

TECHNICAL MANUAL

**OPERATOR'S AND UNIT MAINTENANCE MANUAL
(INCLUDING REPAIR PARTS AND SPECIAL TOOLS LIST)
FOR**

ERDCO SETAFLASH

MODEL 03SF

This technical manual is an authentication of the manufacturer's commercial literature and does not conform with the format and the content requirements normally associated with Army technical manuals. This technical manual does, however, contain all essential information required to operate and maintain the equipment.

Approved for public release; distribution is unlimited.

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SUPPLEMENTARY INTRODUCTORY MATERIAL

1-1. Maintenance Forms and Records

Department of the Army forms and procedures used for equipment maintenance will be those described by DA Pam 738-750, The Army Maintenance Management System.

1-2. 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 letters, DA Form 2028 (Recommended Changes to Publications and Blank Forms), or DA Form 2028-2 located in the back of this manual, directly to: Commander, U S. Army Troop Support Command, ATTN AMSTR-MMTS, 4300 Goodfellow Blvd., St. Louis, MO 63120-1798. A reply will be furnished to you.

1-3. Destruction of Army Material to Prevent Enemy Use

Refer to TM 750-244-3 for instructions covering the destruction of Army Material to prevent enemy use.

1-4. Administrative Storage of Equipment

a. Placement of equipment in administrative storage should be for short periods of time when a shortage of maintenance effort exists. Items should be in mission readiness within 24 hours or within the time factors as determined by the directing authority. During the storage period appropriate maintenance records will be kept.

b. Before placing equipment in administrative storage, current preventive maintenance checks and services should be completed. Shortcomings and deficiencies should be corrected, and all modification work orders (MWO's) should be applied.

c. Storage site selection. Inside storage is preferred for items selected for administrative storage. If inside storage is not available, trucks, vans, Conex containers and other containers may be used.

Setaflash
Models 01SF & 03SF
Technical Manual

Warning

Flash point testers aid in determining the temperature at which application of a test flame causes the vapors of a sample to ignite under specified conditions of test. Flammable and potentially explosive materials are involved in the presence of a source of ignition. It is the direct responsibility of the user to establish appropriate safety and health practices for all personnel. **Under no circumstances should the product be used except by qualified, trained personnel and not until the instructions, labels or other literature accompanying it have been carefully read and understood and the precautions therein set forth followed.**

ERDCO⁰

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SF-15179

Return Policy

For a period of twelve (12) months from the date of shipment, and under normal conditions of use and service, ERDCO ("The Company") will at its option replace, repair or refund the purchase price for any of its manufactured products found, upon return to the Company (transportation charges prepaid and otherwise in accordance with the return procedures established by the Company), to be defective in material or workmanship. This policy shall not apply if the product has been subjected to alteration, misuse, accident, neglect or improper application, installation or operation.

Warranty Disclaimer

Any Buyer of goods or services from the Company agrees with the Company that the sole and exclusive remedies for breach of any warranty concerning the goods or services shall be for the Company, at its option, to repair or replace the goods or services or refund the purchase price. The Company shall in no event be liable for any consequential or incidental damages even if the Company fails in any attempt to remedy defects in the goods or services, but in such case the Buyer shall be entitled to no more than a refund of all monies paid to the Company by the Buyer for purchase of the goods or services. Any cause of action for breach of any warranty shall be commenced by the Buyer no later than twelve months from date of instrument shipment from ERDCO.

Service

If this product requires service, call ERDCO at (708) 328-0550 for a return authorization. Pack instrument in a sturdy carton and ship prepaid to: ERDCO Engineering Corporation, 721 Custer Ave., Evanston, IL 60202 USA. Attention: Service Department.

Include: Description of problem
 Name of person to contact
 Purchase order number
 Return shipping instructions

ERDCO Setaflash instruments are widely used to verify flash points of combustible or flammable liquids for quality assurance regulatory compliance or fuel cleanliness testing. It may be used to determine flammability characteristics when operated in accordance with any of the test methods listed below. This is an equilibrium test method - the test establishes thermal equilibrium between the test liquid and the vapor space above it (ullage). The test procedures contained in this manual are for reference purposes only. The user of this equipment is to follow the instructions, warnings and cautions contained in the industry test methods.

In accordance with:

- | | |
|-------|---|
| ASTM: | American Society for Testing and Materials
Test Methods D 3243
D 3278
D 3828 |
| IP: | Institute of Petroleum
Test Method IP 303 |
| ISO: | International Organization for Standardization
Test Methods ISO 3679
ISO 3680 |
| BSI: | British Standards Institute
Test Methods BS 3900 Part A13
BS 3900 Part A14 |

Accepted by:

- | | |
|-------|--|
| CPSC: | United States Consumer Products Safety Commission |
| DOT: | United States Department of Transportation |
| EPA: | United States Environmental Protection Agency |
| NFPA: | National Fire Protection Association |
| OSHA: | United States Occupational Safety and Health
Administration |

Section 1 General Information

Describes tester physical and operational functions.

Section 2 Preparation for Use

Addresses receiving inspection. Identifies and describes required and optional components.

Section 3 Operation - Flash Point Determination

Instructions for determination of an unknown flash point.

Section 4 Operation - Flash/No Flash

Instructions for verification of a flash point above or below a specified minimum temperature. Use this method for quality assurance and compliance testing.

Section 5 Maintenance Guide

Includes trouble-shooting suggestions.

Section 6 Appendix

Flash Point Check Fluids
Barometric Pressure Correction
Preparation of Dry Ice/Acetone Slurry
Parts List

Introduction

ERDCO Setaflash testers are specifically designed for quickly ascertaining the flash point of a volatile material or whether the flash point temperature of a material is within established limits (Flash/No Flash Procedure). Instruments utilize equilibrium, closed cup technology. Test cup and lid and shutter are dimensionally in accord with ASTM, IP, ISO and BS requirements as delineated in their standards.

Instrument Characteristics

Flash Point Temperature Range:	-22* to 230°F (-30* to 110°C) 01SF 212 to 572°F (100 to 300°C) 03SF * For below ambient testing, use Refrigerant Charged Cooling Block SF-05505.
Temperature Display:	Mercury in glass thermometer. Refer to parts list in appendix for thermometers with different ranges and resolutions. One included with each instrument.
Electrical Power:	100-240v, 50/60 Hz & 12 vdc
Cup Type:	Closed, equilibrium test
Operational Sample Size:	2 ml 01SF, 4 ml 03SF
Repeatability:	In accordance with Industry Test Method
Reproducibility:	In accordance with Industry Test Method
Physical Dimensions:	16 x 4 ½ x 5 ½ inches 01SF (40.6 x 11.4 x 14 cm) 16 ½ x 6 ½ x 6 inches 03SF (42 x 16.5 x 15.2 cm)
Net Weight:	11 lbs (5.0 kg), 01SF 16 lbs (7.3 kg), 03SF

Electrical Circuitry

The primary voltage is selected by use of the plug on the power supply. Be sure that its arrow is pointing to the voltage near your nominal. Each instrument is internally connected for users normal voltage of 110 prior to shipment. If there is a question, disengage the screw which holds the upper chassis to the lower unit. Gently lift the upper chassis and place upside down on protective material such as foam or sponge. Check the plug positions on the primary power supply. Change as necessary. Then reassemble.

Sample Size

The sample size for the 01SF is 2ml and the sample size for the 03SF is 4ml.

Syringe

All testers are supplied with a 2ml pre-set syringe. Materials of higher viscosity such as adhesives require that a 2ml or 4ml sample is placed directly into the cup by use of a spatula (user supplied).

Temperature Control

The Model 01SF covers the temperature range of -22 to 230°F (-30 to 110°C). The Model 03SF covers the temperature range of 212 to 572°F (100 to 300°C). The refrigerant charged cooling block, SF-05505 is required for below ambient testing. The standard thermometers SF-05531 (32 to 230°F) and SF-05533 (0 to 110°C) read to low temperatures of 32°F and 0°C respectively. For lower temperatures, the SF-05536 (-36 to 105°F) or SF-05537 (-38 to 40°C) thermometers will be needed. The thermometers are traceable for accuracy to the U.S. National Institute of Standards and Technology (National Bureau of Standards).

The temperature control knob is located on the left hand side of the control panel and is used in conjunction with the Indicator lamp and the thermometer. The lower portion of the knob is for coarse adjustment while the upper portion of the knob is for fine adjustment. A graduated scale on the temperature control knob allows temperature settings to be repeated.

The temperature control knob may be turned fully clockwise causing the indicator lamp to glow, and adjusted counter-clockwise before the cup reaches the required temperature. The temperature is stable when the indicator lamp cycles slowly on and off or remains at half brilliance.

Alternatively, the temperature control knob may be moved to a predetermined setting. This method will increase the time needed for the cup to acquire the test temperature but less attention will be required during the interim.

Typically, for Flash/No Flash determinations the temperature control knob is left in the same position for repeated testing at the temperature required by product specification or regulatory body having jurisdiction. It is possible to hold the cup indefinitely at the required temperature determined by product specification or regulatory body having jurisdiction

Test Cup

Instrument utilizes closed cup type equilibrium test technology. Dimensions of test cup and lid and shutter assembly meet the exact dimensional requirements of applicable domestic and international standards which are:

ASTM D 3243, D 3278 and D 3828
IP 303
ISO 3679 and 3680
BS 3900 Parts A13, A14

The cup is aluminum construction.

Timer

Model O1SF includes an electronic timer which indicates the required time between sample injection and application of the test flame. The timing period is one minute. After initiating the timing period by pressing the timer push button switch, it flashes once a second until end of time period minus four seconds, then it flashes four times a second. When the timing period is complete, the timer sounds for two seconds. The timer automatically resets itself.

Model O3SF includes a two minute mechanical timer. To set the timing period, its knob should be rotated clockwise to its stop. A bell indicates the conclusion of the timing period.

Integral Gas Tank

Gas for the pilot test jet is supplied from an integral tank which is charged from butane refills. Use only butane fuel refills, part number SF-05540 as it has a filling nozzle of the correct size and container dimensions that do not interfere with the gas ON/OFF valve.

The gas supply to the pilot/test jet is controlled by an ON/OFF valve and a gas regulator gear. A pinch valve is located on the lid and shutter and is only used for fine adjustment of the test flame size (Figure 1).

Fully charge the integral tank when the instrument is at ambient temperature. It is not possible to fully charge the tank at elevated temperatures due to increased pressure within the tank.

The gas is turned on by rotating the ON/OFF valve counter-clockwise through 90°.

Filling instructions.

- Fill at room temperature in a well ventilated area free from sources of ignition.
- Turn ON/OFF valve to ON position.
- Remove instrument recharge valve cover by turning counter-clockwise.
- Press refill container nozzle firmly into gas charging valve.
- Sprayback indicates that filling is complete.
- Turn ON/OFF valve to OFF position.
- Replace recharge valve cover.
- Ventilate area allowing excess fuel to evaporate.

External Propane Operation

For conversion to external propane the special adapter SF-02010 is required.

The following procedure should be carefully followed:

1. Extinguish test flame. The Setaflash tester must be located in an area free of flammable materials except for the 2ml or 4ml test sample.
2. Locate the external gas adapter support stem over the internal gas tank valve stem, in place of the silicone tubing.
3. Disconnect the other end of the silicone tubing removed in Step 2 from the pilot-test flame manifold on the lid and shutter. Install the silicone tubing from the external gas adapter in its place.
4. Turn the adapter control knob fully counter-clockwise to permit unrestricted flow. This functions as a tubing pinch valve only for minor flow rate adjustments.
5. Connect the hose from the external fuel gas supply to the ;1/4" hose barb.
6. On/Off and flow regulation must be done at the fuel gas supply.

Metal Cooling Block

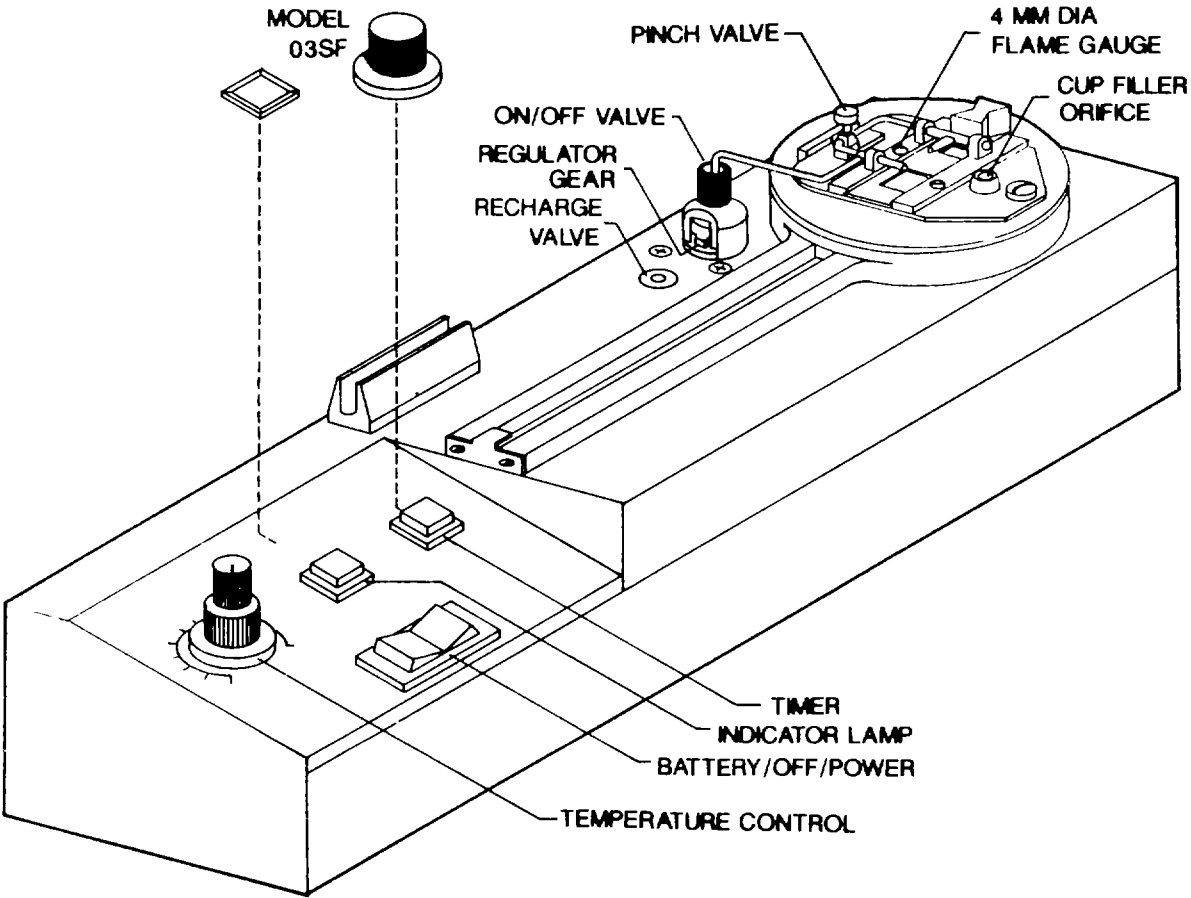
The Metal Cooling Block, SF-05500 is primarily used to help lower the cup temperature quickly to prepare for the next test. One or more may be stored in a refrigerator for this purpose.

For some testing at elevated temperatures, it may require one or more applications to cause required cooling.

Refrigerant Charged Cooling Block

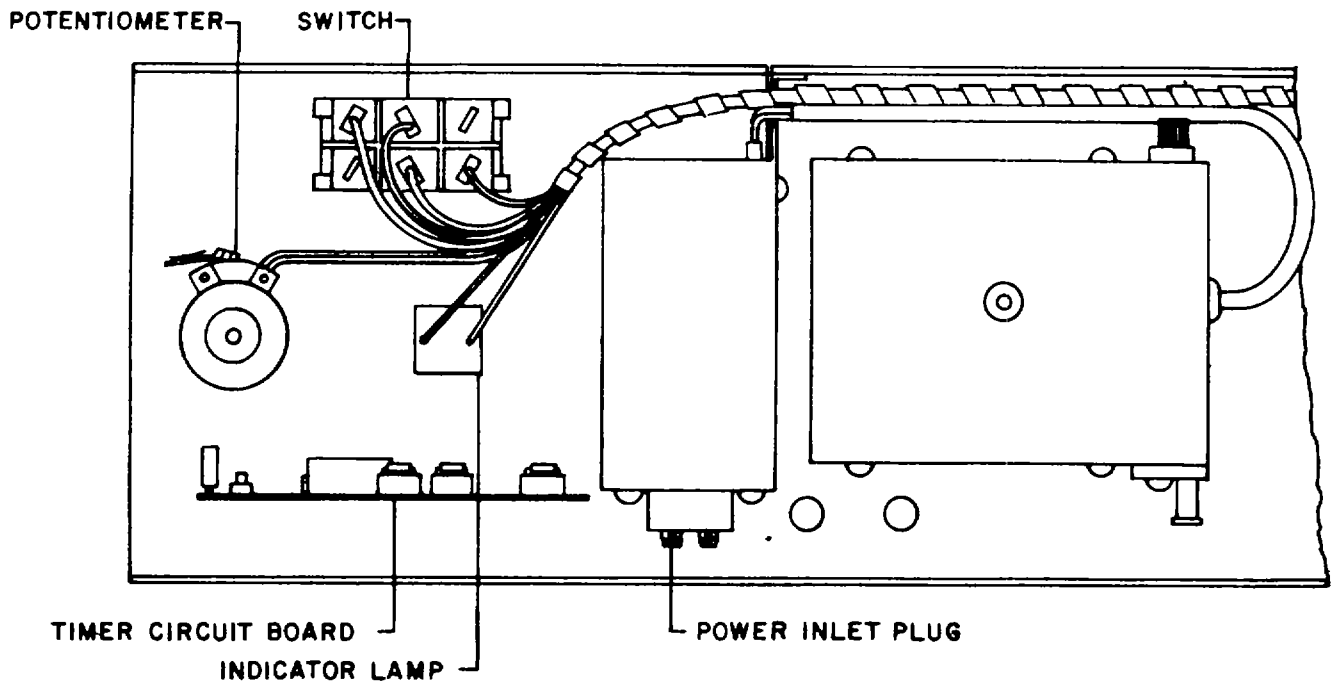
This accessory is a thermally insulated cylinder with an aluminum alloy base which fits the test cup recess. For test temperatures above 40°F/5°C, the cylinder may be charged with a dry ice/acetone slurry. Refer to appendix for directions to prepare dry ice/acetone slurry.

CAUTION: SAFETY GLASSES AND GLOVES SHOULD BE USED WHEN PREPARING ACETONE/DRY ICE MIXTURES. DRY ICE CAN CAUSE PAINFUL BURNS IF ALLOWED TO CONTACT BARE SKIN. SERIOUS INJURY WILL RESULT IF THIS IS ALLOWED TO SPLASH INTO EYES.



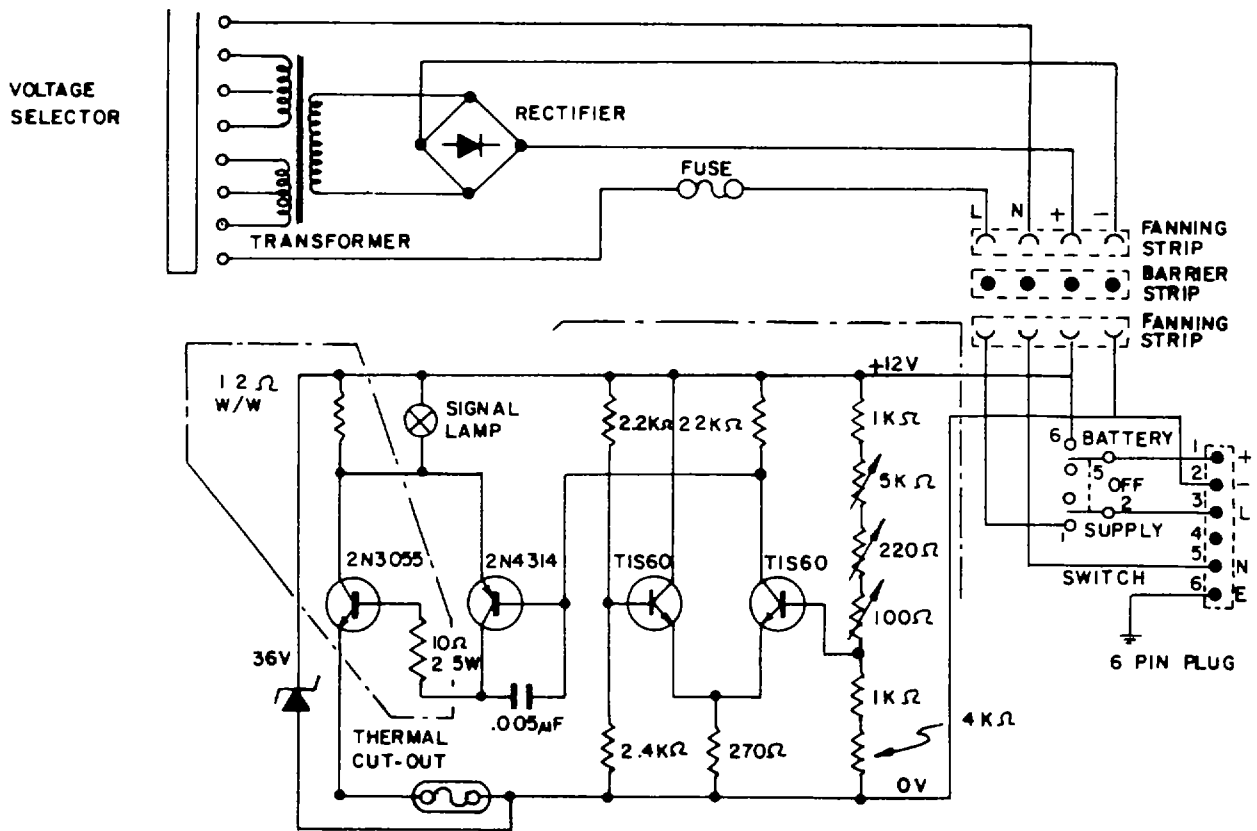
MODEL 01SF and 03SF

FIG. 1



MODEL OISF

FIG. 2



CIRCUIT DIAGRAM MODEL OISF

FIG. 3

Open the integral gas tank ON/OFF valve and light pilot/test flame. Adjust the gas regulator gear for proper pilot/test flame size. The pilot flame is to be at minimum size to automatically relight test flame. Adjust test flame size with the pinch valve to match the 0.157 inch (4mm) diameter gauge ring.

Allow the cup temperature to rise under ambient conditions. When the specified temperature is reached, slowly and uniformly open and close the slide completely over a period of 22 seconds while watching for a flash. The material has flashed if a comparatively large blue flame appears and propagates over the surface of the liquid. Sporadically, when near the actual flash point temperature, application of the test flame may give rise to a blue halo (circular band); this should be ignored.

Close gas control valve after each test.

Record barometric pressure.

Report FLASH or NO FLASH.

Once a test flame has been applied to the sample, the test is terminated and a fresh sample must be used for each successive test.

To prepare for the next test, unlock the lid and shutter. Soak up the sample using paper tissues and clean the lid and shutter assembly. The filling orifice should be cleaned with a pipe cleaner or similar device. Do not lubricate the shutter slide. Clean the syringe.

If No Flash has been observed at the initial estimated flash point temperature, repeat the test at additional 9°F (5°C) higher intervals until a flash is observed.

If a Flash was observed during the initial estimated flash point temperature test, use a test temperature 90F (50C) lower and repeat the procedure. If a Flash is again observed, repeat at 9°F (5°C) lower intervals until No Flash is observed.

Having established a Flash within two temperatures 9°F (5°C) apart, repeat either procedure at 2°F (1°C) intervals from the lower of the two temperatures until a Flash is observed. Record the temperature of the test when the Flash occurs as the Actual Flash Point.

Close the integral gas tank ON/OFF valve after each test.

Record the barometric pressure.

This flash point will be to the nearest 2°F. If closer accuracy is needed, further testing at a 1°F (0.5°C) lower temperature is required.

NOTICE: Dispose of used samples and/or soiled tissues in accordance with your local codes and regulations.

Unpacking

Carefully unpack, account for and inspect the instrument, thermometer, fuel supply, syringe, cord and plug and optional accessories if ordered. Inspect each item for possible shipping damage. Be careful not to discard any components that may be enclosed in packing material.

Assembly

Place instrument on a level bench top in a draft free area.

Remove the two screws at the left hand end of the black molding and remove the thermometer retaining clip.

Remove the thermometer from its shipping tube and inspect. If the mercury column is separated, the thermometer must be cooled and the mercury shaken down into the bulb.

Each instrument is supplied with a small package of Heat Transfer Compound. Apply the compound to the bulb of the thermometer so that full contact will be made when inserted into the cup.

Insert the thermometer carefully into the test cup. Rotate the thermometer to position its scale for convenient reading. Position the thermometer so that its end which is the high temperature reading will be fully under the clip. Replace the thermometer hold down clip. Insert and tighten the two holding screws. Do not tighten the screws to cause more than a soft contact of the clip on the glass.

The primary power cord has a six conductor plug for connection to the instrument. It also includes a plug which mates with the U.S. standard, 120v grounded receptacle. For 230v service or export, the cord does not contain a plug. Its three conductors are stripped of insulation and ready for termination in user supplied plug. The cord contains three No. 18 AWG conductors. When attaching the plug be sure to connect the green ground conductor. The instrument circuitry is internally grounded to its enclosure and integral power cord receptacle.

Check that the instrument primary power switch is in the "OFF" position before connecting cord to primary power receptacle.

Ambient to 230°F (110°C), Model 01SF and 212 to 572°F (300°C),
Model 03SF Testing

Inspect sample well and lid/shutter for cleanliness and freedom from contamination.

Switch Instrument to either "Battery" or "Power" as required.

Turn the temperature dial fully clockwise causing indicator to glow.

When the thermometer reads approximately 3°C/5°F below the specified limit of the product to be tested, slowly return the temperature dial to the point at which the signal light is just extinguished.

Be sure that the syringe is clean and dry. Draw 2ml of sample (Model 01SF) or 4ml (Model 03SF) after target temperature is reached and discharge through the filling orifice into the sample well.

Set timer for Model 01SF by pressing timer push button switch. For Model 03SF, rotate knob clockwise to its stop.

Open the integral gas tank ON/OFF valve and light pilot/test flame. Adjust the gas regulator gear for proper pilot/test flame size. The pilot flame is to be at minimum size to automatically relight test flame. Adjust test flame size with the pinch valve to match the 0.157 inch (4mm) diameter gauge ring on the lid and shutter.

When the time has elapsed, slowly and uniformly open and close the slide completely over a period of 22 seconds while watching for a flash. The material has flashed if a comparatively large blue flame appears and propagates over the surface of the liquid. Sporadically, when near the actual flash point temperature, application of the test flame may give rise to a blue halo (circular band); this should be ignored. It is at a temperature below the actual flash point.

Close the integral gas tank ON/OFF valve after each test.

Record barometric pressure.

Report FLASH or NO FLASH.

Once a test flame has been applied to the sample, the test is terminated and a fresh sample must be used for each successive test.

To prepare for the next test, unlock the lid and shutter. Soak up the sample using paper tissues and thoroughly clean the lid and shutter assembly. The filling orifice should be cleaned with a pipe cleaner or similar device. Do not lubricate the shutter slide. Clean the syringe.

If No Flash has been observed at the initial estimated flash point temperature, repeat the test at additional 9°F (5°C) higher intervals until a flash is observed.

If a Flash was observed during the initial test, use a test temperature 9°F (5°C) lower and repeat the procedure. If a Flash is again observed, repeat at 9°F (5°C) lower intervals until No Flash is observed.

Having established a Flash within two temperatures 9°F (5°C) apart, repeat either procedure at 2°F (1°C) intervals from the lower of the two temperatures until a Flash is observed. Record the temperature of the test when the Flash occurs as the Actual Flash Point.

Close the integral gas tank ON/OFF valve after each test.

Record the barometric pressure.

This flash point will be to the nearest 2°F. If closer accuracy is needed, further testing at a 1°F (0.5°C) lower temperature is required.

NOTICE: Dispose of used samples and/or soiled tissues in accordance with your local codes and regulations.

Sub-Ambient Testing (01SF)

When the tests are to be made at temperatures lower than ambient, it is necessary to use the sub-ambient thermometer SF-05536 or SF-05537. This substitution should be carried out in accordance with Section 2 - Assembly. When the sub-ambient thermometer is installed, care must be taken not to exceed +105°F (+40°C).

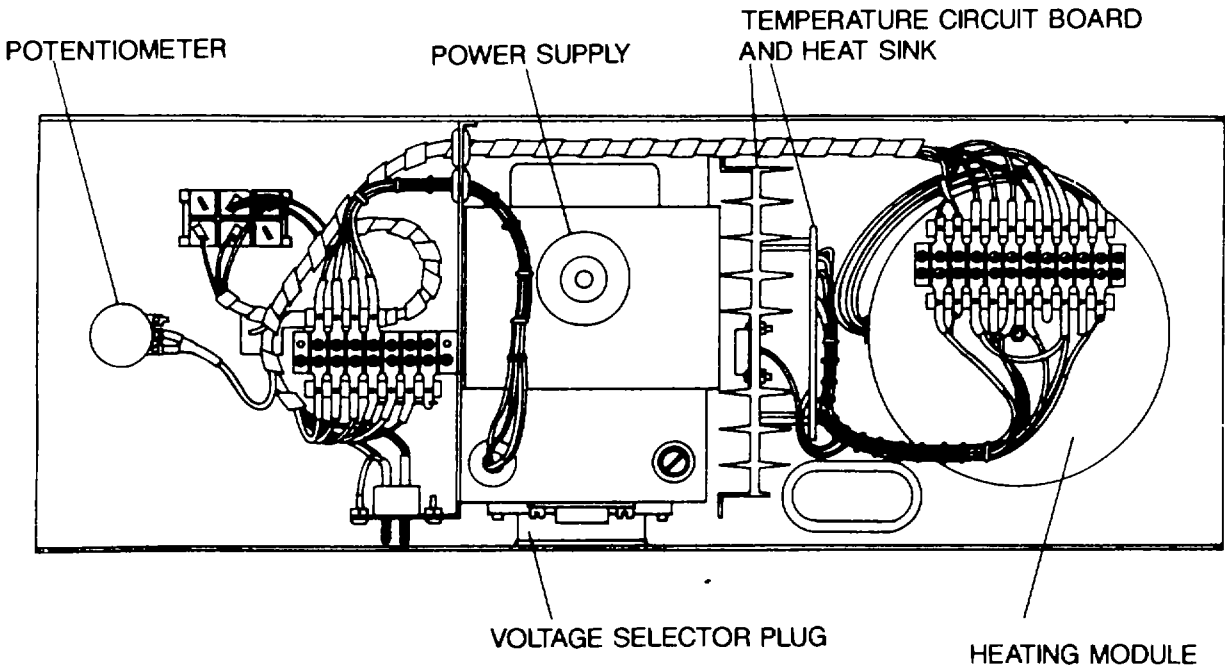
Lower test cup temperature by use of the Refrigerant Charged Cooling Block, SF-05505. For flash point temperatures above 40°F (5°C), a mixture of water and crushed ice placed in the cylinder may be suitable. For temperatures below 40°F (5°C), the cylinder may be charged with a dry Ice/acetone slurry. Refer to appendix for directions to prepare dry ice/acetone slurry.

Switch instrument to "OFF" and raise the lid and shutter assembly.

Cool the sample and syringe in a cooling medium to a temperature approximately 10 to 20°F (5 to 10°C) below the estimated flash point temperature.

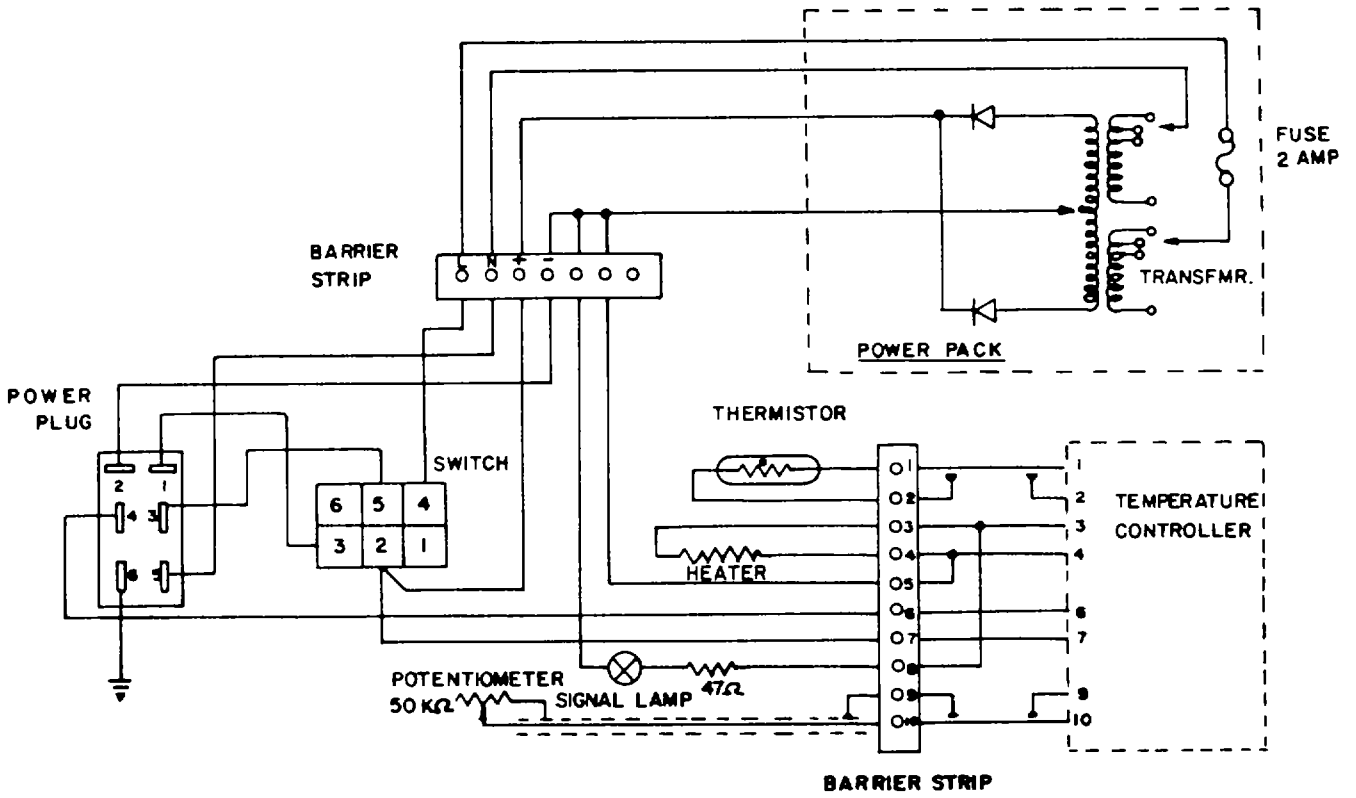
Remove the cooling source and dry the test cup. Close the lid and shutter assembly.

Ensure that the syringe is clean and dry. Charge with 2 ml of sample. Introduce the sample using the syringe, both of which have been pre-cooled to a temperature of 10 to 20°F (5 to 10°C) below the target temperature. Do not switch the timer on.



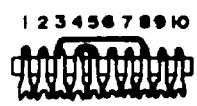
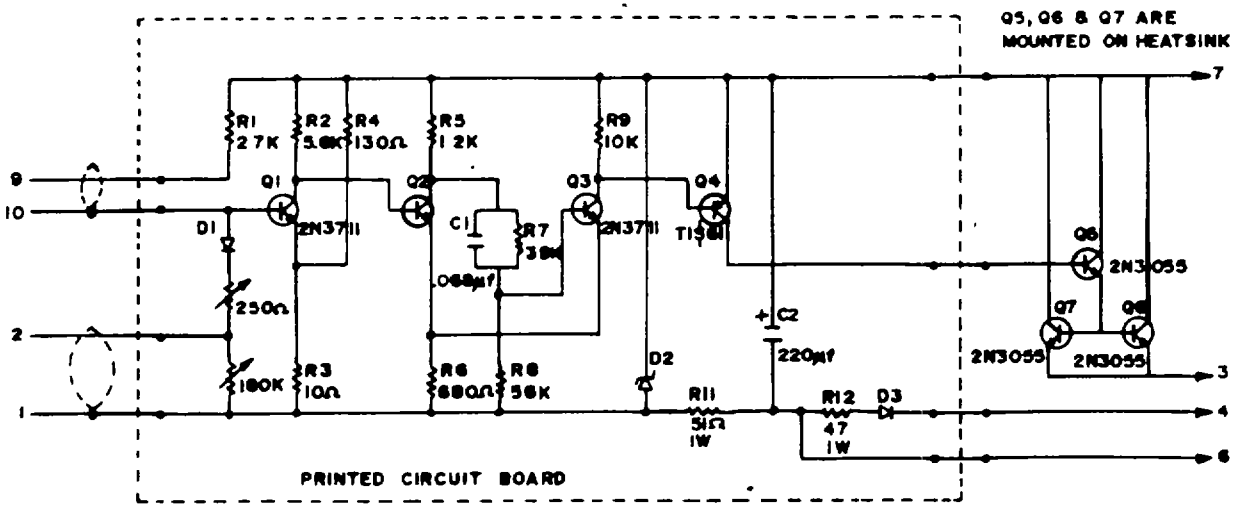
MODEL 03SF

FIG. 4



SCHMATIC MODEL 03SF

FIG. 5



TEMPERATURE CONTROLLER MODEL 03SF

FIG. 6

Ambient to 230°F (110°C), Model 01SF and 212 to 572°F (300°C), Model 03SF Testing

Inspect sample well and lid/shutter for cleanliness and freedom from contamination.

Switch instrument to "ON".

Turn the temperature dial fully clockwise causing indicator to glow.

When the thermometer reads the specified temperature of the product to be tested, slowly return the temperature dial to the point at which the signal light is just extinguished.

Be sure that the syringe is clean and dry. Draw 2ml of sample (Model 01SF) or 4ml (Model 03SF), transfer to the filling orifice after target temperature is reached and discharge into the sample well.

Set timer for Model 01SF by pressing timer push button switch. For Model 03SF, rotate knob clockwise to its stop.

Open the integral gas tank ON/OFF valve and light pilot/test flame. Adjust the gas regulator gear for proper pilot/test flame size. The pilot flame is to be at minimum size to automatically relight test flame. Adjust the test flame size with the pinch valve to match the 0.157 inch (4mm) diameter gauge ring on the lid of the lid and shutter.

When the time has elapsed, slowly and uniformly open and close the slide completely over a period of 22 seconds while watching for a flash. The material has flashed if a comparatively large flame appears and propagates over the surface of the liquid. Sporadically, when near the actual flash point temperature, application of the test flame may give rise to a blue halo (circular band); this should be ignored. It is at a temperature below the actual flash point.

Close the integral gas tank ON/OFF valve after each test.

Record barometric pressure.

Report FLASH or NO FLASH.

Once a test flame has been applied to the sample, the test is terminated and a fresh sample must be used for each successive test.

To prepare for the next test, unlock the lid and shutter. Soak up the sample using paper tissues and clean the lid and shutter assembly. The filling orifice should be cleaned with a pipe cleaner or similar device. Do not lubricate the shutter slide. Clean the syringe.

NOTICE: Dispose of used samples and/or soiled tissues in accordance with your local codes and regulations.

Sub-Ambient Testing (01SF)

When tests are to be made at temperatures lower than ambient it is necessary to use the sub-ambient thermometer SF-05536 or SF-05537. This substitution should be carried out in accordance with Section 2 - Assembly. When the sub-ambient thermometer is installed, care must be taken not to exceed +105°F (+40°C).

Lower test cup temperature by use of the Refrigerant Charged Cooling Block, SF-05505. For flash point temperatures above 40°F (5°C), a mixture of water and crushed ice placed in the cylinder may be suitable. For temperatures below 40°F (5°C), the cylinder may be charged with a dry ice/acetone slurry. Refer to appendix for directions to prepare dry ice/acetone slurry.

Switch instrument to "OFF" and raise the lid and shutter assembly.

Cool the sample and syringe in a cooling medium to a temperature approximately 10 to 20°F (5 to 10°C) below the specified temperature.

Cool the test cup until the temperature declines to approximately 10 to 20°F (5 to 10°C) below the specified temperature.

Remove cooling source and dry the test cup. Close the lid and shutter assembly.

Ensure that the syringe is clean and dry. Charge with 2ml (01SF) or 4ml (03SF) of sample. Introduce the sample using the syringe, both of which have been pre-cooled to a temperature 10 to 20°F (5 to 10°C) below the target temperature. Do not switch the timer on.

Open the integral gas tank ON/OFF valve and light pilot/test flame. Adjust the gas regulator gear for proper pilot/test flame size. The pilot flame is to be at minimum size to automatically relight test flame. Adjust test flame size with the pinch valve to match the 0.157 inch (4mm) diameter gauge ring.

Allow the cup temperature to rise under ambient conditions. When the specified temperature is reached, slowly and uniformly open and close the slide completely over a period of 2½ seconds while watching for a flash.

The material has flashed if a comparatively large blue flame appears and propagates over the surface of the liquid. Sporadically, when near the actual flash point temperature, application of the test flame may give rise to a blue halo (circular band), this should be ignored.

Close the integral gas tank ON/OFF valve after each test.

Record barometric pressure.

Report FLASH or NO FLASH.

Once a test flame has been applied to the sample, the test is terminated and a fresh sample must be used for each successive test.

To prepare for the next test, unlock the lid and shutter. Soak up the sample using paper tissues and clean the lid and shutter assembly. The filling orifice should be cleaned with a pipe cleaner or similar device. Do not lubricate the shutter slide. Clean the syringe.

NOTICE: Dispose of used samples and/or soiled tissues in accordance with your local codes and regulations.

Maintenance Instructions for Models 01SF and 03SF

TROUBLE SHOOTING CHART

Indicator light OFF,
block heats up

- Broken leads or loose connector.
- Indicator light failure - replace with SF-04017.

Indicator light OFF,
block falls to heat

- Check electrical supply and power cord.
- Switch off supply and check fuse.
- Check for correct voltage settings on power pack.
- If instrument is operating from 12v battery, check battery connections, check battery (voltage should NOT be less than 10v).
- Replace heating module SF-05019 (01SF), SF-05027 (03SF).
- Replace temperature control circuit board SF-04013 (01SF), SF-04025 (03SF).
- Check power pack; if faulty, replace with SF-04022 (01SF), SF-04032 (03SF).

Indicator light ON
constantly, block heats
up, NO control

- Replace heating module SF-05019 (01SF), SF-05027 (03SF).
- Replace temperature control circuit board SF-04013 (01SF), SF-04025 (03SF).
- Replace potentiometer SF-04015B (01SF), SF-04028 (03SF).

Indicator light ON
constantly, block falls
to heat

- Replace heating module.

Erratic temperature control

- Check circuit board edge connectors.
- Replace circuit board SF-04013 (01SF), SF-04025 (03SF).
- Replace heating module SF-05019 (01SF), SF-05027 (03SF).
- Replace potentiometer SF-04015 (01SF), SF-04028 (03SF).

Block heating but not reaching 300°C (Model 03SF only)

- Proceed as follows:

Primary Power Operation:

- Check supply voltage and adjust power pack primary selector to nearest setting, i.e. if supply is 230v, select 220v.
- With a voltmeter of 20,000 ohms per volt, check the voltage on the terminal block at the base of the heating module. The voltage between terminals 3 and 4 should be 8.5 - 9v dc under load. Check voltage between terminals 4 and 7. This should be 10.5 - 11.0v dc under load.

If both voltages are low, the power power pack is faulty and should be replaced. If voltage at terminals 4 and 7 is correct but voltage between terminals 3 and 4 is low, the circuit board SF-04025 is faulty and should be replaced.

Flash results too high

- Check thermometer for breaks in mercury column.
- Replace thermometer if damaged.
- Inspect lid/shutter for excessive wear on slides.
- Check sealing ring. If worn, replace with SF-05011 (01SF), SF-05025 (03SF). Ensure gas-tight seal between lid and seal by lightly smearing the seal with oil. Close lid/shutter. On opening, check for continuous print line of oil on underside of lid. If print line is broken check for flatness of lid, strained hinge, smoothness of seal.

Flash results too low

- Check for contamination. Thoroughly clean sample well and lid/shutter if applicable.
- Inspect silicone rubber gas tubing. Replace if necessary with SF-05012A.

Difficulty in lighting gas

- Recharge gas tank with SF-05540 (Refill).
- Adjust gas regulator gear counterclockwise.
- Inspect jets and gas tubing.
- Replace gas tank assembly SF-03010.

Unable to recharge gas tank

- Install new recharge valve SF-03013.

Gas flow insufficient

- Adjust gas regulator gear counterclockwise.
- Recharge gas tank.

Gas flow too high

- Adjust gas regulator gear clockwise.

Gas falls to turn off

- Check for any obstruction of the ON/OFF valve. Remove silicone rubber gas tubing from valve outlet. Turn valve to OFF position. Reinstall silicone rubber gas tubing.
- Replace gas tank assembly SF-03010.

Excessive gas consumption

- Check for leaks - remove tank, charge and immerse in water. If gas bubbles appear, replace tank.

A. CALIBRATION OF FLASH POINT TESTER

1. Determine the flash point of the check or reference standard that has a flash point temperature that is near your target temperature by following the directions in Section 3. When the instrument is operating properly, the flash point temperature for that check fluid will be obtained within the tolerances stated for it. If the flash point obtained is not within the tolerance stated, refer to Section 5.

2. Specifications for Flash Point Check or Reference Standard

P-Xylene

Specific Gravity:	60/60°F (15.5/15.6°C), 0.86 nominal
Boiling Point:	281.03°F (138.35°C)
Melting Point:	560F (13.3°C) minimum
Flash Point:	78 ± 1°F (25.6 ± 0.5°C) acceptable range

n-Butanol

Specific Gravity:	60/60°F (15.5/15.6°C), 0.81
Boiling Point:	242.9°F (117.2°C)
Melting Point:	-129.1°F (-89.5°C)
Flash Point:	97.9 ± 1.7°F (36.6 ± 0.8°C)

n-Undecane

Specific Gravity:	60/60°F (15.5/15.6°C), 0.74 nominal
Boiling Point:	386.15°F (196.75°C)
Melting Point:	-14.8°F (-25.6°C)
Flash Point:	145.4 ± 2°F (63 ± 1.0°C)

n-Hexadecane

Specific Gravity:	60/60°F (15.5/15.6°C), 0.77
Boiling Point:	548.6°F (287°C)
Melting Point:	64.4°F (18°C)
Flash Point:	270.5 ± 2°F (132.5 ± 1.0°C)

B. BAROMETRIC PRESSURE CORRECTION

When the barometric pressure differs from 760 mm Hg (101.2 kPa), calculate the flash point temperature by means of the following equations:

$$\begin{aligned}\text{Calculated flash point} &= F + 0.06 (760 - P) \\ &= C + 0.03 (760 - P)\end{aligned}$$

Where: F,C = observed flash point, °F (or °C) and
P = barometric pressure, mm Hg.

Determine the corrected specification flash point by the following equation:

$$\begin{aligned}F &= S - 0.06 (760 - P) \\ C &= S - 0.03 (760 - P)\end{aligned}$$

Where: F,C = flash point to be observed to obtain the specification flash point at standard pressure (P).
S = specification flash point

C. PREPARATION OF DRY ICE/ACETONE SLURRY

Solid carbon dioxide in equilibrium with carbon dioxide vapor at one atmosphere will provide cooling to a temperature as low as -78.5°C / 109.3°F . The liquid acetone provides good thermal contact throughout the bath. It also prevents air from diluting the carbon dioxide gas at the surface of the dry ice. The test cup must not be cooled to a temperature below -38.4°C , the freezing point of mercury.

Extinguish the pilot and test flames.

Remove the top cover of the refrigerant charged cooling block and fill the cylinder one-quarter to one-half full with acetone. **DO NOT FILL TO HIGHER LEVEL.**

Pulverize some dry ice with a grinder or by wrapping chunks of dry ice in a towel and crushing them with a mallet.

CAUTION: Use tongs or insulated gloves when handling dry ice.

Add small quantities of pulverized dry ice to the cylinder with a spatula. This dry ice will evaporate almost immediately and cause considerable foaming at the surface.

Add additional small amounts of pulverized dry ice, waiting after each addition until the foaming subsides.

Eventually, some dry ice will begin to accumulate at the bottom of the cylinder. At this point, small chunks of dry ice can be added without causing serious foaming.

Stir the mixture to ensure temperature uniformity. There should be a slow but steady stream of carbon dioxide bubbles rising from the bottom of the refrigerant charged cooling block.

Replace the top cap to prevent excess venting of acetone vapor.

Remove the bottom cap just before inserting the cooling block into the test cup.

NOTICE: Dispose of used mixture in accordance with your local codes and/or regulations.

D. PARTS LIST

SF-02010	Adapter for External LPG Supply
SF-02021	Timer (1 minute) 01SF
SF-02024	Timer (2 minutes) 03SF
SF-03010	Gas Tank Assembly
SF-03013	LPG Recharge Valve with Dust Cap
SF-04013	Temperature Control Circuit Board (01SF)
SF-04015B	Potentiometer (01SF)
SF-04015C	Potentiometer Knob - Small
SF-04015D	Potentiometer Knob - Large
SF-04016	Rocker Switch
SF-04017	Indicator Assembly (includes lamp)
SF-04019	Timer Knob
SF-04020A	Power Cord with Plug
SF-04021	Battery Leads and Clips
SF-04022	Power Pack (01SF)
SF-04025	Temperature Control Circuit Board (03SF)
SF-04028	Potentiometer (03SF)
SF-04032	Power Pack (03SF)
SF-04034	Thermister (03SF)
SF-04035A	Fuse (3 amp)
SF-05011	"O" Ring, Test Cup (01SF)
SF-05012A	Silicone Gas Tubing (bulk/ft)
SF-05013	Heat Transfer Compound (2oz. jar)
SF-05015	Thermometer Retaining Clip
SF-05015A	6BA x 3/16" Phillips Round Head Screws
SF-05017	Sample Block Assembly (aluminum) (01SF)
SF-05018	Lid/Shutter Assembly (01SF)
SF-05018B	Tubing Pinch Valve
SF-05018D	Shutter Spring
SF-05019	Heating Module
SF-05023	Sample Block Assembly (aluminum) (03SF)
SF-05023A	Lid/Shutter Locking Pin (latch pin) (03SF)
SF-05025	"O" Ring, Test Cup (03SF)
SF-05026	Lid/Shutter Assembly (03SF)
SF-05026B	Locking Handle for Lid/Shutter Assembly
SF-05027	Heating Module (03SF)
SF-05500	Metal Cooling Block (01SF,03SF)
SF-05505	Refrigerant Charged Cooling Block
SF-05520	Syringe 2ml/4ml
SF-05530	Thermometer/Magnifier
SF-05531	Thermometer - 32 to 230°F
SF-05532	Thermometer - 212 to 572°F
SF-u5533	Thermometer - 0 to 110°C
SF-05534	Thermometer - 100 to 300°C
SF-05536	Thermometer - -36 to 105°F
SF-05537	Thermometer - -38 to 40°C
SF-05540	Butane Charging Cylinder
SF-13267	Thermal Fuse
SF-13559	Shutter Spring
SF-13824	Thermister (01SF)
SF-14074	Shutter Knob (01SF)
SF-14204	Locking Knob (01SF)
SF-15179	User Guide

APPENDIX A

REFERENCES

A-1. PUBLICATIONS INDEX.

The following index should be consulted frequently for latest changes or revisions of references given in this appendix and for new publications relating to material covered in this manual.

Index of Administrative Publications..... DA PAM 25-30

A-2. FORMS AND RECORDS.

Recommended Changes to Publications and Blank Forms..... DA Form 2028-2

Equipment Inspection and Maintenance WorksheetDA Form 2404

Equipment Control Record DA Form 2408-9

A-3. TECHNICAL MANUALS

The Army Maintenance Management System (TAMMS) DA PAM 738-750

Destruction of Army Material to Prevent Enemy Use..... TM 750-244-3

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 categories.

b. The Maintenance Allocation Chart (MAC) in Section II designates overall authority and responsibility for the performance of maintenance functions on the identified end item or component. The application of the maintenance functions to the end item or component will be consistent with the capacities and capabilities of the designated maintenance categories.

c. Section III lists the tools and test equipment (both special tools and common tool sets) required for each maintenance function as referenced from Section II.

d. Section IV contains supplemental Instructions and explanatory notes for a particular maintenance function.

B-2. Maintenance Functions. Maintenance functions will be limited to and defined as follows.

a. Inspect. To determine the serviceability of an Item by comparing its physical, mechanical, and/or electrical characteristics with established standards through examination (e.g., by sight, sound, or feel).

b. Test. To verify serviceability by measuring the mechanical, pneumatic, hydraulic, 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 (Includes decontaminate, when required), to preserve, to drain, to paint, or to replenish fuel, lubricants, chemical fluids, or gases.

d. Adjust. To maintain or regulate, 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. Remove/Install. To remove and install the same item when required to perform service or other maintenance functions. Install may be the act of emplacing, seating, or fixing into position a spare, repair part, or module (component or assembly) in a manner to allow the proper functioning of an equipment or system.

h. Replace. To remove an unserviceable Item and install a serviceable counterpart in its place. "Replace" is authorized by the MAC and is shown as the third position code of the SMR code

i. Repair. The application of maintenance services, ¹including fault location/troubleshooting, ²removal/installation, and disassembly/assembly procedures, ³and maintenance actions ⁴to identify troubles and restore serviceability to an item by correcting specific damage, fault, malfunction, or failure in a part, subassembly, module (component or assembly), end item, or system.

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

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

B-3. Explanation Of Columns In The MAC, Section II.

a. Column 1, Group Number. Column 1 lists functional group code numbers, the purpose of which is to identify maintenance significant components, assemblies, subassemblies, and modules with the next higher assembly. End item group number shall be "00."

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 Function. Column 3 lists the functions to be performed on the item listed in column 2. (For a detailed explanation of these functions, see paragraph B-2.)

d. Column 4, Maintenance Category. Column 4 specifies, by the listing of a work time figure in the appropriate subcolumn(s), the category of maintenance authorized to perform the function listed in column 3. This figure represents the active time required to perform that maintenance function at the indicated category of maintenance. If the number or complexity of the tasks within the listed maintenance function vary at different maintenance categories, appropriate work time figures will be shown for each category. 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 (including any necessary disassembly/assembly time), troubleshooting/fault location 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 categories are as follows:

-
- 1 Services - inspect, test, service, adjust, align, calibrate, and/or replace
 - 2 Fault locate/troubleshoot- the process of investigating and detecting the cause of equipment malfunctioning; the act of isolating a fault within a system or unit under test (UUT).
 - 3 Disassemble/assemble - encompasses the step-by-step taking apart (or breakdown) of a spare/functional group coded item to the level of its least commonality identified as maintenance significant (i.e., assigned an SMR code) for the category of maintenance under consideration
 - 4 Actions - welding, grinding, riveting, straightening, facing, remachining, and/or resurfacing

- C Operator/Crew
- O..... Unit 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, TMDE, and support equipment required to perform the designated function

f. Column 6. Remarks. This column shall, when applicable, contain a letter code, in alphabetic order, which shall be keyed to the remarks contained in section IV.

B-4. Explanation Of Columns In Tool And Test Equipment Requirements, Section III.

a. Column 1. Reference Code. The tool and test equipment reference code correlates with a code used in the MAC, section II, column 5.

b. Column 2. Maintenance Category. The lowest category 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 Stock Number. The National stock number of the tool or test equipment

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

B-5. Explanation Of Columns In Remarks, Section IV.

a. Column 1. Reference Code. The code recorded in column 6, Section II.

b. Column 2. Remarks. This column lists information pertinent to the maintenance function being performed as indicated in the MAC, section II.

Section II. MAINTENANCE ALLOCATION CHART

(1) GROUP NUMBER	(2) COMPONENT/ ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIPMENT	(6) REMARKS	
			UNIT		DS	GS	DEPOT			
			C	O	F	H	D			
00	Setaflash, Closed Tester	Inspect	0.1					1,2	A	
		Test		0.5					A	
		Service	0.3						B	
		Calibrate	0.3						C	
		Replace		0.5					1,3	D
Repair		1.0								
01	Heater Control Assembly	Inspect	0.1					1,3	D	
		Test		0.5						
		Repair		1.0						
0101	Power Pack	Test		0.5					E	
		Replace		1.0						
0102	Heating Module	Replace		1.0			1,3			
0103	Potentiometer	Test		0.5				1,3,4	F	
		Replace		1.0						
0104	Circuit Board	Test		0.5				1,3	G	
		Replace		1.0						
0105	Thermistor	Test		0.5				1,3	H	
		Replace		1.0						
0106	Thermometer	Inspect	0.1					3	I	
		Replace		0.2						
02	Gas Control Assembly	Inspect	0.1					3	A	
0201		Adjust	0.2				C			
0202		Repair		0.5					D	
03		Gas Tank	Service	0.5						J
			Replace		0.5					
	Recharge Valve	Inspect	0.1					3	K	
		Replace		0.5						
	Timer Assembly	Inspect	0.2					3	L	
		Adjust		0.5						
		Replace		1.0						3

**Section III. TOOL AND TEST EQUIPMENT REQUIREMENTS
FOR
MAINTENANCE ALLOCATION CHART**

(1) TOOL/TEST EQUIP. REF CODE	(2) MAINTENANCE CATEGORY	(3) NOMENCLATURE	(4) NSN	(5) TOOL NUMBER
1	C,O	Multimeter, 0-500 Volt	6625-00-691-2453	
2	C,O	Barometer	6685-00-255-9507	
3	C,O	Assorted Tools 1 ea Pliers, Large Nose, 6 inch 1 ea. Screwdriver, Flat Tip, 6 inch 1 ea. Screwdriver, Cross Tip, 8 inch-	5120-00-247-5177 5120-00-278-1283 5120-00-542-3438	
4	O	Kit, Soldering Gun, 115 V, 60 Hz, Complete with Solder and Case	3439-99-618-6623	

Section IV. REMARKS

REFERENCE CODE	REMARKS
A	Refer to Fault Finding Chart for specific tests and inspections
B	Periodically clean sample well and lid per Section 4.12 of manual.
C	Calibrate per Instructions in Appendix 6.
D	Repair by replacement of defective part.
E	Check power pack fuse and test power pack for proper voltage per Section 5, Maintenance.
F	Remove one wire from the potentiometer, alternately short and open circuit against the other wire. If control of the heating block is made the potentiometer is defective.
G	Test circuit board per Section 6 of Maintenance.
H	Test for open circuit
I	Inspect for breaks in Mercury column.
J	Recharge gas tank with Liquid Petroleum Gas (LPG).
K	Inspect jets and gas tubes
L	Inspect for accuracy of timer (-O +15sec)
M	To adjust timer, remove the timer from the panel and loosen the adjusting screw nut Turn adjusting screw counter clockwise to decrease interval and clockwise to increase Interval

APPENDIX C

COMPONENTS OF END ITEM AND BASIC ISSUE ITEMS LISTS

Section I. INTRODUCTION

C-1. Scope.

This appendix lists components of end Item and basic issue items for the ERDCO Setaflash 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 In identifying items.

b. Section III. Basic Issue Items. These are the minimum essential items required to place the ERDCO Setaflash in operation, to operate It, and to perform emergency repairs. Although shipped separately packaged, BII must be with the shelter during operation and whenever it is transferred between property accounts. The illustrations will assist you with hard-to-identify items. This manual is your authority to request/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 Federal item name and, if required, a minimum description to identify and locate the item. The last line for each item indicates the CAGEC (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.

Section II. COMPONENTS OF END ITEM

NOT APPLICABLE

Section III. BASIC ISSUE ITEMS

(1) Illus	(2) National Stock Number	(3) Description Usable CAGEC And Part Number On Code	(4) U/M	(5) Qty
		Thermometer (212-572 °F) (01579) 3SF-5532	EA	1
		Thermometer (100-300 °F) (01579) 5534	EA	1
		LPG External Source Adapter (01579) 2010	EA	1
		Gas Tank Assembly (01579) 3010	EA	1
		LPG Recharge Valve (01579) 3013	EA	1
	6830-00-584-3041	Butane Cylinder, 16 oz (01579) 5540	EA	1
	6685-00-255-9507	Barometer	EA	1
		Calculator (22527) 12-099	EA	1
		Technical manual, Operator's and Unit, Maintenance Manual (Including Repair Parts and Special Tools Lists), TM 10-6630-243-12&P	EA	1

APPENDIX D
ADDITIONAL AUTHORIZATION LIST
NOT APPLICABLE

APPENDIX E

EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST

Section I. INTRODUCTION

E-1. Scope. This listing is for Informational purposes only and is not authority to requisition the listed items. These items are authorized to you by CTA 50-970, Expendable/Durable 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, appendix C)

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

- C - Operator/Crew
- O - Unit 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 Commercial and Government Entity Code (CAGEC) in parentheses followed by the part number.

e. Column (5) - Unit of Measure (U/M). Indicates the measure used in performing the actual 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/DURABLE SUPPLIES AND MATERIALS LIST

(1) Item Number	(2) Level	(3) National Stock Number	(4) Description	(5) U/M
1	C	6810-00-753-4780	Acetone	oz
2	C	6810-00-543-7415	Alcohol, Denatured	oz
3	C	8415-00-715-0450	Apron	ea
4	C	5920-00-010-6652	Fuse,3A	ea
5	C		Gloves, Disposable (22527) 11-394-100B	pk
6	C	4240-00-269-7912	Goggles, Industrial	pr
7	C		Hamilton Needle (01579) 5523	ea
8	C		Silicone Tubing (01579) 5021	ft
9	C	6640-00-171-5198	Spatula	ea
10	C		Syringe, 5 ml, with Chaney Adapter and Hamilton Needle Assembly (01579) 5520	ea
11	C	6645-00-880-8045	Timer, Interval	ea
12	C	7920-00-928-1203	Tissue, Large	bx
13	C	6810-00-815-6105	Xylene, ACS 350 ml	cn
14	C	6810-00-584-4070	Xylene (Technical)	oz

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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
 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 milliliters = .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 acres
 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
----	------------------------	----------------------------	---------------------	----

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