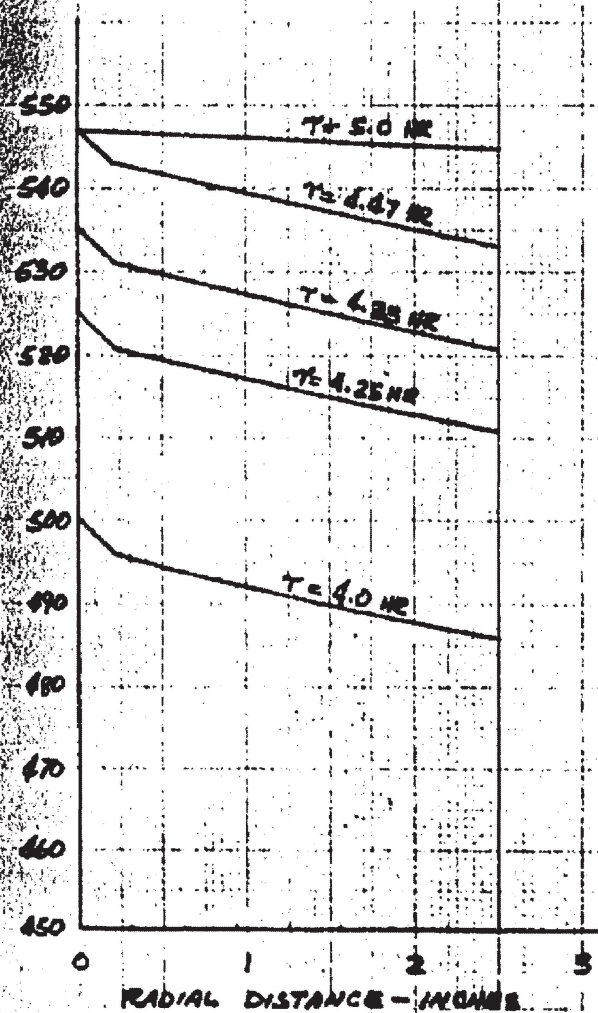
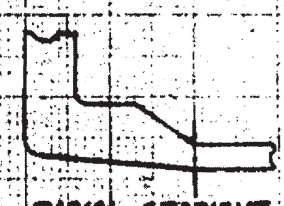
RIV000053O
Submitted: December 27, 2011

United States Nuclear Regulatory Commission Official Hearing Exhibit
In the Matter of: Entergy Nuclear Operations, Inc.
(Indian Point Nuclear Generating Units 2 and 3)
ASLBP #: 07-858-03-LR-BD01
Docket #: 05000247 | 05000286
Exhibit #: RIV00053O-00-BD01 Identified: 10/15/2012
Admitted: 10/15/2012 Withdrawn:
Rejected: Stricken:
Other:

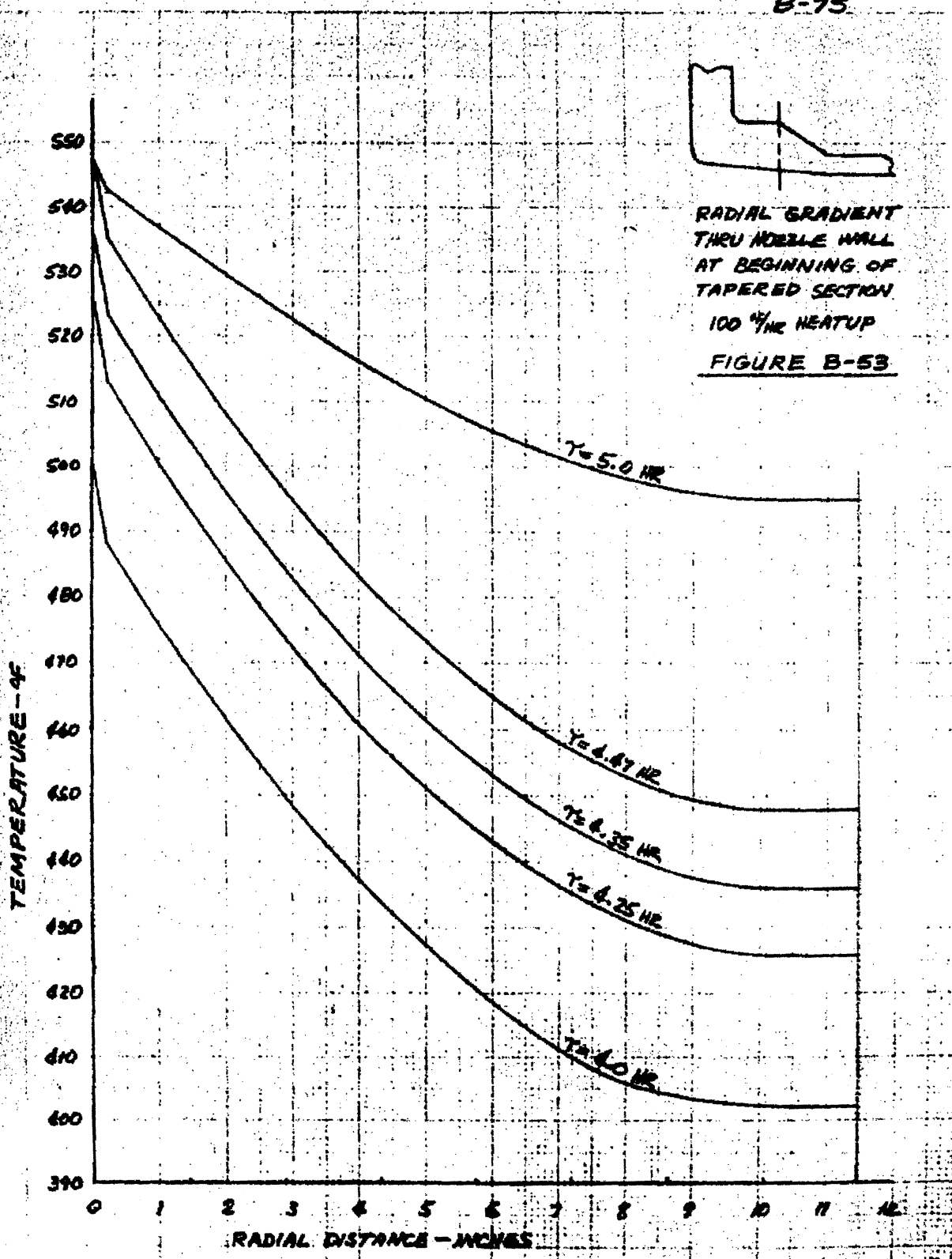




RADIAL GRADIENT AT THIN SECTION OF INLET NOZZLE WHERE TAPER ENDS AND THE HEAT UP

FIGURE B-52

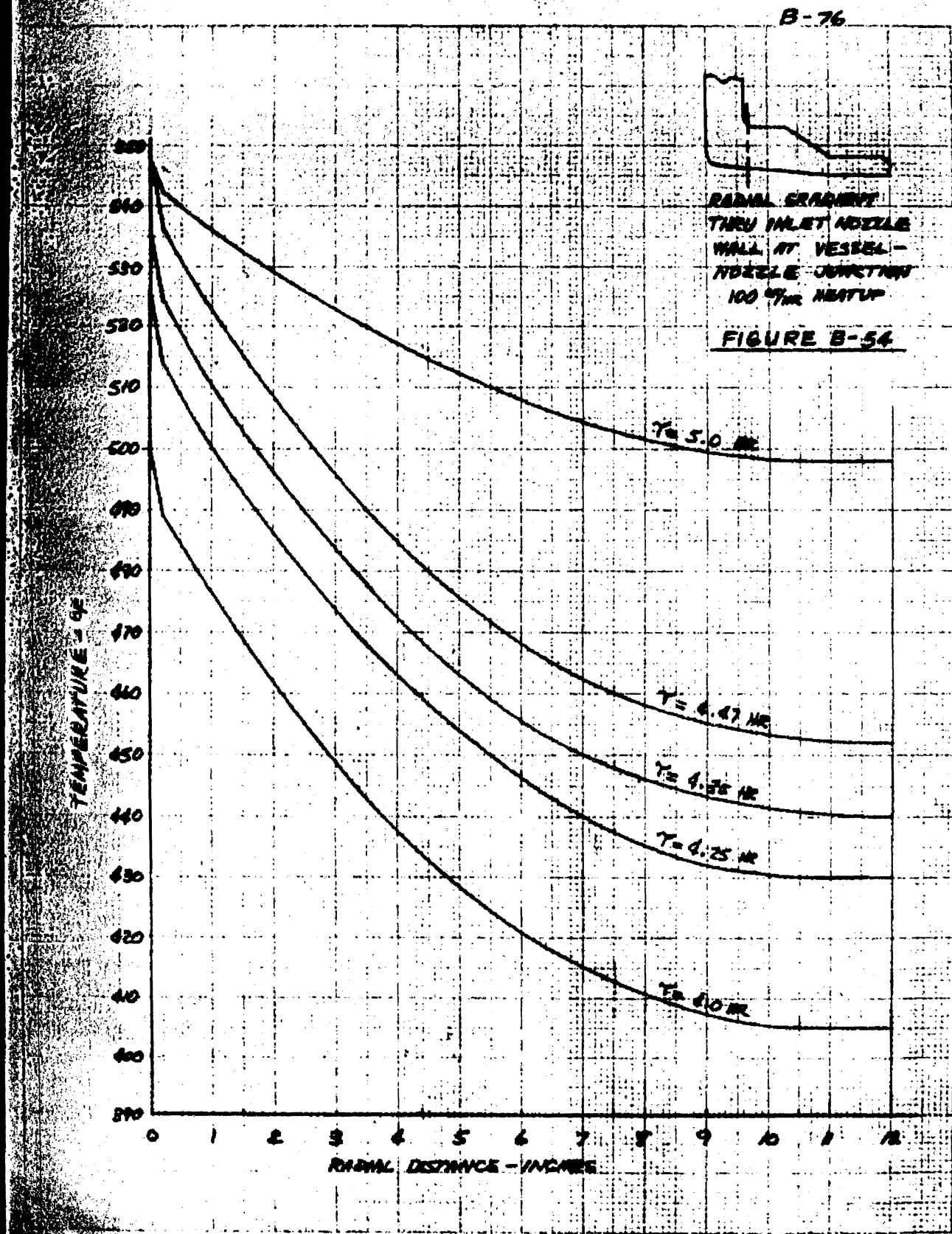
RIV000053O
Submitted: December 05, 2011



RADIAL GRADIENT THRU NOZZLE WALL AT BEGINNING OF TAPERED SECTION

100 °/HR HEATUP

FIGURE B-53


RADIAL GRADIENT
THRU INLET NOZZLE
WALL AT VESSEL-
NOZZLE JUNCTION
100 °F/HR HEATUP
FIGURE B-54
TEMPERATURE - °F
RADIAL DISTANCE - INCHES
r = 5.0 IN
r = 4.47 IN
r = 4.75 IN
r = 4.25 IN
r = 4.0 IN
590
580
570
560
550
540
530
520
510
500
490
480
470
460
450
440
430
420
410
400
390
0
1
2
3
4
5
6
7
8
9
10
11
12

RIV000053O
Submitted: December 07, 2011

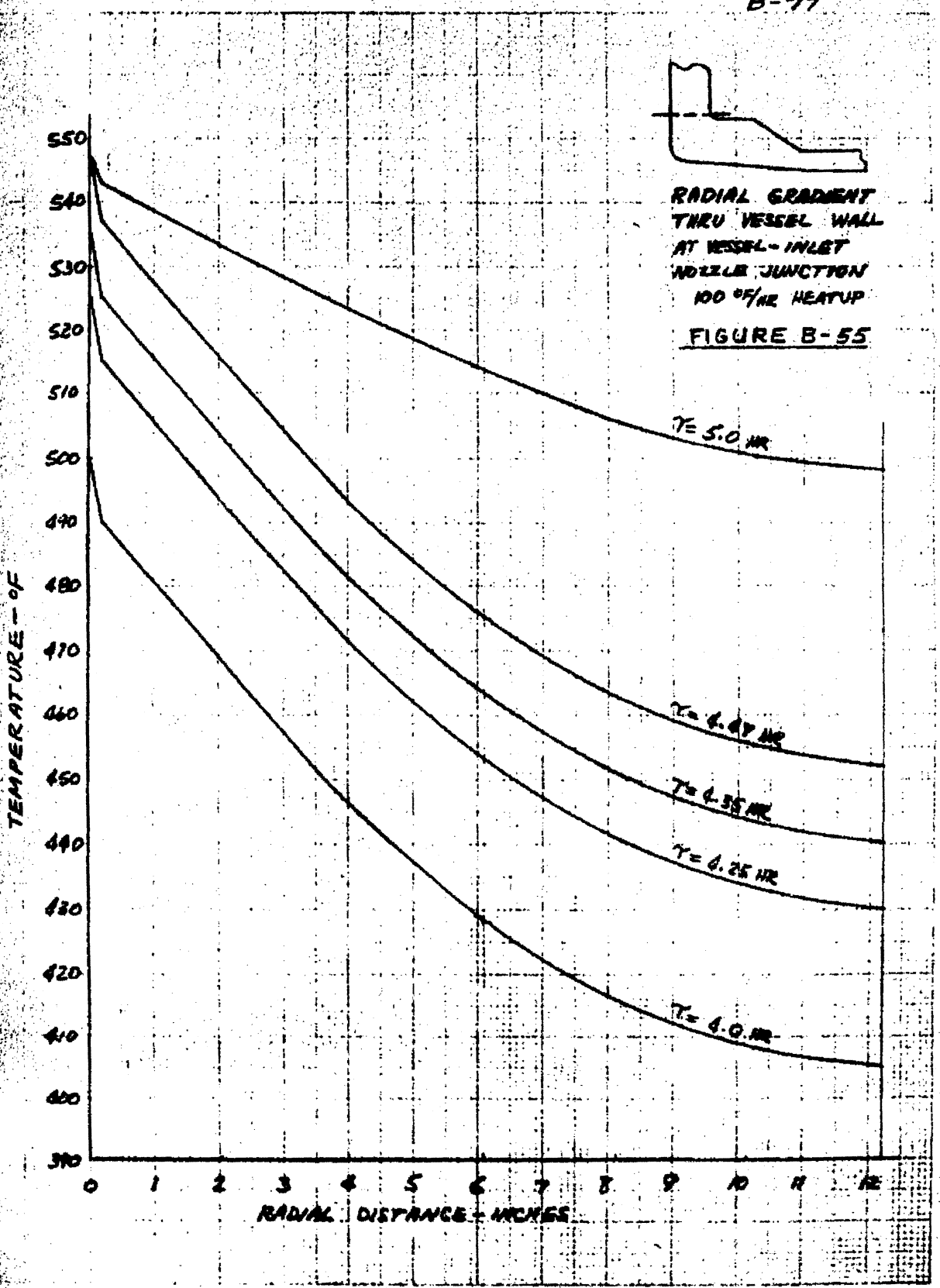
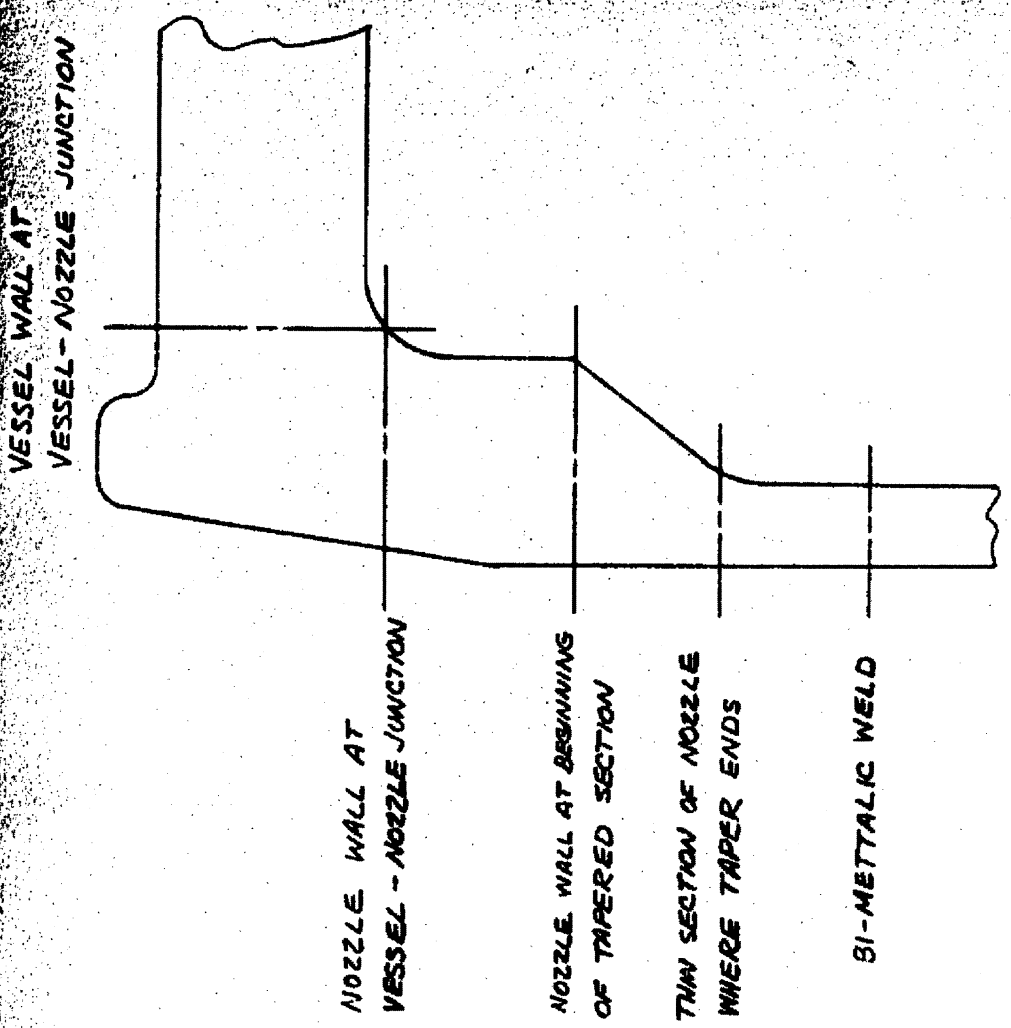


FIGURE B-55

COMBUSTION ENGINEERING, INC.
ENGINEERING DEPARTMENT, CHATTANOOGA, TENN.
CHARGE NO.
DESCRIPTION OUTLET NOZZLE

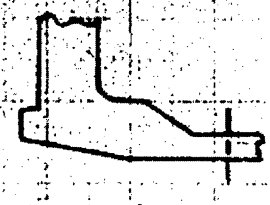
NUMBER
SHEET B-78 OF
DATE BY
CHECK DATE BY



THIS SKETCH INDICATES THE LOCATIONS WHERE RADIAL GRADIENTS WERE PLOTTED AND THE THERMAL MOMENT CALCULATED.

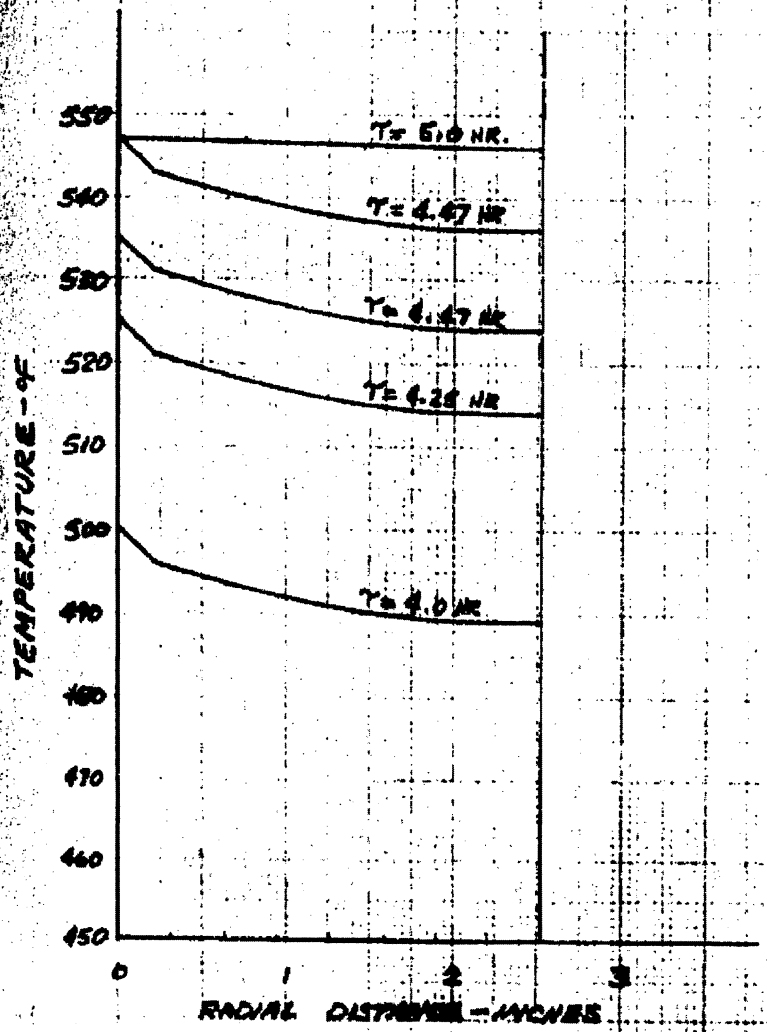
FIGURE B-56

RIV000053O
Submitted: December 27, 2011



RADIAL GRADIENT
THRU OUTLET NOZZLE
AT BI-METTALIC WELD
100 °F/HR HEATUP

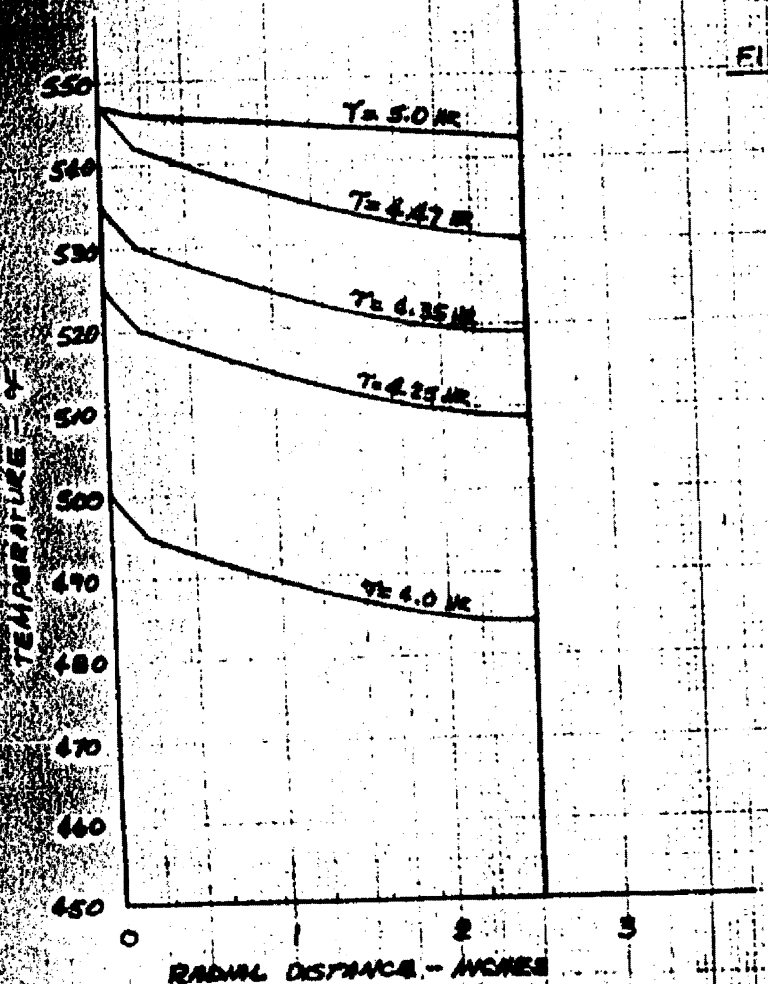
FIGURE B-57



RADIAL GRADIENT AT THIN SECTION OF OUTLET NOZZLE WHERE TAPER ENDS

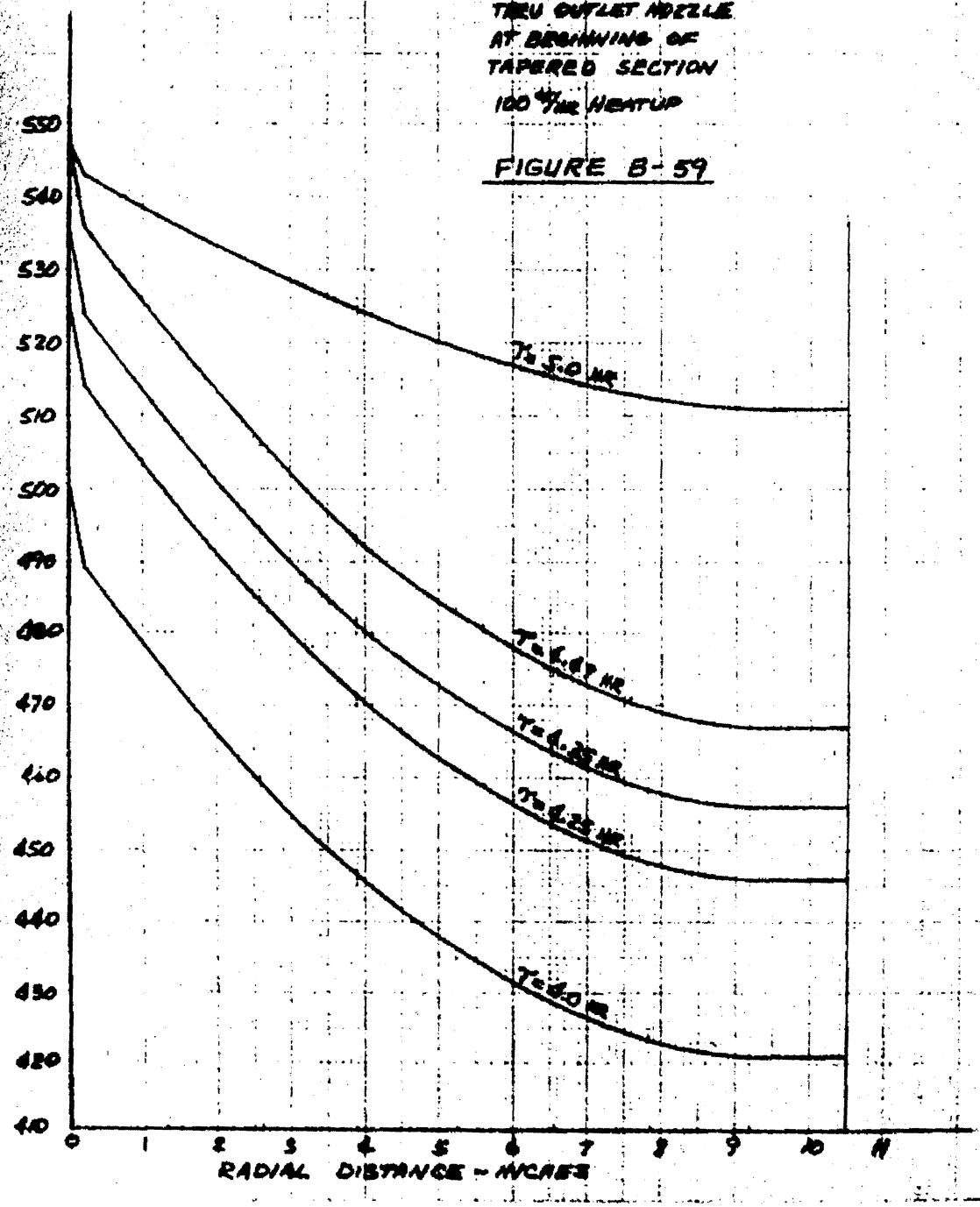
100 °F/HR HEATUP

FIGURE B-58



RADIAL GRADIENT THRU OUTLET NOZZLE AT BEGINNING OF TAPERED SECTION 100 °F/HR HEATUP

FIGURE B-59



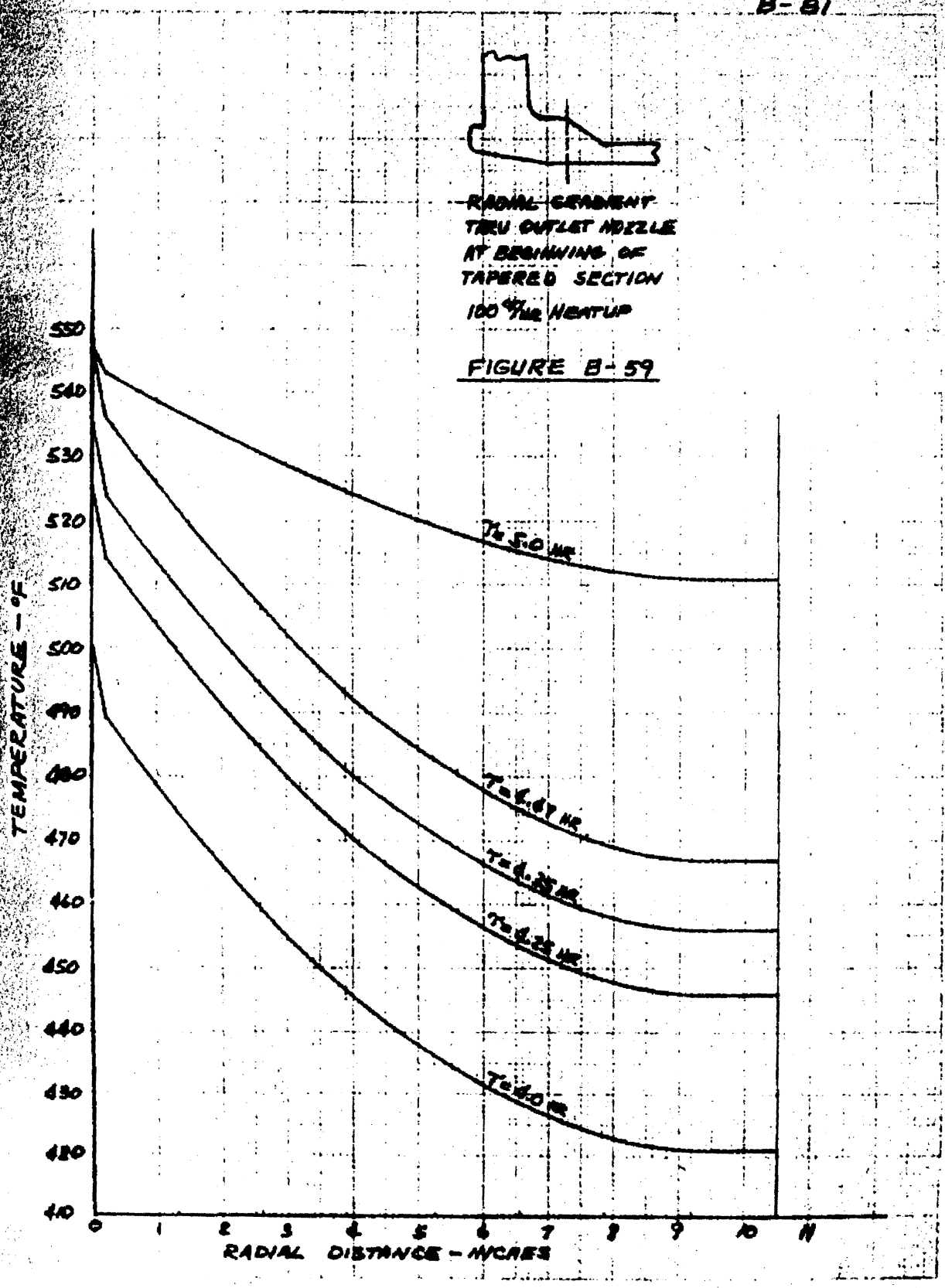

RADIAL GRADIENT
THRU OUTLET NOZZLE
AT BEGINNING OF
TAPERED SECTION
100 °F/HR HEATUP
TEMPERATURE - °F
550
540
530
520
510
500
490
480
470
460
450
440
430
420
410
0
1
2
3
4
5
6
7
8
9
10
11
RADIAL DISTANCE - INCHES
T= 5.0 HR.
T= 4.0 HR.
T= 3.0 HR.
T= 2.0 HR.
T= 1.0 HR.

FIGURE B-59

RIV0000530
Submitted: December 27, 2011

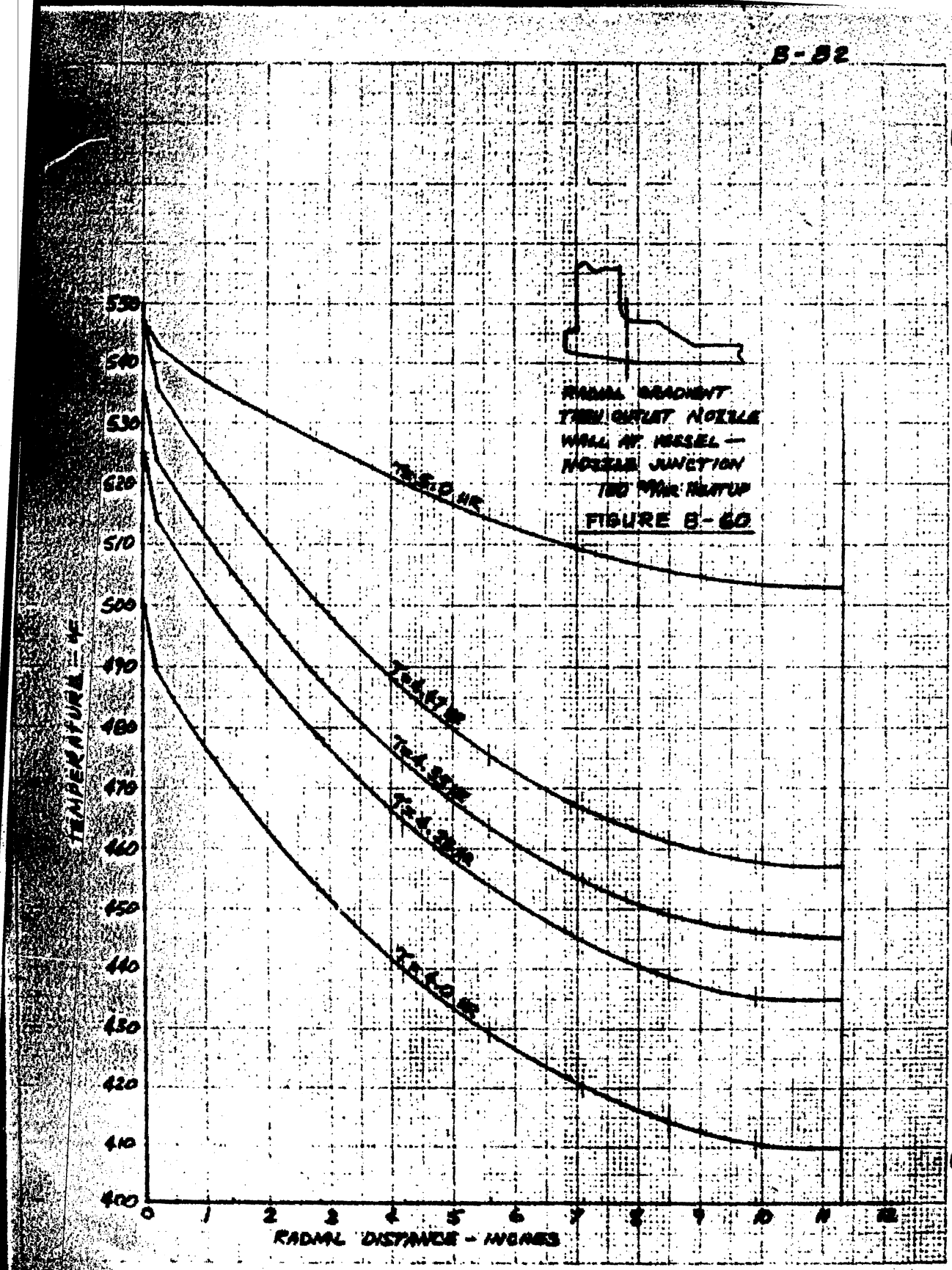


FIGURE B-60

RIV0000530
Submitted: December 27, 2011

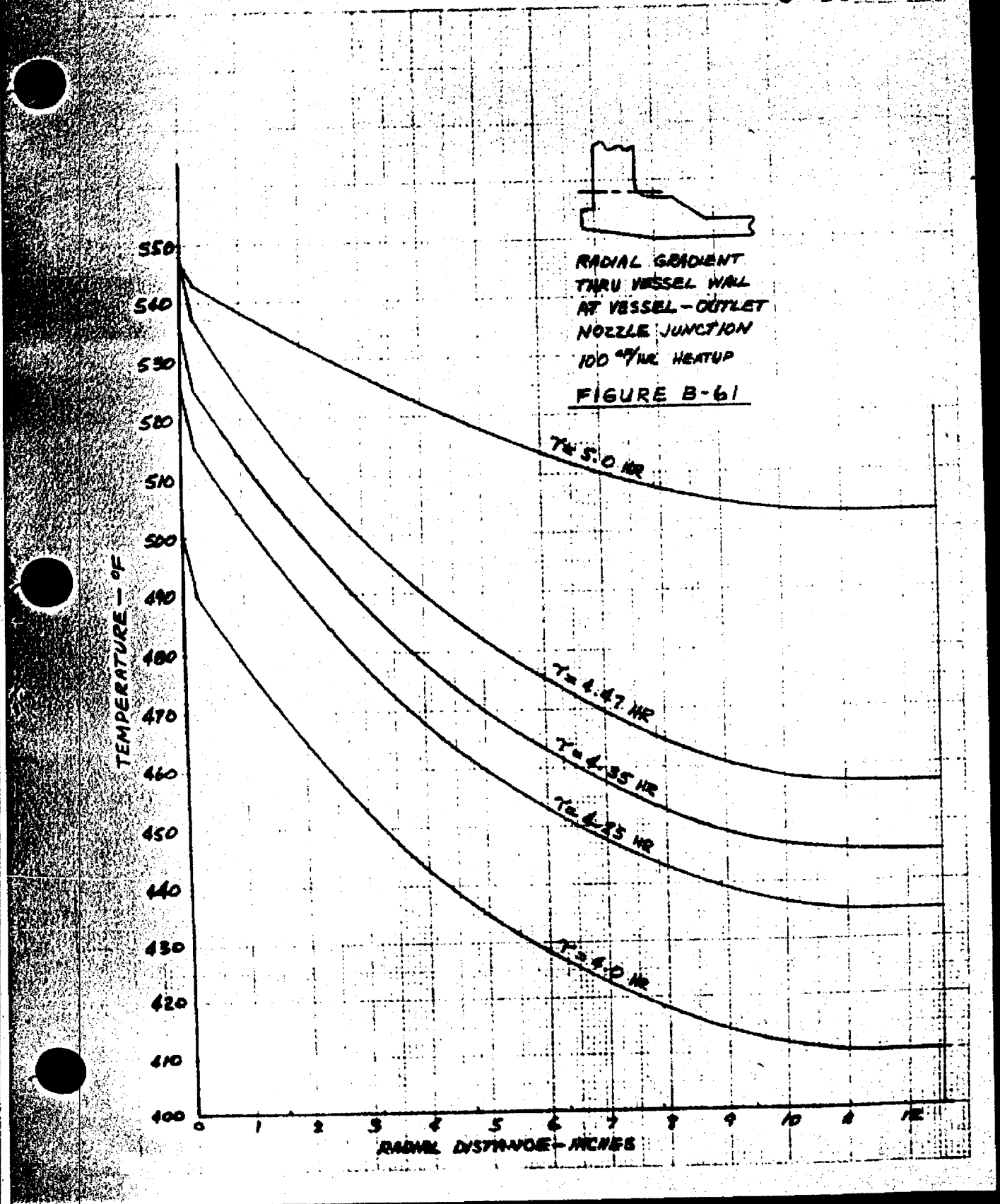
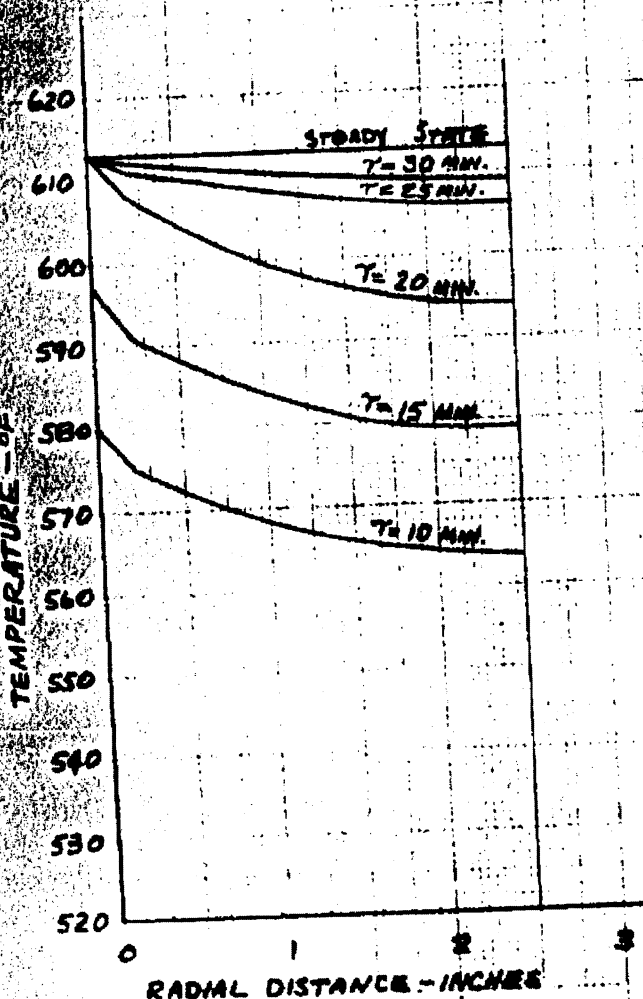


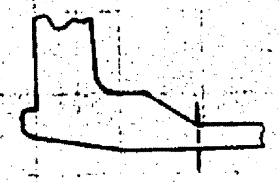
FIGURE B-61

RIV0000530
Submitted: December 27, 2011

RADIAL GRADIENT
THRU OUTLET NOZZLE
AT BI-METTALIC WELD
PLANT LOADING

FIGURE B-62

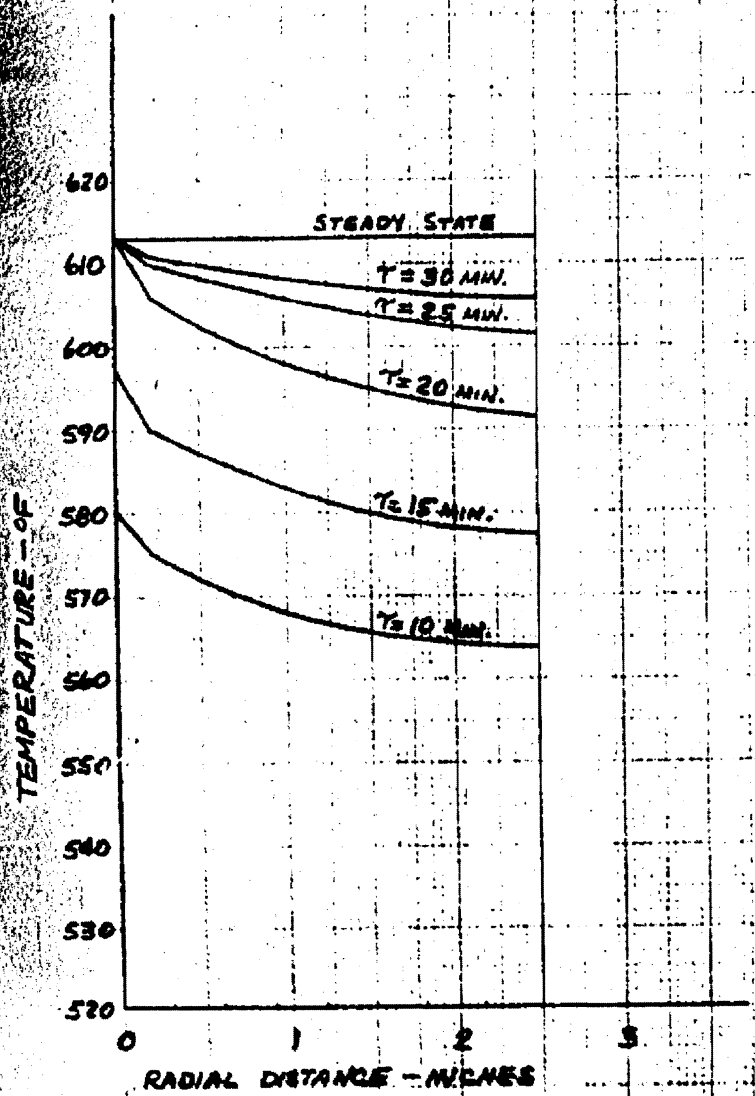


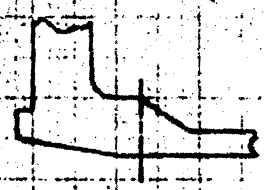


RADIAL GRADIENT AT THIN SECTION OF OUTLET NOZZLE WHERE TAPER ENDS

PLANT LOADING

FIGURE B-63

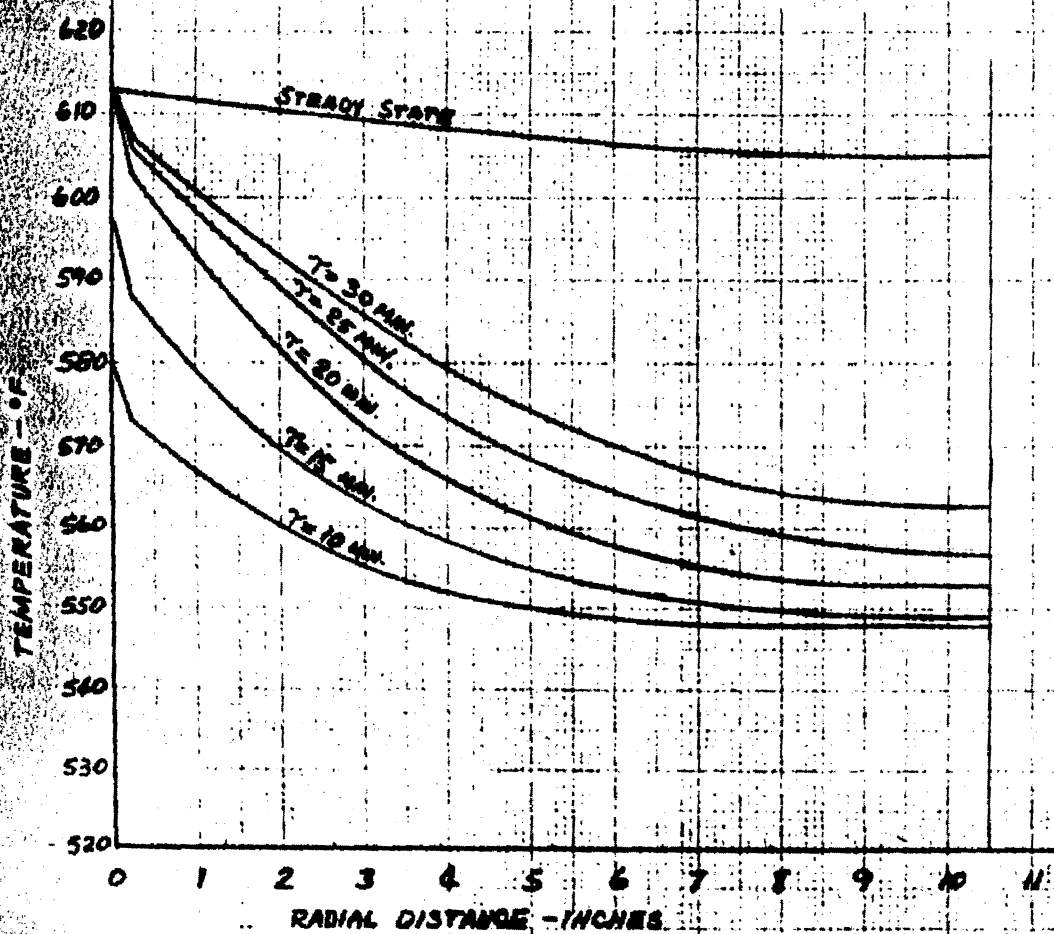


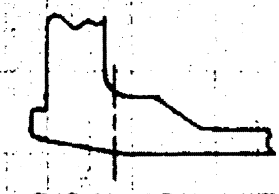


RADIAL GRADIENT
OUTLET NOZZLE WALL
AT BEGINNING OF
TAPERED SECTION

PLANT LEMOING

FIGURE B-64

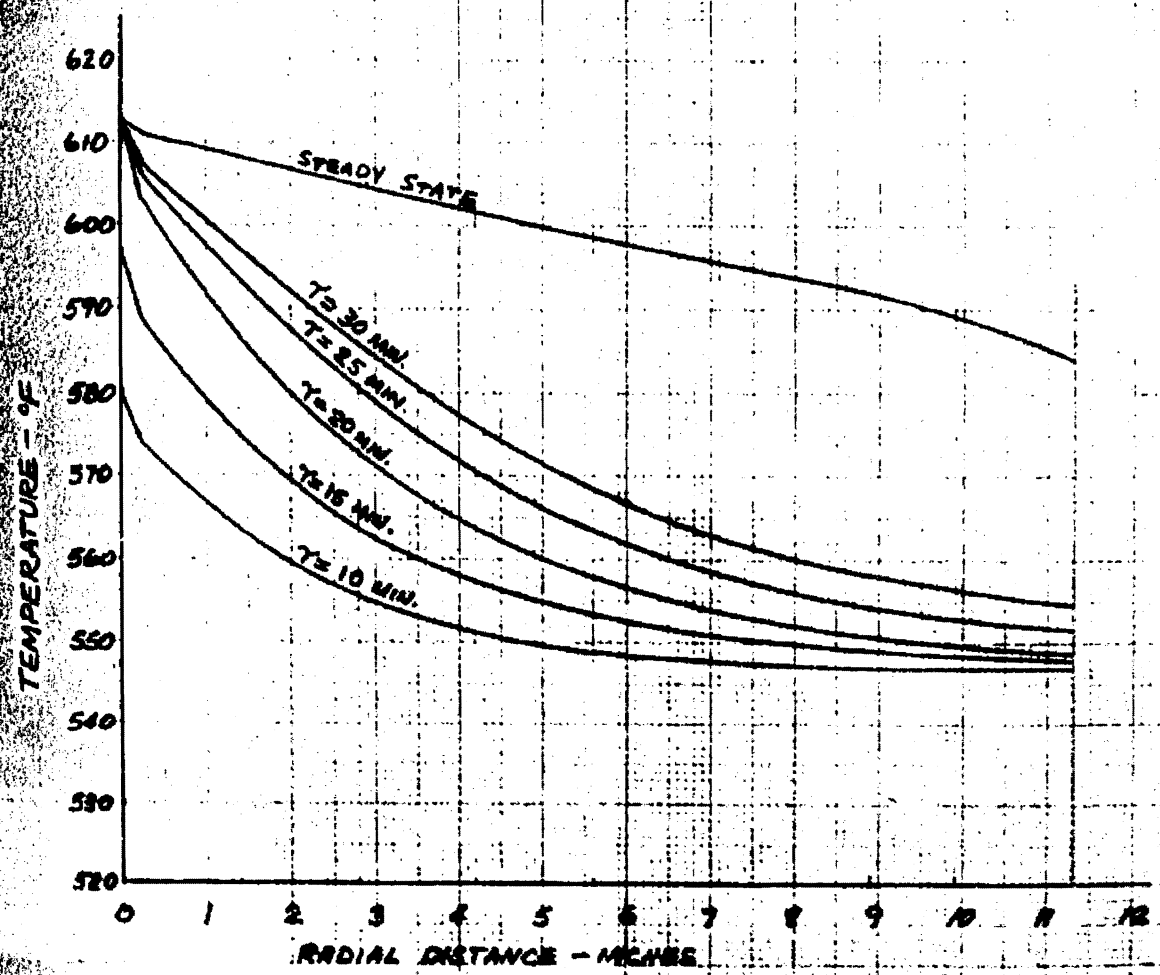


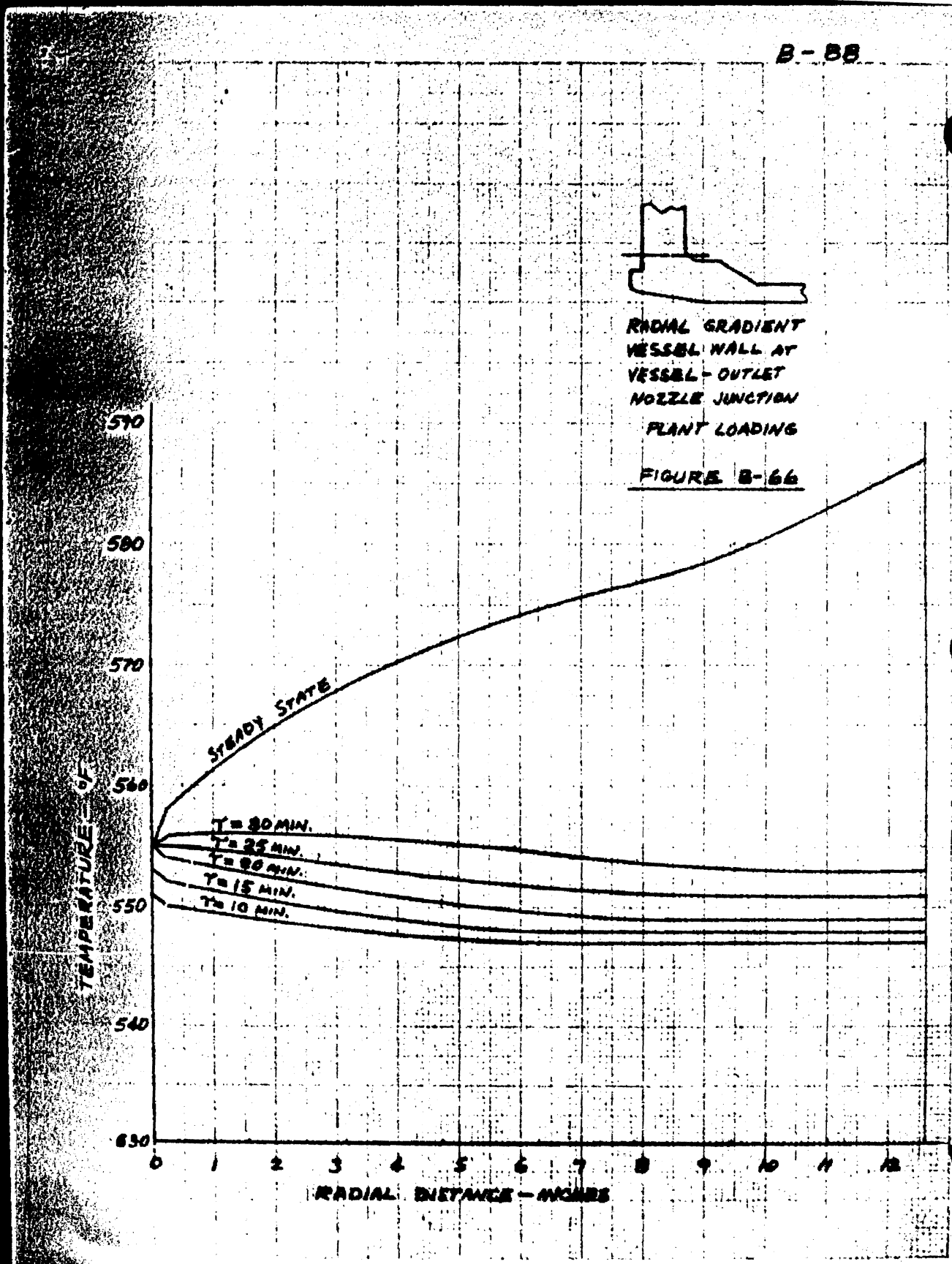


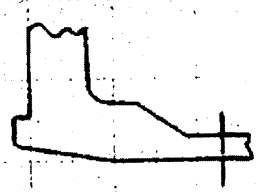
RADIAL GRADIENT
OUTLET NOZZLE WALL
AT VESSEL-NOZZLE
JUNCTION

PLANT LOADING

FIGURE B-65



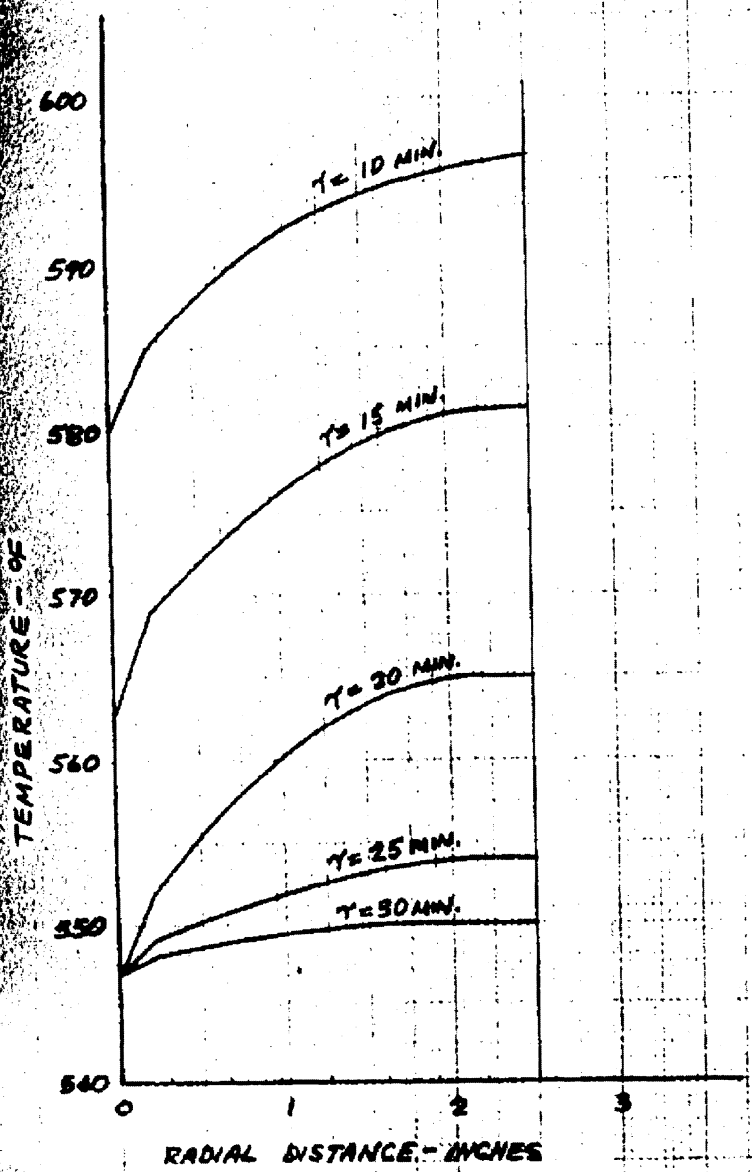

RADIAL GRADIENT
VESSEL WALL AT
VESSEL - OUTLET
NOZZLE JUNCTION
PLANT LOADING
FIGURE B-66
590
580
570
560
550
540
530
TEMPERATURE - °F
STEADY STATE
T = 30 MIN.
T = 25 MIN.
T = 20 MIN.
T = 15 MIN.
T = 10 MIN.
0
1
2
3
4
5
6
7
8
9
10
11
12
RADIAL DISTANCE — INCHES

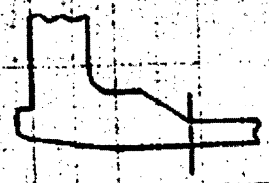


RADIAL GRADIENT
OUTLET NOZZLE WALL
AT BI-METTALIC WELD

PLANT UNLOADING

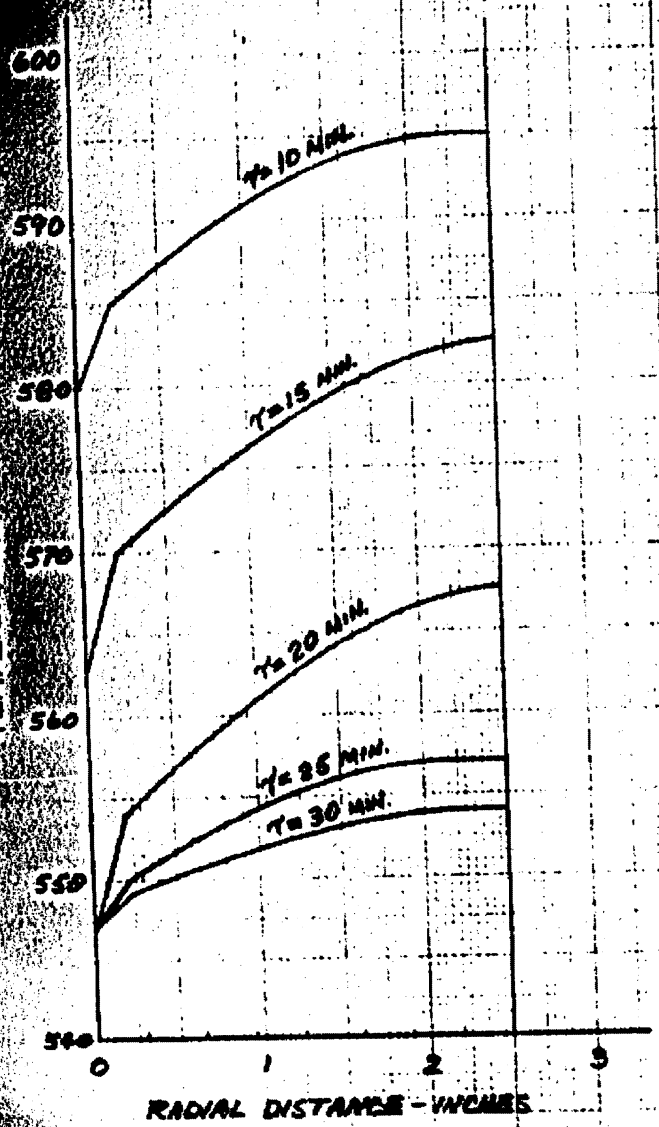
FIGURE B-67





RADIAL GRADIENT AT THIN SECTION OF OUTLET NOZZLE WHERE TAPER ENDS PLANT UNLOADING

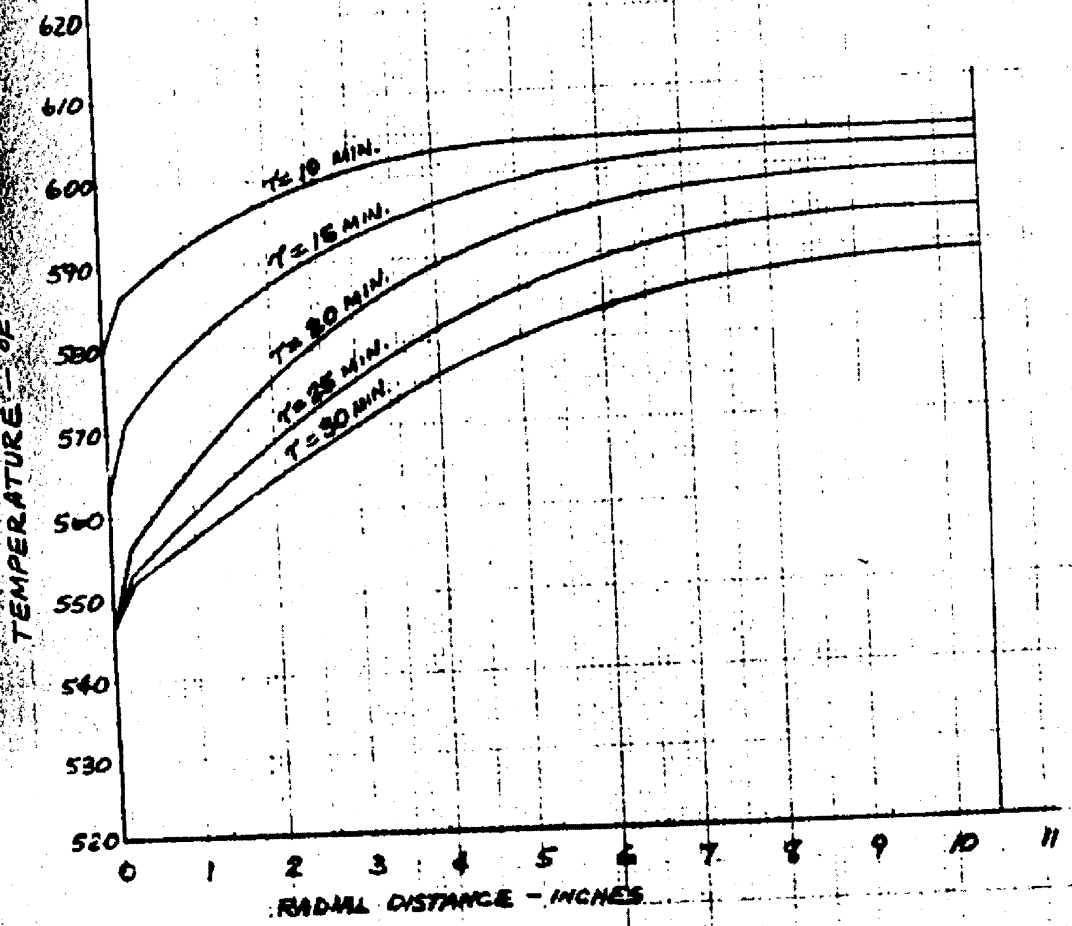
FIGURE B-68



RADIAL GRADIENT
OUTLET NOZZLE WALL
AT BEGINNING OF
TAPERED SECTION

PLANT UNLOADING

FIGURE B-69



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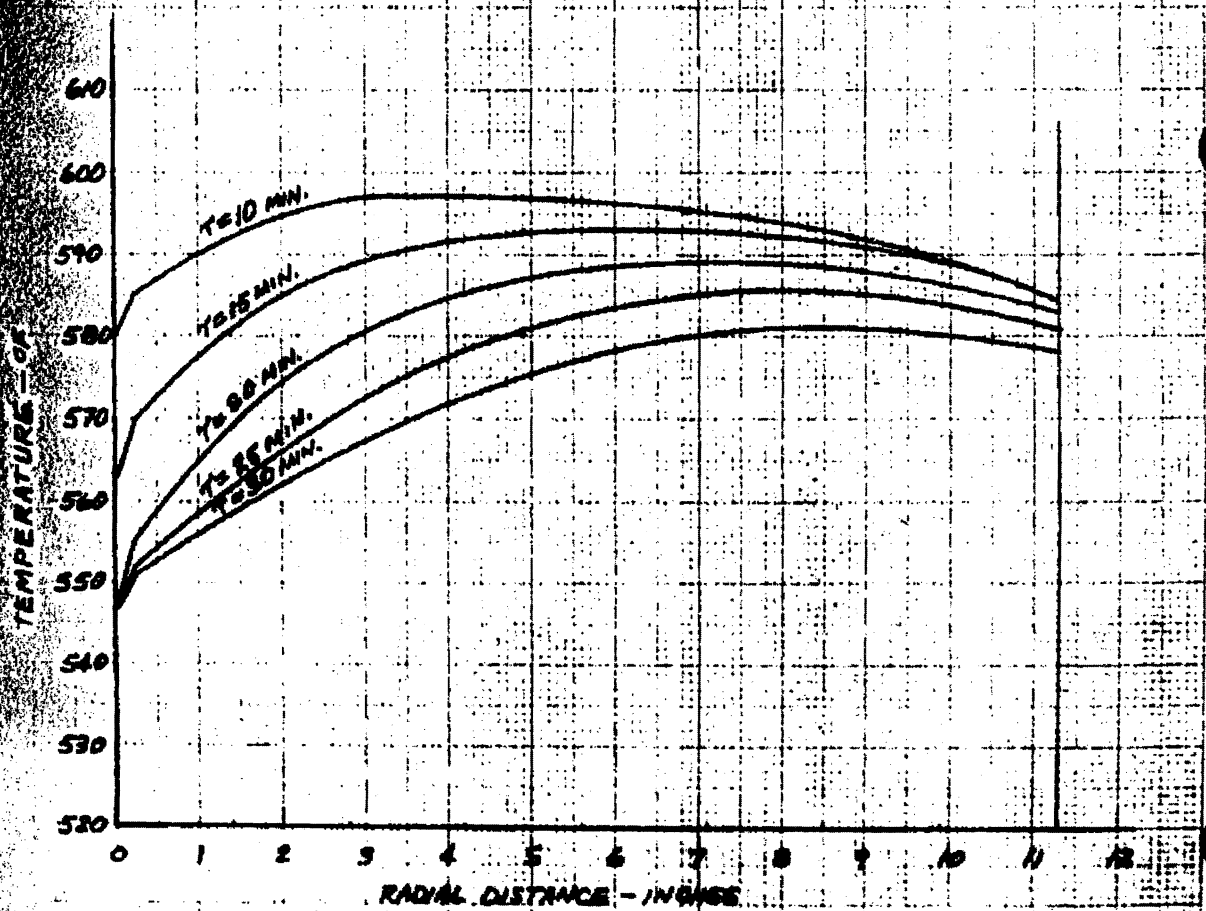
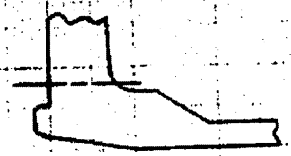
RADIAL GRADIENT
OUTLET NOZZLE WALL
AT VESSEL-NOZZLE
JUNCTION

PLANT UNLOADING

FIGURE B-70

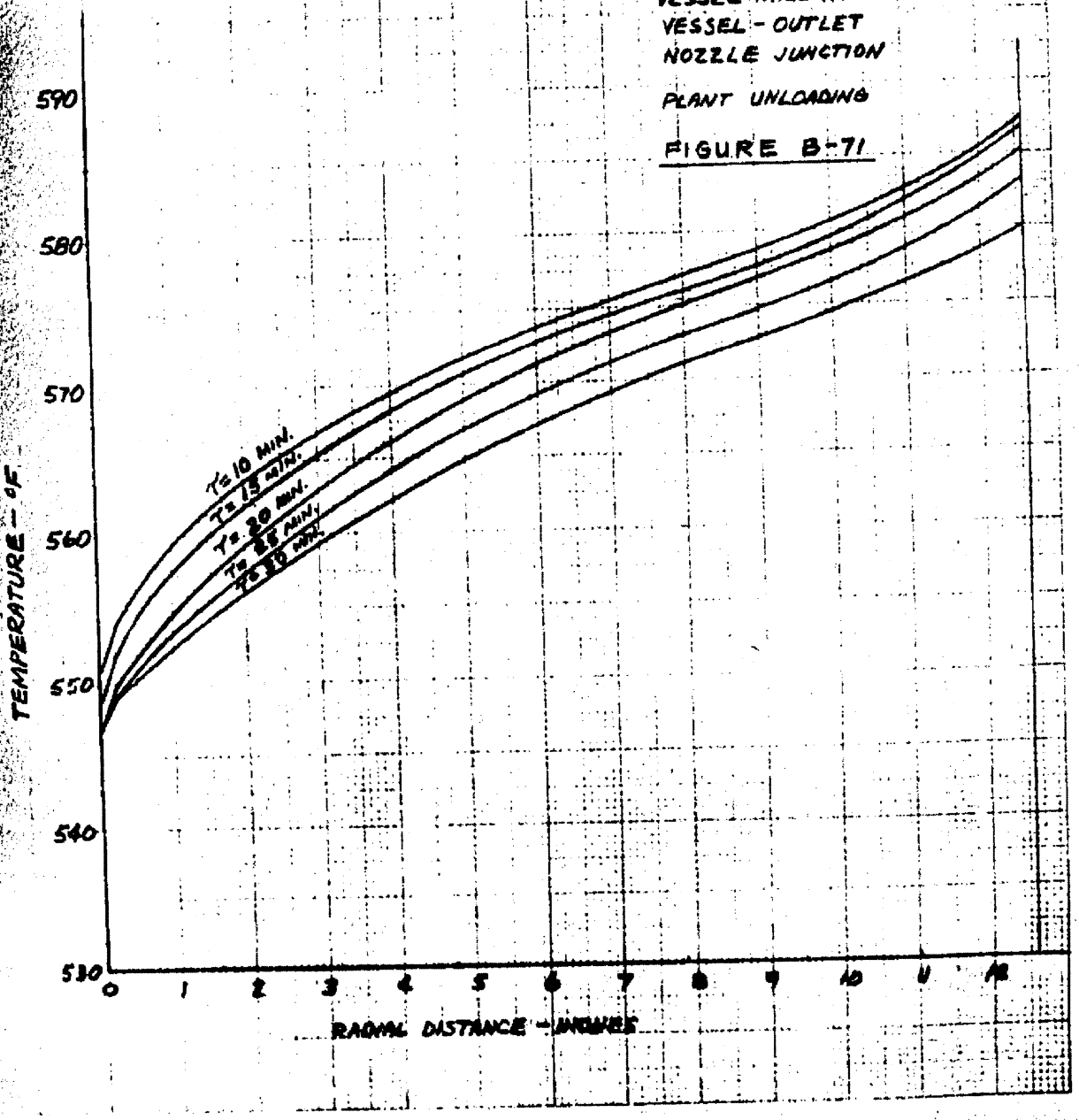




RADIAL GRADIENT
VESSEL WALL AT
VESSEL - OUTLET
NOZZLE JUNCTION

PLANT UNLOADING

FIGURE B-71



COMBUSTION ENGINEERING, INC.
ENGINEERING DEPARTMENT, CHATTANOOGA, TENN.

CHARGE NO.
DESCRIPTION VESSEL WALL

NUMBER
SHEET B-94 OF
DATE BY
CHECK DATE BY

FOLLOWING ARE TEMPERATURE DISTRIBUTIONS IN THE VESSEL WALL FOR NORMAL HEATUP, 100°F → 547°F @ 100°F/HR, AND FOR THE HYDROSTATIC TEST HEATUP, 100°F → 400°F @ 100°F/HR. IN EACH CASE, THE DISTRIBUTION FOR COOLDOWN IS A MIRROR IMAGE OF HEATUP, SINCE THE COOLDOWN TRANSIENT IS OVER THE SAME RANGE AND AT THE SAME RATE AS HEATUP.

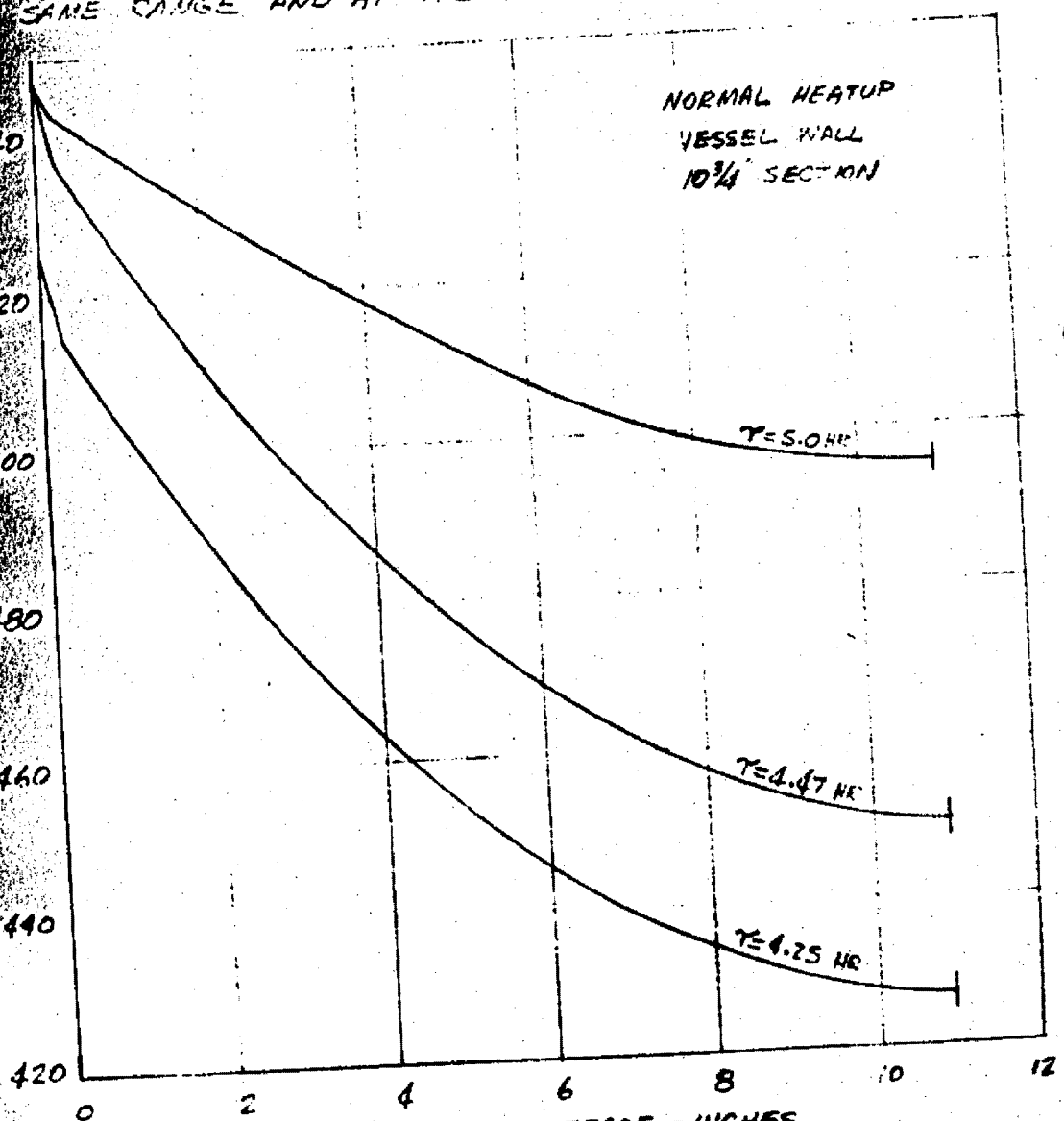


FIGURE 8-7E

COMBUSTION ENGINEERING, INC.
ENGINEERING DEPARTMENT, CHATTANOOGA, TENN.

CHARGE NO.
DESCRIPTION VESSEL WALL

NUMBER
SHEET B-95 OF
DATE BY
CHECK DATE BY

NORMAL HEATUP, VESSEL WALL, 8 5/8" SECTION

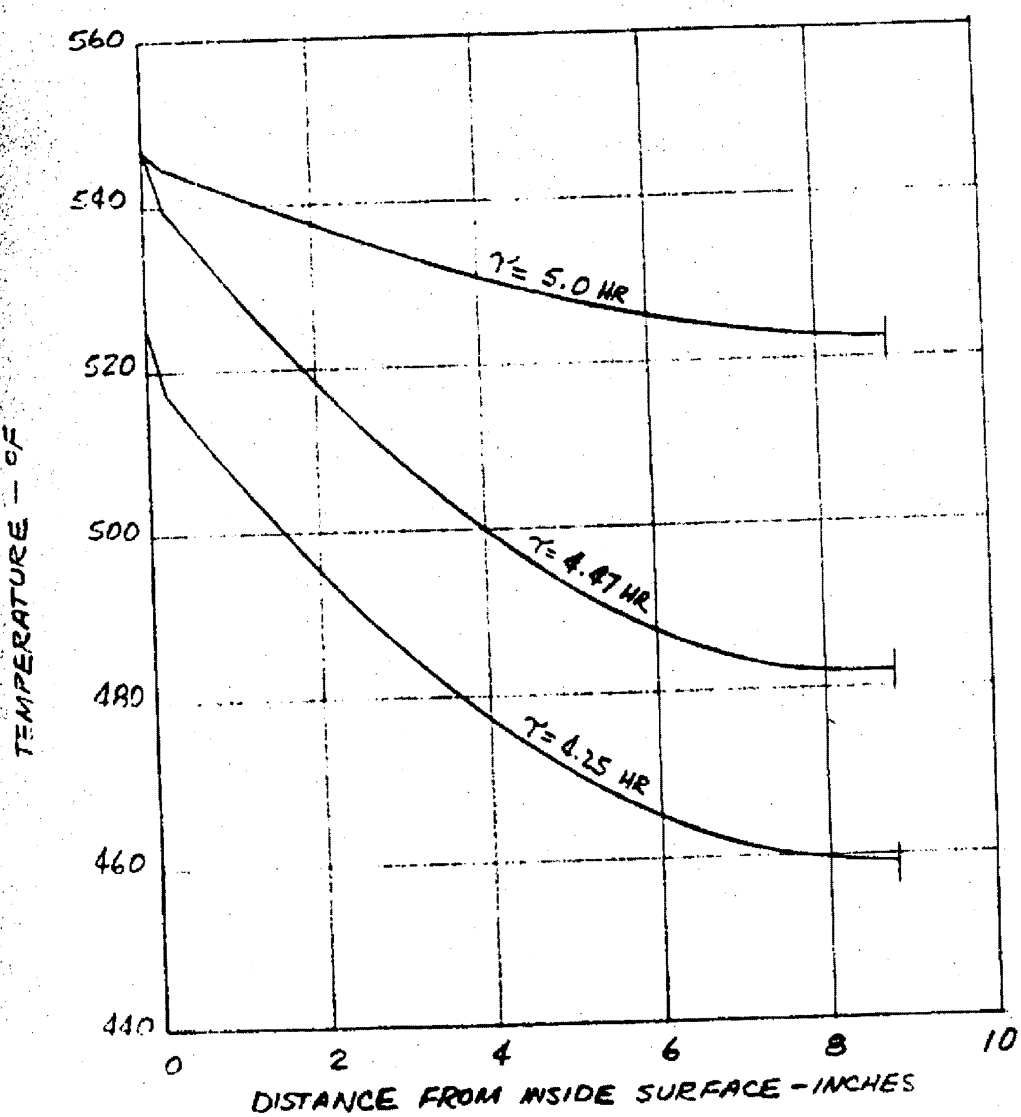


FIGURE B-73

COMBUSTION ENGINEERING, INC.
ENGINEERING DEPARTMENT, CHATTANOOGA, TENN.
CHARGE NO.
DESCRIPTION VESSEL WALL

NUMBER
SHEET B-96 OF
DATE BY
CHECK DATE BY

HYDRO HEATUP, VESSEL WALL, 10 3/4" SECTION

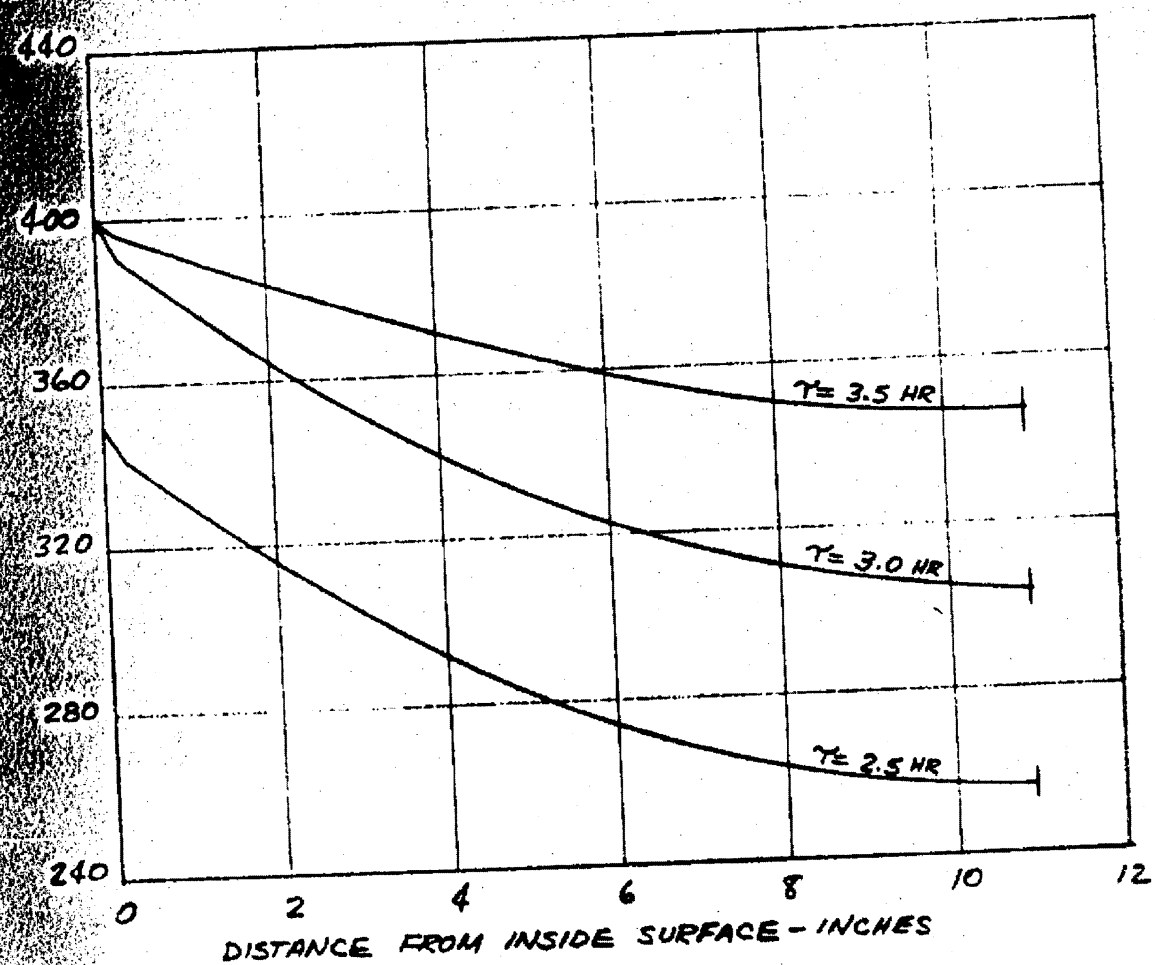


FIGURE B-74

COMBUSTION ENGINEERING, INC.
ENGINEERING DEPARTMENT, CHATTANOOGA, TENN.

CHARGE NO.

DESCRIPTION VESSEL WALL

NUMBER
SHEET B-97 OF
DATE BY
CHECK DATE BY

HYDRO HEATUP, VESSEL WALL, 8 5/8" SECTION

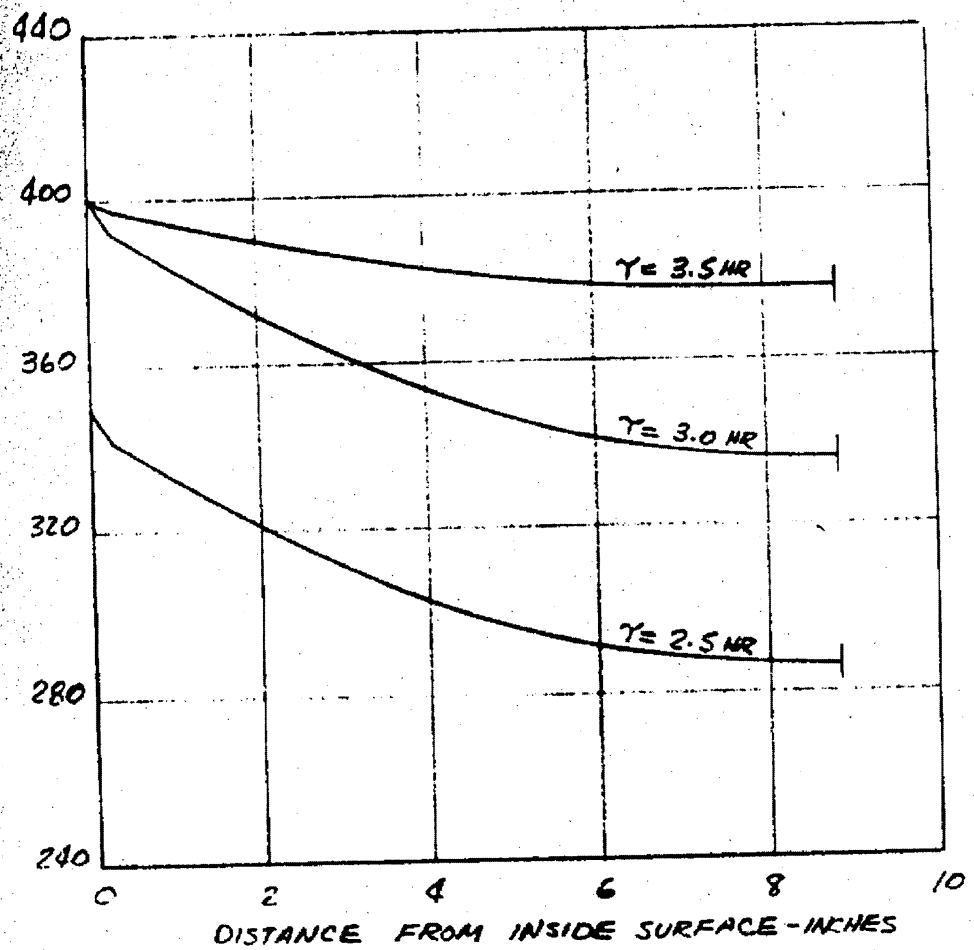
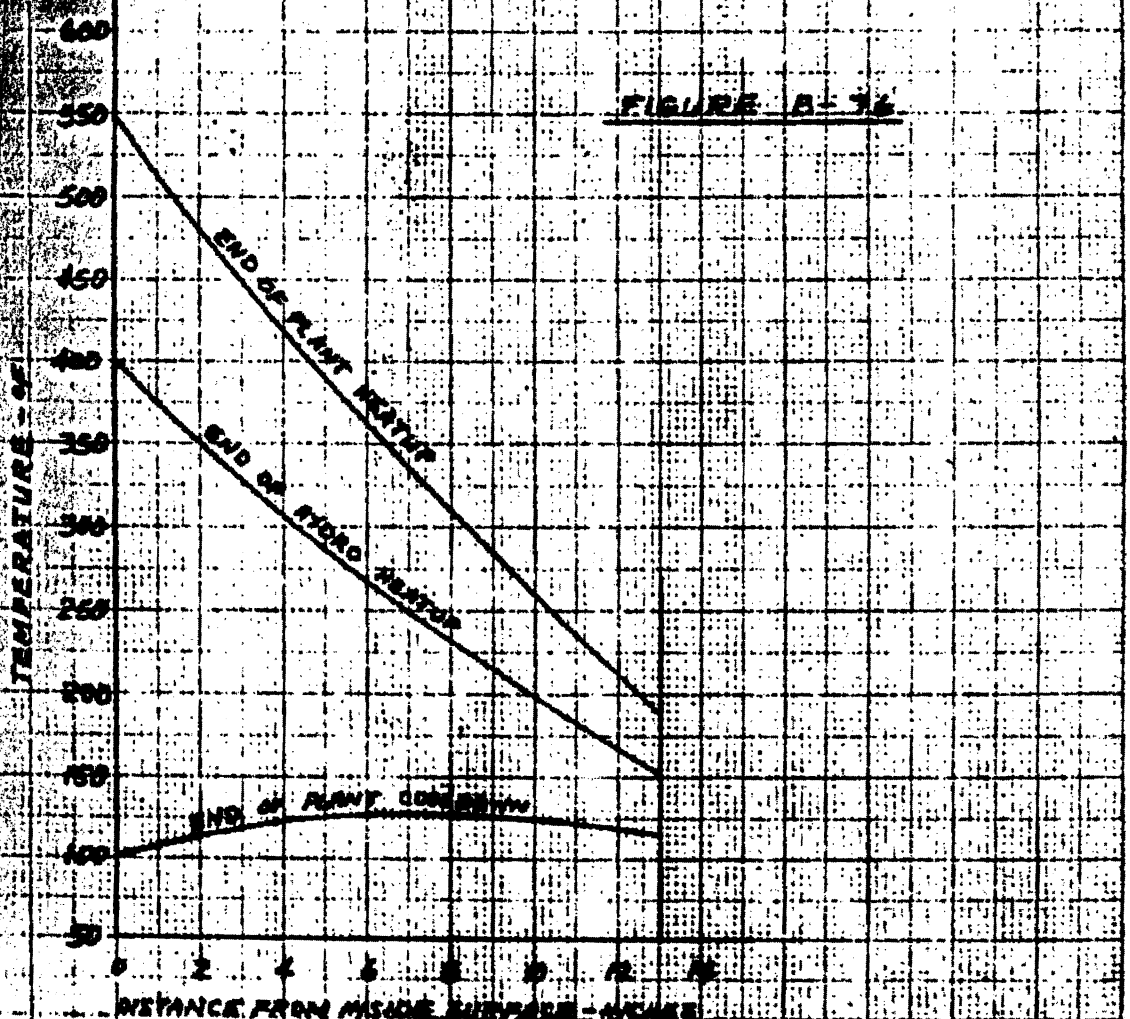


FIGURE B-75

TEMPERATURE DISTRIBUTION
THRU NOZZLE WALL AND PAD
FOR
INLET AND OUTLET NOZZLES

FIGURE B-76



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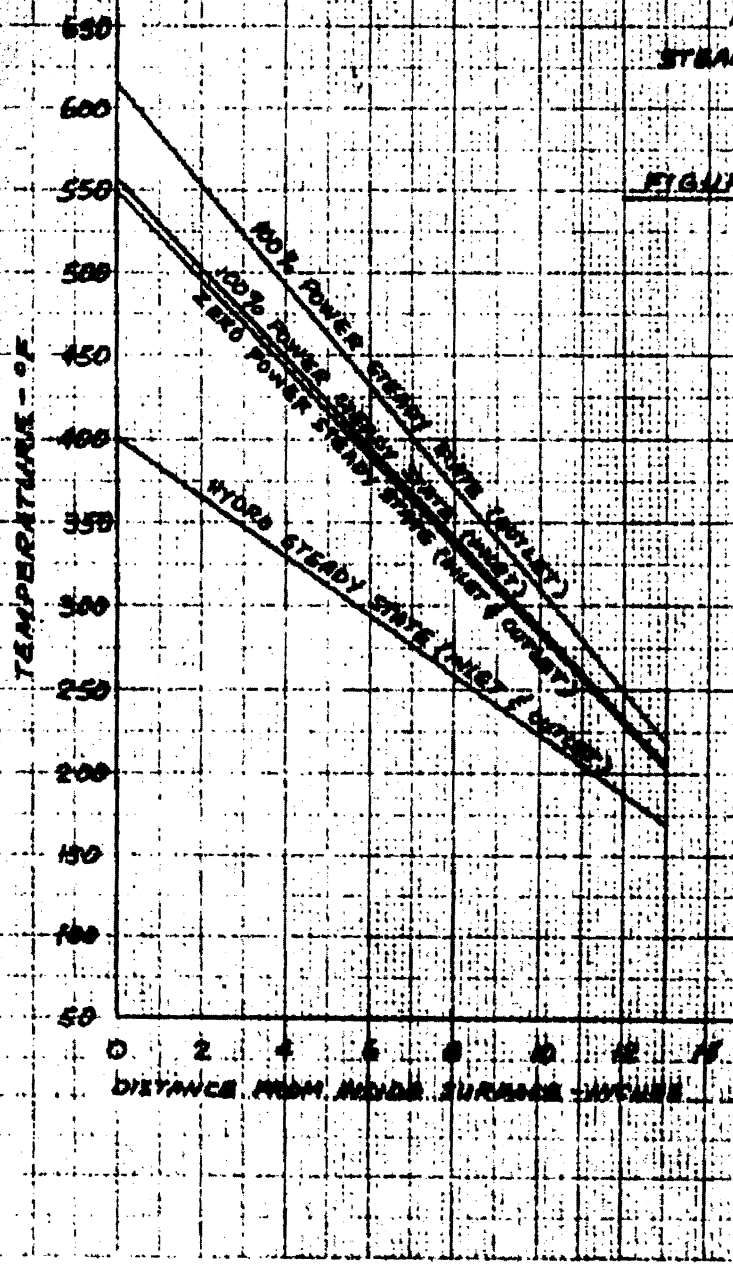
Submitted: December 27, 2011

TEMPERATURE DISTRIBUTION
THRU NOZZLE WALL AND PAD
AT
STEADY STATE

FIGURE B-77



COMBUSTION ENGINEERING, INC.
ENGINEERING DEPARTMENT, CHATTANOOGA, TENN.
CHARGE NO.
DESCRIPTION HEAD AND VESSEL FLANGES

NUMBER
SHEET B-100 OF
DATE BY
CHECK DATE BY

THERMAL MOMENTS RESULTING FROM RADIAL GRADIENTS FOR 100 °F/HR HEATUP AND COOLDOWN, 100°F ⟷ 547°F

		100 °F/HR HEATUP		100 °F/HR COOLDOWN	
LOCATION	TIME (HR)	T_{MEAN} (°F)	THERMAL MOMENT (IN-LB/IN)	T_{MEAN} (°F)	THERMAL MOMENT (IN-LB/IN)
HEAD FLANGE-HEAD JUNCTION	4.0	412	332271	234	-289429
	4.25	434	334688	212	-292207
	4.35	443	335628	203	-293446
	4.47	456	336991	190	-295197
	5.0	482	259934	164	-225118
	STEADY STATE	546	3217		
TOP OF HEAD FLANGE	4.0	308	4099231	330	-4053144
	4.25	326	4307030	312	-4254050
	4.35	334	4397693	306	-4260472
	4.47	346	4526824	294	-4365332
	5.0	380	4444551	264	-4140627
	STEADY STATE	545	94314		
BOTTOM OF HEAD FLANGE	4.0	307	2178931	332	-2143347
	4.25	325	2267317	314	-2200498
	4.35	334	2295041	306	-2218839
	4.47	344	2332781	295	-2230669
	5.0	375	2180188	264	-2045856
	STEADY STATE	539	64743		
TOP OF VESSEL FLANGE	4.0	243	1023212	374	-726730
	4.25	258	1069229	358	-774763
	4.35	265	1101081	352	-796483
	4.47	274	1134218	343	-821931
	5.0	307	1176806	310	-842210
	STEADY STATE	516	361003		
VESSEL FLANGE-SHELL JUNCTION	4.0	391	468071	193	-402539
	4.25	413	461449	191	-406478
	4.35	423	462890	190	-408144
	4.47	435	464736	189	-410452
	5.0	466	361170	186	-304752
	STEADY STATE	544	17291		

COMBUSTION ENGINEERING, INC.
ENGINEERING DEPARTMENT, CHATTANOOGA, TENN.

CHARGE NO.

DESCRIPTION: INLET NOZZLE

NUMBER
SHEET B-101 OF
DATE BY
CHECK DATE BY

THERMAL MOMENTS RESULTING FROM RADIAL GRADIENTS

100 °F/HR HEATUP

LOCATION	TIME (HR)	T_{MEAN} (°F)	THERMAL MOMENT (IN-lb/IN)
NOZZLE WALL AT BI-METTALIC WELD	4.0	492	1432
	4.25	517	1439
	4.35	527	1446
	4.47	539	1453
	5.0	547	0
THIN SECTION OF NOZZLE WALL WHERE TAPER ENDS	4.0	490	1884
	4.25	515	1893
	4.35	525	1902
	4.47	537	1910
	5.0	546	398
NOZZLE WALL AT BEGINNING OF TAPERED SECTION	4.0	423	296455
	4.25	448	297894
	4.35	458	299333
	4.47	470	300772
	5.0	508	171974
NOZZLE WALL AT VESSEL-NOZZLE JUNCTION	4.0	426	308138
	4.25	451	311129
	4.35	461	312625
	4.47	473	314121
	5.0	510	169914
VESSEL WALL AT VESSEL-NOZZLE JUNCTION	4.0	435	336543
	4.25	460	338168
	4.35	470	339794
	4.47	482	341420
	5.0	515	184075

NOTE: THERMAL MOMENTS FOR THE COOLDOWN TRANSIENT ARE EQUAL IN MAGNITUDE BUT OPPOSITE IN SIGN FROM THOSE FOR HEATUP.

COMBUSTION ENGINEERING, INC.
ENGINEERING DEPARTMENT, CHATTANOOGA, TENN.
CHARGE NO.
DESCRIPTION OUTLET NOZZLE

NUMBER
SHEET B-102 OF
DATE BY
CHECK DATE BY

THERMAL MOMENTS RESULTING FROM RADIAL GRADIENTS

100 °F/HR HEATUP

LOCATION	TIME (HR)	T_{MEAN} (°F)	THERMAL MOMENT (IN-LB/IN)
NOZZLE WALL AT BI-METTALIC WELD	4.0	492	1432
	4.25	517	1439
	4.35	527	1446
	4.47	539	1453
	5.0	547	0
THIN SECTION OF NOZZLE WALL WHERE TAPER ENDS	4.0	488	2296
	4.25	513	2307
	4.35	523	2318
	4.47	535	2328
	5.0	544	677
NOZZLE WALL AT BEGINNING OF TAPERED SECTION	4.0	440	201261
	4.25	465	202228
	4.35	475	203196
	4.47	487	204164
	5.0	521	98858
NOZZLE WALL AT VESSEL-NOZZLE JUNCTION	4.0	433	259971
	4.25	458	262483
	4.35	468	263739
	4.47	480	264995
	5.0	516	136549
VESSEL WALL AT VESSEL-NOZZLE JUNCTION	4.0	435	320808
	4.25	460	322358
	4.35	470	323908
	4.47	481	325458
	5.0	516	174296

NOTE: THERMAL MOMENTS FOR THE COOLDOWN TRANSIENT ARE EQUAL IN MAGNITUDE BUT OPPOSITE IN SIGN FROM THOSE FOR HEATUP.

COMBUSTION ENGINEERING, INC.
ENGINEERING DEPARTMENT, CHATTANOOGA, TENN.

CHARGE NO.
DESCRIPTION OUTLET NOZZLE

NUMBER
SHEET B-103 OF
DATE BY
CHECK DATE BY

THERMAL MOMENTS RESULTING FROM RADIAL GRADIENTS

		PLANT LOADING		PLANT UNLOADING	
LOCATION	TIME	T_{MEAN} (°F)	THERMAL MOMENT (IN-lb/IN)	T_{MEAN} (°F)	THERMAL MOMENT (IN·lb/IN)
NOZZLE WALL AT BI-METALIC WELD	10 MIN.	568	2219	592	- 2300
	15 MIN.	583	2511	577	- 2531
	20 MIN.	599	2825	561	- 2619
	25 MIN.	608	1070	552	- 1020
	30 MIN.	610	646	549	- 420
	STEADY STATE	613	0	547	0
THIN SECTION OF NOZZLE WHERE TAPER ENDS	10 MIN.	568	2199	592	- 2129
	15 MIN.	582	2571	577	- 2601
	20 MIN.	597	2946	562	- 2739
	25 MIN.	605	1655	554	- 1460
	30 MIN.	608	1090	552	- 1040
	STEADY STATE	613	0	547	0
NOZZLE WALL AT BEGINNING OF TAPERED SECTION	10 MIN.	553	67384	602	- 42350
	15 MIN.	558	107043	596	- 72208
	20 MIN.	565	142450	590	- 118670
	25 MIN.	571	145947	584	- 120442
	30 MIN.	576	134611	578	- 111940
	STEADY STATE	607	23488	547	0
NOZZLE WALL AT VESSEL-NOZZLE JUNCTION	10 MIN.	552	78067	593	+ 7834
	15 MIN.	556	123200	589	- 40630
	20 MIN.	562	169119	583	- 82080
	25 MIN.	567	180557	578	-100958
	30 MIN.	571	178923	574	- 94772
	STEADY STATE	598	85758	547	0
VESSEL WALL AT VESSEL-NOZZLE JUNCTION	10 MIN.	548	11628	573	-120431
	15 MIN.	549	16178	572	-125024
	20 MIN.	550	22245	570	-130637
	25 MIN.	552	18706	568	-128000
	30 MIN.	555	15167	566	-121397
	STEADY STATE	574	-108694	547	0

COMBUSTION ENGINEERING, INC.
ENGINEERING DEPARTMENT, CHATTANOOGA, TENN.

NUMBER
SHEET B-104 OF
CHARGE NO.
DATE BY
DESCRIPTION VESSEL WALL
CHECK DATE BY

TABULATED RESULTS

		TIME (HR)	T_{MEAN} (°F)	T_{INSIDE} (°F)	$T_{INTERFACE}$ (°F)	$T_{OUTSIDE}$ (°F)	$T_M - T_{IN}$ (°F)	$T_M - T_{INS}$ (°F)	$T_M - T_{OUT}$ (°F)
10 3/4" SECTION	NORMAL HEATUP	4.25	460	525	515	427	-65	-55	33
		4.47	492	547	537	450	-65	-55	32
		5.00	514	547	543	495	-33	-29	19
	NORMAL COOLDOWN	4.25	187	122	132	220	65	55	-33
		4.47	165	100	110	197	65	55	-32
		5.00	133	100	104	152	33	29	-19
	HYDRO HEATUP	2.50	289	350	341	256	-63	-54	33
		3.00	336	400	390	303	-64	-54	33
		3.50	367	400	396	347	-33	-29	20
	HYDRO COOLDOWN	2.50	211	150	159	244	63	54	-33
		3.00	164	100	110	197	64	54	-33
		3.50	133	100	104	153	33	29	-20
8 5/8" SECTION	NORMAL HEATUP	4.25	482	525	517	460	-43	-35	22
		4.47	504	547	540	482	-43	-36	22
		5.00	533	547	544	522	-14	-11	11
	NORMAL COOLDOWN	4.25	165	122	130	187	43	35	-22
		4.47	143	100	107	165	43	36	-22
		5.00	114	100	103	125	14	11	-11
	HYDRO HEATUP	2.50	308	350	342	286	-42	-36	22
		3.00	357	400	393	336	-43	-36	21
		3.50	384	400	397	378	-16	-13	6
	HYDRO COOLDOWN	2.50	192	150	158	214	42	36	-22
		3.00	143	100	107	164	43	36	-21
		3.50	116	100	103	122	16	13	-6

COMBUSTION ENGINEERING, INC.
ENGINEERING DEPARTMENT, CHATTANOOGA, TENN.

CHARGE NO.
DESCRIPTION: BOTTOM HEAD

NUMBER
SHEET B-105 OF
DATE BY
CHECK DATE BY

TABULATED RESULTS

	TIME (HR)	T_{MEAN} (°F)	T_{INSIDE} (°F)	$T_{OUTSIDE}$ (°F)	$T_M - T_{IN}$ (°F)	$T_M - T_{OUT}$ (°F)
NORMAL HEATUP	4.25	507	525	499	-18	8
	4.47	529	547	521	-18	8
	5.0	545	547	544	-2	1
NORMAL COOLDOWN	4.25	140	122	148	18	-9
	4.47	118	100	126	18	-9
	5.0	102	100	103	2	-1
HYDRO HEATUP	2.5	332	350	324	-18	8
	3.0	382	400	374	-18	8
	3.5	398	400	397	-2	1
HYDRO COOLDOWN	2.5	168	150	176	18	-9
	3.0	118	100	126	18	-9
	3.5	102	100	103	2	-1

COMBUSTION ENGINEERING, INC.
ENGINEERING DEPARTMENT, CHATTANOOGA, TENN.

CHARGE NO.

DESCRIPTION VESSEL SUPPORTS

NUMBER

SHEET B-106 OF

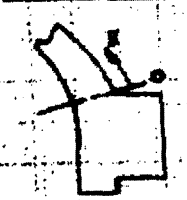
DATE BY

CHECK DATE BY

DIFFERENCES BETWEEN THE MEAN TEMPERATURE AND THE TEMPERATURES OF THE INSIDE AND OUTSIDE SURFACES OF THE NOZZLE WALL AND PAD FOR THE CONDITIONS ANALYZED

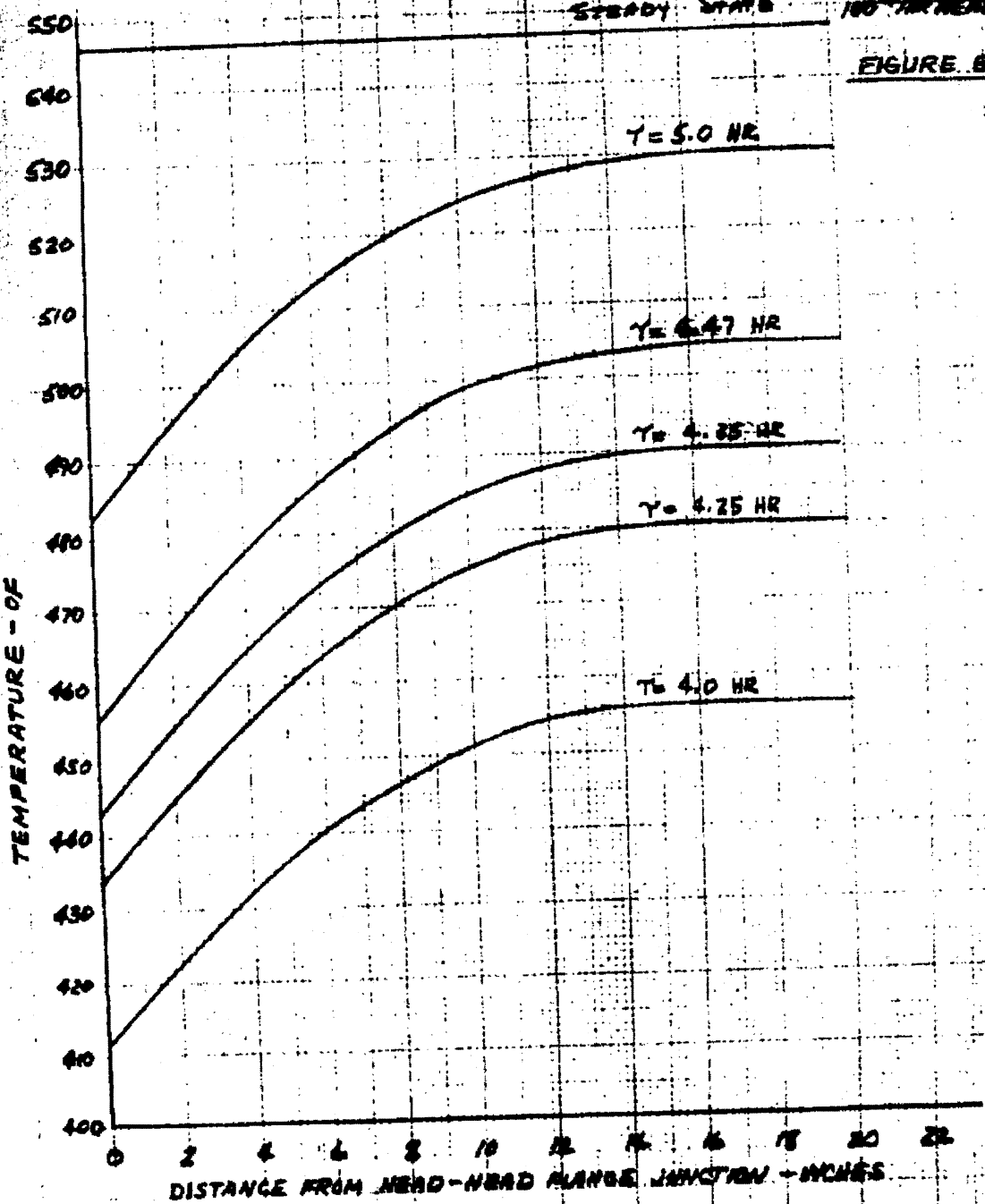
CONDITION	INLET NOZZLE			OUTLET NOZZLE		
	T_{MEAN} °F	$T_M - T_{IN}$ °F	$T_M - T_{OUT}$ °F	T_{MEAN} °F	$T_M - T_{IN}$ °F	$T_M - T_{OUT}$ °F
END OF HYDRO HEATUP	263	-137	113	263	-137	113
END OF PLANT HEATUP	354	-193	168	354	-193	168
HYDRO STEADY STATE	285	-115	115	285	-115	115
ZERO POWER STEADY STATE	375	-172	172	375	-172	172
100% POWER STEADY STATE	379	-176	176	415	-198	198
END OF HYDRO COOLDOWN	120	20	5	120	20	5
END OF PLANT COOLDOWN	120	20	5	120	20	5

B-107



GRADIENT IN HEAD
100 °F PER INCH OF

FIGURE B-78



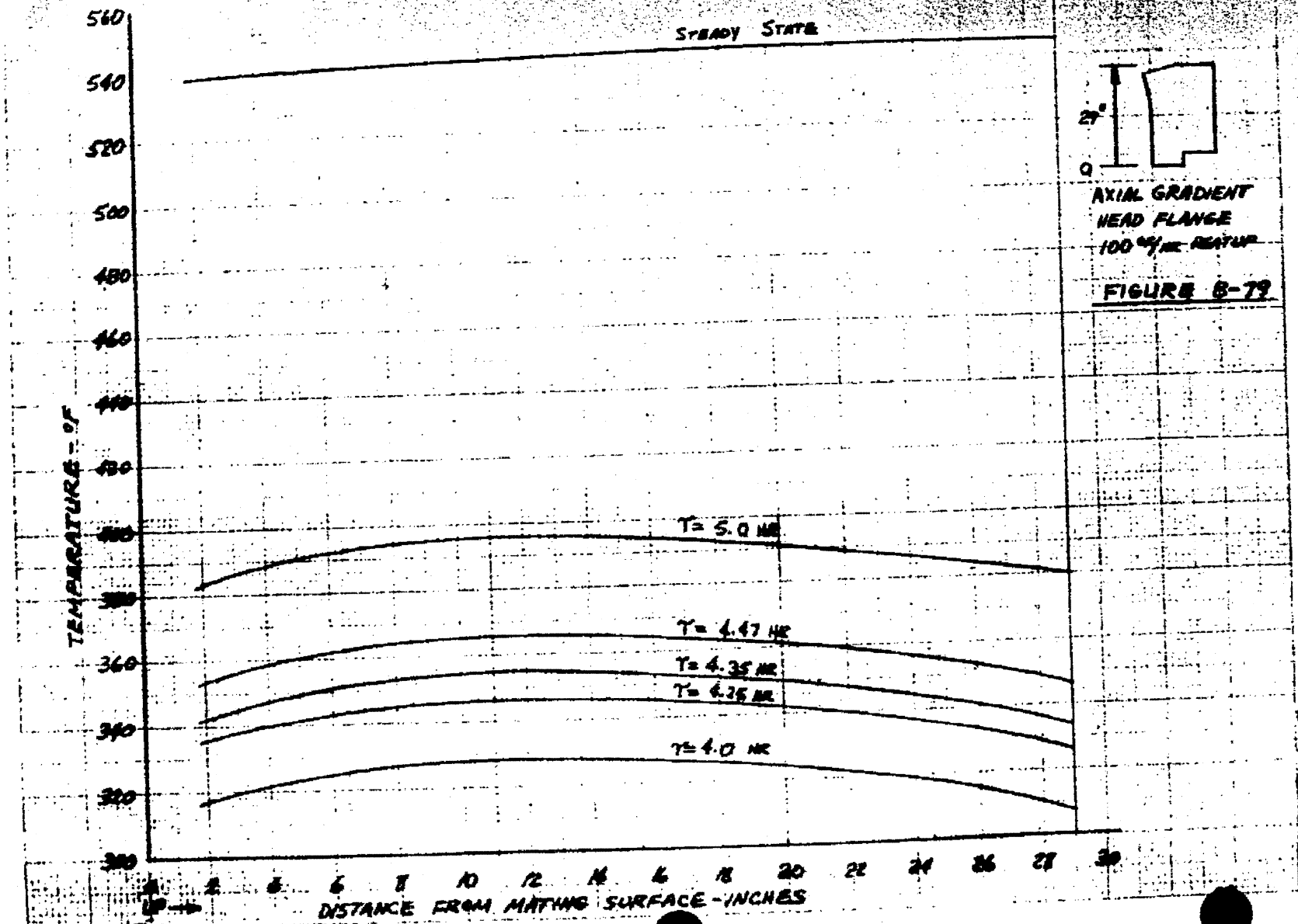
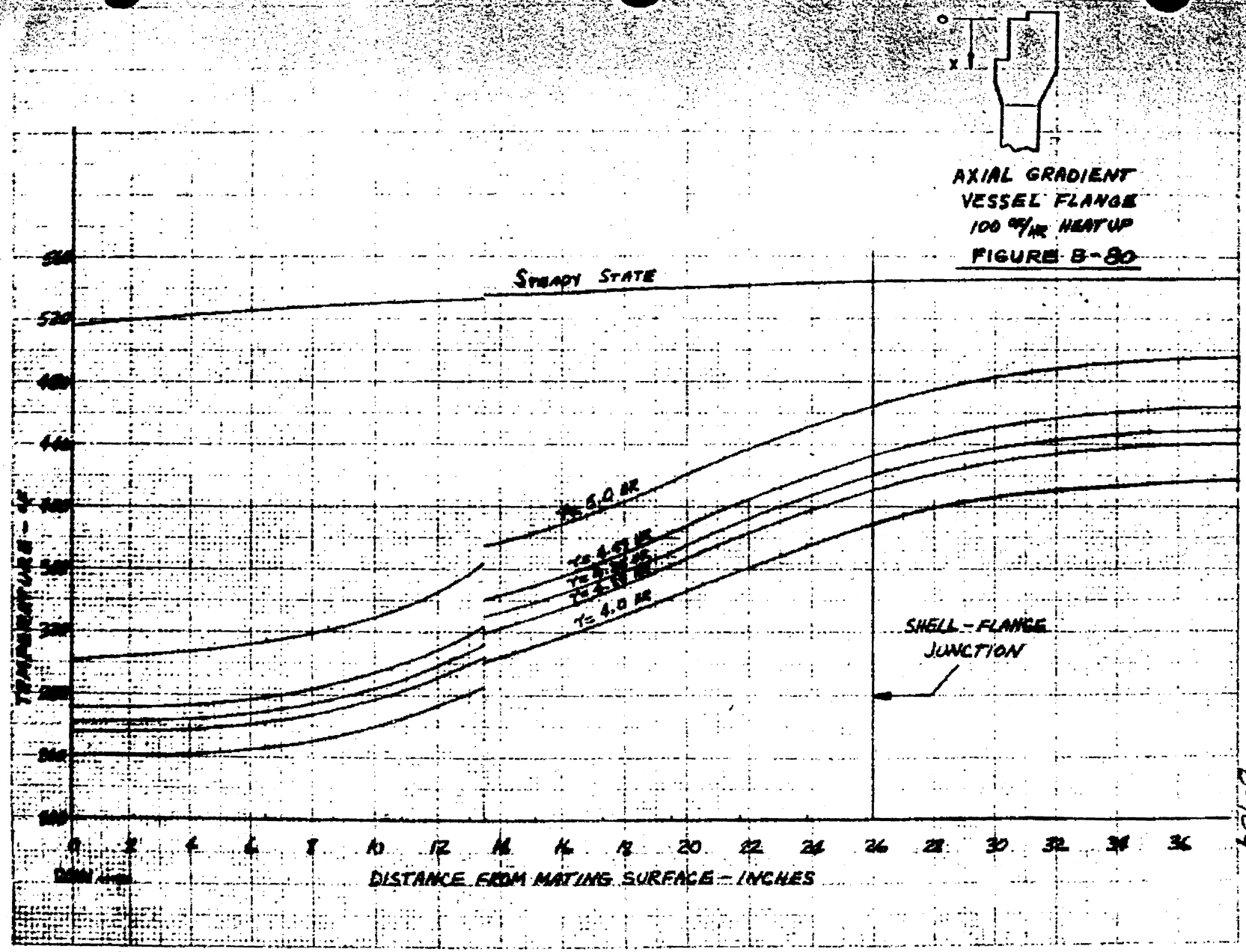


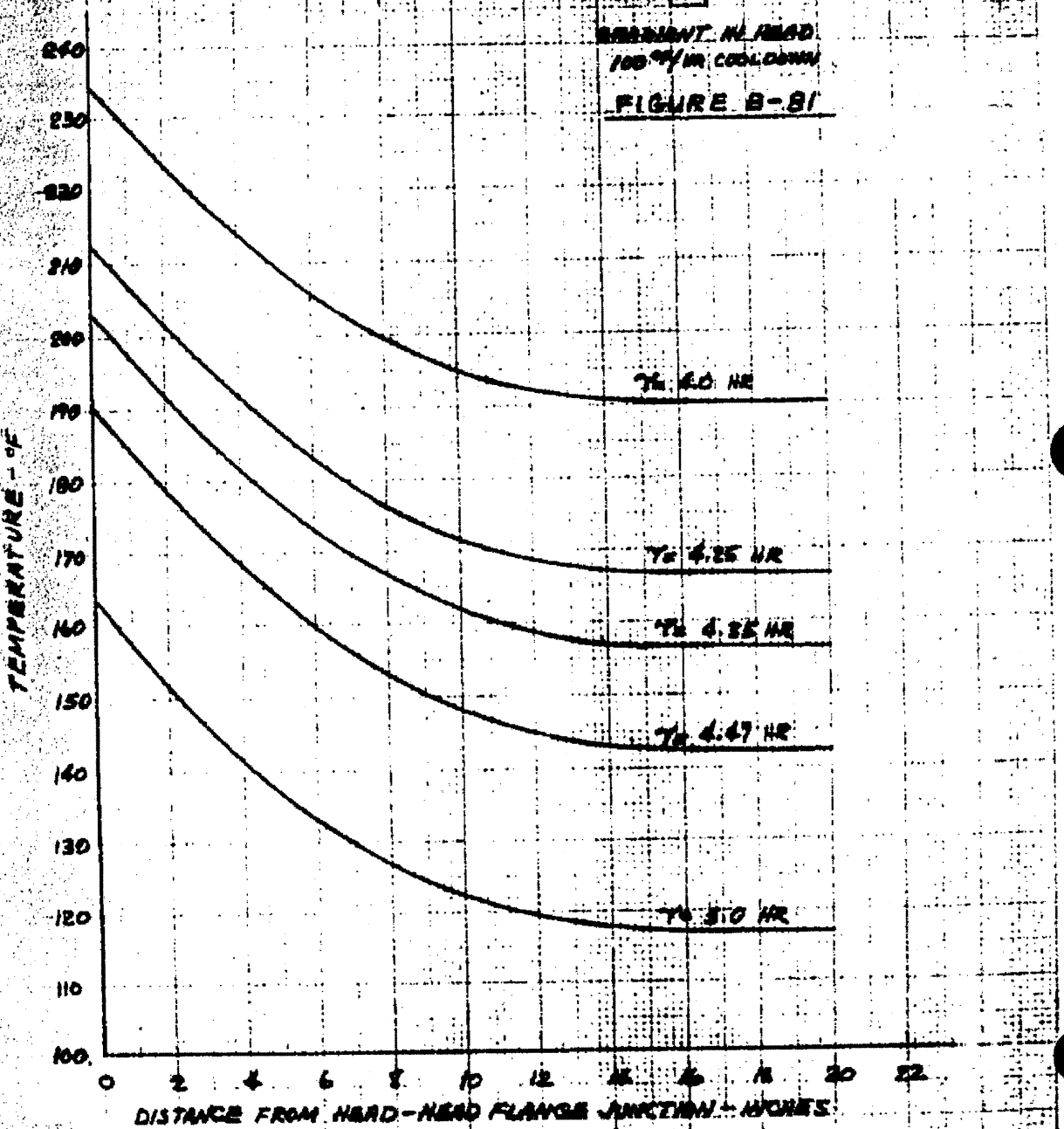
FIGURE B-79

B-108

RIV0000530
Submitted: December 27, 2011



RIV0000530
Submitted: December 27, 2011



GRADIENT IN HEAD
100 °F/HR COOLDOWN

FIGURE B-81

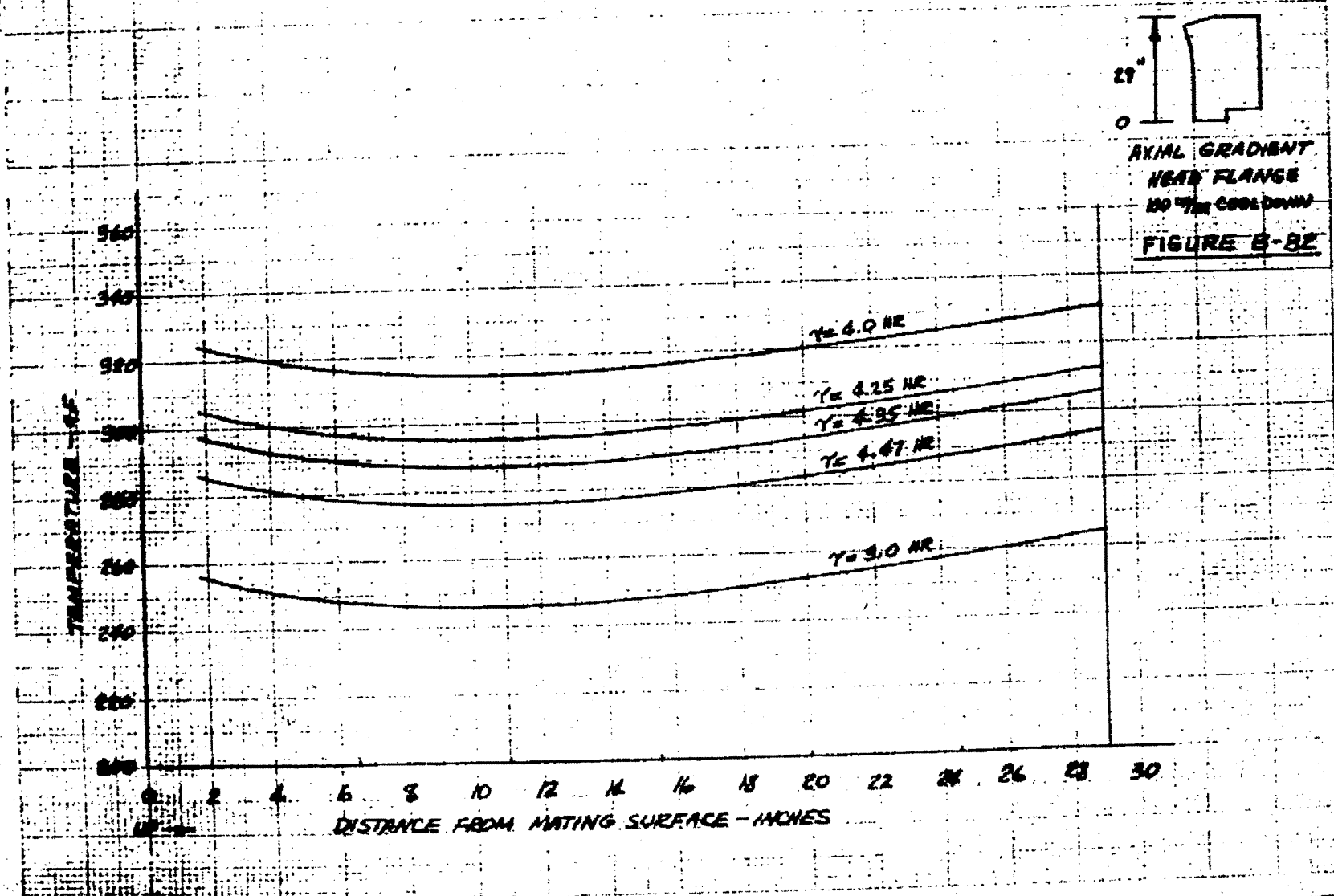


FIGURE B-82

RIV0000530
Submitted: December 27, 2011

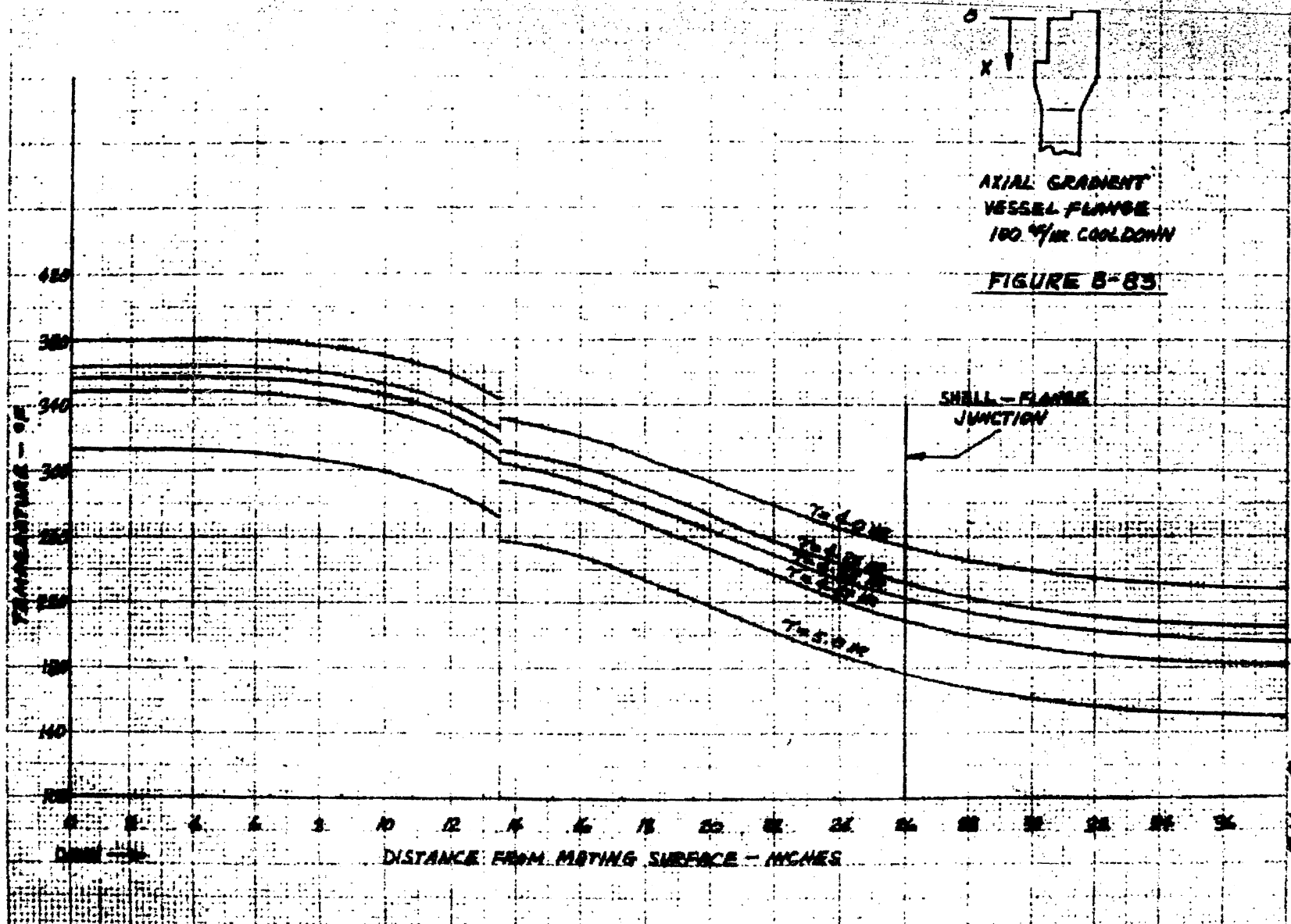
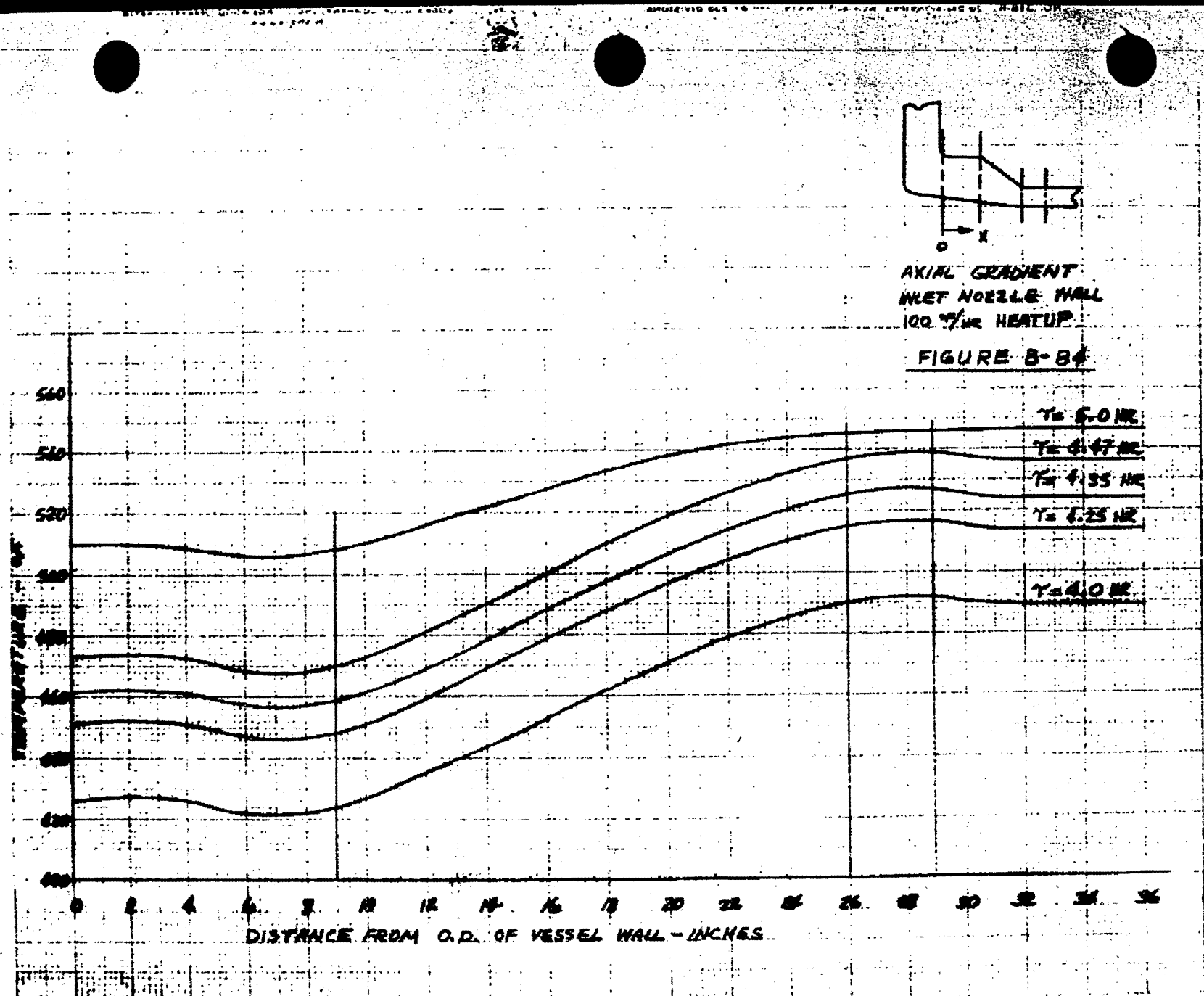
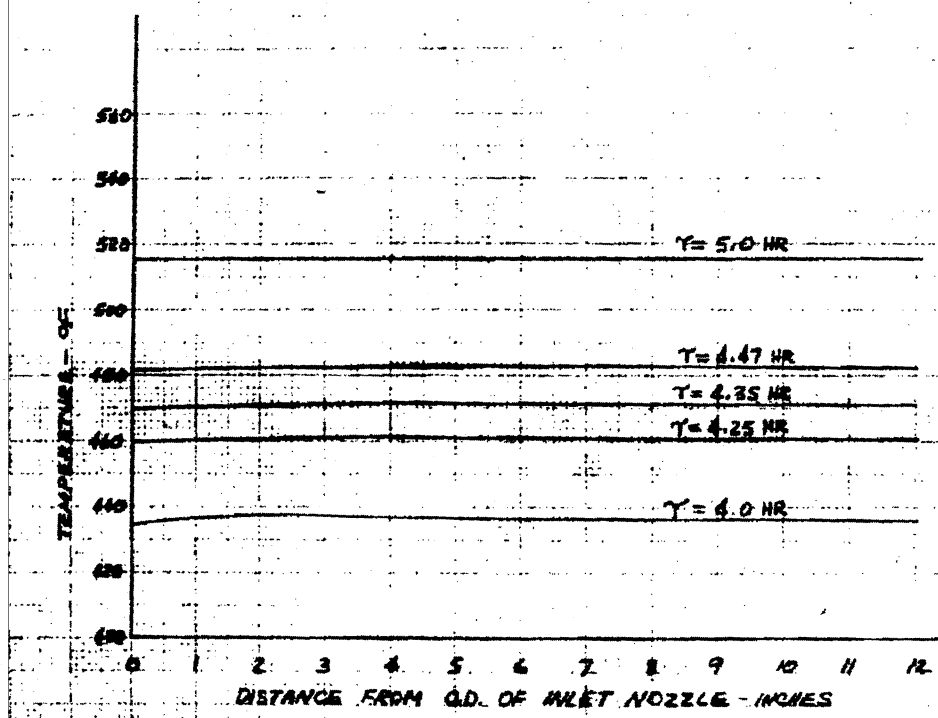


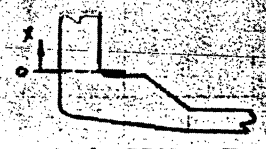
FIGURE B-83

RIV0000530
Submitted: December 27, 2011



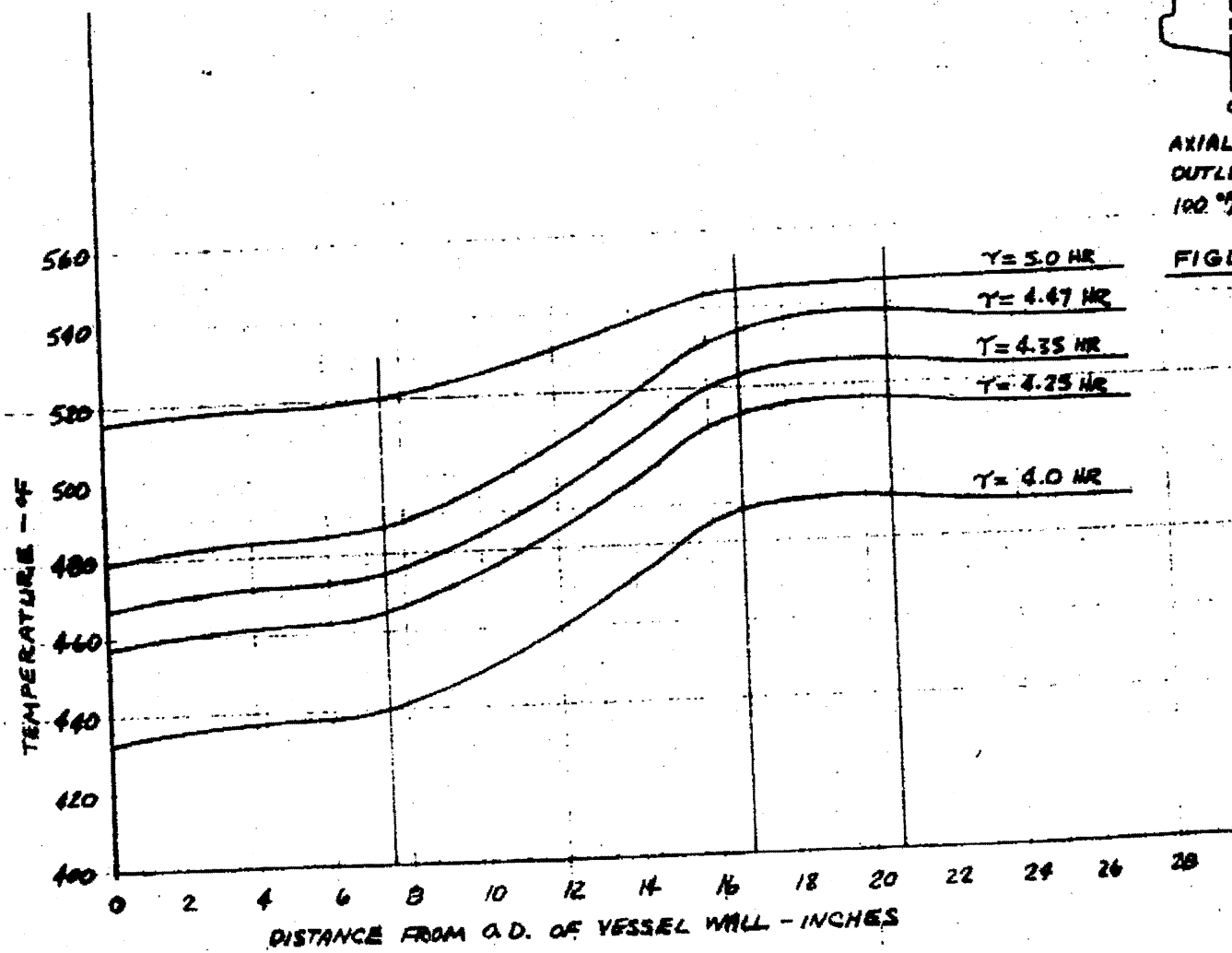
RIV0000530
Submitted: December 27, 2011

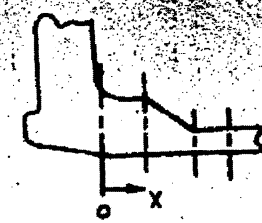




AXIAL GRADIENT
VESSEL WALL
100 °F/HR HEATUP

FIGURE B-85

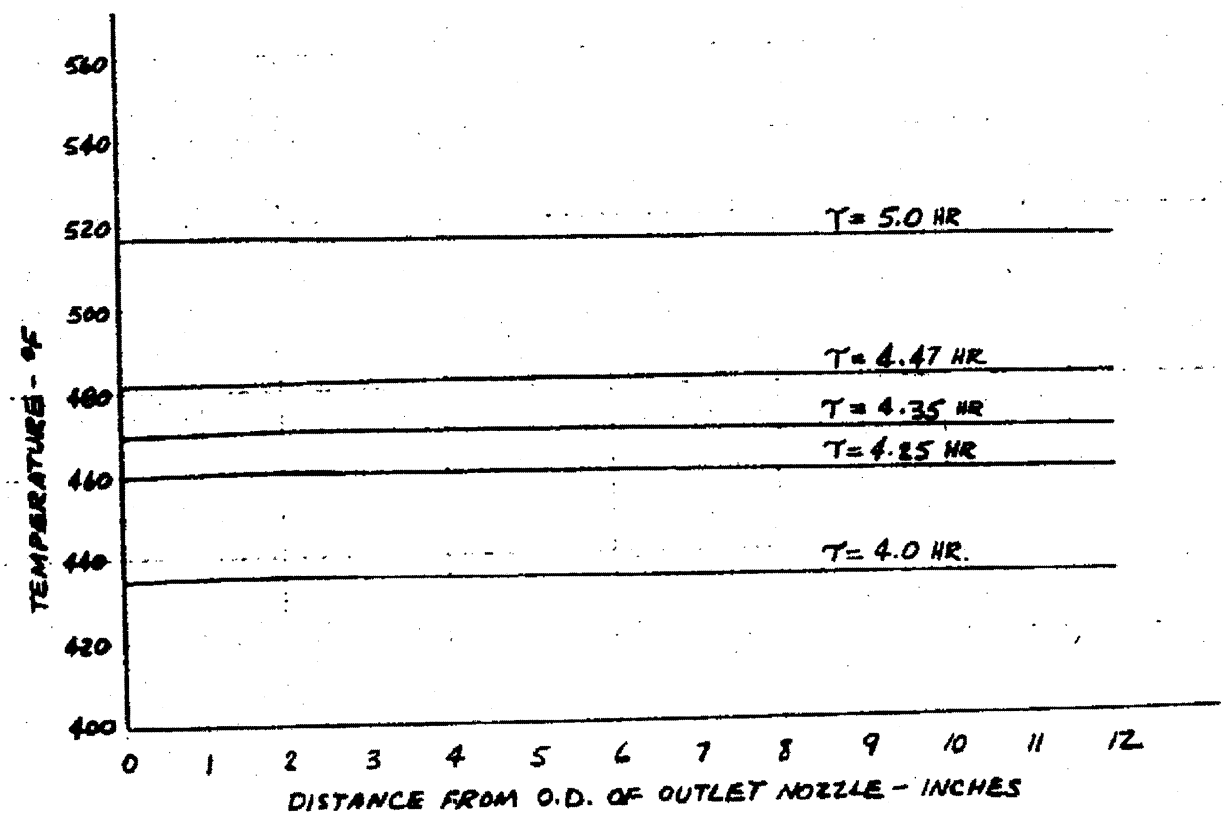




AXIAL GRADIENT
OUTLET NOZZLE WALL
100 °F/HR HEATUP

FIGURE B-86

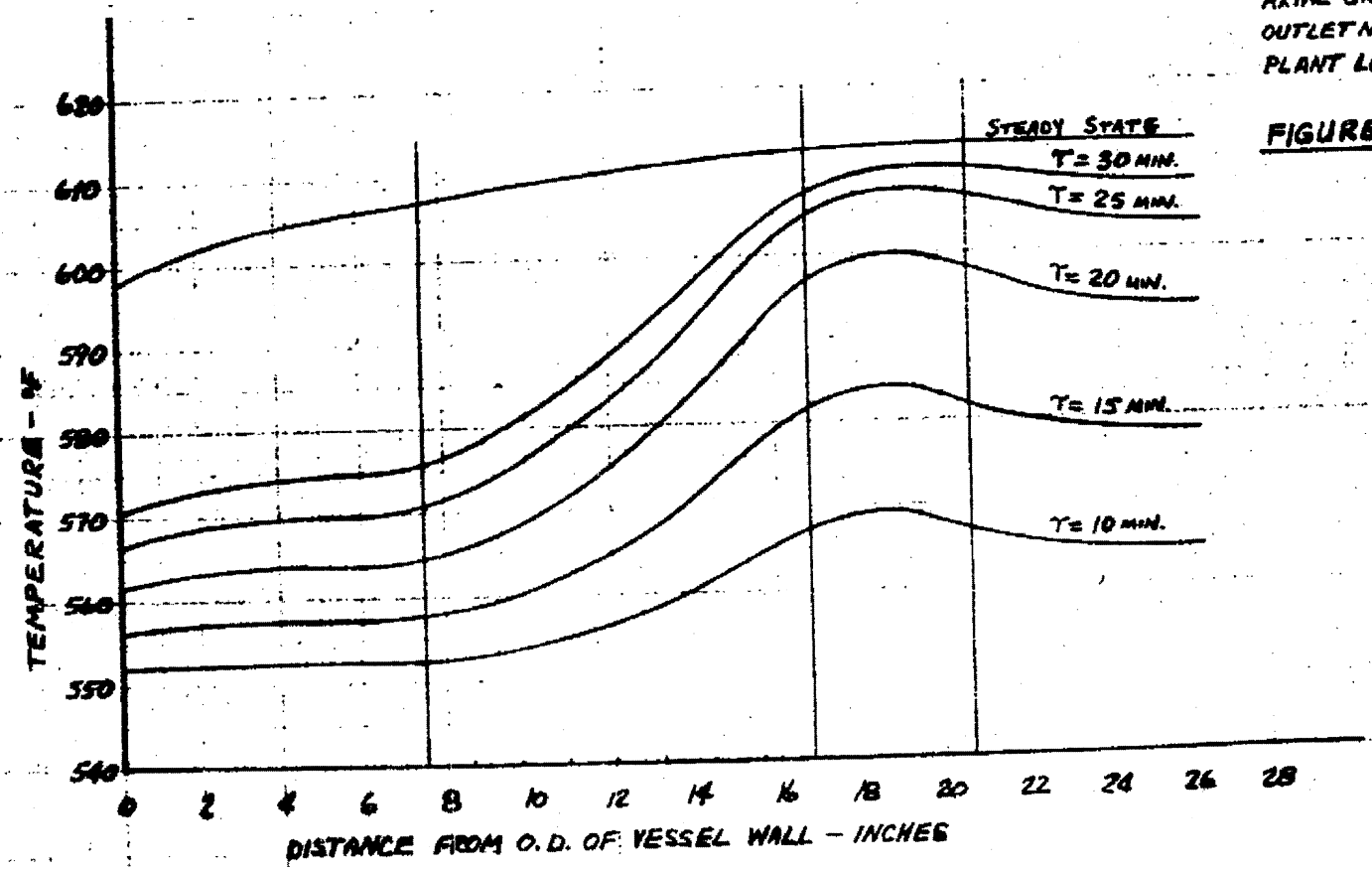
Submitted: December 27, 2011
RIV0000530

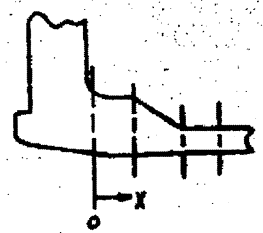


AXIAL GRADIENT
VESSEL WALL
100 °F/HR HEATUP

FIGURE B-87

RIV0000530
Submitted: December 27, 2011

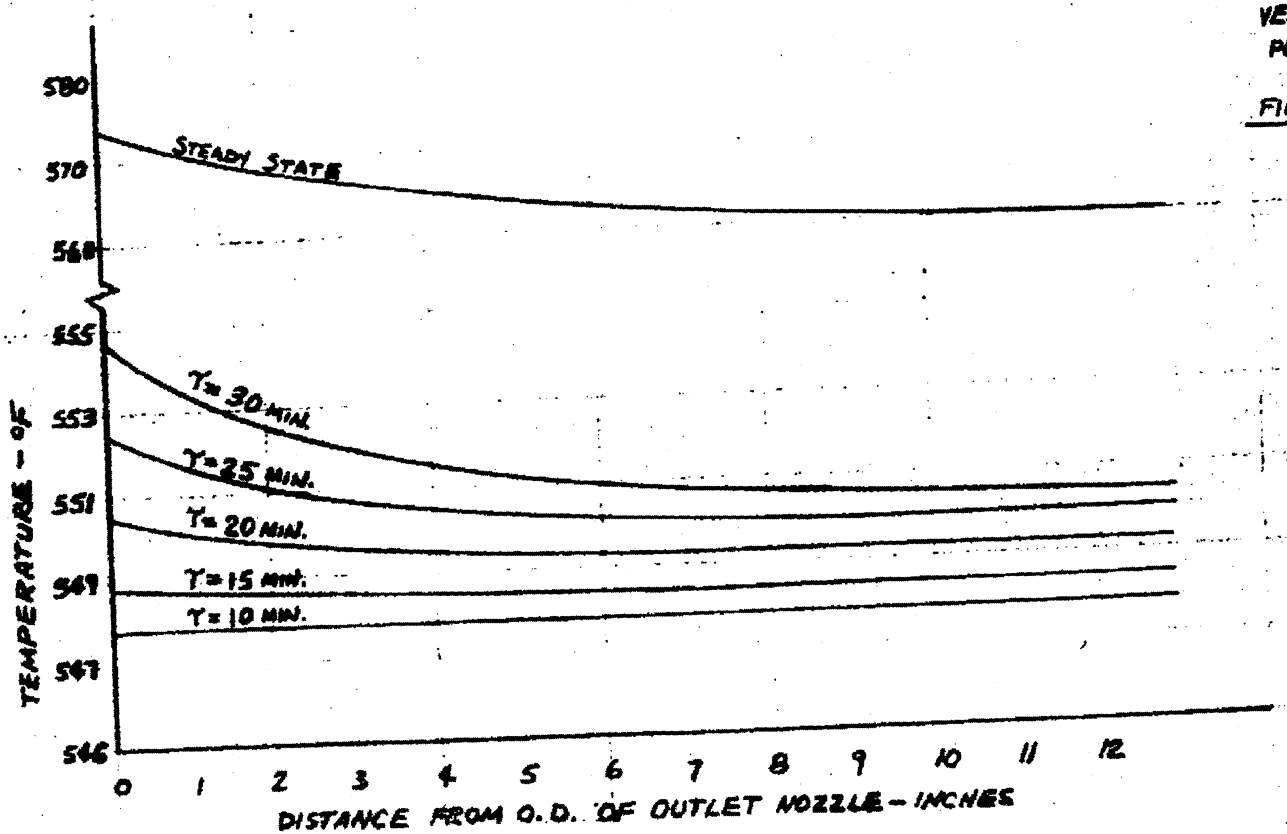




AXIAL GRADIENT
OUTLET NOZZLE WALL
PLANT LOADING

FIGURE B-88

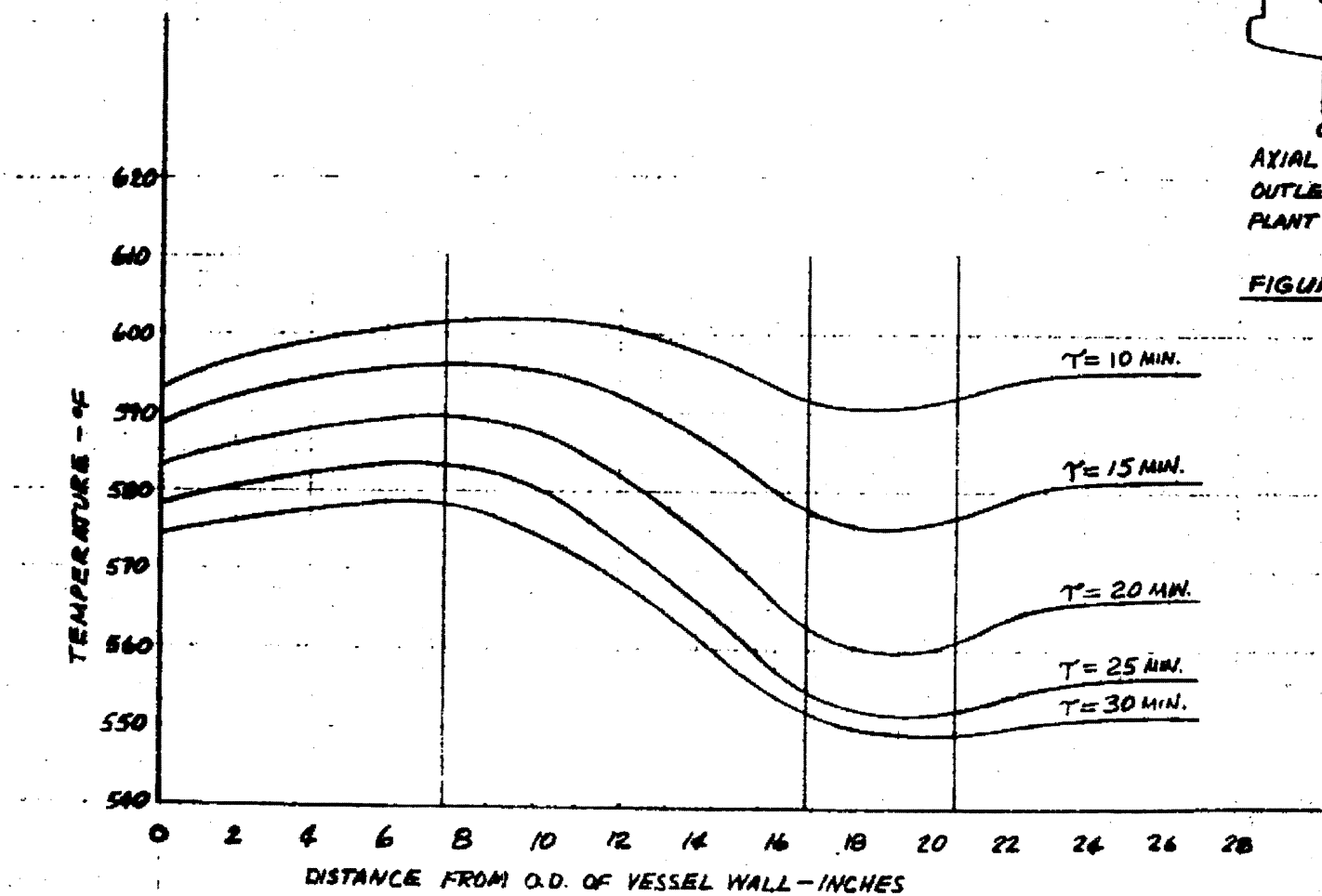
RIV0000530
Submitted: December 27, 2011

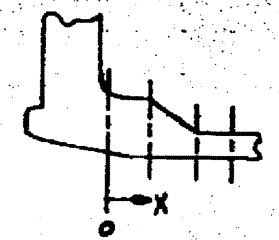


AXIAL GRADIENT
VESSEL WALL
PLANT LOADING

FIGURE B-89

RIV0000530
Submitted: December 27, 2011

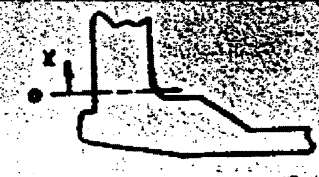




AXIAL GRADIENT
OUTLET NOZZLE WALL
PLANT UNLOADING

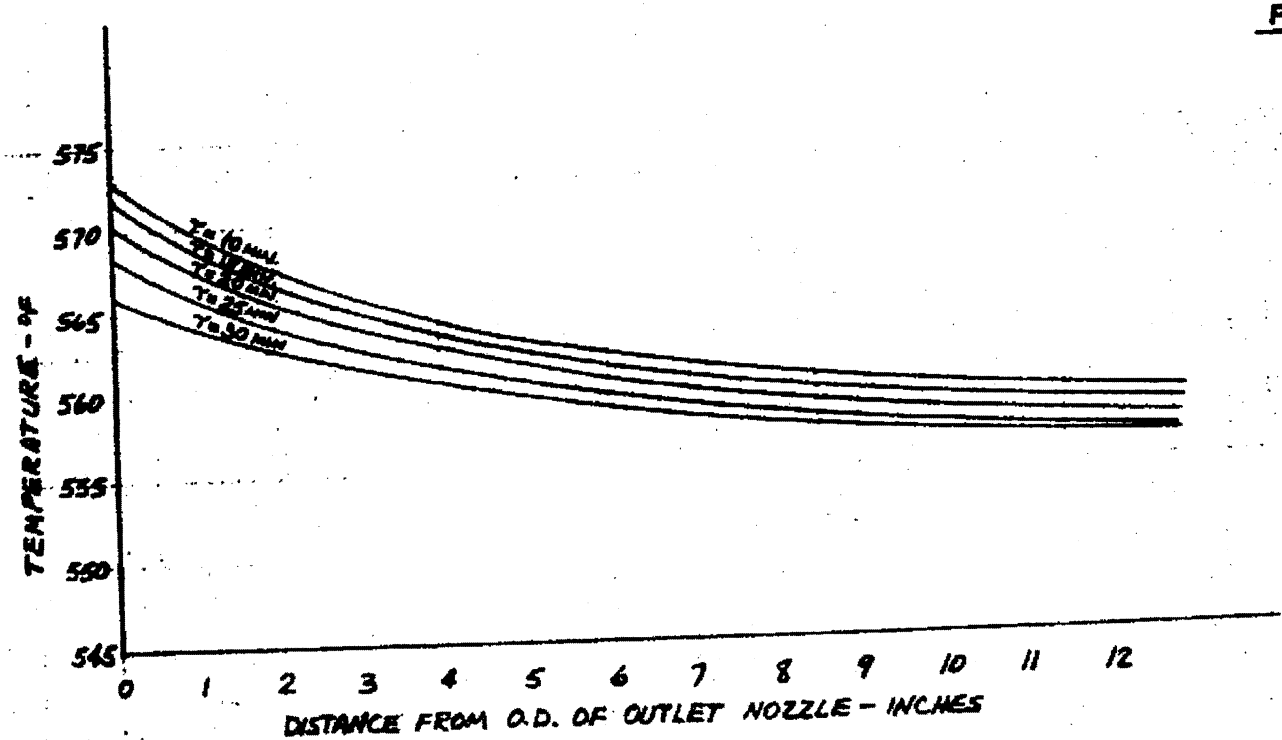
FIGURE B-90

RIV0000530
Submitted: December 27, 2011



AXIAL GRADIENT
VESSEL WALL
PLANT UNLOADING

FIGURE B-91



RIV0000530
Submitted: December 27, 2011

COMBUSTION ENGINEERING, INC.
ENGINEERING DEPARTMENT. CHATTANOOGA. TENN.

CHARGE NO.
DESCRIPTION HEAD AND VESSEL FLANGES

NUMBER
SHEET B-121 OF
DATE BY
CHECK DATE BY

$T_{MEAN} - T_{SURFACE}$ FOR OPERATING TRANSIENTS

TRANSIENT	TIME	$T_{MEAN} - T_{SURFACE}$
PLANT LOADING	0 20 MIN.	0 -7.8 °F
PLANT UNLOADING	0 20 MIN.	0 7.8 °F
10% STEP INCREASE (INITIAL POWER 90%)	0 100 SEC. 225 SEC.	0 11.2 °F 1.7 °F
10% STEP DECREASE (INITIAL POWER 100%)	0 40 SEC. 100 SEC. 260 SEC.	0 -9.3 °F -13.3 °F -1.3 °F
STEP REDUCTION 100% TO 50% LOAD	0 2 MIN. 3.2 MIN. 10.4 MIN.	0 -12.0 °F -15.0 °F 0
REACTOR TRIP FROM FULL POWER	0 10 SEC. 65 SEC.	0 -9.5 °F 8.5 °F
LOSS OF FLOW, ONE PUMP	0 12 SEC.	0 33.3 °F
LOSS OF LOAD	0 10 SEC. 28 SEC. 160 SEC.	0 -30.2 °F -41.2 °F 4.8 °F
STEAM BREAK	0 33 SEC. 54 SEC.	0 117 °F 197 °F

COMBUSTION ENGINEERING, INC.
ENGINEERING DEPARTMENT, CHATTANOOGA, TENN.
CHARGE NO.
DESCRIPTION INLET NOZZLE

NUMBER
SHEET B-122 OF
DATE BY
CHECK DATE BY

$T_{MEAN} - T_{SURFACE}$ FOR OPERATING TRANSIENTS

TRANSIENT	TIME	$T_{MEAN} - T_{SURFACE}$
PLANT LOADING	0 20 MIN.	0 -7.8 °F
PLANT UNLOADING	0 20 MIN.	0 7.8 °F
10% STEP INCREASE (INITIAL POWER 90%)	0 100 SEC. 225 SEC.	0 11.2 °F 1.7 °F
10% STEP DECREASE (INITIAL POWER 100%)	0 40 SEC. 100 SEC. 260 SEC.	0 -9.3 °F -13.3 °F -1.3 °F
STEP REDUCTION 100% TO 50% LOAD	0 2 MIN. 3.2 MIN. 10.4 MIN.	0 -12.0 °F -15.0 °F 0
REACTOR TRIP FROM FULL POWER	0 10 SEC. 65 SEC.	0 -9.5 °F 8.5 °F
LOSS OF FLOW, ONE PUMP	0 12 SEC.	0 33.3 °F
LOSS OF LOAD	0 10 SEC. 28 SEC. 160 SEC.	0 -30.2 °F -41.2 °F 4.8 °F
STEAM BREAK	0 33 SEC. 54 SEC.	0 117 °F 197 °F

COMBUSTION ENGINEERING, INC.
ENGINEERING DEPARTMENT, CHATTANOOGA, TENN.
CHARGE NO. 17765
DESCRIPTION OUTLET NOZZLE

NUMBER
SHEET B-123 OF
DATE BY
CHECK DATE BY

$T_{MEAN} - T_{SURFACE}$ FOR OPERATING TRANSIENTS

		NOZZLE WALL AT BI-METTALIC WELD		THIN SECTION OF NOZZLE WHERE TAPER ENDS		NOZZLE WALL AT BEGINNING OF TAPERED SECTION		NOZZLE WALL AT VESSEL-NOZZLE JUNCTION		VESSEL WALL AT VESSEL-NOZZLE JUNCTION	
TRANSIENT	TIME	T_M (°F)	$T_M - T_S$ (°F)	T_M (°F)	$T_M - T_S$ (°F)	T_M (°F)	$T_M - T_S$ (°F)	T_M (°F)	$T_M - T_S$ (°F)	T_M (°F)	$T_M - T_S$ (°F)
10% STEP INCREASE INITIAL POWER 90%	0	584	0	584	0	584	0	584	0	584	0
	100 SEC.	584	11.2	584	11.2	584	11.2	584	11.2	584	11.2
	225 SEC.	584	1.7	584	1.7	584	1.7	584	1.7	584	1.7
10% STEP DECREASE INITIAL POWER 100%	0	584	0	584	0	584	0	584	0	584	0
	40 SEC.	584	-9.3	584	-9.3	584	-9.3	584	-9.3	584	-9.3
	100 SEC.	584	-13.3	584	-13.3	584	-13.3	584	-13.3	584	-13.3
	260 SEC.	584	-1.3	584	-1.3	584	-1.3	584	-1.3	584	-1.3
STEP REDUCTION FROM 100%-50% LOAD	0	613	0	613	0	607	-6	598	-15	574	19
	2 MIN.	616	-9	616	-9	608	-17	599	-26	575	6
	3.5 MIN.	620	-8	620	-8	609	-19	599	-29	575	5
	6 MIN	620	5	620	5	609	-6	600	-15	576	12
	11 MIN.	604	14	604	14	606	16	597	7	575	21
	15.5 MIN.	591	11	591	11	602	22	594	14	574	22
	17 MIN.	588	8	588	8	601	21	593	13	574	22
REACTOR TRIP FROM FULL POWER	0	613	0	613	0	607	-6	598	-15	574	19
	5 SEC.	613	10	612	9	607	4	598	-5	574	11
	10 SEC.	612	20	612	20	607	15	598	6	574	10
	15 SEC.	611	27	611	27	607	23	598	14	574	11
	40 SEC.	605	46	604	45	605	46	596	37	574	20
	90 SEC.	593	46	592	45	603	56	594	47	573	28

COMBUSTION ENGINEERING, INC.
ENGINEERING DEPARTMENT, CHATTANOOGA, TENN.
CHARGE NO. 17765
DESCRIPTION OUTLET NOZZLE

NUMBER
SHEET B-124 OF
DATE BY
CHECK DATE BY

$T_{MEAN} - T_{SURFACE}$ FOR OPERATING TRANSIENTS

		NOZZLE WALL AT BI-METALLIC WELD		THIN SECTION OF NOZZLE WHERE TAPER ENDS		NOZZLE WALL AT BEGINNING OF TAPERED SECTION		NOZZLE WALL AT VESSEL-NOZZLE JUNCTION		VESSEL WALL AT VESSEL-NOZZLE JUNCTION	
TRANSIENT	TIME (SEC.)	T_M (°F)	$T_M - T_S$ (°F)	T_M (°F)	$T_M - T_S$ (°F)	T_M (°F)	$T_M - T_S$ (°F)	T_M (°F)	$T_M - T_S$ (°F)	T_M (°F)	$T_M - T_S$ (°F)
LOSS OF FLOW ONE PUMP	0	613	0	613	0	607	-6	598	-15	574	19
	12	613	0	613	0	607	-6	598	-15	573	52
	13	613	33	612	32	607	27	598	18	573	50
	14	613	48	612	47	607	42	598	33	573	45
	16	611	71	611	71	607	67	598	58	573	31
	18.5	609	89	609	89	606	86	597	77	573	21
	22	607	81	607	81	606	80	597	71	573	15
	30	603	75	602	74	605	77	596	68	573	15
LOSS OF LOAD	0	613	0	613	0	607	-6	598	-15	574	19
	7	614	-37	614	-37	607	-44	598	-53	574	-4
	12	616	-37	615	-38	608	-45	598	-55	574	-11
	20	618	-32	617	-33	608	-42	599	-51	574	-19
	26	618	-17	618	-17	608	-27	599	-36	575	-21
	34	618	3	618	3	608	-7	599	-16	575	-19
	60	613	29	613	29	607	23	598	14	576	3
	115	601	44	600	43	605	48	596	39	575	25
	144	595	45	594	44	603	53	595	45	574	24
STEAM BREAK	0	547	0	547	0	547	0	547	0	547	0
	33	547	117	547	117	547	117	547	117	547	117
	54	547	197	547	197	547	197	547	197	547	197

RIV0000530
Submitted: December 27, 2011

APPENDIX C

COMBUSTION ENGINEERING DRAWINGS

RIV000053O
Submitted: December 27, 2011

APPENDIX C

COMBUSTION ENGINEERING DRAWINGS

1.	Control Rod Mechanism Housing - Details	E-234-051
2.	Control Rod Penetrations - Details	E-234-052
3.	Closure Head Forming and Welding	E-234-046
4.	Closure Head Machining	E-234-047
5.	Stud, Nut and Washer Details	E-234-049
6.	Pressure Vessel Forming and Welding	E-234-042
7.	Pressure Vessel Final Machining	E-234-044
8.	Nozzle Details	E-234-045
9.	Miscellaneous Attachments	E-234-050
10.	Miscellaneous Details	E-234-055
11.	Bottom Head Forming and Welding	E-234-043
12.	Instrumentation Penetrations Assembly and Details - Bottom Head	E-234-056