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ABSTRACT

Burnout tests were conducted in Freon-12 at four different inlet pressures for four uniformly heated annuli, and three different inlet pressures for a 19-rod cluster (the respective inlet to critical pressure ratios being 0.21, 0.26, 0.33, 0.40 and 0.26, 0.32, 0.41). For the rod cluster, the ratio of the heat flux on the outer rods to the heat flux on the inner rods was 1.6. All annulus test sections were internally heated except one whose outer tube (shroud) only was heated. Resistance heating using d.c. power was used.

Results show that, in general, for a constant inlet subcooling, increasing inlet pressure caused a non-linear decrease of burnout heat flux

(continued)

for mass velocities up to 4 Mg $m^{-2}s^{-1}$. An apparent independence of burnout heat flux from inlet pressure was observed for the rod cluster at a very small value of mass velocity (50 kg $m^{-2}s^{-1}$). At a high mass velocity (4 Mg $m^{-2}s^{-1}$), the internally heated annulus had a significantly greater burnout heat flux than the corresponding externally heated one.

The CISE burnout correlation, modified for the effect of inlet pressure, generally underpredicted the burnout heat flux by up to 40 per cent.

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ANNULAR SPACE; BURNOUT; CRITICAL HEAT FLUX; FREONS; FUEL ELEMENT CLUSTERS; PRESSURE DEPENDENCE; PRESSURE DROP; SUBCOOLING

CONTENTS

1. INTRODUCTION

Following tests on the effect of pressure on burnout in a tube (Ilic 1974), results are reported of the subsequent tests with more complex test sections; these comprised four annuli and a 19-rod cluster.

In addition to enabling comparison of the performance of the geometrically complex test sections with that of a tube, the data provided should be useful for current investigations of burnout scaling laws.

2. APPARATUS AND DATA COLLECTION

2.1 The Burnout Rig and Test Sections

All tests were done on the Freon-12 rig ACTOR described elsewhere (Ilic 1972). Briefly, the rig is a closed loop with a liquid capacity of about 340 kg of Freon-12, a maximum operating pressure of 2 MPa and a d.c. power supply up to about 300 kW. The circulating pump is rated at 6.4 $\ell\ s^{-1}$ at 200 kW and a head of 43 m.

All test sections were made of stainless steel and were resistance heated. They consisted of four annuli coded 2F, 8F, 14F and CE29952 and a 19-rod cluster. Two of the annulus test sections, 8F and 14F, were identical in construction the only difference being in the manner of heating; in the former, the inner rod was used as a heater, while in the latter the shroud only was heated. Dimensional details of test sections are given in Tables 1 to 5. Layout of the 19-rod cluster is shown in Figure 1.

2.2 Instrumentation

The mass flowrate was measured with a multiorifice system (V. Ilic, AAEC unpublished report), especially designed for operation on the Freon-12 rig ACTOR. Pressure drop across an orifice plate was indicated by a differential mercury manometer. The pressure difference thus obtained was substituted in the mass flow equation derived either from British Standard BS1042: Part 1, 1964, if the mass flowrate was greater than 0.2 kg s^{-1}, or from calibration data for non-standard orifices (V. Ilic, AAEC unpublished report) if the flowrate was less than 0.2 kg s^{-1}. The fluid temperature at the inlet to the test section was measured by a chromel-alumel thermocouple situated 2 m upstream of the orifice and read off the printed record from a multipoint temperature recorder.

The power to the test section was obtained from measurements of the voltage drop between heater power clamps and the current through the test section. The latter was obtained by measuring the voltage drop across a calibrated precision resistance in the power supply line. The test section pressure drop was measured by means of a differential mercury manometer.

The test section inlet static pressure was obtained from a pressure indicator connected to a pressure transmitter unit. All the above data were manually recorded.

Owing to test section construction, static pressure drop at burnout includes the pressure drop over 76 mm (38 mm at each end of the annulus test section) of unheated test section length for test sections 2F and 8F. With heated outer test section 14F, brass clamps 64 mm long were used, such that the heated surface was 38 mm below the top pressure tapping and 38 mm above the lower pressure tapping, each of which was straddled by a brass clamp.

Burnout detection was achieved by means of a thermopile in each of the 18 heater rods in the cluster test section, and a bridge type detector in the annuli. The thermopile detectors consisted of four chromel-alumel thermocouples connected in series and equally spaced around the periphery at the same axial position within each heater rod. Sets of three thermopiles were monitored by a trip amplifier, which was set to switch off the power to the test section when the temperature difference between the hot and cold junctions exceeded 30°C. The hot junction was about 1 cm below the downstream end of the heater, while the cold junction was about 30 cm upstream from it.

2.3 Experimental Method

In all cases, the required flow conditions were initially established and a trial burnout obtained through a fairly rapid succession of test section power increments. The power was then reduced such that the test section voltage was about 0.5V below the burnout value, and conditions were allowed to settle. The burnout was then approached at small power increments, until the pen monitor registered a substantial deviation in the burnout signal (corresponding to a power variation of the order of 1 watt). A record was then made of all the relevant parameter values.

2.4 Error Estimates

The estimate of random errors associated with each measurement is given below:

flowrate	± 1.5%	heater power	± 2%
inlet pressure	± 14 kPa	heater area	± 0.6%
inlet temperature	± 1°C	pressure drop	± 1%

3. RESULTS AND DISCUSSION

All data have been tabulated in Tables 1 to 5. The salient features of the effect of the inlet pressure on burnout heat flux are shown in Figure 2

for an arbitrarily chosen inlet subcooling Δh_i = 18 kJ kg^{-1}.

All figures show in general a non-linear decrease of burnout heat flux with increasing values of inlet pressure. The decrease of the burnout heat flux with increasing values of inlet pressure might be expected since the latent heat of vaporisation also decreases with pressure. However, other factors must be involved because at high values of mass flux and high values of inlet pressure, there is a tendency towards an increase in the burnout heat flux with an increase in the inlet pressure. The existence of such 'peaking' was reported by Collier (1972) for tests with water in round tubes.

Comparative performances of all annuli used in these tests are shown in Figure 3 for a high and low value of mass velocity (4 and 1 Mg $m^{-2}s^{-1}$ respectively), and inlet subcooling of 18 kJ kg^{-1}. At both mass velocities, the performance of annulus CE29952 was the poorest, while annulus 2F obtained highest burnout heat flux at the same inlet pressure. The burnout heat flux of the internally heated annulus 8F is significantly higher than the externally heated annulus 14F at the high mass velocity. At the low mass velocity (1 Mg $m^{-2}s^{-1}$), the performances of the two test sections are nearly identical.

The wide variation in test section performances is associated with the geometries, heating modes and the presence of spacers in the annular space. Although test sections 2F, 8F and 14F each have the same heated length and inner rod diameter, 2F has the largest annular gap, which enhances its performance at a given mass velocity.

Annulus CE29952, on the other hand, is one and a half times longer than other annuli and has the largest annular gap. In general, it has the smallest burnout heat flux (at high mass velocities and inlet pressures its performance is almost identical with that of annulus 14F). The reason for this behaviour may be partly the relatively smaller amount of flow mixing, as the heater rod was supported at planes set further apart than in other annuli (91 cm in contrast to 15 cm). It is probable that eccentricity of the inner rod could have also adversely affected the CE29952 annulus performance.

The mass velocity through the cluster test section was considerably smaller than in annuli because of the large flow area. However, its burnout heat flux was comparatively high, probably owing to the considerable flow turbulence caused by spacer grids providing an effective area blockage of 36 per cent (flow area blockage caused by spacers in annuli was about one third this figure). Contrary to results at high values of mass velocity, the burnout heat flux at 50 kg $m^{-2}s^{-1}$ and constant inlet subcooling was

independent of inlet pressure.

The CISE burnout correlation, modified for the effect of inlet pressure (Cumo, Ferrari & Urbani 1972), was used in the following form:

$$W = \frac{a + b}{1+D^{1.4} \times \left(\frac{G}{1000}\right) \times C} \times F.\lambda.J$$

where $$a = \frac{P_H}{P_w} \cdot \frac{1-R}{\left(\frac{G}{1000}\right)^{1/3}}$$

$$b = \frac{\Delta h_i}{\lambda_i}$$

$$C = \left(\frac{1}{R} - 1\right)^{0.4} \frac{k_1}{L}$$

$$F = G\, k_2\, (d_s^2 - d_r^2)$$

$$J = 1 - \frac{\frac{1}{4} - R}{\left(\frac{9}{4} - R\right)^2}$$

$$k_1 = 378.5738$$

$$k_2 = 0.7853976$$

The comparison of the burnout power estimates using this correlation revealed almost consistent underprediction (up to 40 per cent) in all cases. Error histograms were constructed expressing the difference between the burnout correlation estimate and the data as the percentage of the experimental value for the burnout power (Figure 4). Since the correlation does not take into account the effect of spacers on burnout, the trend shown in Figure 4 is reasonable.

4. CONCLUSIONS

(i) The burnout heat flux varies non-linearly with inlet pressure for the annulus and rod cluster test sections. In general, as was found for round tubes, increasing the system pressure decreases burnout heat flux for a given inlet subcooling.

(ii) At a very low mass velocity (50 kg $m^{-2}s^{-1}$), the cluster test section showed independence of the burnout heat flux from the system pressure for a constant value of inlet subcooling.

(iii) The CISE burnout correlation modified for the effect of system pressure, generally underpredicts the experimental data by up to 40 per cent. The agreement was better where the effect of spacers was small.

5. RECOMMENDATION

Since the CISE burnout correlation does not take into account the effect of spacers and grids, comparison with the burnout data obtained for test sections with spacers and grids gives a quantitative measure of their effect. Further study of this is desirable because of the importance of spacer effect for the estimation of the fuel rod burnout power.

6. NOMENCLATURE

(i) Roman letters

A - area

d - diameter

D - hydraulic diameter = $\frac{4A_F}{P_w}$

G - mass velocity

h - enthalpy

L - heated length

P - perimeter

p - pressure

R - reduced pressure = $\frac{p}{p_o}$

W - burnout power

(ii) Greek letters

Δ - a small portion

λ - latent heat of vaporisation

(iii) Subscripts

c - critical

E - experimental

F - flow

i - inlet

r - rod

S - shroud

w - wetted

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The test sections 2F, 8F, 14F and the 19-rod cluster were obtained on loan from the UKAEA Winfrith.

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8. REFERENCES

Collier, J.G. (1972) - Convective Boiling and Condensation. McGraw-Hill, London.

Cumo, M., Ferrari, G. & Urbani, G. (1972) - Prediction of Burnout Power with Freon up to the Critical Pressure. Advances in Heat Transfer RT/ING(72)19. Comitato Nazionale Energie Nucleare, Italy.

Ilic, V. (1972) - The AAEC Freon Burnout Rig ACTOR and Initial Boiling Crisis (Burnout) Results. AAEC/TM632.

Ilic, V. (1974) - The Effect of Pressure on Burnout in a Round Tube Cooled by Freon-12. AAEC/E325.

TABLE 1

BURNOUT DATA FOR THE 19-ROD CLUSTER

Heater Rod	Number off	18
	Outside diameter mm (in)	15.9 (0.625)
	Wall thickness inner tubes mm (in)	0.2 (0.008)
	Wall thickness outer tubes mm (in)	0.3 (0.013)
	Heater length mm (in)	1251 (49½)
	Material	Inconel 600
	Overall resistance of rods, ohm	0.005
Grid	Type	plate
	Material	stainless steel
	Flow area blockage %	36
	Total number	5
	Pitch mm (in)	254 (10)
	Distance from heater downstream end mm (in)	238 (9⅜)
	Rod spacing mm (in)	6.4 (0.25)
	Distance between pressure taps	1257 (49½)
	Axial heat flux profile	uniform
	Outer/inner rod heat flux ratio	1.6
	Burnout detector	thermopile in each heater rod

Run Number	Inlet Pressure		Inlet Subcooling		Mass Velocity		Burnout Flux		Exit Quality	Power kW	Test Section Pressure Drop				Boiling Length	
											Zero Power		Burnout			
	MPa	psia	kJ kg^{-1}	Btu lb^{-1}	kg m^{-2} s^{-1}	lb ft^{-2} hr^{-1} x 10^{-3}	kW m^{-2}	Btu hr^{-1} ft^{-2} x 10^{-4}			kPa	psi	kPa	psi	m	ft
18027003	1.054	152.8	8.70	3.74	46.92	34.59	39.9	1.266	1.072	43.70	17.1	2.5	25.6	3.7	1.15	3.76
20047005	1.054	152.8	5.82	2.50	63.52	46.84	48.6	1.542	0.982	53.23	17.3	2.5	26.4	3.8	1.16	3.81
20047004	1.057	153.4	10.30	4.43	63.58	46.88	51.9	1.646	1.015	56.85	17.1	2.5	26.0	3.8	1.13	3.70
20047006	1.061	153.9	23.70	10.19	64.20	47.34	59.0	1.871	1.047	64.61	16.6	2.4	25.2	3.6	1.03	3.39
19027001	1.059	153.6	8.91	3.83	80.62	59.45	59.7	1.893	0.925	65.35	18.9	2.7	25.9	3.8	1.13	3.71
19027002	1.054	152.8	8.26	3.55	104.56	77.10	74.1	2.350	0.887	81.15	16.8	2.4	25.9	3.8	1.13	3.72
21047001	1.057	153.4	23.45	10.08	127.05	93.68	99.4	3.151	0.865	108.75	16.6	2.4	24.5	3.6	1.00	3.29
18047005	1.057	153.4	9.65	4.15	127.45	93.97	89.0	2.821	0.862	97.39	16.8	2.4	25.8	3.7	1.12	3.67
20047001	1.054	152.8	5.61	2.41	127.57	94.06	84.4	2.675	0.844	92.34	17.0	2.5	26.1	3.8	1.16	3.80
14047003	1.054	152.8	23.26	10.00	203.13	149.78	120.5	3.820	0.614	131.88	16.9	2.5	23.1	3.4	0.94	3.07
21047004	1.054	152.8	15.21	6.54	206.36	152.16	115.4	3.659	0.633	126.35	16.6	2.4	23.6	3.4	1.02	3.36
21047005	1.064	154.4	6.26	2.69	206.44	152.22	108.5	3.438	0.660	118.71	16.8	2.4	24.4	3.5	1.13	3.72
21047003	1.061	153.9	10.05	4.32	206.51	152.27	112.5	3.566	0.655	123.12	16.6	2.4	23.8	3.5	1.09	3.56
14047002	1.061	153.9	3.95	1.70	210.39	155.13	106.3	3.368	0.650	116.30	16.9	2.5	24.3	3.5	1.16	3.81
14047001	1.057	153.4	13.97	6.01	213.80	157.65	115.4	3.658	0.617	126.29	16.9	2.5	23.5	3.4	1.03	3.39

Run Number	Inlet Pressure		Inlet Subcooling		Mass Velocity		Burnout Flux		Exit Quality	Power kW	Test Section Pressure Drop				Boiling Length	
											Zero Power		Burnout			
	MPa	psia	kJ kg^{-1}	Btu lb^{-1}	kg m^{-2} s^{-1}	lb ft^{-2} hr^{-1} x 10^{-3}	kW m^{-2}	Btu hr^{-1} ft^{-2} x 10^{-4}			kPa	psi	kPa	psi	m	ft
2037003	1.329	192.7	14.24	6.12	63.04	46.49	49.2	1.561	0.995	53.9	15.7	2.3	24.8	3.6	1.09	3.57
3037001	1.336	193.8	5.77	2.48	63.14	46.55	46.5	1.473	1.004	50.87	15.3	2.2	26.2	3.8	1.16	3.81
2037002	1.332	193.2	24.10	10.36	63.54	46.85	52.9	1.678	0.987	52.92	15.8	2.3	24.9	3.6	1.01	3.31
26027001	1.332	193.2	23.35	10.04	125.92	92.85	90.5	2.869	0.831	99.06	15.6	2.3	24.5	3.6	0.98	3.23
2037001	1.336	193.8	5.61	2.41	126.63	93.37	80.2	2.542	0.860	87.78	15.9	2.3	25.9	3.8	1.16	3.79
27027001	1.336	193.8	14.58	6.27	126.83	93.52	85.3	2.703	0.839	93.32	15.9	2.3	25.4	3.7	1.06	3.49
16037001	1.332	193.2	5.09	2.19	182.92	134.88	95.1	3.051	0.711	105.36	15.9	2.3	24.9	3.6	1.15	3.77
13037001	1.338	194.0	23.61	10.15	183.26	135.13	112.1	3.552	0.677	122.65	16.5	2.4	23.5	3.4	0.94	3.09
13037002	1.339	194.3	15.03	6.46	183.81	135.53	106.4	3.374	0.704	116.49	15.8	2.3	24.3	3.5	1.03	3.38
14047005	1.325	192.2	13.93	5.99	201.09	148.28	107.6	3.412	0.649	117.82	16.9	2.5	24.2	3.5	1.03	3.38
17047009	1.332	193.2	9.96	4.28	201.20	148.36	106.8	3.386	0.677	116.90	17.3	2.5	23.6	3.4	1.09	3.56
21047006	1.329	192.7	6.44	2.77	201.23	148.38	101.4	3.215	0.668	111.01	16.8	2.4	24.8	3.6	1.13	3.70
14047004	1.318	191.2	24.38	10.48	202.28	149.15	116.3	3.686	0.616	127.28	16.9	2.5	23.2	3.4	0.91	3.00
18037001	1.332	193.2	14.39	6.19	255.34	188.28	119.1	3.774	0.548	130.31	15.9	2.3	22.5	3.3	1.00	3.27
18037002	1.325	192.2	4.88	2.10	256.38	189.04	110.2	3.493	0.575	120.61	17.2	2.5	23.2	3.4	1.14	3.73
17047002	1.681	243.7	16.79	7.22	63.94	47.15	48.0	1.523	1.007	52.58	17.7	2.6	25.6	3.7	1.06	3.47
17047001	1.695	245.8	26.38	11.34	64.64	47.66	52.5	1.664	1.017	57.45	17.0	2.5	24.9	3.6	0.98	2.32
16047005	1.688	244.8	36.96	15.89	64.70	47.70	57.8	1.831	1.043	63.22	17.0	2.5	24.2	3.5	0.92	3.02
18047004	1.695	245.8	8.30	3.57	64.81	47.79	45.5	1.443	1.012	49.81	18.3	2.7	26.2	3.8	1.13	3.72
18047003	1.691	245.3	7.16	3.08	128.38	94.66	74.4	2.358	0.833	81.41	18.3	2.7	26.2	3.8	1.13	3.71
16047001	1.653	239.7	15.91	6.84	128.65	94.86	81.4	2.580	0.828	89.10	16.8	2.4	25.0	3.6	1.04	3.40
15047002	1.681	243.7	26.68	11.47	128.94	95.07	88.2	2.795	0.814	96.49	16.8	2.4	24.6	3.6	0.94	3.08
15047001	1.677	243.2	36.73	15.79	129.08	95.18	95.2	3.019	0.805	104.25	16.8	2.4	23.9	3.5	0.86	2.82
18047002	1.695	245.8	9.72	4.18	184.71	136.20	93.9	2.977	0.701	102.80	17.30	2.5	24.2	3.5	1.08	3.55
16047004	1.695	245.8	16.72	7.19	184.82	136.28	98.3	3.115	0.673	107.54	17.71	2.6	24.2	3.5	0.99	3.25
16047003	1.684	244.3	26.77	11.51	184.85	136.30	106.3	3.368	0.646	116.30	17.23	2.5	21.7	3.1	0.88	2.90
16047002	1.684	244.3	36.66	15.76	185.38	136.69	115.0	3.646	0.626	125.87	17.0	2.5	22.7	3.3	0.79	2.60

Run Number	Inlet Pressure		Inlet Subcooling		Mass Velocity		Burnout Flux		Exit Quality	Power kW	Test Section Pressure Drop				Boiling Length	
											Zero Power		Burnout			
	MPa	psia	kJ kg^{-1}	Btu lb^{-1}	kg m^{-2} s^{-1}	lb ft^{-2} hr^{-1} x 10^{-3}	kW m^{-2}	Btu hr^{-1} ft^{-2} x 10^{-4}			kPa	psi	kPa	psi	m	ft
18047001	1.681	243.7	11.21	4.82	206.66	152.39	98.4	3.120	0.636	107.73	17.4	2.5	24.2	3.5	1.05	3.44
17047006	1.691	245.3	27.19	11.69	206.72	152.42	112.1	3.553	0.593	122.67	17.4	2.5	23.0	3.3	0.85	2.81
17047007	1.691	245.3	16.63	7.15	207.10	152.71	103.5	3.282	0.624	113.32	17.4	2.5	23.8	3.5	0.98	3.21
17047005	1.684	244.3	36.75	15.80	207.85	153.26	119.3	3.783	0.554	130.61	17.4	2.5	22.4	3.2	0.76	2.48
17047004	1.691	245.3	26.98	11.60	251.90	185.743	119.3	3.782	0.489	130.59	17.2	2.5	22.0	3.2	0.81	2.65
17047003	1.684	244.3	16.42	7.06	259.21	191.131	112.4	3.564	0.523	123.04	17.2	2.5	22.8	3.3	0.94	3.10

TABLE 2

BURNOUT DATA FOR ANNULUS CE29952

Test Section	code number type mode of heating	CE 29952 annulus inner
Inner rod	outer diameter mm (in) wall thickness mm (in) material	14.4 (0.565) 1.63 (0.064) stainless steel AS-G19-316
Shroud	bore mm (in) wall thickness mm (in) material	22.1 (0.870) 1.63 (0.064) stainless steel AS-G19-316
Heater resistance (at 20 C) ohm		0.034
Axial heat flux profile		Uniform

Spacer	type material outer diameter mm (in) total number pitch mm (in) distance from heater end mm (in) configuration	pin Tufnol 3.2 (0.125) 9 914 (36) 914 (36) and longitudinally in line
Burnout detector	Thermocouple	
Heater Length mm (in)	2743 (108.0)	
Distance between pressure taps mm (in)	2743 (108.0)	

Run Number	Inlet Pressure		Inlet Subcooling		Mass Velocity		Burnout Flux		Exit Quality	Power kW	Test Section Pressure Drop				Boiling Length	
											Zero Power		Burnout			
	MPa	psia	$kJ\ kg^{-1}$	$Btu\ lb^{-1}$	$Mg\ m^{-2}\ s^{-1}$	$lb\ ft^{-2}\ hr^{-1}\ \times 10^{-6}$	$kW\ m^{-2}$	$Btu\ hr^{-1}ft^{-2}\ \times 10^{-4}$			kPa	psi	kPa	psi	m	ft
10067002	0.834	121.0	20.54	8.83	0.685	0.505	81.5	2.584	0.357	10.09	36.5	5.3	36.2	5.2	1.89	6.22
10067001	0.831	120.5	20.47	8.80	0.685	0.505	83.6	2.649	0.370	10.34	36.5	5.3	36.2	5.2	1.90	6.30
10067004	0.834	121.0	12.79	5.50	0.696	0.513	74.3	2.354	0.364	9.19	36.5	5.3	36.2	5.2	2.15	7.07
10067003	0.838	121.5	12.96	5.57	0.696	0.513	74.6	2.366	0.365	9.24	36.5	5.3	36.2	5.2	2.15	7.05
10067006	0.831	120.5	2.54	1.09	0.698	0.515	64.9	2.056	0.382	8.03	36.5	5.3	36.2	5.2	2.61	8.56
10067005	0.834	121.0	4.09	1.76	0.698	0.515	65.4	2.072	0.374	8.09	36.5	5.3	36.2	5.2	2.53	8.30
27057003	0.827	120.0	12.16	5.23	1.272	0.938	98.1	3.109	0.244	12.14	36.5	5.3	36.5	5.3	1.97	6.46
27057006	0.831	120.5	5.79	2.49	1.272	0.938	85.8	2.720	0.252	10.62	36.5	5 3	37.2	5.4	2.32	7.62
27057005	0.831	120.5	5.98	2.57	1.272	0.938	84.0	2.663	0.245	10.40	36.5	5.3	37.2	5.4	2.30	7.54
28057002	0.831	120.5	18.72	8.05	1.275	0.940	110.2	3.492	0.235	13.63	36.5	5.3	36.5	5.3	1.68	5.51
28057001	0.831	120.5	18.63	8.01	1.275	0.940	109.0	3.456	0.232	13.49	36.5	5.3	36.5	5.3	1.68	5.50
27057004	0.834	121.0	12.23	5.26	1.279	0.943	97.1	3.078	0.239	12.01	36.5	5.3	36.5	5.3	1.95	6.41
28057003	0.831	120.5	20.28	8.72	2.777	2.048	150.8	4.780	0.089	18.66	37.2	5.4	37.9	5.5	0.91	2.98
28057004	0.838	121.5	20.63	8.87	2.777	2.048	152.7	4.840	0.089	18.89	37.2	5.4	37.9	5.5	0.90	2.96
27057001	0.834	121.0	5.75	2.47	2.803	2.067	102.5	3.249	0.124	12.68	37.2	5.4	40.0	5.8	1.97	6.47
27057002	0.845	122.5	6.26	2.69	2.803	2.067	104.0	3.297	0.123	12.87	37.2	5.4	40.0	5.8	1.92	6.29
26057004	0.834	121.0	12.98	5.58	2.829	2.086	126.2	4.001	0.104	15.62	37.2	5.4	38.6	5.6	1.32	4.32
26057003	0.831	120.5	12.82	5.51	2.829	2.086	124.6	3.950	0.102	15.42	37.2	5.4	39.3	5.7	1.32	4.32

Run Number	Inlet Pressure		Inlet Subcooling		Mass Velocity		Burnout Flux		Exit Quality	Power kW	Test Section Pressure Drop				Boiling Length	
											Zero Power		Burnout			
	MPa	psia	kJ kg^{-1}	Btu lb^{-1}	Mg m^{-2} s^{-1}	lb ft^{-2} hr^{-1} x 10^{-6}	kW m^{-2}	Btu $hr^{-1}ft^{-2}$ x 10^{-4}			kPa	psi	kPa	psi	m	ft
26057001	0.838	121.5	13.17	5.66	4.096	3.020	145.4	4.608	0.065	17.99	38.6	5.6	41.4	6.0	0.92	3.03
22057004	0.849	123.1	14.12	6.07	4.096	3.022	152.1	4.823	0.065	18.83	38.6	5.6	42.1	6.1	0.87	2.87
22057003	0.838	121.5	13.63	5.86	4.101	3.024	147.4	4.672	0.063	18.24	38.6	5.6	41.4	6.0	0.88	2.90
22057001	0.831	120.5	19.91	8.56	4.103	3.025	181.7	5.761	0.051	22.49	38.6	5.6	40.7	5.9	0.54	1.76
22057002	0.838	121.5	20.17	8.67	4.103	3.025	182.3	5.778	0.050	22.56	38.6	5.6	40.7	5.9	0.52	1.69
22057006	0.852	123.6	6.58	2.83	4.104	3.026	110.5	3.504	0.079	13.68	40.0	5.8	43.4	6.3	1.54	5.06
22057005	0.852	123.6	6.00	2.58	4.104	3.026	110.4	3.500	0.083	13.65	40.0	5.8	43.4	6.3	1.65	5.40
26057002	0.838	121.5	13.63	5.86	4.154	3.063	150.6	4.774	0.065	18.64	38.6	5.6	42.1	6.1	0.90	2.95
21057003	0.831	120.5	8.21	3.53	4.199	3.096	117.0	3.710	0.071	14.48	38.6	5.6	42.7	6.2	1.30	4.25
21057001	0.845	122.5	8.21	3.53	4.231	3.120	119.4	3.784	0.072	14.77	38.6	5.6	42.7	6.2	1.32	4.32
10067008	1.061	153.9	23.98	10.31	0.698	0.515	84.1	2.667	0.354	10.41	36.5	5.3	35.9	5.2	1.76	5.79
10067007	1.061	153.9	23.98	10.31	0.698	0.515	84.4	2.675	0.355	10.44	36.5	5.3	35.9	5.2	1.77	5.80
10067010	1.058	153.4	13.98	6.01	0.701	0.517	71.8	2.277	0.354	8.89	36.5	5.3	35.9	5.2	2.08	6.81
10067010	1.058	153.4	13.98	6.01	0.701	0.517	70.8	2.244	0.347	8.76	36.5	5.3	35.9	5.2	2.06	6.77
11067002	1.058	153.4	5.75	2.47	0.703	0.518	61.2	1.940	0.351	7.57	36.5	5.3	35.9	5.2	2.42	7.94
11067001	1.054	152.8	3.44	1.48	0.703	0.518	60.9	1.932	0.376	7.54	36.5	5.3	35.9	5.2	2.55	8.36
11067003	1.054	152.8	5.81	2.50	0.703	0.518	61.1	1.936	0.349	7.56	36.5	5.3	35.9	5.2	2.42	7.93
29057006	1.061	153.9	24.47	10.52	1.230	0.907	117.0	3.708	0.239	14.48	36.5	5.3	36.5	5.3	1.48	4.86
29057005	1.061	153.9	24.75	10.64	1.230	0.907	116.9	3.706	0.237	14.47	36.5	5.3	36.5	5.3	1.47	4.81
1067001	1.061	153.9	4.98	2.14	1.250	0.922	74.4	2.357	0.235	9.20	36.5	5.3	36.5	5.3	2.33	7.65
1067002	1.058	153.4	4.84	2.08	1.250	0.922	76.0	2.410	0.242	9.41	36.5	5.3	36.5	5.3	2.35	7.72
29057008	1.058	153.4	14.28	6.14	1.260	0.929	94.2	2.985	0.229	11.65	36.5	5.3	36.5	5.3	1.81	5.93
29057007	1.061	153.9	14.03	6.03	1.261	0.930	94.2	2.987	0.231	11.66	36.5	5.3	36.5	5.3	1.82	5.98
29057002	1.058	153.4	23.84	10.25	2.839	2.093	160.5	5.088	0.074	19.86	37.2	5.4	37.9	5.5	0.68	2.22
29057001	1.058	153.4	23.84	10.25	2.839	2.093	158.7	5.032	0.071	19.64	37.2	5.4	37.9	5.5	0.65	2.14
29057003	1.058	153.4	5.44	2.34	2.855	2.105	98.2	3.112	0.122	12.15	37.2	5.4	39.3	5.7	1.97	6.45
27057007	1.054	152.8	14.12	6.07	2.855	2.105	128.5	4.072	0.100	15.90	37.2	5.4	38.6	5.6	1.20	3.95
27057008	1.054	152.8	14.12	6.07	2.855	2.105	128.5	4.074	0.100	15.90	37.2	5.4	38.6	5.6	1.20	3.95
29057004	1.061	153.9	4.37	1.88	2.866	2.113	99.5	3.155	0.132	12.32	37.2	5.4	39.3	5.7	2.12	6.97

Run Number	Inlet Pressure		Inlet Subcooling		Mass Velocity		Burnout Flux		Exit Quality	Power kW	Test Section Pressure Drop				Boiling Length	
											Zero Power		Burnout			
	MPa	psia	$kJ\ kg^{-1}$	$Btu\ lb^{-1}$	$Mg\ m^{-2}\ s^{-1}$	$lb\ ft^{-2}\ hr^{-1} \times 10^{-6}$	$kW\ m^{-2}$	$Btu\ hr^{-1} ft^{-2} \times 10^{-4}$			kPa	psi	kPa	psi	m	ft
2067005	1.061	153.9	19.54	8.40	3.991	2.943	167.5	5.309	0.044	20.73	38.6	5.6	40.0	5.8	0.46	1.50
2067002	1.058	153.4	4.84	2.08	4.002	2.951	114.2	3.620	0.102	14.13	38.6	5.6	42.7	6.2	1.91	6.27
2067003	1.065	154.4	5.14	2.21	4.002	2.951	115.9	3.674	0.102	14.34	38.6	5.6	40.0	6.2	1.87	6.15
1067003	1.058	153.4	23.17	9.96	4.024	2.967	178.2	5.650	0.026	22.06	38.6	5.6	39.3	5.7	0.18	0.58
1067004	1.058	153.4	23.84	10.25	4.065	2.997	177.5	5.627	0.018	21.97	38.6	5.6	39.3	5.7	0.07	0.22
1067005	1.058	153.4	14.28	6.14	4.104	3.026	152.2	4.826	0.065	18.84	38.6	5.6	40.7	5.9	0.86	2.81
1067006	1.065	154.4	14.58	6.27	4.104	3.026	150.5	4.772	0.061	18.63	38.6	5.6	40.7	5.9	0.79	2.60
2067004	1.061	153.9	9.96	4.28	4.107	3.028	133.4	4.229	0.079	16.51	38.6	5.6	41.4	6.0	1.24	4.07
2067007	1.058	153.4	23.84	10.25	4.115	3.034	177.7	5.632	0.016	21.98	38.6	5.6	39.3	5.7	0.04	0.12
2067001	1.061	153.9	4.98	2.14	4.233	3.121	112.8	3.575	0.093	13.96	38.6	5.6	40.0	6.2	1.83	5.99
2067006	1.054	152.8	23.68	10.18	4.250	3.134	180.7	5.729	0.014	22.36	38.6	5.6	39.3	5.7	0.01	0.03
11067005	1.350	195.8	24.26	10.43	0.698	0.515	77.0	2.440	0.326	9.52	36.5	5.3	35.9	5.2	1.66	5.46
11067004	1.347	195.3	24.03	10.33	0.698	0.515	76.0	2.408	0.321	9.40	36.5	5.3	35.9	5.2	1.66	5.44
11067006	1.347	195.3	24.21	10.41	0.700	0.516	76.0	2.409	0.319	9.41	36.5	5.3	35.9	5.2	1.65	5.41
12067001	1.350	195.8	13.82	5.94	0.700	0.516	65.0	2.060	0.332	8.04	35.9	5.2	35.9	5.2	2.01	6.60
12067002	1.350	195.8	14.03	6.03	0.70	0.516	64.0	2.028	0.324	7.92	35.9	5.2	35.9	5.2	1.99	6.53
11067009	1.350	195.8	5.12	2.20	0.703	0.518	55.7	1.767	0.342	6.90	35.9	5.2	35.9	5.2	2.43	7.96
11067010	1.350	195.8	4.65	2.00	0.703	0.518	55.5	1.759	0.345	6.87	35.9	5.2	35.9	5.2	2.46	8.07
4067012	1.347	195.3	5.30	2.28	1.273	0.939	64.7	2.052	0.206	8.01	36.5	5.3	36.5	5.3	2.23	7.32
4067011	1.347	195.3	4.98	2.14	1.273	0.939	64.7	2.052	0.209	8.01	36.5	5.3	36.5	5.3	2.26	7.42
4067007	1.347	195.3	23.38	10.05	1.290	0.951	111.6	2.539	0.222	13.82	36.5	5.3	36.5	5.3	1.42	4.65
4067008	1.350	195.8	23.75	10.21	1.291	0.952	110.3	3.496	0.214	13.65	36.5	5.3	36.5	5.3	1.38	4.53
4067009	1.347	195.3	14.00	6.02	1.298	0.957	88.5	2.805	0.214	10.95	36.5	5.3	36.5	5.3	1.73	5.69
4067010	1.347	195.3	13.79	5.93	1.299	0.958	86.6	2.744	0.209	10.71	36.5	5.3	36.5	5.3	1.73	5.67
4067006	1.350	195.8	5.65	2.43	2.756	2.032	92.9	2.944	0.123	11.49	37.2	5.4	38.6	5.6	1.92	6.3
4067005	1.347	195.3	5.09	2.19	2.756	2.032	91.7	2.907	0.126	11.35	37.2	5.4	38.6	5.6	1.98	6.5
9067002	1.347	195.3	15.96	6.86	2.768	2.041	128.4	4.070	0.096	15.89	37.2	5.4	37.9	5.5	1.07	3.5
9067001	1.350	195.8	16.07	6.91	2.768	2.041	128.5	4.073	0.095	15.90	37.2	5.4	37.9	5.5	1.04	3.4
4067001	1.350	195.8	23.35	10.04	2.784	2.053	150.5	4.771	0.070	18.63	37.2	5.4	37.9	5.5	0.61	2.0
4067002	1.347	195.3	23.42	10.07	2.792	2.059	150.4	4.768	0.068	18.61	37.2	5.4	37.9	5.5	0.61	2.0

Run Number	Inlet Pressure		Inlet Subcooling		Mass Velocity		Burnout Flux		Exit Quality	Power kW	Test Section Pressure Drop				Boiling Length	
											Zero Power		Burnout			
	MPa	psia	kJ kg^{-1}	Btu lb^{-1}	Mg m^{-2} s^{-1}	lb ft^{-2} hr^{-1} x 10^{-6}	kW m^{-2}	Btu $hr^{-1}ft^{-2}$ x 10^{-4}			kPa	psi	kPa	psi	m	ft
3067002	1.343	194.8	24.00	10.32	3.975	2.931	168.6	5.343	0.010	20.86	38.6	5.6	38.6	5.6	–	–
3067003	1.347	195.3	14.30	6.15	4.010	2.957	140.5	4.453	0.057	17.38	38.6	5.6	38.6	5.8	0.73	2.4
3067006	1.353	196.3	5.68	2.44	4.014	2.960	111.1	3.523	0.096	13.75	38.6	5.6	41.4	6.0	1.74	5.7
3067001	1.347	195.3	24.03	10.33	4.104	3.026	171.9	5.448	0.007	21.27	38.6	5.6	38.6	5.6	–	–
3067004	1.350	195.8	14.24	6.12	4.130	3.045	140.3	4.446	0.053	17.35	38.6	5.6	40.0	5.8	0.70	2.3
3067005	1.347	195.3	5.63	2.42	4.242	3.128	112.3	3.561	0.090	13.90	38.6	5.6	41.4	6.0	1.71	5.6
12067008	1.642	238.2	13.23	5.69	0.704	0.519	57.2	1.813	0.300	7.08	35.9	5.2	35.9	5.2	1.95	6.4
12067007	1.646	238.7	13.44	5.78	0.704	0.519	58.9	1.867	0.310	7.29	35.9	5.2	35.9	5.2	1.95	6.4
12067010	1.639	237.7	4.65	2.00	0.704	0.519	46.6	1.476	0.301	5.76	35.9	5.2	35.9	5.2	2.41	7.9
12067009	1.639	237.7	4.65	2.00	0.704	0.519	46.6	1.477	0.301	5.76	35.9	5.2	35.9	5.2	2.41	7.9
12067006	1.646	238.7	23.03	9.90	0.712	0.525	71.7	2.273	0.309	8.87	35.9	5.2	35.9	5.2	1.62	5.3
12067005	1.642	238.2	23.24	9.99	0.712	0.525	72.0	2.281	0.309	8.90	35.9	5.2	35.9	5.2	1.62	5.3
4067016	1.639	237.7	13.96	6.00	1.275	0.940	77.4	2.455	0.190	9.58	36.5	5.3	36.5	5.3	1.62	5.3
4067015	1.635	237.2	13.86	5.96	1.275	0.940	77.2	2.448	0.190	9.56	36.5	5.3	36.5	5.3	1.62	5.3
4067013	1.639	237.7	23.66	10.17	1.282	0.945	99.3	3.147	0.187	12.29	36.5	5.3	36.5	5.3	1.25	4.1
4067018	1.639	237.7	6.72	2.89	1.290	0.951	61.9	1.961	0.191	7.65	36.5	5.3	36.5	5.3	2.04	6.7
4067014	1.639	237.7	23.66	10.17	1.290	0.951	98.3	3.117	0.181	12.17	36.5	5.3	36.5	5.3	1.22	4.0
4067017	1.639	237.7	5.63	2.42	1.290	0.951	60.2	1.908	0.194	7.45	36.5	5.3	36.5	5.3	2.16	7.1
19067002	1.646	238.7	14.51	6.24	2.749	2.027	118.9	3.769	0.098	14.71	37.2	5.4	37.9	5.5	1.10	3.6
19067001	1.639	237.7	13.56	5.83	2.750	2.028	119.7	3.794	0.108	14.81	37.2	5.4	37.9	5.5	1.22	4.0
18067004	1.635	237.2	4.42	1.90	2.763	2.037	89.7	2.844	0.134	11.10	37.2	5.4	38.6	5.6	2.07	6.8
18067003	1.635	237.2	4.30	1.85	2.763	2.037	91.0	2.884	0.137	11.26	37.2	5.4	38.6	5.6	2.10	6.9
22067008	1.635	237.2	17.05	7.33	2.765	2.039	129.1	4.091	0.092	15.97	37.2	5.4	37.9	5.5	0.94	3.1
22067007	1.635	237.2	17.49	7.52	2.770	2.042	127.9	4.053	0.085	15.82	37.2	5.4	37.9	5.5	0.88	2.9
22067002	1.639	237.7	18.54	7.97	2.873	2.052	131.5	4.168	0.081	16.27	37.2	5.4	37.9	5.5	0.82	2.7
19067004	1.639	237.7	25.70	11.05	2.784	2.053	149.8	4.750	0.050	18.54	37.2	5.4	37.9	5.5	0.40	1.3
19067003	1.639	237.7	25.19	10.83	2.784	2.053	150.0	4.755	0.055	18.56	37.2	5.4	37.9	5.5	0.46	1.5
22067001	1.639	237.7	18.54	7.97	2.790	2.057	132.1	4.188	0.082	16.35	37.2	5.4	37.9	5.5	0.82	2.7
22067005	1.639	237.7	13.03	5.60	2.791	2.058	116.6	3.697	0.104	14.43	37.2	5.4	37.9	5.5	1.22	4.0
22067006	1.635	237.2	12.05	5.18	2.791	2.058	113.4	3.594	0.107	14.03	37.2	5.4	37.9	5.5	1.28	4.2

Run Number	Inlet Pressure		Inlet Subcooling		Mass Velocity		Burnout Flux		Exit Quality	Power kW	Test Section Pressure Drop				Boiling Length	
											Zero Power		Burnout			
	MPa	psia	kJ kg^{-1}	Btu lb^{-1}	Mg m^{-2} s^{-1}	lb ft^{-2} hr^{-1} x 10^{-6}	kW m^{-2}	Btu $hr^{-1}ft^{-2}$ x 10^{-4}			kPa	psi	kPa	psi	m	ft
22067004	1.639	237.7	8.91	3.83	2.792	2.059	105.0	3.330	0.120	13.00	37.2	5.4	37.9	5.5	1.58	5.2
22067003	1.639	237.7	9.02	3.88	2.792	2.059	105.0	3.330	0.119	13.00	37.2	5.4	37.9	5.5	1.55	5.1
5067004	1.642	238.2	16.33	7.02	2.796	2.062	125.6	3.980	0.090	15.54	37.2	5.4	37.9	5.5	0.98	3.2
5067003	1.639	237.7	16.21	6.97	2.798	2.063	123.7	3.921	0.087	15.31	37.2	5.4	37.9	5.5	0.94	3.1
5067002	1.642	238.2	25.61	11.01	2.798	2.063	148.3	4.700	0.047	18.35	37.2	5.4	37.2	5.4	0.37	1.2
5067001	1.642	238.2	24.80	10.66	2.799	2.064	146.2	4.633	0.050	18.09	37.2	5.4	37.2	5.4	0.43	1.4
5067005	1.642	238.2	6.16	2.65	2.799	2.064	96.2	3.050	0.128	11.91	37.2	5.4	37.9	5.5	1.86	6.1
18067002	1.639	237.7	23.33	10.03	4.086	3.013	163.3	5.178	0.002	20.21	38.6	5.6	38.6	5.6	–	–
18067001	1.639	237.7	22.61	9.72	4.092	3.017	161.5	5.118	0.006	19.98	38.6	5.6	38.6	5.6	–	–
9067004	1.646	238.7	15.14	6.51	4.094	3.019	138.5	4.389	0.045	17.13	38.6	5.6	39.3	5.7	0.55	1.8
9067005	1.646	238.7	5.19	2.23	4.094	3.019	108.0	3.424	0.097	13.36	38.6	5.6	40.7	5.9	1.77	5.8
9067006	1.639	237.7	6.07	2.61	4.098	3.022	110.3	3.495	0.092	13.64	38.6	5.6	40.7	5.9	1.65	5.4
9067003	1.646	238.7	15.37	6.61	4.100	3.023	139.2	4.414	0.044	17.23	38.6	5.6	39.3	5.7	0.52	1.7
5067008	1.639	237.7	24.68	10.61	4.121	3.039	166.8	5.287	–	20.64	38.6	5.6	38.6	5.6	–	–

TABLE 3

BURNOUT DATA FOR ANNULUS 2F

Test section	code number type mode of heating	2 F annulus inner
Inner rod	outer diameter mm (in) wall thickness mm (in) material	15.88 (0.625) 1.22 (0.048) stainless steel
Shroud	bore mm (in) wall thickness mm (in) material	22.73 (0.895) 2.11 (0.083) stainless steel
Heater resistance (at 20 C) ohm		0.0245
Axial heat flux profile		Uniform

Spacer	type material outer diameter mm (in) length mm (in) total number pitch mm (in) distance from heater end mm (in) configuration	cylindrical Tufnol 3.35 (0.132) 12.7 (0.5) 36 (12 x 3) 152.4 (6.0) 76.2 (3.0) and longitudinally in line
Burnout detector	Thermopile	
Heater Length mm (in)	1829 (72)	
Distance between pressure taps mm (in)	1905 (75)	

Run number	Inlet Pressure		Inlet Subcooling		Mass Velocity		Burnout Flux		Exit Quality	Power kW	Test Section Pressure Drop				Boiling Length	
											Zero Power		With Power			
	MPa	psia	kJ kg^{-1}	Btu lb^{-1}	kg $s^{-1}m^{-2}$ x10^{-3}	lb $h^{-1}ft^{-2}$ x10^{-6}	kW m^{-2}	Btu $h^{-1}ft^{-2}$ x10^{-4}			kPa	psi	kPa	psi	m	ft
31077006	0.876	127.09	1.98	0.85	0.689	0.508	97.00	3.075	0.464	8.85	26.48	3.84	32.54	4.72	1.771	5.81
31077005	0.880	127.59	2.28	0.98	0.685	0.505	96.69	3.065	0.463	8.82	26.48	3.84	32.27	4.68	1.762	5.78
31077004	0.869	126.08	10.14	4.36	0.684	0.504	107.00	3.392	0.453	9.76	27.10	3.93	31.16	4.52	1.558	5.11
31077003	0.869	126.08	10.14	4.36	0.692	0.510	106.37	3.372	0.444	9.70	27.10	3.93	31.51	4.57	1.554	5.10
31077002	0.880	127.59	21.96	9.44	0.690	0.509	123.85	3.926	0.441	11.30	27.85	4.04	30.89	4.48	1.320	4.33
31077001	0.880	127.59	22.19	9.54	0.690	0.509	122.52	3.884	0.432	11.18	27.85	4.04	30.89	4.48	1.308	4.29
3087006	0.866	125.57	4.19	1.80	1.390	1.025	134.64	4.268	0.310	12.28	32.68	4.74	65.57	9.51	1.649	5.41
3087005	0.873	126.58	5.23	2.25	1.390	1.025	136.85	4.338	0.307	12.48	32.68	4.74	63.78	9.25	1.606	5.27
3087004	0.873	126.58	13.26	5.70	1.390	1.025	153.94	4.880	0.286	14.04	33.03	4.79	58.88	8.54	1.329	4.36
3087003	0.873	126.58	13.82	5.94	1.390	1.025	153.12	4.854	0.279	13.97	33.03	4.79	56.12	8.14	1.305	4.28
3087002	0.869	126.08	22.45	9.65	1.387	1.023	177.76	5.635	0.273	16.21	34.68	5.03	54.47	7.90	1.097	3.60
3087001	0.869	126.08	22.47	9.66	1.387	1.023	175.68	5.569	0.268	16.02	34.68	5.03	54.47	7.90	1.088	3.57
10087002	0.869	126.08	6.51	2.80	2.735	2.017	176.88	5.607	0.213	16.13	49.44	7.17	144.38	20.94	1.408	4.62
10087001	0.880	127.59	7.00	3.01	2.734	2.016	178.46	5.657	0.210	16.28	49.44	7.17	139.48	20.23	1.381	4.53
3087010	0.873	126.58	7.77	3.34	2.748	2.026	179.72	5.697	0.204	16.39	50.06	7.26	138.86	20.14	1.332	4.37
4087001	0.869	126.08	7.84	3.37	2.749	2.027	179.43	5.688	0.204	16.37	50.06	7.26	141.62	20.54	1.329	4.36
5087003	0.866	125.57	14.51	6.24	2.752	2.029	199.65	6.329	0.168	18.21	50.54	7.33	109.97	15.95	0.994	3.26
5087004	0.869	126.08	14.58	6.27	2.752	2.029	198.45	6.291	0.166	18.10	50.54	7.33	111.83	16.22	0.985	3.23
3087007	0.852	123.55	20.77	8.93	2.745	2.024	213.69	6.774	0.133	19.49	51.57	7.48	93.22	13.52	0.716	2.35
10087003	0.869	126.08	21.68	9.32	2.735	2.017	224.61	7.120	0.138	20.49	49.92	7.24	87.77	12.73	0.728	2.39
10087004	0.869	126.08	21.77	9.36	2.735	2.017	222.56	7.055	0.136	20.30	49.92	7.24	88.67	12.86	0.713	2.34

Run Number	Inlet Pressure		Inlet Subcooling		Mass Velocity		Burnout Flux		Exit Quality	Power kW	Test Section Pressure Drop				Boiling Length	
											Zero Power		With Power			
	MPa	psia	kJ kg^{-1}	Btu lb^{-1}	kg s^{-1} m^{-2} x 10^{-3}	lb h^{-1} ft^{-2} x 10^{-6}	kW m^{-2}	Btu $h^{-1}ft^{-2}$ x 10^{-4}			kPa	psi	kPa	psi	m	ft
3087008	0.869	126.08	21.82	9.38	2.745	2.024	218.33	6.921	0.129	19.91	51.57	7.48	89.63	13.00	0.686	2.25
3087009	0.873	126.58	22.05	9.48	2.745	2.024	222.24	7.045	0.132	20.27	51.57	7.48	88.39	12.82	0.692	2.27
4087006	0.887	128.60	9.70	4.17	4.154	3.063	207.86	6.589	0.309	18.96	84.39	12.24	-	-	1.021	3.35
4087005	0.897	130.12	10.07	4.33	4.154	3.063	209.18	6.631	0.309	19.08	84.39	12.24	-	-	0.994	3.26
5087002	0.887	128.60	15.58	6.70	4.159	3.067	231.99	7.354	0.309	21.16	85.01	12.33	-	-	0.661	2.17
5087001	0.887	128.60	15.70	6.75	4.161	3.068	232.37	7.366	0.126	21.20	85.01	12.33	171.29	24.82	0.655	2.15
10087006	0.869	126.08	21.79	9.37	4.140	3.053	255.4	8.096	0.089	23.30	83.50	12.11	139.83	20.28	0.354	1.16
10087007	0.869	126.08	21.91	9.42	4.140	3.053	257.64	8.167	0.091	23.50	83.50	12.11	142.24	20.63	0.360	1.18
10087005	0.883	128.10	22.31	9.59	4.146	3.057	260.82	8.268	0.086	23.79	83.50	12.11	129.76	18.82	0.351	1.15
4087003	0.866	125.57	22.75	9.78	4.146	3.057	264.8	8.394	0.088	24.15	81.36	11.80	135.55	19.66	0.344	1.13
4087004	0.869	126.08	22.91	9.85	4.145	3.056	258.3	8.188	0.080	23.56	81.36	11.80	133.07	19.30	0.296	0.97
11087002	1.040	150.82	21.12	9.08	0.690	0.509	115.40	3.658	0.419	10.53	27.37	3.97	28.13	4.08	1.301	4.27
11087001	1.040	150.82	21.12	9.08	0.690	0.509	115.17	3.651	0.418	10.50	27.37	3.97	28.13	4.08	1.301	4.27
11087003	1.040	150.82	15.61	6.71	0.692	0.510	108.23	3.431	0.426	9.87	26.96	3.91	28.48	4.13	1.414	4.64
11087004	1.040	150.82	15.61	6.71	0.693	0.511	108.77	3.448	0.428	9.92	26.96	3.91	28.48	4.13	1.414	4.64
11087005	1.043	151.33	8.28	3.56	0.693	0.511	100.28	3.179	0.443	9.15	26.48	3.84	28.61	4.15	1.591	5.22
11087006	1.043	151.33	8.75	3.76	0.694	0.512	99.496	3.154	0.435	9.08	26.48	3.84	28.75	4.17	1.573	5.16
5087006	1.043	151.33	22.56	9.70	1.397	1.03	164.32	5.209	0.243	14.99	32.68	4.74	46.40	6.73	1.030	3.38
5087007	1.043	151.33	9.70	4.17	1.397	1.03	140.41	4.451	0.287	12.81	32.41	4.70	53.71	7.79	1.426	4.68
5087005	1.040	150.82	22.61	9.72	1.397	1.03	167.79	5.319	0.252	15.31	32.68	4.74	47.30	6.86	1.045	3.43
6087001	1.043	151.33	4.21	1.81	1.397	1.03	129.02	4.090	0.303	11.77	31.65	4.59	56.12	8.14	1.640	5.38
6087002	1.043	151.33	4.21	1.81	1.397	1.03	128.14	4.062	0.301	11.69	31.65	4.59	56.12	8.14	1.637	5.37
5087008	1.040	150.82	9.77	4.20	1.397	1.03	141.36	4.481	0.289	12.89	32.41	4.70	54.33	7.88	1.426	4.68
17087002	1.043	151.33	20.96	9.01	2.753	2.03	207.67	6.583	0.122	18.94	48.54	7.04	79.84	11.58	0.671	2.20
17087003	1.047	151.83	13.61	5.85	2.756	2.032	192.08	6.089	0.165	17.52	48.54	7.04	97.49	14.14	1.015	3.33
17087001	1.047	151.83	21.10	9.07	2.756	2.032	206.88	6.558	0.119	18.87	48.54	7.04	78.05	11.32	0.658	2.16
17087004	1.043	151.33	13.40	5.76	2.756	2.032	185.05	5.866	0.160	16.88	48.54	7.04	104.18	15.11	0.997	3.27
6087004	1.043	151.33	23.03	9.90	2.757	2.033	213.19	6.758	0.112	19.45	49.92	7.24	79.57	11.54	0.588	1.93
6087003	1.040	150.82	22.42	9.64	2.757	2.033	214.07	6.786	0.117	19.52	49.92	7.24	78.32	11.36	0.625	2.05
6087005	1.043	151.33	8.75	3.76	2.761	2.036	173.41	5.497	0.185	15.82	49.16	7.13	115.14	16.70	1.247	4.09
6087006	1.047	151.83	9.03	3.88	2.761	2.036	175.30	5.557	0.185	15.99	49.16	7.13	113.97	16.53	1.237	4.06

Run Number	Inlet Pressure		Inlet Subcooling		Mass Velocity		Burnout Flux		Exit Quality	Power kW	Test Section Pressure Drop				Boiling Length	
											Zero Power		With Power			
	MPa	psia	$kJ\ kg^{-1}$	$Btu\ lb^{-1}$	$kg\ s^{-1}\ m^{-2} \times 10^{-3}$	$lb\ h^{-1}\ ft^{-2} \times 10^{-6}$	$kW\ m^{-2}$	$Btu\ h^{-1} ft^{-2} \times 10^{-4}$			kPa	psi	kPa	psi	m	ft
6087008	1.043	151.33	3.95	1.70	2.761	2.036	166.44	5.276	0.219	15.18	50.06	7.26	136.17	19.75	1.554	5.10
6087007	1.043	151.33	3.95	1.70	2.763	2.037	166.59	5.281	0.218	15.20	50.06	7.26	132.52	19.22	1.554	5.10
18087002	1.043	151.33	13.21	5.68	4.143	3.055	213.00	6.752	0.137	19.43	77.15	11.19	192.43	27.91	0.756	2.48
27107003	1.043	151.33	9.21	3.96	4.143	3.055	209.37	6.637	0.172	19.10	74.39	10.79	215.53	31.26	1.067	3.50
27107005	1.043	151.33	7.54	3.24	4.143	3.055	198.93	6.306	0.185	18.14	74.39	10.79	242.90	35.23	1.173	3.85
7087002	1.043	151.33	22.79	9.80	4.150	3.060	255.30	8.093	0.075	23.29	80.81	11.72	123.07	17.85	0.283	0.93
7087001	1.043	151.33	22.79	9.80	4.150	3.060	255.11	8.087	0.075	23.27	80.81	11.72	124.86	18.11	0.280	0.92
18087001	1.043	151.33	13.21	5.68	4.161	3.068	216.00	6.847	0.139	19.70	77.15	11.19	192.43	27.91	0.768	2.52
17087006	1.040	150.82	20.52	8.82	4.166	3.072	242.94	7.701	0.085	22.16	78.05	11.32	132.79	19.26	0.363	1.19
17087007	1.040	150.82	20.17	8.67	4.166	3.072	239.56	7.594	0.084	21.85	78.05	11.32	130.38	18.91	0.366	1.20
11087013	1.338	194.05	7.28	3.13	0.688	0.507	86.22	2.733	0.410	7.86	25.10	3.64	25.72	3.73	1.588	5.21
11087011	1.338	194.05	10.28	4.42	0.686	0.506	88.71	2.812	0.399	8.09	25.72	3.73	25.72	3.73	1.497	4.91
11087012	1.338	194.05	10.77	4.63	0.688	0.507	88.93	2.819	0.395	8.11	25.72	3.73	25.72	3.73	1.481	4.86
11087010	1.339	194.25	13.51	5.81	0.696	0.513	93.28	2.957	0.389	8.51	25.72	3.73	24.48	3.55	1.408	4.62
11087009	1.339	194.25	13.77	5.92	0.697	0.514	94.70	3.002	0.394	8.64	25.72	3.73	24.48	3.55	1.408	4.62
11087008	1.339	194.25	27.98	12.03	0.696	0.513	112.5	3.567	0.370	10.26	26.96	3.91	25.10	3.64	1.106	3.63
11087007	1.339	194.25	27.98	12.03	0.696	0.513	113.0	3.582	0.372	10.31	26.96	3.91	25.10	3.64	1.109	3.64
12087003	1.336	193.75	6.98	3.00	1.387	1.023	116.1	3.681	0.262	10.59	30.41	4.41	41.85	6.07	1.481	4.86
12087004	1.332	193.24	7.35	3.16	1.387	1.023	117.5	3.725	0.263	10.72	30.41	4.41	42.47	6.16	1.466	4.81
12087009	1.332	193.24	16.40	7.05	1.387	1.023	135.2	4.287	0.233	12.33	30.89	4.48	39.09	5.67	1.128	3.70
12087002	1.339	194.25	18.10	7.78	1.387	1.023	135.7	4.301	0.221	12.38	31.37	4.55	39.71	5.76	1.058	3.47
12087008	1.329	192.74	19.63	8.44	1.387	1.023	142.4	4.513	0.225	12.98	31.51	4.57	39.58	5.74	1.030	3.38
12087007	1.332	193.24	19.75	8.49	1.387	1.023	140.9	4.466	0.220	12.85	31.51	4.57	39.44	5.72	1.018	3.34
12087005	1.329	192.74	24.98	10.74	1.389	1.024	152.4	4.832	0.206	13.90	31.92	4.63	38.96	5.65	0.881	2.89
12087001	1.339	194.25	25.19	10.83	1.387	1.023	152.5	4.835	0.205	13.91	32.13	4.66	38.47	5.58	0.875	2.87
12087006	1.339	194.25	25.42	10.93	1.389	1.024	153.2	4.855	0.205	13.97	31.92	4.63	38.82	5.63	0.869	2.85
13087002	1.336	193.75	7.23	3.11	2.753	2.030	160.2	5.078	0.181	14.61	47.92	6.95	94.46	13.70	1.311	4.30
13087001	1.338	194.05	7.56	3.25	2.753	2.030	159.6	5.060	0.177	14.56	47.92	6.95	91.43	13.26	1.286	4.22
12087013	1.338	194.05	9.54	4.10	2.752	2.029	166.3	5.273	0.169	15.17	47.92	6.95	89.29	12.95	1.170	3.84
12087014	1.338	194.05	10.03	4.31	2.752	2.029	165.6	5.249	0.164	15.10	47.92	6.95	89.01	12.91	1.134	3.72
18087005	1.329	192.74	20.77	8.93	2.745	2.024	192.3	6.097	0.106	17.54	48.40	7.02	73.64	10.68	0.594	1.95

Run Number	Inlet Pressure		Inlet Subcooling		Mass Velocity		Burnout Flux		Exit Quality	Power kW	Test Section Pressure Drop				Boiling Length	
											Zero Power		With Power			
	MPa	psia	kJ kg^{-1}	Btu lb^{-1}	kg s^{-1} m^{-2} x 10^{-3}	lb h^{-1} ft^{-2} x 10^{-6}	kW m^{-2}	Btu $h^{-1}ft^{-2}$ x 10^{-4}			kPa	psi	kPa	psi	m	ft
18087006	1.329	192.74	20.82	8.95	2.745	2.024	192.9	6.115	0.106	17.60	48.40	7.02	72.74	10.55	0.594	1.95
12087012	1.336	193.75	24.12	10.37	2.754	2.031	210.1	6.660	0.100	19.16	48.19	6.99	68.95	10.00	0.509	1.67
12087011	1.336	193.75	24.35	10.47	2.754	2.031	203.8	6.459	0.088	18.59	48.19	6.99	66.47	9.64	0.454	1.49
12087010	1.338	194.05	24.91	10.71	2.754	2.031	209.9	6.654	0.092	19.15	48.19	6.99	65.57	9.51	0.466	1.53
13087009	1.339	194.25	10.07	4.33	4.014	2.960	195.6	6.202	0.142	17.85	81.36	11.80	157.8	22.88	0.966	3.17
13087008	1.332	193.24	10.07	4.33	4.147	3.058	194.8	6.176	0.136	17.77	81.36	11.80	157.8	22.88	0.936	3.07
13087007	1.332	193.24	10.07	4.33	4.158	3.066	194.3	6.158	0.136	17.72	81.36	11.80	158.6	23.01	0.930	3.05
13087005	1.332	193.24	15.63	6.72	4.157	3.065	203.9	6.463	0.090	18.60	81.84	11.87	130.7	18.95	0.500	1.64
18087003	1.336	193.75	21.07	9.06	4.150	3.060	232.5	7.369	0.065	21.20	78.05	11.32	114.0	16.53	0.259	0.85
13087010	1.338	194.05	21.14	9.09	4.151	3.061	238.3	7.555	0.070	21.74	81.36	11.80	114.5	16.61	0.293	0.96
18087004	1.339	194.25	21.19	9.11	4.151	3.061	234.2	7.423	0.065	21.36	78.05	11.32	113.0	16.39	0.262	0.86
13087011	1.339	194.25	21.68	9.32	4.155	3.064	241.3	7.648	0.067	22.01	81.36	11.80	111.5	16.17	0.271	0.89
13087003	1.332	193.24	25.14	10.81	4.161	3.068	259.9	8.240	0.051	23.71	79.84	11.58	102.7	14.89	0.149	0.49
13087004	1.336	193.75	25.28	10.87	4.161	3.068	258.9	8.207	0.049	23.61	79.84	11.58	102.7	14.89	0.134	0.44
16087006	1.600	232.13	15.12	6.50	0.700	0.516	80.04	2.791	0.365	8.03	25.72	3.73	21.58	3.13	1.329	4.36
16087005	1.600	232.13	15.12	6.50	0.704	0.519	87.32	2.768	0.358	7.96	25.72	3.73	21.79	3.16	1.320	4.33
16087004	1.600	232.13	24.42	10.50	0.698	0.515	99.02	3.139	0.344	9.03	26.34	3.82	22.34	3.24	1.109	3.64
16087003	1.600	232.13	24.45	10.51	0.698	0.515	99.75	3.162	0.347	9.10	26.34	3.82	22.06	3.20	1.116	3.66
16087001	1.604	232.63	34.31	14.75	0.698	0.515	113.9	3.611	0.340	10.39	26.96	3.91	22.82	3.31	0.951	3.12
16087002	1.600	232.13	34.36	14.77	0.698	0.515	114.5	3.631	0.343	10.45	26.96	3.91	23.17	3.36	0.957	3.14
14087005	1.600	232.13	13.49	5.80	1.401	1.033	122.5	3.883	0.232	11.17	30.61	4.44	37.09	5.38	1.186	3.89
14087006	1.600	232.13	13.61	5.85	1.401	1.033	122.3	3.876	0.230	11.15	30.61	4.44	37.09	5.38	1.180	3.87
14087003	1.604	232.63	23.10	9.93	1.400	1.032	138.6	4.393	0.191	12.64	31.16	4.52	35.58	5.16	0.856	2.81
14087004	1.604	232.63	23.26	10.00	1.400	1.032	141.6	4.490	0.199	12.92	31.16	4.52	35.78	5.19	0.872	2.86
14087002	1.600	232.13	33.33	14.33	1.398	1.031	164.3	5.208	0.172	14.98	31.51	4.57	34.82	5.05	0.646	2.12
14087001	1.600	232.13	33.38	14.35	1.400	1.032	162.6	5.155	0.167	14.83	31.51	4.57	35.16	5.10	0.631	2.07
14087012	1.600	232.13	8.79	3.78	2.749	2.027	157.7	4.998	0.167	14.38	47.92	6.95	78.67	11.41	1.189	3.90
14087011	1.600	232.13	9.56	4.11	2.749	2.027	158.7	5.030	0.161	14.47	47.92	6.95	76.81	11.14	1.137	3.73
18087008	1.600	232.13	11.10	4.77	2.753	2.030	165.2	5.237	0.156	15.07	47.92	6.95	76.19	11.05	1.058	3.47
18087007	1.600	232.13	11.61	4.99	2.756	2.032	163.0	5.168	0.148	14.87	47.92	6.95	75.64	10.97	1.012	3.32
14087010	1.600	232.13	23.26	10.00	2.748	2.026	206.1	6.533	0.103	18.80	48.54	7.04	63.43	9.20	0.536	1.76

Run Number	Inlet Pressure		Inlet Subcooling		Mass Velocity		Burnout Flux		Exit Quality	Power kW	Test Section Pressure Drop				Boiling Length	
											Zero Power		With Power			
	MPa	psia	$kJ\ kg^{-1}$	$Btu\ lb^{-1}$	$kg\ s^{-1}\ m^{-2} \times 10^{-3}$	$lb\ h^{-1}\ ft^{-2} \times 10^{-6}$	$kW\ m^{-2}$	$Btu\ h^{-1} ft^{-2} \times 10^{-4}$			kPa	psi	kPa	psi	m	ft
14087009	1.597	231.62	23.40	10.06	2.752	2.029	201.0	6.372	0.095	18.33	48.54	7.04	62.81	9.11	0.494	1.62
15087001	1.600	232.13	33.52	14.41	2.754	2.031	241.6	7.660	0.061	22.04	48.82	7.08	58.61	8.50	0.238	0.78
15087002	1.600	232.13	33.63	14.46	2.756	2.032	241.6	7.658	0.059	22.03	48.82	7.08	58.61	8.50	0.229	0.75
15087007	1.597	231.62	9.93	4.27	4.147	3.058	184.9	5.861	0.122	16.87	78.32	11.36	131.6	19.08	0.899	2.95
15087008	1.600	232.13	10.84	4.66	4.147	3.058	189.9	6.021	0.118	17.33	78.32	11.36	129.1	18.73	0.841	2.76
15087006	1.600	232.13	23.63	10.16	4.154	3.063	247.0	7.830	0.050	22.53	77.57	11.25	99.01	14.36	0.171	0.56
15087005	1.600	232.13	23.63	10.16	4.157	3.065	246.3	7.807	0.049	22.46	77.57	11.25	99.01	14.36	0.165	0.54
15087003	1.600	232.13	33.75	14.51	4.165	3.071	300.3	9.520	0.006	27.39	77.91	11.30	86.53	12.55	-0.122	-0.40
15087004	1.604	232.63	34.05	14.64	4.166	3.072	298.4	9.460	0.002	27.22	77.91	11.30	87.77	12.73	-0.155	-0.51

TABLE 4

BURNOUT DATA FOR ANNULUS 8F

Test section	code number type mode of heating	8 F annulus inner
Inner rod	outer diameter mm (in) wall thickness mm (in) material	15.88 (0.625) 1.22 (0.048) stainless steel
Shroud	bore mm (in) wall thickness mm (in) material	20.96 (0.825) 1.78 (0.07) stainless steel
Heater resistance (at 20 C) ohm		0.02418
Axial heat flux profile		Uniform

Spacer	type material outer diameter mm (in) length mm (in) total number pitch mm (in) distance from heater end mm (in) configuration	cylindrical Tufnol 2.46 (0.097 12.7 (0.5) 36 (12 x 3) 152.4 (6.0) 76.2 (3.0) △and longitudinally in line
Burnout detector	Thermopile	
Heater Length mm (in)	1829 (72)	
Distance between pressure taps mm (in)	1905 (75)	

Run number	Inlet Pressure		Inlet Subcooling		Mass Velocity		Burnout Flux		Exit Quality	Power kW	Test Section Pressure Drop				Boiling Length	
											Zero Power		With Power			
	MPa	psia	kJ kg^{-1}	Btu lb^{-1}	kg $s^{-1}m^{-2}$ x10^{-3}	lb $h^{-1}ft^{-2}$ x 10^{-6}	kW m^{-2}	Btu $h^{-1}ft^{-2}$ x 10^{-4}			kPa	psi	kPa	psi	m	ft
2097007	0.887	128.60	9.89	4.25	0.677	0.499	81.36	2.579	0.494	7.4	37.44	5.43	52.26	7.58	1.588	5.21
2097005	0.887	128.60	9.98	4.29	0.677	0.499	81.29	2.577	0.493	7.4	37.44	5.43	52.06	7.55	1.585	5.20
1097014	0.887	128.60	19.24	8.27	0.677	0.499	89.69	2.843	0.481	8.2	38.13	5.53	50.81	7.37	1.402	4.60
1097012	0.887	128.60	19.26	8.28	0.677	0.499	89.09	2.824	0.476	8.1	38.13	5.53	50.61	7.34	1.396	4.58
1097007	0.887	128.60	25.59	11.00	0.677	0.499	96.12	3.047	0.477	8.8	38.69	5.61	49.64	7.20	1.298	4.26
1097005	0.887	128.60	25.63	11.02	0.677	0.499	95.40	3.024	0.472	8.7	38.69	5.61	49.64	7.20	1.292	4.24
2097031	0.887	128.60	12.93	5.56	1.352	0.997	128.8	4.083	0.352	11.7	48.33	7.01	112.5	16.32	1.430	4.69
2097029	0.887	128.60	13.03	5.60	1.352	0.997	128.5	4.074	0.351	11.7	48.33	7.01	113.4	16.44	1.423	4.67
2097023	0.887	128.60	18.82	8.09	1.353	0.998	136.3	4.321	0.333	12.4	48.33	7.01	105.7	15.33	1.277	4.19
2097021	0.887	128.60	18.96	8.15	1.353	0.998	135.9	4.307	0.331	12.4	48.33	7.01	103.7	15.04	1.271	4.17
2097015	0.887	128.60	24.73	10.63	1.353	0.998	148.0	4.692	0.329	13.5	48.55	7.10	96.25	13.96	1.161	3.81
2097013	0.887	128.60	24.82	10.67	1.353	0.998	148.2	4.697	0.329	13.5	48.55	7.10	97.08	14.08	1.161	3.81
2097045	0.887	128.60	18.84	8.10	2.697	1.989	173.2	5.491	0.160	15.8	75.08	10.89	180.0	26.10	0.963	3.16
2097047	0.887	128.60	19.03	8.18	2.697	1.989	174.4	5.527	0.161	15.9	75.08	10.89	181.6	26.34	0.960	3.15
2097039	0.887	128.60	23.73	10.20	2.697	1.989	184.0	5.832	0.142	16.8	75.29	10.92	160.6	23.30	0.805	2.64
2097037	0.887	128.60	23.79	10.23	2.697	1.989	184.2	5.840	0.142	16.8	75.29	10.92	160.2	23.24	0.802	2.63

Run Number	Inlet Pressure		Inlet Subcooling		Mass Velocity		Burnout Flux		Exit Quality	Power kW	Test Section Pressure Drop				Boiling Length	
											Zero Power		With Power			
	MPa	psia	kJ kg^{-1}	Btu lb^{-1}	kg s^{-1} m^{-2} x 10^{-3}	lb h^{-1} ft^{-2} x 10^{-6}	kW m^{-2}	Btu $h^{-1}ft^{-2}$ x 10^{-4}			kPa	psi	kPa	psi	m	ft
3097030	1.043	151.33	21.21	9.12	0.677	0.499	86.91	2.755	0.470	7.93	28.06	4.07	32.54	4.72	1.341	4.40
3097032	1.043	151.33	21.17	9.10	0.677	0.499	85.68	2.716	0.462	7.82	28.06	4.07	32.13	4.66	1.335	4.38
3097039	1.043	151.33	13.61	5.85	0.678	0.500	79.87	2.532	0.478	7.28	27.51	3.99	32.68	4.74	1.487	4.88
3097037	1.043	151.33	13.49	5.80	0.678	0.500	78.45	2.487	0.469	7.16	27.51	3.99	32.89	4.77	1.484	4.87
3097044	1.043	151.33	4.79	2.06	0.679	0.501	71.10	2.254	0.484	6.49	27.03	3.92	33.65	4.88	1.695	5.56
3097046	1.043	151.33	4.75	2.04	0.679	0.501	71.04	2.252	0.484	6.48	27.03	3.92	33.72	4.89	1.695	5.56
4097022	1.043	151.33	4.68	2.01	1.360	1.003	107.60	3.411	0.371	9.82	34.27	4.97	75.15	10.90	1.655	5.43
4097007	1.043	151.33	21.40	9.20	1.360	1.003	132.43	4.198	0.326	12.08	35.39	5.13	63.29	9.18	1.183	3.88
4097015	1.043	151.33	13.93	5.99	1.360	1.003	122.37	3.879	0.350	11.16	34.82	5.05	68.33	9.91	1.372	4.50
4097006	1.043	151.33	21.63	9.30	1.362	1.004	134.39	4.260	0.331	12.26	35.37	5.13	62.95	9.13	1.183	3.88
4097013	1.043	151.33	14.19	6.07	1.362	1.004	122.68	3.889	0.349	11.19	34.82	5.05	67.98	9.86	1.366	4.48
4097020	1.043	151.33	4.84	2.08	1.363	1.005	106.53	3.377	0.366	9.72	34.27	4.97	75.29	10.92	1.646	5.40
4097028	1.043	151.33	22.14	9.52	2.702	1.992	173.91	5.513	0.175	15.86	55.23	8.01	107.21	15.55	0.814	2.67
4097030	1.043	151.33	22.17	9.53	2.702	1.992	173.66	5.505	0.174	15.84	55.23	8.01	106.94	15.51	0.814	2.67
4097036	1.043	151.33	13.91	5.98	2.703	1.993	153.76	4.874	0.208	14.03	54.33	7.88	126.73	18.38	1.109	3.64
4097038	1.043	151.33	13.79	5.93	2.703	1.993	154.01	4.882	0.209	14.05	54.33	7.88	126.38	18.33	1.116	3.66
4097044	1.043	151.33	5.42	2.33	2.703	1.993	139.24	4.414	0.256	12.70	54.61	7.92	154.37	22.39	1.518	4.98
4097046	1.043	151.33	5.56	2.39	2.703	1.993	137.48	4.358	0.252	12.54	54.61	7.92	153.75	22.30	1.506	4.94
20107008	1.043	151.33	13.30	5.72	4.033	2.974	178.80	5.668	0.182	16.31	81.70	11.85	216.77	31.44	0.945	3.10
20107010	1.043	151.33	13.70	5.89	4.033	2.974	178.74	5.666	0.179	16.30	81.70	11.85	218.29	31.66	0.917	3.01
20107012	1.043	151.33	20.79	8.94	4.033	2.974	198.65	6.297	0.133	18.12	81.70	11.85	169.89	24.64	0.585	1.92
20107014	1.043	151.33	5.16	2.22	4.033	2.974	152.15	4.823	0.234	13.88	81.70	11.85	285.79	41.45	1.426	4.68
7097019	1.332	193.24	19.17	8.24	0.677	0.499	76.72	2.432	0.432	7.0	36.61	5.31	37.85	5.49	1.329	4.36
7097021	1.332	193.24	19.26	8.28	0.677	0.499	77.48	2.456	0.437	7.1	36.61	5.31	37.85	5.49	1.332	4.37
7097014	1.332	193.24	23.05	9.91	0.677	0.499	80.82	2.562	0.432	7.4	37.03	5.37	38.27	5.55	1.262	4.14
7097012	1.332	193.24	23.10	9.93	0.677	0.499	80.98	2.567	0.433	7.4	37.03	5.37	38.27	5.55	1.259	4.13
7097007	1.332	193.24	25.68	11.04	0.674	0.497	81.77	2.592	0.419	7.5	37.23	5.40	37.85	5.49	1.204	3.95
7097005	1.332	193.24	25.80	11.09	0.674	0.497	82.43	2.613	0.423	7.5	37.23	5.40	37.65	5.46	1.207	3.96

Run Number	Inlet Pressure		Inlet Subcooling		Mass Velocity		Burnout Flux		Exit Quality	Power kW	Test Section Pressure Drop				Boiling Length	
											Zero Power		With Power			
	MPa	psia	$kJ\ kg^{-1}$	$Btu\ lb^{-1}$	$kg\ s^{-1}\ m^{-2} \times 10^{-3}$	$lb\ h^{-1}\ ft^{-2} \times 10^{-6}$	$kW\ m^{-2}$	$Btu\ h^{-1} ft^{-2} \times 10^{-4}$			kPa	psi	kPa	psi	m	ft
8097021	1.332	193.24	19.05	8.19	1.362	1.004	115.7	3.667	0.285	10.6	46.54	6.75	69.91	10.14	1.167	3.83
8097023	1.332	193.24	19.19	8.25	1.362	1.004	116.1	3.680	0.285	10.6	46.54	6.75	69.64	10.10	1.164	3.82
8097016	1.332	193.24	22.59	9.71	1.360	1.003	122.4	3.879	0.281	11.2	46.68	6.77	67.50	9.79	1.088	3.57
8097014	1.332	193.24	22.75	9.78	1.360	1.003	120.7	3.826	0.273	11.0	46.68	6.77	67.60	9.79	1.073	3.52
8097008	1.332	193.24	25.54	10.98	1.359	1.002	126.3	4.005	0.272	11.5	47.09	6.83	66.05	9.58	1.018	3.34
8097006	1.332	193.24	25.89	11.13	1.359	1.002	127.4	4.040	0.273	11.6	47.09	6.83	66.67	9.67	1.015	3.33
8097045	1.332	193.24	18.93	8.14	2.693	1.986	151.6	4.807	0.135	13.8	70.74	10.26	120.7	17.51	0.838	2.75
8097047	1.332	193.24	18.98	8.16	2.693	1.986	152.1	4.822	0.136	13.9	70.74	10.26	120.7	17.51	0.838	2.75
8097037	1.332	193.24	22.79	9.80	2.692	1.985	163.2	5.174	0.125	14.9	71.15	10.32	114.4	16.59	0.722	2.37
8097039	1.332	193.24	22.93	9.86	2.691	1.984	163.5	5.182	0.125	14.9	71.15	10.32	113.6	16.47	0.716	2.35
8097031	1.332	193.24	25.63	11.02	2.704	1.994	165.9	5.259	0.105	15.1	70.12	10.17	108.4	15.72	0.597	1.96
8097029	1.332	193.24	25.66	11.03	2.704	1.994	166.1	5.265	0.105	15.1	70.12	10.17	108.2	15.69	0.597	1.96
9097016	1.332	193.24	19.00	8.17	4.039	2.978	179.3	5.685	0.072	16.4	113.4	16.44	192.7	27.95	0.567	1.86
9097014	1.332	193.24	19.05	8.19	4.039	2.978	179.9	5.704	0.073	16.4	113.4	16.44	191.9	27.83	0.567	1.86
9097008	1.332	193.24	22.63	9.73	4.036	2.976	193.6	6.138	0.060	17.7	112.9	16.38	178.7	25.92	0.439	1.44
9097006	1.332	193.24	22.79	9.80	4.039	2.978	191.5	6.069	0.056	17.5	112.9	16.38	177.9	25.80	0.411	1.35
8097056	1.332	193.24	25.68	11.04	4.033	2.974	203.6	6.453	0.048	18.6	113.6	16.47	168.9	24.49	0.329	1.08
8097054	1.332	193.24	25.73	11.06	4.033	2.974	205.8	6.525	0.050	18.8	113.6	16.47	167.2	24.25	0.344	1.13
10097040	1.621	235.16	5.26	2.26	0.692	0.510	57.29	1.816	0.417	5.2	33.10	4.80	34.34	4.98	1.643	5.39
10097042	1.621	235.16	5.54	2.38	0.692	0.510	57.63	1.827	0.417	5.3	33.10	4.80	34.34	4.98	1.634	5.36
10097036	1.621	235.16	14.70	6.32	0.692	0.510	64.73	2.052	0.392	5.9	35.16	5.10	34.54	5.01	1.366	4.48
10097034	1.621	235.16	14.70	6.32	0.692	0.510	65.17	2.066	0.396	5.9	35.16	5.10	34.54	5.01	1.369	4.49
10097029	1.621	235.16	22.17	9.53	0.690	0.509	74.07	2.348	0.401	6.8	35.99	5.22	35.16	5.10	1.219	4.00
10097027	1.621	235.16	22.45	9.65	0.692	0.510	73.63	2.334	0.394	6.7	35.99	5.22	35.16	5.10	1.207	3.96
11097020	1.621	235.16	6.30	2.71	1.381	1.018	93.06	2.950	0.321	8.5	45.44	6.59	68.12	9.88	1.554	5.10
11097022	1.621	235.16	6.44	2.77	1.379	1.017	94.07	2.982	0.324	8.6	45.44	6.59	67.71	9.82	1.551	5.09
11097015	1.621	235.16	15.24	6.55	1.379	1.017	101.7	3.225	0.276	9.3	46.20	6.70	62.95	9.13	1.219	4.00
11097013	1.621	235.16	15.31	6.58	1.381	1.018	101.8	3.227	0.275	9.3	46.20	6.70	62.54	9.07	1.216	3.99
11097008	1.621	235.16	21.52	9.25	1.379	1.017	113.3	3.591	0.266	10.3	46.88	6.80	60.47	8.77	1.058	3.47
11097006	1.621	235.16	21.79	9.37	1.381	1.018	113.6	3.600	0.264	10.4	46.88	6.80	60.47	8.77	1.049	3.44

Run Number	Inlet Pressure		Inlet Subcooling		Mass Velocity		Burnout Flux		Exit Quality	Power kW	Test Section Pressure Drop				Boiling Length	
											Zero Power		With Power			
	MPa	psia	$kJ\ kg^{-1}$	$Btu\ lb^{-1}$	$kg\ s^{-1}\ m^{-2} \times 10^{-3}$	$lb\ h^{-1}\ ft^{-2} \times 10^{-6}$	$kW\ m^{-2}$	$Btu\ h^{-1} ft^{-2} \times 10^{-4}$			kPa	psi	kPa	psi	m	ft
10097022	1.621	235.16	5.21	2.24	2.716	2.003	130.9	4.150	0.223	11.9	70.67	10.25	134.7	19.54	1.509	4.95
10097020	1.621	235.16	5.51	2.37	2.716	2.003	130.8	4.145	0.220	11.9	70.67	10.24	133.9	19.42	1.490	4.89
10097012	1.621	235.16	15.17	6.52	2.715	2.002	134.9	4.276	0.142	12.3	71.43	10.36	110.5	16.02	0.930	3.05
10097014	1.621	235.16	15.40	6.62	2.715	2.002	135.6	4.298	0.141	12.4	71.43	10.36	110.5	16.02	0.920	3.02
10097004	1.621	235.16	22.00	9.46	2.715	2.002	153.7	4.873	0.119	14.0	70.12	10.17	101.0	14.65	0.686	2.25
10097006	1.621	235.16	22.31	9.59	2.715	2.002	152.6	4.837	0.114	13.9	70.12	10.17	101.0	14.65	0.661	2.17
9097032	1.621	235.16	14.79	6.36	4.047	2.984	157.8	5.001	0.085	14.4	114.6	16.62	182.2	26.43	0.710	2.33
9097033	1.621	235.16	14.84	6.38	4.047	2.984	157.4	4.990	0.084	14.4	114.6	16.62	182.6	26.49	0.704	2.31
9097026	1.621	235.16	21.84	9.39	4.040	2.979	180.5	5.723	0.053	16.5	116.0	16.83	163.1	23.66	0.390	1.28
9097024	1.621	235.16	21.86	9.40	4.044	2.982	184.0	5.832	0.057	16.8	116.0	16.83	160.6	23.30	0.411	1.35
9097022	1.621	235.16	22.26	9.57	4.046	2.983	184.1	5.836	0.054	16.8	116.0	16.83	161.9	23.48	0.387	1.27

TABLE 5

BURNOUT DATA FOR ANNULUS 14F

Test section	code number type mode of heating	14F annulus outer
Inner rod	outer diameter mm (in) wall thickness mm (in) material	15.88 (0.625) 1.22 (0.048) stainless steel
Shroud	bore mm (in) wall thickness mm (in) material	20.96 (0.825) 1.78 (0.07) stainless steel
Heater resistance (at 20 C) ohm		0.02418
Axial heat flux profile		Uniform

Spacer	type material outer diameter mm (in) length mm (in) total number pitch mm (in) distance from heater end mm (in) configuration	cylindrical Tufnol 2.46 (0.097) 12.7 (0.5) 36 (12x3) 152.4 (6.0) 76.2 (3.0) △ and longitudinally in line
Burnout detector	Thermocouple	
Heater Length mm (in)	1829 (72)	
Distance between pressure taps mm (in)	1905 (75)	

Run number	Inlet Pressure		Inlet Subcooling		Mass Velocity		Burnout Flux		Exit Quality	Power kW	Test Section Pressure Drop				Boiling Length	
											Zero Power		With Power			
	MPa	psia	kJ kg^{-1}	Btu lb^{-1}	kg s^{-1} m^{-2} x10^{-3}	lb h^{-1} ft^{-2} x 10^{-6}	kW m^{-2}	Btu h^{-1} ft^{-2} x 10^{-4}			kPa	psi	kPa	psi	m	ft
12097027	0.887	128.60	9.58	4.12	0.677	0.499	88.42	2.803	0.754	10.65	28.06	4.07	52.47	7.61	1.664	5.46
12097023	0.887	128.60	19.26	8.28	0.679	0.501	96.31	3.053	0.749	11.60	28.61	4.15	50.54	7.33	1.524	5.00
12097019	0.887	128.60	21.86	9.40	0.679	0.501	98.30	3.116	0.747	11.83	28.75	4.17	49.16	7.13	1.490	4.89
12097015	0.887	128.60	9.86	4.24	1.372	1.012	117.3	3.718	0.486	14.12	35.44	5.14	105.4	15.29	1.573	5.16
12097010	0.887	128.60	19.05	8.19	1.375	1.014	132.6	4.204	0.482	15.97	35.85	5.20	97.22	14.10	1.387	4.55
12097005	0.887	128.60	23.63	10.16	1.372	1.012	139.5	4.422	0.478	16.79	36.27	5.26	91.70	13.30	1.311	4.30
21107004	0.887	128.60	9.79	4.21	2.688	1.982	144.1	4.569	0.317	17.35	54.74	7.94	120.1	27.42	1.402	4.66
21107005	0.887	128.60	10.14	4.36	2.688	1.982	140.8	4.464	0.306	16.95	54.74	7.94	186.6	27.07	1.396	4.58
15097001	0.887	128.60	18.77	8.07	2.699	1.990	164.9	5.227	0.289	19.85	55.85	8.10	166.1	24.09	1.143	3.75
21107002	0.887	128.60	19.45	8.36	2.688	1.982	158.1	5.011	0.264	19.03	54.74	7.94	146.2	21.20	1.091	3.58
14097006	0.887	128.60	23.79	10.23	2.697	1.989	175.0	5.547	0.267	21.07	56.12	8.14	140.7	20.41	1.009	3.31
14097008	0.887	128.60	23.82	10.24	2.696	1.988	176.1	5.583	0.274	21.20	56.12	8.14	154.7	22.44	1.015	3.33
16097004	1.043	151.33	4.75	2.04	0.688	0.507	83.44	2.645	0.757	10.05	26.82	3.89	45.02	6.53	1.74	5.71

Run Number	Inlet Pressure		Inlet Subcooling		Mass Velocity		Burnout Flux		Exit Quality	Power kW	Test Section Pressure Drop				Boiling Length	
											Zero Power		With Power			
	MPa	psia	kJ kg^{-1}	Btu lb^{-1}	kg s^{-1} m^{-2} x 10^{-3}	lb h^{-1} ft^{-2} x 10^{-6}	kW m^{-2}	Btu $h^{-1}ft^{-2}$ x 10^{-4}			kPa	psi	kPa	psi	m	ft
16097019	1.043	151.33	4.88	2.10	1.374	1.013	105.25	3.336	0.479	12.67	34.68	5.03	89.63	13.00	1.69	5.53
16097009	1.043	151.33	21.49	9.24	1.374	1.013	124.48	3.946	0.436	14.99	35.65	5.17	75.91	11.01	1.30	4.26
16097014	1.043	151.33	13.58	5.84	1.377	1.015	113.63	3.602	0.448	13.68	35.23	5.11	82.46	11.96	1.46	4.80
23107003	1.043	151.33	5.05	2.17	2.697	1.989	134.10	4.251	0.331	16.15	51.57	7.48	174.78	25.35	1.60	5.26
16097025	1.043	151.33	21.05	9.05	2.710	1.998	159.78	5.065	0.249	19.24	54.95	7.97	111.49	16.17	1.03	3.38
16097030	1.043	151.33	13.84	5.95	2.711	1.999	149.53	4.740	0.291	18.00	53.85	7.81	148.45	21.53	1.27	4.16
16097024	1.043	151.33	21.17	9.10	2.711	1.999	160.06	5.074	0.252	19.27	54.95	7.97	125.21	18.16	1.03	3.38
22107002	1.043	151.33	21.40	9.20	4.025	2.968	181.58	5.756	0.185	21.86	81.98	11.89	194.57	28.22	0.77	2.53
22107004	1.043	151.33	6.42	2.76	4.031	2.972	149.78	4.748	0.289	18.03	81.98	11.89	324.47	47.06	1.44	4.74
22107003	1.043	151.33	13.89	5.97	4.035	2.975	169.59	5.376	0.243	20.42	81.98	11.89	259.31	37.61	1.09	3.58
23107015	1.332	193.24	5.26	2.26	0.673	0.496	66.97	2.123	0.650	8.06	26.61	3.86	34.26	4.97	1.710	5.61
23107011	1.332	193.24	15.37	6.61	0.675	0.498	74.83	2.372	0.643	9.01	26.61	3.86	33.92	4.92	1.518	4.98
23107013	1.332	193.24	15.56	6.69	0.674	0.497	76.37	2.421	0.658	9.19	26.61	3.86	33.92	4.92	1.521	4.99
17097026	1.332	193.24	19.03	8.18	0.682	0.503	80.38	2.548	0.660	9.68	27.10	3.93	32.41	4.70	1.469	4.82
17097022	1.332	193.24	23.26	10.00	0.681	0.502	83.38	2.643	0.657	10.04	27.51	3.99	32.75	4.75	1.405	4.61
17097018	1.332	193 24	25.98	11.17	0.679	0.501	84.80	2.688	0.650	10.21	27.51	3.99	32.75	4.75	1.362	4.47
23097027	1.332	193.24	5.21	2.24	1.347	0.993	89.40	2.834	0.430	10.76	33.99	4.93	65.64	9.52	1.655	5.43
23097023	1.332	193.24	14.54	6.25	1.345	0.992	101.2	3.209	0.412	12.19	34.54	5.01	61.92	8.98	1.396	4.58
18097015	1.332	193.24	19.05	8.19	1.367	1.008	107.4	3.403	0.397	12.92	34.89	5.06	59.78	8.67	1.286	4.22
18097010	1.332	193.24	22.56	9.70	1.366	1.007	113.3	3.592	0.397	13.64	35.16	5.10	57.99	8.41	1.222	4.01
18097005	1.332	193.24	25.80	11.09	1.366	1.007	117.8	3.733	0.394	14.18	35.78	5.19	64.19	9.31	1.161	3.81
22107015	1.332	193.24	5.05	2.17	2.695	1.987	108.7	3.447	0.269	13.09	57.64	8.36	121.2	17.58	1.551	5.09
23097032	1.332	193.24	11.10	4.77	2.693	1.986	121.8	3.862	0.250	14.67	52.33	7.59	113.0	16.39	1.280	4.20
22107013	1.332	193.24	15.24	6.55	2.696	1.988	126.8	4.018	0.225	15.26	57.64	8.36	102.7	14.89	1.106	3.63
18097030	1.332	193.24	19.10	8.21	2.704	1.994	142.6	4.520	0.232	17.17	53.09	7.70	102.2	14.83	1.021	3.35
18097025	1.332	193.24	22.70	9.76	2.710	1.998	143.8	4.557	0.201	17.31	53.16	7.71	92.05	13.35	0.875	2.87
18097020	1.332	193.24	25.68	11.04	2.712	2.000	148.4	4.705	0.188	17.87	53.71	7.79	92.67	13.44	0.780	2.56
22107010	1.332	193.24	5.28	2.27	4.027	2.969	128.4	4.070	0.237	15.46	81.98	11.89	216.2	31.35	1.457	4.78
22107008	1.332	193.24	15.65	6.73	4.028	2.970	151.4	4.798	0.177	18.22	81.98	11.89	169.3	24.56	0.899	2.95
22107006	1.332	193.24	25.62	10.97	4.031	2.972	173.8	5.509	0.123	20.92	81.98	11.89	132.5	19.22	0.506	1.66

Run Number	Inlet Pressure		Inlet Subcooling		Mass Velocity		Burnout Flux		Exit Quality	Power kW	Test Section Pressure Drop				Boiling Length	
											Zero Power		With Power			
	MPa	psia	$kJ\ kg^{-1}$	$Btu\ lb^{-1}$	$kg\ s^{-1}\ m^{-2} \times 10^{-3}$	$lb\ h^{-1}\ ft^{-2} \times 10^{-6}$	$kW\ m^{-2}$	$Btu\ h^{-1}ft^{-2} \times 10^{-4}$			kPa	psi	kPa	psi	m	ft
22097004	1.621	235.16	5.79	2.49	0.684	0.504	56.21	1.782	0.561	6.77	25.44	3.69	27.30	3.96	1.670	5.48
21097012	1.621	235.16	14.72	6.33	0.682	0.503	66.47	2.107	0.592	8.00	25.99	3.77	28.27	4.10	1.490	4.89
21097008	1.621	235.16	21.89	9.41	0.682	0.503	71.04	2.252	0.577	8.55	26.61	3.86	27.72	4.02	1.359	4.46
21097004	1.621	235.16	35.22	15.14	0.682	0.503	78.90	2.501	0.542	9.50	27.44	3.98	27.51	3.99	1.149	3.77
22097017	1.621	235.16	5.61	2.41	1.364	1.006	85.36	2.706	0.422	10.28	33.30	4.83	53.43	7.75	1.628	5.34
22097013	1.621	235.16	14.91	6.41	1.364	1.006	93.88	2.976	0.385	11.30	33.92	4.92	50.95	7.39	1.344	4.41
22097009	1.621	235.16	22.00	9.46	1.364	1.006	104.6	3.316	0.378	12.59	34.54	5.01	49.16	7.13	1.189	3.90
19097017	1.621	235.16	9.49	4.08	2.719	2.005	112.1	3.555	0.242	13.50	52.33	7.59	96.32	13.97	1.317	4.32
19097012	1.621	235.16	16.96	7.29	2.719	2.005	125.8	3.989	0.210	15.15	53.57	7.77	87.15	12.64	1.012	3.32
19097007	1.621	235.16	24.73	10.63	2.721	2.006	141.4	4.483	0.181	17.03	53.71	7.79	80.19	11.63	0.768	2.52
23107002	1.621	235.16	7.82	3.36	4.029	2.971	120.4	3.816	0.191	14.49	81.98	11.89	160.8	23.32	1.247	4.09
19097028	1.621	235.16	16.79	7.22	4.059	2.993	140.6	4.456	0.141	16.92	87.91	12.75	140.4	20.36	0.747	2.45
19097023	1.621	235.16	23.00	9.89	4.063	2.996	158.6	5.028	0.115	19.10	87.91	12.75	126.7	18.38	0.512	1.68

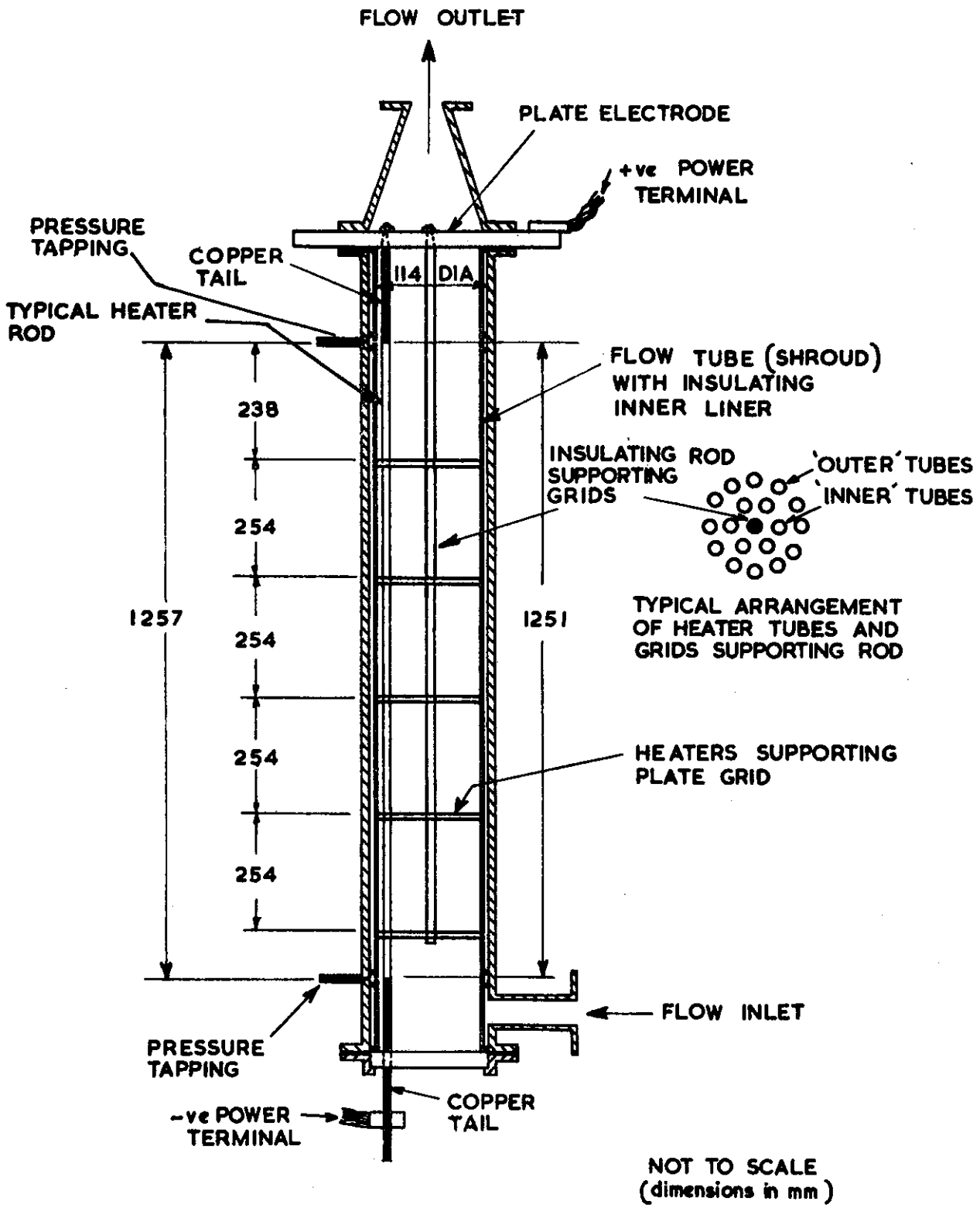

FIGURE 1. 19-ROD CLUSTER LAYOUT

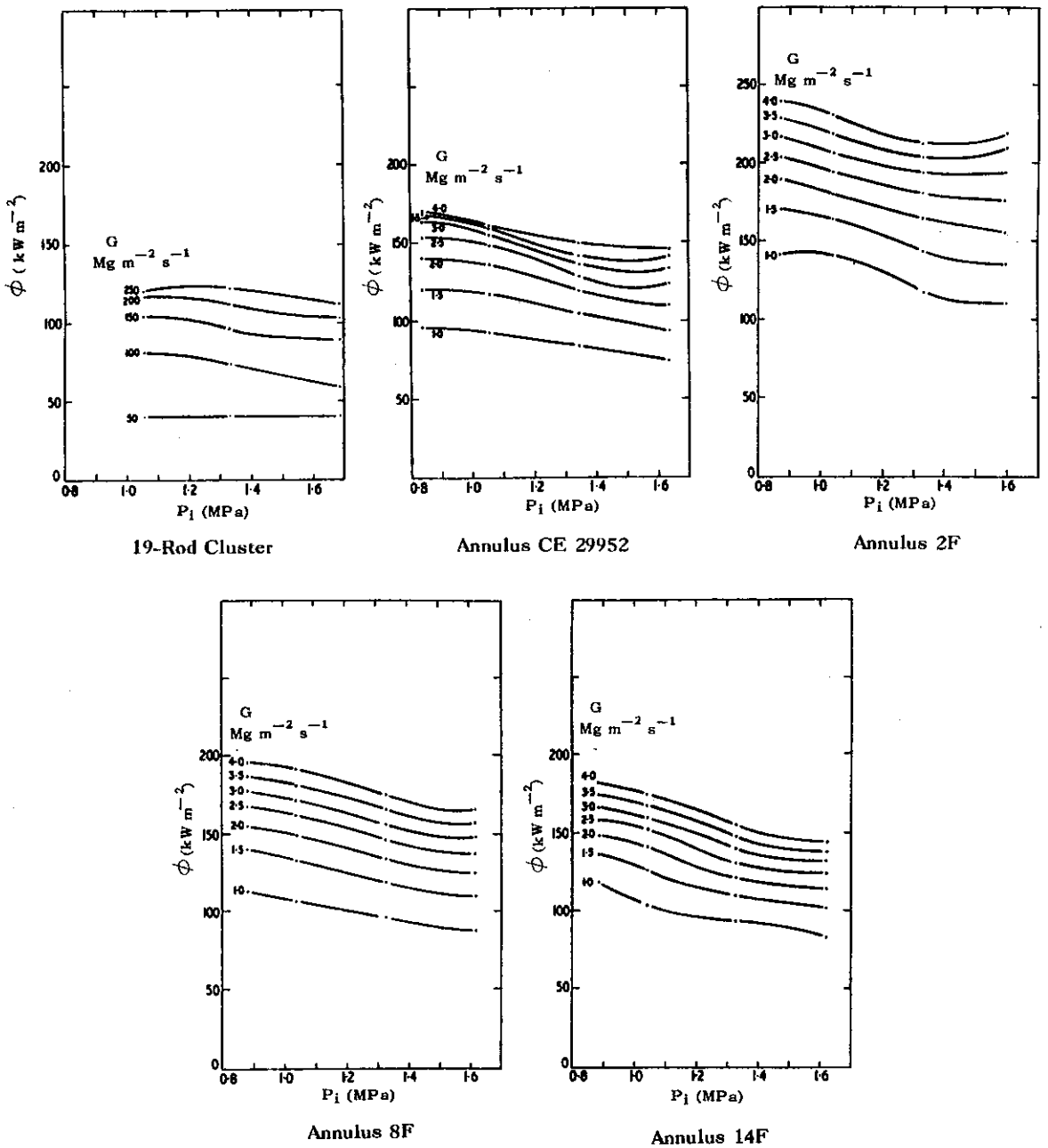

FIGURE 2. BURNOUT HEAT FLUX VARIATION WITH INLET PRESSURE AT 18 kJ kg^{-1} INLET SUBCOOLING FOR A RANGE OF MASS VELOCITIES FOR A 19-ROD CLUSTER AND FOUR ANNULI

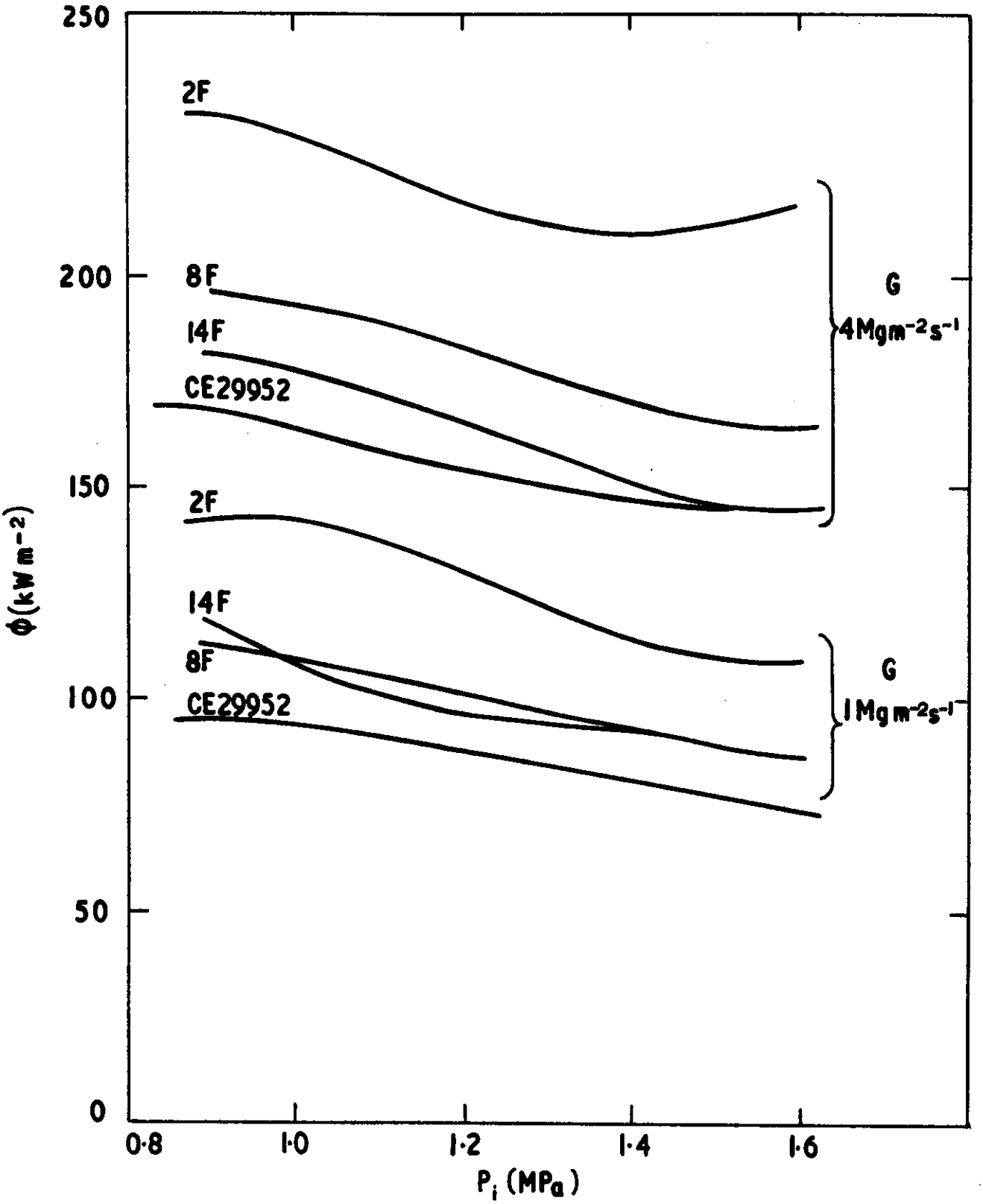

FIGURE 3. COMPARISON OF THE PERFORMANCE OF THE ANNULUS TEST SECTIONS AT 18 kJ kg^{-1} INLET SUBCOOLING

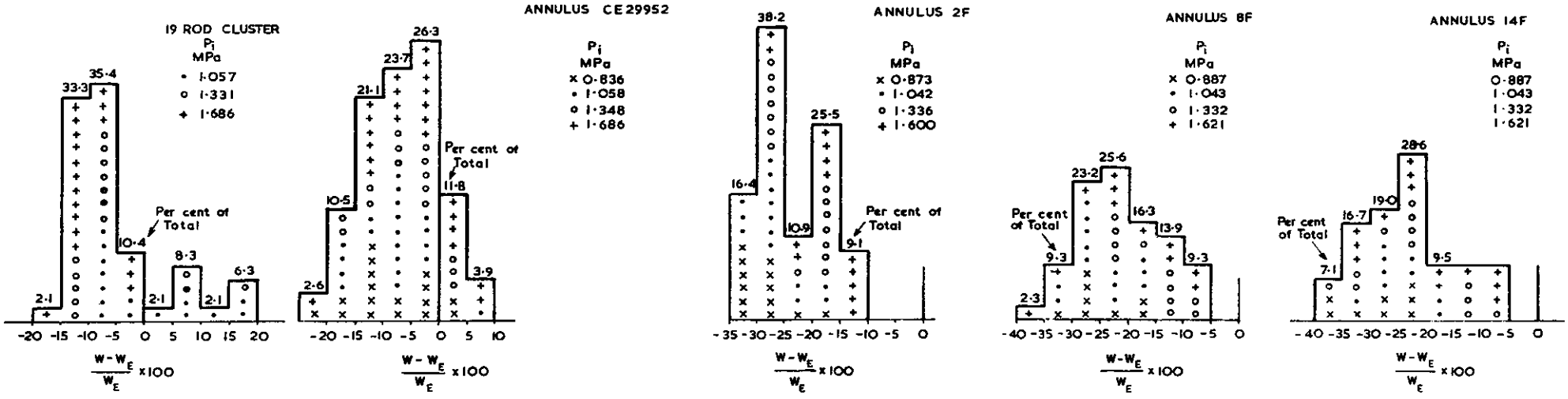

FIGURE 4. COMPARISON OF THE REPRESENTATIVE BURNOUT DATA WITH THE CISE BURNOUT CORRELATION RESULTS FOR THE FIVE TEST SECTIONS