NUCLEAR PRODUCT ADVISORY:

BARTON 763/763A/764 Transmitter Heat Rise and Qualified Life

DATE OF ISSUE: 1/9/2020 DOCUMENT NO.: 210316064.2

ATTENTION: If you have a Barton Model 763 or 763A or 764 Electronic Transmitter please read the following notice in its entirety.

Issue

Cameron was recently asked to review the Qualified Life extrapolations in qualification reports 9A-CR3-763-6 and 9A-CR3-764-9 due to green findings in recent NRC inspection reports to account for circuitry component heat rise, which results in an increase of temperature of the component that is above the ambient temperature.

Background

Qualification reports 9A-CR3-763-6 and 9A-CR3-764-9, Table II and Figure 4-1 provide qualified life extrapolations for conditions not explicitly tested as part of the original Barton qualification effort. These extrapolations are based on Arrhenius Analysis extrapolation of actual qualification ambient temperatures to various other times and ambient temperatures. The purpose of the extrapolations is to give customers a simple way to correlate the qualified life of the Barton 763/763A/764 transmitters based on customer's specific, unique operating ambient temperature. The qualified life extrapolations originally provided appear consistent with the industry standard for this type of product at the time of their publication. However recent NRC reviews have identified heat rise as a factor not previously accounted for in transmitter extrapolated qualified life analysis.

It is noted that the Cameron manufactured Barton Model 763A and 764 transmitters have maintained design control consistent with the original qualification units qualified in the 1980s. This notice provides an updated review of the original qualified life extrapolations, with the acknowledgement that the product itself has not undergone any significant design change that would negatively affect their actual qualified life. As a result, the new qualified life guidance provided here is limited by the Barton qualification aging data and does not account for plant in-service life or historical usage experiences.

Conclusions

The Barton qualified life Arrhenius extrapolations and qualification aging were based on the components with the limiting activation energy, which were the metal film resistors on the circuit board that have an activation energy of 0.78 eV. Based on recent analysis of the circuit, it was determined that the metal film resistor having the greatest heat rise on the circuit is the R1 resistor, which will have a heat rise above case internal temperature of 2.62°C (4.71°F), and case internal temperature will have a heat rise of up to 2.0°C above ambient temperature (for a total of 4.62°C heat rise above ambient). Due to the function of the circuit and the location of this resistor in the circuit, this resistor heat rise will be the same regardless of transmitter output, power supply voltage, total loop resistance, and circuit type (4-20 mA or 10-50 mA versions).

However, further evaluation into heat rise also determined that under certain power supply, circuit output, and total loop resistance conditions, heat rise in the Q7 and Q8 transistors on the circuit board could possibly be significant and result in these components becoming the life limiting components for extrapolation of qualified life. These NPN transistors have a higher activation energy (1.01 eV) than the metal film resistors, and so were not considered in the original qualified life extrapolations. However, as part of this heat rise investigation it was found that some conditions are possible that may result in significant reduction in qualified life, potentially much more so than the reduction in qualified life due to the R1 resistor heat rise.

Cameron has created a Qualification Addendum report 9A-CR3-764-94 to detail this new information. This new addendum will become part of the standard certification package for all new 763A / 764 quotes and orders.

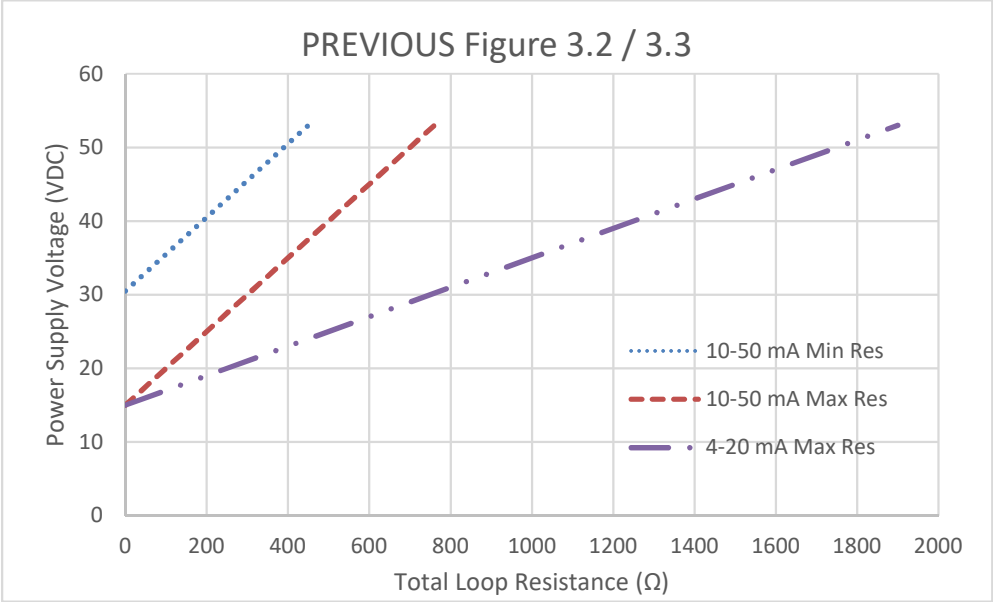
Customer Actions

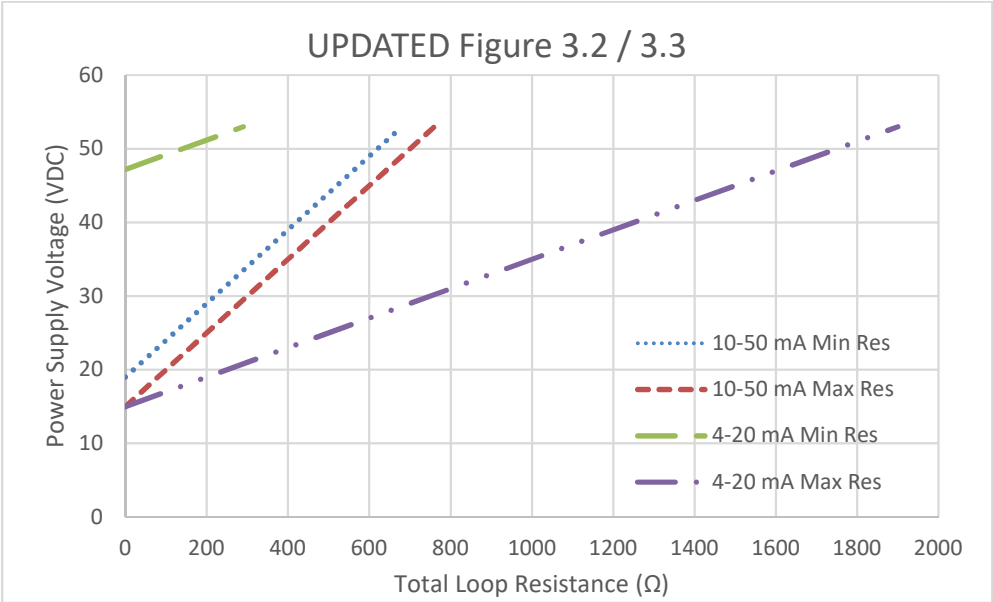
Customers should verify their qualified life extrapolations as applicable and consider heat rise of the limiting component of the circuit as recently identified by the NRC. Because Q7 and Q8 transistor heat rise varies with transmitter output, power supply and total loop resistance, current installations may not be able to be generically analyzed and may require unique analysis based on these factors and ambient temperatures to accurately determine qualified life.

The Barton original report qualified life of 40 years at 50°C ambient temperature will no longer be valid when accounting for heat rise. It will instead be reduced to approximately 35.7 years at the same temperature, based on the heat rise in the R1 resistor. Furthermore, this reduced qualified life is only valid so long as the updated power supply voltage and total line resistance requirements are followed. Due to transistor heat rise considerations, use of the user manual's previously supplied power supply voltage and total line resistance lower limits could possibly result in significant reduction of qualified life if transmitters are continuously operated at full scale (100%) output. For example, for a 4-20 mA circuit operated continuously at 20 mA, qualified life at 50°C ambient could be reduced from 40 years, to 27.8 years. And for a 10-50 mA circuit operated continuously at 50 mA, qualified life at 50°C could be reduced from 40 years to 9.1 years.

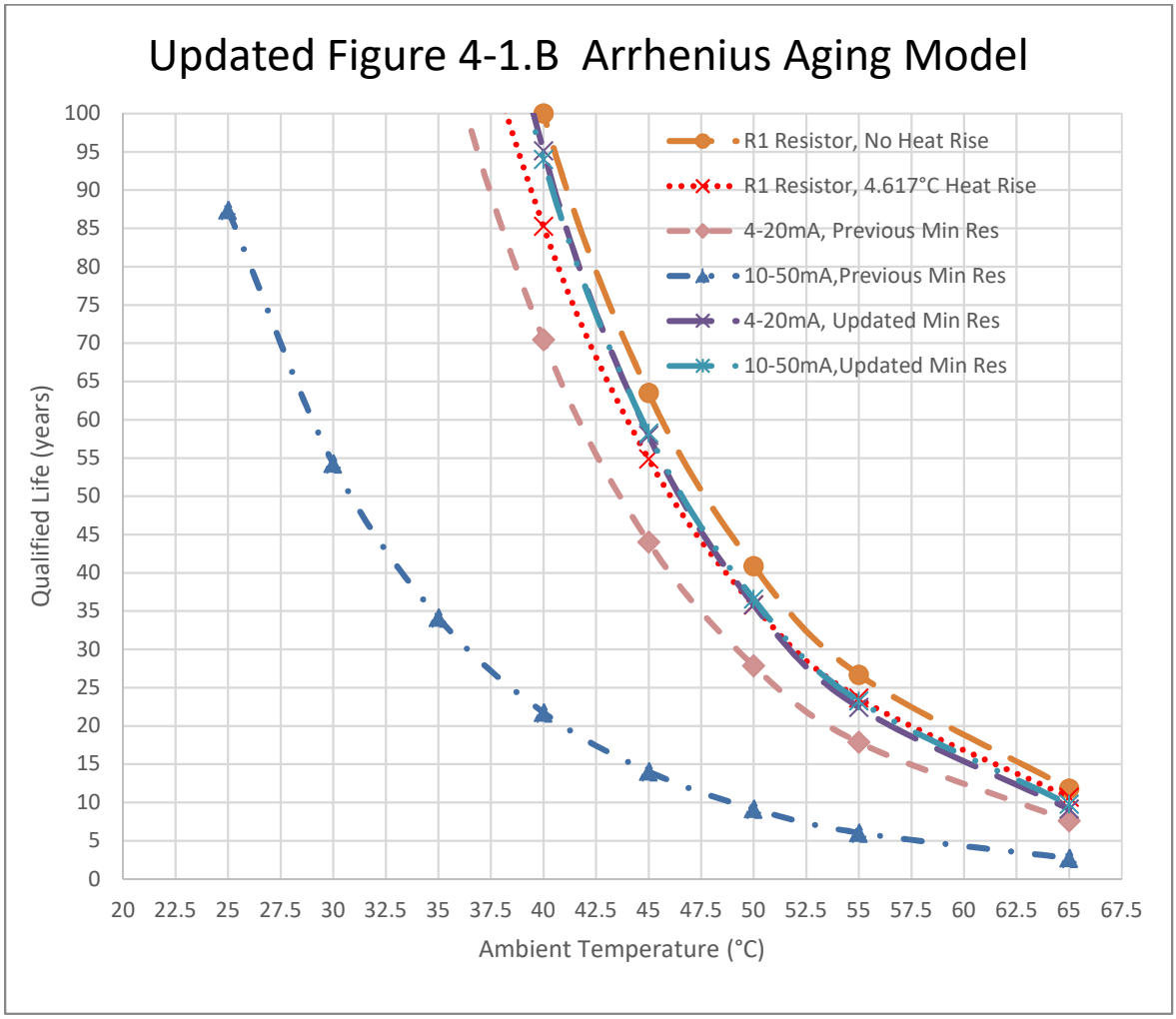
Due to the potential for significant reductions in qualified life, Cameron recommends re-evaluating customer loop installations to ensure power supply and total line resistances comply with the updated figures as provided herein. Compliance with these updated figures will result in maintaining the original life limiting component (R1 metal film resistor), and only a slight reduction in qualified life from 40 years to ~35 years (at 50°C ambient) for all transmitters.

Cameron is in the process of updating the Model 763A and 764 user manuals, which will have updated Figure 3.2 and Figure 3.3 "Power supply v. Total Loop Resistance" figures incorporating heat rise considerations described here. The following two figures show the previous, and updated user manual figures.





NOTE: User manual updated power supply voltage v. total loop resistance Figure 3.2 / 3.3 is based on keeping life limiting component as the metal film resistor accounting for its heat rise. It is based on analysis for 50°C ambient temperature and transmitter operation at continuous full scale (100%) output. Lower ambient temperatures or lower continuous transmitter output would expand acceptable power supply and total loop resistance boundaries while maintaining or improving extrapolated qualified life.



NOTE: The 9A-CR3-763-6 and 9A-CR3-764-9 reports' updated qualified life v. ambient temperature Figure 4-1.B is based on transmitter full scale (100%) output for the entirety of customer installation. Transmitter outputs below 100% will result in increase in qualified life.

Cameron can provide support to customers for review of their current installations if they do not meet the updated power supply and total loop resistance limitations.

If you have any questions, please contact Dr. Bernard Johnson, Quality Manager, Cameron Measurement Systems, City of Industry, CA at (562) 321-9140 or (562) 222-8440.