



INSTRUCTION MANUAL

Data Collection

PART

15<sup>C</sup>

**Examination Staff Procedures Manual  
for the Health Examination Survey,  
1974-1975**



U.S. DEPARTMENT OF  
HEALTH, EDUCATION, AND WELFARE  
Public Health Service  
Health Resources Administration



**INSTRUCTION MANUAL**  
**Data Collection**

PART

**15c**

**Examination Staff Procedures Manual  
for the Health Examination Survey,  
1974-1975**



**U.S. DEPARTMENT OF  
HEALTH, EDUCATION, AND WELFARE**  
**Public Health Service**  
**Health Resources Administration**

# CONTENTS

Page

## PART I. INTRODUCTION

### CHAPTER 1. THE HEALTH EXAMINATION SURVEY

General-----	1-1
Description of the Examination-----	1-2

### CHAPTER 2. QUALITY CONTROL IN DATA COLLECTION

General-----	2-1
Recording-----	2-2
Replicate Data-----	2-3

### CHAPTER 3. RESPONSIBILITIES OF EXAMINATION STAFF MEMBERS

Medical Policy Regarding the Examination-----	3-1
Responsibilities of All Staff Members-----	3-2
Responsibilities for Completing the Control Record-----	3-20
Responsibilities for Completing the Report of Findings to Physician----	3-21
Responsibilities for Checking HES Documents in the Field-----	3-22

### CHAPTER 4. EMERGENCY MEDICAL PROCEDURES

Procedure -----	4-1
-----------------	-----

## PART II. PROCEDURES

### CHAPTER 5. COORDINATOR

General-----	5-1
Beginning of Stand-----	5-1
Before the Examination Session-----	5-1
During the Examination Session-----	5-2
After the Examination Session-----	5-5
End of Stand-----	5-5
Communication Between FOM and Examination Staff-----	5-5

	Page
CHAPTER 6. PHYSICIAN'S EXAMINATION	
General-----	6-1
Format for the Examination-----	6-1
Examination Procedure-----	6-3
Recording of Findings-----	6-4
Criteria and Definitions-----	6-5
CHAPTER 7. BLOOD PRESSURE	
Equipment -----	7-1
Procedure -----	7-1
CHAPTER 8. VENIPUNCTURE	
Equipment -----	8-1
Venipuncture Procedure-----	8-1
T <sub>3</sub> and T <sub>4</sub> Handling-----	8-2
Hematology -----	8-2
Clinical and Nutritional Biochemistries-----	8-3
CHAPTER 9. CASUAL URINE COLLECTION	
Procedure -----	9-1
CHAPTER 10. ELECTROCARDIOGRAPHY AND SPIROMETRY	
Equipment -----	10-1
Code Interpretation-----	10-1
Codes -----	10-2
Digicorder Computer Tape-----	10-3
EKG-Spiro Data Book-----	10-4
Electrocardiogram-----	10-4
Spirometer-----	10-9
Calibration Procedures-----	10-15
Sterilization Procedure-----	10-21
CHAPTER 11. SINGLE-BREATH DIFFUSING CAPACITY	
Equipment -----	11-1
General-----	11-1
Machine Maintenance and Calibration-----	11-2
Criteria for an Acceptable Exam-----	11-4
Examination Procedure-----	11-5
Recording of Temperatures and Pressure-----	11-11
Interpretation of Spirogram-----	11-11
Optional Check Procedures-----	11-13

	Page
CHAPTER 12. X-RAY	
Restrictions-----	12-1
Radiation Badges-----	12-1
X-Ray Exposures-----	12-2
Procedure -----	12-3
Processing-----	12-6
Field Checks and Calibrations-----	12-7
CHAPTER 13. AUDIOMETRY	
Equipment and Field Check Forms-----	13-1
Pure Tone Air Conduction Testing-----	13-2
Speech Discrimination Testing-----	13-14
CHAPTER 14. BODY MEASUREMENTS	
Equipment -----	14-1
General-----	14-1
Measuring and Recording-----	14-2
Procedure -----	14-3
Field Checks-----	14-7
Replicates -----	14-9
CHAPTER 15. QUESTIONNAIRES	
General-----	15-1
Health Care Needs Questionnaire-----	15-1
General Well-Being Questionnaire-----	15-5
CHAPTER 16. DISTANCE VISION TESTING	
Equipment -----	16-1
Procedure -----	16-1
CHAPTER 17. NEAR VISION TESTING	
Equipment -----	17-1
General-----	17-1
Procedure -----	17-1
Special Cases-----	17-4

# PART I. INTRODUCTION

## CHAPTER 1

### THE HEALTH EXAMINATION SURVEY

#### General

Congress in 1956 authorized the Public Health Service to conduct continuing U.S. national health surveys to collect information about the Nation's health. This information is used by Federal, State, and local health agencies, medical researchers, educators, physicians, dentists, and many other public and private agencies. One part of these national health surveys is the Health Examination Survey which collects data on scientifically designed samples of the U.S. population through a series of consecutive programs.

The National Health Survey obtains information in several ways. People are asked questions about themselves and their health. Records of hospitals and nursing homes where people receive health care are studied. Actual health examinations are administered to get information which can only be obtained by this means. This latter method is being employed in the current Health Examination Survey (HES), a major part of the National Health Survey. Over the past 15 years, 38,000 American children, adolescents, and adults have participated voluntarily in four different surveys involving special health examinations. When the present survey is completed in 1975, an additional 7,000 persons will have received examinations.

In HES data are collected by actual examinations of and tests on the individuals in the sample. Such examinations and tests can yield morbidity information that is unobtainable through other programs of the National Health Survey. They can provide information about diagnosed conditions including those which persons may fail to report or may be incapable of

reporting in a survey based upon individual interviews. They can also reveal previously undiagnosed, unattended, and nonmanifested chronic diseases. In addition to serving this primary purpose of determining prevalence of specified diseases, the examinations are intended to obtain baseline data on certain nutritional, physical, psychological, and physiological measurements. Such measurement data on a defined population are needed for understanding departures from the norms, as well as for assisting in planning certain specific programs dependent upon human engineering information.

The individuals entering these examinations are selected through the use of a nationwide probability sample of the civilian, noninstitutionalized population of the United States. The use of such a procedure makes it possible to obtain the desired statistics efficiently, economically, and in such a manner that the statistical reliability of results is determinable.

The most recently completed program, the Health and Nutrition Examination Survey, was designed to measure the nutritional status of the population. A broader age range (persons aged 1 to 74) was covered for the nutrition examination part of this survey which began on April 2, 1971, and was completed on June 10, 1974. In this same survey about one-fifth of the sample persons (adults aged 25-74) also received a more detailed examination designed to detect certain chronic diseases and to obtain information on health care needs. The current program is designed to complete the required sample size of persons receiving this more detailed examination to allow us to make accurate estimates of the prevalence of chronic pulmonary disease, disabling arthritis of the hip or knee, and cardiovascular diseases.

All information collected in the survey is held in strictest confidence. Findings are summarized and issued as statistical reports reflecting the health status of the American people as a whole. Information is never released in any form that could be used to identify any individual participant.

## **Description of the Examination**

Examinations are given in three Mobile Examination Centers, each of which consists of three specially built and equipped trailers. They are brought into the area and set up at a convenient location. The examination teams include physicians, nurses, and medical and laboratory technicians. There is no cost to participants, and transportation to and from the examination is provided.

Questionnaires are used to obtain basic demographic and socioeconomic characteristics and medical history data.

The examination consists of a general medical examination by a physician; an electrocardiograph, audiometric and speech discrimination test; X-rays of chest and major joints; spirometry and carbon monoxide diffusion tests to measure pulmonary function; vision tests; and anthropological measurements. In addition, numerous laboratory tests are performed on whole blood, serum, plasma, and urine.

At the Mobile Examination Center, urine specimens are screened for the presence of glucose, albumin, blood, urobilinogen, bilirubin, and ketones; hematological tests are performed including determination of hemoglobin, hematocrit, and red and white cell counts. Biochemical analyses performed on specimens of serum or plasma include assays for vitamin C, serum folates, serum cholesterol, SGOT, alkaline phosphatase, uric acid, calcium, phosphate, T3 and T4, B.U.N., creatinine, sodium, and potassium. All biochemical testing is performed in a thoroughly standardized manner at the laboratories of the Center for Disease Control at Atlanta, Georgia. Personnel of that Center also assist in developing procedures for obtaining and shipping specimens and for the quality control procedures used in the field.

A report of findings for each person receiving the examination is sent to his physician or clinic. This report includes any new significant medical findings; it also includes height, weight, visual acuity, hearing levels, urinalysis and hematological results, chest X-rays, and an electrocardiogram tracing.

## CHAPTER 2

### QUALITY CONTROL IN DATA COLLECTION

#### General

There are two sources of error that may enter into a sample survey, sampling error and nonsampling error. The sampling error—error due to making measurements on a sample rather than on the entire population—can be quantified and is the concern of all statisticians in sample survey design.

The less heralded but equally important nonsampling error is often neglected in sampling texts but is inevitably present in all data gathering ventures. It is on the control of nonsampling error that quality control centers. Much time and effort in the Health Examination Survey is devoted to reducing nonsampling error and to collecting data that are of a high degree of quality.

One type of nonsampling error which occurs in voluntary surveys is the bias introduced by nonresponse. Various measures are employed to obtain the highest response rates possible, e.g., advance planning and publicity, diligent work by the Health Examination Representatives, assignment of supervisory HER's, special literature describing the goals and importance of the survey, and proper handling of examinees by the examination staff. Changes in population attitudes and demographic characteristics which have occurred over the past years have made it increasingly difficult to match the response rates of previous cycles. However, with new techniques and interviewing procedures and with everyone's concerted effort, we hope we will reach a satisfactory level.

More closely related to the purposes of this manual are the nonsampling errors which may be introduced by variabilities and biases associated with the examiners and the mechanical devices used. Many machines, some simple and some complex, are used in HES. With proper calibration and maintenance the errors associated with these devices can be controlled. Instructions for

the calibration and maintenance of equipment are found in this manual. Bearing in mind the potential uses of the data, we adopt procedures that will reduce examiner and subject errors; but in general, we cannot design procedures that will eliminate errors. However, certain types of examiner and subject errors can be readily identified and controlled.

Several measures are taken to assure completeness and consistency in the recording process. All questionnaires are reviewed for omissions and inconsistencies. If errors are noted, correct information is obtained by phone or from the examinee when he comes in for the examination. Errors in recording some measurements are reduced by having a second person act as a recorder. In addition, all data gathered in the examining center are reviewed by a designated exam staff member before the examinees leave. Records of unusual occurrences which may affect the validity of the data are also maintained.

Although emphasis is placed on doing examinations in a uniform and standard manner in the staff training (and retraining) periods, drift in technique is apt to occur in lengthy surveys such as HES. We intend that this manual be used as a reference to help standardize procedures and reduce errors throughout the entire HES.

## Recording

Just as uniformity and standardization are important in performing the procedures of the health examination, these same two characteristics are vital to recording the observations or measurements which are the result of the procedures. Accuracy, precision, and legibility are also important. A scrawled entry which cannot be read is no entry at all, it is lost data.

Completeness in recording is something that is often overlooked. We do not mean here long, drawn-out wordy entries. Rather, we do mean being sure not to omit entries—of course, the entries should be accurate, precise, and legible.

We will have unavoidable losses of data—no X-rays on some, inability to obtain optimal performance of a procedure, and so forth. You are expected to use discretion regarding these unavoidable losses, to stop procedures occasionally as necessary when it is apparent that examinees cannot cooperate despite your best efforts. It is the avoidable loss of data that is the responsibility of each staff member to prevent. When no entry is possible, indicate this and the reason why. Most sections of the record now make

provision for this and should be used when necessary. Care should be taken not to write in any of the spaces set aside for coding.

To summarize:

1. A good record is the other half of a good observation; neither is adequate without the other.
2. Recording requires UNIFORMITY, ACCURACY, PRECISION, LEGIBILITY, AND COMPLETENESS.
3. Each staff member should review each case record section as soon as he has finished making entries to be sure there are no avoidable omissions or other errors or shortcomings.

## Replicate Data

Despite precautions there are biases and variable measurement errors that cannot be or are not judged important enough to be eliminated. Another objective of the quality control program, therefore, is the determination of the extent of these errors. In HES the primary means for evaluating both of these types of errors is by replicate measurements. Replicate data are obtained basically in two ways—by reevaluating or rereading a hard document or by reproducing an actual measurement, either by the usual procedure or by a standard procedure. Although hard documents such as the weight and height measurements are reevaluated, the replicate program is primarily concerned with reproducing actual measurements.

During the actual operation of the survey, the primary use of replicate data is to indicate areas where retraining or reevaluation of procedures are needed. When the reports of findings of the survey are published, data from the replicates will be used to apprise the reader of the extent to which the data may be affected by measurement error.

Replicate data are gathered in many specific areas of the examination with varying degrees of frequency. For example, replicate measurements are made as frequently as on every examinee for measurements such as spirometry and hematocrit. Additional blood is drawn from a systematic subsample of examinees. The blood sample is split and sample numbers assigned so that the paired samples cannot be identified as originating from the same examinees by the laboratory doing the determinations. Evaluation performed upon receipt of results will also be used in the final evaluation

of measurement process error. In addition, each laboratory has its own quality control procedures which include the use of standards and repeated determinations. Although replicates are performed for various purposes, the data are preserved and in previous HES surveys have proved useful for indicating the extent of error in final evaluations.

## CHAPTER 3

### RESPONSIBILITIES OF EXAMINATION STAFF MEMBERS

#### Medical Policy Regarding the Examination

We are in the business of collecting data for statistical analyses. We are not set up to treat or manage a particular medical problem, nor are we meant to do any such treatment. Indeed, in most instances the examining physician will not be licensed within the State in which the examinations are being conducted. Because of these as well as other reasons certain policies must be followed.

An individual examinee should not be given any information on the findings of the examination except where medical advice of a very general, non-controversial nature would be beneficial to the examinee. A single examination often does not allow an adequate interpretation of findings nor the best specific advice to give to an examinee. Only the examinee's personal physician or clinic physician, who has the individual's long-term records available and who is primarily involved with the long-term care and followup of the examinee, should interpret the findings for the individual and decide what to tell the person. For this reason reports of findings are sent to the physician or clinic the examinee indicates. For each person undergoing the examination the report summary is sent to the physician along with a CDC laboratory report, EKG, chest X-ray, and audiograms. The examinee is encouraged to contact his physician or clinic for results.

Whenever a condition is found (such as abdominal mass or otitis media) which in the opinion of the examining physician requires early medical care, the examining physician should contact the personal physician or clinic named on the consent form the examinee has given, indicating the presence of the condition after consulting with other staff members to determine whether other findings should also be reported.

When in such a circumstance the examinee has not indicated a physician, appropriate referral should be made depending upon the locality, using the advice of local medical authorities. This may vary from referral to a medical center clinic or emergency room to referral to a private physician nearby listed on the medical society roster for such matters. The medical advisors of the survey should be informed of all physician, nurse, or clinic contacts.

In other cases when it is advisable or necessary to transfer medical findings, laboratory data, X-rays, or electrocardiograms to the examinee's physician before routine reporting of the results, the physician should check that a consent form has been signed and send either a copy of the report form or an official HES letter with the phone number and address of the examination center.

As a matter of policy, when male physicians are examining female examinees either the nurse or another adult female should be present in the examining room.

## **Responsibilities of All Staff Members**

Membership in the Health Examination Survey carries with it many responsibilities. Not the least of these is your responsibility to recognize that you are one member of a team of professional and paraprofessional persons upon whom certain demands have been placed in order to accomplish the overall task of the Health Examination Survey. You should be aware of and respect the job demands placed upon other staff members, should maintain an attitude of tolerance and consideration for fellow members of the team, and should willingly perform the extra tasks that may occasionally be assigned to support other staff members in the performance of their duties.

Each member has a responsibility to the Public Health Service for promoting good public relations. The Public Health Service will be judged by the actions of the staff both on and off duty. You must be discreet in speech and actions. You should refrain from any discussions about an examinee which might be overheard and from any discussions of the survey which might be overheard and unfavorably misinterpreted. You should exercise good judgment in any discussion of controversial subjects. You should be conscious of the customs of the area and should avoid any actions which might reflect unfavorably upon the Public Health Service or interfere with the work of the survey. Your personal appearance and behavior must be governed by these same considerations.

The examinee should be treated courteously as a person, not as a sample number. Exchanges of information between staff members for the better understanding of an examinee must be discreet.

Each individual staff member is the first and best guarantor of the quality of the data being collected. As such you have a responsibility for quality in every single step of the examination process. The most obvious methods of assuring quality are to perform procedures with accuracy, precision, and in a uniform manner according to instructions and to record completely, accurately, uniformly, and legibly. You are urged to suggest areas where quality control procedures need to be instituted and methods for their implementation.

All staff members may be required to drive a government, private rental, or privately owned automobile to transport examinees to and from the examination center or to accompany the examinees by taxicab or public transportation. Staff members may be requested to perform tasks not directly related to their specific professional skills in order to implement the overall organization. Staff members are responsible for appropriate care and safeguarding of portable expensive equipment such as cameras, tape recorders, etc., used during the examination, including storing and locking in instances where applicable.

### 1. Coordinator

In addition to the general responsibilities of all staff members it is the responsibility of the coordinator to:

- A. Coordinate the flow of examinees through the examination center according to the procedure described in this manual.
- B. Carry out the other coordinator duties described in Chapter 5.
- C. Try to make each examinee as comfortable as possible while he is in the examination center.
- D. Complete and review certain parts of the physician's "Report of Findings" (see page 3-21), and to review certain completed records (see page 3-22).
- E. Check all rooms before leaving the trailers to see that all portable expensive equipment is stored and locked, and to see that all doors are locked when she leaves.
- F. See that certain data are transmitted from the field according to the instructions in Chapter III of the HES Field Operations Manual.

## 2. Health Technicians

### A. Responsibilities related to examinations

In addition to the general responsibilities of all staff members it is the responsibility of the health technicians to:

- (1) Arrive for work 30 minutes before the first examinees scheduled.
- (2) Do the necessary calibrations and maintenance before each session as specified in this manual.
- (3) Carry out all your parts of the examination completely and in a uniform way according to the procedures described in this manual.
- (4) Do the exams within the tech block in the following order: (1) X-rays, (2) Distance vision, (3) EKG, (4) Spirometry, and (5) Single breath diffusing capacity.
- (5) Screen examinees before pulmonary function testing unless the physician has already seen the examinees. All examinees who the technicians think have contraindications to testing should, before testing, be examined by the physician who will decide whether or not any tests should be omitted.

Since maximum expiration puts strain on many areas of the body, absolute rules would be voluminous for screening examinees before spirometry. Hence, first explain the strain of blowing maximally and ask "Is there any reason that you should not blow into our machine?" The answers may be as varied as "I have a cerebral aneurysm" to "Blowing brings on my seizures." Each examinee with a serious complaint should be referred to the physician before spirometry. Also ask each examinee specifically "Have you had heart disease, angina or chest pains, tuberculosis, surgery on your abdomen or chest in the last 6 weeks, or do you have a hernia or a respiratory tract infection?" Ask females "Are you pregnant?" Refer examinees with positive responses to the physician before pulmonary function testing with the Ohio Spirometer or Collins Analyzer.

- (6) Make a record on the unusual occurrence form of any exam not done, done on a defective machine, or done in a non-standard way.
- (7) Inform the coordinator, FOM, and chief technician of all equipment failures that prevent you from doing examinations, and see that the equipment is fixed as soon as possible.
- (8) Check all technician parts of the examination record for completeness, accuracy, and consistency.
- (9) See that the physician has seen the EKG's before the examinees leave the examination center.
- (10) See that the physician has seen the X-rays before the examinees leave the examination center.
- (11) Check the X-rays, repeat them if necessary, and duplicate them.
- (12) Complete and review certain parts of the physician's "Report of Findings" (see page 3-21).
- (13) See that certain data are transmitted from the field according to the instructions in Chapter III of the HES Field Operations Manual.

#### B. Additional responsibilities of Technician A

- (1) Flush and calibrate the lung analyzer daily.
- (2) Do the spirometer volume mechanical calibration daily.
- (3) Replenish the necessary supplies in the respiratory and lung analyzer rooms daily, and close down these rooms at the end of each day.
- (4) Check and file the EKG, spiro, and lung analyzer tracings.
- (5) Clean and sterilize the lung analyzer mouthpieces.
- (6) Check the lung analyzer and EKG-Spiro data books to see that the entries are correct.
- (7) Clean the EKG electrodes.
- (8) Maintain all the equipment in the respiratory and lung analyzer rooms.
- (9) Prepare transmittals at the end of the stand for EKG (tracing and tape), Spiro (tracing and tape), and Lung Analyzer forms.

#### C. Additional responsibilities of Technician B

- (1) Check the anthropometer scale and skinfold caliper daily.

- (2) Do an audiometer check daily, and calibrate the audiometer weekly.
- (3) Replenish all the necessary supplies in the body measurement, audiometry, and interview rooms daily, and close down these rooms at the end of each day.
- (4) Maintain all the equipment in the audiometry and body measurement rooms.
- (5) Account for and file the Speech Test forms.
- (6) Account for and file Health Care Needs forms.
- (7) Account for and file the height photos.
- (8) Make sure each technician has completed the GWB Summary Sheet at the end of each session and file the GWB and Summary Sheet forms.
- (9) Prepare transmittals at the end of the stand for the GWB packet, HCN, and speech forms.

D. Additional responsibilities of Technician C

- (1) Start the X-omat, check the chemical levels, and run check films daily.
- (2) Change the date on the X-ray marker daily.
- (3) Replenish all necessary supplies in the X-ray and dark rooms daily, and close down these rooms at the end of the day.
- (4) Label and file all X-rays with their envelopes. See that the envelope numbers agree with the film numbers.
- (5) Maintain all the equipment in the X-ray and dark rooms and the X-omat.
- (6) Check the levelness of the pelvic stand in the X-ray room daily.
- (7) Check the light level for the far vision test daily.
- (8) Make a copy of the X-ray roster sent to George Vose, and send it at the end of the stand to Dr. William O'Brien.
- (9) Prepare transmittals at the end of the stand for the chest X-rays, hip and knee X-rays, and hand and wrist X-rays.

E. Additional responsibilities of the Chief Technician

- (1) Provide supervision and guidance over all health technician procedures including: all examination procedures; equipment

calibrations; and completion of beginning and end of stand inventories and equipment checklists, data log books, unusual occurrence forms, quality control records, and reports of findings.

- (2) Evaluate the quality of all health technician data, provide any necessary feedback to the health technicians, and send completed evaluation forms to Headquarters at the end of each stand.
- (3) Maintain records of all calibrations.
- (4) Perform minor repairs and periodic equipment maintenance.
- (5) Train new health technicians to do the examinations according to the instructions in this manual including applicable theory where appropriate.
- (6) Act as the recorder for body measurements.
- (7) Act as liaison between the health technicians and the Headquarters supervisory health technician and biomedical engineer on matters pertaining to all procedures and equipment involved in the work of the health technicians.
- (8) Assure that the data are collected according to the manual procedures, and correct any departures from the written instructions.
- (9) In coordination with the examining physician, determine whether any examination procedures should be eliminated for any sample person because of physical or mental reasons.
- (10) Provide supervision and guidance over other staff members who might, for various reasons, be required to perform health technician procedures.

F. Technician responsibilities at the beginning of each stand

- (1) Complete the inventory of all supplies, return the original to the coordinator, and note additional supplies needed.
- (2) Plug in the voltmeter to Trailers 1 and 3, and check the readings.
- (3) Lung analyzer
  - (a) Remove the shipping bolt restrainers.
  - (b) Adjust the following switches and leave them for the entire stand:

- Turn the ON-OFF switch on the back of the machine to ON. Minimal warmup time is 6 hours.
- Turn the CO switch on the CO readout panel to the 3 percent position.
- Turn the He ON-OFF switch on the He readout panel to ON.

- (c) Replace the drierite at the back of the little unit.
- (d) Fill the drum with distilled water.
- (e) Replace the arm and tubing.
- (f) Check the kymograph speed with the stopwatch; it should be 32 mm/sec.
- (g) Attach the gas tank regulator, and secure the tank to the wall.
- (h) Post the helium content on the machine.
- (i) Replace the drierite and ascarite in the front towers.
- (j) Check all balloons and tubing for leaks.
- (k) Adjust the vent grid.

#### (4) EKG and Spirometer

- (a) Remove the shipping restraining hardware.
- (b) Untape the barometer and make the necessary adjustments.
- (c) Insert and connect the flow-volume converter.
- (d) Turn on the spiro-rack and all instruments, warmup 60 min.
- (e) Check the digital volume display and oscilloscope.
- (f) Adjust the oscilloscope line voltage setting. Low: 90-110V, medium: 104-126V, high: 112-136V.
- (g) Make the necessary adjustments to the digicorder.
- (h) Mount the computer tape in the digicorder.
- (i) Do spirometry calibrations, and send the tracings to the supervisory technician.
- (j) Record the barometric pressure in the EKG-Spiro data book.
- (k) Tightly close the metal grid on the left half of the vent over the barometer, and switch off the left half of the vent entirely. Adjust the metal grid on the right half so that

the air is directed to the right side of the room. Hot or cold air blowing directly on the barometer will affect the pressure readings.

(5) Body Measurements

- (a) Assemble the anthropometers, and check them and the calipers.
- (b) Disengage the lock on the weight scale.
- (c) Calibrate the standing height and weight scales, and send the calibrations to the Quality Control Section.

(6) Audiometer

- (a) Set up the audiometer, masking unit, and tape recorder.
- (b) Do the audiometer calibrations and send copies to Jean Roberts and Ken Stewart.
- (c) Set the tone level for the speech test.

(7) X-ray room

- (a) Remove all restraining brackets and bars according to the instruction book.
- (b) Level the metal stool.
- (c) Have the transformer matched to the incoming line.
- (d) Check the MAS at all MA stations on the control panel.
- (e) Check the horizontal accuracy of the X-ray tube.
- (f) Do the hand bone densitometry calibrations.

(8) X-omat

- (a) Fill and rinse with water of 90° F.
- (b) Replace the developer filter.
- (c) Mix the chemicals.
- (d) Check the water pressure.
- (e) Check all the settings and chemical temperatures.

(9) Far vision

- (a) Turn on the chart light.
- (b) Set the ambient light at 5 to 10 lumens.
- (c) Check the illumination of the chart.

G. Technician responsibilities at the end of each stand

(1) Complete the inventory of all supplies. Give it to the coordinator to send to Headquarters.

(2) Lung Analyzer room

(a) Lung Analyzer

- Remove water from the reservoir.
- Remove the bell, clean, wrap, stuff, and place in the cabinet.
- Wipe out the reservoir.
- Remove the tubes, sterilize, and store them in the cabinet.
- Remove the 5-way valve, clean, wrap, and store it.
- Remove the sample bag and tube, inspect it, if good, wrap and store it.
- Pull the analyzer's power plug from the wall receptacle.
- Secure the IR analyzer with two straps to the lung analyzer.
- Roll the lung analyzer to its storage position, and bolt it to the wall and floor with the bracket.
- Do not remove the ascarite and drierite from the drying towers.
- Push the RV/BB valve into the IN position.
- Sterilize all mouthpieces and store them in the cabinet.
- Clean the sterilizer tray and lid, wrap, and store them in the cabinet.
- Wrap and store in the plastic box the stopwatch, hemostats, picks, A.C. Voltmeter, tank regulator, gauze pads, lung analyzer daily calibration book, kymograph foot pedal, metric ruler, proportional dividers, and

nose clamps without used sponges.

- Store the plastic box next to the balloon box in the lung analyzer.
- Remove the kymograph drum, wrap, and store it in the cabinet.
- Return the kymograph paper to storage.

(b) Chairs - turn them on their sides and secure them to the wall.

(c) Tank

- Note and record the tank gas pressure on the tank, if it is less than 500 psi, notify the FOM.
- Turn the tank valve off.
- Release the pressure in the regulator, remove the regulator from the tank, and store it in the plastic box.
- Replace the metal head protection cap in the tank.
- Make sure the tank is secured to the wall.

(3) EKG Spirometry room

(a) Ohio spirometer

- Position the piston to the .10 liter stop and cork the portal.
- Disconnect the autonegator spring.
- Bolt the spirometer to the rack.
- Return the flow-volume converter to the storage area in the spirometer.
- Remove the hose, sterilize, and store it.
- Return the extra mouthpieces to the storage area.

(b) Beckman recorder

- Take the tape off the recorder.
- Clean the EKG examinee cable and electrodes, and return them to the drawer in the recorder.

- Turn off the recorder.
  - Bolt the recorder into the rack.
  - Return the electro pads to storage.
  - Return the EKG-spiro book to the drawer in the recorder.
  - Tape the drawer shut.
- (c) Tektronic scope
- Turn off the scope.
  - Bolt the scope to the rack.
- (d) Voltmeter
- Turn off the voltmeter.
  - Secure it to the rack.
- (e) Spiro rack drawer - tape it shut.
- (f) EKG table - lower it and secure it to the wall with straps.
- (g) Step stool - secure it to the wall with the straps holding EKG table.
- (h) Barometer
- Turn the adjustment screw so the Hg column is at top of the barometer tube.
  - Tape the column to the stand at the top and bottom.
- (4) Audiometry room
- (a) Disconnect: the audiometer from the masking generator, the earphone cable from the masker, the bone oscillator from the dB pad, the tape recorder from the audiometer, the earphones from the head band, and the bone oscillator from the head bands.
- (b) Wrap and store in the audiometer: earphones, bone oscillator, cords, bone head band, and earphone head band.
- (c) Tape the audiometer door closed and place the machine in the wooden box.

- (d) Place the masking generator in the wooden box.
- (e) Remove the adapter ring from the coupler, place the protective grid over the diaphragm, and put it in the storage box. Replace the adapter ring on the coupler.
- (f) Unscrew the artificial ear coupler from the B&K meter, wrap, then bolt.
- (g) Store the B&K meter, the artificial ear coupler, and the diaphragm box in the body measurement table.
- (h) Secure the face cover on the Ballantine voltmeter and store it in the body measurement table.
- (i) Store the audiometer and the masking generator box in the room unless they are to return to Pittsburgh, Pennsylvania.
- (j) Bring the backup audiometer and masking generator from under the trailer to store in the room.
- (k) Remove the tape from the recorder.
- (l) Place the recorder on its back on the audio room floor.
- (m) Turn off the lights and shut the door.

(5) Body measurement room

- (a) Return the calipers to their cases and return the cases to the drawer.
- (b) Lock and tape the table doors shut.
- (c) Secure the table with straps.
- (d) Shift the scale weights to the right and lock or tape them in place.
- (e) Secure the scale platform with the wooden wedge placed between the platform and scale upright frame.
- (f) Use elastic cords to further secure the scale platform.
- (g) Place the weights around the edge of the scale to prevent them from shifting during transit.
- (h) Lock the scale mechanism by moving the lever behind the upright frame to the vertical position.
- (i) Unplug the weight scale and the light on the height scale.

- (j) Push the height scale to the top of the bar and tape it in place. Do not remove the camera but tape it securely to the upright frame.
  - (k) Secure the stool to the wall with rubber straps.
- (6) X-ray area
- (a) X-omat
    - Turn off the main power breaker (left side).
    - Empty the replenisher tanks, rinse, and refill them with hot water.
    - Open the drain valves (in dark room) and drain fixer, developer, and water. Close the drains and fill all three tanks with water. Remove and dispose of the developer filter. Return the trap lid.
    - Open the replenisher rate valves (front right).
    - Remove the two cross over rollers, the detector entrance roller assembly, and the squeegee or dryer roller assembly; and clean them using water and a Scotch Brite pad.
    - Turn on the power, and push the replenisher switch (button) and hold for 5 minutes.
    - Drain the insert tanks by opening the drain valves; remove the developer, fixer, and washer transport rollers. Scrub the insert tanks to remove all chemical deposits. Rinse and fill the insert tanks with hot water.
    - Turn the power on and push replenisher switch again and hold for 5 minutes (check to make sure there is sufficient water in replenisher tanks so as not to draw air through the pumps).
    - Drain all tanks and wipe out the insert and replenisher tanks.
    - Scrub the transport rollers and gears with Scotch Brite pads until all deposits are removed, rinse, and let them stand to dry.
    - Clean the area where the replenisher tanks sit and the shelf where the blower motor sits (accessible when the rear panel is removed).

- Remove, rinse, and wipe down the dryer air tubes and transport rollers. Replace the dryer tubes.
- Inspect the transport rollers for deposits. If there are any, reclean the rollers with Scotch Brite pad. Replace the rollers into the appropriate insert tank.
- Replace cross over and squeegee assemblies.
- Replace the detector entrance roller assembly.
- Replace the cover, clean the outside of the X-omat, loading table, and dryer bin. Tape the panels and cover in place.
- Check that all water and mixing valves are off. Close the drains. Turn off the power.

(b) Dark room

- Lock the film and tape around the edge.
- Check to see that the duplicator is anchored firmly in the corner of the counter.
- Place the small film separators and the extra hand film on the floor and secure in place.
- Remove the shelf from holders and place on the floor.
- Place the 14 x 17 cassette between the wall and film bin.
- Close the door and make sure it is secure.

(c) X-ray equipment

- Turn the machine off at the breaker (located on the wall of the dark room).
- X-ray floor to ceiling tube stand:
  - Rotate the tube stand so it faces the dark room wall.
  - Push the tube arm all the way in.
  - Lock the tube stand in place with swinging angle brackets. See that the stand can't move.
  - Put a bolt in the stand to secure the counter weights.
  - Secure the tube arm with the wall mounted bracket.
  - Test to see that the arm can't move up or down, in or out.
  - Secure the top of the tube stand with the bracket.

- Check that all brackets are secured in place with holding pins.
- Radiographic table
  - Install four bolts and a bracket to the bucky at the head end of the table to secure the bucky and tray.
- Cassette changer
  - Install a screw into the base of the cassette changer to secure the lucite sliding door.
  - Lower the cassette changer to its lowest position and install two bolts into the counter weights (one in each column).
  - Install two brackets and four bolts into the side of each column so each bracket overlaps the top of the cassette changer.
  - Unscrew the plumb bob from the lead line and secure the line to the cassette changer with tape. Place the plumb bob in the tool box.
  - Install a rubber strap to the front track and to the base of the cassette changer to secure the bucky door.
- Metal stool
  - Turn the metal stool upside down and tape it to the upright cassette holder.

### 3. Laboratory technicians

In addition to the general responsibilities of all examination staff members it is the responsibility of the laboratory technicians to:

- A. Arrive for work at the time the first examinees are scheduled.
- B. Perform the basic hematology, urinalysis, and sample preparation on examinee specimens obtained.

- C. Check out all equipment before the receipt of the first whole blood and urine at the beginning of each examination session.
- D. Record all values on a daily worksheet and on the individual specimen identity cards.
- E. Record all abnormalities found in the hematology (after verification by repeating the tests) on the daily worksheet.
- F. Ship all required specimens daily to CDC after verifying the packing list.
- G. Perform all required quality control procedures daily or weekly as prescribed by CDC, and send the appropriate forms to CDC weekly.
- H. Complete an inventory of all supplies at the beginning of each stand. Give a copy to the coordinator to send to Headquarters. Keep the FOM apprised of the status of the dry ice supply.
- I. See that the laboratory equipment is properly maintained. If necessary call the Operations Section and the manufacturer's representative to insure proper repair of the equipment.
- J. Complete and review certain parts of the physician's "Report of Findings" (See page 3-21).
- K. See that certain data are transmitted from the field according to the instructions in Chapter III of the HES Field Operations Manual.

#### 4. Nurse

##### A. Responsibilities related to examinations

In addition to the general responsibilities of all examination staff members it is the responsibility of the nurse to:

- (1) Arrive for work 20 minutes before the first examinees scheduled.
- (2) Draw the appropriate amount of blood from all examinees according to the instructions in this manual.
- (3) Give the near vision test to all examinees according to the instructions in this manual.
- (4) Complete the required items on the CDC report form.
- (5) Assist the physician in his examination except during the administration of medical history supplements.

- (6) Help with arriving examinees if the coordinator asks.
- (7) Try to provide to each examinee a feeling of continuity throughout the examination, in this way perhaps making the examinee less anxious and more comfortable during his stay in the exam center.
- (8) Complete and review certain parts of the physician's "Report of Findings" (see page 3-21) and to review certain completed records (see page 3-22).
- (9) See that certain data are transmitted from the field according to the instructions in Chapter III of the HES Field Operations Manual.

#### B. Additional responsibilities

- (1) See that letters to physicians get mailed when done.
- (2) See that the appearance of the examination areas, the equipment, and the inventories of supplies for physician's examinations, near vision testing, and venipuncture are maintained.
- (3) Change Cidex solutions at least every 5 to 10 days as needed.
- (4) Recharge the otoscopes over each weekend.

#### C. Responsibilities at the beginning of each stand

- (1) Check new supplies with the new inventory list, and then put the supplies away.
- (2) Complete the beginning of stand inventories and give them to the coordinator.
- (3) Set up the physician's, venipuncture, and near vision rooms for use, making sure all equipment works and supplies are adequate.

#### D. Responsibilities at the end of each stand

- (1) Do the physician's, venipuncture, and near vision room inventories.
- (2) Give the unusual occurrence form from the physician's, venipuncture, and near vision rooms to the coordinator.
- (3) Pack the physician's, venipuncture, and near vision rooms for travel.

## 5. Physician

In addition to the general responsibilities of all examination staff members it is the responsibility of the physician to:

- A. Arrive for work 15 minutes before the first examinees scheduled.
- B. Review the Sample Person Supplement before the arrival of the examinees and notify the coordinator if any section of the routine examination should be omitted or altered for any examinee or if the physician should further question or examine any examinee before undertaking any section of the routine examination (see responsibility G.).
- C. Review pertinent "positive" responses, clarify questionable or inconsistent information, and update the histories at the time of the examination so that the histories are correct and current.
- D. Administer the Physician's Supplement before doing the physical examination.
- E. Carry out a complete physical examination as outlined in this manual in a uniform way, insuring complete data collection on all those findings which are of primary importance to the survey.
- F. Administer the supplemental histories "A" (Arthritis), and/or "B" (Respiratory), and/or "C" (Cardiovascular) if indicated. Each section of an administered supplement should be completed in detail.
- G. Assess the status of the examinee and decide if any sections of our routine examination should be omitted. For instance, examinees with acute upper or lower respiratory tract infections or with active tuberculosis (including those still on chemotherapy) should be excluded from both CO diffusion and spirometry studies to prevent contamination of the machinery; and examinees with recent abdominal surgery, incipient delivery or complicated pregnancy, or active angina pectoris might have to be excluded from spirometry to prevent damage to the examinees.
- H. Assist in the blood-drawing and EKG recording when requested. If the nurse is absent from work the physician should do those parts of the examination normally done by the nurse.
- I. Read all X-rays and EKG's before the examinee leaves the examination center. Initial those of acceptable quality, and have those of unacceptable quality repeated.

- J. Arrange medical care for examinees ill or injured in the exam center or needing medical attention prior to the time that the routine reports will be mailed (use 2 months as a guideline) according to the "Medical Policy Regarding the Examination." If possible, this care should be delivered by the examinee's own health delivery system or by the ambulance and emergency room service listed in the exam center. In those instances where immediate care in the exam center is necessary, you should direct this care.
- K. Complete the physician's section of the "Report of Findings" so that any significant new medical findings are called to the attention of the examinee's physician.
- L. Review certain completed records (see page 3-22).
- M. Be present within the examination center until the last examinee has completed his examination (excluding any questionnaire completion).
- N. Promptly notify the Field Operations Manager if because of illness or any other reason you are unable to discharge any of your duties.
- O. Be familiar with the "Medical Policy Regarding the Examination."

## **Responsibilities for Completing the Control Record**

Each examiner is responsible for filling in the section of the control record pertaining to the procedure he performed. This involves entering the time of the start and end of a procedure and the examiner number. If a procedure is not done, the reason must be recorded under "Procedure or part of overall procedure not done." If a part of the procedure is not done, the reason for the omission should be noted on the control record.

Staff members should pay particular attention to the "Special Notes" section. This section is filled in by the coordinator from the Daily Appointment Schedule and indicates any special consideration or action involving the examinee. For example, an entry of "No X-rays" must be noted by the health technician, and the procedure should not be performed. The reason for not doing the procedure should be ascertained and entered under "Reason Not Done" by the health technician. Similar considerations apply to other staff members responsible for other procedures which are indicated as not to be performed.

## Responsibilities for Completing the Report of Findings to Physician

These reports will be mailed from Headquarters. Each examinee will have a report sent which will also include a copy of the chest X-ray, the EKG tracing, and a machine printout of almost all of the lab work performed at CDC.

### 1. Coordinator

Enter the name and address from the authorization form of the physician or clinic to whom results are to be sent. Stay within the box outlines since the form has been designed for a window envelope. Enter the name and address of the examinee from the top of the medical history form. Enter the exam date, age, and sex from the control record. It will be the overall responsibility of the coordinator to assure that all staff members have made their appropriate entries and that the form is complete.

### 2. Physician

A box is provided to check if there are no significant findings. If there are significant findings for which no treatment had been sought and/or no history given, they should be reported. If the box is not checked or no significant findings reported, the coordinator will return the record to the physician for completion.

### 3. Health technicians

The technician administering the procedures is responsible for entering height (in inches) and weight, distance visual acuity, and the results of the audiometry. The X-ray and EKG boxes will be checked at Headquarters when the report is mailed.

### 4. Laboratory technician

Enter each day values for all of the blood and urine tests done in the examination center. These can be entered from the results recorded on the laboratory worksheet.

## Responsibilities for Checking HES Documents in the Field

### 1. Records to be checked

- A. Examination Case Record
- B. Vision test form
- C. Speech test form
- D. Medical History Supplements A, B, and C
- E. Sample Person Supplement
- F. General Well-Being questionnaire
- G. Health Care Needs questionnaire

### 2. What to check for

#### A. Blanks

These may be a whole section or only a part. There may be a positive or "yes" answer to one part which necessitates something being written in the second part which has, however, been left blank.

#### B. Contradictory entries

An example would be a statement that the examinee had never seen a doctor followed by extensive descriptions of medical care in a following section. Another example might be a "no" answer to a question of trouble seeing, but a "yes" answer on trouble with vision even when wearing glasses.

#### C. Miscellaneous errors including

(1) Writing something in an "other" category which should have been specified in an included code, for example, on the General Medical Examination form, "conjunctival injection" written in under *other* (code 029) when *conjunctival injection* (code 010) is available.

(2) Two answers where only one is allowed.

### 3. Assignments

- A. Physician: Sample Person Supplement, Vision Test
- B. Nurse: Medical History Supplements A, B, and C; Physician's Supplement; and physician's exam.

- C. Coordinator: Remainder of case record.
- D. Chief Technician: Health Care Needs, General Well-Being, and Speech Test:

All records should be checked over so that corrections can be made or missing data obtained while the examinee is still in the exam center.

The physician will be furnished the Sample Person Supplement by the office staff and he should complete checking before examinations start. The nurse and the coordinator will be required to check out examination records during the examination session and to request the physician and technicians to make corrections as indicated. The nurse should check all medical histories to see that the proper supplements have been administered and that the necessary changes have been made on them if the physician has ruled out any supplements. Technicians and the coordinator should pay special attention to checking over the General Well-Being forms that are self-administered since these are especially prone to errors. If the appropriate health technician is not available to correct an error or omission on the GWB before the examinee leaves the exam center, the coordinator should take the responsibility to see that the GWB is corrected. After checking the record, the person doing the checking should place his or her initials in the lower left-hand corner of the document.

#### 4. Importance of review

The objective of the review is to see that we obtain the best data possible. Missing data are no data, and while imputation procedures can be applied in some instances, there is no substitute for complete and accurate data. The information obtained on these documents will be given directly to persons in data preparation who will code and punch only what they see in front of them, without giving thought to correcting apparent errors. This will provide misleading information which becomes greatly magnified in the process of inflating the data from our sample to national estimates. If caught in time through computer editing procedures, some corrections can be made but the cost of these corrections in terms of time and money is very high. We hope that you will provide every assistance possible in doing your assignments to the best of your abilities.

# CHAPTER 4

## EMERGENCY MEDICAL PROCEDURES

### Procedure

In the event of a medical emergency at the Mobile Examination Center (MEC), the following procedures will be followed.

1. The best method is prevention. The examining physician can at his discretion with good medical judgment void certain procedures such as respiratory tests if the testing will lead to any endangering of the examinee's health.
2. Before examinations begin the FOM will have the responsibility for obtaining information on the types and availability of emergency medical services in the area in which the Mobile Examination Center is located. This should include emergency medical services available from police or fire rescue squads, other county or local rescue squads, and hospital ambulance services, as well as the nearest medical facility. The FOM will select the best services available from the standpoint of convenience to the Mobile Examination Center and availability of service and equipment. In some cases it may be desirable to select two. He will then post the names and phone numbers of the services he has selected in a conspicuous place near the phones in the center and the offices. For other reasons, the number of the nearest police and fire stations will also be posted.
3. The following emergency equipment will be available, inventoried by the nurse, and kept in the physician's room. All equipment will be checked by the nurse and the physician at the start of each stand.
  - A. Oxygen
  - B. Bag and mask

- C. Disposable oral airway—small, medium, and large (4 of each)
- D. Drugs:

Atropine 1/150 gr. in single dosage form which must be re-constituted for use. Four doses supplied.

Valium injectable 5 mg/cc. Four vials supplied.

Epinephrine 1:1000 in small vials. Four vials supplied.

50 percent oral glycerol soln. Four 3- or 4-oz. bottles supplied.

Xylocaine 1 percent already at MEC.

The drugs will be used for the following situations:

Myocardial infarction - atropine for bradycardia

xylocaine for arrhythmia

epinephrine for cardiac arrest

Seizures - valium IV. In small children do not push more than 1 cc.

(5 mg) at start for respiratory depression is common.

Severe asthmatic attack - epinephrine. The childhood dose is

0.01 ml/kg. with a max. of 0.04 cc.

Allergic reaction, severe - epinephrine

Acute angle closure post eye drops - glycerol soln.

4. All emergency procedures and the use of all emergency equipment will be handled by the physician.
5. The use of this equipment is for emergency situations only.
6. The primary concern of all the field staff is to get the person to the nearest medical facility, and the emergency equipment is not to be used in lieu of this.
7. All persons seriously ill who received emergency care at the examination center will be accompanied to the hospital by the physician. The person's private physician will be contacted as soon as possible by the nurse.
8. A short report will be made and signed by the physician and the nurse about the medical problem and how it was handled. This report will be sent to the Medical Advisor at Headquarters.

# **PART II. PROCEDURES**

## **CHAPTER 5**

### **COORDINATOR**

#### **General**

Efficient coordination of the flow of examinees through the examination center is the most important function of the coordinator. In addition to this, the coordinator has other responsibilities which are described in this chapter.

#### **Beginning of Stand**

1. Complete the inventory of all supplies. Send the original along with the original inventories collected from the nurse, health techs, and lab techs to Headquarters, and note additional supplies needed. Also, let the FOM know what supplies are needed.
2. Be sure that each examining room has an "unusual occurrence" form posted in it.

#### **Before the Examination Session**

1. Sometime before each session see that the charts for that session are ready for use. You should advise the Field Management Assistant (FMA) of any discrepancies in sample numbers, but don't change a sample number without first confirming the change with the FMA. Review the medical histories, then give them to the examining physician to review. Check the daily schedule for any notes from the administrative office about unusual requests or instructions. If there are any, they should be noted on the examinee's control record.

2. Arrive for work 20 minutes before the first scheduled examinee.

## During the Examination Session

1. Rules of the examinee flow system

- A. Basic rule for pairing examinee with examiner

- (1) If several examinees are waiting, the examinee who has been waiting the longest since the time he was last seen should be served first.
    - (2) If several examiners are available to an examinee, the following priorities determine who serves the examinee:
      - (a) Venipuncture
      - (b) Change into paper clothes, void, temperature
      - (c) Audiometry
      - (d) Technician block
      - (e) Questionnaires
      - (f) Physician's examination
      - (g) Body measurements
      - (h) Near vision test
      - (i) Change into street clothes

- B. Exceptions to the basic rule and other helpful information

- (1) The first examinee to arrive for each session should be assigned to the designated health technician (see part D) who will have him change, void, and go through the technician block. He should be assigned to the rest of his exam according to the regular priorities.
    - (2) The oral temperature of each examinee should be taken by the time he has changed into his paper clothes. Any temperature over 101° F should be reported to the examining physician.
    - (3) Audiometry, near vision testing, and the questionnaires as well as venipuncture, can be done before changing or after rechanging.

- (4) The technician block should not be assigned unless the X-ray room is free.
- (5) Within the questionnaire block, the Health Care Needs comes before the General Well Being (GWB). When the GWB is self-administered, the technician should leave the interview room and be available for reassignment to another examination.
- (6) During sessions with at least five examinees, the chief technician is available for the first 2 hours of the session to be assigned to questionnaires and audiometry.
- (7) The chief technician and one other technician must be available before body measurements can be assigned.
- (8) The nurse must chaperone all physician's examinations of females.
- (9) Although the technician block should normally include only X-rays, distance vision tests, EKG, spirometry, and single breath diffusing capacity, occasionally, when the chief technician is available, body measurements may be done during the tech block, after X-rays.

#### C. Other rules

- (1) The examinations within the technician block must be done in the following order: X-rays, distance vision, EKG, spirometry, and single breath diffusing capacity testing.
- (2) The examiners should help the examinees get ready for their examinations so that you do not have to leave the reception area too often.

#### D. Assignment of examinees to health technicians

At the beginning of the stand, each health technician (other than the chief technician) will be assigned a letter "A," "B," or "C." He should keep that letter throughout the stand. The Schedule Sheet shows for each session which technician is to take the first examinee. That technician should help the examinee change and void and then take him immediately through the technician block.

However, when the technician screens the examinee for the lung function tests he may find that the physician needs to make the final decision about whether or not the examinee should undergo the lung function tests. If the physician must see the examinee, the technician should inform you so that you can assign the examinee first to the physician and then back to the technician block. After the tech block is completed, the first examinee should be assigned to the rest of his exam according to the priorities.

The other two technicians should be assigned to their first examinees (that is, the first examinees who need to be served by a technician) according to the Schedule Sheet. If there is any deviation from the pattern on the Schedule Sheet for assigning the technicians to examinees, note on the sheet what the deviation was and why it was necessary.

#### E. Body measurement replicates

An intertechnician body measurement replicate is to be done every fourth session on the examinee who arrives first at the exam center. The sessions on which replicates are to be done are shown on the Schedule Sheet.

For the sessions during which a replicate is to be done, you should write the examinee's sample number in the appropriate space on the Schedule Sheet and assign the original body measurements on that examinee to a technician according to the usual flow system rules. You should assign the replicate measurements in a *random* way to one of the other three technicians and write that technician's number in the appropriate space on the Schedule Sheet.

### 2. Duties not directly related to examinee flow

- A. Quickly review for completeness and consistency each chart as it is returned by the examiner. Have all errors corrected before the examinee leaves the examination center.
- B. See that transportation from the examination center is available for each examinee when he is ready to go.

- C. See that any necessary remuneration is given to each examinee before he leaves the examination center.
- D. Stay until the last examinee leaves the examination center.  
All examiners except the physician can leave when finished with all their exams after first checking with the chief technician.  
The physician must be in the examination center during the whole examination session unless there are only questionnaires left to be administered.

## After the Examination Session

You probably don't need any instructions here.

## End of Stand

1. Send the following forms to headquarters, Quality Control Section:

Schedule Sheet

Copies of body measurement forms

Copies of audiometry forms

Copies of respiratory function test forms

Unusual occurrence forms

2. Complete the inventory of all supplies. Send a copy along with the copies of the inventories collected from the nurse, health techs, and laboratory techs to Headquarters in a separate envelope.

## Communication Between FOM and Examination Staff

The coordinator is the channel of communication between the Field Operations Manager (FOM) and the examination staff as far as operational matters within the examination center are concerned. She should report to the FOM any problems that occur during the examination which require contact with the family, physician, school, etc. She should inform the exam staff of any schedule changes and reasons for them as she receives them from the administrative office. She should also inform the FOM of any necessary repairs to or re-ordering of faulty equipment as soon as possible.

# CHAPTER 6

## PHYSICIAN'S EXAMINATION

### General

HES is designed to gather data for statistical analysis. Rather than have a general clinical examination performed in the manner most familiar to the examining physician, we have a physical examination structured to gather data on physical conditions pertinent to certain chronic diseases. This section of the manual, which describes the method of performing the examination and specifies the method of recording findings, should be followed explicitly. This is important because it helps insure that complete and uniform examinations are performed by the examining physicians who will participate in the collection of the data. Other sections of the manual (see Role and Responsibilities of the Examining Physician, Medical Policy Regarding the Examination, and Emergency Medical Procedures) describe the other obligations and duties of the examining physician.

### Format for the Examination

#### *Sitting*

Blood pressure and pulse

#### HEENT

Hair, skin, skull, glands

Ears

Nose

Eyes

Mouth

Neck

Thyroid

Nodes and trachea

Chest (including heart)

Inspect

Auscult

*Reclining*

Heart

Inspect

Palpate

Auscult

Abdomen

Inspect

Percuss

Palpate

Arteries

Musculoskeletal

Knee

Hip

Straight leg raising

*Sitting*

Extremities

Lower

Upper

Neurological

DTR's

## *Standing*

### Musculoskeletal

Back

Knees

### Skin

General appearance and behavior

## *Supine and Sitting*

Blood pressure by nurse

## Examination Procedure

0. *Blood pressure and pulse:* While the examinee is sitting, check his blood pressure and pulse in the right upper extremity. (Count the pulse for at least 30 seconds.)
1. *HEENT examination:* Perform a routine HEENT. Inspect the external ear and, with an otoscope, examine the auditory canal and tympanic membrane. Check each nostril for patency with inspiration during alternate unilateral occlusion and examine each nostril with an otoscope.
2. *Neck examination:* Observe the neck at rest for thyroid visibility while the examinee swallows small aliquots of water. Repeat with the neck extended to judge thyroid size and contour. Palpate the neck for thyroid contour and tenderness, lymph nodes, and tracheal deviation.
3. *Chest examination:* Auscult the chest with care to cover representative areas for all lung segments.
4. *Cardiovascular examination:* While the examinee is sitting, and then while he is supine, palpate and auscult the heart. Check especially for cyanosis and venous distention. Check the peripheral pulses—note the character of the artery as well as the quality of the pulsation.
5. *Abdominal examination:* Inspect the abdomen for evidence of past surgery. During quiet respiration in the supine position, percuss the liver. With the examinee's knees and hips flexed to relax the abdominal musculature, palpate the abdomen.

6. *Musculoskeletal examination:* Examine the knees and hips for deformities and signs of inflammation, check for tenderness and for pain with active and passive motion, and perform the straight leg raising test. With the examinee seated, check the legs for calf tenderness and check the extremities for pretibial edema, petechiae, and ecchymoses. With the examinee standing, check the cervical, thoracic, and lumbar spine for deformities, limited range of motion, and pain with motion by having the examinee flex, extend, laterally bend, and rotate the spine. Check for sciatic notch and sacro-iliac tenderness. With the examinee bending forward (as in touching toes) check for exacerbation or relief of scoliosis (including rotary component). While the examinee is standing, again check the knees for deformities and the legs for varicosities.
7. *Neurological examination:* While the examinee is seated, test for knee jerks and ankle jerks.
8. *Dermatological examination:* Check the skin regionally during the other parts of the examination as described previously.
9. *General appearance and behavior:* Take special note of the general appearance and behavior of the examinee which might reflect organic or functional disorders.
10. *Blood pressure:* At the close of the physician's examination the nurse should check the blood pressure while the examinee is in both the supine and sitting positions.

## Recording of Findings

The forms contain structured responses, open ended responses, and summaries of diagnostic impressions. Since the structured responses will be used for computer analysis, certain criteria for and/or definitions of these responses will be given below to insure comparability of data collected by numerous physicians. The open ended responses are for recording both common and rare findings (which have not been put into structured form because of rarity or secondary importance to the goals of the survey) so that a more complete medical record will be available if information beyond the structured responses is needed in the future. The summary of findings and diagnostic impressions allows a reviewer to quickly synthesize the physician's findings on a given examinee and to ascertain the physician's subjective, as well as objective evaluations.

Unless otherwise noted in the instructions, positive responses should be recorded with a check, and corrections should be made by circling the response to be negated.

Either the "Findings" or "No findings" box should be checked when they occur. If there are no findings for any section of the examination, check the "No findings" box; if there are findings check the "Findings" box as well as the individual boxes for whatever findings there are.

The letters "R" or "Rt.," "L" or "Lt.," and "B" mean right, left, and both, respectively.

At the end of the chart are forms for reporting findings to physicians. Record there any significant medical findings which need to be reported to a physician or check the box to indicate that there are no significant new medical findings to be reported.

## Criteria and Definitions

0. *Pulse and blood pressure*: Record the pulse as the number of radial pulsations per minute and the systolic and diastolic blood pressures in even digits to the nearest 2 mm. pressure.

### 1. HEENT:

- A. *Conjunctival injection (bilateral)*: Generalized increase in the vascularity of the bulbar conjunctivae in the absence of obvious infection.
- B. *Filiform papillary atrophy of tongue*: The filiform papillae are exceedingly low or absent, giving the tongue a smooth or "slick" appearance which remains after scraping slightly with an applicator stick.
- C. *Fungiform papillary hypertrophy of tongue*: The fungiform papillae can be seen and felt when a tongue blade is drawn lightly over the anterior two-thirds of the tongue.
- D. *Fissures of tongue*: Linear lesions or cracks with a definite break in the continuity of the epithelium.
- E. *Serrations or swelling of tongue*: Tooth impressions at sides of tip, often noted when tongue is swollen.
- F. *Scarlet, beefy tongue*: Entire tongue is red, angry in appearance, with or without denudation or fissures. Not just a modification of the natural color due to the loss of papillae. Associated almost

always with subjective symptoms of hypersensitivity, burning, and even taste changes.

## 2. Thyroid evaluation:

The World Health Organization (WHO) criteria used for grading goiter are:

*Grade 0:* Persons without goiter. By definition these are persons whose thyroid glands are less than 4 to 5 times enlarged.

*Grade 1:* Persons with palpable goiters. The thyroid is considered to be more than 4 to 5 times enlarged although not visible with head in normal position. Most of these will be readily visible with the head thrown back and the neck fully extended.

*Grade 2:* Persons with visible goiters. Persons with goiters which are easily visible with the head in normal position, but which are smaller than those in Grade 3. Palpation may be helpful in determining the mass of the gland but is not needed for diagnosis.

*Grade 3:* Persons with very large goiters. The goiters of persons in this category can be recognized at a considerable distance. They are grossly disfigured and may be of such size as to cause mechanical difficulties with respiration and the wearing of clothes. (Perez, C., Scrimshaw, N.S., and Munoz, J.A., Technique of endemic goitre surveys. In endemic Goitre; p. 369, see esp. p. 376, World Health Organization Monograph Series No. 44, Geneva, 1960.)

*Other thyroid findings:* Record any tenderness, nodularity, enlargement of the isthmus, or other abnormal thyroid findings not included in grading thyroid size.

## 3. Cardiovascular evaluation:

A. *Cyanosis:* Record definite cyanosis which is thought to be related to generalized hemoglobin desaturation. (Focal phenomena, e.g., one extremity cyanotic, should be recorded under "Other cardiac or cardiovascular findings.")

B. *Irregular pulse:* Record any irregularities of pulse except physiological variations.

4. Abdominal evaluation:

- A. *Hepatomegaly*: Record livers palpable 2 centimeters or more below the right costal margin.
- B. *Splenomegaly*: Record all palpable spleens.
- C. *Uterine enlargement*: Record all enlarged uteri including those enlarged secondary to pregnancy.
- D. *Umbilical hernia*: Record all umbilical hernias.
- E. *Masses*: If masses are present, check 054. Record the number(s) of the location(s) of the mass(es) to the right of 055. Use the number which locates the center of the mass. Check 056 and write in a description of the masses, identifying each by its number location, e.g., (7) 3 cm. diameter firm, fixed, nontender.
- F. *Scars*: If scars are present, check 057. Record the number(s) of the location(s) of the scar(s) to the right of 058. Use the number which locates the center of the scar. Check 059 and write in a description of the scars, identifying each by its number location, e.g., (7) 3 cm. well-healed appendectomy scar.

5. Musculoskeletal evaluation:

If there are findings, check the findings box and also 066. Then describe the findings in the space provided.

6. Neurological evaluation:

- A. *Absent knee jerks*: Record bilaterally absent knee jerks—unilateral absence should be described under "Other findings."
- B. *Absent ankle jerks*: Record bilaterally absent ankle jerks—unilateral absence should be described under "Other findings."

7. Skin evaluation:

- A. *Petechiae*: Record petechiae which you as a physician judge to be due to abnormalities of the examinee. Do not record normal responses to minor trauma as positives. Qualify by describing distribution and severity, e.g., minimal pigmented purpuric eruption on the legs. If deemed contributory, a tourniquet test may be per-

formed on the upper extremity with the blood pressure cuff adjusted between systolic and diastolic pressures for 5 minutes, and the results described.

B. *Ecchymoses*: Record ecchymoses which you as a physician judge to be due to abnormalities of the examinee. Do not record normal minor responses to known minor trauma.

8. Obesity: Record either "Obesity" or "No obesity."

9. External ear:

Record if ears are pierced. Check "Operative scar" only for mastoid operation scars. Check and write under "Other" additional findings which are significant cosmetically and/or which might impair hearing.

10. Auditory canal:

Check "Completely occluded" if there is not sufficient tympanic membrane visible to characterize the membrane under "Drum" (below), and check as "Partially occluded" all other cases in which there is obstruction of or protrusion into the auditory canal. For all positive responses, check the cause of the obstruction; write cause under "Other" for causes other than cerumen.

11. Drum:

Check "Not visible" only if "Completely occluded" is checked above. Check as many structured responses as apply in the description of the membrane, e.g., dull, bulging, and fluid may all be checked under R ear. However, do not check two responses for one code number. If the membrane is perforated, check either "With discharge" or "Without discharge." Check "Other" and write in a description if the structured responses need to be supplemented.

12. Nares:

Check "Acute" or "Chronic" if the naris is obstructed (use physical appearance plus history to judge if obstruction is acute or chronic).

Check as many responses under "Other significant findings" as are necessary to describe the nares.

13. Neck:

Check "Adenopathy," "Tracheal deviation," or "Other" (describe) to describe significant clinical findings (except thyroid findings) in the neck.

14. Chest:

In the structured response chart, check the columns corresponding to the observed abnormalities at the levels of the lobes over which the findings are observed. (If needed, see diagrams present in the MEC for normal distributions of pulmonary segments and lobes.) Other auscultatory findings and findings on inspection, percussion, or palpation should be checked and written in under "Other chest findings."

15. Heart:

- A. *PMI*: Check whether the PMI is "Felt" or "Not felt." If felt, check the number of the closest interspace and check the relationship to the mid-clavicular line.
- B. *Thrills*: Check whether a thrill is "Absent" or "Present." If present, check systolic and/or diastolic to time the thrill, and check either base or apex to locate the maximum intensity of a given thrill. For multiple thrills, record only the most intense one.
- C. *Heart sounds*: Check the structured response which best describes the first heart sound and the one which best describes the second heart sound.
- D. *Murmurs*: Check "None" if no murmurs are heard. If a murmur or murmurs are heard, place checks under the appropriate period—systolic and/or diastolic—to indicate the timing when categorizing by type and location of the murmur(s) or the component(s) of murmur(s) within each period—systolic and diastolic. When typing systolic murmurs, check "Organic" if any systolic murmur, or systolic component of a murmur, is thought secondary to a cardiovascular lesion; and check "Functional" if no systolic murmur, or systolic component of a murmur, is thought secondary to a cardiovascular

lesion. Check "Don't know" only if a reasonable clinical judgment cannot be made. Follow the same guidelines for typing diastolic murmurs. Note that "Functional," "Organic," and "Don't know" are to be considered mutually exclusive responses with each period (systole, diastole). In locating and grading a murmur, record the grade of the murmur by checking the grade, as judged at its point of maximum intensity, in the appropriate period column to the right of the structured location response which best approximates the location of its point of maximum intensity. Unless there are both systolic and diastolic components to a murmur, check only one grade-location response for each murmur; for multiple murmurs, make multiple responses. (However, there should be only one response at a given location within a given period.) To locate the origin of each murmur, or component, thought secondary to a cardiovascular lesion ("Organic" will have been checked), check in the appropriate period column (systolic, diastolic, or both) to the right of the location of the cardiovascular lesion thought to be the origin of the murmur; e.g., for Pulmonic Stenosis check to the right of 097 in the box numbered 1. Make multiple responses for multiple murmurs of "Organic" origin. Check "Other" if the location is other than 94-99, and check "Don't know" if the murmur is thought to be organic but a reasonable clinical judgment of the origin cannot be made.

- E. *Other cardiac and cardiovascular findings:* If there are significant cardiac or cardiovascular findings for which there are no other appropriate responses under either "Heart" or "Arterial evaluation," check "Yes" and then check the structured or open ended (under "Other") response which applies. Check "No" if this space is not needed to describe cardiac or cardiovascular findings.

#### 16. Arterial evaluation:

Check the structured response ("Normal," "Sclerotic," "Tortuous," or "Sclerotic or Tortuous") which best characterizes each artery listed, and check the structured response ("Normal," "Bounding," "Diminished," or "Absent") which best characterizes each pulse listed. If the dorsalis pedis pulse is absent and the posterior tibial pulse is present, check "Absent" for dorsalis pedis and write in "posterior tibial" after

"Other" and check its character. If the dorsalis pedis and posterior tibial pulses are both absent, check "Absent" for dorsalis pedis and write in "popliteal" after "Other" and check the character of the popliteal pulse.

## 17. Joints:

- A. *Knees*: Record knee deformities by checking the appropriate location to the right of the described "Bony irregularity." If there is pain with active or passive motion (or both) or tenderness to palpation, check the appropriate finding(s) to the right of the described location. Since "Diffuse" is sufficient to include locations "Medial" and "Lateral," do not check "Medial" or "Lateral" when "Diffuse" has been checked for any one side (rt. or lt.). Record other knee findings by checking the appropriate location to the right of the description of the findings.
- B. *Hips*: Record "Pain on motion" by checking the appropriate locations (R, L, Both) within the appropriate columns (active and passive) to the right of the motion which elicits the pain. Similarly, check the appropriate location to the right of any other findings related to the hips.
- C. *Other joints*: To record findings in other joints, locate the square made by the finding to be recorded (e.g., tender, swelling, deformity, limitation, Heberden's nodes, pain on motion, other) and the joint involved. Within that square check right, left, or both to indicate the location of involvement for shoulder, elbow, wrist, ankle, and feet, and check the total number of digits involved on each side for the MP, DIP joints. Check the total number of digits involved on the right and on the left for each finding (note this is the total number of digits involved and not the digit involved).
- D. *Back*: Check the described deformities if observed, and check the location of any tenderness or limitation of motion. If there is pain with motion, check the location at the right of the motion which elicits the pain—"Diffuse" should be checked if all three locations (cervical, thoracic, lumbar (low back)) are involved, but do not check cervical, thoracic, lumbar (low back) in these instances. "Uncertain" should be checked if pain occurs but the site cannot be specified.

E. *Straight leg raising*: For the SLR test, check negative or positive for both the right and the left. Also, for "Increase with dorsiflexion," check either "Yes" or "No" for both the right and left.

18. Other systems:

Record here system findings which cannot be noted in other parts of the form, e.g., Reticulo endothelial—marked inguinal and axillary adenopathy plus cervical adenopathy, pallor, and petechiae previously noted. But if only petechiae and cervical adenopathy were observed, they would have previously been recorded and need not be recorded here.

19. Blood pressure:

Record the systolic and the diastolic blood pressures to the nearest even digit for both the recumbent and the sitting positions and note the time to the nearest minute of the determination.

20. Summary of diagnostic impressions:

On the last page of the physical examination recording form under the heading "Summary of Diagnostic Impressions" findings should be summarized. Certainly not each and every physical finding should be listed, only those findings considered significant in relation to disease or certain condition states. It is preferable to summarize findings by condition, such as "osteoarthritis" rather than by listing symptoms or signs. After completing the examination, indicate whether the examinee is "normal" or "abnormal." If abnormal, summarize findings according to the directions briefly outlined above. Cardiovascular (including venous disease), musculoskeletal, and respiratory findings should be listed in their appropriate sections with other findings below.

Following each such listing, indicate the seeming severity of each, checking whether it appears to be either minimal, moderate, or severe. This will be strictly subjective and based on your own appraisal. Should there arise some difficulty in deciding between two of the possible classifications, the lesser of the two should be selected.

Then indicate the certainty of the diagnosis using a scale ranging from 0 to 9 according to the following criteria:

- 0 - not at all certain
- 2 - little bit certain
- 4 - somewhat certain
- 6 - fairly well certain
- 8 - very certain
- 9 - extremely certain

The range, of course, is continuous and any number representing a degree of certainty between two of the listed scale numbers may be selected. When selected, the number should be written in the appropriate space.

Each condition should finally be coded according to the International Classification of Diseases. Since the vast majority of examinees with findings will have one or more of a small number of more common conditions, a listing of the more probable conditions with the appropriate code numbers will be posted within each examining area. Other code numbers for conditions not listed may be found by consulting a complete listing of ICDA codes kept within each examination center.

# CHAPTER 7

## BLOOD PRESSURE

### Equipment

Stethoscope  
Sphygmomanometer  
Cuff

### Procedure

Three blood pressures are to be taken, the first at the beginning of the examination with the examinee sitting, the second at the end of the physician's examination with the examinee supine, and the third immediately after the second with the examinee sitting on the edge of the examination table. The physician takes the first blood pressure, the nurse takes the second and third.

In order to standardize the recording of blood pressures, several guidelines are given below. These follow, in general, the recommendations of the American Heart Association (AHA) and are listed in the publication "Recommendations for Human Blood Pressure Determinations by Sphygmomanometers." It is important to remember that despite these attempts at standardization there are several inherent sources of error in the auscultatory method of measuring the blood pressure; these sources introduce a mean error of  $\pm 8$  mm. Hg. into the individual readings regardless of attempts to achieve consistency.

1. The operators should be at eye level with the manometer.
2. The meniscus should be checked for zero-level calibration each week. This requires simply a check on the meniscus level with an uninflated cuff.

3. The rate of fall should be steady and slow enough to detect the precise levels of first and last sounds. If it is too slow, intermittent trapping of blood occurs between systolic and diastolic levels; a rate of 2-3 mm. Hg. per heartbeat is recommended.
4. Determination of diastolic pressure is a controversial point. The AHA has decided that "the point of complete cessation (of sounds) is the best index of diastolic pressure." If there is no cessation of Korotkoff's sounds, "the point of muffling should be taken as diastolic pressure." Note if muffling was used as diastolic pressure; i.e., 120/70 muffled.
5. Readings should be made to the nearest 2 mm. interval on the measurement scale.

# CHAPTER 8

## VENIPUNCTURE

### Equipment

- Tourniquet
- Alcohol sponges
- Dry sponges
- Band-Aids
- Lavender top tubes (3 cc.)
- Green top tubes (3 cc.)
- Red top tubes (20 cc.)
- Butterfly needles (no. 21)
- Luer adapters

### Venipuncture Procedure

The venipuncture is done in the hematology room by the nurse. The primary area from which the blood is to be drawn is the antecubital fossa; the dorsum of the hand is a secondary site. Cleanse the area with alcohol and apply an appropriately-sized tourniquet proximal to that site. Once the needle is inserted into the vein, release the tourniquet in order to permit free circulation and flow of blood.

Manually fill and change the required tubes according to the instructions in the Laboratory Manual. Put the tubes in a styrofoam holder. At the end of the procedure, withdraw the needle and apply pressure and a Band-Aid to the venipuncture site. Label each tube with the examinee's number and take the tubes along with the data card to the laboratory in the styrofoam holder.

## T<sub>3</sub> and T<sub>4</sub> Handling

Put 4 ml. of serum into the 5 ml. "mailing tube" and cap the tube. Stick a sample number label on the mailing tube and on the report paper, and write the data on the report paper. Put the mailing tube into the styrofoam mailing holder and keep refrigerated until mailed. The styrofoam holder should be mailed daily to:

Scientia Research Laboratories, Inc.  
429 Westlake North  
Seattle, Washington 98109

## Hematology

The basic procedures and reporting methods are explained in the Laboratory Manual. Lists of equipment and specifications are also included. It is the responsibility of the laboratory technicians to follow these procedures carefully to insure work of the highest quality and uniformity.

The following tests are performed for each examinee if sufficient specimen is available:

- Hemoglobin (cyanmethemoglobin)
- Hematocrit (spum hematocrit)
- Red cell count (Coulter)
- White cell count (Coulter)
- Blood film (sent to CDC)

These tests constitute a basic hematology package that is done entirely in the field facility. All tests are performed in duplicate and all results are recorded on a daily work sheet by the laboratory technicians. All clinically borderline results are to be repeated immediately. To facilitate the reporting of any abnormal result the hematocrit should be done before the other laboratory work is completed. This allows the cell indices to be calculated immediately.

Once it has been ascertained that a particular result is abnormal, according to predetermined guidelines prepared by CDC, the laboratory technician should report the result directly to the examining physician. The technician should also see that an abnormal findings report is initiated when the abnormal result has been verified.

## Clinical and Nutritional Biochemistries

The Bureau of Laboratories, Center for Disease Control (CDC), performs the laboratory determinations listed below. CDC has devised the procedures for the collection, identification, processing of the specimens, and for the transmittal of the specimens from the field operation to the laboratory in Atlanta, Georgia. The processing procedures are explained in the Laboratory Manual prepared by the CDC Bureau of Laboratories. Thus the validity of the biochemical results is the dual responsibility of NCHS and CDC.

Biochemistries are performed for all examinees for whom a sufficient specimen is available. Specimen vials are sent to CDC as described in the Laboratory Manual. Specimen allocation is as follows:

EDTA Vacutainer for all local hematologic examinations;

Vial 1: 1.0 ml. of serum in ascorbic acid for determination of serum folates;

Vial 2: 0.5 ml. (500 ul.) of heparinized plasma in 2.0 ml. of mPa preservative and precipitant for plasma vitamin C assays;

Vials 3, 4, 5, and 6: 3 ml. of pooled, clear serum in each of 4 vials for chemical analyses.

If all specimens per examinee are actually collected and are of a sufficient quantity and quality as determined by CDC, the following nutritional biochemistries are performed:

Serum folate (bio-assay)

Plasma reduced ascorbic acid

Serum cholesterol

The following clinical biochemistries are performed:

Total bilirubin

SGOT

Alkaline phosphatase

Calcium

Phosphorus

Uric-acid

BUN

Creatinine  
Sodium  
Potassium

The following serological tests and hematology analysis are performed:

White blood cell differential count  
Amebiasis  
Measles  
Tetanus  
Diphtheria  
Rubella  
Polio

# CHAPTER 9

## CASUAL URINE COLLECTION

### Procedure

1. The coordinator (or other staff member) will give the examinee a labeled urine bottle and have him void at the time he is changing clothes. If a urine specimen is not obtained at that time, it will be the coordinator's responsibility to get it during waiting periods.

2. The coordinator (or other staff member) will take the urine collected to the laboratory.

3. The laboratory technician will do a dip stick test on one urine sample at a time following the instructions on the Multistix bottle and record the results on the laboratory work sheet.

A. Dip Multistix into the urine.

B. Read:

*What*

*When*

pH

immediately

protein

immediately

glucose

10 seconds after wetting

ketones

15 seconds after wetting

bilirubin

20 seconds after wetting

blood

30 seconds after wetting

urobilinogen

60 seconds after wetting

# CHAPTER 10

## ELECTROCARDIOGRAPHY AND SPIROMETRY

### Equipment

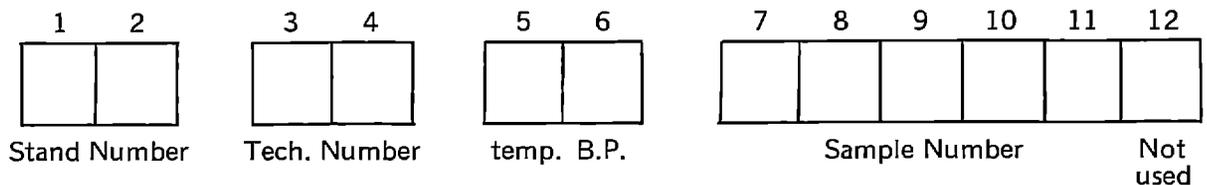
The Beckman digicorder is used in HES to record spirometers and electrocardiograms. All data gathered by this unit are recorded on magnetic tapes which are to be forwarded to the Collection and Analysis Linkage Section at the end of each stand.

Aside from recording data, the little unit also provides a special coding circuit. The code is a series of pulses which the computer program identifies as the lead code; the recording location; the examinee's identification number; age, sex, race, and height; technician number; and a calibration constant.

This calibration constant is the product of the temperature correction factor and the water vapor pressure factor. The constant corrects volumes from ambient temperature and pressure saturated with water vapor (ATPS) to body temperature pressure saturated with the water vapor (BTPS). The code initiates each recording.

### Code Interpretation

1. Coded information to be recorded with lead selector switch turned to Electrocardiogram STD:



2. Coded information to be recorded with lead selector switch turned to EKG leads 1 through 12:

1	2	3	4	5	6	7	8	9	10	11	12
Height		Weight			Age		S/R	9	9	I.D	Not used

3. Coded information to be recorded with lead selector switch turned to Aux. Lo (spirometer electronic calibration) and Aux. Hi I (spirogram):

1	2	3	4	5	6	7	8	9	10	11	12
Height		Weight			Age		S/R	9	9	I.D	Not used

### Codes

Stand Number:

00-99

Technician Number:

71-99, 01-09

Temperature:

8 = 28°C

9 = 29°C or greater

0 = 20°C or less

1 = 21°C

2 = 22°C

3 = 23°C

4 = 24°C

5 = 25°C

6 = 26°C

7 = 27°C

Sample Number:

First two digits: 01-99,00 = stand number

Last three digits: 600-799 = examinee number

Height:

01-98 = height to nearest inch  
99 = height unknown

Weight:

001-998 = weight to nearest pound  
999 = weight unknown

Age:

25-74 = age in years  
99 = age unknown

Barometric Pressure:

0 = 695 mm. to 704.9	5 = 745.0 to 754.9
1 = 705.0 to 714.9	6 = 755.0 or greater
2 = 715.0 to 724.9	7 = less than 675.0
3 = 725.0 to 734.9	8 = 675.0 to 684.9
4 = 735.0 to 744.9	9 = 685.0 to 694.9

Sex/Race:

1 = white male	5 = other male
2 = white female	6 = other female
3 = Negro male	9 = race unknown
4 = Negro female	

I.D.:

0-9 = last digit of sample number

Digicorder Computer Tape

1. Label all tapes with the stand number, location, date, and the number of the tape for that stand, e.g., Stand 01, Philadelphia, Pa., Tape 1, 4-27-71.

2. Don't record more than 30 examinations on one computer tape.
3. If the power is shut off while the digicorder is on, remove the data tape and mount a new tape on the digicorder.
4. Send the computer tapes, all tracings, and two copies of the log book to Headquarters at the end of each stand.

## EKG-Spiro Data Book

At the beginning of each stand record the barometric pressure at the top of the page.

On the top of each right hand page write the stand number and tape number. Below this make six columns headed respectively: Examinee ID (sticker), Date, Technician, EKG, Spiro, Temp. 29. Enter the appropriate information in these columns as the examinations are done.

On top of each left hand page write "Comments." Record on this page, directly opposite such comments as:

1. Miscoded info on 01999; should be ...
2. Info not coded on 01999; should be ...
3. Canc/PHY (Exam cancelled per physician)
4. Exam not done (or not completed) due to maximum time
5. Exam done on backup unit
6. New tape mounted on digicorder

The EKG-Spiro data book is to be used as the unusual occurrence form for these two sections. Any information which the technician regards as pertinent to the exams should be noted.

## Electrocardiogram

### 1. General

For the electrocardiogram analysis, information from twelve leads is recorded on magnetic tape. A computer program has been developed to analyze this information and print diagnostic messages along with the data.

## 2. Procedure

Record the time on the control record. Put up the table and ask the examinee to lie on his back on the table and make himself comfortable.

### A. Place the electrodes on the examinee.

- (1) Place the electrodes over areas with the least muscle movement (approximately 2 to 3 inches above wrist and ankle joints over medial radius and medial tibia).
- (2) Sensitize the areas where limb lead electrodes are to be placed by rubbing them lightly with electropads and leaving the pads in place.

### B. Turn the selector switch to the STANDARD (STD) position.

### C. Enter the examinee's identifying information in the following positions:

- 1 } Location (stand number)
- 2 }
- 3 } Technician number
- 4 }
- 5 Temperature in °C
- 6 Barometric pressure
- 7 )
- 8 )
- 9 ) Sample number
- 10 )
- 11 )
- 12 Not used

### D. Record a standard by depressing the RECORD DATA push button. Criteria for an adequate STD are listed below.

- 10 mm. in height  $\pm$  1/2 mm.
- baseline on 25 mm. line  $\pm$  5 mm.
- four standard complexes present not varying vertically by  $\pm$  3 mm. between complexes

E. Change the examinee's identifying information code to the following:

- 1 } Height to the nearest inch
- 2 }
- 3 }
- 4 } Weight to the nearest pound
- 5 }
- 6 }
- 7 } Age
- 8 Sex/Race
- 9 9
- 10 9
- 11 ID (same as STD)
- 12 Not used

F. Turn the selector switch to Leads I, II, III, aVR, aVL, aVF in turn and record these leads. Wait a few seconds after turning selector switch before recording lead to allow machine to stabilize.

G. Place the chest lead on the examinee:

- (1) Sensitize the areas where chest leads are to be placed by rubbing them lightly with the electropads and leaving the pads in place.
- (2) Place the lead on the examinee before turning the selector switch to the position for that lead. Automatic centering is activated by positioning the chest lead before turning the selector switch.

H. Record chest leads, V1, V2, V3, V4, V5, V6.

### 3. Recording

A. The quality of the tracings should be checked in the monitoring oscilloscope before recording.

B. If any of the below described artifacts are present, check the possible causes and repeat the lead. The computer will process the last recording of each lead EXCEPT FOR LEAD  $V_6$  which should not be repeated even if it is unacceptable.

The following criteria should be used to determine if a recorded lead is acceptable.

- (1) Noisy signals in a lead are interference causing the baseline to be thickened; obscuring or obliterating the P wave. This can

be corrected by having the examinee relax completely and not touch any metal objects on or off the bed. Also check that the electrode clamps are not too tight.

- (2) Wandering baseline occurs when the vertical difference between consecutive complexes is 3 mm. or more. If the baseline is wandering the electrodes should be reapplied using new electro-pads and frictioning the area well. Loose electrode clamps will cause high contact resistances that will result in a wandering baseline. By allowing a few seconds for the baseline to stabilize after changing the lead selector switch you may avoid many wandering leads.
- (3) Check that the entire complex is on the tracing. If not, correct by adjusting centering control on the digicorder.
- (4) Check the tracing for adequate stylus performance. Complex peaks should be clearly defined, the baseline should not be fuzzy. Adjustments can be made with the heat control on the digicorder.
- (5) Four acceptable complexes must be present on each lead. The length of each lead should be 5 sec. (25 boxes).
- (6) Check that the leads are marked correctly.

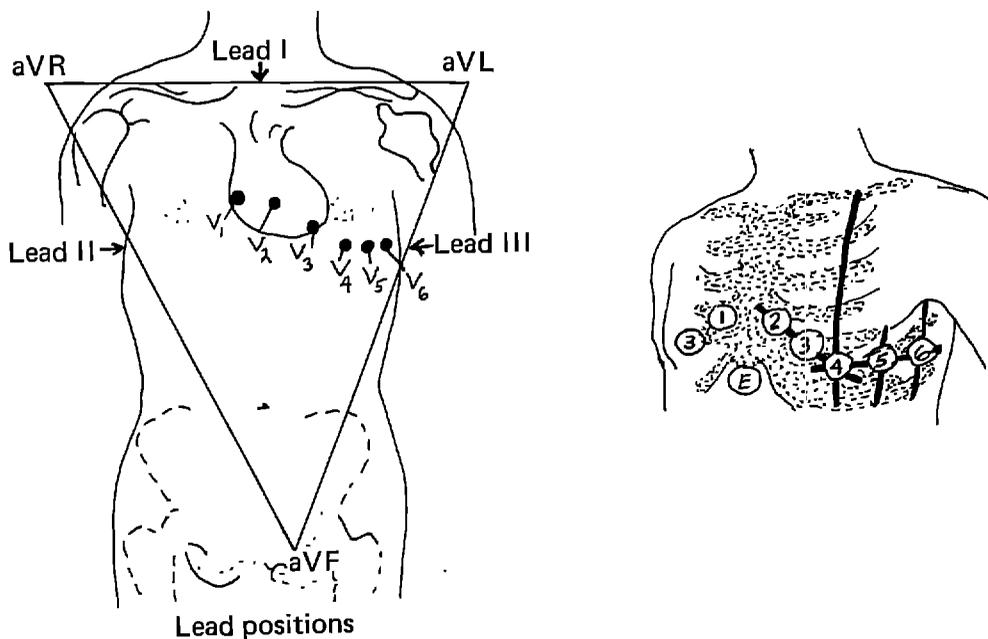
#### 4. Lead positions

The basis of electrocardiography is the neuromuscular mechanism of the heart. The heart muscle contracts and the heart "beats" in response to a stimulus. The action of this stimulus sets up a tiny electric current which can be received and recorded by electrodes. Since electrical current in the heart flows from negative to positive, EKG electrodes are paired negative with positive to record the flow. Below is a listing of the negative and positive electrodes for each lead.

<i>LEAD</i>	<i>POSITIVE</i>	<i>NEGATIVE</i>
I	LA	RA
II	LL	RA
III	LL	LA
aVR	RA	LL & LA
aVL	LA	LA & RA
aVF	LL	LL & RA
V	Chest	LL & LA & RA

Graphic locations of standard leads (I, II, III), augmented limb leads (aVR, aVL, aVF), and precordial leads ( $V_1 - V_6$ ) with reference to the heart are shown in the diagram. The electrical potential of any extremity is the same anywhere from its point of attachment to the torso to its most distal end. Therefore, electrodes attached to wrists and ankles will give the same EKG pattern as those placed at the point of union of torso and extremity. The extremity electrodes should be placed over the area where muscle is at a minimum. This prevents picking up muscle potential artifacts. The electrodes should be placed on the inside area of arms and legs, approximately 2-3 inches above ankles and wrists. The electrodes may be moved around to obtain a better recording at the discretion of the technician doing the test. The electrodes should be cleaned weekly with an abrasive cleaner.

### STANDARD ELECTRODE POSITIONS



The accompanying chart illustrates the most commonly used electrode positions for chest or precordial leads. The positions shown are located or determined as follows:

- |       |   |       |   |
|-------|---|-------|---|
| $V_1$ | Fourth intercostal space, at right border of sternum. | $V_4$ | Fifth interspace, at left midclavicular line. |
| $V_2$ | Same interspace, at left sternal border.              | $V_5$ | Same level as 4, in anterior axillary line.   |
| $V_3$ | Midway between positions 2 and 4.                     | $V_6$ | Same level as 4 and 5, in midaxillary line.   |

# Spirometer

## 1. General

The volume output of an electronic spirometer is recorded on magnetic tape. A computer program has been developed that is capable of measuring the forced vital capacity, the forced expiratory volumes at 1, 2, and 3 seconds, the maximum expiratory flow rate, the maximum mid-expiratory flow rate, and various peak flow rates for the tape recorded signal.

The examinee, who must stand during the test, is instructed to inhale maximally from room air, then exhale with maximal force and speed into the spirometer. A nose clip, if needed, and a disposable mouth-piece are provided for the examinee.

The important variables that affect the performance of the Forced Expiratory Spirogram (FES) fall into three categories:

- Equipment function
- Technician skill
- Examinee comprehension and motivation

The section labeled "Calibration Procedure" is designed to help you control the first variable. The second variable refers to the technician's ability to establish initial rapport with the examinee, clearly administer the test instructions, provide the necessary stimulus and motivation for each examinee to perform maximally, and to judge the quality and reproducibility of the spirometry signals. Examinee comprehension and motivation are the end results of technician skill, i.e., the interaction between the technician and the examinee.

Should your best efforts not provide an acceptable test, indicate on the chart and in the EKG Spiro data book that the exam is VOID; and record on the chart your comments concerning the reason for such poor recordings; i.e., language barrier, submaximal effort (SME), inhalation artifact (IH), premature termination (PT).

## 2. Procedure

- A. Depress the ON button on the storage display unit.
- B. Set the BTPS factor on the calibrator in the spirometer to 000.

C. Set the BTPS factor on the F/V converter to 0.

D. Record the spirometer calibration as follows:

- (1) Turn the selector switch to AUX LO. Use the same coding as in EKG lead 1-12 (page 10-2).
- (2) Depress the RECORD DATA push button.
- (3) Turn the spirometer VOLUME CALIBRATION selector switch from 0 to 5 three times, recording each selection for a minimum of 1 second.
- (4) Set the spirometer volume calibration selector switch on "Operate."
- (5) Set the spirometer flow calibration selector switch on "Operate."

E. Turn the selector switch to AUX HI.

F. Instruct the examinee according to the following instructions:

- (1) "Take in a great big deep breath of air." (Have the examinee inhale maximally from room air.)
- (2) "Hold all of the air in." (Have him hold his breath long enough to insert the cardboard mouthpiece into his mouth while you start the recording.)
- (3) "Put the mouthpiece into your mouth with your teeth resting lightly on it. Seal your lips tightly around it." (Demonstrate the right way.)
- (4) "Blast your air into the tube as fast as you can, like a cough." (The exhalation should be made with the lips tight around the mouthpiece with maximal force and speed. Do not have the examinee use the nose clip unless he exhales through his nose.)
- (5) "Keep on blowing out the same breath of air—don't stop, don't take another breath—until you just can't blow anymore." (Have him blow out as hard and fast as he can and to keep blowing until he "empties" his lungs.)

G. Demonstrate to the examinee a deep inspiration, proper placement of the mouthpiece, and the bursting of air into the tube. Continue to blow for at least 4 seconds.

H. Have the examinee do the first trial; observe closely to insure that all instructions are being followed.

- I. Using the oscilloscope, calculate the examinee's approximate volume and flow rate. Refer to the regression chart and find Peak Flow Rate (PFR) and Vital Capacity (VC) cutoff points for the examinee.
- J. If the examinee's values fall below the cutoff points, give additional instructions.
- K. Make sure that the following requirements are met:
  - (1) The onset of the spirogram should occur within 3 seconds after you depress the Record Data button.
  - (2) An optimal baseline should not be less than 1 second or more than 3 seconds in length.
  - (3) The spirogram should not fall at the completion of the examinee's effort. It is a good technique to try to maintain a straight line.
  - (3) The computer program demands that the peak of the spirogram be maintained for at least 0.2 second (5 mm.).
- L. Proceed with trials 2, 3, 4, and 5. Five trials must be done but no more may be done without allowing the examinee to rest for 20 min.
- M. Try your best to get the full cooperation of the examinee. Since there is a great deal of voluntary control over respiration, the success of lung-function tests depends on your getting the examinee to actively and fully participate.
- N. If two of the trials are not within the allowable range for both volume and flow rate after five trials, stop testing and let the computer decide which two trials are the most comparable.
- O. Label and keep all tracings.

### 3. Determining data

#### A. Monitoring the volume signal with a strip chart recorder

A clinically acceptable curve must be smooth and free of inhalation artifacts. The extent of the examinee's cooperation should be questioned if successive total volumes vary more than  $\pm 5$  percent for volumes greater than 3 liters or  $\pm 10$  percent for volumes less than

3 liters. This variability can be easily estimated on the oscilloscope by eye and on Sanborn paper in the following manner:

- 5 percent of 6 liters (30 mm.) is 1.50 mm.
- 5 liters (25 mm.) is 1.25 mm.
- 4 liters (20 mm.) is 1.00 mm.
- 10 percent of 3 liters(15 mm.) is 1.5 mm.
- 2 liters (10 mm.) is 1.0 mm.
- 1 liter (5 mm.) is 0.5 mm.

#### B. Monitoring flow and volume with an oscilloscope

A memory oscilloscope with an X-Y axis is the most precise method of monitoring examinee effort. Flow is registered on the Y axis (vertically one square equals 2 liters per second). Volume is registered on the X axis (horizontally one square equals 1 liter). Both parameters can be calibrated so that flow and volume readings are read directly from the face of the CRT. Each respiratory effort results in a flow-volume loop. This is displayed on the oscilloscope and compared with subsequent efforts. Discreet changes in examinee effort and cooperation can be monitored by observing the shape of the loop and peak flow deflection. Small variations in respiratory effort cannot successfully be monitored with a volume curve alone. Acceptable spiograms result in reproducible loops. Reproducibility is determined by superimposing one loop over the other or comparing them side by side.

#### C. Oscilloscope evaluation

After the examinee has blown into the spirometer and you have watched the FV loop on the screen, evaluate the examinee's effort. If the vertical and horizontal movement of the scribing point of the scope is low or reduced, look for the following conditions in your examinee:

- (1) The mouthpiece not being inserted into the mouth far enough or putting the lips in front of instead of around the mouthpiece.
- (2) Collapsing of the mouthpiece by excessive mouth pressure.
- (3) Tongue occluding the mouthpiece opening.

- (4) Submaximal effort due to a lack of understanding of the procedure, reluctance to give a full effort, or improper instructions.
- (5) Inability to comprehend instructions.

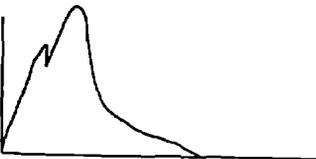
OSCILLOSCOPE EVALUATION USING THE FLOW-VOLUME LOOP



Typical flow loop



Sub-maximal effort (SME)



Hesitation in initial expiration effort - inhalation artifact (IH)

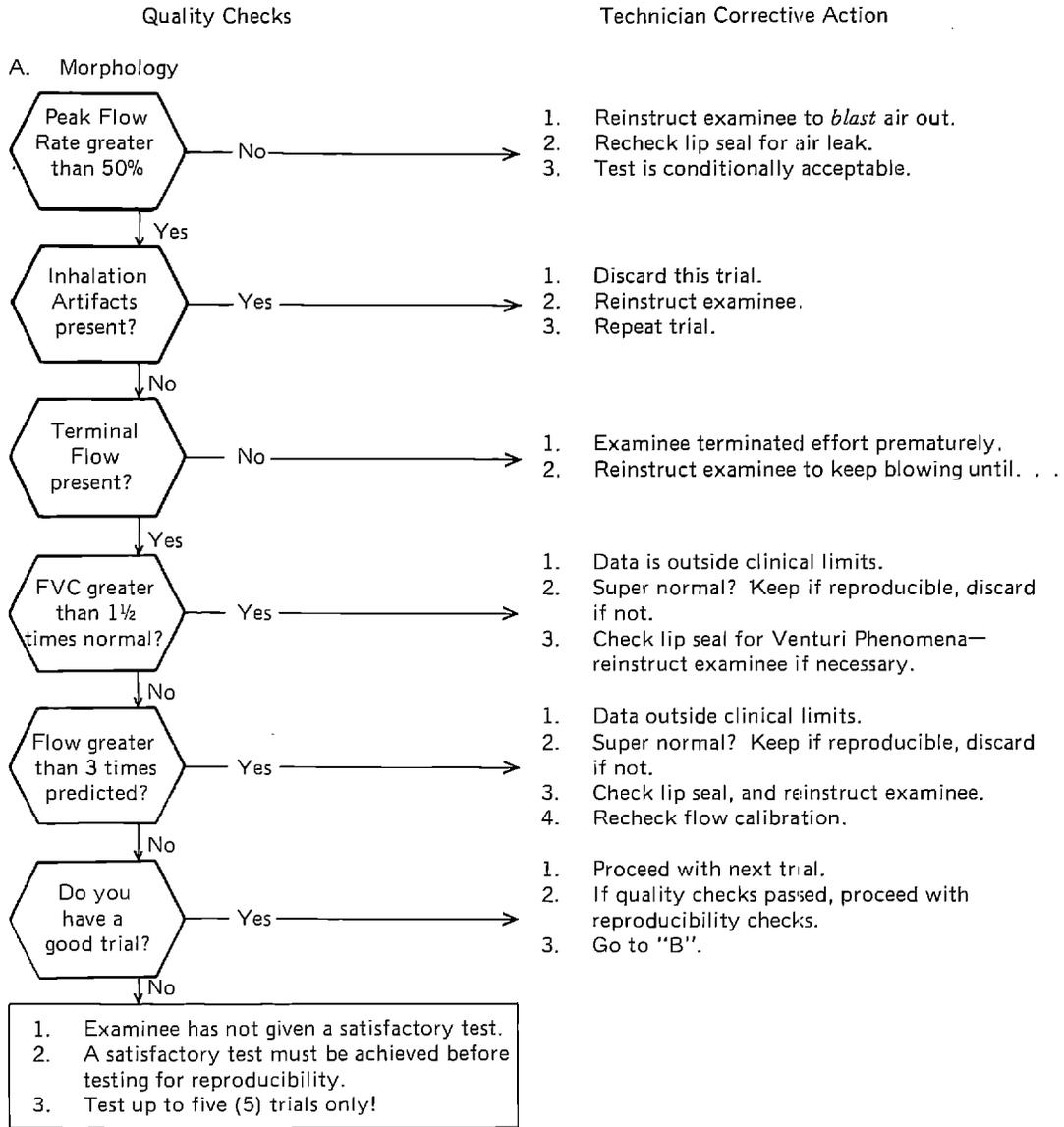


Blowing stopped too soon or mouthpiece removed before completed expiration - premature termination (PT)

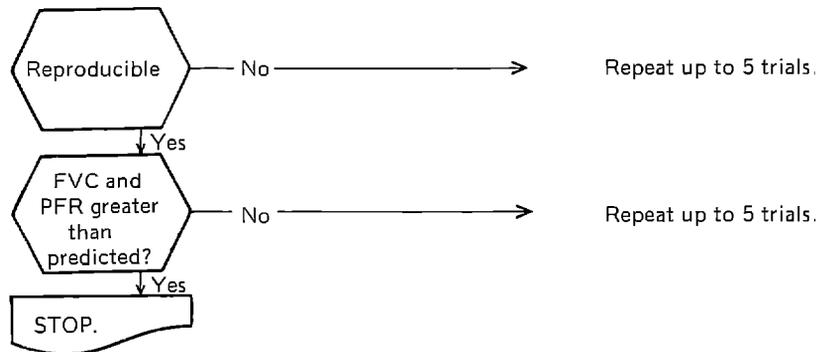


Repeated efforts without removing mouthpiece - inhalation artifact (IH)

## QUALITY CONTROL PROCEDURE



**B. Reproducibility**



## Calibration Procedures

### 1. Voltmeter calibration procedure

The instrument takes Volume and Flow Signals from a spirometer and freezes the display of the Volume voltage when the Flow voltage is zero. This freeze will happen at the maximum *or* minimum value of the Volume Signal when used in conjunction with a spirometer + Yoke Calibrator. The instrument will hold and display the first maximum or minimum after the RESET button is *released*.

To operate, plug Volume and Flow cables from the spirometer into the appropriate front panel connectors or the rear panel connectors. Set the Front/Back switch located on the front panel to the appropriate position. Turn power on with ON/OFF switch. Allow 10 minutes warmup. Press RESET button and turn HOLD switch to hold position. The display will change as the Volume voltage changes until a minimum or maximum voltage is encountered. The display will hold the minimum or maximum voltage until the RESET button is pushed.

To get the desired maximum or minimum value, the release of the RESET must be synchronized with the movement of the spirometer piston. Look at volume display for indication of increasing volume. A similar procedure for holding minimums can be used.

For best results, it is advisable to take 12 maximum and 12 minimum readings. Discard the highest and lowest value from each set leaving 10 readings to average.

Subtract the means of the maximum and minimum sets, then add .003L (calculations done in Headquarters).

The voltmeter calibrator can be used as a voltmeter by placing the HOLD switch in the off or electronic position. The meter has a maximum range of  $\pm 20V$ . The voltage displayed will be on the leads connected to the VOLTAGE terminals.

### 2. Spirometry calibration

#### A. Beginning of stand

##### (1) Preliminary setup

##### (a) Insert and connect the flow volume converter.

- (b) Check to see if the bellows were completely open for transit, and remove the stopper from the portal.
- (c) Engage the autonegator.
- (d) Turn on all equipment and check the function of it.
- (e) Put a tape on the digicorder labeled: Test tape - van number - beginning stand number - stand location - date - tech number. Proceed only after a minimum 20-minute warmup.

(2) EKG standard

- (a) Turn the DRS lead selector switch to "STD" position.
- (b) Turn the strip chart to "RUN" and use the "CENTERING CONTROL" on the main operator panel to position the baseline of the 10 mm. standardization pulse so that it coincides with the 25 mm. line on the chart.
- (c) Check that the baseline is at the 25 mm. level on the DRS scope.
- (d) Check that the height of the leading edge of the standardization pulse is  $10 \pm 1/2$  mm.
- (e) Code in on the DRS: stand number - tech number - temperature - barometric pressure; then 9's for the remaining six digits.
- (f) Depress the "RECORD DATA" button on the DRS.

(3) Electronic spirometer calibration

- (a) Code in all 9's on the DRS.
- (b) Turn DRS lead selector switch to Aux Lo.
- (c) Check that the BTPS on calibrator is on 000.
- (d) Check that the BTPS on F/V converter is on 0.
- (e) Place the "Front/Back" switch on the voltmeter calibrator to the "BACK" position.
- (f) Turn the "HOLD" switch on the voltmeter calibrator to the "ELECTRONIC" position.
- (g) Turn volume calibration dial (F/V converter) to "OPERATE."
- (h) Record values (volts) from voltmeter calibrator on calibration form (Column 1).
- (i) Depress the "RECORD DATA" button on the DRS.

- (j) Turn volume calibration dial to "0."
- (k) Record values on form.
- (l) Depress "RECORD DATA" button.
- (m) Turn volume calibration dial to "5."
- (n) Record values on form.
- (o) Depress "RECORD DATA" button.
- (p) Turn volume calibration dial to "3."
- (q) Record values on form.
- (r) Depress "RECORD DATA" button.
- (s) Turn volume calibration dial to "1."
- (t) Record values on form.
- (u) Depress "RECORD DATA" button.
- (v) Repeat steps (g) through (u) (Record results in Column 2).
- (w) Depress "RECORD DATA" button.
- (x) Turn volume calibration dial (F/V converter) from "OPERATE" to: 0-5-0-5-0-5-0 (holding each for 1 second; the whole process should be completed in 9 seconds).
- (y) Repeat steps (w) and (x) five times.
- (z) Look at the storage scope for horizontal displacement, the large squares are equal to 1 liter/square horizontally.
- (aa) Check the strip chart tracing for proper stylus placement; 0 should be 5 mm. from bottom of tracing and 5 should be 35 mm. from bottom of tracing.
- (bb) Record in EKG/SPIRO data book the date and the values (volts) for "0" and "5" ( e.g., 0 = 0.016 volts; 5 = +5.007 volts).
- (cc) Compare these values to the values posted on the spirometer.
- (dd) Report any differences greater than 0.020 volts to the supervisory technician.

#### (4) Mechanical spirometer calibration

- (a) Turn volume calibration dial (F/V converter) to "OPERATE."
- (b) Turn the DRS selector switch to AUX HI.
- (c) Turn the "HOLD" switch on the voltmeter calibrator to the "HOLD" position.
- (d) Attach the piston rod with the bolt on the shaft of the calibrator yoke.
- (e) Turn on the calibrator.

- (f) Check the circle on the storage scope for accuracy and any irregularity of the line while allowing the bellows to loosen up. Report any persistent irregularity of the line to the supervisory technician.
- (g) Push the "RESET" button on the voltmeter calibrator between 2 →6 liters (observe on the digital display) to obtain the maximum value (volts).

NOTE: Do not hold the reset button, just depress firmly and then release.

- (h) Record the value (volts) from the reading on the voltmeter calibrator in column A of the form.
  - (i) Depress "RECORD DATA" button on DRS.
  - (j) Repeat steps (g), (h), and (i) five times.
  - (k) Push the "RESET" button on the voltmeter calibrator between 7 →3 liters (observe on the digital display) to obtain the minimum value (volts).
  - (l) Record the value (volts) from the reading on the voltmeter calibrator in column B of the form.
  - (m) Depress "RECORD DATA" button on the DRS.
  - (n) Repeat steps (k), (l), and (m) five times.
  - (o) In the EKG/SPIRO data book record the date and the first values in columns A and B. Subtract the first number in column A from the first number in column B (e.g.: 8/27/73 7.328 - 2.189 = 5.139 volts)
  - (p) Compare the difference with the posted value.
  - (q) Report any differences greater than 0.020 volts to the supervisory technician.
  - (r) Remove the test tape and send it to Headquarters.
  - (s) Send the calibration form and tracing to the supervisory technician at Headquarters.
- (5) Bellows leak check —beginning of stand
- (a) Detach the bolt on the calibrator yoke.
  - (b) Open the bellows 5 →7 liters (read on projection display).
  - (c) Insert the stopper in the portal.

- (d) Turn the "HOLD" switch to the "ELECTRONIC" position.
- (e) Turn volume calibration dial (F/V converter) to "OPERATE."
- (f) Record values (volts) from voltmeter calibrator on calibration form.
- (g) Turn off all equipment for 12 to 24 hours.
- (h) Turn on all equipment (Dry Run Day).
- (i) Allow minimum warmup period of 15 minutes.
- (j) Record values (volts) from voltmeter calibrator on calibration form.
- (k) Difference of 0.020 or greater is significant.
- (l) Repeat leak test (steps (a) through (k)).
- (m) Report any significant findings to the supervisory technician.
- (n) If the second test also showed a leak of 0.020 volts or more:
  - Remove the front plate of the spirometer with rubber glove on.
  - Rub a light, smooth coat of talcum powder into the surface of the seal and the cylinder surface. Remove the excess dust.
  - Rub a light film of Vaseline on "O" ring.
  - Carefully reinstall the front plate. NOTE: See detailed instructions in Ohio Instrument Operations Manual, pages 39-40.
- (o) Repeat leak test and report results to the supervisory technician; contact the engineer if difference is 0.020 volts or greater.

## B. Daily calibration

A daily calibration is to be performed at the beginning of the first session of each examining day and at the beginning of both sessions when there is a break between; for example, morning and evening.

A MINIMUM OF A 20-MINUTE WARMUP OF THE EQUIPMENT MUST PRECEDE THE DAILY CALIBRATION.

- (1) Turn the DRS lead selector switch to the STD position.
- (2) Position the baseline of the 10 mm. standardization pulse to coincide with the 25 mm. line on the strip chart with the "Centering Control" on the DRS.

- (3) Code in the stand number, technician number, temperature, and barometric pressure, then 9's for the remaining six digits on the digicorder.
- (4) Depress "RECORD DATA" button on the DRS.
- (5) Code in 9's for all 12 digits on the digicorder.
- (6) Turn DRS lead selector switch to AUX LO.
- (7) Check that the BTPS on calibrator is on 000.
- (8) Check that the BTPS on F/V converter is on 0.
- (9) Turn the "HOLD" switch to the "ELECTRONIC" position.
- (10) Depress "RECORD DATA" button.
- (11) Turn volume calibration dial (F/V converter) from "OPER" to: 0-5-0-5-0-5-0 (holding each for 1 second; the whole process should be completed in 9 seconds).
- (12) Check reading on voltmeter calibrator at "0" and "5."
- (13) Record in EKG/SPIRO data book; DAILY CALIB -- DATE-- TECH #-- VALUES (volts) for "0" and "5."
- (14) Compare these values with the values posted on the spirometer.
- (15) Report any differences greater than 0.020 to the supervisory technician.
- (16) Turn the volume calibrator (F/V converter) to "OPERATE."
- (17) Turn the DRS selector switch to AUX HI.
- (18) Turn the "HOLD" switch on the voltmeter calibrator to the "HOLD" position.
- (19) Attach the piston rod with the bolt on the shaft of the calibrator yoke.
- (20) Turn on the calibrator.
- (21) Check the circle on the storage scope for accuracy while allowing the bellows to loosen up.
- (22) Push the "RESET" button on the voltmeter calibrator between 2 →6 liters (observe on the digital display) to obtain the maximum value (volts).
- (23) Record the value (volts) from the reading on the voltmeter calibrator in the EKG/SPIRO data book.
- (24) Depress "RECORD DATA" button on DRS.
- (25) Push the "RESET" button on the voltmeter calibrator between 7 →3 liters (observe on the digital display) to obtain the minimum value (volts).

- (26) Record the value (volts) from the reading on the voltmeter calibrator in the EKG/SPIRO data book.
- (27) Depress "RECORD DATA" button on DRS.
- (28) Repeat step (27) three times.
- (29) Turn off the calibrator.
- (30) Subtract the two values in the EKG/SPIRO data book (e.g.:  $7.328 - 2.189 = 5.139$  volts).
- (31) Compare the difference with the posted value.
- (32) Report any differences greater than 0.020 volts to the supervisory technician.
- (33) Detach the piston rod from the shaft of the calibrator yoke.

#### C. End of stand

Perform the normal daily calibration on the last day of examinations.

### Sterilization Procedure

Soak the spirometer hose for at least 1 hour in cidex aqueous solution and then wash it at the end of each stand and after an examination has been performed on an examinee who has TB or any other active respiratory tract disease.

Remove the front panel of the spirometer and wash the cylinder bore, seal, and piston with cidex aqueous at the end of every third stand. See the spirometer manual for further details.

**FORCED VITAL CAPACITY  
80 Percent of Predicted Value**

**Male**

Age range in years	Height range in inches				
	59-63	64-68	69-73	74-78	79
20-25	3.24	3.85	4.47	5.08	5.33
26-30	3.11	3.73	4.35	4.96	5.21
31-35	3.00	3.62	4.24	4.85	5.10
36-40	2.89	3.51	4.13	4.74	4.99
41-45	2.78	3.40	4.02	4.63	4.88
46-50	2.67	3.29	3.90	4.52	4.77
51-55	2.53	3.18	3.78	4.38	4.66
56-60	2.45	3.07	3.68	4.30	4.56
61-65	2.34	2.96	3.57	4.19	4.44
66-70	2.23	2.85	3.46	4.08	4.33

**Female**

Age range in years	Height range in inches			
	55-59	60-64	65-69	70-72
20-25	2.33	2.74	3.16	3.49
26-30	2.26	2.67	3.09	3.42
31-35	2.19	2.61	3.02	3.35
36-40	2.13	2.54	2.96	3.29
41-45	2.06	2.48	2.89	3.22
46-50	2.00	2.41	2.82	3.16
51-55	1.93	2.34	2.76	3.09
56-60	1.86	2.28	2.69	3.02
61-65	1.80	2.21	2.63	2.96
66-70	1.73	2.15	2.56	2.89

**Peak Flow Rate**

Age range in years	80 percent of predicted		50 percent of predicted	
	Male	Female	Male	Female
20-29	9.46	6.14	5.91	3.84
30-39	9.08	5.90	5.68	3.68
40-49	8.71	5.65	5.44	3.53
50-59	8.33	5.40	5.21	3.38
60-69	7.96	5.16	4.97	3.22

# CHAPTER 11

## SINGLE-BREATH DIFFUSING CAPACITY

### Equipment

Spirometer with 7-liter bell mounted in console  
30-liter box-balloon system and single-breath 5-way valve mounted on console  
Seven push-button panel with seven solenoid valves and associated electric circuitry  
CO meter with relay-rack-mountable control panel with digital readout  
Relay rack version of Collins helium meter with digital readout  
Foot switch to activate kymograph  
Tank of gas mixture containing approximately 10 percent helium, approximately 0.3 percent carbon monoxide, balance air, and reduction valve  
Stopwatch  
Proportional divider  
Metric ruler  
Nose clip and foam inserts  
Chart paper  
Pens

### General

The single-breath diffusing capacity will be measured on all examinees except those who the physician says are medically unable to do this part of the exam.

Because of the need for knowing the examinee's vital capacity before measuring the single-breath diffusing capacity, the spirometry measurements must be taken before the single-breath diffusing capacity.

## Machine Maintenance and Calibration

### 1. Beginning of stand

- A. Tightly close the metal grid on the right half of the vent over the Lung Analyzer machine and switch off the right half of the vent entirely. Adjust the metal grid on the left half so that the air is directed to the left side of the room.
- B. Adjust the following switches and leave them for the entire stand:
  - (1) Turn the ON-OFF switch on the back of the machine to ON. Minimal warmup time is 6 hours.
  - (2) Turn the CO switch on the CO readout panel to the .03 percent position.
  - (3) Turn the He ON-OFF switch on the He readout panel to ON.
- C. Replace the drierite in the back of the machine.
- D. Replace the pens.
- E. Check the speed of the kymograph with the stopwatch; it should be 32 mm./sec.
- F. Fill the drum with distilled water to a level of 1 inch from the top.

### 2. Daily

- A. Replace the ascarite each morning.
- B. Check the drierite and replace when one-half inch is pink.
- C. Check the position of the pen and make sure it writes.
- D. Place paper on the the kymograph and cut sheets for the entire day's exams.
- E. See that the water level of the spirometer is 1 inch from the top.
- F. Check the pressure in the tank and notify the FOM if it's less than 500.
- G. Adjust the mercury level on the barometer base so that the ivory tip just kisses the top of the mercury.

3. Before each examination session

A. Fill the balloon.

- (1) Push the RV-BB valve IN.
- (2) Connect the tubing from the gas tank to the CO-IN petcock.
- (3) Open the CO-IN and CO-OUT petcocks.
- (4) Slowly fill the balloon to between one-half and two-thirds full.
- (5) When the gas escape has stopped, close the CO-IN and then the CO-OUT petcock.
- (6) Pull the RV-BB valve OUT.

B. Empty the balloon.

- (1) Turn the 5-way valve to Position 3. Raise the spiro bell.
- (2) Turn the valve to Position 2. Lower the spiro bell.
- (3) Repeat steps (1) and (2) until the bag is empty.

C. Fill the balloon a second time.

D. Fill and flush the system.

- (1) Turn the 5-way valve to Position 1, and remove the side stopper.
- (2) Raise the spiro bell and replace the stopper.
- (3) Turn the valve to Position 2, and lower the spiro bell.
- (4) Repeat steps (1), (2), and (3) until the bag is empty.

E. Fill the balloon a third time.

F. Check the zero and gain (span).

- (1) Set the pump on Position 4.
- (2) Push the AIR and GAS-PMP buttons.
- (3) Set the flow meter on 400.
- (4) Make all readings with the pump off.
- (5) Adjust the CO and He meter readings to zero and check again.

- (6) Push the INSP and PMP buttons and let the machine run until the numbers stabilize.
- (7) Stop PMP and then run again for a few seconds.
- (8) If the helium reading is within  $\pm 1$  percent of the percentage certified on the tank, change it to read the same as the certified percentage.
- (9) If the CO reading is within 10 percent of 100, change it to read 100.
- (10) If both readings exceed the known percentages by  $\pm 1$  percent and  $\pm 10$  percent, respectively, flush the bag and start over.
- (11) Record the zero, span, and gain settings in the log book.

The gain setting and helium reading should not change from day to day by more than  $\pm 3$  percent. Any larger deviation on any given day suggests that the balloon has been incompletely flushed or that there are leaks.

### Criteria for an Acceptable Exam

Three trials must be done and all three must meet all the criteria listed below. A maximum of five trials may be done in order to meet the criteria. A small amount of CO is taken up by the bloodstream with each trial. Therefore, the blood carboxyhemoglobin saturation slowly rises. As a result, a significant "back pressure" develops after 5-10 trials, depending upon the depth of inspiration, which causes a measurable but small reduction in successive measures of "apparent diffusing capacity."

1. The volumes inspired must be at least 80 percent of vital capacity as determined by spirometry.
2. Inspiration time must not be longer than 3 seconds (9.6 cm.). The only exception to this rule is the case in which all three trials are identical with full examinee cooperation.
3. Breathholding time may not vary more than  $1\frac{1}{2}$  seconds from the ideal of 10 seconds (32 cm.  $\pm$  4.8 cm.).
4. There must be a minimum dead space washout of 500 ml.; the ideal is 1000 ml.
5. There must be a minimum volume collected of 500 ml.
6. The volume of inspired gas should not decrease more than 200 ml. during breathholding time. A decrease greater than 200 ml. indicates a defective J-valve in the machine.

7. Expired CO and He results from successive trials should not vary by more than 10 percent provided the inspired volumes were the same.
8. There should not be any inhalation artifacts.
9. There should be a smooth 1 second baseline before the onset of inspiration.

## Examination Procedure

1. Apply paper to the kymograph drum; overlap right over left and tape. Place examinee label and technician number on the tracing.
2. Empty the balloon. This step is always required when gas has remained in the balloon for more than one-half hour. It should be done twice at the beginning of an examining session.
  - A. Set the RV-BB valve in the BB position (OUT).
  - B. See that the free-breathing valve is closed ("examinee to room air") (Position 1).
  - C. Move the single-breath 5-way valve to Position 3.
  - D. Gently raise the spirometer bell by hand to near the top. The bottom of the bell must remain in the water. During this maneuver air enters into the mouth opening of the single-breath 5-way valve, proceeds through Sidearm 3 to the box, thereby permitting gas to be removed from the box through the other orifice into the spirometer.
  - E. Turn the single-breath valve to Position 2.
  - F. Gently lower the spirometer bell by manual pressure. Note that air from the spirometer now enters the box and cannot escape the box. Therefore, the gas compresses the balloon which now empties via the one-way V-valve to Opening 2 of the single-breath valve and hence escapes through its mouthpiece. Each time the spirometer bell is depressed a decrease in the size of the balloon can be seen through the window in the box.
  - G. Repeat Steps C, D, E, and F until the bag is empty, which is signaled by arrest of the descent of the spirometer bell.
3. Fill the balloon.
  - A. Turn the RV-BB valve to the RV position (IN). This must always

be done when filling the balloon; otherwise, the pressure within the box will force up the spirometer bell.

- B. Turn the 5-way valve to Position 1.
- C. Connect a rubber tubing from a CO tank to the CO-IN petcock on the front of the panel.
- D. Open both petcocks—CO-IN and CO-OUT—during filling. Opening of the CO-OUT petcock permits air to escape from the box while the balloon is filled. If it is not opened the box or associated tubing will rupture.
- E. Open the reduction valve on the CO tank. In order to avoid development of excessive pressure in the box, do not permit a flow of more than 10-15 liters/minute. At this rate it will require 2-3 minutes to fill the balloon about half full. The filling can be checked by inspection through the box window. The balloon should be filled until it is well-rounded and its edges touch the sides of the box, but it should not be filled to the point at which it appears to be under pressure. Meteorological balloons vary somewhat in size but, without pressure, they hold approximately 25-35 liters.
- F. Close the CO tank valve.
- G. Close the CO-IN valve and wait until no more gas escapes from the CO-OUT valve.
- H. Close the CO-OUT valve.
- I. Return the RV-BB valve to the BB position (OUT).

#### 4. Zero the helium and CO meters.

- A. Push the AIR button and GAS-PMP button. The sampling flow rate produced by the gas pump is now indicated on the flow meter.
- B. Set the gas pump to Position 4.
- C. Set the flow meter on 400.
- D. Allow the GAS-PMP to run until the numbers stabilize.
- E. Turn the GAS-PMP button off by pushing it a second time. (Note: During all analytical procedures associated with the single-breath procedures, meter readings should be taken while the sample pump is off. When the sample pump is running the pressure in the analytical cells is reduced slightly below atmospheric. Inasmuch as the CO meter reading indicates the total

- number of molecules of CO within the sample cell, the meter reading will be slightly lower while the pump is running.)
- F. Set the helium meter reading to  $00.00 \pm 0.02$  with the Zero Adjust knob.
  - G. Set the CO meter reading to  $000.0 \pm 0.2$  with the Zero Adjust knob.
  - H. Push the GAS-PMP button and pump for another 30 seconds. Then repeat the zeroing process.
  - I. If the CO meter cannot be set to zero by means of the zero control, then the internal shutter on the control chamber within the CO meter will have to be changed. (See Section I and directions in the CO meter manual.) The CO meter and front panel CO readings should be the same.
5. Make the inspired gas adjustments (repeat before each trial).
- A. Push the INS-GAS button and the GAS-PMP button and run the sample pump until the numbers stabilize (30-60 seconds). If the machine takes a long time to stabilize, check:
    - (1) The flow meter (it should be at 400).
    - (2) The ascarite sample tube (discoloration should not exceed a quarter of an inch), and hardening should not be present.
    - (3) The drierite sample tube (discoloration should not exceed one-half inch).
  - B. Stop the GAS-PMP and check the readings.
  - C. Repeat Steps A and B.
  - D. If the reading is within 1 or 2 percent of 100 unlock the CO meter gain control and turn it until the meter reads exactly 100. If not, repeat Steps 2-5.
  - E. If the reading is within 1 or 2 percent of the certified percentage unlock the helium meter gain control and turn it until the meter reads the same as the percentage certified by the gas supplier on the tank. If not, repeat Steps 2-5.
6. Now bring on the examinee.
- A. Flush and fill the system with known gas:
    - (1) Turn the single-breath valve to Position 2.
    - (2) Lower the spirometer bell by manual pressure.

- (3) Turn the valve to Position 1.
- (4) Remove the rubber stopper from the examinee's side of the machine.
- (5) Raise the spirometer bell and replace the rubber stopper.  
Note: Do not use weights on the spirometer. Always lift the spirometer bell by hand with the free-breathing valve open to permit gas to enter the spirometer. Opening the free-breathing valve and raising the spirometer bell do not contaminate the system because the spirometer is connected only to the box and not the balloon. Raising the spirometer bell as just described is an essential step. If the spirometer bell is not filled as high as possible with the base submerged in water, then, when the examinee suddenly makes a maximal inspiration the spirometer bell will hit bottom and may crack. Furthermore, water will be sucked into the interior of the spirometer and will run into the box because the RV-BB valve is in the BB position. Such a disaster necessitates the dismantling of the equipment.

- B. Be sure the balloon has at least 15-20 liters of gas in it (even more if the examinee's vital capacity is greater than 4 liters).
- C. Be sure the RV-BB valve is in the BB (OUT) position.
- D. Be sure the spirometer pen is working properly on the paper. Start the pen just left on the paper overlap.
- E. Set the paper speed to 1920 mm./minute.
- F. Adjust the height of the single-breath valve to the level of the seated-examinee's nose; attach a rubber mouthpiece and insert it in the examinee's mouth. The examinee's neck will be extended upward slightly.
- G. With the single-breath valve in Position 1 do a practice trial in the following way:

Place the nose clip on the examinee's nose and instruct him thusly: "Take in a deep breath. Now blow all the air all the way out. When all the air is out, raise one hand or knock on the side of the machine. Now take in a great big breath as fast as you can and hold it. . . Hold it. . . hold it (10 seconds from start to expiration). Breathe out as fast and as much as you can. Now just breathe quietly."

If the examinee does the trial satisfactorily, proceed with the test.

If the examinee does not do the practice trial satisfactorily, repeat the trial.

- H. Push the BAG-PMP button; wait until the sample bag is entirely evacuated and the tubing is flattened; and then push the OFF button to seal the vacuum in the bag.
- I. Put one foot on the remote kymograph control, one hand on the single-breath valve, and the other hand around a stopwatch.
- J. See that the single-breath valve is in Position 1 and that the examinee is breathing quietly.
- K. Ask the examinee to take in a deep breath, blow all the air all the way out, and then signal (put a finger up or tap the side of the machine).
- L. At the examinee's signal step on the foot switch to start the kymograph. There should be at least 1 inch of baseline before the onset of inspiration.
- M. Turn the single-breath valve to Position 2; ask the examinee to take in a deep breath, and start the stopwatch.
- N. When a full inspiration is achieved as rapidly as possible, encourage the examinee to hold his breath. (As long as the single-breath valve is in Position 2 expiration is prevented by the one-way J-valve near the side of the machine.)
- O. When  $9\frac{1}{2}$  seconds have passed, quickly turn the valve to Position 3 and tell the examinee to exhale as fast and as fully as possible. After a minimum of 500 ml. has been expelled (a fraction of a sec.) turn the valve to Position 4 until the sample bag is nearly full or until expiration has ceased (whichever occurs first). Then return the valve to the original Position 1 and remove your foot from the foot switch.
- P. Take the examinee off the mouthpiece, and remove the nose clip.
- Q. Number the tracing of each trial at the beginning and the end.

Smooth operation of the valve requires some practice. With normal examinees the valve can be turned from Positions 2 through 4, and 4 back to Position 1 in one smooth motion. This will result in an adequate flush-out and bag sample because of

the large volume and rapid flow rate. For examinees with obstructive disease the valve may have to be held in Positions 3 and 4 for one-half second or more. For examinees with a vital capacity of 1400-1500 ml., several trials may be required. If the vital capacity is less than 1400 ml., it will not be possible to do the test because a minimum of 500 ml. is required to flush out the dead space (of the mouthpiece and valve as well as the anatomical dead space of the examinee), and a minimum of 500 ml. more is required in the bag as a sample for flushing of the sampling circuit and the CO and helium cells. Usually an examinee whose vital capacity is less than 1000 ml. cannot hold his breath for 10 seconds anyway.

7. Analyze the sample.
  - A. Push the GAS-PMP button and the BAG button once each and wait until the numbers stabilize.
  - B. Stop the GAS-PMP and check the readings.
  - C. Repeat Steps A and B.
  - D. Press the OFF button for the seven solenoid valves.
  - E. Record the CO meter reading on the examinee's chart (Expired CO).
  - F. Record the He meter readings on the examinee's chart (Expired Helium Percent).

For examinees with a normal vital capacity, the bag will contain approximately 1500 ml. Since the pump is set for 400 ml./min., pumping for 1½ to 3 minutes should allow for several readings to be taken. If the sample is small (less than 1000 ml.) reduce the pump flow speed to about 300 ml./min. by regulating the flow control at the bottom of the sample CO and He flow tube. Since the volume of tubing, chemical tubes, and CO and He analysis cells is about 300 ml., a reliable reading will not be possible if there are less than 400 or 500 ml. of gas in the bag.

8. At least 5 minutes must be allowed between trials to assure complete removal of all CO and He from the lung gas. For examinees with marked obstructive disease, it may be wise to wait even a little longer.

## Recording of Temperatures and Pressure

1. Record the Uncorrected Barometric Pressure to the nearest tenth of a mm. of mercury on the examinee's chart.
2. Record on the chart the room temperature to the nearest degree centigrade from the thermometer mounted on the barometer. Record it in the space to the right of the Uncorrected Barometric Pressure. This temperature is used to correct the barometric pressure.
3. Record on the chart the Small Spirometer Temperature to the nearest degree centigrade from the thermometer on the CO tubing system. This temperature is used in the calculation of the STPD factor.

## Interpretation of Spirogram

1. Data from the spirogram
  - A. Inspired volume (VC ATPS) in ml. This is calculated and recorded on the examinee's chart.
  - B. Breathholding time. This is measured and recorded on the chart in cm. as the distance from the midpoint of inspiration to the onset of gas collection.
  - C. Volume of dead space washout (minimum of 500 ml.). This is not recorded on the chart.
2. Procedure for getting this data
  - A. Set the proportional divider for lines at a 1:2 ratio.
  - B. Extrapolate the baseline of the tracing until it reaches a point where the line is perpendicular to the peak volume point of the spiro tracing. If there is a decrease in volume of more than 200 ml. during breathholding, use the mean of the volume from beginning to end of breathholding as the peak volume point. Small artifacts at the peak of inspiration should not be interpreted as peak volume as they are due to the inertia of the spirometer bell.
  - C. Put one arm of the proportional divider on the baseline under the peak volume point and the other at the peak volume point of the spiro tracing.

- D. Without altering the divider setting, remove the divider from the tracing, put one arm on a vertical line at zero and the other arm on the same line above it. Read the number of ml. at this point to get the inspired volume (VC ATPS) and record this volume on the tracing.
- E. Without altering the divider setting, turn the divider over and place one arm on the baseline and the other on a point directly above.
- F. Draw a horizontal line from this point parallel to the baseline until it intersects the spiro inspiration tracing. This intersection is the one-half inspiration point.
- G. Draw a vertical line through the small artifact at the point where the washout tracing ends and the collection of gas in the sample bag begins.
- H. Place one arm of the divider on the tracing at the point where gas collection begins and the other arm directly above at the level of the peak volume. This is the washout (dead space) measurement and must be at least 500 ml.
- I. Place one arm of the divider on the tracing at the point where gas collection begins and the other arm on the extended baseline. This is the air sample collected and must measure at least 500 ml.
- J. Measure and record the distance from the vertical line drawn through the artifact to the one-half inspiration point with a metric ruler. Make sure the ruler is parallel to the baseline. This is the breathholding time in cm. The computer program will divide the cm. results by 3.2 (the paper speed of the kymograph is 32 mm./sec.) to get breathholding time in seconds.
- K. If inspiration time is hard to determine, extrapolate lines from the major (most constant, longest, and most obvious) section of the inspiration tracing. Zero inspiration is the point at which the extrapolated line intersects the baseline. Termination of inspiration is either the point at which the extrapolated line crosses a horizontal line tangent to the total volume peak, or the point at which a normal-looking inspiration curve reaches a peak and levels off with only a slight gradual increase.

## Optional Check Procedures

1. Checking the tank gas against the balloon gas.
  - A. Completely remove the sample bag from the single-breath valve and from the machine.
  - B. Remove the rubber tubing from the CO-IN petcock and connect it to the sample bag.
  - C. Open the CO tank valve and allow the gas to pass in and through the sample bag, thereby flushing the bag but still retaining a reasonably large sample.
  - D. Close the CO tank valve.
  - E. Seal off both ends of the sample bag.
  - F. Remove the tubing from the sample bag.
  - G. Reattach the sample bag to the machine; keep the other end sealed off.
  - H. Push the BAG and GAS-PMP button and allow the machine to run until the numbers stabilize.
  - I. Turn the GAS-PMP off.
  - J. Repeat Steps H and I and then check the readings. The readings obtained with gas directly from the tank should be the same as the readings obtained from inspired gas in the bag.
  
2. Checking the gas in the tubing and system against the gas in the tank.
  - A. Remove the end of the sample bag tubing from the machine inlet.
  - B. Attach one end of a 2-3 foot piece of tubing of the appropriate size to this inlet.
  - C. Attach the other end to the petcock on the 5-way valve, and open the petcock.
  - D. Push the BAG and PMP buttons and allow the machine to run until the numbers stabilize.
  - E. Turn the GAS-PMP off.
  - F. Repeat Steps D and E and check the readings. They should be the same as the readings obtained from the gas in the bag (inspired gas).

## **CHAPTER 12**

### **X-RAY**

#### **Restrictions**

1. No examinee who is known to be pregnant is to have any X-rays taken. This restriction will be noted on the Control Record by the coordinator or the physician. If not already noted, the technician must ask any female whether she is pregnant.
2. No female under the age of 50 shall have an X-ray of the pelvis taken.
3. The lead shield shall be used when taking all pelvic X-rays.

#### **Radiation Badges**

Every precaution recommended by the American College of Radiology and the Radiation Surveys of the Caravans by the Radiological Health Division of PHS is incorporated in our X-ray setup.

Radiation detection badges shall be worn by X-ray technicians during all operating sessions in the Mobile Examination Center. These badges are for the optional use of examining staff in adjacent trailers in areas near the X-ray machine.

New badges will be provided every 3 months. When the new ones are received, the used badges should be returned to Headquarters for reading.

## X-Ray Exposures

Chest: 72" distance - Bucky - 110 kilovoltage

### PA view

CM	MA.S	MA	Sec.
17 - 18	2.5	300	1/120
19 - 20	5.0	300	1/60
21 - 22	7.5	300	1/40
23 - 24	10.0	300	1/30
25 - 26	15.0	300	1/20
27 - 28	20.0	300	1/15
29 - 30	30.0	300	1/10

### Lateral View

CM	MA.S	MA	Sec.
27 - 28	20.0	300	1/15
29 - 30	30.0	300	1/10
31 - 32	40.0	300	2/15
33 - 34	60.0	300	1/5
35 - 36	75.0	300	1/4

**Pelvis:** PA Bucky 72" distance upright

200 MA.S - 65-85 KVP - 400 MA - 1/2 sec. -65-85 KV

**Knees:** AP Bucky 40" distance

30 MA.S - 50-75 KVP - 200 MA - 3/20 sec. -50-70 KV

**Hand:** 36" distance - AA industrial film

VAN I - 50 MA.S - 58 KVP - 100 MA - 1/2 sec. -58 KV

VAN II - 50 MA.S KVP - 100 MA - 1/2 sec. -59 KV

VAN III - 50 MA.S - 63 KVP - 100 MA - 1/2 sec. -63 KV

## Procedure

### 1. Preliminary

- A. Record the time the examinee enters the X-ray room.
- B. Note the sample number that has been previously stamped on each record. Put this number in the lead number holder along with the date and an L (which designates left).
- C. Set X-ray control for correct X-ray exposure.

### 2. Chest

- A. Place both 14 x 17 cassettes in the upright cassette holder. Put the lead number holder in the upper left corners for the PA and along the right border of the cassette for the lateral. Put one cassette in position for the first exposure.
- B. Have the examinee raise both arms up. With calipers measure width and depth of the examinee's chest at the level of the sixth thoracic vertebra. Using the exposure chart, set the proper technique for these measurements.
- C. Position the examinee with his anterior chest pressed against the cassette. Have him rest the back of his hands on top of his hips and roll his shoulders forward.
- D. Position the X-ray tube 72 inches from the film with the central beam at the midthoracic spine.
- E. Adjust the videx cone on the X-ray tube so that only the chest area will be exposed.
- F. Ask the examinee to take in a deep breath and hold it.
- G. Make the exposure while standing in the darkroom where you can observe both the meters on the X-ray machine and the examinee.
- H. Have the examinee breathe and relax while you put the other cassette in position for the second exposure.
- I. Have the examinee stand with his left side to the cassette. Have him extend both arms up and across his forehead and grasp opposite elbows. Make sure his chin is up and that he is in a true lateral position to the film.
- J. Position the X-ray tube 72 inches from the film with the central beam just below the axillary area.
- K. Repeat steps E, F, and G.

### 3. PA pelvis (hip) X-ray

- A. Put a 14 x 17 cassette in the cassette holder with an 8:1 movable grid.
- B. Hang the plumb bob so that it falls freely through the cut out slots on the cassette holder at the center front of the film.
- C. Stand the examinee on a perfectly level foot stand with his face to the cassette. The foot stand can be leveled by adjusting the legs, using the spirit levels as guides. Align the medial borders of the examinee's feet against the 7-inch block in the center of the stand. See that the center of the foot stand is at the midpoint of the film.
- D. Adjust the lower edge of the cassette so that it is 4 inches below the palpated greater trochanter.
- E. Adjust the lead gonad shield so that a point midway between the top of the shield and the top of the circle is level with the greater trochanter at the midpoint of the film.
- F. If the examinee is unable to keep his knees straight, secure a binder or belt snugly around his knees to be sure that they are fully extended.
- G. Position the X-ray tube 72 inches from the cassette and direct the central beam through the small metal circle projecting 2 inches above the top of the gonad shield. In doing so you will direct the central ray to the level of the femoral heads at the midline of the examinee.
- H. Ask the examinee to breathe in, breathe out, and then stop breathing. Make the exposure from the darkroom while observing both the examinee and the machine dials.
- I. Have the examinee resume breathing.

### 4. Knee X-ray (AP of right and left)

- A. Have the examinee lie or sit on the X-ray table with both legs extended.
- B. Place a 14 x 17 cassette crosswise in the Bucky tray with a 12:1 movable grid and place the number holder on it with the appropriate R or L marker on the correct side.
- C. Place both knees over the cassette with the palpated condyles in the center of the film.

- D. Adjust the X-ray tube so that it is 40 inches from the film and direct the central ray to the center of the film in the Bucky tray.
  - E. Ask the examinee to bring his toes back and hold very still. Make the exposure from the darkroom while observing both the examinee and the machine dials.
5. Hand X-ray (bone mineral measurement)
- A. Place a 10 x 12 Eastman Industrial Type AA X-ray film upon a sheet of lead rubber on the table.
  - B. Have the examinee sit on the stool with his left side to the X-ray table.
  - C. Place the examinee's left hand on the film posteroanteriorly with the fingers neither pressed closely together nor spread widely apart but straight and flat on the film. Rest the forearm flat on the table with the elbow at a 90° angle. The long axis of the forearm should be parallel to the long axis of the X-ray tube to reduce "heel effect." In case of deformity, amputation, or severe arthritic condition, the right hand should be substituted with adequate notation on the film. Remove all watches, bracelets, and rings that are in the area to be X-rayed.
  - D. Carefully place the lead "wrap-around" around the fifth digit making sure it is flat (so as to cast a wide shadow) and its side is vertical.
  - E. Place the "phalanx wedge" parallel to the fifth digit, one-half inch from the digit, with the tip of the wedge level with the tip of the digit.
  - F. Place the bone-simulating phantom marked "P" at the end of the wedge.
  - G. Place the "radius wedge" parallel to the first digit with the tip at a level with the distal end of the radius one-half inch from it.
  - H. Place the bone-simulating phantom marked "R" at the end of the wedge.
  - I. Place the lead number holder on the film so that it is within one-half inch of the edge of the film but not covering any part of the hand, wrist, wedges, or phantoms.
  - J. Center X-ray beam on the midpoint of the third (middle) metacarpal with the X-ray tube 36 inches from the film.

- K. Ask the examinee to hold still while you make the exposure from the darkroom.
- L. Record the date, sample number, technician number, and any comments on the sheet posted outside the X-ray room.
- M. Put the Ready-Pak X-ray in the box provided in the darkroom.

## Processing

### 1. X-rays developed in trailers

Films (except for the hand X-ray) are to be developed before the examinees are released from the trailers so that unsatisfactory films can be repeated.

All X-rays developed in the trailers should be carefully checked by the technician in charge and the physician.

Duplicate the PA and Lat chest X-rays on the Blu-Ray radiograph duplicating printer and process in the X-omat.

Save each examinee's X-rays in an envelope marked with his sample number (copied from the daily appointment schedule). Put both original and duplicate chest X-rays in a 14 x 17 envelope. Put the knee and hip X-rays in a 14 x 17 envelope and mark it "knee and hip." If a hip X-ray was not taken, mark the envelope "knee only."

At the end of the stand check all X-rays for correct sample numbers on both film and envelope, dates, and R and L identification; and send the film to Headquarters.

### 2. Hand X-ray

Send by registered mail at the end of each stand the Ready-Pak films and the shipping list in the box provided to:

George P. Vose  
P.O. Box 23546  
TWU Station  
Denton, Texas 76204

## Field Checks and Calibrations

### 1. Check of the horizontal accuracy of the X-ray beam

This check should be made at the beginning of each stand.

Place two cassettes in the upright cassette changer. Position the X-ray tube 72" from the upright cassette changer, and lock it at an exact 90° angle. Adjust the gonad shield so that the metal circle is over the center of the film, and direct the central beam through the middle of the metal circle. Lock the cassette changer and the gonad shield in position. Slide the glass panel across in front of the film and tape a "1" on the glass panel at the exact spot in the center of the metal circle as shown by the central beam. Tape a "1" on the side of the cassette for identification. Expose the film (100 MA - 1/10 sec. - 50 KV). Without moving the X-ray tube or the gonad shield, change the cassette and replace the "1" identification on the side of the glass panel with a "2." Do not move the "1" taped in the center of the glass panel. Release the lock holding the X-ray tube at a 90° angle. Turn the tube down and then back up into position in the same manner as you normally would for a hip X-ray. Make an exposure the same as above. Process the films and check to see if the "1's" are projected identically in the center of the circle on both films. If not, repairs to correct the angle must be made. Until then you will have to lock the tube at the 90° angle when taking X-rays.

### 2. Calibration exposures for hand bone densitometry

A plastic plate with permanently attached wedges and bone phantoms will be mailed in a shipping container from TWU at the beginning of each stand. The wedges and phantoms are located on the plastic plate at approximately the same locations and angles that the wedges and real bone sites are located in routine hand radiography.

The following directions for using the plate phantoms are also shown on the plate:

- A. Identify 10 x 12 film in upper right corner with stand number and date.
- B. Center on intersection of black lines.
- C. Make two exposures at usual X-ray setting.
- D. Mail films and this plate at once to TWU for analysis.

After the two exposures have been made the undeveloped films and phantom should be returned at once in the shipping container to TWU. It will then be forwarded to another caravan.

In order to avoid confusion between this shipping container and the container for shipping X-rays routinely at the end of the stand, the container with the phantom will be clearly labeled:

NOTE: X-RAY TECHNICIAN - OPEN AT ONCE

Should anything appear to be wrong with the phantom upon arrival, or if other information is needed, place a collect telephone call to George Vose, AC (817) 387-5305.

### 3. Leveling of the X-ray stool

Before each stand and daily during each stand the levelness of the metal X-ray stool should be checked using two spirit levels not attached to the stool. If the stool is not level, adjust the legs until it is level. The results of this check should be recorded daily on the form provided.

## CHAPTER 13

### AUDIOMETRY

#### Equipment and Field Check Forms

Soundproof room.

Beltone audiometers.

The Environmental Acoustics Research Corp. Laboratory provides two audiometers and two masking generators to each stand. Both are to be carefully packed and returned to Bridgeville at the end of each stand. Mark "FRAGILE" and ship prepaid "AIR FREIGHT-SPECIAL DELIVERY" to:

Kenneth Stewart, President  
Environmental Acoustics Research Corp.  
523 Washington Avenue  
Bridgeville, Pennsylvania 15017

Revox Tape Recorder

Tape recordings of University of Maryland Revised CID Sentence Lists

Equipment for field checks:

Bruel and Kjaer Precision Sound Level Meter (Type 2203),  
Bruel and Kjaer - Artificial Ear Coupler (Type 4151),  
Ballentine Voltmeter (Type 302C).

Forms for field checks:

Daily checklist for audiometric technician.  
Weekly field calibration of earphones and masking generators.

Environmental noise survey (per stand).  
(Order supply through FOM).

## Pure Tone Air Conduction Testing

1. Instructions for daily check for hearing testing equipment  
Before starting testing each day the audiometers should be checked as follows after turning main switch to the manual position:
  - A. Check each frequency of 500-4000 Hertz (Hz) with intensity set at 40 decibels (dB).
  - B. Check the intensities in the following manner:
    - (1) Turn the interrupter switch to the ON position.
    - (2) Set the frequency dial on the 2000 Hz tone.
    - (3) Turn the intensity dial slowly from 20 to 60 decibels and back again to zero and listen for scratch, abrupt increases in loudness, or for other extraneous signals and note any that are present in the "Remarks" section. Intensity dial should be held so that no mechanical clicks are heard when intensity steps are changed. Repeat the procedure in (1), (2), and (3) for each earphone.
    - (4) Check the appropriate spaces as the phone is checked for intensity increase.
  - C. Check the interrupter switch as follows:
    - (1) Turn the interrupter switch to the OFF position.
    - (2) Depress the interrupter switch first at the 20-decibel level and then at the 60-decibel level; listen for a smooth onset of tone. Check the appropriate space on Checklist Form if this type of tone is heard. If the interrupter switch is faulty, this performance should be noted in the space provided for the check mark or in the "Remarks" section.
    - (3) The interrupter switch should be depressed in such a way that no mechanical clicks are heard.

D. Check the wires leading to the earphone and bone vibrator in the following manner:

- (1) While wearing the earphones and with the tone on at 1000 Hz intensity dial at 40 dB, shake the wire to each earphone lightly. Listen for scratch, interrupted signal, or any other abnormality. Note any unusual performance in the "Remarks" section.
- (2) If the tone is interrupted or changes loudness, tighten the set screws holding the earphone cord in the earphone. If this action does not correct the fault, change audiometers.
- (3) It may be necessary to replace an earphone cord from time to time. This can be done by loosening the set screws in the earphone, unplugging the old earphone cord, plugging in the new cord, and tightening up the set screws once more.

E. The attenuator and frequency dials may slip on the shaft. If this happens, report it under "Remarks" and change audiometers.

F. Any *failure* of the audiometer in the daily check will be sufficient reason for audiometer replacement.

G. *Failure of instruments to meet specifications on daily field check*

When the first audiometer does not meet specifications on the daily field check, do the earphone field calibration for that instrument (See section 2). If it is out of specifications (exceeds or falls below the ANSI tolerance limits by one decibel or more or if there is some other defect), do a check and the field calibration of the earphones on the second audiometer. If neither instrument works properly, call Mr. Kenneth Stewart for instructions at Area Code 412, 683-1620, Ext. 2230. He will indicate which audiometer is to be returned to him. If the second audiometer tested is in working condition, send the first audiometer to Mr. Stewart as soon as possible.

2. *Instructions for field calibration of audiometers, masking generators, voltmeters, and other related equipment*

*General.* Field calibration of the earphones and pads for both audiometers, the masking generators, and the voltmeters will be performed at

the start of each stand, weekly during the examination period, and at the end of each stand for the equipment in use. Be sure to use the form with the appropriate expected readings for reporting the test results—C, D, E, A, or B calibrator. If the calibration shows the earphones to exceed or fall below (be + or -) the ANSI intensity tolerance limits, a second independent calibration is to be made. The reports on these field calibrations are to be made in duplicate. One copy is to be mailed that day to the Central Office, Miss Jean Roberts; the other is to be mailed that day to Mr. Stewart at the above address.

A. *Earphone calibration*

(1) *Precision sound level meter* (Type 2203) (Bruel and Kjaer).  
To make the meter ready for use:

- (a) Pull out the large black knob below the meter dial (Function Selector Knob) referred to as Knob 1.
- (b) Set Knob 1 to "Batt" position.  
(If pointer falls below section marked "battery" on dial, the batteries need to be replaced. See page 26 of Bruel and Kjaer manual for instructions on this.)
- (c) Turn black knob full counterclockwise, red circle knob full clockwise (Ref. position). Set function knob (Knob 1) to Lin. Refer to microphone *K factor* which is printed on the paper enclosed in the microphone box. Set screwdriver adjustment control (just to the left of black knob on the face of the instrument) to cause the meter (K factor scale) to read a value equal to the K factor of the microphone.
- (d) Switch Knob 1 to "A-Slow" position.
- (e) Turn black knob (Knob 2) counterclockwise until 70 on the dial is at the small black dot to the right of the knob.
- (f) Turn transparent knob with red circle (Knob 3) clockwise until the 60 on Knob 2 shows through the red circle.

B. *Operation of the artificial ear* (coupler) (Type 4151) (Bruel and Kjaer).

To make the coupler ready for use in field calibration of the audiometer earphones:

- (1) Screw the artificial ear coupler onto the sound level meter.
  - (2) Unscrew the top half of the coupler.
  - (3) Remove the protective grid from the microphone cartridge (Type 4132) and screw the special adapter ring onto the cartridge. Then screw the microphone cartridge onto the bottom half of the coupler. Note: *Take great care not to damage the diaphragm.*
  - (4) Screw the top of the coupler, which contains the capillary hole, onto the bottom half over the microphone.
  - (5) *Remove the capillary pin.*
  - (6) Place spring pressure device onto the fitting for it on the baseboard.
  - (7) Mount the earphone to be tested on top of the coupler. Make sure that the earphone to be tested rests squarely on top of the coupler.
  - (8) Place the platform of the spring pressure device over the center of the earphone. Push down on the arm of the spring loading device until a reading of 0.5 kg. (500 grams) is obtained on the calibrated scale and lock with the retaining screw.
  - (9) Insert capillary pin.
- Now the coupler is ready to use for testing the earphone.

### C. *Testing the earphones*

- (1) Set audiometer to a frequency of 500 Hz for the earphone under test.
- (2) Set hearing loss dial on audiometer to 60 dB.
- (3) Turn audiometer interrupter switch to "ON" position.
- (4) Turn earphone selector switch to position for earphone being tested, 1R - 2L or 1L - 2R.
- (5) Record the meter reading on the field calibration report forms provided. The meter reading at this frequency is

determined as in the following example (for the "C" calibrator):

(500 Hz)	Red circle on	60	dB
	Meter needle on	<u>6.5</u>	dB
	Actual meter reading	66.5	dB

The expected reading at this frequency is 67.75. The actual reading to be recorded on the report form is 66.5 dB. Since this is within the ANSI tolerance limits of  $67.75 \pm 3$  dB (64.75-70.75 dB), the earphone in this example is within specifications at this frequency.

- (6) Turn the audiometer to the next frequency to be tested—1000 Hz. Leave black knob of Sound Level Meter at 70 and red circle at 60. Record the meter reading obtained as in the following example (for "C" calibrator):

(1000 Hz)	The Red circle is at	60	dB
	The meter needle is at	<u>8.0</u>	dB
	Actual meter reading	68.0	dB

Since the expected reading at this frequency is 66.25 and the actual reading is within the ANSI tolerance of  $\pm 3$  dB (63.25-69.25), the earphone in this example is well within specifications at this frequency.

- (7) Continue testing as indicated above at each frequency shown on the field calibration report form. The form gives the setting for the black knob and the red circle to be used at each frequency.

At each frequency, the actual meter reading is the sum of the setting used for the red circle and the reading indicated by the needle on the meter dial taking into account the sign of the latter reading (i.e., add if positive number, subtract if negative).

- (8) To test the other earphone of the audiometer:

- (a) Hold the earphone just tested gently with one hand, raise the platform on the spring pressure device slightly, and rotate the latter away from the earphone.

- (b) Lift earphone off coupler.
- (c) Remove capillary pin.
- (d) Proceed with steps (d) and (e) of part A (1).
- (e) Proceed with steps (6) through (9) of part B.
- (f) Proceed with steps (1) through (7) of part C.

D. Earphones found to be out of specifications

- (1) The field calibration report form gives the expected reading at each frequency and the ANSI tolerance limits allowable around that reading. The expected reading was determined for each set of field calibration equipment in Mr. Stewart's Acoustical Laboratory. As indicated on the report forms, it differs slightly for each set of field calibration equipment.
- (2) If Mr. Stewart has replaced a microphone in the field, the calibration equipment is to go back to him for determination of the set of expected readings for the new microphone.
- (3) If in two of the independent calibrations the actual reading for the earphone under test is found to be 1 or more decibels above or below ANSI specifications ( $\pm$  dB) place the alternate audiometer in use and immediately return the defective audiometer to Mr. Stewart.

E. *Masking generator calibration*

- (1) Set up Bruel and Kjaer field calibrator as for earphone calibration (Steps (a) and (b) of earphone calibration, Item (1)).
- (2) Set Knob 1 to "C-slow" position.
- (3) Turn masking generator "left-off-right" switch to *left* position.
- (4) Set masking level knob to 60 dB.
- (5) Set masking center frequency to 500 Hz.
- (6) Set black knob and red circle (on the Bruel and Kjaer meter) to 80.
- (7) Read the masking signal level as in the following example:

Red circle on	80	dB
Meter needle on	<u>2.4</u>	dB
Actual signal level	82.4	dB

The expected reading at this frequency is 81.7. The actual reading to be recorded on the report form is 82.4. At this writing there is no ANSI specification for the tolerance limit for the masking generator signal. For this study a limit of  $\pm 3$  dB (same as pure tone limit) has been chosen. In the above example the masking generator is within the tolerance limit.

- (8) Turn the masking generator to 1000 Hz center frequency and proceed as in the above example using the appropriate expected readings listed on the report form. Note that the masking level, black knob, and red circle values change with frequency tested.
- (9) Continue and obtain readings at 2000 Hz and 4000 Hz center frequencies.
- (10) *Masking generators found to be out of specifications*

The field calibration report form gives the expected readings for the masking generator at each center frequency and the tolerance limits allowable around that reading. The expected reading was obtained for each set of field calibration equipment at Mr. Stewart's Acoustical Laboratory. If the masking signal level is found to exceed the  $\pm 3$  dB tolerance limit by more than 1 dB the alternate masking generator should be field calibrated and placed in use. Immediately, send the defective masking generator to Mr. Stewart.

### 3. Instructions for environmental noise-survey

To be done during the "dry run" before the start of each stand of examinations. One copy of the completed form should be sent immediately to Miss Roberts and one to Mr. Stewart.

For the survey:

- A. Screw the microphone (with protective grid in place) directly onto the fixture on the Bruel and Kjaer instrument (#2203).
- B. Make the Bruel and Kjaer instrument ready for operation as under Earphone Calibration; instructions (1), (a), (b), and (c).
- C. Set Knob 1 to Ext. Filt. slow position.

- D. Set "weighting" switch on the octave filter set to "OFF" position.
- E. Close both doors to the audiometer room.
- F. Turn off all hearing test equipment.
- G. Set black knob to 70.
- H. Rotate "Frequency Hz" knob to 31.5.
- I. Adjust red circle knob to obtain a meter reading which is somewhat above "O" dB on the meter scale. Read the red circle number and add to it the meter reading. Example:

Red circle on	60 dB
Meter reading	<u>4 dB</u>
Environmental noise level	64 dB at 31.5 Hz

- J. Record the reading on the appropriate form.  
NOTE: The meter reading will fluctuate considerably. Try to estimate an average reading after having observed the meter for a few moments.
- K. Turn "Frequency Hz " knob to 63.
- L. Turn red circle knob to obtain a meter reading as in instruction 9.
- M. Proceed through each octave band 125 Hz...8,000 Hz.
- N. Under "Comments" explain circumstances, if possible, where environmental noise level exceeds ANSI allowable levels.

#### 4. *Audiometry testing procedures*

- A. *General.* At the beginning of each day, turn on the audiometer at least 10 minutes before performing the daily field check. Leave the audiometer turned on until completion of the day's testing. Do second field check upon completion of testing. Make sure that both doors of the audiometry room are closed when testing.
- B. *Recording.* Use the left side of form first when sample number is even and right side first when sample number is odd.
- C. *Audiometry testing.* Complete air conduction tests for both ears in the sequence indicated on the recording form. For any other part of the test that cannot be completed enter "X" in the appropriate box and indicate the reason under "Conditions Affecting Test Results." When "defective equipment," "behavior," or "other" conditions have affected all or part of the audiometric test results,

record in the space provided the frequencies that are affected, in addition to checking the specific condition. If the examinee does not respond to the 100 dB intensity for air conduction for any one of the test frequencies, record "100+" in the space provided for that frequency for the ear under test.

D. *Instruction to the examinee.* After entering the beginning time, the audiometer number, and the technician number on the control record, the technician will proceed with the following steps:

(1) Detailed instructions should be given examinee to stress the following points:

- (a) Earphones will be placed by the technician and must not be touched by the examinee.
- (b) Sounds will be heard in one ear at a time.
- (c) Sounds will get progressively fainter.
- (d) Examinee should show when the sound is heard by raising the index finger of his right or left hand depending on the ear in which the sound is heard.
- (e) Examinee should keep his finger up until the sound is no longer heard.
- (f) Examinee should raise his finger to the sound even if he just thinks he hears it (because it sounds very faint).
- (g) During the test eyeglasses, earrings, chewing gum, wigs, and bobbypins should be removed if they interfere with the proper placement of phones.

(2) Examples of detailed instructions

- (a) We are going to see how well you can hear some tones from earphones over your ears.
- (b) The tones will be short and most of them will be faint.
- (c) Some tones will be fainter than others.
- (d) When you hear a tone, no matter how faint it is, raise your finger to show that you hear it.
- (e) Use your right hand when you hear tones in your right ear and your left hand when you hear tones in your left ear.
- (f) Hold up your finger only as long as you hear the sounds.

- (g) As soon as the sound goes away, put your finger down.
  - (h) Listen carefully when the sound starts to get fainter but even if you just think you hear it keep your finger raised.
  - (i) First you will hear a tone in your right/left ear (point).
  - (j) But if the tone seems to be in this ear (point to nontest ear), please tell me.
  - (k) Remember to raise your finger when you hear one; lower it when you don't.
  - (l) Do you understand? (If not, clarify as necessary.)
- (3) Examples of instructions when masking on better ear is required (when differences between hearing levels of two ears are 40 dB or more).
- (a) Now you will hear the tone in your right/left ear (point).
  - (b) At the same time you will hear a noise, like wind, in your other ear (point).
  - (c) The noise is to keep you from hearing the tone in that ear, so try not to pay attention to it.
  - (d) Listen for the faint tone in your right/left ear (point) and raise your finger whenever you hear the tone.
  - (e) Do you understand? (If not, clarify as necessary.)

#### E. Conduct of the air-conduction hearing test.

- (1) Take the examinee into the test room and seat him opposite the examiner but facing away so that he cannot see the examiner's movements or the equipment being operated, but so that his signals can be seen by the examiner.
- (2) Close the test room doors.
- (3) Ask examinee if he has any problems which might affect his hearing—colds, earache, etc. Record these under "Conditions Affecting Test Results."
- (4) Repeat the instructions briefly.
- (5) Make sure that the ears are not obstructed with cotton before placing earphones.
- (6) Place the earphones on the examinee, and make sure the earphone opening is over the ear canal and that it has a good seal

against the examinee's ear. Red earphone is placed on the right ear; grey on the left. Hair should be pushed away from the ears before earphone is placed.

- (7) Make sure that the audiometer is ready for the test by checking that it is set in the following manner:
  - (a) Power on for at least 10 minutes before start of test.
  - (b) Main switch is the manual position; interrupter switch on; output switch at 1R-2L for right ear; 1L-2R for left ear; masking generator output selector in "OFF" position; attenuator pads correctly hooked up.
  - (c) Frequency dial set at 1000 cycles.
  - (d) Intensity dial set at 40 decibels.
  - (e) Earphone indicator on the switch box is turned to the ear being tested first as prescribed by the test form. When the examinee number is even, test the right ear first; use the left column and follow the sequence indicated. When the examinee number is odd, the left ear first; use the right column and follow the sequence indicated there.
- (8) The 1000 cycle tone is introduced to the first ear to be tested at a level of 40 decibels for about 1 second. This should be well within the range of audibility for most examinees and will serve as listening practice.

If the sound is not heard at 40 dB increase the level in steps of 10 dB until the listener signals that he has heard it.
- (9) When the examinee responds, set the intensity dial 10 decibels below the previous stimulus intensity (30 dB) and present the tone for 1 or 2 seconds.
- (10) The procedure of dropping the level of the tone in 10 decibel steps with at least one presentation at each level should be continued until no response is obtained.
- (11) Then raise the intensity dial 5 decibels.
- (12) If a response is obtained at this level, the intensity is reduced by 10 decibels. If there is no response, raise the intensity 5 decibels. Always descend 10 decibels and count the number of responses at the lowest level while ascending in intensity in 5 decibel steps.

- (13) The threshold recorded is the lowest dial reading at which 50 percent or more of the responses are obtained to ascending presentations—that is, 2 out of 3 or 3 out of 5 trials. Below this level less than 50 percent response is obtained and above this 100 percent response is approached.
- (14) Make the proper two-digit entry on the test form. Test other frequencies in the order indicated on the form.
- (15) Repeat the procedure presenting each successive frequency in the order listed on the examination form to the test ear and then shift to the other ear as indicated on the test form until the air-conduction test has been completed for all frequencies and for both ears.

F. Procedure when the difference in thresholds between the two ears is 40 dB or more.

When the threshold of one ear at any frequency is 40 dB or more poorer than that of the other ear, you must retest the poorer ear at that frequency using masking of the same frequency on the better ear. Use a masking level of 60 dB whenever masking is necessary no matter what the difference in thresholds is between the two ears. Record the results in the appropriate spaces on the audiometry form.

G. Procedure necessary for threshold accuracy.

- (1) Avoid rhythmic presentation of signals to the examinee. The examinee may respond to the rhythm rather than to the sound. This is especially true of younger persons.
- (2) Avoid a long, drawn-out search for a threshold which tends to lessen the interest and cooperation of the person being tested and to produce fatigue. If necessary, shift to another frequency and test, then return to the problem frequency later. Note at the bottom of the form any change in the order of the test on the test form.
- (3) Avoid giving visual or auditory cues when the tone is presented; for example, looking at the person each time a tone is presented, making a click with the interrupter switch, or clicking in the intensity dial.

- (4) Double check the dial reading.
- (5) Check whether the interrupter switch was at OFF position.
- (6) Avoid activity which will distract the examinee.
- (7) Check the response of the examinee occasionally by leaving the tone off for several seconds and then presenting the tone to see if he is responding consistently.
- (8) Avoid presentation of the test tone for longer than 3 seconds. This may lead to a false response.
- (9) Count only the ascending responses in determining the threshold.
- (10) Avoid being influenced by the threshold obtained for the first cycle tone when obtaining the threshold for the second presentation of this tone.
- (11) Make sure all forms are complete. Record the time the test is finished and the technician number on the control record. When the test is not done or incomplete, record reason.

## Speech Discrimination Testing

### 1. Operation of the Revox tape recorder

#### A. General

The Revox tape recorder has been modified to form an electro-acoustic system that is compatible with the Beltone 15c audiometer. The modification consists of a voltage divider and load resistor arrangement which is built into the connecting cable between the audiometer "tape" input jack and the Revox recorder. In addition, the "record mode" of the tape recorder has been immobilized to prevent accidental erasures of the tapes employed in the speech testing program.

#### B. Connections

A cable supplied with the tape recorder has a "pin plug" on one end and a phone plug on the other end. The pin plug is inserted into the "CH1" jack on the rear of the Revox and the phone plug is inserted into the "tape" jack of the audiometer.

### C. Function control positions

The function controls on the Revox tape recorder should be positioned as follows:

- (1) Volume control: fully on
- (2) Tape selection: monaural
- (3) Response weighting: NAB
- (4) Balance control: center
- (5) Power switch: 7½ small
- (6) Reel motor switch: "out" position
- (7) Record block: both controls on AUX.

### D. Speech testing

The Revox tape recorder instruction manual accompanying the tape recorder indicates the method of threading the tape to make it ready for playback. With the tape properly threaded and with the function controls positioned, proceed with the calibration of the speech material.

### E. Calibration

Position the audiometer frequency elect dial on "speech." Position the audiometer mike, phono, and tape switch on "tape" position. Start the tape recorder by depressing the push button labeled "play." Hold the button depressed until the tape recorder continues to operate following release of the play button. Adjust the hearing level dial on the audiometer to about 60 dB. Listen to either phone to detect the presence of the 1000 Hz calibration tone which precedes the speech material on the tape. When the tone is heard, adjust the audiometer signal level control until the VU meter on the audiometer reads "0" VU. This completes the calibration of the speech system.

### F. Cleaning

The only care the machine needs is to keep the tape path clean. This is very important, however, for the machine will perform its

best only if all parts of the tape path are clean. A soft cotton or linen cloth is most suitable for cleaning. If necessary the cloth may be moistened with a little alcohol. Hard instruments must not be used for cleaning the tape path under any circumstances. The heads should be cleaned carefully. The capstan and pressure roller should be cleaned with a dry cloth. The recorder must never be oiled.

## 2. Testing procedure

### A. Instructions to the examinee

"This is a test to find out how well you hear speech. You will hear lists of 10 sentences, first in your (left, right) ear and then in your (right, left) ear. All you have to do is repeat any or all of each sentence you hear. For example, if the sentence is 'the train will leave at five o'clock,' and all you hear is 'five o'clock,' repeat it for me. Will you practice a couple of sentences with me?

'The fresh produce looks nice today.' 'My grandfather took me fishing.' The sentences will start out soft and then get louder. Be sure to listen carefully and repeat any part you hear."

### B. Test ear

(1). If the sample number is odd, test the left ear first, then the right.

(2). If the sample number is even, test the right ear first, then the left.

### C. Test list

Start testing each examinee with the list after the last list the previous examinee used. After list 10, rewind the tape and start testing again with list 1.

### D. Presentation level

The first list should be presented to the examinee at 10-15 dB below the air-conduction threshold obtained from the first test at 1000

Hz. If the air-conduction threshold is 35 dB or better, present the first list at 20 dB.

AC threshold at first 1000 Hz	Starting speech level
35 dB or lower	20 dB
40-45 dB	30 dB
50-55 dB	40 dB
60-65 dB	50 dB
70-75 dB	60 dB
80-85 dB	70 dB
90 dB or above	80 dB

If the examinee misses five or fewer keywords on the first list tested, stop testing that ear and start on the other ear. If the examinee misses six or more keywords on the first list, present the next list at a level 10 dB above that used for the first list. If he misses five or fewer keywords, stop testing that ear and go on to the other. If he misses six or more keywords, present the next list at a level 10 dB higher. Continue in this way until he misses five keywords or fewer or until you have tested the ear at 80 dB. Test the other ear in the same way.

#### E. Recording of responses

- (1) Use the yellow speech test form when testing at levels of 20-60 dB. Use the blue speech test form when testing at 70-80 dB levels.
- (2) Be sure the examinee's name and sample number are entered correctly on the form.
- (3) Check the appropriate boxes at the top of each list presented indicating which ear was tested at what decibel level.
- (4) Draw a horizontal line through the *correct* keywords as the examinee says the sentences. At the end of each list count up the *incorrect* words and enter the total in the box at the bottom of the list of sentences.

Consider regional dialect differences as correct. Consider as correct words that make up a stimulus contraction such as "we

will" for "we'll." Consider singulars for plurals or vice versa as incorrect.

- (5) If any condition interferes with the speech test check the "other" box under "Conditions Affecting Test Results" and on the air-conduction form describe the condition. Examples of conditions that should be described are stroke, mental retardation, and language difficulty.

### 3. Exceptions to the general procedures

- A. If an ear must be tested at more than five decibel levels, test at the sixth level with the same list used for the first level, and if necessary, test at the seventh level with the same list used for the second level. Save the other five lists for the other ear.
- B. If the examinee cannot respond with understandable speech, provide for written responses. If that doesn't work, record the responses on tape. Identify the recording with the examinee's age, sex, sample number, and date of examination. If recording the responses is also unsatisfactory, cancel the examination. Describe any of these instances on the air-conduction form under "Conditions Affecting Test Results." If it is necessary to record on tape the responses of a person with a language difficulty, present and record no more than three lists for each ear.
- C. If there is a difference between ears in air-conduction thresholds at 1000 Hz of at least 40 dB, broad band masking should be used in the good ear when doing the speech test. Mask at a level 10 dB above the difference between air-conduction thresholds at 1000 Hz. For example, if the right ear threshold is 60 dB and the left ear threshold is 20 dB, mask the better ear at 50 dB when testing the poor ear. Keep the masking level constant while testing the poorer ear.

Daily Checklist for Audiometric Technicians

Stand No. \_\_\_\_\_  
 Audiometer Number \_\_\_\_\_ Date \_\_\_\_\_ Location (city) \_\_\_\_\_  
 Technician (sign) \_\_\_\_\_

A. Check each frequency with intensity set at 40 dB.	500		1000		2000		4000	
	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.
Right earphone								
Left earphone								
B. Check intensities: Frequency at 2000 Hz Increase intensity slowly from 20 dB to 60 dB.	Right earphone				A.M.		P.M.	
	Left earphone				A.M.		P.M.	
C. Check interrupter at 20 dB and 60 dB. No. clicks present	A.M.							
	P.M.							
D. Check wires at 1000 Hz intensity dial at 40 dB.	A.M.							
	P.M.							

Remarks:

Field Calibration of Masking Generator

Date \_\_\_\_\_

Audiometer No. \_\_\_\_\_

Location \_\_\_\_\_

Masking Generator Calibration

Masking Generator Center Frequency	Masking Level Knob	Setting for		Expected Reading "C" Slow	Tolerance dB	Actual Reading Left Phone
		Black Knob	Red Knob			
500	60	80	80	81.7	± 3	_____
1000	70	80	80	88.7	± 3	_____
2000	70	90	90	94.9	± 3	_____
4000	70	80	80	82.0	± 3	_____

Note: Each field calibrator (C, D, and E) has the same expected readings for these masking generator signals.

\_\_\_\_\_  
Technician

ENVIRONMENTAL NOISE SURVEY (HANES)

\_\_\_\_\_  
Date

\_\_\_\_\_  
Location

Band Center Frequency (Hz)	ANSI Max. Allowable Sound Pressure Level (dB) for no masking at audio zero	Band level dB/0.0002u bar	
		Air conditioning OFF	Air conditioning ON
31.5	(35)	_____	_____
63	(35)	_____	_____
125	35	_____	_____
250	35	_____	_____
500	35	_____	_____
1000	35	_____	_____
2000	42	_____	_____
4000	52	_____	_____
8000	62	_____	_____

Comments: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

\_\_\_\_\_  
Technician

Field Calibration of Earphones  
For audiometer No. \_\_\_\_\_ Caravan \_\_\_\_\_

\_\_\_\_\_ Date\_\_\_\_\_ Location

"C" Calibrator

Audiometer 60 dB at Frequency	Setting for		Expected Reading "A" Slow	ANSI intensity tolerance	Actual Reading	
	Black knob	Red circle			Right	Left
500	70	60	67.75	± 3 dB		
1000	70	60	66.25	± 3 dB		
2000	70	60	69.75	± 3 dB		
4000	70	70	74.75	± 4 dB		

"D" Calibrator

Audiometer 60 dB at Frequency	Setting for		Expected Reading "A" Slow	ANSI intensity tolerance	Actual Reading	
	Black knob	Red circle			Right	Left
500	70	60	67.25	± 3 dB		
1000	70	60	66.00	± 3 dB		
2000	70	60	69.50	± 3 dB		
4000	70	70	75.00	± 4 dB		

"E" Calibrator

Audiometer 60 dB at Frequency	Setting for		Expected Reading "A" Slow	ANSI intensity tolerance	Actual Reading	
	Black knob	Red circle			Right	Left
500	70	60	67.50	± 3 dB		
1000	70	60	66.00	± 3 dB		
2000	70	60	69.25	± 3 dB		
4000	70	70	74.50	± 4 dB		

\_\_\_\_\_ Technician

# CHAPTER 14

## BODY MEASUREMENTS

### Equipment

Anthropometer parts: 2 sets of four sections each, 4 sliding arms, 1 circular metal base  
Body measurement table  
Footstool  
Sliding calipers  
Skinfold calipers  
Steel tape  
Special height scale  
Polaroid land camera  
Special light attachment for camera  
Self-balancing weight scale  
Set of weights for calibration of weight scale (one 25-lb. weight and five 50-lb. weights).

### General

Two anthropometers are provided, one as a spare. Each anthropometer consists of a rod in four sections with two caliper arms. One of the arms is fixed to the top end of the instrument; the other slides. The lower two sections are used for sitting heights and will be mounted in the circular metal base. The top section is used for bitrochanteric breadth. The remaining section can be used when required for measuring sitting heights of large examinees. The sliding calipers used to measure elbow breadth may become too loose, if so, use candle wax to tighten them.

With these anthropometers there are three sources of error which must be checked daily. The chief technician should see that:

1. The anthropometer numbers read in the proper sequence and the movable arms slide freely without slipping;
2. When mounted in the base, the instrument stands vertically without support; and
3. The bottom end of the anthropometer is perfectly flush with the under-surface of the metal stand. (Do not handle anthropometers by the upper ends alone as this tends to wrench them from their bases.)

## Measuring and Recording

The examiner takes each measurement and says it to the recorder. The recorder repeats the number, records it in the proper space, and says the name of the next measurement. The examiner should keep the measuring instrument set until the recorder repeats the number. If the anthropometer becomes unset in any way before the measurement is read back, the measurement should be made again. On standing measurements the recorder will insure that the subject stands erect. For the standing height measurement, the recorder should check the height photo to be sure of the accuracy of the technician's reading.

A recorder is important because he helps insure the accurate recording of the measurement while also helping the examiner position the examinee correctly. The recorder also assists the examiner by seeing that the steel tape is horizontal with proper tension when girths are measured. The recorder, having had the same training as the examiner, should recognize an error in measurement or in reading from the wrong scale. (The anthropometer has two scales—ascending and descending.) When he does see an error he should call it to the examiner's attention and have the mistake corrected.

All measurements are to be taken to the nearest tenth of a centimeter, except skinfolds which are to be taken to the nearest half of a millimeter. If the digit to the right of the last digit to be recorded appears to be exactly 5, the last digit to be recorded should be raised one unit if it is odd, or should stay unchanged if it is even. If a skinfold is too tight to be measured, write "too tight" in the recording space for that measurement (but, do try to get the subject to relax for the measurement).

The original examiner and recorder will complete an examination once it is started.

The measurements taken consist of various heights, breadths, girths, and skinfolds. All are to be taken on the *right side of the body* if possible. When any of the measurements cannot be taken on the right side because of casts, amputations, or any other reasons, these particular measurements should be made on the left side and the reasons noted on the recording page.

When the examinee's sample number ends in "3" or "6," four of the measurements are to be taken on the left side as well as the right side unless there is some reason it is impossible to take them on the left side. In this instance, again, the reason not taken should be noted on the body measurement page.

## Procedure

Record on the control record the examiner number and the time the procedure begins. Record on the body measurements form the examiner and recorder numbers.

Have the examinee stand with his feet together in the standard erect position for the following six measurements.

1. *Bitrochanteric breadth*.—With the top section of the anthropometer measure to the nearest 0.1 cm. the maximum breadth of the body at the level of the greater femoral trochanters. *Compress the soft tissue over the trochanters as much as possible.*
2. *Elbow breadth*.—Have the examinee extend his right arm forward until it is perpendicular to his body. Bend the arm so the angle at the elbow forms  $90^{\circ}$  with the fingers pointing up and the dorsal part of the wrist toward the examiner. With the sliding caliper along the axis of the upper arm, measure to the nearest 0.1 cm. *the greatest breadth across the elbow joint.* This is a bone to bone measurement across the epicondyles of the humerus. Be careful that the caliper does not slide off the epicondyles.
3. *Upper arm girth*.—With the examinee's right arm flexed  $90^{\circ}$  at the elbow, use the steel tape to measure to the nearest 0.1 cm. the distance from the outer edge of the acromial process to the olecranon process of the ulna. Mark the outer edge of the acromial process first, then place the tape on the mark, and locate the midpoint between the acromial and olecranon processes. Mark this midpoint carefully. This is the level at which both the arm girth and triceps skinfold are measured.

4. *Chest circumferences.*—These chest girths, which are done using the narrow, flexible nonstretch tape, are measurements of the bony rib cage, not tissue measurements. The measurements are made at *the level of the fourth intercostal space*. To find this level palpate the sternal manubrial junction which is at the level of the second intercostal space. Count down two intercostal spaces from this point to the fourth intercostal space. Pass the tape around the examinee's chest at this level. Smooth down the examination gown so that there are no folds or knotted-up areas. Then take the measurements to the nearest 0.1 cm, as follows:
  - A. *Full expiration.*—Ask the examinee to take in a deep breath and then let all his air out (coach him to really get it all out). Take the measurement with enough tension on the tape to depress the gown and the tissue.
  - B. *Full inspiration.*—Ask the examinee to take in a great big deep breath. Take the measurement with the same amount of tension on the tape as in the expiration measurement.
5. *Triceps skinfold.*—Have the examinee relax his shoulder and let his arm hang freely at his side. *Mark a point on the right mid-triceps in the same plane as the midhumeral point used for the upper arm girth and perpendicular to the olecranon process of the ulna.* Grasp the skin and subcutaneous tissue firmly with thumb and forefinger approximately 1 cm. above this level and draw directly back from the body *making sure that no muscle tissue is included in the fold.* The crest of the fold should be parallel to the long axis of the arm. Apply the calipers at the level of the point marked above and measure the fold to the nearest  $\frac{1}{2}$  mm. *without releasing the fingers.* Take a second measurement; if the two disagree, continue taking measurements until you get two that agree to within 1 mm.
6. *Subscapular skinfold.*—Have the examinee relax his shoulders and arms. Palpate the inferior angle of the scapula. Grasp a fold of skin and subcutaneous tissue directly above the angle firmly with the thumb and forefinger and draw straight back from the body making sure that no muscle tissue is included in the fold. *The fold should parallel natural cleavage lines of the skin* which are often lines about 45° from the horizontal extending medially upward. Apply the calipers

about 1 cm. below the thumb and forefinger and measure the fold to the nearest  $\frac{1}{2}$  mm. without releasing the fingers. Take a second measurement; if the two disagree, continue taking measurements until two agree to within 1 mm.

7. *Sitting height.*—Have the examinee sit *erectly* on the measuring table with his eyes straight ahead and the infraorbital meatal line parallel to the table top (i.e., eyes in horizontal plane looking straight ahead). The examinee should sit as far back on the table as he can so that the backs of his knee joints (popliteal fossae) are at the front edge of the table. *Check with the recorder on the examinee's position before making the measurement.* Then bring the caliper arm down *firmly* against the midline of the examinee's head. (Note: You might have to compress some hairstyles.) Take the measurement to the nearest 0.1 cm. *with your eyes at the same level as the caliper arm.* Do not make the reading at an angle. *Shorter technicians should use the stool available in the measuring room as an aid.*
8. When measurements are taken on both sides of the body, ask the examinee whether he is right-handed or left-handed and record his answer by checking the appropriate box. If both sides aren't measured, check the "not applicable" box.
9. Weight

A. Examinees who weigh 250 pounds or less:

- (1) Ask the examinee to stand still on the scale (in slippers).
- (2) *Wait until the scale pointer stops moving.*
- (3) Insert the bottom of the body measurement page on the case record in the slot at the front of the scale's printer.
- (4) Depress the bar on the front of the printer to record the weight on the record to the nearest quarter of a pound.
- (5) Check to be sure that the recorded weight is legible.
- (6) Record weight on the body measurement form in the space provided (Item 9) near the bottom of the form. Always record the weight in five digits, fill in the blank spaces with zeroes as appropriate, e.g., 98.5 should be entered as 098.50.

B. Examinees who weigh more than 250 pounds:

Since the scale printer will only print to 250 pounds, the follow-

ing procedure must be followed if an examinee weighs more than 250 pounds:

- (1) If the examinee weighs more than 250 pounds, but no more than 350 pounds:
  - (a) Move the bottom weight on the notched bar on the front of the scale to 100 pounds (far right);
  - (b) Weigh the examinee and stamp his case record just as though he weighed less than 250 pounds;
  - (c) Add 100 pounds to the stamped weight total on the body measurement page; and then
  - (d) Record the total weight (stamped weight plus 100 pounds) in the proper space on the body measurement page.
  
- (2) If the examinee weighs more than 350 pounds, but no more than 400 pounds:
  - (a) Move the bottom weight on the notched bar to 100 pounds;
  - (b) Move the top weight on the numbered bar to 50 pounds (far right);
  - (c) Weigh the examinee and stamp his case record just as though he weighed less than 250 pounds;
  - (d) Add 150 pounds to the stamped weight total on the body measurement page; and then
  - (e) Record the total weight (stamped weight plus 150 pounds) in the proper space on the body measurement page.
  
- (3) If the examinee weighs more than 400 pounds, ask him to estimate his weight.

10. Height *according to Bob Malina, examinees were instructed to do gentle upward stretching.*
- A. Have the examinee stand with his back and heels against the upright bar of the weight scale, erect ("Stand up tall" or "Stand up straight") and with feet together and head in the Frankfort Horizontal Plane ("Look straight ahead").
  - B. Bring the horizontal bar down snugly to the examinee's head.

- C. Stick one of the case number labels next to the tape on the upright bar so the number label can be read when the height scale is photographed.
- D. Photograph the height measurement and ask the examinee to step aside.
- E. Process the film and place the case number label from the height scale on the photo. Do not cover up the scale or the photographed case number.
- F. Record the standing height on the body measurement form as read from the photograph in the space provided (Item 10). This should be recorded in four digits to the nearest mm. (0.1 of cm.) from the metric scale. If there are less than four digits, fill in the blank spaces with zeroes as appropriate, e.g., 99.0 should be 099.0. When the measurement is exactly at the half-way point between 2 mm., round up if the preceding whole number is odd and round down if the preceding whole number is even.

## Field Checks

1. *Calipers.* --Calipers must be checked before each stand and once a week during the stand against a metric tape. *The skinfold caliper should be checked daily before use.* To do this place the standards between caliper arms and see that the reading on the scale is corrected according to the length of the standard. If the calipers are not right, adjust them by pressing firmly on the arms.
2. *Height.* --At the beginning and end of each stand, checks should be made to assure that:
  - A. The upright bar and tape measure have not been changed or damaged. Check the accuracy of the tape with the sitting height anthropometer. Set the sitting height anthropometer at about the middle of the height scale base. Turn the movable anthropometer's caliper arm upside down. Take the picture of the height measurement. Read the anthropometer measurement the same way as for sitting height and record the reading on the back of the photograph. Send the photograph to the Chief, Quality Control Section, Headquarters. The photograph should include the stand number and

location, date, number of person who checked the scale, anthropometer reading, and whether it was the beginning or end of the stand. If the measurement does not agree with the sitting height anthropometer, adjust the sighting window until the measurement does agree with the sitting height anthropometer setting. Take a picture after the adjustment and send the photograph to Headquarters.

B. The horizontal bar is firmly attached to the upright section that slides on the upright bar.

C. The camera and light are working to produce optimum photos. Any necessary repairs and adjustments should be made as soon as possible. This equipment is the only means we have for measuring height.

3. *Weight.*—At the beginning of each stand before the examinations begin and again at the end of the stand, the scale should be calibrated at zero and at intervals of 25 pounds all the way up to 250 pounds. If the scale is out of calibration by a constant amount at all calibration weights, correct the error with the adjustment knob on the left side of the scale. If the trailer is not level the scale will have to be zeroed. If adjusted to lower than 0.00 it will read E.EE; but when adjusted correctly it will read 0.00. After zeroing the scale properly, stamp zero on any ordinary sheet of 8 x 10½ paper. Then weigh the calibration weights in increments of 25 pounds, starting with 25 pounds and going up to 250 pounds, stamping each weight on the paper. Altogether, 11 recordings should be made on the paper. The paper with the recorded weights should also include the stand number and location, date, the number of the person doing the check procedure, and whether it was the beginning or end of the stand.

The recording should be mailed immediately to the Chief, Quality Control Section, Headquarters.

The ribbon for printing the weight will need occasional replacement (approximately every 6 months). When the printing starts getting dim call a Toledo Scales dealer for replacement ribbon.

At the end of each stand, turn the scale lock to a vertical position for transit.

4. *Cleaning of equipment.*—At the beginning of each stand the anthropometer, calipers, and tape measures should be cleaned with vinegar.

## Replicates

An intertechnician body measurement replicate is to be done every fourth session on the examinee who arrives first at the exam center. The sessions on which replicates are to be done are shown on the Schedule Sheet.

For the sessions during which a replicate is to be done, the coordinator should write the examinee's sample number in the appropriate space on the Schedule Sheet and should assign the original body measurements on that examinee to a technician according to the usual flow system rules. She should assign the replicate measurements in a *random* way to one of the other three technicians and write that technician's number in the appropriate space on the Schedule Sheet.

# CHAPTER 15

## QUESTIONNAIRES

### General

Within the block of time given to the two questionnaires, the Health Care Needs (HCN) form is to be administered before the General Well-Being (GWB). The HCN is entirely interviewer-administered while the GWB is self-administered most of the time. Thus the technician usually can leave the interview room after he has given the GWB form to the examinee along with the instructions for filling it out. Then the technician is free to be assigned to another examinee. After the GWB is completed, the examinee returns the form to the coordinator and can be assigned to another part of the examination.

### Health Care Needs Questionnaire

#### 1. Procedure

Fill in name, sample number, segment, serial, and column numbers. Read the instructions at the top of the form to the examinee. Then ask each question as it is written and check the appropriate box. If an error is made, circle the incorrect response and check the correct box. If the examinee doesn't understand a question, reread the question in order to obtain the best possible answer for each of the answer categories.

#### 2. Guidelines for specific items

*Question 1:* If the examinee has never seen a doctor, ('never' to each of the code designations 001-009) skip to question 9 and put NA on questions

2 through 3. There should be an entry in a box for every code designation, 001-009, in this question. The sense of the question may be gotten by asking, "Did you ever talk to a doctor about your own health at a private doctor's office, etc.?" If the answer is "yes," how long ago was it? If "no," check the "Never" box. Continue down the rest of the code designations. A city clinic refers to a public clinic run by a municipality or town. An example would be a public health clinic run by New York City or Philadelphia. Clinics run by labor unions or health maintenance organizations such as Kaiser Permanente would be examples of other kinds of clinics. Most group practice doctors can be considered as private doctors.

*Question 2:* An entry should be made in code box 1 if the examinee went to the physician for a sickness or illness. Symptoms such as headache, dizziness, etc., should be included in this group even though no precise diagnostic information is available. When asking for what the problem is, try to get the best possible description since this material is being coded. A followup visit is any visit in which the patient has been asked to come in as a consequence of a previous visit. For example, a removal of stitches following minor surgery would be a followup visit. A visit regularly scheduled at some interval following some long-term condition would be a regular checkup visit.

*Question 3a:* If this visit was scheduled previously by a doctor (for example a followup visit) the time of decision is the time of recommendation by the doctor. A house call by a physician is *not* considered to be a visit with a doctor. Information should be obtained on the last visit to a doctor in some sort of medical installation (office, hospital, clinic, etc.,) outside of the examinee's home.

*Question 3c:* The time of appointment is the time the examinee's name was actually put down in the appointment book.

*Question 7a:* Give the time in minutes. An entry of a "few" minutes is not acceptable. If the time is approximate, estimate in minutes. Waiting time is the time of entry until the time a doctor is seen. If the examinee says she didn't have to wait, enter three zeros beside code 018 for minutes.

*Question 9b:* There should be an entry in every code designation, 022-030. Give as much description as possible if 030 is "yes." Ask in all cases if there were any other reasons for not seeing a physician.

*Question 10:* General checkup includes physical exam and any other procedures such as cardiogram, etc.

*Question 11:* Hospital clinic includes general outpatient clinic and speciality clinics. See comments on question 1 for the definitions of doctor's office and other clinics.

*Question 12:* For code 041, for males only, don't ask but check the "not applicable" box.

*Question 13a:* What we are interested in here are immunizations, not injections with antibiotics or vitamins.

*Question 13b:* Possible "other" reasons for getting this shot should include: (1) immunization required for school attendance, (2) immunization required for employment, (3) compulsory immunization for any other purpose such as immigration, (4) immunizations recommended by physician or nurse, (5) immunizations sought for by examinee without prior recommendation by physician or nurse (obtained from any medical facility) but not part of an organized immunization campaign, and (6) any other reason—specify.

*Question 15:* If the examinee's doctor requires an appointment to be seen, the answer is yes. On the other hand if the doctor may make appointments but still lets patients in without appointments (after waiting) for nonemergency visits, the answer is no.

*Question 17:* A "sometimes" answer is counted as "yes."

*Question 20:* Follow the same procedure as in question 1. If code designations 051 through 056 are all coded "never," put NA on questions 21 through 28 and skip to question 29.

*Question 21:* Try to be as specific as possible for "other reason." Complete only *one* box since "main" reason means one reason.

*Question 22:* If the visit was scheduled by the dentist (e.g., 6 months checkup) the time of decision is the time of recommendation by the dentist.

*Question 23b:* Appointments date from the time the examinee's name is actually on appointment book. If the examinee has regular dental visits every 6 months, do not check 3 months or more unless appointment was actually made then.

*Question 26a:* Use the same guidelines as question 7a. It is a common practice for dental aides to have patients wait in the dental chair for the dentist. If no actual work is done by the aide on the patient this time should be included in dental waiting time.

*Question 28:* Give the actual practice of the dentist or dental clinic question 29b. There must be entries in all code designations 69-75. If "some other reason" is given, ask specifically what it is. Fear of being hurt is probably behind a large percentage of the other reason category. Please write in the reason.

*Question 33a:* Try to be as specific as possible for this question. Diagnostic information is important if available.

*Questions 34 and 35:* These refer to the last hospital visit.

*Questions 36a, 37a, and 38a:* The word "usually" should have been in all three questions. The time frame for this question may be for the past several years if there has been no recent change in medical insurance or medical care coverage.

*Question 39:* This is a global estimate. To answer it accurately would require income tax type accounting. Again the time frame may be for several years if there has been no recent change in medical insurance or medical care coverage.

All code designations 090-097, must have entries in them. Codes 098-105 must have entries for each "yes" in 090-097.

# General Well-Being Questionnaire

## 1. Purpose

The General Well-Being questionnaire was developed to obtain information to serve the following purposes:

- A. To serve as a "moderator variable" or control in the statistical assessment of medical needs. The assumption is that people who are emotionally disturbed may have more complaints about unmet medical needs and of medical services actually rendered.
- B. To collect information on psychologic services needed and prevalence of use of some services as indicated in questions 19-25.
- C. To serve as an indicator of overall adjustment (questions 1-18).
- D. To provide some differential indicators or subscales of adjustment as follows (questions 1-18):

Worry or concern about health (questions 10, 15)

Energy level (questions 9, 14, 17)

Satisfied, interesting life (questions 6, 11)

Mood—cheerful vs. depressed (questions 1, 4, 12, 18)

Emotional stability and control (questions 3, 7, 13)

Tension (questions 2, 5, 8, 16)

- E. To provide a current status index (during the past week) of depressed mood state (questions 26-45).

## 2. Approach

The General Well-Being questionnaire was designed to be essentially self-administered, however, about 20-40 percent of the examinees will need help in reading the questions and following the instructions. It is essential that we obtain what the individual says about himself (or how he represents himself), not our judgment or evaluation of what we think he should say. Do not "put words" in the examinee's mouth. Let him represent himself. Your role is to help him accurately reflect what he wants to convey.

## 3. Procedures

- A. Present the GWB by reading or paraphrasing the blocked in sentence on the first page while handing the examinee the form. Ask him to go ahead and fill it out while you observe.

Should it become apparent that help is needed in reading or understanding it, say something like "If you like I will read it as you fill it out." Leave his form in front of him while you read from another form. Read back the questions and the response options if needed in a slow modulated tone. If he doesn't seem to understand, repeat slowly. Let him check his own answers if possible, if not you may check in front of him his verbal responses. Try not in any case to influence his answer choices.

- B. In some cases you may have to translate, paraphrase, or rephrase a given question. If so, stick as close to the meaning of the question as possible. However, do not use key words from other questions! See the Glossary for some examples.
- C. Do not unduly "hurry" the examinee—give him time to think.
- D. After the form is completed, check to see that every question is answered and there is only one response per question except questions 20-23. If not, call his attention to the question and try to get a proper response. On the rating bar questions, 15-18, note to insure that he understands what is needed. Watch out for responses only at the ends of the bars. Have him circle a number which best represents his feelings.
- E. If the response to a question seems unreasonable or inconsistent during review, gently call his attention to the question and ask "Did you mean to answer like this?"
- F. If "yes" is checked to any of questions 19-23 try to verify that "yes" is what the examinee meant to check. You may say, gently, "I see you checked 'yes' to question(s) X, is that what you meant to check?" On questions 20-23 if both the first and second boxes are checked, circle the second box so that only the entry in the first box will be recorded on tape.
- G. When the interview is completed, fill out the last line on the form. Check "examinee" if he filled it out with only little or no guidance, "interviewer" if basically read by the interviewer, "mixed" if considerable help and guidance was needed.
- H. If the examinee does not fill out or complete the GWB, send in the form to Headquarters with comments about why not. If the examinee is too mentally or emotionally disturbed or is incapable, at least try to obtain information on questions 19-25.
- I. Completing the Examiner Observation Sheet

(1) Circle the code which best describes your observations.

- a. In case two or more codes are applicable (in A-E) circle the code with the lowest numerical value. Thus if under A codes 1, 2, 3, are equally applicable circle code 1 and make notations under "comments" about the other applicable codes.
- b. The expected normal codes are:

A: \*7

B: \*12

C: \*9

D: \*8 NOTE: Code 9 is an exception code.

E: \*9

Exceptions to these codes require your careful consideration and should be based on fairly evident indications for an exception code.

- c. Where the "other" indication is used circle the applicable code: (A) -6, (B) -11, (C) -8, (D) -7, and (E) -8. Then in the space provided describe the specific observations leading to this qualification.

- (2) Enter your examiner number as item 48, GWB examiner number.
- (3) If a different technician does the technician block, have him complete item 49 - C, D, E, and item 50, his examiner number.
- (4) Never fill out the Examiner Observation Sheet in front of an examinee.

J. Since every GWB form will be reviewed, please feel free to make any comments or observations (beyond what is required) including impressions or indications of good adjustment as well as limitations or signs of distress on the Examiner Observation Sheet.

K. Always see that extra copies of the GWB and observation sheets are available for your use should something go amiss with the copy that is provided for each examinee.

4. Responsibilities for completing the GWB and Examiner Observation Sheet
  - A. Health technicians will normally be responsible for administering the GWB and complying with all instructions A-J under Section 3, Procedures.
  - B. However, if the health technician is reassigned to another examination before the GWB is completed then the coordinator will see that all instructions under Section 3, Procedures, are followed, including the completion of items 47 and 48 on the Examiner Observation Sheet.
  - C. When the tech block and GWB are done by different technicians the technician who does the technician block should complete item 49, C, D, E, and item 50.
  - D. Technician B is responsible for reviewing each GWB questionnaire and Examiner Observation Sheet to see that they have been filled out properly and to staple each Examiner Observation Sheet to its corresponding GWB.

## 5. Glossary

This glossary has been prepared to provide analogous words, expressions, or paraphrases for use with examinees who have difficulty in comprehending some of the key words or phrases in the GWB. Sometimes it is sufficient to simply repeat (or read) the question slowly and carefully, or to change the word order in the question or responses.

### A. General words or terms

*in general (during the past month):*

the most usual or common; the prevailing or dominant state, or that state most noticed by the individual.

*bothered by:*

troubled, disturbed, annoyed, irked, vexed, interfering

*feelings and emotions:*

bodily reactions and sensations. Usually experienced as pleasurable or painful such as joy, elation, love, happiness, satisfaction or fear, pain, rage, or grief.

*behavior:*

physical, verbal, or social acts or conduct

*thoughts:*

mental processes, content, or ideas. Includes memory or recollections, attention, intentions, concepts, opinions, and beliefs.

B. Specific words or phrases (by question number)

1. Good spirits: lively, vigorous  
Low spirits: sluggish, dull
3. Thoughts/feelings: "Are you able to manage your thoughts, behavior, or feelings as you intended to? Plan and do things as you want to? Not get angry or hurt over little things?"
6. Personal life includes work, money, relations with family members, other relatives, friends, and hopes and ambitions.
13. "Are you generally calm and self-confident or do you get easily disturbed; have ups and downs in mood a lot; bothered by self-doubts or lack of assurance?"
15. "Do you worry about your health at all?" If yes, "How concerned or worried are you?"
16. "Are you generally relaxed, at ease; or do you feel all keyed-up, high strung, tense?"
17. "Do you generally feel just full of energy and life, active; or do you feel all drained out, listless, lifeless?"
18. "Do you generally feel cheerful, lighthearted, carefree; or very depressed, miserable?"
24. "Have you talked about any mental or emotional problems, worries or 'nerves' you may have had with:\_\_\_\_\_?"  
(Remember - During the past year concerning the S.P.)

# CHAPTER 16

## DISTANCE VISION TESTING

### Equipment

Goodlite transilluminated wall charts with Sloan letters  
Eye cover

### Procedure

1. Before testing.
  - A. Have the examinee stand in the X-ray room 20 feet away from the wall charts.
  - B. Pull the curtain in the doorway between Trailers 2 and 3.  
Turn out the lights in the X-ray room and the hallway outside the X-ray room.
2. Marking the vision test form
  - A. Be sure the examinee's name, age, sex, and sample number are entered correctly on the form.
  - B. Check the appropriate box in Section 1 of the form indicating whether or not the examinee is wearing corrective lenses for the test.
  - C. Draw diagonal lines through the letters missed by the examinee. Draw horizontal lines through sections of the lines of letters not attempted and through the top full line not attempted.
  - D. After each part of the test, binocular without correction, binocular with correction, and left and right monocular with correction; check the box that indicates the smallest line of letters correctly read by the examinee.

### 3. Testing procedure

#### A. Binocular vision without correction.

- (1) If the examinee wears glasses or contact lenses, ask him to remove them.
- (2) Have him read the 20/30 line with both eyes. If he makes two errors or fewer, ask him to read the 20/25 line. If he makes two errors or fewer on that line have him continue reading successively smaller lines until he makes more than the allowable number of errors for any line or until he has read the smallest line of letters. (The allowable number of errors for each line is shown on the vision test form.) ✓

If he cannot acceptably read the 20/30 line, try the 20/80 line. If that is successful, continue with successively smaller lines until he makes more than the allowable number of errors.

If the 20/80 line is not read correctly, try the 20/200 line. If it is read correctly, proceed with successively smaller lines as before until the examinee makes more than the allowable number of errors.

If he cannot read the 20/200 line ask him to move up to a point 10 feet away from the chart and try to read the line. If he can, check the box that indicates 20/400 vision. If he cannot read it, draw a diagonal line through the "K," but do not check a box to indicate the smallest line read. Check the "test unsatisfactory" box at the bottom of the page and write in after "specify" that the examinee had vision worse than 20/400.

#### B. Binocular vision with correction.

- (1) If the examinee does not wear corrective lenses draw a large "X" through the "with correction" section of the form and go on to test monocular vision.
- (2) If the examinee wears corrective lenses (other than for near vision) ask him to put them on. Then test binocular vision with correction in the same way as binocular vision without correction.

### C. Monocular vision with usual correction.

- (1) If the examinee's sample number is odd, ask him to cover his right eye with the eye cover. Test the left eye with its usual correction in the same way as before. Then have him cover the left eye while you test the right eye.
- (2) If the examinee's sample number is even, ask him to cover his left eye. Test the right eye with its usual correction in the same way as before. Then have him cover the right eye while you test the left eye.

## 4. Special cases

### A. Blindness in one eye.

If an examinee is blind in one eye and wears no corrective lens on the other eye, use only that part of Section C of the form that applies to the good eye. Draw large "X's" through the three sections of the form not used. Check the "test unsatisfactory" box at the bottom of the page and write in the reason only one eye was tested.

If an examinee is blind in one eye and wears a corrective lens on the other eye (other than for near vision) test the eye both with and without the lens. Draw a large "X" through the section of the form not used for the blind eye, check the "test unsatisfactory" box, and write in the reason only one eye was tested.

### B. Blindness in both eyes.

Check the "test not done" box at the bottom of the page and write in the reason why.

# CHAPTER 17

## NEAR VISION TESTING

### Equipment

Keeney near vision test card  
Sloan reading cards  
Tape measure

### General

The near vision test, which is given by the nurse in the near vision testing room, is designed to measure vision problems people may have when reading ordinary types of reading material. Both the Keeney and Sloan vision tests are given to every examinee.

### Procedure

1. Before the test
  - A. Be sure the identifying information at the top of page 1 of the Vision Test form is filled in.
  - B. Have the examinee sit at the table so that his legs straddle the table leg and his head is directly underneath the space between the two fluorescent lights above.
  - C. See that he is wearing his corrective lenses if he has any.
  - D. Give him the Keeney Card and ask him to hold it in front of him at a comfortable reading distance either touching or not touching the table. Have him hold the card in his right hand if that is comfortable so that the distance from the card to the left eye can be

more easily measured. Explain to him that the object of the test is to see how good his eyesight is for reading not to see how well he can read. Tell him he should try to do his best in reading the selections and should read any part of the selection he can make out even if he can't see all of it. However, you should not ask him to make a do-or-die effort, for he probably would not make such an effort for ordinary reading.

## 2. Test using Keeney Card

- A. Ask the examinee to tell you the number of the selection with the smallest print he can read without any trouble. Then take the card from him.
- B. Ask him to read out loud the next larger selection still holding the card at a comfortable reading distance. Tell him that after he finishes reading the selection you are going to measure the distance between his eyes and the card and that he should try not to move either his head or the card until after the measurement. Then, show him with the tape measure how you are going to take the measurement.
- C. As the examinee reads the selection, draw a line through the correct words on the scoring sheet. A word should still be considered correct if it is mispronounced. If you are not sure how to score a word, ask the examinee to spell it. Words not attempted in a selection that was attempted are considered incorrect.
- D. When the examinee has read the last word of the selection, ask him again not to move his head or the card. Then measure the distance to the nearest centimeter from the card at the level of the selection read to the corner of the left eye. Record the distance on page 2 of the Vision Test form in Column C in the spaces corresponding to the Keeney selection read. If the number has only two digits, precede it with a zero. Then take the card from the examinee.
- E. Count the number of words read incorrectly or not read at all and record this number on page 2 of the Vision Test form in Column E in the appropriate spaces. If this number has only one digit, precede it with a zero. If no words are wrong, enter "00."
- F. Hand the Keeney Card back to the examinee and ask him to read out loud at a comfortable distance the next smaller selection on

the card. Again measure and record the distance between eyes and card, and record the number of words wrong in the appropriate spaces on the Vision Test form.

- G. Repeat the procedure until he has read the selection with the smallest print or until he says he can no longer read the printing.
- H. Check on page 2 of the Vision Test form in Column D the box that indicates the smallest selection "satisfactorily" read. Whether or not the reading was satisfactory does not necessarily depend on the number of words read correctly. The examiner must make a judgment that is based not only on accuracy but on the relative amount of time taken to read the selection and whether or not the sense of the selection was preserved. For example, an examinee may read a selection accurately but still not satisfactorily if he takes an excessive amount of time to read it. That is, if he makes a considerable effort to puzzle out each word (because of a near vision problem, not a reading difficulty), this should not be considered practical for ordinary reading.
- I. Make a check in Column B on page 2 of the Vision Test form in each box that corresponds to a selection that the examinee read or tried to read.

### 3. Test using Sloan reading cards

- A. Start the Sloan part of the test by asking the examinee to read aloud the selection on the card with printing one stage larger than that first read out loud on the Keeney Card. Use only the 20-foot equivalent notation, and determine which Sloan Card to present first according to the following table:

<i>Keeney selection</i>	<i>Sloan selection to be read first</i>
20/20	20/50
20/30	20/50
20/40	20/50
20/50	20/75
20/65	20/75
20/85	20/100
20/120	20/125
20/130	20/150

Ask him to read the selection aloud while holding the card at a comfortable reading distance. Measure the eye-to-card distance and record it and the number of words wrong the same as for the Keeney selections.

- B. Continue testing, measuring, and recording with the Sloan cards in exactly the same way as with the Keeney Card until the examinee has read the selection with the smallest print or until he says he can no longer read the printing.
  - C. If no Keeney selection was tried by the examinee, present to him the Sloan Card with the largest print. Ask if he can read it without any trouble. If so, present him cards with successively smaller print and ask each time if he can read the card without any trouble. When you have determined the card with the smallest print he can read without any trouble, start the Sloan testing with the card with the next larger sized print; and proceed from there according to the instructions already given.
4. After the test
- A. Check the appropriate box in Section 1 at the top of page 2 of the Vision Test form. If an examinee whose glasses are either lost or broken intends to replace them soon, check the "forgot" box. If he does not intend to replace the lost or broken glasses, check the "does not wear glasses or contact lenses" box.
  - B. If there is some condition that interfered with the test, check one of the boxes in Section 4 at the bottom of page 2; and describe the condition if necessary.
  - C. Be sure the examinee's name and sample number are entered on the scoring sheets; and keep them separate from the Vision Test form. At the end of each stand the scoring sheets should be sent to Headquarters, Collection and Analysis Linkage Section.

## Special Cases

### 1. Inability to read English

- A. Using page 3 of the Vision Test form, proceed to test with first the Keeney Card and then the appropriate Sloan cards the same as you

would with an examinee who can read English with the following exception. Instead of asking him to read selections, ask him to read the first and last letters of the first 8 words of the selections. Do not use the scoring sheets to indicate missed letters, but draw a diagonal line through each letter missed on page 3 of the Near Vision form. Draw a horizontal line through the parts of a line of letters not attempted and through the highest full line of letters not attempted.

- B. Measure and record the card-to-eye distances in the appropriate spaces of Column B on page 3 the same as you would with an examinee who read the words.
- C. Continue testing until the examinee has read the smallest letters or until he can no longer see the letters well enough to distinguish them.
- D. For both the Keeney and Sloan tests, check the box in Column E that indicates the smallest set of letters read with less than five errors made. Letters not attempted are considered to be errors.
- E. Check the box "cannot read English" in Section 4 on page 2 of the Vision Test form.

## 2. Illiteracy

- A. Using page 3 of the Vision Test form proceed to test with first the Keeney Card and then the appropriate Sloan cards the same way as you would with an examinee who couldn't speak English. However, if the examinee can't read the letters have him draw them out for you.
- B. Check the box "cannot read" in Section 4 on page 2 of the Vision Test form.

**April 1975**