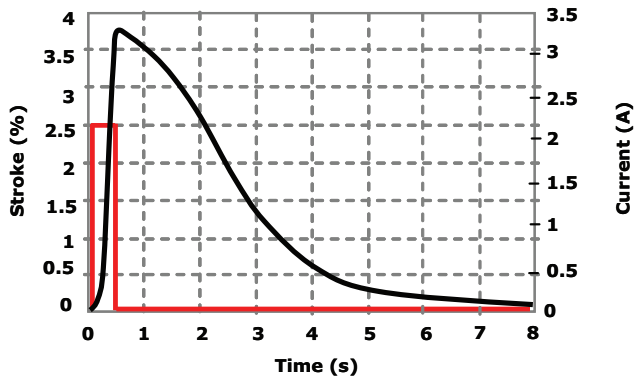
SmartFlex[®]

300 μm



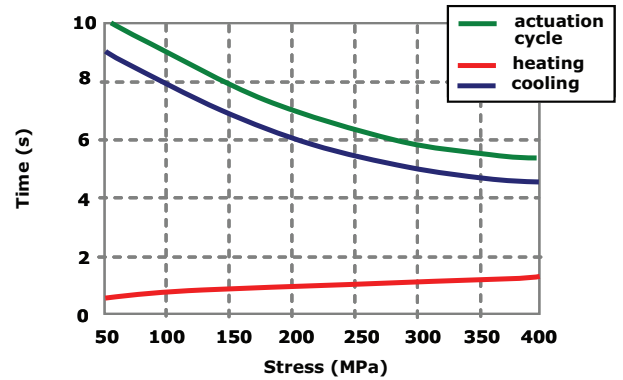
Stroke vs Time

| 1st cycle | L 100 mm | 25°C | 2.1 A | 170 MPa |



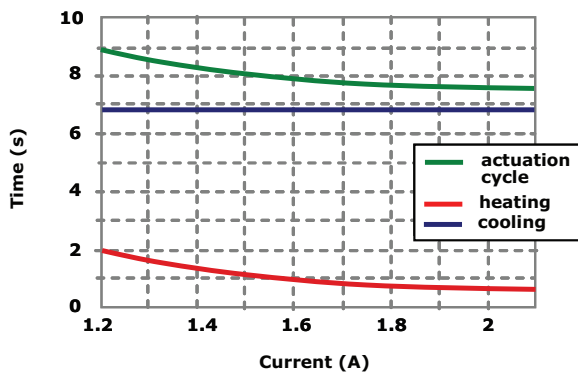
Cycle time vs Stress

| 25°C | 1,8 A | 3,5% |



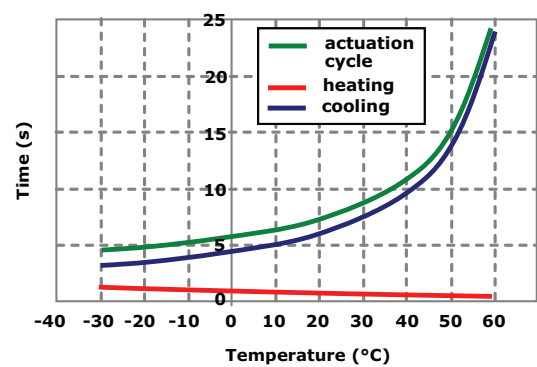
Cycle time vs Current

| 25°C | 170 MPa | 3,5% |



Cycle time vs Temperature

| 2,1 A | 200 MPa | 3,5% |



SmartFlex®

300 μm with silicon sleeve

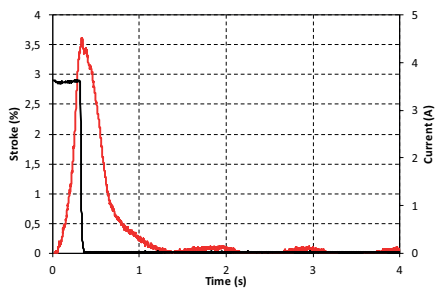


Different cooling methods improving response time after actuation

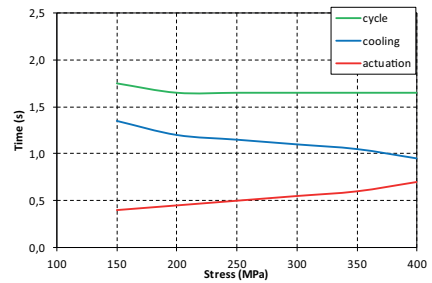
	Speed performance's increasing
Standard air convection	1:1
Solid Heat Sink Materials	2:1
Forced Air	4:1
Heat Conductive Grease	8:1
Silicon	10:1
Oil Immersion	25:1
Water with Glycol	100:1

Increased cooling time performances

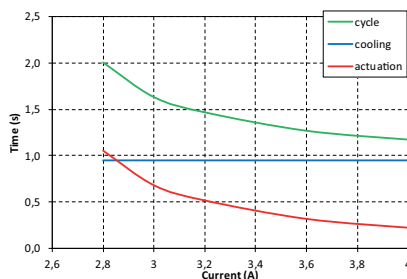
Stroke vs Time First cycle
| L 100 mm | 25°C | 3,5 A | 170 MPa |



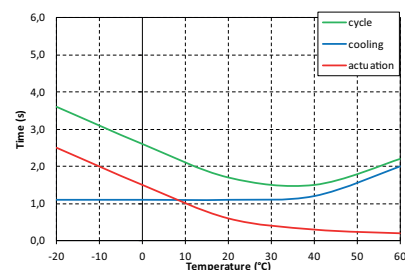
Cycle time vs Stress
| 25°C | 3,5 A | 3,5% |



Cycle time vs Current
| 25°C | 170 MPa | 3,5% |



Cycle time vs Temperature
| 3,5 A | 170 MPa | 3,5% |



* Getting quicker time response requires more current to heat the wire

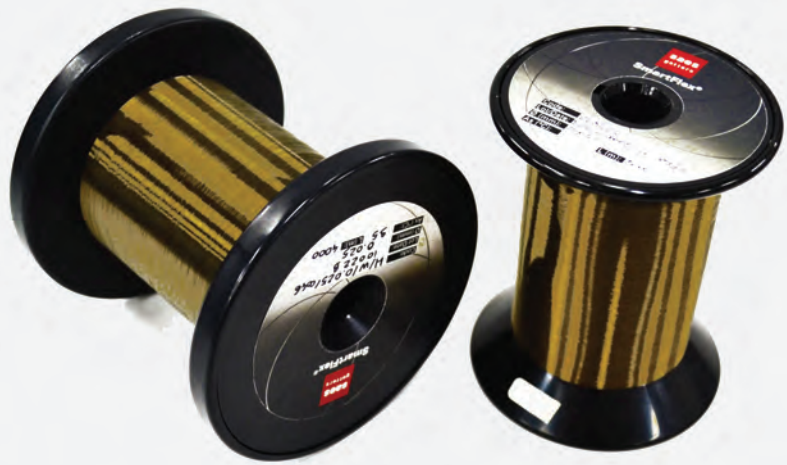
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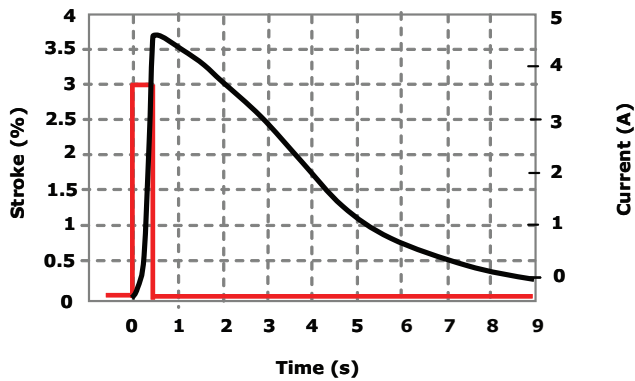
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SmartFlex® 400 μm



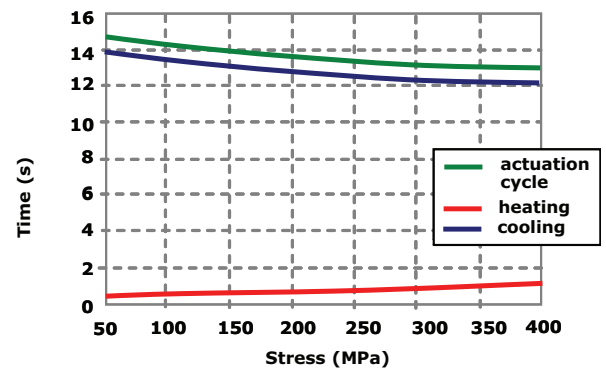
Stroke vs Time

| 1st cycle | L 100 mm | 25°C | 3.8 A | 170 MPa |



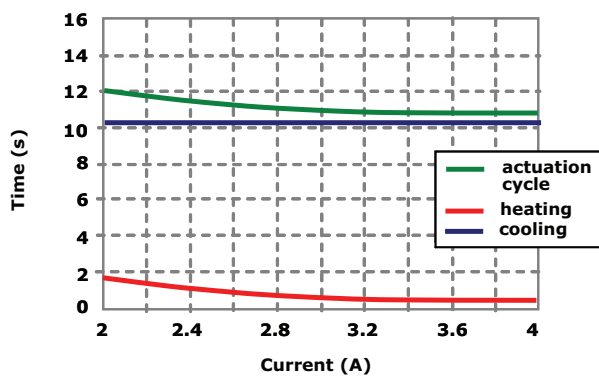
Cycle time vs Stress

| 25°C | 3 A | 3,5% |



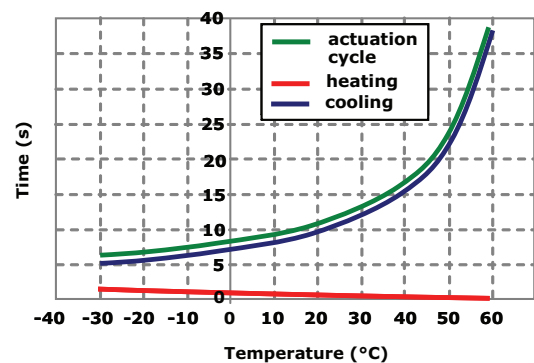
Cycle time vs Current

| 25°C | 170 MPa | 3,5% |



Cycle time vs Temperature

| 3,8 A | 200 MPa | 3,5% |



SmartFlex®

400 μm with silicon sleeve

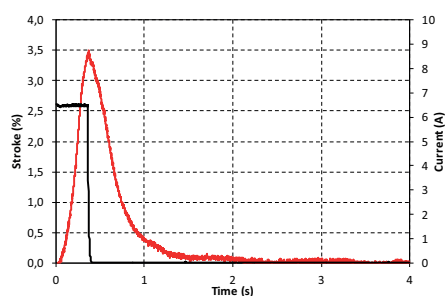


Different cooling methods improving response time after actuation

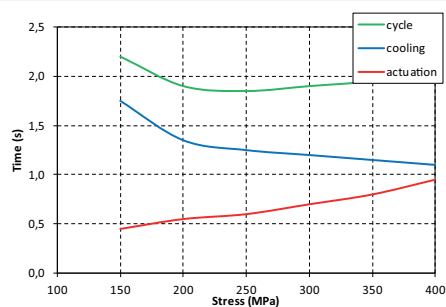
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Water with Glycol	100:1

Increased cooling time performances

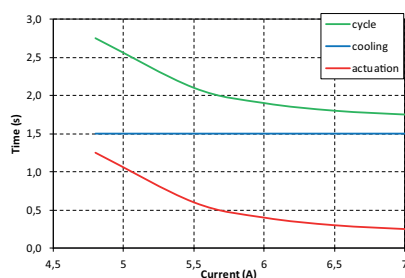
Stroke vs Time First cycle
| L 100 mm | 25°C | 6,5 A | 170 MPa |



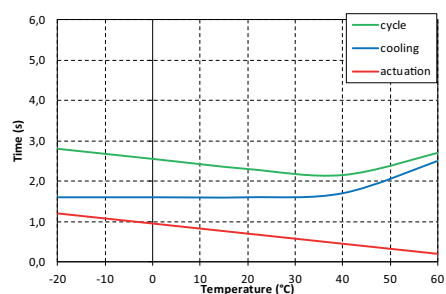
Cycle time vs Stress
| 25°C | 6,0 A | 3,5% |



Cycle time vs Current
| 25°C | 170 MPa | 3,5% |



Cycle time vs Temperature
| 6,0 A | 170 MPa | 3,5% |



* Getting quicker time response requires more current to heat the wire

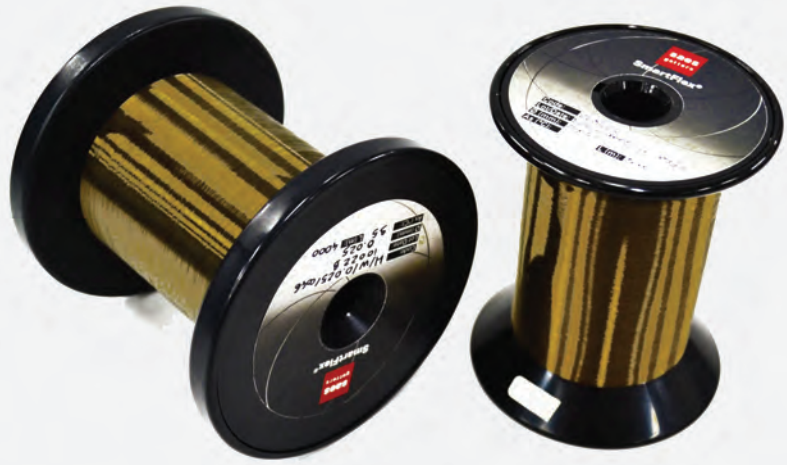
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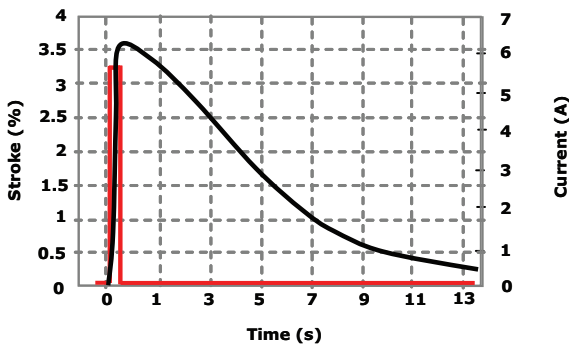
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SmartFlex® 500 μm



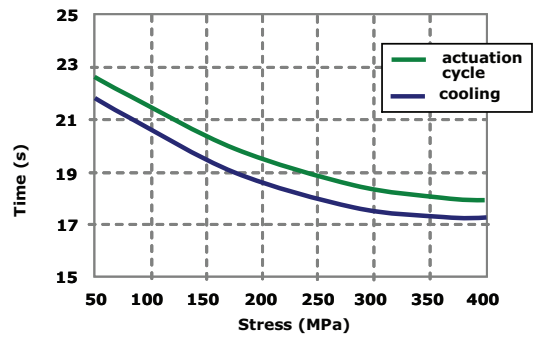
Stroke vs Time

| 1st cycle | L 100 mm | 25°C | 5.7 A | 170 MPa |



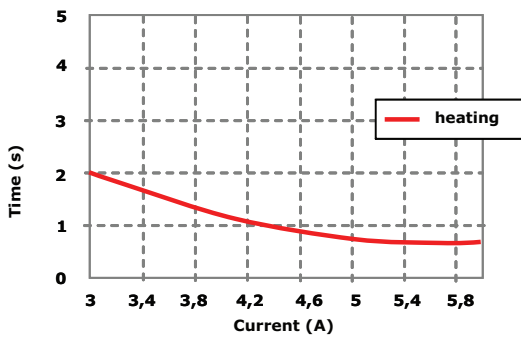
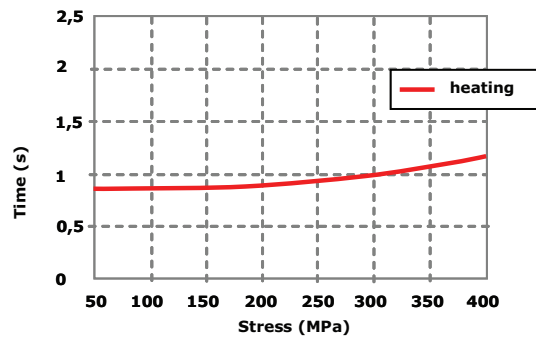
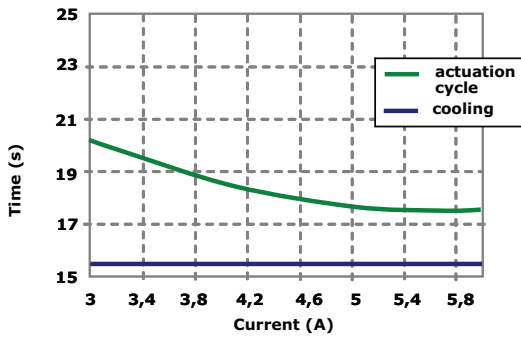
Cycle time vs Stress

| 25°C | 4 A | 3,5% |



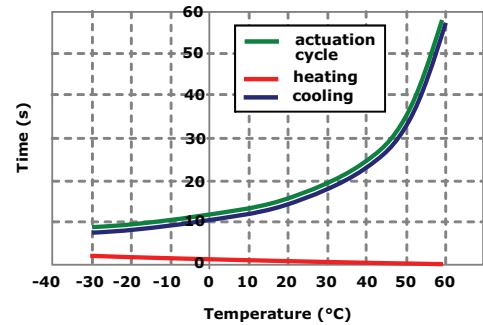
Cycle time vs Current

| 25°C | 170 MPa | 3,5% |



Cycle time vs Temperature

| 5,7 A | 200 MPa | 3,5% |



SmartFlex®

500 μm with silicon sleeve



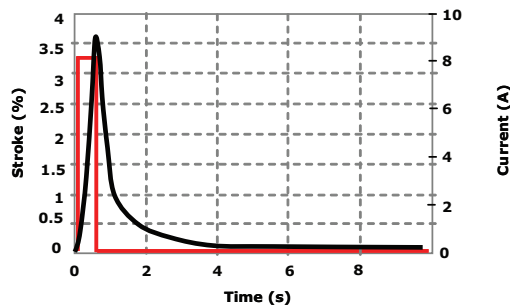
Different cooling methods improving response time after actuation.

	Speed performance's increasing
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Increased cooling time performances

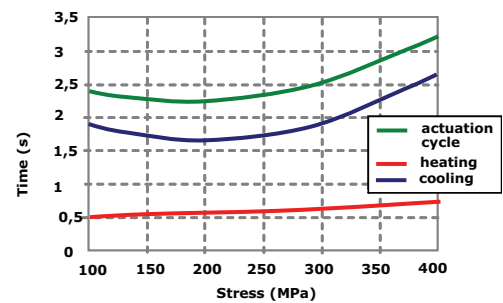
Stroke vs Time First cycle

| L 100 mm | 25°C | 8,5 A | 170 MPa |



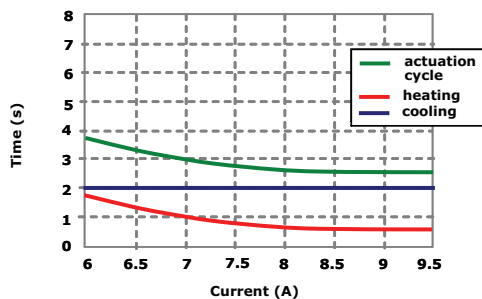
Cycle time vs Stress

| 25°C | 8,5 A | 3,5% |



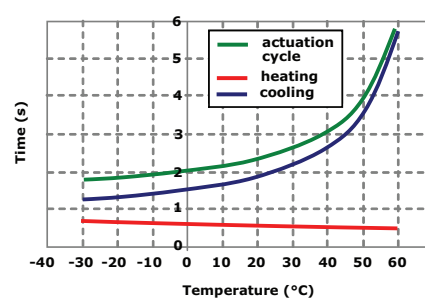
Cycle time vs Current

| 25°C | 170 MPa | 3,5% |



Cycle time vs Temperature

| 8,5 A | 200 MPa | 3,5% |



* Getting quicker time response requires more current to heat the wire

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