

T
JN 841-75-15

本資料は 年 月 日付けで登録区分、
変更する。 2001. 6. -6

[技術情報室]

*CERTIFICATE AND RECORDS OF PNC
FUEL PINS FOR RAPSODIE-5
IRRADIATION PROGRAM*

April 1975

*TOKAI WORKS
POWER REACTOR & NUCLEAR FUEL
DEVELOPMENT CORPORATION*

本資料の全部または一部を複写・複製・転載する場合は、下記にお問い合わせください。

〒319-1184 茨城県那珂郡東海村大字村松4番地49
核燃料サイクル開発機構
技術展開部 技術協力課

Inquiries about copyright and reproduction should be addressed to:
Technical Cooperation Section,
Technology Management Division,
Japan Nuclear Cycle Development Institute
4-49 Muramatsu, Tokai-mura, Naka-gun, Ibaraki, 319-1184
Japan

© 核燃料サイクル開発機構 (Japan Nuclear Cycle Development Institute)
2001



Certificate and Records of PNC Fuel Pins for
RAPSODIE-5 Irradiation Program

M. Koizumi and S. Kashima

Approved by

H. Akutsu

Manager of Plutonium
Fuel Div.

T. Itaki

Manager, Quality Control Section
of Plutonium Fuel Div.

INDEX

1. General Remarks	1
2. Shipping List	1
3. Fabrication process of fuel	1
3-1 Fabrication flow sheet of $\text{PuO}_2\text{-UO}_2$ powder prepared by co-precipitation process	1
3-2 Pellet fabrication flow sheet and sampling position	1
3-3 Fabrication process of fuel pins	1
4. Fabrication records of fuel pins	2
4-1 Fuel (core fuel)	2
4-2 Axial blanket pellets	4
4-3 Cladding	5
4-4 Outer internal structure material of the fuel pins	6
4-5 Fuel pins	8
4-6 Grid spacers	9
4-7 Framework and knock bars	9
4-8 Tie rods, tie rod end plugs and tie rod sleeves.	10
5. Fuel pellets for analysis at C.E.A.	10

1. General remarks

This document is completed according to the Quality Control and testing procedures described in "Preliminary Design of PNC-5 Subassembly for Rapsodie Irradiation".

Co-precipitation method was employed for preparing $\text{PuO}_2\text{-UO}_2$ powder. Five lots of pellets are provided for fabrication of forty fuel pins.

Fabrication process of $\text{PuO}_2\text{-UO}_2$ powder, Pellets and fuel pins are shown in Fig. 3-1, Fig. 3-2 and Fig. 3-3 respectively.

2. Shipping List

Forty fuel pins and components of assembly were shipped in March, 1975.

The shipping list are shown in Tables 2-1 and 3-2 respectively.

3. Fabrication process of the fuel

3-1 Fabrication flow sheet of $\text{PuO}_2\text{-UO}_2$ powder prepared by co-precipitation process.

; Fig. 3-1

3-2 Pellet fabrication flow sheet and sampling position

; Fig. 3-2

3-3 Fabrication process of fuel pins

; Fig. 3-3.

4. Fabrication records of fuel pins

4-1 Fuel (Core fuel)

4-1-1 Sampling

1) Lot size and lot number

Lot size of co-precipitation process; 100 gr

Co-precipitation lot number ; 40

All lots for co-precipitated $\text{PuO}_2\text{-UO}_2$ powder were cross blended before pressing.

Lot size of sintering ; 800 gr

Sintering lot number ; 5

2) Two samples were taken out at random from cross blended powder for mass spectroscopic analysis of uranium.

3) Pellets were taken out at random from each sintering lot for the following examinations.

a) Plutonium content 3 pellets

b) Impurity (Spectroscopy) 3 "

c) " (Chemical analysis) 6 "

d) Amount of gas released 4 "

e) O/M ratio 3 "

f) Ceramography, α -autoradiography
and X-ray diffraction 2 "

4) About sixty pellets were centerless grounded for the diametral adjustment. Four pellets of them were taken out for determination of total gas released.

4-1-2 Analysis and other inspection methods.

Analysis and other inspection methods of fuel are described in the preliminary design of PNC-5 sub-

assembly for Rapsodie irradiation.

4-1-3 Inspection results

- 1) Isotopic composition of uranium and plutonium of five sintering lots are same because all lots of the $\text{PuO}_2\text{-UO}_2$ powder prepared by co-precipitation were cross blended before pressing.

The results of analysis are shown in Table 4-1-1.

- 2) Chemical analysis

The results of plutonium content and impurities in the mixed oxide fuel are shown in Table 4-1-2.

- 3) Amount of gas released

The amount of moisture in the pellets was measured at 500°C, and released gas extracted at 1700°C for 30 minutes.

The results is as follows.

Specification		LOT NO.				
		RF-31-03	RF-31-04	RF-31-05	RF-41-01	RF-41-02
150 $\mu\text{l/g}$	$\mu\text{l/g}$ Moisture	<10	<10	<10	18	24
(Including H_2O)	$\mu\text{l/g}$ Released gas	18	28	22	50	51

- 4) O/M ratio

The O/M ratio of the pellet was determined by thermo-gravimetric method.

The results are as follows.

O/M Specification	LOT NO.				
	RF-31-03	RF-31-04	RF-31-05	RF-41-01	RF-41-02
	1.96 ~ 2.00	1.99	1.99	1.98	1.99

5) Dimension and density

The diameter, height and weight of all finished pellets were measured for geometrical density determination. Measured value and calculated density are listed in Table 4-1-3.

6) X-ray diffraction

The detail method of X-ray diffraction examination is described in our preliminary design of PNC-5 subassembly for Rapsodie Irradiation. The X-ray diffraction chart for each lot are shown with lattice parameter in Figs. 4-1-1 ~ 4-1-5.

7) Macrography

The ceramography and alpha-autoradiography of fuel pellets are shown in Figs. 4-1-6 ~ 4-1-15.

4-2 Axial blanket pellet

1) Dimension and density

Seven hundred of UO_2 pellets prepared for blanket pellets, and 10% of the pellets were taken out at random for dimensional and density measurement. The results are shown in Table 4-2-1.

2) o/u ratio

The result of o/u ratio measured by ignition method is 2.01.

3) Amount of gas released

The result of analysis is $<30 \mu\text{l/g}$.

4) Impurities

The result of impurity analysis is shown in Table 4-2-2.

4-3 Cladding

Two kinds of cladding were used for this irradiation program, and all claddings used have been inspected by CEA. Fabrication process of cladding presented by manufacturer is shown in Fig. 4-3-1.

4-3-1 Sampling

Sampling and inspection items are shown in our preliminary design of PNC-5 Subassembly for Rapsodie Irradiation, in detail.

4-3-2 Inspection results

1) Chemical composition

Chemical analysis of cladding made by manufacturer are shown in Table 4-3-1.

2) Mechanical properties

Mechanical properties which measured by manufacturer are shown in Table 4-3-2.

3) Metallography

Metallurgical tests such as grain size and inclusion were made by PNC.

The result of grain size measurements is listed in Table 4-3-2 with mechanical properties. Typical micrographs of cladding are shown in Fig. 4-3-2.

4) Dimension

The results of dimensional measurements made by manufacturer are listed in Table 4-3-3.

5) Non destructive test

Non destructive tests such as surface roughness, visual inspection and ultrasonic inspection were made by PNC.

Any harmful defect was not observed.

The results are shown in Table 4-3-4.

4-4 Outer internal structure material of the fuel pin.

4-4-1 Each plug of fuel pin, end plug of container of tagging gas capsule, end plug of container of Sic and stainless steel, and plate. These end plugs were made from the same material as PNC-4 irradiation program fuel pin.

1) Shape and dimension

Shape and dimension of end plugs are shown in drawing RAPSODIE-5-1031(3), 5-1032, 5-2051, 5-2061 and 5-2071(3).

2) Chemical composition

Chemical analysis of end plug material were made by manufacturer.

The results are shown in Table 4-4-1.

3) Mechanical properties

Mechanical properties are as follows.

Properties	Spec.	Result	
		R.T.	at 600°C
Tensile strength (kg/mm ² ;	≥60	60.6	35.6
0.2% offset strength(kg/mm ²)	≥40	39.4	25.1
Elongation (%)	≥25	65.7	53.0

4-4-2 Container of tagging gas capsule, container of Sic and stainless steel, and sleeve. These containers were made by PNC.

1) Shape and dimension

Shape and dimension of containers are shown in drawing No. RAPSODIE-5-2061, 5-2051, 5-2071(3) and 5-2042. These results of length and weight measurement are listed in Table 4-5-1 with fuel materials.

2) Chemical analysis

Chemical analysis made by manufacturer are shown in Table 4-4-2.

4-4-3 Spring

1) Shape and dimension

Drawing No. RAPSODIE-5-2031.

2) Material and spring constant.

1 Material : SWPAC piano wire

2 Spring constant : 0.15 kg/mm².

3) Chemical composition

The data of the chemical analysis for the spring are taken from the manufacturer mill sheet.

The data are listed in Table 4-4-3.

4-5 Fuel pin

4-5-1 Dimension and weight of fuel pins

- 1) Weight of components in the fuel pins are shown in Table 4-5-1.
- 2) Length of components, total length of core fuels and blanket fuels were measured. The results are shown in Table 4-5-1 also.
- 3) Pin diameters were measured at welded part and at 5 cm intervals with a blade micrometer.
The results are shown in Table 4-5-2.
- 4) Weights of fissile material in the core fuels are shown in Table 4-5-3.

4-5-2 Helium leak test

The results were below enough than the allowable leak rate of 1.0×10^{-8} atm cc/sec.

The results are shown in Table 4-5-4.

4-5-3 X-ray radiography

The welded sections and components of fuels pins were inspected by X-ray radiography. Any harmful defects or abnormalities were not absorved. The results are shown in Table 4-5-4.

X-ray films of each fuel pin will be sent to C.E.A. together with this document.

4-5-4 Surface contamination

Loose and fix contamination of each fuel pin were checked and the results are shown in Table 4-5-4.

4-6 Grid spacer

1) Shape and dimension

Shape of grind spacer is shown in attached drawing RAPSODIE-5-3041.

Dimensional inspection was done for the following items by P.N.C.

(a) Pin pitch

(b) Grid height

(c) Thickness of grid unit wall

(d) Height of dimple

Any abnormalities were not observed in these inspections.

2) Metallography of the welded part

Metallography of welded part of grid was made on welding sample. The photographs are shown in Fig. 4-6-1.

3) Thermal cycling test and compression test

these tests were not performed.

4) Chemical composition

The data of chemical composition made by manufacturer are shown in Table 4-6-1.

5) Defect inspection

All grid spacers were visually inspected by PNC and any defects were not observed.

4-7 Framework and knock bar

1) Shape

Shape of Framework and knock bar are shown in drawing RAPSODIE-5-3011(2), 5-3021(2) and 5-3024(2).

2) Dimension and defect inspection

Dimension and defect inspections were done by PNC and the results are acceptable.

3) Chemical composition

The results are summarized in Table 4-6-2.

4-8 Tie rod, tie rod end plugs and tie rod sleeve

1) Shape

Shape of tie rod, tie rod end plug and tie rod sleeve are shown in the attached drawing RAPSODIE-5-3031.

2) Dimension and defect inspection

Dimension and defect inspection were made by PNC, and the results are acceptable.

3) Chemical composition

Chemical composition of tie rod, tie rod end plug and tie rod sleeve are shown in Table 4-6-2 along with other assembly components.

5. Fuel pellet for analysis at C.E.A.

Three pellets were taken from each sintering lot for analysis at CEA. These pellets are encapsuled in 30.7 cm long pin.

Location of each pellets are shown in Fig. 5-1.

Table 2-1 Shipping list of fuel pin

- 1 Numbers of pin 40
 2 Identification 001 ~ 040
 3 Weight of fuel pin

Pin No.	Weight of fuel pin	Weight of fuel	
		PuO ₂ -UO ₂	UO ₂ (Nat)
001	208.70 gr	68.48 gr	36.2 gr
002	209.60	69.24	36.1
003	209.22	68.65	36.3
004	209.10	68.38	35.4
005	208.60	67.27	36.4
006	208.78	69.00	36.3
007	209.68	69.19	35.9
008	209.31	69.38	35.9
009	209.80	68.81	35.9
010	210.16	69.01	35.7
011	209.81	68.85	35.7
012	208.60	68.49	36.7
013	208.60	68.26	34.9
014	207.90	68.65	35.5
015	208.92	68.16	36.2
016	209.43	68.97	36.6
017	209.56	68.56	36.8
018	208.80	68.70	36.0
019	209.50	68.59	36.0
020	209.82	69.10	36.1
021	207.83	66.34	35.3
022	208.21	66.89	36.5
023	206.36	67.27	35.3
024	207.22	67.98	35.7
025	210.41	67.68	36.2
026	210.41	66.84	36.1
027	211.04	67.28	36.7
028	210.04	66.53	36.2
029	210.12	66.81	36.0
030	211.07	68.25	46.2
031	210.95	68.17	35.9
032	210.42	68.58	35.6
033	212.00	69.33	35.6
034	211.82	68.44	35.9
035	209.11	68.72	35.9
036	208.90	68.67	36.5
037	209.54	69.62	35.9
038	212.56	70.14	35.9
039	210.43	67.35	35.7
040	209.74	67.32	35.5
Total	8382.07	2731.95	1439.2
15 pellets for analysis*	65.47	35.29	
S total	8447.54	2767.24	1439.2

+ These pellets are contained in 30.7 cm-long pin.

Table 2-2 Shipping list of samples

	Number
1. Grid spacer	12
2. Upper and lower end plug	4 sets
3. Sleeve	4 sets
4. Knock bar	2 sets
5. Framework	2
6. Stainless steel bar (20cm long)	1
7. Welding sample (upper and lower end plug)	5 sets
8. Spring	1
* 9. Tie-Rod	4

* ; These Tie-Rods were packed in the fuel shipping cask.

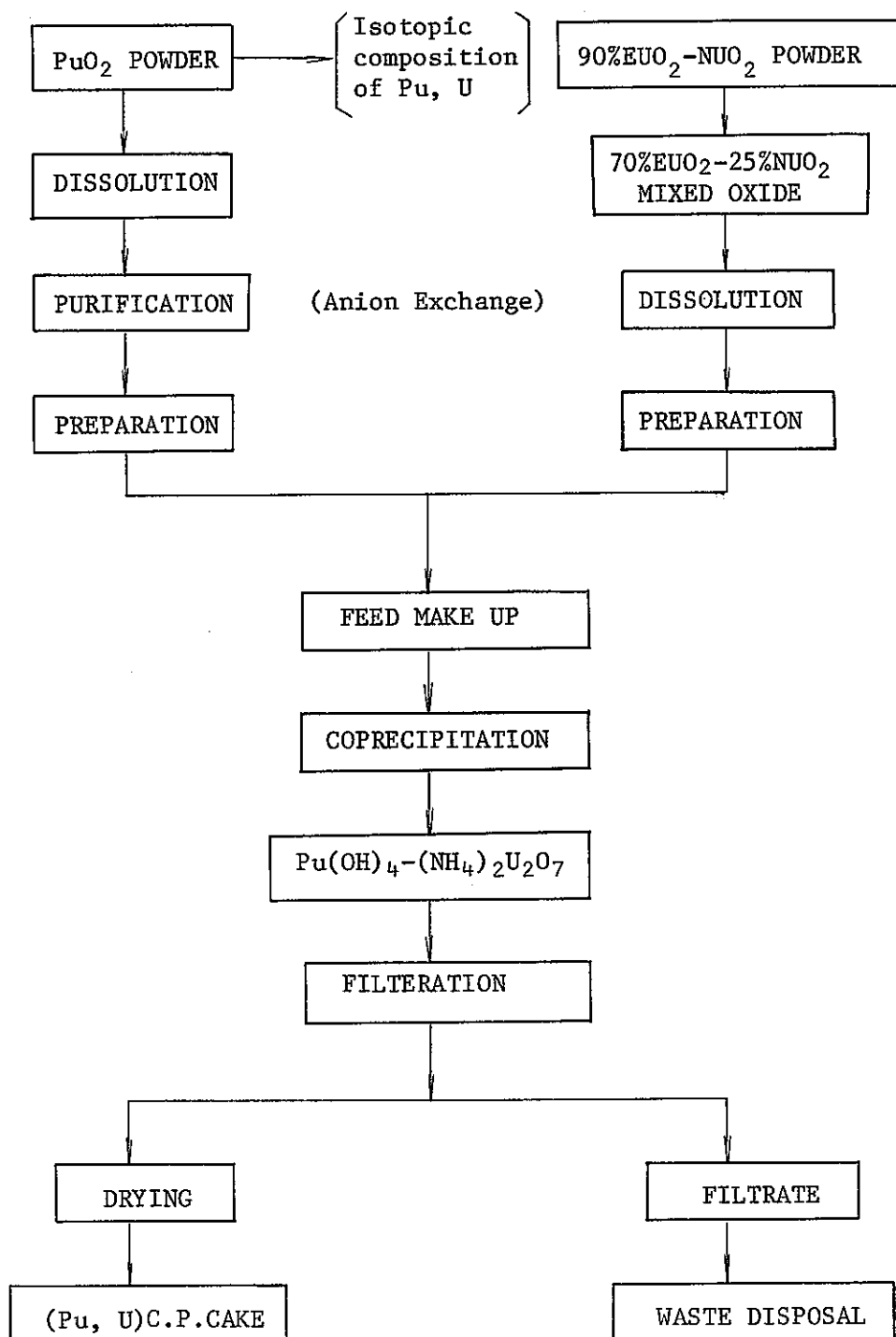


Fig. 3-1 Fabrication flow sheet of C.P. powder

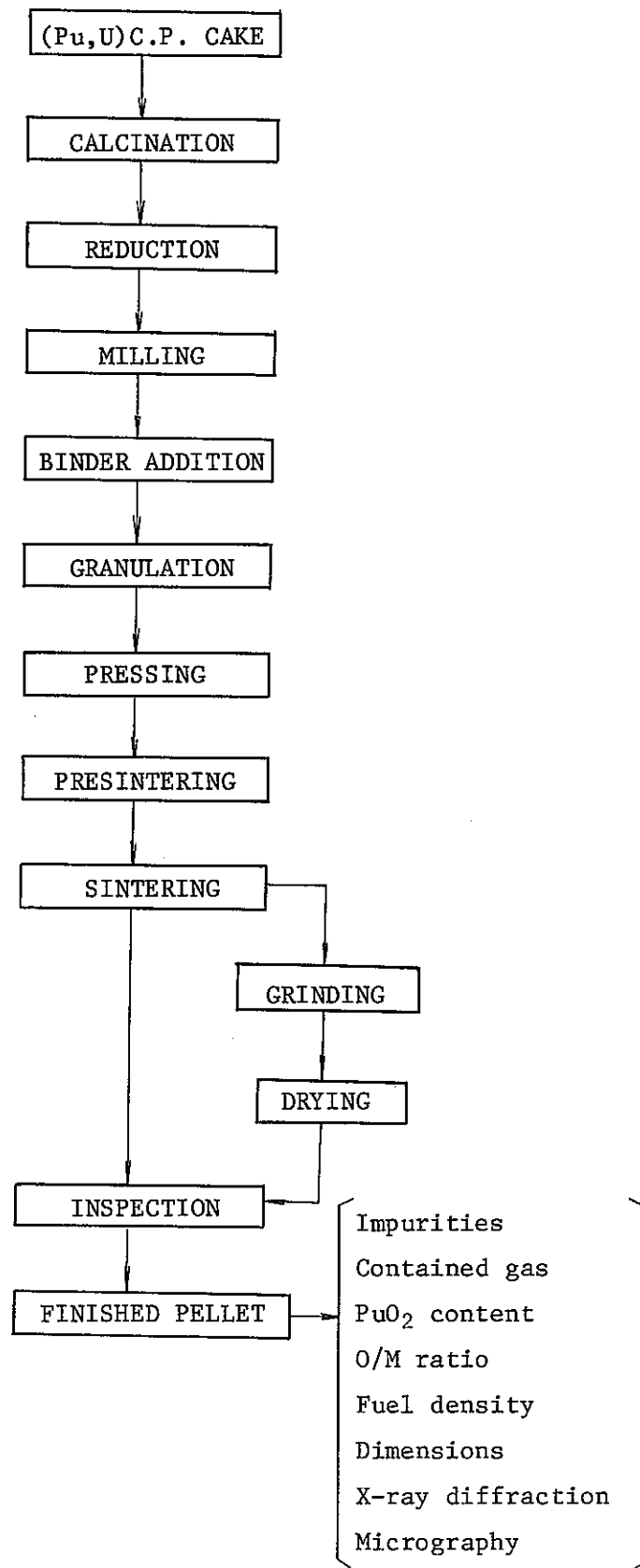


Fig. 3-2 Pellet fabrication process and sampling position

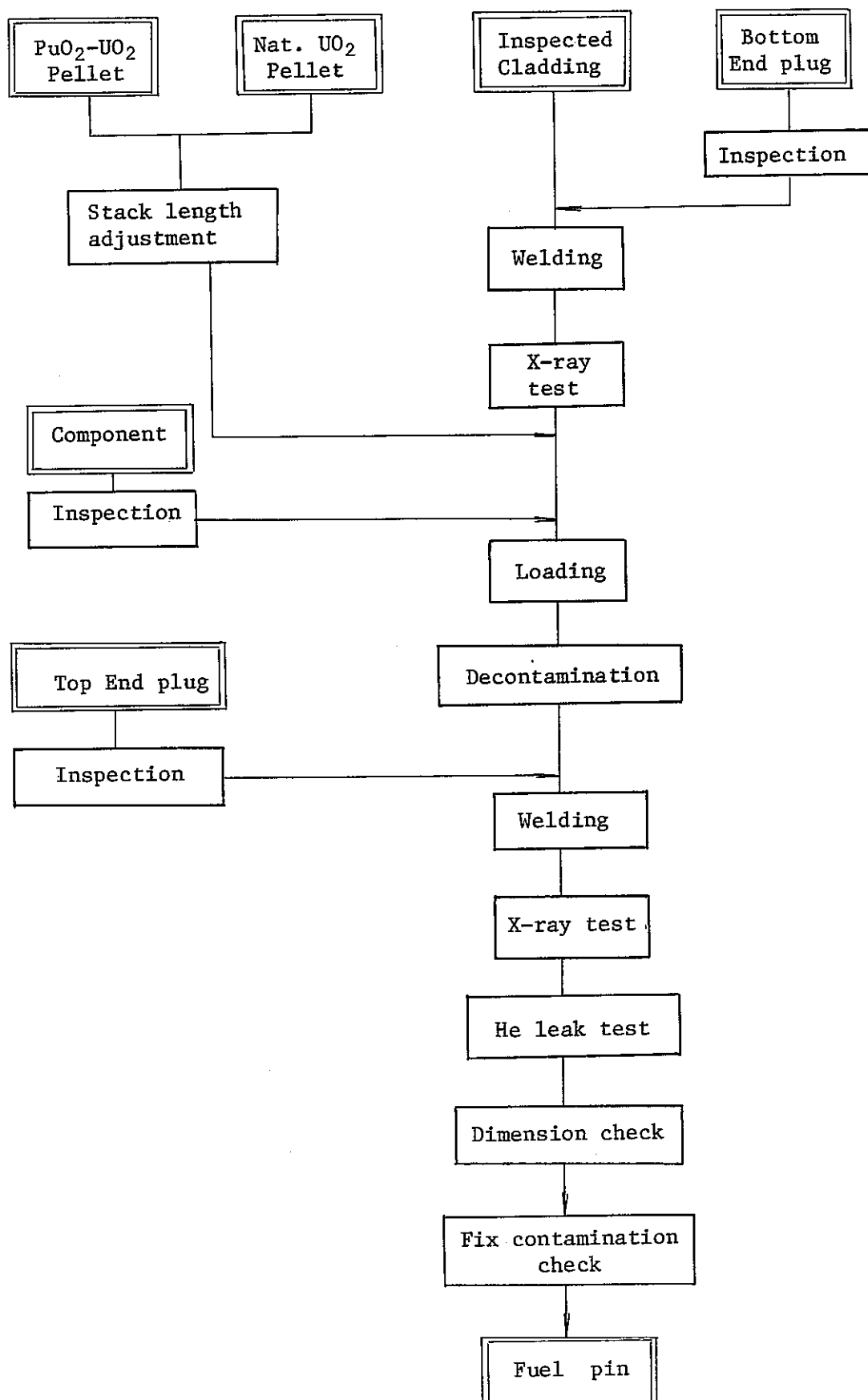


Fig. 3-3 Fabrication process of fuel pin

Table 4-1-1 Isotopic Composition of Rap-V Fuels

	Spec. %	Isotopic Composition		
		Sample-1	Sample-2	Average
U-235	75 ± 0.5	74.93	74.99	74.96
Pu-238	0.71 ± 0.02	-	-	0.708
-239	76.04 ± 0.04	-	-	76.043
-240	14.46 ± 0.04	-	-	14.455
-241	7.49 ± 0.03	-	-	7.493
-242	1.30 ± 0.01	-	-	1.301

Table 4-1-2 Results of chemical analysis

	Specification	Lot No.				
		RF-31-03	RF-31-04	RF-31-05	RF-41-01	RF-41-02
Pu		16.79	16.79	16.79	16.79	16.79
PuO ₂ %	20.0 ± 1	19.04	19.04	19.04	19.04	19.04
Al	<500 ppm	45	45	40	<10	<10
B	<20	<0.3	<0.3	<0.3	<0.3	<0.7
C	<150	<30	<30	<30	35	<30
Cd	<20	<1	<1	<1	<1	<1
Cl	<25	<25	<25	<25	<25	<25
Cr	<500	25	30	20	<10	<10
F	<25	<10	<10	<10	<10	<10
Fe	<500	80	85	30	15	30
Mg	<25	10	10	6	<2	7
N	<200	<50	<50	<50	<50	<50
Ni	<500	35	25	15	10	10
V	<200	<10	<10	<10	<10	<10
Total of Cu•Zn•Si	<600	<61	<61	<61	<61	<61
Total of Ag•Mn•Mo•Pb•Sn	<200	<41.1	<41.1	<41.1	<37	<38

Table 4-1-3 Demension and density of fuel pellets

Pin No.		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
DIAMETER	MAXIMUM	5.450	5.450	5.450	5.450	5.440	5.450	5.450	5.450	5.440	5.447	5.450	5.450	5.447	5.450	5.446
	AVERAGE	5.432	5.416	5.433	5.439	5.391	5.432	5.433	5.439	5.407	5.391	5.424	5.429	5.437	5.432	5.384
	MINIMUM	5.390	5.364	5.391	5.423	5.360	5.400	5.376	5.410	5.370	5.350	5.380	5.375	5.420	5.393	5.350
HEIGHT	MAXIMUM	11.175	11.090	11.252	11.338	11.448	11.635	11.385	11.510	11.135	10.920	11.669	11.415	11.359	11.600	11.380
	AVERAGE	10.960	10.736	10.969	11.016	10.632	10.975	11.141	10.758	10.711	10.396	10.994	10.990	11.037	10.987	10.689
	MINIMUM	10.678	10.241	10.594	10.320	10.255	10.575	10.569	10.005	10.315	9.913	10.630	10.375	10.616	10.417	10.030
WEIGHT	MAXIMUM	2.405	2.380	2.424	2.437	2.460	2.498	2.443	2.500	2.404	2.297	2.510	2.428	2.430	2.517	2.448
	AVERAGE	2.361	2.308	2.367	2.358	2.242	2.379	2.386	2.313	2.294	2.226	2.374	2.362	2.354	2.367	2.272
	MINIMUM	2.309	2.177	2.299	2.224	2.150	2.263	2.253	2.133	2.232	2.105	2.307	2.170	2.268	2.284	2.100
% T.D	MAXIMUM	86.73	86.87	86.91	85.07	86.64	85.96	86.33	86.70	86.94	87.00	86.87	86.99	84.66	86.07	86.41
	AVERAGE	84.59	84.85	84.71	83.83	83.95	83.98	83.70	84.20	84.83	85.39	85.05	84.48	83.56	84.58	84.69
	MINIMUM	83.05	83.26	83.02	83.15	83.05	83.12	83.17	83.06	83.28	83.10	83.03	83.00	83.02	83.26	83.04
Pin No.		16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
DIAMETER	MAXIMUM	5.450	5.450	5.450	5.450	5.450	5.390	5.420	5.410	5.415	5.415	5.415	5.410	5.420	5.395	5.445
	AVERAGE	5.427	5.431	5.428	5.433	5.425	5.371	5.376	5.390	5.385	5.390	5.382	5.381	5.387	5.371	5.422
	MINIMUM	5.375	5.400	5.362	5.380	5.385	5.353	5.350	5.350	5.350	5.350	5.360	5.350	5.350	5.350	5.360
HEIGHT	MAXIMUM	11.710	11.784	11.697	11.725	11.680	11.059	11.060	11.090	11.090	10.990	11.075	11.010	11.070	11.065	11.365
	AVERAGE	10.709	11.000	10.982	10.989	10.720	10.607	10.664	10.711	10.725	10.760	10.623	10.745	10.599	10.673	10.320
	MINIMUM	8.944	10.454	10.401	10.264	8.556	9.995	10.069	10.085	10.170	10.401	9.400	9.900	9.270	9.790	9.545
WEIGHT	MAXIMUM	2.514	2.512	2.529	2.539	2.490	2.314	2.315	2.310	2.320	2.305	2.410	2.301	2.312	2.320	2.412
	AVERAGE	2.299	2.364	2.369	2.365	2.303	2.211	2.230	2.242	2.266	2.256	2.228	2.243	2.218	2.227	2.202
	MINIMUM	1.928	2.223	2.188	2.190	1.807	2.098	2.105	2.115	2.155	2.170	2.000	2.052	1.939	2.029	2.045
% T.D	MAXIMUM	86.49	86.97	86.88	86.10	86.98	84.67	86.92	84.33	85.95	84.79	84.70	86.38	84.78	84.68	87.97
	AVERAGE	84.43	84.41	84.68	84.47	84.43	83.74	83.82	83.52	84.42	83.61	83.58	83.52	83.59	83.82	84.10
	MINIMUM	83.10	83.09	83.06	83.30	83.00	83.00	83.04	83.00	83.03	83.01	83.01	83.00	83.03	83.03	83.09
Pin No.		31	32	33	34	35	36	37	38	39	40		Spec.			
DIAMETER	MAXIMUM	5.440	5.445	5.450	5.450	5.435	5.405	5.400	5.418	5.395	5.390		5.40±			
	AVERAGE	5.418	5.404	5.423	5.425	5.419	5.364	5.402	5.408	5.376	5.374		0.05			
	MINIMUM	5.350	5.390	5.405	5.410	5.395	5.350	5.355	5.375	5.360	5.355					
HEIGHT	MAXIMUM	11.420	11.375	11.350	11.320	11.428	10.842	11.365	10.880	11.095	11.070		—			
	AVERAGE	10.689	10.411	10.173	10.376	10.407	10.358	10.401	10.034	10.764	10.720					
	MINIMUM	9.590	9.500	9.540	9.540	9.498	9.533	9.205	9.455	10.120	9.560					
WEIGHT	MAXIMUM	2.425	2.415	2.419	2.395	2.423	2.316	2.395	2.318	2.315	2.365		—			
	AVERAGE	2.272	2.295	2.167	2.208	2.217	2.215	2.246	2.192	2.245	2.244					
	MINIMUM	2.045	2.003	2.016	2.025	2.030	2.028	2.021	2.080	2.101	2.046					
% T.D	MAXIMUM	86.72	85.36	84.94	84.52	85.88	86.97	87.00	86.99	84.17	85.56		85±			
	AVERAGE	83.92	83.70	83.89	83.75	84.04	86.11	85.79	86.52	83.60	83.90		2%T.D			
	MINIMUM	83.04	83.00	83.22	83.08	83.19	84.74	83.16	83.51	83.18	83.05					

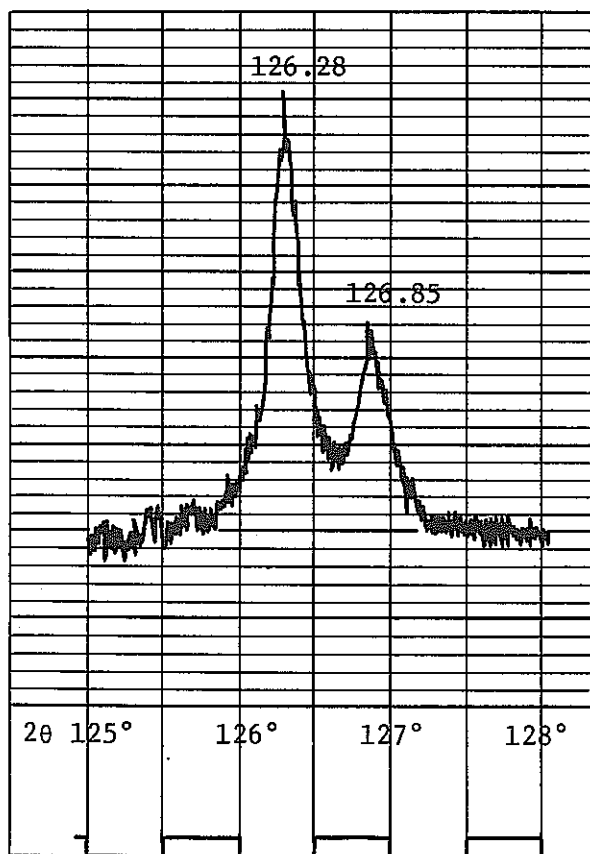


Fig. 4-1-1 RF 31-03
X-ray chart
Lattice parameter
 $5.45894 \pm 0.00026\text{\AA}$

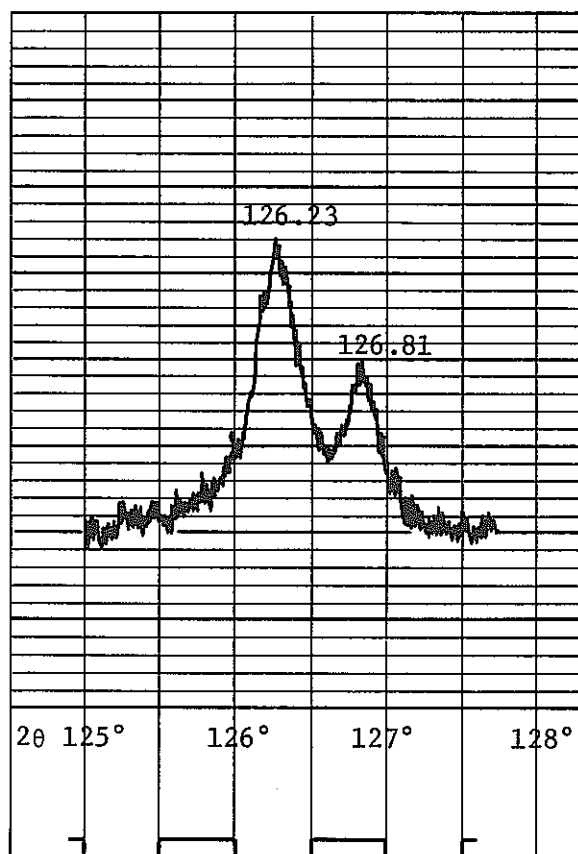


Fig. 4-1-2 RF 31-04
X-ray chart
Lattice parameter
 $5.46122 \pm 0.00032\text{\AA}$

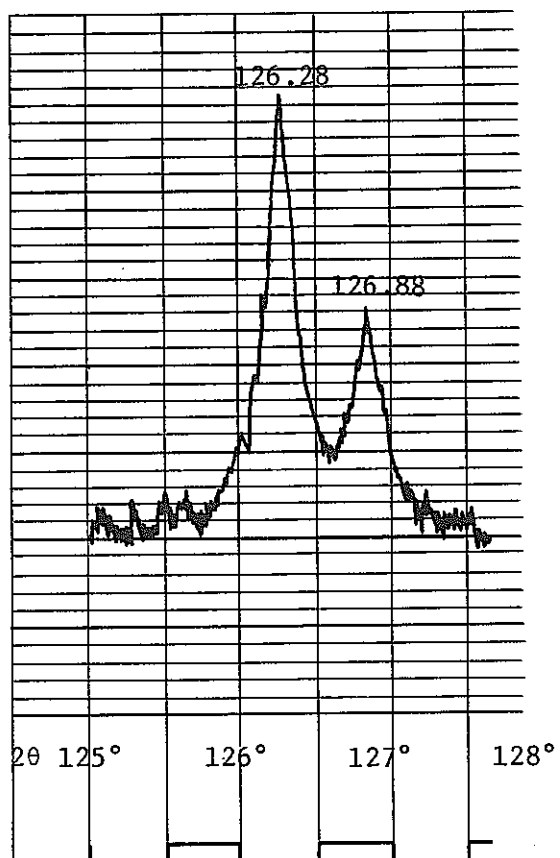


Fig. 4-1-3 RF 31-05
X-ray chart
Lattice parameter
 $5.45949 \pm 0.00026 \text{ \AA}$

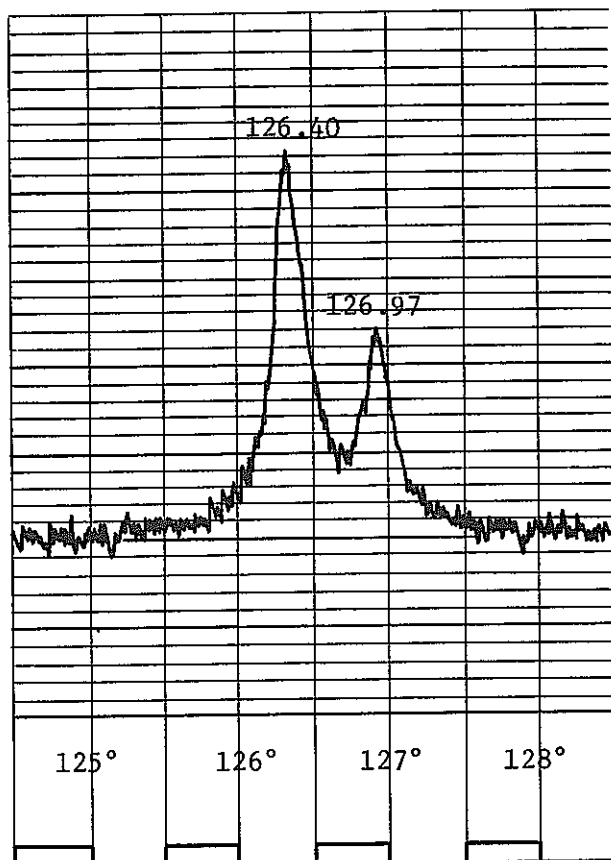


Fig. 4-1-4 RF 41-01
X-ray chart
Lattice parameter
 $5.45876 \pm 0.00035 \text{ \AA}$

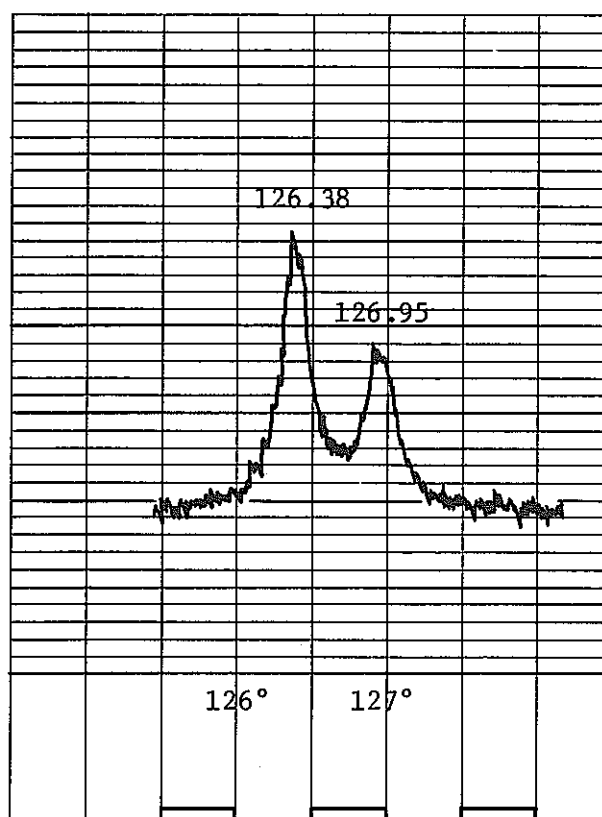


Fig. 4-1-5 RF 41-02
X-ray chart
Lattice parameter
 $5.46051 \pm 0.00018 \text{ \AA}$

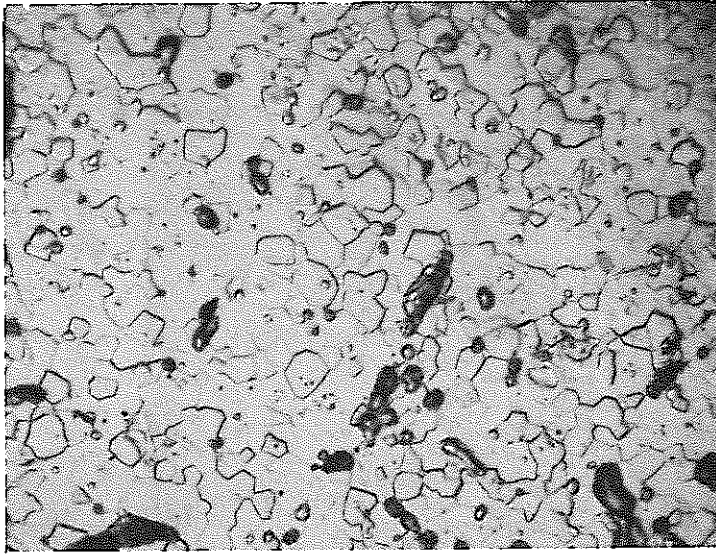


Fig.4-1-6 Ceramograph of Lot RF31-03

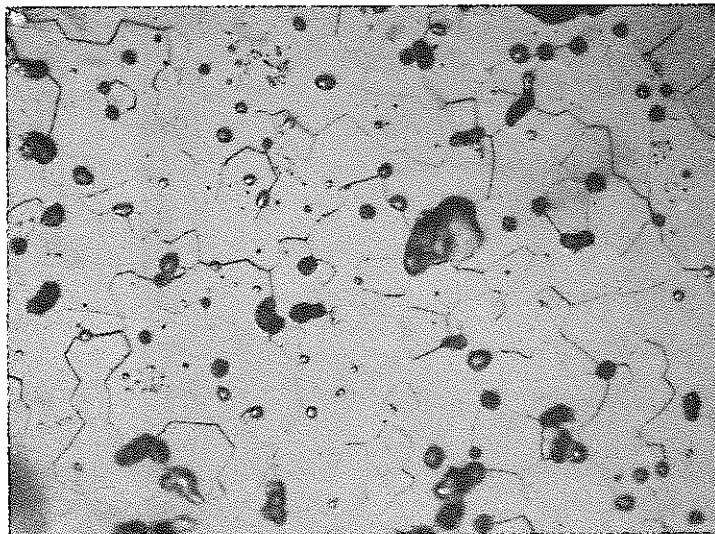


Fig.4-1-7 Ceramograph of Lot RF31-04

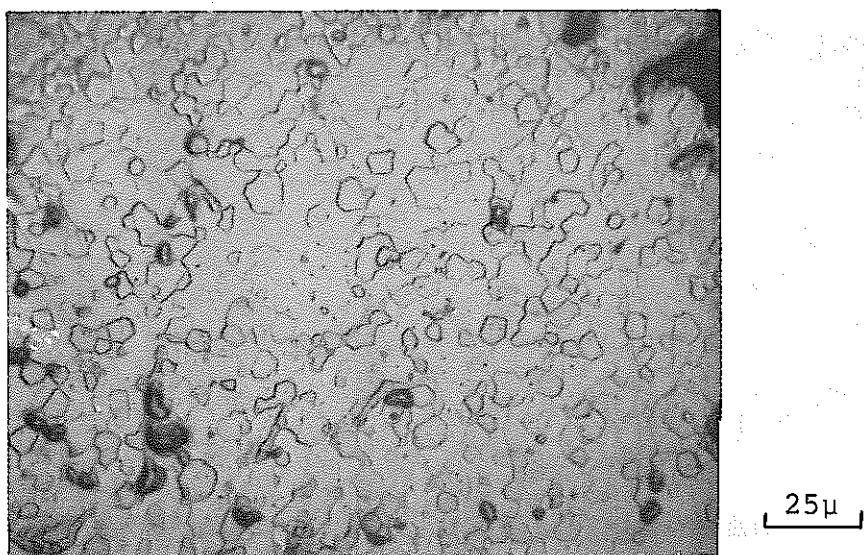


Fig.4-1-8 Ceramograph of Lot RF31-05

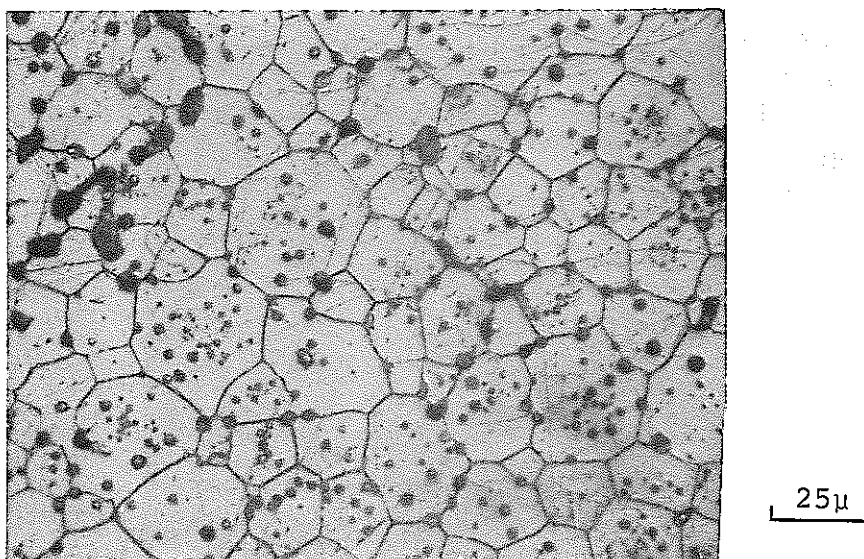


Fig.4-1-9 Ceramograph of Lot RF41-01

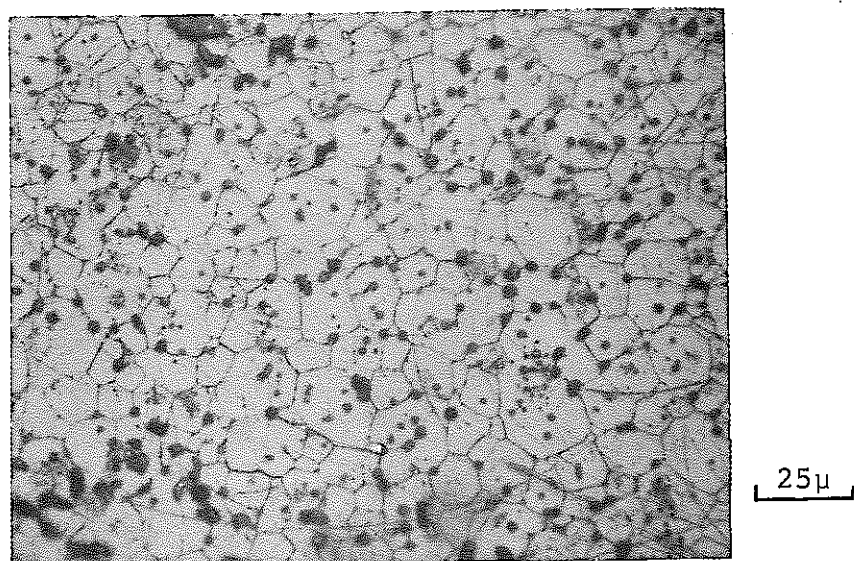


Fig.4-1-10 Ceramograph of Lot RF41-02

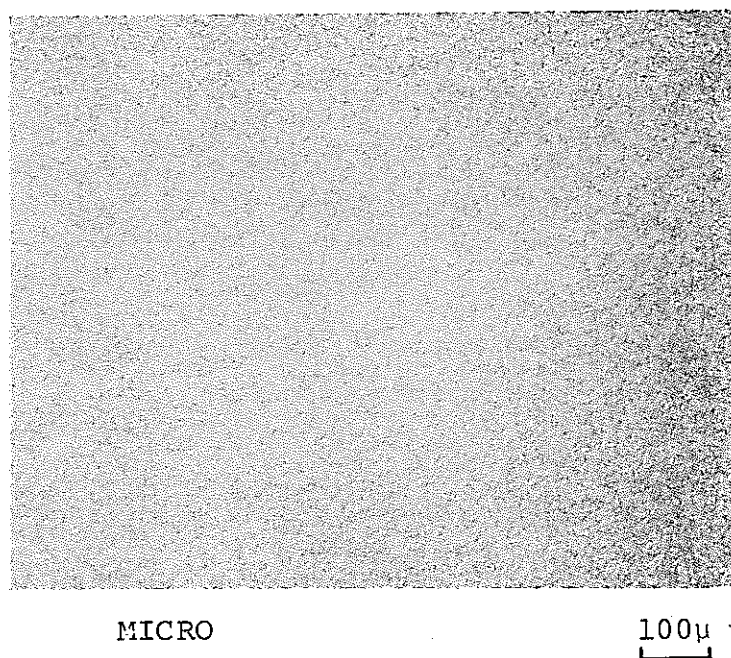
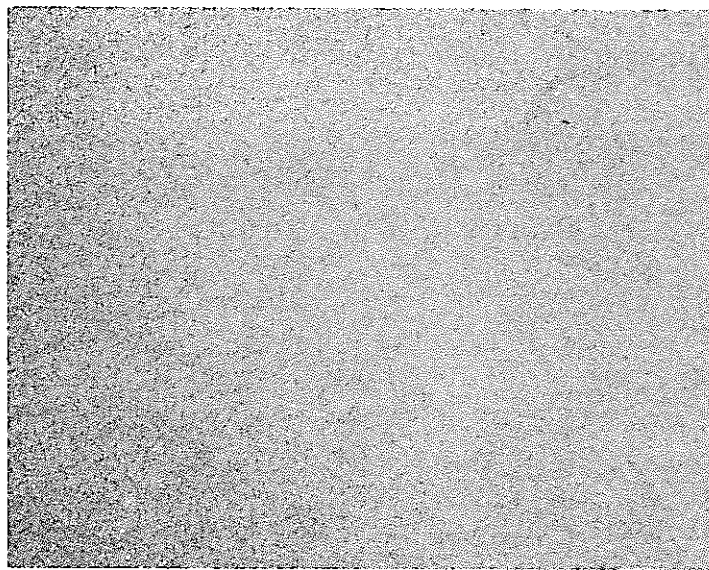


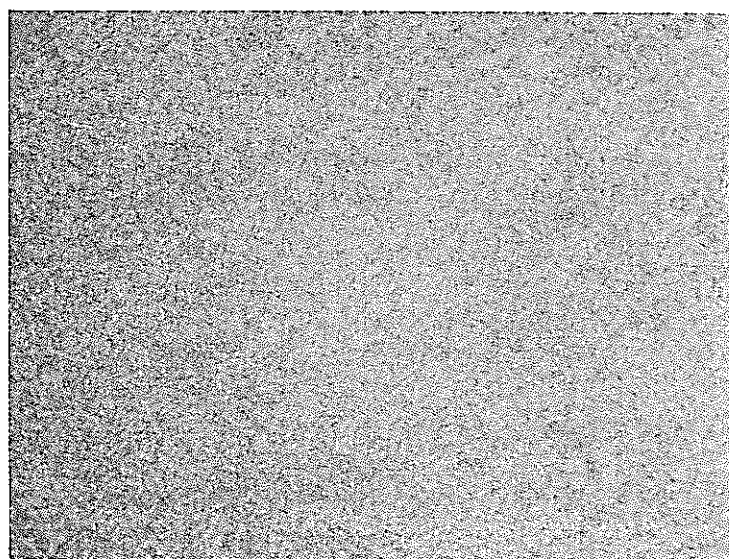
Fig.4-1-11 α -autoradiograph of
Lot RF31-03



MICRO

100μ

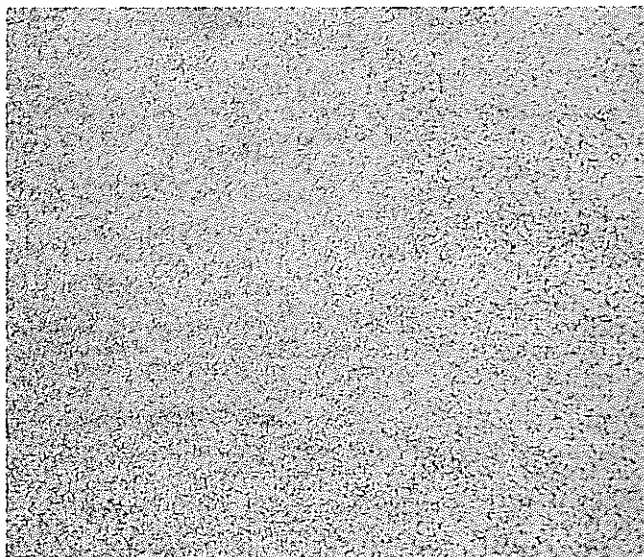
Fig.4-1-12 α -autoradiograph of
Lot RF31-04



MICRO

100μ

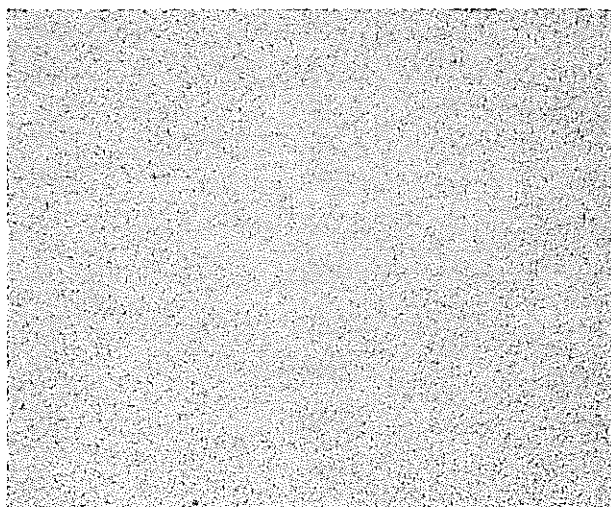
Fig.4-1-13 α -autoradiograph of
Lot RF31-05



MICRO

100μ

Fig.4-1-14 α -Autoradiograph of
Lot RF41-01



MICRO

100μ

Fig.4-1-15 α -autoradiograph of
Lor RF41-02

Table 4-2-1 Dimension and density of blanket UO₂

	Diameter	Height	Weight	Density
Specification	5.30 ± 0.05	—	—	92 ± 3
Max,	5.307 ^(mm)	10.60 ^(mm)	2.452 ^(g)	95.00 ^(%T.D)
Min	5.252	9.60	2.159	89.02
Ave	5.290	10.15	2.227	91.37

Table 4-2-2 The result of chemical analysis of blanket pellet

Item	Specification	Result of analysis
(ppm)	(ppm)	(ppm)
Al	<200	<14
B	<10	0.2
C	<150	17
Ca	<25	<10
Cd	<20	<0.3
Cl	<25	<10
Cr	<200	<8
F	<25	<10
Fe	<200	70
H	<5	5
Mg	<25	6
N	<150	23
Na	<200	5
Ni	<200	10
V	<200	<3
Cu+Zn+Si+Ti	<600	83
Ag+Mn+Mo+Pb+Sn	<200	9

Table 4-3-1 The result of chemical analysis of claddings

Item	Specification (%)	Cladding-K	Cladding-S
C	0.04 ~ 0.07	0.044	0.057
Mn	1.50 ~ 2.00	1.66	1.75
P	≤0.03	0.011	0.003
S	≤0.03	0.005	0.007
Si	≤0.75	0.66	0.53
Ni	11.00 ~ 14.00	13.75	12.96
Cr	16.00 ~ 18.00	17.47	17.10
Mo	2.00 ~ 3.00	2.28	2.56
Co	≤0.10	0.04	0.060
B	≤0.0005	0.0003	0.0002
N	≤0.010	0.006	0.0056
Fe	Balance	Balance	Balance
Reference	—	Mill sheet No S-73-6	Mill sheet No MS-RD-0001

Table 4-3-2 Mechanical properties of claddings

	Spec.	Cladding-K	Cladding-S
Tensile strength (kg/cm ²)	ASTM A-370		
At room temperature	≥70	86.7	80.1
At 650°C	≥40	49.9	47.2
Yield strength (kg/cm ²)	ASTM A-450		
At room temperature	≥58	77.8	70.6
At 650°C	≥30	39.2	37.3
Elongation (%)	ASTM E-21		
At room temperature	≥10	16.5	20.0
At 650°C	≥7	20.8	20.4
Hydrostatic strength (kg/cm ²)	ASTM A-450		
Rupture pressure	≥900	1400	1450
Yield pressure	≥800	1380	1360
Grain size	ASTM E-112 <No 6	ASTM No 9	ASTM No 8
Hardness		271	293
Flattening test	ASTM A-450	Not performed	Not performed
Flaring test	ASTM A-450	Go	Go

Table 4-3-3 Dimension of claddings

Pin No.	Tube No.	Outer diameter		Inner diameter		Thickness		Straightness
		Max.	Min.	Max.	Min.	Max.	Min.	
	Spec.	6.50±0.030 mm		5.600±0.025 mm		0.450±0.030 mm		0.50mm/ Total length
01	K2283~2	6.493	6.490	5.603	5.601	0.463	0.451	<0.5
02	K2213~1	6.505	6.502	5.602	5.599	0.458	0.448	<0.5
03	S2220~2	6.506	6.504	5.607	5.603	0.459	0.448	
04	K2177~1	6.504	6.502	5.602	5.600	0.456	0.445	<0.5
05	S2202~1	6.503	6.501	5.593	5.590	0.456	0.446	
06	S2305~1	6.508	6.505	5.604	5.599	0.458	0.447	
07	K2152~3	6.500	6.499	5.597	5.594	0.454	0.445	<0.5
08	S2189~2	6.503	6.500	5.601	5.596	0.458	0.447	
09	K2254~2	6.501	6.499	5.600	5.597	0.457	0.445	<0.5
10	S2168~2	6.506	6.503	5.600	5.597	0.457	0.446	
11	K2108~1	6.511	6.510	5.602	5.600	0.454	0.442	<0.5
12	K2077~3	6.499	6.497	5.601	5.599	0.460	0.449	<0.5
13	K2177~2	6.504	6.502	5.602	5.600	0.456	0.445	<0.5
14	K2292~3	6.499	6.497	5.601	5.600	0.473	0.452	<0.5
15	S2189~1	6.503	6.500	5.603	5.595	0.456	0.450	
16	S2165~1	6.505	6.503	5.606	5.604	0.456	0.448	
17	S2318~1	6.507	6.504	5.600	5.596	0.457	0.447	
18	K2081~2	6.494	6.491	5.599	5.596	0.460	0.449	<0.5
19	S2197~2	6.505	6.503	5.600	5.593	0.456	0.446	
20	S2215~3	6.504	6.502	5.599	5.593	0.456	0.445	
21	S2217~2	6.507	6.504	5.597	5.592	0.453	0.444	
22	K2160~3	6.504	6.501	5.603	5.600	0.458	0.446	<0.5
23	K2352~2	6.502	6.499	5.600	5.597	0.457	0.444	<0.5
24	S2202~2	6.502	6.500	5.593	5.589	0.456	0.447	
25	S2318~1	6.507	6.504	5.600	5.596	0.457	0.447	
26	S2203~1	6.504	6.501	5.593	5.589	0.456	0.446	
27	K2112~3	6.513	6.511	5.605	5.605	0.454	0.442	<0.5
28	S2188~1	6.503	6.500	5.602	5.596	0.456	0.447	
29	S2203~2	6.503	6.500	5.599	5.590	0.455	0.444	
30	K2081~3	6.494	6.492	5.601	5.596	0.460	0.450	<0.5
31	K2213~3	6.505	6.503	5.600	5.599	0.456	0.445	<0.5
32	K2040~1	6.495	6.492	5.601	5.596	0.459	0.448	<0.5
33	S2217~1	6.508	6.505	5.597	5.592	0.453	0.444	
34	K2112~2	6.513	6.511	5.606	5.602	0.454	0.442	<0.5
35	K2113~1	6.507	6.506	5.600	5.597	0.456	0.443	<0.5
36	K2203~3	6.503	6.501	5.604	5.603	0.458	0.447	<0.5
37	S2312~2	6.504	6.502	5.598	5.591	0.457	0.447	
38	S2189~3	6.502	6.500	5.601	5.598	0.458	0.448	
39	S2312~1	6.505	6.502	5.595	5.589	0.457	0.447	
40	K2129~3	6.506	6.503	5.603	5.601	0.458	0.447	<0.5

Table 4-3-4 Non destructive test of claddings

No.	Spec. Cladding No.	Surface roughness	Visual inspection	Ultrasonic inspection	Reference
		3S	Free of all scale and oxide	$\leq 32\mu$ in Depth & $< 750\mu$ in length	
1	K2283-2	<3S	A *1	A *2	*1
2	K2213-1	"	A	A	{ A; defect <25 μ (go) B; 25~32 (") C; >32 (no go)
3	S2220-2	"	A	A	
4	K2177-1	"	A	A	
5	S2202-1	"	B	A	
6	S2305-1	"	A	A	
7	K2152-3	"	A	A	*2 { A; <20 μ (go) B; 20~32 μ (go) C; >32 (no go)
8	S2189-2	"	A	A	
9	K2254-2	"	A	A	
10	S2168-2	"	A	A	
11	K2108-1	"	A	A	
12	K2077-3	"	A	A	
13	K2177-2	"	A	A	
14	K2242-3	"	A	A	
15	S2189-1	"	A	A	
16	S2165-1	"	A	A	
17	S2318-1	"	B	A	
18	K2081-2	"	B	A	
19	S2197-2	"	A	A	
20	S2215-3	"	A	A	
21	S2217-2	"	A	A	
22	K2160-3	"	A	A	
23	K2352-2	"	A	A	
24	S2202-2	"	B	A	
25	S2318-3	"	B	A	
26	S2203-1	"	A	A	
27	K2112-3	"	A	A	
28	S2188-1	"	A	A	
29	S2203-2	"	B	A	
30	K2081-3	"	B	A	
31	K2213-3	"	A	A	
32	K2040-1	"	A	A	
33	S2216-1	"	A	A	
34	K2112-2	"	A	A	
35	K2113-1	"	A	A	
36	K2203-3	"	A	A	
37	S2312-2	"	A	A	
38	S2189-3	"	A	A	
39	S2312-1	"	B	A	
40	K2129-3	"	A	A	

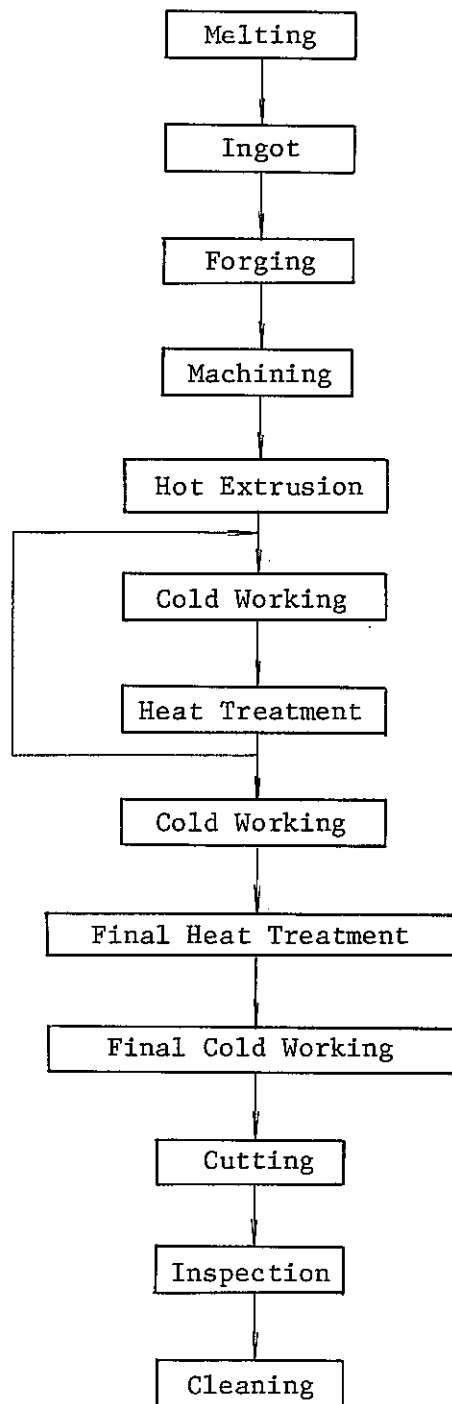
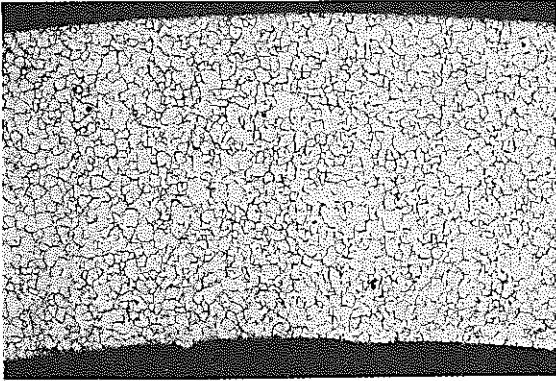
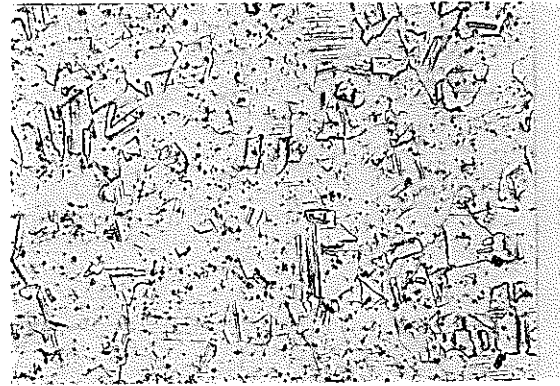


Fig. 4-3-1 Fabrication flow sheet of cladding

Cladding-K

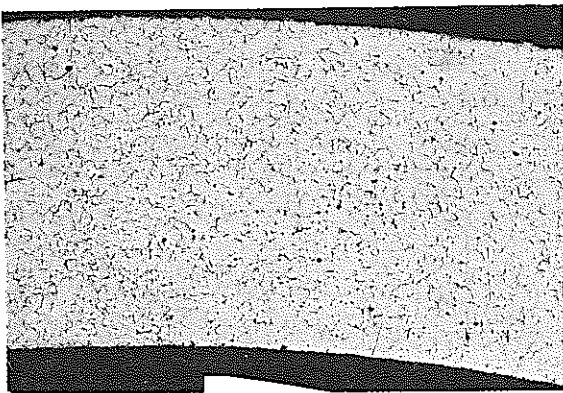


X100

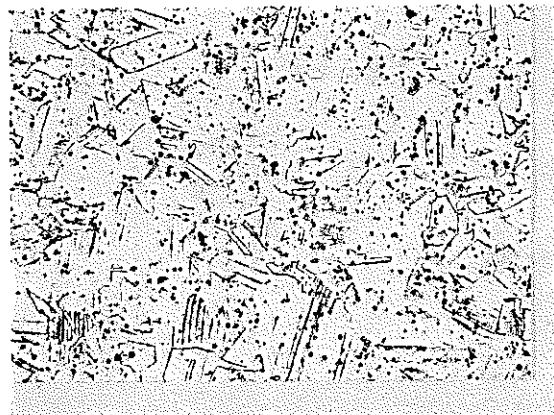


X400

Cladding-S



X100



X400

Fig.4-3-2 Micrography of cladding

Table 4-4-1 Chemical composition
of end plug material

	Specification (%)	Result (%)
C	0.04 ~ 0.08	0.06
Si	≤0.75	0.53
Mn	≤2.00	1.54
P	≤0.03	0.02
S	≤0.03	0.01
Ni	11.0 ~ 14.0	12.9
Cr	16.0 ~ 18.0	16.4
Co	≤0.10	0.04
Mo	2.00 ~ 3.00	2.3
B	≤0.0005	0.0003
N	≤0.035	0.022

Table 4-4-2 Chemical composition of
capsule container and sleeve

	Specification (%)	Result (%)
C	0.04 ~ 0.08	0.058
Si	≤0.75	0.52
Mn	≤2.00	1.74
P	≤0.03	0.003
S	≤0.03	0.007
Cr	16.00 ~ 18.00	17.20
Ni	11.00 ~ 14.00	12.92
Mo	2.00 ~ 3.00	2.50
Co	≤0.10	0.06
B	≤0.001	0.0001
N	≤0.035	0.006

Table 4-4-3 Chemical composition of spring

	Specification (%)	Result (%)
C	0.60 ~ 0.85	0.81
Si	0.12 ~ 0.32	0.25
Mn	0.30 ~ 0.90	0.41
P	≤0.025	0.019
S	≤0.030	0.015
Cu	≤0.20	0.03

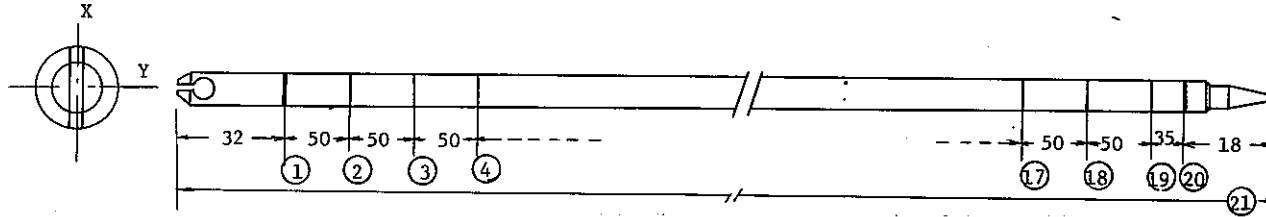
Table 4-5-1 Dimension and weight of fuel pins and components

Pin No.	Cladding No.	Item	A L. end plug	B Tagging gas capsule	C Lower blanket	D S.S. capsule	E Fuel pellet	F Upper blanket	G SiC capsule	H Spring	I Plenum sleeve	J U.end plug	Total	α-Fix (DPM)
1	K2283-2	1 Length(mm) 2 Weight(gr)	37.00 8.37	70.15 4.49	100.90 22.6	1 144.90 13.40	317.75 68.476	60.6 13.6	39.95 3.67	36.40 0.97	161.10 6.33	23.00 3.42	984.92 208.70	7.9
2	K2213-1	1 2	37.00 8.36	69.93 4.49	100.80 22.4	2 144.95 13.40	321.05 69.243	60.55 13.7	39.95 3.68	36.40 0.97	157.45 5.91	23.03 3.42	985.00 209.60	283.0
3	S2220-2	1 2	37.01 8.36	69.76 4.50	101.30 22.7	3 144.90 13.09	317.45 68.645	60.85 13.6	39.90 3.70	36.40 0.97	161.05 6.34	23.01 3.42	984.78 209.22	70.8
4	K2177-1	1 2	37.00 8.36	70.15 4.51	100.95 23.0	4 144.90 13.22	319.25 68.381	60.85 13.0	40.0 3.68	36.40 0.97	159.40 6.25	23.00 3.42	985.04 209.10	86.5
5	S2202-1	1 2	37.00 8.37	70.21 4.51	101.95 23.0	5 144.96 13.22	318.20 67.265	60.65 13.4	39.95 3.63	36.40 0.97	159.55 6.26	23.00 3.42	985.00 208.60	7.9
6	S2305-1	1 2	37.00 8.36	70.07 4.49	100.95 22.7	6 145.00 13.35	318.00 69.00	60.90 13.6	39.95 3.66	36.40 0.97	161.00 6.01	23.04 3.42	985.22 208.78	31.5
7	K2152-3	1 2	37.00 8.37	70.17 4.50	101.75 22.3	7 144.85 13.25	322.85 69.19	60.25 13.6	39.90 3.67	36.40 0.97	154.30 6.09	23.00 3.42	985.68 209.68	63.0
8	S2189-2	1 2	36.99 8.37	69.96 4.50	100.70 22.2	8 144.85 13.26	322.15 69.38	60.70 13.7	40.00 3.64	36.40 0.97	157.10 6.18	23.00 3.42	985.12 209.31	585.4
9	K2254-2	1 2	36.99 8.36	69.95 4.49	101.75 22.9	9 145.00 13.16	320.95 68.81	60.95 13.0	40.00 3.70	36.40 0.97	157.15 6.19	23.00 3.42	985.00 209.80	39.4
10	S2168-2	1 2	37.00 8.36	69.99 4.49	100.75 22.6	10 145.00 13.18	322.00 69.01	60.25 13.1	39.95 3.68	36.40 0.97	156.80 6.10	23.00 3.42	985.02 210.16	0
11	K2108-1	1 2	37.01 8.36	70.04 4.49	99.95 22.1	11 144.90 13.30	317.95 68.85	60.85 13.6	39.90 3.66	36.40 0.97	161.70 6.38	23.00 3.42	984.98 209.81	133.7
12	K2077-3	1 2	37.00 8.37	70.27 4.50	101.05 23.0	12 144.80 13.27	317.00 68.49	61.0 13.7	39.95 3.69	36.40 0.97	161.15 6.05	23.01 3.42	985.10 208.60	31.5
13	K2177-2	1 2	37.00 8.36	69.96 4.50	100.70 21.9	13 144.90 13.27	320.15 68.26	60.75 13.0	39.95 3.68	36.40 0.97	159.15 6.26	23.00 3.42	984.14 208.60	94.5
14	K2292-3	1 2	37.01 8.37	70.14 4.51	100.00 21.8	15 144.90 13.13	318.25 68.65	60.95 13.7	39.85 3.64	36.40 0.97	156.60 6.17	23.00 3.42	985.10 207.90	173.2
15	S2189-1	1 2	37.00 8.37	70.25 4.50	101.75 22.6	15 144.90 13.31	321.35 68.16	60.25 13.6	39.90 3.65	36.40 0.97	154.75 6.09	23.02 3.42	985.06 208.92	15.7

Pun No.	Cladding No.	Item	A L. end plug	B Tagging gas capsule	C Lower blanket	D S.S. capsule	E Fuel pellet	F Upper blanket	G SiC capsule	H Spring	I Plenum sleeve	J U.end plug	Total	α-Fix (DPM)
16	S2165-1	1 Length(mm) 2 Weight(gr)	37.01 8.36	70.18 4.49	100.50 22.9	144.90 13.06	319.55 68.97	60.55 13.7	39.95 3.67	36.40 0.97	159.60 6.31	23.00 3.42	984.90 209.43	102.4
17	S2318-1	1 2	36.99 8.36	70.15 4.50	99.90 23.1	144.90 13.04	319.70 68.56	60.70 13.7	40.00 3.64	36.40 0.97	160.00 6.30	23.00 3.42	985.04 209.56	157.2
18	K2081-2	1 2	37.01 8.36	70.14 4.51	100.95 22.3	144.90 13.63	318.05 68.70	60.80 13.7	39.95 3.63	36.40 0.97	159.90 6.25	23.00 3.42	984.98 208.80	70.9
19	S2197-2	1 2	37.00 8.37	70.11 4.50	101.05 22.4	144.85 13.82	318.50 68.59	60.90 13.6	39.95 3.67	36.40 0.97	160.20 6.00	23.00 3.42	984.96 209.50	39.4
20	S2215-3	1 2	37.01 8.37	70.11 4.50	101.40 22.3	145.00 12.84	321.85 69.09	60.90 13.8	39.90 3.64	36.40 0.97	156.10 6.16	22.99 3.42	985.16 209.52	15.7
21	S2217-2	1 2	37.00 8.37	70.10 4.50	99.95 21.9	144.95 13.32	318.90 66.34	59.85 13.4	39.90 3.57	36.40 0.97	160.00 6.32	23.00 3.42	985.16 207.83	0
22	K2160-3	1 2	37.01 8.36	70.27 4.51	99.85 22.6	144.95 13.55	320.30 66.89	60.10 13.9	39.95 3.59	36.40 0.97	164.40 6.33	23.01 3.42	985.00 208.21	23.6
23	K2352-2	1 2	37.01 8.37	70.13 4.50	101.95 21.9	144.90 12.66	319.20 67.27	60.90 13.4	40.00 3.66	36.40 0.97	159.90 6.02	23.01 3.42	985.04 206.36	15.7
24	S2202-2	1 2	37.00 8.37	70.27 4.52	101.75 22.4	144.90 13.30	319.85 67.98	60.70 13.3	39.90 3.60	36.40 0.97	158.40 6.25	23.00 3.42	985.08 207.51	0
25	S2318-3	1 2	36.99 8.36	70.26 4.50	101.85 22.8	144.90 13.18	320.85 67.68	60.70 13.4	39.95 3.65	36.40 0.97	157.05 6.20	23.00 3.42	985.06 207.22	70.8
26	S2203-1	1 2	37.00 8.37	70.28 4.50	102.00 22.7	144.90 16.29	321.60 66.84	60.65 13.4	39.95 3.61	36.40 0.97	153.20 6.08	23.01 3.42	985.18 210.41	47.2
27	K2112-3	1 2	37.00 8.36	70.25 4.52	102.00 22.9	144.90 16.07	322.15 67.28	60.95 13.8	39.80 3.69	36.40 0.97	155.50 6.13	23.01 3.42	985.34 211.04	7.9
28	S2188-1	1 2	37.00 8.36	70.23 4.50	102.00 22.8	144.90 16.13	322.80 66.53	60.40 13.4	39.95 3.72	36.40 0.97	154.80 6.11	23.01 3.42	985.04 210.04	7.9
29	S2703-2	1 2	36.99 8.36	70.04 4.49	101.65 22.6	144.85 16.19	320.60 66.81	60.70 13.4	39.85 3.54	36.40 0.97	157.80 6.21	23.00 3.42	985.00 210.12	7.9
30	K2081-3	1 2	36.97 8.36	70.10 4.50	100.60 22.7	144.90 16.30	322.05 68.25	60.20 13.5	40.00 3.65	36.40 0.97	156.00 6.18	23.00 3.42	984.90 211.07	23.6

			A	B	C	D	E	F	G	H	I	J		
Pin No.	Cladding No.	Item	L. end plug	Tagging gas capsule	Lower blanket	S.S. capsule	Fuel pellet	Upper blanket	SiC capsule	Spring	Plenum sleeve	U.end plug No.	Total	α -Fix (DPM)
31	K2213~3	1 Length(mm)	37.00	70.19	100.55	144.90	319.05	60.20	39.95	36.40	159.90	23.00	984.98	31.5
		2 Weight(gr)	8.36	4.52	22.2	16.02	68.17	13.7	3.65	0.97	6.30	3.42	210.95	
32	K2040~1	1	37.00	70.10	99.75	144.95	322.35	59.90	39.90	36.40	158.00	23.00	985.04	31.5
		2	8.36	4.49	22.4	16.03	68.58	13.2	3.66	0.97	6.22	3.42	210.42	
33	S2217~1	1	37.00	70.13	99.95	144.80	320.90	59.7	39.90	36.40	158.20	23.00	985.10	118.1
		2	8.37	4.50	22.2	16.18	69.33	13.4	3.59	0.97	6.30	3.42	212.00	
34	K2112~2	1	37.00	70.20	100.30	144.90	321.60	60.60	39.85	36.40	158.00	23.00	985.26	0
		2	8.37	4.52	22.3	15.95	68.44	13.6	3.64	0.97	6.22	3.42	211.82	
35	K2113~1	1	37.00	70.23	100.20	144.95	322.35	60.15	39.90	36.40	155.45	23.04	985.22	0
		2	8.36	4.49	22.4	13.40	68.72	13.5	3.66	0.97	6.14	3.42	209.11	
36	K2203~3	1	37.00	70.12	100.10	144.95	320.85	60.60	39.95	36.40	158.75	23.00	985.32	23.6
		2	8.37	4.50	22.6	13.23	68.69	13.9	3.66	0.97	6.27	3.42	208.90	
37	S2312~2	1	37.00	69.98	100.50	144.85	320.07	60.45	39.90	36.40	159.65	23.00	985.20	23.6
		2	8.36	4.45	22.3	13.11	69.62	13.6	3.62	0.97	6.00	3.42	208.22	
38	S2189~3	1	37.00	70.26	100.45	144.90	320.05	60.20	39.85	36.40	159.40	23.00	984.94	0
		2	8.36	4.38	22.3	16.14	70.14	13.6	3.60	0.97	6.29	3.42	212.56	
39	S2312~1	1	37.00	70.17	101.0	144.85	323.00	60.35	39.95	36.40	156.00	23.00	985.16	7.9
		2	8.36	4.50	22.3	16.11	67.35	13.4	3.61	0.97	6.16	3.42	210.43	
40	K2129~3	1	37.01	70.25	100.25	144.85	321.45	60.45	39.85	36.40	157.05	23.00	985.24	63.0
		2	8.37	4.49	22.2	16.04	67.32	13.3	3.61	0.97	6.20	3.42	209.74	

Table 4-5-2 Results of pin diameter measurement



Pin No.	Clad. No.		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1	K2283-2	X	6.556	6.488	6.489	6.488	6.489	6.488	6.489	6.489	6.488	6.489	6.488	6.488	6.490	6.490	6.490	6.490	6.490	6.490	6.489	6.554	984.92
		Y	.546	.490	.491	.492	.492	.490	.491	.489	.488	.488	.487	.492	.490	.492	.492	.492	.492	.490	.492	.559	
2	K2213-1	X	.572	.500	.502	.507	.507	.504	.505	.504	.504	.504	.503	.505	.505	.504	.502	.505	.503	.504	.505	.557	985.00
		Y	.559	.501	.500	.500	.501	.500	.501	.500	.500	.500	.500	.501	.501	.501	.498	.498	.498	.498	.498	.577	
3	S2220-2	X	.547	.507	.507	.507	.507	.506	.506	.506	.506	.506	.506	.506	.506	.506	.506	.506	.506	.507	.505	.578	984.78
		Y	.580	.507	.507	.507	.507	.507	.507	.507	.507	.506	.506	.506	.506	.505	.506	.506	.506	.506	.505	.567	
4	K2177-1	X	.536	.498	.498	.498	.498	.498	.498	.498	.498	.498	.498	.499	.499	.499	.500	.500	.500	.500	.500	.551	985.04
		Y	.561	.498	.498	.498	.498	.498	.498	.498	.498	.498	.498	.499	.499	.499	.498	.500	.500	.500	.500	.552	
5	S2202-1	X	.552	.503	.503	.503	.504	.503	.504	.503	.502	.501	.501	.500	.500	.499	.498	.499	.498	.499	.500	.545	985.00
		Y	.549	.504	.503	.504	.504	.504	.503	.504	.504	.502	.502	.502	.502	.501	.500	.501	.497	.502	.501	.544	
6	S2305-1	X	.579	.507	.507	.507	.507	.507	.507	.507	.507	.507	.507	.508	.508	.508	.509	.509	.509	.508	.509	.539	985.22
		Y	.553	.508	.508	.508	.508	.508	.508	.508	.508	.508	.508	.508	.509	.509	.509	.509	.509	.509	.509	.533	
7	K2152-3	X	.561	.504	.499	.503	.499	.499	.500	.498	.498	.503	.500	.502	.502	.502	.503	.504	.504	.502	.497	.550	985.68
		Y	.561	.497	.498	.498	.498	.499	.498	.498	.497	.496	.497	.497	.496	.496	.496	.496	.496	.496	.497	.550	
8	S2189-2	X	.561	.504	.503	.503	.504	.505	.505	.505	.505	.504	.505	.498	.499	.498	.502	.502	.500	.499	.500	.571	985.12
		Y	.541	.503	.503	.503	.503	.503	.504	.504	.501	.502	.504	.398	.499	.498	.498	.498	.499	.499	.499	.552	
9	K2254-2	X	.563	.496	.496	.496	.496	.497	.497	.496	.497	.497	.497	.497	.497	.497	.497	.497	.497	.497	.497	.571	985.00
		Y	.539	.496	.496	.496	.497	.496	.496	.496	.497	.495	.497	.497	.497	.495	.496	.496	.496	.495	.496	.575	
10	S2168-2	X	.545	.506	.506	.506	.506	.505	.505	.505	.505	.505	.505	.505	.505	.505	.505	.505	.505	.505	.505	.570	985.02
		Y	.570	.505	.505	.506	.505	.505	.505	.506	.504	.506	.507	.506	.506	.506	.505	.507	.507	.506	.505	.540	

Pin No.	Clad. No.		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
11	K2108-1	X	6.550	6.503	6.505	6.503	6.504	6.504	6.504	6.504	6.504	6.505	6.504	6.505	6.504	6.504	6.505	6.505	6.505	6.505	6.505	6.569	984.98
		Y	.558	.504	.505	.504	.504	.504	.504	.504	.504	.505	.505	.505	.505	.504	.504	.505	.504	.505	.505	.548	
12	K2077-3	X	.553	.495	.495	.495	.494	.494	.495	.494	.495	.494	.494	.494	.494	.494	.494	.494	.494	.494	.494	.557	985.10
		Y	.583	.502	.498	.496	.496	.496	.496	.497	.496	.495	.496	.497	.494	.495	.496	.496	.497	.496	.498	.497	
13	K2177-2	X	.557	.498	.498	.498	.498	.498	.498	.498	.498	.498	.498	.498	.499	.499	.499	.499	.499	.499	.499	.555	984.14
		Y	.558	.498	.500	.498	.498	.498	.498	.498	.498	.498	.498	.498	.499	.499	.499	.499	.499	.499	.499	.499	
14	K2292-3	X	.574	.500	.498	.500	.498	.497	.498	.496	.495	.495	.490	.490	.491	.490	.494	.493	.494	.495	.495	.540	985.10
		Y	.558	.495	.495	.495	.495	.495	.495	.495	.494	.492	.494	.489	.488	.488	.488	.493	.493	.493	.495	.549	
15	S2189-1	X	.582	.497	.497	.496	.497	.497	.497	.497	.497	.497	.497	.497	.498	.498	.498	.498	.498	.497	.498	.497	985.06
		Y	.550	.497	.497	.497	.497	.497	.497	.497	.497	.497	.497	.497	.498	.498	.498	.498	.498	.498	.498	.542	
16	S2165-1	X	.564	.502	.503	.503	.502	.502	.503	.503	.503	.503	.503	.503	.504	.504	.504	.498	.498	.498	.498	.582	984.90
		Y	.562	.502	.503	.503	.502	.502	.502	.502	.502	.502	.502	.502	.501	.498	.498	.498	.498	.498	.498	.563	
17	S2318-1	X	.560	.500	.502	.502	.502	.502	.502	.502	.501	.501	.501	.502	.500	.499	.498	.498	.498	.498	.498	.547	985.04
		Y	.543	.501	.502	.502	.502	.502	.501	.501	.500	.501	.503	.499	.505	.503	.501	.503	.499	.499	.499	.546	
18	K2081-2	X	.540	.486	.490	.493	.486	.490	.491	.486	.485	.485	.486	.488	.488	.488	.488	.488	.490	.488	.491	.555	984.98
		Y	.549	.486	.486	.486	.486	.486	.485	.486	.485	.486	.485	.487	.488	.489	.488	.488	.490	.489	.489	.536	
19	S2197-2	X	.556	.504	.505	.504	.504	.504	.504	.504	.504	.505	.505	.505	.505	.505	.505	.505	.506	.505	.505	.578	984.96
		Y	.568	.505	.505	.504	.505	.505	.505	.505	.505	.505	.506	.505	.504	.505	.505	.505	.505	.504	.504	.556	
20	S2215-3	X	.588	.507	.505	.504	.504	.504	.504	.503	.504	.505	.504	.505	.505	.505	.505	.504	.504	.504	.504	.536	985.16
		Y	.545	.506	.505	.504	.504	.503	.504	.503	.503	.503	.505	.504	.505	.506	.505	.505	.505	.505	.504	.505	
21	S2217-2	X	.549	.507	.507	.507	.507	.507	.508	.507	.507	.507	.507	.507	.507	.507	.506	.505	.506	.507	.507	.574	985.16
		Y	.580	.505	.505	.506	.505	.505	.505	.506	.506	.507	.505	.508	.507	.507	.507	.507	.507	.507	.507	.506	
22	K2160-3	X	.543	.502	.502	.500	.500	.500	.501	.501	.502	.504	.501	.500	.501	.500	.500	.500	.500	.500	.500	.538	985.00
		Y	.578	.505	.504	.501	.501	.502	.505	.505	.502	.501	.501	.500	.501	.500	.501	.500	.501	.501	.505	.556	
23	K2352-2	X	.568	.501	.502	.501	.501	.501	.500	.500	.499	.499	.498	.498	.498	.498	.498	.498	.498	.497	.497	.549	985.04
		Y	.544	.506	.501	.499	.505	.504	.504	.503	.503	.501	.499	.498	.498	.498	.500	.498	.501	.498	.497	.499	
24	S2202-2	X	.538	.503	.504	.503	.504	.503	.504	.503	.503	.504	.504	.505	.506	.506	.506	.506	.506	.506	.506	.560	985.08
		Y	.542	.503	.503	.503	.503	.503	.504	.503	.504	.504	.504	.505	.506	.506	.506	.506	.506	.506	.506	.507	
25	S2318-3	X	.533	.504	.504	.505	.505	.505	.505	.505	.505	.505	.504	.504	.502	.498	.497	.498	.497	.497	.497	.559	985.06
		Y	.552	.504	.505	.505	.504	.506	.505	.505	.504	.505	.505	.505	.502	.505	.504	.502	.501	.505	.498	.502	

Pin No.	Clad. No.		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
26	S2203-1	X	6.581	6.505	6.505	6.506	6.506	6.506	6.506	6.505	6.505	6.505	6.505	6.504	6.505	6.504	6.505	6.506	6.505	6.505	6.505	6.558	985.18
		Y	.548	.505	.506	.506	.506	.506	.505	.505	.505	.505	.505	.505	.506	.505	.506	.504	.505	.505	.506	.549	
27	K2112-3	X	.555	.505	.505	.506	.506	.506	.506	.506	.506	.507	.506	.507	.507	.507	.507	.506	.507	.506	.508	.559	985.34
		Y	.555	.507	.506	.506	.506	.506	.507	.506	.507	.507	.507	.507	.507	.506	.507	.507	.507	.507	.507	.572	
28	S2188-1	X	.556	.504	.502	.503	.502	.504	.502	.503	.502	.503	.502	.501	.501	.498	.498	.500	.498	.498	.499	.552	985.04
		Y	.571	.503	.504	.503	.504	.503	.505	.503	.503	.503	.502	.500	.502	.498	.501	.502	.501	.502	.501	.535	
29	S2203-2	X	.561	.502	.502	.501	.501	.501	.501	.501	.501	.501	.501	.500	.500	.500	.500	.500	.500	.500	.500	.560	985.00
		Y	.552	.501	.502	.501	.501	.500	.501	.501	.502	.502	.502	.502	.501	.502	.502	.502	.500	.501	.500	.546	
30	K2081-3	X	.553	.506	.504	.504	.505	.505	.506	.504	.504	.503	.503	.503	.503	.503	.504	.504	.504	.505	.503	.533	984.90
		Y	.545	.504	.504	.504	.505	.504	.504	.504	.503	.503	.503	.503	.503	.503	.503	.503	.503	.503	.503	.530	
31	K2213-3	X	.557	.506	.502	.503	.503	.503	.505	.504	.504	.503	.503	.501	.502	.501	.501	.502	.501	.501	.501	.557	984.98
		Y	.546	.505	.503	.504	.503	.504	.505	.504	.503	.502	.502	.501	.501	.501	.501	.501	.501	.501	.502	.569	
32	K2040-1	X	.534	.495	.497	.496	.496	.496	.494	.496	.494	.495	.495	.495	.493	.490	.490	.490	.490	.490	.490	.543	985.04
		Y	.572	.497	.497	.496	.495	.496	.495	.499	.495	.496	.496	.490	.491	.494	.490	.490	.490	.494	.494	.562	
33	S2217-1	X	.543	.504	.504	.504	.505	.505	.505	.505	.505	.502	.502	.503	.500	.501	.501	.500	.500	.500	.500	.562	985.10
		Y	.574	.504	.504	.504	.504	.504	.505	.505	.505	.504	.504	.502	.500	.500	.500	.500	.500	.500	.500	.538	
34	K2112-2	X	.564	.506	.507	.505	.505	.506	.505	.505	.505	.506	.506	.506	.507	.507	.507	.508	.507	.507	.508	.577	985.26
		Y	.559	.507	.507	.507	.507	.506	.506	.507	.507	.506	.506	.506	.508	.507	.507	.507	.507	.507	.507	.554	
35	K2113-1	X	.548	.498	.498	.498	.498	.498	.498	.498	.498	.498	.498	.498	.498	.499	.499	.499	.499	.499	.499	.546	985.22
		Y	.540	.498	.498	.498	.498	.498	.498	.498	.498	.498	.498	.498	.499	.499	.499	.499	.499	.499	.499	.568	
36	K2203-3	X	.554	.499	.499	.499	.499	.499	.499	.499	.500	.501	.502	.501	.504	.504	.504	.505	.504	.504	.504	.555	985.32
		Y	.564	.503	.501	.504	.503	.501	.500	.504	.501	.501	.503	.507	.505	.506	.506	.505	.505	.505	.504	.550	
37	S2312-2	X	.551	.501	.499	.501	.501	.502	.500	.502	.501	.503	.501	.502	.499	.501	.500	.502	.500	.500	.501	.548	984.88
		Y	.562	.500	.501	.501	.502	.502	.502	.502	.502	.502	.502	.501	.501	.499	.501	.501	.501	.500	.501	.559	
38	S2189-3	X	.534	.501	.501	.500	.501	.500	.501	.500	.499	.499	.499	.499	.498	.498	.498	.499	.498	.498	.498	.550	984.94
		Y	.557	.501	.501	.501	.501	.501	.501	.501	.500	.500	.499	.498	.500	.498	.499	.499	.500	.498	.498	.544	
39	S2312-1	X	.576	.501	.499	.501	.501	.502	.500	.502	.501	.503	.501	.502	.499	.501	.500	.502	.500	.500	.501	.570	985.16
		Y	.548	.500	.501	.501	.502	.502	.502	.502	.502	.502	.502	.501	.501	.499	.501	.501	.501	.500	.501	.542	
40	K2129-3	X	.550	.499	.498	.499	.499	.502	.497	.496	.496	.497	.494	.501	.497	.496	.496	.497	.496	.495	.495	.548	985.24
		Y	.572	.498	.498	.498	.498	.498	.498	.496	.495	.494	.493	.503	.493	.496	.495	.495	.495	.495	.495	.545	

Table 4-5-3 Weights of fuel material

Pin No,	MO ₂ (g)	Plutonium			E. Uranium			N. Uranium	
		PuO ₂ (g)	Pu (g)	Pu fissile (g)	EUO ₂ (g)	EU (g)	U ²³⁵ (g)	NUO ₂	NU
1	68.48	13.04	11.50	9.62	55.44	48.85	36.63	36.2	31.89
2	69.24	13.18	11.63	9.72	56.06	49.39	37.04	36.1	31.80
3	68.65	13.07	11.53	9.64	55.58	48.97	36.73	36.2	31.98
4	68.38	13.02	11.48	9.60	55.36	48.77	36.58	35.4	31.19
5	67.27	12.81	11.29	9.45	54.46	47.98	35.99	36.4	32.07
6	69.00	13.14	11.59	9.69	55.86	49.22	36.91	36.3	31.98
7	69.19	13.17	11.62	9.72	56.02	49.35	37.01	35.9	31.63
8	69.38	13.21	11.65	9.74	56.17	49.49	37.12	35.9	31.63
9	68.81	13.10	11.55	9.66	55.71	49.08	36.81	35.9	31.63
10	69.01	13.14	11.59	9.69	55.87	49.22	36.92	35.7	31.45
11	68.85	13.11	11.56	9.67	55.74	49.11	36.83	35.7	31.45
12	68.49	13.04	11.50	9.62	55.45	48.85	36.64	36.7	32.33
13	68.26	12.99	11.46	9.58	55.27	48.69	36.52	34.9	30.75
14	68.65	13.07	11.53	9.64	55.58	48.97	36.73	35.5	31.28
15	68.16	12.98	11.44	9.57	55.18	48.62	36.46	36.2	31.89
16	68.97	13.13	11.58	9.68	55.84	49.20	36.90	36.6	32.24
17	68.56	13.05	11.51	9.63	55.51	48.90	36.68	36.8	32.42
18	68.70	13.08	11.53	9.65	55.62	49.00	36.75	36.0	31.72
19	68.59	13.06	11.52	9.63	55.53	48.92	36.69	36.0	31.72
20	69.10	13.15	11.60	9.70	55.95	49.29	36.97	36.1	31.80
21	66.34	12.63	11.14	9.32	53.71	47.32	35.49	35.3	31.10
22	66.89	12.73	11.23	9.39	54.16	47.71	35.78	36.5	32.16
23	67.27	12.81	11.29	9.45	54.46	47.98	35.99	35.3	31.10
24	67.98	12.94	11.41	9.55	55.04	48.49	36.37	35.7	31.45
25	67.68	12.88	11.36	9.50	54.80	48.28	36.21	36.2	31.89
26	66.84	12.72	11.22	9.39	54.12	47.68	35.76	36.1	31.80
27	67.28	12.81	11.30	9.45	54.47	47.99	35.99	36.7	32.33
28	66.53	12.66	11.17	9.34	53.87	47.46	35.59	36.2	31.89
29	66.81	12.72	11.22	9.38	54.09	47.65	36.74	36.0	31.72
30	68.25	12.99	11.46	9.58	55.26	48.68	36.51	36.2	31.89
31	68.17	12.98	11.45	9.57	55.19	48.63	36.47	35.9	31.63
32	68.58	13.06	11.51	9.63	55.52	48.92	36.69	35.1	31.36
33	69.33	13.20	11.64	9.73	56.13	49.45	37.09	35.6	31.36
34	68.44	13.03	11.49	9.61	55.41	48.82	36.61	35.9	31.63
35	68.72	13.08	11.54	9.65	55.64	49.02	36.76	35.9	31.63
36	68.67	13.07	11.53	9.64	55.60	48.98	36.74	36.5	32.16
37	69.62	13.25	11.69	9.78	56.37	49.66	37.24	35.9	31.63
38	70.14	13.35	11.78	9.85	56.79	50.03	37.52	35.9	31.63
39	67.35	12.82	11.31	9.46	54.53	48.04	36.03	35.7	31.45
40	67.32	12.82	11.30	9.45	54.50	48.02	36.01	35.5	31.28
Total	2731.95	520.06	458.69	383.61	2211.89	1948.67	1461.51	1439.20	1267.94
15 Pellets for analysis	35.29	6.72	5.93	4.96	28.57	25.17	18.88		
S. Total	2767.24	526.78	464.62	388.57	2240.46	1973.84	1480.39	1439.20	1267.94

Table 4-5-4 Results of non destructive inspection of fuel pins

Pin No. Spec.	X-ray radiography	He-Leak test (atm·cc/s)	Surface contamination	
			Loose (dpm)	Fix (dpm)
	No harmful defects	1×10^{-8}	<10	<1,000
01	GO	9.1×10^{-11}	<5	7.9
02	GO	9.1×10^{-11}	<5	283.0
03	GO	4.8×10^{-11}	<5	70.8
04	GO	4.8×10^{-11}	<5	86.5
05	GO	4.5×10^{-11}	<5	7.9
06	GO	4.2×10^{-11}	<5	31.5
07	GO	4.2×10^{-11}	<5	63.0
08	GO	4.2×10^{-11}	<5	585.4
09	GO	4.8×10^{-11}	<5	39.4
10	GO	1.9×10^{-11}	<5	0
11	GO	4.8×10^{-11}	<5	133.7
12	GO	9.1×10^{-11}	<5	31.5
13	GO	4.2×10^{-11}	<5	94.5
14	GO	1.8×10^{-11}	<5	173.2
15	GO	4.8×10^{-11}	<5	15.7
16	GO	9.1×10^{-11}	<5	102.4
17	GO	9.1×10^{-11}	<5	157.2
18	GO	9.1×10^{-11}	<5	70.9
19	GO	4.8×10^{-11}	<5	39.4
20	GO	9.1×10^{-11}	<5	15.7
21	GO	4.5×10^{-11}	<5	0
22	GO	4.5×10^{-11}	<5	23.6
23	GO	4.5×10^{-11}	<5	15.7
24	GO	4.2×10^{-11}	<5	0
25	GO	1.8×10^{-10}	<5	70.8
26	GO	4.5×10^{-11}	<5	47.2
27	GO	1.9×10^{-10}	<5	7.9
28	GO	1.8×10^{-10}	<5	7.9
29	GO	1.8×10^{-10}	<5	7.9
30	GO	1.9×10^{-10}	<5	23.6
31	GO	1.9×10^{-10}	<5	31.5
32	GO	1.9×10^{-10}	<5	31.5
33	GO	1.9×10^{-10}	<5	118.1
34	GO	1.9×10^{-10}	<5	0
35	GO	1.9×10^{-10}	<5	0
36	GO	1.9×10^{-10}	<5	23.6
37	GO	1.9×10^{-10}	<5	23.6
38	GO	1.9×10^{-10}	<5	0
39	GO	1.9×10^{-10}	<5	7.9
40	GO	1.9×10^{-10}	<5	63.0

Table 4-6-1 Chemical composition of
assembly components

Items	Grid (%)	Knock bar (%)	Framwork (%)	Tie rod, Tie rod end plug (%)	Tie rod sleeve (%)
C	0.03	0.06	0.06	0.06	0.04
Si	0.62	0.45	0.90	0.58	0.53
Mn	1.61	1.43	1.46	1.58	1.75
P	0.020	0.036	0.040	0.018	0.003
S	0.006	0.004	0.012	0.010	0.007
Ni	13.90	11.94	10.35	10.46	12.96
Cr	16.21	16.29	17.25	16.68	17.10
Mo	2.15	2.33	2.29	2.21	2.56
Co	0.30	0.11	0.22	0.23	0.06
N	0.090	0.030	0.021	0.030	0.006

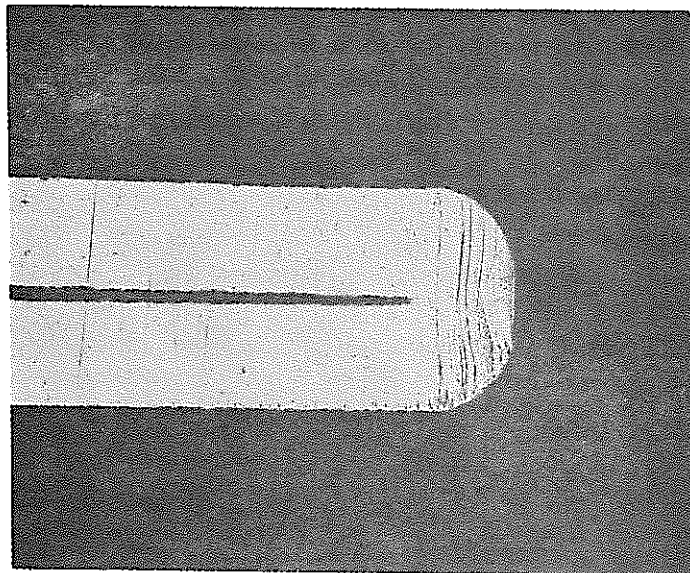
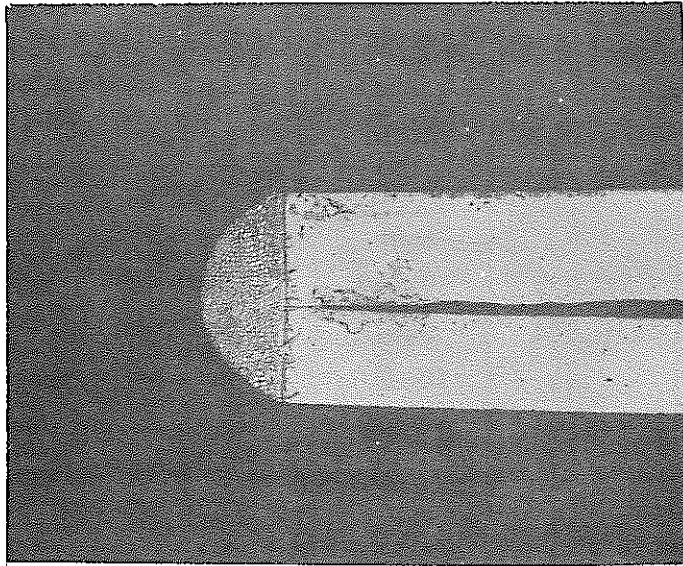


Fig.4-6-1 Metallography of welded
part of grid

Location of 15 Pellets for analysis

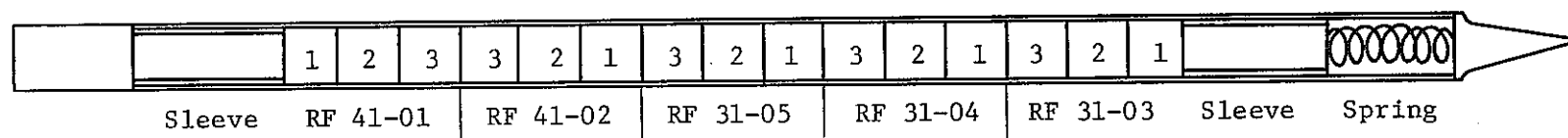
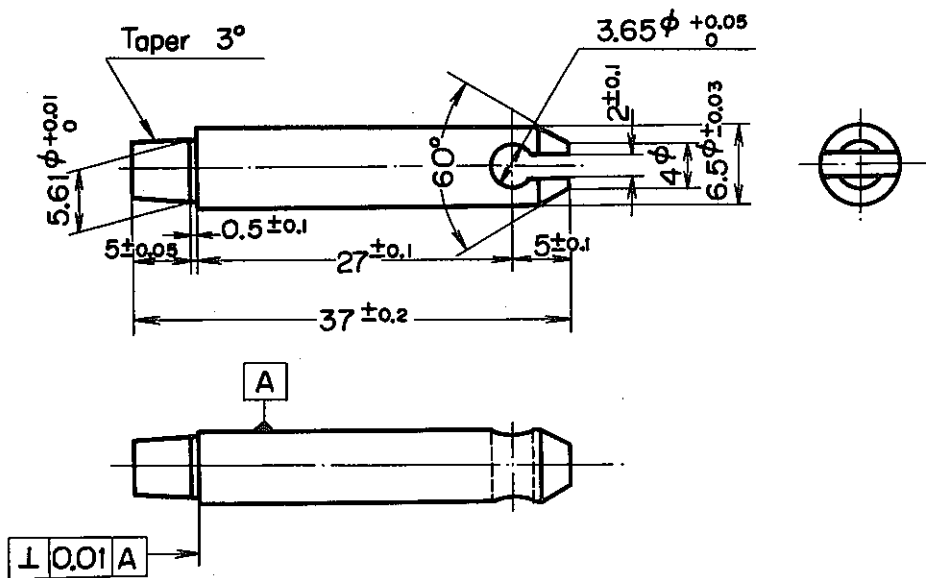


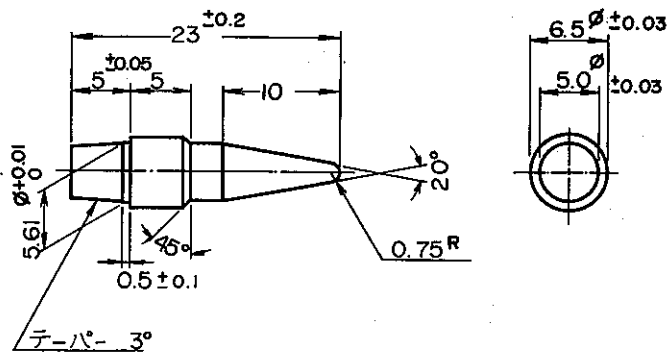
Fig. 5-1

DRAWING LIST

1. RAPSODIE-5-1031(3)
Lower End Plug
2. RAPSODIE-5-1032
Upper End Plug
3. " -5-2031
Spring
4. " -5-2042
Plenum Sleeve
5. " -5-2051
SiC Capsule
6. " -5-2061
Tagging Gas Capsule Container
7. " -5-2071(3)
Stainless Steel Capsule
8. " -5-3011(2)
Framework
9. " -5-3021(2)
Knock Bar (1,2,3)
10. " -5-3024(2)
Knock Bar (4)
11. " -5-3031(2)
TIE Rod And
TIE Rod Sleeve
12. RAPSODIE-5-3041
Grid



1	LOWER END PLUG	AISI 316	34		
ITEM	NAME	MATERIAL	SUPL. NO	REMARKS	
TITLE					
LOWER END PLUG			DESIGN	NAME	DATE
			DWG.	<i>[Signature]</i>	July-30-'73
			CHECK	<i>[Signature]</i>	Aug-20-'73
			APPR.	<i>[Signature]</i>	Aug-21-'73
POWER REACTOR AND NUCLEAR FUEL DEVELOPMENT CORPORATION TOKAI - JAPAN			SCALE 2/1	DRAWING NO. RAPSODIE - 5 - 1031 (3)	
3			ANGLE		

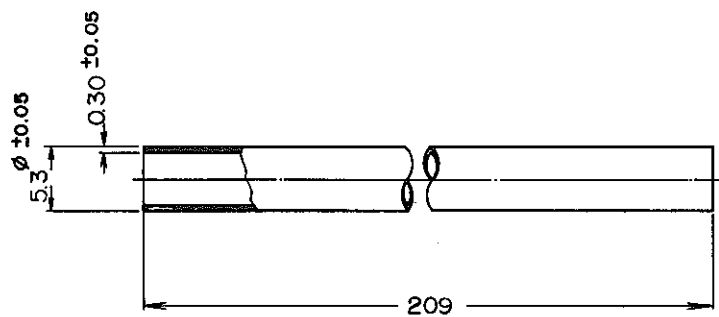


I	UPPER END PLUG	AISI 316	34		
ITEM	NAME	MATERIAL	SUPL. NO	REMARKS	
TITLE					
UPPER END PLUG			DESIGN	NAME	DATE
			DWG.		July-30-'73
			CHECK		Aug.-20-'73
			APPR.		Aug.-21-'73
					"-22-'73
POWER REACTOR AND NUCLEAR FUEL DEVELOPMENT CORPORATION TOKAI - JAPAN			SCALE 2 / 1 ANGLE	DRAWING NO. RAPSODIE-5-1032	



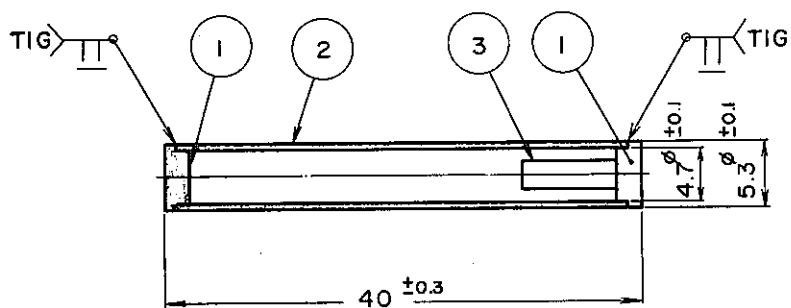
WIRE DIAMETER	0.7 mm
COIL OUTER DIAMETER	4.9 ϕ mm
EFFECTIVE TURNS	24
FREE LENGTH	36 $\pm$ 0.5 mm
SPRING CONSTANT	0.15 kg/mm

I	SPRING	SWPA	34		
ITEM	NAME	MATERIAL	SUPL. NO	REMARKS	
TITLE				NAME	DATE
SPRING			DESIGN	<i>[Signature]</i>	July-30-'73
			DWG.	<i>[Signature]</i>	Aug-20-'73
			CHECK	<i>[Signature]</i>	Aug-21-'73
			APPR.	<i>[Signature]</i>	" - 22 - '73
POWER REACTOR AND NUCLEAR FUEL DEVELOPMENT CORPORATION TOKAI - JAPAN			SCALE	DRAWING NO.	
			ANGLE	RAPSODIE - 5 - 2031	

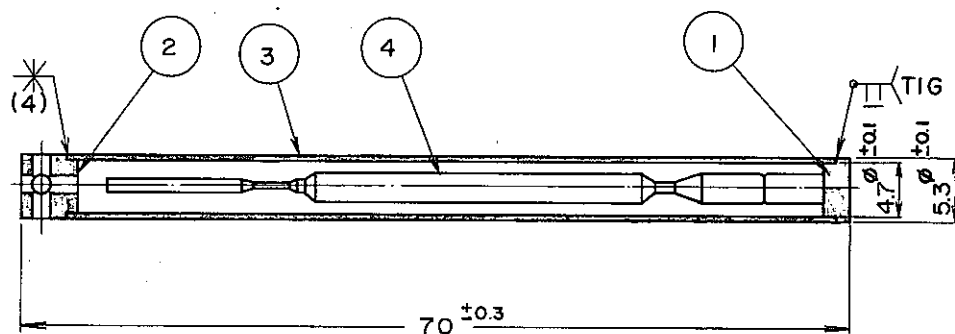


730724

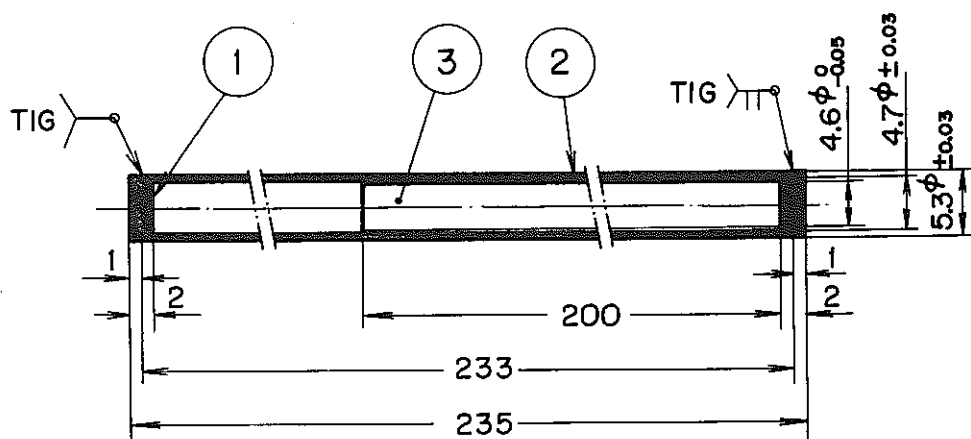
PLENUM SLEEVE		AISI 316			
ITEM	NAME	MATERIAL	SUPL. NO	REMARKS	
TITLE				NAME	DATE
PLENUM SLEEVE			DESIGN	<i>[Signature]</i>	<i>July-30-'73</i>
			DWG.	<i>[Signature]</i>	<i>Aug.-20-'73</i>
			CHECK	<i>K 57</i>	<i>Aug.-21-'73</i>
			APPR.	<i>Hester</i>	<i>-22-'73</i>
POWER REACTOR AND NUCLEAR FUEL DEVELOPMENT CORPORATION TOKAI - JAPAN			SCALE	DRAWING NO.	
			ANGLE	RAPSODIE - 5 - 2042	



3	SiC SAMPLE	SiC		
2	CAPSULE TUBE	AISI 316		
1	END PLUG	AISI 316		
ITEM	NAME	MATERIAL	SUPL. NO	REMARKS
TITLE			NAME	DATE
SiC CAPSULE			DESIGN	<i>[Signature]</i> July-30-'73
			DWG.	<i>[Signature]</i> Aug-20-'73
			CHECK	<i>[Signature]</i> Aug-21-'73
			APPR.	<i>[Signature]</i> -22-'73
POWER REACTOR AND NUCLEAR FUEL DEVELOPMENT CORPORATION TOKAI - JAPAN			SCALE 2/1 ANGLE	DRAWING NO. RAPSODIE-5-2051

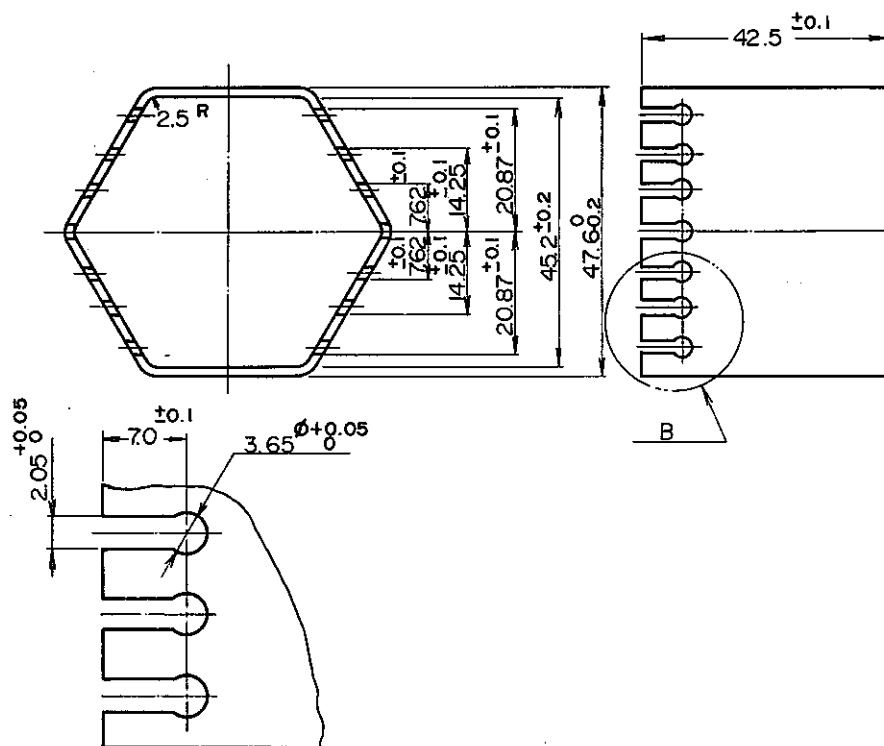


4	TAGGING GAS CAPSULE			
3	CAPSULE TUBE	AISI 316	34	
2	END PLUG (2)	AISI 316	34	
1	END PLUG (1)	AISI 316	34	
ITEM	NAME	MATERIAL	SUPL. NO	REMARKS
TITLE				
TAGGING GAS CAPSULE CONTAINER			NAME	DATE
			DESIGN	July-30-'73
			DWG.	Aug-20-'73
			CHECK	Aug-21-'73
			APPR.	-22-'73
POWER REACTOR AND NUCLEAR FUEL DEVELOPMENT CORPORATION TOKAI - JAPAN		SCALE 2/1	DRAWING NO. RAPSODIE - 5 - 2061	
		ANGLE		



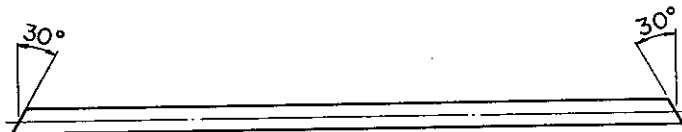
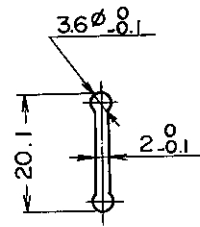
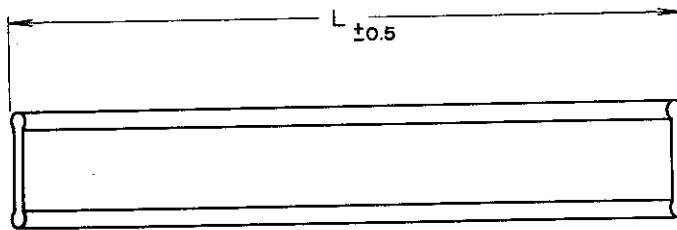
730733

3	STAINLESS STEEL SAMPLE			
2	CAPSULE TUBE	AISI 316		
1	END PLUG	AISI 316		
ITEM	NAME	MATERIAL	SUPL. NO	REMARKS
TITLE			NAME	DATE
STAINLESS STEEL CAPSULE			DESIGN	July-30-'73
			DWG.	Aug.-20-'73
			CHECK	Aug.-21-'73
			APPR.	Aug.-22-'73
POWER REACTOR AND NUCLEAR FUEL DEVELOPMENT CORPORATION TOKAI - JAPAN			SCALE 2/1	DRAWING NO. RAPSODIE - 5-2071 (3)



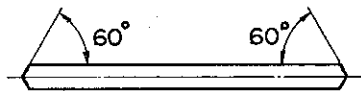
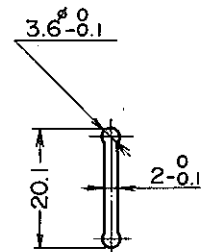
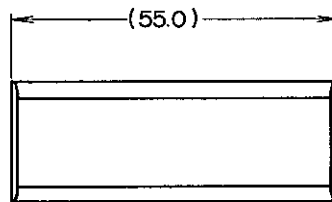
DETAIL OF B (2/1)

I	FRAMEWORK	AISI 316	I	
ITEM	NAME	MATERIAL	SUPL. NO	REMARKS
TITLE				NAME
FRAMEWORK			DESIGN	DATE
			DWG.	July-30-'73
			CHECK	Aug-20-'73
			APPR.	Aug-21-'73
POWER REACTOR AND NUCLEAR FUEL DEVELOPMENT CORPORATION			SCALE	DRAWING NO.
TOKAI - JAPAN			ANGLE	RAPSODIE-5 -3011(2)

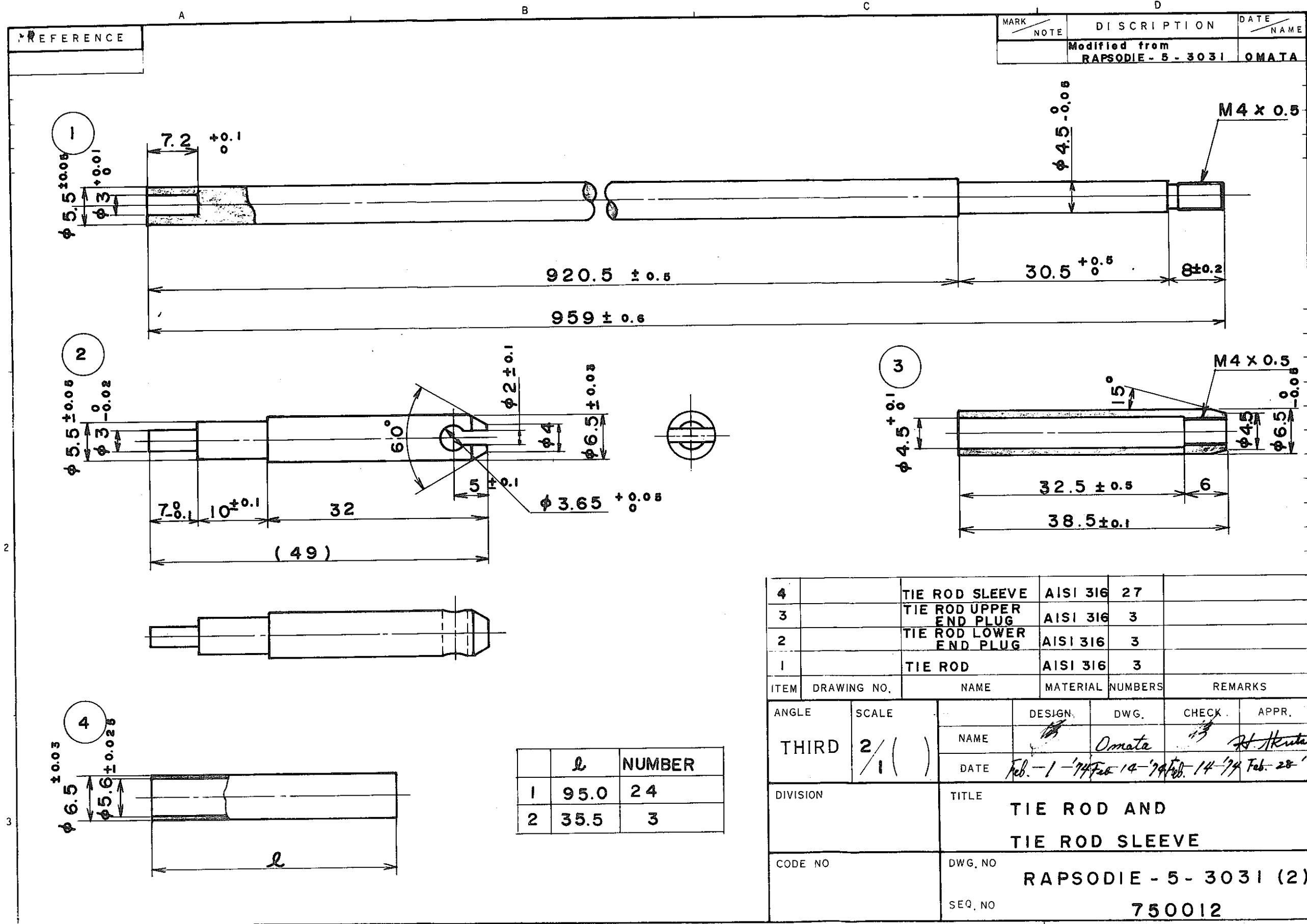


NO	L
1	33.17
2	40.82
3	48.47

3	KNOCK BAR	AISI 316	2	
2	KNOCK BAR	AISI 316	2	
1	KNOCK BAR	AISI 316	2	
ITEM	NAME	MATERIAL	SUPL. NO	REMARKS
TITLE				
KNOCK BAR (1,2,3)				
		DESIGN	NAME	DATE
		DWG.	<i>[Signature]</i>	July-30-'73
		CHECK	<i>[Signature]</i>	Aug-20-'73
		APPR.	<i>[Signature]</i>	Aug-21-'73
POWER REACTOR AND NUCLEAR FUEL DEVELOPMENT CORPORATION TOKAI - JAPAN		SCALE 1/1	DRAWING NO. RAPSODIE-5-3021(2)	
		ANGLE		

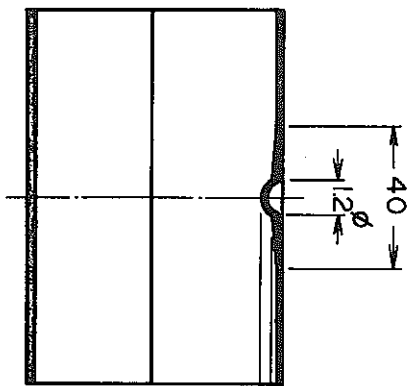
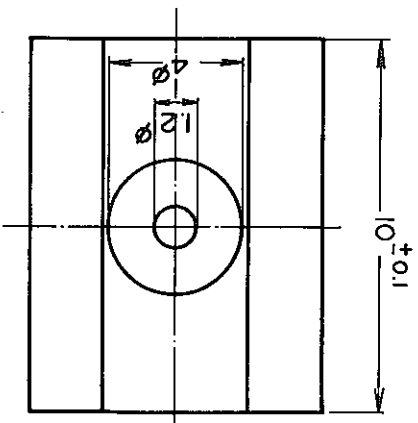
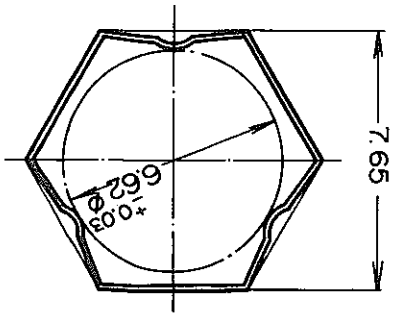
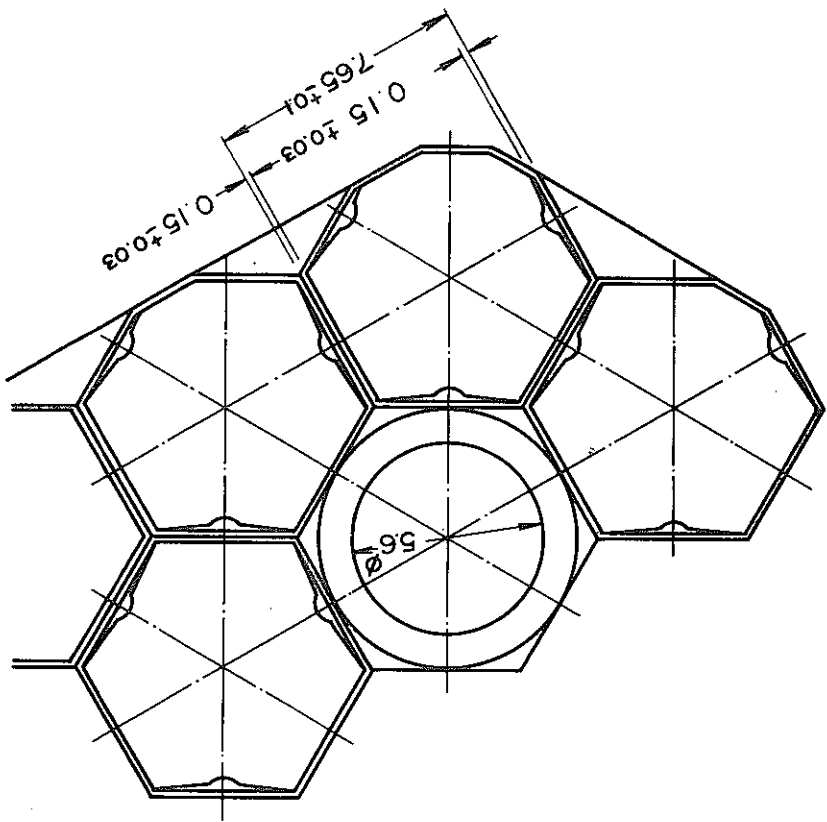
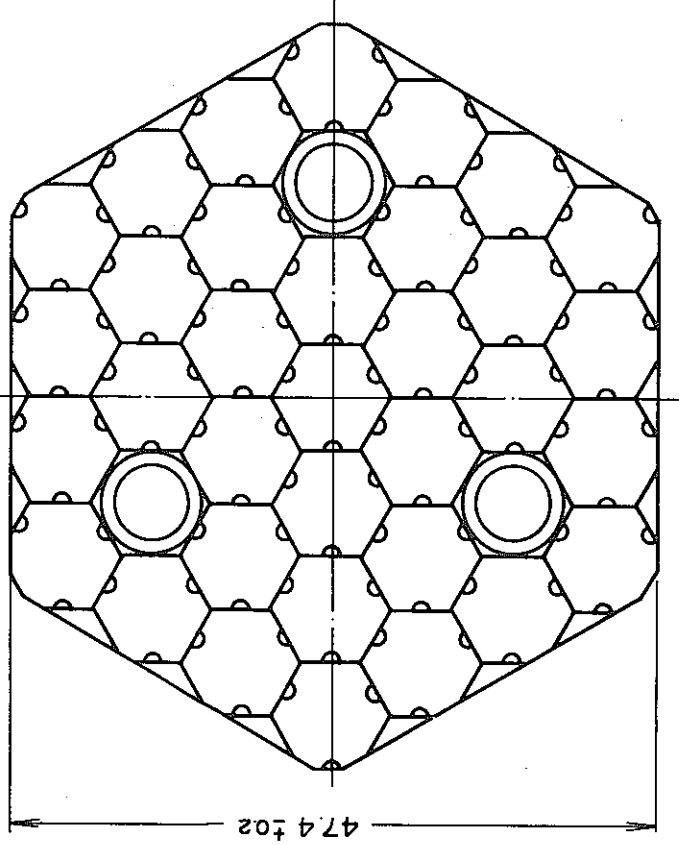


1	KNOCK BAR	AISI 316	1	
ITEM	NAME	MATERIAL	SUPL. NO	REMARKS
TITLE				
KNOCK BAR (4)		DESIGN	NAME	DATE
		DWG.		July-30-'73
		CHECK		Aug-20-'73
		APPR.		Aug-21-'73
POWER REACTOR AND NUCLEAR FUEL DEVELOPMENT CORPORATION TOKAI - JAPAN		SCALE 1/1	DRAWING NO. RAPSODIE - 5 - 3024(2)	
		ANGLE		



MARK	DISCRIPTION	DATE
NOTE	Modified from	NAME
	RAPSODIE - 5 - 3031	OMATA

4		TIE ROD SLEEVE	AISI 316	27	
3		TIE ROD UPPER END PLUG	AISI 316	3	
2		TIE ROD LOWER END PLUG	AISI 316	3	
1		TIE ROD	AISI 316	3	
ITEM	DRAWING NO.	NAME	MATERIAL	NUMBERS	REMARKS
ANGLE	SCALE	DESIGN	DWG.	CHECK	APPR.
THIRD	2/1	NAME	Omata	H. Kenta	
		DATE	Feb. -1 '74	Feb. 14 '74	Feb. 28 '74
DIVISION	TITLE				
	TIE ROD AND TIE ROD SLEEVE				
CODE NO	DWG. NO				
	RAPSODIE - 5 - 3031 (2)				
	SEQ. NO				
	750012				



0.15
0.25
0.52

ITEM	NAME	MATERIAL	SUPL. NO	REMARKS
		AISI-316		
TITLE				
GRID				
POWER REACTOR AND NUCLEAR FUEL DEVELOPMENT CORPORATION				
TOKAI - JAPAN				
DWG. NO				
RAPSODIE - 5 - 30 41				
SCALE	DATE	DESIGN	DWG.	CHECK
ANGLE.				
DWG. NO				