



NATIONAL COMPETENCY SKILL STANDARDS FOR PERFORMING NERVE CONDUCTION STUDIES

Nerve Conduction Study (NCS) providers practice in accordance with the facility policy and procedure manual which details every aspect and modality of testing.

The American Society of Electroneurodiagnostic Technologists, Inc. (ASET) presents this document to provide national criteria for evaluating the competencies needed by technologists to perform Nerve Conduction Studies (NCS). These national competencies were established following the analysis of survey data collected in the Fall of 2004. This document was updated in the Spring of 2010 according to nationally recognized and accepted criteria and approved by ASET's Board of Trustees in March 2011.

Section I: NCS Core Knowledge

The NCS technologist has a level of technical knowledge of electrical conduction of motor and sensory nerves in the human body. The technologist possesses the appropriate knowledge level of diseases to correlate patient history and clinical symptoms to understand the appropriate nerve conduction studies to be performed.

Technical Skills and Other Abilities:

The NCS technologist prepares for the study by:

- ensuring that the laboratory and testing site adheres to Occupational Safety and Health Administration (OSHA) standards
- ensuring that standard precautions are followed
- ensuring that filter, sensitivity, and timebase are accurate according to facility policy and procedures
- explaining the procedure to the patient
- addressing any patient concerns regarding the test
- communicating with patient at the age and educationally appropriate level
- adequately preparing the skin to reduce impedance
- adequately warming site(s) to be tested.

The NCS technologist prepares a data sheet that includes:

- patient demographics (name, date of birth, age, ID number, referring physician, reason for referral)
- procedure date, procedure number, technologist's name, interpreting physician's name
- detailed history pertinent to the referring physician's reason for request, medications (anticoagulants, etc.)
- results and/or copies of other relevant studies.

The NCS technologist identifies and eliminates or reduces artifact by:

- positioning the patient to ensure adequate accessibility and patient comfort
- creating an environment which is optimal for patient relaxation

- cleansing the skin where the electrode will be placed to reduce skin impedance
- placing the stimulus probe so that the cathode is directed towards the recording electrode when stimulating, except when performing H-reflexes, F-waves (late responses)
- recognizing, identifying, and resolving artifacts and determining whether physiologic or nonphysiologic
- applying stimulus at a low intensity level and slowly increasing intensity with each stimulus given
- verifying correct nerve stimulation by observing appropriate muscle contraction
- removing or unplugging extraneous equipment, i.e., diathermy machine, fluorescent lighting, etc.

When studies are completed, the NCS technologist:

- removes recording electrodes and cleans electrodes and stimulation sites according to facility policy and procedures
- prepares the patient and equipment for the needle examination, if applicable
- stores copy of study according to facility policies and procedures (paper, hard copy, electronic media)
- disinfects recording electrodes and stimulator probe according to facility policy and procedures.

The NCS technologist documents the following for physician review:

- waveform latencies in milliseconds
- waveform amplitudes in microvolts or millivolts, as applicable for study
- conduction velocities in meters/second, if applicable
- limb temperature
- any unusual characteristics of the waveforms
- nerve(s) stimulated and recording and stimulation sites with annotation of abnormal nerve responses or technical difficulties encountered.

The NCS technologist should possess the appropriate knowledge to distinguish (not interpret) the difference between normal and abnormal waveforms, and should:

- understand the physiology of the study being performed
- perform studies with adherence to standard precautions and facility infection control policy and procedures
- understand the cause for variance, i.e., artifact vs. disease vs. anomaly
- understand the importance the effect of height can make on certain studies including conduction velocities, F-waves, and H-reflexes
- understand the relevance of abnormalities as associated with clinical symptoms
- understand the importance of morphology
- understand the appropriate use of sensitivity, intensity, timebase, averaging, and duration to maximize and ensure integrity of the response
- determine appropriate studies to provide clarification of disease process and/or clinical correlation.

The NCS technologist:

- reports critical test results* to the interpreting physician and supervisor and documents this communication according to facility policy and procedures.

Section II: Electrical Principles and Instrumentation

The NCS technologist should adhere to the following with regard to electrical safety:

- calibrate or have qualified personnel calibrate the electromyography (EMG)/NCS equipment as recommended by the facility policy and procedures or equipment manufacturer guidelines
- ensure the equipment is turned-on prior to applying or removing electrodes from the patient
- ensure equipment is grounded with a 3-prong electrical plug and outlet that has been checked and monitored for electrical safety and meets facility biomedical guidelines
- maintain safety with protected electrical power cords, ensuring that there is no current leakage
- provide proper grounding for the patient, ensuring that additional metal near the patient does not form a "ground loop"
- understand the physiology of electrical safety in electrically sensitive patients (pacemakers, cardiac catheters, etc.)
- discard disposable electrodes or disinfect reusable electrodes after each patient
- disinfect stimulator probe after each patient per facility policy and procedures
- perform studies with the electrodes plugged only into the equipment amplifier
- guarantee the equipment is clear of all liquids.

The NCS technologist should adhere to the following with reference to the stimulator:

- determine stimulation intensity to produce the proper waveforms by using milliamps (0 to 99 mA) or volts (0 to 400 V)
- coordinate the proper stimulus pulse duration (0.05 msec to 1.0 msec) with the correct stimulus intensity using the correct impulse for each study
- understand the difference in stimulus pulse durations and stimulus intensity and how it affects the patient and the study results
- use the stimulator correctly via the anode (+) and cathode (-) to produce the appropriate waveforms and ensure desired polarity for the particular study being performed
- use a conductive solution (saline or electrode gel) on the stimulator to maximize conductivity.

The NCS technologist should adhere to the following with reference to the electrodes used in nerve conduction studies:

- clean the electrode site to reduce skin impedance
- understand the basis of the active, reference, and ground electrodes as they apply to each study
- apply surface electrodes using disposable or metal electrodes with conductive gel
- evaluate how skin resistance (i.e., oily or rough skin) affects electrode impedance
- position electrodes correctly for each study as determined by facility policy and procedures
- ensure that the ground is placed between stimulating and recording sites.

The NCS technologist should adhere to the following with reference to the equipment amplifier:

- record the nerve conduction study at the appropriate sensitivity for each procedure: general guidelines include sensory setting of 5 to 10 μV per vertical division, and motor settings of 1,000 μV (1 mV) to 10,000 μV (10 mV) per vertical division or 1 mV to 10 mV per vertical division
- maintain consistent sensitivity settings and filter settings for each study in accordance with normal values
- identify proper filter settings for each study
- use motor settings that filter frequencies below 1.6 Hz and above 16 KHz
- use sensory settings that filter frequencies below 32 Hz and above 3.2 KHz
- understand the effects of filter settings on each study
- assess the proper timebase for each study
- ensure that the entire waveform acquired is fully displayed on the oscilloscope and is expressed in millisecond per division, or full screen milliseconds
- troubleshoot interference artifact (electrical, 60 Hz, muscle, movement, or stimulus artifact) and eliminate it.

Section III: F-Wave Studies

The NCS technologist obtains F-wave studies utilizing steps that include:

- placing recording, reference, and ground electrodes utilizing anatomical sites for study being performed
- a completed motor study on the nerve from which the F-wave will be obtained to assess nerve status
- adequately warming the patient
- stimulator probe oriented so that the anode is distal to the cathode increasing from a low stimulus intensity to supramaximal until a series of sample F-waves can be obtained
- a series of F-waves to offer a true representation of proximal motor unit status
- the ability to differentiate between A-waves, H-reflex, and F-waves
- waveforms displayed according to facility policy and procedures
- waveform measurements according to facility policy and procedures
- additional studies, if necessary, to clarify abnormalities
- studies tailored to patient history, maximizing information for best diagnostic capability
- comparison studies on the contralateral side if normal values are not established.

The NCS technologist should possess the appropriate knowledge base in order to distinguish (not interpret) the difference between normal and abnormal waveforms, to include:

- cause for variance, i.e., artifact vs. disease
- relevance of abnormalities associated with clinical symptoms
- use of sensitivity, intensity, timebase, and duration to maximize responses
- understanding of appropriate studies, as identified by the supervising physician, to provide clarification of disease process and/or clinical correlation.

Section IV: Repetitive Nerve Studies

The NCS technologist obtains the repetitive nerve stimulation study by:

- ensuring the equipment is appropriately equipped to obtain a repetitive stimulation study
- adequately warming the patient
- ensuring the patient has not taken any form of cholinesterase inhibitor, such as Mestinon®, within the last 24 hours
- positioning the patient to ensure limited/restrained movement during testing
- obtaining a pre-repetitive supramaximal motor conduction study to assess nerve function and ensure correct electrode placement
- placing the stimulus probe in a manner that ensures consistent stimulus in a precise location
- securing the stimulating electrodes to the skin to reduce movement artifact
- utilizing 3 to 10 Hz to stimulate the nerve
- obtaining two pre-exercise repetitive stimulations utilizing a train stimuli determined by facility policies and procedures to notate any decrement and to ensure optimal placement of electrodes and to notate any pre-exercise decrement
- isometrically exercise the patient's muscle and understand how the exercise protocol affects the study (either through directives to the patient, or using 50 Hz stimulus if the patient is unable to cooperate)
- instructing the patient to relax post-exercise
- continuing to test in time intervals as described in facility policy and procedures
- continually supporting the patient through verbal reassurance
- ensuring waveforms are displayed in accordance with facility policy and procedures.

The NCS technologist should possess the appropriate knowledge level in order to distinguish (not interpret) the difference between an abnormal and normal set of waveforms, to include:

- recognizing presence of nonartifactual decremental response and the significance
- recognizing variations of waveforms that can be the result of other neurological disorders, such as botulism poisoning or Lambert-Eaton
- recognizing the effects of neuromuscular blocking agents used in the intensive care unit (ICU)/critical care patient, or in the operating theatre.

Section V: H-Reflex Studies

The NCS technologist obtains the H-reflex utilizing steps that include:

- adequately warming the patient
- placement of recording, reference, and ground electrodes utilizing anatomical sites for the study being performed
- use of nonconnected recording and reference electrodes to ensure proper placement of reference electrode at a point off the muscle being recording, i.e., bone or tendon;
- stimulator probe oriented so that the anode is distal to the cathode
- appropriate submaximal stimulus rate and long duration level to obtain optimal results

- a series of waveforms showing initial appearance of H-reflex from onset through maximal height of amplitude and subsequent attenuation of H-reflex waveform with corresponding increase in motor response
- waveforms displayed according to facility policy and procedures
- waveform measurements according to facility policy and procedures
- studies tailored to patient history, maximizing information for best diagnostic capability
- comparison studies on the contralateral side if normal values are not established.

The NCS technologist should possess the appropriate knowledge level in order to distinguish (not interpret) the difference between an abnormal and normal set of waveforms, to include:

- the cause for variance, i.e., artifact vs. disease
- relevance of abnormalities associated with clinical symptoms
- use of sensitivity, intensity, timebase, and duration to maximize responses
- observe appropriate limb movement with stimulation of the nerve
- understanding of appropriate studies, as identified by the supervising physician, to provide clarification of disease process and/or clinical correlation.

Section VI: Blink Reflexes

The NCS technologist obtains the blink reflex by:

- appropriately grounding the patient
- placement of the recording electrode over the orbicularis oculi bilaterally
- placement of the reference electrode over the outer canthus bilaterally
- connecting the electrodes from the stimulated side of the face into the EMG instrument to display appropriate responses
- connecting the electrodes from the indirectly stimulated side of the face into the EMG instrument to display appropriate responses
- locating the supraorbital notch for stimulation
- ensuring that the cathode is pointed toward the eye
- applying the stimulus at a slow and low intensity level, increasing with each subsequent stimulus given until optimal response is recorded
- maintaining dialogue with patient to prepare patient for next stimulus
- ensuring correct nerve stimulation by observing muscle response, i.e., blinking of the eyes
- recording 3 to 4 waveforms representing the R1, R2, and R2 prime components if obtainable
- measuring latencies for each of the R1, R2, and R2 prime components
- repeating the process for the contralateral side
- ensuring waveforms are displayed according to facility policy and procedures.

The NCS technologist should possess the appropriate knowledge level in order to distinguish (not interpret) the difference between an abnormal and normal set of waveforms, to include:

- recognizing presence or absence of all components (R1, R2, R2 prime) and their significance
- recognizing variations of waveforms for various disease processes, i.e., Bell's palsy, cerebropontine angle tumors, Guillain-Barre syndrome, and multiple sclerosis.

Section VII: Knowledge Base Statements

The NCS technologist possesses the knowledge base necessary to correlate patient history and clinical symptoms in order to understand the appropriate nerve conduction studies, as identified by the supervising physician, in the following disease processes:

- Amyotrophic Lateral Sclerosis (ALS)
- Charcot Marie Tooth (HMSN Type I)/CMT
- Chronic Inflammatory Demyelinating Polyneuropathy (CIDP)
- Friedreich's Ataxia
- Guillain-Barre Syndrome/Acquired Inflammatory Demyelinating Polyneuropathy (AIDP)
- Kugelberg-Welander (adult onset SMA)
- Lambert Eaton Myasthenic Syndrome (LEMS)
- Myasthenia Gravis
- Werdnig-Hoffman (SMA)
- other peripheral nerve injuries and disease processes that may be present.

The NCS technologist maintains and improves knowledge and skills by:

- reviewing NCS records with the electromyographer on a regular basis
- reading journal articles
- studying textbooks related to the field
- attending continuing education courses in NCS and EMG
- completing online NCS courses
- participating in quality assurance/improvement reviews
- participating in professional organizations for neurodiagnostics
- achieving NCS certification and meeting recertification requirements

* Critical test results – any values/interpretations where delays in reporting may result in serious adverse outcomes for patients. MA Coalition for Prevention of Medical Errors; www.macoalition.org/document/CTRPractices.pdf

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