Commonwealth Edison
One First National Plaza, Chicago, Illinois
Address Reply to Post Office Box 767
Chicago, Illinois 60690

June 2, 1981

Mr. G. C. Lainas, Assistant Director
for Safety Assessment
Division of Licensing
U. S. Nuclear Regulatory Commission
Washington, DC 20555

Subject: Dresden Station Units 2 and 3
Quad Cities Station Units 1 and 2
Containment Vent and Purge
Valve Operability
NRC Docket Nos. 50-237/249 and
254/265

Reference (a): R. F. Janecek letter to G. C. Lainas
dated February 27, 1981

Dear Mr. Lainas:

Reference (a) transmitted a previous response to NRC questions concerning the operability of the Dresden 2/3 and Quad Cities 1/2 18-inch containment vent and purge isolation valves. That response indicated that six (6) valves at Dresden and Quad Cities required further evaluation.

Our evaluation has been completed and a revised response to question 1.1 is provided in Attachment 1. Please note that during our review it was determined that three of the six valves under consideration actually were oriented with the valve shaft in-plane with the upstream elbow, thereby eliminating them from concern. Accordingly, a revised Table I is also provided. This revised response to question 1.1 and the new Table I completely replace those tramitted by Reference (a).

Please address any questions concerning this matter to this office.

One (1) signed original and fifty-nine (59) copies of this transmittal are provided for your use.

Very truly yours,

Thomas J. Rausch

Thomas J. Rausch
Nuclear Licensing Administrator
Boiling Water Reactors

cc: Region III Inspector, Dresden
Region III, Inspector, Quad Citie

2097N

Dupe 8106080309

Response to Request for Additional Information
Quad Cities 1 & 2 and Dresden 2 & 3
Containment Purge/Vent Valves

Question 1.1: Describe how each of the valve installations, relative to the piping configurations, have been reviewed to assure that the dynamic torque coefficients (C_t) developed by Fluid dynamic testing are applicable to the Dresden & Quad Cities valves. C_t can be affected by shaft orientation relative to close proximity of upstream elbows and disc closure direction relative to these close proximity upstream elbows.

Answer: The testing performed at FluiDyne did not model the piping upstream or downstream of the valve. The test stand at FluiDyne was designed to maximize the flow velocity through the valve. A sketch of the test facility and Table I, "Summary of Piping and Valve Geometry", are attached to this letter.

Testing performed by Allis-Chalmers indicates that when the upstream elbow is in-plane with the valve shaft, C_T is not changed in comparison to a system geometry with straight upstream piping. This means that the testing performed at FluiDyne is conservative for "in-plane" and straight inlet piping.

As shown in Table I, Dresden Valves AO-2-1601-23 and AO-3- 1601-23 and Quad Cities Valve AO-1-1601-24 have valve shafts which are not in-plane with the upstream elbow. This geometric condition will cause a slight increase in the hydrodynamic torque coefficient, C_T, and hence an increase in hydrodynamic torque. The information contained in the next few paragraphs will demonstrate that the increased hyrodynamic torque is within the capacity of the valve.

The relationship between "out-of-plane" elbows and C_T used in this verification is based on information contained in "Test Report on an Allis-Chalmers 6" STREAMSEAL Butterfly Valve in Air Concerning Nuclear Containment Isolation Valves", a report submitted to Dairyland Power's LaCrosse docket. Test 21 and Test 24 data were selected for comparison to the

Pratt 6" valve FluiDyne test data since the upstream disc shape and aspect ratio of the tested valves are approximately equal. The data from Test 21 and the FluiDyne test data correspond to "in-plane" shaft geometry and Test 24 corresponds to "out-of-plane" geometry.

The C_T information for Pratt valves in Tables II.1, II.2, and II.3 and tables extracted from the Allis-Chalmers report have been summarized in Figures II.1, II.2 and II.3. These figures show that the shape of the "in-plane" C_T curves are similar and that the maximum difference between C_T "in-plane" and C_T "out-of-plane" for sonic conditions (P_{T1} = 40 or 60 psia) for Allis-Chalmers STREAMSEAL valves is a factor of 1.283.

The maximum torque on a Pratt eighteen (18) inch butterfly valve, as scaled from test data gathered at FluiDyne, is 216 ft-lbs. Multiplying 216 ft-lbs times 1.283 yields a maximum torque value of 277 ft-lbs for "out-of-plane" valves. Since this is less than the 300 ft-lbs used in the valve analysis (Reference 1), no further evaluation is necessary.

TABLE I

SUMMARY OF PIPING AND VALVE GEOMETRY

	UNIT	VALVE NUMBER	LINE NUMBER	ELBOWS UPSTREAM OF THE VALVE (<10D)?	IN-PLANE WITH THE VALVE SHAFT	ELBOWS DOWNSTREAM OF THE VALVE (<10D)?	VALVE POSITION*	DRAWI
DRESDEN	2	AO-2-1601-21	2-1604-18-LX	YES	YES	NO	2	DETAIL
	2	AO-2-1601-22	2-1604-18-LX	YES	YES	NO	2	DEATIL
	2	AO-2-1601-23	2-1605-18-LX	YES	NO	YES	1	DETAIL
	2	AO-2-1601-24	2-1605-18-LX	NO	N/A	YES	1	DETAIL
	3	AO-3-1601-21	3-1604-18-LX	YES	YES	NO	2	DETAIL
	3	AO-3-1601-22	3-1604-18-LX	YES	YES	NO	2	DETAIL
	3	AO-3-1601-23	3-1605-18-LX	YES	NO	YES	1	DETAIL
	3	AO-3-1601-24	3-1605-18-LX	NO	N/A	YES	1	DETAIL
QUAD CITIES	1	AO-1-1601-21	1-1604-18-LX	YES	YES	NO	1	DETAIL
	1	AO-1-1601-22	1-1604-18-LX	YES	YES	NO	1	DETAIL
	1	AO-1-1601-23	1-1605-18-LX	NO	N/A	YES	1	DETAIL
	1	AO-1-1601-24	1-1605-18-LX	YES	NO	YES	1	DETAIL DETAIL DETAIL
	2	AO-2-1601-21	2-1604-18-LX	NO	N/A	NO	1	DETAIL
	2	AO-2-1601-22	2-1604-18-LX	NO	N/A	NO	1	DETAIL
	2	AO-2-1601-23	2-1605-18-LX	NO	N/A	YES	1	DETAIL
	2	AO-2-1601-24	2-1605-18-LX	YES	YES	YES	1	DETAIL DETAIL DETAIL

*See Figure I

TABLE II.1

CALCULATION OF HYDRODYNAMIC TORQUE COEFFICIENT C_T - PRATT 6" Ø

UPSTREAM PRESSURE - P_{t2} = 20 psia

RUN No.	VALVE DISC ANGLE	P_{t2} (psia)	AVG [P_4 thru P_9] (psia)		DP_{AVG} (psid)	TORQUE, T_H (in-lbs) $\begin{pmatrix} T_M - T_M \ (T_M \text{ negative}) \\ T_F + T_F \ (T_F \text{ positive}) \end{pmatrix}$	C_T	C_T x 144 in^2/ft^2
3.10	8°	20.22	[4-9]	14.60	5.62	+31.3 + 5.0 = +36.3	+.0289	+4.165
6.00	18°	20.03	[4-9]	14.43	5.60	+59.9 + 6.0 = +65.9	+.0527	+7.588
9.00	28°	20.23	[4-9]	14.12	6.11	+59.5 + 7.0 = +66.5	+.0487	+7.018
12.00	38°	18.36	[4-9]	14.08	4.28	+43.6 + 7.0 = +50.6	+.0529	+7.623
15.00	48°	20.16	[4-9]	13.88	6.28	+30.1 + 7.0 = +37.1	+.0265	+3.809
15.10	48°	20.06	[4-9]	13.88	6.18	+29.8 + 7.0 = +36.8	+.0267	+3.840
18.10	58°	19.76	[4-9]	13.86	5.90	+16.6 + 7.0 = +23.6	+.0179	+2.579
21.0	68°	19.86	[4-9]	14.13	5.73	-1.3 - 7.0 = -8.3	-.0065	-1.449
24.0	78°	20.03	[4-9]	14.23	5.80	+1.5 +30.0 = +31.5	+.0243	+3.502

T_M - Torque measured at FluiDyne test facility

T_F - Torque due to friction as measured at FluiDyne test facility

TABLE II.2

CALCULATION OF HYDRODYNAMIC TORQUE COEFFICIENT C_T - PRATT 6" Ø

UPSTREAM PRESSURE - P_{t2} = 38 psia

RUN No.	VALVE DISC ANGLE	P_{t2} (psia)	AVG $[P_4$ thru $P_9]^*$ (psia)		DP_{AVG} (psid)	Torque, T_H (in-lbs) ($T_M - T_F$ (T_M negative); $T_M + T_F$ (T_M positive))	C_T	$C_T \times 144$ in^2/ft^2
2.10	8°	38.32	[5-9]	18.49	19.83	-8.9 - 5.0= -13.9	-.0031	-.452
5.00	18°	38.13	[5-9]	18.08	20.05	+29.3 + 6.0 = +35.3	.0079	1.135
8.00	28°	38.28	[4-9]	14.85	23.43	+55.6 + 7.0 = 62.6	.0120	1.723
11.10	38°	38.46	[5,6,8, 9]	15.32	23.14	+80.1 + 7.0 = +87.1	.0169	2.427
14.00	48°	38.26	[5,6,8, 9]	14.57	23.69	+69.6 + 7.0 = +76.6	.0145	2.085
17.10	58°	37.86	[4,5,6, 8,9]	13.59	24.27	+37.0 + 7.0 = +44.0	.0081	1.169
17.00	58°	37.96	[4,5,6, 8,9]	13.58	24.38	+30.1 + 7.0 = +37.1	.0068	.981
20.10	68°	37.86	[4-9]	13.96	23.90	- 5.4 - 7.0 = -12.4	.0023	-.335
23.00	78°	38.23	[4-9]	14.18	24.05	-16.9 -30.0 = -46.9	-.0087	-1.257

*P_4 thru P_9 pressure readings were not averaged if a particular pressure reading was much less or more than the other values. The averaged values are indicated by [ ].

TABLE II.3

CALCULATION OF HYDRODYNAMIC TORQUE COEFFICIENT C_T - PRATT 6" Ø

UPSTREAM PRESSURE P_{t2} = 63 psia

RUN No.	VALVE DISC ANGLE	P_{t2} (psia)	AVG [P_4 thru P_9]* (psia)		DP_{AVG} (psid)	Torque, T_H (in-lbs) ($T_M - T_F$ (T_M negative); $T_M + T_F$ (T_M positive))	C_T	$C_T \times 144$ in^2/ft^2
1.10	8°	63.32	[5-9]	29.95	33.37	-15.0 - 5.0 = -20.0	-.0027	- .386
4.00	18°	62.53	[5-9]	29.23	33.30	+56.4 + 6.0 = +62.4	+.0084	+1.208
7.00	28°	62.23	[4-9]	22.02	40.21	+51.9 + 7.0 = +58.9	+.0066	+ .945
10.00	38°	62.46	[5-9]	12.18	50.28	+64.6 + 7.0 = +71.6	+.0064	+ .918
13.00	48°	63.06	[5,6,8,9]	14.96	48.10	+57.9 + 7.0 = +64.9	+.0060	+ .870
16.10	58°	62.96	[4,5,6, 8,9]	13.63	49.33	+36.8 + 7.0 = +43.8	+.0040	+ .573
16.20	58°	62.86	[4,5,6, 8,9]	13.59	49.27	+42.8 + 7.0 = +49.8	+.0045	+ .652
19.00	68°	63.26	[4,5,6, 8,9]	13.75	49.51	-18.0 - 7.0 = -25.0	-.0023	- .326
22.0	78°	62.23	[4-9]	14.11	48.11	-46.2 - 30 = -76.2	-.0071	-1.021

*P_4 thru P_9 pressure readings were not averaged if a particular pressure reading was much less or much more than the other values. The averaged values are indicated by [ ].

Test 21 20 PSI

° Open	P_1	P_2	ΔP	T_D	C_T	Temp °F
90	10	5.5	4.5	-16.5	-29.3	7.8
80	10.5	5	5.5	-13.8	-20.1	8.4
70	14	4	10	-13.8	-11.0	10.5
60	15	3	12	-13.8	-9.2	11.8
50	16.5	2	14.5	-11.8	-6.5	13.8
40	18	1.5	16.5	-9.8	-4.5	15.2
30	19	1	18	-6.3	-2.8	16.5
20	20	.5	19.5	-3.9	-1.6	17.2
10	20	0	20	-9.8	-3.9	17.9
0	20	0	20	-11.8	-4.7	17.9

Test 21 30 PSI

90	17.5	7	10.5	-30.7	-23.4	13.2
80	20	7	13	-24.8	-15.3	13.8
70	22.5	6	16.5	-24.8	-12.0	16.5
60	25	5	20	-25.9	-10.4	18.5
50	28.5	4	24.5	-25.9	-8.5	19.9
40	29	3	26	-24.8	-7.6	21.2
30	30	2	28	-16.5	-4.7	21.9
20	31	1	30	-15.7	-4.2	22.6
10	31	1	30	-16.5	-4.4	22.6
0	31	1	30	-16.5	-4.4	22.6

Extracted from: "Test Report on an Allis-Chalmers 6" STREAMSEAL Butterfly Valve in Air Concerning Nuclear Containment Isolation Valves"

Test 21 40 PSI

° Open	P_1	P_2	ΔP	T_D	C_T	Temp °F
90	25	12.5	12.5	-41.3	-26.4	20.6
80	25	12.5	12.5	33.0	-21.1	21.9
70	30	12	18	-33.0	-14.7	23.9
60	30.5	8	22.5	-33.0	-11.7	25.3
50	35	6	29	-41.3	-11.4	28.0
40	35	4	31	-33.0	-8.5	29.3
30	35.5	4	31.5	28.1	-7.1	30.7
20	38	4	34	-24.8	-5.8	31.3
10	40	3	37	-24.8	-5.4	31.3
0	40	2	38	-24.8	-5.2	31.3

Test 21 50 PSI

° Open	P_1	P_2	ΔP	T_D	C_T	Temp °F
90	34.0	16.5	17.5	-42.9	-19.6	32.0
80	33.0	16.0	17.0	-36.3	-17.1	33.3
70	37.5	15.0	22.5	-39.6	-14.1	36.0
60	40.0	12.5	27.5	-41.3	-12.0	38.1
50	43.0	9.0	34.0	-46.2	-10.9	38.7
40	46.0	6.5	39.5	-47.9	-9.7	40.1
30	47.0	5.0	42.0	-39.6	-7.5	40.7
20	47.5	3.5	44.0	-33.0	-6.0	41.4
10	49.0	2.5	46.5	-28.1	-4.8	42.1
0	49.0	1.5	47.5	-24.8	-4.2	42.1

Extracted from: "Test Report on an Allis-Chalmers 6" STREAMSEAL Butterfly Valve in Air Concerning Nuclear Containment Isolation Valves"

Test 21 60 PSI

° Open	P_1	P_2	ΔP	T_D	C_T	Temp °F
90	40	17.5	22.5	-41.3	-14.7	39.4
80	40	17.5	22.5	-41.3	-14.7	40.7
70	45	17.5	27.5	-41.3	-12.0	43.4
60	47.5	12.5	35	-49.5	-11.3	45.5
50	50	10	40	-57.8	-11.6	47.5
40	54	7.5	46.5	-57.8	-9.9	49.5
30	55	5	50	-49.5	-7.9	50.2
20	55	5	50	-41.3	-6.6	50.8
10	55	1	54	-41.3	-6.1	51.5
0	57	0	57	-33.0	-4.6	51.5

Extracted from: "Test Report on an Allis-Chalmers 6" STREAMSEAL Butterfly Valve in Air Concerning Nuclear Containment Isolation Valves"

Test 24 P_{T_1} = 20 PSI

° Open	P_1	P_2	ΔP	T_D	C_T	Temp °F
90	10.0	5.0	5.0	-21.5	-34.3	6.4
80	10.0	4.0	6.0	-23.1	-30.8	6.4
70	12.5	3.5	9.0	-16.5	-14.7	9.8
60	15.0	3.0	12.0	-13.2	-8.8	11.8
50	15.5	2.5	13.0	-11.6	-7.1	13.2
40	17.5	20.0	15.5	-11.6	-6.0	14.5
30	17.5	1.5	16.0	-8.3	-4.1	15.2
20	18.5	1.0	17.5	-5.0	-2.3	15.2
10	19.5	1.0	18.5	-8.3	-3.6	15.8
0	19.5	0.5	19.0	-11.6	-4.9	15.8

Test 24 P_{T_1} = 30 PSI

° Open	P_1	P_2	ΔP	T_D	C_T	Temp °F
90	17.5	7.5	10.0	-33.0	-26.5	12.5
80	20.0	5.5	14.5	-33.0	-18.2	15.2
70	21.0	4.5	16.5	-29.7	-14.4	17.2
60	25.0	3.5	21.5	-24.6	-9.2	18.5
50	27.5	2.5	25.0	-24.6	-7.9	19.9
40	30.0	2.0	28.0	-19.8	-5.7	20.6
30	30.0	1.0	29.0	-16.5	-4.6	21.9
20	30.0	1.0	29.0	-16.5	-4.6	21.9
10	30.0	1.0	29.0	-24.8	-6.8	21.9
0	30.0	1.0	29.0	-19.8	-5.5	21.9

Extracted from: "Test Report on an Allis-Chalmers 6" STREAMSEAL Butterfly Valve in Air Concerning Nuclear Containment Isolation Valves"

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Test 24 P_{T_1} = 40 PSI

° Open	P_1	P_2	ΔP	T_D	C_T	Temp °F
90	25	12.5	12.5	-41.3	-26.4	21.2
80	25	11.0	14.0	-41.3	-23.6	21.9
70	30	10.0	20.0	-33.0	-13.2	23.9
60	32	7.5	24.5	-33.0	-10.8	26.6
50	35.0	5.0	30.0	-33.0	-8.8	28.6
40	36.0	3.0	33.0	-33.0	-8.0	30.0
30	37.0	3.0	34.0	-24.8	-5.8	30.7
20	38.0	3.0	35.0	-16.56	-3.8	31.3
10	39.0	3.0	36.0	-24.8	-5.5	32.0
0	39.0	3.0	36.0	-24.8	-5.5	32.0

Test 24 P_{T_1} = 50 PSI

° Open	P_1	P_2	ΔP	T_D	C_T	Temp °F
90	30.0	17.5	12.5	-49.5	-31.7	33.3
80	34.0	15.0	19.0	-47.9	-20.2	34.7
70	35.0	12.5	22.5	-42.9	-15.3	36.0
60	40.0	12.5	27.5	-39.6	-11.5	37.4
50	43.5	16.0	27.5	-42.9	-12.5	40.1
40	45.0	17.5	27.5	-42.9	-12.5	41.4
30	47.0	19.0	28.0	-33.0	-9.3	42.1
20	47.5	20.0	27.5	-28.0	-8.2	42.1
10	48.5	21.5	27.0	-29.7	-8.8	42.1
0	48.5	21.5	27.0	-33.0	-9.8	42.1

Extracted from: "Test Report on an Allis-Chalmers 6" STREAMSEAL Butterfly Valve in Air Concerning Nuclear Containment Isolation Valves".

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Test 24 P_{T_1} = 60 PSI

° Open	P_1	P_2	ΔP	T_D	C_T	Temp °F
90	40.0	17.5	22.5	-46.2	-16.4	37.4
80	40.0	16.0	24.0	-47.9	-16.0	37.4
70	40.0	15.0	25.0	-47.9	-15.3	38.7
60	42.0	12.5	29.5	-46.2	-12.5	41.4
50	47.5	10.0	37.5	-47.9	-10.2	45.5
40	54.0	6.0	48.0	-49.5	-8.3	46.8
30	55.0	5.0	50.0	-41.3	-6.6	47.5
20	56.0	3.0	53.0	-33.0	-5.0	48.2
10	57.5	1.5	56.0	-28.1	-4.0	48.8
0	57.5	1.5	56.0	-41.3	-5.9	48.8

Extracted from: "Test Report on an Allis-Chalmers 6" STREAMSEAL Butterfly Valve in Air Concerning Nuclear Containment Isolation Valves"

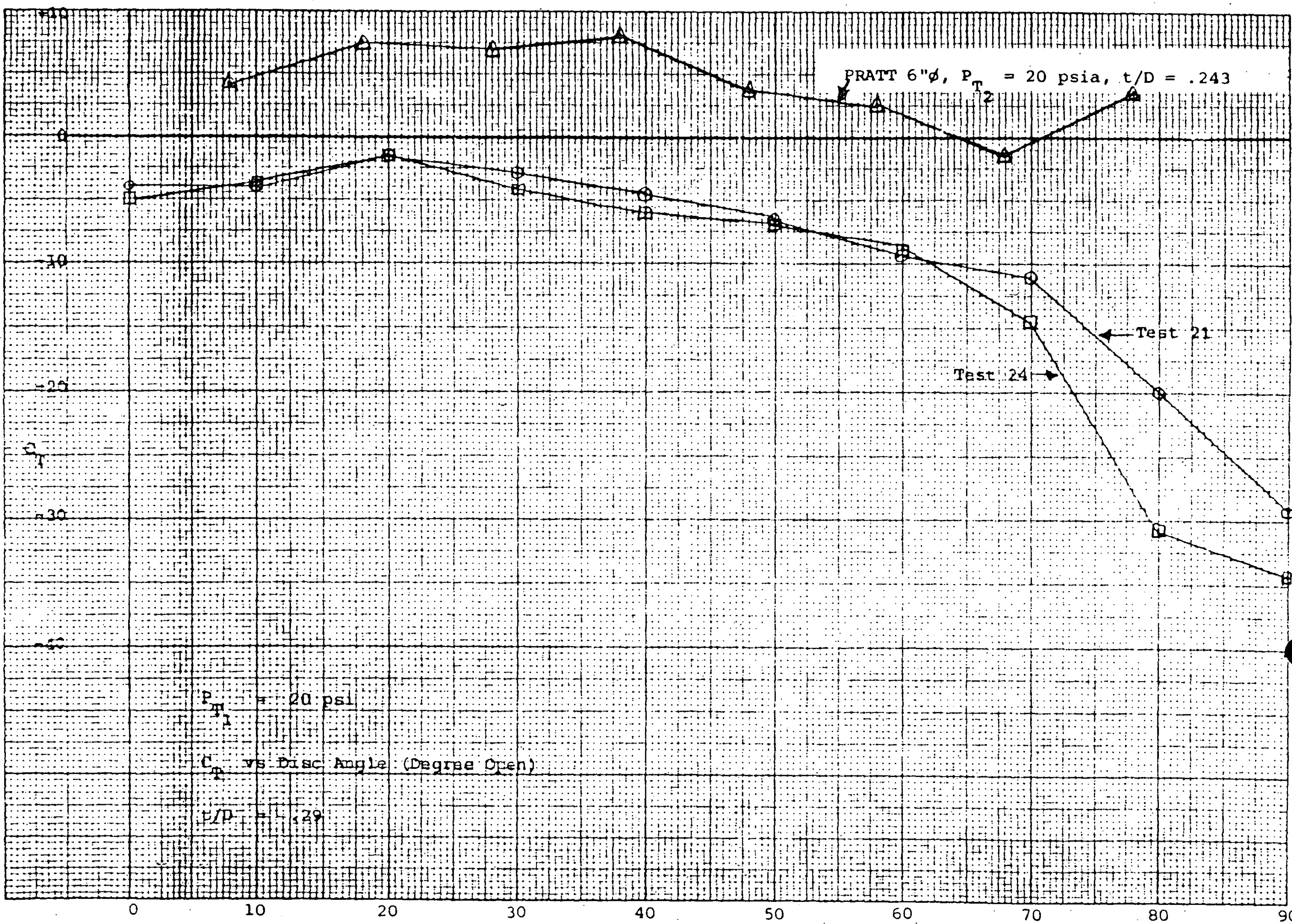
PRATT 6"ø, P_T2 = 20 psia, t/D = .243
Test 21
Test 24
C_T
0
-10
-20
-30
P_T1 = 20 psi
C_T vs Disc Angle (Degree Open)
t/D = .29
0
10
20
30
40
50
60
70
80
90

FIGURE II.1

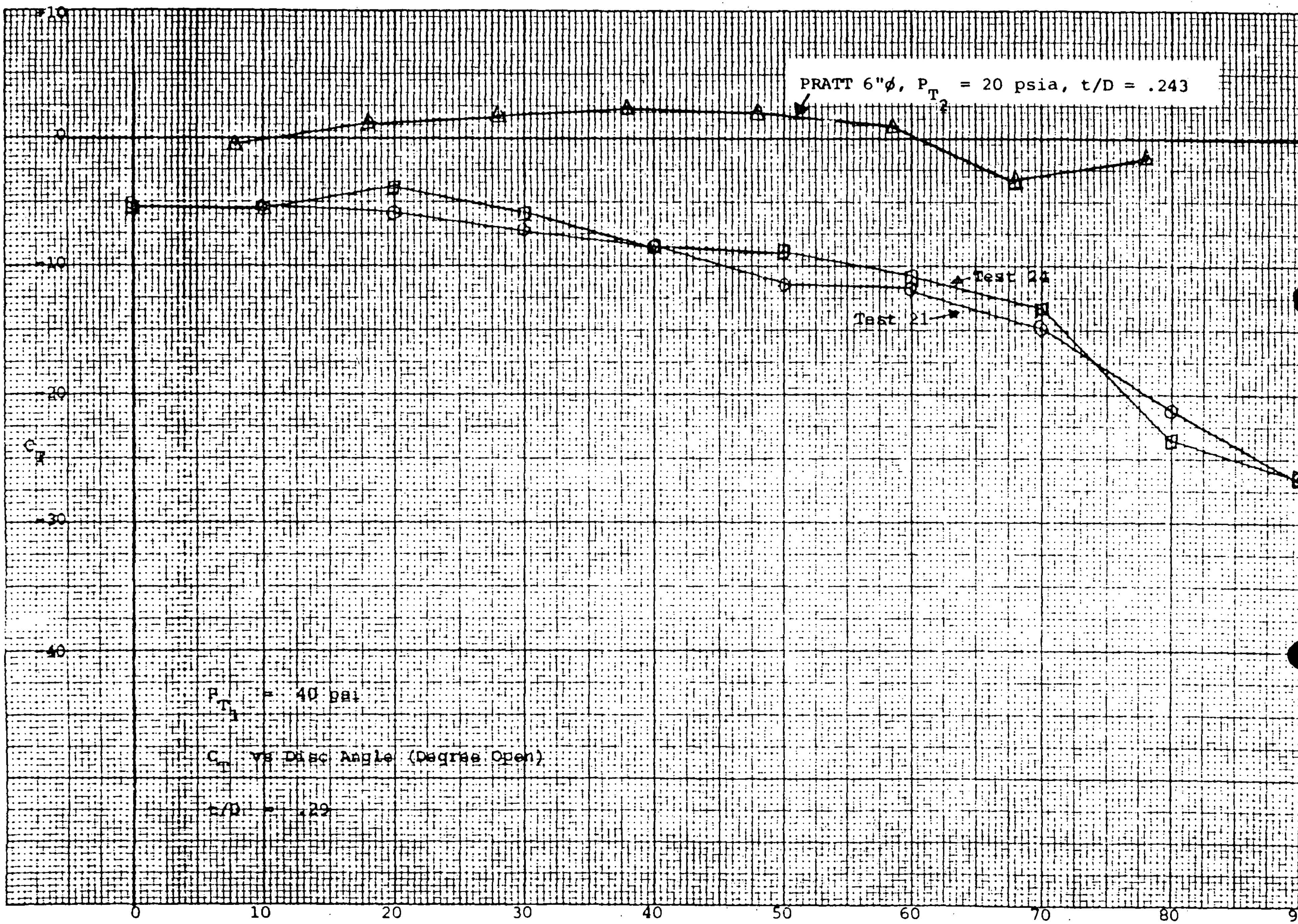
PRATT 6"ϕ, P_{T_2} = 20 psia, t/D = .243
Test 21
Test 21
P_{T_1} = 40 psi
C_T vs Disc Angle (Degree Open)
t/D = .29
C_T
+10
0
-10
-20
-30
-40
0
10
20
30
40
50
60
70
80
90

FIGURE II.2

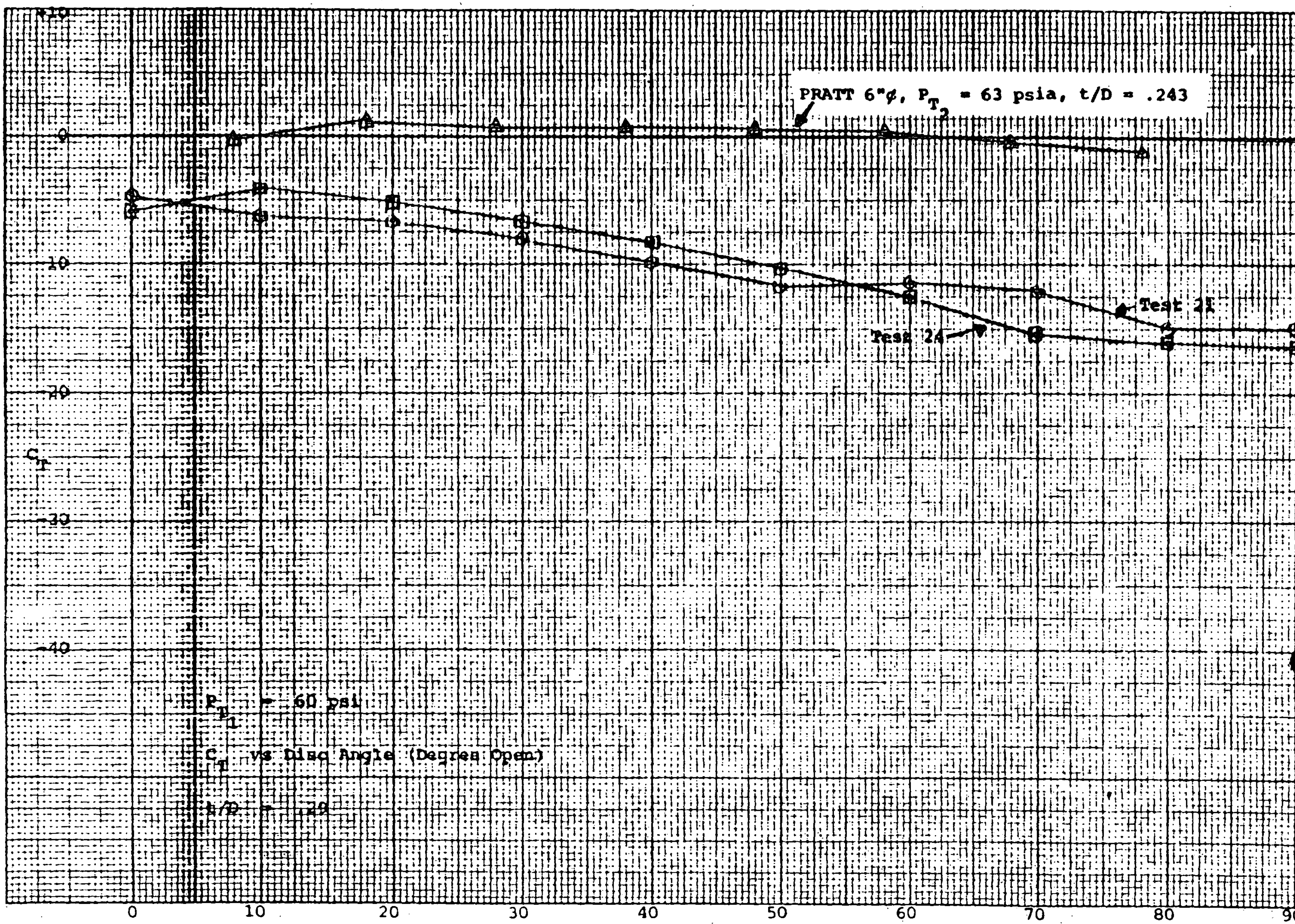
PRATT 6"ϕ, P_{T_2} = 63 psia, t/D = .243
Test 21
Test 24
C_T
+10
0
-10
-20
-30
-40
0
10
20
30
40
50
60
70
80
90
P_{T_1} = 60 psi
C_T vs Disc Angle (Degrees Open)
t/D = .29

FIGURE II.3