

**SORRI**®

# MONOFILAMENT AESTHESIOMETER

TOUCH SENSITIVITY TESTING KIT

User's Manual



## PRECAUTIONS

- Read this Manual carefully and study the instructions before you use the instrument.
- Follow the instructions and manufacturer's recommendations for correct use of the product.
- If any doubt should arise as to the correct procedure in any specific situation, please consult the qualified personnel at SORRI-BAURU.

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## **INTRODUCTION:**

The SORRI-BAURU Touch Sensitivity Testing Kit is a “Synthetic monofilament aesthesiometer”.

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## **INTENDED USE:**

The sense of touch afforded by our nervous system is an important point of contact with the world around us. It permits the perception of objects, helps to protect the skin and underlying tissues against damage, providing the rapid perception of light touch or deep pressure and discriminating between rough and smooth, movement or vibration, a gentle contact or a sharp point.

Changes in the tactile perception threshold of the skin can impair this ability we have to protect us from dangerous objects or eventualities around us.

The SORRI aesthesiometer kit serves to evaluate and monitor the degree of skin sensitivity to forces applied as stimuli to the nerves which should be sensitive to light touch and pressure. The forces are graded in steps reflecting the functional thresholds considered most critical for the hands and feet, (Bell-Krotoski, 1989)<sup>3</sup> composed of six force levels between 0.07 gf (0.686 mN) and 300 gf (2.94 N).

Thus, the instrument allows detection and monitoring of functional alterations of the patient’s peripheral nerves. In diabetes and leprosy, as well as other diseases that cause debilitating neuropathies, early detection of such changes is fundamental in order to prevent disability, prevent injuries and reduce risk of amputations.

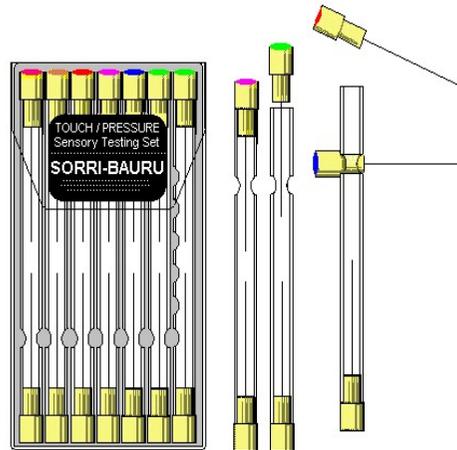
## PRINCIPLES OF OPERATION:

- A nylon filament tends to bend elastically when a compression force applied axially reaches a critical value (LEVIN et al 1978)<sup>13</sup>.
- Under typical laboratory or clinic conditions, this critical force depends on the elastic modulus of the nylon, the monofilament length and its diameter.
- In these conditions the elastic modulus is constant, while the diameter and length are carefully controlled in the manufacturing process of the instrument.
- Thus, when properly applied, a clear sign (curve of the filament) appears when the critical force, known for each filament, is applied via the filament.
- Even if the filament suffers slightly more compression or a slight vibration, the elastic curvature of the filament effectively helps maintain a constant applied force. (BELL-KROTOKI, 1989)<sup>3</sup>

## BACKGROUND:

- After several attempts to introduce and spread through Brazil a practical method for the evaluation of functional changes in the cutaneous touch sensitivity of people with leprosy, professionals from American Leprosy Missions (ALM) brought the problem to SORRI-Bauru – an innovative Brazilian non-profit involved in the rehabilitation process, with a focus on the stigma and social rejection problems associated with leprosy. Through its vocational training activities, SORRI had an already prominent programme for development of assistive technology and special products.

- In collaboration with ALM and the Lauro de Souza Lima Hospital (now a Research Institute), SORRI-Bauru's product designer developed a portable instrument, robust, reliable and easy to use in the clinic or in the field, even in adverse conditions (LEHMAN et al.1993)<sup>12</sup>.



- The Kit developed by SORRI-Bauru, follows Sidney Weinstein's proposal to use mounted nylon filaments of equal lengths, varying only their diameter (WEINSTEIN, 1962).
- Weinstein, as is known, based his ideas on the experimental work of the European physiologist Maximilian Von Frey, who used animal hairs, calibrated to provide precise stimulus values, (Von FREY, 1922)<sup>16</sup>.

## CHARACTERISTICS AND USE OF THE INSTRUMENT

- The **SORRI touch sensitivity testing kit** is designed as a simple and convenient means of detecting and monitoring functional alterations in the peripheral nerves.
- It consists of a flexible plastic wallet containing a set of seven tubes, each containing a pair of special nylon filaments.
- Six of the tubes are drilled transversally to provide **mounting holes** to secure the filament in the correct position for use.
- Each tube has two nylons, one of which is a reserve.
- To facilitate interpretation, a colour-code is used to indicate the approximate axial force necessary to bend each filament.
- The Kit also contains a tube with a spare set of the most delicate filaments (0,07 g – green) and the set of holes in this tube allow it to be used as a convenient support for the other tubes when they are mounted for use.
- Other combinations of filaments may sometimes be available – for example, single tube packs, with a particular filament and its reserve, for use in specific screening tests.
- Each wallet contains an explanatory leaflet with instructions for care of the instrument and information about its use. It also provides suggestions to facilitate mapping of the results and a grid to assist with interpretation of the readings.

## EXAMINATION PROTOCOL:

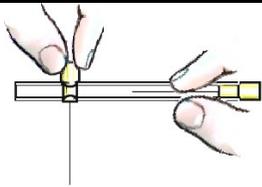
To ensure reliability of the test, it is fundamental to carefully follow a standard procedure.

- The validity of a sensory test is dependent on rigorous adherence to a standard procedure.
- The testing should take place in a calm environment, without noise or distractions.
- Tactile sensation may alter with temperature. Allow the patient who has just come in out of strong sunshine, or from the cold, enough time to adjust to normal temperature.
- Filament elasticity may vary with alterations in relative humidity. Make sure the filaments are well dried after washing, and, where possible, avoid their use in exceptionally dry or moist environments.
- Prepare mapping evaluation sheets and colour pens prior to testing. Careful documentation facilitates case-analysis and the use of colour-coding helps to quickly interpret observations.
- The following procedure should first be demonstrated on an area of skin where there is good sensitivity and the subject can observe the process.
- When the patient understands the testing procedure, his vision of the site is excluded and the tester begins the sensory test, documenting as threshold the first affirmative response in each site tested.

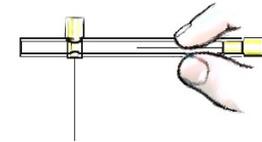
In Hansen's disease, the WHO Disability Grading of Grade 1 is documented when any palmar or plantar area has a LOSS of PROTECTIVE SENSATION. Therefore, any area where the first positive test response is to a 4.0 gf, or heavier filament, (red or black area) should be documented with a GRADE 1 DISABILITY.

## MOUNTING and APPLYING the MONOFILAMENTS:

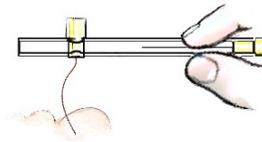
1



2



3



- Prepare one filament of each colour.
- Withdraw the filament nearest to the mounting holes, and introduce it carefully until the support is firm.
- The other filament remains in the tube as a reserve.
- Damaged, kinked, or bent filaments should be discarded and replaced with a new filament of the same specifications.
- Hold the tube so that the nylon filament is perpendicular to the subject's skin, but not touching.
- The test begins with the lightest filament, (green) and continues through progressively heavier filaments until a positive response is obtained.
- Without letting the patient see, touch the nylon to the skin with a smooth, gentle pressure, which just causes the nylon to bend. The pressure is maintained for about 2 seconds and then the filament is lifted smoothly away.
- If the nylon slides over the skin, the test at this site should be repeated.
- Ask the patient to say "yes" when he feels the filament.
- Apply the green and blue filaments up to three times at each test site before confirming absence of sensitivity at this level.
- Never use the same filament on more than 10 patients a day - utilise the reserve filament.

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- Filaments should be cleaned by washing the nylon very carefully with warm soapy water, taking care not to stretch, crush, or twist the filament, after which the nylon is rinsed with 70% alcohol as disinfectant, but not left to soak. Allow to dry completely before re-use or storage.
- These filaments should not be used on the eyes, or mucous tissue, or open wounds. In the case of ulcers, scars, or callus tissue, perform the test on a nearby site, within the same peripheral nerve territory.
- To avoid damaging the filaments while replacing them carefully in their protective tubes after use, it is helpful to block the mounting holes by holding the tube between finger and thumb.

## TRADITIONAL THRESHOLD MAPPING PROTOCOL

Perform the evaluation in the sequence listed below, and for each site tested, document the first nylon that has a positive response.

Lightest filament whose touch can be felt:	INTERPRETATION	Suggested mapping code:
<p style="text-align: center;"><b>Green</b> (Nominal: 0.07gf)</p>	<p style="text-align: center;">- Sensation within normal limits for the hand and foot.</p>	<p>Green filled circle </p>
<p style="text-align: center;"><b>Blue</b> (Nominal: 0.2gf)</p>	<p style="text-align: center;">- Diminished light touch sensation in the hand with difficulty in fine tactile discrimination. Within normal limits for the foot.</p>	<p>Blue filled circle </p>
<p style="text-align: center;"><b>Purple</b> (Nominal: 2.0gf)</p>	<p style="text-align: center;">- Diminished protective sensation in the hand but sufficient to prevent injury. Gross tactile discrimination, shape and temperature discrimination are difficult.</p>	<p>Purple filled circle </p>
<p style="text-align: center;"><b>Dark Red</b> (Nominal: 4.0gf)</p>	<p style="text-align: center;">- Loss of protective sensation for the hand; in some cases, for the foot. Hands particularly vulnerable to injuries. Usually, loss of temperature discrimination.</p>	<p>Red filled circle </p>
<p style="text-align: center;"><b>Orange</b> (Nominal: 10gf)</p>	<p style="text-align: center;">- Definite loss of protective sensation for the foot. Pressure and pain may still be felt in hands and feet.</p>	<p>Red cross </p>
<p style="text-align: center;"><b>Light red/ Pink</b> (Nominal: 300gf)</p>	<p style="text-align: center;">- Still able to feel deep pressure and pain.</p>	<p>Red circle </p>
<p style="text-align: center;"><b>No response</b></p>	<p style="text-align: center;">- Loss of deep pressure sensation. Usually does not feel pain. Proprioceptive function may persist.</p>	<p>Black filled circle </p>

**EQUIVALENCE WITH OTHER TESTS AND ASSOCIATED FUNCTIONAL LEVELS:**

Correlation between functional skin sensitivity thresholds and traditional tests was first observed by Von Prince & Butler (1967)<sup>17</sup>.

Threshold	Equivalence	
<p><b>Green:</b> ( Nominal: 0,07 gf )</p>	<p><b>Normal sensation</b> (Threshold <math>\leq</math> 0.07gf ) -Touch-discrimination of symbols traced on the skin (graphaesthesia) retained. -Light touch and texture discrimination retained.</p>	<p>-Shape (stereognosis) and temperature discrimination retained. -Deep pressure and pain sensation retained. -Awareness of position and movement (proprioception) retained.</p>
<p><b>Blue:</b> ( Nominal: 0,2 gf )</p>	<p><b>Diminished light touch sensation:</b> (0.07 gf &lt; threshold &lt; 0.2 gf ) -Loss of graphaesthesia. -Difficulty with fine texture discrimination.</p>	<p>-Shape and temperature discrimination retained. -Deep pressure and pain sensation retained. -Proprioception retained.</p>
<p><b>Purple:</b> ( Nominal: 2,0 gf )</p>	<p><b>Diminished protective sensation:</b> (0.2 gf &lt; threshold &lt; 2.0 gf ) -Loss of graphaesthesia. -Loss of fine texture discrimination</p>	<p>- Difficulty or loss of stereognosis and thermal discrimination. -Deep pressure and pain sensation retained. -Proprioception retained.</p>
<p><b>Red:</b> ( Nominal: 4,0 gf )</p>	<p><b>Loss of protective sensation:</b> (threshold <math>\leq</math> 4.0 gf for hand) (threshold <math>\leq</math> 10.0 gf for foot) -Loss of graphaesthesia.</p>	<p>-Loss of stereognosis and usually thermal discrimination. -Deep pressure and pain sensation retained.</p>
<p><b>Orange:</b> ( Nominal: 10,0 gf )</p>	<p>-Loss of fine texture discrimination</p>	<p>-Proprioception retained.</p>
<p><b>Light Red:</b> ( Nominal: 300 gf )</p>	<p><b>Deep pressure sensation:</b> (10.0 gf &lt; threshold &lt; 300 gf ) -Loss of graphaesthesia. -Loss of fine texture discrimination</p>	<p>-Loss of stereognosis and thermal discrimination. -Deep pressure and pain sensation retained. -Proprioception retained.</p>
<p><b>No response at the site tested</b></p>	<p><b>Deep pressure sensation loss:</b> (threshold &gt; 300 gf – no response to 300 gf nylon). -Loss of graphaesthesia. -Loss of fine texture discrimination.</p>	<p>-Loss of stereognosis and thermal discrimination. -Loss of deep pressure sensation. -Pain sensation may persist. -Proprioception may still be present.</p>

## SANITIZING the MONOFILAMENTS:

The aesthesiometer monofilaments can be used for testing many patients, provided that the necessary care is taken with sanitization.

The object of cleaning is to reduce the risk of infection and the spread of pathogens.

Brief instructions for use and cleaning of the instrument accompany the SORRI kit.

- It is recommended to carefully wash the filaments immediately after use, avoiding any tendency to stretch, crush, or twist the filament in the process.
- A liquid soap solution in warm water can be used, optionally with 4% chlorhexidine, but avoiding other additives, especially iodine and its compounds (PVP, iodophor, etc).
- Then wipe gently with 70% ethyl alcohol as disinfectant, and allow the filament to dry completely.
- The filaments should not be left to soak because the absorption of water or alcohol may cause temporary changes in the elasticity of the nylon.
- The set is not designed to withstand high temperature or chemical sterilization processes.
- Under ideal conditions the aesthesiometer can maintain its accuracy for many years, but after a period of 18 months of use, replace the instrument to avoid risks associated with alterations in the calibration, which may occur with time.
- Any filament presenting sign of damage (wrinkles, bends, cracks, loose mounting, etc.) must be replaced. The kit already includes reserve filaments of each size and replacement units can also be purchased through your distributor.

## TAKING CARE of your FILAMENTS:

1. Keep the filaments out of the sunlight and protected from other sources of UV radiation.
2. Keep the filaments well away from strong chemicals (acids, alkalis, oxidizing agents, solvents, etc.)
3. Store them in a dark, dry and well ventilated place.
4. After use replace each filament carefully in its protective tube. As you do this, it is a good idea to block the mounting holes between finger and thumb so that the filament will not protrude and get damaged.
5. If the filament shows signs of damage (a pronounced curve, breakage, cracking or undulations), it should be discarded. Replacement filaments can be obtained from SORRI.
6. It is important to let the filament rest for 24 hours after repeated use (BOOTH & YOUNG, 2000)<sup>6</sup>. Swap filaments after every 100 “touches” or after testing with 10 patients on the same day - as you recall, the SORRI Kit contains reserve filaments.
7. Before starting the test, bend each filament a couple of times, as a "warm-up". (BELL-KROTOSKI, 1989<sup>3</sup>; BOOTH & YOUNG, 2000<sup>6</sup>).

## FAQs – Frequently Asked Questions

### ABOUT THE SETS OF SIX OR TWENTY MONOFILAMENTS:

The SORRI kit, composed of 6\* selected diameters of monofilament, was designed for convenience and efficiency in evaluating functional sensitivity thresholds of the peripheral nerves of the hands and feet.

The use of a reduced number of filaments to identify important functional thresholds was established by Von Prince and Butler (1967)<sup>17</sup> and Werner and Omer, (1970)<sup>18</sup>, validated by Bell Krotoski (1990)<sup>4</sup>. A sixth filament was

added following widespread acceptance of the proposals of Birke and Sims (1986)<sup>5</sup>.

In some research projects that aim to investigate subtle changes of sensitivity in other parts of the body, a denser grid may be justifiable, with smaller increments of discrimination, such as is offered by the set of 20 monofilaments.

These sets are not available from SORRI.

\* (The SORRI Standard Kit contains six different filament diameters - each with a second filament in reserve, except for the most delicate, green filament which comes with three reserves - constituting a total of 14 filaments in seven protective tubes.)

## TERMINOLOGICAL CONFUSION: FORCE / PRESSURE / "M"

The magnitude "Force" is used to classify the SORRI Semmes-Weinstein monofilaments.

This value may be obtained directly by measurement, in the laboratory, of the average axial force required to initiate buckling.

Despite the use of the word "pressure" in the literature, the actual pressure transmitted may only be obtained by calculation, because it depends on this force and also the contact area, which may vary during the application of the filament.

Further, the same pressure value might be applied by a heavy force distributed over a large area as by a light force over a relatively small area, and this would have very different effects on the nerves. Thus, to facilitate, in general, manufacturers tend to use the magnitude "Force" instead of an estimate of "pressure" or "stress" to identify each monofilament.

In the past, to facilitate graphic demonstrations - (since a logarithmic scale of applied forces approximates a linear scale of the perceived strength), this was done by using the variable "M," which is calculated as the logarithm of ten times the force in milligrams required to bow the filament.

$$M = \log (10.Fmg)$$

Thus the filaments were marked with a number such as "**2.83**" or "**3.61**", etc.

Some manufacturers still use this system, despite the problems of interpretation that it generates. In fact, this practice was already identified as a source of potential confusion in the article by Scott Levin<sup>13</sup>, back in 1978.

The problem is further complicated in some studies where the logarithmic value is associated with the acronym MN ("Marking Number" or "Manufacturer's Number"), easily confused with mN or milinewtons - unit of force accepted in the International System of Units (SI).

At the suggestion of specialists from the Research Department of the Leprosy Center in Carville, Louisiana, when developing the Sensitivity Testing Kit, SORRI eliminated this complication in the identification of their filaments, by using the simple force value. The value is marked in grams force (or simply "g") and represents the rounded value of the force necessary to initiate a bend in the filament during correct application of the test.

Today many other models of monofilament aesthesiometer also adopt this more rational system.

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**SORRI**, which means “SMILE” in Portuguese, is a Brazilian non-governmental organisation (NGO), founded in 1976 in the town of Bauru. Its purpose was to help break down the stigma associated with the disease of Leprosy (Hansen’s disease) and its sequels, and to remedy the lack of services for disabled people. It is a non-profit rehabilitation centre, and has gradually opened the scope of its mission, which, through a wide range of services and activities, now aims toward the long-term empowerment of disabled people and their families, and the construction of an inclusive society.

The manufacture and distribution of the monofilament skin sensitivity testing kit is one of the ways that SORRI participates in the prevention of disabilities, while revenue from the sales helps to maintain the quality of services provided without cost to disabled members of the community.

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