NUCLEAR ENVIRONMENTAL QUALIFICATION TEST REPORT NO. ES-1000 ON E7000 SERIES TIMING RELAYS

BY

CONTROL PRODUCTS DIVISION

AMERACE CORPORATION

(P/N 37032-01)

DONALD C. COOK NUCLEAR PLANT
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DATE: 071382		X

E. G. SECT. FILE: AMERACE Corp

NUCLEAR ENVIRONMENTAL QUALIFICATION TEST REPORT ON E7000 SERIES TIMING RELAYS BY CONTROL PRODUCTS DIVISION AMERACE CORPORATION

	DATE	SIGNATURE
PREPARED BY:	4/3/80	[signature] E. J. LESZCZAK, PRODUCT ENGINEER
APPROVED BY:	4/3/80	[signature] R. J. MALECKI, CHIEF ENGINEER
APPROVED BY:	4/7/80	[signature] J. TONINI, PRODUCT MANAGER
APPROVED BY:	4/3/80	[signature] M. MARTIN, QUALITY ASSURANCE MANAGER
COMPANY OFFICIAL:	4/14/80	[signature] R. J. BERTLING, PLANT GENERAL MANAGER

STATE OF WISCONSIN
COUNTY OF OZAUKEE

On this 14th day of April 1980 personally appeared before me the above named R. J. Bertling to me known or known to me to be the person described in and who executed the foregoing instrument and he acknowledged that he executed the same.

(Seal) _____ (Notary Public)

Notary Public of Wisconsin
My Commission Expires _____

PREFACE

This test report (number ES-1000) complements Wyle Test Report Number 43706-2, Volume I, and replaces Volume II (which is the raw data volume for baseline, hostile environment and post test inspection tests).

Together, these two documents contain results from a generic qualification test program which was performed on representative samples from a family of timing relays which are coded E7000 series. The tests performed were part of a larger qualification test program conducted at Wyle Laboratories in Huntsville, Alabama which consisted of a total of thirty-eight (38) relays including various other models and types.

Some parts of Wyle Test Report Number 43706-2, Volume I do not pertain entirely or in part to the E7000 series timing relays. This is because the Wyle test report reflects the total test program which included the testing of other products (as stated above).

ES-1000 addresses only the E7000 series timing relays and will act as a guide to the applicable portions of the Wyle test report for these particular relays. This document also replaces Volume II of the Wyle test report which contains raw data from the baseline, hostile environment and post test inspection portions of the test program. This was done in order to present this data in a more reduced, meaningful and understandable form. Certain data will be stated in terms of min. or max. value rather than a specific value of performance. The original raw test data is on file at Amerace Corporation and is available if necessary.

The relay model numbers have been revised from those as stated in the accompanying Wyle Test Report Number 43706-2, Volume I and Qualification Test Plan Number 545/5614-3/ES. This was done in order to facilitate the handling of certain requirements of Federal Regulation 10CFR part 21. The "E" (nuclear safety related) designator was moved from the end of the model code to the front and a three digit numerical suffix was added in order to provide configuration control capabilities. If and/or when a design change is required, which effects form, fit and/or function with respect to qualification test status, the configuration code number will advance (001 to 002, etc.) and this report will be amended to justify the change either by test or analysis. Since this ES-1000 Test Report reflects the new model numbering system and the Wyle test report expresses the old model numbers, the following cross reference will correlate the old to the new numbering systems.

PREFACE: (cont'd)

AS STATED IN WYLE TEST REPORT NO. 43706-2	AS STATED IN AMERACE TEST REPORT NO. ES-1000
OLD CATALOG MODEL NO.	NEW CATALOG MODEL NO.
7012ACE	E7012AC001
7022ACE	E7022AC001
7012PCE	E7012PC001
7022PCE	E7022PC001
7014ACE	E7014AC001
7024ACE	E7024AC001
7014PCE	E7014PC001
7024PCE	E7024PC001

7012PCLE
7012ACLLE
7012ACTE
7022PCTE

These relays were engineering prototypes and are not available as Class 1E qualification tested timing relays.

REVISIONS

REV	PAGES AFFECTED	DESCRIPTION OF CHANGE	DATE	APPROVAL
A	1-105	ORIGINAL RELEASE	4-3-80	E.J.L.

TABLE OF CONTENTS

ADMINISTRATIVE DATA

PURPOSE OF TEST: To provide Generic Qualification Test Data covering AGASTAT® E7000 Series Timing Relays, which were subjected to a qualification test program to determine compliance of said items to the applicable portions of IEEE STD. 323-1974 (IEEE STANDARD FOR QUALIFYING CLASS 1E EQUIPMENT FOR NUCLEAR POWER GENERATING STATIONS) and IEEE STD. 344-1975 (IEEE RECOMMENDED PRACTICE FOR SEISMIC QUALIFICATION OF CLASS 1E EQUIPMENT FOR NUCLEAR POWER GENERATING STATIONS.)

NOTE: Reference will also be made in the seismic portion of this document to IEEE STD. 501-1978 (IEEE STANDARD FOR SEISMIC TESTING OF RELAYS) even though not a standard at the time of testing.

LIMITATIONS OF TEST RESULTS: Since it is not possible to define the conditions for every conceivable application for relays, those parameters which in practice encompass the majority of applications have been specified.

If this data is not applicable to a particular requirement, then proof testing or justification by analysis must be performed for that particular case.

The data documented in this Test Report applies only to AGASTAT® E7000 Series Relays mounted on RIGID TEST FIXTURES and does not apply to the relays as mounted on switch boards, panels or any structure.

It is the responsibility of the POWER SYSTEM FACILITY DESIGNER to combine data on seismic and environmental performance of the relays to arrive at an acceptable equipment design for a particular application.

MANUFACTURER: Control Products Division
of Amerace Corporation
Grafton, Plant

MANUFACTURER'S TYPE AND MODEL NOS. OF ITEMS TESTED: E7012AC001, E7012PC001, E7022AC001, E7022PC001, E7014AC001, E7024AC001, E7014PC001, and E7024PC001.

QUANTITY OF ITEMS TESTED: A total of sixteen (16) E7000 series timing relays were tested (two (2) each of the models and types specified). However, only eight (8) devices (one (1) of each model and type) were actually tested to completion. The other (8) devices were spares and were purposely parallel tested, up to, and through the heat aging point for use in case of accidental damage of actual test devices.

TEST ORIENTATION: The relays were qualification tested for vertical mounting only.

DATE TEST STARTED: September 1977

DATE TEST COMPLETED: August 23, 1978

QUALIFIED LIFE OBJECTIVE: Ten (10) years from date of manufacture or 25,000 operations, whichever occurs first.

TEST CONDUCTED BY: Wyle Laboratories
Scientific Services and Systems Group
Huntsville, Alabama

TEST PLAN: Applicable portions of Wyle Qualification Test Plan 545/5614-3/ES, Revision A, copy of which can be found in the accompanying Wyle Test Report No. 43706-2, Volume I, Section XIII.

Deviations from procedures as stated in Wyle Qualification Test Plan Number 545/4614-3/ES

(1) Paragraph 2.0, Page 4 of Wyle Qualification Test Plan calls for "Contact Transfer Time" to be recorded during baseline tests. This was changed during the test program to operate and release time for all relays. This change is reflected in Wyle Test Report Number 43706-2, Volume I, Section I, Pages I-1 and I-2, paragraphs 1.0 and 2.0.

(2) Paragraph 11.2.1, Page 10 of Wyle Qualification Test Plan calls for hostile environment test at a temperature of 35°F at 95% Relative Humidity. In actual testing the 35°F temperature humidity test could not be conducted due to formation of ice on the relays and in the test chamber. For this reason the temperature was changed to 40°F and the test was conducted at that value. This change is reflected in Wyle Test Report Number 43706-2, Volume I, Section X, Pages X-1 and X-2 paragraphs 2.0 and 3.0.

(3) Figures 1 and 2, Pages 16 and 17 of Wyle Test Plan calls for Dielectric Test Voltage to be conducted at 2420 VRMS, 60 Hz. This value was reduced for all relays (during the post cycle with load aging functional test portion of the test program) to 1650 VRMS, 60 Hz. This change is reflected in Wyle Test Report Number 43706-2, Volume I, Section V, Pages V-1, paragraph 3.0 and Pages V-3 and V-4.

OBJECTIVES: The basic objective of this test program was to verify and/or establish the operational and performance parameters for the projected qualified life of each type of relay. Also, with respect to seismic response, to establish seismic levels and to demonstrate operability before, during and after design basis earthquakes.

REFERENCES: IEEE 323-1974, "IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations."

IEEE 344-1975, "IEEE Standard for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations."

IEEE 501-1978, "IEEE Standard for Seismic Testing of Relays."

ABSTRACT: The relays were tested in accordance with the applicable portions of Wyle Qualification Test Plan Number 545/5614-3/ES and the deviations to same as stated on page 7 of this ES-1000 test report.

The Baseline Test Specifications which were established and/or verified from the data which resulted from this program can be found on Figure 1 for models E7012/E7022 and Figure 2 for models E7014/E7024 on pages 13 and 14 respectively.

The Class 1E (Nuclear Safety Related) performance characteristics which were established and/or verified from data generated from this test program and which were published in documents E7012/E7022 and E7014/E7024 can be found in the appendixes of this report.

Baseline functional test data, hostile environment and post test inspection summaries; which were derived from the raw data of Volume II, of the Wyle Test Report can be found on pages 15 thru 33, 49 thru 57 and 58 thru 59 respectively.

Seismic test summary which complements Section VIII, of the Wyle Test Report can be found on pages 34 thru 48 in the body of this report.

The Engineering Analysis and cause for Anomalies 1, 3 & 4 can be found on page 11 of this report.

TEST PROGRAM SUMMARY: A brief test program summary can be found on pages 1 thru 8 of Wyle Test Report Number 43706-2, Volume I.

For the complete test program summary follow the test program summary table on page 10 of this report.

TEST PROGRAM SUMMARY TABLE

	WYLE TEST REPORT NO. 43706-2 VOLUME I	AMERACE TEST REPORT ES-1000
QUALIFICATION TEST PLAN & DEVIATIONS	SECTION XIII	PAGES 7-8
ESTABLISHED AND/OR VERIFIED SPECIFICATIONS FOR BASELINE TESTS	N/A	PAGES 12-14
INITIAL BASELINE FUNCTIONAL TESTS AND DATA	SECTION I	PAGES 15-33
RADIATION AGING TEST	SECTION II	N/A
POST RADIATION FUNCTIONAL TESTS AND DATA	SECTION III	PAGES 15-33
CYCLING WITH LOAD AGING TEST	SECTION IV	N/A
POST-CYCLE/LOAD AGING FUNCTIONAL TESTS AND DATA	SECTION V	PAGES 15-33
TEMPERATURE AGING TEST	SECTION VI	N/A
POST TEMPERATURE FUNCTIONAL TESTS AND DATA	SECTION VII	PAGES 15-33
SEISMIC AGING & FRAGILITY-TYPE TESTS AND DATA	SECTION VIII	PAGES 34-48
POST SEISMIC FUNCTIONAL TESTS & DATA	SECTION IX	PAGES 15-33
HOSTILE ENVIRONMENT TESTS AND DATA	SECTION X	PAGES 49-57
POST HOSTILE ENVIRONMENT FUNCTIONAL TESTS AND DATA	SECTION XI	PAGES 15-33
POST TEST INSPECTION	SECTION XII	PAGES 58 & 59
ESTABLISHED AND/OR VERIFIED NUCLEAR SAFETY RELATED PERFORMANCE CHARACTERISTICS FOR:		
MODELS E7012/E7022	N/A	PAGES 60-82
E7014/E7024	N/A	PAGES 83-105

ENGINEERING ANALYSIS AND CAUSE FOR ANOMALIES 1, 3 AND 4:

Notice of Anomalies 1 & 3 were both due to the following condition. A brass insert that is molded in the phenolic terminal block was tilted beyond allowable design tolerances. This misalignment caused an insufficient air gap between non connected contacts on one side of the switch which resulted in an abnormally low dielectric breakdown level. The reason this condition existed and is not typical in production is because the molded terminal blocks used were among the first prototypes to be produced using a new non-asbestos filled material. This material reacted a little differently in the mold than the previously used compound. Necessary corrections have been made to the molding process so that by the time the new material was introduced into full production proper alignment was being maintained on the insert.

Rather than delay the test program and replace the terminal block assemblies, Amerace Corporation decided to lower the dielectric test voltage for the remainder of the tests from 2420 VRMS, 60 Hz to 1650 VRMS, 60 Hz. This change is reflected in notice of Anomaly #4 which can be found in the body of Wyle Test Report #43706-2, Volume I.

ESTABLISHED AND/OR VERIFIED OPERATING SPECIFICATIONS FOR BASELINE TESTS

THE FOLLOWING CROSS REFERENCE CORRELATES OLD TO NEW NUMBERING SYSTEMS:

AS STATED IN WYLE TEST REPORT NO. 43706-2 (OLD CATALOG MODEL NO.)	AS STATED IN AMERACE TEST REPORT NO. ES-1000 (NEW CATALOG MODEL NO.)
7012ACE	E7012AC001
7022ACE	E7022AC001
7012PCE	E7012PC001
7022PCE	E7022PC001
7014ACE	E7014AC001
7024ACE	E7024AC001
7014PCE	E7014PC001
7024PCE	E7024PC001

OPERATING SPECIFICATIONS FOR BASELINE TESTS (E7012 & E7022 SERIES)

BASELINE FUNCTIONAL TESTS		OPERATING SPECIFICATIONS BY RELAY CATALOG NUMBERS			
		E7012AC001 (7012ACE)	E7012PC001 (7012PCE)	E7022AC001 (7022ACE)	E7022PC001 (7022PCE)
COIL OPERATING VOLTAGE, NOMINAL RATED VOLTAGE		120 VAC	125 VDC	120 VAC	125 VDC
	PULL-IN % RATED VALUE	85% MIN	80% MIN	85% MIN	80% MIN
	DROP-OUT % RATED VALUE	50% APPROX	10% APPROX	50% APPROX	10% APPROX
OPERATING FREQUENCY		60 HZ	N/A	60 HZ	N/A
DIELECTRIC STRENGTH (VRMS, 60 HZ)					
	BETWEEN TERMINALS AND GROUND	1,500	1,500	1,500	1,500
	BETWEEN NON-CONNECTED TERMINALS	1,000	1,000	1,000	1,000
INSULATION RESISTANCE (MEGOHMS AT 500 VDC)		500 MIN	500 MIN	500 MIN	500 MIN
RELAY OPERATE TIME (MILLISECONDS)		NOTE 1	NOTE 1	50 MAX	50 MAX
RELAY RELEASE (RECYCLE) TIME (MILLISECONDS)		50 MAX	50 MAX	NOTE 2	NOTE 2
TIME DELAY (SECONDS)		NOTE 3	NOTE 3	NOTE 3	NOTE 3
*	TIME DELAY REPEATABILITY (PERCENT)	±10%	±10%	±10%	±10%
**	CONTACT BOUNCE (MILLISECONDS) AT 28 VDC, 1 AMP	10 MAX	10 MAX	10 MAX	10 MAX
**	CONTACT RESISTANCE (MILLIOHMS) AT 28 VDC, 1 AMP	200 MAX	200 MAX	200 MAX	200 MAX

* THE REPEAT ACCURACY DEVIATION (A_R) OF A TIME-DELAY RELAY IS A MEASURE OF THE MAXIMUM DEVIATION IN THE TIME-DELAY THAT WILL BE EXPERIENCED IN FIVE (5) SUCCESSIVE OPERATIONS AT ANY PARTICULAR TIME SETTING OF THE RELAY AND FOR ANY PARTICULAR OPERATING VOLTAGE OR CURRENT.

REPEAT ACCURACY IS OBTAINED FROM THE FOLLOWING FORMULA:

$$A_R = 100\,\frac{(T_1 - T_2)}{(T_1 + T_2)}$$

WHERE T_1 = MAXIMUM TIME DELAY
T_2 = MINIMUM TIME DELAY

** MAXIMUM CONTACT BOUNCE AND RESISTANCE AS STATED IS AVERAGE OF FIVE (5) CONSECUTIVE READINGS.

NOTE #1 - SINCE THIS IS THE TIME DELAY MODE FOR ON DELAY RELAY (SERIES E7012) THE OPERATE TIME IS NOT APPLICABLE. HOWEVER, TIME DELAY AT ZERO TIME DELAY SETTING SHOULD NOT EXCEED 200 MILLISECONDS.

NOTE #2 SINCE THIS IS THE TIME DELAY MODE FOR OFF DELAY RELAY (SERIES E7022) RELEASE (RECYCLE) TIME IS NOT APPLICABLE. HOWEVER, TIME DELAY AT ZERO TIME DELAY SETTING SHOULD NOT EXCEED 200 MILLISECONDS.

NOTE #3 THE TIME DELAY VALUES AS STATED IN THE BASE LINE TEST SUMMARY SHEETS DO NOT REFLECT TRUE SET POINT DRIFT. THIS IS BECAUSE, IN ORDER TO PROPERLY CONDUCT MANY OF THE OTHER BASELINE FUNCTIONAL TESTS, IT WAS NECESSARY TO REMOVE THE TIME DELAY BY TURNING THE (TIME DELAY) REGULATING DIAL TO THE ZERO SETTING, THEN RETURNING SAME TO ITS APPROXIMATE PREVIOUS SETTING FOR THE NEXT TEST SEQUENCE. DUE TO THE INTRODUCTION OF THE DIAL SETTING ERROR THE ACTUAL TIME DELAYS WERE RECORDED ONLY.

FIGURE 1

FIGURE 1

OPERATING SPECIFICATIONS FOR BASELINE TESTS (E7014 & E7024 SERIES)

	BASELINE FUNCTIONAL TESTS	OPERATING SPECIFICATIONS BY RELAY CATALOG NUMBERS			
		E7014AC001 (7014ACE)	E7014PC001 (7014PCE)	E7024AC001 (7024ACE)	E7024PC001 (7024PCE)
	COIL OPERATING VOLTAGE, NOMINAL RATED VOLTAGE	120 VAC	125 VDC	120 VAC	125 VDC
	PULL-IN % RATED VALUE	90% MIN	85% MIN	90% MIN	85% MIN
	DROP-OUT % RATED VALUE	50% APPROX	10% APPROX	50% APPROX	10% APPROX
	OPERATING FREQUENCY	60 HZ	N/A	60 HZ	N/A
	DIELECTRIC STRENGTH (VRMS, 60 HZ)				
	BETWEEN TERMINALS AND GROUND	1,500	1,500	1,500	1,500
	BETWEEN NON-CONNECTED TERMINALS	1,000	1,000	1,000	1,000
	INSULATION RESISTANCE (MEGOHMS AT 500 VDC)	500 MIN	500 MIN	500 MIN	500 MIN
	RELAY OPERATE TIME (MILLISECONDS)	NOTE 1	NOTE 1	75 MAX	75 MAX
	RELAY RELEASE (RECYCLE) TIME (MILLISECONDS)	75 MAX	75 MAX	NOTE 2	NOTE 2
	TIME DELAY (SECONDS)	NOTE 3	NOTE 3	NOTE 3	NOTE 3
*	TIME DELAY REPEATABILITY (PERCENT)	±10%	±10%	±10%	±10%
	CONTACT BOUNCE (MILLISECONDS) AT 28 VDC, 1 AMP	10 MAX	10 MAX	10 MAX	10 MAX
**	CONTACT RESISTANCE (MILLIOHMS) AT 28 VDC, 1 AMP	200 MAX	200 MAX	200 MAX	200 MAX

* THE REPEAT ACCURACY DEVIATION (A_R) OF A TIME-DELAY RELAY IS A MEASURE OF THE MAXIMUM DEVIATION IN THE TIME-DELAY THAT WILL BE EXPERIENCED IN FIVE (5) SUCCESSIVE OPERATIONS AT ANY PARTICULAR TIME SETTING OF THE RELAY AND FOR ANY PARTICULAR OPERATING VOLTAGE OR CURRENT.

REPEAT ACCURACY IS OBTAINED FROM THE FOLLOWING FORMULA:

$$A_R = 100 \frac{(T_1 - T_2)}{(T_1 + T_2)}$$

WHERE T_1 = MAXIMUM TIME DELAY

T_2 = MINIMUM TIME DELAY

** MAXIMUM CONTACT BOUNCE AND RESISTANCE AS STATED IS AVERAGE OF FIVE (5) CONSECUTIVE READINGS.

NOTE #1 SINCE THIS IS THE TIME DELAY MODE FOR ON DELAY RELAY (SERIES E7014) THE OPERATE TIME IS NOT APPLICABLE. HOWEVER, TIME DELAY AT ZERO TIME DELAY SETTING SHOULD NOT EXCEED 200 MILLISECONDS.

NOTE #2 SINCE THIS IS THE TIME DELAY MODE FOR OFF DELAY RELAY (SERIES E7024) RELEASE (RECYCLE) TIME IS NOT APPLICABLE. HOWEVER, TIME DELAY AT ZERO TIME DELAY SETTING SHOULD NOT EXCEED 200 MILLISECONDS.

NOTE #3 THE TIME DELAY VALUES AS STATED IN THE BASE LINE TEST SUMMARY SHEETS DO NOT REFLECT TRUE SET POINT DRIFT. THIS IS BECAUSE, IN ORDER TO PROPERLY CONDUCT MANY OF THE OTHER BASELINE FUNCTIONAL TESTS, IT WAS NECESSARY TO REMOVE THE TIME DELAY BY TURNING THE (TIME DELAY) REGULATING DIAL TO THE ZERO SETTING, THEN RETURNING SAME TO ITS APPROXIMATE PREVIOUS SETTING FOR THE NEXT TEST SEQUENCE. DUE TO THE INTRODUCTION OF THE DIAL SETTING ERROR THE ACTUAL TIME DELAYS WERE RECORDED ONLY.

FIGURE 2

DATA - BASELINE FUNCTIONAL TESTS FOR ACTUAL TEST DEVICES

NOTE: 1. SEE FIGURES 1 AND 2, PAGES 13 AND 14 OF THIS REPORT FOR OPERATING SPECIFICATIONS FOR BASELINE TESTS.

2. FOR PROCEDURE AND ADDITIONAL INFORMATION SEE WYLE TEST REPORT NO. 43706-2, VOLUME I, SECTIONS I,III,V,VII,IX, AND XI.

THE FOLLOWING CROSS REFERENCE CORRELATES OLD TO NEW NUMBERING SYSTEMS:

AS STATED IN WYLE TEST REPORT NO. 43706-2 (OLD CATALOG MODEL NO.)	AS STATED IN AMERACE TEST REPORT NO. ES-1000 (NEW CATALOG MODEL NO.)
7012ACE	E7012AC001
7022ACE	E7022AC001
7012PCE	E7012PC001
7022PCE	E7022PC001
7014ACE	E7014AC001
7024ACE	E7024AC001
7014PCE	E7014PC001
7024PCE	E7024PC001

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BASELINE TEST DATA SUMMARY.

RELAY CATALOG NO. E7012AC001 (7012ACE)

TEST ITEM NO. 2

PREPARED BY E.J. [illegible] DATE 2-7-80

BASELINE FUNCTIONAL TESTS	INITIAL FUNCTIONALS	RADIATION AGING	POST-RADIATION FUNCTIONALS	CYCLING WITH LOAD AGING	POST-CYCLE/LOAD AGING FUNCTIONALS	TEMPERATURE AGING	POST-TEMPERATURE AGING FUNCTIONALS	SEISMIC TESTS	POST-SEISMIC FUNCTIONALS	HOSTILE ENVIRONMENT TEST	POST-HOSTILE ENV FUNCTIONALS	POST-TEST INSPECTION
PULL-IN VOLTS VAC COIL	PASSED <102	2 X 10^5 RADS (GAMMA) TOTAL INTEGRATED DOSE	PASSED <102	RELAYS CYCLED FOR 27,500 OPERATIONS WITH ONE SET OF CONTACTS LOADED TO 120 VAC, 60 HZ AT 10 AMP, OR 125 VDC AT 1 AMP (RESISTIVE) WHICH IS RATED LOAD.	PASSED <102	100° CENTIGRADE FOR 42 DAYS	PASSED <102	RANDOM, MULTIFREQUENCY VIBRATION; 1-40 HZ, 30 SECOND DURATION, @ 5% DAMPING.	PASSED <102	COMBINATION TEMPERATURE/HUMIDITY/UNDER AND OVER VOLTAGE TEST.	PASSED <102	VISUAL INSPECTION FOR CONDITION OF MECHANICAL, ELECTRICAL AND RELAY CASE PARTS.
DROP-OUT VOLTS VAC COIL	PASSED 57 AVG.		PASSED 58 AVG.		PASSED 52 AVG.		PASSED 52 AVG.		PASSED 52 AVG.		PASSED 44 AVG.	
DIELECTRIC STRENGTH VOLTS RMS	PASSED @ 2420		PASSED @ 2420		PASSED @ 1650		PASSED @ 1650		PASSED @ 1650		PASSED @ 1650	
INSULATION RESISTANCE @ 500 VDC	PASSED >500 MEGOHMS		PASSED >500 MEGOHMS		PASSED >500 MEGOHMS		PASSED >500 MEGOHMS		PASSED >500 MEGOHMS		PASSED >500 MEGOHMS	
OPERATE TIME MILLISECONDS	PASSED <200		PASSED <200		PASSED <200		PASSED <200		PASSED <200		PASSED <200	
RECYCLE TIME MILLISECONDS	PASSED <50		PASSED <50		PASSED <50		PASSED <50		PASSED <50		PASSED <50	
TIME DELAY SECONDS	1.7 AVG.		1.7 AVG.		1.7 AVG.		1.9 AVG.		2.0 AVG.		1.8 AVG.	
REPEATABILITY PERCENT	PASSED 3.0%		PASSED 3.0%		PASSED 2.7%		PASSED 2.7%		PASSED 0.8%		PASSED 3.0%	
CONTACT BOUNCE @28 VDC, 1 AMP	PASSED AVG. <10 MS		PASSED AVG. <10 MS		PASSED AVG. <10 MS		PASSED AVG. <10 MS		PASSED AVG <10 MS		PASSED AVG. <10 MS	
CONTACT RESISTANCE @28 VDC, 1 AMP	PASSED AVG. <200 MILLIOHMS		PASSED AVG. <200 MILLIOHMS		PASSED AVG. <200 MILLIOHMS		PASSED AVG. <200 MILLIOHMS		PASSED AVG. <200 MILLIOHMS		PASSED AVG <200 MILLIOHMS	
DATE TEST CONDUCTED	2-15-78		3-20-78		4-4-78		5-30-78		7-6-78		8-18-78	

amerace

CONTROL PRODUCTS DIVISION

AMERACE CORPORATION
CONTROL PRODUCTS DIVISION
UNION, N.J. 07083

TEST REPORT NO. ES-1000

REV. A

EN 224 3/80

BASELINE TEST DATA SUMMARY

RELAY CATALOG NO. E7022AC001 (7022ACE)

TEST ITEM NO. 2

PREPARED BY A. Brazil

DATE 2-7-80

BASELINE FUNCTIONAL TESTS	INITIAL FUNCTIONALS	RADIATION AGING	POST-RADIATION FUNCTIONALS	CYCLING WITH LOAD AGING	POST-CYCLE/LOAD AGING FUNCTIONALS	TEMPERATURE AGING	POST-TEMPERATURE AGING FUNCTIONALS	SEISMIC TESTS	POST-SEISMIC FUNCTIONALS	HOSTILE ENVIRONMENT TEST	POST-HOSTILE ENV FUNCTIONALS	POST-TEST INSPECTION
PULL-IN VOLTS AC 60HZ	PASSED ≤102	2X10⁵ RADS (Gamma) Total Integrated Dose	PASSED ≤102	Relays Cycled for 27,500 operations with one set of contacts loaded to 120VAC, 60HZ at 10 AMP or 125VDC at 1 AMP (resistive) which is Rated Load.	PASSED ≤102	100°CENTIGRADE for 42 DAYS	PASSED ≤102	Random, Multifrequency Vibration: 1-40 HZ, 30 Second Duration, @ 5g Damping.	PASSED ≤102	Combination Temperature/Humidity/Under And Over Voltage Test.	PASSED ≤102	Visual Inspection for Condition of Mechanical, Electrical and Relay Case Parts.
DROP-OUT VOLTS AC 60HZ	PASSED 37 AVG.		PASSED 42 AVG.		PASSED 38 AVG.		PASSED 42 AVG.		PASSED 41 AVG.		PASSED 41 AVG	
DIELECTRIC STRENGTH VOLTS RMS	PASSED @ 2420		PASSED @ 2420		PASSED @ 2420		PASSED @ 1650		PASSED @ 1650		PASSED @ 1650	
INSULATION RESISTANCE @ 500 VDC	PASSED >500 MEGOHMS		PASSED >500 MEGOHMS		PASSED >500 MEGOHMS		PASSED >500 MEGOHMS		PASSED >500 MEGOHMS		PASSED >500 MEGOHMS	
OPERATE TIME MILLISECONDS	PASSED ≤50		PASSED ≤50		PASSED ≤50		PASSED ≤50		PASSED ≤50		PASSED ≤50	
RECYCLE TIME MILLISECONDS	PASSED ≤200		PASSED ≤200		PASSED ≤200		PASSED ≤200		PASSED ≤200		PASSED ≤200	
TIME DELAY SECONDS	1.6 AVG.		1.6 AVG.		1.6 AVG.		1.7 AVG.		1.8 AVG.		1.6 AVG.	
REPEATABILITY PERCENT	PASSED 0%		PASSED 3.2%		PASSED 3.0%		PASSED 1.0%		PASSED 0.3%		PASSED 0.7%	
CONTACT BOUNCE @28 VDC, 1 AMP	PASSED AVG. ≤10 MS		PASSED AVG. ≤10 MS		PASSED AVG. ≤10 MS		PASSED AVG. ≤10 MS		PASSED AVG. ≤10 MS		PASSED AVG. ≤10 MS	
CONTACT RESISTANCE @28 VDC, 1 AMP	PASSED AVG. ≤200 MILLIOHMS		PASSED AVG. ≤200 MILLIOHMS		PASSED AVG. ≤200 MILLIOHMS		PASSED AVG. ≤200 MILLIOHMS		PASSED AVG. ≤200 MILLIOHMS		PASSED AVG. ≤200 MILLIOHMS	
DATE TEST CONDUCTED	2-16-78		3-20-78		4-4-78		5-30-78		7-6-78		8-18-78	

BASELINE TEST DATA SUMMARY

RELAY CATALOG NO. E7012PC001 (7012PCE)

TEST ITEM NO. 1/

PREPARED BY E. J. Lagyel DATE 2-7-80

BASELINE FUNCTIONAL TESTS	INITIAL FUNCTIONALS	RADIATION AGING	POST-RADIATION FUNCTIONALS	CYCLING WITH LOAD AGING	POST-CYCLE/LOAD AGING FUNCTIONALS	TEMPERATURE AGING	POST-TEMPERATURE AGING FUNCTIONALS	SEISMIC TESTS	POST-SEISMIC FUNCTIONALS	HOSTILE ENVIRONMENT TEST	POST-HOSTILE ENV FUNCTIONALS	POST-TEST INSPECTION
PULL-IN VOLTS VDC	PASSED <100	2X10⁶ RADS (Gamma) TOTAL INTEGRATED DOSE	PASSED <100	RELAYS CYCLED FOR 27,500 OPERATIONS WITH ONE SET OF CONTACTS LOADED TO 120 VDC, 60 MA. AT 10 MA. OR 125 VDC AT 1 AMP (RESISTIVE) WHICH IS RATED LOAD.	PASSED <100	- 100° CENTIGRADE FOR 42 DAYS	PASSED <100	RANDOM, MULTIFREQUENCY VIBRATION: 1-40 HZ.) 30 SECOND DURATION, @ 5G DAMPING	PASSED <100	COMBINATION TEMPERATURE/HUMIDITY/UNDER AND OVER VOLTAGE TEST.	PASSED <100	VISUAL INSPECTION FOR CONDITION OF MECHANICAL, ELECTRICAL AND RELAY CASE PARTS.
DROP-OUT VOLTS VDC	PASSED 14 AVG		PASSED 11 AVG.		PASSED 15 AVG.		PASSED 23 AVG.		PASSED 12 AVG		PASSED 10 AVG.	
DIELECTRIC STRENGTH VOLTS RMS	PASSED @ 2420		PASSED @ 2420		PASSED @ 2420		PASSED @ 1650		PASSED @ 1650		PASSED @ 1650	
INSULATION RESISTANCE @ 500 VDC	PASSED >500 MEGOHMS		PASSED >500 MEGOHMS		PASSED >500 MEGOHMS		PASSED >500 MEGOHMS		PASSED >500 MEGOHMS		PASSED >600 MEGOHMS	
OPERATE TIME MILLISECONDS	PASSED <200		PASSED <200		PASSED <200		PASSED <200		PASSED <200		PASSED <200	
RECYCLE TIME MILLISECONDS	PASSED <50		PASSED <50		PASSED <50		PASSED <50		PASSED <50		PASSED <50	
TIME DELAY SECONDS	1.6 AVG.		1.7 AVG		1.6 AVG.		2.0 AVG.		1.9 AVG.		1.7 AVG	
REPEATABILITY PERCENT	PASSED 3.0%		PASSED 5.9%		PASSED 3.0%		PASSED 0%		PASSED 0.3%		PASSED 0.4%	
CONTACT BOUNCE @28 VDC, 1 AMP	PASSED AVG. <10MS		PASSED AVG. <10MS		PASSED AVG. <10MS		PASSED AVG. <10MS		PASSED AVG. <10MS		PASSED AVG <10 MS	
CONTACT RESISTANCE @28 VDC, 1 AMP	PASSED AVG. <200 MILLIOHMS		PASSED AVG. <200 MILLIOHMS		PASSED AVG. <200 MILLIOHMS		PASSED AVG <200 MILLIOHMS		PASSED AVG <200 MILLIOHMS		PASSED AVG <200 MILLIOHMS	
DATE TEST CONDUCTED	2-15-78		3-20-78		4-4-78		5-30-78		7-6-78		8-19-78	

BASELINE TEST DATA SUMMARY

RELAY CATALOG NO. EP022AC001 (7022ACE)

TEST ITEM NO. 1

PREPARED BY E.J. Langwell DATE 2-8-80

BASELINE FUNCTIONAL TESTS	INITIAL FUNCTIONALS	RADIATION AGING	POST-RADIATION FUNCTIONALS	CYCLING WITH LOAD AGING	POST-CYCLE/LOAD AGING FUNCTIONALS	TEMPERATURE AGING	POST-TEMPERATURE AGING FUNCTIONALS	SEISMIC TESTS	POST-SEISMIC FUNCTIONALS	HOSTILE ENVIRONMENT TEST	POST-HOSTILE ENV FUNCTIONALS	POST-TEST INSPECTION
PULL-IN VOLTS VDC	PASSED <100	2X10⁵ RADS (GAMMA) TOTAL INTEGRATED DOSE	PASSED <100	RELAYS CYCLED FOR 27,500 OPERATIONS WITH ONE SET OF CONTACTS LOADED TO 120 VAC, 60HZ. AT 10 AMP OR 125 VDC AT 1 AMP (RESISTIVE) UNION IS RATED LOAD.	PASSED <100	100° CENTIGRADE FOR 42 DAYS	PASSED <100	RANDOM, MULTIFREQUENCY VIBRATION: 1-40 HZ., .30 SECOND DURATION, @ 5G DAMPING.	PASSED <100	COMBINATION TEMPERATURE/HUMIDITY/VIBRATION AND OVER VOLTAGE TEST.	PASSED <100	VISUAL INSPECTION FOR CONDITION OF MECHANICAL, ELECTRICAL AND RELAY CASE PARTS.
DROP-OUT VOLTS VDC	PASSED 15 AVG.		PASSED 12 AVG.		PASSED 28 AVG.		PASSED 38 AVG.		PASSED 83 AVG.		PASSED 22 AVG.	
DIELECTRIC STRENGTH VOLTS RMS	PASSED @ 2420		PASSED @ 2420		PASSED @ 2420		PASSED @ 1650		PASSED @ 1650		PASSED @ 1650	
INSULATION RESISTANCE @ 500 VDC	PASSED >500		PASSED >500		PASSED >500		PASSED >500		PASSED >500		PASSED >500	
OPERATE TIME MILLISECONDS	PASSED <50		PASSED <50		PASSED <50		PASSED <50		PASSED <50		PASSED <50	
RECYCLE TIME MILLISECONDS	PASSED <200		PASSED <200		PASSED <200		PASSED <200		PASSED <200		PASSED <200	
TIME DELAY SECONDS	1.6 AVG.		1.6 AVG.		1.4 AVG.		1.7 AVG.		1.7 AVG.		1.6 AVG	
REPEATABILITY PERCENT	PASSED 3.2%		PASSED 3.2%		PASSED 3.4%		PASSED 0.6%		PASSED 0.3%		PASSED 0.6%	
CONTACT BOUNCE @28 VDC, 1 AMP	PASSED AVG. <10MS		PASSED AVG <10MS		PASSED AVG. <10MS		PASSED AVG. <10MS		PASSED AVG. <10MS		PASSED AVG <10MS	
CONTACT RESISTANCE @28 VDC, 1 AMP	PASSED AVG. <200 MILLIOHMS		PASSED AVG <200 MILLIOHMS		PASSED AVG. <200 MILLIOHMS		PASSED AVG. <200 MILLIOHMS		PASSED AVG. <200 MILLIOHMS		PASSED AVG. <200 MILLIOHMS	
DATE TEST CONDUCTED	2-15-78		3-20-78		4-4-78		5-30-78		7-6-78		8-19-78	

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TEST REPORT NO. ES-1000

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BASELINE TEST DATA SUMMARY

RELAY CATALOG NO. E7014AC001 (7014ACE1)

TEST ITEM NO. 1

PREPARED BY C.J. Lugiak

DATE 2-8-80

BASELINE FUNCTIONAL TESTS	INITIAL FUNCTIONALS	RADIATION AGING	POST-RADIATION FUNCTIONALS	CYCLING WITH LOAD AGING	POST-CYCLE/LOAD AGING FUNCTIONALS	TEMPERATURE AGING	POST-TEMPERATURE AGING FUNCTIONALS	SEISMIC TESTS	POST-SEISMIC FUNCTIONALS	HOSTILE ENVIRONMENT TEST	POST-HOSTILE ENV FUNCTIONALS	POST-TEST INSPECTION
PULL-IN VOLTS VAC, 60HZ	PASSED <108	2X10⁶ RADS (GAMMA) TOTAL INTEGRATED DOSE	PASSED <108	RELAYS CYCLED FOR 27,500 OPERATIONS WITH ONE SET OF CONTACTS LOADED TO 120 VAC, 60HZ. AT 10 AMS OR 125 VDC AT .5 AMP (RESISTIVE) WHICH IS RATED LOAD.	PASSED <108	100°CENTIGRADE FOR 42 DAYS	PASSED <108	SEE NOTE #7, NOR #5, WYLE TEST REPORT NO. 43706-2, VOLUME I, PAGE 5.				
DROP-OUT VOLTS VAC, 60HZ	PASSED 53 AVG.		PASSED 55 AVG.		PASSED 55 AVG.		PASSED 51 AVG.					
DIELECTRIC STRENGTH VOLTS RMS	PASSED @ 2420		PASSED @ 2420		PASSED @ 1650		PASSED @ 1650					
INSULATION RESISTANCE @ 500 VDC	PASSED >500 MEGOHMS		PASSED >500 MEGOHMS		PASSED >500 MEGOHMS		PASSED >500 MEGOHMS					
OPERATE TIME MILLISECONDS	PASSED <200		PASSED <200		PASSED <200		PASSED <200					
RECYCLE TIME MILLISECONDS	PASSED <75		PASSED <75		PASSED <75		PASSED <75					
TIME DELAY SECONDS	3.7 AVG.		4.0 AVG.		4.1 AVG.		5.0 AVG.					
REPEATABILITY PERCENT	PASSED 5.4%		PASSED 2.5%		PASSED 1.2%		PASSED 0.3%					
CONTACT BOUNCE @28 VDC, 1 AMP	PASSED AVG. <10MS		PASSED AVG. <10MS		PASSED AVG. <10MS		PASSED AVG. <10MS					
CONTACT RESISTANCE @28 VDC, 1 AMP	PASSED AVG. <200 MILLIOHMS		PASSED AVG. <200 MILLIOHMS		PASSED AVG. <200 MILLIOHMS		PASSED AVG. <200 MILLIOHMS					
DATE TEST CONDUCTED	2-15-78		3-20-78		4-4-78		5-30-78					

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TEST REPORT NO. ES-1000

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BASELINE TEST DATA SUMMARY

RELAY CATALOG NO. E7014ACOO1 (7014ACE)

TEST ITEM NO. 2

PREPARED BY E.J. Lyng   DATE 2-8-80

BASELINE FUNCTIONAL TESTS	INITIAL FUNCTIONALS	RADIATION AGING	POST-RADIATION FUNCTIONALS	CYCLING WITH LOAD AGING	POST-CYCLE/LOAD AGING FUNCTIONALS	TEMPERATURE AGING	POST-TEMPERATURE AGING FUNCTIONALS	SEISMIC TESTS	POST-SEISMIC FUNCTIONALS	HOSTILE ENVIRONMENT TEST	POST-HOSTILE ENV FUNCTIONALS	POST-TEST INSPECTION
PULL-IN VOLTS VAC 60HZ	PASSED <108	2X10^5 RADS (GAMMA) TOTAL INTEGRATED DOSE	PASSED <108	RELAYS CYCLED FOR 27,500 OPERATIONS WITH ONE SET OF CONTACTS LOADED TO 120 VAC, 60HZ. AT 10 AMP OR 125VDC AT 1AMP (RESISTIVE) WHICH IS RATED LOAD.	PASSED <108	100°CENTIGRADE FOR 42 DAYS	PASSED <108	RANDOM, MULTIFREQUENCY VIBRATION, 1-40 HZ, 30 SECOND DURATION, @ 5% DAMPING	PASSED <108	COMBINATION TEMPERATURE/HUMIDITY/UNDER AND OVER VOLTAGE TEST.	PASSED <108	VISUAL INSPECTION FOR CONDITION OF MECHANICAL, ELECTRICAL, AND RELAY CASE PARTS.
DROP-OUT VOLTS VAC 60HZ	PASSED 60AVG.		PASSED 61AVG.		PASSED 53AVG.		PASSED 50AVG.		PASSED 51AVG.		PASSED 58AVG.	
DIELECTRIC STRENGTH VOLTS RMS	PASSED @ 2420		PASSED @ 2420		PASSED @ 2420		PASSED @ 1650		PASSED @ 1650		PASSED @ 1650	
INSULATION RESISTANCE @ 500 VDC	PASSED >500 MEGOHMS		PASSED >500 MEGOHMS		PASSED >500 MEGOHMS		PASSED >500 MEGOHMS		PASSED >500 MEGOHMS		PASSED >500 MEGOHMS	
OPERATE TIME MILLISECONDS	PASSED <200		PASSED <200		PASSED <200		PASSED <200		PASSED <200		PASSED <200	
RECYCLE TIME MILLISECONDS	PASSED <75		PASSED <75		PASSED <75		PASSED <75		PASSED <75		PASSED <75	
TIME DELAY SECONDS	4.1AVG.		4.0AVG.		4.4AVG.		4.9AVG.		4.5AVG.		4.5AVG.	
REPEATABILITY PERCENT	PASSED 4.2%		PASSED 1.3%		PASSED 3.5%		PASSED 2.8%		PASSED 4.4%		PASSED 3.4%	
CONTACT BOUNCE @28 VDC, 1 AMP	PASSED AVG <10 MS		PASSED AVG <10 MS		PASSED AVG. <10MS		PASSED AVG <10MS		PASSED AVG. <10 MS		PASSED AVG <10MS	
CONTACT RESISTANCE @28 VDC, 1 AMP	PASSED AVG <200 MILLIOHMS		PASSED AVG. <200 MILLIOHMS		PASSED AVG. <200 MILLIOHMS		PASSED AVG. <200 MILLIOHMS		PASSED AVG. <200 MILLIOHMS		PASSED AVG. <200 MILLIOHMS	
DATE TEST CONDUCTED	2-15-78		3-20-78		4-4-78		5-30-78		7-6-78		8-18-78	

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TEST REPORT NO. ES-1000

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BASELINE TEST DATA SUMMARY

RELAY CATALOG NO. KE7024AC001 (7024ACE)

TEST ITEM NO. 1

PREPARED BY C.J. Lazzari

DATE 2-2-80

BASELINE FUNCTIONAL TESTS	INITIAL FUNCTIONALS	RADIATION AGING	POST-RADIATION FUNCTIONALS	CYCLING WITH LOAD AGING	POST-CYCLE/LOAD AGING FUNCTIONALS	TEMPERATURE AGING	POST-TEMPERATURE AGING FUNCTIONALS	SEISMIC TESTS	POST-SEISMIC FUNCTIONALS	HOSTILE ENVIRONMENT TEST	POST-HOSTILE ENV FUNCTIONALS	POST-TEST INSPECTION
PULL-IN VOLTS VAC-60HZ	PASSED < 108	2X10^5 RADS (GAMMA) TOTAL INTEGRATED DOSE	PASSED < 108	RELAYS CYCLED FOR 27,500 OPERATIONS WITH ONE SET OF CONTACTS LOADED TO 120 VAC. 60HZ. AT 10 AMP OR 125 VDC AT 1AMP (RESISTIVE) WHICH IS RATED LOAD.	PASSED < 108	100° CENTIGRADE FOR 42 DAYS	PASSED < 108	RANDOM, MULTIFREQUENCY VIBRATION: 1-40 MC., 30 SECOND DURATION, @ 5% DAMPING.	PASSED < 108	COMBINATION TEMPERATURE / HUMIDITY / VACUUM AND OVEN VOLTAGE TEST.	PASSED < 108	VISUAL INSPECTION FOR CONDITION OF MECHANICAL, ELECTRICAL AND RELAY CASE PARTS.
DROP-OUT VOLTS VAC-60HZ	PASSED 48 AVG.		PASSED 42 AVG.		PASSED 45 AVG.		PASSED 46 AVG		PASSED 44 AVG.		PASSED 48 AVG	
DIELECTRIC STRENGTH VOLTS RMS	PASSED @ 2420		PASSED @ 2420		PASSED @ 2420		PASSED @ 1650		PASSED @ 1650		PASSED @ 1650	
INSULATION RESISTANCE @ 500 VDC	PASSED > 500 MEGOHMS		PASSED > 500 MEGOHMS		PASSED > 500 MEGOHMS		PASSED > 500 MEGOHMS		PASSED > 500 MEGOHMS		PASSED > 500 MEGOHMS	
OPERATE TIME MILLISECONDS	PASSED < 75		PASSED < 75		PASSED < 75		PASSED < 75		PASSED < 75		PASSED < 75	
RECYCLE TIME MILLISECONDS	PASSED < 200		PASSED < 200		PASSED < 200		PASSED < 200		PASSED < 200		PASSED < 200	
TIME DELAY SECONDS	1.5 AVG.		1.8 AVG.		1.9 AVG.		2.1 AVG.		2.1 AVG.		1.9 AVG.	
REPEATABILITY PERCENT	*SEE NOTE 13.3%		PASSED 2.7%		PASSED 0%		PASSED 0.5%		PASSED 1.4%		PASSED 3.0%	
CONTACT BOUNCE @28 VDC, 1 AMP	PASSED AVG. < 10MS		PASSED AVG < 10MS		PASSED AVG. < 10MS		PASSED AVG. < 10MS		PASSED AVG. < 10MS		PASSED AVG. < 10MS	
CONTACT RESISTANCE @28 VDC, 1 AMP	PASSED AVG. < 200 MILLIOHMS		PASSED AVG < 200 MILLIOHMS		PASSED AVG < 200 MILLIOHMS		PASSED AVG. < 200 MILLIOHMS		PASSED AVG < 200 MILLIOHMS		PASSED AVG. < 200 MILLIOHMS	
DATE TEST CONDUCTED	2-15-78		3-20-78		4-4-78		5-30-78		7-6-78		8-19-78	

* NOTES: THIS FIGURE IS INCONSISTENT WITH ALL OTHER REPEATABILITY READINGS OF THIS TEST PROGRAM AND IS CONSIDERED SPURIOUS. IT IS LIKELY TO BE THE RESULT OF SOME IRREGULARITY IN THE TEST METHOD SUCH AS A FAULTY ELECTRICAL CONNECTION (BETWEEN RELAY TERMINALS AND TEST FIXTURE) WHICH COULD CAUSE IRREGULAR CLOCK OPERATION.

BASELINE TEST DATA SUMMARY

RELAY CATALOG NO. E7014PC001 (7014PCE)

TEST ITEM NO. 1

PREPARED BY [signature] DATE 2-9-80

BASELINE FUNCTIONAL TESTS	INITIAL FUNCTIONALS	RADIATION AGING	POST-RADIATION FUNCTIONALS	CYCLING WITH LOAD AGING	POST-CYCLE/LOAD AGING FUNCTIONALS	TEMPERATURE AGING	POST-TEMPERATURE AGING FUNCTIONALS	SEISMIC TESTS	POST-SEISMIC FUNCTIONALS	HOSTILE ENVIRONMENT TEST	POST-HOSTILE ENV FUNCTIONALS	POST-TEST INSPECTION
PULL-IN VOLTS VDC	PASSED <106	2 x 10^5 RADS (GAMMA) TOTAL INTEGRATED DOSE	PASSED <106	RELAYS CYCLED FOR 27,500 OPERATIONS WITH ONE SET OF CONTACTS LOADED TO 120 VAC, 60HZ. AT 10 AMP OR 125VDC AT 1 AMP (RESISTIVE) WHICH IS RATED LOAD.	PASSED <106	100° CENTIGRADE FOR 42 DAYS	PASSED <106	RANDOM, MULTIFREQUENCY, VIBRATION; 1-40HZ; 30 SECOND DURATION @6% DAMPING.	PASSED <106	COMBINATION TEMPERATURE/HUMIDITY/UNDER AND OVER VOLTAGE TEST.	PASSED <106	VISUAL INSPECTION FOR CONDITION OF MECHANICAL, ELECTRICAL AND RELAY CASE PARTS.
DROP-OUT VOLTS VDC	PASSED 7.7 AVG.		PASSED 7.2 AVG.		PASSED 18 AVG.		PASSED 15 AVG.		PASSED 14 AVG.		PASSED 11 AVG.	
DIELECTRIC STRENGTH VOLTS RMS	PASSED @ 2420		PASSED @ 2420		PASSED @ 2420		PASSED @ 1650		PASSED @ 1650		PASSED @ 1650	
INSULATION RESISTANCE @ 500 VDC	PASSED >500 MEGOHMS		PASSED >500 MEGOHMS		PASSED >500 MEGOHMS		PASSED >500 MEGOHMS		PASSED >500 MEGOHMS		PASSED >500 MEGOHMS	
OPERATE TIME MILLISECONDS	PASSED <200		PASSED <200		PASSED <200		PASSED <200		PASSED <200		PASSED <200	
RECYCLE TIME MILLISECONDS	PASSED <75		PASSED <75		PASSED <75		PASSED <75		PASSED <75		PASSED <75	
TIME DELAY SECONDS	4.0 AVG.		4.1 AVG.		3.8 AVG.		5.1 AVG.		4.1 AVG.		3.6 AVG.	
REPEATABILITY PERCENT	PASSED 1.3%		PASSED 1.2%		PASSED 0%		PASSED 1.4%		PASSED 1.1%		PASSED 5.4%	
CONTACT BOUNCE @28 VDC, 1 AMP	PASSED AVG. <10 MS		PASSED AVG. <10 MS		PASSED AVG. <10 MS		PASSED AVG. <10 MS		PASSED AVG. <10 MS		PASSED AVG. <10 MS	
CONTACT RESISTANCE @28 VDC, 1 AMP	PASSED AVG. <200 MILLIOHMS		PASSED AVG. <200 MILLIOHMS		PASSED AVG. <200 MILLIOHMS		PASSED AVG. <200 MILLIOHMS		PASSED AVG. <200 MILLIOHMS		PASSED AVG. <200 MILLIOHMS	
DATE TEST CONDUCTED	2-15-78		3-20-78		4-4-78		5-30-78		7-6-78		8-18-77	

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TEST REPORT NO. ES-10CJ

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BASELINE TEST DATA SUMMARY

RELAY CATALOG NO. E7024PC001 (7024PCE)

TEST ITEM NO. 1 PREPARED BY C.J. [illegible] DATE 2-2-80

BASELINE FUNCTIONAL TESTS	INITIAL FUNCTIONALS	RADIATION AGING	POST-RADIATION FUNCTIONALS	CYCLING WITH LOAD AGING	POST-CYCLE/ LOAD AGING FUNCTIONALS	TEMPERATURE AGING	POST-TEMPERATURE AGING FUNCTIONALS	SEISMIC TESTS	POST-SEISMIC FUNCTIONALS	HOSTILE ENVIRONMENT TEST	POST-HOSTILE ENV FUNCTIONALS	POST-TEST INSPECTION
PULL-IN VOLTS VDC	PASSED < 106	2×10^5 RADS (GAMMA) TOTAL INTEGRATED DOSE	PASSED < 106	RELAYS CYCLED FOR 27,500 OPERATIONS WITH ONE SET OF CONTACTS LOADED TO 120 VAC, 60HZ. AT 10 AMP OR 125 VDC AT 1 AMP (RESISTIVE) WHICH IS RATED LOAD.	PASSED < 106	100°CENTIGRADE FOR 42 DAYS	PASSED < 106	RANDOM, MULTIFREQUENCY VIBRATION, 1-40 HZ., 30 SECOND DURATION, @ 5% DAMPING.	PASSED < 106	COMBINATION TEMPERATURE/HUMIDITY/UNDER AND OVER VOLTAGE TEST.	PASSED < 106	VISUAL INSPECTION FOR CONDITION OF MECHANICAL, ELECTRICAL AND RELAY CASE PARTS.
DROP-OUT VOLTS VDC	PASSED 27 AVG.		PASSED 27 AVG.		PASSED 27 AVG.		PASSED 45 AVG.		PASSED 29 AVG.		PASSED 25 AVG.	
DIELECTRIC STRENGTH VOLTS RMS	PASSED @ 2420		PASSED @ 2420		PASSED @ 1650		PASSED @ 1650		PASSED @ 1650		PASSED @ 1650	
INSULATION RESISTANCE @ 500 VDC	PASSED > 500 MEGOHMS		PASSED > 500 MEGOHMS		PASSED > 500 MEGOHMS		PASSED > 500 MEGOHMS		PASSED > 500 MEGOHMS		PASSED > 500 MEGOHMS	
OPERATE TIME MILLISECONDS	PASSED < 75		PASSED < 75		PASSED < 75		PASSED < 75		PASSED < 75		PASSED < 75	
RECYCLE TIME MILLISECONDS	PASSED < 200		PASSED < 200		PASSED < 200		PASSED < 200		PASSED < 200		PASSED < 200	
TIME DELAY SECONDS	1.6 AVG.		1.5 AVG.		1.4 AVG.		1.8 AVG		1.5 AVG.		1.5 AVG.	
REPEATABILITY PERCENT	PASSED 3.2%		PASSED 3.2%		PASSED 3.4%		PASSED 0.3%		PASSED 0.3%		PASSED 7.2%	
CONTACT BOUNCE @28 VDC, 1 AMP	PASSED AVG. < 10 MS		PASSED AVG. < 10 MS		PASSED AVG. < 10 MS.		PASSED AVG. < 10 MS		PASSED AVG. < 10 MS		PASSED AVG. < 10 MS.	
CONTACT RESISTANCE @28 VDC, 1 AMP	PASSED AVG. < 200 MILLIOHMS		PASSED AVG. < 200 MILLIOHMS		PASSED < 200 MILLIOHMS		PASSED < 200 MILLIOHMS		PASSED < 200 MILLIOHMS		PASSED < 200 MILLIOHMS	
DATE TEST CONDUCTED	2-15-78		3-20-78		4-4-78		5-30-78		7-6-78		8-18-78	

DATA - BASELINE FUNCTIONAL TESTS FOR ACCOMPANING SPARES

NOTE: 1. THESE DEVICES ARE SPARES AND WERE AGED TO POINT SHOWN FOR USE IN CASE OF ACCIDENTAL DAMAGE OF ACTUAL TEST DEVICES. ALSO, THESE DEVICES MIGHT BE USED BY AMERACE IN POSSIBLE FUTURE TEST PROGRAMS.

2. SEE FIGURE 1 AND 2, PAGES 13 AND 14 OF THIS REPORT FOR OPERATING SPECIFICATION FOR BASELINE TESTS.

3. FOR PROCEDURE AND ADDITIONAL INFORMATION SEE WYLE TEST REPORT NO. 43706-2, VOLUME I, SECTIONS I, III, V, AND VII.

THE FOLLOWING CROSS REFERENCE CORRELATES OLD TO NEW NUMBERING SYSTEMS:

AS STATED IN WYLE. TEST REPORT NO. 43706-2 (OLD CATALOG MODEL NO.)	AS STATED IN AMERACE TEST REPORT NO. ES-1000 (NEW CATALOG MODEL NO.)
7012ACE	E7012AC001
7022ACE	E7022AC001
7012PCE	E7012PC001
7022PCE	E7022PC001
7014ACE	E7014AC001
7024ACE	E7024AC001
7014PCE	E7014PC001
7024PCE	E7024PC001

BASELINE TEST DATA SUMMARY

RELAY CATALOG NO. E7012AC001 (7012ACE)

TEST ITEM NO. 3

PREPARED BY C.J. Liegyd

DATE 2-10-80

BASELINE FUNCTIONAL TESTS	INITIAL FUNCTIONALS	RADIATION AGING	POST-RADIATION FUNCTIONALS	CYCLING WITH LOAD AGING	POST-CYCLE/LOAD AGING FUNCTIONALS	TEMPERATURE AGING	POST-TEMPERATURE AGING FUNCTIONALS	SEISMIC TESTS	POST-SEISMIC FUNCTIONALS	HOSTILE ENVIRONMENT TEST	POST-HOSTILE ENV FUNCTIONALS	POST-TEST INSPECTION
PULL-IN VOLTS VAC-CONT.	PASSED < 102	2 X 10^5 RADS (GAMMA) TOTAL INTEGRATED DOSE	PASSED < 102	RELAYS CYCLED FOR 23,500 OPERATIONS WITH ONE SET OF CONTACTS LOADED TO 120 VAC, 60HZ AT 10 AMP OR 125 VDC AT 1AMP (RESISTIVE) WHICH IS RATED LOAD.	PASSED < 102	100°C AMBIENCE FOR 42 DAYS	PASSED < 102					
DROP-OUT VOLTS VAC-CONT	PASSED 51 AVG.		PASSED 53 AVG.		PASSED 50 AVG.		PASSED 41 AVG.					
DIELECTRIC STRENGTH VOLTS RMS	PASSED @ 2420		PASSED @ 2420		PASSED @ 2420		PASSED @ 1650					
INSULATION RESISTANCE @ 500 VDC	PASSED > 500 MEGOHMS		PASSED > 500 MEGOHMS		PASSED > 500 MEGOHMS		PASSED > 500 MEGOHMS					
OPERATE TIME MILLISECONDS	PASSED < 200		PASSED < 200		PASSED < 200		PASSED < 200					
RECYCLE TIME MILLISECONDS	PASSED < 50		PASSED < 50		PASSED < 50		PASSED < 50					
TIME DELAY SECONDS	1.6 AVG.		1.5 AVG.		1.6 AVG.		2.1 AVG.					
REPEATABILITY PERCENT	PASSED 3.0%		PASSED 3.2%		PASSED 3.0%		PASSED 5.4%					
CONTACT BOUNCE @28 VDC, 1 AMP	PASSED AVG. < 10 mS		PASSED AVG. < 10 mS		PASSED AVG. < 10 mS		PASSED AVG < 10 mS					
CONTACT RESISTANCE @28 VDC, 1 AMP	PASSED AVG. < 200 MILLIOHMS		PASSED AVG. < 200 MILLIOHMS		PASSED AVG. < 200 MILLIOHMS		PASSED AVG < 200 MILLIOHMS					
DATE TEST CONDUCTED	2-2-78		3-20-78		4-4-78		5-30-78					

BASELINE TEST DATA SUMMARY

RELAY CATALOG NO. E7022AC001 (7022ACE)

TEST ITEM NO. 1. PREPARED BY C.J. Ruppel DATE 2-10-80

BASELINE FUNCTIONAL TESTS	INITIAL FUNCTIONALS	RADIATION AGING	POST-RADIATION FUNCTIONALS	CYCLING WITH LOAD AGING	POST-CYCLE/LOAD AGING FUNCTIONALS	TEMPERATURE AGING	POST-TEMPERATURE AGING FUNCTIONALS	SEISMIC TESTS	POST-SEISMIC FUNCTIONALS	HOSTILE ENVIRONMENT TEST	POST-HOSTILE ENV FUNCTIONALS	POST-TEST INSPECTION
PULL-IN VOLTS VAC-CONZ	PASSED <102	2X10⁵ RADS (GAMMA) TOTAL INTEGRATED DOSE	PASSED <102	RELAYS CYCLED FOR 22,500 OPERATIONS WITH ONE SET OF CONTACTS LOADED TO 120 VAC, CONT. AT 10 AMP OR 125 VDC AT 1 AMP (RESISTIVE) WHICH IS RATED LOAD.	PASSED <102	100°C AMBIENT FOR 42 DAYS	PASSED <102					
DROP-OUT VOLTS VAC-CONZ	PASSED 40 AVG		PASSED 37 AVG.		PASSED 42 AVG		PASSED 42 AVG.					
DIELECTRIC STRENGTH VOLTS RMS	PASSED @ 2420		PASSED @ 2420		PASSED @ 2420		PASSED @ 1650					
INSULATION RESISTANCE @ 500 VDC	PASSED >500 MEGOHMS		PASSED >500 MEGOHMS		PASSED >500 MEGOHMS		PASSED >500 MEGOHMS					
OPERATE TIME MILLISECONDS	PASSED <50		PASSED <50		PASSED <50		PASSED <50					
RECYCLE TIME MILLISECONDS	PASSED <200		PASSED <200		PASSED <200		PASSED <200					
TIME DELAY SECONDS	1.6 AVG.		1.6 AVG.		1.6 AVG.		1.7 AVG					
REPEATABILITY PERCENT	3.2%		3.2%		3.2%		1.0%					
CONTACT BOUNCE @28 VDC, 1 AMP	PASSED AVG. <10 MS		PASSED AVG. <10 MS		PASSED AVG <10 MS		PASSED AVG. <10 MS					
CONTACT RESISTANCE @28 VDC, 1 AMP	PASSED AVG <200 MILLIOHMS		PASSED AVG. <200 MILLIOHMS		PASSED AVG. <200 MILLIOHMS		PASSED AVG. <200 MILLIOHMS					
DATE TEST CONDUCTED	2-15-78		3-20-78		4-4-78		5-30-75					

BASELINE TEST DATA SUMMARY

RELAY CATALOG NO. E7012AC001 (Source)

TEST ITEM NO. 2

PREPARED BY R.J. Bryant DATE 2-19-80

BASE LINE FUNCTIONAL TESTS	INITIAL FUNCTIONALS	RADIATION AGING	POST-RADIATION FUNCTIONALS	CYCLING WITH LOAD AGING	POST-CYCLE/LOAD AGING FUNCTIONALS	TEMPERATURE AGING	POST-TEMPERATURE AGING FUNCTIONALS	SEISMIC TESTS	POST-SEISMIC FUNCTIONALS	HOSTILE ENVIRONMENT TEST	POST-HOSTILE ENV FUNCTIONALS	POST-TEST INSPECTION
PULL-IN VOLTS VDC	PASSED <100	2X10⁵ RADS (GAMMA). TOTAL INTEGRATED DOSE	PASSED <100	RELAYS CYCLED FOR 23,500 OPERATIONS WITH ONE SET OF CONTACTS LOADED TO 120 VDC, 60MS. AT 10AMP OR RESIS AT 1AMP (RESISTIVE) WHEN IS NOTED LOAD.	PASSED <100	100°C AMBIENT FOR 72 DAYS	PASSED <100					
DROP-OUT VOLTS VDC	PASSED 10 AVG.		PASSED 8 AVG.		PASSED 13 AVG.		PASSED 13 AVG.					
DIELECTRIC STRENGTH VOLTS RMS	PASSED @ 2420		PASSED @ 2420		PASSED @ 2420		PASSED @ 1650					
INSULATION RESISTANCE @ 500 VDC	PASSED >500 MEGOHMS		PASSED >500 MEGOHMS		PASSED >500 MEGOHMS		PASSED >500 MEGOHMS					
OPERATE TIME MILLISECONDS	PASSED <200		PASSED <200		PASSED <200		PASSED <200					
RECYCLE TIME MILLISECONDS	PASSED <50		PASSED <50		PASSED <50		PASSED <50					
TIME DELAY SECONDS	1.8 AVG		1.7 AVG.		1.7 AVG.		2.0 AVG.					
REPEATABILITY PERCENT	PASSED 2 %		PASSED 5.7%		PASSED 2.9%		PASSED 0.3%					
CONTACT BOUNCE @28 VDC, 1 AMP	PASSED <10 MS		PASSED <10 MS		PASSED <10 MS		PASSED <10 MS					
CONTACT RESISTANCE @28 VDC, 1 AMP	PASSED <200 MILLIOHMS		PASSED <200 MILLIOHMS		PASSED <200 MILLIOHMS		PASSED <200 MILLIOHMS					
DATE TEST CONDUCTED	2-15-78		3-20-78		4-4-78		5-30-78					

BASELINE TEST DATA SUMMARY

RELAY CATALOG NO. E7022PC001 (7022ACE)

TEST ITEM NO. 2

PREPARED BY C.J. Lengyel DATE 2-10-80

BASELINE FUNCTIONAL TESTS	INITIAL FUNCTIONALS	RADIATION AGING	POST-RADIATION FUNCTIONALS	CYCLING WITH LOAD AGING	POST-CYCLE/LOAD AGING FUNCTIONALS	TEMPERATURE AGING	POST-TEMPERATURE AGING FUNCTIONALS	SEISMIC TESTS	POST-SEISMIC FUNCTIONALS	HOSTILE ENVIRONMENT TEST	POST-HOSTILE ENV FUNCTIONALS	POST-TEST INSPECTION
PULL-IN VOLTS VDC	PASSED < 100	.2X10⁶ RADS (GAMMA) TOTAL INTEGRATED DOSE	PASSED < 100	ABOVE CYCLED FOR 27,500 OPERATIONS WITH ONE SET OF CONTACTS LOADED TO 120 VAC, 60HZ. AT 10 AMP. OR 125 VDC AT 1AMP (RESISTIVE) WITH 15 AMP INRUSH LOAD.	PASSED < 100	100°CENTIGRADE FOR 42 DAYS	PASSED < 100					
DROP-OUT VOLTS VDC	PASSED 12 AVG.		PASSED 13 AVG.		PASSED 17 AVG.		PASSED 25 AVG.					
DIELECTRIC STRENGTH VOLTS RMS	PASSED @ 2420		PASSED @ 2420		PASSED @ 2420		PASSED @ 1650.					
INSULATION RESISTANCE @ 500 VDC	PASSED > 500 MEGOHMS		PASSED > 500 MEGOHMS		PASSED > 500 MEGOHMS		PASSED > 500. MEGOHMS					
OPERATE TIME MILLISECONDS	PASSED < 50MS		PASSED < 50 MS		PASSED < 50MS		PASSED < 50MS					
RECYCLE TIME MILLISECONDS	PASSED < 200MS		PASSED < 200MS		PASSED < 200MS		PASSED < 200 MS					
TIME DELAY SECONDS	1.4 AVG.		1.5 AVG.		1.3 AVG.		1.7 AVG.					
REPEATABILITY PERCENT	PASSED 3.4%		PASSED 3.4%		PASSED 3.7%		PASSED 0%.					
CONTACT BOUNCE @28 VDC, 1 AMP	PASSED AVG. < 10 MS.		PASSED AVG. < 10 MS		PASSED AVG. < 10 MS.		PASSED AVG. < 10 MS.					
CONTACT RESISTANCE @28 VDC, 1 AMP	PASSED AVG. < 200 MILLIOHMS		PASSED AVG. < 200 MILLIOHMS		PASSED AVG. < 200 MILLIOHMS		PASSED AVG. < 200. MILLIOHMS					
DATE TEST CONDUCTED	2-15-78		3-20-78		4-4-79		5-30-78					

BASELINE TEST DATA SUMMARY

RELAY CATALOG NO. E7024AC001 (7024ACE)

TEST ITEM NO. 2

PREPARED BY C.J. Bryan

DATE 2-11-80

BASELINE FUNCTIONAL TESTS	INITIAL FUNCTIONALS	RADIATION AGING	POST-RADIATION FUNCTIONALS	CYCLING WITH LOAD AGING	POST-CYCLE/LOAD AGING FUNCTIONALS	TEMPERATURE AGING	POST-TEMPERATURE AGING FUNCTIONALS	SEISMIC TESTS	POST-SEISMIC FUNCTIONALS	HOSTILE ENVIRONMENT TEST	POST-HOSTILE ENV FUNCTIONALS	POST-TEST INSPECTION
PULL-IN VOLTS VAC, 60HZ	PASSED < 108	2 X 10^6 RADS (Gamma) Total Integrated Dose	PASSED < 108	Actuate Cycled for 27,500 operations with one set of Contacts loaded to 120 VAC, 60HZ at 10 AMPS or 125 VAC at 1AMP (Resistive) which is Rated load.	PASSED < 108	200°C Centigrade for 42 DAYS	PASSED < 108					
DROP-OUT VOLTS VAC, 60HZ	PASSED 45 AVG.		PASSED 46 AVG.		PASSED 43 AVG.		PASSED 36 AVG.					
DIELECTRIC STRENGTH VOLTS RMS	PASSED @ 2420		PASSED @ 2420		PASSED @ 1650		PASSED @ 1650					
INSULATION RESISTANCE @ 500 VDC	PASSED > 500 MEGOHMS		PASSED > 500 MEGOHMS		PASSED > 500 MEGOHMS		PASSED > 500 MEGOHMS					
OPERATE TIME MILLISECONDS	PASSED < 75		PASSED < 75		PASSED < 75		PASSED < 75					
RECYCLE TIME MILLISECONDS	PASSED < 200		PASSED < 200		PASSED < 200		PASSED < 200					
TIME DELAY SECONDS	1.8 AVG.		1.8 AVG.		1.7 AVG.		2.2 AVG.					
REPEATABILITY PERCENT	PASSED 2.7%		PASSED 5.6%		PASSED 0%		PASSED 2.2%					
CONTACT BOUNCE @28 VDC, 1 AMP	PASSED < 10MS		PASSED < 10MS		PASSED < 10MS		PASSED < 10MS					
CONTACT RESISTANCE @28 VDC, 1 AMP	PASSED < 200 MILLIOHMS		PASSED < 200 MILLIOHMS		PASSED < 200 MILLIOHMS		PASSED < 200 MILLIOHM					
DATE TEST CONDUCTED	2-15-78		3-20-78		4-4-78		5-30-78					

BASELINE TEST DATA SUMMARY

RELAY CATALOG NO. E7014PCA01 (SOURCE)

TEST ITEM NO. 2

PREPARED BY E.J. Luzzi DATE 2-11-80

BASELINE FUNCTIONAL TESTS	INITIAL FUNCTIONALS	RADIATION AGING	POST-RADIATION FUNCTIONALS	CYCLING WITH LOAD AGING	POST-CYCLE/LOAD AGING FUNCTIONALS	TEMPERATURE AGING	POST-TEMPERATURE AGING FUNCTIONALS	SEISMIC TESTS	POST-SEISMIC FUNCTIONALS	HOSTILE ENVIRONMENT TEST	POST-HOSTILE ENV FUNCTIONALS	POST-TEST INSPECTION
PULL-IN VOLTS VDC	PASSED <106	2X10⁶ RADS GAMMA TOTAL INTEGRATED DOSE	PASSED <106	RELAYS CYCLED FOR 27,500 OPERATIONS WITH ONE SET OF CONTACTS LOADED TO 120 VAC CONT. AT 10 AMP. OR 125 VDC AT 1AMP (RESISTIVE) WHICH IS RATED LOAD.	PASSED <106	100°CENTIGRADE FOR 72 DAYS	PASSED <106					
DROP-OUT VOLTS VDC	PASSED 14 AVG.		PASSED 14 AVG		PASSED 15 AVG.		PASSED 14 AVG.					
DIELECTRIC STRENGTH VOLTS RMS	PASSED @ 2420		PASSED @ 2420		PASSED @ 2420		PASSED @ 2420					
INSULATION RESISTANCE @ 500 VDC	PASSED >500 MEGOHMS		PASSED >500 MEGOHMS		PASSED >500 MEGOHMS		PASSED >500 MEGOHMS.					
OPERATE TIME MILLISECONDS	PASSED <200		PASSED <200		PASSED <200		PASSED <200					
RECYCLE TIME MILLISECONDS	PASSED <75		PASSED <75		PASSED <75		PASSED <75					
TIME DELAY SECONDS	4.1 AVG.		4.0 AVG		3.9 AVG.		5.2 AVG.					
REPEATABILITY PERCENT	PASSED 1.2%		PASSED 1.3%		PASSED 2.6%		PASSED 0.6%					
CONTACT BOUNCE @28 VDC, 1 AMP	PASSED <10 MS		PASSED <10 MS		PASSED <10 MS		PASSED <10 MS					
CONTACT RESISTANCE @28 VDC, 1 AMP	PASSED <200 MILLIOHMS		PASSED <200 MILLIOHMS		PASSED <200 MILLIOHMS		PASSED <200 MILLIOHMS					
DATE TEST CONDUCTED	2-15-78		3-20-78		4-4-78		5-30-78					

CONTROL PRODUCTS DIVISION

AMERACE CORPORATION
CONTROL PRODUCTS DIVISION
UNION, N.J. 07083

TEST REPORT NO. ES-1000

REV. A

BASELINE TEST DATA SUMMARY

RELAY CATALOG NO. E7024AC001 (7024ACE)

TEST ITEM NO. 2

PREPARED BY A. J. Lonzo

DATE 2-11-80

BASELINE FUNCTIONAL TESTS	INITIAL FUNCTIONALS	RADIATION AGING	POST-RADIATION FUNCTIONALS	CYCLING WITH LOAD AGING	POST-CYCLE/LOAD AGING FUNCTIONALS	TEMPERATURE AGING	POST-TEMPERATURE AGING FUNCTIONALS	SEISMIC TESTS	POST-SEISMIC FUNCTIONALS	HOSTILE ENVIRONMENT TEST	POST-HOSTILE ENV FUNCTIONALS	POST-TEST INSPECTION
PULL-IN VOLTS VDC	PASSED <106	2X10⁵ RADS (Gamma) Total Integrated Dose	PASSED <106	82,500 operations with one set of contacts adjusted to 120 VAC, 60HZ, at 10 amp or 125 VDC at 1 amp (Resistive) when is rated load.	PASSED <106	100°C Centigrade for 42 days	PASSED <106					
DROP-OUT VOLTS VDC	PASSED 18 AVG.		PASSED 16 AVG.		PASSED 38 AVG.		PASSED 42 AVG.					
DIELECTRIC STRENGTH VOLTS RMS	PASSED @ 2420		PASSED @ 2420		PASSED @ 2420		PASSED @ 1650					
INSULATION RESISTANCE @ 500 VDC	PASSED >500 MEGOHMS		PASSED >500 MEGOHMS		PASSED >500 MEGOHMS		PASSED >500 MEGOHMS					
OPERATE TIME MILLISECONDS	PASSED <75		PASSED <75		PASSED <75		PASSED <75					
RECYCLE TIME MILLISECONDS	PASSED <200		PASSED <200		PASSED <200		PASSED <200					
TIME DELAY SECONDS	1.7 AVG.		1.8 AVG.		1.7 AVG.		1.9 AVG.					
REPEATABILITY PERCENT	PASSED 3.0%		PASSED 2.7%		PASSED 0%		PASSED 8.4%					
CONTACT BOUNCE @28 VDC, 1 AMP	PASSED AVG. <10 MS		PASSED AVG. <10 MS.		PASSED AVG. <10 MS		PASSED AVG. <10 MS					
CONTACT RESISTANCE @28 VDC, 1 AMP	PASSED AVG. <200 MILLIOHMS		PASSED AVG. <200 MILLIOHMS		PASSED AVG. <200 MILLIOHMS		PASSED AVG. <200 MILLIOHMS					
DATE TEST CONDUCTED	2-15-78		3-20-78		4-4-78		5-30-78					

SEISMIC TEST DATA

SUMMARY

FOR DETAILED PROCEDURE AND ADDITIONAL INFORMATION SEE WYLE TEST REPORT NO. 43706-2, VOLUME I, SECTION VIII.

THE FOLLOWING CROSS REFERENCE CORRELATES OLD TO NEW NUMBERING SYSTEMS:

AS STATED IN WYLE TEST REPORT NO. 43706-2 (OLD CATALOG MODEL NO.)	AS STATED IN AMERACE TEST REPORT NO. ES-1000 (NEW CATALOG MODEL NO.)
7012ACE	E7012AC001
7022ACE	E7022AC001
7012PCE	E7012PC001
7022PCE	E7022PC001
7014ACE	E7014AC001
7024ACE	E7024AC001
7014PCE	E7014PC001
7024PCE	E7024PC001

SEISMIC TESTS SUMMARY

The artificially aged devices were subjected to simulated seismic vibration, which verified each individual device's ability to perform its required function, before, during, and/or following design basis eathquakes.

Using a Generic Required Response Spectra (RRS) for control systems purposes for the majority of nuclear power plant locations in the continental United States as a Guideline, the devices should have met, exceeded, and/or established their own fragility levels.

The relays were tested in the following electrical states.

(a) Non-operating Mode (Relay coil deenergized - off-delay relays timed out).

(b) Operating Mode (Relay coils energized - on-delay relays timed out).

(c) Transistional Mode (Relay time delay) with nominal rated voltage, less 10%, applied to coils. Relays timed out twice during seismic test.

CONDITIONS OF SEISMIC TESTS:

Value of Damping used - 5%
Device Mounting - Vertical only (Rigid Test Fixture)
Mode of Vibration - Identical (Dependent) biaxial inputs (45° Thruster)
Seismic Input - Random multifrequency (Spaced at 1/3 octaves over a range of 1-40 Hz). 30 second duration.

SEISMIC RESPONSE

The three figures for each type relay as specified below represent the actual vertical and horizontal test response of the relays in their three (3) electrical states. Using the Failure Criteria specified, these values were derived by combining the lowest Test Response Spectrum (TRS) values from the four (4) test orientations and multiplying that composite value by .707 due to the 45-degree inclination of the test machine. Also, superimposed on the graphs are: (1) The Standard Response Spectrum (SRS) for relays per IEEE Standard 501-1978 which gives a specific zero period acceleration "G" level for each of the relay states, and, (2) The Required Response Spectrum (RRS) which was used as a guideline and artificially created by Control Products Div. as a goal or maximum test level.

Figures: 3, 4 & 5	Model E7012
6, 7 & 8	Model E7022
9, 10 & 11	Model E7014
12, 13 & 14	Model E7024

BRIEF TEST DESCRIPTION

The test machine was inclined at 45° to the horizontal plane to simulate two-axes excitation. In order to orient the test articles to their normal service position, they were placed on a 45° Rigid Test Fixture. This arrangement gave the input motion equal vectors in the vertical plane and in one horizontal direction. The relays were tested in four horizontal orientations. This was done to test for the in-phase and out-of-phase conditions of the test items. This method of test input is recognized as an acceptable alternative to true biaxial excitation in Section 6.6.6 of IEEE Standard 344-1975.

FAILURE CRITERIA (CLASS 1E FUNCTIONS MONITORED DURING SEISMIC TESTS)

(A) Non-Operating Mode (Relay coils de-energized) Normally closed contacts for chatter in excess of 1 millisecond with 28 vdc at a amp applied to contacts. Normally open contacts for false transfer of 1 millisecond or greater with 28 vdc at 1 ampere applied to contacts.

(B) Operate Mode (Relay coils energized) Normally open contacts for chatter in excess of 1 millisecond with 28 vdc at 1 amp applied to contacts. Normally closed contacts for false transfer of 1 millisecond or greater with 28 vdc at 1 ampere applied to contacts.

(C) Transitional Mode (Relay operated for time delay) Failure of the relays to time-out twice. Note: Relays set for approximately 10 seconds time delay.

NOTE: Nominal rated voltage less 10% applied to relays coils during operate and transitional modes.

FRAGILITY LEVEL

Device fragility level was obtained in the following manner:

Using the Failure Criteria as described, all relays were first subjected to the artificial RRS acceleration level. If a relay failed to meet its ClassiE function the testing was continued, but at regressive increments (of approximately 10% levels) until the malfunction ceased. The level at which fault free operation of the relay had been established was documented as the fragility level of that relay.

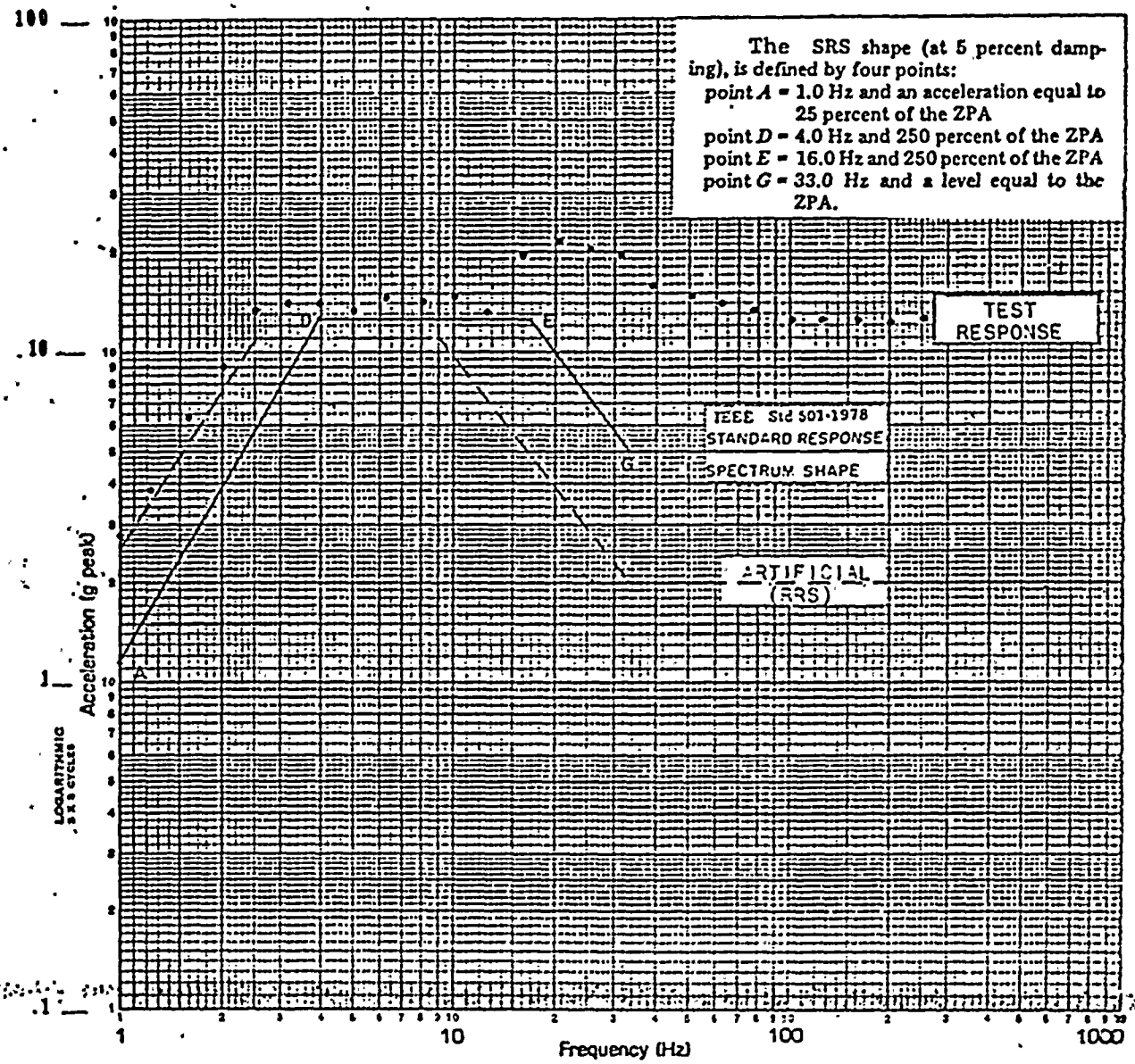
TEST RESPONSE

The test responses which exceed the artificial RRS level and stated as such are not device fragility levels but are highest values tested to

FULL SCALE SHOCK SPECTRUM (g Peak) MODELS TESTED:
E7012AC001
E7012PC001

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING 5 %



SPECIMEN 1 & 3 (E7012 SERIES) RELAY STATE: NON-OPERATE MODE (DE-ENER.)

AXIS * SEE NOTE (H+V) TEST RUN NO. 35,29,21,11

* COMPOSITE OF FB/V-,SS/V-,SS/V+,FB/V+ X .707 DUE TO 45° INCLINATION OF TEST MACHINE.

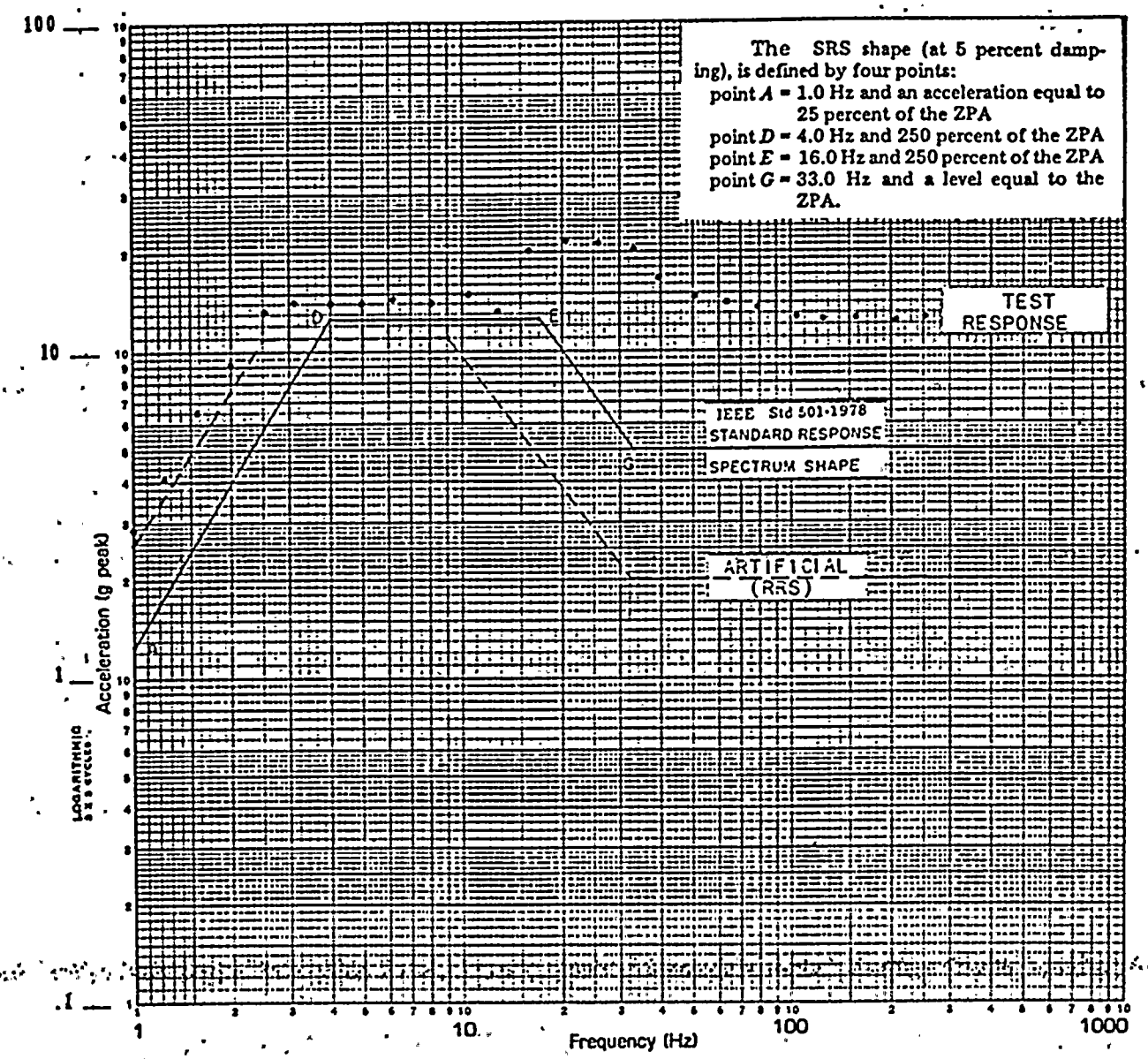
Figure 3. Model E7012, Response Spectrum, Non-Operate Mode

FULL SCALE SHOCK SPECTRUM (g Peak)

MODELS TESTED:
E7012AC001
E7012PC001

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING 5 %



SPECIMEN 1 & 3 (E7012 SERIES) RELAY STATE: OPERATE MODE (ENERGIZED)

AXIS * SEE NOTE (H+V) : TEST RUN NO. 40,52,59, 70

* COMPOSITE OF FB/V-, SS/V-, SS/V+, FB/V+ X .707 DUE TO 45° INCLINATION OF TEST MACHINE.

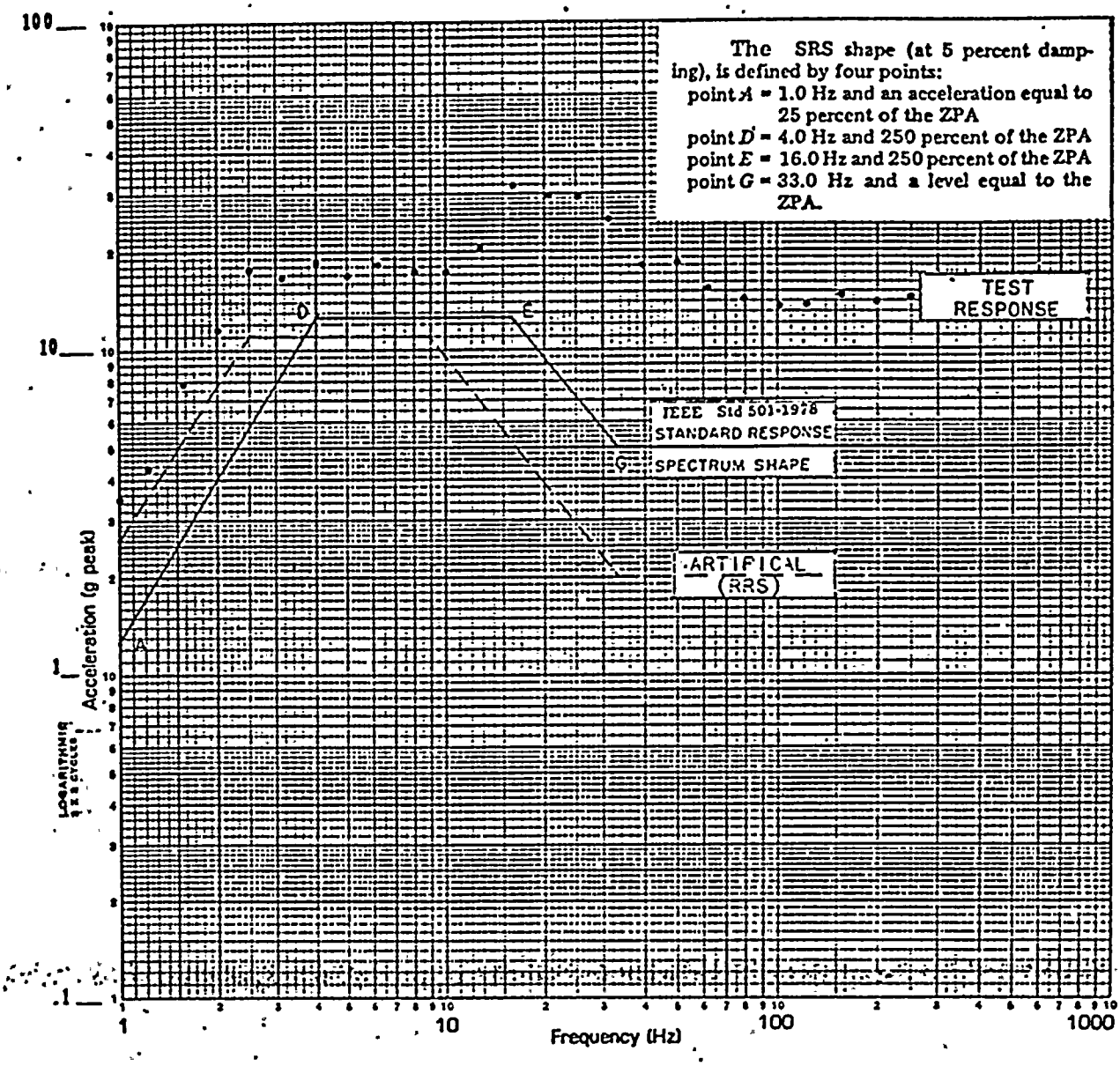
Figure 4. Model E7012, Response Spectrum, Operate Mode

FULL SCALE SHOCK SPECTRUM (g Peak) MODELS TESTED:

E7012AC001
E7012PC001

1.0 ☐ 10 ☐ 100 ☒ 10000 ☐

DAMPING 5 %



SPECIMEN 1 & 3 (E7012 SERIES) RELAY STATE: TRANSITIONAL MODE (TD X 2)

AXIS * SEE NOTE (H+V) TEST RUN NO. 41,45,60, 63

*COMPOSITE OF FB/V-, SS/V-, SS/V+, FB/V+ X .707 DUE TO 45° INCLINATION OF TEST MACHINE.

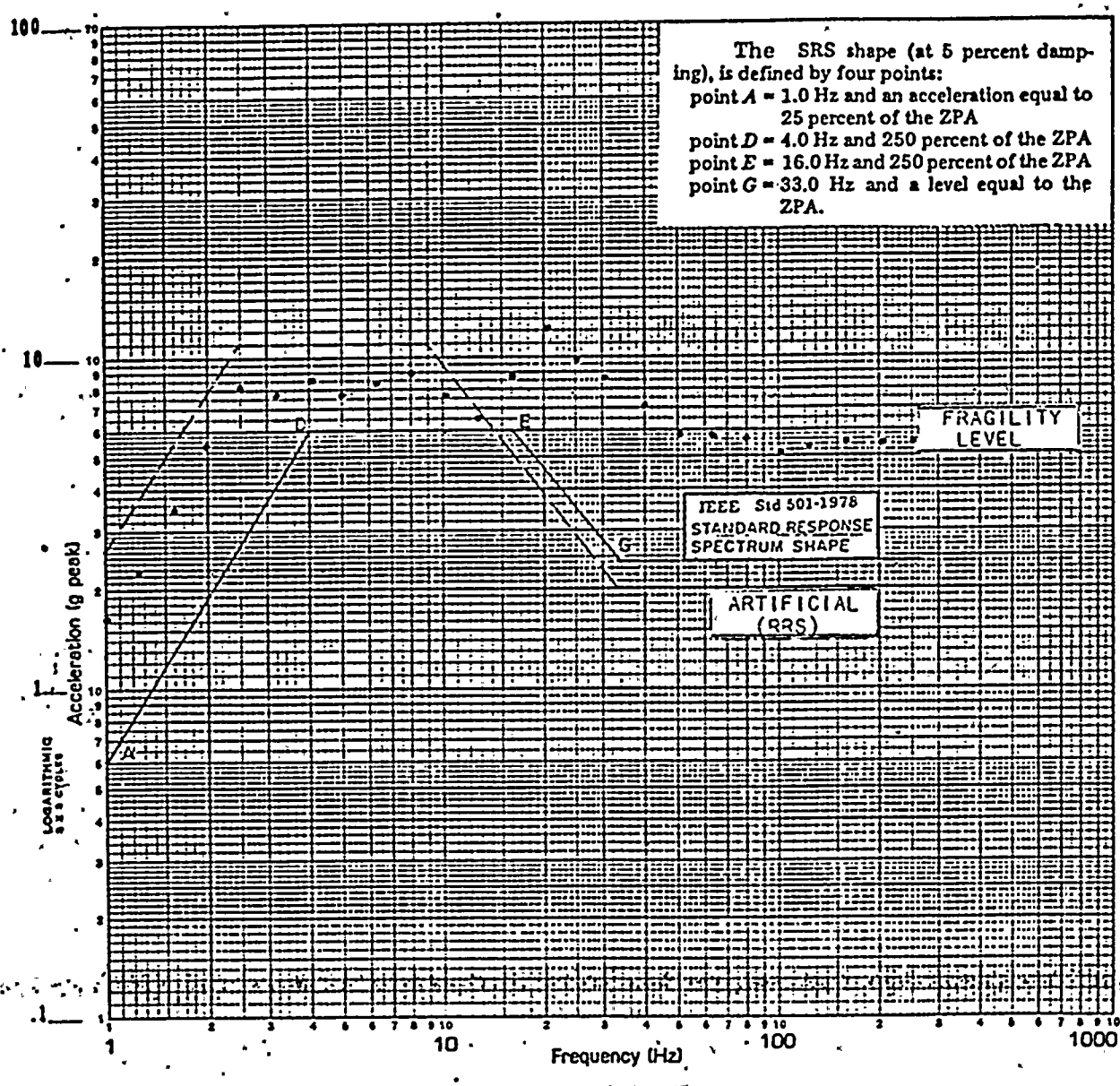
Figure 5. Model E7012, Response Spectrum, Transitional Mode

FULL SCALE SHOCK SPECTRUM (g Peak) MODELS TESTED:

E7022AC001
E7022PC001

1.0 ☐ 10 ☐ 100 ☒ .1000☐

DAMPING 5 %



SPECIMEN 2 & 4 (E7022 SERIES) RELAY STATE: NON-OPERATE MODE (DE-ENER)

AXIS * SEE NOTE (H+V) TEST RUN NO (103,104),(95,99),86,76

*COMPOSITE OF FB/V-, SS/V-, SS/V+, FB/V+ X.707 DUE TO 45° INCLINATION OF TEST MACHINE.

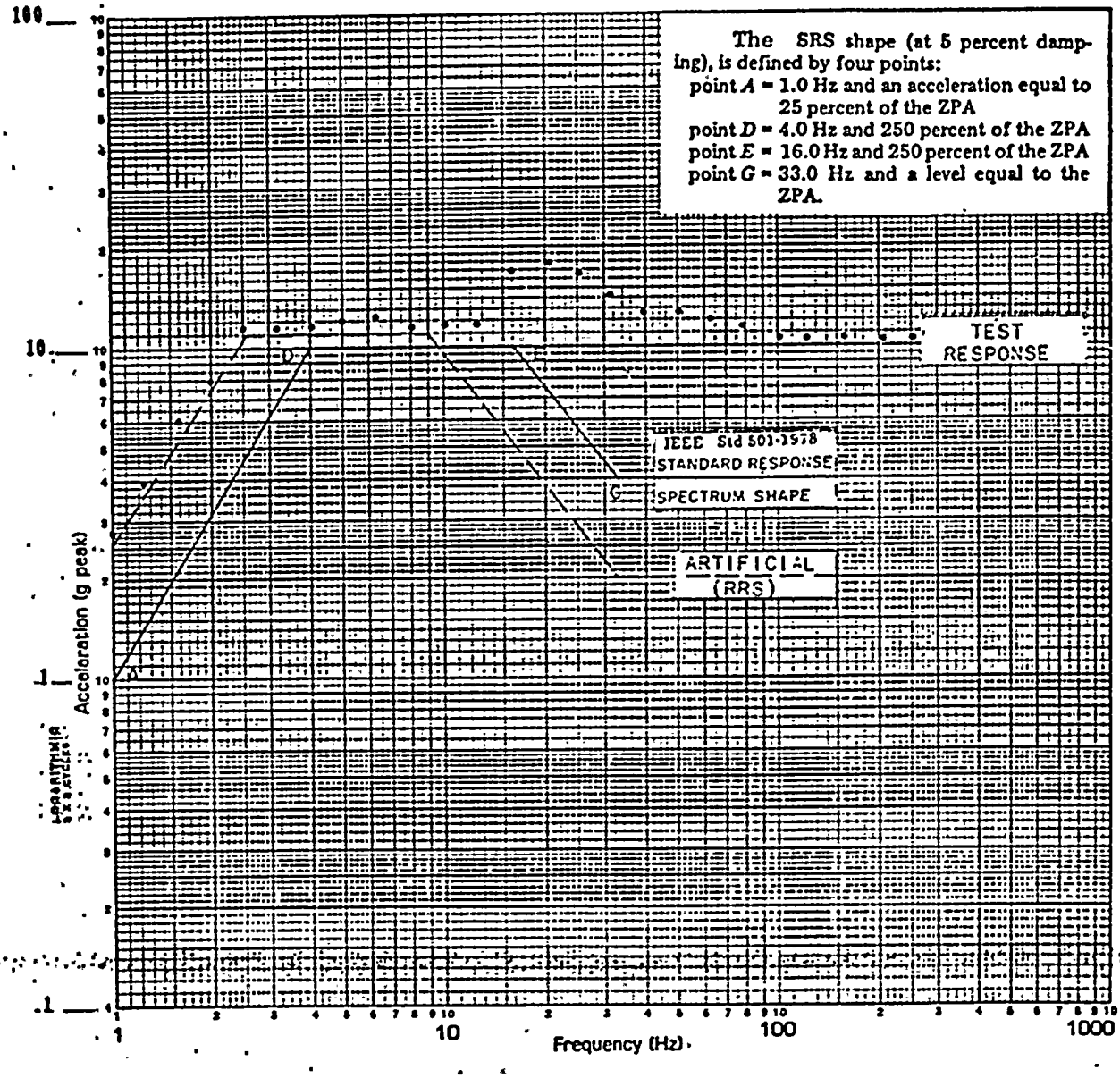
Figure 6. Model E7022, Response Spectrum, Non-Operate Mode

FULL SCALE SHOCK SPECTRUM (g Peak) MODELS TESTED:

E7022AC001
E7022PC001

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING 5 %



SPECIMEN 2 & 4 (E7022 SERIES) RELAY STATE: OPERATE MODE (ENERGIZED)

AXIS * SEE NOTE (H+V) TEST RUN NO. 312,309,306,+303

* COMPOSITE OF: FB/V+, SS/V-, SS/V+, FB/V+ X .707 DUE TO 45° INCLINATION OF TEST MACHINE.

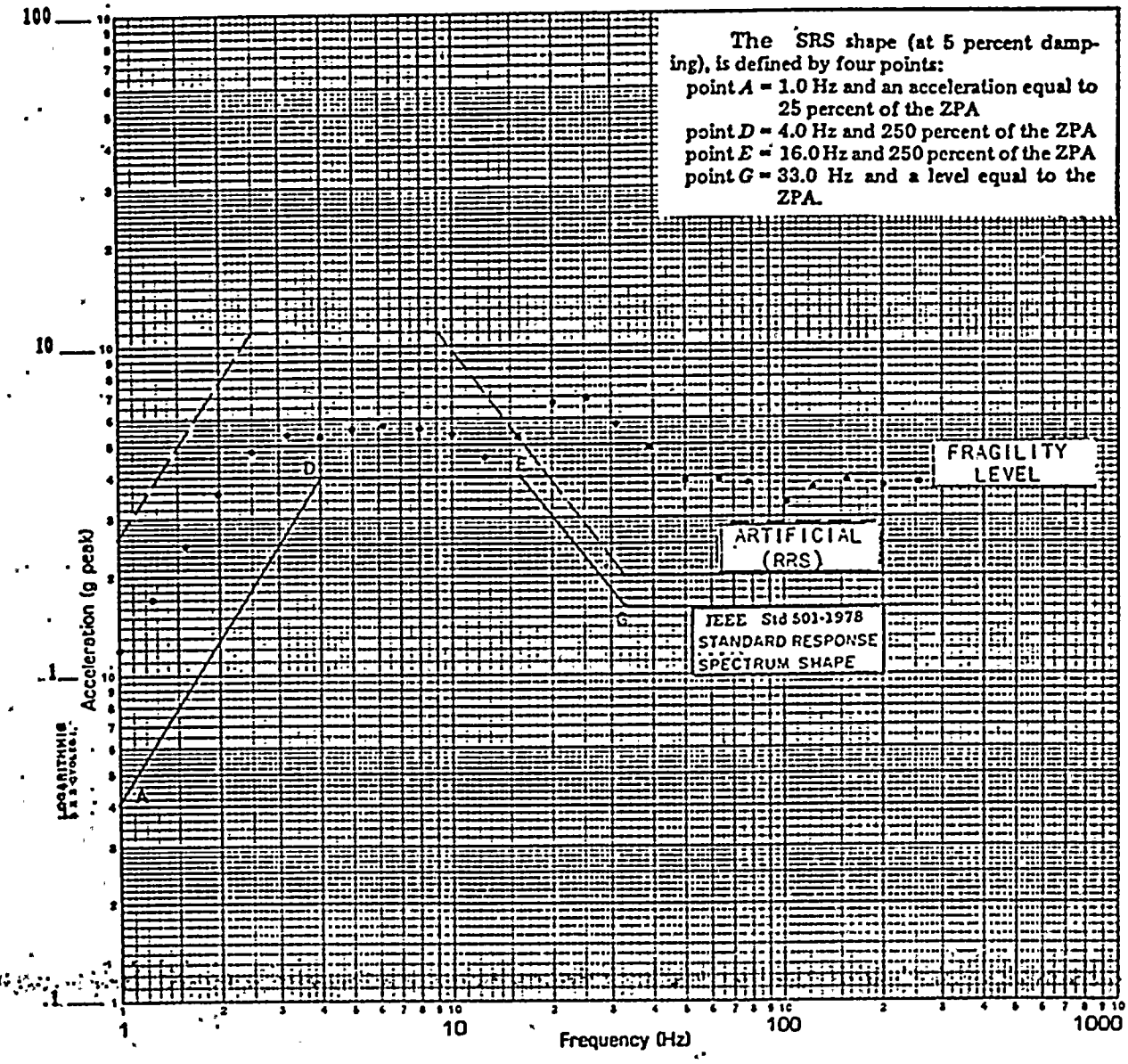
Figure 7. Model E7022, Response Spectrum, Operate Mode

FULL SCALE SHOCK SPECTRUM (g Peak). MODELS TESTED:

E7022AC001
E7022PC001

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING 5%



SPECIMEN 2 & 4 (E7022 SERIES) RELAY STATE: TRANSITION MODE (TD X 2)

AXIS * SEE NOTE (H+V) TEST RUN NO. 253,257,(153,154),(165,166)

* COMPOSITE OF FB/V-, SS/V-, SS/V+, FB/V+ X.707 DUE TO 45° INCLINATION OF TEST MACHINE.

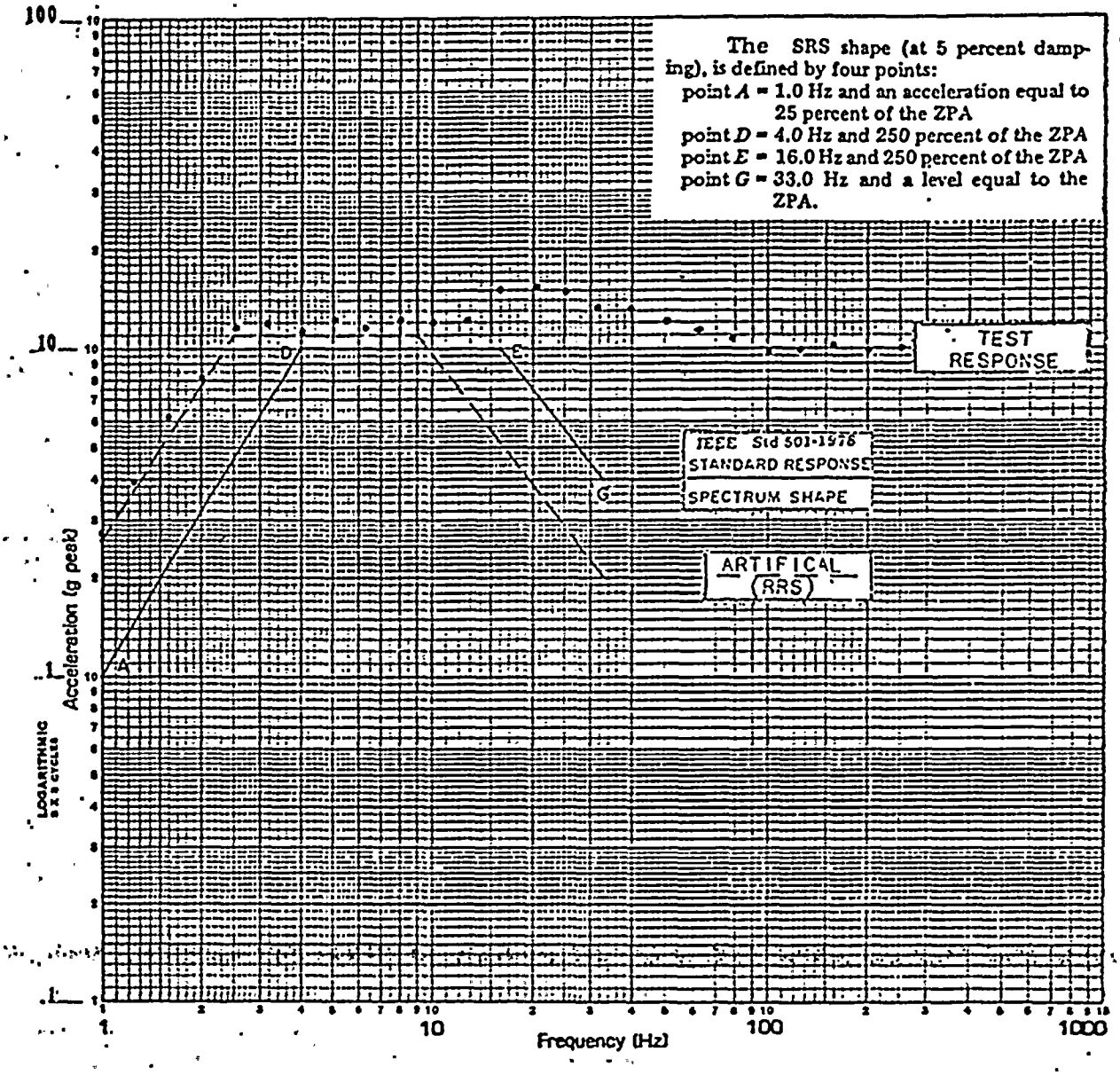
Figure 8. Model E7022, Response Spectrum, Transitional Mode

FULL SCALE SHOCK SPECTRUM (g Peak) MODELS TESTED:

E7014AC001
E7014PC001

1.0 ☐ 10 ☐ 100 ☒ 10000 ☐

DAMPING 5 %



SPECIMEN 7 & 22 (E7014 SERIES) RELAY STATE: NON-OPERATE MODE (DE-ENER.)

AXIS * SEE NOTE (H+V) TEST RUN NO. (35,320)(29,319)(21,318)(11,317)

* COMPOSITE OF: FB/V-, SS/V-, SS/V+, FB/V+ X .707 DUE TO 45° INCLINATION OF TEST MACHINE.

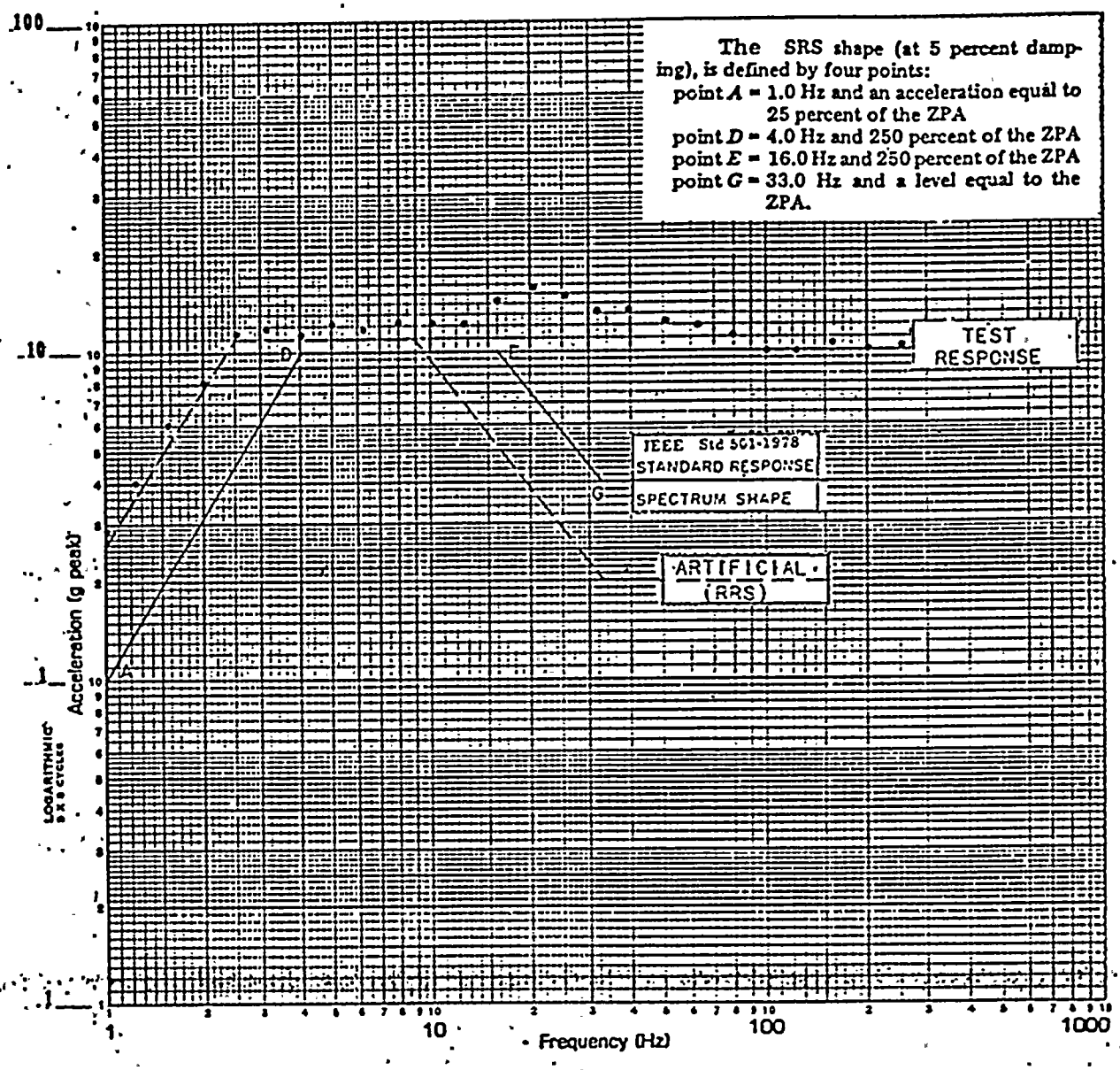
Figure 9. Model E7014, Response Spectrum, Non-Operate Mode

FULL SCALE SHOCK SPECTRUM (g Peak) MODELS TESTED:

E7014AC001
E7014PC001

1.0 ☐ 10 ☐ 100 ☒ 10000 ☐

DAMPING 5 %



SPECIMEN 7 & 22 (E7014 SERIES) RELAY STATE: OPERATE MODE (ENERGIZED)

AXIS * SEE NOTE (H+V) TEST RUN NO. (40,321)(52,323)(59,325)(70,327)

* COMPOSITE OF FB/V-,SS/V-,SS/V+,FB/V+ X.707 DUE TO 45° INCLINATION OF TEST MACHINE.

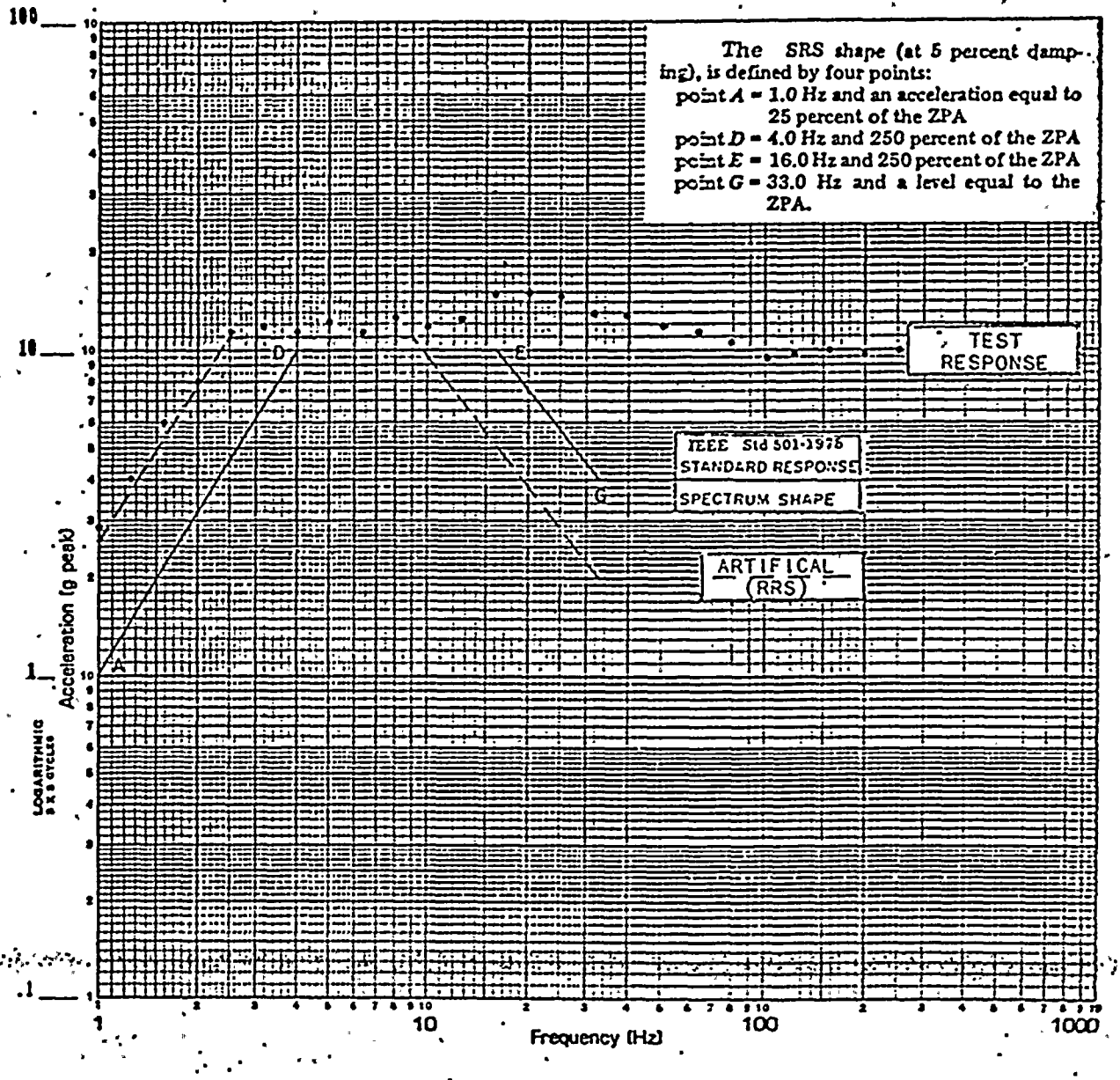
Figure 10. Model E7014, Response Spectrum, Operate Mode

FULL SCALE SHOCK SPECTRUM (g Peak) MODELS TESTED:

E7014AC001
E7014PC001

1.0 ☐ 10 ☐ 100 ☒ 10000 ☐

DAMPING 5 %



SPECIMEN 7 & 22 (E7014 SERIES) RELAY STATE: TRANSITIONAL MODE (TD X 2)

AXIS * SEE NOTE (H+V) TEST RUN NO. (41,322)(45,324)(60,326)(63,328)

*COMPOSITE OF FB/V-, SS/V-, SS/V+, FB/V+ X .707 DUE TO 45° INCLINATION OF TEST MACHINE.

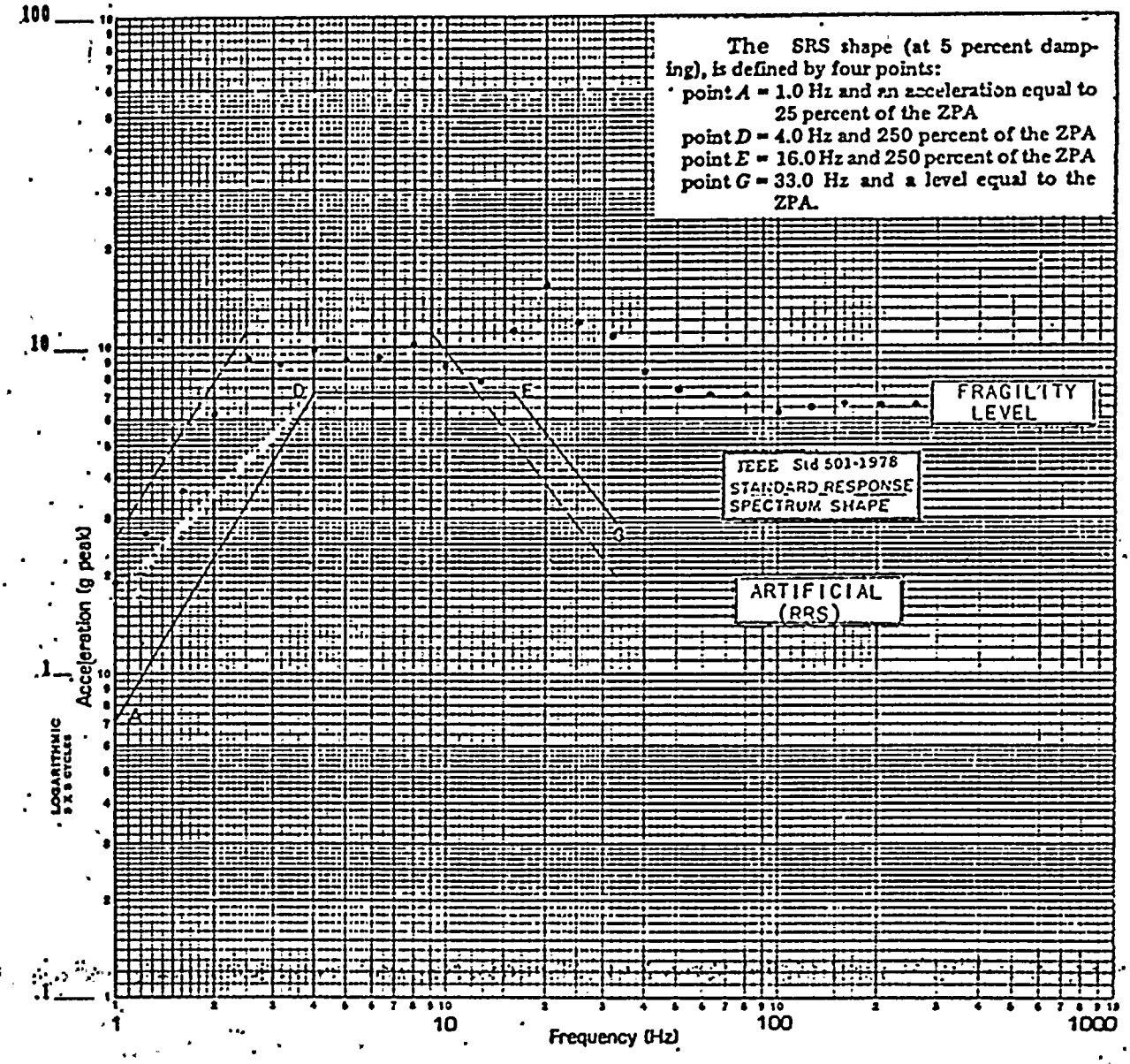
Figure 11. Model E7014, Response Spectrum, Transitional Mode

FULL SCALE SHOCK SPECTRUM (g Peak)

MODELS TESTED:
E7024AC001
E7024PC001

1.0 ☐ 10 ☐ 100 ☒ 10000 ☐

DAMPING 5 %



SPECIMEN 6 & 8 (E7024 SERIES) RELAY STATE: NON-OPERATE MODE (DE-ENER)

AXIS * SEE NOTE (H+V) TEST RUN NO. (104,106) (97,98)85,76

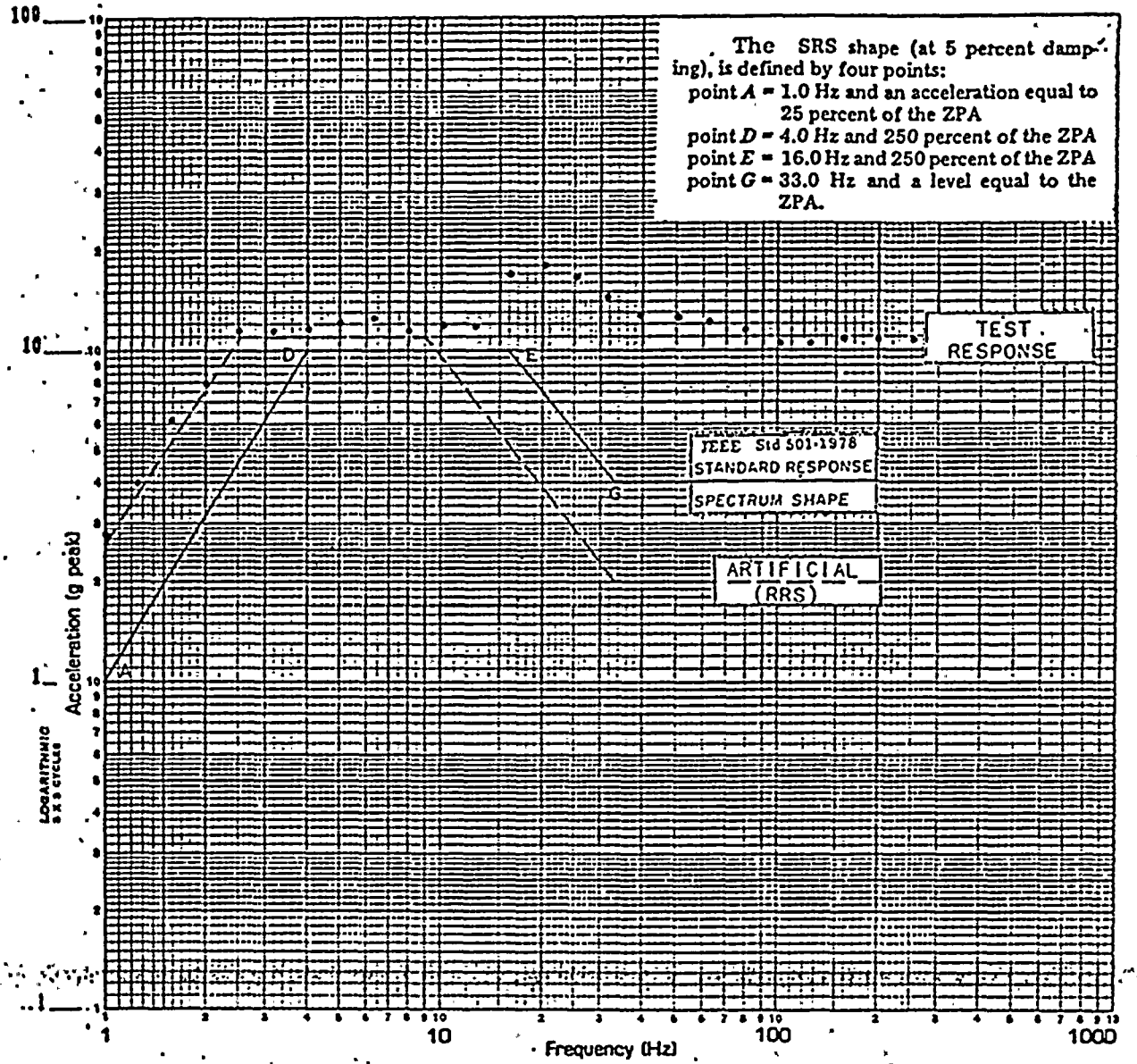
*COMPOSITE OF FB/V-, SS/V-, SS/V+, FB/V+ X .707 DUE TO 45° INCLINATION OF TEST MACHINE.

Figure 12. Model E7024, Response Spectrum, Non-Operate Mode

FULL SCALE SHOCK SPECTRUM (g Peak) MODELS TESTED:
E7024AC001
E7024PC001

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING 5 %



SPECIMEN 6 & 8 (E7024 SERIES) RELAY STATE: OPERATE MODE (ENERGIZED)

AXIS * SEE NOTE (H+V) TEST RUN NO. 312,309,306,+303

* COMPOSITE OF FB/V-, SS/V-, SS/V+, FB/V+ X .707 DUE TO 45° INCLINATION OF TEST MACHINE.

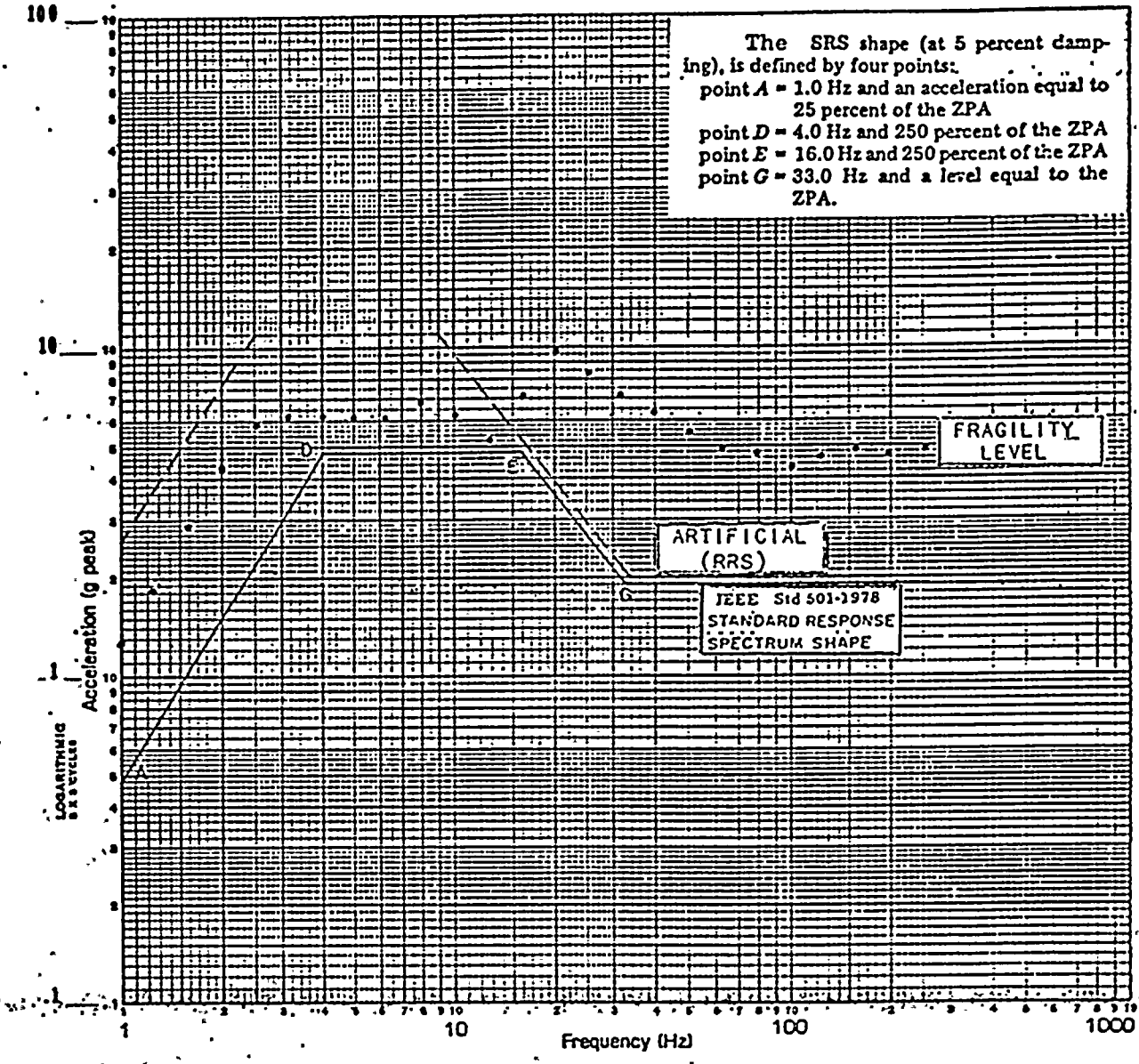
Figure 13. Model E7024, Response Spectrum, Operate Mode

FULL SCALE SHOCK SPECTRUM (g Peak) MODELS TESTED:

E7024AC001
E7024PC001

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING 5 %



SPECIMEN 6 & 8 (E7024 SERIES) RELAY STATE: TRANSITIONAL MODE (TD X 2)

AXIS * SEE NOTE (H+V) TEST RUN NO. 253,257,(152,153),164

* COMPOSITE OF FB/V-,SS/V-,SS/V+,FB/V+ X .707 DUE TO 45° INCLINATION OF TEST MACHINE.

Figure 14. Model E7024, Response Spectrum, Transitional Mode

DATA- HOSTILE ENVIRONMENT TESTS

FOR PROCEDURE AND ADDITIONAL INFORMATION SEE WYLE TEST REPORT NO. 43706-2, VOLUME I, SECTION X.

THE FOLLOWING CROSS REFERENCE CORRELATES OLD TO NEW NUMBERING SYSTEMS:

AS STATED IN WYLE TEST REPORT NO. 43706-2 (OLD CATALOG MODEL NO.)	AS STATED IN AMERACE TEST REPORT NO. ES-1000 (NEW CATALOG MODEL NO.)
7012ACE	E7012AC001
7022ACE	E7022AC001
7012PCE	E7012PC001
7022PCE	E7022PC001
7014ACE	E7014AC001
7024ACE	E7024AC001
7014PCE	E7014PC001
7024PCE	E7024PC001

HOSTILE ENVIRONMENT TEST DATA

SUMMARY SHEET

MODEL NO. E7012AC001 (7012ACE)

TEST ITEM NO. 2

TEMPERATURE	MINIMUM VOLTAGE TEST		MAXIMUM VOLTAGE TEST	
AT 95% R.H. (DEGREES FAHRENHEIT)	AVERAGE TIME DELAY (SECONDS)	REPEAT ACCURACY (PERCENT)	AVERAGE TIME DELAY (SECONDS)	REPEAT ACCURACY (PERCENT)
40°F	2.06 sec.	1.8%	1.92 sec.	9.4 %
50°F	2.07	3.4	2.06	2.8
70°F	2.02	2.6	2.09	2.7
90°F	1.99	3.1	2.01	4.5
110°F	1.98	4.5	1.97	2.1
130°F	1.87	6.9	1.90	1.8
150°F	1.83	1.4	1.84	1.0
165°F	1.75	1.8	1.78	0.8
172°F	1.81	0.7	1.80	1.9

NOTES:

1. TEMPERATURES STATED ARE AT 95% RELATIVE HUMIDITY.
2. AVERAGE TIME DELAY IS AVERAGE OF FIVE (5) CONSECUTIVE READINGS.
3. FOR REPEAT ACCURACY DEFINITION SEE FIGURES 1 AND 2, PAGES 13 AND 14 RESPECTIVELY OF THIS REPORT.

MINIMUM VOLTAGE USED 102 VAC

MAXIMUM VOLTAGE USED 145 VAC

PREPARED BY C. J. Legnos

DATE 2-25-80

HOSTILE ENVIRONMENT TEST DATA

SUMMARY SHEET

MODEL NO. E7022AC001 (7022ACE)

TEST ITEM NO. 2

TEMPERATURE	MINIMUM VOLTAGE TEST		MAXIMUM VOLTAGE TEST	
AT 95% R.H. (DEGREES FAHRENHEIT)	AVERAGE TIME DELAY (SECONDS)	REPEAT ACCURACY (PERCENT)	AVERAGE TIME DELAY (SECONDS)	REPEAT ACCURACY (PERCENT)
40°F	1.77 SEC.	0.6 %	1.67 SEC.	10.1 %
50°F	1.75	0.6	1.74	1.2
70°F	1.79	2.6	1.84	0.8
90°F	1.75	0.9	1.75	0.6
110°F	1.77	0.9	1.75	0.3
130°F	1.73	0.8	1.71	0.7
150°F	1.65	0.9	1.65	1.1
165°F	1.57	0.9	1.54	1.0
172°F	1.51	2.1	1.50	0.9

NOTES:

1. TEMPERATURES STATED ARE AT 95% RELATIVE HUMIDITY.
2. AVERAGE TIME DELAY IS AVERAGE OF FIVE (5) CONSECUTIVE READINGS.
3. FOR REPEAT ACCURACY DEFINITION SEE FIGURES 1 AND 2, PAGES 13 AND 14 RESPECTIVELY OF THIS REPORT.

MINIMUM VOLTAGE USED 102 VAC

MAXIMUM VOLTAGE USED 145 VAC

PREPARED BY C. J. Lagund

DATE 2-25-90

HOSTILE ENVIRONMENT TEST DATA

SUMMARY SHEET

MODEL NO. E7012PC001 (7012PCE)

TEST ITEM NO. 1

TEMPERATURE	MINIMUM VOLTAGE TEST		MAXIMUM VOLTAGE TEST	
AT 95% R.H. (DEGREES FAHRENHEIT)	AVERAGE TIME DELAY (SECONDS)	REPEAT ACCURACY (PERCENT)	AVERAGE TIME DELAY (SECONDS)	REPEAT ACCURACY (PERCENT)
40°F	1.97 sec.	2.5%	1.92 sec.	9.4%
50°F	1.89	1.5	1.92	5.0
70°F	1.84	0.2	1.84	0.8
90°F	1.76	1.6	1.75	1.4
110°F	1.71	1.3	1.70	1.3
130°F	1.81	2.0	1.71	1.3
150°F	1.77	2.1	1.67	1.6
165°F	1.80	3.7	1.61	1.5
172°F	1.80	2.0	1.58	3.5

NOTES:

1. TEMPERATURES STATED ARE AT 95% RELATIVE HUMIDITY.
2. AVERAGE TIME DELAY IS AVERAGE OF FIVE (5) CONSECUTIVE READINGS.
3. FOR REPEAT ACCURACY DEFINITION SEE FIGURES 1 AND 2, PAGES 13 AND 14 RESPECTIVELY OF THIS REPORT.

MINIMUM VOLTAGE USED 96 VDC

MAXIMUM VOLTAGE USED 154 VDC

PREPARED BY C. J. Lienard

DATE 2-25-80

HOSTILE ENVIRONMENT TEST DATA

SUMMARY SHEET

MODEL NO. E7022PC001 (7022PCE)

TEST ITEM NO. 1

TEMPERATURE	MINIMUM VOLTAGE TEST		MAXIMUM VOLTAGE TEST	
AT 95% R.H. (DEGREES FAHRENHEIT)	AVERAGE TIME DELAY (SECONDS)	REPEAT ACCURACY (PERCENT)	AVERAGE TIME DELAY (SECONDS)	REPEAT ACCURACY (PERCENT)
40°F	1.66 SEC.	9.6%	1.75 SEC.	0.3%
50°F	1.71	0.2	1.73	0.7
70°F	1.72	0.6	1.72	0.5
90°F	1.60	1.6	1.61	0.2
110°F	1.65	3.6	1.73	1.7
130°F	1.63	2.2	1.69	1.3
150°F	1.54	0.4	1.57	0.6
165°F	1.43	1.0	1.43	0.7
172°F	1.40	0.3	1.39	0.3

NOTES:

1. TEMPERATURES STATED ARE AT 95% RELATIVE HUMIDITY.
2. AVERAGE TIME DELAY IS AVERAGE OF FIVE (5) CONSECUTIVE READINGS.
3. FOR REPEAT ACCURACY DEFINITION SEE FIGURES 1 AND 2, PAGES 13 AND 14 RESPECTIVELY OF THIS REPORT.

MINIMUM VOLTAGE USED 9.6 VDC

MAXIMUM VOLTAGE USED 15.4 VDC

PREPARED BY A. J. Lugosh

DATE 2-25-80

HOSTILE ENVIRONMENT TEST DATA

SUMMARY SHEET

MODEL NO. E7014AC001 (7014ACE)

TEST ITEM NO. 2

TEMPERATURE	MINIMUM VOLTAGE TEST		MAXIMUM VOLTAGE TEST	
AT 95% R.H. (DEGREES FAHRENHEIT)	AVERAGE TIME DELAY (SECONDS)	REPEAT ACCURACY (PERCENT)	AVERAGE TIME DELAY (SECONDS)	REPEAT ACCURACY (PERCENT)
40°F	4.21 sec.	5.5%	4.31 sec.	12.9%
50°F	4.50	9.6	4.27	1.9
70°F	4.88	11.0	4.75	5.1
90°F	4.97	22.5	4.29	1.7
110°F	4.81	8.9	4.25	1.7
130°F	4.33	11.2	4.21	1.3
150°F	4.87	11.6	4.18	1.4
165°F	4.35	14.4	4.11	2.7
172°F	4.31	13.0	3.99	0.6

NOTES:

1. TEMPERATURES STATED ARE AT 95% RELATIVE HUMIDITY.
2. AVERAGE TIME DELAY IS AVERAGE OF FIVE (5) CONSECUTIVE READINGS.
3. FOR REPEAT ACCURACY DEFINITION SEE FIGURES 1 AND 2, PAGES 13 AND 14 RESPECTIVELY OF THIS REPORT.

MINIMUM VOLTAGE USED 102 VAC

MAXIMUM VOLTAGE USED 145 VAC

PREPARED BY E. J. Lisnyak

DATE 2-25-80

HOSTILE ENVIRONMENT TEST DATA

SUMMARY SHEET

MODEL NO. E7024AC001 (7024ACE)

TEST ITEM NO. 1

TEMPERATURE	MINIMUM VOLTAGE TEST		MAXIMUM VOLTAGE TEST	
AT 95% R.H. (DEGREES FAHRENHEIT)	AVERAGE TIME DELAY (SECONDS)	REPEAT ACCURACY (PERCENT)	AVERAGE TIME DELAY (SECONDS)	REPEAT ACCURACY (PERCENT)
40°F	1.65 SEC.	0.2%	1.57 SEC.	9.2%
50°F	1.60	0.5	1.60	0.6
70°F	2.02	0.7	2.17	6.4
90°F	1.94	0.8	2.0	3.6
110°F	1.94	1.8	1.87	5.4
130°F	1.85	0.6	1.84	1.2
150°F	1.82	0.5	1.90	3.1
165°F	1.41	1.0	1.41	0.4
172°F	1.40	3.0	1.38	0.5

NOTES:

1. TEMPERATURES STATED ARE AT 95% RELATIVE HUMIDITY.
2. AVERAGE TIME DELAY IS AVERAGE OF FIVE (5) CONSECUTIVE READINGS.
3. FOR REPEAT ACCURACY DEFINITION SEE FIGURES 1 AND 2, PAGES 13 AND 14 RESPECTIVELY OF THIS REPORT.

MINIMUM VOLTAGE USED 102 VAC

MAXIMUM VOLTAGE USED 145 VAC

PREPARED BY C.J. Lesyak

DATE 2-25-60

HOSTILE ENVIRONMENT TEST DATA

SUMMARY SHEET

MODEL NO. E7014PC001 (7014PCE)

TEST ITEM NO. 1

TEMPERATURE	MINIMUM VOLTAGE TEST		MAXIMUM VOLTAGE TEST	
AT 95% R.H. (DEGREES FAHRENHEIT)	AVERAGE TIME DELAY (SECONDS)	REPEAT ACCURACY (PERCENT)	AVERAGE TIME DELAY (SECONDS)	REPEAT ACCURACY (PERCENT)
40°F	3.53 sec.	0.8 %	3.51 sec.	1.3%
50°F	3.58	1.6	3.63	1.8
70°F	3.99	2.4	3.93	2.7
90°F	3.72	1.6	3.72	0.8
110°F	3.72	1.0	3.75	0.8
130°F	3.66	1.0	3.63	0.8
150°F	3.54	1.0	3.61	1.2
165°F	3.53	1.4	3.55	0.9
172°F	3.36	1.1	3.30	0.8

NOTES:

1. TEMPERATURES STATED ARE AT 95% RELATIVE HUMIDITY.
2. AVERAGE TIME DELAY IS AVERAGE OF FIVE (5) CONSECUTIVE READINGS.
3. FOR REPEAT ACCURACY DEFINITION SEE FIGURES 1 AND 2, PAGES 13 AND 14 RESPECTIVELY OF THIS REPORT.

MINIMUM VOLTAGE USED 96 VDC

MAXIMUM VOLTAGE USED 154 VDC

PREPARED BY C.J. Luzzak

DATE 2-25-80

HOSTILE ENVIRONMENT TEST DATA

SUMMARY SHEET

MODEL NO. E7024PC001 (7024PCE)

TEST ITEM NO. 1

TEMPERATURE	MINIMUM VOLTAGE TEST		MAXIMUM VOLTAGE TEST	
AT 95% R.H. (DEGREES FAHRENHEIT)	AVERAGE TIME DELAY (SECONDS)	REPEAT ACCURACY (PERCENT)	AVERAGE TIME DELAY (SECONDS)	REPEAT ACCURACY (PERCENT)
40°F	1.50 sec.	5.9 %	1.61 sec.	1.2 %
50°F	1.56	2.1	1.54	0.8
70°F	1.62	0.4	1.64	1.5
90°F	1.51	0.5	1.56	1.3
110°F	1.52	0.9	1.59	1.2
130°F	1.49	1.3	1.50	0.3
150°F	1.35	0.3	1.43	0.5
165°F	1.32	0.4	1.36	0.3
172°F	1.28	0.2	1.32	1.2

NOTES:

1. TEMPERATURES STATED ARE AT 95% RELATIVE HUMIDITY.
2. AVERAGE TIME DELAY IS AVERAGE OF FIVE (5) CONSECUTIVE READINGS.
3. FOR REPEAT ACCURACY DEFINITION SEE FIGURES 1 AND 2, PAGES 13 AND 14 RESPECTIVELY OF THIS REPORT.

MINIMUM VOLTAGE USED 96 VDC

MAXIMUM VOLTAGE USED 154 VDC

PREPARED BY C.J. Lizzak

DATE 2-25-80

DATA - POST-TEST INSPECTION

NOTE: FOR ADDITIONAL INFORMATION SEE WYLE REPORT NO. 43706-2 VOLUME I, SECTION XII

THE FOLLOWING CROSS REFERENCE CORRELATES OLD TO NEW NUMBERING SYSTEMS:

AS STATED IN WYLE TEST REPORT NO. 43706-2 (OLD CATALOG MODEL NO.)	AS STATED IN AMERACE TEST REPORT NO. ES-1000 (NEW CATALOG MODEL NO.)
7012ACE	E7012AC001
7022ACE	E7022AC001
7012PCE	E7012PC001
7022PCE	E7022PC001
7014ACE	E7014AC001
7024ACE	E7024AC001
7014PCE	E7014PC001
7024PCE	E7024PC001

DATA SHEET

Customer: Amerace Corporation
Specimen: Agastat Relays
Part No.: SEE BELOW
Spec.: WYLE 545/5614-3/ES, REV. A
Para.: 13.0
S/N: N/A
GSI: N/A
Test Title: POST-TEST INSPECTION

Amb. Temp.: ROOM
Photo: SEE SECTION XII, VOL. I
Test Med.: N/A
Specimen Temp.: ROOM

WYLE LABORATORIES
Job No.: 43706
Report No.: 43706-2
Start Date: 8-25-78

Catalog #	Item	Mech. Parts	Elect. Parts	Relay Case	Remarks
7012ACE	2	✓	✓	✓	NO VISUAL EVIDENCE OF DAMAGE
7012ACE	3	✓	✓	✓	NO VISUAL EVIDENCE OF DAMAGE
7022ACE	1	✓	✓	✓	NO VISUAL EVIDENCE OF DAMAGE
7022ACE	2	✓	✓	✓	NO VISUAL EVIDENCE OF DAMAGE
7012PCE	1	✓	✓	✓	NO VISUAL EVIDENCE OF DAMAGE
7012PCE	2	✓	✓	✓	NO VISUAL EVIDENCE OF DAMAGE
7022PCE	1	✓	✓	✓	NO VISUAL EVIDENCE OF DAMAGE
7022PCE	2	✓	✓	✓	NO VISUAL EVIDENCE OF DAMAGE
* 7014ACE	1	N/A	N/A	N/A	Removed From Test
7014ACE	2	✓	✓	✓	NO VISUAL EVIDENCE OF DAMAGE
7024ACE	1	✓	✓	✓	NO VISUAL EVIDENCE OF DAMAGE
7024ACE	2	✓	✓	✓	NO VISUAL EVIDENCE OF DAMAGE
7014PCE	1	✓	✓	✓	NO VISUAL EVIDENCE OF DAMAGE
7014PCE	2	✓	✓	✓	NO VISUAL EVIDENCE OF DAMAGE
7024PCE	1	✓	✓	✓	NO VISUAL EVIDENCE OF DAMAGE
7024PCE	2	✓	✓	✓	NO VISUAL EVIDENCE OF DAMAGE

Specimen Failed: SEE REMARKS
Specimen Passed: SEE REMARS
NOD Written: N/A

Tested By: C. Blackwell Date: 9-25-78
Witness: _____ Date: _____
Sheet No. 1 of 2
Approved: R. Bridge

WH-614A

Copy of applicable portion of Post Test Inspection Data Sheet from Wyle Test Report Number 43706-2, Volume II.

* See notice of anomaly #5 of Wyle Test Report Number 43706-2, Volume I, Section IX, Page IX-4.

APPENDIX A

ESTABLISHED AND/OR VERIFIED NUCLEAR SAFETY RELATED PERFORMANCE CHARACTERISTICS FOR MODELS E7012/E7022

THE FOLLOWING CROSS REFERENCE CORRELATES OLD TO NEW NUMBERING SYSTEMS:

AS STATED IN WYLE TEST REPORT NO. 43706-2 (OLD CATALOG MODEL NO.)	AS STATED IN AMERACE TEST REPORT NO. ES-1000 (NEW CATALOG MODEL NO.)
7012ACE	E7012AC001
7022ACE	E7022AC001
7012PCE	E7012PC001
7022PCE	E7022PC001

PRODUCT SPECIFICATION

DOCUMENT NO. E7012/E7022	PREPARED F. Kusko	DATE 4/3/80	NUCLEAR SAFETY RELATED
TITLE MODEL E7012/E7022 SERIES TIMING RELAYS CLASS 1E	CHECKED T. K. Grubb	4/3/80	
	APPROVED G. J. Rumpel	4/3/80	
	APPROVED R. Matich	4/3/80	

REVISION INDEX

ECO	REV	SHEETS EFF.	DATE	ECO	REV	SHEETS EFF.	DATE
80-47	D	ALL	4-3-80				

REVISION STATUS OF SHEETS	REV.	D ← → D																					
	SHEET	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22

1.0 PURPOSE

1.1 The purpose of this specification is to define the performance characteristics of Control Products Division of Amerace Corp. (CTP) Agastat® relays identified herein. The performance characteristics stated were derived from the results of a qualification test program, which was designed to measure the performance of the devices under normal and abnormal (Design Basis Events) conditions as specified. The qualification test program used was in accordance with the requirements of IEEE STD. 323-1974 (IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations) and IEEE STD. 344-1975 (IEEE Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations).

NOTE

In the following information, reference will also be made to IEEE STD. 501-1978 (IEEE Standard for Seismic Testing of Relays)

2.0 LIMITATIONS OF TEST RESULTS.

2.1 Since it is not possible to define the conditions for every conceivable application for relays, those parameters, which in practice encompass the majority of applications, have been specified.

2.2 If this data is not applicable to a particular requirement; then proof testing must be performed for that particular case.

2.3 The data documented in this specification applies only to Agastat® relays mounted on rigid test fixtures and does not apply to relays mounted on switch boards, panels or any structure.

2.4 It is the responsibility of the power system facility designers to combine data on seismic and environmental performance of the relays to arrive at an acceptable equipment design for a particular application.

NOTE

Control Products Division of Amerace Corporation does not recommend the use of its products in the containment areas of nuclear power generating stations.

3.0 QUALIFICATION TEST OUTLINE.

3.1 AGING SIMULATION. (10 year or 25,000 operations qualified life). The following sequence of tests was performed on Agastat® devices identified herein (prior to seismic fragility testing). The sole intent being that the combination of these tests, with applied margins, degraded the relays and their related hardware to a state which constitutes the equivalency of their end of service condition to satisfy the aging requirements of IEEE STD. 323-1974 and IEEE STD. 344-1975.

3.1.1 Aging Sequence.

(a) Radiation Aging. (2.0×10^5 rads integrated dose.) This dosage is considered to be of sufficient integrated exposure, with margin included that exceeds the adverse plant operating requirements for areas outside the reactor containment building. Mainly the auxiliary and control buildings.

(b) Cycling with Load Aging. (27,500 operations with one set of contacts loaded to 120 vac, 60 Hz at 10 amp or 125 vdc at 1 amp, which is rated load.) The objective of this test was to operate the devices at an accelerated rate with contacts loaded. The intent being to exceed by 10% the amount of mechanical operations the relays will see in service. Also, by loading the contacts, the wear at the end of the test should exceed their normal end of qualified life conditions.

NOTE

10% margin added to cycles (25,000 plus 10% = 27,500 operations)

(c) Temperature Aging. (100°C for 42 days)
This test subjected the relays to an artificially elevated temperature (100°C) for an extended period of time (Forty two (42) days). The device performance was measured before and after the thermal stress. Negligible degradation in device performance stands as evidence of capability to handle the thermal aging requirements of Class 1E applications.

(d) Seismic Aging. Since this was basically a fragility type test, sufficient interactions were performed at levels less than the fragility level of the devices in order to satisfy, with required margins, the seismic aging requirements of IEEE STD. 323-1974 and IEEE STD, 344-1975.

3.2 BASELINE PERFORMANCE TESTS.

3.2.1 In addition to the aging tests, a series of baseline tests were conducted before (in order to establish a data base) and then immediately following each aging sequence, with the purpose being to measure the effects, if any, on the various devices.

3.2.2 The baseline tests consisted of:

(a) Pull-in Voltage

(b) Drop-out Voltage

(c) Dielectric Strength at 1650 vac, 60 Hz.

(d) Insulation Resistance at 500 vdc

(e) Operate Time (Milliseconds)

(f) Recycle Time (Milliseconds)

(g) Time Delay (Seconds)

(h) Repeatability (%)

(i) Contact Bounce (Milliseconds at 28 vdc, 1 ampere)

(j) Contact Resistance (Milliohms at 28 vdc, 1 ampere)

3.2.3 The data from these tests was measured and recorded. This data was used for comparison to functional data throughout the qualification test program to measure any degradation in the performance of the relays.

3.3 SEISMIC QUALIFICATION (IEEE STD. 344-1975 and IEEE STD. 501-1978).

3.3.1 The artificially aged devices were subjected to simulated seismic vibration, which verified the individual device's ability to perform its required function, before, during, and/or following design basis earthquakes.

3.3.2 Using a Generic Required Response Spectra (RRS) for control systems purposes for the majority of nuclear power plant locations in the continental United States as a Guideline, the devices should have met, exceeded, and/or established their own fragility levels.

3.3.3 The relays were tested in the following electrical states.

(a) Non-operating Mode (Relay coil deenergized - off-delay relays timed out).

(b) Operating Mode (Relay coils energized - on-delay relays timed out).with nominal rated voltage less 10% applied to coils.

(c) Transitional Mode (Relay time delay) with nominal rated voltage, less 10%, applied to coils. Relays timed out twice during seismic test.

3.4 HOSTILE ENVIRONMENT.

3.4.1 The relays are not recommended for use in the actual reactor containment area, but are intended mainly for use in the auxiliary and control buildings. Therefore, in lieu of a loss-of-coolant accident (LOCA) test, a hostile environment test was performed.

3.4.2 After simulated aging and seismic fragility testing, a combination temperature/humidity and under/over voltage test was conducted in order to demonstrate that the devices will function under adverse plant operating conditions even after having undergone all the aforementioned aging simulation and seismic qualification testing.

3.4.3 The relays were operated at minimum and maximum voltage extremes; 85 and 120 percent of rated voltage for AC devices and 80 and 120 percent of rated voltages for DC devices.

NOTE

Plus 10% was added to maximum rated voltages to satisfy margin requirements per IEEE STD. 323-1974.

3.4.4 Five (5) minimum voltage and five (5) maximum voltage operations were performed (time delays recorded) in each of the following environmental conditions: 95% relative humidity at 40°F, 50°F, 70°F, 90°F, 110°F, 130°F, 150°F, 165°F and 172°F.

NOTE

Plus 15°F was added to maximum use temperature (156°F) to satisfy the margin requirements of IEEE.STD. 323-1974.

3.5 POST TEST INSPECTION

3.5.1 Upon completion of all testing, each relay was thoroughly inspected. The condition of mechanical and electrical parts and the relay case was recorded.

3.6 QUALIFICATION TEST SUMMARY.

3.6.1 The Baseline Performance Tests (Para. 3.2) were conducted before and after each special test in order to measure and record any effects on the various devices.

3.6.2 The Qualification Test was conducted in the following sequence.

(a) Baseline Test (Initial)

(b) Radiation - Aging Test

(c) Baseline Test - (Repeated)

(d) Cycling with Load - Aging Test

(e) Baseline Test (Repeated)

(f) Temperature - Aging Test

(g) Baseline Test (Repeated)

(h) Seismic Aging and Qualification Test

(i) Baseline Test (Repeated)

(j) Hostile Environment Test

(k) Baseline Test (Final)

(l) Post Test Inspection

4.0 DEVICE INDENTIFICATION

4.1 CATALOG CODE NUMBERS

4.1.1 Figure 1 illustrates the method of identifying, by catalog code, the Model E7012 and E7022 series timing relays.

4.2 ACTUAL MODEL NUMBERS OF DEVICES TESTED.

(a) E7012AC001 & E7012PC001

(b) E7022AC001 & E7022PC001

E 70 * 2 * * ** C**** 001

E — NUCLEAR SAFETY RELATED

70 — ACASTAT® 7000.SERIES TIMING RELAY

***** — OPERATION
1 - ON-DELAY
2 - OFF-DELAY

2 — CONTACT ARRANGEMENT
2 - DOUBLE POLE DOUBLE THROW

***** — COIL VOLTAGE

CODE		
A	120 V 60Hz / 110 V 50Hz	AC VOLTAGE
B	240 V 60Hz / 220 V 50Hz	AC VOLTAGE
C	480 V 60Hz	AC VOLTAGE
D	550 V 60Hz	AC VOLTAGE
E	24 V 60Hz	AC VOLTAGE
F	127 V 50Hz	AC VOLTAGE
G	240 V 50Hz	AC VOLTAGE
H	12 V 60Hz	AC VOLTAGE
I	6 V 60Hz	AC VOLTAGE
J	208 V 60Hz	AC VOLTAGE
M	28 VDC	DC VOLTAGE
N	48 VDC	DC VOLTAGE
O	24 VDC	DC VOLTAGE
P	125 VDC	DC VOLTAGE
Q	12 VDC	DC VOLTAGE
R	60 VDC	DC VOLTAGE
S	250 VDC	DC VOLTAGE
T	550 VDC	DC VOLTAGE
U	16 VDC	DC VOLTAGE
V	32 VDC	DC VOLTAGE
W	96 VDC	DC VOLTAGE
Y	6 VDC	DC VOLTAGE
Z	220 VDC	DC VOLTAGE

***** — TIME RANGE

CODE	
A	.1 TO 1 SEC.
B	.5 TO 5 SEC.
C	1.5 TO 15 SEC.
D	5 TO 50 SEC.
E	20 TO 200 SEC.
F	1 TO 10 MIN.
H	3 TO 30 MIN.
I	6 TO 60 MIN.
J	:NOT AVAILABLE
K	1 TO 300 SEC.

****** — FACTORY INSTALLED OPTIONS

PERFORMANCE SPECIFICATIONS ON THIS SHEET ARE NOT VALID FOR MODELS WITH FACTORY INSTALLED OPTIONS. ON ALL MODELS WITH FACTORY INSTALLED OPTIONS, CUSTOMER ASSUMES RESPONSIBILITY OF ESTABLISHING VALIDITY OF PERFORMANCE DATA IN ES1000.

C**** — CUSTOM MODIFICATIONS

CUSTOMER SPECIAL MODIFICATIONS WHICH DO NOT AFFECT THE FUNCTIONAL CHARACTERISTICS OF THE UNIT OR THE RELEVANCY OF PERFORMANCE DATA IN ES1000 ARE CODED C2000 OR HIGHER.

CUSTOMER SPECIAL MODIFICATIONS WHICH DO AFFECT THE FUNCTIONAL CHARACTERISTICS OF THE UNIT AND THE RELEVANCY OF PERFORMANCE DATA IN ES1000 ARE CODED C1999 OR BELOW. FOR THESE UNITS THE CUSTOMER ASSUMES RESPONSIBILITY OF ESTABLISHING VALIDITY OF PERFORMANCE DATA IN ES1000.

001 — CONFIGURATION CODE

FIGURE 1. Device Code Designations

5.0 RELAY DESIGN CHARACTERISTICS.

5.1 DESCRIPTION OF OPERATION.

5.1.1 Model E7012. (See Figure 2) Applying a continuous voltage to the coil (L1-L2) starts a time delay lasting for the preset time. During this period, the normally closed contacts (3-5 and 4-6) remain closed. At the end of the delay period, the normally closed contacts break and the normally open contacts (1-5 and 2-6) make. The contacts remain in this position until the coil is deenergized, at which time the switch instantaneously returns to is original position. Deenergizing the coil, either during or after the delay period, will recycle the unit within .050 second. It will then provide a full-delay period upon reenergization, regardless of how often the coil voltage is interrupted before the unit has been permitted to "time-out" to its full-delay setting.

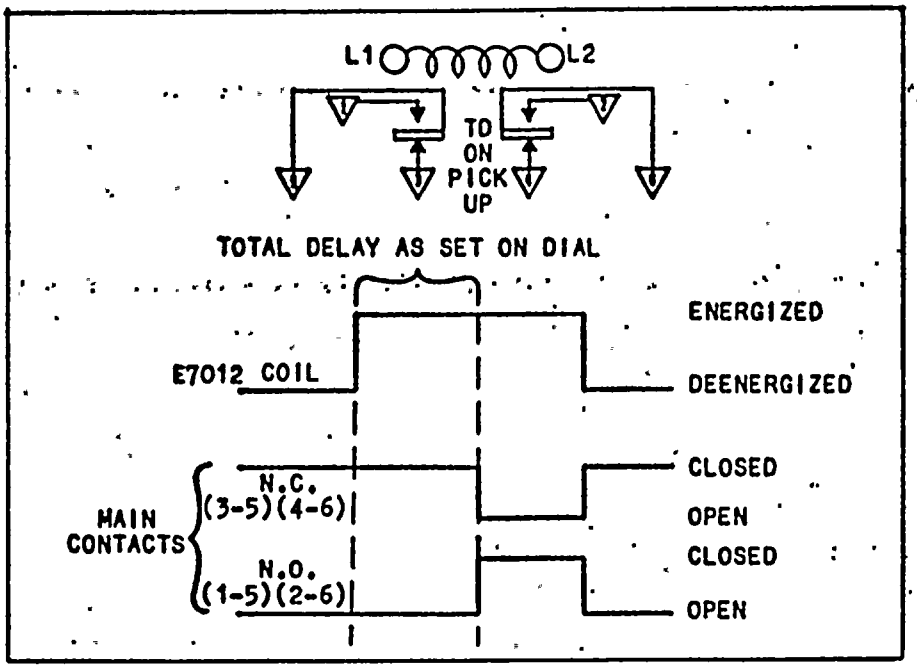


Figure 2. Operation of E7012, On-Delay Relay.

5.1.2 Model E7022 (See Figure 3) Applying a voltage to the coil (L1-L2) for at least .050 second will instantaneously transfer the switch, breaking the normally closed contacts (1-5 and 2-6) and making the normally open contacts (3-5 and 4-6). Contacts remain in this transferred position as long as the coil is energized. The time delay begins immediately upon deenergization. At the end of the delay period, the switch returns to

its normal position. Reenergizing the coil during the delay period will immediately return the timing mechanism to a point where it will provide a full-delay period upon subsequent de-energization. The switch remains in the transferred position.

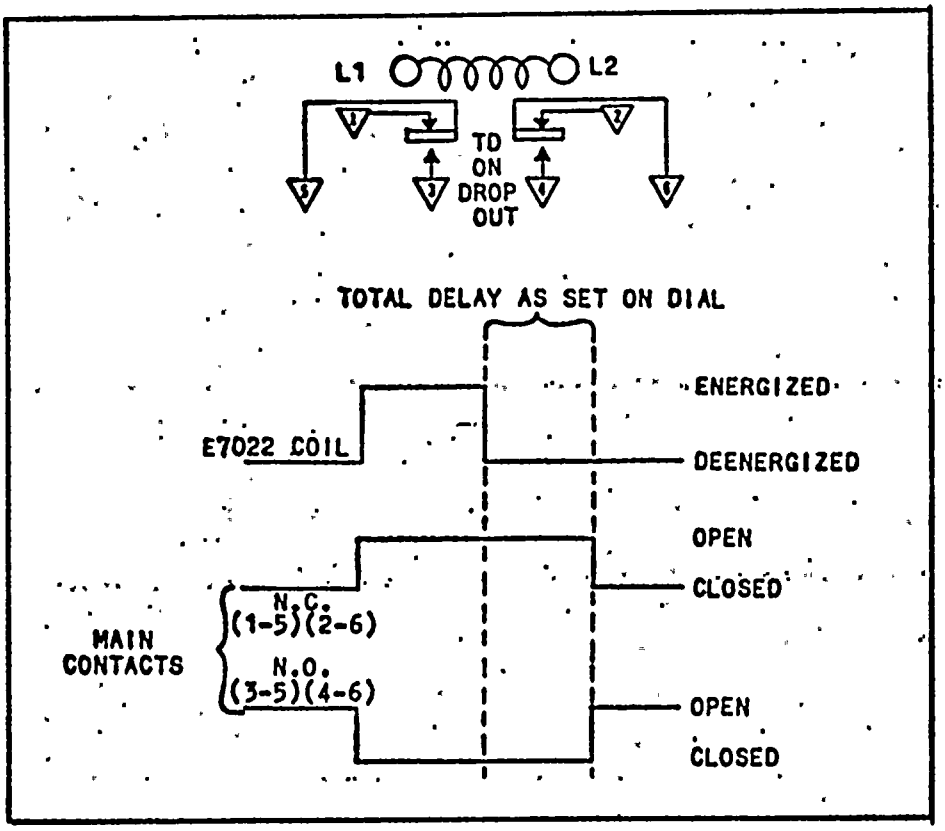


Figure 3. Operation of E7022, Off-Delay Relay.

5.2 PHYSICAL CHARACTERISTICS.

5.2.1 Relay Dimensions (See Figure 4)

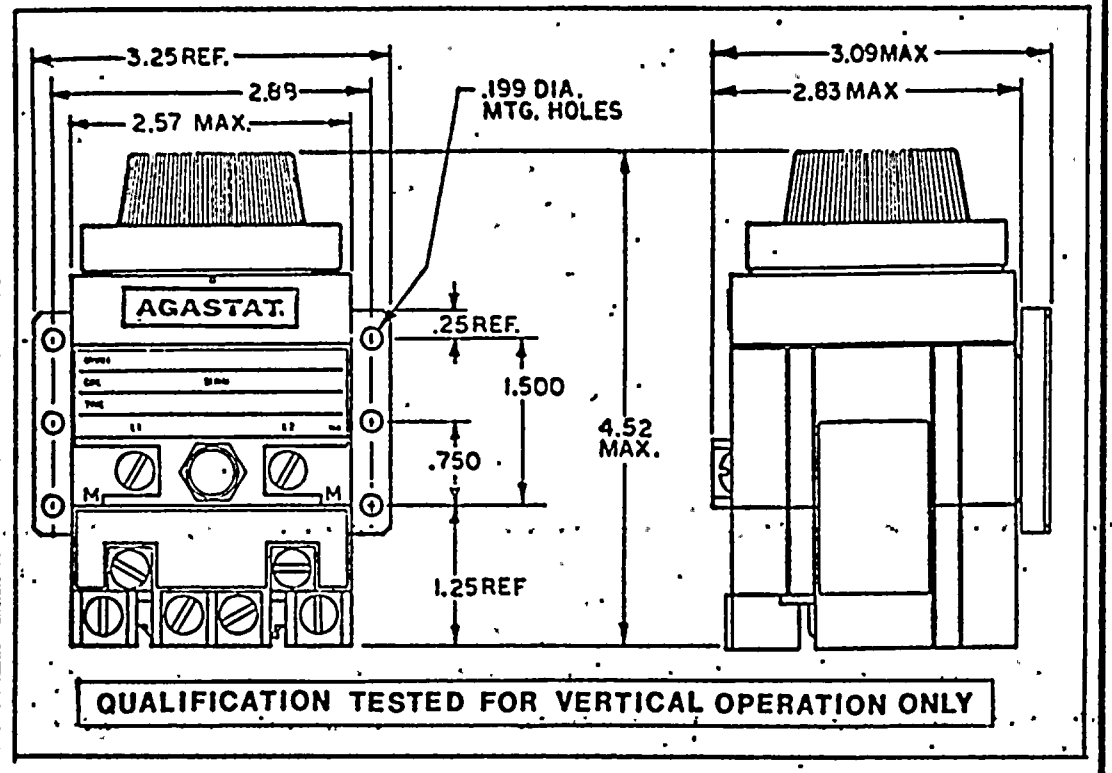


Figure 4. Model E7012 and E7022 Outline and Dimension Drawing.

5.2.2 Approximate Weight.

(a) Model E7012 and E7022 with (AC) coils - 2.13 lbs.

(b) Model E7012 and E7022 with (DC) coils - 2.25 lbs.

NOTE

Weight may vary slightly with relay coil voltage specified.

5.2.3 Terminals. Standard screw terminals (#8-32 truss head screws supplied) are located on the front of the unit with permanent schematic markings. Barrier isolation is designed to accomodate spade or ring tongue terminals with spacing to meet industrial control specifications.

5.2.4 Linear Time Range Adjustment. Basic models are furnished with dials calibrated in linear increments covering the range selected.

5.3 OPERATING CHARACTERISTICS.

5.3.1 Environmental Conditions. (Qualified Life)

PARAMETER	MIN.	NORMAL	MAX.
Temperature (°F)	40	70-104	156
Humidity (R.H. %).	10	40-60	95
Pressure	--	Atmospheric	---
Radiation (rads)	--	-----	2.0×10^5 (Gamma)

5.3.2 Operating Conditions. (Normal Environment)

NORMAL OPERATING SPECIFICATIONS	RELAYS W/ (DC) COILS	RELAYS W/ (AC) COILS
Coil Operating Voltage, Nominal (Rated)	As Spec	As Spec
Pull-in (% of rated value)	80% Min.	85% Min.
Drop-out (% of rated value)	10% Approx.	50% Approx.
Power (Watts at rated value)	8 Approx.	8 Approx.
Relay Operate Time (In ms)		
Model E7012	N/A	N/A
Model E7022	50 ms Max.	50 ms Max.
Relay Release (Recycle) Time (In ms)		
Model E7012	50 ms Max.	50 Ms Max.
Model E7022	N/A	N/A
Contact Ratings, Continuous		
(Resistive at 125 vdc)	1.0 amp	1.0 amp
(Resistive at 120 vac, 60 Hz)	10.0 amp	10.0 amp
Insulation Resistance (In megohms at 500 vdc)	500 Min.	500 Min.
Dielectric (vrms, 60 Hz)		
Between Terminals and Ground	1,500	1,500
Between Non-connected Terminals	1,000	1,000
Repeat Accuracy (See definition in Paragraph 5.3.2.1)	± 10%	± 10%

5.3.2.1 Repeat Accuracy. Repeat Accuracy at any fixed temperature is defined as (Ref. Nema Part ICS 2-218.07); "The repeat accuracy deviation (A_R) of a time delay relay is a measure of the maximum deviation in the time delay that will be experienced in five successive operations at any particular time setting of the relay and for any particular operating voltage or current." Repeat Accuracy is obtained from the following formula:

$$A_R = 100 \frac{(T_1 - T_2)}{(T_1 + T_2)}$$

Where; T_1 = Maximum Time Delay

T_2 = Minimum Time Delay

E7012 On delay on pull-in units with timing range of 3-30 min. and 6-60 min. the first delay will be approximately 15% longer than subsequent delays due to coil temperature rise.

NOTE

Dial settability with respect to the indicum (Marking on the regulating dials) is not included in the above repeatability value.

5.3.2.2 Dial Setting. The calibration markings, as with most timing relays, are for convenience and to reduce the required time for setting a relay to a specific value. However, relays can be set very accurately by using the following procedure:

(a) Turn regulating dial (Located on the top of relay) to correspond with value desired.

(b) Record one or more time delays. If more than one time delay is recorded, average the results.

(c) Compare the value obtained with the value required. If value obtained is less than the value required, turn regulating dial clockwise slightly to increase time. If value obtained is greater than the value required, turn regulating dial counterclockwise to reduce the time.

(d) Repeat steps (b) and (c) as necessary until required time delay is achieved.

5.3.3 Operating Conditions. (Abnormal Environment)

ADVERSE OPERATING SPECIFICATIONS	NORMAL	DBE "A"	DBE "B"	DBE "C"	DBE "D"
Temperature (°F)	70-104	40	120	145	156
Humidity (R.H. %)	40-60	10-95	10-95	10-95	10-95
Coil Operating Voltage * (% of Rated)					
Model E7012 (AC)	85-110	85-110	85-110	85-110	85-110
(AC)	80-110	80-110	80-110	90-110	90-110
Model E7022 (AC)	85-110	85-110	85-110	85-110	85-110
(DC)	80-110	80-110	80-110	80-110	80-110
Seismic Response **	——	——	——	——	——

NOTES

* All coils may be operated on intermittent duty cycles at voltages 10% above listed maximums (Intermittent Duty = Maximum 50% duty cycle and 30 minutes "ON" time.)

** For Seismic Response see Figures 5, 6, 7 for Model E7012 and Figures 8, 9 and 10 for Model E7022.

5.4 SEISMIC RESPONSE.

5.4.1 Conditions of Seismic Tests.

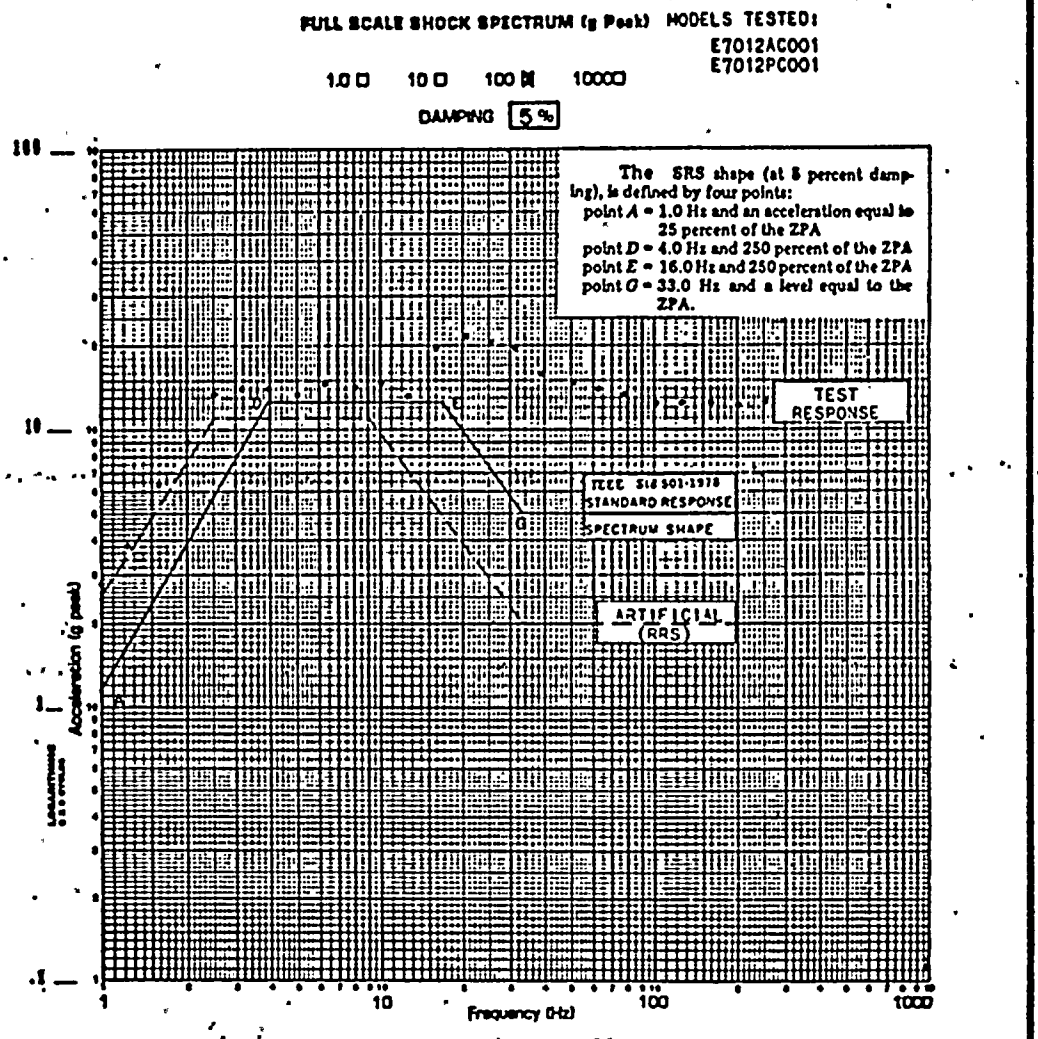
(a) Value of Damping Used - 5%

(b) Device Mounting - Vertical Only (Rigid Test Fixture)

(c) Mode of Vibration - Identical (Dependent) Biaxial Inputs (45° Thruster)

(d) Seismic Input - Random Multifrequency (Spaced at 1/3 Octaves Over a Range of 1-40 Hz). 30 Second Duration.

5.4.2 Response Spectrum. Figures 5, 6 and 7 (E7012) and Figures 8, 9 and 10 (E7022) represent the actual vertical and horizontal test response of the relays in their three electrical states. Using the Failure Criteria specified in Para. 5.4.4, these values were derived by combining the lowest test response spectrum (TRS) values from the four test orientations and multiplying that composite value by 0.707 due to the 45-degree inclination of the test machine. Also, superimposed on the graphs are the following:



SPECIMEN 1 & 3 (E7012 SERIES) RELAY STATE: NON-OPERATE MODE (DE-ENERG)

AXIS * SEE NOTE (H+V) TEST RUN NO. 35,29,21,11

* COMPOSITE OF FB/V-, SS/V-, SS/V+, FB/V+ X .707 DUE TO 45° INCLINATION OF TEST MACHINE.

Figure 5. Model E7012, Response Spectrum, Non-Operate Mode

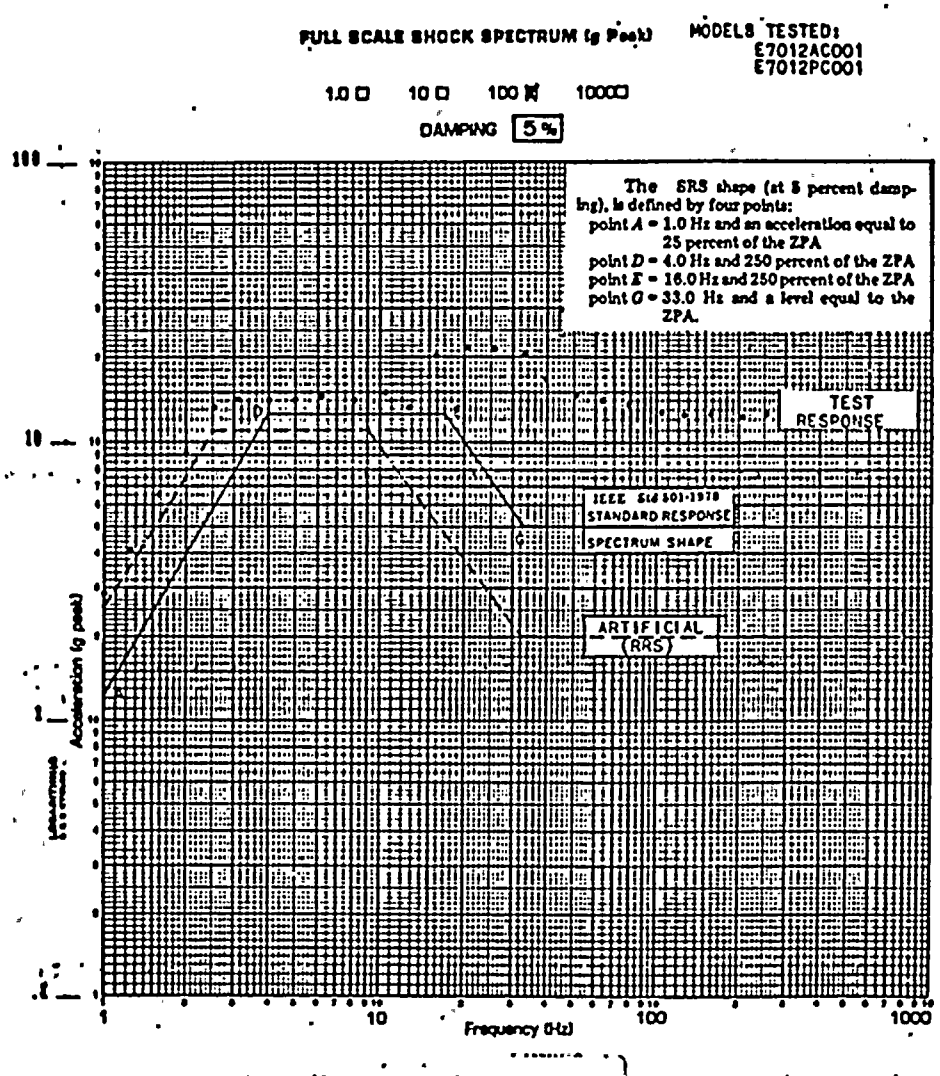


Figure 6. Model E7012, Response Spectrum, Operate Mode

CONTROL PRODUCTS DIVISION	AMERACE CORPORATION CONTROL PRODUCTS DIVISION UNION, N.J. 07083	DOCUMENT NO. E7012/E7022	
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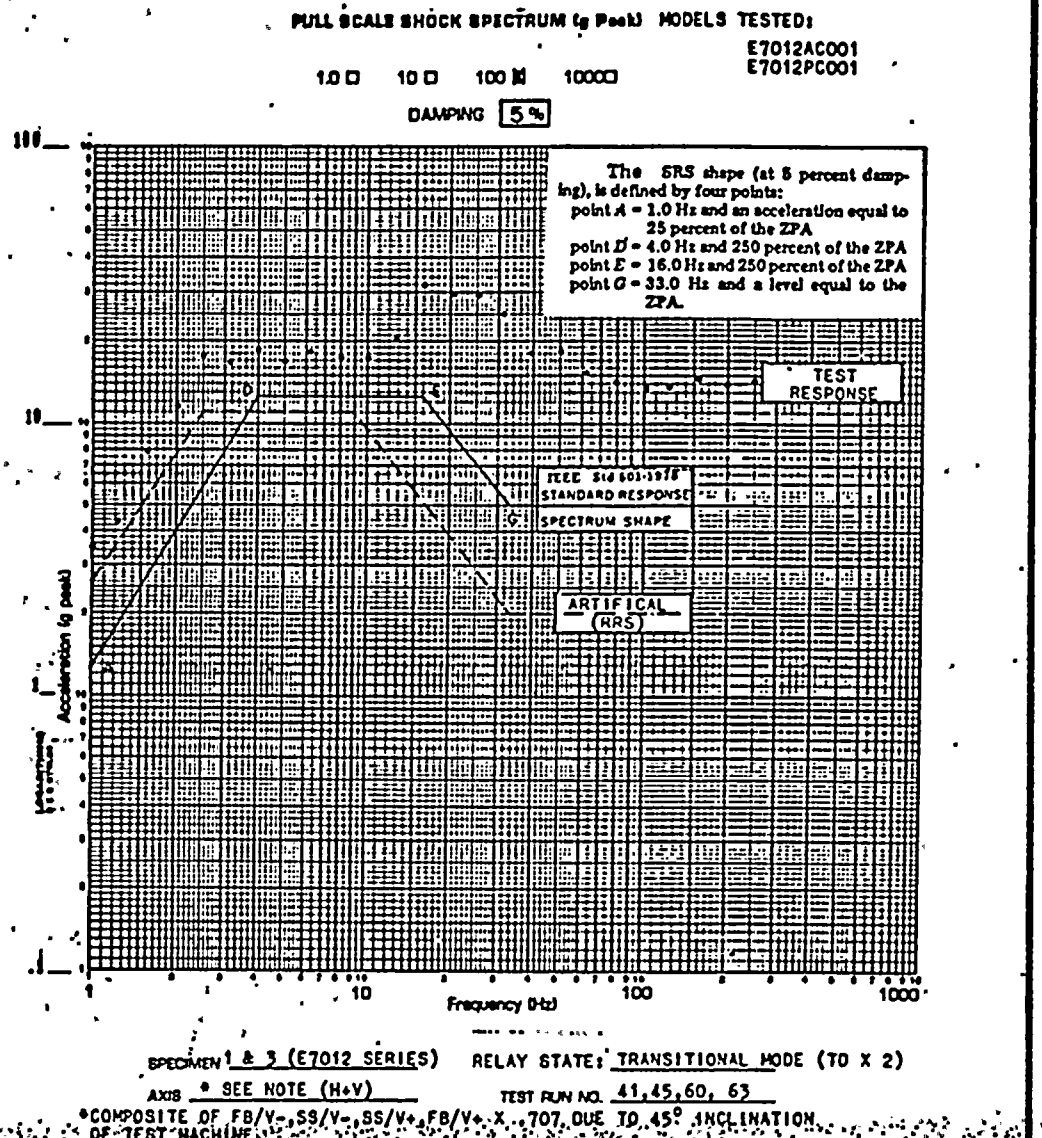
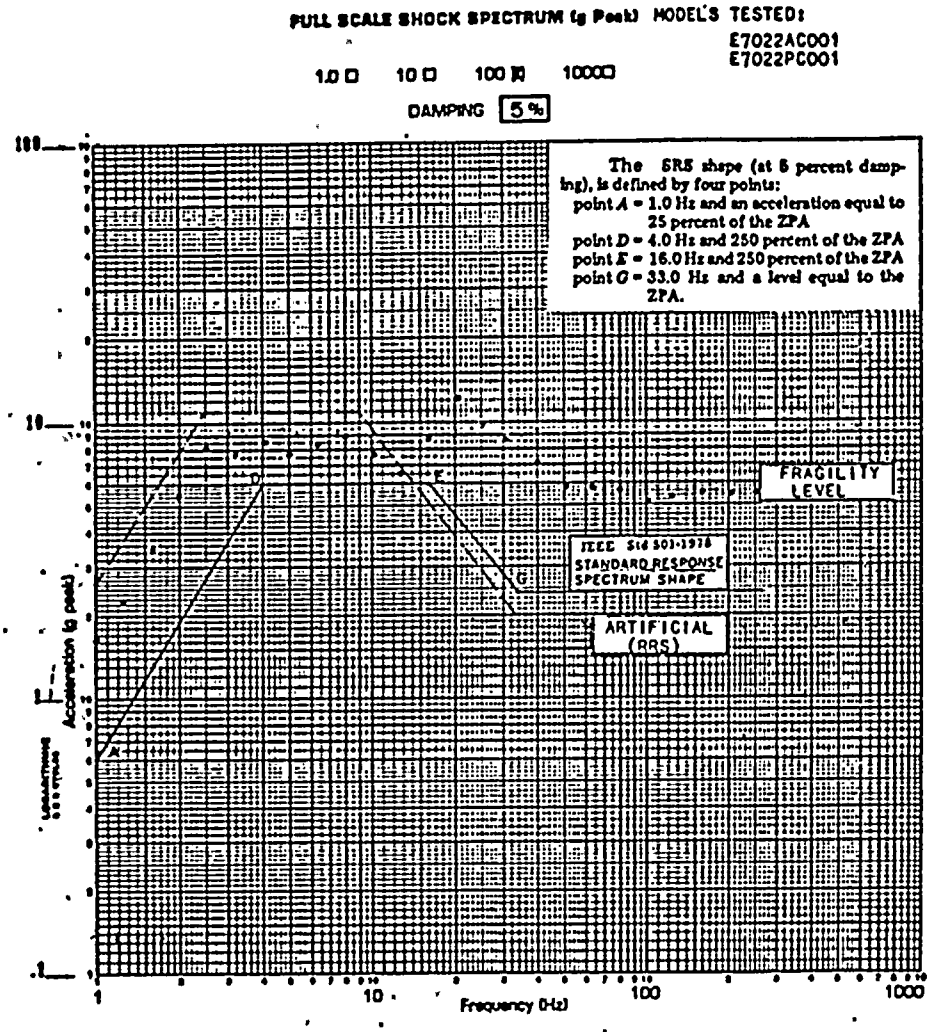


Figure 7. Model E7012, Response Spectrum, Transitional Mode.

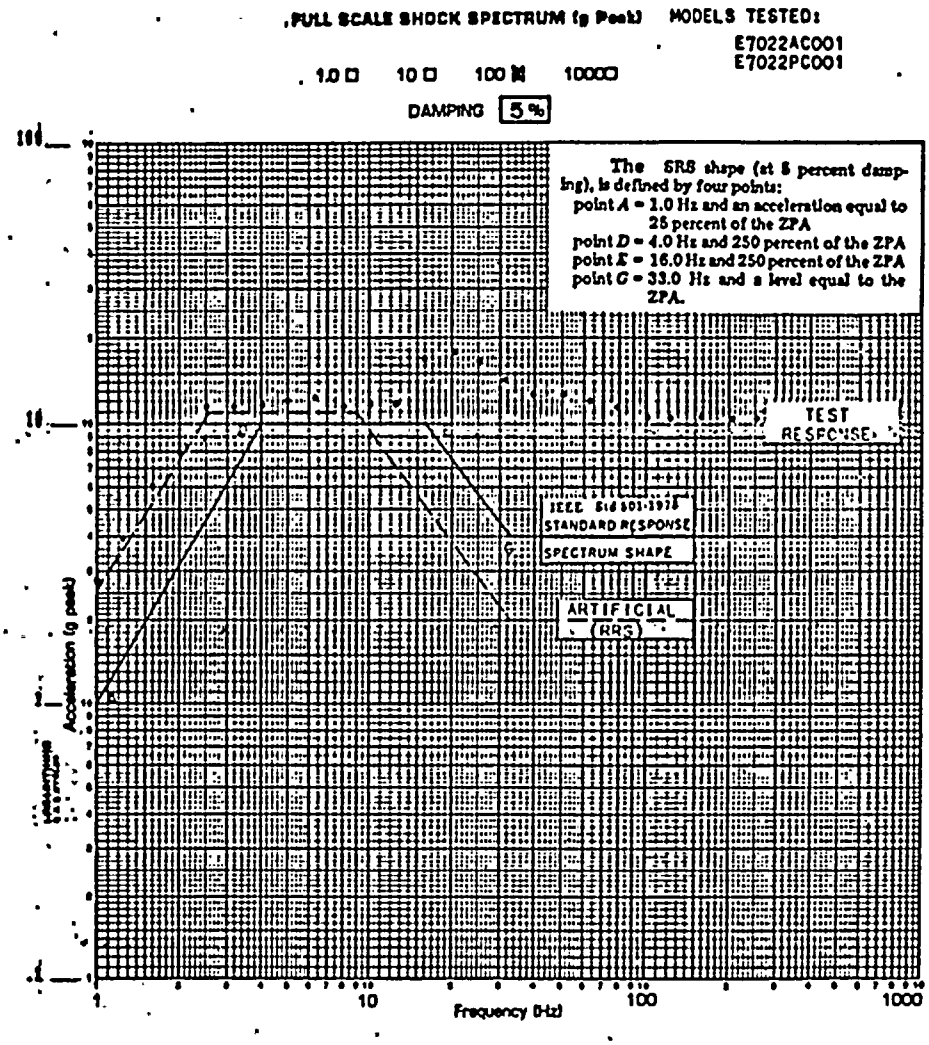


SPECIMEN 2 & 4 (E7022 SERIES) RELAY STATE: NON-OPERATE MODE (DE-ENER)

AXIS * SEE NOTE (H+V) TEST RUN NO (103,104),(95,99),86,76

*COMPOSITE OF FB/V-,SS/V-,SS/V+,FB/V+ X.707 DUE TO 45° INCLINATION OF TEST MACHINE.

Figure 8. Model E7022, Response Spectrum, Non-Operate Mode

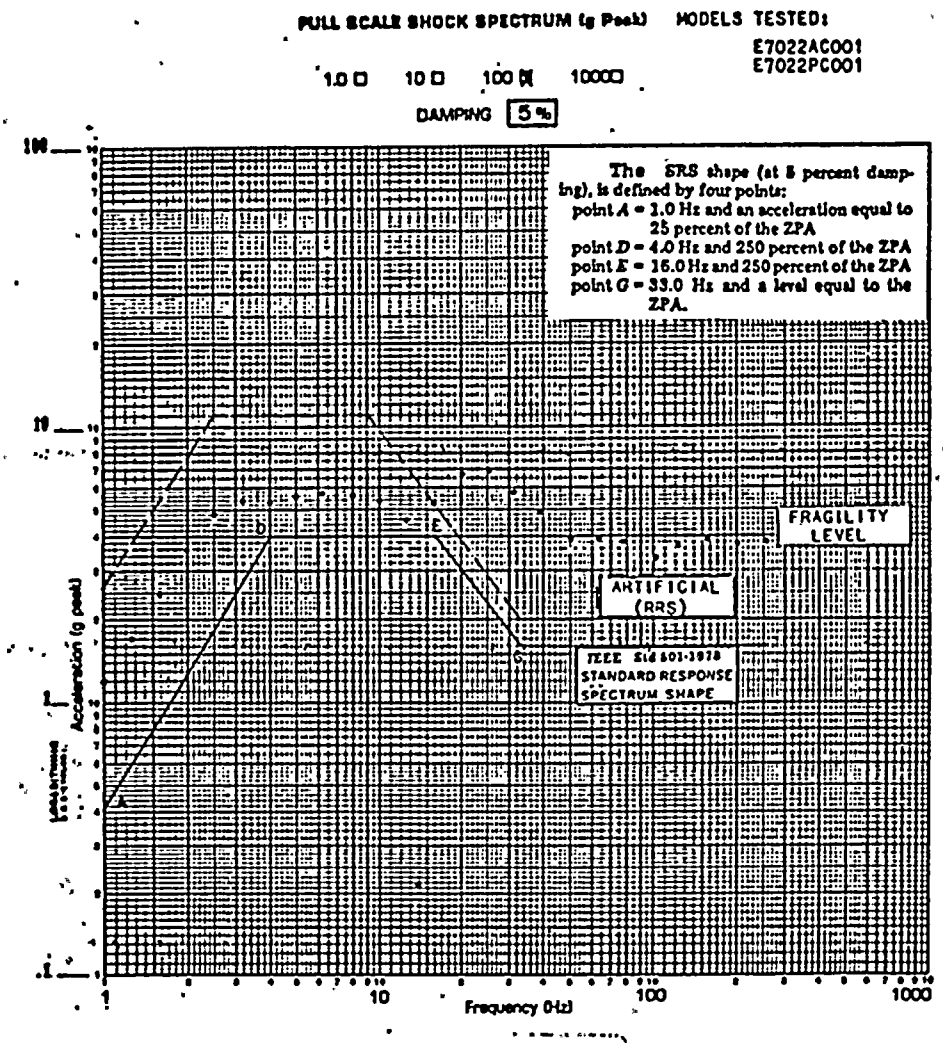


SPECIMEN 2 & 4 (E7022 SERIES) RELAY STATE: OPERATE MODE (ENERGIZED)

AXIS * SEE NOTE (H+V) TEST RUN NO. 312,309,306,303

* COMPOSITE OF FB/V-,SS/V-,SS/V+,FB/V+ X .707 DUE TO 45° INCLINATION OF TEST MACHINE.

Figure 9. Model E7022, Response Spectrum, Operate Mode



SPECIMEN 2 & 4 (E7022 SERIES) , RELAY STATE: TRANSITION MODE (TO X 2)

AXIS * SEE NOTE (H+V) , TEST RUN NO 253,257,(153,154),(165,166)

* COMPOSITE OF FB/V-, SS/V-, SS/V+, FB/V+ X.707 DUE TO 45° INCLINATION OF TEST MACHINE.

Figure 10. Model E7022, Response Spectrum, Transitional Mode

(a) The standard response spectrum (SRS) for relays per IEEE STD. 501-1978, which gives a specific zero period acceleration "G" level for each of the relay states

(b) The required response spectrum (RRS), which was used as a guideline and was artificially created by Control Products Division as a goal or maximum test level.

5.4.3 Seismic Test Description. The test machine was inclined at 45-degrees to the horizontal plane to simulate two-axes excitation. In order to orient the test articles to their normal in-service position, they were placed on a 45-degree rigid test fixture. This arrangement gave the input motion equal vectors in the vertical plane and in one horizontal direction. The relays were tested in four horizontal orientations. This was done to test for the in-phase and out-of-phase conditions of the test items. This method of test input is recognized as an acceptable alternative to true biaxial excitation in Section 6.6.6 of IEEE STD. 344-1975.

5.4.4 Failure Criteria. (Class 1E functions monitored during Seismic Tests.)

(a) Non-Operating Mode. (Relay coils deenergized).

Normally closed contacts monitored for chatter in excess of 1 millisecond with 28 vdc at 1 ampere applied to contacts. Normally open contacts monitored for false transfer of 1 millisecond or greater with 28 vdc at 1 ampere applied to contacts.

(b) Operate Mode. (Relay coils energized)

Normally open contact monitored for chatter in excess of 1 millisecond with 28 vdc at 1 ampere applied to contacts. Normally closed contacts monitored for false transfer of 1 millisecond or greater with 28 vdc at 1 ampere applied to contacts.

(c) Transitional Mode. (Relays operated for time delay)

Failure of the relays to timeout twice. Relays set for approximately 10 second time delay.

NOTE

Nominal rated voltage less 10% applied to relay coils during operate and transitional mode tests.

5.4.5 Fragility Level. (Model E7022 only) Device fragility level was obtained in the following manner: Using the Failure Criteria described in paragraph 5.4.4, all relays were first subjected to the artificial RRS acceleration level. If a relay failed to meet its Class 1E function, the testing was continued, but at regressive increments (of approximately 10% levels) until the malfunction ceased. The level at which fault free operation of the relay had been established was documented as the fragility level of that relay.

5.4.6 Test Response. The test responses which exceed the artificial RRS level (and are stated as such) are not the device fragility levels but are highest values tested to.

6.0 DESIGN LIFE. (Non-Nuclear)

The relays are actually designed to perform under the conditions given in the following paragraphs.

6.1 TEMPERATURE RANGE.

(a) Operating temperature range is -20°F to +165°F

(b) Storage temperature range is -67°F to +165°F

NOTE

The maximum shift in the average of three consecutive time delays taken at +77°F is -20% at -20°F and +20% at +165°F.

6.2 REPEAT ACCURACY.

6.2.1 Repeat Accuracy at any fixed temperature is;

(a) ± 5% for time delays of 200 seconds or less.

(b) ± 10% for time delays of 200 seconds or greater.

NOTE

The first time delays afforded by Model E7012 relays with "H" (3-30 min.) and "I" (6-60 min.) time ranges will be approximately 15% longer than subsequent delays due to coil temperature rise.

6.3 COIL VOLTAGE.

6.3.1 All coils may be operated on intermittent duty cycles at voltages 10% above listed maximums. (Intermittent duty = Maximum 50% duty cycle and 30 minutes "ON" time.

6.4 CONTACT RATINGS.

6.4.1 Contact Capacity, in Amperes, (Resistive Loads)

CONTACT VOLTAGE	MIN. 100,000 OPERATIONS	MIN. 1,000,000 OPERATIONS
30 vdc	15.0	7.0
110 vdc	1.0	0.5
120 vac, 60 Hz	20.0	15.0
240 vac, 60 Hz	20.0	15.0
480 vac, 60 Hz	12.0	10.0

6.4.2 Contact Ratings, UL.

Contact ratings as listed under the Underwriters Lab. component recognition program for 100,000 operations;

10 Amps, Resistive, 240 vac
1/4 Horsepower, 120 vac/240 vac

15 Amps, 30 vdc
5 Amps, General purpose, 600 vac

} Per Pole

7.0 QUALITY ASSURANCE PROVISIONS.

7.1 PROJECTED QUALIFIED LIFE.

7.1.1 Ten (10) years from date of manufacture or 25,000 operations, whichever occurs first. (This statement does not alter in any way the warranty on the relay.)

7.2 MAINTENANCE SCHEDULE.

7.2.1 Replacement of the device after 25,000 operations or 10 years from date of manufacture, or before.

7.2.2 The date of manufacture can be found in the first four digits of the serial number which is located on the nameplate. The date code used is a four digit number reflecting year and week of manufacture.

** **
First two digits indicate year
Second two digits indicate week

EXAMPLE: Date code 7814; 78 indicates 1978, 14 indicates week of April 3 thru 7 as year and week of manufacture.

MODEL	E7022PC001
COIL	125VDC SERIAL 7814****
TIME	1.5 TO 15 SEC.
	L1 L2

7.2.3 No field repairs or modifications are allowed. A complete relay must be ordered where spares are required.

7.3 QUALITY ASSURANCE.

7.3.1 Quality Assurance Program. Agastat® devices are built and controlled through an established quality assurance program which is in accordance with the applicable requirements of ANSI N45.2-1977; 10CFR21; and 10CFR50, Appendix B.

7.3.2 Traceability Records. Device traceability records will be maintained by CTP for a period of 11 years from the date of manufacture.

7.3.3 Configuration Control. The configuration code (See Figure 1) is a suffix to the model number and provides a means of identification and configuration control. When a Class 1 change is processed on the product, the configuration code will advance (-001 to -002, etc.) and this specification will be revised if necessary.

7.4 QUALIFICATION TEST REPORT, ES1000.

7.4.1 The actual qualification test report, from which the data presented in this specification has been derived, can be obtained from Control Products Division of Amerace Corp. by ordering Test Report Number ES1000.

CONTROL PRODUCTS DIVISION

Amerace Corporation | Control Products Division | 2330 Vauxhall Road | Union, New Jersey 07083
Telex 138-978

APPENDIX B

ESTABLISHED AND/OR VERIFIED NUCLEAR SAFETY RELATED PERFORMANCE CHARACTERISTICS FOR MODELS E7014/E7024

THE FOLLOWING CROSS REFERENCE CORRELATES OLD TO NEW NUMBERING SYSTEMS:

AS STATED IN WYLE TEST REPORT NO. 43706-2 (OLD CATALOG MODEL NO.)	AS STATED IN AMERACE TEST REPORT NO. ES-1000 (NEW CATALOG MODEL NO.)
7014ACE	E7014AC001
7024ACE	E7024AC001
7014PCE	E7014PC001
7024PCE	E7024PC001

PRODUCT SPECIFICATION

DOCUMENT NO.	PREPARED	DATE	
E7014/E7024	Fred Kuster	4-3-80	NUCLEAR SAFETY RELATED
TITLE: MODEL E7014/E7024 SERIES TIMING RELAYS CLASS 1E	CHECKED T. K. Grubb	4-3-80	
	APPROVED E. J. Legyod	4-3-80	
	APPROVED Ronald Melick	4-3-80	

REVISION INDEX

ECO	REV	SHEETS EFF.	DATE	ECO	REV	SHEETS EFF.	DATE
80-48	D	ALL	4-3-80				

REVISION STATUS OF SHEETS																							
REV.	D	◄																				►	D
SHEET	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	

1.0 PURPOSE

1.1 The purpose of this specification is to define the performance characteristics of Control Products Division of Amerace Corp. (CTP) Agastat® relays identified herein. The performance characteristics stated were derived from the results of a qualification test program, which was designed to measure the performance of the devices under normal and abnormal (Design Basis Events) conditions as specified. The qualification test program used was in accordance with the requirements of IEEE STD. 323-1974 (IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations) and IEEE STD. 344-1975 (IEEE Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations).

NOTE

In the following information, reference will also be made to IEEE STD. 501-1978 (IEEE Standard for Seismic Testing of Relays)

2.0 LIMITATIONS OF TEST RESULTS.

2.1 Since it is not possible to define the conditions for every conceivable application for relays, those parameters, which in practice encompass the majority of applications, have been specified.

2.2 If this data is not applicable to a particular requirement; then proof testing must be performed for that particular case.

2.3 The data documented in this specification applies only to Agastat® relays mounted on rigid test fixtures and does not apply to relays mounted on switch boards, panels or any structure.

2.4 It is the responsibility of the power system facility designers to combine data on seismic and environmental performance of the relays to arrive at an acceptable equipment design for a particular application.

NOTE

Control Products Division of Amerace Corporation does not recommend the use of its products in the containment areas of nuclear power generating stations.

3.0 QUALIFICATION TEST OUTLINE.

3.1 AGING SIMULATION. (10 year or 25,000 operations qualified life). The following sequence of tests was performed on Agastat® devices identified herein (prior to seismic fragility testing). The sole intent being that the combination of these tests, with applied margins, degraded the relays and their related hardware to a state which constitutes the equivalency of their end of service condition to satisfy the aging requirements of IEEE STD. 323-1974 and IEEE STD. 344-1975.

3.1.1 Aging Sequence.

(a) Radiation Aging. (2.0×10^5 rads integrated dose.) This dosage is considered to be of sufficient integrated exposure, with margin included that exceeds the adverse plant operating requirements for areas outside the reactor containment building. Mainly the auxiliary and control buildings.

(b) Cycling with Load Aging. (27,500 operations with one set of contacts loaded to 120 vac, 60 Hz at 10 amp or 125 vdc at 1 amp, which is rated load.) The objective of this test was to operate the devices at an accelerated rate with contacts loaded. The intent being to exceed by 10% the amount of mechanical operations the relay will see in service. Also, by loading the contacts, the wear at the end of the test should exceed their normal end of qualified life conditions.

NOTE

10% margin added to cycles (25,000 plus 10% = 27,500 operations)

(c) Temperature Aging. (100°C for 42 days)
This test subjected the relays to an artificially elevated temperature (100°C) for an extended period of time (Forty two (42) days). The device performance was measured before and after the thermal stress. Negligible degradation in device performance stands as evidence of capability to handle the thermal aging requirements of Class 1E. applications.

(d) Seismic Aging. Since this was basically a fragility type test, sufficient interactions were performed at levels less than the fragility level of the devices in order to satisfy, with required margins, the seismic aging requirements of IEEE STD. 323-1974 and IEEE STD. 344-1975.

3.2 BASELINE PERFORMANCE TESTS.

3.2.1 In addition to the aging tests, a series of baseline tests were conducted before (in order to establish a data base) and then immediately following each aging sequence, with the purpose being to measure the effects, if any, on the various devices.

3.2.2 The baseline tests consisted of:

(a) Pull-in Voltage

(b) Drop-out Voltage

(c) Dielectric Strength at 1650 vac, 60 Hz

(d) Insulation Resistance at 500 vdc

(e) Operate Time (Milliseconds)

(f) Recycle Time (Milliseconds)

(g) Time Delay (Seconds)

(h) Repeatability (%)

(i) Contact Bounce (Milliseconds at 28 vdc, 1 ampere)

(j) Contact Resistance (Milliohms at 28 vdc, 1 ampere)

3.2.3 The data from these tests was measured and recorded. This data was used for comparison to functional data throughout the qualification test program to measure any degradation in the performance of the relays.

3.3 SEISMIC QUALIFICATION (IEEE STD. 344-1975 and IEEE STD. 501-1978).

3.3.1 The artificially aged devices were subjected to simulated seismic vibration, which verified the individual device's ability to perform its required function, before, during, and/or following design basis earthquakes.

3.3.2 Using a Generic Required Response Spectra (RRS) for control systems purposes for the majority of nuclear power plant locations in the continental United States as a Guideline, the devices should have met, exceeded, and/or established their own fragility levels.

3.3.3 The relays were tested in the following electrical states.

(a) Non-operating Mode (Relay coil de-energized - off-delay relays timed out).

(b) Operating Mode (Relay coils energized - on-delay relays timed out).

(c) Transitional Mode (Relay time delay) with nominal rated voltage, less 10%, applied to coils. Relays timed out twice during seismic test.

3.4 HOSTILE ENVIRONMENT.

3.4.1 The relays are not recommended for use in the actual reactor containment area, but are intended mainly for use in the auxiliary and control buildings. Therefore, in lieu of a loss-of-coolant accident (LOCA) test, a hostile environment test was performed.

3.4.2 After simulated aging and seismic fragility testing, a combination temperature/humidity and under/over voltage test was conducted in order to demonstrate that the devices will function under adverse plant operating conditions even after having undergone all the aforementioned aging simulation and seismic qualification testing.

3.4.3 The relays were operated at minimum and maximum voltage extremes; 85 and 120 percent of rated voltage for AC devices and 80 and 120 percent of rated voltages for DC devices.

NOTE

Plus 10% was added to maximum rated voltages to satisfy margin requirements per IEEE STD. 323-1974.

3.4.4 Five (5) minimum voltage and five (5) maximum voltage operations were performed (time delays recorded) in each of the following environmental conditions: 95% relative humidity at 40°F, 50°F, 70°F, 90°F, 110°F, 130°F, 150°F, 165°F and 172°F.

NOTE

Plus 15°F was added to maximum use temperature (156°F) to satisfy the margin requirements of IEEE STD. 323-1974.

3.5 POST TEST INSPECTION

3.5.1 Upon completion of all testing, each relay was thoroughly inspected. The condition of mechanical and electrical parts and the relay case was recorded.

3.6 QUALIFICATION TEST SUMMARY.

3.6.1 The Baseline Performance Tests (Para. 3.2) were conducted before and after each special test in order to measure and record any effects on the various devices.

3.6.2 The Qualification Test was conducted in the following sequence.

(a) Baseline Test (Initial)

(b) Radiation - Aging Test

(c) Baseline Test - (Repeated)

(d) Cycling with Load - Aging Test

(e) Baseline Test (Repeated)

(f) Temperature - Aging Test

(g) Baseline Test (Repeated)

(h) Seismic Aging and Qualification Test

(i) Baseline Test (Repeated)

(j) Hostile Environment Test

(k) Baseline Test (Final)

(l) Post Test Inspection

4.0 DEVICE INDENTIFICATION

4.1 CATALOG CODE NUMBERS

4.1.1 Figure 1 illustrates the method of identifying, by catalog code, the Model E7014 and E7024 series timing relays.

4.2 ACTUAL MODEL NUMBERS OF DEVICES TESTED.

(a) E7014AC001 & E7014PC001

(b) E7024AC001 & E7024PC001

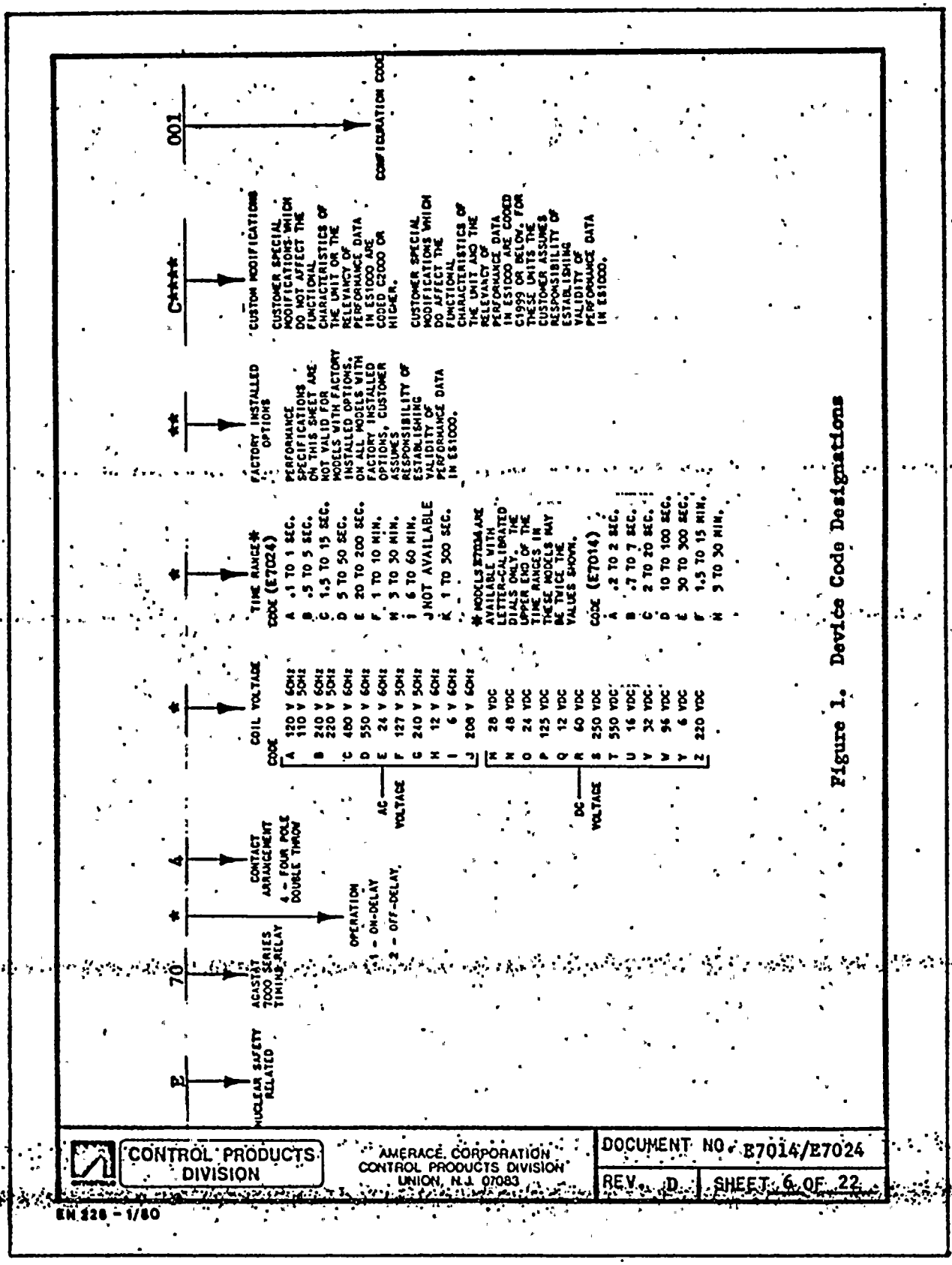


Figure 1. Device Code Designations

CONTROL PRODUCTS DIVISION

AMERACE CORPORATION
CONTROL PRODUCTS DIVISION
UNION, N.J. 07083

DOCUMENT NO. E7014/E7024

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5.0 RELAY DESIGN CHARACTERISTICS.

5.1 DESCRIPTION OF OPERATION.

5.1.1 Model E7014 (See Figure 2) Applying a continuous voltage to the coil (L1-L2) starts a time delay lasting for the preset time. During this period, the normally closed contacts (3-5, 4-6, 9-11, 10-12) remain closed. At the end of the delay period, the normally closed contacts break and the normally open contacts (1-5, 2-6, 7-11, 8-12) make. The contacts remain in this position until the coil is deenergized, at which time the switch instantaneously returns to its original position. Deenergizing the coil, either during or after the delay period will recycle the unit within .075 second. It will then provide a full delay period upon reenergization regardless of how often the coil voltage is interrupted before the unit has been permitted to "time-out" to it's full delay setting.

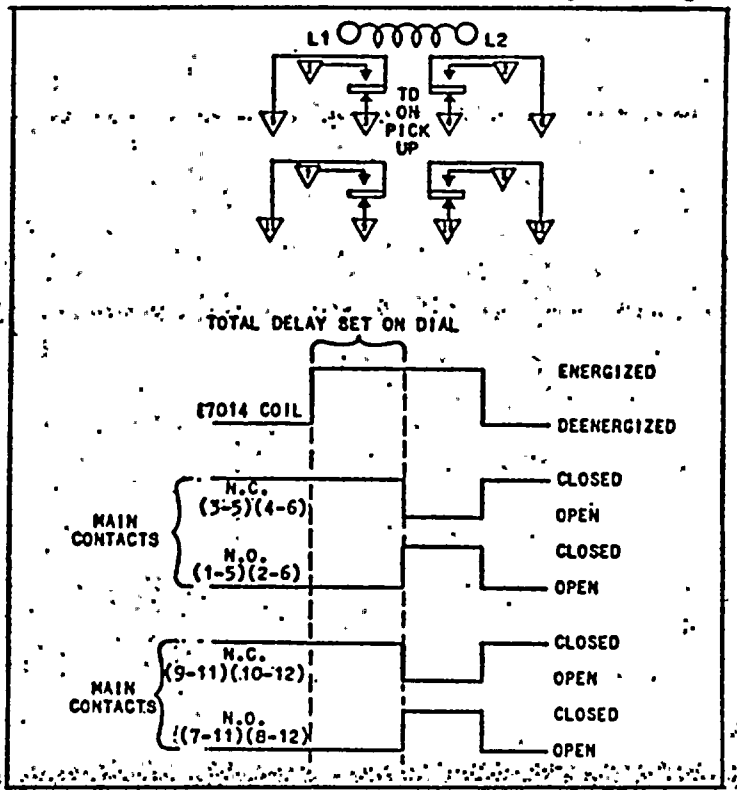


Figure 2. Operation of E7014, On-Delay Relay

5.1.2 Model E7024 (See Figure 3) Applying a voltage to the coil (L1-L2) for at least .075 second will instantaneously transfer the switch, breaking the normally closed contacts (1-5, 2-6, 7-11, 8-12) and making the normally open contacts (3-5, 4-6,

9-11, 10-12). Contacts remain in this transferred position as long as the coil is energized. The time delay begins immediately upon deenergization. At the end of the delay period, the switch returns to its normal position. Reenergizing the coil during the delay period will immediately return the timing mechanism to a point where it will provide a full delay period upon subsequent deenergization. The switch remains in the transferred position.

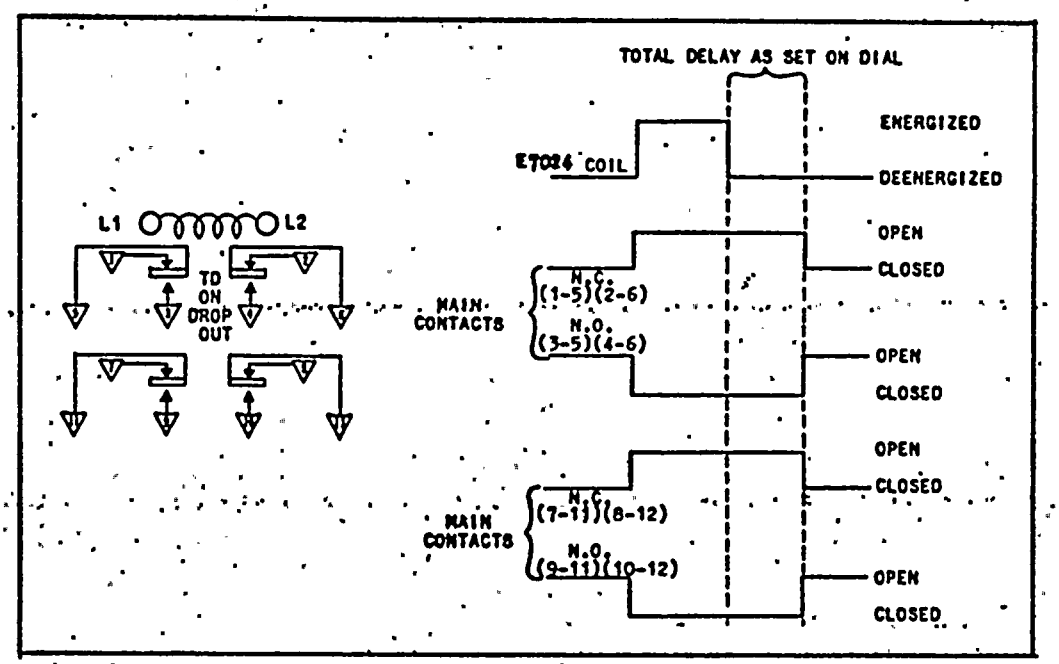


Figure 3. Operation of E7024, Off-Delay Relay

5.2 PHYSICAL CHARACTERISTICS.

5.2.1 Relay Dimensions. (See Figure 4)

5.2.2 Approximate Weight.

(a) Model E7014 and E7024 with (AC) coils - 2.43 lbs.
(b) Model E7014 and E7024 with (DC) coils - 2.57 lbs.

NOTE

Weight may vary slightly with relay coil voltage specified.

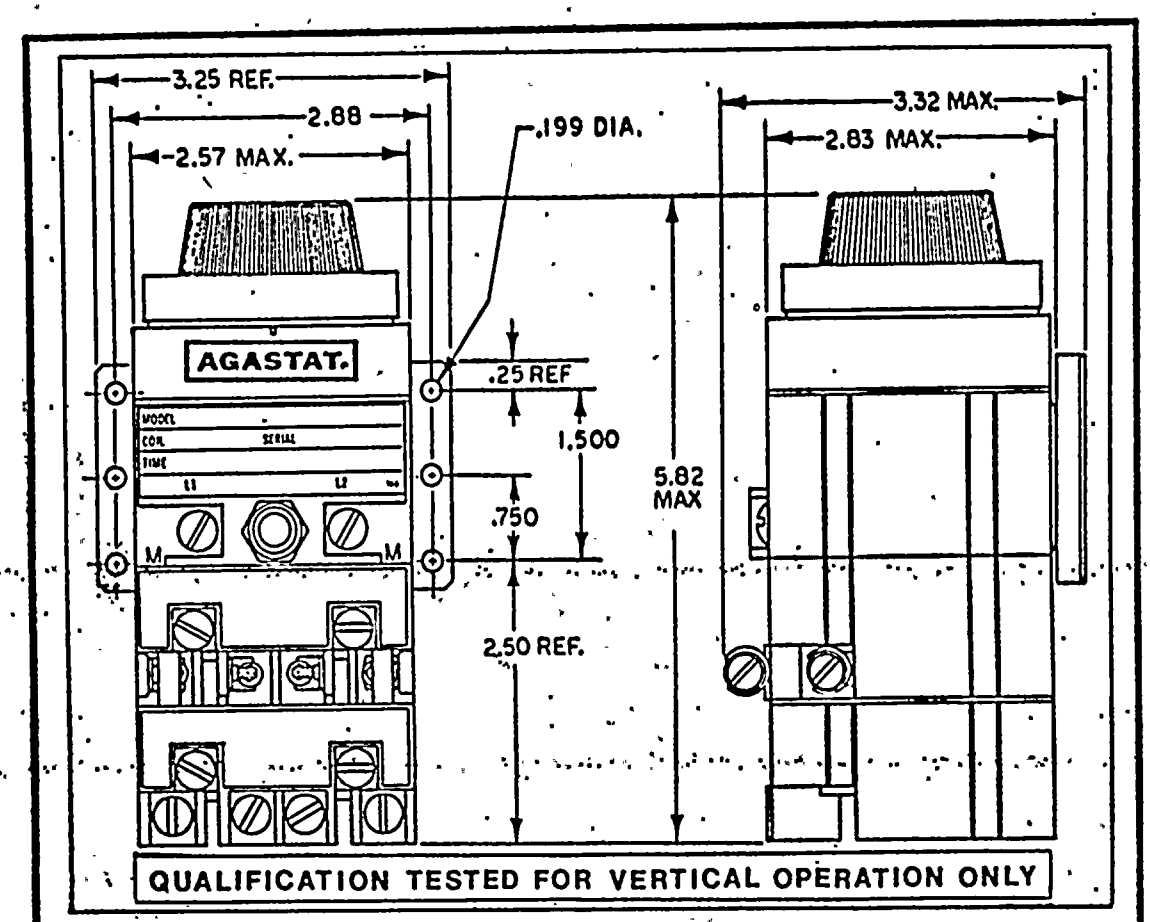


Figure 4. Model E7014 and E7024 Outline and Dimension Drawing

5.2.3 Terminals. Standard screw terminals (#8-32 truss head screws supplied)are located on the front of the unit with permanent schematic markings. Barrier isolation is designed to accommodate spade or ring tongue terminals with spacing to meet industrial control specifications.

5.2.4 Linear Time Range Adjustment.

(a) Model E7014 relays are available with letter-calibrated dials only. The upper end of the time ranges in these Models may be twice the value specified in Figure 1.

(b) Model E7024 relays are furnished with dials calibrated in linear increments covering the range selected.

5.3 OPERATING CHARACTERISTICS.

5.3.1 Environmental Conditions. (Qualified Life)

PARAMETER	MIN.	NORMAL	MAX.
Temperature (°F)	40	70-104	156
Humidity (R.H: %)	10	40-60	95
Pressure	--	Atmospheric	---
Radiation (rads)	--	-----	2.0×10^5 (Gamma)

5.3.2 Operating Conditions. (Normal Environment)

NORMAL OPERATING SPECIFICATIONS	RELAYS W/ (DC) COILS	RELAYS W/ (AC) COILS
Coil Operating Voltage, Nominal (Rated)	As Spec	As Spec
Pull-in (% of rated value)	85% Min.	90% Min.
Drop-out (% of rated value)	10% Approx.	50% Approx.
Power (Watts at rated value)	8 Approx.	8 Approx.
Relay Operate Time (In ms)		
Model E7014	N/A	N/A
Model E7024	75 ms Max.	75 ms Max.
Relay Release (Recycle) Time (In ms)		
Model E7014	75 ms Max.	75 Ms Max.
Model E7024	N/A	N/A
Contact Ratings, Continuous		
(Resistive at 125 vdc)	1.0 amp	1.0 amp
(Resistive at 120 vac, 60 Hz)	10.0 amp	10.0 amp
Insulation Resistance (In megohms at 500 vdc)	500 Min.	500 Min.
Dielectric (vrms, 60 Hz)		
Between Terminals and Ground	1,500	1,500
Between Non-connected Terminals	1,000	1,000
Repeat Accuracy (See definition in Paragraph 5.3.2.1)	± 10%	± 10%

5.3.2.1 Repeat Accuracy. Repeat Accuracy at any fixed temperature is defined as (Ref. Nema Part ICS 2-218.07); "The repeat accuracy deviation (A_R) of a time delay relay is a measure

of the maximum deviation in the time delay that will be experienced in five successive operations at any particular time setting of the relay and for any particular operating voltage or current." Repeat Accuracy is obtained from the following formula:

$$A_R = 100 \frac{(T_1 - T_2)}{(T_1 + T_2)}$$

Where; T_1 = Maximum Time Delay

T_2 = Minimum Time Delay

E7014 On Delay on pull-in units with timing range of 1.5-15 min. and 3-30 min. the first delay will be approximately 15% longer than subsequent delays due to coil temperature rise.

NOTE

Dial settability with respect to the indicum (Marking on the regulating dials) is not included in the above repeatability value.

5.3.2.2 Dial Adjustment, E7014 Each dial is calibrated with the letters "A" through "E" with the symbol (▲), which precedes the letter "A", as the starting point. Between each letter are three lines for fine adjustment. The setting (▲), which precedes the letter "A" provides minimum time delay and the time delay is increased gradually until maximum time delay is attained at setting "E". After adjusting the time delay setting, the relay should be operated electrically two or three times to check the time delay.

5.3.2.3 Dial Adjustment, E7024 The calibration markings, as with most timing relays, are for convenience and to reduce the required time for setting a relay to a specific value. However, relays can be set accurately by using the following procedure:

(a) Turn regulating dial (Located on top of relay) to correspond with value desired.

(b) Record one or more time delays. If more than one time delay is recorded, average the results.

(b) Compare the value obtained with the value required. If value obtained is less than the value required, turn regulating dial clockwise slightly to increase time. If value obtained is greater than the value recorded, turn regulating dial counterclockwise to reduce the time.

(d) Repeat steps (b) and (c) as necessary until required time delay is achieved.

5.3.3 Operating Conditions. (Abnormal Environment)

ADVERSE OPERATING SPECIFICATIONS	NORMAL	DBE "A"	DBE "B"	DBE "C"	DBE "D"
Temperature (°F)	70-104	40	120	145	156
Humidity (R.H. %)	40-60	10-95	10-95	10-95	10-95
Coil Operating Voltage * (% of Rated)					
Model E7014 (AC)	90-110	90-110	90-110	90-110	90-110
(DC)	85-110	85-110	85-110	85-110	85-110
Model E7024 (AC)	90-110	90-110	90-110	90-110	90-110
(DC)	85-110	85-110	85-110	85-110	85-110
Seismic Response **	———	———	———	———	———

NOTES

* All coils may be operated on intermittent duty cycles at voltages 10% above listed maximums (Intermittent Duty = Maximum 50% duty cycle and 30 minutes "ON" time.)

** For Seismic Response see Figures 5, 6, 7 for Model E7014 and Figures 8, 9 and 10 for Model E7024.

5.4 SEISMIC RESPONSE.

5.4.1 Conditions of Seismic Tests.

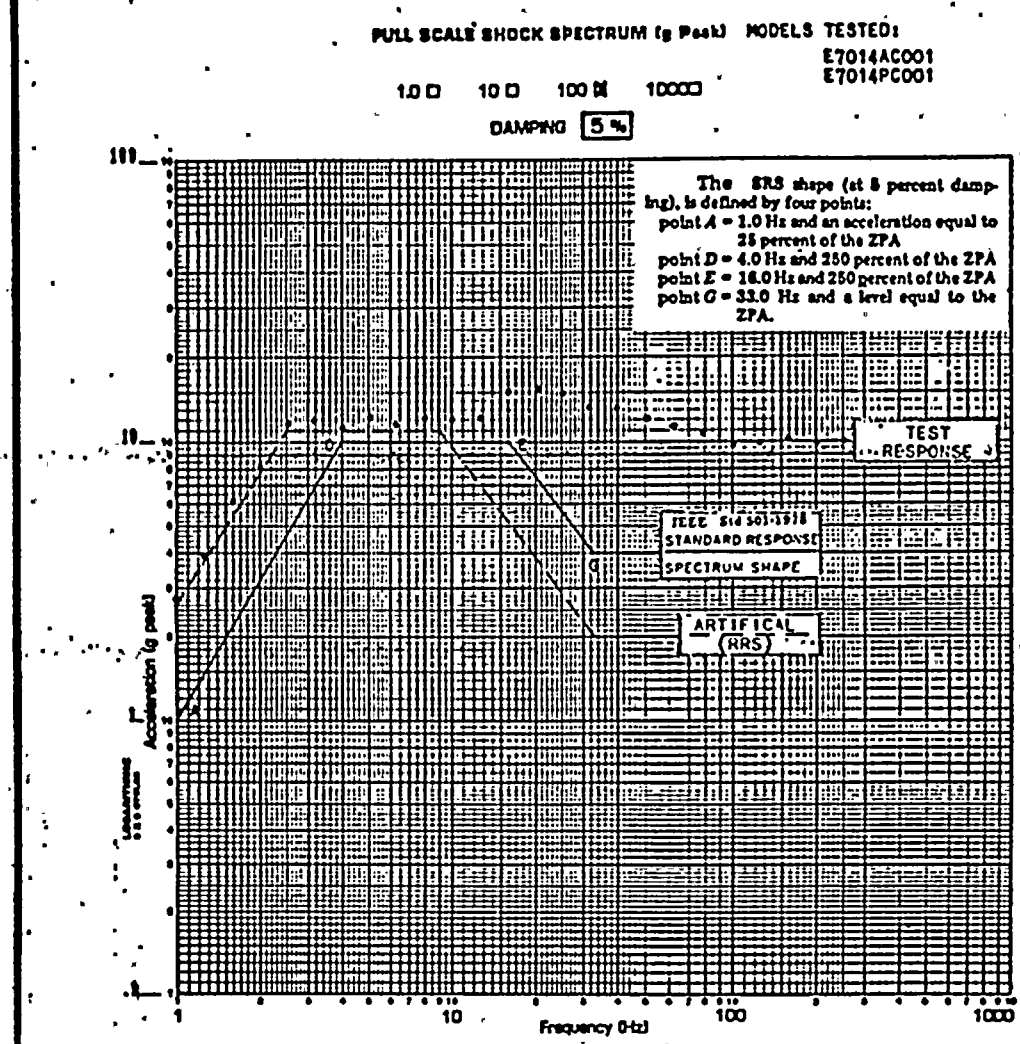
(a) Value of Damping Used - 5%

(b) Device Mounting - Vertical Only (Rigid Test Fixture)

(c) Mode of Vibration - Identical (Dependent) Biaxial Inputs (45° Thruster)

(d) Seismic Input - Random Multifrequency (Spaced at 1/3 Octaves Over a Range of 1-40 Hz). 30 Second Duration.

5.4.2 Response Spectrum. Figures 5, 6 and 7 (E7014) and Figures 8, 9 and 10 (E7024) represent the actual vertical and horizontal test response of the relays in their three electrical states. Using the Failure Criteria specified in Para. 5.4.4 these values were derived by combining the lowest test response spectrum (TRS) values from the four test orientations and multiplying that composite value by 0.707 due to the 45-degree inclination of the test machine. Also, superimposed on the graphs are the following:

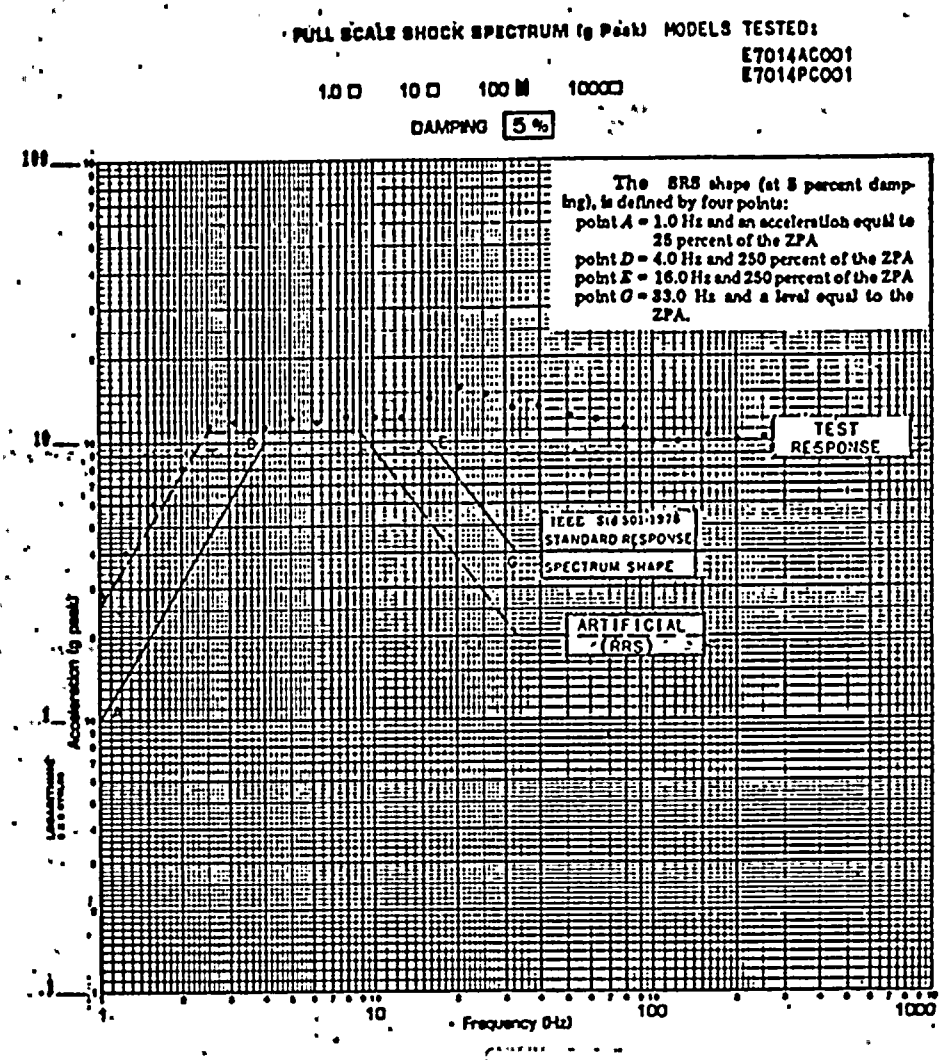


SPECIMEN 7 & 22 (E7014 SERIES) RELAY STATE: NON-OPERATE MODE (DE-ENER.)

AXIS * SEE NOTE (H+V) TEST RUN NO. (35,320)(29,319)(21,318)(11,317)

* COMPOSITE OF FB/V-,SS/V-,SS/V+,FB/V+ X .707 DUE TO 45° INCLINATION OF TEST MACHINE.

Figure 5. Model E7014, Response Spectrum, Non-Operate Mode

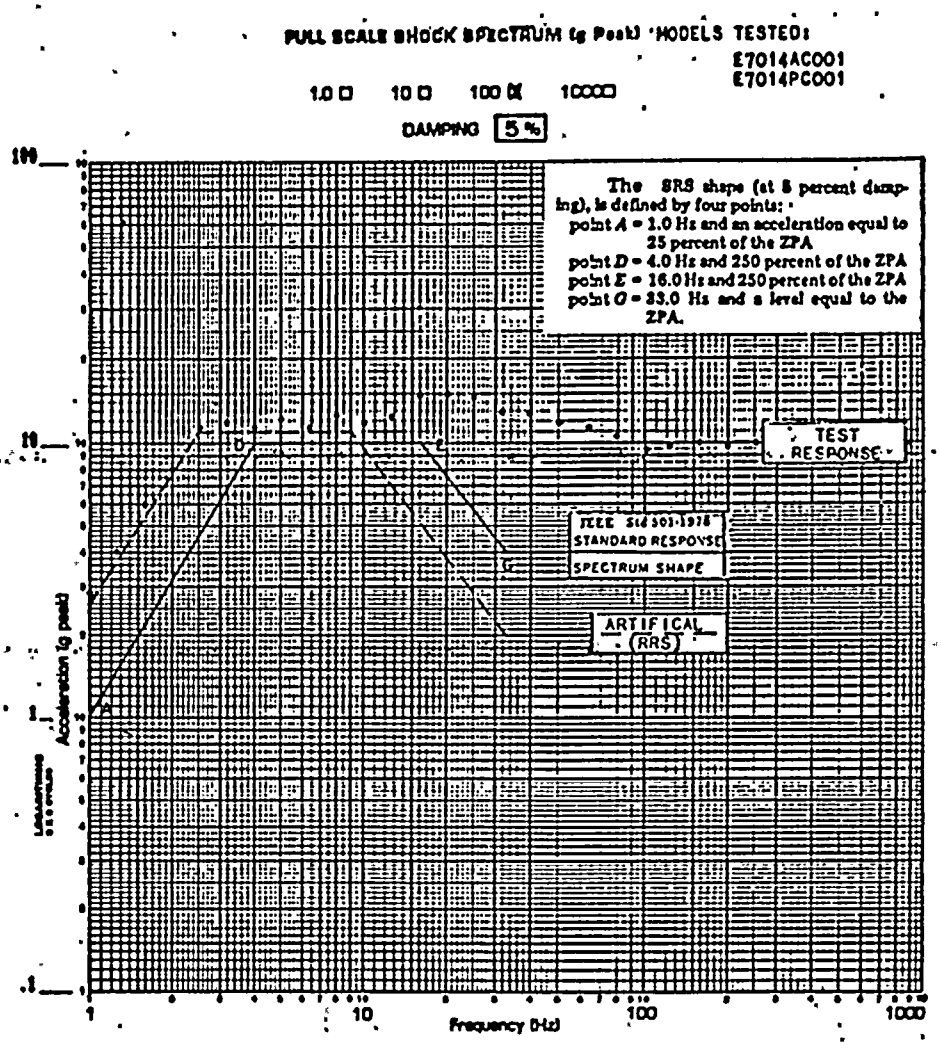


SPECIMEN 7 & 22 (E7014 SERIES) RELAY STATE: OPERATE MODE (ENERGIZED)

AXIS SEE NOTE (H+V) TEST RUN NO: (40,321)(52,325)(59,325)(70,327)

* COMPOSITE OF FB/V-,SS/V-,SS/V+,FB/V+ X.707 DUE TO 45° INCLINATION OF TEST MACHINE.

Figure 6. Model E7014, Response Spectrum, Operate Mode



SPECIMEN 7 & 22 (E7014 SERIES) RELAY STATE: TRANSITIONAL MODE (TD X 2)

AXIS * SEE NOTE (H+V). TEST RUN NO. (44,322)(45,324)(60,326)(63,328).

*COMPOSITE OF FB/V-,SS/V-,SS/V+,FB/V+ X .707 DUE TO 45° INCLINATION OF TEST MACHINE.

Figure 7. Model E7014, Response Spectrum, Transitional Mode

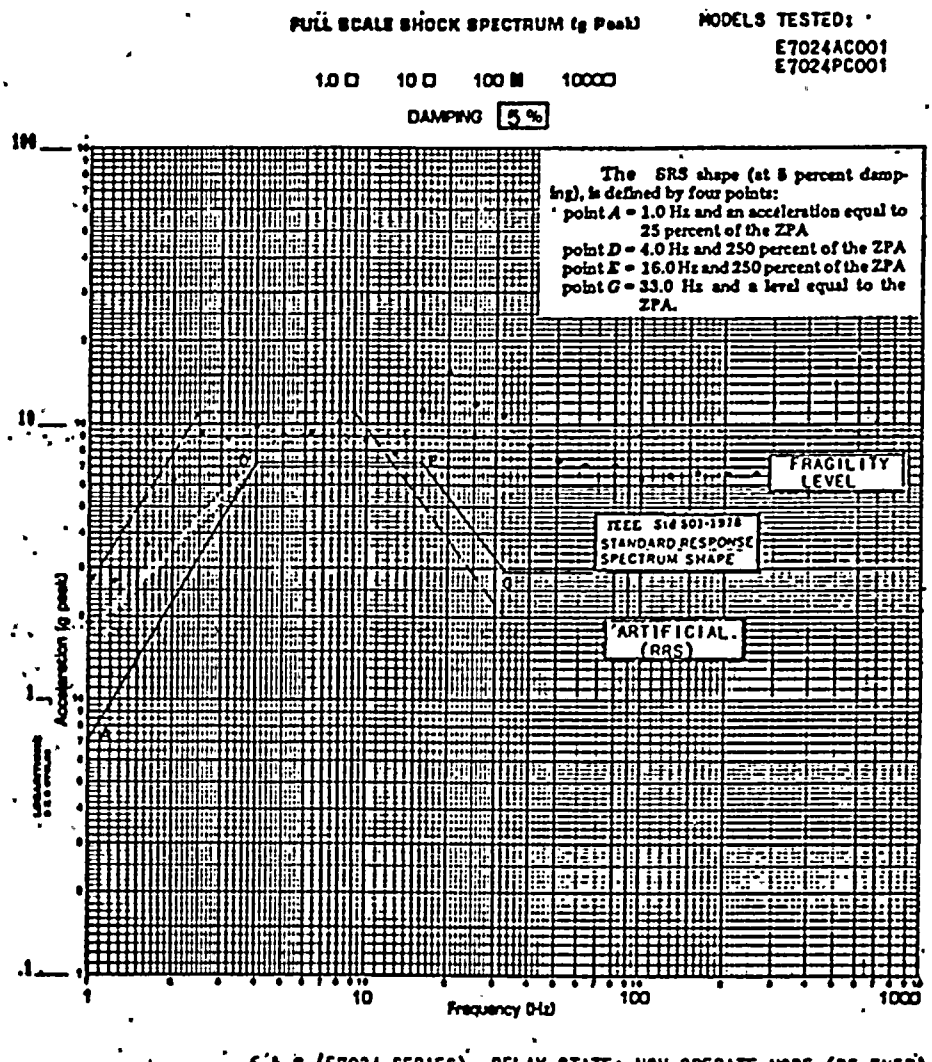


Figure 8. Model E7024, Response Spectrum, Non-Operate Mode

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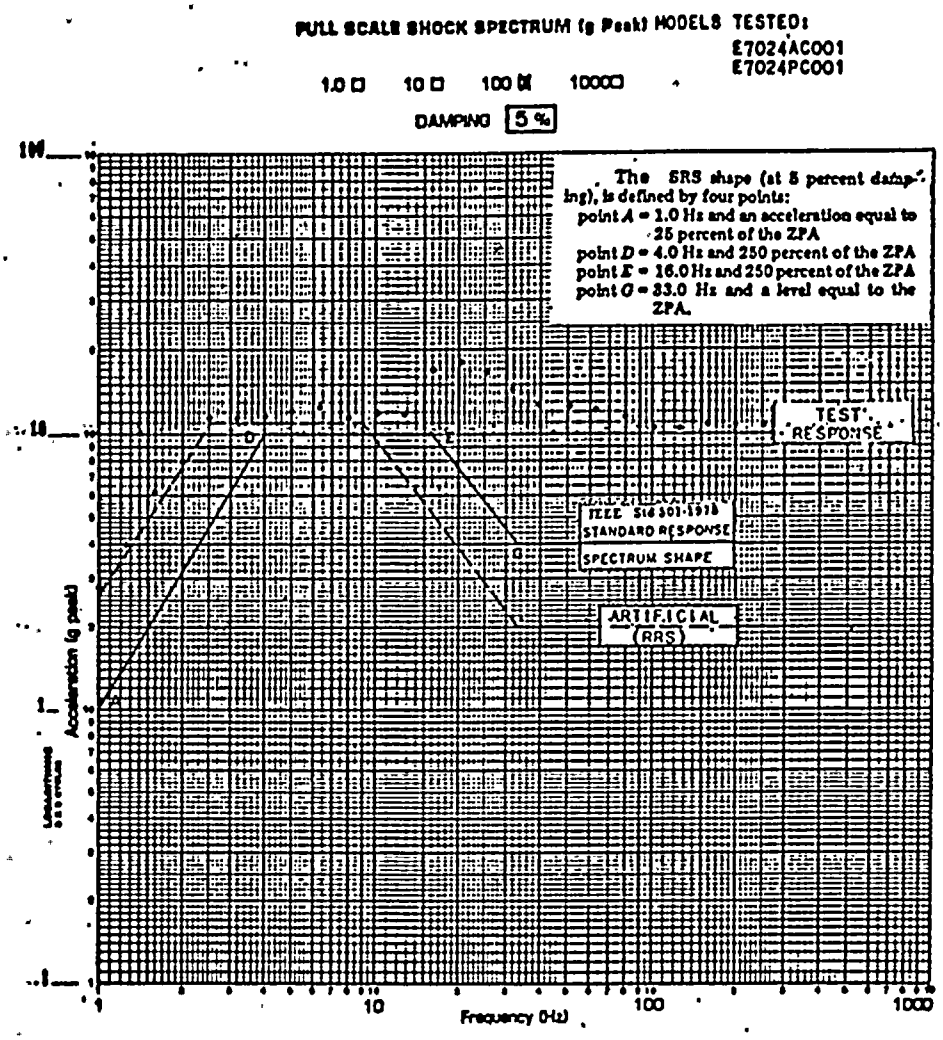
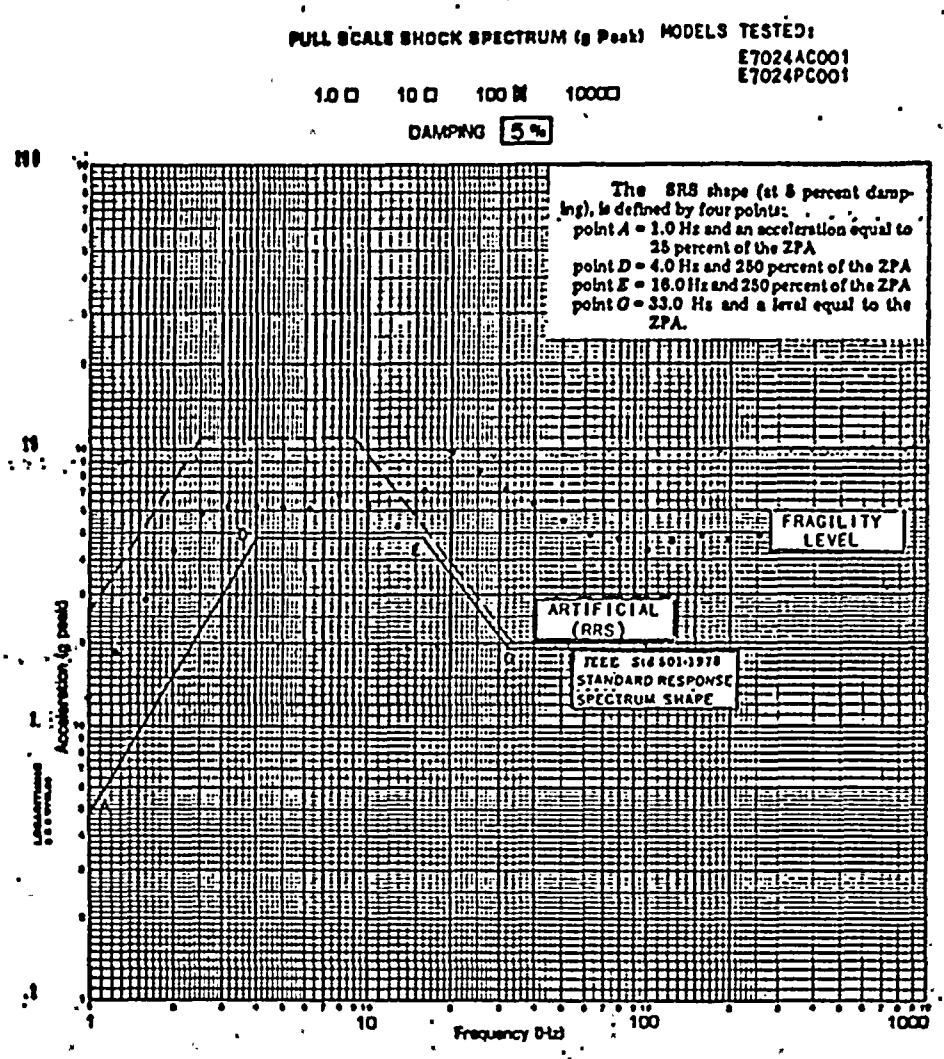


Figure 9. Model E7024, Response Spectrum, Operate Mode



SPECIMEN 6 & 8 (E7024 SERIES). RELAY STATE: TRANSITIONAL MODE (TO X 2)
AXIS * SEE NOTE (H+V) TEST RUN NO 255,257,(152,155),164
* COMPOSITE OF FB/V-,SS/V-,SS/V+,FB/V+ X .707 DUE TO 45° INCLINATION OF TEST MACHINE.

Figure 10. Model E7024, Response Spectrum, Transitional Mode

(a) The standard response spectrum (SRS) for relays per IEEE STD. 501-1978, which gives a specific zero period acceleration "G" level for each of the relay states

(b) The required response spectrum (RRS), which was used as a guideline and was artificially created by Control Products Division as a goal or maximum test level.

5.4.3 Seismic Test Decription. The test machine was inclined at 45-degrees to the horizontal plane to simulate two-axes excitation. In order to orient the test articles to their normal in-service position, they were placed on a 45-degree rigid test fixture. This arrangement gave the input motion equal vectors in the vertical plane and in one horizontal direction. The relays were tested in four horizontal orientations. This was done to test for the in-phase and out-of-phase conditions of the test items. This method of test input is recognized as an acceptable alternative to true biaxial excitation in Section 6.6.6 of IEEE STD. 344-1975.

5.4.4 Failure Criteria. (Class 1E functions monitored during Seismic Tests.)

(a) Non-Operating Mode. (Relay coils deenergized)

Normally closed contacts monitored for chatter in excess of 1 millisecond with 28 vdc at 1 ampere applied to contacts. Normally open contacts monitored for false transfer of 1 millisecond or greater with 28 vdc at 1 ampere applied to contacts.

(b) Operate Mode. (Relay coils energized)

Normally open contact monitored for chatter in excess of 1 millisecond with 28 vdc at 1 ampere applied to contacts. Normally closed contacts monitored for false transfer of 1 millisecond or greater with 28 vdc at 1 ampere applied to contacts.

(c) Transitional Mode. (Relays operated for time delay)

Failure of the relays to timeout twice. Relays set for approximately 10 second time delay.

NOTE

Nominal rated voltage less 10% applied to relay coils during operate and transitional mode tests.

5.4.5 Fragility Level. (Model E7024 only) Device fragility level was obtained in the following manner: Using the Failure Criteria described in paragraph 5.4.4, all relays were first subjected to the artificial RRS acceleration level. If a relay failed to meet it's Class 1E function, the testing was continued, but at regressive increments (of approximately 10% levels) until the malfunction ceased. The level at which fault free operation of the relay had been established was documented as the fragility level of that relay.

5.4.6 Test Response. The test responses which exceed the artificial RRS level (and are stated as such) are not the device fragility levels but are highest values tested to.

6.0 DESIGN LIFE. (Non-Nuclear)

The relays are actually designed to perform under the conditions given in the following paragraphs.

6.1 TEMPERATURE RANGE.

(a) Operating temperature range is -20°F to +165°F

(b) Storage temperature range is -67°F to +165°F

NOTE

The maximum shift in the average of three consecutive time delays taken at +77°F is -20% at -20°F and +20% at +165°F.

6.2 REPEAT ACCURACY.

6.2.1 Repeat Accuracy at any fixed temperature is;

(a) ± 5% for time delays of 200 seconds or less.

(b) ± 10% for time delays of 200 seconds or greater.

NOTE

The first time delays afforded by Model E7014 relays with (1.5-15 min.) and (3-30 min.) time ranges will be approximately 15% longer than subsequent delays due to coil temperature rise.

6.3 COIL VOLTAGE.

6.3.1 All coils may be operated on intermittent duty cycles at voltages 10% above listed maximums. (Intermittent duty = Maximum 50% duty cycle and 30 minutes "ON" time.

6.4 CONTACT RATINGS.

6.4.1 Contact Capacity, in Amperes. (Resistive Loads)

CONTACT VOLTAGE	MIN. 100,000 OPERATIONS	MIN. 1,000,000 OPERATIONS
30 vdc	15.0	7.0
110 vdc	1.0	0.5
120 vac, 60 Hz	20.0	15.0
240 vac, 60 Hz	20.0	15.0
480 vac, 60 Hz	12.0	10.0

6.4.2 Contact Ratings, UL.

Contact ratings as listed under the Underwriters Lab. component recognition program for 100,000 operations;

10 Amps, Resistive, 240 vac
1/4 Horsepower, 120 vac/240 vac
15 Amps, 30 vdc
5 Amps, General purpose, 600 vac

} Per Pole

7.0 QUALITY ASSURANCE PROVISIONS.

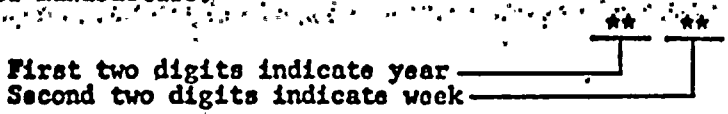
7.1 PROJECTED QUALIFIED LIFE.

7.1.1 Ten (10) years from date of manufacture or 25,000 operations, whichever occurs first. (This statement does not alter in any way the warranty on the relay.)

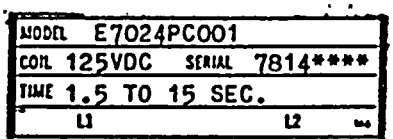
7.2 MAINTENANCE SCHEDULE.

7.2.1 Replacement of the device after 25,000 operations or 10 years from date of manufacture, or before.

7.2.2 The date of manufacture can be found in the first four digits of the serial number which is located on the nameplate. The date code used is a four digit number reflecting year and week of manufacture.



EXAMPLE: Date code 7814; 78 indicates 1978, 14 indicates week of April 3 thru 7 as year and week of manufacture.



7.2.3 No field repairs or modifications are allowed. A complete relay must be ordered where spares are required.

7.3 QUALITY ASSURANCE.

7.3.1 Quality Assurance Program. Agastat devices are built and controlled through an established quality assurance program which is in accordance with the applicable requirements of ANSI N45.2-1977; 10CFR21; and 10CFR50, Appendix B.

7.3.2 Traceability Records. Device traceability records will be maintained by CTP for a period of 11 years from the date of manufacture.

7.3.3 Configuration Control. The configuration code (See Figure 1) is a suffix to the model number and provides a means of identification and configuration control. When a Class 1 change is processed on the product, the configuration code will advance (-001 to -002, etc.) and this specification will be revised if necessary.

7.4 QUALIFICATION TEST REPORT, ES1000.

7.4.1 The actual qualification test report, from which the data presented in this specification has been derived, can be obtained from Control Products Division of Amerace Corp. by ordering Test Report Number ES1000.

CONTROL PRODUCTS DIVISION

Amerace Corporation | Control Products Division | 2330 Vauxhall Road | Union, New Jersey 07083

Telex 138 878