MANNING/AUTOMATION TRADEOFFS THROUGH FUNCTION ALLOCATION

PHASE I FINAL REPORT
(Contract N00019-70-C-0449)

Prepared For

NAVAL AIR SYSTEMS COMMAND
SHIPS COMPATIBILITY BRANCH
SHIPS CONCEPTS

INGALLS WEST DIVISION/AMTD
LITTON SYSTEMS, INC.
P.O. Box 92911
Los Angeles, Cal. 90009

Prepared By:

Joel Cooper
Project Manager, Systems Research

Approved By:

Robert E. Apple
Vice President and Director
of Advanced Projects

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

LIST OF FIGURES

LIST OF FIGURES (continued)

LIST OF TABLES

FOREWORD

This report covers the work performed between March 1970 and September 1970 under Contract No. N00019-70-C-0449, "Manning/Automation Tradeoffs Through Function Allocation." The project was administered by the Ships Compatibility Branch of the Naval Air Systems Command by Mr. T. Momiyama, Ships Concepts.

The work was greatly aided by the continuous support, advice and critical comments of Mr. Momiyama.

The project was administered at Ingalls West Division/AMTD, Litton Systems, Inc. Mr. Joel Cooper was responsible for the technical direction and preparation.

MANNING/AUTOMATION TRADEOFFS THROUGH FUNCTION ALLOCATION

PHASE I

FINAL REPORT

1.0 BACKGROUND

One of the problems which the Navy has been facing, and will continue to face, is the problem of evaluating manning/automation alternatives. Normal (industrial) consequences of such alternatives are based on an assumption that man-hours saved by the introduction of automation can be calculated on a cost basis over time and compared with the non-automated alternative to establish a tradeoff as to the efficacy of introducing or not introducing automation. In this approach, man-hours saved can be applied to other gainful areas or deleted from the enterprise.

In the Navy's case, the man-hour savings which could be attained are frequently not realized because other conditions, dictated by operational constraints, often demand that the manpower be included in the ship's roster.

2.0 INTRODUCTION TO PROBLEM

If maximum flexibility of crew could be attained, then crew members could be transferred from one work unit to the next. Under this approach, the units of shipboard work would be counted, and since all crew members could be transferred, the necessary number of crew members would be billeted.

It is obvious that this concept (complete flexibility) is nonachievable, but it does seem possible to modify the concept to a point where interchangeability can be achieved within certain groups of required skills.

Under the present longitudinal classification, each man climbs the rate ladder within his rating. Under a latitudinal concept, men could be crosstrained at their skill level for various skill categories. The

crewman would thus have the capability to assume duties at some given level in other similar skill categories. The problem consists of (1) determining what ratings are sufficiently closely related so as to require minimum cross-training to qualify personnel in the related ratings, (2) the degree of relationship between these ratings (3) the ladder step at which it is most feasible to initiate cross-training, and (4) the effect and method of implementation of the results.

3.0 SCOPE OF PRESENT STUDY

To make the determinations detailed the following general steps were initially undertaken:

1. Tabulate the total Naval Aviation rate/rating structure into a preliminary structure which is a set of logically cohesive groups.
2. Perform a content analysis within each set to identify common elements.
3. Regroup the structure in light of the content analysis to yield a "refined" rate/rating group structure.
4. Gather the ratings by definable elements and record in a homotaxial form.
5. Examine resulting group for any further iteration.

It was agreed that the study would confine itself to the examination of aviation ratings, namely

AG-Aerographer's Mate
AC-Air Controlman
AW-Aviation Antisubmarine Warfare Operator
AX-Aviation Antisubmarine Warfare Technician
AB-Aviation Boatswain's Mate
AE-Aviation Electrician's Mate
AT-Aviation Electronics Technician
AQ-Aviation Fire Control Technician

AD-Aviation Machinist's Mate
AZ-Aviation Maintenance Administrationman
AO-Aviation Ordnanceman
AK-Aviation Storekeeper
AM-Aviation Structural Mechanic
AS-Aviation Support Equipment Technician
PR-Aviation Survival Equipmentman
PH-Photographer's Mate
PT-Photographic Intelligenceman
TD-Tradevman

4.0 APPROACH

4.1 TASK CLASSIFICATION

It was initially assumed that qualification requirements used in the "Quals Manual"* could be broken down into two task categories. The first category would be composed of the types of skills which would be employed in a task, i.e., maintain, supervise, etc. This category for this report will be entitled "Characteristics." The second category would be composed of the general nature of the equipment used in a task, i.e., electronic, mechanical, etc. This category for this report will be entitled "Nature."

The "Characteristics" of the task were proposed, and during the course of the study revised, as to the following final list.

Operate	Administer
Maintain	Plan
Inspect	Evaluate
Supervise	Interface

Similarly, the "Nature" of the tasks were revised for the classifications considered to:

Electronic	Electrical
General Technical	Mechanical
Electro-Mechanical	

---

*"Manual of Qualifications for Advancement in Rating" (Quals Manual) NAVPERS 18068B.

While other possibilities (clerical, medical, etc.) were initially considered, the essence of the particular ratings studied did not require the use of these.

4.2 RATING COMMONALITIES

It can be safely assumed that certain ratings would be more closely related than others. To initiate the groupings several alternatives were looked at. The grouping method finally selected was derived from examination of two things. The path of advancement to Master Chief and Warrant Officer (WO) as described in the "Quals Manual" was examined to determine the ultimate step for all ratings. Secondly, the equivalent civilian occupation as shown in the "Quals Manual" was also examined. These results are shown in Table 1. The groups finally formed were:

GROUP I		GROUP 2	
AX	TD	PR	AM
AT	AW	AD	AB
AQ	AE	AO	AS

Although the Aviation Maintenance Administrationman (AZ) eventually led to the same WO and Master Chief Rate as the AM-AS-AD-PR ratings, the civilian equivalent coupled with a content analysis revealed that AZ was primarily composed from administrative skills while the rest were technical by nature.

The Aviation Boatswain's Mate (AB), Aviation Ordnanceman (AO) ratings were subsumed under Group 2 by virtue of an initial content analysis of the skill requirements.

The Air Controlman (AC) was found unique by the requirements for FAA certification for control tower operators.

The Aerographer's Mate (AG) was found unique in the requirement for maintenance of specific meteorological equipment and the knowledge of meteorological interpretations and observations.

TABLE 1

Normal Path of Advancement to Master Chief and Warrant Officer and Transition to Civilian Occupation

Enlisted Rating	Master Chief*	Warrant Officer Designator and Category **	Civilian Occupational Relation Code and Title ***
AW	AWCM	761X Aviation Electronics Tech	828 Electronics Mechanics
AX	AVCM	" " " "	" " "
AT	"	" " " "	" " "
TD	"	" " " "	" " "
AQ	"	" " " "	632 Ordnance Mechanics
AE	"	" " " "	825 Electrician
AM	AFCM	741X Aviation Maintenance Tech	621 Aircraft Mechanic
AD	"	" " " "	" " "
PR	"	" " " "	912 Air Transport Occups.
AS	ASCM	" " " "	629 Motorized Vehicle Mech.
AB	ABCM	760X Aviation Boatswain	638 Machine Install/Repair Occups
AO	AOCM	721X Aviation Ordnance Tech	632 Ordnance Mech
AZ	AFCM	741X Aviation Maintenance Tech	221 Production Clerk
AK	SKCM	798X Supply Clerk	223 Stock Clerk
PH	PHCM	831X Photographer	143 Photographers
PT	PTCM	831X Photographer 762X Air Intelligence Tech	029 Photographic Interpreters
AC	ACCM	745X Aviation Control Tech	193 Radio Operators
AG	AGCM	821X Aerographer	025 Meteorology Occups

* Based on "Quals Manual" Appendix A

** Based on "Quals Manual" Appendix B

*** Based on "Quals Manual" Appendix C

It was initially felt that the Aviation Maintenance Administrationman (AZ) and the Aviation Storekeeper (AK) would form a natural skill grouping. The correlation between the two based on the requirements of "Quals Manual" was found not sufficiently high to justify grouping the two. As a consequence, the two ratings were left as unique for the initial portion of the study.

It was also initially felt that the Photographer's Mate (PH) and the Photographic Intelligenceman (PT) could be grouped. Here again the "Nature" and "Characteristics" of the task elements were sufficiently diverse so as to preclude this grouping.

An analysis of the civilian occupations revealed that Group 1 generally seemed to be electrical/electronic in "nature" while Group 2 seemed mechanically oriented. The balance, as can be seen from Table 1, led to civilian occupations which were greatly diverse.

4.3 NOMENCLATURE

Pay grade equivalent to rates were used as a matter of convenience. For example, rather than using PO3, E4 was used. Since the cross-translation was consistent, there was no effect on the total analysis. No pay grades under E4 were considered since the qualifications below this pay grade were general to the entire group of aviation ratings.

4.4 DATA BASE

The basic data source was the "Quals Manual." The qualification requirements as written were used to determine the content of each job which was analyzed. Although there can be some question as to the detailed accuracy of the "Quals Manual," it does reflect the basic philosophy for Navy manning and as such seems a reasonable data base for the study.*

---

*Some notes on the detailed accuracy of the "Quals Manual" are contained in Appendix A.

5.0 ANALYSIS STEPS

Step 1 Tasks were sorted by the areas as specified in the "Quals Manual" (Safety, Test Equipment, etc.). They were further broken down in terms of Practical Factors and Knowledge Factors. Within each group, they were ordered by pay grades into an array. Each requirement item was checked, marked for each rating where it was recorded as shown in the sample of Table 2.

Each array was examined to determine whether the groupings were, in a cursory examination, logically cohesive.

Step 2 Having determined that the groups were, in fact, logically cohesive, the arrays were perturbed to yield the following four arrays:

1. Group 1. All Practical Factors ordered by pay grades from E4 - E9.
2. Group 1. All Knowledge Factors similarly ordered.
3. Group 2. All Practical Factors similarly ordered.
4. Group 2. All Knowledge Factors similarly ordered.

Step 3 All the arrays of Step 2 were examined to determine what were the "Characteristics" of the qualifications for advancement. The number of times a specific "Characteristic" appeared by pay grade within a group was counted. The proportion of times each "Characteristic" appeared was determined. The results of this count are discussed later under "Findings." The backup data is not included but has been retained in Litton files for examination if desired.

Step 4 The proportion of appearance of each "Characteristic" and "Nature" for each rating in Group 1 was compared against the total proportion of "Characteristics." The same was done for each rate/rating in Group 2.

TABLE 2

Example of Task Sorting by Paygroup for Group of Ratings

	AX	AT	AQ	TD	AW	AE
TEST EQUIPMENT						
Practical Factors						
Select, use, perform routine upkeep of:						
a. Test Equipment used to measure voltage, current and resistance	E-4	E-4	E-4			E-4
b. Signal generators and oscilloscopes	E-5	E-5	E-5			E-5
Knowledge Factors						
Theory and characteristics of basic electrical measuring instruments	E-4	E-4	E-4	E-4		E-4
Procedures for obtaining repair and calibration of test equipment	E-6	E-6	E-6			E-6
SAFETY						
Practical Factors						
Observe safety precautions in making adjustments on energized electrical and electronic equipment	E-4	E-4	E-4	E-4	E-4	E-4
Knowledge Factors						
Potential hazards and effects of electrical currents and electromagnetic radiations on the human body		E-4	E-4	E-4	E-4	

In order to determine the degree of mutuality between rating within a group, the actual statements of qualifications as set down in the "Quals Manual" were checked for each rating where they appeared. Each qualification requirement was recorded. Where qualification requirements in the second rating were given exactly the same as in the first rating they were recorded as such. The same process was continued for the balance of the ratings within a group.

The criterion of exact correlation between statements offered some advantages and some disadvantages. There are two disadvantages to using this type of criterion. First, although the writers may have made the same statements in all cases, they may have meant something else which may be the "real world" application. Second, different statements which really mean the same are precluded from being interpreted as the same.

On the other hand, there is no problem on interpretation when the criterion is firmly fixed as was chosen. It would be a reasonably logical conclusion that the same statement was intended to, and in fact does, mean the same thing wherever used.

6.3 GROUPING CRITERIA

Several variations of groupings were tried initially. The final grouping arrived at was initially formed based on a general task summary for each rating. Each summary was examined and tentatively assigned to a group. The group was examined to see if there appeared to be sufficient cross-correlation between ratings within the group.

A list of possible "Characteristics" was initially formed from the task statements. These "Characteristics" form the column headings of Table 3.

% Tasks by Type		DO	TEST/CHECK	PREPARE FORMS	VERIFY	ANALYZE	SUPERVISE	EVALUATE	USE PUBLICATIONS	MAINTAIN RECORDS	TRAIN	ORDER MATERIAL	INTERPRET & REVISE	COORDINATE	PLAN	ENSURE COMPLIANCE	PREPARE REPORTS, ETC.	MAKE PRESENTATION	PROVIDE SUPPORT	FORMULATE GUIDELINES	PROVIDE LIAISON	MONITOR	RECOMMEND
	GR1																						
E4	39	56	41	03																			
E5	22	41	36		05	18																	
E6	20		05				15	20	20	15	05	05	15										
E7	24		08			17	38	17		08			08	04									
E8	19					05	05	26					11		21	11	05	05	11				
E9	12														42				25	17	08	08	
	GR2																						
E4	36	78	11	11																			
E5	13	31	38	08			08		15														
E6	23	04	04				13	09		39			09		04		17						
E7	35							14			03		23		46		08					03	03
E8	25						08						08	16	16	08	04		08			08	24
E9	27														37	11			15		11		26

Frequency of Task Types by Percentage for Pay Grade as Shown in "Quals Manual"

TABLE 3

6.4 ANALYSIS OF DEFINITION OF "CHARACTERISTICS"

As can be seen from the column headings of Table 3, the "Characteristics" were initially generated as they generally appeared in the "Quals Manual." No real attempt was made at this point other than to develop a loose taxonomy of what might later be considered as definable "Characteristics."

There is at least a superfically evident trend here that as personnel move up the skill ladder the tasks change from "do" type tasks to analysis, supervision and thence to planning type tasks.

To further investigate this trend, the "Characteristic" classifications were refined to be more inclusive. Table 4 presents the reclassification. It was felt that the elements within the new "Characteristic" classification were sufficiently allied to form a smaller number of cohesive categories that were essentially within the meaning of the new classification.

6.5 DUPLICATION OF REQUIREMENTS BETWEEN RATINGS

Table 5 provides a table of the "Frequency of Commonality of Requirements Between Ratings." It is broken down into Knowledge Factors and Practical Factors as shown in the "Quals Manual" for Groups 1 and 2 by pay grades.

Looking at the totals for both Knowledge Factors and Practical Factors for all pay grades in Group 1, it can be seen that only 44.8% of the qualifications are unique while the balance of the qualifications are common to two or more ratings. Strangely enough, a peak of 19.2 percent occurs at four ratings, indicating that about 1/5 of the total qualification requirements are common to four ratings out of the six.

TABLE 4

CLASSIFICATION AMALGAMATION

OLD CLASSIFICATION	NEW CLASSIFICATION
Do Test/Check	Do-Test/Check
Prepare forms Maintain records Prepare reports Order material	Administer
Supervise Train Ensure compliance Monitor	Supervise
Analyze Verify Evaluate Use publications Interpret & revise	Analyze/Evaluate
Plan Coordinate Formulate guidelines Recommend	Plan & Coordinate
Make presentation Provide support Provide liasion	Provide Support & Liasion

TABLE 5

Frequency of Commonality of Requirements between Ratings
(By Percentage)

GROUP 1

Knowledge Factors

	Unique	Dup.	Trip.	Quad.	Quint.	Sext.
E4	21.0	9.0	15.0	18.0	24.0	12.0
E5	47.8	13.0	13.0	21.7	4.3	
E6	60.8	21.7	13.0	4.3		
E7	75.0		8.3	16.7		
E8	52.2	13.0	8.7	21.7	4.3	
E9	55.5		33.3	11.1		
All Rates	47.2	11.4	13.8	16.3	8.1	3.3

Practical Factors

E4	50.0	5.0	12.5	10.0	20.0	2.5
E5	50.0	13.6	9.1	27.2		
E6	35.0		15.0	20.0	15.0	15.0
E7	25.0	31.3		25.0	12.5	6.2
E8	42.1	5.3		36.8	10.5	5.3
E9	40.0			30.0	30.0	
All Rates	42.5	8.7	7.9	22.0	14.2	4.7
Both Factors	44.8	10.0	10.8	19.2	11.2	4.0

GROUP 2

Knowledge Factors

E4	73.7	15.8	5.3	5.3	
E5	57.1	28.6	14.3		
E6	70.0	30.0			
E7	100.0				
E8	57.1	19.0	14.3	9.5	
E9	75.0			12.5	12.5
All Rates	69.4	16.7	6.9	5.6	1.4

Practical Factors

E4	80.5	11.1	5.6	2.8	
E5	90.9			9.1	
E6	68.2	13.6	9.1	9.1	
E7	66.7	16.7		13.3	3.3
E8	60.0	16.0	8.0	12.0	4.0
E9	63.0	3.7	25.9	3.7	3.7
All Rates	70.2	11.3	8.6	7.9	2.0
Both Factors	70.0	13.0	8.1	7.2	1.8

The greatest degree of commonality exists in the Knowledge Factors of Group 1 at the E4 pay grade. Here only 21 percent of the total qualifications are unique to one rating and 24 percent of the qualifications are common to four ratings. Oddly enough for Group 1, the Knowledge Factors exhibit a great degree of commonality at the E4 and E5 pay grades, while the Practical Factors exhibit their greatest degree of commonality above the E5 level.

Group 2 seems much less cohesive in almost all cases than does Group 1. Comparisons can best be seen by looking at Table 6.

Since the greatest commonality and consequent ease of cross-training necessarily exists where there are the least unique elements and the most common elements, it is obvious from Table 6 that Group 1 has almost invariably the greatest commonality. It must be remembered, however, that this is based in a criterion which has a degree of artificiality in that no two elements are considered the same unles they are worded the same in the "Quals Manual." It is very safe to assume that there are many other task elements, which, when acquired by personnel, would be applicable across many other elements, thus making the elements essentially common.

6.6 AMALGAMATION OF "CHARACTERISTICS"

As indicated in 6.4, "Analysis of Definition of Characteristics," the "Characteristics" of Table 3 were revised as shown in Table 4. The analytical data base which resulted from this revision is shown in Table 7.

Table 7 defines cutoff points very sharply. It can easily be seen that for Group 1, the E4 pay grade is 97 percent physical maintenance tasks. Group 2, at the E4 pay grade, is 89 percent physical maintenance tasks but does also require 11 percent Administrative "Characteristics." If Group 1 and 2 are considered together at

TABLE 6

PROPORTION OF COMMONALITY OF REQUIREMENTS
(By Percentage)

FOR GROUPS 1 AND 2

	PRACTICAL FACTORS		KNOWLEDGE FACTORS	
	Group 1	Group 2	Group 1	Group 2
Unique Max	50.0	90.9%	75.0%	100.0%
Unique Min	25.0	60.0	21.0	57.1
Duplicated Max	31.3	16.7	21.7	30.0
Duplicated Min	5.3	3.7	9.0	15.8
Tripled Max	15.0	25.9	33.3	14.3
Tripled Min	7.9	0	8.3	0
Quadrupled Max	36.8	13.3	21.7	12.5
Quadrupled Min	10.0	3.7	4.3	0
Quintupled Max	30.0	4.0	24.0	12.5
Quintupled Min	0	0	0	0
Sextupled Max	15.0	0	0	0
Sextupled Min	0	0	0	0

	DO TEST/CHECK	ANALYZE EVALUATE	ADMINISTER	SUPERVISE	PLAN & COORDINATE	PROVIDE SUPPORT & LIAISON
GROUP 1						
E4	97%		03%			
E5	77	23%				
E6	05	70	05	20%		
E7	08	38	16	38		
E8		42	05	16	21%	16%
E9				08	59	33
GROUP 2						
E4	89		11			
E5	69	15	08	08		
E6	08	18	56	13	04	
E7		37	08	06	49	
E8		08	04	24	56	08
E9				11	63	26

GROUP 1

AX - Aviation Antisub Warfare Technician
AT - Aviation Electronics Technician
AQ - Aviation Fire Control Technician
TD - Tradevman
AW - Aviation Antisub Warfare Operator
AE - Aviation Electrician's Mate

GROUP 2

PR - Aviation Survival Equipment Man
AD - Aviation Machinist's Mate
AO - Aviation Ordnanceman
AM - Aviation Structural Mechanic
AB - Aviation Boatswain's Mate
AS - Aviation Support Equipment Technician

CHARACTERISTIC DISTRIBUTION BY PAY GRADE
(By Percentage)

TABLE 7

the E4 and E5 level there is a minimum of 69 percent physical maintenance tasks and a maximum of 23 percent analytical/evaluative tasks. Supervisory and administrative tasks are prevalent at the E6 and E7 level while planning, coordination and liaison is mainly confined to the supergrades (E8-E9) with the notable exception of 49 percent planning at the E7 level of Group 2. It would seem that the nontechnical tasks start above one pay grade lower in Group 2 than in Group 1.

6.7 INTERNAL CONSISTENCY WITHIN GROUPS BY PAY GRADE

The physical maintenance process was broken down into Operate, Maintain and Inspect. The analytical and evaluative "Characteristics" were separated in order to determine whether more finite demarkation lines could be established.

The factor of task "Nature" was also introduced at this point, being broken down into Electronic, General Technical, Electro-mechanical, Electrical, and Mechanical types of tasks.

6.7.1 "Characteristics" and "Nature"-Group 1

Table 8, sheets 1 and 2 provide the revised task proportion for Group 1 "Characteristics" and "Nature" by pay grades E4-E9.

The "Operate Characteristic" occurs only at the E4 level and then only for two ratings, AW and AE, in Group 1. In fact, the major deviation from the overall average within Group 1 is most prevalent in these two ratings. There is some degree of deviation from the average in the TD rating. The task "Characteristics" and "Nature" in the AX, AT and AQ ratings are extremely closely correlated at all pay grades.

GROUP 1 RATING E4

CHARACTERISTICS	TOTAL	AX	AT	AQ	TD	AW	AE
Operate	.02					.11	.07
Maintain	.88	.88	.90	.91	1.00	.67	.79
Inspect	.05	.06	.05	.04		.11	.07
Supervise							
Administer	.05	.06	.05	.04		.11	.07
Plan							
Evaluate							
Interface							
NATURE							
Electronic	.44	.47	.50	.57	.46	.22	.21
General Tech.	.18	.18	.15	.13		.44	.29
Electro Mech.	.05				.08	.11	.21
Electrical	.13	.12	.10	.09	.15	.22	.14
Mechanical	.21	.24	.25	.22	.31		.14

GROUP 1 RATING E5

CHARACTERISTICS	TOTAL	AX	AT	AQ	TD	AW	AE
Operate							
Maintain	.91	.92	.91	.89	1.00		.83
Inspect	.09	.08	.09	.11			.17
Supervise							
Administer							
Plan							
Evaluate							
Interface							
NATURE							
Electronic	.58	.62	.55	.67	.62		.17
General Tech.	.18	.31	.36		.25		
Electro Mech.							
Electrical	.11				.13		.67
Mechanical	.13	.08	.09	.33			.17

GROUP 1 RATING E6

CHARACTERISTICS	TOTAL	AX	AT	AQ	TD	AW	AE
Operate							
Maintain	.14	.15	.17	.08	.18	.17	.10
Inspect	.09	.08	.08	.08	.09	.17	.10
Supervise	.20	.23	.17	.25	.27		.20
Administer	.55	.54	.58	.58	.36	.67	.60
Plan							
Evaluate	.02				.09		
Interface							
NATURE							
Electronic	.06	.08	.08		.09	.17	
General Tech.	.91	.92	.92	1.00	.91	.83	.80
Electro Mech.							
Electrical	.03						.20
Mechanical							

GROUP 1 RATING E7

CHARACTERISTICS	TOTAL	AX	AT	AQ	TD	AW	AE
Operate							
Maintain	.04						.14
Inspect							
Supervise	.27	.30	.30	.22	.14	.40	.29
Administer	.25	.20	.20	.22	.43	.40	.21
Plan	.02			.11			
Evaluate	.42	.50	.50	.44	.43	.20	.36
Interface							
NATURE							
Electronic	.02					.20	
General Tech.	.91	1.00	1.00	1.00	1.00	.80	.71
Electro Mech.							
Electrical	.07						.29
Mechanical							

REVISED CHARACTERISTIC AND NATURE TASK PROPORTION MATRIX

GROUP 1

TABLE 8

GROUP 1 RATING E8

CHARACTERISTICS	TOTAL	AX	AT	AQ	TD	AW	AE
Operate							
Maintain							
Inspect							
Supervise	.02					.13	
Administer	.17	.20	.18	.20		.13	.18
Plan	.26	.20	.18	.20	.25	.62	.18
Evaluate	.52	.60	.64	.60	.75		.55
Interface	.04					.13	.09
NATURE							
Electronic							
General Tech.	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Electro Mech.							
Electrical							
Mechanical							

GROUP 1 RATING E9

CHARACTERISTICS	TOTAL	AX	AT	AQ	TD	AW	AE
Operate							
Maintain							
Inspect							
Supervise	.10	.13	.13	.13			.13
Administer	.10	.13	.13	.13			.13
Plan	.28	.25	.25	.25		.75	.25
Evaluate	.26	.25	.25	.25	.67		.25
Interface	.26	.25	.25	.25	.33	.25	.25
NATURE							
Electronic							
General Tech.	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Electro Mech.							
Electrical							
Mechanical							

GROUP ___ RATING ___

CHARACTERISTICS	TOTAL	AX	AT	AQ	TD	AW	AE
Operate							
Maintain							
Inspect							
Supervise							
Administer							
Plan							
Evaluate							
Interface							
NATURE							
Electronic							
General Tech.							
Electro Mech.							
Electrical							
Mechanical							

GROUP ___ RATING ___

CHARACTERISTICS	TOTAL	AX	AT	AQ	TD	AW	AE
Operate							
Maintain							
Inspect							
Supervise							
Administer							
Plan							
Evaluate							
Interface							
NATURE							
Electronic							
General Tech.							
Electro Mech.							
Electrical							
Mechanical							

REVISED CHARACTERISTIC AND NATURE TASK PROPORTION MATRIX
GROUP 1

TABLE 8 (continued)

The "Nature" of tasks at the E4 and E5 level ranges across the "Nature" spectrum. It is interesting to note, however, that the "Nature" of tasks at the E6 and above level seem to generally converge to tasks of a General Technical level. However, even here the AW and AE ratings prove the exception even though the deviation is not great.

At E6 the Maintenance "Characteristic" comprises only 14 percent of the overall within this group, at E7 two percent, and does not exist above E7. Interestingly enough, Supervisory "Characteristics" obtain almost entirely at the E6 level being non-existent below and less than ten percent above.

As indicated before at the higher pay grades there is a convergence toward General Technical tasks for the "Nature" of the tasks. At E4 and E5 the tasks are heavily Electronic, 44 and 58 percent respectively. At E6 and E7 they are 91 percent General Technical and at the supergrades E8 and E9 they are 100 percent General Technical in nature.

6.7.2 "Characteristics" and "Nature"-Group 2

Table 9 Sheets 1 and 2 provide the revised task proportion for Group 2 "Characteristics" and "Nature" by pay groups E4-E9.

As in Group 1 the lower pay grades are mainly technical by "Characteristic" while the supervisory, planning and coordinating "Characteristics" are essentially confined to the higher pay grades.

Though the deviations in Group 2 are slightly greater than in Group 1 in the main the norm of the group seems to prevail.

GROUP 2 RATING E4

CHARACTERISTICS	TOTAL	PR	AD	AO	AM	AB	AS
Operate							
Maintain	.89	.50	1.00	.83	.86	1.00	.80
Inspect							
Supervise							
Administer	.11	.50		.17	.14		.20
Plan							
Evaluate							
Interface							
NATURE							
Electronic							
General Tech.	.45	.50	.54	.67	.57		.50
Electro Mech.							
Electrical	.02						.10
Mechanical	.53	.50	.46	.33	.43	1.00	.40

GROUP 2 RATING E5

CHARACTERISTICS	TOTAL	PR	AD	AO	AM	AB	AS
Operate							
Maintain	.88	1.00	1.00	.75	1.00	.75	1.00
Inspect							
Supervise	.06					.25	
Administer	.06			.25			
Plan							
Evaluate							
Interface							
NATURE							
Electronic							
General Tech.	.62		.33	.50	1.00	1.00	.67
Electro Mech.							
Electrical	.06		.33				
Mechanical	.31	1.00	.33	.50			.33

GROUP 2 RATING E6

CHARACTERISTICS	TOTAL	PR	AD	AO	AM	AB	AS
Operate							
Maintain	.11	.17	.13			.20	.17
Inspect							
Supervise	.14	.17	.25	.20	.20		
Administer	.60	.67	.50	.60	.60	.80	.50
Plan	.03						.17
Evaluate	.11		.13	.20	.20		.17
Interface							
NATURE							
Electronic							
General Tech.	.74	.67	.63	1.00	.80	.80	1.00
Electro Mech.							
Electrical							
Mechanical	.26	.33	.37		.20	.20	

GROUP 2 RATING E7

CHARACTERISTICS	TOTAL	PR	AD	AO	AM	AB	AS
Operate							
Maintain							
Inspect	.09	.11	.10		.12	.11	.08
Supervise	.16	.33	.10	.22	.12	.22	
Administer	.05	.11		.22			
Plan	.33	.33	.50	.22	.38	.11	.42
Evaluate	.33	.11	.30	.33	.38	.56	.33
Interface	.04						.17
NATURE							
Electronic							
General Tech.	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Electro Mech.							
Electrical							
Mechanical							

REVISED CHARACTERISTIC AND NATURE TASK PROPORTION MATRIX
GROUP 2

TABLE 9

GROUP 2 RATING E8

CHARACTERISTICS	TOTAL	PR	AD	AO	AM	AB	AS
Operate							
Maintain							
Inspect							
Supervise	.10	.11	.11			.33	
Administer	.14	.22	.11	.25	.11	.17	
Plan	.40	.44	.33	.50	.44	.33	.40
Evaluate	.17		.22		.22	.17	.40
Interface	.19	.22	.22	.25	.22		.20
NATURE							
Electronic							
General Tech.	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Electro Mech.							
Electrical							
Mechanical							

GROUP 2 RATING E9

CHARACTERISTICS	TOTAL	PR	AD	AO	AM	AB	AS
Operate							
Maintain							
Inspect							
Supervise	.12	.11	.11	.13	.11	.13	.17
Administer							
Plan	.59	.56	.56	.75	.56	.62	.50
Evaluate	.12	.11	.11	.13	.11	.13	.17
Interface	.16	.22	.22		.22	.13	.17
NATURE							
Electronic							
General Tech.	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Electro Mech.							
Electrical							
Mechanical							

GROUP ___ RATING ___

CHARACTERISTICS	TOTAL	PR	AD	AO	AM	AB	AS
Operate							
Maintain							
Inspect							
Supervise							
Administer							
Plan							
Evaluate							
Interface							
NATURE							
Electronic							
General Tech.							
Electro Mech.							
Electrical							
Mechanical							

GROUP ___ RATING ___

CHARACTERISTICS	TOTAL	PR	AD	AO	AM	AB	AS
Operate							
Maintain							
Inspect							
Supervise							
Administer							
Plan							
Evaluate							
Interface							
NATURE							
Electronic							
General Tech.							
Electro Mech.							
Electrical							
Mechanical							

REVISED CHARACTERISTIC AND NATURE TASK PROPORTION MATRIX
GROUP 2

TABLE 9 (continued)

6.8 CONSISTENCY AND DEVIATION INTER AND INTRA GROUPS

Ideally the structure of groups would be one in which the following criteria would prevail:

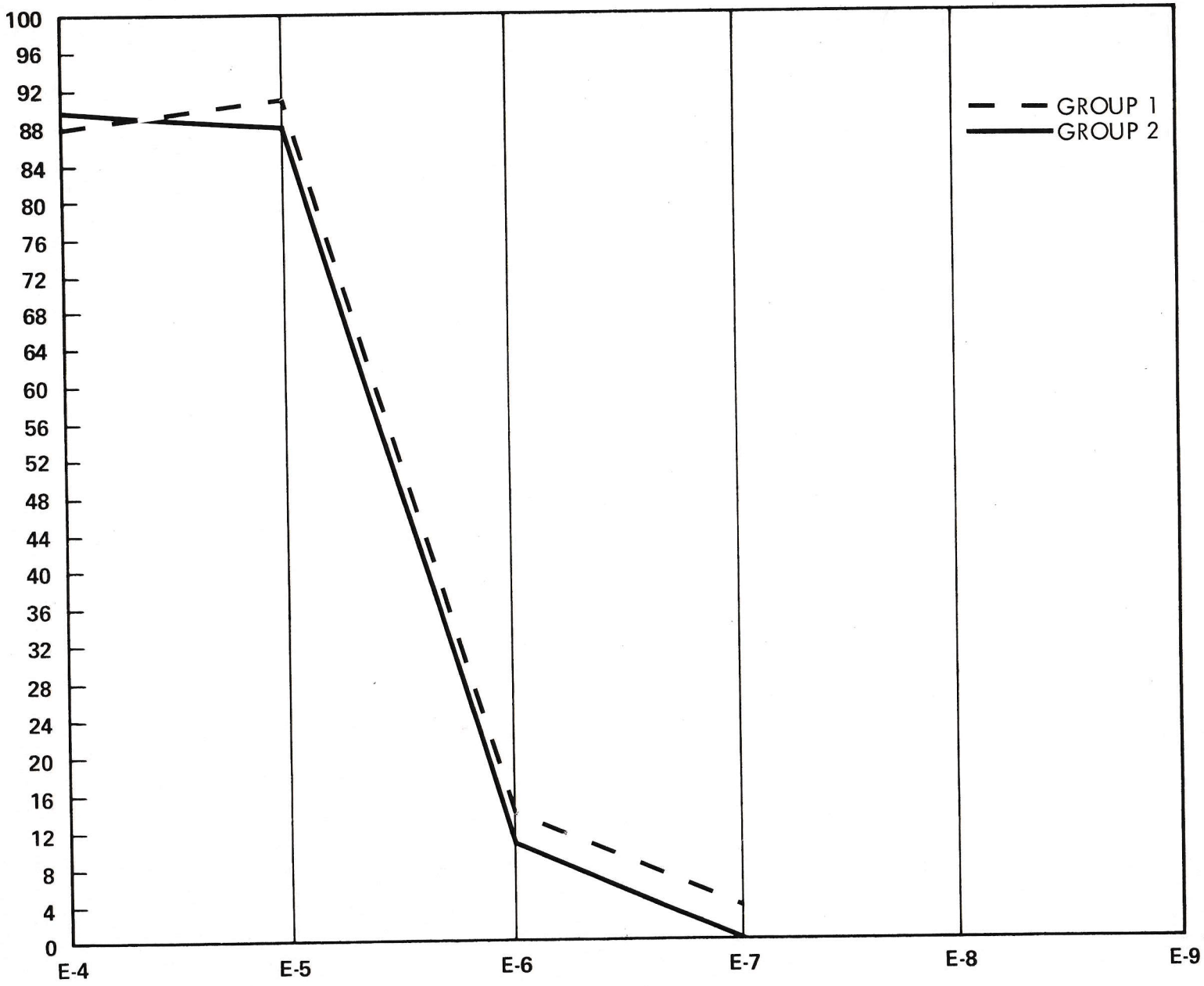
1. The "Characteristics" of the tasks are consistent inter and intra group for specific pay grades. This would allow mutual overall rate changes.
2. The "Characteristics" of the tasks change mutually and definitively as pay grades change. This would allow for definition of type of selection and training for revised rating processes.
3. The "Nature" of the tasks are consistent within a group. This would allow group cohesiveness and ease of cross-training.
4. The "Nature" of the tasks are deviant between groups. This would allow mutually exclusive groups.

6.8.1 InterGroup Task Consistency-"Characteristics"

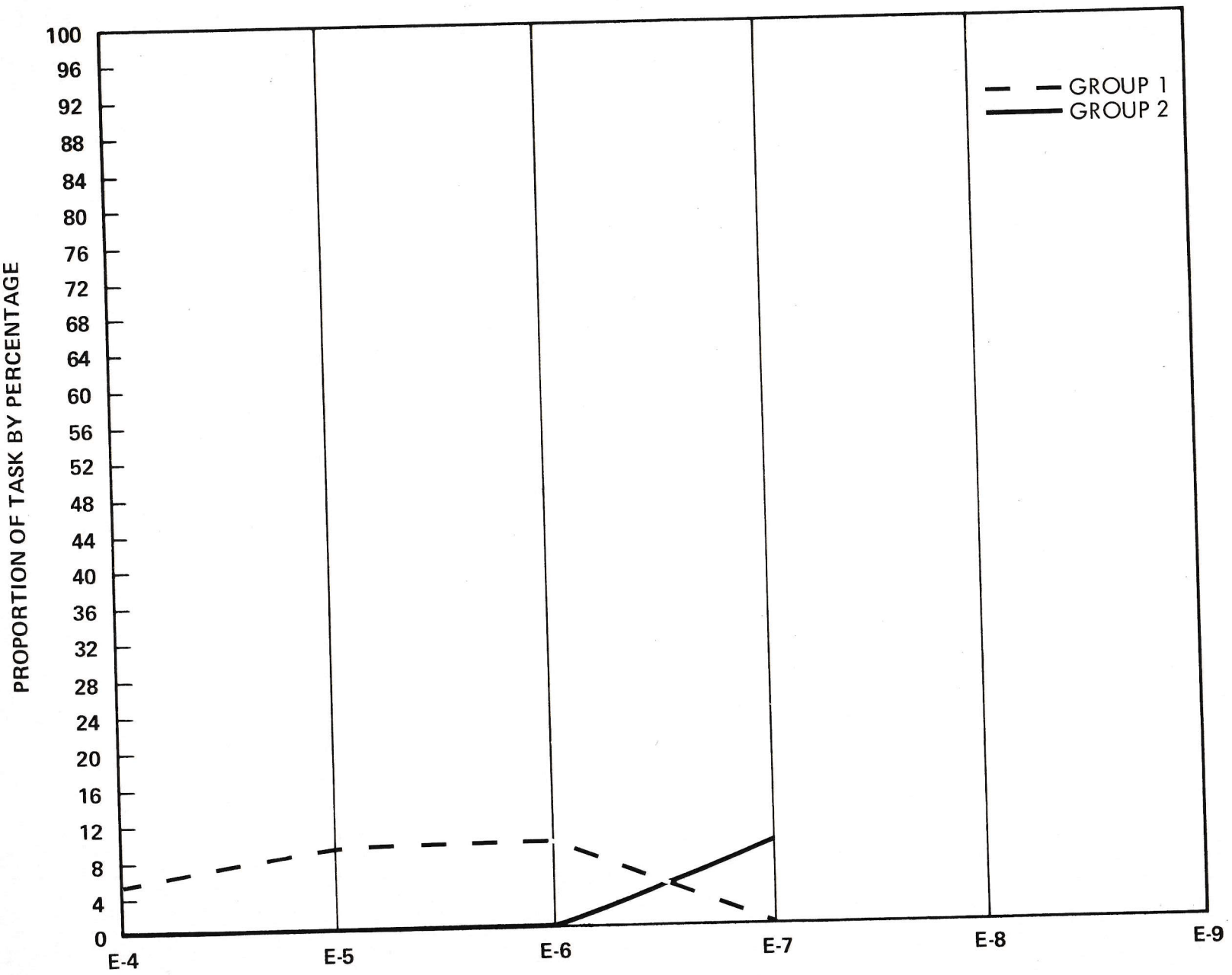
Figures 1A-1G present by "Characteristic the comparative group average of the portion of the "Characteristic" by pay grades. In general, the plots are remarkably consistent as can easily be seen. No plot is shown for the Operate"Characteristic"since it only occurs at the E4 level at one rating and then is only two percent of the total.

There are a few occurrences where a particular "Characteristic" comes in or drops out at a lower pay grade at one group as compared with the other.

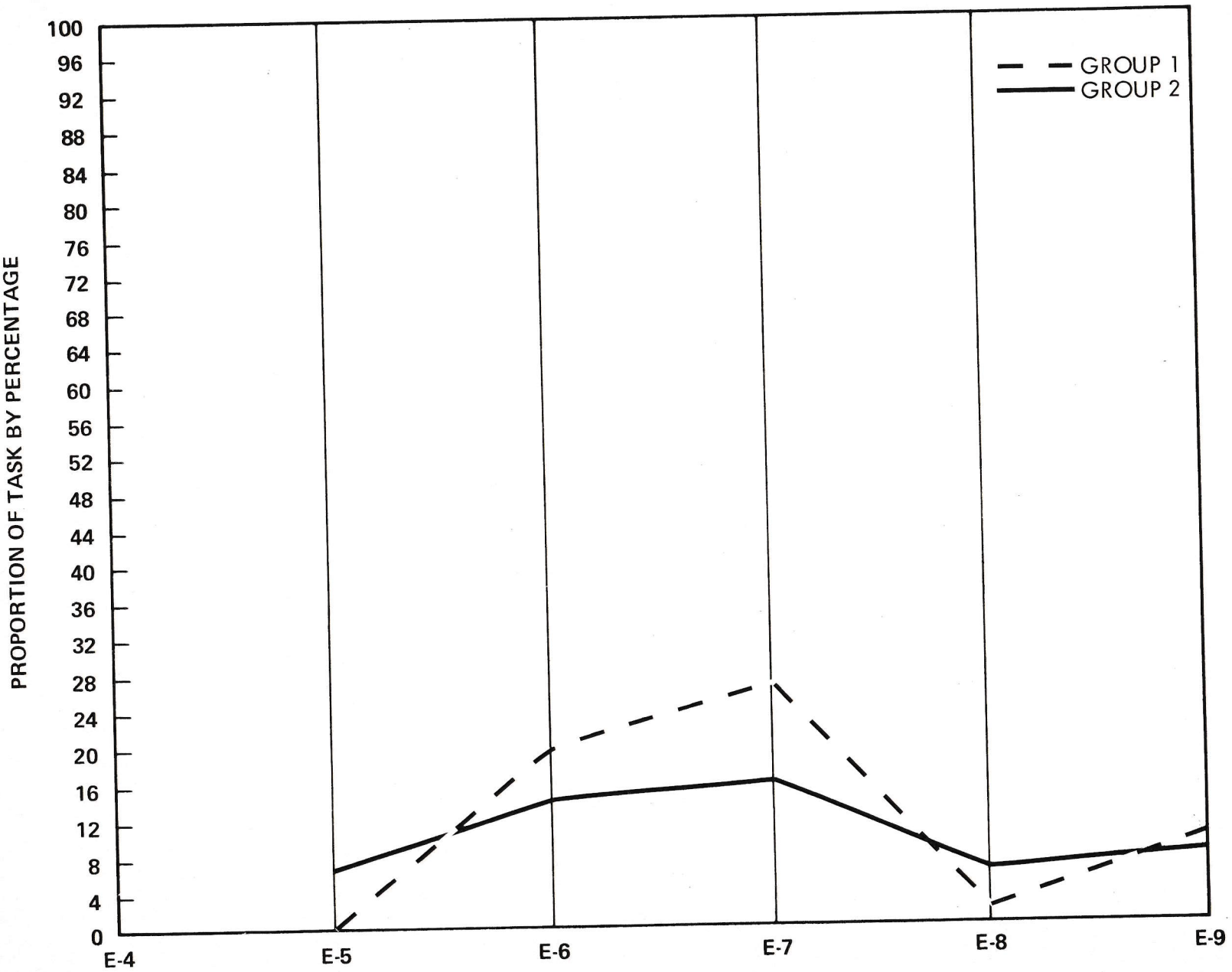
Notably the Inspect "Characteristic" occurs at E4, E5, and E6 pay grade for Group 1 but occurs only at the E7 pay grade for Group 2. At no point does it involve more than nine percent of the tasks so it can reasonably be ignored. (See Figure 1B)



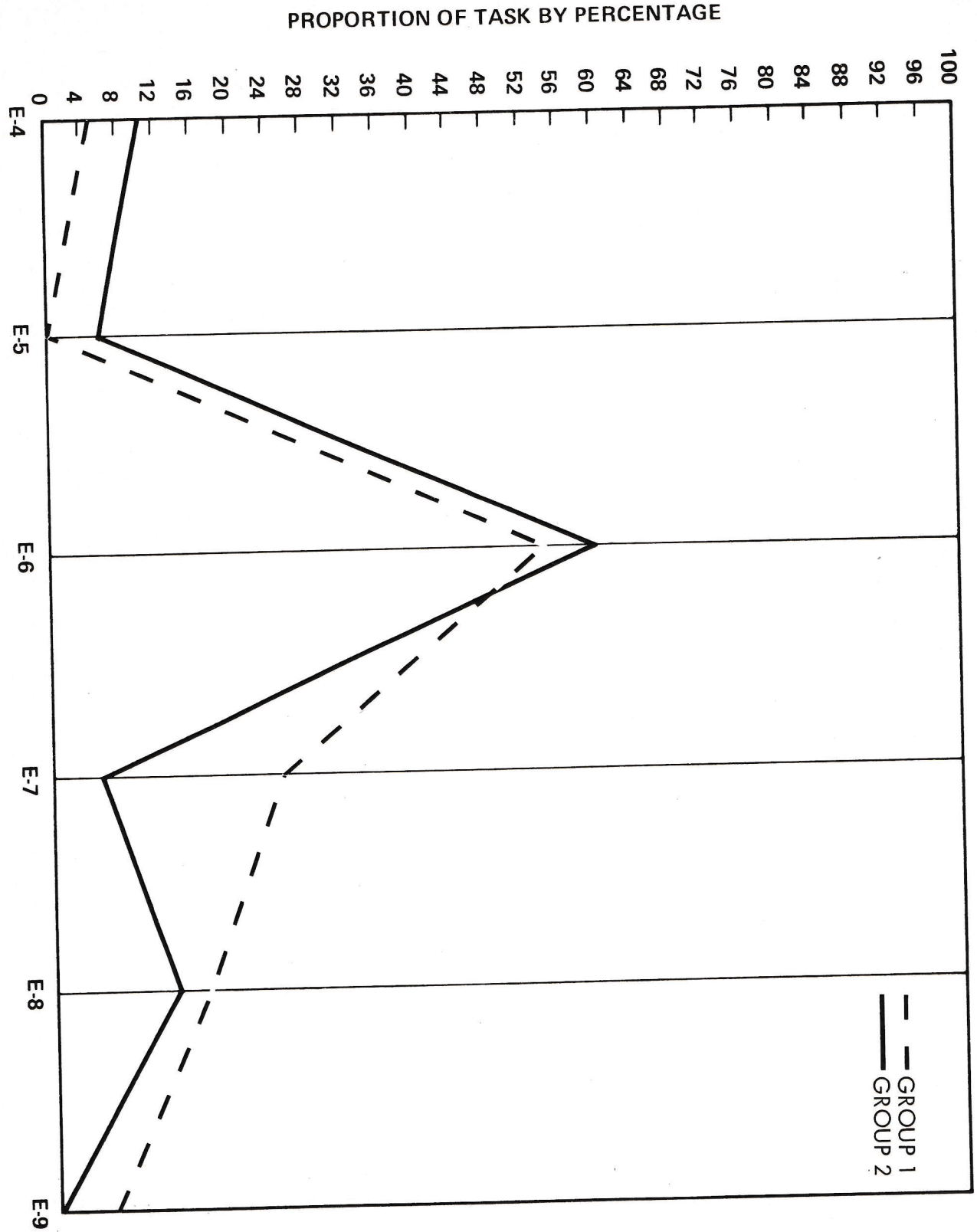
PLOT OF AVERAGES OF CHARACTERISTICS
FOR PAYGRADES GROUP 1 VS GROUP 2
(MAINTAIN) FIGURE 1-A



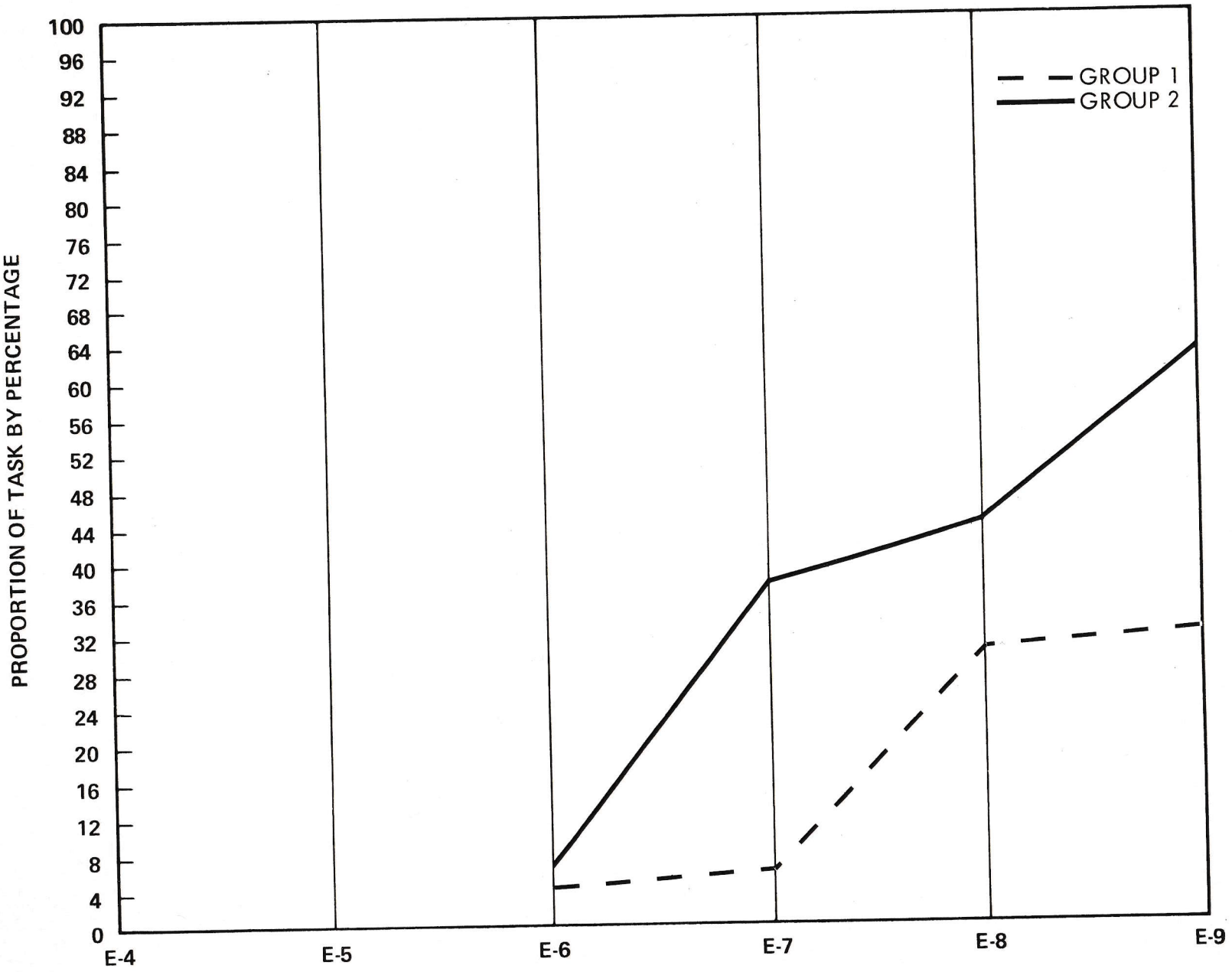
PLOT OF AVERAGES OF CHARACTERISTICS
FOR PAYGRADES GROUP 1 VS GROUP 2
(INSPECT) FIGURE 1-B



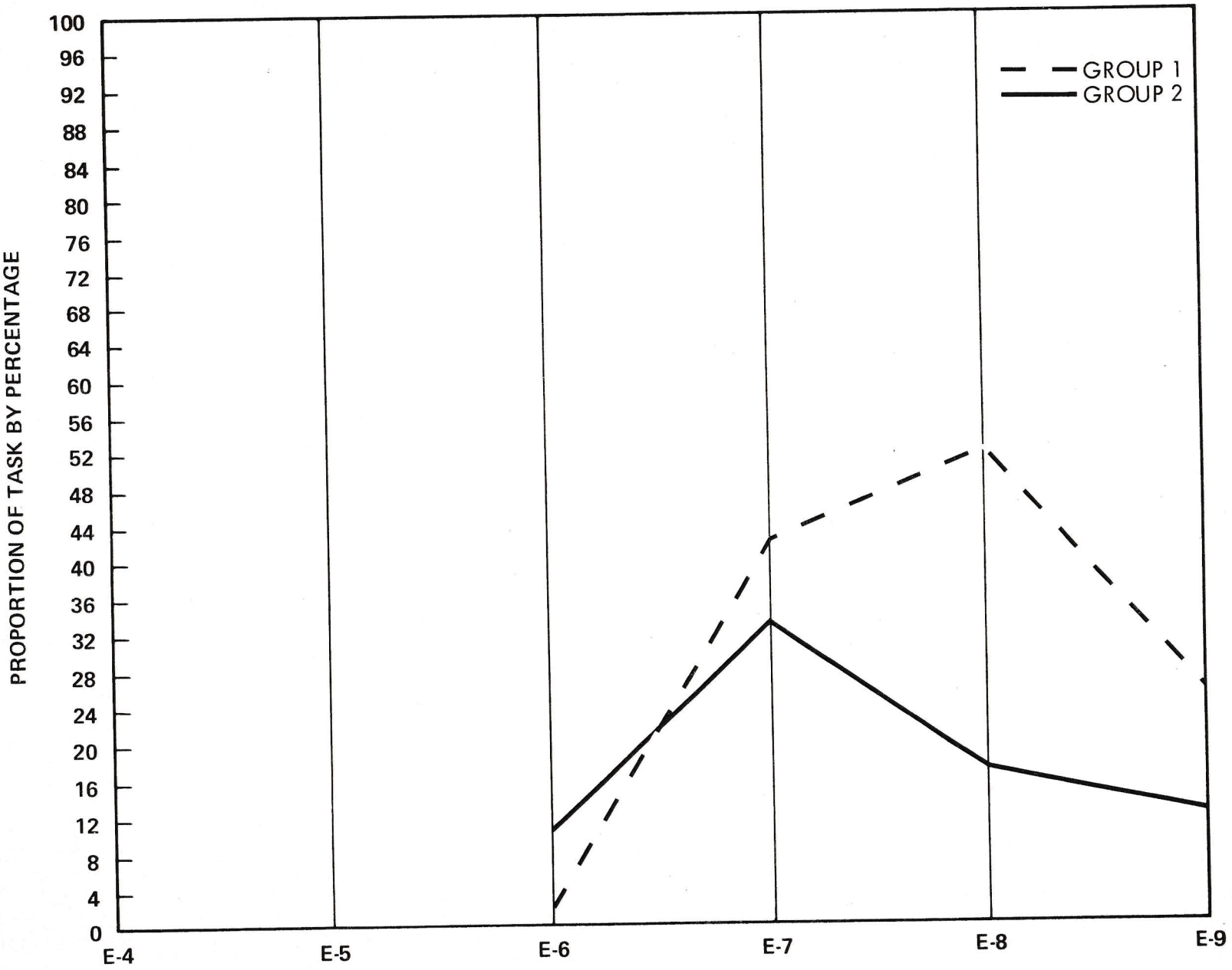
PLOT OF AVERAGES OF CHARACTERISTICS
FOR PAYGRADES GROUP 1 VS GROUP 2
(SUPERVISE) FIGURE 1-C



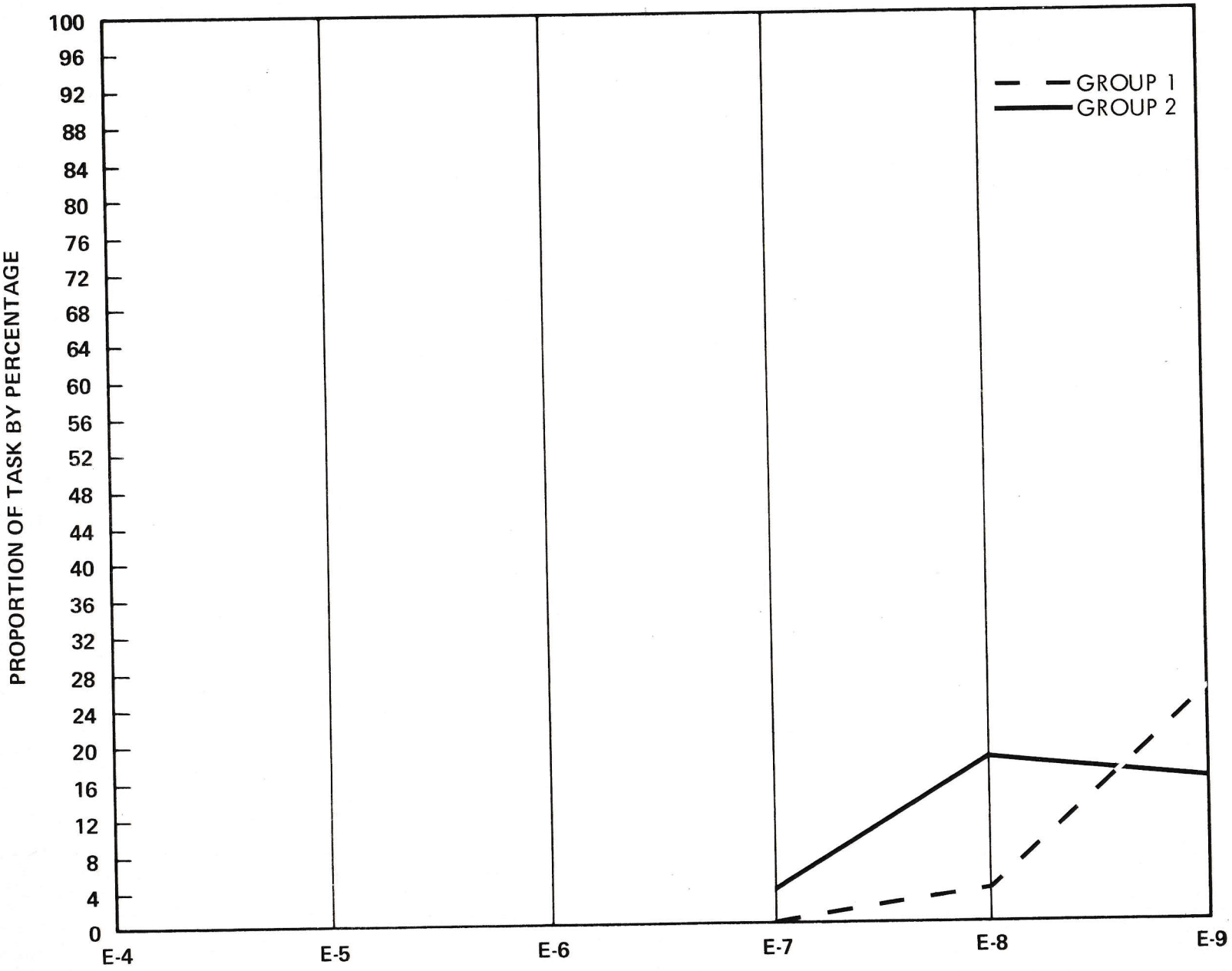
PLOT OF AVERAGES OF CHARACTERISTICS
FOR PAYGRADES GROUP 1 VS GROUP 2
(ADMINISTER) FIGURE 1-D



PLOT OF AVERAGES OF CHARACTERISTICS
FOR PAYGRADES GROUP 1 VS GROUP 2
(PLAN) FIGURE 1-E



PLOT OF AVERAGES OF CHARACTERISTICS
FOR PAYGRADES GROUP 1 VS GROUP 2
(EVALUATE) FIGURE 1-F



PLOT OF AVERAGES OF CHARACTERISTICS
FOR PAYGRADES GROUP 1 VS GROUP 2
(INTERFACE) FIGURE 1-G

The Maintain "Characteristic" does not occur at the E7 pay grade for Group 2, but it is only four percent of the tasks for Group 1. (See Figure 1A)

The Supervise "Characteristic" does not occur until the E5 pay grade for Group 1, while it is seven percent of the tasks at the E5 pay grade for Group 2. (See Figure 1C)

The Administer "Characteristic" does not occur at the E5 and E9 pay grades for Group 1. For Group 2, the "Characteristic" is six and eleven percent for three grades respectively. (See Figure 1G)

In general, there is a slight tendency to continue technical requirements for one pay grade higher in Group 1 as compared with Group 2. The nontechnical functions - on the other hand, seem to often start at one pay grade lower in Group 2 than in Group 1. The proportion change, however, is significantly small in all cases.

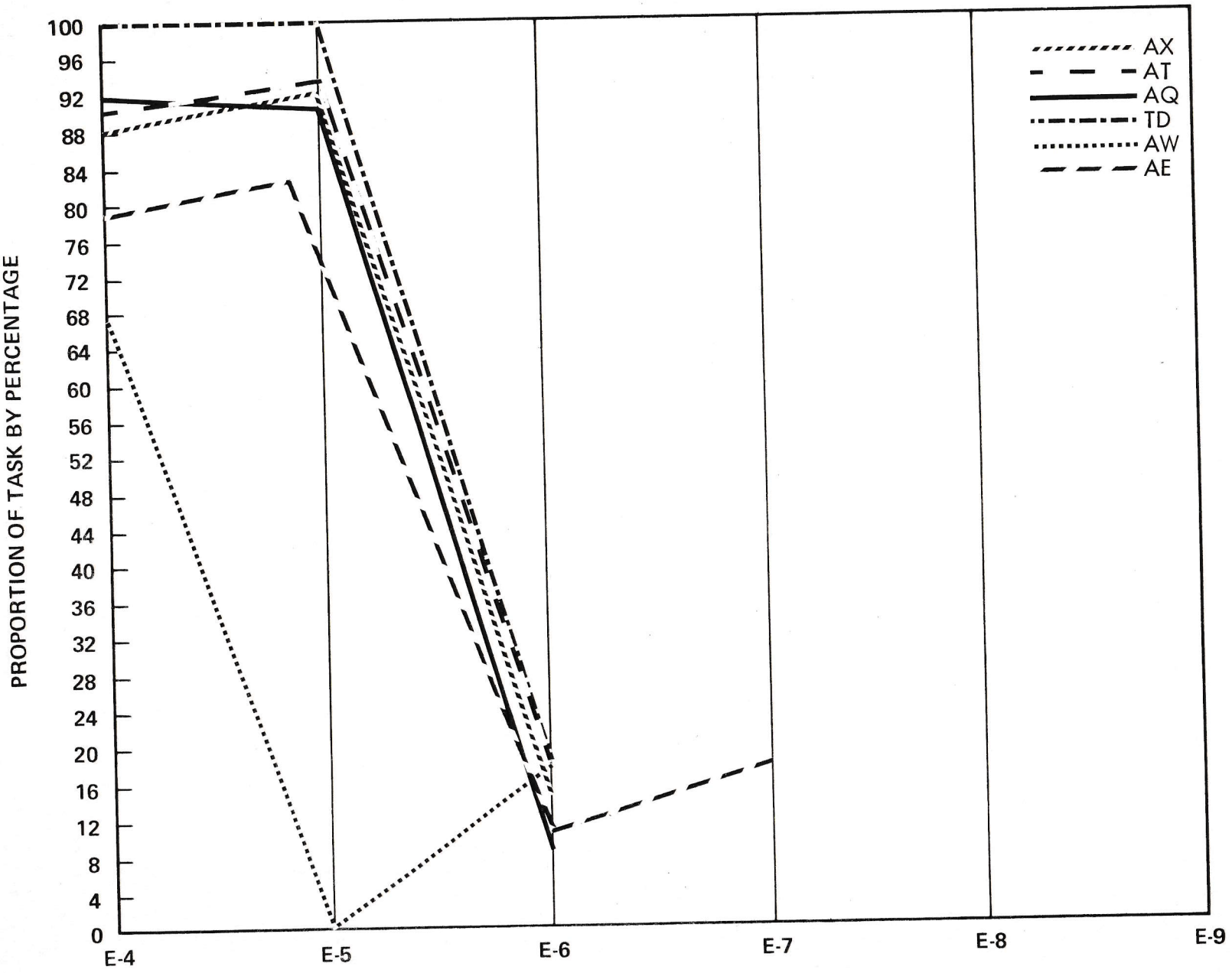
6.8.2 Intra Ground Task Consistency-"Characteristics"

6.8.2.1 Group 1 "Characteristic" consistency

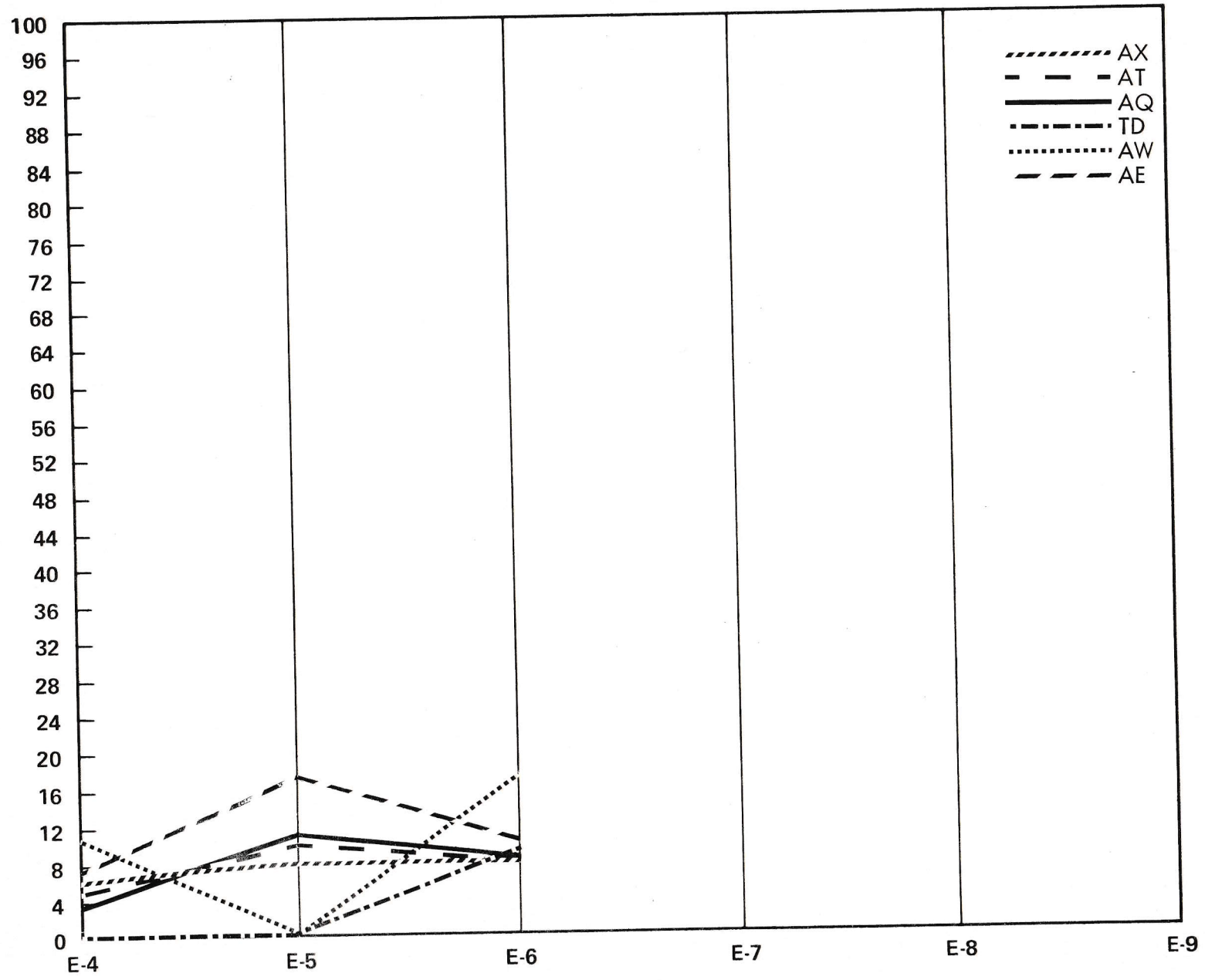
Figures 2A-2G provide the plots for the intra group correlation for "Characteristics" in Group 1.

For all "Characteristics," there is an evident high correlation at all pay grades for the AX, AT and AQ ratings. Deviations here are so small as to be practically indistinguishable. In the Plan "Characteristic" the AQ rating deviates by introducing eleven percent at the E7 pay grade.

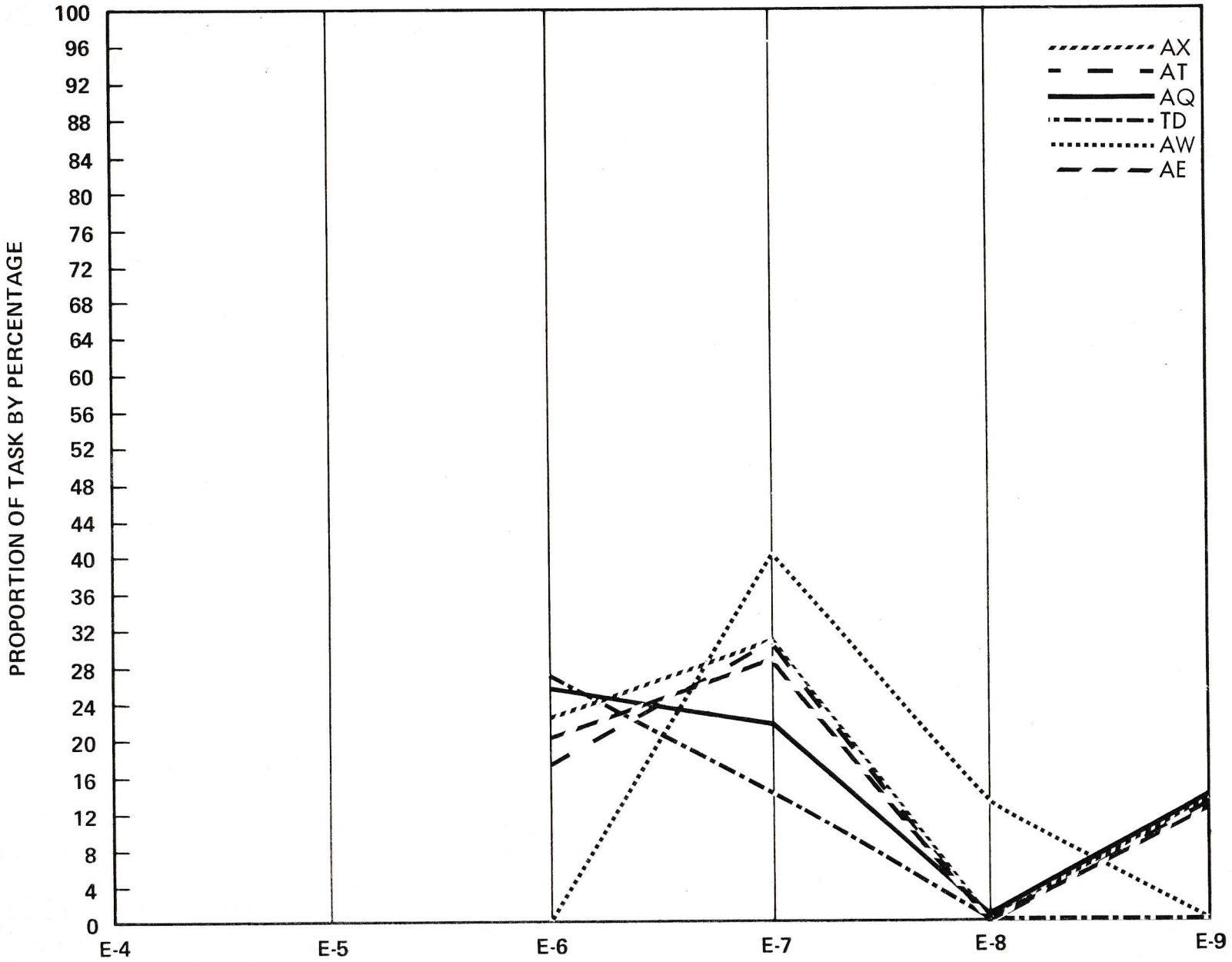
The deviations for the TD, AW, and AE ratings from the AX, AT, and AQ subgroup are summarized in Table 10.



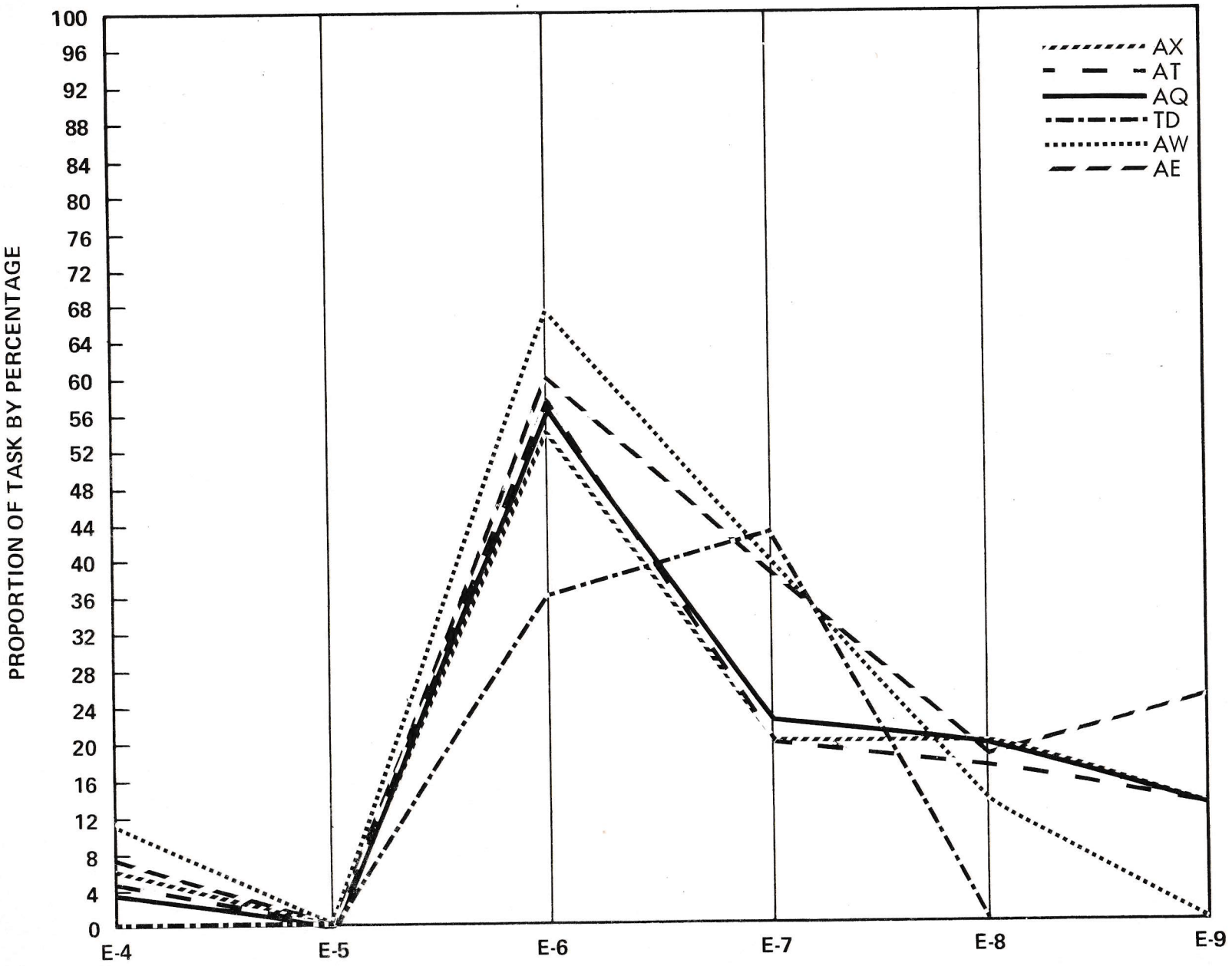
PLOT OF AVERAGES OF CHARACTERISTICS
FOR PAYGRADE INTRA GROUP RATINGS
GROUP 1
(MAINTAIN) FIGURE 2-A



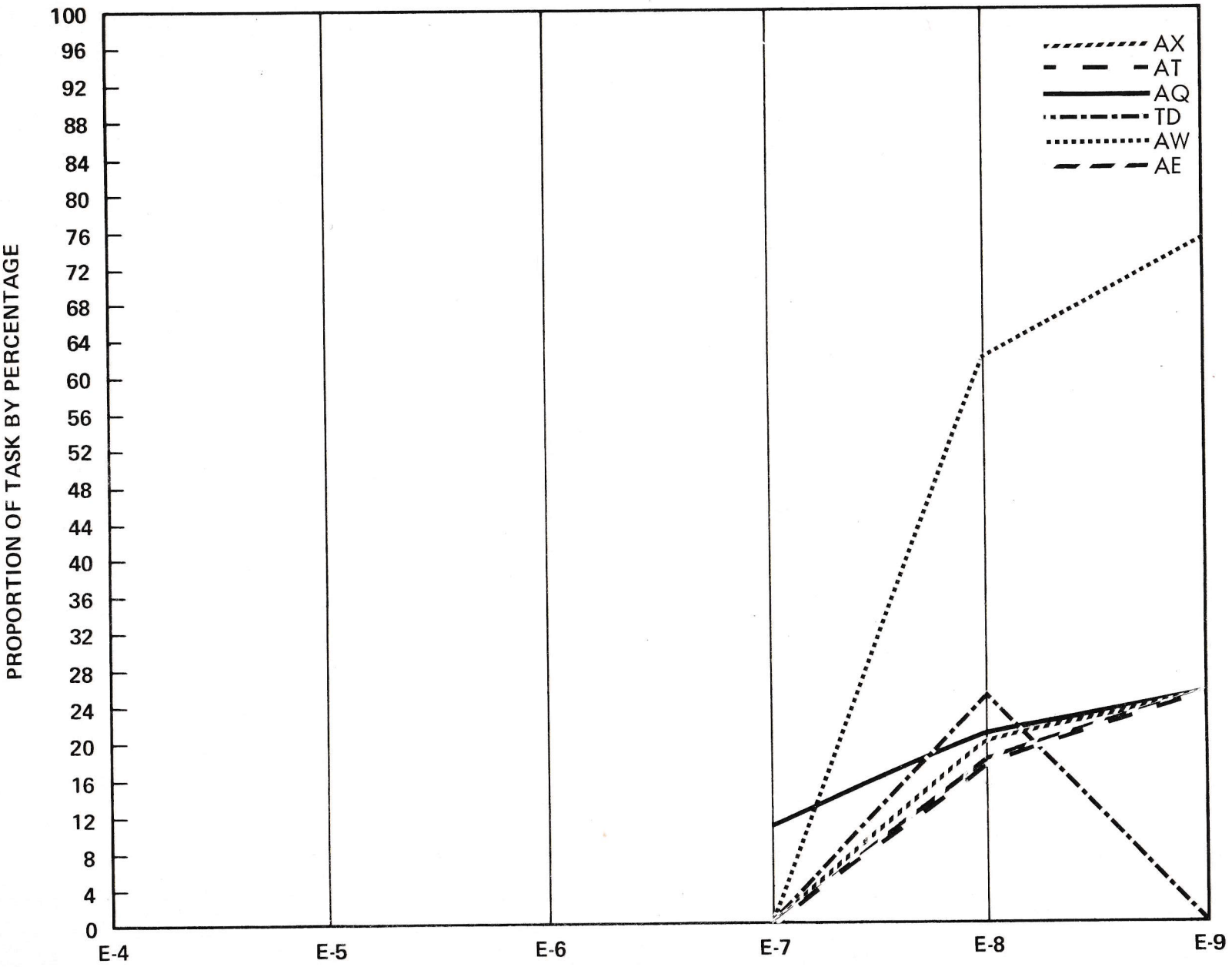
PLOT OF AVERAGES OF CHARACTERISTICS
FOR PAYGRADE INTRA GROUP RATINGS
GROUP 1
(INSPECT) FIGURE 2-B



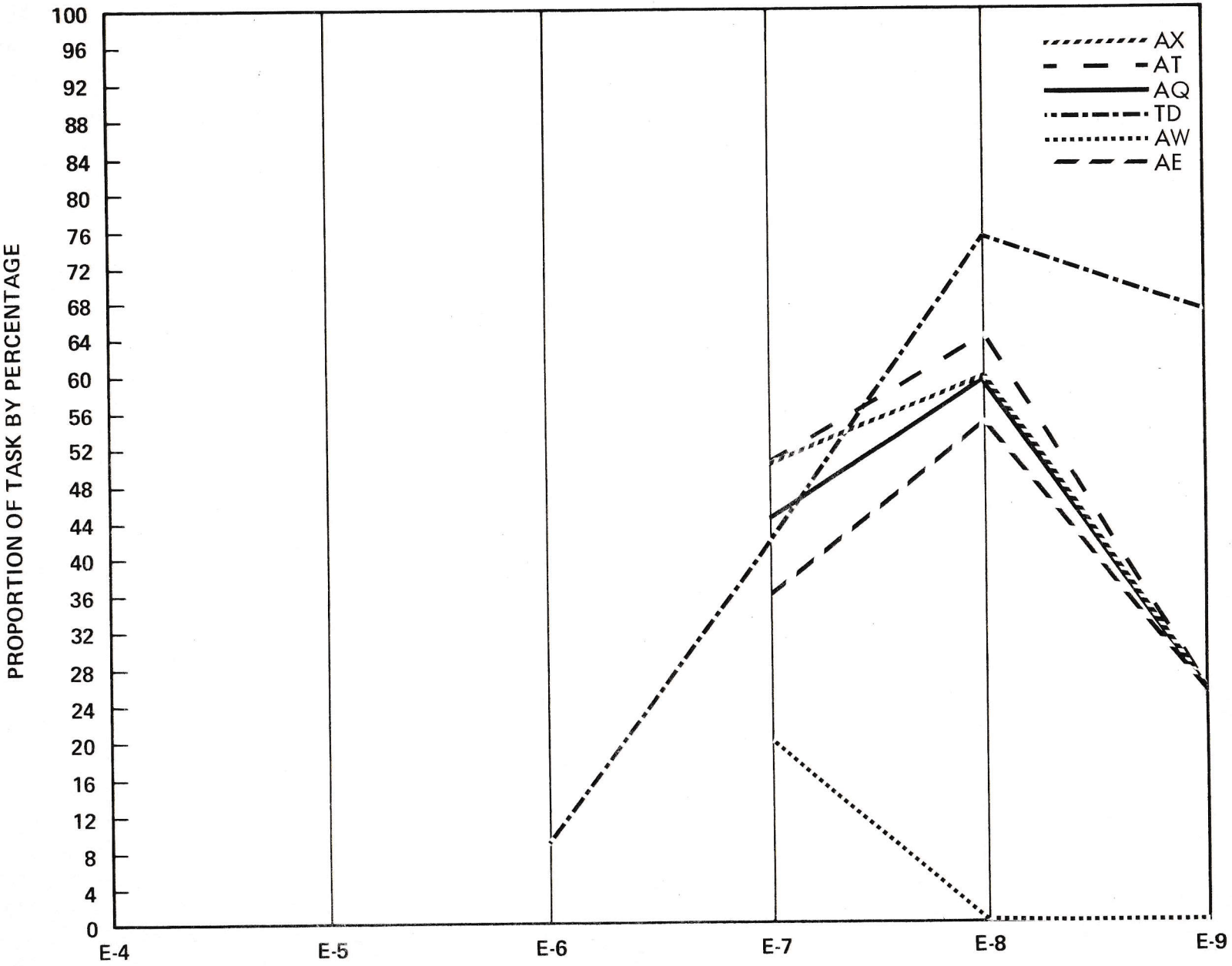
PLOT OF AVERAGES OF CHARACTERISTICS
FOR PAYGRADE INTRA GROUP RATINGS
GROUP 1
(SUPERVISE) FIGURE 2-C



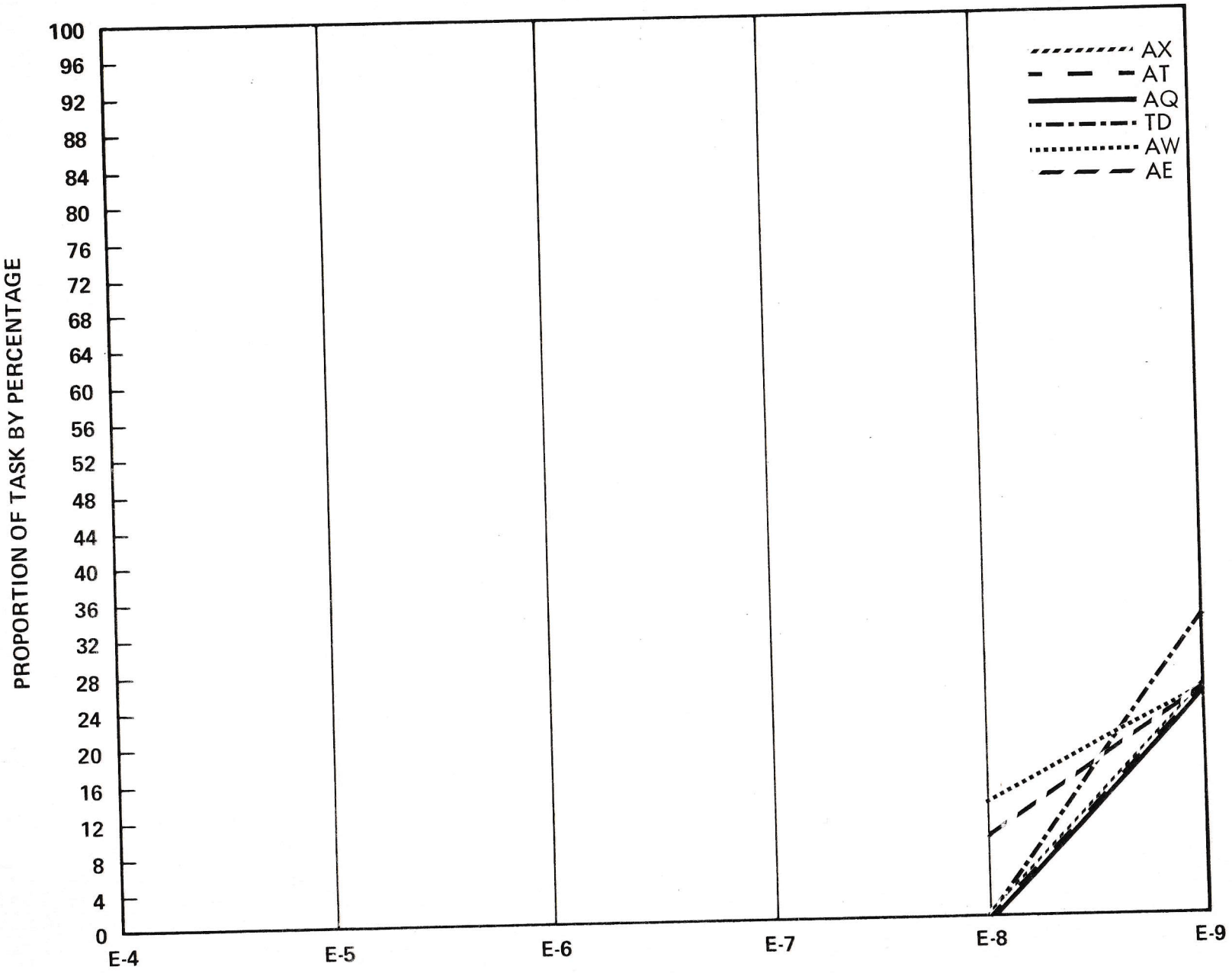
PLOT OF AVERAGES OF CHARACTERISTICS
FOR PAYGRADE INTRA GROUP RATINGS
GROUP 1
(ADMINISTER) FIGURE 2-D



PLOT OF AVERAGES OF CHARACTERISTICS
FOR PAYGRADE INTRA GROUP RATINGS
GROUP 1
(PLAN) FIGURE 2-E



PLOT OF AVERAGES OF CHARACTERISTICS
FOR PAYGRADE INTRA GROUP RATINGS
GROUP 1
(EVALUATE) FIGURE 2-F



PLOT OF AVERAGES OF CHARACTERISTICS
FOR PAYGRADE INTRA GROUP RATINGS
GROUP 1
(INTERFACE) FIGURE 2-G

TABLE 10

COMPARISON OF CORRELATION OF AX, AT, AQ
AGAINST TD AND AW AND AE

	TD	AW	AE
Maintain Figure 2A	Reasonable correlated with AX, AT, and AQ subgroup	Somewhat low at E4. No new maintenance tasks added at E5 pay grade	18% Maintenance tasks continue to appear at E7 pay grade
Inspect Figure 2	No inspection tasks appear except at the E6 pay grade	No new inspection tasks appear at the E5 pay grade	Somewhat higher proportion of inspection tasks
Supervise Figure 2C	Supervision drops out at E9	Supervision does not appear as a characteristic until E7 and drops out at E9	Correlates well with AX,AT,AQ subgroup
Administer Figure 2D	No administrative tasks until E6 although generally correlation is reasonably good. However, no administrative tasks at all beyond the E7 pay grade	Correlates generally well though administrative tasks are not added at E9 pay grade	Correlates well with AX,AT,AQ subgroup
Plan Figure 2E	Planning tasks do not appear at the E9 pay grade	Extremely large proportion of planning tasks at E8 and E9 pay grades 66 and 75 percent respectively	Correlates well with AX,AT,AQ subgroup
Evaluate Figure 2F	Evaluative tasks appear at the E6 pay grade	Evaluative tasks appear only at the E7 pay grade and then are a small proportion comparatively	Correlates generally well with AX, AT, AQ subgroup
Interface Figure 2G	Correlates well with AX, AT, AQ subgroups	Appears at E8 pay grade as opposed to E9 for all but AE	Appears at E8 pay grade as opposed to E9 for all but AW

In general there is reasonably good correlation within this group although some ratings tend to introduce a "Characteristic" earlier than others. The introduction, however, rarely occurs more than one pay grade lower. By the same token, some ratings tend not to add more of a requirement for a specific characteristic as the pay grade increases.

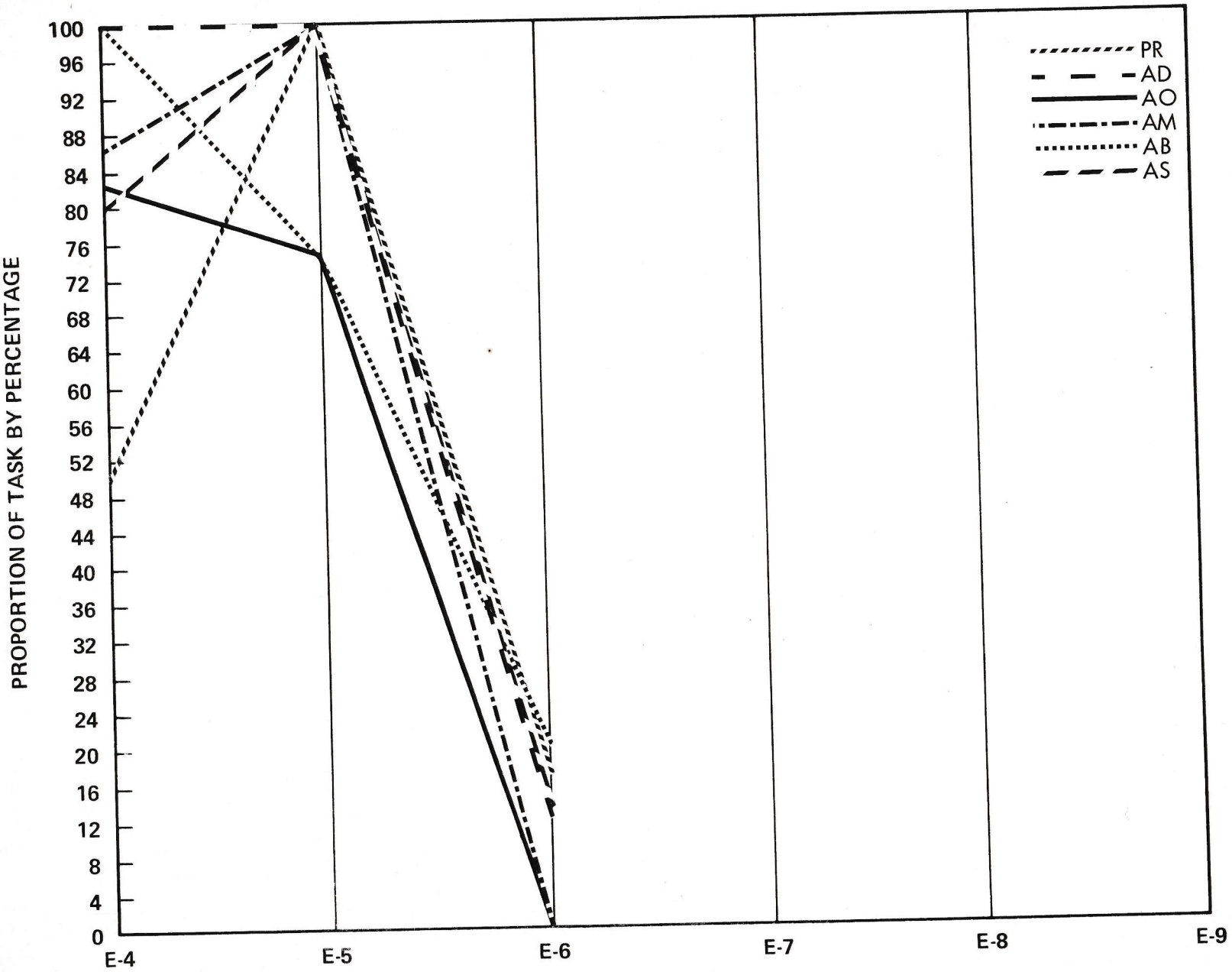
6.8.2.2 Group 2 "Characteristic" consistency

Figures 3A-3G provide the plot for the intra group "Characteristics" in Group 2.

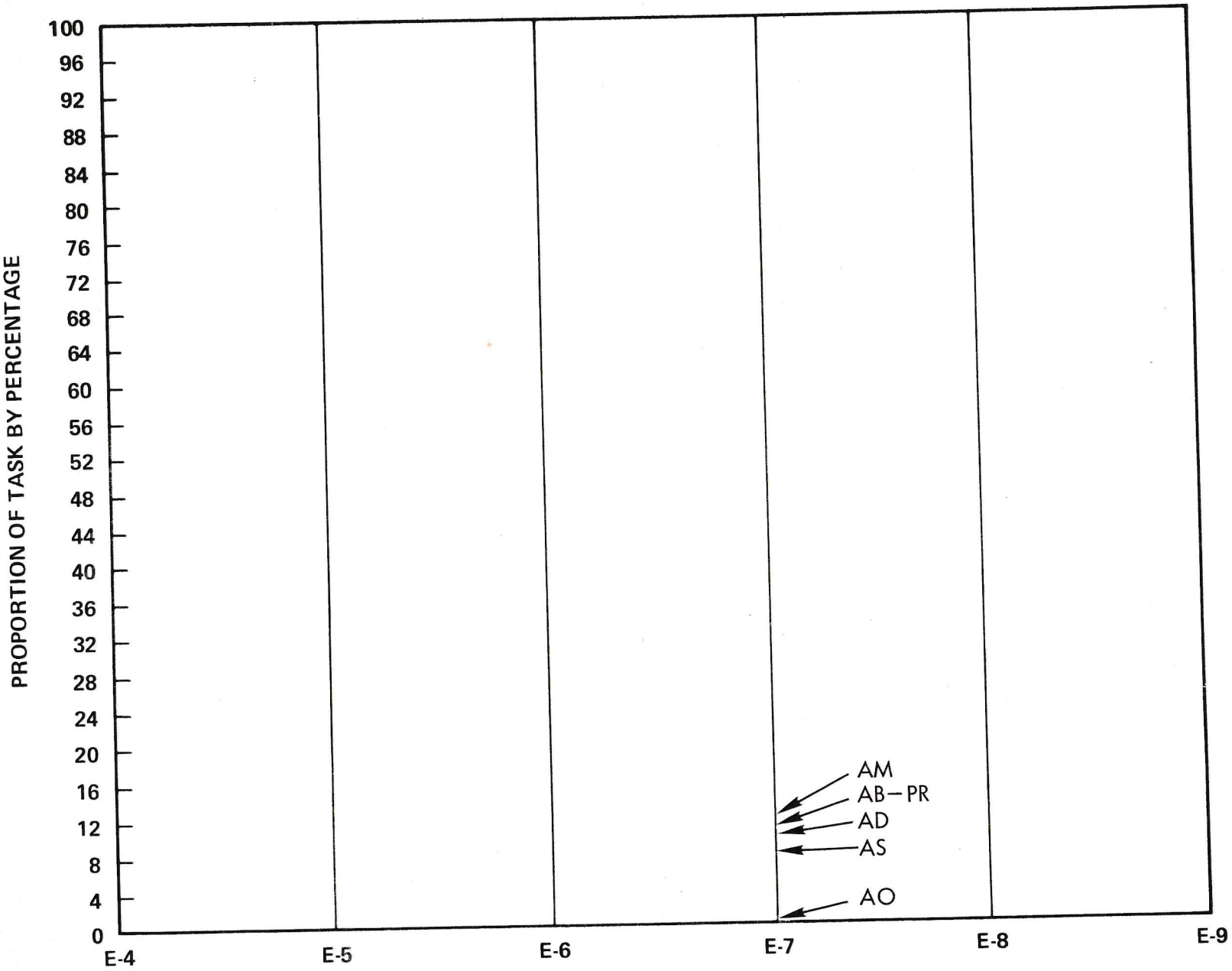
Although Group 2 does not seem nearly as well correlated as does Group 1, there is sufficient correlation to continue to maintain this as a group at least for initial considerations.

The Maintain "Characteristic" seems to be well correlated though the AM rating is only 50 percent at the E4 pay grade as opposed to 80 to 100 percent for the balance of the ratings. Additionally, the AM and AO ratings require no new qualifications on this "Characteristic" at the E6 pay grade while the balance of the ratings in this group require from 12 to 20 percent of the qualifications at this pay grade.

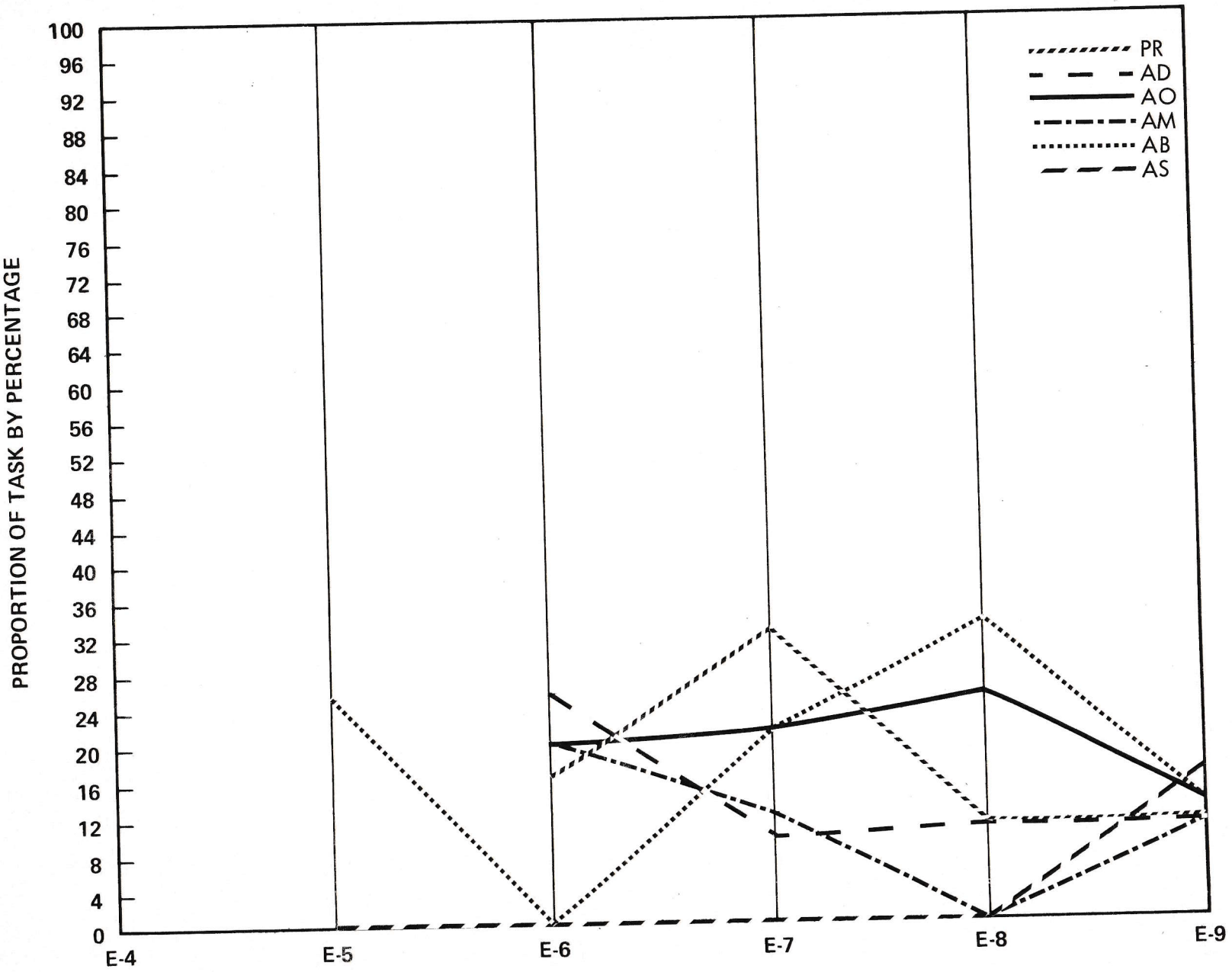
The Inspect "Characteristic," although extremely well inter-correlated with the exception of the non-existent AO rating, is peculiar in that it only appears at the E7 pay grade. Referring back to Figure 2B of Group 1, the inspection "Characteristic" appears at the E4-E5 and E6 pay grades and not at all at the E7 pay grade. It would seem that inspection as a "Characteristic" would more closely approximate the Maintain "Characteristic" and would therefore more likely fall at a lower pay grade if in keeping with general trends. This seeming discrepancy may either be due to the method of classification within this report, undue emphasis in the "Quals Manual" or possibly a spurious element in the correlation.



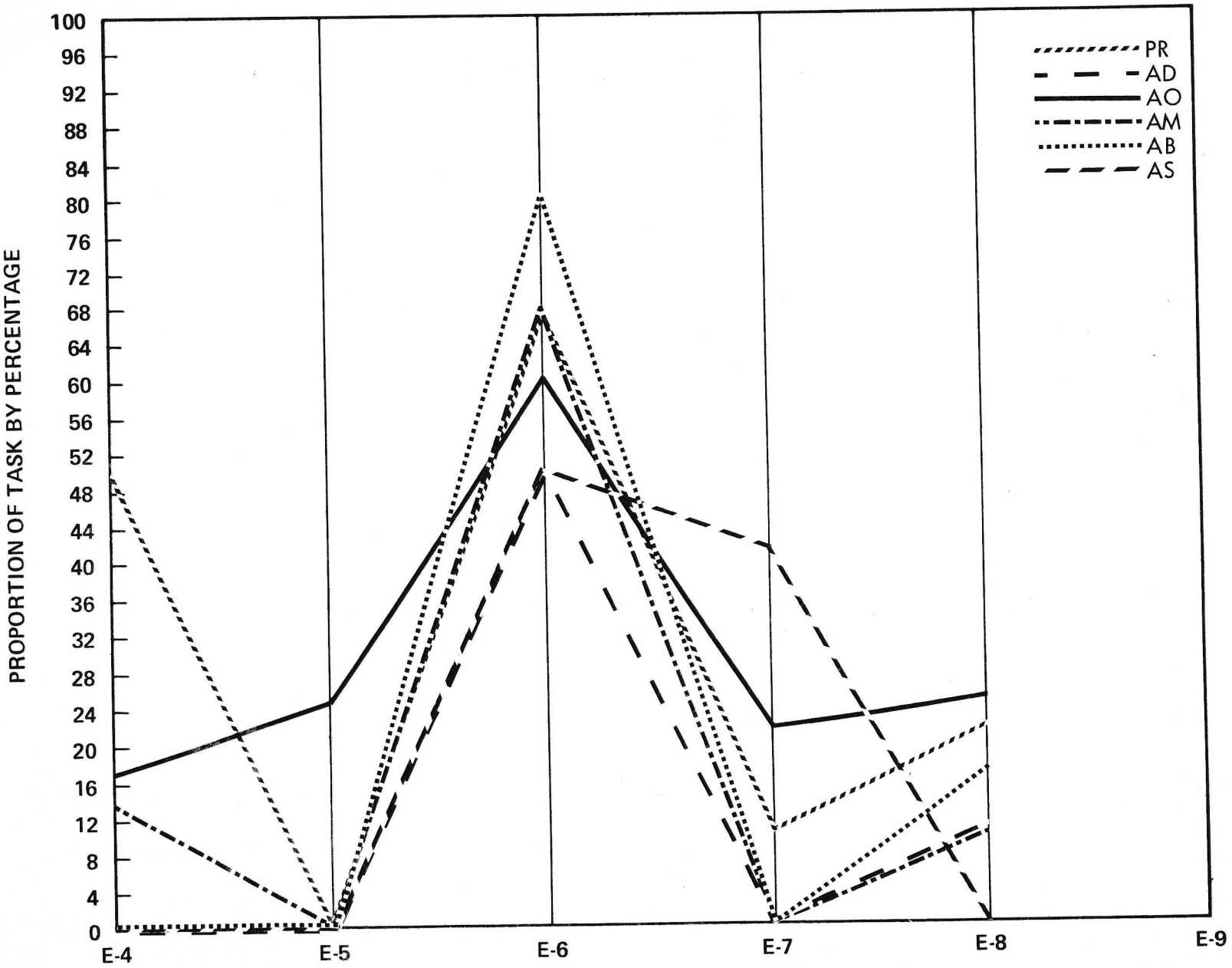
PLOT OF AVERAGES OF CHARACTERISTICS
FOR PAYGRADE INTRA GROUP RATINGS
GROUP 2
(MAINTAIN) FIGURE 3-A



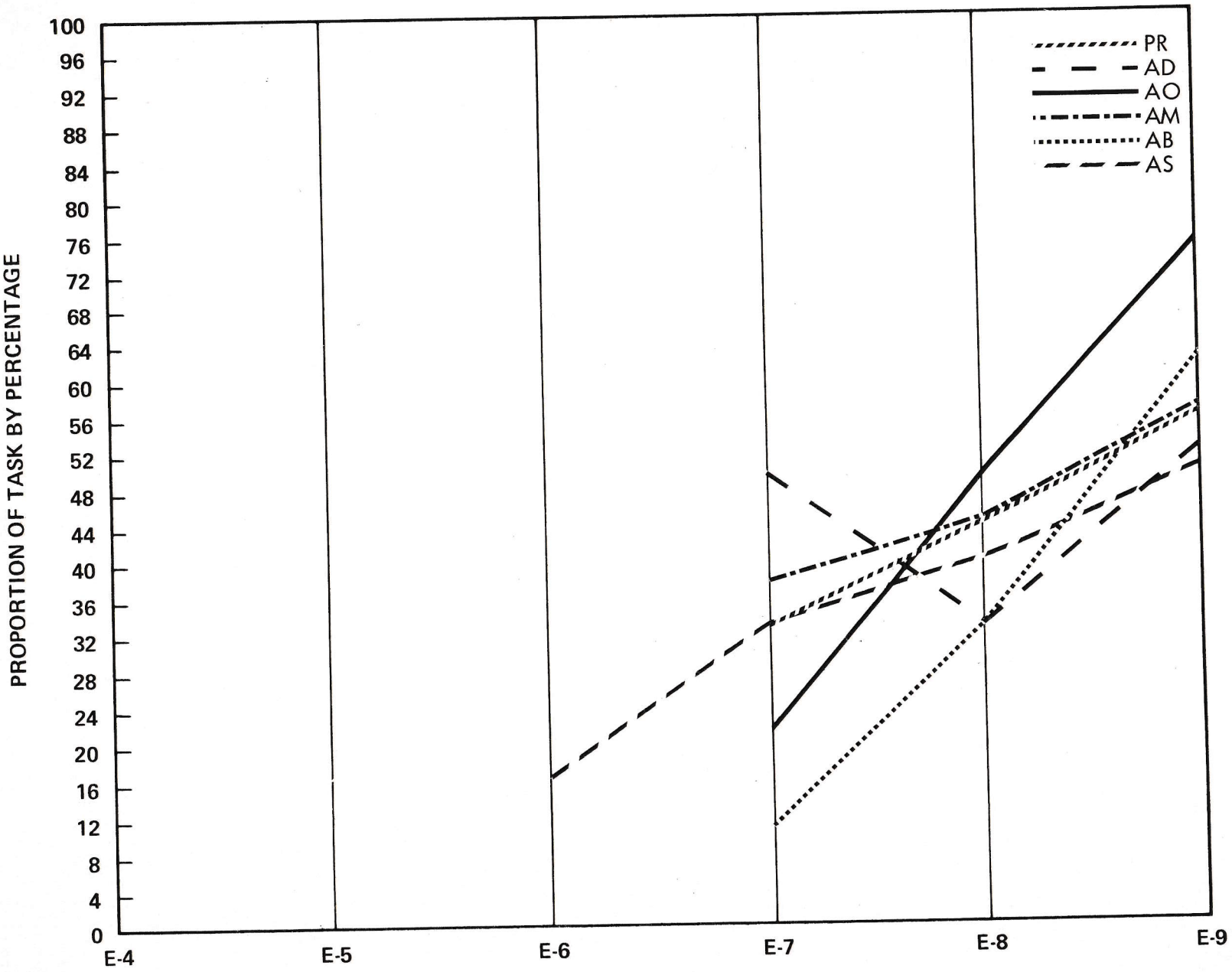
PLOT OF AVERAGES OF CHARACTERISTICS
FOR PAYGRADE INTRA GROUP RATINGS
GROUP 2
(INSPECT) FIGURE 3-B



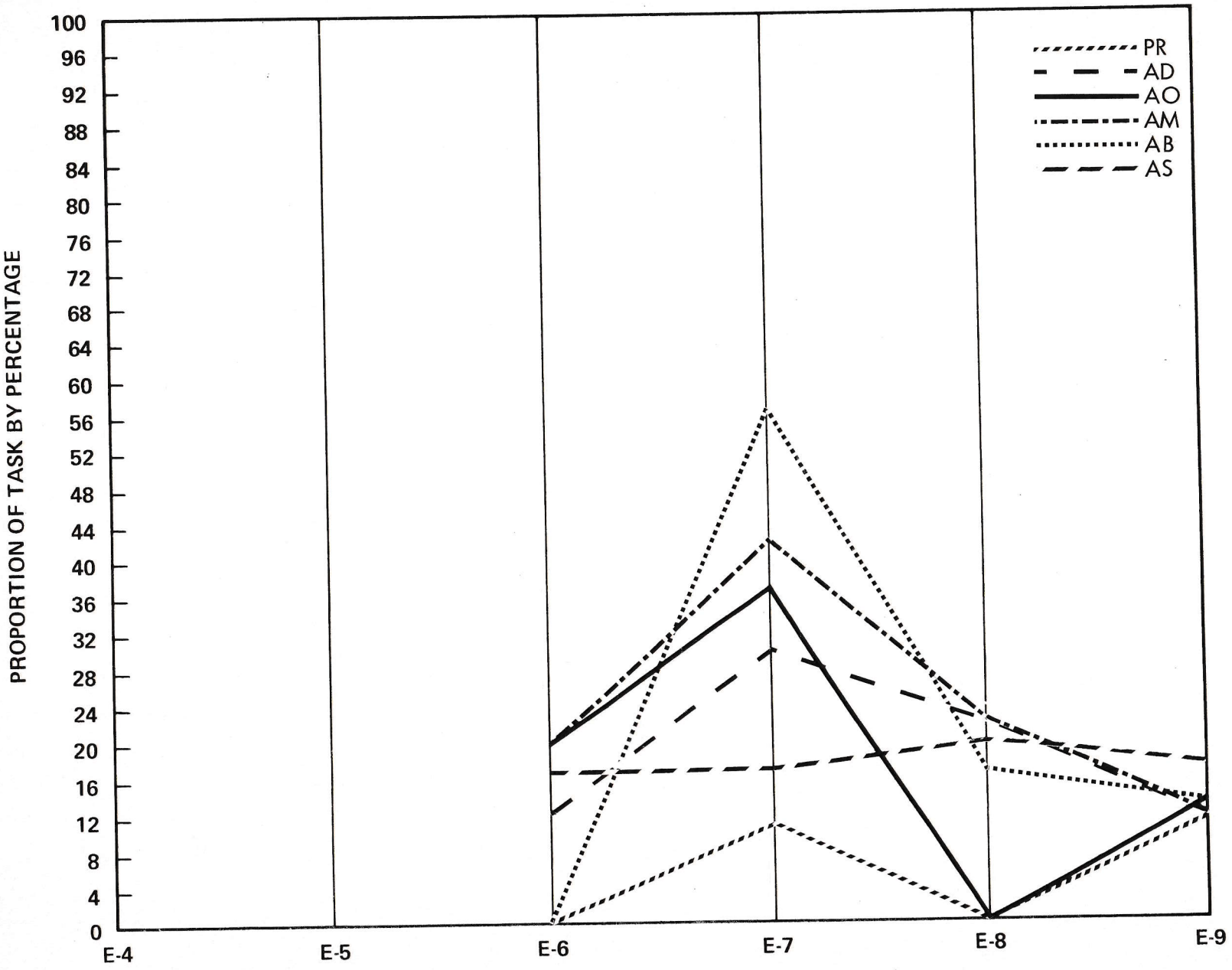
PLOT OF AVERAGES OF CHARACTERISTICS
FOR PAYGRADE INTRA GROUP RATINGS
GROUP 2
(SUPERVISE) FIGURE 3-C



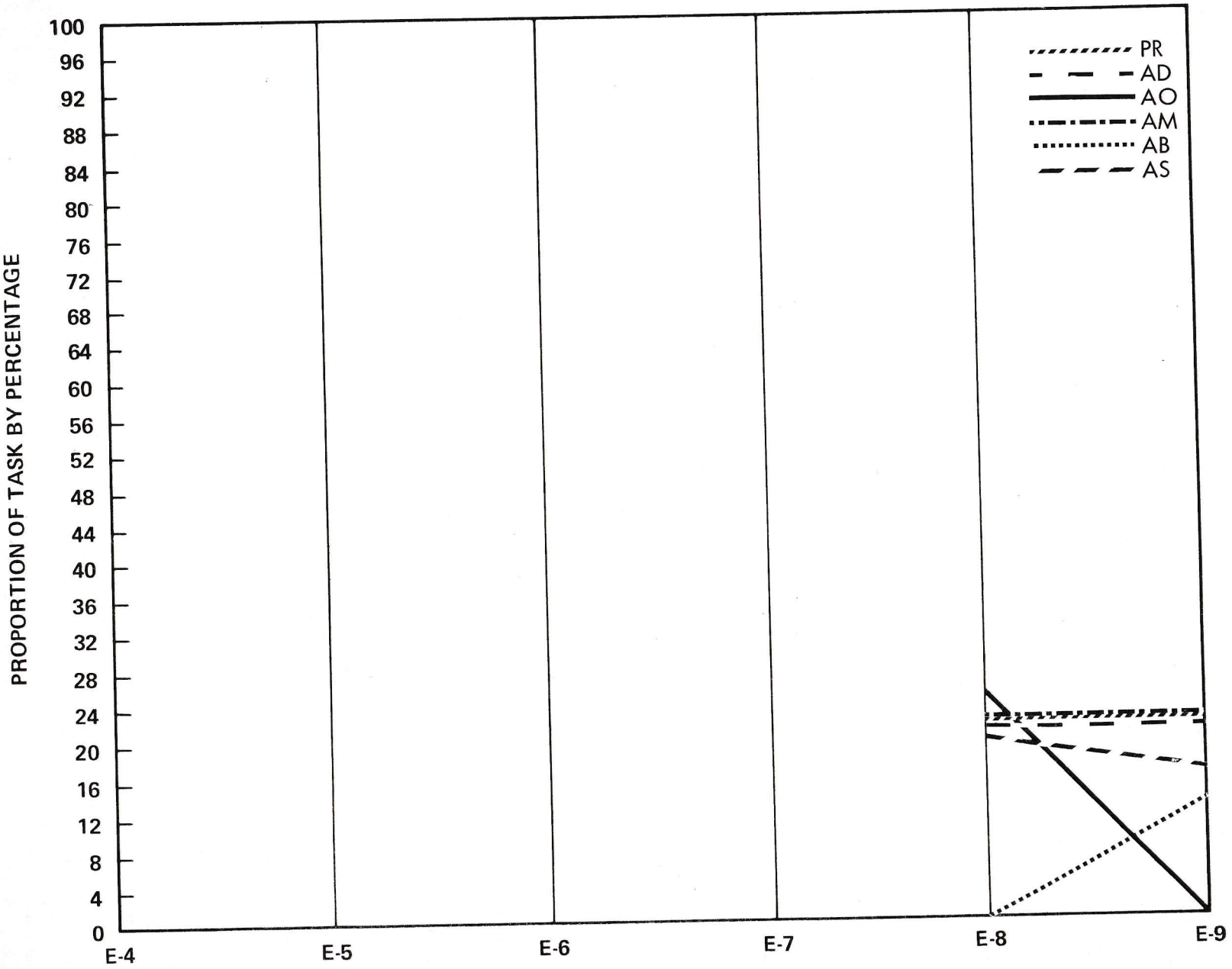
PLOT OF AVERAGES OF CHARACTERISTICS
FOR PAYGRADE INTRA GROUP RATINGS
GROUP 2
(ADMINISTER) FIGURE 3-D



PLOT OF AVERAGES OF CHARACTERISTICS
FOR PAYGRADE INTRA GROUP RATINGS
GROUP 2
(PLAN) FIGURE 3-E



PLOT OF AVERAGES OF CHARACTERISTICS
FOR PAYGRADE INTRA GROUP RATINGS
GROUP 2
(EVALUATE) FIGURE 3-F



PLOT OF AVERAGES OF CHARACTERISTICS
FOR PAYGRADE INTRA GROUP RATINGS
GROUP 2
(INTERFACE) FIGURE 3-G

The Supervise "Characteristic," with the exception of the AB and AS ratings, seems well correlated. Why no supervisory tasks are called out below the E9 level for the AS rating is hard to understand.

The Administer "Characteristic" is also well correlated with the exception of possible differences which occur in the AB and AS ratings.

The Plan, Evaluate, Interface "Characteristics" generally also follow well.

From an overall standpoint, if there are deviations sufficient to separate any ratings out, it would be in terms of the AB and AS ratings. Although they follow the trend in general, they seem to be the greatest contributors to the deviations which do occur.

6.8.3 Inter Group Task Consistency - "Nature"

Figure 4 presents the plot of the averages of the Group 1 vs. Group 2 for the "Nature" of the tasks. As can be seen, both groups tend heavily toward the General Technical "Nature" and less toward any specific "Nature" of the tasks at the higher pay grades.

At the lower pay grades, the specific "Natures" seem reasonably sharply differentiated. For example, no Electronics "Nature appears in Group 2 though it reaches as high as 59 percent of the task in Group 1. There is a small increment, maximum of six percent electrical in Group 1 for E4 and E5 pay grades while the same "Nature" appears in pay grades E4 -- E7 in Group 1, ranging from three to thirteen percent of the task. There seems to be a much higher mechanical content in the tasks of Group 2, ranging through E4 - E6 pay grades at 53 to 26 percent as opposed to E4 and E5 at 21 to 13 percent for Group 1.

PLOT OF AVERAGES OF NATURE FOR PAYGRADES E4-E9
GROUP 1 VS GROUP 2
FIGURE 4

In general, there is a reasonably sharp differentiation between the "Nature" of the tasks from Group 1 to Group 2 despite the tendency of both groups to converge to the General Technical "Nature" at the higher pay grades.

6.8.4 Intra Group "Nature" Consistency

6.8.4.1 Group 1 "Nature" Consistency

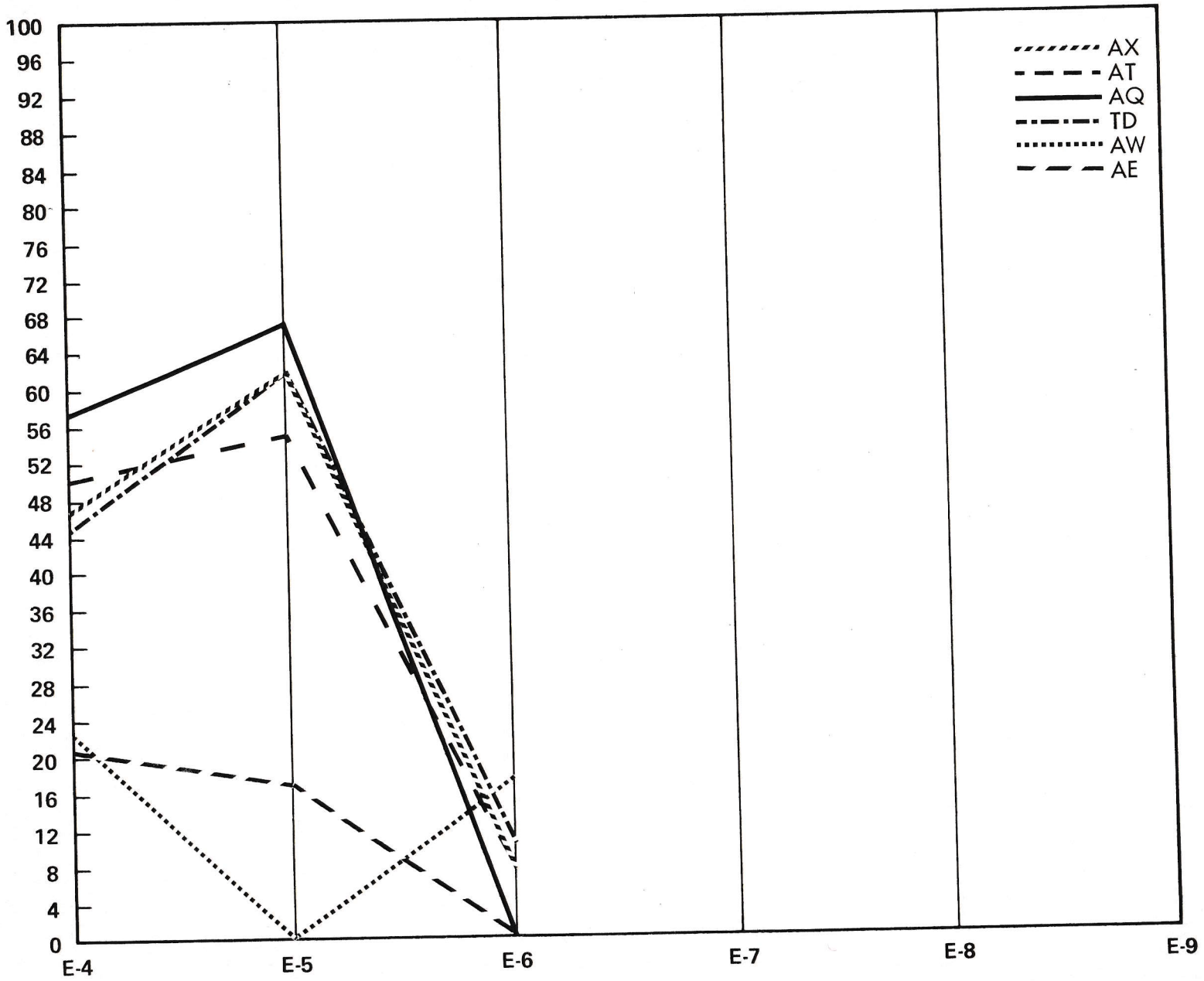
Figures 5A-5E provide plots of the various "Nature" elements in Group 1. As has been the pattern in the "Characteristic" consistency, the AX, AT, AQ ratings correlate extremely well; the TD rating somewhat less well; while the greatest deviation from the norm is usually found in the AW and AE ratings.

The Electronic "Nature" of the task (Figure 5A), is extremely highly correlated in the AX, AT, AQ, and TD ratings. The AW rating seems to have a somewhat higher portion of Electronic "Nature" at the E6 pay grade than any other rating, while the AE only carries a relatively small portion at the E4 and E5 pay grades.

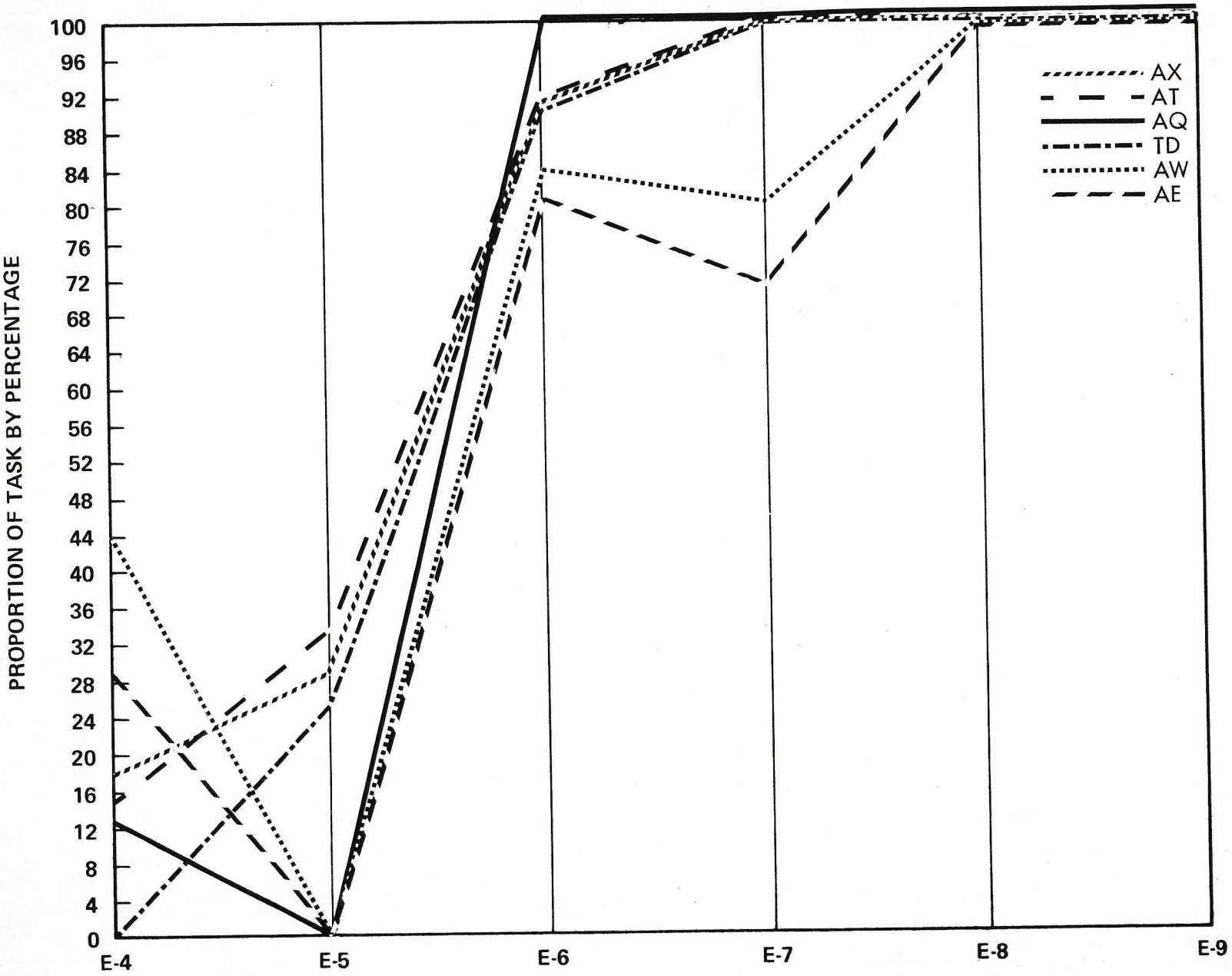
The General Technical "Nature" (Figure 5B) is generally well correlated throughout, though as usual the AW and AE ratings provide the greatest deviation from the norm; in fact, continuing in specific "Nature" elements for one full pay grade beyond the others.

The Electro-mechanical "Nature" (Figure 5C) only appears in three of the ratings at all-TD, AW, AE; but then only for the E4 pay grade and with a range of eight to twenty-one percent of the task.

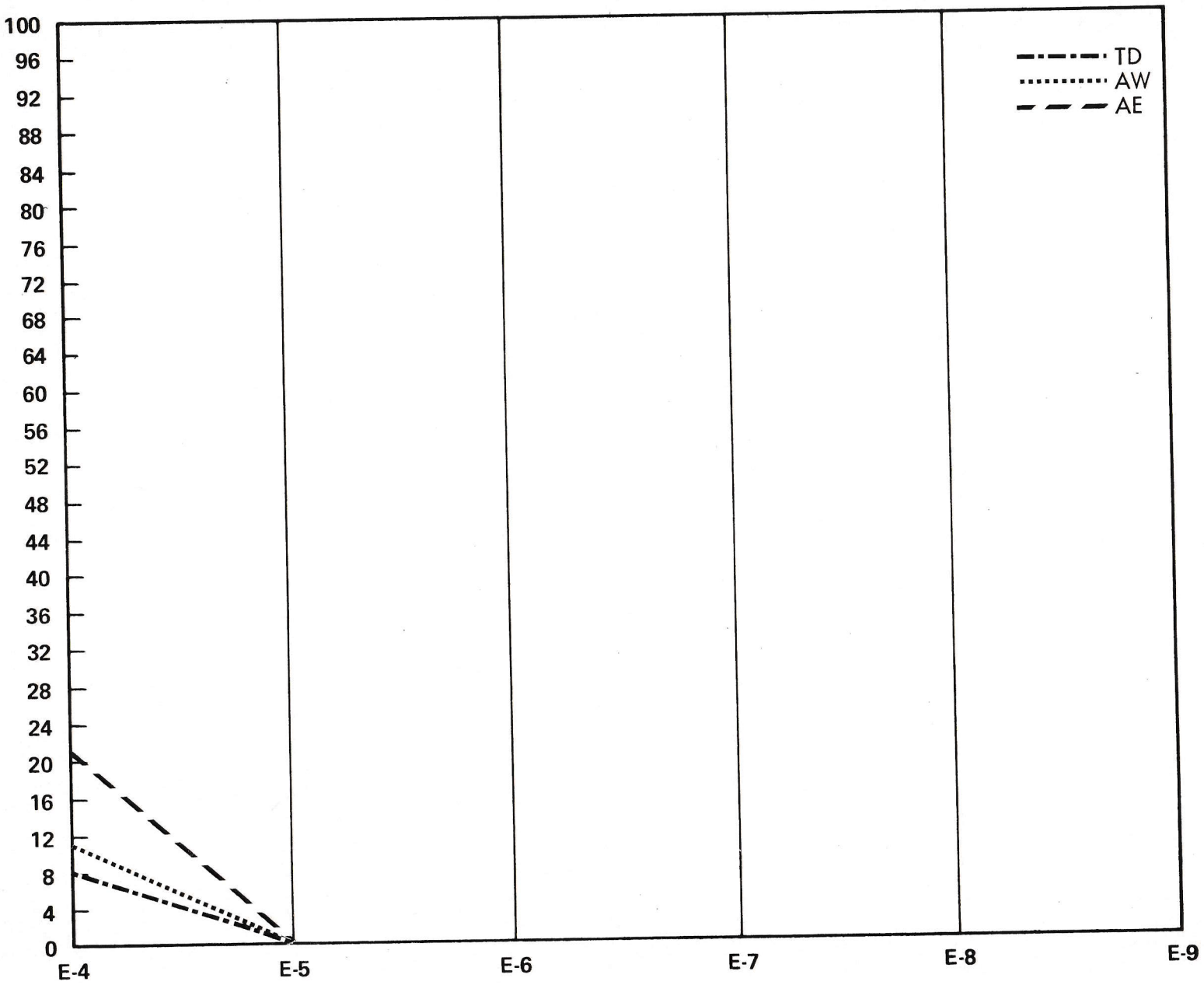
The Electrical "Nature" (Figure 5D) presents a very odd plot. The AX, AT, AQ ratings have a small portion of this "Nature" at the E4



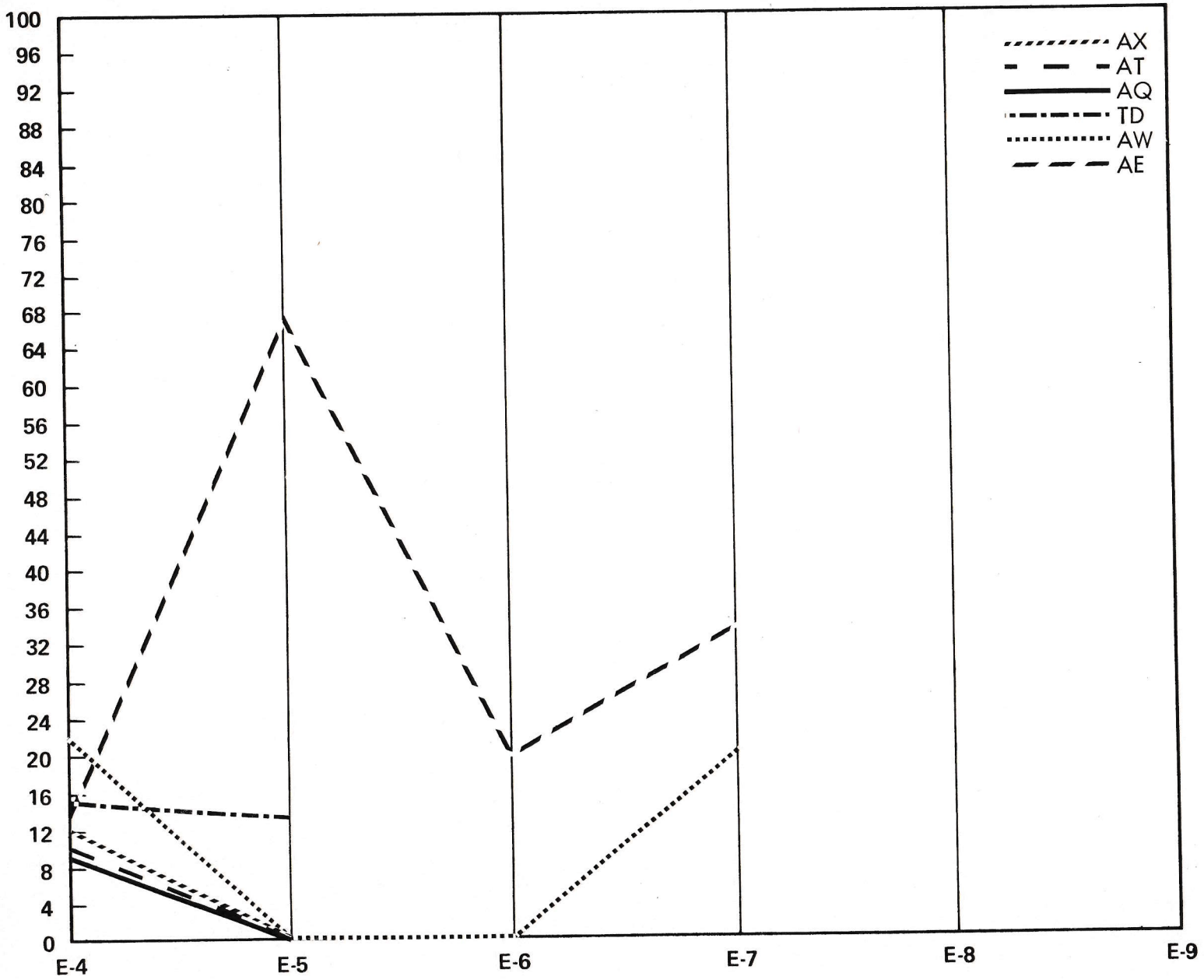
PLOT OF AVERAGES OF NATURE
FOR PAYGRADE INTRA GROUP RATINGS
GROUP 1
(ELECTRONIC) FIGURE 5-A



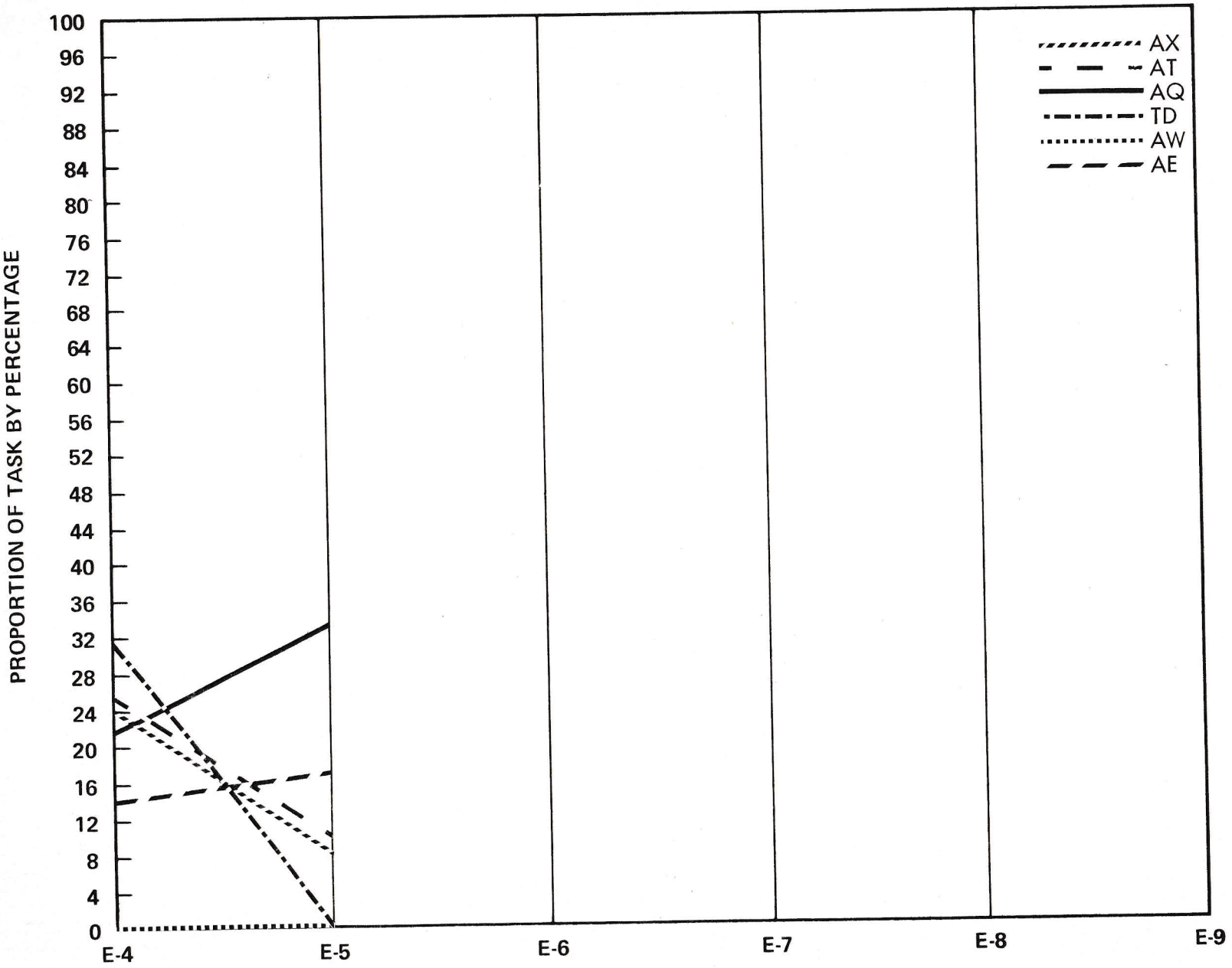
PLOT OF AVERAGES OF NATURE
FOR PAYGRADE INTRA GROUP RATINGS
GROUP 1
(GENERAL TECHNICAL) FIGURE 5-B



PLOT OF AVERAGES OF NATURE
FOR PAYGRADE INTRA GROUP RATINGS
GROUP 1
(ELECTRO MECHANICAL) FIGURE 5-C



PLOT OF AVERAGES OF NATURE
FOR PAYGRADE INTRA GROUP RATINGS
GROUP 1
(ELECTRICAL) FIGURE 5-D



PLOT OF AVERAGES OF NATURE
FOR PAYGRADE INTRA GROUP RATINGS
GROUP 1
(MECHANICAL) FIGURE 5-E

pay grade only (nine to twelve percent). Fifteen and thirteen percent of the "Nature" of the TD rating is Electrical at the E4 and E5 pay grade only. The Electrical "Nature" of the AW rating appears only at the E4 and E7 pay grade; 22 and 20 percent respectively. The AE rating has a substantial Electrical portion of the "Nature" from the E4-E7 pay grade, ranging from 14 to 67 percent.

The Mechanical "Nature" is a small portion of the task for all ratings. (See Figure 5E). In no case does it appear beyond the E5 pay grade. It appears only at the E4 pay grade in the TD rating and not at all in the AW rating. There is a tendency for the requirement to increase slightly from E4 to E5 for the AQ and AE ratings and to decrease slightly for the same pay grades for the AT and AX ratings. The overall range of from eight to thirty-three percent indicates a reasonably small to medium amount of this "Nature" contained in this group.

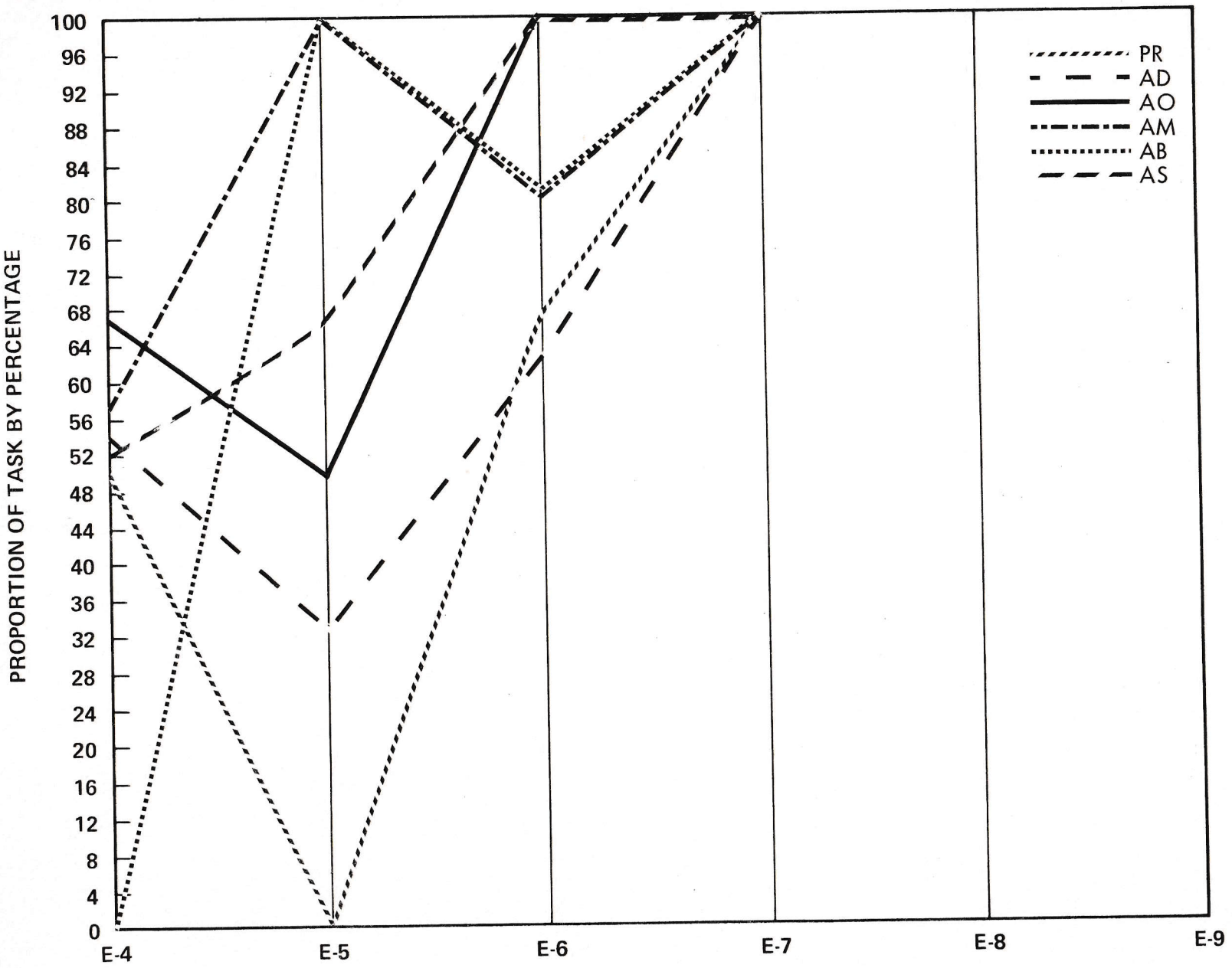
6.8.4.2 Group 2 "Nature" consistency

Figures 6A-6C present the plots of the consistency of the "Nature" factors of the tasks in Group 2.

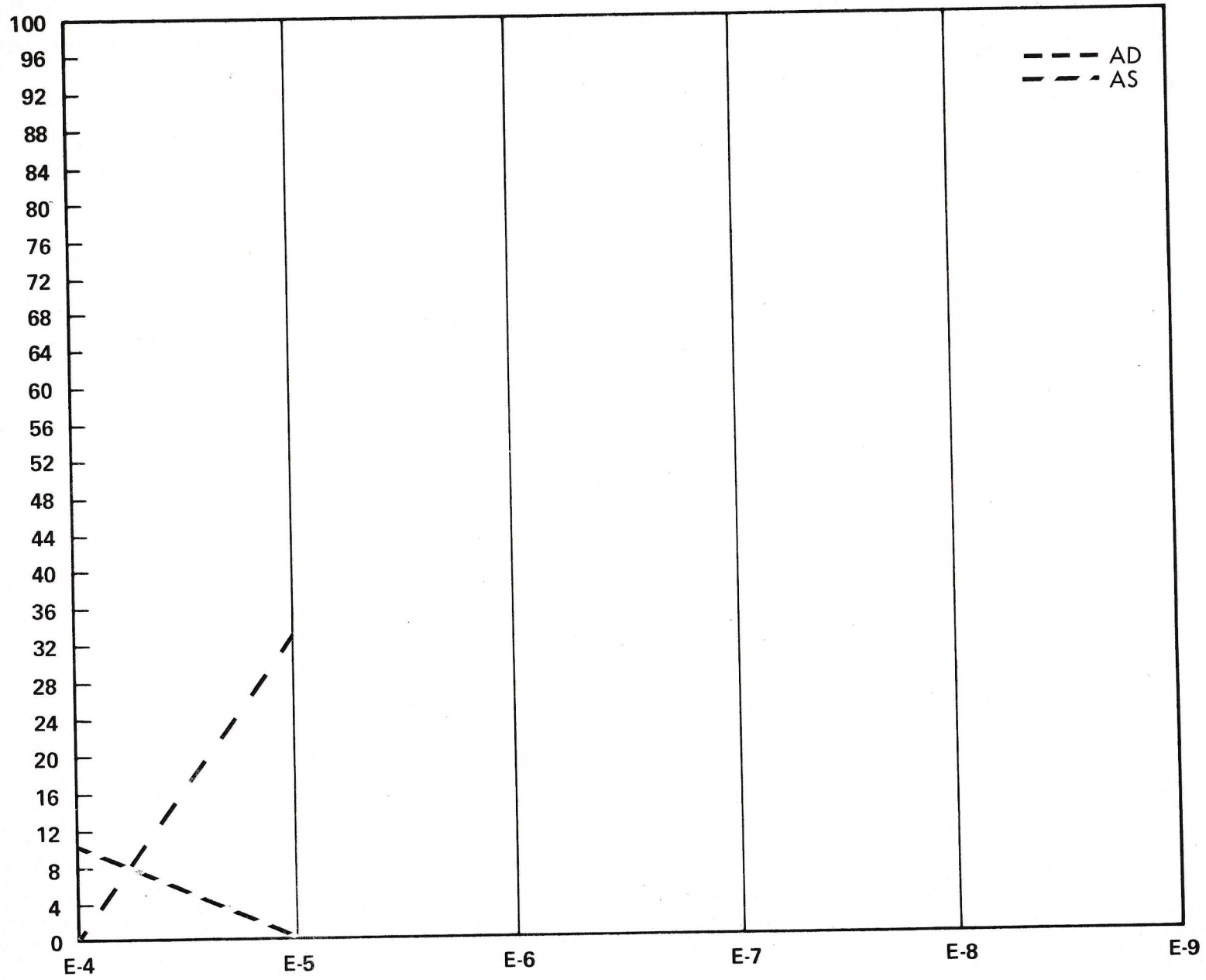
The total "Nature" of the tasks accomplished by Group 2 are predominantly in the General Technical and Mechanical areas.

The AD and AS ratings alone exhibit requirements in the Electrical "Nature" AS requiring ten percent in the E4 pay grade and AD requiring 33 percent in the E5 pay grade.

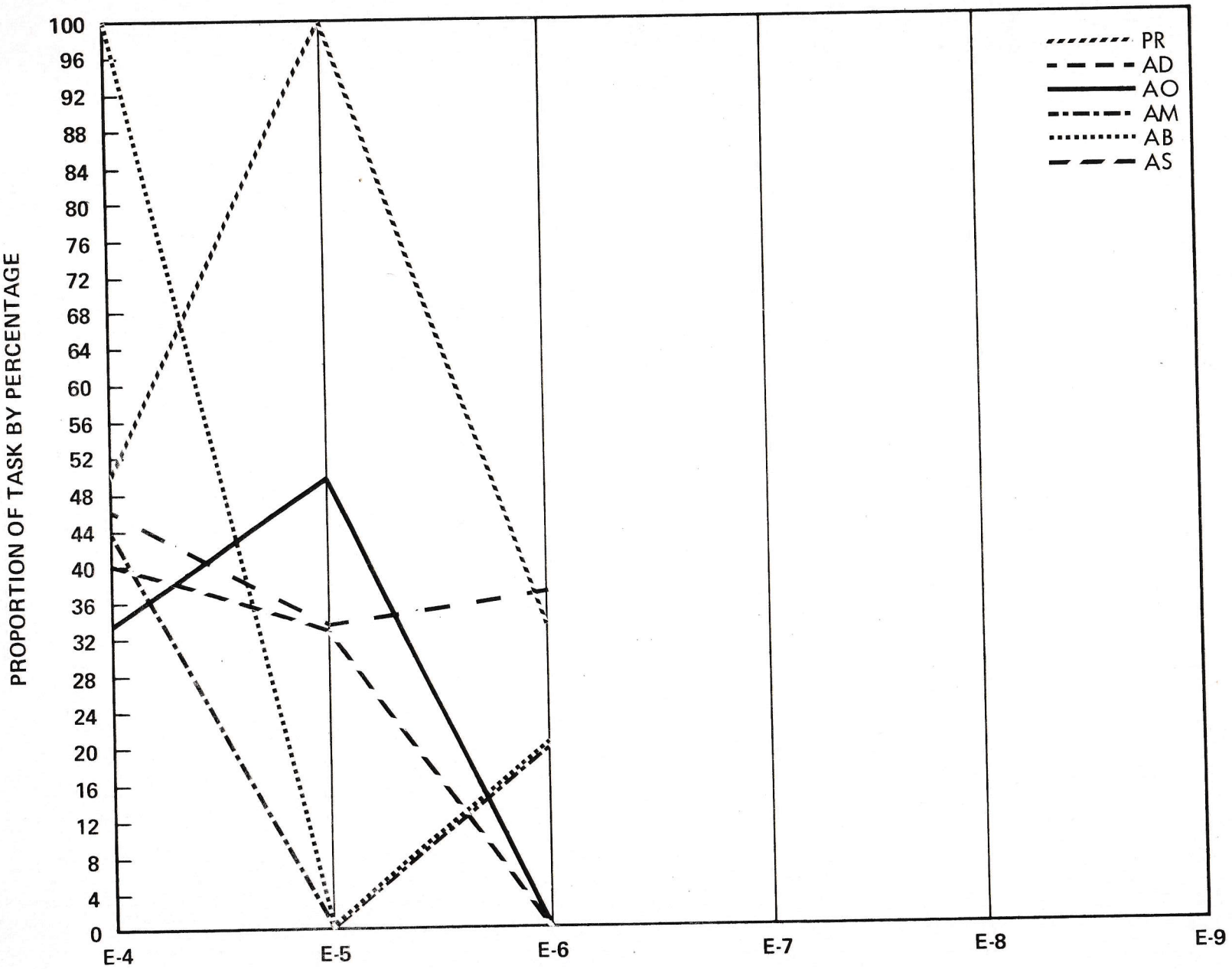
The PR, AD, and AO ratings generally track on the General Technical "Nature" but change considerably in magnitude at the E5 pay grade. The AM, AB, and AS ratings are reasonably in agreement on direction on this "Nature," but disagree also on magnitude.



PLOT OF AVERAGES OF NATURE
FOR PAYGRADE INTRA GROUP RATINGS
GROUP 2
(GENERAL TECHNICAL) FIGURE 6-A



PLOT OF AVERAGES OF NATURE
FOR PAYGRADE INTRA GROUP RATINGS
GROUP 2
(ELECTRICAL) FIGURE 6-B



PLOT OF AVERAGES OF NATURE
FOR PAYGRADE INTRA GROUP RATINGS
GROUP 2
(MECHANICAL) FIGURE 6-C

For the final "Nature" factor, Mechanical, the pattern between PR, AO is in the same direction but deviant in magnitude; AM and AB are in the same direction but deviant in magnitude, while AD and AS are almost random by comparison.

6.9 CUTOFF POINTS

In 6.6, Amalgamation of "Characteristics," there was found to be a changing of the "Characteristics" of tasks as pay grades changed. It is necessary to determine at which point in the pay grade structure differences in "Characteristics" are most sharply defined.

To define these cutoff points the proportion of each "Characteristic" which occurred at the E4 pay grade was compared against the same "Characteristic" amalgamation for the E5, E6, E7, E8, and E9 pay grades. The same process was followed for E4 and E5 vs. E6, E7, E8, and E9. Also E4, E5 and E6 were compared against E7, E8, and E9. This was done for Groups 1 and 2. The data for these analyses are shown in Table 11.

Figure 7 presents the plot of the "Characteristics" for the amalgamations of Group 1. Ideally there would be a point at which no "Characteristics" would overlap in pay grade groups, thus providing highly definitive cutoff points. Although this is not fully achieved, it can be seen that if pay grades E4 and E5, as a group, are compared against pay grades E6, E7, E8, and E9, as a group, the overlap is rather insignificant. There are only three "Characteristics" in which overlap occurs, Maintain, Inspect, and Administer. Only five percent of the Maintain "Characteristic" appears in the E6 and above pay grades, while 89 percent appears between E4 and E5 pay grades. Similarly, only three percent of the Inspect "Characteristic" appears in the E6 and above group while six percent appears between E4 and E5 pay grades. On the other hand, 29 percent of the

GROUP 1 RATING Total

CHARACTERISTICS	E4	E5,6,7,8,9	E4&5	E6,7,8,9	E4,5,6	E7,8,9
Operate	.02		.01			
Maintain	.88	.21	.89	.05	.47	.01
Inspect	.05	.04	.06	.03	.09	
Supervise		.13		.16	.12	.14
Administer	.05	.23	.04	.29	.32	.18
Plan		.10		.12		.18
Evaluate		.24		.29	.01	.41
Interface		.05		.06		.08
NATURE						
Electronic	.44	.12	.48	.02	.27	.01
General Tech.	.18	.82	.19	.95	.61	.97
Electro Mech.	.05		.04			
Electrical	.13	.04	.12	.03	.06	.03
Mechanical	.21	.02	.18		.05	

GROUP 2 RATING Total

CHARACTERISTICS	E4	E5,6,7,8,9	E4&5	E6,7,8,9	E4,5,6	E7,8,9
Operate						
Maintain	.89	.09	.89	.02	.61	
Inspect		.03		.03		.03
Supervise		.13	.02	.13	.06	.13
Administer	.11	.16	.09	.16	.28	.06
Plan		.33		.36	.01	.44
Evaluate		.18		.20	.04	.22
Interface		.09		.10		.12
NATURE						
Electronic						
General Tech.	.45	.92	.49	.95	.58	1.00
Electro Mech.						
Electrical	.02	.01	.03		.02	
Mechanical	.53	.07	.48	.05	.40	

GROUP ___ RATING ___

CHARACTERISTICS	E4	E5,6,7,8,9	E4&5	E6,7,8,9	E4,5,6	E7,8,9
Operate						
Maintain						
Inspect						
Supervise						
Administer						
Plan						
Evaluate						
Interface						
NATURE						
Electronic						
General Tech.						
Electro Mech.						
Electrical						
Mechanical						

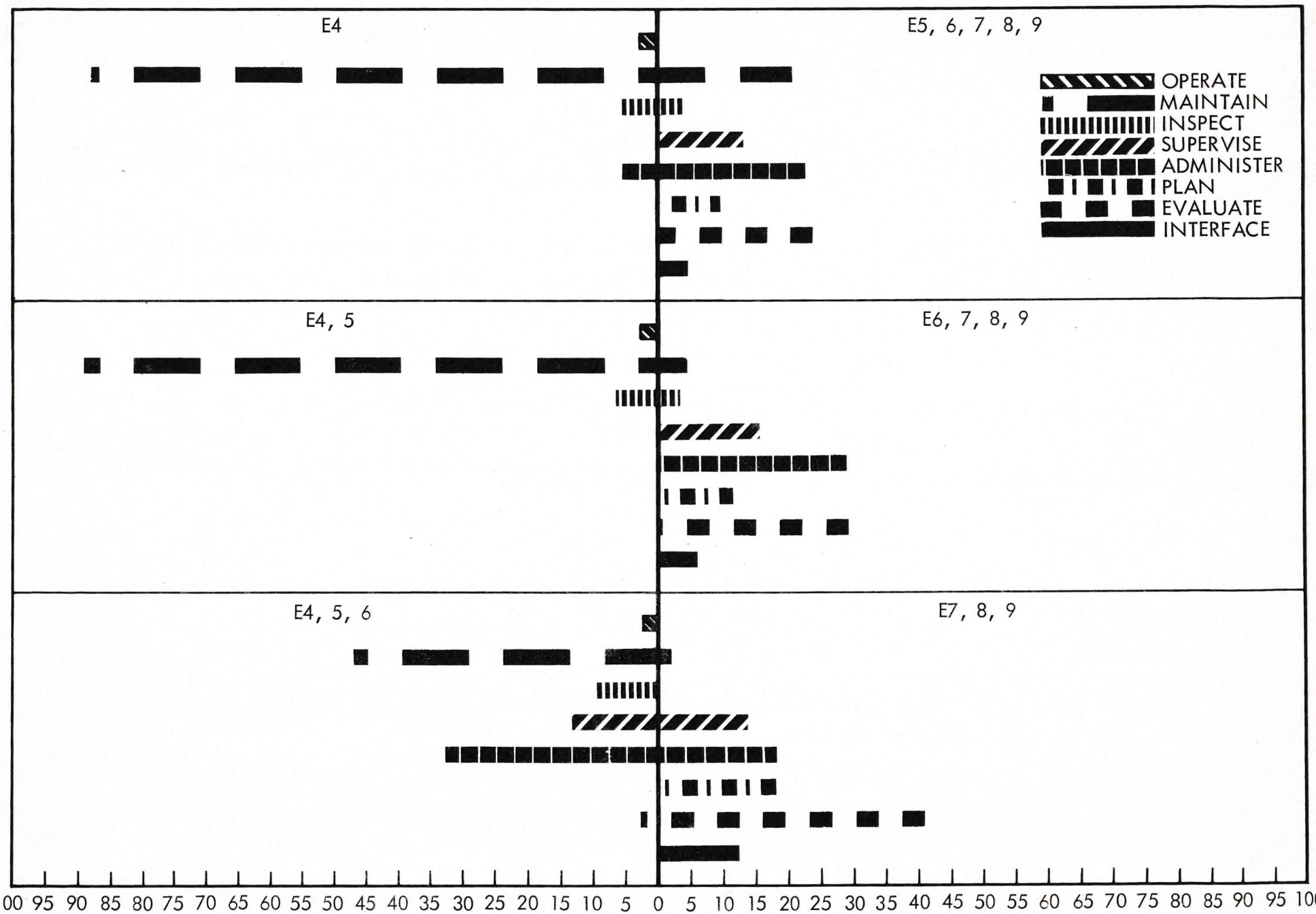
GROUP ___ RATING ___

CHARACTERISTICS	E4	E5,6,7,8,9	E4&5	E6,7,8,9	E4,5,6	E7,8,9
Operate						
Maintain						
Inspect						
Supervise						
Administer						
Plan						
Evaluate						
Interface						
NATURE						
Electronic						
General Tech.						
Electro Mech.						
Electrical						
Mechanical						

BASE FOR DETERMINING CUTOFF
FOR AMALGAMATING PAY GROUPS

SUMMARY GROUP 1 AND GROUP 2

TABLE 11



CUT OFF POINTS FOR PAYGRADE AMALGAMATION
GROUP 1 FIGURE 7

Administer "Characteristic" appear at the E6 and above pay grades, while four percent appears in the E4 and E5 pay grades.

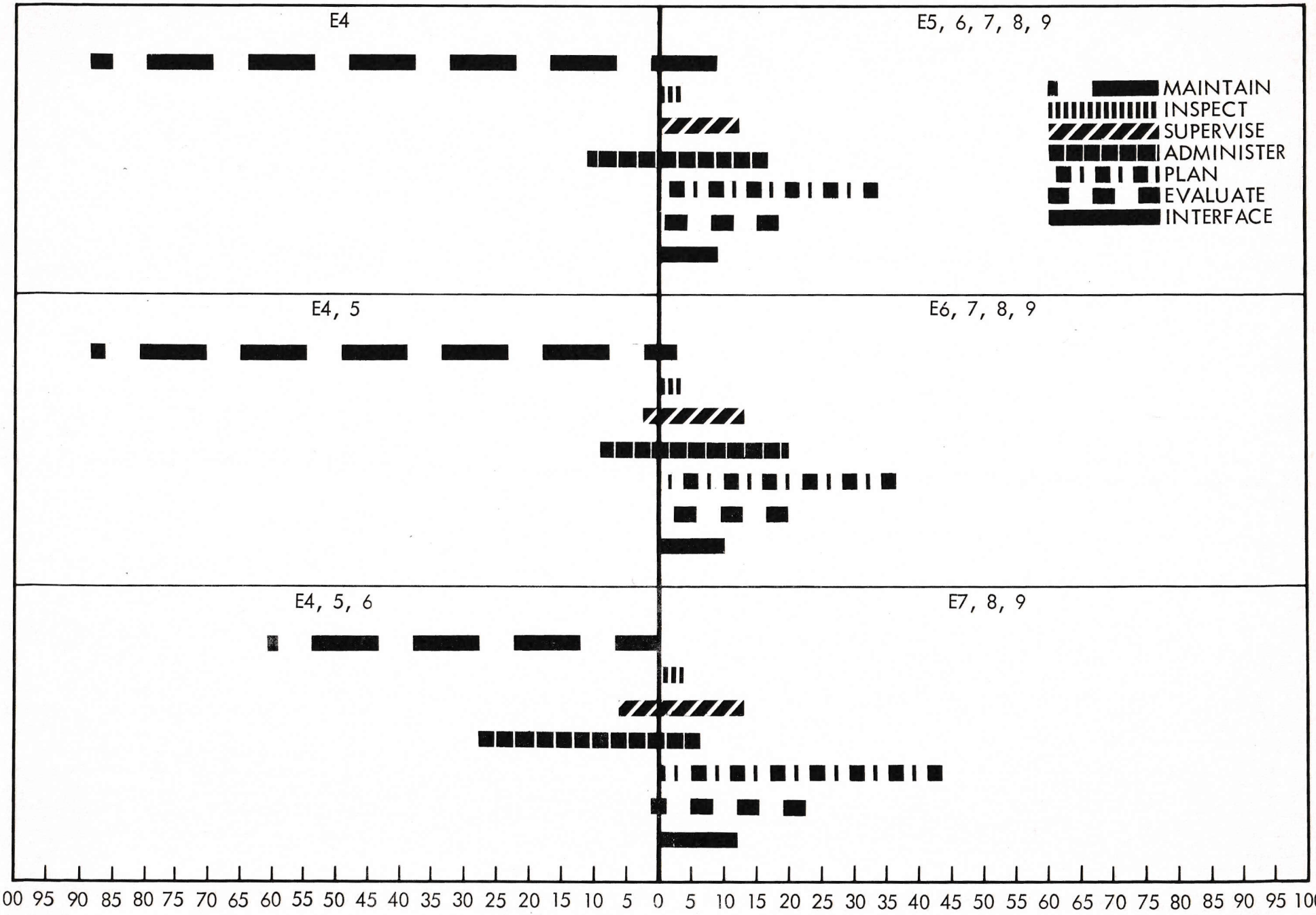
The same general condition prevails in Group 2, as shown in Figure 8. There is a very small amount of the Supervise "Characteristic" (two percent) in the E4 and E5 pay grades, as opposed to E6 and above. The Inspect "Characteristic" appears only at E6 and above but only constitutes three percent of the tasks. This is somewhat contrary to Group 1 where the bulk of the "Characteristic," though small, appears below the E6 pay grade. The Inspect "Characteristic" in Group 2 is also somewhat dissimilar from Group 1 in that the "Characteristic" appears at E6 pay grade and above in Group 2, while the larger portion of this "Characteristic" appears below the E6 pay grade in Group 1.

7.0 CONCLUSIONS

7.1 GENERAL

There seems to be reasonably strong evidence that a change occurs in the "Characteristics" of the enlisted task as the pay grade changes. Initial results indicate that the lower pay grades (E4 and E5) are fundamentally technical tasks. At E6 and above, the tasks seem to first become administrative, progressing to supervisory and thence managerial; planning, evaluating, interfacing.

The original concept of this proposal is that man-hours can be allocated over a given work week per man if maximum crew flexibility can be attained. There seems to be reasonably good evidence that such flexibility can be attained. This is based in the degree of correlation which occurs in the tasks of groups as they were divided. Further, the correlation obtained in the consistency in mutations of the "Characteristics" of the tasks on a pay grade scale seem to allow for a managerial group separated from a technical group. Having such a managerial group (rating) may allow general coverage across several other clerical or administrative ratings, thus providing greater flexibility.



CUT OFF POINTS FOR PAYGRADE AMALGAMATION
GROUP 2 FIGURE 8

7.2 THE SELECTION PROCESS

Since there are fundamentally different kinds of skills involved in technical "Characteristics" than are in administrate/managerial "Characteristics," there should be consideration in the selection process for the types of skills which are required in the overall advancement process. If the enlistees are selected for a particular rating, on the basis of their aptitudes in technical areas, i.e., electronic, mechanical, etc., they may find themselves in a position later in which they have become extremely highly skilled technicians but are stymied in their advancement because they do not possess managerial capability.

Conversely, there are groups of potential enlistees who may have a high managerial capability, but have no mechanical aptitude. In a sense, this group is prevented from exercising their possible managerial competence by not being able to take the first few steps because of their lack of technical skills.

Since the selection batteries are generally geared to distinguish on these factors, it would be a relatively simple matter to segregate on the specific factors desired, thus generating a potential pool for entry on either a technical or managerial ladder.

7.3 POSSIBLE ULTIMATE APPROACH

Assuming that a differential selection which separates managerial and technical skills is viable, then two problems must be solved. First there is the problem of providing an equitable advancement program and goal for each of the categories. Second, there must be a training program which prepares enlistees in each category.

7.3.1 Equitable Advancement Program

In general, the present Navy enlisted advancement program presents a peculiar situation in the area of the supergrades E8 and E9 vs. Warrant Officer (W.O.). It is understood that the initial concept of the introduction of the supergrades was the expectation of the elimination of the W.O. category.

Regardless of the influences which were instrumental in retaining the W.O., the fact remains that there is a subtly definable difference between the supergrades and the W.O. program. Partly it is sensed in the fact that the supergrade progression is determined by competitive examination and the advancement to W.O. is by recommendation. The examination process indicates the requirement to have a body of information in order to qualify. The recommendation process is more closely aligned with indefinable qualities and seems possibly more inclined toward selection of leadership abilities. Admittedly, there is a highly speculative factor in this analysis, but there is a sufficient possibility to justify further pursuit.

Assuming the viability of cross-training (discussed later under 7.3.2) in the technical area in the purely technical sense, and a separate advancement ladder in the managerial skills, there could be several advancement ladders. In all cases, the same basic steps would apply as in the present classification system. The enlistee would go through AR, AA, AN to learn his basic Navy processes for the aviation group. One group would follow one of several technical skills ladders, e.g., Group 1 electronic or Group 2 mechanical. The striker would undertake an area which presently constitutes a rating. At some level of proficiency (logically equivalent to the present E5) he could then strike for additional grade which would consist of learning a second area of technical skills within the overall group with which he is allied. As he acquired a broader technical skill base his pay would increase accordingly.

The managerial trainee would be likely to start in administration, move through supervision, evaluation, planning, liaison and management, with equivalent pay.

7.3.2 Training

In both cases, technical and management training should become easier and more effective. In the case of the technical skills much of the

training in one specialty should carry over into the next. There would be no different types of requirements which might cause a technically oriented enlistee trouble. In the case of the managerially oriented enlistee, there would be no technical stumbling blocks, and the training could be much more specifically oriented.

8.0 RECOMMENDATIONS FOR FURTHER STUDY

As originally proposed, Phase II of this study, the detailed matrices of the nature and characteristic factors would be related to a sample of Naval Aviation operations, an "idealized" crew would be determined in light of functional requirements a feasible crew would be generated.

In addition to this, it is felt that further refinement of Phase I would prove exceedingly helpful. It should be now possible to test the possibility of including the Aviation Maintenance Administrationman (AZ) and the Aviation Storekeeper (AK) in the overall managerial group.

It is proposed that the correlations obtained here be tested and refined by using the actual test previously administered for qualification testing.

It is further proposed that these same tests be used to establish a base for a study of the extent to which training concepts, practices and details would have to be modified to accept the concepts delineated in this report.

As originally proposed, an approach to computerizing the output of Phase II will be detailed, in addition to an approach to integrating this output with other available computer models.

APPENDIX A

As indicated in the text, there are certain inconsistencies in the "Quals Manual." Since these inconsistencies do not constitute a portion of the present report, they are presented for information purposes only.

No attempt has been made to evaluate whether different requirements are at equivalent levels. What is shown is the points at which the same qualifications are shown at non-equivalent rates for different ratings. As can be seen most of the qualifications change by one pay grade. However, as can also be seen, some qualifications range from E4 - E7 pay grades for different ratings.

There are some ratings in which the qualifications requirements change rates by rating but different types of equipment are called out. These are indicated by a blank shown in the qualification, and the specific equipment type indicated in the interface above the pay grade.

In one specific case, the AS rating shows the qualification to "review material allowance lists . . . . . " at both the E7 and E8 paygrades.

	AX	AT	AQ	TD	AW	AE
THEORY AND PRINCIPLES						
Principles of electron tubes, semiconductors, and transistors.	E4	E4	E4	E4		E5
Principles of rectifiers, filters, and regulators used in power supply circuits.	E4	E4	E4	E4		E5
Principles and applications of synchros and servo systems.	E4	E4	E4			E5
Principles of detectors, amplifiers, and oscillators.	E4	E4	E4	E5		E6
Principles of phase inverters and cathode followers.	E4	E4	E4	E5		E5
Principles and applications of gas-filled and cathode-ray tubes.	E4	E4	E4	E5		
Principles and applications of:						
• Magnetic Anomaly Detection System (MAD)	E4				E7	
• Jezebel	E4				E6	
Principles and applications of limited, clamper, counter, and discriminator circuits	E5		E5	E6		E6
Principles of sweep generators, gated amplifiers, and timing circuits.	E5	E6	E6	E6		
Principles and applications of saturable core reactors and magnetic amplifiers.	E5	E6	E5	E6		
Principles of impedance matching.	E5	E6	E6			
Principles and applications of digital computer:						
a. Input-output devices	E6	E5				
b. Numbering systems and codes	E6	E5				
c. Control, arithmetic and memory sections	E6	E5				
d. Analog-digital and digital-analog conversion	E7	E6			E6	
e. Logic circuits	E7	E6				
Principles of:						
a. Resonant circuits, coupling circuits, and filter networks.	E5	E5	E5	E5		E6
b. Klystrons and magnetrons		E5	E6			
c. Traveling wave tubes		E5	E6			
Function and characteristics of electronic circuit parts	E4	E4	E4	E4	E4	E5

	AX	AT	AQ	TD	AW	AE
Maintenance						
Make tests for short circuits, grounds and continuity of interconnecting cables between units of _____ equipment	ASW E4	Elec E4	Elec E4		ASW E5	E4
Verify discrepancies in aircraft _____ equipment	ASW E5	Nav & Com E5		TrDev E4		Elect E5
Isolate equipment malfunctions to defective units (black boxes in _____ equipment)	ASW	Nav & Com Radar ECM E5	Bomb Dir F/C E5	Tr Dev E4		
Supervise and direct _____ organizational maintenance inspect completed work	ASW E6	Elec E6	Arm Control E6	Tr Dev E7		Elect E6
Evaluate performance of overhauled, modified or newly installed aircraft _____ equipment	ASW E7	Elect E7	Arm Control E7		ASW E7	E6
Administration						
Standard organization and maintenance procedures of aircraft squadrons and maintenance activities	E6	E6	E6			E7
Procedures for surveying accountable materials	E7	E7	E7			E6
Regulations governing classification, preparation, safeguarding and declassification of classified material			E8		E9	E7
Senior Chief						
Draft letters, instructions, notices and messages applicable to avionics maintenance activities	E8	E8	E8		E9	E8

	AX	AT	AQ	TD	AW	AE
DRAWINGS, SCHEMATICS, AND PUBLICATIONS						
Use system block diagrams and data flow charts in checking aircraft _____ equipment	ASW E4	E5	Bomb Dir F/C E4			Elect & Instru-mentation E5
Use mechanical, electrical, electronic schematics and drawings in the installation of changes and modifications	E5	E5		E4		Elect E5
Follow pictorial diagrams and service instructions to disassemble, clean and lubricate mechanical and electrical equipment	E5	E4	E4			E5
Types and uses of information contained in manuals relating to operation, servicing, inspection, and maintenance of aircraft _____ equipment	ASW E4	Elec E4	Arm E4	TD E5		E4

	PR	AD	AO	AM	AB	AS
Senior Chief						
Draft letters, instructions, notices, and messages applicable to aircraft maintenance activities	E8	E8		E8	E9	
Safety						
Inspect work areas, tools and equipment to detect potentially hazardous and unsafe conditions and take appropriate corrective action	E7	E6		E7	E4	E7
Maintenance						
Screen defective components for feasibility of repair					E7	E6
Perform periodic inspections		E5	E6	E5		E4
Administration						
Fundamental concepts, objectives, and functions of quality control	E7		E8	E8		
Review material allowance lists periodically for adequacy and make recommendations for changes as necessary	E8		E8	E8	E8	E7 E8