TECHNICAL MANUAL

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

PRECISION UNIVERSAL CENTRIFUGE

MODEL TS-67310 AU 10
(48619) 67310

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

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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-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.

Precision®
Instruction Manual TS-67310 AU 10

Precision Scientific

Precision Scientific Inc. 3737 W. Cortland St. Chicago, IL 60647 - 312-227-2660 Telex: 4330120 (ITT), 254028 (WU)· Fax: 312-227-1828

Universal Centrifuge Catalog 67310, 67318

Introduction

Your satisfaction and safety are important to PRECISION SCIENTIFIC and a complete understanding of this unit is necessary to attain these objectives.

As the ultimate user of this apparatus, it is your responsibility to understand its proper function and operational characteristics. This instruction manual should be thoroughly read and all operators given adequate training before attempting to place this unit in service. Awareness of the stated cautions and warnings, and compliance with recommended operating parameters-- together with maintenance requirements-are important for safe and satisfactory operation. The unit should be used for its intended application; alterations or modifications will void the Warranty.

WARNING

As a routine laboratory precaution, always wear safety glasses when working with this apparatus.

This product is not intended, nor can it be used, as a sterile or patient connected device. In addition, this apparatus is not designed for use in Class I, II, or III locations as defined by the National Electrical Code.

Unpacking and damage

Save all packing material if apparatus is received damaged. This merchandise was carefully packed and thoroughly inspected before leaving our factory. Responsibility for its safe delivery was assumed by the carrier upon acceptance of the shipment; therefore, claims for loss or damage sustained in transit must be made upon the carrier by the recipient as follows:

Visible Loss or Damage: Note any external evidence of loss or damage on the freight bill, or express receipt, and have it signed by the carrier's agent. Failure to adequately describe such external evidence of loss or damage may result in the carrier's refusing to honor your damage claim. The form required to file such a claim will be supplied by the carrier.

Concealed Loss or Damage: Concealed loss or damage means loss or damage which does not become apparent until the merchandise has been unpacked and inspected. Should either occur, make a written request for inspection by the carrier's agent within 15 days of the delivery date; then file a claim with the carrier since the damage is the carrier's responsibility.

By following these instructions care- fully, we guarantee our full support of your claim to be compensated for loss from concealed damage.

DO NOT -- FOR ANY REASON -- RETURN THIS UNIT WITHOUT FIRST OBTAINING AUTHORIZATION. In any correspondence to PRECISION SCIENTIFIC please supply the nameplate data, including catalog number and serial number.

General information

These instructions encompass the models listed below with their specific electrical characteristics:

Cat. No.	Volts	Hz	Watts	Amps
67310	120	50/60	460	4.2
67318	220	50/60	460	2.1

Features are incorporated in the Precision Universal Centrifuge for utmost convenience and safety in preparing separations. With a capability of accepting 1/2 to 100 ml tubes, the Centrifuge handles a wide variety of laboratory tests in clinical, food testing, petroleum, chemistry, research, and other applications.

The stepless solid-state speed control gives an accurate RPM digital display of the rotating head. Speed settings are repeatable. Power assist braking is automatic; simply push the Stop button.

In "Automatic" mode, time is preset for any duration up to 99 minutes. The digital display timer counts down to zero (0) time, and the unit stops automatically. ("Manual Stop" can be used at any time.) In "Manual" mode, the digital display timer counts elapsed time 0-99 minutes. If the Centrifuge is not stopped manually during that interval, the timer automatically returns to zero and the Centrifuge continues operating uninterrupted.

For personal safety, the cover is equipped with an electronic safety latch. The cover cannot be opened if the Centrifuge is operating or the line switch is in the "Off" position. Conversely, the Centrifuge will not operate if the cover is open.

To meet the greatest variety of test requirements, this unit is designed with a four-place horizontal head. Places are permanently numbered for sample identification after spinning.

Exterior housing construction is made of heavy steel. The louvered design relieves interior air resistance, and rubber feet are provided to dampen vibration and sound.

WARNING
The Centrifuge is <u>not</u> explosion proof.

The following ASTM tests can be performed on the standard units with corresponding size trunnion rings (see Accessories):

ASTM D91 Test for Precipitation Number
ASTM D96 Test for Water and Sediment by Centrifuge
ASTM D483 Test for Unsulfonated Residue of Plant Spray Oils
ASTM D484 Hydrocarbon Drycleaning Solvents
ASTM D872 Sulfonation Index of Road Tars
ASTM D875 Calculation of Olefins and Aromatics in Petroleum Distillates from Bromine Number and Acid Absorption
ASTM D893 Test for Insolubles in Used Lubricating Oils
ASTM D1019 Olefinic Plus Aromatic Hydrocarbons in Petroleum Distillates
ASTM D1290 Sediment in Water-Emulsion Polishes by Centrifuge
ASTM D1796 Water and Sediment in Crude Oils and Fuel Oils by Centrifuge

Explanation of controls

MANUAL/AUTOMATIC SWITCH: When operated in the "Manual" mode, the Centrifuge will operate continuously until the "Stop" button is pressed.

EXPLANATION OF CONTROLS (Contd.)

When operated in the "Automatic" mode, and in conjunction with Test Time digital control, the Centrifuge will operate continuously until the selected time has elapsed or until unit is manually stopped.

NOTE

The "Automatic" mode can be overridden any time during its operation by simply pressing the "Stop" button.

TEST TIME (Automatic only): When operated in the "Automatic" mode, up to 99 minutes can be selected via the digital thumbwheel "Test Time" switch. The associated digital display, located above the "Test Time" switch, reads out the amount of time remaining for the Centrifuge to continue in "Automatic" mode. If the "Stop" switch is pressed during operation, the digital display will return to the time originally selected via the digital thumbwheel "Test Time" switch.

RUN SWITCH: Starts Centrifuge operation in "Manual" or "Automatic" mode. The green "Run" button will glow when switch is activated.

NOTE

Do not press "Run" button more than once in succession; otherwise, unit will shut down. If "Run" button should be pressed more than once consecutively, press "Stop" button; wait at least five (5) seconds; then press "Run" button again.

SPEED/BRAKE CONTROL (Min./Max.): This control has a dual function: (1) it precisely controls the speed of the Centrifuge (operating range should be 100 to 2400 rpm's-see page 7 for chart); and (2) it brakes centrifuging for 5 seconds before allowing Centrifuge to coast to a complete stop.

NOTE

Braking time will always be 5 seconds at 100 rpm's or above, whether after elapsed time in the "Automatic" mode, or when the "Stop" button is utilized in either mode.

The true revolutions/minute are read out in the "Speed" (rpm) display window, located directly above the "Speed/ Brake Control". To increase rpm's, turn control knob clockwise from "Min" to "Max".

STOP SWITCH: A power-assist braking switch that stops centrifuge operation in either the "Manual" or "Automatic" mode. When activated, the red button will glow and simultaneously initiate a 5-second braking action before coasting to a complete stop.

NOTE

The power-assist braking feature can be overridden by quickly turning the "Speed/Brake Control" knob CCW to "Min" and simultaneously pressing the "Stop" button. Since the braking action is a function of speed (rpm's), and at "Min" there is no speed, the Centrifuge will be permitted to slowly coast to a complete stop--without any braking. (If in the "Automatic" mode, press "Stop" button a couple of seconds before total time has elapsed.)

Installation

Location: Unit has no exposed moving parts and can be placed on a bench or a table convenient to a wall socket.

The most uniform operating conditions and results will be obtained by placing unit on a level, solid surface in an area remote from rapidly changing ambient conditions.

INSTALLATION (Contd.)

Electrical Conditions: Important (Please Read Carefully)

WARNING
For personal safety this apparatus must be properly grounded.

The power cord of the remote control unit is equipped with a three-prong (grounding) plug, which mates with a standard three-prong (grounding) wall receptacle to minimize the possibility of electric shock hazard from this apparatus. The user should have the wall receptacle and circuit checked by a qualified electrician to be sure the receptacle is properly grounded.

Where a standard two-prong wall receptacle is encountered, it is the personal responsibility and obligation of the user to have it replaced with a properly grounded three-prong wall receptacle.

WARNING
Do not under any circumstances cut or remove the third (ground) prong from the power cord. Do not use a two-prong adapter plug.

Determine the total amount of current being used by other apparatus connected to the circuit that will be used for this apparatus. It is critical that the added current demand (see nameplate) of this and other equipment used on the same circuit does not exceed the rating of the fuse or circuit breaker.

CAUTION
Make sure power supply is of the same voltage as specified on nameplate.

CAT. NO. 67318, 220 VOLT UNIT ONLY

Power line sources of 200 volts or greater should be connected to Auto Transformer T1 as follows:

Line Voltage	Transformer T1 To Unit
200	Blue lead at Low
220	Blue lead at Low
240	Blue lead at Med.

NOTE
Catalog No. 67310 is wired for 120 volt, 60 Hz. operation; 67318 for 220 volt, 50 Hz. operation. The 60 Hz. operation can be modified to operate on 50 Hz. by: (1) locating the Auto/Manual Timer PCB (at rear of control housing); (2) locating jumper wire connected to J15, and (3) disconnecting jumper wire from J15 and connecting it to J14. The PCB is now wired for 50 Hz. operation.

Operation

NOTE
To open lid, unit must be connected to power source and line switch turned "On". In the event of power failure, insert screw driver through hole located in front of lid handle, and push the solenoid plunger forward to release latch.

Loading: It is important to have a balanced load in position each time unit is operated. This means the number of tubes used for any centrifuge operation should be "even" and their respective positions should be directly opposite one another. Example: If only one actual sample is to be centrifuged, another tube should be filled with similar liquid to the same level and placed in the head position directly across from the sample. If three samples are to be centrifuged, a fourth tube should be added to counterbalance the quadrant. The positions are numbered one through four. This will permit easy reference to the sample or samples after centrifuging is completed.

OPERATION (Contd.)

CAUTION

When inserting a centrifuge tube, be sure bottom of tube is in contact with padding. If not, insert additional padding of felt or sponge rubber.

To operate Centrifuge in Manual mode:

WARNING

When closing cover before starting unit, be sure no loose clothing or jewelry can be caught between cover and housing. Turn "Speed/Brake Control" fully counterclockwise.

1) Connect line cord to power source and turn line switch "On".
2) Close lid cover; otherwise unit will not start.
3) Press operating mode switch to "Manual".
4) Press "Run" button to start operation.
5) Turn "Speed/Brake Control" knob clockwise to the desired rpm's.

To operate Centrifuge in Automatic mode:

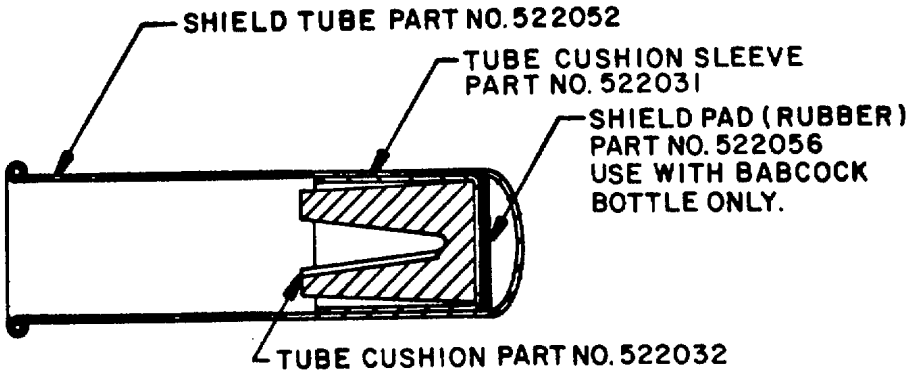
WARNING

When closing cover before starting unit, be sure no loose clothing or jewelry can be caught between the cover and housing. Turn "Speed/Brake Control" fully counterclockwise.

1) Connect line cord to power source and turn line switch to "On".
2) Close lid cover; lid must be closed to start.
3) Press operating mode switch to "Automatic".
4) Set "Test Time" thumbwheel switches to desired operating time (1 to 99 minutes).
5) Press "Run" button to start operation.
6) Turn "Speed/Brake Control" knob clockwise to desired rpm's.

To stop Centrifuge manually or interrupt automatic operation, press red "Stop" button switch.

Padding of the Shields: Each of the tube shields (see "Accessories") is furnished with a felt or rubber insert. It is important that these inserts be used with the appropriate tube and shield.



SHIELD AND TUBE CUSHION ASSEMBLY

FOR CAT. NO. 67359

Servicing

Troubleshooting:

WARNING

Service should be per- formed by a qualified technician. Disconnect line cord before re- placing any components.

Problem 1: No power to unit.

Symptom 1: "Run" pushbutton "on", lamp "out", motor doesn't start.
Cause 1: Open fuse(s) open line switch (Sl), or loose line cord terminals.
Remedy 1: Replace fuse(s), activate or replace line switch, or tighten TB1 terminals.

Problem 2: Power to unit but head does not rotate (centrifuge).

Symptom 1: Run pushbutton and lamp "on", Stop pushbutton "off", motor armature doesn't rotate.
Cause 1: Lid cover not tightly closed.
Remedy 1: Close lid cover.
Cause 2: Worn motor brushes.
Remedy 2: Replace motor brushes.
Cause 3: Microswitch (S5) failed.
Remedy 3: Replace microswitch.
Cause 4: Motor or motor control (A20) failed.
Remedy 4: Replace malfunctioning part(s).
Cause 5: Microswitch not properly positioned.
Remedy 5: Realign microswitch and tighten screws.

Problem 3: Digital display malfunctions.

Symptom 1: Display digits "Time" or "Speed" do not register, or they register partial digits.
Cause 1: IC failed on Auto/Manual Timer Control PCB (AlO), or on Time and Tach PCB (A50).
Remedy 1: Replace corresponding printed circuit board.

Parts Replacement:

WARNING

Replacement of parts should be performed by a qualified technician. Disconnect the line cord before replacing. any components.

To replace parts in the control housing assembly, remove the six (6) housing cover screws and remove cover. Refer to Figure 5A and Parts List to deter- mine which parts are located in the control housing assembly.

To replace parts located in power sup- ply chassis, remove screw from each one of the four (4) rubber feet and remove bottom cover from inside of chassis body assembly.

To remove motor assembly from Centrifuge, remove the four (4) mounting screws from bottom of motor base plate (refer to Figure 5B). Before removing motor and head from inside of unit, disconnect lead wires and timer disc.

CAUTION

Do not lay unit on its side; denting of louvered flange may result.

SERVICING (Contd.)

Maintenance:

The design of the Centrifuge is such that only a minimum of maintenance is required.

Occasionally check the two (2) motor brushes for wear, which are accessible from top of unit through the cover unit. Both brushes are located on side of motor housing, near bottom of mounting flange.

To remove, turn brush holder counter- clockwise and examine for wear. Replace brushes if there is remaining 1/8" or less of carbon.

NOTE

When removing brushes, observe orientation of wear characteristics. The curved surface must match the curved armature surface.

ACCESSORIES PERFORMANCE DATA

Accessories	RPM Range	RCF Maximum	Rotating Tip (Shield) Radius Inches (mm)
With (4) trunnion rings, Cat. No. 67311, and (7) shields, Cat. No. 67357	100-2400	1290	7.9 (201)
With (4) trunnion rings, Cat. No. 67312, and (2) shields, Cat. No. 67358	100-2400	1415	8.6 (218)
With (4) trunnion rings, Cat. No. 67313, and (1) shield, Cat. No. 67359	100-2100	1305	10.4 (264)
With (4) trunnion rings, Cat. No. 67314, and (1) shield, Cat. No. 67360	100-2400	1485	9.1 (231)

Accessories

NOTE Unit furnished without trunnion rings or shields. Select by pair from ordering information provided below.

The following trunnion rings and tube shields indicate one (1) each as specified. For proper Centrifuge balance, rings and shields must be used in pairs.

Cat No.	Description (Each number is for one piece only)
	Trunnion Ring Assembly
67311	Holds seven 15 ml tube shields, Cat. No. 67357.
67312	Holds two 50 ml tube shields, Cat. No. 67358.
67313	Holds one 100 ml tube shield, Cat. No. 67359.
67314	Holds one 100 ml tube shield, Cat. No. 67360.
	Tube Shields
67357	15 ml, aluminum w/felt cushion; fits trunnion ring, Cat. No. 67311.
67385	5 ml, insert accessory for tube shield, Cat. No. 67357; holds 13 x 105 mm or 13 x 100 mm tubes.
67386	5 ml, insert accessory for tube shield, Cat. No. 67357; holds 13 x 75 mm or 13 x 63 mm tubes.
67387	3 ml, insert accessory for tube shield, Cat. No. 67357; Holds 11 x 75 mm or 10 x 75 mm tubes.
67389	Shield assembly insert accessory for tube shield, Cat. No. 67357. Holds 1/2 ml tube (5 x 60 mm); 1 ml tube (6 x 60 mm); or 5 ml tube (10 x 62 mm).
67358	50 ml, aluminum w/felt cushion; fits trunnion ring, Cat. No. 67312.
67359	100 ml, w/rubber cushion in aluminum insert for cone-shaped tubes 8" long, plus rubber pad for 6-1/2" Babcock bottles; fits trunnion ring, Cat. No. 67313.
67360	100 ml, pear-shaped, aluminum w/felt cushion; fits trunnion ring, Cat. No. 67314.

Revolutions Per Minute

Vs.

Relative Centrifugal Force

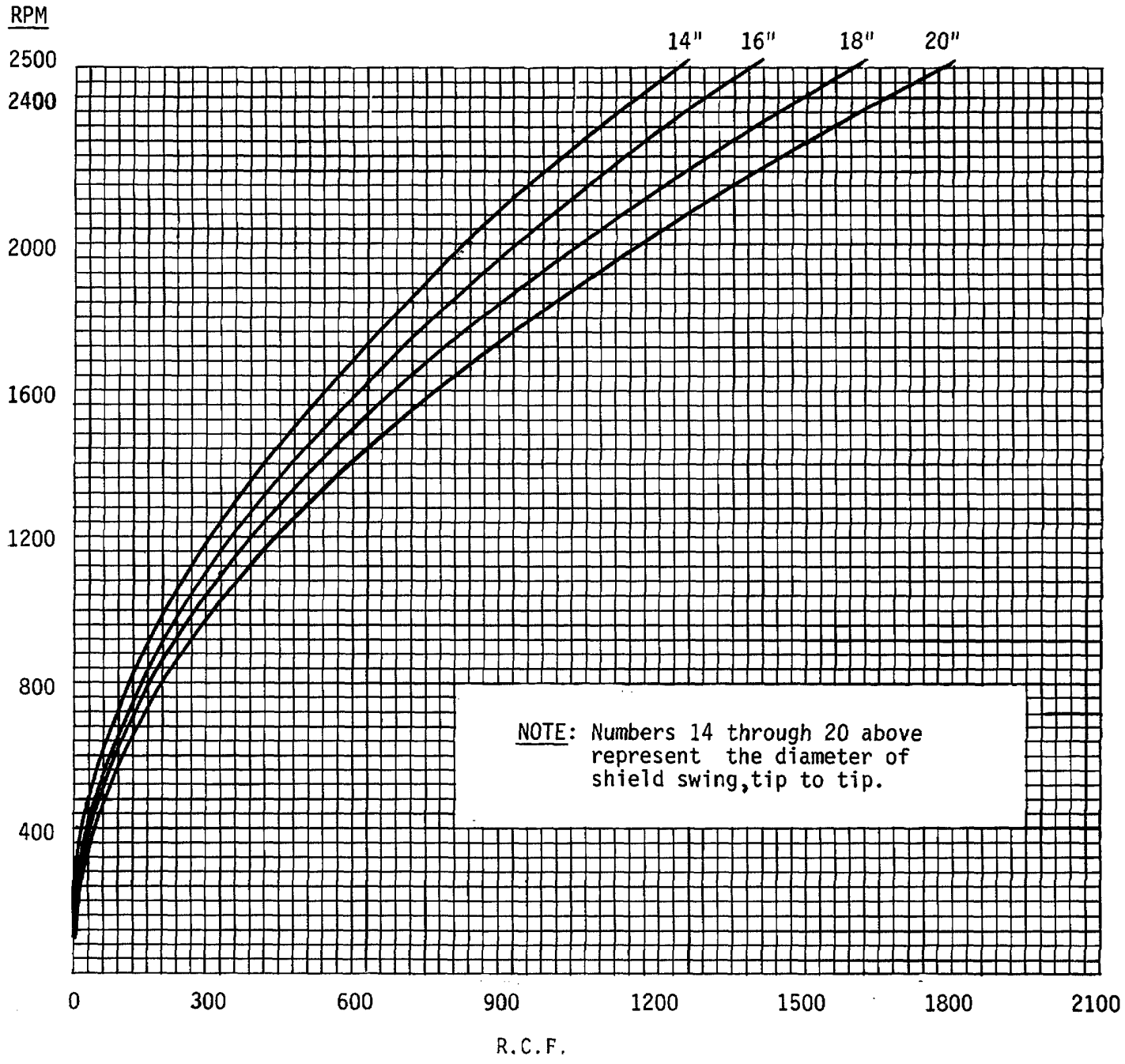


FIGURE 1

PARTS LIST

Item No.	Symbol	Description	Part Number	
1.	A10	Auto/Manual Timer PCB	00819701	
2.	A50	Time and Tach Display PCB	00819401	
3.	A60	RPM Detector PCB	00330901	
4.	DS2,3	Lamp, 28V, "Run" and "Stop"	234055	
5.	F1,2,3	Fuse, 8 Amp, 250V	289064	
6.	L1	Solenoid, Door Latch, 120 VAC	297025	
7.	R1	Resistor, 65 Ohms, 160W	238326	
8.	R2	Potentiometer, "Speed/Brake Control", 5K	00841101	
9.	S1	Switch, D.P.S.T., "Line"	240304	
10.	S2,3	Switch, 2P, Pushbutton, "Run" & "Stop"	240442	
11.	S4	Switch, D.P.D.T. "Manual/Automatic"	240412	
12.	S5	Microswitch, Lid Interlock	240419	
13.	S6	Thumbwheel Switch, "Test Time"	240411	
14.	T1	Autotransformer (220V only)	225180	
			Serial Number	
			12 & Below	13
15.	A20	Motor Speed Control PCB	540965 (KIT)	323035
16.	B1	Motor Assembly	00829501	00829502
17.		Disc, Timer	00829901	
18.		Motor	00894401	223687
19.		Roll Pin 1/8 x 3/4	N/A	214101
20.		Brush & Spring Assy. (2 Required)	223504	N/A
21.		Brush Holder (2 Required)	223505	N/A
22.		Brush Cap (2 Required)	223506	N/A
23.		Motor Cover	522002P	N/A
24.		Spring	522008	N/A
25.		Shaft Extension (L.H. Threads)	00846901	N/A
26.	K1	Relay, D.P.D.T., 25 Amp	248199	—
27.	K2	Relay, S.P.S.T., 25 Amp	248278	—
28.	K1,2	Relay, S.P.D.T., 20 Amp	—	248347
29.	RC1,2	RC Network Assembly	00841001	N/A
30.	RC3	RC Network Assembly	00840901	N/A

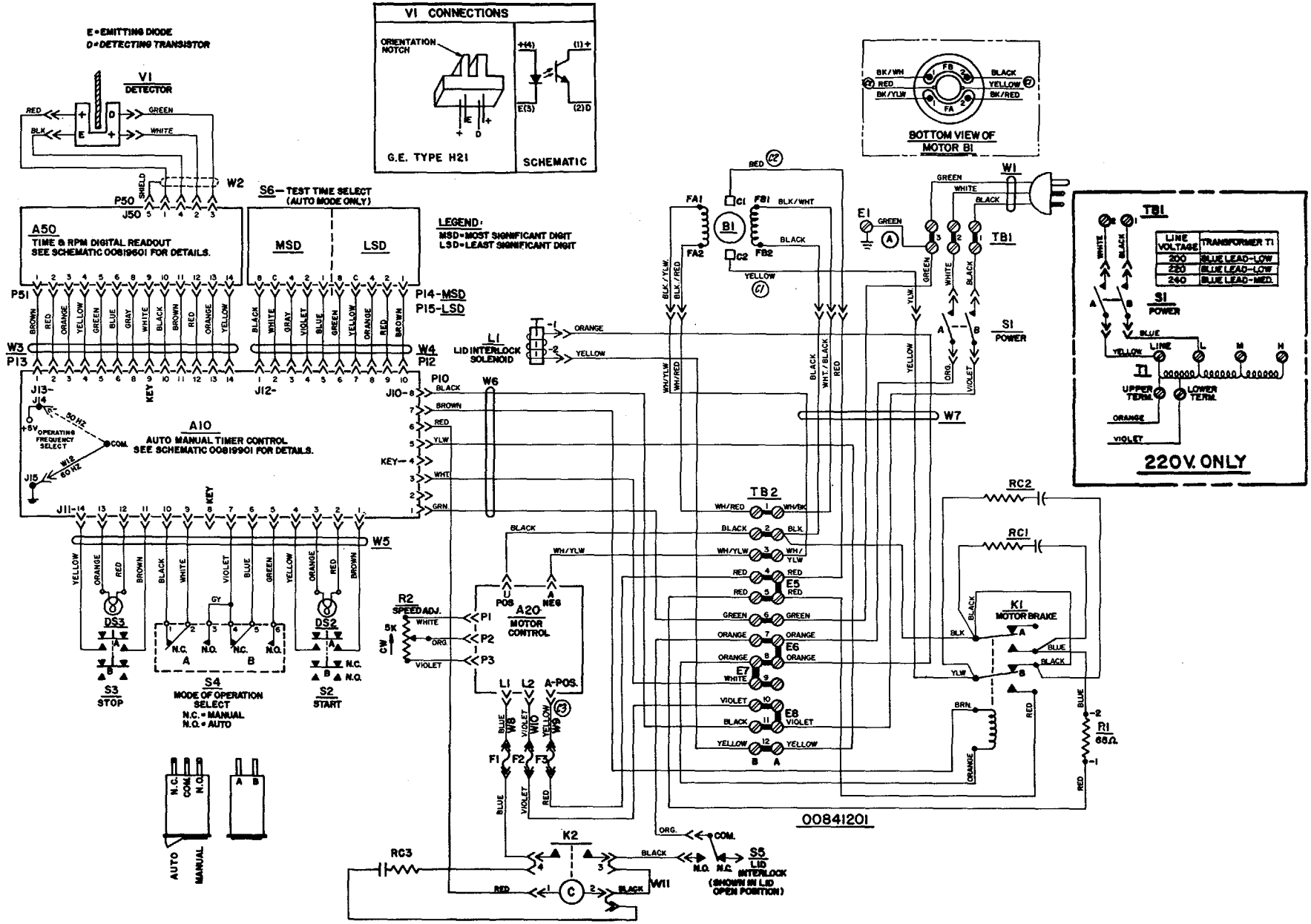


FIGURE 2. WIRING DIAGRAM

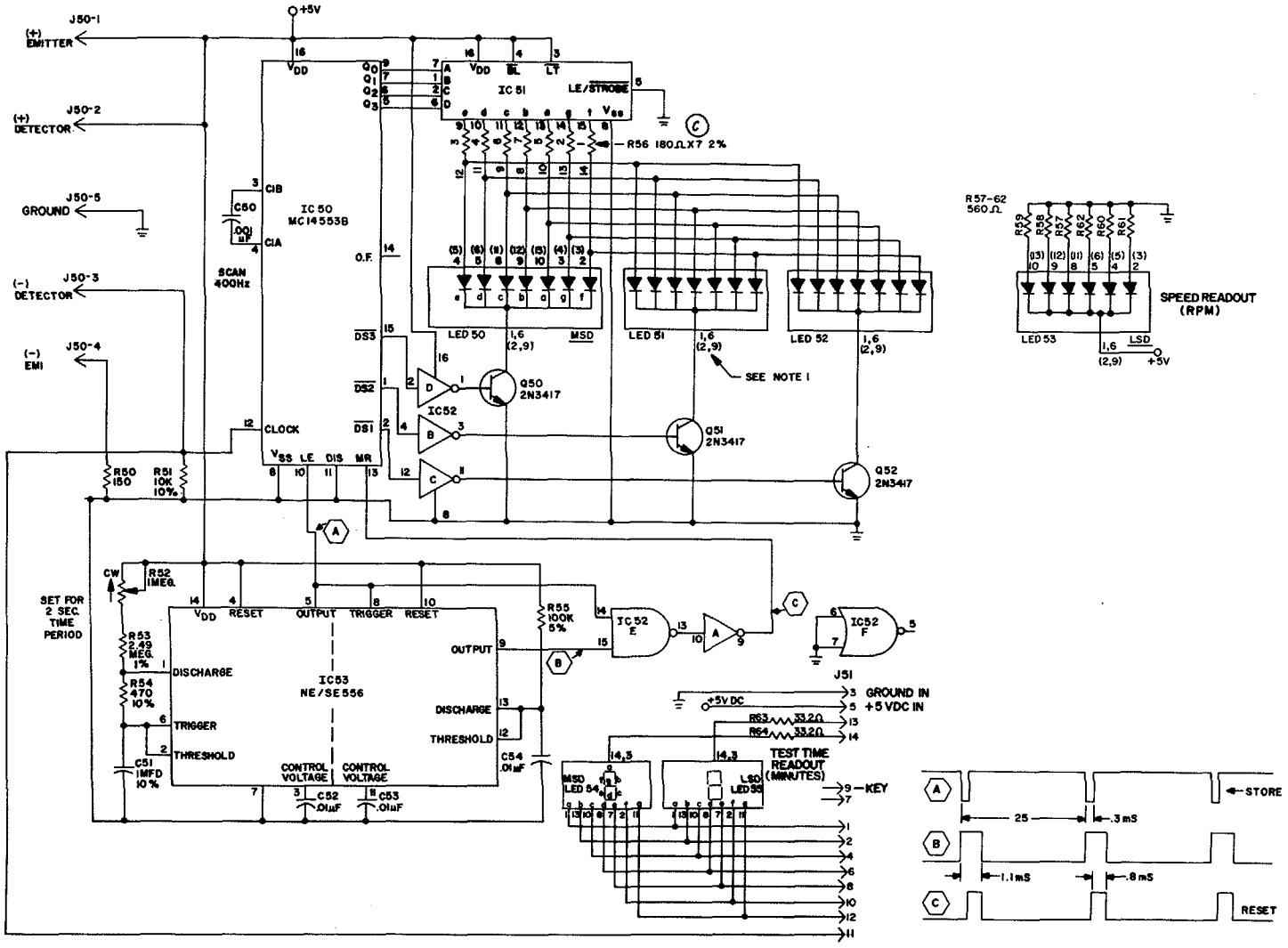


FIGURE 3. TIME/TACH DISPLAY PCB SCHEMATIC

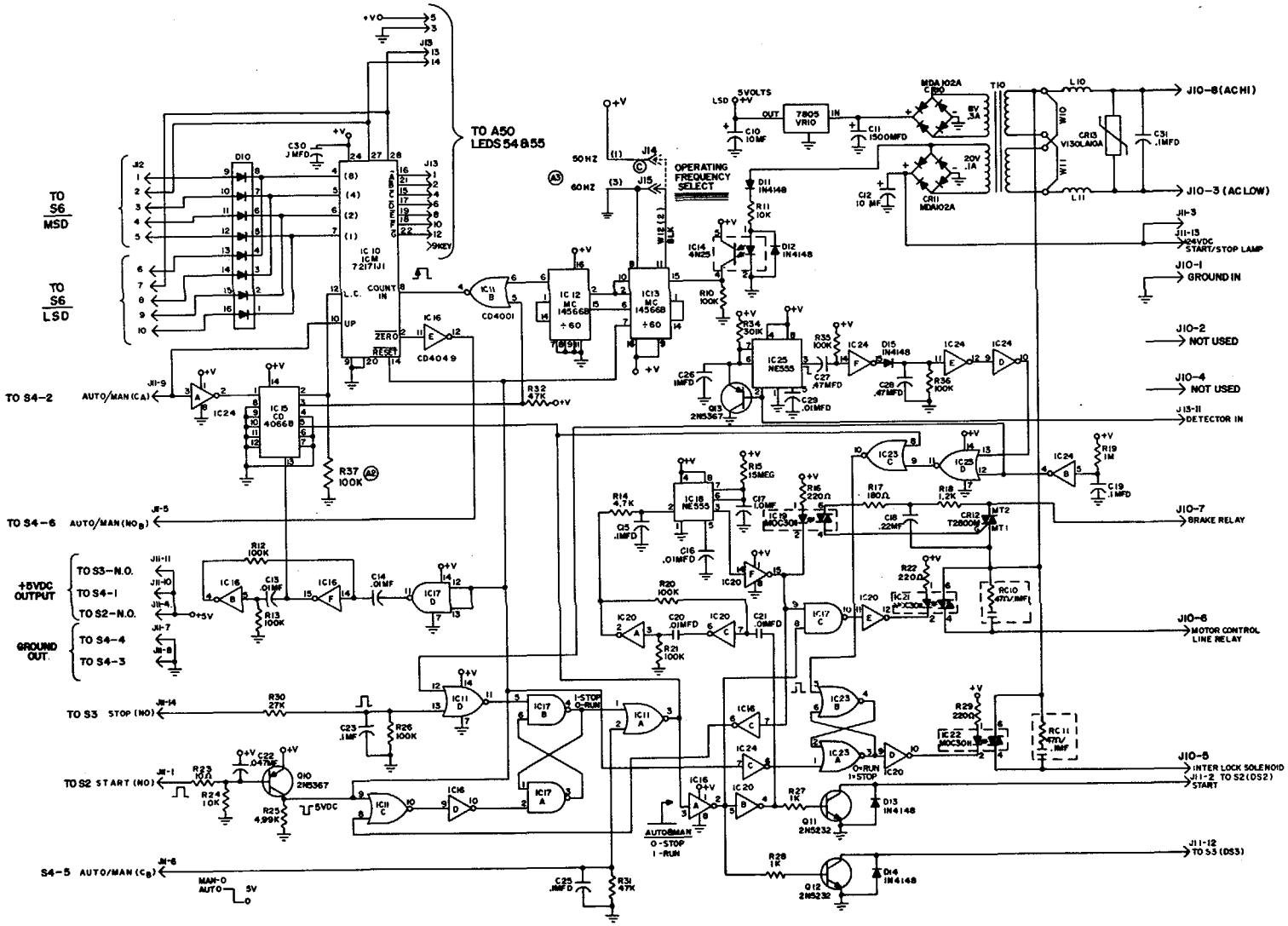


FIGURE 4. AUTO/MANUAL TIMER CONTROL PCB SCHEMATIC

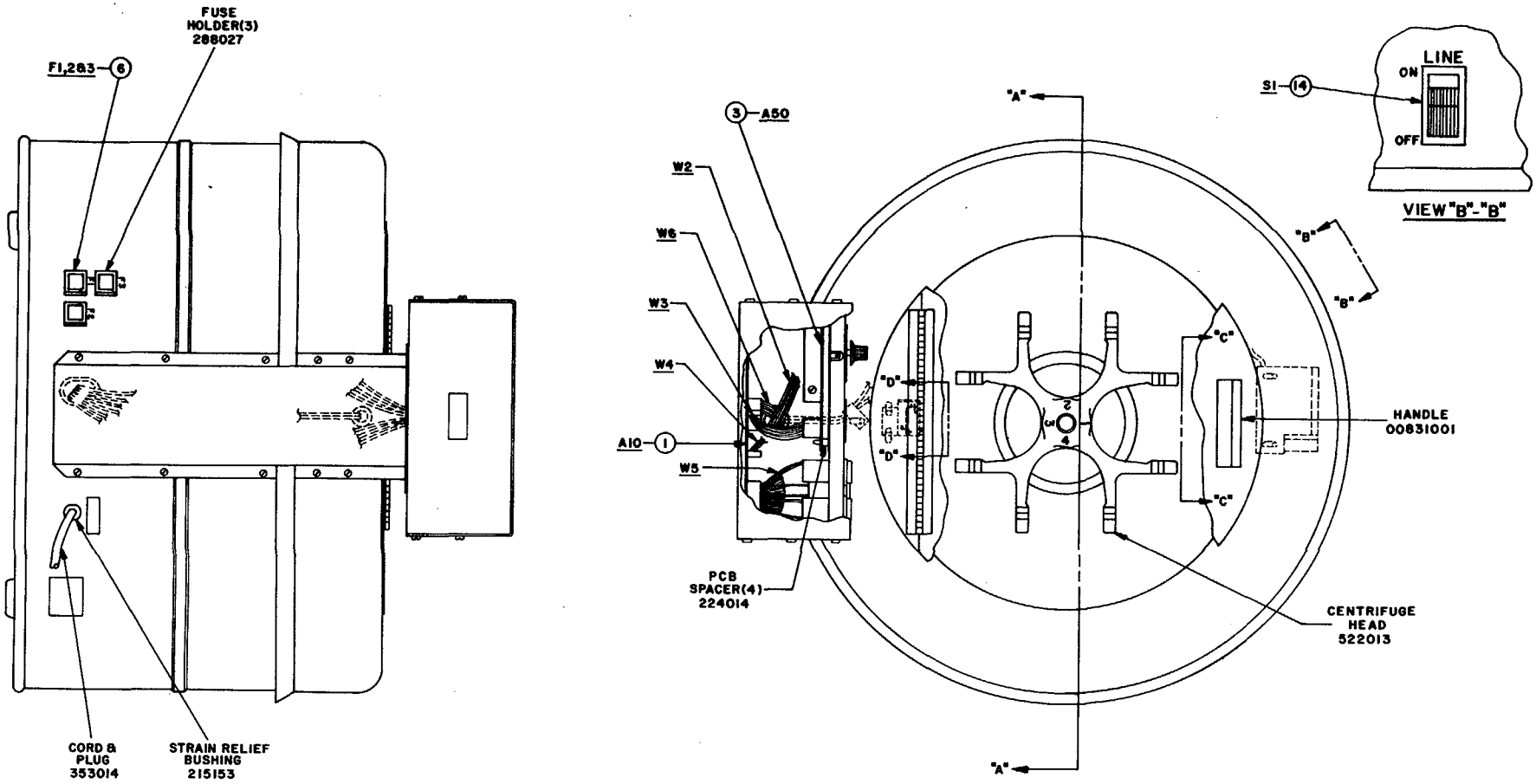


FIGURE 5A. ASSEMBLY DRAWING (REAR AND TOP VIEWS)

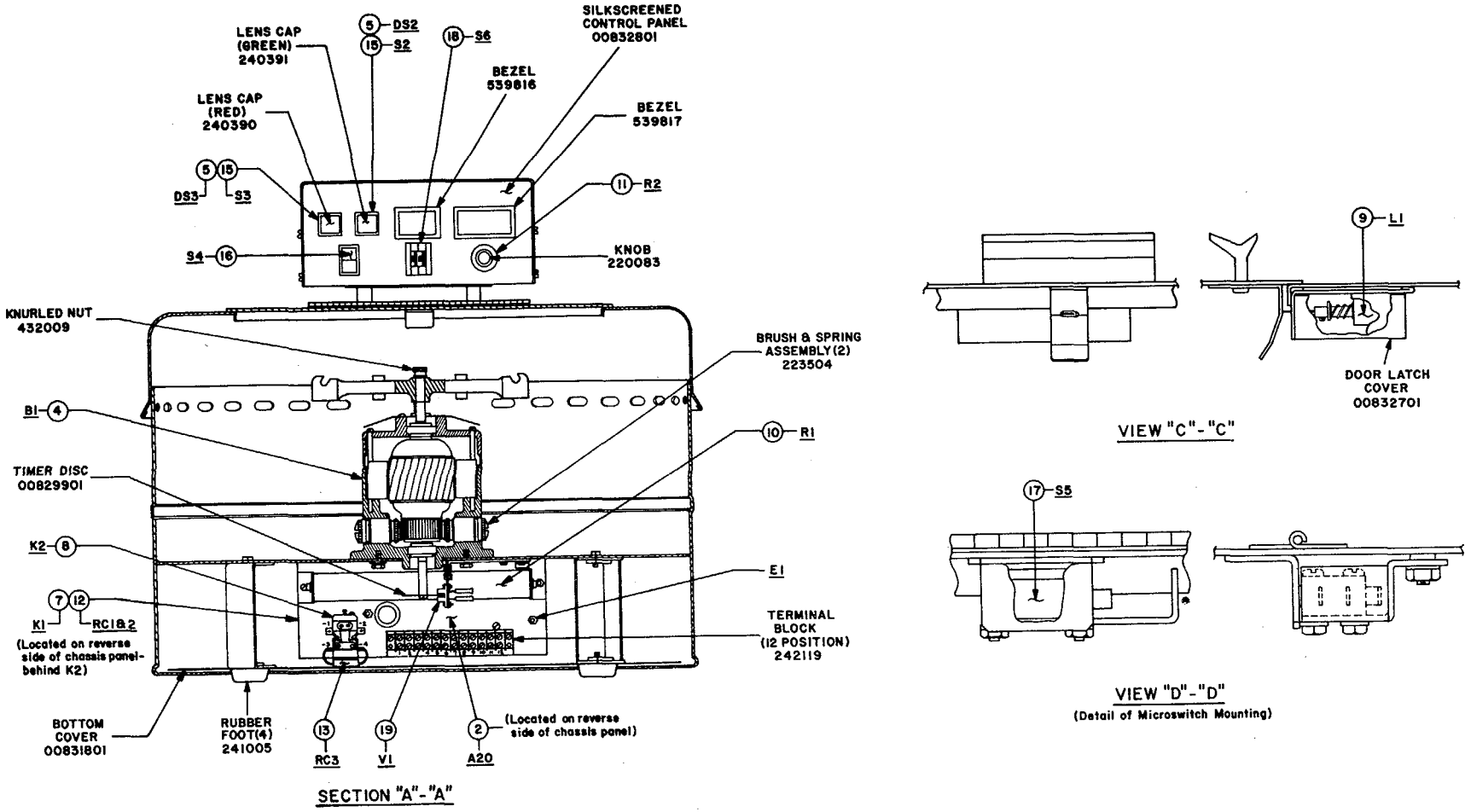
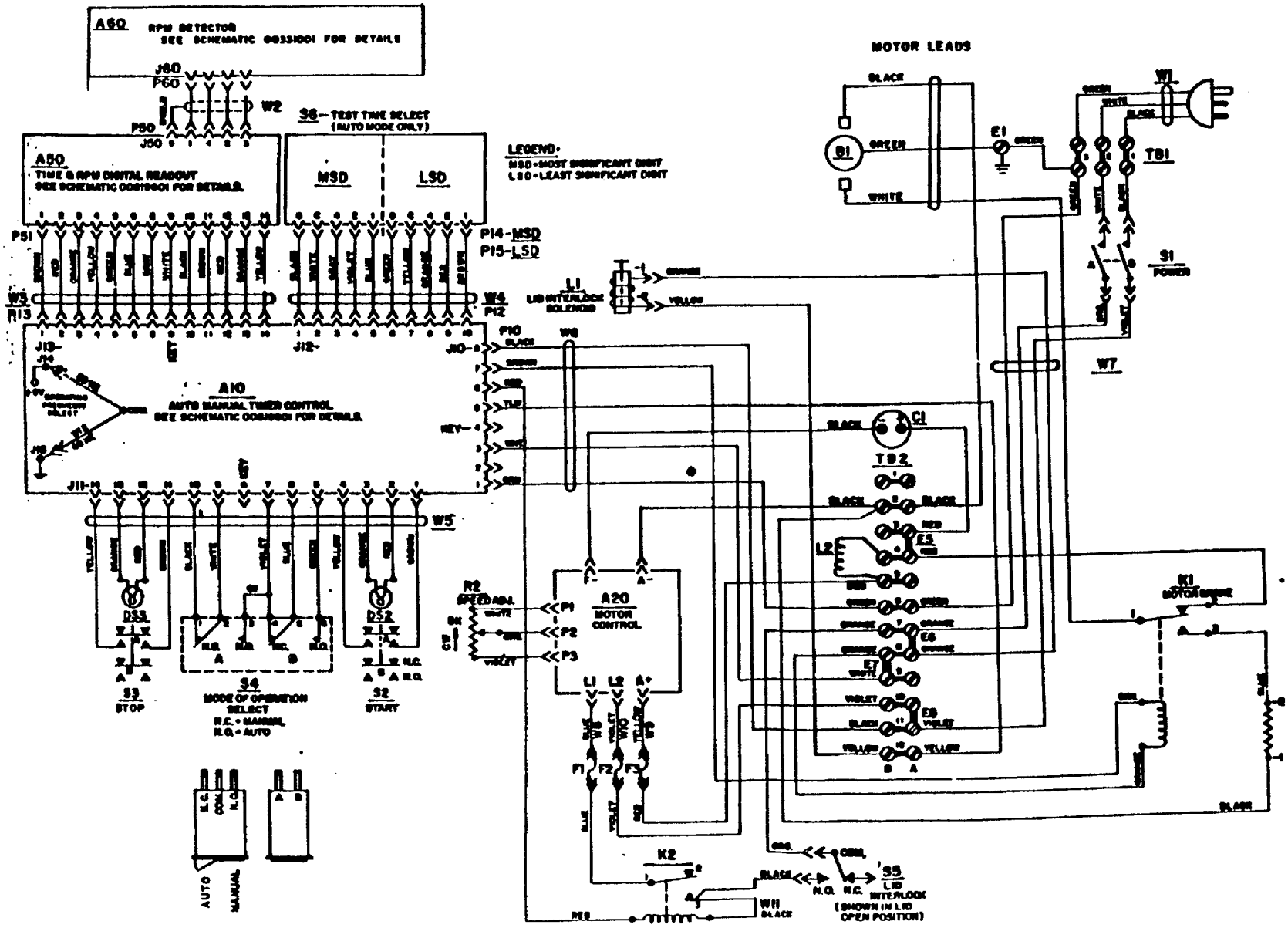


FIGURE 5B. ASSEMBLY DRAWING (SECTION VIEW)



WIRING DIAGRAM FOR SERIAL NO. 13

Exclusive Precision® Warranty

PRECISION SCIENTIFIC warrants its products against defects in material or in workmanship, when used under appropriate conditions and in accordance with appropriate operating instructions for a period of no less than one (1) year from the date of delivery of the products.

Sole obligation of PRECISION SCIENTIFIC shall be to repair or replace at our option, FOB factory or locally, without charge, any part(s) that prove defective within the warranty period, provided the customer notifies PRECISION SCIENTIFIC promptly and in writing of any such defect. Compensation for labor by other than PRECISION SCIENTIFIC employees will not be our obligation. Part(s) replacement does not constitute an extension of the original warranty period.

> PRECISION SCIENTIFIC MAKES NO WARRANTY OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, OR ANY OTHER WARRANTY, EXPRESSED OR IMPLIED, AS TO THE DESIGN, SALE, INSTALLATION, OR USE OF ITS PRODUCTS, AND SHALL NOT BE LIABLE FOR CONSEQUENTIAL DAMAGES RESULTING FROM THE USE OF ITS PRODUCTS.

PRECISION SCIENTIFIC will not assume responsibility for unauthorized repairs or failure as a result of unauthorized product modifications, or for repairs, replacements, or modifications negligently or otherwise improperly made or performed by persons other than PRECISION SCIENTIFIC employees or authorized representatives.

While our personnel are available to advise customers concerning general applications of all manufactured products, oral representations are not warranties with respect to particular applications and should not be relied upon if inconsistent with product specifications or the terms stated herein.

In any event, the terms and conditions contained in PRECISION SCIENTIFIC formal sales contracts shall be controlling; and any changes must be in writing and signed by an authorized executive of PRECISION SCIENTIFIC.

All defective components will be replaced without charge one (1) year from the date of delivery. There will be no charge for labor if the apparatus is returned to the factory prepaid.

Conditions and qualifications of the warranty statement shall prevail at all times.

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
Bacharach Gas Alarm and Calibration Data	TM 10-6665-297-13&P
Brother Portable Typewriter	TM 10-7430-218-13&P
Chemtrix Field Ph Meter	TM 10-630-237-13&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 Kinematic 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 106640-232-13&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
Sartorious 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 equipments 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, including fault location/troubleshooting,2 removal/installation, and disassembly/assembly procedures3 and maintenance actions4 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 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 I. 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 componency 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 I. 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 I. 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 C	O	F	H	D	(5) TOOLS AND EQUIPMENT	(6) REMARKS
00	CENTRIFUGE, UNIVERSAL	INSPECT	0.1						
		REPLACE		0.3					
		REPAIR		1.0	2.0			1, 2, 3	A
01	CONTROL ASSEMBLY	TEST			0.5				
		REPLACE			1.0			1,2	
		REPAIR			2.0			1,2	B
02	POWER SUPPLY	TEST		0.5				3	
	ASSEMBLY	REPLACE			1.0			1, 2	
		REPAIR			2.0			1, 2	B
03	MOTOR ASSEMBLY	REPLACE			1.0			1, 2	
		REPAIR			1.0			1, 2	B

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

TOOL OR TEST EQUIPMENT REF CODE	MAINTENANCE CATEGORY	NOMENCLATURE	NSN	TOOL NUMBER
1	O, F	TOOL KIT, GENERAL AUTOMOTIVE	5180-00-177-7033	(50980) SC 5180-90-CL-N26
2	0, F	KIT, SOLDERING GUN, 115V, 60 CYCLE, COMPLETE WITH SOLDER AND CASE	3439-99-618-6623	
3	0, F	MULTIMETER, 0-500V	6625-00-691-2453	

Section IV. REMARKS

REFERENCE CODE	REMARKS
A	Repair at organization level limited to replacement of motor brushes, switches, lamp bulbs, cord and plug and fuses.
B	Repair limited to replacement of defective parts.

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 Universal Centrifuge 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 Universal Centrifuge 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

(1) ILLUS	(2) NATIONAL STOCK NUMBER	(3) DESCRIPTION CAGEC AND PART NUMBER	(4) U/M	(5) QTY
		TRUNNION RING ASSEMBLY		
		HOLDS SEVEN 15 ML TUBE SHIELDS, CAT. NO. 67357 (48619) 67311	EA	2
		HOLDS TWO 50 ML TUBE SHIELDS, CAT. NO. 67358 (48619) 67312	EA	2
		HOLDS ONE 100 ML TUBE SHIELD, CAT. NO. 67359 (48619) 67313	EA	2
		HOLDS ONE 100 ML TUBE SHIELD, CAT. NO. 67360 (48619) 67314	EA	2
		TUBE SHIELDS		
		15 ML, ALUMINUM W/FELT CUSHION; FITS TRUNNION RING, CAT. NO. 67311 (48619) 67357	EA	2
		5 ML, INSERT ACCESSORY FOR TUBE SHIELD, CAT. NO. 67357; HOLDS 13 X 105 MM OR 13 X 100 MM TUBES (48619) 67385	EA	2
		5 ML, INSERT ACCESSORY FOR TUBE SHIELD, CAT. NO. 67357; HOLDS 13 X 75 MM OR 13 X 63 MM TUBES (48619) 67386	EA	2
		3 ML, INSERT ACCESSORY FOR TUBE SHIELD, CAT. NO. 67357; HOLDS 11 X 75 MM OR 10 X 75 MM TUBES (48619) 67387	EA	2
		SHIELD ASSEMBLY INSERT ACCESSORY FOR TUBE SHIELD, CAT. NO. 67357; HOLDS 1/2 ML TUBE (5 X 60 MM); 1 ML TUBE (6 X 60 MM); OR 5 ML TUBE (10 X 62 MM) (48619) 67389	EA	2
		50 ML, ALUMINUM W/FELT CUSHION; FITS TRUNNION RING, CAT. NO. 67312 (48619) 67358	EA	2
		100 ML, W/RUBBER CUSHION IN ALUMINUM INSERT FOR CONE-SHAPED TUBES 8" LONG, PLUS RUBBER PAD FOR 6 1/2" BABCOCK BOTTLES; FITS TRUNNION RING, CAT NO. 67313 (48619) 67359	EA	2
		100 ML, PEAR-SHAPED, ALUMINUM W/FELT CUSHION; FITS TRUNNION RING, CAT. NO. 673114 (486119) 67360	EA	2

Section III. BASIC ISSUE ITEMS
NOT APPLICABLE

APPENDIX D
ADDITIONAL AUTHORIZATION LIST

NOT APPLICABLE

APPENDIX E

EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST

NOT APPLICABLE

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

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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 = 3.2808.8 feet

Weights

1 *centigram = 10 milligrams = .15 grain*
1 decigram = 10 centigrams = 1.54 grains
1 gram = 10 decigram = .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

Cubic Measure

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

Square measure

1 sq. centimeter = 100 sq. millimeters = .155 sq. in.
1 sq. decimeter = 100 sq. centimeters = 15.5 inches
1 sq. meter (centare) = 100 sq. decimeters = 10.76 feet
1 sq. dekameter (are) = 100 sq. meters = 1.076.4 sq. ft.
1 sq. hectometer (hectare) = 100 sq. dekameters = 2.47 acres
1 sq. kilometer = 100 hectometers = .386 sq. miles

Liquid Measure

1 dekaliter = 10 liters = 2.64 gallons
1 hectoliter = 10 dekaliters = 26.42 gallons
1 kiloliter = 10 hectoliters = 264.18 gallons
1 liter = 10 deciliters = 33.81 fl. ounces
1 centiliter = 10 milliliters = .34 fl. ounce
1 deciliter = 10 centiliters = 3 38 fl. ounces
1 metric ton = 10 quintals = 1.1 short tons

Approximate Conversion Factors

To change	To	Multiply by
inches	centimeters	2.540
feet	meters	.305
yards	meters	.914
miles	kilometers	1.609
sq. inches	sq. centimeters	6.451
sq. feet	sq. meters	.093
sq. yards	sq. meters	.836
sq. miles	sq. kilometers	2.590
acres	sq. hectometers	.405
cubic feet	cubic meters	.028
cubic yards	cubic meters	.765
fluid ounces	milliliters	29.573
pints	liters	.472
quarts	liters	.946
gallons	liters	3.785
ounces	grams	28.349
pounds	kilograms	.454
short tons	metric tons	.907
pound inches	newton-meters	.11296

To change	To	Multiply by
ounce inches	newton-meters	.0070062
centimeters	inches	.394
meters	feet	3.280
meters	yards	1.094
kilometers	miles	.621
sq. centimeters	sq. inches	.155
sq. meters	sq. yards	10.764
sq. kilometers	sq. miles	1.196
sq. hectometers	acres	2.471
cubic meters	cubic feet	35.315
milliliters	fluid ounces	.034
liters	pints	2.113
liters	quarts	1.057
grams	ounces	.035
kilograms	pounds	2.205
metric tons	short tons	1.102
pound-feet	newton-meters	1.356

Temperature (Exact)

°F Fahrenheit temperature — 5/9 (after subtracting 32) — Celsius Temperature °C

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