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LUCAS HEIGHTS

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ABSTRACT

Results from boiling crisis ('burnout') tests, including associated pressure drop data, are reported for vertical upflow of Freon-12 at a nominal inlet pressure of 1.0 MPa, in three round tube test sections (15 to 21 mm internal diameter, heated lengths 2.85 to 3.94 m) and four annular test sections of identical cross section dimensions (16 mm diameter inner tube and 21 mm diameter shroud) with different heated lengths. The tests covered a range of values for coolant flowrate and inlet subcooling.

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The following descriptors have been selected from the INIS Thesaurus to describe the subject content of this report for information retrieval purposes. For further details please refer to IAEA-INIS-12 (INIS: Manual for Indexing) and IAEA-INIS-13 (INIS: Thesaurus) published in Vienna by the International Atomic Energy Agency.

BURNOUT; BOILING; HEAT TRANSFER; LIQUID FLOW; FREONS; REACTOR COOLING SYSTEMS; COOLANTS; FLOW RATE; SIMULATION; WATER; PRESSURE DROP; SUBCOOLING; TUBES

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1. INTRODUCTION

A series of three round tube and four annular test sections has been used on a Freon-12 heat transfer rig to obtain experimental flow boiling crisis ('burnout') and associated pressure drop data. This program of experiments is part of an investigation of the use of the refrigerant Freon-12 as a model fluid for high pressure water for burnout measurements under flow boiling conditions.

Tests were carried out on each section in turn at a constant nominal inlet pressure of 1.0 MPa (actual inlet pressures were in the range 0.98 to 1.07 MPa), for a range of mass flowrates and inlet subcooling conditions. Results on the effect of pressure on burnout in round tube and annular tests sections have been reported by Ilic [1974a, 1974b].

2. TEST FACILITY

The ACTOR test rig (Figure 1) has been described in detail by Ilic [1972]. The flow circuitry of the rig (Figure 2) contains about 340 kg of Freon-12. The working fluid is circulated by a centrifugal pump, with a flow rate of 6.4 x 10^{-3} m^3 s^{-1} and 43 m differential head, around a closed loop fabricated mainly of approx. 30 m of 51 mm nominal bore mild steel pipe. The flow is monitored by turbine meters after leaving the pump and before a 30 kW chiller unit and an 80 kW preheater unit which provide the required subcooling condition at test section inlet.

The maximum test section length is 5 m and the maximum electric power for test section heating is 300 kW. Freon-12 vapour leaving the test section is passed through two heat exchangers connected in series, where it is subcooled and condensed with water supplied from either a 0.5 MW or a 1 MW induced draught cooling tower. Between the heat exchangers and the pump there is a connection to a pressuriser which controls the loop static pressure by means of a 3 kW electric immersion heater and a cooling coil in the partially filled vessel.

3. TEST SECTIONS AND INSTRUMENTATION

All test sections have been manufactured from stainless steel type 321 with provisions for measuring pressure drop and attaching power cables (Figures 3 and 4). Relevant dimensions of the test sections are given in the following table.

Test Section Geometry

Identification Number	Heated Length (mm)	Tube or Shroud Inside Diameter (mm)	Inner Tube Outside Diameter (mm)
CE 27491	2863	16.08	
CE 37338-1	3940	21.34	
CE 37338-2	2850	15.34	
A2E 47268-1	876	20.95	15.88
A2E 47268-2	1791	20.95	15.88
A2E 47268-3	2705	20.95	15.88
A2E 47268-4	3620	20.95	15.88

The four annular test sections are of the same cross sectional dimensions, with the inner surface heated but having different lengths (nominally 0.9, 1.8, 2.7 and 3.6 m). The inner tubes are made of stainless steel with a thick-wall copper tube of the same outer diameter brazed to each end. The upper copper tail terminates in an insulated flange which provides one electrical power connection; the lower tail protrudes at the bottom end for the other electrical power connection (see Figure 4). The inner tubes are located concentrically within the shroud by means of spacer elements which consist of three ceramic rods, 2.5 mm dia. x 13 mm long, equally spaced around the inner tubes located as shown in Figure 4. The large pitch between sets of spacers and the absence of spacer elements near the downstream end of the heated length (see Figure 4) are expected to ensure that the effect of the spacer elements on burnout conditions [Ilic 1975] will be insignificant.

A chromel/alumel thermocouple sheathed in stainless steel is attached to the wall of each heater tube at the downstream end, approximately 10 mm upstream from the power connection. In the case of annular test sections, attachment is made to the inner wall of the heater rod, the leads being taken outside the tube via the hollow copper tail. Once wall over-heating (burnout) occurs, the signal from this thermocouple is transmitted to a temperature indicator/controller, causing an immediate drop in the test section power. A resistance type burnout detector is also fitted. The upper and lower halves of the electrically heated walls of the test section form two arms of a

Wheatstone bridge; if the resistance of either half is changed owing to local over-heating, an imbalance is detected and the test section power is immediately reduced.

A digital data logger unit records the data. Output is produced in two ways; a typewriter output allows data inspection after a test run, and punched paper tape stores the data for later computer evaluation.

Test section pressure drop is measured with a diaphragm-type differential pressure transducer which provides an electrical signal to the data logger. Power to the test section is determined from the product of the measured voltage and current. A calibrated precision electrical shunt is used for current measurement and voltage is measured across the power attachments.

4. TEST PROCEDURE

The required flow and inlet subcooling conditions were established; a trial burnout run was then made by increasing test section power in steps until an indication of burnout was observed. At this stage, power was lowered a little, say a few per cent, and, when the operator had judged that conditions had settled, a data logger scan was made of all channels. This was followed by small step increases in test section power while a continuous data logger scan was taken of selected rig signals. When a burnout indication was observed, the data logger was stopped and the test section power reduced by only that amount necessary to remove the burnout condition. A quick check was made of any obvious errors in the data just recorded. If an error was detected, or suspected, the run was repeated while rig conditions were still steady. When satisfied with the test data, the power was lowered by about 10 per cent and the inlet subcooling and/or the flowrate changed to the next predetermined condition.

Zero power single phase pressure drop runs were carried out for each flowrate. Generally these were done at the beginning of the day before the test section power was applied. Two data logger scans were recorded for each flowrate.

On those occasions when errors in the data logging necessitated a re-run, the correct values in the discarded run were compared with those of the repeat run and found to be in excellent agreement (usually within ± 0.2 per cent).

Heat balance checks were carried out daily as a means of detecting drift and malfunction in rig instrumentation. Errors of ± 3 per cent were judged to be excessive.

5. EXPERIMENTAL RESULTS

5.1 Freon-12 Rig Data Evaluation

A computer program was used to process the raw pressure drop and heat transfer data recorded on paper tape via the data logger. Operating data were recorded for the test conditions (a) at pre-burnout (usually a few per cent below burnout power); (b) at burnout; and (c) with no power applied to the test section to determine the single phase pressure drop. Other program input requirements were: run number identification; test section geometry specifications; and dimensions.

From the recorded data the program calculated the test section coolant mass flux, inlet subcooling, pressure drop, exit quality, and surface heat flux. The required fluid physical property information for the relevant flow conditions was calculated from information based on a fairly recent collation of physical property data for Freon-12 [Watson 1975].

5.2 Data Presentation

Separate output tables are presented for the pre-burnout/burnout data and the zero power pressure drop data for each test section (see Tables 1-8). Each pre-burnout/burnout table of data provides the following information concerning the test section:

(i) identification number (engineering drawing number of test section);

(ii) material of construction (stainless steel material specification);

(iii) mode of heating (d.c. electrical resistance heating was used in all of these tests);

(iv) burnout detecting device (resistance type and/or thermocouple);

(v) geometry (heated length, distance between pressure taps, relevant diameter(s), wall thickness); and

(vi) electrical resistance of heated section.

6. CONCLUSION

Boiling crisis tests on a number of round-tube and annular channel test sections have provided an extensive set of burnout data for Freon-12 over a range of inlet temperatures and flowrates at a constant nominal inlet pressure of 1.0 MPa. These will be useful for investigations on the use of Freon-12 as a model fluid for water in measurements of burnout conditions.

7. ACKNOWLEDGEMENT

Constructive comments of Dr K.R. Lawther, under whose direction this work was carried out, are gratefully acknowledged.

8. REFERENCES

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

Ilic, V. [1974b] - Effect of Pressure on Burnout in Annuli and a 10-rod Cluster Cooled by Upflow of Freon-12. AAEC/E324.

Ilic, V. [1975] - An Examination of the Influence of Spacers on Burnout in an Annulus Cooled by Upflow of Freon-12. AAEC/E349.

Watson, J.T.R. [1975] - Thermophysical Properties of Refrigerant 12. H.M. Stationery Office, Edinburgh.

TABLE 1(a)

BURNOUT DATA FOR FREON-12 IN ROUND TUBE TEST SECTION

ORIGIN OF TEST SECTION		A.A.E.C.
TEST SECTION IDENTIFICATION NUMBER		CE 27491
MATERIAL OF CONSTRUCTION		AS -G19-321
MODE OF HEATING		D.C. RESISTANCE
BURNOUT DETECTOR		RESISTANCE TYPE THERMOCOUPLE
HEATED LENGTH	2863.0	MILLIMETRES
DISTANCE BETWEEN PRESSURE TAPS	3200.0	MILLIMETRES
INTERNAL DIAMETER	16.08	MILLIMETRES
WALL THICKNESS	1.14	MILLIMETRES
HEATED SECTION RESISTANCE AT 20 DEG.C	0.033	OHM

* DENOTES A BURNOUT RUN

RUN NUMBER	INLET PRESSURE	POWER	PRESSURE DROP	EXIT QUALITY	MASS VELOCITY	INLET SUBCOOLING	HEAT FLUX
	MEGA-PASCAL	KILO-WATT	KILO-PASCAL		MEGAGRAM / SEC.METRE2	KILOJOULE / KILOGRAM	KILOWATT / METRE2
02027601	1.072	13.18	23.8	0.554	0.654	29.98	91.1
02027602*	1.067	13.69	24.7	0.594	0.647	29.77	94.6
02027603	1.071	12.45	25.4	0.535	0.672	24.33	86.1
02027604*	1.071	13.49	24.3	0.599	0.669	24.33	93.3
02027605	1.072	12.26	23.5	0.580	0.660	18.92	84.7
02027606*	1.072	12.77	23.2	0.608	0.661	18.92	88.3
02027607	1.073	11.13	21.5	0.598	0.662	7.86	76.9
02027608*	1.073	11.59	21.0	0.625	0.662	7.85	80.1
03027601	1.072	16.10	35.9	0.297	1.184	30.72	111.3
03027602*	1.073	17.25	35.5	0.334	1.184	30.75	119.3
03027603	1.072	15.92	35.3	0.329	1.191	25.45	110.0
03027604*	1.072	16.69	34.4	0.354	1.191	25.47	115.4
03027605	1.073	14.82	33.7	0.355	1.188	17.71	102.4
03027606*	1.074	15.32	33.3	0.372	1.185	17.74	106.0
03027607	1.074	13.42	31.9	0.381	1.194	8.25	92.8
03027608*	1.073	14.06	31.2	0.402	1.194	8.24	97.2
04027601	1.071	17.71	41.0	0.233	1.506	29.96	122.5
04027602*	1.072	19.07	39.8	0.269	1.502	29.97	131.8
04027603	1.072	17.73	39.6	0.280	1.483	24.90	122.6
04027604*	1.072	18.40	38.9	0.296	1.488	24.87	127.2
04027605	1.073	15.37	38.6	0.280	1.477	17.26	106.3
04027606*	1.073	16.82	37.8	0.318	1.477	17.23	116.3
04027607	1.073	13.88	37.5	0.309	1.483	8.35	96.0
04027608*	1.073	15.18	36.9	0.344	1.478	8.34	105.0

CONTINUED

TABLE 1(a) (Continued)

RUN NUMBER	INLET PRESSURE	POWER	PRESSURE DROP	EXIT QUALITY	MASS VELOCITY	INLET SUBCOOLING	HEAT FLUX
	MEGA-PASCAL	KILO-WATT	KILO-PASCAL		MEGAGRAM / SEC.METRE2	KILOJOULE / KILOGRAM	KILOWATT / METRE2
04027609	1.075	20.52	51.4	0.097	2.417	31.55	141.8
04027610*	1.074	21.29	50.5	0.110	2.416	31.50	147.2
04027611	1.073	18.93	51.7	0.122	2.402	25.38	130.9
04027612*	1.072	19.95	50.5	0.138	2.405	25.34	137.9
05027601	1.070	17.19	53.1	0.165	2.404	16.38	118.8
05027602*	1.072	18.68	52.7	0.187	2.409	16.45	129.1
05027603	1.072	16.57	54.9	0.239	2.380	6.01	114.6
05027604*	1.071	17.11	53.9	0.248	2.382	5.97	118.3
05027605	1.074	22.10	56.4	0.037	3.053	33.21	152.8
05027606*	1.074	23.87	55.1	0.059	3.057	33.21	165.0
05027607	1.082	19.84	57.4	0.061	3.041	26.77	137.2
05027608*	1.079	21.19	56.5	0.078	3.040	26.66	146.5
05027609	1.072	15.67	61.6	0.123	3.029	12.28	108.4
05027610*	1.064	18.58	55.1	0.161	3.035	11.92	128.4
05027611	1.072	15.56	66.5	0.170	3.042	6.17	107.6
05027612*	1.057	17.91	55.1	0.200	3.060	5.52	123.8
06027601	1.076	23.71	59.1	0.014	3.465	34.35	164.0
06027602*	1.092	26.09	59.3	0.037	3.443	35.01	180.4
06027603	1.071	18.87	63.6	0.061	3.541	21.11	130.5
06027604*	1.072	20.32	62.9	0.077	3.529	21.15	140.5
06027605	1.073	16.91	65.1	0.077	3.517	16.49	116.9
06027606*	1.070	18.83	64.3	0.099	3.514	16.36	130.2
06027607	1.073	16.96	75.5	0.158	3.523	6.64	117.2
06027608*	1.064	18.02	68.2	0.168	3.551	6.28	124.6
06027609	1.075	25.89	62.8	0.007	3.868	34.62	179.0
06027610*	1.088	27.88	63.0	0.026	3.830	35.13	192.7
06027611	1.073	19.91	66.1	0.060	3.729	21.36	137.7
06027612*	1.073	20.60	65.2	0.067	3.739	21.33	142.4
06027613	1.075	17.23	69.3	0.067	3.862	16.23	119.1
06027614*	1.073	19.09	68.1	0.086	3.858	16.17	132.0
06027615	1.073	16.86	79.5	0.132	3.867	7.93	116.6
06027616*	1.060	17.81	68.5	0.141	3.886	7.36	123.2

TABLE 1(b)

TEST SECTION PRESSURE DROP DATA FOR ZERO POWER INPUT

TEST SECTION IDENTIFICATION NUMBER CE 27491

RUN NUMBER	INLET PRESS.	INLET TEMP.	MASS VELOCITY	PRESSURE DROP
	MEGAPASCAL	DEG.C	MEGAGRAM / SEC.METRE2	KILOPASCAL
12027601	1.071	22.4	0.671	39.3
12027602	1.071	22.3	0.674	39.3
12027603	1.071	23.2	1.206	40.3
12027604	1.070	23.2	1.202	40.8
12027605	1.070	23.2	1.454	41.3
12027606	1.070	23.1	1.452	41.4
12027607	1.069	22.9	2.507	46.0
12027608	1.071	22.9	2.509	46.0
12027609	1.071	23.5	3.226	50.0
12027610	1.071	23.5	3.173	50.1
12027611	1.071	23.9	3.382	51.4
12027612	1.072	23.9	3.346	51.8
12027613	1.070	24.0	3.676	54.3
12027614	1.071	24.0	3.661	54.2

TABLE 2(a)

BURNOUT DATA FOR FREON-12 IN ROUND TUBE TEST SECTION

ORIGIN OF TEST SECTION		A.A.E.C.
TEST SECTION IDENTIFICATION NUMBER		CE 37338-1
MATERIAL OF CONSTRUCTION		S.S. AISI 321
MODE OF HEATING		D.C. RESISTANCE
BURNOUT DETECTOR		RESISTANCE TYPE THERMOCOUPLE
HEATED LENGTH	3940.0	MILLIMETRES
DISTANCE BETWEEN PRESSURE TAPS	3950.0	MILLIMETRES
INTERNAL DIAMETER	21.34	MILLIMETRES
WALL THICKNESS	2.03	MILLIMETRES
HEATED SECTION RESISTANCE AT 20 DEG.C	0.021	OHM

* DENOTES A BURNOUT RUN

RUN NUMBER	INLET PRESSURE	POWER	PRESSURE DROP	EXIT QUALITY	MASS VELOCITY	INLET SUBCOOLING	HEAT FLUX
	MEGA-PASCAL	KILO-WATT	KILO-PASCAL		MEGAGRAM / SEC.METRE2	KILOJOULE / KILOGRAM	KILOWATT / METRE2
18057601	1.040	19.13	25.1	0.685	0.454	31.34	72.4
18057602*	1.041	20.10	27.4	0.731	0.454	31.37	76.1
18057603	1.041	18.37	26.3	0.690	0.466	23.24	69.5
18057604*	1.041	19.19	25.8	0.729	0.465	23.27	72.6
18057605	1.041	17.15	23.7	0.702	0.467	14.07	64.9
18057606*	1.041	17.94	23.4	0.739	0.467	14.10	67.9
18057607	1.041	16.28	20.3	0.743	0.470	2.83	61.6
18057608*	1.041	16.74	19.9	0.765	0.470	2.82	63.4
27027601	1.040	23.66	35.4	0.471	0.773	26.75	89.6
27027602*	1.041	24.78	34.1	0.504	0.771	26.77	93.8
27027603	1.041	22.90	33.6	0.493	0.759	22.63	86.7
27027604*	1.041	23.71	33.2	0.515	0.760	22.64	89.8
27027605	1.041	21.52	31.4	0.509	0.764	14.94	81.5
27027606*	1.041	22.22	30.8	0.528	0.766	14.95	84.1
27027607	1.044	18.70	28.5	0.502	0.762	5.69	70.8
27027608*	1.046	20.02	27.9	0.539	0.762	5.75	75.8
01037601	1.038	29.10	44.9	0.297	1.230	29.90	110.2
01037602*	1.039	30.65	43.7	0.325	1.228	29.94	116.0
01037603	1.039	28.34	43.8	0.319	1.242	24.69	107.3
01037604*	1.039	29.23	43.0	0.335	1.242	24.69	110.7
01037605	1.040	25.92	41.3	0.337	1.237	17.15	98.1
01037606*	1.040	27.16	40.5	0.358	1.237	17.15	102.8
01037607	1.039	22.87	37.5	0.377	1.234	5.14	86.6
01037608*	1.040	23.73	36.9	0.392	1.232	5.18	89.8

TABLE 2(a) (Continued)

RUN NUMBER	INLET PRESSURE	POWER	PRESSURE DROP	EXIT QUALITY	MASS VELOCITY	INLET SUBCOOLING	HEAT FLUX
	MEGA-PASCAL	KILO-WATT	KILO-PASCAL		MEGAGRAM / SEC.METRE2	KILOJOULE / KILOGRAM	KILOWATT / METRE2
01037609	1.035	35.49	55.8	0.175	1.885	32.55	134.3
01037610*	1.028	35.85	55.1	0.181	1.884	32.28	135.7
01037611	1.041	31.81	53.8	0.229	1.882	20.15	120.4
01037612*	1.041	32.72	52.7	0.239	1.882	20.14	123.9
01037613	1.041	29.91	53.1	0.245	1.879	15.31	113.2
01037614*	1.039	30.93	52.4	0.257	1.880	15.25	117.1
01037615	1.041	25.88	51.1	0.277	1.880	5.02	98.0
01037616*	1.042	28.07	49.9	0.302	1.882	5.06	106.3
02037601	1.035	35.66	62.9	0.077	2.483	32.97	135.0
02037602*	1.032	37.79	61.7	0.096	2.482	32.82	143.1
02037603	1.040	33.45	62.5	0.144	2.488	21.72	126.6
02037604*	1.035	34.28	59.8	0.151	2.495	21.51	129.8
02037605	1.041	29.65	63.0	0.164	2.470	15.07	112.2
02037606*	1.041	32.32	62.3	0.188	2.466	15.08	122.4
02037607	1.039	28.70	63.8	0.238	2.460	4.73	108.7
02037608*	1.040	29.65	63.0	0.246	2.459	4.75	112.2

TABLE 2(b)

TEST SECTION PRESSURE DROP DATA FOR ZERO POWER INPUT

TEST SECTION IDENTIFICATION NUMBER CE 37338-1

RUN NUMBER	INLET PRESS.	INLET TEMP.	MASS VELOCITY	PRESSURE DROP
	MEGAPASCAL	DEG.C	MEGAGRAM / SEC.METRE2	KILOPASCAL
02037601	1.041	22.8	0.788	53.6
02037602	1.041	22.8	0.787	53.6
02037603	1.040	22.5	1.242	54.8
02037604	1.041	22.4	1.243	54.7
02037605	1.041	22.5	1.879	57.0
02037606	1.041	22.4	1.882	57.1
02037607	1.042	22.1	2.450	59.6
02037608	1.041	22.0	2.452	60.2

TABLE 3(a)

BURNOUT DATA FOR FREON-12 IN ROUND TUBE TEST SECTION

ORIGIN OF TEST SECTION		A.A.E.C.
TEST SECTION IDENTIFICATION NUMBER		CE 37338-2
MATERIAL OF CONSTRUCTION		S.S. AS-G19-321
MODE OF HEATING		D.C. RESISTANCE
BURNOUT DETECTOR		RESISTANCE TYPE THERMOCOUPLE
HEATED LENGTH	2850.0	MILLIMETRES
DISTANCE BETWEEN PRESSURE TAPS	2860.0	MILLIMETRES
INTERNAL DIAMETER	15.34	MILLIMETRES
WALL THICKNESS	1.63	MILLIMETRES
HEATED SECTION RESISTANCE AT 20 DEG.C	0.022	OHM

* DENOTES A BURNOUT RUN

RUN NUMBER	INLET PRESSURE	POWER	PRESSURE DROP	EXIT QUALITY	MASS VELOCITY	INLET SUBCOOLING	HEAT FLUX
	MEGA-PASCAL	KILO-WATT	KILO-PASCAL		MEGAGRAM / SEC.METRE2	KILOJOULE / KILOGRAM	KILOWATT / METRE2
19027601	0.984	10.20	23.8	0.651	0.512	24.61	74.2
19027602*	0.985	11.48	22.8	0.765	0.507	24.62	83.6
19027603	0.975	10.39	22.5	0.712	0.511	18.73	75.6
19027604*	0.975	10.81	22.4	0.745	0.512	18.72	78.7
19027605	0.975	10.01	21.3	0.729	0.517	11.33	72.9
19027606*	0.975	10.33	21.2	0.758	0.515	11.33	75.2
19027607	0.975	9.42	19.8	0.745	0.515	3.37	68.6
19027608*	0.976	9.82	19.6	0.779	0.514	3.41	71.5
19027609	0.975	15.64	41.7	0.273	1.441	25.11	113.8
19027610*	0.976	16.76	42.0	0.304	1.443	25.15	122.0
19027611	0.976	15.13	41.3	0.301	1.440	19.47	110.2
19027612*	0.976	16.09	41.0	0.330	1.438	19.49	117.2
20027601	0.973	14.30	40.8	0.333	1.440	12.16	104.1
20027602*	0.974	14.82	40.4	0.348	1.441	12.22	107.9
20027603	0.974	12.40	39.6	0.337	1.439	4.52	90.3
20027604*	0.975	13.60	39.7	0.371	1.442	4.57	99.0
20027605	0.977	18.18	52.6	0.154	2.205	26.90	132.4
20027606*	0.977	19.22	52.6	0.173	2.204	26.92	139.9
20027607	0.975	17.86	53.7	0.182	2.207	22.43	130.0
20027608*	0.976	18.55	53.9	0.195	2.209	22.46	135.1
20027609	0.975	16.46	54.7	0.221	2.193	14.18	119.8
20027610*	0.975	17.17	54.9	0.235	2.192	14.21	125.0
20027611	0.976	14.81	57.9	0.273	2.208	3.29	107.8
20027612*	0.974	15.56	57.3	0.287	2.210	3.22	113.3

TABLE 3(a) (Continued)

RUN NUMBER	INLET PRESSURE	POWER	PRESSURE DROP	EXIT QUALITY	MASS VELOCITY	INLET SUBCOOLING	HEAT FLUX
	MEGA-PASCAL	KILO-WATT	KILO-PASCAL		MEGAGRAM / SEC.METRE2	KILOJOULE / KILOGRAM	KILOWATT / METRE2
20027613	0.975	20.45	59.6	0.080	3.017	28.89	148.9
20027614*	0.977	20.60	59.2	0.082	3.014	28.94	150.0
20027615	0.980	17.97	64.5	0.133	3.018	17.67	130.8
20027616*	0.977	18.47	63.8	0.141	3.016	17.54	134.5
20027617	0.976	16.08	68.0	0.158	3.003	11.40	117.1
20027618*	0.976	17.93	67.8	0.183	2.999	11.38	130.6
20027619	0.968	15.97	79.1	0.226	3.018	2.54	116.3
20027620*	0.972	17.12	76.9	0.239	3.027	2.72	124.6
23027601	0.981	19.60	59.0	0.068	3.007	28.98	142.7
23027602*	0.980	20.72	59.3	0.085	3.000	28.92	150.9
23027603	0.974	17.17	66.2	0.145	2.997	15.01	125.0
23027604*	0.973	18.20	65.9	0.159	2.997	14.97	132.5
23027605	0.974	16.26	69.0	0.168	2.986	10.63	118.4
23027606*	0.972	17.84	68.7	0.190	2.983	10.57	129.9
23027607	0.974	14.60	77.9	0.209	3.009	2.29	106.3
23027608*	0.973	16.85	78.4	0.242	2.983	2.28	122.7

TABLE 3(b)

TEST SECTION PRESSURE DROP DATA FOR ZERO POWER INPUT

TEST SECTION IDENTIFICATION NUMBER CE 37338-2

RUN NUMBER	INLET PRESS.	INLET TEMP.	MASS VELOCITY	PRESSURE DROP
	MEGAPASCAL	DEG.C	MEGAGRAM / SEC.METRE2	KILOPASCAL
23027601	0.972	23.6	0.524	38.6
23027602	0.972	23.7	0.523	38.6
23027603	0.971	24.4	1.425	41.0
23027604	0.972	24.6	1.428	41.1
23027605	0.971	24.9	2.184	44.2
23027606	0.972	25.0	2.183	44.4
23027607	0.972	25.1	2.997	49.0
23027608	0.972	25.0	2.993	49.0

TABLE 4(a)

BURNOUT DATA FOR FREON-12 IN ROUND TUBE TEST SECTION

ORIGIN OF TEST SECTION	A.A.E.C.
TEST SECTION IDENTIFICATION NUMBER	CE 37338-2
MATERIAL OF CONSTRUCTION	S.S. AS-G19-321
MODE OF HEATING	D.C. RESISTANCE
BURNOUT DETECTOR	RESISTANCE TYPE THERMOCOUPLE
HEATED LENGTH	2850.0 MILLIMETRES
DISTANCE BETWEEN PRESSURE TAPS	2860.0 MILLIMETRES
INTERNAL DIAMETER	15.34 MILLIMETRES
WALL THICKNESS	1.63 MILLIMETRES
HEATED SECTION RESISTANCE AT 20 DEG.C	0.022 OHM

* DENOTES A BURNOUT RUN

RUN NUMBER	INLET PRESSURE	POWER	PRESSURE DROP	EXIT QUALITY	MASS VELOCITY	INLET SUBCOOLING	HEAT FLUX
	MEGA-PASCAL	KILO-WATT	KILO-PASCAL		MEGAGRAM / SEC.METRE2	KILOJOULE / KILOGRAM	KILOWATT / METRE2
02067601	1.044	10.57	23.4	0.707	0.471	32.30	76.9
02067602*	1.043	11.35	23.2	0.770	0.474	32.28	82.7
02067603	1.044	9.95	22.2	0.690	0.486	23.57	72.5
02067604*	1.044	10.82	23.2	0.768	0.485	23.57	78.8
02067605	1.043	9.81	20.2	0.765	0.481	13.69	71.4
02067606*	1.044	10.08	23.2	0.784	0.484	13.72	73.4
02067607	1.044	9.18	18.8	0.748	0.504	5.88	66.7
02067608*	1.045	9.24	18.7	0.768	0.485	5.90	67.3
17027601	1.039	12.13	26.4	0.587	0.641	28.38	88.3
17027602*	1.042	12.60	25.9	0.617	0.642	28.49	91.7
17027603	1.041	11.74	25.4	0.604	0.645	22.28	85.4
17027604*	1.041	11.90	25.3	0.611	0.649	22.29	86.7
17027605	1.042	10.87	24.1	0.602	0.647	15.10	79.1
17027606*	1.042	11.27	23.7	0.629	0.646	15.10	82.1
17027607	1.042	9.88	22.1	0.618	0.653	3.94	71.9
17027608*	1.043	10.25	21.9	0.644	0.651	3.98	74.6
24027601	1.044	14.04	33.8	0.369	1.028	28.18	102.2
24027602*	1.045	15.10	33.3	0.412	1.028	28.19	110.0
24027603	1.045	13.45	33.1	0.385	1.033	22.58	97.9
24027604*	1.045	14.24	32.7	0.418	1.031	22.61	103.7
24027605	1.046	12.32	31.0	0.427	1.023	11.85	89.7
24027606*	1.046	12.90	30.5	0.452	1.021	11.86	93.9
24027607	1.046	11.10	29.7	0.437	1.023	4.21	80.8
24027608*	1.046	11.64	29.4	0.459	1.021	4.20	84.7

TABLE 4(a) (Continued)

RUN NUMBER	INLET PRESSURE	POWER	PRESSURE DROP	EXIT QUALITY	MASS VELOCITY	INLET SUBCOOLING	HEAT FLUX
	MEGA-PASCAL	KILO-WATT	KILO-PASCAL		MEGAGRAM / SEC.METRE2	KILOJOULE / KILOGRAM	KILOWATT / METRE2
17027601	1.042	16.14	40.7	0.280	1.400	28.28	117.5
17027602*	1.043	16.95	40.4	0.305	1.396	28.32	123.4
17027603	1.044	15.74	40.2	0.303	1.399	23.83	114.6
17027604*	1.043	16.16	40.2	0.316	1.396	23.81	117.7
17027605	1.044	14.53	39.2	0.327	1.397	16.05	105.8
17027606*	1.045	14.86	39.0	0.337	1.396	16.07	108.2
17027607	1.043	12.94	37.6	0.343	1.394	7.86	94.2
17027608*	1.043	13.84	37.5	0.370	1.396	7.86	100.8
17027609	1.043	17.97	48.7	0.174	1.989	28.70	130.9
17027610*	1.045	18.76	48.8	0.191	1.988	28.60	136.6
18027601	1.042	16.24	49.7	0.225	1.992	17.34	118.3
18027602*	1.042	17.05	49.2	0.242	1.993	17.32	124.1
18027603	1.043	15.62	49.4	0.240	1.987	13.87	113.7
18027604*	1.043	16.35	49.4	0.255	1.987	13.87	119.0
18027605	1.043	14.37	50.5	0.278	1.998	5.44	104.6
18027606*	1.043	15.11	49.5	0.293	1.996	5.42	110.0

TABLE 4(b)

TEST SECTION PRESSURE DROP DATA FOR ZERO POWER INPUT

TEST SECTION IDENTIFICATION NUMBER CE 37338-2

RUN NUMBER	INLET PRESS.	INLET TEMP.	MASS VELOCITY	PRESSURE DROP
	MEGAPASCAL	DEG.C	MEGAGRAM / SEC.METRE2	KILOPASCAL
18027601	1.045	28.1	0.636	39.2
18027602	1.044	28.0	0.639	39.1
24027601	1.046	23.5	1.040	39.7
24027602	1.046	24.0	1.047	39.9
18027601	1.044	28.2	1.375	41.3
18027602	1.044	28.2	1.376	41.0
18027603	1.044	27.9	1.978	43.5
18027604	1.045	27.9	1.980	43.6

TABLE 5(a)

BURNOUT DATA FOR FREON-12 IN ANNULAR TEST SECTION: HEATED INNER TUBE

ORIGIN OF TEST SECTION		A.A.E.C.
TEST SECTION IDENTIFICATION NUMBER		A2E 47268-1
MATERIAL OF CONSTRUCTION		S.S AISI 321
MODE OF HEATING		D.C. RESISTANCE
BURNOUT DETECTOR		RESISTANCE TYPE
HEATED LENGTH	876.3	MILLIMETRES
DISTANCE BETWEEN PRESSURE TAPS	863.6	MILLIMETRES
SHROUD INNER DIAMETER	20.95	MILLIMETRES
OUTER DIAMETER OF INNER TUBE	15.88	MILLIMETRES
WALL THICKNESS OF INNER TUBE	1.98	MILLIMETRES
HEATED SECTION RESISTANCE AT 20 DEG.C	0.008	OHM

* DENOTES A BURNOUT RUN

RUN NUMBER	INLET PRESSURE	POWER	PRESSURE DROP	EXIT QUALITY	MASS VELOCITY	INLET SUBCOOLING	HEAT FLUX
	MEGA-PASCAL	KILO-WATT	KILO-PASCAL		MEGAGRAM / SEC.METRE2	KILOJOULE / KILOGRAM	KILOWATT / METRE2
04027701	1.040	5.29	11.3	0.274	0.577	27.88	121.1
04027702*	1.041	5.65	11.2	0.303	0.582	27.90	129.3
04027703	1.041	4.70	11.0	0.280	0.569	20.98	107.5
04027704*	1.042	5.12	10.9	0.320	0.569	21.03	117.2
04027705	1.042	4.38	10.9	0.298	0.584	13.52	100.2
04027706*	1.043	4.84	10.9	0.344	0.578	13.56	110.7
04027707	1.042	3.94	10.8	0.317	0.588	5.69	90.1
04027708*	1.043	4.31	11.0	0.348	0.591	5.73	98.6
07027701	1.041	7.06	16.7	0.022	1.465	30.73	161.6
07027702*	1.036	7.80	17.1	0.051	1.465	30.50	178.6
07027703	1.038	6.54	17.0	0.046	1.495	24.59	149.7
07027704*	1.039	7.24	17.7	0.071	1.493	24.65	165.7
07027705	1.039	6.35	19.6	0.111	1.531	14.90	145.4
07027706*	1.040	6.84	20.2	0.129	1.525	14.95	156.5
07027707	1.039	5.51	22.4	0.168	1.499	4.48	126.1
07027708*	1.040	5.92	23.0	0.183	1.499	4.54	135.5
07027709	1.037	8.44	20.3	0.003	1.974	29.49	193.0
07027710*	1.039	8.83	20.6	0.014	1.972	29.59	202.0
07027711	1.040	7.54	20.2	0.010	1.982	25.44	172.5
07027712*	1.041	8.35	21.1	0.032	1.982	25.47	191.0
07027713	1.040	7.15	23.8	0.083	1.990	14.86	163.7
07027714*	1.042	7.47	24.4	0.091	1.990	14.94	171.0
07027715	1.040	5.97	29.2	0.132	1.986	4.78	136.6
07027716*	1.041	6.38	29.9	0.143	1.987	4.84	145.9

TABLE 5(a) (Continued)

RUN NUMBER	INLET PRESSURE	POWER	PRESSURE DROP	EXIT QUALITY	MASS VELOCITY	INLET SUBCOOLING	HEAT FLUX
	MEGA-PASCAL	KILO-WATT	KILO-PASCAL		MEGAGRAM / SEC.METRE2	KILOJOULE / KILOGRAM	KILOWATT / METRE2
08027701	1.038	9.82	23.9	-0.028	2.505	31.30	224.7
08027702*	1.038	10.65	24.9	-0.010	2.503	31.29	243.7
08027703	1.040	9.00	24.6	-0.002	2.497	25.79	206.0
08027704*	1.044	9.77	25.5	0.014	2.496	25.96	223.5
08027705	1.040	8.05	28.2	0.056	2.512	15.78	184.1
08027706*	1.040	8.53	29.1	0.067	2.511	15.80	195.2
08027707	1.039	6.82	36.4	0.112	2.512	5.64	156.0
08027708*	1.041	7.21	37.8	0.121	2.509	5.73	165.1

TABLE 5(b)

TEST SECTION PRESSURE DROP DATA FOR ZERO POWER INPUT

TEST SECTION IDENTIFICATION NUMBER A2E 47268-1

RUN NUMBER	INLET PRESS.	INLET TEMP.	MASS VELOCITY	PRESSURE DROP
	MEGAPASCAL	DEG.C	MEGAGRAM / SEC.METRE2	KILOPASCAL
04027701	1.037	23.5	0.584	12.3
04027702	1.037	23.6	0.591	12.4
04027703	1.038	24.4	0.966	13.3
04027704	1.038	24.4	0.971	13.2
04027705	1.038	25.1	1.484	14.9
04027706	1.039	25.2	1.490	14.7
04027707	1.039	25.5	1.981	16.9
04027708	1.039	25.5	1.982	17.0
04027709	1.039	25.7	1.981	17.1
04027710	1.040	25.7	1.979	17.0
04027711	1.038	25.8	2.503	19.8
04027712	1.039	25.9	2.500	19.8

TABLE 6(a)

BURNOUT DATA FOR FREON-12 IN ANNULAR TEST SECTION: HEATED INNER TUBE

ORIGIN OF TEST SECTION		A.A.E.C.
TEST SECTION IDENTIFICATION NUMBER		A2E 47268-2
MATERIAL OF CONSTRUCTION		S.S AISI 321
MODE OF HEATING		D.C. RESISTANCE
BURNOUT DETECTOR		RESISTANCE TYPE
HEATED LENGTH	1790.7	MILLIMETRES
DISTANCE BETWEEN PRESSURE TAPS	1727.2	MILLIMETRES
SHROUD INNER DIAMETER	20.95	MILLIMETRES
OUTER DIAMETER OF INNER TUBE	15.88	MILLIMETRES
WALL THICKNESS OF INNER TUBE	4.80	MILLIMETRES
HEATED SECTION RESISTANCE AT 20 DEG.C	0.010	OHM

* DENOTES A BURNOUT RUN

RUN NUMBER	INLET PRESSURE	POWER	PRESSURE DROP	EXIT QUALITY	MASS VELOCITY	INLET SUBCOOLING	HEAT FLUX
	MEGA-PASCAL	KILO-WATT	KILO-PASCAL		MEGAGRAM / SEC.METRE2	KILOJOULE / KILOGRAM	KILOWATT / METRE2
18017701	1.052	5.95	21.2	0.365	0.543	29.07	66.7
18017702*	1.053	6.74	21.0	0.439	0.545	29.10	75.5
18017703	1.052	5.88	20.7	0.411	0.542	22.43	65.9
18017704*	1.053	6.24	20.4	0.443	0.545	22.45	69.9
18017705	1.052	5.37	19.6	0.429	0.534	14.60	60.1
18017706*	1.053	5.88	19.7	0.482	0.533	14.62	65.9
18017707	1.053	4.77	19.2	0.446	0.540	4.33	53.5
18017708*	1.054	5.33	19.0	0.501	0.538	4.40	59.7
20017701	1.052	9.63	29.8	0.276	1.012	30.87	107.9
20017702*	1.053	10.68	29.7	0.330	1.013	30.92	119.6
20017703	1.052	8.69	30.1	0.280	1.030	22.98	97.3
20017704*	1.054	9.67	30.5	0.330	1.030	23.05	108.3
20017705	1.053	7.92	30.7	0.309	1.020	14.74	88.7
20017706*	1.053	8.73	30.9	0.351	1.020	14.74	97.7
20017707	1.053	6.76	31.2	0.303	1.024	7.62	75.7
20017708*	1.054	7.62	31.7	0.348	1.023	7.65	85.3
21017701	1.050	10.82	36.7	0.179	1.439	29.85	121.2
21017702*	1.053	11.78	37.9	0.214	1.439	30.02	131.9
21017703	1.053	10.63	38.8	0.219	1.429	24.27	119.0
21017704*	1.054	10.96	38.9	0.230	1.434	24.32	122.8
24017701	1.051	8.97	41.3	0.228	1.466	14.24	100.5
24017702*	1.052	9.70	42.5	0.255	1.465	14.27	108.6
24017703	1.051	7.93	44.4	0.253	1.473	6.13	88.8
24017704*	1.052	8.34	45.0	0.268	1.471	6.16	93.4

TABLE 6(a) (Continued)

RUN NUMBER	INLET PRESSURE	POWER	PRESSURE DROP	EXIT QUALITY	MASS VELOCITY	INLET SUBCOOLING	HEAT FLUX
	MEGA-PASCAL	KILO-WATT	KILO-PASCAL		MEGAGRAM / SEC.METRE2	KILOJOULE / KILOGRAM	KILOWATT / METRE2
24017705	1.052	12.33	43.3	0.116	1.953	31.70	143.7
24017706*	1.056	14.53	47.1	0.163	1.946	31.89	162.7
24017707	1.053	12.00	50.2	0.177	1.953	21.24	134.4
24017708*	1.055	12.70	51.7	0.197	1.949	21.33	142.2
24017709	1.053	10.66	53.5	0.190	1.955	15.02	119.4
24017710*	1.055	11.57	55.0	0.214	1.957	15.08	129.6
24017711	1.053	8.56	57.0	0.196	1.962	6.97	95.8
24017712*	1.055	9.74	59.0	0.228	1.957	7.07	109.0
25017701	1.054	15.22	50.6	0.094	2.398	33.30	170.4
25017702*	1.058	16.72	53.8	0.127	2.396	33.48	187.3
25017703	1.054	13.41	53.3	0.105	2.430	26.39	150.1
25017704*	1.060	15.21	57.8	0.144	2.421	26.67	170.3
26017701	1.051	11.40	64.1	0.157	2.414	14.64	127.7
26017702*	1.054	12.41	66.5	0.179	2.415	14.75	139.0
26017703	1.052	9.71	72.3	0.185	2.399	6.75	108.8
26017704*	1.055	10.40	73.7	0.201	2.392	6.85	116.4

TABLE 6(b)

TEST SECTION PRESSURE DROP DATA FOR ZERO POWER UNIT

TEST SECTION IDENTIFICATION NUMBER A2E 47268-2

RUN NUMBER	INLET PRESS.	INLET TEMP.	MASS VELOCITY	PRESSURE DROP
	MEGAPASCAL	DEG.C	MEGAGRAM / SEC.METRE2	KILOPASCAL
15037701	1.044	26.3	0.585	23.5
15037702	1.044	26.4	0.581	23.2
15037703	1.046	26.6	0.992	25.4
15037704	1.046	26.6	0.987	25.2
15037705	1.044	26.7	1.497	28.7
15037706	1.046	26.7	1.499	28.7
15037707	1.046	27.0	1.995	33.0
15037708	1.046	27.1	1.994	33.0
15037709	1.044	27.1	2.507	38.5
15037710	1.045	27.1	2.507	38.6

TABLE 7(a)

BURNOUT DATA FOR FREON-12 IN ANNULAR TEST SECTION: HEATED INNER TUBE

ORIGIN OF TEST SECTION		A.A.E.C.
TEST SECTION IDENTIFICATION NUMBER		A2E 47268-3
MATERIAL OF CONSTRUCTION		S.S AISI 321
MODE OF HEATING		D.C. RESISTANCE
BURNOUT DETECTOR		RESISTANCE TYPE
HEATED LENGTH	2705.0	MILLIMETRES
DISTANCE BETWEEN PRESSURE TAPS	2705.0	MILLIMETRES
SHROUD INNER DIAMETER	20.95	MILLIMETRES
OUTER DIAMETER OF INNER TUBE	15.88	MILLIMETRES
WALL THICKNESS OF INNER TUBE	1.98	MILLIMETRES
HEATED SECTION RESISTANCE AT 20 DEG.C	0.023	OHM

* DENOTES A BURNOUT RUN

RUN NUMBER	INLET PRESSURE	POWER	PRESSURE DROP	EXIT QUALITY	MASS VELOCITY	INLET SUBCOOLING	HEAT FLUX
	MEGA-PASCAL	KILO-WATT	KILO-PASCAL		MEGAGRAM / SEC.METRE2	KILOJOULE / KILOGRAM	KILOWATT / METRE2
07037701	1.044	6.65	34.5	0.384	0.587	29.41	49.3
07037702*	1.045	7.03	34.5	0.418	0.587	29.42	52.1
07037703	1.045	6.03	33.9	0.379	0.588	22.83	44.7
07037704*	1.046	6.49	34.2	0.419	0.589	22.87	48.1
07037705	1.045	5.93	33.7	0.421	0.585	16.55	44.0
07037706*	1.046	6.09	33.8	0.439	0.582	16.57	45.1
07037707	1.046	5.03	33.3	0.429	0.595	4.11	37.3
07037708*	1.047	5.41	33.8	0.461	0.597	4.14	40.1
07037709	1.047	9.23	48.6	0.272	1.006	29.56	68.4
07037710*	1.048	9.65	49.1	0.295	1.006	29.60	71.6
07037711	1.047	8.59	49.2	0.290	1.002	23.27	63.7
07037712*	1.048	8.91	49.6	0.307	1.000	23.31	66.1
08037701	1.046	7.73	50.8	0.311	1.000	14.85	57.3
08037702*	1.047	8.05	51.1	0.328	0.999	14.89	59.7
08037703	1.046	6.48	52.5	0.328	0.995	4.42	48.0
08037704*	1.047	6.74	52.9	0.342	0.996	4.44	50.0
08037705	1.047	12.06	65.5	0.211	1.489	30.81	89.4
08037706*	1.049	12.99	67.2	0.244	1.488	30.90	96.3
08037707	1.046	10.27	64.5	0.191	1.507	24.49	76.1
08037708*	1.050	11.23	66.8	0.225	1.504	24.66	83.2
08037709	1.048	9.37	71.6	0.237	1.504	14.87	69.4
08037710*	1.049	9.70	72.8	0.249	1.505	14.89	71.9
08037711	1.048	7.78	78.3	0.260	1.501	5.04	57.7
08037712*	1.049	8.03	79.0	0.269	1.500	5.09	59.5

TABLE 7(a) (Continued)

RUN NUMBER	INLET PRESSURE	POWER	PRESSURE DROP	EXIT QUALITY	MASS VELOCITY	INLET SUBCOOLING	HEAT FLUX
	MEGA-PASCAL	KILO-WATT	KILO-PASCAL		MEGAGRAM / SEC.METRE2	KILOJOULE / KILOGRAM	KILOWATT / METRE2
08037713	1.051	13.57	78.6	0.150	1.987	30.54	100.6
08037714*	1.053	14.51	80.8	0.176	1.980	30.62	107.6
09037701	1.047	12.75	83.8	0.167	2.005	25.21	94.5
09037702*	1.049	13.30	85.1	0.183	1.996	25.31	98.6
09037703	1.047	10.93	93.2	0.199	1.984	15.77	81.0
09037704*	1.049	11.41	94.1	0.212	1.978	15.87	84.5
09037705	1.047	8.81	106.9	0.225	1.996	5.45	65.3
09037706*	1.049	9.09	107.5	0.232	1.996	5.51	67.4
09037707	1.047	15.40	92.2	0.106	2.519	31.84	114.2
09037708*	1.052	16.68	97.4	0.134	2.508	32.05	123.6
09037709	1.050	13.64	95.5	0.115	2.508	26.24	101.1
09037710*	1.055	15.20	101.7	0.150	2.488	26.47	112.7
09037711	1.048	12.00	121.4	0.179	2.510	14.43	88.9
09037712*	1.051	12.46	122.3	0.189	2.509	14.52	92.4
09037713	1.048	9.58	139.4	0.202	2.500	5.79	71.0
09037714*	1.049	9.83	140.1	0.207	2.502	5.83	72.9

TABLE 7(b)

TEST SECTION PRESSURE DROP DATA FOR ZERO POWER INPUT

TEST SECTION IDENTIFICATION NUMBER A2E 47268-3

RUN NUMBER	INLET PRESS.	INLET TEMP.	MASS VELOCITY	PRESSURE DROP
	MEGAPASCAL	DEG.C	MEGAGRAM / SEC.METRE2	KILOPASCAL
09037701	1.050	23.2	0.599	38.6
09037702	1.050	23.3	0.594	38.2
09037703	1.049	23.2	1.009	41.4
09037704	1.049	23.2	1.006	41.0
09037705	1.048	22.9	1.492	47.5
09037706	1.049	23.4	1.497	47.2
09037707	1.049	23.1	1.496	47.5
09037708	1.049	23.1	1.496	47.7
09037709	1.049	22.7	2.520	67.3
09037710	1.049	23.2	2.519	67.0

TABLE 8(a)

BURNOUT DATA FOR FREON-12 IN ANNULAR TEST SECTION: HEATED INNER TUBE

ORIGIN OF TEST SECTION		A.A.E.C.
TEST SECTION IDENTIFICATION NUMBER		A2E 47268-4
MATERIAL OF CONSTRUCTION		S.S AISI 321
MODE OF HEATING		D.C. RESISTANCE
BURNOUT DETECTOR		RESISTANCE TYPE
HEATED LENGTH	3619.5	MILLIMETRES
DISTANCE BETWEEN PRESSURE TAPS	3619.5	MILLIMETRES
SHROUD INNER DIAMETER	20.95	MILLIMETRES
OUTER DIAMETER OF INNER TUBE	15.88	MILLIMETRES
WALL THICKNESS OF INNER TUBE	1.98	MILLIMETRES
HEATED SECTION RESISTANCE AT 20 DEG.C	0.031	OHM

* DENOTES A BURNOUT RUN

RUN NUMBER	INLET PRESSURE	POWER	PRESSURE DROP	EXIT QUALITY	MASS VELOCITY	INLET SUBCOOLING	HEAT FLUX
	MEGA-PASCAL	KILO-WATT	KILO-PASCAL		MEGAGRAM / SEC.METRE2	KILOJOULE / KILOGRAM	KILOWATT / METRE2
16?27701	1.052	7.06	46.6	0.445	0.578	28.09	39.1
16?27702*	1.?53	7.47	46.4	0.483	0.578	28.12	41.4
16?27703	1.052	6.56	46.4	0.455	0.585	20.00	36.3
16?27704*	1.053	6.85	46.3	0.482	0.585	20.04	38.0
17?27701	1.050	6.08	45.4	0.456	0.577	15.21	33.7
17?27702*	1.?51	6.38	45.4	0.484	0.577	15.24	35.3
17?27703	1.052	5.63	45.1	0.490	0.580	5.19	31.2
17?27704*	1.052	5.83	45.0	0.509	0.580	5.19	32.3
17?27705	1.052	9.60	65.2	0.311	0.983	29.25	53.2
17?27706*	1.054	10.12	65.8	0.337	0.986	29.32	56.1
17?27707	1.053	8.86	65.1	0.304	0.985	24.90	49.1
17?27708*	1.055	9.68	66.2	0.348	0.986	24.98	53.6
01?37701	1.054	8.43	67.4	0.332	1.005	17.21	46.7
01?37702*	1.054	8.82	67.9	0.352	1.007	17.22	48.8
17?27701	1.053	7.12	69.9	0.360	0.988	5.67	39.4
17?27702*	1.054	7.45	70.1	0.377	0.990	5.72	41.3
24?27701	1.049	12.68	88.3	0.248	1.479	30.07	70.2
24?27702*	1.050	13.21	89.7	0.266	1.481	30.15	73.2
24?27703	1.049	11.82	91.9	0.261	1.490	24.08	65.5
24?27704*	1.053	12.09	92.7	0.271	1.491	24.10	67.0
24?27705	1.049	10.21	96.3	0.277	1.483	15.18	56.6
24?27706*	1.050	10.61	97.2	0.291	1.481	15.21	58.8
24?27707	1.050	8.10	103.6	0.285	1.484	4.62	44.9
24?27708*	1.051	8.40	104.2	0.295	1.486	4.66	46.5

TABLE 8(a) (Continued)

RUN NUMBER	INLET PRESSURE	POWER	PRESSURE DROP	EXIT QUALITY	MASS VELOCITY	INLET SUBCOOLING	HEAT FLUX
	MEGA-PASCAL	KILO-WATT	KILO-PASCAL		MEGAGRAM / SEC.METRE2	KILOJOULE / KILOGRAM	KILOWATT / METRE2
24?27709	1.049	15.05	112.9	0.203	1.988	29.96	83.4
24?27710*	1.052	15.72	115.6	0.223	1.980	30.06	87.1
24?27711	1.049	14.04	119.3	0.225	1.974	24.24	77.8
24?27712*	1.051	14.47	120.2	0.236	1.973	24.33	80.1
25?27701	1.049	11.71	128.4	0.233	1.991	15.16	64.9
25?27702*	1.049	12.31	130.6	0.250	1.986	15.23	68.2
25?27703	1.049	9.04	142.4	0.249	1.987	4.56	50.1
25?27704*	1.049	9.39	143.3	0.258	1.988	4.59	52.0
25?27705	1.049	17.26	134.4	0.160	2.497	31.96	95.6
25?27706*	1.054	18.36	140.4	0.185	2.486	32.18	101.7
25?27707	1.049	15.76	148.7	0.188	2.511	24.53	87.3
25?27708*	1.052	16.42	151.5	0.203	2.504	24.64	91.0
25?27709	1.049	12.82	164.3	0.206	2.510	14.93	71.0
25?27710*	1.052	13.43	166.7	0.219	2.500	15.04	74.4
25?27711	1.051	9.81	185.1	0.229	2.485	4.85	54.3
25?27712*	1.052	10.13	186.4	0.235	2.487	4.88	56.1

TABLE 8(b)

TEST SECTION PRESSURE DROP DATA FOR ZERO POWER INPUT

TEST SECTION IDENTIFICATION NUMBER A2E 47268-4

RUN NUMBER	INLET PRESS.	INLET TEMP.	MASS VELOCITY	PRESSURE DROP
	MEGAPASCAL	DEG.C	MEGAGRAM / SEC.METRE2	KILOPASCAL
25027701	1.048	19.2	0.603	51.6
25027702	1.049	19.3	0.604	51.6
25027703	1.048	21.0	1.003	56.1
25027704	1.048	21.0	1.005	56.1
25027705	1.048	22.1	1.509	64.4
25027706	1.048	22.1	1.509	64.4
25027707	1.048	22.2	2.024	76.0
25027708	1.048	22.2	2.024	76.2
25027709	1.049	22.1	2.528	90.6
25027710	1.048	22.1	2.529	90.8

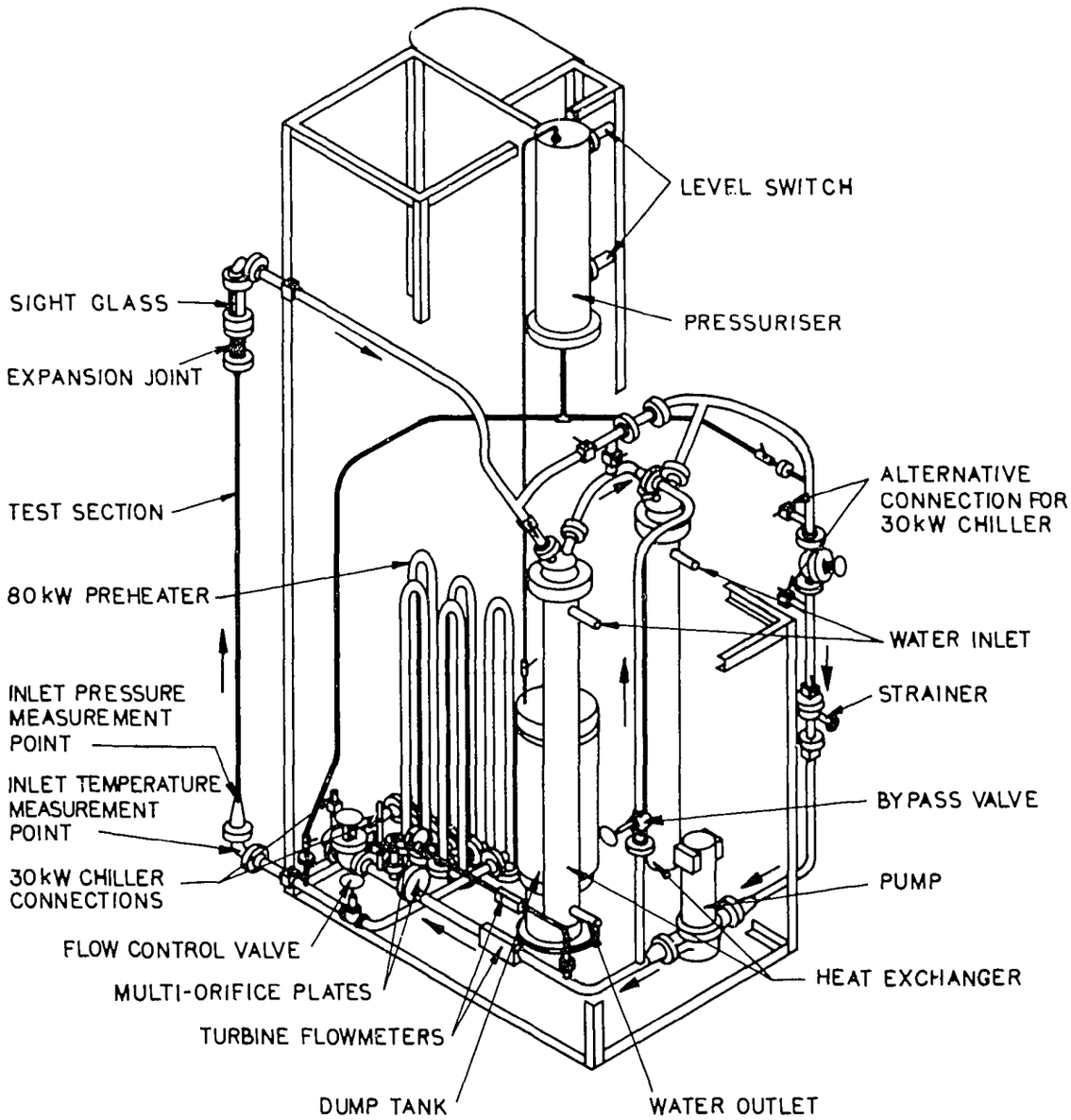

FIGURE 1. FREON-12 TEST RIG ACTOR

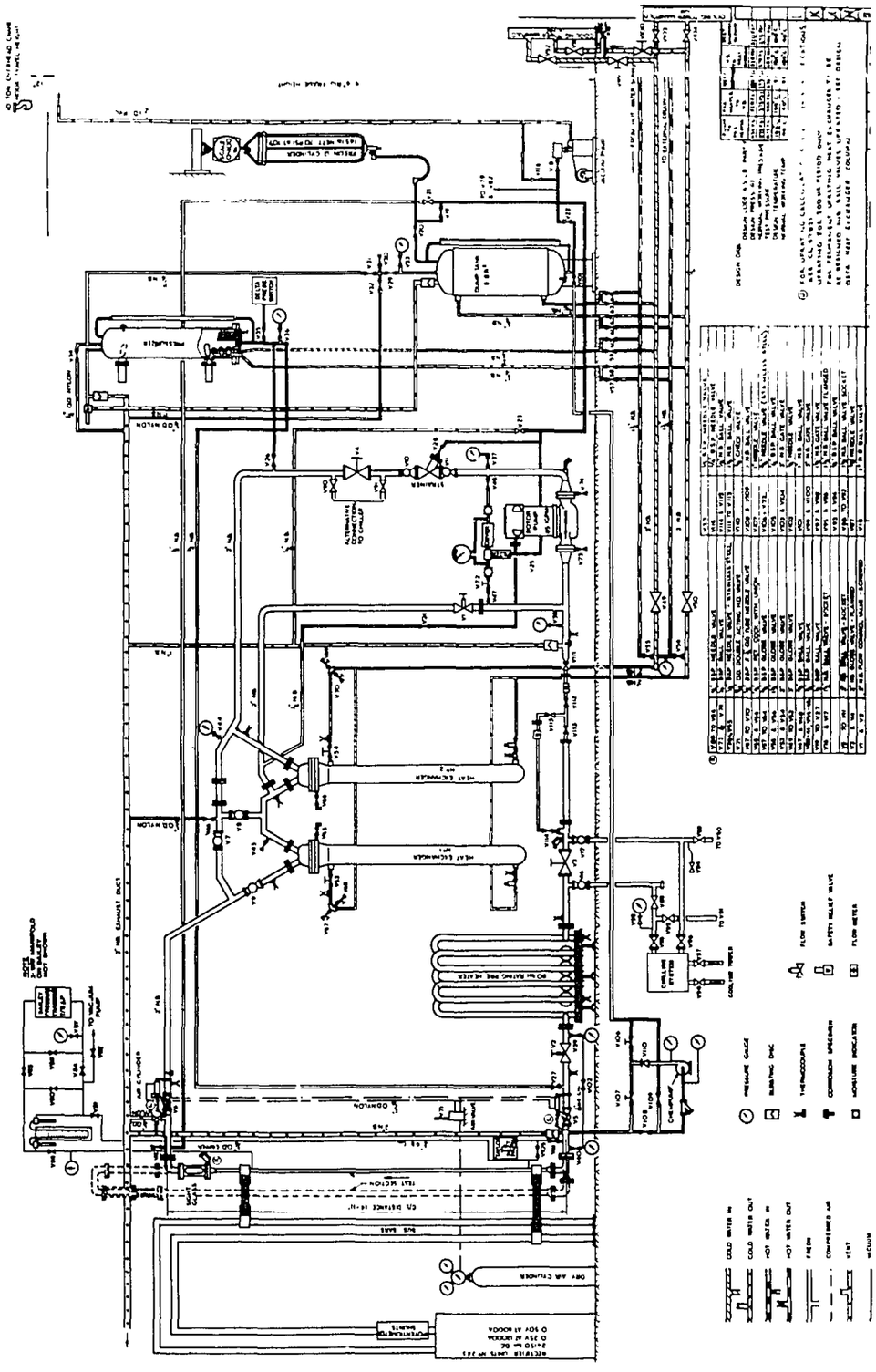

FIGURE 2. ACTOR RIG FLOW CIRCUITRY

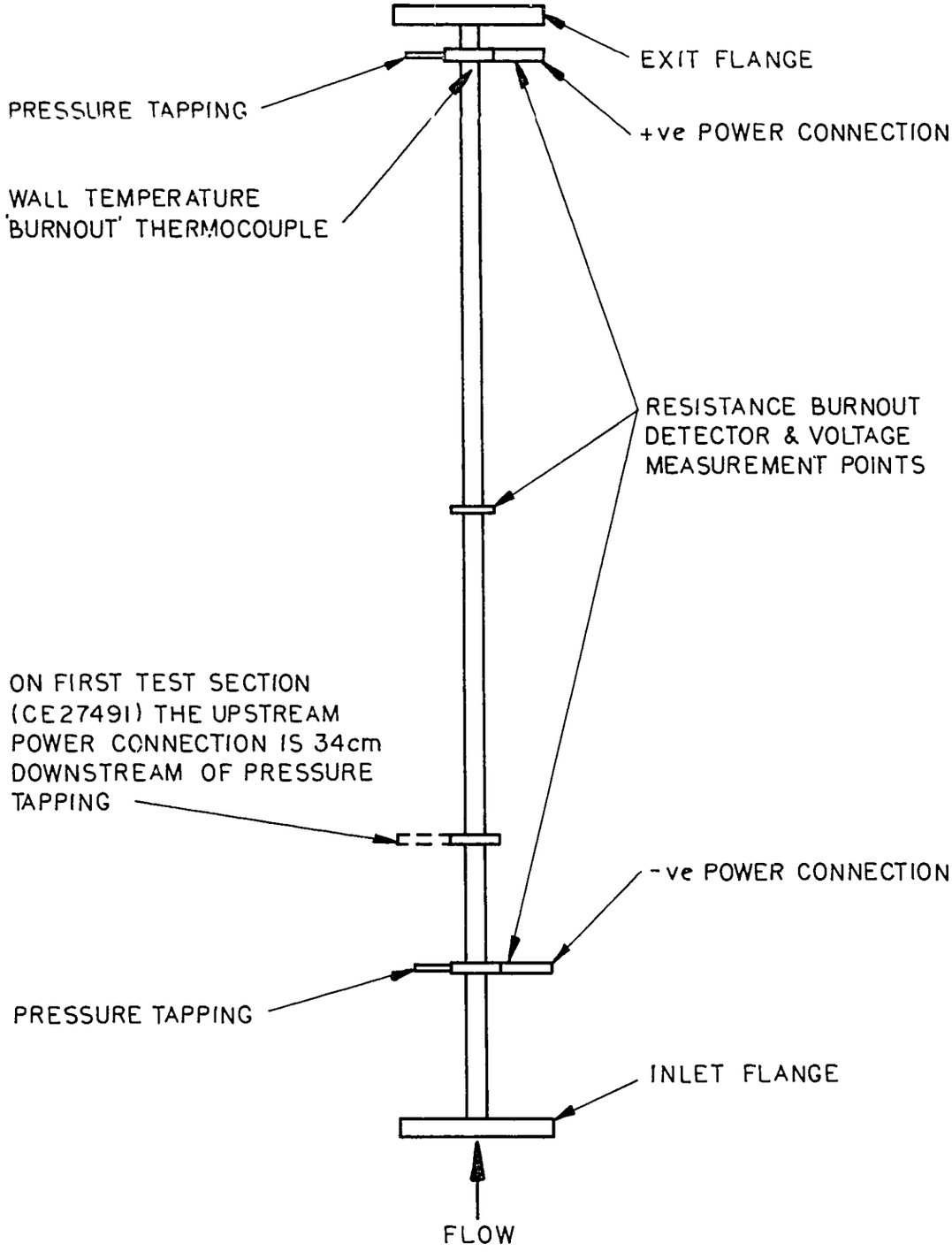

FIGURE 3. SINGLE TUBE TEST SECTION

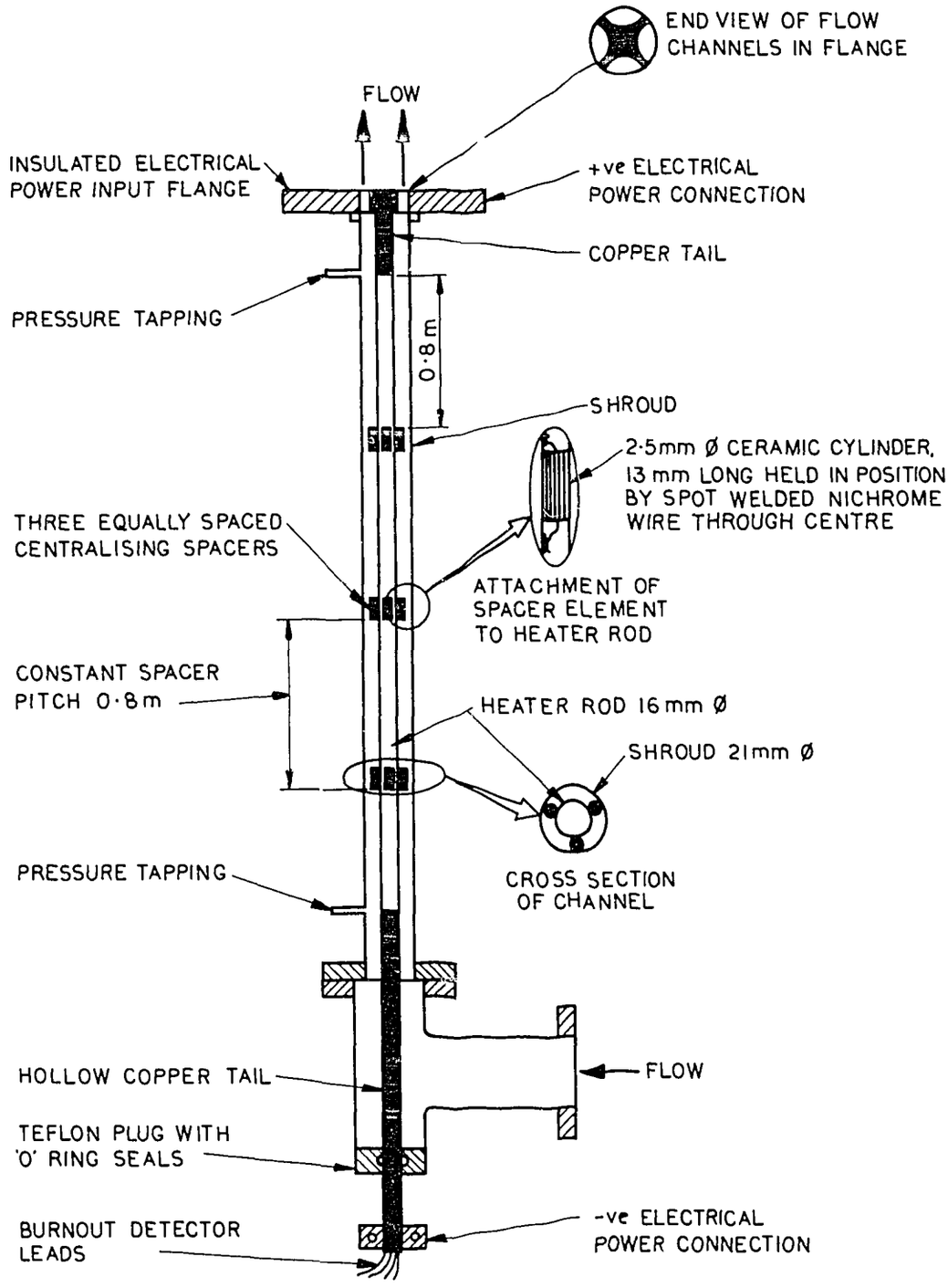

FIGURE 4. ANNULAR TEST SECTION

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