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**WANL-TME-2764
JANUARY 1971**

MASTER

DATA ITEM S-47

**MASS PROPERTIES ANALYSIS
REPORT
NUCLEAR SUBSYSTEM (U)**

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DATA ITEM S-47

**MASS PROPERTIES ANALYSIS
REPORT
NUCLEAR SUBSYSTEM (U)**

APPROVED BY:

F. D. Retallick
F. D. Retallick, Manager
NERVA Engineering

EXCLUDED FROM AUTOMATIC DOWNGRADING

INFORMATION CATEGORY

1-12

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ABSTRACT

This document describes the weight, center-of-gravity, and mass moments of inertia for the NERVA Nuclear Subsystem. The data are based on the configuration shown on WANL Drawing 939J740 and are prepared in support of the NSS Preliminary Design Review.

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1.0 INTRODUCTION

The purpose of this Mass Properties Analysis Report is to document the weights, the center-of-gravity and mass moment-of-inertia of the Nuclear Subsystem (NSS) and its Engineering Critical Components.

The mass properties data listed in this report are based upon the derivation of the mass properties needed for nuclear performance analysis and the specification of shield mass requirements from the Internal Shielding analysis.

The mass properties data is used for continuous evaluation, assessment, and allocation of the NSS weight against the specification goals. The primary emphasis is to minimize the Nuclear Subsystem weight consistent with reliability requirements. In addition, the weight, center-of-gravity and moments of inertia will be used in systems, subsystems, and component structural analysis where maneuvers, "g" loads, and accelerations are applied during assembly, handling, transportation, and launch and space operation.

The data included herein will be updated consistent with design maturity during the program life cycle.

2.0 NUCLEAR SUBSYSTEM

2.1 INTRODUCTION

The Nuclear Subsystem consists of a hydrogen cooled, graphite moderated, intermediate neutron energy reactor, its instrumentation, and its associated reactivity control devices consisting of neutron absorbing control drums with their actuation system and the Structural Support Coolant Assembly.

The subsystem includes engineering critical components as defined in the NERVA Engine Specification Tree, SNPO-C-ST-1, and the NSS CEI Specification, CP-677555.

These Engineering Critical Components include the Fuel Elements, Cluster Hardware, Core Periphery, Support Plate and Plena, Internal Shield, Reflector Assembly, Control Drum Drive Assembly, Structural Support Coolant Valve, the Structural Support Coolant Valve Actuator, the NSS Instrumentation and the Neutron Source.

2.2 METHOD OF ANALYSIS

As outlined in the following chapters, the weights of the components have been estimated or calculated at the component level to accommodate either the composite or graphite core Nuclear Subsystem. The weights and mass properties are for the configurations as defined on the tables and are based upon the following:

- a. Anticriticality poison wires weights are listed separate from the NSS since these are defined as an AGE item and not launched with the NSS.
- b. Weights and mass properties are for dry NSS, i.e., without hydrogen propellant.
- c. SSCV target and design weights are defined by ANSC, but target weights are included in NSS totals in accordance with the specification tree.

The weights and mass properties analysis for the NSS are made up from the selected component design configurations shown on Drawing 939J740.

These selected components are defined in the following ECC chapters. The Engineering Critical Components within the Nuclear Subsystem have been classified as Category A, B or C components based upon the following definition:

Category A	Conceptual evaluation has or will indicate single component design can be developed for R-1 meeting all 10-hour requirements.
Category B	Conceptual evaluation has or will indicate further investigation of alternates is needed, but with selection of one design needed prior to PDR.
Category C	Conceptual evaluation has or will indicate component design concepts are uncertain to such an extent that two or more concepts will probably have to be carried to PDR and possibly into R-1 as well as considering alternates aimed at R-2.

The weights of the alternates that are not shown on the NSS assembly drawing 939J740 have also been determined. These weights are listed on tables in the ECC chapters.

2.3 MASS PROPERTIES SUMMARY

2.3.1 Weights

The target weights for the Nuclear Subsystem with either the graphite or composite material core are shown on Table 2-1. The target weight for the ECCs are listed below the NSS in the same table. Due to the directive that the NSS component design and analysis be based upon the worst case with the composite or graphite material core, the target weights of the majority of ECCs are the same for either core material.

The current design weights for NSS and its Engineering Critical Components are summarized on Table 2-2.

2.3.2 Centers-of-Gravity and Mass Moments-of-Inertia

The center of gravity and moments of inertia are supplied for the composite core NSS only as defined on Table 2-3. These were calculated using the weight and centers of gravity of the NSS without the SSCA, since the SSCA hardware location and orientation is defined by ANSC. These properties were determined for the NSS with all poison wires removed.

The values for the center-of-gravity and mass moments were calculated for a previous NSS weight of 15,524 lbs. Since this is only 51 lbs. heavier than the latest calculated design weight, the change in center-of-gravity and mass properties will be quite small and was not recalculated. After specific alternates are selected for the Category C components at PDR, the NSS center-of-gravity and moments of inertia will be recalculated.

The location of the center of gravity of that portion of the NSS within or upon the pressure vessel is based upon engine station locations as defined in Figure 2-1.

TABLE 2-1
NSS TARGET WEIGHT SUMMARY

	<u>Composite Core</u> <u>Lbs.</u>	<u>Graphite Core</u> <u>Lbs.</u>
Nuclear Subsystem	15,017	13,522
Fuel Elements	5,165	3,670
Cluster Hardware	975	975
Core Periphery	455	455
Support Plate and Plena	850	850
Internal Shield	3,275	3,275
Reflector Assembly	3,750	3,750
Control Drum Drive Assembly	305	305
SSCVs (2)	60	60
SSCV Actuators (2)	32	32
Instrumentation	150	150

TABLE 2-2
CURRENT DESIGN WEIGHTS

	<u>Part Name</u>	<u>Weight, Lbs.</u>
2.0	Nuclear Subsystem (939J740)	15505
3.0	Fuel Elements (Composite)	5190
4.0	Cluster Hardware	1019
5.0	Core Periphery	447
6.0	Support Plate & Plena	905
7.0	Internal Shield	3237
8.0	Reflector Assembly	3947
9.0	Control Drum Drive Assembly	452
10.0	Structural Support Coolant Assembly	---
	Structural Support Coolant Valves (2)	---
	Structural Support Coolant Valve Actuators (2)	31
11.0	Instrumentation	275
12.0	Miscellaneous	
	Poison Wires	164
	Neutron Source	2

TABLE 2-3
CENTER OF GRAVITY AND MASS MOMENTS OF INERTIA

<u>CEI</u>	<u>Part No.</u>	NSS ⁽²⁾ Weights lbs	Center of Gravity (in.)			Moment of Inertia ⁽¹⁾		
						Slug - Ft ²		
			<u>X</u>	<u>Y</u>	<u>Z</u>	<u>I_x</u>	<u>I_y</u>	<u>I_z</u>
Nuclear Subsystem	939J740	15,524	143.79	0	0	1,212	2,660	2,660

(1) About Center of Gravity of NSS

(2) Without SSCA

ENGINE DATUM ORIENTATION

Figure 2-1

3.0 FUEL ELEMENTS

3.1 INTRODUCTION

This Engineering Critical Component includes the central support elements and the fuel elements of various nuclear loadings. The Fuel Elements, in conjunction with the Cluster Hardware and Core Periphery, comprise the reactor core. The Fuel Elements are supported in cluster arrays by the Cluster Hardware and bounded by the Core Periphery. The fuel elements receive the propellant from the core inlet plenum and exhaust it to the thrust chamber.

3.2 WEIGHT SUMMARY

The target weights for this ECC are 5,165 lbs. if composite material is used and 3,670 lbs. if graphite material is used in the elements. This is classified as a Category C component.

The current design weights for this ECC are shown on Table 3-1. The detailed weight breakdown of the alternates are shown on Table 3-2 and Table 3-3. Also shown on these tables is the design used in the analysis (drawing number, materials and densities).

TABLE 3-1

DESIGN WEIGHT SUMMARY
ENGINEERING CRITICAL COMPONENT

FUEL ELEMENTS - EC 677566

<u>Nomenclature</u>	<u>Drawing No.</u>	<u>Group No.</u>	<u>Weight Lbs.</u>	<u>One Std. Deviation, Lbs.</u>
Composite Material				
Fuel Elements	947C844	--	4,603	
Support Elements	947C843	--	<u>587</u>	
		Total	5,190	78
Alternate No. 1:				
Graphite Material				
Fuel Elements	947C617	--	3,345	
Support Elements	947C618	--	<u>381</u>	
		Total	3,726	56

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TABLE 3-2
DESIGN WEIGHT ANDSystem: NSSPrepared By: R. V. RittenbergerECC: Fuel ElementDate: 11/24/70Dwg. No: 947C844 Group *

Revision: _____

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
(C) 1	Fuel Element	Fueled Composite PDS-30253-1	0.14227	17.2270	1	2.451	1878	4602.75	
	* The data are for a fuel element with an average uranium loading.								

Superscripts Refer to Items Listed on Sheet _____

Sheet 1 of 2

TABLE 3-2 ()
DESIGN WEIGHT ANALYSIS SHEET

System: NSS

Prepared By: R. V. Rittenberger

ECC: Fuel Element

Date: 11/24/70

Dwg. No: 947C843 Group *

Revision: _____

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
(C) 1	Support Element	Composite PDS-30254-1	0.11982	14.042	1	1.683	349	587.19	
	* The data are for an average support element regardless whether instrumented or uninstrumented.								

Supplement to Remarks Listed on Sheet _____

Sheet 2 of 2

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TABLE 3-3

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DESIGN WEIGHT ANALYSIS SHEET

System: NSS

Prepared By: R. V. Rittenberger

ECC: Fuel Elements

Date: 11/24/70

Dwg. No: 947C617 Group *

Revision:

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
(C) 1	Fuel Element * The data are for a fuel element with an average uranium loading.	Fueled Graphite PDS-30255-1	0.102138	17.4366	1	1.781	1878	3344.60	

Supp. ~~CONFIDENTIAL~~ Sheet

~~CONFIDENTIAL~~ Sheet 1 of 2

TABLE 3-3 (Continued)
DESIGN WEIGHT ANALYSIS SHEET

System: NSS

Prepared By: R. V. Rittenberger

ECC: Fuel Element

Date: 11/24/70

Dwg. No: 947C618 Group *

Revision:

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
(C) 1	Support Element	Graphite PDS-30256-1	.077274	14.12595	1	1.092	349	380.95	
	* The data are for an average support element regardless whether instrumented or uninstrumented.								

Supplies never returned on Sheet

Sheet 2 of 2

4.0 CLUSTER HARDWARE

4.1 INTRODUCTION

The Cluster Hardware consists of an arrangement of parts that provide axial support for the core elements and a means to provide a hydrogen inventory that can be changed by varying flow to vary reactivity. This equipment includes, for each fuel cluster, a counter flow structural support assembly, fixed impedance flow metering components, thermal insulators, flow screens, cold end structural parts and hot end hardware.

4.2 WEIGHT SUMMARY

The target weight for the Cluster Hardware is 975 lbs. for either the Composite or Graphite Core Material. This is classified as a Category C component.

The current design weights for this ECC is shown on Table 4-1. The detailed weight breakdown for the alternates are shown on Table 4-2 through Table 4-5 inclusive. Also defined on these tables are the design used in the analysis (drawing number, materials, and densities).

TABLE 4-1

DESIGN WEIGHT SUMMARY
ENGINEERING CRITICAL COMPONENT

CLUSTER HARDWARE - EC 677558

<u>Nomenclature</u>	<u>Drawing No.</u>	<u>Group No.</u>	<u>Weight, Lbs.</u>	<u>One Std. Deviation, Lbs.</u>
Shown on 939J740:				
Cluster Hardware	939J738	G02	1019	21
Alternate No. 1				
Cluster Hardware	939J738	G01	1099	25
Alternate No. 2				
Cluster Hardware	939J739	G02	1072	22
Alternate No. 3				
Cluster Hardware	939J739	G01	1158	28

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TABLE 4-2
DESIGN WEIGHT ANALYSIS SHEET

System: NSS

Prepared By: R. Lampe

ECC: Cluster Hardware (Shown on 939J740)

Date: November 9, 1970

Dwg. No: 939J738 Group G02

Revision: _____

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
(C) 1	Tube, Liner	CRES PDS 30257-2	0.287	1.07	1	.307	349	107.2	
2	Nut, Support	CRES (A-286)	0.287	0.213	1	.06113	349	21.3	
3	Cap, Closure	CRES (A-286)	0.287	0.168	1	.0482	349	16.8	
4	Ring, Orifice	CRES (304 Cond. A)	0.287	0.0100	1	.00287	349	1.00	
(C) 5	Stem, Support	CRES PDS 30257-2	0.287	0.896	1	.25715	349	89.75	
6	Seal, Cap	CRES (A-286)	0.287	0.00356	1	.00102	349	0.356	
7	Screw, Closure Cap	Thoriated Tungsten	0.689	0.029	1	.01998	349	6.98	

Superscripts refer to Remarks Listed on Sheet _____

Sheet 1 of 9

TABLE 4-2 (Cont.)
DESIGN WEIGHT ANALYSIS

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System: NSS

ECC: Cluster Hardware

Dwg. No: 939J738 Group G02

Prepared By: R. Lampe

Date: November 9, 1970

Revision: _____

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
8	Cap, Protection	Thoriated Tungsten	0.689	0.120	1	.0827	349	28.9	
10	Cap, Insulating	Pyro-Graphite	0.079	0.019	1	.00861	349	3.01	
11	Cup, Insulating	Pyro-Graphite	0.079	0.123	1	.00972	349	3.39	
12	Washer, Insulating	Pyro-Graphite	0.079	0.0217	1	.00171	349	0.598	
13	Pin, Stem Locking-.0781 Dia.	CRES (304 Cond. A)	0.287	0.00105	1	.000301	349	0.105	
14	Sleeve, Forward Insulating	Pyro-Graphite	0.079	0.239	1	.0189	349	6.59	
15	Sleeve, Insulating	Pyro-Graphite	0.079	0.279	11	.0220	349	84.5	

Superscripts Refer to Remarks Listed on Sheet _____

Sheet 2 of 9

TABLE 4-2 (Cont.)
DESIGN WEIGHT ANALYSIS SHEET

System: NSS

Prepared By: R. Lampe

ECC: Cluster Hardware

Date: November 9, 1970

Dwg. No: 939J738 Group G02

Revision: _____

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
16	Sleeve, Aft Insulating	Pyro- Graphite	0.079	0.190	1	.0150	349	5.24	
17	Tube, Sealing	Pyrofoil	0.041	0.0204	1	.00084	349	0.292	
18	Tube, Spacer	CRES (304 Cond.A)	0.287	0.0623	1	.0179	349	6.24	
19	Sleeve, Threaded	Moly-TZM	0.369	0.155	1	.0572	349	20.0	
20	Jet, Threaded Orifice	Moly-TZM	0.369	0.0207	1	.00764	1878	14.3	
21	Jet, Orifice	Moly-TZM	0.369	0.00182	18	.00067	33804	22.7	
22	Spring, Disc - .492 OD x .244 ID x .028 Thick	CRES-302	0.286	0.00401	2	.00115	1878	4.31	
23	Collar, Support	CRES (304 Cond. A)	0.287	0.00820	1	.00235	1878	4.42	
24	Plate, Cluster	CRES (304 Cond. A)	0.287	0.551	1	.158	349	50.3	

Superscripts Refer to Remarks Listed on Sheet _____

Sheet 3 of 9

TABLE 4-2 (Cont.)
DESIGN WEIGHT ANALYSIS SHEET

System: NSS

Prepared By: R. Lampe

ECC: Cluster Hardware

Date: November 9, 1970

Dwg. No: 939J738 Group G02

Revision: _____

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
25	Nut, Element Support	CRES (304 Cond. A)	0.287	0.00950	1	.00273	1878	5.12	
26	Key Pin	CRES (304 Cond. A)	0.287	0.0109	1	.00313	698	2.18	
27	Plate, Poison - .060 Thick	Cu-B ^N	0.28	0.0928	1	0.026	349	8.27	
28	Plate, Screen Retention	CRES (304 Cond. A)	0.287	0.1359	1	.039	349	12.3	
29	Flange, Screen	CRES (304 Cond. A)	0.287	0.00403	1	.00116	1878	2.17	
30	Screen	CRES (304 Cond. A)	0.287	0.00508	1	.00146	1878	2.74	
31	Cap, Screen - 80 x 80 Mesh .0055 Dia. Wire	CRES (304 Cond. A)	0.287	0.00167	1	.00048	1878	0.90	
32	Spring, Cluster	CRES (302 Cond. B)	0.286	0.358	1	.102	349	35.7	

Superscripts Refer to Remarks Listed on Sheet _____

Sheet 4 of 9

TABLE 4-2 (Cont.)
DESIGN WEIGHT ANALYSIS SHEET

System: NSS

Prepared By: R. Lampe

ECC: Cluster Hardware

Date: November 9, 1970

Dwg. No: 939J738 Group G02

Revision: _____

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
33	Sleeve, Spring Bearing	CRES (304 Cond. A)	0.287	0.150	1	.0431	349	15.0	
34	Hanger	CRES (A-286)	0.287	0.212	1	.0608	349	21.2	
35	Bushing, Threaded	CRES (304 Cond. A)	0.287	0.231	1	.0663	349	23.1	
36	Bushing, Split	CRES (304 Cond. A)	0.287	0.230	1	.0660	349	23.0	
37	Collar, Stepped	CRES (304 Cond. A)	0.287	0.162	1	.0465	349	16.2	
38	Seal, Liner Tube	Pyrofoil	0.041	0.0595	1	.00244	349	0.85	
39	Seal, Liner Tube	Pyrofoil	0.041	0.0595	1	.00244	349	0.85	
40	Holder, Regular Stem	CRES (A-286)	0.287	1.27	1	.364	247	90.0	

Superscripts Refer to Remarks Listed on Sheet _____

Sheet 5 of 9

TABLE 4-2 (Cont.)
DESIGN WEIGHT ANALYSIS SHEET

System: NSS

Prepared By: R. Lampe

ECC: Cluster Hardware

Date: November 9, 1970

Dwg. No: 939J738 Group G02

Revision: _____

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
41	Screw, Set - No. 1-72 UNF-3A x .156 LG Hex Soc. Cup Pt.	CRES (304 Cond. A)	0.287	0.000471	1	.00014	349	0.047	
42	Washer, .0055 Thick	Pyrofoil	0.041	0.00209	2	.000085	349	0.059	
43	Seal, Stem	Pyrofoil	0.041	0.0285	1	.00117	349	0.408	
45	Retainer	Thoriated Tungsten	0.689	0.279	1	.192	349	67.1	
46	Tube, Shim	CRES (304 SML)	0.287	0.147	1	.0422	233	9.83	
47	Nut, Cluster	CRES (304 Cond. A)	0.287	0.0391	1	.0112	349	3.92	
48	Nut, Retention	CRES (304 Cond. A)	0.287	0.0514	1	.0148	349	5.15	

Superscripts Refer to Remarks Listed on Sheet _____

Sheet 6 of 9

TABLE 4-2 (Cont.)
DESIGN WEIGHT ANALYSIS SHEET

System: NSS

Prepared By: R. Lampe

ECC: Cluster Hardware

Date: November 9, 1970

Dwg. No: 939J738 Group G02

Revision: _____

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
49	Collar, Shim Tube	CRES (304 Cond. A)	0.287	0.0132	1	.00379	349	1.32	
50	Spring, Shim Tube	CRES (304 Cond. B)	0.287	0.00803	1	.00230	349	0.804	
51	Cup, Locking	CRES (304 Cond. A)	0.287	0.0188	1	.00540	247	1.33	
52	Nut, Regular Closure	CRES (304 Cond. A)	0.287	0.604	1	.173	247	42.8	
53	Ring, Seating	CRES (304 Cond. A)	0.287	0.0103	1	.00296	349	1.03	
54	Pin, Dowel - .0781 Dia. x .375	CRES (416 Cond. A)	0.280	0.00180	1	.000504	349	0.176	
55	"O" Ring - .063 Dia. x 1.250 OD x .010 Wall	CRES (321 Ag Plated)	0.290	0.00621	1	.00180	349	0.628	

Superscripts Refer to Remarks Listed on Sheet _____

Sheet 7 of 9

TABLE 4-2 (Cont.)
DESIGN WEIGHT ANALYSIS SHEET

System: NSS

Prepared By: R. Lampe

ECC: Cluster Hardware

Date: November 9, 1970

Dwg. No: 932J738 Group G02

Revision: _____

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
56	"O" Ring - .063 Dia. x 1.000 x .010 Wall	CRES (321 Ag Plated)	0.290	0.00490	1	.00142	349	0.496	
57	"O" Ring - .031 Dia. x 1.313 OD x .005 Wall	CRES (321 Ag Plated)	0.290	0.00164	1	.00048	247	0.117	
58	Nut, Irregular Closure	CRES (304 Cond. A)	0.287	0.604	1	.173	102	17.6	
59	Holder, Irregular Stem	CRES (304 Cond. A)	0.287	1.27	1	.364	102	37.2	
60	Disc, Poison - .060 Thick	Cu-B ^N	0.28	0.00860	1	.00241	1878	4.52	
61	Cup, Protection	NbC Composite	0.144	0.310	1	.0446	349	15.6	

Superscripts Refer to Remarks Listed on Sheet _____

Sheet 8 of 9

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TABLE 4-2 (Cont.)
DESIGN WEIGHT ANALYSIS SHEET

System: NSS

Prepared By: R. Lampe

ECC: Cluster Hardware

Date: November 9, 1970

Dwg. No: 939J738 Group G02

Revision: _____

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
64	Ring, Braze	AuNi	0.630	0.0000683	18	.0000430	1878	1.45	
65	Screen - 16 x 16 Mesh .018 Dia. Wire	CRES (304 Cond. A)	0.287	0.0599	1	.0172	349	6.00	
66	Shroud	CRES (A-286)	0.287	0.0955	1	.0274	349	9.57	
67	Shim, Tube Dummy	CRES (304 SML)	0.287	0.147	1	.0422	116	4.89	
68	Spring, Outer	CRES (302 Cond. B)	0.286	0.295	1	.0844	349	29.5	

Superscripts Refer to Remarks Listed on Sheet _____

Sheet 9 of 9

TABLE 4-3

DESIGN WEIGHT ANALYSIS SHEET

System: NSSPrepared By: R. LampeECC: Cluster Hardware Alt. No. 1Date: November 9, 1970Dwg. No: 939J738 Group G01

Revision: _____

4-12

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
(C) 1	Tube, Liner	CRES PDS 30257-2	0.287	1.07	1	.307	349	107.2	
2	Nut, Support	CRES (A-286)	0.287	0.213	1	.0611	349	21.3	
3	Cap, Closure	CRES (A-286)	0.287	0.168	1	.0482	349	16.8	
4	Ring, Orifice	CRES (304 Cond.A)	0.287	0.0100	1	.00237	349	1.00	
(C) 5	Stem, Support	CRES PDS 30257-2	0.287	0.896	1	.257	349	89.7	
6	Seal, Cap	CRES (A-286)	0.287	0.00356	1	.00102	349	0.356	
7	Screw, Closure Cap	Thoriated Tungsten	0.689	0.029	1	.0200	349	6.98	

Items Listed on Sheet _____

Sheet 1 of 9

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TABLE 4-3 (Cont)

DESIGN WEIGHT ANALYSIS SHEET

System: NSSPrepared By: R. LampeECC: Cluster HardwareDate: November 9, 1970Dwg. No: 939J738 Group G01

Revision: _____

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
8	Cap, Protection	Thoriated Tungsten	0.689	0.120	1	.0827	349	28.9	
9	Cup, Protection	Thoriated Tungsten	0.689	0.672	1	.463	349	162.	
10	Cap, Insulating	Pyro-Graphite	0.079	0.109	1	.00861	349	3.01	
11	Cup, Insulating	Pyro-Graphite	0.079	0.123	1	.00972	349	3.39	
12	Washer, Insulating	Pyro-Graphite	0.079	0.0217	1	.00171	349	0.598	
13	Pin, Stem Locking	CRES (304 Cond.A)	0.287	0.00105	1	.00030	349	0.105	
14	Sleeve, Forward Insulating	Pyro-Graphite	0.079	0.239	1	.0189	349	6.59	
15	Sleeve, Insulating	Pyro-	0.079	0.279	11	.0220	349	84.5	

Superscripts Refer to Remarks Listed on Sheet _____

Sheet 2 of 9

TABLE 4-3 (Cont.)

DESIGN WEIGHT ANALYSIS SHEET

System: NSSPrepared By: R. LampeECC: Cluster HardwareDate: November 9, 1970Dwg. No: 939J738 Group G01

Revision: _____

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
16	Sleeve, Aft Insulating	Pyro- Graphite	0.079	0.190	1	.0150	349	5.24	
17	Tube, Sealing	Pyrofoil	0.041	0.0204	1	.00084	349	0.292	
18	Tube, Spacer	CRES (304 Cond.A)	0.287	0.0623	1	.0179	349	6.24	
19	Sleeve, Threaded	Moly-TZM	0.369	0.155	1	.0572	349	20.0	
20	Jet, Threaded Orifice	Moly-TZM	0.369	0.0207	1	.00764	1878	14.3	
21	Jet, Orifice	Moly-TZM	0.369	0.00182	11	.00067	33804	22.7	
22	Spring, Disc - .492 OD x .244 ID x .028 Thick	CRES-302	0.286	0.00401	2	.00115	1878	4.31	
23	Collar, Support	CRES (304 Cond.A)	0.287	0.00820	1	.00235	1878	4.42	
24	Plate, Cluster	CRES	0.287	0.551	1	.158	349	50.3	

Superscripts Refer to Remarks Listed on Sheet _____

Sheet 3 of 9

TABLE 4-3 (Cont.)

DESIGN WEIGHT ANALYSIS SHEET

System: NSSPrepared By: R. LampeECC: Cluster HardwareDate: November 9, 1970Dwg. No: 939J738 Group G01

Revision: _____

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
25	Nut, Element Support	CRES (304 Cond.A)	0.287	0.00950	1	.00273	1878	5.12	
26	Key Pin	CRES (304 Cond.A)	0.287	0.0109	1	.00313	698	2.18	
27	Plate, Poison - .060 Thick	Cu-B ^N	0.28	0.0928	1	.026	349	8.27	
28	Plate, Screen Retention	CRES (304 Cond.A)	0.287	0.1359	1	.039	349	12.3	
29	Flange, Screen	CRES (304 Cond.A)	0.287	0.00403	1	.00116	1878	2.17	
30	Screen	CRES (304 Cond.A)	0.287	0.00508	1	.00146	1878	2.74	
31	Cap, Screen - 80 x 20 Mesh .0055 Dia. Wire	CRES (304 Cond.A)	0.287	0.00167	1	.00048	1878	0.90	
32	Spring, Cluster	CRES (302 Cond.B)	0.286	0.358	1	.102	349	35.7	

Superscripts Refer to Remarks Listed on Sheet _____

Sheet 4 of 9

TABLE 4-3 (Cont.)

DESIGN WEIGHT ANALYSIS SHEET

System: NSSPrepared By: R. LampeECC: Cluster HardwareDate: November 9, 1970Dwg. No: 939J738 Group G01

Revision: _____

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
33	Sleeve, Spring Bearing	CRES (304 Cond.A)	0.287	0.150	1	.0432	349	15.0	
34	Hanger	CRES (A-286)	0.287	0.212	1	.0608	349	21.2	
35	Bushing, Threaded	CRES (304 Cond.A)	0.287	0.231	1	.0663	349	23.1	
36	Bushing, Split	CRES (304 Cond.A)	0.287	0.230	1	.0660	349	23.0	
37	Collar, Stepped	CRES (304 Cond.A)	0.287	0.162	1	.0465	349	16.2	
38	Seal, Liner Tube	Pyrofoil	0.041	0.0595	1	.00244	349	0.851	
39	Seal, Liner Tube	Pyrofoil	0.041	0.0595	1	.00244	349	0.851	
40	Holder, Regular Stem	CRES	0.287	1.27	1	.364	247	90.0	

Superscripts Refer to Remarks Listed on Sheet _____

Sheet 5 of 9

TABLE 4-3 (Cont.)

DESIGN WEIGHT ANALYSIS SHEET

System: NSSPrepared By: R. LampeECC: Cluster HardwareDate: November 9, 1970Dwg. No: 939J738 Group G01

Revision: _____

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
41	Screw, Set - No. 1-72 UNF-3A x .156, LG Hex Soc. Cup Pt.	CRES (304 Cond.A)	0.287	0.000471	1	.00014	349	0.047	
43	Seal, Stem	Pyrofoil	0.041	0.0285	1	.00117	349	0.408	
46	Tube, Shim	CRES (304 SML)	0.287	0.147	1	.0422	233	9.83	
47	Nut, Cluster	CRES (304 Cond.A)	0.287	0.0391	1	.0112	349	3.92	
48	Nut, Retention	CRES (304 Cond.A)	0.287	0.0514	1	.0148	349	5.15	

Superscripts Refer to Remarks Listed on Sheet _____

Sheet 6 of 9

TABLE 4-3 (Cont.)

DESIGN WEIGHT ANALYSIS SHEET

System: NSSPrepared By: R. LampeECC: Cluster HardwareDate: November 9, 1970Dwg. No: 939J738 Group G01

Revision: _____

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
49	Collar, Shim Tube	CRES (304 Cond.A)	0.287	0.0132	1	.00379	349	1.32	
50	Spring, Shim Tube	CRES (304 Cond.B)	0.287	0.00803	1	.00230	349	0.804	
51	Cup, Locking	CRES (304 Cond.A)	0.287	0.0188	1	.00540	247	1.33	
52	Nut, Regular Closure	CRES (304 Cond.A)	0.287	0.604	1	.173	247	42.8	
53	Ring, Seating	CRES (304 Cond.A)	0.287	0.0103	1	.00296	349	1.03	
54	Pin, Dowel - .0781 Dia. x .375	CRES (416 Cond.A)	0.280	0.00180	1	.000504	349	0.176	
55	"O" Ring - .063 Dia. x 1.250 OD x .010 Wall	CRES (321 Ag Plated)	0.290	0.00621	1	.00180	349	0.628	

Superscripts Refer to Remarks Listed on Sheet _____

Sheet 7 of 9

TABLE 4-3 (Cont.)

DESIGN WEIGHT ANALYSIS SHEET

System: NSSPrepared By: R. LampeECC: Cluster HardwareDate: November 9, 1970Dwg. No: 939J738 Group G01

Revision: _____

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
56	"O" Ring - .063 Dia. x 1.000 x .010 Wall	CRES (321 Ag Plated)	0.290	0.00490	1	.00142	349	0.496	
57	"O" Ring - .031 Dia. x 1.313 OD x .005 Wall	CRES (321 Ag Plated)	0.290	0.00164	1	.00048	247	0.117	
58	Nut, Irregular Closure	CRES (304 Cond A)	0.287	0.604	1	.173	102	17.7	
59	Holder, Irregular Stem	CRES (304 Cond A)	0.287	1.27	1	.365	102	37.2	
60	Disc, Poison - .060 Thick	Cu-B ^N	0.28	0.00860	1	.00241	1878	4.52	

Superscripts Refer to Remarks Listed on Sheet _____

Sheet 8 of 9

TABLE 4-3 (Cont.)

DESIGN WEIGHT ANALYSIS SHEET

System: NSSPrepared By: R. LampeECC: Cluster HardwareDate: November 9, 1970Dwg. No: 939J738 Group G01

Revision: _____

Item	Nomenclature	Material	Density Lb/in ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
64	Ring, Braze	Au Ni	0.630	0.0000683	18	.0000430	1878	1.45	
65	Screen - 16 x 16 Mesh .018 Dia. Wire	CRES (304 Cond.A)	0.287	0.0599	1	.0172	349	6.00	
66	Shroud	CRES (A-286)	0.287	0.0955	1	.0274	349	9.57	
67	Shim, Tube Dummy 2/3 of 349	CRES (304 SML)	0.287	0.147	1	.0423	116	4.89	
68	Spring, Outer	CRES (302 Cond.B)	0.286	0.295	1	.0843	349	29.5	

Superscripts Refer to Remarks Listed on Sheet _____

Sheet 9 of 9

TABLE 4-4
DESIGN WEIGHT ANALYSIS SHEET

System: NSS

Prepared By: R. Lampe

ECC: Cluster Hardware Alt. No. 2

Date: November 9, 1970

Dwg. No: 939J739 Group G02

Revision: _____

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
1	Holder, Stem	CRES	0.287	1.39	1	.399	247	98.6	
1	Holder, Stem Irreg.	AMS 5737 (A-286)	0.287	1.259	1	.363	102	37.03	
2	Shroud	CRES AMS 5737 (A-286)	0.287	0.0955	1	.0274	349	9.57	
3	Bushing, Threaded	CRES QQ-S-763 (CL 304 Cond. A)	0.287	0.397	1	.114	349	39.8	
4	Split, Ring	CRES QQ-S-763 (CL 304 Cond. A)	0.282	0.0870	1	.0250	349	8.71	
5	Sleeve, Spring Bearing (Forward)	CRES AMS 5737 (A-286)	0.287	0.243	1	.0697	349	24.3	

Superscripts Refer to Remarks Listed on Sheet _____

Sheet 1 of 11

TABLE 4-4 (Cont.)
DESIGN WEIGHT ANALYSIS SHEET

System: NSS
ECC: Cluster Hardware (Alt. No. 2)
Dwg. No: 939J739 Group G02

Prepared By: R. Lampe
Date: November 9, 1970
Revision: _____

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
6	Coupling	CRES AMS 5737 (A-286)	0.287	0.324	1	.0730	349	32.5	
7	Locking, Ring Split	CRES QQ-S-763 (CL 304 Cond. A)	0.287	0.0709	1	.0203	349	7.10	
8	Cup, Spring Bearing	CRES QQ-S-763 (CL 304 Cond. A)	0.287	0.0879	1	.0252	349	8.80	
9	Spring, Disc	CRES MIL-S-5059 (TY 302)	0.286	0.0416	1	.0119	1396	16.6	

Superscripts Refer to Remarks Listed on Sheet _____

Sheet 2 of 11

~~CONFIDENTIAL~~

TABLE 4-4 (Cont.)

DESIGN WEIGHT ANALYSIS SHEET

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System: NSSPrepared By: R. LampeECC: Cluster Hardware (Alt. No. 2)Date: November 9, 1970Dwg. No: 939J739 Group G02

Revision: _____

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
10	Spring, Cluster	CRES QQ-W-423 (CL 302 Cond. B)	0.286	0.208	1	.0595	349	0.8	
11	Sleeve, Spring Bearing (Aft)	CRES QQ-S-763 (CL 304 Cond. A)	0.287	0.124	1	.0356	349	12.4	
12	Collar, Stepped	CRES QQ-S-763 (CL 304 Cond. A)	0.287	0.0919	1	.0264	349	9.20	
13	Tube, Shim	CRES AMS 5566 (CL 304 SML)	0.287	0.148	1	.0425	116	4.93	

Superscripts Refer to Remarks Listed on Sheet _____

Sheet 3 of 11~~CONFIDENTIAL~~

~~CONFIDENTIAL~~
~~RESTRICTED DATA~~
1954

TABLE 4-4 (Cont.)
DESIGN WEIGHT ANALYSIS SHEET

System: NSS
ECC: Cluster Hardware (Alt. No. 2)
Dwg. No: 939J739 Group G02

Prepared By: R. Lampe
Date: November 9, 1970
Revision: _____

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
14	Cylinder, Slip Joint	CRES AMS 5737 (A-286)	0.287	0.141	1	.0405	349	14.1	
15	Stem, Support	CRES PDS 30257-1 (A-286)	0.287	0.900	1	.258	349	90.1	
16	Pin	CRES (304 Cond. A)	0.287	.000447	1	.000139	349	0.105	
17	Cap, Closure	CRES (A-286)	0.287	0.205	1	.0588	349	20.5	
18	Nut, Slip Joint	CRES (A-286)	0.287	0.0521	1	.0150	349	5.22	
19	Cap, Insulating	Pyro- Graphite	0.079	0.128	1	.0101	349	3.53	
20	Cup, Protection	Thoriated Tungsten	0.689	0.717	1	.494	349	172.	

Superscripts Refer to Remarks Listed on Sheet _____

Sheet 4 of 11

~~CONFIDENTIAL~~
~~RESTRICTED DATA~~
ATOMIC ENERGY ACT
OF 1954

4-24

(C)

~~CONFIDENTIAL~~

TABLE 4-4 (Cont.)

DESIGN WEIGHT ANALYSIS SHEET

THIS PAGE UNCLASSIFIED

System: NSS

Prepared By: R. Lampe

ECC: Cluster Hardware (Alt. No. 2)

Date: November 9, 1970

Dwg. No: 939J739 Group G02

Revision: _____

Item	Nomenclature	Material	Density Lb/in ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
21	Cup, Protection	NbC Composite	0.144	0.387	1	.0557	349	19.4	
22	Seal, Cap	CRES (A-286)							
23	Screw, Closure Cap	Thoriated Tungsten							
24	Cup, Insulating	Pyro- Graphite	0.079	0.144	1	.0114	349	3.97	

Superscripts Refer to Remarks Listed on Sheet _____

Sheet 5 of 11

~~CONFIDENTIAL~~

TABLE 4-4 (Cont.)

DESIGN WEIGHT ANALYSIS SHEET

System: NSS

Prepared By: R. Lampe

ECC: Cluster Hardware (Alt. No. 2)

Date: November 9, 1970

Dwg. No: 939J739 Group G02

Revision: _____

(1) Item	Nomenclature	Material	Density Lb/in ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
1	Tube, Liner	CRES PDS30257-2	0.287	1.07	1	.307	349	107.	
4	Ring, Orifice	CRES (304 Cond. A)	0.287	0.0100	1	.00287	349	1.00	
6	Seal, Cap	CRES (A-286)	0.287	0.00356	1	.00102	349	0.356	
7	Screw, Closure Cap	Thoriated Tungsten	0.689	0.029	1	.0200	349	6.98	
8	Cap, Protection	Thoriated Tungsten	0.689	0.120	1	.0827	349	28.9	
12	Washer, Insulating	Pyro- Graphite	0.079	0.0217	1	.00171	349	0.60	
14	Sleeve, Forward Insulating	Pyro- Graphite	0.079	0.239	1	.0189	349	6.59	
15	Sleeve, Insulating	Pyro- Graphite	0.079	0.279	11	.0220	349	84.5	

Superscripts Refer to Remarks Listed on Sheet _____

(1) Item Numbers on 939J738 used on Alternate No. 2.

TABLE 4-4 (Cont.)

DESIGN WEIGHT ANALYSIS SHEET

System: NSSPrepared By: R. LampeECC: Cluster Hardware (Alt. No. 2)Date: November 9, 1970Dwg. No: 939J739 Group G02

Revision: _____

(1) Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
16	Sleeve, Aft Insulating	Pyro- Graphite	0.079	0.190	1	.0150	349	5.24	
17	Tube, Sealing	Pyrofoil	0.041	0.0204	1	.00084	349	0.29	
18	Tube, Spacer	CRES (304 Cond.A)	0.287	0.0623	1	.0179	349	6.24	
19	Sleeve, Threaded	Moly-TZM	0.369	0.155	1	.0572	349	20.0	
20	Jet, Threaded Orifice	Moly-TZM	0.369	0.0207	1	.00764	1878	14.3	
21	Jet, Orifice	Moly-TZM	0.369	0.00182	11	.00067	33, 804	22.7	
22	Spring, Disc - .492 O.D. x .244 I.D. x .028 Thick	CRES-302	0.286	0.00401	2	.00115	1878	4.31	
23	Collar, Support	CRES (304 Cond.A)	0.287	0.00820	1	.00235	1878	4.42	
25	Nut, Element Support	CRES (304 Cond.A)	0.287	0.00950	1	.00273	1878	5.12	

Superscripts Refer to Remarks Listed on Sheet 6Sheet 7 of 11

TABLE 4-4 (Cont.)
DESIGN WEIGHT ANALYSIS SHEET

System: NSS

Prepared By: R. Lampe

ECC: Cluster Hardware (Alt. No. 2)

Date: November 9, 1970

Dwg. No: 939J739 Group G02

Revision: _____

(1) Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
26	Key Pin	CRES (304 Cond.A)	0.287	0.0109	2	.00313	349	2.18	
27	Plate, Poison - .060 Thick	Cu-B ^N	0.28	23.0	1	6.44	349	8.27	
28	Plate, Screen Retention	CRES (304 Cond.A)	0.287	0.0945	1	.039	349	12.3	
29	Flange, Screen	CRES (304 Cond.A)	0.287	0.00403	1	.00116	1878	2.17	
30	Screen	CRES (304 Cond.A)	0.287	0.00508	1	.00146	1878	2.74	
31	Cap, Screen - 80 x 20 Mesh .0055 Dia. Wire	CRES (304 Cond.A)	0.287	0.00167	1	.00048	1878	0.90	
34	Hanger	CRES (A-286)	0.287	0.212	1	.0608	349	21.2	
38	Seal, Liner Tube	Pyrofoil	0.041	0.0995	1	.00244	349	0.85	
39	Seal, Liner Tube	Pyrofoil	0.041	0.0595	1	.00244	349	0.85	

Superscripts Refer to Remarks Listed on Sheet 6

Sheet 8 of 11

TABLE 4-4 (Cont.)

DESIGN WEIGHT ANALYSIS SHEET

System: NSSPrepared By: R. LampeECC: Cluster Hardware (Alt. No. 2)Date: November 9, 1970Dwg. No: 939J739 Group G02

Revision: _____

(1) Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
41	Screw, Set - No. 1-72 UNF-3A x .156 lg. Hex Soc. Cup Pt.	CRES (304 Cond.A)	0.287	0.000471	1	.00014	349	0.047	
42	Washer, .0055 Thick	Pyrofoil	0.041	0.00209	2	.00009	349	0.0599	
43	Seal, Stem	Pyrofoil	0.041	0.0285	1	.00117	349	0.408	
45	Retainer	Thoriated Tungsten	0.689	0.279	1	.192	349	67.1	
47	Nut, Cluster	CRES (304 Cond.A)	0.287	0.0391	1	.0112	349	3.92	
48	Nut, Retention	CRES (304 Cond.A)	0.287	0.0514	1	.0148	349	5.15	
49	Collar, Shim Tube	CRES (304 Cond.A)	0.287	0.0132	1	.00379	349	1.32	
50	Spring, Shim Tube	CRES (304 Cond.B)	0.287	0.00803	1	.00230	349	0.804	

Superscripts Refer to Remarks Listed on Sheet 6Sheet 9 of 11

TABLE 4-4 (Cont)
DESIGN WEIGHT ANALYSIS SHEET

System: NSS

Prepared By: R. Lampe

ECC: Cluster Hardware (Alt. No. 2)

Date: November 9, 1970

Dwg. No: 939J739 Group G02

Revision: _____

(1) Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
51	Cup, Locking	CRES (304 Cond. A)	0.287	0.0188	1	.00540	247	1.33	
52	Nut, Regular Closure	CRES (304 Cond. A)	0.287	0.604	1	.173	247	42.8	
53	Ring, Seating	CRES (304 Cond. A)	0.287	0.0103	1	.00296	349	1.03	
54	Pin, Dowel - .0781 dia. x .375	CRES (416 Cond. A)	0.280	0.00180	1	.000504	349	0.176	
55	"O" Ring - .063 dia. x 1.250 O.D. x .010 Wall	CRES (321 Ag Plated)	0.290	0.00621	1	.00180	349	0.628	
56	"O" Ring - .063 dia. x 1.000 x .010 Wall	CRES (321 Ag Plated)	0.290	0.00490	1	.00142	349	0.496	
57	"O" Ring - .031 dia. x 1.313 O.D. x .005 Wall	CRES (321 Ag Plated)	0.290	0.00164	1	.00048	247	.119	
58	Nut, Irregular Closure	CRES (304 Cond. A)	0.287	0.604	1	.173	102	17.6	

Superscripts Refer to Remarks Listed on Sheet 6

Sheet 10 of 11

TABLE 4-4 (Cont.)

DESIGN WEIGHT ANALYSIS SHEET

System: NSSPrepared By: R. LampeECC: Cluster Hardware (Alt. No. 2)Date: November 9, 1970Dwg. No: 939J739 Group G02

Revision: _____

(1) Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
60	Disc, Poison - .060 Thick	Cu-B ^N	0.28	0.00860	1	.00241	1878	4.52	
64	Ring, Braze	Au Ni	0.630	0.0000683	18	.000430	1878	1.45	
65	Screen - 16 x 16 Mesh .018 dia. Wire	CRES (304 Cond.A)	0.287	0.0599	1	.0172	349	6.00	
67	Shim, Tube Dummy	CRES (304 SML)	0.287	0.147	1	.0423	233	9.83	

Superscripts Refer to Remarks Listed on Sheet 6Sheet 11 of 11

TABLE 4-5
DESIGN WEIGHT ANALYSIS SHEET

System: NSS

Prepared By: R. Lampe

ECC: Cluster Hardware (Alt. No. 3)

Date: November 9, 1970

Dwg. No: 939J739 Group G01

Revision: _____

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
1	Holder, Stem	CRES	0.287	1.39	1	.399	247	98.6	
1	Holder, Stem, Irreg.	AMS 5737 (A-286)	0.287	1.259	1	.363	102	37.03	
2	Shroud	CRES AMS 5737 (A-286)	0.287	0.0955	1	.02	349	9.57	
3	Bushing, Threaded	CRES QQ-S-763 (CL 304 Cond. A)	0.287	0.397	1	.114	349	39.8	
4	Split, Ring	CRES QQ-S-763 (CL 304 Cond. A)	0.287	0.0870	1	.0250	349	8.71	
5	Sleeve, Spring Bearing (Forward)	CRES AMS 5737 (A-286)	0.287	0.243	1	.0699	349	24.3	

Scripts Refer to Remarks Listed on Sheet _____

Sheet 1 of 14

TABLE 4-5 (Continued)
DESIGN WEIGHT ANALYSIS SHEET

System: NSS

Prepared By: R. Lampe

ECC: Cluster Hardware (Alt. No. 3)

Date: November 9, 1970

Dwg. No: 939J739 Group G01

Revision: _____

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
6	Coupling	CRES AMS 5737 (A-286)	0.287	0.324	1	.0930	349	32.5	
7	Locking, Ring Split	CRES QQ-S-763 (CL 304 Cond. A)	0.287	0.0709	1	.0203	349	7.10	
8	Cup, Spring Bearing	CRES QQ-S-763 (CL 304 Cond. A)	0.287	0.0879	1	.0252	349	8.80	
9	Spring, Disc	CRES MIL-S-5059 (TY 302)	0.286	0.0416	1	.0119	1396	16.6	

Superscripts Refer to Remarks Listed on Sheet _____

Sheet 2 of 14

TABLE 4-5 (Continued)
DESIGN WEIGHT ANALYSIS SHEET

System: NSS

Prepared By: R. Lampe

ECC: Cluster Hardware (Alt. No. 3)

Date: November 9, 1970

Dwg. No: 939J739 Group G01

Revision: _____

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
10	Spring, Cluster	CRES QQ-W-423 (CL 302 Cond. B)	0.286	0.203	1	.0595	349	20.8	
11	Sleeve, Spring Bearing (Aft)	CRES QQ-S-763 (CL 304 Cond. A)	0.287	0.124	1	.0356	349	12.4	
12	Collar, Stepped	CRES QQ-S-763 (CI 304 Cond. A)	0.287	0.0919	1	.0264	349	9.20	
13	Tube, Shim	CRES AMS 5566 (CL 304 SML)	0.287	0.148	1	.0425	116	4.93	

Superscripts Refer to Remarks Listed on Sheet _____

Sheet 3 of 14

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TABLE 4-5 (Continued)

DESIGN WEIGHT ANALYSIS SHEET

System: NSS

Prepared By: R. Lampe

ECC: Cluster Hardware (Alt. No. 3)

Date: November 2, 1970

Dwg. No: 939J739 Group G01

Revision: _____

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
14	Cylinder, Slip Joint	CRES AMS 5737 (A-286)	0.287	0.141	1	.0405	349	14.1	
15	Stem, Support	CRES PDS 30257-1 (A-286)	0.287	0.900	1	.258	349	90.1	
16	Pin	CRES (304 Cond.A)	0.287	.000449	1	.000129	349	.105	
17	Cap, Closure	CRES (A-286)	0.287	0.205	1	.0588	349	20.5	
18	Nut, Slip Joint	CRES (A-286)	0.287	0.0521	1	.0150	349	5.22	
19	Cap, Insulating	Pyro- Graphite	0.079	0.128	1	.0101	349	3.53	
20	Cup, Protection	Thoriated Tungsten	0.689	0.717	1	.494	349	172.	

Superscripts Refer to Remarks Listed on Sheet _____

Sheet 4 of 14

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~~OF THE UNITED STATES~~

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TABLE 4-5 (Continued)
DESIGN WEIGHT ANALYSIS SHEETSystem: NSSPrepared By: R. LampeECC: Cluster Hardware (Alt. No. 3)Date: November 9, 1970Dwg. No: 939J739 Group G01

Revision: _____

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
22	Cup, Insulating	Pyro- Graphite	0.079	0.144	1	.0114	349	3.97	

Superscripts Refer to Remarks Listed on Sheet _____

Sheet 5 of 14~~CONFIDENTIAL~~

TABLE 4-5 (Cont.)

DESIGN WEIGHT ANALYSIS SHEET

System: NSSPrepared By: R. LampeECC: Cluster Hardware (Alt. No. 3)Date: November 9, 1970Dwg. No: 939J739 Group G01

Revision: _____

(1) Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
1	Tube, Liner	CRES PDS 30257-2	0.287	1.07	1	.307	349	107.2	
4	Ring, Orifice	CRES (304 Cond A)	0.287	0.0100	1	.00237	349	1.00	
6	Seal, Cap	CRES (A-286)	0.287	0.00356	1	.00102	349	0.36	
7	Screw, Closure Cap	Thoriated Tungsten	0.689	0.029	1	.0200	349	6.98	

Superscripts Refer to Remarks Listed on Sheet _____

Sheet 6 of 14

(1) Item Numbers on 939J738 used in Alternate No. 3.

TABLE 4-5 (Cont.)

DESIGN WEIGHT ANALYSIS SHEET

System: NSSPrepared By: R. LampeECC: Cluster Hardware (Alt. No. 3)Date: November 9, 1970Dwg. No: 939J739 Group G01

Revision: _____

(1) Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
8	Cap, Protection	Thoriated Tungsten	0.689	0.120	1	.0827	349	28.9	
12	Washer, Insulating	Pyro-Graphite	0.079	0.0217	1	.00171	349	0.60	
14	Sleeve, Forward Insulating	Pyro-Graphite	0.079	0.239	1	.0189	349	6.59	
15	Sleeve, Insulating	Pyro-Graphite	0.079	0.279	11	.0220	349	84.5	

Superscripts Refer to Remarks Listed on Sheet 6Sheet 7 of 14

TABLE 4-5 (Cont.)

DESIGN WEIGHT ANALYSIS SHEET

System: NSSPrepared By: R. LampeECC: Cluster Hardware (Alt. No. 3)Date: November 9, 1970Dwg. No: 939J739 Group G01

Revision: _____

(1) Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
16	Sleeve, Aft Insulating	Pyro- Graphite	0.079	0.190	1	.0150	349	5.24	
17	Tube, Sealing	Pyrofoil	0.041	0.0204	1	.00084	349	0.29	
18	Tube, Spacer	CRES (304 Cond.A)	0.287	0.0623	1	.0179	349	6.24	
19	Sleeve, Threaded	Moly-TZM	0.369	0.155	1	.0572	349	20.0	
20	Jet, Threaded Orifice	Moly-TZM	0.369	0.0207	1	.00764	1878	14.3	
21	Jet, Orifice	Moly-TZM	0.369	0.00182	11	.00067	33,804	22.7	
22	Spring, Disc - .492 O.D. x .244 I.D. x .028 Thick	CRES-302	0.286	0.00401	2	.00115	1878	4.31	
23	Collar, Support	CRES (304 Cond.A)	0.287	0.00820	1	.00235	1878	4.42	
24	Plate, Cluster	CRES (304 Cond.A)	0.287	0.551	1	.158	349	50.3	

Superscripts Refer to Remarks Listed on Sheet 6Sheet 8 of 14

TABLE 4-5 (Cont.)

DESIGN WEIGHT ANALYSIS SHEET

System: NSSPrepared By: R. LampeECC: Cluster Hardware (Alt. No. 3)Date: November 9, 1970Dwg. No: 939J739 Group G01

Revision: _____

(1) Item	Nomenclature	Material	Density Lb/in ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
25	Nut, Element Support	CRES (304 Cond.A)	0.287	0.00950	1	.00273	1878	5.12	
26	Key Pin	CRES (304 Cond.A)	0.287	0.0109	2	.00313	349	2.18	
27	Plate, Poison - .060 Thick	Cu-B ^N	0.28	23.0	1	.026	349	8.27	
28	Plate, Screen Retention	CRES (304 Cond.A)	0.287	0.0945	1	.039	349	12.3	
29	Flange, Screen	CRES (304 Cond.A)	0.287	0.00403	1	.00116	1878	2.17	
30	Screen	CRES (304 Cond.A)	0.287	0.00508	1	.00146	1878	2.74	
31	Cap, Screen - 80 x 80 Mesh	CRES (304 Cond.A)	0.287	0.00167	1	.00048	1878	0.90	

Superscripts Refer to Remarks Listed on Sheet 6Sheet 9 of 14

TABLE 4-5 (Cont.)

DESIGN WEIGHT ANALYSIS SHEET

System: NSSPrepared By: R. LampeECC: Cluster Hardware (Alt. No. 3)Date: November 9, 1970Dwg. No: 939J739 Group G01

Revision: _____

(1) Item	Nomenclature	Material	Density Lb/in ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
34	Hanger	CRES (A-286)	0.287	0.212	1	.0608	349	21.2	
38	Seal, Liner Tube	Pyrofoil	0.041	0.0595	1	.00244	349	0.851	
39	Seal, Liner Tube	Pyrofoil	0.041	0.0595	1	.00244	349	0.851	

Superscripts Refer to Remarks Listed on Sheet 6Sheet 10 of 14

TABLE 4-5 (Cont.)

DESIGN WEIGHT ANALYSIS SHEET

System: NSSPrepared By: R. LampeECC: Cluster Hardware (Alt. No. 3)Date: November 9, 1970Dwg. No: 939J739 Group G01

Revision: _____

(1) Item	Nomenclature	Material	Density Lb/in ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
41	Screw, Set - No. 1-72 UNF-3A x .156, LG Hex Soc. Cup Pt.	CRES (304 Cond.A)	0.287	0.000471	1	.00014	349	0.047	
43	Seal, Stem	Pyrofoil	0.041	0.0285	1	.00117	349	0.408	
47	Nut, Cluster	CRES (304 Cond.A)	0.287	0.0391	1	.0112	349	3.92	
48	Nut, Retention	CRES (304 Cond.A)	0.287	0.0514	1	.0148	349	5.15	

Superscripts Refer to Remarks Listed on Sheet 6Sheet 11 of 14

TABLE 4-5 (Cont.)

DESIGN WEIGHT ANALYSIS SHEET

System: NSSPrepared By: R. LampeECC: Cluster Hardware (Alt. No. 3)Date: November 9, 1970Dwg. No: 939J739 Group G01

Revision: _____

(1) Item	Nomenclature	Material	Density Lb/in ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
49	Collar, Shim Tube	CRES (304 Cond.A)	0.287	0.0132	1	.00379	349	1.32	
50	Spring, Shim Tube	CRES (304 Cond.B)	0.287	0.00803	1	.00230	349	0.804	
51	Cup, Locking	CRES (304 Cond.A)	0.287	0.0188	1	.00540	247	1.33	
52	Nut, Regular Closure	CRES (304 Cond.A)	0.287	0.604	1	.173	247	42.8	
53	Ring, Seating	CRES (304 Cond.A)	0.287	0.0103	1	.00296	349	1.03	
54	Pin, Dowel - .0781 Dia. x .375	CRES (416 Cond.A)	0.280	0.00180	1	.000504	349	0.176	
55	"O" Ring - .063 Dia. x 1.250 O.D. x .010 Wall	CRES (321 Ag Plated)	0.290	0.00621	1	.00180	349	0.628	

Superscripts Refer to Remarks Listed on Sheet 6Sheet 12 of 14

TABLE 4-5 (Cont.)

DESIGN WEIGHT ANALYSIS SHEET

System: NSSPrepared By: R. LampeECC: Cluster Hardware (Alt. No. 3)Date: November 9, 1970Dwg. No: 939J739 Group G01

Revision: _____

(1) Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
56	"O" Ring - .063 Dia. x 1.000 x .010 Wall	CRES (321 Ag Plated)	0.290	0.00490	1	.00142	349	0.496	
57	"O" Ring - .031 Dia. x 1.313 O.D. x .005 Wall	CRES (321 Ag Plated)	0.290	0.00164	1	.00043	247	.117	
58	Nut, Irregular Closure	CRES (304 Cond.A)	0.287	0.604	1	.173	102	17.7	
60	Disc, Poison - .060 Thick	Cu-B ^N	0.28	0.00860	1	.00241	1878	4.52	

Superscripts Refer to Remarks Listed on Sheet 6Sheet 13 of 14

- TABLE 4-5 (Cont.)

DESIGN WEIGHT ANALYSIS SHEET

System: NSS

Prepared By: R. Lampe

ECC: Cluster Hardware (Alt. No. 3)

Date: November 9, 1970

Dwg. No: 939J739 Group G01

Revision:

(1) Item	Nomenclature	Material	Density Lb/in ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
64	Ring, Braze	Au Ni	0.630	0.0000683	18	.0000430	1878	1.45	
65	Screen - 16 x 16 Mesh .018 Dia. Wire	CRES (304 Cond A)	0.287	0.0599	1	.0172	349	6.00	
67	Shim, Tube Dummy	CRES (304 SML)	0.287	0.147	1	.0423	233	9.83	

Superscripts Refer to Remarks Listed on Sheet 6

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5.0 CORE PERIPHERY

5.1 INTRODUCTION

The Core Periphery consists of filler strips, insulators, and a flow barrier located radially between the outermost fuel elements and the lateral support/load and/or seal rings of the Reflector Assembly and axially from the cluster plates to the support pedestal area. The filler strips are located adjacent to the Reflector Assembly; the insulators and flow barrier are located between the filler strips and the peripheral fuel elements.

5.2 WEIGHT SUMMARY

The target weight for this ECC is 455 lbs. when used with either the composite or graphite material core. This is classified as a Category C component.

The current design weights for this ECC are shown on Table 5-1. The detailed breakdown of the weight of the alternates are shown on Tables 5-2 through Table 5-5. Also shown on these tables are the designs used in the analysis (drawing numbers, materials, and densities).

TABLE 5-1
 DESIGN WEIGHT SUMMARY
 ENGINEERING CRITICAL COMPONENT
 CORE PERIPHERY - EC 677564

<u>Nomenclature</u>	<u>Drawing No.</u>	<u>Group No.</u>	<u>Weight Lbs.</u>	<u>One Std. Deviation Lbs.</u>
Shown on 939J740:				
Core Periphery	939J728	1	447	13
Alternate No. 1:				
Core Periphery	939J729	1	469	15
Alternate No. 2:				
Core Periphery	939J730	-	451	14
Alternate No. 3:				
Core Periphery	939J731	-	317	10

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TABLE 5-2

DESIGN WEIGHT ANALYSIS SHEET

System: NSSPrepared By: R. V. RittenbergerECC: Core PeripheryDate: 11/24/70Dwg. No: 939J728 Group 1Revision:

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
(C) 1	Strip, Filler	Graphitite G	0.06575	18.22996	174	1.20	1	208.56	
(C) 2	Tile, Insulating	ZrC 50% Dense	0.12170	0.04749	27702	.006	1	160.19	
3	Key	A-286	0.287	0.05508	150	.016	1	2.37	
4	Spring	A-286	0.287	.43935	174	.126	1	21.94	
5	Support Rod	A-286	0.287	.12369	174	.036	1	6.18	
6	Hanger	A-286	0.287	.12026	174	.035	1	6.00	

Superscripts Refer to Remarks Listed on Sheet Sheet 1 of 3

TABLE 5-2

DESIGN WEIGHT ANALYSIS SHEET

System: NSSPrepared By: R. V. RittenbergerECC: Core PeripheryDate: 11/24/70Dwg. No: 939J728 Group 1

Revision: _____

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
(C) 7	Wrapper, Metal	Moly (TZM)	0.36900	0.11900	342	.044	1	15.018	
8	Wrapper, Slip Plane	Pyrofoil	0.04046	0.17845	342	.007	1	2.468	
(C) 9	V-Strip Laminate	Pyrofoil	0.04046	0.35368	1368	.014	1	19.579	
10	Key	A-286	0.287	0.04340	24	.012	1	0.299	
11	Bracket	A-286	0.287	.59730	6	.171	1	1.029	
12	Collar	A-286	0.287	.01967	174	.006	1	0.983	
13	Pin	A-286	0.287	.002	174	.002	1	0.275	

Superscripted Refs to Previous Sheets Sheet _____

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TABLE 5-2

~~DESIGN WEIGHT ANALYSIS SHEET~~

System: NSS

Prepared By: R. V. Rittenberger

ECC: Core Periphery

Date: 11/24/70

Dwg. No: 939J728 Group 1

Revision:

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
14	Bolt, .250-28 UNF-2A	A-286	0.287	.03927	90	.011	1	1.014	
15	Cup, Locking	A-286	0.287	.00996	90	.003	1	0.257	
16	Orifice, Screened	A-286	0.287	.01182	150	.003	1	0.509	

Superscripts Refer to Remarks Listed on Sheet

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TABLE 5-3
DESIGN WEIGHT ANALYSIS SHEET

System: NSS

Prepared By: R. Rittenberger

ECC: Core Periphery Alt. No. 1

Date: December 2, 1970

Dwg. No: 939J729 Group

Revision:

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
(C) 1	Filler Strip	Graphitite G	.06575	16.1885	174	1.0644	1	185.706	
2	Support Block	*	.14966	1.25598	150	.18797	1	28.196	
(C) 3	Tile, Insulating	ZrC 50% Density	.1217	.04199	31806	.00511	1	162.550	
(C) 4	V-Strip Laminate	Pyrofoil Laminate	.04046	.35368	1368	.01431	1	19.579	
(C) 5	Wrapper, Slip Plane	Pyrofoil	.04046	.16041	513	.00649	1	3.327	
6	Tie Tube	(A-286)	.287	.17620	150	.05057	1	7.585	
7	Collar	(A-286)	.287	.03998	150	.01147	1	1.721	
(C) *35	V/o - Graphite - 35 V/o - Niobium								

For purposes refer to Remarks Listed on Sheet

Sheet 1 of 4

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TABLE 5-3 (Cont.)
DESIGN WEIGHT ANALYSIS

System: NSS

Prepared By: R. Rittenberger

ECC: Core Periphery Alt. No. 1

Date: December 2, 1970

Dwg. No: 939J729 Group

Revision:

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
8	Washer, Split	(A-286)	.287	.03926	150	.0087	1	1.305	
9	Tube Spacer, Split	(A-286)	.287	.00261	3300	.00075	1	2.475	
10	Cup, Insulating	Pyro Graphite	.07894	.01138	150	.00090	1	0.135	
11	Spacer, Insulating, Split	Pyro Graphite	.07894	.00314	150	.00025	1	.038	
12	Spacer, Insulating, Split	Pyro Graphite	.07894	.00301	150	.00024	1	.036	
13	Spacer, Insulating, Split	Pyro Graphite	.07894	.00121	3000	.00010	1	.300	
14	Seal, Split	Pyrofoil	.04046	.01661	300	.00067	1	.201	

Superscripts Refer to Remarks Listed on Sheet

Sheet 2 of 4

TABLE 5-3 (Cont.)
DESIGN WEIGHT ANALYSIS SHEET

System: NSS

Prepared By: R. Rittenberger

ECC: Core Periphery Alt. No. 1

Date: December 2, 1970

Dwg. No: 939J729 Group

Revision:

5-8

(C)

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
15	Gland, Packing, Split	(A-286)	.287	.0162	150	.00465	1	0.698	
16	Spring	(A-286)	.287	.43935	174	.12609	1	21.940	
17	Nut	(A-286)	.287	.035043	150	.01006	1	1.509	
18	Hanger	(A-286)	.287	.12026	174	.03451	1	0.005	
19	Key	(A-286)	.287	.0434	24	.01246	1	0.299	
20	Wrapper, Metal	Moly. (TZM)	.369	.11816	174	.0436	1	7.586	
21	Bracket	(A-286)	.287	.5973	6	.17143	1	1.029	
22	Collar	(A-286)	.287	.01967	174	.00565	1	.983	
23	Pin	(A-286)	.287	.00551	174	.00158	1	.275	

Superscripts Refer to Remarks Listed on Sheet

Sheet 3 of 4

TABLE 5-3 (C)
DESIGN WEIGHT AND

System: NSS

Prepared By: R. Rittenberger

ECC: Core Periphery Alt. No. 1

Date: December 2, 1970

Dwg. No: 939J729 Group

Revision:

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
24	Bolt .250 - 28UNF-2A	(A-286)	.287	.03927	90	.01127	1	1.014	
25	Cup, Locking	(A-286)	.287	.00996	90	.00286	1	0.257	
26	Nut, Gland	(A-286)	.287	.0252	150	.00723	1	1.085	
27	Spring	(A-286)	.287	.04644	150	.01333	1	2.000	
28	Washer, Split	(A-286)	.287	.03026	150	.0087	1	1.305	
29	Rod, Support	(A-286)	.287	.12369	24	.0355	1	.852	
30	Block, Support	*	.14966	1.25598	24	.18796	1	4.511	
31	Seal, Metal Wrapper	Moly (TZM)	.369	.11816	174	.0436	1	7.580	
* 35 V/o - Graphite - 35 V/o - Niobium									

Superior to Remarks Listed on Sheet

Sheet 4 of 4

TABLE 5-4

DESIGN WEIGHT ANALYSIS SHEET

System: NSSPrepared By: R. RittenbergerECC: Core Periphery Alt. No. 2Date: November 4, 1970Dwg. No: 939J730 Group Revision:

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
(C) 1	Strip, Filler	Graphite G	.06575	16.1835	114	1.064	1	185.206	
2	Block, Support	*	.14966	1.25598	150	.18797	1	28.196	
(C) 3	Tile, Insulating	ZrC 50% Dense	.1217	.04059	31,806	.00494	1	157.122	
(C) 4	V-Strip Laminate	Pyrofoil	.04046	.34701	1368	.01404	1	19.203	
(C) 5	Wrapper	Pyrofoil	.04046	.18586	684	.00752	1	5.147	
6	Tube, Tie	(A-286)	.287	.17620	150	.0505	1	7.585	
7	Collar	(A-286)	.287	.03998	150	.01147	1	1.721	
8	Washer (Split)	(A-286)	.287	.03026	150	.0087	1	1.305	
(C)	* 65 v/o - Graphite - 35 v/o - Niobium								

Supplies listed on Sheet Sheet 1 of 4

TABLE 5-4 (Cont.)

DESIGN WEIGHT ANALYSIS SHEET

System: NSSPrepared By: R. RittenbergerECC: Core Periphery Alt. No. 2Date: November 4, 1970Dwg. No: 939J730 Group Revision:

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
9	Tube, Spacer (Split)	(A-286)	.287	.00261	3300	.0007	1	2.475	
10	Cup, Insulating	Pyro Graphite	.07894	.01138	150	.0009	1	0.135	
11	Spacer, Insulating (Split)	Pyro Graphite	.07894	.00314	150	.00025	1	.038	
12	Spacer, Insulating (Split)	Pyro Graphite	.07894	.00301	150	.00024	1	.036	
13	Spacer, Insulating (Split)	Pyro Graphite	.07894	.00121	3000	.0001	1	.300	
14	Seal (Split)	Pyrofoil	.04046	.01661	300	.00067	1	.201	
15	Gland, Packing (Split)	(A-286)	.287	.0162	150	.00465	1	.698	
16	Spring	(A-286)	.287	.43935	174	.1260	1	21.940	
17	Nut	(A-286)	.287	.035043	150	.0100	1	1.509	

Superscripts Refer to Remarks Listed on Sheet Sheet 2 of 4

TABLE 5-4 (Cont.)

DESIGN WEIGHT ANALYSIS SHEET

System: NSSPrepared By: R. RittenbergerECC: Core Periphery Alt. No. 2Date: November 4, 1970Dwg. No: 939J730 Group Revision:

Item	Nomenclature	Material	Density Lb/in ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
18	Hanger	(A-286)	.287	.12026	174	.03451	1	6.005	
19	Key	(A-286)	.287	.0434	24	.01246	1	0.299	
20	Rod, Support	(A-286)	.287	.12369	24	.0353	1	0.852	
21	Bracket	(A-286)	.287	.5973	6	.1714	1	1.029	
22	Collar	(A-286)	.287	.01967	174	.00565	1	0.983	
23	Pin	(A-286)	.287	.00551	174	.00158	1	.275	
24	Bolt .250-28 UNF-2A	(A-286)	.287	.03927	90	.01127	1	1.014	
25	Cup, Locking	(A-286)	.287	.00976	90	.00286	1	0.257	
26	Nut, Gland	(A-286)	.287	.0252	150	.00723	1	1.085	

Superscripts Refer to Remarks Listed on Sheet Sheet 3 of 4

TABLE (Cont.)

DESIGN WEIGHT ANALYSIS SHEET

System: NSS

Prepared By: R. Rittenberger

ECC: Core Periphery Alt. No. 2

Date: November 4, 1970

Dwg. No: 939J730 Group

Revision:

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
27	Spring	(A-286)	.287	.04644	150	.0133	1	2.000	
28	Washer (Split)	(A-286)	.287	.03026	150	.008	1	1.305	
29	Block, Support	*	.14966	1.25598	24	.187	1	4.511	
*65% v/o - Graphite, 35 v/o - Niobium									

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(C)

TABLE 5-5
DESIGN WEIGHT ANALYSIS SHEET

System: NSS

Prepared By: R. Rittenberger

ECC: Core Periphery Alt. No. 3

Date: December 4, 1970

Dwg. No: 939J731 Group

Revision:

5-14

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
(C) 1	Filler Strip	Hitron	.05419	18.217	174	.9872	1	171.773	
2	Key	(A-286)	.287	.05508	150	.01581	1	2.372	
3	Support Rod	(A-286)	.287	.12369	174	.0355	1	6.177	
4	Orifice, Screened	(A-286)	.287	.01182	150	.00339	1	0.509	
5	Spring	(A-286)	.287	.43935	174	.12609	1	21.940	
(C) 6	Wrapper, Metal	Moly TZM	.369	.11894	312	.04389	1	15.010	
(C) 7	V-Strip Laminate	Pyrofoil	.04046	.14533	976	.00588	1	88.257	
8	Pin	(A-286)	.287	.00551	174	.00158	1	0.275	
(C) 9	Wrapper, Slip Plane	Pyrofoil	.04046	.08922	312	.00361	1	1.234	

TABLE 5-5 (Cont.)
DESIGN WEIGHT ANALYSIS SHEET

System: NSS

Prepared By: R. Rittenberger

ECC: Core Periphery Alt. No. 3

Date: December 4, 1970

Dwg. No: 939J731 Group

Revision:

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
10	Collar	(A-286)	.287	.01967	174	.00565	1	0.983	
11	Hanger	(A-286)	.287	.12026	174	.03451	1	6.005	
12	Bracket	(A-286)	.287	.59930	6	.17443	1	1.029	
13	Locking Cup	(A-286)	.287	.00996	90	.00286	1	0.257	
14	Bolt.250-28 UNF-2A	(A-286)	.287	.03937	90	.01120	1	1.014	
15	Key	(A-286)	.287	.0484	24	.01246	1	0.299	

Superscripts Refer to Remarks Listed on Sheet

Sheet 2 of 2

6.0 SUPPORT PLATE AND PLENA

6.1 INTRODUCTION

The Support Plate and Plena consists of (a) A core support plate with three integral plena (an SSCA bypass flow plenum, a support stem inlet flow plenum and a plenum which combines the bypass flow with the support stem effluent); (b) A piping arrangement which distributes the SSCA outlet flow to the Support Plate, and (c) Flow separation baffles and associated hardware which separates the flow to the turbine from the turbine exit flow.

6.2 WEIGHT SUMMARY

The target weight for this ECC is 850 lbs. This is classified as a Category A component.

The current design weights for the components in this ECC and the total ECC weight are shown on Table 6-1. The detailed weight breakdown of the parts of this ECC is shown on Tables 6-2 and 6-3. Also defined on these tables are the designs used in the analysis (drawing numbers, materials, and densities).

TABLE 6-1
 DESIGN WEIGHT SUMMARY
 ENGINEERING CRITICAL COMPONENT
SUPPORT PLATE AND PLENA - EC 677561

<u>Nomenclature</u>	<u>Drawing No.</u>	<u>Group No.</u>	<u>Weight Lbs.</u>	<u>One Std Deviation, Lbs.</u>
Internal SSCA & Shield Baffle	939J725	1	446	-
Support Plate & Plena	940J449	1	459	-
		Total	905	9

TABLE 6-2
DESIGN WEIGHT ANALYSIS SHEET

System: NSS

Prepared By: J. Karbowski/A. Fero

ECC: Internal SSCA and Shield Baffle

Date: December 3, 1970

Dwg. No: 939J725 Group 1

Revision: _____

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
1	Piping Cylinder	AL (6061-T61)	0.098	2050.	1	201.	1	201.	
2	Tubing-.875 O.D. x .058 Wall	AL T6(6061)	0.098	2.14	36	.210	1	7.55	
3	O Ring-.125 O.D. x .012 Wall 39.750 O.D.	T6(6061)	0.098	0.530	2	.0520	1	0.104	
4	Bolt-.375-24 UNF-2A	(A-286)	0.287	0.1665	12	.0475	1	0.570	
5	Locking Device	CRES TY304- Cond. A	0.287	0.0330	12	.00947	1	0.114	

Superscripts Refer to Remarks Listed on Sheet _____

Sheet 1 of 9

TABLE 6-2 (Cont.)
DESIGN WEIGHT ANALYSIS SHEET

System: NSS

Prepared By: J. Karbowski/A. Fero

ECC: Internal SSCA and Shield Baffle

Date: December 3, 1970

Dwg. No: 939J725 Group 1

Revision: _____

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
6	Stud-.375-24UNF-2A	CRES (A-286)	0.287	1.56	36	.448	1	16.1	
7	Nut-.275-24UNF-2B	CRES (A-287)	0.287	0.101	36	.0290	1	1.04	
8	Locking Device	CRES TY304- Cond. A	0.287	0.0330	36	.00947	1	0.341	
9	Wave Spring	CRES TY302-1/4 Hard	0.286	2.49	2	.713	1	1.43	
10	Piston Ring Seal	CRES TY302-1/2 Hard	0.286	8.80	2	2.52	1	5.03	

Superscripts Refer to Remarks Listed on Sheet _____

Sheet 2 of 9

TABLE 6-2 (Cont.)
DESIGN WEIGHT ANALYSIS SHEET

System: NSS

Prepared By: J. Karbowski/A. Fero

ECC: Internal SSCA and Shield Baffle

Date: December 3, 1970

Dwg. No: 939J725 Group 1

Revision: _____

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
11	Piston Ring Housing	AL(6061-T61)	0.098	63.8	1	6.26	1	6.26	
12	Sleeve	AL T651 (6061)	0.098	0.141	8	.0138	1	0.111	
13	Flow Diffuser	AL(6061-T61)	0.098	15.4	1	1.51	1	1.51	
14	Locking Device	CRES 304-Cond. A	0.287	0.0330	8	.00948	1	0.0758	
15	Bolt-.375-24UNF-2A	CRES (A-286)	0.287	0.306	8	.0878	1	0.702	

Superscripts Refer to Remarks Listed on Sheet _____

Sheet 3 of 9

TABLE 6-2 (Cont.)
DESIGN WEIGHT ANALYSIS SHEET

System: NSS

Prepared By: J. Karbowski/A. Fero

ECC: Internal SSCA and Shield Baffle

Date: December 3, 1970

Dwg. No: 939J725 Group 1

Revision: _____

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
16	Central Dome	AL (6061-T61)	0.098	1860.	1	182.	1	182.	
17	Elbow Union (Special)	AL (6061)	0.098	2.37	30	.232	1	6.97	
18	Tubing .875 O.D. x .058 Wall	AL T6(6061)	0.098	0.940	29	.0921	1	2.67	
19	Elbow Union (Special)	AL(6061)	0.098	2.48	6	.243	1	1.46	
20	Tubing .875 O.D. x .053 Wall	AL T6(6061)	0.098	0.456	6	.0447	1	0.268	
21	Inlet Torus	AL T6(6061)	0.098	39.3	1	3.85	1	3.85	

Superscripts Refer to Remarks Listed on Sheet _____

Sheet 4 of 9

TABLE 6-2 (Cont.)
DESIGN WEIGHT ANALYSIS SHEET

System: NSS

Prepared By: J. Karbowski/A. Fero

ECC: Internal SSCA and Shield Baffle

Date: December 3, 1970

Dwg. No: 939J725 Group 1

Revision: _____

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
22	ByPass Torus	AL T6(6061)	0.098	28.1	1	2.75	1	2.75	
23	Interface Seal Sleeve	AL(6061-T61)	0.098	7.42	1	.728	1	0.728	
24	Wave Spring	CRES TY302-1/4 Hard	0.286	0.564	2	.161	1	0.323	
25	Piston Ring Seal	CRES TY302-1/2 Hard	0.286	1.30	2	.373	1	0.745	
26	Screen No. 20 Mesh (.016 dia. wire)	CRES TY304- Cond. A	0.287	0.199	1	.0571	1	0.057	

Superscripts Refer to Remarks Listed on Sheet _____

Sheet 5 of 9

TABLE 6-2 (Cont.)
DESIGN WEIGHT ANALYSIS SHEET

System: NSS

Prepared By: J. Karbowski/A. Fero

ECC: Internal SSCA and Shield Baffle

Date: December 3, 1970

Dwg. No: 939J725 Group 1

Revision: _____

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
27	Ring, Retainer	CRES TY304- Cond. A	0.287	1.75	1	.503	1	0.503	
28	Spirolox 3.875 O.D. 120 Thk.	CRES TY302-1/4 Hard	0.286	0.0906	1	.0259	1	0.0259	
29	Interface Seal Sleeve	AL(6061- T61)	0.098	4.19	1	.411	1	0.411	
30	Screen No. 20 Mesh (.016 dia.	CRES TY304- Cond. A	0.287	0.0333	1	.00956	1	0.00956	
31	Piston Ring Seal	CRES TY302-1/2 Hard	0.286	0.265	2	.0758	1	0.152	

Superscripts Refer to Remarks Listed on Sheet _____

Sheet 6 of 9

TABLE 6-2 (Cont.)
DESIGN WEIGHT ANALYSIS SHEET

System: NSS

Prepared By: J. Karbowski/A. Fero

ECC: Internal SSCA and Shield Baffle

Date: December 3, 1970

Dwg. No: 939J725 Group 1

Revision: _____

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
32	Wave Spring	CRES TY302-1/4 Hard	0.286	0.147	2	.0421	1	0.0842	
33	Ring, Retainer	CRES TY304- Cond. A	0.287	0.691	1	.198	1	0.198	
34	Spirolox 1.562 O.D. .068 Thk	CRES TY302-1/4 Hard	0.286	0.0256	1	.00733	1	0.007	
35	Seal, Interface Ring	AL(6061- T61)	0.098	107.	1	10.5	1	10.5	

Superscripts Refer to Remarks Listed on Sheet _____

Sheet 7 of 9

TABLE 6-2 (Cont.)
DESIGN WEIGHT ANALYSIS SHEET

System: NSS

Prepared By: J. Karbowski/A. Fero

ECC: Internal SSCA and Shield Baffle

Date: December 3, 1970

Dwg. No: 939J725 Group 1

Revision: _____

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
36	Locking Device	CRES TY304 Cond. A	0.287	0.0205	12	.00588	1	0.0705	
37	Screw .250-28UNF 2A	CRES (A-286)	0.287	0.0619	12	.0178	1	0.213	
38	Tubing .875 O.D. x .058 Wall	AL T6(6061)	0.098	0.940	1	.0921	1	0.0921	
43	O' Ring .125 dia. .012 Wall 9.750 O.D.	AL T6(6061)	0.098	0.129	1	.0126	1	0.0126	
44	SSCA Inlet Pipe	AL T651(6061)	0.098	13.6	1	1.33	1	1.33	

Superscripts Refer to Remarks Listed on Sheet _____

Sheet 8 of 9

TABLE 6-2 (Cont.)
DESIGN WEIGHT ANALYSIS SHEET

System: NSS

Prepared By: J. Karbowski/A. Fero

ECC: Internal SSCA and Shield Baffle

Date: December 3, 1970

Dwg. No: 939J725 Group 1

Revision: _____

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
45	ByPass Inlet Pipe	AL T651(6061)	0.098	5.43	1	.532	1	0.532	
46	Reducing "Y" (Special)	AL(6061)	0.098	4.34	1	.425	1	0.425	
47	Expanding "Y" (Special)	AL(6061)	0.098	1.63	1	.159	1	0.159	
48	Elbow (Special)	AL(6061)	0.098	0.795	1	.0779	1	0.0779	

Superscripts Refer to Remarks Listed on Sheet _____

Sheet 9 of 9

TABLE 6-3
DESIGN WEIGHT ANALYSIS SHEET

System: NSS

Prepared By: R. Lampe

ECC: Support Plate & Plena

Date: November 6, 1970

Dwg. No: 940J449 Group G01

Revision: _____

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
1	Support Plate & Plena	Al (6061-T61)	0.098	3880.	1	381	1	381.	
2	Bolt - .375-24 UNF-2A	CRES (A-286)	0.287	0.178	36	.0511	1	1.84	
3	Locking Cup	CRES (304 Cond.A)	0.287	0.0330	36	.00948	1	0.341	
4	"O" Ring - 42.625 O.D.	CRES (TY 321 Ag Coated)	0.290	0.482	1	.140	1	0.140	
5	"O" Ring - 41.250 I.D. .125 Tube Dia. x .010 Wall	CRES (TY 321 Ag Coated)	0.290	0.467	1	.136	1	0.136	
6	"O" Ring - 41.000 O.D. .125 Tube Dia. x .010 Wall	CRES (TY 321 Ag Coated)	0.290	0.464	1	.135	1	0.135	

Superscripts Refer to Remarks Listed on Sheet _____

Sheet 1 of 3

TABLE 6-3 (Cont.)

DESIGN WEIGHT ANALYSIS SHEET

System: NSSPrepared By: R. LampeECC: Support Plate & PlenaDate: November 6, 1970Dwg. No: 940J449 Group G01

Revision: _____

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
7	"O" Ring - 38.500 I.D. .125 Tube Dia. x .010 Wall	CRES (TY 321 Ag Coated)	0.290	0.436	1	.126	1	0.126	
8	Ring, Plenum Closure	Al (6061-T61)	0.098	440.	1	43.1	1	43.1	
9	Segment, Baffle	Al (6061-T61)	0.098	1.76	6	.173	1	1.04	
10	Ring, Instrumentation	Al (6061-T61)	0.098	132.	1	12.9	1	12.9	
11	Bolt - .375-24 UNF-2A	CRES (A-286)	0.287	0.284	36	.0814	1	2.93	
12	Locking Cup	CRES (304 Cond. A)	0.287	0.0330	36	.00948	1	0.341	

Superscripts Refer to Remarks Listed on Sheet _____

Sheet 2 of 3

TABLE 6-3 (Cont.)
DESIGN WEIGHT ANALYSIS SHEET

System: NSS

Prepared By: R. Lampe

ECC: Support Plate & Plena

Date: November 6, 1970

Dwg. No: 940J449 Group G01

Revision: _____

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
13	Cap Screw, Soc. Hd. - .312-24 UNF-2A	CRES (A-286)	0.287	0.0944	72	.0271	1	1.95	
14	"O"Ring - .937 OD .063 O.D. x .010 Wall	CRES (TY 321 Ag Coated)	0.290	0.00453	78	.00131	1	0.102	

Superscripts Refer to Remarks Listed on Sheet _____

Sheet 3 of 3

7.0 INTERNAL SHIELD

7.1 INTRODUCTION

The Internal Shield consists of a Lead and Boron Carbide-Aluminum-Titanium Hydride (BATH) central and peripheral shield. The central shield is located forward of the core extending to the outer radius of the core. The peripheral shield is located forward of the reflector between the central shield and the pressure vessel.

7.2 WEIGHT SUMMARY

The target weight for this ECC is **3,275** lbs. The weight for the Internal Shield is established by the design requirements for the composite core. This is classified as a Category A component.

The current design weights for this ECC is shown on Table 7-1. The detailed weight breakdown is shown on Table 7-2. This includes definition of the design used in the analysis (drawing number, material and densities).

TABLE 7-1
 DESIGN WEIGHT SUMMARY
 ENGINEERING CRITICAL COMPONENT
INTERNAL SHIELD - EC 677562

<u>Nomenclature</u>	<u>Drawing No.</u>	<u>Group No.</u>	<u>Weight Lbs.</u>	<u>One Std. Deviation, Lbs.</u>
Internal Shield	939J741	-	3,237	32

TABLE 7-2
DESIGN WEIGHT ANALYSIS SHEET

System: NSS

Prepared By: R. Nassano

ECC: Internal Shield

Date: November 3, 1970

Dwg. No: 939J741 Group

Revision:

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
1	Stud .312-24UNF-2A x 14.23 lg.	AL T6(6061)	0.098	1.061	18	.1040	1	1.87	
2	Stud .190-32UNF-2A x 13.66 lg.	AL T6(6061)	0.098	0.3775	55	.0370	1	2.04	
3	Bolt .190-32UNF-2A x 12.09 lg.	AL T6(6061)	0.098	0.363	18	.0356	1	0.641	
4	Heli-Coil Insert .312-24	CRES SST 18-8	0.287	0.00866	18	.00249	1	0.045	
5	Heli-Coil Insert .190-32	CRES SST 18-8	0.287	0.00506	55	.00145	1	0.080	
6	Nut-.190-32 UNF-28	CRES (304 Cond.A)	0.287	0.00941	73	.0027	1	0.197	

Superscripts Refer to Remarks Listed on Sheet

Sheet 1 of 3

TABLE 7-2 (Cont.)

DESIGN WEIGHT ANALYSIS SHEET

System: NSSPrepared By: R. NassanoECC: Internal ShieldDate: November 3, 1970Dwg. No: 939J741 Group Revision:

Item	Nomenclature	Material	Density Lb/in ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
7	Nut - .312-24 UNF-28	CRES (304 Cond A)	0.287	0.0244	18	0.007	1	0.126	
8	Locking Device	AL T651 (6061)	0.098	.00870	91	.000853	1	0.078	
9	Locking Device	AL T651 (6061)	0.098	.02131	18	.00209	1	0.038	
10	Locating Pin .125 Dia.	AL T6(6061)	0.098	.00767	594	.000752	1	0.447	
13	Plate, Support .805 thk	AL T651 (6061)	0.098	759.	1	74.4	1	74.4	

Superscripts Refer to Remarks Listed on Sheet Sheet 2 of 3

TABLE 7-2 (Cont.)

DESIGN WEIGHT ANALYSIS SHEET

System: NSS

Prepared By: R. Nassano

ECC: Internal Shield

Date: November 3, 1970

Dwg. No: 939J741 Group

Revision:

Item	Nomenclature	Material	Density lb/in ³	Volume in ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
14	Module, Regular 11.100 lg. (central)	Bath PDS-30259	0.103	34.917 34.503*	258 55	3.596 3.554	1 1	928. 195.	
15	Module, irregular 11.100 lg.(central)	Bath PDS-30259	0.103	1203.**	N/A	N/A	N/A	124.	
16	Cluster, Regular 1.300 thk	Lead	0.404	26.56	37	10.73	1	397.	
17	Cluster, Irregular 1.300 thk.	Lead	0.404	348.4**	N/A	N/A	N/A	139.	
18	Plate, Cover .200 thk.	AL T651(6061)	0.098	202.6	1	19.85	1	19.9	

Superscripts Refer to Remarks Listed on Sheet

* Refers to modules with stud holes

** Refers to total volume of all irregular modules or irregular clusters

Sheet 3 of 5

TABLE 7-2 (Cont.)

DESIGN WEIGHT ANALYSIS SHEET

System: NSSPrepared By: R. NassanoECC: Internal ShieldDate: November 3, 1970Dwg. No: 939J741 Group Revision:

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
19	Cylinder, Flow Control	AL T61 (6061)	0.098	239.2	1	23.4	1	23.4	
20	Plate, Cover .200 thk.	T651 (6061)	0.098	122.1	1	12.0	1	12.0	
21	Module, Peripheral 11.100 lg.	Bath PDS-30259	0.103	6335*	N/A	N/A	N/A	653.	
22	Block, Filler-Outer 1.300 thk.	Lead	0.404	18.79	18	7.59	1	137.	
23	Ring, Support	AL T651 (6061)	0.098	69.62	1	6.82	1	6.82	

Superscripts Refer to Remarks Listed on Sheet

* Refers to all 11.1 inch long peripheral bath modules

Sheet 4 of 5

- TABLE 7-2 (Cont.)

DESIGN WEIGHT ANALYSIS SHEET

System: NSS

Prepared By: R. Nassano

ECC: Internal Shield

Date: November 3, 1970

Dwg. No: 939J741 Group

Revision:

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
24	Sleeve 1.750 O.D.	AL MIL-P-25995	0.098	2.749	18	.269	1	4.84	
25	Ring, Impedance	CRES (A-286)	0.287	11.21	1	3.22	1	3.22	
26	Sector, Peripheral 1.300 thk.	Lead	0.404	27.5	18	11.1	1	200	
27	Block, Filler-Inner 1.300 thk.	Lead	0.404	146.8*	N/A	N/A	N/A	59.3	
28	Module, Peripheral 9.600 lg.	Bath PDS-30259	0.103	23.11	90	2.38	1	214	
				22.07**	18	2.27	1	40.9	

Superscripts Refer to Remarks Listed on Sheet

* Refers to all filler blocks

** Refers to modules with stud holes and cut outs for drive shafts

Sheet 5 of 5

8.0 REFLECTOR ASSEMBLY

8.1 INTRODUCTION

The Reflector Assembly consists of a hollow right circular cylinder which encompasses the core from its forward to aft surface. The basic load-bearing member is an aluminum support structure to which are attached beryllium segments required to fulfill the primary function of neutron reflection. The reactivity function is satisfied by 18 control drums which are mounted within the reflector and rotate on bearings mounted on each end of the reflector. Rotation of the drums changes the position of control plates to vary the reactivity.

The Reflector Assembly also consists of the core support ring; the lateral support hardware consisting of load and seal rings, loading plungers, springs, spring retainers and thermal insulation.

8.2 WEIGHT SUMMARY

The target weight for this ECC is 3,750 lbs. The weight of this ECC is established by design for composite material core. This is classified as a Category A component except for the Lateral Support portion of this ECC which is Category C.

The current design weight for this ECC is shown on Table 8-1. The detailed weight breakdown is shown on Table 8-2. Also defined on Table 8-2 is the design used in the analysis (drawing numbers, materials, and densities).

TABLE 8-1
 DESIGN WEIGHT SUMMARY
 ENGINEERING CRITICAL COMPONENT
REFLECTOR ASSEMBLY - EC 677559

<u>Nomenclature</u>	<u>Drawing No.</u>	<u>Group No.</u>	<u>Weight Lbs.</u>	<u>One Std Deviation, Lbs.</u>
Shown on 939J740 Reflector Assembly	939J733	G01	3, 947	79
With Lateral Support:				
Alternate No. 1 Reflector Assembly	940J438	-	4, 235	90
Alternate No. 2 Reflector Assembly	939J724	-	4, 055	85
Alternate No. 3 Reflector Assembly	939J737	-	4, 067	85
Alternate No. 4 Reflector Assembly	939F266	-	4, 029	80

TABLE 8-2
DESIGN WEIGHT ANALYSIS SHEET

System: NSS

Prepared By: R.V. Rittenberger

ECC: Reflector Assembly

Date: November 24, 1970

Dwg. No: 939J733 Group G01

Revision: _____

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
1	Cylinder, Structural	Al PDS 30258-1 (6061-T61)	.098	6803.575	1	666.75	1	666.75	
2	Ring, Forward Extension	Al PDS 30258-1 (6061-T61)	.098	683.628	1	66.996	1	66.996	
3	Ring, Aft Support	Al QQ-A- 250/11-T6 (6061)	.098	108.821	1	10.664	1	10.664	
4	Segment, Inner Reflector	Be PDS 30018-1	.067	14.770	1	.9896	378	374.065	
5	Segment, Outer Reflector	Be PDS 30018-1	.067	23.598	1	1.581	378	597.656	
6	Can, Reflector Baffle	Al QQ-A-250/ 11-T6(6061)	.098	728.966	1	71.439	1	71.439	

Superscripts Refer to Remarks Listed on Sheet _____

Sheet 1 of 13

TABLE 8-2 (Cont.)
DESIGN WEIGHT ANALYSIS SHEET

System: NSS

Prepared By: R.V. Rittenberger

ECC: Reflector Assembly

Date: November 24, 1970

Dwg. No: 939J733 Group G01

Revision: _____

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
7	Cylinder, Locating	Al QQ-A-367 (6061-T652)	.098	138.228	1	13.546	1	13.546	
8	Liner, Drum Bore	Al WW-T-700/ 6-T6(6061)	.098	36.428	1	3.5699	18	64.258	
9	Cylinder, Drum	Be PDS 30018-1	.067	592.979	1	39.7296	18	715.13	
10	Can, Drum	Al WW-T-700/ 6-T6(6061)	.098	34.389	1	3.37	18	60.660	
11	Shaft, Forward Drum	Al QQ-A-225/ 8-T6(6061)	.098	6.8629	1	.6725	18	12.114	
12	Shaft, Aft Drum	Al QQ-A-225/ 8-T6(6061)	.098	3.427	1	.3358	18	6.048	

Superscripts Refer to Remarks Listed on Sheet _____

Sheet 2 of 13

TABLE 8-2 (Cont.)
DESIGN WEIGHT ANALYSIS SHEET

System: NSS

Prepared By: R.V. Rittenberger

ECC: Reflector Assembly

Date: November 24, 1970

Dwg. No: 937J733 Group G01

Revision: _____

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
13	Spring, Drum Cylinder	CRES AMS-5737 (A-286)	.287	2.061	1	.5915	18	10.656	
14	Housing, Forward Bearing	Al QQ-A-225/ 8-T6(6061)	.098	5.710	1	.5596	18	10.080	
15	Support, Aft Bearing	Al QQ-A-225/ 8-T6(6061)	.098	3.044	1	.2983	18	5.364	
16	Vane, Control	CuB ¹⁰ PDS30127-1	.280	6.964	1	1.9499	54	105.300	
17	Stop	CRES QQ-S-763 (304 Cond. A)	.287	.707	1	.2029	18	3.654	

Superscripts Refer to Remarks Listed on Sheet _____

Sheet 3 of 13

TABLE 8-2 (Cont.)
DESIGN WEIGHT ANALYSIS SHEET

System: NSS

Prepared By: R.V. Rittenberger

ECC: Reflector Assembly

Date: November 24, 1970

Dwg. No: 937J733 Group G01

Revision: _____

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
18	Spring, Anti-Backlash	CRES AMS-5525 (A-286)	.287	2.226	1	.638	18	11.502	
19	Coupling	CRES QQ-S-763 (304 Cond. A)	.287	2.994	1	.8593	18	15.462	
20	Bearing	CRES 440 C	.279	1.792	1	.500	36	18.000	
21	Standoff	CRES AMS 5737 (A-286)	.287	1.006	1	.2887	18	5.202	
22	Pad, Standoff	Al QQ-A-250/ 11-T6(6061)	.098	.521	1	.05106	18	.918	

Superscripts Refer to Remarks Listed on Sheet _____

Sheet 4 of 13

TABLE 8-2 (cont.)

DESIGN WEIGHT ANALYSIS

THIS PAGE UNCLASSIFIED

System: NSSPrepared By: R.V. RittenbergerECC: Reflector AssemblyDate: November 24, 1970Dwg. No: 937J733 Group G01

Revision: _____

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
23	Ring, Clamp	Al QQ-A-250/ 11-T6(6061)	.098	10.430	1	1.0221	18	18.396	
24	Capsule	Al QQ-A-225/ 8-T6(6061)	.098	.96048	1	.09413	756	71.160	
25	Cap, Capsule	Al QQ-A-250/ 11-T6(6061)	.098	.9273	1	.09087	756	68.720	
26	Sleeve	CRES AMS 5737 (A-286)	.287	.2367	1	.0676	756	51.332	
27	Spring, Segment Retainer	CRES AMS 5525 (A-286)	.287	.05308	1	.01523	756	11.514	
28	Plunger	Graphite PDS 30086-1	.0668	.7553	1	.05045	756	38.140	

Superscripts Refer to Remarks Listed on Sheet _____

Sheet 5 of 13

DESIGN WEIGHT ANALYSIS SHEET

System: NSSPrepared By: R.V. RittenbergerECC: Reflector AssemblyDate: November 24, 1970Dwg. No: 937J733 Group G01

Revision: _____

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
29	Spring, Lateral Support	CRES AMS-5737 (A-286)	.287	1.512	1	.43394	756	328.06	
(C) 30	Segment, Outer Seal	Graphite PDS 30019-1	.0694	13.476	1	.93523	189	176.75	
(C) 31	Segment, Inner Seal	Graphite PDS 30019-1	.0694	15.491	1	1.075	189	203.17	
(C) 32	Segment, Insulation	Grafoil PDS 30097-1	.0405	1.032	1	.0479	189	7.89	
33	Screen	CRES QQ-W-423 (CL 304, Cond. A)	.287	8.529	1	2.448	1	2.45	
34	Pin, Locating	Al QQ-A-225/ 8-T6(6061)	.098	.011	1	.00108	756	0.81

 Marks Listed on Sheet _____

Sheet 6 of 13

TABLE 8-2 (Cont.)

DESIGN WEIGHT ANALYSIS SHEET

System: NSSPrepared By: R. V. RittenbergerECC: Reflector AssemblyDate: November 24, 1970Dwg. No: 939J733 Group G01

Revision: _____

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
35	Nut, Adjustment	CRES AMA 5737 (A-286)	.287	.373	1	.107	18	1.93	
36	Seal, Aft Structure Outer	CRES AMS 5525 (A-286)	.287	.9212	1	.2644	1	0.26	
37	Seal, Aft Structure Inner	CRES AMS 5525 (A-286)	.287	.9020	1	.258	1	0.259	
38	O-Ring .125 Dia. x .012 Wall	CRES AISI 321 Ag Plated	.290	.2847	1	.083	1	0.083	
39	O-Ring .062 Dia. x .012 Wall	AL WW-T-700/ 6-T6 (6061)	.098	.0029	1	.000284	756	0.215	

Superscripts Refer to Remarks Listed on Sheet _____

Sheet 7 of 13

TABLE 8-2 (Cont.)

DESIGN WEIGHT ANALYSIS SHEET

System: NSS

Prepared By: R. V. Rittenberger

ECC: Reflector Assembly

Date: November 24, 1970

Dwg. No: 939J733 Group G01

Revision: _____

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
40	O-Ring .062 Dia. x .012 Wall 1.500 O. D.	Al WWW-T-700/ 6-T6 (6061)	.098	.0045	1	.000441	756	.333	
41	Seal, Forward Impedance	CRES AMS-5525 (A-286)	.287	6.927	1	1.988	1	1.988	
42	Insulator, Drum Cylinder	Grafoil PDS 30097-1	.041	11.372	1	.466	18	8.393	
43	Retainer, Insulation	Al QQ-A-250/ 11-T4(6061)	.098	12.339	1	1.21	18	21.762	
44	Spring, Drive Shaft	CRES AMS 5737 (A-286)	.287	1.268	1	.364	18	6.552	
45	Housing, Spring	Al QQ-A-225/ 8-T6 (6061)	.098	2.262	1	.222	18	3.996	

Superscripts Refer to Remarks Listed on Sheet _____

Sheet 8 of 13

TABLE 8-2 (Cont.)

DESIGN WEIGHT ANALYSIS SHEET

System: NSSPrepared By: R. V. RittenbergerECC: Reflector AssemblyDate: November 24, 1970Dwg. No: 939J733 Group G01

Revision: _____

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
46	Filler, Segment	Al QQ-A-250/ 11-T4(6061)	.098	17.406	1	1.71	18	30.708	
47	Bolt - .375-24 UNF-2A	CRES AMS 5737 (A-286)	.287	.260	1	0.075	36	2.686	
48	Nut, Aft Bearing Retainer	Al QQ-A-225/8 (6061-T6)	.098	.2461	1	0.024	18	0.434	
49	Lockwasher, Bearing Nut	CRES QQ-S-766 (304 Cond. A)	.287	.0774	1	0.022	18	0.400	
50	Nut, Forward Bearing Retainer	Al QQ-A-225/8 T6(6061)	.098	.7498	1	.074	18	1.323	

Superscripts Refer to Remarks Listed on Sheet _____

Sheet 9 of 13

TABLE 8-2 (Cont.)
DESIGN WEIGHT ANALYSIS SHEET

System: NSS

Prepared By: R. V. Rittenberger

ECC: Reflector Assembly

Date: November 24, 1970

Dwg. No. 939J733 Group G01

Revision: _____

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
51	Lockwasher	CRES QQ-S-766 (304 Cond. A)	.287	.0774	1	.022	18	0.400	
52	Bolt - .250-28 UNF-2A	CRES AMS 5737 (A-286)	.287	.0733	1	.021	72	1.512	
53	Locking Device	CRES QQ-S-763 (304 Cond. A)	.287	.0134	1	.004	72	0.281	
54	Bolt - .625-18 UNJF-3A	CRES AMS 5735 (A-286)	.287	.7187	1	.206	36	7.416	
55	Locking Device	CRES QQ-S-763 (304 Cond. A)	.287	.308	1	.088	36	3.182	
56	Bolt - .375-24 UNF-2A	CRES AMS 5737 (A-286)	.287	.2844	1	.082	36	2.938	

Superscripts Refer to Remarks Listed on Sheet _____

Sheet 10 of 13

TABLE 8-2 (Cont.)

DESIGN WEIGHT ANALYSIS SHEET

System: NSSPrepared By: R. V. RittenbergerECC: Reflector AssemblyDate: November 24, 1970Dwg. No: 939J733 Group G01

Revision: _____

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
57	Locking Device	CRES QQ-S-763 (304 Cond. A)	.287	.0342	1	.010	36	0.35	
58	Keensert - .375-24 UNF-3A	CRES AMS 5737 (A-286)	.287	.00072	1	.0002	108	.022	
59	Locking Device	CRES QQ-S-763 (304 Cond. A)	.287	.0342	1	.010	36	.353	
60	Rivet, Control Plate	Cu PD 13406- AC	.321	.0046	1	.00147	3186	4.70	
61	Pin, Control Plate	Al QQ-A-225/8 (6061-T6)	.098	.0132	1	.001	108	0.140	
62	Bolt - .375-24 UNF-2A	CRES AMS 5737 (A-286)	.287	.2021	1	.058	72	4.176	

Superscripts Refer to Remarks Listed on Sheet _____

Sheet 11 of 13

TABLE 8-2 (Cont.)

DESIGN WEIGHT ANALYSIS SHEET

System: NSSPrepared By: R.V. RittenbergerECC: Reflector AssemblyDate: November 24, 1970Dwg. No: 939J733 Group G01

Revision: _____

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
63	Locking Device	CRES QQ-S-763 (304 Cond. A)	.287	.0342	1	.00982	72	0.707	
64	Nut, Retainer	Al QQ-A-225/ 8(6061-T6)	.098	.1221	1	.012	18	0.216	
65	Lockwasher	CRES QQ-S-766 (304 Cond. A)	.287	.0261	1	.008	18	0.1350	
66	Retainer, Segment	CRES AMS 5737 (A-286)	.287	.01878	1	.005	756	4.078	
67	Screw - .250-28 UNF-2A	CRES AMS 5737 (A-286)	.287	.0221	1	.006	1512	9.526	

Superscripts Refer to Remarks Listed on Sheet _____

Sheet 12 of 13

TABLE 8-2 (Cont.)

DESIGN WEIGHT ANALYSIS SHEET

System: NSSPrepared By: R.V. RittenbergerECC: Reflector AssemblyDate: November 24, 1970Dwg. No: 939J733 Group G01

Revision: _____

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
68	Locking Device	CRES QQ-S-763 (304 Cond. A)	.287	.00396	1	.00116	18	0.021	
69	Screw - .250-28 UNF-2A	CRES AMS 5737 (A-286)	.287	.02798	1	.008	18	0.145	
70	Bolt - .375-24 UNF-2A	CRES AMS 5737 (A-286)	.287	.2325	1	.067	18	1.201	
71	Locking Device	CRES QQ-S-763 (304 Cond. A)	.287	.0342	1	.010	18	0.177	

Superscripts Refer to Remarks Listed on Sheet _____

Sheet 13 of 13

9.0 CONTROL DRUM DRIVE ASSEMBLY

9.1 INTRODUCTION

The Control Drum Drive Assembly (CDDA) is made up of eighteen (18) individual subassemblies, each consisting of an electrical actuator mechanism, a controller and an actuator malfunction override device (AMOD).

9.2 WEIGHT SUMMARY

The target weight for this ECC is 305 lbs. This is classified as a Category A component.

The current design weight for this ECC is shown on Table 9-1. A detailed breakdown of the weights in this ECC is shown on Table 9-2. Also defined on Table 9-2 is the design used in the analysis (drawing numbers, materials, and densities).

TABLE 9-1
 DESIGN WEIGHT SUMMARY
 ENGINEERING CRITICAL COMPONENT
CONTROL DRUM DRIVE ASSEMBLY - EC 677585

<u>Nomenclature</u>	<u>Drawing No.</u>	<u>Group No.</u>	<u>Weight Lbs.</u>	<u>One Std. Deviation, Lbs.</u>
Actuator	939J990	-	239	
AMOD	939J990	-	159	
Controllers	TBD	-	54*	
		Total	<hr/> 452	12

*Assuming no local shielding

TABLE 9-2

DESIGN WEIGHT ANALYSIS SHEET

System: NSSPrepared By: J. Cangilla/J. KarasECC: Control Drum Drive AssemblyDate: December 4, 1970Dwg. No: 939J990 Group Revision:

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
*1	Clamp, Cable	304 SST	.287	.555	2	.159	18	5.742	
*2	Screw - Socket Head Cap	303 SST	.290	.003	2	.001	18	.036	
3	Lock Wire	304 SST			AR	Neg.	18		
*4	Shell, Connector	347 SST	.290	1.003	1	.291	18	5.238	
5	Contact, Female	304 SST			26	Neg.	18		
6	Insert	Polyimide	.0575	.765	1	.044	18	.792	
*7	Spring	302 SST	.286	.108	1	.031	18	.558	
*8	Nut, Retaining	304 SST	.287	1.076	1	.309	18	5.562	
9	Pin, Bayonet	304 SST	.287		3	Neg.	18		
10	Shell, Receptacle, Weldment	347 SST	.290	.831	1	.241	18	4.338	
11	Housing	304 SST	.287	15.122	1	4.340	18	78.120	
12	Contact, Male	347 SST			26	Neg.	18		
13	Weld Ferrule	304 SST			16	Neg.	18		

Superscripts Refer to Remarks Listed on Sheet 8Sheet 1 of 8

TABLE 9-2 (Continued)
DESIGN WEIGHT ANALYSIS SHEET

System: NSS

Prepared By: J. Cangilla/J. Karas

ECC: Control Drum Drive Assembly

Date: December 4, 1970

Dwg. No: 939J990 Group

Revision:

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
14	Lead, Potentiometer	Cu			6	Neg.	18		
15	Lead, AMOD Trigger	Cu			2	Neg.	18		
16	Tubing, Shrinkable	Kynar			AR	Neg.	18		
17	Bolt	A286 SST	.287	.299	3	.086	18	4.644	
18	Dowel	321 SST	.290	.105	2	.030	18	1.098	
19	Dowel	321 SST	.290	.027	1	.008	18	.144	
20	End Bell, Motor	304 SST	.287	.822	1	.236	18	4.248	
21	Key, Motor Stator	302 SST	.286	.017	1	.005	18	.090	
22	Lamination, Stator	Si Iron	.280	.037	70	.010	18	13.302	
23	Insulation, Interlaminar	Iron Phosphate			AR	Neg.	18		
24	Winding, Stator Phase	Cu	.280	.625	4	.175	18	12.600	
25	Impregnant, Stator	Polyimide			AR	Neg.	18		
26	Sleeve, Insulating	Polyimide			AR	Neg.	18		

Superscripts Refer to Remarks Listed on Sheet 8

Sheet 2 of 8

TABLE 9-2 (Continued)
DESIGN WEIGHT ANALYSIS SHEET

System: NSS

Prepared By: J. Cangilla/J. Karas

ECC: Control Drum Drive Assembly

Date: December 4, 1970

Dwg. No: 939J990 Group

Revision:

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
27	Grill	304 SST	.287	.052	1	.015	18	.270	
28	Shaft, Rotor	304 SST	.287	1.007	1	.289	18	5.202	
30	Magnet, Rotor	Alnico	.325	1.145	1	.372	18	6.696	
31	Spring, Preload	302 SST	.286	.003	1	.001	18	.018	
32	Bearing, Motor, Forward	440 SST	.279	.358	1	.100	18	1.800	
33	Bearing, Motor, Aft	440 SST	.279	.322	1	.090	18	1.620	
34	End Bell, Motor	304 SST	.287	.993	1	.285	18	5.130	
35	Pinion, Duplex	A286 SST	.287	1.804	1	.518	18	9.324	
36	Contact Jumper, Ribbon	Nickel			20	Neg.	18		
37	Washer, Thrust	304 SST	.287	.003	1	.001	18	.018	
38	Spring, Preload	302 SST	.286	.003	1	.001	18	.018	
39	Lock, Retaining Ring	304 SST	.287	.007	1	.002	18	.036	

Superscripts Refer to Remarks Listed on Sheet 8

Sheet 3 of 8

TABLE 9-2 (Continued)

DESIGN WEIGHT ANALYSIS SHEET

System: NSS

Prepared By: J. Cangilla/J. Karas

ECC: Control Drum Drive Assembly

Date: December 4, 1970

Dwg. No: 939J990 Group

Revision:

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
40	Ring, Retaining	AMS5643	.281	.007	1	.002	18	.036	
41	Bearing	440 SST	.279	.179	2	.050	18	1.800	
42	Gear, Internal	A 286 SST	.287	1.965	1	.564	18	10.152	
43	Housing	4750 SST	.297	5.323	1	1.581	18	28.458	
44	Bearing	440 SST	.279	.645	2	.180	18	6.480	
45	Track, Resistance	Diallyl Phthalate			1	Neg.	18		
46	Terminal	Paliney			6	Neg.	18		
47	Contact, Terminal Pressure	Paliney			6	Neg.	18		
48	Washer, Index	Polyimide			2	Neg.	18		
49	Ring, Insulation	Polyimide	.0575	.123	1	.007	18	.126	
50	Spring	302 SST	.286	.014	1	.004	18	.072	
51	Ring, Retaining	AMS 5643	.281	.071	1	.020	18	.360	
52	Arm, Wiper				2	Neg.	18		

Superscripts Refer to Remarks Listed on Sheet 8

Sheet 4 of 8

TABLE 9-2 (Continued)
DESIGN WEIGHT ANALYSIS SHEET

System: NSS

Prepared By: J. Cangilla/J. Karas

ECC: Control Drum Drive Assembly

Date: December 4, 1970

Dwg. No: 939J990 Group

Revision:

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
53	Plate, Insulator	Polyimide			2	Neg.	18		
54	Support, Contact Finger	P-Bronze			2	Neg.	18		
55	Contact Finger	Paliney			2	Neg.	18		
56	Insulator, Eyelet	Polyimide			4	Neg.	18		
57	Eyelet	Be Cu			4	Neg.	18		
58	Screw	303 SST	.290	.002	4	Neg.	18	.054	
59	Shaft, Output	A 286 SST	.287	1.864	1	.535	18	9.630	
60	Spring, Preload	302 SST	.286	.007	1	.002	18	.036	
61	Lock, Retaining Ring	304 SST	.287	.111	1	.032	18	.576	
62	Ring, Retaining	AMS 5643	.281	.025	1	.007	18	.126	
63	Grommet	Polyimide			3	Neg.	18		
64	Screw	303 SST	.290	.007	6	.002	18	.234	
65	Bobbin	Polyimide	.0575	.608	1	.035	18	.630	

Superscripts Refer to Remarks Listed on Sheet 8

Sheet 5 of 8

TABLE 9-2 (Continued)

DESIGN WEIGHT ANALYSIS SHEET

System: NSSPrepared By: J. Cangilla/J. KarasECC: Control Drum Drive AssemblyDate: December 4, 1970

Dwg. No: _____ Group _____

Revision: _____

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
A66	Ball, Latch	440 SST	.279	.006	9	.002	18	.306	
67	Coil Winding	Cu	.280	1.271	1	.356	18	6.408	
68	Impregnant, Trigger Coil	Polyimide			AR	Neg.	18		
69	Magnet	Alnico	.325	.430	1	.140	18	2.520	
70	Pole Face, Trigger	Relay 5	.276	.855	1	.236	18	4.248	
71	Spring	302 SST	.286	.255	1	.073	18	1.314	
72	Hammer	Relay 5	.276	.228	1	.063	18	1.134	
73	Cup	304 SST	.287	1.686	1	.484	18	8.712	
74	Guard, Wiring	304 SST	.287	.958	1	.275	18	4.950	
75	Screw	303 SST	.290	.012	6	.003	18	.396	
A76	Housing, Ram	304 SST	.287	3.250	1	.933	18	16.794	
A77	Ram	A 286 SST	.287	1.560	1	.448	18	8.064	
78	Weld Ferrule	304 SST			16	Neg.	18		

Superscripts Refer to Remarks Listed on Sheet 8Sheet 6 of 8

TABLE 9-2 (Continued)
DESIGN WEIGHT ANALYSIS SHEET

System: NSS

Prepared By: J. Cangilla/J. Karas

ECC: Control Drum Drive Assembly

Date: December 4, 1970

Dwg. No: 939J990 Group

Revision:

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
A79	Tube, Drive Shaft	304 SST	.287	7.515	1	2.157	18	38.826	
A80	Collar, Thrust	304 SST	.287	.136	1	.039	18	.702	
A81	Piston	304 SST	.287	1.846	1	.530	18	9.540	
A82	Ring, Piston	Polyimide	.0575	.191	1	.011	18	.198	
83	Filter, Coolant	304 SST			1	Neg.	18		
A84	Spring, AMOD Drive	A286 SST	.287	9.303	1	2.670	18	48.060	
A85	Coupling, Spline	A286 SST	.287	1.811	1	.520	18	9.360	
86	Terminal	Be Cu			2	Neg.	18		
A87	Ring, Target	A286 SST	.287	.223	1	.064	18	1.152	
A88	Spring, Latch	302 SST	.286	.098	1	.028	18	.504	
A89	Cam, AMOD	A286 SST	.287	4.641	1	1.332	18	23.976	
A90	Dowel	321 SST	.290	.007	1	.002	18	.036	
A91	Screw	A286 SST	.287	.027	8	.009	18	1.350	

Superscripts Refer to Remarks Listed on Sheet 8

Sheet 7 of 8

TABLE 9-2 (Continued)
DESIGN WEIGHT ANALYSIS SHEET

System: NSS

Prepared By: J. Cangilla/J. Karas

ECC: Control Drum Drive Assembly

Date: December 4, 1970

Dwg. No: 939J990 Group

Revision:

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
92	Seal, Interface	A287 SST	.287	.156	1	.045	18	.810	
93	Insulator, Compression	Glass			AR	Neg.	18		
94	Spring, Preload	302 SST	.286	.063	1	.018	18	.324	
* Cable Clamp and Connector not Included in Control Drum Drive Total Weight A - AMOD Items Total of all Neg. Items estimated to weigh less than (1) pound.									

Superscripts Refer to Remarks Listed on Sheet 8

Sheet 8 of 8

10.0 STRUCTURAL SUPPORT COOLANT ASSEMBLY

10.1 INTRODUCTION

The SSCA consists of a valve module containing two actively redundant flow channels each consisting of an SSCV and SSBV with associated actuators, and inter-connecting piping (SSCL) between the valve module and other engine components.

The weights considered in this chapter will be for two Structural Support Coolant Valves and their actuators.

The actuators used on the valves are essentially the same as the control drum drive actuator, i.e., consisting of an electric drive actuation and its controller. Refer to Chapter 9 for its description. The differences between the CDDA actuator and the SSCV actuator are primarily that of drive shaft or coupling arrangement.

10.2 WEIGHT SUMMARY

The target weight of the two valves are 60 lbs. (30 lbs. each). The target weight for the SSCV actuators (two) is 32 lbs. (16 lbs. each) including the controllers.

The actuator is classified as a Category A component.

The current design weight definition, as provided by ANSC, is 36 lbs. for each of the two valves (i.e. 72 lbs. total for the NSS).

The current design weight for the actuators is listed on Table 10-1. A detailed breakdown of the actuator parts weights is shown on Table 10-2. Also defined on this table is the design used in the weight analysis (drawing number, materials, and densities).

The weights of the other components in the structural support coolant module are defined in ANSC data item S-047.

TABLE 10-1
 DESIGN WEIGHT SUMMARY
 ENGINEERING CRITICAL COMPONENT
STRUCTURAL SUPPORT COOLANT VALVE ACTUATOR - EC 677576

<u>Nomenclature</u>	<u>Drawing No.</u>	<u>Group No.</u>	<u>Weight Lbs.</u>	<u>One Std. Deviation, Lbs.</u>
SSCV Actuators (2)	940J510	-	25	
Controllers	TBD	-	6*	
		Total	<u>31</u>	1

* Assuming no local shielding

TABLE 10-2

DESIGN WEIGHT ANALYSIS SHEET

System: NSSPrepared By: J. Cangilla/J. KarasECC: Structural Support Coolant Valve ActuatorDate: December 4, 1970Dwg. No: 940J510 Group Revision:

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
*1	Clamp, Cable	304 SST	.287	.555	2	.159	2	.638	
*2	Screw - Socket Head Cap	303 SST	.290	.003	2	.001	2	.004	
3	Lock Wire	304 SST			AR	Neg.	2		
*4	Shell, Connector	347 SST	.290	1.003	1	.291	2	.382	
5	Contact, Female	304 SST			26	Neg.	2		
6	Insert	Polyimide	.0575	.765	1	.044	2	.088	
*7	Spring	302 SST	.286	.108	1	.031	2	.062	
*8	Nut, Retaining	304 SST	.287	1.076	1	.309	2	.618	
9	Pin, Bayonet	304 SST	.287		3	Neg.	2		
10	Shell, Receptacle, Weldment	347 SST	.290	.831	1	.241	2	.482	
11	Housing	304 SST	.287	15.122	1	4.340	2	8.680	
12	Contact, Male	347 SST				Neg.	2		
13	Weld Ferrule	304 SST				Neg.	2		

Superscripts Refer to Remarks Listed on Sheet 6Sheet 1 of 6

TABLE 10-2 (Continued)

DESIGN WEIGHT ANALYSIS SHEET

System: NSS

Prepared By: J. Cangilla/J. Karas

ECC: Structural Support Coolant Valve Actuator

Date: December 4, 1970

Dwg. No: 940J510 Group

Revision:

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
14	Lead, Potentiometer	Cu			6	Neg.	2		
15	Lead, AMOD Trigger	Cu			2	Neg.	2		
16	Tubing, Shrinkable	Kynar			AR	Neg.	2		
17	Bolt	A286 SST	.287	.299	3	.086	2	.516	
18	Dowel	321 SST	.290	.105	2	.030	2	.122	
19	Dowel	321 SST	.290	.027	1	.008	2	.016	
20	End Bell, Motor	304 SST	.287	.822	1	.236	2	.472	
21	Key, Motor Stator	302 SST	.286	.017	1	.005	2	.010	
22	Lamination, Stator	Si Iron	.280	.037	70	.010	2	1.478	
23	Insulation, Interlaminar	Iron, Phosphate			AR	Neg.	2		
24	Winding, Stator Phase	Cu	.280	.625	4	.175	2	1.400	
25	Impregnant, Stator	Polyimide			AR	Neg.	2		
26	Sleeve, Insulating	Polyimide			AR	Neg.	2		

Superscripts Refer to Remarks Listed on Sheet 6

Sheet 2 of 6

TABLE 10-2 (Continued)

DESIGN WEIGHT ANALYSIS SHEET

System: NSS

Prepared By: J. Cangilla/J. Karas

ECC: Structural Support Coolant Valve Actuator

Date: December 4, 1970

Dwg. No: 940J510 Group

Revision:

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
27	Grill	304 SST	.287	.052	1	.015	2	.030	
28	Shaft, Rotor	304 SST	.287	1.007	1	.289	2	.578	
30	Magnet, Rotor	Alnico	.325	1.145	1	.372	2	.744	
31	Spring, Preload	302 SST	.286	.003	1	.001	2	.002	
32	Bearing, Motor, Forward	440 SST	.279	.358	1	.100	2	.200	
33	Bearing, Motor, Aft	440 SST	.279	.322	1	.090	2	.180	
34	End Bell, Motor	304 SST	.287	.993	1	.285	2	.570	
35	Pinion, Duplex	A286 SST	.287	1.804	1	.518	2	1.036	
36	Contact Jumper, Ribbon	Nickel			20	Neg.	2		
37	Washer, Thrust	304 SST	.287	.003	1	.001	2	.002	
38	Spring, Preload	302 SST	.286	.003	1	.001	2	.002	
39	Lock, Retaining Ring	304 SST	.287	.007	1	.002	2	.004	

Superscripts Refer to Remarks Listed on Sheet 6

Sheet 3 of 6

TABLE 10-2 (Continued)

DESIGN WEIGHT ANALYSIS SHEET

System: NSS

Prepared By: J. Cangilla/J. Karas

ECC: Structural Support Coolant Valve Actuator

Date: December 4, 1970

Dwg. No: 940J510 Group

Revision:

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
40	Ring, Retaining	AMS 5643	.281	.007	1	.002	2	.004	
41	Bearing	440 SST	.279	.179	2	.050	2	.200	
42	Gear, Internal	A 286 SST	.287	1.965	1	.564	2	1.128	
43	Housing	4750 SST	.297	5.286	1	Neg.	2	3.140	
44	Bearing	440 SST	.279	.645	2	.180	2	.720	
45	Track, Resistance	Diallyl Phthalate			1	Neg.	2		
46	Terminal	Paliney			6	Neg.	2		
47	Contact, Terminal Pressure	Paliney			6	Neg.	2		
48	Washer, Index	Polyimide			2	Neg.	2		
49	Ring, Insulation	Polyimide	.0575	.123	1	.007	2	.014	
50	Spring	302 SST	.286	.014	1	.004	2	.008	
51	Ring, Retaining	AMS 5643	.281	.071	1	.020	2	.040	
52	Arm, Wiper	304 SST			2	Neg.	2		

Superscripts Refer to Remarks Listed on Sheet 6

Sheet 4 of 6

TABLE 10-2 (Continued)
DESIGN WEIGHT ANALYSIS SHEET

System: NSS

Prepared By: J. Cangilla/J. Karas

ECC: Structural Support Coolant Valve Actuator

Date: December 4, 1970

Dwg. No: _____ Group _____

Revision: _____

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
53	Plate, Insulator	Polyimide			2	Neg.	2		
54	Support, Contact Finger	P-Bronze			2	Neg.	2		
55	Contact Finger	Paliney			2	Neg.	2		
56	Insulator, Eyelet	Polyimide			4	Neg.	2		
57	Eyelet	Be Cu			4	Neg.	2		
58	Screw	303 SST	.290	.002	4	Neg.	2	.006	
59	Shaft, Output	A 286 SST	.287	1.864	1	.535	2	1.070	
60	Spring, Preload	302 SST	.286	.007	1	.002	2	.004	
61	Lock, Retaining Ring	304 SST	.287	.111	1	.032	2	.064	
62	Ring, Retaining	AMS5643	.281	.025	1	.007	2	.014	
63	Grommet	Polyimide			3	Neg.	2		
64	Screw	303 SST	.290	.007	6	.002	2	.026	
65	Guard, Wiring	304 SST	.287	.477	1	.137	2	.274	

Superscripts Refer to Remarks Listed on Sheet 6

Sheet 5 of 6

TABLE 10-2 (Continued)
DESIGN WEIGHT ANALYSIS SHEET

System: NSS

Prepared By: J. Cangilla/J. Karas

ECC: Structural Support Coolant Valve Actuator

Date: December 4, 1970

Dwg. No: _____ Group _____

Revision: _____

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
66	End	304 SST	.287	.634	1	.182	2	.364	
67	Seal, Interface	A 286 SST	.287	.156	1	.045	2	.090	
68	Spring	302 SST	.286	.073	1	.021	2	.042	
69	Shaft, Coupling	A 286 SST	.287	1.017	1	.292	2	.584	
70	Weld, Ferrule	304 SST			16	Neg.	2		
71	Insulator, Compression	Glass			AR	Neg.	2		
72	Spring, Preload	302 SST	.286	.063	1	.018	2	.036	
Total of all Neg. Items estimated to weigh less than (1) pound.									
*Cable Clamp and Connector not Included in Total Weights									

Superscripts Refer to Remarks Listed on Sheet 6

Sheet 6 of 6

11.0 NSS INSTRUMENTATION

11.1 INTRODUCTION

This ECC consists of pressure transducers, thermocouples, displacement transducers, strain transducers, accelerometers and neutronic instruments. This ECC also includes the pressure tubing, sensor and cable mounting hardware and the electrical leads with the NSSI side of the connectors to the wiring harness. The weight of the instrumentation port seal blocks and transition adaptors are also included.

11.2 WEIGHT SUMMARY

The target weight for this ECC is 150 lbs. As defined in Trade Study 792, some of the transducers are classified as Category A; some classified as Category B and some classified as Category C.

The current design weight for this ECC is shown on Table 11-1. The detailed breakdown of the weight of the components in this ECC is shown on Table 11-2.

TABLE 11-1
 DESIGN WEIGHT SUMMARY
 ENGINEERING CRITICAL COMPONENT
NSS INSTRUMENTATION - EC 677565

<u>Nomenclature</u>	<u>Drawing No.</u>	<u>Group No.</u>	<u>Weight Lbs.</u>	<u>One Std. Deviation, Lbs.</u>
NSS Instrumentation	TBD	TBD	275	8*

*Estimated based upon Engineering judgement.

TABLE 11-2

DESIGN WEIGHT ANALYSIS SHEET

System: NSSPrepared By: C. McCullough/
J. KarbowskiECC: NSS InstrumentationDate: 12/9/70Dwg. No: TBD Group --Revision:

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt. *	Grp/ NSS		
1	Acoustics Transducer	TBD	TBD	TBD	N/A	1.52	9	13.7	
2	Displacement Transducers	TBD	TBD	TBD	N/A	1.85	15	27.8	
3	Load Transducers	TBD	TBD	TBD	N/A	.90	5	4.5	
4	Neutronics	TBD	TBD	TBD	N/A	2.09	30	62.8	
5	Pressure Transducers	TBD	TBD	TBD	N/A	1.87	16	29.9	
6	Diff. Pressure Transducers	TBD	TBD	TBD	N/A	1.99	21	41.8	
7	Temperature Transducers	TBD	TBD	TBD	N/A	.325	97	31.5	
8	Vibration Transducers	TBD	TBD	TBD	N/A	1.1	3	3.3	
9	Strain	TBD	TBD	TBD	N/A	.088	9	0.8	
10	Seal Blocks	TBD	TBD	TBD	N/A	4.93	10	49.3	
11	Brackets, Mounting	TBD	TBD	TBD	N/A	--	TBD	9.6	

Superscripts Refer to Remarks Listed on Sheet Sheet 1 of 1

* Average unit weight based upon Engineering judgement.

12.0 MISCELLANEOUS

12.1 INTRODUCTION

This chapter provides data on items not included in the preceding ECCs as follows:

- (a) The anticriticality poison wires. The poison wires are an AGE and are removed prior to launch. The poison wire weights are, therefore, not included in flight weight of the NSS.
- (b) The neutron source. The configuration and location of the neutron source has not been determined. An ECP has been written requesting its addition to the specification tree.

12.2 WEIGHT SUMMARY

Target weights for the poison wires and neutron source have not been established. The current design weights for the items in this chapter are shown on Table 12-1.

TABLE 12-1
DESIGN WEIGHT ANALYSIS SHEET

System: NSS
Component: POISON WIRES

Prepared By: J. Karbowski

Date: 12/9/70

Dwg. No: 909E751 Group

Revision:

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
-	Poison Wires	--	--	--	-	14.8 grams	5000*	164	
	*Estimated								

Superscripts Refer to Remarks Listed on Sheet

Sheet 1 of 2

TABLE 12-1 (Continued)
DESIGN WEIGHT ANALYSIS SHEET

System: NSS

Prepared By: J. Karbowski

ECC: Neutron Source

Date: _____

Dwg. No: TBD Group _____

Revision: _____

Item	Nomenclature	Material	Density Lb/In ³	Volume In ³ /Item	Quantities			Weight Lb/NSS	One Std. Dev.
					Items/ Group	Item Wt.	Grp/ NSS		
	Neutron Source	TBD	TBD	TBD			1	2	

Superscripts Refer to Remarks Listed on Sheet _____

Sheet 2 of 2

APPENDIX A

WEIGHT HISTORY

This section contains a summary of the design weights as of December 1970 for the Nuclear Subsystem and its critical components as it has changed over the recent period.

This weight history is summarized as shown on Table A-1. The NERVA Engine Specification Tree defines that the SSCA and the NSSI are part of the Nuclear Subsystem. The weight of the SSCV and its effect on the NSS weights are not shown here. The weight of the SSCV actuator, which WANL will supply, is listed. Figures A-1 and A-2 present a graphic history.

A brief description of the changes shown on Table A-1 is outlined as follows:

March 13, 1970, Weight Status (IED 423A)

The March issue of the NSS weights included a number of changes from the previous estimated weights. The NSS total increased by 4347 lbs. to include changes as follows:

- (a) Change from graphite to composite fuel +2006 lbs.
- (b) Reflector weight change resulting from trade studies.

The changes include:

- (1) Aluminum frame reflector
- (2) Higher reflector ΔP
- (3) Increase reactivity requirements
- (4) Corrosion resistant periphery +825 lbs.
- (c) Increased shielding +1031 lbs.

April 21 Weight Status (IED 522)

Changes in weights for the NSS are as a result of designs from trade studies and Change Order W-70-6. The following changes were made:

- (a) Reflector OD reduced from 57.286 to 54.381 inches. -825 lbs.
- (b) Internal Shield weight reduced to include deletion of Boral liner at forward end and a reduced O.D. -640 lbs.

- (c) Weights were transmitted with graphite core rather than with the composite core included in the March 13 weights. -2006 lbs.

June 1 Weight Status (ECP 017)

The NSS weights at this time were based upon layout 940J385 with a nominal reflector OD of 54.381 inches. These weights are essentially the same as the April 21 issue, except for an internal shield weight reduction of 50 lbs.

June 24 Weight Status (SI:RLO:1276)

The NSS weight change at this time, including change from the graphite to the composite fuel elements, yielded a net increase of 1259 lbs. These changes are summarized:

(a) Fuel elements changed to composite	+2006 lbs.
(b) Internal Shield - including changes from BATH material to a combination BATH/Lead assembly	-600 lbs.
(c) Reflector Assembly (axial and radial optimization)	-123 lbs.

The above results on the reflector and shield included the preliminary results of the axial and radial optimization study and an estimated reduction associated with changes in shield criteria. Weights were based upon Trade Study layouts.

July Weight Status (IED 427C)

The NSS weight was reduced 224 lbs. from the June 24 total. The changes in the weights are as follows:

(a) Internal Shield changes including deletion of the peripheral	-250 lbs.
(b) Fueled elements - corrected calculations	+90 lbs.
(c) Support Plate & Plena - corrected calculations	+28 lbs.
(d) Reflector Assembly - corrected calculations	+4 lbs.
(e) Control Drum Drive Assembly - changes to recessed actuator.	-96 lbs.

The Nuclear Subsystem Instrumentation weight was adjusted to include ten instrument port seal blocks and adapters and a reestimation of Nuclear Instrumentation weights.

September Weight Status (IED 482C)

The September weight represents a NSS weight reduction of 130 lbs. from the July 27, 1970, issue. This reduction consists of:

(a) Change in manifold/shield support structure	-58 lbs.
(b) Recomputation of more mature design	-72 lbs.

October 1970 Weight Status (DRM 52832-A)

The NSS weight total change of +258 lbs. does not involve any component weight increase. This change is due to addition of NSS Instrumentation as per the revised specification tree and the addition of the SSCV actuator weight.

December, 1970, Weight Status

As a result of completion of Engineering Critical Component layouts and definition of detailed material and quantities on bills of materials, a more precise weight calculation is presented in this report. The weight changes for components are briefly summarized as follows:

Fuel Elements (Composite)	-250 lbs.	Reduction primarily due to effect of lower density carbon in elements.
Cluster Hardware	+2 lbs.	More detailed calculation.
Core Periphery	-18 lbs.	More detailed calculation.
Support Plate & Plena	+9 lbs.	More detailed calculation.
Internal Shield	-113 lbs.	Removal of corner at P/V flange. More detailed calculation. Reduction in support structure.
Reflector Assembly	+134 lbs.	Recalculation without rib cylinder. More detailed calculation. Aft end design change.
Control Drum Drive Assembly	+131 lbs.	More detailed calculation
NSS Instrumentation	+53 lbs.	More detailed calculation. Additional instr.

SSCVA	-5 lbs.	More detailed calculation. (New estimate on controller = -6 lbs.)
Neutron Source	+2 lbs.	Item added.

The NSS design (without SSCV) weight change from 15560 lbs. to 15505 is a 56 lb. reduction.

TABLE A-1
WEIGHT SUMMARY (LBS.)

<u>Part Name</u>	IED 423A	TLX 3885	ECP-017	SI:RLO:1276	IED 427C	IED 482C
	3/13/70 <u>Composite</u>	IED 522 4/21/70 (Refl. OD=54.38) <u>Graphite</u>	6/1/70 940J385 <u>Graphite</u>	6/24/70 (No. L/O Estimated) <u>Composite</u>	7/27/70 939J723 <u>Composite</u>	9/70 939J723 <u>Composite</u>
Nuclear Subsystem (Without SSCA)	17,847	14,447	14,397	15,656	15,432	15,302
Fuel Elements	5,360	3,354	3,354	5,350	5,440	5,440
Cluster Hardware	1,017	1,017	1,017	1,017	1,017	1,017
Core Periphery	537	537	537	537	537	465
Support Plate and Plena	855	926	926	926	954	896
Internal Shield	4,904	4,264	4,214	3,600	3,350	3,350
Reflector Assembly	4,757	3,932	3,932	3,809	3,813	3,813
Control Drum Drive Assembly	417	417	417	417	321	321
Nuclear Subsystem Instrumentation	95	95	95	95	222	222
Structural Support						
Coolant Valve Actuator	24	24	24	36	36	36
Structural Support Coolant Valve	←———— Defined by ANSC —————→					

A-5

TABLE A-1 (Continued)
WEIGHT SUMMARY (LBS.)

	DRM No.	
	52832 A	10/5/70
<u>Part Name</u>	939J723	12/1/70
	<u>Composite</u>	939J740
		<u>Composite</u>
Nuclear Subsystem (With SSCV Actuator)	15,560	15,505
Fuel Elements	5,440	5,190
Cluster Hardware	1,017	1,019
Core Periphery	465	447
Support Plate & Plena	896	905
Internal Shield	3,350	3,237
Reflector Assembly	3,813	3,947
Control Drum Drive Assembly	321	452
Nuclear Subsystem Instrumentation	222	275
SSCV Actuator	36	31
Neutron Source	--	2

Figure A-1. NSS Weight History

Figure A-2. Component Weight History

TITLE Mass Properties Analysis Report, Nuclear Subsystem	
DOCUMENT NO. WANL-TME-2764		DATE December 1970	
ABSTRACT <p>This document describes the weight, center-of-gravity, and mass moments of inertia for the NERVA Nuclear Subsystem. The data are based on the configuration shown on WANL Drawing 939J740 and are prepared in support of the NSS Preliminary Design Review.</p>			
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