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Technical Memorandum

LOWER PLENUM VOIDING DATA REPORT

by

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ABSTRACT

This data report supplements a previous Creare report entitled "Lower Plenum Voiding" by providing figures and tables to document the data. Rresults of equilibrium, transient, and two-phase lower plenum voiding experiments performed in vessels ranging from 1/10 to 1/30 of PWR scale are reported.

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NOMENCLATURE

A_c	cross sectional area of core inlet
A_d	cross sectional area of downcomer
A_{MH}	cross sectional area of core inlet with multihole core plate
A_v	cross sectional area of vessel
D_c	diameter of core inlet
D_{eq}	equivalent diameter for multihole core inlet, $\sqrt{4A_{MH}/\pi}$
D_v	diameter of vessel
g	acceleration due to gravity
h	water level depression below bottom of core barrel
J^*_{gc}	dimensionless reverse steam flow in annulus, $\rho_g^{1/2} j_{gc}/[gw\Delta\rho]^{1/2}$
j^*_{gc}	dimensionless core steam flow, $\rho_g^{1/2} V_{gc}/[gw\Delta\rho]^{1/2}$
j^*_{gj}	critical dimensionless core steam flow at which the Film Entrainment Regime occurs
j^*_{gs}	critical dimensionless core steam flow at which the Bulk Sloshing Regime occurs
j_{gc}	superficial steam velocity in annulus
K^*_{gc}	Kutateladze Number, $\rho_g^{1/2} V_{gc}/(g\sigma\Delta\rho)^{1/4}$
L_D	length of downcomer
L_{LP}	depth of lower plenum
P_{LP}	lower plenum pressure
Q_f	volumetric water flow injected into lower plenum
Q_T	volumetric water flow injected into annulus
s	annulus gap size
T_{ECC}	temperature of water injected into annulus
T_f	temperature of water injected into lower plenum
V_{gc}	average steam velocity at core inlet (based on core inlet open area)
V^*_{gc}	Steen Number, $(\rho_g/\rho_f)^{1/2} V_{gc}\ \mu/\sigma$
$\frac{V_{\ell p}(f)}{V_{\ell p}(0)}$	remaining plenum liquid volume fraction
W_e	Weber Number, $(\rho_g D_c V_{gc}^2/\sigma)$
W_{gc}	reverse core steam flow
w	mean annulus circumference

NOMENCLATURE (continued)

α	lower plenum fluid void fraction
τ	transient duration
σ	surface tension
ρ_f	density of liquid
ρ_g	density of gas
$\Delta\rho$	density difference, $(\rho_f-\rho_g)$
μ	viscosity of gas

1 INTRODUCTION

This is one of a series of reports which document experimental and analytical efforts to provide best-estimate models and sensitivity calculations for lower plenum filling during postulated Loss-of-Coolant Accidents (LOCA) in Pressurized Water Reactors (PWRs). This informal report supplements Creare TN-310 (Reference [3]) and presents facility descriptions and recent experimental results of equilibrium, transient and two-phase voiding experiments.

A complete review of the literature on lower plenum voiding is given in Section 3.2 of Reference [1]. In addition, Reference [1] describes the results of studies conducted during a parallel program at Creare with steam/water and at Dartmouth with air/water [2] which establishes the basic flow regimes for equilibrium liquid voiding and unifies previous data. Recent experimental studies at Creare have been conducted to assess more realistic effects involving two-phase mixtures, flow and pressure transients, ECC interactions, and model plenum geometries. The experiments which support this assessment are documented in this report. A complete discussion of these studies is provided in Reference [3]. Important conclusions from that report are briefly noted below.

As a result of the gain in understanding of equilibrium voiding processes in simple geometries, increased attention has been directed toward obtaining information of practical value in the reactor context. The conclusions from Creare's recent efforts toward this goal demonstrate that:

1) voiding of single phase liquid and two-phase swelled lower plenum fluid differ significantly;

2) reverse core steam, rather than enhancing voiding, actually lengthens depressurization time in some flashing transients, thereby suppressing voiding of the lower plenum fluid;

3) certain equilibrium voiding processes such as sloshing are too slow to play a role in rapid large break transients in model PWR vessels;

4) sloshing is suppressed by water injection either from the lower plenum or the cold leg;

5) realistic multihole core inlet geometries suppress sloshing;

6) ECC bypass, in the confined downcomer, is more limiting than voiding of ECC in the relatively open lower plenum.

These conclusions are drawn from several sources of information. This report provides Creare's recent experimental results, supplementing data available elsewhere, which form the data base from which the above conclusions of Reference [1] are drawn. Specifically, descriptions of experiments and tabulated data are given for five independent studies at Creare:

1) Equilibrium liquid voiding with simple geometries at 1/10 and 1/30 scale--supplementary tests to increase the data base for conclusions about scaling relationships.

2) Two-phase voiding experiments at 1/30 scale--to document lower plenum voiding during more realistic processes in the reactor context.

3) Transient liquid voiding at 1/15-scale--to investigate the effect of transient steam flows and compare the results with steady state voiding tests.

4) Lower plenum injection tests at 1/10, 1/15 and 1/30 scale--to evaluate lower plenum voiding behavior as a function of injection flow rate.

5) Multihole core inlet geometry tests at 1/30 scale--to supplement previous data.

The following sections document the test facilities and procedures used in obtaining the experimental data. Test results are given in the main text with appropriate discussion of the results. The reader is referred to Reference [3] for a more complete treatment of the subject of lower plenum voiding incorporating all available information to date.

Tables 1, 2 and 3 are reproduced from Reference [3] (reference numbers in Table 1 have been changed) to provide a guide to availability of existing data on lower plenum voiding studies. Table 4 provides a detailed breakdown of the data from Creare and Dartmouth programs. Those tests without references in Table 4 have not been documented previously and are tabulated in the appendices.

2 EXPERIMENTAL FACILITIES

The data presented in this report have been obtained in several different test vessels at Creare. The test facilities are briefly described below. Important geometry dimensions are summarized in Table 2. Further details can be found in the appropriate references.

2.1 1/30-Scale Transparent Vessel

Figure 1 is a sketch of the 1/30-scale transparent vessel. A detailed description of the vessel and instrumentation is given in Section 3.3 of Reference [1]. As noted in Table 2, this vessel has been used to obtain equilibrium voiding data for tube, multihole and orifice configurations. It has been used for single and two-phase voiding experiments.

2.2 1/15-Scale Vessels

Two 1/15-scale vessels have been used to obtain equilibrium voiding data with tube and multihole configurations. The majority of the experiments were performed in the elevated pressure facility described in Reference [17]. (Certain early experiments were performed in a previous vessel of the same size and are described in Reference [18].) The later vessel has also been used for tests with prototypical geometries and more recently to study transient voiding effects. Figure 2 is a sketch of the vessel and instrumentation details are provided in Reference [17].

2.3 1/10-Scale Facility

The 1/10-scale facility is shown in Figure 3 and described in Section 3.3 of Reference [1]. It has been used to provide equilibrium voiding data with orifice configurations as noted in Table 2.

3 EQUILIBRIUM LIQUID VOIDING DATA

The 1/10, 1/15 and 1/30-scale vessels have been used to provide a data base for studying equilibrium voiding behavior. Data have been obtained with single hole core inlet configurations for the purpose of determining the appropriate scaling relationships. Multihole configurations have also been tested to evaluate the voiding behavior of geometries more closely simulating reactor core inlet geometries. The following sections present the results of equilibrium voiding tests with single and multihole configurations.

Test results are presented in the form of plots of h/D_C versus j^*_{gc}. Comparisons with other correlating parameters are made in a later section. D_C is the inside diameter of the orifice or tube for single hole tests and equal to $\sqrt{4/\pi A_{MH}}$ for multihole configurations. j^*_{gc} is the dimensionless core steam flow and h is the equilibrium depression level of the liquid measured below the bottom of the core barrel as shown in Figure 4.

Reference [1] describes several alternate procedures used in conducting equilibrium voiding tests. Of those described, each yielded nearly identical results. The procedures used for equilibrium voiding data presented in the following section are:

1) heat the water and vessel to approximately 210°F;

2) fill the vessel with water to a level above the bottom of the core barrel;

3) turn on the steam at a low value until an equilibrium level h is reached (it can take several minutes for the water level to stop dropping at which time equilibrium is said to exist);

4) record the data;

5) set the steam flow rate to the next (higher) desired level and wait for equilibrium.

3.1 Single Hole Test Results

Figures 5a and 5b present data obtained with the 1/30 and 1/10-scale vessels with similar values of D_C/D_V. The results demonstrate that the h/D_C and j^*_{gc} parameters are appropriate for correlating the effect of vessel size. Good agreement between the two scales is achieved throughout all regimes.*

The effect of core inlet open area is illustrated in Figure 6. The 1/30-scale data are shown for core inlet areas of 44%, 79%, and 100% of the total core flow area. The dimensionless level depression h/D_C is insensitive to D_C/D_V in the Horizontal Wave Regime. However, both the j^*_{gc} values at which transition occurs and the h/D_C levels in the Bulk Sloshing and Film Entrainment Regimes are dependent on D_C/D_V. Additional 1/30 and 1/10-scale data with similar values of D_C/D_V are included in Appendix A.

Some care must be taken in making direct comparisons between the data shown in Figures 5 and 6 and earlier 1/10 and 1/30-scale data presented in Reference [1]. The earlier data with tube geometries were reduced using the characteristic dimension D_C equal to the inner diameter of the core inlet which seemed reasonable at the time. However, Figures 6 and 7 of Reference [1] show that an insulating liner of smaller diameter ends near the core inlet. This results in a step at the core inlet and raises the question as to which dimension should be used to properly reduce the data. The insulating liners on both facilities have been extended to the end of the core barrel to eliminate the question of the appropriate characteristic dimension. All of the data presented in this report were obtained with the modified vessels.

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*The three principal regimes of behavior (Horizontal Wave, Bulk Sloshing, and Film Entrainment) are described in References [1,2,3].

3.2 Multihole Test Results

Experiments with multihole core inlets have shown that bulk sloshing is suppressed when the single discrete jet is broken up into a number of small jets. Figure 7 (reproduced from Reference [3]) compares data with a single hole inlet and data for a multihole inlet of the same area. In these experiments the multihole core inlet had 64 holes of 0.375 in. diameter arranged uniformly in a region of 4.6 in. diameter (44% open area). The Horizontal Wave regime persisted to much larger core steam flow rates with the multihole geometry and less voiding occurred. Bulk sloshing was not observed with the multihole geometry although the data show a transition to a larger level depression at steam fluxes above $j^*_{gc}=0.7$. Additional 1/30-scale data with a multihole core inlet configuration are included in Appendix A.

3.3 Lower Plenum Injection Tests

The effect of lower plenum water injection was investigated during the equilibrium voiding test program. Experiments with the 1/10 and 1/30-scale vessels were conducted using identical test procedures as those for the basic voiding tests except that a steady injection of saturated liquid into the lower plenum was maintained.

Figures 8a and 8b show the results of these tests. Bulk sloshing is suppressed to higher j^*_{gc} values as the injection rate is increased. The results from 1/10 and 1/30-scale tests do not scale using the reduction parameters chosen for presentation, but the trends from each scale are similar.

3.4 Alternate Scaling Schemes

Several dimensionless groups have been suggested for correlating equilibrium voiding data. In this section, the data of Figures 5 and 6 are replotted in terms of these alternative parameters to assess their ability to correlate the voiding data.

Figure 9 presents core inlet open area and vessel size comparisons on h/D_c vs J^*_{gc} coordinates where J^*_{gc} is the dimensionless annulus steam flow used in countercurrent flow with $j_{gc}=W_{gc}/\rho_g sw$:

$$J^*_{gc} = \frac{\rho_g^{\frac{1}{2}} j_{gc}}{(gw\Delta\rho)^{\frac{1}{2}}} \qquad (1)$$

Figure 9a shows that the J^*_{gc} parameter does not scale core inlet area. This is expected since J^*_{gc} is not descriptive of the core geometry which has been observed to greatly influence the voiding phenomena. The J^*_{gc} parameter does scale vessel size as shown in Figures 9b and 9c. One might argue that J^*_{gc} scales the voiding results as well as j^*_{gc}. However, tests done in vessels with different gap dimensions indicate that the voiding is insensitive to gap size. Figure 10 supports this claim by showing that data with different gap dimensions overlay in j^*_{gc} coordinates but not in J^*_{gc} coordinates.

The data of Figure 9 are replotted in Figures 11, 12 and 13 using the Kutateladze Number K^{*}_{gc}, Weber Number W_e, and Steen Number V^{*}_{gc} respectively. These parameters are defined by the following expressions

$$K^{*}_{gc} = \frac{\rho_g^{1/2}\, V_{gc}}{\sqrt[4]{g\sigma\Delta\rho}} \qquad (2)$$

$$W_e = \frac{\rho_g\, D_c\, V_{gc}^{2}}{\sigma} \qquad (3)$$

$$V^{*}_{gc} = \left(\frac{\rho_g}{\rho_f}\right)^{1/2} V_{gc}\, \frac{\mu}{\sigma} \qquad (4)$$

Plotting the data in these coordinates yields similar results in each case. The data for various core inlet areas overlay up to the Bulk Sloshing Regime as they do with j^{*}_{gc}. None of the coordinates scale vessel size, however.

4 EQUILIBRIUM VOIDING OF TWO-PHASE MIXTURES

During a LOCA, processes such as flashing may occur which result in two phase mixtures in the lower plenum. For this reason, several scoping tests were conducted with the 1/30-scale vessel to evaluate the voiding behavior under two-phase conditions and to compare this behavior with single phase results.

A steam bubbler ring (Figure 1) located at the bottom of the vessel was used to inject steam into the liquid in the plenum. The rates of injection were relatively low and did not support liquid carryover into the downcomer. Steam rates were arbitrarily chosen to produce plenum average void fractions of 5%, 10%, 15% and 28%. Other than the steady injection of steam into the plenum, test procedures were identical to those used for the single phase tests. Void fraction was determined by measuring the liquid level with steam injection (swelled mixture) and without steam injection (collapsed level).

The results of these tests are shown in Figure 14. An equilibrium level was achieved faster with the two phase mixture than with single phase liquid in the lower plenum. For a given value of j^{*}_{gc}, the level depression increases with increasing void fraction. The complete set of two phase voiding data is included in Appendix B.

5 TRANSIENT LOWER PLENUM VOIDING TESTS

Tests with transient steam flows have been done with the 1/15-scale vessel. Three values of initial steam flow have been tested which are all above the transitional steam flow ($j_{gc}^{*}=0.3$) which causes bulk sloshing in the steady state experiments. Figure 15 is a reproduction of a steam flow and water level trace for a 33 second transient. Similar plots for all tests are given in Appendix C.

Results of the series of transient experiments are shown in Figure 16. The final water level depression is plotted against the initial steam flow rate with the transient time as a parameter. The data indicate that voiding is substantially reduced during transient tests when compared with the equilibrium test results.

6 CONCLUDING REMARKS

This report includes additional data which support the detailed conclusions stated in Reference [3]. This is the final document which addresses lower plenum voiding as a separate effect. Studies are currently underway to investigate the lower plenum inventory depletion caused by flashing, level swell, and carryover during blowdown transients. Additional definition of lower plenum voiding is an expected outcome of the flashing studies.

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TABLE 1

SUMMARY OF LPV RESEARCH

Investigator	Scale	Gas/Liquid	Reference	Date
ANC	Semiscale	Steam/Water	[4]	6/74
BCL	1/15	Steam/Water	[5]	2/77
BCL	1/15	Steam/Water	[6]	4/78
BCL	1/15	Steam/Water	[7]	12/78
Creare	1/50	Air/Water	[8]	5/78
Creare	1/15	Steam/Water	[9]	6/75
Creare	1/15	Steam/Water	[10]	5/77
Creare	1/15	Steam/Water	[11]	5/77
Creare	1/10, 1/15, 1/30	Steam/Water	[1]	6/78
Dartmouth	1/30	Steam/Water	[12]	1/75
Dartmouth	1/30	Steam/Water	[13]	7/75
Dartmouth	1/30	Steam/Water	[14]	1/76
Dartmouth	1/15, 1/24, 1/45	Air/Water	[15]	4/77
Dartmouth	1/15, 1/24, 1/45	Air/Water Air/Glycerine Air/Butanol	[16]	3/78
Dartmouth	1/15, 1/24, 1/45	Steam/Water Air/Methanol	[2]	9/78

TABLE 2

VESSEL GEOMETRIES UNDER CURRENT INVESTIGATION

Scale		1/30	1/15	1/10
D_V (in.)		6.0	11.5	17.5
s (in.)		0.25	0.50	0.75
s/D_V		0.04	0.04	0.04
L_D/D_V		2.0	1.6	2.1
L_{LP}/D_V		2.5, 6.0	0.5, 3.1	1.5
D_c/D_V	T*	0.75	0.5	
	O*	0.5, 0.67		0.5, 0.67
	MH*	0.5		

TABLE 3

VESSEL GEOMETRIES FOR DARTMOUTH STUDIES

Scale		1/45	1/24	1/15
D_V (in.)		3.9	7.5	11.5
s (in.)		0.35	0.50	0.47, 0.75, 1.0
s/D_V		0.09	0.07	0.04, 0.06, 0.09
L_D/D_V		2.1	0.47, 1.1, 1.7	1.1
L_{LP}/D_V		1.5	1.0, 1.7, 2.2	1.5
D_c/D_V	T*	0.76	0.80	0.91, 0.87, 0.83
	O*			0.52

*KEY: T = Tube
O = Orifice
MH = Multihole

TABLE 4

CORE INLET CONFIGURATIONS FOR CREARE AND DARTMOUTH LPV STUDIES

Investigator	D_v (in.)	D_c^* (in.)	Reference
Creare	17.5	15.2 ST	1
"	"	9.0 O	-
"	"	11.7 O	-
"	11.5	5.8 T	1
"	"	4.0 O	9
"	"	5.6 O	9
"	"	4.0 MH	9
"	"	5.8 MH	9
"	"	9.2 ST	9
"	"	1.9 O	10
"	"	3.9 O	10
"	"	5.6 MH	10
"	"	7.2 ST	10
"	"	6.2 W	11
"	"	7.0 BW	11
"	6.0	1.0 O	1
"	"	2.4 O	1
"	"	3.0 O	1
"	"	3.0 T	1
"	"	3.0 MH	1
"	"	5.0 ST	1
"	"	3.0 O	-
"	"	3.0 MH	-
"	"	4.0 O	-
"	"	4.5 T	-
Dartmouth	11.5	6.0 O	2
"	"	7.2 O	2, 16
"	"	9.0 O	2, 16
"	"	9.5 T	2, 15, 16
"	"	9.9 T	2, 15, 16
"	"	10.5 T	2, 15, 16
"	"	6.2 W	2, 16
"	"	7.0 BW	2, 16
"	7.4	6.0 T	2
"	"	6.2 T	15, 16
"	"	6.5 T	15
"	"	6.8 T	15
"	5.8	1.0 O	13
"	"	2.2 O	13
"	"	3.0 O	13
"	"	2.6 MH	13, 14
"	"	4.5 T	12, 13
"	3.9	3.0 T	12, 15, 16
"	"	3.5 T	15, 16

Key: T = Tube
O = Orifice
MH = Multihole, $D_c = \sqrt{4/\pi A_{MH}}$
ST = Stepped Tube, D_c is the O.D.
W = Westinghouse prototypical hardware
BW = Babcock & Wilcox prototypical hardware.

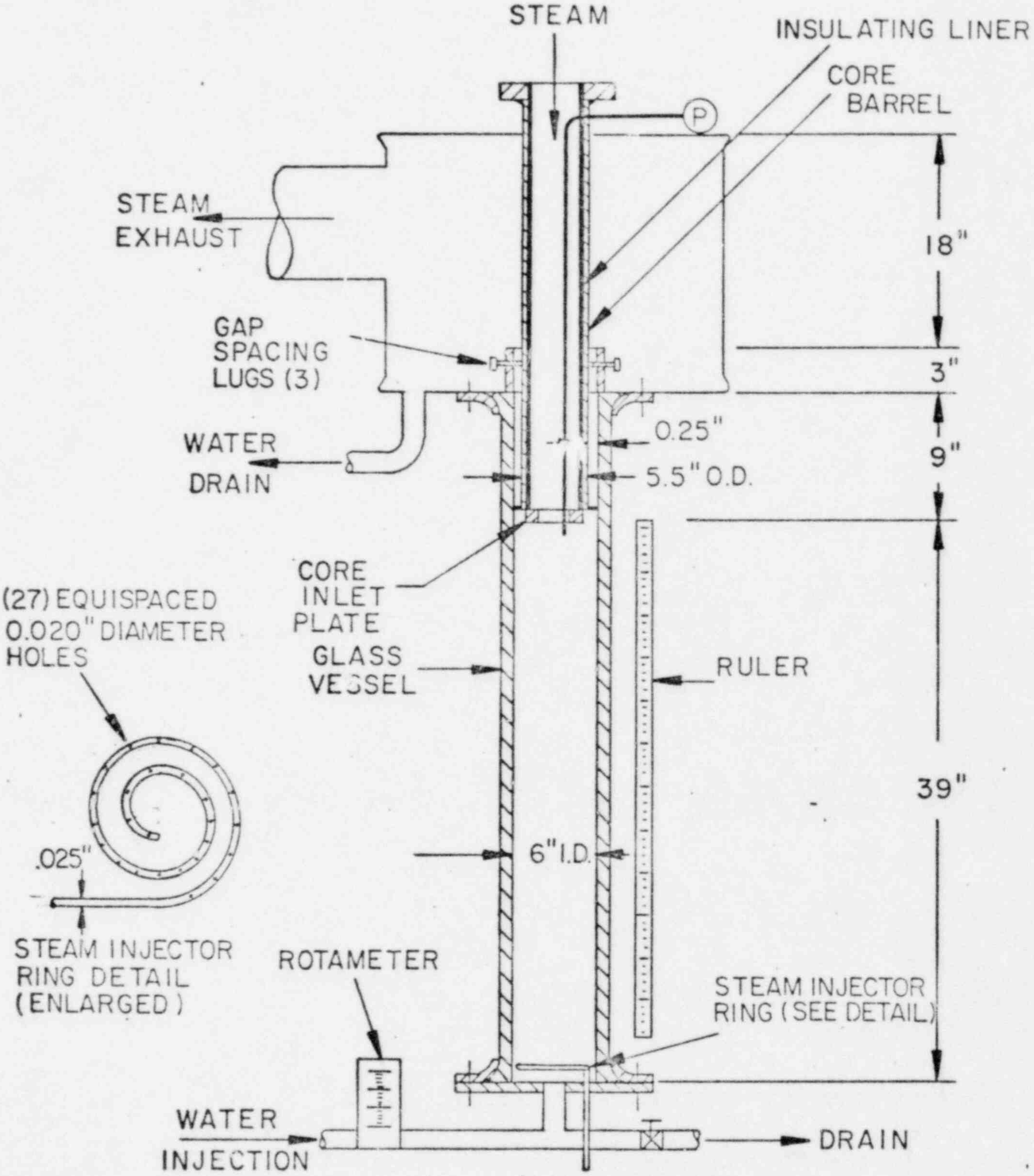
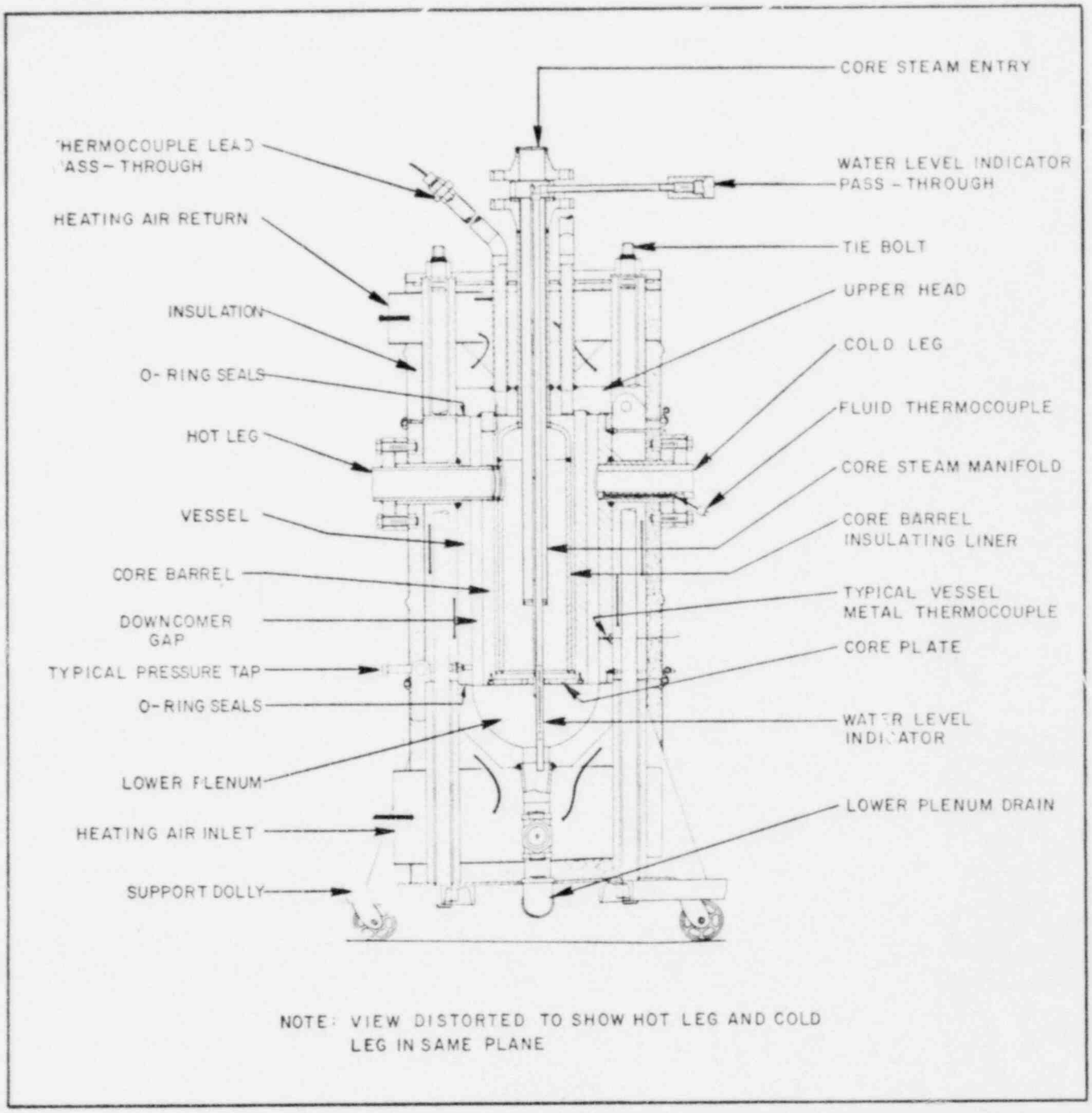


Figure 1. SKETCH OF 1/30-SCALE GLASS VESSEL FOR LOWER PLENUM VOIDING EXPERIMENTS



NOTE: VIEW DISTORTED TO SHOW HOT LEG AND COLD LEG IN SAME PLANE

Figure 2. CUTAWAY VIEW OF CREARE 1/15-SCALE HIGH PRESSURE CYLINDRICAL VESSEL

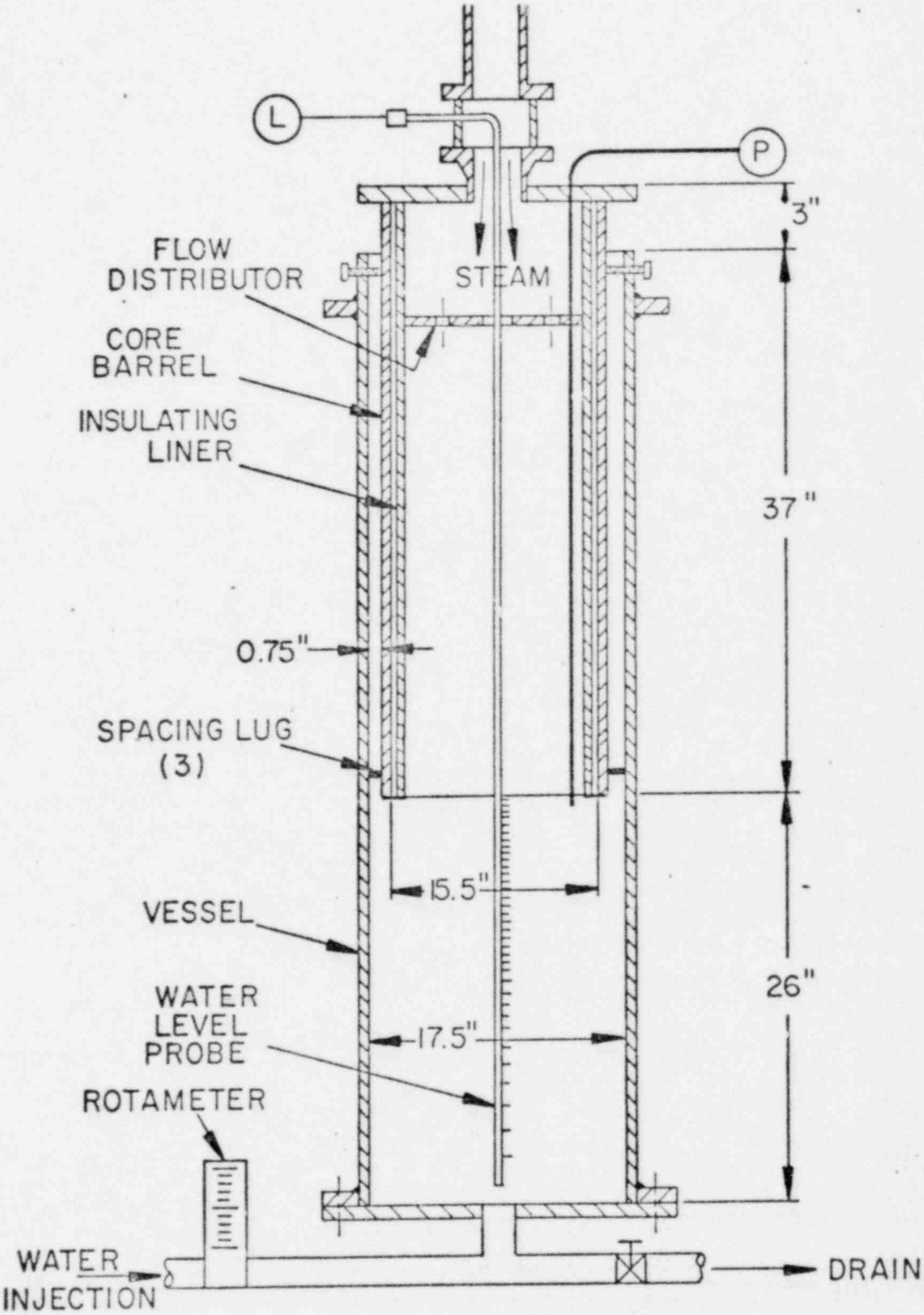


Figure 3. SKETCH OF 1/10-SCALE VESSEL FOR LOWER PLENUM VOIDING EXPERIMENTS

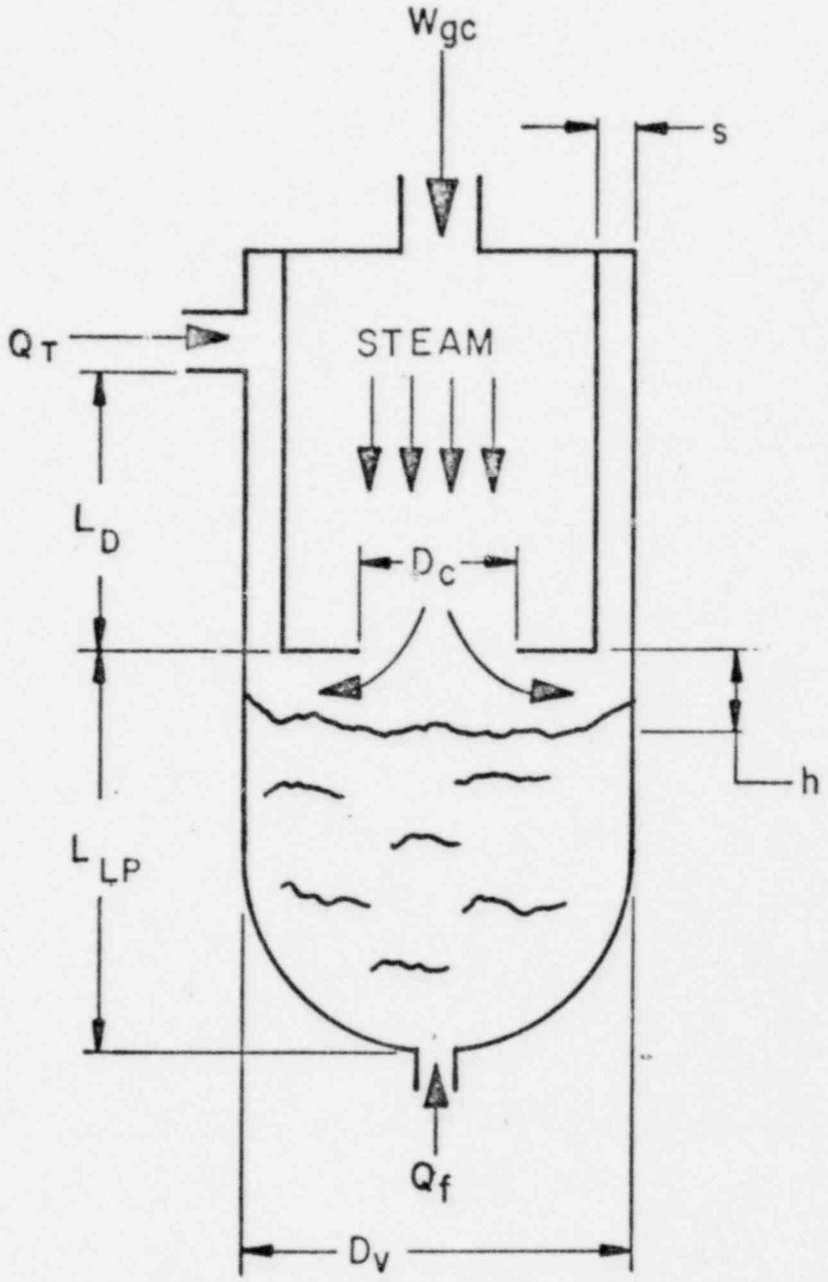


Figure 4. SKETCH OF LOWER PLENUM VOIDING SITUATION

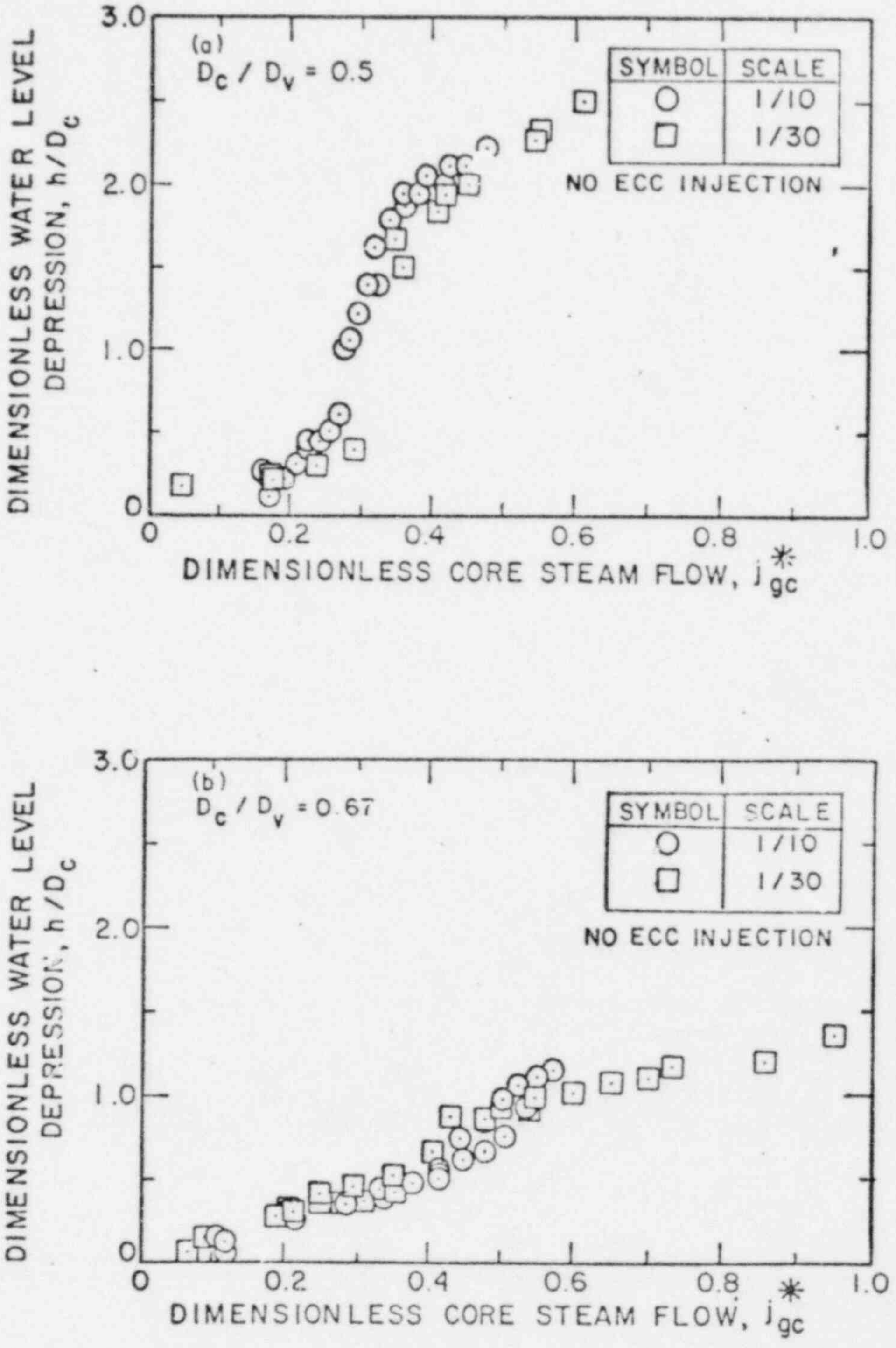


Figure 5. EFFECT OF VESSEL SIZE ON EQUILIBRIUM LIQUID VOIDING

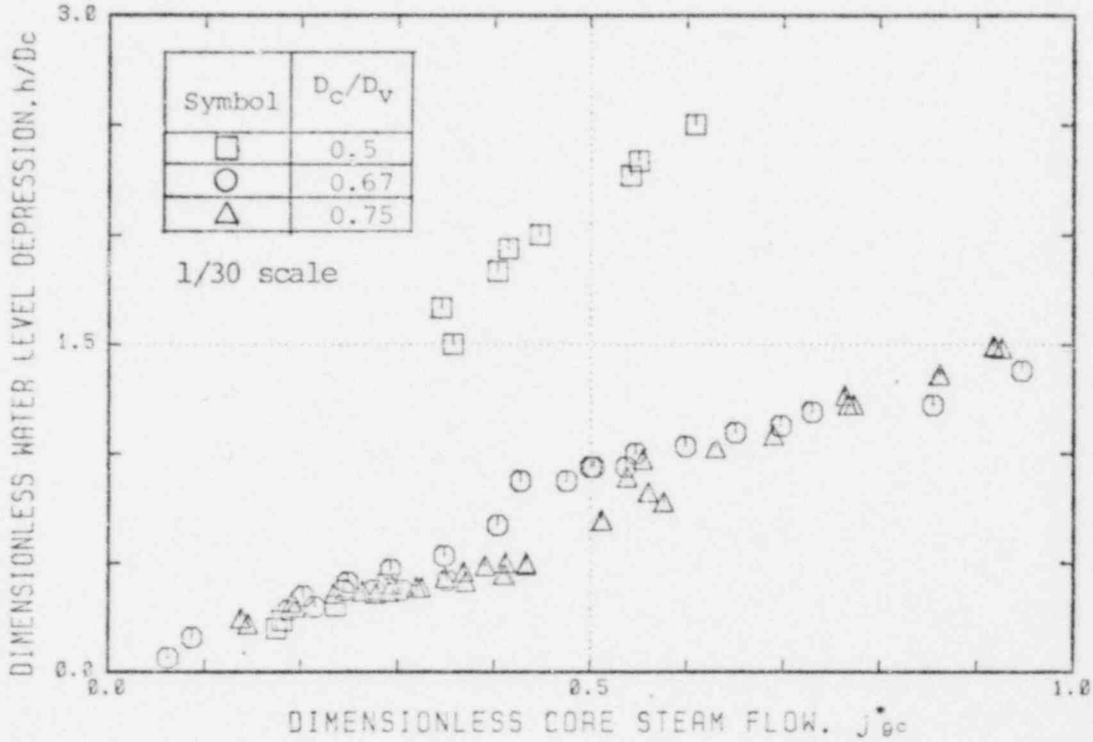


Figure 6. EFFECT OF CORE INLET OPEN AREA ON EQUILIBRIUM LIQUID VOIDING

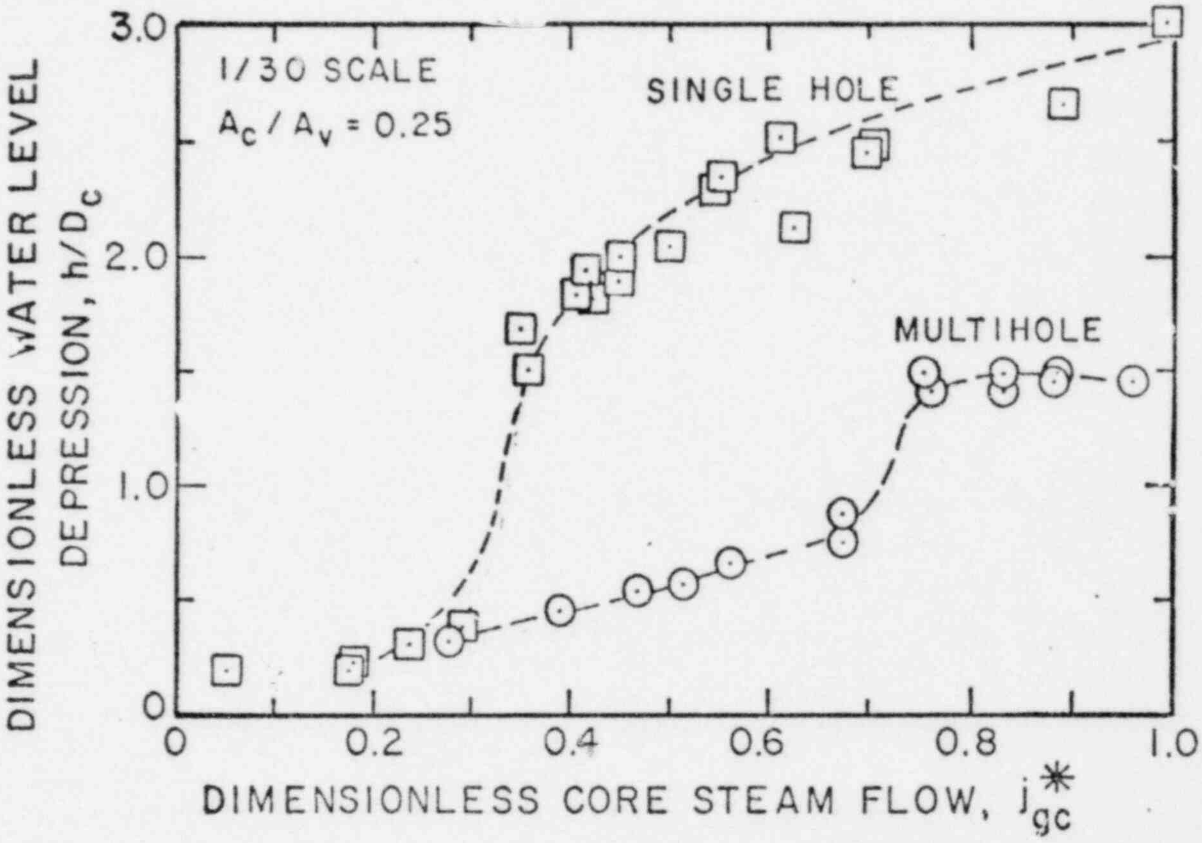


Figure 7. EFFECT OF MULTIHOLE CORE INLET OPEN AREA ON EQUILIBRIUM LIQUID VOIDING

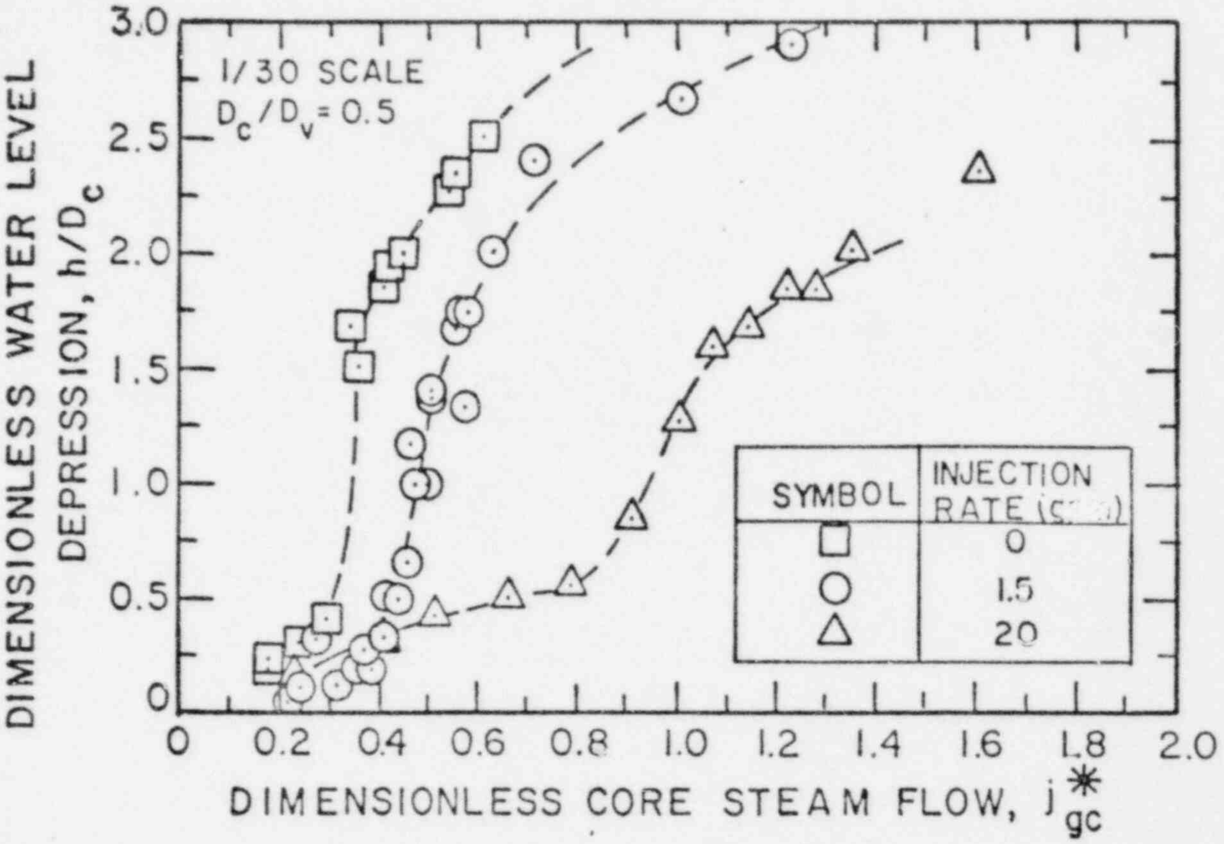


Figure 8a. EQUILIBRIUM LIQUID VOIDING WITH LOWER PLENUM WATER INJECTION

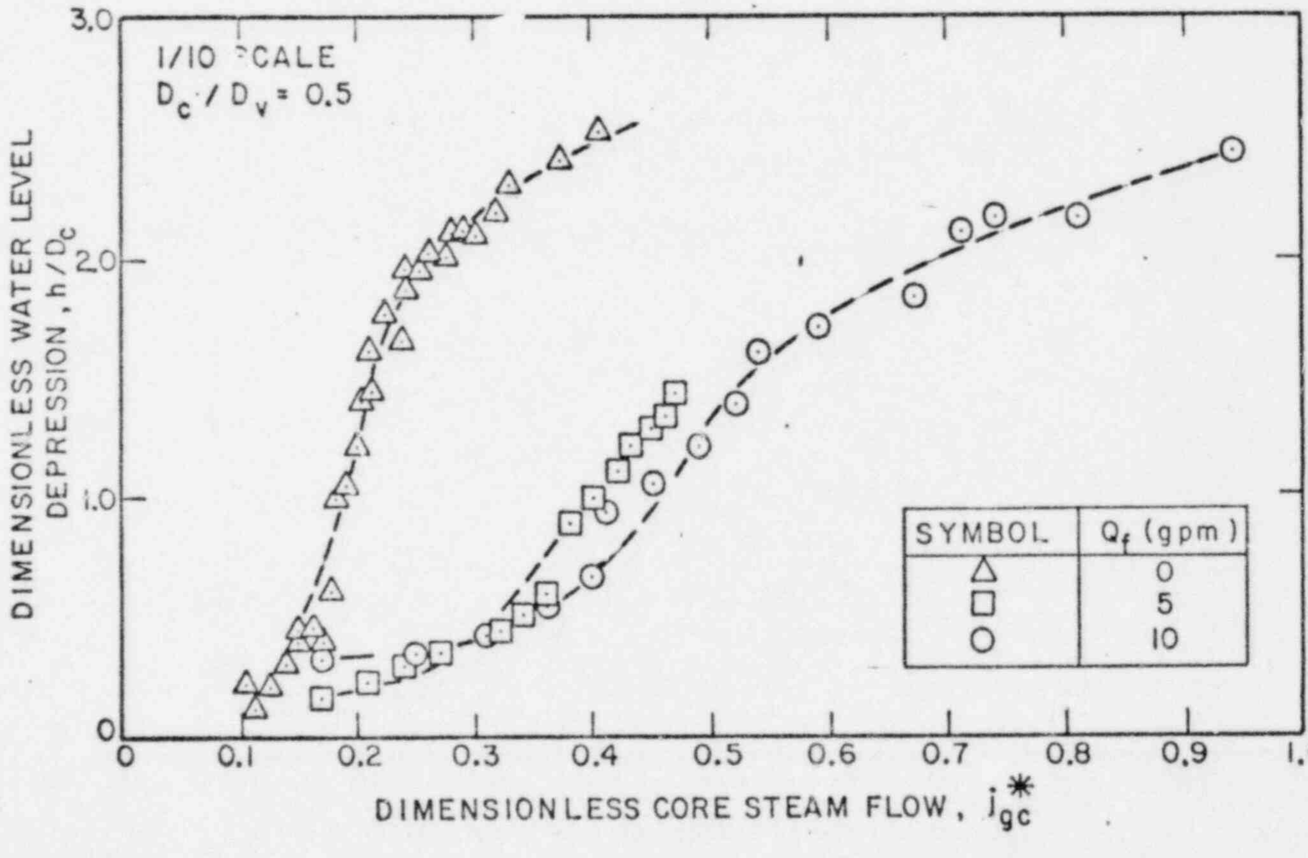


Figure 8b.

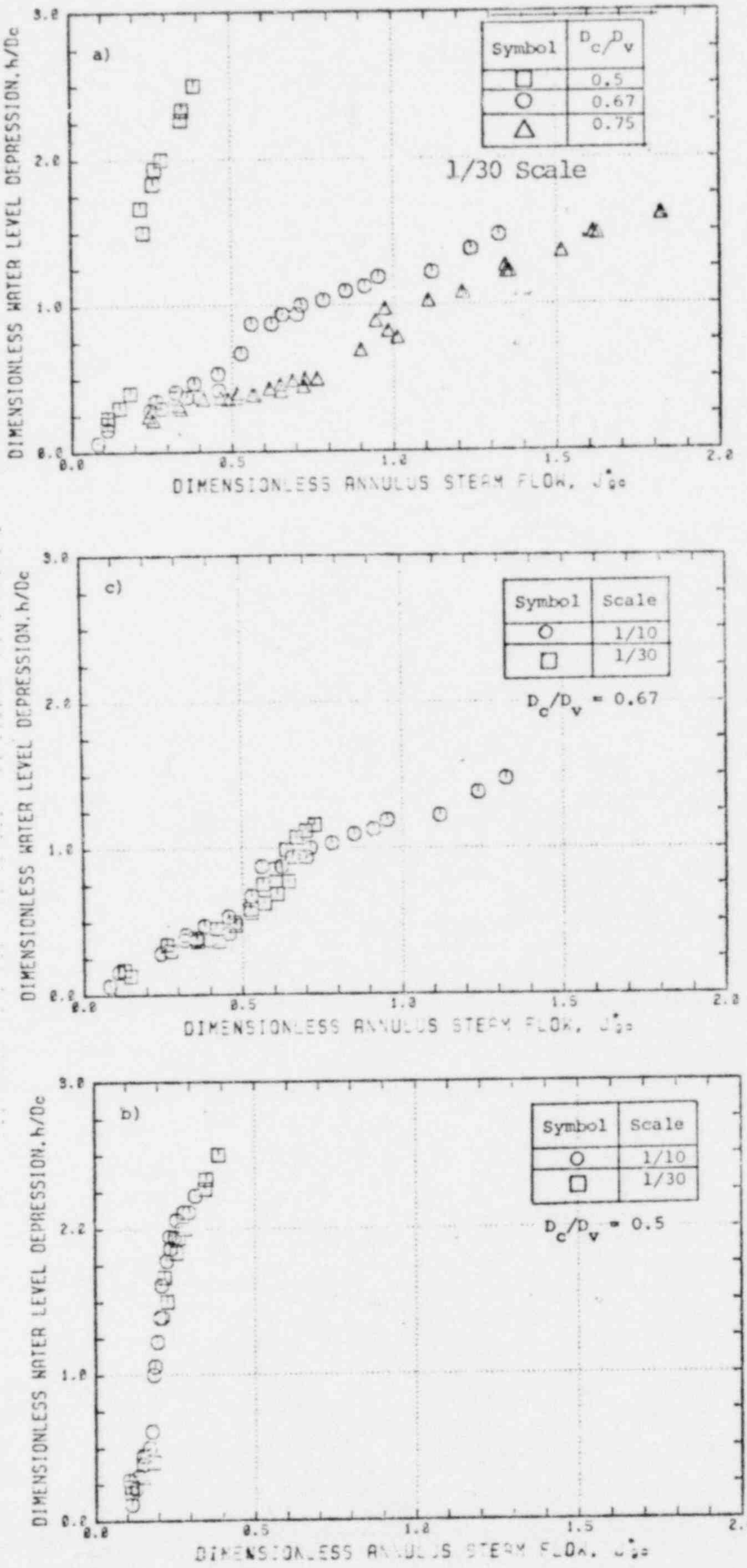


Figure 9. EFFECT OF CORE INLET OPEN AREA AND VESSEL SIZE WHEN PLOTTING J^*_{gc}

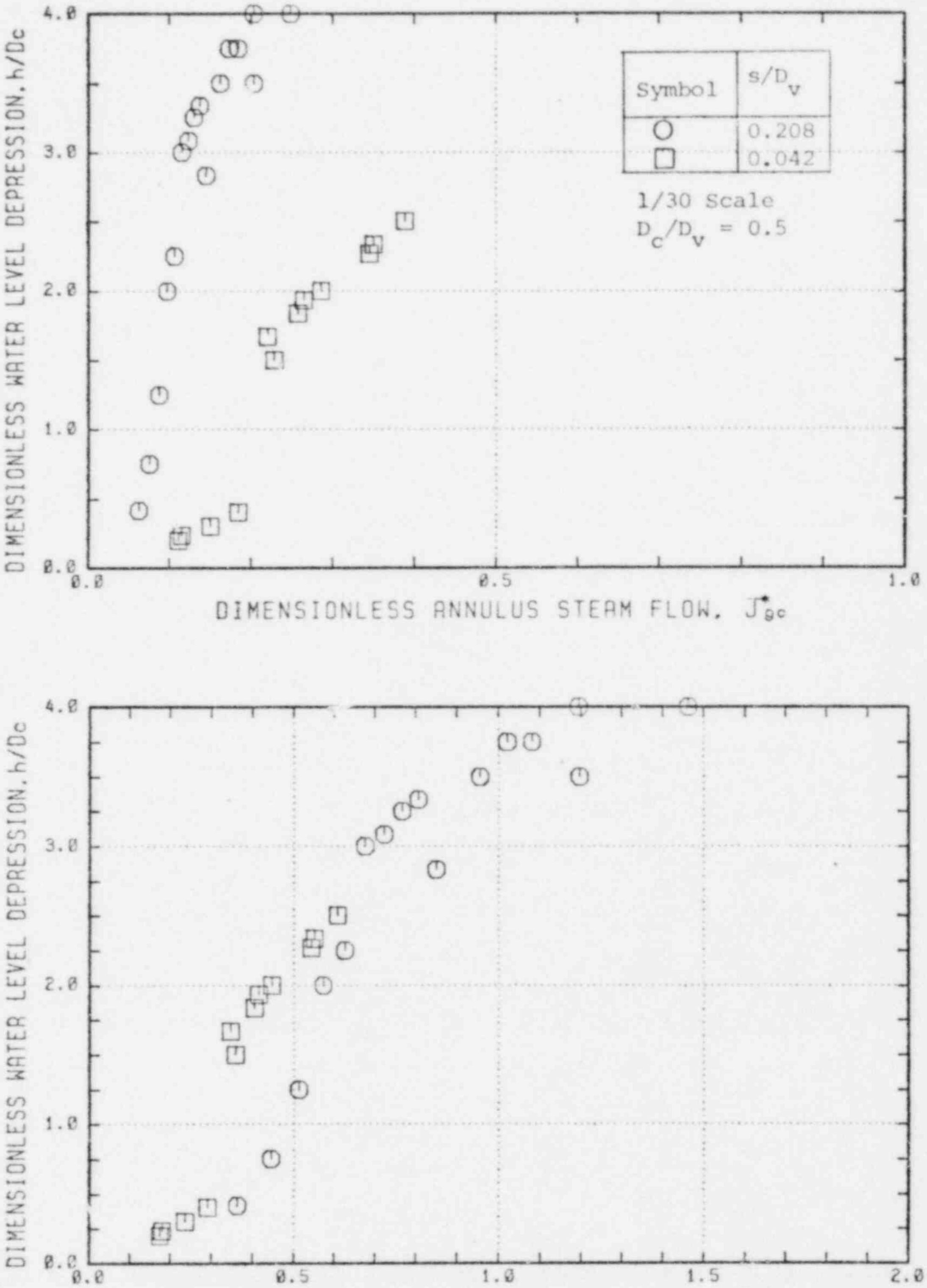


Figure 10. EFFECT OF GAP SIZE WHEN PLOTTING j^*_{gc} AND J^*_{gc}

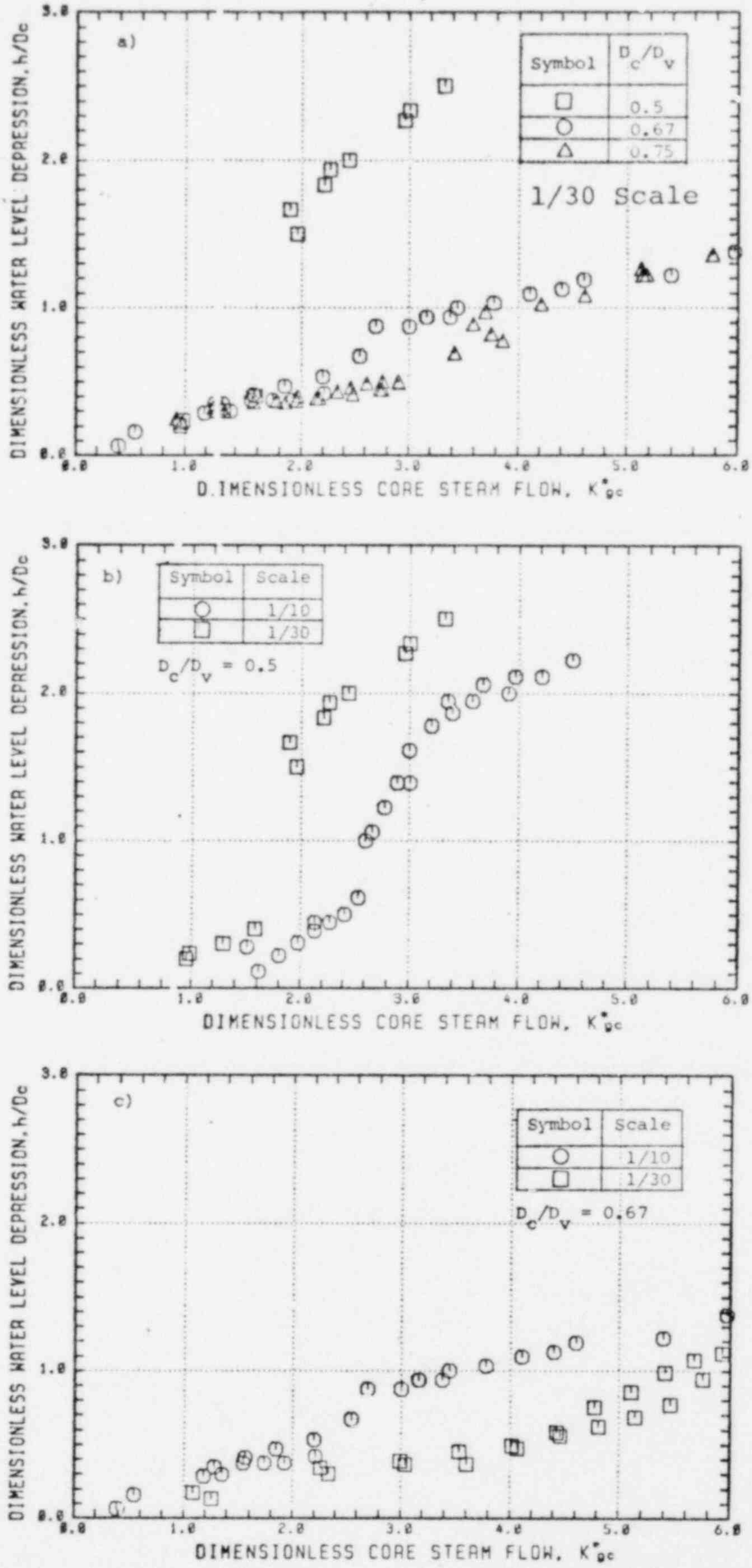


Figure 11. EFFECT OF CORE INLET OPEN AREA AND VESSEL SIZE WHEN PLOTTING $K_{gc}^{\star}$

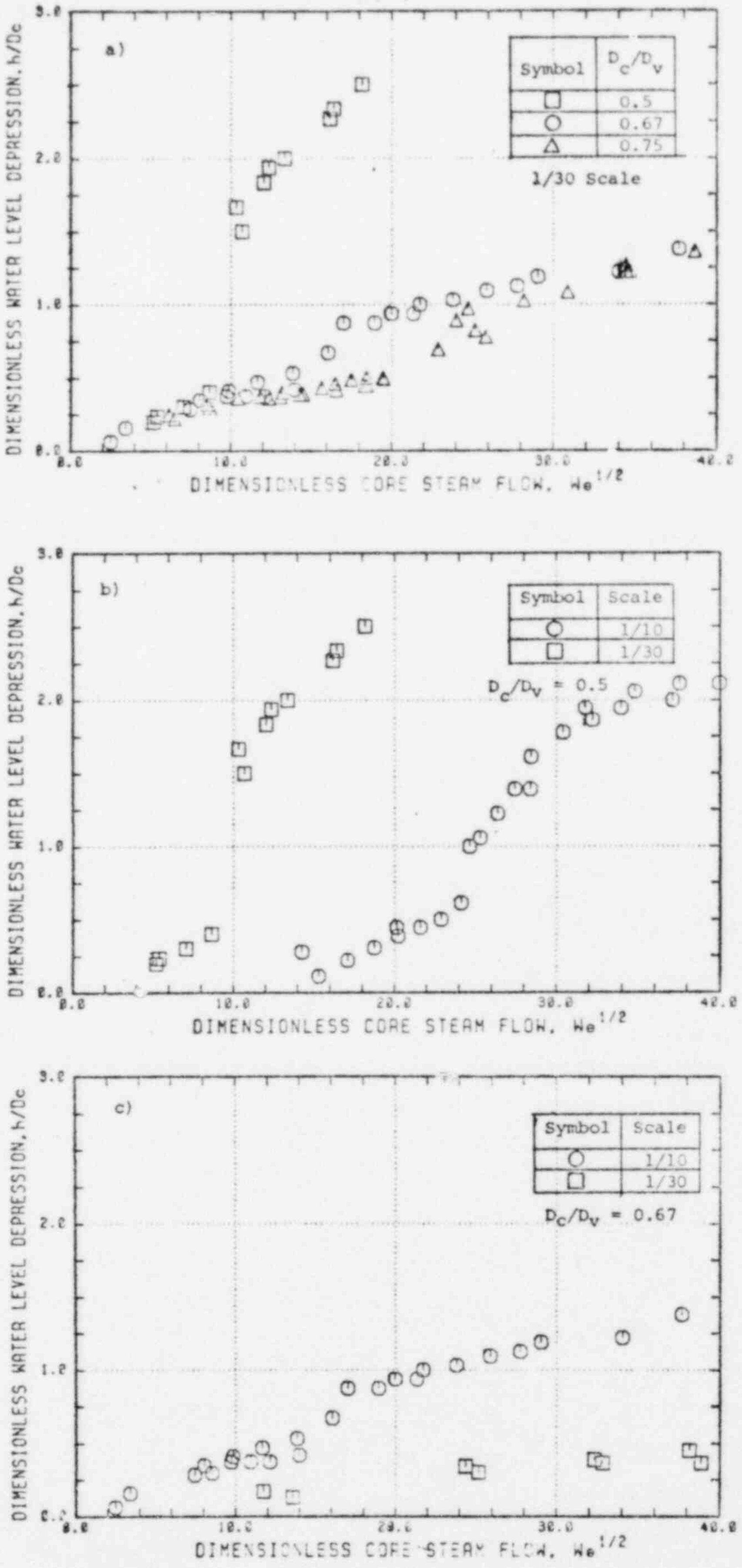


Figure 12. EFFECT OF CORE INLET OPEN AREA AND VESSEL SIZE WHEN PLOTTING $W_e^{1/2}$

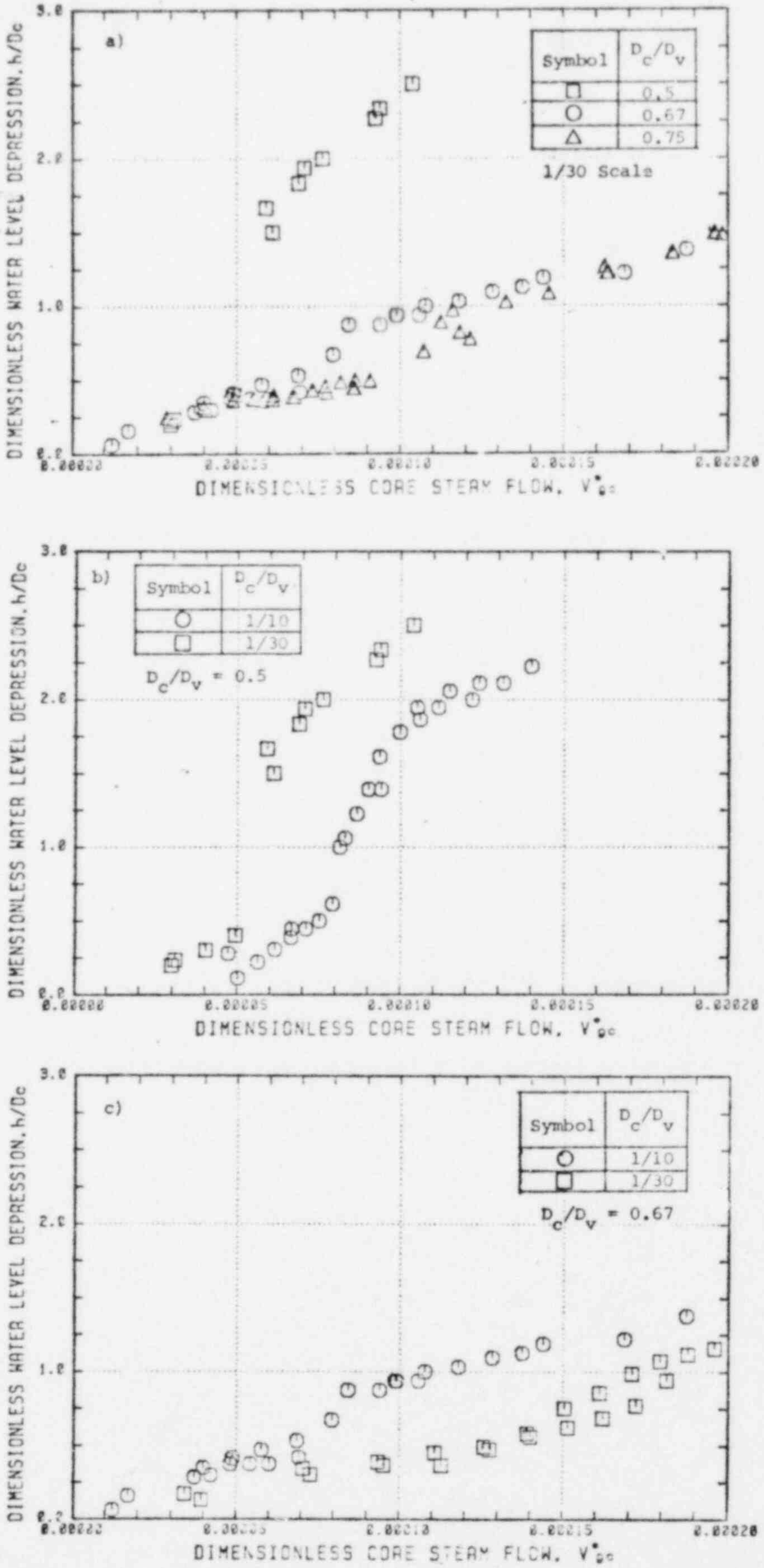


Figure 13. EFFECT OF CORE INLET OPEN AREA AND VESSEL SIZE WHEN PLOTTING V^*_{gc}

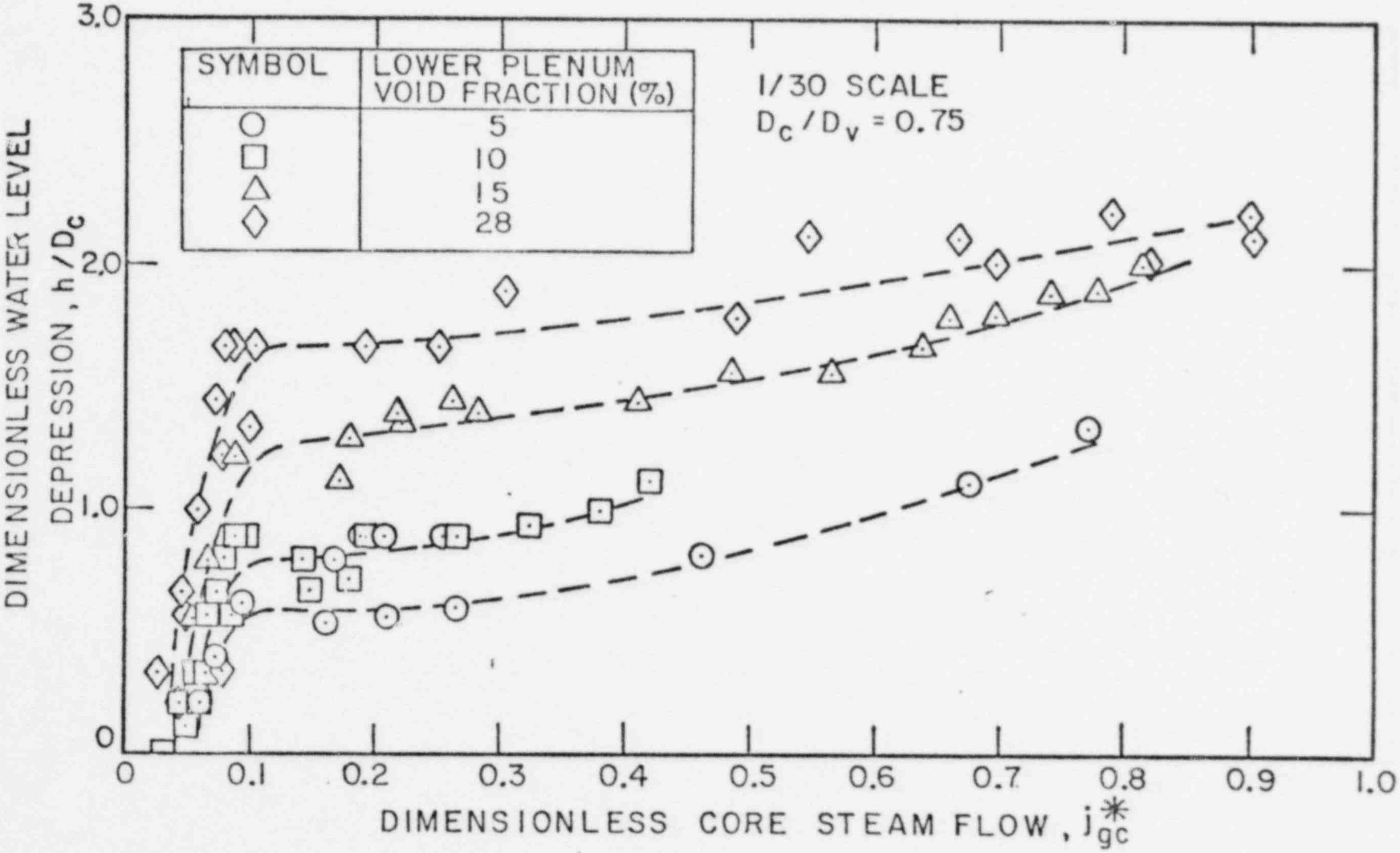


Figure 14. LOWER PLENUM VOIDING OF TWO-PHASE PLENUM MIXTURES

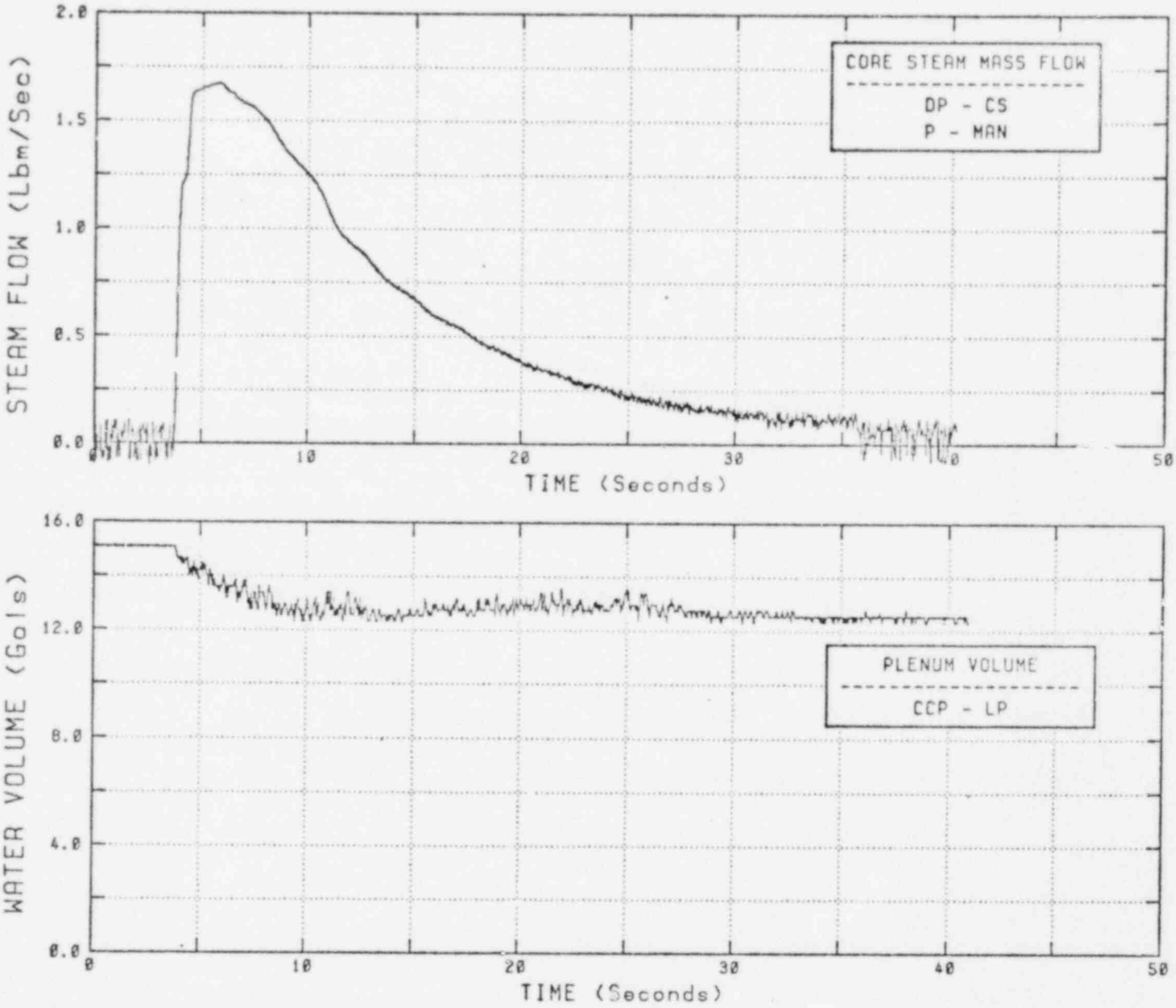


Figure 15. STEAM FLOW AND WATER LEVEL TRACE FOR A TRANSIENT LOWER PLENUM VOIDING TEST AT 1/15 SCALE

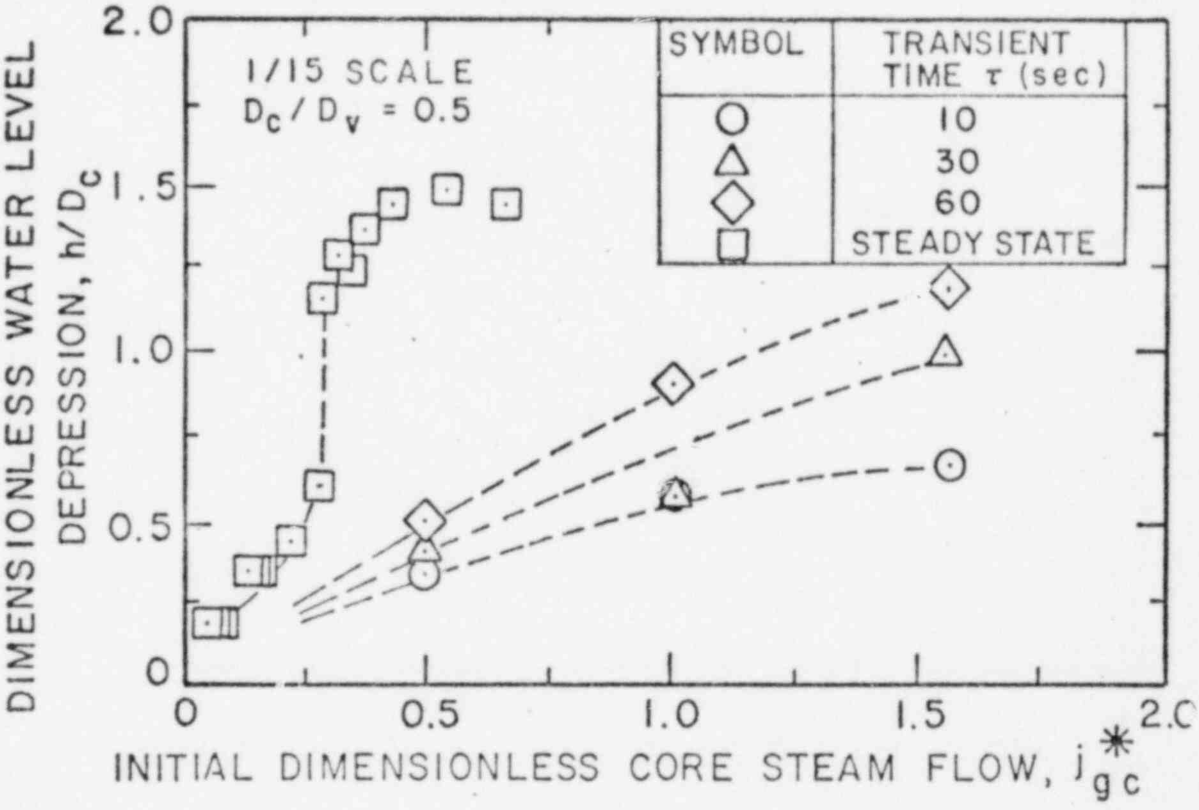


Figure 16. TRANSIENT LOWER PLENUM VOIDING AT 1/15 SCALE

APPENDIX A

EQUILIBRIUM LIQUID VOIDING DATA

The data presented here are from LPV tests with reverse core steam flow and lower plenum injection at two different scales. The correspondence between tables and test conditions is as follows:

TABLE A-1

EQUILIBRIUM LIQUID VOIDING DATA

Table	D_V (in.)	L_{LP} (in.)	L_D (in.)	s (in.)	D_T (in.)	D_c (in.)	Inlet Geometry	Q_f (gpm)	T_f (°F)
A2	6.0	39	12	0.25	4.5	3.0	Multihole	0-2	210
A3	6.0	39	12	0.25	4.5	3.0	Orifice	0-2	200
A4	6.0	39	12	0.25	4.0	3.0	Multihole	2-10	190
A5	6.0	39	12	0.25	4.0	3.0	Orifice	0-10	185-210
A6	6.0	39	12	0.25	4.5	4.0	Orifice	0-1	204-210
A7	6.0	39	12	0.25	4.0	4.0	Tube	0-10	195-210
A8	6.0	39	12	0.25	4.5	4.5	Tube	0-2	190-210
A9	17.5	27	36	0.75	13.25	9.0	Orifice	0-10	180-212
A10	17.5	27	36	0.75	13.25	11.67	Orifice	0-5	190

TABLE A-2

Test ID	W_{gc} (lbm/s)	Q_{fin} (gpm)	T_{ECC} (°F)	P_{LP} (psia)	P_{CON} (psia)	J^*_{gc}	j^*_{gc}	Voiding Level (in.)
8.9200	0.0572	0	210.	14.5	14.5	0.176	0.276	1
8.9200	0.0964	0	210.	14.5	14.5	0.297	0.464	1.6
8.9200	0.1155	0	210.	14.5	14.5	0.356	0.558	2.
8.9200	0.1387	0	210.	14.5	14.5	0.427	0.67	2.6
8.9200	0.1573	0	210.	14.5	14.5	0.484	0.76	4.3
8.9200	0.1716	0	210.	14.5	14.5	0.528	0.829	4.3
8.9200	0.1825	0	210.	14.5	14.5	0.562	0.881	4.4
8.9200	0.1984	0	210.	14.5	14.5	0.61	0.958	4.4
8.9210	0.0577	2	210.	14.5	14.5	0.178	0.279	0.4
8.9210	0.0834	2	210.	14.5	14.5	0.257	0.403	0.6
8.9210	0.1118	2	210.	14.5	14.5	0.344	0.540	0.9
8.9210	0.1422	2	210.	14.5	14.5	0.438	0.688	1
8.9210	0.1545	2	210.	14.5	14.5	0.476	0.746	1.1
8.9210	0.1710	2	210.	14.5	14.5	0.526	0.826	1.3
8.9210	0.1819	2	210.	14.5	14.5	0.56	0.878	1.4
8.9210	0.2013	2	210.	14.5	14.5	0.62	0.97	1.5
8.9210	0.2088	2	210.	14.5	14.5	0.643	1.008	1.5
8.9210	0.2316	2	210.	14.5	14.5	0.713	1.118	1.6
8.9210	0.2403	2	210.	14.5	14.5	0.74	1.16	1.8
8.9220	0.0572	0	210.	14.5	14.5	0.176	0.276	1
8.9220	0.0804	0	210.	14.5	14.5	0.248	0.388	1.4
8.9220	0.106	0	210.	14.5	14.5	0.326	0.512	1.8
8.9220	0.1389	0	210.	14.5	14.5	0.428	0.671	2.3
8.9220	0.1557	0	210.	14.5	14.5	0.479	0.752	4.5
8.9220	0.1718	0	210.	14.5	14.5	0.529	0.83	4.5
8.9220	0.1831	0	210.	14.5	14.5	0.564	0.884	4.5
8.9230	0.0531	1	210.	14.5	14.5	0.163	0.256	0.5
8.9230	0.0821	1	210.	14.5	14.5	0.253	0.396	0.7
8.9230	0.1078	1	210.	14.5	14.5	0.332	0.521	1.
8.9230	0.1389	1	210.	14.5	14.5	0.428	0.671	1.2
8.9230	0.1566	1	210.	14.5	14.5	0.482	0.756	1.1
8.9230	0.1666	1	210.	14.5	14.5	0.513	0.805	1.2
8.9230	0.1825	1	210.	14.5	14.5	0.562	0.881	1.4
8.9230	0.1964	1	210.	14.5	14.5	0.605	0.948	1.6
8.9230	0.2155	1	210.	14.5	14.5	0.663	1.104	1.8
8.9230	0.2291	1	210.	14.5	14.5	0.705	1.106	2.0
8.9230	0.2351	1	210.	14.5	14.5	0.724	1.135	2.1

TABLE A-3

Test ID	W_{gc} (lbm/s)	Q_{fin} (gpm)	T_{ECC} (°F)	P_{LP} (psia)	P_{CON} (psia)	J^*_{gc}	j^*_{gc}	Voiding Level (in.)
8.917	0.0443	2.0	200.	14.5	14.5	0.136	0.214	0.2
8.917	0.0651	2.0	200.	14.5	14.5	0.20	0.314	0.4
8.917	0.073	2.0	200.	14.5	14.5	0.225	0.353	0.6
8.917	0.0790	2.0	200.	14.5	14.5	0.243	0.382	0.6
8.917	0.0839	2.0	200.	14.5	14.5	0.258	0.405	1
8.917	0.0909	2.0	200.	14.5	14.5	0.28	0.439	1.5
8.917	0.0974	2.0	200.	14.5	14.5	0.30	0.470	3.0
8.917	0.1018	2.0	200.	14.5	14.5	0.313	0.492	3.0
8.917	0.1178	2.0	200.	14.5	14.5	0.363	0.569	4.0
8.916	0.0487	1.0	200.	14.5	14.5	0.15	0.235	0.3
8.916	0.0748	1.0	200.	14.5	14.5	0.23	0.361	0.8
8.916	0.0851	1.0	200.	14.5	14.5	0.262	0.411	1.5
8.916	0.0959	1.0	200.	14.5	14.5	0.295	0.463	3.5
8.916	0.1047	1.0	200.	14.5	14.5	0.322	0.506	4.1
8.916	0.1144	1.0	200.	14.5	14.5	0.352	0.552	5.0
8.916	0.1196	1.0	200.	14.5	14.5	0.368	0.578	5.2
8.916	0.1298	1.0	200.	14.5	14.5	0.40	0.627	6.0
8.914	0.0373	0.0	200.	14.5	14.5	0.115	0.18	0.7
8.914	0.0599	0.0	200.	14.5	14.5	0.184	0.298	1.2
8.914	0.0715	0.0	200.	14.5	14.5	0.22	0.345	5
8.914	0.0857	0.0	200.	14.5	14.5	0.264	0.414	5.8
8.914	0.0925	0.0	200.	14.5	14.5	0.285	0.447	6.0
8.914	0.1121	0.0	200.	14.5	14.5	0.345	0.541	6.8
8.914	0.1137	0.0	200.	14.5	14.5	0.35	0.549	7
8.914	0.1259	0.0	200.	14.5	14.5	0.388	0.608	7.5
8.915	0.0361	0.0	200.	14.5	14.5	0.111	0.174	0.6
8.915	0.0488	0.0	200.	14.5	14.5	0.15	0.236	0.9
8.915	0.0740	0.0	200.	14.5	14.5	0.228	0.357	4.5
8.915	0.0835	0.0	200.	14.5	14.5	0.257	0.403	5.5

TABLE A-4

Test ID	W_{gc} (lbm/s)	Q_{fin} (gpm)	T_{ECC} (°F)	P_{LP} (psia)	P_{CON} (psia)	J^*_{gc}	j^*_{gc}	Voiding Level (in.)
8.437	0.03[illegible]	10.	190.	14.5	14.5	0.942	0.148	0.4
8.437	0.0[illegible]	10.	190.	14.5	14.5	0.183	0.288	0.7
8.437	0.0979	10.	190.	14.5	14.5	0.301	0.473	1
8.437	0.1526	10.	190.	14.5	14.5	0.470	0.737	1.3
8.437	0.1866	10.	190.	14.5	14.5	0.549	0.861	1.5
8.437	0.2152	10.	190.	14.5	14.5	0.633	0.992	1.9
8.437	0.2627	10.	190.	14.5	14.5	0.751	1.178	2.1
8.437	0.3026	10.	190.	14.5	14.5	0.865	1.356	2.3
8.437	0.3375	10.	190.	14.5	14.5	0.952	1.493	2.5
8.438	0.0266	2.0	190.	14.5	14.5	0.082	0.128	0.2
8.438	0.0406	2.0	190.	14.5	14.5	0.125	0.196	0.5
8.438	0.0669	2.0	190.	14.5	14.5	0.206	0.323	0.7
8.438	0.0953	2.0	190.	14.5	14.5	0.293	0.460	1.0
8.438	0.1556	2.0	190.	14.5	14.5	0.479	0.751	1.5
8.438	0.1955	2.0	190.	14.5	14.5	0.602	0.944	1.8
8.438	0.2254	2.0	190.	14.5	14.5	0.673	1.055	2.1
8.438	0.2627	2.0	190.	14.5	14.5	0.772	1.212	3.5
8.438	0.3026	2.0	190.	14.5	14.5	0.890	1.400	4
8.438	0.3375	2.0	190.	14.5	14.5	0.992	1.556	4.5

TABLE A-5

Test ID	W_{gc} (lbm/s)	Q_{fin} (gpm)	T_{ECC} (°F)	P_{LP} (psia)	P_{CON} (psia)	J^*_{gc}	j^*_{gc}	Voiding Level (in.)
8.7060	0.0325	0.0	210.	14.5	14.5	0.100	0.157	0.6
8.7060	0.0464	0.0	210.	14.5	14.5	0.143	0.224	0.9
8.7060	0.0570	0.0	210.	14.5	14.5	0.175	0.275	1.4
8.7060	0.0658	0.0	210.	14.5	14.5	0.203	0.318	4.5
8.7060	0.0712	0.0	210.	14.5	14.5	0.219	0.344	5.1
8.7060	0.0769	0.0	210.	14.5	14.5	0.237	0.371	5.6
8.7060	0.0910	0.0	210.	14.5	14.5	0.280	0.439	6.1
8.7060	0.0986	0.0	210.	14.5	14.5	0.304	0.476	6.5
8.7060	0.1073	0.0	[illegible]	14.5	14.5	0.330	0.518	6.8
8.7060	0.1149	0.0	210.	14.5	14.5	0.354	0.555	7.1
8.7060	0.1288	0.0	210.	14.5	14.5	0.397	0.622	8
8.7060	0.1[illegible]	0.0	210.	14.5	14.5	0.422	0.662	8.1
8.7120	0.0343	0.0	210.	14.5	14.5	0.106	0.166	0.9
8.7120	0.0444	0.0	210.	14.5	14.5	0.137	0.214	1.1
8.7120	0.0577	0.0	210.	14.5	14.5	0.178	0.279	1.6
8.7120	0.0668	0.0	210.	14.5	14.5	0.206	0.323	4.9
8.7120	0.0788	0.0	210.	14.5	14.5	0.243	0.381	5.3
8.7110	0.0844	0.0	200.	14.5	14.5	0.260	0.408	6
8.7110	0.0891	0.0	200.	14.5	14.5	0.274	0.430	6.5
8.7110	0.0981	0.0	200.	14.5	14.5	0.302	[illegible]	6.9
8.7110	0.1084	0.0	200.	14.5	14.5	0.334	0.523	7.1
8.7110	0.1261	0.0	200.	14.5	14.5	0.388	0.609	7.4
8.7110	0.1324	0.0	200.	14.5	14.5	0.408	0.639	8.2
8.7110	0.1422	0.0	200.	14.5	14.5	0.438	0.687	8.3
8.433	0.0574	0.0	195.	14.5	14.5	0.177	0.277	0.7
8.433	0.0763	0.0	195.	14.5	14.5	0.235	0.368	1.3
8.433	0.0931	0.0	195.	14.5	14.5	0.287	0.450	5.3
8.433	0.1081	0.0	195.	14.5	14.5	0.333	0.522	6.0
8.433	0.1526	0.0	195.	15.5	14.5	0.455	0.714	7.3
8.433	0.2152	0.0	195.	15.5	14.5	0.642	1.007	9
8.433	0.2627	0.0	195.	15.8	14.5	0.772	1.212	9.8
8.433	0.3135	0.0	195.	16.[illegible]	14.5	0.922	1.446	10.3
8.434	0.0552	2.0	195.	14.5	14.5	0.170	0.267	1
8.434	0.0940	2.0	195.	14.5	14.5	0.289	0.454	2
8.434	0.1045	2.0	195.	14.5	14.5	0.322	0.505	4.3
8.434	0.1191	2.0	195.	14.5	14.5	0.367	0.575	5.3
8.434	0.1526	2.0	195.	15.5	14.5	0.455	0.714	7.3
8.434	0.2167	2.0	195.	16.	14.5	0.637	0.999	8
8.434	0.2670	2.0	195.	16.	14.5	0.785	1.231	8.7
8.434	0.3100	2.0	195.	16.5	14.5	0.898	1.409	4.3
8.432	0.0266	0.0	185.	14.5	14.5	0.082	0.128	0.5
8.432	0.0596	0.0	185.	14.5	14.5	0.183	0.289	1
8.432	0.0763	0.0	185.	14.5	14.5	0.235	0.368	1.5
8.432	0.0992	0.0	185.	14.5	14.5	0.305	0.479	5.5
8.432	0.1081	0.0	185.	14.5	14.5	0.333	0.522	6
8.432	0.1321	0.0	185.	15.5	14.5	0.394	0.618	6.5
8.432	0.1526	0.0	185.	15.8	14.5	0.449	0.704	7.3
8.432	0.1925	0.0	185.	15.8	14.5	0.566	0.888	8
8.432	0.2627	0.0	185.	16.	14.5	0.772	1.212	9.5
8.435	0.0401	10.0	200.	14.5	14.5	0.123	0.194	0.7
8.435	0.0650	10.0	200.	14.5	14.5	0.200	0.314	1.2
8.435	0.0917	10.0	200.	14.5	14.5	0.282	0.443	1.5
8.435	0.1092	10.0	200.	14.5	14.5	0.336	0.527	2
8.435	0.1330	10.0	200.	15.8	14.5	0.391	0.613	4.5
8.435	0.1548	10.0	200.	16[illegible]	14.5	0.455	0.714	5.3
8.435	0.2152	10.0	200.	16.[illegible]	14.5	0.624	0.978	8
8.435	0.2627	10.0	200.	18	14.5	0.731	1.147	9

TABLE A-6

Test ID	W_{gc} (lbm/s)	Q_{fin} (gpm)	T_{ECC} (°F)	P_{LP} (psia)	P_{CON} (psia)	J^*_{gc}	j^*_{gc}	Voiding Level (in.)
8.9290	0.0860	0.0	204.	14.5	14.5	0.203	0.265	1.4
8.9290	0.1052	0.0	204.	14.5	14.5	0.248	0.324	1.6
8.9290	0.1240	0.0	204.	14.5	14.5	0.292	0.382	1.9
8.9290	0.1477	0.0	204.	14.5	14.5	0.348	0.455	2.1
8.9290	0.1815	0.0	204.	14.5	14.5	0.427	0.559	3.5
8.9290	0.2123	0.0	204.	14.5	14.5	0.50	0.654	3.7
8.9290	0.2318	0.0	204.	14.5	14.5	0.546	0.714	4
8.9290	0.2539	0.0	204.	14.5	14.5	0.598	0.782	4.1
8.9290	0.2761	0.0	204.	14.5	14.5	0.650	0.850	4.4
8.9290	0.2961	0.0	204.	14.5	14.5	0.697	0.912	4.5
8.9290	0.3097	0.0	204.	14.5	14.5	0.729	0.953	4.8
8.9290	0.3627	0.0	204.	14.5	14.5	0.854	1.117	4.9
8.9290	0.4086	0.0	204.	15.	14.5	0.947	1.239	5.5
8.9290	0.4535	0.0	204.	16.2	14.5	1.020	1.333	5.[illegible]
8.9280	0.0263	0.0	210.	14.5	14.5	0.062	0.081	0.2
8.9280	0.0364	0.0	210.	14.5	14.5	0.086	0.112	0.6
8.9290	0.0795	0.0	210.	14.5	14.5	0.187	0.245	1.1
8.9280	0.0908	0.0	210.	14.5	14.5	0.214	0.280	1.2
8.9280	0.1036	0.0	210.	14.5	14.5	0.244	0.319	1.5
8.9280	0.1166	0.0	210.	14.5	14.5	0.275	0.359	1.5
8.9280	0.1291	0.0	210.	14.5	14.5	0.304	0.397	1.5
8.9280	0.1487	0.0	210.	14.5	14.5	0.350	0.458	1.7
8.9280	0.1710	0.0	210.	14.5	14.5	0.403	0.526	2.7
8.9280	0.2017	0.0	210.	14.5	14.5	0.475	0.621	3.5
8.9280	0.2132	0.0	210.	14.5	14.5	0.502	0.656	3.7
8.9280	0.2272	0.0	210.	14.5	14.5	0.535	0.699	3.7
8.9320	0.0747	0.0	210.	14 5	14.5	0.176	0.230	1.1
8.9320	0.1026	0.0	210.	14.5	14.5	0.242	0.316	1.4
8.9320	0.1253	0.0	210.	14.5	14.5	0.295	0.386	1.6
8.9320	0.1526	0.0	210.	14.5	14.5	0.359	0.470	2.1
8.9320	0.1697	0.0	210.	14.5	14.5	0.400	0.522	2.2
8.9320	0.1855	0.0	210.	14.5	14.5	0.437	0.571	2.5
8.9320	0.1944	0.0	210.	14.5	14.5	0.458	0.599	2.6
9.9320	0.2041	0.0	210.	14.5	14.5	0.481	0.628	2.9
8.9320	0.2148	0.0	210.	14.5	14.5	0.506	0.661	3.4
8.9320	0.2249	0.0	210.	14.5	14.5	0.530	0.692	3.4
8.9300	0.0443	0.0	210.	14.5	14.5	0.104	0.136	0.6
8.9300	0.0604	0.0	210.	14.5	14.5	0.142	0.186	0.7
8.9300	0.0761	0.0	210.	14.5	14.5	0.179	0.234	1.2
8.9300	0.0917	0.0	210.	14.5	14.5	0.216	0.282	1.5
8.9300	0.1021	0.0	210.	14.5	14.5	0.240	0.314	1.8
8.9300	0.1251	0.0	210.	14.5	14.5	0.295	0.385	2.1
8.9300	0.1526	0.0	210.	14.5	14.5	0.359	0.470	2.1
8.9300	0.1688	0.0	210.	14.5	14.5	0.397	0.520	2.2
8.9300	0.1802	0.0	210.	14.5	14.5	0.424	0.555	2.3
8.9300	0.1899	0.0	210.	14.5	14.5	0.447	0.585	2.5
8.9300	0.2026	0.0	210.	14.5	14.5	0.477	0.624	2.8
8.9300	0.2135	0.0	210.	14.5	14.5	0.503	0.657	2.9
8.9300	0.2250	0.0	210.	14.5	14.5	0.530	0.693	3.6
8.9310	0.0599	1.0	210.	14.5	14.5	0.141	0.184	0.6
8.9310	0.0852	1.0	210.	14.5	14.5	0.201	0.262	0.8
8.9310	0.1044	1.0	210.	14.5	14.5	0.246	0.321	0.9
8.9310	0.1279	1.0	210.	14.5	4.5	0.301	0.394	1.1
8.9310	0.1459	1.0	210.	14.5	14.5	0.344	0.449	1.2
8.9310	0.1615	1.0	210.	14.5	14.5	0.380	0.497	1.4
8.9310	0.1786	1.0	210.	14.5	14.5	0.421	0.550	1.4
8.9310	0.1906	1.0	210.	14.5	14.5	0.449	0.587	1.5
8.9310	0.2043	1.0	210.	14.5	14.5	0.481	0.629	1.5
8.9310	0.2177	1.0	210.	14.5	14.5	0.513	0.670	1.7
8.9310	0.2266	1.0	210.	14.5	14.5	0.534	0.698	1.8

TABLE A-7

Test ID	W_{gc} (lbm/s)	Q_{fin} (gpm)	T_{ECC} (°F)	P_{LP} (psia)	P_{CON} (psia)	J^*_{gc}	j^*_{gc}	Voiding Level (in.)
8.429	0.0360	2.0	195.	14.5	14.5	0.085	0.111	0.5
8.429	0.0530	2.0	195.	14.5	14.5	0.125	0.163	0.7
8.429	0.0951	2.0	195.	14.5	14.5	0.224	0.293	0.7
8.429	0.1274	2.0	195.	14.5	14.5	0.300	0.392	0.9
8.429	0.1951	2.0	195.	14.5	14.5	0.459	0.601	1
8.429	0.2347	2.0	195.	15.5	14.5	0.536	0.700	1.2
8.429	0.2787	2.0	195.	15.8	14.5	0.627	0.819	1.3
8.429	0.3293	2.0	195.	16	14.5	0.740	0.968	1.5
8.429	0.3823	2.0	195.	16.5	14.5	0.847	1.108	1.7
8.429	0.4351	2.0	195.	17.5	14.5	0.938	1.227	1.7
8.420	0.4902	2.0	195.	16.8	14.5	1.071	1.401	1.8
8.43	0.0322	10.0	200.	14.5	14.5	0.076	0.099	0.2
8.43	0.0670	10.0	200.	14.5	14.5	0.158	0.206	0.5
8.43	0.1251	10.0	200.	15.5	14.5	0.285	0.373	0.7
8.43	0.1843	10.0	200.	15.8	14.5	0.414	0.542	1
8.43	0.2412	10.0	200.	16.3	14.5	0.535	0.699	1.2
8.43	0.2837	10.0	200.	16.5	14.5	0.629	0.822	1.3
8.43	0.3407	10.0	200.	17.0	14.5	0.745	0.974	1.5
8.43	0.4070	10.0	200.	17.5	14.5	0.878	1.148	1.5
8.43	0.4627	10 0	200.	18.0	14.5	0.985	1.288	1.7
8.7000	0.0282	0.0	210.	14.5	14.5	0.066	0.087	0.7
8.7000	0.0398	0.0	210.	14.5	14.5	0.094	0.123	0.9
8.7000	0.0596	0.0	210.	14.5	14.5	0.140	0.183	0.9
8.7000	0.0889	0.0	210.	14.5	14.5	0.209	0.274	1.1
8.7000	0.1098	0.0	210.	14.5	14.5	0.259	0.338	1.6
8.7000	0.1345	0.0	210.	14.5	14.5	0.317	0.414	1.6
8.7000	0.1571	0.0	210.	14.5	14.5	0.370	0.484	1.9
8.7000	0.1685	0.0	210.	14.5	14.5	0.397	0.519	1.9
8.7000	0.1839	0.0	210.	14.5	14.5	0.433	0.566	2.1
8.7000	0.1978	0.0	210.	14.5	14.5	0.466	0.609	2.3
8.7000	0.2118	0.0	210.	14.5	14.5	0.499	0.652	3.0
8.7000	0.2235	0.0	210.	14.5	14.5	0.526	0.688	4.1
8.7000	0.2364	0.0	210.	14.5	14.5	0.557	0.728	4.3
8.7010	0.0425	0.0	210.	14.5	14.5	0.100	0.131	0.7
8.7010	0.1001	0.0	210.	14.5	14.5	0.236	0.308	1.5
8.7010	0.1321	0.0	210.	14.5	14.5	0.311	0.407	1.6
8.7010	0.1733	0.0	210.	14.5	14.5	0.408	0.534	1.8
8.7010	0.2027	0.0	210.	14.5	14.5	0.477	0.624	2.0
8.7010	0.2238	0.0	210.	14.5	14.5	0.527	0.689	2.4
8.7010	0.2364	0.0	210.	14.5	14.5	0.557	0.728	2.8
8.7010	0.2448	0.0	210.	14.5	14.5	0.576	0.754	3.9
8.7050	0.1569	0.0	210.	14.5	14.5	0.369	0.483	2.1
8.7050	0.2182	0.0	210.	14.5	14.5	0.514	0.672	2.6
8.7050	0.2661	0.0	210.	14.5	14.5	0.627	0.819	4.3
8.7050	0.3069	0.0	210.	14.5	14.5	0.723	0.945	4.6
8.7050	0.3603	0.0	210.	15.	14.5	0.835	1.092	5.1
8.7050	0.3693	0.0	210.	15	14.5	0.856	1.119	5.6
8.7050	0.3964	0.0	210.	15.5	14.5	0.905	1.183	5.9
8.7050	0.4236	0.0	210.	16	14.5	0.953	1.245	6.2
8.7050	0.4519	0.0	210.	16.5	14.5	1.002	1.310	6.6
8.7020	0.0405	0.0	210.	14.5	14.5	0.095	0.125	0.6
8.7020	0.1020	0.0	210.	14.5	14.5	0.240	0.314	1.2
8.7020	0.1292	0.0	210.	14.5	14.5	0.304	0.398	1.6
8.7020	0.1696	0.0	210.	14.5	14.5	0.399	0.522	2.1
8.7020	0.2061	0.0	210.	14.5	14.5	0.485	0.635	2.2
8.7020	0.2237	0.0	210.	14.5	14.5	0.527	0.689	3.9
8.7020	0.2348	0.0	210.	14.5	14.5	0.553	0.723	4.1
8.7020	0.2450	0.0	210.	14.5	14.5	0.577	0.754	4.3

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TABLE A-7 (continued)

Test ID	W_{gc} (lbm/s)	Q_{fin} (gpm)	T_{ECC} (°F)	P_{LP} (psia)	P_{CON} (psia)	J^*_{gc}	j^*_{gc}	Voiding Level (in.)
8.7040	0.0776	1.0	210.	14.5	14.5	0.183	0.239	0.7
8.7040	0.1082	1.0	210.	14.5	14.5	0.255	0.333	0.9
8.7040	0.1383	1.0	210.	14.5	14.5	0.326	0.426	1.1
8.7040	0.1569	1.0	210.	14.5	14.5	0.369	0.483	1.2
8.7040	0.2208	1.0	210.	14.5	14.5	0.520	0.680	1.5
8.7040	0.2673	1.0	210.	14.5	14.5	0.629	0.823	1.5
8.7040	0.3133	1.0	210.	15	14.5	0.726	0.949	1.8
8.7040	0.3364	1.0	210.	15.5	14.5	0.768	1.004	1.9
8.7040	0.3754	1.0	210.	16	14.5	0.844	1.104	2.0
8.7040	0.3953	1.0	210.	16.5	14.5	0.876	1.146	2.0
8.7040	0.4276	1.0	210.	16.6	14.5	0.948	1.239	2.1
8.7040	0.4479	1.0	210.	16.8	14.5	0.979	1.280	2.1
8.7040	0.4789	1.0	210.	17	14.5	1.047	1.369	2.3
8.7030	0.562	1.0	210.	14.5	14.5	0.132	0.173	0.5
8.7030	0.0920	1.0	210.	14.5	14.5	0.217	0.283	0.8
8.7030	0.1060	1.0	210.	14.5	14.5	0.250	0.326	0.9
8.7030	0.1325	1.0	210.	14.5	14.5	0.312	0.408	0.1
8.7030	0.1536	1.0	210.	14.5	14.5	0.362	0.473	0.2
8.7030	0.1744	1.0	210.	14.5	14.5	0.411	0.537	0.2
8.7030	0.1882	1.0	210.	14.5	14.5	0.443	0.579	1.4
8.7030	0.2018	1.0	210.	14.5	14.5	0.475	0.621	1.4
8.7030	0.2143	1.0	210.	14.5	14.5	0.505	0.660	1.5
8.7030	0.2271	1.0	210.	14.5	14.5	0.535	0.699	1.6
8.7030	0.2327	1.0	210.	14.5	14.5	0.548	0.716	1.8
8.7030	0.2475	1.0	210.	14.5	14.5	0.583	0.762	1.6

TABLE A-8

Test ID	W_{gc} (lbm/s)	Q_{fin} (gpm)	T_{ECC} (°F)	P_{LP} (psia)	P_{CON} (psia)	J^*_{gc}	j^*_{gc}	Voiding Level (in.)
8.904	0.3396	0.0	195.	14.5	14.5	0.594	1.046	3
8.904	0.4856	0.0	195.	16.5	14.5	0.800	1.407	5.3
8.904	0.5836	0.0	195.	17	14.5	0.948	1.668	6
8.904	0.6703	0.0	195.	17.6	14.5	1.074	1.890	6.7
8.904	0.7305	0.0	195.	18.2	14.5	1.156	2.033	7
8.908	0.1662	0.0	200.	14.5	14.5	0.291	0.512	1.7
8.908	0.2346	0.0	200.	14.5	14.5	0.411	0.722	2
8.908	0.3390	0.0	200.	15.5	14.5	0.575	1.012	3.5
8.908	0.4643	0.0	200.	16.5	14.5	0.767	1.349	5.5
8.908	0.5739	0.0	200.	17.3	14.5	0.920	1.618	6.7
8.908	0.6513	0.0	200.	17.8	14.5	1.030	1.812	7.3
8.912	0.0822	0.0	205.	14.5	14.5	0.144	0.253	1
8.912	0.1105	0.0	205.	14.5	14.5	0.193	0.340	1.3
8.912	0.1501	0.0	205.	14.5	14.5	0.263	0.462	1.7
8.912	0.1845	0.0	205.	14.5	14.5	0.323	0.568	1.8
8.912	0.2108	0.0	205.	14.5	14.5	0.369	0.649	1.9
8.912	0.2328	0.0	205.	14.5	14.5	0.407	0.717	2
8.913	0.1674	0.0	190.	14.5	14.5	0.293	0.515	1.8
8.913	0.2477	0.0	190.	14.5	14.5	0.434	0.763	2.2
8.913	0.3303	0.0	190.	15.5	14.5	0.560	0.986	3.7
8.913	0.4645	0.0	190.	16.5	14.5	0.765	1.346	5.7
8.913	0.5660	0.0	190.	17	14.5	0.920	1.618	6.7
8.9240	0.0781	0.0	210.	14.5	14.5	0.137	0.240	1.1
8.9240	0.1078	0.0	210.	14.5	14.5	0.189	0.332	1.4
8.9240	0.1329	0.0	210.	14.5	14.5	0.233	0.409	1.6
8.9240	0.1575	0.0	210.	14.5	14.5	0.276	0.485	1.6
8.9240	0.1817	0.0	210.	14.5	14.5	0.318	0.559	1.8
8.9240	0.1990	0.0	210.	14.5	14.5	0.348	0.613	1.9
8.9240	0.2097	0.0	210.	14.5	14.5	0.367	0.646	2.1
8.9240	0.2223	0.0	210.	14.5	14.5	0.389	0.684	2.2
8.9240	0.2342	0.0	210.	14.5	14.5	0.410	0.721	2.3
8.9240	0.2467	0.0	210.	14.5	14.5	0.432	0.760	2.3
8.9240	0.2911	0.0	210.	14.5	14.5	0.510	0.896	3.1
8.9240	0.3056	0.0	210.	14.5	14.5	0.535	0.941	4
8.9240	0.3180	0.0	210.	14.8	14.5	0.548	0.964	4.4
8.9240	0.3644	0.0	210.	15	14.5	0.628	1.104	4.6
8.9240	0.4054	0.0	210.	15.5	14.5	0.688	1.210	4.9
8.9240	0.4613	0.0	210.	16	14.5	0.771	1.356	5.5
8.9240	0.5205	0.0	210.	16.5	14.5	0.858	1.509	6.1
8.91	0.2405	1.0	195.	15.5	14.5	0.408	0.718	1.3
8.91	0.3326	1.0	195.	16	14.5	0.556	0.978	1.5
8.91	0.4721	1.0	195.	17	14.5	0.767	1.349	2
8.91	0.5724	1.0	195.	18	14.5	0.906	1.593	2.5
8.91	0.6517	1.0	195.	18.7	14.5	1.018	1.790	2.8
8.911	0.0919	1.0	200.	14.5	14.5	0.161	0.283	0.7
8.911	0.1085	1.0	200.	14.5	14.5	0.190	0.334	0.7
8.911	0.1507	1.0	200.	14.5	14.5	0.264	0.464	1
8.911	0.1825	1.0	200.	15.5	14.5	0.310	0.545	1.2
8.911	0.2106	1.0	200.	15.5	14.5	0.357	0.628	1.3
8.911	0.2311	1.0	200.	15.5	14.5	0.392	0.690	1.3

- continued -

TABLE A-8 (continued)

Test ID	W_{gc} (lbm/s)	Q_{fin} (gpm)	E_{CC} (°F)	P_{LP} (psia)	P_{CON} (psia)	J^*_{gc}	j^*_{gc}	Voiding Level (in.)
8.9250	0.0781	2.0	210.	14.5	14.5	0.137	0.240	0.6
8.9250	0.1817	2.0	210.	14.5	14.5	0.318	0.559	1.1
8.9250	0.2617	2.0	210.	14.5	14.5	0.458	0.806	1.5
8.9250	0.3554	2.0	210.	15.5	14.5	0.603	1.061	1.9
8.9250	0.4047	2.0	210.	16	14.5	0.676	1.190	1.9
8.9250	0.4713	2.0	210.	16.5	14.5	0.777	1.366	2.1
8.9250	0.5265	2.0	210.	17	14.5	0.855	1.505	2.3
8.9250	0.5696	2.0	210.	16.5	14.5	0.939	1.651	2.4
8.9250	0.6131	2.0	210.	17	14.5	0.996	1.752	2.4
8.9250	0.6509	2.0	210.	17.5	14.5	1.043	1.835	2.6
8.9250	0.6896	2.0	210.	17.5	14.5	1.105	1.944	2.6
8.9260	0.0941	1.0	210.	14.5	14.5	0.165	0.290	0.7
8.9260	0.1740	1.0	210.	14.5	14.5	0.305	0.536	1.1
8.9260	0.2342	1.0	210.	14.5	14.5	0.410	0.721	1.4
8.9260	0.3470	1.0	210.	14.5	14.5	0.598	1.052	1.8
8.9260	0.4040	1.0	210.	15.5	14.5	0.685	1.206	2.1
8.9260	0.4696	1.0	210.	16.5	14.5	0.774	1.361	2.1
8.9260	0.5300	1.0	210.	16.8	14.5	0.861	1.515	2.4
8.9260	0.5728	1.0	210.	16.9	14.5	0.931	1.637	2.5
8.9260	0.6230	1.0	210.	17.1	14.5	1.012	1.781	2.6
8.9260	0.6563	1.0	210.	17.5	14.5	1.052	1.850	2.8
8.9260	0.7103	1.0	210.	18	14.5	1.124	1.976	2.9
8.9270	0.0816	1.0	210.	14.5	14.5	0.143	0.251	0.7
8.9270	0.1708	1.0	210.	14.5	14.5	0.299	0.526	1.1
8.9270	0.2342	1.0	210.	14.5	14.5	0.410	0.721	1.5
8.9270	0.3519	1.0	210.	14.5	14.5	0.616	1.083	1.9
8.9270	0.4067	1.0	210.	15.5	14.5	0.690	1.214	2.1
8.9270	0.4691	1.0	210.	16.5	14.5	0.773	1.360	2.4
8.9270	0.5220	1.0	210.	16.5	14.5	0.860	1.513	2.5
8.9270	0.5799	1.0	210.	16.9	14.5	0.942	1.657	2.6
8.9270	0.6238	1.0	210.	17	14.5	1.014	1.783	2.8
8.9270	0.6663	1.0	210.	17.5	14.5	1.068	1.879	2.9
8.9270	0.7075	1.0	210.	17.5	14.5	1.134	1.995	3.
8.909	0.2579	0.5	200.	15.5	14.5	0.438	0.770	1.5
8.909	0.3308	0.5	200.	15.8	14.5	0.553	0.973	1.7
8.909	0.4653	0.5	200.	16.5	14.5	0.767	1.349	2
8.909	0.5760	0.5	200.	17.5	14.5	0.923	1.624	2.3
8.909	0.6533	0.5	200.	18.5	14.5	1.020	1.795	2.7
8.902	0.0661	0.5	200.	14.5	14.5	0.116	0.204	1.0
8.902	0.0932	0.5	200.	14.5	14.5	0.163	0.287	1.0
8.902	0.1311	0.5	200.	14.5	14.5	0.229	0.404	1.2
8.902	0.1611	0.5	200.	14.5	14.5	0.282	0.496	1.5
8.902	0.1836	0.5	200.	14.5	14.5	0.321	0.565	1.5
8.902	0.2043	0.5	200.	15.5	14.5	0.347	0.610	1.5
8.903	0.0932	1.0	200.	14.5	14.5	0.163	0.287	1
8.903	0.1311	1.0	200.	14.5	14.5	0.229	0.404	1.2
8.903	0.1598	1.0	200.	14.5	14.5	0.280	0.492	1.2
8.903	0.1836	1.0	200.	14.5	14.5	0.321	0.565	1.5
8.903	0.2043	1.0	200.	15.5	14.5	0.347	0.610	1.5

- continued -

TABLE A-8 (continued)

Test ID	W_{gc} (lbm/s)	Q_{fin} (gpm)	T_{ECC} (°F)	P_{LP} (psia)	P_{CON} (psia)	J^*_{gc}	j^*_{gc}	Voiding Level (in.)
8.906	0.3471	1.0	195.	16	14.5	0.580	1.021	1.5
8.906	0.4798	1.0	195.	16.8	14.5	0.780	1.371	2.3
8.906	0.5868	1.0	195.	17.5	14.5	0.941	1.654	2.5
8.906	0.6648	1.0	195.	18.5	14.5	1.038	1.826	2.7
8.906	0.7215	1.0	195.	19	14.5	1.113	1.957	2.8
8.907	0.3676	1.0	200.	16	14.5	0.614	1.081	1.5
8.907	0.4804	1.0	200.	16.8	14.5	0.781	1.373	2
8.907	0.5882	1.0	200.	17.5	14.5	0.943	1.658	2.5
8.907	0.6640	1.0	200.	18.5	14.5	0.1037	1.824	2.7
8.907	0.7280	1.0	200.	19.5	14.5	1.109	1.951	2.9

TABLE A-9

Test ID	W_{gc} (lbm/s)	Q_{fin} (gpm)	T_{ECC} (°F)	P_{LP} (psia)	P_{CON} (psia)	J^*_{gc}	j^*_{gc}	Voiding Level (in.)
8.516	0.5507	0.0	180.	14.5	14.5	0.169	0.114	1
8.516	0.6154	0.0	180.	14.5	14.5	0.189	0.127	2
8.516	0.6737	0.0	180.	14.5	14.5	0.207	0.139	2.8
8.516	0.7272	0.0	180.	14.5	14.5	0.224	0.150	3.5
8.516	0.7770	0.0	180.	14.5	14.5	0.239	0.160	4
8.516	0.8237	0.0	180.	14.5	14.5	0.253	0.170	4.5
8.516	0.8678	0.0	180.	14.5	14.5	0.267	0.179	5.5
8.516	0.9096	0.0	180.	14.5	14.5	0.280	0.188	9.5
8.516	0.9495	0.0	180.	14.5	14.5	0.292	0.196	11.0
8.516	0.9878	0.0	180.	14.5	14.5	0.304	0.204	12.5
8.516	1.0246	0.0	180.	14.5	14.5	0.315	0.211	14.5
8.516	1.0941	0.0	180.	14.5	14.5	0.336	0.226	16
8.516	1.1593	0.0	180.	14.5	14.5	0.356	0.239	16.8
8.516	1.2208	0.0	180.	14.5	14.5	0.375	0.252	17.5
8.516	1.3346	0.0	180	14.5	14.5	0.410	0.275	18
8.516	1.4388	0.0	180.	14.5	14.5	0.442	0.297	19
8.516	1.5348	0.0	180.	14.5	14.5	0.472	0.317	20
8.533	0.8058	0.0	200.	14.5	14.5	0.248	0.166	3.5
8.533	1.1375	0.0	200.	14.5	14.5	0.350	0.235	15
8.533	1.3914	0.0	200.	14.5	14.5	0.428	0.287	19
8.533	1.6054	0.0	200.	14.5	14.5	0.493	0.331	21
8.533	1.7898	0.0	200.	14.5	14.5	0.550	0.369	22
8.533	1.9599	0.0	200.	14.5	14.5	0.602	0.404	22.8
8.515	0.7249	0.0	212.	14.5	14.5	0.223	0.150	4
8.515	0.5133	0.0	212.	14.5	14.5	0.158	0.106	2.5
8.515	0.7249	0.0	212.	14.5	14.5	0.223	0.150	4
8.515	0.8864	0.0	212.	14.5	14.5	0.272	0.183	9
8.515	1.0230	0.0	212.	14.5	14.5	0.314	0.211	12.5
8.515	1.1427	0.0	212.	14.5	14.5	0.351	0.236	17.5
8.515	1.2508	0.0	212.	14.5	14.5	0.384	0.258	18.5
8.515	1.3502	0.0	212.	14.5	14.5	0.415	0.279	19
8.527	0.5649	5.0	200.	14.5	14.5	0.174	0.117	1.5
8.527	0.8058	5.0	200.	14.5	14.5	0.248	0.166	2
8.527	0.9822	5.0	200.	14.5	14.5	0.302	0.203	3.5
8.527	1.1375	5.0	200.	14.5	14.5	0.350	0.235	4
8.527	1.2682	5.0	200.	14.5	14.5	0.390	0.262	5
8.527	1.3914	5.0	200.	15.5	14.5	0.415	0.278	5.8
8.527	1.5001	5.0	200.	15.5	14.5	0.447	0.300	9
8.527	1.6054	5.0	200.	15.5	14.5	0.478	0.321	10.5
8.527	1.7001	5.0	200.	15.5	14.5	0.506	0.340	11.3
8.527	1.7898	5.0	200.	15.5	14.5	0.533	0.358	12.8
8.527	1.9599	5.0	200.	16	14.5	0.575	0.386	15.5
8.527	2.1162	5.0	200.	16	14.5	0.621	0.417	15.8
8.518	0.5507	5.0	212.	14.5	14.5	0.169	0.114	1.5
8.518	0.6737	5.0	212.	14.5	14.5	0.207	0.139	2
8.518	0.7770	5.0	212.	14.5	14.5	0.239	0.160	2.5
8.518	0.8678	5.0	212.	14.5	14.5	0.267	0.179	3
8.518	0.9495	5.0	212.	14.5	14.5	0.292	0.196	3.5
8.518	1.0246	5.0	212.	14.5	14.5	0.315	0.211	4
8.518	1.0941	5.0	212.	14.5	14.5	0.336	0.226	4.5
8.518	1.1593	5.0	212.	14.5	14.5	0.356	0.239	5.3
8.518	1.2208	5.0	212.	14.5	14.5	0.375	0.252	8
8.518	1.2791	5.0	212.	14.5	14.5	0.393	0.264	9
8.518	1.3346	5.0	212.	14.5	14.5	0.410	0.275	10
8.518	1.3877	5.0	212.	14.5	14.5	0.427	0.286	11
8.518	1.4388	5.0	212.	14.5	14.5	0.442	0.297	11.5
8.518	1.4876	5.0	212.	14.5	14.5	0.457	0.307	12
8.518	1.5348	5.0	212.	15	14.5	0.464	0.312	13

- continued -

TABLE A-9 (continued)

Test ID	W_{gc} (lbm/s)	Q_{fin} (gpm)	T_{ECC} (°F)	P_{LP} (psia)	P_{CON} (psia)	J^*_{gc}	j^*_{gc}	Voiding Level (in.)
8.526	0.5649	10.0	200.	14.5	14.5	0.174	0.117	2.8
8.526	0.8058	10.0	200.	14.5	14.5	0.248	0.166	3
8.526	0.9822	10.0	200.	14.5	14.5	0.302	0.203	3.7
8.526	1.1375	10.0	200.	14.5	14.5	0.350	0.235	4.8
8.526	1.2682	10.0	200.	14.5	14.5	0.390	0.262	6
8.526	1.3914	10.0	200.	15.5	14.5	0.415	0.278	8.5
8.526	1.5001	10.0	200.	15.5	14.5	0.447	0.300	9.5
8.526	1.6054	10.0	200.	15.5	14.5	0.478	0.321	10.8
8.526	1.7001	10.0	200.	15.5	14.5	0.506	0.340	12.5
8.526	1.7898	10.0	200.	15.5	14.5	0.533	0.358	14.5
8.526	1.9599	10.0	200.	16	14.5	0.575	0.386	15.5
8.526	2.2615	10.0	200.	16	14.5	0.664	0.446	16.5
8.526	2.3977	10.0	200.	16	14.5	0.704	0.472	19
8.526	2.5262	10.0	200.	16	14.5	0.742	0.498	19.5
8.526	2.7625	10.0	200.	16	14.5	0.811	0.544	19.5
8.526	3.1847	10.0	200.	16.5	14.5	0.921	0.618	22

TABLE A-10

Test ID	W_{gc} (lbm/s)	Q_{fin} (gpm)	T_{ECC} (°F)	P_{LP} (psia)	P_{CON} (psia)	J^*_{gc}	j^*_{gc}	Voiding Level (in.)
8.529	0.6239	5.0	190.	14.5	14.5	0.101	0.129	0.5
8.529	1.2943	5.0	190.	14.5	14.5	0.209	0.267	2.5
8.529	1.7184	5.0	190.	14.5	14.5	0.278	0.364	3.3
8.529	2.0559	5.0	190.	15	14.5	0.327	0.417	4.3
8.529	2.3439	5.0	190.	15.5	14.5	0.367	0.469	4.8
8.529	2.5995	5.0	190.	15.5	14.5	0.407	0.520	5
8.529	2.8310	5.0	190.	15.6	14.5	0.443	0.566	5.3
8.529	3.0444	5.0	190.	15.8	14.5	0.470	0.600	5.5
8.529	3.2428	5.0	190.	15.9	14.5	0.500	0.639	5.5
8.529	3.4293	5.0	190.	16	14.5	0.529	0.676	5.5
8.529	3.6052	5.0	190.	16	14.5	0.556	0.710	5.5
8.53	0.6239	5.0	190.	14.5	14.5	0.101	0.129	1
8.53	1.0166	5.0	190.	14.5	14.5	0.164	0.210	2.3
8.53	1.2943	5.0	190.	14.5	14.5	0.209	0.267	3
8.53	1.7184	5.0	190.	14.8	14.5	0.273	0.349	3.7
8.53	2.0559	5.0	190.	15.	14.5	0.327	0.417	4.3
8.53	2.3439	5.0	190.	15.3	14.5	0.367	0.469	4.8
8.53	2.5995	5.0	190.	15.6	14.5	0.407	0.520	5
8.53	2.8310	5.0	190.	15.7	14.5	0.443	0.566	5.3
8.53	3.0444	5.0	190.	15.8	14.5	0.470	0.600	5.3
8.53	3.2428	5.0	190.	16	14.5	0.500	0.639	5.5
8.53	3.4293	5.0	190.	16	14.5	0.529	0.676	5.8
8.53	3.6052	5.0	190.	16	14.5	0.556	0.710	6
8.528	0.6239	0.0	190.	14.5	14.5	0.101	0.129	2
8.528	1.2943	0.0	190.	14.5	14.5	0.209	0.267	4
8.528	1.7184	0.0	190.	14.5	14.5	0.278	0.354	4.5
8.528	2.0559	0.0	190.	14.9	14.5	0.327	0.417	5.3
8.528	2.3439	0.0	190.	15	14.5	0.373	0.476	5.8
8.528	2.5995	0.0	190.	15	14.5	0.413	0.528	6.8
8.528	2.8310	0.0	190.	15.5	14.5	0.433	0.566	8.7
8.528	3.0444	0.0	190.	15.7	14.5	0.477	0.609	10
8.528	3.2428	0.0	190.	16	14.5	0.500	0.639	11.5
8.528	3.4293	0.0	190.	16	14.5	0.529	0.676	12.5
8.528	3.6052	0.0	190.	16.5	14.5	0.548	0.700	13
8.528	3.7725	0.0	190.	16.5	14.5	0.573	0.733	13.5
8.531	0.7203	0.0	190.	14.5	14.5	0.116	0.149	1.5
8.531	1.3424	0.0	190.	14.6	14.5	0.217	0.277	3.5
8.531	1.7553	0.0	190.	14.7	14.5	0.283	0.362	4.3
8.531	2.0866	0.0	190.	14.8	14.5	0.332	0.424	4.3
8.531	2.3708	0.0	190.	15	14.5	0.377	0.481	5.5
8.531	2.6234	0.0	190.	15	14.5	0.410	0.525	6.5
8.531	2.8531	0.0	190.	15.5	14.5	0.447	0.570	7.3
8.531	3.0649	0.0	190.	15.7	14.5	0.480	0.613	8
8.531	3.2620	0.0	190.	15.8	14.5	0.503	0.643	9
8.531	3.4471	0.0	190.	15.9	14.5	0.532	0.679	11
8.532	0.7203	0.0	190.	14.5	14.5	0.116	0.149	0.5
8.532	1.3424	0.0	190.	14.6	14.5	0.217	0.277	3.0
8.532	1.7553	0.0	190.	14.7	14.5	0.283	0.362	4.0
8.532	2.0866	0.0	190.	14.8	14.5	0.332	0.424	4.5
8.532	2.3708	0.0	190.	15	14.5	0.377	0.481	5.5
8.532	2.6234	0.0	190.	15.5	14.5	0.410	0.525	6
8.532	3.0649	0.0	190.	15.5	14.5	0.480	0.613	7.8

APPENDIX B

TWO PHASE EQUILIBRIUM VOIDING DATA

This appendix includes data obtained with the 1/30-scale vessel to investigate the effect of lower plenum void fraction. The table below indicates the vessel geometry for these experiments and summarizes the data which follow.

TABLE B-1

TWO PHASE EQUILIBRIUM VOIDING DATA

D_V = 6 in. D_C = 4.5 in. (tube)
s = 0.25 in. L_{LP} = 21 in. L_D = 12 in.

Table	Void Fraction
B-2	0.05
B-3	0.10
B-4	0.15
B-5	0.28

TABLE B-2

Test ID	W_{gc} (lbm/sec)	P_{LP} (psia)	P_{CON} (psia)	j^*_{gc}	h (in.)	h/D_c
2.051	0.03	14.5	14.5	0.059	1.0	0.22
2.051	0.04	14.5	14.5	0.073	1.7	0.38
2.051	0.05	14.5	14.5	0.094	2.7	0.61
2.051	0.09	14.5	14.5	0.167	3.5	0.78
2.051	0.11	14.5	14.5	0.189	4.0	0.89
2.051	0.12	14.5	14.5	0.208	4.0	0.89
2.051	0.14	14.5	14.5	0.251	4.0	0.89
2.052	0.09	14.5	14.5	0.162	2.4	0.53
2.052	0.11	14.5	14.5	0.207	2.5	0.56
2.052	0.15	14.5	14.5	0.265	2.8	0.61
2.052	0.26	14.5	14.5	0.461	3.6	0.81
2.052	0.39	15.5	14.5	0.675	5.0	1.11
2.052	0.46	16.5	14.5	0.77	6.0	1.33

TABLE B-3

Test ID	W_{gc} (lbm/sec)	P_{LP} (psia)	P_{CON} (psia)	j^*_{gc}	h (in.)	h/D_c
2.101	0.03	14.5	14.5	0.049	0.5	0.11
2.101	0.04	14.5	14.5	0.067	1.5	0.33
2.101	0.05	14.5	14.5	0.085	2.5	0.55
2.101	0.08	14.5	14.5	0.145	3.0	0.66
2.101	0.10	14.5	14.5	0.180	3.2	0.72
2.102	0.03	14.5	14.5	0.057	1.0	0.22
2.102	0.08	14.5	14.5	0.143	3.5	0.77
2.102	0.10	14.5	14.5	0.191	4.0	0.88
2.102	0.14	14.5	14.5	0.267	4.0	0.88
2.102	0.18	14.5	14.5	0.325	4.2	0.94
2.102	0.20	14.5	14.5	0.376	4.5	.00
2.102	0.23	14.5	14.5	0.417	5.0	1.11
2.103	0.02	14.5	14.5	0.030	0.0	0.00
2.103	0.03	14.5	14.5	0.046	1.0	0.22
2.103	0.03	14.5	14.5	0.055	1.5	0.33
2.103	0.03	14.5	14.5	0.065	2.5	0.55
2.103	0.04	14.5	14.5	0.071	3.0	0.66
2.103	0.04	14.5	14.5	0.077	3.5	0.77
2.103	0.05	14.5	14.5	0.087	4.0	0.88
2.103	0.05	14.5	14.5	0.095	4.0	0.88

TABLE B-4

Test ID	W_{gc} (lbm/sec)	P_{LP} (psia)	P_{CON} (psia)	j^*_{gc}	h (in.)	h/D_c
2.151	0.03	14.5	14.5	0.055	2.5	0.55
2.151	0.03	14.5	14.5	0.066	3.5	0.77
2.151	0.05	14.5	14.5	0.086	5.5	1.22
2.151	0.09	14.5	14.5	0.177	5.8	1.27
2.151	0.12	14.5	14.5	0.220	6.2	1.38
2.151	0.14	14.5	14.5	0.260	6.5	1.44
2.152	0.09	14.5	14.5	0.171	5.0	1.11
2.152	0.12	14.5	14.5	0.224	6.0	1.33
2.152	0.15	14.5	14.5	0.281	6.2	1.38
2.152	0.21	14.5	14.5	0.409	6.5	1.44
2.152	0.25	14.5	14.5	0.485	7.0	1.55
2.152	0.30	14.5	14.5	0.563	7.0	1.55
2.152	0.34	14.5	14.5	0.639	7.5	1.66
2.152	0.36	15.5	14.5	0.657	8.0	1.77
2.152	0.38	16.0	14.5	0.695	8.0	1.77
2.152	0.41	16.2	14.5	0.739	8.5	1.88
2.152	0.43	16.4	14.5	0.778	8.5	1.88
2.152	0.46	16.5	14.5	0.814	9.0	2.00

TABLE B-5

Test ID	W_{gc} (lbm/sec)	P_{LP} (psia)	P_{CON} (psia)	j^*_{gc}	h (in.)	h/D_c
2.281	0.02	14.5	14.5	0.050	2.5	0.55
2.281	0.04	14.5	14.5	0.078	5.5	1.22
2.281	0.05	14.5	14.5	0.099	6.0	1.33
2.282	0.01	14.5	14.5	0.025	1.5	0.33
2.282	0.02	14.5	14.5	0.045	3.0	0.66
2.282	0.03	14.5	14.5	0.058	4.5	1.00
2.282	0.04	14.5	14.5	0.073	6.5	1.44
2.282	0.04	14.5	14.5	0.080	7.5	1.66
2.282	0.04	14.5	14.5	0.086	7.5	1.66
2.282	0.05	14.5	14.5	0.104	7.5	1.66
2.282	0.02	14.5	14.5	0.049	1.0	0.22
2.282	0.04	14.5	14.5	0.079	1.5	0.33
2.283	0.12	14.5	14.5	0.251	7.5	1.66
2.283	0.24	14.5	14.5	0.487	8.0	1.77
2.283	0.34	14.5	14.5	0.697	9.0	2.00
2.283	0.40	14.5	14.5	0.824	9.0	2.00
2.283	0.46	16.5	14.5	0.904	9.5	2.11
2.284	0.09	14.5	14.5	0.193	7.5	1.66
2.284	0.15	14.5	14.5	0.304	8.5	1.88
2.284	0.26	14.5	14.5	0.544	9.5	2.11
2.284	0.33	15.1	14.5	0.665	9.5	2.22
2.284	0.39	15.2	14.5	0.788	10.0	2.22
2.284	0.46	16.5	14.5	0.900	10.0	2.22

APPENDIX C

TRANSIENT LIQUID VOIDING DATA

Results of the transient liquid voiding tests at 1/15 scale are presented in this appendix. Core steam flow rate, lower plenum water volume, and lower plenum pressure are included for each test. Table C-1 summarizes the results.

TABLE C-1

TRANSIENT LIQUID VOIDING DATA

D_V = 11.5 in. D_C = 5.75 in. (tube)
s = 0.5 in. L_{LP} = 30.75 in. L_D = 18 in.

Figure	Test ID	j^*_{gc} (initial)	Transient Time (sec)	h/D_C (final)
C-1	14.0028	1.6	∞	1.47
C-2	14.0041	1.6	11	0.66
C-3	14.0030	1.6	30	1.06
C-4	14.0038	1.6	34	1.06
C-5	14.0039	1.6	37	0.97
C-6	14.0040	1.6	60	1.15
C-7	14.0031	1.6	60	1.23
C-8	14.0042	1.0	∞	1.14
C-9	14.0043	1.0	10	0.57
C-10	14.0044	1.0	29	0.57
C-11	14.0045	1.0	55	0.90
C-12	14.0032	0.5	∞	1.14
C-13	14.0036	0.5	10	0.33
C-14	14.0023	0.5	25	0.41
C-15	14.0034	0.5	36	0.41
C-16	14.0024	0.5	56	0.57
C-17	14.0035	0.5	75	0.49

It should be noted that different test procedures were used for some of the tests. In one case, the steam was allowed to flow into the separator initially. (The vessel discharges into the separator during a test). Once the initial flow rate was set, a two way valve was actuated which simultaneously stopped the flow into the separator and started the flow into the vessel. The other method was to set the steam flow rate into the separator and shut it off with a quick closing valve. The test was started by actuating a quick opening valve allowing the steam to flow into the vessel. This is why the steam flow traces differ before the start of each test.

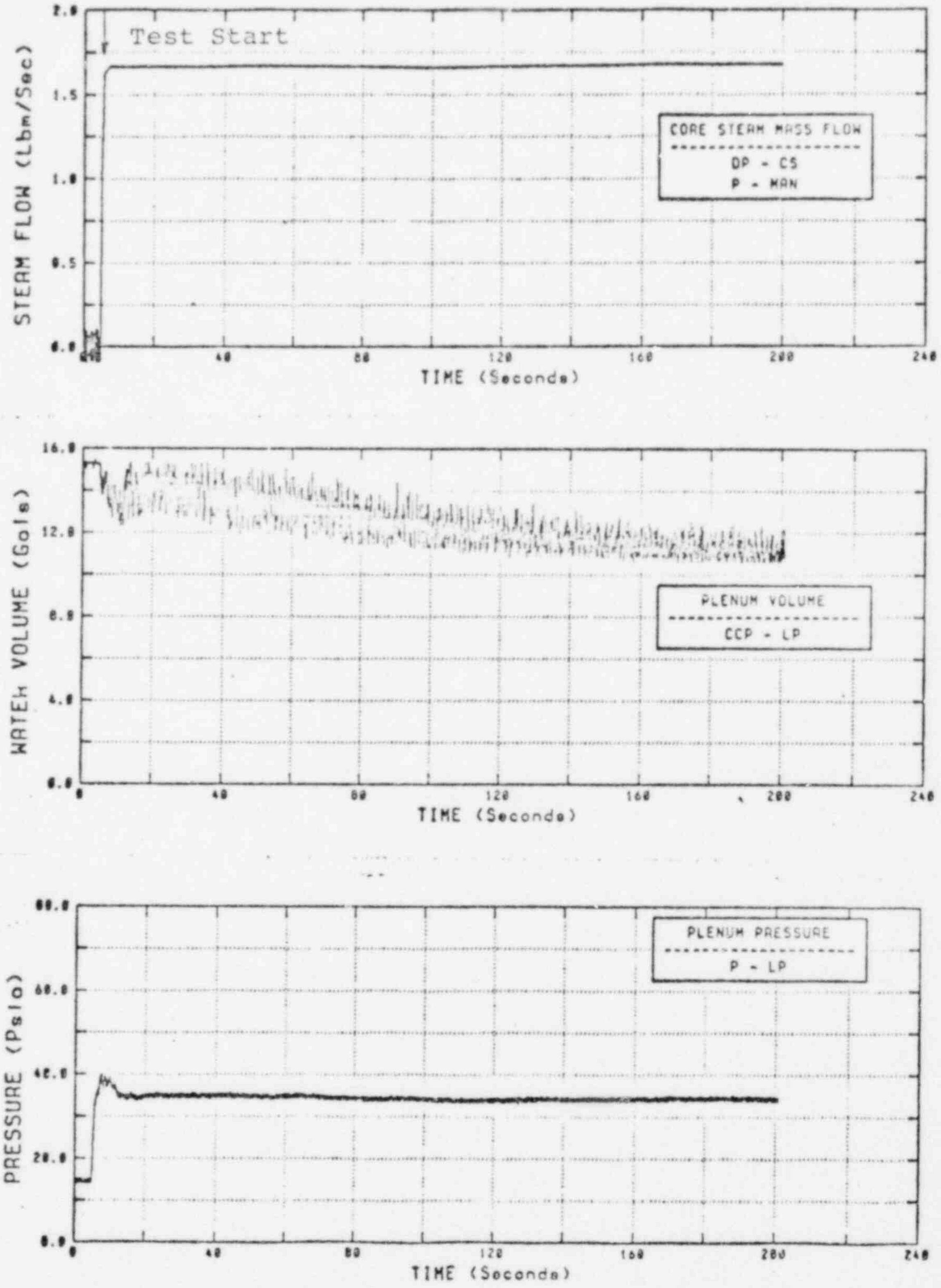

Figure C-1. <u>TRANSIENT LIQUID VOIDING</u>

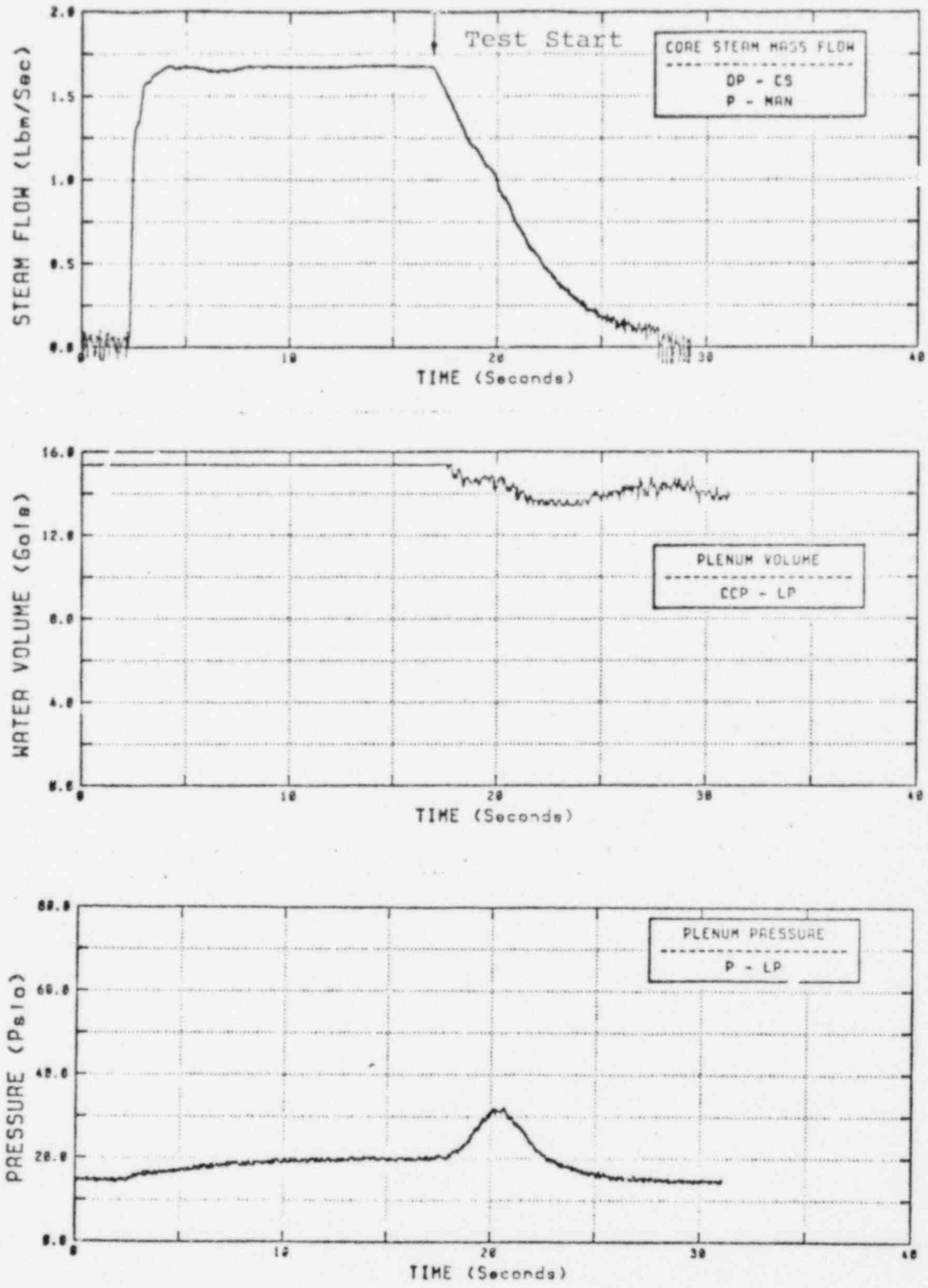

Figure C-2. TRANSIENT LIQUID VOIDING

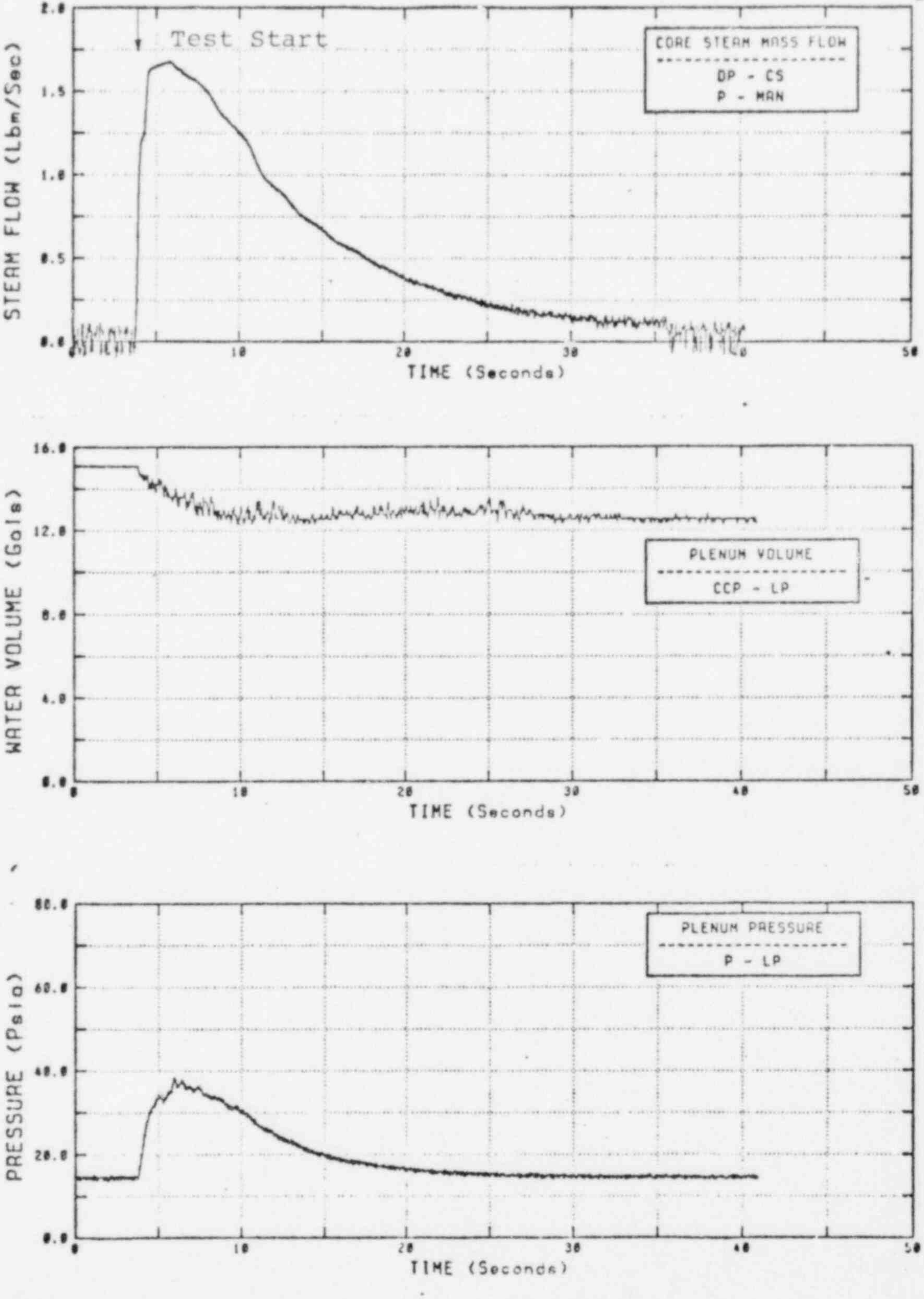

Figure C-3. TRANSIENT LIQUID VOIDING

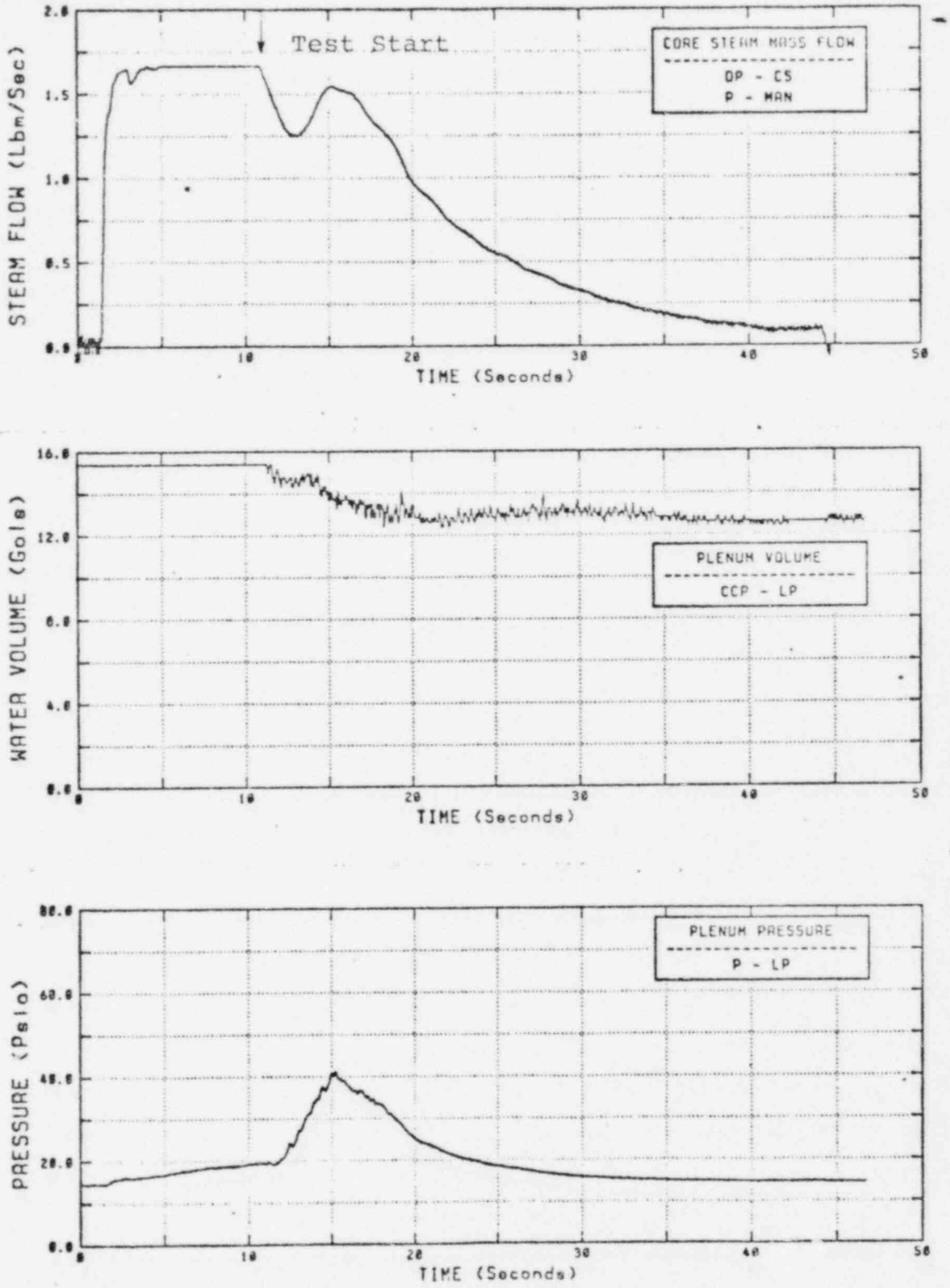

Figure C-4. TRANSIENT LIQUID VOIDING

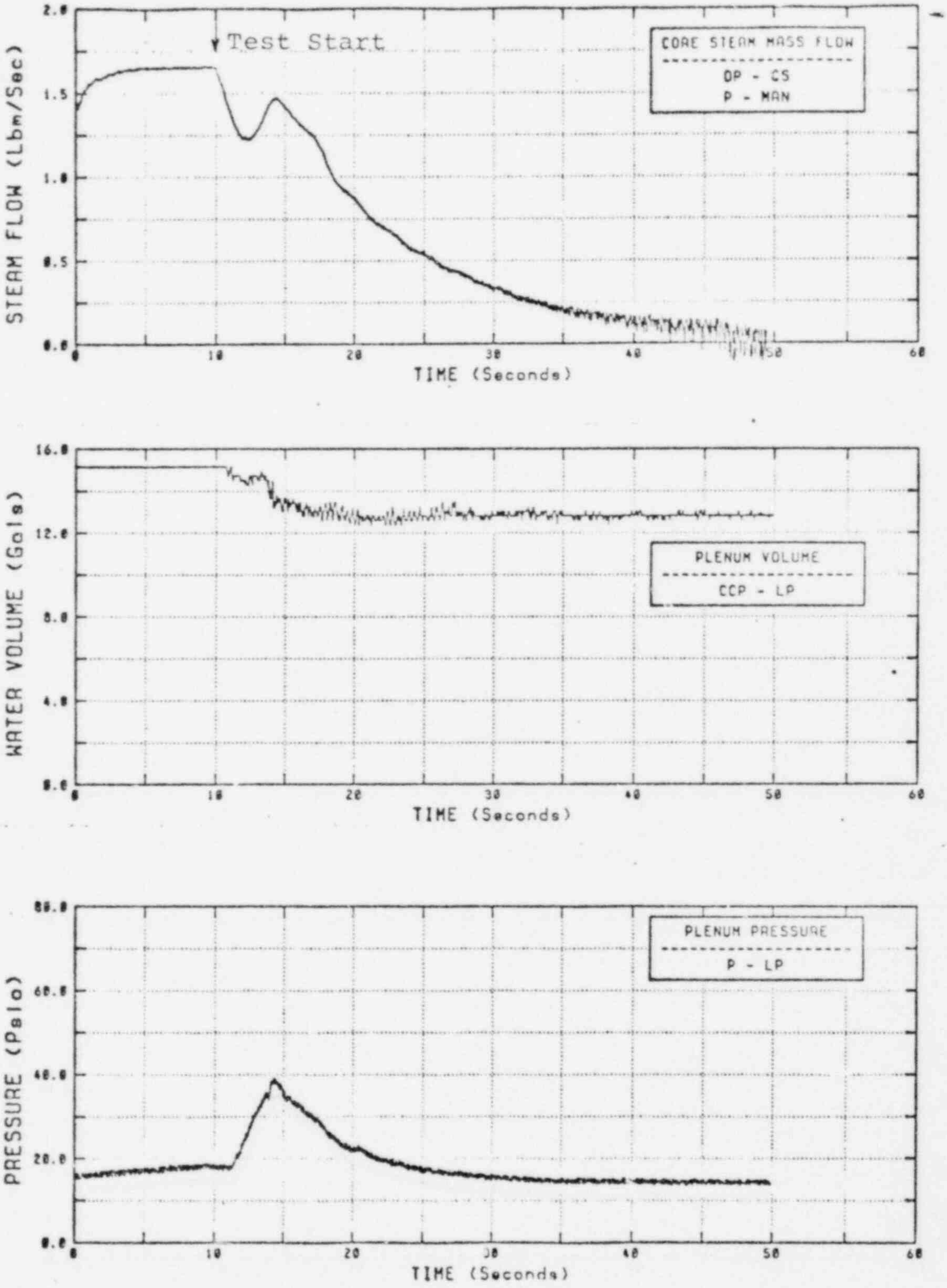

Figure C-5. TRANSIENT LIQUID VOIDING

POOR ORIGINAL

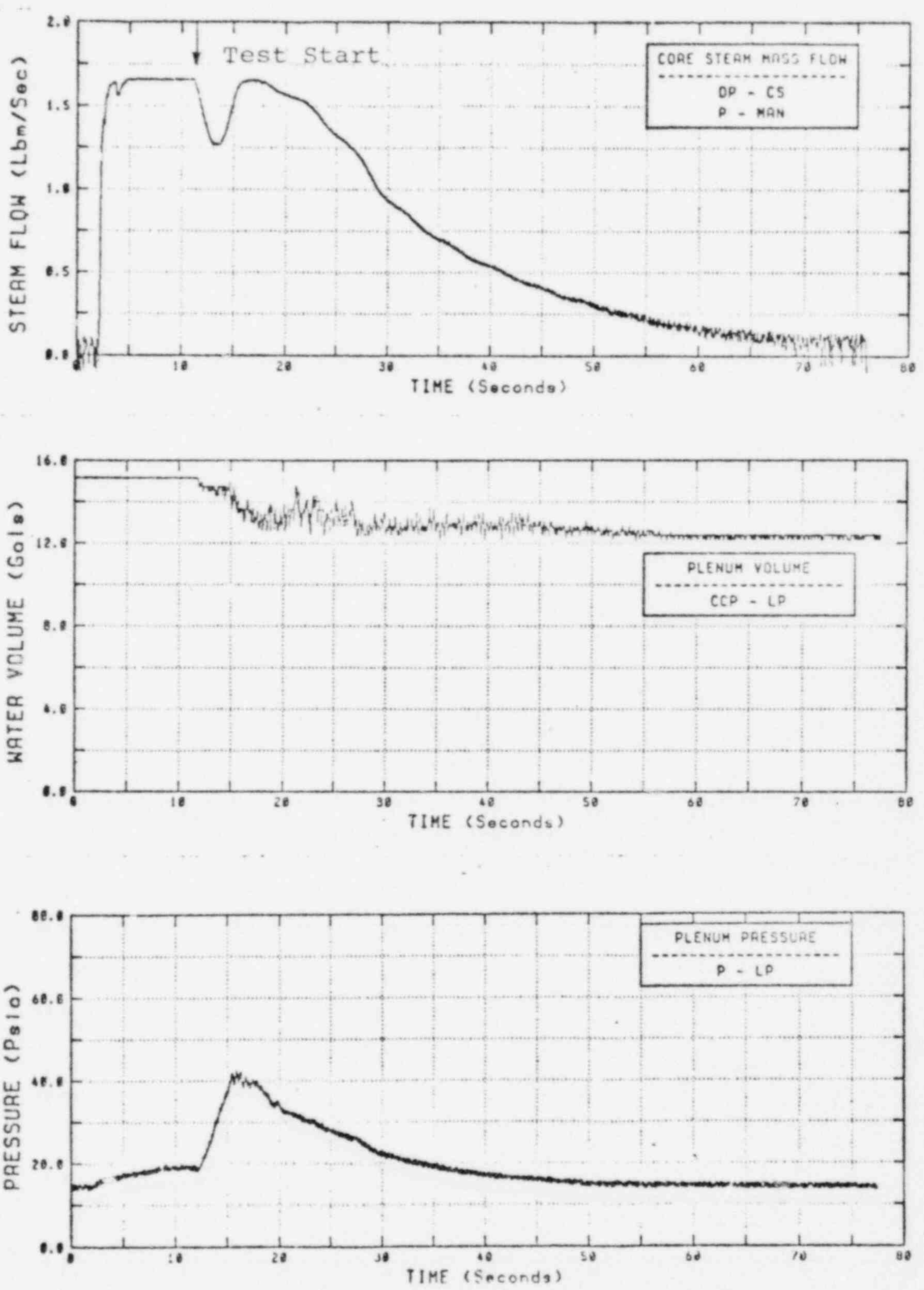

Figure C-6. TRANSIENT LIQUID VOIDING

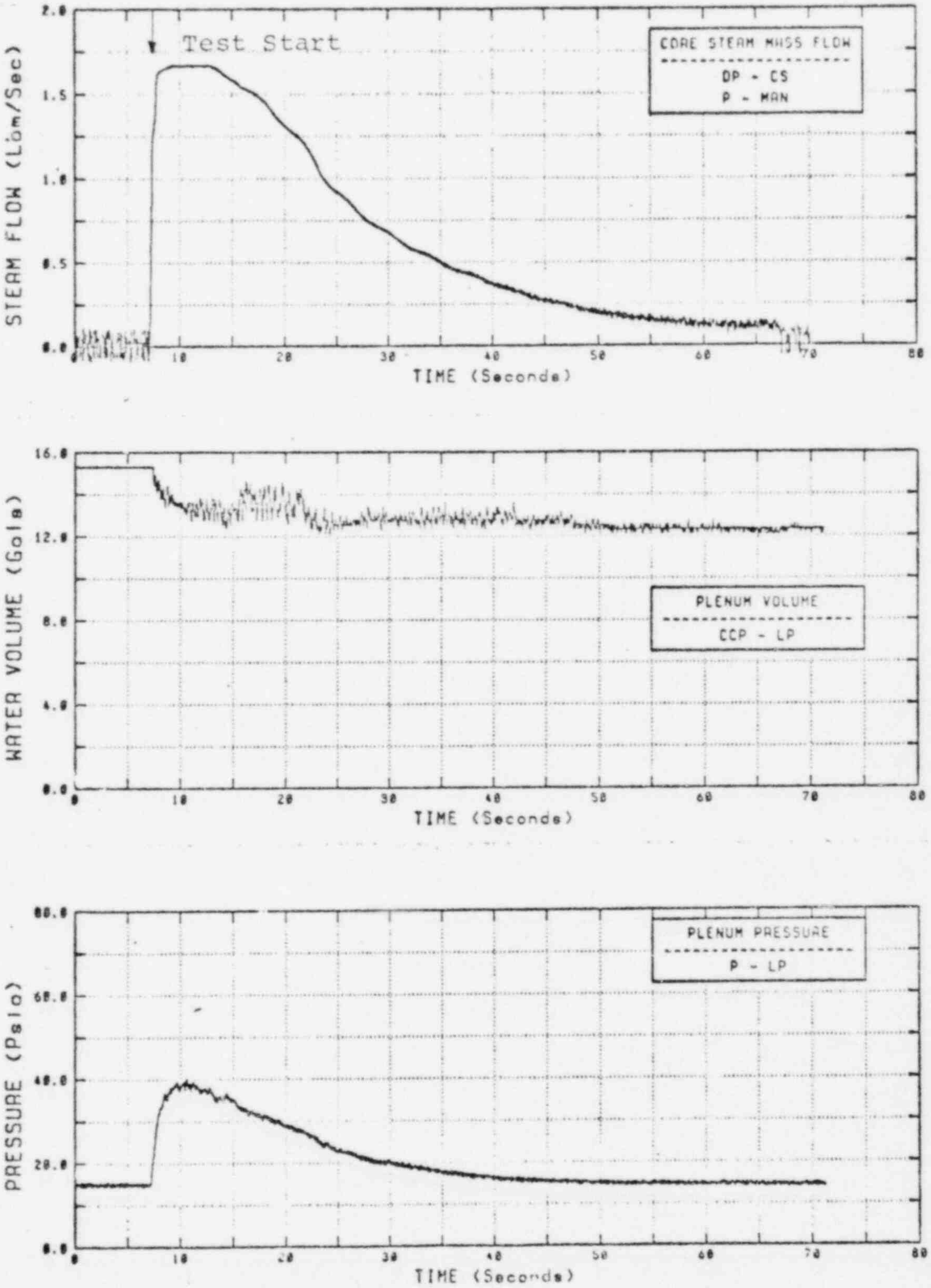

Figure C-7. TRANSIENT LIQUID VOIDING

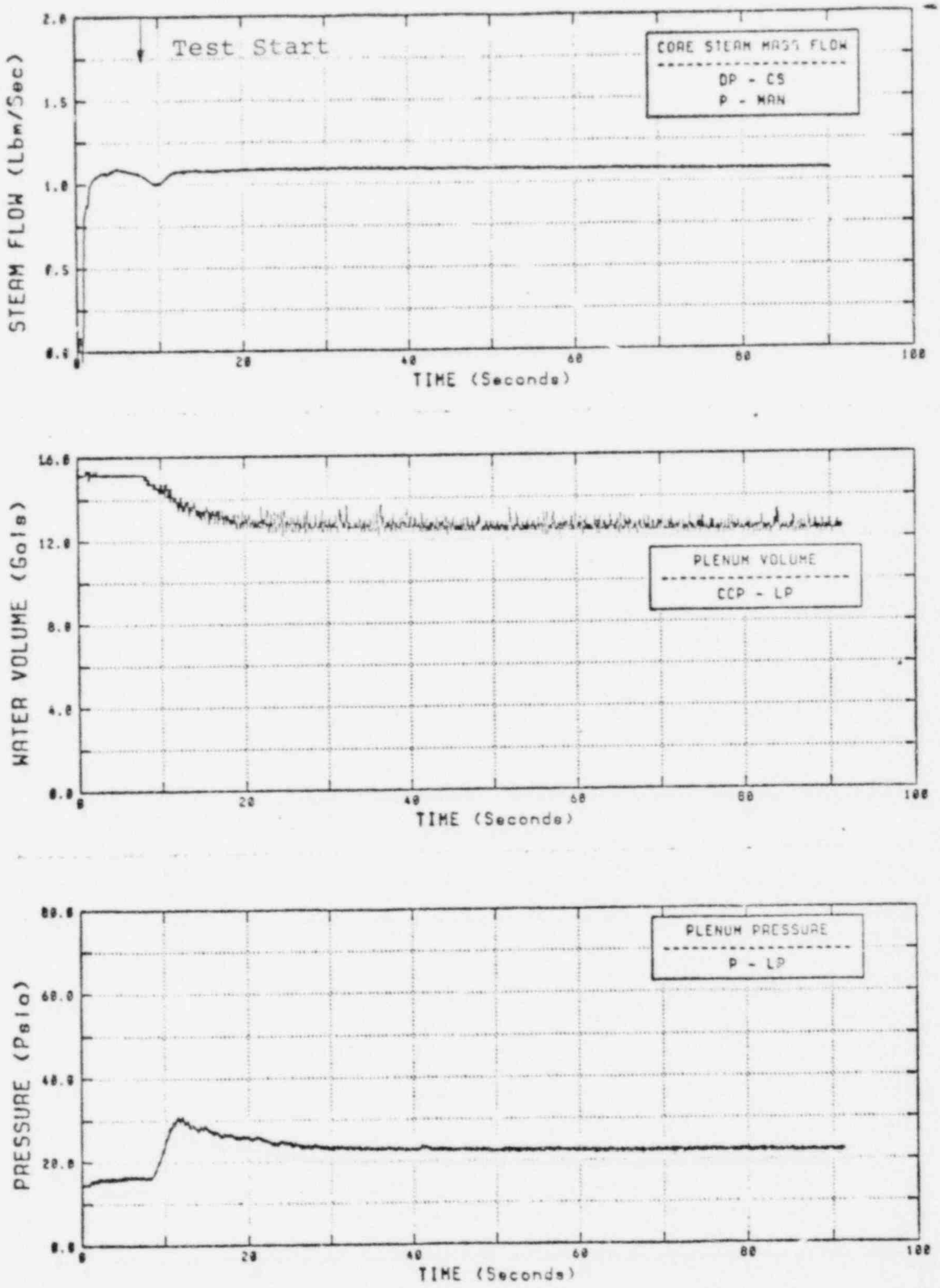

Figure C-8. TRANSIENT LIQUID VOIDING

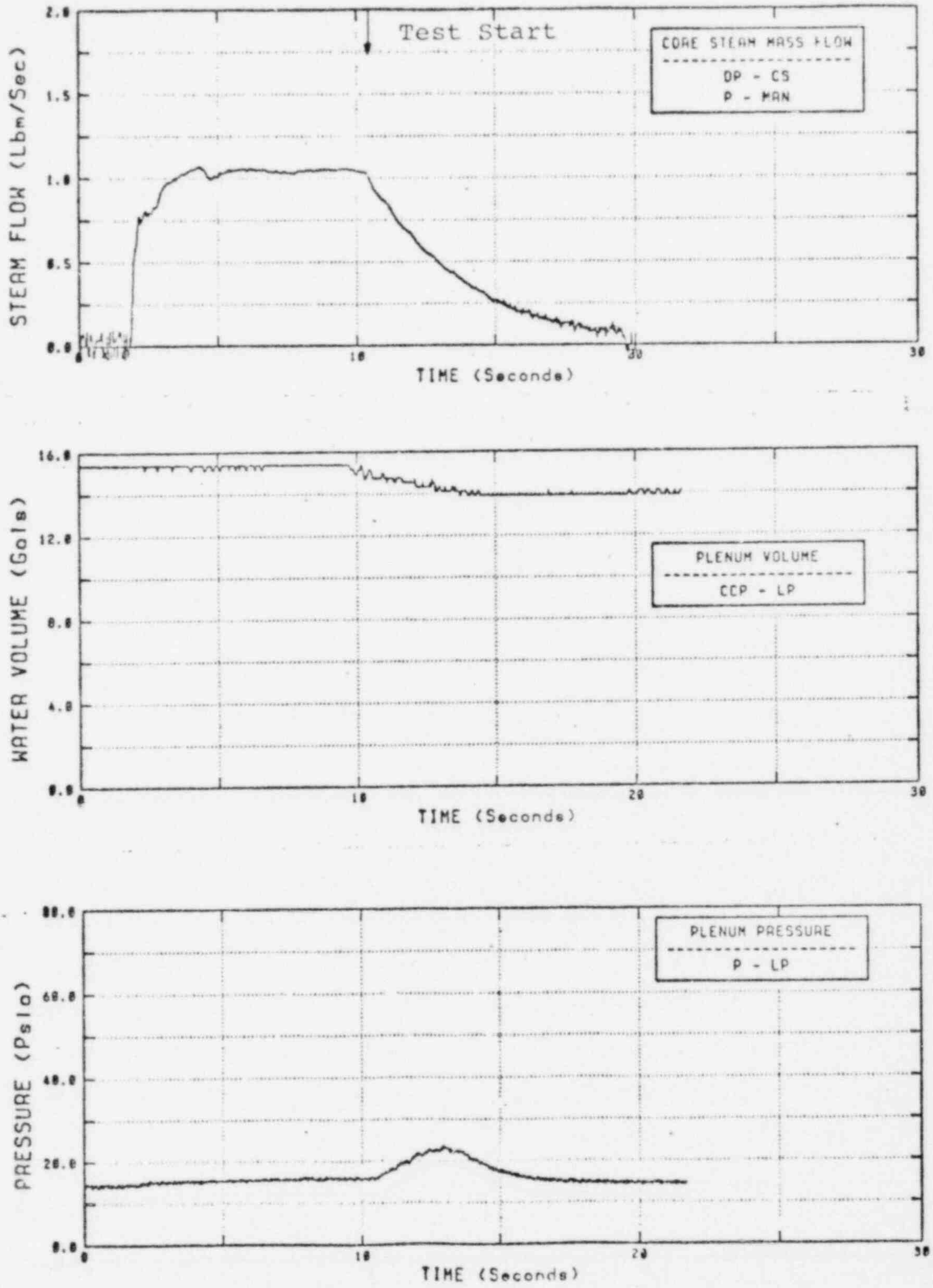

Figure C-9. TRANSIENT LIQUID VOIDING

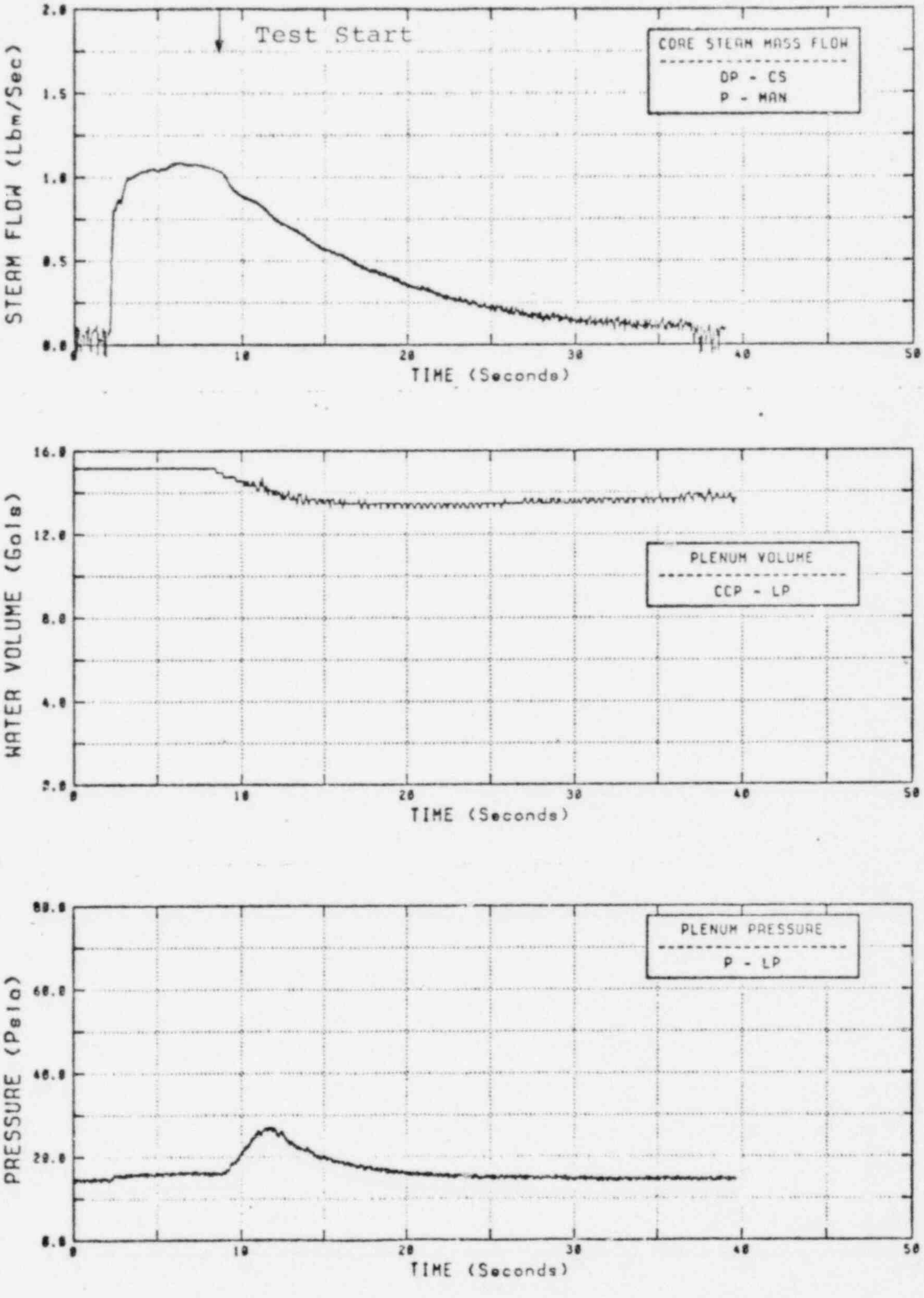

Figure C-10. TRANSIENT LIQUID VOIDING

POOR ORIGINAL

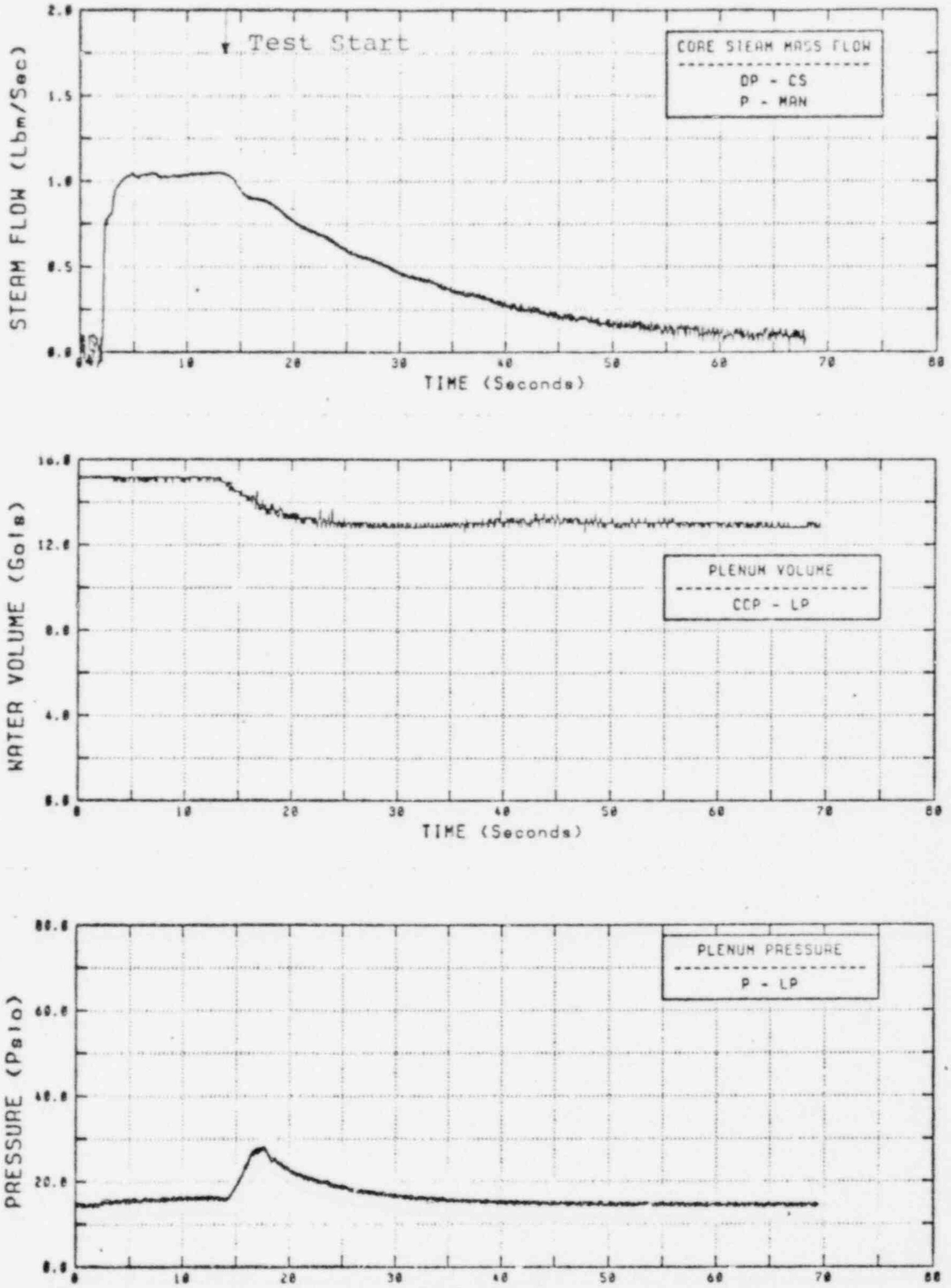

Figure C-11. TRANSIENT LIQUID VOIDING

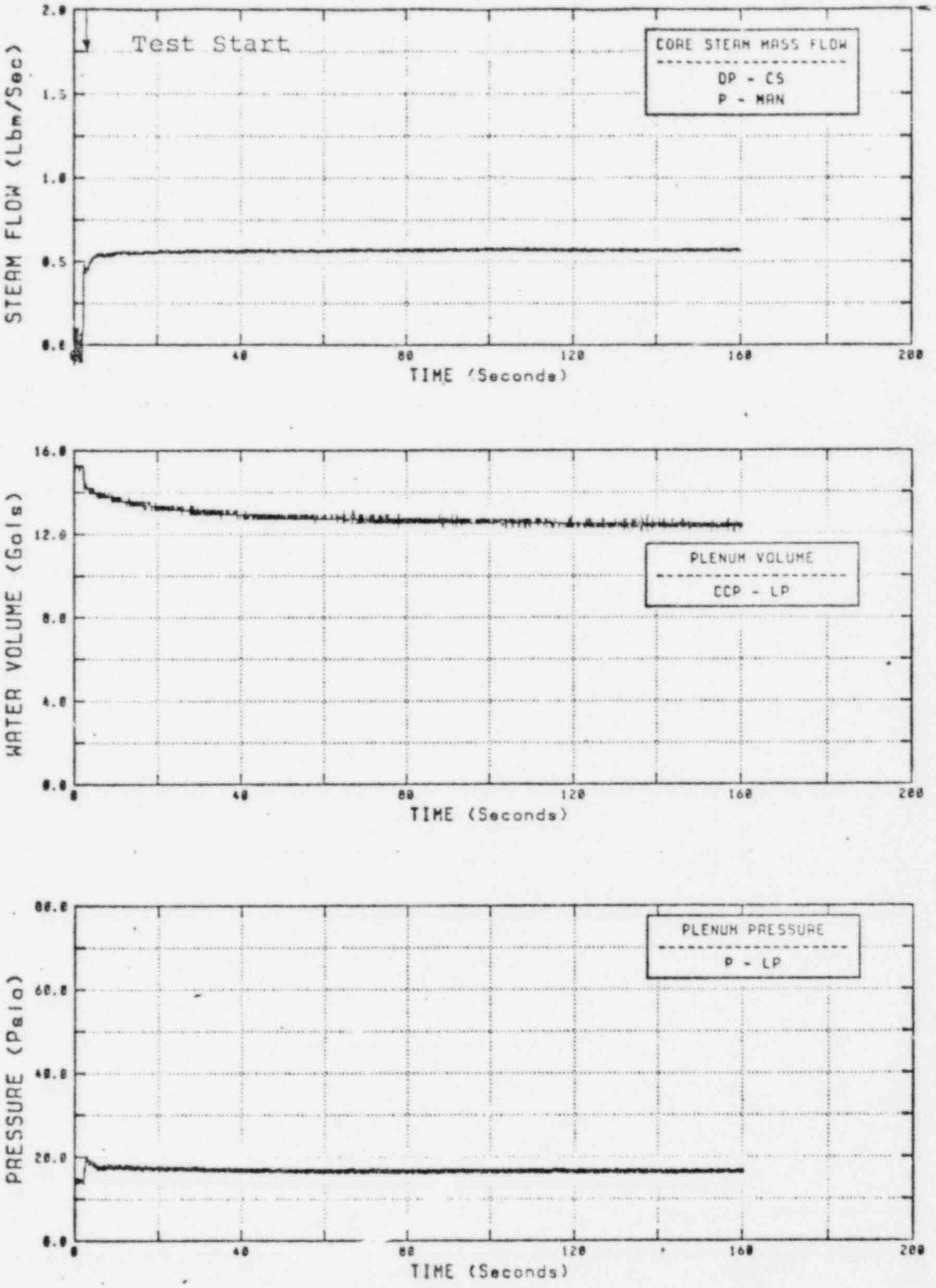

Figure C-12. TRANSIENT LIQUID-VOIDING

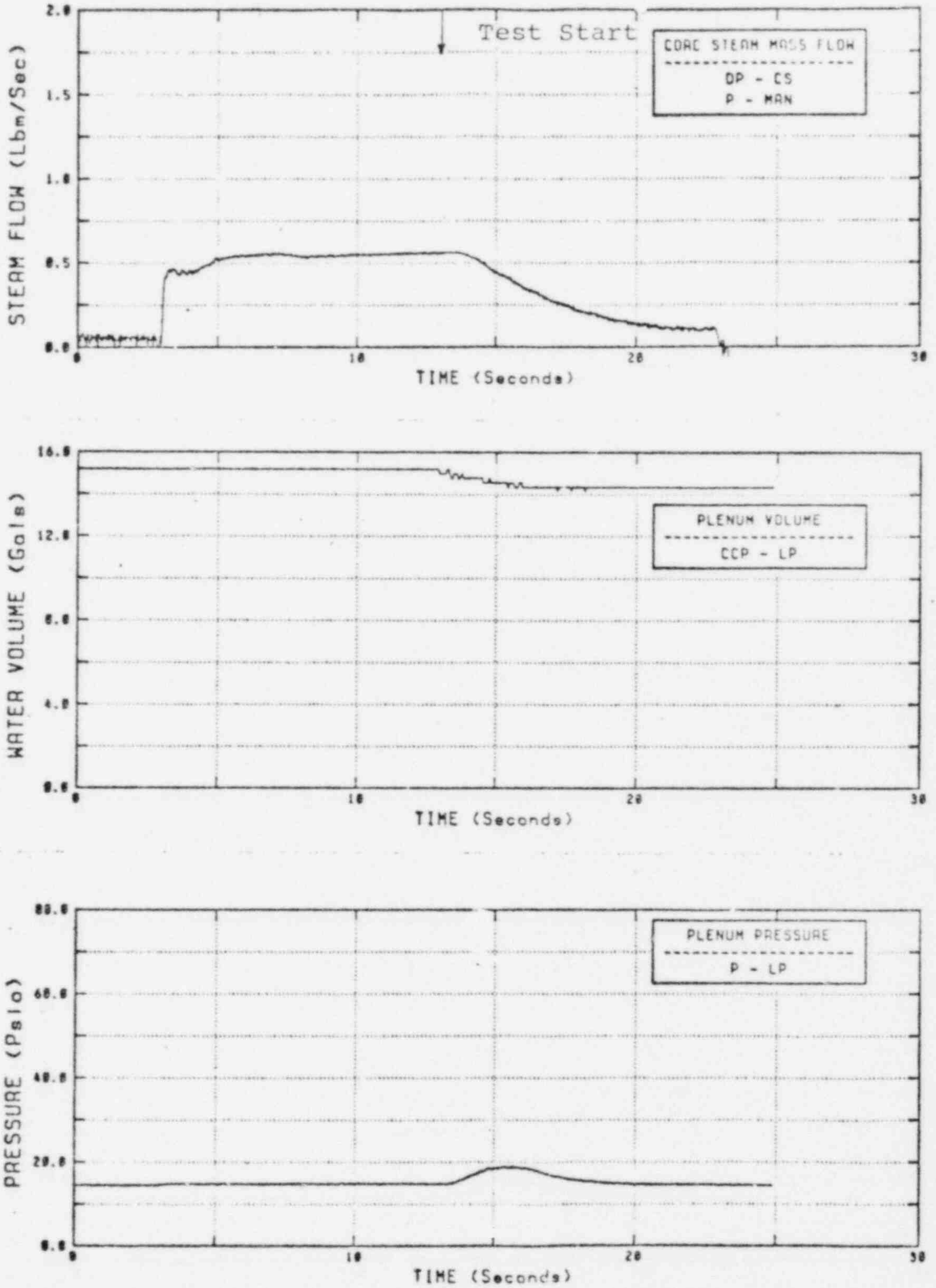

Figure C-13. TRANSIENT LIQUID VOIDING

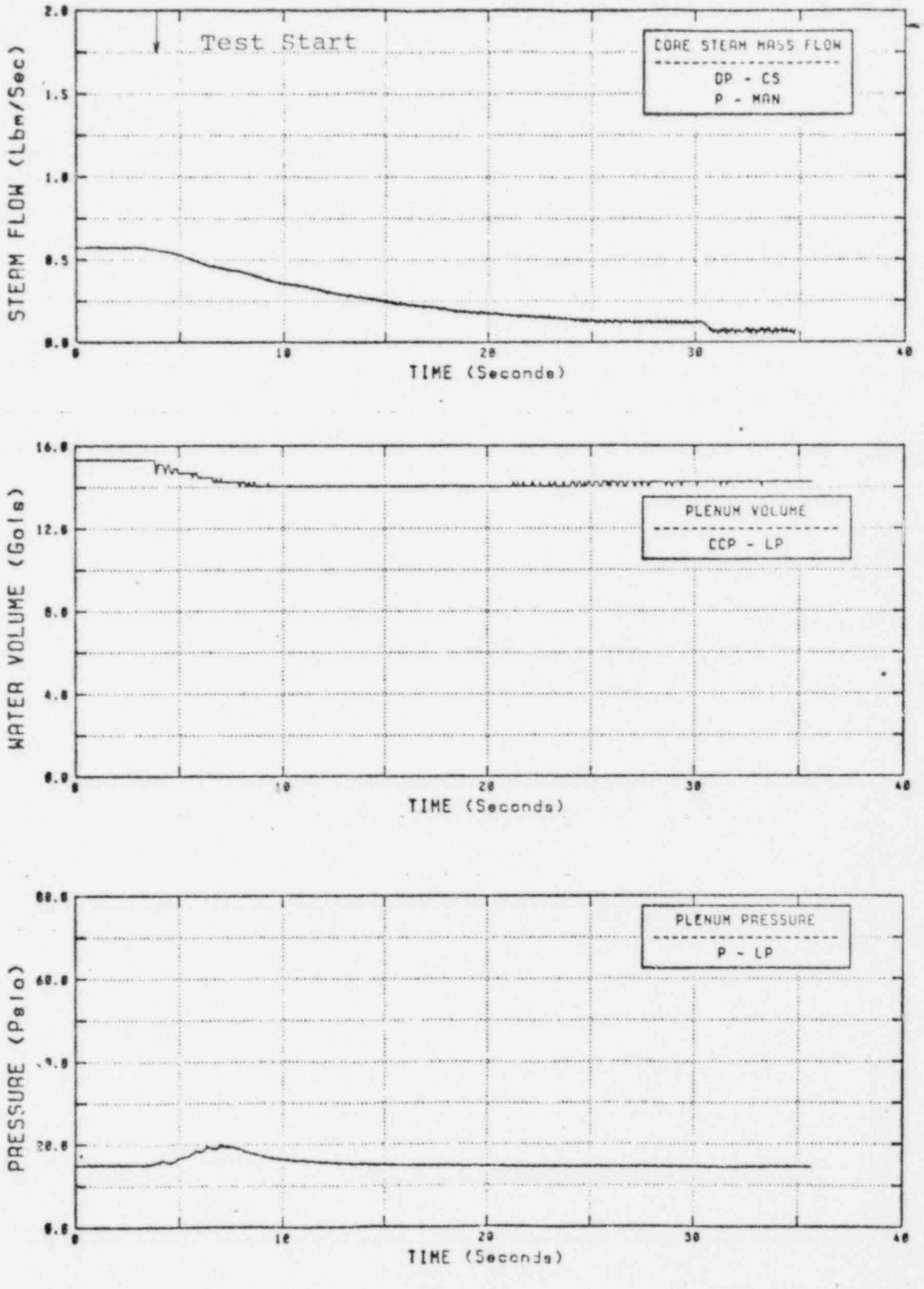

Figure C-14. TRANSIENT LIQUID VOIDING

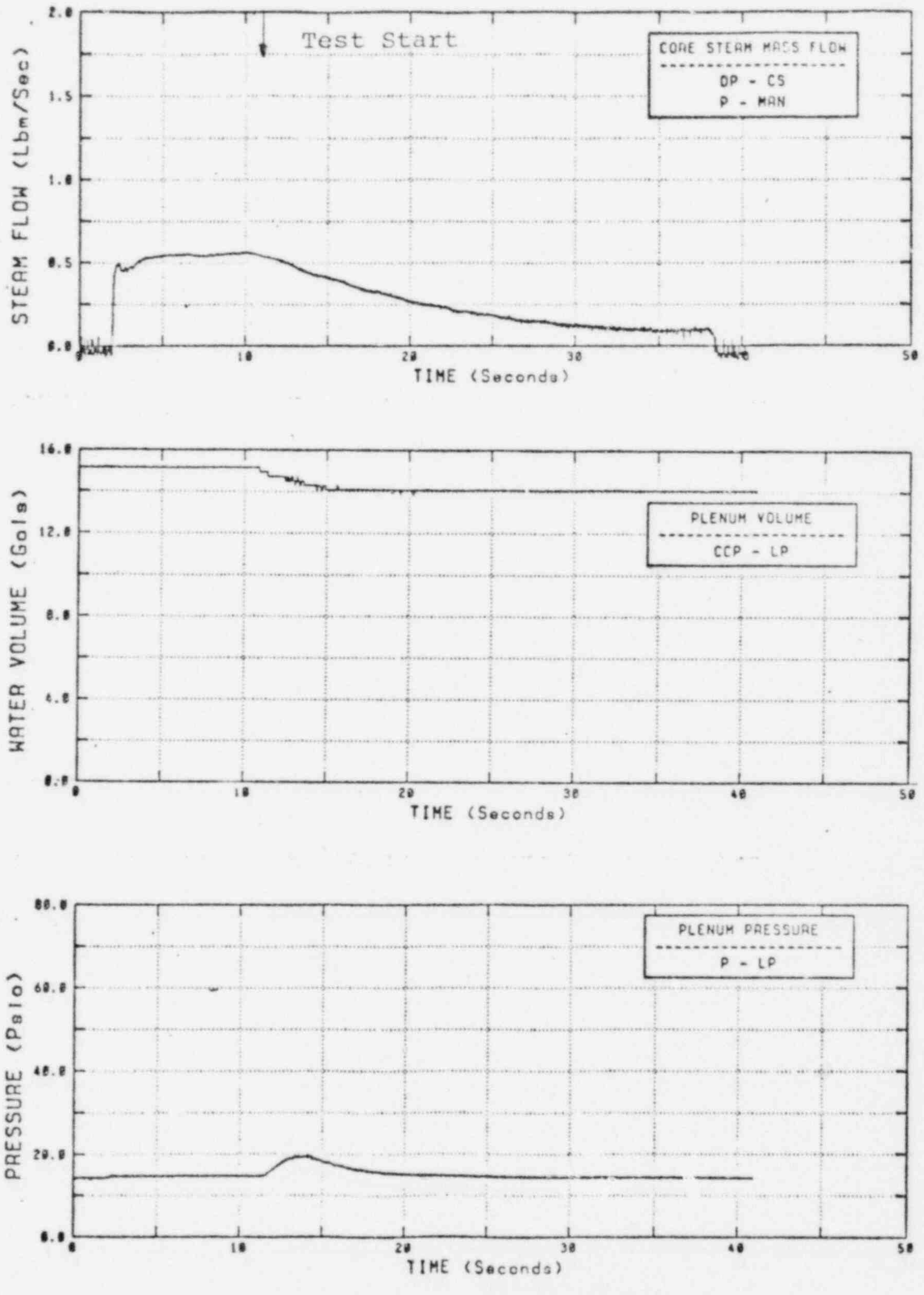

Figure C-15. TRANSIENT LIQUID VOIDING

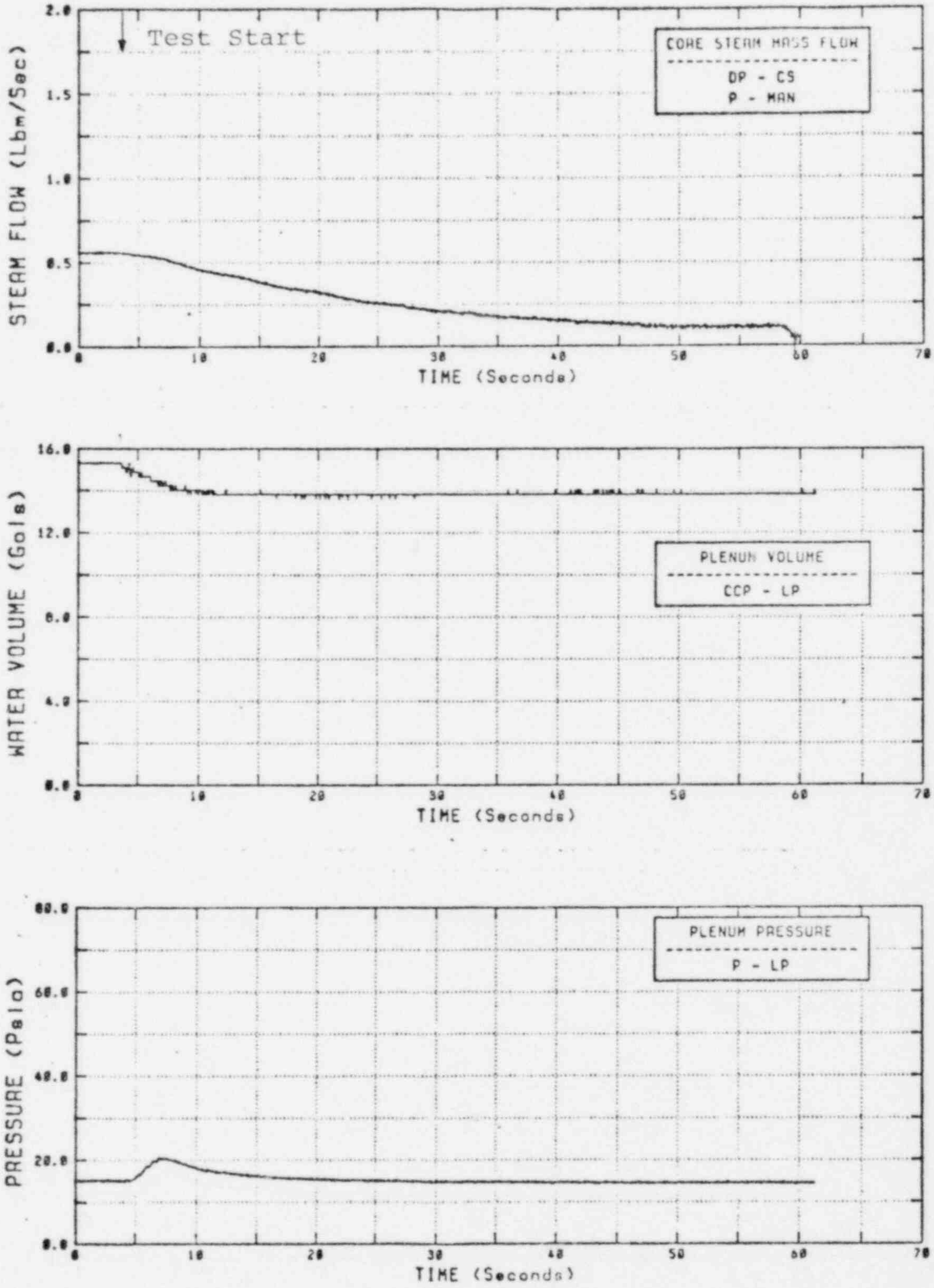

Figure C-16. TRANSIENT LIQUID VOIDING

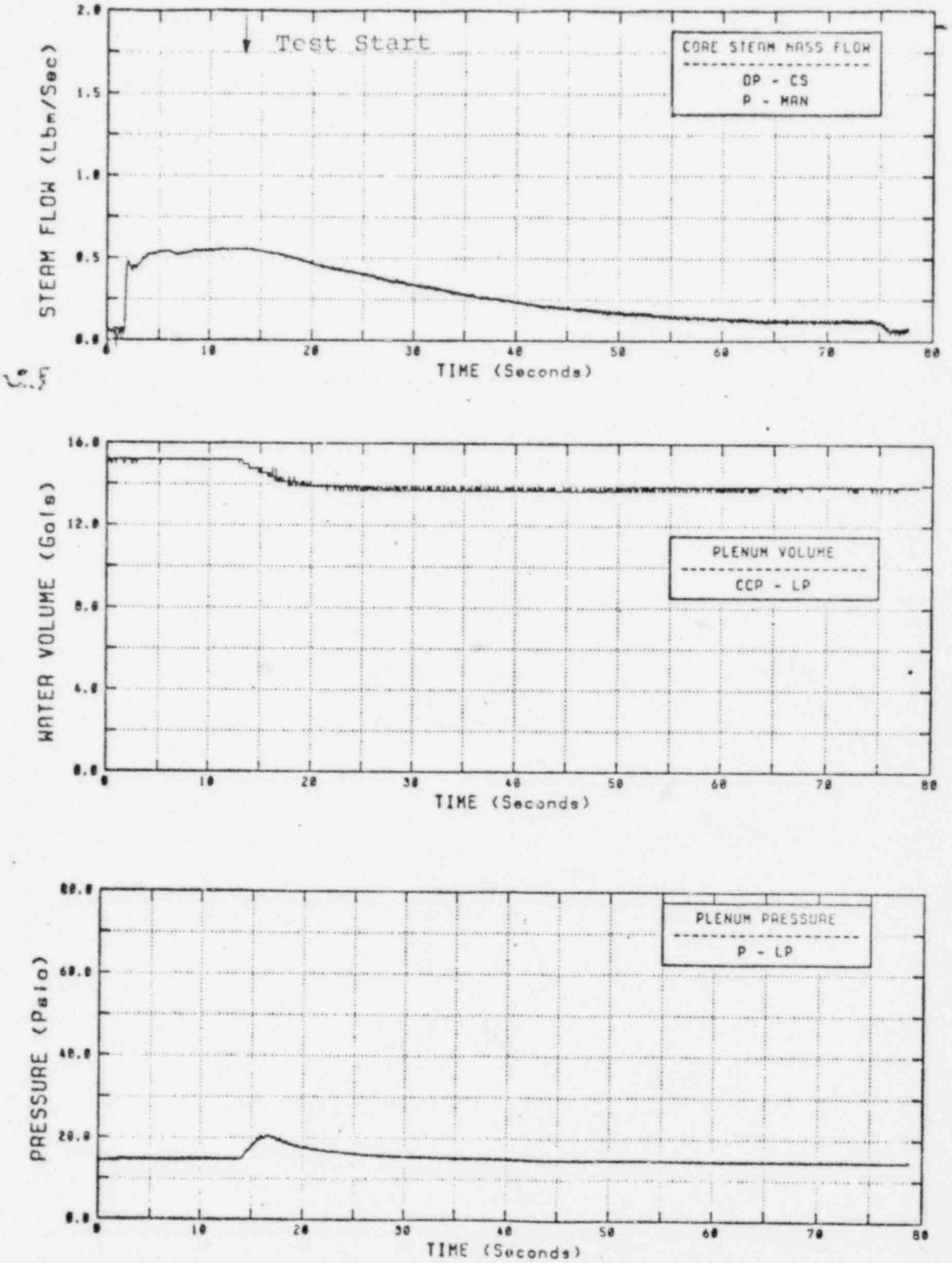

Figure C-17. TRANSIENT LIQUID VOIDING