
TECHNICAL MANUAL

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

KOEHLER CLEVELAND OPEN TESTER

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.

**HEADQUARTERS, DEPARTMENT OF THE ARMY
28 SEPTEMBER 1990**

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.
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-MCTS, 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.

i/(ii Blank)



K13800. K13900 K13970
K13980. K13987. K13990
CLEVELAND OPEN TESTER
ASTM D92
FLASH AND FIRE POINTS
CLEVELAND OPEN CUP

1595 SYCAMORE AVE.
BOHEMIA, N Y 11716
(516) 589-3800
TELEX 4973677 "KOEHLER"
FAX (516)589-3815

Quality Test Equipment for Petroleum Products

KOEHLER
K13800 & K13900
ASTM D92

(OPEN CUP FLASH AND FIRE POINTS

BY CLEVELAND OPEN CUP)

TABLE OF CONTENTS

SECTION:

(A) GENERAL INSTRUCTIONS:

- (1) UNPACKING INSTRUCTIONS
- (2) ASSEMBLY INSTRUCTIONS (K13800,K13900,K13990)
- (3) OPERATING INSTRUCTIONS
- (4) SERVICE INSTRUCTIONS

(B) ASSEMBLY DRAWINGS:

- *(1) K13800 CLEVELAND FLASH TESTER (GAS)
- (2) K13900 CLEVELAND FLASH TESTER (ELECTRIC)

(C) WIRING DIAGRAM:

POWERTRON HEATER, K42000, K42090, FOR CLEVELAND FLASH TESTER (ELECTRIC)

(D) SPARE PARTS LIST:

- (1) K13800 CLEVELAND FLASH TESTER (GAS)
- (2) K13900 CLEVELAND FLASH TESTER (ELECTRIC)

NOTE: All gas operated Flash Point Testers Manufactured by Koehler Instrument Company come with a choice of burners. The types available are natural gas, L.P.G. and artificial gas. In the event the burner supplied is not suitable for your gas supply, burners are easily exchanged.

K13800

K13900, K13990, K13980, K13970

SAFETY AND HAZARD WARNING

THIS EQUIPMENT MAY INVOLVE HAZARDOUS MATERIAL AND OPERATIONS. THIS MANUAL DOES NOT PURPORT TO ADDRESS ALL OF THE SAFETY PROBLEMS ASSOCIATED WITH THE USE OF THE EQUIPMENT. IT IS THE RESPONSIBILITY OF WHOEVER USES THIS EQUIPMENT TO CONSULT AND ESTABLISH APPROPRIATE SAFETY AND HEALTH PRACTICES, AND DETERMINE THE APPLICABILITY OF REGULATORY LIMITATIONS PRIOR TO USE.

NOTE: AS A SAFETY PRECAUTION, NEVER USE UNREGULATED GAS WITH THIS TESTER

SECTION A
GENERAL INSTRUCTIONS

1. UNPACKING INSTRUCTIONS. !

The K13800 Gas Flash Tester comes partially disassembled and wrapped in corrugated cardboard and microform packing. The flame test burner assembly is packed in-between two pieces of cardboard with the remainder of parts packed around the base and wrapped in corrugated cardboard.

The K13800, K13990 Electrically Heated Flash Tester comes with the Powertrol heater base packed in cardboard and wrapped in microfoam and corrugated cardboard. The flame test burner assembly is packed in-between two pieces of cardboard, with the remainder of parts packed around the powertrol base and wrapped in corrugated cardboard.

2. ASSEMBLY INSTRUCTIONS: (K13800 GAS FLASH TESTER)

NOTE: The unit comes basically assembled except for the flame test burner assembly which was disassembled at the factory to protect the instrument in transit.

(A) To assemble the flame test burner, remove the 2-56 screw first from the support (Item 5) and attach the flame test burner assembly. Reinstall the 2-56 screw and secure firmly.

(B) Assemble the remainder of the components as shown in assembly drawing and attach gas lines. Unit is now ready for operation.

2. ASSEMBLY INSTRUCTIONS:

NOTE: The K13900 electrically heated unit is shipped disassembled to avoid breakage of delicate parts. (see K13900 Assembly Drawing.)

SECTION A**GENERAL INSTRUCTIONS**

(A) Place silver casting on heater as shown and attach with 4 #8 X 1/2 pan head sheet metal screws provided.

(B) Place item 5 in casting, as shown in drawing, and screw item 6 onto it. Tighten, using one 9/16 wrench and one 5/8 wrench and secure firmly.

(C) To assemble the flame test burner, remove the 2-56 screw first from the burner support (Item 5) and attach the flame test burner assembly. Reinstall the 2-56 screw and secure firmly. Unit is now ready for operation.

3. OPERATING INSTRUCTIONS: (Per ASTM D92)

(A) All tests should be made in a room free of excessive drafts. The room or compartment should be darkened sufficiently to allow the flash to be readily seen, and the operator should avoid breathing over the surface of the test oil.

(B) Suspend the thermometer in a vertical position by the thermometer holder (Item 2) so that the bottom of the bulb is 1/4" from the bottom of the cup, and a point half way between the center and back of the cup.

(C) Fill cup with the oil to be tested in such a manner that the top of meniscus is exactly at filling line at ambient temperature.

(D) Viscous samples should be heated until they are reasonably fluid before being poured into the cup; however the temperature during heating must not exceed 100°F below the probable Flash Point.

(E) Use a test flame approximately 5/32 of an inch in diameter, the same size as the flame guide. Adjust valve (Item 11 on assembly drawing), if needed, until flame compares to the flame guide.

SECTION A

(G) Apply the test flame as the temperature reading on the Fahrenheit thermometer reaches each successive 5 degree mark, and pass the flame across the top of the cup. The time duration for the passage of the test flame across the cup should be approximately one second.

(H) Heat the oil (at a rate not exceeding 30°F. below the anticipated flash point of the oil. Thereafter decrease the rate of heating, and for at-least the last 50°F. before the flash point is reached the rate should be 10 degrees +/- 1 degree per minute.

(I) Record as the flash point, the temperature read on the thermometer when a flash appears at any point on the surface of the oil. The true flash must not be confused with a bluish halo that sometimes surrounds the test flame.

(J) After the flash point has been established and recorded, continue heating the oil at the specified rate (10 degrees +/-1 degrees per minute) and apply the test flame at the same intervals until the oil ignites and continues to burn for a period of at least 5 seconds. Record as the fire point the temperature reading at the time of the flame application that caused burning for a period 5 seconds or more.

4. SERVICE INSTRUCTIONS:

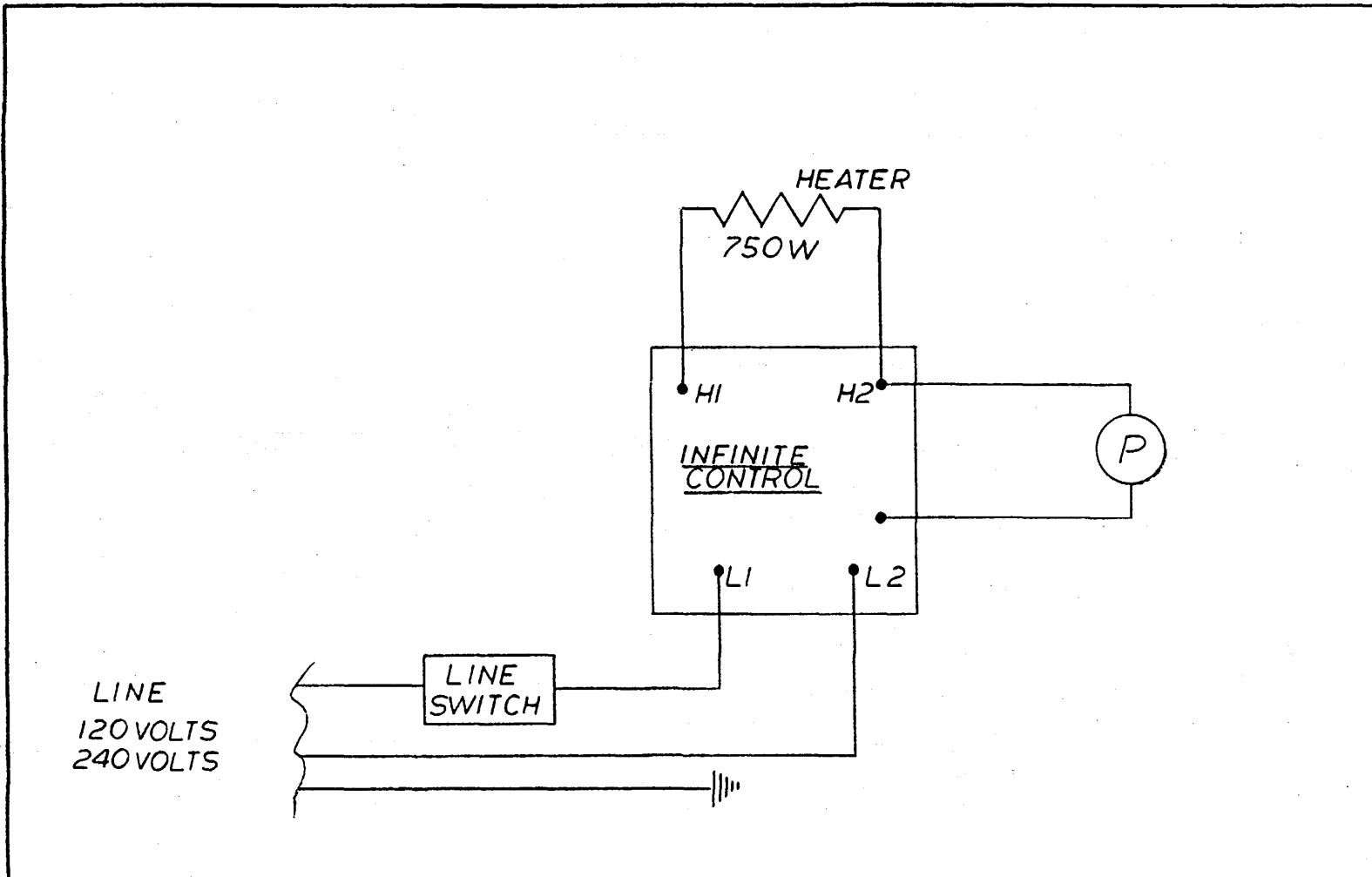
Under normal conditions service is not required. However, any service problems can often be resolved quickly and inexpensively by phone or letter. Please contact our office at:

KOEHLER INSTRUMENT COMPANY, INC.
1595 SYCAMORE AVENUE
BOHEMIA, NEW YORK 11716

TELEPHONE: (516) 589-3800

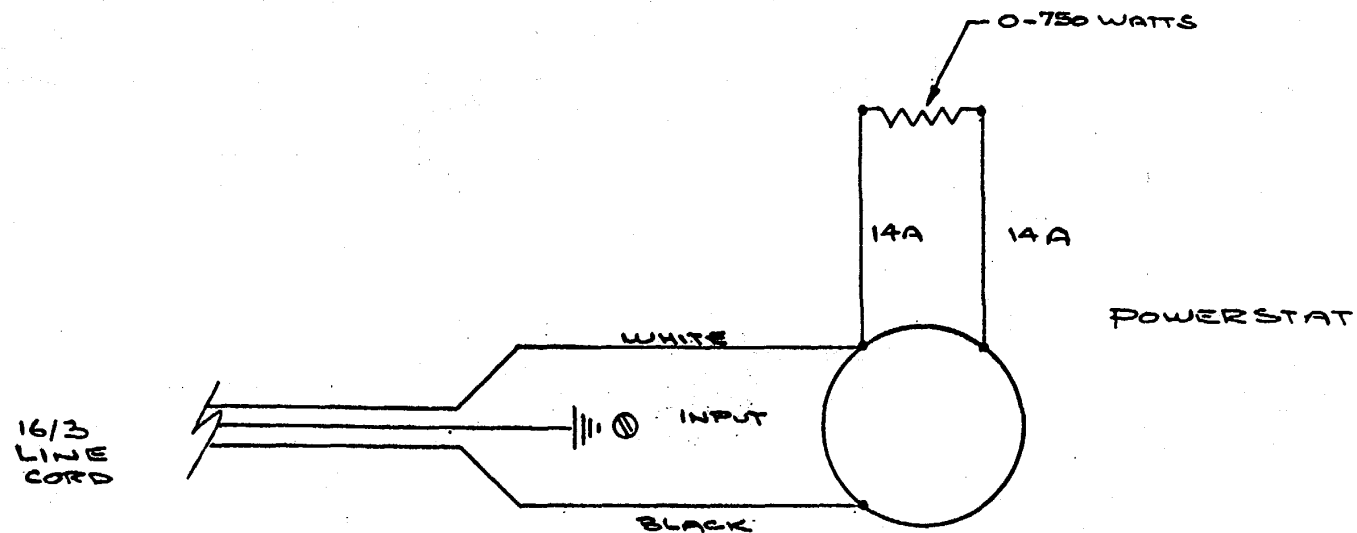
TELEX: 4973677KOEHLER

:

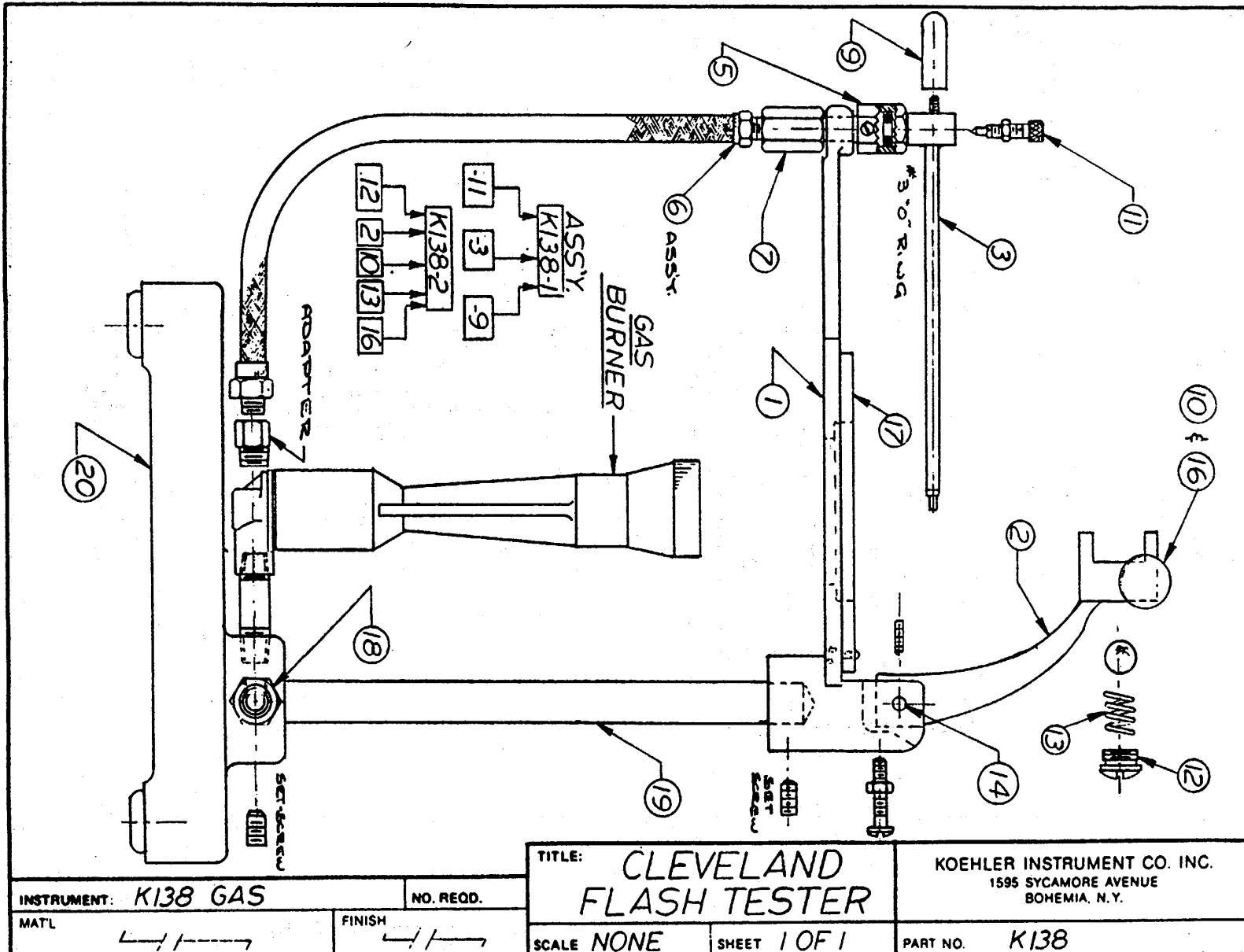


INSTRUMENT: K422		NO. RECD.	TITLE: INFINITE CONTROL		KOEHLER INSTRUMENT CO INC 1595 SYCAMORE AVENUE BOHEMIA, N. Y.	
MATL	HH	FINISH	HH	SCALE NONE	SHEET 1 OF 1	PART NO. K422

K 420 FOR USE WITH K 139
 & K 420A



INSTRUMENT. SEE ABOVE		NO. RECD.	TITLE: POWERTEOL HEATER.		KOEHLER INSTRUMENT CO 1595 SYCAMORE AVENUE BOHEMIA N.Y.	
MAT'L	FINISH		SCALE	SHEET	PART NO K 420	



INSTRUMENT: K138 GAS

MATL 41

FINISH 41

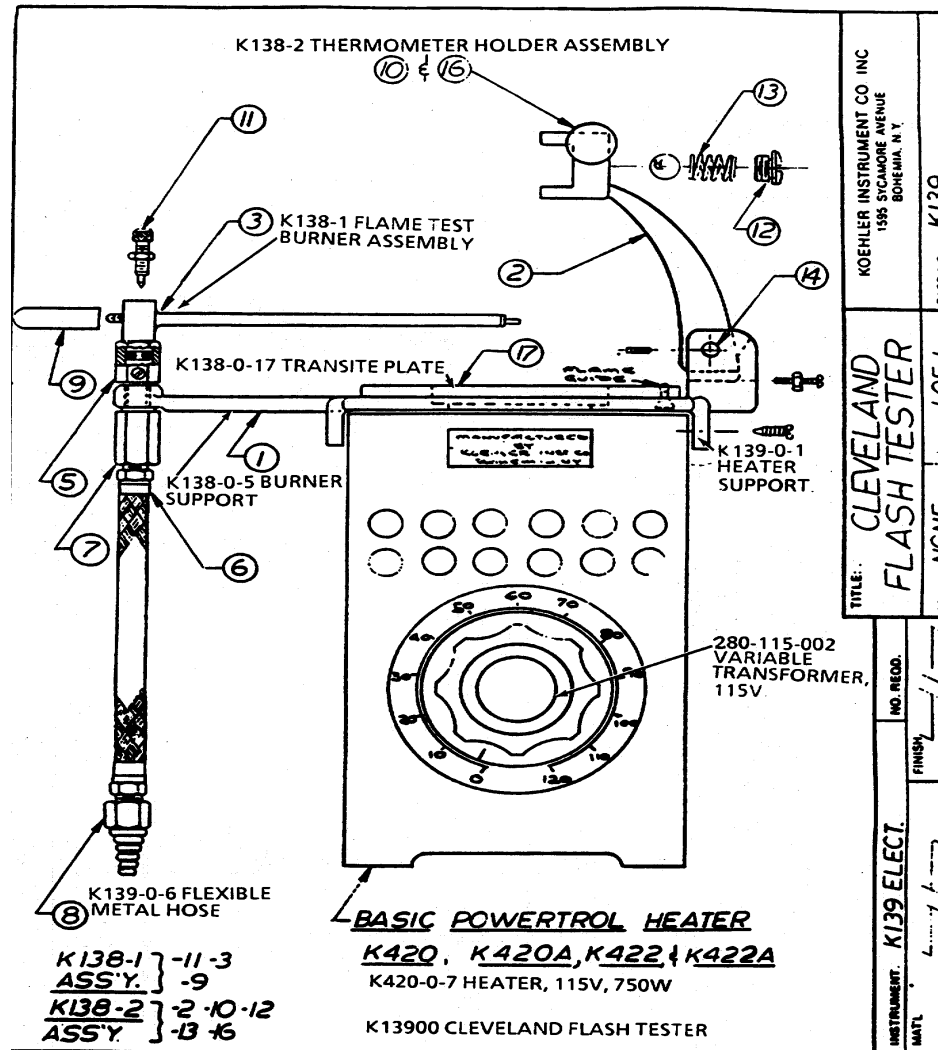
TITLE: CLEVELAND FLASH TESTER

COEHLER INSTRUMENT CO. INC.
1595 SYCAMORE AVENUE
BOHEMIA, N. Y.

SCALE NONE

SHEET 1 OF 1

PART NO. K138



K138-1 } -11-3
 ASS'Y. } -9
 K138-2 } -2-10-12
 ASS'Y. } -13-16

K13800, K13900, K13990, K13980 & K13987

CLEVELAND FLASH TESTER

SPARE PARTS LIST

<u>Part No.</u>	<u>Description</u>	<u>Quantity</u>
<u>K13800</u>		
K138-0-20	Base	1 each
K16040	Natural Gas Burner (Std.)	1 each
K160-4-P	Propane Gas Burner	1 each
K160-4A	Artificial Gas Burner	1 each
K138-0-6	Flexible Hose	1 each
K138-1	Flame Test Burner Assembly	1 each
K138-0-5	Burner Support	1 each
K138-2	Thermometer Holder Assembly	1 each
R138-0-1	Heater Support	1 each
K138-0-19	Aluminum Support Rod	1 each
K138-0-17	Transite Plate	1 each
<u>K13900 & K13990</u>		
K420-0-7	Heater, 115V., 750W.	1 each
K420-0-?A	Heater, 230V., 750W.	1 each
K139-0-6	Flexible Metal Hose	1 each
K138-1	Flame Test Burner Assembly	1 each
K138-0-5	Burner Support	1 each
K138-2	Thermometer Holder Assembly	1 each
K139-0-1	Heater Support	1 each
K138-0-17	Transite Plate	1 each
280-115-002	Variable Transformer, 115V.	1 each
280-230-001	Variable Transformer, 230V.	1 each
<u>K13980 & K13987</u>		
K420-0-7	Heater, 115V., 750W.	1 each
K420-0-7A	Heater, 230V., 750W.	1 each
K139-0-6	Flexible Metal Hose	1 each
K138-1	Flame Test Burner Assembly	1 each
K138-0-5	Burner Support	1 each
K138-2	Thermometer Holder Assembly	1 each
K139-0-1	Cast Iron Support	1 each
K138-0-17	Transite Plate	1 each
255-120-001	Infinite Control (120V.)	1 each
255-240-001	Infinite Control (240V.)	1 each

APPENDIX A

REFERENCES

A-1. Scope. This appendix contains all forms, pamphlets and technical manuals referenced in both the Air mobile and Semitrailer mounted Laboratories.

A-2. Forms.

Recommended Changes to Publications.....	DA Form 2028
.....	DA Form 2028-2
Quality Deficiency Report.....	SF 368
Equipment Inspection and Maintenance Work Sheet.....	DA Form 2404
Hand Receipts	DA Form 2062

A-3. Field Manuals.

Petroleum Testing Facilities:

Laboratories and Kits	FM 10-72
Inspecting and Testing Petroleum Products	FM 10-70
ASTM Test Method Supplement to	FM 10-92C1/C2

A-4. Technical Manuals.

Atlas-Copco Compressor	TM 10-4310-392-13&P
Alcor Jet Fuel Thermal Oxidation Tester Operating and Maintenance Manual	TM 10-6635-210-13&P
Baccarat Gas Alarm and Calibration Data	TM 10-6665-297-13&P
i Brother Portable Typewriter	TM 10-7430-218-13&P
Chemtrix Field Ph Meter	TM 10-6630-237-13&P
Elkay Manufacturing 30 GPH Cooler	TM 10-4130-240-13&P
Emcee Micro-Separometer	TM 10-6640-222-13&P
Foxboro Pressure Recording Gauge	TM 10-6685-365-13&P
Gammon Aqua Glo Water Detector	TM 10-6640-221-13&P
Gammon Mini Monitor Fuel Sampling Kit	TM 10-6630-230-13&P
Jelrus Burn-Out Furnace	TM 10-6640-231-13&P
Koehler Cleveland Open Tester	TM 10-6630-236-13&P
Koehler Cloud and Pour Point Chamber	TM 10-6630-238-13&P
Koehler Copper Strip Corrosion Bomb Bath	TM 10-6640-220-13&P
Koehler Distillation Apparatus	TM 10-6630-233-13&P
Koehler Dropping Point Apparatus	TM 10-6635-211-13&P
Koehler Electric Pensky-Martins Tester	TM 10-6630-231-13&P
Koehler Foaming Characteristics Determination Apparatus.....	TM 10-6640-228-13&P
Koehler Kinematics Viscosity Bath	TM 10-6630-239-13&P
Koehler Tag Closed Cup Flash Tester	TM 10-6630-235-13&P
Lab-Line Explosion Proof Refrigerator	TM 10-6640-219-13&P
Lily Freezer	TM 10-6640-234-13&P
Millipore OM 39 Filter Holder	TM 10-6640-225-13&P
Millipore Vacuum Pump	TM 10-6640-217-13&P
Ohaus Harvard Trip Balance	TM 10-6670-278-13&P
Precision Gas-Oil Distillation Test Equipment	TM 10-6630-219-13&P
Precision General Purpose Water Bath.....	TM 10-6640-229-13&P

Precision High Temperature Bronze Block Gum Bath	TM 10-6630-234-13&P
Precision General Purpose Ovens	TM 10-6640-218-13&P
Precision Heater Instruction Manual and Parts List	TM 10-6640-223-13&P
Precision Oxidation Stability Bath	TM 10-6640-232-13&P
Precision Pensky-Martens Flash Testers	TM 10-6630-231-13&P
Precision Reid Vapor Pressure Bath	TM 10-6640-226-13&P
Precision Slo-Speed Stirrer	TM 10-6640-224-13&P
Precision Universal Centrifuge	TM 10-6640-230-13&P
Precision Universal Penetrometer	TM 10-6640-228-13&P
Sargent-Welch Vacuum Pump	TM 10-4310-391-13&P
Sartorius Analytical Balance	TM 10-6670-277-13&P
Scotsman Cuber	TM 10-6640-227-13&P
Soltec VOM-Multimeter	TM 10-6625-3127-13&P
Teel Self-Priming Centrifugal Pump	TM 10-6640-217-13&P
Teel Submersible Pump	TM 10-4320-320-13&P
Texas Instrument TI-503011 Calculator	TM 10-7420-210-13&P

A-5. Pamphlets.

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

A-6. Miscellaneous Publications.

The Army Integrated Publishing and Printing Program	AR 25-30
Laboratory, Airmobile, Aviation Fuel	MIL-L-52733A(ME)
Apparatus, Instruments, Chemicals, Furniture, and Supplies for Industrial, Clinical, College and Government Laboratories.....	Fisher Scientific Laboratories Catalog
Petroleum-Petrochemical Testing Equipment.....	Precision Scientific Catalog

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 equipment used in precision measurement. Consists of comparisons of two instruments, one of which is a certified standard of knob 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,³ end maintenance actions,⁴ to 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 by 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 component 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 CATEGORY					(5) TOOLS AND EQPT	(6) REMARKS
			C	O	F	H	D		
01	TESTER, FLASH POINT OPEN CUP	INSPECT REPLACE REPAIR	0.1	0.2 0.5				1	A

**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	O, F	TOOL KIT,GENERAL AUTOMOTIVE	5180-00-177-7033	(50980) SC 5180-90- CL-N26

SECTION IV. REMARKS

REFERENCE CODE	REMARKS
A	REPAIR LIMITED TO REPLACEMENT OF DEFECTIVE PARTS

APPENDIX C

COMPONENTS OF END ITEM AND BASIC ISSUE ITEMS LISTS

NOT APPLICABLE

C-1/(C-2 Blank)

APPENDIX D

ADDITIONAL AUTHORIZATION LIST

NOT APPLICABLE

D-1/(D-2 Blank)

**APPENDIX E
EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST**

NOT APPLICABLE

E-1/(E-2 Blank)

By Order of the Secretary of the Army:

CARL E. VUONO
General, United States Army
Chief of Staff

Official:

THOMAS F. SIKORA
Brigadier General, United States Army
The Adjutant General

DISTRIBUTION:

To be distributed in accordance with DA Form 12-21A, Operator, Unit and Direct Support Maintenance requirements for Laboratory, Petroleum, MTD

U.S. GOVERNMENT PRINTING OFFICE: 1990 554-123/20056

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.

TEAR ALONG PERFORATED LINE

PRINTED NAME, GRADE OR TITLE AND TELEPHONE NUMBER

SIGN HERE

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 decigrams = .035 ounce
 1 dekagram = 10 grams = .35 ounce
 1 hectogram = 10 dekagrams = 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
----	------------------------	----------------------------	---------------------	----

This fine document...

Was brought to you by me:



[Liberated Manuals -- free army and government manuals](#)

Why do I do it? I am tired of sleazy CD-ROM sellers, who take publicly available information, slap “watermarks” and other junk on it, and sell it. Those masters of search engine manipulation make sure that their sites that sell free information, come up first in search engines. They did not create it... They did not even scan it... Why should they get your money? Why are not letting you give those free manuals to your friends?

I am setting this document FREE. This document was made by the US Government and is NOT protected by Copyright. Feel free to share, republish, sell and so on.

I am not asking you for donations, fees or handouts. If you can, please provide a link to liberatedmanuals.com, so that free manuals come up first in search engines:

<A HREF=<http://www.liberatedmanuals.com/>>Free Military and Government Manuals

- Sincerely
Igor Chudov
<http://igor.chudov.com/>
- [Chicago Machinery Movers](#)