SUBCOURSE
SS0548

EDITION
6

OPERATION OF ELECTRONIC NEWS GATHERING SYSTEM/ELECTRONIC FIELD PRODUCTION COMPONENTS (ENG/EFP)

THE ARMY INSTITUTE FOR PROFESSIONAL DEVELOPMENT

ARMY CORRESPONDENCE COURSE PROGRAM

IPD

READINESS/
PROFESSIONALISM

THRU
GROWTH

U.S. ARMY AUDIO TELEVISION SPECIALIST
MOS 84F SKILL LEVEL 1 COURSE

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OPERATION OF ELECTRONIC NEWS GATHERING SYSTEM/ ELECTRONIC FIELD PRODUCTION COMPONENTS (ENG/EFP)

SUBCOURSE NO. SS0548-6
(Developmental Date: 30 Jun 86)

U.S. ARMY SIGNAL SCHOOL
FORT GORDON, GEORGIA

Three Credit Hours

GENERAL

The operation of Electronic News Gathering Systems/Electronic Field Production Components (ENG/EFP) Subcourse, part of the Audio Television, MOS 84F Skill Level 1 course, is designed to teach the knowledge necessary for performing tasks related to the operation of the ENG/EFP system. Information is provided on several tasks which are performed at increasing levels of difficulty at Skill Levels 1, 2, and 3. The subcourse is presented in four lessons, each lesson corresponding to a terminal objective as indicated below.

Lesson 1: DEFINE THE ENG/EFP SYSTEM, ITS COMPONENTS, USES AND OPERATION

TASK: Define ENG/EFP System, components, and operation of the ENG/EFP system.

CONDITIONS: Given information and illustrations about terms relating to ENG/EFP system, the uses, components, and operation thereof.

STANDARDS: Demonstrate competency of the task skills and knowledge by correctly responding to 85 percent of the multiple-choice test covering theory and operation of the ENG/EFP system.

(This objective supports STP tasks listed at the end of this section.)

Lesson 2:
DEFINE A ZOOM LENS AND ITS OPERATION

TASK: Describe a zoom lens, the principles behind a zoom lens and the operation thereof.

CONDITIONS: Given information and illustrations about terms relating to the zoom lens, its principles and the operation.

STANDARDS: Demonstrate competency of the task skills and knowledge by correctly responding to 80 percent of the multiple-choice test covering theory and terminology and principles and operation of the zoom lens.

(This objective supports SM tasks listed at the end of this section.)

Lesson 3:
DESCRIBE OPERATOR'S MAINTENANCE ON AN ENG/EFP SYSTEM

TASK: Describe how to clean videotape recorder/reproducer heads, how to perform operator's maintenance of camera cables and connectors, and operator's maintenance on a zoom lens.

CONDITIONS: Given information and illustrations about terms relating to the operator's maintenance of the ENG/EFP system.

STANDARDS: Demonstrate competency of the task skills and knowledge by correctly responding to 85 percent of the multiple-choice test covering theory and maintenance of the ENG/EFP system.

(This objective supports SM tasks listed at the end of this section.)

Lesson 4:
PACK, TRANSPORT, AND STORE AN ENG/EFP SYSTEM, SAFETY, AND LIMITATIONS

TASK: Describe the proper ways to pack, transport, and store an ENG/EFP system. Describe the safety precautions necessary in operating an ENG/EFP system. Describe the limitations of the ENG/EFP system.

CONDITIONS: Given information and illustrations about terms relating to the packing, transport, and storage of ENG/EFP systems safety and limitations.

STANDARDS: Demonstrate competency of the task skills and knowledge by responding to 80 percent of the multiple-choice test covering theory and terminology of packing, transporting, storing, safety, and limitations.

(This objective supports SM tasks listed at the end of this section.)

The objectives for this subcourse support SM tasks:

113-577-1050	Operate Electronic News Gathering Systems/Electronic Field Production Components (ENG/EFP)
113-577-4023	Operate a Zoom Lens
113-577-9007	Perform Operator's Maintenance of Camera Cables and Connectors
113-577-9011	Clean Videotape Recorder/Reproducer Heads
113-577-9006	Perform Operator's Maintenance of Zoom Lens

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Whenever pronouns or other references denoting gender appear in this document, they are written to refer to either male or female unless otherwise indicated.

All references to video tape recorders, or video cassette recorders, either portable (cassette), are identified generically, in this subcourse as video recorder (VR).

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INTRODUCTION TO OPERATION OF ENG/EFP COMPONENTS

This subcourse for the Audio/Television Specialist contains four lessons on the components and operation of the ENG/EFP system. Also included in the instruction are simple operator's maintenance, safety measures, and the limitations of this portable television system.

The television industry has found through increasing advancements in technology that the video recording system is easy to use and can save large amounts of money and time. Recording on video tape saves time on processing and having to add existing sound or new sound tracks, as has to be done in the movie film industry. With video, the audio (environmental sounds and/or voice) is recorded simultaneously. The operator can check the recording after shooting and before leaving the site, and use an electronic editor for making changes. He may also use the same video several times without having to do any reprocessing.

There may be great variances between this portable television system and the basic television production equipment and procedures with which you are already familiar. This course will provide you with a definition of the ENG/EFP system, its components and operation, maintenance, packing, transporting, storage, safety procedures, and limitations of this system.

LESSON 1
DEFINE THE ENG/EFP SYSTEM, ITS COMPONENTS, USES, AND OPERATION

TASK

Define the ENG/EFP system, components, and its operation.

CONDITIONS

Given information and illustrations and terms relating to the ENG/EFP system, and the uses, components, and operation thereof.

STANDARDS

Demonstrate competency of the task skills and knowledge by correctly responding to 85 percent of the multiple-choice test covering theory and operation of the ENG/EFP system.

REFERENCES

JVC Instructions, GX-S700U Color Video Camera, and CR-4900U Video Cassette Recorder

Learning Event 1:
DESCRIBE THE COMPONENTS AND USES OF THE ENG/EFP SYSTEM

1. The availability of portable television production systems gives the commanders in the field another tool with which to train their troops. In addition to working in a studio environment, you may be tasked to work "on location" for a variety of reasons. There are three major uses of ENG/EFP systems in the military; education, briefings and orientations, and surveillance.

a. Education. A majority of education and training situations in the military use the demonstration method of instruction. By using portable TV equipment you can bring a large object into the classroom. This reduces the need to move soldiers from one part of the post to another, and avoids repeating costly demonstrations. In some cases a videotape demonstration allows soldiers to complete training quickly and begin performing the mission.

b. Briefing and orientations. A briefing is intended to give personnel a rapid presentation of a particular situation. For example, in a tactical situation, remote television equipment can record pertinent data to the performance of a particular mission and play it back at another location. This provides speed and versatility that is not otherwise possible.

c. Surveillance. Remote equipment can be easily adapted for use in tactical situations. Should a commander require a special look at a given area, remote television equipment will record terrain and other features that can be used to support a maneuver or other deployment of troops.

2. ENG/EFP is the most flexible of remote operations. One person can handle a complete ENG/EFP assignment, as long as the signal can be videotaped with a portable VR. But even if the signal has to be relayed back to the station or transmitted, ENG/EFP requires only a fraction of the equipment and people of a big remote filming. The major disadvantage of ENG/EFP is that the pictures are of lower quality than when using studio equipment. This is of little consequence in news, where we generally deal with brief, one-time news stories. However, ENG equipment and production methods are often considered not good enough for productions that require top quality picture and sound.

a. Because ENG/EFP equipment is so compact and self-contained, you can get to an event and videotape or broadcast it faster than with any other type of television equipment. One of the important operational differences between ENG/EFP or big remotes is that in ENG/EFP you do not need preproduction surveys. The ENG/EFP system is specifically designed for immediate response to a breaking story.

b. The major production features of ENG are the readiness with which you can respond to an event, the mobility possible in the coverage of an event, and the flexibility of the ENG/EFP equipment system. ENG/EFP equipment can go wherever you go. It can operate in a car, an elevator, a small kitchen, or a military helicopter. You do not need an expensive studio pedestal to get smooth dolly or trucking shots; riding in a shopping cart with the ENG/EFP camera can often accomplish the same thing. Low angle shots, with the camera looking up at the object from below eye level, are as easy to accomplish as the high angle shots, or shots from above eye level with the ENG/EFP camera. The operator simply lies on the floor and points the camera up for the low angle shots, or climbs a ladder and points the camera down for high angle shots.

c. With ENG/EFP equipment, you can videotape an event or transmit it live. You can also use the ENG/EFP camera and the VR as a single independent unit or as part of a multicamera system.

3. Video recorder. The portable camera and recorder (VR) offers a whole new concept in television production, ENG and EFP. The advantage of videotape over film in news gathering is that videotape is a much faster and more flexible production device. Videotape does not have to be developed in a processing lab and it can be edited much more quickly than sound film. The VR is one essential component of the ENG/EFP system.

a. The portable video cassette recorder (VR) works on the same principle as audio cassettes. Although VRs are more complex electronically than audiotape recorders, they are not more difficult in operation. The ease of

handling VRs and their portability make them the preferred recorder for ENG/EFP work.

b. The most popular VRs used are the 3/4-inch tape format. When combined with special image-enhancing devices, 3/4-inch machines can deliver pictures acceptable for broadcast. Some of the 1/2-inch cassette recorders, originally made for home recordings, are now used successfully for television productions. Some ENG cameras have a small 1/2-inch cassette recorder attached to them, so that the operator no longer has to carry a separate recorder. As you can see, the trend is towards extremely small, portable, high quality videotape recording equipment.

c. Some important features of portable VRs are tape format, track arrangements, system standards, and tape speeds. Tape format refers to the width of the videotape required to operate the recorder. All quad machines use 2-inch tape; helical machines use 1-inch, 3/4-inch, 1/2-inch, and even 1/4-inch tape. The 1-inch is generally used for high quality productions. The 3/4-inch tape is the format for standard cassette VRs. There are no 3/4-inch reel-to-reel recorders. The 1/2-inch format was designed for home use as in the beta and video home systems (VHS), some broadcast field production units, and aboard navy ships.

d. Almost two decades after the development of the first helical scan VR, one could easily distinguish between broadcast quality and nonbroadcast VRs. Only the 2-inch quad VRs were considered broadcast quality. Helical scan, which used smaller format tapes (1-inch, 3/4-inch, 1/2-inch, and 1/4-inch) were not. "Small format" became synonymous with more or less portable low quality nonbroadcast equipment. Today the 1-inch VR has all but replaced the 2-inch models as the industry standard, and the 3/4-inch is the standard for ENG/EFP systems. However, some ENG/EFP operations even use 1/2-inch tape, which with high speed tape recorders produces broadcast quality pictures. The old formula, "the wider the tape the better the quality" no longer applies.

e. Tape is the recording medium used by both audio and video recorders. Tape is a very thin layer of polyester which is coated on one side with a smooth layer of oxide which is capable of magnetization by the recording heads. The oxide is most commonly iron, though some newer and high quality tapes consist of chromium dioxide, cobalt xxxxx(5X) metal evaporated tapes. The last types mentioned give a considerably higher frequency response with improvements in picture quality and recording density. The tape will also have a higher polished coating on the emulsion side to protect the heads and the emulation pulse to improve the tape to head contact.

f. There are two basic types of video tape recording formats found in use today; quad-head recorders and the helical scan recording systems.

g. Quad-head recorders got their name because of the four heads they have mounted in a wheel-type system for recording and playback of the video tape. These four heads are used to record and play back the video information onto and from the video tape.

h. The head wheel which holds the heads was generally 2 inches in diameter and rotated vertically 240 revolutions per second. Each head would record 16.4 lines of video information on each video track. Since there are 525 lines to a frame, the head wheel had to lay about 32 video tracks on the video tape to get one frame. This quad-head recording system was the first type of recorder to be used commercially. But because of their size, expense, and the equipment required to operate them, the industry that did use them was the television broadcast station. They are what is termed reel-to-reel machines which used 2-inch video tape (fig 1-1).

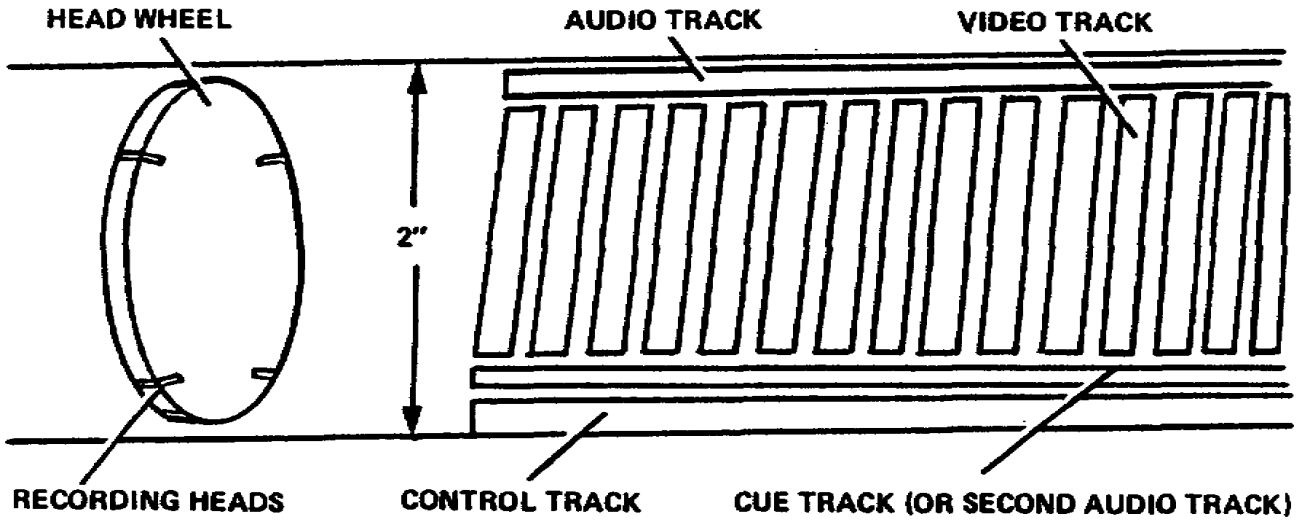

Figure 1-1. Quad-head recording system

i. As the broadcast television was developing prior to the early 1960s, so was another area of television production, nonbroadcast television. Nonbroadcast A is that area which is made up of educational TV, industry, and others. By 1960, nonbroadcast TV had come to the point where the industry had developed a need for the good but small VR, combining the newly-developed transistor with some video head design changes. It was not exactly broadcast standards like the quad-head system, but it was satisfactory for most nonbroadcast use.

4. Helical scan system. The first helical scan system was reel-to-reel and offered some distinct advantages. It was smaller and more portable than the quad-head VRs. It used 1/2-inch tape which was put on smaller reels and thus was easier to handle and take on location.

a. The helical scan VRs got their name from the way the videotape was wrapped around the head drum which surrounded the rotating head. The tape was wrapped in the form of a helical or spiral around a cylinder. You will note that the tape starts at the low end of the cylinder and comes off at the top end (fig 1-2). The video tape is never completely wrapped around the drum, but may look like one of the two views of the drum in Figure 1-2.

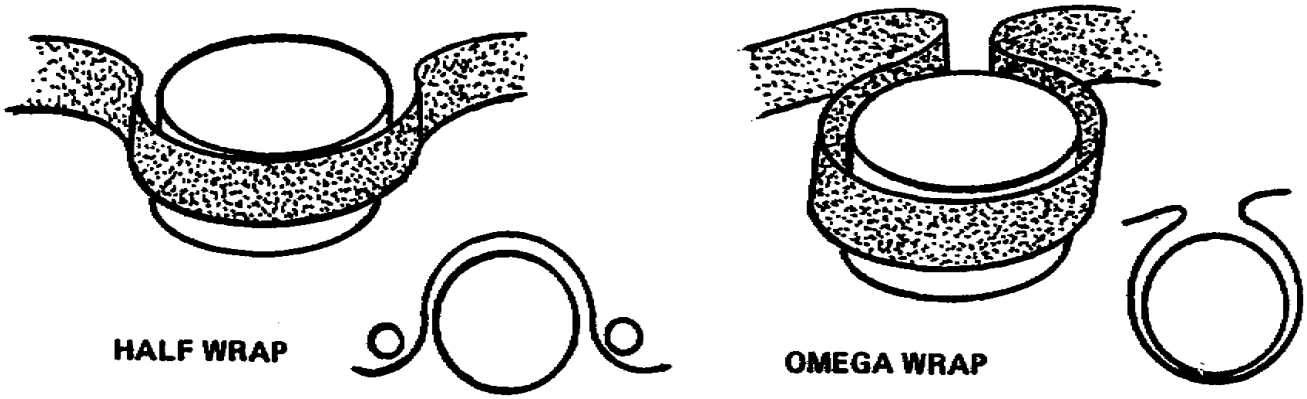

Figure 1-2. Half wrap and omega wrap

b. The dotted line in the center of each line represents the gap through which the rotating heads would establish contact with the videotape as it passes by. By using a tape path like this past the rotating heads, it is possible to put more video information on a single track, a whole field or 262.5 lines instead of 16.4 lines per track, as the quad-heads VRs required. Because of the new design, only one or two heads were required on a rotating wheel instead of four. The new helical scan design produced slanted video tracks like the example in Figure 1-3, as opposed to almost perpendicular video tracks produced by quad-head VRs as was shown in Figure 1-1.

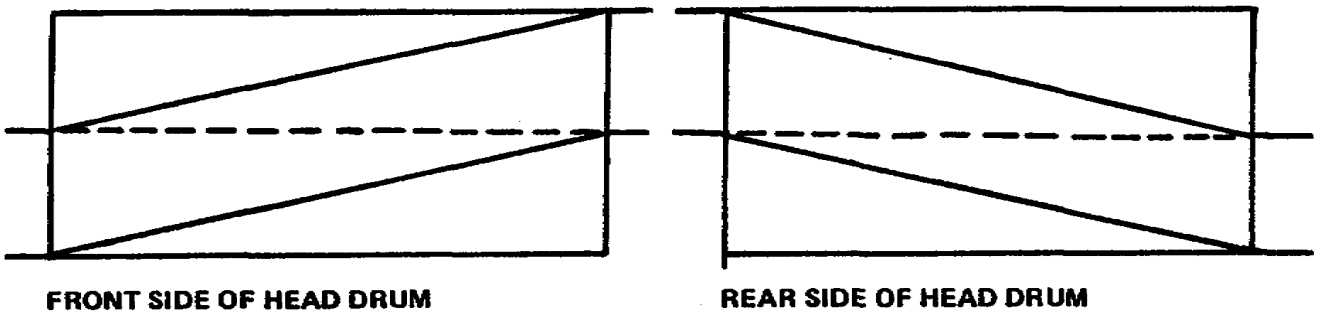

Figure 1-3. Helical tape wrapping system

c. After much development of the helical scan system on 1/2-inch reel-to-reel type systems, the industry developed two unique systems of packaging, storing, and loading the tape on VRs. At this time new VRs had also been developed to handle this new system of tape. The cartridge (CART) and CASSETTE systems were developed for ease of loading and handling by the operator. Now the recorder does all the loading by just inserting the cassette or cartridge into the recorder draw, which activates the mechanical arms that open the dust cover and retract the tape that wraps it around the head drum. After this operation the tape is ready to record or play back.

(1) The CART system is a large representation of the old audio 8-track system which had a short life, due to the mechanical problems in the CART machines. CART systems were designed for 2-inch machines and also for the short-lived 1/2-inch system (1/2-inch home units).

(2) At the present there are two cassette systems used in the broadcast industry, 3/4-inch UV and 1/2-inch beta systems. The 3/4-inch UV is now a broadcast industry standard and is replacing the 2-inch reel tape machines. The 3/4-inch still does not have the quality of the 2-inch but it has enough to be broadcast standard tape, and be usable in the field for ENG/EFP. Even though 3/4-inch tape has become a standard with ENG/EFP, 1/2-inch beta has started a new revolution of the single camera recorder system, called camcorders. The camcorder system brings a positive light to ENG/EFP because of less equipment needed and the ability to broadcast quality recordings.

d. Track arrangement refers to the arrangement of the audio, video, and control tracks in a VR. Because of the great variety of helical VRs with different tape formats, you will no longer find a standard arrangement of the audio, control, and video tracks. Each format has its own arrangement even within certain tape formats.

e. The system standard we are going to use is the 3/4-inch, which was later called the U-Matic system. The U-Matic system is the single standard for all of the more popular 3/4-inch VRs. Sometimes the system is simply called the "U-system." Cassettes recorded on the U-Matic VRs are all interchangeable. Besides the video track, the cassettes have two audio channels, one address code track (which can be used as a third audio channel), and a control track (fig 1-4).

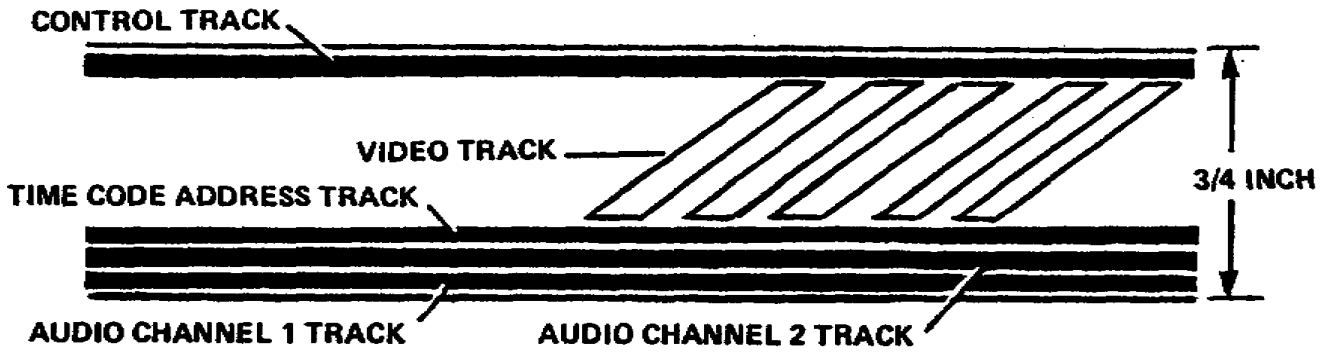

Figure 1-4. Track arrangement of 3/4-inch videotape system

f. Tape speeds vary greatly among the various systems. In general they are slower than the 15 ips of the quad recorders. Most 3/4-inch cassettes record and play back at a tape speed of 3.75 ips. These machines can play back

frame by frame jogging at 10 times the recording speed while producing recognizable images. Rewind speeds can reach up to 40 times the recording speed. A freeze frame effect can be obtained by momentarily stopping the tape. Do not keep the recorder too long in this zero tape speed mode because it wears away the magnetic coating on the tape quickly.

g. Even the large video cassette recorders are small enough for one person to carry, if need be. However, portable VRs are designed specifically for ENG work. This implies they must be lightweight, rugged, easy to carry and operate, and reliable. This is no small order, but there are some models that fulfill all of these operational requirements.

h. Some of the portable VRs run on battery or AC power. The battery has a lifetime of about 4 hours and if you hook up the camera to the same battery, the lifetime is shorter, or about 1.5 hours. For AC operations the operator would use an AC/DC converter. In this case there is no limit to the operating time, but you are always tied to an AC cord.

5. The camera. The most obvious production element, the camera, comes in all sizes and configurations. Some cameras can be easily carried and operated by one person, while others are so large and heavy they must be placed on special camera mounts. The studio camera is one such unit needing the camera mount. The camera mount enables the camera operator to move the camera throughout the studio with relative ease. The camera we are going to discuss is the portable camera and it is often used in ENG/EFP.

a. All important productions are done with color cameras. Monochrome or black and white cameras are used for inexpensive taping, training, surveillance, and a variety of industrial applications.

b. The TV camera has three major parts, the lens, the viewfinder, and the body itself with its electronic components. The ENG/EFP cameras are portable, which means they are usually carried by the camera operator rather than put on a camera mount. They are largely self-contained and can be operated without additional camera control equipment. In news gathering, the ENG camera has replaced the film camera. When using an ENG camera, you either record your scene on a portable VR or send your signals via microwave link to the station or directly to the transmitter for live telecast. The VR can be played back immediately; unlike film, it does not need to go to the lab for processing. In EFP situations, the portable camera can be easily carried into locations that can accommodate larger cameras only with great difficulty.

c. The ENG/EFP cameras are automated as much as possible. When shooting a news story, you do not have to perform intricate camera setup maneuvers. Nor do you have time to do many camera adjustments while shooting. Fortunately, most ENG/EFP cameras are fully operational within just a few seconds after switching them on, and you can make the adjustments to extreme production situations quickly and easily.

d. You will probably come across many types of portable cameras. The big difference among the various models is picture quality and degree of automation. There are currently four types of ENG cameras; the three-tube (three-gun) camera, the single-tube (single-gun), the charge-couple device (CCD) camera, and the camera-recorder unit. The two-tube camera is almost obsolete.

e. The high quality three-tube portable camera works on the same principle as the three-tube studio camera, except it contains the smaller 2/3-inch or 1/2-inch camera pickup tubes. Its internal optical system can either be dichroic mirrors or prism block. The latter is preferred, because it makes the camera more sensitive to light and less sensitive to physical shock.

f. The single-tube camera contains a single 1/2-inch, 2/3-inch, or 25mm tube with a stripe filter as color separator device. It is usually smaller and lighter than the three-tube camera, but its pictures are of lesser quality.

g. The smallest camera is the one using a CCD as the imaging device. Although such "solid state" cameras have many advantages over the conventional camera with pickup tubes as the imaging device, (small size, long life, no lag), the relatively low resolution of the chip has so far prevented the CCD camera from replacing the heavier and more sensitive pickup tube camera.

h. The camera-recorder unit is a hybrid of an ENG/EFP camera and mini-recorder that attaches directly onto the back of the camera. This unit, which is slightly heavier than a three-tube camera, rests on your shoulder. There is no need for additional VRs dangling from your shoulder or for cables to connect your camera with the VR. This camera-recorder combination comes close to the traditional news film camera in weight and operation. The news film camera generally uses a single 1/2-inch Plumbicon or Saticon tube and has all the automatic features of the three-tube ENG/EFP cameras. The camera and VR can be separated and used independently.

6. Parts of the camera. The standard TV camera consists of three main parts which are the lens, the camera body itself, and the viewfinder.

a. The lens selects a certain field of view and produces a small optical image of this view. The lens and certain attachments to it are sometimes called the external optical system.

b. The camera body includes camera pickup tube(s) or a solid state imaging device and the internal optical system which consists of a series of mirrors or prisms.

c. Viewfinders are an intricate part of the camera and are designed for operator use for framing, focusing, and automatic messages displayed on the screen. The viewfinder is about 1.5 inches in size.

d. The camera, the combination of lens, pickup device and internal optical system, and the viewfinder, is called the camera head because it is at

the head of the chain of other essential electronic camera equipment. The camera head itself has a series of attachments and controls that help you use the camera efficiently and creatively.

e. Portable cameras, used for the ENG/EFP, are self-contained, which means that they contain all the electronics equipment necessary to produce and deliver to a portable VR high quality color pictures.

7. How the camera works. All TV cameras, whether color or monochrome, big studio models or small portable ones, work on the same basic principle, the conversion of an optical image into electrical signals that are reconverted by a television set into visible screen images (fig 1-5).

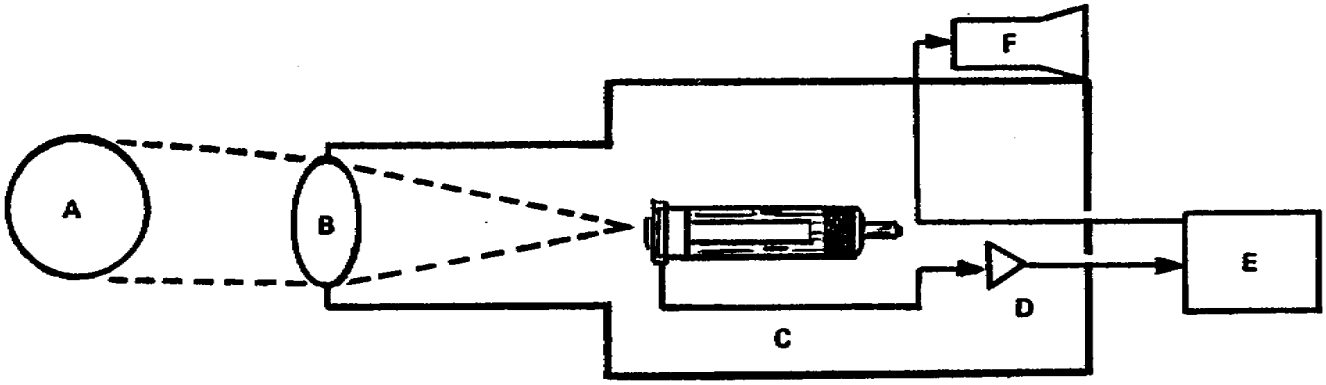

Figure 1-5. Basic principle of the camera. The light, reflected off the object (a) is gathered by the lens (b) and focused on the camera pickup tube (c). There light is transformed into electrical energy, the video signal. It is amplified and processed (d, e) and converted back to visible screen images in the viewfinder (f).

8. Monochrome cameras. The monochrome camera is color blind. Its single camera pickup tube reacts only to the various degrees of brightness, which are the light and dark areas and shades of gray of a scene as viewed by the lens.

a. Basically, the light areas in the screen produce a relatively strong video signal, the dark area a weak signal. When reproduced on a television monitor, the strong video signal shows up as a bright spot on the screen and the weak signal as a dark area. If two colors happen to be the same brightness, a monochrome camera produces video signals of identical strengths, which in turn, show up on the monitor as the same shade of gray.

b. The original high quality monochrome cameras were quite heavy and served primarily as studio cameras. It was a major effort to take these heavy cameras outside for a remote telecast. When a small portable camera and videotape recorders were first developed, they did not meet broadcast quality standards, as determined by the Federal Communication Commission (FCC) and could not, therefore, be used for ENG/EFP. But this first small portable camera recorder unit, generally known as the portapak, and used primarily by nonbroadcast people, nevertheless demonstrated the production potential of such a portable unit.

c. The modern ENG/EFP camera recorder systems still operate on the portapak principle, though they have become much more sophisticated electronically and more versatile in production.

9. The color camera. The color camera works on the same fundamental principle as the monochrome camera, with the conversion of the electrical energy (video signal) into visible images. But the color camera is more complicated than its monochrome ancestor. In order for you to understand some of the do's and don'ts of color production, you need to know some of the basic workings of the color camera. We will, therefore, briefly discuss these points; internal optical systems, imaging devices, electronic characteristics of color cameras, and camera types and operational characteristics.

a. Internal optical systems. In the monochrome camera the lens catches the light and focuses it directly onto the front surface of a single camera pickup tube. The color camera, however, first splits the entering beam of light into the three primary light colors, red, blue, and green. These three colors are then processed by separate channels, called chrominance (color) channels. Thus, we have a red channel to process red light into the red signal, the green channel for the green signal, and the blue channel for the blue signal.

b. Beam splitters. The color separation device that splits the white light into the three primary colors (or, into some other colors for ENG cameras) is called the beam splitter. There are three types of beam splitters, the dichroic mirror system, the prism block, and the striped filter.

(1) Dichroic mirror system. In the dichroic mirror system, the light that comes through the lens is separated by three dichroic (light separating) mirrors into the three primary light colors of red, green, and blue, and directed by other mirrors and lenses into the three camera pickup tubes (fig 1-6).

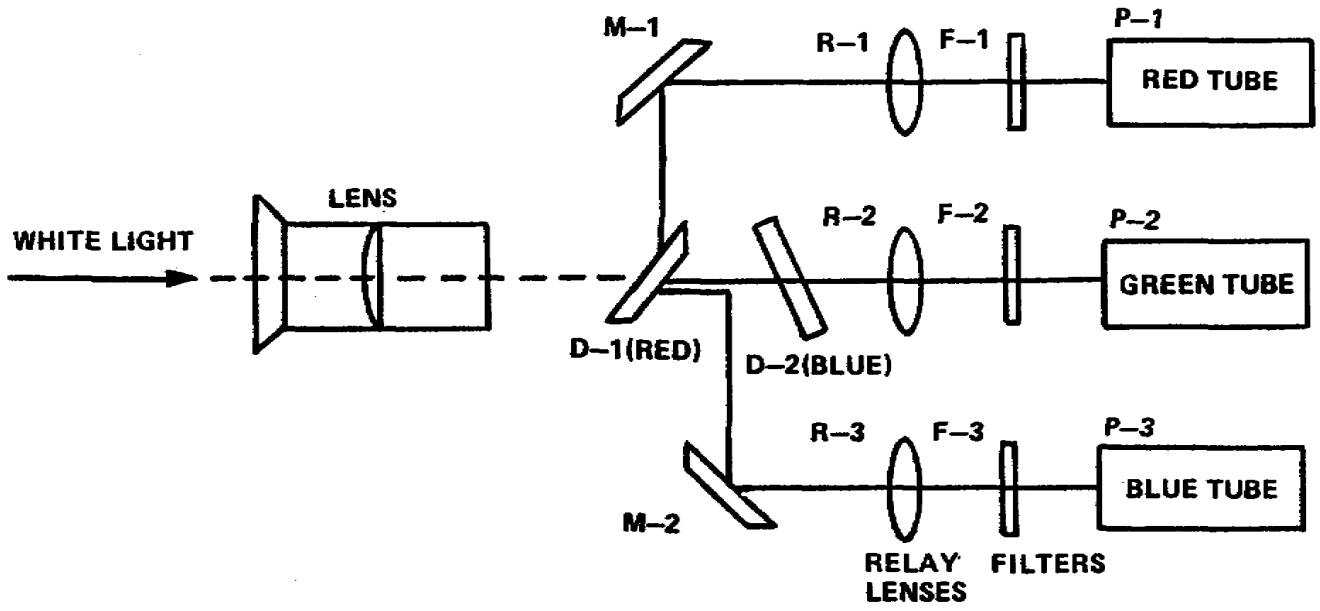

Figure 1-6. Dichroic mirror system

(2) The prism block. Because the dichroic mirror system is so critical in its alignment and therefore, quite vulnerable to physical shock, most cameras, especially the ENG/EFP cameras, use as their internal optical system the prism block. The incoming light is separated and directed to the pickup tubes by prisms and color filters. Since prism blocks soak up less light than dichroic mirrors, they are used in high quality cameras (fig 1-7).

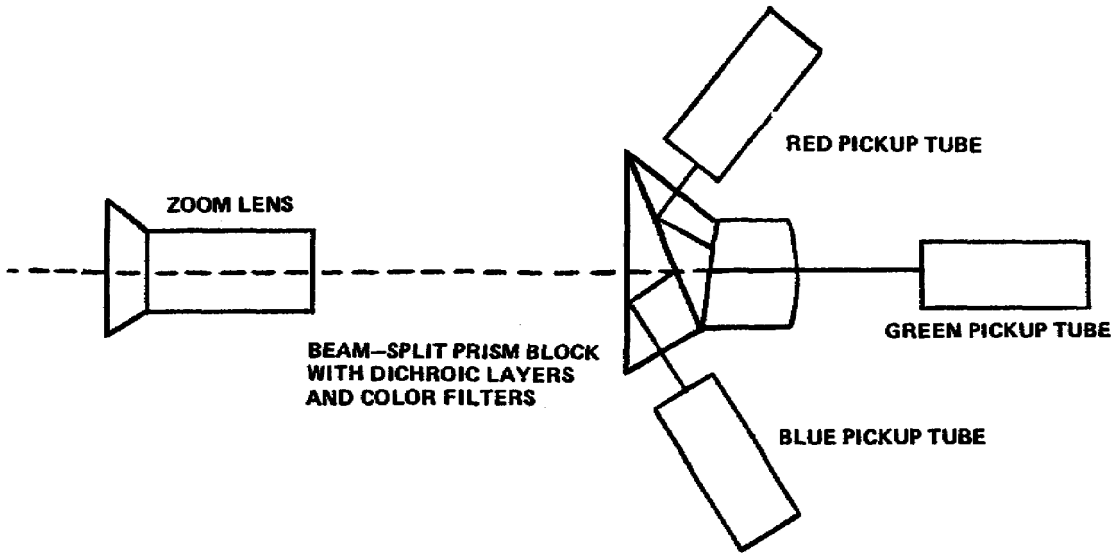

Figure 1-7. The prism block system

(3) The stripe filter. The third color separation device is the stripe filter that makes up the front surface of the pickup tube of a single gun camera. The incoming light is directed into a specific color and translated into the video signal (fig 1-8).

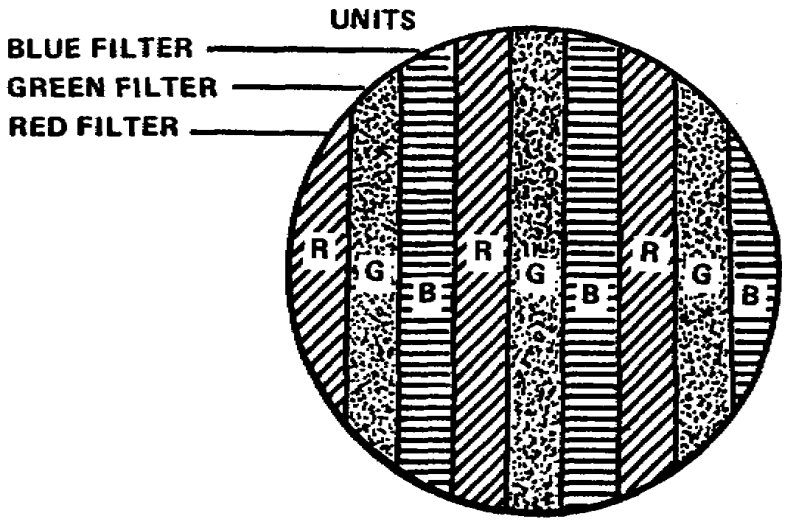

Figure 1-8. Stripe filter system

b. Chrominance and luminance channels. Because the three channels process the primary light colors of red, green, and blue, they are called chrominance channels (from the Greek chroma, a color). But as you may know from painting or color printing, the colors alone are usually not sufficient to give the picture the necessary crispness and depth. Besides the colors, a good picture needs to show variations in brightness, from white to various shades of gray to black. TV pictures are no exception. We perceive monochrome TV pictures by distinguishing among brightness variations. Color pictures get the necessary brightness variations through a separate signal, called a luminance channel. Some of the first cameras contained a separate pickup tube for the luminance channel. In the present cameras, the luminance signal is derived from the green channel, because the green signal is strong enough to serve two purposes at once. Sometimes, all three chrominance signals are matrixed (electronically combined) into a monochrome luminance signal.

c. Imaging devices. In color cameras the principal electronic component that converts light into electricity is called the imaging device. There are two major types, the camera pickup tube and the charged-coupled device (CCD), or, as it is commonly called, the chip. At the present state of development, most cameras use the various types of pickup tubes as an imaging device. The image orthicon (or i-o) tube was the standard camera pickup tube in high quality monochrome cameras and the first generation of color cameras. But because of its large size and electronic flicker, it was soon replaced by the smaller and more stable vidicon tube and its vastly improved descendants. Today all pickup tubes are improved models of the original vidicon tube.

(1) The two most commonly used tubes are the various versions of the Plumbicon and Saticon tubes. The diode gun pickup tube is an improved Plumbicon tube. You may hear of motre cons, which all try to minimize the negative aspects of the camera pickup tube and maximize the positive ones in order to produce optimal pictures in a great variety of production conditions.

(2) Camera pickup tubes come in four formats, which actually refer to the diameter of the front surface of the tube. Thus we have 30mm (1.2-inch) tubes; 25mm (1-inch) tubes; 18mm (2/3-inch) tubes; and 13mm (1/2-inch) tubes. The 18mm and 13mm tubes are almost always referred to as the 2/3-inch and 1/2-inch tubes. Large studio cameras usually have 30mm or 25mm tubes. Most ENG/EFP cameras that use a pickup tube as an imaging device use small 2.3-inch format. Some ENG/EFP cameras, especially the camera-recorder, use 1/2-inch tubes.

(3) Why so many formats? All other things being equal, the larger format tubes (tubes with a large front surface) produce higher quality pictures than the 3/4-inch tubes. You many want to compare the various pickup tube formats to the size of a film negative. A 35mm film generally produces a sharper picture than a 16mm film which again is superior in quality to a super 8mm film. However, constant efforts are being made to manufacture small-format tubes that produce high quality pictures.

(4) The CCD is radically different from the camera pickup tube. Whereas the pickup tube utilizes an electron beam that scans a light-sensitive photoconductive target to produce the video signal, the CCD has a great number of image-sensing elements that transfer an optical image into many spots carrying an electric charge. These charges are temporarily stored and then translated line by line into a video signal (voltage). The major advantage of the CCD over the tube is its small size. TV cameras using the CCD as an image device are considerably smaller than even the smallest ENG cameras using a pickup tube. So far, the major disadvantage of the CCD camera is that it does not produce the high-quality pictures produced by cameras that use pickup tubes as an imaging device.

d. The electronic characteristics of a camera depend primarily on the performance of the imaging device used. However, the camera incorporates certain electronic equipment and controls that either boost the positive or minimize the negative aspects of the imaging device. Because the electronic characteristics of the camera influence many other production aspects such as lighting, graphics, and what people should and should not wear, we will take a brief look at color response, resolution, operating light level, and contrast.

(1) Color response. Ideally the camera should respond to all colors alike. However, this is not the case. The Plumbicon tube, for example, has had a continuous battle with the color red. Red produces not only a weak video signal but also a fuzzier image than other colors. Improved Plumbicon tubes, and especially the Saticon, are designed to treat all colors as equally as possible. In an inexpensive color camera you can use the same type of vidicon tube for all three chrominance channels. This is why the color response in less sophisticated cameras is not "true" - that is, certain colors do not reproduce exactly like the original color in the scene. High-quality color

cameras not only use a special tube for each chrominance channel, but have special color-correction filters and electronic circuits as well.

(2) Resolution. The camera pickup tube is the principal element in the camera that determines the crispness of the picture. Other elements that influence the resolution of the picture are the lens, the quality of the internal optical system, and, of course, the TV set on which you see the picture reproduced. The power of resolution in a pickup tube is very much like printing.

(a) For instance, take a magnifying glass and look at a photo that is reproduced in a newspaper. Then look at one in a slick magazine. You will notice that the newspaper picture consists of rather coarse dots, whereas the individual dots are barely discernible in the magazine picture. The newspaper picture has a lower resolution than the magazine picture.

(b) As pointed out earlier, manufacturers are trying to make a small camera pickup tube that produces a high-resolution image. For the present, however, the large-format tubes still have a better resolution than the 1/2-inch and 2/3-inch tubes and are, therefore, preferred for the high-quality studio cameras.

(c) So far, the CCDs have a considerably lower resolution than the quality camera pickup tubes. The lower the resolution of the camera, the less fine picture detail it can show.

(d) Special electronic devices, called image enhancers, are generally used to sharpen the picture detail as delivered by the camera, However, although this device can enhance the image as delivered by the camera, it cannot invent detail the camera did not see in the first place.

(e) You should be conscious of the limited resolution of the TV picture, especially when dealing with television graphics and similar areas of production where fine picture detail predominates.

(3) Operating light level. Because it is the job of the camera pickup tube to convert light into electricity, the camera needs some light to produce a video signal and requires a specific amount of light to produce an optimal image. Most color cameras need an operating light level from 100 to 250 foot candles of illumination.

(a) You will hear and read that certain cameras can produce pictures with "full video," meaning that the video signal has a certain prescribed intensity, with as little as 3 foot candles of illumination. There are certain electronic devices that compensate for the lack of illumination, such as the gain control, which boosts the brightness of the picture, and the bias light, a small light that illuminates evenly the front surface of the camera pickup tube, providing a weak video signal even if no light comes through the lens.

(b) Neither of these devices can entirely prevent the various negative effects of minimal levels of illumination, such as video noise, lag, and color distortion.

(4) Video noise. Under low light levels, even the best of cameras cannot avoid "noisy" pictures. A "noisy" picture has a great amount of snow, or white vibrating spots in the picture. This occurs when the video signal as produced by the pickup tube is not strong enough to override the electronic interference that the system usually generates.

(a) Video noise works very much like audio noise. Even the best high fidelity system has some inherent electronic noise. You can hear the speakers hiss a little as soon as you turn on the amplifier. Or, when the music is very low, which is equivalent to a weak audio signal, you may become aware of the rumble of the turntable. As soon as the music gets louder again, equivalent to a stronger audio signal, you are no longer aware of the noise.

(b) The relation of the strength of the picture signal to the accompanying interference, the noise, is generally expressed in a signal-to-noise ratio. A high signal-to-noise ratio is desirable. It means that the signal is high (strong), relative to the noise under normal operating conditions.

(5) Lag or comet tailing. Lag is the following image that occurs under low lighting conditions, especially when a bright object moves against a dark background, or when the camera moves past some bright objects against a dark background.

(a) Lag occurs quite frequently during the televising of a concert. For example, when watching a concert on TV, you may notice that the conductor's white cuffs and baton causes large color streaks against the dark background of the dark house. The same effect occurs when televising a football game as the players run from a brightly lighted area of the field to a shadow area and they suddenly seem to emit streaks of red flames.

(b) Comet tailing is similar to lag, except that it occurs when the camera pickup tube is unable to process "video hits," extremely bright highlights that are reflected off highly polished surfaces. You may have observed red flames that seem to tail shiny trumpets whenever they are moved in a brightly illuminated area. This effect is called comet-tailing because the red flames resemble the fiery tail of a comet.

10. Viewfinder. The viewfinder is relatively small, about 1.5 inches, but produces a high image. It is shielded from outside reflections by a flexible rubber eyepiece that you can adjust to your eye.

a. The viewfinder contains a number of control lights or displays that indicate the status of certain camera or production functions. Most viewfinders display, automatically, some or all of information on VR recording, tape warning, and battery status.

b. Most viewfinders display, on command, color bars, patterns, white balance, black balance, and registration of camera.

c. Most cameras permit the viewfinder to be used as a playback monitor for the VR. The advantage of having all these controls is that you do not need any additional equipment to set up the camera.

11. Camera lens. One type of lens can give you a wide vista, although you may be relatively close to the scene, another type may give you a close view of an object that is quite far away from the camera. Different types of lenses also determine the basic perspective, whether you see the object distorted or whether you perceive more or less distance between the objects than there really is. Because the lens determines what the camera can see, you need to know the basic optical characteristics of the lens and the chief operating controls.

a. All broadcast-type cameras are equipped with a zoom lens, or as they are sometimes called, variable focal length lenses. Some of the older monochrome cameras used individual, fixed focal length lenses, which were mounted on a lens turret so the camera operator could quickly flip to one of four lenses. Each of the four lenses performs its specific function. The focal length of a lens determines how wide or narrow a vista a particular camera has, and how much and in what ways objects appear magnified. Lenses are identified by their focal length, such as:

(1) wide angle, or short focal length;
(2) normal, or medium focal length;
(3) narrow angle, or long focal length.

b. The wide angle or narrow angle refers to the field of view, the relative vista of the lens. The short and long refers to the actual focal length, the distance from the optical center of the lens (often the midpoint between the front and back lens elements) to the point where the distant image as seen by the lens is in focus.

(1) With a wide angle, or short, lens, you can see more, you have a wider vista. Objects very close to the lens appear quite magnified, but the ones just a little further back look rather small. A short lens creates an effect similar to looking through binoculars the wrong way.

(2) With a narrow angle, or long, lens, you have a narrow vista. But what you see, even the distant object, is greatly magnified. A long lens is similar to binoculars used correctly.

(3) The normal lens gives you approximately the view of normal human vision.

c. Contrary to the fixed focal lenses, the zoom lens can assume all focal lengths from the wide angle position to the narrow angle position. This is why it is called a variable focus length lens. You will learn more about the zoom lens in Lesson 2, Learning Events 1 and 2.

Lesson 1
Learning Event 1
PRACTICE EXERCISE

1. What are three major uses for ENG/EFP system in the military?

   a. Lectures, drawings, and staff meetings
   b. Orientations, and briefings, surveillance, and education
   c. Command information, communication, electronic news gathering
   d. Information, entertainment, and documentaries

2. ENG/EFP systems use what recording format?

   a. Quad scan
   b. Quad recording
   c. Helical scan
   d. Multiple head recording

3. What are the two cassette formats used in ENG/EFP?

   a. U-matic, 1-inch
   b. Beta, VHS
   c. Alpha, 2-inch beta
   d. 3/4-inch cassette, 1/2-inch cassette

4. What are the three major parts of a camera?

   a. Lens, viewfinder, camera itself
   b. Recorder, cables, microphone
   c. Power supply, recorder, dolly
   d. Power supply, lens, viewfinder

5. What is an image device?

   a. Pickup tube
   b. Internal optical system
   c. Stripe filter
   d. Dichroic mirror

6. What are three tape formats for helical scan tape?

   a. 1/2-inch tape, 3/4-inch tape, 1-inch tape
   b. Reel, cassette, cartridge
   c. 3/4-inch cassette, 1/2-inch cassette, 1-inch cassette
   d. U-matic, chromatic, di-matic

7. How can zero tape speed be obtained?

   a. Freeze frame
   b. OFF position on the tape recorder
   c. Record mode
   d. Pause mode

8. What is the quad system of recording for 2-inch tape?

   a. Four heads rotating 240 revolutions on a horizontal format
   b. Vertical rotation of four heads mounted on a head wheel
   c. Slanted track recording with four heads
   d. 16 revolutions of four heads

9. What are the basic principles of a TV camera?

   a. Conversion of optical images into electrical signals
   b. Transferring electrical signals to electrical energy to the pickup tube
   c. Conversion of the pickup patterns to transmitted light into visual pictures
   d. Transmitting light waves into visual pictures

10. What is the basic principle of helical scan VTRs?

   a. Slanted track recording
   b. Perpendicular track recording
   c. Quad track recording
   d. Reverse polar recording

11. Which definition best describes the CCD system?

   a. Electronic beam that scans a light-sensitive photoconductive target
   b. Color correction device
   c. Charge coupled device
   d. Image sensing elements, which transfer optical images into spots carrying an electric charge

12. Which best defines an internal optical system?

   a. Color separation device
   b. Optical lens of the zoom lens system
   c. Image enhancing device
   d. Chromomatic dividing device

13. What are the electronic characteristics of a camera?

   a. Chrominance, luminance, imaging
   b. Resolution, operating light levels, contrast
   c. Beam splitter, imaging device, color control
   d. Chips, circuits, and cables

Lesson 1
Learning Event 1
ANSWERS TO PRACTICE EXERCISE

1. B
2. C
3. D
4. A
5. A
6. B
7. A
8. B
9. A
10. A
11. D
12. A
13. B

Learning Event 2
DESCRIBE THE OPERATION OF THE PORTABLE VIDEO RECORDER AND THE PORTABLE CAMERA

1. The portable VR is powered by 12 volts of DC current. Power can be supplied two different ways as required by the operator. The operator can use a nickel-cadmium (NICAD) battery or the optional AC/DC power converter which will deliver 12 volts of DC current. Insert the battery in the battery compartment and close the cover. Check the battery indicator to make sure there is enough energy to operate the equipment. This battery can be used to supply power to the VR and the camera at the same time. At this time you can push the POWER button on to operate the equipment.

2. The great advantage of video cassette recorders or the portable recorder, over the larger reel-to-reel recorder, is the ease of operation (fig 1-9). There is no need for you to thread the tape from the supply reel past the head assembly to the takeup reel in a more or less complicated path.

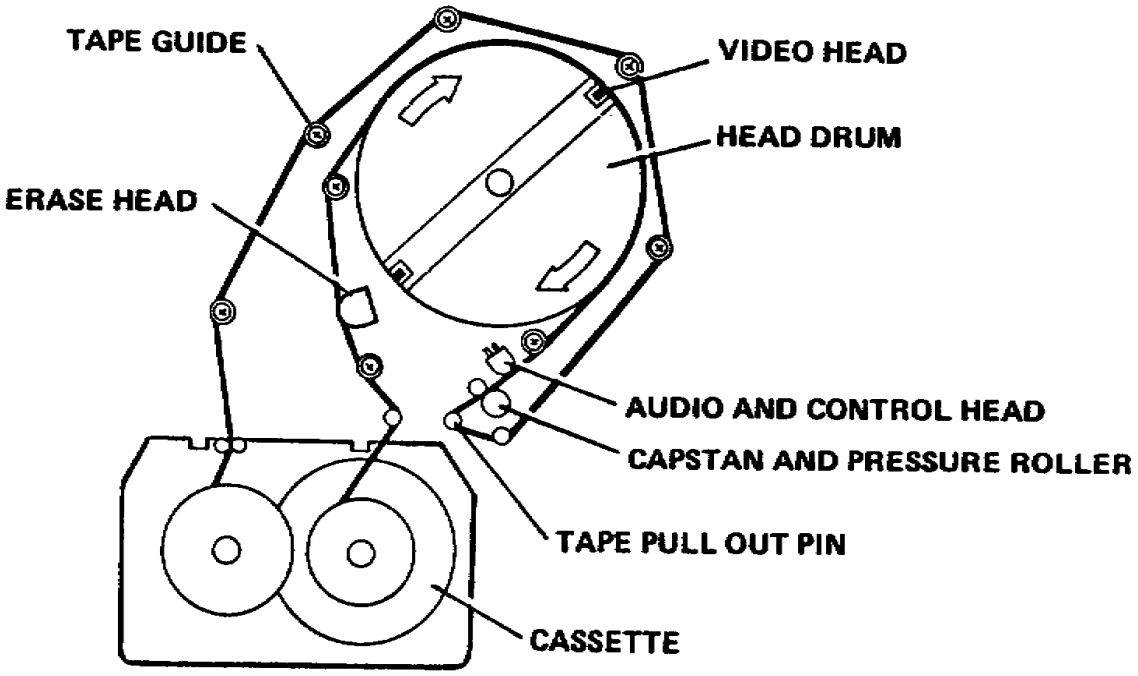

Figure 1-9. Portable recorder threading pattern

a. Loading cassette. To load and unload a cassette, press the power button to the ON position before inserting a cassette. Before inserting the cassette, check to see if there is any tape slack. Press the EJECT button, and the cassette housing will lift gently.

(1) Insert a cassette correctly so that the grooves on the bottom of the cassette are in line with the cassette guide of the cassette housing.

(2) Press the housing cover down by hand at the front edge. When a cassette is inserted, it takes a few seconds for the tape to be seated. During this time the stop indicator light will start flashing. At this time the tape is automatically loaded around the head drum.

(3) A tape threading arm will pull some of the tape out of the cassette. At this point the tape comes from the supply reel. In the unthreading operation, the tape is rewound onto the supply reel.

(4) If any of the operational buttons are pressed during this period, the information will be memorized and after tape loading process is completed, the VR enters the corresponding operational mode automatically.

(5) If the cassette is loaded and the supply portion of the tape reel is near the end, tape loading will not occur and the TAPE END indicator will remain lighted.

b. To unload or remove the cassette, the power should be on, otherwise the tape will not be unloaded.

(1) If the EJECT button does not function when the power is off, first switch on the power, then press the EJECT button, and the cassette housing cover will lift gently.

(2) After securing the cassette, press the housing cover down by hand at the front edge.

3. Located on the side of the VR and out of the way to prevent damage to the cable, is the camera input connector housing. The cable is inserted into this housing and the opposite end of the cable is inserted into the camera connector housing. The operator can now operate the recorder from the camera.

4. Operational controls and indicator meters located on the front panel are designed for ease of operation for the operator. Refer to Figure 1-10.

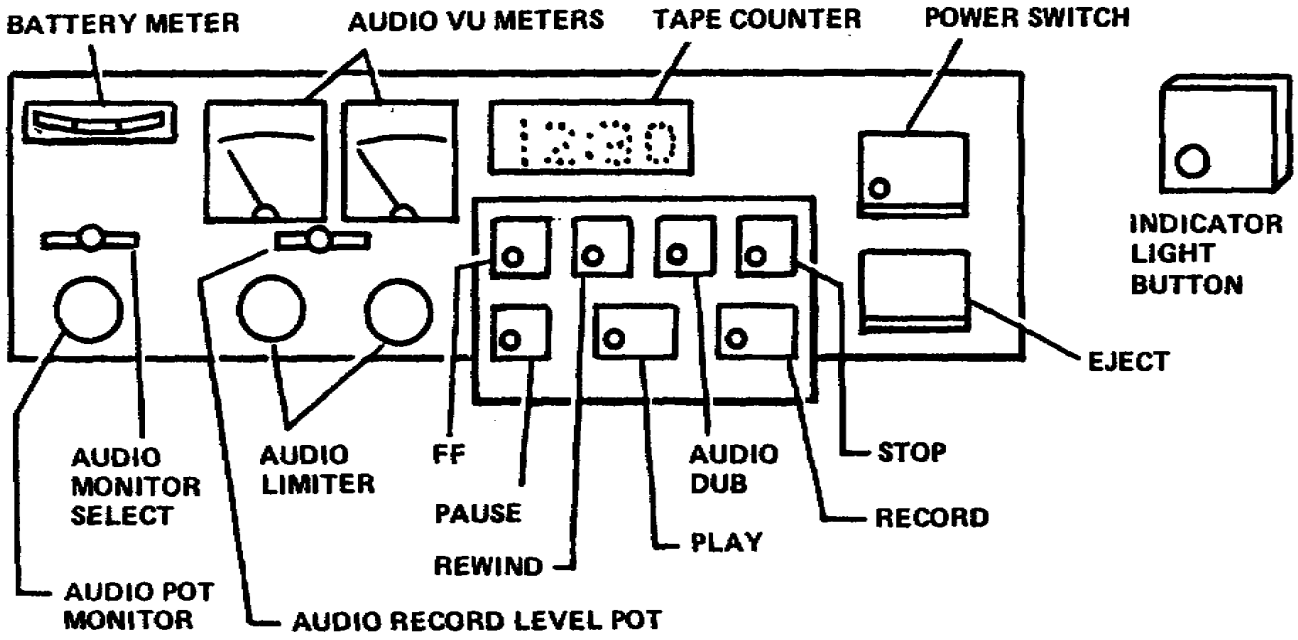

Figure 1-10. Operational control of VR

a. The POWER button has only one function and that is to supply power to the recorder by pressing it once; press the button a second time to turn it off. It is important to remember to turn the power off when you are not recording in order to save the batteries' energy.

b. The PLAY button. Press to start the playback mode of operation. The PLAY indicator will light. At this time the operator will be able to view the video already recorded on the tape through the viewfinder or optional video monitor connected to the VCR. When viewing the video through the camera viewfinder, the audio will be heard through a headset. When using the optional video monitor, the operator can hear the audio through an optional audio monitor.

c. The RECORD button pressed together with the PLAY button will start the recording.

> WARNING: If you press the PLAY button before the RECORD button, the VR will only go into the playback mode and recording will not start. After pressing the RECORD and PLAY button together, the RECORD and PLAY indicator will light. To stop recording, press the STOP button. When the RECORD button is pressed by itself, the input video signal can be seen on the monitor, but is not being recorded. During the recording process the control track, video and audio, are being recorded on the tape.

d. When a cassette is inserted, the tape is partially loaded automatically and stopped (this state is referred to as the "stop" mode). The STOP indicator will be on at this time. When the STOP button is pressed in any operation mode, the tape is partially unloaded and then stopped in the "stop" mode.

e. The FAST FORWARD button can function in two ways, for fast forward and forward search. The fast forward is designed to advance the tape at a high rate of speed. The forward search is designed to advance the tape at a high rate of speed, 10 times the normal speed, allowing the operator to see the video as the tape is moving.

f. The REWIND button functions in two ways: for rewinding the tape and reverse search of the video. When the REWIND button is pressed in the STOP mode, the tape is rewound with a scrambled picture appearing on the monitor screen. During rewind the tape is still wrapped around the head drum. When the REWIND button is pressed while in the play or pause mode, the reverse search mode is engaged with the tape running at about 10 times the normal speed. At this time the video signal is recognizable. In both cases, the REWIND indicator lights up. To release the rewind or search mode, press the REWIND button again.

g. The PAUSE button has two functions. When the PAUSE button is pressed while in the PLAY mode, the video image will be a still picture, and when in the RECORD mode, the record process is stopped until the PAUSE button is pressed a second time. It is important to note that when in the pause mode the tape is not moving but the head drum is. If the pause mode is left on too long it will damage the tape as well as cause the heads to become clogged. When the heads are clogged, the recorder cannot record or play back a clear picture.

h. It is possible to record audio only and not erase the existing video. The AUDIO DUB button will energize one of the audio record heads and only record on one head or both as the operator sees fit. To do this the operator must press the AUDIO DUB button and the PLAY button at the same time; at this time the PLAY indicator and AUDIO indicator will light up.

i. When recording audio, the operator must first select either audio channel one or channel two, or both, with the AUDIO METER select switch. The operator must also turn the AUDIO-1 or AUDIO-2 AUDIO RECORD LEVEL controls to a proper position, as indicated on the VU meters, to achieve the proper audio levels. To hear the audio, the operator must turn the AUDIO MONITOR LEVEL control. In addition to the AUDIO RECORD LEVEL controls there is an AUDIO LIMITER ON/OFF switch, which provides an automatic gain control. The only problem with automatic gain controls is that they are always looking for an audio signal even if none is present. When this happens, noise is recorded on the audio.

5. The side of the recorder may house many input or output connectors in order to allow audio and video signals to be monitored (fig 1-11).

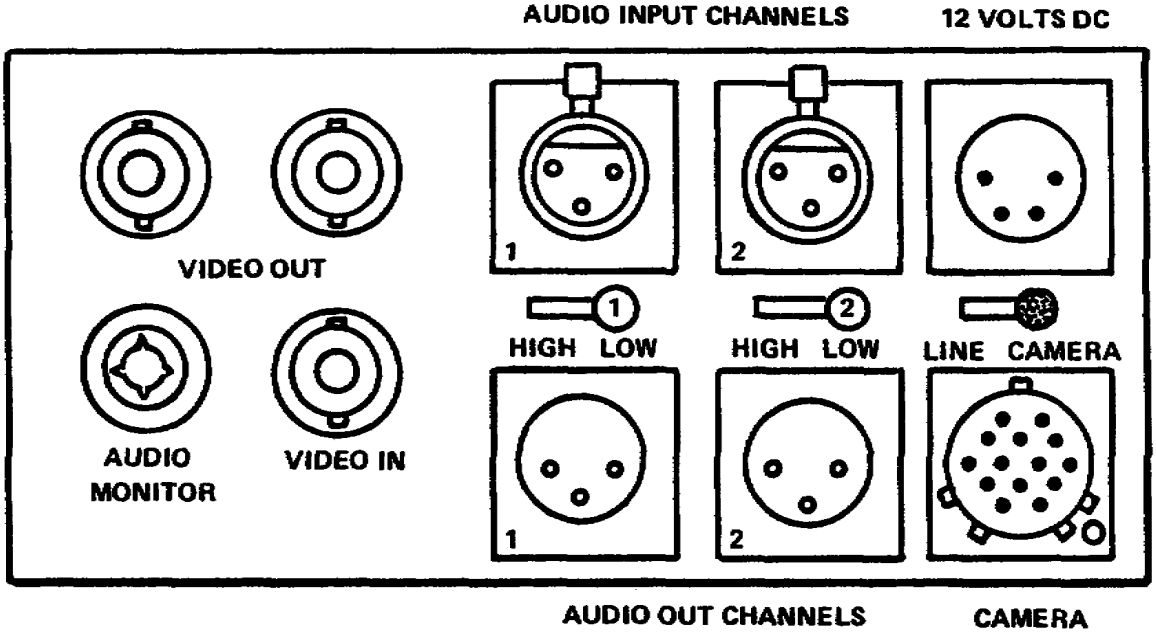

Figure 1-11. VR input and outputs

a. For viewing video on a monitor, other than the viewfinder, or for recording on an additional recorder, the VIDEO OUT-1 or VIDEO OUT-2 would be connected to a video monitor or a second recorder.

b. To connect an additional signal source to the camera the operator would use the VIDEO IN connector.

c. In the event the operator wanted to add several microphones using an audio mixer, the operator would connect this to the AUDIO IN AUDIO-1 or AUDIO-2 connectors. Because of the difference of impedance in microphones, there is a LINE HIGH/LOW selector switch to correct this.

d. As with the two AUDIO IN connectors, there are two AUDIO OUT connectors for hearing audio from the two audio channels.

e. When operating the recorder with the camera, a cable is used and connected to the CAMERA connector. At this time a switch for MIC LINE/CAMERA select switch is put into the camera position. When using external signals from VIDEO IN and AUDIO IN connector, the operator must put the MIC LINE/CAMERA select switch into the line position.

f. In order to use AC outlets instead of battery power the operator can connect an AC power adapter to the DC 12 volt input connector. While the AC adapter is connected, the operator can charge any batteries connected (fig 1-11).

6. Now that we have discussed a recorder, we will look at the camera and its controls and its relationship to the recorder.

a. The camera is powered by a 12-volt DC current, supplied by the camera or the recorder through the camera cable connector housing on the recorder and the camera by a cable.

b. With the camera receiving power from the camera or recorder, the operator can turn on the power to the camera by using the CAMERA POWER select switch. The CAMERA POWER select switch has three functions: (1) When in the center position, the camera is in the OFF position, and at this time no power is applied to the camera; (2) When the switch is in the up position or CAMERA position, the power comes from the battery attached to the back of the camera; (3) When the operator moves the switch to the down position, or the VR position, the power comes from the VR battery. It is very important for the operator to keep the CAMERA POWER switch in the OFF position when the camera is not in use to conserve the energy from the battery. The camera also has two indicator lights that inform the operator that power is being applied to the recorder or the camera or both.

c. Once the power has been applied to the camera and recorder, the operator must white balance the camera for optimum setting that exactly corresponds to the color temperature of the lighting. To white balance the camera, the operator must select a position on the filter ring located back of the lens. Refer to manufacturer's manual for location, because exact location varies from camera to camera. When using the outdoors (daylight) setting, the camera is automatically adjusted for the pickup tubes rating of 3200 kelvin for normal color temperature. At this time two white balance settings are available.

(a) SET. When pressing the SET position, the operator must use a white object to white balance, noting to focus on the object.

(b) STANDARD. When pressing the STANDARD setting button, the white balance is electronically adjusted.

(c) For the most accurate setting, the SET button is used for a perfect white balance.

d. Located on the zoom lens is the iris ring which has three settings the operator can use. The "A" position is for complete automatic iris settings based on the amount of light entering the lens of the camera. The "AL" position is for automatic lock which is designed to prevent the iris from changing once the iris is set. The "C" position is for manually operating the iris by the operator or the close position in which no light is permitted to enter the camera. Turning the ring past the "C" position will allow the operator to select the f stop needed, based on lighting conditions. There is a

GAIN select control located on the camera for operation of the camera under insufficient illumination conditions. The GAIN select switch has three positions:

(1) "0", which is the off position or normal position when there is enough light present for camera operation.

(2) "+6", for operations which do not have enough illumination.

(3) + 12 when "+6" does not satisfy the lighting conditions.

e. For the ease of handling and operation by the operator, there are two remote control VR START/STOP buttons on the camera system. One button is located on the camera itself and designed to start and stop the recorder in the play or record modes. For use in the play mode, the operator must press PLAY on the recorder. Until the VR STOP/START button is pressed, the recorder will automatically go into PAUSE mode and both the PAUSE and PLAY indicator will light. When pressing the RECORD and PLAY buttons, the PAUSE mode is activated and PAUSE, PLAY and RECORD indicators will light up. This only happens when the camera is connected to the recorder and its power is on. To activate for PLAY or RECORD, the VR START/STOP button is pressed. To stop the operation of the recorder, the VR START/STOP button must be pressed again.

f. The camera comes with an electronic viewfinder for monitoring the video that the camera lens sees and also for monitoring the video playback from the recorder. The viewfinder is connected to the camera by a short cable and attached to the camera carrying handle on the camera. It is possible for the operator to adjust the eyecap and viewfinder housing for ease of viewing by the operator. The eyepiece can rotate 90 degrees up or down for better viewing by the operator.

g. Because of the VR having two audio channels, the camera has the capability of recording in stereo through the use of a camera-mounted microphone or the external microphone connector located on the rear of the camera. There is also an external microphone switch by which the operator can select either the camera mounted mic or external mic.

h. The zoom lens and its controls will be discussed in Lesson 2, Learning Events 1 and 2.

7. Now that you are familiar with the controls and functions of an ENG/EFP system, let's put it all together for a "shoot."

a. The operator will need a complete ENG/EFP system to consist of a portable recorder and portable camera with power supply.

(1) Attach the camera and recorder together, using the camera cable, to the camera housing connectors, located on the camera and the recorder.

(2) The operator will then insert the battery into the recorder. At this time all power will come from the recorder.

(3) The operator will apply power to the recorder, pressing the POWER button, located on the front panel of the recorder.

(4) Power is then applied to the camera using the CAMERA POWER switch in the VR position. If the camera had a battery, the operator would use the CAMERA position on the CAMERA POWER switch.

(5) The operator would then press the EJECT button to insert the small video cassette, making sure the red button is in place in the bottom of the cassette, and gently press down on the recorder cassette housing cover.

(6) At this time, the operator will select on the FOCUS RING the INDOOR or OUTDOOR position in order to obtain a true white balance for the lighting conditions. Once selected, the operator would zoom in on a white object, making sure he is in focus, and then would press the SET button to white balance the camera. An indicator light will light up in the viewfinder to tell the operator that the camera is white balanced or more light is needed.

(7) After this operation, the camera is ready for use by the operator (fig 1-12).

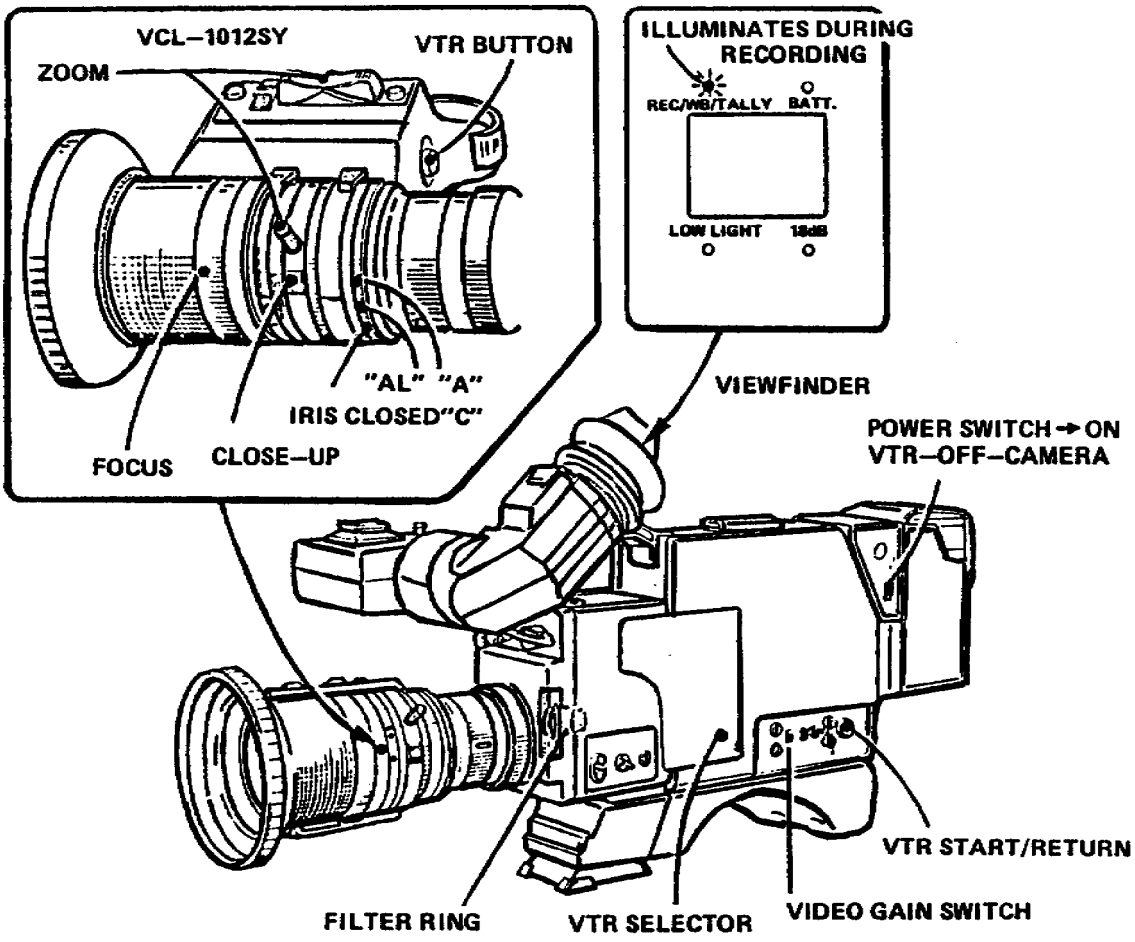

Figure 1-12. Portable video recorder

b. In order to record on the recorder, the operator must now press the PLAY and RECORD buttons at the same time. The PAUSE, RECORD and PLAY indicators will light up to indicate to the operator that the equipment is now ready to record.

(1) Because the camera is attached to the recorder, the operator must press the VR START/STOP button once to start the actual recording on the tape.

(2) When the operator is finished recording, he will press the VR START/STOP button to stop the recorder.

(3) If the operator wanted to see what was recorded, he must return the recorder to the stop mode using the STOP button. Once the recorder is in the stop mode, the operator would press the PLAY button on the recorder or VR START/STOP button on the camera and look through the viewfinder.

(4) If everything is satisfactory with the video, the operator would press the STOP button to stop the playback, and then the EJECT button, to remove the tape.

(5) At this time, the power to the camera is turned off, setting the CAMERA POWER switch to the OFF position and the recorder can be turned off using the RECORDER POWER button, ensuring that the tape has been removed.

(6) The operator would then remove the battery and put it in the charging unit to recharge it for future use.

Lesson 1
Learning Event 2
PRACTICE EXERCISE

1. The ENG/EFP system can function from what two power sources?

   a. 12 volts DC and AC/DC power converter
   b. 9 volts DC and AC/DC power supply
   c. AC outlet and DC power supply
   d. 9 volts DC and 12 volts AC

2. What must be done before turning off power to the recorder?

   a. Disconnect all cables
   b. Remove the video cassette
   c. Complete the mission
   d. Disconnect the camera

3. How do you put a VR into the RECORD mode?

   a. Press RECORD button
   b. Press RECORD, then PLAY button
   c. Press RECORD and PLAY buttons at the same time
   d. Press PLAY button, then RECORD button

4. The FAST FORWARD button has two functions. What are they?

   a. To remove tape from the takeup reel to the supply reel at a medium rate of speed
   b. Advance tape at a high rate of speed and forward search
   c. Advance the tape at a medium rate of speed
   d. Remove the tape from the right side of the cassette to the left side at a fast speed

5. What should the operator do to activate reverse search?

   a. Press REVERSE and PLAY at the same time
   b. Press REWIND
   c. Press REWIND while in the PLAY mode
   d. Press the REVERSE SEARCH button

6. If the pause mode is on too long, what problems will it cause?

   a. Tape stretch
   b. Head clog and tape damage
   c. Nothing. VTRs are designed to pause for long periods of time
   d. Print through and video blanking

7. A camera white balance is done for what reason?

   a. For optimum setting, corresponding to the color temperature
   b. Correcting color guide and contrast
   c. Correct resolution and contrast
   d. Provide adequate lighting and color control

8. The outdoor position on the filter ring is used for what?

   a. For adjusting from 5100 kelvin to 3200 kelvin for pickup tube rating
   b. For color correction of artificial lighting
   c. For standard white balance with white card
   d. For color balance with gray scale charts

9. What does the "AL" position on the zoom lens provide?

   a. Automatic iris setting
   b. Automatic iris control
   c. Prevents iris setting from changing after set with the "A" position
   d. Manual setting of iris in any switch position

10. For what reason is the gain control used?

   a. Automatic level control for audio
   b. Low light levels not adjusted by automatic iris control or manual iris
   c. White balance of camera
   d. Adjust zoom control speed

11. What does the "C" position on the iris rings mean?

   a. Close lens, then manual control
   b. Manual iris setting
   c. White balance of camera
   d. Open lens, automatic control

12. What are the two types of imaging devices called?

   a. Pickup tube and charged-coupled device
   b. Dichroic mirror and split beam
   c. Prism block and dichroic mirror
   d. Prism block and split beam

Lesson 1
Learning Event 2
ANSWERS TO PRACTICE EXERCISE

1. A
2. B
3. C
4. B
5. C
6. B
7. A
8. A
9. C
10. B
11. A
12. A

LESSON 2
DEFINE A ZOOM LENS AND ITS OPERATION

TASK

Describe a zoom lens, the principles behind a zoom lens and the operation thereof.

CONDITIONS

Given information and illustrations about terms relating to the zoom lens, its principles and operation.

STANDARDS

Demonstrate competency of task skills and knowledge by correctly responding to 80% of the multiple-choice test covering theory and terminology of the zoom lens, principles and operations.

REFERENCE:

Course Material, Audio/Television Specialist

Learning Event 1
DEFINE THE ZOOM LENS AND DEPTH OF FIELD

1. The television camera has three major parts, the camera itself, the viewfinder, and the lens. This section will discuss the lens. All broadcast-type color cameras are equipped with zoom lenses, or as they are called in technical language, variable focal-length lenses. Some of the older monochrome (black and white) cameras are individual, fixed focal-length lenses, which are mounted on a turret so that the camera operator can quickly flip to one of four different lenses. Each one of the four lenses performs its specific function. Although you will not find any turrets on modern cameras, we will refer to fixed focal-length lenses because the basic optical and performance characteristics are more easily explained and understood. In this lesson, we will discuss these optical characteristics: focal length, focus, lens aperture, and depth of field.

a. The focal length of a lens determines how wide or narrow a vista a particular camera has, and how much and in what ways objects appear magnified. Consequently, we identify lenses by their focal lengths:

(1) Wide angle, or short focal length lenses.

(2) Normal, or medium focal length lenses.

(3) Narrow angle, or long focal length lenses, often called telephoto lenses.

(4) Zoom, or variable focal length lenses.

b. The wide angle or narrow angle refers to the field of view, the relative vista of the lens. The "short" and "long" refer to the actual focal length (fig 2-1) the distance from the optical center of the lens (often the midpoint between the front and back lens elements) to the point where the distant image as seen by the lens is in focus.

(1) With a wide angle lens, or short lens, you can see more; you have a wider vista. Objects very close to the lens appear quite magnified, but the ones just a little farther back look rather small. A short lens creates an effect similar to looking through binoculars the wrong way.

(2) With a narrow angle lens, or long lens, you have a narrower vista, but what you see, even the distant objects, are greatly magnified. A long lens is similar to binoculars used correctly.

(3) The normal lens gives you the view of the normal human vision.

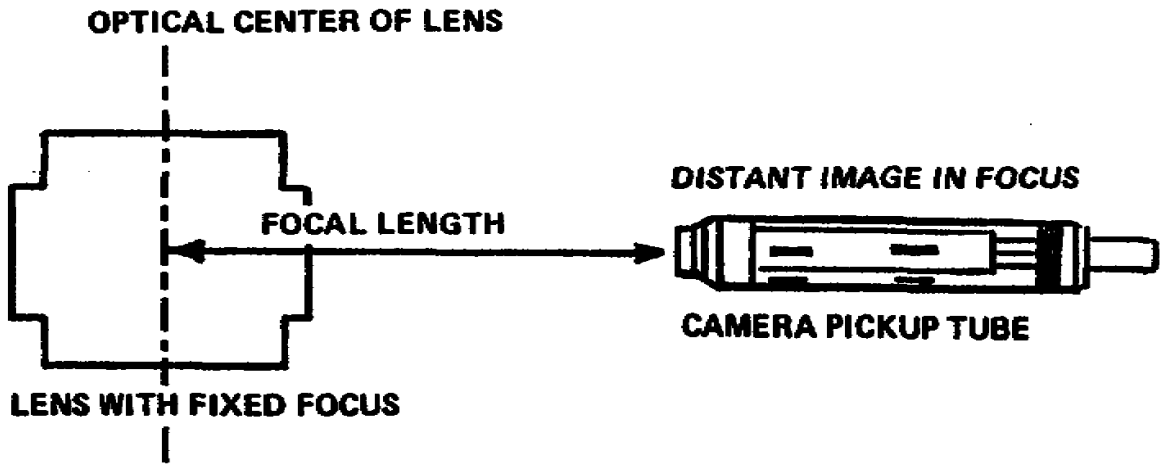

Figure 2-1. Focal length

c. Contrary to the fixed focal length lenses, the zoom lens can assume all focal lengths from the wide angle position to the narrow angle position. This is why it is called the variable focal length lens. You can change from a wide angle to a narrow angle with one continuous operation, without changing lenses or moving the camera. The zoom in means to change the vista gradually from a wide angle view to a narrow angle view. On television the zoom seems to appear as if the object is coming towards you. When the lens zooms out, the object is getting smaller and seems to move away from you, but the camera remains stationary during the operation.

(1) A picture is in focus when the projected image is sharp and clear. The focus depends on the distance from lens to the pickup tube. Simply changing the distance from the lens to the pickup tube brings the image into or out of focus.

(2) A zoom lens has several lenses that move in relation to one another when you zoom as well as when you focus. One set of these sliding elements, normally located at the front part of the lens, takes care of focusing.

(3) The focus control on the ENG/EFP has a focus ring that you must turn by hand on the lens. If properly preset, a zoom lens keeps in focus during the entire range, assuming that neither the camera nor the object moves very much.

(4) Sometimes the operator has to "follow focus" and operate the focus control while at the same time zooming in on the object. To preset the zoom for focusing during a zooming operation so that the camera stays in focus throughout the zoom, the operator must first zoom all the way in on the object and get the sharpest focus and then zoom out to a long shot or the desired shot. When the operator starts to zoom back to the long shot, he will see that everything stays in focus.

2. The lens aperture on a television camera is like that of the human eye. All lenses have a mechanism to control the amount of light that is admitted through the lens. This mechanism is called the diaphragm or iris.

a. The iris consists of a series of thin metal blades that form a fairly round hole. If you set the lens to its maximum aperture, it admits a maximum amount of light. If you close the lens, the metal blades of the diaphragm forms a smaller hole. The aperture is then smaller and less light goes through the lens. If you close the lens to its minimum aperture, very little light goes through. Some diaphragms can be closed entirely, which means no light is permitted to enter.

b. The standard scale that indicates how much light goes through a lens, regardless of whether it is a wide angle or telephoto lens, or any other type of zoom lens is the f-stop. The lower f-stop (f/1.2) indicates a relatively

large aperture (the lens is wide open). The higher f-stop indicates the smaller opening. These numbers may seem confusing; however, they represent the ratio. In this sense f/2 is actually f-1/2 (read: f one-half).

c. The quality of a lens is based on how much light it lets through the lens. A lens that lets in a great amount of light is called a fast lens, thus a slow lens lets in a relatively small amount of light (fig 2-2).

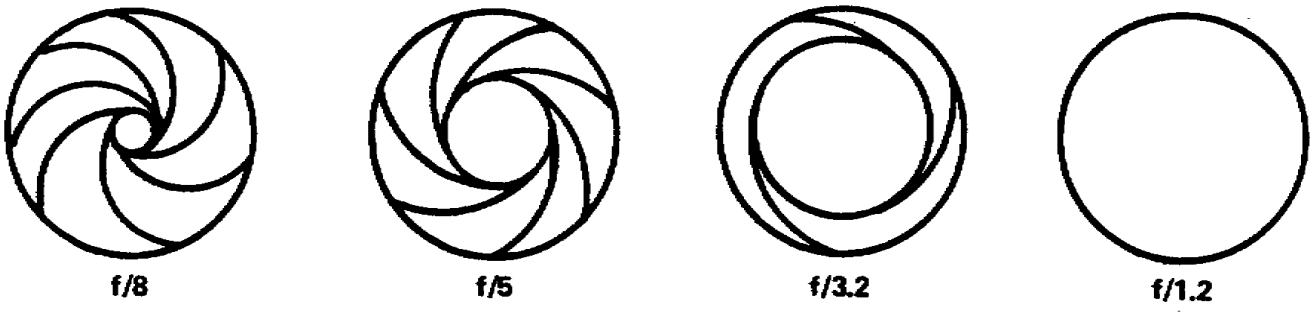

Figure 2-2. F-stop and lens aperture

d. One additional feature to a zoom lens is the automatic iris control. Most cameras, especially the ENG/EFP systems, can be switched over to automatic iris mode. The camera then senses the amount of light entering the lens and adjusts the iris automatically for optimal pickup tube performance.

(1) Although this procedure seems ideal for ENG/EFP systems, it does not always work to the operator's advantage. With a fairly even illumination the auto iris closes down when it sees an extremely bright area in your scene, or opens up when sensing a rather dark set area.

(2) The automatic iris responds to whatever light it receives, regardless of the lights' origin. Some cameras are equipped with an auto lock which prevents the automatic iris from drifting in and out.

3. One very important thing to remember about a lens is depth of field. If you place several objects at different distances from the camera, some of them will be in focus and some of them out of focus. The area in which the objects are seen in focus is called depth of field.

a. The depth of field can be shallow or great. If you have a shallow depth of field and you focus on an object in the middle ground, the foreground and background will be out of focus. If people or objects move around in a shallow depth of field, they quickly move out of the depth of field and get out of focus, unless you adjust the focus on the camera. The same thing may happen when you move the camera.

b. If the depth of field is great, all objects in the foreground, middle ground, and background, will be in focus, even though you focused on the middle ground object only. If you have a great depth of field there is a large sharp zone in which people or objects can move around and stay in focus. This great depth of field makes it possible to dolly and stay in focus. The depth of field depends on the coordination of three factors:

(1) The focal length of the lens.

(2) The aperture.

(3) The distance of the object from the camera (fig 2-3).

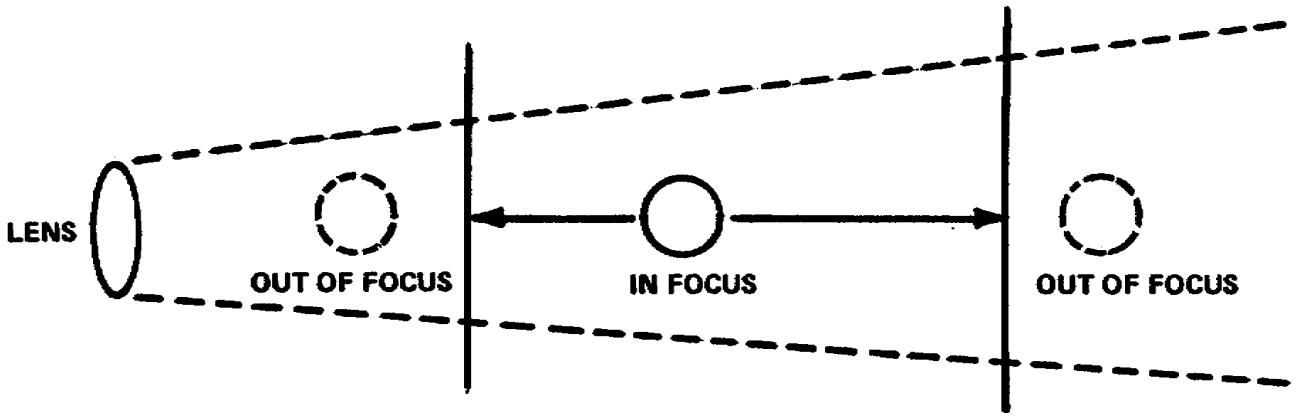

Figure 2-3. Depth of field

c. With the focal length given a fixed camera to object distance, short focal length lenses or wide angle zoom positions have a great depth of field. Long or telephoto lenses or narrow angle zoom positions have a shallow depth of field. Large aperture openings (small f-stop numbers) cause a shallow depth of field. Small lens opening (large f-stop number) provides a great depth of field.

Learning Event 2:
DESCRIBE HOW TO OPERATE A ZOOM LENS

1. There are two basic controls needed to operate a zoom lens: the zoom control unit which activates the variable focal length of the lens (the zooming mechanism) and the focus control unit which activates the intricate focus mechanism in a zoom lens. Both controls can be operated manually or automatically by a servo control.

a. On the ENG/EFP zoom lens, the manual control is a small rod extended from the zoom ring for control of the zooming process. To zoom in or out you would turn the zoom either clockwise or counter clockwise. It takes some skill and practice to accomplish smooth zooms with such a manual control.

(1) The servo zoom control unit does not activate the zoom lens mechanism directly, rather it signals a complex motor system that in turn drives the zoom mechanism in the lens. The servo control can make a fast zoom or slow zoom depending on the amount of pressure applied to the servo rocker button.

(2) There are several advantages to the servo system. Zooms are steady and smooth, especially during slow zooms. The zoom control is easy to operate and allows you to concentrate more on picture composition and focusing. The servo zoom frees your left hand to operate the manual focus and aperture controls.

b. The focus control is a manual function. To operate this control, the operator would rotate the focus ring on the zoom lens, either counter-clockwise or clockwise, while looking into the viewfinder to determine if the picture is sharp and in focus. Some cameras come with an automatic focus device that works on a simple radar principle. The camera sends out an infrared beam that is bounced back to the camera by objects to be photographed. The camera then computes the distance and adjusts the focus accordingly. Obvious problems occur when you want to focus not on the object that lies next to the camera, but on the one farther away.

c. The zoom lens is used to mount other controls such as the Automatic Iris Control, the VR remote control button, and the manual iris control.

Lesson 2
PRACTICE EXERCISE

1. What is the technical name for the zoom lens?

   a. Variable focus lens
   b. Short angle, long angle lens
   c. Speed lens
   d. Wide angle lens

2. What is a telephoto lens?

   a. Short focal length lens
   b. Long focal length lens
   c. Wide angle lens
   d. Narrow angle lens

3. Which is the correct definition of a lens aperture?

   a. A mechanism to control the amount of light admitted through the lens
   b. A control for white balance setting on the camera
   c. A mechanism to control and adjust the black balance on the camera
   d. A control for color resolution

4. Which is the correct definition of an f/stop?

   a. A variation of the iris and pickup tube setting
   b. A reference guide for iris correction
   c. A standard scale that indicates the amount of light to enter through lens
   d. A focus adjustment on a zoom lens

5. What does a large aperture opening represent?

   a. A smaller amount of light able to enter the lens
   b. A smaller f-stop number
   c. A larger f-stop number
   d. A lower f-stop number is greater depth of field

6. The automatic iris control is used for what?

   a. A light-sensitive control that adjusts the iris automatically
   b. A control for allowing only the amount of light needed
   c. A control for opening and closing down the iris
   d. All of the above

7. What is the purpose of the zoom lens servo control?

   a. To adjust the iris setting
   b. To control the automatic lens aperture
   c. To drive the zoom mechanism in the lens
   d. To provide control of the zoom function and iris setting

8. Which is the correct definition of depth of field?

   a. The vista of the zoom lens
   b. The field of view seen by the lens
   c. The area in which the subject is in focus
   d. The area in front of and behind the subject area

9. For what purpose does a short focal length lens have a great depth of field?

   a. Because short focal length lenses have large aperture openings
   b. Because short focal length lenses have a smaller aperture opening
   c. Because short focal length lenses only provide for shallow depth of field
   d. Because short focal length lenses are used for closeups

10. When is the automatic focus control considered to be "true"?

   a. Only when properly registered
   b. Only when not used in the manual mode
   c. Only when trying to focus on object far away from camera
   d. Only when trying to focus on an object close to the camera

11. What are the two basic controls needed to operate the zoom lens?

   a. Servo control and automatic control
   b. Zoom control unit and focus control unit
   c. Servo control and manual control unit
   d. Aperture ring control and servo control

Lesson 2
PRACTICE EXERCISE

1. A
2. B
3. A
4. C
5. B
6. D
7. C
8. C
9. A
10. C
11. B

LESSON 3
DESCRIBE OPERATOR'S MAINTENANCE OF AN ENG/EFP SYSTEM

TASK

Describe how to clean videotape recorder/reproducer heads, how to perform operator's maintenance of camera cables and connectors and operator's maintenance on a zoom lens.

CONDITIONS

Given information and illustrations about terms relating to the operator maintenance of the ENG/EFP system.

STANDARDS

Demonstrate competency of the task skills and knowledge by correctly responding to 85 percent of the multiple-choice test covering theory and maintenance of the ENG/EFP systems.

REFERENCES

None

Learning Event 1:
CLEAN VIDEO RECORDER/REPRODUCER HEADS

1. Performance of maintenance on the ENG/EFP system is the responsibility of the operator to ensure that the equipment is always ready to perform its task. Maintenance can prevent loss of manhours as well as save money on down time, which is very important for every military application.

a. All VRs tend to accumulate deposits of dirt on the spinning video heads, the static heads, and the rollers. The dirt is an amalgam of oxide, dust, and grease, which is ventilated into the machine with cool air. After about 30 hours of play this dirt will produce noticeable degradation in the picture, drop-out, streaking, and video noise.

(1) Quite a wide variety of so-called cleaning cassettes are available, but they should be chosen and used with great care, since they are abrasive, and in the process of cleaning the heads shorten the life of the heads.

(2) The manual method used for cleaning reel-to-reel heads can apply to the VR system. It is important to note that the heads are more sensitive than that of audio heads and more costly.

(a) It is important to disconnect any power source to the VR. Make sure foreign objects are not dropped into the VR. If it is necessary to remove the top cover of the VR, ensure that the screws are located and secured in a safe place to be returned to their proper location. Once the cover is removed, the operator visually inspects the VR for foreign objects.

(b) The most effective tools for cleaning heads are cotton swabs and alcohol. The operator dips the swab into the alcohol and very gently wipes the heads in a horizontal direction, back and forth across the heads. This movement must only be done in the same path that the tape is transported in order not to damage the heads. The video erase, audio, and control track heads, and pole guides may be cleaned the same way.

b. After several hundred hours of use, the heads will tend to become permanently magnetized. In performing maintenance, the operator would then have to demagnetize the heads. The demagnetizer is operated by AC current and puts out a magnetic field in order to demagnetize the heads. The operator turns the demagnetizer on and approaches the heads, places the demagnetizer in close proximity to the heads, then draws very slowly away before turning off the tool. All heads in the VR should be demagnetized as well as guides.

Learning Event 2:
PERFORM OPERATOR'S MAINTENANCE OF CAMERA CABLES

1. The camera cables are a major link between the recorder and the camera. If the camera is damaged or parts are defective, the needed signal will not travel to the recorder. It is important to perform operator maintenance on cables as on all of your equipment.

a. The operator must check the pins on the connectors to make sure they are not loose. If the pins are loose, the operator must fix them by either soldering and/or putting new pins on by crimping them in place.

b. The operator must inspect the cable itself to ensure that it does not have a break in it or that the shield is not broken. If the cable has a break, then the cable must be repaired by a qualified technician and not by the operator. There are times when it may be cheaper to replace the cable than repair it.

c. The cable should be free from dirt or grease. Cables should be wiped with a clean rag. All this is done to prevent loss of valuable equipment time.

Learning Event 3
PERFORM OPERATOR'S MAINTENANCE OF THE ZOOM LENS

1. A zoom lens is one important part of the ENG/EFP equipment and it is necessary to make sure it is always in good working order.

a. The zoom lens should never be taken apart by the operator. The zoom lens is a delicate item. The lens should never be cleaned with a cloth and even lens tissues or special lens cloths should only be used for stubborn smears that cannot be blown away with a blower or compressed air. If you should use them be sure not to grind the dirt into the delicate coating on the lens.

b. Never touch the lens and always use the lens cap when the camera is not in use. The exterior surface of a zoom lens can be wiped clean with a soft brush, but not the lens itself.

Lesson 3
PRACTICE EXERCISE

1. Dirty heads may cause streaking and video noise. What other problems may they cause?

   a. Dropout, and poor picture
   b. Sticking tape, audio noise
   c. Gummy heads and screeching
   d. Blanking and burning odors

2. What is the most effective way to clean heads?

   a. Cotton swabs and alcohol or freon
   b. Automatic cassette cleaner
   c. Soft cotton cloth and alcohol
   d. Abrasive cleaners

3. What happens if heads are not demagnetized?

   a. Heads and guide become permanently magnetized after several hours of operation
   b. Guides will become sticky
   c. The video heads will become magnetized
   d. Audio and video heads will burn

4. The use of cleaning cassettes cause what problems to video heads on VRs?

   a. None. Most manufacturers recommend the use of cassette cleaning tapes for their equipment
   b. The heads on the VR will wear out faster
   c. Cassette cleaning tapes sometimes leave debris or residue after use
   d. The heads will get too hot and create a smoky odor

5. Video heads are cleaned in what direction?

   a. Vertically only to prevent damage to heads
   b. Horizontally across the heads
   c. In any direction as long as the residue is removed
   d. Perpendicular to the tape travel on the heads

6. How should camera cables be stored?

   a. Kept free from dust and dirt
   b. Not rolled up with kinks or breaks
   c. Not allowed to be rolled
   d. Rolled up as tight as possible

7. One purpose of camera cable inspections is to ensure cable shield is not broken or frayed. What is another reason?

   a. To prevent someone tripping over it
   b. To ensure it is the correct size
   c. To ensure it is taped to ground
   d. To prevent loss of manhours

8. Which of the following is the best way to describe operation maintenance of a zoom lens?

   a. The operator should never take the lens apart or touch it directly
   b. The operator must try to maintain high maintenance standards by performing all maintenance
   c. The operator does not perform any type of maintenance on a zoom lens
   d. The operator must always wear white gloves when performing zoom lens maintenance

Lesson 3
ANSWERS TO PRACTICE QUESTIONS

1. A
2. A
3. A
4. B
5. B
6. B
7. D
8. A

Lesson 4
PACK, TRANSPORT, AND STORE AN ENG/EFP SYSTEM, SAFETY AND LIMITATIONS

TASK

Describe the proper way to pack, transport and store an ENG/EFP system; describe the safety precautions necessary in operating an ENG/EFP system; describe the limitations of the ENG/EFP system.

CONDITIONS

Given information and illustrations about terms relating to packing, transporting, storage, safety, and limitations.

STANDARDS

Demonstrate competency of the task skills and knowledge by correctly responding to 80% of the multiple-choice test covering theory and terminology of packing, transporting, storing, safety, and limitations.

REFERENCES

None

Learning Event 1:
DESCRIBE HOW TO PACK AND TRANSPORT AN ENG/EFP SYSTEM

1. There are times when the ENG/EFP system must be transported for a long distance. At these times, the operator must ensure that the equipment gets to the event in good working order. A camera and recorder shipping case should be obtained for this purpose. The VR should be disconnected from the camera cable and all batteries removed. The camera should be broken down only as far as needed to pack in the special case supplied for that camera. Usually, the cases are designed with compartments and to hold the equipment tight and in place. The cases are also designed to withstand dropping or other abuse.

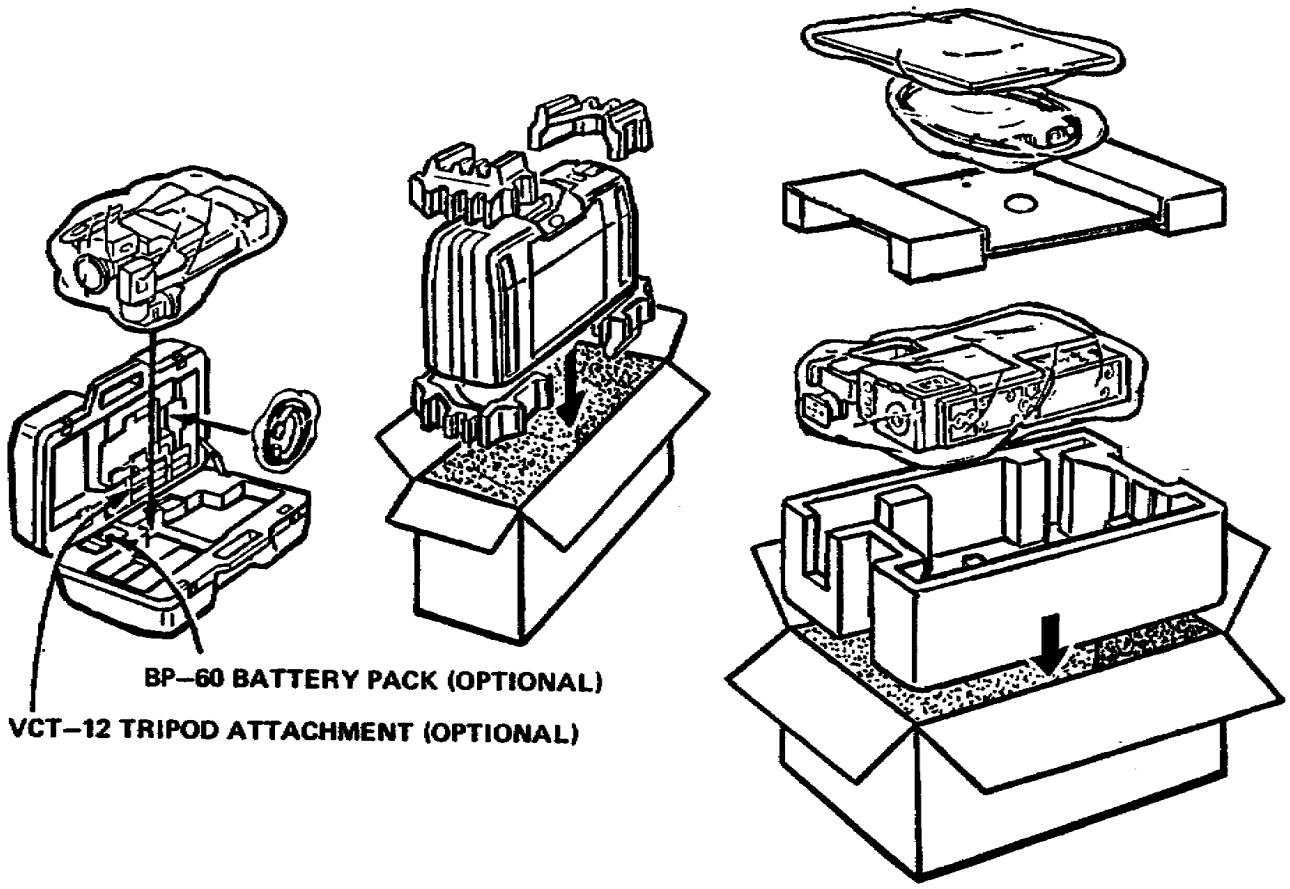

Figure 4-1. VR packing and storage

Learning Event 2:
DESCRIBE SAFETY MEASURES

1. There are several things that may cause the equipment to fail. The operator must always think of the ENG/EFP as delicate equipment and handle it with extreme care.

a. One thing that may destroy a VR, is liquid or beverage of any kind. The operator ensures there is no eating or drinking around the equipment that may get spilled by accident onto the VR.

b. Rings and jewelry may cause electric shock to one's self and equipment when cleaning heads and they come in contact with inside of a VR with power on. It is important to remember to turn off all power to equipment when performing maintenance.

c. A safety precaution for equipment with respect to storage and operations is dust and dirt. Dust and dirt may damage videotape and heads and other moving parts of the VR or camera.

d. Humid areas may destroy tape causing the heads to clog and shorten the life of the heads of the recorder.

e. If the operator points the camera in bright lights or sun, there may be damage to the pickup tube.

f. The operator must be sure that he knows where he is at all times and where his cables are, to ensure that he does not trip over them or the recorder. Stepping on cables may cause a short in the cable itself rendering the cable useless or cause a short in the camera or recorder.

g. The camera iris should be closed and lens cap in place when the camera is not in use to prevent damage to the pickup tube.

h. All these safety precautions should be practiced to ensure a perfect shooting assignment.

Learning Event 3:
DESCRIBE THE LIMITATION OF THE ENG/EFP SYSTEM

1. There are limitations on the use of the ENG/EFP system. The operator must avoid using the equipment under the following conditions: humid conditions, dusty places, poorly ventilated places, and near strong magnetic fields.

a. Using ENG/EFP in a humid place can cause the tapes oxide coating to come loose from its backing, causing the oxide to cling to the heads. This will cause the head to clog and the recording will be of a poor quality. The more clogs on the heads will require the heads to be cleaned more often and thus shortening the life of the heads.

b. Dusty places for storage and operation will cause damage to the heads and any moving parts as well as transferring the dust to the tape which may cause damage to any other recorder that tape may be played in.

c. Like all electronic equipment, the VR and camera can only stand certain temperatures before damage to the electronics occur. It is important to note that excessive usage in extreme temperatures may cause the electronics to burn themselves, thus rendering the equipment useless.

d. Strong magnetic fields may cause the camera or recorder to run improperly, causing an unstable picture. It is important to note that this equipment does generate and uses radio frequency energy and may be interfered with by strong magnetic energy.

Lesson 4
PRACTICE EXERCISE

1. What is the recommended method for shipping an ENG/EFP camera?

   a. The camera should be dismantled, completely wrapped in foil, and the box bonded
   b. The camera should be packed intact with enough padding to ensure no damage and a special case must be built for it
   c. The camera should have the lens removed by packing securely in a metal suitcase
   d. The camera should be broken down only as far as needed to pack in special case supplied for that camera

2. What are the three safety measures for ENG/EFP systems?

   a. No liquids around VTR, clean dust and dirt, remove jewelry
   b. No electromagnetics, dusty fields of view, no polluted environment
   c. No power lines, radar interference, or radio frequencies
   d. Handle gently, plug in carefully, use sparingly

3. What four major conditions limit the effectiveness of any ENG/EFP systems?

   a. Liquids, power supplies, magnetization, polluted environment
   b. Dusty areas, humid conditions, poor ventilation, and strong magnetic fields
   c. Stepping on cables, bright lights, magnetic fields, and artificial lighting
   d. Carelessness, incompetency, laziness, and poor maintenance

4. Do humid conditions effect videotape?

   a. Videotape is environmentally safe to use in any condition
   b. Tape will start to stretch
   c. Tape will become brittle and break
   d. Oxide starts flaking and may clog heads

Lesson 4
ANSWERS TO PRACTICE EXERCISE

1. D

2. A

3. B

4. D