TM 11-6695-210-12

TECHNICAL MANUAL

OPERATOR'S AND ORGANIZATIONAL MAINTENANCE MANUAL INCLUDING REPAIR PARTS AND SPECIAL TOOLS LIST

POLYGRAPH INSTRUMENT, RECORDING AN/USS-2F (NSN 6695-00-543-6078)

This copy is a reprint which includes current pages from Changes 1 and 2. The title was changed by C 2 to read as shown above.

H E A D Q U A R T E R S , D E P A R T M E N T O F T H E A R M Y

JUNE 1970

WARNING

DANGEROUS VOLTAGES EXIST IN THIS EQUIPMENT

Be careful not to come in contact with 115-volt line connections when testing or servicing Polygraph Instrument. Recording AN/USS-2F.

DON'T TAKE CHANCES!

The fumes of trichloroethane are toxic. Provide thorough ventilation whenever used. DO NOT use near an open flame. Trichloroethane is not flammable, but exposure of the fumes to an open flame converts the fumes to highly toxic, dangerous gases.

TECHNICAL MANUAL
.
No. 11-6695·210-12

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, DC, *9 June 1970*

OPERATOR'S AND ORGANIZATIONAL MAINTENANCE MANUAL INCLUDING REPAIR PARTS AND SPECIAL TOOLS LIST POLYGRAPH INSTRUMENT, RECORDING AN/ USS-2F (NSN 6695-00-543-6078)

Current as of 6 May 1975

LIST OF ILLUSTRATIONS

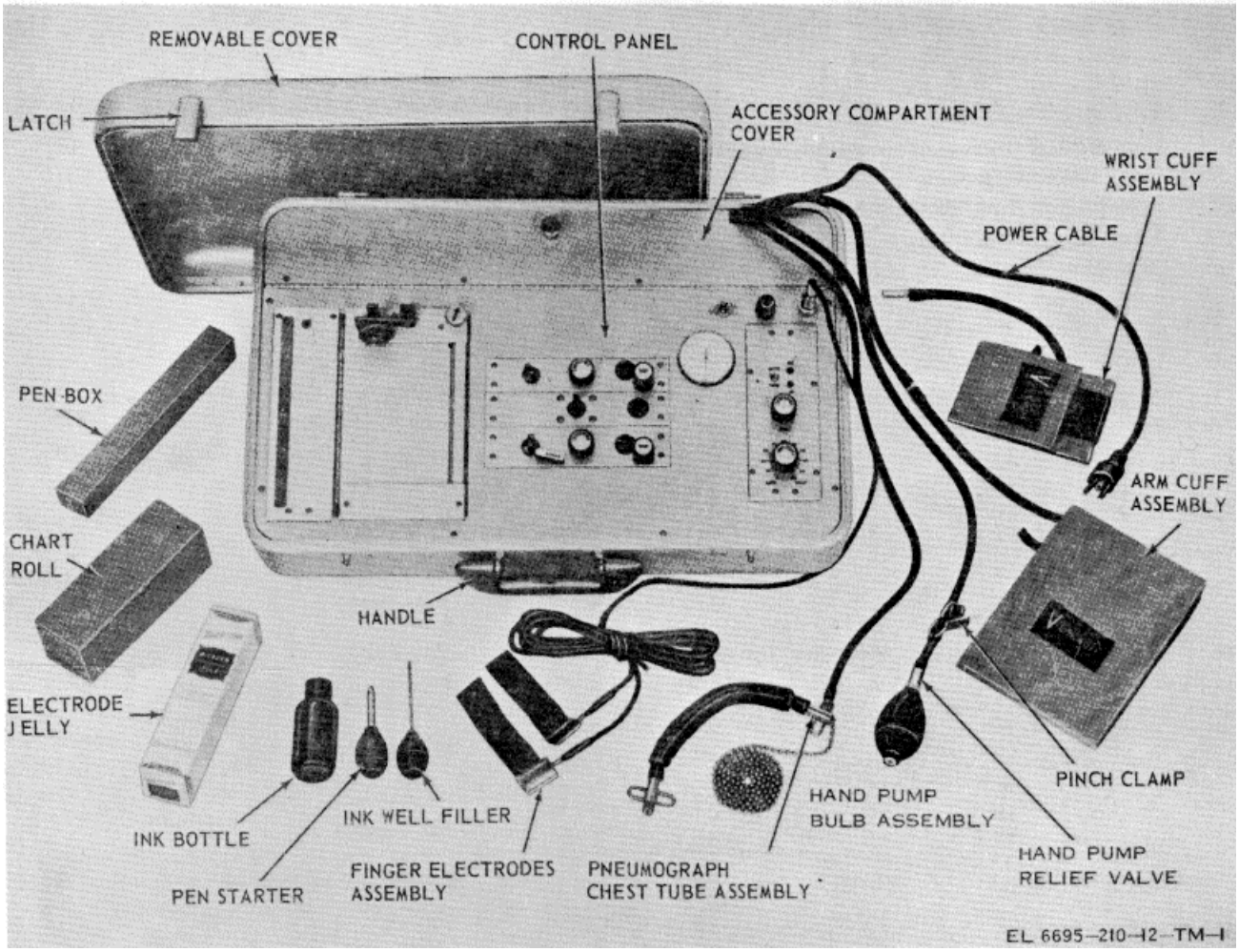

Figure 1-1. Polygraph Instrument, Recording AN/USS-2F, less running spares.

CHAPTER 1

INTRODUCTION

Section I. GENERAL

1-1. Scope

a. This technical manual describes Polygraph Instrument, Recording AN/USS-2F and covers its operation and operator and organizational maintenance. It includes operation under usual and unusual conditions, cleaning and inspection of the equipment, and replacement of parts available to operator and organizational maintenance personnel. It also lists tools and materials required for organizational maintenance. Demolition of the equipment is covered in chapter 4.

b. The repair parts and special tools list is contained in appendix B, and the maintenance allocation chart (MAC) is contained in appendix C.

1-2. Indexes of Publications

a. DA Pam 310-4. Refer to the latest issue of DA Pam 310-4 to determine whether there are new editions, changes, or additional publications pertaining to the equipment.

b. DA Pam 310-7. Refer to DA Pam 310-7 to determine whether there are modification work orders (MWO's) pertaining to the equipment.

1-3. Forms and Records

a. Reports of Maintenance and Unsatisfactory *Equipment.* Maintenance forms, records, and reports which are to be used by maintenance personnel at all maintenance levels are listed in and prescribed by TM 38-750.

b. Report of Packaging and Handling Deficiencies. Fill out and forward DD Form 6 (Packaging Improvement Report) as prescribed in AR 700-58/NAVSUPINST 4030.29/AFR 7113/MCO P4030.29A, and DSAR 4145.8.

c. Discrepancy in Shipment Report (DISREP) (SF 361). Fill out and forward Discrepancy in Shipment Report (DISREP) (SF 361) as prescribed in AR 55-38/NAVSUPINST 4610.33A/AFR 75-18/MCO P4610.19B, and DSAR 4500.15.

1-3.1. Reporting of errors.

The reporting of errors, omissions, and recommendations for improving this publication by the individual user is encouraged. Reports should be submitted on DA Form 2028 (Recommended Changes to Publications and Blank Forms) and forwarded direct to Commander, US Army Electronics Command, ATTN: AMSEL-MA-Q, Fort Monmouth, NJ 07703.

Section II. DESCRIPTION AND DATA

1-4. Purpose and Use

a. *Purpose.* Polygraph Instrument, Recording AN/USS-2F (fig. 1-1) provides a facility for monitoring a person's (subject's) reaction to questioning.

b. *Use.* Polygraph Instrument, Recording AN/USS-2F is used to detect and record a subject's breathing rate and depth, relative blood pressure and pulse rate, and skin resistance (rate of perspiration) when these reactions occur under questioning. The recording (fig. 2-9) provides an on-the-spot check of the subject's reaction to questioning, and a permanent record for detailed study and analysis.

1-5. Technical Characteristics

a. Primary Power Requirements.

Voltage	115 vac t 10.
Frequency	60 Hz - 3.
Current	1 ampere (approx).

b. Gsr System.

Subject's resistance range	1.000 to 250.000 ohms.
Sensitivity (at HIGH setting	1 inch minimum pen displacement for 1,000-ohm change in skin resistance.
Response time (AUTO mode of operation)	5 to 10 seconds.
Limits of pen travel (approx)	1/8 inch below top chart guide: 1/8 inch above bottom chart guide.

c. Pneumography System.

Sensitivity ---------- 1 inch pen displacement for 1/4 inch chest tube extension (approx)
Limits of pen travel (approx)---------- 1/4 inch below top chart guide; 1/8 inch above center chart line.
Maximum permissible air leakage---------- 1/4 inch pen displacement in 30 seconds.

d. Cardio-Sphygmograph System.

Sensitivity (90 mm Hg (mercury) initial pressure) ---------- 3/4 inch (minimum) pen displacement for 2-mm Hg change of pressure.
Maximum permissible pressure ---------- 150 mm Hg.
Permissible air leakage (within 10 minutes at 90-mm Hg initial pressure) ---------- 1/4 inch pen displacement.
Limits of pen travel (approx) ---------- 1/8 inch below center chart line, 1/8 inch above bottom chart guide.

e. Chart-Drive Assembly.

Chart speed---------- 6 inches per minute.
Chart width---------- 6 inches.
Chart length---------- 100 ft per roll (approx).
Motor - ---------- Synchronous, 1 rpm, 3 watts, gear motor drive.

1-6. Items Comprising an Operable Equipment

a. *Components* (fig. 1-1). The components of Polygraph Instrument, Recording AN/USS-2F are listed in the following chart.

NOTE

This listing is based on the original shipment (Contract No. DAAB05-69-C-0770).

a. Components.

FSN	QTY	Nomenclature, part No., and mfr code	Fig. No.
6695-543-6078	1	Polygraph Instrument, Recording AN/USS-2F including:	1-1
6695-4593321	1	Pen, Long, Recorder	1-2
6695-459-3320	2	Pen, Short, Recorder	1-2
NSN	1	Box, Pen	1-1
6695-563-0489	1	Filler Assembly, Inkwell	1-1
7510-159-4475	1	Ink, Recording Instrument	1-1
8125-181-7451	3	Bottle Assembly, Applicator	1-2
6695-753-4560	1	Chart, Recording	1-2
6695-489-6086	1	Electrode Assembly, Finger	1-1
6515-327-3800	1	Electrode Paste, Electrocardiograph	1-1
6695-073-9178	1	Sphygmomanometer Cuff Assembly, Wrist	1-1
6695-489-6088	1	Sphygmomanometer Cuff Assembly, Arm	1-1
6515-762-2110	1	Bulb Assembly, Sphygmomanometer	1-1
6695-489-6085	1	Pneumograph Assembly	1-1
6695-563-0488	1	Starter, Pen	1-1

b. Running Spares.

FSN	QTY	Nomenclature, part No., and mfr code	No.
6695-753-4560	4	Chart, Recording	1-2
6695-459-3321	1	Pen, Long, Recorder	1-2
6695-459-3320	1	Pen, Short, Recorder	1-2
8125-181-7451	1	Bottle Assembly, Applicator	1-2
	5	Fuse, 0.6 amp slo-blo	1-2

c. Dimensions and Weights, Polygraph Instrument, Recording AN/USS-2F.

FSN	QTY	ITEM	Dimensions (in.)			Unit weight (oz)
			Height	Depth	Width	
6695-543-6078	1	Polygraph Instrument, Recording AN/USS-2F:	13	61/2	21	16 lb
6695-4593321	1	Pen, Long, Recorder	7			1/4
6695-459-3320	2	Pen, Short, Recorder	5			1/4
NSN	1	Box, Pen				1
6695-5630489		Filler Assembly, Inkwell				1/2
7510159-4475	1	Ink, Recording Instrument				3
	1					

FSN	QTY	ITEM	Dimensions (in.)			Unit weight (oz)
			Height	Depth	Width	
8125181-7451	3	Bottle Assembly, Applicator				1\4
6695-7534560	1	Chart, Recording	100 ft lg		6	8
6695-489-6086	1	Electrode Assembly, Finger				3
6515-327-3800	1	Electrode Paste, Electrocardiograph				8
6695073-9178	1	Sphygmomanometer Cuff Assembly, Wrist				4 1/2
669,5489-6088	1	Sphygmomanometer Cuff Assembly, Arm				7
6515-76i2-2110	1	Bulb Assembly, Sphygmomanometer				3 1/2
6695-489-6085	1	Pneumograph Assembly				7 1/2
6695-563-0488	1	Starter, Pen				1/2

1-7. Common Names

The common names for Polygraph Instrument, Recording AN/USS-2F and its associated items are listed below.

Nomenclature or item	Common name
Polygraph Instrument, Recording AN/USS-2F	Polygraph
Galvanic skin resistance amplifier	Gsr amplifier
Pneumograph	Pneumo
Galvanometer	Galvo
Cardio-Sphygmograph	Cardio
Pneumograph chest tube assembly	Chest tube
Sphygmomanometer	Pressure gage
Pen, long, recorder	Galvo pen
Pen, short, recorder	Cardio or pneumo pen
Filler assembly, inkwell	Inkwell filler
Ink, recording instrument	Ink bottle
Bottle assembly, applicator	Ink reservoir
Chart, recording	Chart paper
Electrode assembly, finger	Finger electrodes assembly
Electrode paste, electrocardiograph	Electrode jelly
Sphygmomanometer cuff assembly, Arm	Arm cuff assembly
Sphygmomanometer cuff assembly, wrist	Wrist cuff assembly
Bulb assembly, sphygmomanometer	Hand pump bulb assembly
Pneumograph assembly Chest tube	

1-8. Description of Polygraph

(fig. 1-1 and 1-2)

The polygraph is enclosed in a high strength, light-weight, luggage-type case, with a removable cover which is secured by latches. A handle is attached to the side of the polygraph to facilitate carrying the unit. An accessory compartment, located under the accessory compartment cover, contains a permanently secured three conductor, rubber-insulated power cable, operating accessories, and running spares. A pen box is also included which contains five pens (two galvo pens and three cardio or pneumo pens). The accessory compartment also contains connectors (fig. 2-3) for connecting the finger electrodes assembly, the hand-pump bulb assembly, the chest tube assembly, and the arm cuff or wrist cuff assembly. The chart drive assembly, which can be independently operated, accommodates and drives the chart paper. The main operating accessories are described in *a* through *g* below.

a. Chest Tube Assembly. The chest tube consists of a 7-inch, bellows type rubber tube, a 36-inch beaded chain, and a 6-foot rubber hose. The bellows-type tube is placed on the subject's chest, where it is retained by the beaded chain. The rubber hose provides interconnection between the bellows-type tube and polygraph. The chest tube is used to sense and transmit the breathing rate and depth of the subject.

b. Arm Cuff or Wrist Cuff Assembly. Each cuff assembly consists of a cloth retainer, which contains a rubber bag and a rubber hose; the cuff may or may not contain a sealed-off rubber stud. The arm cuff wraps around the arm; the wrist cuff goes around the wrist. Each cuff assembly is used to sense and transmit the blood pressure and pulse rate of the subject.

c. Hand-Pump Bulb Assembly. The hand pump bulb assembly consists of a rubber bulb, a hand-pump release valve operated by a knurled headscrew, and an 18-inch length of rubber hose. The hand-pump release valve is used as a slow release to adjust cuff pressure. A pinch clamp is provided as a shutoff device. The hand-pump bulb assembly is used to pressurize (inflate) the cardio system.

d. Finger Electrode Assembly. The finger electrode assembly consists of two stainless steel electrodes equipped with retaining bands. This pair of electrodes is attached to a shielded electrical cord by telephone tip's and terminated at the other end by a screw-connector fitting. The finger electrode assembly senses and transmits the skin resistance of the subject.

e. Pens. The cardio, pneumo, and galvo pens consist of a pen pivot, threaded brass counterweight, and a hollow stainless-steel tubing. The cardio and pneumo pens are 5 inches long and are identical. The galvo pen is 7 inches long and is bent so that it can travel above and ahead of the other two pens.

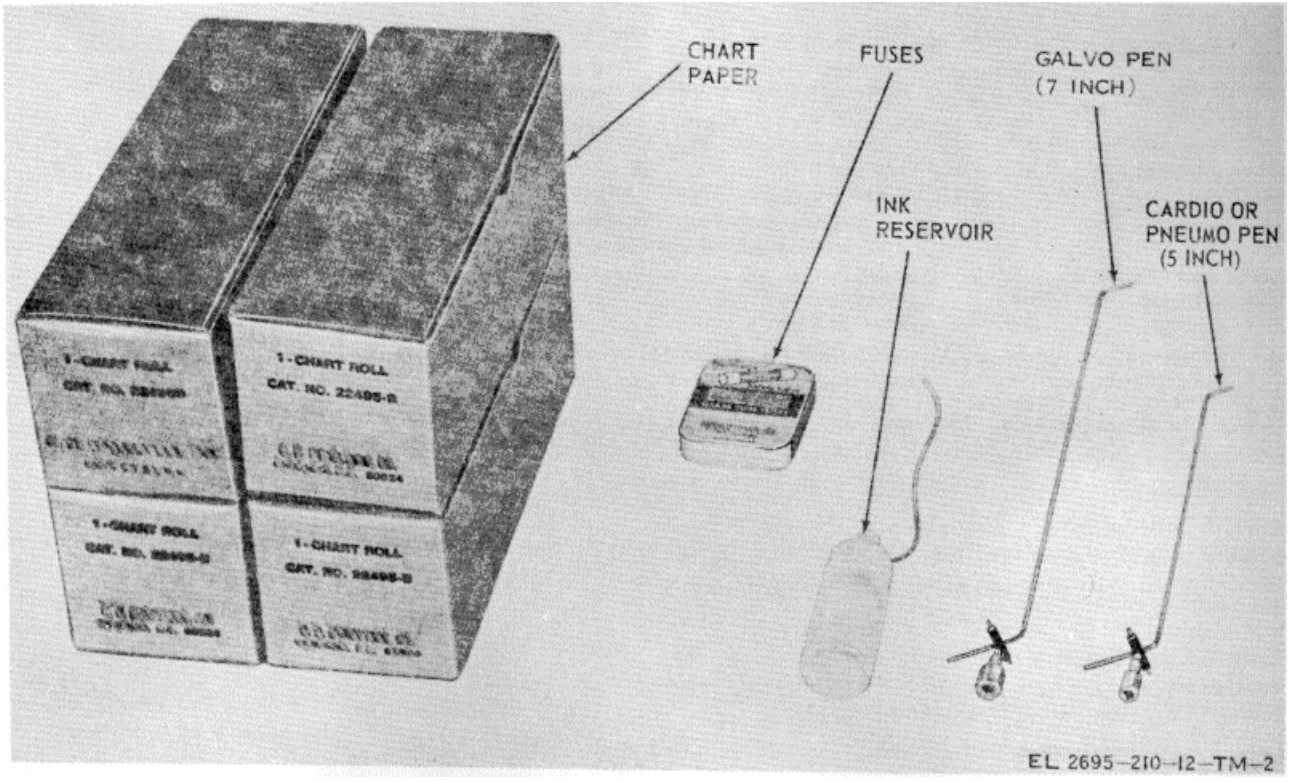

Figure 1-2. Running Spares.

The pens are used to record a subject's reaction on a paper chart.

f. Inkwell Filler. The inkwell filler consists of a metal tube and a rubber bulb. It is used to fill the ink reservoirs with ink.

g. Pen Starter. The pen starter consists of a plastic tube and a rubber bulb. It is used to siphon ink through the pens.

CHAPTER 2

INSTALLATION AND OPERATION

Section I. SERVICE UPON RECEIPT OF EQUIPMENT

2-1. Unpacking

(fig. 2-1)

a. Packaging Data. For the purpose of shipping, the polygraph is put into a fiber carton with protective packing on all sides. The shipping box is 27 inches long, 12 inches wide, and 22 inches deep; it has a volume of 4.1 cubic feet. The entire package weights 49 pounds when packed for shipment.

b. Removing Contents.

(1) Cut and fold back the metal straps.

CAUTION

Do not attempt to pry the wooden cover off because the equipment may become damaged.

(2) Remove the nails from the wooden cover with a nail puller and remove the cover.

(3) Remove the waterproof bag which contains the manuals and remove the manuals.

(4) Remove the carton which contains the running spares.

(5) Remove the packing material and remove the fiber box; open the box and remove the contents.

2-2. Checking Unpacked Equipment

a. Inspect the equipment for damage that may have occurred during shipment. If the equipment has been damaged, fill out and forward DD Form 6 (para 1-3*b*).

b. Check to see that the equipment is complete as listed on the packing slip. If a packing slip is not available, check the equipment against the chart in paragraph 1-6. Report all discrepancies in accordance with TM 38-750. The equipment should be placed in service even though a minor assembly or part that does not affect proper functioning is missing.

c. Check to see whether the equipment has been modified. If the equipment has beet; modified, the MWO number will appear on the front panel, near the nomenclature plate. Check also to see whether all MWO's current at the time the equipment is placed in use have been applied.

NOTE

Current MWO's applicable to the equipment are listed in DA Pam 310-7.

d. Check the latest issue of DA Pam 310-4 (never more than 1 year old) and its latest changes (never more than 6 months old) to see that the latest editions of all applicable maintenance literature are on hand.

NOTE

Equipment issued by depots may have been in stock for some time and may contain superseded manuals.

2-3. Placement of Equipment

a. A quiet, plainly furnished, medium-size room with soft-colored walls provides the best place to set up the equipment. Whenever possible, avoid locations where outside noises would be annoying. Make whatever preparations are necessary to make the subject comfortable and at ease.

NOTE

Do not set up the equipment in locations that are close to alternating current (ac) powerlines, radio transmitters, or wherever strong magnetic fields might be present.

b. Place the polygraph on a desk or table where working papers, records, and accessories can be easily accommodated.

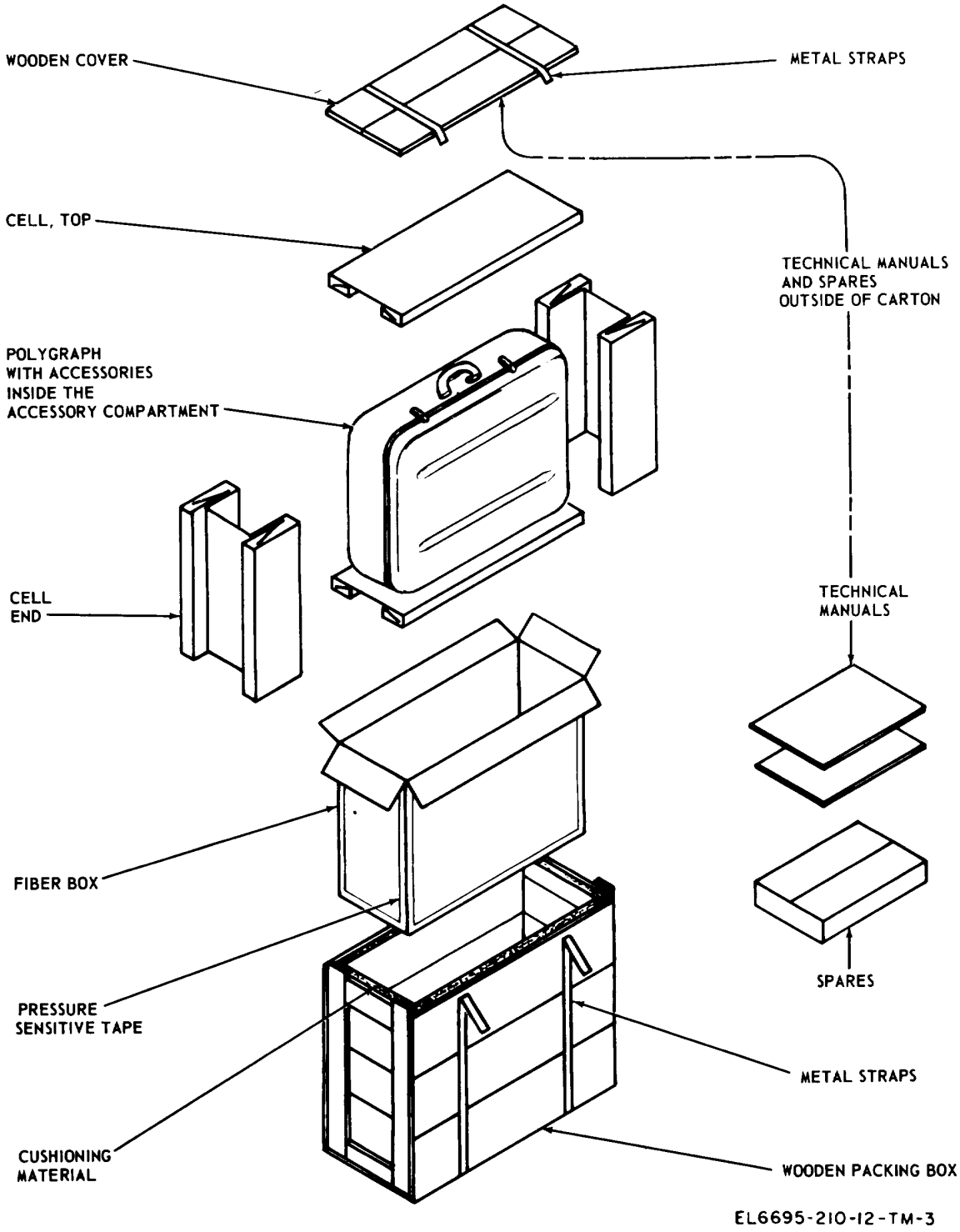

Figure 2-1. Typical packaging diagram.

Allow enough room at either side of the polygraph for the free run of the chart to the left of the equipment, and distribution of the cardio and pneumo rubber tubing and finger electrode cable to the right. Position the subject's chair so that the subject cannot see either the examiner or the polygraph while being questioned. The desk or table should be located within 3 feet of a 115-volt ac, 60-Hertz (Hz) power source with good ground connection.

NOTE

Make sure the subject is isolated from earth ground. If necessary, use a rubber mat or other insulator to isolate the subject from damp ground or concrete floors. Equipment performance may be impaired if the subject is touching earth ground.

Section II. PRELIMINARY PROCEDURES

2-4. Controls, Indicators, Detectors, and Connectors

(fig. 2-2).

a. *Pneumo System*

Control. indicator, detector, or connector	Function
Pneumo pen	Records subject's breathing rate and depth (respiration) on chart paper (fig. 2-9).
Pneumo CENTERING control.	Positions pneumo pen writing tip to a zero-reference table index line on chart paper.
Pneumo VENT push-button.	When open (pressed), prevents movement of pneumo pen; when closed (raised), permits movement of pen.
Chest tube (fig. 2-7)	Transmits breathing rate and depth changes from subject to polygraph.
PNEUMO chest tube connector (fig. 2-3).	Permits attachment of chest tube hose to polygraph.

b. Gsr System.

Galvo pen	Records subject's skin resistance (perspiration) changes on chart paper (fig. 2-9).
Gsr CENTERING control.	Positions gsr pen writing tip to a zero-reference index line on chart paper.
SENSITIVITY control..	When placed at LOW, permits minimum amplitude of gsr tracing; when placed at HIGH, perits maximum amplitude of gsr tracing.
Mode switch	When set at AUTO, gsr pen is automatically centered on zero-reference index line after each reaction; when set at MAN, gsr pen is continuously displaced in proportion to subject's resistance changes.
Gsr power switch	When set at ON, applies 115-volt ac, 60-Hz power to the gsr system.
Finger electrodes (fig. 1-1).	Transmit changes in skin resistance from subject to polygraph.

Control, indicator, detector, or connector	*Function*
Finger electrode connector	Permits attachment of finger electrode cable to polygraph.
Pip switch (1K) push-button.	Introduces 1,000-ohm resistance change for checking or scaling of pen deflection.
Pip switch (5K) push-button.	Introduces 5000 ohm resistance change for checking or scaling of pen deflection.

C. Cardio System.

Cardio pen	Records subject's relative blood pressure changes and pulse rate on chart paper (fig. 2-9).
Cardio CENTERING control.	Positions cardio pen writing tip to a zero-reference index line on chart paper.
Cardio VENT push-button.	When open (pressed), prevents operation of cardio pen; when closed (raised), permits movement of pen.
Pressure gage	Indicates proper inflation pressure of cuff attachment. Gage indicates pressure measured in millimeters (mm) of mercury (Hg); scale markings are in divisions of 20, ranging from 0 to 300.
Arm or wrist cuff (fig. 1-1).	Transmits blood pressure and pulse rate changes from subject to polygraph.
Hand-pump bulb (fig. 2-8).	When pumped, builds up air pressure in cuff.
Hand-pump release valve (fig. 2-8).	When closed (knob turned clockwise), permits hand-pump bulb to inflate cardio system; when opened (knob turned counter-clockwise), releases air from cuff; used as a slow release to adjust cuff pressure.
Pinch clamp (fig. 2-8)	When opened (press tip to open), permits inflation of cardio cuff; when closed, prevents air leakage through hand-pump bulb.

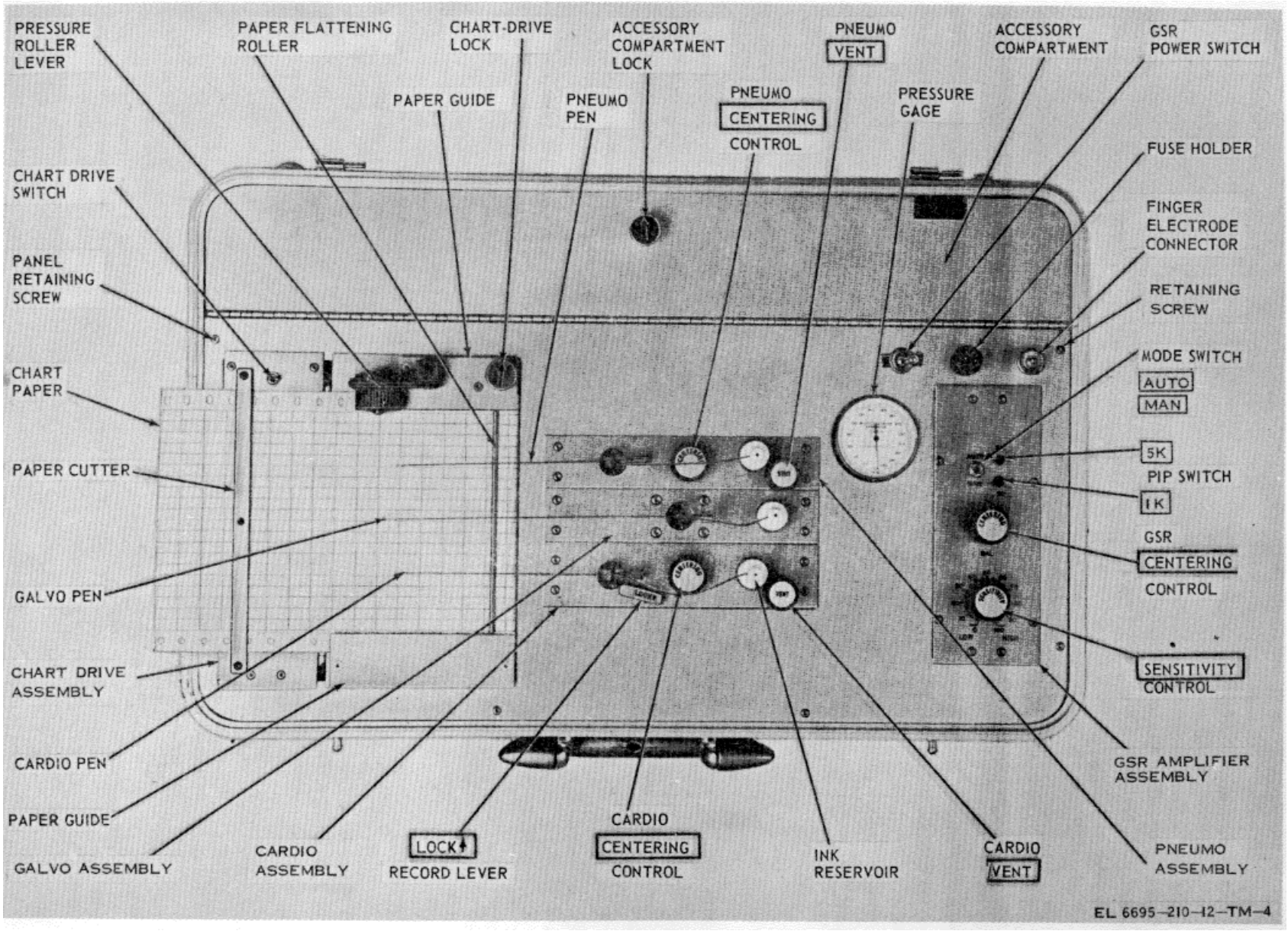

Figure 2-2. Controls and instruments.

c. Cardio System (cont).

Control, indicator, detector, or connector	*Function*
CUFF arm or wrist hose to cuff connector (fig. 2-3)	Permits attachment of cuff polygraph.
PUMP hand-pump hose connector (fig. 2-3).	Permits attachment of hand-pump bulb hose to polygraph.
Lock ↑ record lever	Locks pen during system pres surization.

d. Chart Drive System.

Chart drive switch	When set at on (left), applies 115-volt ac, 60-Hz power to chart drive motor; when set at off (right), disconnects power from chart drive motor.
Pressure roller lever	Lifts pressure roller for installation of paper chart (may be used in place of chart drive switch to stop paper chart movement).
Chart drive lock	Locks chart drive assembly to top panel during shipment.

2-5. Preparation of Equipment

a. General.

(1) Open and remove the removable cover from the polygraph (fig. 1-1).

(2) Turn the accessory compartment lock to open the accessory compartment door, and remove the accessory items from the accessory compartment.

b. *Preliminary Control Setting* (fig. 2-2). Set the controls on the polygraph as follows:

Control	*Position*
Gsr power switch	OFF
Chart drive switch	Off (right)
Pressure roller lever	Up (turn counterclockwise)
Pneumo VENT push-button	Open (press knob and turn to lock)
Cardio VENT push-button	Open (press knob and turn to lock)
Cardio LOCK ↑ record lever.	LOCK ↑ (move in direction of arrow)
SENSITIVITY control	LOW
Mode switch	MAN
CENTERING (cardio, gsr, pneumo) controls.	Any position

c. Connections (fig. 1-1 and 2-3).

NOTE

Moistening the ends of the rubber hoses (during the procedures in (1), (2), and (3) below) will aid in slipping it onto the connectors.

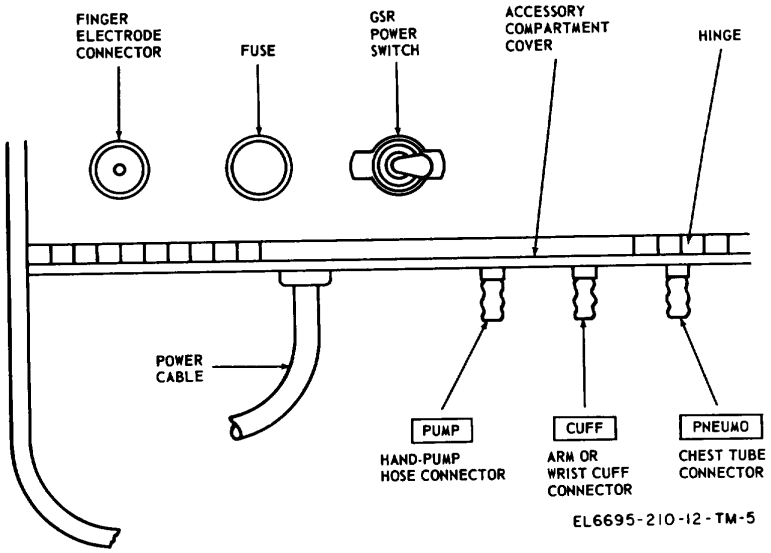

Figure 2-3. Accessory compartment connectors.

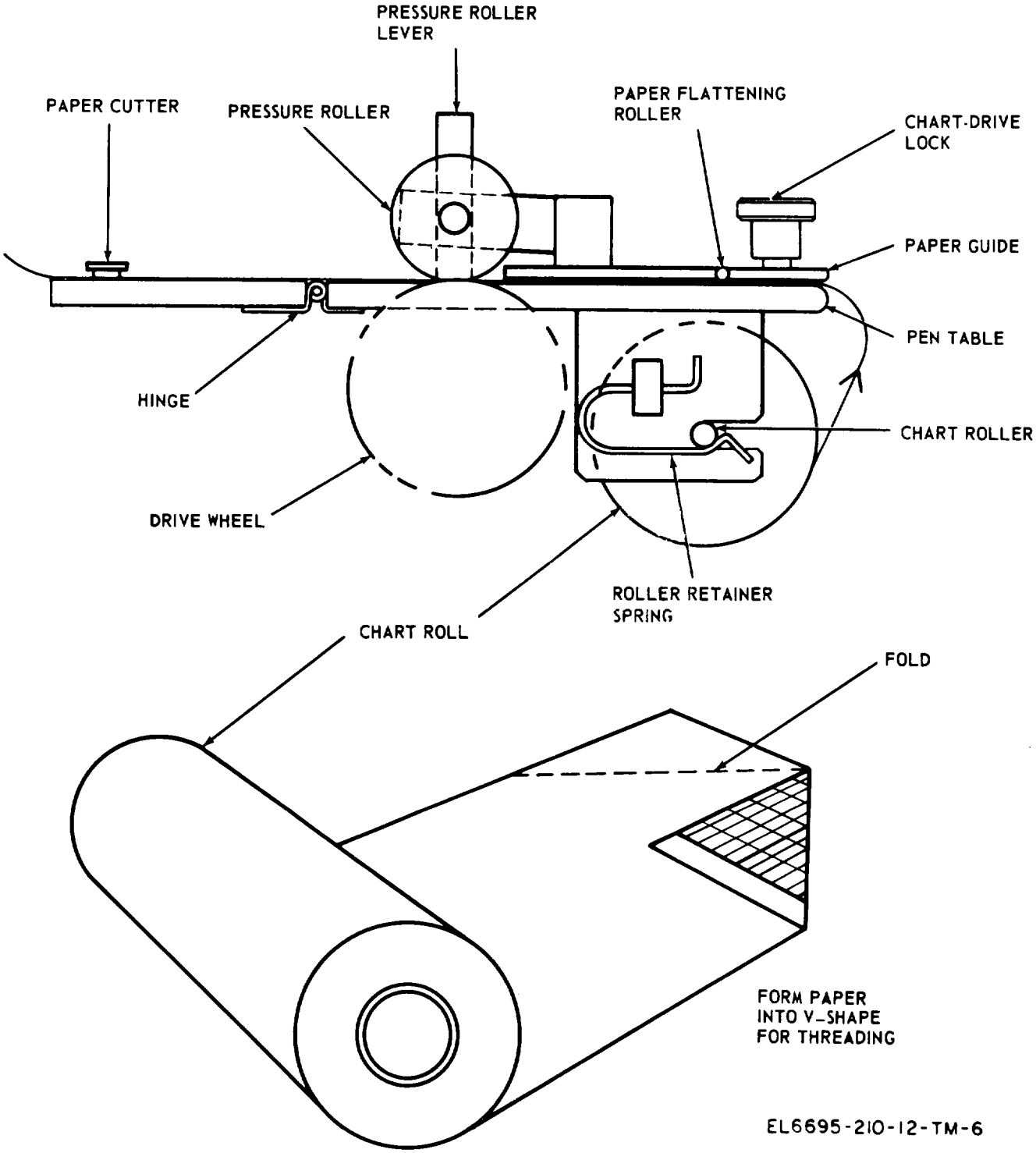

Figure 2-4. Installation of chart roll.

(1) *Arm or wrist cuff assembly*. Attach the rubber hose of the cuff to the arm or wrist cuff connector.

(2) *Hand-pump bulb assembly*. Attach the rubber hose of the cuff to the arm or wrist cuff hand-pump hose connector.

(3) *Chest tube assembly*. Attach the rubber hose of the chest tube to the chest tube connector.

(4) *Finger electrode assembly*. Attach the screw-type connector on the finger electrode assembly to the finger electrode connector and screw it down tight.

WARNING

Make sure the gsr power switch is set to OFF and the chart drive switch is set to the off position (right) before making power connections.

(5) *Power cable.* Connect the power cable to a 115-volt ac, 60-Hz grounded power source.

d. Installing Chart (fig. 2-4).

(1) Unlock (turn the chart drive lock) and lift the pen table so that the chart roller is accessible.

(2) Remove the chart roller and insert it into the chart roll.

(3) Place the chart roll in the chart roller retainer slot. Make sure each end of the roller snaps into place and is held by the roller retainer spring, and turns smoothly in the retainer slots.

(4) Fold, or cut, the free end of the chart paper into a V-shape.

(5) Lift the pressure roller lever. Feed the end of the chart over the pen table end, under the paper flattening roller and paper guides, and between the pressure and drive wheels.

(6) Lower and lock the pen table.

(7) Feed the paper under the paper cutter.

(8) Lower the pressure roller lever.

(9) Set the chart drive switch (fig. 2-2) to on (left) and be sure the chart travels smoothly without any signs of binding, jamming, or skewing.

(10) Set the chart drive switch to off (right).

e. *Filling Ink Reservoirs*.

(1) Fill the inkwell filler (B, fig. 2-5) with ink.

NOTE

Wipe off the outside of the inkwell filler tube with a tissue to prevent formation of bubbles, which burst and splatter when the ink is pumped into the ink reservoir.

(2) Insert the inkwell filler into a hole in the cap of the ink reservoir and gently squeeze the bulb until the ink reservoir is filled to the neck.

(3) Repeat the procedure given in (2) above for the other two ink reservoirs.

(4) Place the ink reservoirs in retainers of the respective assemblies.

f. *Installing Pens*.

CAUTION

Be careful while handling the pens. Do not drop, bend, or twist a pen, as the pen will become damaged and will not write properly.

(1) Open the pen box (fig. 1-1) and remove two short (cardio and pneumo) pens (fig. 2-2) and one long (galvo) pen from the pen box.

(2) Connect the pen into the plastic pen tubing (A, fig. 2-5).

(3) Place each pen gently into each respective pen cradle slot. If the pen cradle prongs are not aligned with the pen pivot pins, gently compress or expand the prongs, as required, to enable the pen to fit the prongs.

NOTE

The two short pens are interchangeable and are installed in the cardio and pneumo pen cradles; the long pen is installed in the galvo pen cradle.

(4) Check to see that the pen pivot pins fit into the cradle slots and that each pen does not not bind in its pen cradle.

(5) Allow each pen to rest on the chart (*i* below).

g. Priming Pens with Ink Reservoir.

(1) Raise the ink reservoir from the ink reservoir retainer so that is may be squeezed with the fingers (C, fig. 2-5).

(2) Place the finger on top of the cap and gently squeeze the reservoir until ink appears at the pen tip. (3) Remove the finger from the cap and slowly release pressure from the reservoir; insert the reservoir into the retainer.

NOTE

If finger is not removed from the cap before the release of finger pressure on the ink reservoir, ink will be drawn back into the ink reservoir.

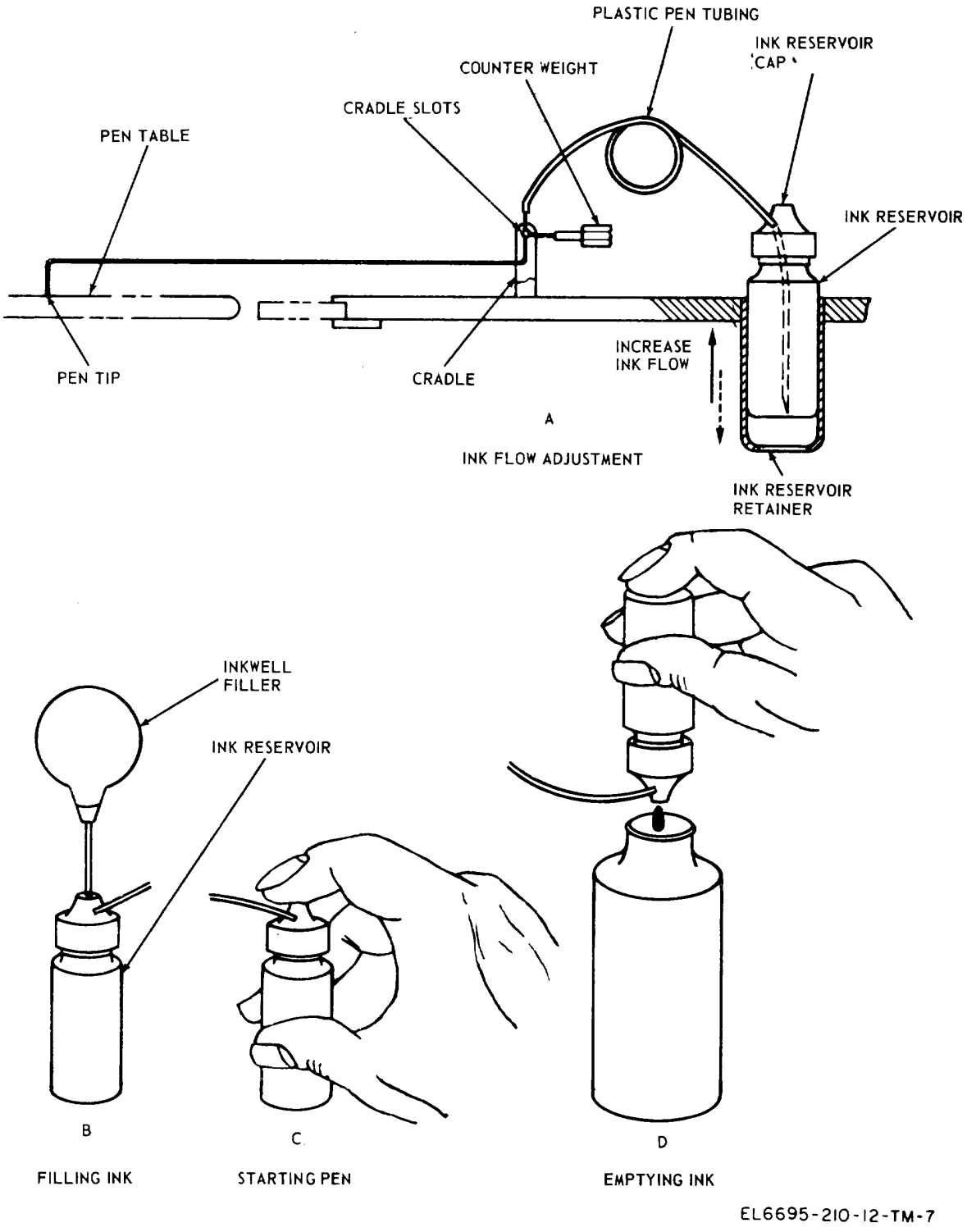

Figure 2-5. Individual inking system.

If pens are primed correctly, ink will continue to flow, as the chart paper moves, because of gravity and capillary action.

(4) Set the chart drive switch (fig. 2-2) to on (left) and feed a short length of chart paper; check to see that the pen writes continuously. If the pen does not write or stops writing during the short run, not enough ink has been forced through the pen or air has been drawn into the pen because of improper timing in (3) above. Repeat the procedures given in (2) and (3) above.

(5) Repeat the priming procedures given in (1), (2), and (3) above for the other two pens.

(6) Adjust the counterweights on each pen (*i* below).

h. Priming Pens with Pen Starter (fig. 2-6).

NOTE

Do not compress the pen starter while it is attached to the pen, or it may squirt ink out of the ink reservoir.

(1) Squeeze the bulb of the pen starter gently and insert the writing tip of one of the pens into the small hole in the pen starter.

(2) Gently release the compressed starter bulb and watch for the ink flow to appear through the transparent starter tip on the pen starter.
When ink shows, withdraw the pen starter and allow the pen to rest on the chart. Use a soft cloth to blot ink.

(3) Set the chart drive switch (fig. 2-2) to on (left) and feed a short length of chart paper; check to see that the pen writes continuously. If the pen does not write or stops writing during this short run, not enough ink has been siphoned through the pen or air may have been drawn in; repeat the procedures given in (1) and (2) above.

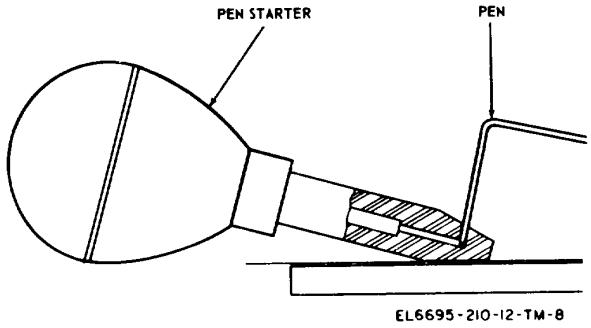

Figure 2-6. Priming recording pens.

(4) Repeat the priming procedure in (1), (2), and (3) above for the other two pens.

(5) Adjust the counterweight on each pen (i below).

i. Adjusting Pen Counterweight. To adjust the pen counterweight (A, fig. 2-5), screw it in or out as required to balance the pen. The pen is balanced correctly when there is minimum pen weight on the chart and the pen traces a smooth, continuous pattern. If a pen drags or moves slowly, screw the counterweight out slightly until the pen rides easily. If a pen jiggles or overshoots, screw the counterweight in slightly to correct the condition. Set the chart drive switch to off (right).

NOTE

If a pen is not balanced correctly, an inaccurate recording may be obtained.

j. Adjustment of Ink Reservoir. The ink flow at the pen tip is controlled by adjustment of the level of the ink reservoir (A, fig. 2-5). Proper height of ink reservoir reflects in an even line when the chart is moving and absence of flooding at the pen tip when the chart is stopped. If flooding occurs at the pen tip, lower the ink reservoir. If the pen skips, elevate the ink reservoir.

Section III. OPERATION UNDER USUAL CONDITIONS

2-6. General

a. To determine the presence or absence of deception by a subject when answering a series of questions, three independent physical characteristics are measured simultaneously and recorded on a moving paper chart; pulse rate and relative blood pressure (cardio system), skin resistance or rate of perspiration (gsr system), and respiration or breathing rate and depth (pneumo system). Figure 2-9 shows a typical recording. Each tracing is made by a recording pen moving in accordance with a detector which is placed on the subject as shown in figure 2-7. (Instructions for placing detectors on a subject are given in paragraph 2-7.) The polygraph contains three corresponding systems, each of which operates one of the pens.

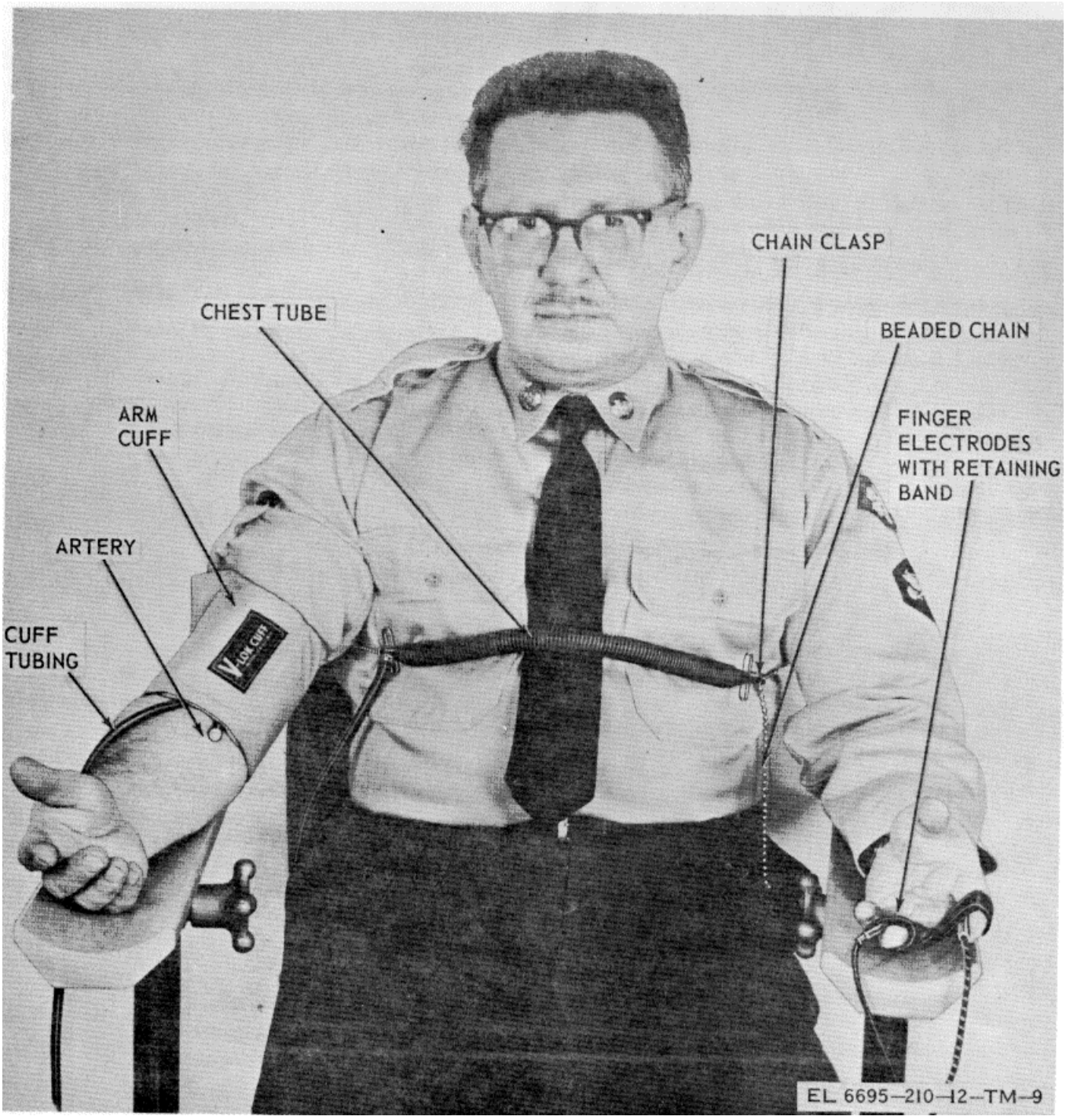

Figure 2-7. Placement of detectors on subject.

Preliminary adjustments are necessary to set up each system so that an accurate recording of the subject's reactions can be made. The adjustments of the three system (pneumo, gsr, and cardio) are described in paragraph 2-9, 2-10, and 2-11.

b. Before starting to test a subject, be sure that all initial preparations (para 2-5) have been made. Be ready to start the test as soon as the subject enters the room; needless delays will make him uneasy, possibly resulting in an inconclusive record. Before the subject is tested, have him wash his hands to remove any substance that might interfere with good contact by the finger electrodes. Have him remove any bulky clothing, pencils, etc, that might interfere with placing

the chest tube on his chest, or the cardio cuff on his arm. Seat the subject in a comfortable chair.

NOTE

Keep visitors out during the test procedure. Seat subject so that both polygraph and examiner are out of his view while he is being tested.

2-7. Placement of Detectors on Subject

a. Chest Tube. Attach the chest tube as follows:

(1) Place the chest tube (fig. 2-7) on the portion of the subject's chest where breathing is most noticed.

(2) Position the beaded chain around the back of the subject.

(3) While the subject is exhaling, extend the chest tube about 1 inch, and hook the beaded chain into the chain clasp.

b. Finger Electrode Assembly. Before placing finger electrodes on the subject, make sure that the subject's fingers are clean and dry. Place the finger electrodes on the lower portion of nonadjacent fingers of either hand. Wrap the retaining bands snugly around the fingers to insure good contact of the finger electrodes with the subject's fingers and proper interlocking of "hooked" and "napped" section of the closure.

c. *Arm Cuff or Wrist Cuff* (fig. 2-7 and 2-8).

The arm cuff may cause discomfort to the subject during a long test period. If a long test period is anticipated, attach the wrist cuff ((2) below); if a short test period is anticipated, attach the arm cuff ((1) below).

(1) *Arm cuff.*

(*a*) With the subject's palm facing up, position the arm cuff over the artery on the inside of the upper arm, and line up the cuff tubing over the brachial artery leading towards the subject's palm.

(*b*) Wrap the cuff firmly around the arm so the bladder (small rubber bag portion) section is covered firmly and evenly; secure it by pressing firmly enough to insure proper interlocking of "hooked" and "napped" section of the closure.

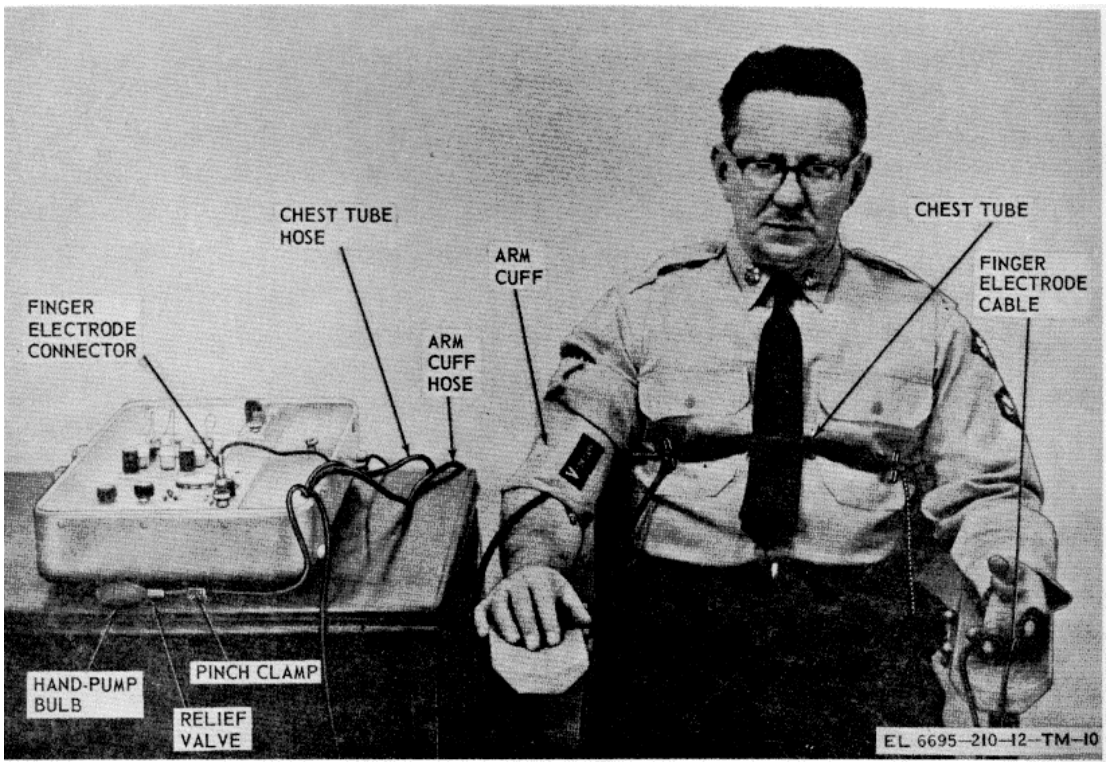

Figure 2-8. Detectors attached to subject and connected to polygraph.

(*c*) Work any folds out of the cuff so that it is wrapped flat around the arm.

(2) Wrist cuff.

(*a*) With the subject's palm facing up, position the wrist cuff over the artery on the inside of the wrist, and line up the cuff tubing near the radial artery leading toward the subject's palm.

(*b*) Wrap cuff firmly around wrist so the bladder section is covered firmly and evenly; secure it by pressing firmly enough to insure proper interlocking of "hooked" and "napped" section of the closure.

(*c*) Work any folds out of the cuff so that it is wrapped flat around the wrist.

2-8. Starting Procedure

a. Prepare the equipment for operation (para 2-5).

b. Place the detectors on the subject (para 2-7).

c. Set the gsr power switch to ON (fig. 2-2).

d. Set the chart drive switch to on (left) and lower the pressure roll (turn lever clockwise). The chart should travel smoothly without binding, bulging, or skewing.

e. Perform the pneumo, gsr, and cardio systems adjustments (para 2-9, 2-10, and 2-11).

2-9. Pneumo System Adjustment

(fig. 2-2 and 2-9)

a. Close (raise) the pneumo VENT pushbutton by turning the knob and releasing.

b. To observe a trial tracing on the chart, proceed as follows:

(1) While the subject is inhaling, the pneumo pen should move toward the top of the chart; it should move toward the bottom of the chart when he exhales.

(2) Adjust the pneumo CENTERING control until the pneumo trace is positioned equally above and below its index line. (Clockwise rotation of the pneumo CENTERING control causes the pneumo pen to move toward the top of the chart; counterclockwise rotation of the control causes the pen to move toward the bottom of the chart.)

(3) If the amplitude of the pen trace is too small or too large for proper interpretation, reposition the chest tube on the subject until the desired amplitude of the pneumo trace is obtained.

(4) Check to see that the pneumo pen traces a smooth, continuous pattern. If it does not trace a smooth, continuous pattern, adjust the counterweight (para 2-5*i*).

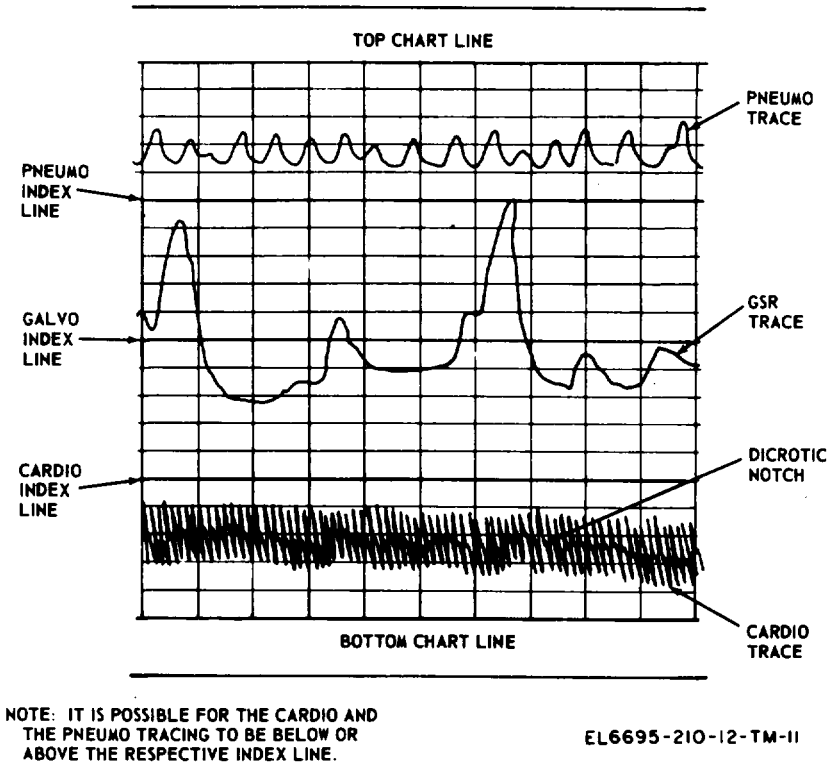

Figure 2-9. Typical pen recordings.

2-10. Gsr System Adjustment

(fig. 2-2 and 2-9)

a. Set the mode switch to MAN.

b. Set the SENSITIVITY control to 25.

c. Have the subject remain (quiet, and adjust the gsr CENTERING control until the galvo pen is positioned on the galvo index line; clockwise rotation of the CENTERING control causes the galvo pen to move toward the top of the chart and a counterclockwise rotation of the control causes the pen to move toward the bottom of the chart.

NOTE

Changes in resistance between the subject's fingers after a short period of time will cause the galvo pen to move off-center. (An increase in subject's resistance will cause the pen to move down from the previous position on the chart; a decrease in subject's resistance will cause the pen to move up from the previous position on the chart.) When either condition occurs, adjust the CENTERING control until the pen rests as close as possible to the galvo index line.

d. If the galvo pen remains below the galvo index line after advancing the gsr CENTERING control fully clockwise, proceed as follows:

(1) Remove the finger electrodes (fig. 2-7) and vigorously rub a small amount of electrode jelly on the portion of the fingers where the electrodes touch the skin.

(2) Remove any surplus jelly around this skin area and reattach the finger electrodes.

(3) Repeat the procedures in *b* and *c* above.

e. Because the response of different subjects will vary widely and may even change during testing, adjust the gsr SENSITIVITY control to suit the individual subject. Operate this control during the following tests to obtain a pen tracing of sufficient amplitude for proper interpretation of subject response.

NOTE

A clockwise rotation of the gsr SENSITIVITY control causes an increase in the galvo pen swing; a counterclockwise rotation of the control causes a decrease in pen swing.

f. Ask the subject to cough, and note the galvo pen swing. A 1- to 1 ½-inch movement of the pen is ample. Repeat this procedure at the same SENSITIVITY control setting, but with the mode switch set at AUTO. Note that after stimulus, the pen will return to or near to the galvo index line of the chart in 5 to 10 seconds and will stay there unless the subject's resistance varies rapidly. It is important--in this and other tests--that the subject remain quiet and avoid any muscular movements.

g. Check that the galvo pen traces a smooth, continuous pattern. If it does not trace a smooth, continuous pattern, adjust the counterweight (para 2-5*i*).

h. Make trial test runs using both MAN and AUTO settings of the mode switch. The acquired efficiency will help when important and actual records are to be produced which will allow intelligent diagnosis and become the basis for influential reports.

NOTE

Normal operation (MAN) generally is preferred, except when the subject is so responsive that the pen must continually be repositioned on the chart. In this case, use self-center operation (AUTO); however, during self-center operation, only sudden changes in subject's response are recorded and some of the overall picture is lost.

2-11. Cardio System Adjustment

(fig. 2-2 and 2-9)

a. Set the LOCK ↑ lever in the direction of the arrow on the lever, limiting the pen excursion to approximately 1¼) inch to prevent excessive pen whip during priming of the system.

b. Close (raise) the cardio VENT pushbutton by turning the knob and releasing.

c. Release the pinch clamp (press to release) (fig. 2-8) and close the hand-pump release valve (knob turned clockwise).

CAUTION

Do not exceed 150-mm pressure as this may damage the equipment.

d. Pressurize the system while gently squeezing the hand-pump bulb; watch the pressure gage for recurring small oscillations (flickering) of the pointer. As soon as the oscillations become 1 mm to 2 mm wide (distance between dial graduations), stop pumping.

NOTE

When the arm cuff is attached, the maximum oscillation occurs when

the blood pressure gage indicates 90 mm of pressure. If the wrist cuff is attached, a slightly higher pressure may be required.

e. Release LOCK ↑ lever (move in direction opposite to arrow-on the lever), and adjust the cardio CENTERING control until the pattern is centered on the cardio index line.

f. Observe the shape of the pattern. The dicrotic notch should be in the center of the downward stroke. If the dicrotic notch is too high in the pattern shape, increase the cuff pressure; using the hand-pump bulb. If the dicrotic notch is too low in the pattern shape, decrease the cuff pressure; use the hand-pump release valve.

g. Close the pinch clamp.

NOTE

If the amplitude of the pattern is too small to interpret, the pen is not balanced correctly or the cuff is too loose around the subject's arm or wrist. Reposition the cuff, and adjust the counterweight (para 2-5*i*) and repeat the cardio adjustment procedures.

2-12. Operating Instructions

(fig. 2-2 and 2-9)

After the adjustments have been performed (para 2-9, 2-10, and 2-11), the examiner may continue into the recorded tests. There is no fixed normal behavior tracing because every subject, under a controlled test procedure, establishes his own. The use of the operating controls to position the pen tracings at a particular point on the chart and obtain pen tracings of sufficient amplitude for proper interpretation is a matter of examiner's preference. An entire examination and interpretation of pen tracings on the chart depend on the training, skill, and experience of the operator. The following are operating hints to observe, but they do not eliminate additional refinements acquired by repeat test runs.

a. Conserve the chart paper between and after tests.

b. Readjust the CENTERING control of the cardio, pneumo, or galvo module when tracing tends to move to the extreme limits of the chart. Note the point of the readjustment on the chart paper.

c. During gsr tests, set the gsr SENSITIVITY control at the lowest possible setting that will still produce gsr trace of sufficient amplitude for proper interpretation after impressive stimuli. A wide swing of the pen will show an excessive response which may confuse the examiner and result in an incorrect interpretation. If the setting of the gsr SENSITIVITY control is changed during the test, note the point of readjustment on the chart.

d. Use the galvo pen calibrating feature consisting of the two pushbutton pip switches (1K or 5K) to obtain a permanent record of amplifier sensitivity setting during any test. Pressing the 1K or 5K switch introduces changes in the amplifier input of 1,000 or 5,000 ohms respectively. The resistance changes are represented on a chart by a pip (vertical tracing of the galvo pen when either of the pip switches is pressed). The height of a pip may be used also as a calibrating value to measure the sensitivity of the amplifier at a given sensitivity setting or to test the gsr amplifier. The gsr amplifier is calibrated to provide approximately a 1-inch pen displacement for each 1,000-ohm change with the SENSITIVITY control set at HIGH. Select the 1K or 5K pip, depending on the sensitivity setting during the test; pressing the 1K switch may give hardly a visible value if the SENSITIVITY control was set too low and pressing the 5K switch may give too large a value if the SENSITIVITY control was set too high.

e. Use a code or marking scheme on the chart to indicate the point at which the question was asked and what question was asked. Use an easy writing pen to prevent stopping or interfering with the chart progress.

f. When analyzing a record, note that the galvo pen (because of its greater length) writes approximately three-eighths inch ahead of the other pens. Allow for the delay in recording when the pens write at their extreme arc limits.

g. Identify a record by the name of the subject, date, time, and other data for later reference.

h. If the arm cuff or wrist cuff causes discomfort to the subject during the test, proceed as follows:

(1) Note and record the pressure indication on the pressure gage.

(2) Set the cardio LOCK lever in the direction of the arrow.

(3) Open (press) the cardio VENT pushbutton and turn it to lock. This action will release the cuff pressure.

(4) When the test is resumed, perform the cardio system adjustment (para 2-11), use the same pressure setting recorded while performing the procedure given in (1) above.

2-13. Stopping Procedure

(fig. 2-2 and 2-9)

a. Temporary.

(1) Turn the gsr SENSITIVITY control to low.

(2) Set the chart drive switch to off (right).

(3) Set the gsr power switch to OFF.

(4) Set the cardio LOCK ↑ lever in the direction of the arrow.

(5) Open (press) the pneumo VENT and the cardio VENT pushbuttons and turn to lock.

(6) Remove the arm cuff or the wrist cuff from the subject.

(7) Remove the finger electrodes from the subject; wipe the finger electrodes with a clean dry cloth.

(8) Remove the chest tube from the subject.

(9) Remove the chart (para 2-14).

b. Shutdown.

(1) Perform the procedures given in *a* above.

(2) Disconnect the power cable from the power source.

(3) Remove and clean the pens and ink reservoirs (para 3-6*b*).

(4) Place the pens in the pen box (fig. 1-1).

(5) Place the accessory items and the power cable in the accessory compartment.

NOTE

Leave the detectors attached to the respective connectors for day-to-day use.

(6) Place the removable cover on the polygraph and secure it with the latches.

2-14. Chart Removal

(fig. 2-4)

a. Removal of Used Chart

(1) Unlock (by turning the chart drive lock) and lift the pen table so that the chart is accessible.

(2) Remove the chart roller with the chart paper from the roller retainer springs.

(3) Lift the pressure roller by means of the pressure roller lever and pull the end of the chart out from the paper guides.

(4) Remove the chart roller from the chart roll, and insert the roller back into the roller retainer springs.

(5) Close and lock the pen table.

b. Removal of Used Portion of Chart.

(1) Gently press down on the paper cutter.

(2) Tear off the used portion of the chart paper.

Section IV. OPERATION UNDER UNUSUAL CONDITIONS

2-15. Operation at Low Temperatures

When cold equipment is brought into a warm room, moisture will condense on the equipment. Allow the equipment to reach room temperature, and then wipe it with a clean, dry cloth before putting it into operation.

2-16. Operation Under Tropical Conditions

When operated in tropical climates, the equipment may be operated in swampy areas where extreme moisture conditions exist. The high relative humidity causes condensation to form on the equipment whenever the temperature of the equipment becomes lower than that of the air. Wipe the equipment with a clean, dry cloth, and turn the equipment on once each day to eliminate moisture.

2-17. Operation in Desert Climates

When operated in desert climates, large amounts of sand may enter the moving parts of the equipment. During operation, try to keep the equipment as free from sand as possible. When the equipment is not in use, keep the removable cover secured to the top of the equipment.

CHAPTER 3
OPERATOR AND ORGANIZATIONAL MAINTENANCE

Section I. OPERATOR'S MAINTENANCE

3-1. Scope of Operator Maintenance

The maintenance duties assigned to the operator of Polygraph Instrument, Recording AN/USS-2F are listed below, together with a reference to the paragraphs covering the specific maintenance functions.

a. Daily preventive maintenance checks and services (para 3-5).

b. Cleaning (para 3-6).

3-2. Materials Required

a. Trichloroethane.

b. Cleaning cloth.

c. Cleaning brush.

3-3. Operator's Preventive Maintenance

Preventive maintenance is the systematic care, servicing, and inspection of equipment to prevent the occurrence of trouble, to reduce downtime, and to assume that the equipment is serviceable.

a. Systematic Care. The procedures given in paragraphs 3-4, 3-5, and 3-6 cover routine systematic care and cleaning essential to proper upkeep and operation of the equipment.

b. Preventive Maintenance Checks and Services. The preventive maintenance checks and services chart (para 3-5) outlines functions to be performed daily. These checks and services are to maintain Army electronic equipment in serviceable condition; that is, in good general (physical condition) and in good operating condition. To assist operators in maintaining serviceability, the chart indicates what to check, how to check, and the normal conditions. The *Paragraph references* column lists the paragraphs that contain detailed repair or replacement procedures. If the defect cannot be remedied by performing the corrective actions indicated, a higher category of maintenance or repair is required. Records and reports of these checks and services must be made in accordance with the requirements set forth in TM 38-750.

3-4. Operator's Preventive Maintenance Checks and Services Periods

Preventive maintenance checks and services of the polygraph are required daily or at least once each week if the equipment is maintained in a standby condition. Paragraph 3-5 specifies the items to be checked and serviced.

3-5. Daily Preventive Maintenance Checks and Services Chart

Sequence No.	*Item to be inspected*	*Procedure*	*Paragraph references*
1	Exterior surfaces	Clean the exterior of the equipment.	Para 3-6a..
2	Cables and hoses	Check to see that all cables and hoses are tight (fig. 2-3 and 2-8).	None.
3	Cuffs, hoses, chest tube, and cables.	Check cuffs, hoses, cables, and chest tube (fig. 1-1) for cracks and breaks.	None.
4	Finger electrodes	Check finger electrodes for signs of dirt and corrosion.	None.
5	Operation	During normal operation, be alert for any unusual signs or conditions.	None.

3-6. Cleaning

a. Exterior Surfaces. Inspect the exterior of the equipment. The exterior surfaces should be free of dust, dirt, grease, and fungus.

(1) Remove dust and loose dirt with a clean, soft, lint-free cloth.

WARNING

The fumes of Trichloroethane are toxic. Provide thorough ventilation whenever used. DO NOT use near an open flame. Trichloroethane is not flammable, but exposure of the fumes to an open flame converts the fumes to highly toxic, dangerous gases.

(2) Remove grease, fungus, and ground-in dirt from the case; use a cloth dampened (not wet) with trichloroethane. After cleaning, wipe dry with a cloth.

(3) Remove dust or dirt from the chart drive module with a brush.

(4) Remove bits of paper from the drive wheel (fig. 2-4) and paper guide; use compressed air or a brush.

CAUTION

Do not press on the face of the pressure gage (glass) cleaning; the gage may be damaged.

(5) Clean the control panel, pressure gage, finger electrodes, and control knobs; use a soft, clean cloth. If necessary, dampen the cloth with water; mild soap may be used for more effective cleaning. dry with a lint-free cloth.

b. Removal and Cleaning of Pens and Ink Reservoirs.

NOTE

Do not leave the pens and ink reservoirs uncleaned in the equipment overnight. Pens may be left for a few hours if the inking system is intact, filled, and the pen tip rests on the chart.

(1) Carefully remove the pens from the cradle slots and the ink reservoirs from retainers, but do not disconnect the plastic pen tubing (fig. 2-5).

CAUTION

Do not drip ink from the pens on the pen cradle; it may clog the mechanism and prevent proper operation of the pens.

(2) Invert the ink reservoir over the ink supply bottle and squeeze the reservoir repeatedly until empty (D, fig. 2-5).

(3) Remove the cap from the reservoir. Rinse and fill it with clean water.

(4) Replace the cap. Hold the reservoir in the vertical position with finger over the hole in the cap and squeeze the reservoir repeatedly until clear water runs from the pen tip (C, fig. 2-5).

(5) Remove the cap and empty excess water from the ink reservoir and dry parts with a soft, clean cloth. Replace the cap, place the finger over the hole in the cap and pump air through the pen tubing until the water is forced out from the pen tubing and pen.

(6) Place the pens and reservoirs in the pen box in the accessory compartment.

Section II. ORGANIZATIONAL MAINTENANCE

3-7. Scope of Operational Maintenance

The maintenance duties assigned to the organizational repairman of the polygraph are listed below, together with a reference to the paragraphs covering the specific maintenance functions.

NOTE

Lubrication of the polygraph is not required.

a. Weekly preventive maintenance checks and services (para 3-11).

b. Quarterly preventive maintenance checks and services (para 3-13).

c. Troubleshooting pressure leaks in the pneumo system (para 3-16).

d. Troubleshooting pressure leaks in the cardio system (para 3-17).

e. Repairs (para 3-18).

3-8. Test Equipment, Tools, and Material Required

The test equipment, tools, and technical manuals for the organizational repairman are listed below.

a. Tool Kit, Radar and Radio Repair TK-101/G.

b. Rubber tubing (Federal stock no. 4720-920-2023).

c. Multimeter AN/URM-105 (TM 11-6625-203-12).
d. Clamp, pinch (Federal stock No. 4730-918-5432).

3-9. Organizational Maintenance

a. Preventive maintenance is the systematic care, inspection, and servicing of equipment to maintain it in serviceable condition, prevent breakdowns, and assure maximum operating capability. Preventive maintenance is the responsibility of all maintenance categories concerned with the equipment and includes the inspection, testing, and repair or replacement of parts, subassemblies, or assemblies that inspection and tests indicate would probably fail before the next scheduled periodic service. Preventive maintenance checks and services of the polygraph at organizational category are made weekly and quarterly unless otherwise directed by the commanding officer.

b. Maintenance forms and records to be used and maintained on this equipment are specified in TM 38-750.

3-10. Weekly Maintenance

Weekly preventive maintenance checks and services on the polygraph are required. Periodic daily services constitute a part of the weekly preventive maintenance checks and services and must be performed concurrently. All deficiencies or shortcomings will be recorded in accordance with the requirements of TM 38-750. Perform all the checks and services listed in the weekly preventive maintenance checks and services chart (para 3-11) in the sequence listed.

3-11. Weekly Preventive Maintenance Checks and Services Chart

NOTE

Two men are required while the procedures given in sequence No. 4 through 8 below are performed.

3-11. Weekly Preventive Maintenance Checks and Services Chart

Sequence No.	*Item to be inspected*	*Procedures*	*Paragraph reference*
1	External hardware	Check that .external hardware is properly tightened.	None.
2	Knobs, dials, and switches	While making operating checks (sequence No. 4 through 8), observe that mechanical action of each knob, dial, and switch is free of external or internal binding.	None.
3	Operation.....	Perform procedures given in sequence No. 4 through No. 8 to check for normal operation.	None.
4	Preliminary.....	*a.* Open and remove removable cover from polygraph (fig. 1-1).	*a.* None.
		b. Open accessory compartment door and remove accessories from accessory compartment.	*b.* None.
		c. Perform preliminary control setting.	*c.* Para 2-5*b*.
		d. Connect equipment.	*d.* Para 2-5*c*.
		e. Install chart.	e. Para 2-5*d*.
		f. Fill reservoirs with ink.	*f.* Para 2-5*e*.
		g. Install pens.	*g.* Para 2-5*f*.
		h. Prime pens and adjust counterweights.	*h.* Para 2-5*g* or *h* and *i*.
		i. Place detectors on subject and set gsr power switch to ON.	*i.* Para 2-7.
5	Chart-drive operation.....	Set chart drive switch to on (left) (fig. 2-2). Chart should travel smoothly without signs of jamming, skewing, or tearing.	Para 3-15.
6	Pneumo system operation	*a.* Perform pneumo system adjustments. Operation of pneumo pen should be as stated in procedure, and a pneumo trace similar to that shown in figure 2-9 should be obtained.	*a.* Para 2-9 and 3-15.
		b. Open (press) pneumo VENT pushbutton and turn to lock (fig. 2-2). Pneumo pen should stop moving.	*b.* Para 3-15.

3-11. Weekly Preventive Maintenance Checks and Services Chart (cont.)

Sequence No.	*Item to be inspected*	*Procedures*	*Paragraph reference*
7	Gsr system operation	*a*. Set gsr power switch to ON (fig. 2-2).	*a*. Para 3-15.
		b. Perform the gsr system adjustments. The operation of the galvo pen should be as stated in procedure and a gsr trace similar to that shown in figure 2-9 should be obtained.	*b*. Para 2-10*c* and 3-15.
		c. Set gsr power switch (fig. 2-2) to OFF. Pen should stop moving.	*c*. Para 3-15.
8	Cardio system operation	*a*. Perform cardio system adjustment. Operation of cardio pen should be as stated in procedure, and a cardio trace similar to that shown in figure 2-9 should be obtained.	*a*. Para 2-11 and 3-15.
		b. Open (press) cardio VENT pushbutton (fig. 2-2). Cardio pen should stop moving.	*b*. Para 3-15.
		c. Perform stopping procedures.	*c*. Para 2-13.

3-12. Quarterly Maintenance

Quarterly preventive maintenance checks and services on the polygraph are required. Periodic daily and weekly services constitute a part of the quarterly preventive maintenance checks and services and must be performed concurrently. All deficiencies or shortcomings will be recorded in accordance with the requirements of TM 38-750. Perform all the checks and services listed in the quarterly preventive maintenance checks and services chart (para 3-13) in the sequence listed.

3-13. Quarterly Preventive Maintenance Checks and Services Chart

Sequence No.	*Item to be inspected*	*Procedures*	*Paragraph reference*
1	Completeness	Check that the equipment is complete.	Para 1-6.
2	Spare parts.....	Check all snare parts for general condition and method of storage. There should be no evidence of overstock, and all shortages must be on valid requisitions.	None.
3	Cleanliness.....	See that the equipment is clean.	Para 3-6.
4	Preservation	Check all surfaces for evidence of fungus. Remove corrosion.	None.
5	Publications.....	See that all publications are complete, serviceable, and current.	DA Pam 310-4.
6	Modifications	Check DA Pam 310-7 to determine if new applicable MWO's have been published. ALL URGENT MWO's must be applied immediately. ALL NORMAL MWO's must be scheduled.	TM 38-750 and DA Pam 310-7.
	.....		
7	Connections	Cheek to see that hose connections are clean and tight.	None.
8	Top panels and removable modules.	Check tightness of top panel and module retaining screws.	None.

3-14. Touchup Painting Instruction

Remove rust and corrosion from metal surfaces by lightly sanding them with fine sandpaper. Brush two thin coats of paint on the bare metal to protect it from further corrosion. Refer to the applicable cleaning and refinishing practices specified in SB 11-573 and TB 746-10.

Section III. ORGANIZATIONAL TROUBLESHOOTING

3-15. General

Troubleshooting of this equipment is based upon the operational checks contained in the weekly preventive maintenance checks and services chart (para 3-11). To troubleshoot the equipment, proceed until an abnormal condition or result is observed. When an abnormal condition or result is observed, perform the corrective measures indicated in the *Checks and corrective measures*

column. If the corrective measures indicated do not result in correction of the trouble, a higher category of maintenance is required. Paragraphs 3-17, 3-18, and 3-19 contain additional information and step-by-step instructions for performing equipment tests and repairs to be used during the troubleshooting procedures.

WARNING

Be careful not to come in contact with 115-volt connections when testing or servicing the polygraph.

3-16. Troubleshooting Chart

Sequence No.	*Trouble symptom*	*Probable trouble*	*Checks and corrective measures*
1	Chart paper does not advance when chart drive switch is set to on (left) (fig. 2-2).	*a.* Power cable disconnected from power source.	*a.* Reconnect power cable.
		b. No power output from power source.	*b.* Using multimeter, check voltage at power source. Voltage should be 115 volts ac±10.
		c. Defective fuse.	*c.* Change fuse.
		d. Pressure roller lever raised.	*d.* Lower lever.
		e. Chart paper not installed properly.	*e.* Reinstall chart paper (para 2-5*d*).
2	Chart paper binds, jams, or tears.	*a.* Bits of paper clogging paper guides.	*a.* Remove bits of paper from paper guides (para 3-6*a*(4)).
		b. Bent paper flattening roller.	*b.* Straighten roller (para 3-19*b*).
		c. Loose paper guides.	*c.* Tighten paper guides.
3	One or more pens do not write.	a. Pen not primed properly.	*a.* Prime pen (para 2-5*g* or *h*).
		b. Ink reservoir out of ink.	*b.* Fill ink reservoir (para 2-5*e*).
		c. Clogged pen.	*c.* Clean pen (para 3-6*b*).
		d. Defective pen.	*d.* Replace pen (para 3-19*i).*
		e. Defective ink reservoir.	*c.* Replace ink reservoir (para 3-18*g*).
4	One or more pens write erratically.	Damaged jewel bearing or pivot tip.	Refer to higher maintenance category.
5	One or more pens skip or blot.	Misadjusted pen counterweight.	Adjust pen counterweight (para 2-5*i*).
6	Pneumo pen writes but does not move.	*a.* Chest tube not positioned correctly on subject's chest.	*a.* Reposition chest tube on subject's chest (fig. 2-8).
		b. Pneumo VENT not closed.	*b.* Close (raise) pneumo VENT push-button (fig. 2-2); turn and release it.
		c. Dirty pneumo VENT valve.	*c.* Clean pneumo VENT valve (para 3-19*a*).
		d. Pressure leak in pneumo system.	*d.* Check for pressure leak in pneumo system (para 3-17).
7	Pneumo pen trace is of insufficient amplitude for proper interpretation or pneumo pen swings toward bottom of chart and remains in its lower limit (fig. 2-9).	*a.* Chest tube not positioned correctly on subject's chest.	*a.* Reposition chest tube on subject's chest (fig. 2-8).
		b. Dirty pneumo VENT valve.	*b.* Clean pneumo VENT valve (para 3-19*a*).
		c. Pressure leak in pneumo system.	*c.* Check for pressure leak in pneumo system (para 3-17).
8	Galvo pen does not center on index line when gsr power switch is set to OFF.	Bent cradle prongs.	
9	Galvo pen vibrates.	*a.* Convenience outlet not grounded.	*a.* Check convenience outlet ground.
		b. Poor ground connection.	*b.* Move to location with properly grounded outlet.
		c. Open galvo coil.	*c.* Refer to higher maintenance category.
10	Amplitude of gsr trace (fig. 2-9) insufficient for proper interpretation.	*a.* Subject not isolated from ground.	*a.* Isolate subject from ground.
		b. Defective amplifier.	*b.* Refer to higher maintenance category.
		c. Defective galvo assembly.	*c.* Refer to higher maintenance category.

3-16. Troubleshooting Chart (cont.)

Sequence No.	*Trouble symptom*	*Probable trouble*	*Checks and corrective measures*
11	Galvo pen moves to lower limit (bottom of chart), or does not move from lower limit (fig. 2-9).	*a*. Connector on finger electrode cable not making proper contact with finger electrode connector.	*a*. Tighten connector. If trouble persists, proceed to *b* below.
		b. Open circuit in finger electrode assembly.	*b*. Disconnect finger electrode assembly from subject and polygraph. If pen moves up it is an indication that finger electrodes assembly is defective. Replace defective finger electrode cable (para 3-19*d*) or finger electrode (para 3-10*c*).
		c. Subject's resistance out of range of instrument.	*c*. Refer to paragraph 2-10*d*.
12	Galvo pen moves to upper limit or does not move from upper limit.	Short circuit in finger electrode assembly.	Disconnect finger electrode assembly from subject and polygraph. Press normally closed center conductor of finger electrode connector (fig. 2-2.) If pen moves down, it is an indication that electrode is defective. Replace defective finger electrode cable (para 3-19*d*) on finger electrode (para 3-19*c*).
13	Galvo reacts as in 11 and 12 above and in addition intermittently moves away from upper or lower limit.	Intermittent short or open circuit in finger electrode assembly.	Apply stress along length of cable, at finger electrode connector and finger electrodes terminals. If pen reacts intermittently, proceed as in 11 and 12 above.
14	Cardio system cannot be pressurized, or cardio pen writes but pen does not move.	*a*. Cardio VENT not closed.	*a*. Close (raise) VENT pushbutton (fig. 2-2); turn and release it.
		b. Dirty cardio VENT valve.	*b*. Clean cardio VENT valve (para 3-19*a*).
		c. Pressure leak in cardio system.	*c*. Check for pressure leak in cardio system (para 3-18).
15	Cardio trace is of insufficient amplitude for proper interpretation, or cardio pen swings toward bottom of chart and remains in its lower limit (fig. 2-9).	*a*. Arm or wrist cuff not positioned correctly on subject.	*a*. Reposition cuff on subject.
		b. Dirty cardio VENT valve.	*b*. Clean cardio VENT valve (para 3-19*a*).
		c. Air leak in cardio system.	*c*. Check for pressure leak in cardio system para 3-18).

3-17. Troubleshooting Pressure Leaks in Pneumo System

If a gradual decrease in amplitude of the pneumo trace or a gradual movement of the pneumo pen toward the bottom of the chart is noticed, it is probably caused by a pressure leak in the pneumo system. Localize the trouble as follows:

a. Prepare the pneumo system for operation as follows:

(1) Place the pinch clamp near the open end of the chest tube rubber base and attach the rubber hose of the chest tube to the chest tube connector (fig. 2-3).

(2) Install chart paper in the chart drive assembly (para 2-5*d*).

(3) Fill the ink reservoirs with ink (para 2-5*e*).

(4) Prime the pneumo pen (para 2-5*g* or *h*).

(5) Adjust the pneumo pen counterweight (para 2-5*i*).

(6) Open (press) the pneumo VENT pushbutton (fig. 2-2), and turn to lock it.

(7) Place the chest tube around the back of a chair; extend it about 1 inch and attach the beaded chain (fig. 2-7).

(8) Close (raise) the pneumo VENT pushbutton by turning to unlock it.

(9) Center the pneumo pen with the pneumo CENTERING control on the pneumo index line.

b. Carefully wedge a small 1/2- to 1-inch thick object between the chest tube and the back of the chair.

The pen should move at least 1 inch above the pneumo index line. If the pen returns to its index line within 2 minutes, a pressure leak is indicated.

c. Remove the wedge from between the chest tube and the back of the chair, and then replace the wedge. Immediately pinch the chest tube hose at the chest tube connector (fig. 2-3), and watch for a gradual downward movement of the pen toward the pneumo index line on the chart.

(1) If the pen returns to its index line within 2 minutes, the pressure leak is inside the polygraph and higher category of maintenance is required.

(2) If the pen holds its position, the pressure leak is in the chest tube assembly. Proceed to *d* below.

d. Remove the wedge from between the chest tube and the back of the chair, and then reinsert the wedge. Immediately pinch the chest tube hose at the chest tube connector and watch for a gradual movement of the pen toward the pneumo index line on the chart (fig. 2-9).

(1) If the pen returns to its index line within 2 minutes, the pressure leak is in the chest tube hose. Replace the chest tube hose (para 3-19*h*).

(2) If the pen holds its position, the pressure leak is in the chest tube. Replace the chest tube assembly.

3-18. Troubleshooting Pressure Leaks in Cardio System

If a gradual diminishing of the cardio trace or a gradual movement of the cardio pen toward the bottom of the chart is noticed, it is probably caused by a pressure leak in the cardio system. To locate the cause of the trouble when either a cardio cuff or a wrist cuff is used, proceed as follow:

a. Prepare the cardio system for operation as follows:

(1) Place the pinch clamp near the open end of the cuff assembly rubber hose and attach the cuff assembly to the cuff connector (fig. 2-3).

(2) Move the pinch clamp near the open end of the hand-pump bulb assembly rubber hose and attach the hand-pump bulb assembly to the PUMP connector (fig. 2-3).

(3) Install chart paper in the chart in the chart drive assembly (para 2-5*d*).

(4) Fill the ink reservoirs with ink (para 2-5*e*).

(5) Prime the cardio pen (para 2-5*g* or *h*).

(6) Adjust the cardio pen counterweight (para 2-5*i*).

(7) Open (press) the cardio VENT pushbutton; and turn to lock (fig. 2-2).

(8) Move LOCK ↑ lever in direction of arrow on lever.

(9) Wrap cuff (fig. 2-7) around a table leg, a strong mailing tube, or a small can.

(10) Close (raise) the cardio VENT pushbutton, turn knob to unlock it (fig. 2-2).

(11) Close the hand-pump release valve (knob turned fully clockwise) and release the pinch clamp (fig. 2-8).

CAUTION

Do not exceed 150-mm pressure as this may damage the equipment.

(12) Pump the hand pump gently and continuously until the pressure gage (fig. 2-2) indicates 90; clamp the hose with the pinch clamp.

(13) Release LOCK ↑ lever (move in direction opposite to arrow).

(14) Adjust the cardio CENTERING control until the cardio trace is centered on the cardio index line (fig. 2-9).

b. Watch for a decrease of pressure indication on the pressure gage (fig. 2-2) and a gradual downward movement of the cardio pen toward the bottom of the chart (fig. 2-9). If the pen moves more than one-quarter inch toward the bottom of the chart in 15 minutes, a pressure leak is indicated in the cardio system.

c. Repeat the procedures given in a (11) and (12) above.

d. Pinch the hand-pump hose and the cuff hose at their respective connectors (fig. 2-3), and watch for a decrease of pressure indication on the pressure gage (fig. 2-2) and a gradual movement of the cardio pen toward the bottom of the chart (fig. 2-9).

(1) If the pen moves more than one-quarter inch toward the bottom of the chart in 15 minutes, the pressure leak is inside the polygraph and troubleshooting at higher category maintenance is required.

(2) If the pressure remains constant, and the pen does not move more than indicated above, the pressure leak is in the hand-pump hose assembly or the cuff assembly. Proceed to *e* below.

e. Repeat the procedures given in a (11) and (12) above.

f. Pinch the cuff hose at its connection on the cuff.

(1) If the pen moves more than one-quarter inch toward the bottom of the chart in 10 minutes, the pressure leak is in the hand-pump hose assembly.

(2) If the pressure remains constant, the pressure leak is in the cuff assembly. Proceed to *g* below.

CAUTION

The hand-pump bulb should not be subjected to severe leak tests; it pressurizes the system only. During normal operation, it should be cut off from the cardio system with a pinch clamp. The handpump bulb may be considered operable as long as it is possible to pressurize the cardio system to required pressure.

g. Repeat the procedures given in a (11) and (12) above.

h. Pinch the cuff hose at its connection on the cuff.

(1) If the pen moves more than one-quarter inch toward the bottom of the chart in 15 minutes, the pressure leak is in the cuff hose. Replace the hose (para 3-19*h*).

(2) If the pressure remains constant, the pressure leak is in the cuff. Replace the cuff (para 3-19*h*(3)).

3-19. Repairs

a. Cleaning Dirty VENT Valves. Dirt or other foreign matter can enter the VENT valve seats and cause air leakage. To clean the pneumo VENT valve, perform the procedure given in (1) below. To clean the cardio VENT valve, perform the procedure given in (2) below.

CAUTION

Pens should be removed for the following cleaning operation.

(1) Open (press) the pneumo VENT pushbutton (fig. 2-2), and turn to lock. Squeeze the chest tube to force air through the VENT valve at a rapid rate.

(2) Open (press) the cardio VENT pushbutton (fig. 2-2), and turn to lock. Pinch the hose of the arm or wrist cuff near its connector in the accessory compartment (fig. 2-3). Force air through the VENT valve at a rapid rate with the hand-pump bulb.

b. Straightening Paper Flattening Roller (fig. 2-2). Remove lower paper guide and remove paper flattening roller. Straighten roller and end pins. Reinstall roller and paper guide. Roller should rest on chart table and rotate without binding.

c. Replacement of Finger Electrode (fig. 2-7).

(1) Pull the finger electrode out of its connector.

(2) Insert a new finger electrode in the connector.

(3) If the finger electrode slips on freely, tighten the two grips on the connector by squeezing them gently with a pair of pliers.

d. Replacement of Finger Electrode Cable (fig. 2-8).

(1) Pull both finger electrodes out of their connectors on the finger electrode cable; discard the cable.

(2) Insert the finger electrodes in the finger electrode connectors of the new cable.

(3) If the finger electrodes slip on freely, tighten the two grips on the connector by squeezing them gently with a pair of pliers.

e. Replacement of Hand-Pump Bulb (fig. 2-8).

(1) Pull the hand-pump bulb off the handpump release valve; discard the hand-pump bulb.

(2) Moisten the bulb connector (filter end) of the hand-pump release valve; push the new hand-pump bulb onto the connector.

f. Replacement of Hand-Pump Release Valve (fig. 2-8).

(1) Pull the hose free from the valve.

(2) Pull the hand-pump bulb free from the valve.

(3) Blow dirt out of the hand-pump bulb.

(4) Moisten the bulb connector (filter end) of the new valve; work the hand-pump bulb into the connector.

(5) Moisten the hose connector on the new valve; push the hose onto the connector.

g. Replacement of Ink Reservoir (fig. 2-5).

(1) Pull out the ink reservoir from the ink reservoir retainer.

(2) Pull out the plastic pen tubing from the ink reservoir cap.

(3) Push the pen tubing through the hole in the new reservoir cap until the pen tubing reaches the bottom of the reservoir.

h. Replacement of Rubber Hoses or Cuffs. To replace the hose of the chest tube assembly, perform the procedure in (1) below. To replace the

CHAPTER 4
SHIPMENT, LIMITED STORAGE, AND DEMOLITION

4-1. Repackaging for Shipment or Limited Storage

The exact procedure for repackaging depends on the material available and the conditions under which the equipment is to be shipped or stored. Adapt the procedures outlined below whenever possible. The information concerning the original packaging (para 2-1) will also be helpful. Repackaging of equipment for shipment or limited storage normally will be performed at a packaging facility or by a repackaging team. Should emergency packaging be required, select the materials from those listed in SB 38-100, Preservation, Packaging, and Packing Materials, Supplies, and Equipment Used by the Army. Package the equipment in accordance with the original packaging, in so far as possible, with the available materials.

a. Preparation for Repackaging.

(1) Perform shutdown procedures (para 2-13*b*).

(2) Remove chart (para 2-14*a*).

(3) Disconnect arm cuff or wrist cuff, pneumograph, and hand pump from connectors in accessory compartment.

(4) Disconnect finger electrodes at the connector on top panel.

b. Material Requirements. The following materials are required for packaging the polygraph. For stock numbers of materials, refer to SB 38-100.

Material	*Quantity*
Tape, cloth-backing, waterproof	8 ft
Waterproof bag	12 in. X 15 in.
Fiberboard, corrugated	14 sq ft
Tape, gummed paper	8 ft
Cushioning material	16 sq ft
Wood, pine, 3/4 X 6 inches	36 ft
Nails, common, 4d, or equivalent	1/4 lb
Metal strapping	10 ft

c. Packaging. Package the items of the polygraph as follows:

(1) *Technical manuals*. Heat seal the manuals in the waterproof bag.

(2) *Recording pens*. Cushion the pens in the box with a pad of cushioning material.

(3) *Accessories*. Roll up the detectors and the power cable and place them in the accessory compartment; use cushioning material to cushion each item as required. Wrap the chart roll, bottle of ink, filler, and tube of electrode jelly in cushioning material and place the items in the accessory compartment.

(4*) Pen table and accessory compartment cover*. Lock and type down the pen table and accessory compartment with waterproof, cloth-backing tape.

(5) *Polygraph*. Cushion the polygraph on all surfaces with pads of corrugated fiberboard within a carton.

(6) *Spares*. Place spares in a carton.

(7) *Seal*. Seal all the seams and folds on both cartons with waterproof, cloth-backing tape.

d. Packing.

(1) Pack the packaged polygraph in a nailed, wooden box. Place carton with spares on top of packaged polygraph. Fill all voids with pads of corrugated fiberboard to prevent movement.

(2) Place the package that contains the technical manuals between the packaged polygraph and the lid of the wooden box.

(3) Nail the lid to the wooden box and bind the box with steel strapping.

4-2. Authority for Demolition

Demolition of the equipment will be accomplished only upon order of the commander. Use the destruction procedures outlined in paragraph 4-3 to prevent further use of the equipment.

4-3. Methods of Destruction

The tactical situation and time available will determine the method to be used when destruction of equipment is ordered.

Use any of the following methods to destroy the equipment.

a. Smash. Smash the detectors, pens, chart drive, all internal parts of the equipment, and all parts mounted on the control panel.

b. Cut. Cut hoses, wiring, cording, and cabling.

WARNING

Be extremely careful with explosives and incendiary devices. Use these items only when the need is urgent.

c. Burn. Burn the technical manuals first. Burn as much of the equipment as is flammable.

d. Explode. Use explosives to complete demolition or to cause maximum damage, before burning, when time does not permit complete demolition by other means. Place an incendiary grenade inside the accessory compartment, or under chart drive table. Get away from the equipment after the grenade is placed.

e. Dispose. Bury or scatter destroyed parts or throw them into nearby waterways. This is particularly important if a number of parts have not been completely destroyed.

f. Reporting. Reporting of the destruction of the equipment will be made through command channels.

APPENDIX A
REFERENCES

DA Pam 310-4	Index of Technical Manuals, Technical Bulletins, Supply Manuals (Types 7, 8, and 9), Supply Bulletins, and Lubrication Orders.
DA Pam 310-7	U. S. Army Equipment Index of Modification Work Orders.
SB 11-573	Painting and Preservation Supplies Available for Field Use for Electronics Command Equipment.
SB 38-100	Preservation, Packaging, and Packing Materials, Supplies, and Equipment Used by the Army.
TB 746-10	Field Instructions for Painting and Preserving Electronic Command Equipment.
TM 11-6625-203-12	Operator and Organizational Maintenance: Multimeter AN/URM-105 Including Multimeter ME-77/U.
TM 38-750	The Army Maintenance Management System (TAMMS).

APPENDIX B

OPERATOR'S AND ORGANIZATIONAL MAINTENANCE

REPAIR PARTS AND SPECIAL TOOLS LIST

Section I. INTRODUCTION

B-1. Scope

This appendix lists repair parts required for operation and performance of organizational maintenance of the AN/USS-2F.

B-2. General

This Repair Parts List is divided into the following sections:

a. Section II. Basic Issue Items List. Not applicable.

b. Section III. Items Troop Installed or Authorized List. Not applicable.

c. Section IV. Repair Parts List. A list of repair parts authorized for used in the performance of maintenance. The list also includes parts which must be removed for replacement of the authorized parts. Parts lists are composed of functional groups in ascending numerical sequence, with the parts in each group listed in figure and item number sequence.

d. Section V. Special Tools List. Not applicable.

e. Section VI. National Stock Number and Part Number Index. A list, in ascending numerical sequence, of all National stock numbers appearing in the listings, followed by a list, in alphanumeric sequence, of all part numbers appearing in the listing. National stock numbers and part numbers are cross-reference to each illustration figure and item number appearance.

B-3. Explanation of Columns

The following provides an explanation of columns found in the tabular listings:

a. Illustration. This column is divided as follows:

(1) *Figure number.* Indicates the figure number of the illustration in which the item is shown.

(2) *Item number.* The number used to identify each item called out in the illustration.

b. Source, Maintenance, and Recoverability Codes (SMR).

(1) *Source code.* Source codes are assigned to support items to indicate the manner of acquiring support items for maintenance, repair, or overhaul of end items. Source codes are entered in the first and second positions of the Uniform SMR Code format as follows:

Code	*Definition*
PA-	Item procured and stocked for anticipated or known usage.
XA-	Item is not procured or stocked because the requirements for the item will result in the replacement of the next higher assembly.
XB-	Item is not procured or stocked. If not available through salvage, requisition.

NOTE

Cannibalization or salvage may be used as a source of supply for any items source coded above except those coded XA, XD, and aircraft support items as restricted by AR 700-42.

(2) *Maintenance code.* Maintenance codes are assigned to indicate the levels of maintenance authorized to USE and REPAIR support items. The maintenance codes are entered in the third and fourth positions of the Uniform SMR Code format as follows:

(a) The maintenance code entered in the third position will indicate the lowest maintenance level authorized to remove, replace and use the support item. The maintenance code entered in the third position will indicate the following level of maintenance:

Code	*Application/Explanation*
O -	Support item is removed, replaced, used at the organizational level.

(b) The maintenance code entered in the fourth position indicates whether the item is to be repaired and identifies the lowest maintenance level with the capability to perform complete repair (i.e., all authorized maintenance functions). This position will contain the following maintenance code:

Code	*Application/Explanation*
Z-	Nonreparable. No repair is authorized.

(3) *Recoverability code*. Recoverability codes are assigned to support items to indicate the disposition action on unserviceable items. The recoverability code is entered in the fifth position of the Uniform SMR Code format as follows:

Recoverability Code	*Definition*
Z-	Nonreparable item. When unserviceable, condemn and dispose at the level indicated in position 3.

c. National Stock Number. Indicates the National stock number assigned to the item and will be used for requisitioning purposes.

d. Part Number. Indicates the primary number used by the manufacturer (individual, company, firm, corporation, or Government activity), which controls the design and characteristics of the item by means of its engineering drawings, specifications standards, and inspection requirements, to identify an item or range of items.

NOTE

When a stock-numbered item is requisitioned, the repair part received may have a different part number than the part being replaced.

e. Federal Supply Code for Manufacturer (FSCM). The FSCM is a 5-digit numeric code listed in SB 708-42 which is used to identify the manufacturer, distributor, or Government agency, etc.

f. Description. Indicates the Federal item name and, if required a minimum description to identify the item.

g. Unit of Measure (U/M). Indicates the standard of the basic quantity of the listed item as used in performing the actual maintenance function. This measure is expressed by a two-character, alphabetical abbreviation (e.g., ea, in, pr, etc.). When the unit of measure differs from the unit of issue, the lowest unit of issue that will satisfy the required units of measure will be requisitioned.

h. Quantity Incorporated in Unit. Indicates the quantity of the item used in the breakout shown on the illustration figure, which is prepared for a functional group, subfunctional group, or an assembly.

B-4. Special Information

The illustrations published in this manual are identical to those published in TM 11-6695-210-45. Only those parts assigned the third position SMR maintenance code "O" are listed in the tabular listing; therefore, there may be a break in the item number sequence.

B-5. How to Locate Repair Parts

a. When National stock number or part number is unknown:

(1) *First*. Using the table of contents, determine the functional group within which the repair part belongs. This is necessary since illustrations are prepared for functional groups and listings are divided into the same group.

(2) *Second*. Find the illustration covering the functional group to which the repair part belongs.

(3) *Third*. Identify the repair part on the illustration and note the illustration figure and item number of the repair part.

(4) *Fourth*. Using the Repair Parts Listing, find the figure and item number noted on the illustration.

b. When National stock number or part number is known:

(1) *First*. Using the Index of National Stock Numbers and Part Numbers, find the pertinent National stock number or part number. This index is in ascending NSN sequence, followed by a list of part numbers in ascending alphanumeric sequence, cross-referenced to the illustration figure number and item number.

(2) *Second*. After finding the figure and item number, locate the figure and item number in the repair parts list.

B-6. Abbreviations

(Not applicable)

SECTION IV. REPAIR PARTS LIST

(1) ILLUSTRATION (a) FIG NO.	(1) ILLUSTRATION (b) ITEM NO.	(2) SMR CODE	(3) NATIONAL STOCK NUMBER	(4) PART NUMBER	(5) FSCM	(6) DESCRIPTION USABLE ON CODE	(7) U/M	(8) QTY INC IN UNIT
						GROUP: 00 POLYGRAPH INSTRUMENT, RECORDING AN/USS-2F		
B-1	5	PAOZZ	6695-00-073-9178	SA426	57800	CUFF, ASSEMBLY, WRIST, SPHYGMOMANOMETER	EA	1
B-1	6	PAOZZ	6695-00-489-6088	SA307	57800	CUFF ASSEMBLY, ARM, SPYGOMOMANOMETER	EA	1
B-1	8	XBOZZ		SA57	57800	BULB ASSEMBLY, SPHYGOMOMANOMETER	EA	1
B-1	9	PAOZZ	6695-00-489-6085	57113	57800	PNEUMOGRAPH ASSEMBLY	EA	1
B-1	10	PAOZZ	6695-00-489-6086	24222	57800	ELECTRODE ASSEMBLY, FINGER	EA	1
B-1	11	PAOZZ	6695-00-563-0489	SA27	57800	FILLER ASSEMBLY, INKWELL	EA	1
B-1	12	PAOZZ	6695-00-563-0488	SA29	57800	STARTER, PEN	EA	1
B-1	13	PAOZZ	8125-00-181-7451	SA1271	57800	BOTTLE ASSEMBLY, APPLICATOR	EA	3
B-1	15	PAOZZ	6515-00-327-3800	0034641	98079	ELECTRODE PASTE, ELECTROCARDIOGRAPH	EA	1
B-1	16	PAOZZ	6695-00-753-4560	22495B	57800	CHART, RECORDING INSTRUMENT	EA	1
B-1	17	PAOZZ	7510-00-159-4475	224901	57800	INK, RECORDING INSTRUMENT	EA	1
B-1	18	XBOZZ		9082	57800	BOX, PEN	EA	1
B-1	20	PAOZZ	6695-00-459-3321	SA92	57800	PEN, LONG, RECORDER	EA	1
B-1	21	PAOZZ	6695-00-459-3320	SA91	57800	PEN, SHORT, RECORDER	EA	2
						GROUP: 01 CASE ASSEMBLY		
B-2	12	PAOZZ	5920-00-329-8475	MDL6/10AMP	71400	FUSE, CARTRIDGE	EA	1
B-2	18	PAOZZ	5975-00-729-8784	205901	04009	PLATE, DESIGNATION, POWER SWITCH	EA	1
						GROUP: 03 CARDIO-SPHYGMOGRAPH ASSEMBLY'		
B-3	31	PAOZZ	5355-00-471-9350	N5445	57800	KNOB: CENTERING	EA	1
B-3	35	PAOZZ	5305-C-068-5414	MS16995-11	96906	SCREW, CAP, SOCKET HEAD	EA	4
						GROUP: 04 PNEUMOGRAPH ASSEMBLY		
B-4	8	PAOZZ	5305-00-068-5414	MS16995-11	96906	SCREW, CAP, SOCKET HEAD	EA	4
B-4	21	PAOZZ	5355-00-471-9350	N5445	57800	KNOB: CENTERING	EA	1
						GROUP: 05 GALVANIC SKIN RESISTANCE		
						AMPLIFIER ASSEMBLY		
B-5	6	PAOZZ	5305-00-068-5414	MS16995-11	96906	SCREW, CAPTIVE, SOCKET HEAD	EA	4
B-5	12	PAOZZ	5355-00-471-9351	N5448	57800	KNOB: CENTERING	EA	1
B-5	13	PAOZZ	5355-00-471-9352	N5446	57800	KNOB: SENSITIVITY	EA	1
						GROUP: 06 GALVANOMETER ASSEMBLY		
B-6	12	PAOZZ	5305-00-068-5414	MS16995-11	96906	CAP, SCREW, SOCKET HEAD	EA	4
						GROUP: 07 PNEUMOGRAPH CHEST TUBE ASSEMBLY		
B-7	1	PAOZZ	4720-00-470-1812	N3707	57800	TUBING, RUBBER	EA	1
B-7	2	XAOZZ		N3886	57800	STEM AND CHAIN ASSEMBLY, RIGHT HAND	EA	1
B-7	3	XAOZZ		N3881	57800	STEM AND CHAIN ASSEMBLY, LEFT HAND	EA	1
B-7	4	PAOZZ	9320-00-448-4330	8205	57800	BELLOWS, RUBBER	EA	1
						GROUP: 08 FINGER ELECTRODE ASSEMBLY		
B-8	1	PAOZZ	6150-00-448-4322	SA257	57800	LEAD, ELECTRICAL	EA	1
B-8	2	PAOZZ	6695-00-451-8242	SA512	57800	PLATE ASSEMBLY, FINGER ELECTRODE	EA	2
B-8	3	PAOZZ	5935-00-149-4266	75MC1F	02660	CONNECTOR, PLUG, ELECTRICAL	EA	1

SECTION IV. REPAIR PARTS LIST (CONTINUED)

(1) ILLUSTRATION (a) FIG NO.	(1) ILLUSTRATION (b) ITEM NO.	(2) SMR CODE	(3) NATIONAL STOCK NUMBER	(4) PART NUMBER	(5) FSCM	(6) DESCRIPTION USABLE ON CODE	(7) U/M	(8) QTY INC IN UNIT
						GROUP: 09 HAND PUMP BULB ASSEMBLY		
B-9	1	PAOZZ	4720-00-470-1812	N3707	57800	TUBING, RUBBER	EA	1
B-9	2	PAOZZ	4730-00-518-3600	0X973F1	77681	CLAMP, HOSE	EA	1
B-9	3	PAOZZ	6515-00-371-3440	1892	06156	VALVE, SPHYGMOMANOMETER	EA	1
B-9	4	PAOZZ	6515-00-762-2110	1891	06516	BULB, SPHYGMOMANOMETER	EA	1
						GROUP: 10 ARM CUFF ASSEMBLY		
B-10	1	PAOZZ	4720-00-470-1812	N3707	57800	TUBING, RUBBER	EA	1
B-10	2	PAOZZ	6695-00-752-9593	8206	57800	TUBE, CONNECTING LABORATORY GLASSWARE	EA	1

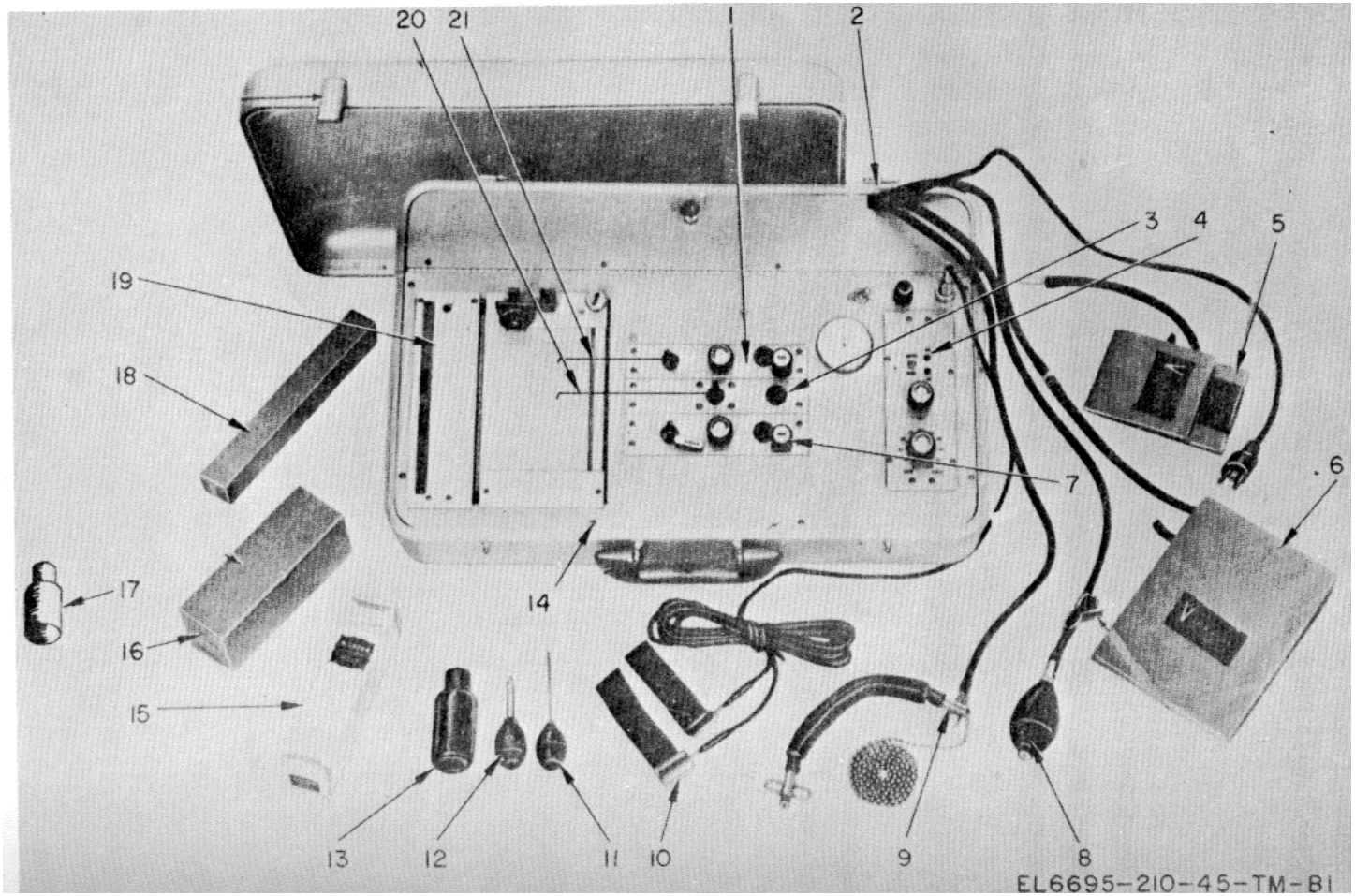

Figure B-1. Polygraph Instrument, Recording AN/USS-2F.

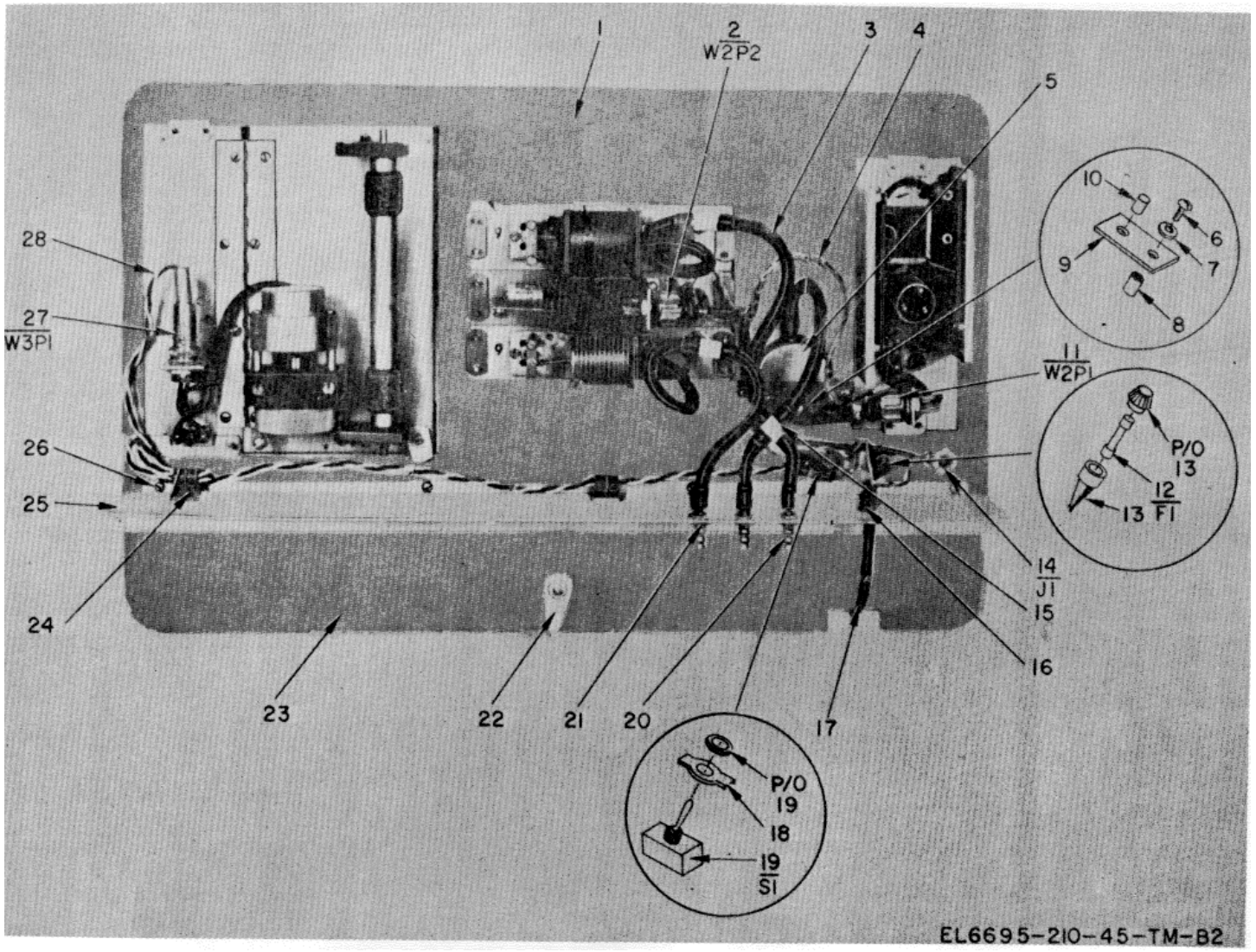

Figure B-2. Case assembly.

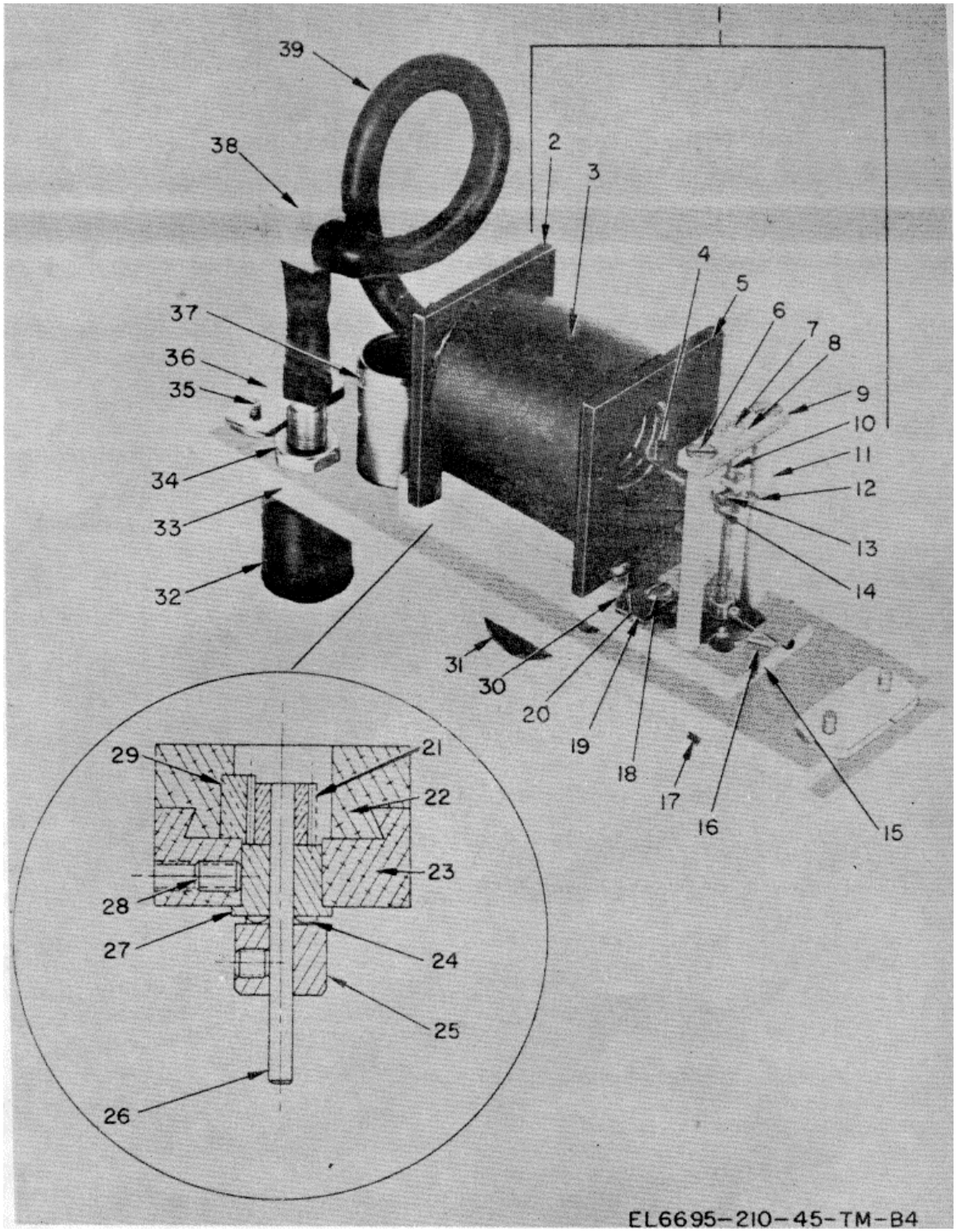

Figure B-3. Cardio-sphygmograph assembly.

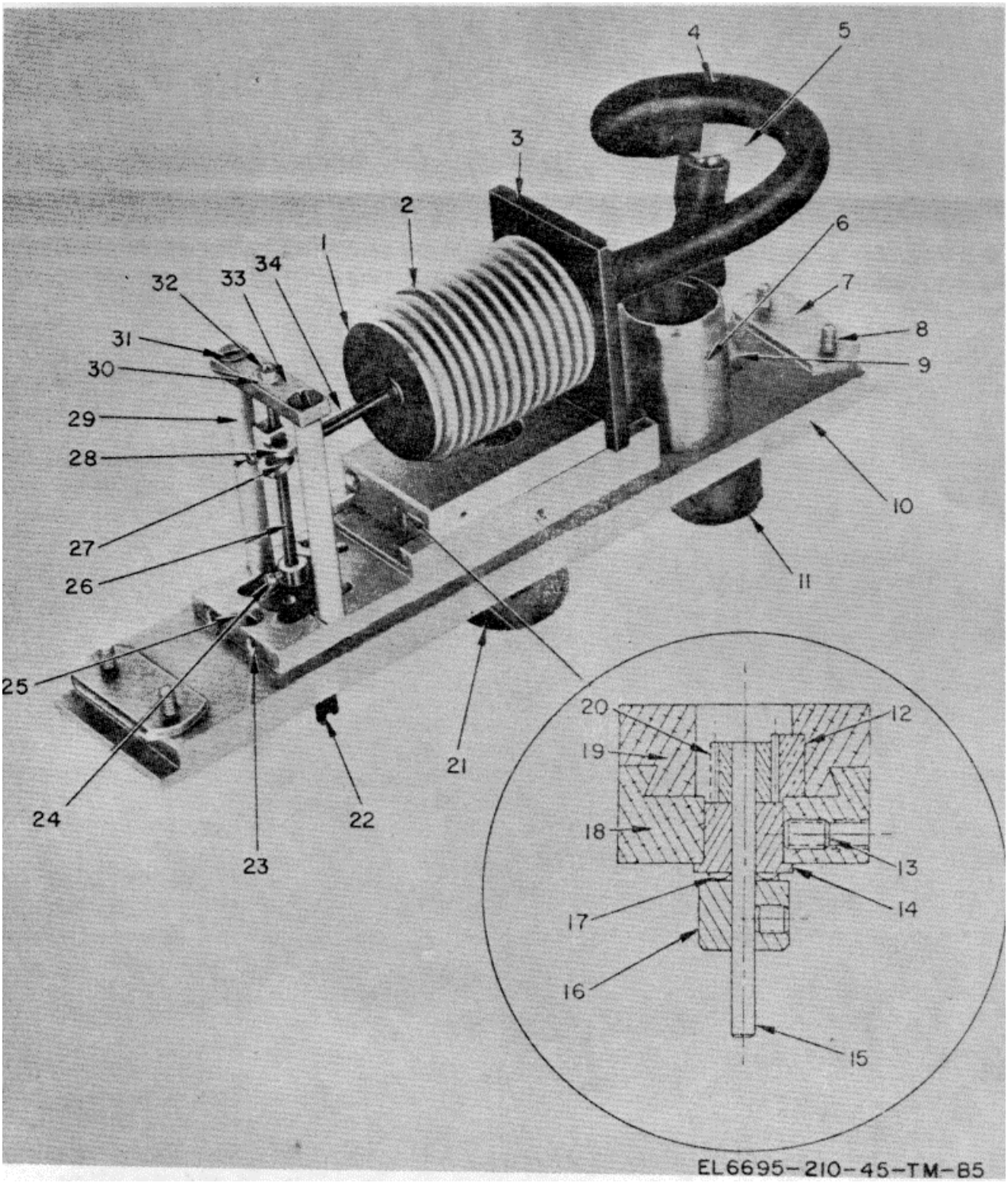

Figure B-4. Pneumograph assembly.

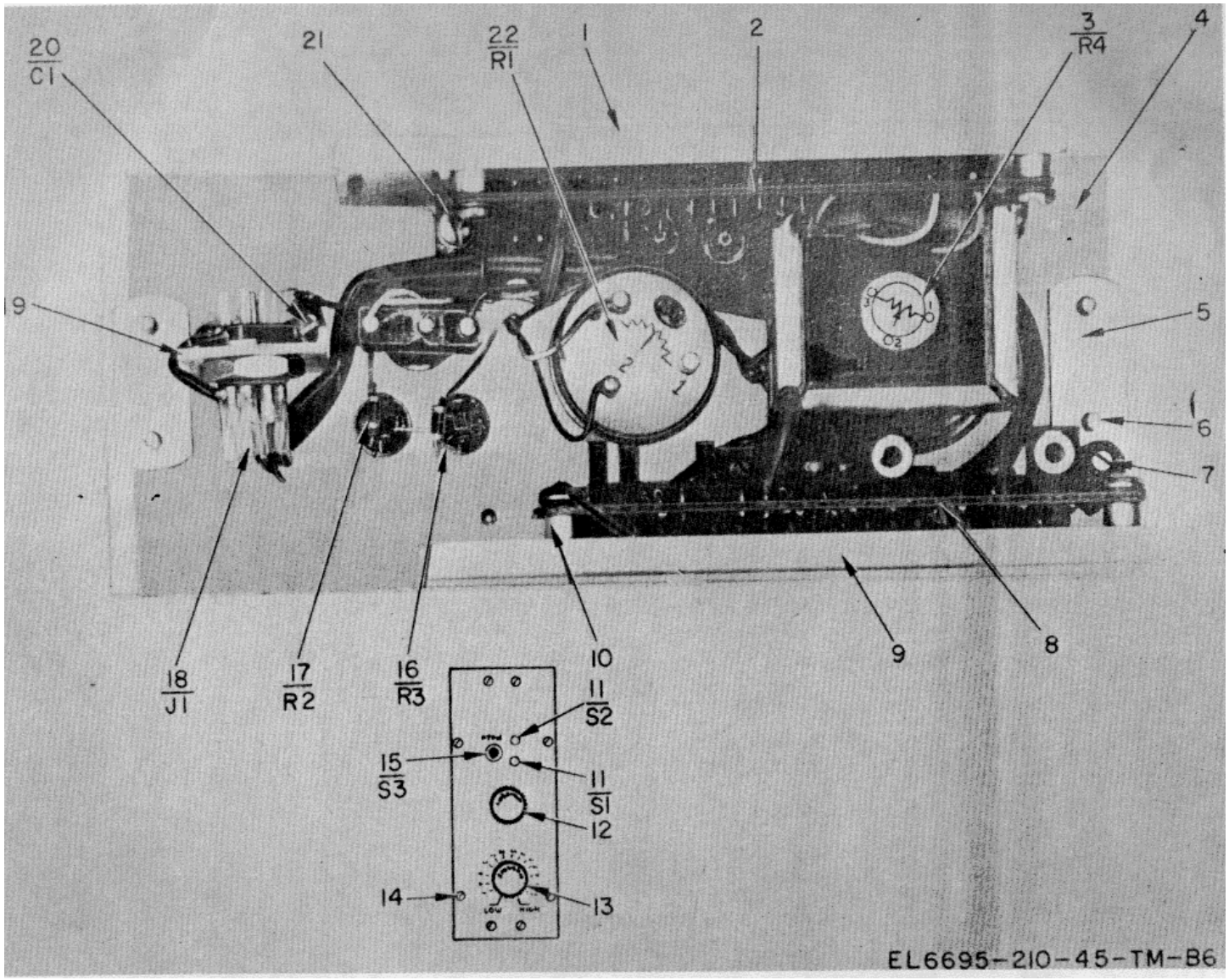

Figure B-5. Calvanic skin resistance amplifier assembly.

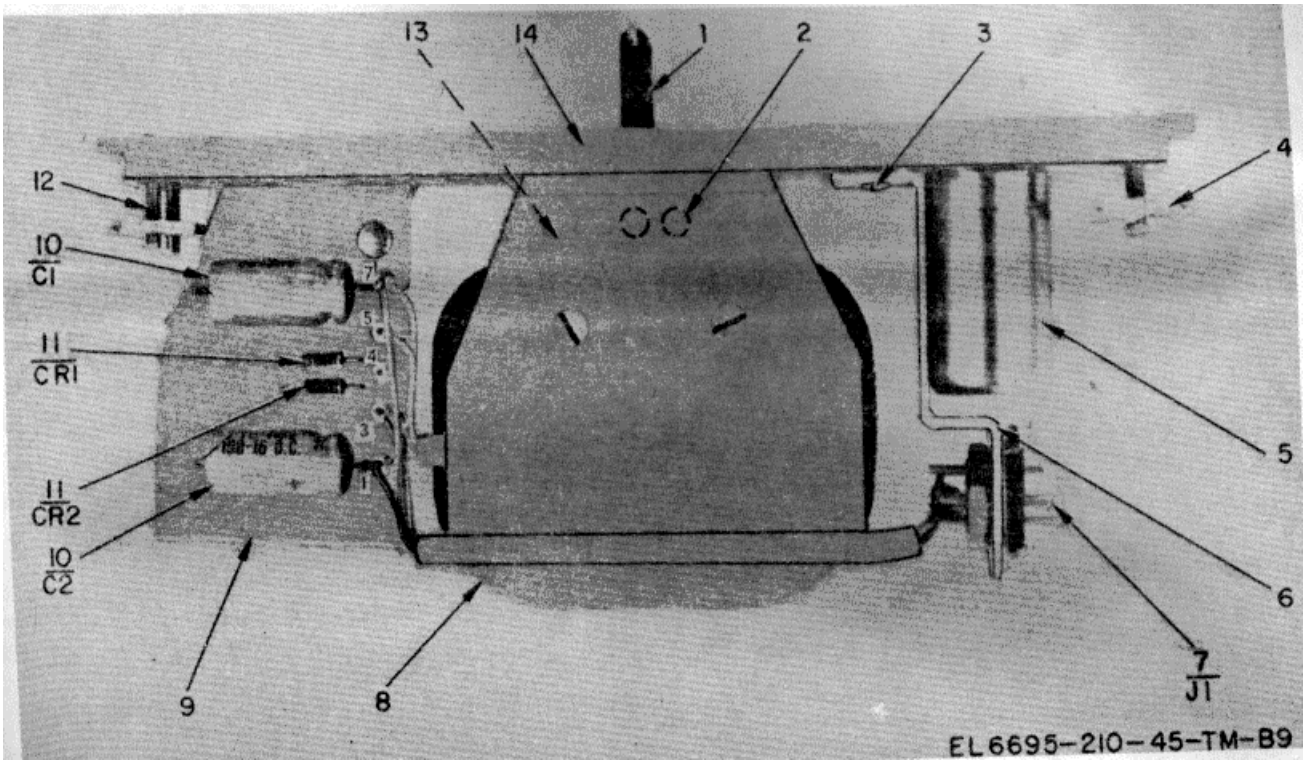

Figure B-6. Galvanometer assembly.

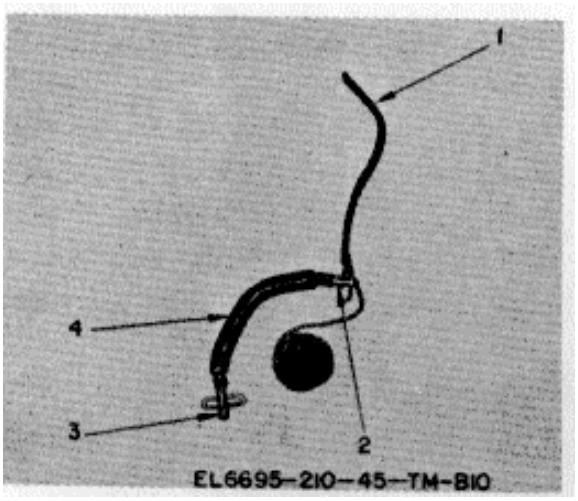

Figure B-7. Pneumograph chest tube assembly.

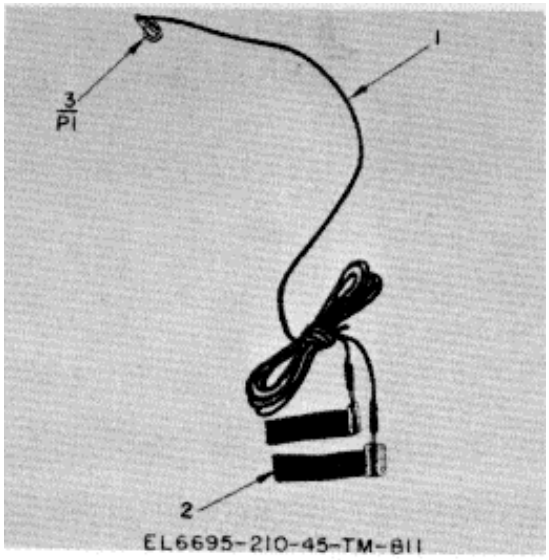

Figure B-8. Finger electrode assembly.

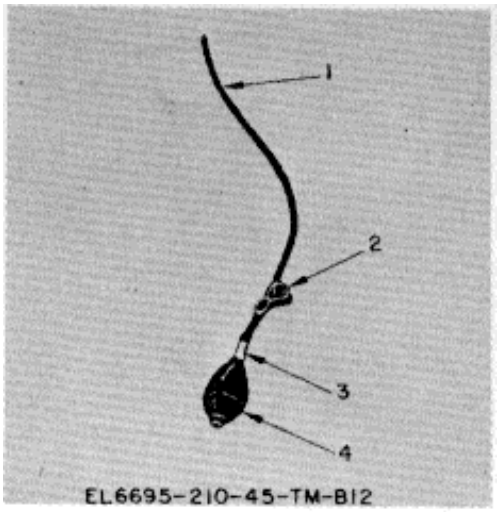

Figure B-9. Hand pump bulb assembly.

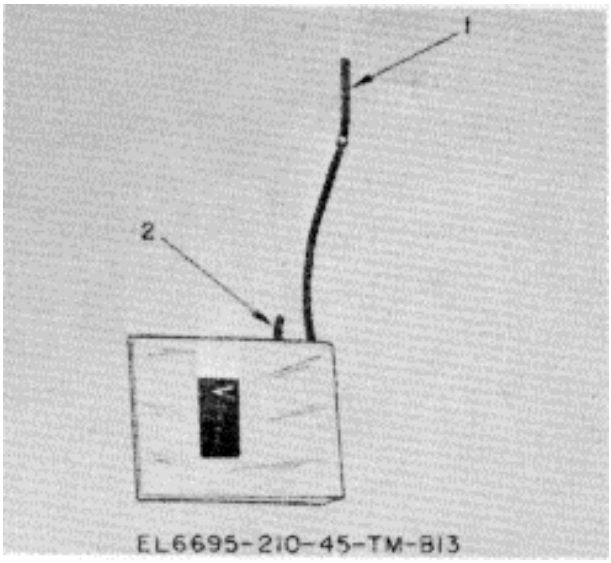

Figure B-10. Arm cuff assembly.

SECTION VI. NATIONAL STOCK NUMBER AND PART NUMBER INDEX

STOCK NUMBER	FIG.	ITEM	STOCK NUMBER	FIG.	ITEM
4720-00-470-1812	B-7	1			
4720-00-470-1812	B-9	1			
4720-00-470-1812	B-10	1			
4730-00-518-3600	B-9	2			
5305-00-068-5414	B-3	35			
5305-00-068-5414	B-4	8			
5305-00-068-5414	B-5	6			
5305-00-068-5414	B-6	12			
5355-00-471-9350	B-3	31			
5355-00-471-9350	B-4	21			
5355-00-471-9351	B-5	12			
5355-00-471-9352	B-5	13			
5920-00-329-8475	B-2	12			
5935-00-149-4266	B-8	3			
5975-00-729-8784	B-2	18			
6150-00-448-4322	B-8	1			
6515-00-327-3800	B-1	15			
6515-00-371-3440	B-9	3			
6515-00-762-2110	B-9	4			
6695-00-073-9178	B-1	5			
6695-00-451-8242	B-8	2			
6695-00-459-3320	B-1	21			
6695-00-459-3321	B-1	20			
6695-00-489-6085	B-1	9			
6695-00-489-6086	B-1	10			
6695-00-489-6088	B-1	6			
6695-00-563-0488	B-1	12			
6695-00-563-0489	B-1	11			
6695-00-752-9593	B-10	2			
6695-00-753-4560	B-1	16			
7510-00-159-4475	B-1	17			
8125-00-181-7451	B-1	13			
9320-00-448-4330	B-7	4			

SECTION VI. NATIONAL STOCK NUMBER AND PART NUMBER INDEX (CONTINUED)

PART NUMBER	FSCM	FIG.	ITEM
MDL 6/10AMP	71400	B-2	12
MS16995-11	96906	B-3	35
MS16995-11	96906	B-4	8
MS16995-11	96906	B-5	6
MS16995-11	96906	B-6	12
N3707	57800	B-7	1
N3707	57800	B-3	1
N3707	57800	B-10	1
N3881	57800	B-7	3
N3886	57800	B-7	2
N5445	57800	B-3	31
N5445	57800	B-4	21
N5446	57800	B-5	13
N5448	57800	B-5	12
SA1271	57800	B-1	13
SA257	57800	B-8	1
SA27	57800	B-1	11
SA29	57800	B-1	12
SA307	57800	B-1	6
SA426	57800	B-1	5
SA512	57800	B-8	2
SA57	57800	B-1	8
SA91	57800	B-1	21
SA92	57800	B-1	20
0X973F1	77681	B-9	2
0034641	98079	B-1	15
1891	06156	B-9	4
1892	06156	B-9	3
205901	04009	B-2	18
22490I	57800	B-1	17
22495B	57800	B-1	16
24222	57800	B-1	10
57113	57800	B-1	9
75MC1F	02660	B-8	3
8205	57800	B-7	4
8206	57800	B-10	2
9082	57800	B-1	18

PART NUMBER	FSCM	FIG.	ITEM

APPENDIX C

MAINTENANCE ALLOCATIONS

Section I. INTRODUCTION

C-1. General

This appendix provides a summary of the maintenance operations covered in the equipment literature for Polygraph Instrument, Recording AN/USS-2F. It authorizes categories of maintenance for specific maintenance functions on repairable items and components and the tools and equipment required to perform each function. This appendix may be used as an aid in planning maintenance operations.

C-2. Maintenance Functions

Maintenance functions will be limited to and defined as follows:

a. Inspect. To determine serviceability of an item by comparing its physical, mechanical, and electrical characteristics with established standards.

b. Test. To verify serviceability and to detect incipient failure of measuring the mechanical or electrical characteristics of an item and comparing those characteristics with prescribed standards.

c. Service. Operations required periodically to keep an item in proper operating condition, i.e., to clean, preserve, drain, paint, or to replenish.

d. Adjust. Maintain within prescribed limits by bringing into proper or exact position, or by setting the operating characteristics to the specified parameters.

e. Align. To adjust specified variable elements of an item to about optimum or desired performance.

f. Calibrate. To determine and cause corrections to be made or to be adjusted on instruments or test measuring and diagnostic equipment used to precision measurement. Consists of the comparison of two instruments, one of which is a certified standard of known accuracy, to detect and adjust any discrepancy in the accuracy of the instrument being compared.

g. Install. The act of emplacing, seating, or fixing into position an item, part, module (component or assembly) in a manner to allow the proper functioning of the equipment/system.

h. Replace. The act of substituting a serviceable like-type part, subassembly, module (component or assembly) in a manner to allow the proper functioning of an equipment/system.

i. Repair. The application of maintenance services (inspect, test, service, adjust, align, calibrate, replace) or other maintenance actions (welding, grinding, riveting, straightening, facing, remachining, or resurfacing) to restore serviceability to an item by correcting specific damage, fault, malfunction, or failure in a part, subassembly, module/component/assembly, end item or system.

j. Overhaul. That maintenance effort (service/action) necessary to restore an item to a completely serviceable/operational condition as prescribed by maintenance standards (e.g., DMWR) in pertinent technical manuals. Overhaul is normally the highest degree of maintenance performed by the Army. Overhaul does not normally return an item to like-new condition.

k. Rebuild. Consists of those services/actions necessary for the restoration of unserviceable equipment to a like-new condition in accordance with original manufacturing standards. Rebuild is the highest degree of materiel maintenance applied to Army equipment. The rebuild operation includes the act of returning to zero those age measurements (hours, miles, etc.) considered in classifying Army equipment/components.

l. Symbols. The uppercase letter placed in the appropriate column indicates the lowest level at which that particular maintenance function is to be performed.

C-3. Explanation of Format

a. Group Number. Column 1 lists group numbers, the purpose of which is to match components, assemblies, subassemblies, and modules with the next higher assembly.

b. Functional Group. Column 2 lists the next higher assembly group and the item names of components, assemblies, subassemblies and modules within the group for which maintenance is authorized.

c. Maintenance Functions. Column 3 lists the twelve maintenance functions defined in C-2 above. Each maintenance function required for an item is specified by the symbol among those listed in d below which indicates the level responsible for the required maintenance. Under this symbol is listed an appropriate work measurement time value determined as indicated in *e* below.

d. Use of Symbols. The following symbols are used to prescribe work function responsibility:

C-Operator/Crew
O-Organization
F-Direct Support
H-General Support
D-Depot

e. Work Measurement Time. The active repair time required to perform the maintenance function is included directly below the symbol identifying the category of maintenance. The skill levels used to obtain the measurement times approximate those found in typical TOE units. Active repair time is the average aggregate time required to restore an item (subassembly, assembly, component, module, end item or system) to a serviceable condition under typical field operating conditions. This time includes preparation time, fault isolation/diagnostic time, and QA/QC time in addition to the time required to perform specific maintenance functions identified for the tasks authorized in the maintenance allocation chart. This time is expressed in man-hours and carried to one decimal place (tenths of hours).

f. Tools and Test Equipment. This column is used to specify, by code, those tools and test equipment required to perform the designated function.

g. Remarks. Self-explanatory.

C-4. Explanation of Format of Table and Test Equipment Requirements

The columns in table I are as follows:

a. Tools and Equipment. The numbers in this column coincide with the numbers used in the tools and equipment column of the maintenance allocation chart. The numbers indicate the applicable tool for the maintenance function.

b. Maintenance Category. The codes in this column indicate the maintenance category normally allocated the facility.

c. Nomenclature. This column lists tools, test, and maintenance equipment required to perform the maintenance functions.

d. Federal Stock Number. This column lists the Federal stock number of the specific tool or test equipment.

e. Tool Number. Not used.

(1) GROUP NUMBER	(2) FUNCTIONAL GROUP COMPONENT ASSEMBLY	SECTION II. MAINTENANCE ALLOCATION CHART (3) MAINTENANCE FUNCTIONS											(4) TOLS AND EQUIPMENT	(5) REMARKS
		INSPECT	TEST	SERVICE	ADJUST	ALIGN	CALIBRATE	INSTALL	REPLACE	REPAIR	OVERHAUL	REBUILD		
	POLYGRAPH INSTRUMENT	C	O	O	O			O	O					
	RECORDING, AN/USS-2F	0.1	0.3	0.3	0.1				0.1	1.0			1,2,7	
1A1	CASE ASSEMBLY		H							H			3,4,7	Replace pressure gage.
			0.3							0.8				
1A2	ACTUATOR, ELECTROMECHANICAL, ROTARY		H		H				H	H			3,4,6	
			0.2		0.1				0.2	1.0				
1A3	RECORDER, CARDIOGRAPHIC		H		H				H	H			3,7	
			0.3		0.1				0.2	0.8				
1A4	RECORDER, PNEUMOGRAPHIC		H		H				H	H			3,7	
			0.3		0.1				0.2	0.8				
1A5	AMPLIFIER, ELECTRONIC CONTROL		H		H				H	H			3,4,12	
			0.5		0.3				0.2	0.8				
1A5A4	PRINTED CIRCUIT BOARDASSEMBLY, AMPLIFIER								H	D			3,4,5,8,10,11	
									0.3	2.0				
1A5A4	POWER SUPPLY ASSEMBLY								H	D			3,4,5,9,11	
									0.3	2.0				
1A6	RECORDER, GALVANOMETER	H		H				H	H				3,4	
			0.3		0.1				0.2	1.0				
1A6A1	PRINTED CIRCUIT BOARD		H						H	H			3,4	
			0.2						0.5	1.0				
1A7	PNEUMOGRAPH ASSEMBLY		O						O	O			1,7	
			0.2						0.1	0.3				
1A19	CUFF ASSEMBLY, ARM, SPHYGMOMANOMETER		O						O	O			1,7	
			0.2						0.1	0.3				
1A20	CUFF ASSEMBLY, WRIST, SPHYGMOMANOMETER		O						O	O			1,7	
			0.2						0.1	0.3				

Table 1. TOOL AND TEST EQUIPMENT REQUIREMENTS

TOOLS AND EQUIPMENT	MAINTENANCE CATEGORY	NOMENCLATURE	FEDERAL STOCK NUMBER	TOOL NUMBER
1	O	TOOLKIT,ELECTRONICEQUIPMENTTK-101/G	5180-064-5178	
2	O	MULTIMETER AN/URM-105	6625-581-2036	
3	H,D	TOOL KIT, ELECTRONIC EQUIPMENTTK-105/G	5180-610-8177	
4	H,D	MULTIMETER TS-352B/U	6625-553-0142	
5	D	OSCILLOSCOPE OS-8( )/U	6625-643-1740	
6	H,D	TENSION SCALE (0-64 oz)	6670-246-8465	
7	O,H,D	PINCH CLAMP (2 required)	4730-918-5432	
8	D	GSR TEST FIXTURE (See note)		
9	D	POWER SUPPLY TEST FIXTURE (See note)		
10	D	POWER SUPPLY PP-3939/G	6130-985-8137	
11	D	TRANSFORMER, VARIABLE, POWER CN-16/U	5950-235-2086	
12	H,D	RESISTOR, 47K±5%, ½ Watt	5905-254-9201	
		NOTE **USER FABRICATED, SEE TM 11-6695-20-45**.		

GLOSSARY

DEFINITIONS OF UNUSUAL TERMS

Cardio-sphygmograph-An instrument that records graphically the movements or character of the pulse.
Dicrotic notch-A tracing characteristic showing action of a heart valve.
Gsr amplifier-An electromechanical device that records graphically the change in a subject's skin resistance.
Pneumograph-A device for recording the volume change during respiration.
Sphygmomanometer-A gage used to indicate the inflation pressure of the cardio cuff.
Stimulus-Anything (such as a question, pin prick, sudden loud noise, subject coughing or taking a deep breath) that will cause the subject's responses to change and thus cause a change in the input to the polygraph.
Mm hg-Millimeters of mercury.

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ACSC-E (1)
USACDCCEA (1)
USACDCCEA Ft Huachucha (1)
USAMC (1)
USAREUR (5)
USAECOM (2)
USASCS (5)
LBAD (5)
SAAD (5)
TOAD (5)
LEAD (5)
NG: None
USAR: None
For explanation of abbreviations used, see AR 310-50.

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THE METRIC SYSTEM AND EQUIVALENTS

LINEAR MEASURE

1 Centimeter = 10 Millimeters = 0.01 Meters = 0.3937 Inches

1 Meter = 100 Centimeters = 1,000 Millimeters = 39.37 Inches

1 Kilometer = 1,000 Meters = 0.621 Miles

SQUARE MEASURE

1 Sq Centimeter = 100 Sq Millimeters = 0.155 Sq Inches

1 Sq Meter = 10,000 Sq Centimeters = 10.76 Sq Feet

1 Sq Kilometer = 1,000,000 Sq Meters = 0.386 Sq Miles

CUBIC MEASURE

1 Cu Centimeter = 1,000 Cu Millimeters = 0.06 Cu Inches

1 Cu Meter = 1,000,000 Cu Centimeters = 35.31 Cu Feet

LIQUID MEASURE

1 Milliliter = 0.001 Liters = 0.0338 Fluid Ounces

1 Liter = 1,000 Milliliters = 33.82 Fluid Ounces

TEMPERATURE

5/9 (°F -32) = °C

212° Fahrenheit is equivalent to 100° Celsius

90° Fahrenheit is equivalent to 32.2° Celsius

32° Fahrenheit is equivalent to 0° Celsius

9/5 C° +32 = F°

WEIGHTS

1 Gram = 0.001 Kilograms = 1,000 Milligrams = 0.035 Ounces

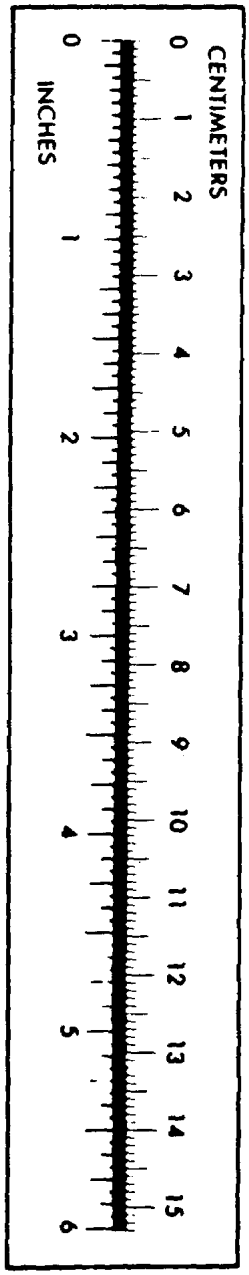
1 Kilogram = 1,000 Grams = 2.2 Lb.

1 Metric Ton = 1,000 Kilograms = 1 Megagram = 1.1 Short Tons

APPROXIMATE CONVERSION FACTORS

TO CHANGE	TO	MULTIPLY BY
Inches	Centimeters	2.540
Feet	Meters	0.305
Yards	Meters	0.914
Miles	Kilometers	1.609
Square Inches	Square Centimeters	6.451
Square Feet	Square Meters	0.093
Square Yards	Square Meters	0.836
Square Miles	Square Kilometers	2.590
Acres	Square Hectometers	0.405
Cubic Feet	Cubic Meters	0.028
Cubic Yards	Cubic Meters	0.765
Fluid Ounces	Milliliters	29.573
Pints	Liters	0.473
Quarts	Liters	0.946
Gallons	Liters	3.785
Ounces	Grams	28.349
Pounds	Kilograms	0.454
Short Tons	Metric Tons	0.907
Pound-Feet	Newton-Meters	1.356
Pounds Per Square Inch	Kilopascals	6.895
Miles Per Gallon	Kilometers Per Liter	0.425
Miles Per Hour	Kilometers Per Hour	1.609

TO CHANGE	TO	MULTIPLY BY
Centimeters	Inches	0.394
Meters	Feet	3.280
Meters	Yards	1.094
Kilometers	Miles	0.621
Square Centimeters	Square Inches	0.155
Square Meters	Square Feet	10.764
Square Meters	Square Yards	1.196
Square Kilometers	Square Miles	0.386
Square Hectometers	Acres	2.471
Cubic Meters	Cubic Feet	35.315
Cubic Meters	Cubic Yards	1.308
Milliliters	Fluid Ounces	0.034
Liters	Pints	2.113
Liters	Quarts	1.057
Liters	Gallons	0.264
Grams	Ounces	0.035
Kilograms	Pounds	2.205
Metric Tons	Short Tons	1.102
Newton-Meters	Pound-Feet	0.738
Kilopascals	Pounds Per Square Inch	0.145
Kilometers Per Liter	Miles Per Gallon	2.354
Kilometers Per Hour	Miles Per Hour	0.621



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