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PHASE IV FINAL REPORT

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ABSTRACT

This document is the report of a test of microfilmed Fully Proceduralized Job Performance Aids (FPJPA's) compared to conventional hardcopy T.O.'s.

FPJPA's were written for the SRAM Missile Program Ground Support Equipment Air Conditioning Unit (ECU) and microfilmed. The standard T.O. for the same equipment was used for comparison purposes.

The test was conducted using four Air Force aircraft environmental systems technicians as test subjects. To obtain maximum comparisons with a limited number of subjects, two technicians were skilled 5 and 7 level subjects. Two subjects were unskilled level 3 technicians with less than six months' experience.

After two weeks of testing, it was concluded that microfilmed FPJPA's had the potential, in the organizational and intermediate level maintenance field, of improving the capability of inexperienced personnel.

The test objectives were met with the exception of a cost comparison. It was determined that additional work and studies would be necessary before such a system could be implemented service-wide.

A recommendation was made that an extensive service test be conducted to obtain both cost and statistical data in an operating environment.

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I. INTRODUCTION

The Advanced Technical Data Research Study was implemented in March 1973. The objectives were to evaluate new techniques and devices for developing and transmitting the technical data required to operate and maintain weapon systems; also, to determine what new concepts should be considered for application to future programs in order to provide accurate data on a timely basis at least cost.

The principal upon which proceduralized troubleshooting is based is job simplification by reducing the technical analysis required of the technician during task performance. This analysis, which the technician would otherwise have to make separately for each observed fault is accomplished before the fact but once, and the results incorporated into the performance aids as a series of decision paths. If this is done thoroughly, the technician need only to "look up" the information instead of generating it himself. If he is not required to generate the information, the training requirements are less complex, not as long, and not as expensive. In addition, by eliminating chances for error and confusion, his performance is made more reliable.

By microfilming the job performance aids, the "look-up" factor has been simplified by reducing the time required to search for the information required and by ease of use of the information once it has been obtained.

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The study was conducted in four phases:

Phase I - Studies made by Government agencies and industry groups on product support technical data problems and on proposed advanced concepts, techniques, and devices for support data preparation; transmittal and retrieval was researched, and published data thereon acquired. A document listing data acquired and containing abstracts of pertinent data was released as "Abstracts of Available Data," Document No. D180-17523-1.

Phase II - Phase I data was analyzed to the extent necessary to single out the most promising concepts, techniques, and devices for the preparation, transmittal, and retrieval of technical support data. That data was then evaluated against the current "use" environment, modified as necessary, and finally the most promising advanced data system was described in the "Phase II - System Description" Document No. D180-17755-1.

Phase III - This phase of the study was to develop and test the theory, premises, and feasibility of the concept expressed in the system description produced in Phase II. The detailed description of the methods, procedures, equipment, and requirements necessary to accomplish the objectives of Phase III is contained in "The Phase III Test Plan," Document No. D180-15671-1.

Phase IV - Conduct the test defined in Phase III and prepare the final report of the study. The report includes a description of the fully procedured job performance microfilm test, the observations made by the test observers, comments of the test subjects, and the conclusions of the test directors.

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II. TEST OBJECTIVES

The objectives of the test were to:

1. Determine if the use of microfilmed JPAs are more efficient than conventional T.O.'s by:
 - a. Reducing the time spent searching for data.
 - b. Reducing the total maintenance task time.
 - c. Increasing the accuracy of troubleshooting diagnostics.
2. Determine if lesser-skilled technicians, using microfilmed JPAs, can accomplish the same maintenance task as highly-skilled technicians using conventional T.O.'s.
3. Determine the degree of user-acceptance of microfilm JPAs vs. conventional hard-copy T.O.'s.
4. Determine the relative cost impact of microfilm JPAs on a representative weapon system.

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III. TEST PLAN

The proposed concept of microfilmed JPAs was tested to verify that the objectives stated earlier could be achieved.

The SRAM weapon system was selected as the system on which this concept could be tested most economically. The following reasons amplify this position:

- a. The system is a mature fielded system with several years accumulated maintenance experience.
- b. The Boeing Company prepared the conventional technical orders.
- c. Boeing personnel are knowledgeable of the SRAM maintenance requirements.

A review of the total published SRAM maintenance manuals was made to select a manual covering a representative set of maintenance functions from which a representative, sample set of procedures could be selected for use in the test.

A set of JPA troubleshooting procedures was prepared to match the troubleshooting procedure in the selected manual and reproduced on microfilm.

The test of the microfilm JPA was conducted in the Boeing SRAM Program, Systems Integration Lab (SIL) with the cooperation of the Air Force Human Resources Laboratory and the Strategic Air Command (SAC), who provided the test subjects. Because this study was an Independent Research and Development project (IR&D) with only limited funding available, the test sample obtained was small (two experienced and two inexperienced performance samples for each procedure). Because of the small test population, statistical analysis of the data would not produce significant results, therefore, the test data and observer's comments are subjectively evaluated for significant trends. A detailed review of the conduct of the test; a record of the subject's performance with extensive observer comments, and some conclusions drawn from those comments, are included in this final report.

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IV. TEST CONDUCT

The test was designated to use one experienced (5 - 7 Skill-level) and one inexperienced (3 Skill-level) technician to accomplish a selected set of checkout and troubleshooting procedures prepared in both the JPA microfilm format and the conventional T.O. format. (See Figure 1.) The test was designed so that each test subject performed a given procedure only once (as shown in Figure 2). The plan called for performance of one checkout and four fault-isolate procedures each week (as shown in Figure 2). In fact, the test subjects were able to proceed at a faster rate than planned. This permitted the addition of the fifth fault-isolate procedure shown in Figure 1.

Each test was conducted by requiring the test subject to complete an identified test sample and evaluating the test subject's performance in terms of time-to-complete, errors committed and failure-to-complete. The checkout procedure test sample required the successful completion of a maintenance activity. The fault test sample required the successful identification, by troubleshooting, of a fault which had previously been inserted into the equipment.

A. PROCEDURES

As outlined in D180-15671-1, Advanced Technical Data Study, Phase III - Test Plan, checkout troubleshooting procedures were prepared in JPA format on the SRAM AGE Environmental Control Unit using the procedures in the existing manual on the equipment (T.O. 35M -5-7-1) as a guide. These procedures were then microfilmed for use in the test.

A matching set of test samples were chosen from the JPA microfilm copy and the existing manual. The test samples were the equipment checkout and the five faults listed in Figure 1.

B. SUBJECTS

Four subjects were provided by the Strategic Air Command (SAC)

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FAULT NO.	SYMPTOM	CAUSE	SYSTEM/SUBSYSTEM	COMPONENT PART NO.
1	TAS ALARM ACTIVATED (DIAPHRAGM PRESSURE SWITCH CONTACTS ARE NOT CLOSED WHEN AIR FLOW IS GREATER THAN 1 LB/MIN)	PRESSURE SWITCH IS OUT OF ADJUSTMENT	ELECTRICAL/AIR FLOW	PRESSURE SWITCH NO. 1637-25 DWYER
2	AGE ECU FAILS TO START (BLOWER DRIVE MOTOR, FAN MOTORS AND ELAPSED TIME METER FAIL TO RUN)	FAULTY START/STOP SWITCH	ELECTRICAL	START/STOP SWITCH 29A-22495-101-11
3	PRESSURE AND FLOW GAGES DO NOT SHOW A INDICATION WHEN BACK PRESSURE APPLIED	PLUGGED IMPACT TUBE	AIR FLOW SYSTEM	IMPACT TUBE
4	CONDENSER FAN MOTOR DOES NOT OPERATE	LOOSE WIRE CONNECTION(S)	ELECTRICAL	
5	SUPPLY TEMPERATURE GAGE INDICATES GREATER THAN 75°F	COMPRESSOR SUCTION LINE SERVICE VALVE NOT FULLY OPEN	SUCTION LINE	SERVICE VALVE NO. A16311 MUELLER

Figure 1 : Fault Table

TIME/DATE	M 10-14		T 10-15		W 10-16		TH 10-17		F 10-18		M 10-21		T 10-22		W 10-23		TH 10-24		F 10-25	
	JPA	TO	JPA	TO	JPA	TO	JPA	TO	JPA	TO	JPA	TO	JPA	TO	JPA	TO	JPA	TO	JPA	TO
	FAMIL										FAMIL									
8-12																				
12-2 CHECK OUT	X										I									
2-4		I									X									
8-12 1ST FAULT			I										X							
1-4				X										I						
8-12 2ND FAULT					X										I					
1-4						I										X				
8-12 3RD FAULT							I										X			
1-4								X										I		
4TH FAULT									X											
8-12										X									I	
12-3 CRITIQUE																			X	
																			X	
																			I	

X = EXPERIENCED TECH
I = INEXPERIENCED TECH

Figure 2 : Schedule — JPA/Microfilm Test

B. SUBJECTS (Continued)

in the 422XX career field. Two subjects were inexperienced 3-level, while the other two were experienced technicians with one year to ten years on the job as a level 5 and 7, respectively. They were stationed at four separate Air Force bases. All were high school graduates and graduates from the Aircraft Environmental Systems Repair Technical Training Course. None had specific experience with the SRAM AGE Environmental Control Unit.

C. EQUIPMENT

Two major units of equipment were used in the test. The SRAM AGE Environmental Control Unit (ECU) and a 3M microfilm reader printer.

The AGE ECU (Figure 3) is mounted on a four-wheel cart with a welded frame. The main components are: self-contained refrigeration cooling unit; positive displacement blower; electric motor with variable speed drive to blower; filters; control panel; and container assembly. The container assembly consists of interface items used to connect the AGE ECU with equipment receiving cooling air.

The AGE ECU is used in the SRAM maintenance area to provide cooling air to Missile Booster Section, and Carrier Aircraft Equipment components (Signal Data Distributor-Processor Group, Signal Data Processing-Distribution Group, Decoder-Multiplexer, Decoder-Multiplexer and Missile Prelaunch Data Computers) during checkout by the Test Adapter Set. Cooling air supplied from the AGE ECU is monitored by sensors and a visual indication of air pressure, temperature and flow are provided by gages located on the control panel. A drop in supply of air flow to less than 1.0 lb/min. or rise in temperature to no greater than 98°F. will open the pressure or temperature switch contacts. When these contacts open, an alarm signal is sent to the test adapter set which stops the missile test in progress.

This ECU is a mechanical system with electrical controls and drive which provides a wide range of characteristics to examine, observe, or test

C. EQUIPMENT (Continued)

in the troubleshooting sequences. This provides a testing sample of reasonable scope, which also requires the use of a variety of techniques.

The 3M Reader Printer (Figure 4) is a 16mm microfilm reader with dry paper print capability. Available but not included in this particular set is an instant page retrieval system with digital keyboard. It has a multiple magnification range.

In addition to the two major items of equipment, the following tools and supplies are also used to conduct the test:

- | | |
|--|--|
| 1. Multimeter | P/N AN/PSM-6 (FSN 6625-724-8582) |
| 2. Stop Watch | |
| 3. Tool Service Kit for Refrigeration Unit | P/N 5180-596-1474 (FSCM 19099 S.C. 5180-93-CL E18) |
| 4. Hand Tools | Miscellaneous |
| 5. Thermometer | P/N FSN 6685-174-6235 |
| 6. Container | Size optional to permit temperature switch immersion. (Local Purchase) |

D. DATA COLLECTION

Test observers monitored the performance of each task as unobtrusively as possible using the checklist shown in Figure 5, to record observations. The time for each major element of the task to be completed was noted. Subject response at each decision point was noted and recorded. In each case where a decision was made based on information exterior to the procedure, the quality of the decision (correct or incorrect) and the relevancy of the information used was noted. An evaluation of the quality of the information available in the procedure was made (adequate, inadequate, confusing). A judgment, based on the evaluation, was made and an error assigned to either the subject or the procedure.

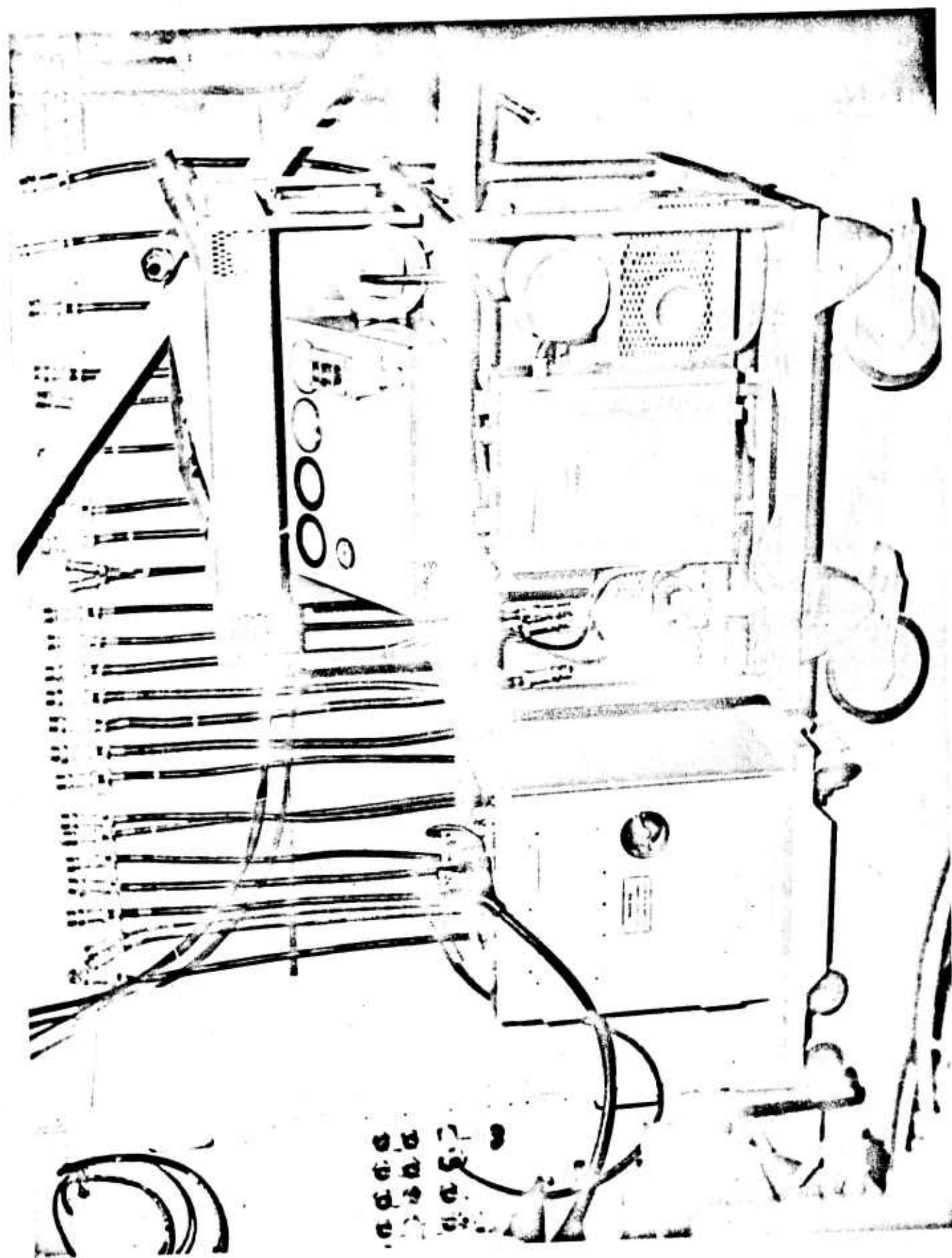


Figure 3: SRAM AGE Environmental Control Unit

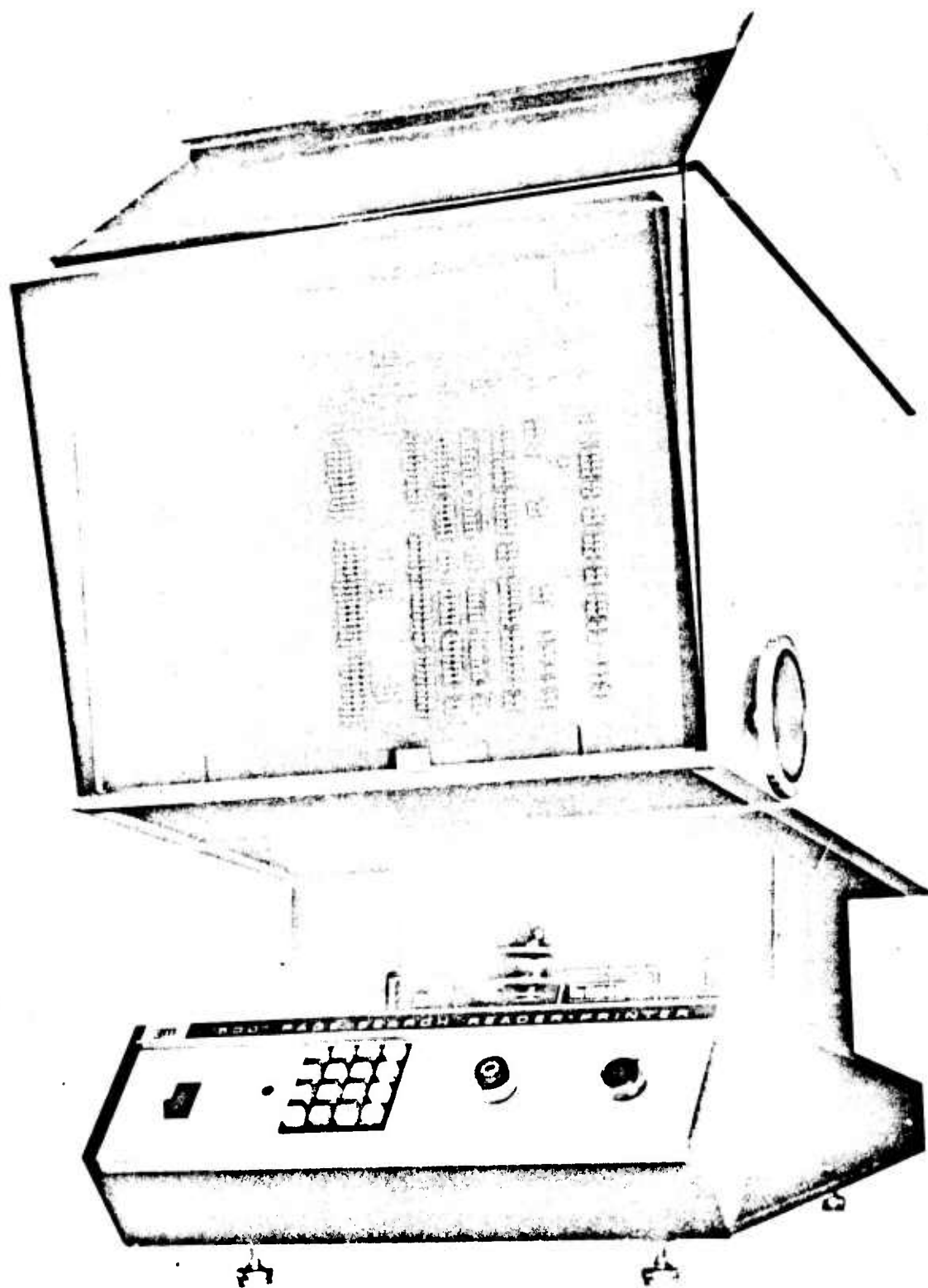


Figure 4: Page Search Microfilm Reader /Printer

PROCEDURE: JPA

TEST DATE:

OBSERVER:

D180-18488-1

D. DATA COLLECTION (Continued)

In each case where an incorrect path was selected, the subject was allowed to proceed for a time to determine if he could return to the correct path. If he could not, the test was stopped and the subject returned to the decision point at which the error was made. The circumstances of the redirection was noted and times recorded.

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V. TEST EVALUATION AND RESULTS

A. OBSERVATIONS

The test data is tabulated in Figures 6 and 7. The data is arranged by skill level, by data format and by test experience for ease in reference and evaluation. The procedural errors are listed for each technician so that the time/error relationship may be explored. An observer's prediction on the possibility of task completion is also recorded. This task completion prediction is purely subjective and was made before any help was given the subject. It is an estimation of the ability of the technician to recover after making one or more procedural errors.

B. EVALUATION

Figure 8 displays the data recorded in Figures 6 and 7 in a form that permits a number of comparisons to be made in evaluating the data. The Test Sequence, Test Period and Test Sample headings, group and specifically identify each test sample.

"Test Sample" identifies the six test sample procedure categories.

"Test Sequence" identifies the series of test samples which constitutes a complete test of a given data format at one skill level. For example: "5 T.O." is one test sequence of six test samples and "5 MICRO" is another test sequence of six test samples.

"Test Period" identifies the series of test samples completed in a given testing period by one team of two test subjects. For example: Test Period A identifies all the test samples accomplished by the team of one 5-7 level and one 3-level test subject during the first week of testing.

The series of test samples accomplished by one test subject can be identified by skill and test period. For example: "5A" indicates skilled technician first test week.

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TEST SEQUENCE	CHECKOUT CONVENTIONAL T.O.'S		CHECKOUT MICROFILM		1ST FAULT CONVENTIONAL T.O.'S		1ST FAULT MICROFILM		2ND FAULT CONVENTIONAL T.O.'S		2ND FAULT MICROFILM	
	A	B	A	B	A	B	A	B	A	B	A	B
TIME REQUIRED TO ISOLATE FAULT 5-7 LEVEL TECHNICIAN		59	75		51			33		12	80	
TIME REQUIRED TO ISOLATE FAULT 3 LEVEL TECHNICIAN	45			95		43	45		65			47
NUMBER OF ERRORS 5-7 LEVEL TECHNICIAN		1	0		0			0		0	2	
NUMBER OF ERRORS 3 LEVEL TECHNICIAN	0			2		1	1		2			0
OBSERVERS PREDICTION ON TASK COMPLETION 5-7 LEVEL TECHNICIAN		NO	YES		YES			YES		YES	NO	
OBSERVERS PREDICTION ON TASK COMPLETION 3 LEVEL TECHNICIAN	YES			NO		YES	YES		NO			YES

Figure 6. Microfilm versus Conventional T.O.'s — Technician Test Times (in Minutes)

TEST SEQUENCE	3RD FAULT CONVENTIONAL T.O.'S		3RD FAULT MICROFILM		4TH FAULT CONVENTIONAL T.O.'S		4TH FAULT MICROFILM		5TH FAULT CONVENTIONAL T.O.'S		5TH FAULT MICROFILM	
	A	B	A	B	A	B	A	B	A	B	A	B
TIME REQUIRED TO ISOLATE FAULT 5-7 LEVEL TECHNICIAN	23			26		10	20		25			37
TIME REQUIRED TO ISOLATE FAULT 3 LEVEL TECHNICIAN		20	30		24			17		23	39	
NUMBER OF ERRORS 5-7 LEVEL TECHNICIAN	0			1		0	0		0			1
NUMBER OF ERRORS 3 LEVEL TECHNICIAN		1	0		2			1		2	3	
OBSERVERS PREDICTION ON TASK COMPLETION 5-7 LEVEL TECHNICIAN	YES			NO		YES	YES		YES			YES
OBSERVERS PREDICTION ON TASK COMPLETION 3 LEVEL TECHNICIAN		YES	YES		NO			YES		NO	NO	

Figure 7. Microfilm versus Conventional T.O.'S — Technician Test Times (in Minutes)

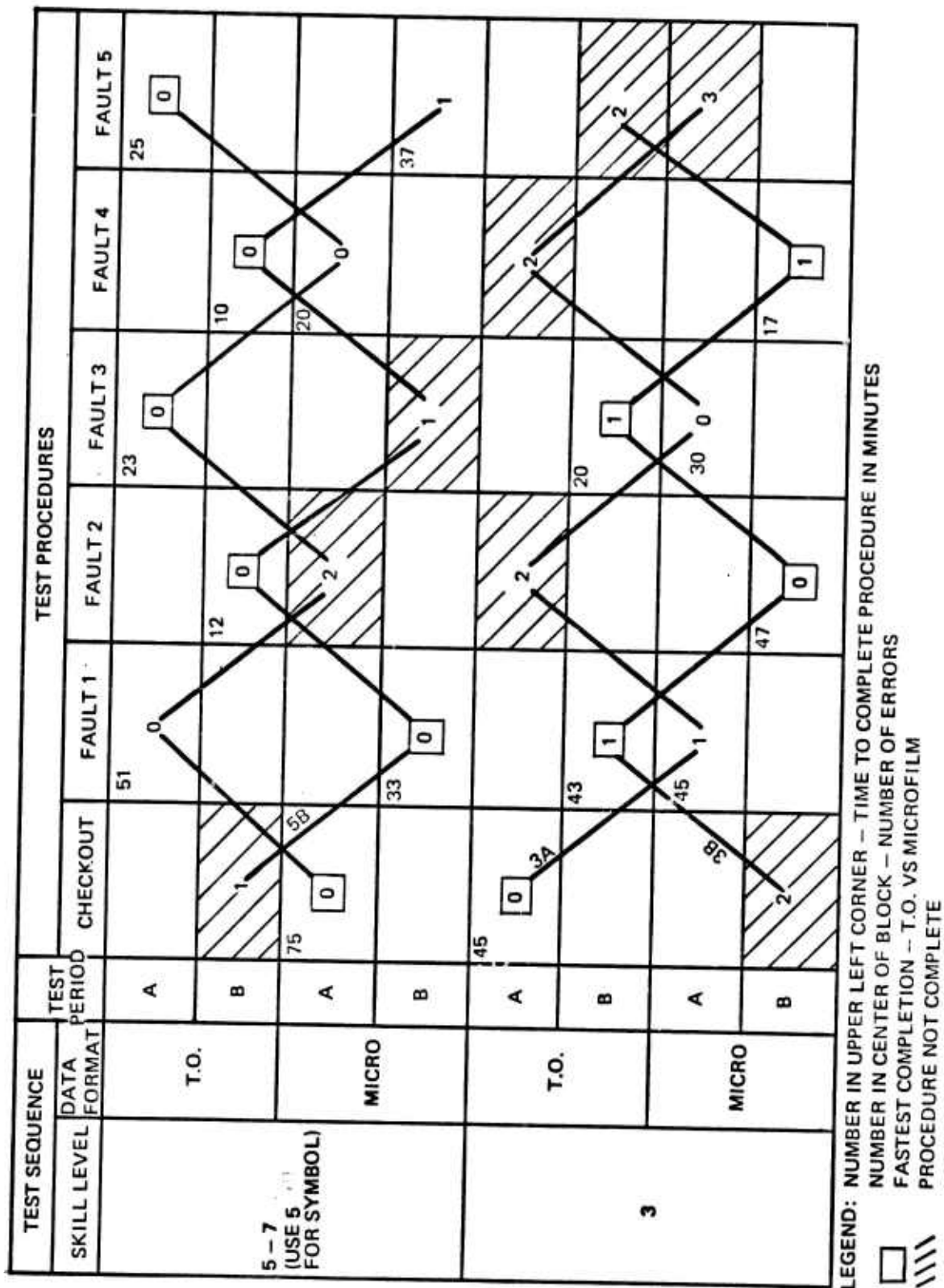


Figure 8. Test Result Analytical Matrix

B. EVALUATION (Continued)

Each test sample can be uniquely identified by skill level, test period and test sample categories. For example: "5A Fault 1." (By design, no subject performed the same test sample in both data formats.

Each block containing data represents a test sample. The number in the center of the block is the number of errors observed during the conduct of that test. The other number in the block is the time taken to accomplish the test sample. Diagonal shading on a block indicates the test subject failed to complete the test. A square around the number in the center of the block indicates that the test was completed quickest in comparing T.O. vs microfilm formats. The diagonal line between blocks is a trace of each test subject's activity. The following is an evaluation of the quality of the test subjects and test procedures developed from this summary of the data.

a. Test Subject Quality

Data which could provide comparison in individual performance include number of failures, number of errors and relative quickness in performance. Since quickness to perform is masked in any case where one subject failed-to-complete only those instances where both subjects completed the test sample are used. Also, since the character of the data format could be a significant factor in relative quickness, the data orientation is shown. The tabulation below indicates that the two test subjects in each skill level were well matched and performed at approximately the same level of ability although there is some indication that 5A and 3B may have had some edge in their respective categories.

Test Subject	Performance Indicators			
	Failures	Errors	Quickness	
			T.O.	Micro
5A	1	2	1	
5B	2	3		1
3A	3	8		
3B	2	7	2	

b. Test Procedure Quality

The test sequences can be grouped in pairs which have an area of commonality between the paired sequences. The two areas of commonality are Data Format and Skill level. Inspection of these pairs for the incidence of failure-to-complete test samples (occurring in the same test sample category in both test sequences) provides an indication as to impact the differing characteristics of each test procedure could have had on the test results.

The paired sequences are: 5 T.O. vs 3 T.O., 5 Micro vs 3 Micro, 5 T.O. vs 5 Micro and 3 T.O. vs 3 Micro. Inspection of these four pairs reveals only one pair (3 T.O. vs 3 Micro) has a failed-to-complete test sample occurring in the same test sample category in both test sequences. This review indicates that the sequences were reasonably equal and that differing procedure characteristics were not a significant factor in the test results.

C. RESULTS

Two forms of test results were obtained, data by testing and data by interview.

The testing data was directed toward determining:

1. If microfilmed JPA is more efficient than conventional T.O.'s.
2. If microfilmed JPA could improve the capability of lesser skilled technicians.

The interview was directed toward determining information on user acceptance.

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a. Test Results

The results of the test are tabulated in Figure 9 in terms of test samples completed, relative completion times and total errors. The data indicates that experienced personnel performed better using the conventional T.O. in terms of test samples completed, time-to-complete the number of errors incurred, and that inexperienced personnel performed better using the JPA microfilm in terms of samples completed and number of errors incurred.

The experienced test subjects performed on the microfilm data at very close to the same capability as the inexperienced test subjects except in number of errors incurred. The experienced personnel incurred significantly less errors, but the impact of the errors was proportionately more severe in terms of failure-to-complete since the percent sample completed is the same (67%) for both groups. Considering the success, the 5-7 skill level group had with the conventional T.O. (83%) and the demonstrated skill of the 5-7 group, this result is considered to be an anomaly.

Conclusions which may be drawn from this test are:

1. Inexperienced personnel will perform better using the JPA microfilm format although they will quite possibly still be subject to incurring more errors than an experienced person.
2. The JPA microfilm format requires a period of familiarization and training in order for the user, experienced or inexperienced, to use them with ease and efficiency.
3. "Time-to-complete" is not as significant a factor as is "failure-to-complete" in evaluating the relative merits of different troubleshooting formats.

SKILL LEVEL	PROCEDURE	NO. TEST SAMPLES	NO. COMPLETE WITHOUT ERROR	NO. SAMPLES COMPLETED WITH ERROR INVOLVED	% SAMPLES COMPLETED WITHOUT ERROR	% SAMPLES COMPLETED INCLUDING ERRORS	QUICKEST COMPLETION T.O. VS MICRO	% SAMPLES COMPLETED QUICKEST	TOTAL ERROR
5-7	T.O.	6	5	5	83	83	4	67	1
	MICROFILM	6	3	4	50	67	2	33	4
3	T.O.	6	1	3	17	50	3	60	8
	MICROFILM	6	2	4	33	67	2	40	7

Figure 9. T.O. versus Microfilm Comparison

4. Overall efficiency in the use of JPA microfilm format vs the conventional T.O. format can not be measured adequately by comparing just "time-to-complete" and "failure-to-complete" on a limited number of test sequences. Many very important factors in the use of a T.O. system are not included in such a limited test. For example: up-dating costs, up-dating efficiency and accuracy, up-dating speed, maintenance time and costs chargeable to manuals, and training requirements.

INTERVIEWS

The test subject interviews was directed toward obtaining from the user data which would permit evaluating the users acceptance of the JPA microfilm format. The test subjects were asked to express their opinion both orally and in written form. An example of the forms and the information requested is shown in Figure 10. The oral discussion in each case amplified the written response. The user's acceptance of the JPA microfilm was high as is indicated by the following summation of their responses.

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NAME:

RANK:

AFSC:

Length of Service:

Service Schools Attended:

Years/months experience in AFSC:

PERSONAL PREFERENCE:

A. Which did you prefer and reasons:

1. JPA or T.O. procedure arrangement
2. Microfilm or manual presentation

B. What is the major difficulty in using:

1. T.O. procedure
2. Microfilm JPA procedure

C. What is the major advantage using:

1. T.O.
2. Microfilm JPA

D. Rate the data for the following quantities:

	Procedure Detail		Illustration Support	
	JPA	T.O.	JPA	T.O.
Just Right				
Too Much				
Too Little				

FIGURE 10

SUBJECT COMMENTS

A. Which did you prefer?

1. JPA or T.O. procedure arrangement?
2. Microfilm or manual presentation?

In every case, experienced or inexperienced, the test subject preferred the JPA presentation format. The inexperienced subjects preferred the microfilm. The experienced subjects said the manual was easier to read.

B. What is the major difficulty in using?

1. T.O. procedure:

In answer to this question, quite a variety of statements were received such as more illustrations were needed, and difficult to follow troubleshooting procedures. The inexperienced subjects stated the procedures were difficult to follow and not enough information given.

2. Microfilm JPA procedures:

The experienced answered this question by stating some pictures were confusing, lack of a wiring diagram was noted. Inexperienced subjects felt that the viewer was awkward to use.

C. What is the major advantage in using:

1. T.O.'s?

The only response other than none was "the only advantage was the availability of wiring diagrams."

2. Microfilm JPA's?

The comments here were "procedures very easy to use." "Picture reference very helpful." "The additional information was very useful." "More confidence in ability to solve troubleshooting problems."

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D. Rate the following quantities:

1. Procedure detail?

All responses indicated the microfilmed JPA's had the right amount of procedural detail, while the T.O.'s had too little.

2. Illustration support?

The responses have indicated the same as the procedural detail. JPA's were just right and the T.O.'s too little. One experienced response indicated too much illustration support.

C. RELATIVE COST IMPACT

Although one of the objectives of the test planning was to determine relative cost impact of microfilm vs. conventional manuals, this objective was not achieved for the following reasons:

1. The sample JPA was prepared as a separate--one time only--task which did not make use of the production flow that provides efficient use of the skills in a regular manual production activity. The tasks associated with the JPA subproducts were accomplished as integral part of the technical effort of preparing the sample and were accomplished only to the extent necessary to produce the sample. The subproduct data items were not documented. For these reasons, the cost of producing the JPA sample would not be representative of a full production effort on JPA's.
2. Only average manual production cost data is available from the production program. The cost of preparing a set of manuals of various characteristics is not necessarily comparable to the cost of preparing a specific manual. Therefore, a comparison of such average cost to the sample JPA preparation cost would not be a valid evaluation.
3. The JPA test sample was a set troubleshooting procedure. This data is the most expensive element of data in any manual. Comparison of the cost of preparing just this data element with the average cost of preparing a complete set of manuals would not provide a valid evaluation.

RECOMMENDATION

This test indicates that JPA microfilm format has definite potential in improving the capability of inexperienced personnel to accomplish trouble-shooting. It also indicates that the format would have user acceptance from both experienced and inexperienced personnel. This particular test did not demonstrate that the JPA microfilm format would enhance the capability of experienced personnel. The test demonstrates that the scope of the test was much too limited to permit drawing conclusions with respect to the overall relative efficiency of the JPA microfilm format vs. conventional T.O. format.

It is recommended that the Air Force Human Resources Laboratory consider an extended microfilm test using the B-52 maintenance T.O.'s prepared to draft MIL-SPEC-38800A. These manuals have just been prepared in the JPA format and would provide a very good vehicle for conducting an extended test of microfilm presentation. The objectives of the test could:

1. Determine if the use of microfilmed Job Performance Aids (JPA's) are more efficient than conventional hard-copy JPA's. Do they:
 - a. Reduce the time spent searching for data:
 - b. Reduce the total maintenance task time?
 - c. Increase the accuracy of troubleshooting diagnostics?
2. Determine the degree of user acceptance of microfilm JPA's vs. Conventional hard-copy JPA manuals.
3. Determine the impact on maintenance efficiency by bringing the data to the work station.
4. Determine the cost savings in data administration, data configuration control and total maintenance time.

The scope of the test could include:

- a. A study of the optimized equipment requirements.
- b. Type/number of test subjects - test organization.
 - Type and number test control subjects.
- c. Optimum length of test.

- d. Develop a training course in the use of microfilm as a maintenance tool.
- e. Detail procedures of how the test would be conducted.

The test should be a full field service test conducted under normal field conditions for at least six months. The only exceptions to normal field operations would be some record keeping, and occasional (weekly or monthly) observations and informal interviews. In this manner, true benefits on disadvantages can be determined, both from an actual cost savings or an improvement in maintenance efficiency.

USE FOR TYPEWRITTEN MATERIAL ONLY

APPENDIX A

TROUBLESHOOTING AIDS

<u>VOLUME</u>	<u>TITLE</u>
2-1	AGE ECU Checkout and Troubleshoot
2-2	AGE ECU Start Circuit (Lear-Sieglar) Troubleshoot
2-3	Omitted
2-4	AGE ECU Test Adapter Set Alarm Signal Troubleshoot
2-5	AGE ECU Instruments Troubleshoot
2-6	AGE ECU Blower Unit Troubleshoot
2-7	AGE ECU Cooling Unit (Lear-Sieglar) Troubleshoot
2-8	Omitted
2-9	AGE ECU Cooling Unit Condenser (Lear-Sieglar) Troubleshoot

USE FOR TYPEWRITTEN MATERIAL ONLY

APPENDIX BTEST SUBJECTS

1. TSGT Virilent M. Whaley, Jr.
Seymore - Johnson AFB,
South Carolina
2AF
2. AMN Earl L. Vernon
Griffiss AFB
New York
2AF
3. AIC Rhonda L. Vandecoevering
Minot AFB
North Dakota
15AF
4. AMN Donald W. Harrell
Ellsworth AFB
South Dakota
15AF

TEST OBSERVERS

1. John Klesch
Human Resources Laboratory
Wright-Patterson AFB
Ohio
2. M/SGT. C. W. Crowe
Strategic Air Command Headquarters
Offutt Air Force Base
Nebraska

USE FOR TYPEWRITTEN MATERIAL ONLY

TECHNICAL MANUAL

VOLUME 2-1

CHECKOUT AND TROUBLESHOOT

AGE ELECTRONICS ENVIRONMENTAL CONTROL UNIT

A/M 32C-13

Part No. 2A14155A-101-17

A/M 32C-13A

Part No. 2A14155A-101-18

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AGE ECU CHECKOUT AND TROUBLESHOOT

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AGE ECU Fail to Start	2-1-15
Test Adapter Set Alarm Activated	2-1-19
AGE ECU Automatic Shutdown	2-1-21
AGE ECU Noisy and Rough	2-1-26

CHECKOUT AND TROUBLESHOOT AGE ENVIRONMENTAL CONTROL UNIT

PRELIMINARY INFORMATION

Introduction

This activity covers the checkout and troubleshooting of the AGE Environmental Control Unit, Lear-Siegler AD100-1. The checkout includes an inspection for physical condition and functional test sequence. Successful completion of the checkout sequence with a positive result at each step indicates the Environmental Control Unit (ECU) is in satisfactory operating condition. A negative result at any step indicates a fault exists. Direction to a subsequent fault isolate or repair procedure is included in the step for such a result.

Applicable Models

A/M 32C-13 or A/M 32C-13A with Lear-Siegler Cooling Unit AD100-1

Special Tools

Refrigeration Unit Tool Kit, Part Number SC5180-93-CL-E18.

Specific item required:

Multimeter, 0 to 5000 VDC, 0 to 1000 VAC, TS-352 B/U

Supplies

None

Personnel

Two technicians AFSC 422X1

Equipment Condition

Preparation for Use, Volume 1-1 completed.

ACTIVITY INDEX

<u>Procedure</u>	<u>Page</u>
Checkout	2-1-2
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AGE ECU Fail to Start	2-1-15
Test Adapter Set Alarm Activated	2-1-19
AGE ECU Automatic Shutdown	2-1-21
AGE ECU Noisy and Rough	2-1-26

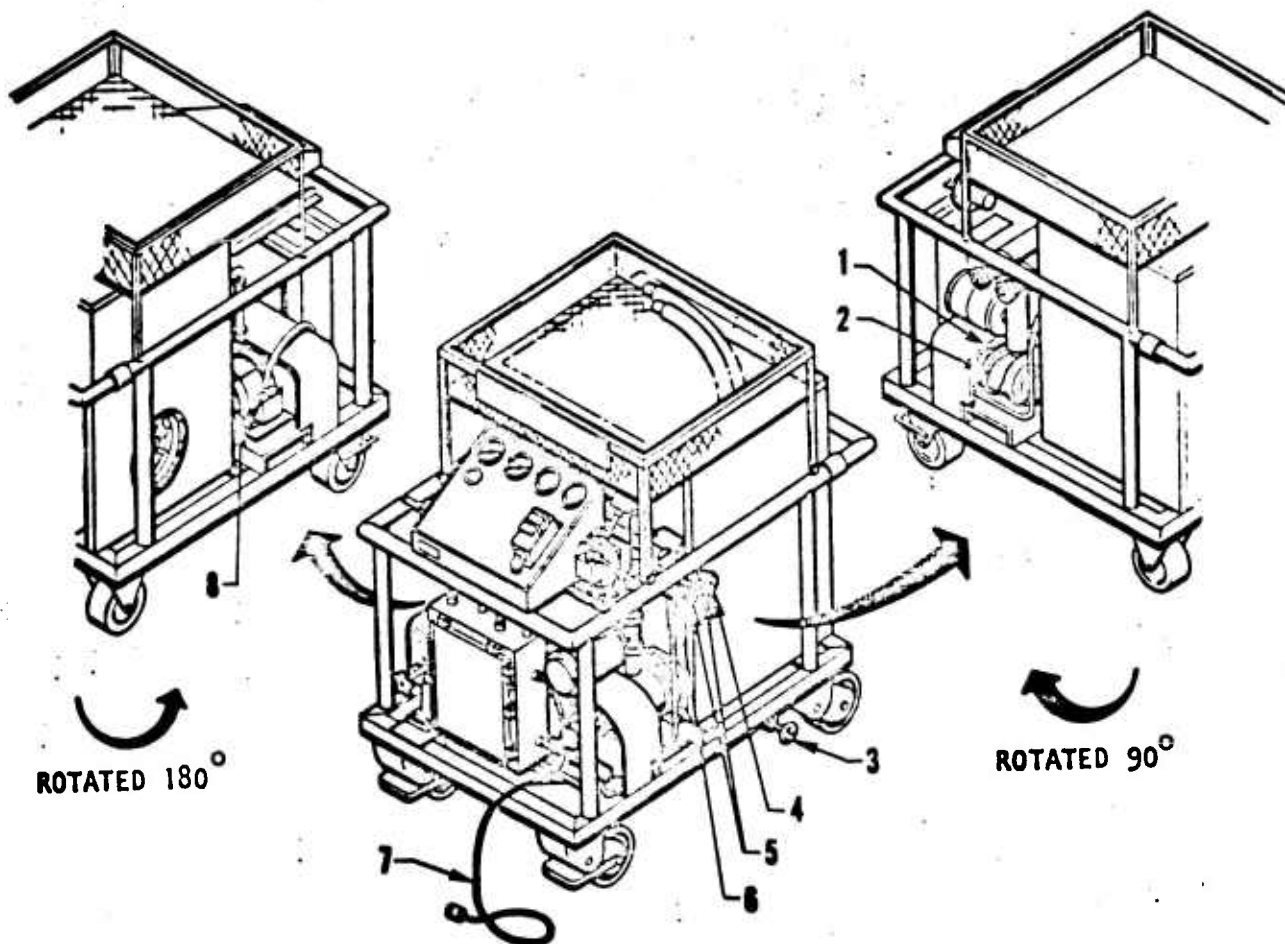
CHECKOUT

1. Verify AGE ECU Power cable (7) is not connected to facility power. If connected, disconnect.

WARNING

Verify power cable is disconnected from facility power before turning blower motor pulley by hand. Injury could result if AGE ECU were started.

2. Rotate blower motor pulley (1) by hand to verify blower (2) and motor (8) turn freely without binding. If not, troubleshoot blower unit. Refer to AGE ECU Blower Unit Troubleshoot, Volume 2-6.
3. Remove dust caps (5) from SUPPLY pipe (4) and RETURN pipe (6).
4. Inspect supply pipe and return pipe for debris. If present, remove debris.
5. Open condensate drain valve (3).



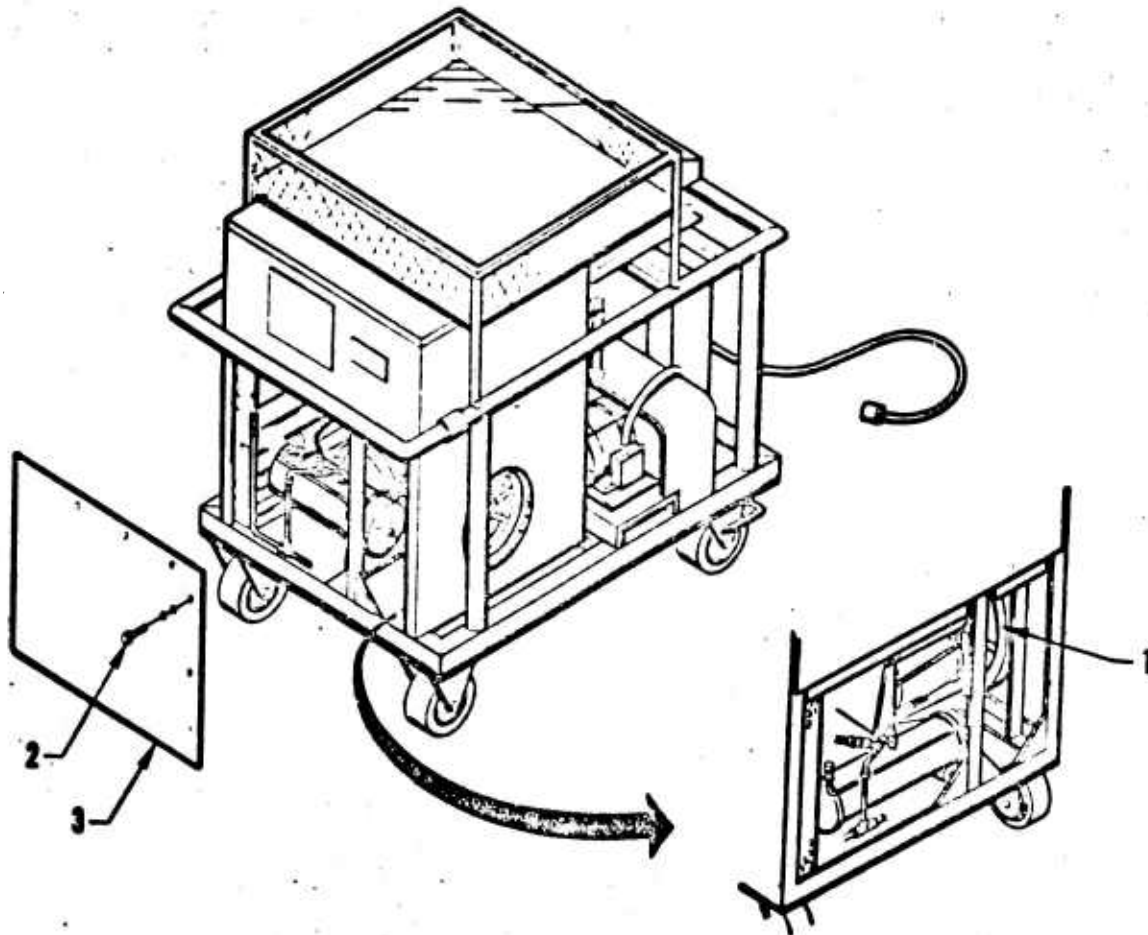
CHECKOUT

6. Remove screws and washers (2) holding back cover (3) on cooling unit and remove cover. Retain screws and washers.

WARNING

Verify power cable is disconnected from facility power before turning condenser fan by hand. Injury could result if AGE ECU were started.

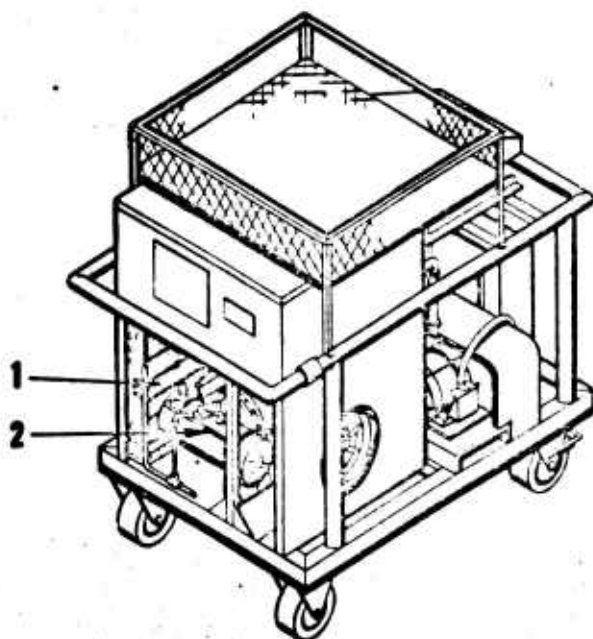
7. Rotate condenser fan (1) by hand to verify fan turns freely without binding. If not, troubleshoot condenser. Refer to AGE ECU Cooling Unit Condenser Troubleshoot, Volume 2-9.



ROUT

8. Inspect condenser fins (1) for debris. If present, remove debris. Refer to Condenser Cleaning, Volume 1-9, page 1-9- . After cleaning, continue with step 9.

9. Using light and mirror, as required, inspect all refrigerant lines (2) for secure mounting and no visual evidence of oil leakage. If mountings are loose or there is evidence of oil leakage, accomplish leak detection (refer to Refrigeration System Leak Detection, Volume 1-7, page 1-7-) and repair refrigerant lines and mountings. (Refer to Refrigeration System Piping Assembly Repair, Volume 1-7, page 1-7- .) After repair, return to step 1.



CHECKOUT

10. Observe RETURN TEMPERATURE gage (2) and SUPPLY TEMPERATURE gage (1) indicates close to ambient temperature. If not, remove temperature gage(s) and calibrate or replace. Refer to Remove and Install Temperature Gages, Volume 1-5, page 1-5- and Calibration of Temperature Gages, Volume 1-5, page 1-5- .
11. Rotate handwheel (5) counterclockwise to limit.
12. Connect AGE ECU power cable (6) to facility power (3-phase, 208 volt, 60 Hz).

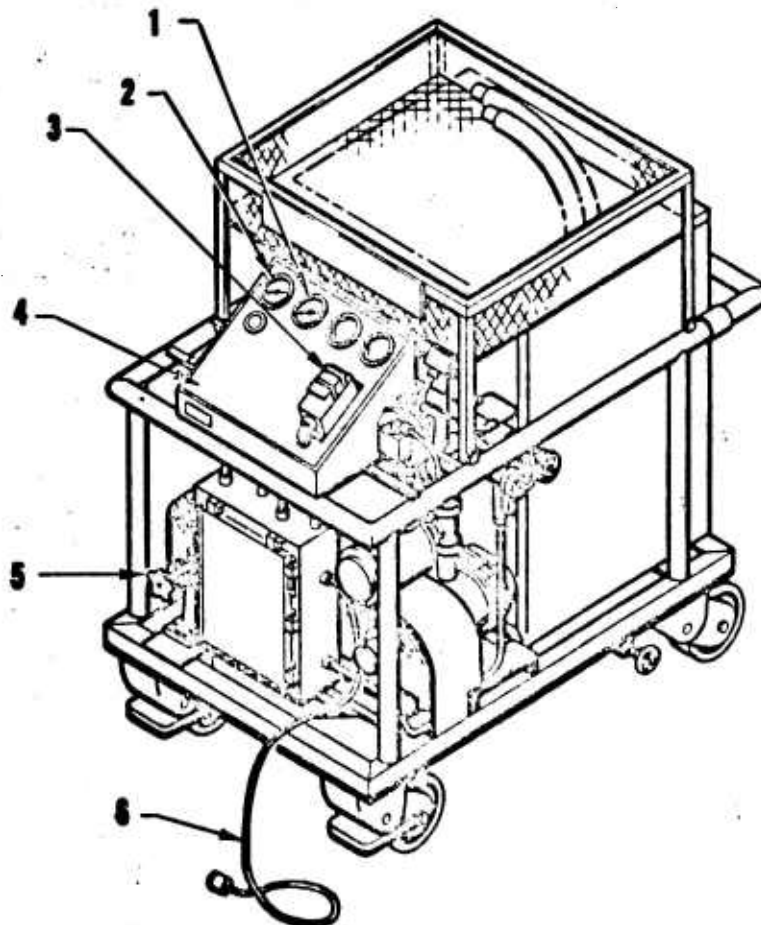
WARNING

Stay clear of condenser fan during operation with back cover removed. Injury could result.

NOTE

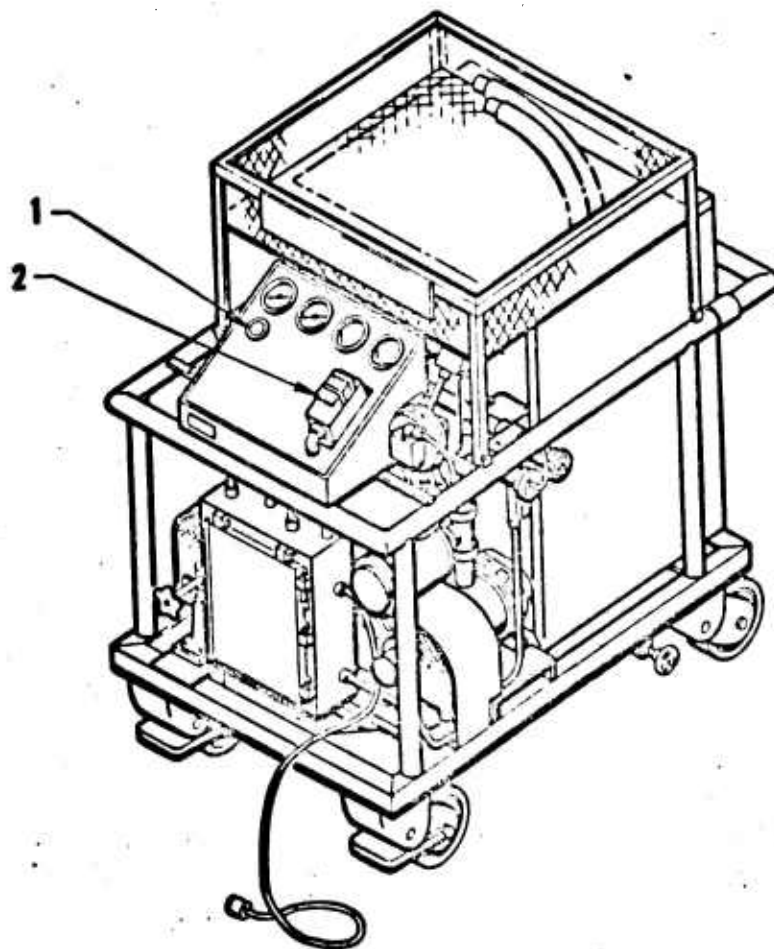
The cooling unit may be operated with back cover removed for only a short time since the condenser cooling air bypasses the condenser coils. The cooling unit will shut down automatically when condenser high pressure causes Pressure Limit Control high pressure switch to release.

13. Press START switch (3) on control panel (4).



CHECKOUT

14. Observe proper start, as indicated by operation of time meter, blower, fan and compressor. If not, press STOP switch (2). Go to Troubleshoot in this Volume for; Fail to Start, page 2-1-15, Automatic Shutdown, page 2-1-21, or Noisy and Rough Operation, page 2-1-26.
15. Operate AGE ECU for 0.2 to 0.3 hour, (12 to 18 minutes).
16. Observe elapsed time meter (1). Reading should advance in time with operating time. If not, press STOP switch. Troubleshoot time meter. Refer to AGE ECU Instruments Troubleshoot, Volume 2-5.



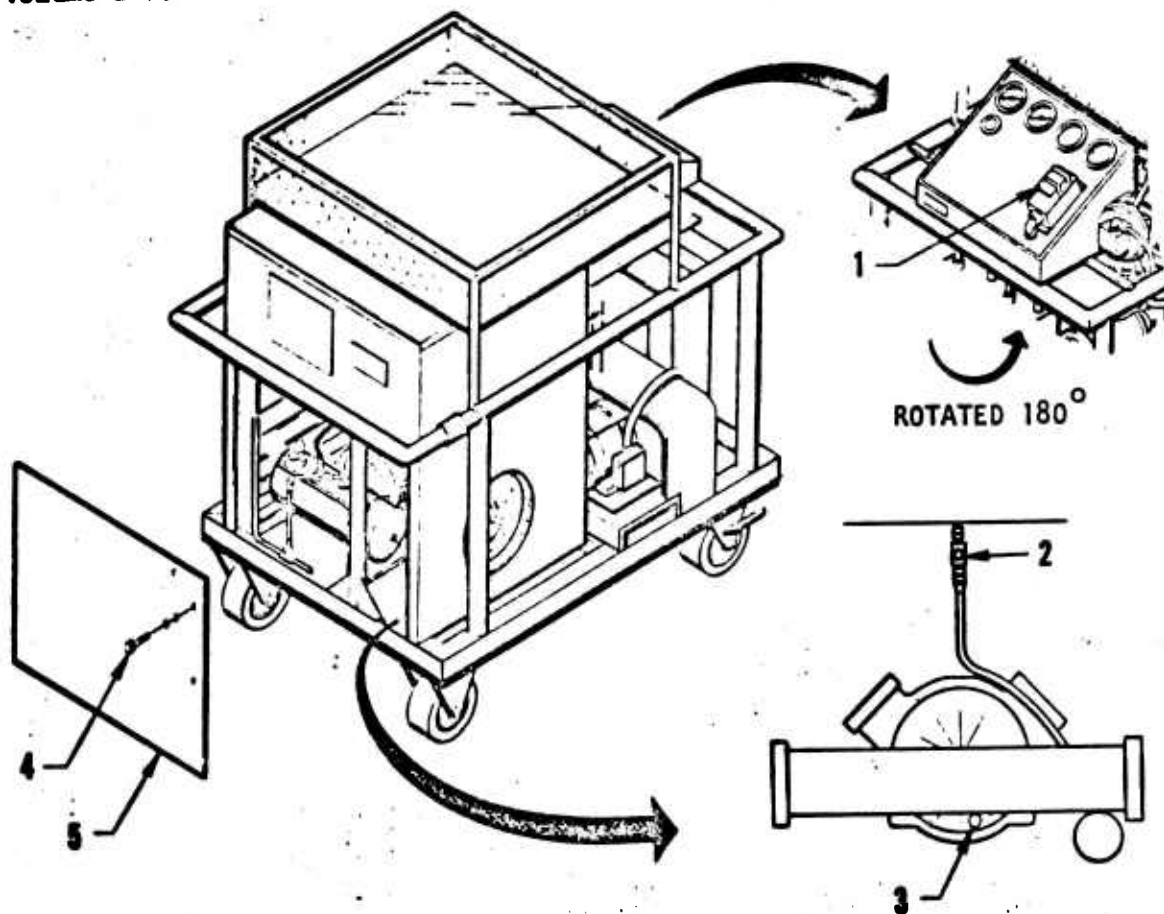
CHECKOUT

WARNING

Stay clear of condenser fan. Injury could result.

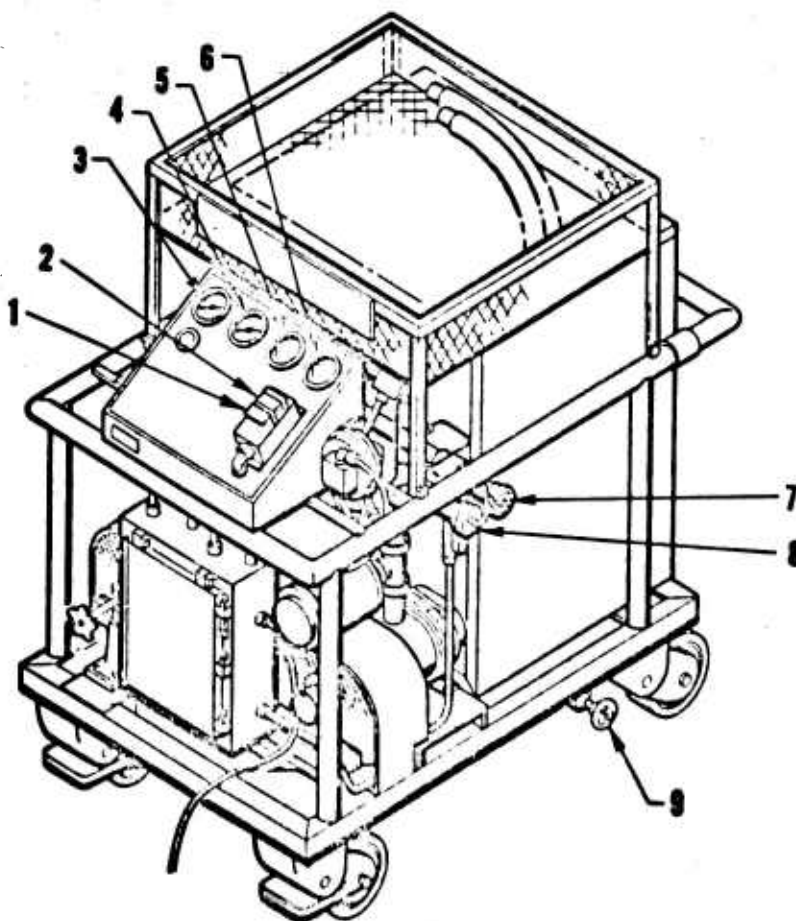
17. Remove cover from refrigerator sight glass (2) and check that refrigerator sight glass is clear and free from bubbles. Replace sight glass cover.
18. Press STOP switch (1). If refrigerator sight glass was not clear and free from bubbles, troubleshoot cooling unit. Refer to AGE ECU Cooling Unit Troubleshoot, Volume 2-7.

19. Check compressor oil sight glass (3) for oil level 1/8 inch or more above bottom of sight glass. If not, troubleshoot cooling unit. Refer to AGE ECU Cooling Unit Troubleshoot, Volume 2-7.
20. Place back cover (5) on cooling unit, and install washers and screws (4).



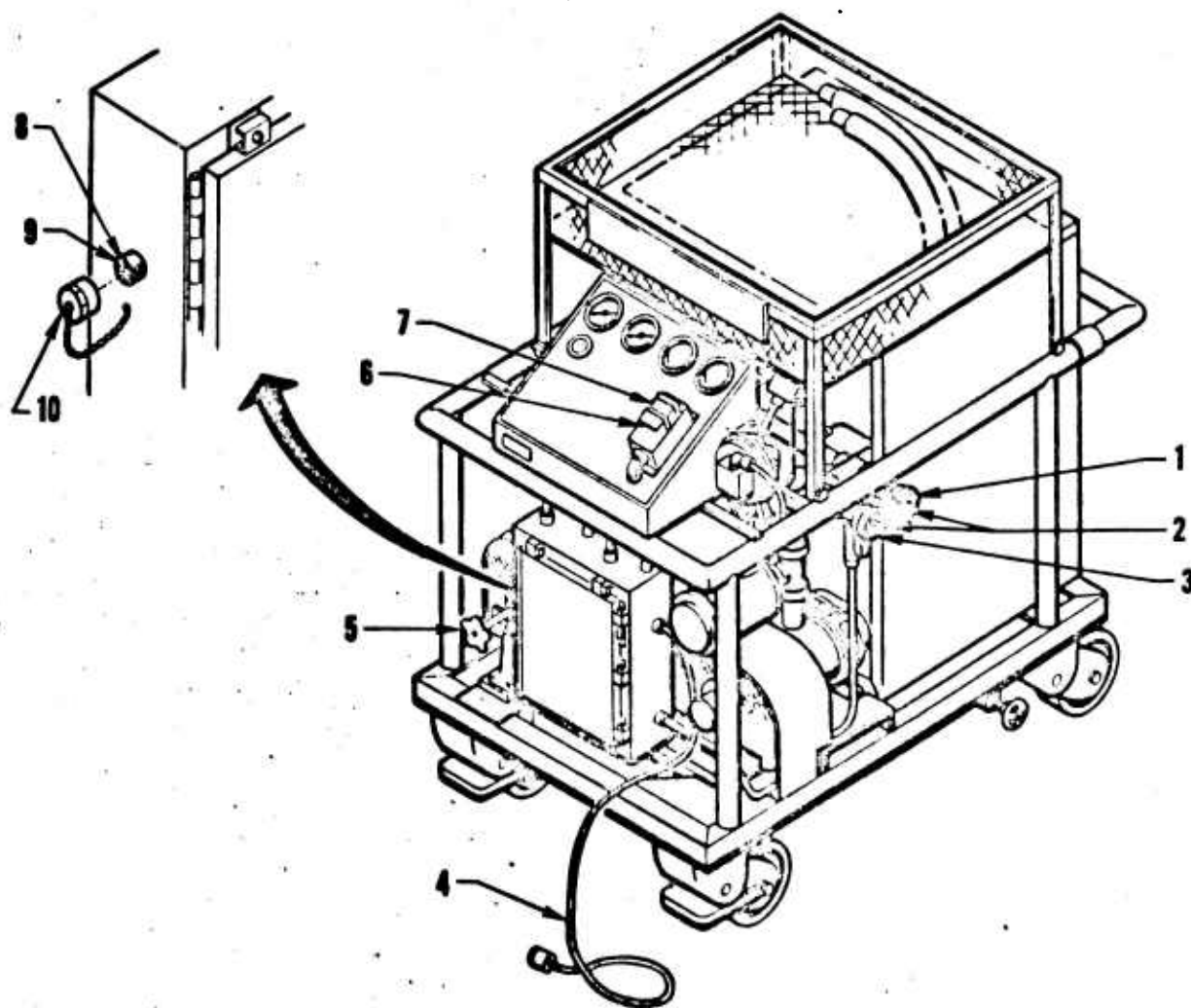
6 TROUBLESHOOT

21. Close condensate drain valve (9), then open 1/4 turn.
22. Press START switch (2).
23. Place hand lightly over SUPPLY pipe (7).
24. Observe back pressure buildup is indicated by an increase in pressure on pressure gage (6) and a decrease in flow on FLOW gage (5). If not, press STOP switch (1) and go to troubleshoot blower unit. Refer to AGE ECU Blower Unit Troubleshoot, Volume 2-6.
25. Observe RETURN TEMPERATURE gage (3) indicates 80°F or above. If not, increase temperature of air entering RETURN pipe (8) sufficiently to obtain a sustained indication of 80°F, or above, on RETURN TEMPERATURE gage.
26. Operate unit 5 minutes or more.
27. Observe SUPPLY TEMPERATURE gage (4) reads less than 76°F. If not, troubleshoot cooling unit. Refer to AGE ECU Cooling Unit Troubleshoot, Volume 2-7.
28. Observe FLOW gage (5) indication exceeds 0.15 inch of water. If not, troubleshoot FLOW gage. Refer to AGE ECU Instruments Troubleshoot, Volume 2-5.



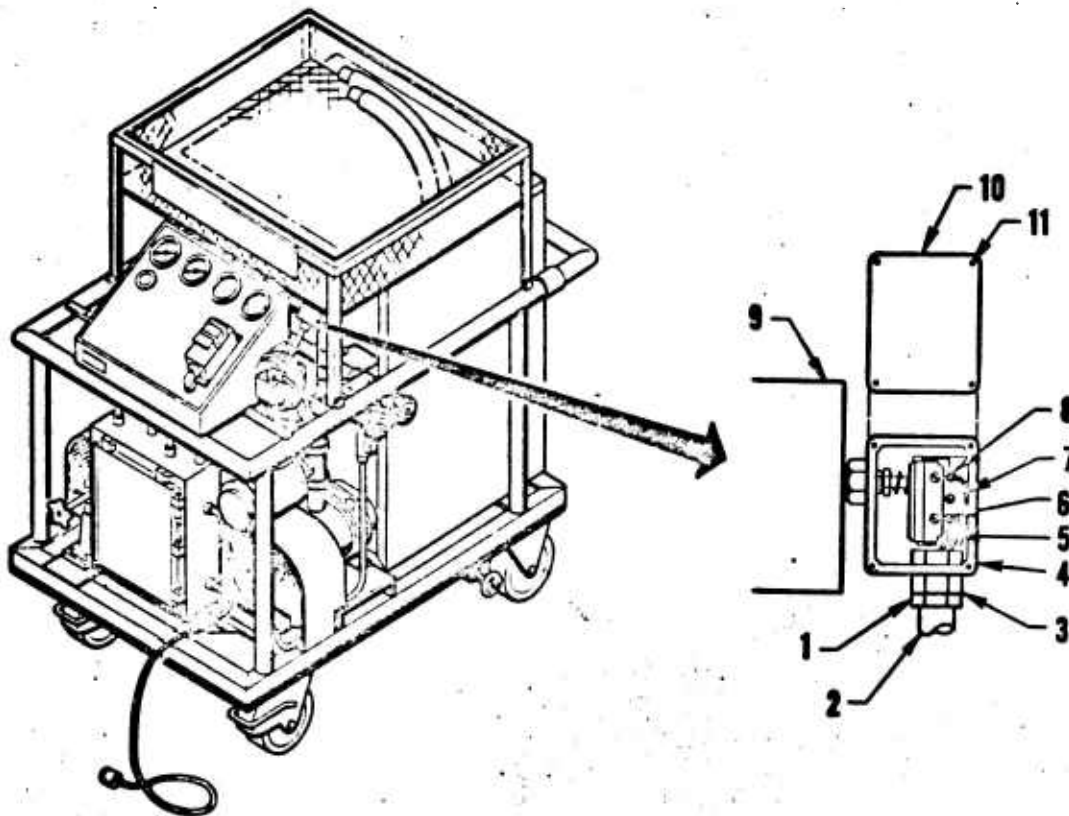
CHECKOUT

29. Remove dust cap (10) from test adapter set connector (8).
30. Set multimeter to read ohms in the 0 to 300 ohm range and zero meter. Refer to Test Equipment Operation, Volume 1-1.
31. Place multimeter leads on terminals A and B (9) of test adapter set connector (8) and read a left to right deflection. If not, press STOP switch (6). Go to step 33.
32. Hold leads in place and request assistant to press STOP switch (6). Read deflection right to left at 0.15 (± 0.05) inch of water on flow gage. If deflection does not occur within flow limits, troubleshoot test adapter set alarm signal. Refer to AGE ECU Test Adapter Set Alarm Signal Troubleshoot, Volume 2-4.
33. Remove multimeter.
34. Disconnect AGE ECU power cable (4) from facility power.



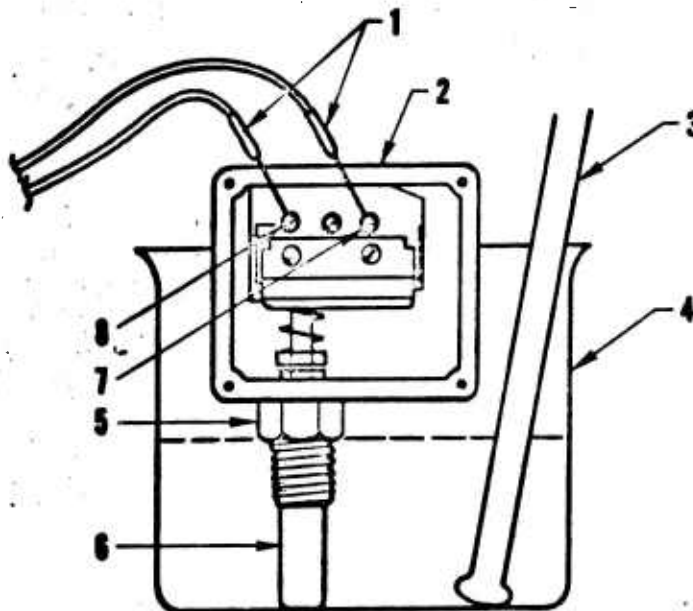
HECKOUT

35. Remove cover (10) from temperature switch (4) by removing screws (11).
36. Disconnect wire 11A20 (5) and 11B20 (7) from temperature switch terminals (6) and (8). Tag wires to aid in reinstallation.
37. Remove conduit nut (1) from conduit connector (3).
38. Pull conduit (2) and wires (5) free of temperature switch.
39. Unscrew temperature switch (4) from tee bushing (9).



CHECKOUT

40. Fill a container (4) with hot tap water to a depth of 2 inches.
41. Place thermometer (3) in water and adjust water temperature to 100 to 105°F.
42. Insert temperature switch (2) into water.
43. Set multimeter to read ohms in the 0 to 300 ohm range and zero meter. Refer to Test Equipment Operation, Volume 1-1.
44. Place multimeter leads (1) on terminals COM (8) and NC (7) of temperature switch (2) and read zero on meter. If not, adjust temperature switch. Refer to Adjustment of Temperature Switch, Volume 1-4, page 1-4-. After adjustment, go to step 49.
45. Observe multimeter as water cools for a left to right meter deflection. If deflection occurs above 98°, adjust temperature switch. Refer to Adjustment of Temperature Switch, Volume 1-4, page 1-4-. After adjustment, go to step 49.
46. Cool water while observing multimeter. If a left to right meter deflection does not occur at or above 76°F, adjust temperature switch. Refer to Adjustment of Temperature Switch, Volume 1-4, page 1-4-. After adjustment, go to step 49.
47. Remove multimeter leads (1) from temperature switch (2).
48. Remove temperature switch (2) from container (4) and dry switch with clean dry cloth.

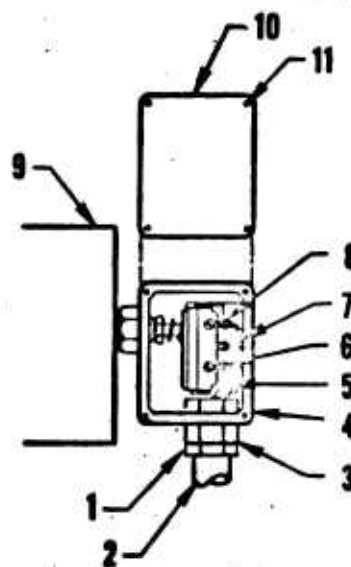
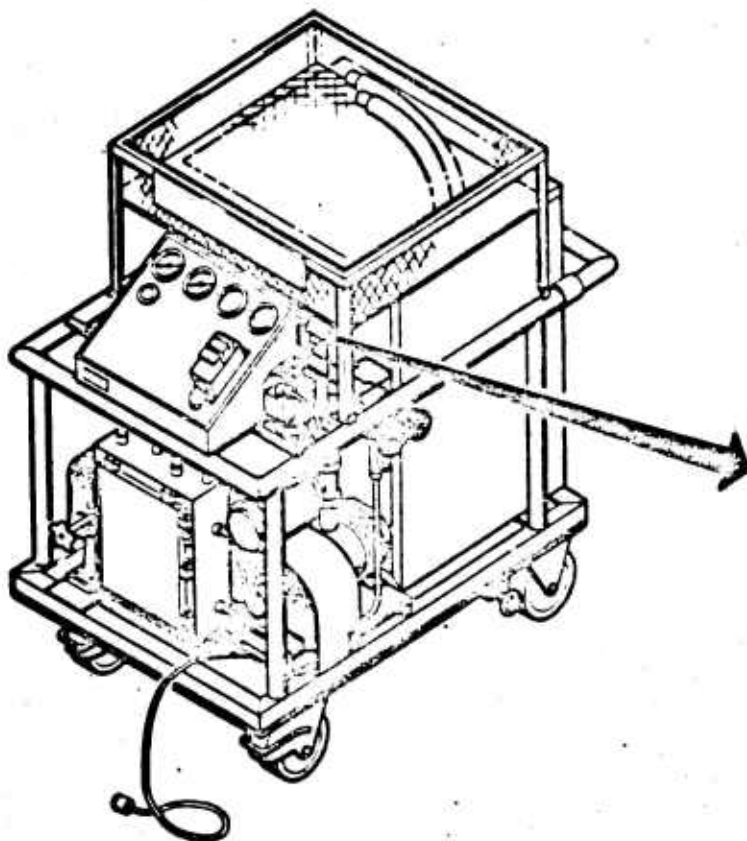


CHECKOUT

49. Apply packing to temperature switch (4) threads and screw temperature switch (4) into tee bushing (9).
50. Pull wires 11A20 (5) and 11B20 (7) into temperature switch (4).
51. Install conduit connector (3) into temperature switch (4) and tighten conduit nut (1).

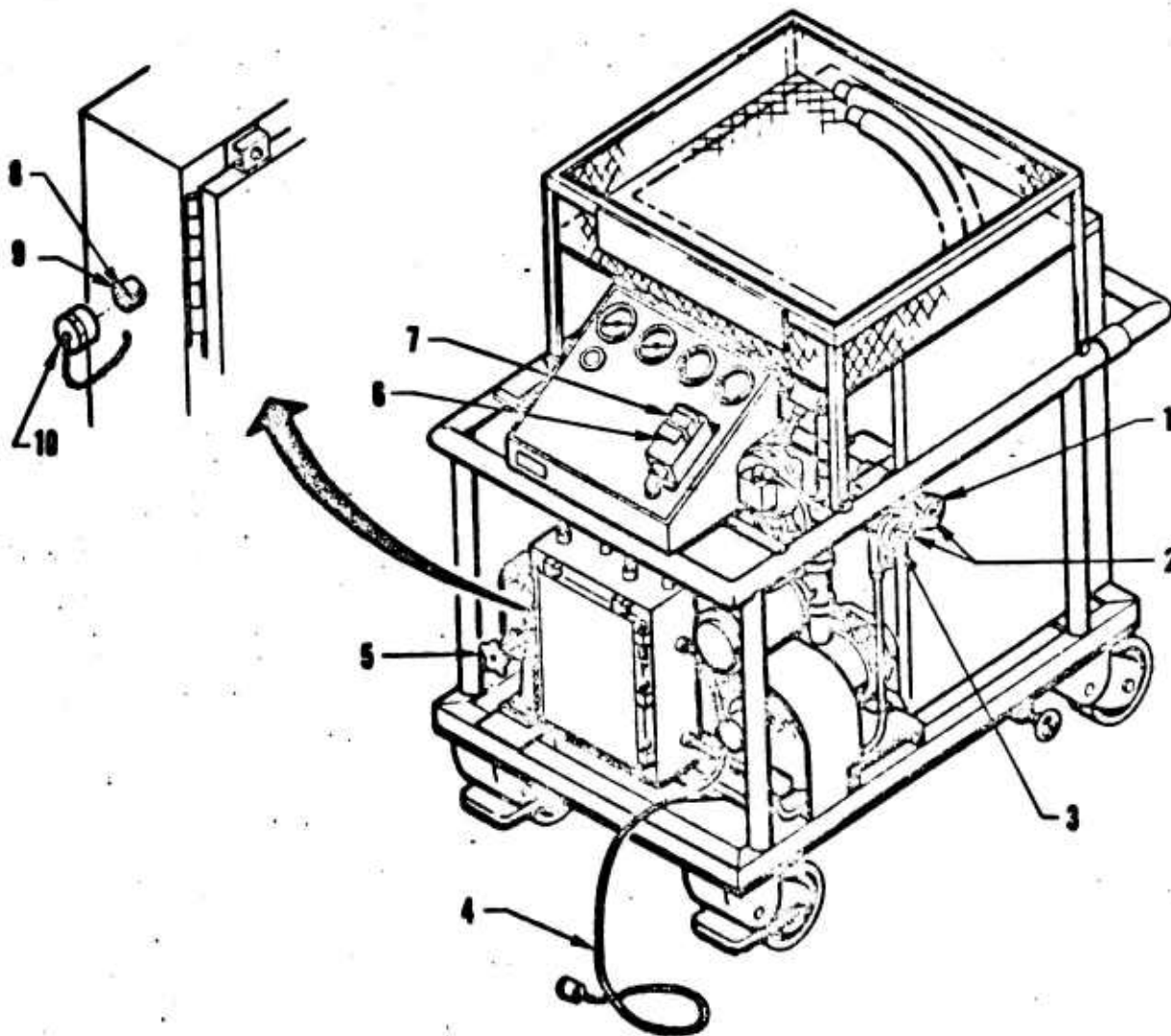
52. Connect wire 11A20 (5) to terminal NC (6) and wire 11B20 (7) to terminal COM (8).

53. Place switch cover (10) on temperature switch (4) and install screws (11).



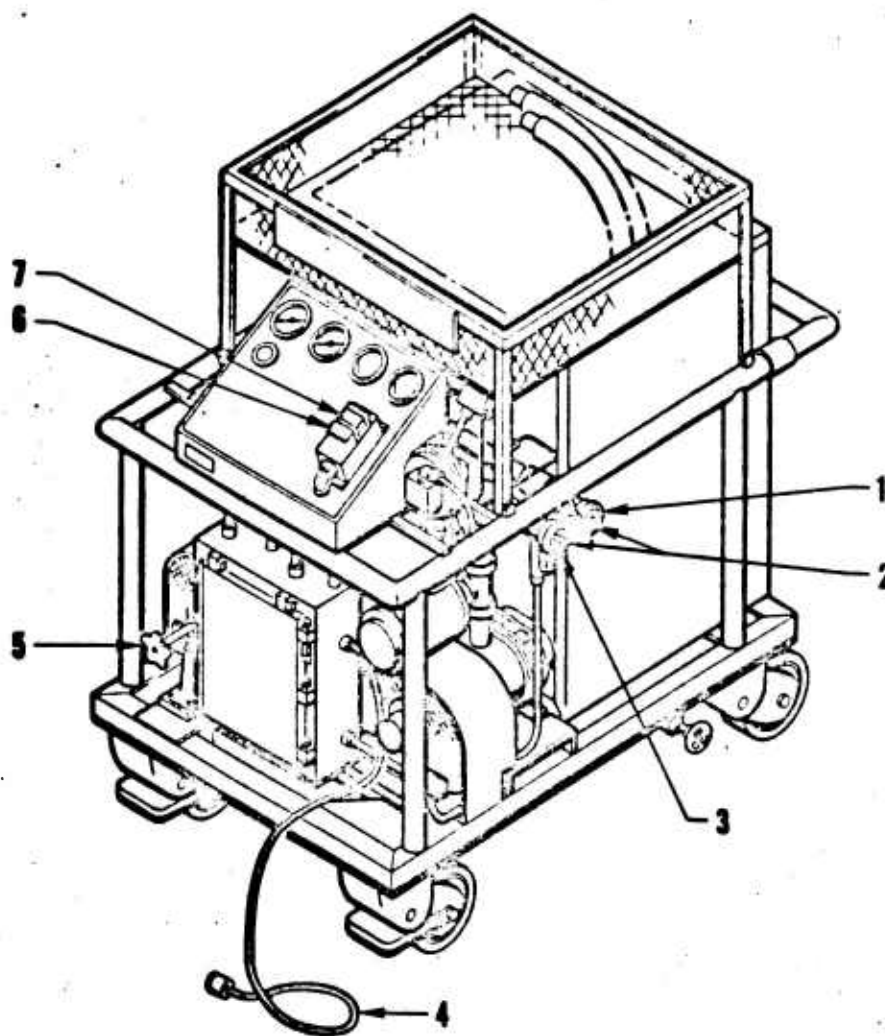
CHECKOUT

54. Connect AGE ECU power cable (4) to facility power.
55. Press START switch (7).
56. Set multimeter to read ohms in the 0 to 300 ohm range and zero meter. Refer to Test Equipment Operation, Volume 1-1.
57. Place multimeter leads on terminals A and B (9) of test adapter set connector (8) and read a left to right deflection. If not, press STOP switch (6) to troubleshoot test adapter set alarm signal. Refer to AGE ECU Test Adapter Set Alarm Signal Troubleshoot, Volume 2-4.
58. Hold leads in place and request assistant to press STOP switch (6). Read deflection right to left at 0.15 (± 0.05) inch of water on flow gage. If deflection does not occur within flow limits, troubleshoot test adapter set alarm signal. Refer to AGE ECU Test Adapter Set Alarm Signal Troubleshoot, Volume 2-4.
59. Remove multimeter.
60. Install dust cap (10) on test adapter set connector (8).



CHECKOUT

61. Press START switch (7).
62. Rotate handwheel (5) clockwise. Observe blower speed increases. If blower speed does not increase, press stop switch. Go to Troubleshoot Blower Unit, Volume 2-6.
63. Rotate handwheel (5) counterclockwise to limit.
64. Press STOP switch (6).
65. Disconnect power cable (4) from facility power.
66. Install dust caps (2) on SUPPLY pipe (1) and RETURN pipe (3).



TROUBLESHOOT

AGE ECU Fails to Start

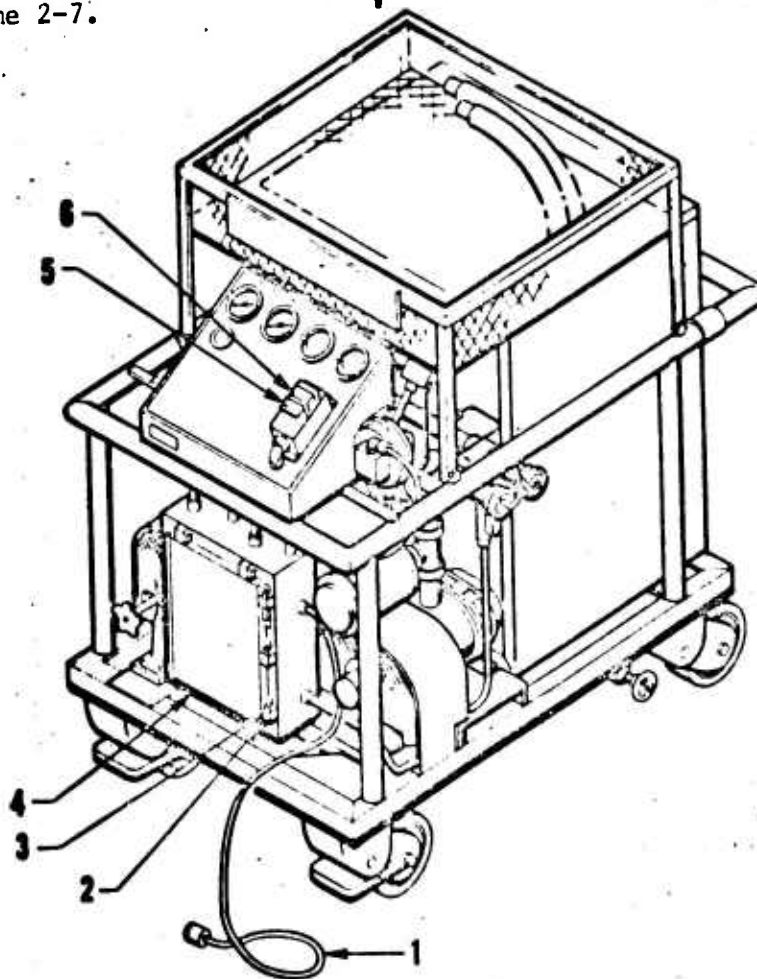
NOTE

If AGE ECU has shutdown automatically during operation, refer to Troubleshoot AGE ECU Automatic Shutdown, page 2-1-21.

If blower unit only did not start, refer to Troubleshoot AGE ECU Blower Unit, Volume 2-6.

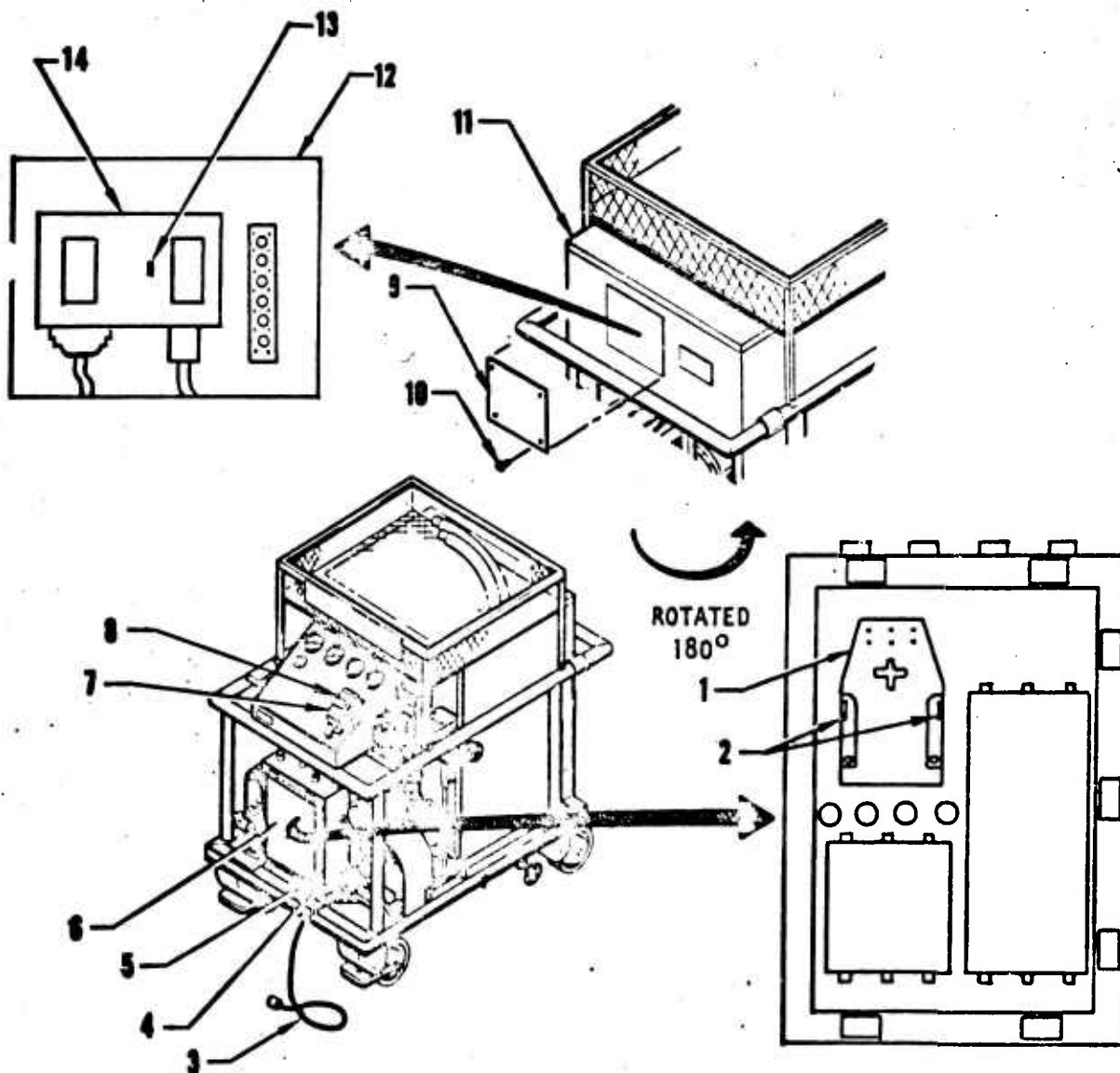
If blower unit started, but either the compressor or the condenser fan did not start, refer to Troubleshoot AGE ECU Cooling Unit, Volume 2-7.

1. Disconnect power cable (1) from facility power and reconnect.
2. Press START switch (6). If proper start occurs, return to Checkout or test in progress.
3. Press STOP switch (5).
4. Check that facility power is on. If not, request assistance from facilities. After facility power is regained, return to Checkout or test in progress.
5. Loosen screws (3) on electrical enclosure cover clamps (2).
6. Move clamps (2) aside and open enclosure cover (4).



TROUBLESHOOT

7. Press reset buttons (2) on motor starter (1) and press START switch (8). If proper start occurs go to step 11.
8. Remove cover (9) from electrical box (12) on cooling unit (11) by removing screws and lockwashers (10) and press reset button (13).
9. Press START switch (8). If proper start does not occur, press STOP switch (7) and disconnect power cable from facility power. Go to step 12.
10. Place cover (9) on cooling unit (11) and install screws and lockwashers (10).
11. Close electrical enclosure cover (6), position clamps (4) to secure cover and tighten screws (5). Return to checkout or test in progress.
12. Set multimeter to read ohms in the 0 to 300 ohm range and zero meter. Refer to Test Equipment Operation, Volume 1-1.



TROUBLESHOOT

WARNING

Verify power cable (6) is disconnected from facility power before making electrical checks. Injury from electrical shock could occur if power cable were connected.

13. With the aid of an assistant, place multimeter leads on each of the following sets of motor starter to power cable plug checkpoints. Read left to right deflection for each check:

Motor Starter (4)

Power Cable Plug (6)

L1 (1)

Pin (10) between arrow (7) and large pin (9)

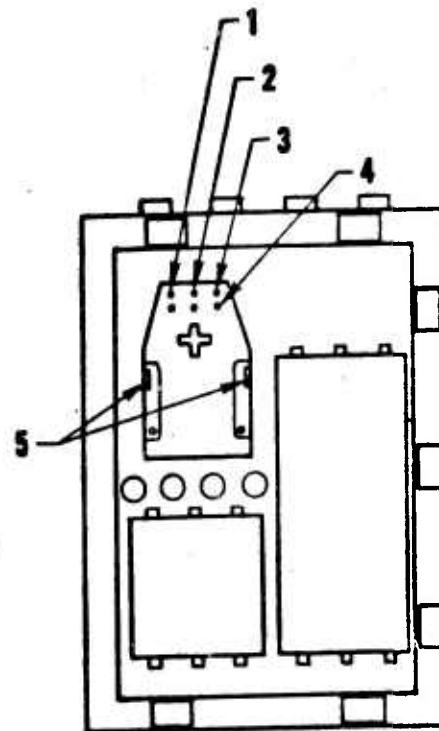
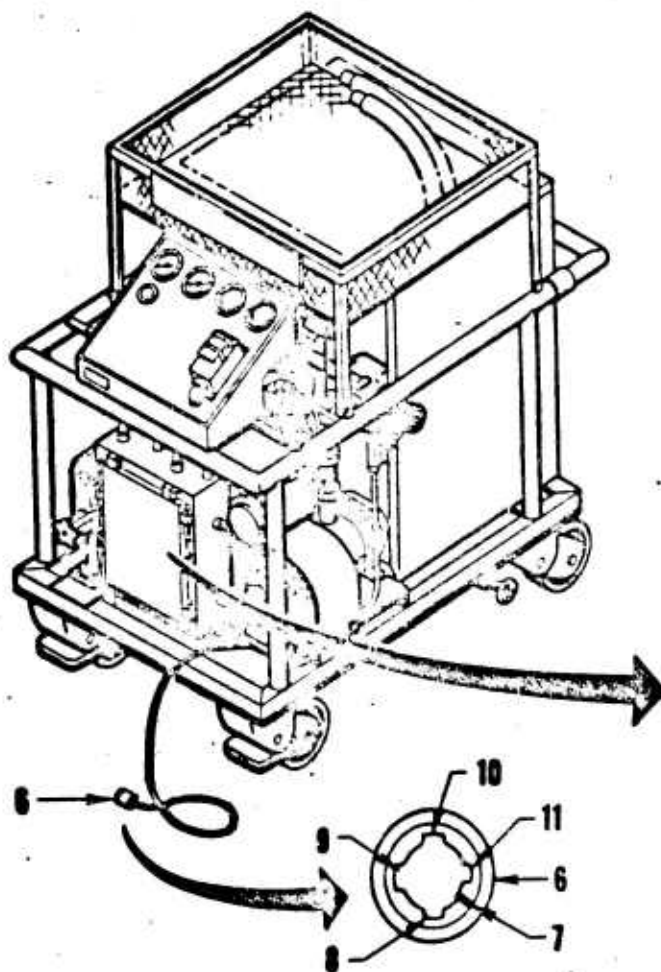
L2 (2)

Pin (11) opposite large pin (9)

L3 (3)

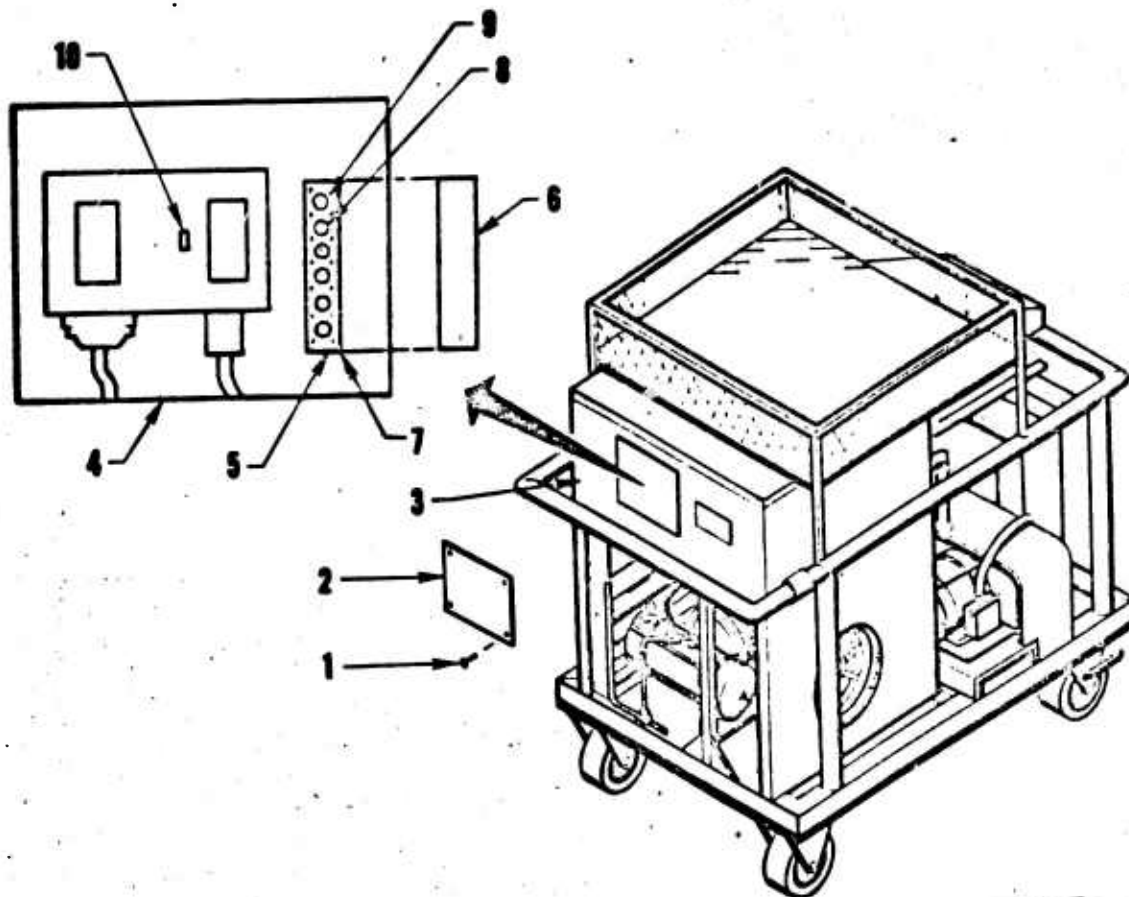
Pin (8) remaining small pin.

If deflection is not observed in all checks, troubleshoot power line EMI and power cable circuit. Refer to AGE ECU Power Circuit Troubleshoot, Volume 2-3.



TROUBLESHOOT

1. Remove cover (6) from terminal board TB-1 (5) by pulling free of posts (7).
15. Place multimeter leads on terminals 5 (8) and 6 (9) of terminal board TB-1 (5). Read a left to right deflection. If no deflection is observed, troubleshoot pressure limit control. Refer to AGE ECU Cooling Unit Pressure Limit Control (Lear-Siegler) Troubleshoot, Volume 2-10.
16. Troubleshoot start circuit. Refer to AGE ECU Start Circuit (Lear-Siegler) Troubleshoot, Volume 2-2.



TROUBLESHOOT

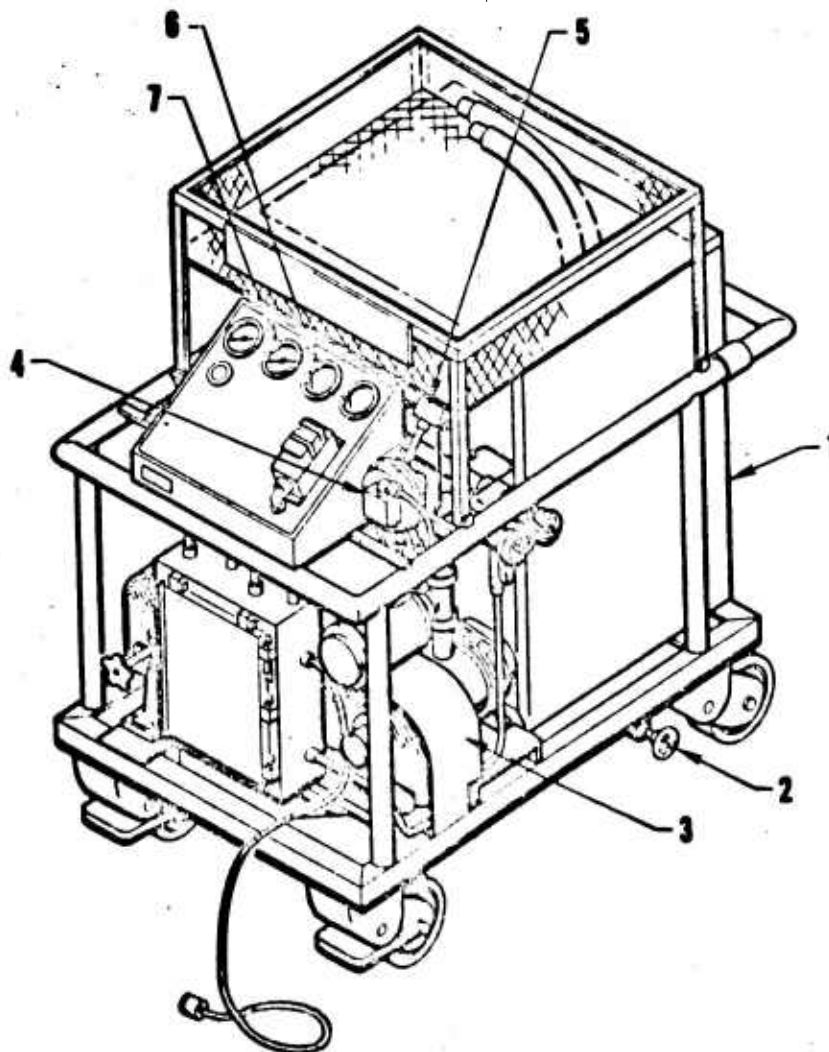
Test Adapter Set Alarm Activated

NOTE

If Test Adapter Set (TAS) Alarm occurred because the AGE ECU shut down automatically, refer to AGE ECU Automatic Shutdown Troubleshoot, page 2-1-21.

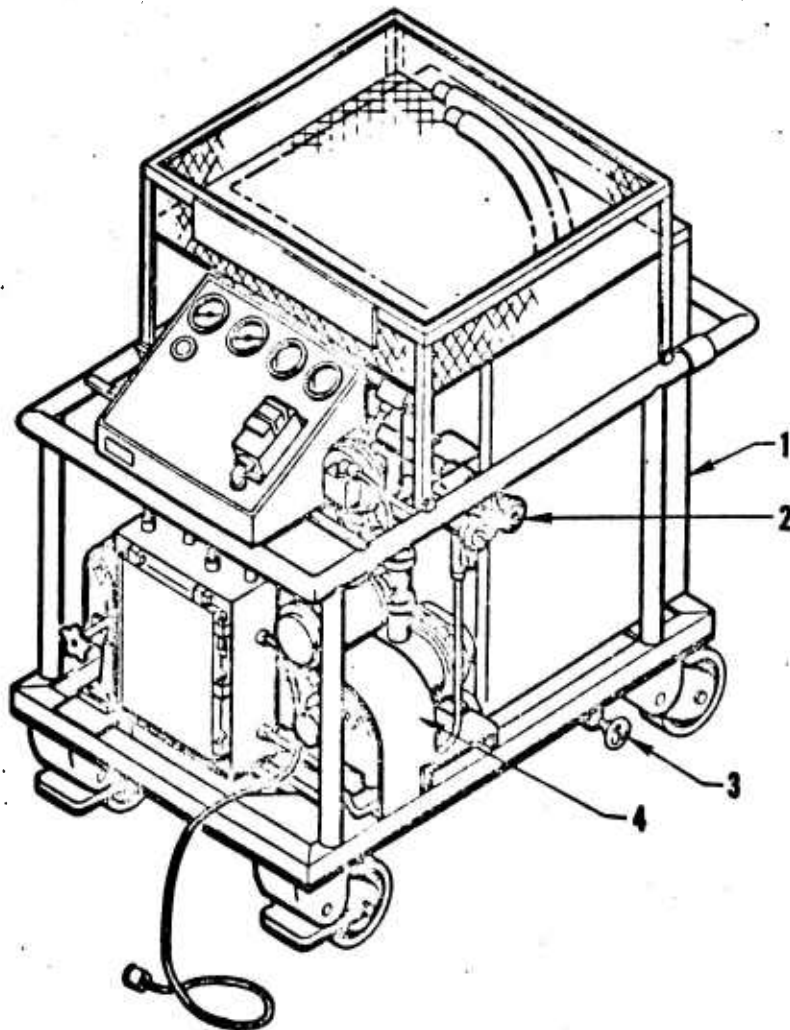
1. Observe AGE ECU operation. If cooling unit (1) condenser fan or compressor are not operating, troubleshoot cooling unit. Refer to AGE ECU Cooling Unit (Lear-Siegler) Troubleshoot, Volume 2-7. If blower unit (3) is not operating, troubleshoot blower unit. Refer to AGE ECU Blower Unit Troubleshoot, Volume 2-6.

2. Check flow gage (6) reading and supply air temperature gage (7) reading. If the flow gage (6) reading is above 0.15 inch of water and the supply air temperature gage (7) reading is below 76°F, troubleshoot test adapter set alarm signal. Refer to AGE ECU Test Adapter Set Alarm Signal Troubleshoot, Volume 2-4.
3. If the flow gage (6) reads below 0.15 inch of water, go to step 4. If the supply air temperature gage (7) reads above 76°F, go to step 8.



TROUBLESHOOT

4. Check drain valve (3) open less than 1/4 turn. If open less than 1/4 turn, go to step 6.
5. Close drain valve (3), then open 1/4 turn. Read flow gage. If reading increases to over 0.15 inch of water, go to step 9.
6. Disconnect unit under test supply line from SUPPLY pipe (2). Read flow gage. If reading increases to over 0.15 inch of water, repair unit under test. Go to step 9.
7. Troubleshoot blower unit (4). Refer to AGE ECU Blower Unit (Lear-Siegler) Troubleshoot, Volume 2-6.
8. Troubleshoot cooling unit (1). Refer to AGE ECU Cooling Unit (Lear-Siegler) Troubleshoot, Volume 2-7.
9. Return to checkout or test in progress.



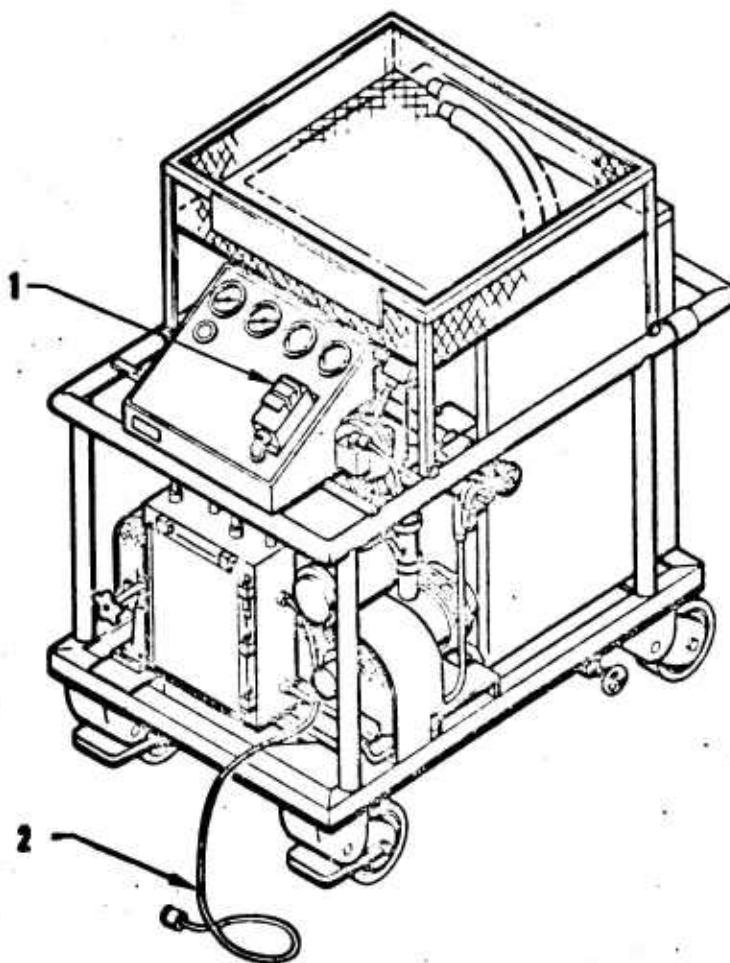
TROUBLESHOOT

AGE ECU Automatic Shutdown

1. Review the manner in which the AGE ECU was operating immediately prior to shutdown. If the blower unit was not delivering air at desired volume or was not operating at normal temperature or noise level, troubleshoot blower unit. Refer to AGE ECU Blower Unit Trou-

bleshoot, Volume 2-6. If the compressor or condenser fan was not operating or was operating with a high noise level, troubleshoot cooling unit. Refer to AGE ECU Cooling Unit Troubleshoot, Volume 2-7.

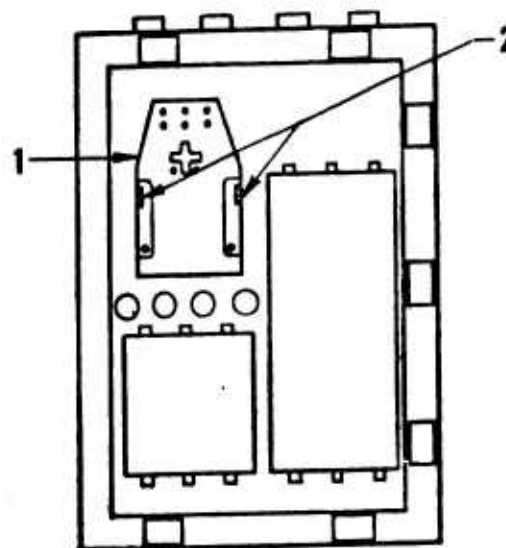
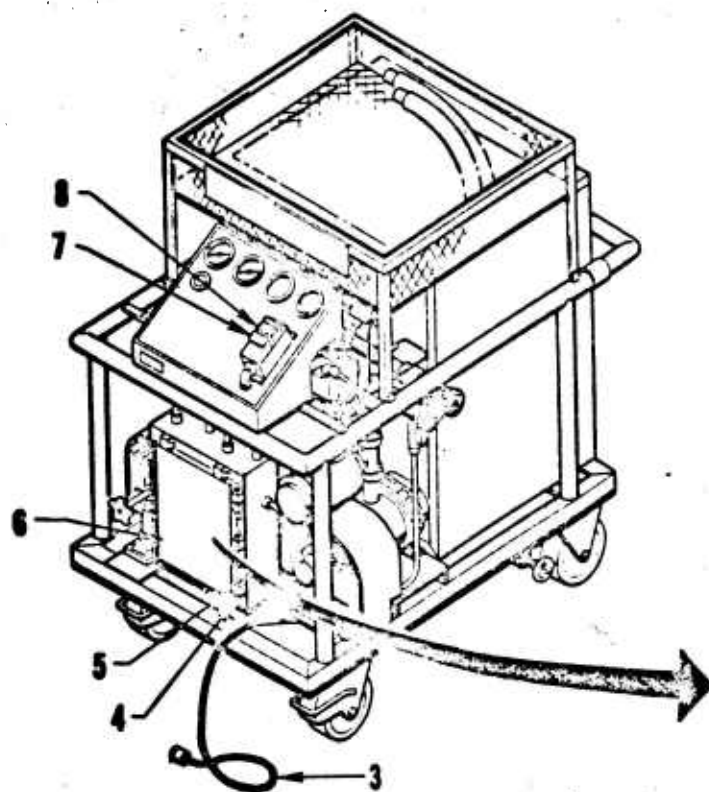
2. Connect power cable (2) to facility power.
3. Wait about 5 minutes, then press START switch (1). If AGE ECU starts properly, go to step 8.



TROUBLESHOOT

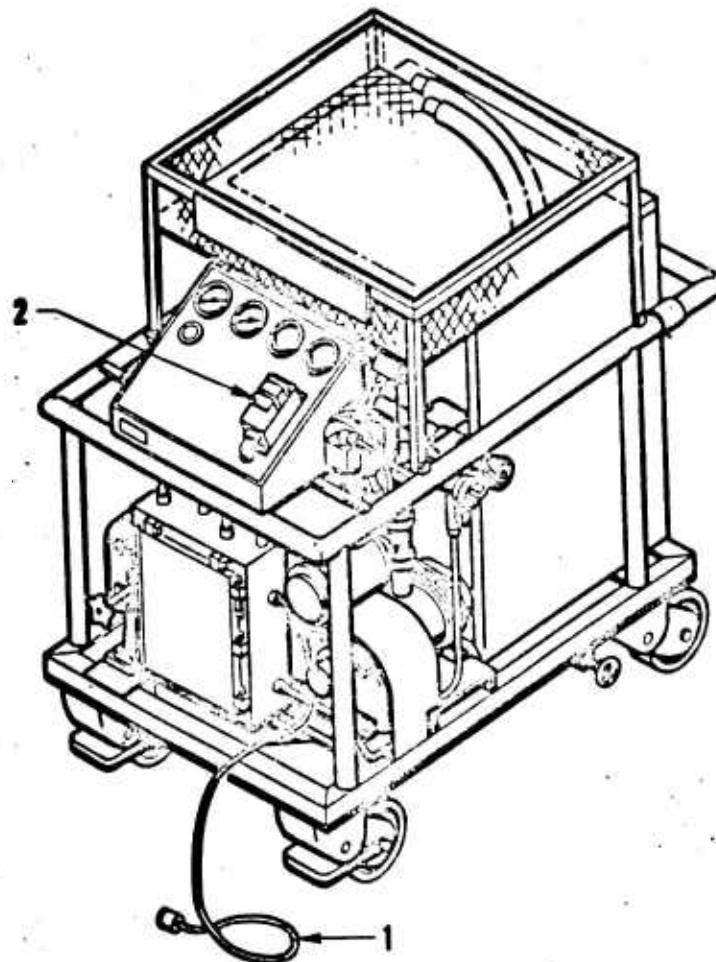
4. Loosen screws (5) on electrical enclosure cover clamps (4).
5. Move clamps (4) aside and open enclosure cover (6).
6. Press reset buttons (2) on motor starter (1). and press START switch (8).

7. If an attempt to start does not occur, press STOP switch. Go to step 10. If an attempt to start occurs but starter circuit breakers open to interrupt start, press STOP switch (7) and disconnect power cable (3). Go to step 15.



C TRROUBLESHOOT

8. If AGE ECU starts properly, monitor AGE ECU operation for a period of 15 to 20 minutes. If shutdown does not recur, go to step 16.
9. If AGE ECU shutdown recurs, press STOP switch (2) and disconnect power cable (1) from facility power. Troubleshoot cooling unit, for HI-LOW pressure switch repeated cutout. Refer to AGE ECU Cooling Unit Troubleshoot, Volume 2-7.

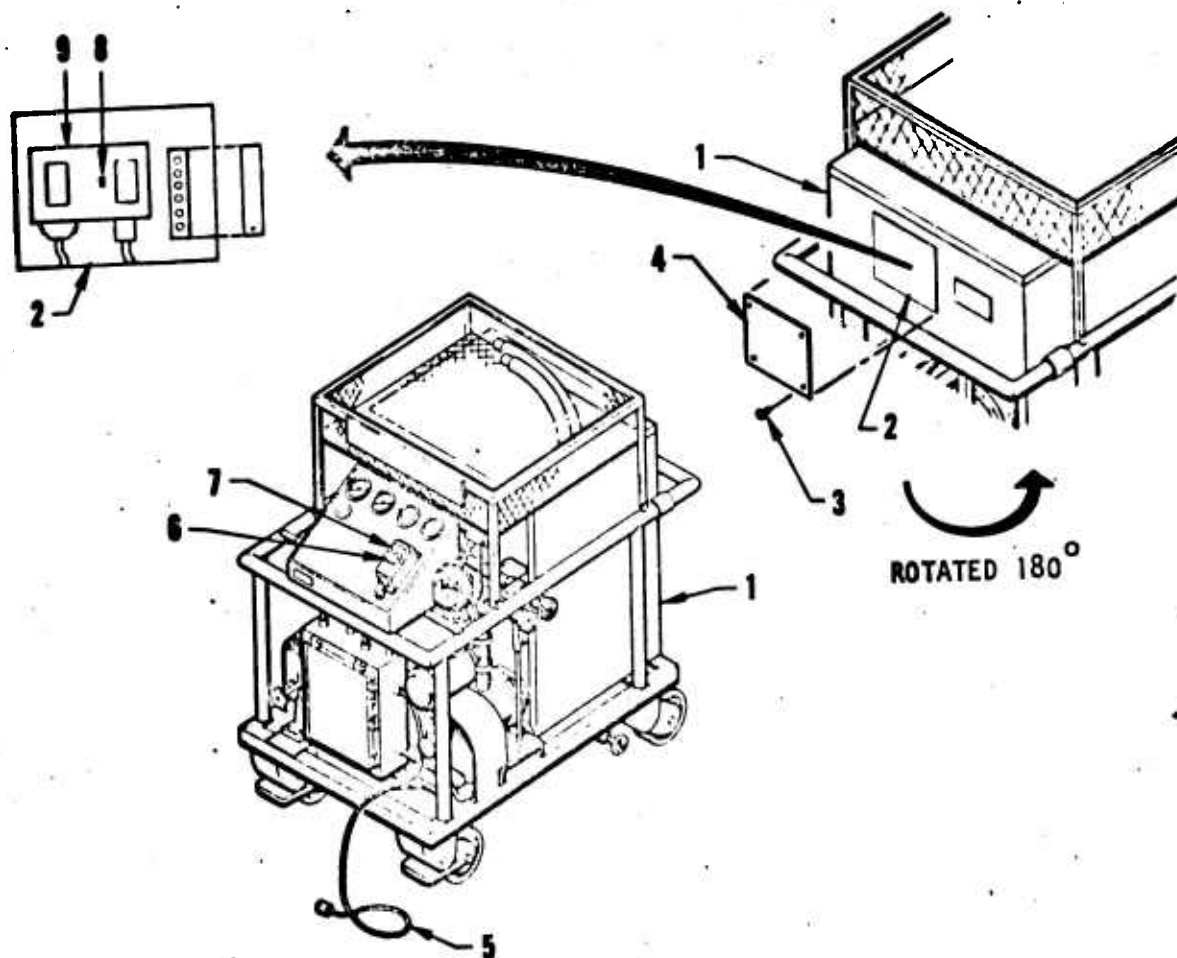


TRUBLESHOOT

10. Remove cover (4) from electrical box (2) on cooling unit (1) by removing screws and lockwashers (3).
11. Check that pressure limit control (9) settings are: low pressure cutin 25 psig, low pressure cutout 5 psig, and high pressure cutout 250 psig. If settings are incorrect, disconnect power cable (5) from facility power and adjust settings. Refer to Pressure Limit Control Adjustment, Volume 1-10, page 1-10- . Go to step 16.
12. Press high pressure reset button (8) and press START switch (7). If start does not occur, press STOP switch (6) and disconnect power cable (5) from facility power. Troubleshoot pressure limit con-

trol. Refer to AGE ECU Cooling Unit Pressure Limit Control (Lear-Siegler) Troubleshoot, Volume 2-10.

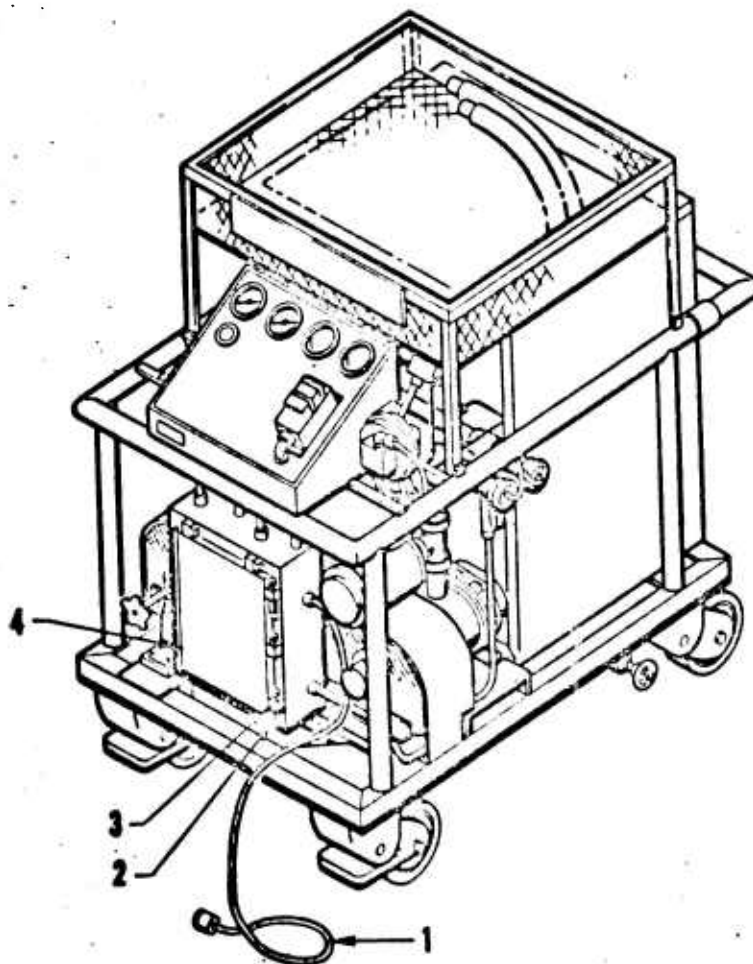
13. If start occurred, monitor AGE ECU operation for a period of 15 to 20 minutes. If shutdown does not occur, place electrical box cover (4) on cooling unit (1) and install screws and washers (3). Go to step 16.
14. If AGE ECU shutdown recurs, press STOP switch (6) and disconnect power cable (5) from facility power. Troubleshoot cooling unit for pressure limit control high pressure switch repeated cutout. Refer to AGE ECU Cooling Unit Troubleshoot, Volume 2-7.



TROUBLESHOOT

15. Review characteristics of attempted start. If blower and fan did not start, troubleshoot power circuit. Refer to AGE ECU Power Circuit Troubleshoot, Volume 2-3. If blower and fan started, but compressor did not, troubleshoot cooling unit. Refer to AGE ECU Cooling Unit Troubleshoot, Volume 2-7. If compressor and fan started but blower did not, troubleshoot blower unit. Refer to AGE ECU Blower Unit Troubleshoot, Volume 2-6.

16. Close electrical enclosure cover (4). Position clamps (2) to secure cover and tighten screws (3).
17. Return to checkout or test in progress.



TROUBLESHOOT

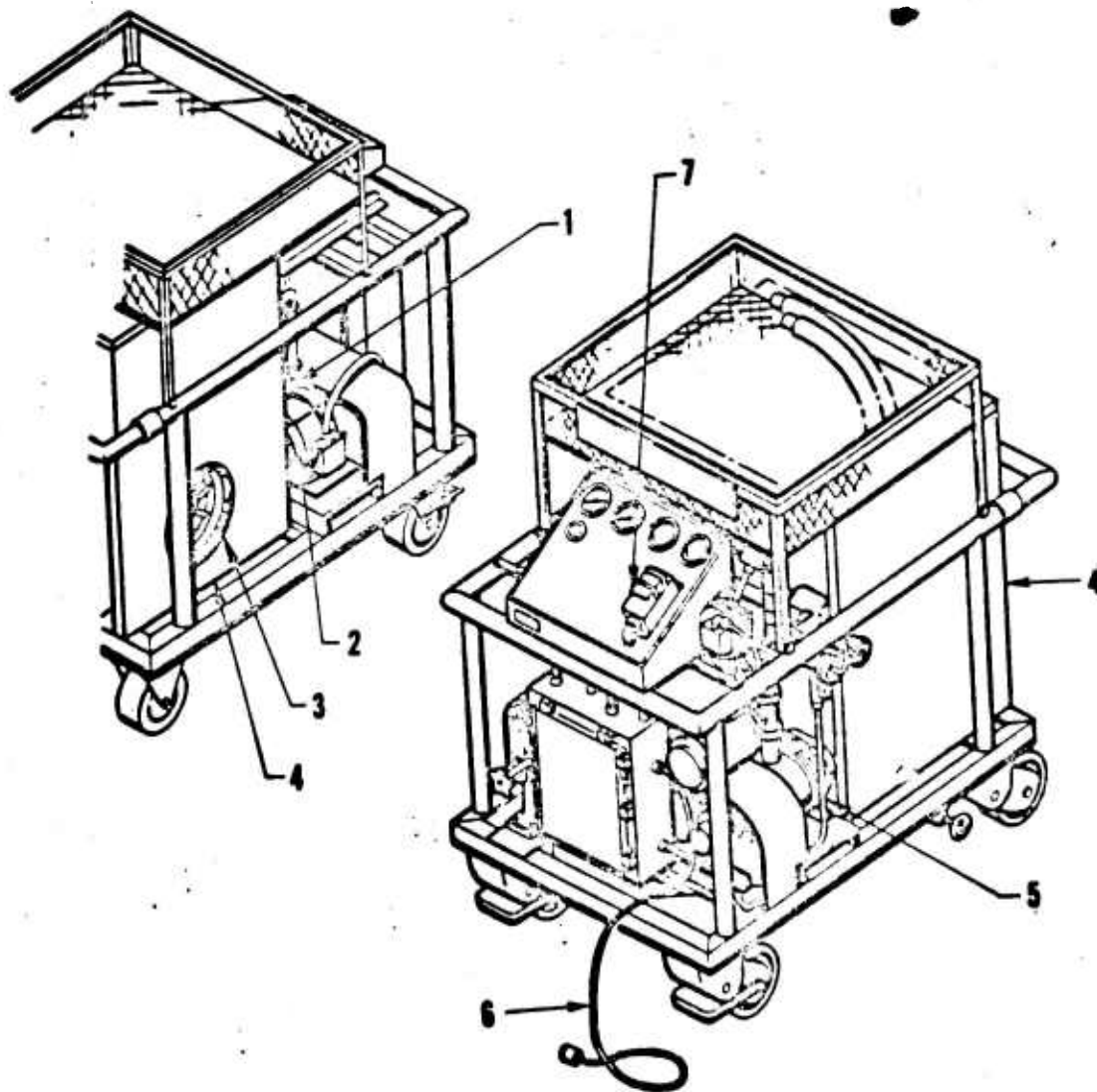
AGE ECU Noisy and Rough

CAUTION

Do not continue to operate the AGE ECU if it is running noisy and rough. Damage to the AGE ECU could result.

1. Press STOP switch (7).
2. Disconnect power cable from facility power (6).

3. Note the location and characteristic of the noise. If noise and/or vibration was coming from the blower (5), blower motor (2) or blower varidrive (1), troubleshoot the blower unit. Refer to AGE ECU Blower Unit Troubleshoot, Volume 2-6. If noise and/or vibration was coming from the cooling unit condenser fan (3) troubleshoot the cooling unit condenser fan. Refer to AGE ECU Cooling Unit Condenser (Lear-Siegler) Troubleshoot, Volume 2-9. If the noise and/or vibration was coming from the cooling unit, but not the condenser fan (3), troubleshoot the cooling unit (4). Refer to AGE ECU Cooling Unit (Lear-Siegler) Troubleshoot, Volume 2-7.



TECHNICAL MANUAL

VOLUME 2-2

TROUBLESHOOT

START CIRCUIT

AGE ELECTRONICS ENVIRONMENTAL CONTROL UNIT

A/M 32C-13

Part No. 2A14155A-101-17

A/M 32C-13A

Part No. 2A14155A-101-18

TROUBLESHOOT START CIRCUIT

PRELIMINARY INFORMATION

ACTIVITY INDEX

Introduction

This activity covers the troubleshooting of the AGE Environmental Control Unit Starting Circuit.

ProcedurePage

Troubleshoot Start Circuit

2-2-2

Applicable Models

A/M 32C-13 or A/M 32C-13A with Lear-Siegler Cooling Unit Model AD100-1

Special Tools

Refrigeration Unit Tool Kit, Part Number SC5180-93-CL-E18.

Specific item required:

Multimeter, 0 to 5000 VDC, 0 to 1000 VAC, TS-352 B/U

Supplies

None

Personnel

Two technicians AFSC 422X1

Equipment Condition

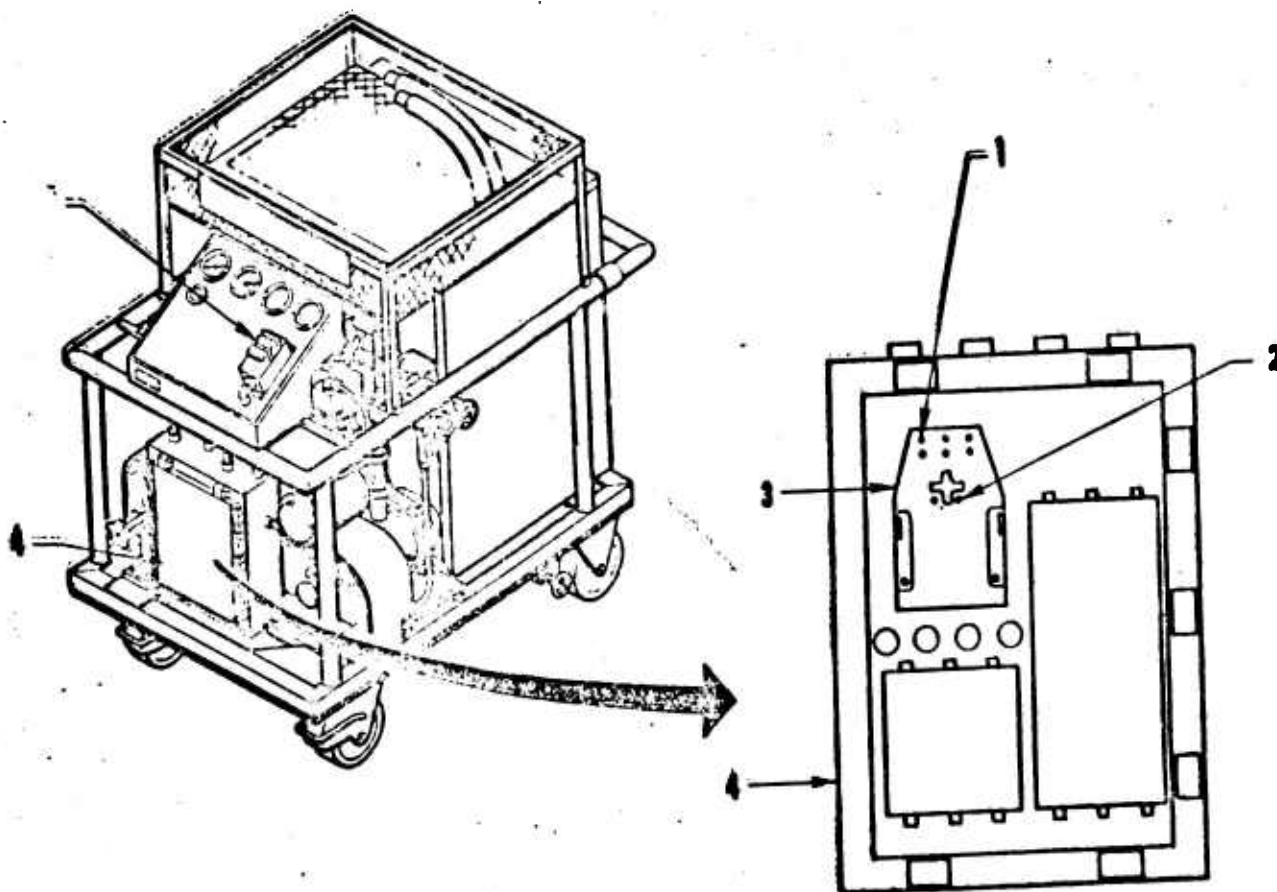
This procedure continues from AGE ECU Fail to Start, Volume 2-1, page 2-1-18. Power cable is disconnected from facility power and electrical enclosure cover is open.

TRO ESHOOT START CIRCUIT

WARNING

Verify power cable is disconnected from facility power before making electrical checks. Injury from electrical shock could occur if power cable were connected.

1. Inspect wiring in electrical enclosure (4) for security of attachment and condition of wire and insulation. If any wires are loose or damaged, reinstall or replace. Refer to Repair of Wiring, Volume 1-2, page 1-2- . Go to step 26.
2. Place multimeter leads on L1 (1) and 3 (2) of motor starter (3). Request assistant to press START switch (5). Read left to right deflection and request assistant to release START switch. If deflection is not observed, go to step 4.

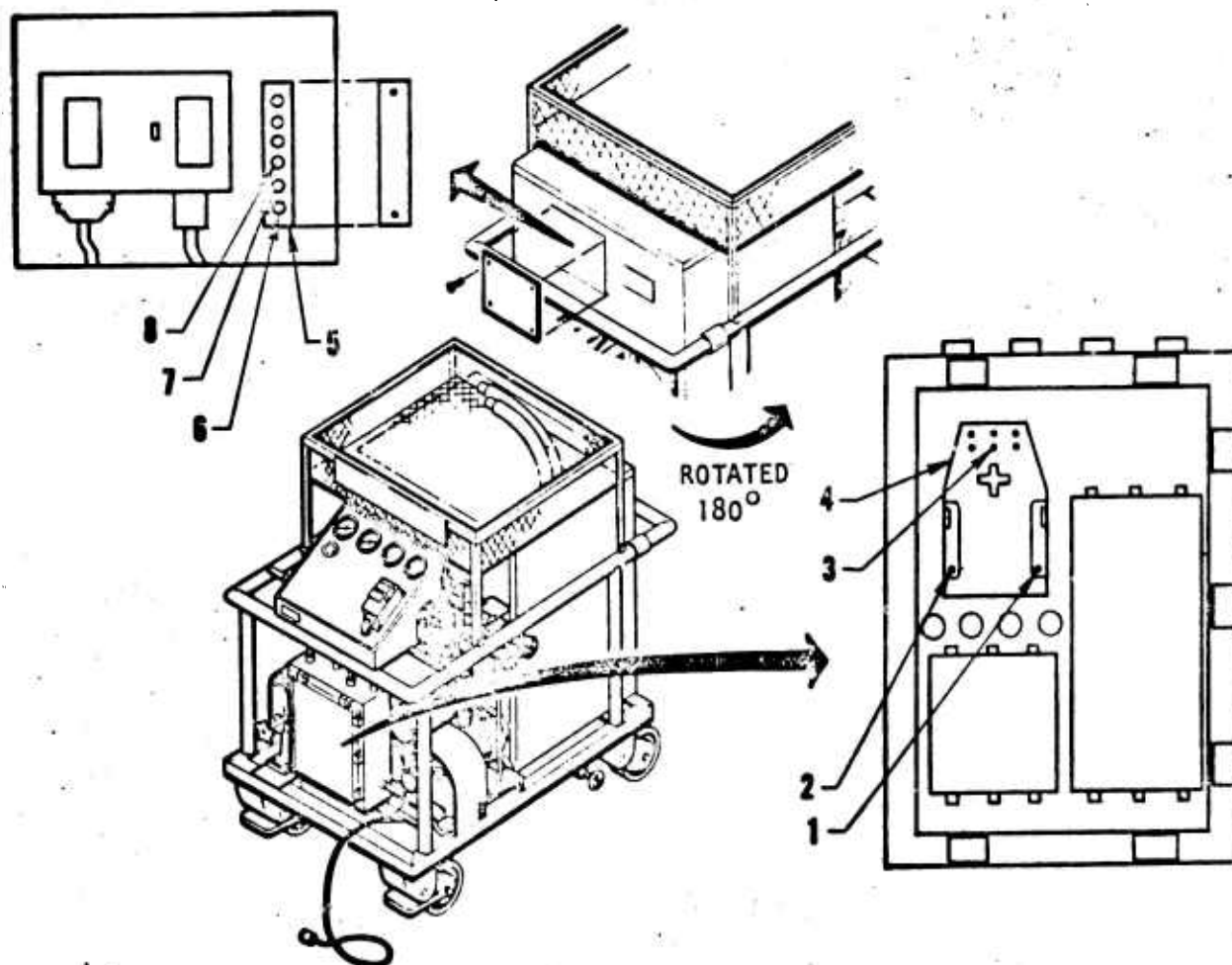


TROUBLESHOOT START CIRCUIT

3. With aid of assistant, place multimeter leads on each of following sets of motor starter to terminal board checkpoints. Read left to right deflection for each set:

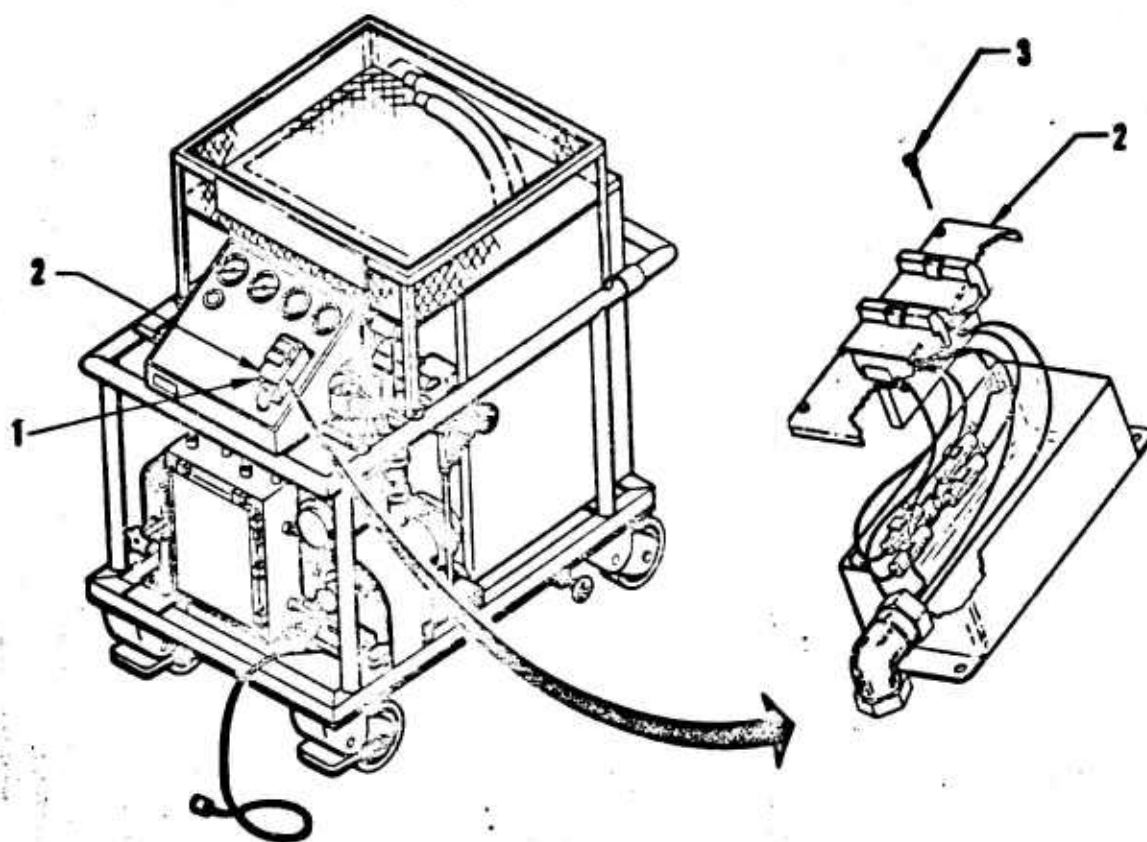
Motor Starter (4)	Terminal Board TB-1 (5)
T1 (2)	1 (6)
T2 (3)	2 (7)
T3 (1)	3 (8)

If deflection is observed in each check, replace motor starter (4). Refer to Remove and Install Motor Starter, Volume 1-2, page 1-2- . If deflection is not observed in all checks, troubleshoot power line EMI filter and input harness. Refer to AGE ECU Power Circuit Troubleshoot, Volume 2-3.



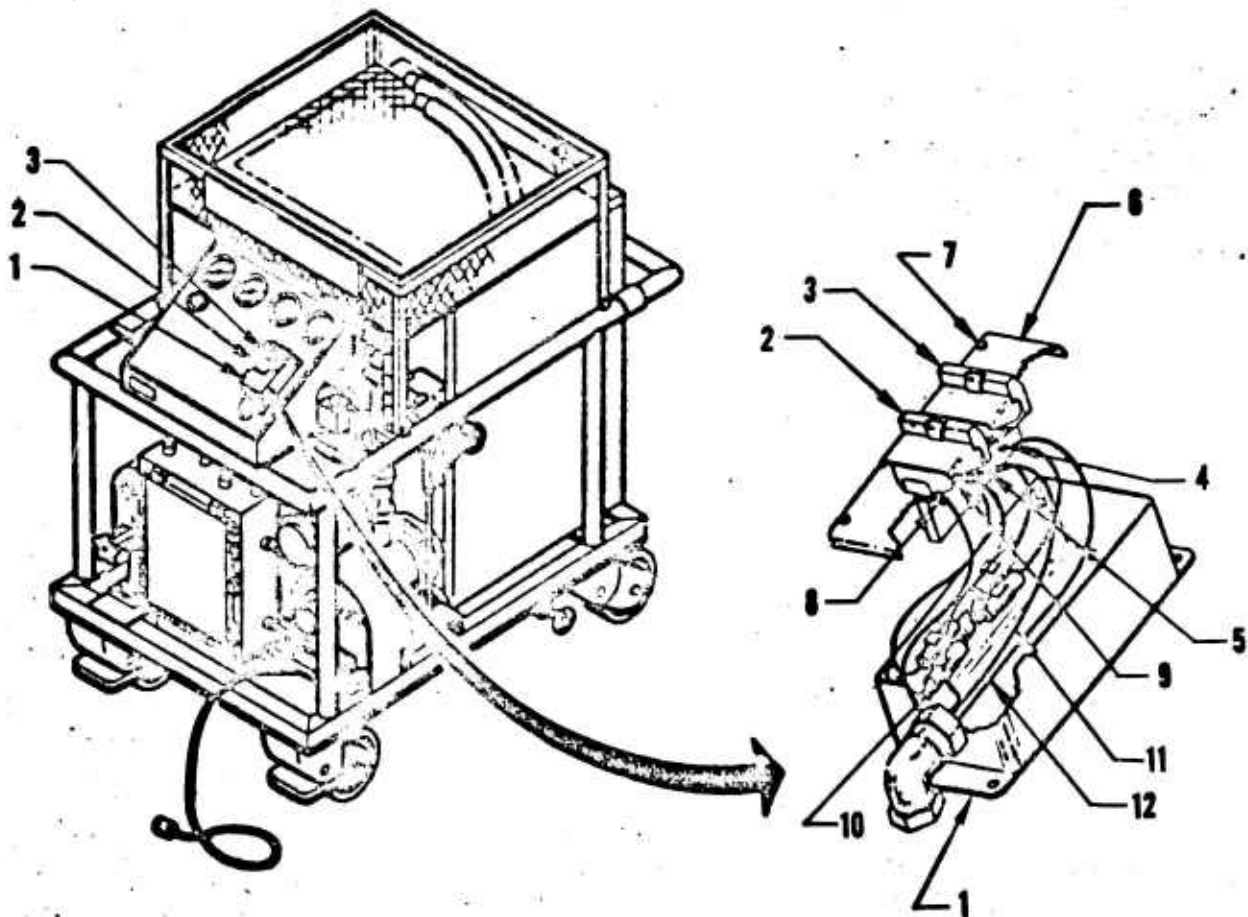
TROUBLESHOOT START CIRCUIT

4. Remove four screws (3) from START-STOP switch cover (2) and lift cover, taking care not to damage gasket.
5. Observe START-STOP switch (1) for burned areas, or the odor of burned insulation. If this condition exists, replace START-STOP switch. Refer to Remove and Install START-STOP Switch, Volume 1-2, page 1-2- . Go to step 23.



TROUBLESHOOT START CIRCUIT

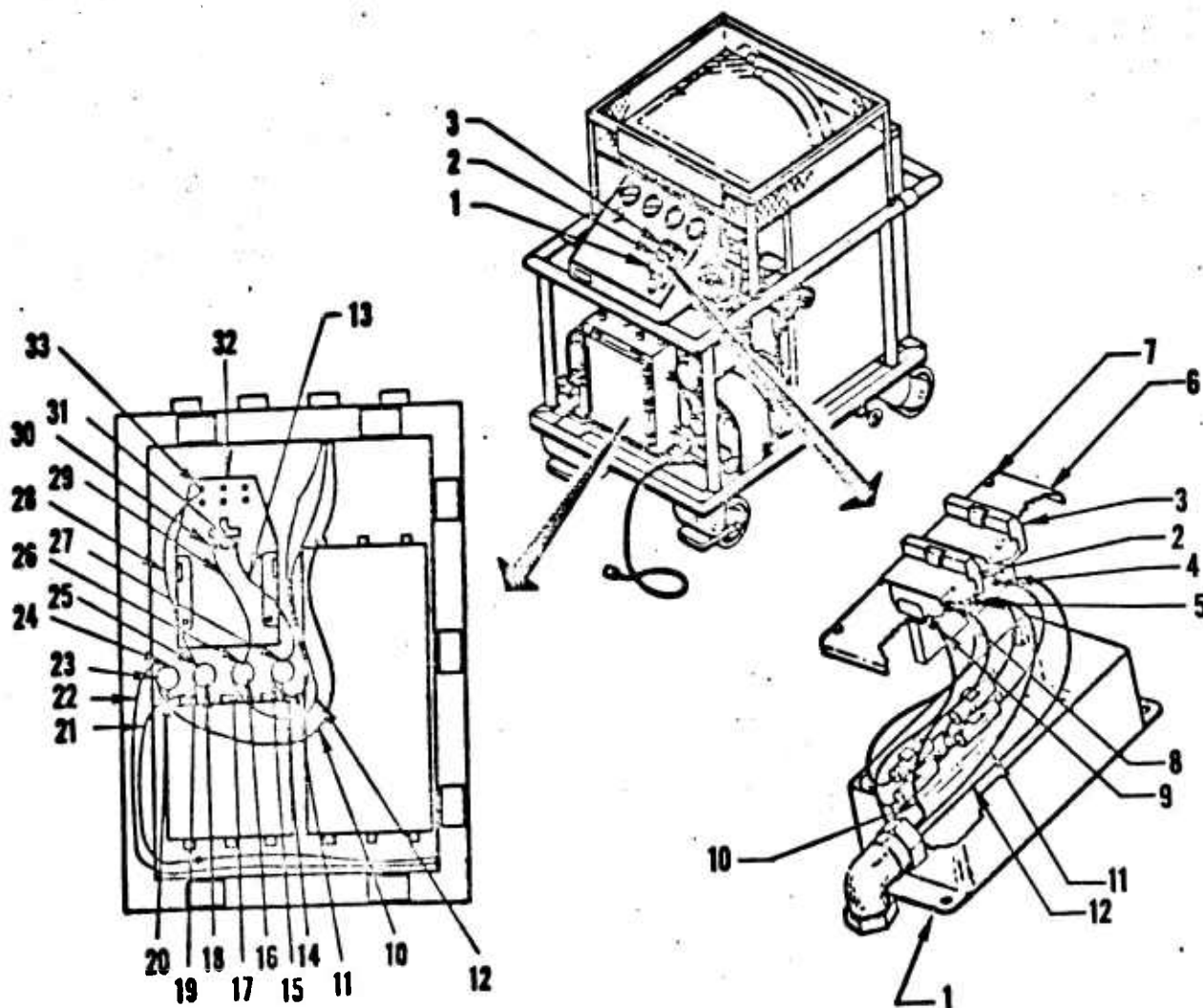
6. Place one multimeter lead on STOP switch (2) NC connector (9) (attached to C2 capacitor) and other multimeter lead on START switch (3) NO connector (5) (attached to R1 resistor). Read left to right meter deflection. If no deflection, replace START-STOP switch (1). Refer to Remove and Install START-STOP Switch, Volume 1-2, page 1-2- . Go to step 23.
7. Move multimeter lead from START switch NO connector (5) (attached to R1 resistor) to START switch NO connector (4) (attached to C1 capacitor). Read no meter deflection. If deflection is observed, replace START-STOP switch (1). Refer to Remove and Install START-STOP Switch, Volume 1-2, page 1-2- . Go to step 23.
8. Press START switch (3). Read left to right deflection. If no deflection, replace START-STOP switch (1). Refer to Remove and Install START-STOP Switch, Volume 1-2, page 1-2- .



TROUBLESHOOT START CIRCUIT

9. Place one multimeter lead on START switch NO connector (4) (attached to C1 capacitor) and other multimeter lead on 3 (31) of motor starter (32). Read left to right meter deflection. If no deflection, go to step 11.
10. Place one multimeter lead on START switch NO connector (5) (attached to R1 resistor) and other multimeter lead on 2 (30) of motor starter (32). Read left to right meter deflection. If no deflection, go to step 14.

11. Move multimeter lead from 3 (31) of motor starter (32) to solder connection (15) (wire 7B22 to inductor). Read left to right meter deflection. If no deflection, replace wire 7B22 (11). Refer to Repair of Wiring, Volume 1-2, page 1-2- . Go to step 23.
12. Move multimeter lead from solder connection (15) (wire 7B22 to inductor) to solder connection (27) (wire 7C22 to inductor). If left to right meter deflection is observed, replace wire 7C22 (13). Refer to Repair of Wiring, Volume 1-2, page 1-2- . If meter deflection is not observed, replace inductor (14). Refer to Remove and Install Inductors, Volume 1-2, page 1-2- .
13. Go to step 23.

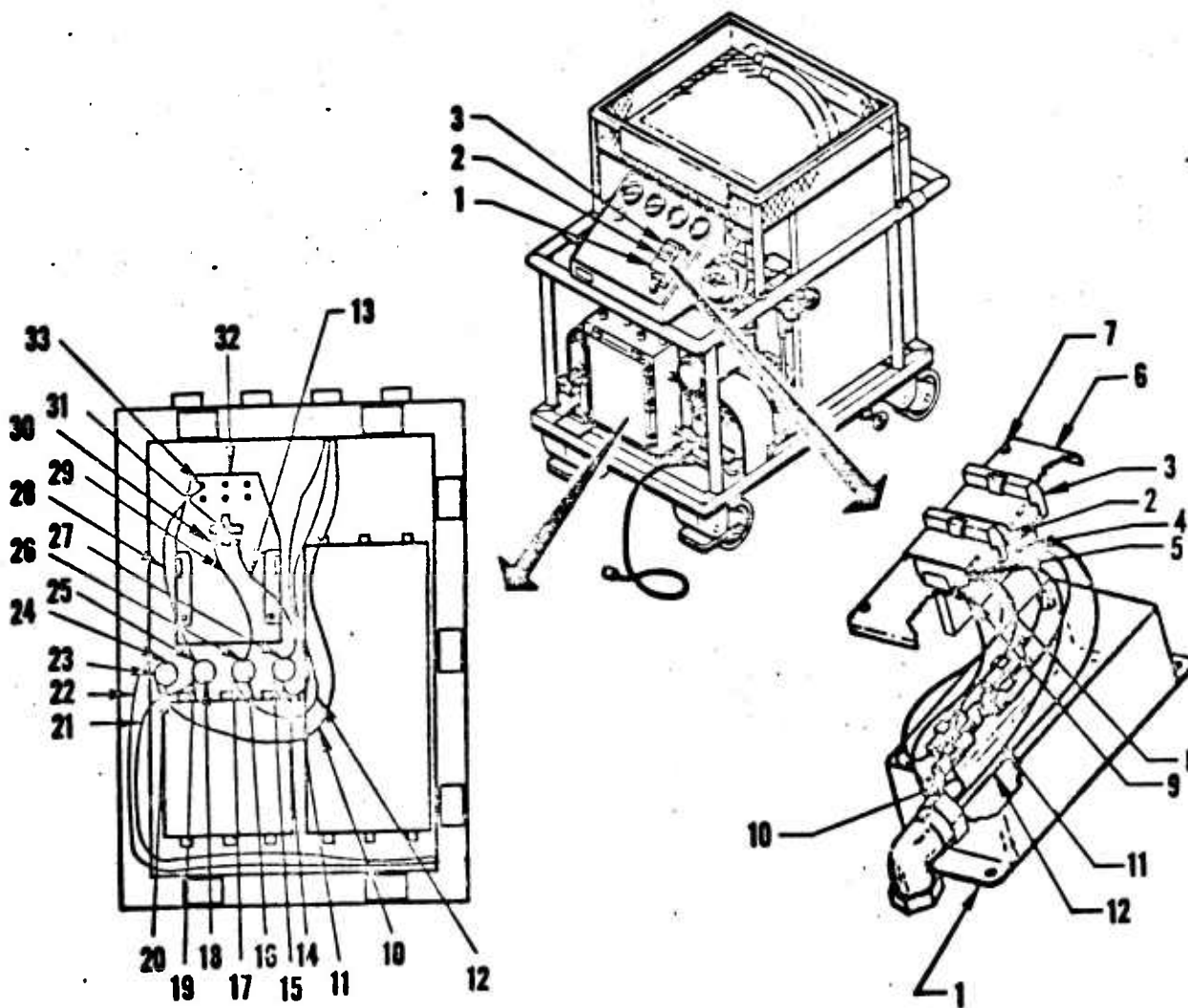


TROUBLESHOOT START CIRCUIT

14. Move multimeter lead from 2 (30) of motor starter (32) to solder connection (17) (wire 6B22 to inductor). Read left to right meter deflection. If no deflection, replace wire 6B22 (12). Refer to Repair of Wiring, Volume 1-2, page 1-2- . Go to step 23.

15. Move multimeter lead from solder connection (17) (wire 6B22 to inductor) to solder connection (26) (wire 6C22 to inductor). If left to right meter deflection is observed, replace wire 6C22 (29). Refer to Repair of Wiring, Volume 1-2, page 1-2- . If meter deflection is not observed, replace inductor (16). Refer to Remove and Install Inductors, Volume 1-2, page 1-2- .

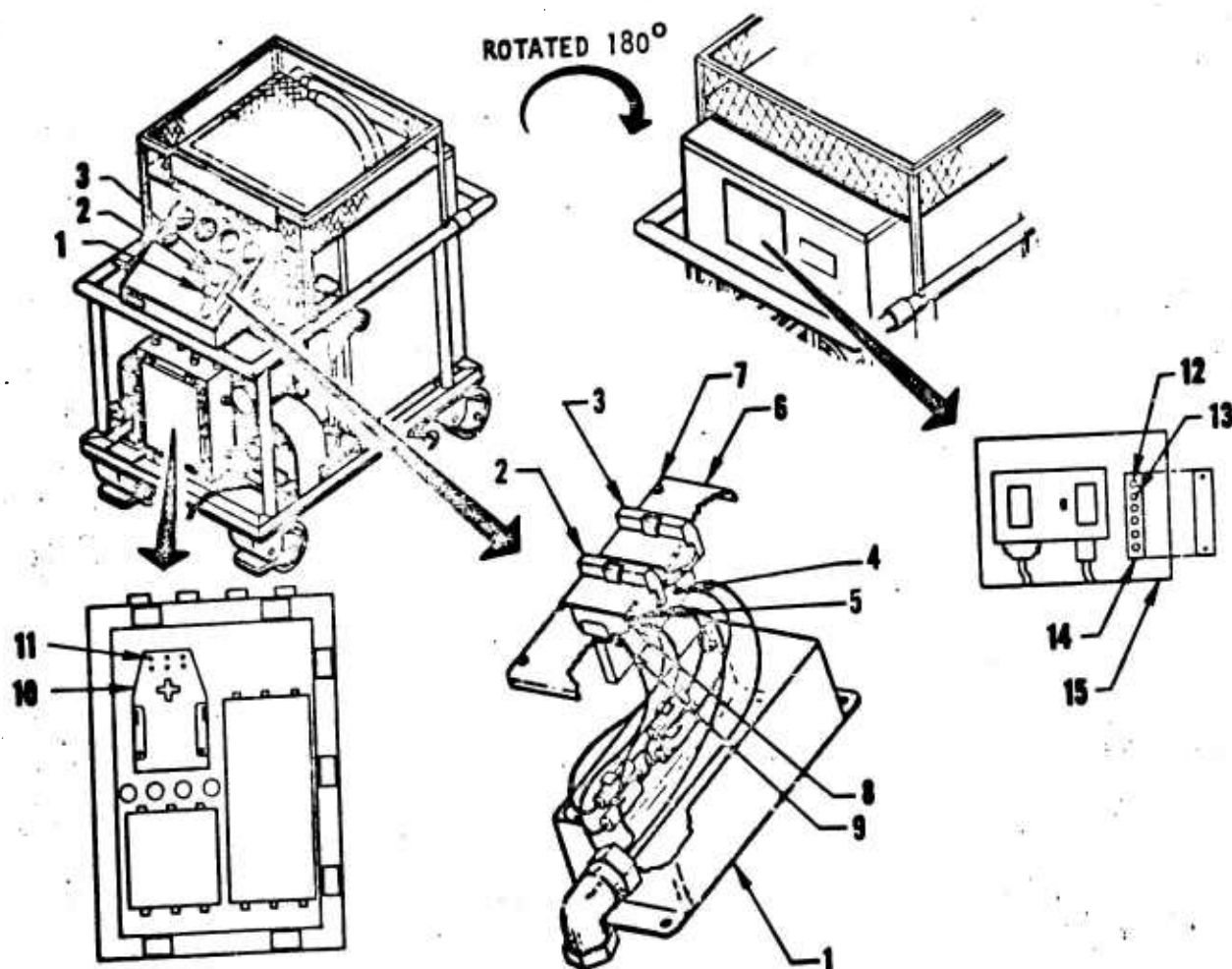
16. Go to step 23.



TROUBLESHOOT START CIRCUIT

17. With the aid of assistant, place one multimeter lead on STOP switch (2) NC connector (9) (attached to C2 capacitor) and other multimeter lead on terminal 5 (13) of terminal board TB-1 (14) in electrical box (15). Read left to right meter deflection. If no deflection, go to step 19.

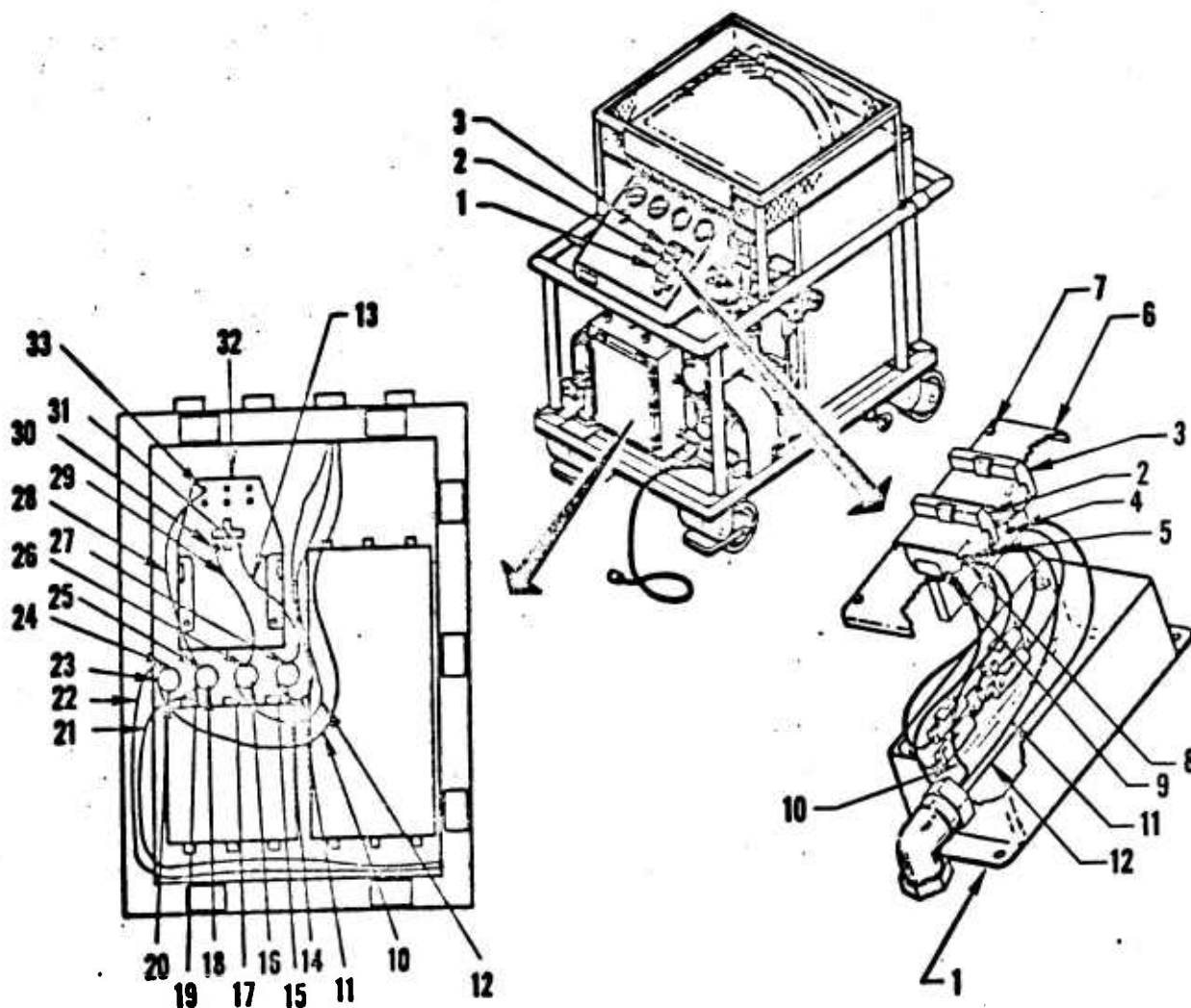
18. With the aid of assistant, place one multimeter lead on terminal L1 (11) of motor starter (10) and other multimeter lead on terminal 6 (12) of terminal board TB-1 (14). Read left to right meter deflection. If no deflection, go to step 21.



TROUBLESHOOT START CIRCUIT

19. With the aid of assistant, move multimeter lead from STOP switch NC connector (9) (attached to C2 capacitor) to solder connection (23) (wire 7D22 to inductor). Read left to right meter deflection. If no deflection, replace wire 7D22 (10). Refer to Repair or Wiring, Volume 1-2, page 1-2- . Go to step 23.

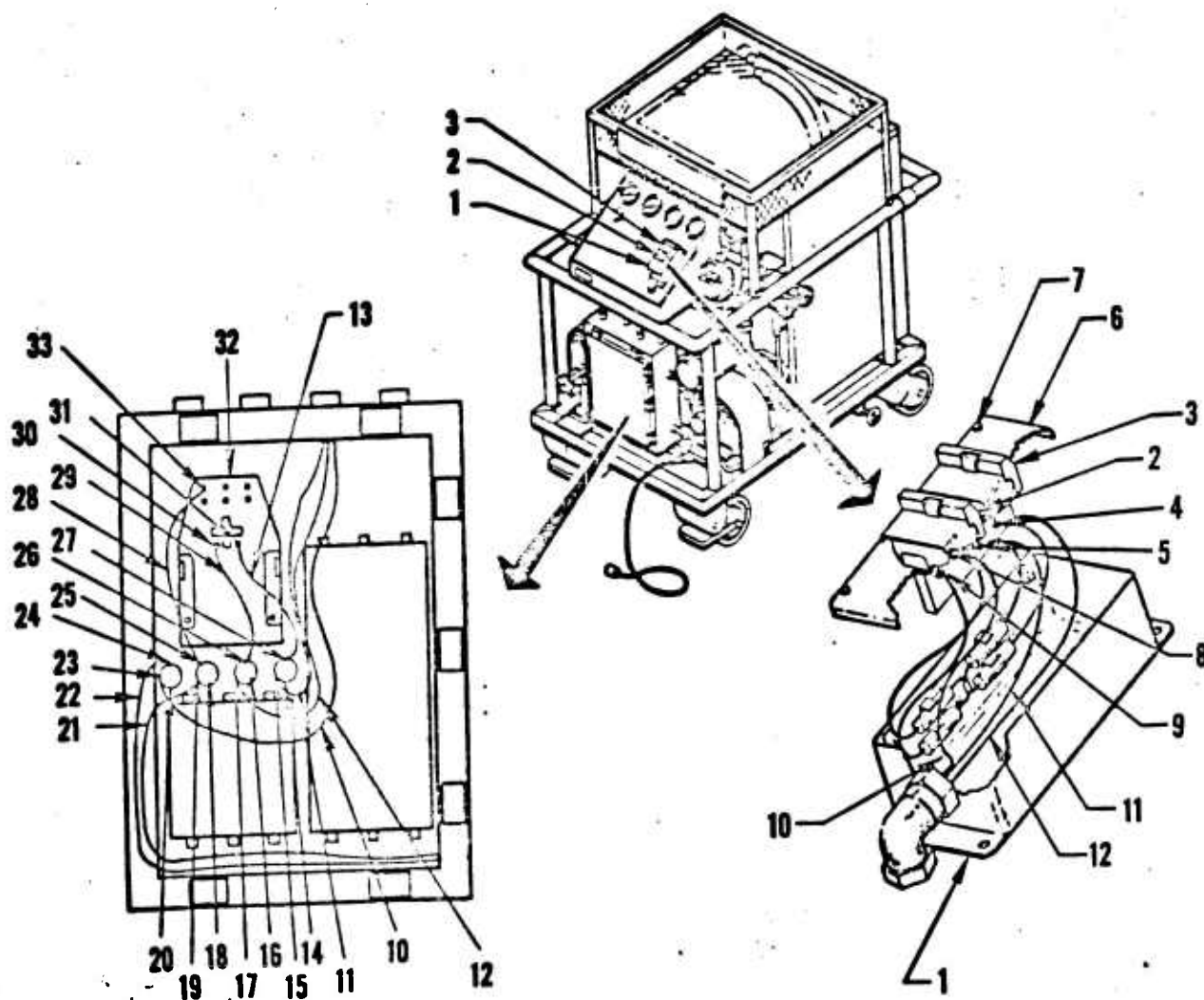
20. Move multimeter lead from solder connection (23) (wire 7D22 to inductor) to solder connection (24) (wire P3B22 to inductor). If left to right meter deflection is observed, replace wire P3B22 (22). Refer to Repair of Wiring, Volume 1-2, page 1-2- . Go to step 23.



TROUBLESHOOT START CIRCUIT

21. Move multimeter lead from terminal L1 (33) of motor starter (32) to solder connection (25) (wire 8B22 to inductor). Read left to right meter deflection. If no deflection, replace wire 8B22 (28). Refer to Repair of Wiring, Volume 1-2, page 1-2- . Go to step 23.

22. Move multimeter to solder connection (19) (wire P1B22 to inductor). If left to right meter deflection is observed, replace wire P1B22 (21). Refer to Repair of Wiring, Volume 1-2, page 1-2- . If meter deflection is not observed, replace inductor (18). Refer to Remove and Install Inductors, Volume 1-2, page 1-2 .



TROUBLESHOOT START CIRCUIT

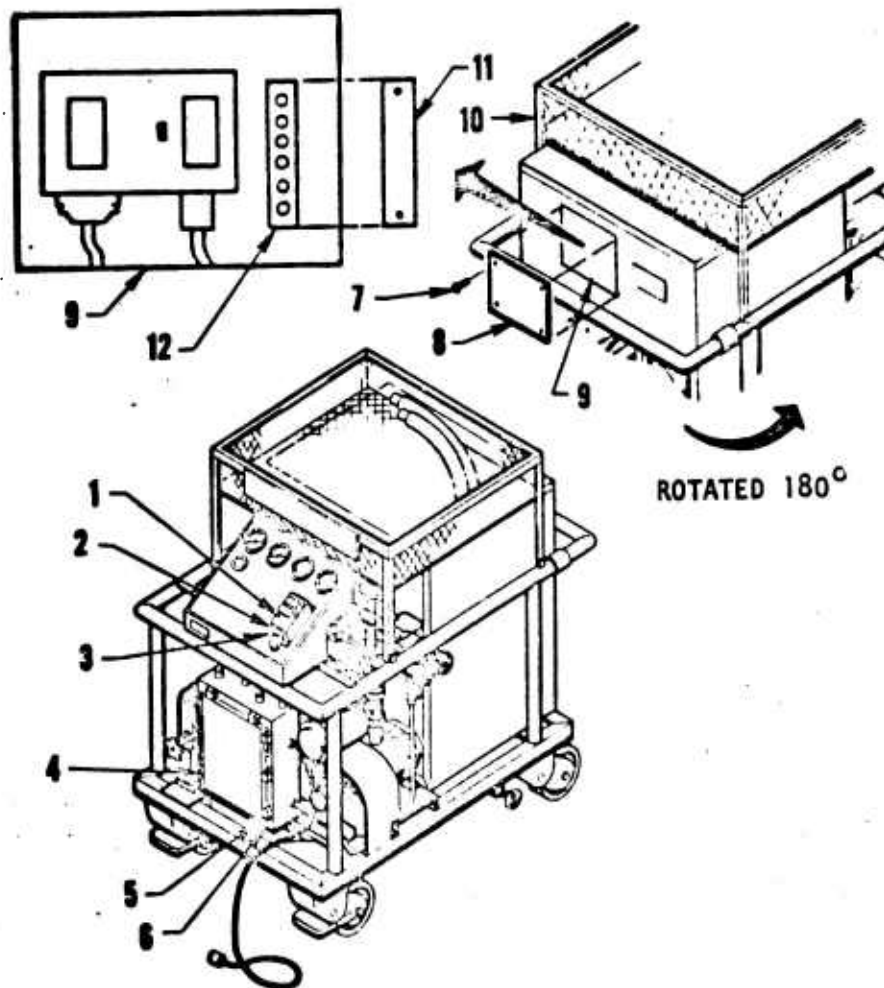
23. Place cover (1) with gasket in place, on START-STOP switch (2) and install four screws (3).

24. Place terminal board cover (11) on terminal board (12).

25. Place electrical box cover (8) on cooling unit (10) and install screws and washers (7).

26. Close electrical enclosure cover (4). Position clamps (5) to secure cover, and tighten screws (6).

27. Return to checkout or test in progress.



TECHNICAL MANUAL

VOLUME 2-4

TROUBLESHOOT

TEST ADAPTER SET ALARM SIGNAL

AGE ELECTRONICS ENVIRONMENTAL

CONTROL UNIT

A/M 32C-13

Part No. 2A14155A-101-17

A/M 32C-13A

Part No. 2A14155A-101-18

TROUBLESHOOT TEST ADAPTER SET ALARM
SIGNAL

PRELIMINARY INFORMATION

ACTIVITY INDEX

Introduction

This activity covers troubleshooting of the AGE ECU Test Adapter Set Alarm Signal following identification of the Test Adapter Set Alarm Signal as the faulty subsystem by completion of AGE ECU Troubleshoot and Blower Unit Troubleshoot. Refer to AGE ECU Checkout and Troubleshoot, Volume 2-1 or AGE ECU Blower Unit Troubleshoot, Volume 2-6.

Applicable Models

A/M 32C-13 or A/M 32C-13A with Lear-Siegler Cooling Unit Model AD100-1

Special Tools

Refrigeration Unit Tool Kit, Part Number SC5180-93-CL-E18.

Specific item required:

Multimeter, 0 to 5000 VDC, 0 to 1000 VAC, TS-352 B/U

Supplies

None

Personnel

Two technicians AFSC 422X1

Equipment Condition

Power cable disconnected from facility power.

Procedure

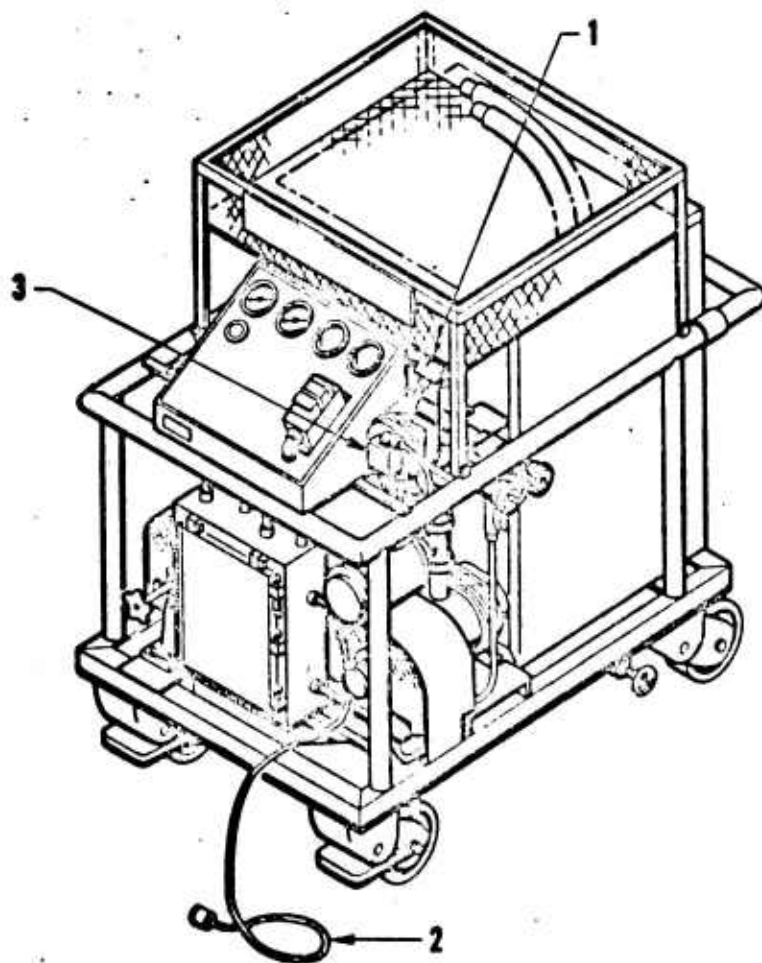
Troubleshoot Test Adapter Set Alarm Signal

Page

2-4-2

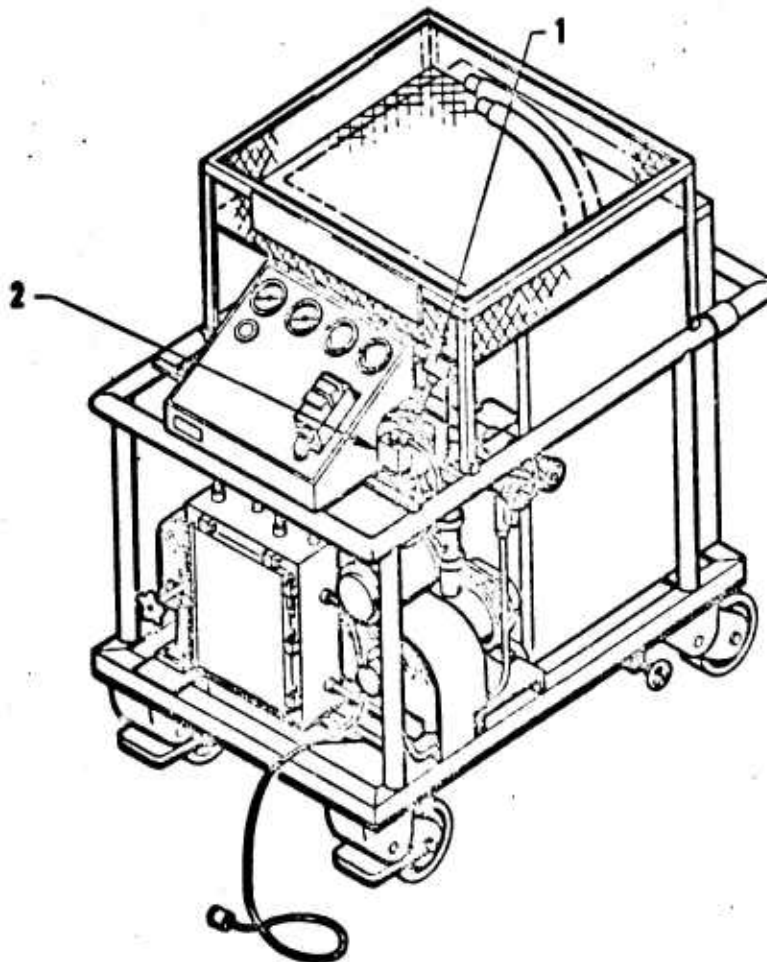
**TROUBLESHOOT TEST ADAPTER SET ALARM
SIGNAL**

- Disconnect power cable (2) from facility power, if connected.
2. Review the trouble symptoms which were evident at time the Test Adapter Set Alarm Signal was identified as the faulty subsystem.
 3. If the alarm signal did not activate when loss of air flow occurred, the pressure switch (3) failed to open circuit. Adjust or replace pressure switch. Refer to Adjustment of Pressure Switch, Volume 1-4, page 1-4- , and Remove and Install Pressure Switch, Volume 1-4, page 1-4- . If the fault remains, go to step 9.
 4. If the alarm signal did not activate with indicated cooling air temperature above 98°F, the temperature switch (1) failed to open circuit. Calibrate or replace temperature switch. Refer to Calibration of Temperature Switch, Volume 1-4, page 1-4- , and Remove and Install Temperature Switch, Volume 1-4, page 1-4- . If the fault remains, go to step 9.



TROUBLESHOOT TEST ADAPTER SET ALARM SIGNAL

5. If the alarm signal activated with an indicated air flow above 0.15 inch of water and an air temperature below 76°F, check out temperature switch (1). Refer to AGE ECU Checkout, Volume 2-1, pages 2-1-11 through 2-1-14.
6. If, in step 5, the temperature switch (1) was found to be at fault, calibrate or replace the temperature switch. Refer to Calibration of Temperature Switch, Volume 1-4, page 1-4- , and Remove and Install Temperature Switch, Volume 1-4, page 1-4- .
7. If, in step 5, the temperature switch was found to be good, check pressure switch (2) and adjust or replace as required. Refer to Adjustment of Pressure Switch, Volume 1-4, page 1-4- , and Remove and Install Pressure Switch, Volume 1-4, page 1-4- .
8. If, in steps 5 through 7, both the pressure switch and the temperature switch were found to be good, the connecting wiring or tubing is at fault. Go to step 9.



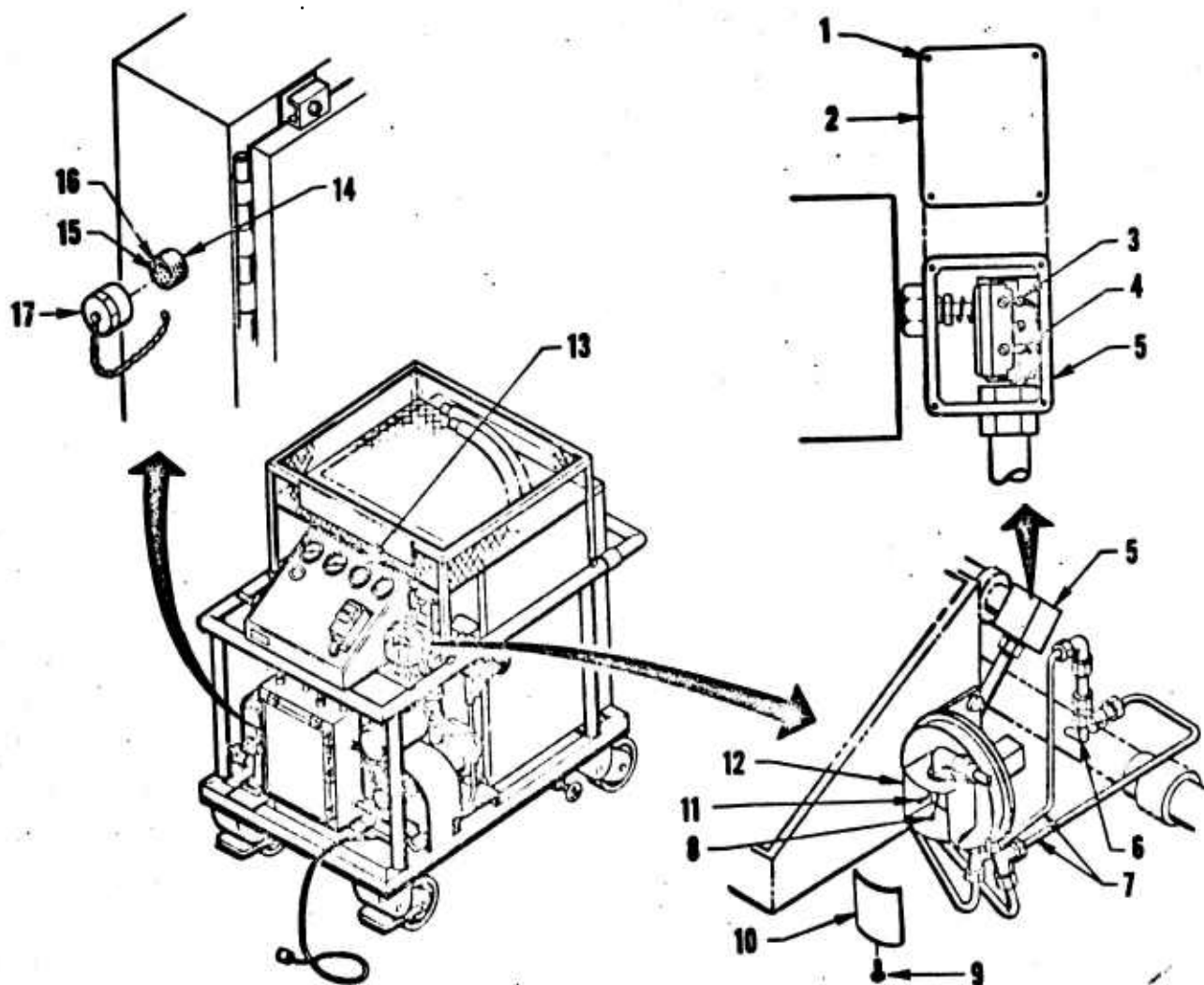
T.O. 35M10-5-7-1JPA-2

TRC LESHOOT TEST ADAPTER SET ALARM
SIGNAL

WARNING

Verify power cable is disconnected from facility power before making electrical checks. Injury from electrical shock could occur if power cable were connected.

9. Remove cover (2) from temperature switch (5) by removing screws (1).
10. Remove cover (10) from pressure switch (12) by removing screw (9).
11. Remove dust cap (17) from test adapter set connector (14).
12. Set multimeter to read ohms in the 0 to 300 ohm range and zero meter. Refer to Test Equipment Operation, Volume 1-1.

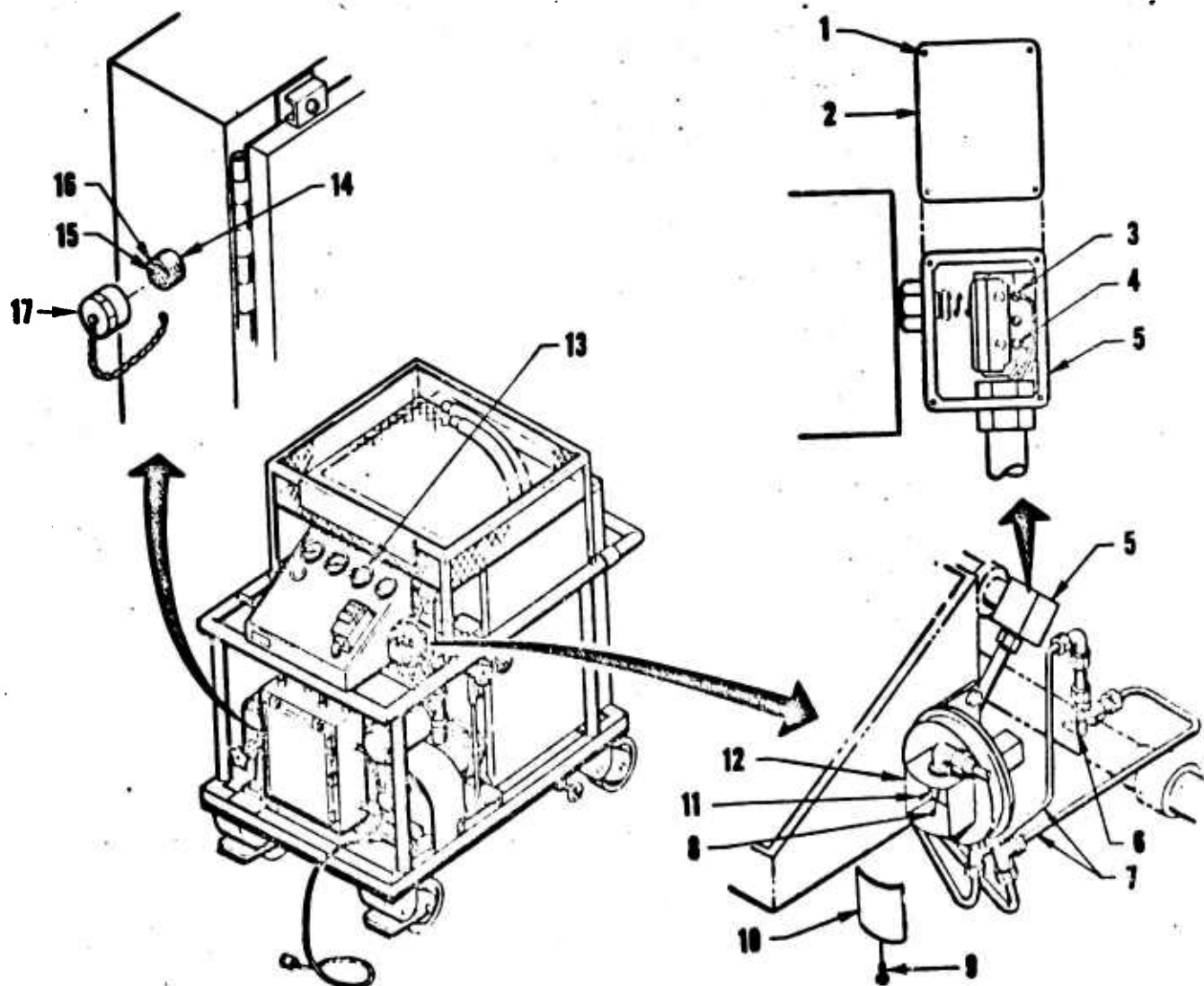


TRUBLESHOOT TEST ADAPTER SET ALARM SIGNAL

13. Place one multimeter lead on terminal A (16) of test adapter set connector (14) and other on temperature switch terminal COM (3). Read a left to right deflection. If not, wire 11B20 is open. Repair connection at test adapter set connector or temperature switch terminals, or replace wire. Refer to Repair of Wiring, Volume 1-5. Go to step 19.
14. Place one multimeter lead on terminal B (15) of test adapter set connector (14) and other on pres-

sure switch terminal COM (11). Read a left to right deflection. If not, wire 12A20 is open. Repair connection at test adapter set connector or pressure switch terminals, or replace wire. Refer to Repair of Wiring, Volume 1-5. Go to step 19.

15. Place one multimeter lead on temperature switch terminal NC (4) and other on pressure switch terminal NO (8). Read a left to right deflection. If not, wire 11A20 is open. Repair connection at temperature switch or pressure switch, terminals, or replace wire. Refer to Repair of Wiring, Volume 1-5. Go to step 19.

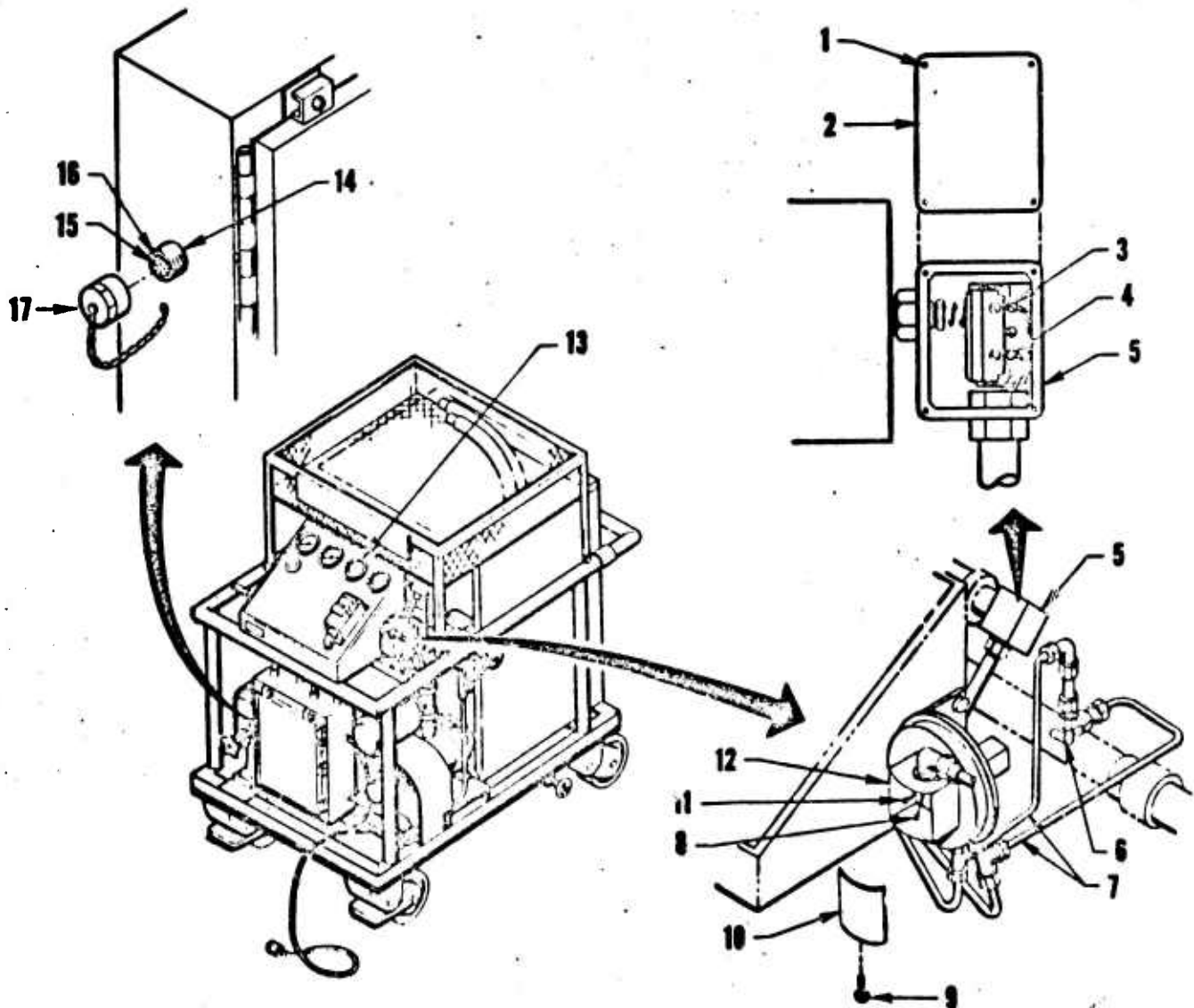


TROUBLESHOOT TEST ADAPTER SET ALARM SIGNAL

16. If the alarm signal activated with a significant air flow being delivered, but an indication of no air flow on the FLOW gage (13), the impact tube (6) is misaligned or obstructed, or the connecting tubing (7) is obstructed.
17. Disconnect tubing (7) at pressure switch (12) and blow through tubing to determine that it is clear of obstructions. If tubing is clear, check impact tube (6) alignment. Refer to Cleaning and

Repair of Tubing, Volume 1-5, page 1-5- , and Alignment of Impact Tube, Volume 1-4, page 1-4- .

18. Connect tubing (7) to pressure switch (12).
19. Install cover (2) on temperature switch (5) with screws (1).
20. Install cover (10) on pressure switch (12) with screw (9).
21. Install dust cap (17) on test adapter set connector (14).



TECHNICAL MANUAL

VOLUME 2-5

TROUBLESHOOT

INSTRUMENTS

AGE ELECTRONICS ENVIRONMENTAL

CONTROL UNIT

A/M 32C-13

Part No. 2A14155A-101-17

A/M 32C-13A

Part No. 2A14155A-101-18

TROUBLESHOOT INSTRUMENTS

PRELIMINARY INFORMATION

ACTIVITY INDEX

Introduction

This activity covers troubleshooting of the AGE ECU instruments following identification of instruments as the faulty components by completion of AGE ECU Troubleshoot and Blower Unit Troubleshoot. Refer to AGE ECU Checkout and Troubleshoot, Volume 2-1, or AGE ECU Blower Unit Troubleshoot, Volume 2-6.

Applicable Models

A/M 32C-13 or A/M 32C-13A with Lear-Siegler Cooling Unit AD100-1

Special Tools

Refrigeration Unit Tool Kit, Part Number SC5180-93-CL-E18.

Specific item required:

Multimeter, 0 to 5000 VDC, 0 to 1000 VAC, TS-352 B/U

Supplies

None

Personnel

Two technicians AFSC 422X1

Equipment Condition

Power cable disconnected from facility power.

ProcedurePage

Troubleshoot Elapsed Time Meter

2-5-2

Troubleshoot Air Temperature Gages, Flow Gage and Pressure Gage

2-5-4

T.O. 35M10-5-7-1JPA-2

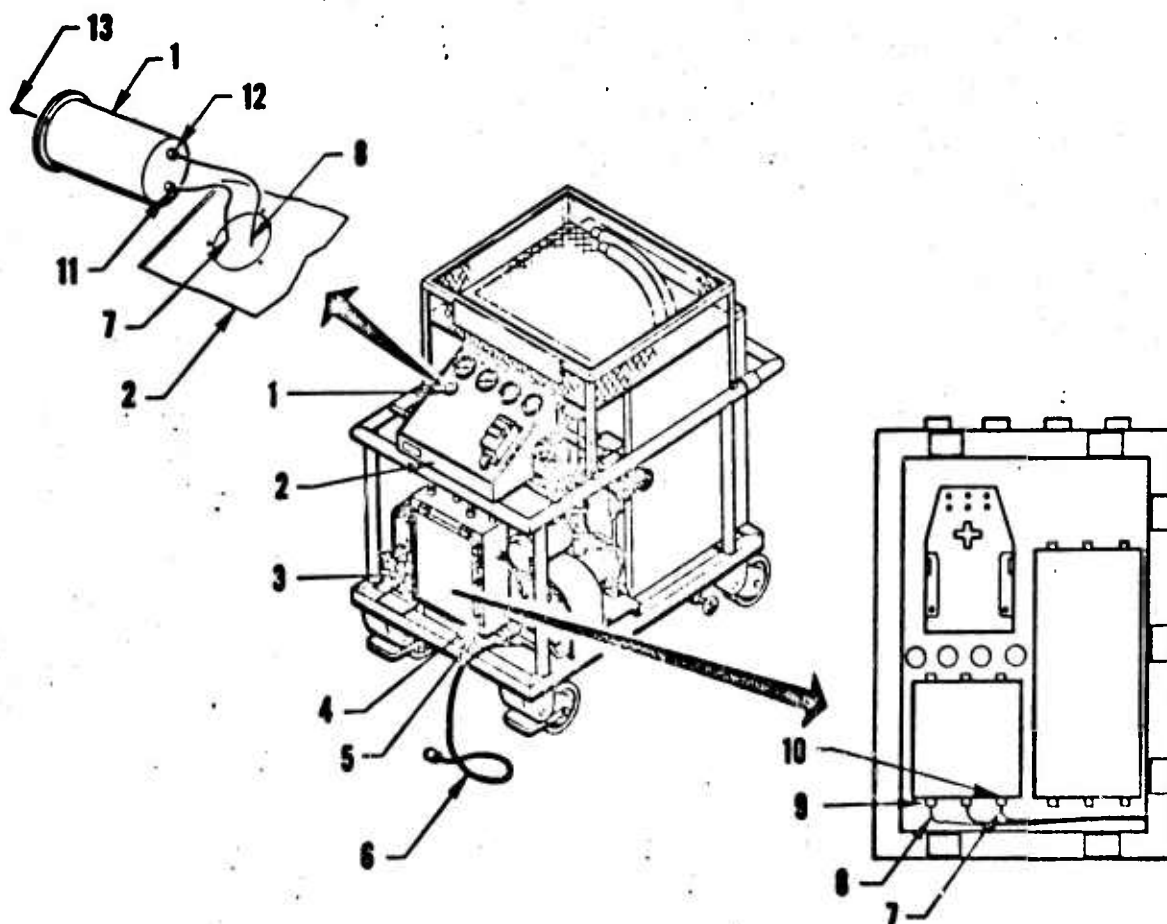
JBLESHOOT ELAPSED TIME METER

1. Disconnect power cable (6) from facility power.
2. Loosen screws (4) on electrical enclosure cover clamps (5).
3. Move clamps aside and open electrical enclosure cover (3).
4. Remove three screws (13) from time meter (1).
5. Lift time meter (1) from ECU control panel (2), to expose electrical connectors (11) and (12).

WARNING

Verify power cable is disconnected from facility power before making electrical checks. Injury from electrical shock could occur if power cable were connected.

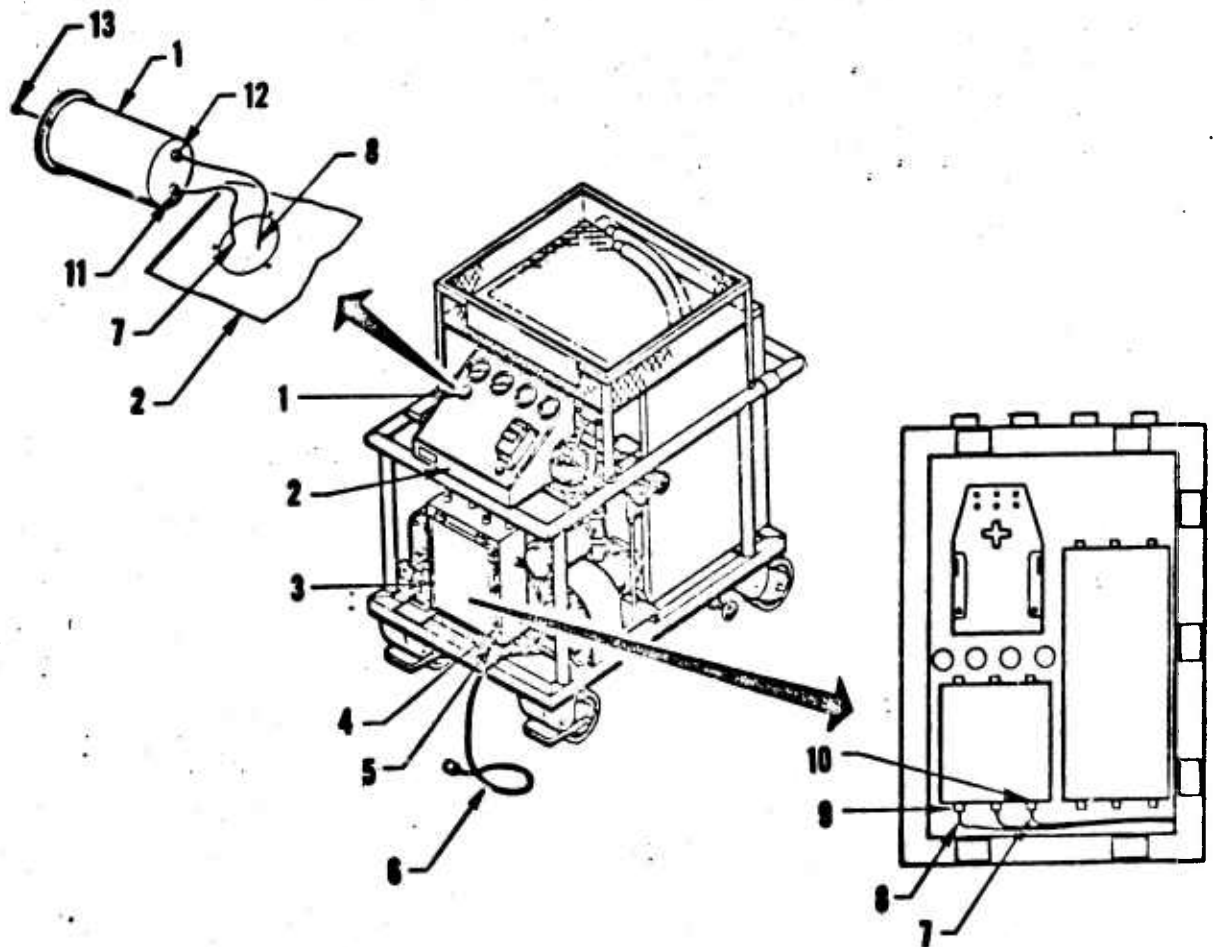
6. Set multimeter to read ohms in the 0 to 300 ohm range and zero meter. Refer to Test Equipment Operation, Volume 1-1, page 1-1- .
7. Place one multimeter lead on power EMI filter terminal 1 (10) and other multimeter lead on time meter terminal (12) to which wire 8C14 (7) is attached. Read left to right meter deflection. If no deflection, replace wire 8C14 (7). Refer to Repair of Wiring, Volume 1-5, page 1-5- . Go to step 9.



TROUBLESHOOT ELAPSED TIME METER

8. Place one multimeter lead on power EMI filter terminal 3 (9) and other multimeter lead on time meter terminal (11) to which wire 10C14 (8) is attached. If left to right meter deflection is observed, replace time meter (1). Refer to Remove and Install Time Meter, Volume 1-5, page 1-5-. If deflection is not observed, replace wire 10C14 (8). Refer to Repair of Wiring, Volume 1-5, page 1-5-.

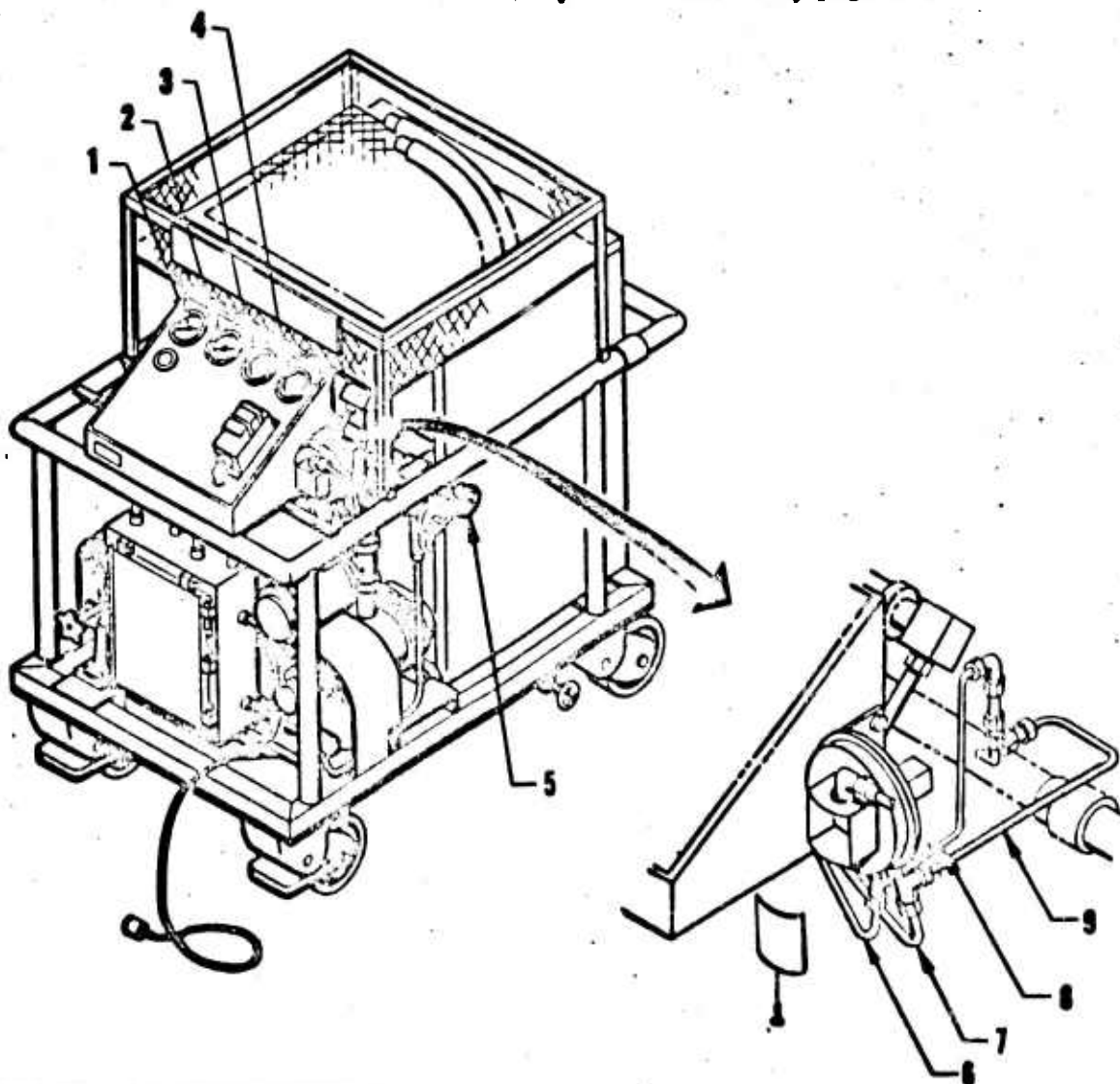
9. Place time meter (1) in ECU control panel (2) and install three screws (13).
10. Close electrical enclosure cover (3), position clamps (5) to secure cover, and tighten screws (4).
11. Return to checkout AGE ECU, step 11, if checkout is in progress, or checkout time meter per steps 11 through 15 of checkout AGE ECU.



**TROUBLESHOOT AIR TEMPERATURE GAGES,
FLOW GAGE AND PRESSURE GAGE**

1. If either the SUPPLY AIR TEMPERATURE gage (2) or the RETURN AIR TEMPERATURE gage (1) does not read the ambient temperature when the AGE ECU is not operating and is at ambient temperature, remove the gage(s) and calibrate or replace. Refer to Remove and Replace Temperature gages, Volume 1-5, page 1-5, and Calibration of Temperature Gages, Volume 1-5, page 1-5.

2. If FLOW gage (3) and PRESSURE gage (4) readings do not change when AGE ECU is started but both PRESSURE gage and FLOW gage readings increase when hand is placed over SUPPLY pipe (5), static pressure tube (9) or (7) is plugged. Inspect tube (9) or (7) and clean or replace. Refer to Repair of Instrument Tubing, Volume 1-5, page 1-5.
3. If FLOW gage (3) and PRESSURE gage (4) readings do not change when AGE ECU is started but FLOW gage reading drops below zero and PRESSURE gage reading increases when hand is placed over SUPPLY pipe, impact pressure tube (8) or (6) is plugged. Inspect tube (8) or (6) and clean or replace. Refer to Repair of Instrument Tubing, Volume 1-5, page 1-5.



T.O. 35M10-5-7-1JPA-2

TECHNICAL MANUAL

VOLUME 2-6

TROUBLESHOOT

BLOWER UNIT

AGE ELECTRONICS ENVIRONMENTAL

CONTROL UNIT

A/M 32C-13

Part No. 2A14155A-101-17

A/M 32C-13A

Part No. 2A14155A-101-18

TROUBLESHOOT BLOWER UNIT

ACTIVITY INDEX

PRELIMINARY INFORMATION

ProcedurePage

Troubleshoot Blower Unit

2-6-2

Introduction

This activity covers troubleshooting of the AGE ECU Blower Unit following identification of the Blower Unit as the faulty subsystem by completion of AGE ECU Troubleshoot. Refer to AGE ECU Checkout and Troubleshoot, Volume 2-1.

Applicable Models

A/M 32C-13 or A/M 32C-13A with Lear-Siegler Cooling Unit AD100-1

Special Tools

Refrigeration Unit Tool Kit, Part Number SC5180-93-CL-E18.

Specific item required:

Multimeter, 0 to 5000 VDC, 0 to 1000 VAC, TS-352 B/U.

Supplies

None

Personnel

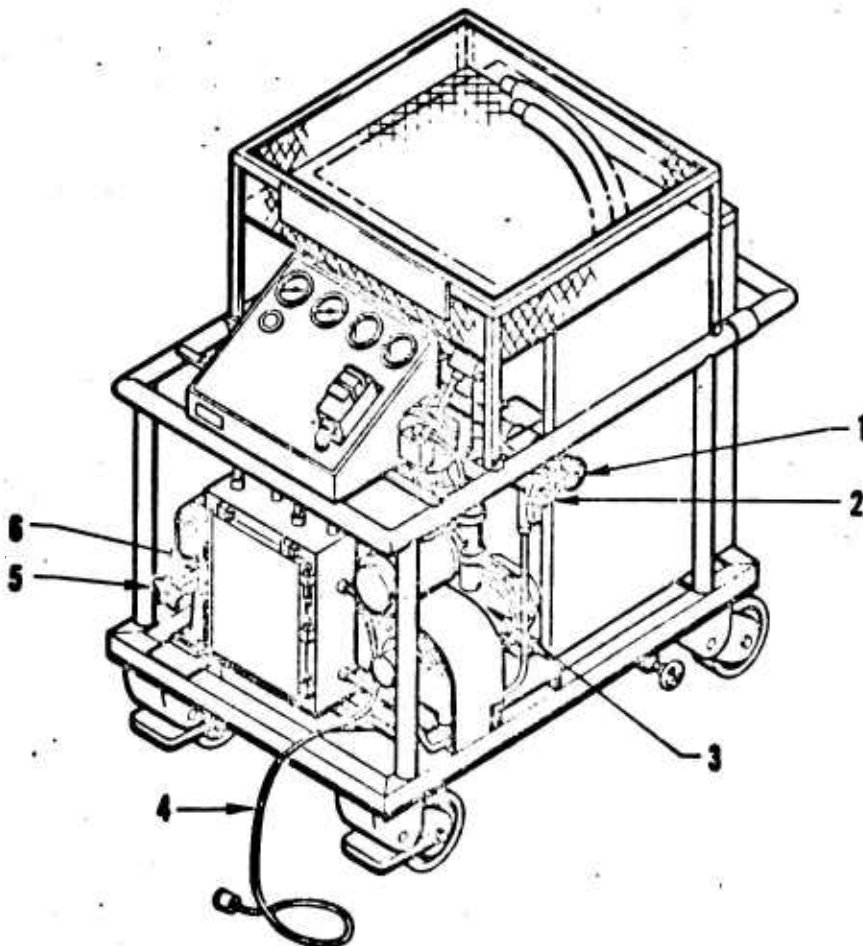
Two technicians AFSC 422X1

Equipment Condition

Power cable disconnected from facility power.

DOUBLESHOOT BLOWER UNIT

1. Disconnect power cable (4) from facility power, if connected.
2. Review the trouble symptoms which were evident at time of AGE ECU shutdown.
3. If blower (3) and blower motor (6) were operating with excessive noise and the air flow was out of the RETURN pipe (2) instead of out of the SUPPLY pipe (1), the motor was running in reverse. Go to step 9.
4. If blower motor (6) has been identified as cause of automatic shutdown, go to step 14.
5. If blower motor (6) was rough and noisy, go to step 24.
6. If blower (3) was rough and noisy, go to step 26.
7. If variable drive (5) was rough and noisy, and/or speed adjustment was sluggish or impossible go to step 28.
8. If inadequate air flow was indicated with blower (3), blower motor (6) and variable drive (5) functioning properly, go to step 33.



TROUBLESHOOT BLOWER UNIT

9. Remove cover (2) from conduit box (1) on blower motor (3) by removing screws (4).
10. Loosen screws (15) on electrical enclosure cover clamps (16).
11. Move clamps aside and open electrical enclosure cover (17).

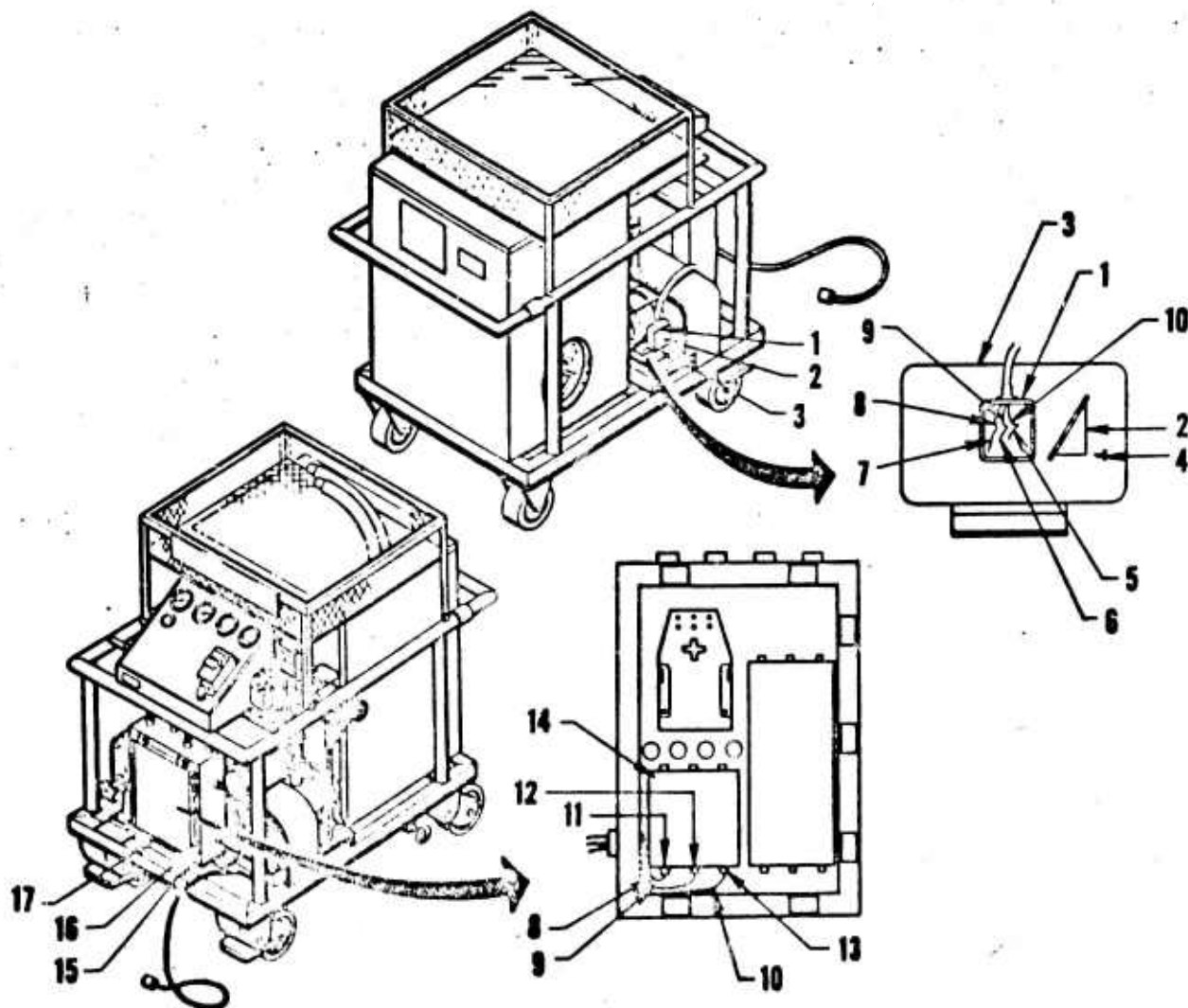
WARNING

Verify power cable is disconnected from facility power before making electrical checks. Injury from electrical shock could occur if power cable was connected.

12. Check wire connections at blower motor (3) and power EMI filter (14) terminals. The connections must be as follows:

Wire	Blower Motor	Power EMI Filter
3B14 (8)	C (7)	3 (11)
2B14 (9)	B (6)	2 (12)
1B14 (10)	A (5)	1 (13)

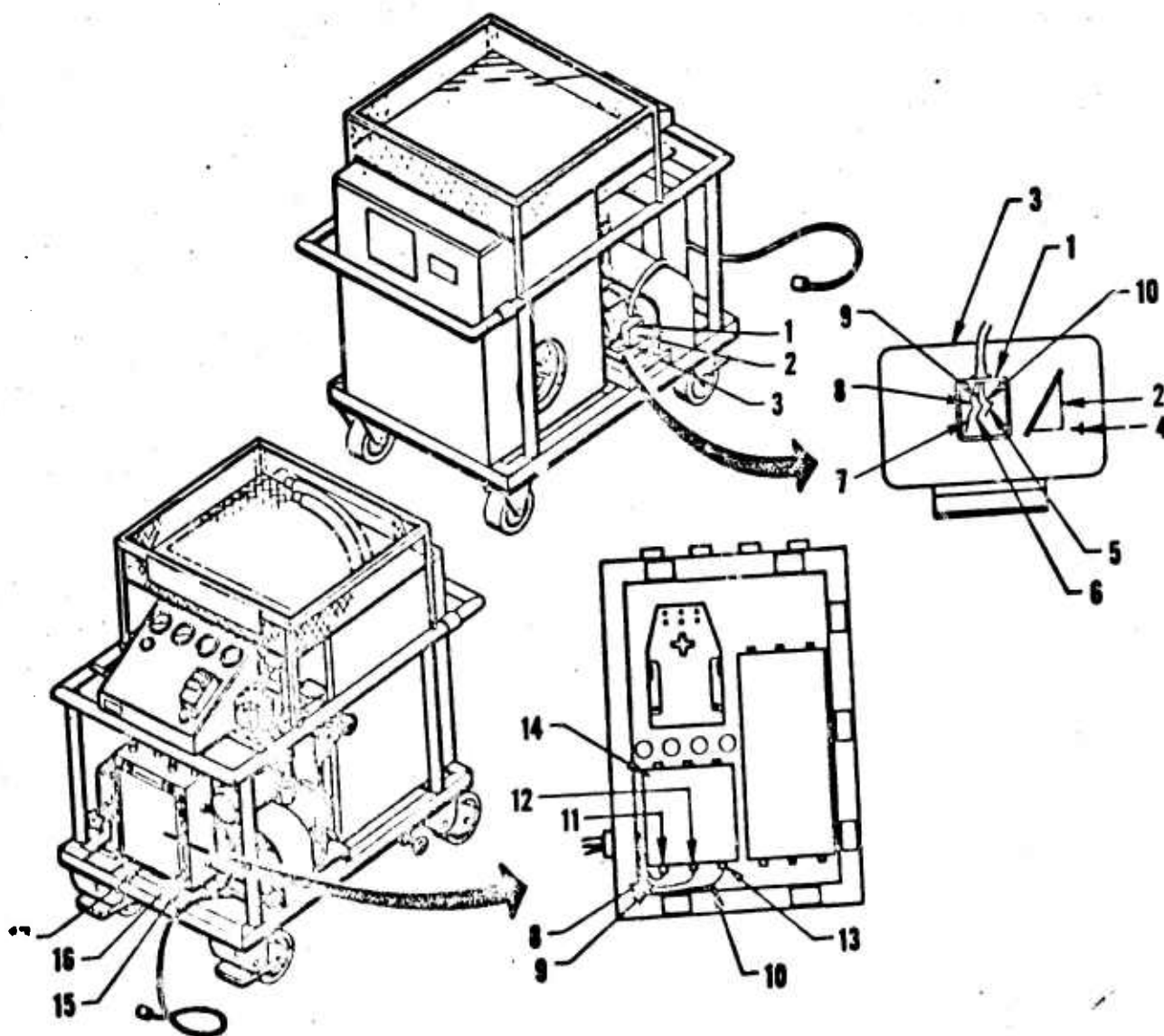
13. If a connection at the motor is incorrect, rewire. Refer to Repair of Wiring, Volume 1-6, page 1-6-. If a connection at the power EMI filter is incorrect, move wires in error to correct terminals. Go to steps 22 and 23.



TRUBLESHOOT BLOWER UNIT

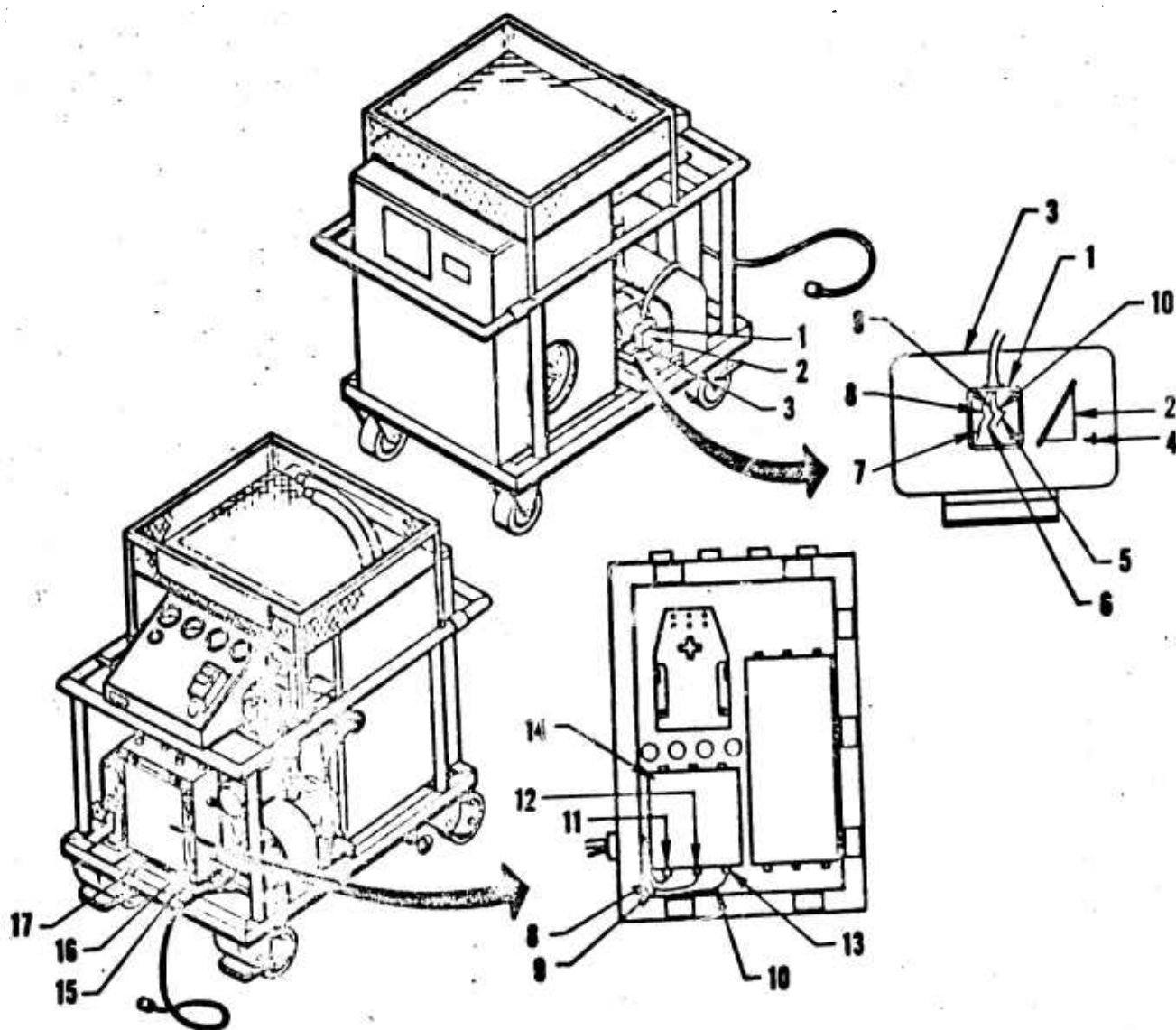
14. Remove cover (2) from conduit box (1) on blower motor (3) by removing screws (4).
15. Examine connections of blower motor power input wires 3B14 (8), 2B14 (9), and 1B14 (10) to blower motor wires C (7), B (6) and A (5) for signs of a poor connection. If a poor connection is observed, separate and reconnect. Refer to Repair of Wiring, Volume 1-6, page 1-6- . Go to step 22.

16. Loosen screws (15) on electrical enclosure clamps (16).
17. Move clamps aside and open electrical enclosure cover (17).



TROUBLESHOOT BLOWER UNIT

18. Examine connection of blower motor power input wires 3B14 (8), 2B14 (9) and 1B14 (10) to power EMI filter terminals 3 (11), 2 (12) and 1 (13). If a poor connection is observed, repair and/or reconnect. Refer to Repair of Wiring, Volume 1-6, page 1-6- . Go to step 23.
19. Separate connections of blower motor input wires 3B14 (8), 2B14 (9) and 1B14 (10) to blower motor wires C (7), B (6) and A (5). Refer to Repair of Wiring, Volume 1-6, page 1-6- .
20. Set multimeter to read ohms in the 0 to 300 ohm range and zero meter. Refer to Test Equipment Operation, Volume 1-1, page 1-1- .



TROUBLESHOOT BLOWER UNIT

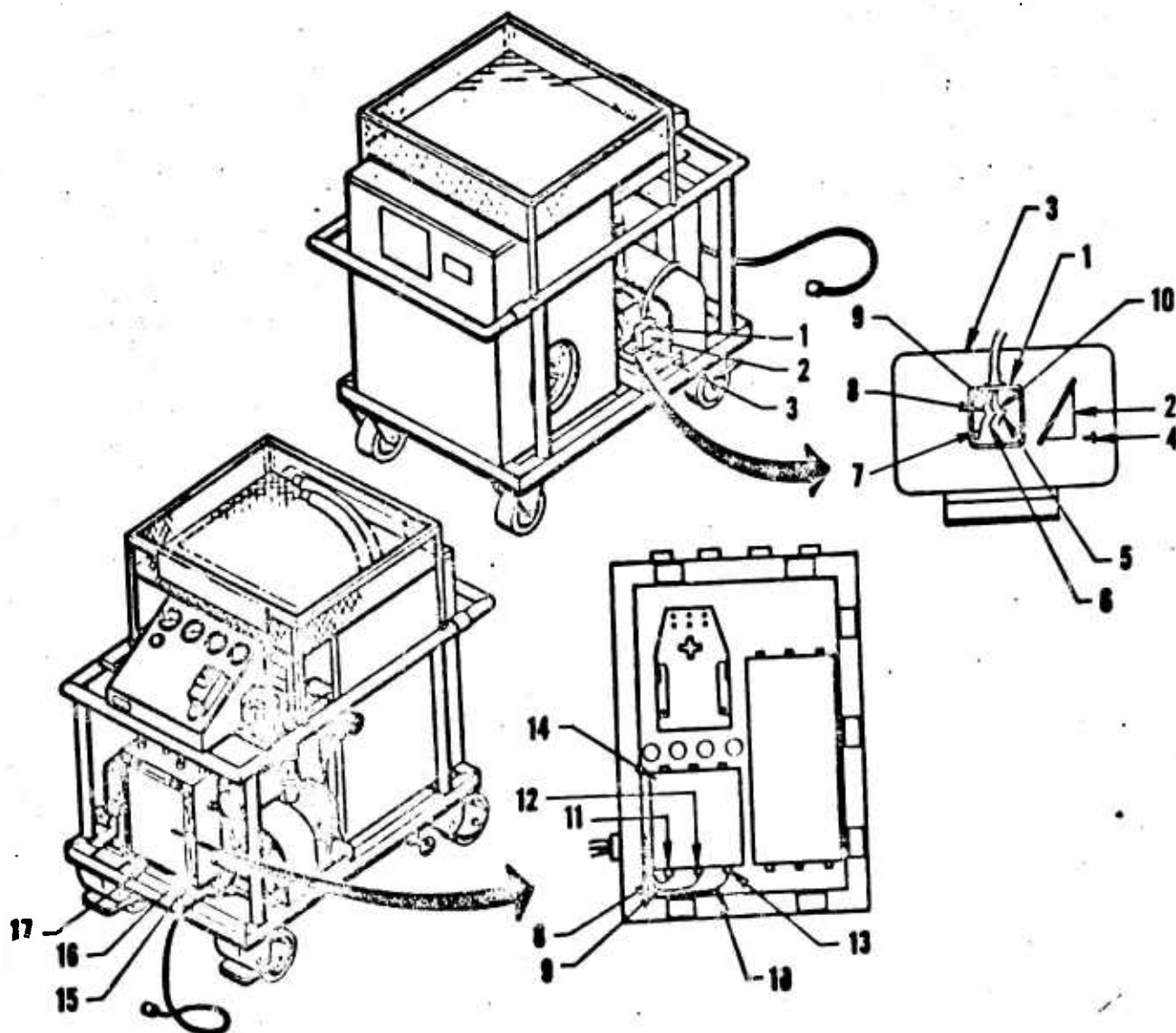
21. Place multimeter leads on each of the following sets of EMI filter terminal to blower motor power input wire checkpoints and read left to right deflection for each check:

Power EMI Filter (14) Terminals	Blower Motor (3) Power Input Wires
1 (13)	3B14 (8)
2 (12)	2B14 (9)
3 (11)	1B14 (10)

If meter deflection is observed in each check, replace blower motor

- (3). Refer to Remove and Install Variable Drive System, Volume 1-6, page 1-6- . If meter deflection is not observed in one or more of the checks, replace blower motor wire showing no deflection. Refer to Repair of Wiring, Volume 1-6, page 1-6- . Go to steps 22 and 23.

22. Install cover (2) on conduit box (1) on blower motor (3) by installing screws (4). Go to step 40.
23. Close electrical enclosure cover (17), position clamps (16) and tighten screws (15). Go to step 40.

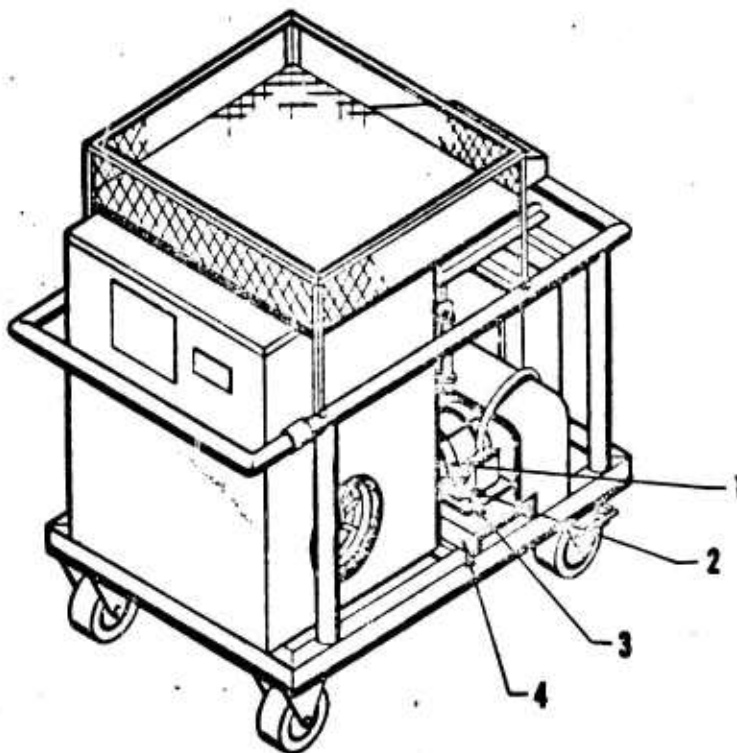


TROUBLESHOOT BLOWER UNIT

WARNING

Verify power cable is disconnected from facility power before making inspection. Injury could result if AGE ECU were started.

24. Examine blower motor mounting base (3), chassis assembly (4) and mounting bolts (2) for broken, loose or worn parts which would allow the motor to vibrate. If such a condition is found, replace or repair affected parts. Refer to Remove and Install Variable Drive System, Volume 1-6, page 1-6- . Go to step 40.
25. Replace blower motor (1). Refer to Remove and Install Variable Drive System, Volume 1-6, page 1-6- . Go to step 40.

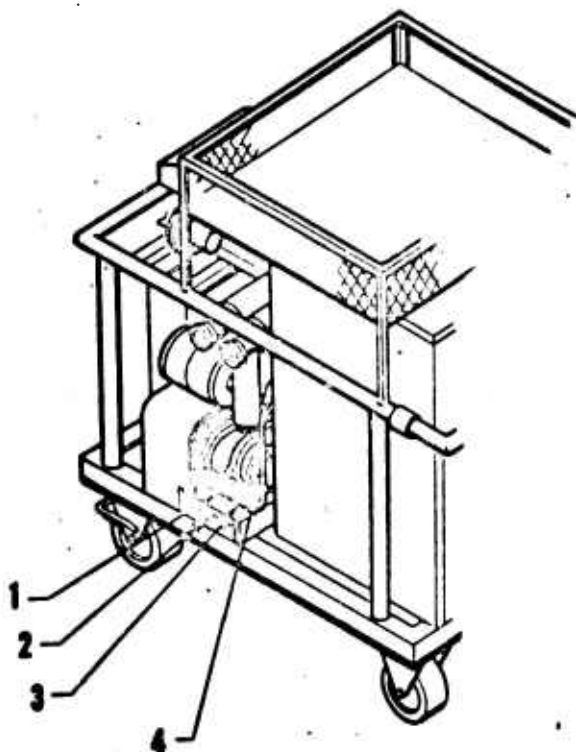


TROUBLESHOOT BLOWER UNIT

WARNING

Verify power cable is disconnected from facility power before making inspection. Injury could result if AGE ECU were started.

26. Examine blower mounting base (1), chassis assembly (2) and mounting bolts (3) for broken, loose or worn parts which would allow the blower to vibrate. If such a condition is found, replace or repair affected parts. Refer to Remove and Install Variable Drive System, Volume 1-6, page 1-6- . Go to step 40.
27. Replace blower (4). Refer to Remove and Install Variable Drive System, Volume 1-6, page 1-6- . Go to step 40.



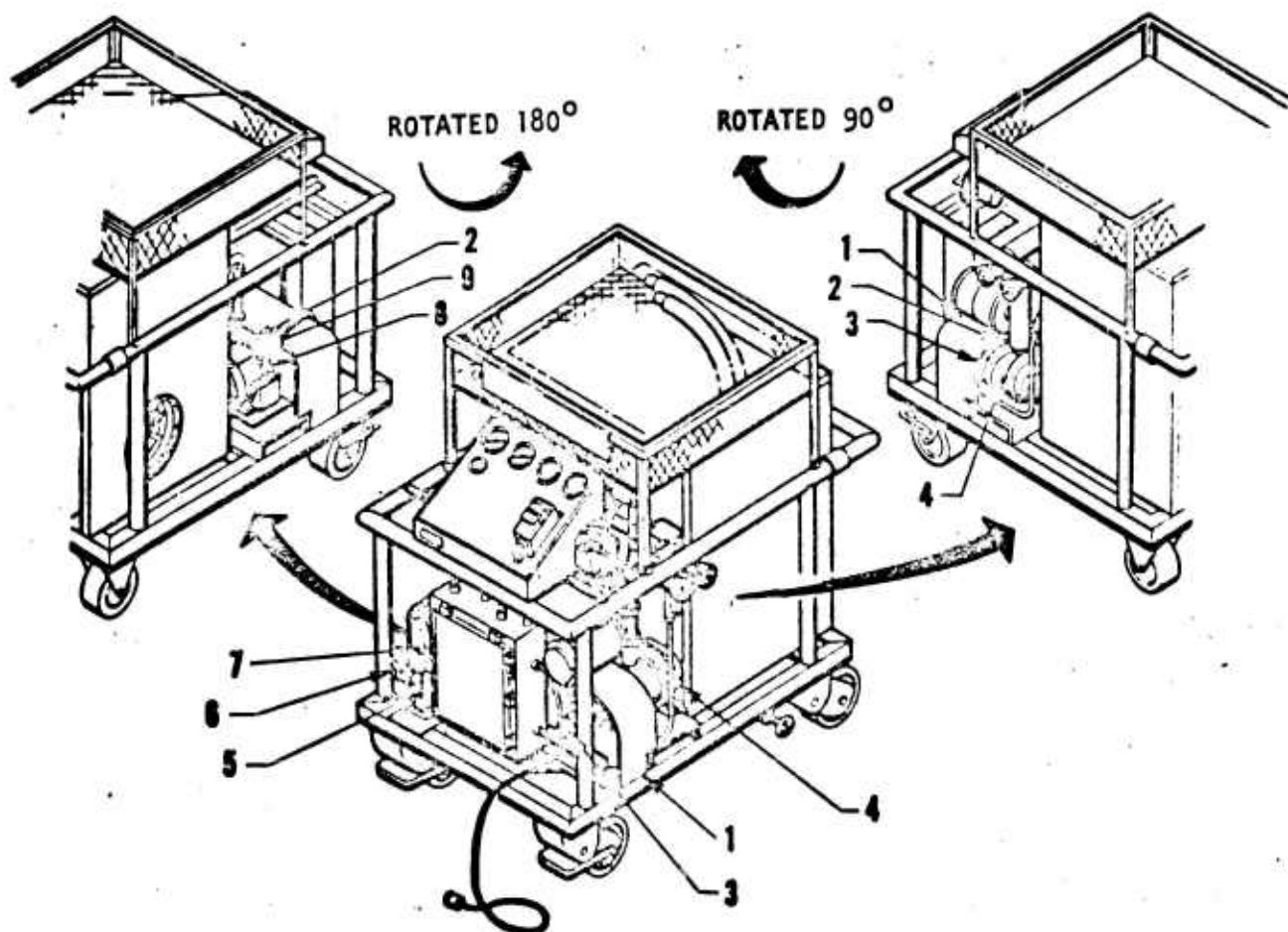
TROUBLESHOOT BLOWER UNIT

WARNING

Verify power cable is disconnected from facility power before making inspection. Injury could result if AGE ECU were started.

28. Examine the variable drive system which includes the blower pulley (3), the motor pulley (9), the belt (2) and the belt guard (1) and review the trouble symptoms which were evident at time of AGE ECU shutdown.

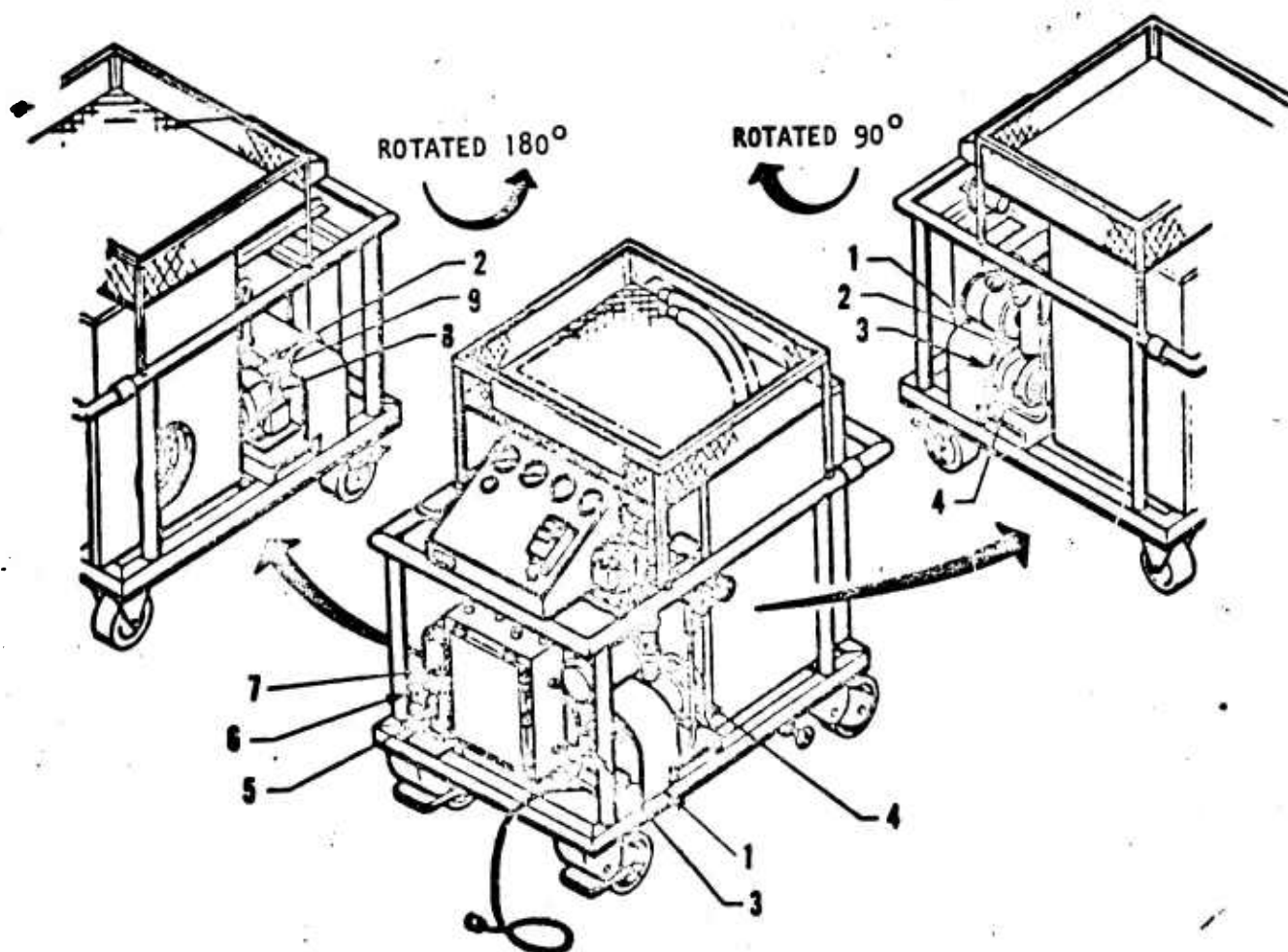
29. If belt (2) was slipping and riding up on one pulley face and speed adjustment was erratic, the variable drive system is out of alignment. Replace damaged and worn parts and realign. Refer to Remove and Replace Variable Drive System, Volume 1-6, page 1-6- and Alignment of Variable Drive System, Volume 1-6, page 1-6- . Go to step 40.



TPCUBLESHOOT BLOWER UNIT

30. If speed adjustment was difficult or impossible, the motor pulley (9), blower pulley (3) or control bracket (5) are at fault. Each pulley has a movable face. The blower pulley is springloaded to hold the pulley faces together. When the control bracket handwheel (6) is in the outermost position, the belt (2) rides at the minimum diameter of the motor pulley and at the maximum diameter of the blower pulley. Rotation of the handwheel (6) forces the movable face of the motor pulley in, causing the belt to move out to a larger diameter position on the motor pulley and into a smaller diameter position on the blower pulley. The pulleys are packed with grease. Dirty, hard, grease

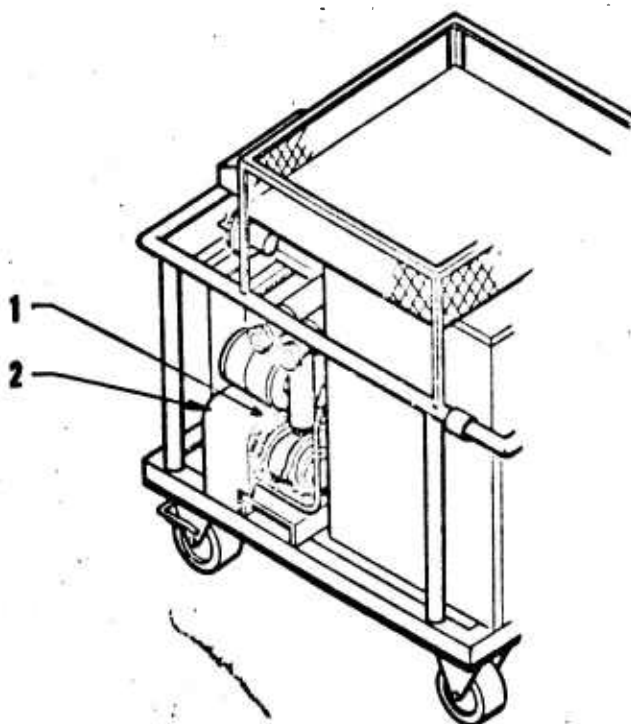
and/or worn sliding surfaces could make operation of the pulleys difficult. Damaged threads on the control bracket handwheel (6) threaded shaft could make rotation of the handwheel difficult. A pulley loose or out of position on the motor or blower shafts could cause erratic speed adjustment. The physical condition of the components will indicate the specific cause. Disassemble variable drive system, replace worn parts, flush out and lubricate pulleys, and align variable drive system. Refer to Remove and Replace Variable Drive System, Volume 1-6, page 1-6- ; Flushing Variable Drive Pulleys, Volume 1-6, page 1-6- ; and Alignment of Variable Drive System, Volume 1-6, page 1-6- . Go to step 40.



TROUBLESHOOT BLOWER UNIT

31. If belt guard (2) is loose or misaligned, inspect for worn, broken or bent parts. Remove belt guard and repair and/or replace parts as required. Reinstall belt guard in aligned position. Refer to Remove and Replace Variable Drive System, Volume 1-6, page 1-6- . Go to step 40.

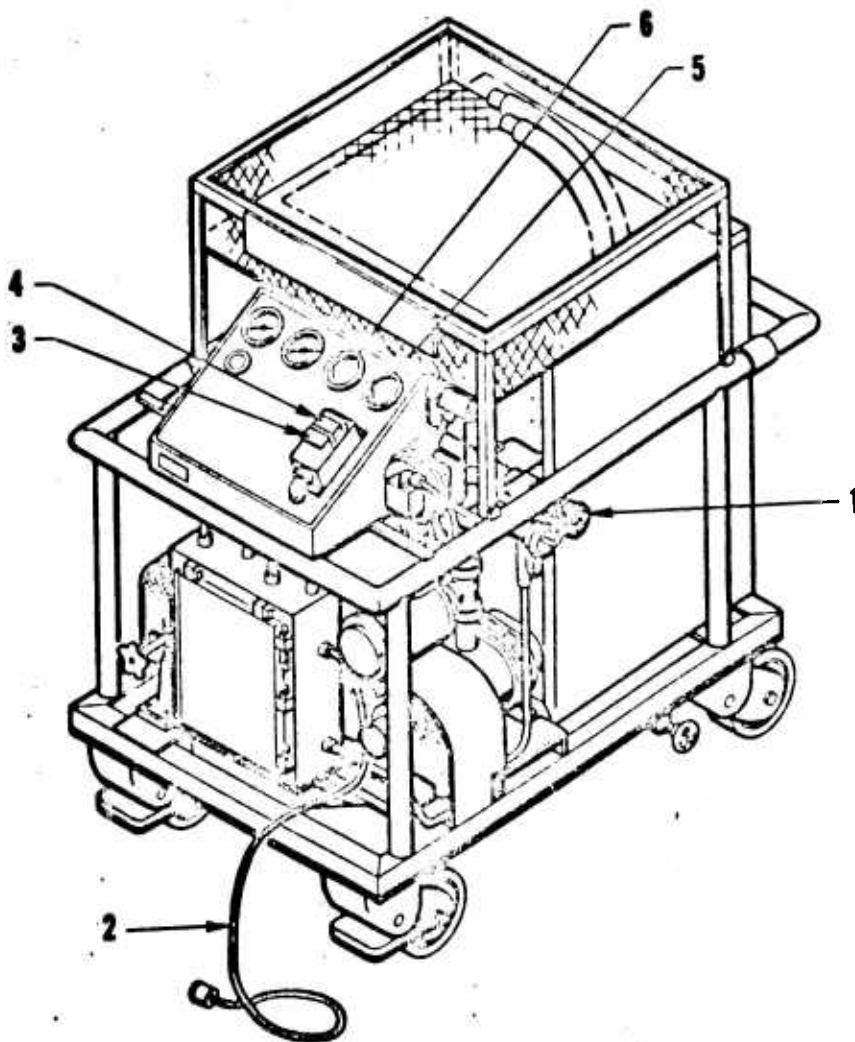
32. If belt (1) is damaged or worn, replace. Refer to Remove and Replace Variable Drive System, Volume 1-6, page 1-6- . Go to step 40.



TROUBLESHOOT BLOWER UNIT

33. Observe PRESSURE gage (5) and FLOW gage (6). Both should read no pressure. If not, recalibrate. Refer to Calibration of Instruments, Volume 1-5, page 1-5- .
34. Connect AGE ECU power cable (2) to facility power.
35. Press START switch (4).

36. Observe that both the PRESSURE gage (5) and the FLOW gage (6) indicate an increase. Then place hand lightly over SUPPLY pipe (1) and observe that FLOW gage indication decreases and PRESSURE gage indication increases further. If all these indications are not observed, press STOP switch (3). Troubleshoot the PRESSURE and FLOW gages. Refer to AGE ECU Instruments Troubleshoot, Volume 2-5.



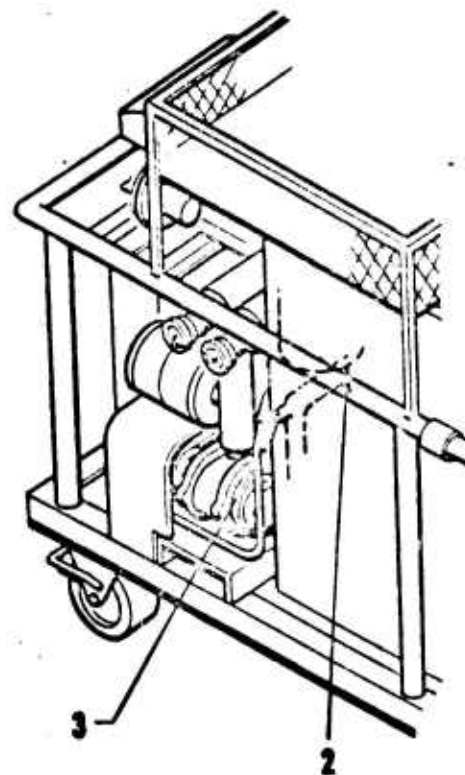
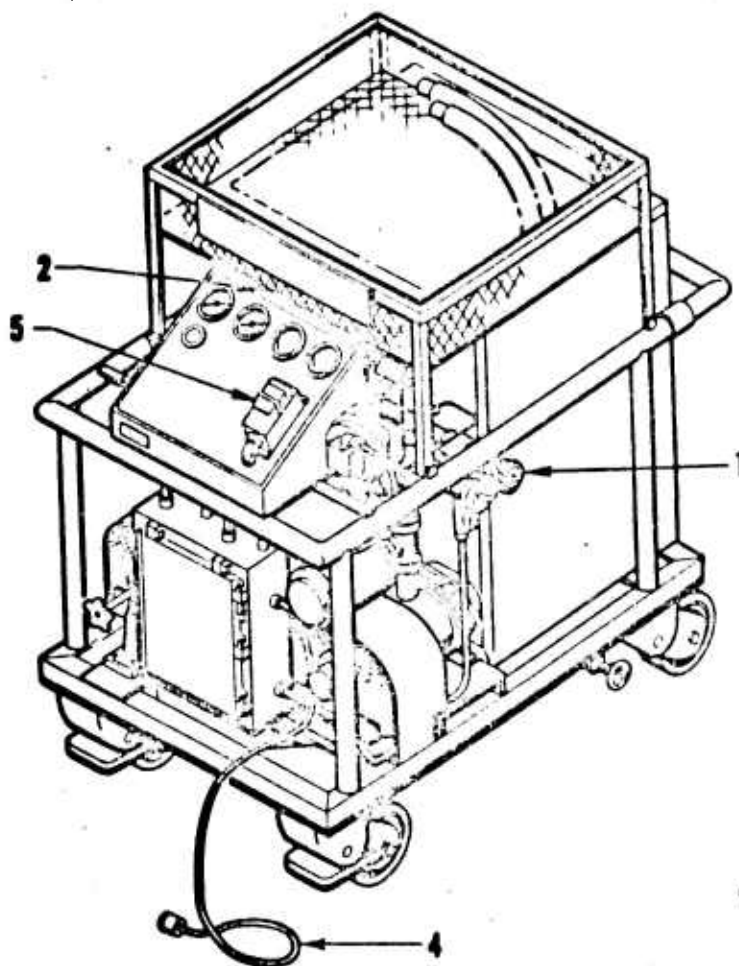
TROUBLESHOOT BLOWER UNIT

37. Operate unit 5 minutes or more. If relief valve (3) releases, a restriction exists in the filter (2) or piping (1). Replace filter and clean piping. Refer to Piping Repair, Volume 1-6, page 1-6- .

38. Press STOP switch (5).

39. Disconnect power cable (4) from facility power.

40. Return to checkout or test in progress.



TECHNICAL MANUAL

VOLUME 2-7

TROUBLESHOOT

COOLING UNIT
(LEAR-SIEGLER)

AGE ELECTRONICS ENVIRONMENTAL

CONTROL UNIT

A/M 32C-13

Part No. 2A14155A-101-17

A/M 32C-13A

Part No. 2A14155A-101-18

TROUBLESHOOT COOLING UNIT

ACTIVITY INDEX

PRELIMINARY INFORMATION

ProcedurePageIntroduction

Troubleshoot Cooling Unit

2-7-2

This activity covers troubleshooting of the AGE ECU Cooling Unit following identification of the Cooling Unit as the faulty subsystem by completion of AGE ECU Troubleshoot. Refer to AGE ECU Checkout and Troubleshoot, Volume 2-1.

Applicable Models

A/M 32C-13 or A/M 32C-13A with Lear-Siegler Cooling Unit AD100-1

Special Tools

Refrigeration Unit Tool Kit, Part Number SC5180-93-CL-E18.

Specific items required are:

Gage, Compound Pressure-Vacuum, Dial Indicating
 Gage, Pressure, Dial Indicating
 Manifold, Charging and Testing, Refrigerant
 Multimeter, 0 to 5000 VDC, 0 to 1000 VAC, TS-352 B/U

Supplies

None

Personnel

Two technicians AFSC 422X1

Equipment Conditions

Power cable disconnected from facility power.

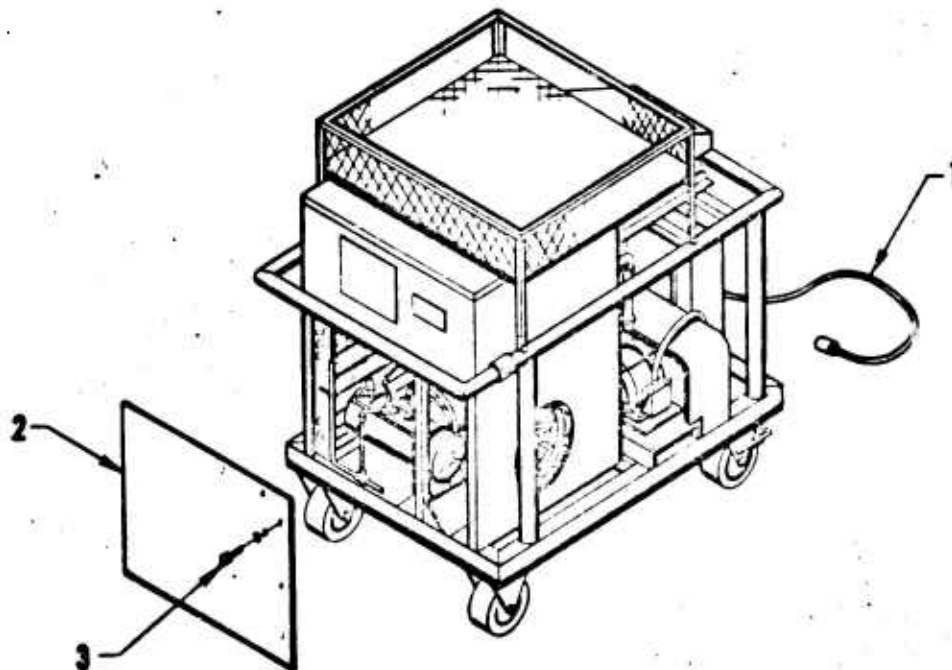
TROUBLESHOOT COOLING UNIT

1. Disconnect Power cable from facility power, if connected.
2. Review AGE ECU Checkout and Troubleshoot results.
3. If condenser fan was not operating or was operating at a high noise level, troubleshoot condenser fan. Refer to AGE ECU Cooling Unit Condenser (Lear-Siegler) Troubleshoot, Volume 2-9.
4. If compressor was not operating or was operating at a high noise level, troubleshoot compressor. Refer to AGE ECU Unit Compressor (Lear-Siegler) Troubleshoot, Volume 2-8.
5. If cooling was not obtained or was obtained slowly, go to step 13.
6. If repeated automatic shutdown occurred because of pressure limit control HI-LOW pressure switch cutout, go to step 14.
7. If repeated automatic shutdown occurred because of pressure limit control high pressure switch cutout, go to step 43.
8. If bubbles or cloudy fluid was observed in refrigerant sight glass, check for leaks. Refer to Refrigeration System Leak Detection, Volume 1-7, page 1-7- . If leaks are found, go to step 10. If no leaks are found, go to step 11.
9. If compressor oil level was low, check for leaks. Refer to Refrigeration System Leak Detection, Volume 1-7, page 1-7- . If no leaks are found, go to step 12.
10. Repair leaks. Refer to Refrigeration System Piping Repair, Volume 1-7, page 1-7- .
11. Replenish refrigerant. Refer to Refrigeration System Recharging, Volume 1-7, page 1-7- .
12. Replenish compressor oil. Refer to Compressor Oil Replenishment, Volume 1-8, page 1-8- .

TROUBLESHOOT COOLING UNIT

13. If cooling was not obtained after the AGE ECU had been stored at low ambient temperature conditions for an extended period of time, use low temperature start procedures. Refer to Preparation for Use After Extended Low Temperature Storage, Volume 1-1, page 1-1- . Continue with step 14 if cooling is not obtained or if low temperature storage was not a factor.

14. If cover (2) is installed, remove screws and washers (3) and remove cover (2) from cooling unit.
15. Connect AGE ECU power cable (1) to facility power.



TRC LESHOOT COOLING UNIT

WARNING

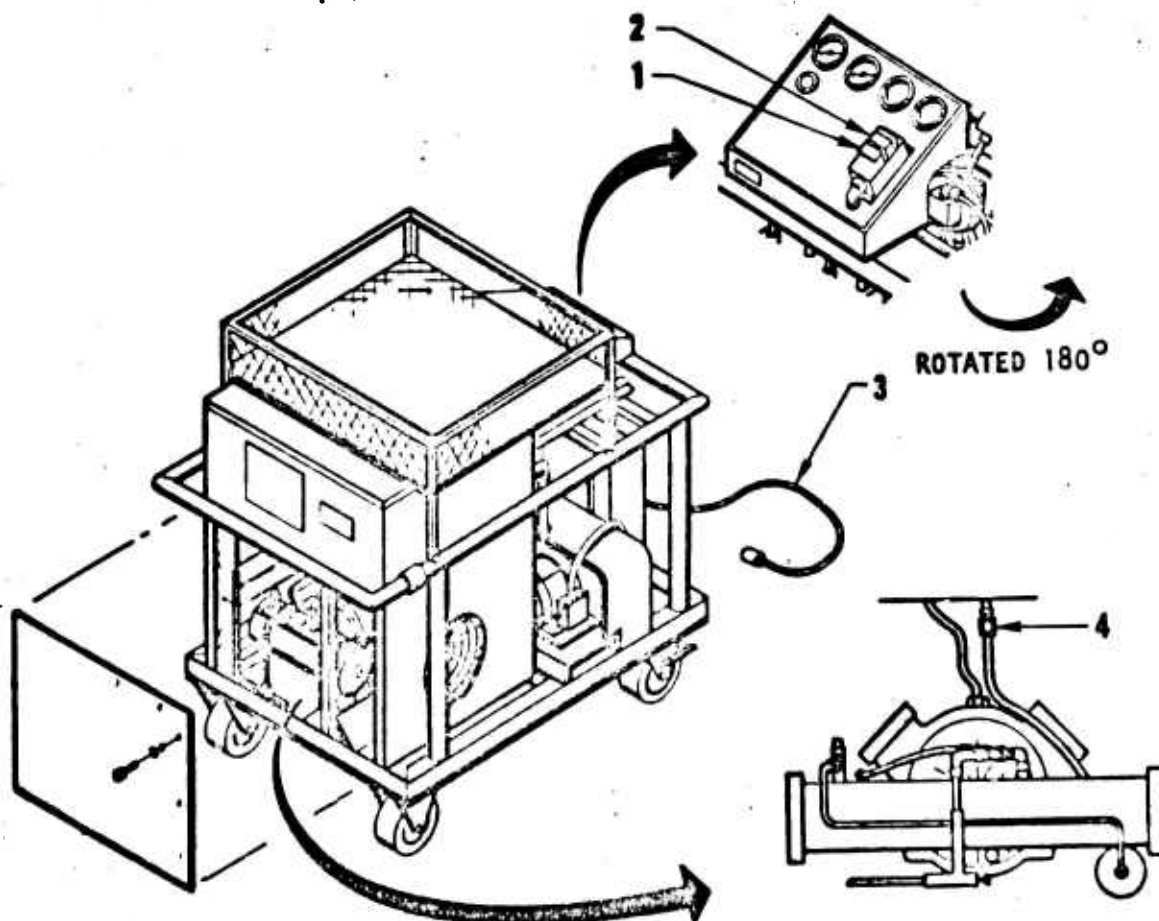
Stay clear of condenser fan during operation with back cover removed. Injury could result.

NOTE

The cooling unit may be operated with the back cover removed for only a short time since the condenser cooling air bypasses the condenser coils. The cooling unit will shut down automatically when condenser high pressure causes Pressure Limit Control high pressure switch to release.

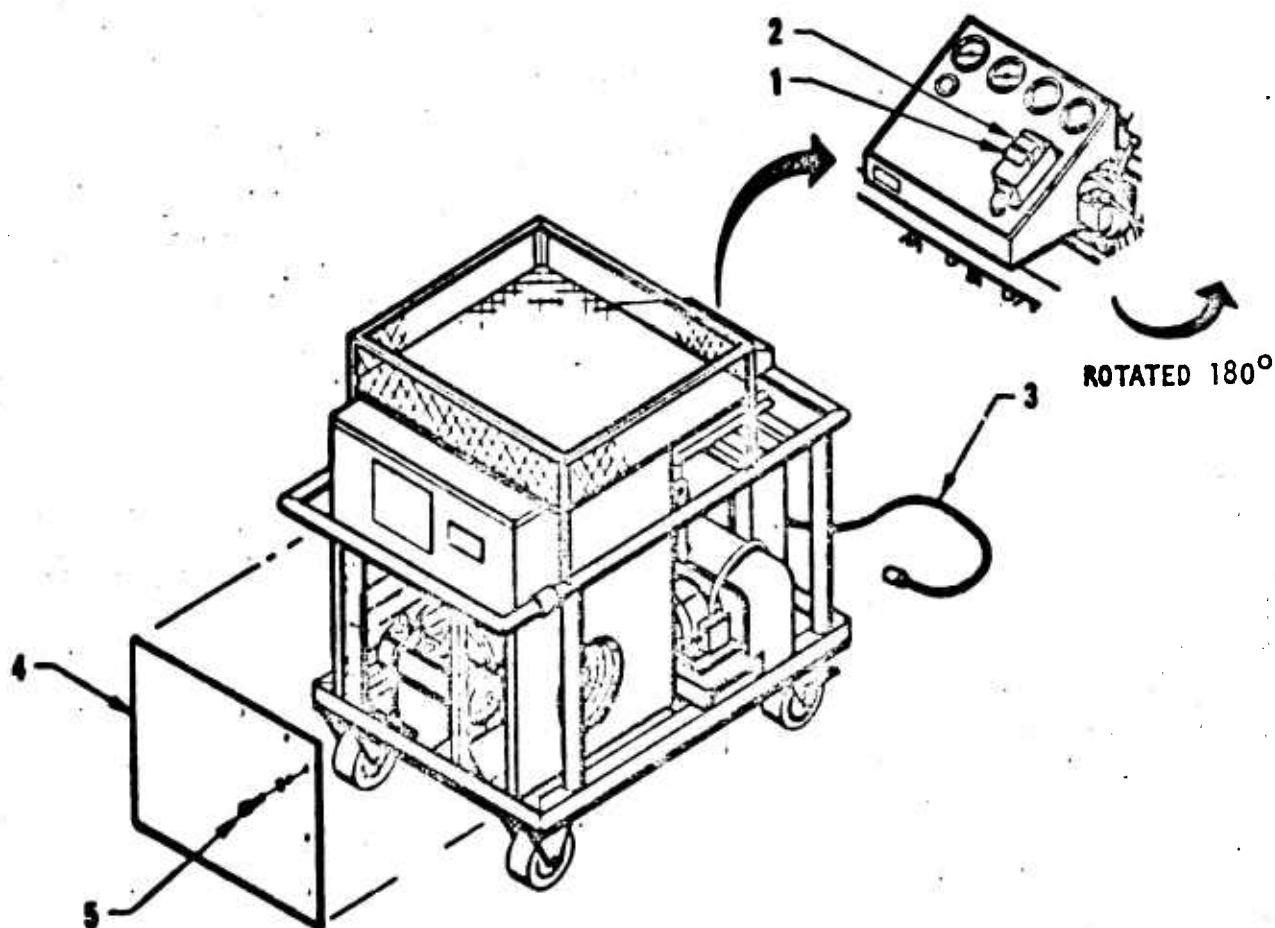
16. Press START switch (2).

17. Remove cover from refrigerator sight glass (4) and check that refrigerator sight glass is clear and free of bubbles. If not, press STOP switch (1) and disconnect AGE ECU power cable (3) from facility power. Go to step 8.



TROUBLESHOOT COOLING UNIT

18. Press STOP switch (1), place back cover (4) on cooling unit and install washers and screws (5).
19. Press START switch (2) and allow the AGE ECU to operate for 10 to 15 minutes.
20. Press STOP switch (1) and disconnect AGE ECU power cable (3) from facility power.
21. Remove screws and washers (5) and remove cover (4) from cooling unit.
22. If repeated automatic shutdown because of pressure limit control HI-LOW pressure switch cutout was the trouble, go to step 39. If lack of cooling was the trouble, continue with step 23.



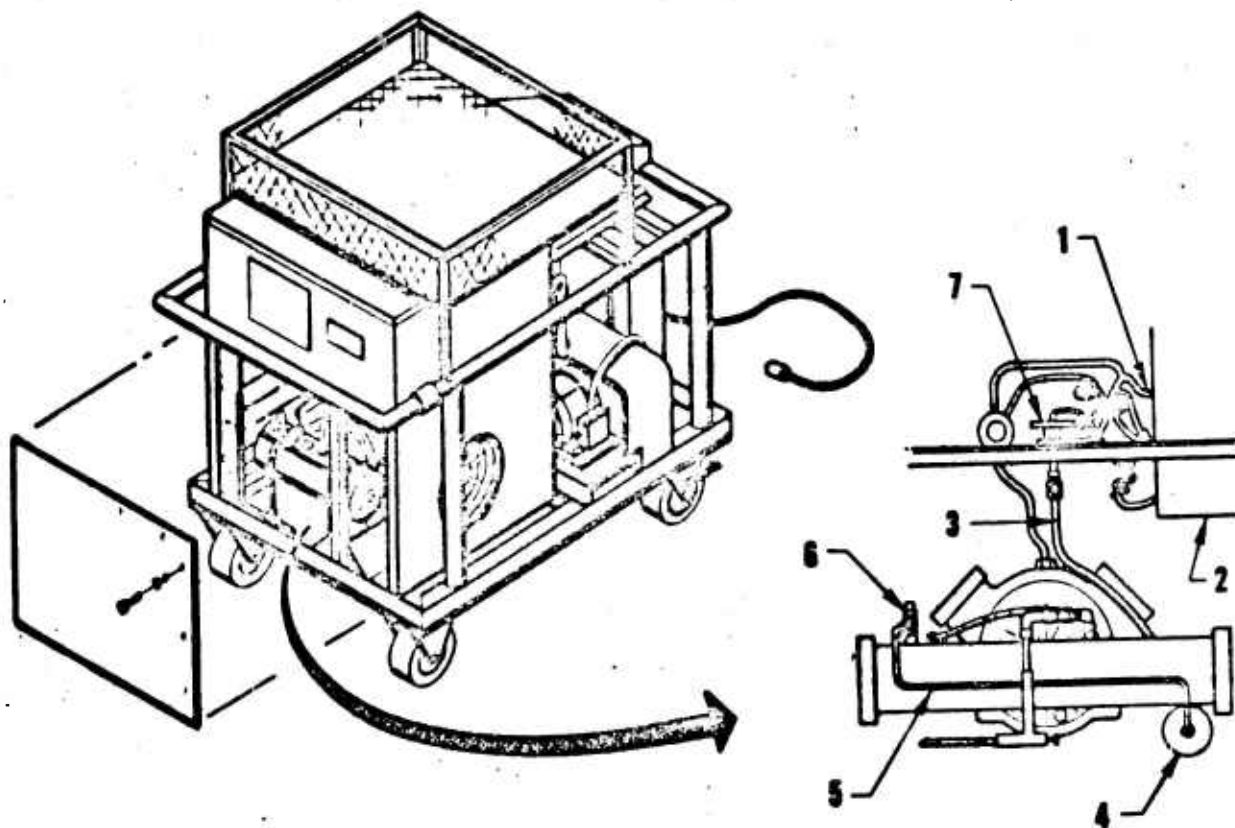
TR/ LESHOOT COOLING UNIT

WARNING

Verify power cable is disconnected from facility power before making inspection. Injury could result if AGE ECU were started.

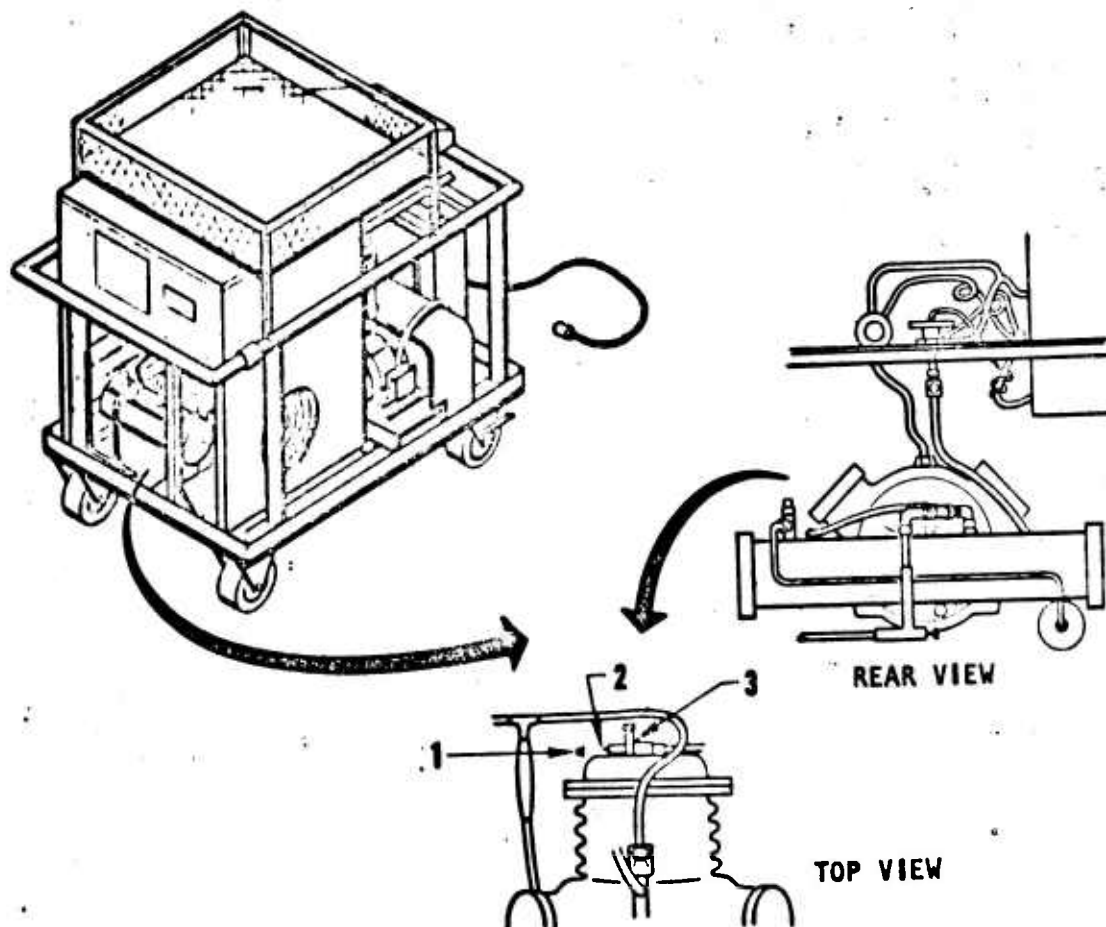
23. Check the liquid line (5) from the shutoff valve V5 (6) to the filter-drier (4) and the liquid line (3) from the filter-drier (4) to the expansion valve V1 (7) for sweating or frost. If sweating or frost is observed, go to step 31.

24. Check the suction line (1) from the expansion valve V1 (7) to the evaporator (2) for a distinctly colder surface than the liquid line (3) surface. If a colder surface is not observed, the expansion valve V1 (7) is closed or obstructed. Remove and replace expansion valve V1 (7). Refer to Repair of Cooling Unit, Volume 1-7, page 1-7- .



TROUBLESHOOT COOLING UNIT

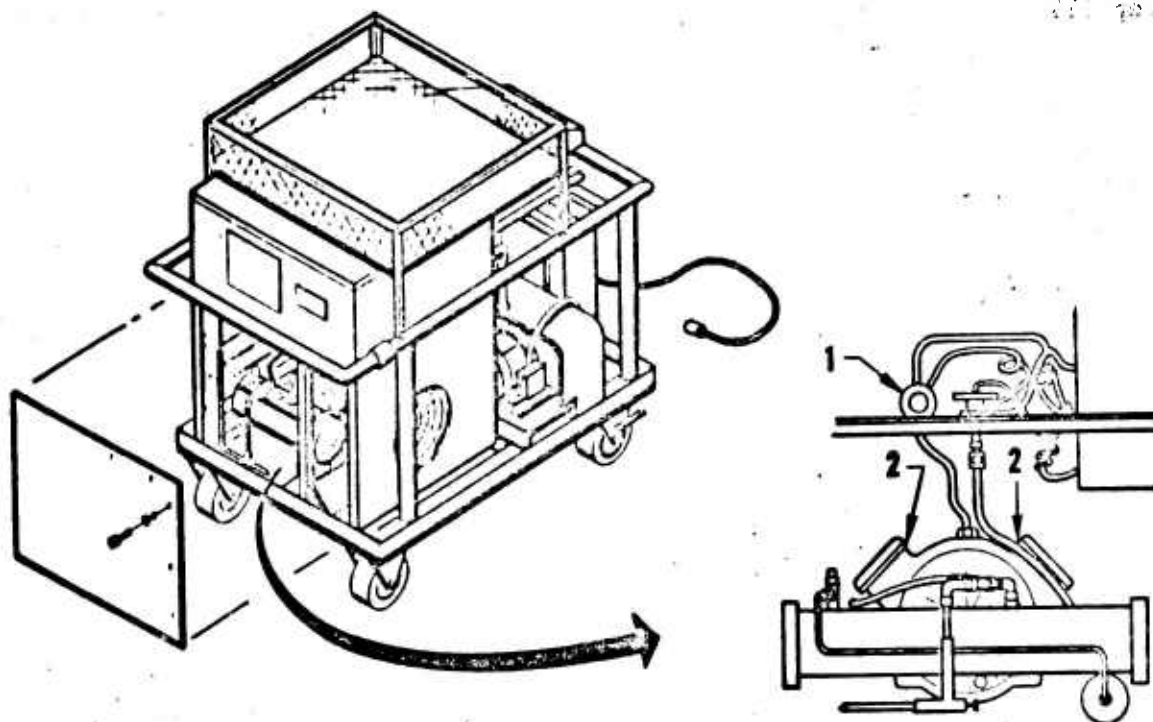
25. Check suction service valve V7 (3) for full open by removing seal cap (1), placing handwheel or wrench on valve stem (2) and attempting to rotate valve stem counterclockwise.
26. If valve V7 (3) was not fully opened, as indicated by the valve stem rotating, continue to rotate valve stem (2) until the suction service valve V7 (3) is backseated. Remove handwheel or wrench, install seal cap (1) and go to step 119.
27. If valve V7 (3) cannot be opened further, attempt to close valve V7 (3) by rotating handwheel or wrench clockwise.
28. If valve V7 (3) operates easily, reopen valve V7 until backseated, by rotating handwheel or wrench counterclockwise and install seal cap (1). Go to step 30.
29. If valve V7 (3) does not operate easily, remove and replace valve V7 (3). Refer to Repair of Cooling Unit, Volume 1-7, page 1-7- .



TF BLESHOOT COOLING UNIT

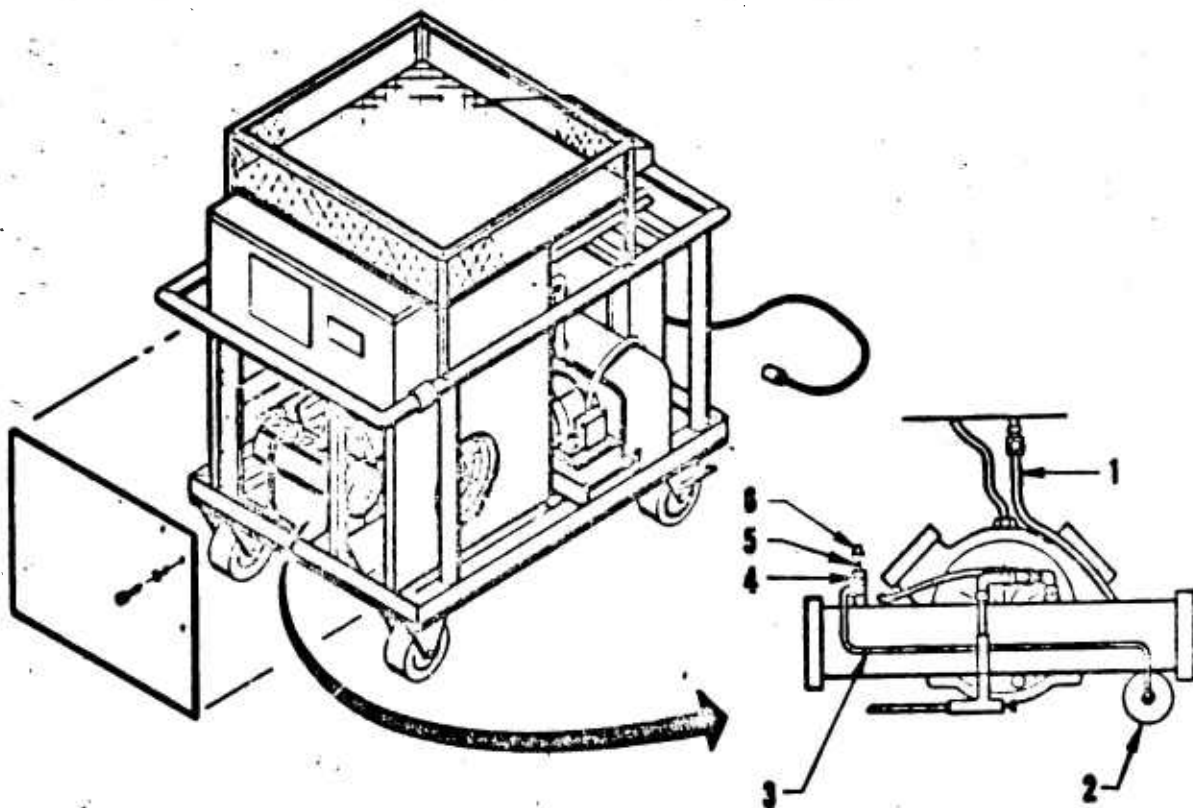
30. Check the hot gas bypass valve V2 (1) for correct setting. Refer to Adjustment of Hot Gas Bypass Valve V2, Volume 1-7, page 1-7- . If suction pressure cannot be reduced when making check, remove and re-

place compressor valve plate assemblies (2). Refer to Repair of Compressor, Volume 1-8, page 1-8- . If hot gas bypass valve V2 (1) will not close when making check, remove and replace valve V2 (1). Refer to Repair of Cooling Unit, Volume 1-7, page 1-7- .



TROUBLESHOOT COOLING UNIT

31. Determine the location, downstream from the line shutoff valve V5 (4), where the sweating or frost begins.
32. If the location is at the filter-drier (2), remove and replace the filter-drier (2). Refer to Repair of Cooling Unit, Volume 1-7, page 1-7- .
33. If the location is in line (1) or in line (3), replace affected line. Refer to Repair of Cooling Unit, Volume 1-7, page 1-7- .
34. If the location is at the line shutoff valve V5 (4), remove the seal cap (6), place handwheel or wrench on valve stem (5) and attempt to rotate valve stem (5) counterclockwise.
35. If valve stem (5) rotates counterclockwise, continue to rotate until the valve V5 (4) is backseated. Remove handwheel or wrench, install seal cap (6) and go to step 119.

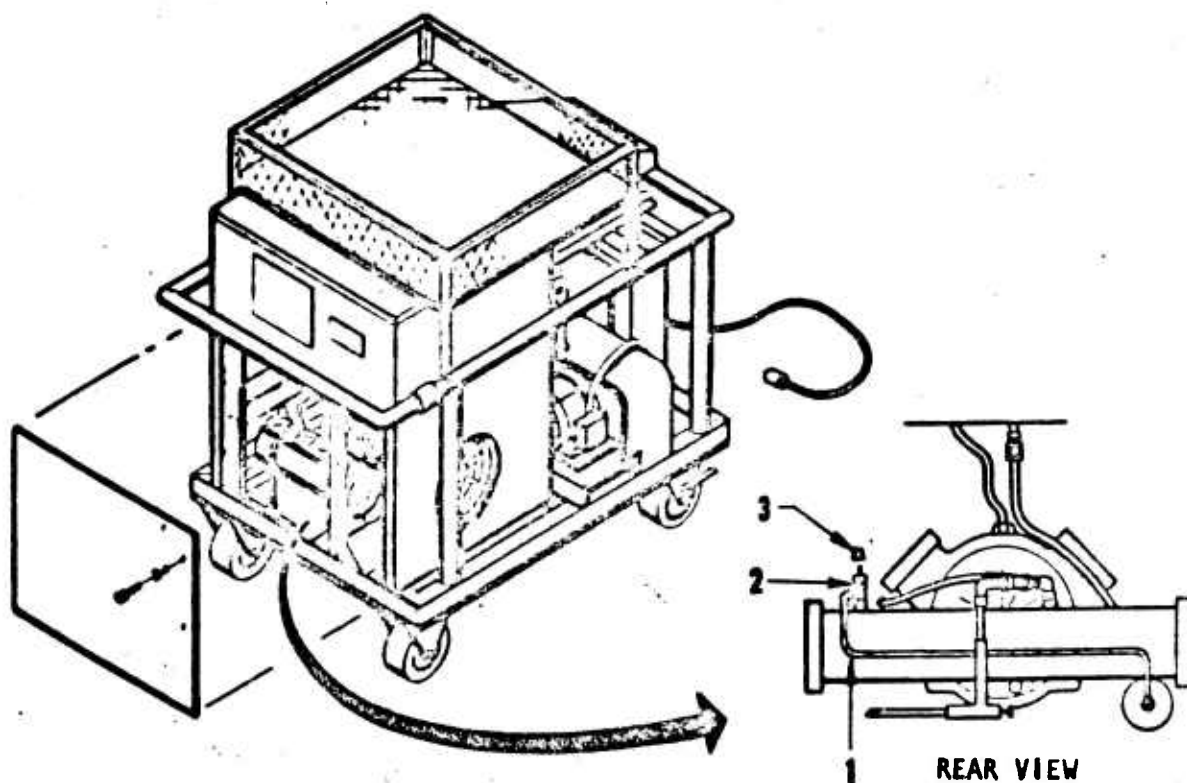


7. BLESshoot COOLING UNIT

36. If valve V5 (2) cannot be opened further, attempt to close valve V5 (2) by rotating handwheel or wrench clockwise.

37. If valve V5 (2) operates easily, reopen valve V5 until backseated, by rotating handwheel or wrench counterclockwise. Remove handwheel or wrench and install seal cap (3). Remove and replace line (1). Refer to Repair of Cooling Unit, Volume 1-7, page 1-7- .

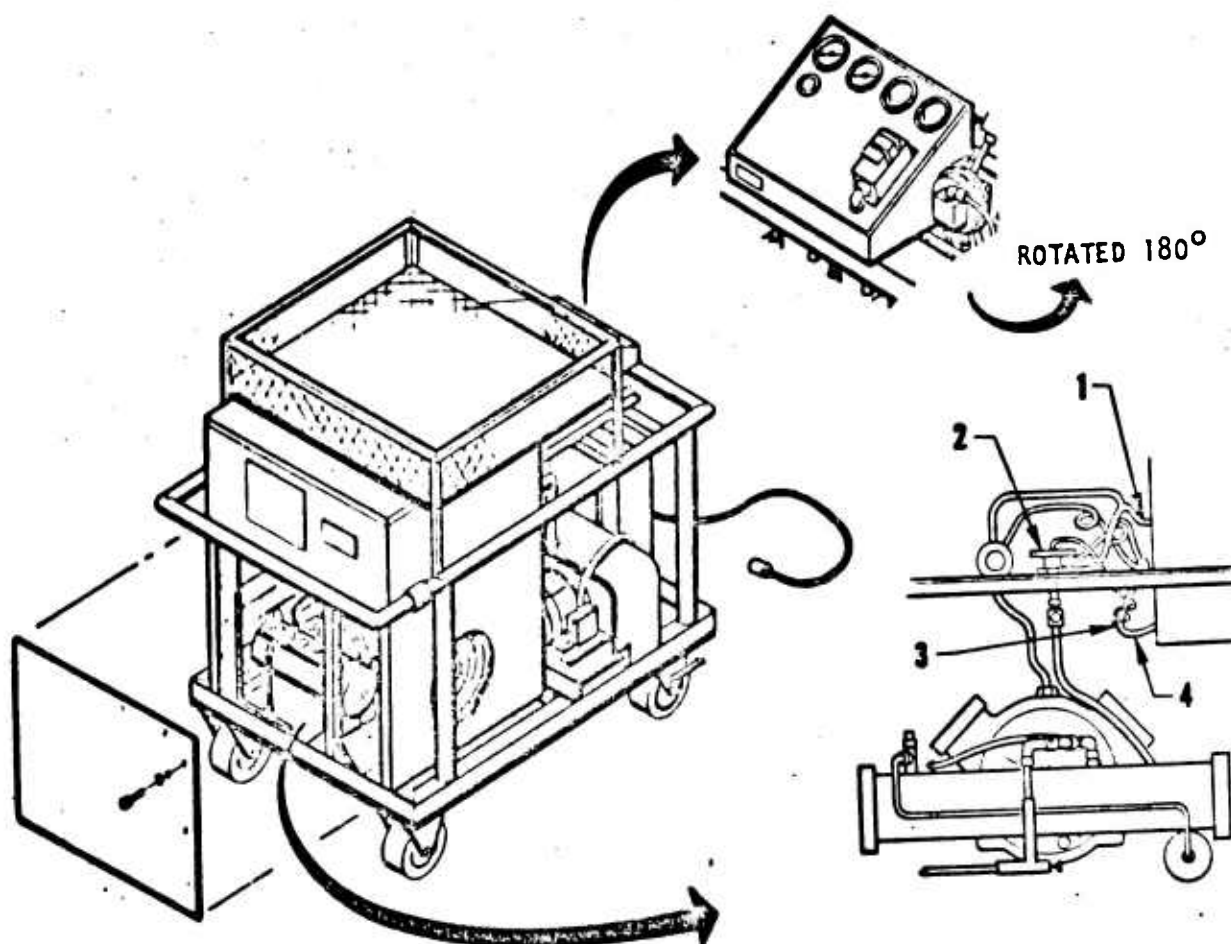
38. If valve V5 (2) does not operate easily, remove and replace valve V5. Refer to Repair of Cooling Unit, Volume 1-7, page 1-7- .



TROUBLESHOOT COOLING UNIT

39. Check suction line (1) for cold or frosted surface. If line is not cold or frosted, go to step 23 and troubleshoot for lack of cooling.
40. Check expansion valve V1 thermal bulb (3) for tight mounting against suction line (4) and insulation over thermal bulb (3) for tight and secure installation.

41. If thermal bulb or insulation is not properly mounted, resecure in place. Refer to Installation of Expansion Valve, Volume 1-7, page 1-7- . Go to step 119.
42. If thermal bulb and insulation are firmly in place, replace expansion valve V1 (2). Refer to Repair of Cooling Unit, Volume 1-7, page 1-7- .



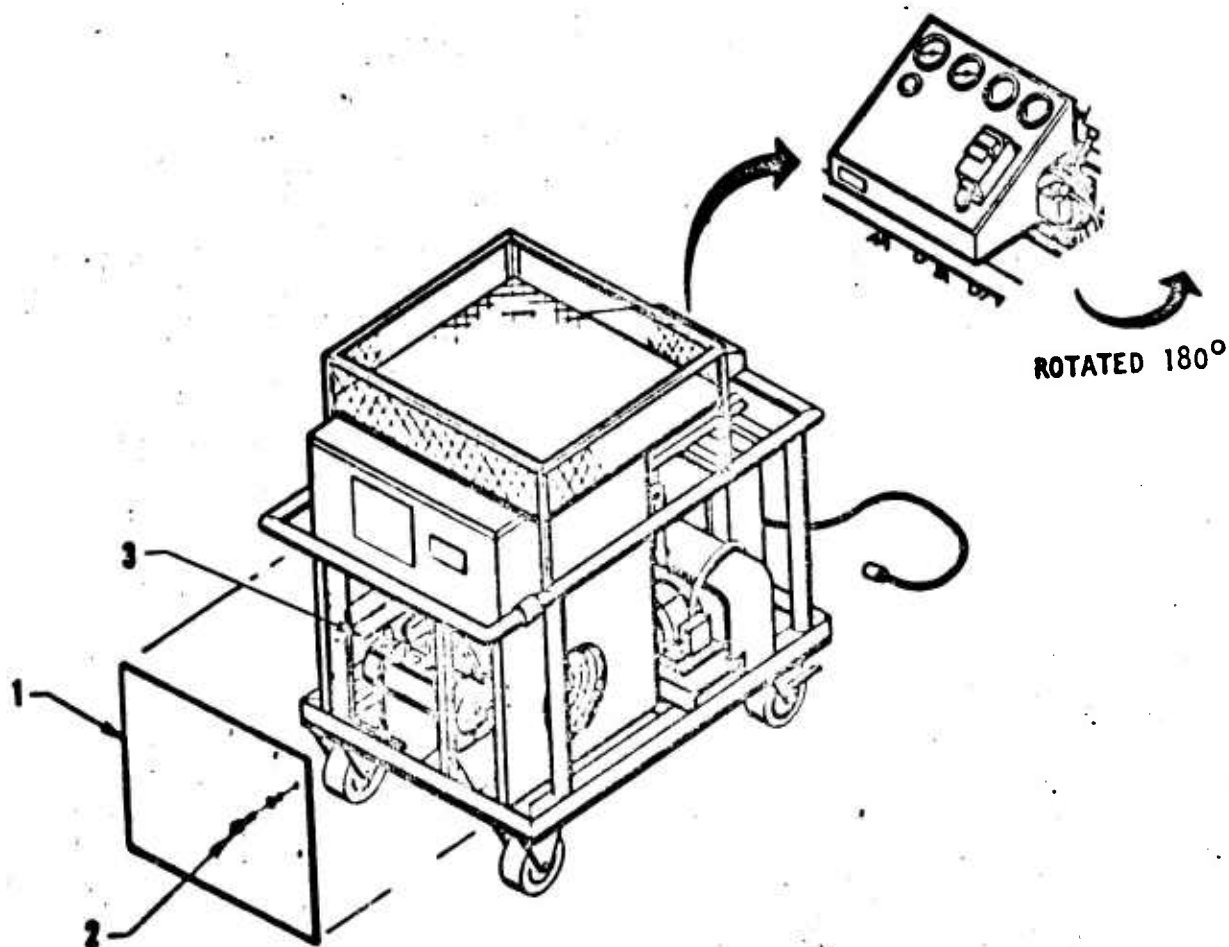
TF BLESshoot COOLING UNIT

43. If cover (1) is installed, remove screws and washers (2) and remove cover from cooling unit.

WARNING

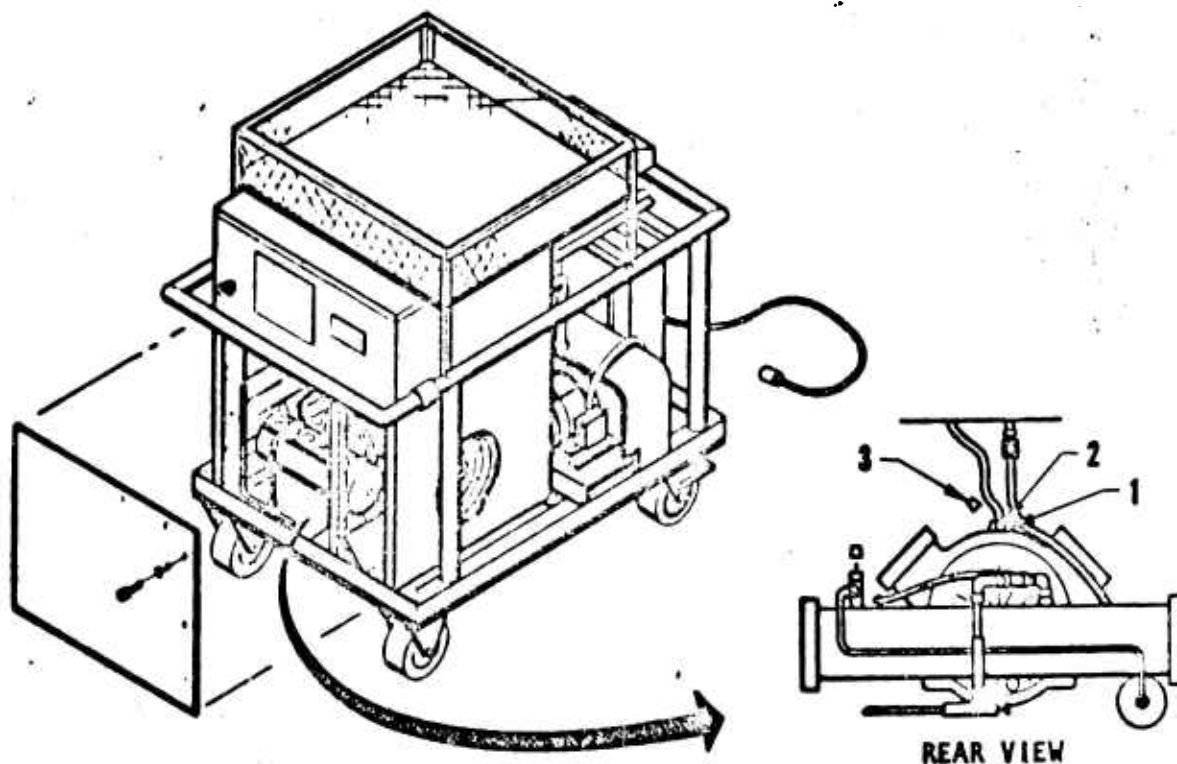
Verify power cable is disconnected from facility power before making inspection. Injury could result if AGE ECU were started.

44. Inspect condenser (3) for clogging with debris. If condenser (3) is clogged with debris, remove debris. Refer to Cleaning of Condenser, Volume 1-9, page 1-9- . Go to step 119.



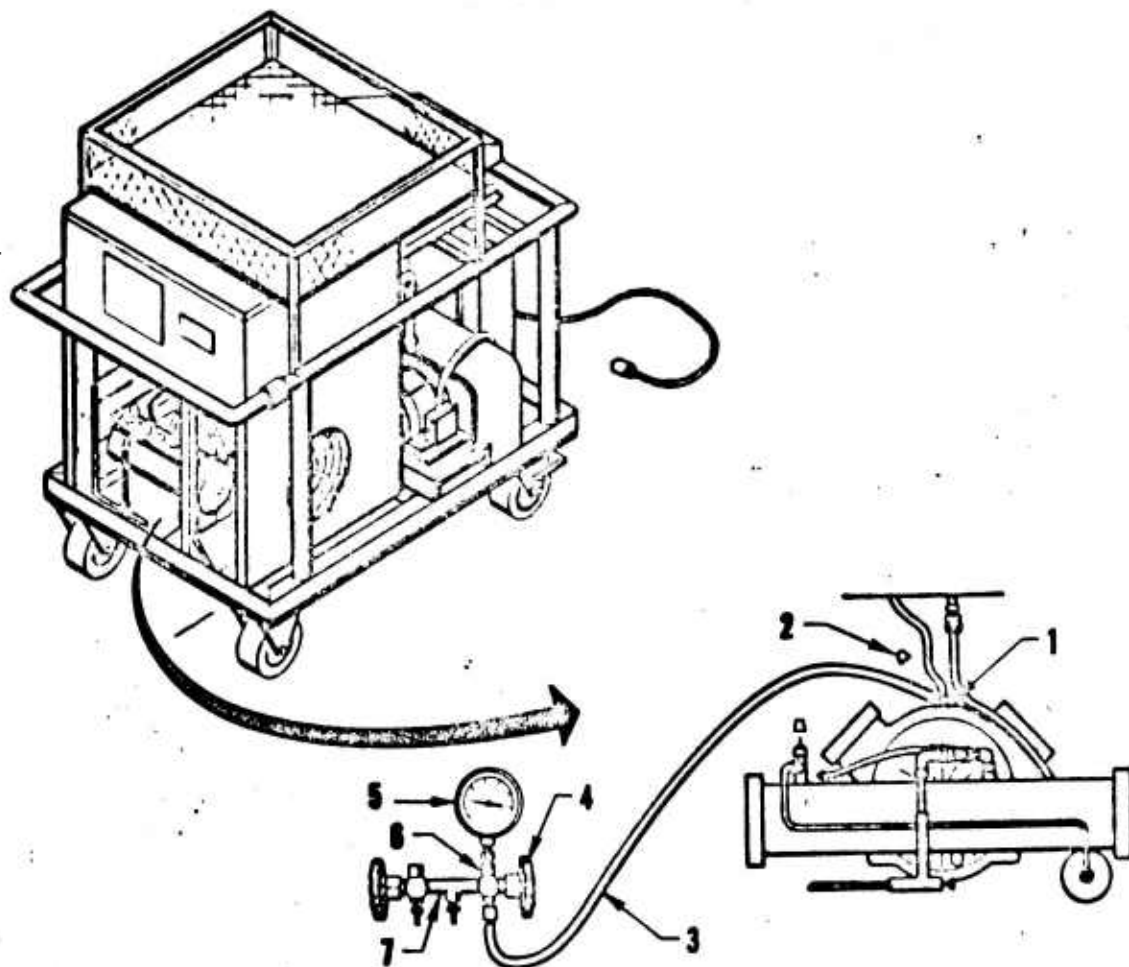
TROUBLESHOOT COOLING UNIT

45. Check head pressure service valve V8 (1) for full open by removing seal cap (3), placing handwheel or wrench on valve stem (2) and attempting to rotate valve stem counterclockwise.
46. If valve V8 was not fully open, as indicated by the valve stem rotating, continue to rotate valve stem (2) until the valve V8 (1) is backseated. Remove handwheel or wrench, install seal cap (3) and go to step 119.
47. If valve V8 (1) cannot be opened further, attempt to close valve V8 (1) by rotating handwheel or wrench clockwise.
48. If valve V8 (1) operates easily, reopen valve V8 until backseated by rotating handwheel or wrench counterclockwise and install seal cap (3). Go to step 119.
49. If valve V8 does not operate easily, remove and replace valve V8 (1). Refer to Repair of Cooling Unit, Volume 1-7, page 1-7- .



TRO ESHOOT COOLING UNIT

50. Allow the cooling unit to stand idle long enough for the refrigeration system to cool to ambient temperature.
51. Remove cap (2) from head pressure service valve V8 (1).
52. Connect charging hose to head pressure service valve V8 (1).
53. Connect charging manifold (7) to charging hose (3).
54. Screw high pressure gage (5) into charging manifold (7) port which is directly opposite charging hose (3).
55. Turn handwheel (4) on charging manifold (7) valve nearest gage clockwise until valve is bottom-seated in innermost position. Valve is closed.



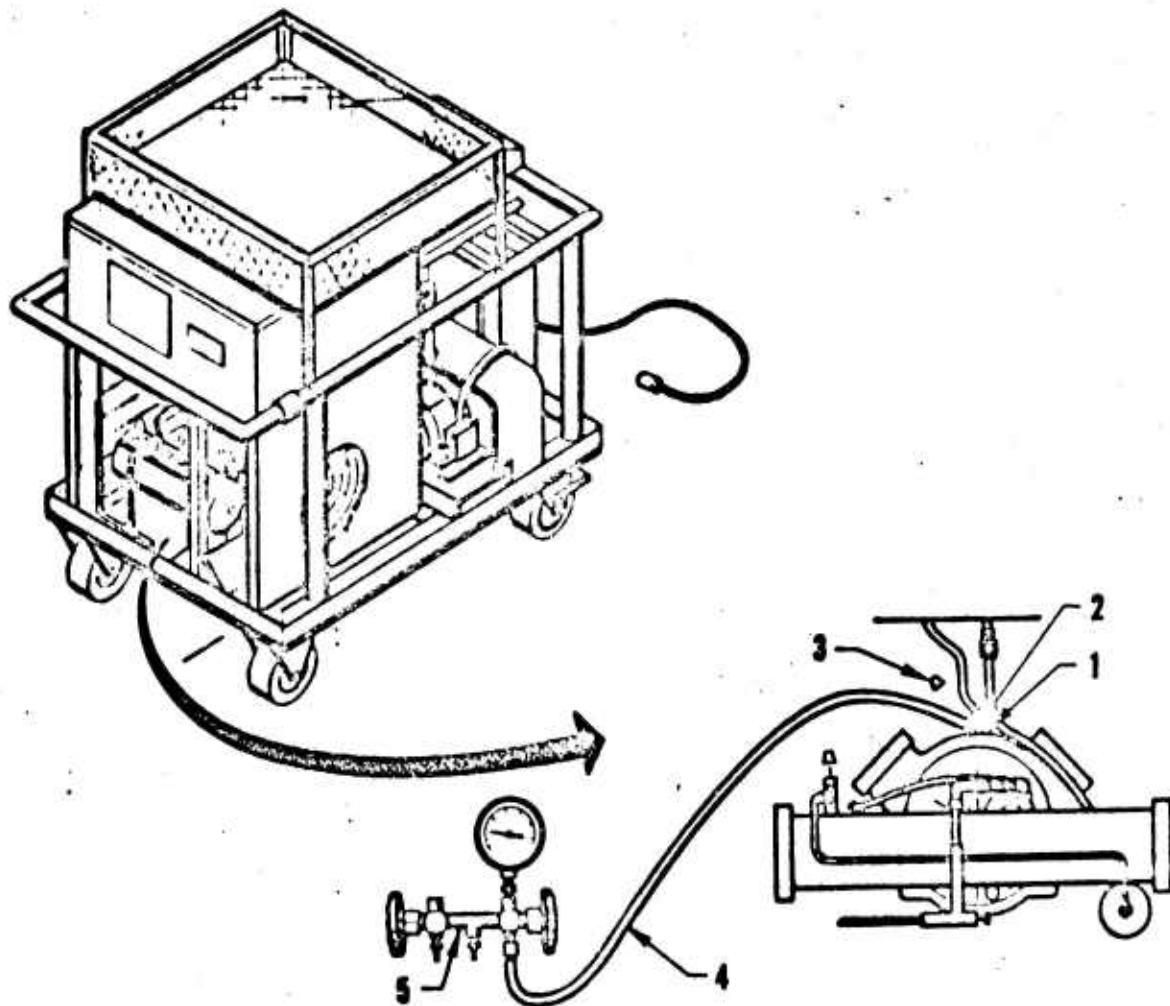
TROUBLESHOOT COOLING UNIT

56. Loosen charging hose (4) at manifold (5).
57. Remove seal cap (3) from head pressure service valve V8 (1).
58. Install handwheel or wrench on valve stem (2) of head pressure service valve V8 (1).

WARNING

Avoid freon vapor inhalation, and provide proper ventilation. Vapor may cause headache, dizziness, sleepiness or unconsciousness due to lack of oxygen.

59. Slowly turn valve stem (2) approximately two turns clockwise into valve, allow enough freon refrigerant to escape to purge charging hose (4), then tighten charging hose at manifold.

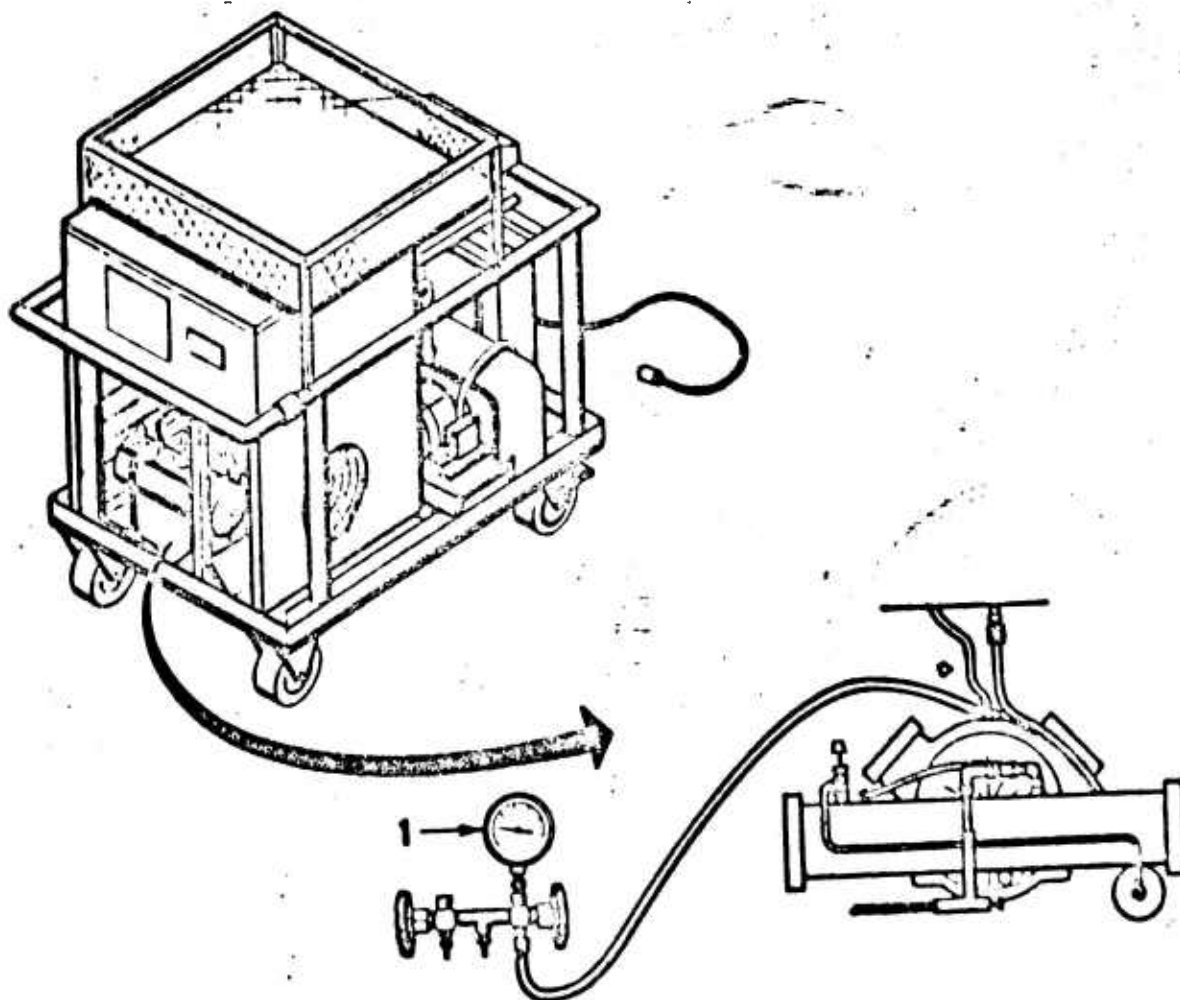


TI BLESHOOT COOLING UNIT

60. Read high pressure indication on high pressure gage (1).
61. Find ambient temperature in table below and read corresponding pressure.

SATURATION TEMPERATURE		PRESSURE
(°C)	(°F)	(psig)
-1.1	30	28.4
1.7	35	32.4
4.4	40	37.0
7.2	45	41.7
10.0	50	46.7
15.6	60	57.7
23.9	75	76.9
35.0	95	108.1
40.6	105	126.2
51.7	125	169.1

62. If pressure on gage (1) is less than 10 psig above pressure read from table, go to step 69.
63. If pressure on gage (1) is more than 10 psig above pressure read from table, there is air in refrigerant. Continue with step 64 following.



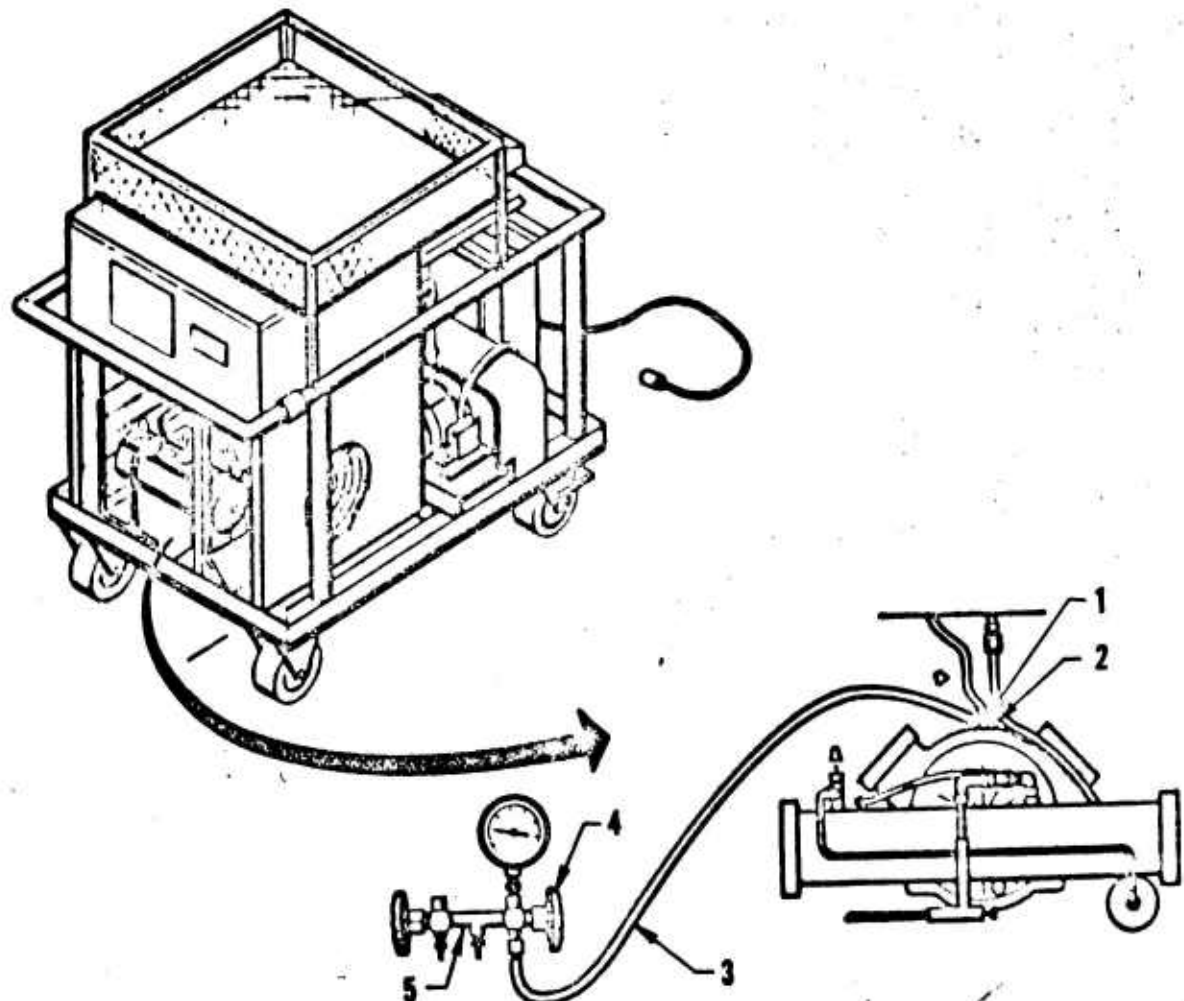
TROUBLESHOOT COOLING UNIT

64. With handwheel or wrench, turn valve stem (1) of head pressure service valve V8 (2) counterclockwise until valve is backseated at outermost position (approximately two turns).

WARNING

Avoid freon vapor inhalation and provide proper ventilation. Vapor may cause headache, dizziness, sleepiness or unconsciousness due to lack of oxygen.

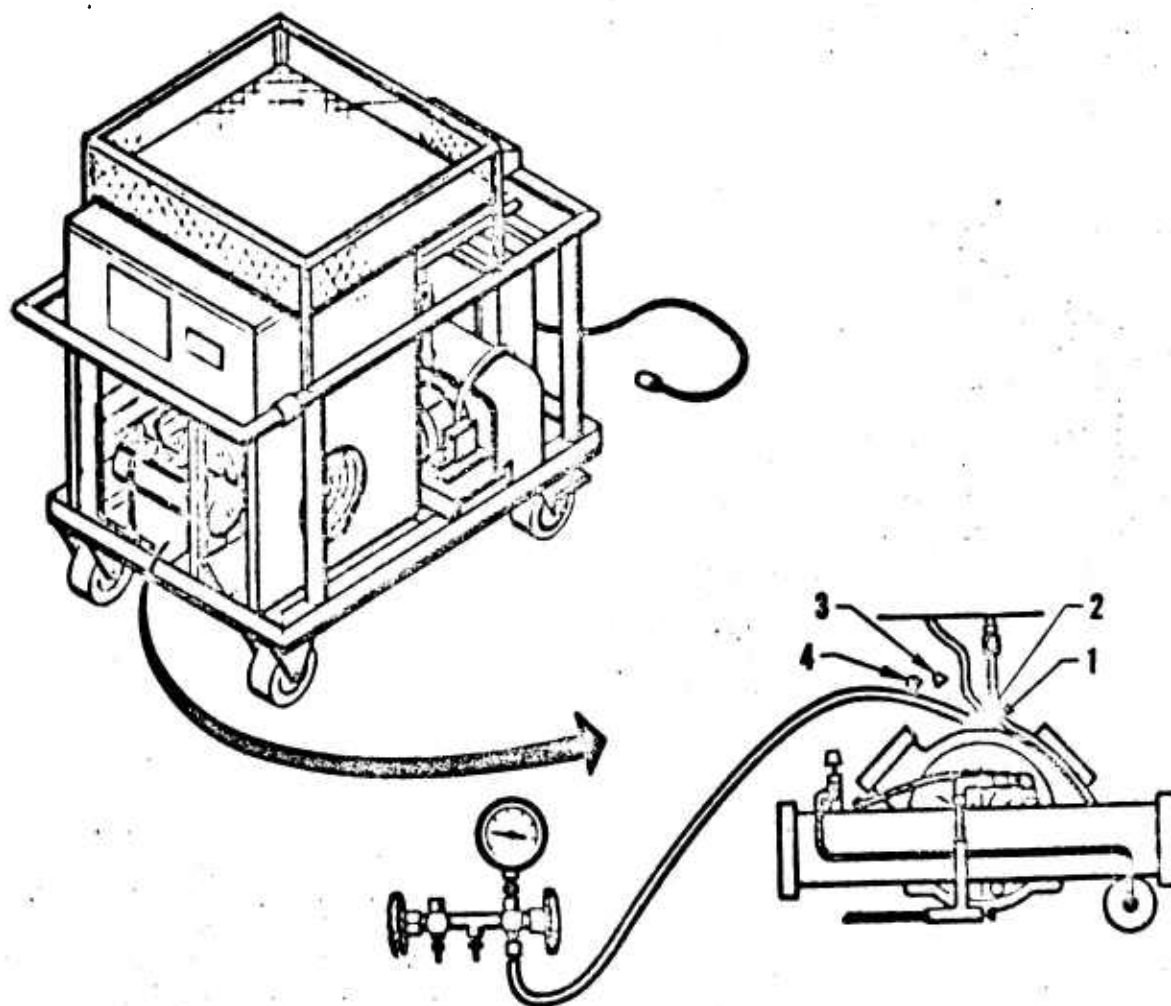
65. Open manifold valve (4) slowly to allow freon refrigerant to bleed from manifold (5) and charging hose (3).
66. Disconnect charging hose (3) from head pressure service valve V8 (2).



TRC LESHOOT COOLING UNIT

67. Install cap (4) and seal cap (3) on head pressure service valve V8 (1).
68. Recharge cooling unit with refrigerant. Refer to Charging Refrigeration System, Volume 1-7, page 1-7- .

69. With handwheel or wrench, turn valve stem (2) of head pressure service valve V8 (1) counterclockwise until valve is backseated at outermost position (approximately two turns).
70. With handwheel or wrench, slowly turn valve stem (2) of head pressure service valve V8 (1) clockwise approximately one-half turn into valve.



TROUBLESHOOT COOLING UNIT

71. Connect AGE ECU power cable (2) to facility power.

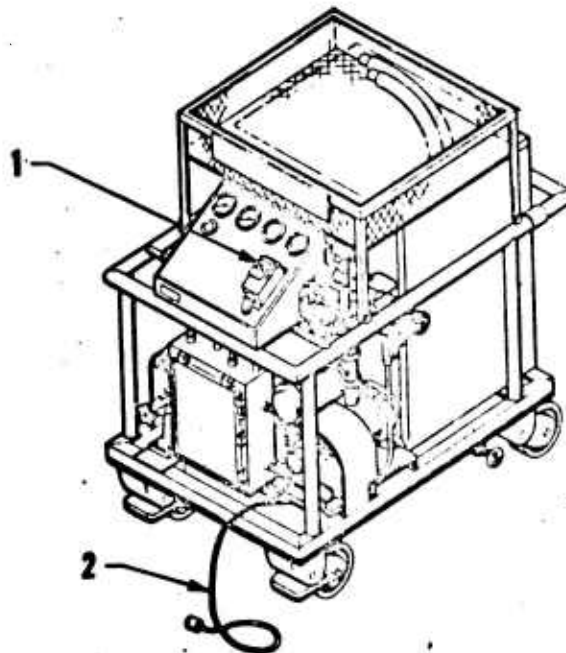
WARNING

Stay clear of condenser fan during operation with back cover removed. Injury could result.

NOTE

The cooling unit may be operated with the back cover removed for only a short time since the condenser cooling air bypasses the condenser coils. The cooling unit will shut down automatically when condenser high pressure causes Pressure Limit Control high pressure switch to release.

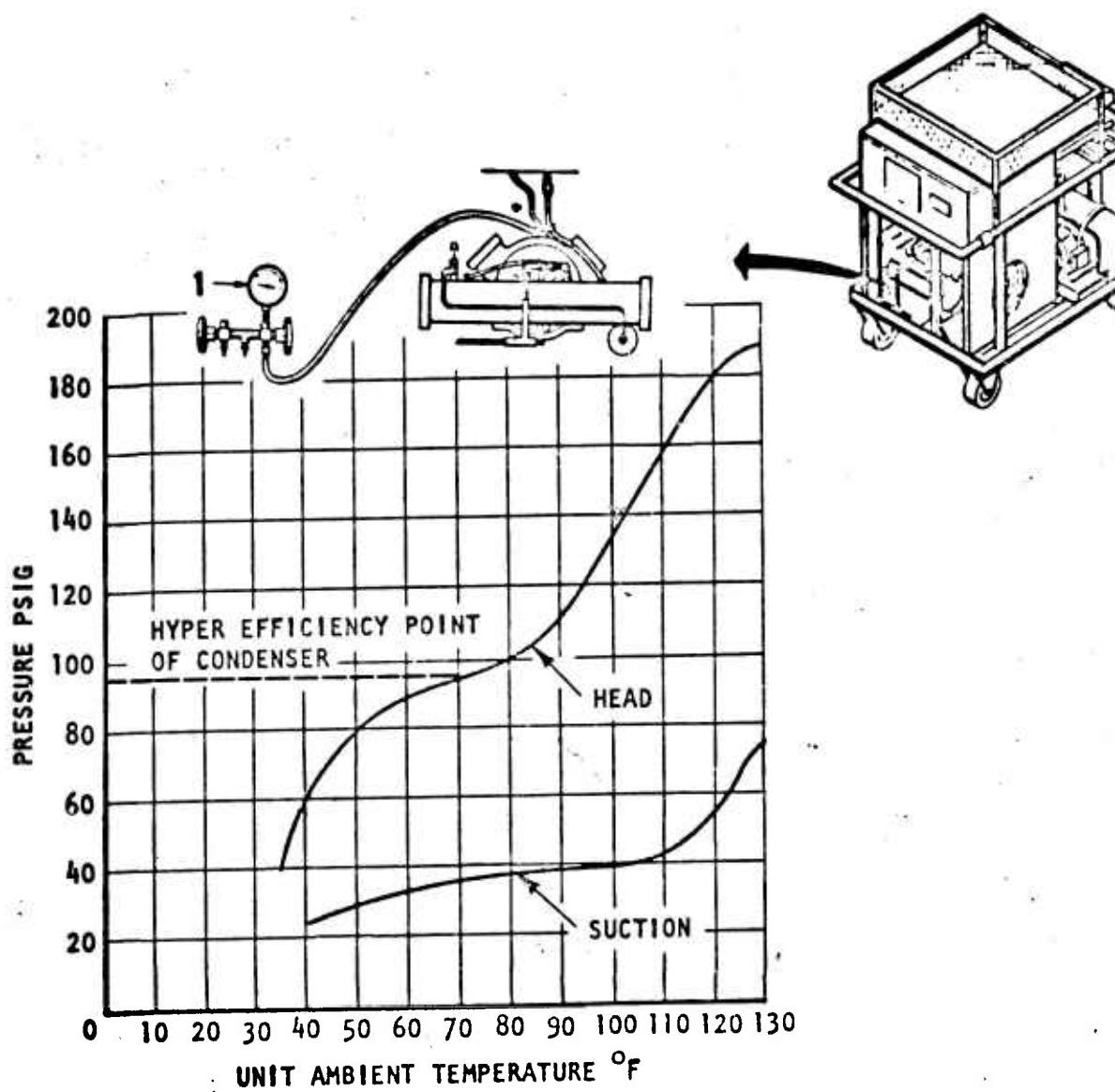
72. Press START switch (1).



UBLESHOOT COOLING UNIT

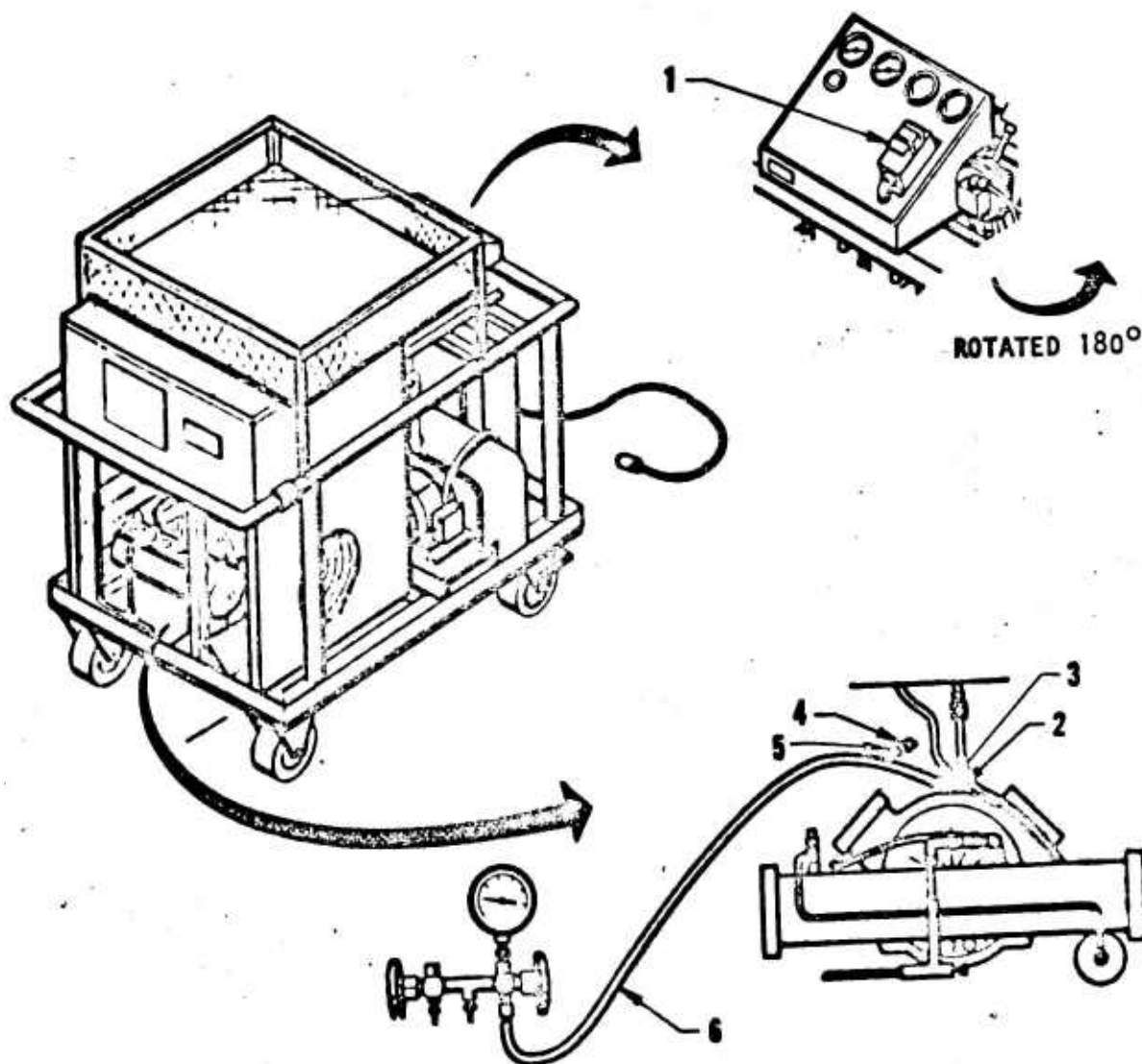
73. Read high pressure gage (1) indication.
74. Read head pressure from chart for ambient temperature.

75. Compare pressure read on pressure gage with pressure read from chart. The pressure read on the pressure gage must be less than 5 psig over the pressure read on the chart. If the pressure is out of tolerance, go to step 82.



TROUBLESHOOT COOLING UNIT

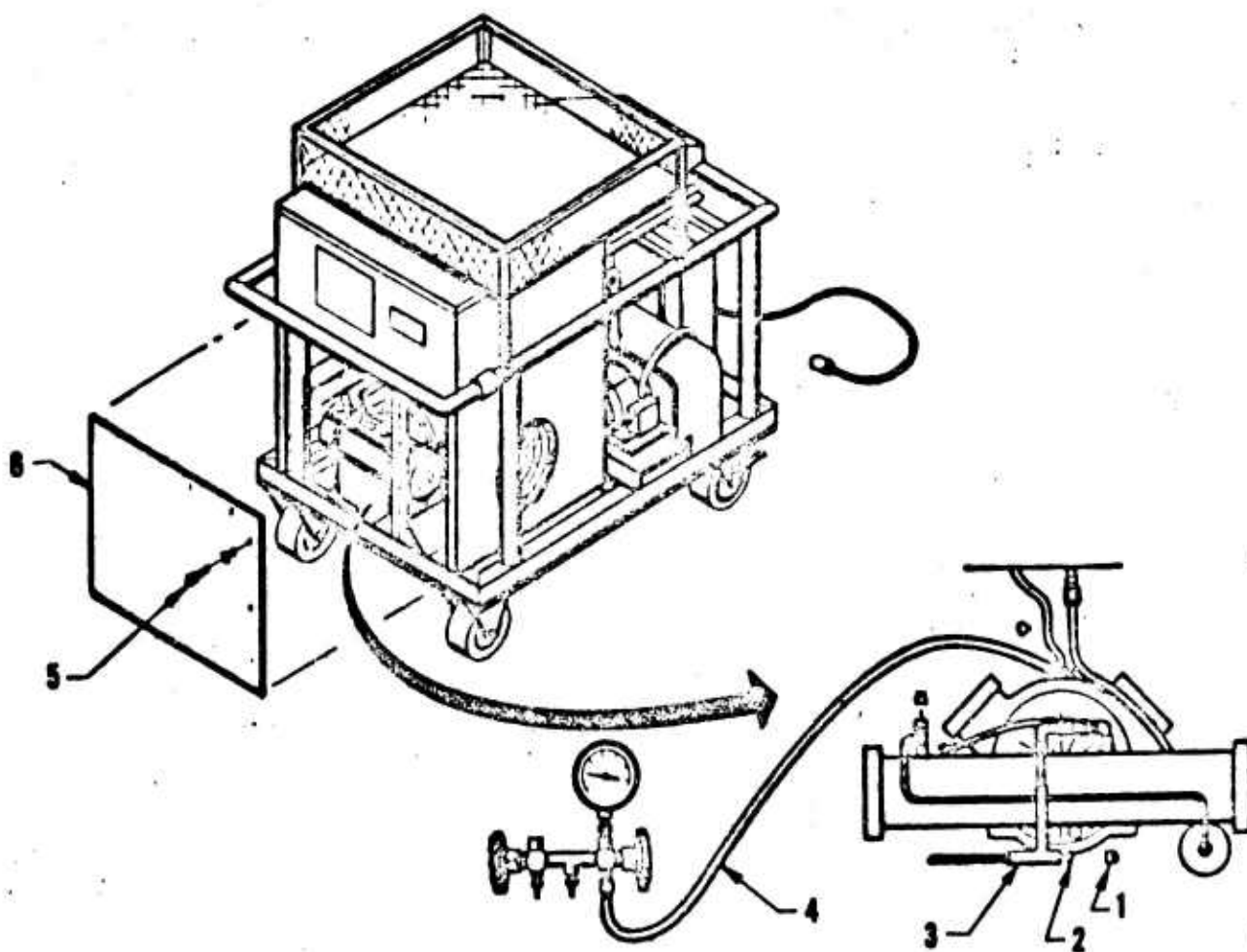
76. Press STOP switch (1).
77. With handwheel or wrench, turn valve stem (3) of head pressure service valve V8 (2) counterclockwise until backseated (approximately one-half turn).
78. Install seal cap (4) on head pressure service valve V8 (2).
79. Disconnect charging hose (6) from head pressure service valve V8 (2).
80. Install cap (5) in head pressure service valve V8 (2) gage port.
81. Troubleshoot pressure limit control. Refer to AGE ECU Cooling Unit Pressure Limit Control (Lear-Siegler) Troubleshoot, Volume 2-10.



T BLESHOOT COOLING UNIT

82. Remove protective cap (1) from head pressure control valve V4 (3) adjustment screw (2).
83. Turn adjustment screw (2) one-fourth turn counterclockwise. Let AGE ECU run 2 minutes and read pressure gage. Make further adjustments, turning screw (2) one-fourth turn or less at a time and waiting 2 minutes between settings to read pressure gage. If satisfactory adjustment is accomplished, reinstall protective cap (1) and go to step 112.

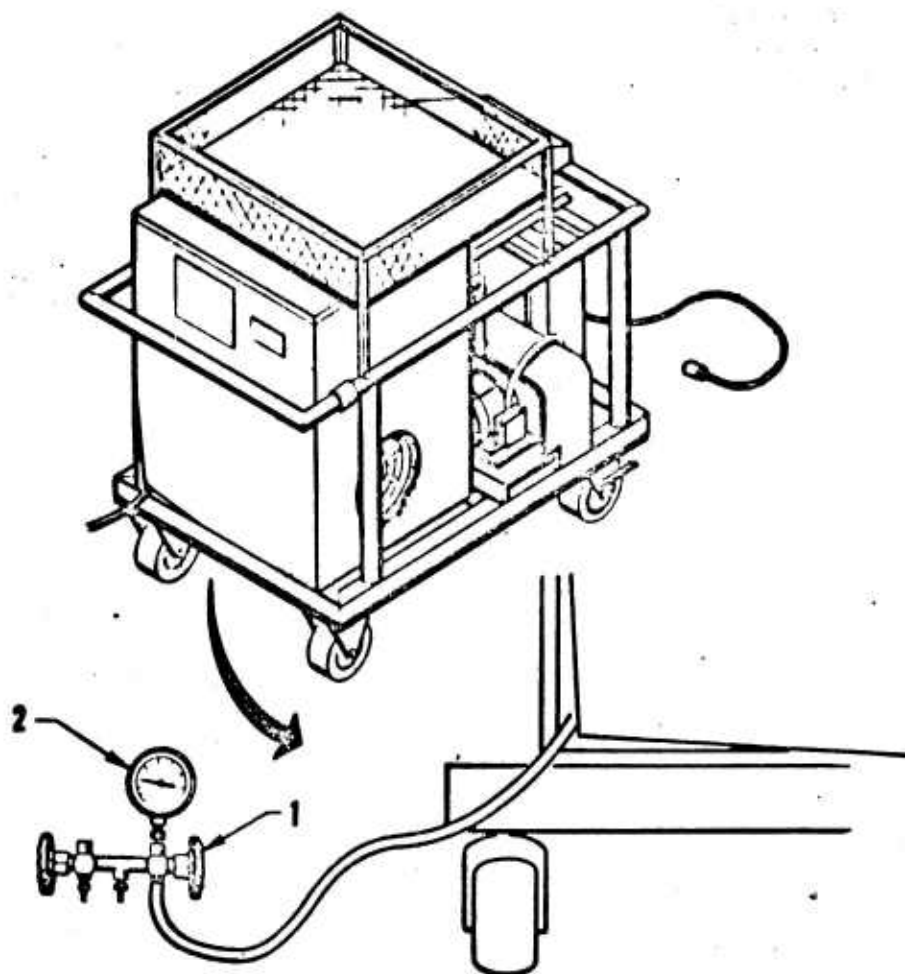
84. If adjustment of head pressure control valve V4 (3) did not reduce head pressure to within tolerance, reinstall protective cap (1) and install back cover (6) in a temporary manner. Use padding around charging hose (4) and install approximately half of the screws (5).



TROUBLESHOOT COOLING UNIT

85. Observe head pressure for 5 minutes as AGE ECU continues to run to determine if head pressure will stabilize. If head pressure stabilizes within tolerance, go to step 112.
86. Open manifold valve (1) slowly and allow a small amount of freon refrigerant to bleed off. Close manifold valve (1). Allow head pressure to stabilize. Then read pressure gage (2) indication.

87. If pressure decreased, bleed off another small increment if required to bring head pressure within tolerance. Go to step 112.
88. If pressure did not decrease with release of a small quantity of refrigerant, discontinue attempt and continue with step 89 following.



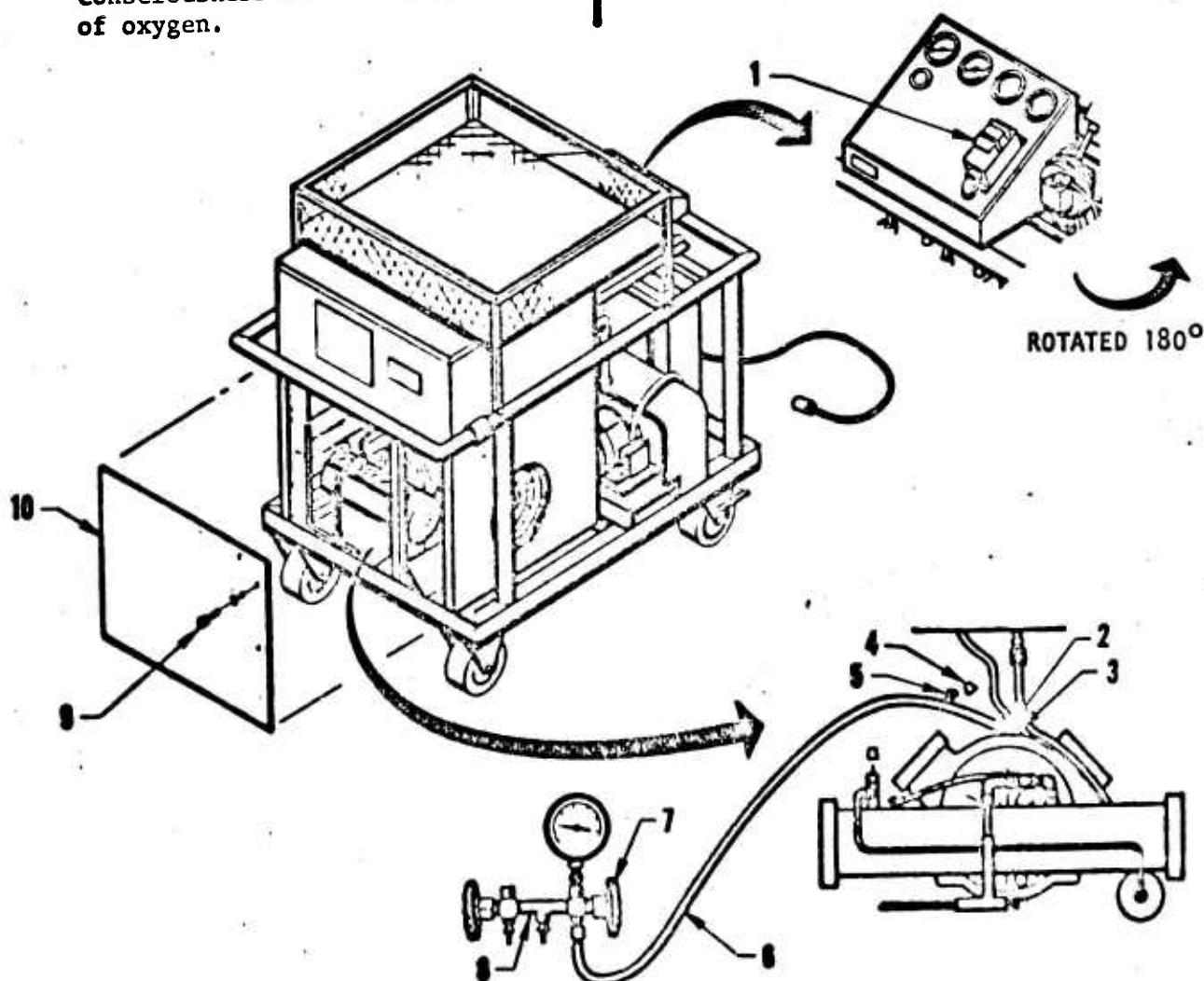
TROUBLESHOOT COOLING UNIT

89. Press STOP switch (1).
90. Remove back cover (10) by removing screws (9) and padding.
91. With handwheel or wrench, turn valve stem (2) of head pressure service valve V8 (3) counterclockwise until valve is backseated at outermost position (approximately one-half turn).

WARNING

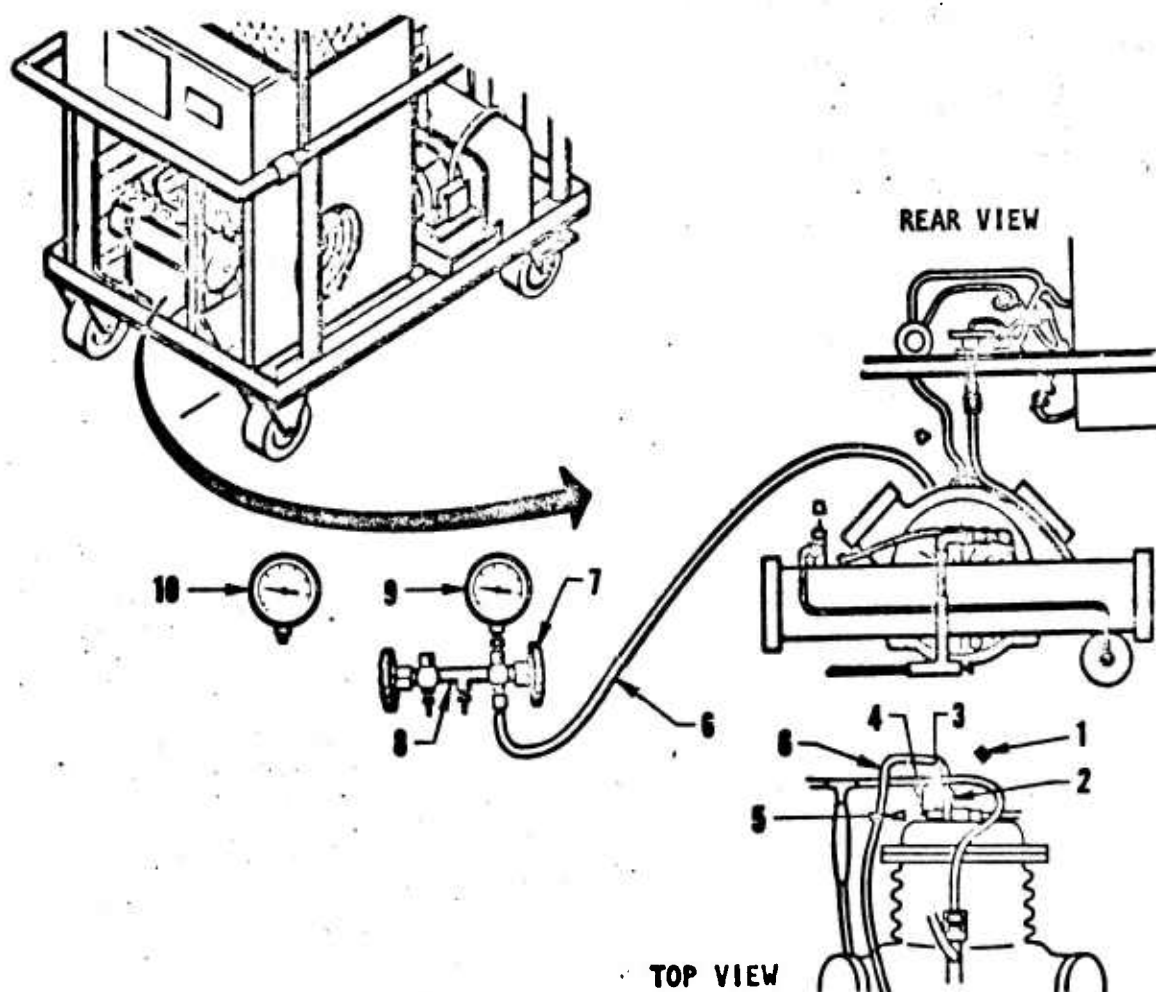
Avoid freon vapor inhalation and provide proper ventilation. Vapor may cause headache, dizziness, sleepiness or unconsciousness due to lack of oxygen.

92. Open manifold valve (7) slowly to allow freon refrigerant to bleed from manifold (8) and charging hose (6).
93. Disconnect charging hose (6) from head pressure service valve V8 (3).
94. Install cap (5) and seal cap (4) on head pressure service valve V8 (3).
95. If head pressure is set satisfactorily, go to step 118.



TROUBLESHOOT COOLING UNIT

96. Remove cap (1) from gage port (2) of suction service valve V7 (3).
97. Connect charging hose (6) from manifold (8) to gage port (2).
98. Remove high pressure gage (10) from manifold (8).
99. Install compound pressure gage (9) on manifold (8) at location from which high pressure gage was removed.
100. Close manifold valve (8) by rotating handwheel (7) clockwise until valve is bottomseated.
101. Remove seal cap (5) from suction service valve V7 (3).
102. With handwheel or wrench, turn valve stem (4) clockwise into suction service valve V7 until valve is closed (bottomseated).



T.O. 35M10-5-7-1JPA-2

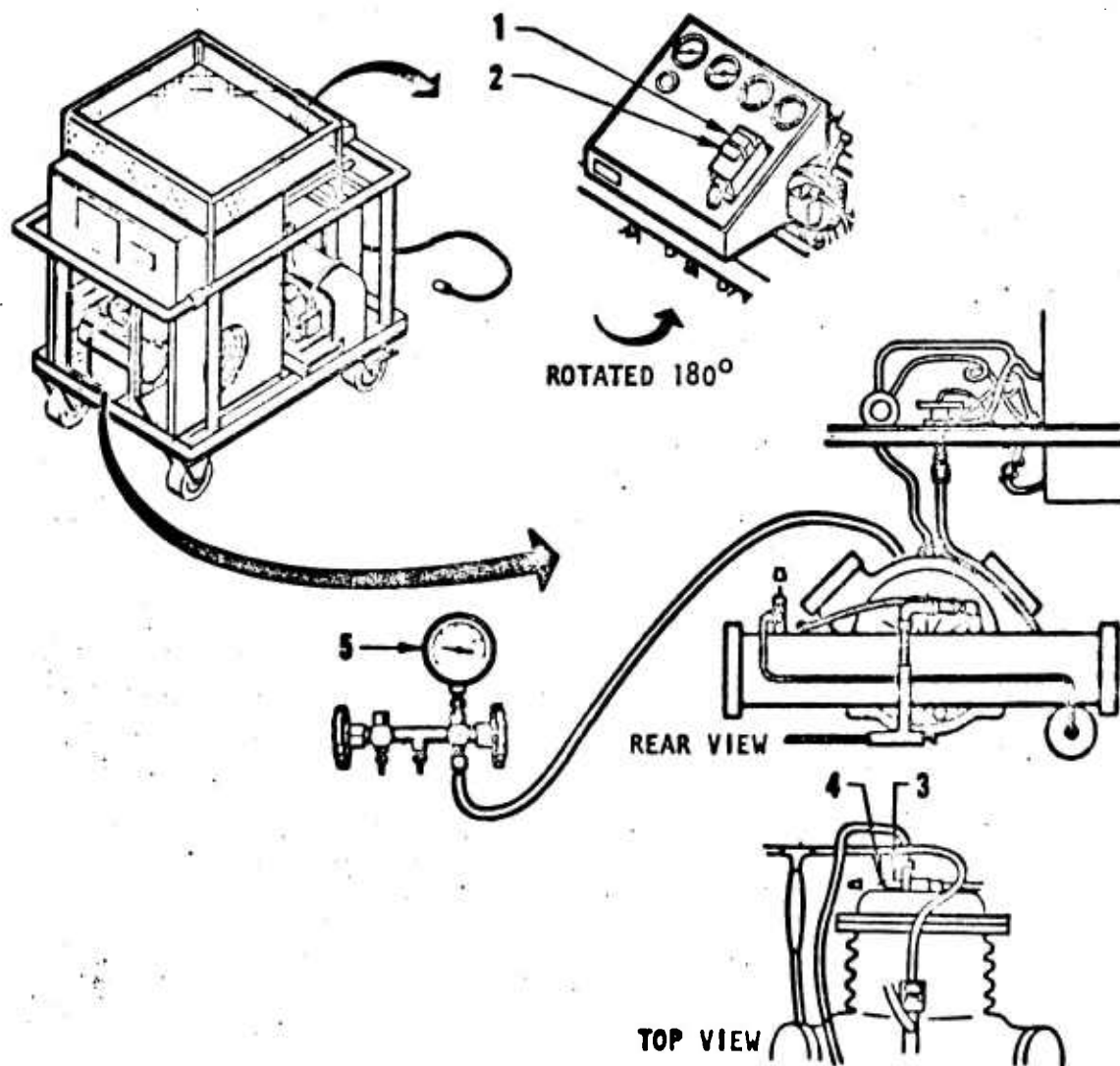
TROUBLESHOOT COOLING UNIT

103. Press START switch (1) and allow AGE ECU to run until a vacuum of 10 to 15 inches of mercury is indicated on compound pressure gage (5).

104. Press STOP switch (2).

105. With handwheel or wrench, turn valve stem (4) of suction service valve V7 (3) counterclockwise to open slightly. Watch pressure gage (5) and close suction service valve V7 (3) tightly when pressure gage reads zero.

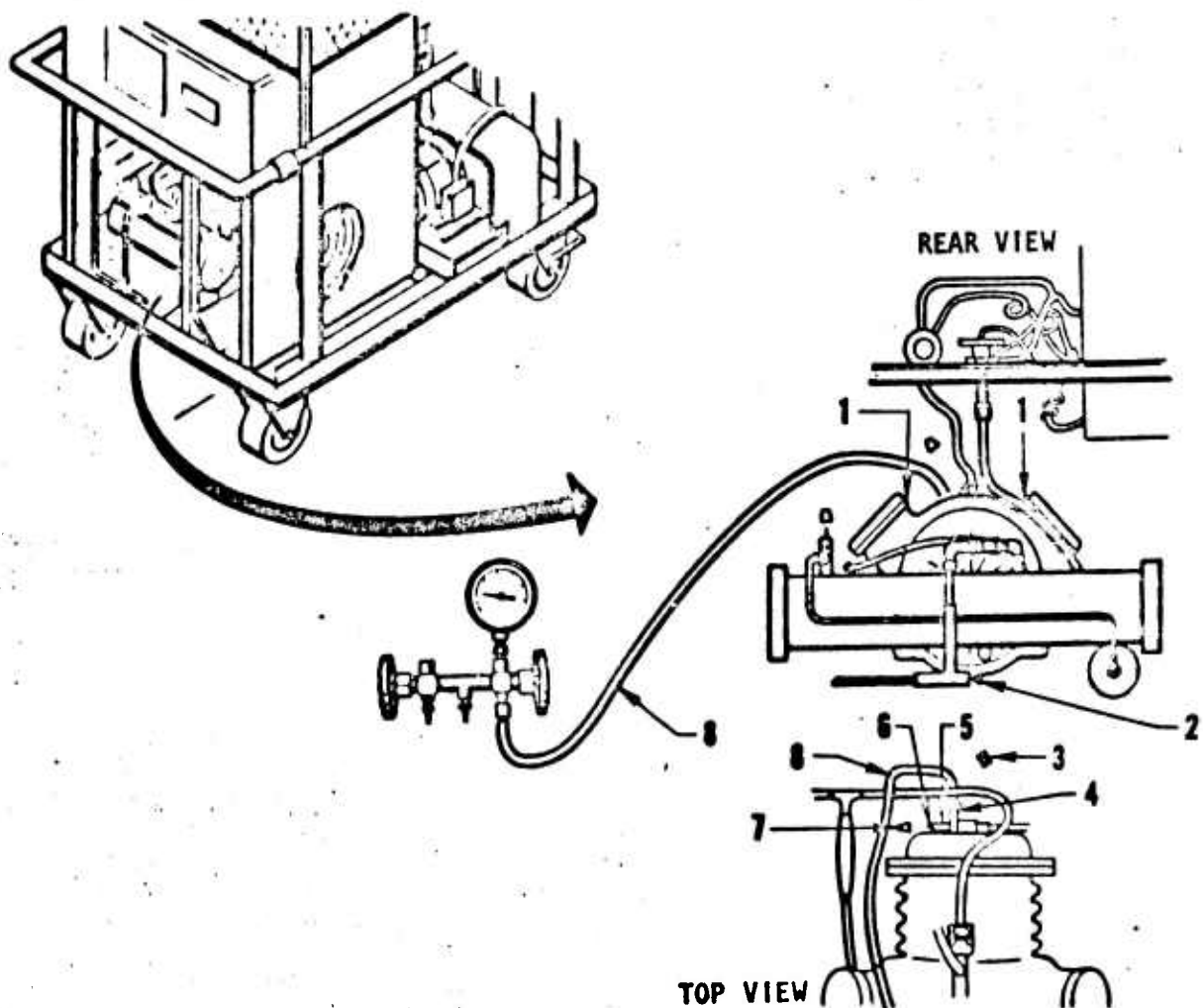
106. Watch pressure gage (5) for 5 minutes for continuing pressure rise. Note whether a pressure rise was observed.



TROUBLESHOOT COOLING UNIT

107. With handwheel or wrench, turn valve stem (6) of suction service valve V7 (5) counterclockwise until valve is full open (backseated).
108. Disconnect pressure hose (8) from suction service valve V7 (5) gage port (4).
109. Install cap (3) and seal cap (7) on suction service valve V7 (5).

110. If pressure did not rise in step 106 observation, remove and replace head pressure control valve V4 (2). Refer to Repair of Cooling Unit, Volume 1-7, page 1-7- .
111. If pressure did rise in step 106 observation, remove and replace compressor valve plate assembly. Refer to Repair of Compressor, Volume 1-8, page 1-8- .



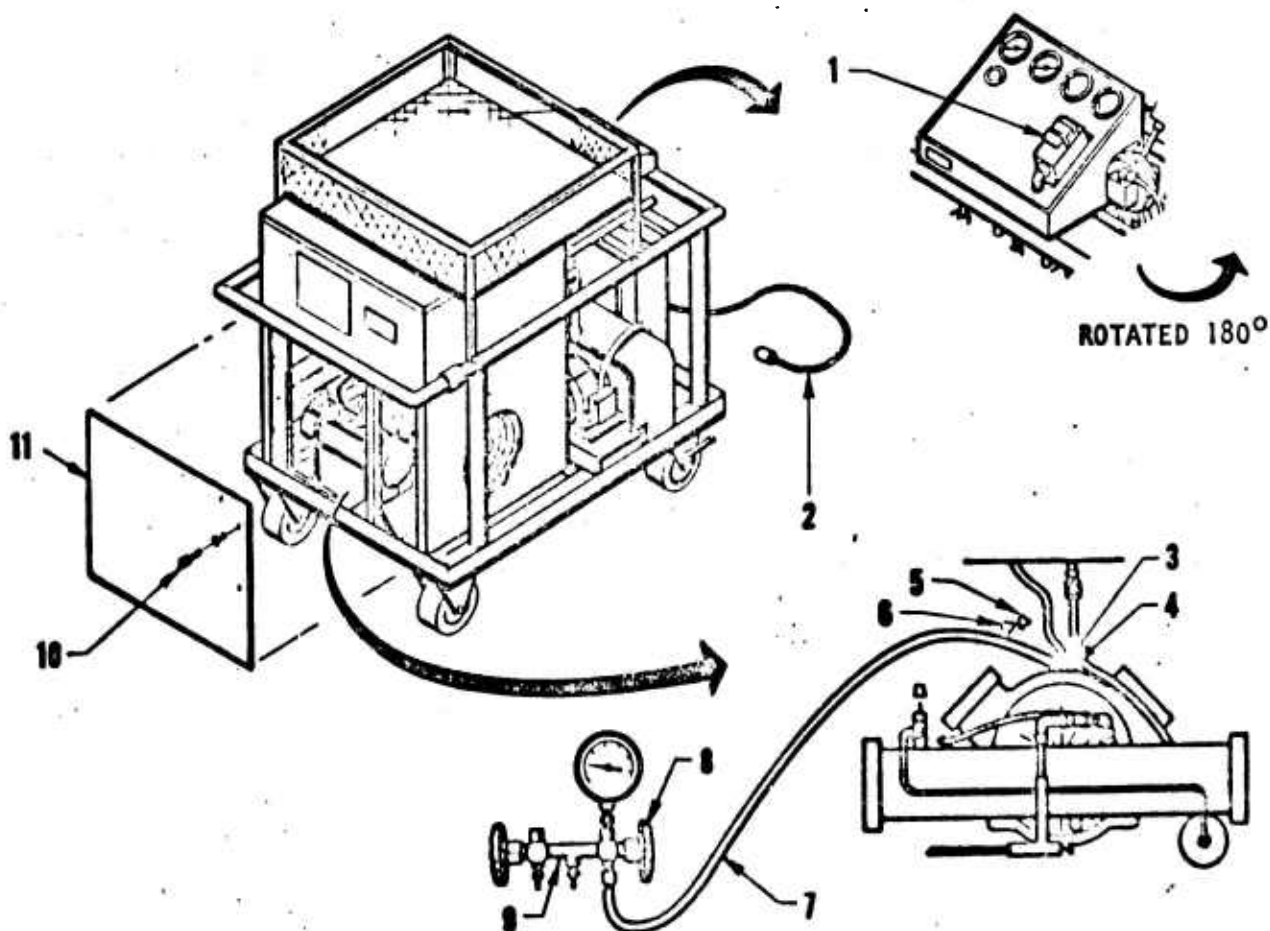
DOUBLESHOOT COOLING UNIT

112. Press STOP switch (1).
113. If installed, remove back cover (11) by removing screws (10) and padding.
114. With handwheel or wrench, turn valve stem (3) of head pressure service valve V8 (4) counterclockwise until valve is backseated at outermost position (approximately one-half turn).

WARNING

Avoid freon vapor inhalation and provide proper ventilation. Vapor may cause headache, dizziness, sleepiness or unconsciousness due to lack of oxygen.

115. Open manifold valve (8) slowly to allow freon refrigerant to bleed from manifold (9) and charging hose (7).
116. Disconnect charging hose (7) from head pressure service valve V8 (4).
117. Install cap (6) and seal cap (5) on head pressure service valve V8 (4).
118. Disconnect power cable (2) from facility power.
119. Install back cover (11) on cooling unit with screws and washers (10).
120. Return to checkout or test in progress.



TECHNICAL MANUAL

VOLUME 2-9

TROUBLESHOOT

COOLING UNIT CONDENSER
(LEAR-SIEGLER)

AGE ELECTRONICS ENVIRONMENTAL

CONTROL UNIT

A/M 32C-13

Part No. 2A14155A-101-17

A/M 32C-13A

Part No. 2A14155A-101-18

TABLE OF CONTENTS

COOLING UNIT CONDENSER TROUBLESHOOT

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Fault Isolate Fan Noisy or Does Not Run	2-9-2

TROUBLESHOOT COOLING UNIT CONDENSER

PRELIMINARY INFORMATION

ACTIVITY INDEX

Introduction

This activity covers troubleshooting of the cooling unit condenser following identification of the condenser unit as the faulty subsystem by completion of AGE ECU Troubleshoot and Cooling Unit Troubleshoot. Refer to AGE ECU Checkout and Troubleshoot, Volume 2-1 or AGE ECU Cooling Unit Troubleshoot, Volume 2-7.

ProcedurePage

Condenser Fan Noisy or
Does Not Run

2-9-2

Applicable Models

A/M 32C-13 or A/M 32C-13A with Lear-
Siegler Cooling Unit AD100-1

Special Tools

Refrigeration Unit Tool Kit, Part Num-
ber SC5180-93-CL-E18.

Specific item required:

Multimeter, 0 to 5000 VDC, 0 to 1000
VAC, TS-352 B/U.

Supplies

None

Personnel

Two technicians AFSC 422X1

Equipment Condition

Power cable disconnected from facility
power.

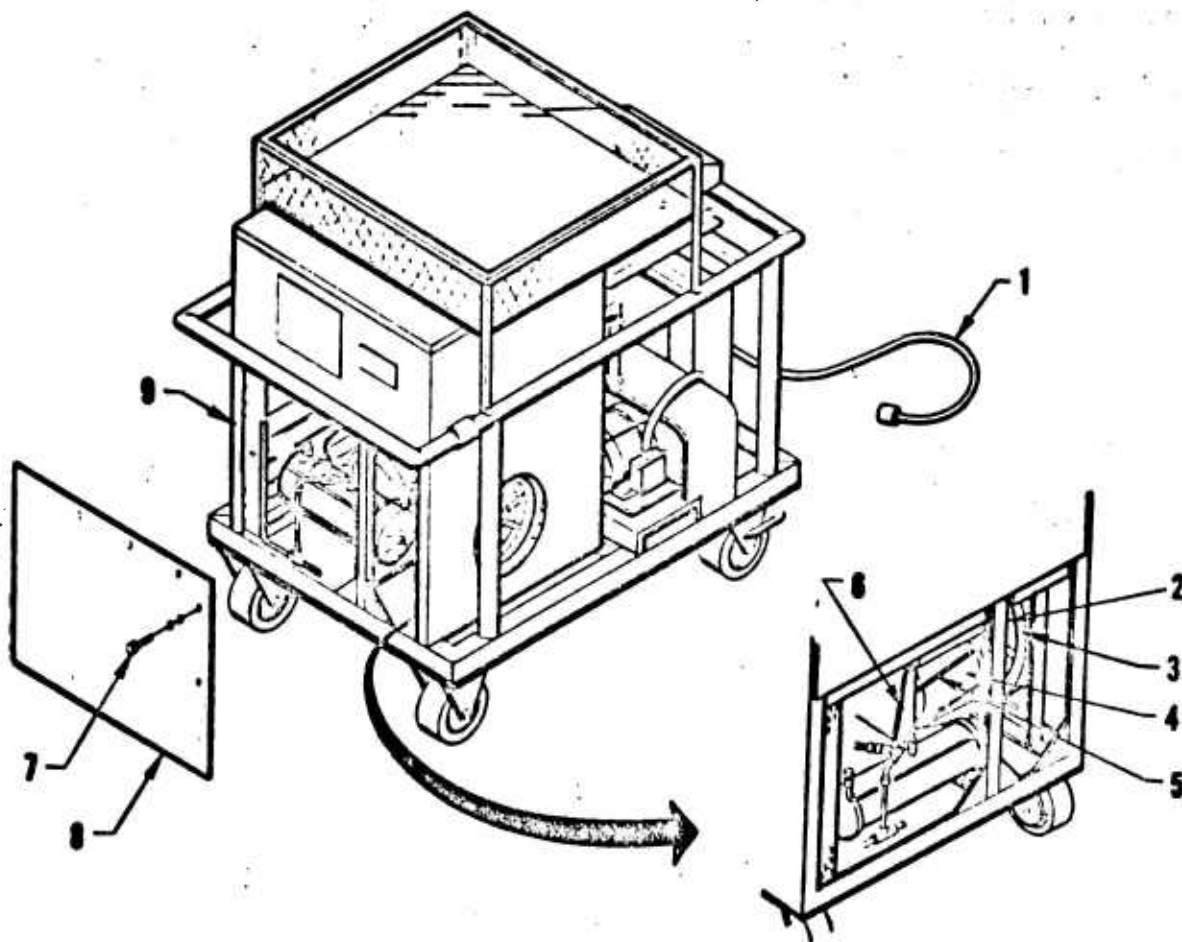
UBLESHOOT CONDENSER FAN NOISY OR
DOES NOT RUN

1. Disconnect power cable (1) from facility power, if connected.
2. If back cover is installed, remove screws and washers (7) holding back cover (8) on cooling unit (9) and remove cover. Retain screws and washers.

WARNING

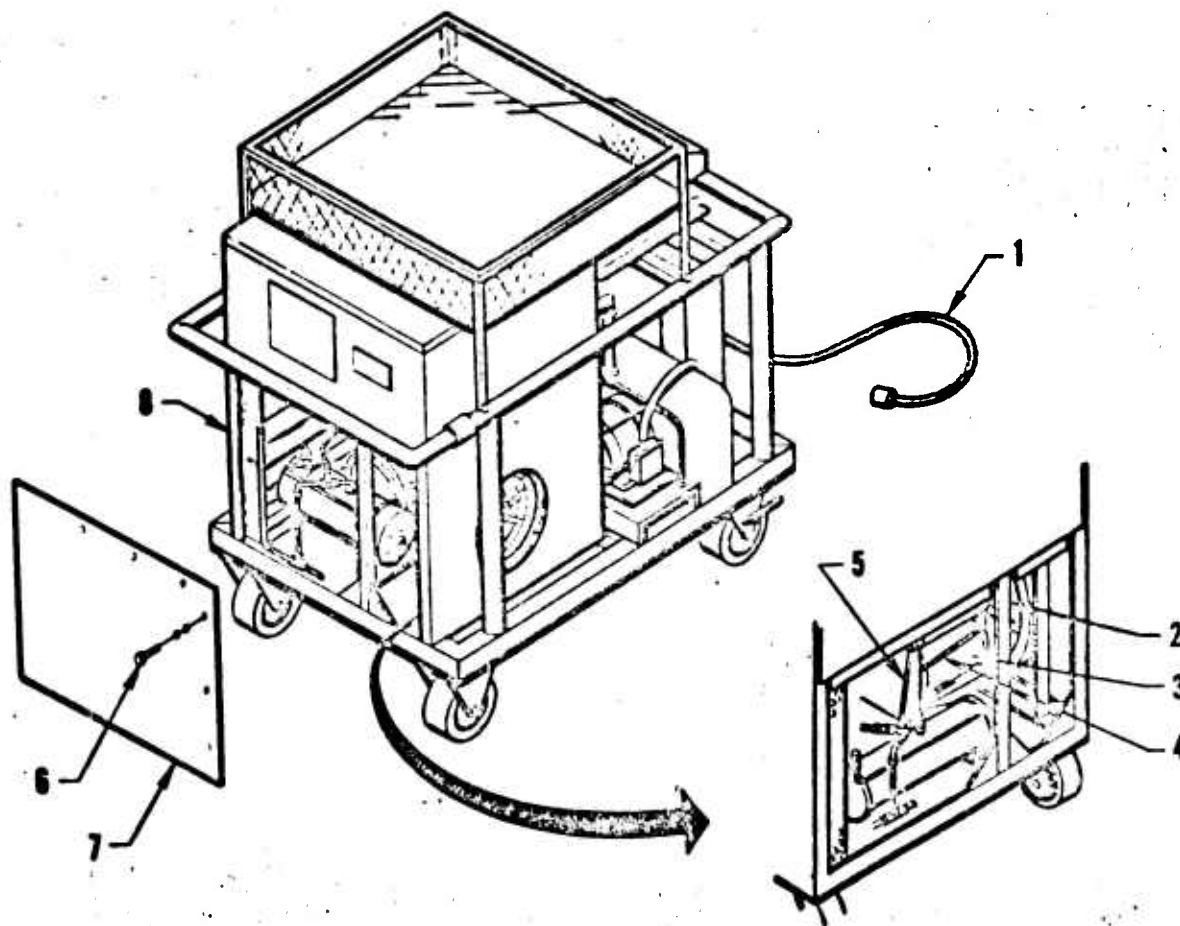
Verify power cable is disconnected from facility power before making inspection. Injury could result if AGE ECU were started.

3. Manually jiggle condenser fan motor (4) to determine that motor is not loose or misaligned in its mounting. If motor is loose or misaligned, look for loose or broken motor mount (6), motor mount strap (5) or fan ring bracket (3). Replace broken parts and remount motor. Refer to Remove and Install Fan Motor, Volume 1-9, page 1-9- . Go to step 17.



TROUBLESHOOT CONDENSER FAN NOISY OR DOES NOT RUN

4. Manually rotate fan (2) to determine that fan is not loose on fan motor (3) shaft. If fan is loose, tighten or replace fan. Refer to Remove and Install Condenser Fan, Volume 1-9, page 1-9- . Go to step 17.
5. Manually rotate fan (2) to determine that fan blades are not bent. If fan blades are bent, replace fan. Refer to Remove and Install Condenser Fan, Volume 1-9, page 1-9- . Go to step 17.
6. Manually rotate fan (2) to determine that fan motor turns freely. If not, replace fan motor (3). Refer to Remove and Install Fan Motor, Volume 1-9, page 1-9- . Go to step 17.



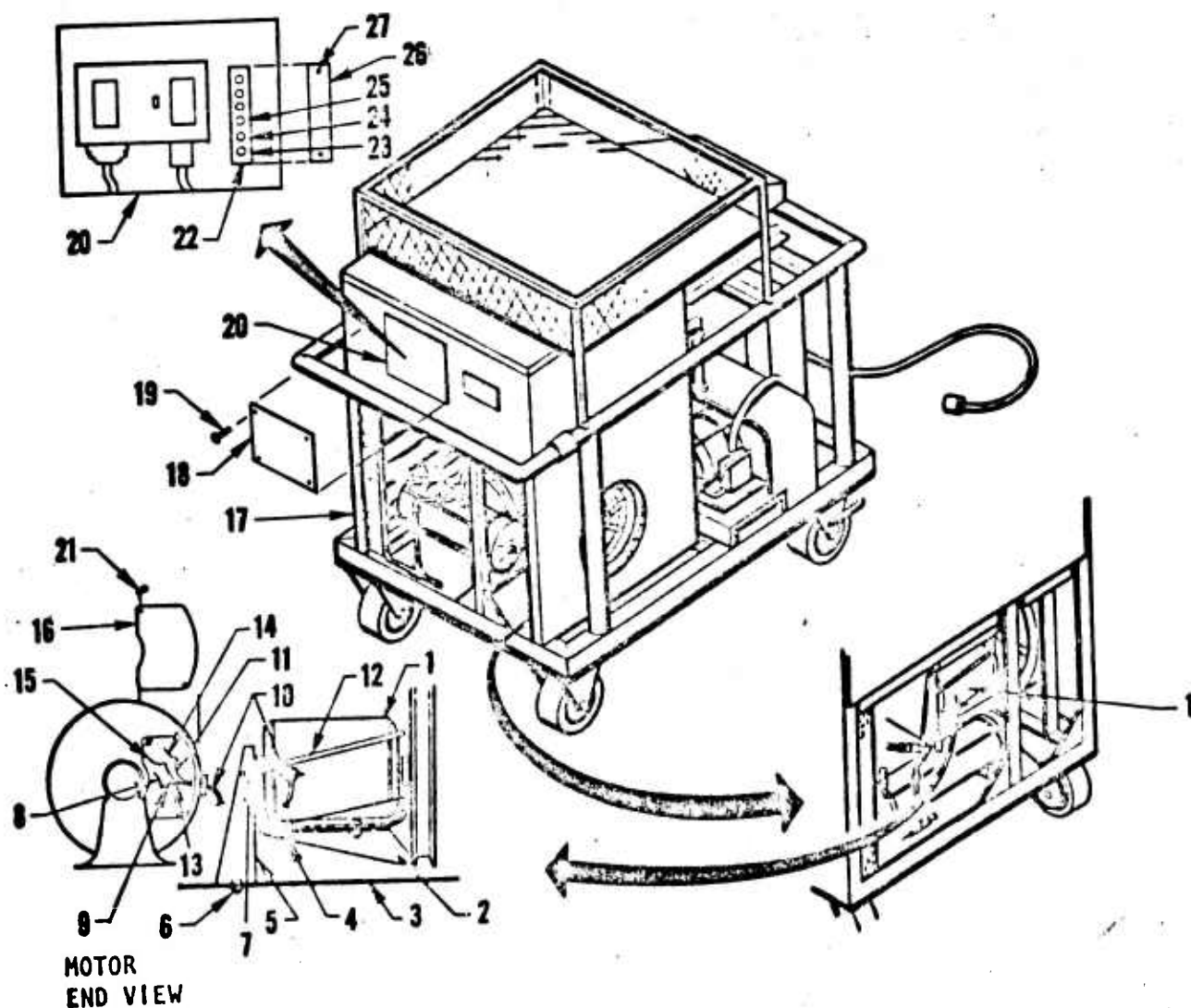
UBLESHOOT CONDENSER FAN NOISY OR
DOES NOT RUN

WARNING

Verify power cable is disconnected from facility power before making electrical checks. Injury from electrical shock could occur if power cable were connected.

7. Remove cover (18) from electrical box (20) on cooling unit (17) by removing screws and lockwashers (19).

8. Remove cover (26) from terminal board TB-1 (22) by removing two screws (27).
9. Remove nuts and washers (7) which fasten fan motor strap (12) to fan motor mount (5) and remove fan motor mount strap (12).
10. Remove two bolts (6) which fasten fan motor mount (5) to frame floor (3).

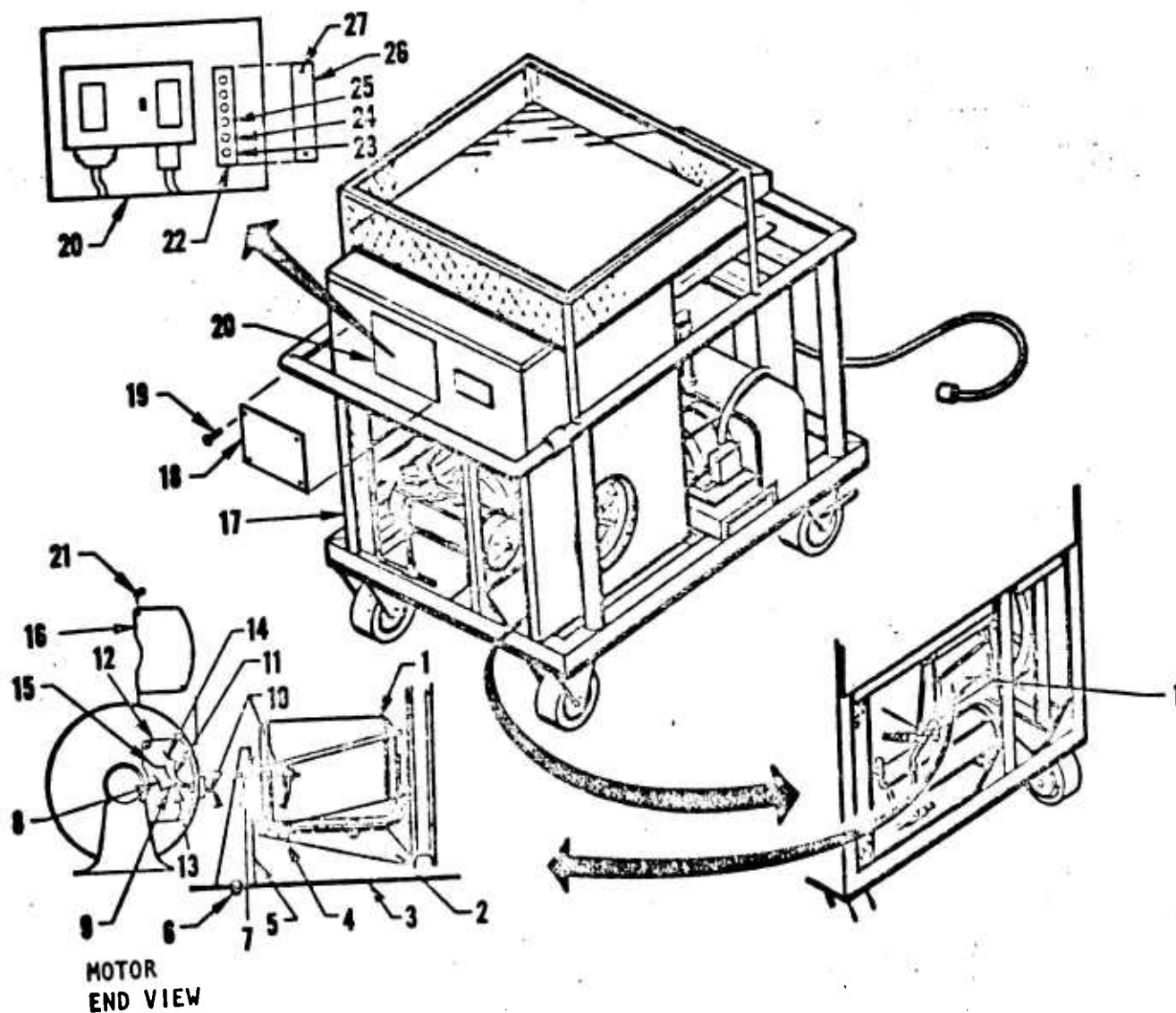


TROUBLESHOOT CONDENSER FAN NOISY OR DOES NOT RUN

11. Remove two bolts (4) which fasten fan motor mount (5) to fan modification assembly (2) and fan motor (1).
12. Slide fan motor mount (5) away from fan motor (1) to provide access to cover (16) of fan motor builtin conduit box (12).

13. Remove two screws (21) and remove cover (16).

14. Inspect fan motor harness (10) wires (9, 13 and 11) for proper connection to motor wires 3 (8), 2 (15) and 1 (14). If poor connection is observed, repair connection and go to step 19. If connections are good, separate fan motor harness wires (9, 13 and 11) from fan motor wires 3 (8), 2 (15) and 1 (14) for continuity check of harness. Refer to Repair of Wiring Volume 1-9, page 1-9- .



**TROUBLESHOOT CONDENSER FAN NOISY OR
D NOT RUN**

15. Set multimeter to read ohms in 0 to 300 ohm range and zero meter. Refer to Test Equipment Operation, Volume 1-1, page 1-1- .
16. Place multimeter leads on each of the following sets of terminal board to fan motor harness wires at fan motor checkpoints and read left to right deflection for each check.

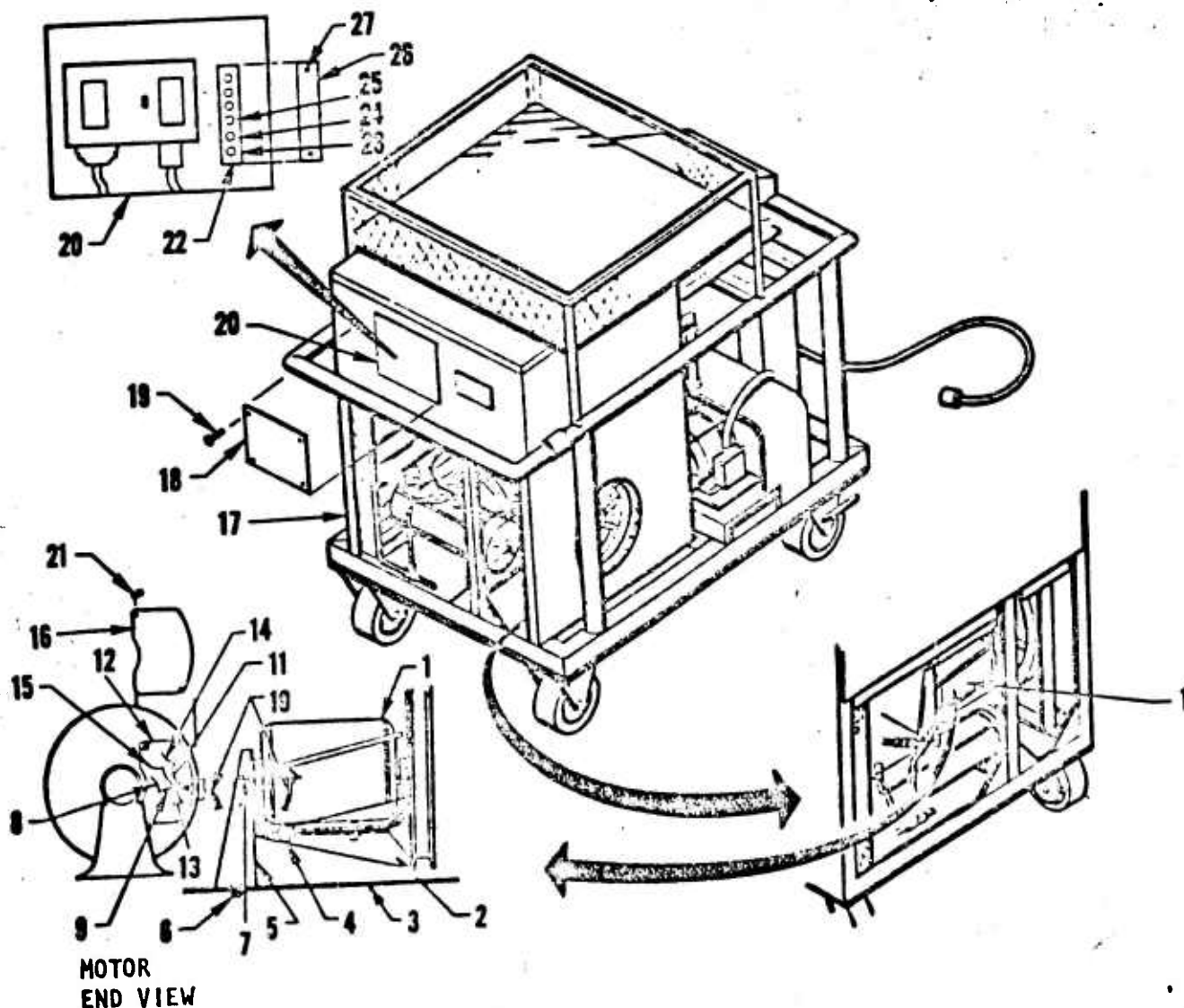
**Terminal Board
TB-1 (16)**

**Fan Motor
Harness Wires (4)**

- 1 (23)
- 2 (24)
- 3 (25)

- X3A10C (9)
- X2A10B (13)
- X1A10A (11)

If meter deflection is observed in each check, replace fan motor (1). Refer to Remove and Install Condenser Fan Motor, Volume 1-9, page 1-9-1. If meter deflection is not observed in one or more of the checks, replace fan motor harness (4). Refer to Repair of Wiring, Volume 1-9, page 1-9- . Go to step 18.



TROUBLESHOOT CONDENSER FAN NOISY OR DOES NOT RUN

17. Return to Checkout AGE ECU, step 8, if checkout is in progress, or place back cover (2) on cooling unit and install screws and washers (1). Go to step 20.
18. Place terminal board cover (7) on terminal board TB-1 (8) and install screws (6).
19. Place electrical box cover (4) on cooling unit (3) and install screws and washers (5).
20. Return to Checkout AGE ECU, step 11, if checkout is in progress, or checkout fan per steps 11 through 13 of Checkout AGE ECU.

