



Engineering Test Report

Fluid Compatibility Testing of Industrial Ethernet TPE Jacket Compound

Prepared by: Jim Rivernider

2012

1. Introduction

Quabbin Wire & Cable Co., Inc. manufactures a complete line of Industrial Ethernet cables for use in harsh environments. The most common application for Industrial Ethernet on the factory floor is plant automation and robotics. However, the product is well suited for a variety of uses that would destroy a typical commercial in a limited amount of time. In order to provide meaningful data about this specialty product line, testing was conducted to validate the resistance of the TPE (thermoplastic elastomer) cable jacket to chemicals commonly found in a heavy manufacturing environment.

Although the Quabbin product has been exposed to a wide variety of substances during this testing and has done remarkably well, the results and conclusions of this test report are meant to be used as a guide and its' application is the responsibility of the user. If there is any doubt as to the applicability of the information contained in this document, please contact Quabbin Design Engineering for further assistance.

2. Testing Equipment

- Tensile and Elongation Tests will be conducted on a Zwick/Roell Z2.5 Tester.
- Diameter measurements will be made using a digital micrometer.
- Wall thickness measurements will be made using the ScienScope video microscope.

3. Resources

Testing Fluid	Dilution	Qty Required for Each Container	Total Qty Required	Sample Qty
Carecut ES2	100%	.3125 Gal.	1.88 Gal	Quart
HYSOL MB 20	8%	.025 Gal	.15 Gal	N/A
HYSOL MB 50	6%	.03125 Gal	.094 Gal	.06 Gal
INHIBITOR 3	0.01%	.003125 Gal	0.0188	N/A
LONGTIME PD-1	100%	.684 Oz	4.1 Oz	N/A
CASTROL SYNTILO 9904	10%	.03125 Gal	.188 Gal	.06 Gal
CASTROL WS3-908F	10%	.03125 Gal	.188 Gal	N/A
CASTROL SUPEREDGE 6768	10%	.03125 Gal	.188 Gal	N/A
ILOCUT 5713	100%	.3125 Gal.	1.88 Gal	.06 Gal
CASTROL GUNDRILL 2190	100%	.3125 Gal.	1.88 Gal	.06 Gal
CASTROL OPTITEMP RB- 1	100%	.684 Oz	4.1 Oz	N/A

Equipment	Qty Required (ea.)
Plastic Containers	50
2 Gal. Mixing Containers	5
Plastic Measuring Cups	2

Personel	Time Required (hrs)
Maintenance Modifications	3
Fluid Mixing	3
Sample Prep	3
Testing	100*

4. CHEMICALS*

CASTROL CARECUT ES2 is a premium ester-based cutting and grinding oil. It is designed for heavy duty applications such as form grinding and gear grinding using CBN grinding wheels, as well as deep hole drilling, boring and trepanning. This product is used full strength (100%). Testing was performed using this product at full strength (100%).

CASTROL WS3-908F is a premium cutting fluid specifically designed to handle difficult aluminum machining jobs. Recommended dilution for machining is 5 – 10%. Testing was performed using this product at the maximum recommended dilution of 10% **WS3-908F** and 90% tap water.

CASTROL GUN DRILL OIL 2190 is a light viscosity, specially compounded gun drilling oil. Used in crush grinding, deep hole drilling, form grinding, and gun drilling. This product is used full strength (100%). Testing was performed using this product at full strength (100%).

CASTROL HYSOL MB 50 is a soluble metalworking fluid recommended for machining and grinding of all grades of aluminum as well as ferrous alloys. Recommended dilutions are 4-6% for grinding and 5-10% for machining. Testing was performed using this product at 6% **CASTROL HYSOL MB 50** and 94% tap water.

CASTROL HYSOL MB 20 is a biocide-free semi-synthetic metalworking fluid for machining and grinding of ferrous and non-ferrous alloys. Recommended dilutions are 4-5% for grinding and 5-8% for machining. Testing was performed using this product at 8% **CASTROL HYSOL MB 20** and 92% tap water.

CASTROL ILOCUT 5713 uses chlorine replacement technology to provide low viscosity cutting oil for machining and grinding ferrous and nonferrous alloys. Recommended for machining small stainless steel, copper and brass parts on screw machines and Swiss-type automatics. This product is used full strength (100%). Testing was performed using this product at full strength (100%).

CASTROL LONGTIME PD is a lithium based bearing grease containing highly refined mineral oils and is fortified with the Micro flux Trans (MFT) additive system. This product is used full strength (100%). Testing was performed using this product at full strength (100%).

CASTROL SUPEREDGE 6768 is a water soluble cutting and grinding fluid for severe operations on ferrous and non-ferrous metals. It is formulated with an extreme pressure additive that provides additional lubrication in difficult operations. The recommended dilutions are 4-5% for grinding and 5-10% for machining. Testing was performed using this product at 10% **CASTROL SUPEREDGE 6768** and 90% tap water.

CASTROL SYNTILO 9904 is a high performance synthetic cutting and grinding fluid for ferrous metals. This oil-rejecting fluid provides maximum machining performance in severe operations such as threading. The recommended dilutions for this product are 3-6% for grinding and 4-10% for machining. Testing was performed using 9.99% **CASTROL SYNTILO 9904** with .01% **CASTROL INHIBITOR 3** and 90% tap water.

CASTROL INHIBITOR 3 is a corrosion inhibitor additive for use with cutting fluid (specific supplier information is not available). The vendor recommended dilutions for this product are 0.01% with 9.99% **CASTROL SYNTILO 9904** and 90% tap water.

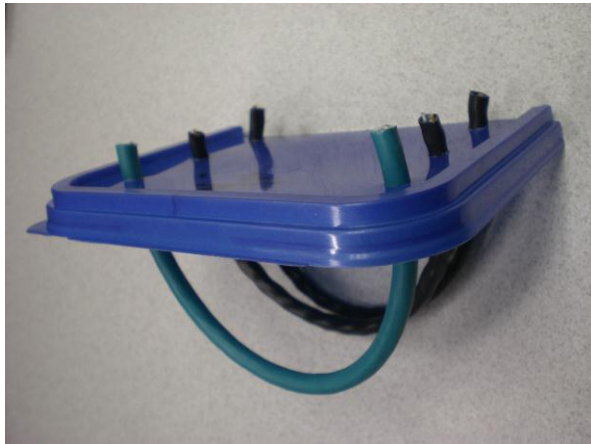
CASTROL OPTITEMP RB-1 is a specialty grease formula based on polyalphaolefins for the lubrication of cables in robots. We are using this product full strength (100%).

*Note: All fluids provided by Kevin Barbeau of KB Page LLC., East Hartford, CT.

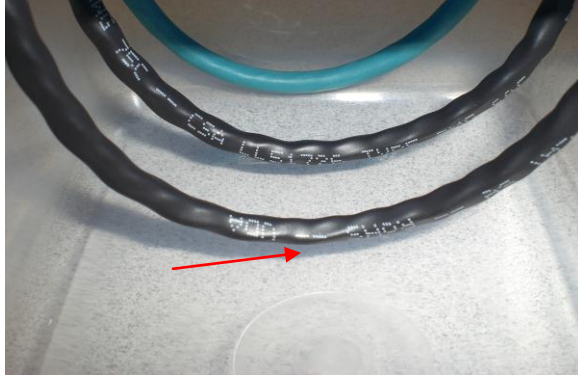
5. PROCEDURE

Procedure (Initial set-up)

1. Cut ten cable samples to 11" length.
2. Measure the O.D. using a digital micrometer. Take three diameter measurements rotating the cable 90° between measurements. Record values in the Initial Readings table on page 7.
3. Remove conductors, and tape from inside the Jacket, cut a piece approximately 1/8" long and measure wall thickness using the ScienScope under a magnification setting of 5x (50x actual). Record results in the Initial Readings table on page 7.
4. Measure Elongation and Tensile Strength (1" benchmark @ 20"/minute) using the Zwick/Roell Z2.5 Tester. Record values in the Initial Readings table on page 7.
5. Cut the remaining cable to length per step 1 for the long term testing. This testing will require preparation of 282 samples.
6. Take one side of the top of the container and slip each end of the cable through each respective opening exposing approximately 2.25" of each end through the top. Please see figure below for orientation. Each cover half will hold three samples.



7. Repeat for other cover half. This testing will require a cover half (3 samples) for each test date.
8. Place cover on container to verify that the cable does not touch container bottom and is approximately 1/4" off of the bottom (see red arrow) when cover is applied. See figure below for reference.



9. Completed container and samples should be mounted similar to the figure below.



10. Remove all covers (with samples inserted) from containers.

11. Label each container with fluid name, the date the sample went in, and the date it needs to be taken out for testing. Refer to specific chemicals on pages 8-26 for test intervals.

Note: It may be desirable to orient the containers in rows, by week, to allow access to each container as each is tested.

12. Fill each container with the respective fluid as called out in chemical dilution table on page 7.

13. Place covers back onto the containers, taking care to not spill or splash any fluid. Remove covers and mark the cable jacket and container with a marker to indicate the fluid level. This is to ensure that only cable that is submerged will be tested.

Procedure (After Test Period)

1. Put on protective gloves for handling of the samples.

2. Remove samples from the container top.

3. Place samples on a paper towel and blot with a paper towel to remove as much residual fluid as possible. Leave sample on paper towel and covered with a paper towel for 30 minutes.

4. Measure the O.D. using a digital micrometer. Take three diameter measurements rotating the cable 90° between measurements. Record values in the appropriate chemical table on pages 8-26.
5. Remove conductors, and tape from inside the Jacket. Cut a piece approximately 1/8" long and measure the wall thickness using the Scioscope under a magnification setting of 5x (50x actual). Record results in appropriate chemical table on pages 8-26.
6. Measure Elongation and Tensile Strength (1" benchmark @ 20"/minute) using the Zwick/Roell Z2.5 Tester. Record values in the appropriate chemical table on pages 8-26.
Note: The cross-sectional area used in the Tensile Strength calculation was calculated using the inside diameter and the outside diameter of the jacket.

6. Results

Jacket Material: TPE

Manufacturer: N/A

Technicians: Jeremy Plasse, John Steffenhagen

Cable Sample: 5772 VZX

Temperature: 20° C

Initial Readings

Week #	Sample #	Date	Time	Elongation	Tensile	Diameter	Wall
0	1	1/14/2009	9:00 AM	295	1989	0.220	0.030
0	2	1/14/2009	9:10 AM	246	1774	0.224	0.031
0	3	1/14/2009	9:20 AM	285	1769	0.226	0.032
0	4	1/14/2009	9:30 AM	285	1966	0.223	0.031
0	5	1/14/2009	9:40 AM	243	1703	0.225	0.030
0	6	1/14/2009	9:50 AM	294	1933	0.223	0.034
0	7	1/14/2009	10:00 AM	275	1871	0.225	0.030
0	8	1/14/2009	10:10 AM	273	1736	0.220	0.031
0	9	1/14/2009	10:20 AM	293	1932	0.220	0.031
0	10	1/14/2009	10:30 AM	286	1901	0.224	0.030

Average	278	1857	0.223	0.031
High	295	1989	0.226	0.034
Low	243	1703	0.220	0.030

Chemical Dilution

CHEMICAL	AMOUNT	SECOND CHEMICAL	AMOUNT	AMOUNT OF TAP WATER
CASTROL LONGTIME PD-1	100%	N/A	N/A	N/A
CASTROL HYSOL MB 20	8% 605 ML	N/A	N/A	92% 6962.5 ML
CASTROL CARECUT ES2	100%	N/A	N/A	N/A
CASTROL HYSOL MB 50	6% 252.2 ML	N/A	N/A	94% 3405.5 ML
CASTROL INHIBITOR 3	.01% 0.75 ML	CASTROL SYNTILO 9904	9.99% 756 ML	90% 6811 ML
CASTROL WS3-908F	10% 756.8 ML	N/A	N/A	90% 6811 ML
CASTROL SUPEREDGE 6768	10% 756.8 ML	N/A	N/A	90% 6811 ML
CASTROL ILOCUT 5713	100%	N/A	N/A	N/A
CASTROL GUN DRILL OIL	100%	N/A	N/A	N/A
CASTROL OPTITEMP RB-1	100%	N/A	N/A	N/A

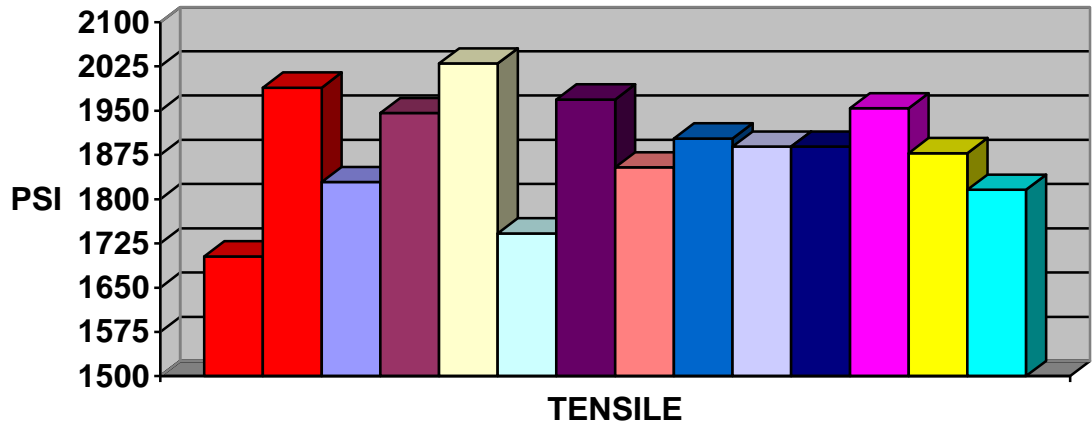
LONGTIME PD-1

SAMPLES IN ON TUESDAY 1/13/09

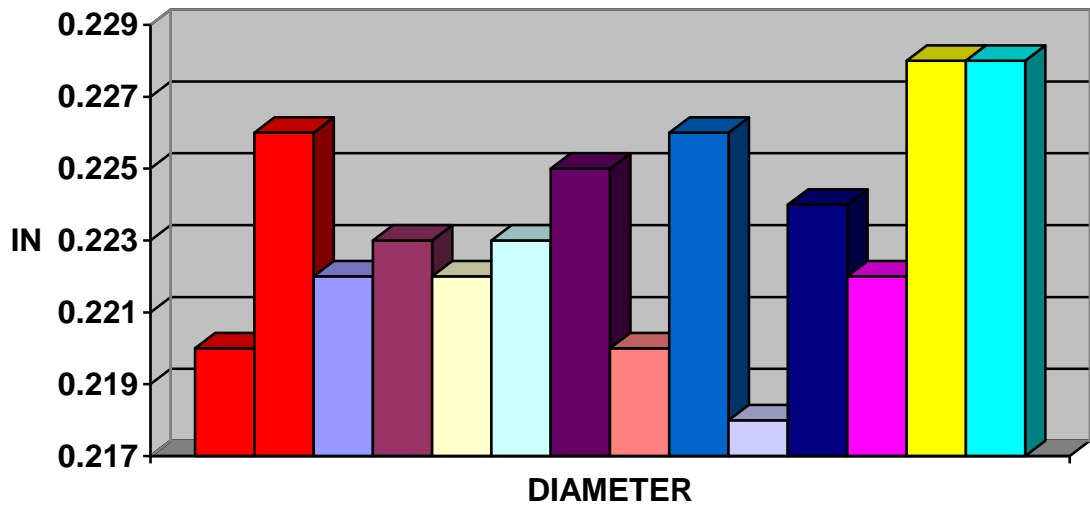
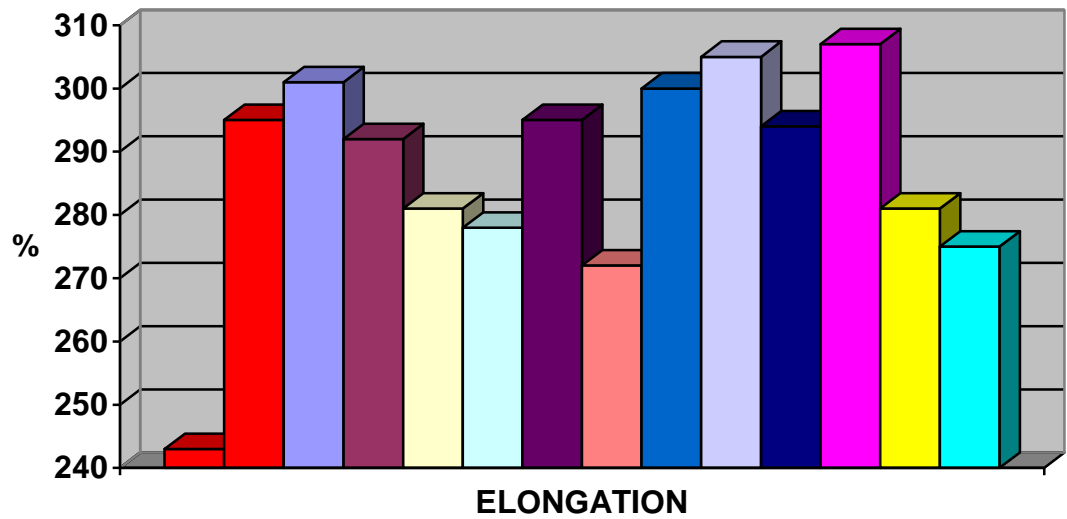
WEEK	SAMPLE	DATE	TIME	ELONGATION	TENSILE	DIAMETER	WALL	TEMP
1	1	1/20/2009	2:00 PM	305	1918	0.221	0.030	70
1	2	1/20/2009	2:20 PM	296	1930	0.224	0.031	70
1	3	1/20/2009	2:40 PM	302	1639	0.222	0.032	70
2	1	1/27/2009	2:30 PM	307	2019	0.223	0.030	67
2	2	1/27/2009	2:45 PM	279	1986	0.222	0.028	67
2	3	1/27/2009	3:10 PM	290	1833	0.224	0.032	67
3	1	2/3/2009	2:45 PM	273	1778	0.222	0.032	68
3	2	2/3/2009	2:55 PM	285	2344	0.221	0.024	68
3	3	2/3/2009	3:08 PM	287	1969	0.222	0.029	68
4	1	2/10/2009	2:45 PM	256	1645	0.224	0.033	68
4	2	2/10/2009	3:00 PM	294	1745	0.222	0.035	68
4	3	2/10/2009	3:20 PM	285	1835	0.224	0.033	68
5	1	2/17/2009	11:50 PM	309	2021	0.227	0.031	68
5	2	2/18/2009	12:05 PM	289	1981	0.224	0.032	68
5	3	2/18/2009	12:20 PM	287	1904	0.225	0.032	68
6	1	2/24/2009	1:45 AM	243	1586	0.216	0.039	68
6	2	2/24/2009	2:00 AM	**	**	0.223	0.030	68
6	3	2/24/2009	2:13 AM	301	2122	0.221	0.031	68
7	1	3/3/2009	3:00 AM	300	1869	0.228	0.033	69
7	2	3/3/2009	3:15 AM	307	1832	0.227	0.036	69
7	3	3/3/2009	3:30 AM	292	2009	0.223	0.031	69
8	1	3/10/2009	5:00 AM	330	2008	0.219	0.034	68
8	2	3/10/2009	5:15 AM	282	1850	0.219	0.032	68
8	3	3/10/2009	5:30 AM	304	1808	0.216	0.037	68
12	1	4/7/2009	2:00 AM	300	1981	0.222	0.030	68
12	2	4/7/2009	2:15 AM	289	1850	0.226	0.033	68
12	3	4/7/2009	2:30 AM	294	1835	0.225	0.032	68
16	1	5/5/2009	3:00 AM	320	2120	0.222	0.034	69
16	2	5/5/2009	3:15 AM	308	1904	0.223	0.030	69
16	3	5/5/2009	3:30 AM	294	1839	0.222	0.033	69
20	1	6/2/2009	12:15 AM	261	1862	0.229	0.032	70
20	2	6/2/2009	12:30 AM	292	1947	0.225	0.034	70
20	3	6/2/2009	12:45 AM	291	1825	0.231	0.036	70
24	1	7/1/2009	2:30 AM	272	1896	0.226	0.034	70
24	2	7/1/2009	2:40 AM	283	1798	0.231	0.036	70
24	3	7/1/2009	2:50 AM	271	1755	0.228	0.035	70

** = equipment issues

LONGTIME PD-1



- INIT'L LOW
- INIT'L HIGH
- WEEK 1
- WEEK 2
- WEEK 3
- WEEK 4
- WEEK 5
- WEEK 6
- WEEK 7
- WEEK 8
- WEEK 12
- WEEK 16
- WEEK 20
- WEEK 24

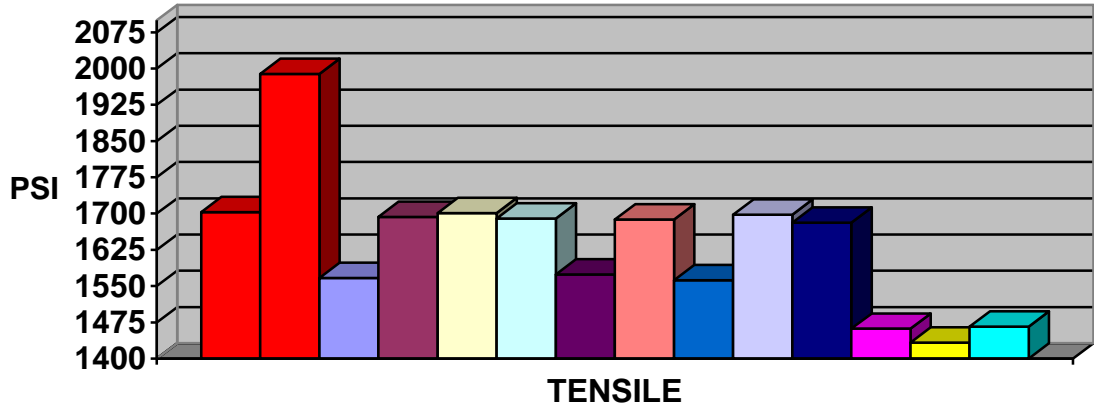


SUPEREDGE 6768

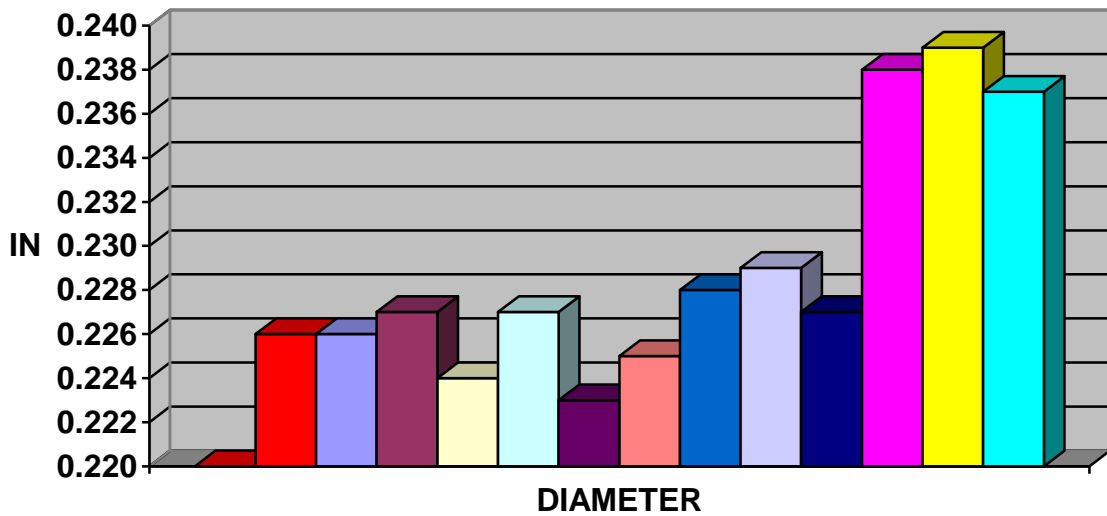
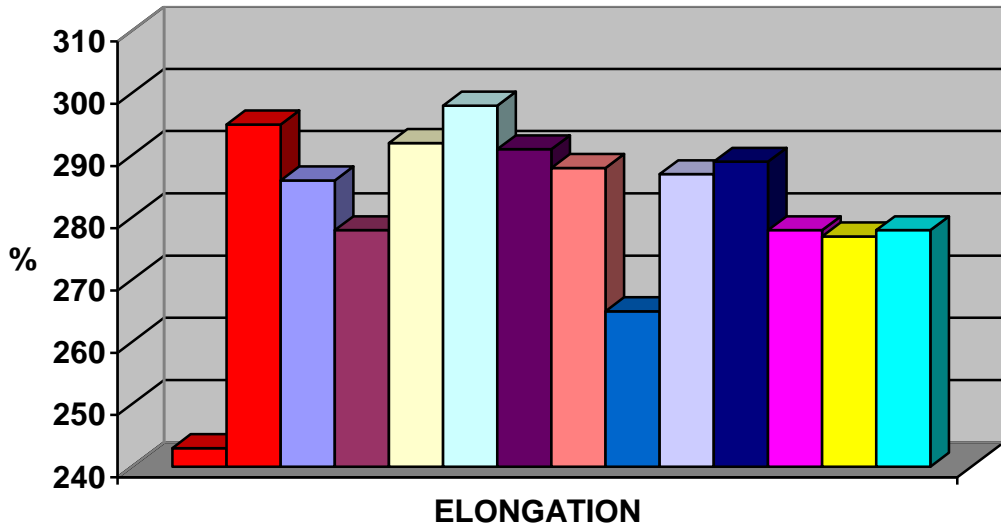
SAMPLES IN ON THURSDAY 2/5/09

WEEK	SAMPLE	DATE	TIME	ELONGATION	TENSILE	DIAMETER	WALL	TEMP
1	1	2/12/2009	12:30 PM	292	1482	0.229	0.039	68
1	2	2/12/2009	12:50 PM	288	1583	0.226	0.035	68
1	3	2/12/2009	1:45 PM	278	1637	0.225	0.033	68
2	1	2/19/2009	11:00 PM	305	1696	0.226	0.036	68
2	2	2/19/2009	11:15 PM	278	1637	0.227	0.036	68
2	3	2/19/2009	11:30 PM	251	1747	0.227	0.030	68
3	1	2/26/2009	12:10 AM	284	1549	0.227	0.037	68
3	2	2/26/2009	12:30 AM	300	1827	0.224	0.032	68
3	3	2/26/2009	12:40 AM	292	1727	0.220	0.035	68
4	1	3/5/2009	1:00 AM	304	1814	0.228	0.031	68
4	2	3/5/2009	1:15 AM	300	1753	0.226	0.033	68
4	3	3/5/2009	1:30 AM	291	1503	0.226	0.039	68
5	1	3/12/2009	12:00 AM	278	1487	0.221	0.036	68
5	2	3/12/2009	12:15 AM	296	1620	0.225	0.036	68
5	3	3/12/2009	12:30 AM	298	1615	0.224	0.037	68
6	1	3/19/2009	11:00 PM	282	1632	0.227	0.034	68
6	2	3/19/2009	11:15 PM	294	1637	0.223	0.035	68
6	3	3/19/2009	11:30 PM	289	1796	0.224	0.031	68
7	1	3/26/2009	12:00 AM	297	1611	0.228	0.034	68
7	2	3/27/2009	12:15 AM	283	1690	0.227	0.034	68
7	3	3/27/2009	12:30 AM	265	1384	0.229	0.039	68
8	1	4/2/2009	3:00 AM	280	1710	0.227	0.036	68
8	2	4/2/2009	3:15 AM	287	1683	0.230	0.035	68
8	3	4/2/2009	3:30 AM	293	1701	0.229	0.038	68
12	1	4/29/2009	12:00 AM	279	1637	0.228	0.031	69
12	2	4/29/2009	12:15 AM	285	1620	0.228	0.034	69
12	3	4/29/2009	12:30 AM	302	1785	0.226	0.036	69
16	1	5/28/2009	10:00 PM	287	1598	0.238	0.032	70
16	2	5/28/2009	10:10 PM	285	1373	0.240	0.037	70
16	3	5/28/2009	10:20 PM	263	1414	0.237	0.034	70
20	1	6/26/2009	3:00 AM	276	1463	0.239	0.035	70
20	2	6/26/2009	3:10 AM	274	1493	0.237	0.036	70
20	3	6/26/2009	3:20 AM	280	1342	0.242	0.040	70
24	1	7/23/2009	1:00 AM	262	1477	0.236	0.035	70
24	2	7/23/2009	1:10 AM	286	1331	0.238	0.041	70
24	3	7/23/2009	1:20 AM	287	1591	0.238	0.035	70

SUPEREDGE 6768



- INIT'L LOW
- INIT'L HIGH
- WEEK 1
- WEEK 2
- WEEK 3
- WEEK 4
- WEEK 5
- WEEK 6
- WEEK 7
- WEEK 8
- WEEK 12
- WEEK 16
- WEEK 20
- WEEK 24

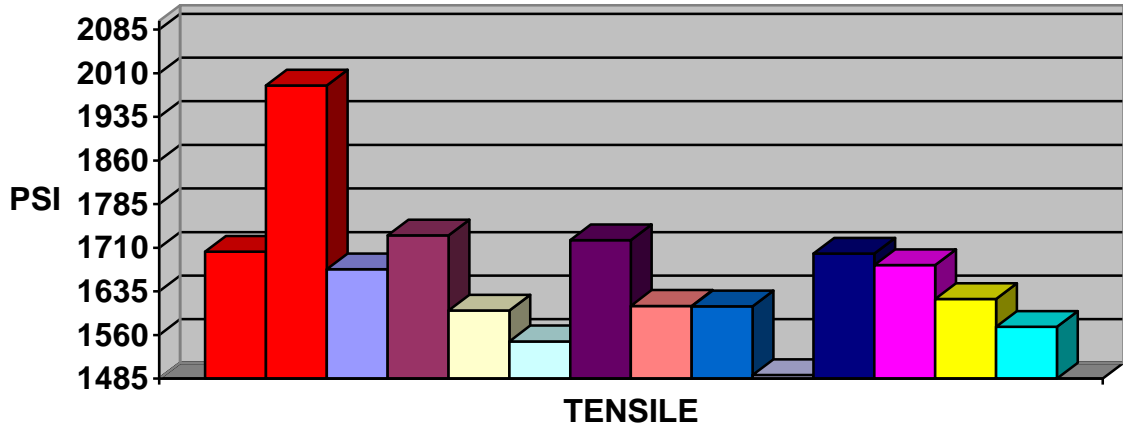


HYSOL MB 20

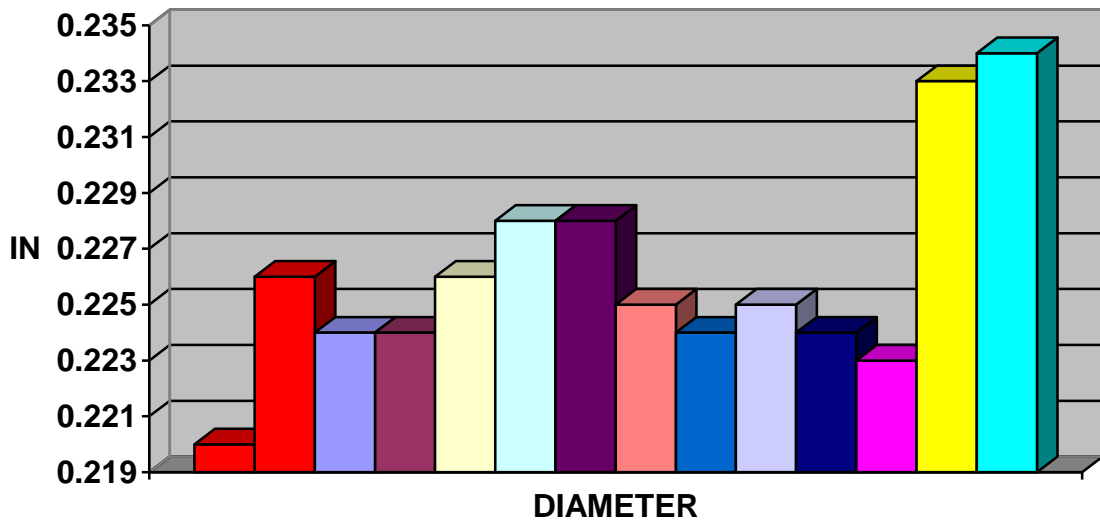
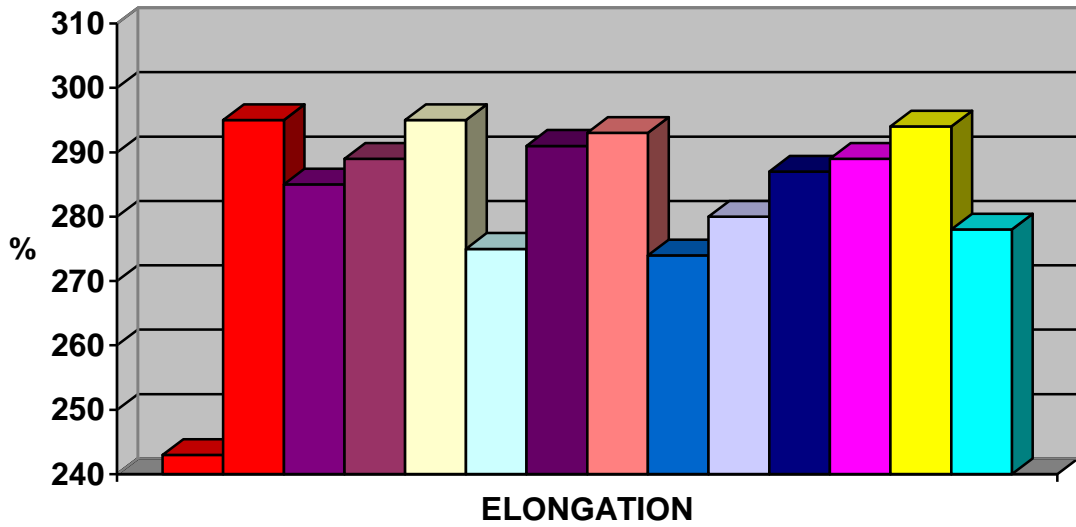
SAMPLES IN ON THURSDAY 1/15/09

WEEK	SAMPLE	DATE	TIME	ELONGATION	TENSILE	DIAMETER	WALL	TEMP	NOTES
1	1	1/22/2009	11:30 AM	295	1907	0.225	0.028	72	
1	2	1/22/2009	11:45 AM	282	1559	0.221	0.032	72	SLIGHT BUT NOTICEABLE COLOR VARIATION SAMPLES IN DRAWER
1	3	1/22/2009	12:00 PM	278	1554	0.226	0.034	72	
2	1	1/29/2009	11:50 AM	287	1757	0.225	0.032	69	
2	2	1/29/2009	12:00 PM	284	1636	0.227	0.034	69	
2	3	1/29/2009	12:15 PM	296	1801	0.222	0.031	69	
3	1	2/5/2009	12:25 PM	281	1446	0.228	0.038	69	COLOR MAY BE HOLDING
3	2	2/5/2009	1:40 PM	303	1725	0.220	0.033	69	
3	3	2/5/2009	2:42 PM	300	1634	0.230	0.035	69	
4	1	2/12/2009	11:20 AM	271	1591	0.228	0.034	68	COLOR NOT GETTING ANY WORSE AT THIS POINT
4	2	2/12/2009	11:40 AM	267	1561	0.230	0.034	68	
4	3	2/12/2009	12:00 PM	287	1496	0.228	0.035	68	
5	1	2/20/2009	12:30 AM	299	1963	0.228	0.029	68	
5	2	2/20/2009	12:45 AM	289	1589	0.225	0.035	68	
5	3	2/20/2009	1:10 AM	285	1616	0.231	0.034	68	
6	1	2/26/2009	1:00 AM	289	1518	0.227	0.037	68	
6	2	2/26/2009	1:20 AM	286	1572	0.226	0.035	68	
6	3	2/26/2009	1:30 AM	304	1741	0.223	0.035	68	
7	1	3/5/2009	2:00 AM	305	1716	0.228	0.033	68	
7	2	3/5/2009	2:15 AM	247	1392	0.224	0.039	68	
7	3	3/5/2009	2:30 AM	271	1720	0.221	0.032	68	
8	1	3/12/2009	2:00 AM	283	1505	0.223	0.036	68	
8	2	3/12/2009	2:15 AM	282	1452	0.227	0.038	68	
8	3	3/12/2009	2:30 AM	274	1517	0.225	0.034	68	
12	1	4/9/2009	4:00 AM	289	1741	0.221	0.034	68	
12	2	4/9/2009	4:15 AM	275	1638	0.227	0.037	68	
12	3	4/9/2009	4:30 AM	298	1722	0.224	0.036	68	
16	1	5/7/2009	2:00 AM	297	1590	0.222	0.032	69	
16	2	5/7/2009	2:15 AM	305	1742	0.225	0.036	69	
16	3	5/7/2009	2:30 AM	265	1708	0.223	0.033	69	
20	1	6/2/2009	1:00 AM	293	1523	0.232	0.037	70	
20	2	6/2/2009	1:15 AM	295	1658	0.238	0.034	70	
20	3	6/2/2009	1:30 AM	295	1684	0.229	0.034	70	
24	1	7/2/2009	1:00 AM	258	1508	0.235	0.034	68	
24	2	7/2/2009	1:10 AM	295	1693	0.236	0.034	68	
24	3	7/2/2009	1:20 AM	281	1521	0.230	0.037	68	

HYSOL MB 20



- INIT'L LOW
- INIT'L HIGH
- WEEK 1
- WEEK 2
- WEEK 3
- WEEK 4
- WEEK 5
- WEEK 6
- WEEK 7
- WEEK 8
- WEEK 12
- WEEK 16
- WEEK 20
- WEEK 24

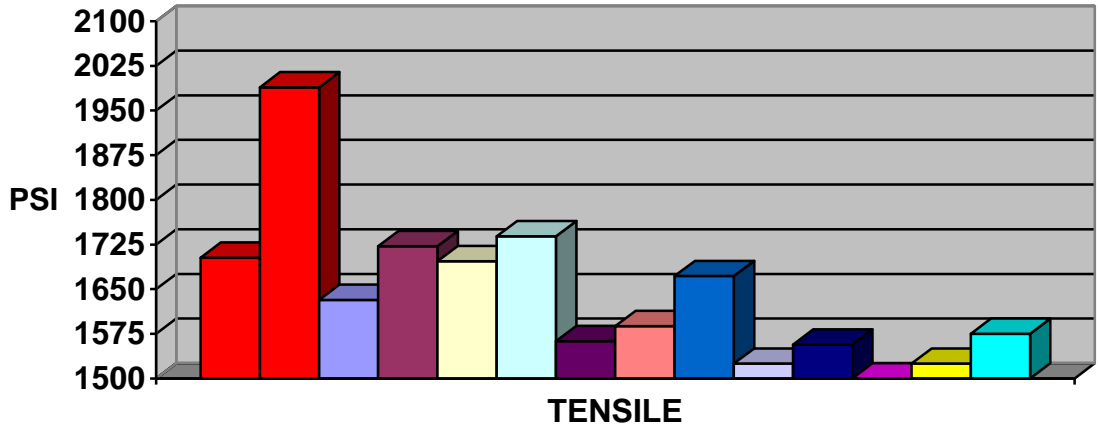


WS3-908F

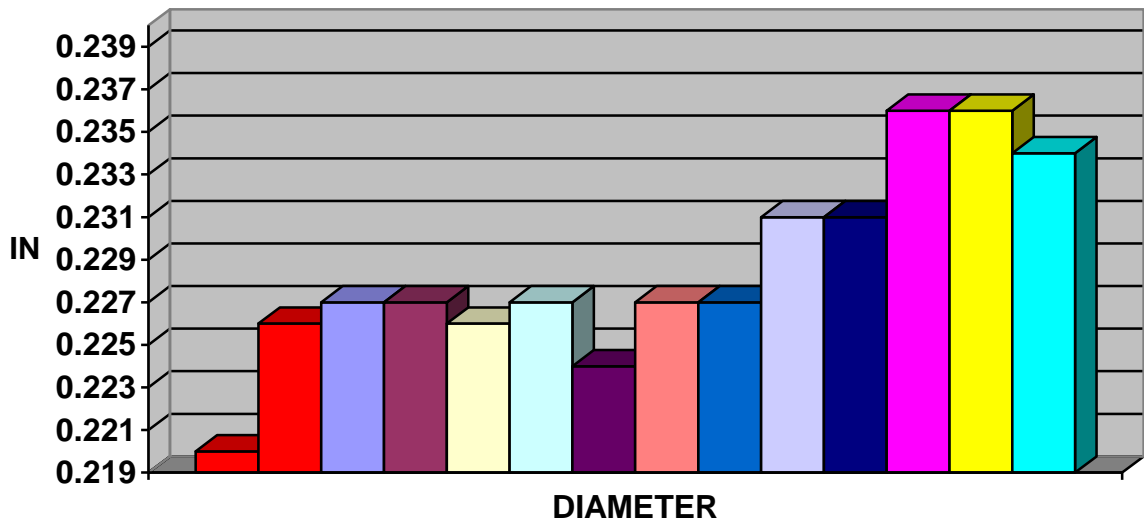
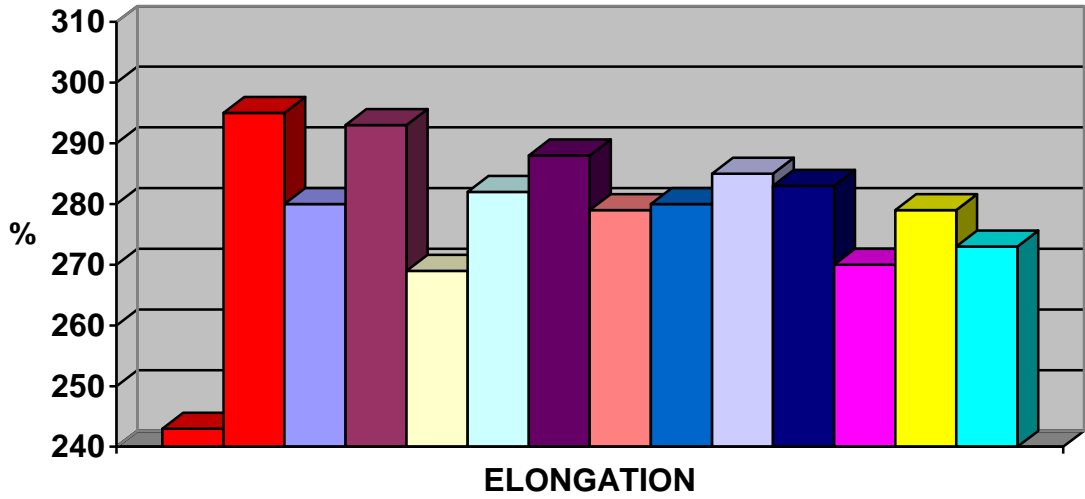
SAMPLES IN ON TUESDAY 2/3/09

WEEK	SAMPLE	DATE	TIME	ELONGATION	TENSILE	DIAMETER	WALL	TEMP
1	1	2/10/2009	2:10 PM	285	1584	0.228	0.035	68
1	2	2/10/2009	2:20 PM	273	1736	0.229	0.030	68
1	3	2/10/2009	2:40 PM	282	1577	0.224	0.034	68
2	1	2/18/2009	12:30 PM	295	1854	0.229	0.030	68
2	2	2/18/2009	12:45 PM	299	1634	0.227	0.036	68
2	3	2/18/2009	12:55 PM	286	1678	0.226	0.034	68
3	1	2/24/2009	2:20 AM	253	1499	0.226	0.034	68
3	2	2/24/2009	2:30 AM	276	1666	0.223	0.035	68
3	3	2/24/2009	2:45 AM	278	1926	0.228	0.028	68
4	1	3/3/2009	2:45 AM	280	1670	0.228	0.033	69
4	2	3/3/2009	3:00 AM	277	1784	0.225	0.032	69
4	3	3/3/2009	3:10 AM	288	1763	0.228	0.032	69
5	1	3/10/2009	4:00 AM	274	1573	0.226	0.034	68
5	2	3/10/2009	4:15 AM	298	1543	0.223	0.034	68
5	3	3/10/2009	4:30 AM	292	1574	0.224	0.036	68
6	1	3/17/2009	3:00 AM	263	1400	0.227	0.039	68
6	2	3/17/2009	3:15 AM	293	1667	0.226	0.036	68
6	3	3/17/2009	3:30 AM	282	1697	0.227	0.033	68
7	1	3/24/2009	3:00 AM	277	1605	0.226	0.035	68
7	2	3/24/2009	3:15 AM	280	1740	0.228	0.030	68
7	3	3/24/2009	3:30 AM	284	1670	0.228	0.032	68
8	1	3/31/2009	1:00 AM	287	1476	0.230	0.035	68
8	2	3/31/2009	1:15 AM	294	1542	0.232	0.036	68
8	3	3/31/2009	1:30 AM	274	1556	0.232	0.033	68
12	1	4/29/2009	1:00 AM	280	1600	0.230	0.032	69
12	2	4/29/2009	1:15 AM	292	1573	0.229	0.036	69
12	3	4/29/2009	1:30 AM	278	1499	0.234	0.037	69
16	1	5/27/2009	12:00 AM	281	1555	0.238	0.034	70
16	2	5/27/2009	12:00 AM	272	1487	0.235	0.035	70
16	3	5/27/2009	12:00 AM	258	1359	0.234	0.038	70
20	1	6/25/2009	1:30 AM	295	1648	0.239	0.033	70
20	2	6/25/2009	1:40 AM	282	1410	0.236	0.038	70
20	3	6/25/2009	1:50 AM	261	1517	0.234	0.034	70
24	1	7/21/2009	11:00 PM	279	1534	0.234	0.036	70
24	2	7/21/2009	11:10 PM	255	1484	0.235	0.033	70
24	3	7/21/2009	11:20 PM	286	1707	0.234	0.031	70

WS3-908F



- INIT'L LOW
- INIT'L HIGH
- WEEK 1
- WEEK 2
- WEEK 3
- WEEK 4
- WEEK 5
- WEEK 6
- WEEK 7
- WEEK 8
- WEEK 12
- WEEK 16
- WEEK 20
- WEEK 24

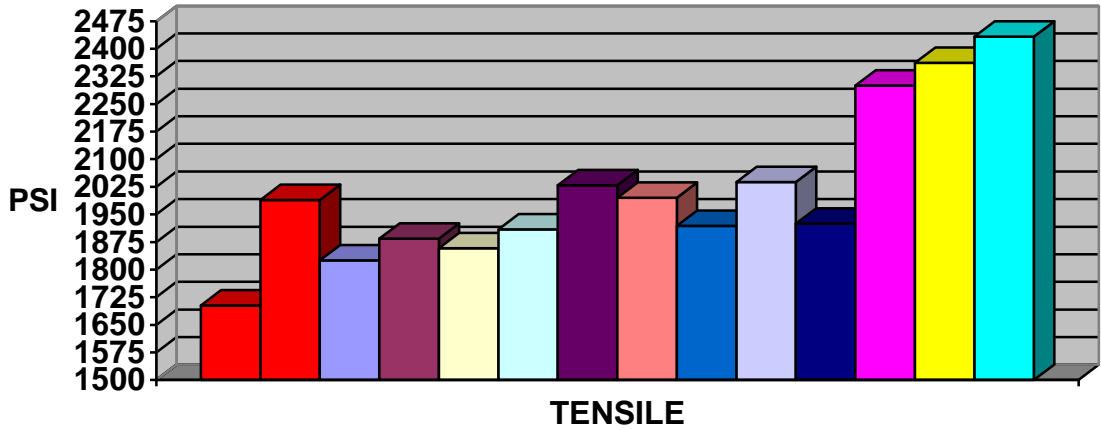


CARECUT ES2

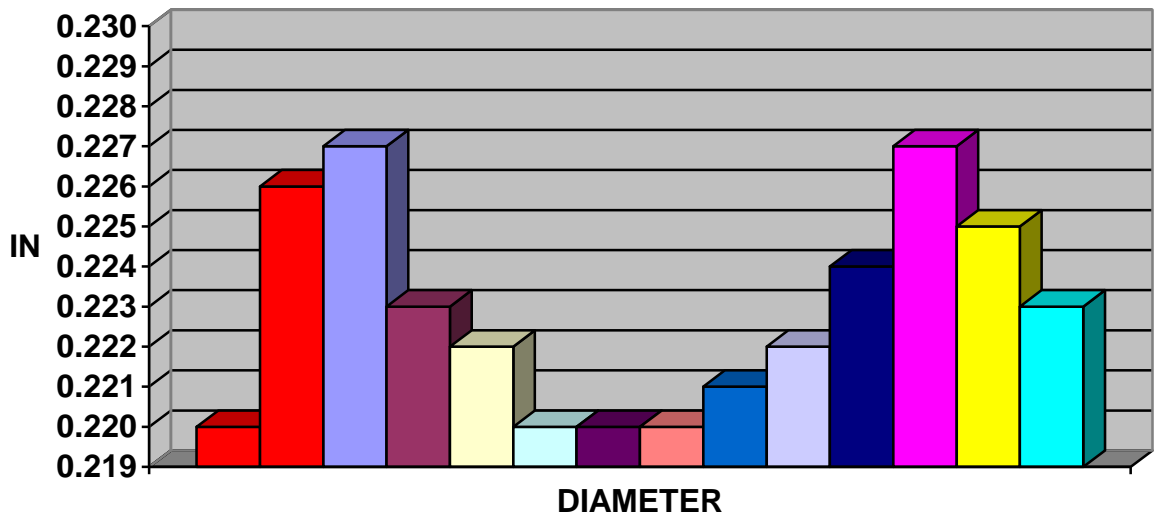
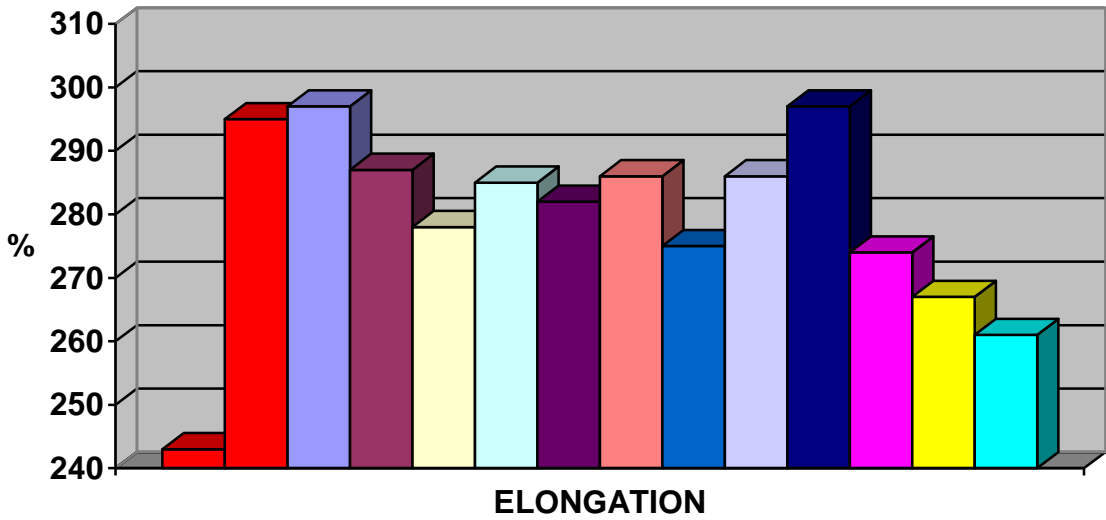
SAMPLES IN ON TUESDAY 2/3/09

WEEK	SAMPLE	DATE	TIME	ELONGATION	TENSILE	DIAMETER	WALL	TEMP
1	1	2/10/2009	1:35 PM	291	1777	0.230	0.031	68
1	2	2/10/2009	1:50 PM	283	1742	0.227	0.031	68
1	3	2/10/2009	2:05 PM	316	1956	0.225	0.031	68
2	1	2/18/2009	2:30 AM	273	1800	0.223	0.034	68
2	2	2/18/2009	2:45 AM	294	1950	0.222	0.032	68
2	3	2/18/2009	3:00 AM	293	1901	0.223	0.033	68
3	1	2/24/2009	4:00 AM	294	1957	0.225	0.035	68
3	2	2/24/2009	4:15 AM	271	1911	0.221	0.033	68
3	3	2/24/2009	4:30 AM	268	1705	0.221	0.039	68
4	1	3/3/2009	4:00 AM	285	1924	0.218	0.036	69
4	2	3/3/2009	4:15 AM	261	1717	0.224	0.035	69
4	3	3/3/2009	4:25 AM	310	2087	0.218	0.034	69
5	1	3/10/2009	3:00 AM	258	1802	0.218	0.033	68
5	2	3/10/2009	3:15 AM	292	2137	0.222	0.033	68
5	3	3/10/2009	3:30 AM	296	2147	0.221	0.031	68
6	1	3/17/2009	4:00 AM	287	1978	0.218	0.035	68
6	2	3/17/2009	4:15 AM	312	2073	0.221	0.033	68
6	3	3/17/2009	4:30 AM	258	1934	0.220	0.035	68
7	1	3/24/2009	2:00 AM	273	1950	0.222	0.032	68
7	2	3/24/2009	2:15 AM	294	1801	0.222	0.034	68
7	3	3/24/2009	2:30 AM	258	2005	0.220	0.033	68
8	1	3/31/2009	2:00 AM	289	1971	0.226	0.033	68
8	2	3/31/2009	2:15 AM	296	2207	0.223	0.031	68
8	3	3/31/2009	2:30 AM	272	1937	0.217	0.034	68
12	1	4/29/2009	3:00 AM	287	1780	0.224	0.034	69
12	2	4/29/2009	3:15 AM	310	1985	0.227	0.032	69
12	3	4/29/2009	3:30 AM	294	2010	0.220	0.035	69
16	1	5/26/2009	4:00 AM	253	2190	0.227	0.031	69
16	2	5/26/2009	4:00 AM	284	2395	0.230	0.030	69
16	3	5/26/2009	4:00 AM	285	2316	0.225	0.031	69
20	1	6/25/2009	2:00 AM	279	2320	0.224	0.030	70
20	2	6/25/2009	2:10 AM	247	2388	0.222	0.030	70
20	3	6/25/2009	2:20 AM	274	2379	0.228	0.030	70
24	1	7/21/2009	11:30 PM	254	2328	0.222	0.031	70
24	2	7/21/2009	11:40 PM	274	2535	0.224	0.028	70
24	3	7/21/2009	11:50 PM	255	2436	0.224	0.028	70

CARECUT ES2



- INIT'L LOW
- INIT'L HIGH
- WEEK 1
- WEEK 2
- WEEK 3
- WEEK 4
- WEEK 5
- WEEK 6
- WEEK 7
- WEEK 8
- WEEK 12
- WEEK 16
- WEEK 20
- WEEK 24

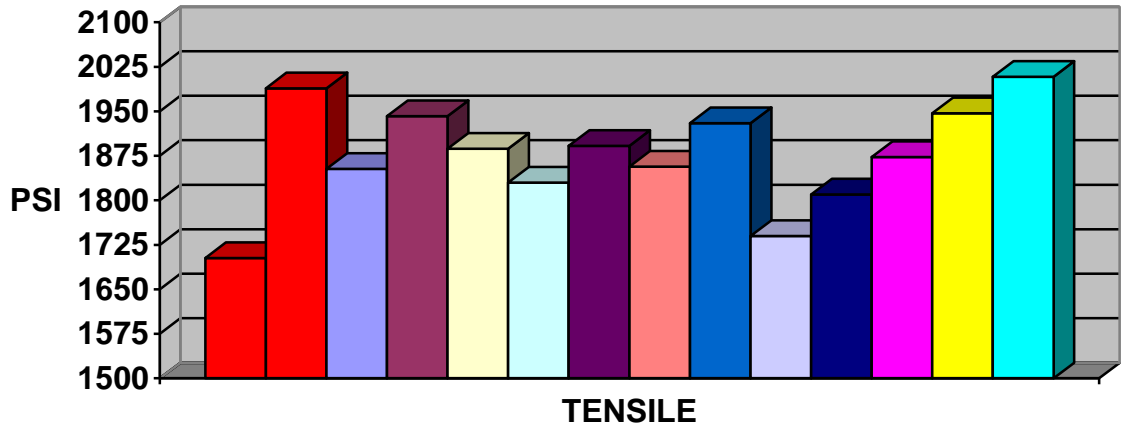


CASTROL OPTITEMP RB-1

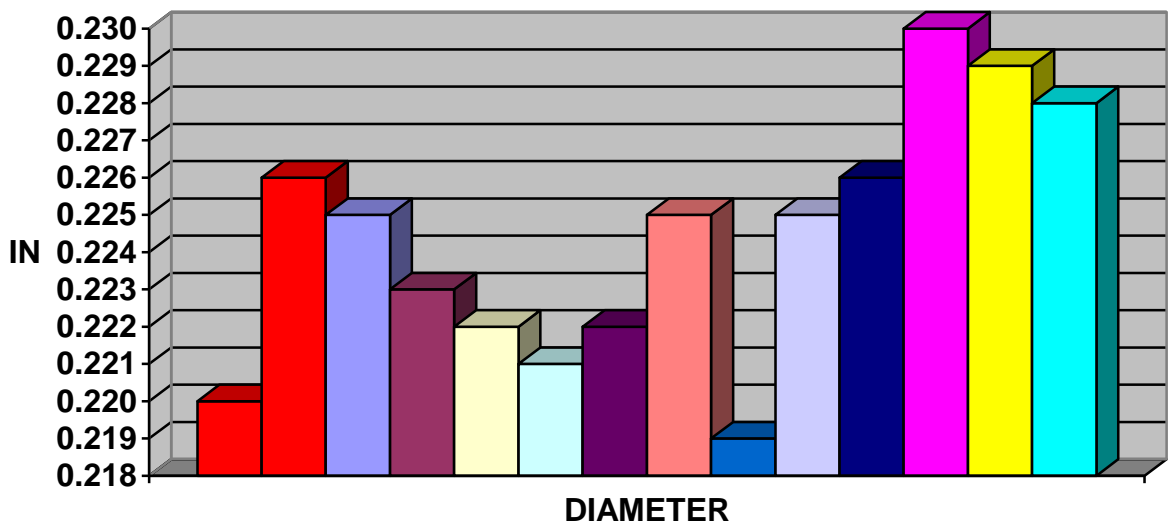
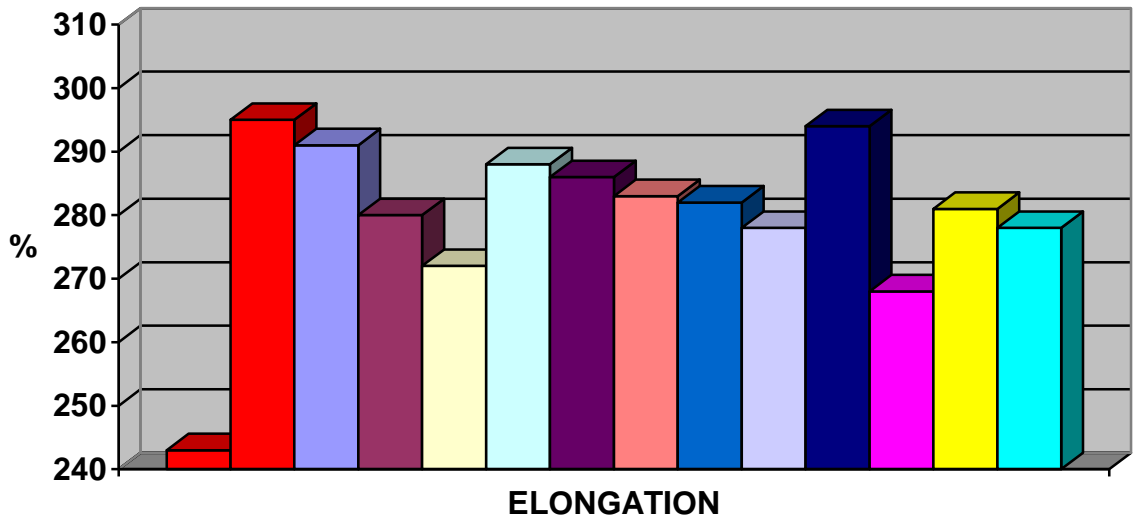
SAMPLES IN ON TUESDAY 2/3/09

WEEK	SAMPLE	DATE	TIME	ELONGATION	TENSILE	DIAMETER	WALL	TEMP
1	1	2/10/2009	3:35 PM	285	2095	0.221	0.028	68
1	2	2/10/2009	3:50 PM	302	1807	0.225	0.034	68
1	3	2/10/2009	4:10 PM	287	1656	0.229	0.036	68
2	1	2/18/2009	3:50 AM	285	1915	0.224	0.033	68
2	2	2/18/2009	4:00 AM	276	1874	0.222	0.034	68
2	3	2/18/2009	4:15 AM	280	2036	0.223	0.030	68
3	1	2/24/2009	5:00 AM	252	1887	0.224	0.030	68
3	2	2/24/2009	5:15 AM	290	1956	0.219	0.034	68
3	3	2/24/2009	5:30 AM	273	1818	0.222	0.034	68
4	1	3/3/2009	4:30 AM	279	1609	0.225	0.036	69
4	2	3/3/2009	4:45 AM	287	1905	0.220	0.033	69
4	3	3/3/2009	5:00 AM	299	1976	0.219	0.033	69
5	1	3/10/2009	2:00 AM	274	1773	0.222	0.031	68
5	2	3/10/2009	2:15 AM	295	1913	0.221	0.033	68
5	3	3/10/2009	2:30 AM	288	1991	0.222	0.032	68
6	1	3/17/2009	5:00 AM	290	1884	0.226	0.035	68
6	2	3/17/2009	5:15 AM	266	1660	0.222	0.036	68
6	3	3/17/2009	5:30 AM	292	2028	0.226	0.031	68
7	1	3/24/2009	1:00 AM	275	1948	0.219	0.033	68
7	2	3/24/2009	1:15 AM	280	1905	0.220	0.031	68
7	3	3/24/2009	1:30 AM	292	1938	0.219	0.035	68
8	1	3/31/2009	3:00 AM	294	1915	0.223	0.035	68
8	2	3/31/2009	3:15 AM	293	1755	0.223	0.032	68
8	3	3/31/2009	3:30 AM	248	1373	0.228	0.033	68
12	1	4/29/2009	4:00 AM	285	1790	0.225	0.032	69
12	2	4/29/2009	4:15 AM	297	1832	0.227	0.034	69
12	3	4/29/2009	4:30 AM	301	1807	0.226	0.035	69
16	1	5/27/2009	12:00 AM	281	1994	0.228	0.031	70
16	2	5/27/2009	12:00 AM	267	1831	0.230	0.032	70
16	3	5/27/2009	12:00 AM	256	1793	0.232	0.032	70
20	1	6/25/2009	2:30 AM	253	1849	0.228	0.032	70
20	2	6/25/2009	2:40 AM	301	2080	0.231	0.031	70
20	3	6/25/2009	2:50 AM	288	1913	0.229	0.034	70
24	1	7/22/2009	12:00 AM	286	2037	0.233	0.030	70
24	2	7/22/2009	12:10 AM	274	1931	0.227	0.032	70
24	3	7/22/2009	12:20 AM	275	2056	0.224	0.031	70

OPTITEMP RB-1



- INIT'L LOW
- INIT'L HIGH
- WEEK 1
- WEEK 2
- WEEK 3
- WEEK 4
- WEEK 5
- WEEK 6
- WEEK 7
- WEEK 8
- WEEK 12
- WEEK 16
- WEEK 20
- WEEK 24

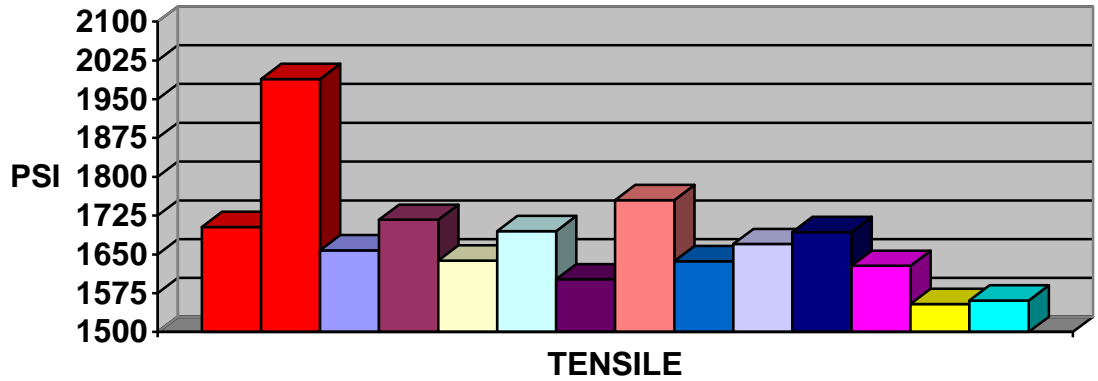


INHIBITOR 3 WITH SYNTILO 9904

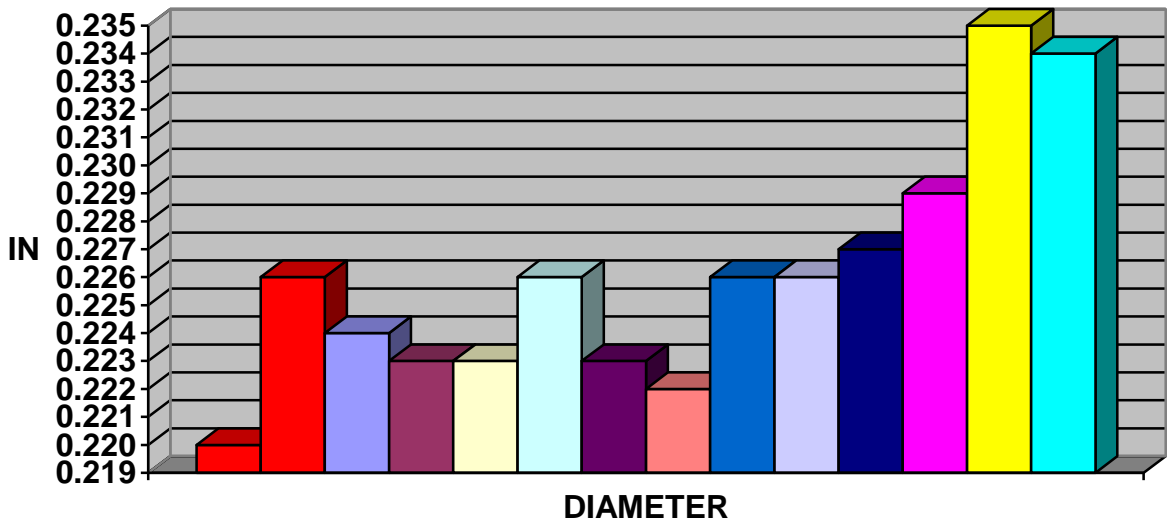
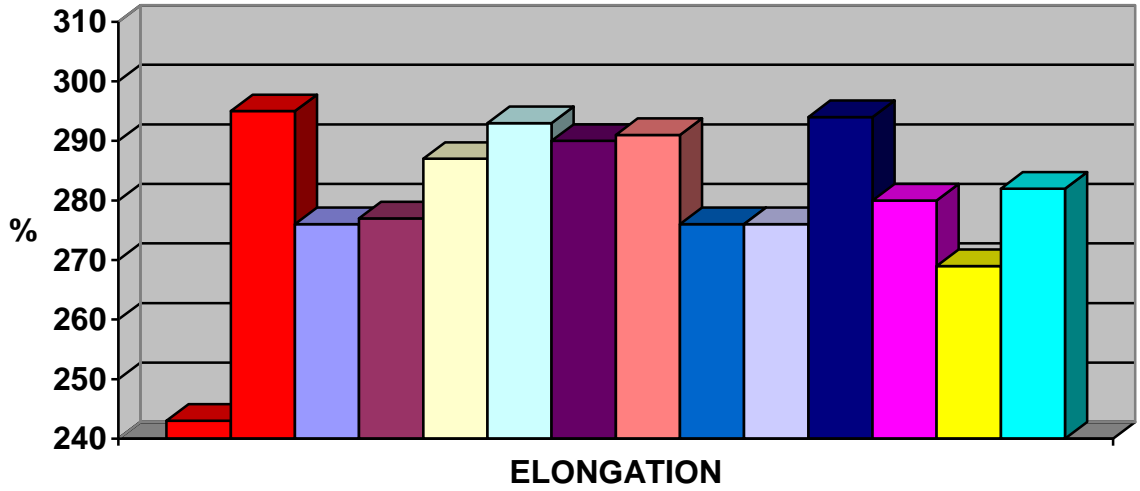
SAMPLES IN ON THURSDAY 2/5/09

WEEK	SAMPLE	DATE	TIME	ELONGATION	TENSILE	DIAMETER	WALL	TEMP
1	1	2/12/2009	2:00 PM	239	1486	0.223	0.035	68
1	2	2/12/2009	2:15 PM	300	1795	0.223	0.034	68
1	3	2/12/2009	2:30 PM	290	1692	0.226	0.035	68
2	1	2/19/2009	11:45 PM	283	1791	0.222	0.032	68
2	2	2/20/2009	12:00 AM	287	1754	0.225	0.033	68
2	3	2/20/2009	12:10 AM	261	1605	0.223	0.037	68
3	1	2/26/2009	2:10 AM	266	1546	0.222	0.036	68
3	2	2/26/2009	2:30 AM	297	1579	0.223	0.038	68
3	3	2/26/2009	2:50 AM	298	1788	0.225	0.032	68
4	1	3/5/2009	3:00 AM	302	1760	0.225	0.035	68
4	2	3/5/2009	3:15 AM	286	1572	0.227	0.038	68
4	3	3/5/2009	3:30 AM	291	1752	0.227	0.034	68
5	1	3/12/2009	1:00 AM	294	1636	0.221	0.035	68
5	2	3/12/2009	1:15 AM	287	1536	0.222	0.037	68
5	3	3/12/2009	1:30 AM	289	1633	0.226	0.036	68
6	1	3/19/2009	10:00 PM	296	1793	0.220	0.034	68
6	2	3/19/2009	10:15 PM	283	1644	0.223	0.033	68
6	3	3/19/2009	10:30 PM	294	1829	0.223	0.036	68
7	1	3/26/2009	1:00 AM	262	1607	0.227	0.033	68
7	2	3/26/2009	1:15 AM	269	1694	0.226	0.031	68
7	3	4/2/2009	1:30 AM	296	1609	0.225	0.035	68
8	1	4/2/2009	4:00 AM	265	1648	0.226	0.033	68
8	2	4/2/2009	4:15 AM	289	1690	0.224	0.036	68
8	3	4/2/2009	4:30 AM	273	1671	0.228	0.034	68
12	1	4/29/2009	2:00 AM	285	1753	0.225	0.035	69
12	2	4/29/2009	2:15 AM	294	1690	0.228	0.032	69
12	3	4/29/2009	2:30 AM	302	1636	0.227	0.033	69
16	1	5/28/2009	10:30 PM	270	1771	0.229	0.030	70
16	2	5/28/2009	10:40 PM	279	1534	0.230	0.036	70
16	3	5/28/2009	10:50 PM	291	1579	0.229	0.035	70
20	1	6/26/2009	3:30 AM	275	1667	0.230	0.034	70
20	2	6/26/2009	3:40 AM	260	1511	0.239	0.034	70
20	3	6/26/2009	3:50 AM	273	1484	0.235	0.036	70
24	1	7/23/2009	1:30 AM	269	1496	0.233	0.036	70
24	2	7/23/2009	1:40 AM	289	1662	0.233	0.035	70
24	3	7/23/2009	1:50 AM	288	1524	0.235	0.037	70

INHIBITOR 3 WITH SYNTILO 9904



- INT'L LOW
- INIT'L HIGH
- WEEK 1
- WEEK 2
- WEEK 3
- WEEK 4
- WEEK 5
- WEEK 6
- WEEK 7
- WEEK 8
- WEEK 12
- WEEK 16
- WEEK 20
- WEEK 24



HYSOL MB 50*

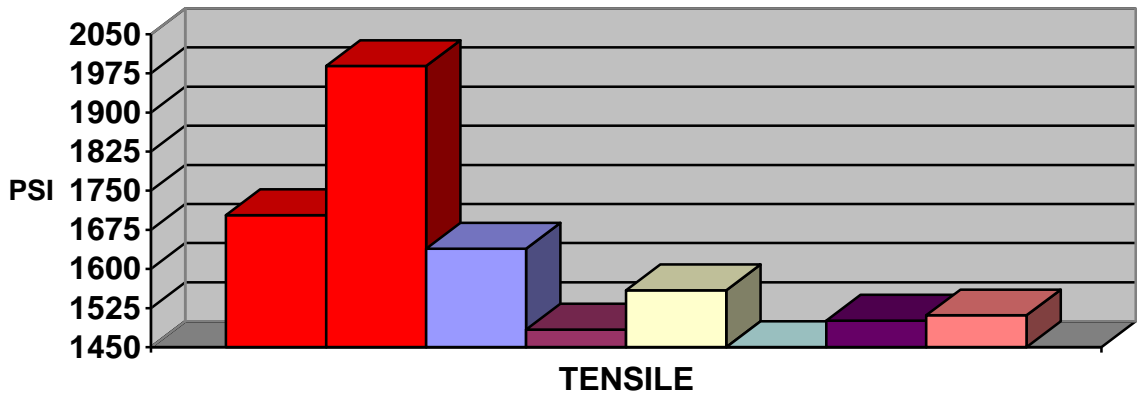
SAMPLES IN ON THURSDAY 2/12/09

MONTH	SAMPLE	DATE	TIME	ELONGATION	TENSILE	DIAMETER	WALL	TEMP
1	1	3/12/2009	3:00 AM	277	1687	0.222	0.035	68
1	2	3/12/2009	3:15 AM	288	1569	0.223	0.034	68
1	3	3/12/2009	3:30 AM	297	1669	0.223	0.036	68
2	1	4/9/2009	2:45 AM	**	**	0.227	0.038	68
2	2	4/9/2009	3:00 AM	234	1409	0.233	0.030	68
2	3	4/9/2009	3:15 AM	290	1558	0.231	0.035	68
3	1	5/7/2009	4:00 AM	253	1562	0.229	0.030	69
3	2	5/7/2009	4:15 AM	279	1601	0.232	0.032	69
3	3	5/7/2009	4:30 AM	301	1515	0.232	0.033	69
4	1	6/2/2009	1:50 AM	259	1447	0.235	0.037	70
4	2	6/2/2009	2:05 AM	258	1425	0.233	0.037	70
4	3	6/2/2009	2:20 AM	270	1470	0.234	0.036	70
5	1	7/2/2009	1:30 AM	286	1481	0.240	0.036	68
5	2	7/2/2009	1:40 AM	250	1475	0.235	0.034	68
5	3	7/2/2009	1:50 AM	246	1548	0.232	0.033	68
6	1	7/30/2009	3:00 AM	289	1587	0.235	0.034	68
6	2	7/30/2009	3:10 AM	282	1554	0.239	0.036	68
6	3	7/30/2009	3:20 AM	269	1391	0.241	0.037	68

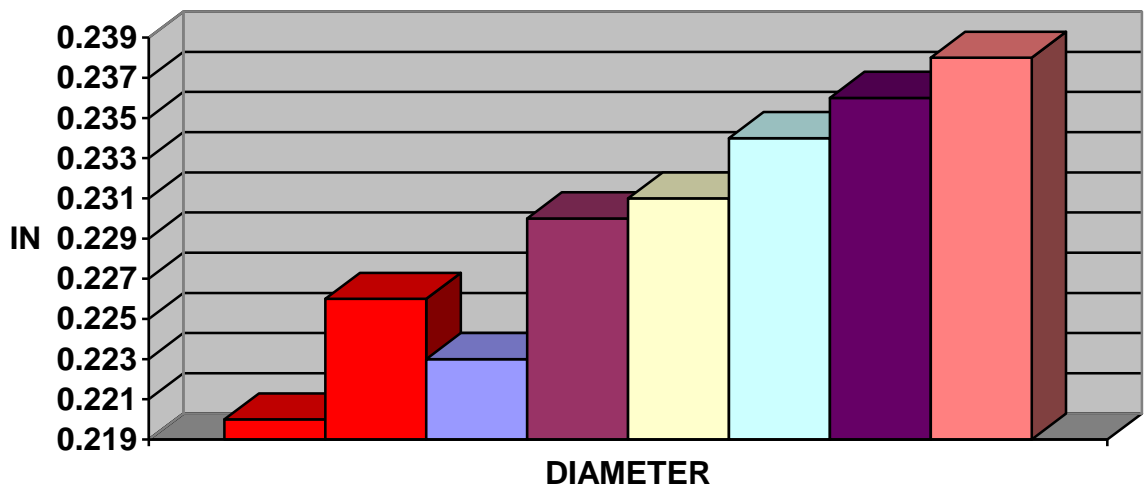
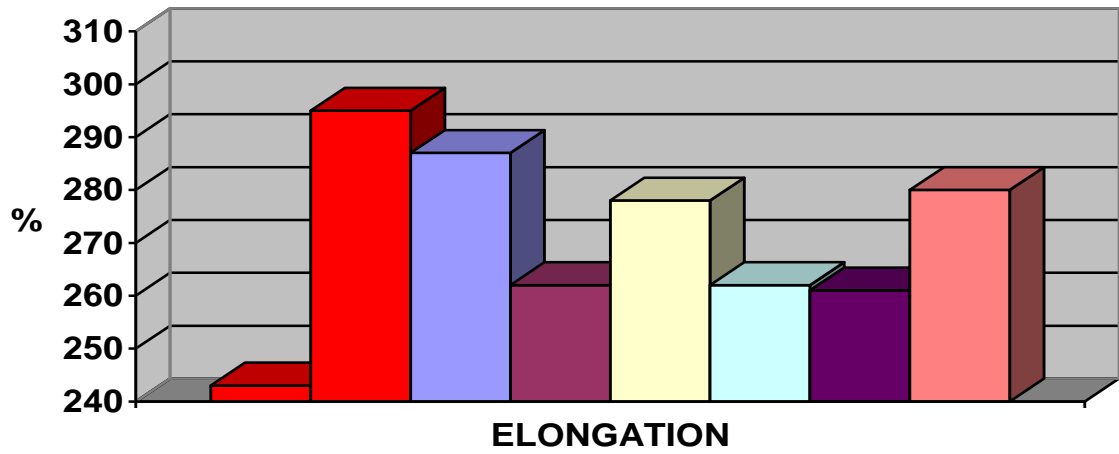
** = machine error

*Note: The test period and dilution were adjusted to accommodate the availability of this fluid.

HYSOL MB 50



- INIT'L LOW
- INIT'L HIGH
- MONTH 1
- MONTH 2
- MONTH 3
- MONTH 4
- MONTH 5
- MONTH 6



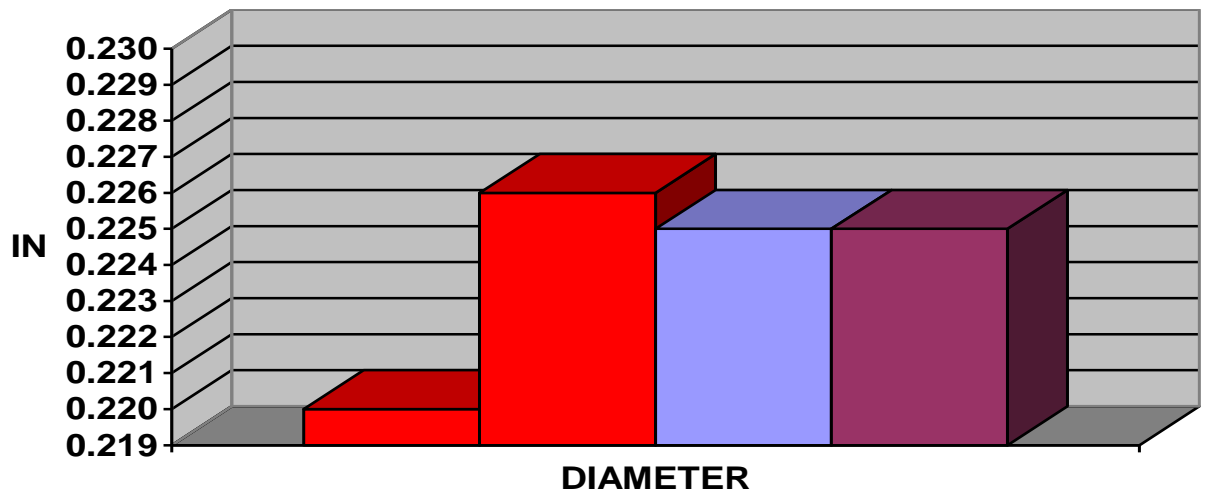
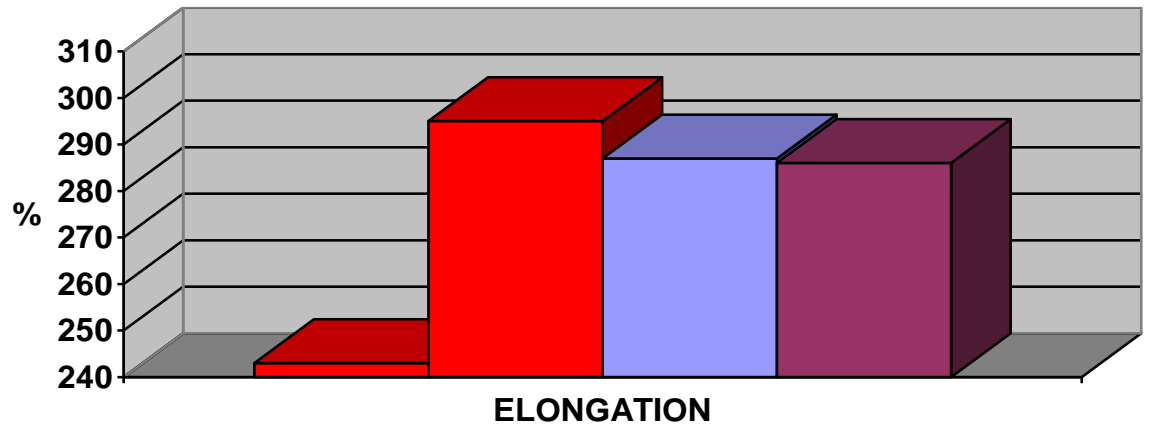
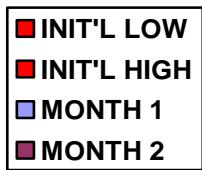
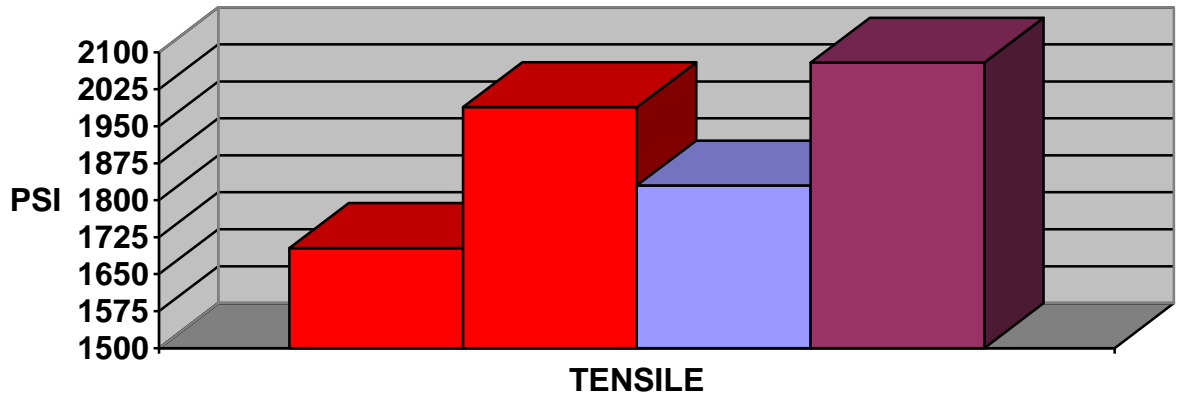
GUNDRILL OIL 2190

SAMPLES IN ON TUESDAY 2/3/09*

MONTH	SAMPLE	DATE	TIME	ELONGATION	TENSILE	DIAMETER	WALL	TEMP	NOTES
1	1	3/3/2009	1:30 AM	315	2093	0.220	0.033	69	CHEMICAL HAS DYED JACKET CAMO GREEN
1	2	3/3/2009	1:45 AM	299	1735	0.223	0.039	69	
1	3	3/3/2009	2:00 AM	247	1661	0.231	0.033	69	
2	1	3/31/2009	5:00 AM	292	2137	0.224	0.033	68	
2	2	3/31/2009	5:15 AM	298	2086	0.227	0.029	68	
2	3	3/31/2009	5:30 AM	267	2014	0.224	0.030	68	

* Note: The test period and dilution were adjusted to accommodate the availability of this fluid.

GUNDRILL OIL 2190



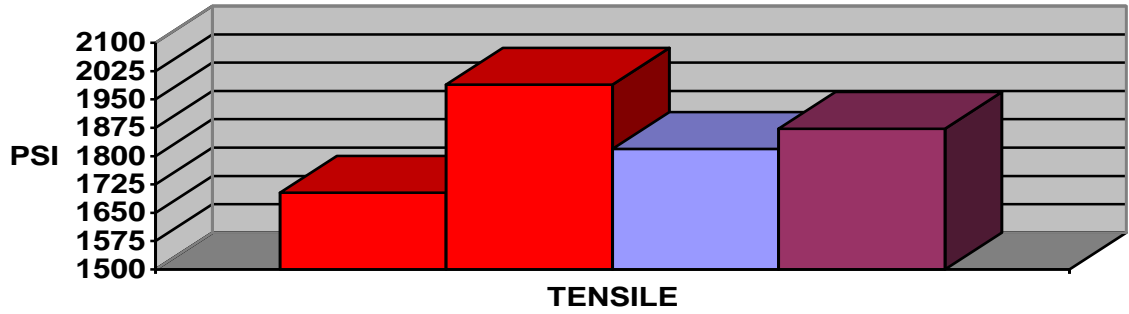
ILOCUT 5713*

SAMPLES IN ON TUESDAY 2/3/09

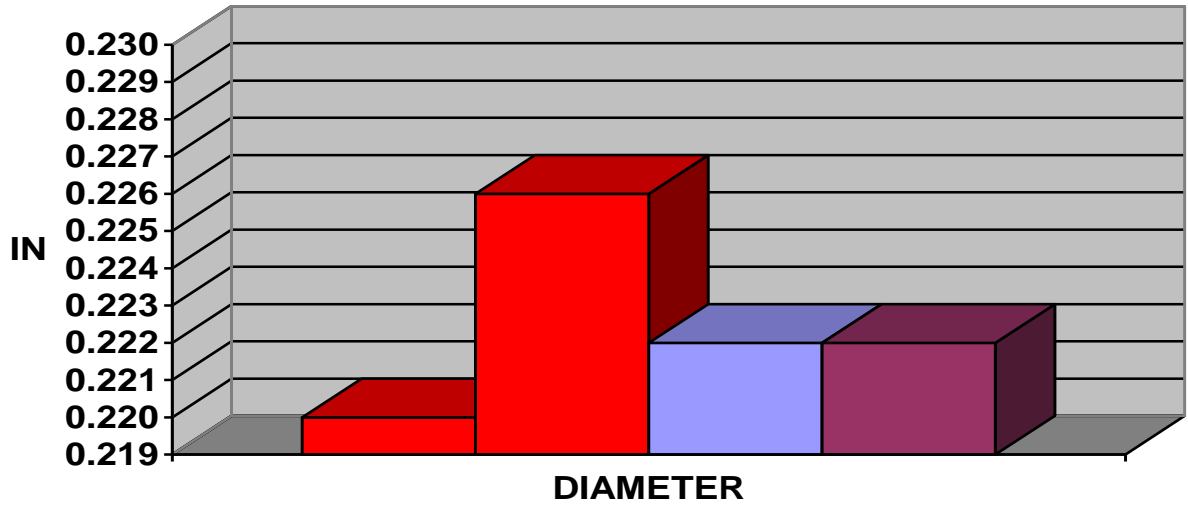
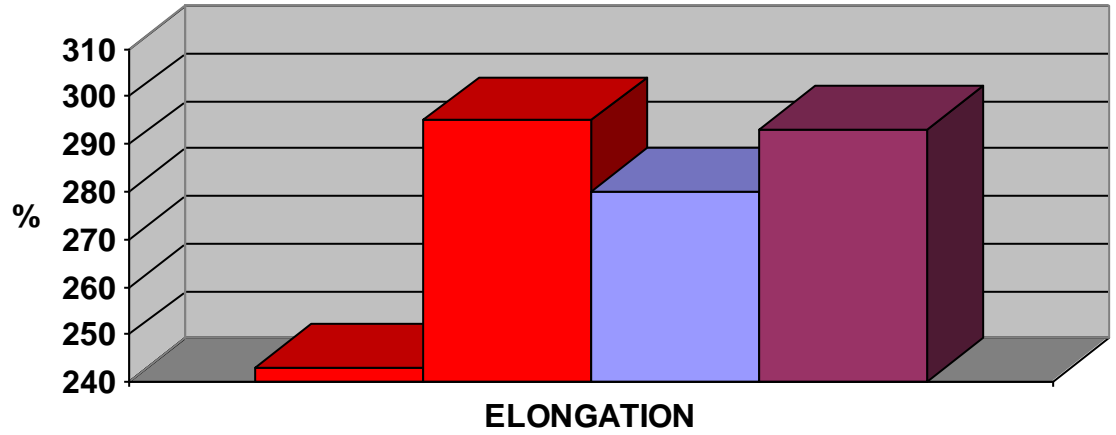
MONTH	SAMPLE	DATE	TIME	ELONGATION	TENSILE	DIAMETER	WALL	TEMP
1	1	3/3/2009	5:10 AM	286	1838	0.222	0.035	69
1	2	3/3/2009	5:25 AM	284	1709	0.223	0.038	69
1	3	3/3/2009	5:40 AM	294	1910	0.222	0.034	69
2	1	3/31/2009	4:00 AM	313	1980	0.221	0.040	68
2	2	3/31/2009	4:15 AM	272	1739	0.221	0.033	68
2	3	3/31/2009	4:30 AM	294	1897	0.224	0.034	68

* Note: The test period and dilution were adjusted to accommodate the availability of this fluid.

ILOCUT 5713



- INIT'L LOW
- INIT'L HIGH
- MONTH 1
- MONTH 2



RESULTS SUMMARY

Chemical	Test Duration (Weeks)	Avg Tensile Strength (PSI)			Avg Elongation (%)			Avg Diameter (IN.)		
		Initial	Final	% Retention	Initial	Final	% Retention	Initial	Final	% Change
Longtime PD-1	24	1857	1816	N/C	278	275	N/C	.223	.228	N/C
Superedge 6768	24	1857	1466	79%	278	278	N/C	.223	.237	+6.3%
Hysol MB 20	24	1857	1574	85%	278	278	N/C	.223	.234	+4.9%
WS3-908F	24	1857	1575	85%	278	273	N/C	.223	.234	+4.9%
Carecut ES2	24	1857	2433	131%	278	261	94%	.223	.223	N/C
Optitemp RB-1	24	1857	2008	108%	278	278	N/C	.223	.228	N/C
Syntilo 9904 with Inhibitor 3	24	1857	1561	84%	278	282	N/C	.223	.234	+4.9%
Hysol MB 50	24	1857	1511	81%	278	280	N/C	.223	.238	+6.7%
Gundrill Oil 2190	8	1857	2079	112%	278	286	N/C	.223	.225	N/C
Ilocut 5713	8	1857	1872	N/C	278	293	105%	.223	.222	N/C

7. CONCLUSIONS

Chemical	Comments	Rating*			
		1	2	3	4
Longtime PD-1	Based on the selected test metrics, the TPE jacket maintained excellent physical integrity during the test. The TPE jacket is recommended in applications that experience continuous contact.				X
Optitemp RB-1	Based on the selected test metrics, the TPE jacket maintained excellent physical integrity during the test. The TPE jacket is recommended in applications that experience continuous contact.				X
Superedge 6768	Based on the selected test metrics, the TPE jacket maintained good physical integrity during the test. The TPE jacket is recommended for applications that experience frequent contact.			X	
Hysol MB 20	Based on the selected test metrics, the TPE jacket maintained good physical integrity during the test. The TPE jacket is recommended for applications that experience frequent contact.			X	
WS3-908F	Based on the selected test metrics, the TPE jacket maintained good physical integrity during the test. The TPE jacket is recommended for applications that experience frequent contact.			X	
Carecut ES2	Based on the selected test metrics, the TPE jacket showed acceptable physical degradation during the test. The increase in tensile strength, may result in a reduction in flexibility. The TPE jacket is considered to have good resistance to this fluid and is recommended in applications that experience frequent contact.			X	
Inhibitor 3 with Syntilo 9904	Based on the selected test metrics, the TPE jacket good physical integrity during the test. The TPE jacket is recommended for applications that experience frequent contact.			X	
Hysol MB 50	Based on the selected test metrics, the TPE jacket showed good physical integrity during the test. The TPE jacket is recommended in applications that experience frequent contact.			X	
Gundrill Oil 2190	Based on the selected test metrics, the TPE jacket showed acceptable physical degradation during the test. Based on the shorter duration (8 weeks) of testing, the TPE jacket is considered to have good resistance to this fluid and is recommended in applications that experience frequent contact.			X	
Ilocut 5713	Based on the selected test metrics, the TPE jacket showed acceptable physical degradation during the test. Based on the shorter duration (8 weeks) of testing, the TPE jacket is considered to have good resistance to this fluid and is recommended in applications that experience frequent contact.				X

***Fluid Resistance Rating Key:**

- 1 = No Contact (Poor)
- 2 = Occasional Contact (Fair)
- 3 = Frequent Contact (Good)
- 4 = Continuous Contact (Excellent)