Eilersen
Industrial Sensors

Kokkedal Industripark 4
DK-2980 Kokkedal
Denmark
info@eilersen.com
Phone +45 49 180 100
Fax +45 49 180 200

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Overload tests of Eilersen web tension sensor type SLCA 500 N

To check and demonstrate the overload tolerance of the Eilersen SLCA web tension sensors, a number of very severe overload tests have been performed on a standard 500 N SLCA load cell. A summary of these tests are presented in the following.

For your information the analog SLCA and the digital SLCAD have exactly the same mechanical specifications and the upgraded SLCAD-ST will also have the same mechanical specifications, but will be able to withstand higher temperatures and extra overloads.

The columns in the test sheets in the appendix may be explained as follows:

- *P is the load in kg*
- *Uabs is the absolute output of the sensor in mV, when mounted in the test rig*
- *Urel is the zeroed output in mV*
- *Udelta is the difference in mV from the test load before the present test load*

Uerror and Udelta does only have a meaning in tests with equally spaced load steps and Udelta and Uerror will not be relevant in the following tests. Also shown are the irrelevant default date and time data for the test system.

Check of Zero after overload

The first test shown on Appendix 1, is a test where the load is increased in steps of 50 kg, with unloading to zero between tests to check the zero shift after each overload. It may be seen from Appendix 1 that an overload to 700 kg, which corresponds to 14 times overload, results in a zero set which is only around 1,4% of the signal at 700 kg and which may simply be zeroed out by the instrumentation.

In Appendix 2, an overload to 800 kg was applied followed by a reset of the zero and then an overload to 700 kg.

This test showed that the zero set after 700 kg now – after the sensor previously had been loaded to the higher load of 800 kg - was only 0,3 mV. This zero set of 0,3 mV after an overload of 14 times, correspond to only 0,3% of the nominal output of 100 mV, at the nominal load of 500 N and indicates that an <u>overload of 14 times is permissible</u>.

Check of accuracy after overload

The test in Appendix 3 is performed to evaluate the accuracy of the sensor after the overload of 800 kg had been applied and it is seen that the accuracy at 150 kg, which corresponds to 3 times the capacity, is still around 0,13% and that the load cell returns to 000,0 after 3 times overload.

In Appendix 4, where the sensor has been tested in regular steps to 700 kg – or 14 times overload, the sensor still retains an accuracy of around 1% at 500 kg – or at 10 times overload. That the hysteresis at 250 kg is only 2 mV on a signal of 1434 mV at 700 kg, which corresponds to around 0,15%, is also an important indication that overloads to 700 kg or 14 times overload is permissible.

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The test in Appendix 5, where the sensor has been overloaded to 1.000 kg or 20 times overload followed by a test in regular steps to 500 kg shows that the load cell still retains an accuracy of around 1% at 500 kg – at 10 times overload and that the load cell returns to 000,0.

Test at very high vertical overload

In Appendix 6, the sensor has been subjected to a max vertical load of 10.000 kg (100 kN) or 200 times the nominal capacity which only resulted in a rather small signal of 55 mV.

A signal of 55 mV – together with the fact that the deflection at 500N is only 10 micrometers with a signal of 100 mV - shows that the sensor at a vertical load of 200 times nominal load has a deflection of around 6 micrometers (0,006 mm) which indicates that the load cell is mechanically stable at this very high vertical overload.

The measured zero set of only 16 mV after the vertical overload load to 100kN also indicates a mechanical stability even at this overload.

Low deflection for high frequency of resonance

At last the deflection of the load cell has been measured at the nominal load of 50 kg and at an overload to 1.000 kg – the test showed deflections of 10 micrometers at 50 kg and 200 micrometers at 1.000 kg.

This extremely low deflection is important to achieve a high frequency of resonance for the system.

General comments to the overload tests

These tests – which could be made on any standard 500 N load cell – are meant to give an idea of the possibilities of the Eilersen SLCA type load cells and could be used for upgrading the specifications, if an application makes this necessary.

The data and overload figures may be scaled up and down for other capacities

Regarding the choice of steel, our very efficient measuring technology with very low stresses in the load cell body material permits us to choose a standard steel 50-2 and with this material a further advantage is gained by fact that this steel is not as susceptible to sudden failures at overloads as high tensile steels, which have a tendency to fail abruptly.

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Comparison Eilersen SLCA 500N vs. ABB ABB PFTL 301E 500N

Parameter	EE SLCA 500	ABB PFTL 301E 500N
Accuracy at nom. Load	0.12%	1%
Accuracy at 8x nom load	> 0.5%	?
Overload in test	20x	?
Permitted overload	> 10x *	3x
Vertical overload in test	200x	?
Permitted vertical load	25x *	5x
Deflection at nom. Load	0.01 mm	0.07 mm
Working temperature range	-20 to +80 degr. C	-10 to +80 degr. C
Compensated temp. range	0 to +50 degr. C	+20 to +60 degr. C
Zero point drift	0.01% /degr. C **	0.015%/degr. C
Sensitivity drift	0.01%/ degr. C **	0.025%/degr. C

* These figures are provisional figures estimated with a reasonable margin to the test results

** These drift figures are today only valid for the digital version SLCAD and the figures for the analog version SLCA are today 2 times the figures in the specifications from 1988 when the sensor was launched.

The data for the Eilersen SLCA 500N, are based on actual tests under extreme mechanical overload conditions

The data for temperature influences are based on production data.

The data for the ABB PFTL 301E 500N sensor has been sourced from the ABB home page.

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Appendix 1

KUNDE: PMAX: TYPE: NR:

FøLER: ø= , l= , Dato= . ELEMENT: d= , h=

I

Dato	Tid	P	Uabs	Urel	Udelta	Uerror
840101	04.36	0	-0011.0	0000.0		
840101	04.36	50	0090.7	0101.7	0101.7	
840101	04.36	0	-0011.1	-0000.1	-0101.8	0000.1
840101	04.37	100	0192.2	0203.2	0203.3	0101.6
840101	04.37	0	-0011.7	-0000.7	-0203.9	0102.2
840101	04.37	150	0293.5	0304.5	0305.2	0203.5
840101	04.38	0	-0011.7	-0000.7	-0305.2	0203.5
840101	04.38	200	0395.1	0406.1	0406.8	0305.1
840101	04.38	0	-0011.6	-0000.6	-0406.7	0305.0
840101	04.39	250	0497.4	0508.4	0509.0	0407.3
840101	04.39	0	-0011.1	-0000.1	-0508.5	0406.8
840101	04.39	300	0600.5	0611.5	0611.6	0509.9
840101	04.41	350	0704.3	0715.3	0103.8	0002.1
840101	04.41	0	-0009.6	0001.4	-0713.9	0612.2
840101	04.43	400	0808.8	0819.8	0818.4	0716.7
840101	04.43	0	-0007.8	0003.2	-0816.6	0714.9
840101	04.44	450	0915.0	0926.0	0922.8	0821.1
840101	04.44	0	-0006.0	0005.0	-0921.0	0819.3
840101	04.45	500	1021.5	1032.5	1027.5	0925.8
840101	04.46	600	1240.3	1251.3	0218.8	0117.1
840101	04.46	0	0002.0	0013.0	-1238.3	1136.6
840101	04.49	700	1468.3	1479.3	1466.3	1364.6
840101	04.49	0	0007.5	0018.5	-1460.8	1359.1

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Appendix 2

FØLER: ø= , l= , Dato= . ELEMENT: d= , h=

II

Dato	Tid	P	Uabs	Urel	Udelta	Uerror
840101	05.00	0	0007.1	0000.0		
840101	05.01	800	1663.6	1656.5	1656.5	
840101	05.01	0	0014.4	0007.3	-1649.2	-0007.3
840101	05.01	0	0014.3	0000.0	-0000.1	-1656.4
840101	05.02	700	1446.8	1432.5	1432.5	-0224.0
840101	05.02	0	0014.6	0000.3	-1432.2	-0224.3

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Appendix 3

FØLER: Ø= , 1= , Dato= . ELEMENT: 0= , n=

III

Dato	Tid	P	Uabs	Urel	Udelta	Uerror
840101	05.03	0	0014.3	0000.0		
840101	05.07	50	0114.2	0100.0	0099.9	
840101	05.07	100	0214.5	0200.3	0100.3	0000.4
840101	05.07	150	0314.6	0300.4	0100.1	0000.2
840101	05.07	0	0014.2	0000.0	-0300.4	0200.5

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Appendix 4

FøLER: ø= , l= , Dato= . ELEMENT: d= , h=

IV

Dato	Tid	P	Uabs	Urel	Udelta	Uerror
840101	05.08	0	0014.2	0000.0		
840101	05.08	50	0114.3	0100.1	0100.1	
840101	05.10	100	0214.6	0200.4	0100.3	0000.2
840101	05.10	150	0314.8	0300.6	0100.2	0000.1
840101	05.10	200	0414.8	0400.6	0100.0	-0000.1
840101	05.10	250	0515.2	0501.0	0100.4	0000.3
840101	05.11	300	0616.0	0601.8	0100.8	0000.7
840101	05.11	350	0717.1	0702.9	0101.1	0001.0
840101	05.11	400	0819.0	0804.8	0101.9	0001.8
840101	05.11	500	1024.6	1010.4	0205.6	0105.5
840101	05.12	600	1233.6	1219.4	0209.0	0108.9
840101	05.12	700	1448.3	1434.1	0214.7	0114.6
840101	05.12	500	1026.7	1012.5	-0421.6	0321.5
840101	05.13	250	0517.2	0503.0	-0509.5	0409.4
840101	05.13	100	0215.9	0201.7	-0301.3	0201.2
840101	05.13	50	0115.0	0100.8	-0100.9	0000.8
840101	05.14	0	0014.8	0000.6	-0100.2	0000.1

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Appendix 5

KUNDE: PMAX: TYPE: NR:

FøLER: ø= , l= , Dato= . ELEMENT: d= , h=

V

Dato	Tid	P	Uabs	Urel	Udelta	Uerror
840101	05.50	0	0016.8	0000.0		
840101	05.51	800	1669.0	1652.2	1652.2	
840101	05.52	0	0018.2	0001.4	-1650.8	-0001.4
840101	05.52	900	1909.5	1892.7	1891.3	0239.1
840101	05.53	0	0027.8	0011.0	-1881.7	0229.5
840101	05.53	0	0027.6	0010.8	-0000.2	-1652.0
840101	05.54	1000	1933.5	1916.7	1905.9	0253.7
840101	05.55	0	0046.7	0029.9	-1886.8	0234.6
840101	05.55	0	0045.8	0000.0	-0000.9	-1651.3
840101	05.55	50	0145.3	0099.5	0099.5	-1552.7
840101	05.56	100	0245.3	0199.5	0100.0	-1552.2
840101	05.56	150	0345.3	0299.5	0100.0	-1552.2
840101	05.56	200	0445.6	0399.8	0100.3	-1551.9
840101	05.56	250	0546.0	0500.2	0100.4	-1551.8
840101	05.56	300	0646.9	0601.1	0100.9	-1551.3
840101	05.57	350	0748.3	0702.5	0101.4	-1550.8
840101	05.57	400	0850.4	0804.6	0102.1	-1550.1
840101	05.57	450	0953.1	0907.3	0102.7	-1549.5
840101	05.58	500	1056.7	1010.9	0103.6	-1548.6
840101	05.58	250	0546.6	0500.8	-0510.1	-1142.1
840101	05.59	0	0045.8	0000.0	-0500.8	-1151.4

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Appendix 6

KUNDE: PMAX: TYPE: NR:

FØLER: ø= , l= , Dato= . ELEMENT: d= , h=

VI

Dato	Tid	P	Uabs	Urel	Udelta	Uerror
840101	00.25	0	0015.7	0000.2		
840101	00.25	1000	0015.7	0000.2	0000.0	
840101	00.26	3000	0034.3	0018.8	0018.6	0018.6
840101	00.26	5000	0047.9	0032.4	0013.6	0013.6
840101	00.26	7000	0059.5	0044.0	0011.6	0011.6
840101	00.27	9000	0067.2	0051.7	0007.7	0007.7
840101	00.27	10000	0070.8	0055.3	0003.6	0003.6
840101	00.28	0	0000.9	-0014.6	-0069.9	0069.9