

muriel-sensor analysis

The present document describes the test carried out on 2 different section yarns, performed by the state industrial and technical institute of Biella (Italy).

The highest diameter yarn will be following called SAMPLE A, while the smaller one will be called SAMPLE B.

To characterize the samples a Instron electronic dynamometer (Fig. 1) has been used, working with constant elongation rate and repetitive rise and fall cycles of the drawing clamp.

The clamps used were made of fiberglass covered with copper (Fig. 2) and equipped with connectors for the electric resistance measuring.

The resistance has been measured with a KEITHLEY multimeter (Fig. 3), regulated to produce a 10 μ A electrical current and acquire the data at regular intervals.

The data acquisition and their processing have been made with a PC provided with appropriate software.

Testing procedure: 100 cycles of elongation and release (1 session)

Testing conditions:

- Initial clamps distance: 50 mm
- Maximum clamps distance reach: 70 mm
- Absolute elongation: 20 mm
- Percentage elongation: 40%.
- Stretching speed: 300 mm/min.
- Number of data acquired for every cycle: 40
- Time between 2 consecutive data acquisitions: 0,2 s
- Total data for every test: 4000

Every yarn sample has been tested for 3 consecutive sessions with a relax time of 1 hour between them. After 24 hours the same procedure has been done for every yarn sample. Before every session, the yarn samples have been stretched for 10 minutes at 200% elongation.

The following graphs show the data of the test made with the dynamometer.

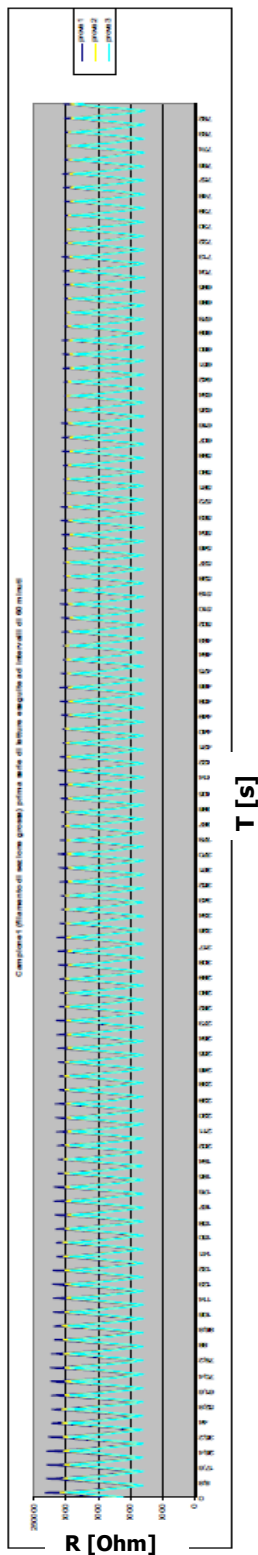
Graph 1: SAMPLE A, 3 cycles

Graph 2: SAMPLE A after 24 hours, 3 cycles

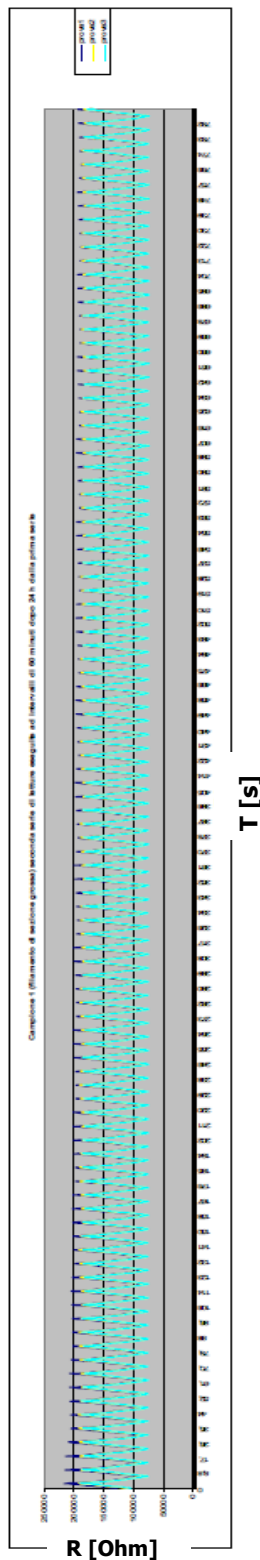
Graph 3: SAMPLE B, 3 cycles

Graph 4: SAMPLE B after 24 hours, 3 cycles

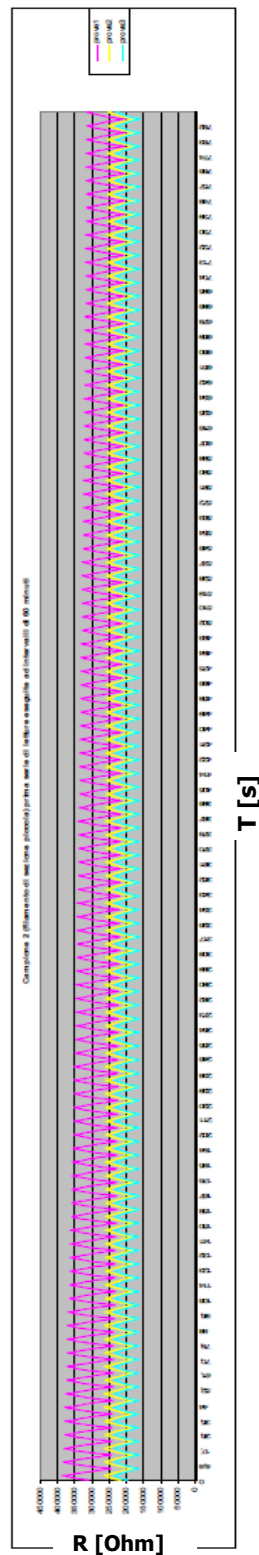
Graph 1



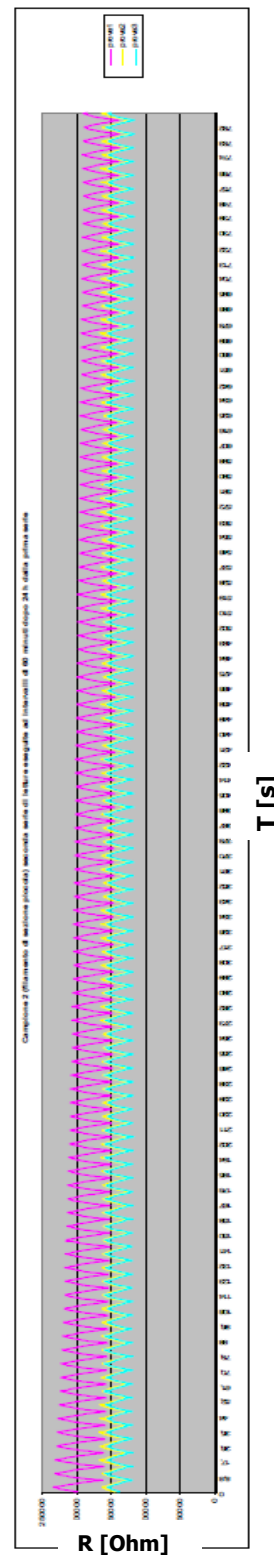
Graph 2



Graph 3



Graph 4



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Soggetta a direzione e coordinamento di M&T S.r.l.

Telefono +39 0464 672 171
Fax +39 0464 672692
info@lemur-italy.com

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The presented graphs show an almost constant electrical resistance trend from the beginning to the end of every cycle and between the 3 consecutive cycles for SAMPLE A.

Differently, SAMPLE B shows a different electrical resistance between the 3 consecutive cycles.

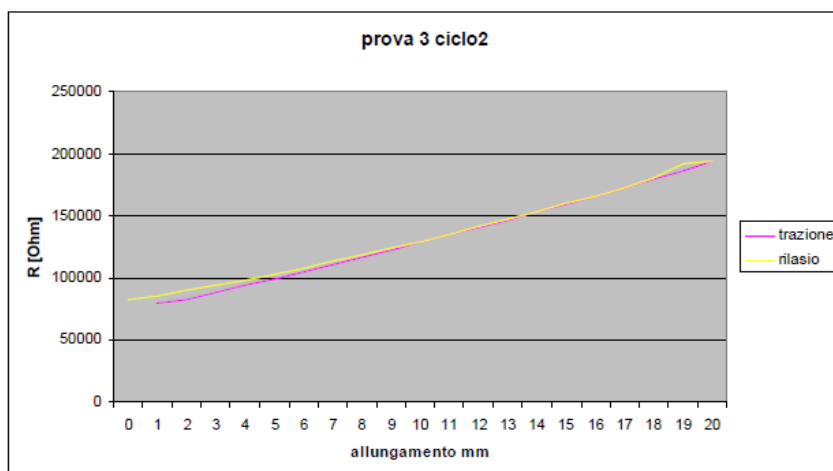
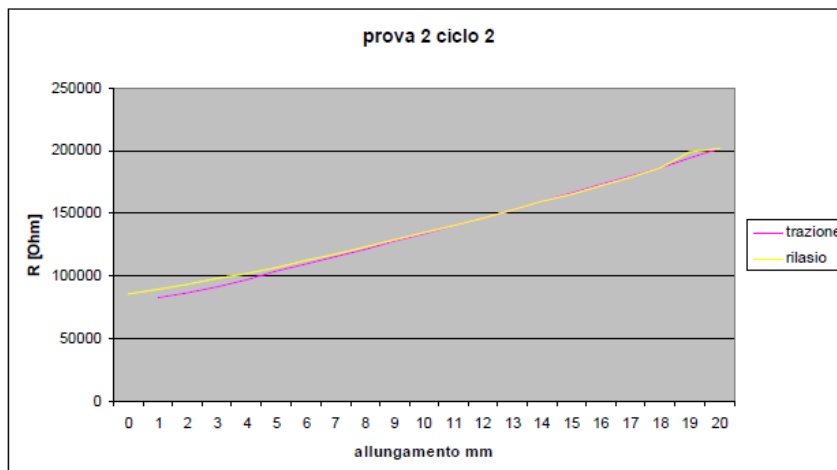
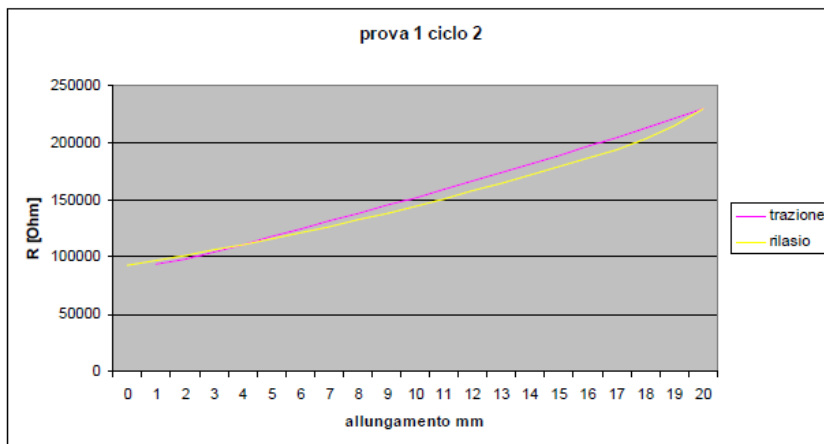
In the following tables and curves are shown trends of single cycles as sample, to highlight the hysteresis that there is between the elongation and the release of the deformation.

Every table reports the data of the same cycle for the 3 consecutive test sessions.

In the curves related to every cycle the pink lines represent the stretching while the yellow ones the release.

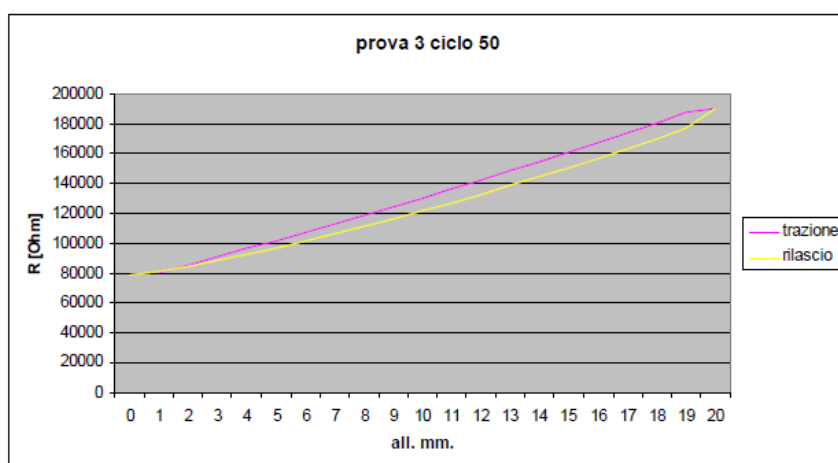
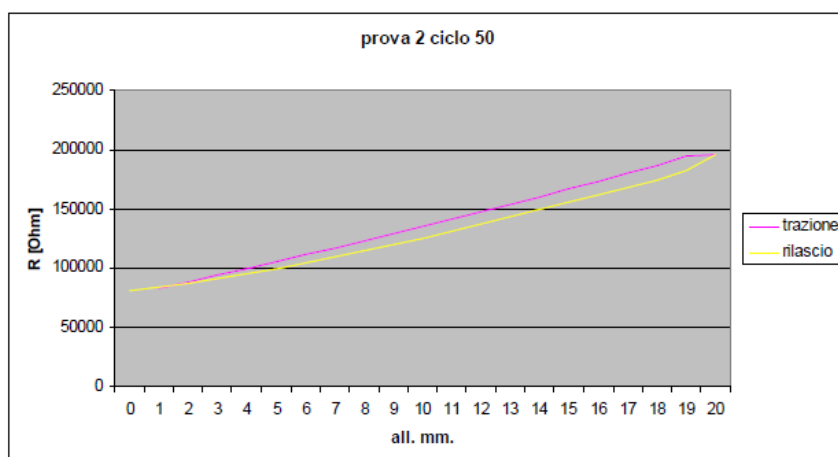
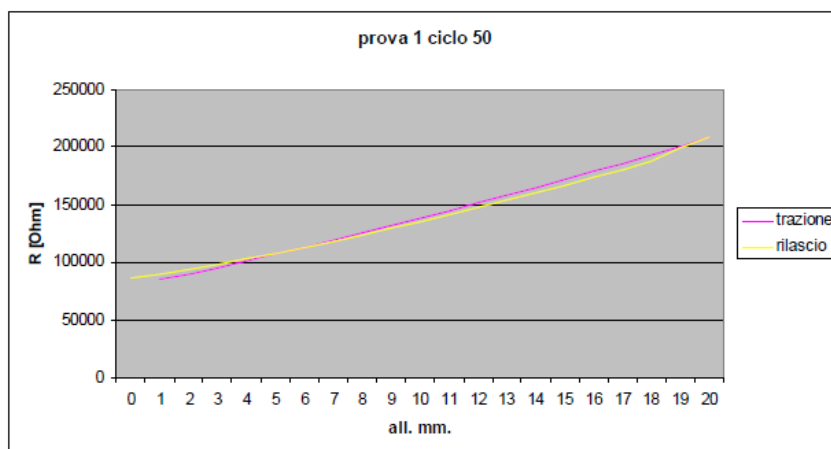
SAMPLE A – Cycle n° 2

Clamps distance [mm]	Session 1 Resistance [Ohm]		Session 2 Resistance [Ohm]		Session 3 Resistance [Ohm]	
	stretching	release	stretching	release	stretching	release
0		93326		85206.5		81901.6
1	93418.7	97173.8	82805.1	89084.9	79521.9	85601.3
2	98241.7	101451	86231.2	93288.9	82789.8	89634.7
3	104530	106027	91739.2	97683.4	87997.2	93877.2
4	111089	110809	97561.4	102325	93570.9	98324.7
5	117842	115887	103504	107172	99313.2	102939
6	124572	121201	109480	112208	105026	107814
7	131424	126760	115548	117460	110853	112888
8	138255	132562	121618	122915	116622	118163
9	145187	138538	127722	128525	122486	123638
10	152125	144817	133869	134380	128406	129313
11	159225	151365	140155	140412	134395	135095
12	166505	158127	146553	146622	140494	141084
13	173939	165076	153047	152914	146698	147194
14	181472	172157	159626	159242	152896	153376
15	189107	179326	166303	165682	159259	159594
16	196904	186714	172980	172131	165693	165769
17	204903	194413	179820	178930	172230	172319
18	213047	203091	186786	186868	178911	179946
19	221545	215070	194006	199371	185769	191982
20	230400	230400	201853	201853	193325	193325



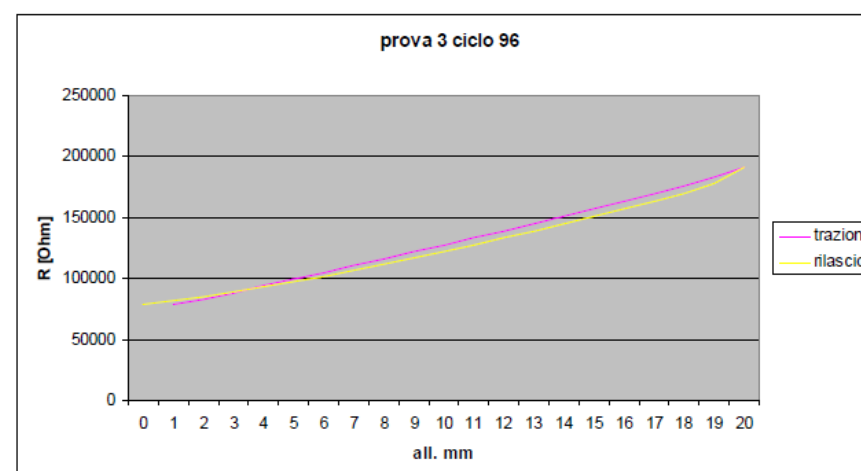
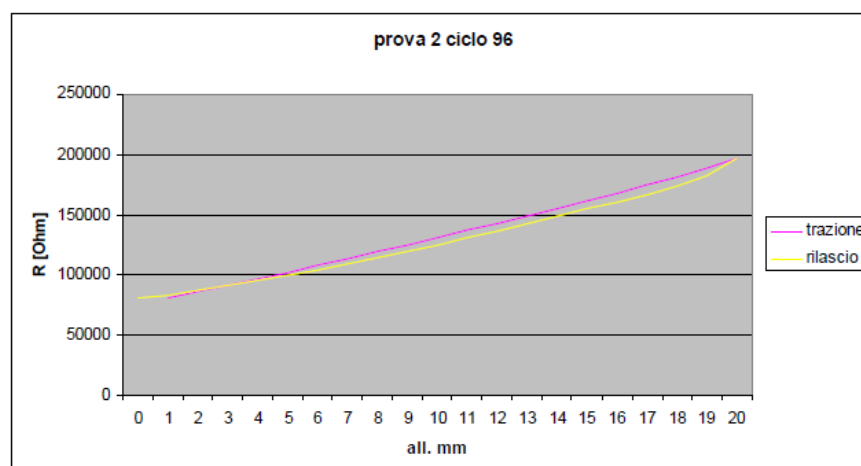
SAMPLE A – Cycle n° 50

Clamps distance [mm]	Session 1 Resistance [Ohm]		Session 2 Resistance [Ohm]		Session 3 Resistance [Ohm]	
	stretching	release	stretching	release	stretching	release
0		86594.7		80982.7		78481.4
1	85554.5	90163.3	83431.5	83560.7	80780.7	81047.6
2	89473.9	94198.6	88486.4	87197.9	85650.8	84550.5
3	95110.4	98581.9	94041.9	91151.4	90950.2	88416
4	101064	103215	99790.4	95404.9	96487.7	92541
5	107217	108055	105500	99882.6	102031	96823.1
6	113299	113132	111336	104572	107632	101387
7	119543	118329	117188	109470	113281	106109
8	125763	123807	123045	114509	118897	111083
9	132090	129498	129043	119838	124660	116244
10	138473	135393	135019	125339	130487	121608
11	144909	141483	141175	131055	136414	127124
12	151496	147720	147417	136939	142410	132844
13	158202	154059	153722	142982	148525	138735
14	164988	160555	160188	149090	154669	144733
15	171889	167091	166673	155302	160952	150804
16	178850	173697	173215	161613	167328	156873
17	185812	180535	179929	167963	173822	163037
18	192950	188275	186882	174675	180585	169567
19	200401	199241	194408	182712	187820	177351
20	208570	208570	195774	195774	190106	190106



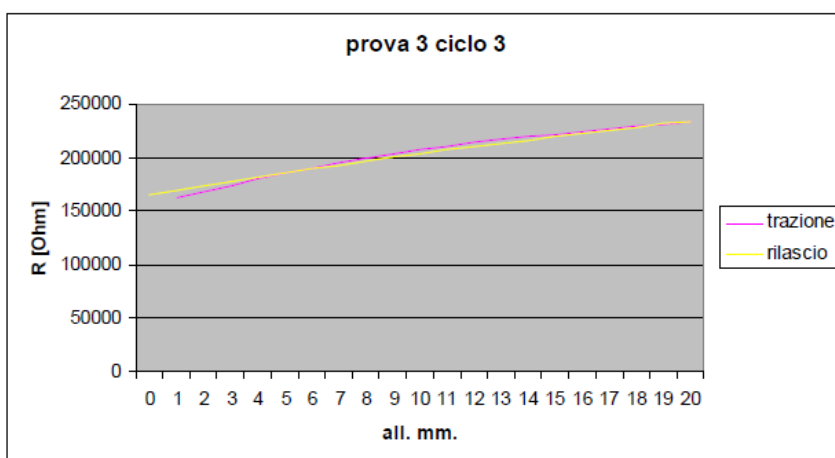
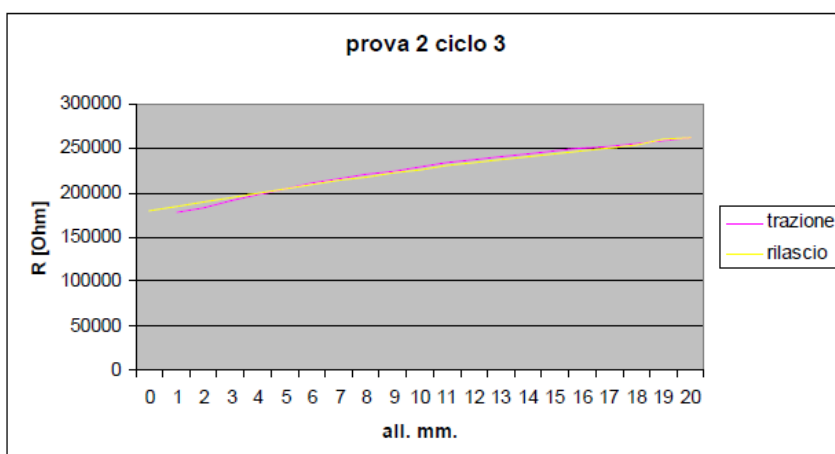
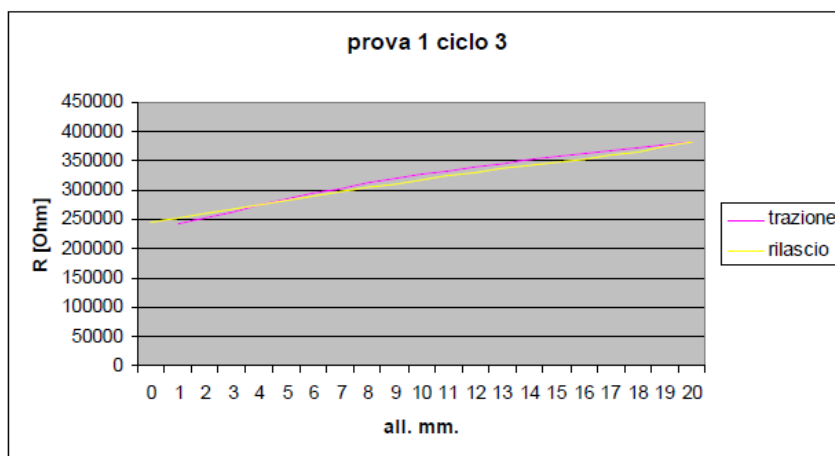
SAMPLE A – Cycle n° 96

Clamps distance [mm]	Session 1 Resistance [Ohm]		Session 2 Resistance [Ohm]		Session 3 Resistance [Ohm]	
	stretching	release	stretching	release	stretching	release
0		85005.6		80102.8		78136.6
1	82691,5	88583,3	80779,8	83120,1	78719,6	81103,8
2	85216,2	92590	85258,3	86771	83105,4	84653,1
3	90353,8	96888,3	90637,1	90723,2	88322,4	88473,7
4	96035,9	101407	96185,6	94938,2	93726,7	92588,4
5	101888	106099	101835	99374,1	99163,6	96926,5
6	107783	111019	107505	103993	104638	101495
7	113745	116174	113185	108833	110204	106252
8	119687	121523	118889	113888	115765	111154
9	125721	127111	124683	119162	121419	116316
10	131815	132893	130592	124623	127133	121665
11	138019	138815	136589	130295	132877	127211
12	144304	144926	142663	136084	138792	132928
13	150706	151187	148766	142083	144776	138784
14	157118	157502	155027	148177	150869	144660
15	163716	163892	161392	154346	157038	150708
16	170379	170285	167834	160554	163204	156769
17	177154	177078	174400	166820	169598	162953
18	184023	185111	181050	173663	176109	169650
19	191052	198204	188235	182456	183119	178149
20	198758	198758	196598	196598	191301	191301



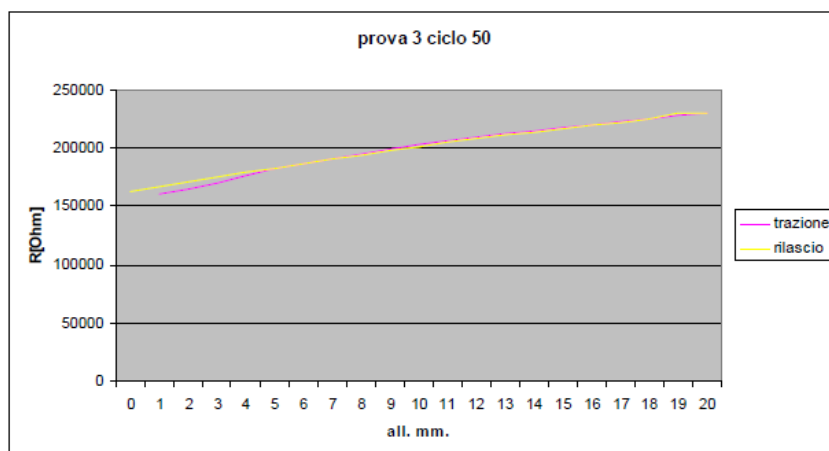
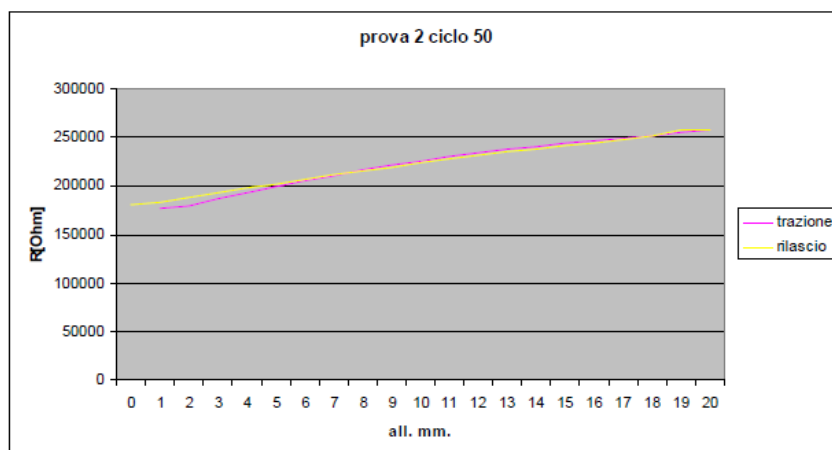
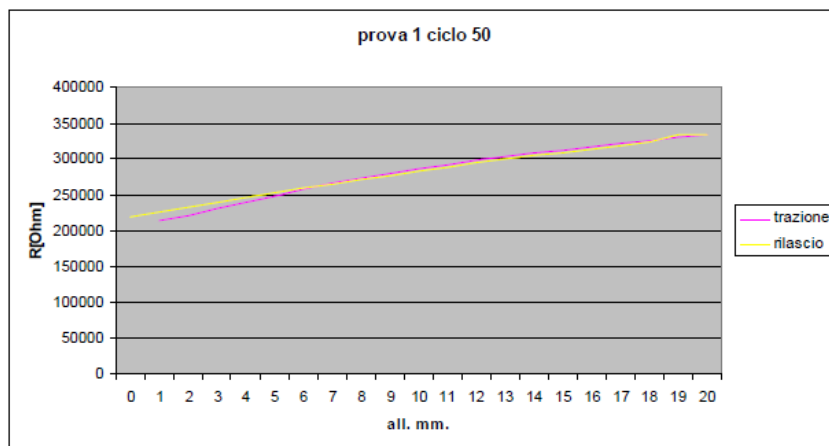
SAMPLE B – Cycle n° 3

Clamps distance [mm]	Session 1 Resistance [Ohm]		Session 2 Resistance [Ohm]		Session 3 Resistance [Ohm]	
	stretching	release	stretching	release	stretching	release
0	245461		180222		165597	
1	243107	252872	177721	185144	162735	168976
2	251925	260478	183212	189989	167595	173112
3	263305	268142	190891	194848	173816	177404
4	274484	275770	197810	199752	179951	181564
5	284845	283199	204337	204552	185449	185562
6	294620	290508	210229	209125	190295	189535
7	303601	296848	215653	213615	194729	193040
8	311807	304547	220682	218093	199369	197023
9	319930	310508	224700	222252	203955	200741
10	326870	318363	229180	226007	207652	204211
11	333619	324857	233372	230225	210920	207578
12	339644	331051	237302	234226	213946	210398
13	345338	336918	240787	237794	216984	213664
14	351995	342686	244115	241107	219610	216362
15	357076	348474	247756	244408	221474	219615
16	362030	353746	250465	247396	224495	222259
17	366736	359269	253016	250467	226549	224772
18	371738	365302	255783	254070	229367	227732
19	376895	375894	258706	259652	231540	232290
20	381957	381957	261757	261757	234213	234213



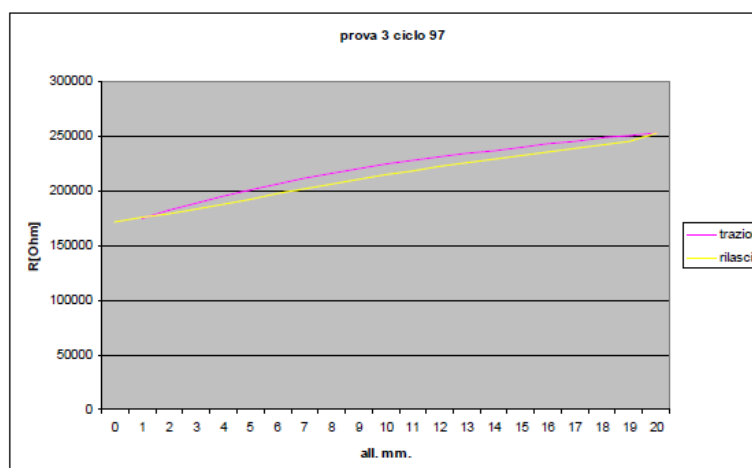
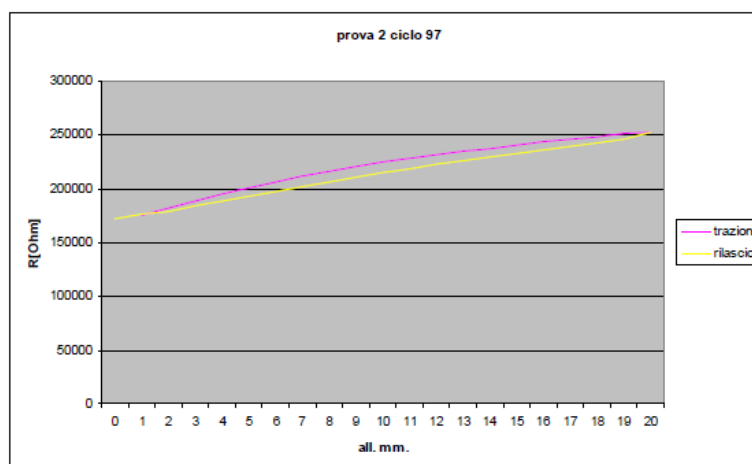
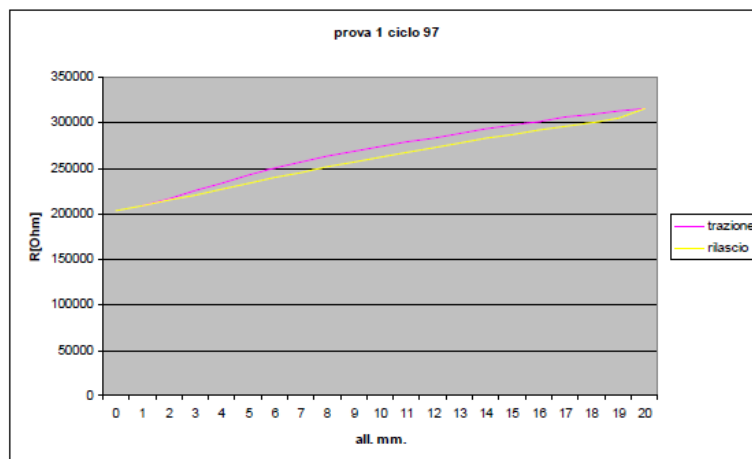
SAMPLE B – Cycle n° 50

Clamps distance [mm]	Session 1 Resistance [Ohm]		Session 2 Resistance [Ohm]		Session 3 Resistance [Ohm]	
	stretching	release	stretching	release	stretching	release
0	219428		180588		162940	
1	215173	225874	177100	183420	160559	166825
2	221016	232641	179479	187697	164505	170951
3	230958	239363	186490	192421	170428	174996
4	239415	246157	192930	197308	176682	179063
5	248580	252685	199597	202103	182122	183017
6	257730	259190	205391	206176	186277	186343
7	265955	265712	210905	211035	190985	190636
8	273130	272024	216299	215026	195317	194483
9	280182	277529	221540	219378	199052	197777
10	286098	283382	225760	223672	202843	201090
11	292680	289200	229723	227402	206242	204933
12	298397	294636	233493	231254	209397	208151
13	303578	300003	237168	234760	212365	211180
14	308672	304782	240479	238195	215102	214072
15	312958	309532	243552	241482	217869	216892
16	317374	314094	246003	244297	220161	219548
17	321856	318486	249284	247510	222804	222145
18	326087	324104	251767	251234	225425	225245
19	330446	333483	255041	257544	227914	230553
20	334853	334853	257964	257964	230480	230480



SAMPLE B – Cycle n° 97

Clamps distance [mm]	Session 1 Resistance [Ohm]		Session 2 Resistance [Ohm]		Session 3 Resistance [Ohm]	
	stretching	release	stretching	release	stretching	release
0	203917		171697		159585	
1	208411	208838	174996	176463	162001	161788
2	217303	214996	182102	179210	167514	165602
3	226454	221260	188808	183898	173312	169604
4	234387	227598	195556	188461	178777	173746
5	242700	233763	201230	192775	183576	177632
6	250133	239840	206754	197600	188431	181634
7	257003	245702	211932	201947	192800	185114
8	263240	251748	216594	206007	196546	189261
9	269038	257559	220729	210534	200308	192636
10	273691	262553	224715	214715	203656	196016
11	279239	267714	228391	218622	206897	199412
12	283823	273597	231203	222519	209892	202851
13	288900	278533	234656	226308	212803	206334
14	294018	283322	237410	229687	215455	209385
15	297550	287854	240071	233045	217638	212135
16	302067	292117	243390	236216	220526	215145
17	306451	296377	245487	239268	222930	217799
18	310114	300743	248485	242203	225402	220504
19	314000	306088	251522	245769	228083	223839
20	316118	316118	253068	253068	229172	229172



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Telefono +39 0464 672 171
Fax +39 0464 672692
info@lemur-italy.com

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Equipment used:



Fig. 1: Instron dynamometer



Fig. 2: clamps

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Fig. 3: KEITHLEY multimeter

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