DEVELOPMENT

This subcourse is approved for resident and correspondence course instruction. It reflects the current thought of the Academy of Health Sciences and conforms to printed Department of the Army doctrine as closely as currently possible. Development and progress render such doctrine continuously subject to change.

ADMINISTRATION

For comments or questions regarding enrollment, student records, or shipments, contact the Nonresident Instruction Section at DSN 471-5877, commercial (210) 221-5877, toll-free 1-800-344-2380; fax: 210-221-4012 or DSN 471-4012, e-mail accp@amedd.army.mil, or write to:

COMMANDER
AMEDDC&S
ATTN MCCS HSN
2105 11TH STREET SUITE 4192
FORT SAM HOUSTON TX 78234-5064

Approved students whose enrollments remain in good standing may apply to the Nonresident Instruction Section for subsequent courses by telephone, letter, or e-mail.

Be sure your social security number is on all correspondence sent to the Academy of Health Sciences.

CLARIFICATION OF TRAINING LITERATURE TERMINOLOGY

When used in this publication, words such as "he," "him," "his," and "men" are intended to include both the masculine and feminine genders, unless specifically stated otherwise or when obvious in context.

USE OF PROPRIETARY NAMES

The initial letters of the names of some products are capitalized in this subcourse. Such names are proprietary names, that is, brandnames or trademarks. Proprietary names have been used in this subcourse only to make it a more effective learning aid. The use of any name, proprietary or otherwise, should not be interpreted as an endorsement, deprecation, or criticism of a product. Nor should such use be considered to interpret the validity of proprietary rights in a name, whether it is registered or not.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Lesson</th>
<th>Paragraphs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1</strong></td>
<td><strong>ORIENTATION TO CENTRAL MATERIEL SERVICE</strong></td>
</tr>
<tr>
<td>Section I. Introduction</td>
<td>1-1 - 1-4</td>
</tr>
<tr>
<td>Section II. Personnel</td>
<td>1-5 - 1-13</td>
</tr>
<tr>
<td>Section III. Definitions</td>
<td>1-14 - 1-16</td>
</tr>
<tr>
<td>Section IV. Principles of Sterile Technique</td>
<td>1-17 - 1-19</td>
</tr>
<tr>
<td>Exercises</td>
<td></td>
</tr>
<tr>
<td><strong>2</strong></td>
<td><strong>SERVICES OF CENTRAL MATERIEL SERVICES</strong></td>
</tr>
<tr>
<td>Section I. Services and Policies</td>
<td>2-1 - 2-2</td>
</tr>
<tr>
<td>Section II. Placement and Sequence</td>
<td>2-3 - 2-4</td>
</tr>
<tr>
<td>Section III. Moving Supplies and Equipment</td>
<td>2-5 - 2-6</td>
</tr>
<tr>
<td>Section IV. CMS Supplies and Equipment</td>
<td>2-7 - 2-8</td>
</tr>
<tr>
<td>Section V. Maintenance and Cleanliness(Housekeeping)</td>
<td>2-9 - 2-10</td>
</tr>
<tr>
<td>Section VI. Safety and Accident Prevention</td>
<td>2-11 - 2-12</td>
</tr>
<tr>
<td>Exercises</td>
<td></td>
</tr>
<tr>
<td><strong>3</strong></td>
<td><strong>STERILIZATION AND DISINFECTION</strong></td>
</tr>
<tr>
<td>Section I. General</td>
<td>3-1 - 3-3</td>
</tr>
<tr>
<td>Section II. Processing - Collection to Sterilization</td>
<td>3-4 - 3-10</td>
</tr>
<tr>
<td>Section III. Processing - Sterilization to Storage</td>
<td>3-11 - 3-16</td>
</tr>
<tr>
<td>Section IV. Chemical Disinfection</td>
<td>3-17 - 3-18</td>
</tr>
<tr>
<td>Exercises</td>
<td></td>
</tr>
<tr>
<td><strong>4</strong></td>
<td><strong>PREPARATION OF SUPPLIES AND EQUIPMENT</strong></td>
</tr>
<tr>
<td>Section I. Trays</td>
<td>4-1 - 4-2</td>
</tr>
<tr>
<td>Section II. Portable Equipment</td>
<td>4-3 - 4-4</td>
</tr>
<tr>
<td>Exercises</td>
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INTRODUCTION

The many exacting techniques and procedures that you must know and practice in your assignment to the Central Materiel Service contribute directly to safeguarding the lives of patients throughout the hospital. You will be entrusted with the processing of both sterile and nonsterile items used in the treatment of patients. You must perform your assigned duties with unflagging attention to the task at hand in order that no patient will be subjected to the danger of infection or injury because of incorrectly processed goods. The purpose of this subcourse is to familiarize you with the overall operation of a centralized materiel service, and especially with the duties of the operating room specialist assigned to CMS in the principles as well as safe procedures and techniques in the processing of both sterile and nonsterile items.

Subcourse Components:

The subcourse instructional material consists of the following:

- Universal Body Substance Precautions
- Lesson 1, Orientation to Central Materiel Service.
- Lesson 2, Services of Central Materiel Services.
- Lesson 3, Sterilization and Disinfection.
- Lesson 4, Preparation of Supplies and Equipment.

Credit Awarded:

To receive credit hours, you must be officially enrolled and complete an examination furnished by the Nonresident Instruction Section at Fort Sam Houston, Texas. Upon successful completion of the examination for this subcourse, you will be awarded 14 credit hours.

You can enroll by going to the web site http://atrrs.army.mil and enrolling under "Self Development" (School Code 555).

A listing of correspondence courses and subcourses available through the Nonresident Instruction Section is found in Chapter 4 of DA Pamphlet 350-59, Army Correspondence Course Program Catalog. The DA PAM is available at the following website: http://www.usapa.army.mil/pdffiles/p350-59.pdf.
UNIVERSAL BODY SUBSTANCE PRECAUTIONS

Prevention of Transmission of Human Immunodeficiency Virus, and Other Blood-Borne Pathogens in Health Care Settings

Only blood, semen, vaginal secretions, and possibly breast milk have been implicated in transmission of human immunodeficiency virus (HIV), hepatitis B virus (HBV), and other blood-borne pathogens.

Blood is the single most important source of transmission of blood-borne pathogens in health care settings. Infection control efforts must focus on preventing exposures to blood.

Although the risk is unknown, universal precautions also apply to tissues and to cerebrospinal fluid, synovial fluid, pleural fluid, peritoneal fluid, and amniotic fluid.

Universal precautions do not apply to feces, nasal secretions, sputum, sweat, tears, urine, and vomitus unless they contain visible blood. Although universal precautions do not apply to these body substances, the wise nurse wears gloves for protection from other infections.

Precautions are used for all patients. (Reason: It is impossible to know which patients are infected with such conditions as HIV, HBV, or other infectious agents.)

Gloves are worn whenever the health care worker may come in contact with blood, body fluids containing blood, and other body fluids to which universal precautions apply. (Reason: Diseases can be carried in the body substances.)

Wear gloves at all times if you have any break in the skin of your hands. If you have an exudative condition, such as weeping dermatitis, you must be evaluated before working with patients and patient care equipment. (Reason: You may be at great risk of contracting a disease; you might also spread disease.)

Change gloves after each contact with a client. (Reason: The gloves may be contaminated.)

Wash your hands and skin surfaces immediately and thoroughly if they are contaminated with blood or body fluids. (Reason: Proper washing will help to stop the spread of infection.)

Wear a gown or apron when clothing could become soiled. (Reason: To prevent spread of infection to yourself or others.)
Wear a mask and eye protection if splashing is possible. Hospital protocol will determine what type of eye protection is required for each specific case.  
(Reason: Infection could enter your body through the mucous membranes of your mouth or nose or through your eyes.)

Dispose of sharp objects carefully.  do not recap or break needles. Needles and sharp objects are placed in a special container after use.  
(Reason: There is a possibility of accidental finger stick. It is important to protect yourself and housekeeping personnel.)

If you have an on-the-job accident that causes a break in the skin, notify your nursing supervisor immediately.  
(Reason: Immediate precautions must be taken to protect you.)

Special care is taken of a deceased patient's body.  
(Reason: To prevent leakage of body substances. It is safer to assume that all patients are infectious.)

All health care workers who perform or assist in vaginal or cesarean delivery should wear gloves and gowns when handling the placenta or the infant until blood and amniotic fluid have been removed from the infant's skin. Gloves should be worn until after postdelivery care of the umbilical cord.

Pregnant health care workers are not known to be at greater risk of contracting HIV infection than health care workers who are not pregnant; however, if a health care worker develops HIV infection during pregnancy, the infant is at risk. Because of this risk, pregnant health care workers should be especially familiar with and strictly adhere to precautions to minimize the risk of HIV transmission.

LESSON ASSIGNMENT

LESSON 1  Orientation to Central Materiel Service.

LESSON ASSIGNMENT  Paragraphs 1-1 through 1-19.

LESSON OBJECTIVES  After completing this lesson, you should be able to:

1-1.  Select the services provided by the central materiel service (CMS).

1-2.  Select the advantages of a central materiel service.

1-3.  Select the duties performed by a central materiel service specialist.

1-4.  Select the description of a properly attired central materiel service worker as described in this course.

1-5.  Select specific terms and definitions that are related to central materiel service and surgery.

1-6.  Select controls that make up a good infection control program.

SUGGESTION  After reading and studying the assignment, complete the exercises at the end of this lesson. These exercises will help you to achieve the lesson objectives.
LESSON 1

ORIENTATION TO CENTRAL MATERIEL SERVICE

Section I. INTRODUCTION

1-1. PURPOSE AND SCOPE

a. The CMS is an organizational unit of the department of nursing service of an Army Medical Department (AMEDD) treatment facility with the Chief, Department of Nursing responsible for its operation.

b. The CMS is the service within the hospital which is responsible for supplying both sterile (defined later) and non-sterile items of supply and certain pieces of technical equipment to the various parts of the hospital that provide patient care. The basic objective of this service is improved patient care through providing supplies and equipment by more efficient means and with greater economy. Improved patient care is first among the objectives of CMS. Specific objectives of this service are:

(1) To provide necessary supplies and equipment for patient care to all using units.

(2) To maintain and supply special items and equipment that may be necessary in the care of the patient.

(3) To promote better care by providing prompt and accurate service to the medical and nursing staff.

(4) To provide supplies of sterile linen packs, basins, and instruments that may be needed in the using units.

(5) To maintain an accurate record of the effectiveness of the various processes of cleaning, disinfecting, and sterilization.

(6) To provide service to the patient by maintaining high quality supplies and equipment that is issued from the CMS.

NOTE: The overall objective of the CMS is to have the right item, at the right place, at the right time, in the right condition.

c. As an operating room (OR) specialist, you may be assigned to the CMS. The duties you will be expected to perform include the preparation and sterilization of supplies, the decontamination and maintenance of technical equipment, and the issue of supplies and equipment.
d. In the Army hospitals of today, CMS has become essential in the maintenance and improvement of economical, effective, and safe patient care. Its importance has increased as those administering the hospitals have discovered the help CMS can give in serving operating rooms, delivery suites, nursing units, and other service departments in the hospital.

1-2. SERVICES OF CENTRAL MATERIEL SERVICE

The services of the CMS come from its objectives. Each hospital or medical unit will develop local standing operating procedures for the CMS to use in providing services. Generally, these services are provided by the CMS:

a. Process, maintain, and dispense supplies and equipment required by medical and nursing personnel in the medical unit for the care, diagnosis, or treatment of patients. This is generally considered the most important service of CMS. Processing supplies through the CMS will be outlined step by step in this subcourse, so that you will become thoroughly familiar with the processing procedures used in CMS.

b. Provide modern equipment maintained in good working condition and use the best methods and techniques for processing the equipment.

c. Develop processing and supply control methods that will provide supplies and equipment most efficiently and economically.

1-3. ADVANTAGES OF CENTRAL MATERIEL SERVICE

There are three main advantages in the centralization of supplies and equipment. They are safety, efficiency, and economy.

a. Safety. Safety for the patient is provided by the use of sterile goods. Safety is increased and improved by putting all processing, preparation, and sterilization of supplies in one area.

b. Efficiency. Efficiency is increased when trained personnel prepare and maintain equipment for immediate use.

c. Economy. Economy occurs when an ample supply of needed supplies is immediately available to users within the hospital. Central materiel service is a central source of supply in a hospital. When such a central source of supply is used, there is maximum use of equipment and a minimum of duplication because there is no need for each unit in the hospital to buy and keep extra supplies. Another economic advantage of a CMS is that the useful life of material is extended by careful processing using trained personnel.
1-4. ORGANIZATIONAL DEFINITIONS IN CENTRAL MATERIEL SERVICE

a. **Central Materiel Service.** Central materiel service is an organizational element of the Nursing Department (charged with the responsibility of processing supplies and equipment used in giving patient care) in a US Army medical treatment facility (MTF).

b. **Using Elements.** Using elements are departments; services; nursing units (wards); clinics; operating, emergency, and delivery rooms within the hospital; troop medical clinics; and other medical facilities within the Army medical department activity (MEDDAC) or Army Medical Center (MEDCEN).

c. **Unit.** A packaged item that is prepared by CMS is a unit. The packaging material may include such things as plastic, cloth, or paper. For example; a packaged syringe is one unit, a packaged tray is one unit, and a linen pack is one unit.

d. **Processing.** Preparing supplies and equipment for patient care is called processing. There are a number of steps and procedures in processing. These procedures will be discussed in detail in later lessons of this subcourse. A brief description of each step in processing follows.

   (1) **Collecting.** Central materiel service is responsible for picking up reusable supplies and equipment from the using units on a regularly scheduled basis for return to CMS. This is called collecting.

   (2) **Receiving and sorting.** Central materiel service receives all soiled and outdated articles in the cleanup area. The initial (first) sorting by type such as instruments, basins, and glassware is done in this receiving area in preparation for decontamination.

   (3) **Decontaminating.** Decontamination is making the article safe for further handling by personnel. This is generally done by machine, such as the washer-sterilizer-decontaminator or autoclave. In certain cases, it may be done by hand using a glove technique and scrubbing with a detergent disinfectant.

   (4) **Cleaning.** Cleaning involves the removing of all matter in which microbial life may find favorable conditions for continued life and growth. Cleaning may be done by hand, scrubbing with hot water and detergent or by machine such as a washer.

   (5) **Preparing.** Preparing includes inspecting, assembling, testing, wrapping, and labeling of medical supplies for further processing.

   (6) **Sterilizing.** Sterilizing involves loading items into the sterilizer as directed, operating the sterilizer and observing for proper operation, unloading and dating the sterile items, and placing the load number on each item. Records of sterilizing procedures must be kept.
(7) **Storing.** Storing is the placing of sterile items in an appropriate storage area in a way that will make the oldest items used first and placing non-sterile items in non-sterile storage areas.

(8) **Inventoring.** Is the physical counting of items, and the withdrawal for reprocessing of those items with expired dates (too old to use).

(9) **Issuing.** Issuing means the removal of the requested item from stock and the delivery of these items to the using unit.

Section II. PERSONNEL

1-5. **INTRODUCTION**

The staff of CMS ordinarily consists of a chief, central materiel service; a chief, central materiel specialist, who is the noncommissioned officer in charge (NCOIC); a senior central materiel specialist; central materiel specialists; and central materiel assistants.

1-6. **CHIEF, CENTRALIZED MATERIEL SERVICE**

a. **Responsibility.** The Chief, CMS, is responsible to the Chief, Department of Nursing for the efficient organization and management of CMS and is also responsible for planning, directing, and coordinating activities relating to CMS in compliance with local standing operating procedures and policies, Army regulations and technical manuals, and safety rules.

b. **Duties.** Depending upon the size of the CMS operation, the duties of the Chief, CMS, will vary; thus, the following listing is not all-inclusive:

   (1) Supervises and coordinates the activities of nursing personnel assigned to CMS.

   (2) Determines realistic stock levels, based upon knowledge of the Department of Nursing operating budget and the CMS services required.

   (3) Coordinates and plans with appropriate medical and nursing officers in developing stock levels for using units.

   (4) Develops operational procedures used in the processing of medical supplies and equipment.

   (5) Coordinates with other pertinent hospital departments and services in matters affecting CMS operations; for example, the Division of Logistics/Supply and Service for requisitioning supplies and equipment.
(6) Participates in planning and implementing the staff development program of the Department of Nursing.

(7) Plans and provides training and clinical experience in CMS for students in phase II of the OR Procedures (Basic) Course and the Clinical Specialist Course.

(8) Plans and provides on-the-job training for personnel inexperienced in CMS operations, including newly employed civilian and military personnel from medical units in a training status.

(9) Periodically evaluates the operations of CMS and makes recommendations to the Chief, Nursing Department for improvements.

(10) Participates in local and national organizations and attends workshops and institutes in order to keep aware of current trends in CMS services and operations and to promote applicable advances.

(11) Provides information to Chief, Nursing Department, for inclusion in that department's report to the Program Budget Advisory Committee (PBAC) of the hospital.

(12) Maintains a listing of desired new equipment with complete justification for inclusion in the Medical Equipment Program Reports System (MEPRS).

(13) Evaluates the performance of new products and equipment as indicated and as appropriate.

(14) Participates in various hospital committees, which includes the CMS Advisory Committee, the Infection Control Committee, the Emergency Medical Program Planning Committee, the Nursing Department Committee for Standardization of Nursing Procedures, and others as appropriate.

1-7. CHIEF, CENTRAL MATERIEL SPECIALIST NONCOMMISSIONED OFFICER IN CHARGE

a. Responsibility. The NCOIC is responsible to and works under the direction of the Chief, CMS. In the absence of the chief and if so directed by the Chief, Nursing Department, he assumes responsibility for the efficient management and operation of the CMS.

b. Duties. The NCOIC of CMS:

(1) Supervises the activities of nonprofessional personnel, to include planning and organizing the workload, assigning duties, establishing duty schedules for full coverage, maintaining time and attendance reports, evaluating performance of personnel, and participating in the planning for in-service training of assigned personnel.
(2) Participates in the planning for clinical experiences or training in CMS for student personnel, newly employed civilians, and field medical unit trainee personnel. Assists in the teaching, when directed.

(3) Requisitions supplies and equipment and provides for their safe storage, inventory, and maintenance. Usually, the hand receipt holder for the CMS.

(4) Inspects the section daily for cleanliness and preventive maintenance needs.

(5) Prepares and maintains the required CMS records and reports.

(6) Performs other duties as assigned.

1-8. SENIOR CENTRAL MATERIEL SPECIALIST

a. Responsibility. The senior central materiel specialist serves as an assistant to the chief specialist and in his absence assumes responsibility for the accomplishment of his duties.

b. Duties. The senior central materiel specialist:

(1) Provides immediate supervision to the nonprofessional personnel, to include assignment within the various areas of CMS to ensure training and experience in specific tasks.

(2) Provides immediate supervision and teaches student personnel and field unit trainees.

(3) Performs administrative duties as assigned, to include inventorying supplies and equipment, preparing requisitions for supplies and equipment, and preparing maintenance requests.

(4) Performs other duties as assigned.

1-9. CENTRAL MATERIEL SPECIALIST

a. Responsibility. The central materiel specialist works under the general supervision of the chief specialist and the immediate supervision of the senior centralized materiel specialist.

b. Duties. The central materiel specialist:

(1) Processes new and reusable medical supplies.
(2) Decontaminates, cleans, inspects, adjusts, disinfects or sterilizes, stores, and issues supplies and special equipment.

(3) Cleans work areas and equipment used in CMS operations.

(4) Reports equipment needing repair to the chief or senior specialist as required.

(5) Maintains first echelon maintenance on installed equipment.

(6) Performs other duties as assigned.

1-10. CENTRAL MATERIEL ASSISTANT

a. Responsibility. The central materiel assistant works under the general supervision of the chief specialist and the immediate supervision of the senior materiel specialist.

b. Duties. These are as indicated for the central materiel specialist (para 1-9b).

1-11. PERSONNEL ATTIRE

a. General. Access to the CMS area must be restricted. No personnel except those assigned or those on official business should be permitted to enter. Traffic through CMS must be controlled and minimized. Unassigned personnel entering the CMS area must wear protective attire.

b. Attire of Personnel Assigned to the Central Materiel Service. No article of outer clothing that has been worn on the street or in another part of the hospital may be worn in CMS. All assigned personnel must change into hospital-provided attire prior to entering CMS. The change of clothing should take place in a dressing room (locker room) located close to or having direct access to CMS. These rooms should be used exclusively by CMS personnel. According to authorities, the best "dress" for wear in the CMS is a coverall which is form fitting, closed at the ankle and neck, made of cotton, and short sleeved (at least 3 inches above the elbow). This type of garment provides the best possible protection, since the shedding of skin is confined and not released into the environment, where it would become a carrier for bacteria. If this type of attire is not available, the suggested attire is scrub-type clothing (dress for women and suit for men) with head covering similar to that worn in the operating room suite. This attire should be changed daily--more often when necessary. When personnel leave the CMS area for any reason, including routine delivery to using units, they must change into the white hospital duty uniform or wear protective covering over their CMS attire. If personnel leave in CMS attire, they must put on clean CMS attire when they re-enter CMS.
1-12. LEGAL RESPONSIBILITIES

a. The law requires that you act in every case with the skill and care expected of a nurse or technician with your training experience. If you fail to do so, there may be serious legal consequences in addition to the needless suffering or even death, which you may cause the patient.

b. Based upon the Gonzalez Act, a law passed in 1976, you may not be held personally liable to pay money damages when patients are injured or killed by your failure to act with proper skill and care as long as you are acting within the scope of your employment. However, the United States (US) Government remains liable for such damages and you as a taxpayer will pay higher taxes to help pay them.

c. While the Gonzalez Act shields you from personal payment of money damages for failure to act with proper skill and care within the scope of your Army employment, it does not shield you from disciplinary and administrative measures based upon your failure to act with proper skill and due care. For example, you may be reclassified in an MOS based upon improper performance of duties. A letter of reprimand could be placed in your Official Military Personnel File, which would make your chances for promotion very unlikely. In some cases, you could be subject to action under the Uniform Code of Military Justice. In the worst case, such action could include court-martial for the offense of negligent homicide (murder).

d. Central materiel service is a high-risk area. Unless you learn and practice the principles of aseptic and sterile technique (defined later in this lesson) established for CMS, you not only reduce your patient's chances for recovery but you also subject yourself to a wide range of disciplinary measures to include trial by court-martial.

1-13. WORK SCHEDULES

a. Depending upon local policy and the workload, CMS may be required to provide 16 to 24 hour service to the medical facility seven days a week. Personnel assigned to the CMS are scheduled so that trained and qualified persons are on duty to respond to the needs of the facility for sterile supplies and equipment for whatever hours they are needed.

b. Use DA Form 3872 (Nursing Service Personnel Time Schedule) (see figure 1-1).
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</table>

SIGNATURE OF HEAD NURSE

WARD CMS

INSTRUCTIONS

List professional personnel first then nonprofessional.
In column under "title" enter title, e.g., Maj., Capt., Sgt.,
 Pvt., Mr., Mrs., Miss.
Entries for "Duty" and for "Off-Duty Status" will be symbolized as follows:

"Duty" symbols: HI - Head Nurse
ASSIST HN - Asst. head nurse
GEN/DUTY - General duty
CLT - Clinical technician
WM - Ward master

Off-Duty Status symbols:
DO - Day off
LV - Leave
SK - Sick leave
HT - Holiday time

DA FORM 3872 REPLACES DA FORM 8-66, 1 JAN 54, WHICH WILL BE USED.

Figure 1-1. DA Form 3872 (Nursing Service Personnel Time Schedule).
Section III. DEFINITIONS

1-14. TERMS ASSOCIATED WITH STERILIZATION

One of the most important parts of life is the ability to effectively communicate, that is to understand the words people use in talking or writing. Medical words are more exact than everyday words, but often, abbreviations, slang, and local phrases make even medical words confusing. To simplify the use of this subcourse, the words used frequently in CMS and related medical areas are defined for you. Words that are specifically related to sterilization are defined in the following paragraphs.

a. **Antisepsis.** The prevention of sepsis by the exclusion, destruction, or inhibition of growth or multiplication of microorganisms from body tissues and fluids.

b. **Antiseptics.** Chemical agents that fight sepsis by inhibiting growth of microorganisms without necessarily killing them. Usually applied to living tissue.

c. **Asepsis.** The absence of microorganisms that cause disease.

d. **Aseptic Technique.** The method by which contamination with microorganisms is prevented, which is also called, "sterile technique."

e. **Autoclave.** A sterilizing apparatus that uses saturated steam under pressure.

f. **Bacteria.** One category of microorganisms. Microorganisms are of great concern to hospital personnel because they are difficult to destroy and produce many different diseases.

g. **Bagged.** Method of enclosing supplies and equipment. This may be done by plastic or paper to prevent the spread of infection or to maintain sterility.

h. **Contaminated.** Soiled with microorganisms.

i. **Cross Contamination.** Transmission of microorganisms from patient to patient and from contaminated objects to patients and vice versa.

j. **Detergent.** A cleansing agent that facilitates removal of grease or soil. A suitable detergent must be selected; it must clean but not injure the surface of the article.

k. **Disease.** A condition of the body in which there is abnormal or poor function.

l. **Disinfectant.** An agent that kills all growing forms of microorganisms, thus completely eliminating them from objects.
m. **Disinfection.** The chemical or physical process of destroying all pathogenic microorganisms except spore-bearing ones. Disinfectants are used on objects—not on tissue.

n. **Ethylene Oxide Gas Sterilizer.** An apparatus using gaseous ethylene oxide, with or without added inert gas, as the sterilizing agent.

o. **Germ.** A microscopic or submicroscopic organism capable of producing disease.

p. **Heat Resistant.** Not affected by heat.

q. **Heat Sensitive.** Will be affected or destroyed by heat—plastic goods, rubber goods, pillows, etc.

r. **High-Vacuum Steam Sterilizer.** A pressure apparatus, employing saturated steam as the sterilizing agent, which operates on the principle by which air is removed from the chamber with the aid of a vacuum pump or other mechanical device.

s. **Infection.** Invasion of the body by pathogenic microorganisms, and the reaction of tissues to their presence.

t. **Microorganism.** Living organisms that cannot be seen with the naked eye, including bacteria, fungi, viruses, yeasts, and molds; also called microbial life.

u. **Moisture Sensitive.** Will be affected or destroyed by excessive moisture such as electric cords, motors, telescopic instruments.

v. **Procedure.** A particular way of doing something; a series of steps followed in a definite order; a traditional way of doing things.

w. **Process.** A series of procedures designed to prepare supplies and equipment for use in giving patient care.

x. **Principle.** The basis upon which the correct way of doing something is determined. A reference to the principles of procedures leads to the right way of doing something.

y. **Sanitation.** A process whereby microorganisms present on an object are reduced in number to a level considered safe for human use.

z. **Sanitizer.** An apparatus employing a sanitizing agent, such as hot water, steam, or chemicals.

aa. **Spores.** An inactive, but viable (capable of living, growing, and developing) microorganism in the environment.
bb. **Sepsis.** Invasion of the body by pyrogenic microorganisms.

c. **Sterile.** Free of microorganisms, including all spores.

dd. **Sterilizer.** Apparatus using saturated steam under pressure, ethylene oxide, or dry heat as the sterilizing agent. These include gravity and mechanical types.

ee. **Sterilization.** The process by which all pathogenic and non-pathogenic microorganisms, including spores are killed.

ff. **Surgically Clean.** Mechanically or physically cleaned but unsterile. Items are rendered surgically clean by the use of chemical, physical, or mechanical means that reduce the number of microorganisms on them.

gg. **Terminal Sterilization and Disinfection.** The procedures carried out for the destruction of pathogens on instruments and supplies before they are handled for complete cleaning and checked for proper functioning. Terminal sterilization is often done by the using unit to protect personnel handling the items prior to sterilization.

hh. **Ultrasonic Washer.** An apparatus in which the cleaning of equipment, principally instruments, is done by the compressional force of the ultra-sound waves.

ii. **Washer.** An apparatus in which glassware, instruments, utensils, and other items are cleaned.

jj. **Washer-Sterilizer.** An apparatus in which instruments and utensils are washed and then sterilized, employing saturated steam under pressure.

**1-15. TERMS ASSOCIATED WITH ORDERING SUPPLIES AND EQUIPMENT FOR CENTRAL MATERIEL SERVICE**

Supplies and equipment must be ordered from the Logistics/Supply and Service Division. The procedures you will need for ordering supplies and equipment are discussed in Lesson 2. The terms you need to know to identify various types of supplies and equipment are defined in the following paragraphs.

a. **Expendable.** Items that are consumed (used up) as they are used (such as tape, gauze, drugs), that lose their identity (such as a spare part), or that are of such low cost that records are not needed.

b. **Nonexpendable.** Items that are not consumed in use, that retain their original identity during the period of use, and that normally require accounting (such as a sterilizer, oxygen equipment, suction pumps, wheelchairs).

c. **Standard Items.** Supplies and equipment that are approved and are available through the Federal Supply Catalog (FSC). These items are issued through the regular supply system, which is discussed in Lesson 2.
d. **Nonstandard Items.** Commercial items that have military application, but have not been approved for issue through the regular supply system.

e. **Disposable Items.** Commercially prepacked, usually presterilized items, intended for one-time use. These items may be standard or nonstandard.

### 1-16. TERMS ASSOCIATED WITH SURGERY

Many items that are prepared and processed by the CMS are used in surgery. As an OR specialist, you should become familiar with the following surgical terms:

a. **Suture (verb).** Suturing is the act of sewing by bringing tissues (skin) together and holding them until healing has taken place.

b. **Suture (noun).** A suture is any strand of material used to sew tissue together. Suturing material must be sterile.

c. **Ligature.** A ligature is a strand of suture material used to "tie off" (seal) blood vessels to prevent bleeding.

d. **Surgical Needles.** Surgical needles are straight or curved needles used to safely carry suture material through tissue with the least amount of effort and with the least amount of tissue damage. Needles must also be sterile.

e. **Positioning.** This is placing the patient in the proper position for surgery in the OR. Positioning is discussed in detail in Subcourse MD0927.

f. **Draping.** Draping is the procedure of covering the patient and surrounding areas with a sterile barrier to create and maintain an adequate sterile field. Draping is discussed in detail in Subcourse MD0933. Draping materials must be sterilized.

g. **Preparation (prep).** This term stands for skin preparation to render the operative area on a patient as free as possible from micro-organisms. This preparation will also be discussed in detail in another subcourse. All the items used for skin preparation must be sterile and are prepared by the CMS.

### Section IV. PRINCIPLES OF STERILE TECHNIQUE

### 1-17. SURGICAL CONSCIENCE

a. An object is considered sterile only when it is completely free of all living microorganisms. One of the most important jobs of the CMS is to provide sterile items to all parts of the hospital. The primary concern of all hospital areas is the care of the patient. When unsterile materials are used in the operating room or other departments of the hospital, the patient may be harmed.
b. It is, therefore, important that OR and CMS personnel develop a "surgical conscience." A "surgical conscience" can best be defined as a surgical Golden Rule--Do unto the patient as you would have others do unto you. "Surgical conscience" is so important that it almost becomes automatic with experienced personnel. Asepsis and sterile technique are done at all times as instruments, materials, and supplies are processed through the CMS, including the storage of items and the delivery of supplies to the using units. "THINK STERILE" is the motto of CMS.

c. Sterile is absolute. Items are either sterile or unsterile. A rule to follow in determining the sterility of an item is "if in doubt, throw it out."

1-18. INFECTION AND INFECTION CONTROL

a. Infection is the invasion of the body by pathogenic microorganisms and the reaction of tissue to the microorganism. Infection control is the prevention of infection as much as possible. A good hospital and operating room infection control program must be carried out by all persons who help care for patients. The infection control program in a hospital includes the following:

(1) Good housekeeping and maintenance of facilities.

(2) Sterility of surgical supplies and equipment.

(3) Cleanliness of the hospital clothes of patients, surgeons, and other personnel.

(4) Strict aseptic technique.

(5) Good personal hygiene by all personnel.

(6) Reporting, evaluating, and maintaining records of infections that occur in patients and personnel.

b. The purposes of infection control are to:

(1) Decrease infection in the hospital.

(2) Improve healing.

(3) Decrease deaths and disability.

(4) Cut hospital costs.
1-19. PRINCIPLES OF STERILE TECHNIQUE

Subcourse MD0935, Routine Procedures for an Operation, focuses on the principles of sterile technique. A review of these principles will be useful for a good understanding of the procedures you need to know in CMS to produce sterile supplies and equipment. Sterile, as used here, is defined as "free of organisms."

- Only sterile items are used within a sterile field.
- Gowns are sterile only from the waist to shoulder level in front, and the sleeves.
- Tables are sterile only at tabletop level.
- Unsterile persons avoid reaching over a sterile field; sterile persons avoid leaning over an unsterile area.
- The edges of anything that encloses sterile contents are considered unsterile.
- A sterile field is created as close as possible to the time of use.
- Sterile areas are continuously kept in view.
- Sterile persons keep well within the sterile area.
- Unsterile persons avoid sterile areas.
- The integrity (sterility) of an item can be destroyed by puncture, moisture, or tearing. All of which cause contamination.
- The number of microorganisms must be kept to the smallest amount possible.
I. An item is either sterile or unsterile. You must always be as certain of sterility as it is possible to be. That certainty rests on the fact that all factors in the sterilization process have been done correctly. You will learn all those factors in detail in Lesson 3. It is impossible to prove that every package is free from microorganisms, but a single break in technique can cost the life of a patient.

Continue with Exercises
EXERCISES, LESSON 1

INSTRUCTIONS. Answer the following exercises by marking the letter response that best answers the question or best completes the incomplete statement or by writing the answer in the space provided.

After you have answered all the exercises turn to "Solutions to Exercises" at the end of the lesson and check your answers. For each exercise answered incorrectly, reread the material referenced with the solution.

1. Prevention of infection as much as possible is the definition for:

2. Infection is spread by patients, by hospital personnel, and by unsterile equipment. Which of the following means of spreading infection is most likely to originate in CMS?
   a. Unsterile equipment to a patient.
   b. Hospital personnel to a patient.
   c. Patient to patient.
   d. None of the above.

3. Commercially prepacked, usually presterilized items intended for one-time use are called ______________________________________________________

4. The Gonzalez Act of 1976 does not shield you from disciplinary and administrative measures based upon your failure to act with proper skill and due care.
   a. True.
   b. False.

5. Define surgically clean. _____________________________________________

______________________________________________________________
6. Who inspects the CMS daily for cleanliness and preventive maintenance needs?
   a. Chief, CMS.
   b. NCOIC of CMS.
   c. Chief, Nursing Service.
   d. Senior Central Materiel Specialist.

7. _________________________ is a process whereby microorganisms present on an object are reduced in number to a level considered safe for human use.

8. According to this subcourse the "best" dress for wearing in CMS is:
   a. Surgical gown.
   b. Street clothing.
   c. Hospital white uniform.
   d. Form fitting cotton coverall.

9. Define infection.___________________________________________________
    ________________________________________________________________

10. CMS is an organizational element of the ____________________ in a US Army medical treatment facility.:
    a. Department of Nursing.
    b. Department of Surgery.
    c. Medical Maintenance.
    d. Pharmacy Department.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

12. As defined in this subcourse, an operating room specialist is normally assigned to work in the operating room or in:

a. CMS.
b. X-ray.
c. Kitchen.
d. Recovery.
e. Intensive Care.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

14. As defined in this subcourse, "the basis upon which the correct way of doing something is determined," is known as a ________________________.
15. As described in this subcourse, list six of the 12 principles of sterile technique.

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

16. Three advantages of a CMS as described in this lesson are:

a. Speed, strength, safety.

b. Safety, efficiency, economy.

c. Interval, time savings, controlled.

d. Economy, consolidation, standardization.
For exercises 17 through 23. Match the terms in Column A to the correct definition in Column B. Place your answer in the space provided on Column A.

<table>
<thead>
<tr>
<th>COLUMN A</th>
<th>COLUMN B</th>
</tr>
</thead>
<tbody>
<tr>
<td>17. Processing</td>
<td>a. A packaged item that is prepared by CMS.</td>
</tr>
<tr>
<td>19. CMS</td>
<td>c. Removing all matter in which microbial life may find favorable conditions for continued life and growth.</td>
</tr>
<tr>
<td>20. Decontaminating</td>
<td>d. The physical counting of items and withdrawal for reprocessing of those items with expired dates.</td>
</tr>
<tr>
<td>21. Cleaning</td>
<td>e. Making the article safe for further handling by personnel.</td>
</tr>
<tr>
<td>22. Inventorying</td>
<td>f. Departments, services, clinics, and nursing units within a medical facility.</td>
</tr>
<tr>
<td>23. Unit</td>
<td>g. An organizational element of the Department of Nursing charged with the responsibility of processing supplies and equipment used in giving patient care.</td>
</tr>
</tbody>
</table>

Check Your Answers on Next Page
SOLUTIONS TO EXERCISES, LESSON 1

1. Infection Control (para 1-18a)

2. a (para 1-18c)

3. Disposable items (para 1-15e)

4. a (para 1-12c)

5. Mechanically or physically cleaned but unsterile. (para 1-14ff)

6. b (para 1-7b)

7. Sanitation (para 1-14y)

8. d (para 1-11b)

9. Invasion of the body by pathogenic microorganisms and the reaction of tissues to their presence. (para 1-14s)

10. a (para 1-4a)

11. An apparatus using gaseous ethylene oxide, with or without added inert gas, as the sterilizing agent. (para 1-14n)

12. a (para 1-1c)

13. Soiled with microorganisms. (para 1-14h)

14. Principle (para 1-14x)

15. Any six of the twelve listed:
   Only sterile items used in sterile field.
   Gowns are sterile from waist to shoulder in the front.
   Tables are sterile only at table top level.
   Unsterile persons do not reach over sterile field; sterile persons do not reach over unsterile field.
   The edges of anything enclosing sterile contents are unsterile.
   A sterile field is created near to time of use.
   Sterile areas are always kept in view.
   Sterile persons stay in sterile area.
   Integrity of item is destroyed by puncture, tearing, moisture.
   Number of microorganisms kept to minimum.
   An item is either sterile or unsterile.
   Unsterile persons avoid sterile area. (para 1-19)
End of Lesson 1
LESSON ASSIGNMENT

LESSON 2

Services of Central Materiel Services.

LESSON ASSIGNMENT

Paragraphs 2-1 through 2-12.

LESSON OBJECTIVES

After completing this lesson, you should be able to:

2-1. Select the proper sequence of steps for processing items that require sterilization in CMS.

2-2. Select the two major considerations in the flow of items through CMS.

2-3. Select from a list of criteria those that apply to the delivery systems used in CMS.

2-4. Select specific terms and definitions that are related to Central Materiel Services.

2-5. Identify the best method for cleaning the floor in CMS.

2-6. Identify cleaning agents that are flammable.

2-7. Identify materials and equipment used in CMS that are potentially hazardous.

2-8. Identify from a list of cleaning methods those that are not authorized in CMS.

SUGGESTION

After completing the assignment, complete the exercises at the end of this lesson. These exercises will help you to achieve the lesson objectives.
LESSON 2
SERVICES OF CENTRAL MATERIEL SERVICES

Section I. SERVICES AND POLICIES

2-1. TYPES OF SERVICES PROVIDED

a. Processing of Supplies. The specific supplies that are processed by CMS for the using units are determined locally, based upon the policies of the hospital, the specialties of the hospital, and the extent to which disposables are used. All items to be issued by CMS should be listed by type, size, and unit of issue, with a copy of the list provided to each using unit. Generally, these items include supplies that are used in the treatment and care of patients, with the exception of pharmaceutical and biological products, delicate instruments which are cleaned by the personnel who use them, and certain supplies which are used in large quantities and which do not require processing.

b. Processing of Equipment. The special portable equipment processed by CMS ordinarily includes those items which are used by various units but which are not required frequently enough to be maintained on the unit as standard equipment. Examples of portable equipment are: suction apparatus, overhead frame, humidifier, inhaler, defibrillator, foot cradle, and turning frame.

2-2. ADMINISTRATIVE POLICY

a. Hospital Policy. A written hospital policy is essential for effective CMS services. The policy should include statements concerning:

   (1) Responsibilities of CMS and using units.

   (2) Services to be provided.

   (3) Hours during which regular and emergency services will be provided.

   (4) Any other pertinent requirements as determined by local policy.

b. Nursing Service Policy. Stock levels are maintained in using units. A stock level is the maximum quantity of material to be maintained on hand to sustain current operations. Each using unit establishes 24-hour stock levels for items obtained from CMS. The kinds of items required depend upon the types of patient treatment and care. Stock levels depend upon the bed capacity or the average patient load and the type of delivery system used in CMS, including delivery schedules and provisions made for special and emergency requests. These stock levels should be reviewed periodically and modified as needed. An excessive number of special requests may indicate inadequate stock levels; a continual return of unused items may indicate excessive stock levels.
Section II. PLACEMENT AND SEQUENCE

2-3. LOCATION

Central materiel services should be centrally located in the hospital in order to make it as convenient as possible to all of the hospital units, clinics, and delivery rooms, as well as the operating suite and the pharmacy. Consideration should also be given to the fact that both materiel and personnel must move into and from the CMS area. However, in a small hospital where space is limited, the CMS and the operating suite must, by necessity, be located in the same area, regardless of the inconvenience of its location to other using units.

2-4. WORKFLOW

a. Workflow is the sequence in which the services of CMS are done. The CMS area is designed to ensure that the flow of materials and supplies processed by CMS is safe and efficient. The efficiency, effectiveness, and safety of the CMS workflow require an uninterrupted progression of processing equipment and supplies from a state of least clean to sterile. No backtracking of CMS items to an area of previous processing can occur without jeopardizing the principles of infection control or aseptic technique.

b. The workflow in CMS starts with receipt in CMS and ends with issue/delivery from CMS. The workflow in CMS must be unbroken and safe with no backtracking (going through the same area more than once) and no hazard to the personnel working in CMS. Therefore:

   (1) Items accepted in the CMS Receiving Area should have had gross soil removed prior to arriving at CMS.

   (2) Some CMS equipment does not go through the sterilization process (suction machines, orthopedic beds, respirators, bed cradles, humidifier, and so forth), but must be decontaminated and sanitized to the point it is clean and safe for use by the next patient or staff member needing to use it.

   (3) Do not backtrack from a cleaner area to a less clean area.

c. A workflow diagram is illustrated in figure 2-1. The workflow sequence in the CMS is:

   (1) Receiving. Items that have been used in giving patient care on wards or in clinics have had the gross soil removed and are returned to CMS.
Figure 2-1. Workflow diagram - sequence of processing through the CMS

(2) **Decontamination/cleaning.** Items received by CMS are further cleaned to the point they are safe for the CMS staff to handle and are ready to be assembled into instrument sets, packs, trays, and so forth. This step may include terminal sterilization.

(3) **Assembly.** Utilizing the Kardex, clean instruments and utensils, equipment is arranged into the appropriate sets, packs, trays, and wrapped for sterilization.

(4) **Pre-sterilization storage (clean).** Items awaiting the actual process of sterilization are shelved or placed on carts until they are placed in the sterilizers.

(5) **Sterilization.** Assembled trays, sets, and packs are loaded into the appropriate sterilizer (steam or gas) and undergo sterilization.

(6) **Sterile storage.** Following a sterilization cycle, items are removed from a sterilizer marked with load number and expiration date, and placed on shelves until such time as they are issued for use by CMS customers such as wards, clinics, and TMCs. Items that have been purchased from the manufacturer in the sterile/ready-to-use state are also shelved in the sterile storage area until they are issued.

(7) **Issue/delivery.** This is the point at which CMS items exit CMS--to be transported to the patient care areas where they will be utilized.
Section III. MOVING SUPPLIES AND EQUIPMENT

2-5. DELIVERY SYSTEMS

   a. A delivery system is the way equipment and supplies are moved from one place to another. In a hospital, many things are moved. Some examples of the movement of things in a hospital are:

   (1) Moving medicine and drugs from the pharmacy to the patient.

   (2) Moving clean linen and towels from the laundry to the patient and soiled linen back to the laundry.

   (3) Moving sterile supplies and equipment from the CMS to the hospital elements and unsterile or contaminated items from hospital elements to CMS.

   b. There are two delivery systems used in the CMS--the conventional system and the automated system.

   (1) In the conventional system, the using unit sends someone to CMS to pick up required supplies and equipment. The using unit also returns soiled and used items to the CMS.

   (2) In an automated system, the CMS picks up used supplies and equipment and delivers fresh and sterile supplies and equipment to the using units in a hospital. The using unit will set up requirements for supplies; CMS will automatically fill those requirements by delivering fresh, sterile supplies to the using organization and collecting used supplies and equipment.

2-6. SELECTING THE DELIVERY SYSTEM

   a. Type of Delivery System. The type of delivery system used in a medical facility will depend on size, location, personnel resources, and other factors. The type of system will be decided by the local facility. Often the system will be a combination of conventional and automated. The NCOIC and Chief, CMS, will work with other components in the hospital to develop an effective delivery system.

   b. Criteria. Regardless of the delivery system used, certain criteria must be met.

   (1) Using units must have supplies and equipment when they need them and where they need them.
(2) Sterility of supplies must be maintained and supplies rotated as required.

(3) Equipment must be safe for both patient and hospital personnel.

(4) No opportunity for cross-contamination must occur in the distribution and collection systems.

(5) Inventories, both in the CMS and at the user level, must be realistic—neither overstocked nor understocked. Inventories can be adjusted as needed.

c. Delivery and Collection Methods and Schedules. The delivery system used in a medical facility should meet the objective of providing the best possible service to the patient. The method and frequency of delivery and collection schedules is determined by the requirements of the medical treatment facility. Some factors that must be considered when establishing the methods and schedules are:

(1) Time when the using units need clean items in large quantities.

(2) Location to which supplies are to be delivered.

(3) Traffic in the hospital.

(4) Availability of CMS personnel to deliver and collect items.

(5) Handling of emergency requests.

(6) Peak workloads within CMS.

d. Availability of Utility Rooms. A specific room or area in each using unit is designated for storage of clean items, and another room or area is designed for storage of soiled or used items. Clean and soiled items must not be stored in the same area.

e. Cabinets. Cabinets must be available in each using unit to store clean items.

(1) Closed cabinets (figure 2-2) are preferred to open ones. Closed cabinets should have windows so items can be seen.

(2) Cabinets should be clearly labeled "Cabinets for clean CMS Items."

(3) Certain shelves should be labeled "Sterile," others should be labeled "Unsterile."
(4) The name of the particular type of item, using standard nomenclature (name) and stock level, should be placed on the edge of the shelf where the item is to be stored.

Figure 2-2. Closed cabinets used for sterile supply storage in CMS.

(5) Cabinets must be placed in an area or room designed "clean."

(6) Cabinets must be cleaned on a regularly scheduled basis, a minimum of each 30 days; more often, if necessary. If you discover a dusty or soiled cabinet when restocking shelves, you must report this fact to the Chief, CMS, for the necessary coordination and corrective action.

Section IV. CENTRAL MATERIEL SERVICES SUPPLIES AND EQUIPMENT

2-7. REQUISITIONING FOR SUPPLIES AND EQUIPMENT

Medical supplies and special technical equipment that are stocked for use by various hospital components including CMS are requisitioned (ordered) from the Logistics/Supply and Service Division in accordance with local standing operating procedures (SOP).
a. The particular medical items stocked and maintained depend upon the needs of the individual hospital. These needs may vary and often change. Current copies of the Federal Supply Catalog (FSC), DOD Section: Medical Materiel is maintained by CMS along with Army Bulletins in the 8-75 series (new items announced and others deleted) and current commercial catalogs. The Logistics/Supply and Service Division procures (buys) medical supplies and equipment for the CMS. Equipment and supplies are classified in the supply system as: Expendable, Nonexpendable, Standard, and Nonstandard. These terms were defined in Lesson 1, paragraph 1-15.

b. When requisitioning (ordering) Medical Materiel Standard items, an 11-digit number called a Federal Stock Number (FSN) is used. All standard items are assigned a Federal Stock Number, whether expendable or nonexpendable.

c. Units within the hospital request supplies from the CMS using DA Form 3750 (Centralized Materiel Service Item Request and Issue). This form may be prepared each time a unit needs supplies or it may be prepared as a standing order request in an automated delivery system. Figures 2-3 and 2-4 illustrate DA Form 3750.

d. Certain items are not stocked by the using units and are provided by the CMS on request. Generally, these items are nonexpendable items that must be accounted for. A DD Form 1150 (Request for Issue or Turn-In) is prepared either by the requesting unit or CMS for these types of items and serves as a hand receipt for the item until it is returned to CMS. Figure 2-5 illustrates a completed DD Form 1150.
Figure 2-3. DA Form 3750, Centralized Materiel Service Item Request and Issue.
<table>
<thead>
<tr>
<th>Item</th>
<th>Requested</th>
<th>Issue</th>
<th>Req</th>
<th>Issued</th>
<th>Remarks</th>
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<tbody>
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<td>18 ga Foley set</td>
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<td>10</td>
<td>21</td>
<td>21</td>
<td></td>
</tr>
<tr>
<td>7&quot; Needle holder</td>
<td>6</td>
<td>6</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>NG Tubing</td>
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<td></td>
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<tr>
<td>Dressing forceps</td>
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<td>12</td>
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<td>Tissue forceps</td>
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<td>12</td>
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<td>18 ga. Butterfly</td>
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<td>35 ga disposable</td>
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<td>Tubing with needle</td>
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<td>3 cc disposable</td>
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<td>Tubing without needle</td>
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<td>ABDs</td>
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<td>TB (100) disposable</td>
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<td>3 cc glass Luer-Lok</td>
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<td>5 cc glass Luer-Lok</td>
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<td>30 cc disposable</td>
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<td>D5W, 1000 cc</td>
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<td>Ringer's Lactate, 500 cc</td>
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<tr>
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</table>

Figure 2-4. Completed DA Form 3750 (CMS Item Request and Issue).
2-8. INVENTORY OF SUPPLIES AND EQUIPMENT

a. An inventory of sterile supplies should be performed daily. The main purpose of this inventory is to ensure that there are enough sterile supplies for CMS to provide the using units as they need them. Stock levels are established by the Chief of CMS, which serve as the guideline in determining requirements for supplies in CMS. The inventory is checked against the established stock level for each item of supply.

   (1) The inventory of sterile supplies should be made at a preestablished time each day. The recommended time is after the first load of requests from using units has been filled. It may be necessary to inventory several times during a 24-hour period when requirements are heavy.

   (2) An inventory of unsterile and bulk supplies should be done on a weekly or semi-weekly basis depending upon the volume of work, storage space available within the CMS, and the time it usually takes to receive supplies from the Logistics/Supply and Service Division.
(3) Inventory of equipment should be performed daily or semiweekly. Frequency depends upon the volume of work, amount of equipment, and the storage area available within CMS.

(4) During the daily inventory of sterile stock, all sterile supplies must be checked for outdated items. Any item that becomes outdated or contaminated must be disassembled and reprocessed. Determination of maximum shelf life, the time a sterile package may be kept in storage, depends on many factors. These factors include:

(a) Conditions of storage, such as cleanliness, closed or open cabinets, temperature and humidity, and controlled traffic.

(b) Material used for packaging, usually muslin, paper, or plastic.

(c) Seal of the package, tape or heat-sealed.

(d) Integrity of the package, if it has been punctured, torn, damaged, or has absorbed moisture.

NOTE: All of these factors will be covered in detail in Lesson 3.

(5) It is expensive to resterilize items; some types of items deteriorate with repeated sterilization. To avoid or decrease the number of items that become outdated, you must rotate the stock of sterile supplies. Rotation of stock means using the older supplies first so that the stock will not become outdated. As you inventory sterile supplies, the older items are moved to the front of the storage area so that they will be used first. Rotating the stock will lower the costs of resterilization and deterioration of supplies.

b. All supplies and equipment are uncrated prior to receipt in CMS in order to prevent as much debris and dust as possible from entering the CMS.

c. No shipping cartons are brought into the CMS. Upon receipt, supplies and equipment are checked by CMS personnel for quality and quantity. Before new technical equipment is delivered to CMS, it is inspected and tested for serviceability and safety by the medical maintenance section. New equipment as well as equipment repaired by medical maintenance is checked by CMS personnel before it is accepted by CMS.

Section V. MAINTENANCE AND CLEANLINESS (HOUSEKEEPING)

2-9. CARE AND MAINTENANCE OF SUPPLIES

a. It is the responsibility of supervisory personnel to ensure that CMS supplies are used properly and economically and that equipment is operated and maintained in accordance with the prescribed directions.
b. The manufacturer's operating and maintenance manual that accompanies each piece of equipment should be placed within a protective cover and kept readily available. If a manual contains maintenance procedures beyond those for which the operator is responsible, it should be so marked. You will be taught to operate and clean the equipment and to perform preventive maintenance strictly in accordance with the manufacturer's manual. In preventive maintenance, for example, over-oiling some pieces of equipment can be just as harmful as no oiling.

(1) Preventive maintenance is the systematic (regular and planned) care, inspection, and servicing of equipment. The purpose of preventive maintenance is to find and correct possible problems with equipment before it quits working. Minor maintenance is also done during preventive maintenance checks. Preventive maintenance is your job. It is everyone's job. It really means continuous inspection of equipment. In your normal duty routine in CMS, you should be alert to any abuse, any unusual sound or smell, or any other indication that a piece of equipment is not operating properly or is being misused. You should report any problems to the chief specialist (NCOIC). In CMS, a definite schedule is made for inspecting, cleaning, lubricating, tightening, and adjusting all equipment. You should follow the manufacturer's instructions on the care of each piece of equipment. The medical maintenance personnel also inspect all equipment on a regular basis in accordance with local policy as a part of preventive maintenance. Records on this maintenance are kept. A good preventive maintenance program will ensure:

(a) Better operating equipment.

(b) Longer life of equipment.

(c) Fewer emergency calls for repair.

(d) Safety for both patients and hospital personnel.

(2) Operating instructions should be with each piece of equipment issued by CMS to using units. Manufacturers are required to incorporate safety measures in their equipment and include detailed instruction on the maintenance, installation, and operation of equipment. You should be briefed by manufacturers, medical maintenance, and other appropriate personnel on new equipment.

(3) Usually, a certain part of each day is set aside for preventive maintenance on the fixed equipment (not portable, stays in CMS) used in CMS. A schedule is made to ensure all equipment is checked regularly. The Medical Maintenance Section of Logistics/Supply and Service Division provides maintenance on equipment that cannot be repaired or serviced by personnel in CMS. Local standing operating procedures will define these requirements. Use DA Form 2407 (Maintenance Request) (see figure 2-6) to request maintenance on equipment.
Figure 2-6. DA Form 2407, Maintenance Request.
2-10. HOUSEKEEPING IN CENTRAL MATERIEL SERVICES


(1) "Clean" is defined as freedom from all matter in which microorganisms may find favorable conditions for continued life and growth. This means that the standards for cleanliness within the CMS must be as high as those maintained in the OR. **THINK STERILE** is a motto for both CMS and OR personnel.

(2) To maintain a high degree of cleanliness in CMS you must know the procedures and means to clean CMS. Sometimes a custodial service is responsible for cleaning floors, walls, ceilings, lights, air conditioning vents and baffles, doors, windows, blinds, dressing rooms, and offices. When this service is not available, CMS personnel are required to clean the CMS.

(3) Regardless of who cleans, the same high standards are required for cleaning the physical facilities. The rules for cleaning CMS are:

   (a) Cleaning methods that stir up dust are prohibited.

   (b) Wet methods of cleaning, dusting, and vacuuming are required.

   (c) Supplies and equipment used in cleaning the CMS must be used only for this purpose and stored within CMS.

   (d) Supplies and equipment used to clean the CMS must be cleaned and autoclaved before being reused.

   (e) Cleaning detergents and disinfectants must be fresh and effective.

b. Specific Areas.

(1) **Floors.** The floor of CMS is considered to be contaminated. Two methods are used to clean floors:

   (a) Double pail technique. Two pails, each containing a detergent-disinfectant solution such as phenolic germicide cleaner, are used. The second pail is used solely to rinse the mop head before it is returned to the solution that is used to mop the floor. After use, mop heads must be laundered and autoclaved before reusing. Used mop heads must never be hung up to dry inside or outside the building and then reused.

   (b) Wet vacuum-pickup technique. A mechanical, wet-process vacuum that does not recirculate dust or aerosols into the air should be used. The cleaning solution must be a detergent-disinfectant. **This is the best method.**
(2) **Walls and ceilings.** Walls and ceilings should be cleaned annually; spot cleaning must be done as necessary (when grossly soiled) with a detergent-disinfectant solution and followed with a thorough rinsing.

(3) **Windows and screens.** Logistics/Supply and Service Division (or, in some cases, the installation engineer) is responsible for maintaining the exterior cleanliness and maintenance of windows and screens. Central materiel services, or custodial service, if provided, will be responsible for cleaning the interior surfaces of all windows.

(4) **Utilities.** Each faucet must be cleaned daily by removing the filter screen, inspecting it, replacing it as necessary, and autoclaving prior to reassembly. Air-conditioning vents must be cleaned monthly. The Post/Hospital Engineering Officer and manufacturer of the air-conditioning system should be consulted for the best method of cleaning and solutions to be used. All the electrical fixtures, connections, and outlets must be carefully inspected periodically, for malfunctioning.

c. **Fixed Equipment.**

   (1) **Daily cleaning.** Each day all counters, tables, and sinks are cleaned with a water-based detergent-disinfectant solution. The sterilizer must be wiped out each day and the strainer removed, cleaned, and replaced.

   (2) **Weekly cleaning.** The sterilizers are inspected and cleaned weekly. All baskets, trays, racks, and so forth are washed thoroughly and rinsed. The strainer is removed and the unit flushed with hot sodium phosphate. The gasket on the sterilizer is checked for wear and replaced when necessary.

   (3) **Monthly cleaning.** Storage cabinets are emptied, cleaned, and dried at least every 30 days. Environmental conditions may require cleaning more often.

d. **Summary.** Excellent housekeeping, using the most effective supplies, techniques, and equipment, is an important part of the CMS because it helps control the spread of infection. As you work in CMS, you must constantly be aware of infection control. Good housekeeping and cleaning techniques will reduce the number of microorganisms present in your work environment and help protect the patient.

Section VI. SAFETY AND ACCIDENT PREVENTION

2-11. SAFEGUARDING PERSONNEL AND EQUIPMENT

a. **General.** Good safety habits are very important in the CMS because of the type of equipment and supplies handled and used. In CMS, you will use combustible material (material that will burn) such as cloth and paper goods for packaging supplies. You will handle sharp objects such as needles, knife blades, and razor blades.
Breakable items such as glassware, crockery, glass tubing, and glass rods are processed through CMS. Some of the equipment you use will contain pressurized steam and pressurized gas; other equipment will be electric. All these substances are potentially hazardous if not used and handled properly.

b. **Accident Prevention.** Two of the most important ways to prevent accidents is to keep machinery and equipment operating properly and to use the machinery and equipment in a proper and safe manner. Other ways to prevent accidents include:

   1. Eliminating or controlling all hazards in the work area.
   2. Establishing safety rules for each technician or each step.
   3. Ensuring that all personnel strictly follow the rules of a safety program.
   4. Using a safety program to teach all personnel to practice safety all the time.

2-12. **SAFETY RESPONSIBILITIES WITHIN CENTRAL MATERIEL SERVICES**

Safety within CMS is important to both the patient and CMS personnel.

a. **Patient Safety.** Set up ways to ensure that items sterilized in CMS stay sterile until they are used. Ensure that soiled items do not come in contact with patients.

b. **Personnel Safety.**

   1. Any person working in CMS should report any unsafe condition or possible hazard immediately.
   2. All personnel in CMS should take an active part in the accident prevention program.
   3. Personnel should report any accident, no matter how small, to the proper person.
   4. All personnel should know the posted fire evacuation plan and take part in fire drills for CMS as well as for the whole hospital.

Continue with Exercises
EXERCISES, LESSON 2

INSTRUCTIONS. Answer the following exercises by marking the letter response that best answers the question or completes the incomplete statement or by writing the answer in the space provided.

After you have answered all the exercises, turn to "Solutions to Exercises" at the end of the lesson check your answers. For each exercise answered incorrectly, reread the material referenced with the solution.

1. Two major considerations in processing supplies and equipment in CMS are:
   a. Sorting and decontaminating to reduce infection.
   b. Speed and economy to return items to using units.
   c. Unbroken and safe flow of supplies and no backtracking.
   d. Decontamination and sterilization of supplies and equipment.

2. List the two delivery systems used in the CMS.

3. List four potentially hazardous items used or handled in CMS.
4. To request maintenance on equipment used in CMS, you should use DA Form:
   a. 1150.
   b. 2062.
   c. 2407.
   d. 3750.

5. Define "shelf life."

   __________________________ ________________________________________
   __________________________ ________________________________________
   __________________________ ________________________________________

6. List two benefits of a good preventive maintenance program.

   ________________________________________________________________
   ________________________________________________________________

7. The title of the form used to order supplies from CMS is "Centralized Materiel Service Item Request and Issue" and the form number is DA Form:
   a. 3710.
   b. 3726.
   c. 3740.
   d. 3750.

8. List two factors that affect the shelf life of a product.

   ________________________________________________________________
   ________________________________________________________________
9. The cabinets located in using units to store clean items should be clearly labeled

10. What is meant by "delivery system"?

11. Define "preventive maintenance."

12. Great care must be taken to keep CMS immaculate. However, any system of cleaning that is prohibited.
   a. Utilizes a vacuum.
   b. Wets the floor.
   c. Dampens walls.
   d. Stirs dust.

13. List two ways accidents may be prevented.

14. Although other factors may be used to determine the type of delivery system used in a medical facility, list the three factors mentioned in this lesson.
15. How often, as a minimum, in CMS should storage cabinets be cleaned?
   a. 7 days.
   b. 10 days.
   c. 15 days.
   d. 30 days.

16. This subcourse gives five criteria that must be met for a delivery system. List three.

   ________________________________________
   ________________________________________
   ________________________________________

17. Define "clean."

   ________________________________________
   ________________________________________

18. Each time mop heads are used in CMS, they should be:
   a. Laundered.
   b. Soaked in disinfectant.
   c. Laundered and autoclaved.
   d. Soaked in detergent-disinfectant.

19. What does the term "backtracking" mean in CMS?

   ________________________________________
20. Generally, walls and ceilings in CMS should be cleaned:
   a. Daily.
   b. Weekly.
   c. Monthly.
   d. Annually.

21. List the seven workflow sequence steps for supplies and equipment used in the care and treatment of patients.

____________________________________________________________________
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________

Check Your Answers on Next Page
SOLUTIONS TO EXERCISES, LESSON 2

1. c (para 2-4b)

2. The conventional system and the automated system. (para 2-5b)

3. Any four of the ten items listed:
   - Combustible material (cloth and paper)
   - Knife blades
   - Needles
   - Razor blades
   - Glassware
   - Pressurized steam
   - Pressurized gas
   - Crockery
   - Glass tubing
   - Glass rod (para 2-11a)

4. c (para 2-9b(3))

5. The time a sterile package may be kept in storage. para 2-8 a(4))

6. Any two of the four listed:
   - Better operating equipment.
   - Longer life of equipment.
   - Fewer emergency calls for repair.
   - Safety for both patients and hospital personnel. (para 2-9b(1))

7. d (para 2-7c)

8. Any two of the four listed:
   - Conditions of storage.
   - Material used for packaging.
   - Seal of the package.
   - Integrity of the package. (para 2-8a(4))

9. "Cabinets for clean CMS items." para 2-6e(2))

10. The way equipment and supplies are moved from one place to another. (para 2-5a)

11. Systematic care, inspection, and servicing of equipment. (para 2-9b(1)).

12. d (para 2-10a(3)(a))
13. Any two of the six listed:
   Properly operating equipment.
   Proper and safe use of equipment and machinery.
   Eliminating or controlling hazards.
   Establishing safety rules.
   Ensure all personnel follow rules of safety.
   Establishing a safety program to teach safety. (para 2-11b)

14. Size, location, personnel resources. (para 2-6a)

15. d (para 2-6e(6))

16. Any three of the five listed:
   Using unit must have supplies and equipment when and where they
   need them.
   Sterility of supplies must be maintained.
   Equipment must be safe to use.
   No opportunity for cross-contamination must occur.
   Inventories must be realistic. (para 2-6b)

17. Free from all matter in which microorganisms may find favorable conditions for
   continued life and growth. (para 2-10a(1))

18. c (para 2-10b(1)(a))

19. Going through the same area more than once. (para 2-4b)

20. d (para 2-10b(2))

21. Receiving
   Decontamination/Cleaning
   Assembly
   Pre-Sterilization
   Sterilization
   Sterile Storage
   Issue/Delivery (para 2-4c and figure 2-1)

   End of Lesson 2
LESSON ASSIGNMENT

LESSON 3  Sterilization and Disinfection.

LESSON ASSIGNMENT  Paragraphs 3-1 through 3-18.

LESSON OBJECTIVES  After completing this lesson, you should be able to:

3-1. Select the type of physical sterilizing agent most often used in the CMS.

3-2. Identify the correct temperature and time requirement of a vacuum type steam sterilizer.

3-3. Identify factor(s) that influence ethylene oxide (EO) sterilization.

3-4. Identify disadvantages of using Cidex® as a sterilizing agent.

3-5. Identify the proper sequence of steps in processing supplies and equipment through the CMS.

3-6. Identify equipment used in the decontaminating/cleaning step in processing in CMS.

3-7. Identify guidelines used in assembling items on trays for packaging.

3-8. Identify environmental factors that are necessary for the sterile storage of supplies and equipment.

3-9. Select appropriate information and develop a load control number.

3-10. Identify a mechanical control indicator.

3-11. Identify the length of time an item is considered sterile when appropriately stored.

SUGGESTION  After completing the assignment, complete the exercises at the end of this lesson. These exercises will help you to achieve the lesson objectives.
LESSON 3
STERILIZATION AND DISINFECTION

Section I. GENERAL

3-1. STERILIZATION

a. General. One of the most important responsibilities of personnel in the CMS is to ensure that equipment is maintained properly and that supplies are sterilized properly. The lives of our patients depend on this. To effectively perform this responsibility, you should: (1) understand the relationship between microorganisms and disease; (2) know the basic principles of sterilization; and (3) know and apply the proper methods of processing supplies and equipment.

(1) The importance of properly processing supplies for the protection of patients and the safeguarding of personnel cannot be overstressed. The safest method of processing should always be used.

(2) Sterilization is defined as that established and approved process by which all forms of microorganisms are destroyed. The aim of sterilization is to destroy all microorganisms including spore-forming microbes. There are three commonly used ways to sterilize supplies and equipment. They are: saturated steam under pressure, EO gas, and dry heat. Steam sterilization and gas sterilization will be discussed in this subcourse. Dry heat is rarely used in the CMS.

b. Basic Principles of Sterilization. Sterilization is essential for the destruction of all microorganisms. You must know the basic principles of sterilization to work in the CMS. These principles include:

(1) Items used in a hospital should not be adversely affected by sterilization.

(2) Items to be sterilized must be free from all foreign substances to permit surface contact with the sterilizing agent.

(3) Items must be assembled and positioned so that complete penetration of the sterilizing agent is possible.

(4) Required time and temperature must be followed for complete destruction of all microorganisms.

(5) Sterilizers and sterilizing agents must be working correctly and properly so they should be checked periodically for efficiency and accuracy.

(6) Sterilizers must be operated according to instructions.
3-2. METHODS OF STERILIZATION

a. **Steam Under Pressure.** Saturated steam under pressure is the most reliable and most frequently used sterilization method. Pressurized steam is the most dependable method because of its heat and its ability to penetrate thus destroying microorganisms. For metals and other non-permeable materials such as instruments and utensils, steam contact of the surface of the item sterilizes the item. Only those surfaces with which the steam has contact are sterile. It is important that you be able to determine the difference between surface sterilization and the sterilization of porous materials. Figure 3-1 illustrates one of the larger autoclaves used in the CMS, while figure 3-2 shows a small autoclave which might be used in a clinic.

![Figure 3-1. Typical autoclave used in the CMS with loading carriage.](image1)

![Figure 3-2. Small autoclave.](image2)
b. Types of Steam Sterilizers Used in the Central Materiel Services

(1) Gravity-displacement type. The gravity-displacement type sterilizer is the slowest of the steam sterilizers but is required for certain types of items such as solutions. In this type of sterilizer, the air is forced out by downward displacement with steam. Figure 3-3 is a simplified diagram of this type of sterilizer. The metal construction of the gravity displacement type contains two shells, either round or rectangular, to form a jacket and a chamber. Steam fills the jacket that surrounds the chamber. After the door is tightly closed, steam enters the chamber at the back (near the top and is deflected upward. Air is more than twice as heavy as steam. Thus, by gravity, air goes to the bottom and steam floats on the top. Steam, as it enters under pressure and remaining above the air, pushes the air in both the chamber and wrapped items downward and out through a filter to the waste line. A thermometer that is located at this outlet below the filter measures the temperature in the chamber. When the steam has filled the chamber, it will begin flowing past the thermometer. Timing for the sterilizing period begins only when the thermometer reaches the desired temperature. The sterilization cycle time begins when the sterilizer is started, and runs through completion. Many factors influence cycle time such as the type of items, size of load, speed of air elimination, geographical altitude, and other environmental factors. The cycle time includes the removal of air, the heating of the steam, the penetration of the steam into the items, the exposure time, and the exhaust and cooling time. Exposure time begins the moment the thermometer in the discharge line indicates the minimum temperature of 250°F (121°C) for the gravity-displacement type sterilizer and ends when the temperature falls below 250°F (121°C) and the cycle ends. The minimum exposure time for a gravity-displacement sterilizer is 30 minutes. The cycle time, of course, would be longer. Each CMS will have local procedures defining minimum exposure time for each type of item and each sterilizer and a procedure for validating sterilization.

Figure 3-3. Simplified diagram showing gravity displacement of air with steam.
(2) **Prevacuum high temperature steam sterilizer.** Figure 3-4 is a diagram of this type of sterilizer. The prevacuum steam sterilizer provides a more efficient and faster method than the gravity-displacement sterilizer for the removal of air and the injection of steam. This permits the processing of larger quantities of materials in a short time. This sterilizer uses a vacuum pump and a steam injection system. The air in the chamber is almost completely evacuated from the chamber by the vacuum pump. The steam injector preconditions the load and helps eliminate the air from the packages. When the sterilizing steam is admitted to the chamber, it penetrates to the center of the packages almost instantaneously. Because of this rapid penetration, higher temperature can be used and the time of the overall sterilization cycle can be reduced. The cycle time for the prevacuum high-temperature steam sterilizer begins when the sterilizer is started and runs through completion. External factors, the size and type of load affect the cycle time with the prevacuum sterilizer. Exposure time for the prevacuum type begins when the temperature reaches 270°F (132°C) and ends when the temperature falls below 270°F. The minimum exposure time for a prevacuum high-temperature sterilizer is 4 minutes. The cycle time will be longer and will include the removal of air by the vacuum pump, the heating period for the steam, the penetration period for the steam and the exhaust and cooling period. The sterilization cycle for prevacuum sterilizers is greatly reduced by the shorter penetration period, higher temperature, and rapid exhaust and cooling time caused by the induced vacuum. The holding and safety period (exposure time) is shortened by the increased temperature. Local procedures for the operation of the prevacuum sterilizer should be carefully followed.

![Figure 3-4. Simplified diagram showing withdrawal of air from chamber, using prevacuum and steam injection. American Sterilizer Company, Erie, Pennsylvania.](image)
Hindrances to sterilization. Effective sterilization may be hindered by certain factors. The main hindrance is the presence of air in the sterilizing chamber. Sterilizing failures may result from:

(a) Overloading. Loose packing of the sterilizer is essential to allow free access of steam and escape of air. If all of the air is not allowed to escape, an air-steam mixture will result in a lower temperature and the outside gauges may not record this error.

(b) Oversized or too-tight packs. Air elimination is difficult to achieve if packages are too large or wrapped too tightly.

(c) Improper operation. Neglecting to follow the manufacturer's directions; shortening the exposure time for a rush order; failing to clean the sterilizer properly; or failing to have regular inspection and proper maintenance.

NOTE: There are some controls available to detect possible failures. These controls will be discussed later in this lesson.

Advantages of steam sterilization. The advantages in steam sterilization are:

(a) It is the easiest, safest, and surest method so that any item that can be steam-sterilized without damage should be.

(b) Steam is the fastest method.

(c) It is the least expensive and most easily supplied.

(d) Most steam sterilization systems use automatic controls and recording devices to eliminate the human factor as much as possible.

(e) Many items withstand repeated processing without damage.

(f) It leaves no harmful residue.

Disadvantages of steam sterilization. The disadvantages with steam sterilization are:

(a) Certain precautions must be used to prepare and package, to load and operate, and to dry the load.

(b) Items must be clean, free from grease and oil, and non-heat sensitive.

(c) Steam must have direct contact with all areas of an item.
(d) Timing of each cycle must be adjusted for differences in materials and size of load that makes it subject to human error.

3-3. GAS STERILIZATION

a. Ethylene oxide gas is used to sterilize items that are heat or moisture sensitive. Ethylene oxide is a chemical agent that kills microorganisms, including spores. Used in its gaseous state, ethylene oxide gas must have direct contact with the microorganisms in or on items to sterilize. Ethylene oxide sterilization is dependent upon EO gas concentration, temperature, humidity, and exposure time. Since pure ethylene oxide is highly flammable and explosive in air, it is mixed with an inert gas for use in sterilizers.

b. Gas sterilizers usually operate at 120º to 140º F (49º to 60ºC). Temperature influences the destruction of microorganisms and the permeability of EO through the packaging material. As temperature increases, exposure time can be decreased. Moisture is also essential in achieving sterility with EO gas so relative humidity of 40 to 80 percent in the sterilizer is required. Exposure time is lengthy; three to six hours may be required. The aeration time is also very lengthy. Newer equipment uses less exposure time. The standard set by the American Association of Medical Institutions (AAMI) for gas sterilizers is 2 hours exposure time. Gas use has also changed; 12 percent EO, 88 percent freon is recommended by AMSCO. However, manufacturers have different exposure time for their products. Gas use has also changed. Because of quality air standards, 3M uses strictly fluorocarbons.

c. Aeration time is the time it takes for the EO gas to diffuse (evaporate) from the items sterilized. Ethylene oxide is not only flammable but is also very toxic and can cause serious chemical burn in case of prolonged contact. Aeration can be accomplished with ambient (room) air or in an aerator chamber designed for this purpose. Only in unusual circumstances will ambient aeration be used. Mechanical aerators are generally available in the CMS today. The nature of the item, the temperature, and the airflow in the aerator influence aeration. Table 3-1 illustrates aeration time for articles sterilized by ethylene oxide gas.

d. The advantages with EO sterilization are:

   (1) It is effective against all types of microorganisms.

   (2) It is noncorrosive.

   (3) It completely permeates all porous materials.

   (4) It leaves no film.

   (5) It is easily obtainable.
It can be used on moisture and heat sensitive items.

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<thead>
<tr>
<th>ITEM</th>
<th>HOURS OF AERATION AT 50°C (122°F)</th>
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<tbody>
<tr>
<td>GLASS</td>
<td>8</td>
</tr>
<tr>
<td>RUBBER GOODS</td>
<td>6</td>
</tr>
<tr>
<td>PLASTIC</td>
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<td>POLYETHYLENE</td>
<td>8</td>
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<tr>
<td>PVC</td>
<td>12</td>
</tr>
<tr>
<td>METAL INSTRUMENTS (WRAPPED)</td>
<td>8</td>
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<tr>
<td>METAL INSTRUMENTS WITH PVC COMPONENT PARTS</td>
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</tr>
<tr>
<td>METAL INSTRUMENTS WITH RUBBER COMPONENTS</td>
<td>8</td>
</tr>
</tbody>
</table>

*AERATION CABINETS SHOULD HAVE AT LEAST 4 AIR CHANGES PER MINUTE*

Table 3-1. Aeration time for articles sterilized by ethylene oxide gas (EO).

e. The disadvantages of gas sterilization are:

1. It is expensive compared with steam.
2. It is a long, slow process.
3. It is toxic and can be harmful to patient and hospital personnel.
4. It is highly flammable and explosive in pure gas form.
5. It is more difficult to verify the effectiveness of gas sterilization. The procedures for preparing items for sterilization, loading the sterilizer, and unloading the sterilizer will be discussed in the next section of this lesson.

Section II. PROCESSING--COLLECTION TO STERILIZATION

3-4. COLLECTION AND RECEIVING

a. Collection. In Lesson 1, you read about the movement of supplies and equipment through the hospital. You were told that each hospital determines the best delivery system for its needs and selects an appropriate procedure for processing equipment and supplies. This procedure may call for personnel in the CMS to collect used equipment and supplies and return them to the receiving area in CMS or it may require the using unit to return used supplies and equipment to CMS. Regardless of who moves the used items, a specific area in the unit is assigned for the used items and
is separate from the area assigned for clean and sterile supplies. Soiled and used items are bagged for return to CMS to prevent the spread of infection. These precautions should be considered in the collection or return of reusable items:

(1) All supplies and equipment used in patient care should be handled as a potential danger to the control of infection.

(2) Every area should have a specific area for the containment of used supplies to be collected or returned.

(3) All items must be made safe for transportation (that is, used and contaminated equipment will be moved in a manner that will not contribute to the spread of infection).

(4) The same cart or device used to move used equipment and supplies should not be used for clean and sterile supplies and equipment.

b. Initial Processing. The using unit will perform initial processing prior to returning items to CMS. This means:

(1) Discard disposable items and knife blades and remove gross soil.

(2) Return all items to CMS regardless of whether they have been used.

(3) Place items to be returned in a double bag, and secure the bag with string or wire tie.

c. Receiving. Central materiel services receives equipment and supplies from at least three sources. The Logistics/Supply Service Division delivers materials and supplies from the general supply area and these are received in a bulk storage area. These items include disposable supplies, paper supplies, supplies to use with processing equipment, and so forth. The laundry delivers linen for the sterile packs that are prepared by the CMS. This clean linen is received in a clean workroom. The hospital using units send used supplies and equipment. These items are received in the cleanup area. These are the items that must be double bagged and carefully handled to prevent contamination and spread of infection. Gloves must be worn. The used equipment and supplies are then processed through the CMS for reuse in patient care. These are the items that will be discussed in the processing cycle in this lesson.

3-5. SORTING

a. General. The cleanup area in CMS is the first place used supplies and equipment are received. The high standard of cleanliness that is so necessary in CMS begins in the cleanup area. Personnel, like you, have a vital role in the continuing battle against microorganisms. The proper handling of equipment and supplies that have
been used or contaminated is not a mere function but an obligation for patient and personnel safety. The preliminary steps in processing equipment through CMS must be done conscientiously.

b. **Sorting.** Sorting of used items is performed first in the cleanup area. It is essential for efficient processing since items are cleaned differently and with various cleaning agents. It is much easier and faster to clean many like-items at one time than to process a few of a variety of items. The instruments are carefully removed from the bags and sorted as follows:

1. Heat-resistant, submergible (can be put in water).
2. Heat-sensitive, submergible.
3. Heat-sensitive, not submergible.

**NOTE:** Like items are put together for further processing.

### 3-6. DECONTAMINATING

a. **The Cleaning of Items.** After supplies and equipment are sorted, cleaning the items is the next step. Cleaning procedures depend on whether the items are soiled or contaminated.

b. **Contaminated Items.** Decontaminating reduces the microbial count on an item to a level where personnel can safely handle the item. Contaminated items must be terminally sterilized (see para 1-14gg) before further processing. Cleaning is a form of decontamination; disinfecting is another. In order to prevent the spread of bacteria from contaminated articles, you must take these actions prior to cleaning and further processing:

1. To decontaminate, place (submerge) in a detergent solution and steam sterilize all items that can withstand moisture and heat. Use a washer-sterilizer-decontaminator for decontaminating whenever possible.
2. Gas sterilize, using double the exposure time, items that cannot be submerged and that are heat-sensitive.
3. Soak in a detergent-disinfectant all items that are heat-sensitive if gas sterilization is not available.

**NOTE:** Personnel working in the decontaminating area must change clothes and thoroughly wash arms and hands before leaving the area. Gloves must be worn while handling contaminated items.
(4) The use of a washer-sterilizer (see figure 3-5) eliminates hand washing of items that are not damaged by heat. The procedures for using the washer-sterilizer follow.

(a) Rinse gross soil from each item when necessary.

(b) Sort into like groups prior to cleaning.

(c) Place sharp-pointed, sharp-edged, and fragile items in a pan for manual washing.

(d) Operate according to the manufacturer's instructions.

(e) Open the door at the end of the sterilizing cycle.

(f) Allow the instruments to remain until thoroughly dry.

(g) If ultrasonic cleaning unit is available, remove the items immediately from the washer-sterilizer and put them through the ultrasonic cleaner.

(5) The Ultrasonic cleaner (see figure 3-6) does not sterilize; it cleans by loosening hidden soil in box locks, hinged or jointed area, crevices, grooves, and other
areas that may or may not be visible. It is useful for cleaning all items which have been through the washer-sterilizer or those that have been decontaminated and manually cleaned. This unit uses a high-frequency sound as a source of energy for cleaning. A cleaning solution of water and detergent is used in this cleaner and the vibrating sound waves clean areas that are difficult to clean in other ways.

Figure 3-6. Ultrasonic cleaner.

c. **Non-Contaminated Items.** Cleaning is an extremely important step in processing reusable items; only when the soil has been thoroughly removed can a sterilizing agent, whether chemical or heat, come in direct contact with the surfaces of the object to be sterilized.

(1) The following requirements are needed to thoroughly remove all soil from non-contaminated items received in CMS.

(a) Use only the cleaning agents that have been selected for each of the various types of material to be cleaned.

(b) Use only the designated cleaning agent--for mechanical or for manual cleaning.

(c) Use only the exact amount of the cleaning agent in the specified amount of water. If this information is not available on the label of the container, the cleaning agent should not be used. Guesswork is not acceptable.
(d) Change the cleaning solution frequently. The length of time the cleaning agent remains active depends upon the kind and amount of soil and upon the temperature of the solution.

(e) Apply friction to remove soil from hard-to-clean surfaces. The friction used should not damage the surface. Use brushes of varying lengths to clean tubular instruments and equipment. Always brush under the surface of the liquid solution. This avoids splatter and possible contamination of the area.

(2) The criteria for cleaning agents are given in Table 3-2.

(3) Each type of item, (for example, instruments, tracheostomy tubes, metalware, needles, glassware, rubber goods, and so forth) has specific procedures for cleaning. FM 8-38 will provide you with specific procedures for each type and will be available to you in the CMS.

<table>
<thead>
<tr>
<th>Must</th>
<th>Must not</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loosen or remove all soil without damaging the item.</td>
<td>Be harmful to the user or patient, even in trace amounts.</td>
</tr>
<tr>
<td>Have a rapid penetration power.</td>
<td>Stain the material or the user.</td>
</tr>
<tr>
<td>Be compatible with mineral content of water.</td>
<td>Have an offensive odor.</td>
</tr>
<tr>
<td>Be compatible with type of material to be cleaned.</td>
<td>Leave a residue.</td>
</tr>
</tbody>
</table>

NOTE: There is no one cleaning agent that is feasible for use on all materials or in all parts of the world. Many manufacturers of cleaning agents have facilities for analyzing individual situations. When this service is available and used, specific guidelines will be given.

Table 3-2. Cleaning materials.

**d. Cleaning Non-Submergible Items.** There are many items that cannot be placed in a solution. The manufacturer's instructions will indicate whether a part can be submerged for cleaning and to what extent the item can be disassembled for cleaning. To clean those types of reusable supplies that cannot be submerged in a solution you will:

(1) Moisten a cloth with a detergent solution and thoroughly clean the parts.
(2) Use a moist cotton-tipped applicator to get into grooves and other areas that are difficult to clean.

(3) Moisten a cloth with clean water and thoroughly remove the detergent.

(4) Dry thoroughly as described in the next paragraph.

3-7. RINSING AND DRYING

a. After cleaning reusable items and instruments, you must rinse and dry them before sending them to the preparation area. In this step you will:

(1) Rinse the items under running tap water to remove a large portion of the cleaning solution.

(2) Rinse a second and a third time using distilled water.

(3) Change rinse water frequently to prevent residual buildup.

b. Items must be dried before taking them to the preparation room and before putting them in unsterile storage. You may dry these items as follows:

(1) Dry heat-resistant items by placing them in the autoclave. The steam must be off in the chamber and the door should be open.

(2) Manually, dry items using a soft absorbent towel.

(3) Items that are heat-sensitive should be air-dried. This means to dry by exposure to the air in the room.

3-8. SORTING, INSPECTING, AND TESTING

Following decontamination and cleaning, all items are brought to the preparation area where they are carefully re-sorted, inspected for cleanliness, and tested for defects or malfunctioning. These directions should be followed:

a. Put like items together.

b. Disassemble items that consist of multiple parts in order to check for cleanliness and defects.

c. Check the normal action of the item. For example, a plunger will glide into the barrel of a syringe when both are properly matched and thoroughly clean. The presence of soil, which sometimes cannot be seen, will not allow a plunger to glide.
d. Watch for a surface that feels slick. It may have grease or oil on it that can be felt but not seen.

e. Check inner surfaces of cannulas by visual inspection and by the use of injected air. The free flow of air through the cannula is only one indication that the cannula is clean.

f. Look for these deficiencies in checking instruments:

   (1) Jointed instruments.
      
      (a) The box lock does not move freely or is too loose.
      
      (b) The ratchets do not glide smoothly over each other and to the last notch.
      
      (c) The ratchets suddenly spring open when the instrument is laid down.
      
      (d) The tips of the instrument are not fully closed when the last ratchet has been reached.
      
      (e) The serrations or teeth are offset and do not come together properly; this can occur in various types of hemostats such as Rankins (straight Kelly) and Kochers.
      
      (f) Cracks, chips, or broken pieces of the metal.
      
      (g) Instruments are bent out of their normal shapes. (Exceptions: Malleable and flexible instruments such as probes and retractors.)

   (2) Tension action instruments (such as various dressing and tissue forceps).

      (a) The tension action is too strong or lacking.
      
      (b) The tips do not meet when the instrument is closed.
      
      (c) The teeth or serrations are offset when they come together.
      
      (d) The teeth are broken.

   (3) Sharp-edged instruments.

      (a) The cutting edges do not close evenly.
(b) The joint does not move freely.

(c) The sharp edge has a nick or chip, or is dull. To test a sharp-edged jointed instrument, see if it will cut smoothly through a piece of moistened gauze roller bandage in one closing action. Wire scissors should cut smoothly through a piece of wire with one closing and using the tip of the scissors.

(4) **Sharp-pointed instruments.**

(a) The sharp points are bent out of normal shape, broken, or dull.

(b) The points of jointed sharp-pointed instruments do not meet correctly. A magnifying glass may also be used to observe the condition of the point.

(5) **Endoscopy instruments.**

(a) The lens cover is cracked or cloudy.

(b) Scratches and other defects appear on the metal, either inside or outside the cannulas and other areas.

(c) Wiring or connectors are loose.

(d) Bulbs are burned out. Replace according to manufacturer's instructions.

**CAUTION:** There may be a possible defect in the light carrier or power source when a replaced bulb does not light.

(e) The wire covering has a break.

(f) A grayish or spotted area appears instead of a clear, bright, lighted area when looking in a fiberoptic scope. (When some of the fiberoptic fibers have been damaged, a portion of the lighted area in the scope will appear gray or darker. The size of this area and the degree of darkness will depend upon the number of fibers damaged.)

g. Use these specific guidelines for needles:

(1) **Special procedure and hypodermic needles.** Most hypodermic needles are disposable. Special needles that are reusable are reprocess as described.

(a) Sort needles according to type, gage, and length.

(b) Inspect the needles and stylets for straightness and the bevel for hooks, burrs, and sharpness. Pull the bevel of the needle and stylet over the surface of
a piece of gauze to discover small hooks and burrs. Discard needles with large burrs, hooks, exceptionally dull points, and bent needles.

(c) Remove hooks and burrs and re-form points by using a fine oilstone as illustrated (see figure 3-7) when necessary. Reclean needles and stylets.

(d) Match each stylet with its needle. It must fit flush or even with the bevel. This occurs when the stylet is fitted in the right needle.

Figure 3-7. Sharpening needle on oilstone.

(2) Suture needles.

(a) Sort needles according to type and size.

(b) Inspect the needle for burrs, hooks, dullness, and distortion from normal shape. Discard needles with any of these defects.

h. Use these general guidelines for linen. (Linen is generally inspected and folded prior to storage so that it will be ready for use in CMS. However, wrappers are an exception; they are inspected prior to use and folding is generally not necessary prior to storage.)
(1) **Inspecting.**

(a) Inspect all linen (see figure 3-8) for tears, holes, and thin and worn areas; ripped seams, belts, and cuffs; missing ties and belts; stains; and other defects. Defects can be found by holding it between you and a light and examining it carefully. If the linen is stained or has holes in it, it must be discarded.

(b) Encircle or otherwise mark the defect with a pencil and send the defective linen to the designated mending room for thermotype patching and other needed repairs. Badly stained linen should be returned to linen supply or some other designated place for its disposal.

(c) Remove hair, lint, and other foreign material from both sides of the linen.

(2) **Folding.** Fold linen so that only the outside edges have to be handled when unfolding it for use. Folding techniques are illustrated in figures 3-9, 3-10 and 3-11.
Figure 3-9. Folding towels for linen packs.

Figure 3-10. Inspecting cuff on surgical gown on right. Step 1 in folding surgical gown on left.

Figure 3-11. Step 1 for folding surgical gown for linen packs on right. Step 2 in folding surgical gown for linen packs on left.
3-9. ASSEMBLING

a. General. Assembling items for packaging is another important step to the final product in CMS. During assembly you should reinspect and retest for functioning prior to packaging. Individual articles are packaged as well as groups of articles. Sets of instruments are assembled in the preparation area. These groups of articles are called trays, sets, and packs. Local hospital policies will establish the requirements for items to be packaged. Normally a checklist for each package is given in a Kardex visible file (see figure 3-12 and figure 3-13). This card file contains a list of the required articles and sometimes a picture of the articles to be included in the pack as well as the location of each article in the pack. To assemble and package you should:

(1) Follow the list of items to be included. Do not add items.

(2) Place open wrapper or hand towel in bottom of perforated tray or pan.

(3) Separate containers when more than one is in a package.

(4) Place any containers to be included within a tray so that they will be on their side when placed in the autoclave.

(5) Open all instruments. (Box locks must be in open position for penetration by the sterilizing agent.)

(6) Disassemble items that have parts that require handling when used.

(7) Separate the barrel and plunger of each syringe.

(8) Add moisture to cannulated items such as tubings, catheters, and needles for moist-heat sterilization. (Cannulated items are tubes used within the body.)

(9) Place linen in such a manner that the steam can easily flow through. Do not place extra linen materials in the tray. Hand towels should be packaged separately.

(10) Recheck the list of items to be included.

b. Assembling Linen Packs. Linen packs are designed so that the item to be used first in the sterile pack is the last item placed on the pack. As you prepare the packs, you should:

(1) Arrange the linen so that the alternate layers of linen are crossed to promote free circulation of steam during sterilization.

(2) Place sponges in the center of the pack to break up the close contact between more closely woven fabrics.
### SUTURE SET
Wrap in two 36 inch muslin wrappers

1 towel lined perforated pan  
1 sterile indicator  
1 solution cup  
1 medicine glass  

**On Stringer**  
4 small towel clips  
4 curved mosquitoes  
4 straight mosquitoes  
2 curved Criles  
2 Allis clamps  
1 6-inch needle holder  
1 7-inch needle holder  
1 sponge stick  
10 4X4 plain sponges  

**In separate 12 " wrapper**  
1 no. 3 knife handle  
1 Adson forcep  
1 tissue forcep, 5 inch  
1 dressing forcep, 5 inch  
2 Hupp retractors  

**In separate 12 " wrapper**  
1 curved Mayo scissors  
1 straight Mayo scissors  
1 point sharp scissors

---

Figure 3-12. Assembling set.
Figure 3-13. Visible card file for pack and tray assembly.

(3) Check size. The largest pack should not exceed 12 x 12 x 20 inches or weigh more than 10 to 12 pounds. See figure 3-14.

Figure 3-14. Linen pack being taped.
Ensure that wrapper provides protection against contact contamination.

Ensure that wrapper is not too tight.

3-10. PACKAGING

a. Packaging Material. Paper, plastic, or fabric materials are used to wrap items for steam or gas sterilization. The packaging materials for all methods of sterilization must:

- Allow penetration of the sterilizing agent so that all items in the package are totally sterilized.
- Allow the release of the sterilizing agent at the end of the exposure period.
- Filter out dust particles and microorganisms and allow contents to remain sterile from the time removed from sterilizer until used.
- Not cracked or be easily torn or punctured. If accidental tears and holes do occur, they must be visible.
- Be flexible.
- Not absorb moisture from the surrounding environment.
- Be economical and readily available. Recommended packaging materials for articles to be sterilized are shown in Table 3-3.

b. Applying Packaging Material. The wrapping of packages and individual articles should be done in a room far enough removed from the sterile storage area that mixing sterile and non-sterile is not possible. Non-sterile cabinets should be noticeably labeled as non-sterile. The procedure for sending items to the sterilizer, and receiving them from it should be set up so that sterile and non-sterile packages can never be confused en route. Muslin is the most frequently used packaging material and furthermore it has many advantages. Paper and plastic are increasingly used; paper and plastic are used in disposables. Muslin is in double thickness; packages are wrapped in two layers of double-thickness muslin (four thicknesses) to provide sufficient dust filter and microbial barrier. Figure 3-15 illustrates wrapping an article in double-thickness muslin. Other materials must provide the same or better protection. Figure 3-16 illustrates paper/plastic wrapper. The visible wrapper is paper; the reverse side is clear plastic.
<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>GRADE OR THICKNESS</th>
<th>SUITABLE FOR</th>
<th>ETHYLENE OXIDE GAS</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEXTILE</td>
<td></td>
<td>STEAM</td>
<td>DRY HEAT</td>
</tr>
<tr>
<td>MUSLIN</td>
<td>140 THREAD COUNT</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>JEAN CLOTH</td>
<td>160 THREAD COUNT</td>
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<tr>
<td>BROAD CLOTH</td>
<td>200 THREAD COUNT</td>
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<td>NO</td>
</tr>
<tr>
<td>CANVAS</td>
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<td>NO</td>
</tr>
<tr>
<td>PAPER¹</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>KRAFT-BROWN</td>
<td>30-40 LB.</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>KRAFT-WHITE</td>
<td>30-40 LB.</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>GLASSINE²</td>
<td>30 LB.</td>
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<tr>
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</tr>
<tr>
<td>CREPE</td>
<td>DENNISON WRAP</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>CELULOSE FILM</td>
<td>WERK STERILIZABLE</td>
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<td>NO</td>
</tr>
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<td>CELLOPHANE</td>
<td>1-3 MILS</td>
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<td>NO</td>
</tr>
<tr>
<td>PLASTIC</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>POLYAMIDE</td>
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<tr>
<td>POLYETHYLENE</td>
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<td>NO</td>
</tr>
<tr>
<td>POLYPROPYLENE</td>
<td>1-3 MILS</td>
<td>*</td>
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<tr>
<td>POLYVINYLCHLORIDE</td>
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<tr>
<td>NYLON-6(PORTEX)³</td>
<td>1-2 MILS</td>
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<tr>
<td>FOIL</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>ALUMINUM</td>
<td>1-2 MILS</td>
<td>NO</td>
<td>YES</td>
</tr>
</tbody>
</table>

¹DO NOT USE PAPERS WITH CHLORINE FORMULATIONS.

²A COATED PAPER WHICH MAY ADHERE TO HARD OBJECTS WHEN DRY AND MAY TEAR.

³DIFFICULT TO HEAT-SEAL. NYLON-6 HAS BEEN USED AS A WRAPPING MATERIAL IN THE AMS CO MEDALLION GAS CYCLE; HOWEVER, OTHER GAS STERILIZERS MAY REQUIRE LONG EXPOSURE PERIODS FOR STERILIZATION.

*DIFFICULT TO ELIMINATE AIR FROM PACKAGE.

Source: American Sterilizer Company (AMSCO), Erie, Pennsylvania.

Table 3-3. Wrapping and packaging materials to be sterilized.
1. Place the wrapper on a flat surface with the point of one corner toward you.

2. Place the article to be wrapped in the center of the wrapper with its parallel (going from right to left) to you.

3. Fold the corner nearest you over the article until it is completely covered.

Figure 3-15. Applying packaging (continued).
4. Make an approximate 2- to 2 1/2-inch fold back from the corner's end toward you. Do not uncover any portion of the article.

5. Next, fold one side of the wrapper firmly, without changing the shape of the article, over and parallel to the article. Then, fold back the end of this corner approximately 2 to 2 1/2 inches while maintaining the tension throughout.

6. Repeat step 5 on the opposite side. The center folds must overlap at least 1/2 inch at the center when finished.

Figure 3-15. Applying packaging (continued).
7. Make a slight tuck in the top layer of the fourth corner, using the material located along and just in front of the article. This will narrow the fourth corner when folded correctly and will eliminate any direct opening into the package.

8. Bring the fourth corner (the one opposite you) up and over the package and tuck underneath the folded sides, while maintaining tension and simultaneously turning back the corner. The corner is turned back so that you can reach its tip without entering the package. (The other three folded corners can also be grasped without touching the sterile article as the wrapper is removed.)

9. Repeat steps 1 through 8. All packages are double wrapped.

Figure 3-15. Applying packaging (concluded).

Figure 3-16. Sample of paper/plastic wrapper.
Section III. PROCESSING - STERILIZATION TO STORAGE

3-11. STERILIZATION

a. General. The steps in processing reusable articles through CMS begin with collecting and receiving; move to sorting, decontaminating, and cleaning; then to sorting, inspecting, and testing; next to assembling and packaging. All of these steps were in preparation for sterilization. The processes of sterilization are covered in this section.

b. Preparation of the Sterilizer. The effectiveness of the sterilization processes depends upon a properly functioning and clean sterilizer.

(1) Daily maintenance of the sterilizer.

(a) Remove lint and debris from chamber wall.

(b) Remove, clean, and replace filter to the chamber discharge line in all autoclaves.

(c) Change recording chart, check ink supply, and close cover.

(2) Periodic maintenance of the sterilizer. Medical maintenance should check the sterilizers on a regular basis for:

(a) Proper operation of mechanical parts such as the gauges, steam lines, and drains.

(b) Accuracy of the temperature, humidity, and vacuum independently of the fixed gauge.

3-12. STEAM STERILIZATION

In the conventional steam sterilizer the sterilization process has five phases.

a. Phase 1. Phase one is the loading phase in which articles are packaged and loaded into the sterilizer.

b. Phase 2. Phase two is the heating phase in which air is removed from the chamber as the steam heats up in the jacket and begins to enter the chamber. This air is removed either with a vacuum pump or by gravity displacement. Only after the air is removed from the chamber and from the packages of items being sterilized can proper sterilization occur.

c. Phase 3. Phase three is the destruction phase. The destruction phase is based on the time-temperature cycle necessary to kill all microbial life. Table 3-1
illustrates the minimum exposure times in steam sterilization for various types of items in both the vacuum and gravity-displacement sterilizers.

d. **Phase 4.** Phase four is the drying and cooling phase. In this phase, the steam inside the chamber is quickly removed so that it will not condense and wet the packs. Filtered air is introduced into the chamber; the door is opened slightly to let the vapor escape. Minimum drying time is 15 to 20 minutes. Items are removed after drying time and allowed to cool. Never place freshly sterilized packages on cold surfaces such as metal table tops since sweating will occur forming pools of water which may be absorbed by the dry goods and contaminate the packages.

e. **Phase 5.** Phase five is called the testing phase. It is in this phase that the sterilization process is checked for failure. For steam sterilization there are four types of controls, which monitor the sterilization process.

1. **Mechanical controls.** A time-temperature chart should be maintained on each sterilizer and each cycle recorded on the chart. This chart is maintained as part of the sterilizer load record. Figure 3-17 illustrates a sample-recording chart on a steam sterilizer. This chart must be checked after each sterilization cycle to ensure that the correct time and temperature standards have been accomplished in the cycle.

![Figure 3-17. Prevacuum, high-temperature steam sterilizer (exterior view) and time-temperature chart.](image-url)
(2) **Biological controls.** A biological spore strip containing *Bacillus stearothermophilus* should be tested once a week in each sterilizer. The biological spore strip is incubated according to the manufacturer's recommendations and recorded in the sterilizer's permanent records. This spore strip tests the effectiveness of steam sterilization. If a positive culture (a culture with living microorganisms after sterilization) is reported during the testing, the affected sterilizer must be checked out by medical maintenance, who will take appropriate action.

(3) **Chemical controls.** Chemical indicators are sensitive to time, temperature, and steam penetration and are used in every package sterilized. Pressure sensitive tape (see figure 3-14) is used to secure packaged items and as a label on items to be sterilized. The paper backing of this pressure-sensitive adhesive changes color when it is exposed to high-temperature steam giving definite indication that the item has been processed through a sterilizer but not necessarily successfully sterilized. Chemically treated paper strips are placed in the center of packs to be sterilized. It also changes to a distinctive color when proper sterilization conditions have occurred within the pack. See figure 3-18.

**NOTE:** Indicators show that the article has been exposed to the sterilization process. They do not guarantee sterilization.

(4) **The Bowie-Dick test.** A fourth type test is used to determine whether air removal from the chamber and load is adequate in prevacuum type sterilizers. It should be used in the first cycle each day to determine whether the sterilizer is removing the air within the chamber properly. As mentioned previously, you learned that air-steam mixture results in a lower temperature and hinder the sterilization process.

### 3-13. GAS STERILIZATION

The gas sterilization process consists of air evacuation, humidification, sterilization, gas evacuation, and admission of filtered air to relieve the vacuum. Only those items that are heat-sensitive and cannot withstand steam sterilization will be gas sterilized with ethylene oxide. Never gas-sterilize any item that can be steam-sterilized.

a. **Advantages of Ethylene Oxide Sterilization.** It is easily available; it is effective against all types of microorganisms; it penetrates through masses of dry material easily; it does not require high temperature, humidity or pressure; it is noncorrosive and non-damaging to items that are heat and moisture sensitive.

b. **Disadvantages of Ethylene Oxide Sterilization.** It requires a long exposure and aeration period; it is expensive; it is toxic, it is explosive.
c. Processing Sequence. The processing sequence for gas sterilization is:

1. Items are loaded.
2. Vacuum is created.
3. Additional moisture is added.
4. Gas is admitted.
5. Temperature, pressure, and humidity are maintained.
6. Exposure period is timed.
7. Gas is exhausted.
8. Air is admitted through bacteria-retentive filter.

d. Validity of Ethylene Oxide Sterilization. The effectiveness in EO sterilization depends upon gas concentration, temperature, humidity, and packaging barriers. Table 3-4 illustrates the conditions for EO sterilization.

<table>
<thead>
<tr>
<th>Concentration and exposure</th>
<th>450 milligrams/liter of chamber space for 5 hours minimum or Concentration/liter and time for minimum effective exposure in accordance with manufacturer’s instructions for EO sterilizer.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>49° to 60° C (120° to 140° F), depending upon type of material.</td>
</tr>
<tr>
<td>Relative humidity</td>
<td>50 to 60 percent.</td>
</tr>
</tbody>
</table>

Table 3-4. Conditions required for sterilization with ethylene oxide mixtures.

e. Controls for Ethylene Oxide Gas Sterilization. Ethylene oxide gas sterilization has mechanical, physical, and chemical controls just as steam sterilization does. The biological control spore strip for ethylene oxide gas contains Bacillus subtilis and must be used for every load every day. Chemical indicators are similar to those used for steam sterilization but the color changes for gas rather than steam. The
Chemical indicator DOES NOT GUARANTEE sterilization; only that it has been through the cycle. The chemical indicator is placed in the center of the pack as well as externally in the form of pressure-sensitive tape. The mechanical indicators include a recording chart, which provides information on time and temperature for the cycle.

f. **Aeration.** An adequate aeration period is essential following EO sterilization.

(1) The manufacturer's suggested aeration times should be followed. Table 3-1 illustrates some aeration times used.

(2) Ambient aeration is defined as open-room aeration. It can be done with ambient air in a clean, well-ventilated area removed from other medical supplies. This type of aeration is rarely used.

(3) When aeration chambers are used, the aeration load records should be maintained on the aeration chamber with time in and time out recorded.

### 3-14. UNLOADING OF STERILIZERS

a. **Steam Sterilizer.** Items should be removed from the sterilizer when the sterilization cycle is completed. The recording thermometer chart must be checked for temperature attained and length of cycle, including the drying time. The chemical/physical indicator should also be checked for color change.

(1) **Loading carriage used.** When the sterilizer has a loading carriage (see figure 3-1), the items remain on the loading carriage about 15 minutes or until cool. They are then dated and stored. Dating and storage are discussed in the next few paragraphs.

(2) **Loading carriage not used.** If the sterilizer does not use a loading carriage, the items are removed from the sterilizer and placed on wire mesh or slatted wooden surfaces which are covered with several layers of muslin and in a position so that air can circulate freely. You should not place the items close together until they are cool. Date and store.

**NOTE:** If warm packages are laid on a solid cold metal surface, they will become damp from steam condensation and may become contaminated. Any item that falls on the floor is considered contaminated.

b. **Gas Sterilizer.** When the cycle is completed, you should open the sterilizer door and wait 15 minutes before removing the articles in the sterilizer. You will check the recording chart for pre- and post-vacuum, temperature attained, and length of cycle. The sterilizer indicating tape will be checked for color change. The items are taken from the sterilizer and placed in an aerator for aeration. After aeration, date and store.
3-15. LABELING OF STERILE SUPPLIES

a. General. A date on each package sets a limit on the number of days an item will be considered sterile. The date the package becomes outdated is stamped on the package as it is removed from the sterilizer; thus an undated package is not considered sterile. To provide a record of the history of sterilization of items, the Army requires load control numbers and expiration dates to be marked on all supplies.

b. Load Control Numbers. A load control number permits ready identification of the sterilizing cycle used on each item. It identifies the exact sterilizer used, the date the item was sterilized, and the load control number. The load control number consists of six digits made up as follows:

(1) The first digit is the numerical designation of the sterilizer.

(2) The second, third, and fourth digits indicate the Julian calendar day of the year, that is, 001 through 365 days.

(3) The fifth and sixth digits indicate the number of times a sterilizer is loaded and operated during a 24-hour period. Table 3-5 shows examples of load control numbers.

<table>
<thead>
<tr>
<th>Sterilizer number</th>
<th>Julian calendar day of year</th>
<th>Sterilizer cycle number</th>
<th>Load control number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1 Jan/001</td>
<td>1</td>
<td>100101</td>
</tr>
<tr>
<td>1</td>
<td>1 JAN/001</td>
<td>2</td>
<td>100102</td>
</tr>
<tr>
<td>2</td>
<td>1 Jan/001</td>
<td>1</td>
<td>200101</td>
</tr>
<tr>
<td>2</td>
<td>1 Jan/001</td>
<td>2</td>
<td>200102</td>
</tr>
<tr>
<td>2</td>
<td>8 Jul/189</td>
<td>1</td>
<td>218901</td>
</tr>
<tr>
<td>2</td>
<td>8 Jul/189</td>
<td>2</td>
<td>218902</td>
</tr>
<tr>
<td>3</td>
<td>31 Dec/365</td>
<td>10</td>
<td>336510</td>
</tr>
<tr>
<td>3</td>
<td>31 Dec/365</td>
<td>11</td>
<td>336511</td>
</tr>
</tbody>
</table>

Table 3-5. Examples of load control numbers.

(4) The load control number must be marked on all items after the sterilization process and after the supplies are cool and safe to handle. For items that are gas sterilized, the load control number is marked on the item after the aeration period.

(5) If the sterilizer is equipped with a temperature indicator and recording chart, the load control number is recorded on the chart.
c. **Expiration Date.** The length of time a pack may be considered sterile depends on the type of packaging material used, whether or not dust covers are used, the number of times a package is handled before use, and the conditions of storage. This period is called shelf life. The expiration of this period must be marked on all items after the sterilization process and after supplies are cool and safe to handle. A color-coding system can be used by a facility in conjunction with expiration date. The expiration date is determined as indicated in Table 3-6.

<table>
<thead>
<tr>
<th>Closure</th>
<th>Permissible Use Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Without dust cover</td>
<td>3 days</td>
</tr>
<tr>
<td>With dust cover, not hermetically (heat)</td>
<td>30 days</td>
</tr>
<tr>
<td>sealed or tape sealed</td>
<td></td>
</tr>
<tr>
<td>Sterilized with hermetically sealed plastic</td>
<td>6 months</td>
</tr>
</tbody>
</table>

Table 3-6. Sample shelf life dates.

### 3-16. STORING

a. **General.** Sterile packages must be handled with care and stored in clean, dry, dustproof, and vermin-proof areas. Shelving should be smooth and well spaced with no projections or sharp corners that might damage the wrappers. Sterilized packs should never be stacked in close contact with each other but rather their arrangement should provide for air circulation on all sides of each package. While items processed through CMS may be stored in open shelving or closed shelving, closed shelving is preferred. Doors or lids should be closed except when removing or replacing items in the cabinets.

b. **Sterile Storage.** Sterilized items must:

   (1) Be thoroughly dry. Any dampness may contaminate the item.

   (2) Display visible evidence of having been sterilized.

   (3) Have identifying data and expiration date recorded after sterilization, if processed by CMS.

   (4) Be placed in storage directly from carts on which they are delivered from sterilizing area.

   (5) Be placed into a properly identified section of the storage cabinet.
(6) Be so positioned in cabinets as to make items with earlier expiration dates available for issue first. The oldest articles are used first. This is called rotation of stock.

(7) Be removed from storage, disassembled, and sent to the receiving, decontamination, and general cleanup area for reprocessing if not issued prior to the expiration date.

(8) Be sent to the hospital laboratory service for culture tests on a periodic basis, as determined by local policy.

c. Plastic Sealer. Figure 3-19 illustrates a plastic sealer that will hermetically seal packs that use plastic packaging. The dust cover is used to protect the supplies from dust, dirt, vermin, and moisture during the storage period and is removed just prior to taking the items into the treatment area.

![Figure 3-19. Plastic sealer.](image)

d. Pre-Sterilized Items. Presterilized, disposable medical material, if sent through CMS, must be:

(1) Removed from outer cases prior to entering CMS. Packing boxes must never be brought into the CMS area.

(2) Inspected for expiration or processing date, lot control number, method of sterilization, and damaged packaging.

(3) Stored in designated cabinets.
Section IV. CHEMICAL DISINFECTION

3-17. DISINFECTION

a. General. A disinfectant may be defined as the physical or chemical means to remove or reduce the capacity of microorganisms to produce disease. Disinfectants do not destroy most viruses or resistant bacterial spores. As a method of preparing items for use in patient care areas, including the operating room, its use should be restricted to those items that would be damaged or destroyed by sterilization means. Chemicals are used to disinfect, not to sterilize. Disinfecting floors, furniture, and portable equipment with chemicals make these reasonably safe to use.

b. Principles of Chemical Disinfection. The following principles should be observed when you use chemicals to disinfect.

1. All items to be disinfected must be clean. Organic soil (such as tissue, blood, feces) makes the chemical inactive.

2. The exposure time must be adequate.

3. The strength (concentration) of the chemical solution must be lethal for microorganisms. The concentration of the solution determines its effectiveness.

4. The disinfectant must be safe to handle.

5. The disinfectant must not be harmful to the item being disinfected.

6. A disinfectant may be good for one item but not for another.

c. Selection of Chemical Disinfectants. There are a variety of disinfectants available in CMS. The most common ones are discussed in the following paragraphs:

1. Alcohol. As a disinfectant, it must be in a solution but it is useful both as an antiseptic and as a disinfectant. For alcohol to be effective, the item must be totally immersed for not less than 30 minutes. Alcohol will not kill bacterial spores. Since alcohol is volatile, its use has been restricted.

2. Formalin. A solution of formaldehyde gas and water is known as formalin. Formalin and alcohol solution used by the military requires 30 minutes to kill bacteria and tubercle bacilli and 12 hours for spores. Some of the disadvantages of formalin include irritating fumes and irritation of tissue.

3. Iodine-alcohol combinations and iodophors. These two chemicals combined increase the effectiveness of both substances and decrease the exposure time required to kill microorganisms but it stains.
(4) **Quaternary ammonium compounds (quads).** These compounds have good germicidal activity, but they are neutralized by soap and certain detergents. They are also absorbed by gauze and fabrics and become diluted.

(5) **Phenolic compounds.** One of the oldest germicides is carbolic acid and phenol. Some of its disadvantages are tissue irritation and odor.

(6) **Glutaraldehyde (Cidex®).** This chemical is more active in a 2-percent aqueous (water) concentration and is used to disinfect cystoscopies and other lensed instruments, which are not used beneath body surfaces.

(a) The advantages of Cidex® are: it is sporicidal, bactericidal, and tuberculocidal, it can be used on cemented parts, and it is noncorrosive and won't injure sharp instruments

(b) The disadvantages of Cidex® are: long exposure time--10 hours, caustic to tissue, leaves residue, loses effectiveness after two weeks at room temperature, and is very expensive.

(c) Cidex® is used as a last resort for sterilization.

**NOTE:** Table 3-7 provides general information on the usefulness and effectiveness of chemical disinfectants.
<table>
<thead>
<tr>
<th><strong>Liquid</strong></th>
<th>Disinfectants</th>
<th>Antiseptics</th>
<th>TBC</th>
<th>Spores</th>
<th>Other properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marcurial compound</td>
<td>None</td>
<td>Poor</td>
<td>None</td>
<td>None</td>
<td>Static only; inactive by organic matter; bland.</td>
</tr>
<tr>
<td>Phenolic compound</td>
<td>Good</td>
<td>Poor</td>
<td>Good</td>
<td>Poor</td>
<td>Bad odor; irritating, not inactive by organic matter or soap, stable.</td>
</tr>
<tr>
<td>Quaternary ammonium compounds (&quot;quats&quot;)</td>
<td>Good</td>
<td>Good</td>
<td>None</td>
<td>None</td>
<td>Neutralized by soap; relatively nontoxic; odorless, absorbed by gauze or fabric.</td>
</tr>
<tr>
<td>Chlorine compounds</td>
<td>Good</td>
<td>Fair</td>
<td>Fair*</td>
<td>Fair*</td>
<td>Inactive by organic matter; corrosive.</td>
</tr>
<tr>
<td>Iodine and iodophors</td>
<td>Good</td>
<td>Good</td>
<td>Good#</td>
<td>Poor#</td>
<td>Staining temporary; relatively corrosive.</td>
</tr>
<tr>
<td>Alcohols</td>
<td>Good+</td>
<td>Very good+</td>
<td>Very good+</td>
<td>None</td>
<td>Volatile: strong concentration required rapidly cidal; inactive by organic matter.</td>
</tr>
<tr>
<td>Formaldehyde</td>
<td>Fair</td>
<td>None</td>
<td>Good**</td>
<td>Fair*</td>
<td>Toxic; irritating fumes.</td>
</tr>
<tr>
<td>Glutaraldehyde</td>
<td>Good</td>
<td>None</td>
<td>Good</td>
<td>Good</td>
<td>Low protein coagulability; aqueous solution useful for lens instruments and rubber articles. Limited stability. Corrodes carbon steel objects after 24 hours exposure.</td>
</tr>
<tr>
<td>Hexaclarophene</td>
<td>Fair</td>
<td>Good</td>
<td>None</td>
<td>None</td>
<td>Slow acting; not neutralized (pHisoHex) by soap; water insoluble; alcohol soluble; inactive by organic matter.</td>
</tr>
<tr>
<td>Combinations:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Iodine-alcohol</td>
<td>Fair</td>
<td>Very good</td>
<td>Very good</td>
<td>None</td>
<td>Stains fabrics</td>
</tr>
<tr>
<td>Formaldehyde alcohol</td>
<td>Good**</td>
<td>None</td>
<td>Very good**</td>
<td>Good**</td>
<td>Toxic; irritating fumes; volatile.</td>
</tr>
<tr>
<td><strong>Gas</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ethylene oxide</td>
<td>Special</td>
<td>None</td>
<td>Good</td>
<td>Good</td>
<td>Poisonous; expensive; penetrating.</td>
</tr>
<tr>
<td>Beta-propiolactone</td>
<td>Special</td>
<td>None</td>
<td>Good</td>
<td>Very good</td>
<td>Vesicant; carcinogenic; expensive; unstable.</td>
</tr>
</tbody>
</table>

* = 4-5% concentration + = 70-90% concentration ** = 5-8% formaldehyde (12-20% formalin) 
# = 450 or more ppm available iodine 

Table 3-7. Evaluation of germicides (bacterial only).
Sanitation is the process by which the number of microorganisms is reduced to a level considered safe for human use. As discussed in Lesson 1, infections or infectious diseases are caused by microorganisms that come from many sources such as feces, blood, and body fluids. These microorganisms are transferred by direct contact such as kissing; by indirect contact such as fingers, foods, water, soil, insects, or articles contaminated by infectious microorganisms; or by droplets released into the air by sneezing, coughing, or speaking. Good sanitation is provided by carefully and regularly using antiseptics, disinfectants, and germicides in the CMS area to kill microorganisms that might be transferred to a patient or other hospital personnel. Using effective disinfectants or germicides to clean the equipment, furniture, floors, and walls and using antiseptics to clean hands will reduce the microorganisms to a safe level.

Continue with Exercises
EXERCISES, LESSON 3

INSTRUCTIONS. The following exercises are to be answered by marking the lettered response that best answers the question or best completes the incomplete statement or by writing the answer in the space provided.

After you have completed all the exercises, turn to "Solutions to Exercises" at the end of the lesson and check your answers. For each exercise answered incorrectly, reread the material referenced with the solution.

1. Define sanitation.

_________________________________________________________________
_________________________________________________________________

2. List the three advantages of Cidex®.

_________________________________________________________________
_________________________________________________________________
_________________________________________________________________

3. Sterile supplies are positioned in cabinets so that the oldest articles are used first. What is this called?

_________________________________________________________________

4. Why does the Army require load control numbers and expiration dates on all supplies that are sterilized?

_________________________________________________________________

_________________________________________________________________
5. For steam sterilization there are four types of controls, which monitor the process. List the four types:

_________________________________________________________________
_________________________________________________________________
_________________________________________________________________
_________________________________________________________________

6. There are ___________ digits in a load control number.

7. The length of time a pack may be considered sterile depends on the type of packaging material used, whether or not dust covers are used, the number of times a package is handled before use, and the conditions of storage. This period is called:

_________________________________________________________________

SPECIAL INSTRUCTIONS FOR ITEMS 8 THROUGH 16. Indicate whether each of the following statements is true or false.


8. Alcohol will kill bacterial spores in 60 minutes.
   a. True.
   b. False.

9. Presterilized disposable medical material should be removed from outer cases prior to entering CMS.
   a. True.
   b. False.
10. Chemicals are used to disinfect, not to sterilize.
   a. True.
   b. False.

11. Only when the soil has been thoroughly removed can a sterilizing agent come in direct contact with the surfaces of the object to be sterilized.
   a. True.
   b. False.

12. The ultrasonic cleaner uses a high-frequency sound as a source of energy for sterilizing.
   a. True.
   b. False.

13. Packing material for all methods of sterilization must be flexible.
   a. True.
   b. False.

14. Only those items, which are heat-resistant should be gas sterilized with ethylene oxide.
   a. True.
   b. False.

15. Gas sterilization is used to sterilize items that are heat or moisture sensitive.
   a. True.
   b. False.
16. Cleaning procedures in CMS depend on whether the items are contaminated or soiled.
   a. True.
   b. False.

17. List two advantages of ethylene oxide sterilization.
   ___________________________________________________________________
   ___________________________________________________________________

18. What is the destruction phase of steam sterilization based upon?
   ___________________________________________________________________

19. The effectiveness of the sterilization processes depend upon a properly functioning and clean _____________________________.

20. In what phase of steam sterilization is the process checked for failure?
   a. Phase 1.
   b. Phase 2.
   c. Phase 3.
   d. Phase 4.
   e. Phase 5.
21. In the conventional steam sterilizer, the sterilization process has five phases. List the five phases.

______________________________________________________________

______________________________________________________________

______________________________________________________________

______________________________________________________________

______________________________________________________________

22. The text presented six principles of chemical disinfection. List three.

______________________________________________________________

______________________________________________________________

______________________________________________________________

23. Using units send used equipment and supplies to which area in CMS?

______________________________________________________________

24. ________________ is the material that has been used the longest and most often by the Army to wrap items for sterilization.

25. The filer to the chamber discharge line is removed, cleaned, and replaced:
   a. After each use.
   b. Daily.
   c. Weekly.
   d. As determined locally.

26. The largest pack in sterilization should not weigh more than _______ to ________ pounds.
27. For items that can withstand moisture and heat, the washer-sterilizer is the preferred method for ________________.

28. List three ways to sterilize supplies and equipment.
   ______________________________________________________
   ______________________________________________________
   ______________________________________________________

29. What is the main hindrance to effective steam sterilization?
   ______________________________________________________

30. What are the two types of steam sterilizers?
   ______________________________________________________
   ______________________________________________________

31. List three advantages of steam sterilization.
   ______________________________________________________
   ______________________________________________________
   ______________________________________________________

32. What is aeration in relation to ethylene oxide sterilization?
   ______________________________________________________

33. How are heat-sensitive items dried after they have been cleaned and rinsed?
   ______________________________________________________
34. What are three disadvantages of EO gas sterilization?

_________________________________________________________________

_________________________________________________________________

_________________________________________________________________

35. Why is an inert gas mixed with ethylene oxide gas?

_________________________________________________________________

36. Why are soiled and used items bagged for return to CMS?

_________________________________________________________________

37. After used supplies and equipment are received by CMS, _________________ is the first step in processing.

38. An established and approved process by which all forms of microorganisms are destroyed is called _________________________.

39. When you wash items in a solution, why must you always brush under the surface of the liquid?

_________________________________________________________________

40. After cleaning in a detergent solution, you must rinse the items three times. Why do you change the rinse water frequently?

_________________________________________________________________

41. How are heat-resistant items dried after rinsing?

_________________________________________________________________

_________________________________________________________________

Check Your Answers on Next Page
1. Process by which the number of microorganisms is reduced to a level considered safe for human use. (para 3-18)

2. It is sporicidal, bactericidal and tuberculocidal. It can be used on cemented parts. It is noncorrosive and won't injure sharp instruments. (para 3-17 c(6))

3. Rotation of stock. (para 3-16b(6))

4. To provide a record of the history of sterilization. (para 3-15a)

5. Mechanical Biological Chemical Bowie-Dick test (para 3-12e)

6. Six (para 3-15b)

7. Shelf life (para 3-15c)

8. b (para 3-17c(1))

9. a (para 3-16c(1))

10. a (para 3-17a)

11. a (para 3-6c)

12. b (para 3-6b(5))

13. a (para 3-10a(5))

14. a (para 3-13)

15. a (para 3-3a)

16. a (para 3-6a)
17. Any two of the five listed:
   - Easily available.
   - Effective against all types of microorganisms.
   - Penetrates easily.
   - Does not require high temperature, humidity, or pressure.
   - Noncorrosive and non-damaging to items. (para 3-13a)

18. The time-temperature necessary to kill all microbial life. (para 3-12c)

19. Sterilizer (para 3-11b)

20. e (para 3-12e)

21. Loading, heating, destruction, drying and cooling, testing. (para 3-12).

22. Any three of the six listed:
   - Item must be clean.
   - Exposure time adequate.
   - Strength lethal for microorganisms.
   - Safe to handle.
   - Not harmful to items being disinfected.
   - Good for one item but not for another. (para 3-17b)

23. Cleanup area (para 3-4c)

24. Muslin (para 3-10b)

25. b (para 3-11b(1)(b))

26. 10 to 12 (para 3-9b(3)

27. Decontamination (para 3-6b(1))

28. Saturated steam under pressure
    Ethylene oxide gas
    Dry heat (para 3-1a(2))

29. The presence of air in the sterilization chamber. (para 3-2b(3))

30. Gravity-displacement and prevacuum high temperature. (para 3-2b)
31. Any three of the six methods listed:
   Easiest and safest.
   Fastest.
   Least expensive.
   Automatic control and recording devices eliminates human factor.
   Many items withstand repeated processing without damage and it leaves no
   harmful residue. (para 3-2b(4)).

32. The time it takes for the EO gas to diffuse from the items sterilized. (para 3-3c)

33. Air dried (para 3-7b(3))

34. Any three of the five listed:
   Expensive.
   Long slow process.
   Toxic.
   Highly flammable and explosive.
   Difficult to verify effectiveness. (para 3-3e)

35. Ethylene oxide gas is highly flammable and explosive in air. (para 3-3a)

36. To prevent the spread of infection. (para 3-4c)

37. Sorting (para 3-5b)

38. Sterilization (para 3-1a(2))

39. To avoid splattering yourself and the surrounding area. (para 3-6c(1)(e))

40. To prevent residual build up on the items. (para 3-7a(3))

41. By placing them in the autoclave and using autoclave without steam.
   (para 3-7b(1))

End of Lesson 3
LESSON ASSIGNMENT

LESSON 4
Preparation of Supplies and Equipment.

LESSON ASSIGNMENT
Paragraphs 4-1 through 4-4.

LESSON OBJECTIVES
After completing this lesson, you should be able to:

4-1. Identify hospital articles normally found in a diagnostic or treatment tray.

4-2. Identify the minimum time required for sterilization.

4-3. Identify common control systems normally used in the CMS as described in the text.

SUGGESTION
After reading and studying the assignment, complete the exercises at the end of this lesson. These exercises will help you to achieve the lesson objectives.
LESSON 4
PREPARATION OF SUPPLIES AND EQUIPMENT

Section I. TRAYS

4-1. TREATMENT TRAYS AND SETS

a. General. The basic diagnostic and therapeutic trays that are commonly used are illustrated in figures 4-4 through 4-19. The legends on these figures indicate how the tray is used as well as list the items displayed. Each medical facility will vary the setups to meet the needs and policies of the individual facility. Some of the common items used on treatment trays and sets are described in the following paragraphs.

(1) Towels. In most procedures, towels are used as a drape. The number of towels depends upon the procedure, so they are packaged separately and added as needed.

(2) Towel clips. Towel clips are necessary to keep the towels in place.

(3) Sponges. Sponges are a sterile surgical dressing of absorbent material for wiping or absorbing blood or other fluids during an operation. Sponges are an essential on almost every tray. The number of sponges is usually standardized in a medical facility.

(4) Sponge forceps. Forceps are instruments, similar to pincers or tongs, for seizing and holding objects, especially in surgical operations. Sponge forceps, often called "sponge stick" are used to hold sponges and used as a swab.

(5) Solution cup. The container for the antiseptic is a solution cup and is made of different material than a medicine glass.

(6) Medicine glass. A one ounce glass used for a number of fluids such as liquid medication, germicides, saline, and so forth. It is included in most trays.

(7) Syringes. Whenever a local anesthetic (a drug used to "deaden" a particular area) is necessary, a syringe is needed. Syringes are wrapped unassembled to assure contact of all surfaces with steam or gas during the process of sterilization.

(8) Needles. When reusable needles are a component of a tray, three sizes of needles are usually included in a tray. Needles are placed in a sponge. See figures 4-1, 4-2, and 4-3.
Figure 4-1. Needles -- points and cross sections.

Figure 4-2. Needles -- types of eyes.

Figure 4-3. Shapes of needle shafts.
Closure. Wherever a surgical opening has been made, it is generally followed by surgical closure. Sutures, suture needles, needle holder, and suture scissors are required for closure.

b. Trays. Trays are assembled and wrapped as described in the next paragraph before sterilizing.

4-2. GUIDELINES FOR SETTING UP TRAYS

a. General.

(1) Trays should be perforated to allow the steam to flow in and the air to flow out more easily.

(2) A hand towel should be placed in the bottom of each tray to protect items and hold them together.

b. Assembling, Wrapping, and Labeling Trays.

(1) Assemble trays in accordance with pre-established list. Photographs illustrating the items to be included on each tray may be used. Figure 3-13 is an example of a pre-established list.

(2) Select the correct forceps. Various types and sizes of forceps are used on trays.

(3) Open all instruments. One method for keeping instruments open is to string them on a rust-resistant (noncorrosive) heavy wire, formed in a "U" shape. In stringing the instruments, turn each instrument so that one loop of the handle is above the other one; then insert the "U" wire through the loops.

(4) Separate containers such as medicine glasses or solution cups by putting such material as a 4 x 4-inch (10 x 10-cm) gauze sponge between them when they are nested together or simply place them in the tray separately.

(5) Place containers on the tray so that they will be on their sides, when the tray is put into the sterilizer.

(6) Disassemble all syringes.

(7) Protect fragile glassware from breaking.

(8) Place rubber items so they will not be in contact with metal or glass (exception (10) below).

(9) Add distilled/demineralized water to lumen (opening) of rubber items.
(10) If connector must be attached to the lumen before sterilization, moisten it with distilled/demineralized water.

(11) Place items so that steam and gas can circulate freely.

(12) Standardize number of sponges placed on trays.

(13) Place the appropriate sterilization process monitor in the tray.

(14) Double wrap each tray in a permeable wrapper large enough to ensure ample coverage of the entire tray. The closure must be secured with appropriate sterilization indicator tape.

(15) Identify each tray, preferably with pressure-sensitive preprinted labels.

c. **Sterilizing.** Although moist-heat sterilization is the preferred method of sterilizing trays, heat-sensitive materials, including electrical equipment, are sterilized with ethylene oxide gas. To sterilize you will:

   (1) Wrap each tray in a permeable wrapper large enough to ensure ample coverage of the entire tray. The closure must be secured with appropriate sterilization indicator tape.

   (2) Identify the tray with pressure-sensitive preprinted labels or pressure-sensitive tape with the identification written on tape.

   (3) Put the set on its side in the autoclave carriage and sterilize as follows:

      (a) Thirty minutes at 250°F (121°C), gravity-displacement sterilizer.

      (b) Fifteen minutes at 272º to 276ºF (132ºC), prevacuum, high-temperature sterilizer.

      (c) For gas sterilization, the required time, concentration, temperature, and humidity is shown in Table 3-4.

   (4) Allow the trays to dry, remove them from the autoclave, and allow them to cool on a nonmetal surface. They should not lie flat on the surface, but in such a way the air can circulate around the tray.

   (5) For trays sterilized in EO gas, you must allow aeration time as prescribed in Table 3-1.

d. **Dating and Storing.** After the sterilization cycle is completed, you must add the load control number and expiration date to each tray and store in a sterile area.
Figure 4-4. Aspirating tray.

USE: TO REMOVE FLUID FROM A JOINT OR BODY CAVITY

A 8 SPONGES, SURGICAL, 4x4 INCH (10 x 10 cm), PLAIN
B 1 LATEX TUBING, 3/16 INCH (0.45 CM) INSIDE DIAMETER, 10 INCH (25.4 cm) LENGTH, WITH GLASS NEEDLE ADAPTER,
1 STOPCOCK, 5-WAY AYER
C 3 TEST TUBES, SCREW CAP, CULTURE
D 1 MEDICINE GLASS
E* 2 NEEDLES, HYPODERMIC, 17 GAGE, 3 INCH (7.5 cm)
2 NEEDLES, HYPODERMIC, 15 GAGE, 1½ INCH (3.7 cm)

F* 1 NEEDLE, HYPODERMIC, 26 GAGE, 1/2 INCH (1.2 cm)
1 NEEDLE, HYPODERMIC, 21 GAGE, 1½ INCH (3.1 cm)
1 NEEDLE, HYPODERMIC, 19 GAGE, 1½ INCH (3.7 cm)
G 1 SYRINGE, 2 ml
H 1 SYRINGE, 10 ml, Luer Lock
I 1 SYRINGE, 30 ml, WITH METAL SYRINGE ADAPTER
J 1 FORCEPS, HEMOSTATIC, RANKIN (STRAIGHT KELLY), STRAIGHT, 6¼ INCH (15.6 cm)
K 1 HANDLE, SURGICAL KNIFE, NO 3
L 1 BLADE, DETACHABLE, NO 11

NEEDLES MUST BE SECURED IN TWO LAYERS OF MUSLIN WITH TIPS EMBEDDED.
TRAY SIZE: 15½ X 9½ X 2 INCHES (90 x 90 cm)
WRAPPER SIZE: 36 X 36 INCHES (90 X 90 cm)
CHEMICAL INDICATOR (STERILIZATION PROCESS MONITOR)
4 HAND TOWELS WRAPPED AND STERILIZED SEPARATELY.
Figure 4-5. Aortogram tray.
Figure 4-6. Biopsy or suture tray.
USE: TO OBTAIN MARROW FROM BONE FOR DIAGNOSTIC PURPOSES

| A  | 6 SPONGES, SURGICAL 4 X 4 INCH (10 X 10 cm), PLAIN |
| B  | 1 CUP, SOLUTION                                      |
| C  | 1 MEDICINE GLASS                                     |
| D  | 2 FORCEPS, TOWEL, BACKHAUS (SMALL TOWEL CLIP), 3/4 INCH (8.7 cm) |
| E  | 1 HANDLE, SURGICAL KNIFE, NO 3                       |
| F  | 1 BLADE, DETACHABLE, NO 11                           |
| G  | 1 FORCEPS, GAUZE PAD HOLDING, FOERSTER (SPONGE FORCEPS), 8/4 INCH (20.7 cm) |
| H  | 1 NEEDLE, HYPODERMIC, 26 GAGE, 1/2 INCH (1.2 cm)     |
| I  | 1 NEEDLE, HYPODERMIC, 22 GAGE, 1 INCH (2.5 cm)       |
| J  | 1 NEEDLE, HYPODERMIC, 22 GAGE, 1 1/4 INCH (3.7 cm)   |
| K  | 1 NEEDLE SET, STEernal PUNCTURE, TURKEL              |
| L  | 1 SYRINGE, 2 ml                                      |
|    | 1 SYRINGE, 10 ml, LUER LOCK                          |
|    | 1 SYRINGE, 20 ml, LUER LOCK                          |

*NEEDLES MUST BE SECURED IN TWO LAYERS OF MUSLIN WITH TIPS EMBEDDED.*

TRAY SIZE: 15/4 X 9/6 X 2 INCHES (39.7 X 23.7 X 5 cm)
HAND TOWEL TO LINE TRAY
WRAPPER SIZE: 50 X 30 INCHES (60 X 90 cm)
CHEMICAL INDICATOR (STERILIZATION PROCESS MONITOR)
2 HAND TOWELS WRAPPED AND STERILIZED SEPARATELY
1 DRAPE WRAPPED AND STERILIZED SEPARATELY

NOTE: THE DESIRED STErnAL PUNCTURE NEEDLES MUST ACCOMPANY THE TRAY. FOR PEDIATRICS, A SET OF NEEDLES, TURKEL, ILiac CREST, CHILD SIZE, MUST ACCOMPANY THE TRAY.

Figure 4-7. Sternal puncture (bone marrow) tray.
USE: TO OBTAIN SPECIMEN OF LIVER OR KIDNEY TISSUE FOR DIAGNOSTIC PURPOSES

A: 6 SPONGES, SURGICAL 4 X 4 INCH (10 X 10 cm), PLAIN
B: 1 CUP, SOLUTION
C: 1 MEDICINE GLASS
D: 3 MICROSCOPE SLIDES
E*: 1 NEEDLE, HYPODERMIC, 26 GAUGE, ½ INCH (1.2 cm)
   1 NEEDLE, HYPODERMIC, 23 GAUGE, ¼ INCH (1.8 cm)
   1 NEEDLE, HYPODERMIC, 22 GAUGE, 1 INCH (2.5 cm)
   1 NEEDLE, HYPODERMIC, 22 GAUGE, 1 ½ INCH (3.7 cm)
   1 NEEDLE, ANESTHESIA, SECURITY STOP, 22 GAUGE, 3 INCH (7.5 cm)
F*: 1 NEEDLE, SPINAL PUNCTURE, 22 GAUGE, 3½ INCH (8.7 cm)
   1 NEEDLE, SPINAL PUNCTURE, 22 GAUGE, 5 INCH (12.5 cm)
   1 NEEDLE, SPINAL PUNCTURE, 22 GAUGE, 6 INCH (15 cm)

G: 1 SYRINGE, 10 ml, Luer lock
H: 1 SYRINGE, 2 ml
I: 4 FORCEPS, TOWEL, BACKHAUS (SMALL TOWEL CLIP), 3½ INCH (8.7 cm)
J: 1 FORCEPS, GALEAZE PAD HOLDING, STRAIGHT, FOERSTER (SPONGE FORCEP), 6½ INCH (23.7 cm)
K: 1 FORCEPS, HEMOSTATIC, RANKIN (STRAIGHT KELLY), STRAIGHT, 6½ INCH (15.6 cm)
L*: 1 NEEDLE, LIVER BIOPSY, SILVERMAN-MODIFIED FRANKLIN TYPE, 5 INCH (12.5 cm)
M: 1 HANDLE, SURGICAL KNIFE, NO 3
N: 1 BLADE, DETACHABLE, NO 11
O: 1 TEST TUBE, SCREW CAP, CULTURE

*NEEDLES MUST BE SECURED IN TWO LAYERS OF MUSLIN WITH TIPS EMBEDDED.

TRAY SIZE: 15½ X 9½ 2 INCHES (39.7 X 23.7 X 5 cm)
HAND TOWEL TO LINE TRAY
WRAPPER SIZE: 36 X 36 INCHES (90 X 90 cm)
CHEMICAL INDICATOR (STERILIZATION PROCESS MONITOR)
4 HAND TOWELS WRAPPED AND STERILIZED SEPARATELY
1 DRAPE WRAPPED AND STERILIZED SEPARATELY

Figure 4-8. Liver-renal biopsy tray.
Figure 4-9. Gastric analysis or lavage tray.
Figure 4-10. Thoracentesis tray.
Figure 4-11. Sigmoidoscopy tray.

**Figure 4-11. Sigmoidoscopy tray.**
Figure 4-12. Cardiac arrest tray.
Figure 4-13. Circumcision tray.

USE: TO REMOVE A PORTION OF THE FORESKIN

A 6 SPONGES, SURGICAL 4 X 4 (10 X 10 cm) PLAIN
B 1 CUP, SOLUTION
C 1 Clamp, Circumcision, Goldstein (4 Parts)
D 1 Forceps, Gauze Pad Holding, Forster (Sponge Forceps), Straight, 5/8 INCH (2.5 cm)
E 1 Probe, General Operating, 5 INCH (12.5 cm)

F 1 Forceps, Dressing, Straight, 5/8 INCH (13.7 cm)
G 3 Forceps, Hemostatic, Halstead (Mosquito), Straight, 5 INCH (12.5 cm)
H 1 Handle, Surgical Knife, No 3
I 1 Blade, Detachable, No 10
J 1 Scissors, General Surgical, Straight, Mayo, 5/8 INCH (13.7 cm)

TRAY SIZE: 15/2 X 9/2 X 2 INCHES (38.7 X 23.7 X 5 cm)
HAND TOWEL TO LINE TRAY
WRAPPER SIZE: 36 X 36 INCHES (90 X 90 cm)
CHEMICAL INDICATOR (STERILIZATION PROCESS MONITOR)
2 HAND TOWELS WRAPPED AND STERILIZED SEPARATELY
1 Drape Wrapped and Sterilized Separately

NOTE: Gauze, Petroleum, Sterile, and Circumcision Board Must Be Available for This Procedure.
Figure 4-14. Cut down tray.
Figure 4-15. Emergency delivery tray.

USE: FOR EMERGENCY DELIVERY OUTSIDE THE OBSTETRICAL AREA

A 1 BABY BLANKET
B 10 SPONGES: SURGICAL, GAUZE, RADIOPAQUE,
  4 X 8 INCHES (10 X 20 cm)
C 1 PAD, PERINEAL
D 1 BOWL, SURGICAL SPONGE, STEEL
E 1 SYRINGE, G6, 3 OUNCE (84 ml) (THE TIP OF THE SYRINGE
  EXTENDS THROUGH A 4 X 4 INCH (10 X 10 cm) SPONGE WITH
  ITS 4 CORNERS SECURED IN A SQUARE KNOT)
F 1 SCISSORS, GENERAL SURGICAL, MAYO, STRAIGHT,
  6 3/4 INCH (16.8 cm)
G 2 FORCEPS, HEMOSTATIC, ROCHESTER-BEAU (CURVED KELLY),
  CURVED, 6 INCH (15.6 cm)
H 1 UMBILICAL TAPE AND/OR
  1 CLAMP, UMBILICAL CORD

TRAY SIZE: 19 1/4 X 12 3/4 X 3/4 INCHES (48.1 X 31.8 X 1.8 cm)
HAND TOWEL TO LINE TRAY
WRAPPER SIZE: 48 X 48 INCHES (120 X 120 cm)
CHEMICAL INDICATOR (STERILIZATION PROCESS MONITOR)
4 HAND TOWELS WRAPPED AND STERILIZED SEPARATELY
1 DOUBLE SHEET WRAPPED AND STERILIZED SEPARATELY
Figure 4-16. Nasal hemorrhage tray.

USE: TO AID IN CONTROLLING NASAL HEMORRHAGE

A 5 SPONGES, SURGICAL, 4 X 4 INCH (10 X 10 cm), PLAIN
B 12 BALLS, ABSORBENT COTTON, ¼ INCH (3.1 cm) DIAMETER
C 6 SPONGES, SURGICAL GAUZE, ¼ INCH (2.1 cm) DIAMETER
D 12 APPLICATORS, DISPOSABLE, ½ INCH (15.6 cm)
E 1 MEDICINE GLASS
F 1 DEPRESSOR, TONGUE, METAL, WEDER

G 1 SPECULUM, NASAL, VIENNA, 5-3/4 INCH (14.3 cm)
H 1 FORCEPS, DRESSING, BAYONET SHAPED
I 1 CANNULA, BRAIN, FRAZIER (SUCTION TIP), SIZE 8 WTI-STYLE
J 1 FORCEPS, HEMOSTATIC, ROCHESTER-PEAN (CURVED KELLY), CURVED, 6¼ INCH (15.6 cm)
K 1 SCISSORS, GENERAL SURGICAL, STRAIGHT, MAYO, 6-3/4 INCH (17.8 cm)

TRAY SIZE: 15½ X 9½ X 2 INCHES (30 X 24 X 5 cm)
HAND TOWEL TO LINE TRAY
WRAPPER SIZE: 36 X 36 INCHES (90 X 90 cm)
CHEMICAL INDICATOR (STERILIZATION PROCESS MONITOR)
2 HAND TOWELS WRAPPED AND STERILIZED SEPARATELY
Figure 4-17. Tracheostomy tray.
Section II. PORTABLE EQUIPMENT

4-3. PROCESSING EQUIPMENT FOR PATIENT TREATMENT AND CARE

a. General. Central Materiel Service is responsible for a number of different types of portable equipment used in the treatment and care of patients. They range from humidifiers to turning frames. The care of the equipment requires both skill and knowledge. It is important that the equipment be in perfect working condition, safe to use, and immediately available for emergencies. Figures 4-18 through 4-24 are examples of portable equipment maintained in the CMS.

b. Operation. Central Materiel Service personnel must know how to operate, disassemble, and reassemble all portable equipment. Instructions on the operation of the equipment must always accompany the equipment. When new equipment is received, a demonstration of its operation and maintenance is usually given by the manufacturer's representative. Central Materiel Service personnel will perform most operating and maintenance procedures under the guidance of the manufacturer's representative so that difficulties can be resolved. Medical maintenance is responsible for major maintenance of the equipment.

c. Initial Processing - Using Unit. The using unit will perform initial processing by:

(1) Removing and discarding all disposable parts that have had direct contact with the patient.

(2) Placing small nondisposable parts in a plastic bag and attaching to equipment.

(3) Placing in CMS pick up area or returning it to CMS.

Figure 4-18. Thoracic drainage pump. (Note sterilized tubing in sealed package).
Figure 4-19. Thermotic drainage pump mounted on stand.

Figure 4-20. Thermotic drainage pump, portable model.
Figure 4-21. Respirator unit. (Note parts in plastic bag secured to the unit).

Figure 4-22. Orthopedic equipment and storage.
Figure 4-23. Foster orthopedic bed.

Figure 4-24. Stryker frame.
4-4. CENTRAL MATERIEL SERVICE PROCESSING

a. Cleaning. In the cleanup area, you will remove all parts that have been in direct contact with the patient. Wash these parts in a suitable detergent and sterilize them. Wash all accessible surfaces of the equipment that cannot be disassembled as follows:

(1) Use a mild detergent solution.
(2) Start at the top and work downward, cleaning the casters (wheels) last.
(3) Change washing solution as often as necessary.
(4) Avoid getting moisture into electrical element or motor.
(5) Rinse with tap water and dry.
(6) Reassemble the equipment.
(7) Test equipment for normal functioning.
(8) Oil equipment in accordance with the manufacturer's instructions.

NOTE: Excessive oiling can damage equipment.
(9) Report equipment requiring repairs immediately to the NCOIC of CMS.

b. Disinfecting. If the entire equipment or a portion of it must be surgically clean and it is heat-sensitive or too large to be placed in available gas or steam sterilizer, you must chemically disinfect it. The procedures for disinfecting it are:

(1) Submerge small parts in a disinfectant solution and wipe all surfaces of larger parts thoroughly with a cloth that is well moistened with the disinfectant solution.
(2) Allow the chemical disinfectant to air dry on items. An exception to this would be all parts used directly on the patient, such as an endotracheal tube. These must be thoroughly rinsed to remove all traces of the disinfectant solution that could result in irritation to the skin, mucous membrane, or other tissues.
(3) Remove parts, which are now considered surgically clean, to a clean area.
(4) Check the parts for wear and other defects. Replace defective parts.
(5) Place the parts that will be used by the patient in a see-through bag. Seal, label, and attach the bag to the equipment as shown in figure 4-21.

(6) When equipment is functioning properly and ready for patient use, place a protective cover on it and move it from the clean area to the storage area.

c. **Sterilizing and Storing.** Equipment which must be sterile (normally those parts used directly on the patient) and that is small enough to be placed in either an autoclave or gas sterilizer should be packaged and sterilized. After sterilizing or disinfecting, the portable equipment and attachments are stored as follows:

(1) Store all equipment and replacement parts in an area or room specifically designed for the purpose. This area must be kept from vermin and spotlessly clean.

(2) Place like items together.

(3) Place items where they are easy to reach and to remove from storage.

(4) Ensure that equipment is ready for immediate delivery by keeping items that come in direct contact with the patient packaged until used and by placing protective covers on infrequently used equipment.

d. **Maintaining.** Preventive maintenance requires time, effort, consistent attention, and records. Each piece of equipment should be routinely checked by medical maintenance personnel on a definite schedule. Local policies determine the frequency and schedule for preventive maintenance.

e. **Control of Equipment.** Some means of knowing the location of all portable equipment that is not in CMS is required. An item of equipment may be in a using unit or in medical maintenance for repairs. Two methods used for control of equipment include:

(1) **Locator board.** A sample locator board is illustrated in figure 4-25. Each piece of equipment may be color-coded. When the equipment is moved from CMS, its identification is moved to the location on the board that identifies the name and location holding the equipment. When the equipment is returned to CMS, the identification is replaced on the item of the equipment.
Figure 4-25. Locator board used by CMS to track portable equipment.

(2) **Visible card file.** A visible card file (Kardex) containing enough slots for one 5 X 8-inch card for each item of equipment is used to record the following information:

(a) Name of item.
(b) Location of item in storage.
(c) Date issued and location, such as nursing unit, clinic, or medical maintenance.
(d) Date returned.
(e) Maintenance check, date, and initials of checker.

Continue with Exercises
EXERCISES, LESSON 4

INSTRUCTIONS. The following exercises are to be answered by marking the lettered response that best answers the question, or by completing the incomplete statement, or by writing the answer in the space provided at the end of the question.

After you have completed all the exercises, turn to "Solutions to Exercises" at the end of the lesson and check your answers with the Academy solutions.

1. What are sponges?

________________________________________________________________
________________________________________________________________
________________________________________________________________

2. List four common items used on treatment trays and sets.

________________________________________________________________
________________________________________________________________
________________________________________________________________
________________________________________________________________
________________________________________________________________
3. The instruments shown above are those usually put in a _____________ tray.
   
   a. Cutdown.
   
   b. Aspirating.
   
   c. Circumcision.
   
   d. Thoracentesis.
4. The instruments shown above are those used to assemble a(n) __________ tray.
   
   a. Gastric analysis or lavage.
   
   b. Emergency delivery.
   
   c. Biopsy or suture.
   
   d. Cardiac arrest.
5. The instruments shown above are used to assemble a(n) ______________ tray.


   b. Sigmoidoscopy.

   c. Tracheostomy.

   d. Aortogram.

Check Your Answers on Next Page
SOLUTIONS TO EXERCISES, LESSON 4

1. Sterile surgical dressings of absorbent material used for wiping or absorbing blood or other fluids during an operation. (para 4-1a(3))

2. Any four of these nine items is correct:
   - Towels
   - Towel clips
   - Sponges
   - Sponge forceps
   - Solution cup
   - Medicine glass
   - Syringes
   - Needles
   - Closure materials (para 4-1a)

3. a (figure 4-14)

4. c (figure 4-6)

5. b (figure 4-11)

End of Lesson 4