



## NATIONAL COMPETENCY SKILL STANDARDS FOR NERVE CONDUCTION STUDIES

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. The tabulation was completed by ASET staff and the NCS Task Force, according to nationally recognized and accepted criteria. These competencies have been reviewed and are supported by the American Association of Electrodiagnostic Technologists [AAET].

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### SECTION I - GENERAL COMPETENCIES FOR NCS

#### The technologist prepares for the study by:

- ensuring that the laboratory or testing site adheres to Occupational Safety and Health Administration (OSHA) standards;
- ensuring that standard precautions are followed;
- ensuring that filters, sensitivity and time base are accurate according to protocol;
- 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; and
- adequately warming site(s) to be tested.

#### The technologist prepares a worksheet that includes:

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

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

#### When studies are completed, the technologist:

- removes recording electrodes and cleans electrode and stimulation sites according to recommended established guidelines;
- prepares the patient and equipment for the needle examination if applicable;
- stores copy of study according to facility protocol (paper, hard copy, electronic media); and
- disinfects recording electrodes and stimulator probe according to standard precautions.

#### The 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; and
- nerve(s) stimulated and recording and stimulation sites with annotation of abnormal nerve responses or technical difficulties encountered.

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

- understand the physiology of the study being performed;
- perform studies with adherence to universal precautions and infection control guidelines;
- 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, time base, averaging, and duration to maximize and ensure integrity of the response; and
- determine appropriate studies to provide clarification of disease process and/or clinical symptoms to aid the physician in determining diagnoses.

## SECTION II- ELECTRICAL PRINCIPLES & INSTRUMENTATION

**The 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's protocol 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 hospital 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 through utilization of universal precautions guidelines;
- perform studies with the electrodes plugged only into the equipment amplifier; and
- guarantee the equipment is clear of all liquids.

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

- determine stimulation intensity to produce the proper waveforms by using milliamps (0 to 99Ma) or volts (0 to 400V);
- coordinate the proper stimulus pulse duration (0.05msec to 1.0msec) 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; and
- use a conductive solution (saline or electrode gel) on the stimulator to maximize conductivity.

**The 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 protocol and normal values; and
- ensure that the ground is placed between stimulating and recording sites.

**The 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 settings of 5 to 10uV per vertical division, and motor settings of 1,000uV (1mV) to 10,000uV (10mV) per vertical division or 1mV to 10mV 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 1.6Hz and above 16KHz;
- use sensory settings that filter frequencies below 32Hz and above 3.2KHz;
- understand the effects of filter settings on each study;
- assess the proper time base 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; and
- troubleshoot interference artifact (electrical, 60Hz, muscle, movement, or stimulus artifact) and eliminate it.

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## SECTION III - F-WAVE STUDIES

**The 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 patient;
- stimulator probe oriented so that the anode is distal to the cathode increasing from a low stimulus intensity to supra-maximal 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 protocol/recommended standards;
- waveform measurements according to protocol/recommended standards;
- additional studies if necessary to clarify abnormalities;
- studies tailored to patient history, maximizing information for best diagnostic capability; and
- comparison studies on the contralateral side if normal values are not established.

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

- cause for variance, i.e. artifact vs. disease;
- relevance of abnormalities associated with clinical symptoms;
- use of sensitivity, intensity, time base, and duration to maximize responses; and
- determine appropriate studies to provide clarification of disease process and /or clinical correlation to aid physician in determining diagnoses.

## SECTION IV – REPETITIVE NERVE STUDIES

**The 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 3-10 Hz to stimulate the nerve;
- obtaining two pre-exercise repetitive stimulations utilizing a train stimuli determined by protocol 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 50Hz stimulus if the patient is unable to cooperate);
- instructing the patient to relax post-exercise;
- continuing to test in time intervals as described in protocol;
- continually supporting the patient through verbal reassurance; and
- ensuring waveforms are displayed in accordance with protocol/recommended standards.

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

## SECTION IV – H-REFLEX STUDIES

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

- adequately warming the patient;
- placement of recording, reference and ground electrode 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 recorded, i.e. bone or tendon;
- stimulator probe oriented so that the anode is distal to the cathode;

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- 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 protocol/recommended standards;
- waveform measurements according to protocol/recommended standards;
- studies tailored to patient history, maximizing information for best diagnostic capability; and
- comparison studies on the contralateral side if normal values are not established.

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

- the cause for variance, i.e. artifact vs. disease;
- relevance of abnormalities associated with clinical symptoms;
- use of sensitivity, time base, intensity, and duration to maximize responses;
- observe appropriate limb movement with stimulation of the nerve; and
- determine appropriate studies to provide clarification of disease process and/or clinical correlation to aid physician in determining diagnoses.

## SECTION V – BLINK REFLEXES

**The technologist obtains the blink reflex study 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 distal to the anode;
- applying the stimulus at a slow and low intensity level, increasing with each subsequent stimulus given until optimal response is recorded;
- maintains dialogue with patient to prepare him/her 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; and
- ensuring waveforms are displayed according to policy/recommended standards.

**The 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; and
- recognizing variations of waveforms for various disease processes, i.e. Bell's palsy, cerebropontine angle tumors, Guillain-Barre syndrome, and multiple sclerosis.

## SECTION VI – KNOWLEDGE BASE STATEMENTS – DISEASE PROCESSES

**The technologist possesses the knowledge base necessary to correlate patient history and clinical symptoms in order to determine the appropriate nerve conduction studies in the following disease processes:**

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

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