June 2018

Revision 18D

NAC-STC

NAC Storage Transport Cask

SAFETY ANALYSIS REPORT

STC High Burnup Fuel Shield Ring Configuration Partial RAI Response Package

Non-Proprietary Version

Docket No. 71-9235

NAC INTERNATIONAL

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Enclosure 1

RAI Response for

NAC-STC SAR, Revision 18D

June 2018

NAC INTERNATIONAL

PROPRIETARY RESPONSES TO THE

UNITED STATES
NUCLEAR REGULATORY COMMISSION

REQUEST FOR ADDITIONAL INFORMATION

May 2018

FOR REVIEW OF THE CERTIFICATE OF COMPLIANCE NO. 9235, STC TRANSPORATION PACKAGE

(CoC NO. 9235 DOCKET NO. 71-9235)

June 2018

TABLE OF CONTENTS

NAC INTERNATIONAL RESPONSE
TO
REQUEST FOR ADDITIONAL INFORMATION

MATERIALS EVALUATION

2.5 Clarify Drawing No. 423-927, 0P to:

- Clarify top/bottom and side view of shield ring assembly (define location of cask body and impact limiters in each view);
- Define acceptance criteria and non-destructive examination for all safety-related welding in the assembly;
- Clarify location of cask body bolts (item 7) and thread inserts (item 13) in top or bottom view;
- Clarify location of hex bolts (item 8) and flat washer (item 9) in side view;
- Clarify relative placement of top sector (item 2) and top sector weldment (item 1); and,
- Define applicability of Note 1.

The viewer perspectives and locations of certain subcomponents are unclear in the drawing. The information is necessary to ensure compliance with 10 CFR 71.31(a)(1).

NAC International Response to Acceptance and Maintenance Tests Evaluation RAI 2-5:

Bullet 1 response: The orientation of the shield ring as installed on the top end of the cask is indicated with the top and side view detail. Consistent with standard drawing practices the top view detail is presented in line with the main side view. The upper section of the cask is shown in phantom, with the top end being indicated by the presence of lifting trunnions. Section A-A details the location of the top impact limiter relative to the shield ring.

Bullet 2 response: The identified weld connects the lift lug to the top sector of the shield ring and is used for handling the top sector for installation and removal. The weld and tab are not credited for structural or shielding performance under transport conditions. Accordingly, the details of the weld non-destructive examination are deemed non-essential details for the licensing drawing, as they do not relate to the safety performance of the transport package.

Bullet 3 response: The structural capacity of the bolted attachment is determined by the size and number of bolts specified, which is detailed in the bill of material. As detailed in

NAC Calculation no. 30067-2010, the bolt tensile area and the shear strength of the internal threads (e.g., length of engagement) provides the limiting capacity for the bolted attachment. Additionally, bolt loads vary based on their angular position. Accordingly, the drawing is revised to detail angular location of the bolts and the ring's counterbore depth which determines the thread length that extends beyond the inner diameter of the ring sector as well as ensures the bolt head remains recessed. The axial position of the bolts does not significantly affect bolt loading and is therefore, deemed not needed on the license drawing.

Bullet 4 response: The bolt (Item 8) and washer (Item 9) are used to attach the side ring sectors to the top and bottom ring sectors which are subsequently bolted to the cask. The axial position of the bolts does not significantly affect bolt loading and is therefore, deemed not needed on the license drawing. Therefore, Item 8 and Item 9 support the weight of the side sectors only and the bolt size and thread specification provide sufficient detail with respect to their design function.

Bullet 5 response: As detailed in the drawing bill of material, Assembly 98 is the Top Sector Weldment (Item 1) and made up of one Top Sector (Item 2) and two Lift Lugs (Item 3). The drawing details the location of top sector and lift lugs.

Bullet 6 response: Note 1 is referenced in the bill of material for the Item 4 specification. The use of a general note is a common method for providing more detail than will fit in the allotted space in the bill of materials.

Enclosure 2

List of Changes

NAC-STC SAR, Revision 18D

June 2018

List of Changes, NAC-STC SAR, Revision 18D

Chapter 1

- Page 1-v, modified List of Drawings to reflect drawing revisions.

Chapter 2

- No changes.

Chapter 3

- No changes.

Chapter 4

- Page 4.5-14, modified text near the end of the paragraph in Section 4.5.2.
- Pages 4.5-20 thru 4.5-22, added data sheets.
- Pages 4.5-23 thru 4.5-38, text flow changes.

Chapter 5

- No changes.

Chapter 6

- No changes.

Chapter 7

- No changes.

Chapter 8

- No changes.

Chapter 9

- No changes.

Enclosure 3

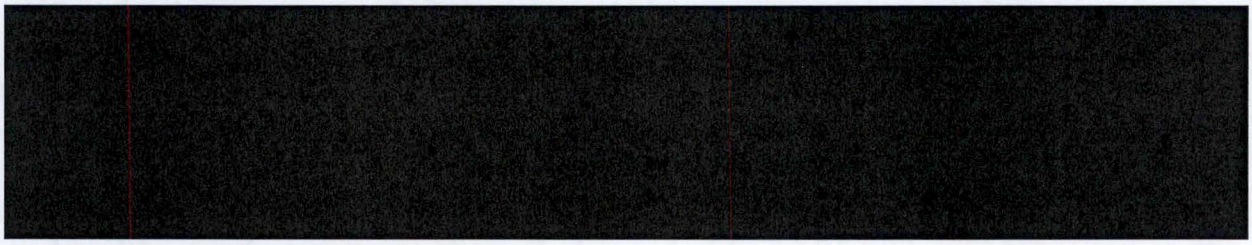
List of Drawing Changes

NAC-STC SAR, Revision 18D

June 2018

List of Drawing Changes, NAC-STC SAR, Revision 18D

Drawing 423-800, Revision 20P



Drawing 423-800, Revision 19P

Drawing 423-800, Revision 19P is currently under NRC review.

Drawing 423-800, Revision 20NP

Sheet 1:

1. Added Delta note 16 that reads "Seal material may be VM125-75 or VM835-75." Added delta note 16 callout symbol to B.O.M. items 26 and 29.
2. B.O.M., Item 26, revised description to "Parker 3-908", was "Parker 3-908VM835-75".
3. B.O.M., Item 29, revised description to "Parker 3-904", was "Parker 3-904VM835-75".

Drawing 423-800, Revision 19NP

Drawing 423-800, Revision 19NP is currently under NRC review.

Drawing 423-803, Revision 15

Sheet 1:

1. Added Delta note 20 that reads "Seal material may be VM125-75 or VM835-75." Added delta note 20 callout symbol to B.O.M. items 10, 11, 15, 16 and 19.
2. B.O.M., Item 10, revised description to "Parker 3-906", was "Parker 3-906VM835-75".
3. B.O.M., Item 11, revised description to "Parker 3-916", was "Parker 3-916VM835-75".
4. B.O.M., Item 15, revised description to "Parker .275 Dia. ID Ø71.8", was "Parker .275 Dia. VM835-75 ID Ø71.8".
5. B.O.M., Item 16, revised description to "Parker .275 Dia. ID Ø73.0", was "Parker .275 Dia. VM835-75 ID Ø73.0".
6. B.O.M., Item 19, revised description to "Parker 3-916", was "Parker 3-916VM835-75".

Drawing 423-805, Revision 9

Sheet 1:

1. Added Delta note 8 that reads "Seal material may be VM125-75 or VM835-75." Added delta note 8 callout symbol to B.O.M. item 3.
2. B.O.M., Item 3, revised description to "Parker .275 Dia.", was "Parker .275 Dia. VM835-75".

Drawing 423-805, Revision 8

Drawing 423-805, Revision 8 is currently under NRC review.

Drawing 423-806, Revision 14

Sheet 1:

1. Added Delta note 9 that reads "Seal material may be VM125-75 or VM835-75." Added delta note 9 callout symbol to B.O.M. items 8, 9, and 10.
2. B.O.M., Item 8, revised description to "Parker #2-238", was "Parker #2-238 VM835-75".
3. B.O.M., Item 9, revised description to "Parker #2-244", was "Parker #2-244 VM835-75".
4. B.O.M., Item 10, revised description to "Parker #3-902", was "Parker #3-902 VM835-75".

Drawing 423-806, Revision 13

Drawing 423-806, Revision 13 is currently under NRC review.

Drawing 423-807, Revision 6

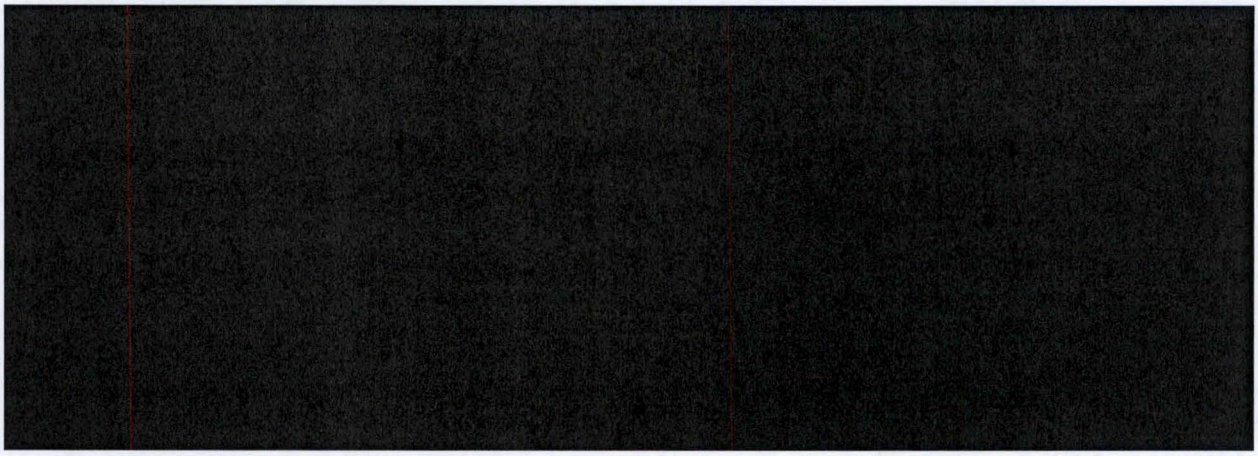
Sheet 1:

1. Revised note 10 to delta note that reads "Seal material may be VM125-75 or VM835-75.", was "(Deleted)". Added delta note 10 callout symbol to B.O.M. items 5, and 9.
2. B.O.M., Item 5, revised description to "Parker #2-147", was "Parker #2-147 VM835-75".
3. B.O.M., Item 9, revised description to "Parker #2-244", was "Parker #2-244 VM835-75".
4. Updated title block to current standard.

Drawing 423-807, Revision 5

Drawing 423-807, Revision 5 is currently under NRC review.

Drawing 423-927, Revision 1P



Drawing 423-927, Revision 1NP

1. B.O.M., Item 1, revised to "(Deleted)", was "Top Sector Weldment"
2. B.O.M., Items 2 and 3, revised Quantity callouts from Assy 98 column to Assy 99 column.

Enclosure 4

Proposed Changes for Certificate of Compliance Revision 18

NAC-STC SAR, Revision 18D

June 2018

CoC Sections (revised)

Page 5 of 22
5.(a)(3) Drawings

(i) The cask is constructed and assembled in accordance with the following Nuclear Assurance Corporation (now NAC International) Drawing Nos.:

423-800, sheets 1-3, Rev. 20P & 20NP	423-811, sheets 1-2, Rev. 12
423-802, sheets 1-7, Rev. 24	423-812, Rev. 6
423-803, sheets 1-2, Rev. 15	423-900, Rev. 9
423-804, sheets 1-3, Rev. 11	423-209, Rev. 0
423-805, sheets 1-2, Rev. 9	423-210, Rev. 0
423-806, sheets 1-2, Rev. 14	423-901, sheets 1-2, Rev. 3
423-807, sheets 1-3, Rev. 6	423-927, Rev. 1P & 1NP

(ii) For the directly loaded configuration, the basket is constructed and assembled in accordance with the following Nuclear Assurance Corporation (now NAC International) Drawing Nos.:

423-870, Rev. 6	423-874, Rev. 2
423-871, Rev. 5	423-875, sheets 1-2, Rev. 11
423-872, Rev. 6	423-878, sheets 1-2, Rev. 4
423-873, Rev. 2	423-880, Rev. 3P & 1NP

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Table 10 – Yankee Class Fuel Assembly Characteristics

Page 15 of 22
Table 11 – Connecticut Yankee Fuel Assembly Characteristics

Page 16 of 22
Table 12 – LACBWR Fuel Assembly Characteristics

Page 21 of 22
12. For shipment of high burn up fuel assemblies, as described in content 5.(b)(1)(i)(2) and 5.(b)(1)(i)(4) and limited in 5.(b)(2)(i)(2) and 5.(b)(2)(i)(4) respectively, the maximum time duration from the time the package breaks the surface of the spent fuel pool until the package is placed in the horizontal orientation is limited to 72 hours. If this time limit cannot be met, the package may be re-flooded. HBU fuel assemblies subjected to a package re-flood are not authorized for shipment. High burnup fuel shipments are limited to a total duration of 6 months from the time package loading is complete until the package arrives at its final destination. These time limits also apply to packages containing commingled loadings of high burnup fuel and low burnup fuel as described in 5.(b)(2)(i).

CoC Sections (new)

Page 10 of 22

5.(b)(1)(i) Contents – Type and Form of Material – Irradiated PWR fuel assemblies (Continued)

(3) Undamaged 17x17 Advanced Fuel Assembly PWR low burnup (i.e., assembly average burnup less than or equal to 45 GWd/MTU) fuel assemblies that meet the fuel assembly criteria for Framatome-Cogema 17x17 fuel listed in Table 1 for content 5.(b)(1)(i)(1). The maximum heat load per assembly is 850 watts and the maximum burnup may not exceed 45 GWd/MTU. The minimum fuel assembly cool time is determined from Table 6. The use of the optional shield ring assembly, as configured in NAC International Drawing No. 423-927, is required.

(4) Undamaged 17x17 Advanced Fuel Assembly PWR high burnup (i.e., assembly average burnup exceeding 45 GWd/MTU) fuel assemblies that meet the fuel assembly criteria for Framatome-Cogema 17x17 fuel listed in Table 1 for content 5.(b)(1)(i)(1). The maximum assembly decay heat may not exceed 1.71 kW, and the maximum burnup may not exceed 55 GWd/MTU, provided the loading pattern meets the requirements of Configuration A, B or C as shown in NAC International Drawing No. 423-800. Only Zirc-4 and M5® Zirconium alloy cladding may be loaded per shipment, with a maximum of 4 Zirc-4 fuel assemblies may be loaded per shipment. Gadolinium based integral fuel burnable absorber rods (IFBAs) are permitted, but boron-based IFBAs are not. The minimum fuel assembly cool time is determined from Tables 7 through 9, depending on loading configuration. The fuel assemblies shall not have been previously stored in an independent spent fuel storage installation licensed under 10 CFR Part 72.

Table 6 – Fuel Cool Time Table
Minimum fuel Cool Time in Years

Enr.	Burnup [GWd/MTU]													
[wt. %]	B≤10	10<B≤15	15<B≤20	20<B≤25	25<B≤30	30<B≤32.5	32.5<B≤35	35<B≤37.5	37.5<B≤40	40<B≤41	41<B≤42	42<B≤43	43<B≤44	44<B≤45
1.7 ≤ E < 1.9	4.0	4.0	4.0	4.5	5.9	7.2	9.8	-	-	-	-	-	-	-
1.9 ≤ E < 2.1	4.0	4.0	4.0	4.4	5.5	6.4	8.3	11.4	15.3	-	-	-	-	-
2.1 ≤ E < 2.3	4.0	4.0	4.0	4.3	5.2	5.9	7.2	9.7	13.2	-	-	-	-	-
2.3 ≤ E < 2.5	4.0	4.0	4.0	4.2	4.9	5.6	6.6	8.4	11.4	12.8	14.3	15.9	17.6	19.2
2.5 ≤ E < 2.7	4.0	4.0	4.0	4.1	4.8	5.3	6.0	7.4	9.8	11.1	12.5	13.9	15.5	17.1
2.7 ≤ E < 2.9	4.0	4.0	4.0	4.0	4.7	5.0	5.7	6.7	8.5	9.6	10.8	12.1	13.6	15.1
2.9 ≤ E < 3.1	4.0	4.0	4.0	4.0	4.6	5.0	5.6	6.2	7.6	8.4	9.4	10.6	11.9	13.3
3.1 ≤ E < 3.3	4.0	4.0	4.0	4.0	4.6	5.0	5.5	6.0	6.9	7.6	8.3	9.2	10.4	11.7
3.3 ≤ E < 3.5	4.0	4.0	4.0	4.0	4.6	4.9	5.4	6.0	6.7	7.0	7.5	8.2	9.1	10.2
3.5 ≤ E < 3.7	4.0	4.0	4.0	4.0	4.5	4.9	5.4	5.9	6.6	6.9	7.2	7.6	8.2	9.0
3.7 ≤ E < 3.9	4.0	4.0	4.0	4.0	4.5	4.9	5.3	5.9	6.5	6.8	7.1	7.5	7.9	8.4
3.9 ≤ E < 4.1	4.0	4.0	4.0	4.0	4.5	4.8	5.3	5.8	6.5	6.8	7.0	7.4	7.8	8.3
4.1 ≤ E < 4.3	4.0	4.0	4.0	4.0	4.5	4.8	5.3	5.8	6.4	6.7	7.0	7.4	7.7	8.1
4.3 ≤ E < 4.5	4.0	4.0	4.0	4.0	4.4	4.8	5.2	5.8	6.4	6.6	6.9	7.3	7.7	8.1

Table 7 – Fuel Cool Time Table (Configuration A 17x17 PWR HBU) Minimum Fuel Cool Time Table

Enr.	Burnup [GWd/MTU]									
[wt. %]	45<B≤46	46<B≤47	47<B≤48	48<B≤49	49<B≤50	50<B≤51	51<B≤52	52<B≤53	53<B≤54	54<B≤55
2.9 ≤ E < 3.1	4.0	4.0	4.5	5.0	5.7	6.3	6.9	7.6	8.4	-
3.1 ≤ E < 3.3	4.0	4.0	4.0	4.3	4.8	5.4	6.0	6.7	7.4	8.1
3.3 ≤ E < 3.5	4.0	4.0	4.0	4.1	4.2	4.7	5.2	5.8	6.4	7.1
3.5 ≤ E < 3.7	4.0	4.0	4.0	4.0	4.1	4.2	4.5	5.0	5.6	6.2
3.7 ≤ E < 3.9	4.0	4.0	4.0	4.0	4.1	4.2	4.3	4.4	4.8	5.4
3.9 ≤ E < 4.1	4.0	4.0	4.0	4.0	4.0	4.1	4.2	4.3	4.5	4.7
4.1 ≤ E < 4.3	4.0	4.0	4.0	4.0	4.0	4.1	4.2	4.3	4.4	4.5
4.3 ≤ E < 4.5	4.0	4.0	4.0	4.0	4.0	4.0	4.1	4.2	4.4	4.5

Table 8 – Fuel Cool Time Table (Configuration B 17x17 PWR HBU) Minimum Fuel Cool Time Table

Enr.	Burnup [GWd/MTU]									
[wt. %]	45<B≤46	46<B≤47	47<B≤48	48<B≤49	49<B≤50	50<B≤51	51<B≤52	52<B≤53	53<B≤54	54<B≤55
2.9 ≤ E < 3.1	4.4	4.9	5.5	6.1	6.8	7.6	8.3	9.1	10.0	-
3.1 ≤ E < 3.3	4.4	4.5	4.7	5.3	5.9	6.6	7.3	8.0	8.8	9.7
3.3 ≤ E < 3.5	4.3	4.4	4.5	4.7	5.1	5.7	6.3	7.0	7.8	8.6
3.5 ≤ E < 3.7	4.2	4.4	4.5	4.6	4.7	4.9	5.5	6.1	6.8	7.5
3.7 ≤ E < 3.9	4.2	4.3	4.4	4.5	4.7	4.8	4.9	5.3	5.9	6.6
3.9 ≤ E < 4.1	4.1	4.3	4.4	4.5	4.6	4.8	4.9	5.0	5.2	5.7
4.1 ≤ E < 4.3	4.1	4.2	4.3	4.4	4.5	4.7	4.8	5.0	5.1	5.3
4.3 ≤ E < 4.5	4.0	4.2	4.3	4.4	4.5	4.6	4.8	4.9	5.0	5.2

Table 9 – Fuel Cool Time Table (Configuration C 17x17 PWR HBU) Minimum Fuel Cool Time Table

Enr.	Burnup [GWd/MTU]									
[wt. %]	45<B≤46	46<B≤47	47<B≤48	48<B≤49	49<B≤50	50<B≤51	51<B≤52	52<B≤53	53<B≤54	54<B≤55
2.9 ≤ E < 3.1	7.4	8.2	9.1	10.0	11.0	12.0	13.1	14.3	15.5	-
3.1 ≤ E < 3.3	6.4	7.1	7.9	8.8	9.7	10.7	11.6	12.7	13.9	15.1
3.3 ≤ E < 3.5	5.5	6.2	6.9	7.7	8.5	9.4	10.4	11.3	12.4	13.5
3.5 ≤ E < 3.7	5.4	5.6	6.0	6.7	7.5	8.3	9.2	10.1	11.0	12.0
3.7 ≤ E < 3.9	5.3	5.5	5.7	5.9	6.6	7.3	8.1	8.9	9.8	10.8
3.9 ≤ E < 4.1	5.2	5.4	5.6	5.8	6.0	6.4	7.1	7.9	8.7	9.6
4.1 ≤ E < 4.3	5.2	5.4	5.6	5.7	5.9	6.1	6.4	7.0	7.7	8.5
4.3 ≤ E < 4.5	5.1	5.3	5.5	5.7	5.9	6.0	6.3	6.6	6.8	7.6

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5.(b)(2)(i) Maximum quantity of material per package

(3) Low burnup assemblies, as described in 5.(b)(1)(i)(3), shall have a maximum decay heat not to exceed 22.1 kW per package.

(4) For high burnup fuel assemblies, as described in 5.(b)(1)(i)(4), the number and the positioning of the fuel assemblies and shielded thermal shunts shall meet the requirements as shown in Configuration A, B or C of NAC International Drawing No. 423-800 and shall have a maximum decay heat not to exceed 24 kW per package. A maximum of four Zirc-4 fuel assemblies may be loaded per shipment.

Low burnup fuel assemblies described in Item 5.(b)(1)(i)(1) may be comingled with high burnup fuel assemblies described in 5.(b)(1)(i)(4), however, the requirements for contents described in Item 5.(b)(1)(i)(4) regarding assembly and thermal shunt numbers and positions apply to package containing the comingled loads.

Low burnup fuel assemblies described in Item 5.(b)(1)(i)(3) may be comingled with high burnup fuel assemblies described in 5.(b)(1)(i)(4), however, the requirements for contents described in Item 5.(b)(1)(i)(4) regarding assembly and thermal shunt numbers and positions apply to package containing the comingled loads. The use of the optional shield ring assembly, as configured in NAC International Drawing No. 423-927, is required.

Enclosure 5

SAR Changed Pages and LOEP

NAC-STC SAR, Revision 18D

June 2018

June 2018

Revision 18D

NAC-STC

NAC Storage Transport Cask

SAFETY ANALYSIS REPORT

Non-Proprietary Version
Volume 1 of 2

Docket No. 71-9235

NAC INTERNATIONAL

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List of Drawings

Drawing Number	Revision No.	Title
423-800, sheets 1-3	Rev 20P[1]	Cask Assembly – NAC-STC Cask
423-800, sheets 1-3	Rev 20NP[1]	Cask Assembly – NAC-STC Cask
423-802, sheets 1-7	Rev 24	Cask Body – NAC-STC Cask
423-803, sheets 1-2	Rev 15	Lid Assembly – Inner, NAC-STC Cask
423-804, sheets 1-3	Rev 11	Details - Inner Lid, NAC-STC Cask
423-805, sheets 1-2	Rev 9	Lid Assembly – Outer, NAC-STC Cask
423-806, sheets 1-2	Rev 14	Port Coverplate Assy – Inner Lid, NAC-STC Cask
423-807, sheets 1-3	Rev 6	Assembly, Port Cover, NAC-STC Cask
423-209	Rev 0	Impact Limiter Assy – Upper, NAC-STC Cask
423-210	Rev 0	Impact Limiter Assy – Lower, NAC-STC Cask
423-257	Rev 2	Balsa Impact Limiter, Upper, NAC-STC Cask
423-258	Rev 2	Balsa Impact Limiter, Lower, NAC-STC Cask
423-811, sheets 1-2	Rev 12	Details – NAC-STC Cask
423-812	Rev 6	Nameplates – NAC-STC Cask
423-843	Rev 6	Transport Assembly, Balsa Impact Limiters, NAC-STC
423-859	Rev 0	Attachment Hardware, Balsa Limiters, NAC-STC
423-870	Rev 6	Fuel Basket Assembly, PWR, 26 Element, NAC-STC Cask
423-871	Rev 5	Bottom Weldment, Fuel Basket, PWR, 26 Element, NAC-STC Cask
423-872	Rev 6	Top Weldment, Fuel Basket, PWR, 26 Element, NAC-STC Cask
423-873	Rev 2	Support Disk and Misc. Basket Details, PWR, 26 Element, NAC-STC Cask
423-874	Rev 2	Heat Transfer Disk, Fuel Basket, PWR, 26 Element, NAC-STC Cask
423-875, sheets 1-2	Rev 11	Tube, NAC-STC Cask
423-878, sheets 1-2	Rev 4	Alternate Tube Assembly, NAC-STC Cask
423-880	Rev 3P[1]	Shielded Thermal Shunt Assembly, NAC-STC Cask
423-880	Rev 1NP[1]	Shielded Thermal Shunt Assembly, NAC-STC Cask
423-900	Rev 9	Package Assembly Transportation, NAC-STC Cask
423-901, sheets 1-2	Rev 3	Transportation Package Concept, NAC-STC Cask
423-927	Rev 1P[1]	Shield Ring Assembly, NAC-STC Cask
423-927	Rev 1NP[1]	Shield Ring Assembly, NAC-STC Cask

(1) Proprietary and Non-proprietary drawing versions are only included in their respective SAR versions.

List of Drawings (continued)

Drawing Number	Revision No.	Title
455-800, sheets 1-2	Rev 2	Assembly, Transport Cask, MPC-Yankee
455-801, sheets 1-2	Rev 4	Assembly, Transport Cask, NAC-MPC
455-820, sheets 1-2	Rev 3	Spacers, Transport Cask, MPC-Yankee
455-870	Rev 5	Canister Shell, MPC-Yankee
455-871, sheets 1-2	Rev 8	Details, Canister, MPC-Yankee
455-871, sheets 1-3	Rev 7P2	Details, Canister, MPC-Yankee
455-872, sheets 1-2	Rev 12	Assembly, Transportable Storage Canister (TSC), MPC-Yankee
455-872, sheets 1-2	Rev 11P1	Assembly, Transportable Storage Canister (TSC), MPC-Yankee
455-873	Rev 4	Assembly, Drain Tube, Canister, MPC-Yankee
455-881, sheets 1-3	Rev 8	PWR Fuel Tube, MPC-Yankee
455-887, sheets 1-3	Rev 4	Basket Assembly, 24 GTCC Container, MPC-Yankee
455-888, sheets 1-2	Rev 8	Assembly, Transportable Storage Canister (TSC), 24 GTCC Container, MPC-Yankee
455-891, sheets 1-2	Rev 1	Bottom Weldment, Fuel Basket, MPC-Yankee
455-891, sheets 1-3	Rev 2P0	Bottom Weldment, Fuel Basket, MPC-Yankee
455-892, sheets 1-2	Rev 3	Top Weldment, Fuel Basket, MPC-Yankee
455-892, sheets 1-3	Rev 3P0	Top Weldment, Fuel Basket, MPC-Yankee
455-893	Rev 3	Support Disk and Misc. Basket Details, MPC-Yankee
455-894	Rev 2	Heat Transfer Disk, Fuel Basket, MPC-Yankee
455-895, sheets 1-2	Rev 5	Fuel Basket Assembly, MPC-Yankee
455-895, sheets 1-2	Rev 5P0	Fuel Basket Assembly, MPC-Yankee
455-919	Rev 2	Retainer, United Nuclear Test Assy, MPC-Yankee
414-801, sheets 1-2	Rev 2	Cask Assembly, NAC-STC, CY-MPC
414-820	Rev 0	Canister Spacer CY-MPC
414-870	Rev 3	Canister Shell, CY-MPC
414-871, sheets 1-2	Rev 6	Details, Canister CY-MPC
414-872, sheets 1-3	Rev 6	Assembly, Transportable Storage Canister (TSC), CY-MPC
414-873	Rev 2	Drain Tube Assembly, CY-MPC
414-874	Rev 0	Shim, Canister, CY-MPC
414-875	Rev 0	Spacer Shim, Canister, CY-MPC
414-881, sheets 1-2	Rev 4	Fuel Tube, Transportable Storage Canister (TSC), CY-MPC

R+237969

REV	CHANGE
0	INITIAL ISSUE
1	INC DCR 0A
2	INC DCR 1A
3	INC DCR 2A
4	INC DCR 3A
5	INC DCR 4A
6	INC DCR 5A
7	INC DCR 6A
8	INC DCR 7A
9	INC DCR 8A
10	INC DCR 9A,9B
11	INC DCR 10A
12	INC DCR 11A,11B
13	INC DCR 12A
14	INC DCR 13A
15	INC DCR 14A
17NP	INC DCR 16NPA
18NP	INC DCR 17NPA
19NP	INC DCR 18NPA
20NP	INC DCR 19NPA

PROPRIETARY INFORMATION REMOVED

CONFIGURATION A
1.7kW/CELL HEAT LOAD

CONFIGURATION B
1.5kW/CELL HEAT LOAD

CONFIGURATION C
1.2kW/CELL HEAT LOAD

(97) CASK ASSEMBLY
DIRECTLY LOADED HBU TRANSPORT

(96) CASK ASSEMBLY
ALTERNATE DIRECTLY LOADED HBU TRANSPORT

96	97	98	99	ITEM	NAME	MATERIAL	SPEC	DRAWING No.	DESCRIPTION
1				30	INNER LID			423-803-97	
A/R	A/R			29	O-RING	VITON	COML		PARKER 3-904
A/R	A/R			28	SHIELDED THERMAL SHUNT			423-880-99	
2	2	2	2	27	LID BOLT WASHER	304 ST.STL.	ASTM A240		8MM PLATE
1	1	1	1	26	O-RING	VITON	COML		PARKER 3-908
		1		25	OUTER LID			423-805-98	
		1		24	INNER LID			423-803-98	
2	2	2	2	23	CSK SOC HD SCREW	ST.STL.	COML		1/2-13 UNC X 1.75
1	1	1	1	22	SWAGE RING	ST.STL.			
1	1	1	1	21	DRAIN LINE BOSS			423-811-98	
		1		20	PORT COVER ASSY			423-807-96	
		1		19	PORT COVER ASSY	ST.STL.		423-807-97	
1	1	1	1	18	NIPPLE	ST.STL.	COML		SNAP-TITE SVHN8-8EMV
A/R	A/R	1	A/R	17	O-RING	METAL	COML		
		4		16	SHIELD BOLT	ST.STL.	COML		1/4-20UNC-2A X 1/2 LG SHCS
		4		15	FLATWASHER	ST.STL.	COML		1/4 DIA.
		1		14	ADAPTOR	ST.STL.	COML		DATA INST. AD-6SS
		1		13	PRESSURE TRANSDUCER	ST.STL.	COML		DATA INST. MODEL AB
1	1		1	12	PLUG	ST.STL.	COML		PARKER 4P5ON
2	2	2	2	11	RELIEF VALVE	ST.STL.	COML		CIRCLE SEAL NO.524T-4M-10 OR 524TI-4M-10
1	1	1	1	10	FERRULE	BRASS	COML		
1	1	1	1	9	DRAIN TUBE	304 ST.STL.	COML		ø1 TUBE W/ .035 WALL
36	36	36	36	8	OUTER LID BOLT	ST.STL.	SEE NOTE 8		1-8UNC X 3 1/2 LG SHCS
42	42	42	42	7	INNER LID BOLT			423-811-1	
1	1	1	1	6	FUEL BASKET			SEE NOTE 1	
2	2		2	5	PORT COVER ASSY			423-807-99	
		2		4	TRUNNION RECESS SHIELD			423-811-99	
1	1		1	3	OUTER LID			423-805-99	
		1		2	INNER LID			423-803-99	
1	1	1	1	1	CASK BODY			423-802-99	
ASSY	ASSY	ASSY	ASSY		QUANTITY				

: PROPRIETARY INFORMATION REMOVED

NAC INTERNATIONAL

14. METAL OR POLYMER SEAL MAY BE USED. QUANTITY OF ONE.

13. LUBRICATE WITH NEVER-SEEZ OR EQUAL AND TIGHTEN 2 1/4 TURNS AFTER HAND TIGHT.

12. ITEM 27 (LID BOLT WASHER) TO BE USED AT THE TWO (2) SLOTTED HOLE LOCATIONS IN THE INNER LID.

11. RELIEF VALVE IS FACTORY PRESET TO 10PSI +/-5%.

10. LUBRICATE WITH NEVER-SEEZ OR EQUAL AND TORQUE TO 20±5 IN-LBS.

9. LUBRICATE WITH NEVER-SEEZ OR EQUAL AND TORQUE TO 50±10 IN-LBS.

8. ASME SA564,TYPE 630,CLASS, A OR B.

7. HEAT TREAT TO CONDITION H1150.

6. CHROME PLATE THE THREADED PORTION OF THE COMPONENT, AT A MINIMUM.

5. LUBRICATE WITH NEVER-SEEZ OR EQUAL AND TORQUE TO 550±50 FT-LBS.

4. LUBRICATE WITH NEVER-SEEZ OR EQUAL AND TORQUE TO 2540±200 FT-LBS.

3. LUBRICATE WITH NEVER-SEEZ OR EQUAL AND TORQUE COVER BOLTS TO 140±10 INCH-LBS.

2. -99 ASSEMBLY IS FOR ALTERNATE DIRECTLY LOADED TRANSPORT CONFIGURATION.
-98 ASSEMBLY IS FOR STORAGE/TRANSPORT CONFIGURATION.
-97 ASSEMBLY IS FOR DIRECTLY LOADED HBU TRANSPORT CONFIGURATION.
-96 ASSEMBLY IS FOR ALTERNATE DIRECTLY LOADED HBU TRANSPORT CONFIGURATION.

1. EITHER FUEL BASKET 423-870-99 OR 423-870-98 MAY BE USED.

NOTES:

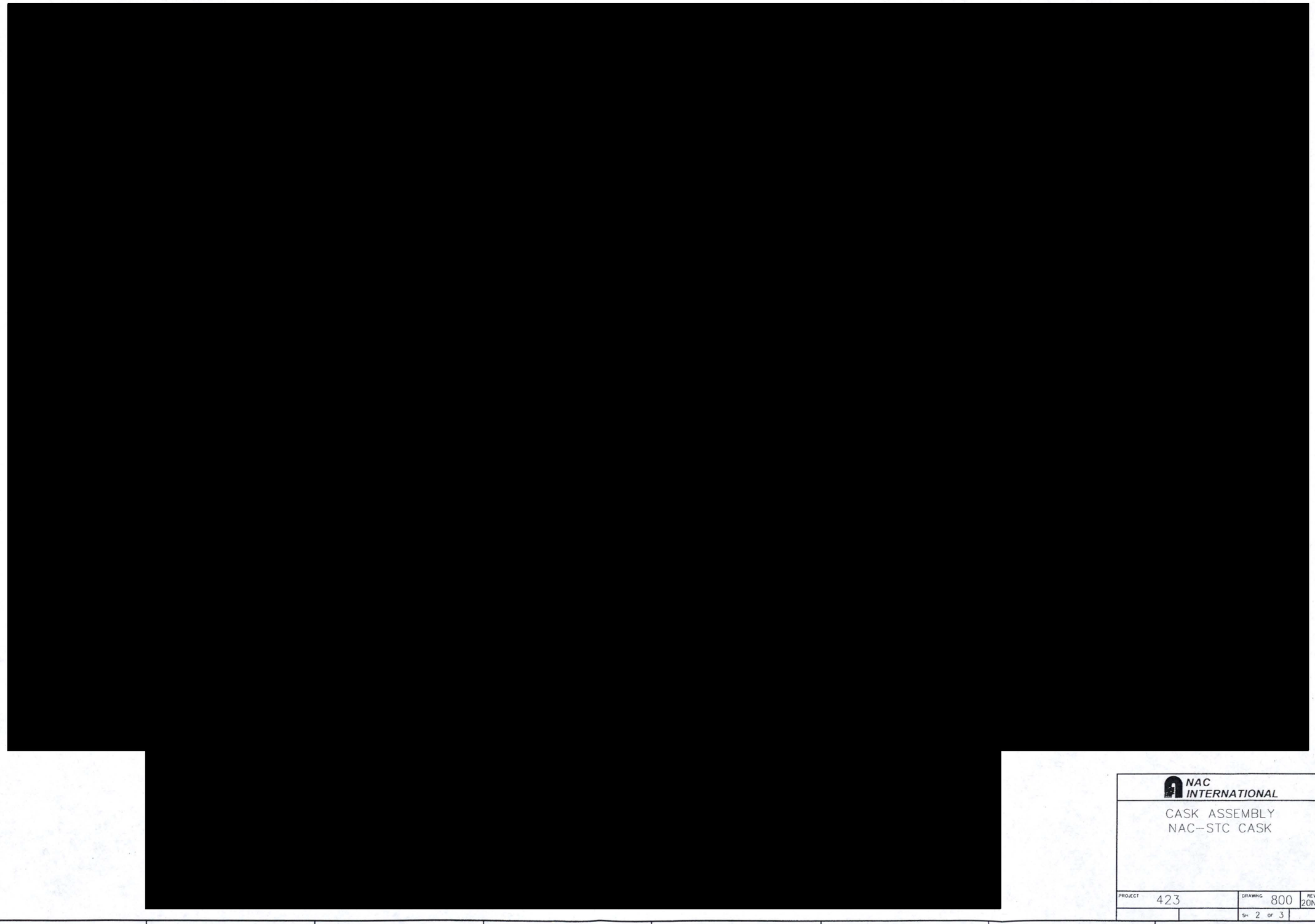
20/16 SEAL MATERIAL MAY BE VM125-75 OR VM835-75.

15. [redacted]

UNLESS OTHERWISE STATED	GROUP	NAME	DATE
DIMENSIONING AND TOLERANCING SHALL BE PER ASME Y14.5M-94	PREPARER		6/13/18
ALL THREAD DEPTH CALLOUTS ARE TO BE CONSIDERED AS A MIN. DEPTH OF PERFECT THREADS.	CHECKER		6-13-18
	PROJECT MANAGER		6/14/18
	ENGINEERING		6-13-18
ALL DIMENSIONS ARE IN INCHES	LICENSING		6/13/18
MACHINED SURFACES TO BE 63 OR BETTER	QUALITY		6/14/18
NEXT ASSEMBLY: 423-843/900			
DRAWING TYPE: LICENSE			

CASK ASSEMBLY-
NAC-STC CASK

PROJECT 423 | DRAWING 800 | REV 20NP | SH 1 OF 3



NAC INTERNATIONAL	
CASK ASSEMBLY NAC-STC CASK	
PROJECT 423	DRAWING 800 Sh 2 of 3
	REV 20NP

NAC INTERNATIONAL

CASK ASSEMBLY
NAC-STC CASK

PROJECT	DRAWING	REV
423	800	20NP
	SH 3 OF 3	

R+237967

REV	CHANGE
0	INITIAL ISSUE
1	INC DCR 0A
2	INC DCR 1A
3	INC DCR 2A
4	INC DCR 3A,3B
5	INC DCR 4A
6	INC DCR 5A
7	INC DCR 6A
8	INC DCR 7A
9	INC DCR 8A
10	INC DCR 9A
11	INC DCR 10A
12	INC DCR 11A
13	INC DCR 12A
14	INC DCR 13A
15	INC DCR 14A

[redacted]

[redacted]

97	98	99	ITEM	NAME	MATERIAL	SPEC	DRAWING No.	DESCRIPTION
			22	SEAL (INNER)	METAL	COML		
			21	PORT COVERPLATE ASSY			423-806-97	
			20	INNER LID			423-804-97	
A/R		A/R	19	O-RING	VITON	COML		PARKER 3-916
		2	18	PORT COVERPLATE ASSY			423-806-99	
		1	17	INNER LID			423-804-99	
1		1	16	O-RING (OUTER)	VITON	COML		PARKER .275 DIA. ID ø73.0
		1	15	O-RING (INNER)	VITON	COML		PARKER .275 DIA. ID ø71.8
1	1	1	14	BUSHING	ST.STL.	COML		PARKER #6-1/4 F50G
1	1	1	13	PLUG	ST.STL.	COML		PARKER #16-P50N
A/R	1	A/R	12	BOSS SEAL	METAL	COML		SAINT-GOBAIN #10061-16-1-0
2	2	2	11	O-RING	VITON	COML		PARKER 3-916
1	1	1	10	O-RING	VITON	COML		PARKER 3-906
			9	(DELETED)				
			8	(DELETED)				
	1		7	SEAL (OUTER)	METAL	COML		
	1		6	SEAL (INNER)	METAL	COML		
1	1	1	5	SEAL	SILICONE RUBBER	COML		ø1 1/2 I.D. X 1/4 WALL
1	1	1	4	NIPPLE	ST.STL.	COML		SWAGELOK #SS-QC4-D-4PM
2	2	2	3	NIPPLE	ST.STL.	COML		SNAP-TITE SVHN16-16EMV
	2		2	PORT COVERPLATE ASSY			423-806-98	
	1		1	INNER LID			423-804-98	

97	98	99	ITEM	NAME	MATERIAL	SPEC	DRAWING No.	DESCRIPTION
ASSY	ASSY	ASSY						
QUANTITY								

NAC INTERNATIONAL

LID ASSEMBLY-
INNER,
NAC-STC CASK

GROUP	NAME	DATE
PREPARER	[redacted]	6-13-18
CHECKER	[redacted]	6-13-18
PROJECT MANAGER	[redacted]	6/14/18
ENGINEERING	[redacted]	6-13-18
LICENSING	[redacted]	6/13/18
QUALITY	[redacted]	6/14/18

UNLESS OTHERWISE STATED
DIMENSIONING AND TOLERANCING SHALL BE PER ASME Y14.5M-94, UNSPECIFIED DIMENSIONAL TOLERANCES ARE SHOWN BELOW.
ALL THREAD DEPTH CALLOUTS ARE TO BE CONSIDERED AS A MIN. DEPTH OF PERFECT THREADS. THE ACTUAL DEPTH OF THE THREADS IS NOT SUBJECT TO TOLERANCE CONTROLS.

XXX	UNDER 3	±.003
	3-12	±.005
	OVER 12	±.010
XX	UNDER 6	±.02
	6-18	±.03
	OVER 18	±.06
X	ALL	±.1
FRACTIONAL		±1/8
ANGLES		±0.5°

WEIGHTS ARE APPROXIMATE AND ARE TO BE USED FOR HANDLING PURPOSES ONLY
ALL DIMENSIONS ARE IN INCHES
BORDER SIZE: F (40 X 28)
ALL UNSPECIFIED TOOL RADII: .015 - .030
BREAK ALL SHARP CORNERS .015 - .030
MACHINED SURFACES TO BE ▽ OR BETTER
NEXT ASSEMBLY: 423-800
DRAWING TYPE: LICENSE

PROJECT	423	DRAWING	803	REV 15
SCALE	N.T.S.	WEIGHT	N/A	SH 1 OF 2

15 20 SEAL MATERIAL MAY BE VM125-75 OR VM835-75.

19 METAL SEAL AND GROOVE DESIGN SHALL PROVIDE HELIUM LEAKTIGHT PERFORMANCE AS SPECIFIED IN THE STC CoC, AN OPERATIONAL TEMPERATURE RANGE OF -40°F TO 500°F AND A PRESSURE RATING OF GREATER THAN OR EQUAL TO 300 PSIG (INTERNAL AND EXTERNAL). COMPRESSION FORCE SHALL BE LESS THAN OR EQUAL TO 410 LB/IN.

18 WHERE "YYY-YYY" IS A UNIQUE IDENTIFIER.

17 METAL SEAL TO BE STAINLESS STEEL OR INCONEL WITH TUBING DIAMETER OF .25±.01, WALL THICKNESS OF .01 - .04 AND SILVER PLATING THICKNESS OF .001-.003.

16 METAL OR POLYMER SEAL MAY BE USED. QUANTITY OF ONE.

15 99, 98 OR 97 AS REQUIRED PER ASSEMBLY.

14 LUBRICATE WITH NEVER SEEZ OR EQUAL AND TORQUE TO 30±3 FT-LBS.

13 ACTUAL DIAMETERS SHALL FIT GROOVE SHOWN IN SECTION E-E, DRAWING #423-804, SHEET 3. FOR ITEM 6, SEAL INNER DIAMETER TO BE .01-.04 GREATER THAN GROOVE INNER DIAMETER. FOR ITEMS 7 AND 22, SEAL OUTER DIAMETER TO BE .01"-.04" LESS THAN GROOVE OUTER DIAMETER.

12 STEEL STAMP/ENGRAVE CHARACTERS AS SHOWN X .03 DEEP, FILL WITH BLACK WEATHER RESISTANT PAINT.

11 LUBRICATE WITH NEVER SEEZ OR EQUAL AND TORQUE TO 300±20 INCH-LBS.

10 NUMBERS INDICATE TORQUE SEQUENCE

9 VALUE TO BE ACTUAL MEASURED WEIGHT

8 METAL STAMP/ENGRAVE CHARACTERS AS SHOWN X .03 DEEP, FILL WITH BLACK WEATHER RESISTANT PAINT.

7 ENGRAVE DELTA 1.5 PER SIDE X .03 DEEP, FILL WITH BLACK WEATHER RESISTANT PAINT

6 LUBRICATE WITH NEVER SEEZ OR EQUAL AND TORQUE TO 50 ±10 INCH-LBS.

5 LUBRICATE WITH NEVER SEEZ OR EQUAL AND TORQUE TO 70±5 INCH-LBS.

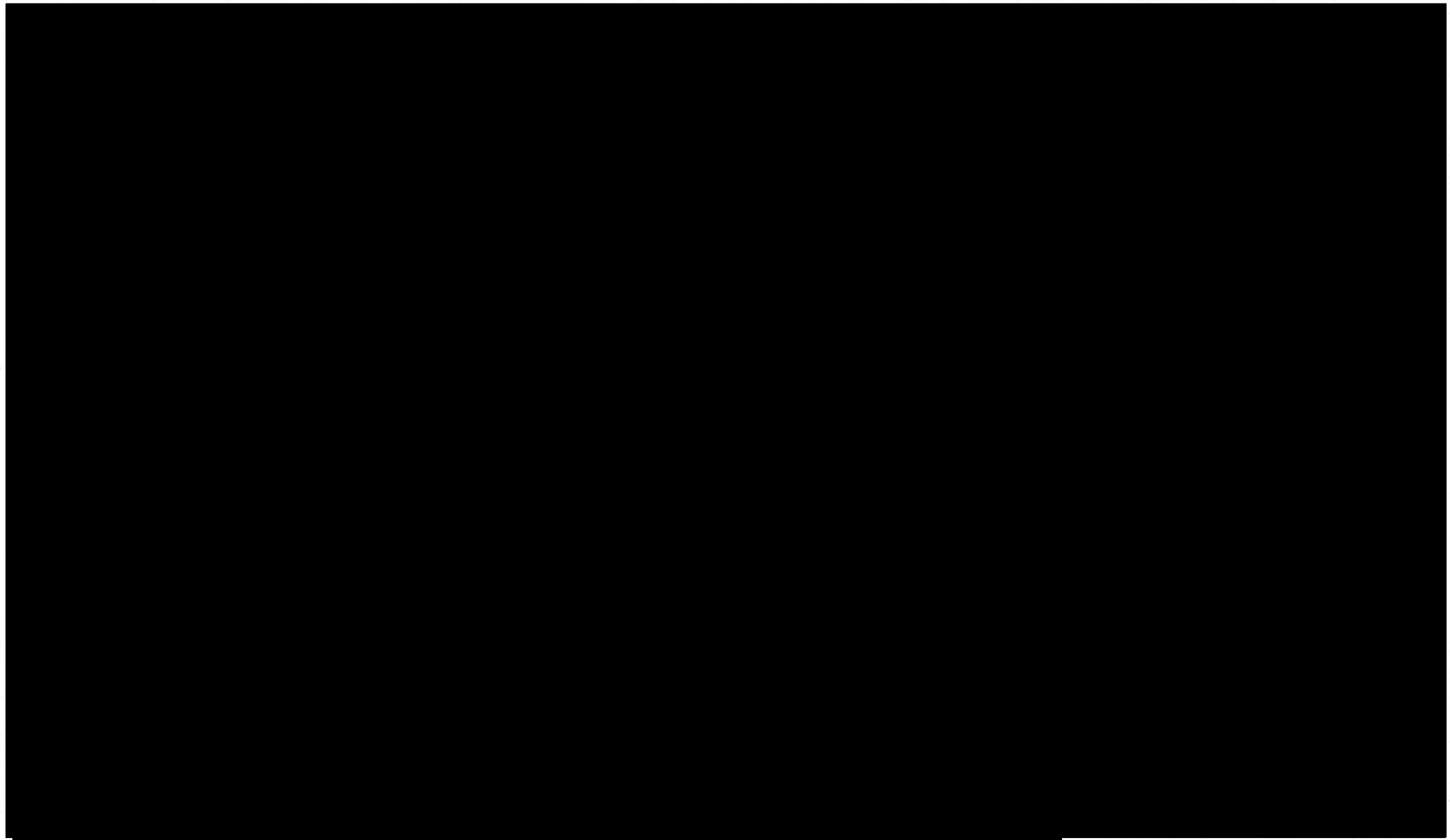
4 METAL SEAL RETENTION PER MANUFACTURER'S GUIDANCE.

3 CUT SILICONE RUBBER TUBE TO LENGTH AS REQUIRED AT TRIAL FIT OF LID WITH BODY. BOND WITH SILICONE SEALANT (e.g., DOW CORNING® 736).

2 CHROME PLATE THE THREADED PORTION OF THE COMPONENT, AT A MINIMUM.

1 ID TOLERANCE IS ±.5 AND CROSS SECTION IS ±.006.

NOTES:



SECTION D—D SH1 F7
ALTERNATE DIRECTLY LOADED,
TRANSPORT ONLY (POLYMER SEALS)
(ASSEMBLY -99)

SECTION D—D SH1 F7
STORAGE/TRANSPORT AND CANISTERED CONTENTS (METAL SEALS)
(ASSEMBLY -98)

NAC INTERNATIONAL

LID ASSEMBLY-
INNER,
NAC-STC CASK

PROJECT 423	DRAWING 803	REV 15
SCALE N.T.S.	EST.WT. N/A	SH 2 OF 2

R-237965

REV	CHANGE
0	INITIAL ISSUE
1	INC DCR 0A
2	INC DCR 1A
3	INC DCR 2A
4	INC DCR 3A,3B
5	INC DCR 4A,4B
6	INC DCR 5A
7	INC DCR 6A
8	INC DCR 7A
9	INC DCR 8A

[redacted]

9 8 SEAL MATERIAL MAY BE VM125-75 OR VM835-75.

7 ACTUAL DIAMETER SHALL FIT GROOVE SHOWN IN DETAIL C-C.

6 STEEL STAMP/ENGRAVE (.03 DEEP) LETTERS, FILL WITH BLACK WEATHER RESISTANT PAINT.

5 STEEL STAMP/ENGRAVE DELTA 1.5 PER SIDE X .03 DEEP AND FILL WITH BLACK WEATHER RESISTANT PAINT.

4 NUMBERS INDICATE TORQUE SEQUENCE

3 AT THE OPTION OF THE FABRICATOR, ITEM 6 (NAMEPLATE) MAY BE ATTACHED USING A MINIMUM OF FOUR (4) STAINLESS STEEL SCREWS. THE SCREWS SHALL BE 3MM TO 5MM IN DIAMETER. THE SCREW HOLE SHALL BE NO DEEPER THAN 15MM. SCREWS SHALL BE TACK WELDED TO ITEM 6 AT INSTALLATION. BOTH SCREW AND TACK WELD ARE TO BE FLUSH WITH THE SURFACE OF ITEM 6 (NAMEPLATE).

2 HEAT TREAT TO CONDITION H-1150

1. (DELETED)

NOTES:

A B3

16X 22.5°

5 2X 1/2-13UNC-2B X ↧1.0

4 16X ⌀1.03 X ↧2.5
16X 1-8UNC-2B X ↧2.00

99 OUTER LID ASSEMBLY
ALTERNATE DIRECTLY LOADED TRANSPORT: WITH POLYMER O-RINGS

98 OUTER LID ASSEMBLY
STORAGE/TRANSPORT: W/METAL O-RING

SECTION A-A B6

		A/R	8	SCREW	304 ST. STL.	COML			SEE NOTE 3
2		1	7	OUTER LID	ST. STL.	SA705,TYPE 630			FORGING
	1		6	NAMEPLATE	ST. STL.		423-812-2		
9 8	2	2	5	SCREW THREAD INSERT	ST. STL.	COML			HELICOIL P/N #1185-8CN X 1.000
	16	16	4	SCREW THREAD INSERT	ST. STL.	COML			HELICOIL P/N #1185-16CN X 2.000
		1	3	O-RING	VITON	COML			PARKER .275 DIA.
7	1		2	O-RING	METAL	COML			HELICOFLEX #U2825-(82.060)SEB
2	1		1	OUTER LID	ST. STL.	SA705,TYPE 630			FORGING
97	98	99	ITEM	NAME	MATERIAL	SPEC	DRAWING No.		DESCRIPTION
ASSY	ASSY	ASSY							
QUANTITY									

UNLESS OTHERWISE STATED
DIMENSIONING AND TOLERANCING SHALL BE PER ASME Y14.5M-94, UNSPECIFIED DIMENSIONAL TOLERANCES ARE SHOWN BELOW.
ALL THREAD DEPTH CALLOUTS ARE TO BE CONSIDERED AS A MIN. DEPTH OF PERFECT THREADS. THE ACTUAL DEPTH OF THE THREADS IS NOT SUBJECT TO TOLERANCE CONTROLS.

XXX	UNDER 3	±.003
	3-12	±.005
	OVER 12	±.010
XX	UNDER 6	±.02
	6-18	±.03
	OVER 18	±.06
X	ALL	±.1
FRACTIONAL ±1/8		
ANGLES ±0.5°		

WEIGHTS ARE APPROXIMATE AND ARE TO BE USED FOR HANDLING PURPOSES ONLY
ALL DIMENSIONS ARE IN INCHES
BORDER SIZE: F (40 X 28)
ALL UNSPECIFIED TOOL RADII: .015 - .030
BREAK ALL SHARP CORNERS .015 - .030
MACHINED SURFACES TO BE ▽ OR BETTER
NEXT ASSEMBLY: 423-800
DRAWING TYPE: LICENSE

GROUP	NAME	DATE
PREPARER	[redacted]	6-13-18
CHECKER	[redacted]	6-13-18
PROJECT MANAGER	[redacted]	6/14/18
ENGINEERING	[redacted]	6-13-18
LICENSING	[redacted]	6/12/18
QUALITY	[redacted]	6/14/18

NAC INTERNATIONAL

LID ASSEMBLY,
OUTER,
NAC-STC CASK

PROJECT	DRAWING	REV
423	805	9
SCALE 1/6	WEIGHT NOTED	SH 1 OF 2

NAC INTERNATIONAL

LID ASSEMBLY,
OUTER,
NAC-STC CASK

PROJECT	423	DRAWING	805	REV 9
SCALE	1/6	EST.WT.	NOTED	SH 2 OF 2

R-237963

REV	CHANGE
0	INITIAL ISSUE
1	INC DCR 0A
2	INC DCR 1A
3	INC DCR 2A
4	INC DCR 3A,3B
5	INC DCR 4A
6	INC DCR 5A
7	INC DCR 6A
8	INC DCR 7A
9	INC DCR 8A
10	INC DCR 9A
11	INC DCR 10A
12	INC DCR 11A
13	INC DCR 12A
14	INC DCR 13A

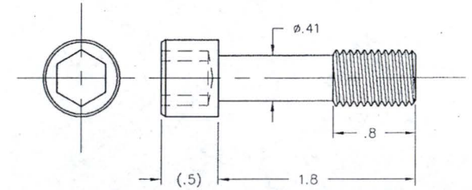
[redacted]

SECTION K-K D3
(BOLT SHOWN)

99 PORT COVERPLATE ASSY
ALTERNATE DIRECTLY LOADED TRANSPORT:
WITH POLYMER SEALS
WEIGHT: 10#

98 PORT COVERPLATE ASSY
STORAGE/TRANSPORT: W/METAL SEALS
WEIGHT: 10#

97 PORT COVERPLATE ASSY
ALTERNATE DIRECTLY LOADED TRANSPORT:
W/ POLYMER AND METAL SEALS
WEIGHT: 10#



2 PORT COVERPLATE BOLT
SCALE: 2/1

14 9 SEAL MATERIAL MAY BE VM125-75 OR VM835-75.

8 METAL SEAL TO BE STAINLESS STEEL OR INCONEL WITH TUBING DIAMETER OF 1/8±.01, WALL THICKNESS OF .01 - .03 AND SILVER PLATING THICKNESS OF .001-.003.

7 METAL SEAL AND GROOVE DESIGN SHALL PROVIDE HELIUM LEAKTIGHT PERFORMANCE AS SPECIFIED IN THE STC CoC, AN OPERATIONAL TEMPERATURE RANGE OF -40°F TO 500°F AND A PRESSURE RATING OF GREATER THAN OR EQUAL TO 300 PSIG (INTERNAL AND EXTERNAL). COMPRESSION FORCE SHALL BE LESS THAN OR EQUAL TO 275 LB/IN.

6 FOR ASSEMBLIES 99 & 97, METAL OR POLYMER SEAL MAY BE USED. QUANTITY OF ONE.

5 SEAL OUTER DIAMETER TO BE .01-.04 LESS THAN GROOVE OUTER DIAMETER.

4 FOR ASSY-99 ONLY.
STEEL STAMP/ENGRAVE (0.03 DEEP) LETTERS, FILL WITH BLACK WEATHER RESISTANT PAINT.

3 LUBRICATE WITH NEVER SEEZ AND TORQUE TO 70±5 INCH-LBS

2 CHROME PLATE THE THREADED PORTION OF THE COMPONENT, AT A MINIMUM.

1. (DELETED)

NOTES:

97	98	99	ITEM	NAME	MATERIAL	SPEC	DRAWING No.	DESCRIPTION
1			11	PORT COVERPLATE	304 ST. STL.	ASME SA240		1 PLATE
A/R		A/R	10	O-RING	VITON	COML		PARKER #3-902
1		1	9	O-RING	VITON	COML		PARKER #2-244
		1	8	O-RING	VITON	COML		PARKER #2-238
		1	7	PORT COVERPLATE	304 ST. STL.	ASME SA240		1 PLATE
A/R	1	A/R	6	BOSS SEAL	ST. STL.	COML		SAINT-GOBAIN #10061-02-1-0
	1		5	SEAL	METAL	COML		
1	1		4	SEAL	METAL	COML		
1	1	1	3	PLUG	ST. STL.	COML		SWAGELOK SS-2-PST
4	4	4	2	PORT COVERPLATE BOLT	410 ST.STL.	ASME SA193 GRB6		1/2-13UNC-2A SHCS
	1		1	PORT COVERPLATE	304 ST. STL.	ASME SA240		1 PLATE
ASSY	ASSY	ASSY						
QUANTITY								

UNLESS OTHERWISE STATED
DIMENSIONING AND TOLERANCING SHALL BE PER ASME Y14.5M-94, UNSPECIFIED DIMENSIONAL TOLERANCES ARE SHOWN BELOW.
ALL THREAD DEPTH CALLOUTS ARE TO BE CONSIDERED AS A MIN. DEPTH OF PERFECT THREADS. THE ACTUAL DEPTH OF THE THREADS IS NOT SUBJECT TO TOLERANCE CONTROLS.

.XXX	UNDER 3	±.003
	3-12	±.005
	OVER 12	±.010
.XX	UNDER 6	±.02
	6-18	±.03
	OVER 18	±.06
X	ALL	±.1
FRACTIONAL		±1/8
ANGLES		±0.5°

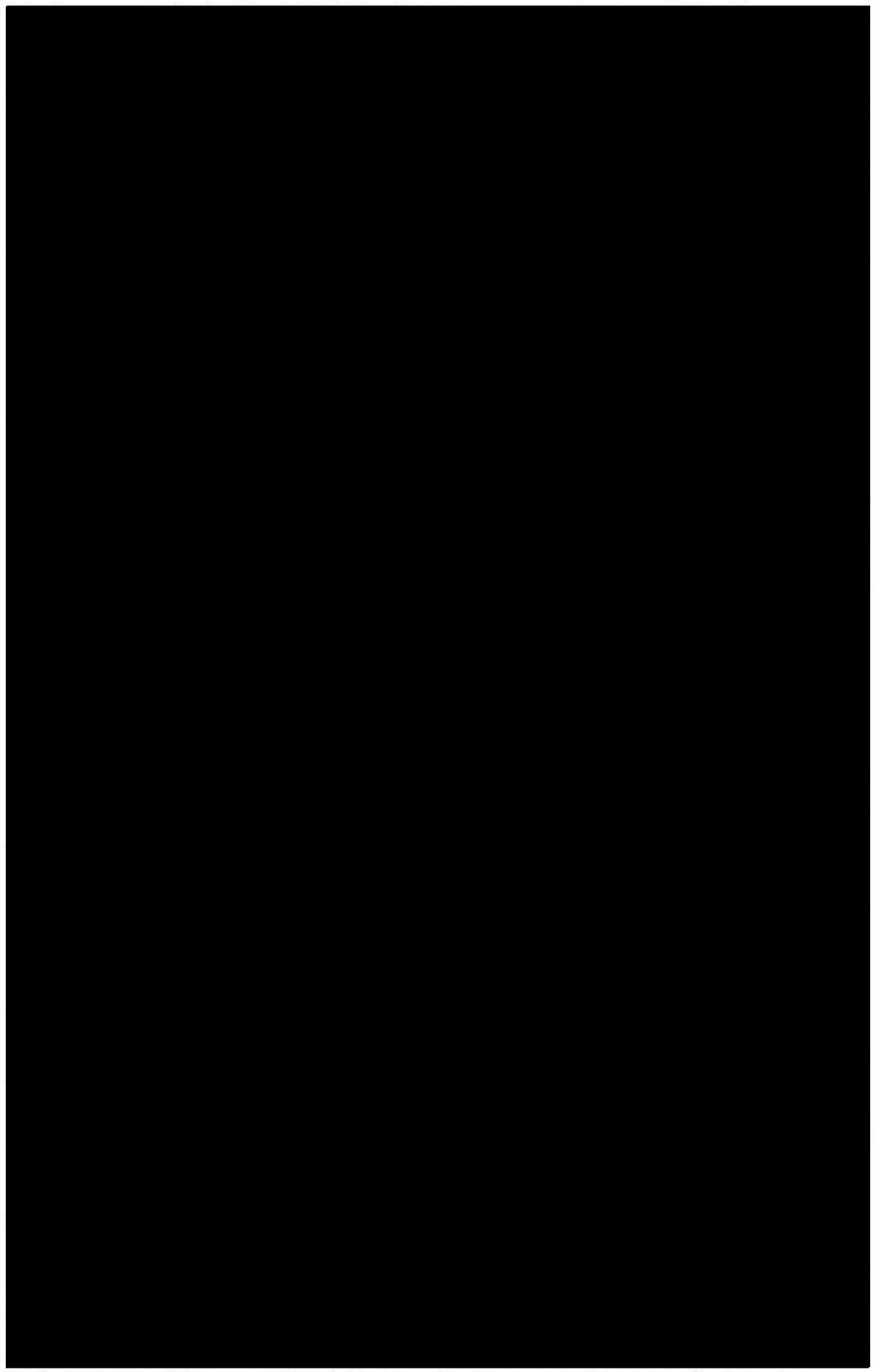
WEIGHTS ARE APPROXIMATE AND ARE TO BE USED FOR HANDLING PURPOSES ONLY
ALL DIMENSIONS ARE IN INCHES
BORDER SIZE: F (40 X 28)
ALL UNSPECIFIED TOOL RADII .015 - .030
BREAK ALL SHARP CORNERS .015 - .030
MACHINED SURFACES TO BE ▽ OR BETTER
NEXT ASSEMBLY: 423-803
DRAWING TYPE: LICENSE

GROUP	NAME	DATE
PREPARER		6/13/18
CHECKER		6-13-18
PROJECT MANAGER		6/14/18
ENGINEERING		6-13-18
LICENSING		6/13/18
QUALITY		6/14/18

NAC INTERNATIONAL

PORT COVERPLATE ASSY.
INNER LID,
NAC-STC CASK

PROJECT	DRAWING	REV
423	806	14
SCALE 1/1	WEIGHT NOTED	SH 1 OF 2



NAC INTERNATIONAL

PORT COVERPLATE ASSY.
INNER LID,
NAC–STC CASK

PROJECT	423	DRAWING	806	REV 14
SCALE	1/1	EST.WT.	NOTED	SH 2 OF 2

R-237961

REV	CHANGE
0	INITIAL ISSUE
1	INC DCR 0A
2	INC DCR 1A,1B
3	INC DCR 2A,2B
4	INC DCR 3A
5	INC DCR 4A
6	INC DCR 5A

[redacted]

SECTION A—A

(99) PORT COVER, TRANSPORT
WEIGHT: 10#

(97) PORT COVER, STORAGE W/FEED THRU
WEIGHT: 10#

(96) PORT COVER, STORAGE
WEIGHT: 10#

11. MATERIAL SPECIFICATION MAY BE ASME SA705, TYPE 630 OR ASME SA564.

(6) (10) SEAL MATERIAL MAY BE VM125-75 OR VM835-75.

(9) LUBRICATE WITH NEVER SEEZ AND TORQUE TO 105±5 INCH-LBS.

(8) LUBRICATE WITH NEVER SEEZ AND TORQUE TO 70±5 INCH-LBS.

(7) CHROME PLATE THE THREADED PORTION OF THE COMPONENT, AT A MINIMUM.

(6) LUBRICATE WITH NEVER SEEZ AND TORQUE TO 4.0±0.5 INCH-LBS.

(5) ENGRAVE DELTA .5 PER SIDE X .03 DEEP AND FILL WITH WEATHER RESISTANT BLACK PAINT.

(4) STEEL STAMP/ENGRAVE LETTERS 1/4 HIGH APPROX. AS SHOWN.

(3) HEAT TREAT TO CONDITION H1150

2. -99 ASSEMBLY IS FOR TRANSPORTATION
-97 ASSEMBLY IS FOR STORAGE
-96 ASSEMBLY IS FOR STORAGE

1. (INTENTIONALLY LEFT BLANK)

NOTES:

(96)(97) (4) STORAGE ONLY

(99) (4) TRANSPORT ONLY

DETAIL B—B

(9) (6)(10) (8) (7) (7) (7) (6) (6)(10) (3)

96 ASSY	97 ASSY	98 ASSY	99 ASSY	ITEM	NAME	MATERIAL	SPEC	DRAWING No.	DESCRIPTION
1	1			12	SHIELD	PB	ASTM B29,CHEM.GRADE		
1	1			11	RETAINING RING	ST.STL.	COML		WALDES-TRUARC #N5000-162
	1			10	FEEDTHRU	ST.STL.	COML		PAVE #S08-80-4-22-12-12
1	1		1	9	O-RING	VITON	COML		PARKER 3-904
1	1		1	8	PLUG	304 OR 316 ST.STL.	COML		PARKER #4 HP5ON-SS
3	3		3	7	PORT COVER BOLT	410 ST.STL.	ASME SA193 GRB6		3/8-16UNC-2A SHCS
4	4		4	6	FLAT HD. SCREW	304 ST.STL.	ASTM A193,GRADE B8		8-32UNC-2A X 1/2 LG
2	2		2	5	O-RING	VITON	COML		PARKER 2-147
1	1		1	4	RETAINER	304 ST.STL.	ASME SA240		10 GA SHEET
1	1		1	3	SPACER	304 ST.STL.	ASME SA240		1/4 PLATE
	1			2	PORT COVER BODY	17-4 PH	SEE NOTE 11		BAR/FORGING
1			1	1	PORT COVER BODY	17-4 PH	SEE NOTE 11		BAR/FORGING
ASSY	ASSY	ASSY	ASSY		QUANTITY				

(6)

UNLESS OTHERWISE STATED
DIMENSIONING AND TOLERANCING SHALL BE PER ASME Y14.5M-94, UNSPECIFIED DIMENSIONAL TOLERANCES ARE SHOWN BELOW.
ALL THREAD DEPTH CALLOUTS ARE TO BE CONSIDERED AS A MIN. DEPTH OF PERFECT THREADS. THE ACTUAL DEPTH OF THE THREADS IS NOT SUBJECT TO TOLERANCE CONTROLS.

.XXX	UNDER 3	±.003
	3-12	±.005
	OVER 12	±.010
.XX	UNDER 6	±.02
	6-18	±.03
	OVER 18	±.06
X	ALL	±.1
FRACTIONAL ±1/8		
ANGLES ±0.5°		

WEIGHTS ARE APPROXIMATE AND ARE TO BE USED FOR HANDLING PURPOSES ONLY
ALL DIMENSIONS ARE IN INCHES
BORDER SIZE: F (40 X 28)
ALL UNSPECIFIED TOOL RADII .015 - .030
BREAK ALL SHARP CORNERS .015 - .030
MACHINED SURFACES TO BE 125 OR BETTER
NEXT ASSEMBLY: 423-800
DRAWING TYPE: LICENSE

GROUP	NAME	DATE
PREPARER	[redacted]	6-14-18
CHECKER	[redacted]	6-14-18
PROJECT MANAGER	[redacted]	6/14/18
ENGINEERING	[redacted]	6-14-18
LICENSING	[redacted]	6/15/18
QUALITY	[redacted]	6/14/18

NAC INTERNATIONAL

ASSEMBLY,
PORT COVER,
NAC-STC CASK

PROJECT	DRAWING	REV
423	807	6
SCALE 2:1	WEIGHT 10LBS	SH 1 OF 3

[redacted]

[redacted]

[redacted]

[redacted]

NAC INTERNATIONAL

ASSEMBLY,
PORT COVER,
NAC-STC CASK

PROJECT 423		DRAWING 807	REV 6
SCALE FULL	EST.WT. 10LBS	SH 2 OF 3	

NAC INTERNATIONAL

ASSEMBLY,
PORT COVER,
NAC-STC CASK

PROJECT 423		DRAWING 807	REV 6
SCALE FULL	EST.WT. 10LBS	SH 3 OF 3	

R-237973

REV	CHANGE
0	INITIAL ISSUE
1	INC DCR 0NPA

PROPRIETARY INFORMATION REMOVED

99 SHIELD RING ASSEMBLY

PROPRIETARY INFORMATION REMOVED

NOTES:

			ITEM	NAME	MATERIAL	SPEC	DRAWING No.	DESCRIPTION
		8	13	THREAD INSERT	ST. STL.	COML		
		A/R	12	PLUG	ST. STL.	COML		PROPRIETARY INFORMATION REMOVED
		A/R	11	LOCKING WIRE	ST. STL.	COML		PROPRIETARY INFORMATION REMOVED
		8	10	TREADED INSERT	ST. STL.	COML		PROPRIETARY INFORMATION REMOVED
		8	9	FLAT WASHER	ST. STL.	COML		PROPRIETARY INFORMATION REMOVED
		8	8	HEX BOLT	410 ST. STL.	ASME SA193, Gr. B6		PROPRIETARY INFORMATION REMOVED
		8	7	SOCKET HEAD SCREW	410 ST. STL.	ASME SA193, Gr. B6		PROPRIETARY INFORMATION REMOVED
		1	6	SIDE SECTOR, LH	304 ST. STL.	ASME SA240/SA182		PLATE/FORGING
		1	5	SIDE SECTOR, RH	304 ST. STL.	ASME SA240/SA182		PLATE/FORGING
		1	4	BOTTOM SECTOR	17-4PH ST. STL.			FORGING/PLATE
		2	3	LIFT LUG	304 ST. STL.	ASME SA240/SA276		PLATE/BAR
		1	2	TOP SECTOR	304 ST. STL.	ASME SA240/SA182		PLATE/FORGING
		1	1	(DELETED)				
97	98	99						
ASSY	ASSY	ASSY						
QUANTITY								

NAC INTERNATIONAL

UNLESS OTHERWISE STATED
DIMENSIONING AND TOLERANCING SHALL BE PER ASME Y14.5M-94.
ALL THREAD DEPTH CALLOUTS ARE TO BE CONSIDERED AS A MIN. DEPTH OF PERFECT TREADS
ALL DIMENSIONS ARE IN INCHES
MACHINED SURFACES SHALL BE √ OR BETTER
NEXT ASSEMBLY 423-900
DRAWING TYPE LICENSE

GROUP	NAME	DATE
PREPARER		6-12-18
CHECKER		6-12-18
PROJECT MANAGER		6/13/18
ENGINEERING		6-12-18
LICENSING		6/12/18
QUALITY		6/14/18

SHIELD RING ASSEMBLY, NAC-STC CASK

PROJECT 423 | DRAWING 927 | REV 1NP
SCALE N.T.S. | WEIGHT N/A | SH 1 OF 1 | 6/12/2018

June 2018

Revision 18D

NAC-STC

NAC Storage Transport Cask

SAFETY ANALYSIS REPORT

Non-Proprietary Version
Volume 2 of 2

Docket No. 71-9235

NAC INTERNATIONAL

Atlanta Corporate Headquarters: 3950 East Jones Bridge Road, Norcross, Georgia 30092 USA
Phone 770-447-1144, Fax 770-447-1797, www.nacintl.com

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How to Specify O-Rings

Denotes Metallic O-Ring	Tubing OD (Thirty-Seconds)		Wall Thickness (Thousandths)				
U	2	3	12	—	03	625	SE	A

Materials

1—Alloy 718	7—Stainless Steel 304
2—Stainless Steel 321	8—Stainless Steel 316
3—Aluminum	9—Stainless Steel 347
4—Copper	X—As Specified
5—Alloy 600	
6—Alloy X-750	

Metallic O-Ring OD (Inches) (Thousandths)

Type

SE—Self-energized on ID
PF—Pressure filled
NP—Not self-energized, not pressure filled
SO—Self-energized on OD
SX—Self-energized as spec.

Example:

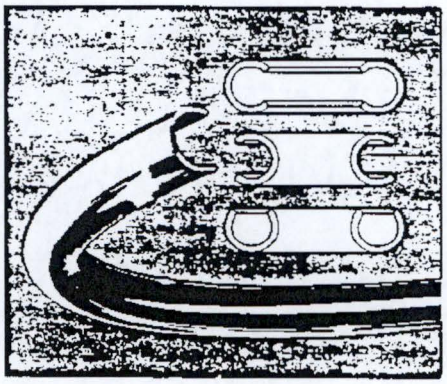
U2312-03625SEA

The above example, U2312-03625SEA, indicates a type 321 stainless steel O-Ring, 3/32" (2.38 mm) tube size, .012 (0.30 mm) wall thickness, 3.625" (92.08 mm) OD, self-energized (ID) and .001-.002" (0,03/0,05 mm) silver coating.

Coatings

A—Silver	.001/.002 (0.03/0.05)	N—None	
B—Silver	.002/.003 (0.05/0.08)	P—Lead	.001/.002 (0.03/0.05)
D—Teflon®	.001/.003 (0.03/0.08)	R—Indium	.001/.002 (0.03/0.05)
E—Teflon	.003/.004 (0.08/0.10)	T—Nickel	.001/.002 (0.03/0.05)
L—Copper	.001/.002 (0,03/0.05)	V—Gold	.0005/.001 (0.02/0.03)

X—As Specified



Fluorocarbon Metallic C-Rings

Fluorocarbon Metallic C-Rings (designated MCR) are designed for static sealing on machinery or equipment and are available for internal pressure, external pressure, or axial pressure ID/OD applications. Because C-Rings are designed with an open side on the pressure side of the installation, the seal is self-energizing. Fluorocarbon C-Rings are offered in round or irregular shapes in a broad range of sizes from .126" (3,2 mm) OD x .032" (0,81 mm) free height to over 300" (7620 mm) OD x 2" (50,80 mm) free height. They are available in a wide variety of metal alloys and metallic or Teflon coatings. Sealing application temperature range is from cryogenic to 3,000° F. (1650° C.); pressure tolerances are from 10^{-10} torr to 100,000 psi (6,804 atm). Where customer requirements are large, the C-Ring provides the lowest unit price of any high performance seal on the market.

® Teflon is DuPont's Registered Trademark.

Helicoflex
Components Division
P.O. Box 9889
Columbia, South Carolina 29290

Telephone (803) 783-1880
FAX (803) 783-4279

4.5.2 Blended Polytetrafluoroethylene (PTFE) O-rings

This section contains applicable technical data from a typical manufacturer of blended polytetrafluoroethylene (PTFE) O-rings. The PTFE O-rings used in the NAC-STC port covers are manufactured from virgin (unreprocessed) polytetrafluoroethylene base material filled with plastic. One product that satisfies the design requirements is the Fluoroloy K O-ring manufactured by the Furon Company, which has an operating temperature range of -450°F to +650°F. NAC has completed supplemental O-ring testing and has determined that the operating range of the PTFE O-rings can be extended to 735 °F. A description of tests performed and the results are contained in Certified Test Report D9-3362-1, Applied Technical Services, Inc., February 8, 1989. Another product that satisfies the design requirements is Parker Compound VM835-75 or VM125-75. The compound's recommended operating temperature range is -40°F to 400 °F.

REPORT DATA

Original Physical Properties	Test Method	Spec Limits	Test Results
(Z1) Hardness, Shore A, pts.	ASTM D2240	75 ±5	78
Tensile Strength, PSI (Mpa)	ASTM D412	1450 (10)	3059
(Z2) Ultimate Elongation, %	ASTM D412	125	215
(Z3) Specific Gravity	ASTM D297	±.03	1.8
Fluid Resistance (Basic Requirement)			
IRM 903, 70 hrs @ 302°F			
Volume Change, %	ASTM D471	+10	+2
(A1-10) Heat Age			
70 hrs. @ 482°F			
Hardness Change, pts.	ASTM D573	+10	+3
Tensile Strength Change, %		-25	-22
Ultimate Elongation Change, %		-25	+8
(B38) Compression Set (Plied)			
22 hrs. @ 392°F			
Percent of Original Deflection, Max	ASTM D395 Method B	50	13
(E078) Fluid Resistance			
Service Fluid 101, 70 hrs @ 392°F			
Hardness Change, pts.	ASTM D471	-15 to +5	-8
Tensile Strength Change, %		-40	-6
Ultimate Elongation Change, %		-20	-1
Volume Change, %		0 to +15	+11
(Z4) Low Temperature Resistance			
TR-10, temperature °F , C	ASTM D1329	report	-22 (-30)

Parker O-Ring Division
2360 Palumbo Drive
Lexington, Ky 40509
(859) 269-2351

2 of 2

COMPOUND DATA SHEET

Parker O-Ring Division, North America

MATERIAL REPORT

Report Number: 118370
10/11/2013

Title: Evaluation of Parker Compound

Elastomer Type: Fluorocarbon (FKM) VM125-75

Purpose: To obtain typical test data.

Specification: ASTM D2000 M4HK714 A1-10 B38 EF31 EO78 F17 Z1 Z2 Z3 Z4
Z1= 75 ± 5 durometer
Z2 = Elongation min, 125%
Z3 = Specific Gravity
Z4 = TR-10

Color: Black

Recommended Temperature Range: -40°F to 400°F

Recommended For: Mineral oil and grease, IRM 901, IRM 902, IRM 903, nonflammable hydraulic fluids, silicone oils and greases, aliphatic hydrocarbons (propane, butane, natural gas), aromatic hydrocarbons (benzene, toluene), chlorinated hydrocarbons (trichloroethylene and carbon tetrachloride), gasoline, high vacuum, ozone, weather, and aging resistance

Not Recommended For: Glycol based brake fluids, ammonia gas, amines, alkalis, superheated steam, and low molecular weight organic acids (formic and acetic acids)

Additional Approvals: AMS-R-83485

REPORT DATA

Original Physical Properties	Test Method	Spec Limits	Results
(Z1) Hardness, Shore A, pts.	ASTM D2240	75 ±5	73
Tensile Strength, PSI (Mpa)	ASTM D412	2031 (14)	2301
(Z2) Ultimate Elongation, %	ASTM D412	125	280
(Z3) Specific Gravity	ASTM D297	1.76 ± 0.02	1.77
(A1-10) Heat Age			
70 hrs. @ 482°F (250°C)			
Hardness Change, pts.	ASTM D573	+10	-2
Tensile Strength Change, %		-25	-13
Ultimate Elongation Change, %		-25	-6
Compression Set (Plied)			
22 hrs. @ 347°F (175°C)			
Percent of Original Deflection, Max	ASTM D395 Method B	35	10
(B38) Compression Set (Plied)			
22 hrs. @ 392°F (200°C)			
Percent of Original Deflection, Max	ASTM D395 Method B	50	12
Fluid Immersion			
IRM 903, 70 hrs. @ 302°F (150°C)			
Volume Change, %	ASTM D471	+10	0
(EF31) Fluid Resistance			
Fuel C, 70 hrs @ 73°F (23°C)			
Hardness Change, pts.	ASTM D471	± 5	-5
Tensile Strength Change, %		-25	-18
Ultimate Elongation Change, %		-20	+5
Volume Change, %		0 to +10	+5
(E078) Fluid Resistance			
Service Fluid 101, 70 hrs @ 392°F			
Hardness Change, pts.	ASTM D471	-15 to +5	-5
Tensile Strength Change, %		-40	-14

Ultimate Elongation Change, %		-20	+10
Volume Change, %		0 to +15	+10
(F17) Low Temperature Brittleness			
Nonbrittle after 3 min @ -40°C	ASTM D2137	Pass	Pass
Low Temperature			
(Z4) TR-10, °C	ASTM D1329	Report	-29

4.5.3 Expansion Foam

This section contains the manufacturer's technical bulletin for the material used to allow for the expansion of the neutron shield as the cask heats up.

Foamega® Brand Cellular Silicones

New Products...New Versatility...New Applications

Foamega® Brand Cellular Silicones, a unique family of products, possess a wide range of physical properties that meet the challenging and demanding applications presented by industry.

Design engineers are recognizing that, because of their light weight, low compressibility and resistance to compression set, they are excellent for gasketing, sealing, sound and vibration damping and thermal insulation.

Foamega offers many exceptional properties and characteristics:

- Withstands extremes in chemical and climatic environments.
- Maintains flexibility and compressibility over a temperature range of −65°F to +450°F.
- Is inherently inert and stable, non-degradable, and ozone and UV-resistant.
- Certain grades are UL-recognized for flame resistance and produce no toxic by-products upon forced combustion.
- Minimal water absorption, maximum 5 percent.
- Easy application to all surfaces, using silicone bonding adhesives; also available with either acrylic or silicone pressure-sensitive adhesives.
- Non-corrosive to metal surfaces.
- Available 1/16" to 1" thick (no laminations) in continuous lengths, 36" wide. Continuous length allows for the most efficient utilization of material during conversion or fabrication into pre-cut shapes or gasket stripping.

Typical Physical Properties

Product	Density Lbs./Ft.³ (Typical)	Compression Deflection 25%@25°C Psi	Compression Set 50%/22 Hr./212°F % (Max.)	Tensile Strength Psi (Min.)	Elongation % (Min.)	Color
Low Density/Flame Retardant FOAM HT-803	14	3-7	10	35	100	White
General Purpose SPONGE HT-800 Medium	22	6-14	15	35	80	Red Grey
HT-820 Firm	26	12-20	15	40	60	Black
Low Compression Set SPONGE HT-810 Medium	22	6-14	5	35	80	Red Grey
HT-830 Soft	16	2-7	5	35	80	Black
Low Compression Set/Flame Retardant SPONGE HT-860 Medium	22	6-14	5	26	80	Red Grey
HT-870 Soft	16	2-7	5	25	60	Blue

Specifications

Product	AMS 3195	AMS 3196	MIL R 6130 Type II, Gr. B&C	MIL-R-46089	Boeing BMS 1-23	Boeing BMS 1-60	Boeing BMS 1-60C	Douglas DMS 1897	Douglas DMS 1880	Lockheed LAC 25-064	Lockheed STM-25-401	General Dynamics F-0071	UL 1370	UL 1371	UL 1372
HT-803							X								
HT-800	X		X		X			X			X	X	X	X	X
HT-820		X						X			X	X			
HT-810	X		X	X								X			
HT-830												X			
HT-860	X		X			X			X	X			X	X	X
HT-870						X			X	X					

Tolerances

Size	Tolerance
1/16"	+1/32—1/64
1/8"	±1/32
3/16"	±1/32
1/4"	+3/64—1/32
3/8"	±1/16
1/2"	±1/8
5/8"	±1/8
3/4"	±5/32
1"	±13/64

. . . the High-Performance Silicone with 10 Ways to Improve Product Performance

1 Insulates in two ways—against electrical current and against heat and cold. Foamega has good dielectric properties that make it ideal for applications requiring electrical insulation, *plus* thermal insulation and one or more of Foamega's other attributes—in computers and other electronic equipment, in microwave ovens and other appliances, in lighting fixtures and in numerous other applications. Its low thermal conductivity gives Foamega an advantage when it is used as gasketing around metal window and door frames and between metal and glazing.

2 Handles heat and cold in a range from −65°F to +450°F. While other materials tend to become dry and brittle and to disintegrate when subjected to heat, Foamega retains its form and density. Foamega HT-603 and HT-850 are UL-listed for fire resistance, are self-extinguishing in a maximum of 10-15 seconds under forced combustion, and produce no toxic by-products. They are quite possibly the best materials for use as fire barriers in automobiles, as bulkhead seals and fire stops in aircraft, as a backup to upholstery and slipcover materials used in aircraft, automobiles, hotels and motels, hospitals and other institutions. In applications requiring heat-resistance, non-combustibility and freedom from dangerous fumes and gases, Foamega proves its value in saving lives and property.

3 Stands up to pressure. Low compression set at high and low temperatures is one of the reasons Foamega makes such excellent gasketing for engine exhaust manifolds, cooling systems and other high-temperature, high-pressure applications.

4 Cushions vibration and stops the wear and tear it can cause. Vibrational damping in aircraft, in automobile steering systems, in air conditioners and other appliances, in laboratory instruments and in hundreds of other applications is an important Foamega contribution. Wherever vibrations can cause a potential hazard, an interference with operation of other systems or merely an annoyance, look to Foamega for a most-efficient solution.

5 Quiets noise. Foamega foam and sponge are not only sound-absorptive by nature, they also provide one of the best means for stopping the distracting, irritating noises of hard surfaces contacting hard surfaces. Automobile dash panels, for example, often hide a potential for squeaks and rattles that need not exist—with Foamega "treatment."

6 Dams water damage. Foamega does not absorb water and provides an impermeable barrier to water incursion when used as washers, "O" rings and other forms of gasketing. Being non-conductive and non-corrosive also, it is perfect for water seals around electrical and electronic components. For watercraft, it is highly effective in making hatches and portholes watertight. For automobiles, it provides a moisture barrier around windshields and other glass. Sidelight: Foamega is also impervious to fungus, insect infestation and rodent damage.

7 Resists chemicals. Foamega is inherently inert and stable and is non-degradable in most chemicals. It resists ozone and UV radiation (Bisco silicone products are used for nuclear shielding in hundreds of nuclear power plants.) For these reasons it is able to perform in environments that rule out use of many other materials.

8 Keeps out weather in all its forms—heat, cold, wind, rain and snow. Foamega's low level of thermal conductivity, its non-water absorptive qualities, and its ability to form a tight seal recommend its use for gasketing building components, lighting fixtures and other items requiring a tight weather seal.

9 Stays flexible at temperatures as low as −100°F and as high as 500°F.

10 Installs easily by means of silicone adhesive bonding. Additionally, all Foamega products come with either acrylic (350°F) or silicone (450°F) pressure-sensitive adhesive pre-applied.

Foamega—a complex of benefits

When you use Foamega for any of the above reasons, you get a combination of advantages—not merely the one you seek. For example: use Foamega for thermal insulation between glass and metal and you also get excellent vibration damping that can prevent fracturing of glass. Use it as a weather barrier on electronics exposed to the elements and you gain insulation values as well.

Few, if any, other materials offer the multiple advantages of Foamega.

How can Foamega help you?

Only a limited number of Foamega's applications are mentioned here. Hundreds more are possible, depending on your needs and imagination. Agencies like NASA and DOT are presently evaluating Foamega for fireblocking and related applications.

Bisco Products stands ready to help you—with evaluating your present products in terms of Foamega capabilities, and with custom design and engineering services.

We welcome your inquiry.

bisco
One of the Brand Companies

bisco products, inc.
1420 renaissance drive
park ridge, illinois 60068
(312) 298-1200
telex 282482

The properties listed herein are typical values and should not be used for writing specifications.

8/86 7.5 M

4.5.4 Fiberfrax Ceramic Fiber Paper

This section contains the manufacturer's technical data for the material used to preclude a lead melt during fabrication welding or a fire accident.

UNIFRAX Product Information Sheet

Fiberfrax® Ceramic Fiber Paper

Introduction

The Fiberfrax® ceramic fiber paper product line is a unique family of products which is manufactured by forming aluminosilicate fibers in a nonwoven matrix. The ceramic fibers are randomly orientated during manufacture, then held in place with a latex binder system. A specialized paper-making process is statistically controlled to form uniform, lightweight, flexible sheets.

Unifrax Corporation has been producing Fiberfrax papers for over 25 years and is the largest ceramic fiber producer worldwide with in-house paper-making capabilities.

By blending different fibers, binders, and additives while varying the manufacturing process, Unifrax Corporation now produces a variety of Fiberfrax paper products for a wide range of applications.

Fiberfrax papers exhibit excellent chemical stability, resisting attack from most corrosive agents. Exceptions are hydrofluoric, phosphoric acids and concentrated alkalies. If Fiberfrax papers are wet by water or steam, all thermal and physical properties are completely restored upon drying. No water of hydration is present in most Fiberfrax paper grades. Fiberfrax papers have good dielectric strengths.

Fiberfrax papers, with the exception of the inorganic series, will generate small amounts of smoke and trace element outgassing during the initial exposure to temperatures above 450°F.

Product Line Advantages

Fiberfrax ceramic fiber papers offer our customers many unique problem-solving advantages which include:

- High-temperature stability
- Low thermal conductivity
- Low heat storage
- Weight reduction
- Resiliency
- Thermal shock resistance
- High heat reflectance
- Good dielectric strength
- Excellent corrosion resistance
- Easy to wrap, shape, or cut
- Ease of fabrication

General Uses of Fiberfrax Papers

Fiberfrax papers are used to solve a wide variety of heat-related problems, and are used as:

- Highly efficient refractory backup
- Dependable fire protection
- Thermal insulation
- Hot gas filtration media
- Molten metal splash and spark protection
- High-temperature gasket, separator, or parting agent

Typical Markets/Applications

Based on the uses listed in the preceding text, Fiberfrax papers solve a range of application problems in the industries listed below:

Aerospace
- Heat shields
- Nose cone ablative shields
- Igniter line protection
- Oxygen generators

Appliance
- Self-cleaning ovens
- Woodburning stoves
- Electrical heaters
- Mobile home appliance insulation

Ceramic and Glass
- Ware separator
- Metal clad brick gaskets
- Glass tank refractory backup

Petrochemical
- Transfer line protection
- Welding
- Brazing protection

Automotive
- Muffler insulation
- Heat shielding

Steel and Nonferrous
- Investment casting mold wrapping
- Ladle refractory backup
- Thermocouple tube protection
- Heat treating parting agent
- Foundry gasketing
- Ladle shroud wrap

Refer to the product Material Safety Data Sheet (MSDS) for recommended work practices and other product safety information

UNIFRAX

Product Range

Product Segmentation

Fiberfrax ceramic fiber papers are differentiated by thickness, density, fiber index, and chemistry. They are often segmented into three groups:

- Utility grades, which include 440 and Rollboard paper, are the most cost-effective products in applications where performance characteristics are less critical.
- Standard grades: 550, 970, 880, and 110 paper are used where reliability and consistency are important.
- Premium grades: 882-H, 972-H, and HSA paper are used either when organic outgassing cannot be tolerated or when thermal performance is critical.

Utility Grade

440 Paper

440 paper is a low-cost, high-strength composite paper made from a combination of ceramic fiber, inert fillers, and reinforcing fiberglass. The fiberglass gives added strength to the 440 paper at operating temperatures between 450 and 1300°F. This product is formulated with a fire retardant smoke suppressant reducing the effects of the organic binder burnout.

Rollboard

The lower density, binder chemistry, and bulk ceramic fiber grade used to manufacture Fiberfrax Rollboard paper result in a product with lower cost, higher flexibility, and reduced smoke and odor during burnout. Rollboard paper is best suited for wrapping intricate shapes or molds and as a standard grade single use product in disposable applications.

Standard Grade

110 Paper

110 paper is a clay-filled, sheeted ceramic fiber paper which is denser and more rigid than other standard grade products. The rigidity is maintained even after burnout of the organic bonding agents. The good dielectric strength, compression resistance, and die cutting characteristics of 110 paper are advantageous in many high-temperature gasketing applications.

550 Paper

550 paper is made from unwashed high-purity ceramic fiber. Its higher density and binders give performance properties ideal for most refractory applications.

970 Paper

970 paper is made from high-purity Fiberfrax washed fiber. During the manufacture of this product, a large portion of the unfiberized particles in the bulk fiber are removed prior to paper lay-up. The washing of the fiber gives great uniformity to the paper's structure while reducing weight and improving the thermal performance; in addition, this product is preferred in automatic die stamping operations where unfiberized particles in the paper can lead to excessive die wear.

Premium Grade

880 Paper

880 paper is made from a higher alumina content, shorter, smaller diameter fiber and laid up at higher densities. These product parameters lead to reduced shrinkage, higher strength, an increased operating temperature range and better chemical resistivity. This product is used in applications where the service life of standard ceramic fiber papers is reduced.

HSA Paper

HSA paper is made from high surface area (HSA) fibers that contain a low percentage of unfiberized material. Use of this fiber results in a paper with lighter weight and extremely low thermal conductivity, making it the choice of the aerospace industry. It is also used when uniform pore structure and a low content of unfiberized material are required in applications such as glass contact or gas filtration.

Inorganic Papers

Fiberfrax papers are available without the organic binder system. These products are completely free of organics and used when higher fired strength is required or in processes and applications where even small amounts of organic burnout is unacceptable. Two temperature grades and several thicknesses and widths are available.

- 972-H is heat treated during the manufacturing process to remove organic binders. As manufactured, 972-H paper remains soft and flexible allowing it to conform to most shapes or contours.
- 882-H has higher temperature stability and higher density than 972-H Paper. The fiber geometry and product density lead to the maximum burn strength of an unbindered paper.

Certifications/Approvals

Fiberfrax papers have been independently tested for conformance to a wide variety of industry standards. For example, several Fiberfrax papers are listed as "Recognized Components" with Underwriters Laboratories, Inc.; conform to U.S. Coast Guard requirements for incombustible materials; and are tested in accordance with ASTM methods. For details of existing approvals and test procedures, contact the Unifrax Application Engineering Group at 716/278-3899.

Additional Capabilities

Unifrax has several manufacturing capabilities which can enhance the performance of Fiberfrax papers in a wide variety of applications. Utilizing precision high-speed slitters, Unifrax can slit paper materials down to one-inch (1") widths for installation speed and convenience. Material can be laminated, foil faced or adhesive backed to tailor the material form to specific application requirements.

Fiberfrax Ceramic Fiber Papers
Typical Product Properties

Paper Grade		440*	Roll Board	110	550	970	880	HSA	972-H	882-H	HSA** (OF)
Physical Properties											
Color		Gray	Off-White	Tan	White	White	White	White	White	White	White
Temperature Grade	°F	1600	2300	2300	2300	2300	2600	2300	2300	2600	2300
	°C	870	1260	1260	1260	1260	1427	1260	1260	1427	1260
Recommended Operating Temp.	°F	1300	2000	1900	2000	2000	2100	2000	2000	2100	2000
	°C	704	1100	1040	1100	1100	1150	1100	1100	1150	1100
Melting Point	°F	1800	3200	2800	3260	3260	3500	3100	3260	3500	3100
	°C	982	1760	1538	1793	1793	1927	1704	1793	1927	1704
Compression (PSI % Deformation)											
10%		5	1	1	4	1.3	—	3	—	—	—
25%		34	5	6	26	5.8	—	16	—	—	—
50%		489	32	35	167	22	—	44	—	—	—
Strength											
Tensile (PSI) (as manufactured)		86	58	147	102	94	136	55	—	—	—
Burst (PSI) (as manufactured)		45	22	19	248	25	—	37	—	—	—

Notes About Chart

*The 440 paper contains a fire retardant smoke suppressant.

**The HSA "OF" designation signifies materials made without the use of organic binders.

- "H" designation references the heat treating process used to remove organics.
- The recommended operating temperature of Fiberfrax insulation is determined by a maximum irreversible linear change criteria, not product melting point.

The test data shown are average results of tests conducted under standard procedures and are subject to variation. Results should not be used for specification purposes.

UNIFRAX

Page 3 of 4

Fiberfrax Ceramic Fiber Papers
Typical Product Parameters

Paper Grade	440*	Roll Board	110	550	970	880	HSA	972-H	882-H	HSA** (OF)
Physical Properties										
Density (pcf)	13	10	18	12	10	18	10	12	16	7
Fiber Index (% Wt)	n/a	40	n/a	50	70	45	100	70	45	100
LOI (incl. binder)	9.5	3.0	8.5	6.5	7.0	8.0	3.0	0.1	0.1	0.1
Chemistry (% Wt)										
Al_2O_3	32-35	47-52	45-50	47-52	47-52	58-60	47-52	47-52	58-60	47-52
SiO_2	42-46	48-53	40-44	48-53	48-53	40-42	47-52	48-53	40-42	47-52
Na_2O_3	<2	<0.5	<1.5	<0.5	<0.5	<0.3	<0.5	<0.5	<0.3	<0.5
Fe_2O_3	<2	<0.5	<1.1	<0.5	<0.5	<0.1	<0.05	<0.5	<0.1	<0.05
Thickness inches* (mm)**										
A = 1/32 (0.8)					X			X		
F = 1/16 (1.6)	X		X	X	X	X	X	X	X	
J = 1/8 (3.2)	X	X	X	X	X	X		X	X	X
K = 1/4 (6.35)				X						
Roll Sizes (std)	25#, Mill	Mill	Sheet	25#, Mill	10#, 25#, Mill	25#, Mill	Sheets	25#	10#, 25#	500sf
Width (std, inches)	24, 48	18, 24	42x48	24, 48	12, 24, 48	12, 24, 48	42x48	12, 24	12, 24	51

Availability

Nonstandard widths available upon request.

Notes About Chart

*The 440 paper contains a fire retardant smoke suppressant.

**The HSA "OF" designation signifies materials made without the use of organic binders.

***Measured under 4 PSF.

"H" designation references the heat-treating process used to remove organics.

For additional information about product performance or to identify the recommended product for your application, please contact the Unifrax Application Engineering Group at 716-278-3899.

Data are average results of tests conducted under standard procedures and are subject to variation. Results should not be used for specification purposes.

Form C-1423
Effective 11/00

Printed in USA

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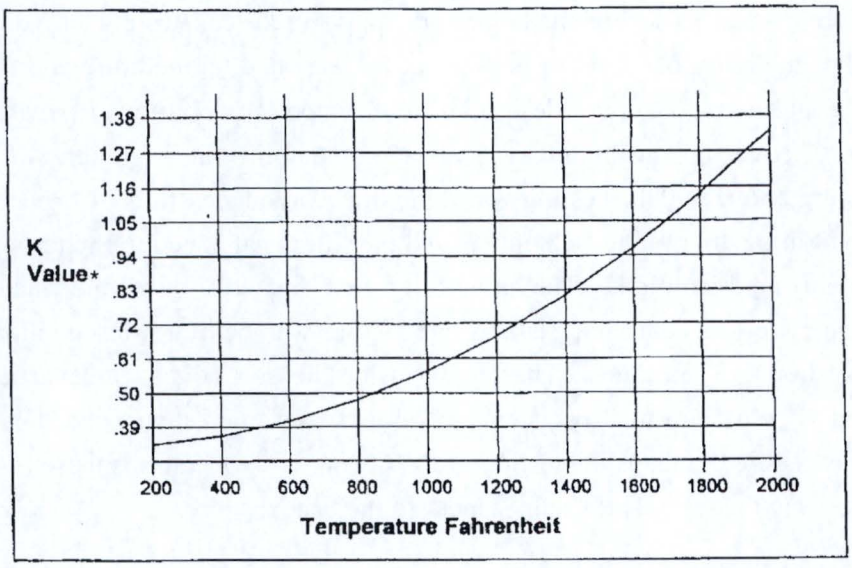
Unifrax Heatflow Calculation

970 Paper



Calculated Graph Points for 970 Paper

Deg F	200	400	600	800	1000	1200	1400	1600	1800
Deg C	93	204	316	427	538	649	760	871	982
K Val	00.334	00.362	00.410	00.480	00.570	00.682	00.815	00.969	01.144

*** Units for K Value are Btu/hr/in/ft^2/ F**

4.5.5 Viton O-rings

This appendix provides a description of the leak testing performed using the Viton O-rings at temperatures exceeding the manufacturer's elevated temperature limit. In addition, it also contains the O-ring manufacturer's material report on the Viton material.

NAC, with the aid of an independent laboratory, performed leak testing in excess of 550°F to demonstrate the capability of Viton to perform at the elevated temperature and to determine the leak rate of the alternate port cover design at the elevated temperature. It was determined that the alternate port cover O-ring maintains its sealing capability at a temperature of 575°F after prolonged heating above 400°F. Testing was done in accordance with NAC Specifications. Two fixtures were put into a thermal test chamber. All the fittings attached to the test assemblies were checked and confirmed leaktight. The assemblies were heated in a manner that conservatively approximates the fire-transient analysis and one fixture was held at a temperature above 550°F for more than 4 hours, 37 minutes. The region inside the port cover was evacuated to below 2 psia, backfilled with helium at 0 psig, evacuated and backfilled again and then leak checked. The leak test procedure emulates the testing of the O-ring with one atmosphere of pressure acting on the O-ring during the test. The data pertinent to the test is:

	Test Assembly 16	Test Assembly 64	Fire-Transient
Time Above 400°F	~6:32 hours	~5:52 hours	4:37 hours
Time Above 550°F	~5:05 hours	~4:25 hours	0 hours
Maximum Seal Temperature	~575°F	~575°F	547°F

The test temperature of 550°F was selected because it approximates the maximum calculated O-ring temperature in the fire-transient analysis. The duration was selected because it is the calculated duration that the O-ring is above the manufacturer's maximum recommended O-ring temperature of 400°F. This result in a conservative test due to the slower heat-up rate of the oven compared to the heat-up rate of the port cover in the fire-transient analysis.

Each test assembly was leak checked after the temperature test, while at a temperature of approximately 575°F. The measured leak rate for each of the assemblies was less than 4.0×10^{-8} atm-cc/sec. In conclusion, the Viton O-rings can provide a leaktight seal, in accordance with ANSI N14.5-1997, at an elevated temperature.

Sep-17-99 03:35P P.01

Parker Seals

Software Version: 2.0 9/17/99

Customer Identification

Company:	NAC International
Contact:	George Carver
Project Name:	
Address:	
City:	**Zip Code:**
State:	
Telephone No.:	770-447-1797 fax
Date/Time:	9-17-1999 15:27

Ordering Specifications

Application:	O-ring Only
Compound Number:	V0835-75
Size:	

Compound Information

Search Parameter

Material Selection Method:	Compound Search
Contained Media:	
Desired Temperature Range	
High:	
Low:	

Selected Material Information

Durometer (Shore A):	75
Polymer:	Fluorocarbon GLT - LOWTEMP COMPOUND.
Temperature	
Normal High:	400 °F
Extended High:	400 °F
Normal Low:	-40 °F
Color:	Black
Static Application Only:	No
Military Spec.:	MIL-R-83485
AMS NAS Spec.:	None
SAE/ASTM Spec.:	None

Seal Size Information

Sizing Selection Method:	Known: O-ring P/N. Search for: O-ring dimensions.

Sep-17-99 03:35P P.02

Compound Data Sheet
O-Ring Division United States

MATERIAL REPORT

REPORT NUMBER: KJ0835
DATE: 10/10/89

TITLE: Test of Parker Compound V0835-75 to MIL-R-83485, Type I.

PURPOSE: To determine if V0835-75 meets MIL-R-83485, Type I.

CONCLUSION: V0835-75 meets the above specification.

Parker O-Ring Division
2360 Palumbo Drive
Lexington, Kentucky 40509
(606) 269-2351

Sep-17-99 03:35P P.03

REPORT DATA

Report Number: KJ0835

ORIGINAL	MIL-R-83485 TYPE 1, O-RINGS & COMPRESSION SEALS	V0835-75 ACTUAL VALUES
Specific Gravity	As determined	1.75
Hardness points	75 ± 5	78
Tensile Strength, psi. min.	1600	1708
Elongation, % min.	120	180
Temperature Retraction, 10% (TR-10), °F, max.	-20	-22
AFTER AIR AGING, 70 HRS.@ 75° + 5°F. Compression Set		
% of original deflection, max.	25	-- (14)
AFTER AGING, 70 HRS. @ 75°F IN TT-S-735, TYPE III		
Hardness Change, pts.	+5	77 (-1)
Tensile Strength decrease, %, max.	30	1662 (-3)
Elongation decrease, %, max.	20	165 (-8)
Volume change, %, max.	1 to 10	-- (+2)
AFTER AIR AGING, 70 HRS. @ 528° ± 5°F		
Hardness change, pts.	+5	78 (0)
Tensile Strength decrease, % max.	35	1136 (-33)
Elongation decrease, %, max.	10	235 (+31)
Weight loss, %, max.	12	-- (-7)
AFTER AIR AGING, 166 HRS @ 347° ± 5°F, COMPRESSION SET		
% of original deflection, max.	25	-- (15)
18 hrs. cooling		-- (24)
AFTER AIR AGING, 22 HRS @ 392° ± 5°F, COMPRESSION SET		
% of original deflection, max.	20	-- (11)

Sep-17-99 03:35P P.04

AFTER AGING, 70 HRS. @ 347°MIL-R-83485 ±5°F in AMS-3021	MIL-R-83485 TYPE 1, O-RINGS % COMPRESSION SEALS	V0835-75 ACTUAL VALUES
Hardness change, pts	+0, -15	73
Tensile Strength decrease, %, max.	35	1406 (-18)
Elongation decrease, %, max.	20	171 (-5)
Volume change, %	1 to 20	-- (+15)
Compression set, % of original deflection, max.	10	-- 7
18 hr. cooling		-- 9

4.5.6 Sample SAS2H Input File

This section provides a sample SAS2H input file employed in the containment analysis of the directly loaded 17×17 fuel at 60,000 MWD/MTU and 3.5 wt % ^{235}U.

Sample File

```
=SAS2H       PARM=(HALT09,SKIPSHIPDATA)
Class 1 - aa17b - STC Hybrid17 (Rev 0) - 3.5 w/o U235, 60000 MWD/MTU, 5 - 16 years cool time
27GROUPNDF4 LATTICECELL
UO2         1 0.943 900 92235 3.5 92238 96.5 END
ZIRCALLOY   2 1.0 620 END
H2O         3 DEN=0.725 1.0 580 END
ARBM-BORMOD 0.725 1 1 0 0 5000 100 3 550.0E-6 580 END
ZIRCALLOY   4 1.0 580 END
H2O         5 DEN=0.725 0.9772 580 END
ZIRCALLOY   5 0.0228 580 END
END COMP
SQUAREPITCH 1.2598 0.8192 1 3 0.9500 2 0.8360 0 END
NPIN=264 FUEL=365.760 NCYC=3 NLIB=3 PRIN=6 LIGH=5
INPL=1 NUMH=24 NUMI=1 MXTUBE=4 ORTU=0.6025 SRTU=0.5644 END
POWER=18.5535 BURN=499.7636 DOWN=60 END
POWER=18.5535 BURN=499.7636 DOWN=60 END
POWER=18.5535 BURN=499.7636 DOWN=1461 END
FE 0.6738 CR 0.1900 NI 0.1150 MN 0.0200 CO 0.0012
END
=ORIGENS
0$$  A4 21 A8 26 A10 51 71  E
1$$  1 1T
COOLING 5 - 16 YEARS AND FISSION PRODUCT GAMMA REBIN
3$$  21 0 1 28 A33 22 E
54$$  A8 1 E T
35$$  0 T
56$$  0 9 A13 -2 5 3 E
57**  4.0 E T
COOLING 5 - 16 YEARS AND FISSION PRODUCT GAMMA REBIN
SINGLE REACTOR ASSEMBLY
60** 5.0 6.0 7.0 8.0 9.0 10.0 12.0 14.0 16.0
65$$  A4 1 A7 1 A10 1 A25 1 A28 1 A31 1 A46 1 A49 1 A52 1 E
61**  F.00000001
81$$  2 51 26 1 E
82$$  F6
83**  1.40e+7  1.20e+7  1.00e+7  8.00e+6   6.50e+6  5.00e+6
      4.00e+6  3.00e+6  2.50e+6  2.00e+6   1.66e+6  1.44e+6
      1.22e+6  1.00e+6  0.80e+6  0.60e+6   0.40e+6  0.30e+6
      0.20e+6  0.10e+6  0.05e+6  0.02e+6   0.01e+6
84**  1.46e+7  1.36e+7  1.25e+7  1.125e+7  1.00e+7
      8.25e+6  7.00e+6  6.07e+6  4.72e+6   3.68e+6
      2.87e+6  1.74e+6  0.64e+6  0.39e+6   0.11e+6
      6.74e+4  2.48e+4  9.12e+3  2.95e+3   9.61e+2
      3.54e+2  1.66e+2  4.81e+1  1.60e+1   4.00e+0
      1.50e+0  5.50e-1  7.09e-2  1.00e-5   T
FISSION PRODUCT GAMMA SPECTRA IN AEA GROUPS
FISSION PRODUCT GAMMA SPECTRA IN AEA GROUPS
FISSION PRODUCT GAMMA SPECTRA IN AEA GROUPS
FISSION PRODUCT GAMMA SPECTRA IN AEA GROUPS
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FISSION PRODUCT GAMMA SPECTRA IN AEA GROUPS
FISSION PRODUCT GAMMA SPECTRA IN AEA GROUPS
56$$ F0  T
END
=ORIGENS
0$$  A4 21 A8 26 A10 51 71  E
1$$  1 1T
COOLING 5 - 16 YEARS AND ACTINIDE GAMMA REBIN
3$$  21 0 1 28 A33 22 E
```

Sample Input File (Continued)

```
54$$  A8 1 E T
35$$  0 T
56$$  0 9 A13 -2 5 3 E
57**  4.0 E T
COOLING 5 - 16 YEARS AND ACTINIDE GAMMA REBIN
SINGLE REACTOR ASSEMBLY
60** 5.0 6.0 7.0 8.0 9.0 10.0 12.0 14.0 16.0
65$$  A4 1 A7 1 A10 1 A25 1 A28 1 A31 1 A46 1 A49 1 A52 1 E
61**  F.00000001
81$$  2 51 26 1 E
82$$  F5
83**  1.40e+7  1.20e+7  1.00e+7  8.00e+6   6.50e+6  5.00e+6
      4.00e+6  3.00e+6  2.50e+6  2.00e+6   1.66e+6  1.44e+6
      1.22e+6  1.00e+6  0.80e+6  0.60e+6   0.40e+6  0.30e+6
      0.20e+6  0.10e+6  0.05e+6  0.02e+6   0.01e+6
84**  1.46e+7  1.36e+7  1.25e+7  1.125e+7  1.00e+7
      8.25e+6  7.00e+6  6.07e+6  4.72e+6   3.68e+6
      2.87e+6  1.74e+6  0.64e+6  0.39e+6   0.11e+6
      6.74e+4  2.48e+4  9.12e+3  2.95e+3   9.61e+2
      3.54e+2  1.66e+2  4.81e+1  1.60e+1   4.00e+0
      1.50e+0  5.50e-1  7.09e-2  1.00e-5   T
ACTINIDE GAMMA SPECTRA IN AEA GROUPS
ACTINIDE GAMMA SPECTRA IN AEA GROUPS
ACTINIDE GAMMA SPECTRA IN AEA GROUPS
ACTINIDE GAMMA SPECTRA IN AEA GROUPS
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ACTINIDE GAMMA SPECTRA IN AEA GROUPS
ACTINIDE GAMMA SPECTRA IN AEA GROUPS
ACTINIDE GAMMA SPECTRA IN AEA GROUPS
56$$ F0  T
END
=ORIGENS
0$$  A4 21 A8 26 A10 51 71  E
1$$  1 1T
COOLING 5 - 16 YEARS AND LIGHT ELEMENT GAMMA REBIN
3$$  21 0 1 28 A33 22 E
54$$  A8 1 E T
35$$  0 T
56$$  0 9 A13 -2 5 3 E
57**  4.0 E T
COOLING 5 - 16 YEARS AND LIGHT ELEMENT GAMMA REBIN
SINGLE REACTOR ASSEMBLY
60** 5.0 6.0 7.0 8.0 9.0 10.0 12.0 14.0 16.0
65$$  A4 1 A7 1 A10 1 A25 1 A28 1 A31 1 A46 1 A49 1 A52 1 E
61**  F.00000001
81$$  2 51 26 1 E
82$$  F4
83**  1.40e+7  1.20e+7  1.00e+7  8.00e+6   6.50e+6  5.00e+6
      4.00e+6  3.00e+6  2.50e+6  2.00e+6   1.66e+6  1.44e+6
      1.22e+6  1.00e+6  0.80e+6  0.60e+6   0.40e+6  0.30e+6
      0.20e+6  0.10e+6  0.05e+6  0.02e+6   0.01e+6
84**  1.46e+7  1.36e+7  1.25e+7  1.125e+7  1.00e+7
      8.25e+6  7.00e+6  6.07e+6  4.72e+6   3.68e+6
      2.87e+6  1.74e+6  0.64e+6  0.39e+6   0.11e+6
      6.74e+4  2.48e+4  9.12e+3  2.95e+3   9.61e+2
      3.54e+2  1.66e+2  4.81e+1  1.60e+1   4.00e+0
      1.50e+0  5.50e-1  7.09e-2  1.00e-5   T
LIGHT ELEMENT AEA GROUP STRUCTURE
LIGHT ELEMENT AEA GROUP STRUCTURE
LIGHT ELEMENT AEA GROUP STRUCTURE
LIGHT ELEMENT AEA GROUP STRUCTURE
LIGHT ELEMENT AEA GROUP STRUCTURE
LIGHT ELEMENT AEA GROUP STRUCTURE
LIGHT ELEMENT AEA GROUP STRUCTURE
LIGHT ELEMENT AEA GROUP STRUCTURE
LIGHT ELEMENT AEA GROUP STRUCTURE
56$$ F0  T
END
```