NAMCO CONTROLS
170 EAST 131ST STREET • CLEVELAND, OHIO 44108 • (216) 268-4200 • TELEX 98-5499
REPLY TO: 149 CUCUMBER STREET · JEFFERSON, OHIO 44047 · (216) 576-4070

REPORT NO. QTR 105
DATE AUG. 28, 1980
REVISION 1
COPY NO. 12

QUALIFICATION OF EA180 SERIES LIMIT SWITCHES FOR USE IN NUCLEAR POWER PLANTS IN COMPLIANCE WITH IEEE STANDARDS 323-1974, 382-1972 AND 344-1975.

THIS REPORT IS AN EXTENSION OF EA180 QUALIFICATION REPORTS DATED SEPTEMBER 5, 1978 AND MARCH 3, 1978.

QTR 105

April 3, 1980

REVISION RECORD

REVISION	DESCRIPTION	PAGE	DATE
0	Rough Draft		4/3/80
1	Revise & 1st Release Revise PP 4-2, 4-3 & 4-6.		7/30/80
2	Revise the following pages: 0-3, 3-2, 3-7, 4-1, 4-4, 4-5, 4-6, 5-1, 5-2, 5-3, 5-4, 6-1, 7-6, 9-1, 9-3, Add Section 11.0		8/28/80

INDEX

FIGURES

*Not available, tests in process.

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CERTIFICATION

THIS QUALIFICATION TEST REPORT IS A TRUE AND ACCURATE PRESENTATION BASED UPON THE ENGINEERING DATA AND TEST REPORTS AVAILABLE AT THE TIME.

John R. Bendokaitis 7/31/80
Project Engineer
Nuclear Switch Coordinator

1.0 PURPOSES OF QUALIFICATION TEST REPORT:

1.1 This Qualification Test Report (QTR) will extend the original qualification of the EA180 series limit switch to include several product improvement changes. See Section 9.0 for description of these changes.

1.2 The original EA180 Qualification Reports are dated September 5, 1978 and March 3, 1978.

1.3 This QTR is for a series of type tests in support of EA180 series generic group qualification to IEEE Std. 323-1974, 344-1975 and 382-1972. These standards pertain to Class 1E safety-related equipment for use in nuclear power plants.

1.4 This QTR summarizes the test reports provided by Acme-Cleveland Development Company and compare them to the requirements of the original test plan.

1.5 This QTR will provide the additional data required by IEEE Std. 323-1974, Section 6.2 Equipment Performance Specifications, such as; Performance Characteristics, Ratings, Installation Requirements, Preventative Maintenance, Design Life, Auxiliary Devices Required, Rated Service Conditions, Periodic Quality Control Tests and Estimated Qualified Life.

1.0 PURPOSES OF QUALIFICATION TEST REPORT: (CONT'D.)

1.6 The tests verify the limit switch performance and include; Aging Simulation, Wear Aging, Radiation Exposure, Seismic Qualification and Design Basis Event Environmental Conditions.

1.7 The tests envelope the environmental conditions set forth in Section 4.0.

1.8 Justification for test requirements and/or conditions will be provided where necessary.

1.9 Note: It is the user's responsibility to determine the acceptability of the tests methods, procedures and specifications for a specific application.

2.0 APPLICABLE SPECIFICATIONS AND DRAWINGS:

2.1 The listed IEEE standards were used as guidelines in the preparation and performance of this qualification program.

2.2 IEEE Std. 323-1974 - Std. for Qualifying Class IE Equipment for Nuclear Power Generating Stations.

2.3 IEEE Std. 382-1972/ANSI N41.6 - IEEE Trial-Use Guide For Type Test of Class IE Electric Valve Operators for Nuclear Power Generating Stations.

2.4 IEEE Std. 344-1975 - Recommended Practice for Seismic Qualification of Class IE Equipment for Nuclear Power Generating Stations.

2.5 Namco Controls Test Plan No. LP10767-3 Test Plan for Qualification of Series EA180 and EA740 Limit Switches.

2.6 Namco Controls Drawings

2.6.1 EA180-11302 Limit Switch Assembly

2.6.2 EA180-14302 Limit Switch Assembly

3.0 GENERIC GROUP IDENTIFICATION, SPECIFICATIONS AND SELECTION FOR TEST

3.1 Generic Group Qualification provided by type test T.R. 3613-PP (Section 10.1). The generic group of EA180 limit switches qualified by T.R. 3613-PP is described as the "standard" series limit switch with a ten (10) degree trip travel, three (3) mounting types and two (2) modes of operation.

3.1.1 The selection of the EA180 limit switch to be used for test was based upon an Engineering analysis of the six (6) limit switch part numbers listed in Figure 1.

The analysis was based upon computation of the allowable tensile and shear areas and strength of the fasteners for the various methods of mounting and attachment of the back cover.

It was concluded that the EA180-11302, standard mounting, represented the most conservative (most severe) conditions for test.

3.1.2 The direction of rotation to operate the switch does not affect the test program because the switch mechanism is symmetrical. The test sequence also provides for testing in the operated and unoperated condition.

3.0 GENERIC GROUP IDENTIFICATION, SPECIFICATIONS AND SELECTION FOR TEST (CONT'D.)

List of Limit Switches
In Standard Operating (10°)
Generic Group

PART NUMBER	MOUNTING		ROTATION *
	TYPE	DESCRIPTION	
EA180-11302	STD	Two threaded holes on either side of housing	CW
EA180-12302	STD		CCW
EA180-21302	Style 1	Four holes through wide bottom cover	CW
EA180-22302	Style 1		CCW
EA180-31302	Style 2	Four holes through long bottom cover	CW
EA180-32302	Style 2		CCW

*Direction of rotation of lever shaft to operate switch.
View-facing lever shaft.

Figure 1

3.0 GENERIC GROUP IDENTIFICATION, SPECIFICATIONS AND SELECTION FOR TEST (CONT'D.)

3.1.3 With exception of the back cover all other components of the listed limit switch part numbers are common.

3.2 Selection and identification of the limit switch for test per T.R. 3613-PP.

3.2.1 The EA180-11302 limit switch used in this test was one chosen at random from several assembled on the Namco Controls production line by Production personnel. All parts were per bill of materials EZ10683-90 and subjected to standard inspection procedures.

3.2.2 Identification

The test switch was marked with the following:

Part Number	EA180-11302
Engineering Number	EZ10683-90
Date of Manufacture	3979
Factory Order Number	13658
Test Number	138-90

3.2.3 Throughout test report T.R. 3613-PP this switch is referred to as No. 138-90.

3.3 Specifications for qualified limit switch generic group, per T.R. 3613-PP, IEEE 323-74, 6.2(2). The specifications for the EA180-11302 group limit switch are as follows:

3.0 GENERIC GROUP IDENTIFICATION, SPECIFICATIONS AND SELECTION FOR TEST (CONT'D.)

3.3.1 The switch is a heavy duty, double pole, double throw, butt contact, quick break and quick make type.

3.3.2 Nameplate rating:

125VAC - 20A

250VAC - 15A

480VAC - 10A

600VAC - 5A

Power Factor of Load 75-100%

125VDC - 5A

250VDC - 1.5A

3.3.3 Operating data

Pretravel - 10°

Differential Travel - 8°

Recommended Travel - 13°

Maximum Torque during Pretravel - 21 In. Lbs.

Note: When operated the limit switch lever shaft is spring loaded and will return to the original position if released.

3.3.4 Enclosure type

The switch enclosure meets the requirements of NEMA 1, 4 & 13.

3.3.5 See assembly drawing EA180-11302 for other detailed information such as size and shape.

3.0 GENERIC GROUP IDENTIFICATION, SPECIFICATIONS AND SELECTION FOR TEST (CONT'D.)

3.3.6 Production released bill of materials for switch part numbers qualified to this report are identified with QTR 105. First release was Revision H.

3.3.7 Production manufactured switches are identified with the following as shown in Figure 11:

Part Number

Ratings

B/M Revision

Factory Order Code

Date Code

3.0 GENERIC GROUP IDENTIFICATION, SPECIFICATIONS AND SELECTION FOR TEST (CONT'D.)

3.4 Generic group qualification of "short travel" series limit switches.

3.4.1 The generic group of EA180 14302 short travel limit switches listed in Figure 2 is qualified by similarity to switches tested in T.R. 3613-PP (Section 10.1) and supplementary tests (Section 10.2).

3.4.2 Similarity analysis. An Engineering comparitive analysis of the short travel limit switch with the standard EA180 determined the only difference is in the latching mechanism.

3.4.3 A short travel switch #83 (EA180 14302) was subjected to heat aging, wear tests, radiation exposure, seismic test and plant induced vibration simulation. (Section 10.2)

3.4.4 Conclusion: The EA180-14302 short travel series of limit switches is qualified by similarity to switches tested in T.R. 3613-PP (Section 10.1). The mechanical differences in the latching mechanism did not affect qualification as illustrated by supplementary test reported in Section 10.2.

3.0 GENERIC GROUP IDENTIFICATION, SPECIFICATIONS AND SELECTION FOR TEST (CONT'D.)

List of Limit Switches
In Short Travel (8°) Operating
Generic Group

PART NUMBER	MOUNTING		ROTATION *
	TYPE	DESCRIPTION	
EA180-14302	STD	Two threaded holes on either side of housing	CW
EA180-15302	STD		CCW
EA180-24302	Style 1	Four holes through wide bottom cover	CW
EA180-25302	Style 1		CCW
EA180-34302	Style 2	Four holes through long bottom cover	CW
EA180-35302	Style 2		CCW

*Direction of rotation of lever shaft to operate switch. View-facing lever shaft.

Figure 2

3.0 GENERIC GROUP IDENTIFICATION, SPECIFICATIONS AND SELECTION FOR TEST (CONT'D.)

3.5 Specifications for qualified limit switch generic short travel group, IEEE 323-74, 6.2 (2).

The specifications for the EA180 14302 group limit switch are as follows:

3.5.1 The switch is a heavy duty, double pole, double throw, butt contact, quick break and quick make type.

3.5.2 Nameplate rating:

125VAC - 20A

250VAC - 15A

480VAC - 10A

600VAC - 5A

Power factor of load 75-100%

125VAC - 5A

250VAC - 1.5A

3.5.3 Operating data:

Pretravel - 6° 30'

Differential travel - 4°

Recommended travel - 7°

Maximum torque during pretravel - 38 In. Lbs.

Note: When operated the limit switch lever shaft is spring loaded and will return to the original position if released.

3.0 GENERIC GROUP IDENTIFICATION, SPECIFICATIONS AND SELECTION FOR TEST (CONT'D.)

3.5.4 Enclosure type

The switch enclosure meets the requirements of NEMA 1, 4 & 13.

3.5.5 See assembly drawing EA180 14302 for other detailed information such as size and shape.

3.5.6 Production released bill of materials for switches qualified to this report are identified with QTR 105. First release was Revision H.

3.5.7 Production manufactured switches are identified with the following, as shown in Figure 11:

Part Number

Ratings

Date Code

B/M Revision

Factory Order Code

3.0 GENERIC GROUP IDENTIFICATION, SPECIFICATIONS AND SELECTION FOR TEST (CONT'D.)

Identification of Production Switches

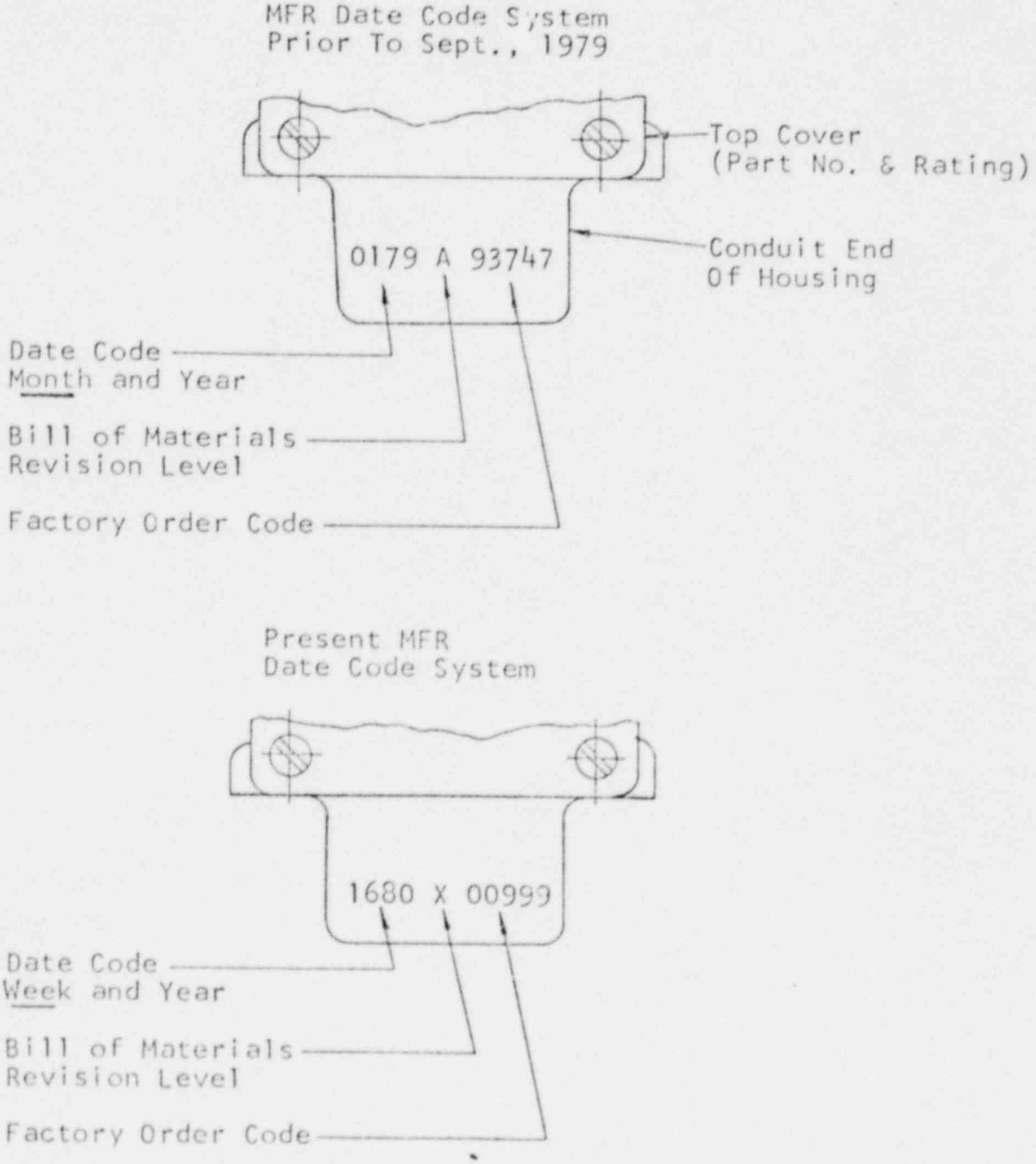


FIGURE 11

4.0 SERVICE CONDITIONS, INSTALLATION REQUIREMENTS, MAINTENANCE AND QUALIFIED LIFE (REF. IEEE 323-1974, SECTION 6.2)

4.1 Installation and connection requirements.

See EA189 90006 (Figure 5) for special instructions.

4.2 Preventive maintenance.

For preventive maintenance during installed life of the limit switch, see EA189 90051 (Figure 6). Replacement parts kit numbers are provided in these instructions.

4.3 Design life.

The mechanical design life is 500,000 cycles (Min.).
Electrical design life is 500,000 cycles (Min.).
The above design life estimations are based upon normal ambient conditions.

4.4 Auxiliary devices required for proper function of the limit switch.

Although it was not considered a part of the qualification test, an operating lever is required for proper operation of the limit switch.
The Namco Controls catalog lists operating levers of many configurations and materials.
It is the users responsibility to chose one suitable for the application.

EA189-90006

INSTALLATION INSTRUCTIONS
EA180 NUCLEAR SWITCH
SILICONE GASKETS

THIS SWITCH IS DESIGNED FOR USE IN THE INNER CONTAINMENT AREA OF A NUCLEAR POWER GENERATING STATION. TO MAINTAIN SWITCH INTEGRITY THE FOLLOWING INSTRUCTIONS MUST BE FOLLOWED.

1.0 ELECTRICAL CONNECTIONS

1.1 WIRE PASSAGE THROUGH SWITCH CONDUIT ENTRANCE MUST BE SEALED IN SUCH A WAY AS TO MAINTAIN THE SWITCH INTEGRITY UNDER REQUIRED SERVICE CONDITIONS.
1.2 WIRE TERMINALS SHALL NOT BE OF ZINC OR ZINC PLATED MATERIAL.
1.3 SOLDERED WIRE ENDS MUST BE CLEAN AND FREE FROM FLUX.

2.0 INSTALLATION OF TOP COVER

2.1 ALIGNMENT OF SCREW HOLES OF COVER AND GASKET SHOULD BE CHECKED.
2.2 TORQUE SCREWS IN A STAGGERED PATTERN, FROM SIDE TO SIDE.
2.3 TOP COVER SCREWS MUST HAVE BELLEVILLE WASHER AND O-RING.
2.4 TORQUE TOP COVER SCREWS 20 INCH POUNDS.
2.5 GASKETS TORN AROUND SCREW HOLES OR OTHERWISE DAMAGED MUST BE REPLACED.

3.0 DO NOT REMOVE BOTTOM COVERS, CHECK SCREWS FOR TIGHTNESS, MUST BE 20 INCH POUNDS.

NOTE: THE ABOVE INSTRUCTIONS ARE TO BE PRINTED ON 40-60# BOND PAPER APPROX. 4 X 6. FOLD ONCE LENGTHWISE AND PACK WITH SWITCH.

CUST PART NO	ASS'Y NO.	REF NO. - EZ10683-89	NAMCO CONTROLS An Acme-Cleveland Company CLEVELAND, OHIO U.S.A.
DATE / CHANGE	UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS XX ± .01 XXX ± .005 ANGULAR ± 0°30' REMOVE ALL SHARP EDGES ALL MACHINED SURFACES 125	DR NLM CK [signature]	TITLE INSTALLATION INSTRUCTIONS
	NOTICE THE INFORMATION CONTAINED HEREON IS THE PROPERTY OF THE NAMCO CONTROLS, A DIVISION OF THE ACME-CLEVELAND CORP. AND IS SUPPLIED IN CONNECTION WITH OUR WORK. IT MAY NOT BE COPIED OR USED IN ANY MANNER [illegible]	DATE 1-23-80 SUPERSEDES SCALE	MATERIAL RM- STOCK SIZE
			DO NOT SCALE EA189-90006

QTR 105

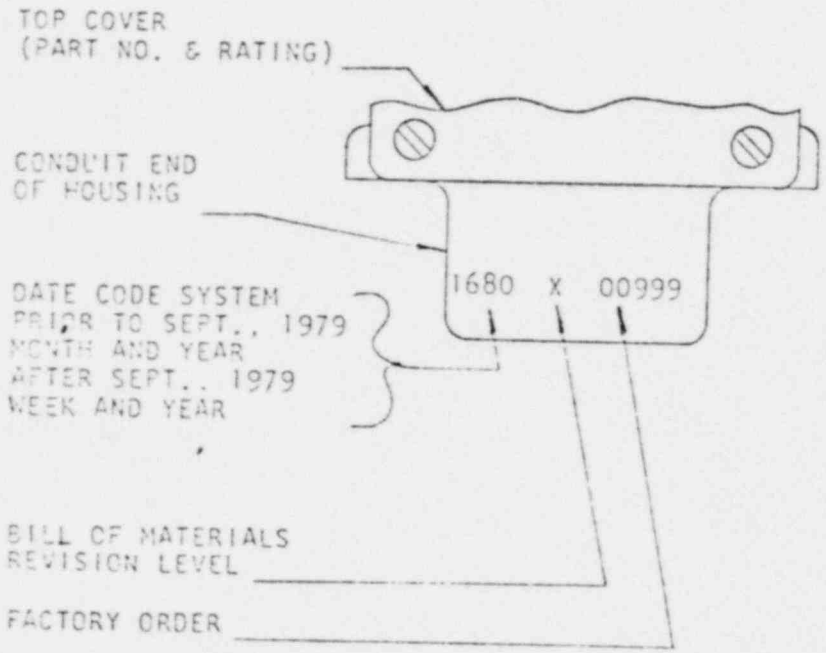
JULY 30, 1980

FIGURE 5

4-2

MAINTENANCE INSTRUCTIONS

TYPE OF SWITCH: EA180 11302 REV. H AND OTHER MODELS AS LISTED
DESCRIPTION : EA180 NUCLEAR SWITCH WITH SILICONE GASKETS
PERIOD OF MFG.: FROM FEBRUARY, 1980



THESE INSTRUCTIONS ARE TO BE USED FOR THE FOLLOWING SWITCH PART NUMBERS AND CORRESPONDING REVISION LEVELS.

PART NUMBER	REVISION LETTER(S)
EA180 11302 - - - -	H
EA180 12302 - - - -	H
EA180 13302 - - - -	H
EA180 14302 - - - -	H
EA180 15302 - - - -	H
EA180 21302 - - - -	H
EA180 22302 - - - -	H
EA180 23302 - - - -	H
EA180 24302 - - - -	H
EA180 25302 - - - -	H
EA180 31302 - - - -	H
EA180 32302 - - - -	H
EA180 33302 - - - -	H
EA180 34302 - - - -	H
EA180 35302 - - - -	H

CUST PART NO | ASS'Y NO | REF NO

M	L	K	H	G	F	E	D	C	B	A	REV	CHANGE	DATE
									A5537				9/16/80

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS
XX ± 01
XXX ± 005
ANGULAR ± 0°30'
REMOVE ALL SHARP EDGES
ALL MACHINED SURFACES 125√

DR TW
CK M.K.
9/16/80
DATE 9/16/80
SUPERSEDES 6/15/80
SCALE

NAMCO CONTROLS
An Acme-Cleveland Company
CLEVELAND, OHIO U.S.A.

TITLE MAINTENANCE INSTRUCTIONS
MATERIAL
STOCK SIZE RM-

DO NOT SCALE
EA189 90051
PAGE 1 OF 3

MAINTENANCE INSTRUCTIONS

TYPE OF SWITCH: EA180 11302 REV. H AND OTHER MODELS AS LISTED
DESCRIPTION : EA180 NUCLEAR SWITCH WITH SILICONE GASKETS
PERIOD OF MFG.: FROM FEBRUARY, 1980

1.0 UNSCHEDULED MAINTENANCE:

IN THE EVENT THAT THE SWITCH DOES NOT FUNCTION PROPERLY.

1.1 CHECK MECHANICAL OPERATION, REMOVE SWITCH IF SLUGGISH, REMOVE BOTTOM COVER, RELUBRICATE STICKING COMPOENTS, USE OIL FROM LUBRICATION KIT (4.2). DO NOT LUBRICATE ELECTRICAL SIDE.
1.2 INSTALL BOTTOM COVER, REPLACE GASKET IF DAMAGED (4.4). TORQUE SCREWS TO 20 IN. LBS. OR AS SPECIFIED IN GASKET KIT.
1.3 IF SWITCH DOES NOT CARRY OPERATING CURRENT, REMOVE POWER, REMOVE TOP COVER, CHECK OPERATION, CLEAN CONTACTS (4.1). IF CLOSED CONTACT RESISTANCE REMAINS GREATER THAN ONE OHM, SEE 2.3.
1.4 INSTALL TOP COVER, REPLACE GASKET IF DAMAGED (4.3). TORQUE SCREWS TO 20 IN. LBS. OR AS SPECIFIED IN GASKET KIT.
1.5 REPLACE BOOT IF DAMAGED (4.7). REPLACEMENT WILL ALSO REQUIRE LUBRICATION KIT (4.2).

2.0 SCHEDULED MAINTENANCE:

SEE SERVICE TEMPERATURE VS. SERVICE TIME CHART BELOW TO DETERMINE WHEN THE FOLLOWING MAINTENANCE SHOULD BE PERFORMED.

SERVICE TEMPERATURE	SERVICE TIME
40° C	20 YEARS
45° C	10 "
55° C	5 "
60° C	3 "

2.1 REMOVE SWITCH. REPLACE LEVER SHAFT AND O-RING ASSEMBLY (4.8). REPLACEMENT WILL ALSO REQUIRE LUBRICATION KIT (4.2).
2.2 REMOVE TOP COVER. CLEAN CONTACTS (4.1).
2.3 REPLACE CONTACT LEVER ASSEMBLY (4.5) THEN CONTACT BLOCK ASSEMBLY (4.6) IF ANY CLOSED CONTACT RESISTANCE REMAINS ABOVE ONE OHM.
2.4 INSTALL TOP COVER AND REPLACE TOP COVER GASKET AND SCREWS (4.3). TORQUE TOP COVER SCREWS TO 20 IN. LBS. OR AS SPECIFIED IN GASKET KIT.

CUST. PART NO. | ASS'Y NO. | REF. NO.

CHANGE: A5594 T.W. 10/16/80; A5573 T.W. 10/16/80 | DATE

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS .XX ± .01 .XXX ± .005 ANGULAR ± 0°30'
REMOVE ALL SHARP EDGES
ALL MACHINED SURFACES $\sqrt{}$

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DR. NLM
CK. [illegible]
DATE 10/16/80
SUPERSEDES 9/16/80
SCALE

NAMCO CONTROLS
An Acme-Cleveland Company
CLEVELAND, OHIO U.S.A.

TITLE MAINTENANCE INSTRUCTIONS

MATERIAL RM-

STOCK SIZE

DO NOT SCALE

MAINTENANCE INSTRUCTIONS

TYPE OF SWITCH: EA180 11302 REV. H AND OTHER MODELS AS LISTED
DESCRIPTION : EA180 NUCLEAR SWITCH WITH SILICONE GASKETS
PERIOD OF MFG.: FROM FEBRUARY, 1980

1.0 UNSCHEDULED MAINTENANCE:

IN THE EVENT THAT THE SWITCH DOES NOT FUNCTION PROPERLY.

1.1 CHECK MECHANICAL OPERATION, REMOVE SWITCH IF SLUGGISH, REMOVE BOTTOM COVER, RELUBRICATE STICKING COMPOENTS, USE OIL FROM LUBRICATION KIT (4.2). DO NOT LUBRICATE ELECTRICAL SIDE.
1.2 INSTALL BOTTOM COVER, REPLACE GASKET IF DAMAGED (4.4). TORQUE SCREWS TO 20 IN. LBS. OR AS SPECIFIED IN GASKET KIT.
1.3 IF SWITCH DOES NOT CARRY OPERATING CURRENT, REMOVE POWER, REMOVE TOP COVER, CHECK OPERATION, CLEAN CONTACTS (4.1). IF CLOSED CONTACT RESISTANCE REMAINS GREATER THAN ONE OHM, SEE 2.3.
1.4 INSTALL TOP COVER, REPLACE GASKET IF DAMAGED (4.3). TORQUE SCREWS TO 20 IN. LBS. OR AS SPECIFIED IN GASKET KIT.
1.5 REPLACE BOOT IF DAMAGED (4.7). REPLACEMENT WILL ALSO REQUIRE LUBRICATION KIT (4.2).

2.0 SCHEDULED MAINTENANCE:

SEE SERVICE TEMPERATURE VS. SERVICE TIME CHART BELOW TO DETERMINE WHEN THE FOLLOWING MAINTENANCE SHOULD BE PERFORMED.

SERVICE TEMPERATURE	SERVICE TIME
40° C	20 YEARS
45° C	10 "
55° C ⓓ	5 "
60° C	3 " .

2.1 REMOVE SWITCH. REPLACE LEVER SHAFT AND O-RING ASSEMBLY (4.8). REPLACEMENT WILL ALSO REQUIRE LUBRICATION KIT (4.2).
2.2 REMOVE TOP COVER. CLEAN CONTACTS (4.1).
2.3 REPLACE CONTACT LEVER ASSEMBLY (4.5) THEN CONTACT BLOCK ASSEMBLY (4.6) IF ANY CLOSED CONTACT RESISTANCE REMAINS ABOVE ONE OHM.
2.4 INSTALL TOP COVER AND REPLACE TOP COVER GASKET AND SCREWS (4.3). TORQUE TOP COVER SCREWS TO 20 IN. LBS. OR AS SPECIFIED IN GASKET KIT.

CUST. PART NO.	ASS'Y NO.	REF. NO.

CHANGE	DATE
A5594 THK.	10/16/80
A5573 THK.	10/16/80

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS
XX ± 01
XXX ± 005
ANGULAR ± 0°30'
REMOVE ALL SHARP EDGES
ALL MACHINED SURFACES 125 V

DR. NLM
CK. [illegible]
DATE 10/16/80
SUPERSEDES 9/16/80
SCALE
STOCK SIZE

NAMCO CONTROLS
An Acme Cleveland Company
CLEVELAND, OHIO U.S.A.

TITLE
MAINTENANCE INSTRUCTIONS

MATERIAL
RM-

DO NOT SCALE

EA189 90051
PAGE 2 OF 3

MAINTENANCE INSTRUCTIONS

TYPE OF SWITCH: EA180 11302 REV. H AND OTHER MODELS AS LISTED
DESCRIPTION : EA180 NUCLEAR SWITCH WITH SILICONE GASKETS
PERIOD OF MFG.: FROM FEBRUARY, 1980

3.0 SCHEDULED MAINTENANCE:

EVERY 20 YEARS IF SWITCH WAS CONTINUOUSLY EXPOSED TO SERVICE TEMPERATURE HIGHER THAN 50° C.

3.1 REMOVE SWITCH. REMOVE TOP COVER. REMOVE AND REPLACE CONTACT BLOCK ASSEMBLY (4.6) AND CONTACT LEVER ASSEMBLY (4.5). INSTALL TOP COVER AND REPLACE TOP COVER GASKET IF DAMAGED (4.3). TORQUE TOP COVER SCREWS TO 20 IN. LBS. OR AS SPECIFIED IN GASKET KIT.

4.0 RECOMMENDED INSTRUCTIONS AND REPLACEMENT KITS:

4.1 CONTACT CLEANING: CLEAN ALL DEPOSITS FROM CONTACTS WITH CLEAN ALCOHOL OR ACETONE USING Q-TIP TYPE APPLICATOR.

4.2 LUBRICATION PROCEDURE - EA181 10160 (LUBRICANT MANUFACTURER: WILLIAM F. NYE, NEW BEDFORD, MASS.)

4.3 TOP COVER GASKET KIT - EA181 10102

4.4 BOTTOM COVER GASKET KIT - EA181 10120

4.5 CONTACT LEVER KIT - EA181 10130

4.6 CONTACT BLOCK KIT - EA181 10140

4.7 BOOT KIT - EA181 10151

4.8 LEVER SHAFT AND O-RING ASSEMBLY KIT - EA181 10170 (FOR STANDARD SWITCHES)

LEVER SHAFT AND O-RING ASSEMBLY KIT (SHORT TRAVEL) - EA181 10171 (FOR SHORT TRAVEL SWITCHES EA180 X4302) EA180 X5302) EA180 X6302)

CUST PART NO	ASS'Y NO	REF NO

M	L	K	H	G	F	E	D	C	B	A		
									9/16/80		DATE	
									ASSY TO		CHANGE	

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS
XX ± 01
XXX ± 005
ANGULAR ± 0°30'
REMOVE ALL SHARP EDGES
ALL MACHINED SURFACES 125√

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DR	TW
CK	H.K.
	9/16/80
DATE	9/16/80
SUPERSEDES	6-5-80
SCALE	

NAMCO CONTROLS
An Acme-Cleveland Company
CLEVELAND, OHIO U.S.A.

TITLE: MAINTENANCE INSTRUCTIONS

MATERIAL: RM-

DO NOT SCALE

EA189 90051
PAGE 3 OF 3

PRINTED IN U.S.A. 21 24966

QTR 105

SEPTEMBER 17, 1980

4.0 SERVICE CONDITIONS, INSTALLATION REQUIREMENTS, MAINTENANCE AND QUALIFIED LIFE (REF. IEEE 323-1974, SECTION 6.2) (CONT'D.)

4.5 Normal service environmental conditions.

The test enveloped the following rated service conditions:

4.5.1 Temperature : Room Temperature to +90° C

4.5.2 Pressure : Ambient

4.5.3 Humidity : 0 to 100% R.H.

4.5.4 Radiation : Total exposure 204×10^6 Rads Gamma

4.5.5 Seismic : O.B.E.

1 - 4 Hz. 0.6 - 9.52 g's

4 -35 Hz. 9.52 g's

Plant induced vibration simulation 333,333 cycles @ 100 Hz. at .75 g's.

4.6 Design Basis Event conditions.

4.6.1 Environmental conditions for this type test were derived from IEEE 323-1974, Appendix A, for pressurized water reactors and boiling water reactors.

See Figure 3 of the test report for pressure/temperature profile obtained.

4.6.2 Radiation total exposure:

204×10^6 Rads Gamma

4.6.3 Seismic: SSE (Same as O.B.E.)

1 - 4 Hz. 0.6 - 9.52 g's

4 - 35 Hz. 9.52 g's

4.0 SERVICE CONDITIONS, INSTALLATION REQUIREMENTS, MAINTENANCE AND QUALIFIED LIFE (REF. IEEE 323-1974, SECTION 6.2) (CONT'D.)

4.7 Operating cycles.

4.7.1 Test

The test switch was operated with electrical load for a total of over 100,300 cycles, 100,200 cycles wear cycling and a minimum of 100 cycles during the other tests.

4.7.2 Periodic testing

As a Quality Control procedure, randomly selected switches will be heat aged for 400 hours at 120° C, then operated for a minimum of 100,000 cycles.

4.0 SERVICE CONDITIONS, INSTALLATION REQUIREMENTS, MAINTENANCE AND QUALIFIED LIFE (REF. IEEE 323-1974, SECTION 6.2) (CONT'D.)

4.8 Estimation of Qualified Life

The purpose of this section is to provide an estimation of qualified life for the EA180 series limit switches enveloped by this report.

Qualified life is defined as "the period of time for which satisfactory performance can be demonstrated for a specific set of service conditions." (1)

The qualification test subjected the limit switch to several accelerated aging tests which included thermal aging at 120° C for 400 hours (5.1).

A primary consideration in estimating qualified life is to first determine the aging mechanism to which the component materials are most susceptible.

The limit switch is composed of metallic and organic components. (Figure 7)

The metallic components, per standard practice in the nuclear industry, are considered to be immune to debilitative aging in the temperature range of this test.

Organic components are susceptible to thermal aging in varying degrees and rates. It was decided to determine the qualified life of these components

4.8 Estimation of Qualified Life (Cont'd.)

through the use of the Arrhenius law (2) to mathematically extrapolate the thermal aging time/temperature to service conditions.

As explained later on in this section an activation energy number of 0.8 eV is considered to be very conservative for the elastomeric parts of the limit switch. (2)

Based upon the 0.8 eV the qualified life of the EA180 series limit switch is 5.0 years at 55.0°C, Figure 8. The qualified life can be extended to 40 years by periodic maintenance and replacement of the elastomeric components as recommended by Maintenance Procedure EA189 90051 (Figure 6).

The organic components can be divided into three (3) groups:

A. Polymeric Lubricants

B. Thermoset Plastic Contact Carrier and Contact Block

C. Elastomeric Seals

The synthetic hydrocarbon grease has a rating of 250° F (121° C) and the aromatic ether based oil is stable to over 475° F (246° C). (3) Neither the lubricant manufacturer nor extensive searches of the current chemical literature concerning lubricant has proven useful in

4.8 Estimation of Qualified Life (Cont'd.)

discovering the thermal aging characteristics of these lubricants. However, due to the ratings of these lubricants and the service conditions that they will be subject to it is Namco Controls' carefully drawn opinion that the application and amount of lubricant applied will be of much greater consequence that changes due to the passage of time. The qualified life of the lubricant is controlled by the maintenance procedure.

The thermoset plastic parts are made of an asbestos filled phenolic with a temperature index of 150° C. (4) The manufacturer of the material was not able to provide activation energy data, however, a number of widely varying values have been located for other phenolics, the lowest value being 0.96 eV. (5)

The elastomeric seals for the limit switch consist of the silicone rubber gaskets and an ethylene propylene o'ring shaft seal. The ethylene propylene boot serves only as an oil retainer and dust shield and therefore, not considered as a seal.

A study and test by Parker Seals (6) concluded that the o'ring seal life appeared to be independent of thermal aging temperatures below 200° F (93° C) and that seal life for ambient temperatures of 55° C to

4.8 Estimation of Qualified Life (Cont'd.)

75° C ranged from 5 to 15 years. Parker was unable to provide an activation energy number.

The manufacturer of the silicone rubber gasket material was not able to supply aging data on the specific compound used, however, data (8) on this type of material indicates a normal service life of 10 to 20 years at 250° F (121° C). A study by Martin Marietta (7) indicates an activation energy number of 1.14 for silicones.

As previously stated; based upon the above and through contacts with others in the nuclear industry (2) an activation energy number of 0.8 eV is considered to be very conservative for the elastomeric parts of the limit switch.

Namco Controls recognizes the importance of thermal aging as a part of qualification and has therefore established a test program to investigate the thermal aging characteristics of the limit switches and of the materials used in them.

This section will be amended as new information becomes available from these tests and other sources.

This statement is based upon the best Engineering information available to us at this time.

4.8 Estimation of Qualified Life (Cont'd.)

Bibliography

(1) IEEE Standard 323-1974, Qualifying Class IE Equipment for Nuclear Power Generating Stations

(2) Namco Controls' Report LP 10835
Thermal Aging Data

(3) Namco Controls' Report LP 10836
Lubricant Data, Thermal Aging

(4) Namco Controls' Report 10837
Thermoset Plastic Data, Thermal Aging

(5) Durez Division of Hooker Chemicals and Plastics Corporation: North Tonawanda, New York;
A Test to Determine Thermal Aging Characteristics of Certain Materials, November, 1969.

(6) Parker Seals, Culver City, California, 90230;
Stress Relaxation Long Term Aging,
E740 Nuclear Report No. 10,4781, January 10, 1979.

(7) Martin Marietta Corporation, Denver, Colorado;
Long Life Assurance Study for Manned Space Craft Long Life Hardware, Volume I, Summary of Long Life Assurance Guidelines, December, 1972.

(8) Namco Controls' Report LP 10838
Silicone Rubber Data, Thermal Aging

4.0 SERVICE CONDITIONS, INSTALLATION REQUIREMENTS, MAINTENANCE AND QUALIFIED LIFE (REF. IEEE 323-1974, SECTION 6.2) (CONT'D.)

List of Non-Metallic
Materials Used in the
Qualified Limit Switch

Material	Where Used
Silicone rubber	Top cover gasket Bottom cover gasket
EPDM	O ring (lever shaft) O ring (cover screws) Boot (lever shaft)
Synthetic hydrocarbon grease w/fluorocarbon	Lubricant
Aromatic ether based oil	Lubricant
Thermoset plastic Phenolic-asbestos filled	Contact block Contact carrier

Figure 7

ARRHENIUS CURVE FOR
ESTIMATED QUALIFIED LIFE

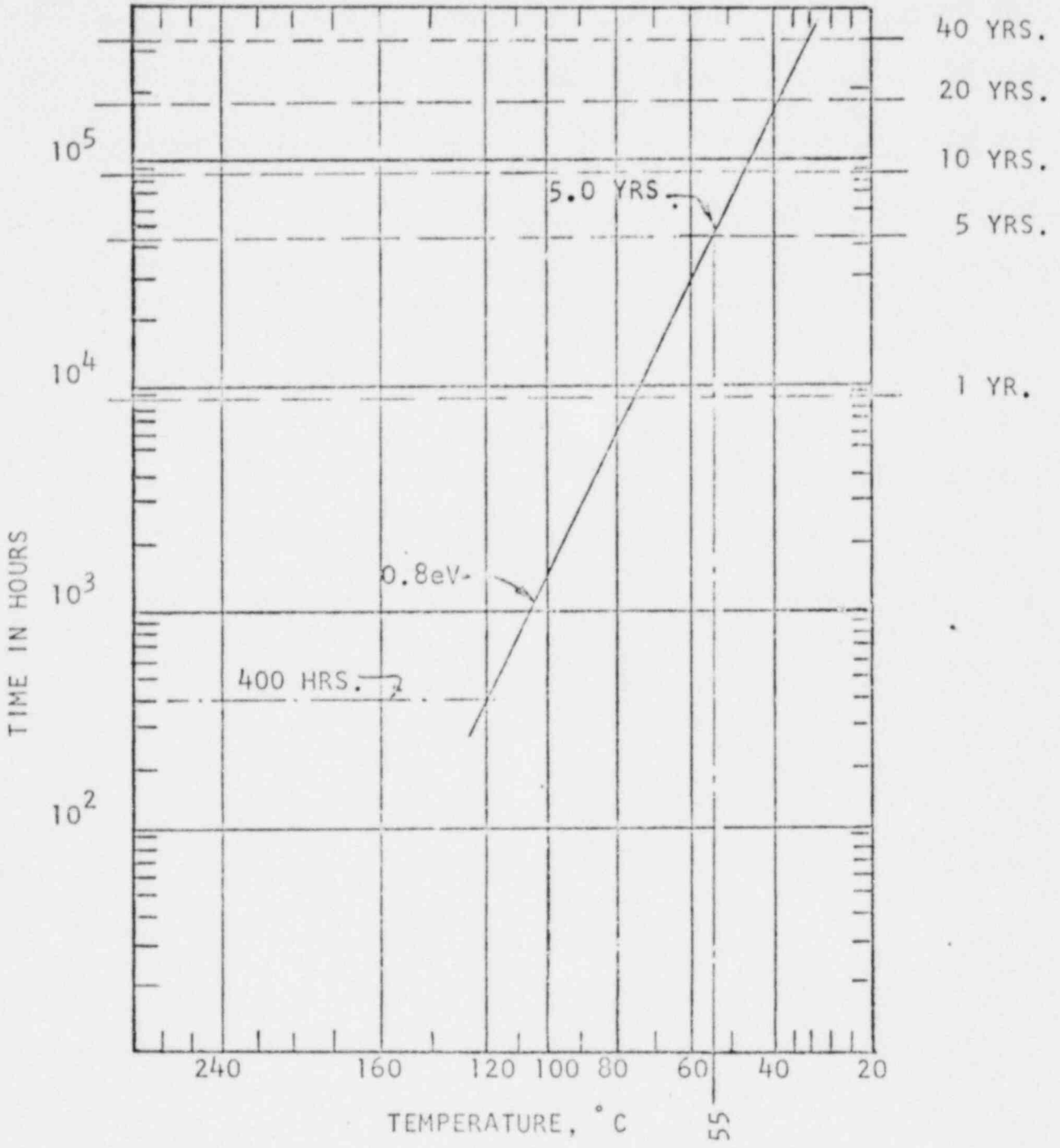


FIGURE 8

5.0 TEST SEQUENCE AND RATIONAL FOR TEST CONDITIONS

5.1 Test sequence for T.R. 3613-PP.

The test sequence was conducted per Test Plan LP10767-3. This test sequence was chosen because it presents the limit switch with the most severe (conservative) conditions in keeping with the IEEE standard guidelines:

Inspect for damage.

Test for baseline data.

Thermal aged, 400 hours @ 120° C.

Performance test.

Mechanical wear age.

Performance test.

Total radiation exposure 204 X 10^6 rads.

Performance test.

Seismic testing.

Performance test.

DBE environmental test.

Performance test.

Final inspection.

5.2 Rational for electrical loads used during qualification testing of nuclear switches.

The Namco Controls' qualification test procedure includes mechanical aging of the switch for 100,000 cycles, minimum, with an electrical load of 500 milliamps at 100 volts DC on the contacts.

5.0 TEST SEQUENCE AND RATIONAL FOR TEST CONDITIONS (CONT'D.)

5.2 Rational for electrical loads used during qualification testing of nuclear switches. (Cont'd.)

The purpose of this test is to simulate the lifetime switching function.

The design/nameplate ratings of these switches are the same as the equivalent commercial versions which are UL and CSA listed. (Snap switches per UL1054) The electrical ratings are for resistive loads. As an example, the 125VDC, 5 amp rating is for continuous loads and make or break conditions (See Section 3.3).

Our experience with this series of switches has been that when they are operated at rated voltages and currents, the contact surfaces tend to be self cleaning and/or the potential of the circuit is sufficient to break down films or oxides that might form on the contact faces. On the other hand, low voltages/low currents may not break down the films and/or oxides, therefore, provide little contact surface renewal.

Testing a switch with two different potentials (V/A) is impractical and would not represent a true switch application.

5.0 TEST SEQUENCE AND RATIONAL FOR TEST CONDITIONS (CONT'D.)

5.2 Rational for electrical loads used during qualification testing of nuclear switches. (Cont'd.)

Therefore, we chose 100 volts DC and 500 milliamps (.5 amps) resistive as being the representative conservative contact loading for mechanical aging. An electrical load of 86 milliamps (.086 amps), 100 volts DC was used to check for proper operation of each circuit during all other test procedures.

5.3 Rational for total radiation exposure.

See the test plan (Page 19 of 37F).

It is Namco Controls Engineering's opinion that the combined normal and DBE exposure is the most conservative radiation test condition.

5.4 Rational for single axis sinusoidal seismic testing.

Section 6.6.2 of IEEE 344-1975 provides for single axis sinusoidal seismic testing if there are no resonances or interactions in the frequency range required.

Previous Engineering analysis of switches similar to the EA180 series found that no natural frequencies below 46.6 Hz. exists on the electrical side of the switch.

Engineering analysis did indicate that the natural frequency of the latch (Item 19) is 10.8 Hz. and 67.07 Hz. for the internal lever. Previous biaxial testing of a similar switch (FIRL Report FC3879)

5.0 TEST SEQUENCE AND RATIONAL FOR TEST CONDITONS (CONT'D.)

5.4 Rational for single axis sinusoidal seismic testing. (Cont'd.)

and the cross coupling tests in T.R. 3613-PP proved that cross coupling is not a factor during seismic testing.

5.5 Rational for DBE environmental test.

The DBE conditions of T.R. 3613-PP were more severe than test plan requirements. Test plan requirements were derived from IEEE 323-1974, Appendix A, for pressurized water reactors and boiling water reactors and IEEE 382-1972.

6.0 INSPECTION AFTER TEST

After the completion of all tests and final examination at the test facility the limit switch was returned to Namco Controls for Engineering review.

The memo of February 29, 1980, Page 6-2, is a record of this review. None of the listed items were considered to be failure mode criteria. The switch functioned properly during performance testing.

NAMCO CONTROLS

QTR 105

April 3, 1980
DATE: FEBRUARY 29, 1980

TO: LP10767-3 OFFICE:

FROM: G. COVELL OFFICE:

SUBJECT: IEEE QUALIFICATION TEST PROGRAM

OBJECTIVE:

Review EA180 Switch #138-90 which has completed Qualification Testing.

OBSERVATIONS:

Contact Resistance:

AB - .2626 OHMS
CD - .0183 "
EF - .1206 "
GH - .0531 "

1. Zero torque to loosen contact block screws.
2. Operative lever shaft moist from o ring to operating lever, (Nye 438 Oil).
3. Shaft dry from o ring to boot groove.
4. EPDM boot dry.
5. Contact lever shaft had a slight film of Nye 438 Oil on it.
6. Plating on roller flaking off.
7. Top and bottom cover gaskets cracked and brittle (Cohrlastic Gaskets).
8. Most of the Nye 734A Grease had dried out.
9. Normal wear on contacts.
10. Slight amount of grease on roller, slide and torsion spring.

GC/nlm
cc: J. Bendokaitis
L. Browning
J. Buzogany
T. Wood

7.0 COMMENTS, SUMMARY AND CONCLUSIONS

7.1 Conclusion

Based upon our review of the test report T.R. 3613-PP it is our opinion that the EA180-11302/EZ10603-90 series limit switch passed the performance limits, in Section 7 of Test Plan LP10767-3, throughout the tests.

Performance limits:

Closed circuit current remained within .001 amperes of .086 amperes @ 100VDC.

Open circuit resistance (insulation resistance) remained greater than 50,000 OHMS (5 Megohms).

Closed circuits did not open, for more than 2 milliseconds, during seismic testing.

7.2 Failure to transfer, Page 6 of T.R. 3613-PP.

Based upon the Engineering review of the test switch and the test set-up, it is our opinion that the one failure to transfer was a random case that may have been aggravated by the test set-up.

7.3 Seismic qualification of the EA180-11302 series switches was conducted by Dr. E. J. Walters and Associates, June, 1977, (Section 10.1, Appendix B). The following comments refer to this report.

7.3.1 Switches #32, 33 and 45 are mechanically and electrically similar to #138-90.

7.0 COMMENTS, SUMMARY AND CONCLUSIONS (CONT'D.)

7.3.2 Switches #32, 33 and 45 were subjected to thermal aging, wear aging and radiation exposure (204×10^6 Rads) prior to seismic testing.

7.3.3 Resonance search, see Figure 9 for a plot of acceleration amplitude (g) versus frequency (Hz.) for this test.

7.3.4 Fragility test, see Figure 10 for a plot of acceleration amplitude (g) versus frequency (Hz.) for this test. A plot of sine dwell point from test T.R. 3613-PP, switch #138-90 is included to raise the tested g level.

Note: All curves represent test limits because no contact opening (exceeding 2 msec) were encountered.

7.3.5 Switch mounting, standard switch mounting (side of housing) was used for all tests.

7.3.6 Switches #32, 33 and 45 were not subjected to plant induced vibration.

7.4 OBE seismic test requirements of IEEE 344-1975, Section 6.1.4.

The OBE test requires that the limit switch be subjected to 5 OBE's and 1 SSE.

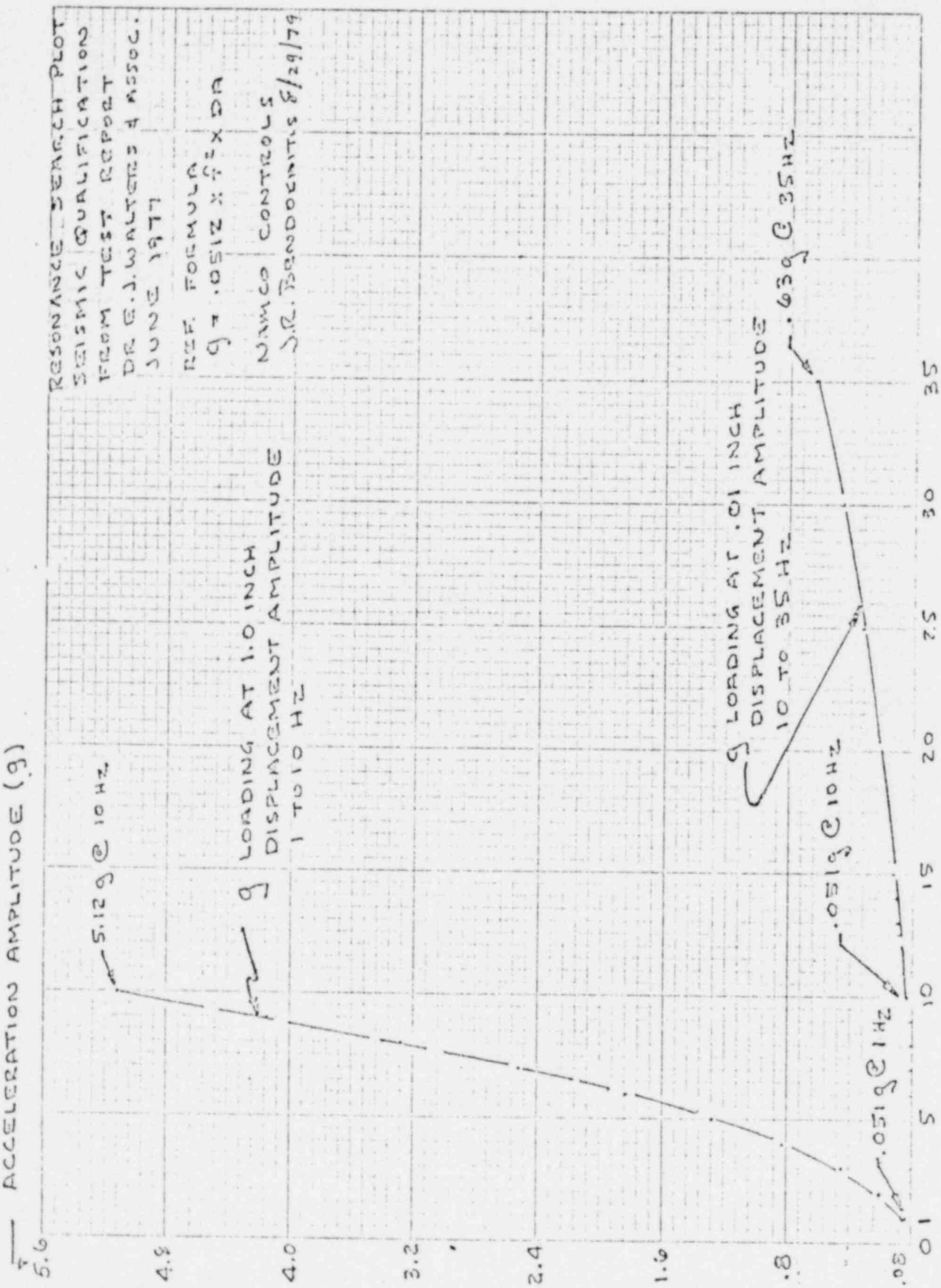

RESONANCE SEARCH PLOT
SEISMIC QUALIFICATION
FROM TEST REPORT
DR E.J. WALTERS & ASSOC.
JUNE 1977
REF FORMULA
g = .0512 x f² x DR
NAMCO CONTROLS
S.R. BENDOCINIS 8/29/79
g LOADING AT 1.0 INCH
DISPLACEMENT AMPLITUDE
1 TO 10 HZ
5.12 g @ 10 HZ
g LOADING AT .01 INCH
DISPLACEMENT AMPLITUDE
10 TO 35 HZ
.639 @ 35HZ
.0512 g @ 10 HZ
.0512 g @ 21 HZ
ACCELERATION AMPLITUDE (g)
FREQUENCY, HZ (f)
5.6
4.8
4.0
3.2
2.4
1.6
.8
0
5
10
15
20
25
30
35

FIGURE 9

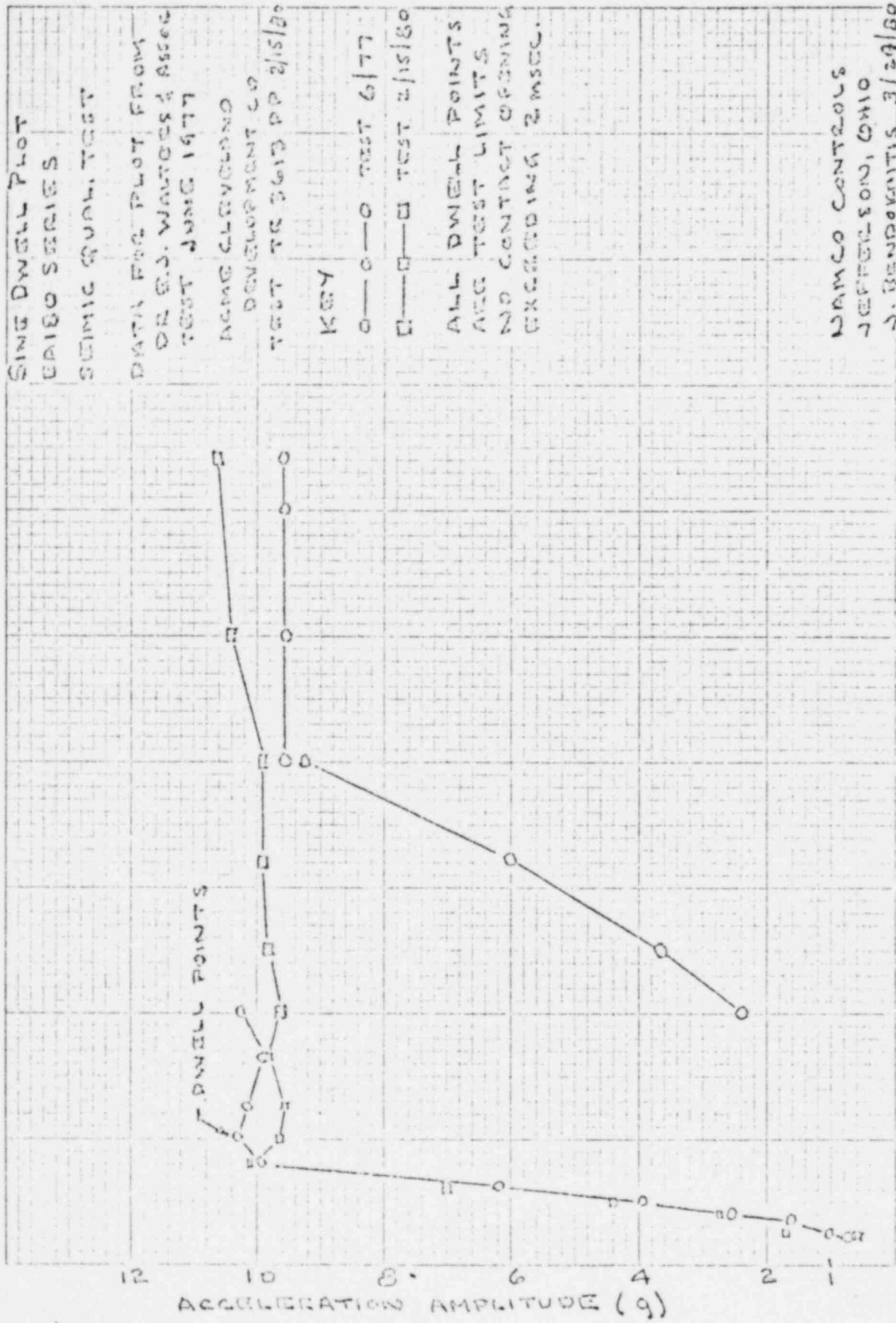

ACCELERATION AMPLITUDE (g)
FREQUENCY (Hz)
0
1
2
4
6
8
10
12
1
5
10
15
20
25
STUDY POINTS

FIGURE 10

7.0 COMMENTS, SUMMARY AND CONCLUSIONS (CONT'D.)

7.4 OBE seismic test requirements of IEEE 344-1975, Section 6.1.4. (Cont'd.)

This requirement has been exceeded during fragility testing. This test subjects the limit switch to a series of 60 second (minimum) sine dwells at sixteen frequencies in each of the three (3) axis. The sine dwell tests provides a minimum of 9,018 stress cycles per axis for a total of 27,054 (minimum) for the test.

For log data regarding fragility testing see Section 10.1, Page 6 of 14B and Pages 6, 7, & 8 of 19D.

7.5 Seismic qualification of #138-90 limit switch.

Limit switch #138-90 is qualified by similarity to switches #32, 33 and 45 per Dr. E. J. Walters' report, Section 6.1, Appendix B. Additional fragility testing was performed in the 10-20 Hz. range per T. R. 3613-PP.

Limit switch #138-90 was subjected to seismic conditioning which included all the sine dwell and plant induced vibration test with circuits energized throughout the tests. Resonance search testing is not required.

7.0 COMMENTS, SUMMARY AND CONCLUSIONS (CONT'D.)

7.6 Conduit sealing, the test report states that teflon tape was used to seal the conduit threads during LOCA test, it must be noted that teflon tape was not used during radiation simulation and further, that no attempt was made to qualify a type of thread sealant. During installation of the limit switch it is the customers responsibility to maintain the integrity of the switch enclosure.

8.0 DESCRIPTION OF PRODUCT IMPROVEMENT CHANGES

8.1 Limit switch #138-90 was made to bill of materials EZ10683-90/EA180-11302 and incorporated the following product improvement changes: (B/M Item No.)

Item 7 Bushing (for contact lever shaft)
Changed from bronze to P/M bronze, oil impregnated.

Item 17 Latch Stud
Changed finish from zinc plating to nickel plating.

Item 27 Contact Block
Changed material from glass filled polyester to asbestos filled phenolic thermoset plastic.

Item 85 Contact Carrier
Changed material from glass filled polyester to asbestos filled phenolic thermoset plastic.

Item 95 Lever (internal)
Material changed from bronwite to brass.

Item 100 Lever Shaft
Added oil groove.

Item 112 Top Cover
Added chamfer to screw holes for o ring.

8.0 DESCRIPTION OF PRODUCT IMPROVEMENT CHANGES

8.1 Limit switch #138-90 was made to bill of materials EZ10683-90/EA180-11302 and incorporated the following product improvement changes: (B/M Item No.) (Cont'd.)

Item 116 Top Cover Screw Assembly

Was: #8-32 Binding Head Screw with Lockwasher.

Now: Special #8-32 SEMS Screw with Belleville washer and EPDM o ring.

Item 114 Top Cover Gasket

Was; Impregnated NBR/Asbestos

Now: Silicone rubber

Item 128 Bottom Cover Gasket

Was: Impregnated NBR/Asbestos

Now: Silicone rubber

Item 131 Bottom Cover Screw Assembly

EPDM o ring added to a special flat head screw.

Item 133 Boot

Material changed from silicone rubber to EPDM.

9.0 ATTACHMENTS

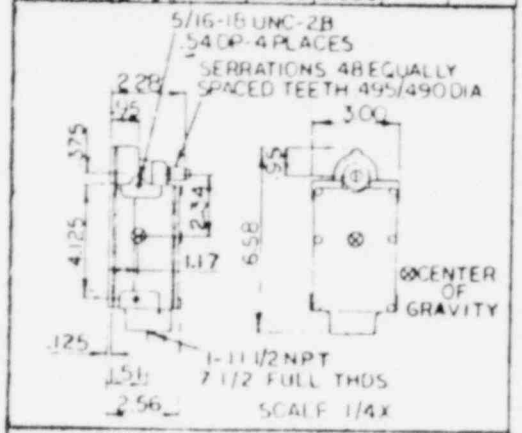
9.2 EA180 11302 Limit Switch Assembly

9.3 EA180 14302 Limit Switch Assembly

9.4 E1060 53300 Operating Lever Assembly

EA180 11302

ASSY NO	ROT	DIM W	DIM X	DIM Y	DIM Z
EA180 11302	CW	—	—	—	—
EA180 21302	CW	—	—	3.687	3.812
EA180 31302	CW	2.250	5.625	—	—
EA180 22302	CCW	—	—	—	—
EA180 22302	CCW	—	—	3.687	3.812
EA180 32302	CCW	2.250	5.625	—	—

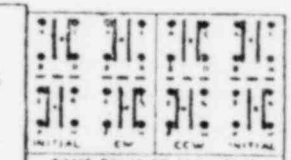


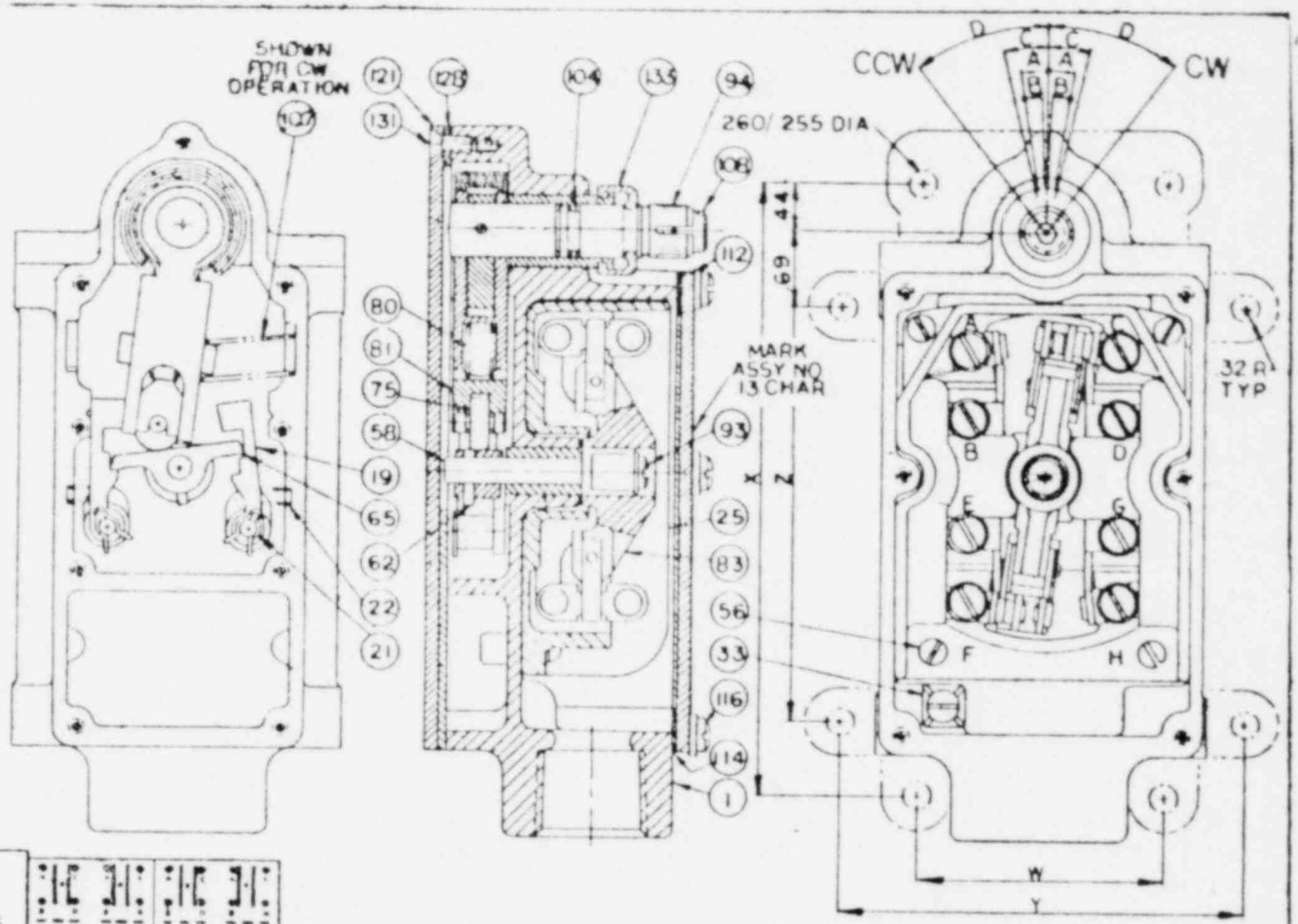
CONTINUOUS CURRENT RATING
75-100% POWER FACTOR

125 VAC 20 AMPS	600 VAC 5 AMPS
250 VAC 15 AMPS	125 VDC 5 AMPS
480 VAC 10 AMPS	250 VDC 1.5 AMPS

A PRETRAVEL	10°
B DIFFERENTIAL TRAVEL	5°
C RECOMMENDED TRAVEL	13°
D TOTAL TRAVEL	38°
E MAX TORQUE DURING PRETRAVEL	21 LB-IN
F MAX TORQUE AT TOTAL TRAVEL	3.3 LB-IN

1 HEAVY DUTY CONTACT ARRANGEMENT IS DOUBLE POLE (POLE 1: A-B-C-D, POLE 2: E-F-G-H) DOUBLE THROW BUTT CONTACTS, QUICK MAKE - QUICK BREAK WITH EIGHT TERMINALS, FOUR FOR NORMALLY OPEN & FOUR FOR NORMALLY CLOSED
2 NEMA ENCLOSURE TYPES 1, 4 & 13
3 OPERATING LEVER (NOT SHOWN) IS ADJUSTABLE IN 7°30' INCREMENTS THRU 180°
4 ADEQUATE WIRING SPACE FOR NINE NO 12 AWG CONDUCTORS
5 ASSY SPEC
6 LUBE SPEC
7 INSTALLATION INSTRUCTIONS PER
8 OPERATING TEMPERATURE -20°C TO +90°C
9 WEIGHT 4.5 LBS
10 SHORT TERM EXPOSURE TO +175°C
11 PROCESS PER QCB-101





CUST PART NO | ASSY NO | REF NO

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS
XX = .01
XXX = .005
ANGULAR = 0°30'
REMOVE ALL SHARP EDGES ALL MACHINED SURFACES 125

DR	A R
CH	
DATE	1-23-80
APPROVED	1-3-79
SCALE	FULL

NAMCO CONTROLS
An Acme Cleveland Company
CLEVELAND OHIO USA
21

TITLE: D2400 NUCLEAR SWITCH

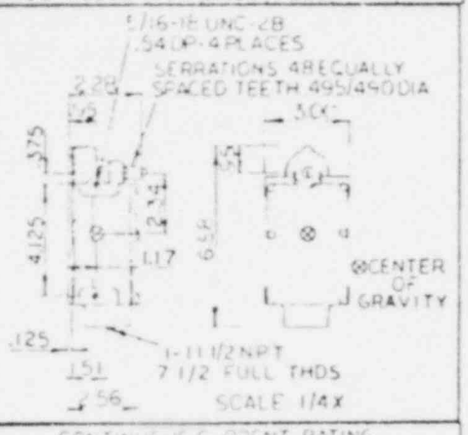
SYSTEM: RM-
STOCK SIZE:

DO NOT SCALE
EA180 11302

QTR 105
APRIL 3, 1980

EA180-14302

ASSY NO	ROT	DIM W	DIM X	DIM Y	DIM Z
EA180-14302	CW	—	—	—	—
EA180-24302	CW	—	—	3.687	3.812
EA180-34302	CW	2.250	5.625	—	—
EA180-14302	CCW	—	—	—	—
EA180-24302	CCW	—	—	3.687	3.812
EA180-34302	CCW	2.250	5.625	—	—

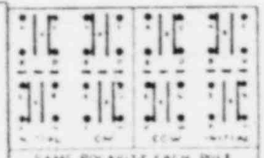


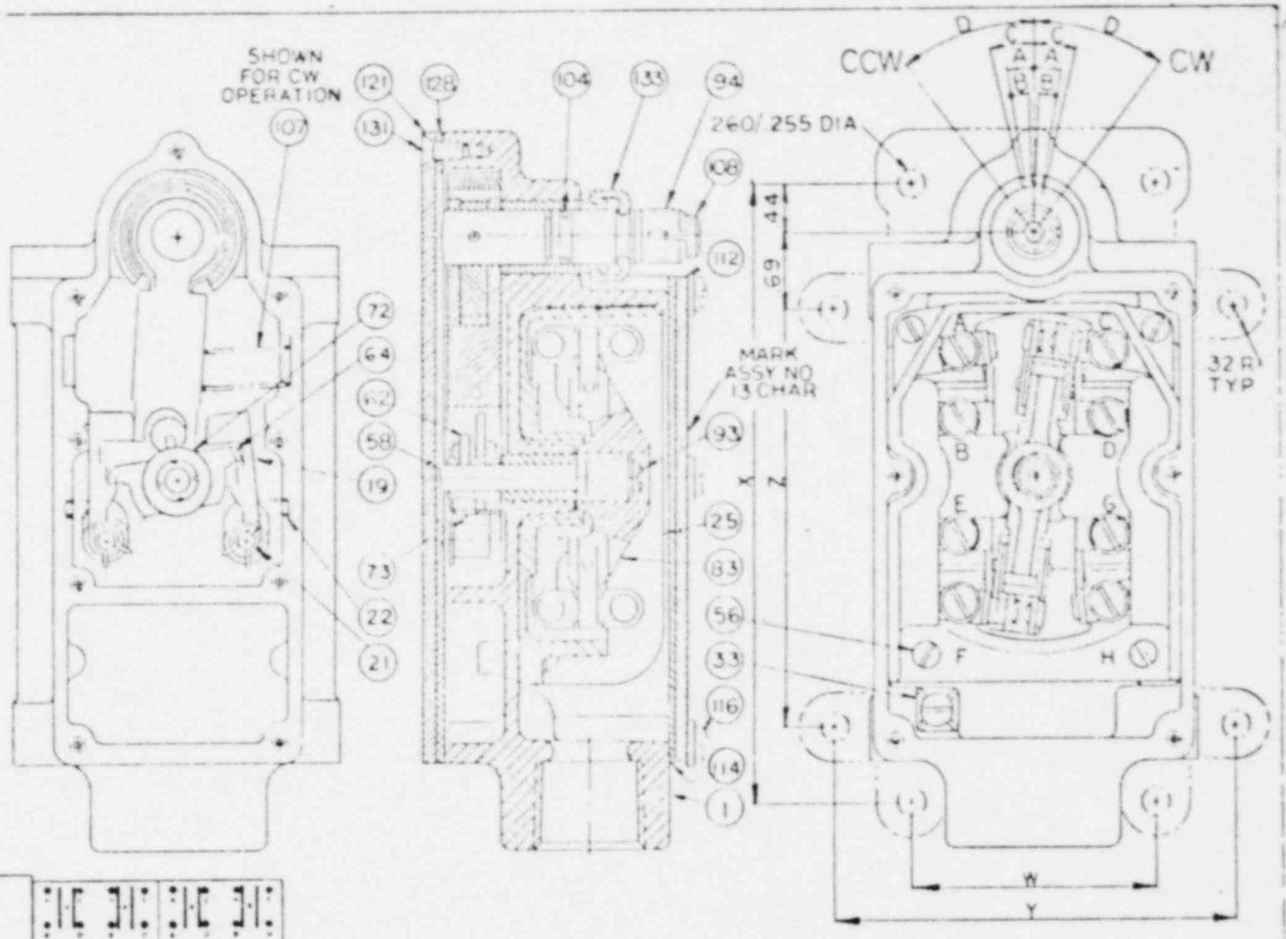
CONTINUOUS CURRENT RATING
75-100% POWER FACTOR

125 VAC 20 AMPS	600 VAC 5 AMPS
250 VAC 15 AMPS	125 VDC 5 AMPS
480 VAC 10 AMPS	250 VDC 1.5 AMPS

A PRETRAVEL	6°30'
B DIFFERENTIAL TRAVEL	4°
C RECOMMENDED TRAVEL	7°
D TOTAL TRAVEL	36°
E MAX TORQUE DURING PRETRAVEL	32 LB-IN
F MAX TORQUE AT TOTAL TRAVEL	45 LB-IN

1. HEAVY DUTY CONTACT ARRANGEMENT IS DOUBLE POLE (POLE 1: A-B-C-D, POLE 2: E-F & G-H) DOUBLE THROW BUTT CONTACTS, QUICK MAKE - QUICK BREAK WITH EIGHT TERMINALS, FOUR FOR NORMALLY OPEN & FOUR FOR NORMALLY CLOSED
2. NEMA ENCLOSURE TYPES 1, 4, 13
3. OPERATING LEVER (NOT SHOWN) IS ADJUSTABLE IN 7°30 INCREMENTS THRU 173°
4. ADEQUATE WIRING SPACE FOR NINE NO. 12 AWG CONDUCTORS
5. ASSY SPEC
6. LUBE SPEC
7. INSTALLATION INSTRUCTIONS PER
8. OPERATING TEMPERATURE -20°C TO +90 C
9. WEIGHT 4.5 LBS
10. SHORT TERM EXPOSURE TO +175°C
11. PROCESS PER QC8-101

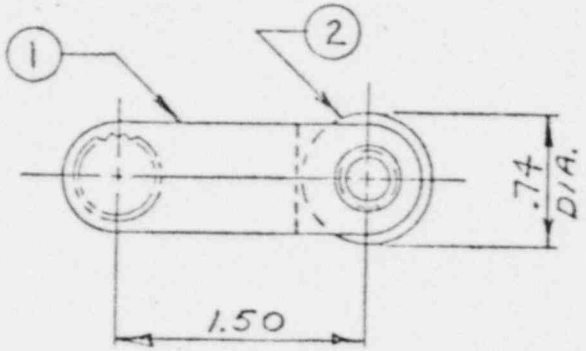


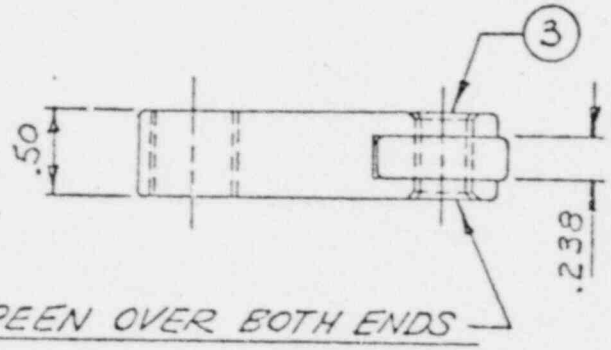


UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS .XX ± .01, .XXX ± .005, ANGULAR ± 1°, REMOVE ALL SHARP EDGES ALL MACHINED SURFACES √	DR T W	© NAMCO CONTROLS an Acme Cleveland Company CLEVELAND OHIO USA	(21)
	DATE 3-18-80	TITLE D2400 NUCLEAR SWITCH SHORT TRAVEL	
	APPROVED 1-3-79	MATERIAL RM	DO NOT SCALE
	FINISH FULL	STOCK SIZE	EA180-14302

EL060 53300	PART NO.	REF. NO.	ITEM 2	REMARKS
	EL060 53300	D1260-RU	EL021 33014	BeCu ROLLER
②	EL060 53301	EZ10619-5,	EL021 33017	NITRONIC 60 ROLLER

	OPERATION	DEPT.	JIG
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			





PEEN OVER BOTH ENDS

SEE B/M FOR P/N

REMOVE ALL SHARP EDGES
UNLESS OTHERWISE SPECIFIED

ALL FRACTIONAL DIMENSIONS
± .010 UNLESS NOTED.

CUST. PART No. _____ LAYOUT No. _____ ASSM. No. _____ ORDER No. _____

REVISIONS			
R			
P			
N			
M			
L			
K			
H			
G			
F			
E			
D			
C	ADDED EL060 53301 CUP	8-4-77	
B	MODIFIED	9-12-62	
A			
AT	DATE		

1ST SERIAL	NO. REQ'D.
LAST SERIAL	DR. DELOSIER
SUPERSEDES	TR.
SUPERSEDED BY	CK.
REMARKS	

STOCK SIZE

THE NATIONAL ACME CO. CLEVELAND, OHIO

OPERATING LEVER ASSEM.

MATERIAL

SCALE FULL DATE 4-13-59

EL060 53300

QTR 105

AUGUST 28, 1980

10.0 TEST REPORTS

This section contains a copy of all the listed test reports.

10.1 Type test T.R. 3613-PP

Dated February 15, 1980, Revision 0

10.2 Supplementary Testing for Short Travel Switches.

An excerpt from EA180 Qualification Test Report Revision 1, dated September 5, 1978.