rotork

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NRC Document Control Desk
US Nuclear Regulatory Commission
Washington DC 20555

May 28, 2004

Re: Rotork Part 21 Notification Dated May 28, 2004 - NA1 Switch Mechanisms Manufactured Between 1978 And November 2001

Please find enclosed a copy of the 10CFR21 report that was faxed to the NRC Operations desk today.

This report references the following Rotork procedures, which are enclosed:

NEP01	Procedure for annealing Ryton switch mechanism components when assembled into an actuator
NEP02	Procedure for annealing Ryton switch mechanism components when assembled into a sub-assembly
ER244	Effect on qualified life of Annealing Nuclear NA1 Switch Mechanism and Add-on-Pak 1 sub-assemblies

If you have any further questions or concerns regarding this matter please do not hesitate to contact me.

Yours truly,

K.C. Black

Karen Black
Quality Manager

IE19

10CFR21 REPORT

Report To:	NRC Operations Centre		
By Mail:	NRC Document Control Desk US Nuclear Regulatory Commission Washington DC 20555	**By Fax:**	301 816 5151
Report Filed By:	Rotork Controls Inc. 675 Mile Crossing Blvd Rochester NY 14624	**Date of Report:**	May 28, 2004
Originated By:	Karen Black Quality Manager	**Approved By:**	Bob Arnold President
Signed	K.C. Black		
Date	May 28, 04		May 28 2004

1.0 Basic Component Affected

Rotork NA1 switchmechanism assemblies manufactured between 1978 (post 78 build) and November 2001 supplied either as a spares item or fitted in an NA1 type Electric Valve Actuator.

Customers supplied with potentially affected actuators manufactured between January 1998 and November 2001, were previously notified individually of this condition and may have completed the risk assessment and corrective action detailed below. This report extends the affected time frame, potentially affecting actuators not identified on the original notifications.

Rotork NA4, NA5, NA1E and NAE5 type Electric Valve Actuators are not affected.

2.0 Nature of the Defect and Associated Safety Hazard

It has recently been identified that the molded (PPS) components within the switchmechanism assembly have a low level of crystallinity and it cannot be confirmed that they are to the same specification as those originally tested and qualified at Wyle in 1978 (refer test report 43979-1 Rev A).

The results of testing conducted in the first quarter of 2002 indicated that the deficiency was limited to product manufactured between January 1998 and November 2001. All affected product was identified through manufacturing records, customers and end users traced and notified in writing. Recent tests have however shown that there is variation in the crystallinity of components manufactured before January 1998. The process was not adequately controlled to ensure consistency of the crystallinity index above 15% and the components supplied may have a low level of crystallinity, which is insufficient for high temperature applications.

The Wyle test monitored the trip point of the switchmechanism switches throughout the qualification program and was reported to be acceptable. This would imply that either that the PPS components in the switchmechanism tested were annealed or that the thermal aging process during the test program annealed the components.

A controlled and documented annealing process was added for all PPS components in November 2001.

Molded PPS switchmechanism components with a low level of crystallinity could distort in extreme circumstances, inhibiting correct operation of the mechanism. For the distortion to occur, the following conditions must exist simultaneously:

1. The actuator is held in the fully open or fully closed position.

2. The temperature of the ***switchmechanism components*** is above 80°C (176°F).

3.0 Effect on Functionality

- Testing has confirmed the switchmechanism is unaffected at or below 80°C (176°F) and prior to the ***switchmechanism components*** exceeding 80°C (176°F) the switchmechanism will function correctly.

- If the valve is in mid travel and the ***switchmechanism components*** are exposed to 110°C (230°F) for 2 hours or more the PPS components will anneal, there will be no distortion and the switchmechanism and the actuator will function correctly thereafter.

- An affected actuator will respond correctly to command signals to alter state until the ***switchmechanism components*** exceed 80°C (176°F).

Attachment A provides a detailed explanation of the effect on function depending on the valve position and open/close action.

Attachment B provides a chart showing the approximate time delay from when the actuator is exposed to different ambient temperatures and the switchmechanism components exceeding 80°C (176°F). This should enable assessment of the temperature-time limits for individual site conditions.

4.0 Date of Discovery

March 31, 2004

5.0 Number and Location of Components (Valve Actuators) Affected

NA4 and NA5 type Electric Valve Actuators have a maximum ambient temperature rating of 70C (160F) and are not affected.

NA1 type Electric Valve Actuators have the same ambient temperature rating but can be subject to a loss of coolant accident (LOCA). The condition reported will only affect Valve Actuators in plant locations where

- The LOCA and Operational temperature specifications, as defined in the Design Basis Document for each facility and location, could result in the ***switchmechanism components*** exceeding 80°C (176°F) (Refer to the time delay chart in Attachment B) **and**
- The switchmechanism fitted was manufactured between 1978 and November 2001 **and**
- The actuator is exposed to the two conditions outlined in section 2.0.

6.0 Corrective Action

This condition can be corrected without removing the actuator from service, or the switchmechanism from the actuator, by annealing "in situ" as documented in Rotork procedure NEP01. Alternatively the switchmechanism can be removed from the actuator and annealed as a separate assembly as documented in Rotork Procedure NEP02. The effect on Qualified Life of the annealing process is documented in Rotork report ER244.

The final option is to replace the switchmechanism with one manufactured after November 2001.
Note: If the switchmechanism is replaced the actuator must be recalibrated.

7.0 Recommended Actions

Each utility must assess whether there are any NA1 actuators installed, fitted with a switchmechanism manufactured between 1978 and November 2001, that could be exposed to the two conditions described in section 2.

The results should be reported to Karen Black, Quality Manager Rotork Inc. to arrange the rework schedule.

e-mail: karen.black@rotork.com
telephone: 585 328 1550 x242
fax: 585 328 5848

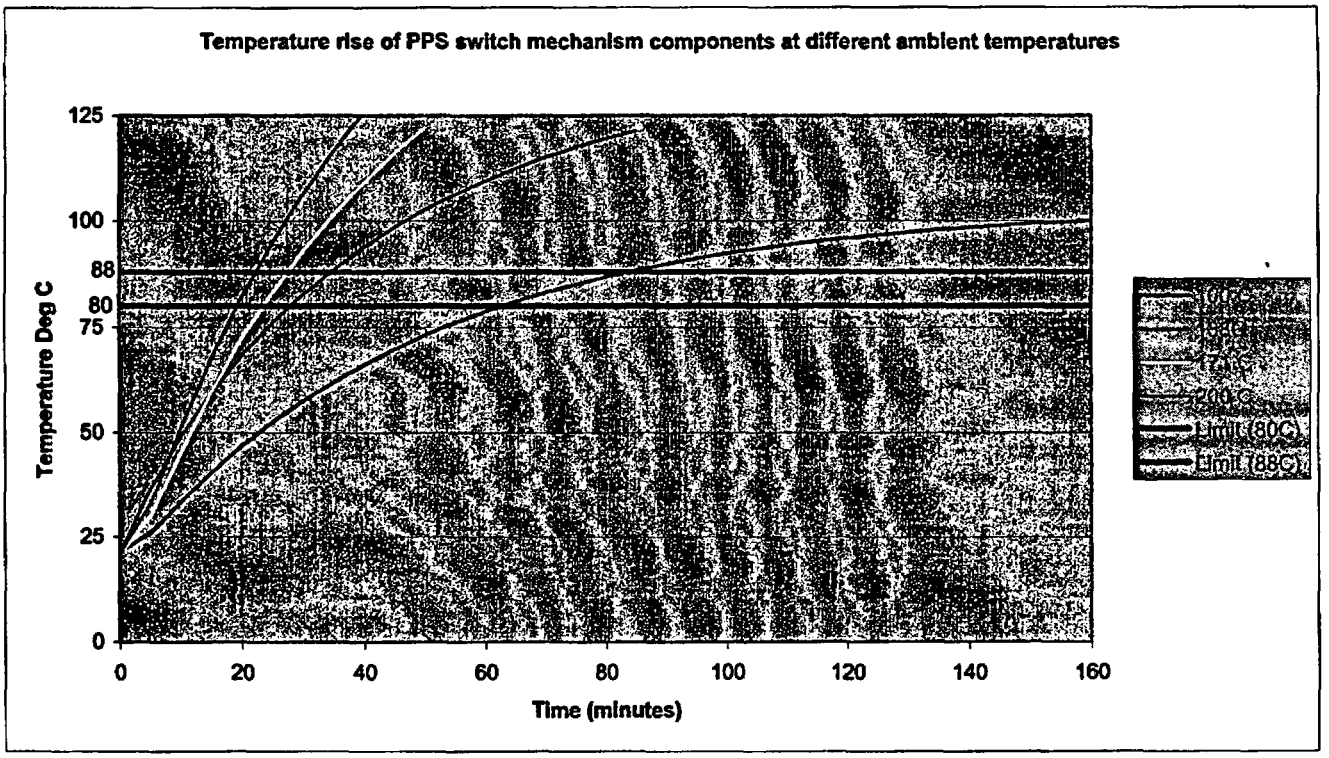
ATTACHMENT A
POSSIBLE EFFECT ON FUNCTIONALITY

Status of Valve Prior to the *switchmechanism components exceeding 80°C (176°F)*		**Effect on Function After the *switchmechanism components have exceeded 80°C (176°F)***	
Valve Position	**Open/Close Status**	**Open/Close Command**	**Effect on Function**
CLOSE	CLOSED ON TORQUE	NONE	None.
CLOSE	CLOSED ON TORQUE	CLOSE	None.
CLOSE	CLOSED ON LIMIT	CLOSE	Limit switch may reset and actuator may restart and apply higher torque or stall torque to the closed seat.
CLOSE	CLOSED ON TORQUE	OPEN ON LIMIT	The actuator could stall when running in the open direction and may show incorrect indication.
CLOSE	CLOSED ON LIMIT	OPEN ON LIMIT	The actuator could stall when running in the open direction and may show incorrect indication.
OPEN	OPENED ON LIMIT	CLOSE ON TORQUE	The actuator will run in the close direction but may stall in the fully closed position and may show incorrect indication.
OPEN	OPENED ON LIMIT	CLOSE ON LIMIT	The actuator will run in the close direction but may stall in the fully closed position and may show incorrect indication.
OPEN	OPENED ON LIMIT	NONE	None.
OPEN	OPENED ON LIMIT	OPEN	Limit switch may reset and actuator may restart and apply higher torque or stall torque to the open seat.
MID TRAVEL	N/A	OPEN ON LIMIT or CLOSE ON TORQUE or CLOSE ON LIMIT	The actuator will run in the direction of the command and will stop at the end of travel on limit or torque depending on the setting. Further commands to operate the actuator will be affected as detailed above.

Note:

1. Testing has confirmed the function of the switchmechanism is unaffected at or below 80°C (176°F)
2. If the valve is in mid travel and the switchmechanism is exposed to 110°C (230°F) for 2 hours or more the PPS components will anneal, there will be no distortion and the switchmechanism and the actuator will function correctly thereafter.
3. **Attachment B provides a chart showing the approximate time delay from when the actuator is exposed to different ambient temperatures and *the switchmechanism components* exceeding 80°C (176°F). This should enable assessment of the temperature-time limits for individual site conditions.**

ATTACHMENT B



The manufacturer's datasheet states that the critical temperature for PPS is *about* 88°C (190°F). This temperature is shown on the chart and in the table below for reference purposes.

As a result of extensive testing, Rotork can guarantee functionality providing the *switchmechanism components* do not exceed 80°C (176°F).

Ambient Temperature	Time to reach 80°C (176°F) in minutes	Time to reach 88°C (190°F) in minutes
100°C (212°F)	60	80
138°C (280°F)	23	30
171°C (340°F)	19	23
200°C (392°F)	14	17

DISTRIBUTION RECORD

INTERNAL			EXTERNAL		
LOCATION	**SIGNATURE**	**DATE**	**LOCATION**	**SIGNATURE**	**DATE**
Rotork Bath			**Rotork Inc**		
Tim Wood			Karen Black		

REVISION SHEET

ORIGIN K Sweet

DATE OF ISSUE 20/02/2002

TITLE Procedure for annealing Ryton switch mechanism components when assembled into an actuator.

Issue No	Date	Revision	By
1	20/02/02	Original	KRS
2	24/04/02	Note added stating spring fitting procedure is only for NA1E actuators.	KRS
3	28/05/02	Attachment 'C' revised to latest details.	KRS
4	10/07/02	Heat gun temperature validation procedure added. (Ref. Section 3)	KRS
5	17/07/02	Section 5 removed & heat gun reference added to certificate.	KRS
6	13/01/03	Section 4 – Note to check switchmechanism latch added	IJB
7	28/11/03	Section 4 – Note to check add-on-pack (A.O.P.1) cam clearance added.	KRS
8	13/05/04	Section 4.8 – Upper temperature limit increased from 125°C to 135°C	IJB

ANNEALING PROCESS FOR ASSEMBLED

NUCLEAR ACTUATOR SWITCH MECHANISMS

Index

Attachments

a) – Annealing certificate.
b) – Heat Gun details
c) – Modified cover detail.

1.0 PURPOSE

1.1 To define a procedure for annealing Ryton R-4 PPS components when assembled into a nuclear actuator switch mechanism assembly.

2.0 SCOPE

2.1 Applicable to all NA1 and NA1E actuators identified as requiring annealing as part of investigation ref. ER239.

3.0 HEAT GUN – TEMPERATURE VALIDATION PROCEDURE

3.1 Every day validate the temperature produced by each heat gun using the following method.
3.2 Set heat gun airflow to maximum and temperature setting 4.
3.3 Place a thermal couple at a distance of 50mm (2.0") from the heat gun nozzle and in the center of the airflow and allow temperature to stabilize.
3.4 Adjust temperature setting to give a measured temperature of 140°C+/-5°C (284°F +/-5°F).
3.5 Record gun serial number and temperature setting.

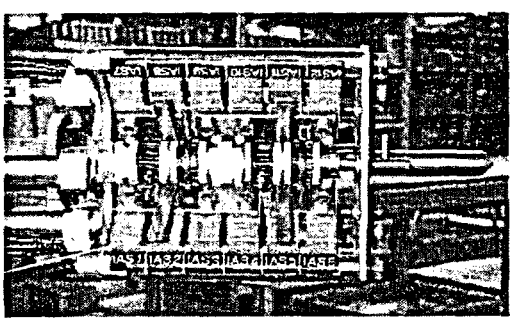
4.0 ANNEALING PROCEDURE

4.1 Remove switch mechanism cover.

4.2 Manually operate actuator until in 'mid-travel'. Ensure that the switch mechanism Ryton parts and the A.O.P.1 Ryton parts are in a neutral position and are **not** 'loaded'.

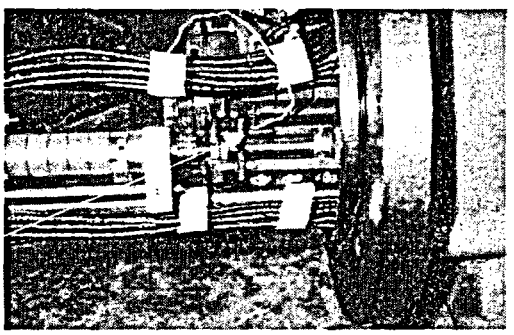
NB. If it is not possible to position the A.O.P.1 cams to a neutral position the striker plates must be held away from the operating surface of the cams. This can be achieved by placing metal strips (part number 04301) between the camshaft and the striker plates as shown below –

Metal strip
04301



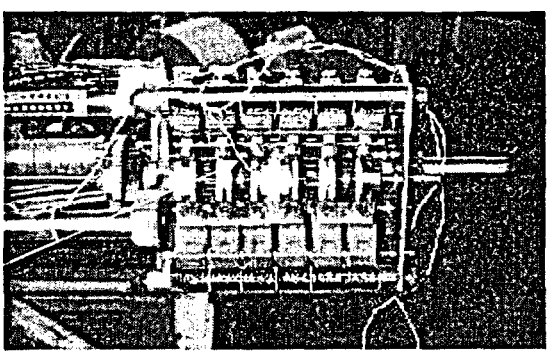
4.3 Fit a thermal couple to the switch mechanism by trapping between striker plate and over travel spring as shown below –

Thermal Couple



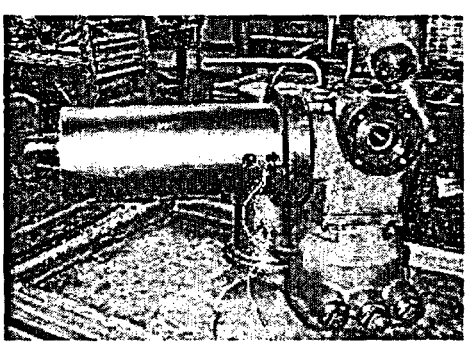
4.4 Fit a thermal couple to the A.O.P.1. by placing between a striker plate and a cam as shown below –

Thermal Couple



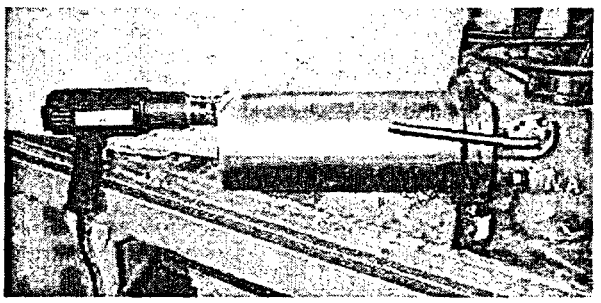
4.5 Fit specially adapted switch mechanism cover and pass thermal couple leads out through exhaust vents.

Insulation material removed for clarity.



4.6 Connect thermal couple leads to chart recorder for temperature logging. Record actuator serial number on chart.

4.7 Fit heat gun and set to maximum flow and temperature setting as defined the temperature validation procedure (Ref. Section 3).

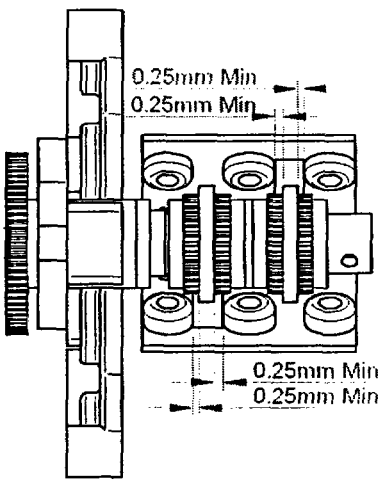


4.8 Heat until thermal couples indicate 110°C (Approximately ½ hour), and leave for a minimum of 2 hours. Temperature must be in the range 110°C to 135°C for this period and must be logged for reference.

4.9 Remove heat gun and leave to cool for ½ hour then remove heating cover.

4.10 When switch mechanism has fully cooled re-tighten A.O.P.1 cam locking nut to 10 lbs. in and visually inspect Ryton components for any sign of damage/cracks. Note switch mechanism Ryton components will have changed colour from a black appearance to a brown appearance.

4.11 Ensure all AOP1 cams have clearance between the side of the cam face and the cut out on switch striker plate. If interference exists then the complete A.O.P.1 frame should be replaced.



Minimum clearance between camface and striker plates. Typical for both 6 and 12 switch assembly's.

4.12 Remove thermal couples, metal spacers 04301 (if fitted) and check operation of A.O.P.1 ensuring that all switches change state when operated by the cam/striker plates.

4.13 Where a switch mechanism latch is fitted, check its setting and function.

4.14 Refit switch mechanism cover using a new 'O' ring seal.

4.15 Complete certificate of site rectification & attach chart from recorder.

ATTACHMENT A

CERTIFICATION OF SITE RECTIFICATION

This is to certify that the actuator identified in section 1A has had the switch mechanism assembly annealed as defined in procedure NEP01.

SECTION 1: IDENTIFICATION

A. **Actuator**
Serial Number: _____

Tag Number: _____

B. **Replacement Components**
_____

SECTION 2: RECORD OF WORK COMPLETED

Temperature log.
Chart recorder serial number _____

Chart reference number. _____

Heat gun reference & setting. _____

Date of work: _____

Work Completed by: _____
(Print Name)

_____
(Signature)

Customer QA Approval: _____
(Print Name)

_____
(Signature)

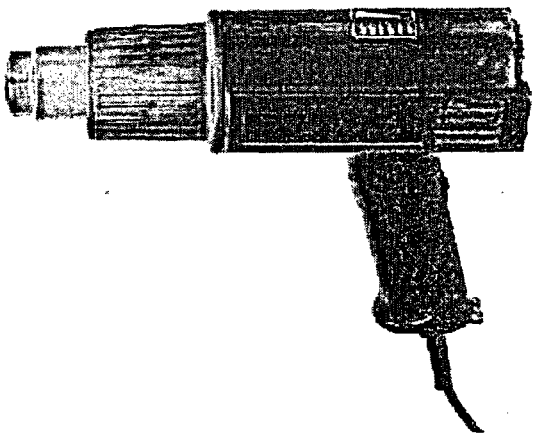
SECTION 3: ROTORK QA APPROVAL

Approved By: _____
Quality Manager

Date: _____

ATTACHMENT B

Steinel HG 3000 SLE Heat Gun

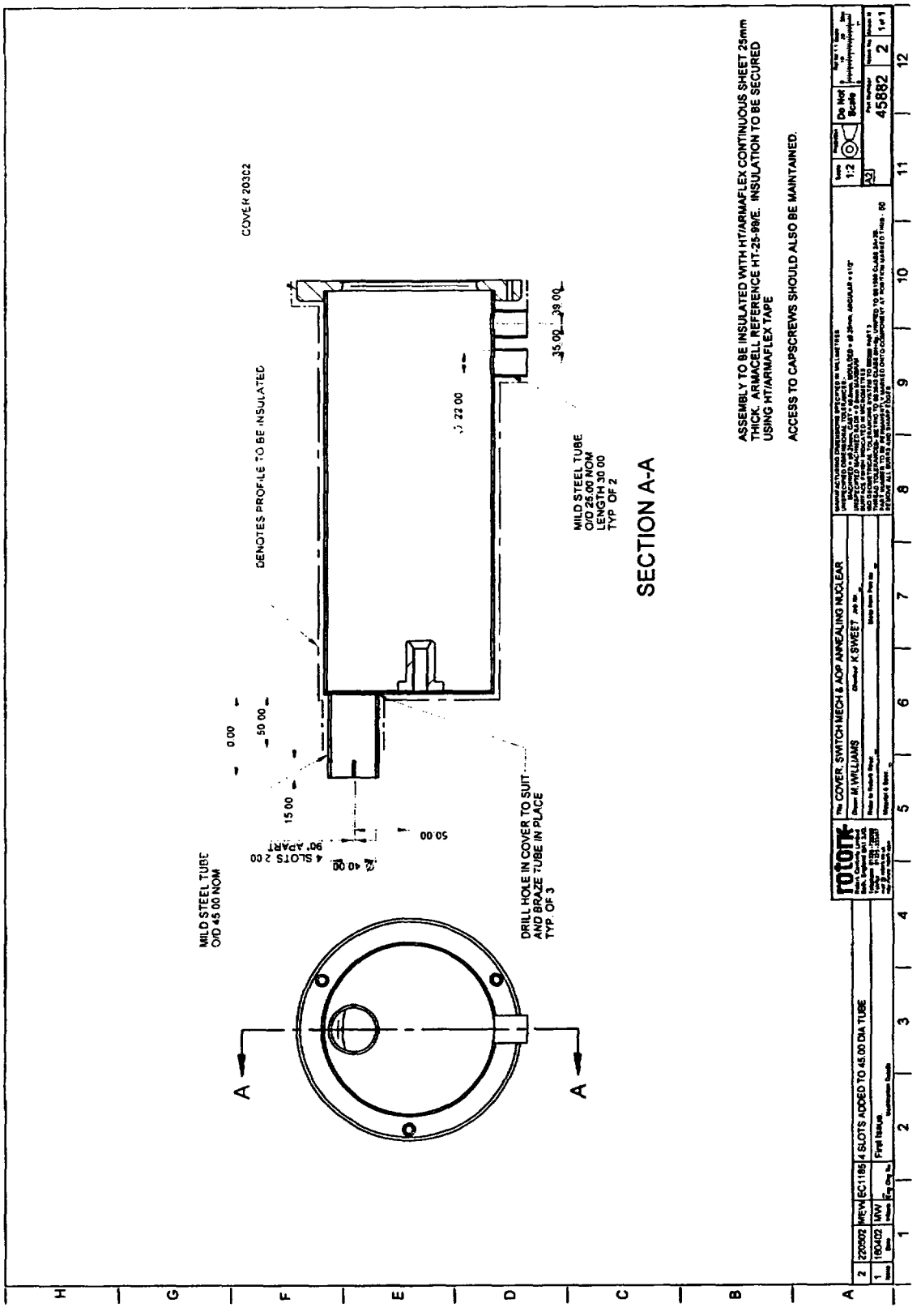


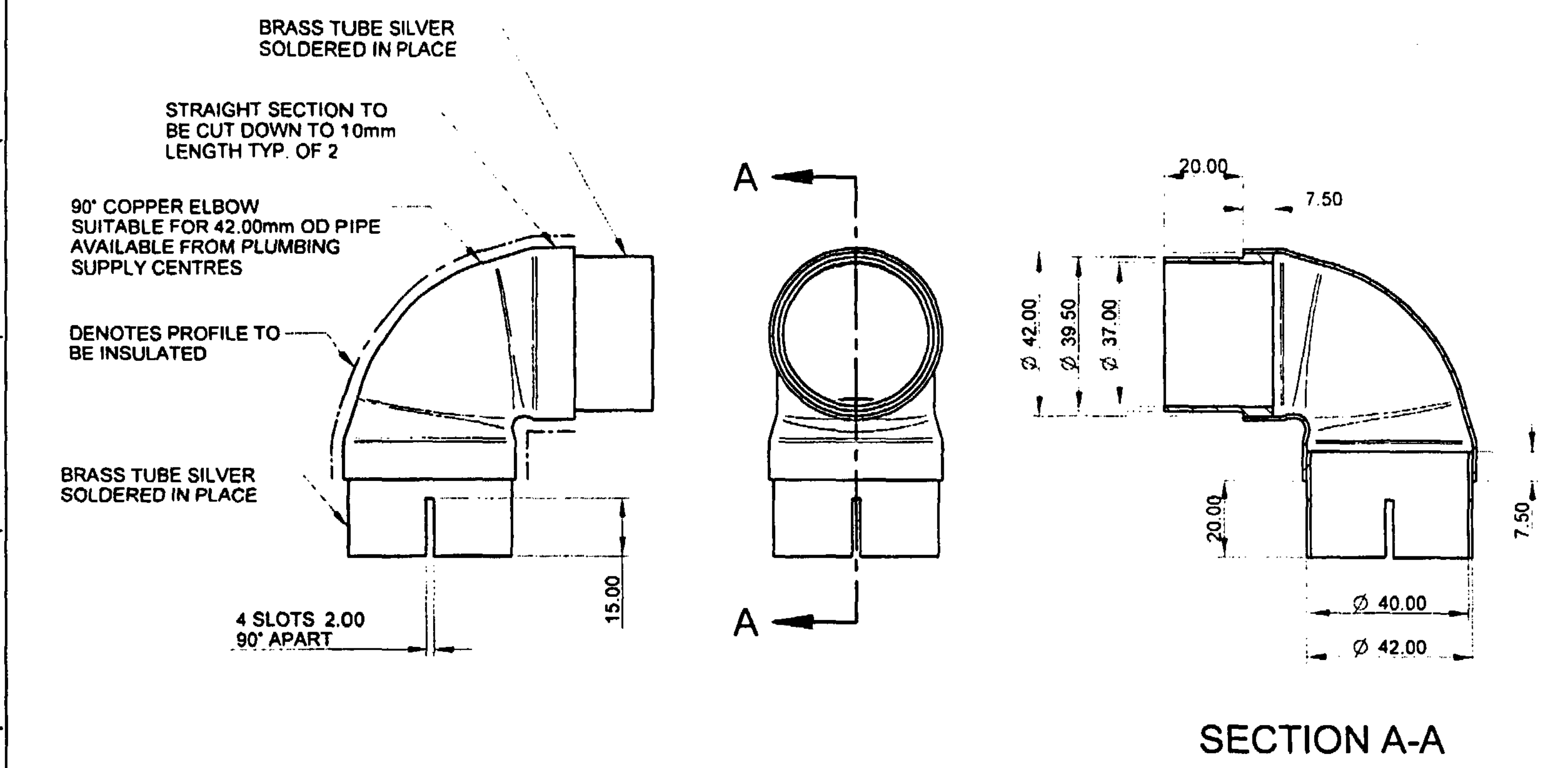
Continuously adjustable, electronically and optically monitored hot air guns. These high quality professional hot air guns feature a built-in temperature sensor which regulates and monitors the set temperature, LEDs to indicate temperature range selected and an adjustable air-flow regulator for precision working. They also have a selectable cool air stage which can be used for drying, cleaning or cooling.
Supplied complete with 1 reflector nozzle, 1 fishtail nozzle, 1×9mm reduction nozzle and instruction leaflet.

- Continuously variable air flow
- Optical temperature displays at 50, 100, 200, 350, 500 and 600°C
- Continuously variable temperature
- 50°C stage for drying, cleaning etc

Technical specification		
Power supply		110V a.c.
Output	110V a.c.	1,400W
Temperature	Stage 1	50°C
	Stage 2	50 to 600°c
Air flow	Minimum	200l/min.
	Maximum	500l/min.
Weight		885g

ATTACHMENT C





ASSEMBLY TO BE INSULATED WITH HT/ARMAFLEX CONTINUOUS SHEET 10mm THICK. ARMACELL REFERENCE HT-10-99/E. INSULATION TO BE SECURED USING HT/ARMAFLEX TAPE OR HIGH TEMPERATURE ADHESIVE (150 C RATED)

Issue	Date	Initials	Eng Chg No	Modification Details
1	210502	MW	EC1185	First Issue.

rotork
Rotork Controls Limited
Bath, England BA1 3JQ

Title ELBOW ASSY, SW/MECH. ANNEALING COVER
Drawn M.WILLIAMS Checked KRS Job No. _
Refer to Rotork Spec: _ Make from Part No: _
Material & Spec. See Drawing

MANUFACTURING DIMENSIONS SPECIFIED IN MILLIMETRES
UNSPECIFIED DIMENSIONAL TOLERANCES:-
MACHINED = ±0.25mm, CAST = ±0.8mm, MOULDED = ±0.25mm, ANGULAR = ±1/2°
UNSPECIFIED MACHINED RADII = 0.8mm MAXIMUM.
SURFACE FINISH INDICATED IN MICROMETRES.
ISO GEOMETRICAL TOLERANCING SYSTEM TO BS308 PART 3.
THREAD TOLERANCES- METRIC TO BS3643 CLASS 6H+6g, UNIFIED TO BS1580 CLASS 2A+2B.
PART NUMBER TO BE PERMANENTLY MARKED ONTO COMPONENT AT POSITION MARKED THUS.-
REMOVE ALL BURRS AND SHARP EDGES.

Scale 1:1 Projection Do Not Scale
A3 Part Number 45937 Issue No 1 Sheet No 1 of 1

ANNEALING COVER BILL OF MATERIALS

Rotork Parts list REF. PL81286

27-247 CHART RECORDER KT655 (120VAC)
27-248 CHART 1 DAY 250 DEGREE
27-249 HEAT GUN STEINEL HG 3000 SLE 110VAC
37-749 CLIP HOSE NORMA TORRO 32-50/9 C7 W3
45882 COVER, SWITCH MECH & AOP ANNEALING
45937 ELBOW ASSY SW/MECH ANNEALING COVER
NEP01 ANNEALING 'IN-SITU' PROCEDURE

Nuclear Engineering Procedure No. **NEP02** **Issue 1** Date: 11th March 2002

DISTRIBUTION RECORD

INTERNAL			EXTERNAL		
LOCATION	SIGNATURE	DATE	LOCATION	SIGNATURE	DATE
Rotork Bath			**Rotork Inc**		
Tim Wood			Karen Black		

REVISION SHEET

ORIGIN K Sweet

DATE OF ISSUE 11/03/2002

TITLE Procedure for annealing Ryton switch mechanism components when assembled into a sub-assembly.

Issue No	Date	Revision	By
1	11/03/02	Original	KRS

ANNEALING PROCESS FOR ASSEMBLED

NUCLEAR ACTUATOR SWITCH MECHANISMS.

Index

Attachments

a) – Annealing certificate.

1.0 PURPOSE

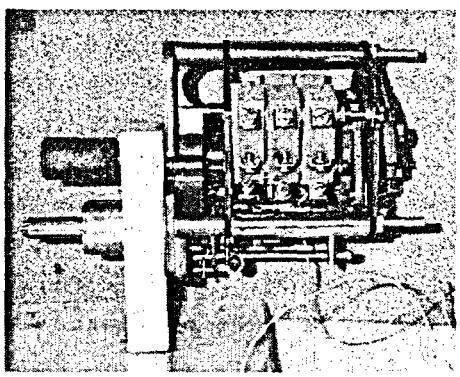
1.1 To define a procedure for annealing Ryton R-4 PPS components when assembled into a nuclear switch mechanism assembly.

2.0 SCOPE

2.1 Applicable to all NA1 and NA1E actuators identified as requiring annealing as part of investigation ref. ER239.

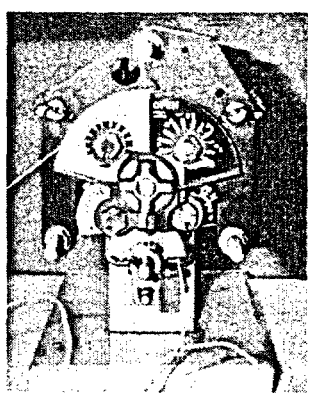
3.0 ANNEALING PROCEDURE

3.1 Mounting switch mechanism onto stand (ref parts SKS3263 & SKZ3262).

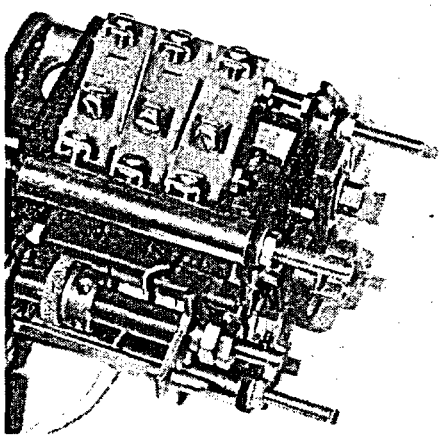


3.2 Ensure torque adjusting front plate is in the mid-position. This is to ensure that the switch mechanism Ryton parts are in a neutral position and are **not** 'loaded'.

Front Plate
in mid-position.



3.3 Fit a thermal couple to the switch mechanism by trapping between striker plate and over travel spring as shown below –



3.4 Connect thermal couple to chart recorder for temperature logging. Record switch mechanism lot reference and order number on chart.

3.5 Heat until thermal couple indicates 110°C, and leave for a minimum of 2 hours. Temperature must be in the range 110°C to 125°C for this period and must be logged for reference.

3.6 Remove switch mechanism from oven and allow to cool naturally.

3.7 When switch mechanism has fully cooled remove thermal couple and visually inspect Ryton components for any sign of damage/cracks. Note switch mechanism Ryton components will have changed colour from a black appearance to a brown appearance.

3.8 For NA1E switch mechanism inspect switch packs for return springs, if not fitted apply spring fitting procedure as defined in section 4.0

3.9 Complete certificate of rectification & attach chart from recorder.

4.0 SPRING FITTING PROCEDURE NA1E ONLY

To improve the vibration resistance of switch mechanism two extra springs (N45367) are fitted as part the switch mechanism switch pack assembly. If these are not present then after the annealing process they must be fitted.

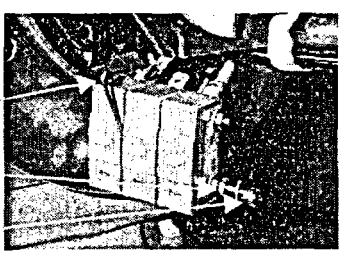
3.1 Remove the switch pack from the switch mechanism by holding the eccentric cam in position by use of a screwdriver and slacken and run back locking nut.
Note position and take care not to move eccentric cam as this will effect the calibration of the switch mechanism.

3.2 Slide the switch pack out of the mechanism and clip return spring N45367 into position as shown and ensure spring is free to operate between switches.

Spring N45367

Lock nut

Eccentric cam



3.3 Place switch pack back into position and retighten locking nut again ensuring eccentric cam isn't moved by holding it in place with a screwdriver.

3.4 Repeat operation for the other switch pack.

ATTACHMENT A

CERTIFICATION OF RECTIFICATION

This is to certify that the switch mechanism identified in section 1A has been annealed as defined in procedure NEP02.

SECTION 1: IDENTIFICATION

A:

Lot reference number: _____

Order reference Number: _____

SECTION 2: RECORD OF WORK COMPLETED

Temperature log.
Chart recorder serial number _____

Chart reference number. _____

Date of work: _____

Work Completed by: _____
(Print Name)

_____
(Signature)

Customer QA Approval: _____
(Print Name)

_____
(Signature)

SECTION 3: ROTORK QA APPROVAL

Approved By: _____
Quality Manager

Date: _____

Title: Effect on qualified life of Annealing Nuclear NA1 Switch Mechanism and Add-on-Pak 1 sub-assemblies.

Distribution:
I Burnell
C Warnett

K Sweet
T Wittamore

Synopsis Only
All Directors

Revision 2		
Prepared	Checked	Approved
M Williams	K Sweet	I Burnell

Revision 3		
Prepared	Checked	Approved

Revision Notes:

Annealing temperature calculations changed to use 0.8 activation energy throughout and a maximum annealing temperature of 127°C(261°F).

1.0 SYNOPSIS

This report determines the reduction in qualified life of nuclear NA1 actuator when annealing Ryton components 'in-situ'.

Calculations using the Arrhenius law show that the annealing process has no impact on the 40 year 'qualified life' of the actuator.

2.0 OBJECTIVE

To determine the reduction in qualified life of nuclear NA1 switch mechanism and A.O.P.1 sub-assembly's when annealing Ryton PPS R-4 components 'in-situ'.

3.0 INTRODUCTION

Engineering report ER239 identified Ryton components that required annealing and a method of annealing components 'in-situ' (Ref. procedure NEP01) was developed.
Nuclear NA1 actuators have specified qualified life of 40 years and this has been demonstrated ref. Rotork test report TR3030 using a conservative activation energy of 0.8 eV in an ambient of 60°C (140°F).
The annealing process locally heats the switch mechanism and A.O.P.1 assemblies to a nominal temperature of 118°C (244°F) for 2 hours, thus the effect on 'qualified life' using the maximum activation energy for the switch mechanism/A.O.P.1 assembly needs to be considered.
Other areas of the actuator enclosure (terminal block and motor) do not need to be considered because there is no direct flow of hot air into these compartments and are only warm to the touch at the end of the annealing process.
Hot air enters one end of the switch mechanism cover at approximately 140°C (284°F) and is exhausted at the other end.
During initial trials of this process a heat sensitive strip was attached to a mounting pillar between the switch mechanism and the A.O.P.1, this indicated that a temperature of 121°C(250°F) had been achieved and 127°C(261°F) had not been exceeded.

The following calculations determine the 'qualified life' for an ambient temperature range of 40°C (104°F) to 60°C (140°F) after the annealing process has been applied assuming a maximum annealing temperature of 127°C(261°F).

4.0 CALCULATIONS

QUALIFIED LIFE OF SWITCH MECHANISM COMPONENTS USING THE ARRHENIUS LAW. Ref. Report TR3030

Boltzman constant $k := 0.0000861$

Ambient temperature range C in 2 degree steps. $Ta := 40, 42 .. 60$

Ambient temperature range K. $T1_{Ta} := Ta + 273$

Aging Temperature K $T_2 := 138 + 273$ $T_2 = 411$

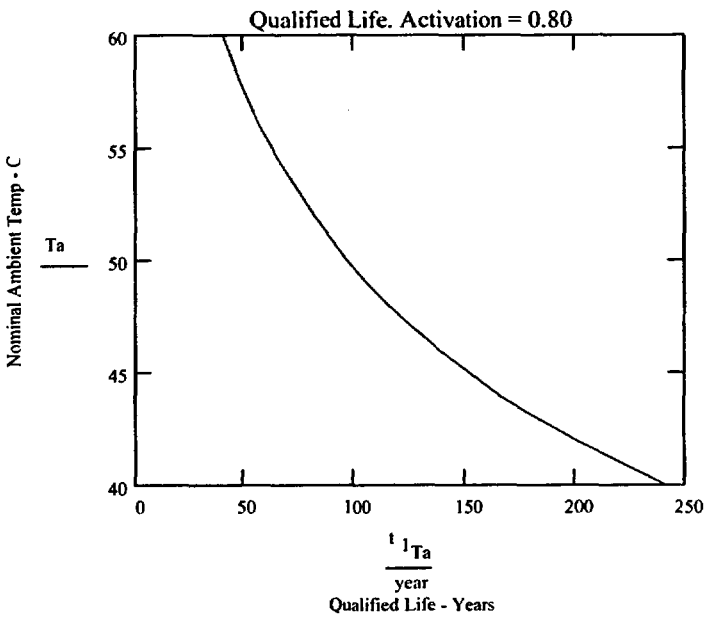
Aging time – hours $t_2 := 1797.6hr$

Switch mechanism activation energy (Nitrile seals) $\phi := 0.80$

Arrhenius calculation $t1_{Ta} := t_2 \cdot e^{\frac{\phi}{k} \cdot \left(\frac{1}{T1_{Ta}} - \frac{1}{T_2}\right)}$

year := 365·day

$T1_{Ta}$	$\frac{t1_{Ta}}{year}$
313	241.96
315	200.43
317	166.42
319	138.5
321	115.53
323	96.59
325	80.93
327	67.96
329	57.18
331	48.22
333	40.74



REDUCTION IN QUALIFIED LIFE DUE TO ANNEALING SWITCH MECHANISM COMPONENTS USING THE ARRHENIUS LAW

Boltzman constant $k := 0.0000861$

Ambient temperature range C in 2 degree steps. $Ta := 40, 42 .. 60$

Ambient temperature range K. $T3_{Ta} := Ta + 273$

Nominal annealing Temperature K $T4 := 127 + 273$ $T4 = 400$

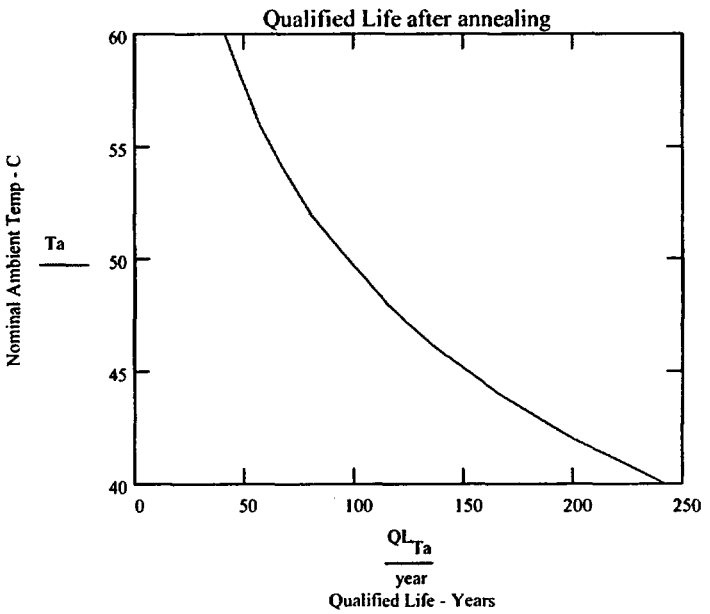
Annealing time – hours $t4 := 2 \cdot hr$

Switch mechanism activation energy (Nitrile seals) $\phi := 0.8$

Arrhenius calculation $t3_{Ta} := t4 \cdot e^{\frac{\phi}{k} \cdot \left(\frac{1}{T3_{Ta}} - \frac{1}{T4}\right)}$

Qualified life after annealing $QL_{Ta} := t1_{Ta} - t3_{Ta}$

QL_{Ta} year
241.815
200.306
166.317
138.418
115.463
96.531
80.882
67.916
57.15
48.191
40.72



5.0 RESULTS

It can be seen from the above calculations that the switch mechanism and A.O.P.1 assembly has a qualified life in excess of 40 years in 60°C (140°F) ambient after the annealing process. Thus the annealing process has no impact on the 40 year 'qualified life' of the actuator.