SARP Update Document for NRC Review

Docket No 71-9337

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1 Introduction

During the manufacture of the 3979A - LS package several issues were discovered with the licensing specification as laid out in the Safety Analysis Report for Packaging (SARP) [Ref 1]. These issues involved errors that existed between the drawings and the SARP, problems noted with the supply of certain materials and an error discovered with the g value calculations. To remedy these issues the SARP has been updated and these updates are identified and justified in this report.

The SARP has been redlined to indicate all the changes that have occurred between the current approved revision 2 and revision 3.

2 Table Presenting the Changes Made to the SARP

Section of SARP	Change Made	Justification for Change
1.2.1.3	Replaced EPDM with EP.	The change of material specification is required because many manufacturers consider EPM and EPDM as the same material and will supply EPDM when you request EPM. The addition of EPDM has no effect on the design of the LS package. Parker seals note that there are very few performances differences between these two variants of EP.
1.2.2.2	Removed the steel filler comment from the table and clarified how the contents weight was derived in the section text.	This is a clarification re how the maximum contents weight was derived and removes any misunderstanding regarding the contents.
1.3.3	Updated 1C-6040 to include new drawing issues.	The reference drawings have been updated.
2.1	Changed the melting point of the low melting point alloy to 95±5°C.	This is the specification given in drawing 0C-6042 and aligns the SARP and the licensing drawings.
2.1	Removed the requirement for the lead to meet the BS 3909/2 standard.	This is a small relaxation on impurities of the lead. The lead requirement has been altered from BS 3909/2 to meet 3.8 to 4.2% antimony composition and 0.5% impurities with the rest being lead. By removing the BS standard the only change to the lead composition is the level of impurities increases from 0.25% to 0.5%. When considering impurities in lead the following must be considered with regards to shielding within the LS package; Change in density Change in melting point Neutron absorption of the impurities. A 0.25% increase in the impurities will have a negligible effect on both the density and

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		melting point of the lead shielding. The LS package does not carry any significant neutron generators therefore neutron absorption is not an issue for this package. Therefore the increase in the allowable impurity content would not have any effect on the shielding capabilities of the LS package.
2.1.4	Altered the NB paragraph standard for ultrasonic testing to 2542 from 2532.1.	This correction to the SARP text and drawings is required as these incorrectly referenced the ultrasonic test for plate material - however the material used in manufacture is bar material.
2.1.4	Changed the text to match the text in the drawings.	To remove any ambiguity that may have existed between the licensing drawings and SARP text.
Table 2-8	Removed Amorim requirement for the cork material and updated steel standards to remove typographical errors.	This clarification is to aligning the information in the SARP text with the licensing drawings.
Table 2-8	Removed the fuse plug alloy composition and replace with requirements.	This simplification aids manufacture. The fuse plug allows venting of the package should the keg body reach high temperatures which is only likely to happen if the package was involved in a fire. The material of the fuse plug is not important as it provides no structural support or containment function. It will never come into contact with the contents so analysis is not required regarding reaction chemistry. Therefore the only critical characteristic of the material is that it melts at the required temperature.
Table 2-8	Altered O-ring material to EP from EPM and changed the hardness specification to 8.	With regards to the material specification this change is required because many manufacturers consider EPM and EPDM as the same material and will supply EPDM when you request EPM. The addition of EPDM has no effect on the design of the LS package. Parker seals note that there are very few performances differences between these two variants of EP. With regards to the hardness the Z1 hardness requirement takes precedence over the 8 in the basic requirements of 810. However within ASTM D2000 there is an ultimate elongation minimum % requirement. For the 710 specification this is 250% and for the 810 requirement this is

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		150%. Elongation is not a critical characteristic for a static O-ring seal. The inner diameter of the containment O-ring is 89.5 mm, it is stretched to fit it into position by a maximum of 9 mm circumferentially which is a 3% increase in length, this fits comfortably into the maximum elongations of both the 710 and 810 therefore changing the specification will have no effect on the O-ring life and sealing capability.
Section 2.2.2	Changed O-ring material from EPM to EP.	The change of material specification is required because many manufacturers consider EPM and EPDM as the same material and will supply EPDM when you request EPM. The addition of EPDM has no effect on the design of the LS package. Parker seals note that there are very few performances differences between these two variants of EP.
Section 2.2.3	Changed O-ring material from EPM to EP.	The change of material specification is required because many manufacturers consider EPM and EPDM as the same material and will supply EPDM when you request EPM. The addition of EPDM has no effect on the design of the LS package. Parker seals note that there are very few performances differences between these two variants of EP.
Section 2.3.1	The fabrication of the containment system has been changed to reflect the requirements in the licensing drawings.	Clarifies the fabrication of the containment vessel and removes ambiguities.
Section 2.3.1	Altered the NB paragraph standard for ultrasonic testing to 2542 from 2532.1.	The SARP text and drawings incorrectly referenced the ultrasonic test for plate material however the material used in manufacture is bar material therefore this error has been corrected.
Section 2.3.1	Removed the requirement for the lead to meet the BS 3909/2 standard.	The lead requirement has been altered from BS 3909/2 to meet 3.8 to 4.2% antimony composition and 0.5% impurities with the rest being lead. By removing the BS standard the only change to the lead composition is the level of impurities increases from 0.25% to 0.5%. When considering impurities in lead the following must be considered with regards to shielding within the LS package; Change in density

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		Change in melting point Neutron absorption of the impurities. A 0.25% increase in the impurities will have a negligible effect on both the density and melting point of the lead shielding. The LS package does not carry any significant neutron generators therefore neutron absorption is not an issue for this package. The increase in the impurity content would not have any effect on the shielding capabilities of the LS package.
Section 2.3.2	Altered the NB paragraph standard for ultrasonic testing to 2542 from 2532.1.	The SARP text and drawings incorrectly referenced the ultrasonic test for plate material however the material used in manufacture is bar material therefore this error has been corrected.
Section 2.3.2	Added the O-ring tests at 150°C and 200°C	Align with section 8 of the SARP
Section 2.3.2	Removed the helium leak test of the containment vessel stock material.	The integrity of the stainless steel stock material is tested using liquid penetrant and ultrasonic tests. Once the material is machined into the component parts these are helium leak tested in accordance with ANSI N14.5 therefore should there be any cracks within the material it will be identified at this point prior to forming the containment vessel. Removing this test is a manufacturing simplification and will not affect the integrity of the containment vessel due to the other tests that are carried out on the containment boundary.
2.3.2	Removed the requirement for the lead to meet the BS 3909/2 standard.	The lead requirement has been altered from BS 3909/2 to meet 3.8 to 4.2% antimony composition and 0.5% impurities with the rest being lead. By removing the BS standard the only change to the lead composition is the level of impurities increases from 0.25% to 0.5%. When considering impurities in lead the following must be considered with regards to shielding within the LS package; Change in density Change in melting point Neutron absorption of the impurities. A 0.25% increase in the impurities will have a negligible effect on both the density and melting point of the lead shielding. The LS package does not carry any significant neutron generators therefore neutron absorption is not an issue for this package.

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		The increase in the impurity content would not have any effect on the shielding capabilities of the LS package.
2.3.2	Corrected the maximum pressure of the pressure test.	This is a correction of an incorrect value.
2.6.7	Corrected the measured g values during the drop tests and the calculated stresses in the containment vessel.	A review of the LS test data indicated that the g values recorded in Revision 2 of CTR 2008/10 were a factor of 2 smaller than the actual measured values. The finite element analysis of the containment vessel was repeated using the correct values and the results are reported in the Arcadis Vectra Report 925-3272 R1 Rev 6. Changing the g values within the SARP has had no effect to the design of the LS package. Furthermore. the package itself was physically tested and demonstrated no loss of containment on completion of the tests. The FEA analysis with the higher g values has demonstrated no areas of the containment vessel exceed the required design margin, indicating that the containment vessel will maintain containment.
2.7.1	Corrected the measured g values during the drop tests and the calculated stresses in the containment vessel.	A review of the LS test data indicated that the g values recorded in Revision 2 of CTR 2008/10 were a factor of 2 smaller than the actual measured values. The finite element analysis of the containment vessel was repeated using the correct values and the results are reported in the Arcadis Vectra Report 925-3272 R1 Rev 6. Changing the g values within the SARP has no effect to the design of the LS package. Furthermore , the package itself was physically tested and demonstrated no loss of containment on completion of the tests. The FEA analysis with the higher g values has demonstrated no areas of the containment vessel exceed the required design margin, indicating that the containment vessel will maintain containment.
2.12.2	Updated Vectra Report 925-3272-R1 with higher g values. Updated Croft Report CTR 2009/21 with higher g values.	A review of the LS test data indicated that the g values recorded in Revision 2 of CTR 2008/10 were a factor of 2 smaller than the actual measured values. The g values therefore have been updated in the test report to show the correct g values measured and used in the Vectra

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		report to calculation the stress values in the FEA analysis.
3.2.2	Altered O-ring material to EP from EPM and changed the hardness specification to 8.	With regards to the material specification this change is required because many manufacturers consider EPM and EPDM as the same material and will supply EPDM when you request EPM. The addition of EPDM has no effect on the design of the LS package. Parker seals note that there are very few performances differences between the two. With regards to the hardness the Z1 hardness requirement takes precedence over the 8 in the basic requirements of 810. However within ASTM D2000 there is an ultimate elongation minimum % requirement. For the 710 specification this is 250% and for the 810 requirement this is 150%. Elongation is not a critical characteristic for a static O-ring seal. The inner diameter of the containment O-ring is 89.5 mm, it is stretched to fit it into position by a maximum of 9 mm circumferentially which is a 3% increase in length, this fits comfortably into the maximum elongations of both the 710 and 810 therefore changing the specification will have no effect on the O-ring life and sealing capability.
3.2.2	Corrected the incorrect temperature test reference from B13 to F17.	Corrected typographical error.
4.1	Referenced the licensing drawings for fabrication rather than ASME section III sub section NB.	This corrects any ambiguity between the licensing drawings and SARP text.
4.1	Changed O-ring material from EPM to EP.	The change of material specification is required because many manufacturers consider EPM and EPDM as the same material and will supply EPDM when you request EPM. The addition of EPDM has no effect on the design of the LS package. Parker seals note that there are very few performances differences between the two.
4.4.1	Removed reference to the containment vessel stock material helium leak test.	The integrity of the stainless steel stock material is tested using liquid penetrant and ultrasonic tests. Once the material is machined into the component parts these are helium leak tested in accordance with ANSI N14.5 therefore should there be any cracks within the material it will be identified

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		at this point prior to forming the containment vessel. Removing this test will not affect the integrity of the containment vessel due to the other tests that are carried out on the containment boundary.
4.4.4	Corrected pre-shipment leak test to sensitivity from pass rate.	Typographical error.
7.1.2	Corrected silicon O-rings to EP O-rings.	Typographical error.
8.1.3	Corrected the maximum pressure for the pressure test.	Incorrect value given.
8.1.5.1	Corrected the weight of the package.	Weight in this section corrected to match the weight given in section 1.
8.1.5.2	Provided detail in the text regarding the temperature tests of the O-rings.	Removes the requirement to include a manufacturing specification which can require update for minor errors during manufacture.
8.1.5.5	Removed any test information for the cork that wasn't given on the licensing drawings.	The only property of the cork that is critical to its function as an impact limiter is its specific weight. Therefore the extra tests have been removed from the SARP. The requirements for the cork are fully met if the desnisty is achieved.
8.1.5.6	Removed the requirement for the lead to meet the BS 3909/2 standard.	The lead requirement has been altered from BS 3909/2 to meet 3.8 to 4.2% antimony composition and 0.5% impurities with the rest being lead. By removing the BS standard the only change to the lead composition is the level of impurities increases from 0.25% to 0.5%. When considering impurities in lead the following must be considered with regards to shielding within the LS package; Change in density Change in melting point Neutron absorption of the impurities. A 0.25% increase in the impurities will have a negligible effect on both the density and melting point of the lead shielding. The LS package does not carry any significant neutron generators therefore neutron absorption is not an issue for this package. The increase in the impurity content would not have any effect on the shielding capabilities of the LS package.
8.1.5.7	Removed reference to the containment vessel stock material helium leak test.	The integrity of the stainless steel stock material is tested using liquid penetrant and ultrasonic tests. Once the material is machined into the component parts these are helium leak tested in accordance with

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		ANSI N14.5 therefore should there be any cracks within the material it will be identified at this point prior to forming the containment vessel. Removing this test will therefore not affect the integrity of the containment vessel.
8.1.6	The shielding test has been altered.	The timing of lead shielding test has been changed from the final checks for the containment vessel to after casting of the lead. By changing the timing of the test any issues with the casting can be identified while the containment vessel is in the component stage rather than when the containment vessel is in the completed state. This change will have no effect on the design. The same test is proposed to check the lead however it will be carried out at a point when only a component part would have to be scrapped rather than a finished containment vessel.
8.2.3.3	Removed description of O-ring tests.	These tests are described in drawing 1C-6044 and to remove the chance of any ambiguities arising between the drawing and the SARP the SARP references the drawing.
8.3.2	Removed CP 427	Removes the requirement to include a manufacturing specification which can require update for minor errors during manufacture. Information in this procedure is now included in the text of section 8.

3 References

1. Safety Analysis Report for Packaging SAFKEG-LS Design No. 3979A Package Docket 71-9337, CTR 2008/10, Revision 2

2. LS SAFKEG 3979A Stress Calculations, QAR 201, Issue A