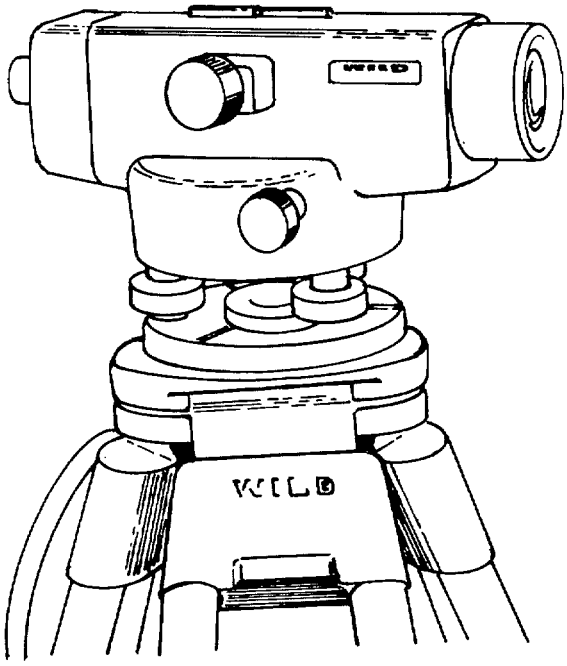
**TECHNICAL MANUAL**

# OPERATOR'S, ORGANIZATIONAL, AND DIRECT SUPPORT MAINTENANCE MANUAL (INCLUDING REPAIR PARTS AND SPECIAL TOOLS LIST)




**SELF-LEVELING**
**SURVEYING LEVEL**
**(WILD HEERBRUGG MODEL NA2-80)**
**NSN 6675-01-101-4724**

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
2 5 F E B R U A R Y 1 9 8 2

TECHNICAL MANUAL
TM 5-6675-329-13 & P

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 25 February 1982

# OPERATOR'S, ORGANIZATIONAL AND DIRECT SUPPORT MAINTENANCE MANUAL INCLUDING REPAIR PARTS AND SPECIAL TOOLS LIST LEVEL, SURVEYING, SELF-LEVELING (WILD HEERBRUGG MODEL NA2-80) NSN 6675-01-101-4724

---

## REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this manual. If you find any mistakes or if you know of a way to improve the procedures, please let us know. Mail your letter, DA Form 2028 (Recommended Changes to Publications and Blank Forms), or DA Form 2028-2 located in back of this manual direct to: The Commanding General, U.S. Army Troop Support and Aviation Materiel Readiness Command, Attn: DRSTS-MPSD, 4300 Goodfellow Blvd., St. Louis, MO 63120. A reply will be furnished to you.

---

## TABLE OF CONTENTS

TABLE OF CONTENTS (CONT)

LIST OF ILLUSTRATIONS

LIST OF TABLES

# CHAPTER 1

# INTRODUCTION

## Section I: GENERAL INFORMATION

### 1-1 SCOPE

a. Type of Manual - Operator's, Organizational and Direct Support Maintenance.

b. Model Number and Equipment Name - NA2-80, Level, Surveying, Self-Leveling (See Figure 1-1).

c. Purpose of the Equipment - To determine the difference in elevation of line of sight.

### 1-2 MAINTENANCE FORMS AND RECORDS

Department of the Army forms and procedures used for equipment maintenance will be those prescribed in TM 38-750.

### 1-3 HAND RECEIPT

Hand receipts covering the End Item/Component of the End Item (COEI), Basic Issue Items (BII) and Additional Authorization Lists Items (AAL) are published in a Hand Receipt Manual. The Hand Receipt Manual numerical designation is the same as the related Technical Manual with the letters HR added to the number. These manuals are published to aid in property accountability and are available through:

Commander
U.S. Army Adjutant General
Publications Center
2800 Eastern Boulevard
Baltimore, MD 21220

### 1-4 REPORTING EQUIPMENT IMPROVEMENT RECOMMENDATIONS (EIR'S)

If your Surveying Level NA2-80 needs improvement, let us know. Send us an EIR. You, the user, are the only one who can tell us what you don't like about your equipment. Let us know why you

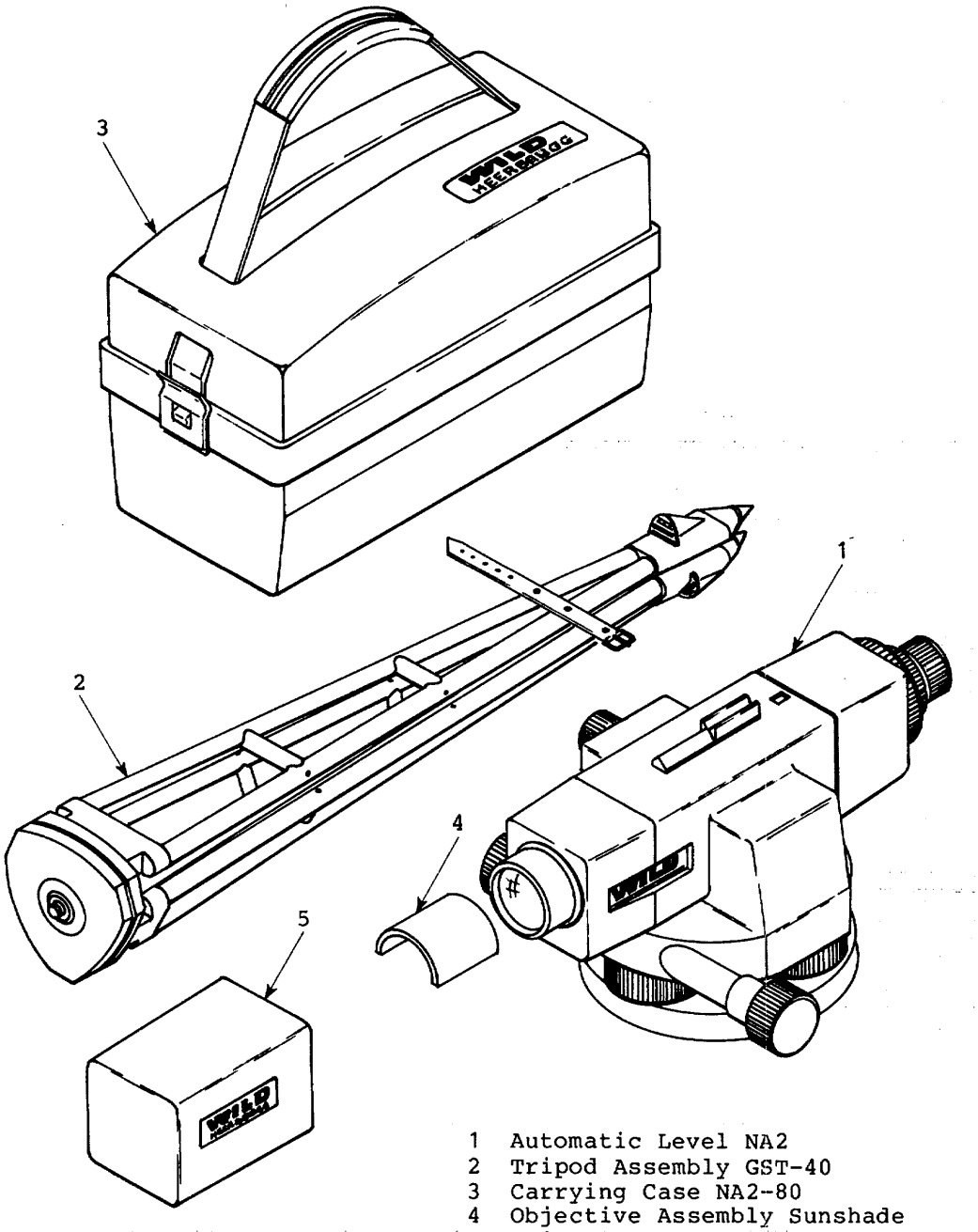



**Figure 1-1. Surveying Level, NA2-80**

don't like the design or performance. Put in on an SF 368 (Quality Deficiency Report). Mail it to us at:

The Commanding General
U.S. Army Troop Support and Aviation
Materiel Readiness Command
Attention: DRSTS-MPDM
4300 Goodfellow Blvd.
St. Louis, MO 63120.

We'll send you a reply.

## 1-5 WARRANTY INFORMATION

The Survey Level NA2-80 is warranted by Wild Heerbrugg Instrument Co., Inc. for one year. It starts on the date, found in block 23, DA form 2408-9, 'in the logbook. Report all defects in material or workmanship to your supervisor, who will take appropriate action through your organizational maintenance shop.

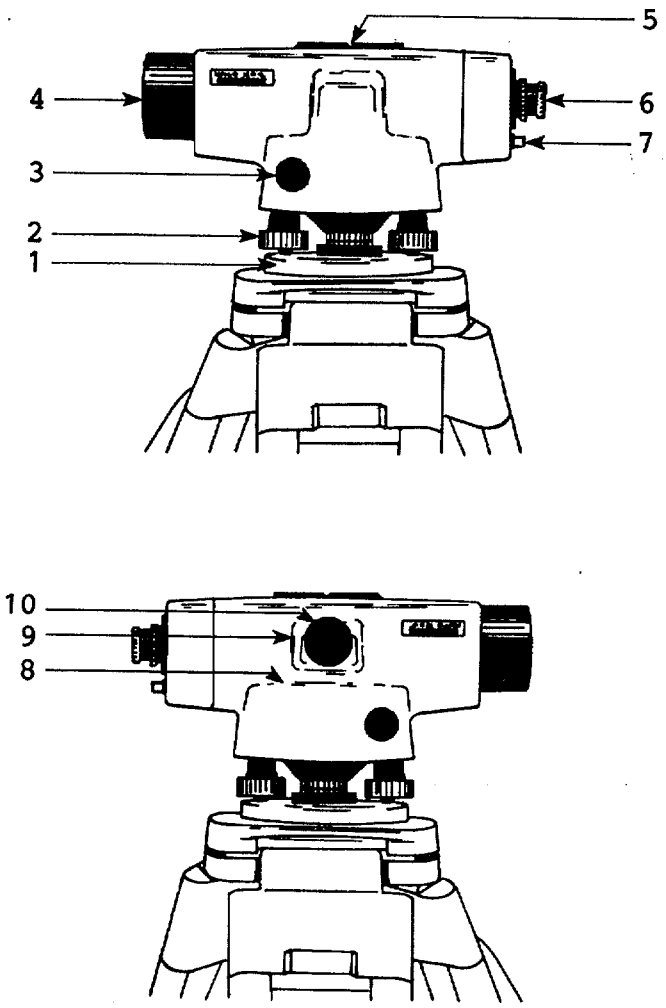
## 1-6 DESTRUCTION OF ARMY MATERIAL TO PREVENT ENEMY USE

Refer to TM750-244-3 covering the destruction of Army material to prevent enemy use.

## 1-7 PREPARATION FOR STORAGE OR SHIPMENT

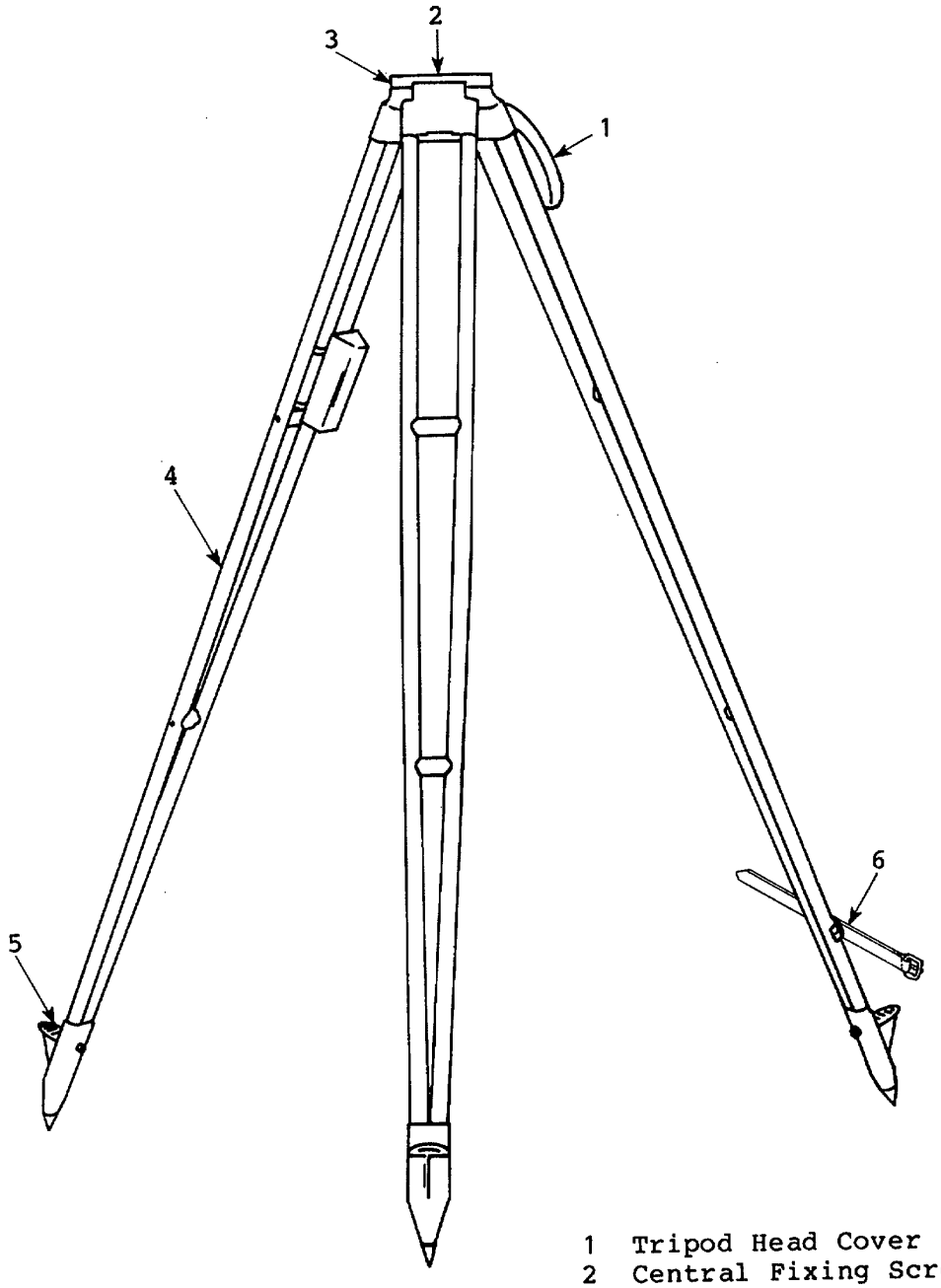
a. Packing Up - Open Carrying Case NA2-80 so that the inside surfaces are visible and accessible, and place both halves on a table, thereby preparing Carrying Case NA2-80 for receiving Automatic Level NA2 (see Figure 1-2). If Automatic Level NA2 is on the Tripod Assembly GST-40 (see Figure 1-3), the Automatic Level NA2 is sup- ported with one hand, and the Tripod Assembly GST-40 central fixing screw (2) is loosened. The Automatic Level NA2 must never be left on Tripod Assembly GST-40 without being screwed into it. The Automatic Level NA2 is properly placed in the transport case (lower half of carrying case NA2-80) and the upper half of carrying case is then fitted over the lower half, closed and locked (see Figure 1-4).

b. Storage - If possible, the Automatic Level NA2 should be stored in a dry, dust-proof room which does not have a big temperature range. In a humid climate the Automatic Level NA2 must be removed from its tightly closed container and the air must be al- lowed to circulate freely around the Automatic Level NA2. This is the best method for preventing mildew or fungus growth. The longer an Automatic Level NA2 is not in use the more liable it becomes to such a growth. To counter this, the Automatic Level NA2 should be stored in an opened state (i.e. not in its container) in a heated airing cupboard, which has an electric bulb or a heating element installed, with shelves which should be either slatted or ventilated with air-holes. In any case, care must be taken to ensure



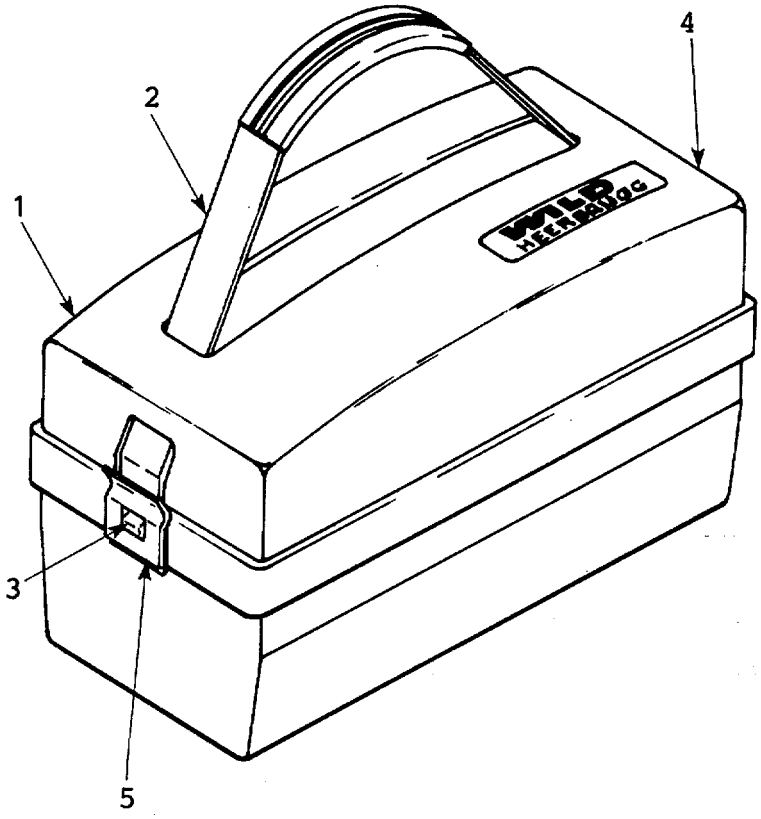

1 Base Plate
2 Footscrew
3 Horizontal Drive Knob
4 Telescope Objective Housing
5 Sight
6 Telescope Eyepiece
7 Push Button
8 Circular Level
9 Prism
10 Focusing Knob

**Figure 1-2. Level, Automatic, NA2**




1 Tripod Head Cover
2 Central Fixing Screw
3 Tripod Head Plate
4 Wooden Leg (3)
5 Tripod Shoe (3)
6 Leather Strap

**Figure 1-3. Tripod Assembly, GST-40**




1 Transport Case
2 Strap and Handle
3 Carrying Case Strap Hook
4 Clamp
5 Strap Lock

**Figure 1-4. Carrying Case, NA2-80**

a steady flow of air. In extremely cold areas, Automatic Level NA2 should not be taken into heated rooms during non-working periods but must be exposed, in a sheltered position, to the outside temperature. In this way the steaming-up of the optics and the formation of water condensation in the Automatic Level NA2's interior is avoided, thus allowing survey work to be restarted without additional delays.

c. Shipment or Transport - For a long journey, by rail or road, Automatic Level NA2 should be packed in its Carrying Case NA2-80. When being carried over water in a small boat, it is advisable to secure the Carrying Case (with the Automatic Level NA2 inside it) firmly to the boat, as an unsecured Automatic Level NA2 is almost certain to be lost if the boat capsizes. At all other times, the best way to transport the Automatic Level NA2 in a vehicle is to carry it (in its Carrying Case NA2-80) on one's lap; or to secure it in such a way that the Automatic Level NA2 cannot suffer any hard knocks or shocks.

## Section II: EQUIPMENT DESCRIPTION

### 1-8 PURPOSE, CAPABILITIES AND FEATURES

a. The Surveying Level NA2-80 is designed to accurately measure the distance from one ground station to another along a horizontal line.

b. The Automatic Level NA2 will give a horizontal line of sight (will be self-leveling) provided the circular bubble is-centered and the instrument is in adjustment.

c. The Automatic Level NA2 is self-contained and may be carried in a single carrying case (see Figure 1-4). The Tripod Assembly GST-40 (see Figure 1-3) is not enclosed in a case. During field use, the Automatic Level NA2 may be further protected from rain and dust by a separate cover (see Figure 1-2) which is placed over it while on the tripod.

### 1-9 LOCATION AND DESCRIPTION OF MAJOR COMPONENTS

a. The Surveying Level NA2-80 is comprised of the Automatic Level NA2 with case, the Tripod Assembly GST-40 and the other major components illustrated in Figures 1-1 through 1-4 and listed in Table 1-1.

b. Figure 1-3 shows the configuration of the Tripod Assembly GST-40 along with an underside view of the head and the cover for the head. The Automatic Level NA2 is illustrated in Figure 1-2. The Carrying Case NA2-80 for the Automatic Level. NA2 is illustrated in Figure 1-4. The tools recommended for operator and organizational level maintenance are shown in Figure 1-5. The related parts for each figure are included.

c. Electrical power is not required for the operation of this instrument.

**TABLE 1-1. LOCATIONS AND FUNCTION OF MAJOR COMPONENTS OF AUTOMATIC LEVEL NA 2**

| COMPONENT | FIGURE 1-2 LOCATION (ITEM) | FUNCTION |
|---|---|---|
| Base Plate | 1 | Allows attachment of Automatic Level NA2 to Tripod GST-40 |
| Footscrew (three) | 2 | Adjusts position of instrument on Tripod head plate to obtain level position. |
| Horizontal Drive NA2 Knob (two) | 3 | Moves the Automatic Level in the horizontal plane. |
| Telescope Objective Housing | 4 | Houses telescope which magnifies distant objects (including staff) for viewer. |
| Sight | 5 | Provides rough pointing capability toward target. |
| Telescope Eyepiece | 6 | Used for sighting of Automatic Level NA2 on target. |
| Pushbutton (Compensator) | 7 | When pressed prior to reading, staff actuates the internal compensator to assure achievement of horizontal line of sight. |
| Circular Level | 8 | Indicates that the automatic level has been leveled in the horizontal plane. |
| Prism | 9 | Allows viewing of circular level (12) without looking down. |
| Focusing Knob assembly | 10 | Used to focus eyepiece to telescope and target. |

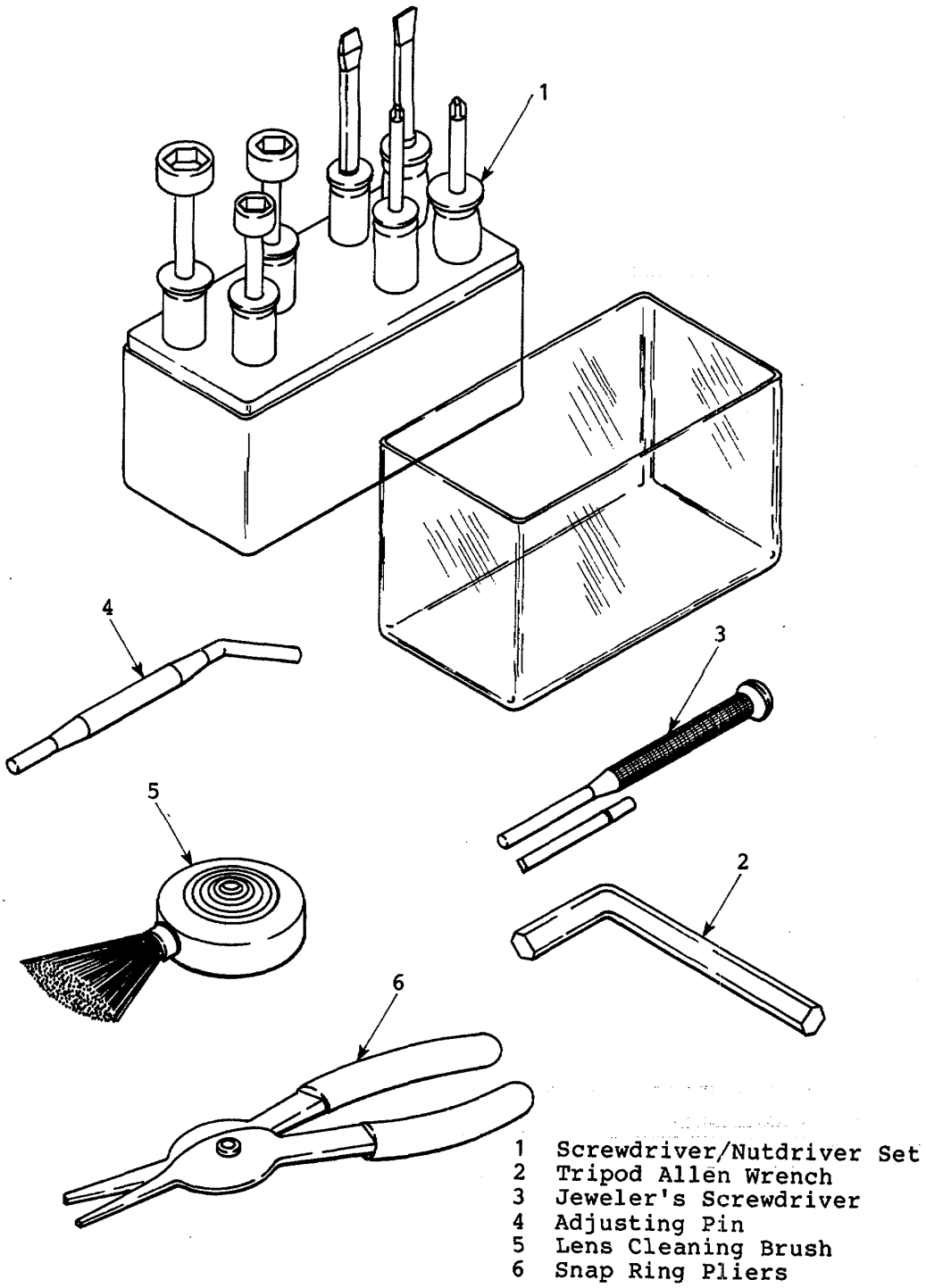



**Figure 1-5. Recommended Tools for Operator and Organizational Level Maintenance**

## 1-10 EQUIPMENT DATA

Equipment data which may needed by the operator for operation and maintenance of the equipment is presented below:

Weights and Dimensions

Carrying Case NA2-80:

Length: 12 inches (0.305 m)

Width: 6.5 inches (0.165 m)

Height: 7.5 inches (0.191 m)

Weight: 4.0 lbs. (1.8 kg.)

Tripod Assembly GST-40

Height: 67 inches (1.702 m)

Weight: 13.2 lbs. (6.0 kg.)

Automatic Level NA2

Length: 10 inches (0.254 m)
.at telescope housing assembly
Width: 2.5 inches (0.064 m)

Height: 5.5 inches (0.140 m)

Weight: 5.3 lbs. (2.4 kg.)

Base Plate Diameter: 4.25 inches (0.108 m)

Performance

| | |
|---|---|
| Standard Deviation, double leveling | As low as ±0.003 ft./mile (±0.001 m/1.61 km) |

Telescope

| | |
|---|---|
| Magnification | 32 times |
| Field of view at 100 ft./m | 2.3 ft. (0.7 m) |
| Shortest focusing distance | 5.3 ft. (1.6 m) |
| Multiplication constant | 100 |

Compensator

| | |
|---|---|
| Working range | ± 15 minutes of arc (1) |
| Setting accuracy | ± 0.3 seconds of arc (") |

Circular Level

| | |
|---|---|
| Sensitivity per 2 mm | 8 minutes of arc, or (1) |

**Section III: PRINCIPLES OF OPERATION**

The principle of operation of the self-leveling Automatic Level NA2-80 is based on a compensating element containing a prism which establishes a horizontal line of sight by correcting the light path of an unleveled instrument. Beyond the range of automatic adjustment, the level can be manually adjusted to a centered-bubble condition.

To check the operation of the compensator, a test pushbutton is incorporated in the level. When momentarily pressed, the pushbutton moves the compensator off-center. A functioning compensator will swing around the level position and then automatically return to it.

For surveying purposes, an adjustable focus telescope has been made an integral part of the level. The level also contains a horizontal drive mechanism which allows it to be turned in the horizontal plane.

# CHAPTER 2

# OPERATING INSTRUCTIONS

## 2-1 GENERAL

The Surveying Level NA2-80 is a survey instrument designed to make precise optical measurements in the field. The precise measurement is vertical and is used to determine difference in elevation. It will perform satisfactorily if it is carefully handled, maintained and operated as specified. While mounted on the tripod and temporarily not in use, the Automatic Level NA-2 must be covered (use rain and dust cover indicated in Figure 1-1, item 5) to protect it from rain, dust and physical damage. In a humid environment, the instrument must not be stored in its carrying case, or any closed container for extended periods of time. Air must be allowed to circulate freely around it in order to prevent mildew or the growth of fungus. (Refer to paragraph 1-3b).

## Section I: DESCRIPTION AND USE OF OPERATOR'S CONTROLS AND INDICATORS

## 2-2 OPERATOR'S CONTROLS AND INDICATORS

The controls and indicators for the Surveying Level NA2-80 are presented in tablular form in Table 2-1. Refer to Figure 1-2 for item numbers where indicated.

**Table 2-1. Controls and Indicators**

| ITEM (SEE FIG. 1-2) | CONTROL OR INDICATOR | FUNCTION |
|---|---|---|
| 2 | Footscrew (three) | Adjusts position of instrument on Tripod head plate to obtain level position. |
| 3 | Horizontal Drive Knob (two) | Moves the Automatic Level NA2 in the horizontal plane. |
| 6 | Telescope Eyepiece | Sighting of Automatic Level NA2 on target. |
| 7 | Pushbutton | When pressed prior to reading, staff actuates the internal compensator to assure achievement of horizontal line of sight. |
| 8 | Circular Level | Indicates that the automatic level has been leveled in the horizontal plane. |
| 10 | Focusing Knob | Focus eyepiece assembly to telescope and target. |

## Section II: PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS)

### 2-3 GENERAL

a. Before-you operate - Always keep in mind the CAUTIONS contained in this manual. Perform your before (B) PMCS. (Table 2-2).

b. While you operate - Always keep in the mind the CAUTIONS contained in this manual. Perform your during (D) PMCS. (Table 2-2).

c. After you operate - Be sure to perform your after (A) PMCS. (Table 2-2).

d. If your equipment fails to operate - Troubleshoot with proper equipment. Report any deficiencies using the proper forms. See TM 38-750.

### 2-4 PMCS PROCEDURES

a. The following PMCS procedures are designed to prevent trouble for the equipment operator, and to assure that the Surveying Level NA2-80 is ready when the operator is ready to work. Service intervals have been designed for the operator to quickly check the readiness of the instrument to function perfectly. Possible defects that may be encountered when performing the PMCS are indicated in the 'Equipment is Not Ready If:" column of Table 2-2 following. If the operator can correct the problem, he should do so before starting on continuing operation.

b. Troubles requiring corrective action beyond the scope of the operator level maintenance must be reported, and the equipment submitted to organizational maintenance.

c. The instrument should be kept clean. If telescope objective housing (Figure 1-2, item 4) and/or telescope eyepiece (item 6) appear dusty or dirty, they may be cleaned with a dusting brush (Figure 1-5, item 5) or a lens tissue and approved cleaning solvent.

**CAUTION**

**Do not rub lens with cloth or fingers.**

d. Operator PMCS procedures are indicated in Table 2-2.

## Table 2-2. Operator Preventive Maintenance Checks and Services

| ITEM NO. | INTERVAL B | D | A | W | M | ITEM TO BE INSPECTED | PROCEDURES Check for and have repaired or adjusted as necessary | EQUIPMENT IS NOT READY/ AVAILABLE IF |
|---|---|---|---|---|---|---|---|---|
| Automatic Level NA2 (see Figure 1-2) | | | | | | | | |
| 1 | | | | | • | External painted surface | Check for dirt, grease | Assembly dirty, greasy. |
| 2 | • | • | | • | • | Footscrew (2) | Check for binding, sticking. | Motion of foot-screw is jammed. |
| 3 | • | | • | | • | Horizontal Drive Knob (two) (3) | Check for binding, sticking. | Motion of hori-zontal drive is not smooth. |
| 4 | • | • | | | • | Objective Assy Lens Eyepiece Assembly Lens | Inspect lens for cracks, chips and serviceability. | Lens defective. |
| | | | | | | | Assure that eye-piece focus is adjustable. | Eyepiece focus does not vary when adjusting with focusing knob (10). |
| 5 | • | • | | | | Pushbutton (7) | When pressed, check that line of sight varies. | Pressing of push-button (7) has no effect on line of sight. |
| 6 | • | • | | | | Circular Level (8) | Check that bubble can be centered. | Adjustment of footscrews (2) does not center bubble. |

Interval Legend: B - Before Operation
D - During Operation
A - After Operation
W - Weekly
M - Monthly

**Table 2-2. Operator Preventive Maintenance Checks and Services (Cont)**

| ITEM NO. | INTERVAL B | D | A | W | M | ITEM TO BE INSPECTED | PROCEDURES Check for and have repaired or adjusted as necessary | EQUIPMENT IS NOT READY/ AVAILABLE IF |
|---|---|---|---|---|---|---|---|---|
| Tripod Assembly GST-40 (see Figure 1-3y) | | | | | | | | |
| 7 | • | | • | | • | Central Fixing Screw | Check for ease of turning and damage to threads. | Threads are stripped or damaged. |
| 8 | • | | • | • | | Shoes | Check for damage to ends. | Ends are damaged or broken. |
| 9 | • | | • | | • | Wooden legs to legs. | Check for damage | Legs are broken. |
| 10 | • | | • | • | | Hardware | Check for damage, loose or missing | Screws are excessively loose, damaged or missing. |

Interval Legend: B - Before Operation
D - During Operation
A - After Operation
W - Weekly
M - Monthly

## Section III: OPERATION UNDER USUAL CONDITIONS

### 2-4 ASSEMBLY AND PREPARATION FOR USE

To set up Surveying Level NA2-80 under usual conditions, proceed as follows:

a. Remove tripod head cover (Figure 1-3, item 1) and set up Tripod Assembly GST-40 with legs extended to a comfortable height and lock. Tripod head plate (3) should be as horizontal as possible. Shoes (5) should be firmly implanted in the ground.

b. Unfasten strap lock (Figure 1-4, item 5) from mating case strap hook (3) on transport case (1). Note how Automatic Level NA2 (Figure 1-2) is positioned and secured before removing it from Carrying Case NA2-80 so that it can be replaced properly after use. (Instrument lies upside down in Carrying Case NA2-80.)

c. Grasp Automatic Level NA2 with one hand and place it on top of tripod headplate (Figure 1-3, item 3). Turn central fixing screw (2) of Tripod Assembly GST-40 with other hand so as to attach Automatic Level NA2 to tripod headplate (3). Do not overtighten central fixing screw (2). Attach objective assembly sunshade (Figure 1-1, item 4) stored in Carrying Case NA2-80 to objective housing (Figure 1-2, item 4). Surveying Level NA2-80 is now set up (see Figure 2-1).

**CAUTION**

**Automatic Level NA2 should never be left on Tripod Assembly GST-40 without being screwed to it.**

d. To level instrument, turn three knurled footscrews (Figure 1-2, item 2) one at a time until bubble lies in center of Circular Level (8). The line of sight is then automatically set by the internal compensator.

**NOTE**

**Circular Level (8) bubble can be viewed through prism (9) directly above it.**

The functioning of the internal compensator is checked by pushing pushbutton (7) located below telescope eyepiece (6) while looking through eyepiece (6) at leveling staff (not supplied). After depressing pushbutton (7) leveling staff image should swing smoothly away and then float gently back to its original position with respect to the horizontal crosshair.

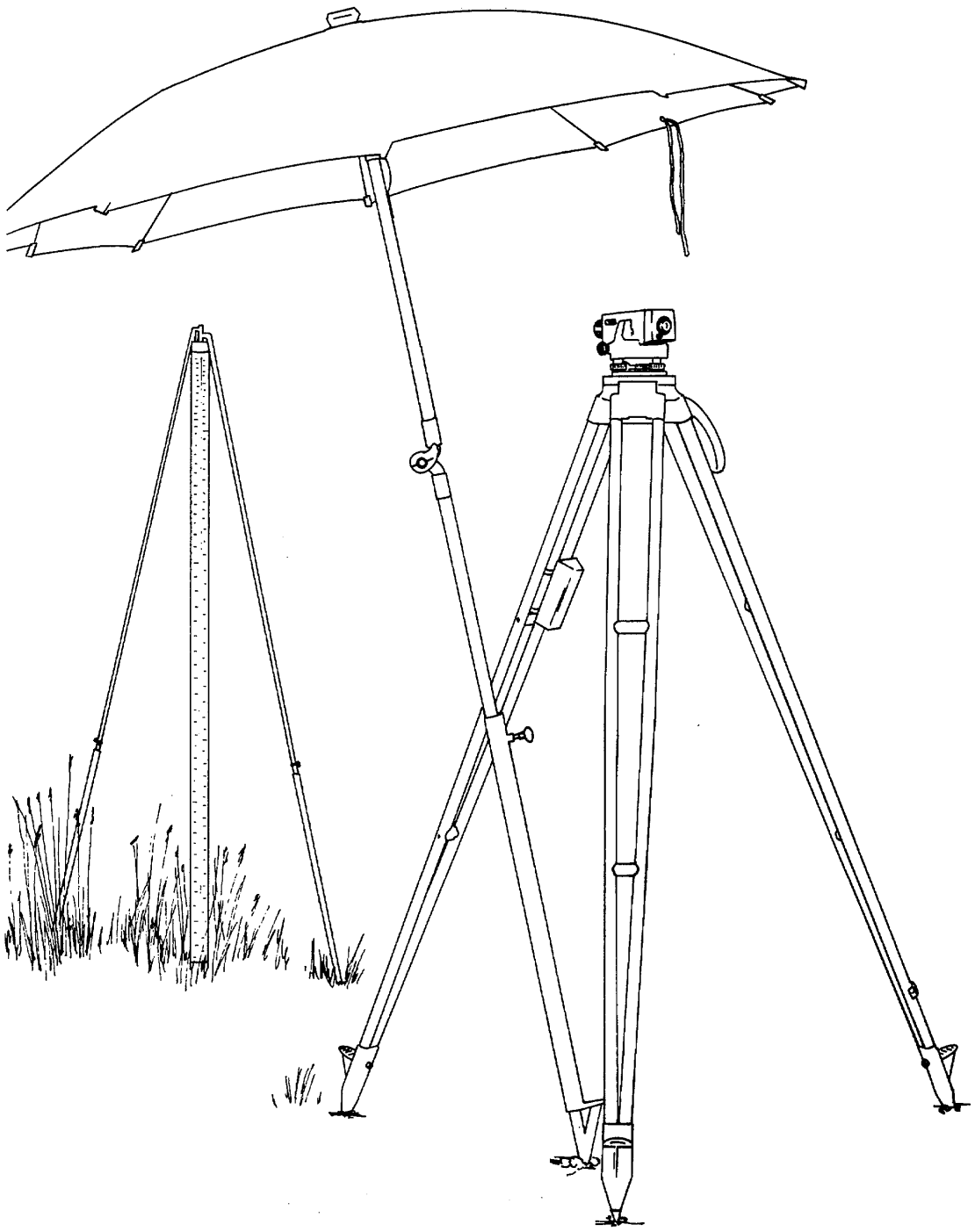


**Figure 2-1. Set Up of Surveying Level NA2-80**

## 2-5 OPERATING PROCEDURE

a. To focus instrument, point it toward a uniformly lighted surface or a sheet of white paper. Adjust eyepiece (6) until reticle crosshairs appear sharp and absolutely black.

b. To sight instrument, using open sight (5), turn instrument by hand until it is pointed at leveling staff. Turn focusing knob (9) until leveling staff image appearing in eyepiece (6) is sharp and free from parallax with respect to reticle crosshairs. To bring vertical crosshair exactly to the center of leveling staff, turn horizontal drive knob (3).

c. Before reading leveling staff check that bubble is centered in the Circular Level (8). Push pushbutton (7) to verify that internal compensator is functioning. Position of horizontal crosshair may now be read on leveling staff.

d. Because of the erect image telescope leveling staff numbers will increase from the bottom to the top in the field of view. Take the nearest whole centimeter value from the graduation below the horizontal crosshair (114 cm) and estimate the millimeters within the center interval cut by the crosshair (3 mm). The reading in Figure 2-2 is therefore 1.143 m. Reading is similar with a non-metric staff.

For line leveling of high accuracy, and as a check against blunder, leveling staff readings of the crosshair and both stadia hairs should be taken (3 wire method). The mean of the two stadia readings serves as a check on the middle crosshair reading.

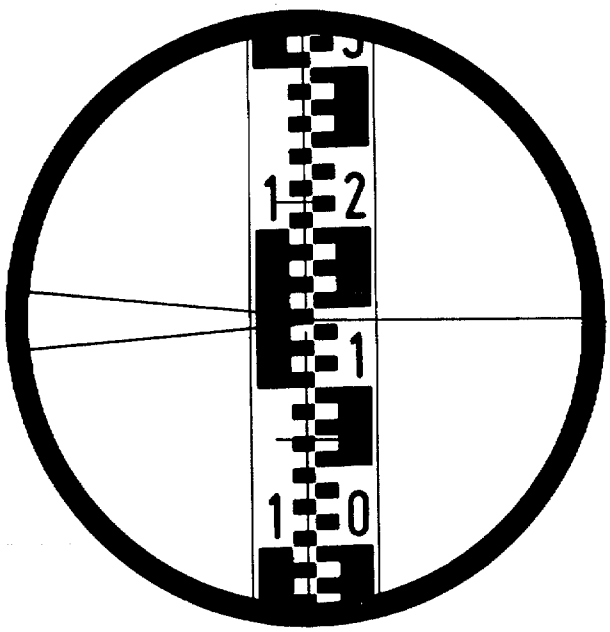
| | | |
|---|---|---|
| Example: | Horizontal crosshair | 1.143 m |
| | Upper stadia $A_1$ | 1.216 m |
| | Lower stadia $A_2$ | 1.068 m |
| | $A_1 + A_2$ | 2.284 m |
| | $1/2 (A_1 + A_2)$ | 1.142 m |

Should telescope image tremble due to ground vibrations or strong wind, suspend observation until vibration conditions cease.

## 2-6 DISTANCE MEASUREMENT FROM STADIA READINGS

To obtain the distance, the readings of the upper (A1) and lower (A2) stadia hairs are used. The difference between the two readings multiplied by 100 gives the horizontal distance from instrument to leveling staff (see Figure 2-2).

| Example: | | |
|---|---|---|
| | Upper stadia $A_1$ | 1.216 m |
| | Lower stadia $A_2$ | 1.068 m |
| | $A_1 - A_2$ | 0.148 m |
| | D | 14.8 m |




NA2 field of view with metric type wooden levelling staff
Height reading from horizontal hair 1.143m
Distance 14.8 m

**Figure 2-2. Distance Measurements from Stadia Readings**

To simplify the distance reading, the footscrew (Figure 1-2, item 2) closest to the line of sight can be turned until the lower stadia hair is on a full decimeter (foot) value. Only the upper stadia hair has now to be read and the subtraction is easier.

## 2-7 LINE LEVELLING (see Figure 2-3)

To determine the difference in elevation between two widely separated ground stations, a line of levels is run between the two stations, e.g. stations A to E in Figure 2-3. A number of intermediate instrument set-ups is selected so that the sighting distances from the instrument-to-staff are about 30-50 m (100-150 ft).

At the first instrument set-up, the telescope is pointed at a leveling staff held on station A and a reading taken. This is the initial backsight reading $R_1$. After the reading has been

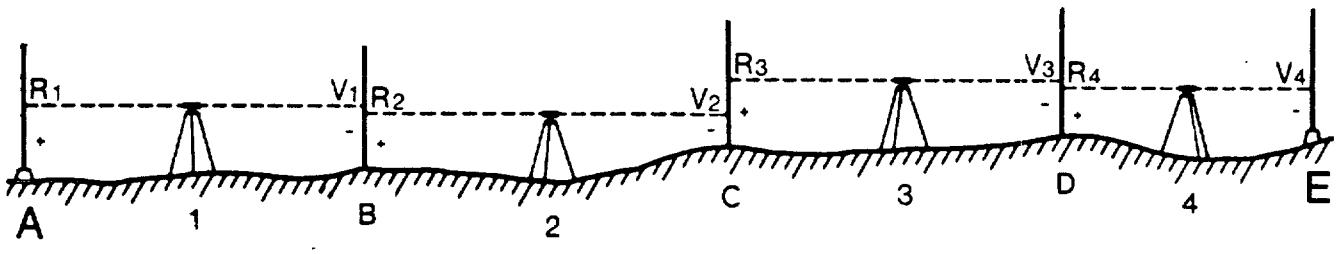



**Figure 2-3. Line Leveling**

taken, the staffman carries the leveling staff to the instrument, counting his paces as he goes.. He then proceeds away from the instrument the same number of paces and sets up the instrument-to-staff at station B. Instrument and leveling staff stations must be selected carefully on firm ground so that neither instrument nor leveling staff will sink into the ground. The observer then points to the new leveling staff station and takes the initial foresight reading $V_1$. The observer then carries his instrument to the next set-up 2 and the staffman carefully turns his leveling staff on station B to face the new instrument station. Now the observer takes the second backsight reading $R_2$ and the leveling continues in this manner towards station E. At the final instrument set-up 4 the observer must ensure that the sighting distances to staff stations D and E are of equal length. The reason for having equal backsights and foresights is to eliminate instrumental and physical errors (collmination error and the influences of curvature and refraction). This is important for accurate leveling.

The difference in elevation between stations A and B is obtained from the difference of staff readings at stations A and B, i.e. $R_1$-$V_1$; this is, of course, a positive value if station B is higher than station A. Similarly the difference in elevation between stations B and C is $R_2$-$V_2$, and so on. Now, the difference in elevation between stations A and E is equal to the sum of all R-V differences; it is also equal to the sum of all R readings minus the sum of all V readings. The identity $\sum$ (R-V) = $\sum$ R- $\sum$V provides a useful check. To guard against gross errors, the line is usually leveled in both directions, i.e. from station A to E and then from station E to A. To check against reading errors, it is useful to read the two stadia hairs as the mean of the stadia readings should equal the reading of the horizontal hair. If the best performance of the instrument is desired, it is advisable to shade it with an umbrella in sunny conditions.

## 2-8 PACKING UP

a. The Carrying Case NA2-80 is opened. Remove the objective assembly sunshade (4, Figure 1-1) from the telescope object housing (4, Figure 1-2) and store it in the Carrying Case NA2-80. With one hand on the Automatic Level NA2, the other hand is used to loosen the tripod central fixing screw (2, Figure 1-3). Holding on to the base plate (1), the instrument is placed upside down in its recess in the lower shell transport case (1, Figure 1-4) of the Carrying Case NA2-80. The upper shell is placed over it, both shells are pressed together, the locking hook is engaged and the clasp (3) at the end of the carrying strap is snapped closed.

If the instrument has become wet during use it should be wiped carefully and the Carrying Case NA2-80 should be opened as soon as possible (normally back at the base) so that the instrument can dry out completely. Never leave a wet instrument in a closed Carrying Case NA2-80.

## Section IV: OPERATION UNDER UNUSUAL CONDITIONS

## 2-9 GENERAL

Surveying Level NA2-80 is designed to operate normally within a wide range of climatic conditions. However, some conditions as indicated in paragraph 2-7, require certain precautions to avoid potential damage to the equipment.

## 2-10 OPERATION IN UNUSUAL WEATHER

a. When the instrument must be used in an atmosphere where the ambient temperature is more than 10°F different than that at which it was stored, allow at least two minutes for each °F difference to permit temperature stabilization and for evaporization of condensation.

b. In order to prevent penetration of dust into the interior of the instrument, it is not recommended that the instrument be used during severe windstorms.

c. Rain will wet the exterior of the instrument and will facilitate penetration of moisture. The cover (5, Figure 1-1) is designed to protect the Automatic Level NA2 from dust and rain and mud. (To protect Surveying Level NA2 (and the operator) from rain, and shade it from the sun during extremely hot conditions, a large umbrella should be available (see Figure 2-1).

d. An instrument which has become wet or muddy during use must be wiped carefully and must be removed from its Carrying Case NA2-80 as soon as possible after returning to base, and allowed to dry out completely. It must not be temporarily stored with the Carrying Case NA2-80 closed before it has dried out completely.

# CHAPTER 3

# OPERATOR'S MAINTENANCE INSTRUCTIONS

## Section I: LUBRICATION INSTRUCTIONS

### 3-1 LUBRICATION REQUIREMENTS

a. Automatic Level NA2 The Automatic Level NA2 has been designed so that no lubrication is required at organizational level during its serviceable lifetime. Required lubrication will be performed at depot level maintenance only when unit is overhauled or repaired.

b. Tripod Assembly GST-40 The Tripod Assembly GST-40 may require an occasional drop of oil at the hinges and at the central fixing screw (2, Figure 1-3) for ease of operation.

## Section II: TROUBLESHOOTING PROCEDURES

### 3-2 USE OF TROUBLESHOOTING TABLE

a. Table 3-1 lists the common malfunctions which you may find during the operation or maintenance of the Surveying Level NA2-80 or its components. You should perform the tests/inspections and corrective actions in the order listed.

b. This manual cannot list all malfunctions that may occur, nor all tests or inspections and corrective actions. If a malfunction is not listed or is not corrected by listed corrective actions, notify your supervisor.

**Table 3-1. Troubleshooting**

| MALFUNCTION<br>TEST OR INSPECTION<br>CORRECTIVE ACTION |
|---|

**1. CIRCULAR LEVEL (8, FIGURE 1-2) BUBBLE DOES NOT REMAIN CENTERED WHEN INSTRUMENT IS ROTATED THROUGH 360°.**

Step 1. Check that footscrews (2, Figure 1-2) have not moved.

Step 2. Check that Tripod Assembly GST-40 leg (s) (4, Figure 1-3) has not moved.

Readjust footscrews to center bubble at Automatic Level position (s) where it goes off center. Re-rotate Automatic Level NA2 through 360°. If bubble still goes off center, this indicates that footscrews have not moved, and circular level requires readjustment. Refer to Maintenance Section III.

There should be no play between the various components of the Tripod Assembly GST-40. The hexagonal key kept in the tripod pouch should be used to tighten up the tripod screws when necessary. The hinges between the tripod head and the legs can be adjusted; they should be sufficiently stiff so that when the tripod is lifted by its head the legs just remain spreadout.

**2. LINE OF SIGHT DOES NOT REMAIN HORIZONTAL.**

Step 1. Check that circular level (8, Figure 1-2) bubble is centered.

Step 2. Press test pushbutton (7, Figure 1-2) and observe image movement in eyepiece (6).

The circular bubble is in correct adjustment when it stays in the center of the circle in whatever

**Table 3-1. Troubleshooting (Cont)**

| MALFUNCTION<br>TEST OR INSPECTION<br>CORRECTIVE ACTION | | |
|---|---|---|
| Step 2. | (cont) | direction the telescope is pointing. Refer to Chapter 4, Section VI, Maintenance Procedures, for testing and adjusting the circular level.<br><br>Refer to Chapter 4, Section VI, Maintenance Procedures, for testing for the horizontality of the line of sight. Necessary adjustment procedures for Automatic Level NA2 are also given. |

# CHAPTER 4

# ORGANIZATIONAL MAINTENANCE

## Section I: REPAIR PARTS, SPECIAL TOOLS, TMDE AND SUPPORT EQUIPMENT

### 4-1 COMMON TOOLS AND EQUIPMENT

For authorized common tools and equipment, refer to the Modified Table of Organization and Equipment (MTOE) applicable to your unit.

### 4-2 SPECIAL TOOLS, TMDE AND SUPPORT EQUIPMENT

No special tools or equipment are required by Operator or Organizational maintenance personnel for maintenance of the NA2-80 level.

### 4-3 SPARES AND REPAIR PARTS

Spares and repair parts are listed and illustrated in Appendix F of this manual.

## Section II: SERVICE UPON RECEIPT

### 4-4 GENERAL

This section provides the information required at the Organizational maintenance level to ensure that the equipment is adequately inspected, serviced and operationally tested before normal use.

### 4-5 SERVICE UPON RECEIPT OF MATERIAL

Service upon receipt procedures are covered in the following checklist.

| LOCATION | ITEM | ACTION | REMARKS |
|---|---|---|---|
| 1. Carrying Case | Components | a. Inspect for crack in plastic material. Inspect for broken lock, strap, handle, rubber inserts and carrying case strap hook. (Refer to Appendix F, Figure F-4.) | Refer to paragraphs 4-6a, b. |

| LOCATION | ITEM | ACTION | REMARKS |
|---|---|---|---|
| 1. Carrying Case (cont) | Components | b. Reject carrying case if damage prevents its normal use. | |
| 2. Tripod Assembly | Components | a. Inspect for broken or damaged Tripod Head Cover, Tripod Head Head Plate wooden legs(s) and leather strap. Inspect for damaged or stripped threads on Central Fixing Screw. Inspect for broken or damaged leg holder(s), Tripod shoe(s) and all hardware. (Refer to Appendix F, Figure F-2.)<br><br>b. Reject Tripod As sembly if damage prevents its normal use. | Refer to paragraphs 4-6a, b. |
| 3. Automatic Level NA2-80 | Components | a. Inspect for broken or damaged outer surfaces of the level. Inspect telescope lens (Objective Housing Lens and Eyepiece Lens) for scratches or breaks. Inspect for broken or scratched Prism. Check for broken or damaged baseplate, footscrew knob(s), Horizontal drive nobs(s), pushbutton, circular level and focusing knob. (Refer to Chapter 1, Figure 1-2.) | Refer to paragraphs 4-6a, b. |

| LOCATION | ITEM | ACTION | REMARKS |
|---|---|---|---|
| 3. Automatic Level NA2-80 (cont) | | b. Reject Automatic Level NA2-80 if damage prevents its normal use. | |
| 4. Objective Assembly Sunshade | - | Inspect for cracks. Reject sunshade if damage prevents its normal use. | Refer to paragraphs 4-6a, b.<br><br>Sunshade for Carrying Case, same as 1 above. |
| 5. Rain and Dust Cover | - | Inspect for broken or cracked cover. Reject if broken or cracked. | Refer to paragraphs 4-6a, b. |

## 4-6 CHECKING UNPACKED EQUIPMENT

a. Inspect the equipment for damage incurred during shipment. If the equipment has been damaged, report the damage on DD Form 6, Packaging Improvement Report.

b. Check the equipment against the packing slip to see if the shipment is complete. Report all discrepancies in accordance with the instructions of TM 38-750.

## Section III: OPERATIONAL CHECKS

### 4-7 OPERATIONAL CHECKS

Operational checks, consisting of instrument leveling and focusing checks, are shown in Table 4-1. Perform the procedures weekly when the instrument is in regular use. When the instrument is not used regularly, perform the procedures before each use.

**Table 4-1. Instrument Leveling and Focusing Checks**

| Step | Operation<br>Normal Indication<br>Corrective procedure |
|---|---|
| 1 | Level the telescope.<br>Circular level (8, Figure 1-2) bubble remains centered when instrument is rotated through 360°.<br>Set up Tripod Assembly GST-40 so that its legs are stable and firmly planted on (or in) the ground, in an as near level position as possible.<br><br>With Automatic Level NA2-80 mounted on Tripod, turn the horizontal drive knob(s) to rotate level through 360° in the horizontal plane, while matching circular level bubble through prism. Bubble should remain centered through 360° of rotation. If not, readjust footscrews(s) at level positions(s) where it goes off center, and re-rotate level until bubble remains centered throughout continuous rotation. Press the test pushbutton (7, Figure 1-2) while looking through the telescope. The telescope image should momentarily move off center and then come back to the centered position. This assures the level compensator mechanism is functioning properly. |
| 2 | Focus crosshairs.<br>When instrument is focused reticle crosshairs appear sharp and absolutely black (See Figure 2-2.)<br>Point instrument to a uniformly lighted surface or a sheet of white paper. Rotate eyepiece (Figure 1-2, item 6) until above normal indication is obtained. |
| 3 | Image Focusing.<br>Image (usually a leveling staff) is sharp and free from parallax with respect to reticle crosshairs. |

**Table 4-1. Instrument Leveling and Checks (Cont)**

| Step | Operation<br>Normal Indication<br>Corrective procedure |
|---|---|
| 3<br>(cont) | Sight instrument using open sight (Figure 1-2, item 5) and turning instrument by hand until it is pointed at leveling staff. Turn focusing knob (9) to achieve normal indication. |

## Section IV: PREVENTIVE MAINTENANCE

### 4-8 PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS)

Table 4-2 presents recommended checks and services arranged in a logical sequence. These service items should be performed at the indicated time interval. When the instrument is not used daily, it is not necessary to perform the daily scheduled procedures. Instead, perform daily scheduled procedures before each use of the instrument.

**Table 4-2. Organizational Preventive Maintenance Checks and Services**

D - Daily
W - Weekly
M - Monthly

| ITEM NO. | INTERVAL D | W | M | ITEM TO BE INSPECTED | PROCEDURES | EQUIPMENT IS NOT READY/ AVAILABLE IF |
|---|---|---|---|---|---|---|
| 1 | • | | | Surveying Level NA2-80 | Perform operator preventive maintenance checks and services (Table 2-2). | Equipment does not pass all indicated operator checks. (Proceed to items 2 through 8 following.) |
| 2 | | • | | Tripod Assy GST-40 | Check Tripod Assy GST-40 leg(s) movement for sufficient tightness to keep tripod stable after it has been set up. | Tripod shifts of its own accord. |

**Table 4-2. Organizational Preventive Maintenance Checks and Services**

D - Daily
W - Weekly
M - Monthly

| ITEM NO. | INTERVAL D | W | M | ITEM TO BE INSPECTED | PROCEDURES | EQUIPMENT IS NOT READY/ AVAILABLE IF |
|---|---|---|---|---|---|---|
| 3 | | • | | Circular Level Bubble (8) | Check that bubble is centered through 180° of horizontal rotation. . | Adjustment of foot-screws and/or circular level adjusting screws fails to keep bubble centered through horizontal rotation of level. |
| 4 | • | | | Compensator Action Check | Check that after momentary pressing of the Push button (7, Figure 1-2) Level automatically returns to its bubble-centered position. | Level does not re-assume a bubble-centered position after Pushbutton is released. |
| 5 | | • | | Horizontality | Perform horizontality of the line of sight test and check that test readings and subsequent calculations are within tolerances indicated in paragraph 4-10b(1). | Readjustments of reticle plate adjustment screw (2, Figure 4-3) as indicated in paragraph 4-10b (2) does not result in acceptable horizontality of line of sight. |
| 6 | | • | | Focusing of telescope | Check that instrument can be focused on levelling staff height markings as staff is moved further and further away from automatic level (between 5.3 ft. (1.6m) and at least 250 ft. (76.2m), utilizing focusing knob (10, Figure 1-2) | Telescope cannot be focused throughout entire range indicated. |

## Section V: TROUBLESHOOTING

### 4-9 GENERAL

Troubleshooting of the NA2-80 level by Organizational maintenance personnel is limited to inspection of the telescope (including eyepiece and focusing assemblies), leveling screw assemblies, base plate and the tripod. The troubleshooting procedures in Table 4-3 provide malfunction, test or inspection and corrective action information for these assemblies. Any malfunction which is observed and is beyond the repair scope of Organizational maintenance personnel shall be reported to Direct Support maintenance.

**Table 4-3. Troubleshooting**

| MALFUNCTION<br>TEST OR INSPECTION<br>CORRECTIVE ACTION |
|---|
| Tripod is unstable.<br>Check tripod hinge elements (items 18, 19 and 22 through 25 of Repair Parts List, Figure 2) for proper adjustment and for wear or damage.<br>Tighten hinge elements as required. Replace any item inspected that is found to be damaged or excessively worn. |
| Telescope does not focus at all settings between 5.3 ft. (1.6m) and at least 250 ft. (76.2 m).<br>Check telescope housing lens, eyepiece assembly and focusing knob for damage.<br>Replace damaged telescope housing lens or damaged eyepiece assembly. (See Repair Parts List, Figure 3. If Focus Drive Assembly knobs are not damaged, but operating them has no effect on focusing, Automatic Level NA2 must be replaced. |
| Operation of a footscrew does not raise (or lower) Automatic Level NA2.<br>Visually check footscrews for damage.<br>Replace Automatic Level NA2. |
| Automatic Level NA2 cannot be securely seated on a functioning Tripod GST-40 assembly.<br>Visually check Automatic Level NA2 Baseplate (1, Figure 1-2).<br>Replace Automatic Level NA2 if baseplate is warped or internal threads are stripped or cross-threaded. |

## Section VI: MAINTENANCE PROCEDURES

### 4-10 GENERAL

a. Circular Level (8, Figure 1-2)

The Tripod Assembly with Automatic Level NA2 attached, is set up on firm ground. Using the three footscrews (2, Figure 1-2), the bubble is centered exactly in the middle of the setting circle. The instrument is now rotated through 180". If the bubble is displaced so that it no longer lies within the setting circle, it should be adjusted. When doing this, the bubble's glass cover must not be touched with the finger. Half of the bubble displacement is taken out with the footscrews and the other half with the two adjustment screws (Figure 4-1) using the adjusting pin kept in the Carrying Case NA2-80. As an adjustment screw is tightened the bubble runs towards it and, as it is loosened, the bubble runs away from it. The first adjustment screw to be turned, therefore, is the one that is the nearest to being in line with the middle of the bubble and the center of the setting circle. It is turned only until the bubble reaches the center of the circle or until it can be set in the center by means of the other screw. The screws must not be turned more than is necessary to complete the adjustment.

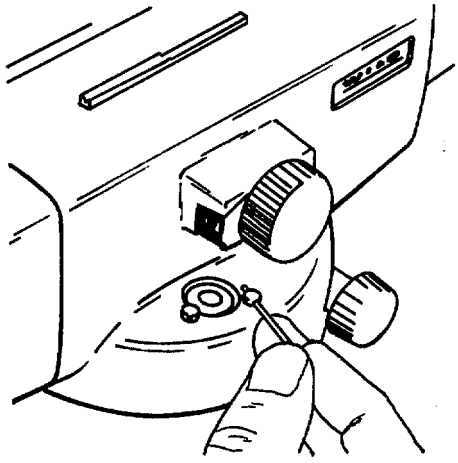


**Figure 4-1. Adjusting the Circular Level**

b. Horizontality of the Line of Sight

(1) Testing (Figure 4-2)

In flat terrain a test bay, between 45 and 60 m long (about 150 to 200 ft.), is selected and divided into three equal sections of length d. A staff is set up on an iron ground plate or peg at each of the intermediate points, B and C. (If only one staff is used it must be moved as required from peg B and peg C.) The instrument is set up, in turn, over the terminal points A and D.

With the instrument at A after centering the circular bubble and checking the compensator with the pushbutton (11) readings $a'_1$ and $a'_2$ are taken to the staffs held at B and C. With the instrument at D, readings $a'_3$ (to C) and $a'_4$ (to B) are then taken. If the line of sight is absolutely horizontal, these readings will be the correct readings $a_1$, $a_2$, a3, and $a_4$ respectively, and the following relationship will be valid, as can be seen from the figure:

$$a_4 - a_1 = a_3 - a_2$$

If this is not so, however, the line of sight is inclined to the horizontal plane by the small angle, $\delta$. If an imaginary line, parallel to $a'_2$ $a'_1$ is projected through $a'_3$, it will cut the staff at B in the correct position $a_4$ , thus giving the required value for a true, horizontal line of sight from D. This is seen quite plainly in the figure.

$$a_4 - a_1 = a'_3 - a'_2$$
$$\text{giving } a_4 = a'_1 - a'_2 + a'3$$

If the actual reading $a'_4$ differs from the computed, correct value $a_4$ by more than 2 mm in 30 m (or 0.005 ft. in 100 ft.), the whole procedure must be repeated. If the difference is confirmed, the line of sight must be adjusted as described in step (2) below.

The tolerance of 2 mm is 30 m (0.005 ft. in 100 ft.) is a practical value for routine leveling with the instrument.

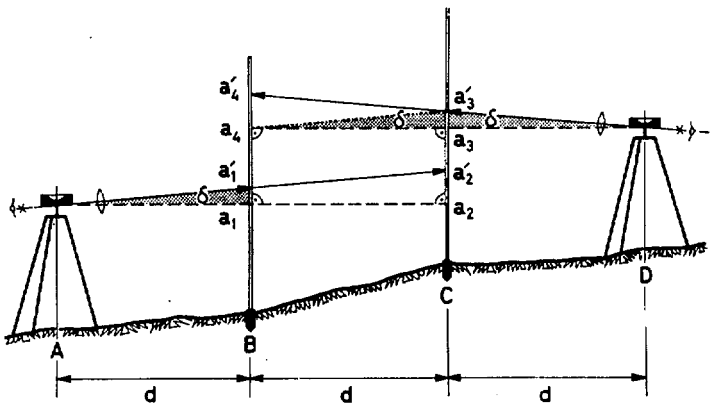
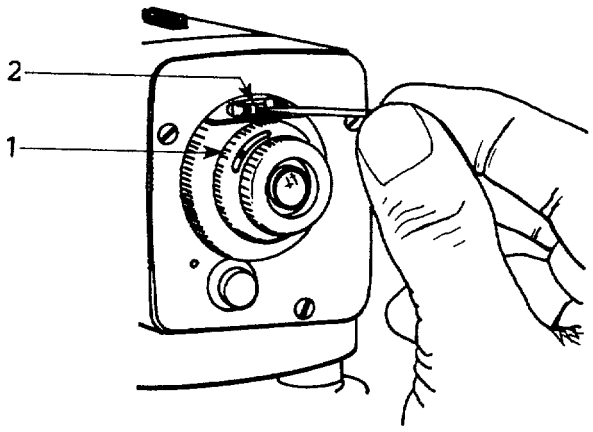



**Figure 4-2. Testing the Horizontally of the Line of Sight**

(2) Adjusting (see Figures 4-2 and 4-3).

The instrument is still at D. The line of sight is adjusted by shifting the reticle plate slightly. This is done with the capstan-headed adjusting screw (2) which can be seen after turning the black, protective cover (1) to the left. Using the adjusting pin from the instrument container, carefully turn the adjusting screw (2) until the horizontal hair gives the computed, correct reading $a_4$ on the staff B. The last turn of the adjustment screw (2) should be clockwise, i.e. to the left. Close the protective cover (1) by turning it to the right to its stop. Finally repeat the test (4-10 b. (1)) to verify the adjustment.




1 Protective cover; turns to give access to 2
2 Adjusting screw

**Figure 4-3. Adjusting the Line of Sight**

# CHAPTER 5

# DIRECT SUPPORT MAINTENANCE

## Section I: REPAIR PARTS, SPECIAL TOOLS, TMDE AND SUPPORT EQUIPMENT

### 5-1 COMMON TOOLS AND EQUIPMENT

For authorized common tools and equipment, refer to the Modified Table of Organization and Equipment (MTOE) applicable to your unit.

### 5-2 SPECIAL TOOLS, TMDE AND SUPPORT EQUIPMENT

No special tools or equipment are required by Direct Support personnel for maintenance of the level.

### 5-3 SPARES AND REPAIR PARTS

Spares and repair parts are listed and illustrated in Appendix F of this manual.

## Section II: TROUBLESHOOTING

### 5-4 GENERAL

Troubleshooting procedures for the-Surverying Level NA2-80 are given in Tables 3-1 and 4-2, and may be referred to as an aid to troubleshooting. Troubleshooting procedures in Table 5-1 provide Direct Support Maintenance personnel with additional tabular information for diagnosing and correcting unsatisfactory operation or failure of the eyepiece, tripod, and focus drive assemblies. Following each malfunction are tests or inspections and corrective actions required to correct the malfunction.

**Table 5-1. Troubleshooting**

| MALFUNCTION<br>TEST OR INSPECTION<br>CORRECTIVE ACTION |
|---|
| Blurred image is seen through the eyepiece.<br>None (lens internal to the telescope housing is broken).<br>Automatic level NA2-80 must be replaced. |
| Automatic Level NA2-80 is wobbly on the Tripod GST-40 base.<br>Check Tripod GST-40 Central Fixing Screw and Central Fixing Screw Retainer.<br>Replace defective part(s). |
| Focus Drive does not continuously drive focusing lens.<br>Check Focus Drive Assembly (item 1, Figure 5-3) for defects.<br>Replace defective component. |
| Horizontal Drive does not drive Automatic Level NA2.<br>Check Horizontal Drive Components (Figure 5-4) for defects.<br>Replace defective component(s). |

## Section III: MAINTENANCE PROCEDURES

### 5-5 GENERAL

Maintenance procedures in this section include removal, cleaning, inspection and installation of the eyepiece, Objective Housing, Focus Drive, Horizontal Drive Components and Tripod GST-40 assemblies. All maintenance procedures can be performed by one maintenance technician.

### 5-6 EYEPIECE ASSEMBLY MAINTENANCE INSTRUCTIONS (Figure 5-1)

This task covers:

a. Removal
b. Cleaning
c. Inspection
d. Installation

Initial Setup

Applicable Configuration

Figure 5-1

Accessories

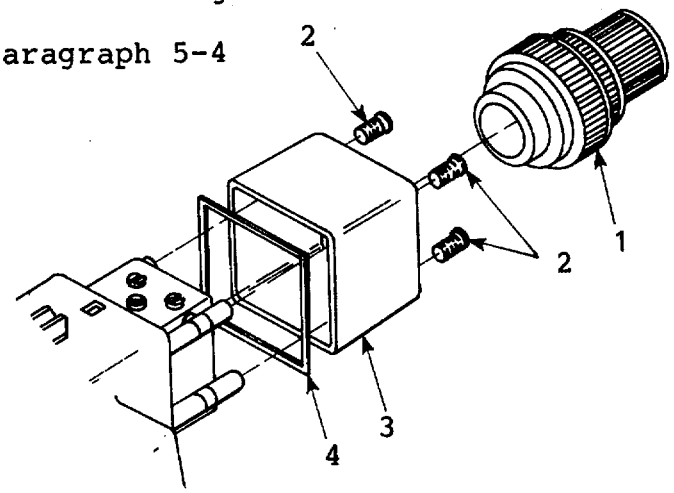
Camel hair dust brush

Materials/Parts

Eyepiece assembly

Troubleshooting References

Paragraph 5-4




1 Eyepiece Assembly
2 Retaining Screw
3 Eyepiece Housing Assembly
4 Housing Gasket

**Figure 5-1. Eyepiece Assembly Maintenance**

**Table 5-2. Eyepiece Maintenance Instructions**

| LOCATION | ITEM | ACTION | REMARKS |
|---|---|---|---|
| REMOVAL | | | |
| Eyepiece Assembly (1) | Retaining screw (2) | Remove three screws. | Use Jeweler's screw-driver supplied (3, Figure 1-5). |
| | Eyepiece Housing Assembly (3) | Remove. | |
| | Housing Gasket (4) | Remove. | |
| | Eyepiece Assembly (1) | Remove | |
| CLEANING | | | |
| | Eyepiece Assembly (1) | Wipe with clean, lint-free cloth. | Lens should be free of grease, dirt, dust, fingerprints. |

**Table 5-2. Eyepiece Maintenance Instructions (Cont)**

| LOCATION | ITEM | ACTION | REMARKS |
|---|---|---|---|
| INSPECTION | | Inspect for damage any parts. | Replace defective parts. |
| INSTALLA-TION | Eyepiece Assembly (1), Housing Gasket (4), Eyepiece Housing Assembly (3), Screw (2) | Install in Eyepiece Housing Assembly (3). Seat Housing Gasket (4) between Eyepiece Housing Assembly (3) and body of Automatic Level NA2. Attach items (1), (3) and (4) to main body of Automatic Level NA2 with three screws (2). | Adjust Eyepiece Assembly (1) following procedures indicated in paragraph 4-3. |

## 5-7 OBJECTIVE HOUSING ASSEMBLY MAINTENANCE INSTRUCTIONS (Figure 5-2)

This task covers:

a. Removal
b. Cleaning
c. Inspection
d. Installation

Initial Setup

Applicable Configuration

Figure 5-2

Accessories

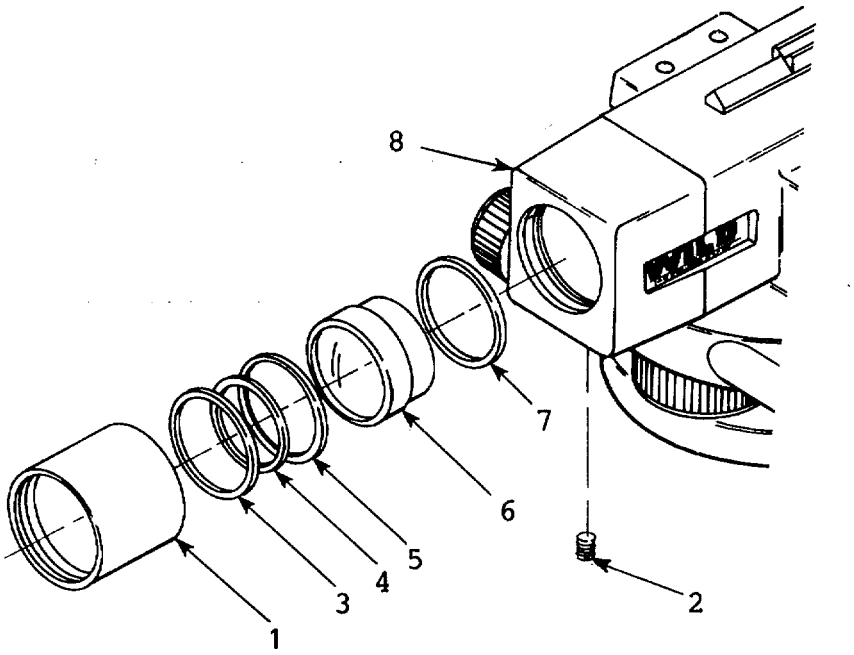
Camel hair dust brush
Jeweler's screwdriver

Materials/Parts

Objective Housing assembly

Troubleshooting References

Paragraph 5-4




1 Objective Housing Assembly
2 Set Screw
3 Lock Ring
4 Front Spacer Ring
5 O-Ring Seal
6 Objective Assembly
7 Rear Spacer Ring
8 Telescope Housing Assembly

**Figure 5-2. Objective Housing Assembly Maintenance**

**Table 5-3. Objective Housing Assembly Maintenance Instructions**

| LOCATION | ITEM | ACTION | REMARKS |
|---|---|---|---|
| REMOVAL<br><br>Objective Housing Assembly (1) | Set screw (2) | Remove | Use Jeweler's screw-driver supplied (3, Figure 1-5). |
| | Objective Housing Assembly (1) | Remove | Unscrew from Objective Housing Assembly (8) |
| | Rear Spacer Ring (7), Objective Assembly (6), O-Ring Seal (5), Front Spacer Ring (4) | Remove Rear Spacer Ring from Telescope Housing Assembly (8). Seperate and remove remaining items. | |
| | Lock Ring (3) | Unscrew from slot in Objective Housing Assembly (1). | |
| CLEANING | Objective Assembly (6) | Wipe with clean, lint-free cloth. | Lens should be free of grease, dirt, dust and fingerprints. |

**Table 5-3. Objective Housing Assembly Maintenance Instructions (cont)**

| LOCATION | ITEM | ACTION | REMARKS |
|---|---|---|---|
| CLEANING | Objective Housing Assembly (6) | Wipe with clean, lint-free cloth. and fingerprints. | Lens should be free of grease, dirt, dust |
| INSPECTION | | Inspect for damage any parts. | Replace defective parts. |
| INSTALLA-TION | Rear Spacer Ring (7) | Install in Tele-scope Housing (8). | |
| | Lock Ring (3) | Install in Objec-tive Housing Assem-bly (1). Assemble items (4), (5) and (6) as indicated in Figure 5-2 and in item (1). Screw Objective Housing Assembly (1) with assembled items into Telescope Housing (8). | |

## 5-8 FOCUS DRIVE ASSEMBLY MAINTENANCE INSTRUCTIONS (Figure 5-3)

This task covers:

a. Removal
b. Cleaning
c. Inspection
d. Installation

Initial Setup

Applicable Configuration

Figure 5-3

Accessories

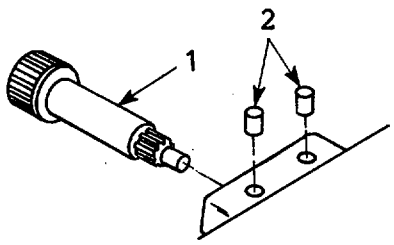
Camel hair dust brush
Jeweler's screwdriver

Materials/Parts

Focus Drive assembly
Light grease, MIL-G-23827

Troubleshooting References

Paragraph 5-4




1 Focus Drive Assembly
2 Machine Screw

**Figure 5-3. Focus Drive Assembly Maintenance**

**Table 5-4. Focus Drive Assembly Maintenance Instructions**

| LOCATION | ITEM | ACTION | REMARKS |
|---|---|---|---|
| REMOVAL<br>Focus Drive Assembly (1) | Machine Screws (2) | Remove. | Use Jeweler's screwdrive (3, Figure F-5). |
| | Focus Drive Assembly (1) | Remove. | |

**Table 5-4. Focus Drive Assembly Maintenance Instructions (cont)**

| LOCATION | ITEM | ACTION | REMARKS |
|---|---|---|---|
| CLEANING | Focus Drive Assembly (1) | Remove dirt from knob. | |
| INSPECTION | | Inspect for damage to any parts. | |
| INSTALLA-TION | Focus Drive Assembly (1) | Install. | |
| | Machine Screws (2) | Install. | Check Focus Drive Assembly for smooth and continuous change in focusing when operated. |

## 5-9 HORIZONTAL DRIVE COMPONENTS MAINTENANCE INSTRUCTIONS (Figure 5-4)

This task covers:

a. Removal
b. Cleaning
c. Inspection
d. Installation

Initial Setup

Applicable Configuration

Figure 5-4

Accessories

Jeweler's screwdriver

Materials/Parts

Horizontal Drive Components
Light grease, MIL-G-23827

Troubleshooting References

Paragraph 5-4

**Table 5-5. Horizontal Drive Components Maintenance Instructions**

| LOCATION | ITEM | ACTION | REMARKS |
|---|---|---|---|
| REMOVAL<br>Horizontal<br><br>Drive Compon-ents | Covers (16)<br>Hex Nuts (17)<br>Horizontal Drive Knobs (18)<br>Bushings (19)<br>Setscrews (20)<br>Nut (21)<br>Bushing (22)<br>Helical Compression Spring (23)<br>Flange (24)<br>Spring Plate (25) | Remove.<br>Remove.<br>Remove.<br>Remove.<br>Remove.<br>Remove.<br>Remove.<br>Remove.<br>Remove.<br>Remove. | Pry off. |

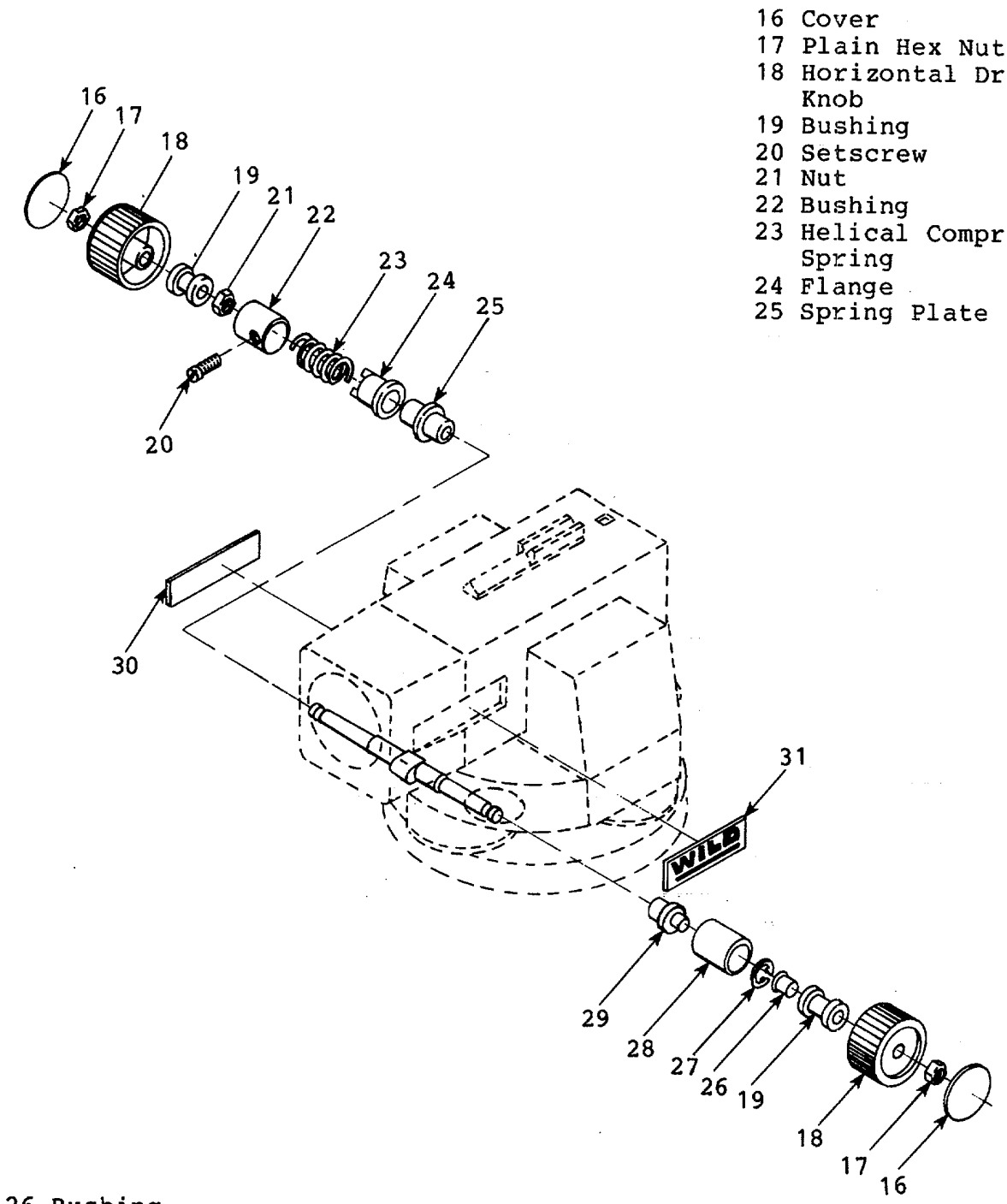



**Figure 5-4. Horizontal Drive Components Maintenance**

**Table 5-5. Horizontal Drive Components Maintenance Instructions (Cont)**

| LOCATION | ITEM | ACTION | REMARKS |
|---|---|---|---|
| REMOVAL Horizontal Drive Components (cont) | Bushing (26) | Remove. | Use Snap Ring Pliers (6, Figure 1-5) |
| | Retaining Ring (27) | Remove. | |
| | Bushing (28) | Remove. | |
| | Special Shaft Washer (29) | | |
| CLEANING | | Remove dirt from Horizontal Drive Knobs (18). | |
| INSPECTION | | Inspect for damage to any parts. | |
| INSTALLATION | Special Shaft Washer (29) | Install. | |
| | Bushing (28) | Install. | |
| | Retaining Ring (27) | Install. | |
| | Bushing (26) | Install. | |
| | Spring Plate (25) | Install. | Spring Plate (25) is screwed on. |
| | Flange (24) | Install. | |
| | Helical Compression Spring (23) | Install. | |
| | Bushing (22) | Install. | |
| | Nut (21) | Install. | |
| | Set Screw (20) | Install. | |
| | Bushing (19) | Install. | |
| | Horizontal Drive Knobs (18) | Install. | |
| | Hex Nuts (17) | Install. | |
| | Covers (16) | Install. | Check for smooth and |
| | | continuous operation of Horizontal Drive. | |

## 5-10 TRIPOD ASSEMBLY GST-40 MAINTENANCE INSTRUCTIONS (Figure 5-5)

This task covers:

a. Removal
b. Cleaning
c. Inspection
d. Installation

Initial Setup

Applicable Configuration

Figure 5-5

Accessories

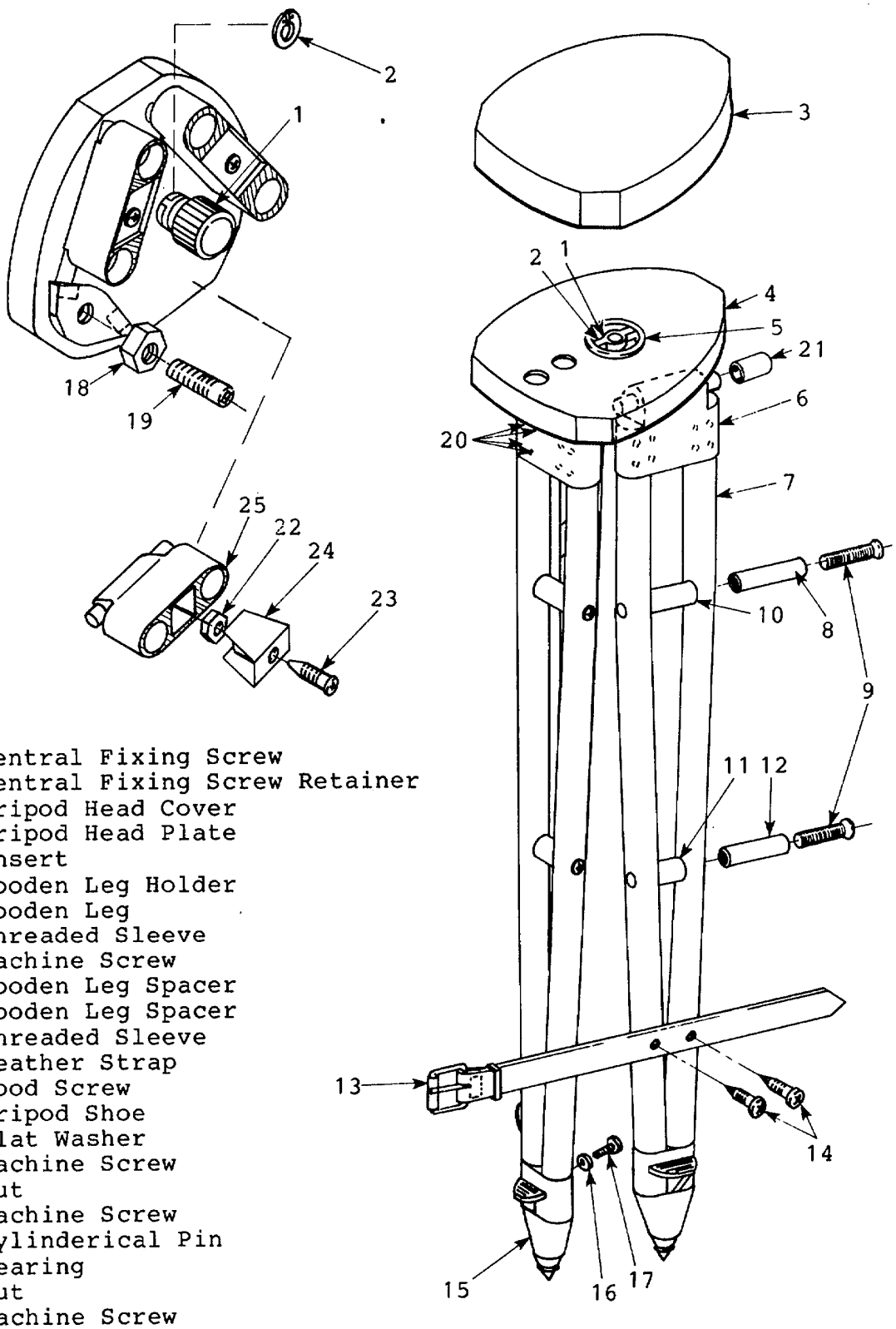
Snap Ring Pliers
Screwdriver, Phillips Head

Materials/Parts

Tripod Assembly GST-40
Light grease, MIL-G-23827

Troubleshooting References

Paragraph 5-4




1 Central Fixing Screw
2 Central Fixing Screw Retainer
3 Tripod Head Cover
4 Tripod Head Plate
5 Insert
6 Wooden Leg Holder
7 Wooden Leg
8 Threaded Sleeve
9 Machine Screw
10 Wooden Leg Spacer
11 Wooden Leg Spacer
12 Threaded Sleeve
13 Leather Strap
14 Wood Screw
15 Tripod Shoe
16 Flat Washer
17 Machine Screw
18 Nut
19 Machine Screw
20 Cylinderical Pin
21 Bearing
22 Nut
23 Machine Screw
24 Wedge
25 Pressure Wedge

**Figure 5-5. Tripod Assembly GST-40 Maintenance**

**Table 5-6. Tripod Assembly GST-40 Maintenance Instructions**

| LOCATION | ITEM | ACTION | REMARKS |
|---|---|---|---|
| REMOVAL | | | |
| Tripod Assembly GST-40 | Retainer (2) | Remove. (6, Figure 1-5) | Use snap ring pliers. |
| | Central Fixing Screw (1) | Remove. | |
| | Insert (5) | Remove. | |
| Wooden Leg Holder (hinge assem-bly) | Machine Screw (23), | Remove. | |
| | Wedge (24), | Remove. | |
| | Square Plain Nut (22), | Remove. | |
| | Pressure Wedge (25) | Remove. | |
| | Screw (19), Nut (18), bearing (21) | Unscrew two screws (19) from two nuts (18) so that the two metal plates holding hinge assem-bly to Tripod Base-plate (4) are loos-ened. Remove hinge assembly, two bear-ings (21) and attached Wooden Leg (7). | |
| Wooden Leg (7) | Cylindrical Pins (20) | For each of three wooden legs (7), pry Cylindrical Pins (20) out of Leg (7) and Wooden Leg Holder (6). | |
| | Machine Screw (9) | Remove. | |
| | Threaded Sleeves (8) & (12) | Remove. | |

**Table 5-6. Tripod Assembly GST-40 Maintenance Instructions (cont)**

| LOCATION | ITEM | ACTION | REMARKS |
|---|---|---|---|
| Wooden Leg (7) (cont) | Wooden Spacers (10) & (11) | Remove. | |
| Tripod Shoe (15) | Machine Screw (17), Washer (16) | Remove.<br>Remove. | |
| | Tripod Shoe (15) | Remove. | |
| CLEANING | Tripod Assembly GST-40 | Remove dirt from external surfaces. Remove grease from Central Fixing Screw (1) threads and Insert (5). | |
| INSPECTION | | Inspect for damage to any parts. | |
| INSTALLATION | Tripod Shoe (15)<br>Machine Screw (17) | Install.<br>Install. | |
| | Washer (16) | Install. | |
| | Wooden Spacers (11) & (10) | Install. | |
| | Threaded Sleeves (12) & (8) | Install. | |
| | Machine Scews (9) | Install. | |
| | Cylinderical Pins (20), Wooden Leg (7), Wooden Leg Holder (6) | Utilizing Cylinderical Pins (20), reattach Wooden Leg (7) and Wooden Leg Holder (6). | |

**Table 5-6. Tripod Assembly GST-40 Maintenance Instructions (cont)**

| LOCATION | ITEM | ACTION | REMARKS |
|---|---|---|---|
| INSTALLA-TION (cont) | | | |
| Hinge Assembly and Tri-pod Base-plate (4) | Bearings (21) | Install. | |
| | Tripod Baseplate (4), Screw (19), Nut (18) | Attach Hinge Assembly with Leg (7) to Tri-pod Baseplate (4) by utilizing two screws (19) and two nuts (18) to tighten the two metal plates holding items to-gether. | |
| | Pressure Wedge (25), | Install. | |
| | Wedge (24), | Install. | |
| | Square Plain Nut (22), | Install. | |
| | Machine Screw (23) | Install. | Tighten Machine Screw (23) so that Leg (7) can be adjusted and held tightly in place. |
| | Insert (5) | Install. | Apply light film of grease to inside sur-face. |
| | Central Fixing Screw (1) | Install. | Apply light film of grease to threads. |
| | Retainer (2) | Install. | Use Snap Ring Pliers (6, Figure 1-5) |

# APPENDIX A

# REFERENCES

A-1. PAINTING

| | |
|---|---|
| TM 43-0139 | Painting Instructions for Field Use |

A-2. MAINTENANCE

| | |
|---|---|
| TM 38-750 | The Army Maintenance Management System (TAMMS) |

A-3. SHIPMENT AND STORAGE

| | |
|---|---|
| TM 740-90-1 | Administrative Storage of Equipment |

A-4. DEMOLITION

| | |
|---|---|
| TM 750-244-3 | Destruction of Materiel to Prevent Enemy Use |

# APPENDIX B

# MAINTENANCE ALLOCATION CHART

## Section I. INTRODUCTION

### B- 1. GENERAL

a. This section provides a general explanation of all maintenance and repair functions authorized at various maintenance levels.

b. The Maintenance Allocation Chart (MAC) in Section II designates overall responsibility for the performance of maintenance functions on the identified end item or component. The implementation of the maintenance functions upon the end item or component will be consistent with the assigned maintenance functions.

c. Section III lists the tools and test equipment required for each maintenance function as referenced from Section II.

d. Section IV contains supplemental instructions or explanatory notes for particular maintenance functions.

### B-2. MAINTENANCE FUNCTIONS

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

b. Test To verify serviceability and detect incipient failure by 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 (decontaminate), to preserve, to drain, to paint, or to replenish fuel, lubricants, hydraulic fluids, or compressed air supplies.

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

e. Align To adjust specified variable elements of an item to bring 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 equipments used in precision measurement. Consists of comparisons 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 or module (component or assembly) in a manner to allow the proper functioning of an equipment or system.

h. Replace The act of substituting a serviceable like type part, subassembly, or module (component or assembly) for an unserviceable counterpart.

i. Repair The application of maintenance services (inspect, test, service, adjust, align, calibrate or 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 or assembly), and item or system.

j Overhaul That maintenance effort (services/actions) necessary to restore an item to a completely serviceable/ operational condition as prescribed by maintenance standards (i.e:., DMWR) in appropriate technical publications. 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's 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 equipments/components.

**B-3. COLUMN ENTRIES USED IN THE MAC**

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

b. Column 2, Component/Assembly Column 2 contains the names of components, assemblies, subassemblies, and modules for which maintenance is authorized.

c. Column 3, Maintenance Functions Column 3 lists the functions to be performed on the item listed in column 2. (For

detailed explanation of these functions, see paragraph B-2).

d. Column 4, Maintenance Level Column 4 specifies, by the listing of a work time figure in the appropriate subcolumn(s), the lowest level of maintenance authorized to perform the function listed in column 3. This figure represents the active time required to perform the maintenance function at the indicated level of maintenance. If the number or complexity of the tasks within the listed maintenance function vary at different maintenance levels, appropriate work time figures will be shown for each level. The number of man-hours specified by the work time figure represents the average time required to restore an item (assembly, subassembly, component, module, end item, or system) to a serviceable condition under typical field operating conditions. This time includes preparation time, troubleshooting time and quality assurance/quality control time in addition to the time required to perform the specific tasks identified for the maintenance functions authorized in the maintenance allocation chart. The symbol designations for the various maintenance levels are as follows:

C.....Operator or crew

O.....Organization maintenance

F .....Direct support maintenance

H.....General support maintenance

D.....Depot maintenance

e. Column 5, Tools and Equipment Column 5 specifies, by code, those common tool sets (not individual tools) and special tools, tests and support equipment required to perform the designated function.

f. Column 6, Remarks This column shall contain a letter code in alphabetical order which shall be keyed to the remarks contained in Section IV.

**B-4. COLUMN ENTRIES USED IN TOOL AND TEST EQUIPMENT REQUIREMENTS**

a. Column 1, Tool or Test Equipment Reference Code The tool and test equipment reference code correlates with a maintenance function on the identified end item or component.

b. Column 2, Maintenance Level The lowest level of maintenance authorized to use the tool or test equipment.

c. Column 3, Nomenclature Name or identification of the tool or test equipment.

d. Column 4, National/NATO Stock Number The National or NATO stock number of the tool or test equipment.

e. Column 5, Tool Number The manufacturer's part number.

**B-5. EXPLANATION OF COLUMNS IN SECTION IV**

a. Reference Code The code scheme recorded in column 6, Section II.

b. Remarks This column lists information pertinent to the maintenance function being performed as indicated on the MAC, Section II.

## Section II. MAINTENANCE ALLOCATION CHART FOR LEVEL, SURVEYING SELF-LEVELLING

| (1) GROUP NUMBER | (2) COMPONENT/ ASSEMBLY | (3) MAINTENANCE FUNCTION | (4) MAINTENANCE LEVEL C | O | F | (5) TOOLS AND EQUIPMENT | (6) REMARKS |
|---|---|---|---|---|---|---|---|
| 01 | LEVEL, SURVEYING ASSEMBLY | INSPECT | 0.6 | | | | |
| | | TEST | 0.6 | | | | |
| | | SERVICE | 0.8 | | | | |
| | | ADJUST | | 1.5 | | | |
| | | REPLACE | | 1.8 | | | |
| | | REPAIR | | | 3.0 | | |
| 02 | TRIPOD ASSEMBLY, GST-40 | INSPECT | 0.2 | | | | |
| | | TEST | 0.3 | | | | |
| | | SERVICE | 0.5 | | | | |
| | | REPLACE | | 0.5 | | | E |
| | | REPAIR | | | 1.5 | 1,2,6 | |
| 03 | LEVEL, AUTOMATIC | INSPECT | 0.2 | | | | |
| | | TEST | 0.3 | | | | |
| | | SERVICE | 0.1 | | | | A |
| | | ADJUST | | 1.5 | | | B |
| | | REPLACE | | 0.5 | | | C |
| | | REPAIR | | | 1.5 | 1,3,4,5,6 | |
| 04 | CARRYING CASE | INSPECT | 0.2 | | | | |
| | | SERVICE | 0.2 | | | 1 | D |
| | | REPLACE | | 0.5 | | | |

## Section III. TOOL AND TEST EQUIPMENT REQUIREMENTS

| (1) TOOL OR TEST EQUIPMENT REFERENCE CODE | (2) MAINTENANCE LEVEL | (3) NOMENCLATURE | (4) NATIONAL/NATO STOCK NUMBER | (5) TOOL NUMBER |
|---|---|---|---|---|
| 1 | C, F | Screwdriver, Nutdriver Set | | PS130 |
| 2 | C, F | Wrench, Allen Tripod | 5120-01-011-8393 | 166494 |
| 3 | C, F | Screwdriver, Jeweler's | | 166794 |
| 4 | C, F | Pin, Adjusting | | 109334 |
| 5 | C, F | Brush, Lens Cleaning | | 109335 |
| 6 | O, F, | Pliers, Snap Ring | | 12R |

## Section IV. REMARKS

| REFERENCE CODE | REMARKS |
|---|---|
| A | Testing consists of field tests for testing the Horizontality of the line of sight. |
| B | Service consists of cleaning and leveling and focusing checks. |
| C | Adjustments consist of Circular Level adjustment and line of sight adjustment. |
| D | Service consists of cleaning. |
| E | Adjustment consists only of loosening and tightening the Hinge Assembly. |

# APPENDIX C

# COMPONENTS OF END ITEM AND BASIC ISSUE ITEMS LIST

## Section I. INTRODUCTION

### C-1. SCOPE

This appendix lists components of end item and basic issue items for the Level, Surveying, NA2-80 to help you inventory items required for safe and efficient operation.

### C-2. GENERAL

The components of End Item and Basic Issue Items Lists are divided into the following sections:

a. Section II Components of End Item. This listing is for informational purposes only, and is not authority to requisition replacements. These items are part of the end item, but are removed and separately packaged for transportation or shipment. As part of the end item, these items must be with the end item whenever it is issued or transferred between property accounts. Illustrations are furnished to assist you in identifying the items.

b. Section III Basic Issue Items. These are the minimum essential items required to place the (Level, Surveying, NA2-80) in operation, to operate it, and to perform emergency repairs. Although shipped separately packaged BII must be with the Level, Surveying, NA2-80 during operation whenever it is transferred between property accounts. The illustrations will assist you with hard-to-identify items. This manual is your authority to requisition replacement BII, based on TOE/MTOE authorization of the end item.

### C-3. EXPLANATION OF COLUMNS

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

a. Column (1) Illustration Number (Illus Number). This column indicates the number of the illustration in which the item is shown.

b. Column (2) National Stock Number. Indicates the National stock number assigned to the item and will be used for requisitioning purposes.

c. Column (3) Description. Indicates the National item name and, if required, a minimum description to identify and locate the item. The last line for each item indicates the FSCM (in parentheses) followed by the part number.

d. Column (4) Unit of Measure (U/M). Indicates the measure used in performing the actual operational/maintenance function. This measure is expressed by a two character alphabetical abbreviation (e.g., ea, in, pr).

e. Column (5) Quantity required (Qty rqr). Indicates the quantity of the item authorized to be used with/on the equipment. A bookkeeping entry log is included to list quantities of items received and dates.

## Section II. INTEGRAL COMPONENTS OF END ITEM

| (1) ILLUSTRATION (a) FIGURE NO. | (b) ITEM NO. | (2) NATIONAL STOCK NUMBER | (3) DESCRIPTION | PART NO. & FSCM | (4) UNIT OF MEASURE (U/M) | (5) QTY REQD | QUANTITY RCVD DATE | DATE | DATE |
|---|---|---|---|---|---|---|---|---|---|
| 1-1 | 3 | | Case, Carrying | (89905) 312978 | Ea. | 1 | | | |
| 1-3 | 1 | | Cover, Tripod Head | (89905) 284797 | Ea. | 1 | | | |
| 1-1 | 1 | 6675-01-076-5465 | Level, Surveying | (89905) 332313 | Ea. | 1 | | | |
| 1-1 | 4 | | Sunshade, Objective Assy | (89905) 350377 | Ea. | 1 | | | |
| 1-1 | 2 | | Tripod Assy. | (89905) 328422 | Ea. | 1 | | | |

## Section III. BASIC ISSUE ITEMS

| (1) ILLUSTRATION (a) FIGURE NO. | (b) ITEM NO. | (2) NATIONAL STOCK NUMBER | (3) DESCRIPTION | PART NO. & FSCM | (4) UNIT OF MEASURE (U/M) | (5) QTY REQD | QUANTITY RCVD | DATE | DATE |
|---|---|---|---|---|---|---|---|---|---|
| 1-5 | 4 | | Pin, Adjusting | (89905) 109334 | Ea. | 1 | | | |

# APPENDIX D

## ADDITIONAL AUTHORIZATION LIST

### Section I. INTRODUCTION

### D-1. SCOPE

This appendix lists additional items you are authorized for the support of the Level, Surveying, NA2-80.

### D-2. GENERAL

This lists identifies items that do not have to accompany the Level, Surveying, NA2-80 and that do not have to be turned in with it. These items are authorized to you by CTA, MTOE, TDA or JTA.

### D-3. EXPLANATION OF LISTING

National stock number, descriptions and quantities are provided to help you identify and request the additional items you require to support this equipment.

### SECTION II. ADDITIONAL AUTHORIZATION LIST

| (1) NATIONAL STOCK NUMBER | (2) DESCRIPTION PART NUMBER & FSCM USABLE ON CODE | U/M | QTY AUTH. |
|---|---|---|---|
| | 109335 (89905) BRUSH, LENS CLEANING | EA. | 1 |
| | 166684 (89905) CHAMOIS, LEATHER | EA. | 1 |
| | 166794 (89905) SCREWDRIVER, JEWELER'S | EA. | 1 |
| | PS130 (89905) SCREWDRIVER, NUTDRIVER SET | EA. | 1 |
| | 166494 (89905) WRENCH, ALLEN, TRIPOD | EA. | 1 |

# APPENDIX E

# EXPENDABLE SUPPLIES AND MATERIALS LIST

## Section I. INTRODUCTION

### E-1. SCOPE

This appendix lists expendable supplies and materials you will need to operate and maintain the Level, Surveying, NA2-80. These items are authorized to you by CTA 50-970, Expendable Items (Except Medical, Class V, Repair Parts, and Heraldic Items).

### E-2. EXPLANATION OF COLUMNS

a. Column (1) - Item number. This number is assigned to the entry in the listing and is referenced in the narrative instructions to identify the material (e.g., "Use cleaning compound, item 5, App. E").

b. Column (2) - Level. This column identifies the lowest level of maintenance that requires the listed item.

(enter as applicable):

C .....Operator or crew

O .....Organization maintenance

F .....Direct support maintenance

H .....General support maintenance

c. Column (3) National Stock Number. This is the National stock number assigned to the item; use it to request or requisition the item.

d. Column (4) Description. Indicates the Federal item name and, if required, a description to identify the item. The last line for each item indicates the Federal Supply Code for Manufacturer (FSCM) in parentheses followed by the part number.

e. Column (5) Unit of Measure (U/M). Indicates the measure used in performing the acutal maintenance function. This measure is expressed by a two-character alphabetical abbreviation (e.g., ea, in, pr). If the unit of measure differs from the unit of issue, requisition the lowest unit of issue that will satisfy your requirements.

## SECTION II

## EXPENDABLE SUPPLIES AND MATERIALS LIST

| (1) ITEM NUMBER | (2) LEVEL | (3) NATIONAL STOCK NUMBER | (4) DESCRIPTION | (5) U/M |
|---|---|---|---|---|
| 1 | C O | 6810-000-223-2739 | Acetone, Technical, 1 pt. can, Fed Spec MMM-A-.185 | PT |
| 2 | C O | 6850-00-664-5685 | Cleaning Solvent Fed Spec PD-680 | QT |
| 3 | C O | 7920-00-401-8034 | Cloth, Lint-Free, Non-Abrasive, General Purpose Part No. 1001 | BX |
| 4 | C O | 9150-00-985-7244 | Grease, Instrument and Aircraft (GIA) MIL-G-23827 | TU |
| 5 | C O | 6640-00-597-6745 | Paper, Lens Tissue (4 in. X 6 in.) 50 sheets | PK |
| 6 | C O | 9150-00-252-6382 | Lubrication Oil, Watchmaking | BT |
| 7 | C O | 5120-01-018-5908 | Orange Sticks 13218E3063 (97403) | PK |

# APPENDIX F

# ORGANIZATIONAL AND DIRECT SUPPORT MAINTENANCE REPAIR PARTS AND SPECIAL TOOLS LIST

## Section I: INTRODUCTION

### F-1. SCOPE

This manual lists spares and repair parts, special test, measurement, and diagnostic equipment (TMDE), and other special support equipment required for performance of organizational and direct support maintenance of the Level, Surveying, NA2-80. It authorizes the requisitioning and issue of spares and repair parts as indicated by the source and maintenance codes.

### F-2. GENERAL

The Repair Parts and Special Tools List is divided into the following sections:

a. Section II. Repair Parts List. A list of spare and repair parts authorized for use 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 numeric sequence, with the parts in each group listed in figure and item number sequence. Bulk materials are listed in NSN sequence.

b. Section III. Special Tools List. (Not applicable.)

c. Section IV. National Stock Number and Part Number Index. A list, in National Item Identification Number (NIIN) sequence, of all National Stock Numbers (NSN) appearing in the listings, followed by a list in alphanumeric sequence of all part numbers appearing in the listings. National stock numbers and part numbers are cross-referenced to each illustration figure and item number appearance. This index is followed by a cross-reference list of reference designators to figure and item numbers.

### F-3. EXPLANATION OF COLUMNS

a. Illustration. This column is divided as follows:

(1) Figure Number. Indicates the figure number of the illustration on which the item is shown.

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

b. Source, Maintenance and Recoverability (SMR) Codes

(1) Source Code. Source codes 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. |
| PB | Item procured and stocked for insurance purposes because essentiality dictates that a minimum quantity be available in the supply system. |
| PD | Support item, excluding support equipment, procured for initial issue or outfitting and stocked only for subsequent or additional initial issues or outfittings. Not subject to automatic replenishment. |
| PE | Support equipment procured and stocked for initial issue or outfitting to specified maintenance repair activities. |
| PF | Support equipment which will not be stocked but which will be centrally procured on demand. |
| PG | Item procured and stocked to provide for sustained support for the life of the equipment. It is applied to an item peculiar to the equipment which, because of probable discontinuance or shutdown of production facilities, would prove uneconomical to reproduce at a later time. |
| KD | An item of a depot overhaul/repair kit and not purchased separately. Depot kit defined as a kit that provides items required at the time of overhaul or repair. |
| KF | An item of a maintenance kit and not purchased separately. Maintenance kit defined as a kit that provides an item that can be replaced at organizational or intermediate levels of maintenance. |
| KB | Item included in both a depot overhaul/repair kit and a maintenance kit. |
| MO | Item to be manufactured or fabricated at the organizational level. |
| MF | Item to be manufactured or fabricated at the direct support maintenance level. |
| MH | Item to be manufactured or fabricated at the general support maintenance level. |

| CODE | DEFINITION |
|---|---|
| MD | Item to be manufactured or fabricated at the depot support maintenance level. |
| AO | Item to be assembled at organizational level. |
| AF | Item to be assembled at the direct support maintenance level. |
| AH | Item to be assembled at the general support maintenance level. |
| AD | Item to be assembled at the depot maintenance level. |
| 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. |
| XC | Installation drawing, diagram, instruction sheet, field service drawing, that is identified by manufacturer's part number. |
| XD | A support item that is not stocked. When required, item will be procured through normal supply channels. |

**NOTE**

**Cannibalization or salvage may be used as a source of supply for any items source coded above except those coded XA.**

(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 one of the following levels of maintenance.

| CODE | DEFINITION |
|---|---|
| C | Crew or operator maintenance performed within organizational maintenance. |

| CODE | DEFINITION |
|---|---|
| O | Support item is removed, replaced, used at the organizational level. |
| F | Support item is removed, replaced, used at the direct support level. |
| H | Support item is removed, replaced, used at the general support level. |
| D | Support items that are removed, replaced, used at depot, mobile depot, or specialized repair activity only. |

(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 one of the following maintenance codes:

| CODE | DEFINITION |
|---|---|
| O | The lowest maintenance level capable of complete repair of the support item is the organizational level. |
| F | The lowest maintenance level capable of complete repair of the support item is the direct support level. |
| H | The lowest maintenance level capable of complete repair of the support item is the general support level. |
| D | The lowest maintenance level capable of complete repair of the support item is the depot level. |
| L | Repair restricted to designated Specialized Repair Activity. |
| Z | Nonrepairable. No repair is authorized. |
| B | No repair is authorized. The item may be reconditioned by adjusting, lubricating, etc., at the user level. No parts or special tools are procured for the maintenance of this item. |

(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:

| CODE | DEFINITION |
|---|---|
| Z | Nonrepairable item. When unserviceable, condemn and dispose at the level indicated in position 3. |
| O | Repairable item. When uneconomically repairable, condemn and dispose at the organizational level. |
| F | Repairable item. When uneconomically repairable, condemn and dispose at the direct support level. |
| H | Repairable item. When uneconomically repairable, condemn and dispose at the general support level. |
| D | Repairable item. When beyond lower level repair capability, return to depot. Condemnation and disposal not authorized below depot level. |
| L | Repairable item. Repair, condemnation, and disposal not authorized below depot/specialized repair activity level. |
| A | Item requires special handling or condemnation procedures because of specific reasons (i.e., precious metal content, high dollar value, critical material or hazardous material). Refer to appropriate manuals/directives for specific instructions. |

(c) National Stock Number. Indicates the National a ; stock number assigned to the item and which will be used for requisitioning purposes.

(d) Part Number. Indicates the primary number used by the manufacturer 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. Items that are included in kits and sets are listed below the name of the kit or set, with the quantity of each item in the kit or set indicated

in the quantity incorporated in unit column. When the part to be used differs between serial numbers of the same model, the effective serial numbers are shown as the last line of the description. In the Special Tools List, the initial basis of issue (BOI) appears as the last line in the entry for each special tool, special TMDE, and other special support equipment. When density of equipments supported exceeds density spread indicated in the basis of issue, the total authorization is increased accordingly.

(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. A "V" appearing in this column in lieu of a quantity indicates that no specific quantity is applicable (e.g., shims, spacers, etc.).

## F-4. SPECIAL INFORMATION

a. Repair parts kits and gasket sets appear as the last entries in the repair parts listing for the figure in which its parts are listed as repair parts.

## F-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 groups.

(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 number 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 NIIN sequence followed by a list of part numbers in 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.

## F-6. ABBREVIATIONS

| Abbreviations | Explanation |
|---|---|
| ASSY | Assembly(ies) |
| FT | Feet (foot) |
| HD | Head |
| HEX | Hexagon |
| IN | Inch(es) |
| LG | Long (length) |
| NO | Number(s) |

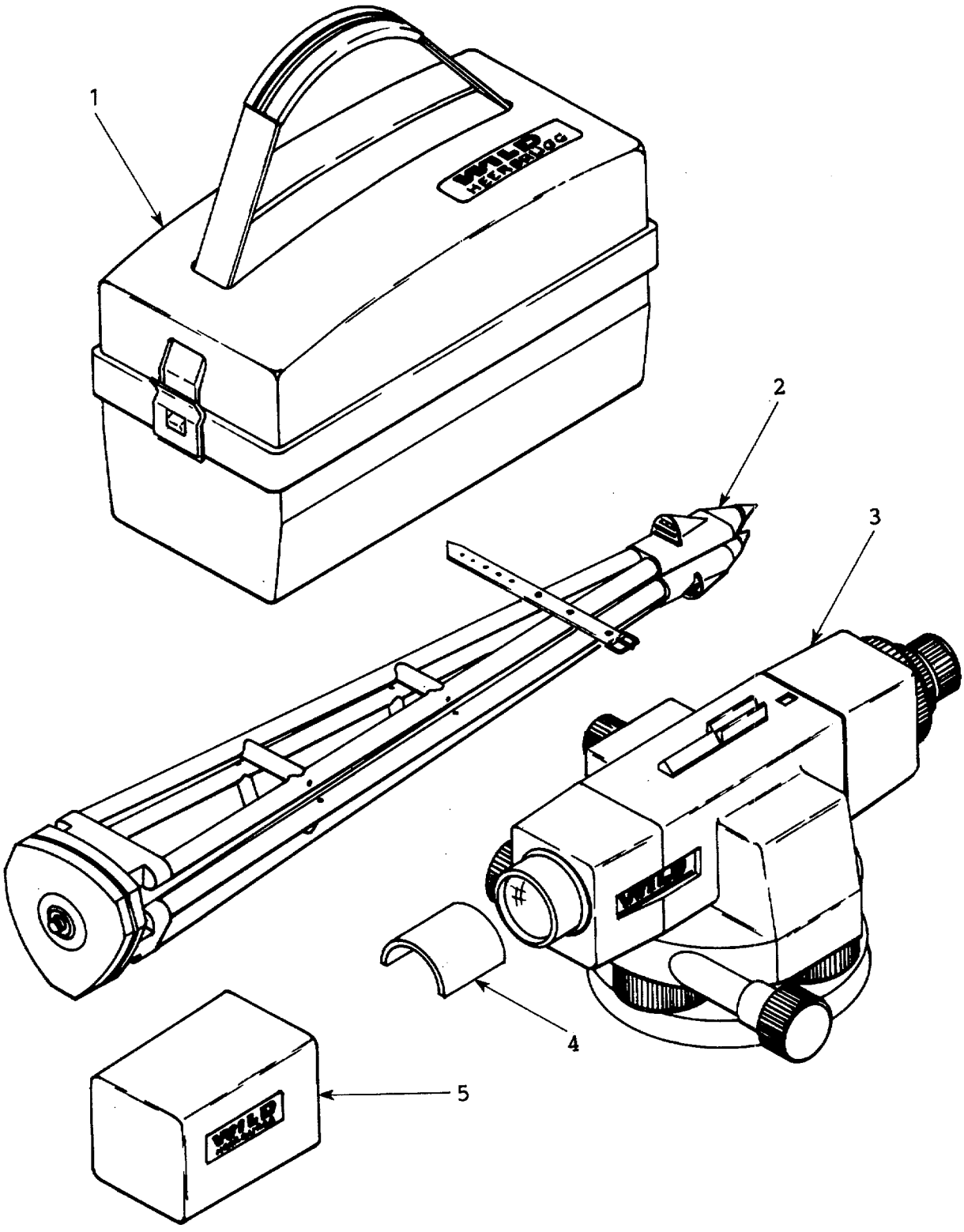



**Figure F-1. Level, Surveying, NA2-80**

| (1) ILLUSTRATION (a) FIG NO. | (1) ILLUSTRATION (b) ITEM NO. | (2) SMR CODE | (3) NATIONAL STOCK NUMBER | (4) FSCM | (5) PART NUMBER | (6) DESCRIPTION USABLE ON CODE | (7) U/M | (8) QTY INC IN UNIT |
|---|---|---|---|---|---|---|---|---|
| | | | | | | GROUP O1-LEVEL, SURVEYING | | |
| F-1 | | PDOFF | 6675-01-101-4724 | 89905 | 242435 | LEVEL, SURVEYING, NA2-80 | EA | 1 |
| F-1 | 1 | XBOZZ | | 89905 | 312978 | CARRYING CASE, NA2-80 | EA | 1 |
| F-1 | 2 | PAOFF | 6675-01-115-4635 | 89905 | 328422 | TRIPOD ASSEMBLY, GST-40 | EA | 1 |
| F-1 | 3 | XBOFD | | 89905 | 352036 | LEVEL, AUTOMATIC, NA2 | EA | 1 |
| F-1 | 4 | PAOZZ | | 89905 | 350377 | SUNSHADE, OBJECTIVE ASSY | EA | 1 |
| F-1 | 5 | PAOFF | 6675-01-113-6096 | 89905 | 385629 | COVER, RAIN AND DUST | EA | 1 |

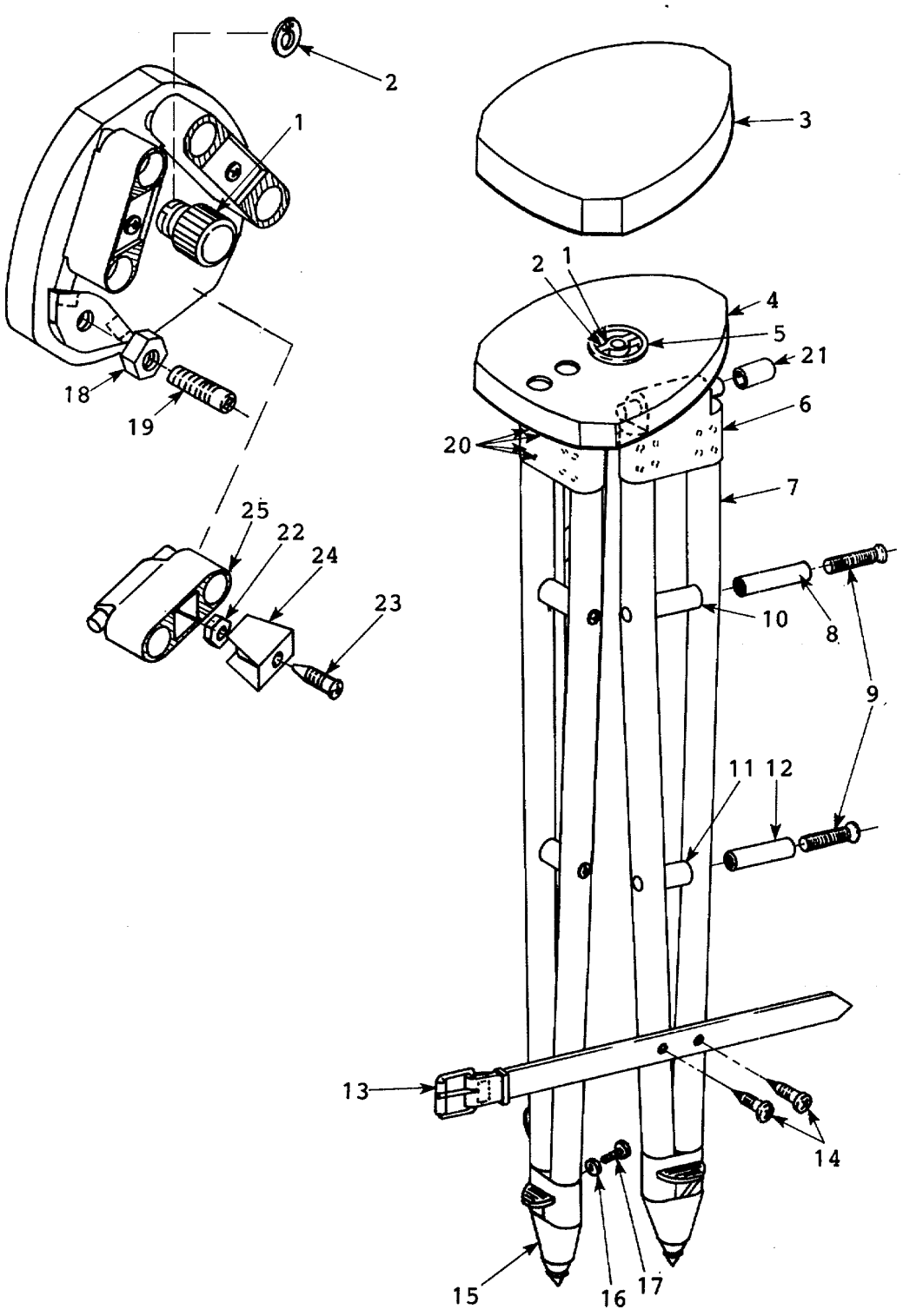



**Figure F-2. Tripod Assembly, GST-40**

| (1) ILLUSTRATION (a) FIG NO. | (1) ILLUSTRATION (b) ITEM NO. | (2) SMR CODE | (3) NATIONAL STOCK NUMBER | (4) FSCM | (5) PART NUMBER | (6) DESCRIPTION USABLE ON CODE | (7) U/M | (8) QTY INC IN UNIT |
|---|---|---|---|---|---|---|---|---|
| | | | | | | GROUP 02-TRIPOD ASSY. | | |
| F-2 | | PAOFF | 6675-01-115-4635 | 89905 | 328422 | TRIPOD ASSY, GST-40 | EA | 1 |
| F-2 | 1 | XBFFZ | | 89905 | 296667 | SCREW, CENTRAL FIXING | EA | 1 |
| F-2 | 2 | XBFZZ | | 89905 | 329593 | RETAINER, CENTRAL FIXING SCREW (DIN6799, M12) | EA | 1 |
| F-2 | 3 | XBFZZ | | 89905 | 284797 | COVER, TRIPOD HEAD | EA | 1 |
| F-2 | 4 | X5FZZ | | 89905 | 328424 | PLATE, TRIPOD HEAD | EA | 1 |
| F-2 | 5 | XBFZZ | | 89905 | 328423 | INSERT, TRIPOD HEAD PLATE | EA | 1 |
| F-2 | 6 | XPFZZ | | 89905 | 344212 | HOLDER, WOOD LEG | EA | 3 |
| F-2 | 7 | XBFZZ | | 89905 | 328427 | LEG, WOODEN | EA | 6 |
| F-2 | 8 | XBFZZ | | 89905 | 328429 | SLEEVE, THREADED | EA | 3 |
| F-2 | 9 | XBFZZ | | 89905 | 370697 | SCREW, MACHINE (DIN7988, MS X 35) | EA | 12 |
| F-2 | 10 | XBFZZ | | 89905 | 328425 | SPACER, WOODEN LEG | EA | 3 |
| F-2 | 11 | XBFZZ | | 89905 | 328426 | SPACER, WOODEN LEG | EA | 3 |
| F-2 | 12 | XBFZZ | | 89905 | 328428 | SLEEVE, THREADED | EA | 3 |
| F-2 | 13 | XBFZZ | | 89905 | 109375 | STRAP, LEATHER | EA | 1 |
| F-2 | 14 | XBFZZ | | 89905 | 346286 | SCREW, WOOD (DIN7981B, M3.5 X 19) | EA | 2 |
| F-2 | 15 | XBFZZ | | 89905 | 323209 | SHOE, TRIPOD | EA | 3 |
| F-2 | 16 | XBFZZ | | 89905 | 323373 | WASHER, FLAT | EA | 3 |
| F-2 | 17 | XBFZZ | | 89905 | 370696 | SCREW, MACHINE (DIN912, M8 X 35) | EA | 3 |
| F-2 | 18 | XBFZZ | | 89905 | 284783 | JAW, CLAMP | EA | 3 |
| F-2 | 19 | XBFZZ | | 89905 | 235978 | SCREW, MACHINE (DIN938, M8 X 24) | EA | 3 |
| F-2 | 20 | XBFZZ | | 89905 | 364657 | PIN, CYLINDRICAL | EA | 24 |
| F-2 | 21 | XBFZZ | | 89905 | 271990 | BEARING | EA | 6 |
| F-2 | 22 | XBFZZ | | 89905 | 312946 | NUT, PLAIN, SQUARE | EA | 3 |
| F-2 | 23 | XBFZZ | | 89905 | 208818 | SCREW, MACHINE (DIN912, M8 X 45) | EA | 3 |
| F-2 | 24 | XBFZZ | | 89905 | 271993 | WEDGE | EA | 3 |
| F-2 | 25 | XBFZZ | | 89905 | 350956 | WEDGE, PRESSURE | EA | 6 |

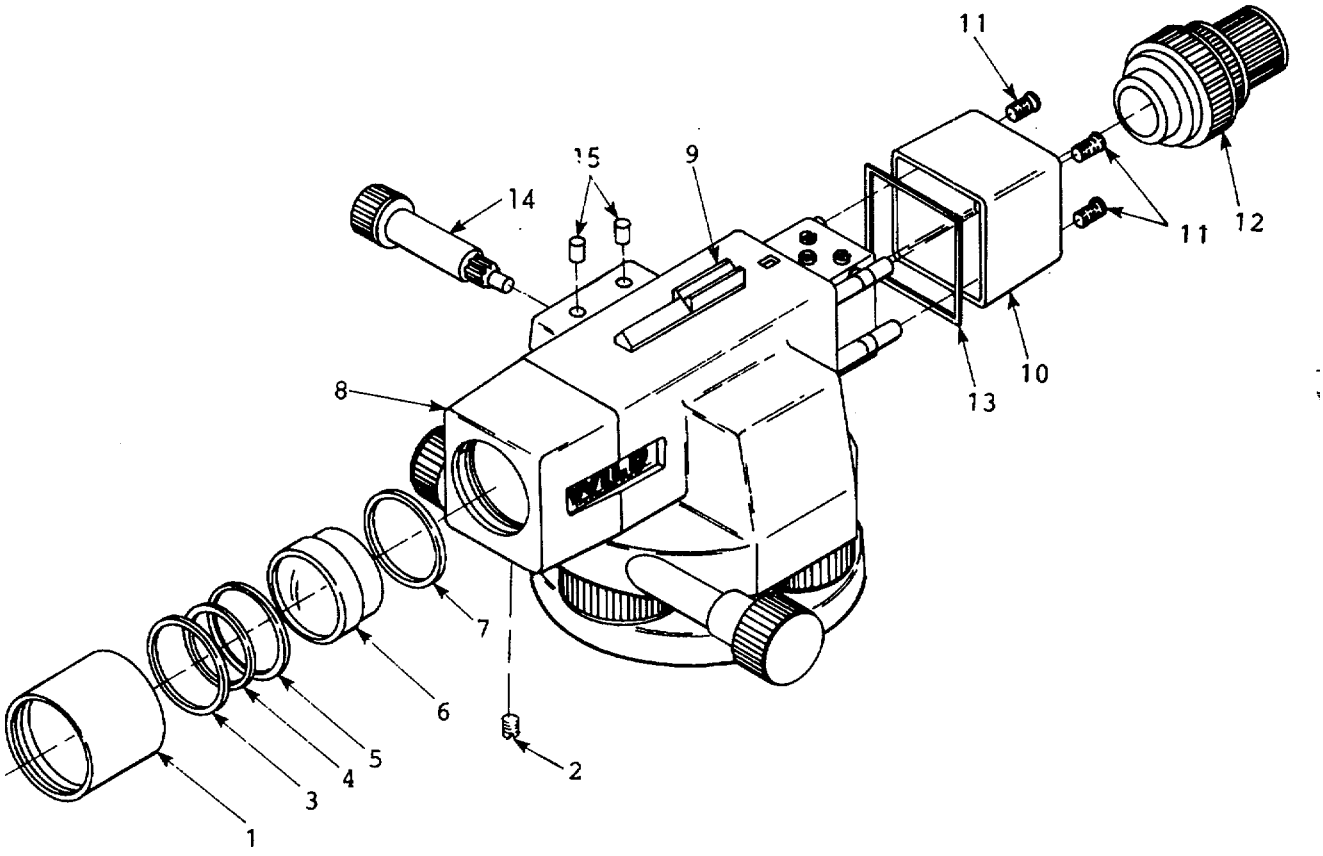



**Figure F-3. Level, Automatic, NA2-80 (Sheet 1 of 2)**

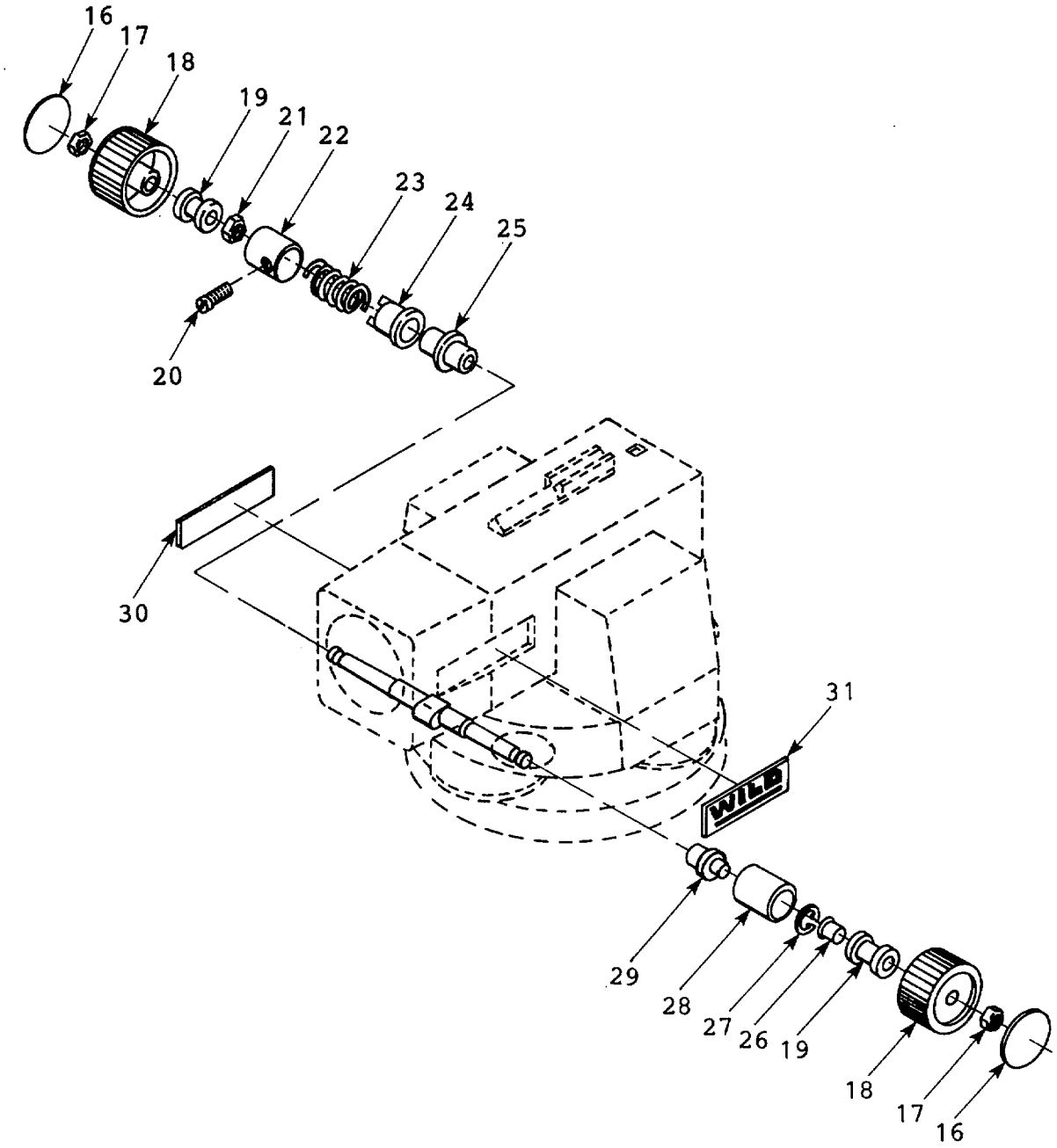



**Figure F-3. Level, Automatic, NA2-80 (Sheet 2 of 2)**
**(Horizontal Drive Components)**

| (1) ILLUSTRATION (a) FIG NO. | (1) ILLUSTRATION (b) ITEM NO. | (2) SMR CODE | (3) NATIONAL STOCK NUMBER | (4) FSCM | (5) PART NUMBER | (6) DESCRIPTION USABLE ON CODE | (7) U/M | (8) QTY INC IN UNIT |
|---|---|---|---|---|---|---|---|---|
| | | | | | | GROUP 03-LEVEL, AUTOMATIC | | |
| F-3 | | XBOFD | 6675-01-076-5465 | 89905 | 332313 | LEVEL, AUTOMATIC NA2 | EA | 1 |
| F-3 | 1 | XBFZZ | | 89905 | 346561 | HOUSING, OBJECTIVE | EA | 1 |
| F-3 | 2 | XBFZZ | 5305-00-378-9539 | 89905 | 163812 | SCREW, SET (DIN553, M2 X 3) | EA | 1 |
| F-3 | 3 | XBFZZ | | 89905 | 346563 | RING, LOCK | EA | 1 |
| F-3 | 4 | XBFZZ | | 89905 | 350696 | RING, SPACER, FRONT | EA | 1 |
| F-3 | 5 | XBFZZ | | 89905 | 315168 | SEAL, O-RING | EA | 1 |
| F-3 | 6 | XBFZZ | | 89905 | 346560 | OBJECTIVE ASSEMBLY | EA | 1 |
| F-3 | 7 | XBFZZ | | 89905 | 346562 | RING, SPACER, REAR | EA | 1 |
| F-3 | 8 | XBFZZ | | 89905 | 376922 | HOUSING, TELESCOPE, NA2-80 | EA | 1 |
| F-3 | 9 | XBFZZ | | 89905 | 348398 | SIGHT | EA | 1 |
| F-3 | 10 | XBFZZ | | 89905 | 369915 | EYEPIECE HOUSING ASSEMBLY | EA | 1 |
| F-3 | 11 | XBFZZ | | 89905 | 161034 | SCREW, MACHINE SLOTTED (DIN920, M3 X 7) | EA | 3 |
| F-3 | 12 | XBFZZ | | 89905 | 388412 | EYEPIECE ASSEMBLY | EA | 1 |
| F-3 | 13 | XBFZZ | | 89905 | 384104 | GASKET, HOUSING | EA | 1 |
| F-3 | 14 | XBFZZ | | 89905 | 353245 | FOCUS DRIVE ASSEMBLY | EA | 1 |
| F-3 | 15 | XBFZZ | | 89905 | 163820 | SCREW, MACHINE (DIN553, N2 X 16) | EA | 2 |
| F-3 | 16 | XBFZZ | | 89905 | 272033 | COVER, HORIZONTAL DRIVE KNOB | EA | 2 |
| F-3 | 17 | XBFZZ | | 89905 | 222875 | NUT, PLAN, HEX (DIN439B, MS) | EA | 2 |
| F-3 | 18 | XBFZZ | | 89905 | 312908 | KNOB, HORIZONTAL DRIVE | EA | 2 |
| F-3 | 19 | XBFZZ | | 89905 | 272032 | BUSHING, HORIZONTAL DRIVE | EA | 2 |
| F-3 | 20 | XBFZZ | | 89905 | 352744 | SETSCREW (DIN438, N3 X 4) | EA | 1 |
| F-3 | 21 | XBFZZ | | 89905 | 335947 | NUT | EA | 1 |
| F-3 | 22 | XBFZZ | | 89905 | 384180 | BUSHING | EA | 1 |
| F-3 | 23 | XBFZZ | | 89905 | 246140 | SPRING, HELICAL, COMPRESSION | EA | 1 |
| F-3 | 24 | XBFZZ | | 89905 | 335949 | FLANGE | EA | 1 |
| F-3 | 25 | XBFZZ | | 89905 | 335946 | PLATE, SPRING | EA | 1 |
| F-3 | 26 | XBFZZ | | 89905 | 272031 | BUSHING | EA | 1 |
| F-3 | 27 | XBFZZ | | 89905 | 163565 | RING, RETAINING (DIN471, M4 X 0.4) | El | 1 |
| F-3 | 28 | XBFZZ | | 89905 | 384181 | BUSHING, HORIZONTAL DRIVE | EA | 1 |
| F-3 | 29 | XBFZZ | | 89905 | 335979 | WASHER, SHAFT SPECIAL | EA | 1 |
| F-3 | 30 | XBFZZ | | 89905 | 208754 | PLATE, IDENTIFICATION | EA | 1 |
| F-3 | 31 | XBFZZ | | 89905 | 333398 | PLATE, IDENTIFICATION | EA | 1 |

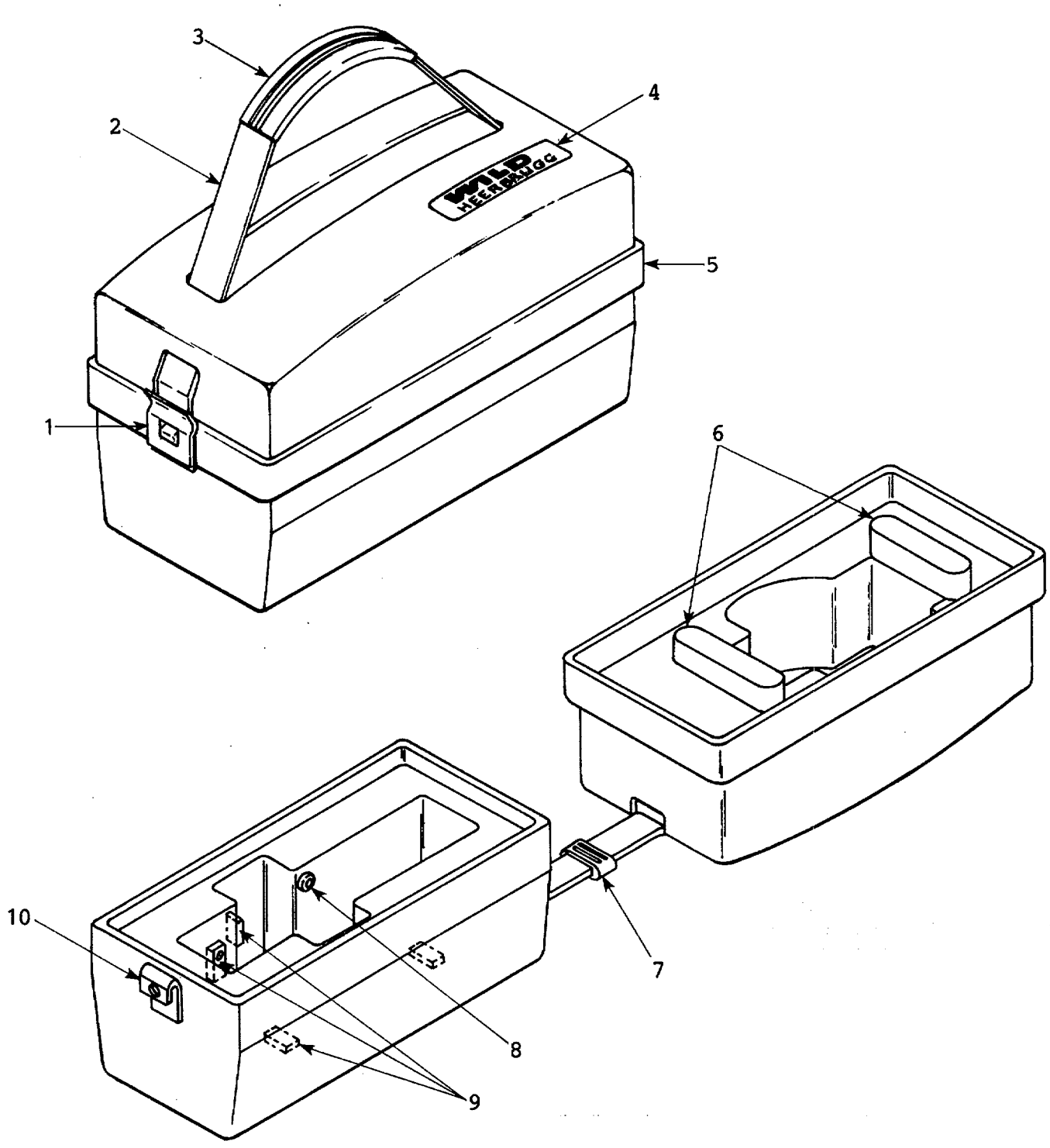



**Figure F-4. Carrying Case, NA2-80**

| (1) ILLUSTRATION (a) FIG NO. | (1) ILLUSTRATION (b) ITEM NO. | (2) SMR CODE | (3) NATIONAL STOCK NUMBER | (4) FSCM | (5) PART NUMBER | (6) DESCRIPTION USABLE ON CODE | (7) U/M | (8) QTY INC IN UNIT |
|---|---|---|---|---|---|---|---|---|
| | | | | | | GROUP 04-CARRYING CASE | | |
| F-4 | | | | 89905 | 312978 | CARRYING CASE, NA2 | EA | 1 |
| F-4 | 1 | XBOZZ | | 89905 | 348473 | LOCK, CARRYING CASE | EA | 1 |
| F-4 | 2 | XBOZZ | | 89905 | 323208 | STRAP, CARRYING CASE | EA | 1 |
| F-4 | 3 | XBOZZ | | 89905 | 200539 | HANDLE, CARRYING CASE | EA | 1 |
| F-4 | 4 | XBFZZ | | 89905 | 333398 | PLATE, IDENTIFICATION | EA | 1 |
| F-4 | 5 | XBOZZ | | 89905 | 306194 | CASE, TRANSPORT | EA | 1 |
| F-4 | 6 | XBOZZ | | 89905 | 355855 | INSERT, RUBBER LARGE | EA | 1 |
| F-4 | 7 | XBOZZ | | 89905 | 323136 | CLAMP, CARRYING CASE | EA | 1 |
| F-4 | 8 | XBOZZ | | 89905 | 200541 | INSERT, RUBBER, ROUND | EA | 3 |
| F-4 | 9 | XBOZZ | | 89905 | 319194 | INSERT, RUBBER, RECTANGLE | EA | 6 |
| F-4 | 10 | XBOZZ | | 89905 | 352826 | HOOK, CARRYING CASE STRAP | EA | 1 |

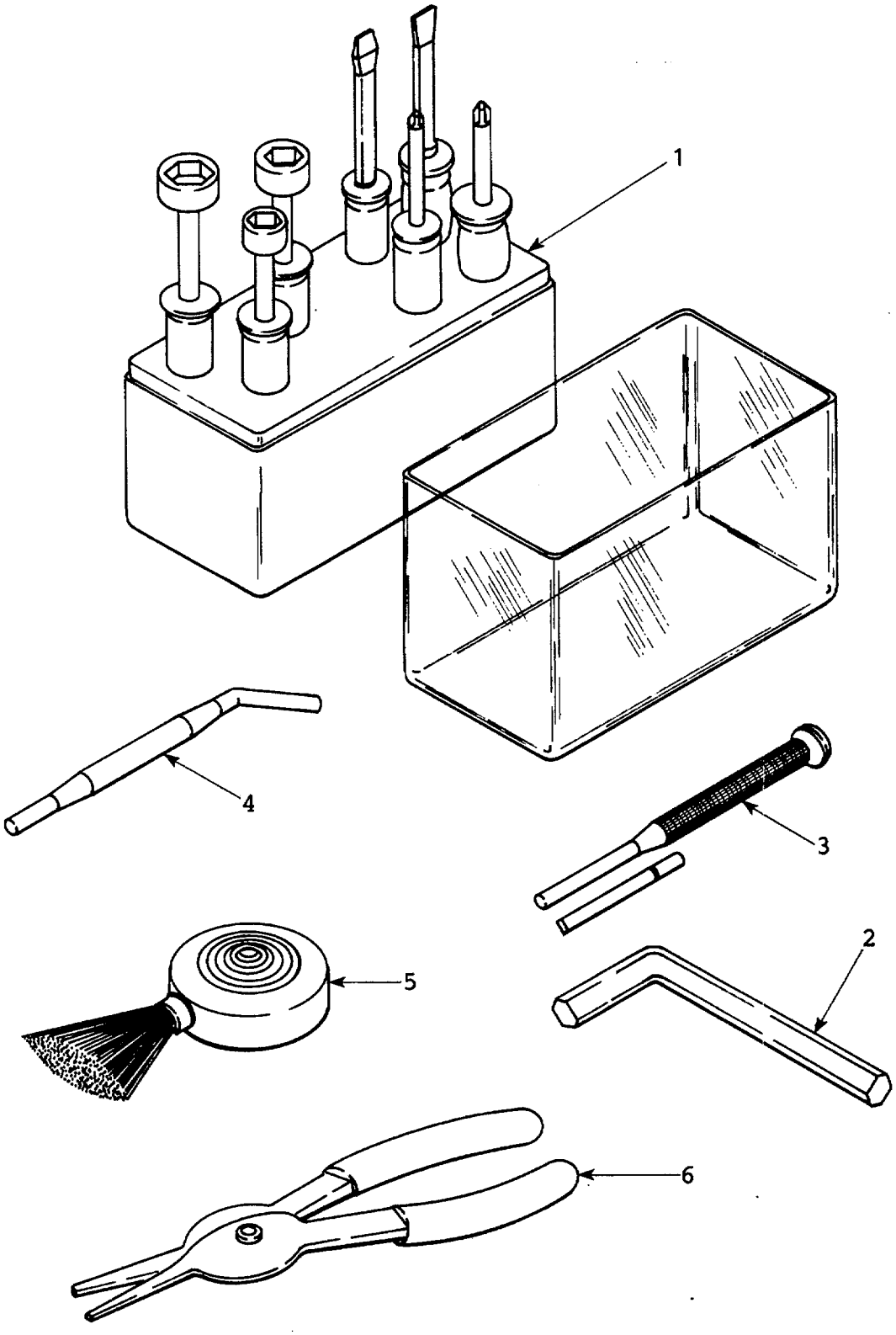



**Figure F-5. Operator's and Organizational Maintenance Tools**

| (1) ILLUSTRATION (a) FIG NO. | (1) ILLUSTRATION (b) ITEM NO. | (2) SMR CODE | (3) NATIONAL STOCK NUMBER | (4) FSCM | (5) PART NUMBER | (6) DESCRIPTION USABLE ON CODE | (7) U/M | (8) QTY INC IN UNIT |
|---|---|---|---|---|---|---|---|---|
| | | | | | | GROUP 05-TOOLS | | |
| F-5 | 1 | PAOZZ | | 30239 | PS130 | SCREWDRIVER/NUTDRIVER SET | SE | 1 |
| F-5 | 2 | PAOZZ | 5120-01-011-8393 | 89905 | 166494 | WRENCH, ALLEN, TRIPOD | EA | 1 |
| F-5 | 3 | PAOZZ | | 89905 | 166794 | SCREWDRIVER, JEWELER'S | SE | 1 |
| F-5 | 4 | PAOZZ | | 89905 | 109334 | PIN, ADJUSTING | EA | 1 |
| F-5 | 5 | PAOZZ | | 89905 | 109335 | BRUSH, LENS CLEANING | EA | 1 |
| F-5 | 6 | PAOZZ | | 30239 | 12R | PLIERS, SNAP RING | EA | 1 |

**Section III: NATIONAL STOCK NUMBER AND PART NUMBER INDEX**

| STOCK NUMBER | FIGURE NO. | ITEM NO. | STOCK NUMBER | FIGURE NO. | ITEM NO. |
|---|---|---|---|---|---|
| 5120-00-440-8008 | 5 | 1 | | | |
| 5120-01-011-8393 | 5 | 2 | | | |
| 5305-00-378-9539 | 3 | 2 | | | |
| 6675-01-076-5465 | 3 | | | | |
| 6675-01-101-4724 | 1 | | | | |
| 6675-01-113-6096 | 1 | 5 | | | |
| 6675-01-115-4635 | 1 | 2 | | | |

| PART NUMBER | FSCM | FIG. NO. | ITEM NO. | PART NUMBER | FIG. FSCM | ITEM NO. | NO. |
|---|---|---|---|---|---|---|---|
| PS130 | 30239 | 5 | 1 | 284797 | 89905 | 2 | 3 |
| 12R | 30239 | 5 | 6 | 296667 | 89905 | 2 | 1 |
| 109334 | 89905 | 5 | 4 | 306194 | 89905 | 4 | 5 |
| 109335 | 89905 | 5 | 5 | 312908 | 89905 | 3 | 18 |
| 109375 | 89905 | 2 | 13 | 312946 | 89905 | 2 | 22 |
| 161034 | 89905 | 3 | 11 | 312978 | 89905 | 1 | 1 |
| 163565 | 89905 | 3 | 27 | 315168 | 89905 | 3 | 5 |
| 163812 | 89905 | 3 | 2 | 319194 | 89905 | 4 | 9 |
| 163820 | 89905 | 3 | 14 | 323136 | 89905 | 4 | 7 |
| 166494 | 89905 | 5 | 2 | 323208 | 89905 | 4 | 2 |
| 166794 | 89905 | 5 | 3 | 323209 | 89905 | 2 | 15 |
| 200539 | 89905 | 4 | 3 | 323373 | 89905 | 2 | 16 |
| 200541 | 89905 | 4 | 8 | 328422 | 89905 | 1 | 2 |
| 208754 | 89905 | 3 | 30 | 328423 | 89905 | 2 | 5 |
| 208818 | 89905 | 2 | 23 | 328424 | 89905 | 2 | 4 |
| 222875 | 89905 | 3 | 17 | 328425 | 89905 | 2 | 10 |
| 235978 | 89905 | 2 | 19 | 328426 | 89905 | 2 | 11 |
| 242435 | 89905 | 1 | - | 328427 | 89905 | 2 | 7 |
| 246140 | 89905 | 3 | 23 | 328428 | 89905 | 2 | 12 |
| 271990 | 89905 | 2 | 21 | 328429 | 89905 | 2 | 8 |
| 271993 | 89905 | 2 | 24 | 329593 | 89905 | 2 | 2 |
| 272031 | 89905 | 3 | 26 | 332313 | 89905 | 3 | - |
| 272033 | 89905 | 3 | 16 | 284783 | 89905 | 2 | 18 |

| PART NUMBER | FSCM | FIG. NO. | ITEM NO. | PART NUMBER | FIG. FSCM | ITEM NO. | NO. |
|---|---|---|---|---|---|---|---|
| 335946 | 89905 | 3 | 25 | 352386 | 89905 | 4 | 10 |
| 335947 | 89905 | 3 | 21 | 352744 | 89905 | 3 | 20 |
| 335949 | 89905 | 3 | 24 | 353245 | 89905 | 3 | 15 |
| 335979 | 89905 | 3 | 29 | 355855 | 89905 | 4 | 6 |
| 344212 | 89905 | 2 | 6 | 364657 | 89905 | 2 | 20 |
| 346286 | 89905 | 2 | 14 | 369915 | 89905 | 3 | 10 |
| 346560 | 89905 | 3 | 6 | 370696 | 89905 | 2 | 17 |
| 346561 | 89905 | 3 | 1 | 370697 | 89905 | 2 | 9 |
| 346562 | 89905 | 3 | 7 | 376922 | 89905 | 3 | 8 |
| 346563 | 89905 | 3 | 3 | 384104 | 89905 | 3 | 13 |
| 348398 | 89905 | 3 | 9 | 384180 | 89905 | 3 | 22 |
| 348473 | 89905 | 4 | 1 | 384181 | 89905 | 3 | 28 |
| 350696 | 89905 | 3 | 4 | 385629 | 89905 | 1 | 5 |
| 350956 | 89905 | 2 | 25 | 388412 | 89905 | 3 | 12 |
| 352036 | 89905 | 1 | 3 | | | | |

## GLOSSARY

| | |
|---|---|
| Compensator | In this equipment a pendulum-type mechanism which automatically keeps the line of sight level (horizontal). |
| Line Leveling | A line of levels (height readings run between intermediate stations to determine the difference in elevation between two widely separated stations. |
| Prism | In this instrument it is a transparent body with triangular ends which will reflect the image of the circular level to the operators eye. Light reflected in vertical plane will be bent 90° to the horizontal plane by the prism. |
| Reticle | The cross hair markings in the focus of the objective of the telescope (horizontal, vertical, wedge-shaped and stadia). |
| Stadia | A method of surveying in which distances are read by noting the interval on surveying staff intercepted by stadia cross hairs in the telescope lens. |

# INDEX

## INDEX (CONT)

## INDEX (CONT)

**By Order of the Secretary of the Army:**

**E. C. MEYER**
**General, United States Army**
**Chief of Staff**

**Official:**

**ROBERT M. JOYCE**
**Brigadier General, United States Army**
**The Adjutant General**

DISTRIBUTION:
To be distributed in accordance with DA Form 12-25A, Operator Maintenance requirements for Surveying.

*U.S. GOVERNMENT PRINTING OFFICE: 1982-564029/1052

RECOMMENDED CHANGES TO EQUIPMENT TECHNICAL PUBLICATIONS

*THEN...JOT DOWN THE DOPE ABOUT IT ON THIS FORM. CAREFULLY TEAR IT OUT, FOLD IT AND DROP IT IN THE MAIL.*

## SOMETHING WRONG WITH PUBLICATION

FROM: (PRINT YOUR UNIT'S COMPLETE ADDRESS)

DATE SENT

| PUBLICATION NUMBER | PUBLICATION DATE | PUBLICATION TITLE |
|---|---|---|
| | | |

BE EXACT PIN-POINT WHERE IT IS

| PAGE NO. | PARA-GRAPH | FIGURE NO. | TABLE NO. |
|---|---|---|---|
| | | | |

IN THIS SPACE, TELL WHAT IS WRONG AND WHAT SHOULD BE DONE ABOUT IT.

| PRINTED NAME, GRADE OR TITLE AND TELEPHONE NUMBER | SIGN HERE |
|---|---|
| | |

DA FORM 1 JUL 79 2028-2

PREVIOUS EDITIONS ARE OBSOLETE.

P.S.--IF YOUR OUTFIT WANTS TO KNOW ABOUT YOUR RECOMMENDATION MAKE A CARBON COPY OF THIS AND GIVE IT TO YOUR HEADQUARTERS.

## The Metric System and Equivalents

### *Linear Measure*

1 centimeter = 10 millimeters = .39 inch
1 decimeter = 10 centimeters = 3.94 inches
1 meter = 10 decimeters = 39.37 inches
1 dekameter = 10 meters = 32.8 feet
1 hectometer = 10 dekameters = 328.08 feet
1 kilometer = 10 hectometers = 3,280.8 feet

### *Weights*

1 centigram = 10 milligrams = .15 grain
1 decigram = 10 centigrams = 1.54 grains
1 gram = 10 decigram = .035 ounce
1 decagram = 10 grams = .35 ounce
acres
1 hectogram = 10 decagrams = 3.52 ounces
1 kilogram = 10 hectograms = 2.2 pounds
1 quintal = 100 kilograms = 220.46 pounds
1 metric ton = 10 quintals = 1.1 short tons

### *Liquid Measure*

1 centiliter = 10 milliters = .34 fl. ounce
1 deciliter = 10 centiliters = 3.38 fl. ounces
1 liter = 10 deciliters = 33.81 fl. ounces
1 dekaliter = 10 liters = 2.64 gallons
1 hectoliter = 10 dekaliters = 26.42 gallons
1 kiloliter = 10 hectoliters = 264.18 gallons

### *Square Measure*

1 sq. centimeter = 100 sq. millimeters = .155 sq. inch
1 sq. decimeter = 100 sq. centimeters = 15.5 sq. inches
1 sq. meter (centare) = 100 sq. decimeters = 10.76 sq. feet
1 sq. dekameter (are) = 100 sq. meters = 1,076.4 sq. feet
1 sq. hectometer (hectare) = 100 sq. dekameters = 2.47

1 sq. kilometer = 100 sq. hectometers = .386 sq. mile

### *Cubic Measure*

1 cu. centimeter = 1000 cu. millimeters = .06 cu. inch
1 cu. decimeter = 1000 cu. centimeters = 61.02 cu. inches
1 cu. meter = 1000 cu. decimeters = 35.31 cu. feet

## Approximate Conversion Factors

| *To change* | *To* | *Multiply by* | *To change* | *To* | *Multiply by* |
|---|---|---|---|---|---|
| inches | centimeters | 2.540 | ounce-inches | Newton-meters | .007062 |
| feet | meters | .305 | centimeters | inches | .394 |
| yards | meters | .914 | meters | feet | 3.280 |
| miles | kilometers | 1.609 | meters | yards | 1.094 |
| square inches | square centimeters | 6.451 | kilometers | miles | .621 |
| square feet | square meters | .093 | square centimeters | square inches | .155 |
| square yards | square meters | .836 | square meters | square feet | 10.764 |
| square miles | square kilometers | 2.590 | square meters | square yards | 1.196 |
| acres | square hectometers | .405 | square kilometers | square miles | .386 |
| cubic feet | cubic meters | .028 | square hectometers | acres | 2.471 |
| cubic yards | cubic meters | .765 | cubic meters | cubic feet | 35.315 |
| fluid ounces | milliliters | 29,573 | cubic meters | cubic yards | 1.308 |
| pints | liters | .473 | milliliters | fluid ounces | .034 |
| quarts | liters | .946 | liters | pints | 2.113 |
| gallons | liters | 3.785 | liters | quarts | 1.057 |
| ounces | grams | 28.349 | liters | gallons | .264 |
| pounds | kilograms | .454 | grams | ounces | .035 |
| short tons | metric tons | .907 | kilograms | pounds | 2.205 |
| pound-feet | Newton-meters | 1.356 | metric tons | short tons | 1.102 |
| pound-inches | Newton-meters | .11296 | | | |

## Temperature (Exact)

| °F | Fahrenheit temperature | 5/9 (after subtracting 32) | Celsius temperature | °C |
|---|---|---|---|---|

**PIN: 050679-000**