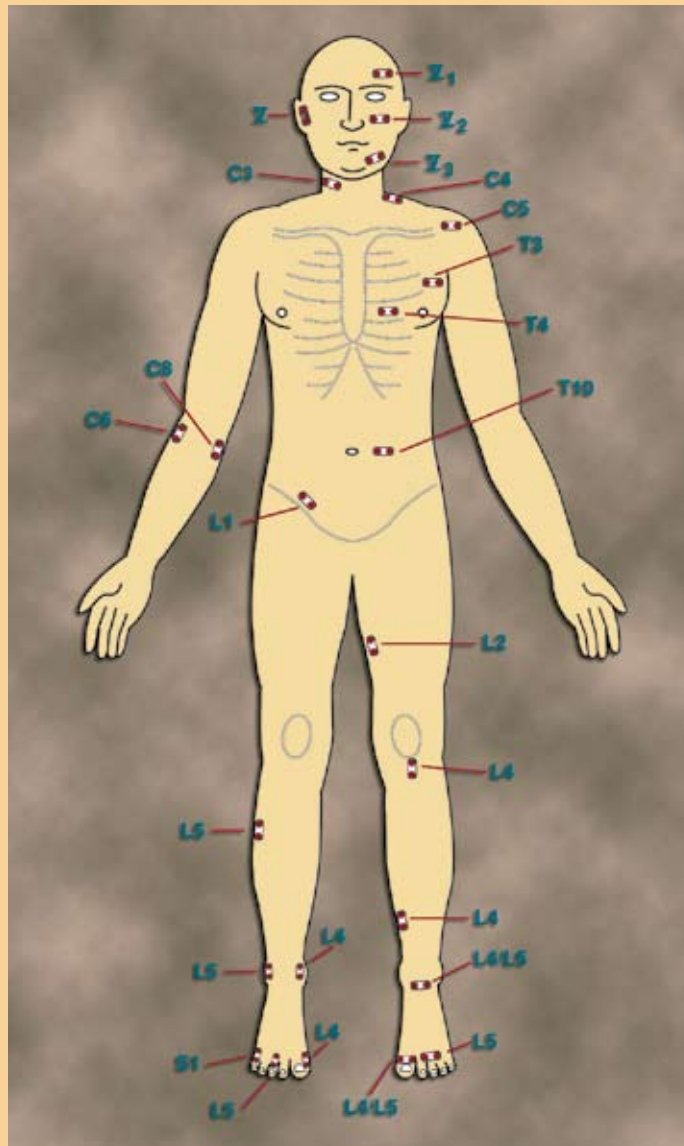


# NEUROMETER®

*Clinical and Research Update (2010 - 2011)*



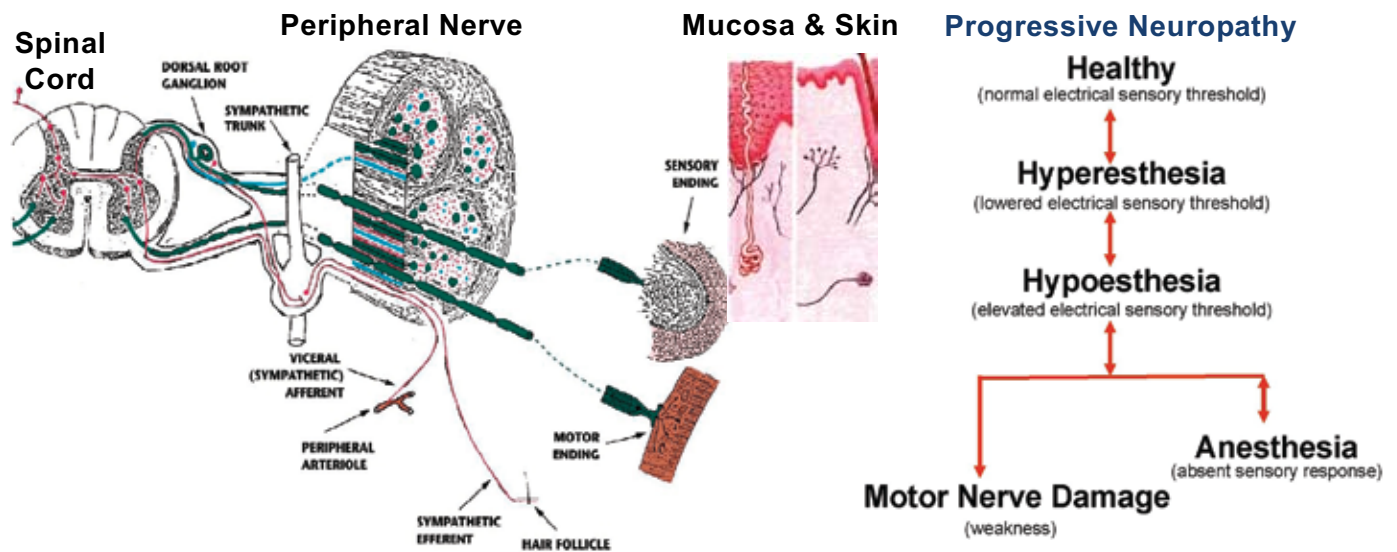
## **Neurometer® Clinical and Research Update (2010-2011)**

Neurometer® Neuroselective Diagnostic Sensory Evaluation. . . . .	1
Performing a Neurometer® Electrodiagnostic Evaluation. . . . .	2
Polyneuropathy Diagnosis: Anatomic & Neuroselective. . . . .	3
Mapping Polyneuropathy - Axonal vs Demyelinating. . . . .	3
Upper Extremity Differential Diagnosis. . . . .	3
Upper /Lower Brachial Plexopathy. . . . .	3
Carpal Tunnel Syndrome (CTS). . . . .	3
Upper Extremity Radiculopathy and Spinal Pathology. . . . .	4
Lower Extremity Differential Diagnosis. . . . .	4
Radiculopathy, Myelopathy & Focal Lesions. . . . .	4
Dental, Mucosal & Genital CPT Measures. . . . .	5
Urethral & Bladder Catheter Electrode. . . . .	5
Neurometer® Device Testing. . . . .	5
Clinical and Automated Current Perception Threshold (CPT). . . . .	5
Ranged Current Perception Threshold (R-CPT). . . . .	5
Pain Tolerance Threshold (PTT). . . . .	5
Remote Computer & Audio Control. . . . .	5
Animal Response Testing. . . . .	5
Computer Interface fMRI, PET, In Vitro Physiological, and In Vivo Testing. . . . .	5
Other Applications. . . . .	6
Cosmetic. . . . .	6
Synthetic Nerves, Stem Cells and Nerve Regeneration. . . . .	6
Environmental/Occupational . . . . .	6
Sports Medicine. . . . .	6
Neurometer® Technology Comparison to Other Diagnostic Procedures. . . . .	6
Sensory Nerve Fiber Types. . . . .	7
Neuroselective Pathology. . . . .	7
“Painless Neuropathy” Loss of Protective Sensation. . . . .	7
C Fiber Neuropathy and Autonomic Dysfunction. . . . .	7
Neuroselectivity, Hyperesthesia and Pain. . . . .	8
Hyperesthesia. . . . .	8
Pain Tolerance Threshold (PTT) and Allodynia. . . . .	9
Direct Nerve Fiber Stimulation. . . . .	9
Reference Material. . . . .	9
Legal Notices. . . . .	9

## Neurometer® Neuroselective Diagnostic Sensory Evaluation

More than 30 years after leaving the laboratory for clinical applications ranging from Podiatry to Neurology and dozens of other specialties in-between, the Neurometer® evaluation continues to provide unique diagnostic measures of sensory nerve conduction thresholds (sNCT™s). The most widely used sNCT™ measure is Current Perception Threshold (CPT®) which is the minimum amount of painless neuroselective electrical stimulus that consistently elicits a nerve response.

The Neurometer generates a constant current stimulus by monitoring and compensating for tissue impedance variations. The stimulus evokes responses that quantify the functional integrity of each of the three major sub-populations of sensory nerve fibers. Specifically, A<sub>β</sub>, A<sub>δ</sub> & C fiber groups are selectively stimulated by sinusoid waveform currents of 2000 Hz, 250 Hz and 5 Hz respectively. Using small surface electrodes, this test generates discrete double-blinded CPT measures (p<0.006) representing minimum detectable current intensities (+/- 20 µAmp.) for each fiber type. Scientific publications documenting all the statements in this document are referenced at [www.neurotron.com](http://www.neurotron.com).



Illustrated nerve fiber types: A<sub>β</sub> (green), A<sub>δ</sub> (blue) & C (red) fibers

### Advantages of the Neurometer Evaluation

Common metabolic/toxic and progressive neuropathies affect sensory nerves before motor nerves. Affected sensory nerves pass through reversible stages of hyperesthesia (often sub-clinical) then hypoesthesia and anesthesia. These sensory impairments occur in specific nerve fiber sub-populations. CPT studies have the unique capacity to evaluate the full spectrum of sensory nerve function in all the major fiber sub-populations. Patients are frequently asymptomatic in the earliest stages. The earliest stage of the pathologic process is usually the easiest phase to effectively intervene. The Neurometer detects hyperesthetic sensory neuropathy in non-diabetics with impaired glucose tolerance and in non-diabetic obese individuals. This ability to detect subclinical abnormalities in conditions known to carry a high risk of polyneuropathy is a tremendous clinical diagnostic advantage. It also detects the hypoesthesia of advanced neuropathic conditions as well as nerve regeneration.

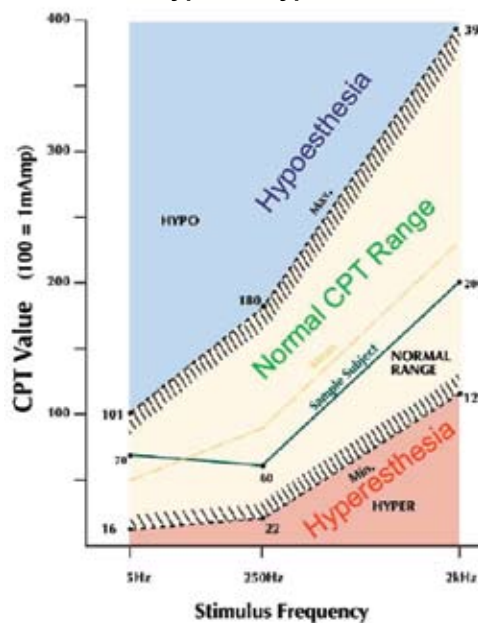
Publications confirm that sensory impairments ranging from polyneuropathies (diabetic, demyelinating, toxic) to compressive lesions (Carpal Tunnel Syndrome), radiculopathies, spinal cord lesions as well as regeneration may be neuroselectively evaluated. Additional publications have confirmed the utility of the application of Neurometer® technology in pharmaceutical/cosmetic, and laboratory animal research.

## Performing a Neurometer® Electrodiagnostic Evaluation

Painless standardized automated double-blind testing methodology is used to determine the CPT. It is based on the same psycho-physical principles used in routine hearing tests. The painless stimulus is characterized as “tingling”, “prickling”, or “buzzing”. Qualitative measures such as warm, cold, vibration, touch etc. are not a factor.

Electrodes are positioned at the prescribed test site and held in place with tape. Directions for the technician are displayed on the LCD screen. The subject is instructed to press a button until a stimulus is detected at the site of the electrode(s) and then release the button. At this point, the CPT measure is verified using Compliance Guard® software. This effectively monitors responses for consistency. CPT measures are the printed or sent directly to a computer for storage and software classification by comparison to a validated normative database. A narrative patient report may be generated.

**Finger CPT vs. Frequency**  
**Normal, Hyper & Hypoesthetic Ranges**



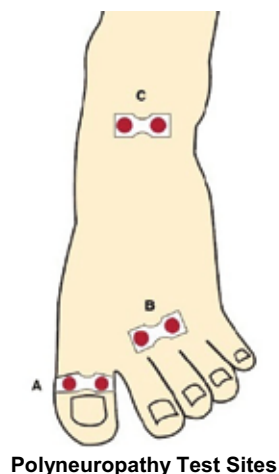
Goldtrode® Electrodes

**Background:** Neurotron, Inc., founded in 1981, in Baltimore, MD, USA designs and develops Neurometer electrodiagnostic devices. The Neurometer emerged from laboratory studies at McGill University, Montreal, PQ, Canada and clinical research at the Johns Hopkins University School of Medicine, Baltimore. FDA registered in 1986, Neurometer® technology had the unique distinction of being the worlds first neuroselective electrodiagnostic device. It was also the first commercially marketed clinical neuro-diagnostic device that included validated evaluation software that graded the clinical severity of detected abnormalities based on established normative values and generated a narrative report. In 2010, a new version of the Neuval® Database Software was released to permit the software to input test data directly from the device. Neurometer® devices may be interfaced for direct control by fMRI or PET imaging control systems. Computer control permits audio and external trigger control and in vitro physiological studies. Applications of Neurometer® technology include more than 24 clinical specialties, as well as pharmaceutical, cosmetic and laboratory animal testing applications. More than one million painless Neurometer studies have been conducted with over 800 scientific peer-reviewed publications. These affirm that this automated electrodiagnostic procedure objectively and selectively quantifies the functioning of both unmyelinated and myelinated sensory nerve fibers at any cutaneous/mucosal/dental test site. The Neurometer has been useful in guiding clinicians to choose the most appropriate therapy and for monitoring and evaluating interventions.

## Polyneuropathy Diagnosis: Anatomic & Neuroselective

### Mapping Polyneuropathy - Axonal vs Demyelinating

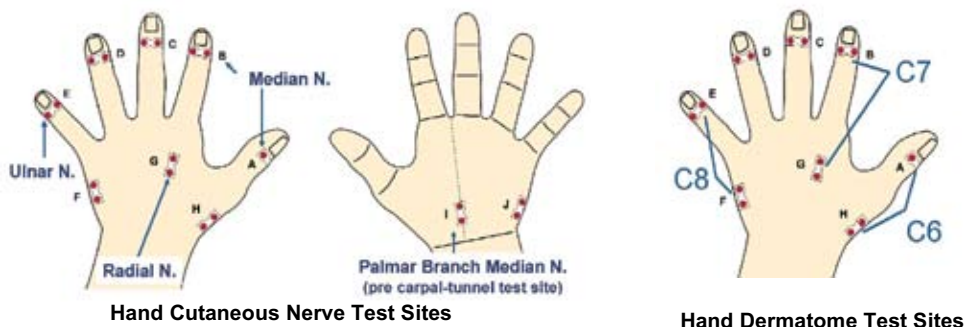
Most metabolic and toxic neuropathies typically affect sensory nerves before motor nerves and present with a dying back distribution in the tips of the toes first and later the fingers. Mapping the distribution of sensory impairment resulting from polyneuropathy and noting the type of axonal dysfunction permits the differential diagnosis of diffuse demyelinating vs distal axonal polyneuropathies. CPT measures from the big toe (A) are generally the first to be affected, ranging from the earliest hyperesthetic stage to the advanced hypoesthetic condition. Normal sensation at proximal test sites (B, C) confirms the clinical diagnosis of distal dying back polyneuropathy. In contrast, demyelinating polyneuropathies typically affect both proximal and distal CPT measures associated with myelinated fiber function (2000 Hz and 250 Hz CPTs) but not measures associated with unmyelinated fiber function (5 Hz CPTs).



CPT testing at the big toe incorporates both the superficial and the deep peroneal nerves (4th and 5th lumbar dermatomes respectively, site A above). This neurological overlap prevents focal nerve lesions or mono-radiculopathies from affecting the CPT measures at this site. Conversely, symmetrical dying back polyneuropathies affecting both the superficial and deep peroneal nerves are easily detectable at this location.

### Upper Extremity Differential Diagnosis

Screening for Carpal Tunnel Syndrome (CTS) is conducted at the distal phalange of the index finger (B). This site is also sensitive to vibration neuropathy (neuroselective for myelinated fibers). Guyon's canal syndrome, may be detected through a comparison of the CPT measures from a digital ulnar nerve (E) and palmar ulnar nerve (J). Upper /Lower Brachial Plexopathy is evaluated by noting the distribution of impairment.



### Carpal Tunnel Syndrome (CTS)

Early CTS is associated with hyperesthetic CPTs (abnormally low electrical excitability) reflecting inflamed nerves that have not lost their functioning. Advanced CTS, associated with a loss of median nerve function, is associated with hypoesthetic (abnormally high) CPTs. The combination of a sensory impairment detected at the distal phalange of the index finger (Site B), combined with normal CPT measures from the ulnar nerve (5th finger, Site E) and palmar branch of the median nerve (Site I), objectively confirms the clinical diagnosis of CTS. The CPT evaluation can detect CTS in the presence of a polyneuropathy. This electrodiagnostic procedure confirms the recovery of median nerve function following conservative or surgical treatment of CTS.



# Upper Extremity Radiculopathy and Spinal Pathology

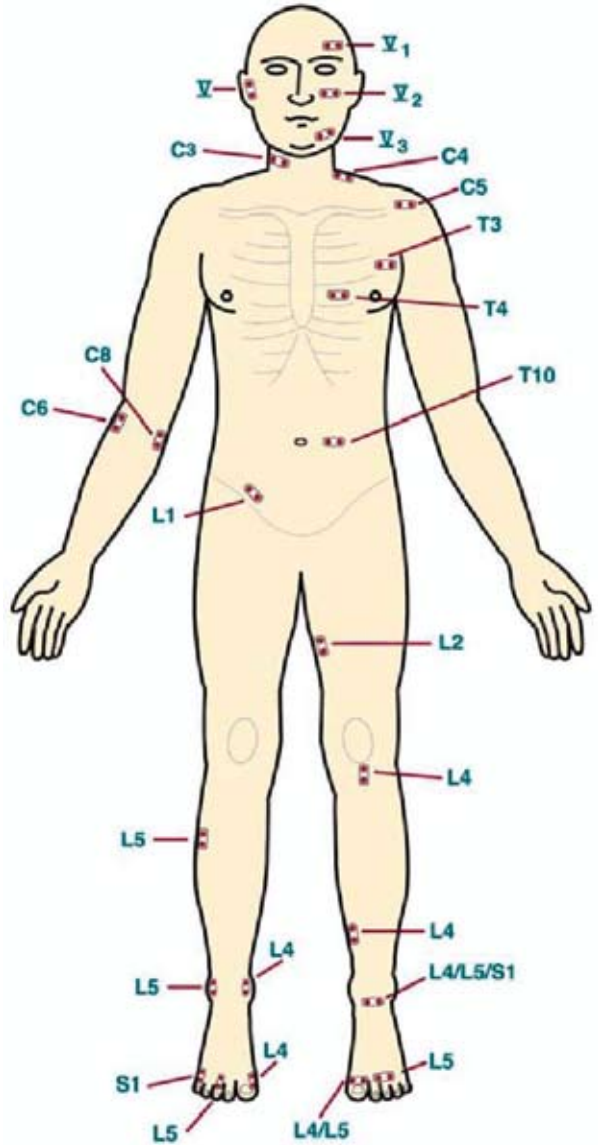
CPT measures quantify the severity of a radiculopathy. This type of diagnostic evaluation is conducted along a dermatomal distribution. Further confirmation of a radiculopathic sensory impairment would include more proximal testing in the same dermatomes. Abnormal CPT measures caused by radiculopathy, myelopathy or conditions such as syringomyelia will be confined to a dermatomal and neuroselective distribution.

## Lower Extremity Differential Diagnosis

## Radiculopathy, Myelopathy & Focal Lesions

Radicular pain can mimic the pain of peripheral neuropathy, peripheral arterial disease or a focal lesion. Sensory impairments resulting from radiculopathy will affect the lower extremity along a dermatomal distribution. Testing the same dermatome at distal and proximal locations (innervated by different nerves, e.g., sites illustrated below: I- Peroneal and J- Saphenous Nerves) or the same peripheral nerve in different dermatomes (e.g., sites I-L4 and H-L5) can help confirm a suspected radiculopathy. The finding of a peripheral sensory impairments measured from several toes, combined with normal CPTs observed at proximal locations within the same dermatome suggests that the lesion involves a peripheral and not a spinal nerve. Spinal lesions or myelopathy will result in a segmental sensory impairment where all dermatomes below the level of the lesion are impaired.

## CPT Dermatome Test Sites



### Standardized CPT Test Sites (Norms Established)



D - (S1) Sural N.  
F - (S1) Sural N.  
H - (L5) Sup. Peroneal N.  
J - (L4) Saphenous N.

E - (L5) Sup. Peroneal N.  
G - (S1) Sural N.  
I - (L4) Sup. Peroneal N.  
K - (L4/S2) Tibial N.

## Herniated Disc

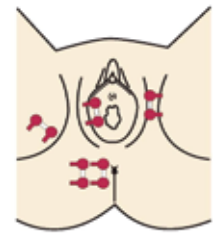
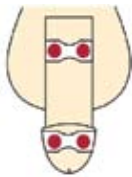


## Dental, Mucosal & Genital CPT Measures

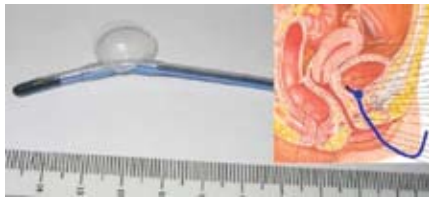
Dental testing includes tooth measures and oral mucosal measures. Neurometer measures have proven useful for uro-gyn and pharmaceutical studies as well as for differential diagnostic applications. Experimental catheter electrodes for oral, urethral (proximal and mid) and , bladder, vaginal/anal applications and other specialized electrodes are available for research.



Urethral & Bladder Catheter Electrode with Lumen (12 Fr)  
(positioning balloon inflated, electrode is black)



Bladdertrode™



Urotrode™ (cuff balloon)



Vaginal/Rectal G-Trode™



## Neurometer® Device Testing

Test results are evaluated using the Neuval® Windows® software. The reports include a grading of the functional integrity for the specific nerves and their sub-fiber groups and a summary. The findings are based upon range, within-site and between-sites ratio analyses through comparison to a database of clinically established normative values. Neurometer test modes include:

### Clinical and Automated Current Perception Threshold (CPT) ( $p < 0.05-0.006$ , resolution $\pm 20-50 \mu A$ )

Painless Current Perception Threshold. Standardized automated double-blind determination mode requires 3-5 minutes (Clinical) to 5-10 minutes (Automated) per nerve/site.

**Ranged Current Perception Threshold (R-CPT) ( $p < 0.05$ , Ranged CPT)** - This mode allows neuroselective sensory threshold determination in approximately 2-3 minutes per nerve/site. Normative data is pre-programmed for 35 of the most common testing sites and a print out of the results immediately indicates if the subject's measures are within these norms, hyperesthetic or hypoesthetic.

**Pain Tolerance Threshold (PTT)** The noninvasive atraumatic PTT mode permits the neuroselective evaluation of pain. There are established PTT values for the finger and toe.

**Percentile Allodynia Testing** This mode provides an automated PTT test completion based on normative PTT values established for the fingers and toes enables a less painful method to evaluate allodynia than the standardized PTT evaluation

**Remote Computer & Audio Control** Windows® software is available for in vivo and in vitro physiological research and laboratory applications.

**Animal Response Testing** A non-invasive and harmless test permitting serial measures from the same site. The test may be used to assess any cutaneous or mucosal site using specialized electrodes for large or small animals. Evaluation of the concha of the ear gives direct access to brain stem neurons for CNS measures. Rat bladder electrodes are available.



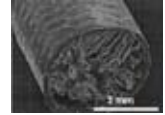
**Computer Interface for fMRI and PET Scans** Custom fMRI cables are available from Neurotron, Inc.

## Other Applications



**Cosmetic** The application of the Neurometer in cosmetics came from dentistry and dermatology studies of sensitive teeth/oral mucosa and skin. Additionally the evaluation of the itch response has proved a useful measure.

**Synthetic Nerves, Stem Cells and Nerve Regeneration** Neurometer measures have assisted in monitoring the recovery of sensation following various implants and transplants.



**Environmental/Occupational** Monitoring rice paddy farmers for pesticide and fire fighters for PCB exposure as well as detecting the toxicity from arsenic, lead, other heavy metals and vibration exposure - the Neurometer has played a key role in environmental medicine.



**Sports Medicine** Providing objective automated measures of sensory function of marathon runners on mountain tops and bicyclers in laboratories is made possible because of the Neurometer's portability. The battery powered device comes with a customized padded crush resistant carrying case the is ideal for



field applications.

**Medical Legal** Neurometer evaluations have been recognized by courts in the USA and other countries for disability evaluation.

## Neurometer® Technology Comparison to Other Diagnostic Procedures

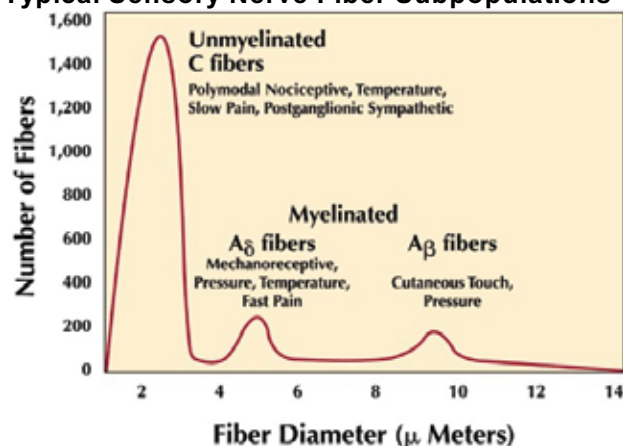
Capabilities and Features	Sensory Diagnostic Study					
	CPT	SSEP	sNCV	Vib	Therm	Biopsy
Neuroselective Evaluation of All Major Sensory Fiber Types	✓					✓
Evaluate Hyperesthesia and Hypoesthesia	✓					
Test Any Cutaneous/Mucosal Site	✓					
Localize Abnormal Sensory Function from Periphery to Spinal Cord	✓	✓				
Evaluate Early and Advanced Regeneration	✓					
Detects Malingering	✓	✓	✓			✓
Unaffected by Skin Thickness, Scar Formation or Edema and Skin Temperature	✓					
Painless Measure	✓			✓	✓	
Standardized Automated double blind study	✓					

*"While early intervention and treatment can be critical to slowing the disease's progression, most Americans don't recognize neuropathy's symptoms, which include weakness, numbness, tingling and pain, especially in the hands and feet. If ignored, the symptoms can intensify to loss of sensation to unremitting pain. Neuropathy may be the most common disease in the United States that you've never heard of. Many are even unaware that they have it".*

Neuropathy Association, May 2008



## Typical Sensory Nerve Fiber Subpopulations



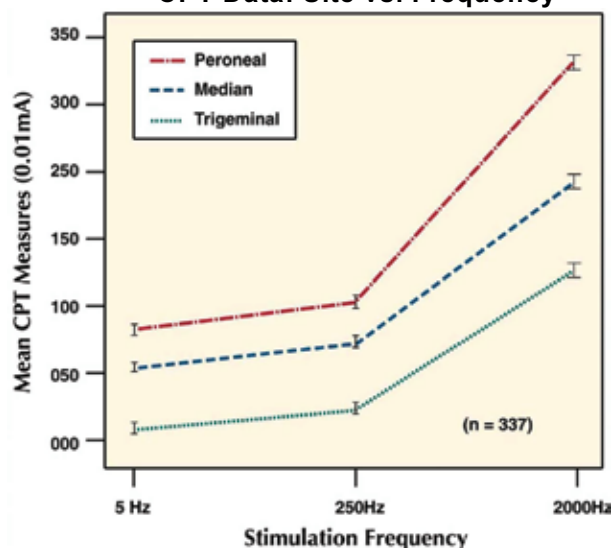
## Sensory Nerve Fiber Types

Typical sensory nerves are composed of 3 major subpopulations of fibers. The large myelinated “ $A_{\beta}$ ” fibers conduct cutaneous touch and pressure sensations, the small myelinated “ $A_{\delta}$ ” fibers conduct temperature, pressure and fast pain sensations while the small unmyelinated “C”-fibers comprising more than 80% of the total, primarily conduct temperature and slow pain sensations. The small myelinated,  $A_{\delta}$  fibers and unmyelinated C fibers are responsible for conducting protective sensations that guard against serious injury. Unmyelinated C fibers also serve a critical role in the peripheral autonomic nervous system providing the innervation to the smooth musculature. One third of the C-fibers are autonomic efferents. Clinical implications of the loss of large fiber function are not as severe as a loss of smaller fiber function.

## Neuroselective Pathology

Clinical complications resulting from C fiber polyneuropathy include foot ulceration, gangrene, cardiac and other types of autonomic dysfunction. The loss of protective function associated with small fiber “Painless” polyneuropathies is also associated with “Painless” myocardial infarction. Standard clinical evaluations ranging from the safety pin to the reflex hammer and sensory nerve conduction velocity tests do not evaluate C fiber function. The Neurometer provides an objective automated non-invasive painless neuroselective evaluation of C fiber as well as  $A_{\delta}$  and  $A_{\beta}$  fiber functional integrity.

## CPT Data: Site vs. Frequency



Both sensory and motor nerves are affected by metabolic polyneuropathy. Common polyneuropathies are associated with sensory symptoms occurring before weakness or motor impairment. Within the sensory nerve, various subpopulations of fibers have differential susceptibilities to different types of neuropathies.

## “Painless Neuropathy”

### Loss of Protective Sensation

“Painless Neuropathy” is characterized by the selective loss of smaller fiber protective sensation. An individual with this condition has intact large fiber touch sensation and may even be unaware of the neuropathy, greatly increasing the risk of serious injury. For example, the individual may feel the “touch” sensation of stepping on a burning cigarette but not the “protective” sensation of the burn. Due to pain insensitivity, complications from the foot burn may progress to infection and amputation. It is also important that the finger tips be evaluated to determine the extent of this neuropathy.

## C Fiber Neuropathy and Autonomic Dysfunction

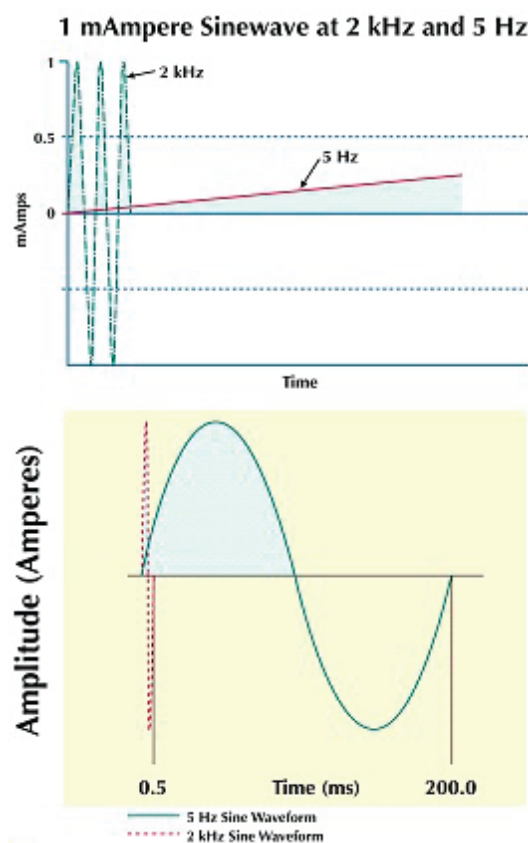
The impairment of autonomic function resulting from C fiber neuropathy can be a risk factor for mortality among diabetic/uremic patients. The CPT evaluation has been reported by an NIH Consensus Conference to be a strong predictor of mortality among kidney dialysis patients.

## Neurometer® Electrodiagnostic Evaluation Neuroselectivity, Hyperesthesia and Pain

The Neurometer® generates a constant alternating current (AC) stimulus to evoke nerve responses. The three major sub-populations of sensory nerve fibers are defined by their morphologic, electrophysiologic and functional (e.g. pain vs. non-pain transmission) characteristics. The smallest diameter unmyelinated fibers comprise greater than eighty percent of the total fibers, possess the longest refractory periods and the slowest average conduction velocity (CV) of 1 m/s. In contrast, large diameter myelinated fibers comprise less than ten percent of the total fibers, have the briefest refractory periods and fastest average CV of 60 m/s. Neuroselectivity is achieved by using three different frequencies of an electrical sinewave stimulus (2000 Hz, 250 Hz and 5 Hz), taking advantage of this waveform's frequency dependent rate of depolarization. Large diameter fibers can generate action potentials in response to the rapid 2000 Hz stimulus but small fibers require several milliseconds of continuous depolarization (i.e. low frequency stimulation, e.g., 5 Hz), to reach threshold potential. Large fibers will generate action potentials to the 5 Hz stimulus, but not at physiologically significant rates.<sup>1</sup> Additionally, the quantity of electrons or charge per depolarization of a 5 Hz sinewave (100 msec) is 400 times the charge and duration of a 2000 Hz sinewave depolarization (0.25 msec). Together, these factors result in the 2000 Hz stimulus selectively evoking physiologically significant large myelinated fiber responses and the 5 Hz stimulus selectively evoking physiologically significant unmyelinated fiber responses.

The neuroselective nature of the sinusoid waveform electrical stimulus was first demonstrated in a study comparing the application of a variety of waveform types on healthy individuals at Johns Hopkins in the 1980's. Neurometer measures have been compared with the results of other physiological /imaging, diagnostic, histologic and pharmaceutical studies. These and other studies involving nerve regeneration, ischemia and neuroselective pathological conditions have corroborated the neuroselective nature of this stimulus. The CPT® measures also have the unique ability of evaluating pathologies such as hyperesthesia and hypoesthesia that may selectively occur in one or more

subpopulations of sensory fibers while sparing the others.



Sinusoid Waveform Stimuli. Top: 2 kHz and 5 Hz waveforms drawn to scale. Bottom: Amplitude vs Time for the two frequencies, depicting the sinusoidal waveform.

### Hyperesthesia

Hyperesthesia, as measured by abnormally low neuroselective Current Perception Threshold (CPT) measures, reflects an increased electrical excitability of sensory nervous tissue for the evocation of responses. The resting membrane potential of the sensory nerve fiber increases as the result of stresses such as hyperglycemia. An elevated resting membrane potential decreases the intensity of the excitatory electrical stimulus required to reach the threshold required to evoke an action potential response. In other words, less electrical energy is required to evoke a neuronal response.

Hyperesthesia is reported in the early stages of progressive neuropathy affecting both pre-diabetics and newly diagnosed diabetics. Other early occurrences of hyperesthesia are present in alcoholism, Carpal Tunnel Syndrome (CTS) and radiculopathy. A different type of hyperesthesia results from chronic hereditary sensory neuropathies associated with lysosomal storage disorders and primary biliary cirrhosis, demyelinating polyneuropathies and infectious conditions (eg. HIV, Lyme Disease). Other neurodiagnostic tests, (e.g. sensory nerve conduction velocity, quantitative tactile, vibration and thermal thresholds) are insensitive to the hyperesthetic condition which is often sub-clinical.

### **Pain Tolerance Threshold (PTT) and Allodynia**

When the Neurometer® stimulus is administered at intensities greater than the painless CPT® sensory threshold it is possible to evoke painful sensation. Under patient control, the maximum tolerable intensity neuroselective stimulus is defined as the Pain Tolerance Threshold (PTT™). The PTT™ has been demonstrated to be a reliable measure for the evaluation of pain and select analgesic agents. Allodynia is characterized by increased sensitivity to a non-noxious stimulus which the subject characterizes as "painful". Allodynia may be evaluated by neuroselective PTT™ measures as well as the less painful "Percentile Allodynia Test". CPT® hyperesthesia and PTT™ allodynia may occur as neuroselective and independent sensory conditions. For example, spinal opiates do not affect the 2000 Hz, 250 Hz or 5 Hz painless CPT® measures or the 2000 Hz and 250 Hz PTT™ measures but they selectively elevate 5 Hz PTT™ measures in humans. Similar Neurometer neuroselective response measures have been reported from rats.

### **Direct Nerve Fiber Stimulation**

Neurometer® CPT® and PTT™ measures are not receptor or end-organ mediated. The electrical stimulus bypasses these transducers and directly excites the nerve fibers. Skin freeze or burn lesions precipitate the local release of an "inflammatory broth" (e.g. bradykinins, prostaglandins, leukotrienes, substance P, etc.) which

bind to receptors resulting in local sensory thermal and tactile threshold changes. Thermal allodynia (pain evoked by normally painless heat stimulus) and tactile allodynia (pain evoked by a normally painless tactile stimulus, e.g., Von Frey filament stimulus) occurs with these lesions. Research has demonstrated that PTT™ electrical allodynia, however, does not occur with the skin freeze model and other differences between these types of stimuli that may be due to their different site of stimulation, i.e., end-organ vs direct nerve stimulation.

### **fMRI and Neurometer Pain**

Functional magnetic resonance imaging studies from the Massachusetts General Hospital have demonstrated that heat pain and 5 Hz sNCT pain increase metabolic activity in the same areas of the brain; however, there is a habituation to the heat pain stimulus that does not occur with the electrical pain stimulus. This and other fMRI related studies are cited at [www.neurotron.com](http://www.neurotron.com).

### **Reference Material**

There are more than 800 peer reviewed publications utilizing Neurometer® technology. Documentation and bibliographies of publications are continuously updated at: [www.neurotron.com](http://www.neurotron.com).

**Legal Notices:** The Neurometer® device and/or the methods of application are patented under one or more of the following patents and international patents pending: US Nos. 4,305,402 & 4,503,863, UK No 2,052,994, Canada No 1,157,526, Japan No 3138428, Brazil No 9610321-3. Neurometer®, CPT/Eagle®, Goldtrode® and Softape®, CPT®, PTT™ and sNCT™ are registered and pending trademarks of Neurotron, Inc.

# Neurometer® NS3000®

## Automated Sensory Nerve Test

### *Painless, Neuroselective Electrodiagnostic Neurostimulator*



The Neurometer® **NS3000**® represents the state-of-the-art in non-invasive sensory nerve testing. Using the advanced sNCT/CPT evaluation procedure, each test quickly and accurately evaluates functioning of the unmyelinated, small myelinated and large myelinated fibers – at any cutaneous site. The **NS3000**® eliminates the need to conduct multiple types of tests and no special temperature, shielding or wiring is required. This patient controlled test is painless and very easy to administer and technicians are easily trained. Free evaluation software is included.

#### **High Sensitivity**

The sNCT/CPT procedure detects and quantifies all stages of neuropathy ranging from hyperesthesia to hypoesthesia and anesthesia. The built-in RCPT mode offers accelerated testing of selected distal sites.

#### **High Reliability**

The Neurometer® **NS3000**® uses a double blinded automated procedure to eliminate operator or patient influence (confirmed to  $p < 0.006$ ). Test results are not effected by edema or normal variations in skin thickness or temperature, so all measures can be evaluated through comparison to standardized, clinically established ranges of normative measures.

#### **Test Any Cutaneous Site**

Tests can be conducted on the face, the tips of the fingers or toes or at any cutaneous site on the body. Testing distal sites allows the earliest detection of dying back neuropathies. The painless stimulus allows testing on sites in sensitive areas like the face or genitalia.

#### **Painless Neuroselective Stimulus**

Each **NS3000**® procedure uses three painless neuroselective stimuli to selectively evaluate both large and small fibers. The painless nature of the test encourages patient compliance with serial evaluations and allows testing of highly sensitive areas of the body. It is ideal for testing children and others adverse to the discomfort associated with traditional electrodiagnostic tests.

#### **Reliable, Accurate & Portable**

The **NS3000**® system is self calibrating and has a built-in procedure that assures the output stimulus and cable assembly are functioning properly and without distortion prior to examinations. The system is powered by a rechargeable battery and comes in a rugged carrying case for convenient testing almost anywhere.

#### **Replaces Other Procedures**

The Neurometer® **NS3000**® is the ideal replacement for imprecise, subjective tests using pinwheels and tuning forks and for older quantitative tests using vibratory (VT) or thermal (TT) stimuli or that measure velocity (sNCV).

### **Technical Specifications**

**Control:** Microprocessor

**Size:** 16" (L), 9.5" (W), 3.5" (H)

**Weight:** 8.5 lbs. (3.86 kg)

**Power:** Rechargeable Internal Battery

**Output Current:** 0-10mA Constant AC

**Output Frequency:** 2000Hz, 250Hz, 5Hz

**Resolution:** 0-40µA

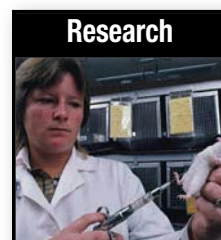
**Calibration:** Digital Quartz

**Neurotron, Inc. • 2747 Geneva Court, Denver, CO 80238-3041 USA • [www.neurotron.com](http://www.neurotron.com)**  
**Phone: (888) 804-5486 | (303) 316-0555 • Fax: (303) 557-6152 • Email: [support@neurotron.com](mailto:support@neurotron.com)**



# NEUROMETER® CPT/C®

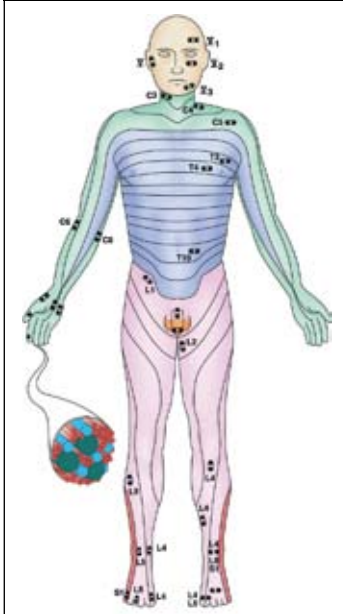
## Automated Neuroselective Sensory Nerve Conduction Thresholds (sNCT)



Neurometer® CPT/C electrodiagnostic devices perform automated neuroselective sensory Nerve Conduction Threshold (sNCT) evaluations by determining Current Perception Threshold (CPT) measures. Neuroselective sinusoidal electrical stimuli quickly, painlessly and objectively quantify the conduction and functional integrity of the large and small myelinated and unmyelinated sensory nerve fibers. Easy operation, portability and versatile computer controlled testing modes provide standardized double blind automated sensory evaluations for clinical, occupational and research settings.

The Neurometer®CPT/C can evaluate and document sensory nerve impairments at any cutaneous or mucosal site. The sNCT/CPT evaluation is extremely sensitive, detecting and quantifying hyperesthesia in early stage progressive neuropathy and hypoesthesia in more advanced conditions. The CPT/C conducts a full range of self-administered, automated, manual and programmable neuroselective sensory nerve evaluations in addition to the sNCT/CPT procedure. The fast and accurate RCPT mode allows individuals and groups to be quickly assessed for changes and abnormalities in sensory nerve function. The atraumatic Pain Tolerance Threshold (PTT) mode

### Test Sites



provides a reproducible, non-invasive method for neuroselective evaluations of conditions like allodynia and analgesia. The external computer control package adds programmable control functions to the CPT/C for creating automated atraumatic sensory evaluation procedures for both humans and laboratory animals. Special cabling also allows concurrent use of the CPT/C with fMRI and other imaging procedures and with bladder mucosal evaluations.

The Neurometer®CPT/C stimulus is self-calibrating and patented circuitry maintains a constant current output that compensates for normal variations in skin thickness and impedance. Compliance Guard® software monitors the consistency of patient responses assuring high reproducibility and significant reliability ( $p < 0.006$ ). Neuval® software, included with each device, performs a multi-dimensional analysis of CPT measures through comparison to clinically established healthy measures and generates a narrative laboratory report. Hundreds of peer reviewed publications and presentations establish the reliability of the sNCT/CPT examination. The Neurometer®CPT/C is uniquely sensitive and effective for evaluating sensory nerve impairments, and can provide significant benefits for you and your patients.

# NEUROMETER® CPT/C® Applications

**Differential Diagnosis:** axonal versus demyelinating polyneuropathy, radiculopathy, myelopathy, compressive neuropathy, focal nerve lesions/peripheral nerve injuries, differentiate between large and small fiber neuropathies

**Clinical Monitoring:** document sensory impairments at any cutaneous or mucosal site, determine clinical severity of impairment or evaluate disability, high compliance for serial evaluations, assess neurotoxicity or neuro-protective sensation

**Outcome Measurements:** pharmaceuticals efficacy/neurotoxicity, nerve blocks, response to therapeutic interventions, nerve regeneration and recovery of function post surgery/injury

**Occupational Testing:** neck & low back injury, carpal tunnel syndrome, vibration neuropathy, neurotoxic exposure, epidemiological studies

**Laboratory Research:** non-invasive neuroselective animal response testing, atraumatic stimulus permits repeated testing of the animals at the same cutaneous site

## Used in the Following Specialties:

Anesthesiology  
Dentistry  
Dermatology/Cosmetics  
Endocrinology  
Family Practice  
Nephrology  
Neurology  
Neuro, Orthopedic & Plastic Surgery  
Occupational Medicine  
Oncology  
Pain Medicine  
Pharmacology and Toxicology  
Physical Medicine & Rehab  
Podiatry  
Rheumatology  
Urology

Comparison of Sensory Neurological Assessment Techniques	sNCT/CPT	sNCV	Vibratory / Thermal	SSEP
Selectively Evaluates Large & Small Fibers	✓			
Measures Hyperesthesia & Hypoesthesia	✓			
Differentiates between Polyneuropathy, Radiculopathy, Compressive Neuropathy	✓			
Detects Carpal Tunnel Syndrome (Compressive Neuropathies)	✓	✓		
Objective Automated Double Blind Forced Choice Testing	✓			
Not Effected by Skin Thickness, Impedance, Temperature, Bone Conduction	✓			
Painless, Non-invasive	✓		✓	✓
Nerve Fiber Function Test Not a Receptor Test	✓	✓		✓

## Neurometer® CPT/C: TECHNICAL SPECIFICATIONS

### CPT/C

**Control:** Microprocessor  
**Size:** 15.5"(L), 11.75"(W), 5"(H)  
**Weight:** 14.25 lbs (6.45 kg)  
**LCD Display:** 9" (L), 15/16"(H)  
**Power:** Rechargeable Internal Battery  
**Battery Charging Time:** 8-18 hrs.  
**Battery Life:** 10-12 hrs. Fully Charged  
**Output:** 5Hz, 250Hz, 2000Hz Sinusoid  
**Output Accuracy:** Digital/Quartz  
**Output Current:** 0-10 mA Constant AC  
**Resolution Measurement:** 0.001 mA

### Remote Switch Box

**Size:** 4.5" (L), 3.5" (W), 2.5" (H)  
**Weight:** 0.75 lbs (0.4 kg)  
Audio & Visual Automated Test Cues

### PRØI Printer

**Size:** 7.5"(L), 4.5" (W), 4.0" (H)  
**Weight:** 1.3 lbs (0.4 kg)

### Neuval® Software Features

- Normative values established for more than 30 multiple testing sites
- Easy to read patient reports
- Analyze CPT data for up to 3 bilateral sites per report
- Multi-dimensional analysis for unilateral and bilateral evaluations
- Automatic database repair feature
- Reports can be saved to disk for use in other software
- Minimum requirements: 512K RAM, hard disk drive, MS DOS 2.1 or greater and a printer

For Additional Information on the Neurometer® CPT/C, Contact:



## NEUROTROTRON, INCORPORATED

INNOVATIVE MEDICAL TECHNOLOGY

2747 Geneva Court

Denver, CO 80238-3041 • USA

Phone: (888) 804-5486 • (303) 316-0555

Fax: (303) 557-6152

Email: support@neurotron.com

Website: www.neurotron.com





## NEUOTRON, INCORPORATED

INNOVATIVE MEDICAL TECHNOLOGY

Phone: (888) 804-5486

(303) 316-0555

web: [www.neurotron.com](http://www.neurotron.com)

email: [support@neurotron.com](mailto:support@neurotron.com)

fax: (303) 557-6152

*Established 1981*