

TEST REPORT

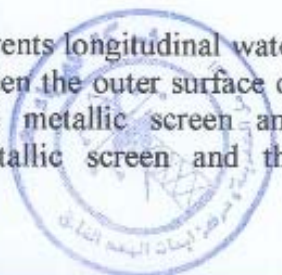
REPORT No. (227/2004)

- **CLIENT:** EGYTECH Cable Co. (EL-SEWEDY).
- **Report Date:** Dec. 2004
- **Place:**
 - Laboratories of Extra High Voltage Research Center.
- **Requirements:**
 - Type tests according to IEC 60840.
- **Standard Specification:**
 - International standard IEC 60840 " Power cables with extruded insulation and their accessories for rated voltages above 30 kV ($U_m = 36$ kV) up to 150 kV ($U_m = 170$ kV).
- **Description of the Specimen :**
 - 38/66 kV Power cable with the following specification:
 - Manufacturer : EGYTECH Cable Co., Cairo, Egypt.
 - Type : 38/66 kV- CU/XLPE/Copper wire + tape sheath/HDPE /
1 x 400 mm²
 - Year of Manufacture : 2004
 - No. of Phases : 1
 - Insulation : XLPE
 - Conductor Material : Copper
 - Conductor cross-section : 400 mm²
 - Screening Material : Copper
 - Sheath Material : HDPE (ST₇)
 - Sheath Color : Black
 - Rated Frequency : 50 Hz
 - Water Penetration Design : A barrier is included which prevents longitudinal water penetration along the gap between the outer surface of the insulation screen and the metallic screen and another one between the metallic screen and the Aluminum PE tape.

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▪ **Description of the Equipment:**

- High voltage reactor – 400 kV – 5000 KVA – 50 Hz – Type: (RSK) – Serial No. 204322/99.
- PD detector – Type: (TE57).
- Tan δ measurement device – Type 254/321/02 Serial No. 144281.
- Standard capacitor – Type NK400 Serial No. 434321.
- Impulse voltage generator 800 kV – 20 kJ – Type SGSA 800-20.
- Air oven up to 300 °C – Type BINDER - Serial No. 02-32772.
- Universal testing machine up to 25 kN – Type TABLE TOP – Model APEX-T5000 Serial No. 2095.

▪ **Test Samples:**

- Test sample was chosen under the responsibility of the client.

▪ **Tests:**

1- Electrical Type Tests on Completed Cable:

- 1.1 Check of insulation thickness of cable before electrical type tests
- 1.2 Bending test on the cable followed by partial discharge test.
- 1.3 **Tan δ** measurement.
- 1.4 Heating cycle voltage test followed by partial discharge test.
- 1.5 Impulse voltage test followed by a power frequency voltage test.
- 1.6 Resistivity of semi-conducting screens.

2- Non-Electrical Type Tests on Cable Components and on Completed Cable:

- 2.1 Check of cable construction.
- 2.2 Tests for determining the mechanical properties of insulation before and after ageing
- 2.3 Tests for determining the mechanical properties of non-metallic sheaths before and after ageing
- 2.4 Ageing tests on pieces of complete cable to check compatibility of materials
- 2.5 Hot set test for XLPE insulation.
- 2.6 Water penetration test.

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3- Verification Of Cable Construction.

▪ Test Method and Results:

1- Electrical Type Tests on Completed Cable:

1.1. Check of insulation thickness before electrical type tests:

- Prior to the electrical type tests the insulation thickness was measured in accordance with clause 11.3.1 of IEC 60480 (1999).
- The measured value of the insulation thickness is shown in the following table

| Average thickness (mm) | Specified thickness (mm) | Requirement |
|---------------------------|-----------------------------|--|
| 12.6 | 12 | The average thickness of the insulation doesn't exceed the specified value by more than 5% |

1.2. Bending test on the cable followed by partial discharge test:

1.2.1 Bending test:

- The test cable was subjected to a bending test at ambient temperature in accordance with clause 11.3.4 of IEC 60840 (1999). The test cable was bent around a test cylinder. The diameter of the cylinder was 2270 mm. The test consisted of three cycles. The test object was bent for one complete turn. It was then unwound. The process repeated, except that the bending of the sample was in the reverse direction.

| Outer diameter of cable D (mm) | Diameter of conductor d (mm) | Requirement of bending diameter $< 25(D+d) \pm 5\%$ (mm) | Hub diameter of drum (mm) |
|--------------------------------------|------------------------------------|---|---------------------------------|
| 63.5 | 23 | 2054 - 2270 | 2270 |

1.2.2 Partial discharge test:

- The test cable was subjected to a partial discharge test in accordance with clause 11.3.5 of IEC 60840 (1999). The test voltage was raised gradually to and held at $1.75 U_0$ for 10 s and then slowly reduced to $1.5 U_0$.

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- The measured value of the partial discharge level is shown in the following table

| Applied voltage (kV) | Duration (S) | Max. partial discharge level (PC) | Measured partial Discharge level (PC) |
|----------------------|--------------|-----------------------------------|---------------------------------------|
| 66.5 | 10 | -- | -- |
| 57 | -- | ≤ 5 | < 0.71 |

- The Figure of the PD- Scope is illustrated in page (11) of this report.
- The cable passed the test.

1.2. Tan δ measurement:

- Another sample test cable was subjected to a $\tan \delta$ measurement in accordance with clause 11.3.6 of IEC 60840 (1999). The test object was heated by passing a current through the conductor until it reached a steady temperature, which was 98 °C. The $\tan \delta$ was measured at a power frequency voltage of U_0 at the temperature specified above.
- The measured value of $\tan \delta$ level is shown in the following table

| Applied voltage (kV) | Maximum allowable value for $\tan \delta (x 10^{-4})$ | $\tan \delta (x 10^{-4})$ [Measured value] |
|----------------------|---|---|
| 38 | 10 | 3.57 |

- The cable passed the test.

1.3. Heating Cycle Voltage Test followed by partial discharge test:

1.4.1 Heating Cycle Voltage Test:

- The test cable was subjected to a heating cycle voltage test in accordance with clause 11.3.7 of IEC 60840 (1999). The test object was heated by passing a current through the conductor until it reached a steady temperature, which was 98 °C. The heating was applied for 8 h. The conductor temperature was maintained within the stated temperature limits for 4 h of each heating period. This was followed by 16 h of natural cooling. The cycle of heating and cooling was carried out 20 times. During the whole of the test period a voltage of $2 U_0$ was applied to the test object.
- The result of the heating cycle voltage test is shown in the following table.

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| No. of heating cycles | Required conductor temperature (°C) | Applied heating current (A) | Heating | | Cooling time (h) | Applied voltage continuously (kV) |
|-----------------------|-------------------------------------|-----------------------------|------------------------|----------------------------------|------------------|-----------------------------------|
| | | | Total heating time (h) | Duration of heating at 98 °C (h) | | |
| 20 | $95 \leq t \leq 100$ | 1170-1190 | 8 | 4 | 16 | 76 |

- The cable passed the test.

1.4.2 Partial discharge test:

- After the last heat cycle, partial discharge was measured for the test cable at ambient temperature in accordance with clause 11.3.7 of IEC 60840 (1999). The measurement was carried out as mentioned above under item 1.2.2.
- The measured value of the partial discharge level is shown in the following table.

| Applied voltage (kV) | Duration (S) | Max. partial discharge level (PC) | Measured partial Discharge level (PC) |
|----------------------|--------------|-----------------------------------|---------------------------------------|
| 66.5 | 10 | -- | -- |
| 57 | -- | ≤ 5 | < 1.5 |

- The Figure of the PD- Scope is illustrated in page (12) of this report.
- The cable passed the test.

1.4. Impulse voltage test followed by a power frequency voltage test:

1.5.1 Impulse Voltage Test:

- The test cable was subjected to a lightning impulse voltage withstand test in accordance with clauses 11.3.8 of IEC 60840 (1999). The test was performed on the sample at a conductor temperature of 98 °C. The cable withstood 10 positive and 10 negative voltage impulses with crest value of 325 kV without failure.
- The results were illustrated by the Figures in page No. (13) of this report.
- The cable passed the test.

1.5.2 Power Frequency Voltage Test:

- After the impulse voltage test, the test cable was subjected to power frequency voltage test of $2.5U_0$ for 15 min. in accordance with clause 11.3.8 of IEC 60840 (1999).

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- The result of the power frequency voltage test is shown in the following table

| Applied voltage (kV) | Frequency (Hz) | Duration (min) | Observations |
|-------------------------|-------------------|-------------------|--------------|
| 95 | 50 | 15 | No breakdown |

- The cable passed the test.

1.5. Resistivity of semi-conducting screens:

- The measurement of the resistivity of the semi-conducting screens were carried out in accordance with clause 11.3.9 of IEC 60840 (1999). The resistivity of extruded semi-conducting screens applied over the conductor and over the insulation was determined by measurements on test pieces taken from the core of a sample of cable as manufactured and a sample of cable which has been subjected to the ageing treatment to test the compatibility of component materials specified in IEC 60840 (1999). The measurements were made at a temperature of 90 °C.
- The results of Resistivity of semi-conducting screens are shown in the following table

| Item | Unit | Requirement | Measured/ Determined |
|--------------------------|------------|-------------|-------------------------|
| Conductor screen | | | |
| - without ageing | Ωm | ≤ 1000 | 10.9 |
| - after ageing | Ωm | ≤ 1000 | 0.7 |
| Insulation screen | | | |
| - without ageing | Ωm | ≤ 500 | 6.7 |
| - after ageing | Ωm | ≤ 500 | 7.7 |

- The cable passed the test.

2- Non-Electrical Type Tests on Cable Components and on Completed Cable:

2.1. Check of Cable Construction:

- The examination of the conductor and measurements of insulation and sheath thickness was carried out in accordance with clause 11.4.1 of IEC 60840 (1999).
- The result of examination of the conductor and measurements are shown in the following table.

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| Item | Unit | Requirement | Measured/ determined |
|---|------|-------------|-------------------------|
| Conductor (IEC 228, Class2) | | | |
| - No. of wires | — | > 53 | 55 |
| Thickness of insulation | | | |
| - minimum | mm | ≥ 10.8 | 10.8 |
| - $(t_{max} - t_{min}) / t_{max}$ | - | ≤ 0.15 | 0.15 |
| Thickness of non-metallic sheath | | | |
| - average | mm | ≥ 3 | 4.03 |
| - minimum | mm | ≥ 2.45 | 2.5 |

- The cable passed the check.

2.2. Tests for determining the mechanical properties of insulation before and after ageing:

- The mechanical properties of insulation before and after ageing were determined in accordance with clause 11.4.2 of IEC 60840 (1999).
- The results of the mechanical properties of insulation before and after ageing are shown in the following table.

| Item | Unit | Requirement | Measured/ determined |
|---|-------------------|-------------|-------------------------|
| Without ageing | | | |
| -tensile strength | N/mm ² | ≥ 12.5 | 24.38 |
| -elongation | % | ≥ 200 | 483 |
| after ageing in air oven | | | |
| -Min. tensile strength | N/mm ² | --- | 24.22 |
| -Max. variation with samples without ageing | % | ± 25 | - 0.7 |
| -Min. elongation | % | --- | 512 |
| -Max. variation with samples without ageing | % | ± 25 | + 6 |

- The results of insulation before ageing showed in attached figures in pages (14, 15, 16, 17, 18) of this report.
- The results of insulation after ageing are showed in attached figures in pages (19, 20, 21, 22, 23) of this report.
- The cable passed the test.

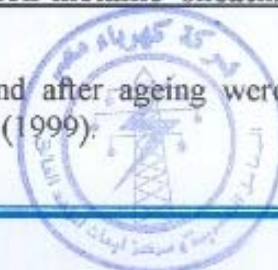
2.3. Tests for determining the mechanical properties of non-metallic sheaths before and after ageing :

- The mechanical properties of the outer sheath before and after ageing were determined in accordance with clause 11.4.3 of IEC 60840 (1999).

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- The results of the mechanical properties of non-metallic sheaths before and after ageing are shown in the following table.

| Item | Unit | Requirement | Measured/ determined |
|--|-------------------|-------------|-------------------------|
| Without ageing | | | |
| -tensile strength | N/mm ² | ≥ 10.0 | 24.6 |
| -elongation | % | ≥ 300 | 696 |
| after ageing | | | |
| -Min. tensile strength | N/mm ² | --- | 27.45 |
| -Max. variation with samples without ageing | % | --- | + 11.6 |
| -elongation | % | ≥ 300 | 717 |
| -Max. variation with samples without ageing | % | --- | + 3 |

- The results of the outer sheath before ageing are showed in attached figures in pages (24, 25, 26, 27, 28) of this report.
- The results of the outer sheath after ageing are showed in attached figures in pages (29, 30, 31, 32, 33) of this report.
- The cable passed the test.

2.4. Ageing Tests on Pieces of Completed Cable to Check Compatibility of Materials:

- Ageing tests on pieces of completed cable were carried out in accordance with clause 11.4.4 of IEC 60840 (1999).
- The results of the mechanical properties of completed cable are shown in the following table.

| Item | Unit | Requirement | Measured - determined |
|--|-------------------|-------------|--------------------------|
| Insulation | | | |
| -Min. tensile strength | N/mm ² | --- | 27.23 |
| -Max. variation with samples without ageing | % | ± 25 | + 11.7 |
| -Min. elongation | % | --- | 528 |
| -Max. variation with samples without ageing | % | ± 25 | + 9.3 |
| Sheath | | | |
| -tensile strength | N/mm ² | --- | 23.52 |
| -variation with samples without ageing | % | --- | - 4.4 |
| -elongation | % | ≥ 300 | 719 |
| -variation with samples without ageing | % | --- | + 3.5 |

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- The results of insulation after ageing showed in attached figures in pages (34, 35, 36, 37, 38) of this report.
- The results of the outer sheath after ageing showed in attached figures in pages (39, 40, 41, 42, 43) of this report.
- The cable passed the test.

2.5. Hot set test for XLPE insulation:

- A hot set test for the XLPE insulation was carried out in accordance with clause 11.4.10 of IEC 60840 (1999).
- The results of the hot set test for the XLPE insulation are shown in the following table.

| Item | Unit | Requirement | Measured |
|------------------------|------|-------------|----------|
| -elongation under load | % | ≤ 175 | 70 |
| -permanent elongation | % | ≤ 15 | 1.5 |

- The cable passed the test.

2.6. Water penetration test :

- The water penetration test was carried out in accordance with clause 11.4.15 of IEC 60840 (1999). In total 3m cable was used for this test. The cable was tested for longitudinal water tightness along the gap between the outer surface of the insulation screen and the metallic screen and over the metallic screen.

| No. of heating cycles | Required conductor temperature (°C) | Heating | | Cooling time (h) |
|-----------------------|-------------------------------------|------------------------|----------------------------------|------------------|
| | | Total heating time (h) | Duration of heating at 98 °C (h) | |
| 10 | 98 | 8 | 4 | 16 |

- After completion of the 10 heating cycles no water emerged from the ends of the cable
- The cable passed the test.

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3- Construction:

- The construction of the cable was checked against the manufacturer specification.
- The results are shown in the following table.

| Items | Determination |
|--------------------------------------|---|
| - Marking of the cable | ELSEWEDY CABLES (EGC) 400 mm ² 66 kV / CU / XLPE / Copper wire + tape sheath/ / HDPE. |
| - Color of the outer sheath | Black |
| Cable construction | <ul style="list-style-type: none"> - 55 copper wires. - Extruded semi-conducting material. - XLPE insulation. - Semi conducting water blocking tape. - Copper wire + tape screen. - Non-conductive water blocking tape. - Aluminum PE tape. - HDPE. ST₇ over sheath. - Semi-conductive jacket |
| Outer diameter of the cable (mm) | 64.95 (average) |
| Outer diameter of the conductor (mm) | 23.8 |

▪ Conclusion :

- The 38/66 kV/CU/XLPE/Copper wire + tape sheath/HDPE / 1x 400 mm² manufactured by EGYTECH Cables Co fulfilled the requirements of tests mentioned in this report according to IEC (60840).

▪ Notes:

- The tests were carried out without any obligation on Egyptian Electricity Holding Company
- This test report shall not be reproduced except in full, without written approval of EHVR.

▪ TEST ENGINEERS:

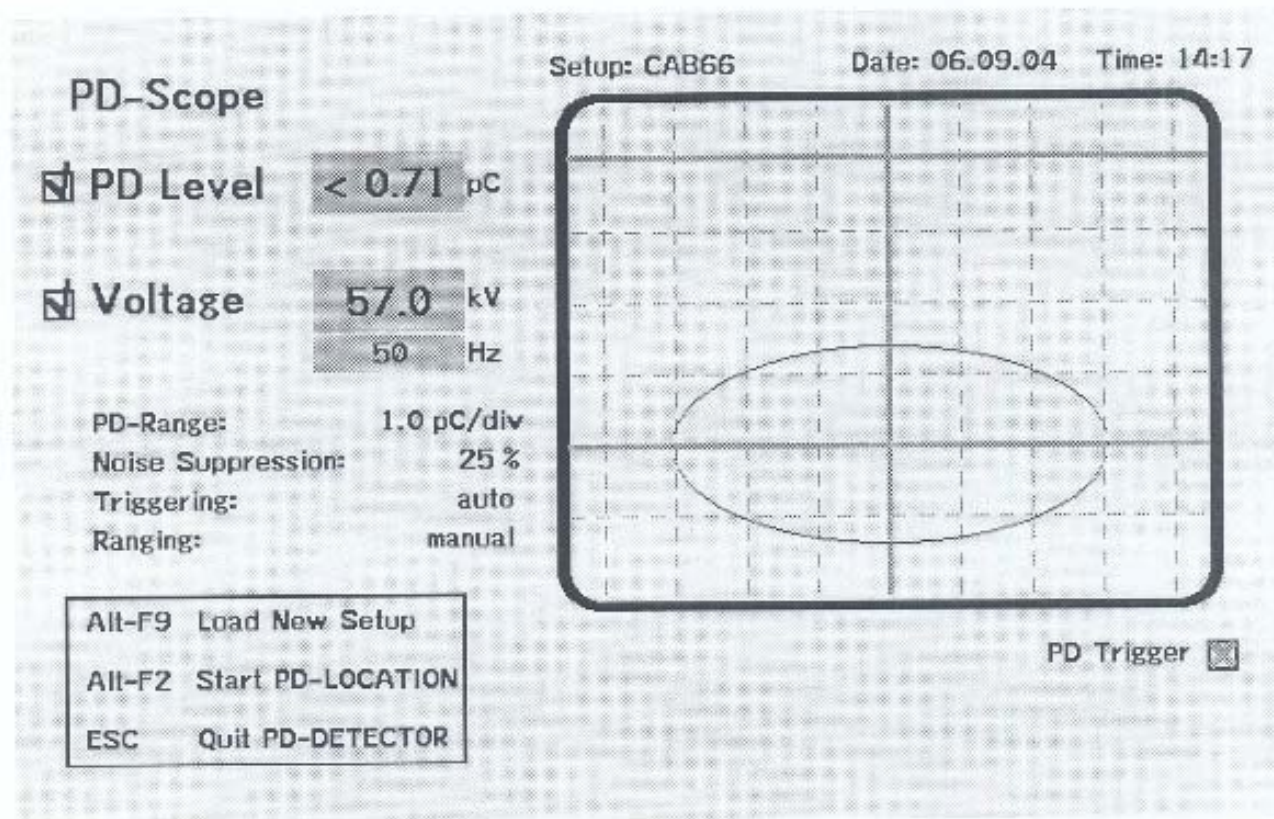
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GENERAL MANGER

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10.1.05

Measurement Results of Partial Discharge for
 Power Cable 38/66 kV – 1 × 400 mm² (EGYTECH Cable)
 (Before Heating Cycle)



- Ambient temp. : 29 °C.
- Calibrate on at : 5 PC.

Test Engineer : *Anr*

Adel

Hoda



Measurement Results of Partial Discharge for
Power Cable 38/66 kV – $1 \times 400 \text{ mm}^2$ (EGYTECH Cable)
(After Heating Cycle conductor at ambient temperature)

PD-Scope

Setup: CAB66

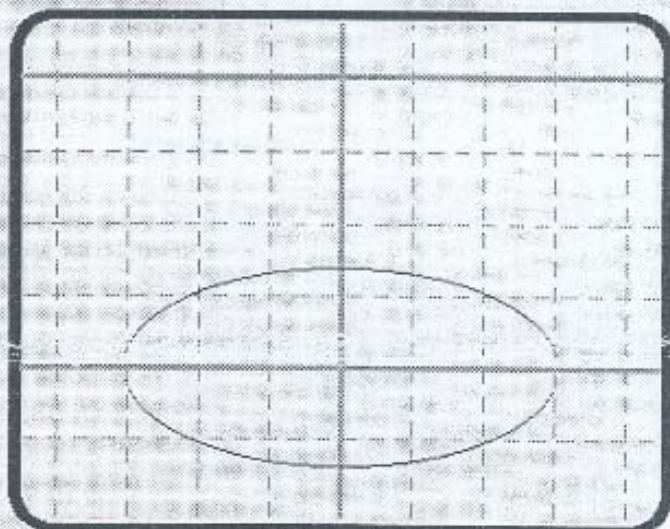
Date: 28.09.04

Time: 11:49

☒ PD Level **< 1.5** pC

☒ Voltage **57.8** kV
50 Hz

PD-Range: **20** pC/div
Noise Suppression: **25** %
Triggering: **auto**
Ranging: **manual**



Alt-F9 Load New Setup
Alt-F2 Start PD-LOCATION
ESC Quit PD-DETECTOR

PD Trigger ☒

- Ambient temp. : 30 °C.
- Calibrate on at : 5 PC.
- Test Engineer : *Amr*

Adel

Hoda



lightning Impulse withstand voltage test
38/66 kV power cable, 400 mm²
Copper conductor (EGYTECH CABLES Co.)

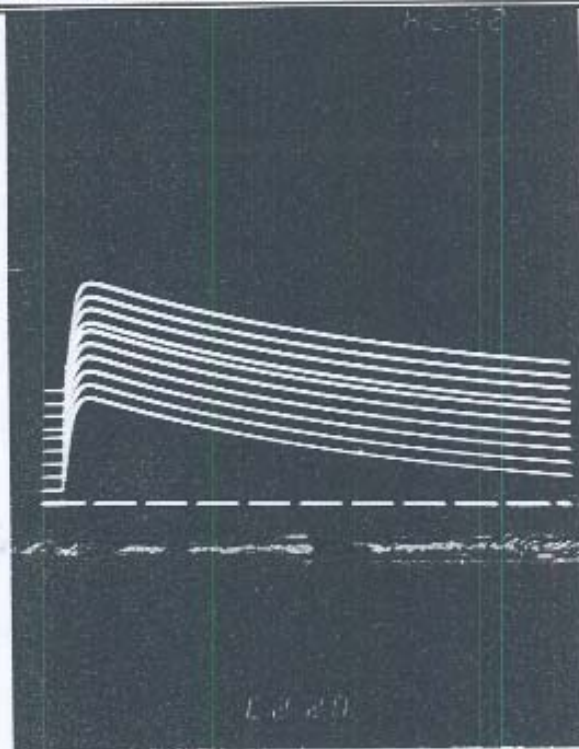
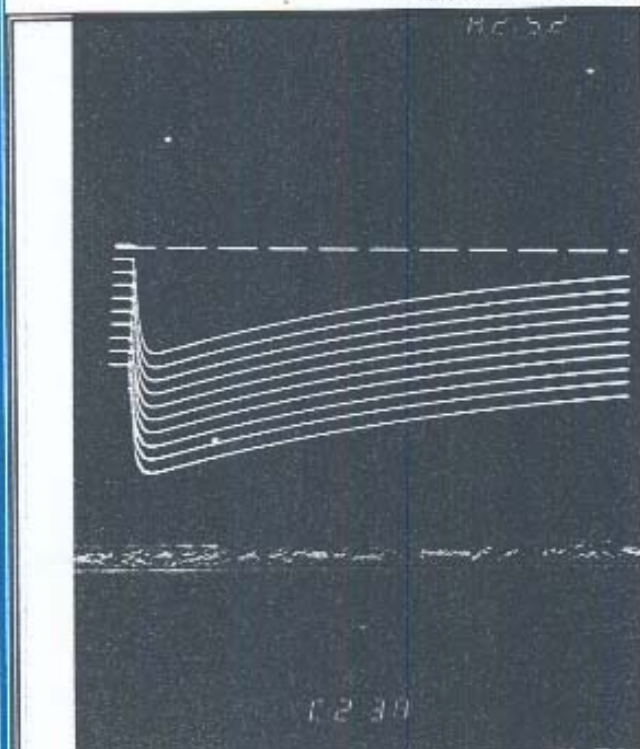


Photo No (214)

Photo No (213)

Ambient Condition :

T = 32 °C

p = 996 MPE

H = 65 %

Atmospheric Correction Factors:

Air density correction Factor Kd = 0.956

Humidity correction Factor Kh = 1.06

Atmospheric Correction Factor K = 1.0133

Test voltage

T.V value before correction = 325 kv

T.V value after correction = 329 kv

Test Voltage Tolerances :

peak = ±3%

Overshoot = +5%

Wave Time Tolerances

Front Time..... = ± 30 %

Time to half value = ± 20 %

M. El-Sherpi



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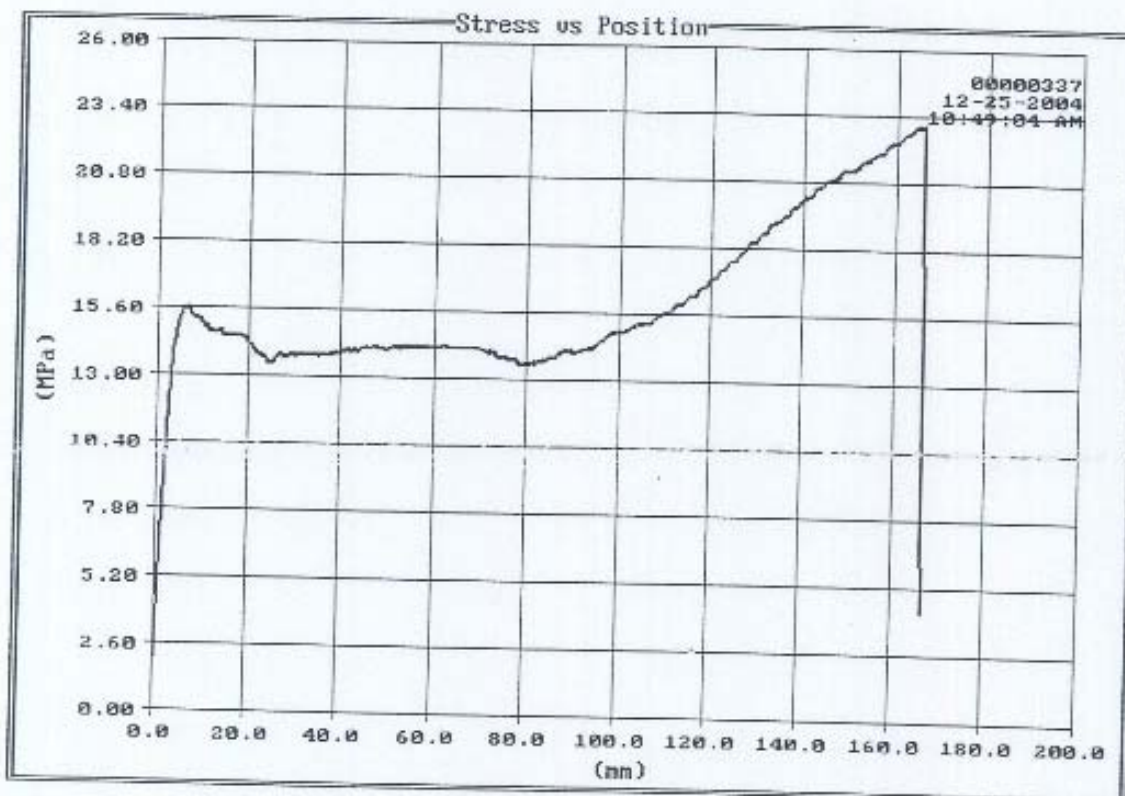
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Procedure Tensile test

Test Date 12-25-2004
Test Time 10:49:04 AM
Elapsed Time 00:00:40

Page 14 of 43
Tested By E.H.V.R.C
Test Counter 00000337
Area 4.0400 mm²

Tensile Strgth 23.0070 MPa
Total Elong 490.00 %

Peak Load 93 N
Init Punch Len 20.000 mm



E. Fawzy

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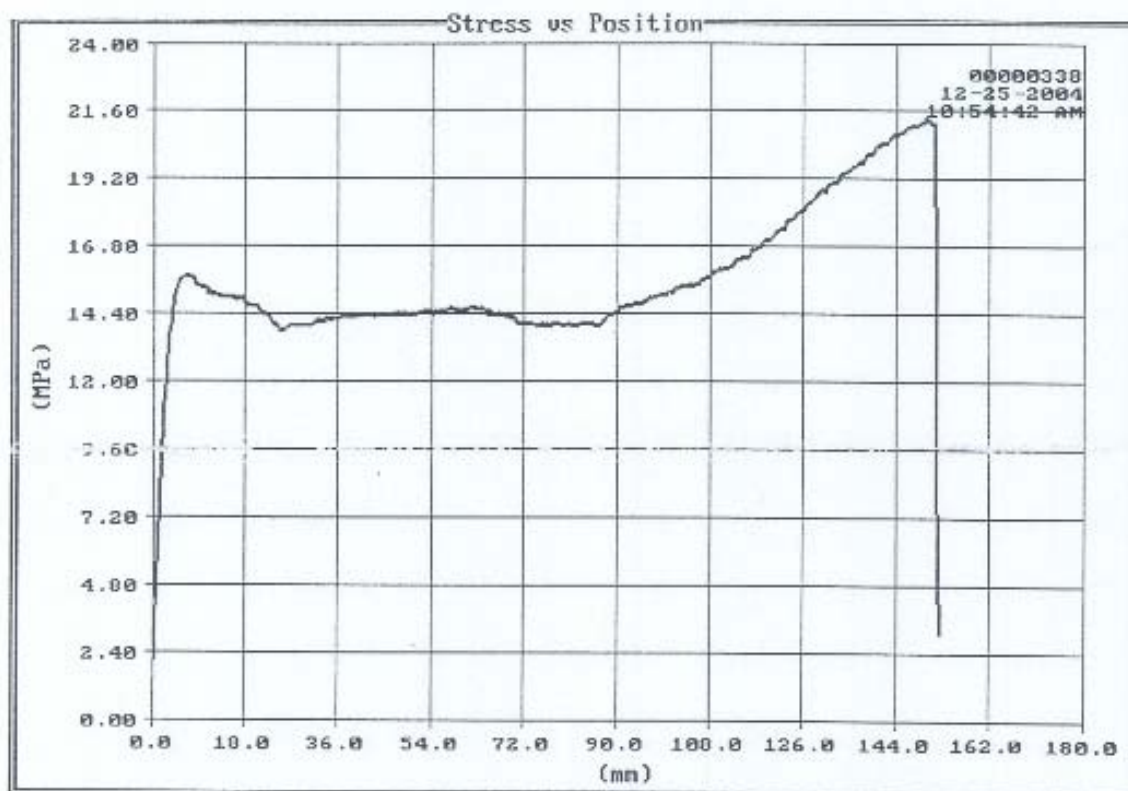
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Area 4.2400 mm²

Tensile Strgth 21.4110 MPa
Total Elong 425.00 %

Peak Load 91 N
Init Punch Len 20.000 mm



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Test Tensile Test
 Procedure Tensile test

Test Date 12-25-2004
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 Elapsed Time 00:00:43

Tested By E.H.V.R.C
 Test Counter 00000339
 Area 4.0400 mm²

Tensile Strgth 25.8570 MPa
 Total Elong 500.00 %

Peak Load 104 N
 Init Punch Len 20.000 mm



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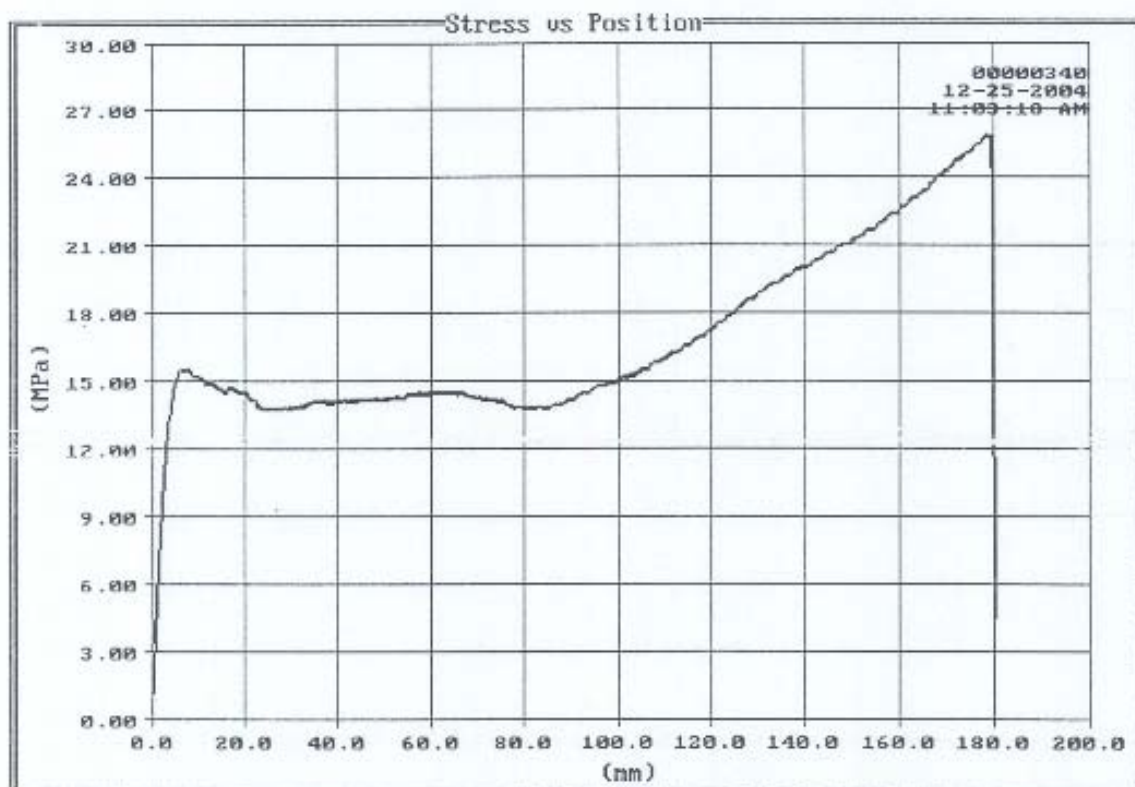
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Elapsed Time 00:00:43

Tested By E.H.V.R.C
Test Counter 00000340
Area 4.1600 mm²

Tensile Strgth 25.7960 MPa
Total Elong 500.00 %

Peak Load 107 N
Init Punch Len 20.000 mm



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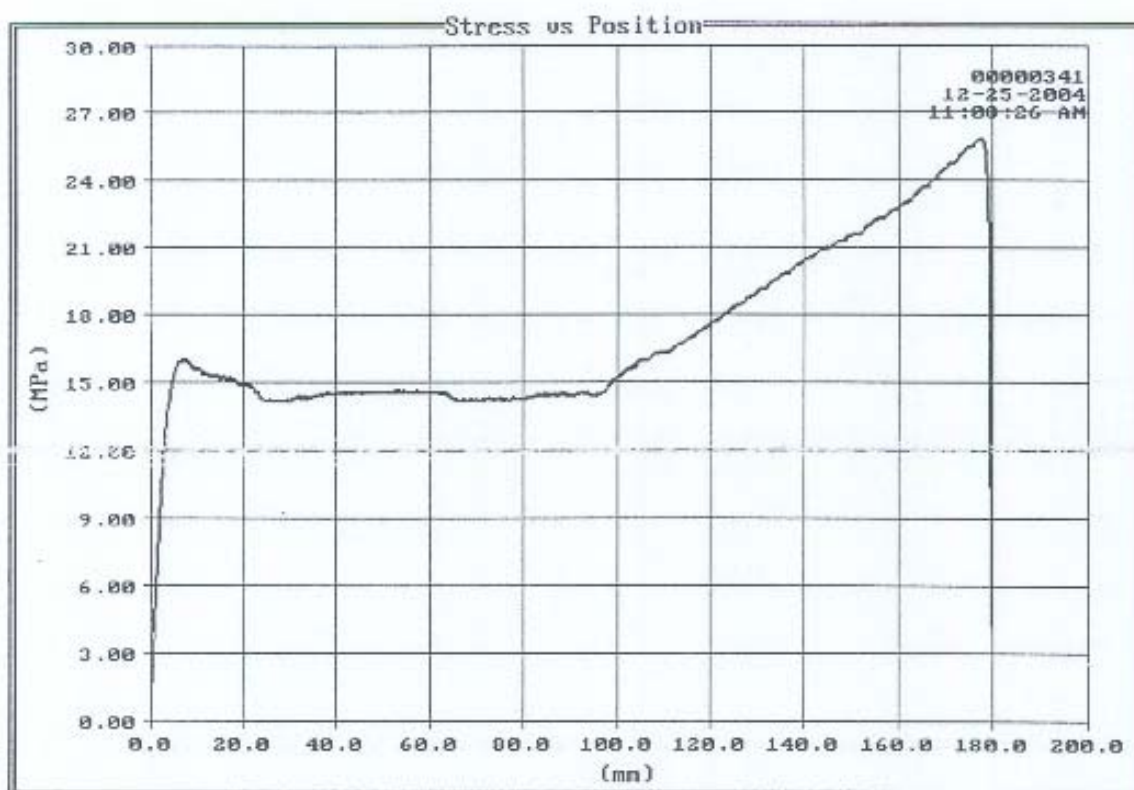
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Elapsed Time 00:00:43

Tested By E.H.V.R.C
Test Counter 00000341
Area 4.0400 mm²

Tensile Strgth 25.8320 MPa
Total Elong 500.00 %

Peak Load 104 N
Init Punch Len 20.000 mm



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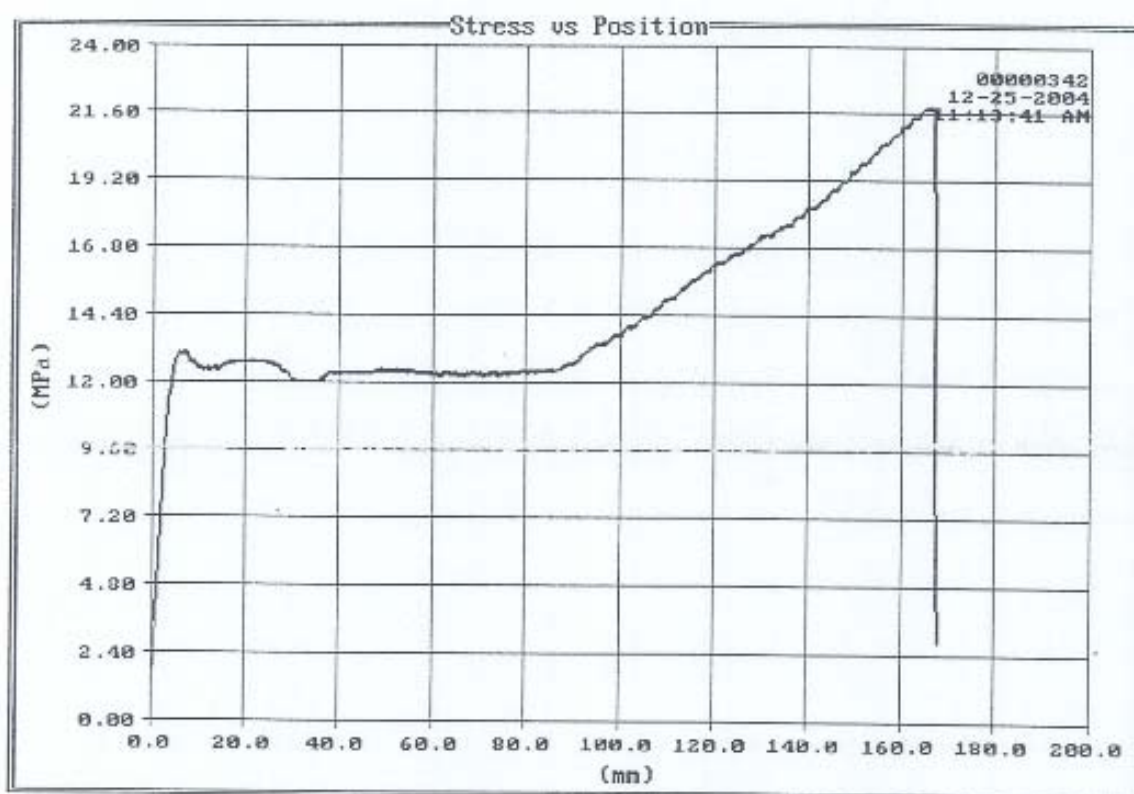
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Procedure Tensile test

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Elapsed Time 00:00:40

Tested By E.H.V.R.C
Test Counter 00000342
Area 4.4000 mm²

Tensile Strgth 22.0940 MPa
Total Elong 475.00 %

Peak Load 97 N
Init Punch Len 20.000 mm



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Test Tensile Test
 Procedure Tensile test

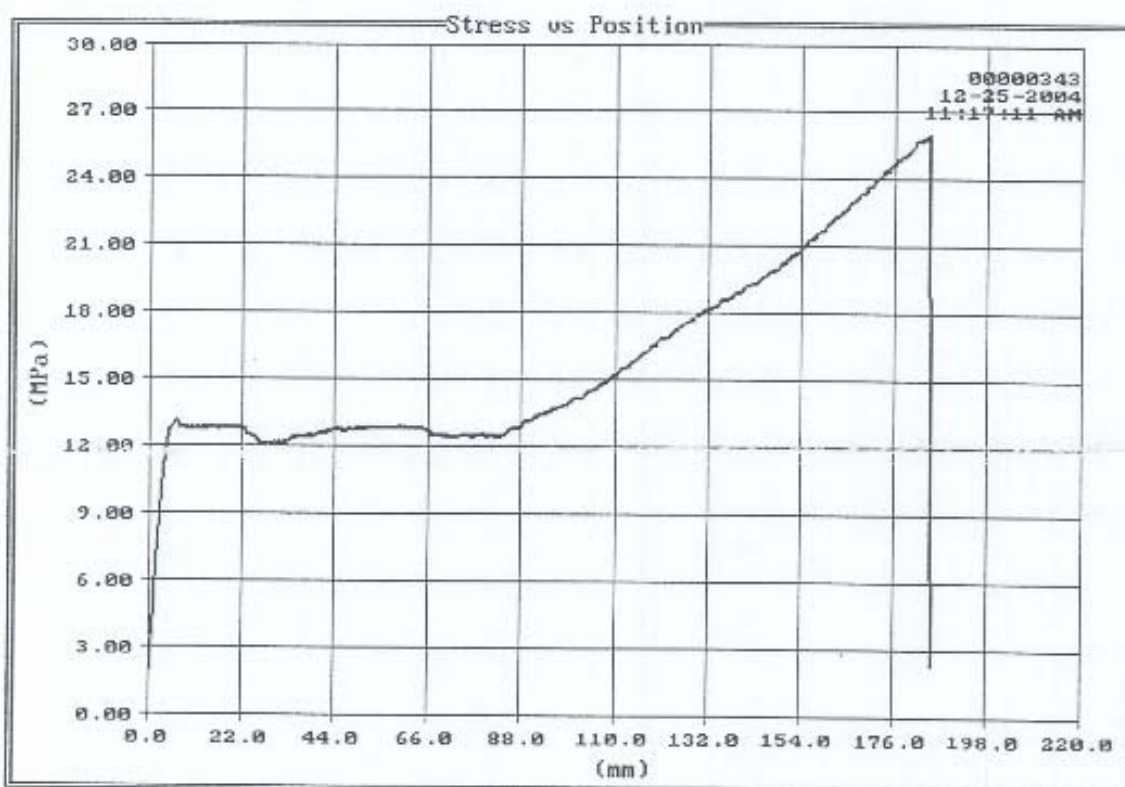
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Tested By E.H.V.R.C
 Test Counter 00000343
 Area 4.2000 mm²

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Tensile Strgth 26.0400 MPa
 Total Elong 525.00 %

Peak Load 109 N
 Init Punch Len 20.000 mm



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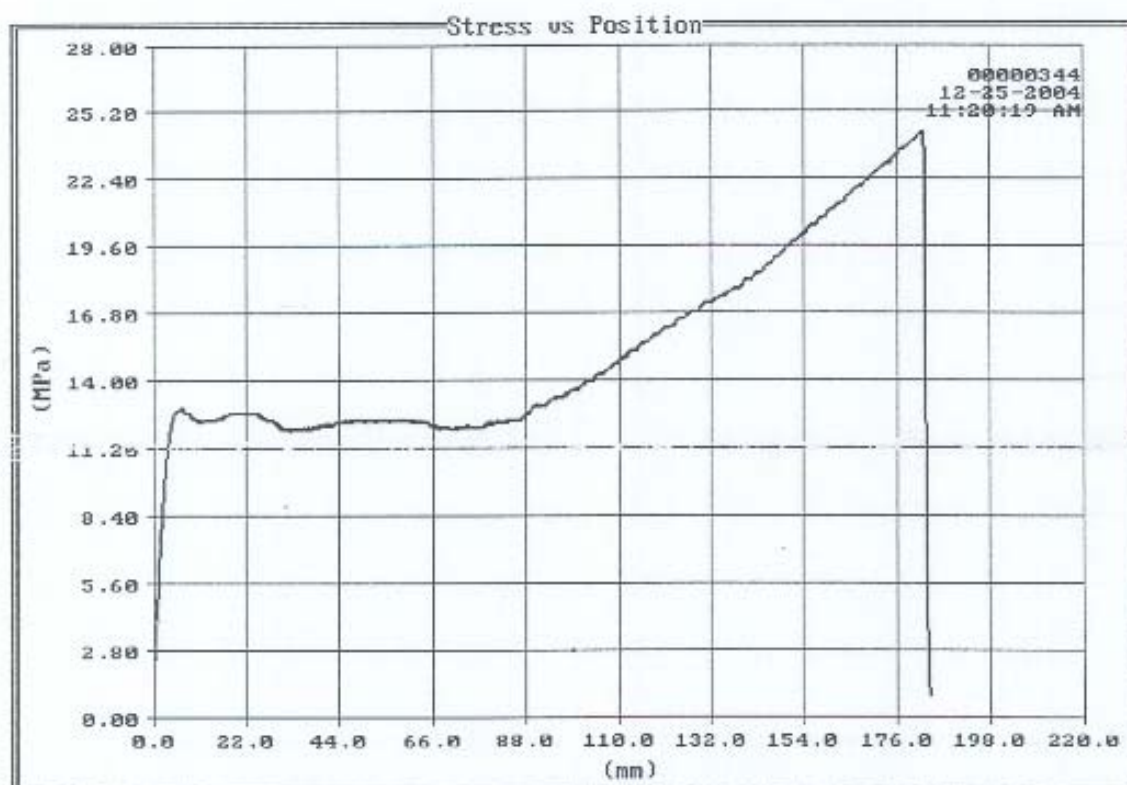
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Elapsed Time 00:00:44

Tested By E.H.V.R.C
Test Counter 00000344
Area 4.4000 mm²

Tensile Strgth 24.2930 MPa
Total Elong 525.00 %

Peak Load 107 N
Init Punch Len 20.000 mm



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Test Tensile Test
Procedure Tensile test

Test Date 12-25-2004
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Elapsed Time 00:00:44

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Tested By E.H.V.R.C
Test Counter 00000345
Area 4.3200 mm²

Tensile Strgth 24.2410 MPa
Total Elong 510.00 %

Peak Load 105 N
Init Punch Len 20.000 mm



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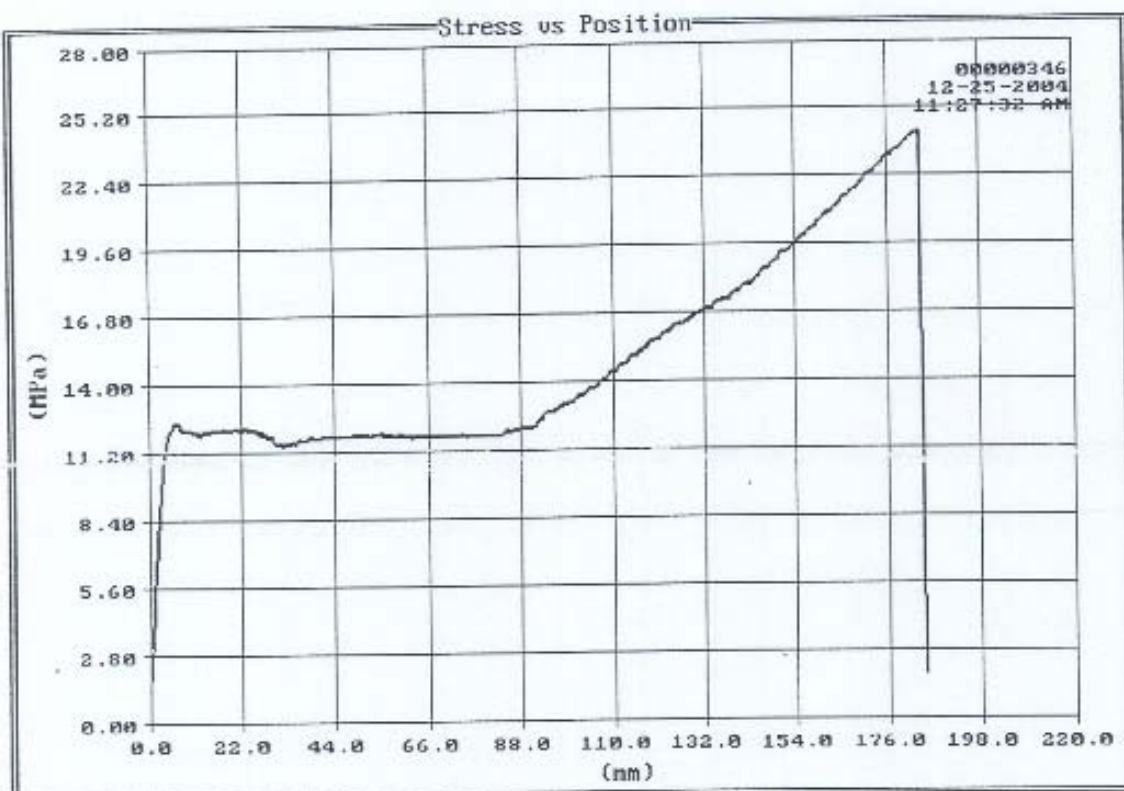
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Elapsed Time 00:00:44

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Test Counter 00000346
Area 4.4000 mm²

Tensile Strgth 24.4390 MPa
Total Elong 525.00 %

Peak Load 108 N
Init Punch Len 20.000 mm



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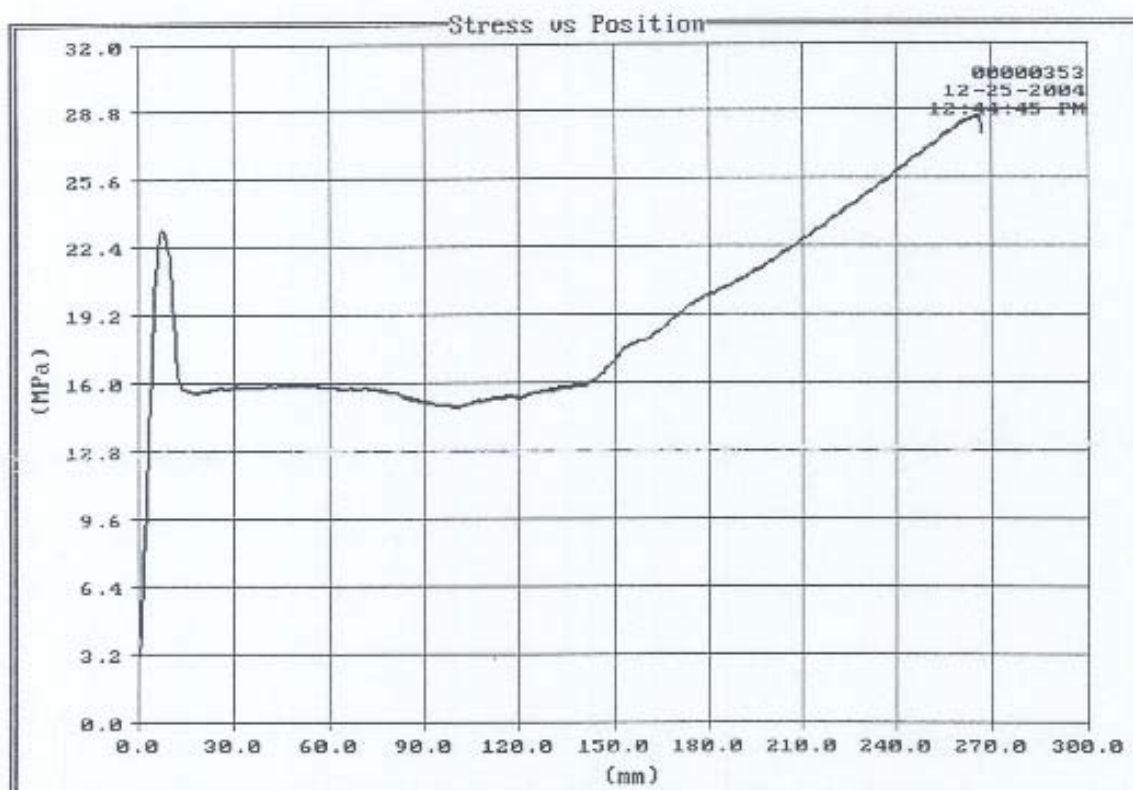
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 Test Time 12:44:45 PM
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Tested By E.H.V.R.C
 Test Counter 00000353
 Area 16.240 mm²

Tensile Strngth 28.4850 MPa
 Total Elong 800.00 %

Peak Load 463 N
 Init Punch Len 20.000 mm



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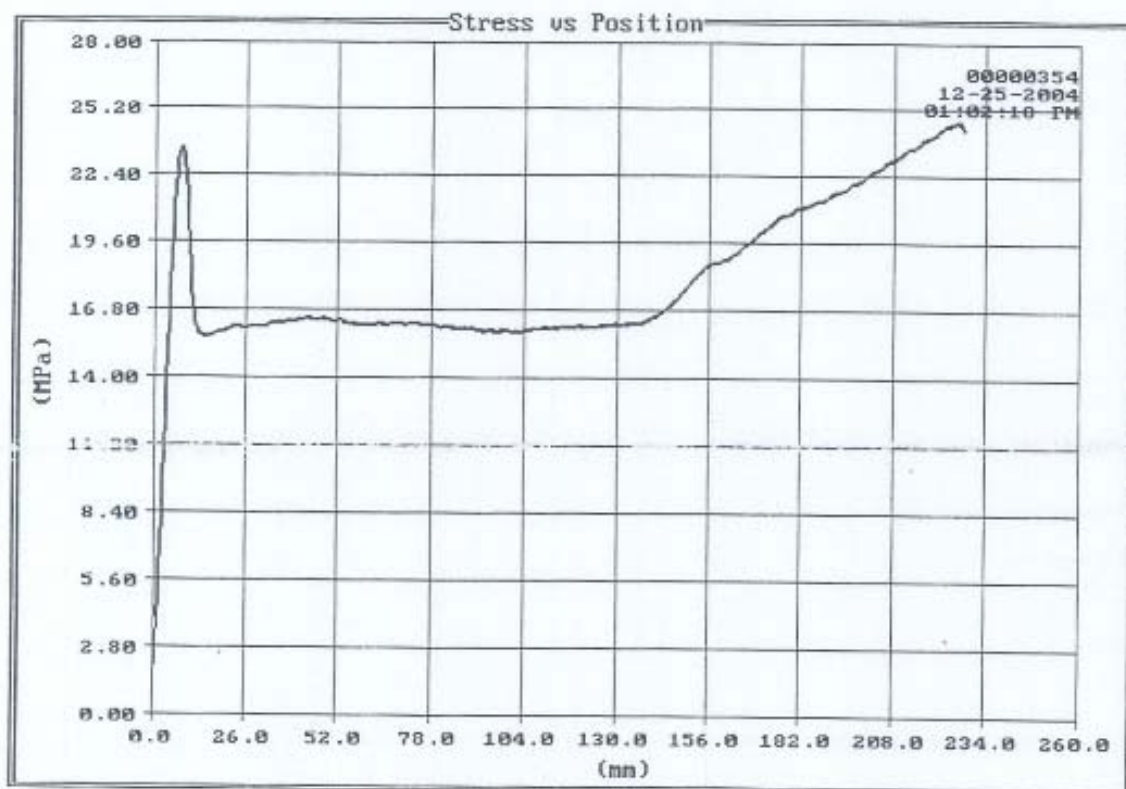
Test Tensile Test
Procedure Tensile test

Test Date 12-25-2004
Test Time 01:02:18 PM
Elapsed Time 00:09:08

Tested By E.H.V.R.C
Test Counter 00000354
Area 16.480 mm²

Tensile Strgth 24.7240 MPa
Total Elong 700.00 %

Peak Load 407 N
Init Punch Len 20.000 mm



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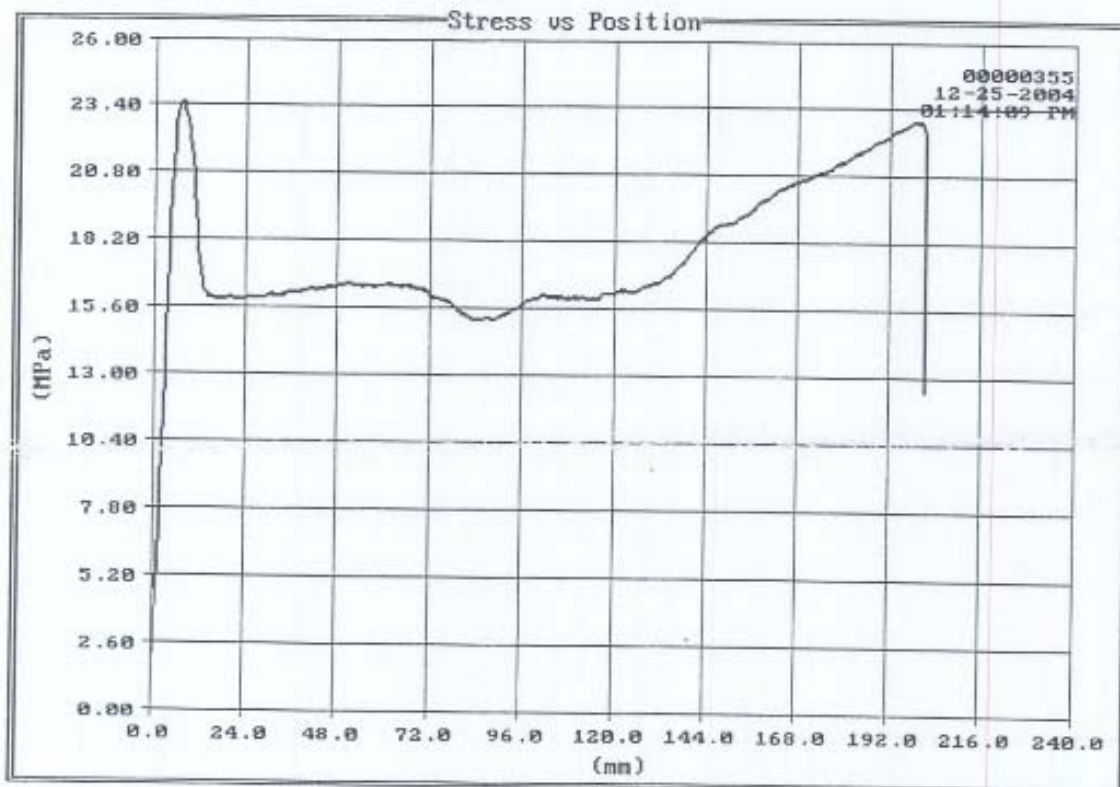
Test Tensile Test
Procedure Tensile test

Test Date 12-25-2004
Test Time 01:14:09 PM
Elapsed Time 00:08:05

Tested By E.H.V.R.C
Test Counter 00000355
Area 16.520 mm²

Tensile Strgth 23.5810 MPa
Total Elong 665.00 %

Peak Load 390 N
Init Punch Len 20.000 mm



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Test Tensile Test
Procedure Tensile test

Test Date 12-25-2004
Test Time 01:24:11 PM
Elapsed Time 00:08:42

Tested By E.H.V.R.C
Test Counter 00000356
Area 15.920 mm²

Tensile Strgth 22.3600 MPa
Total Elong 675.00 %

Peak Load 356 N
Init Punch Len 20.000 mm



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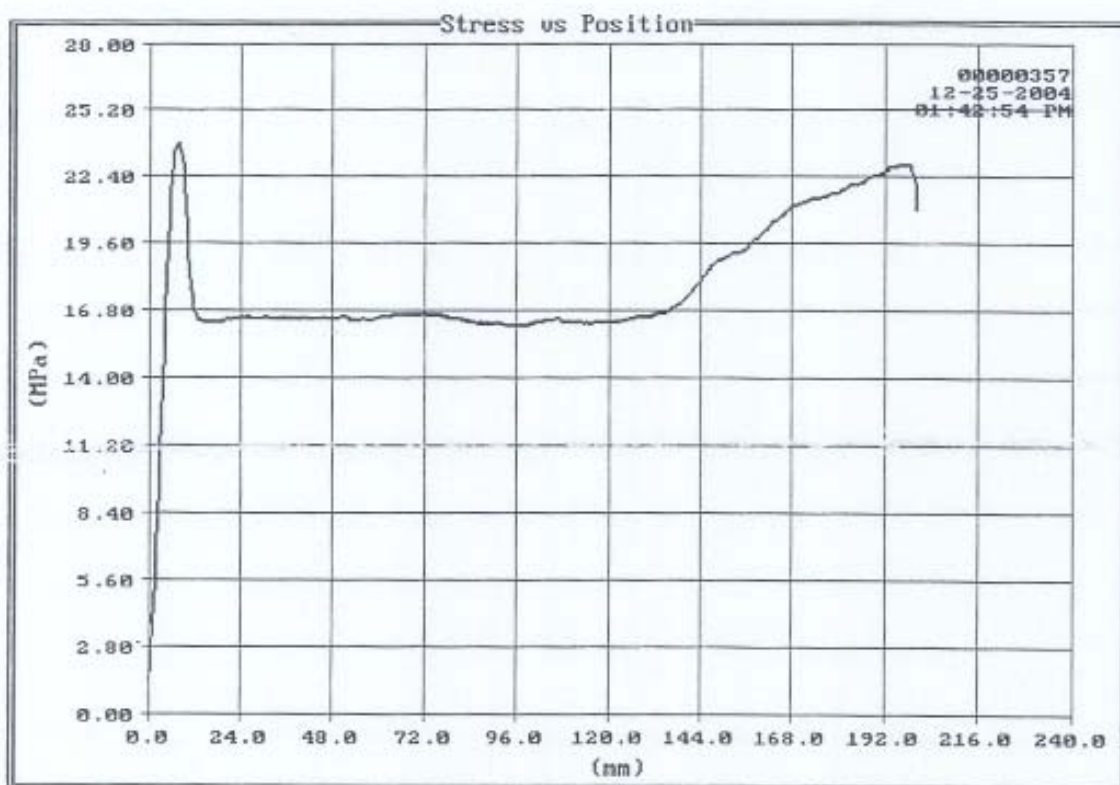
Test Tensile Test
Procedure Tensile test

Test Date 12-25-2004
Test Time 01:42:54 PM
Elapsed Time 00:08:01

Tested By E.H.V.R.C
Test Counter 00000357
Area 16.200 mm²

Tensile Strgth 23.8270 MPa
Total Elong 640.00 %

Peak Load 386 N
Init Punch Len 20.000 mm



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Test Tensile Test
Procedure Tensile test

Test Date 12-25-2004
Test Time 02:02:14 PM
Elapsed Time 00:10:45

Tested By E.H.V.R.C
Test Counter 00000358
Area 16.960 mm²

Tensile Strgth 29.58800 MPa
Total Elong 810.00 %

Peak Load 502 N
Init Punch Len 20.000 mm



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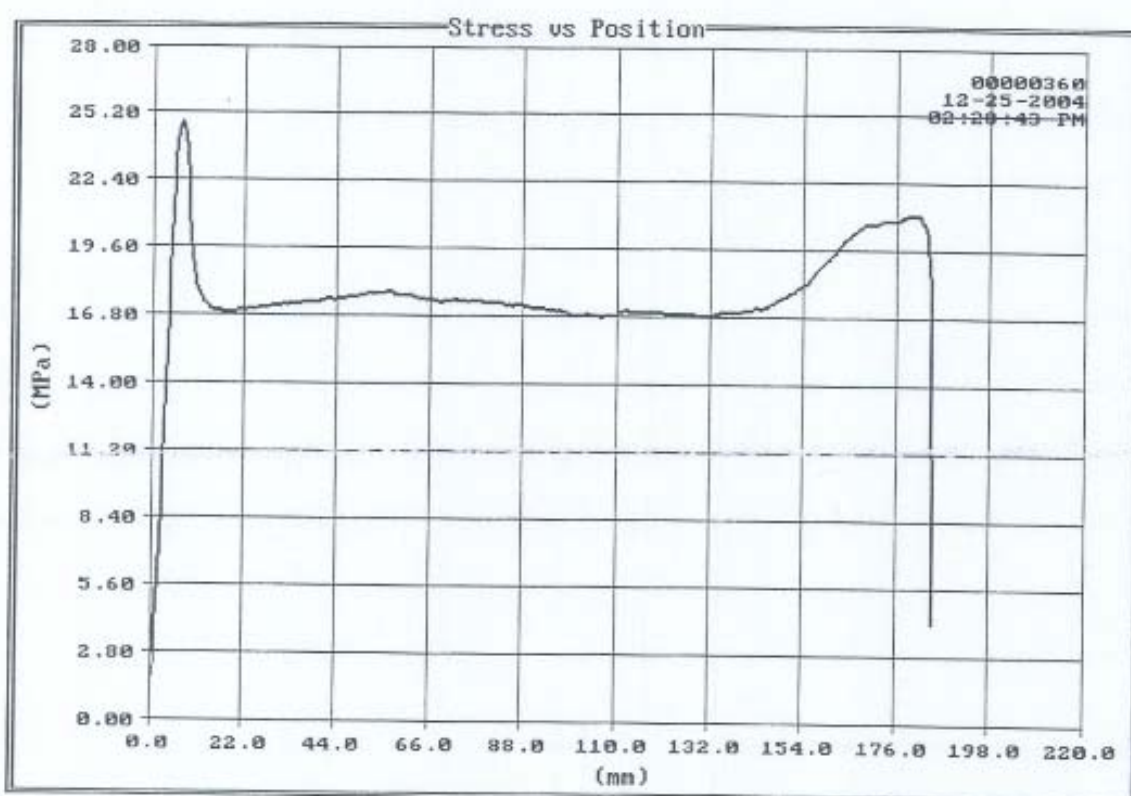
Test Tensile Test
Procedure Tensile test

Test Date 12-25-2004
Test Time 02:28:43 PM
Elapsed Time 00:07:24

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Tested By E.H.V.R.C
Test Counter 00000360
Area 17.080 mm²

Tensile Strgth 24.93300 MPa
Total Elong 625.00 %

Peak Load 426 N
Init Punch Len 20.000 mm



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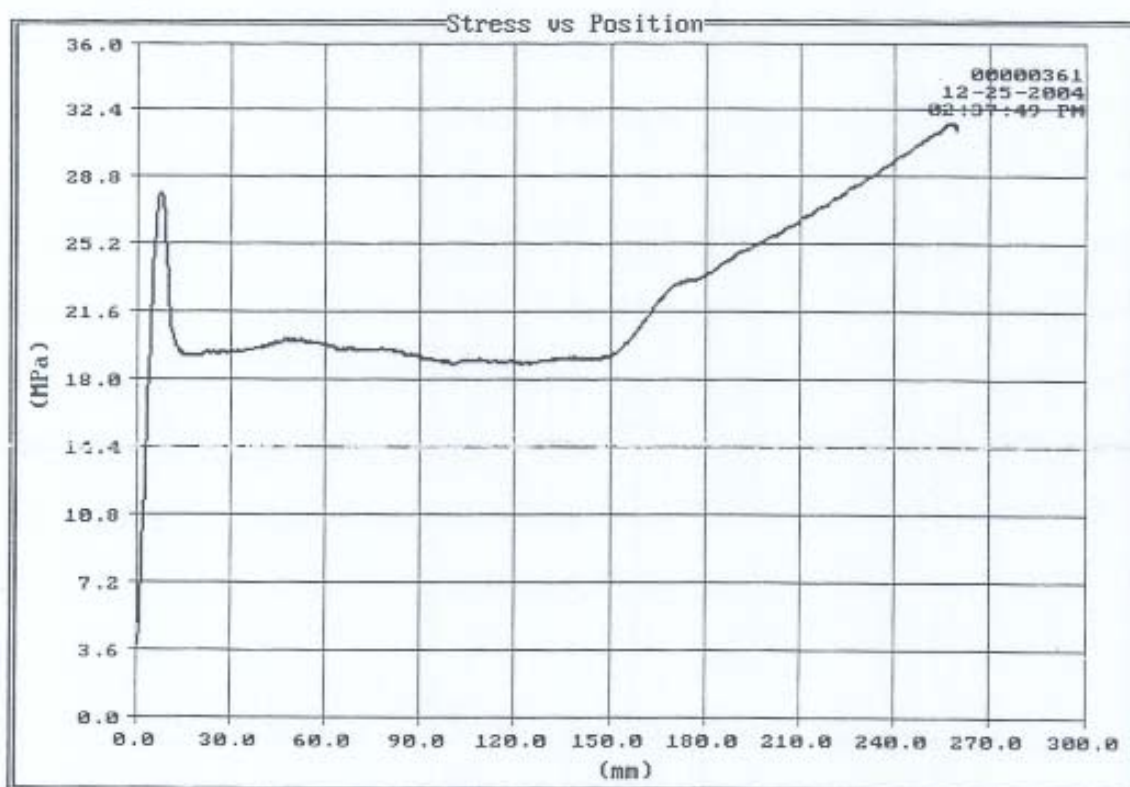
Test Tensile Test
Procedure Tensile test

Test Date 12-25-2004
Test Time 02:37:49 PM
Elapsed Time 00:10:24

Tested By E.H.V.R.C
Test Counter 00000361
Area 16.200 mm²

Tensile Strgth 31.6670 MPa
Total Elong 810.00 %

Peak Load 513 N
Init Punch Len 20.000 mm



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Test Tensile Test
 Procedure Tensile test

Test Date 12-25-2004
 Test Time 03:11:38 PM
 Elapsed Time 00:08:24

Tested By E.H.V.R.C
 Test Counter 00000363
 Area 16.560 mm²

Tensile Strgth 25.8020 MPa
 Total Elong 690.00 %

Peak Load 427 N
 Init Punch Len 20.000 mm



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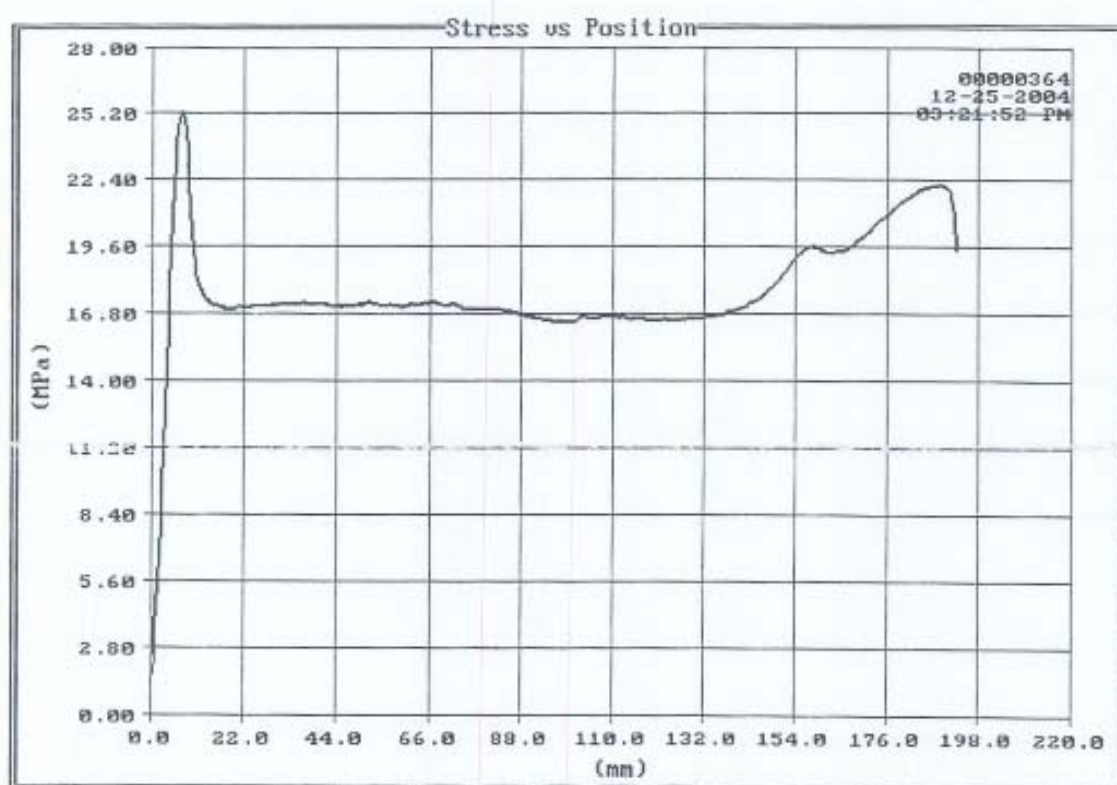
Test Tensile Test
Procedure Tensile test

Test Date 12-25-2004
Test Time 03:21:52 PM
Elapsed Time 00:07:43

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Tested By E.H.V.R.C
Test Counter 00000364
Area 18.840 mm²

Tensile Strgth 25.26900 MPa
Total Elong 650.00 %

Peak Load 476 N
Init Punch Len 20.000 mm



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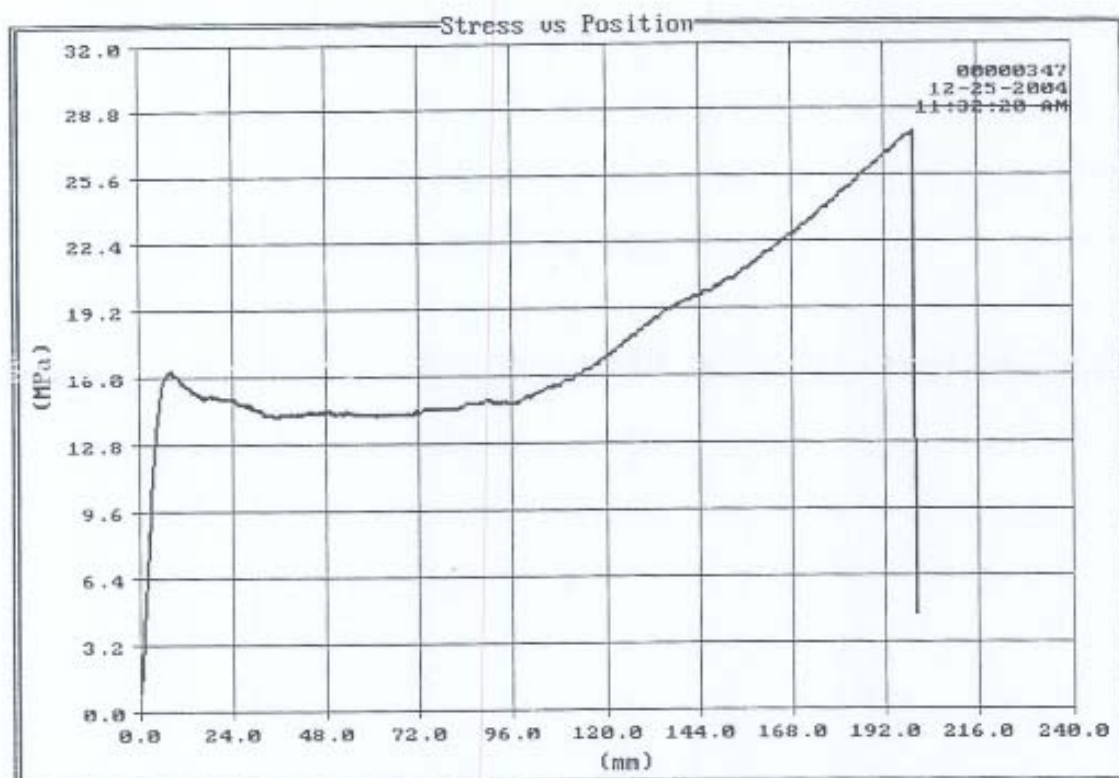
Test Tensile Test
Procedure Tensile test

Test Date 12-25-2004
Test Time 11:32:20 AM
Elapsed Time 00:00:48

Tested By E.H.V.R.C
Test Counter 00000347
Area 5.3600 mm²

Tensile Strgth 27.7350 MPa
Total Elong 540.00 %

Peak Load 149 N
Init Punch Len 20.000 mm



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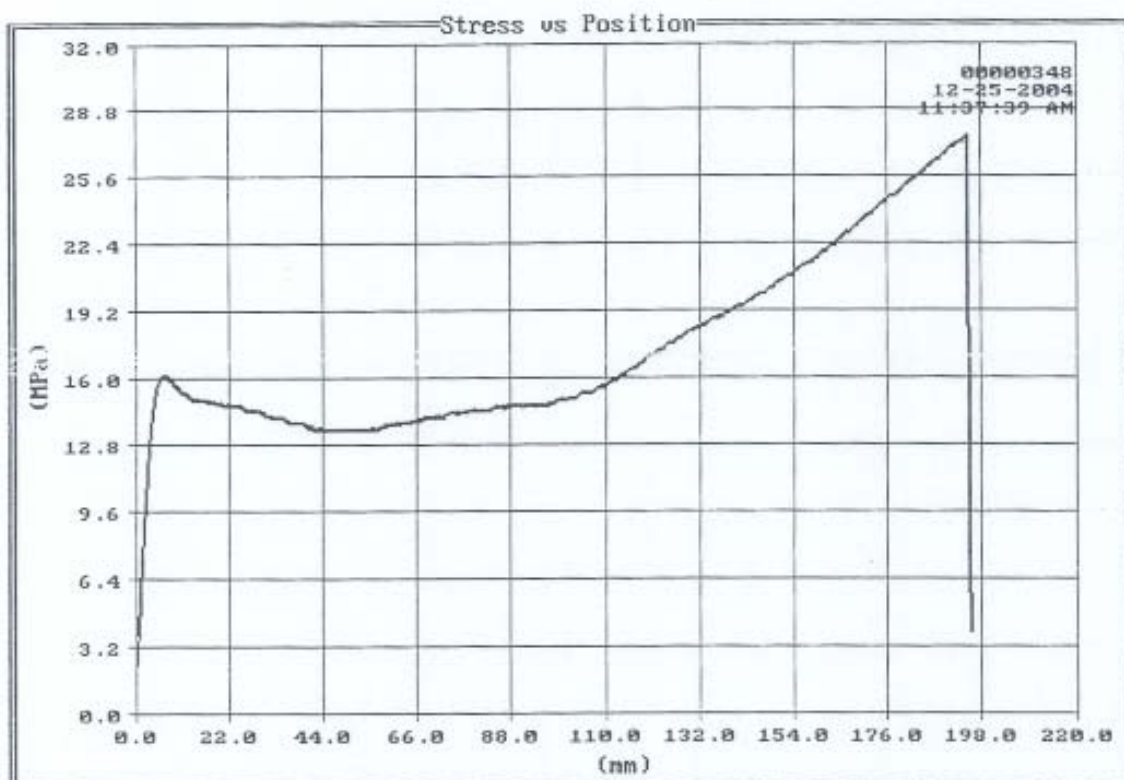
Test Tensile Test
Procedure Tensile test

Test Date 12-25-2004
Test Time 11:37:39 AM
Elapsed Time 00:00:47

Tested By E.H.V.R.C
Test Counter 00000348
Area 4.8800 mm²

Tensile Strgth 27.5430 MPa
Total Elong 525.00 %

Peak Load 134 N
Init Punch Len 20.000 mm



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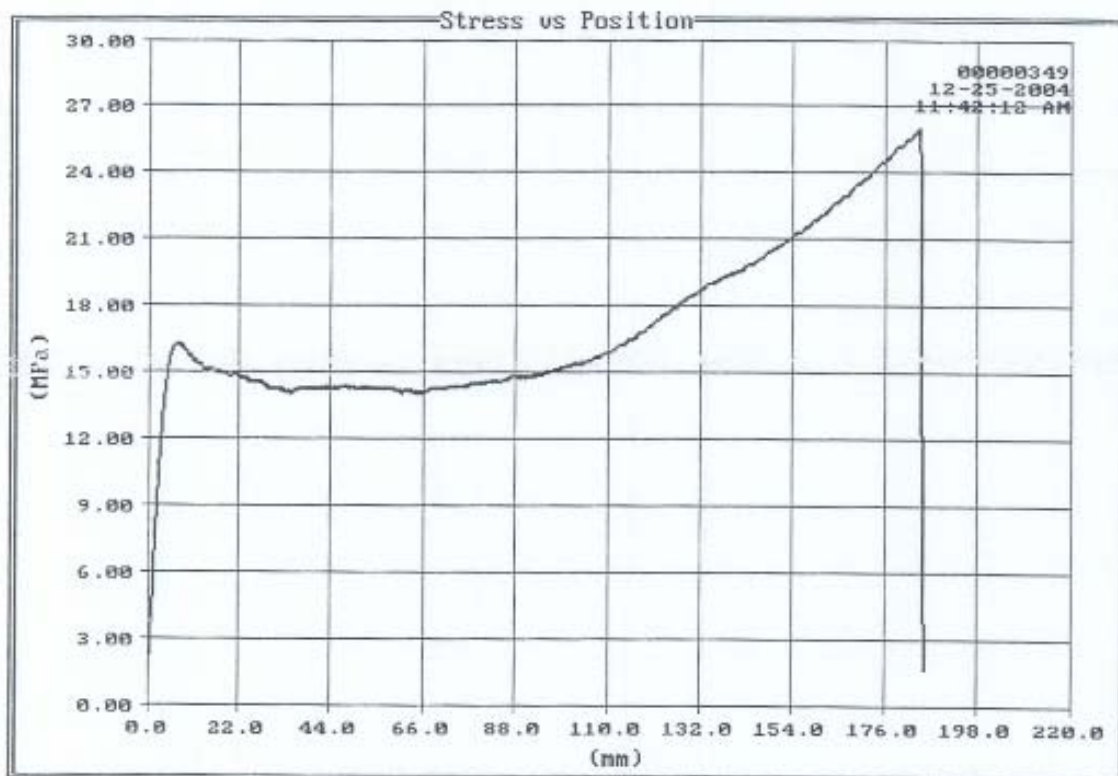
Test Tensile Test
Procedure Tensile test

Test Date 12-25-2004
Test Time 11:42:12 AM
Elapsed Time 00:00:44

Tested By E.H.V.R.C
Test Counter 00000349
Area 5.1000 mm²

Tensile Strgth 25.9960 MPa
Total Elong 510.00 %

Peak Load 133 N
Init Punch Len 20.000 mm



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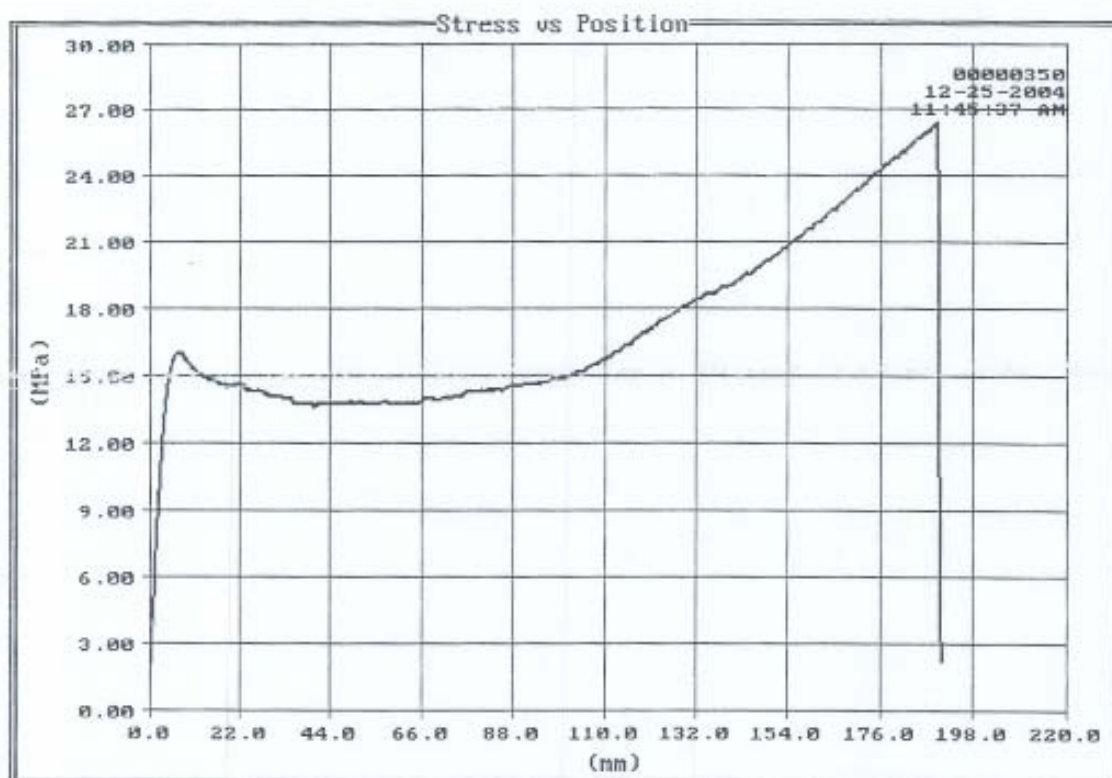
Test Tensile Test
Procedure Tensile test

Test Date 12-25-2004
Test Time 11:45:37 AM
Elapsed Time 00:00:46

Tested By E.H.V.R.C
Test Counter 00000350
Area 4.9000 mm²

Tensile Strgth 26.5500 MPa
Total Elong 525.00 %

Peak Load 130 N
Init Punch Len 20.000 mm



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Test Tensile Test
 Procedure Tensile test

Test Date 12-25-2004
 Test Time 11:49:45 AM
 Elapsed Time 00:00:48

Tested By E.H.V.R.C
 Test Counter 00000351
 Area 5.6000 mm²

Tensile Strgth 28.3210 MPa
 Total Elong 540.00 %

Peak Load 159 N
 Init Punch Len 20.000 mm



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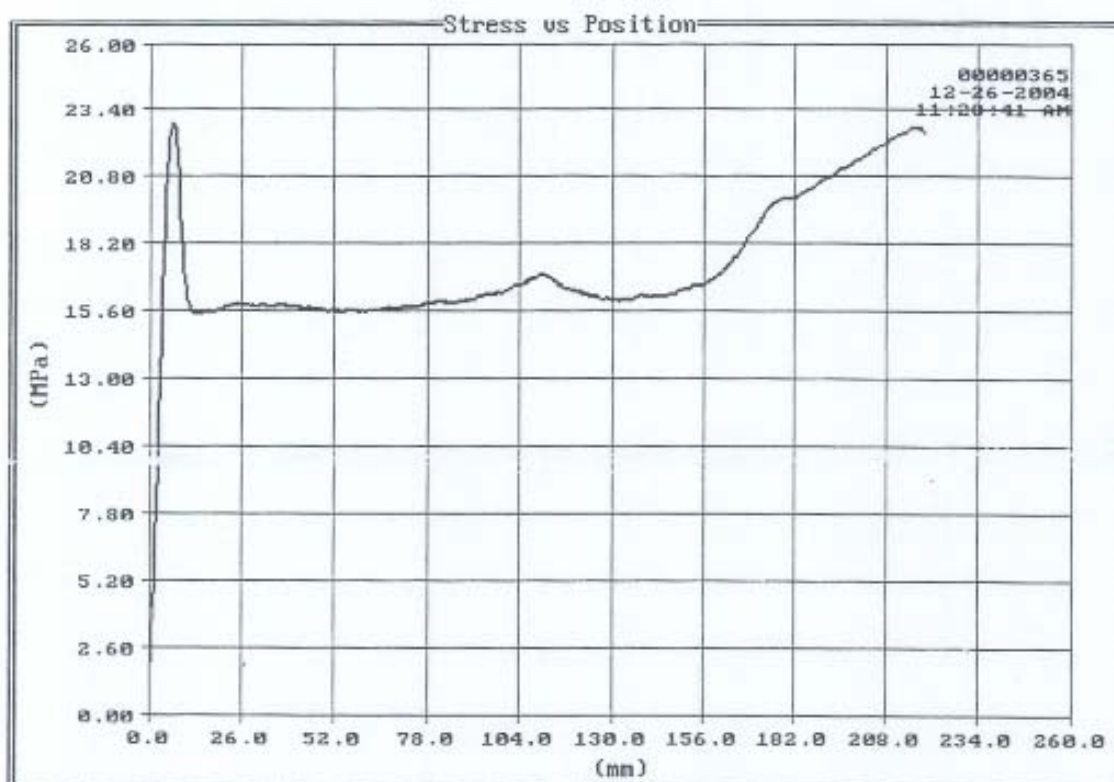
Test Tensile Test
Procedure Tensile test

Test Date 12-26-2004
Test Time 11:28:41 AM
Elapsed Time 00:08:47

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Tested By E.H.V.R.C
Test Counter 00000365
Area 14.250 mm²

Tensile Strgth 22.8680 MPa
Total Elong 710.00 %

Peak Load 326 N
Init Punch Len 20.000 mm



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Test Tensile Test
 Procedure Tensile test

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Test Date 12-26-2004
 Test Time 11:40:57 AM
 Elapsed Time 00:09:27

Tested By E.H.V.R.C
 Test Counter 00000366
 Area 16.670 mm²

Tensile Strgth 23.15500 MPa
 Total Elong 775.00 %

Peak Load 386 N
 Init Punch Len 20.000 mm



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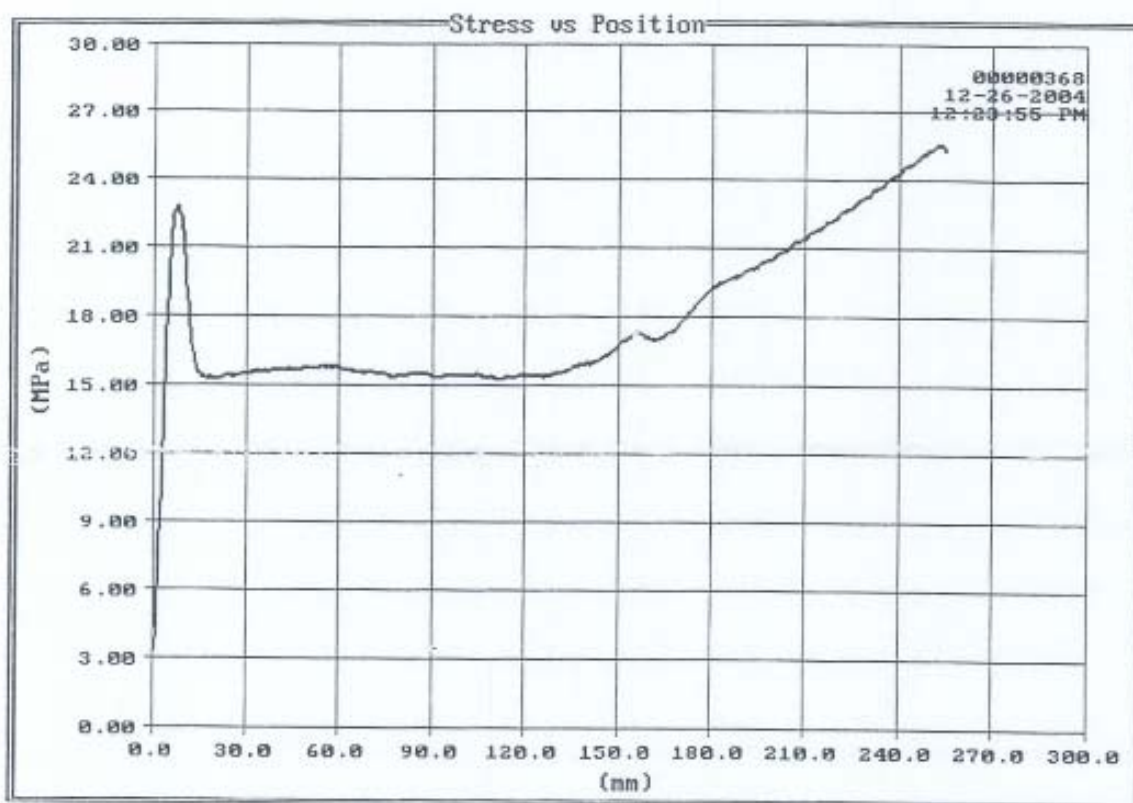
Test Tensile Test
Procedure Tensile test

Test Date 12-26-2004
Test Time 12:23:55 PM
Elapsed Time 00:10:13

Tested By E.H.V.R.C
Test Counter 00000368
Area 14.885 mm²

Tensile Strgth 25.6440 MPa
Total Elong 800.00 %

Peak Load 382 N
Init Punch Len 20.000 mm



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Test Tensile Test
Procedure Tensile test

Test Date 12-26-2004
Test Time 12:46:52 PM
Elapsed Time 00:08:11

Tested By E.H.V.R.C
Test Counter 00000369
Area 16.785 mm²

Tensile Strgth 22.84600 MPa
Total Elong 650.00 %

Peak Load 383 N
Init Punch Len 20.000 mm



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Test Tensile Test
 Procedure Tensile test

Test Date 12-26-2004
 Test Time 01:08:58 PM
 Elapsed Time 00:08:13

Tested By E.H.V.R.C
 Test Counter 00000370
 Area 15.228 mm²

Tensile Strgth 23.0950 MPa
 Total Elong 660.00 %

Peak Load 352 N
 Init Punch Len 20.000 mm



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