

**DEMONSTRATION RESULTS
OF
HOT GAS DECONTAMINATION
FOR EXPLOSIVES**

at

HAWTHORNE ARMY DEPOT

Hawthorne Nevada 89415-0015

VOLUME III OF IV

FINAL

Prepared for

**U.S. ARMY ENVIRONMENTAL CENTER
Aberdeen Proving Ground, Maryland 21010-5401**

Prepared by

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APPENDIX D

TEST ITEM ARRANGEMENT DIAGRAMS

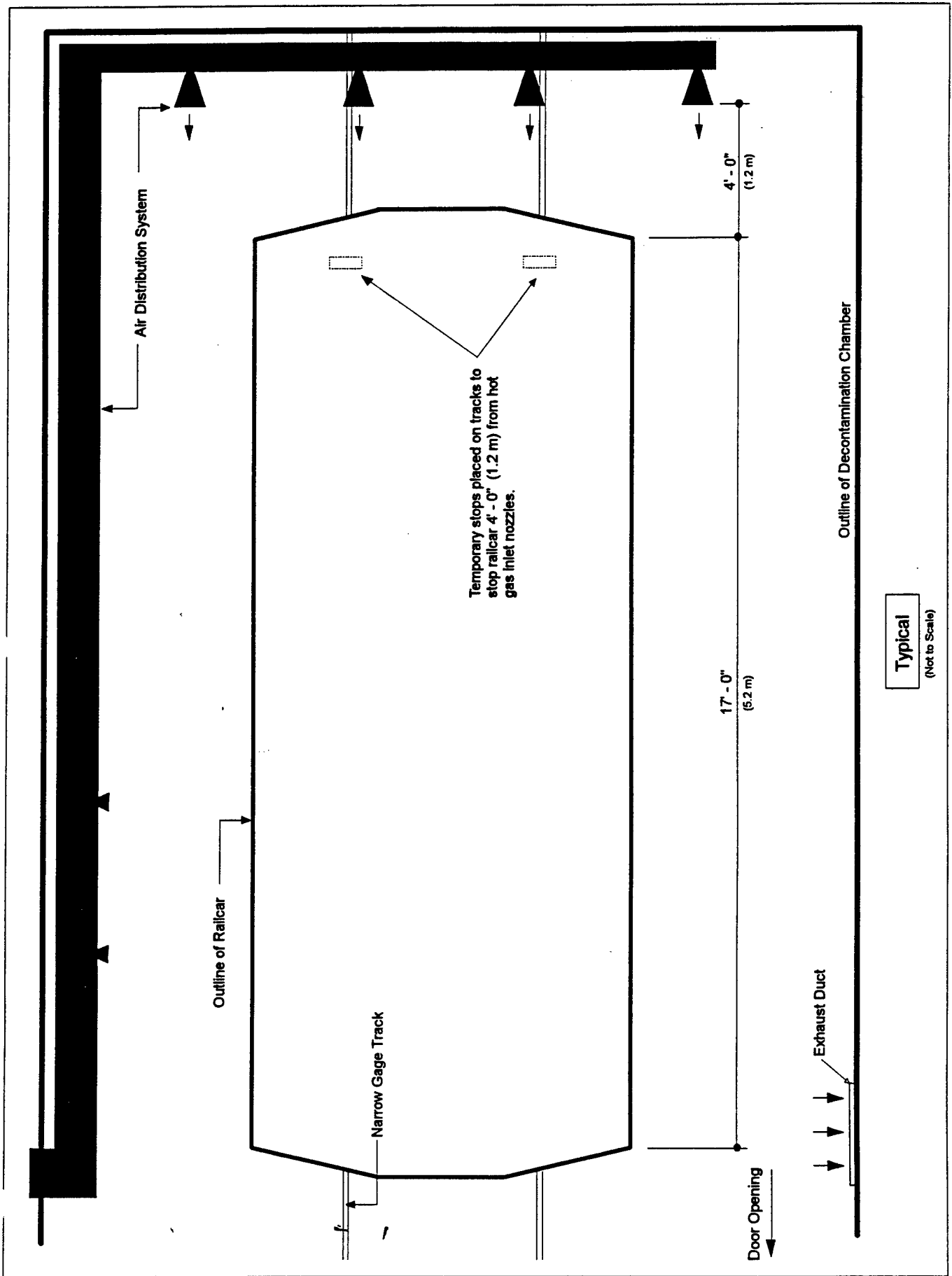


Figure D-1 Railcar Placement Inside Chamber

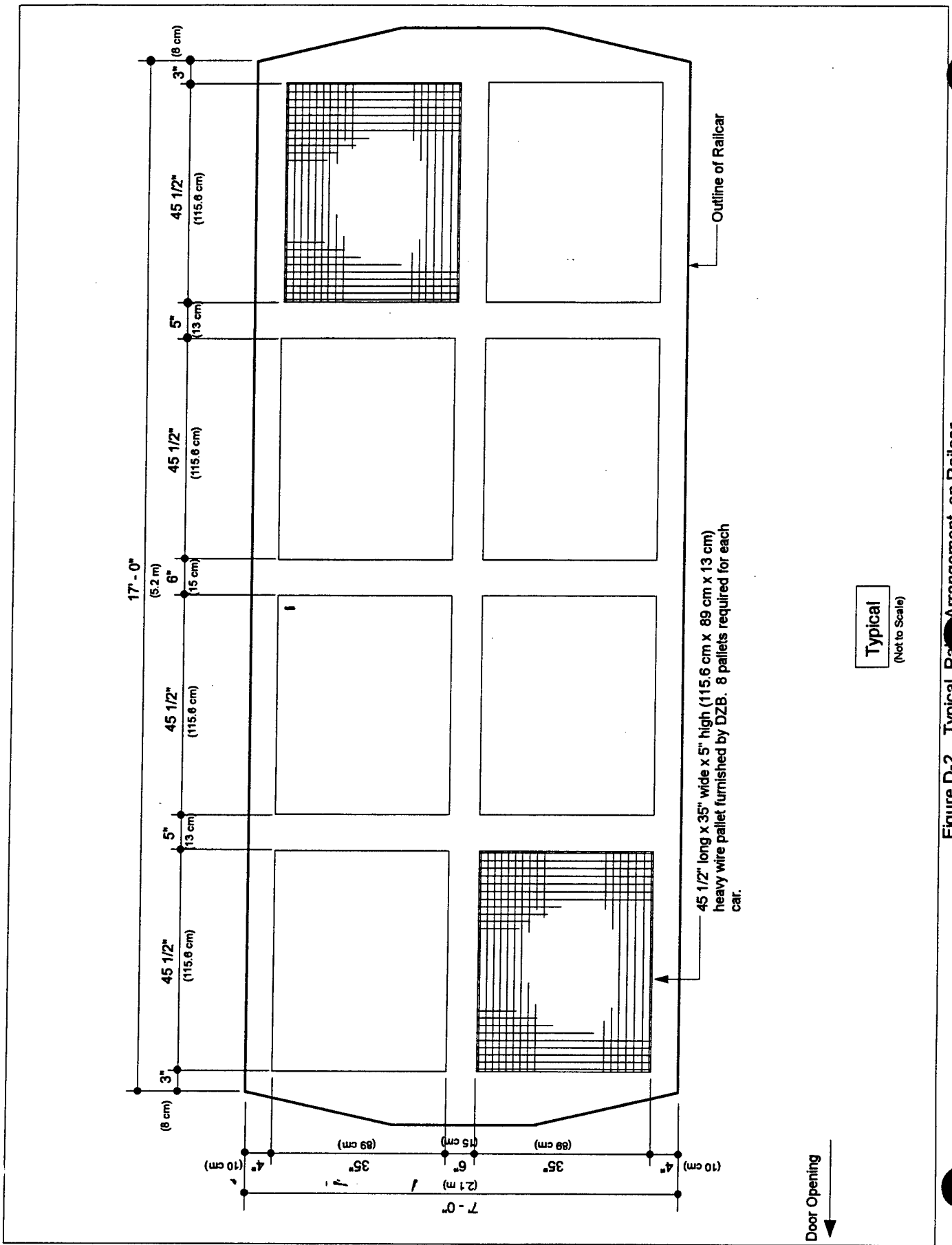
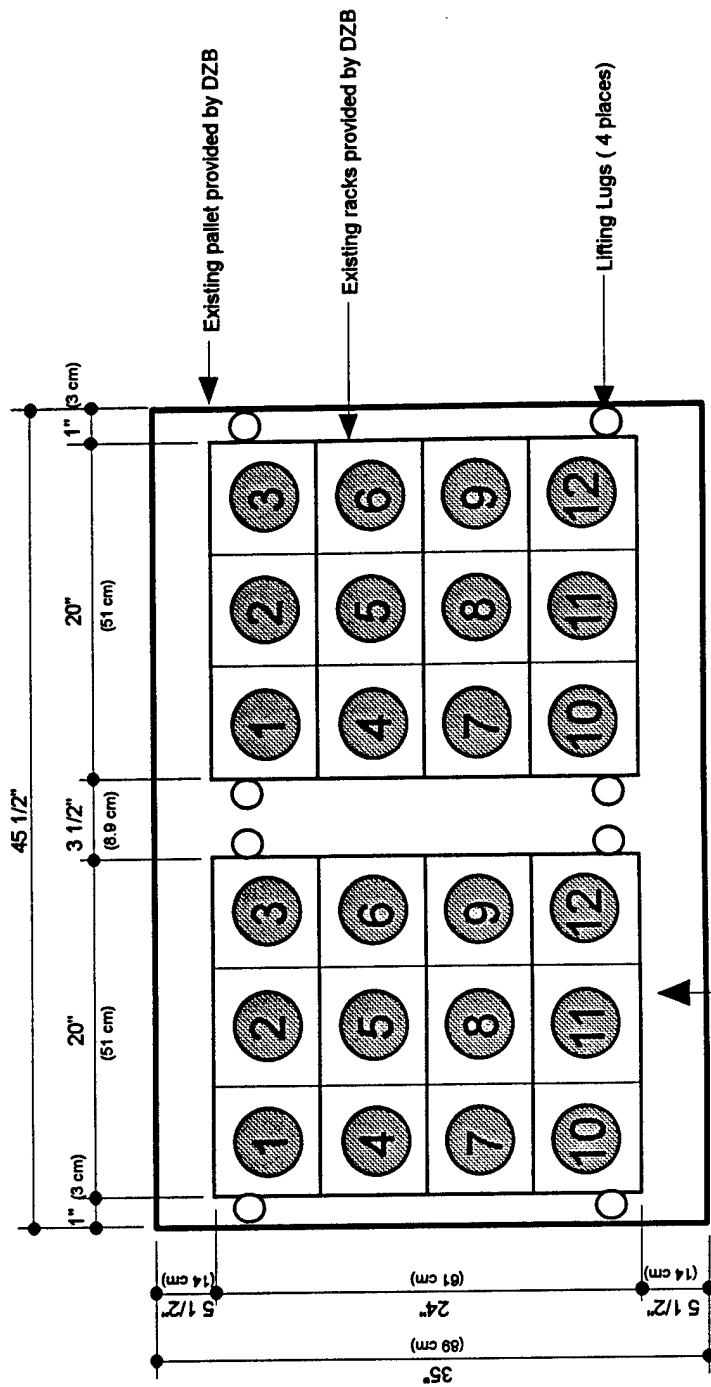


Figure D-2 Typical Pallet Arrangement on Railcar

3-inch Projectiles

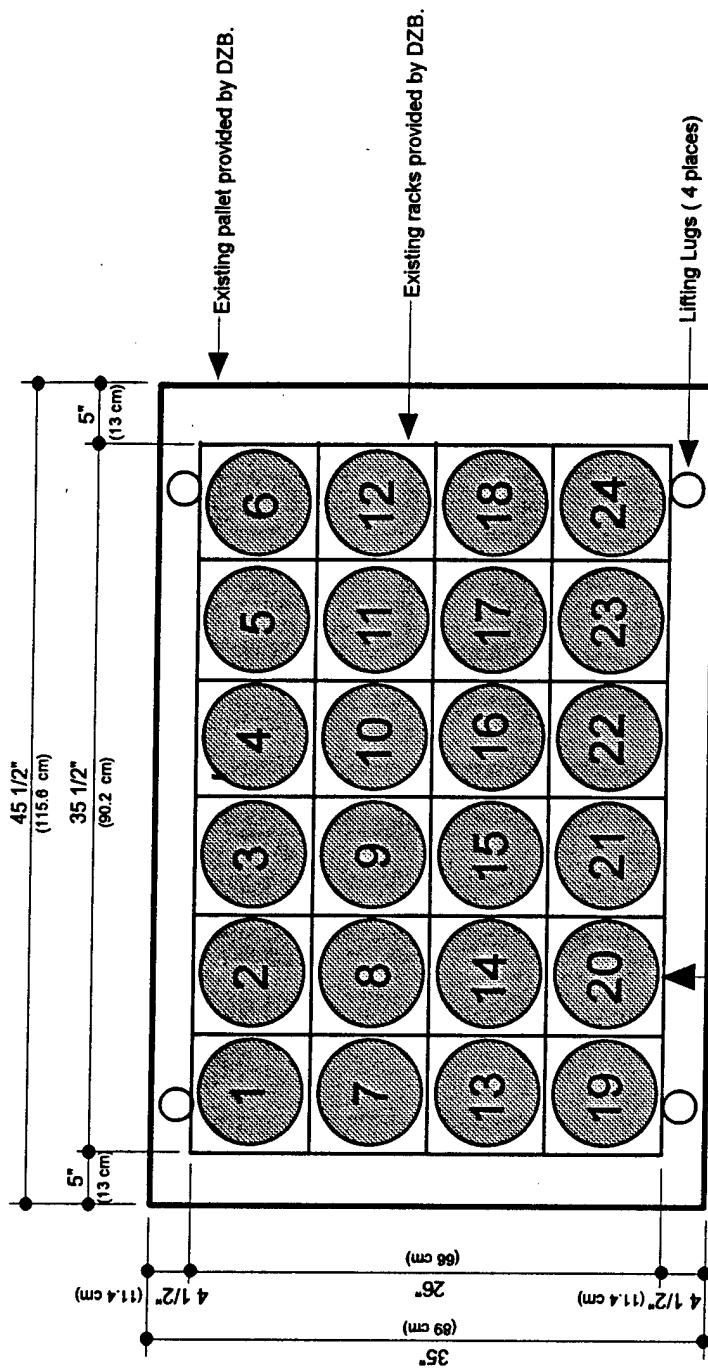


Arrangement indicates each rack supported 12 3-inch projectiles. See individual diagrams for each test for locations of projectiles sampled and locations of inert projectiles.

Typical
(Not to Scale)

Figure D-3 3-inch Projectile Racks Arranged on Pallet

5-inch Projectiles

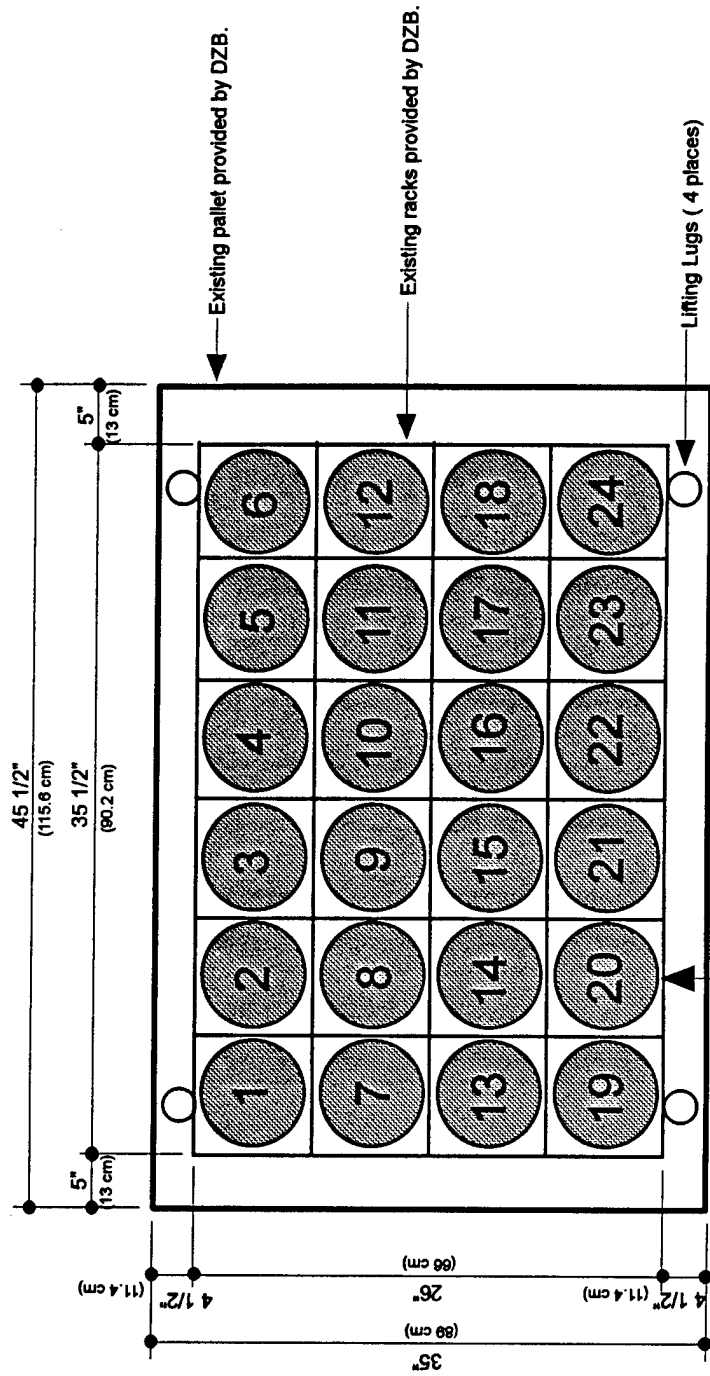


Arrangement indicates each rack supported 24 5-inch projectiles. See individual diagrams for each test for locations of projectiles sampled and locations of inert projectiles.

Typical
(Not to Scale)

Figure D-4 5-inch Projectile Rack Arranged on Pallet

106mm Projectiles



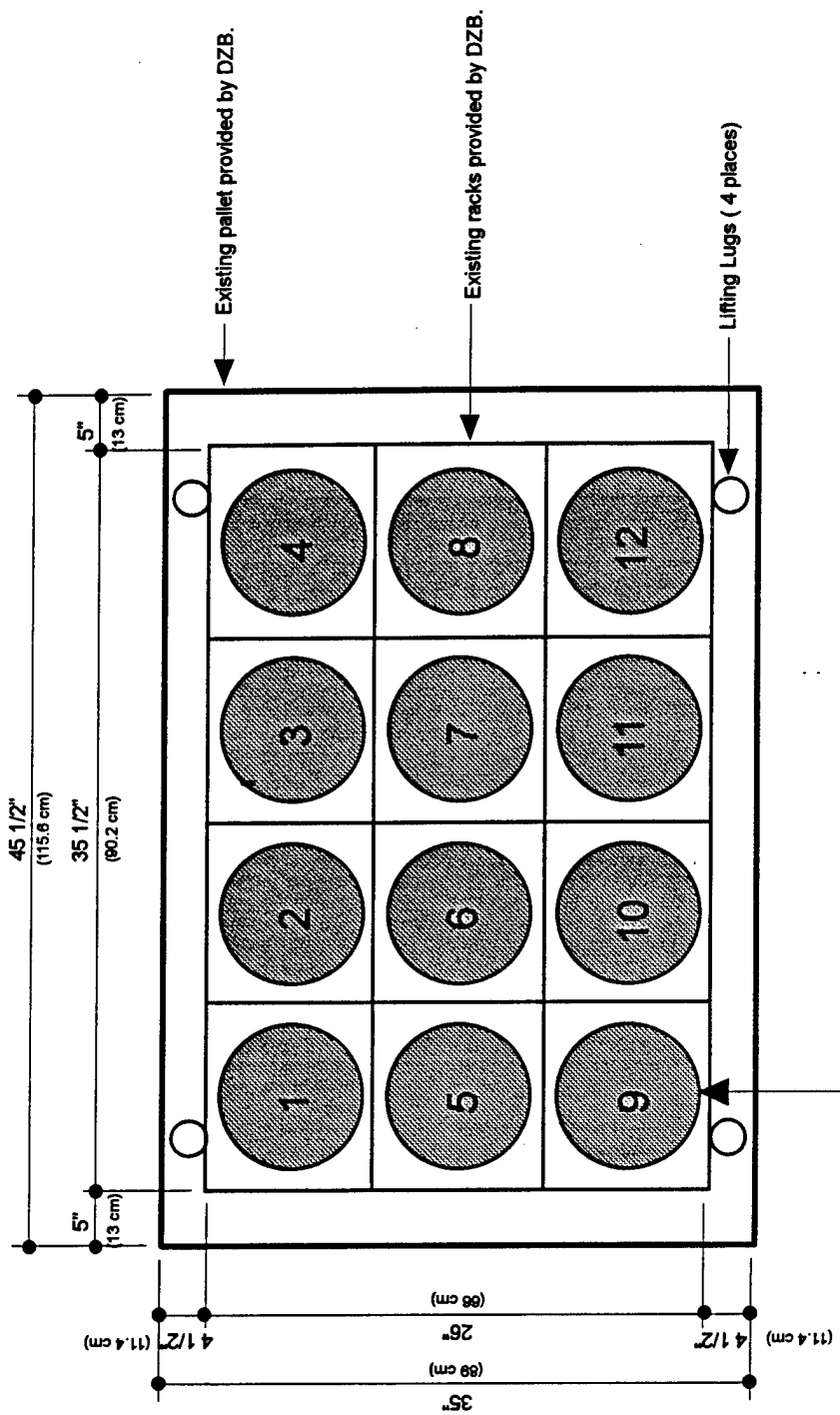
Arrangement indicates each rack supported 24, 106mm projectiles. See individual diagrams for each test for locations of projectiles sampled and locations of inert projectiles. (5-inch racks were used.)

Typical

(Not to Scale)

Figure D-5 106mm Projectile Rack Arranged on Pallet

175mm Projectiles

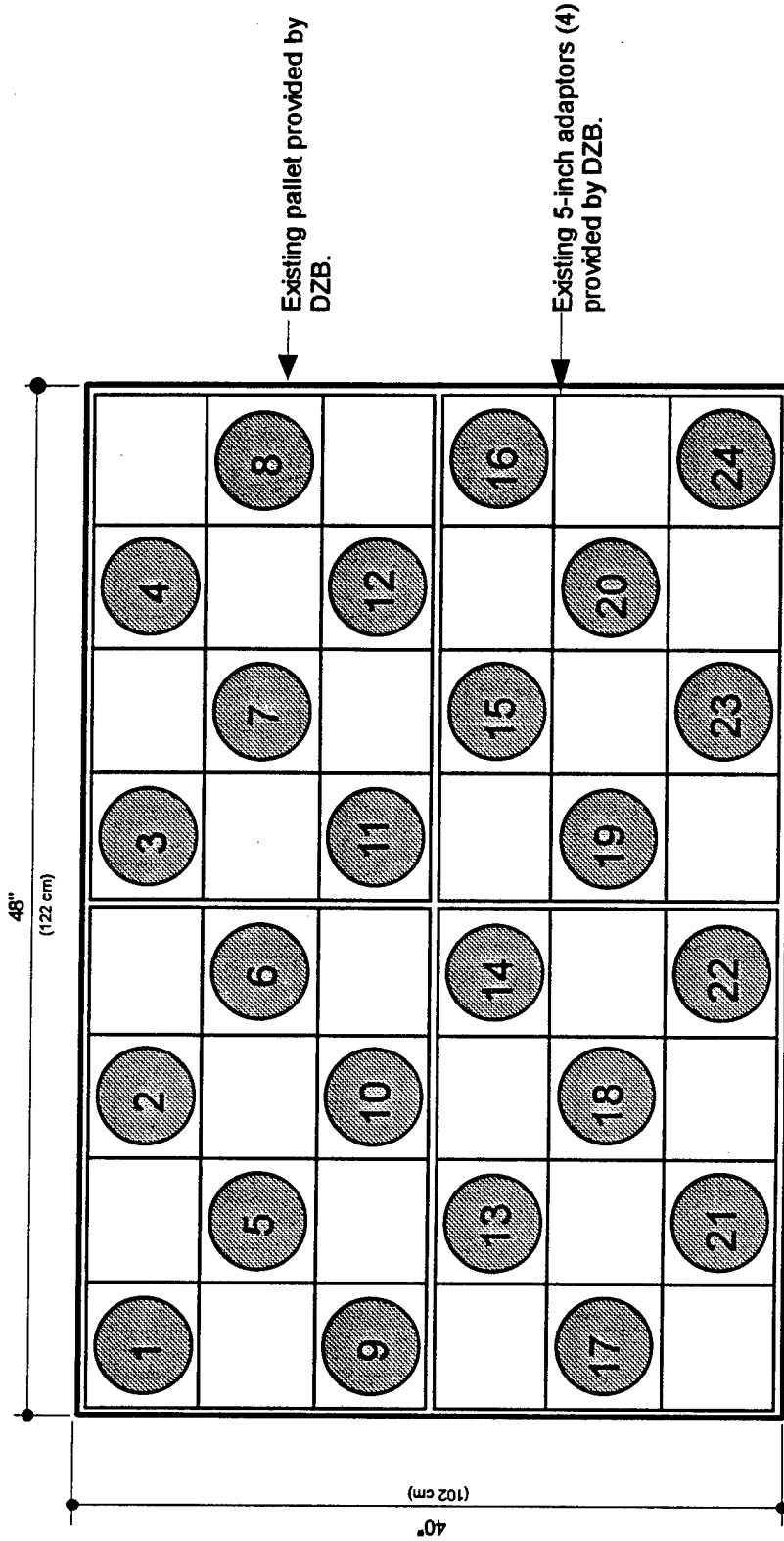


Arrangement indicates each rack supported 12 175mm projectiles. See individual diagrams for each test for locations of projectiles sampled and locations of inert projectiles.

Typical
(Not to Scale)

Figure D-6 175mm Projectile Rack Arranged on Pallet

175mm Projectiles (Chamber Full Load Test)

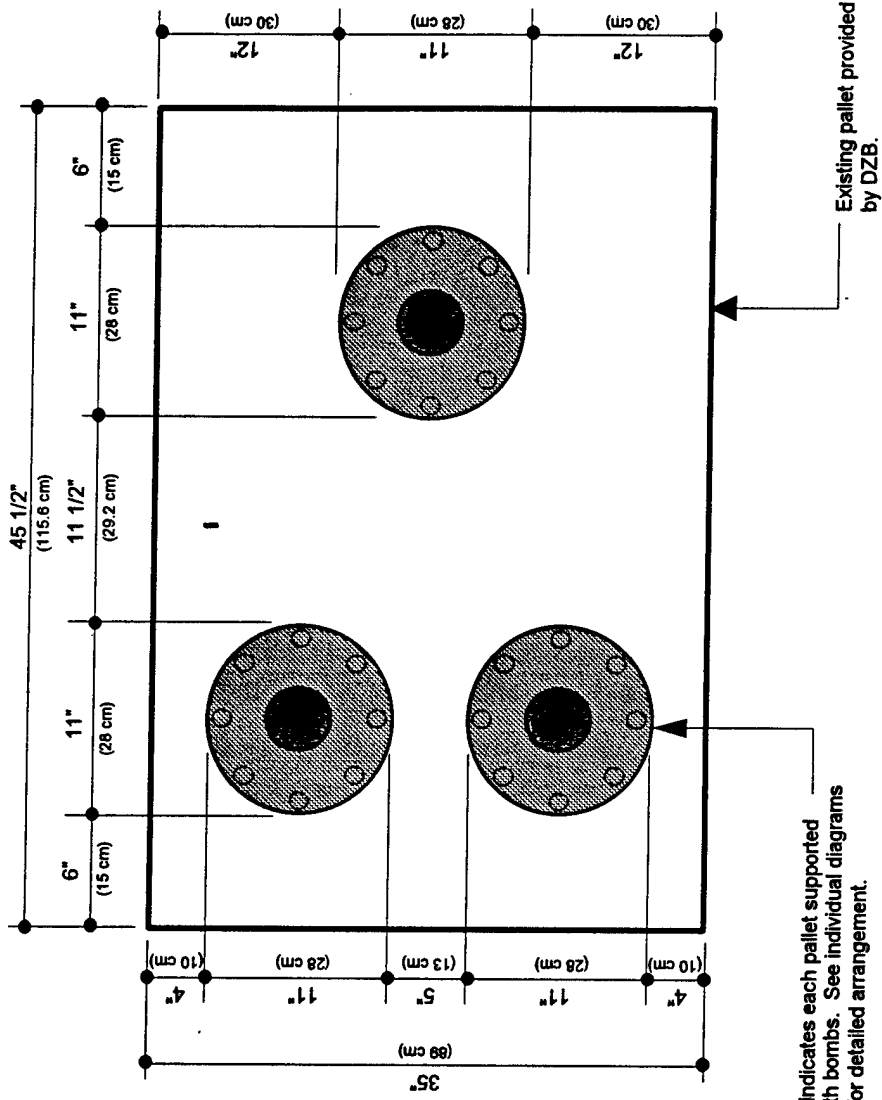


Arrangement indicates each adaptor supported 6 175mm projectiles. Each pallet supported 4 adaptors banded together into one unit, for a total of 24 175mm projectiles. See individual diagrams for each test for locations of projectiles sampled and locations of inert projectiles.

Typical
(Not to Scale)

Figure D-6a 175mm Projectiles Arranged on 5-inch Adaptors and Banded to Pallet

MK 54 Depth Bombs



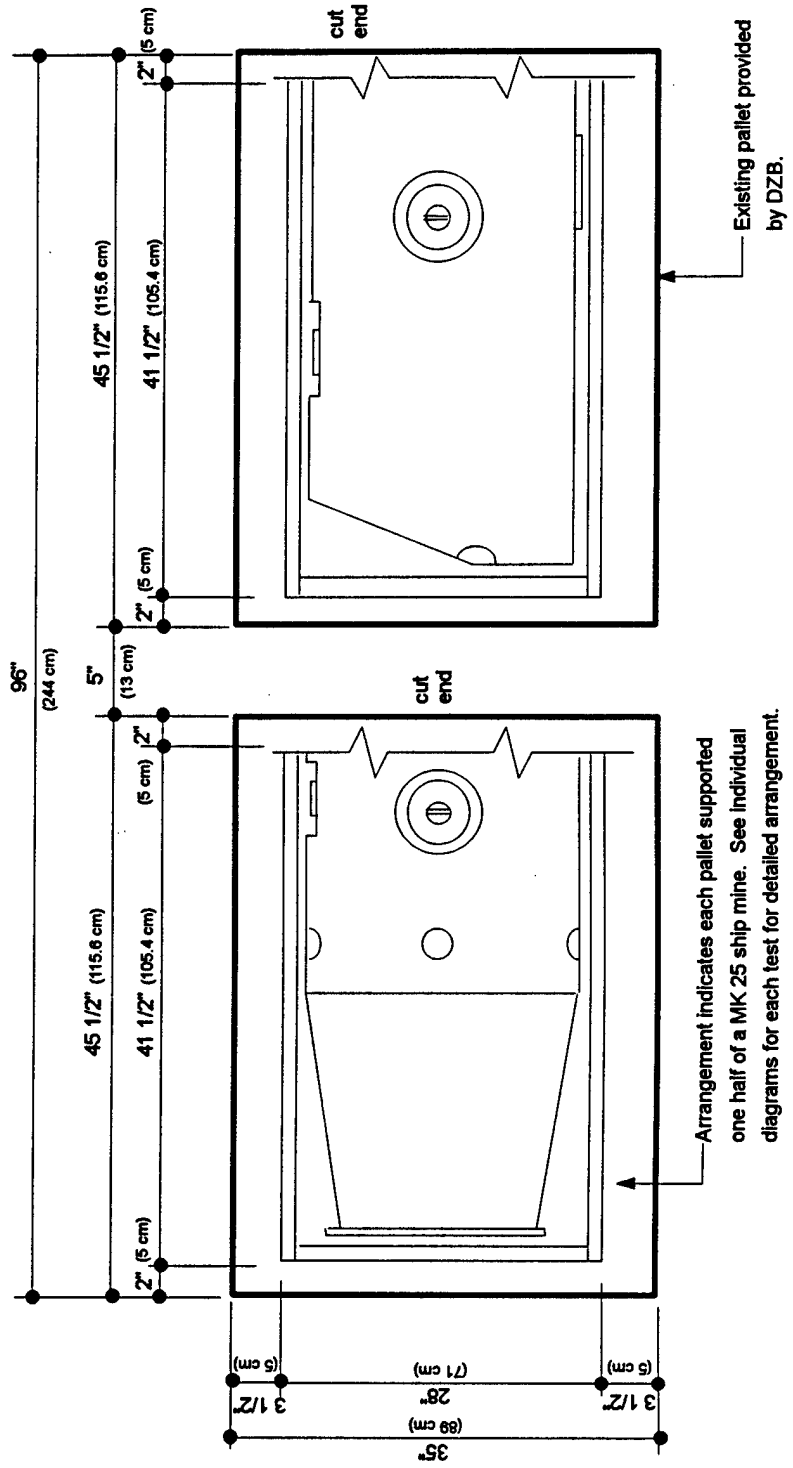
Typical

(Not to Scale)

Figure D-7 MK 54 Depth Bombs (Sawed Ends) Arranged on Pallet

MK 25 Ship Mines

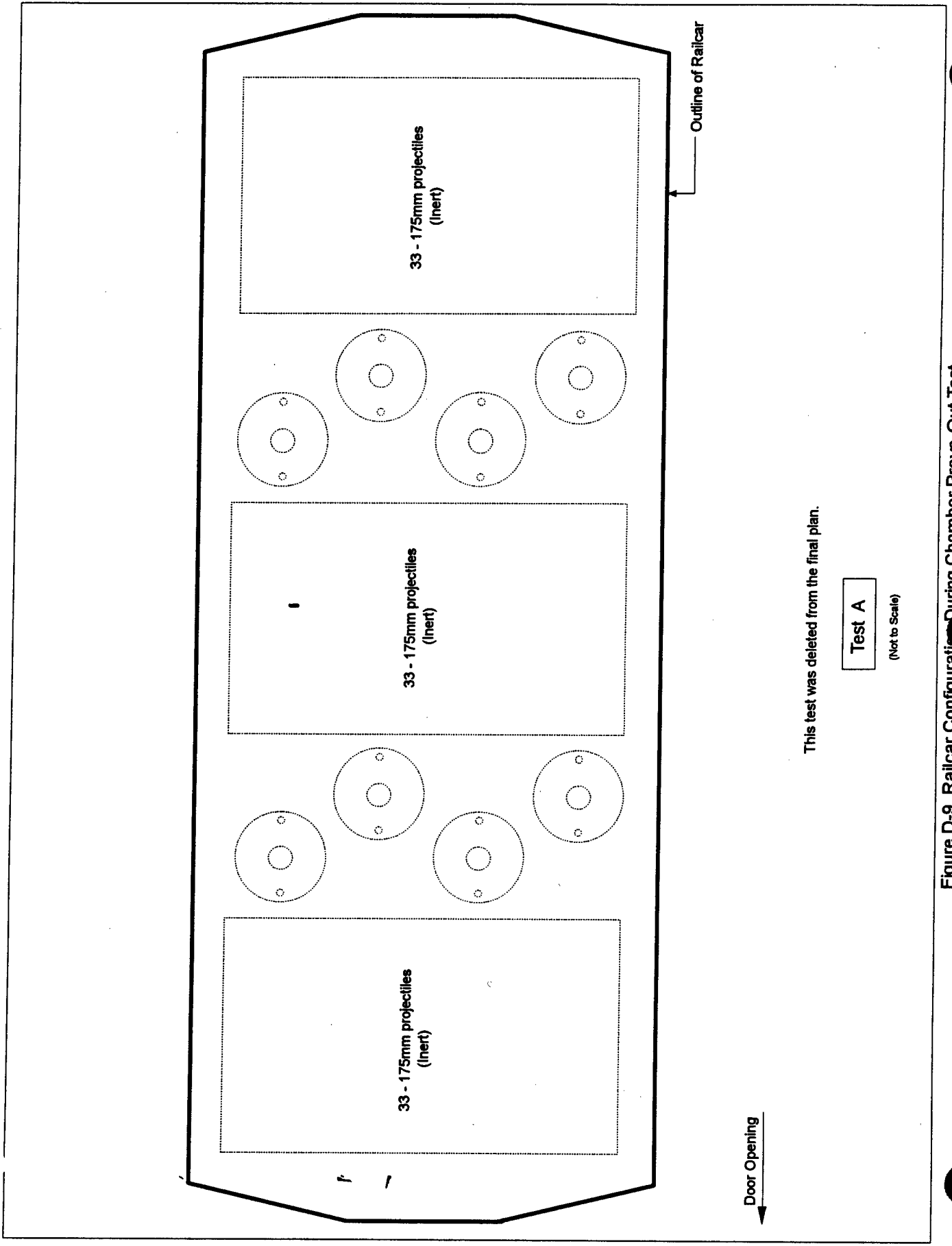
(Mines cut in half)



Typical

(Not to Scale)

Figure D-8 MK 25 Ship Mines Arranged on Pallets



This test was deleted from the final plan.

Test A
(Not to Scale)

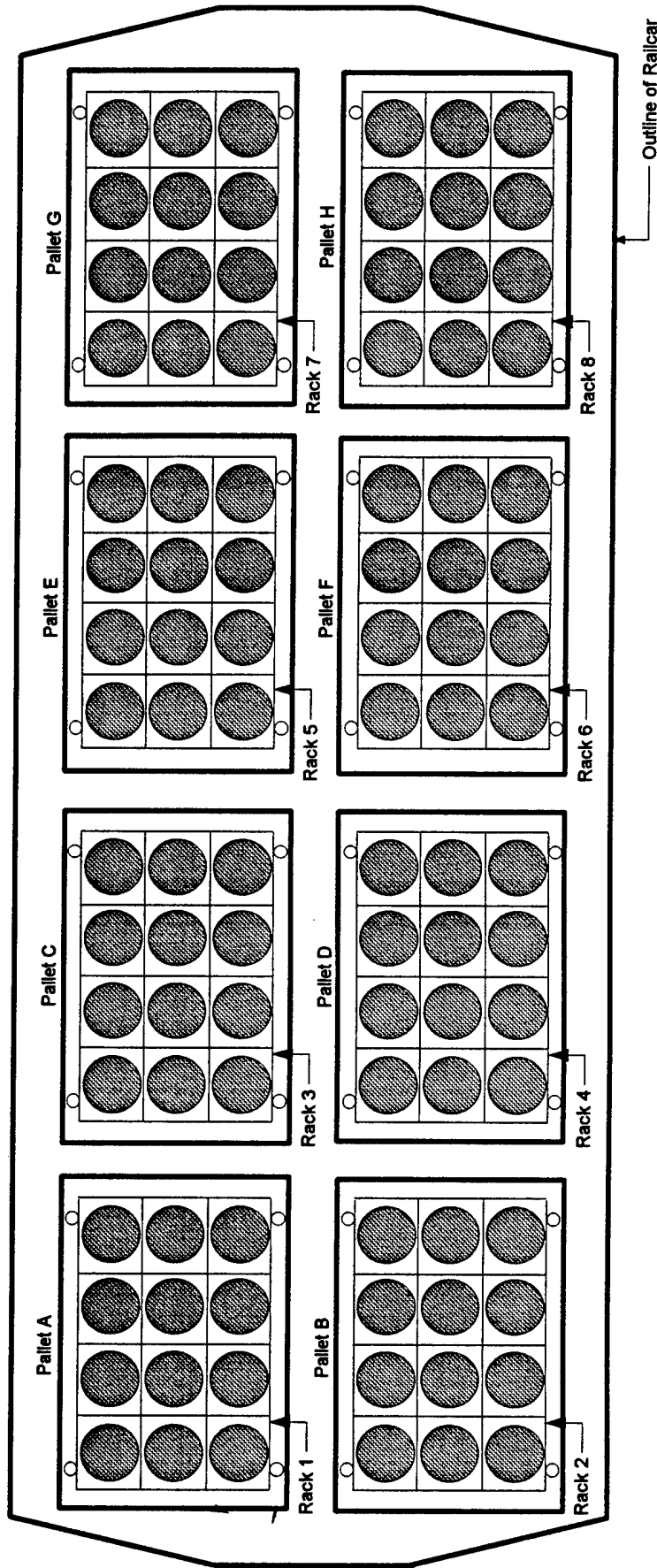
Figure D-9 Railcar Configuration During Chamber Prove-Out Test

175mm Projectiles

(Items from FF-13)

Total Weight, 96 Projectiles = 11,040 lbs (5,008 kg)

 Inert projectile added for thermal mass



Test B
(Not to Scale)

See Figure D-1 for railcar placement in chamber
See Figure D-2 for pallet placement on railcar
See Figure D-6 for rack placement on pallets

22 June 1994
6 Hours at 500 °F / 260 °C &
24 Hours at 700 °F / 371 °C

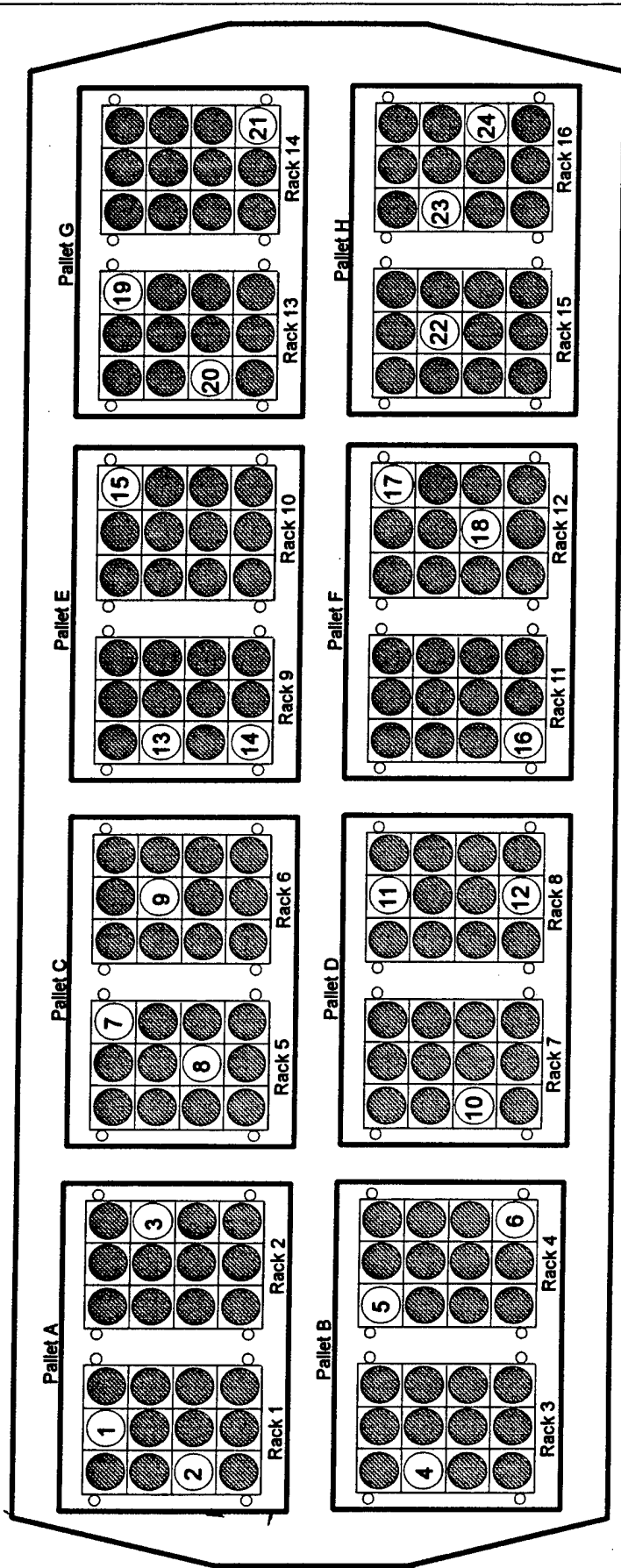
Figure D-10 175mm Projectiles (Inert)

3-inch Projectiles

(Items from FF-13)

Total Weight, 192 projectiles = 1,728 lbs (784 kg)

- ④ Spiked 3-inch projectile sampled
- Inert 3-inch projectile added for thermal mass



Test 1
(Not to Scale)

26 June 1984
6 Hours at 500 °F / 260 °C

See Figure D-1 for railcar placement in chamber
See Figure D-2 for pallet placement on railcar
See Figure D-3 for rack placement on pallets

Figure D-11 3-inch Projectiles Spiked with TNT

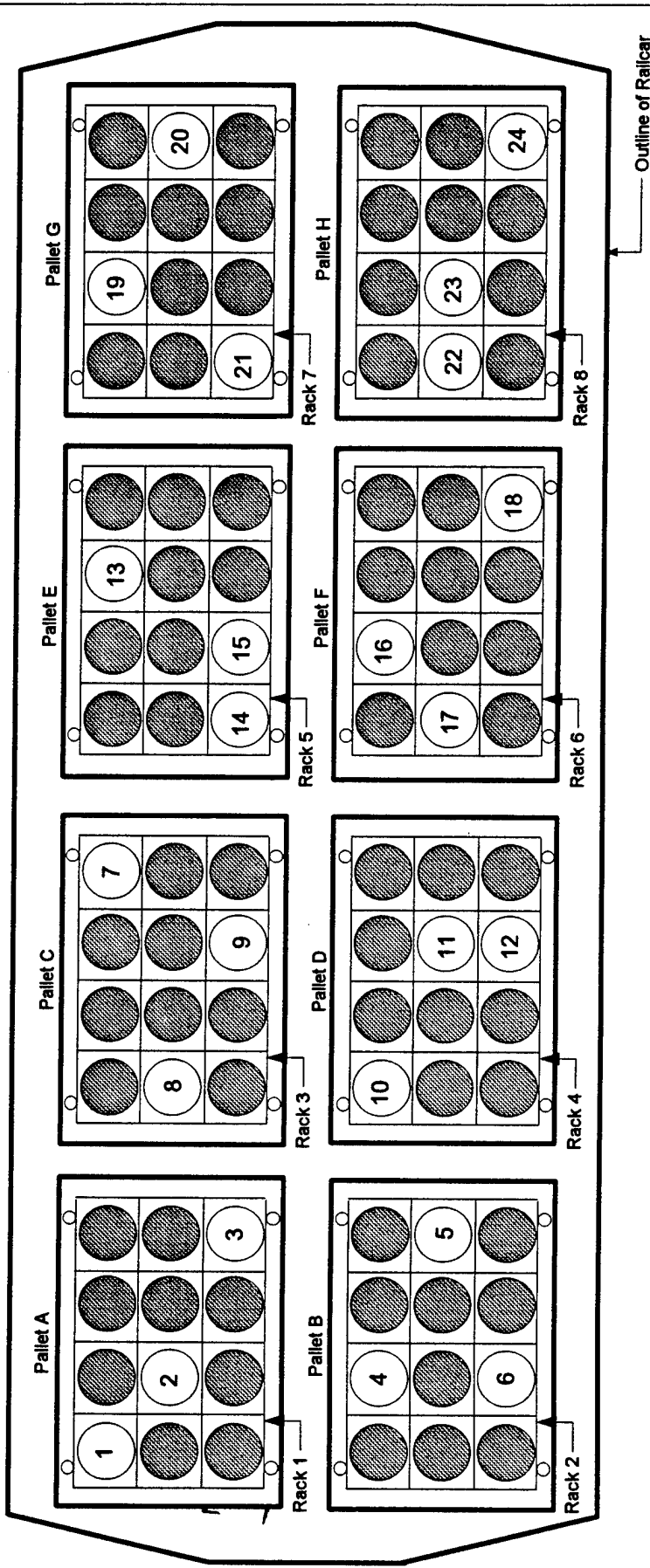
175mm Projectiles

(Items from FF-13)

Total Weight, 96 Projectiles = 11,040 lbs (5,008 kg)

7 Spiked projectile sampled

Inert projectile added for thermal mass

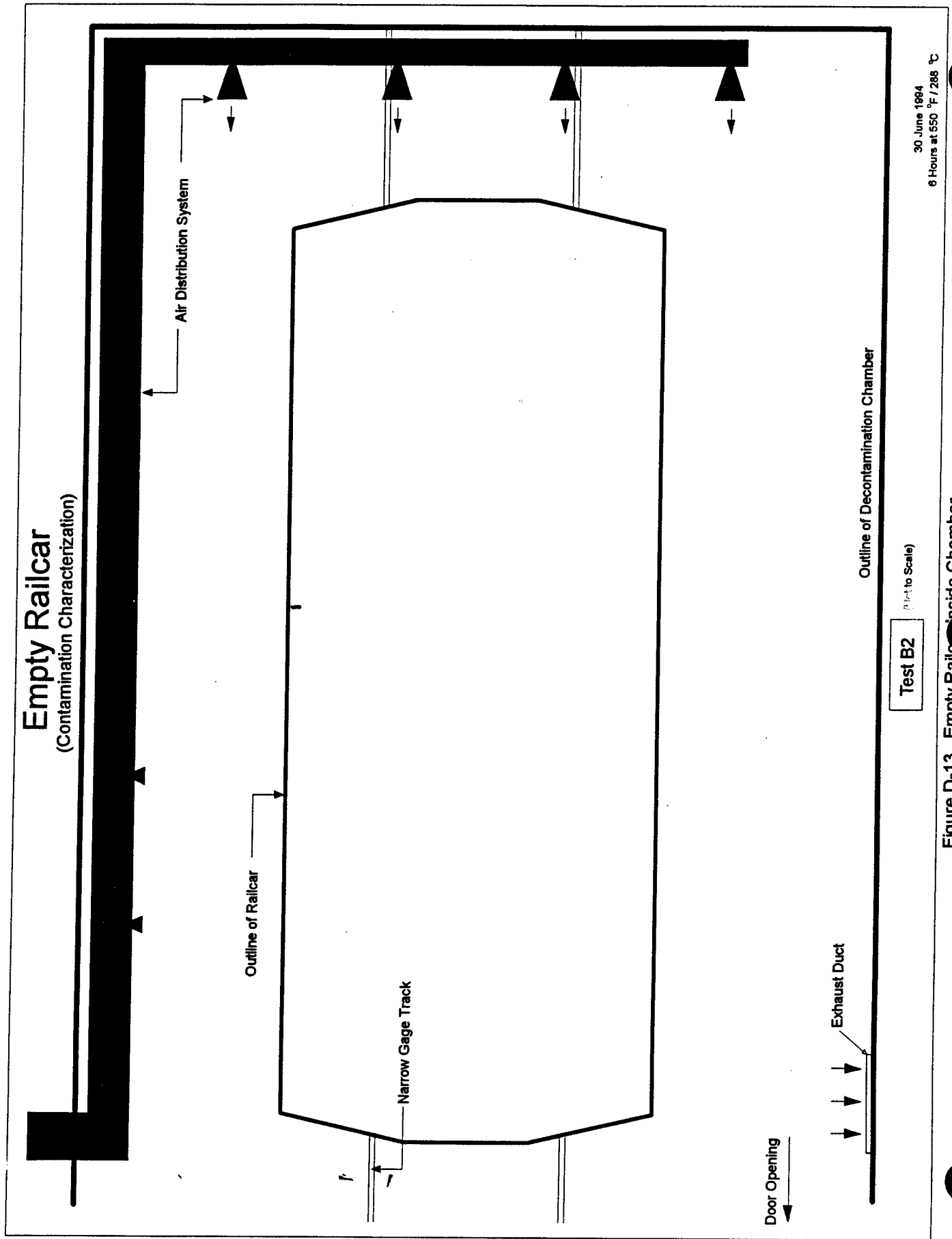


See Figure D-1 for railcar placement in chamber
 See Figure D-2 for pallet placement on railcar
 See Figure D-6 for rack placement on pallets

Test 3
 (Not to Scale)

28 June 1994
 6 Hours at 500 °F / 260 °C

Figure D-12 175mm Projectiles Spiked with Comp B



Empty Railcar
(Contamination Characterization)

Outline of Railcar

Narrow Gage Track

Air Distribution System

Outline of Decontamination Chamber

Test B2

(Not to Scale)

30 June 1964
6 Hours at 550 °F / 288 °C

Figure D-13 Empty Railcar Inside Chamber

Empty Chamber (Contamination Characterization)

Air Distribution System

Outline of Decontamination Chamber

Test B3

(Not to Scale)

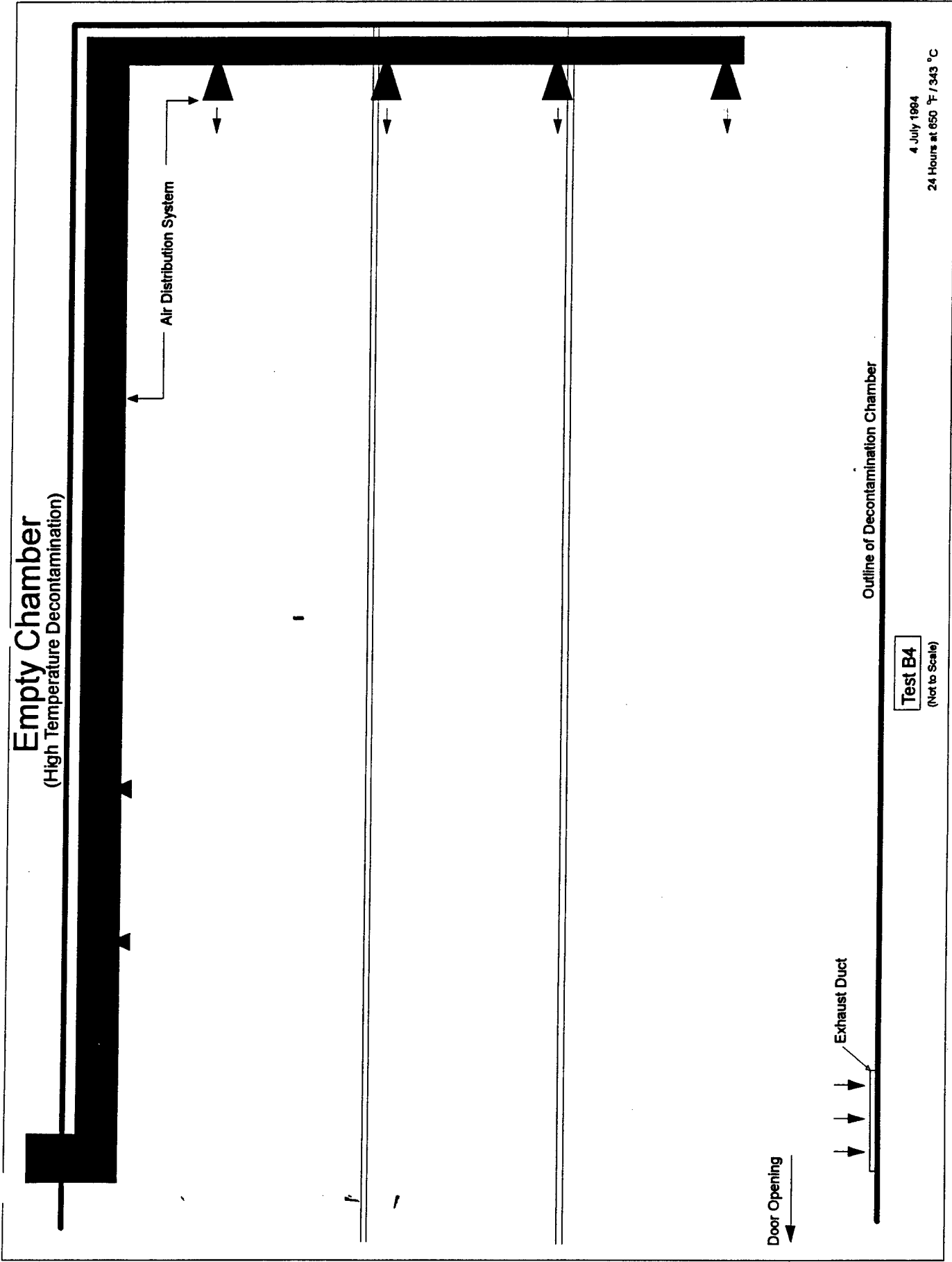
3 July 1994

6 Hours at 550 °F / 288 °C

Door Opening

Exhaust Duct

Figure D-14 Empty Chamber



4 July 1994
 24 Hours at 650 °F / 343 °C

Test B4
 (Not to Scale)

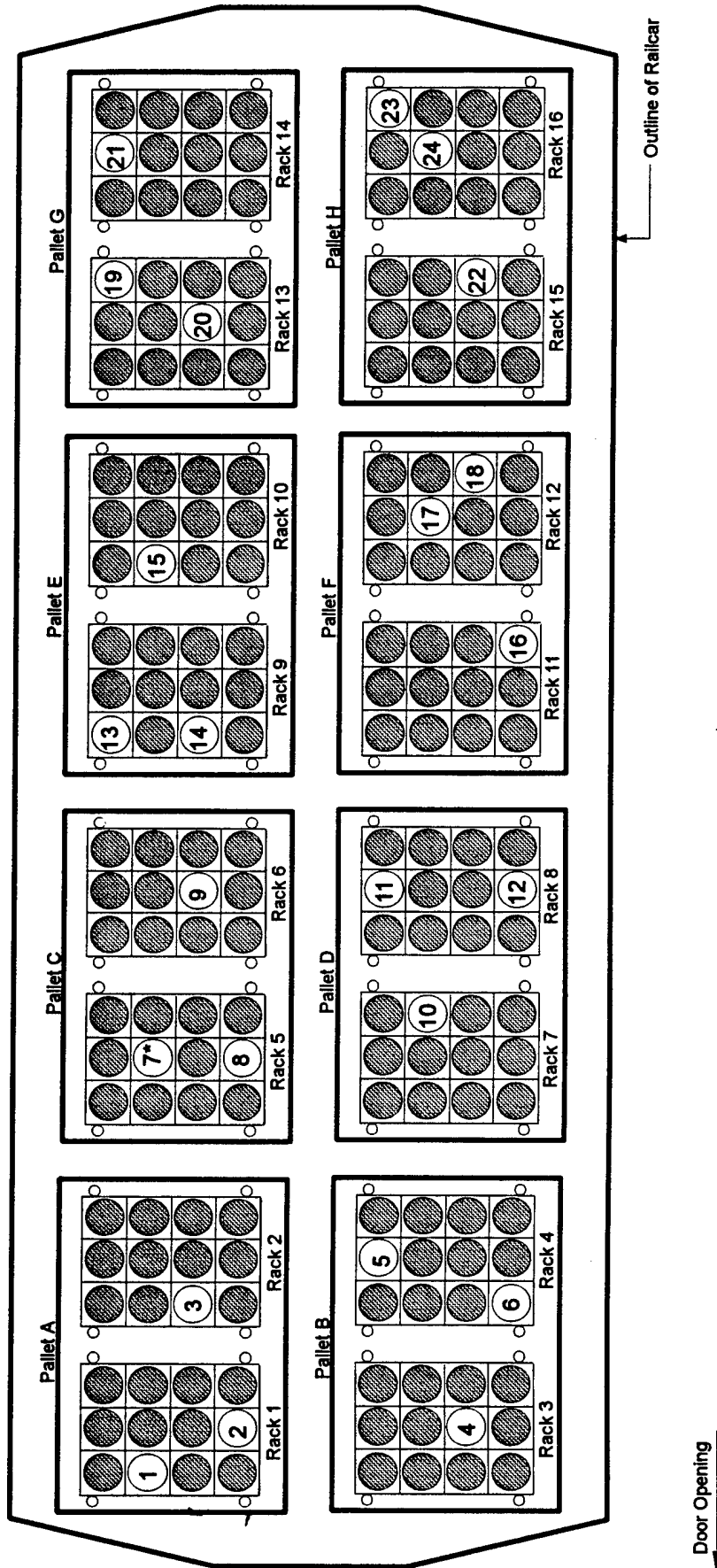
Figure D-15 Empty Chamber

Total Weight, 192 projectiles = 1,728 lbs (784 kg)

3-inch Projectiles

(Items from FF-13)

- ⑤ Spiked 3-inch projectile sampled
- Inert 3-inch projectile added for thermal mass



See Figure D-1 for railcar placement in chamber
 See Figure D-2 for pallet placement on railcar
 See Figure D-3 for rack placement on pallets

Test 5
 (Not to Scale)

10 July 1994
 6 Hours at 550 ° F / 286 ° C

Figure D-16 3-inch Projectiles Spiked with HBX

3-inch/5-inch Projectiles

(Items from FF-13)

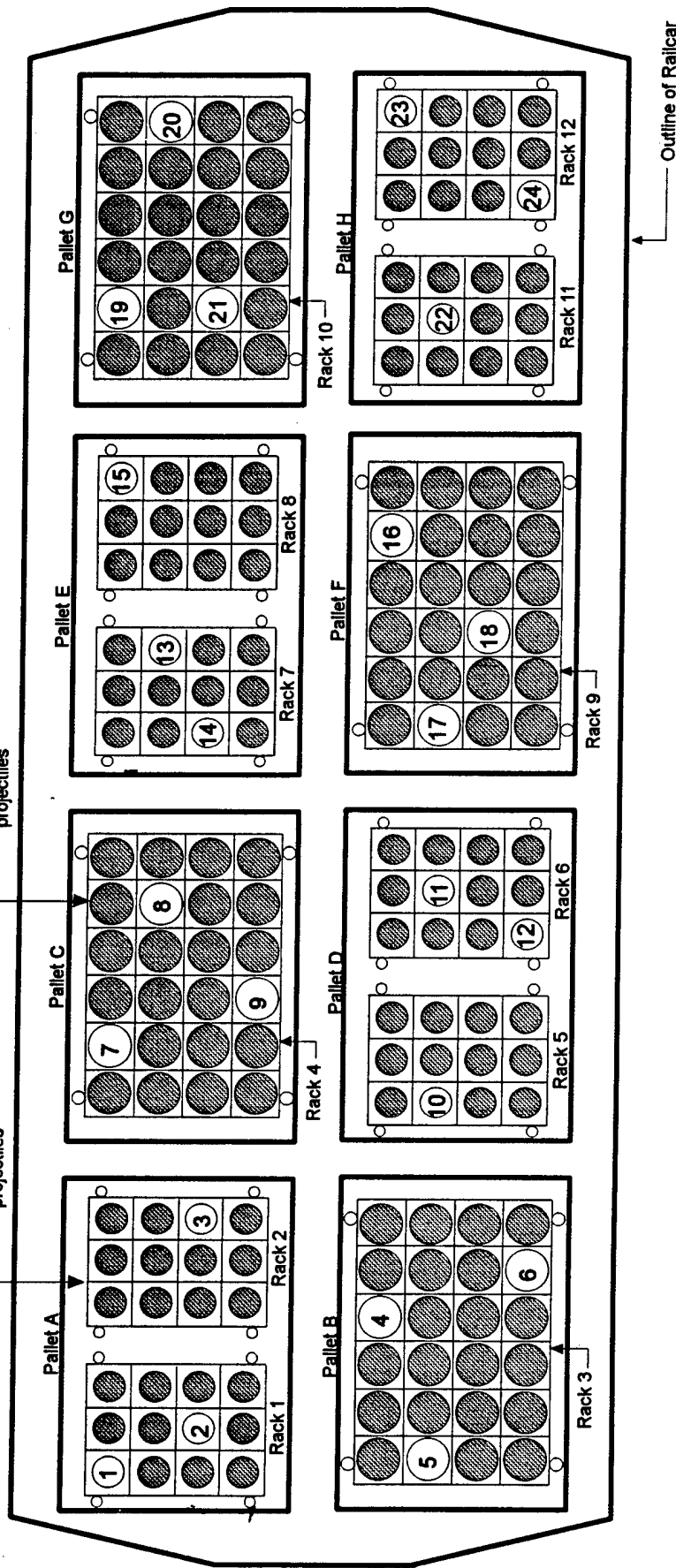
Total Weight, 192 projectiles = 7,296 lbs (3,309 kg)

8 Spiked projectile sampled

Inert projectile added for thermal mass

Rack with 3-inch projectiles

Rack with 5-inch projectiles



Test 2
(Not to Scale)

See Figure D-1 for railcar placement in chamber
 See Figure D-2 for pallet placement on railcar
 See Figure D-3 for 3-inch rack placement on pallets
 See Figure D-4 for 5-inch rack placement on pallets

12 July 1994
 6 Hours at 500 °F / 260 °C

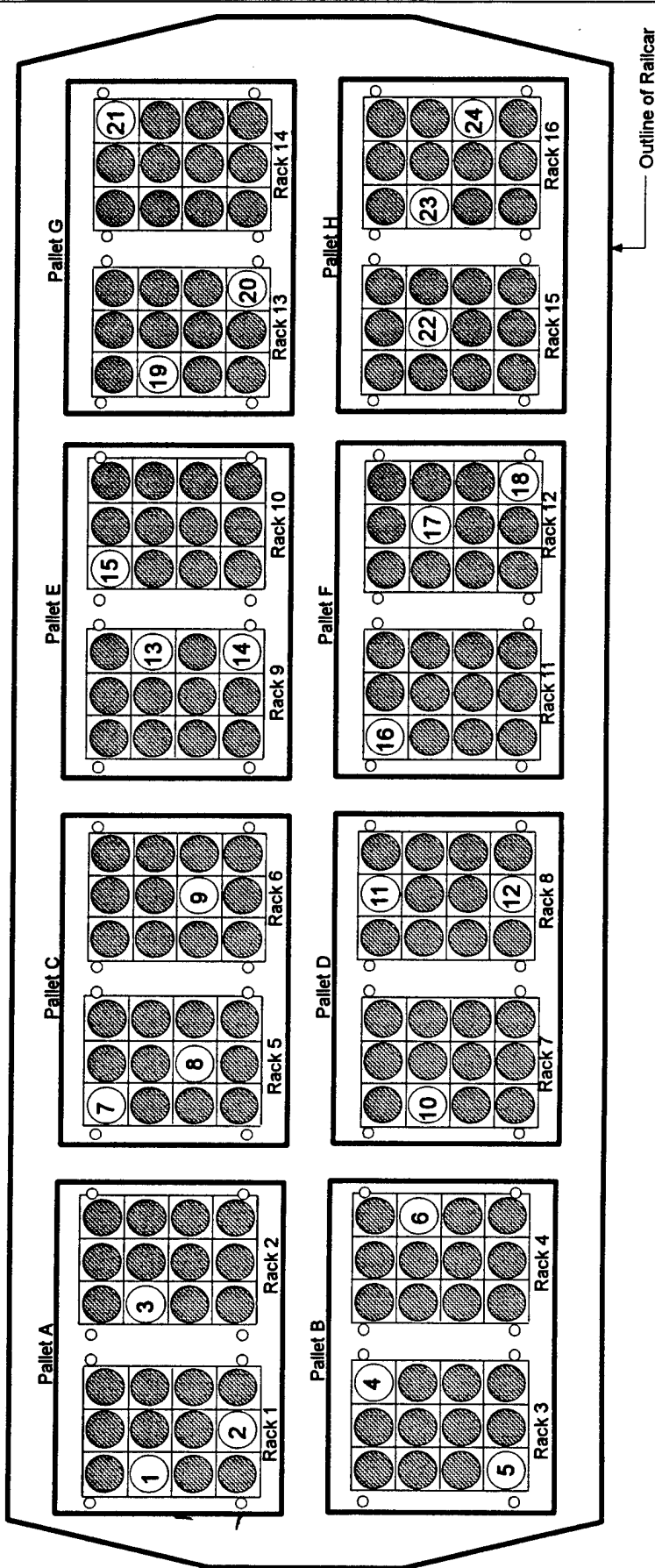
Figure D-17 3-inch / 5-inch Projectiles Spiked with RDX

Total Weight, 192 projectiles = 1,728 lbs (784 kg)

3-inch Projectiles

(Items from FF-13)

- ④ Spiked 3-inch projectile sampled
- Inert 3-inch projectile added for thermal mass



Door Opening

Outline of Railcar

Test 4
(Not to Scale)

See Figure D-1 for railcar placement in chamber
 See Figure D-2 for pallet placement on railcar
 See Figure D-3 for rack placement on pallets

15 July 1984
 6 Hours at 550 ° F / 288 ° C

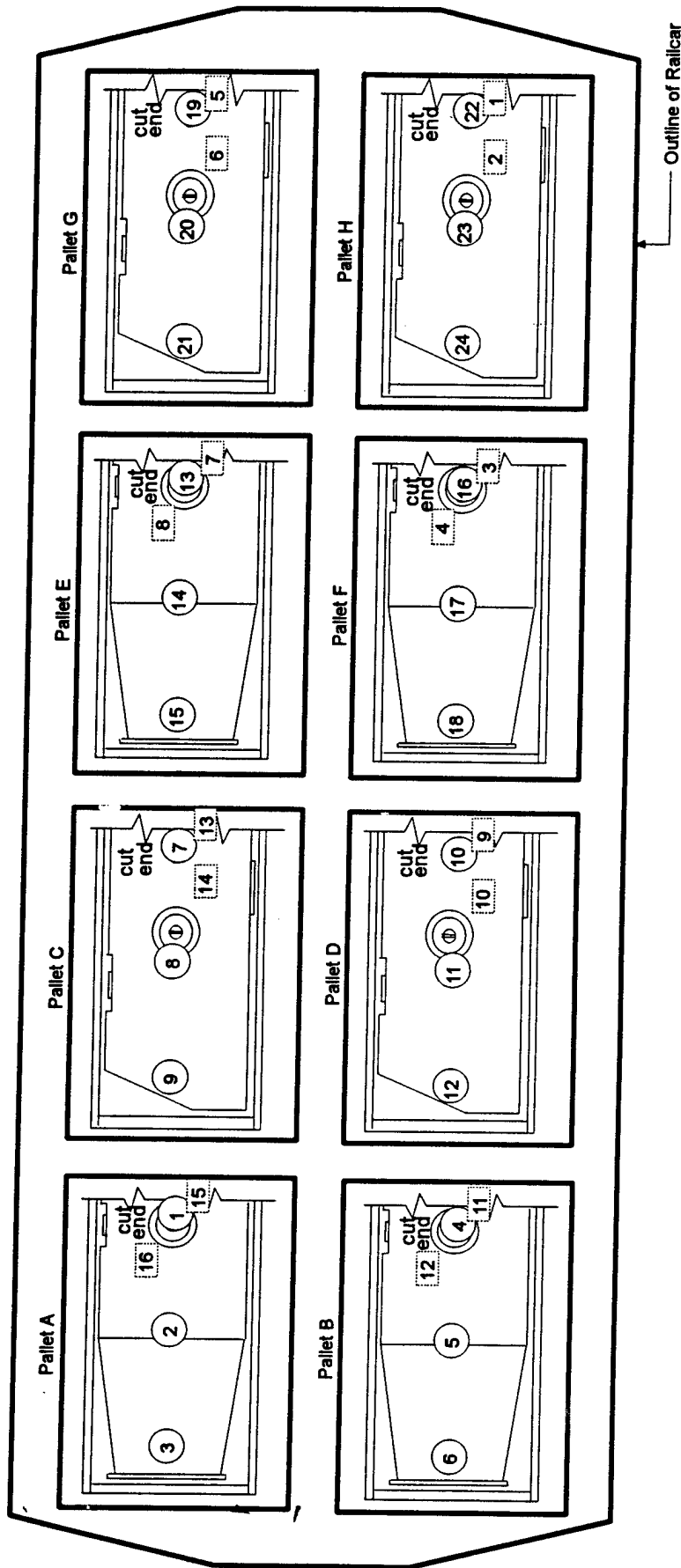
Figure D-18 3-inch Projectiles Spiked with TNT

Total Weight, 4 Mines = 2,860 lbs (1,297 kg)

MK 25 Ship Mines

(Unused mines - internals coated with hot-melt)

- 5 Thermocouple Number and Approximate Location
- 1 Sample Number and Approximate Location



Test 6
(Not to Scale)

See Figure D-1 for railcar placement in chamber
See Figure D-2 for pallet placement on railcar
See Figure D-8 for mine placement on pallets

18 July 1994
48 Hours at 700 ° F / 371 ° C

Figure D-19 MK 25 Ship Mines Hot-Melt Coated Internals and Spiked with TNT

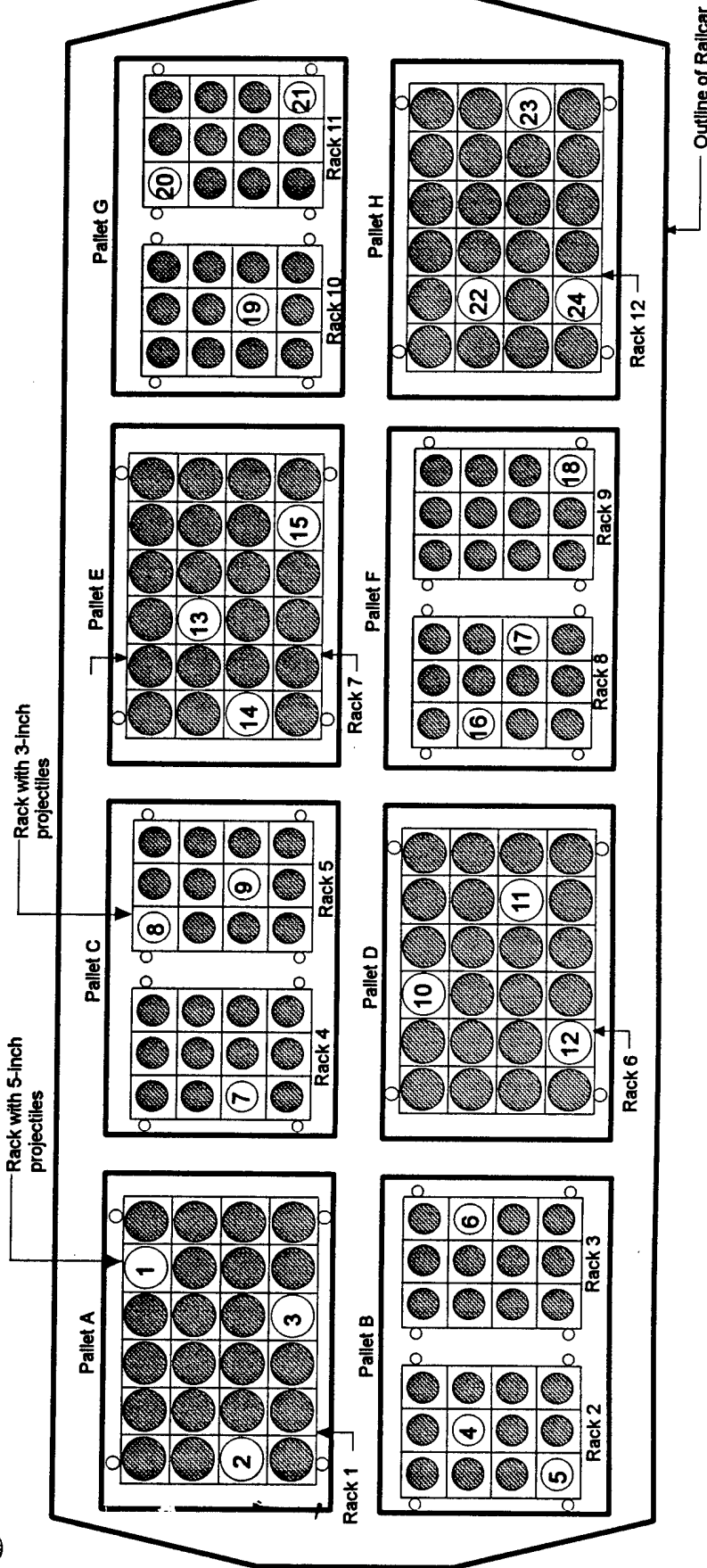
3-inch / 5-inch Projectiles

(Items from FF-13)

Total Weight, 192 projectiles = 7,296 lbs (3,309 kg)

6 Spiked projectile sampled

Inert projectile added for thermal mass



Test 7

(Not to Scale)

See Figure D-1 for railcar placement in chamber
 See Figure D-2 for pallet placement on railcar
 See Figure D-3 for 3-inch rack placement on pallets
 See Figure D-4 for 5-inch rack placement on pallets

22 July 1964
 6 Hours at 550 °F / 288 °C

Figure D-20 3-inch / 5-inch Projectiles Spiked with RDX

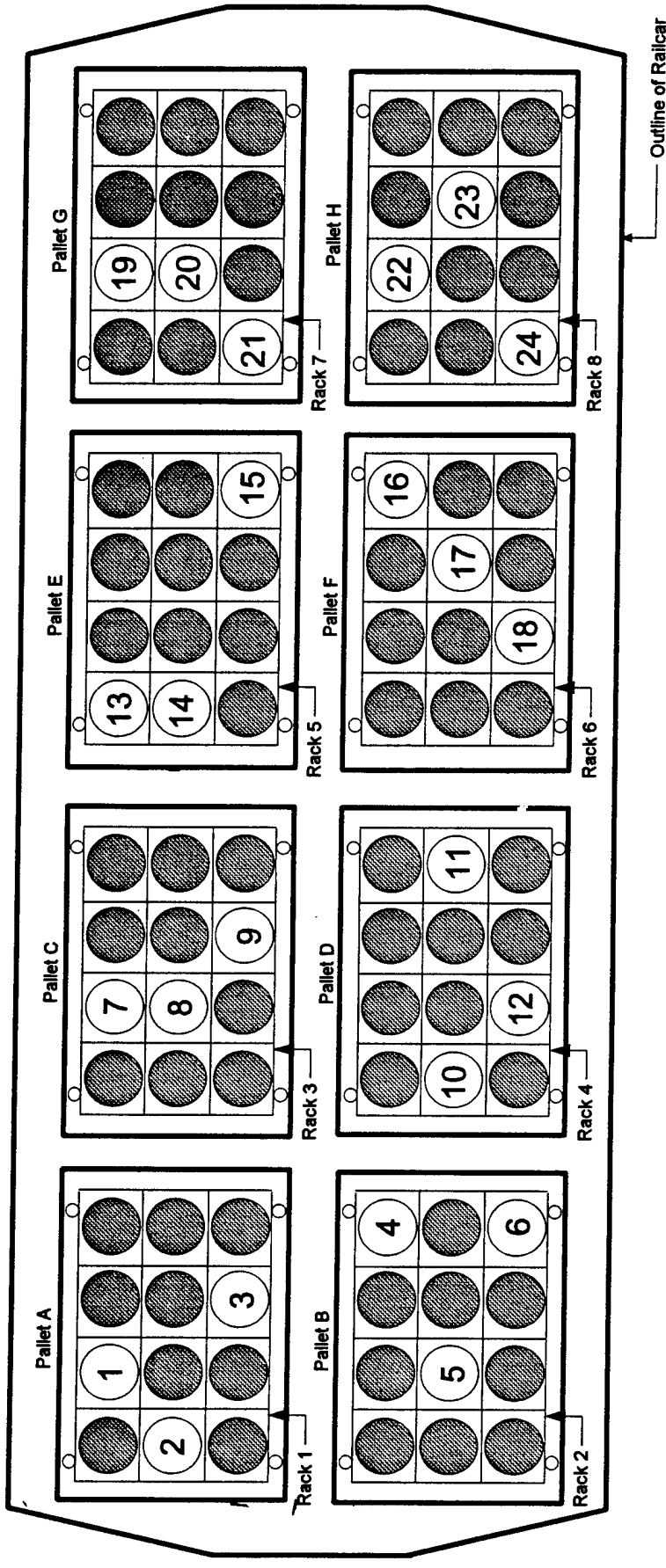
Total Weight, 96 Projectiles = 11,040 lbs (5,008 kg)

175mm Projectiles

(Items from FF-13)

9 Spiked projectile sampled

Inert projectile added for thermal mass



Door Opening

See Figure D-1 for railcar placement in chamber
 See Figure D-2 for pallet placement on railcar
 See Figure D-6 for rack placement on pallets

Test 8
 (Not to Scale)

24 July 1994
 6 Hours at 550 ° F / 288 ° C

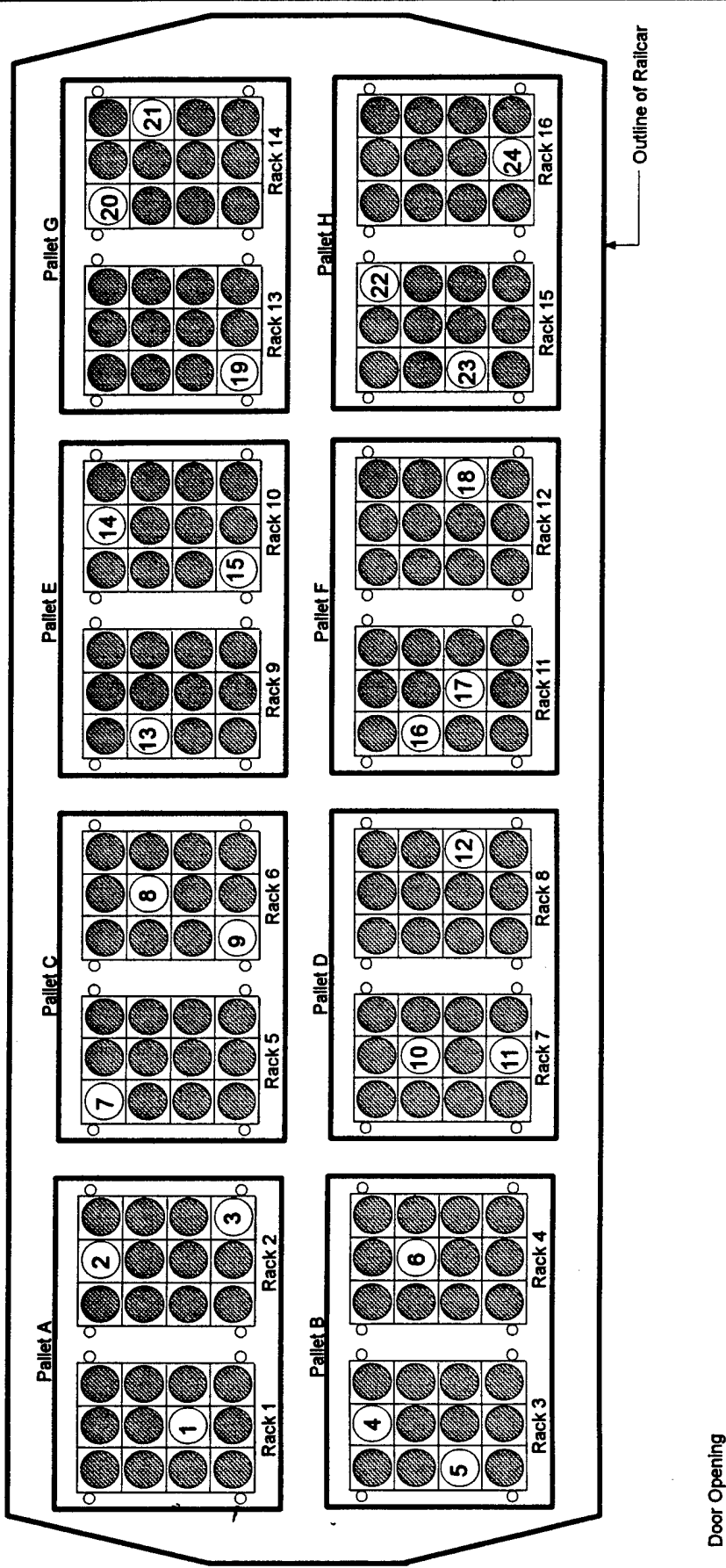
Figure D-21 175mm Projectiles Spiked with Comp B

Total Weight, 192 projectiles = 1,728 lbs (784 kg)

3-inch Projectiles

(Items from FF-13)

- 5 Spiked 3-inch projectile sampled
- Inert 3-inch projectile added for thermal mass



See Figure D-1 for railcar placement in chamber
 See Figure D-2 for pallet placement on railcar
 See Figure D-3 for rack placement on pallets

Test 9
 (Not to Scale)

28 July 1984
 6 Hours at 800 °F / 316 °C

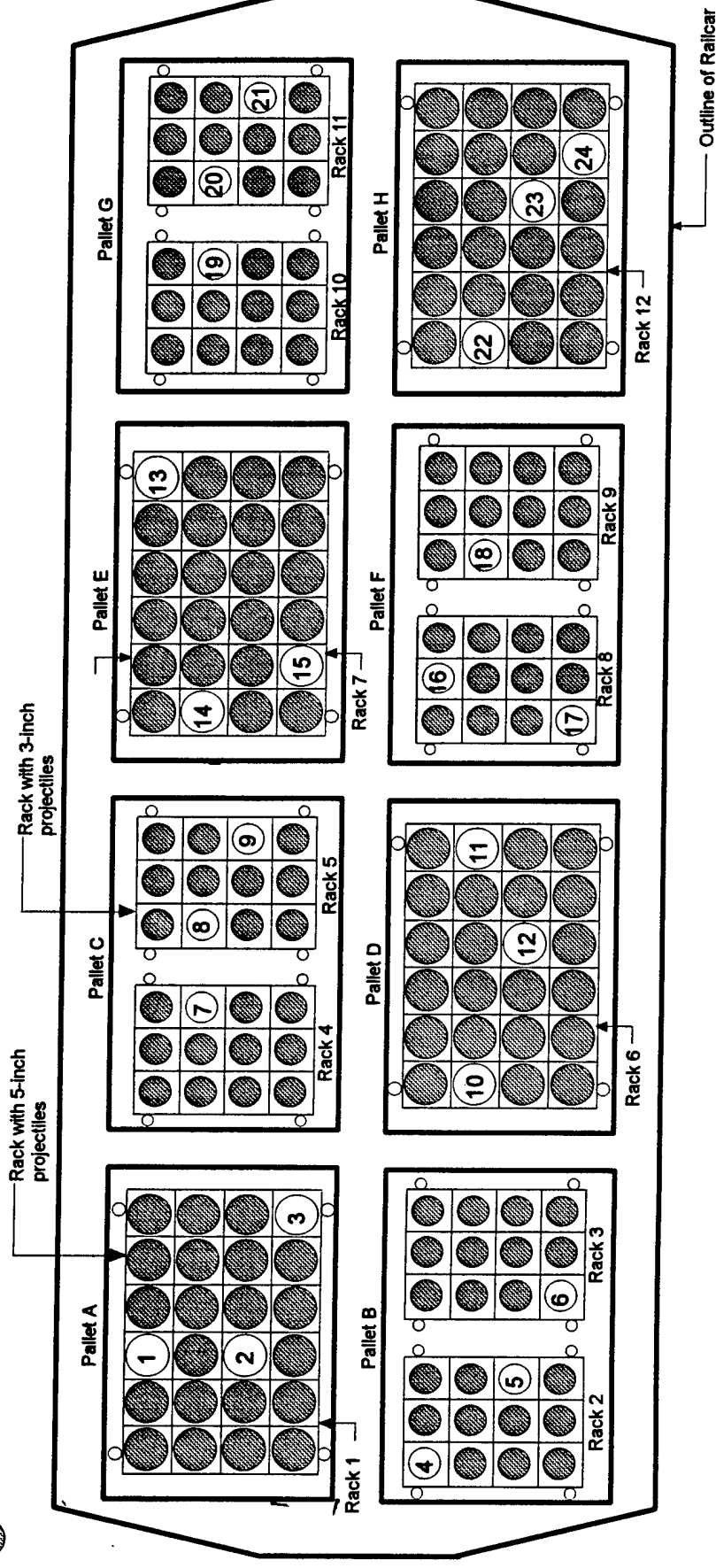
Figure D-22 3-inch Projectiles Spiked with HBX

3-inch / 5-inch Projectiles

(Items from FF-13)

Total Weight, 192 projectiles = 7,296 lbs (3,309 kg)

- Spiked projectile sampled
- Inert projectile added for thermal mass

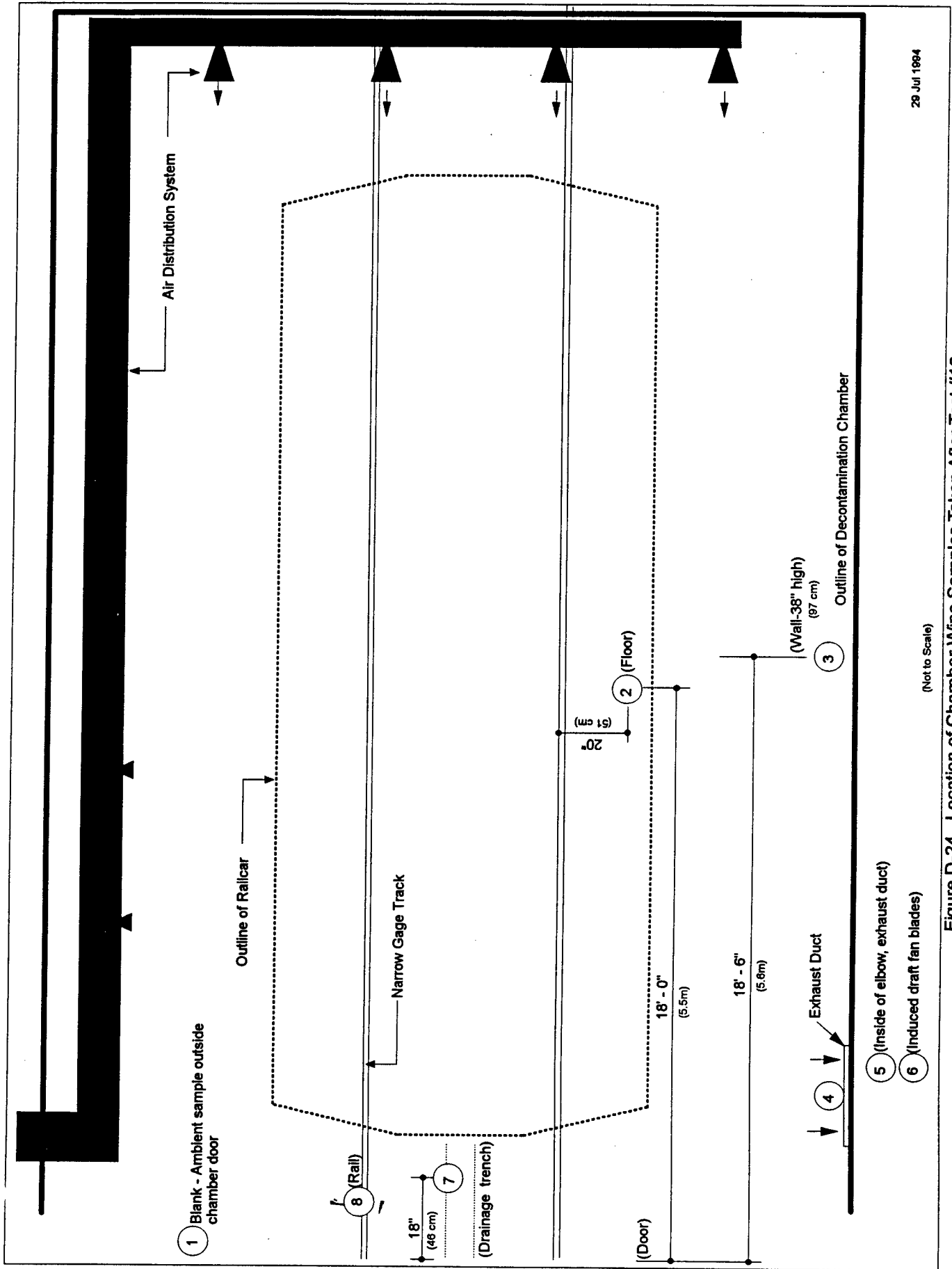


Test 10
(Not to Scale)

29 July 1994
12 Hours at 800 °F / 316 °C

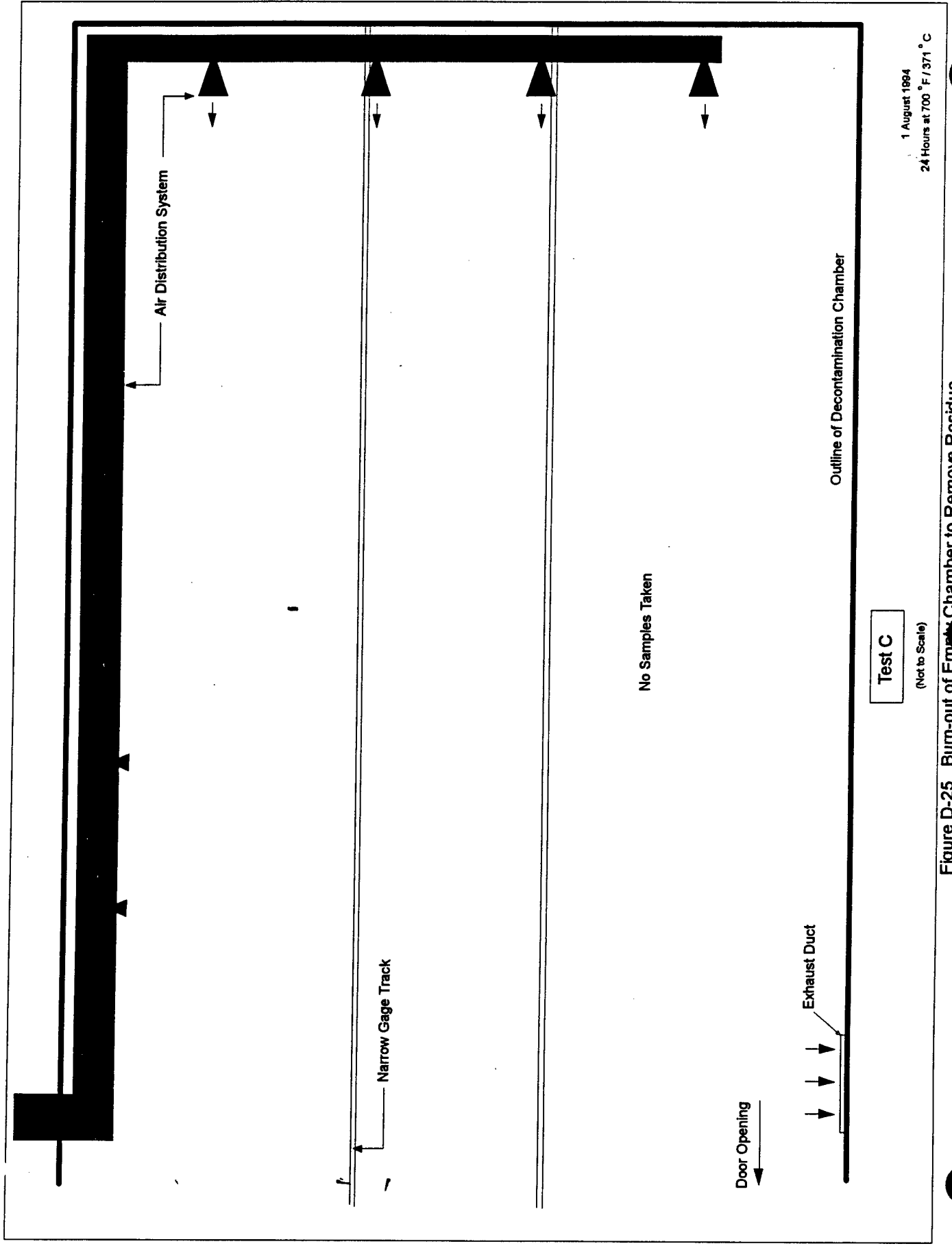
See Figure D-1 for railcar placement in chamber
See Figure D-2 for pallet placement on railcar
See Figure D-3 for 3-inch rack placement on pallets
See Figure D-4 for 5-inch rack placement on pallets

Figure D-23 3-inch / 5-inch Projectiles Spiked with Yellow D



28 Jul 1994

Figure D-24 Location of Chamber Wipe Samples Taken After Test #10



1 August 1994
 24 Hours at 700 ° F / 371 ° C

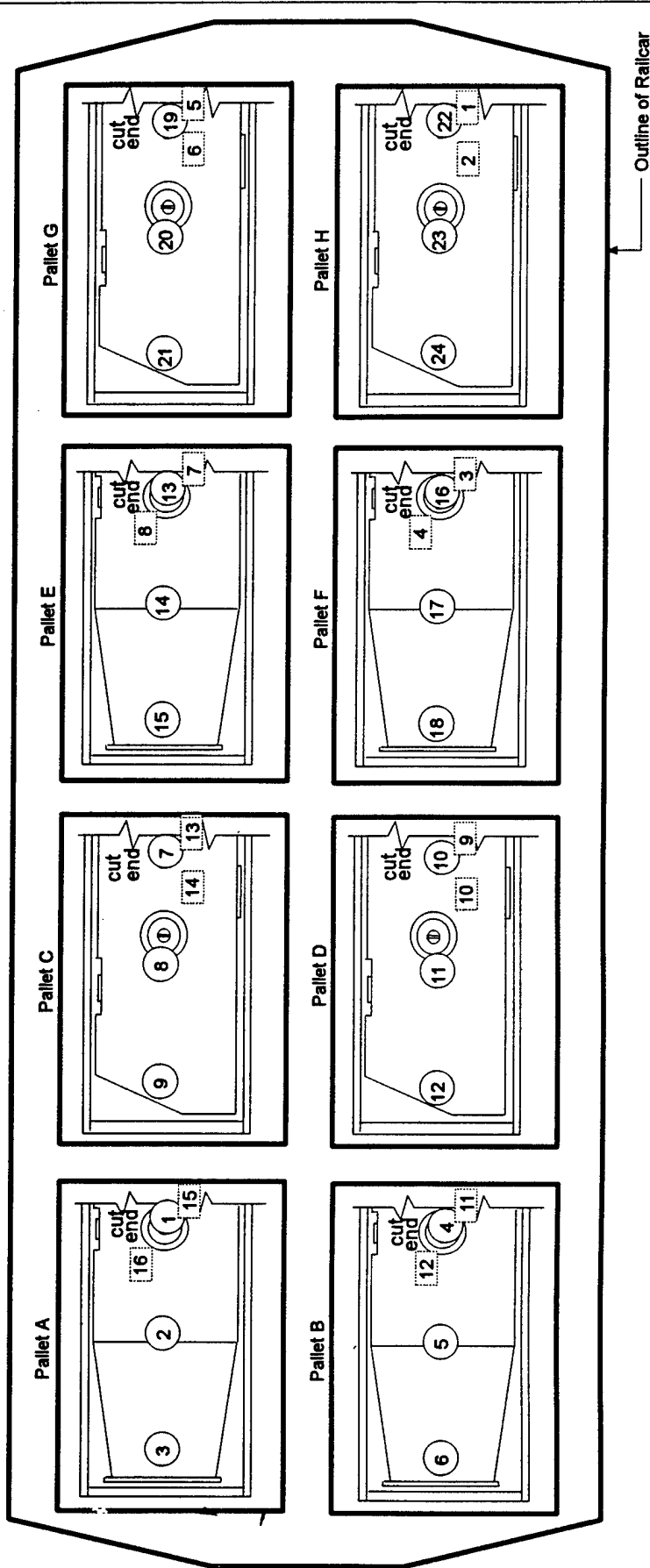
Figure D-25 Burn-out of Empty Chamber to Remove Residue

Total Weight, 4 Mines = 2,860 lbs (1,297 kg)

MK 25 Ship Mines

(Unused mines - internals coated with hot-melt)

- 5 Thermocouple Number and Approximate Location
- 1 Sample Number and Approximate Location



Door Opening

See Figure D-1 for railcar placement in chamber
See Figure D-2 for pallet placement on railcar
See Figure D-8 for mine placement on pallets

Test 11

(Not to Scale)

9 August 1994
32 Hours at 700 °F / 371 °C

Figure D-26 MK 25 Ship Mines Hot-Melt Coated Internals and Spiked with TNT

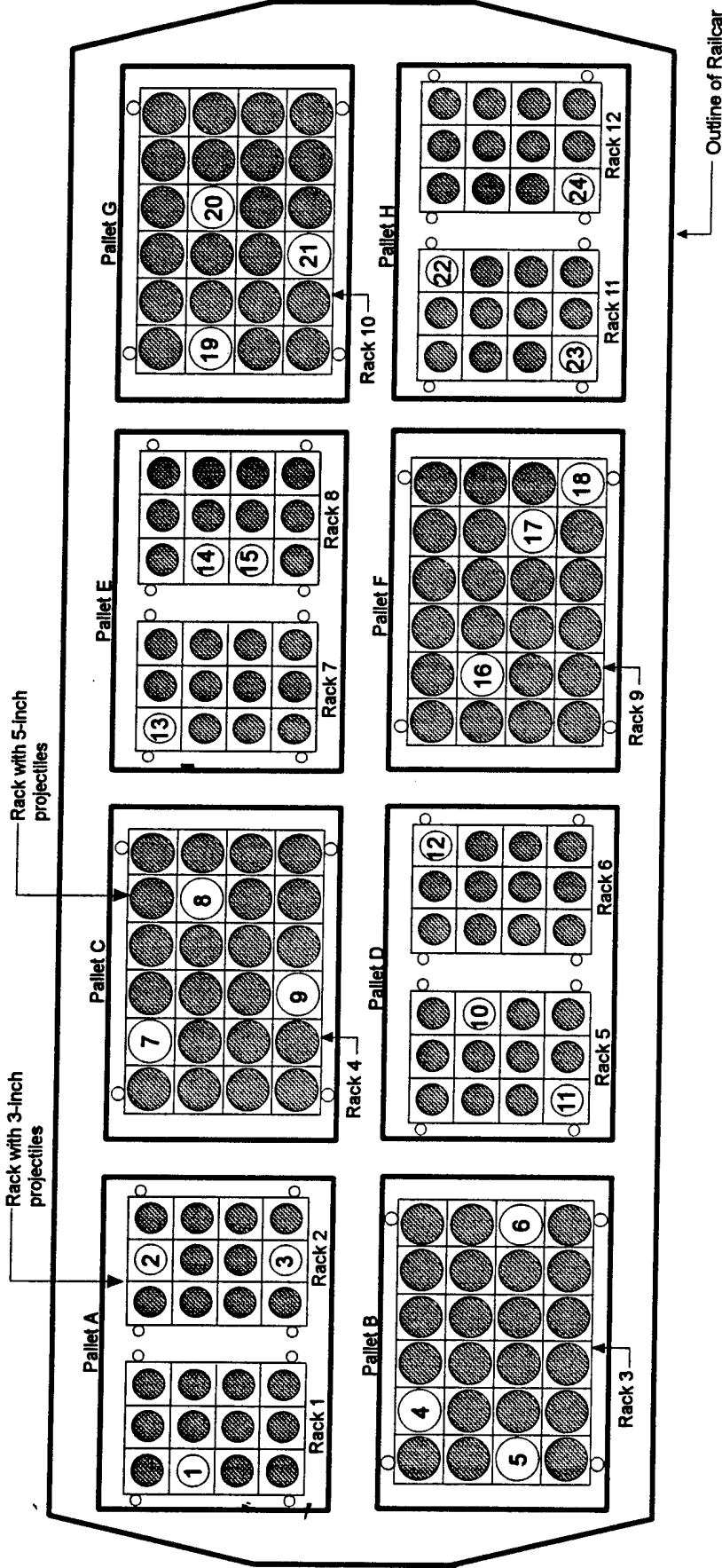
Total Weight, 192 projectiles = 7,296 lbs (3,309 kg)

3-inch / 5-inch Projectiles

(Items from FF-13)

8 Spiked projectile sampled

● Inert projectile added for thermal mass



Test 12

(Not to Scale)

13 August 1994
6 Hours at 550 ° F / 288 ° C

See Figure D-1 for railcar placement in chamber
See Figure D-2 for pallet placement on railcar
See Figure D-3 for 3-inch rack placement on pallets
See Figure D-4 for 5-inch rack placement on pallets

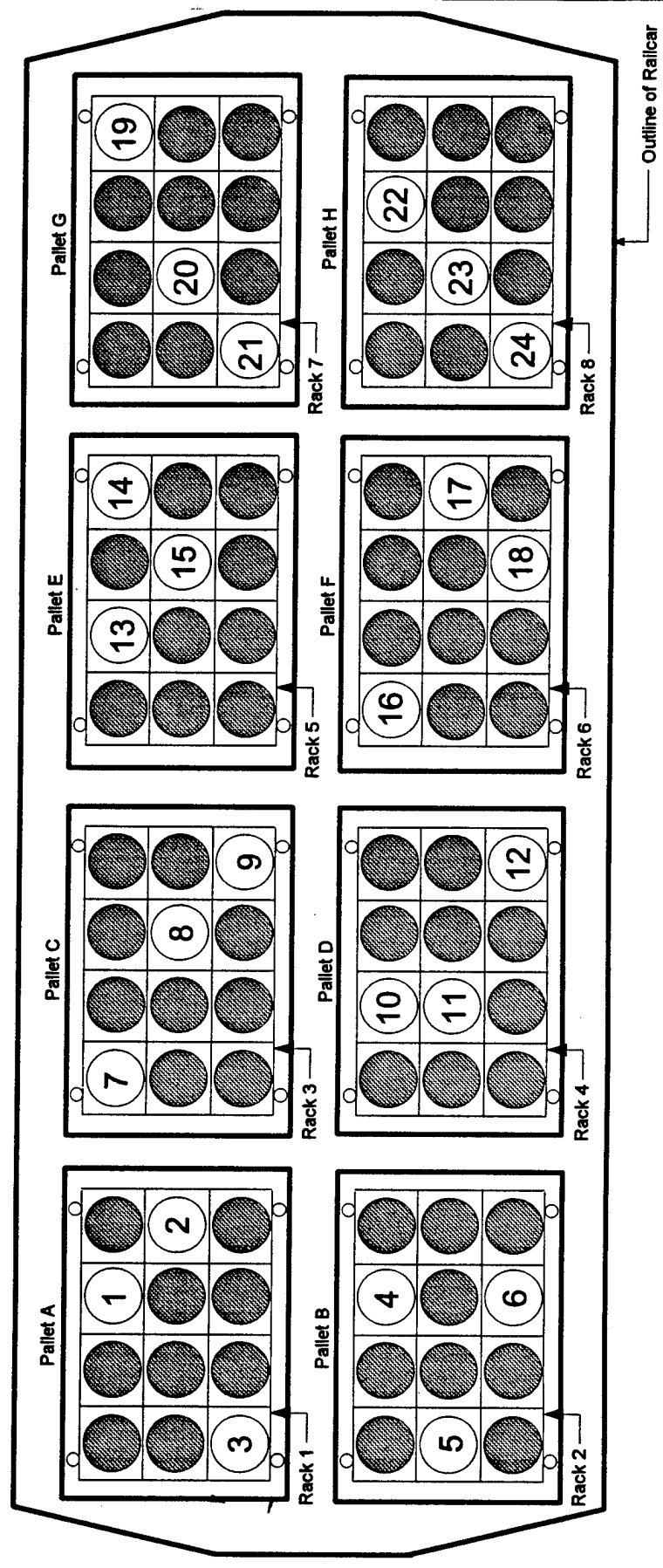
Figure D-27 3-inch / 5-inch Projectiles Spiked with RDX

Total Weight, 96 Projectiles = 11,040 lbs (5,008 kg)

175mm Projectiles

(Items from FF-13)

- ② Spiked projectile sampled
- Inert projectile added for thermal mass



Test 13
(Not to Scale)

See Figure D-1 for railcar placement in chamber
See Figure D-2 for pallet placement on railcar
See Figure D-6 for rack placement on pallets

15 August 1984
6 Hours at 550 °F / 288 °C

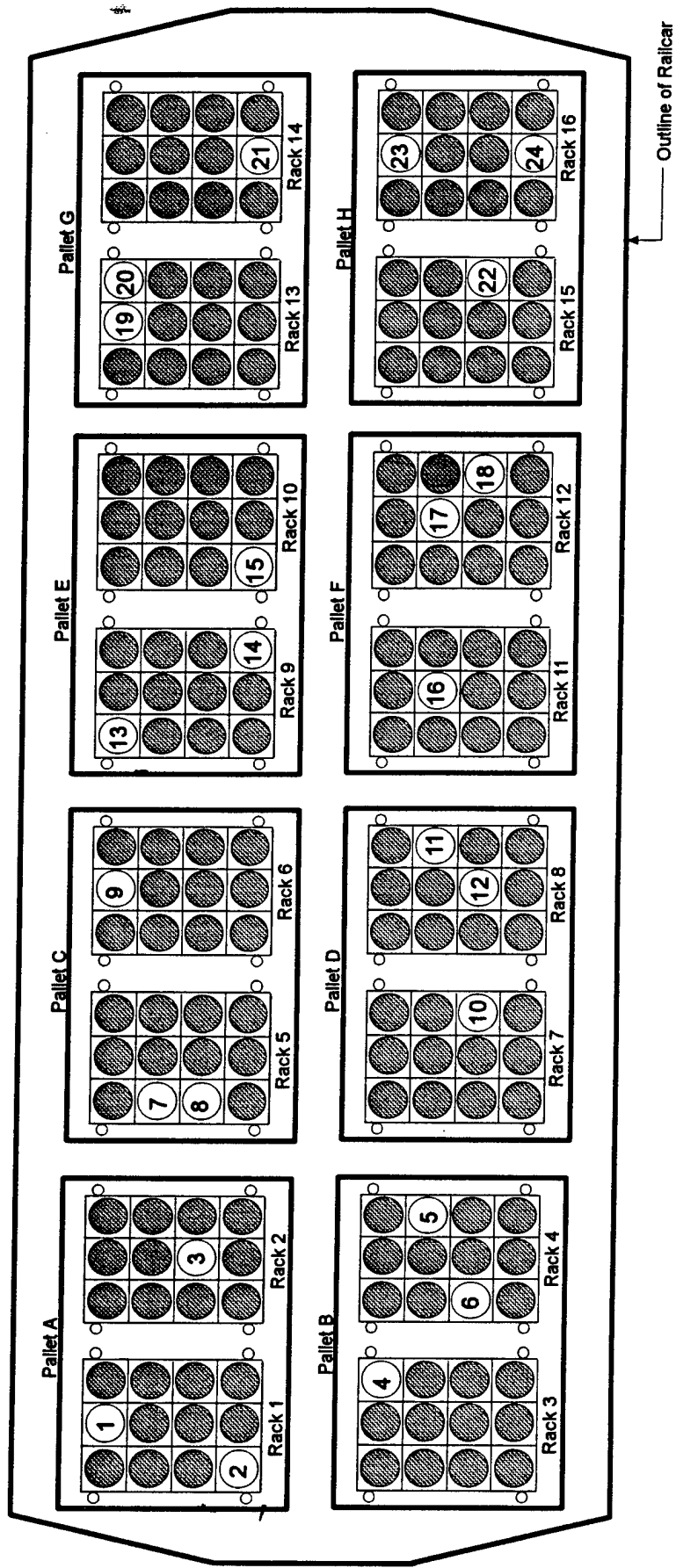
Figure D-28 175mm Projectiles Spiked with Comp B

Total Weight , 192 projectiles = 1,728 lbs (784 kg)

3-inch Projectiles

(Items from FF-13)

- 5 Spiked 3-inch projectile sampled
- Inert 3-inch projectile added for thermal mass



Test 14
(Not to Scale)

17 August 1994
6 Hours at 800 °F / 316 °C

See Figure D-1 for railcar placement in chamber
See Figure D-2 for pallet placement on railcar
See Figure D-3 for rack placement on pallets

Figure D-29 3-inch Projectiles Spiked with HBX

3-inch / 5-inch Projectiles

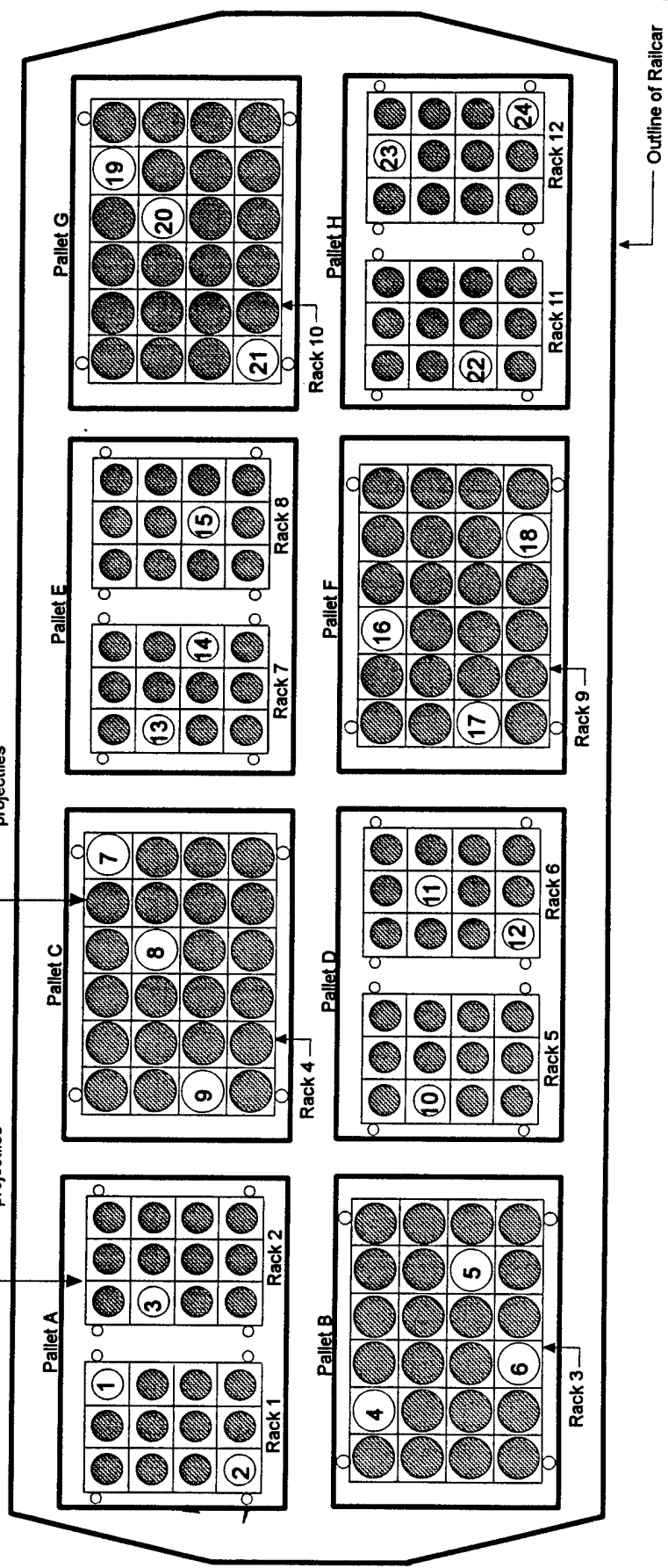
(Items from FF-13)

Total Weight, 192 projectiles = 7,296 lbs (3,309 kg)

- 5 Spiked projectile sampled
- Inert projectile added for thermal mass

Rack with 3-inch projectiles

Rack with 5-inch projectiles



Test 15
(Not to Scale)

See Figure D-1 for railcar placement in chamber
 See Figure D-2 for pallet placement on railcar
 See Figure D-3 for 3-inch rack placement on pallets
 See Figure D-4 for 5-inch rack placement on pallets

20 August 1964
 6 Hours at 600 ° F / 318 ° C

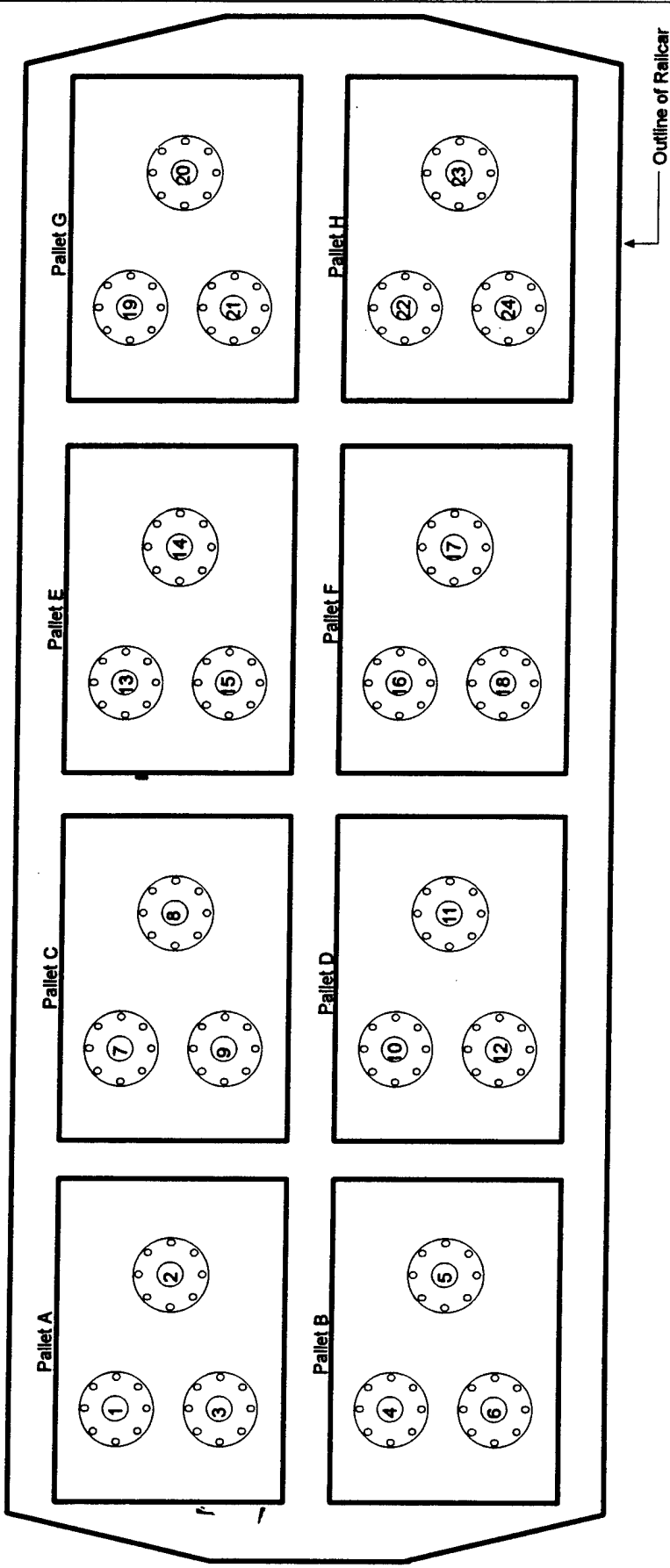
Figure D-30 3-inch / 5-inch Projectiles Spiked with Yellow D

Total Weight, 24 pieces = 384 lbs (174 kg)

MK 54 Depth Bombs

(Sawed ends contained HBX residue)

① Contaminated pieces sampled



Door Opening

Outline of Railcar

Test 16
(Not to Scale)

See Figure D-1 for railcar placement in chamber
See Figure D-2 for pallet placement on railcar
See Figure D-7 for sawed ends placement on pallets

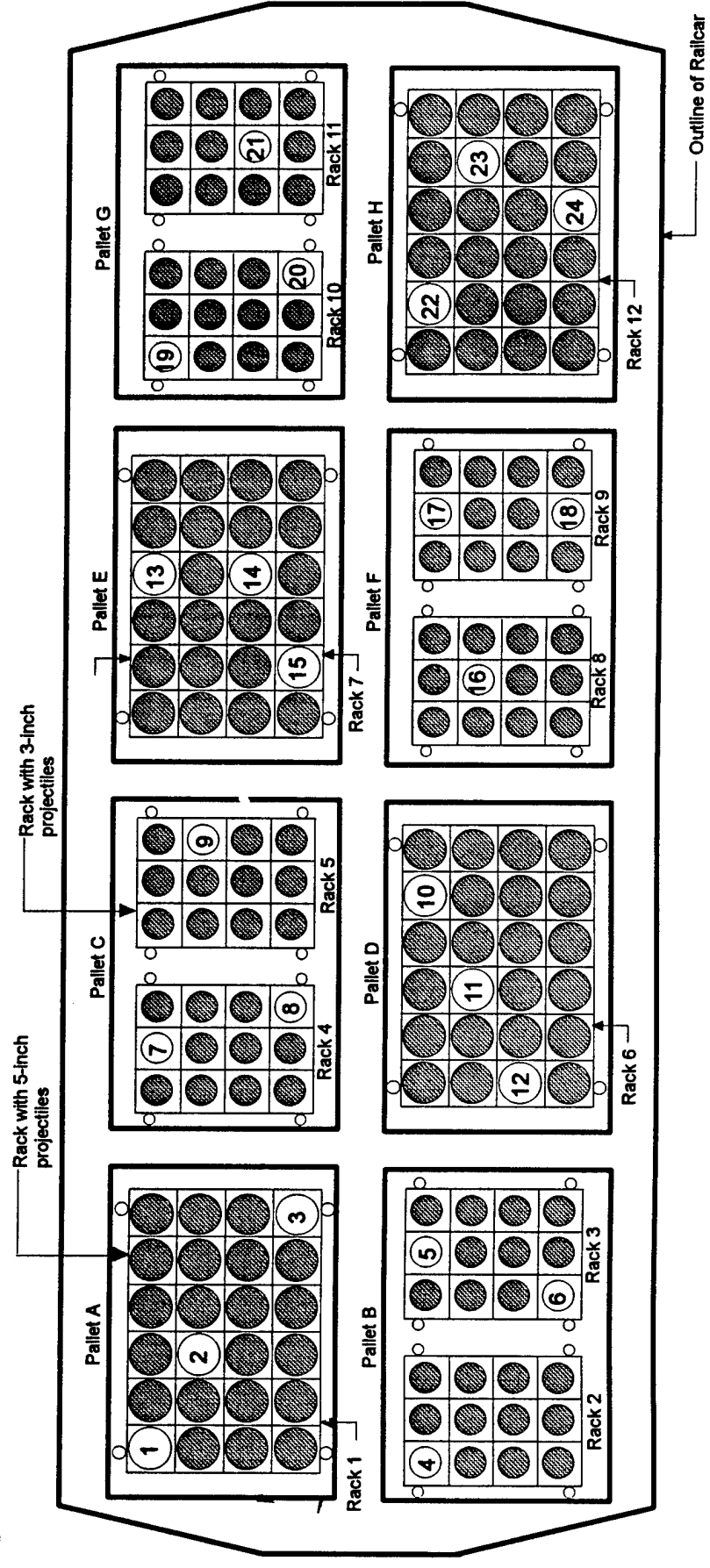
21 August 1964
32 Hours at 700° F / 317° C

Figure D-31 MK 54 Depth Bombs (Sawed Ends) with HBX Residue

Total Weight, 192 projectiles = 7,296 lbs (3,309 kg)

3-inch / 5-inch Projectiles (Items from FF-13)

- ① Spiked projectile sampled
- Inert projectile added for thermal mass



Door Opening →

Test 17
(Not to Scale)

25 August 1994
6 Hours at 550 °F / 288 °C

See Figure D-1 for railcar placement in chamber
See Figure D-2 for pallet placement on railcar
See Figure D-3 for 3-inch rack placement on pallets
See Figure D-4 for 5-inch rack placement on pallets

Figure D-32 3-inch / 5-inch Projectiles Spiked with RDX

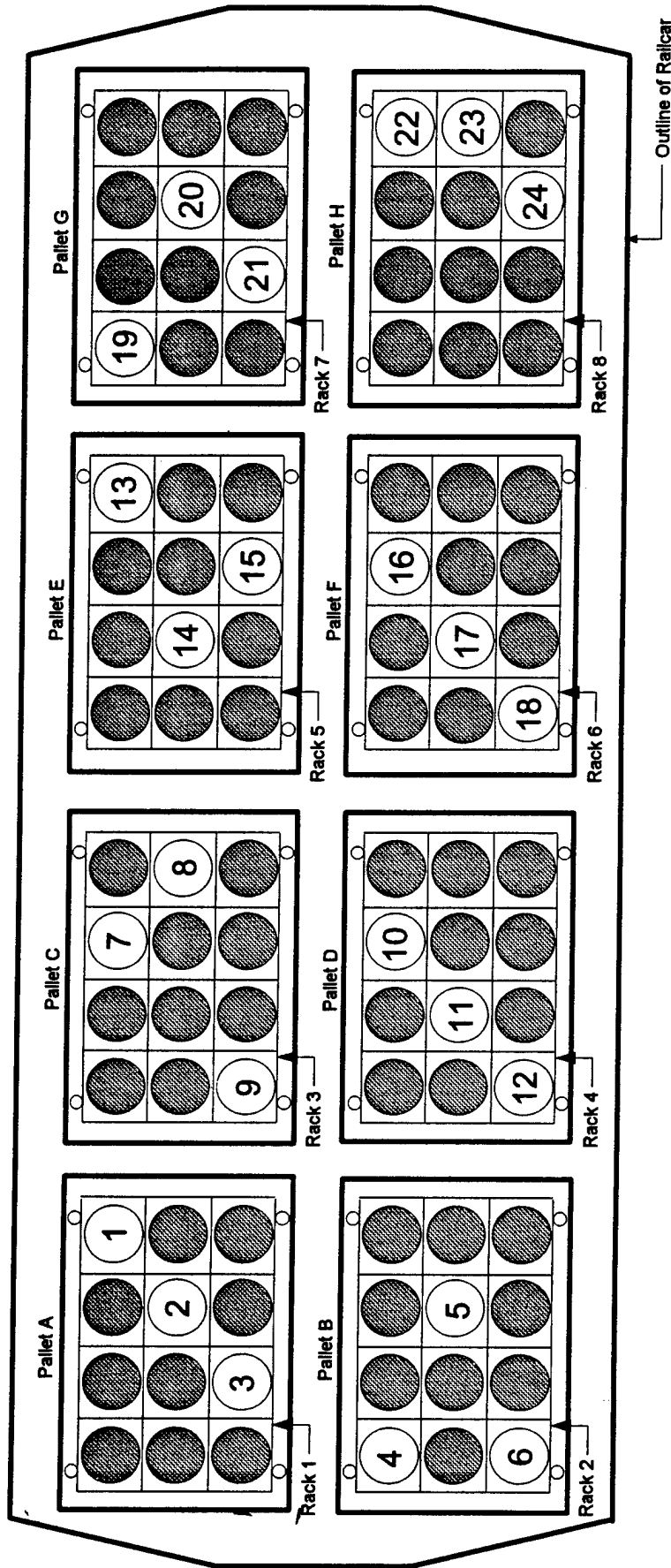
Total Weight, 96 Projectiles = 11,040 lbs (5,008 kg)

175mm Projectiles

(Items from FF-13)

2 Spiked projectile sampled

Inert projectile added for thermal mass



See Figure D-1 for railcar placement in chamber
See Figure D-2 for pallet placement on railcar
See Figure D-6 for rack placement on pallets

Test 18

(Not to Scale)

27 August 1994
6 Hours at 550 ° F / 288 ° C

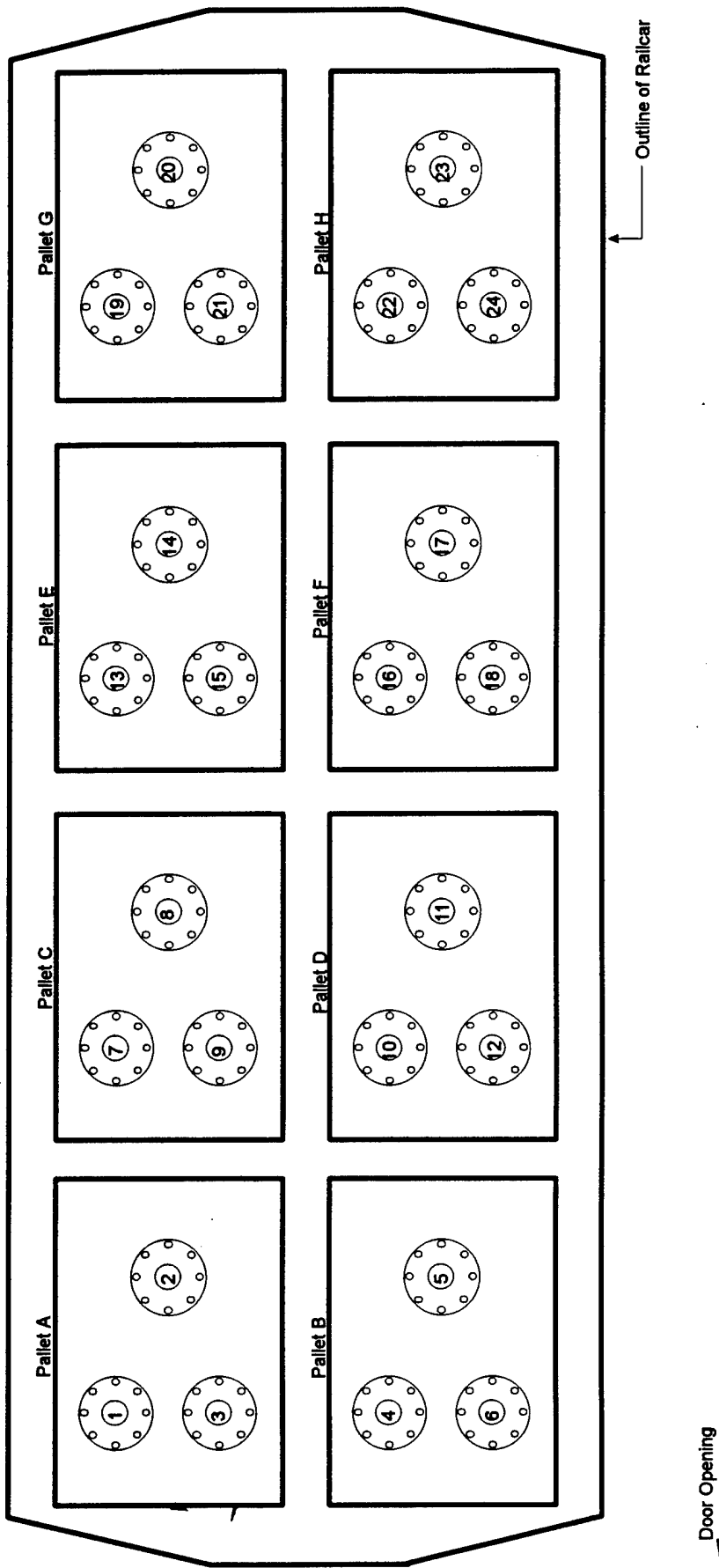
Figure D-33 175mm Projectiles Spiked with Comp B

Total Weight, 24 pieces = 384 lbs (174 kg)

MK 54 Depth Bombs

(Sawed ends contained HBX residue)

1 Contaminated pieces sampled



See Figure D-1 for railcar placement in chamber
See Figure D-2 for pallet placement on railcar
See Figure D-7 for sawed ends placement on pallets

Test 19
(Not to Scale)

28 August 1994
24 Hours at 700 ° F / 371 ° C

Figure D-34 MK 54 Depth Bombs (Sawed Ends) with HBX Residue

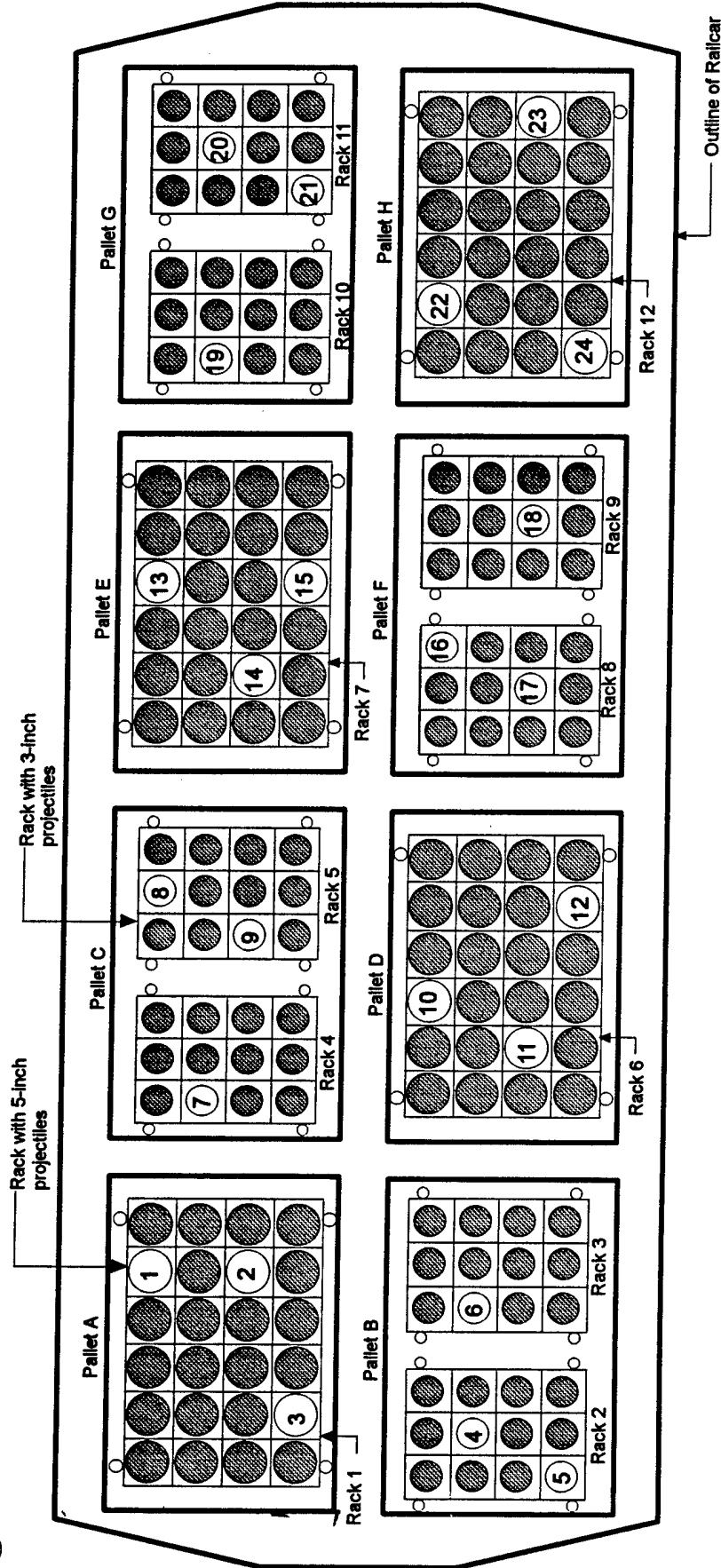
3-inch / 5-inch Projectiles

(Items from FF-13)

Total Weight, 192 projectiles = 7,296 lbs (3,309 kg)

⑨ Spiked projectile sampled

● Inert projectile added for thermal mass



Test 20

(Not to Scale)

3 September 1994
8 Hours at 600 ° F / 316 ° C

See Figure D-1 for railcar placement in chamber
See Figure D-2 for pallet placement on railcar
See Figure D-3 for 3-inch rack placement on pallets
See Figure D-4 for 5-inch rack placement on pallets

Figure D-35 3-inch / 5-inch Projectiles Spiked with Yellow D

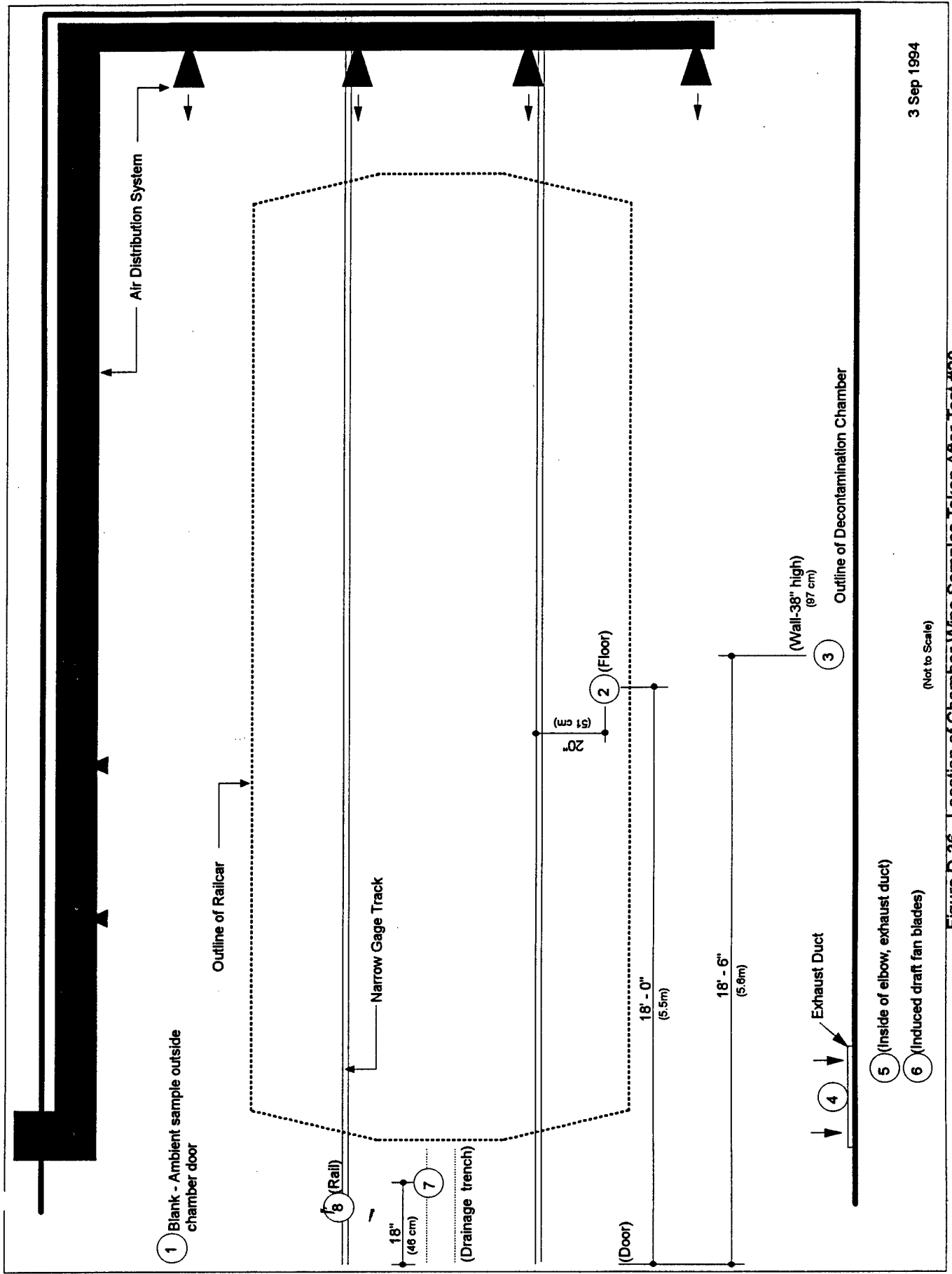
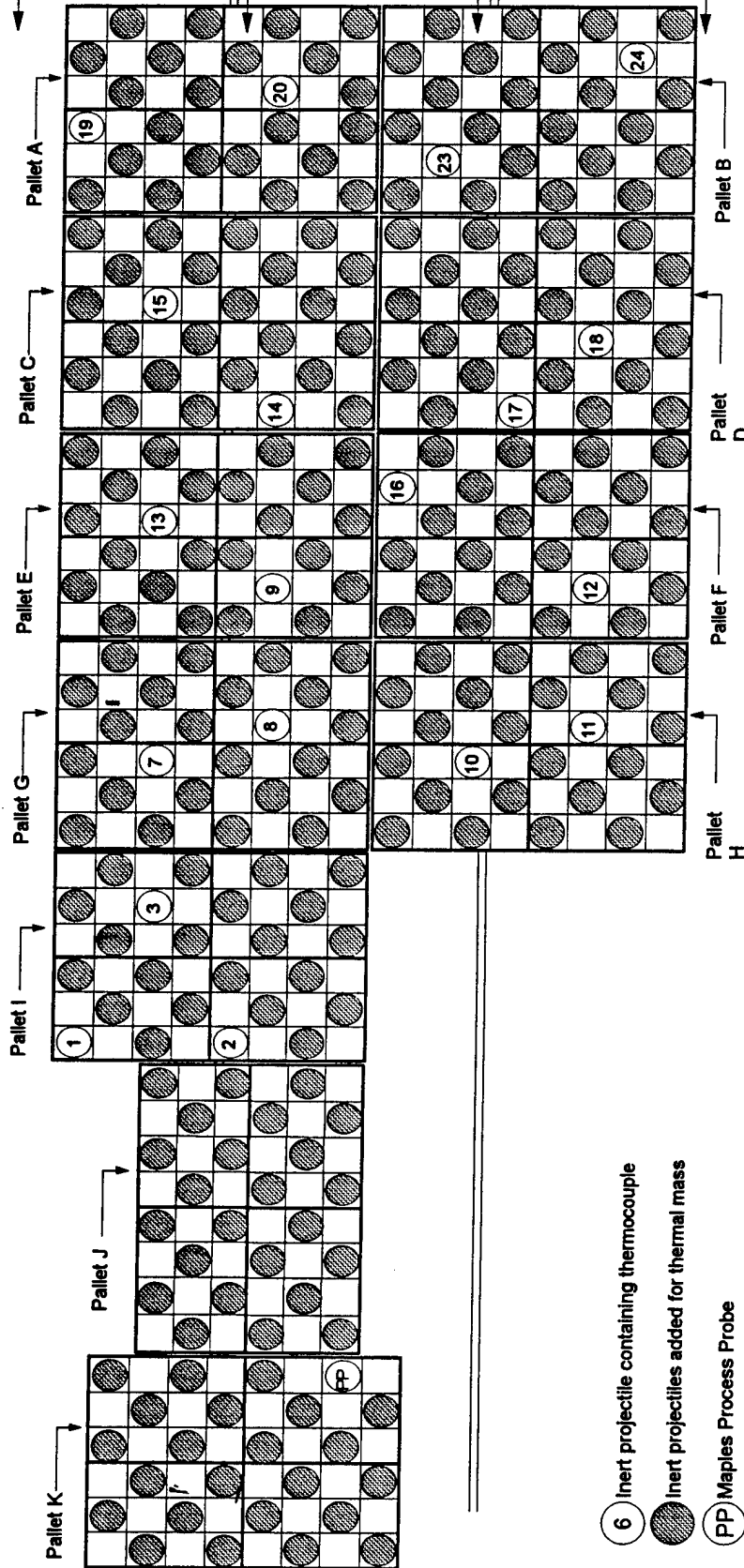


Figure D-36 Location of Chamber Wipe Samples Taken After Test #20

175mm Projectiles (Items from FF-13)

Total Weight, 480 projectiles = 55,200 lbs (25,038 kg)

Air Distribution System



- 6 Inert projectile containing thermocouple
- Inert projectiles added for thermal mass
- PP Maples Process Probe



See Figure D-6a for 5-inch adaptor placement on pallet

Test D
(Not to Scale)

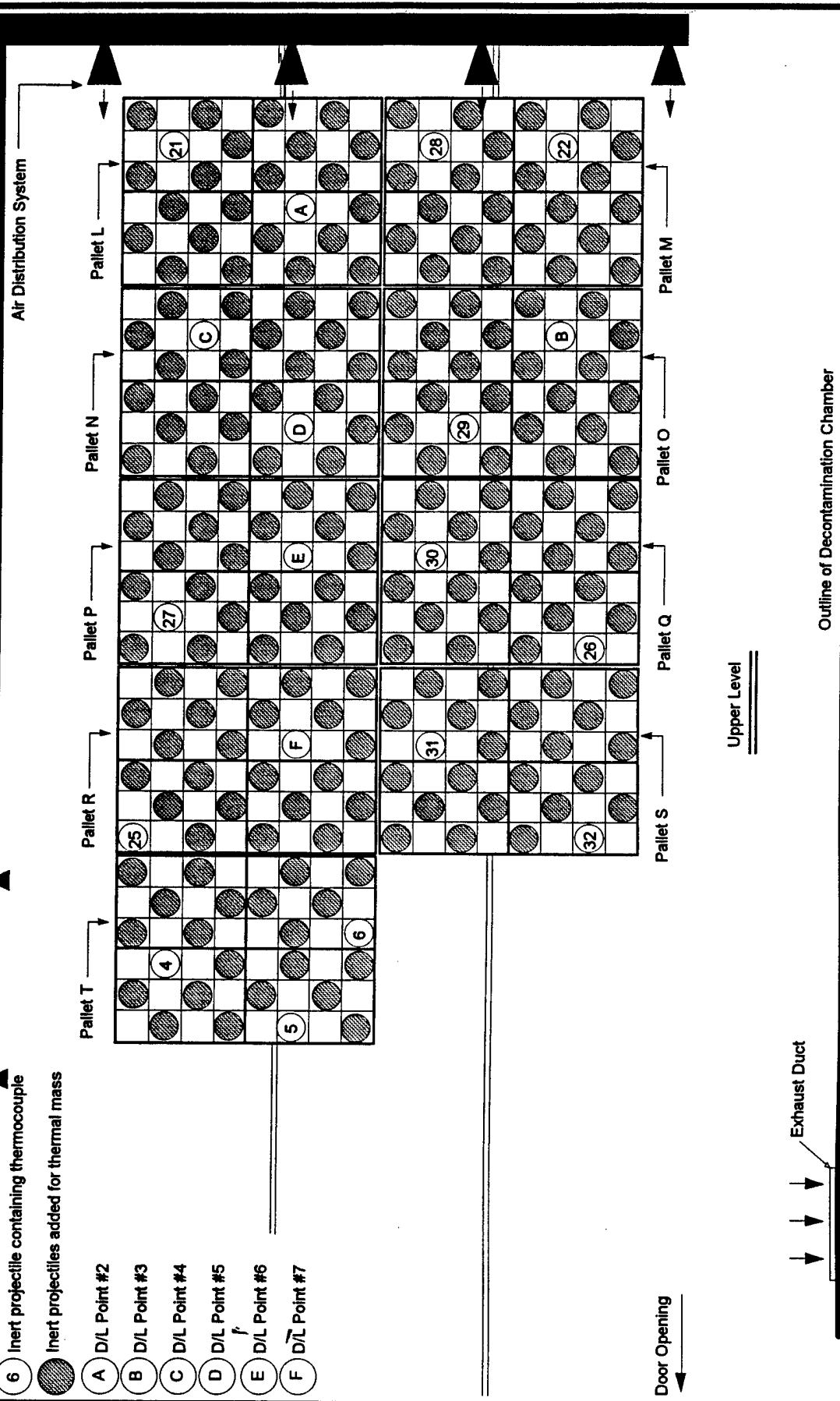
Outline of Decontamination Chamber

8 Sep 1994
6 Hours at 550 °F / 288 °C

Figure D-37 175mm Projectiles (Lower) - Lower Level - Full Chamber Load

175mm Projectiles (Items from FF-13)

- 6 Inert projectile containing thermocouple
- Inert projectiles added for thermal mass
- A D/L Point #2
- B D/L Point #3
- C D/L Point #4
- D D/L Point #5
- E D/L Point #6
- F D/L Point #7



Test D
(Not to Scale)

8 Sep 1994
6 Hours at 550 ° F / 288 ° C

See Figure D-6a for 5-inch adaptor placement on pallet

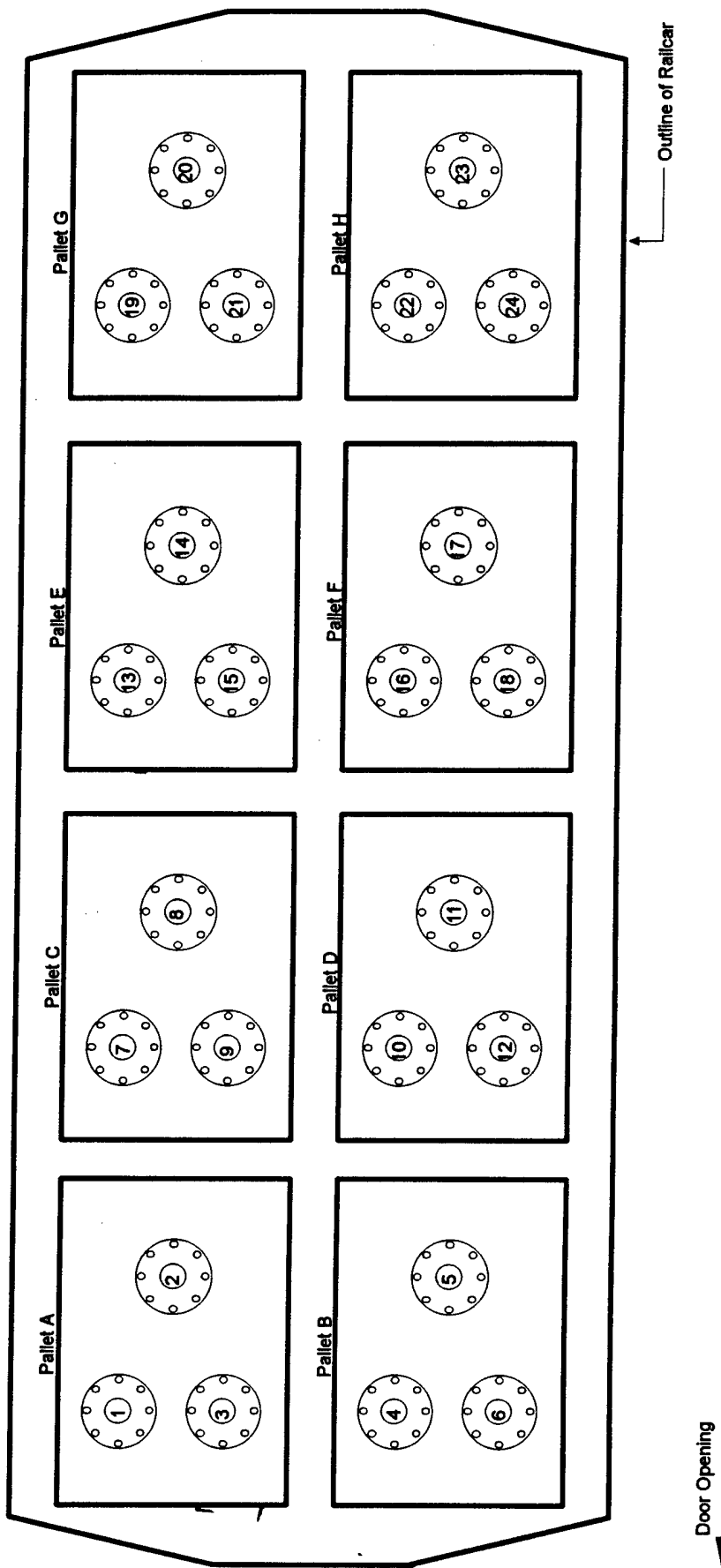
Figure D-37a 175mm Projectiles (Inert) - Upper Level - Full Chamber Load

Total Weight, 24 pieces = 384 lbs (174 kg)

MK 54 Depth Bombs

(Sawed ends contained HBX residue)

① Contaminated pieces sampled



See Figure D-1 for railcar placement in chamber
See Figure D-2 for pallet placement on railcar
See Figure D-7 for sawed ends placement on pallets

Test 21
(Not to Scale)

12 September 1994
24 Hours at 700 ° F / 371 ° C

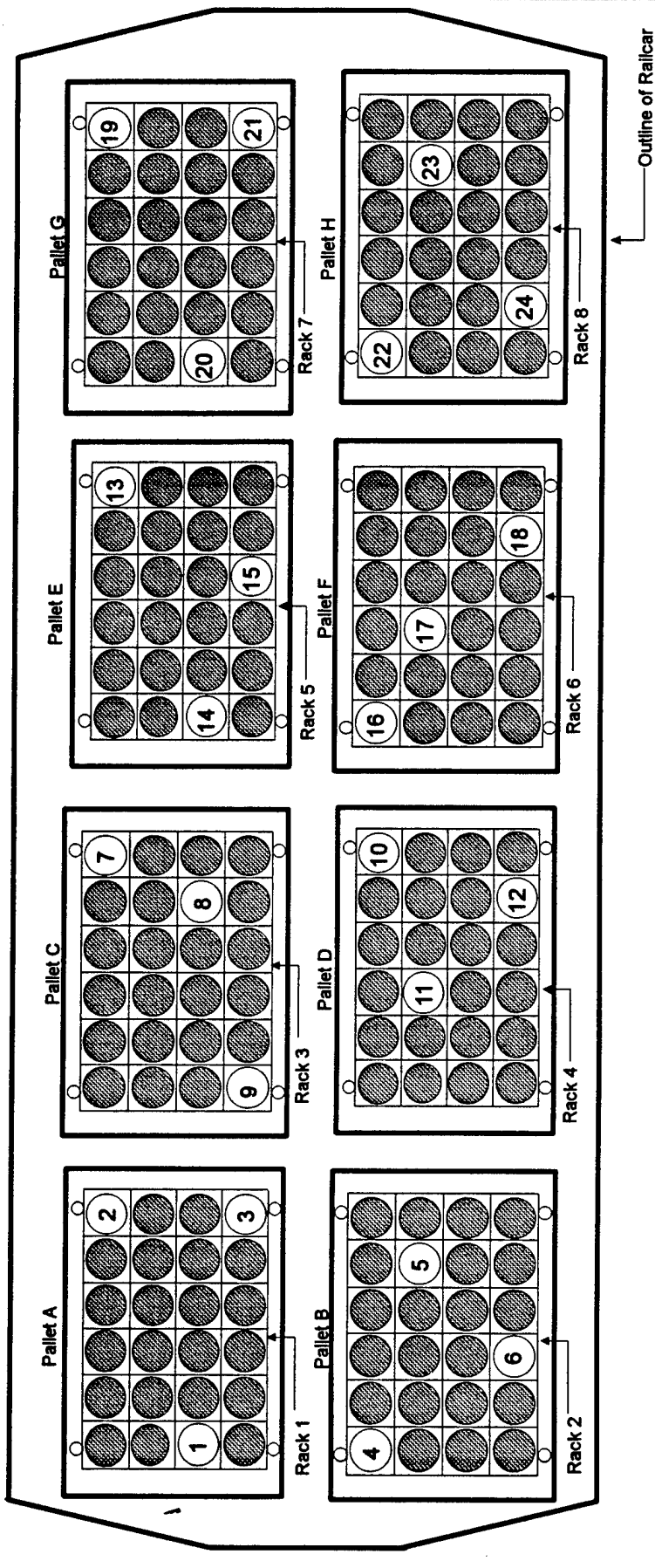
Figure D-38 MK 54 Depth Bombs (Sawed Ends) with HBX Residue

Total Weight, 192 projectiles = 10,560 lbs (4,790 kg)

106mm Projectiles

(Projectiles contained Comp A-3 residue)

- 7 Contaminated projectile sampled
- Inert 106mm projectile added for thermal mass



Test 22
(Not to Scale)

See Figure D-1 for railcar placement in chamber
See Figure D-2 for pallet placement on railcar
See Figure D-5 for 5-inch rack placement on pallets

16 September 1994
5.3 Hours at 550 °F / 286 °C

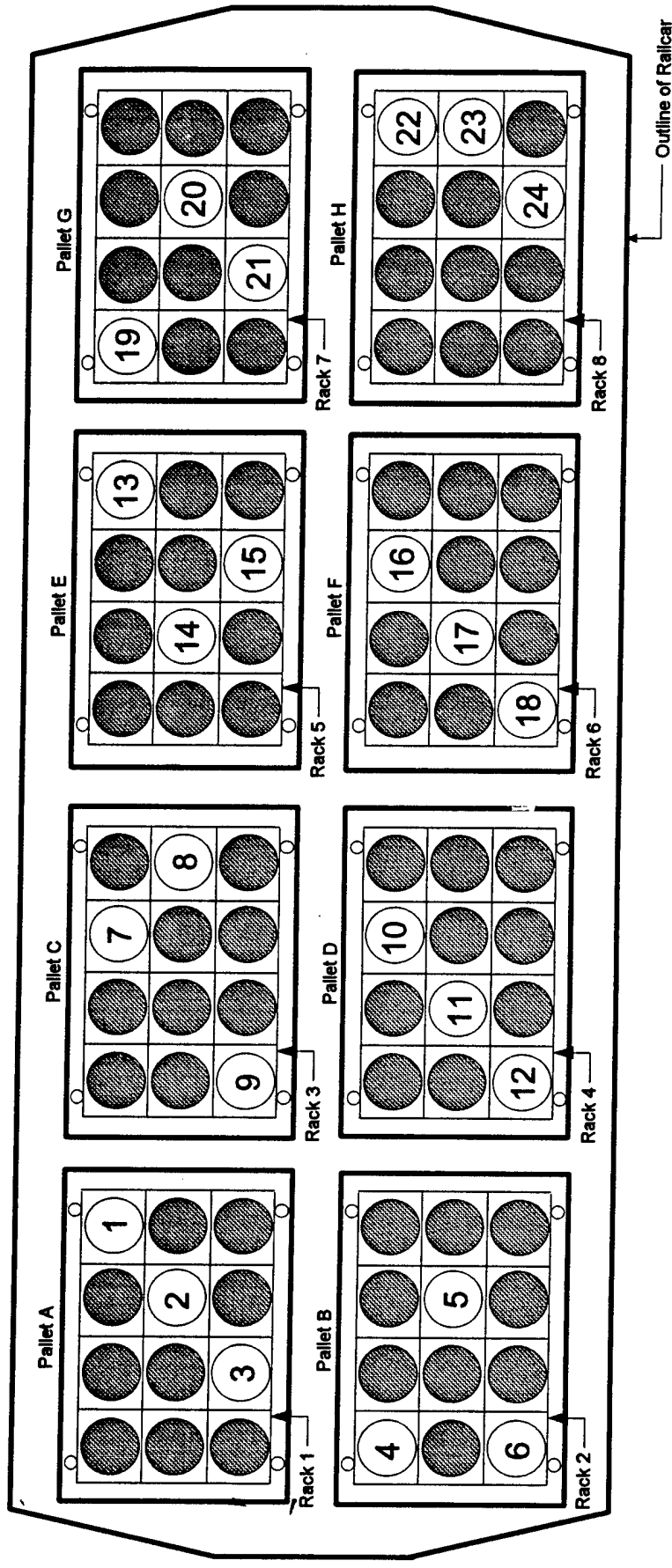
Figure D-39 106mm Projectiles with Comp A-3 Residue

Total Weight, 96 Projectiles = 11,040 lbs (5,008 kg)

175mm Projectiles

(Projectiles contained Comp B residue)

- ② Contaminated projectiles sampled
- Inert projectile added for thermal mass



Test 23
(Not to Scale)

18 September 1994
6 Hours at 550 ° F / 288 ° C

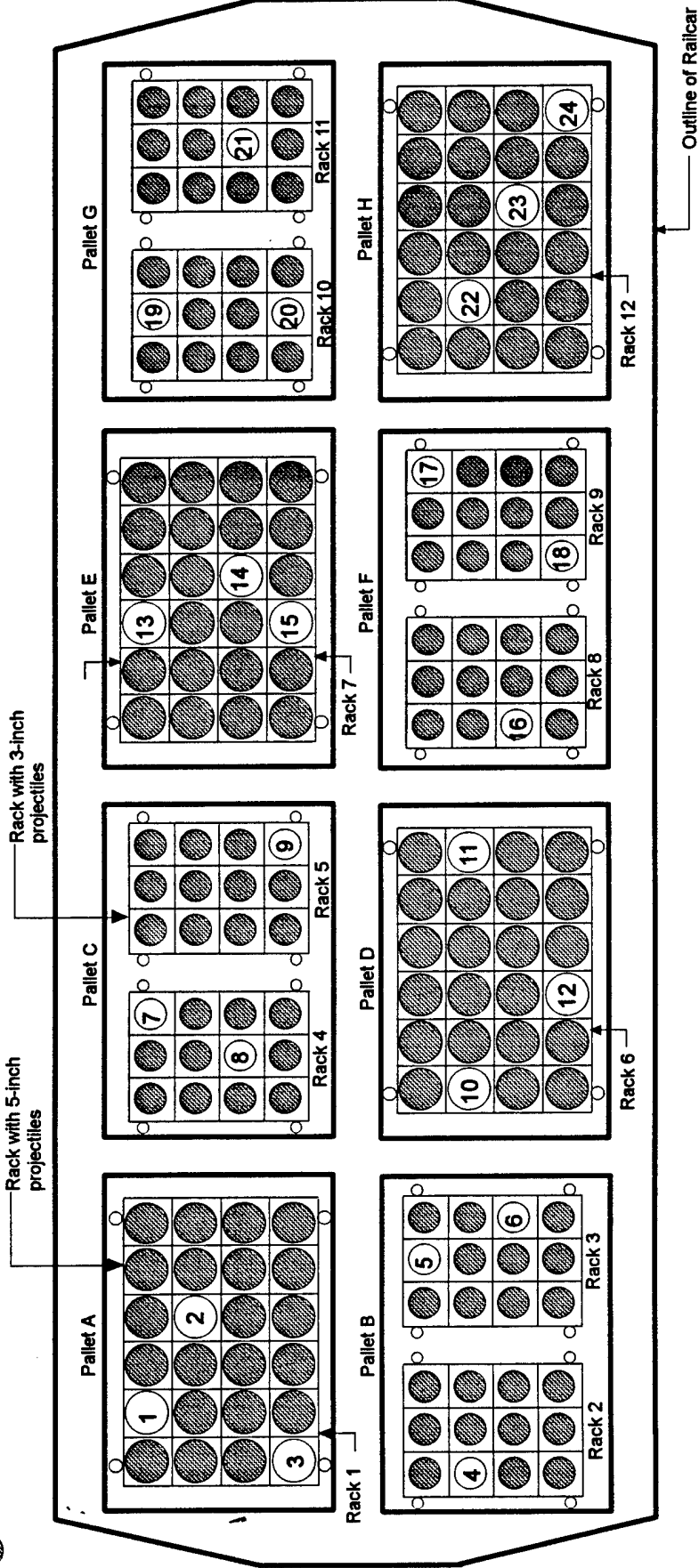
See Figure D-1 for railcar placement in chamber
See Figure D-2 for pallet placement on railcar
See Figure D-6 for rack placement on pallets

Figure D-40 175mm Projectiles with Comp B Residue

Total Weight, 192 projectiles = 7,296 lbs (3,309 kg)

3-inch / 5-inch Projectiles (Items from FF-13)

- ② Spiked projectile sampled
- Inert projectile added for thermal mass



Test 24
(Not to Scale)

20 September 1994
6 Hours at 600 ° F / 316 ° C

See Figure D-1 for railcar placement in chamber
See Figure D-2 for pallet placement on railcar
See Figure D-3 for 3-inch rack placement on pallets
See Figure D-4 for 5-inch rack placement on pallets

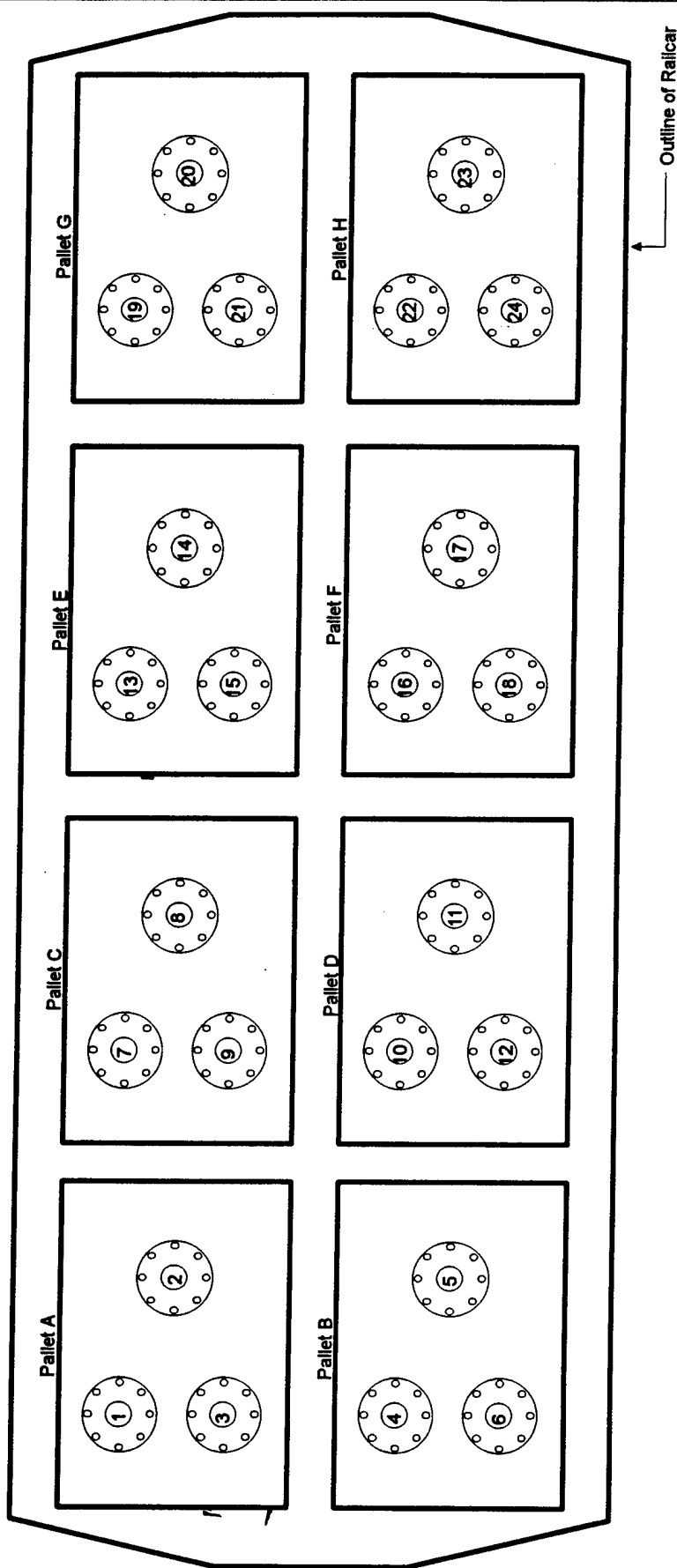
Figure D-41 3-inch / 5-inch Projectiles Spiked with Yellow D

Total Weight, 24 pieces = 384 lbs (174 kg)

MK 54 Depth Bombs

(Sawed ends contained HBX residue)

15 Contaminated pieces sampled



Test 25

(Not to Scale)

See Figure D-1 for railcar placement in chamber
See Figure D-2 for pallet placement on railcar
See Figure D-7 for sawed ends placement on pallets

21 September 1994
24 Hours at 700 ° F / 371 ° C

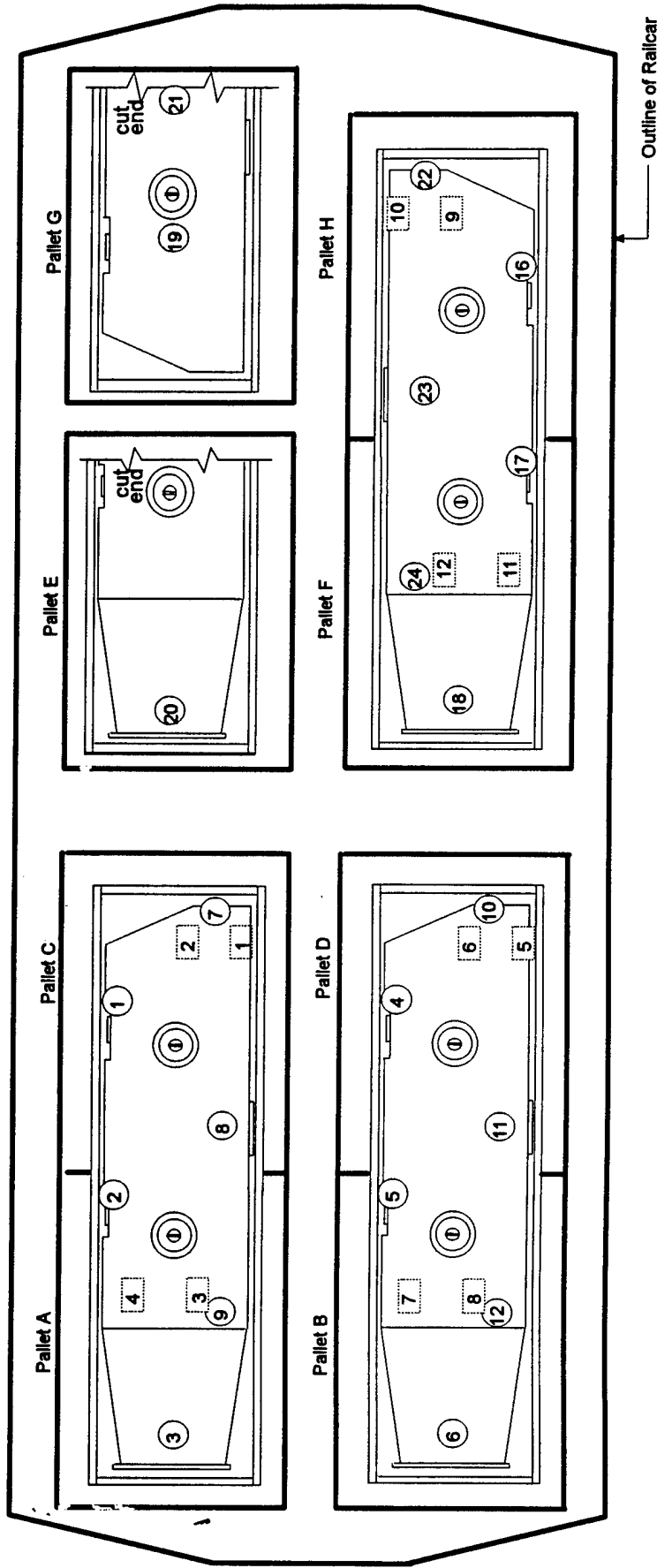
Figure D-42 MK 54 Depth Bombs (Sawed Ends) with HBX Residue

Total Weight, 4 Mines = 2,860 lbs (1,297 kg)

MK 25 Ship Mines

(Unused mines - internals coated with hot-melt)

- 5 Thermocouple Number and Approximate Location
- 1 Sample Number and Approximate Location



See Figure D-1 for railcar placement in chamber
 See Figure D-2 for pallet placement on railcar
 See Figure D-8 for mine placement on pallets

Test 26
 (Not to Scale)

25 September 1984
 32 Hours at 700 °F / 371 °C

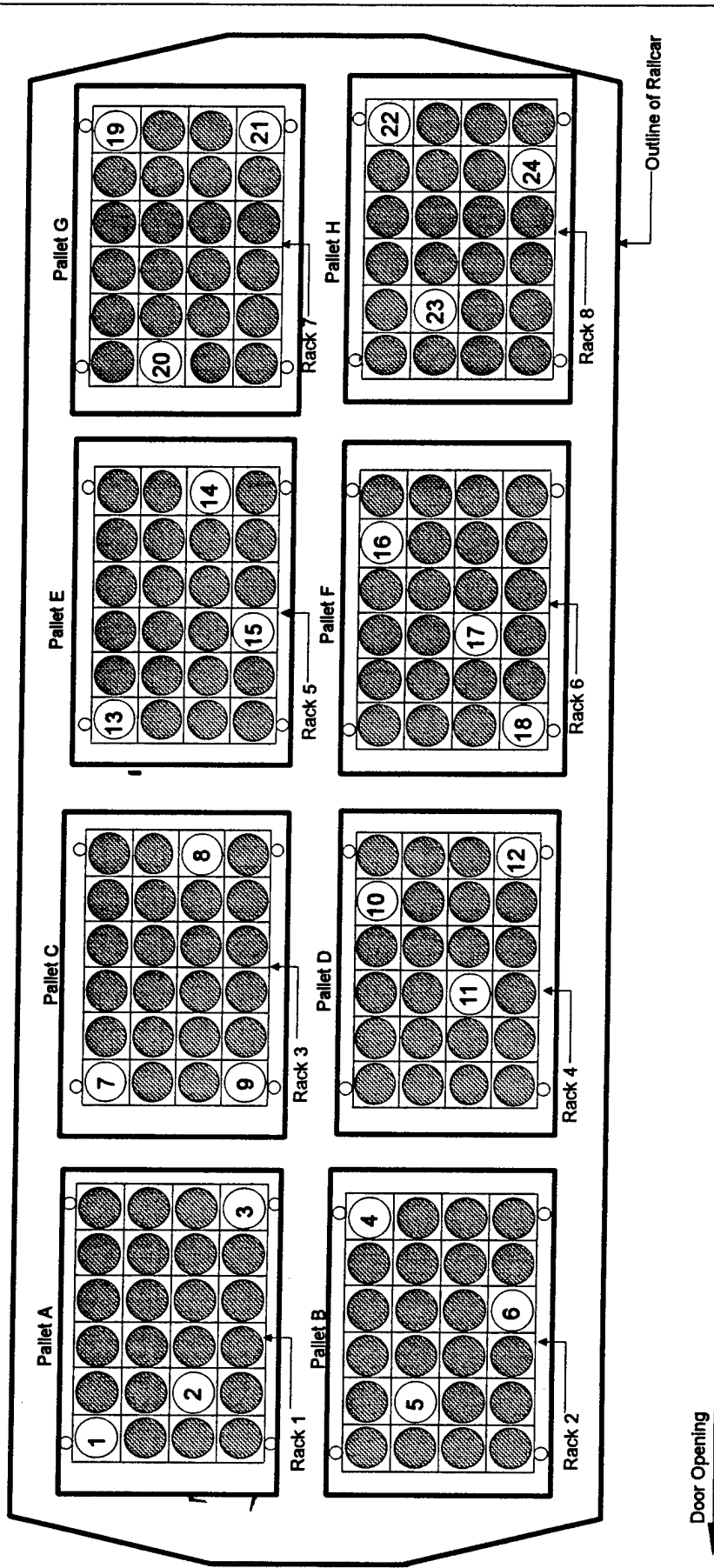
Figure D-43 MK 25 Ship Mines Hot-Melt Coated Internals and Spiked with TNT

Total Weight, 192 projectiles = 10,560 lbs (4,790 kg)

106mm Projectiles

(Projectiles contained Comp A-3 Residue)

- 7 Contaminated projectile sampled
- Inert 106mm projectile added for thermal mass



Test 28
(Not to Scale)

28 September 1994
6 Hours at 550 °F / 288 °C

See Figure D-1 for railcar placement in chamber
See Figure D-2 for pallet placement on railcar
See Figure D-5 for 5-inch rack placement on pallets

Figure D-44 106mm Projectiles with Comp A-3 Residue

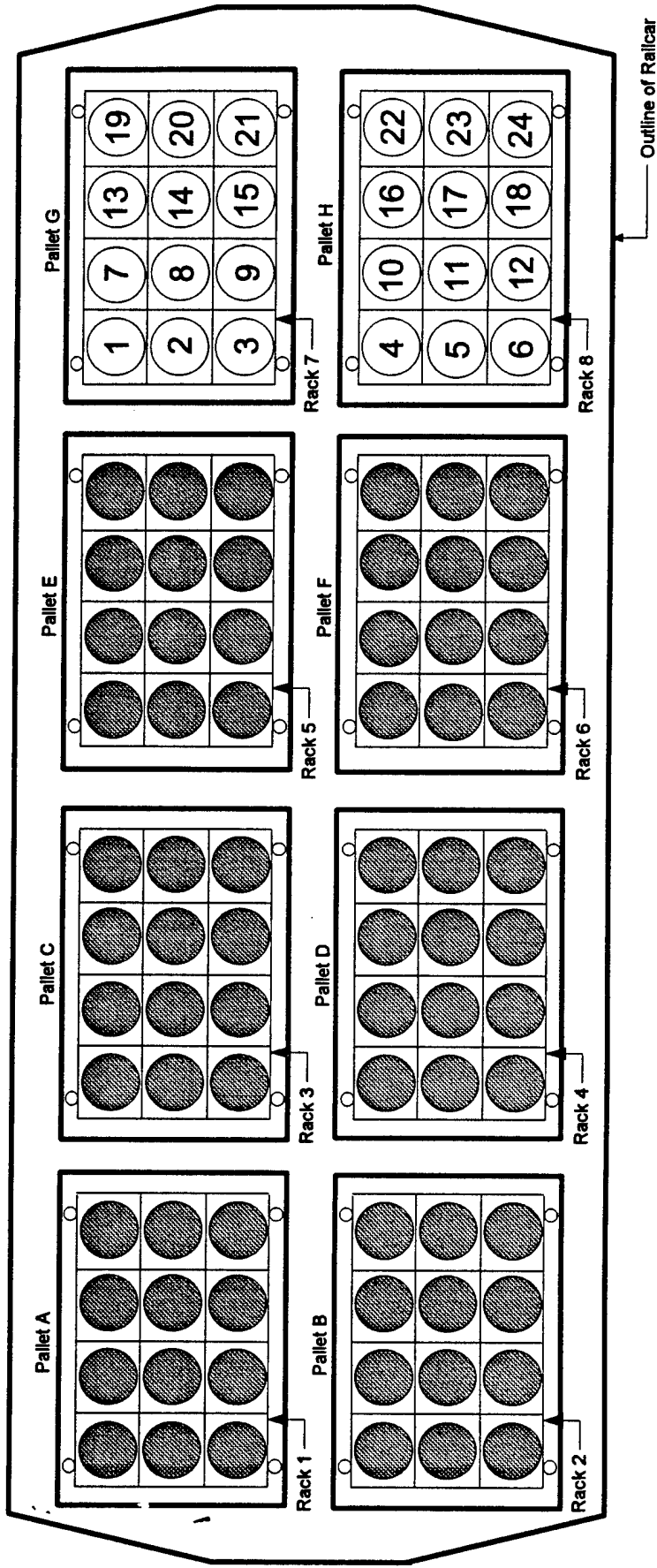
Total Weight, 96 Projectiles = 11,040 lbs (5,008 kg)

175mm Projectiles

(Projectiles contained Comp B residue)

15 Contaminated projectile sampled

inert projectile added for thermal mass



Door Opening

Outline of Railcar

Test 27
(Not to Scale)

See Figure D-1 for railcar placement in chamber
See Figure D-2 for pallet placement on railcar
See Figure D-6 for rack placement on pallets

1 October 1994
6 Hours at 550 °F / 288 °C

Figure D-45 175mm Projectiles with Comp B Residue

3-inch / 5-inch Projectiles (Items from FF-13)

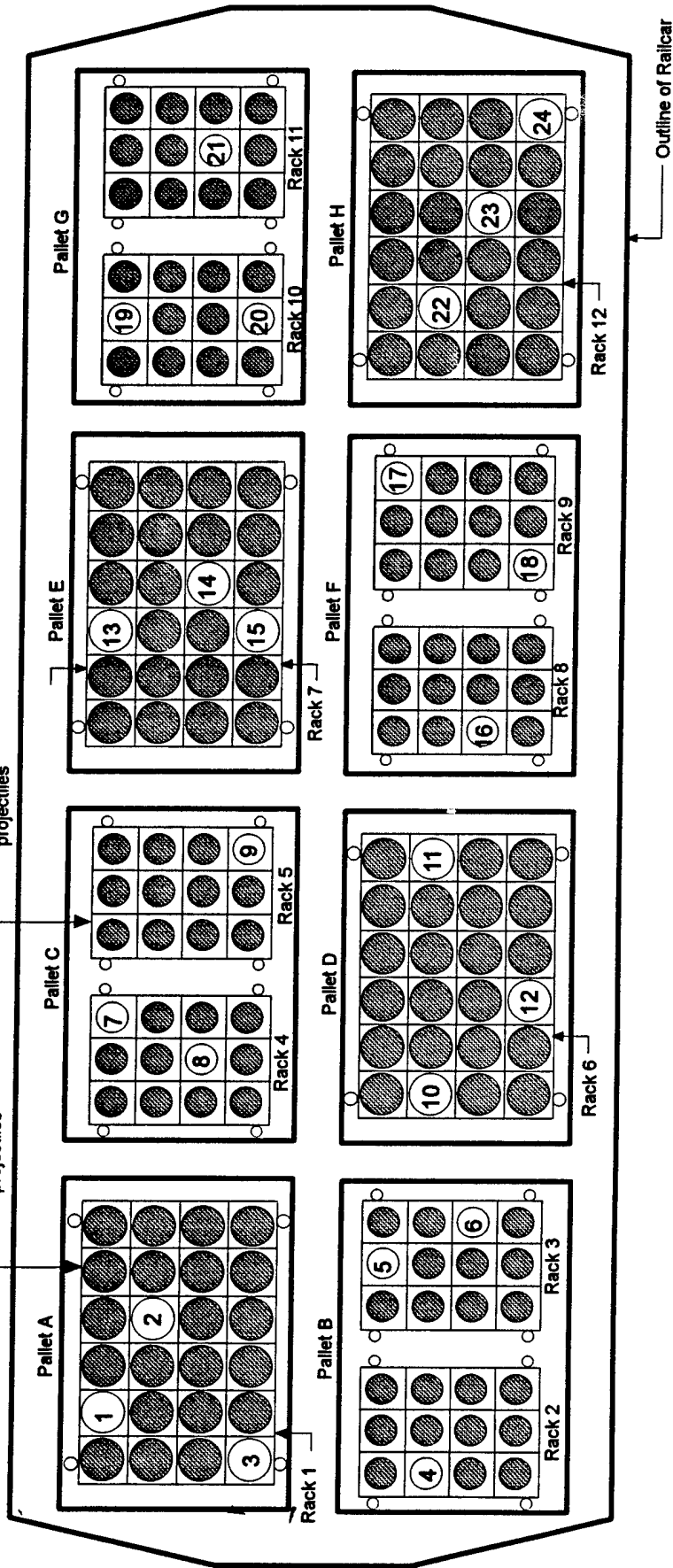
Total Weight, 192 projectiles = 7,296 lbs (3,309 kg)

② Spiked projectile sampled

● Inert projectile added for thermal mass

→ Rack with 5-inch projectiles

→ Rack with 3-inch projectiles



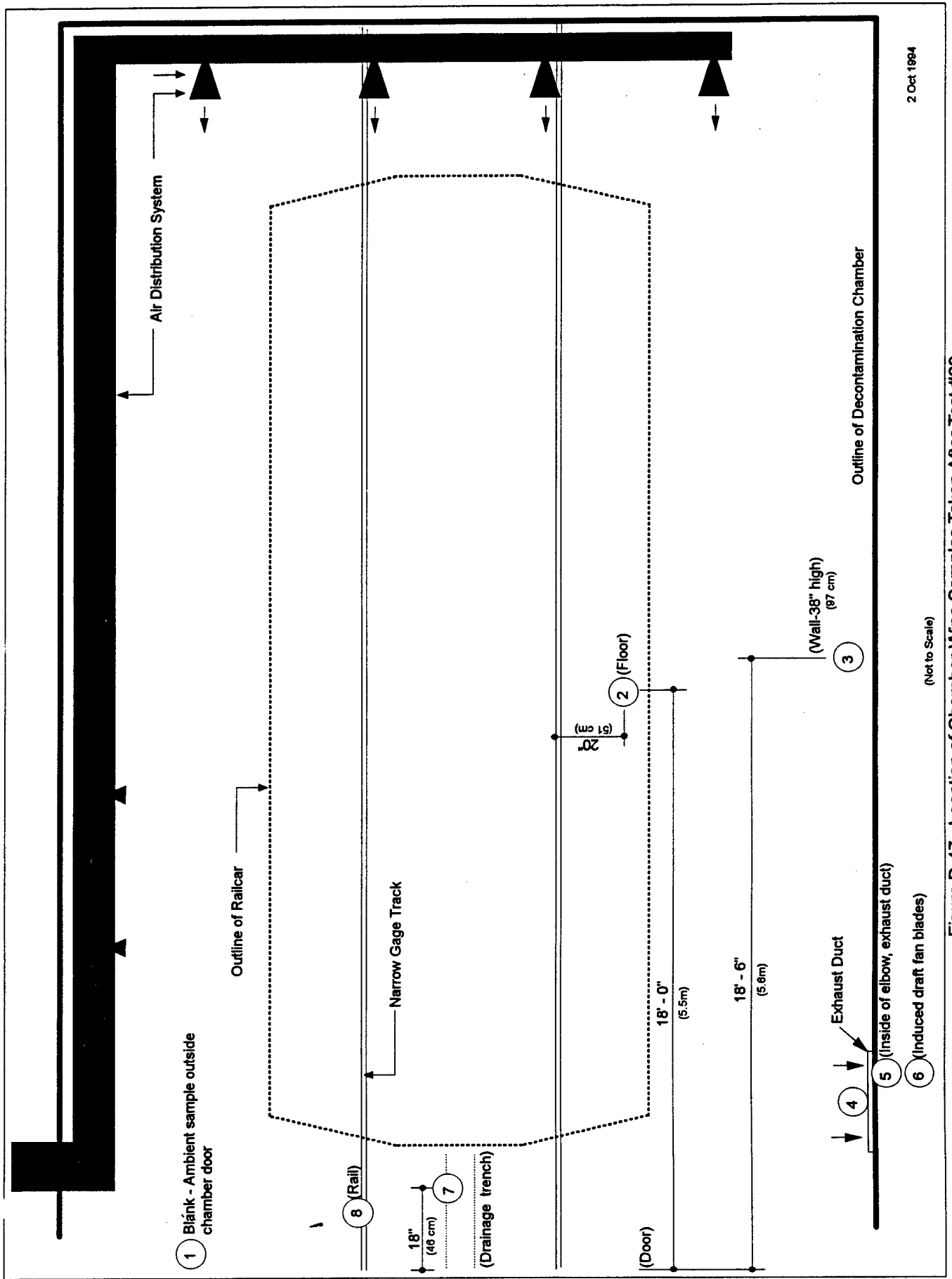
Test 29

(Not to Scale)

2 October 1984
6 Hours at 800 °F / 316 °C

See Figure D-1 for railcar placement in chamber
See Figure D-2 for pallet placement on railcar
See Figure D-3 for 3-inch rack placement on pallets
See Figure D-4 for 5-inch rack placement on pallets

Figure D-46 3-inch / 5-inch Projectiles Spiked with Yellow D



2 Oct 1984

Figure D-47 Location of Chamber Wipe Samples Taken After Test #29

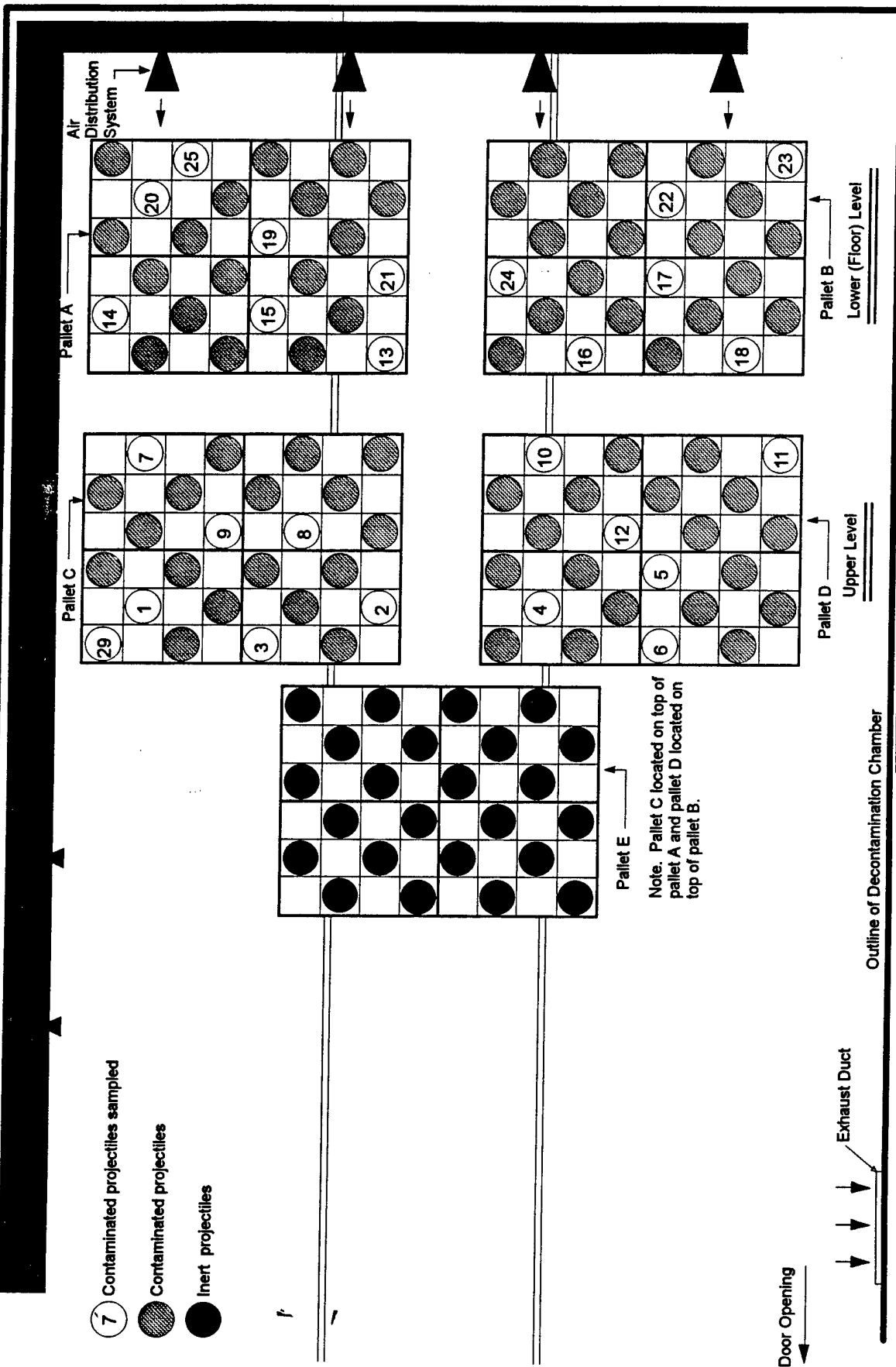
(Not to Scale)

Total Weight, 96 projectiles = 11,040 lbs (5,008 kg)

175mm Projectiles

(Projectiles contained Comp B Residue)

- 7 Contaminated projectiles sampled
- Contaminated projectiles
- Inert projectiles



Note. Pallet C located on top of pallet A and pallet D located on top of pallet B.

See Figure D-6a for 5-inch adaptor placement on pallet

Test "96"
(Not to Scale)

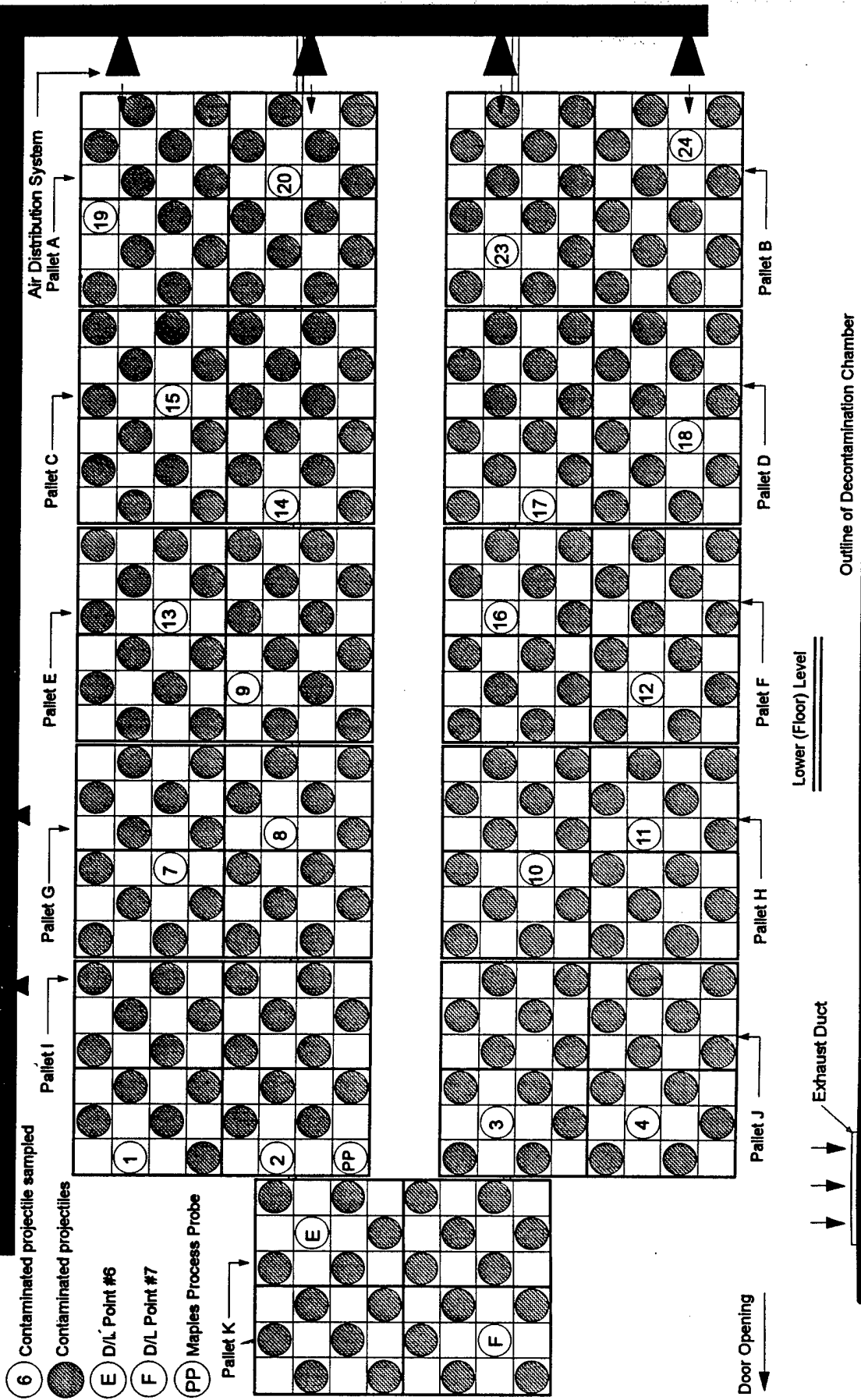
13 October 1994
2 Hours at 550 °F / 288 °C

Figure D-48 175mm Projectiles with Comp B Residue

Total Weight, 480 projectiles = 55,200 lbs (25,038 kg)

175mm Projectiles

(Projectiles contained Comp B Residue)



- 6 Contaminated projectile sampled
- Contaminated projectiles
- E D/L Point #6
- F D/L Point #7
- PP Maples Process Probe
- Pallet K

15 October 1994
6 Hours at 550 °F / 288 °C

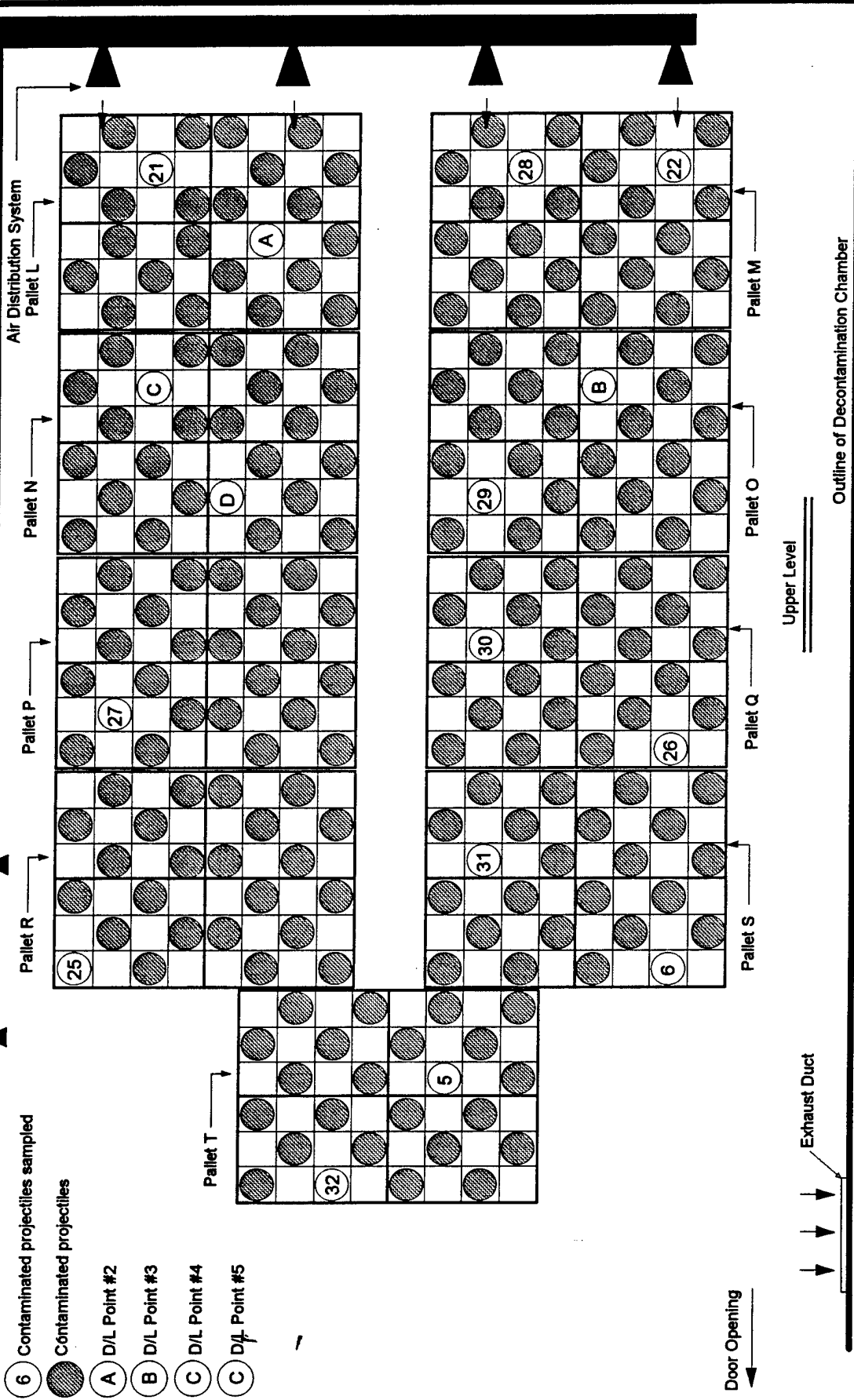
Test 30
(Not to Scale)

See Figure D-6a for 5-inch adaptor placement on pallet

Figure D-49 175mm Projectiles with Comp B Residue - Lower Level - Full Chamber Load

175mm Projectiles

(Projectiles contained Comp B Residue)



15 October 1994
6 Hours at 550 °F / 286 °C

Test 30
(Not to Scale)

See Figure D-6a for 5-inch adaptor placement on pallet

Figure D-49a 175mm Projectiles with Comp B Residue - Upper Level - Full Chamber Load

175mm Projectiles

(Projectiles contained Comp B Residue)

Total Weight, 480 projectiles = 55,200 lbs (25,038 kg)

6 Contaminated projectile sampled

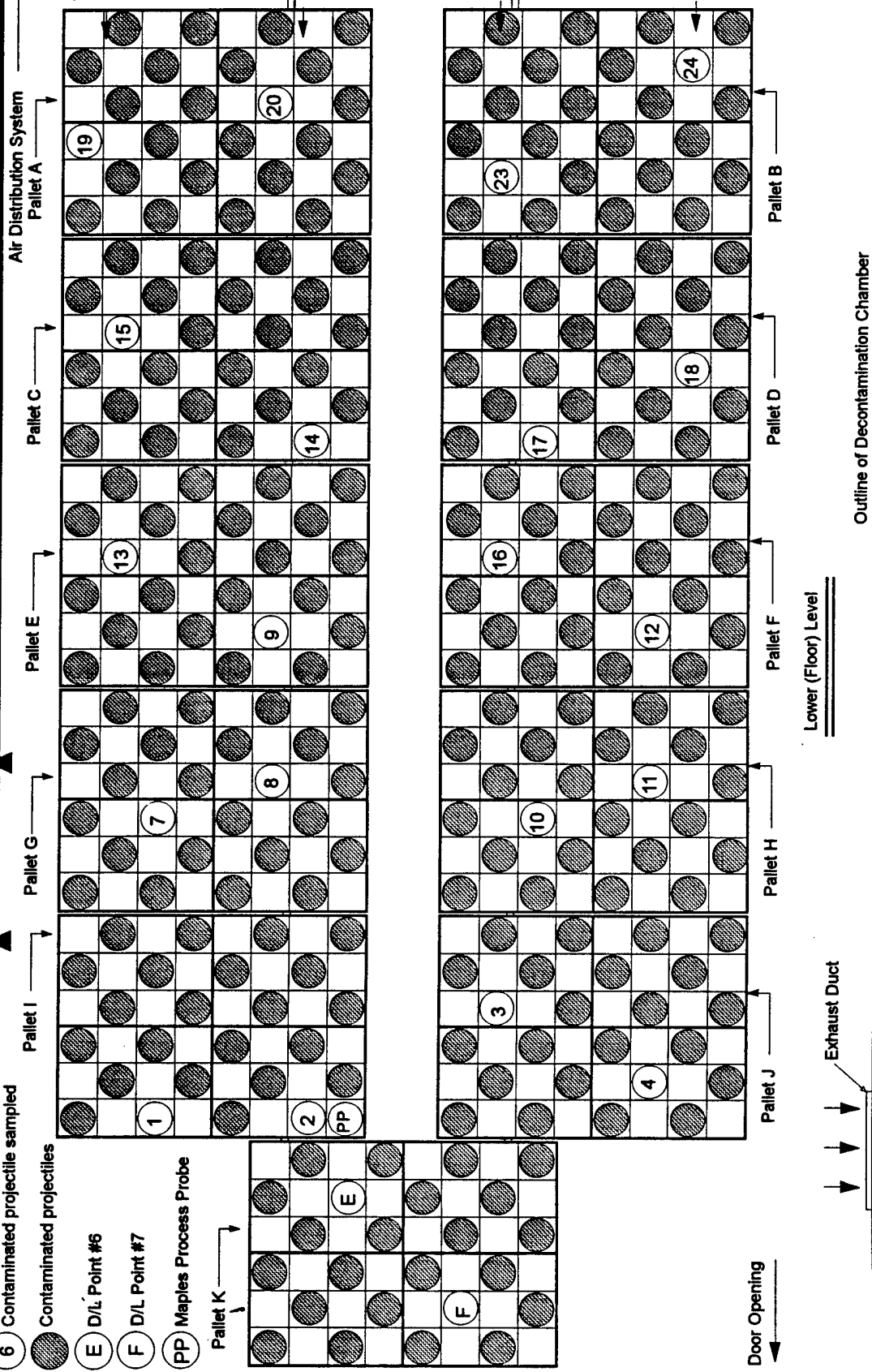
Contaminated projectiles

E D/L Point #6

F D/L Point #7

PP Maples Process Probe

Pallet K



See Figure D-6a for 5-inch adaptor placement on pallet

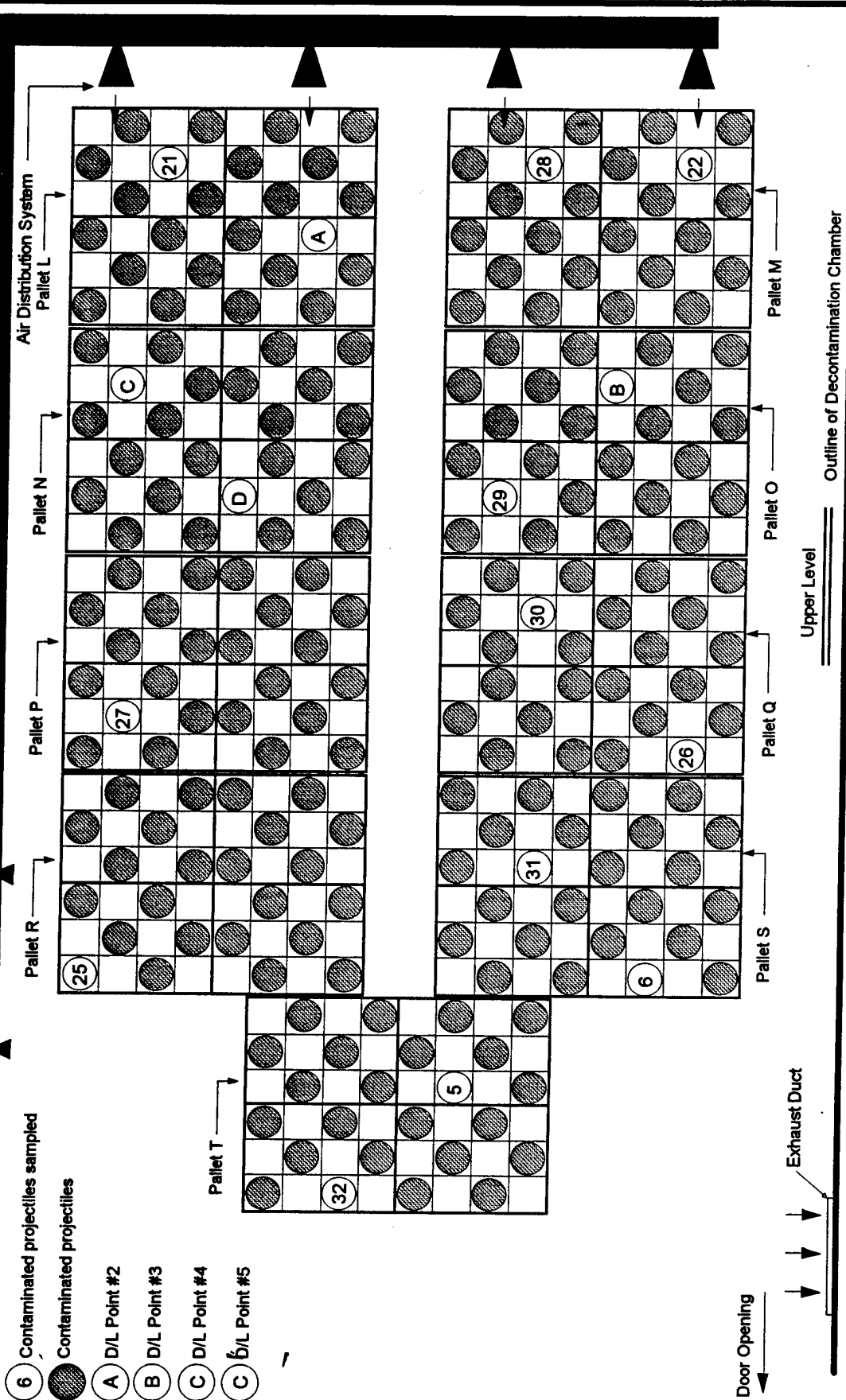
Test 31
(Not to Scale)

19 October 1994
6 Hours at 550 °F / 288 °C

Figure D-50 175mm Projectiles with Comp B Residue - Lower Level - Full Chamber Load

175mm Projectiles

(Projectiles contained Comp B Residue)



See Figure D-6a for 5-inch adaptor placement on pallet

Test 31

(Not to Scale)

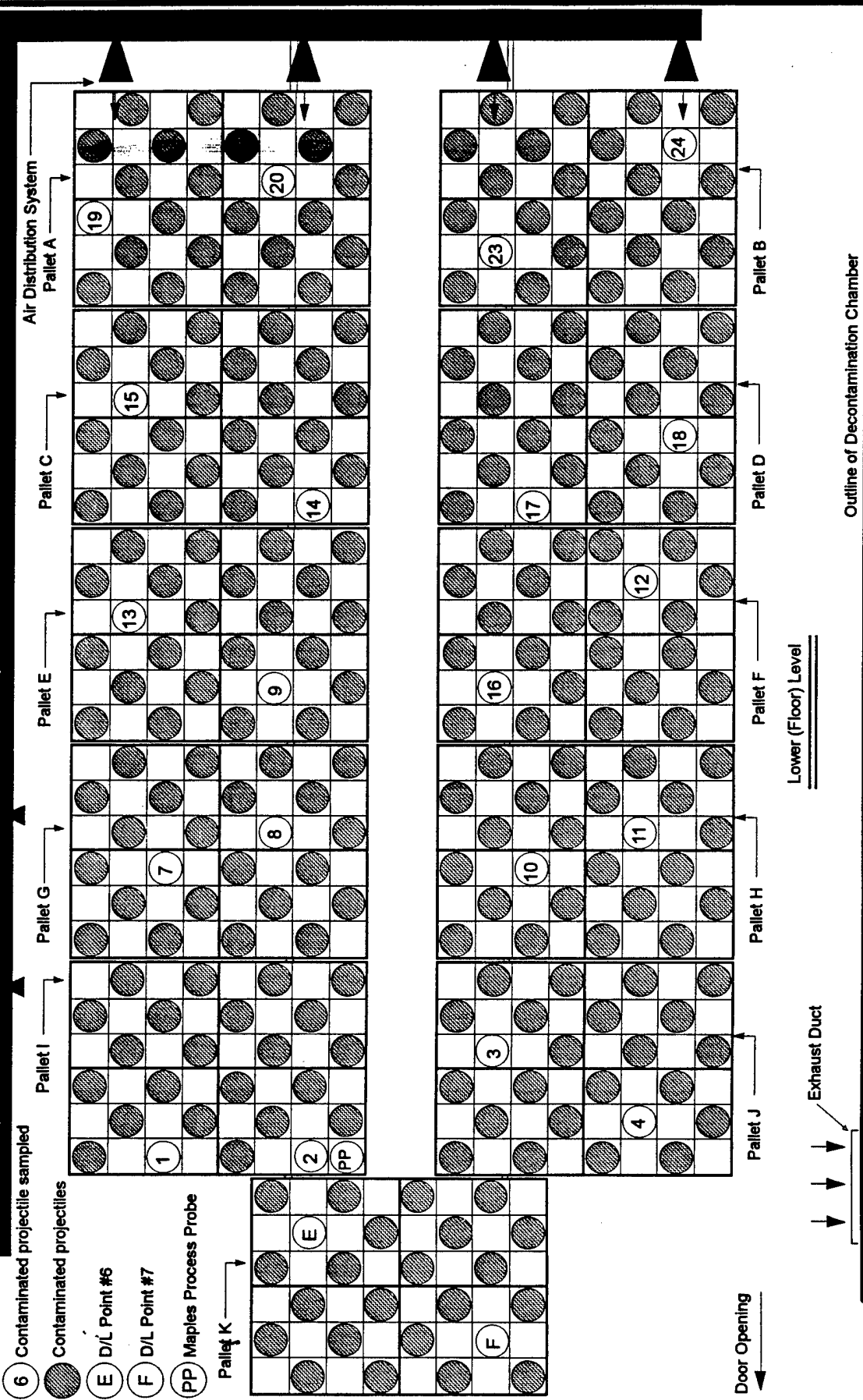
19 October 1994
6 Hours at 550 °F / 288 °C

Figure D-50a 175mm Projectiles with Comp B Residue - Upper Level - Full Chamber Load

175mm Projectiles

(Projectiles contained Comp B Residue)

Total Weight, 480 projectiles = 55,200 lbs (25,038 kg)



- 6 Contaminated projectile sampled
- Contaminated projectiles
- E D/L Point #6
- F D/L Point #7
- PP Maples Process Probe

Test 32
(Not to Scale)

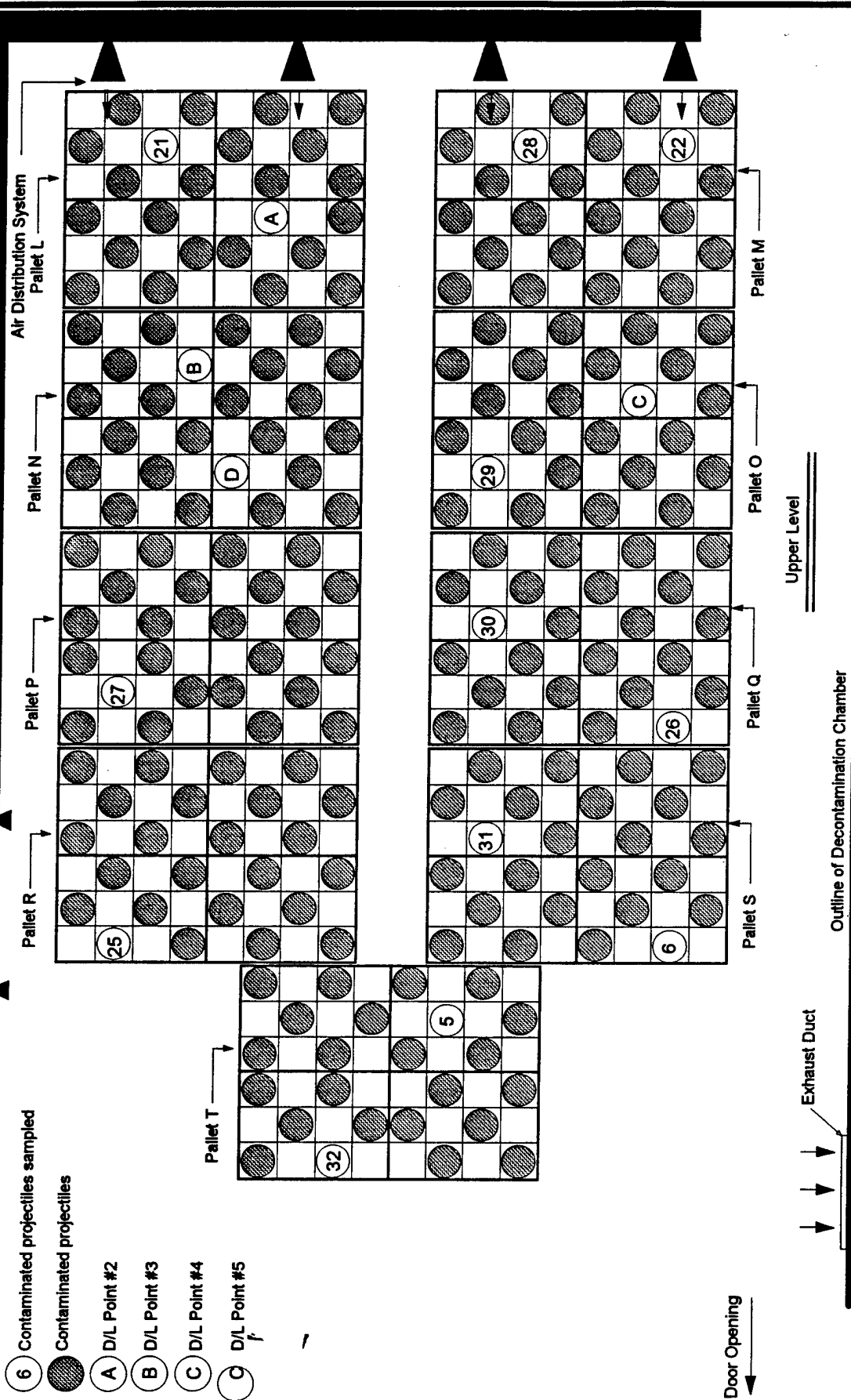
See Figure D-6a for 5-inch adaptor placement on pallet

23 October 1994
6 Hours at 550 ° F / 288 ° C

Figure D-51 175mm Projectiles with Comp B Residue - Lower Level - Full Chamber Load

175mm Projectiles

(Projectiles contained Comp B Residue)



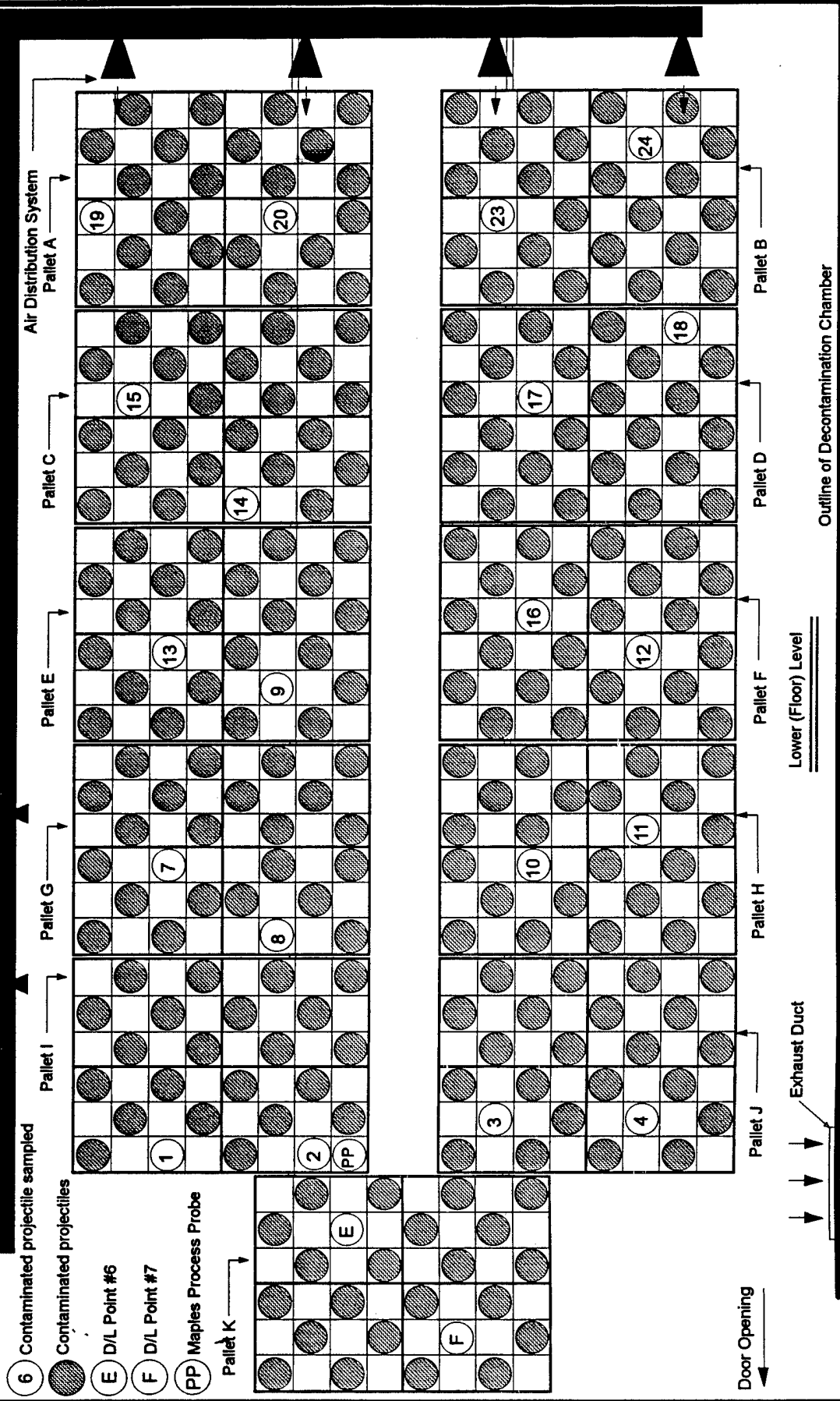
23 October 1994
6 Hours at 550 °F / 288 °C

Figure D-51a 175mm Projectiles with Comp B Residue - Upper Level - Full Chamber Load

See Figure D-6a for 5-Inch adaptor placement on pallet

Total Weight, 480 projectiles = 55,200 lbs (25,038 kg)

175mm Projectiles (Projectiles contained Comp B Residue)



- ⑥ Contaminated projectile sampled
- Contaminated projectiles
- ⊙ E D/L Point #6
- ⊙ F D/L Point #7
- ⊙ PP Maples Process Probe

Test 33
(Not to Scale)

See Figure D-6a for 5-inch adaptor placement on pallet

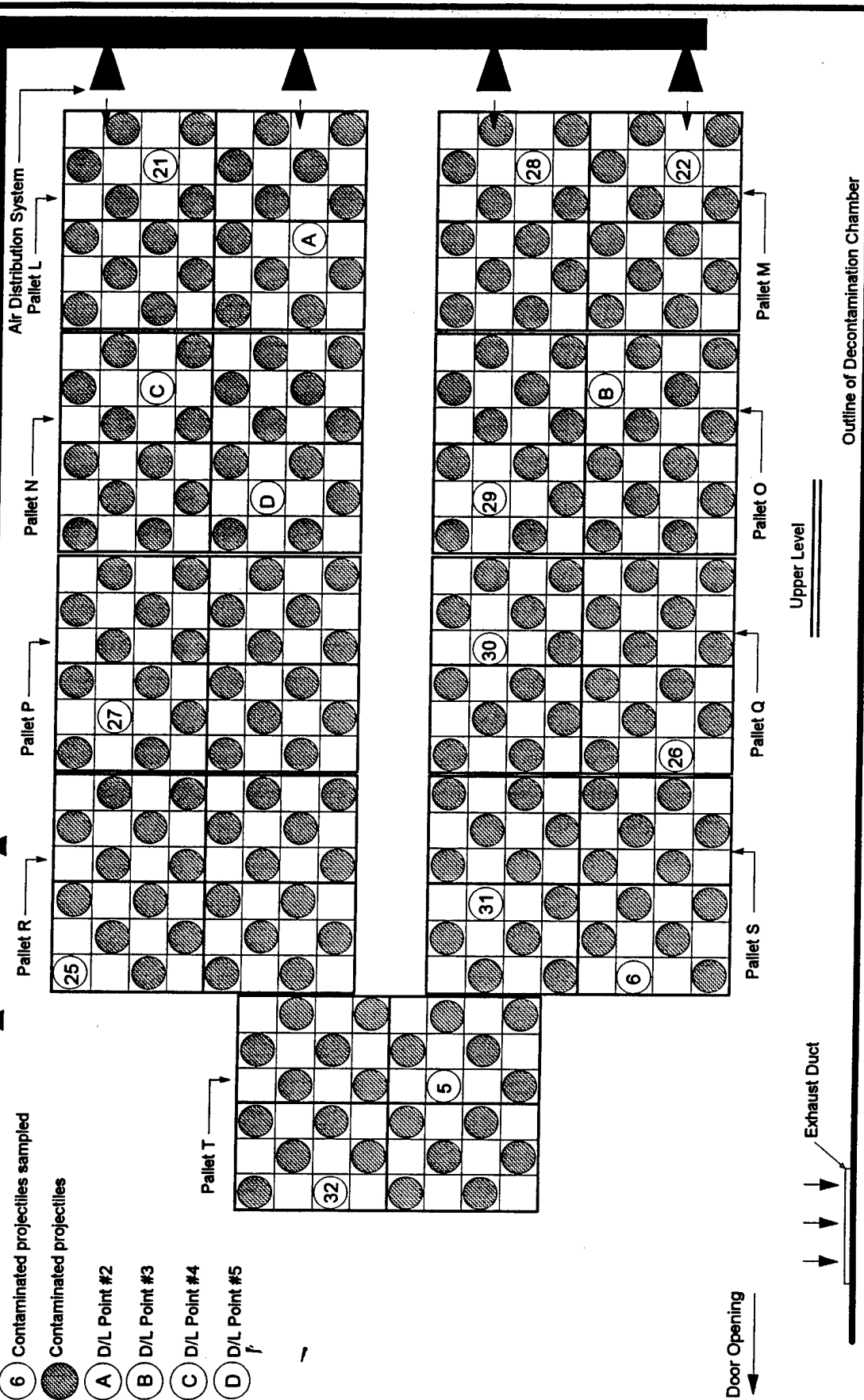
28 October 1984
6 Hours at 550 ° F / 288 ° C

Figure D-52 175mm Projectiles with Comp B Residue - Lower Level - Full Chamber Load

175mm Projectiles

(Projectiles contained Comp B Residue)

- 6 Contaminated projectiles sampled
- Contaminated projectiles
- A D/L Point #2
- B D/L Point #3
- C D/L Point #4
- D D/L Point #5



See Figure D-6a for 5-inch adaptor placement on pallet

Test 33
(Not to Scale)

26 October 1964
8 Hours at 550 °F / 288 °C

Figure D-52a 175mm Projectiles with Comp B Residue - Upper Level - Full Chamber Load

175mm Projectiles

(Projectiles contained Comp B Residue)

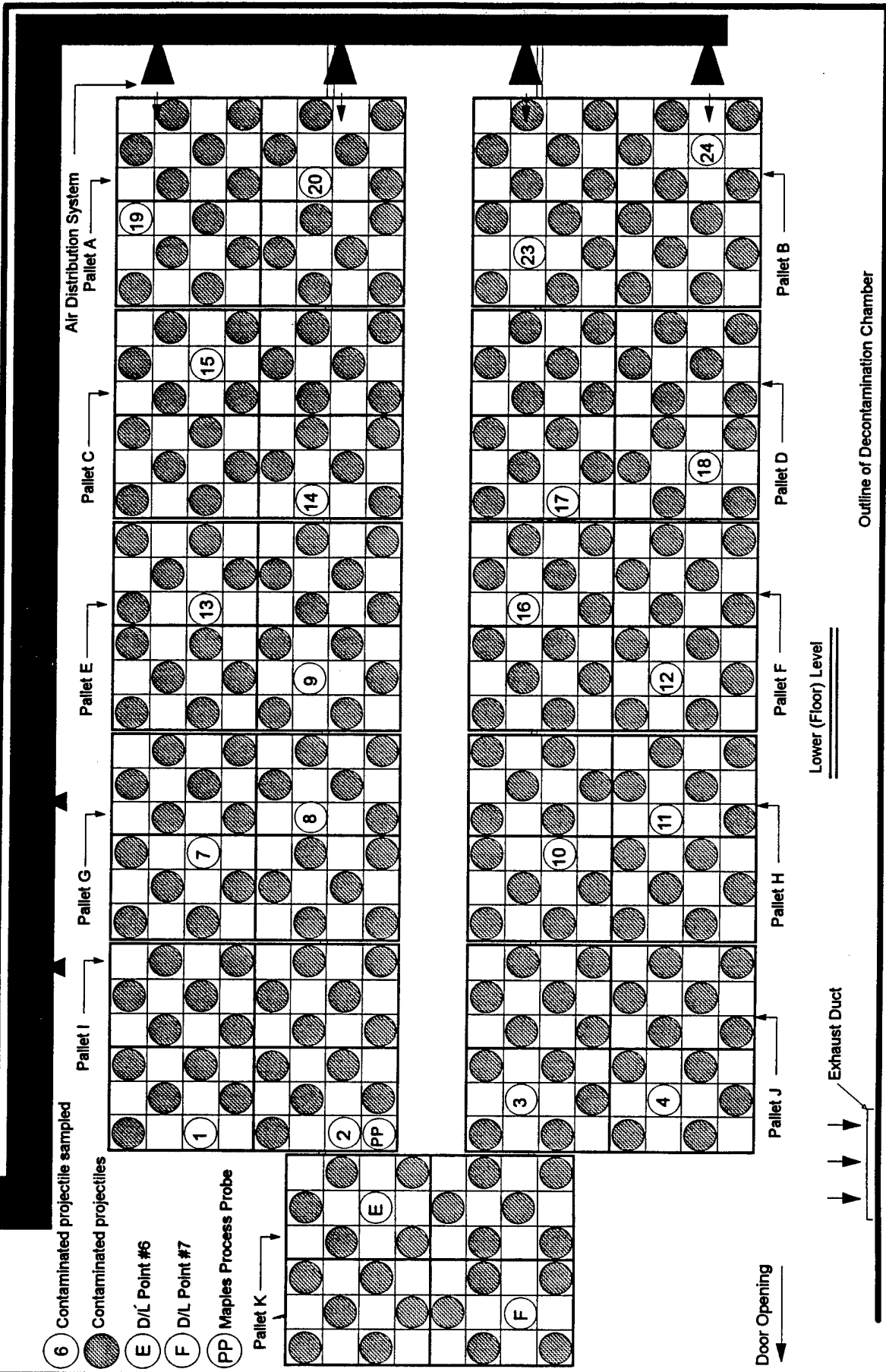
Total Weight, 480 projectiles = 55,200 lbs (25,038 kg)

- 6 Contaminated projectile sampled
- Contaminated projectiles

E D/L Point #6

F D/L Point #7

PP Maples Process Probe



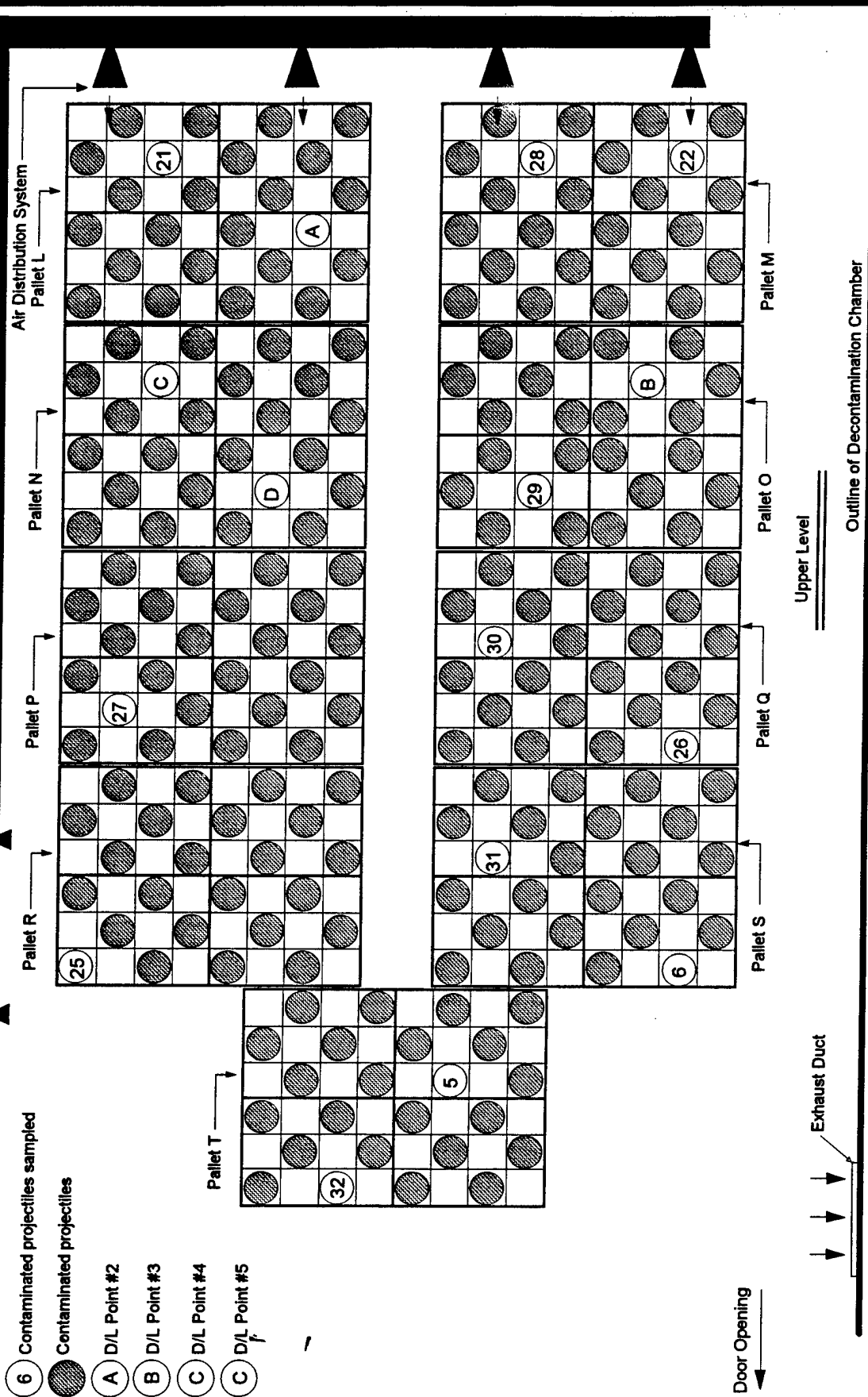
28 October 1984
6 Hours at 550 ° F / 288 ° C

Test 34
(Not to Scale)

See Figure d-6a for 5-inch adaptor placement on pallet

Figure D-53 175mm Projectiles with Comp B Residue - Lower Level - Full Chamber Load

175mm Projectiles (Projectiles contained Comp B Residue)



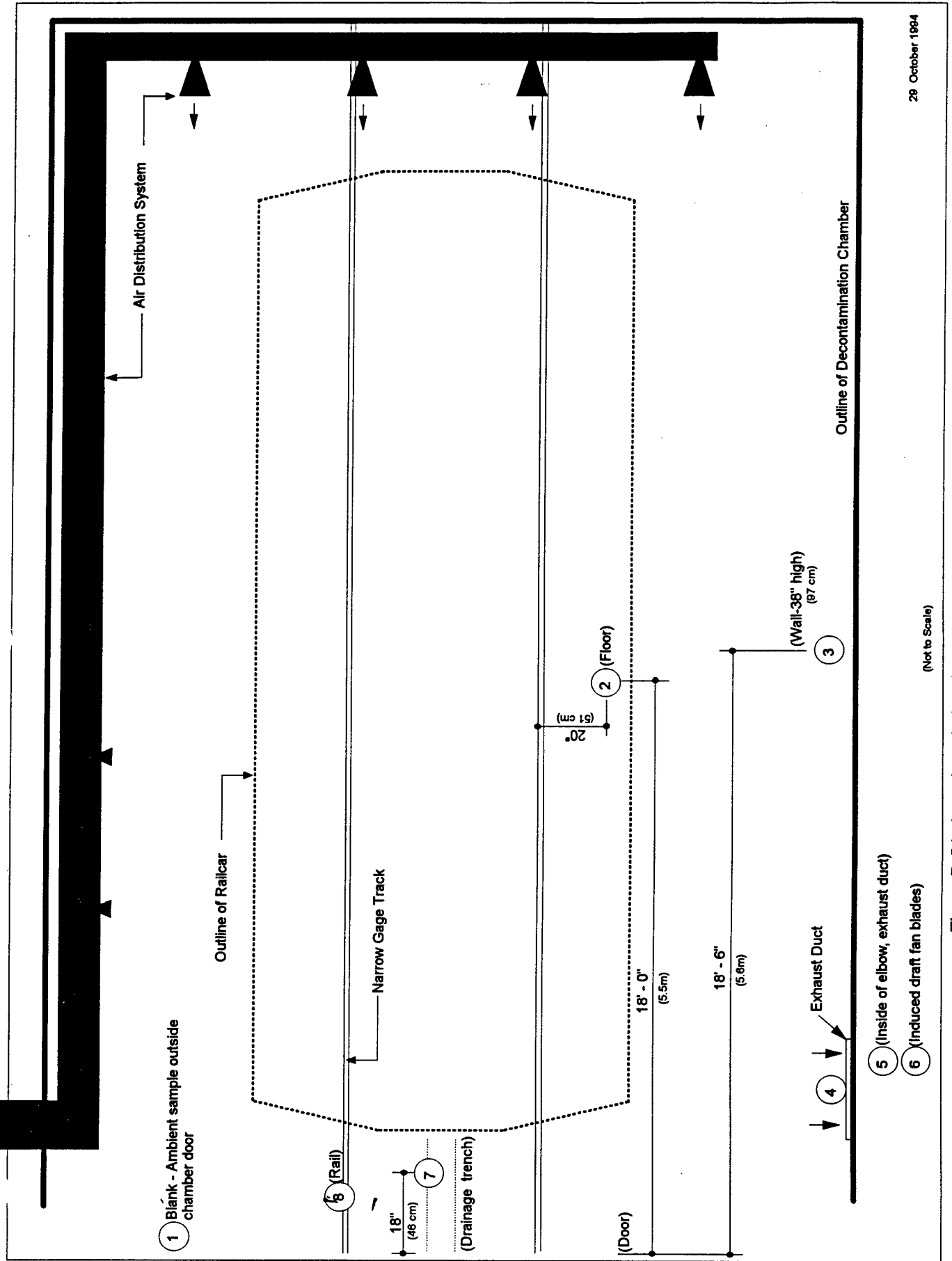
See Figure D-6a for 5-inch adaptor placement on pallet

Test 34

(Not to Scale)

29 October 1994
6 Hours at 550 °F / 286 °C

Figure D-53a 175mm Projectiles with Comp B Residue - Upper Level - Full Chamber Load



29 October 1994

Figure D-54 Location of Chamber Wipe Samples Taken After Test #34

APPENDIX E

PHOTOGRAPHS

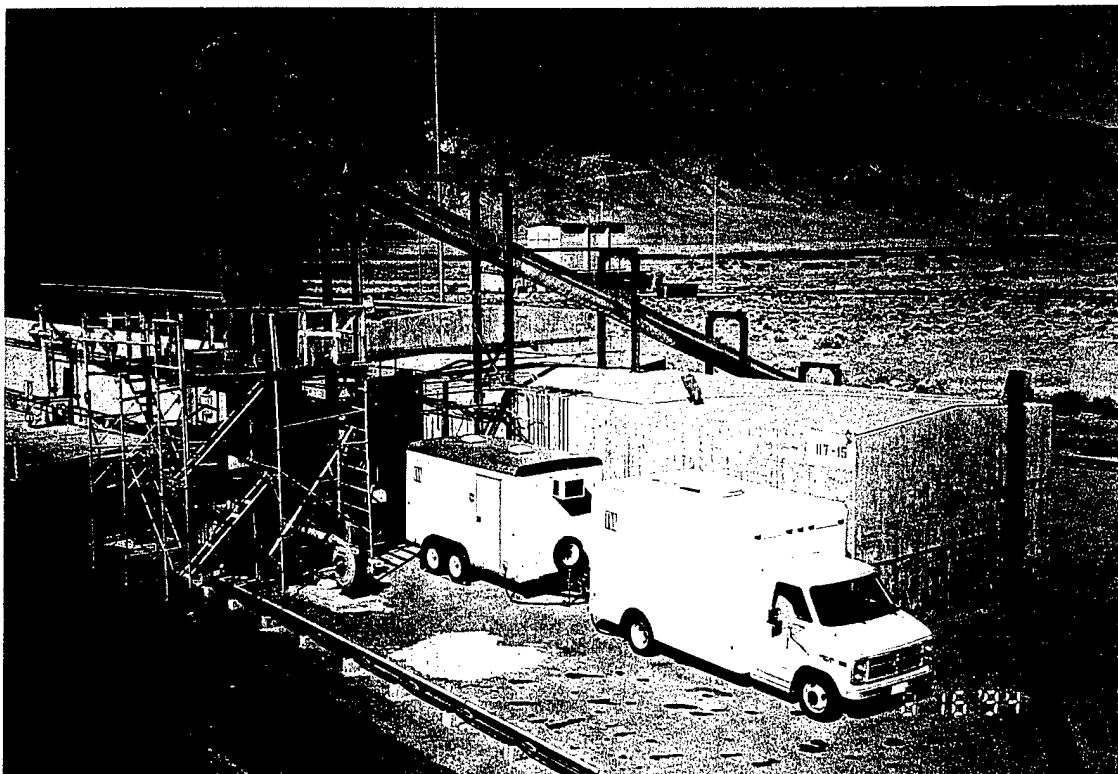


Photo E-1: Overview of Building 117-15, Facing Northwest.

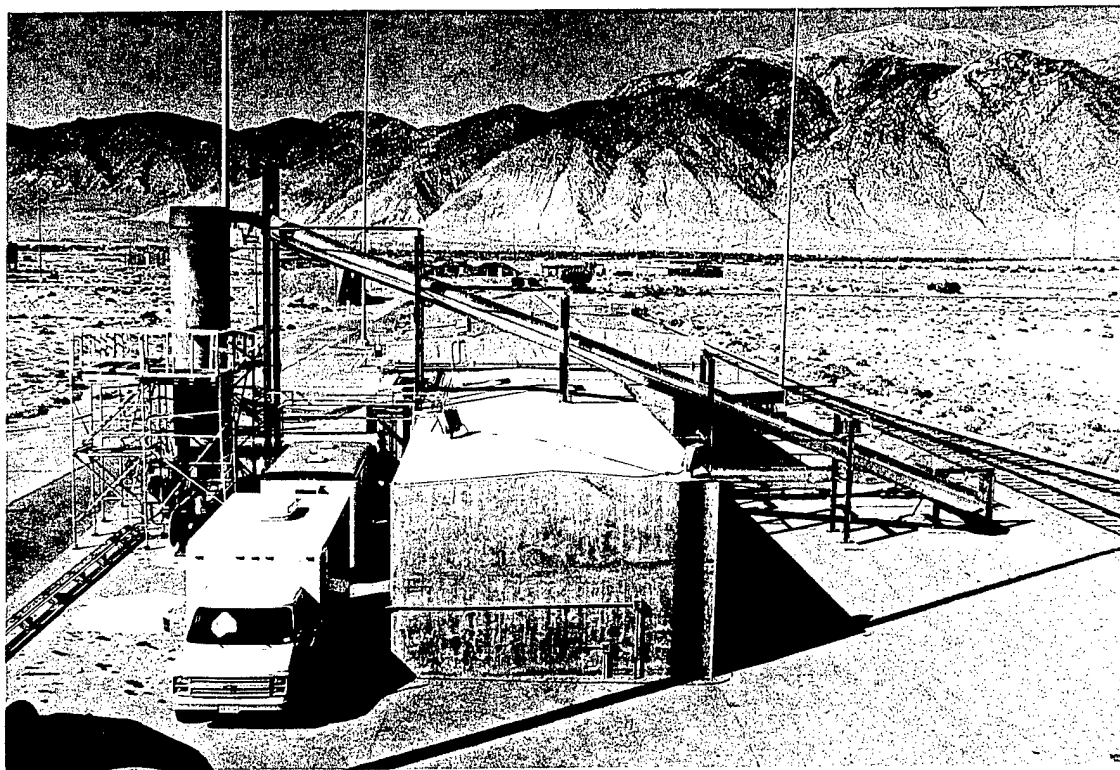


Photo E-2: Overview of Building 117-15, Facing West.

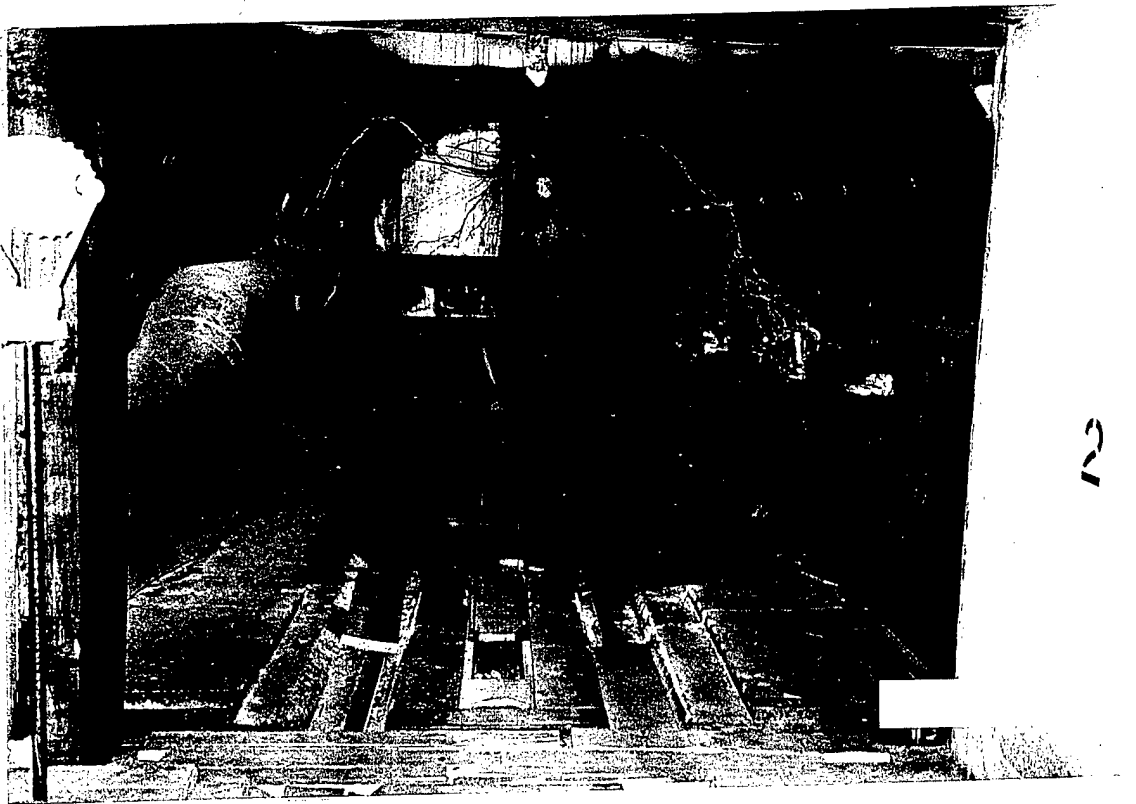


Photo E-3. End View of Chamber.



Photo E-4: End View of Hot Gas Diffusers Inside the Chamber.

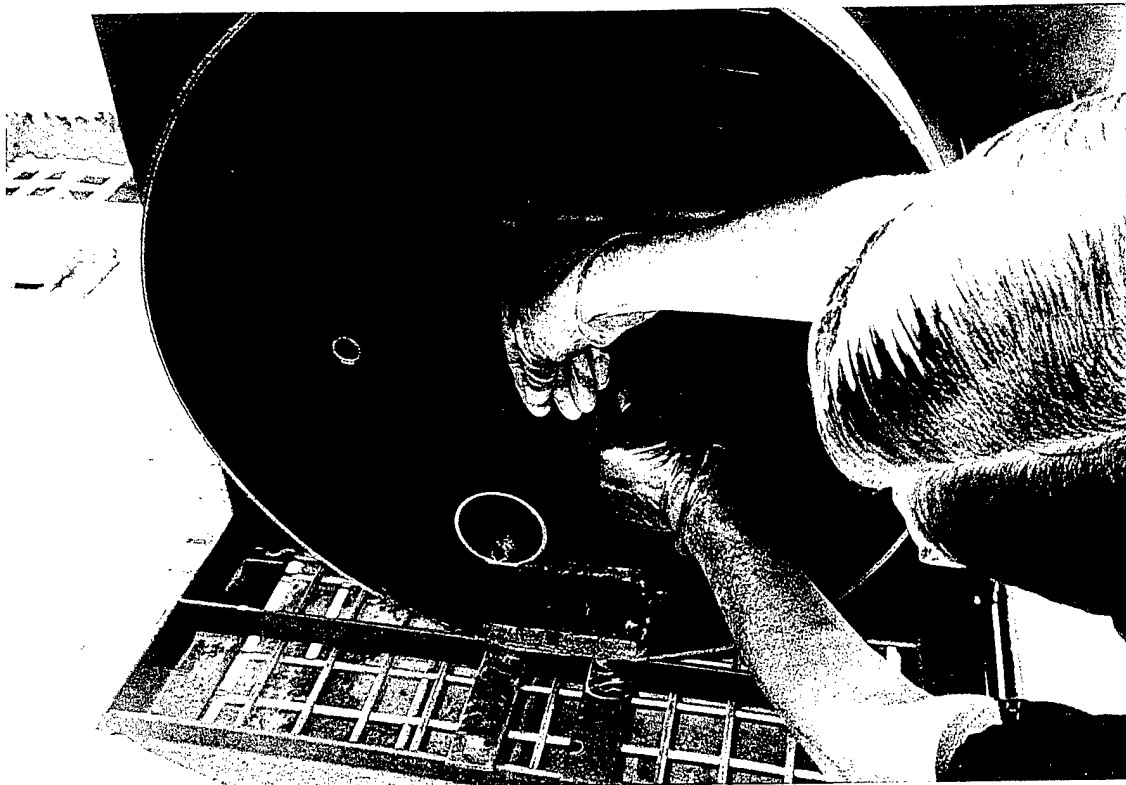


Photo E-5: Spiking Procedure for a MK 25 Ship Mine.



Photo E-6: Sampling Procedure for a 3-inch Projectile.

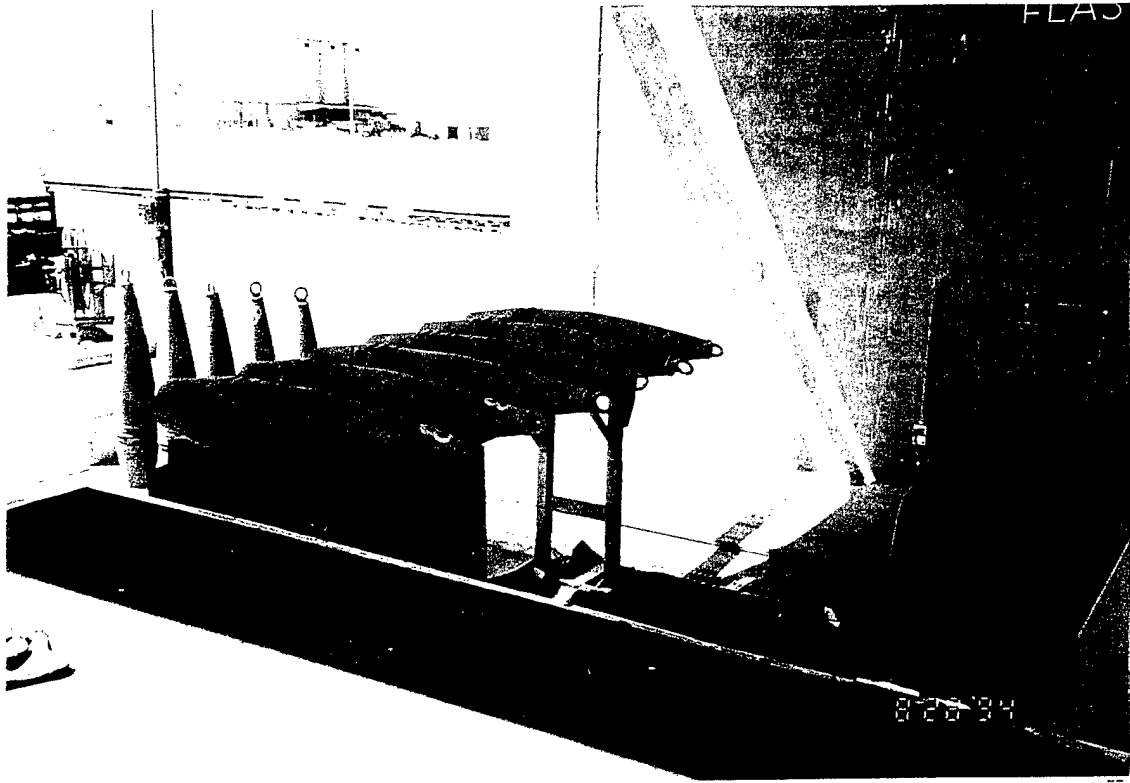


Photo E-7: Apparatus Used to Roll Projectiles During Projectile Extraction Sampling.

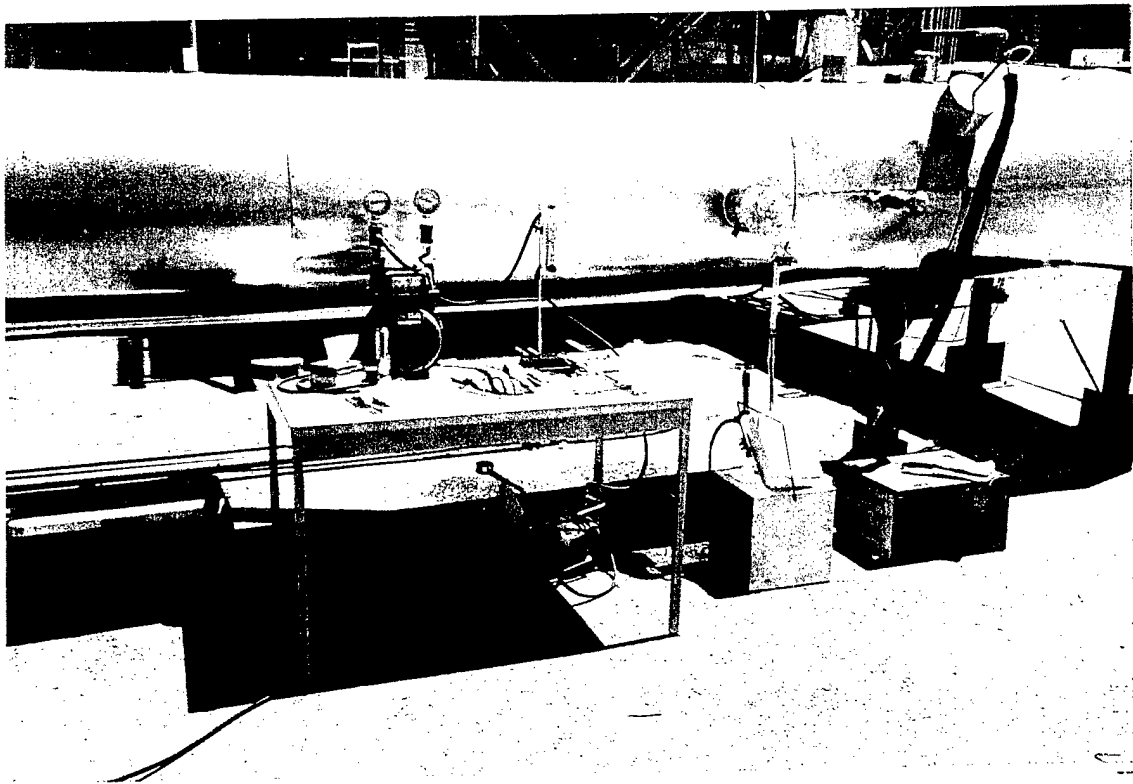


Photo E-8: Arrangement of TVA Gas Sampling Train for the Chamber Discharge Duct.

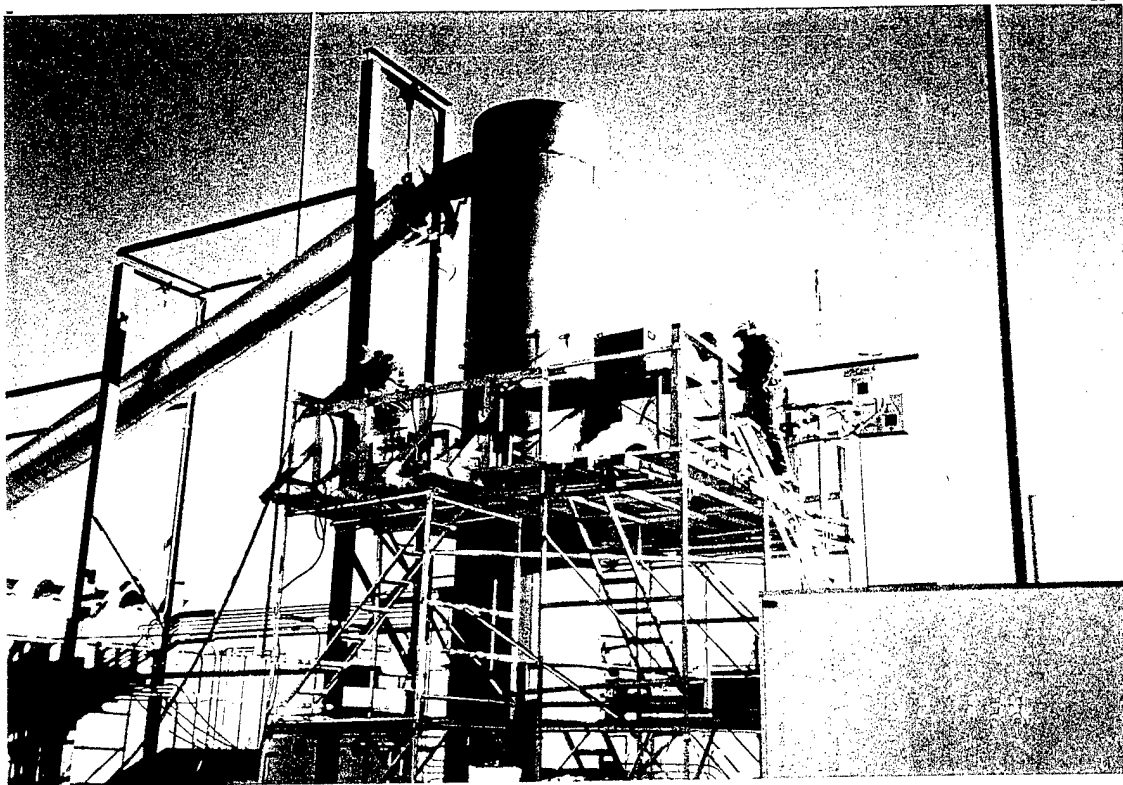


Photo E-9: View of Sampling Train Used by USACHPPM To Conduct Atmospheric Emissions Sampling of The Thermal Oxidizer Stack.



Photo E-10: Untreated (Right) and Treated (Left) MK 54 Depth Bombs (sawed base end).

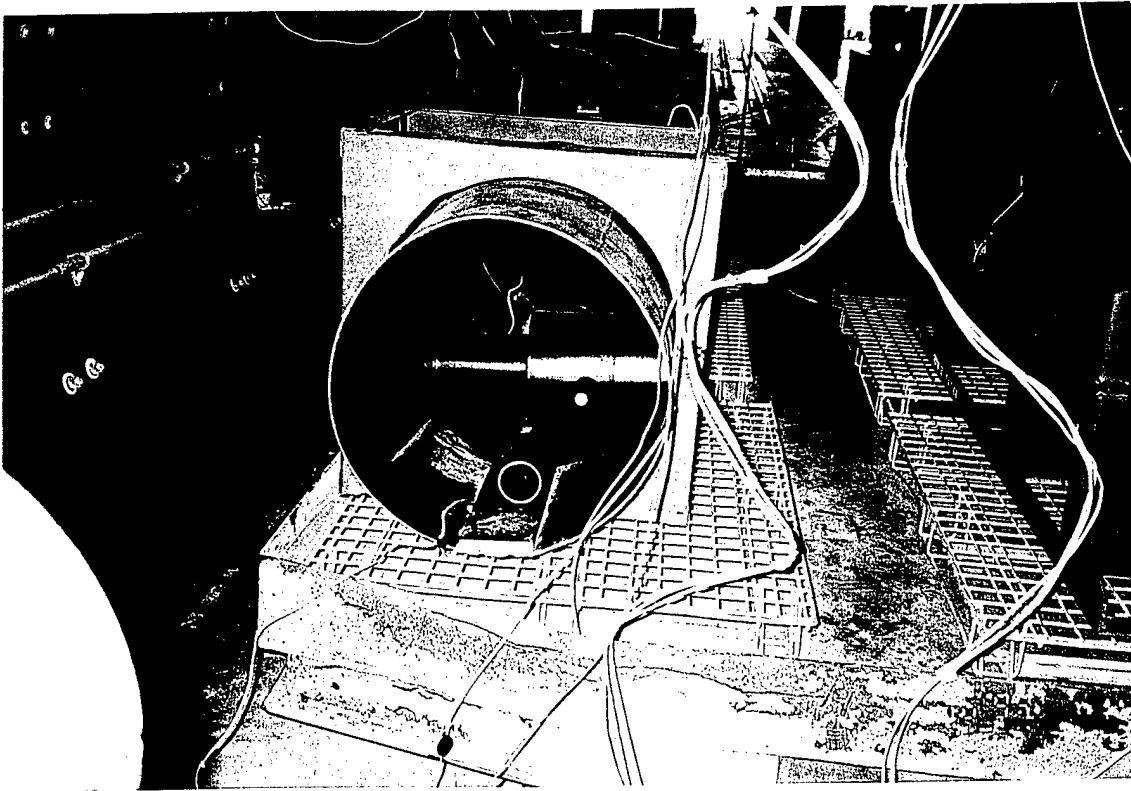


Photo E-11: Untreated MK 25 Ship Mine (Sawed End).



Photo E-12: Treated MK 25 Ship Mine (Sawed End).

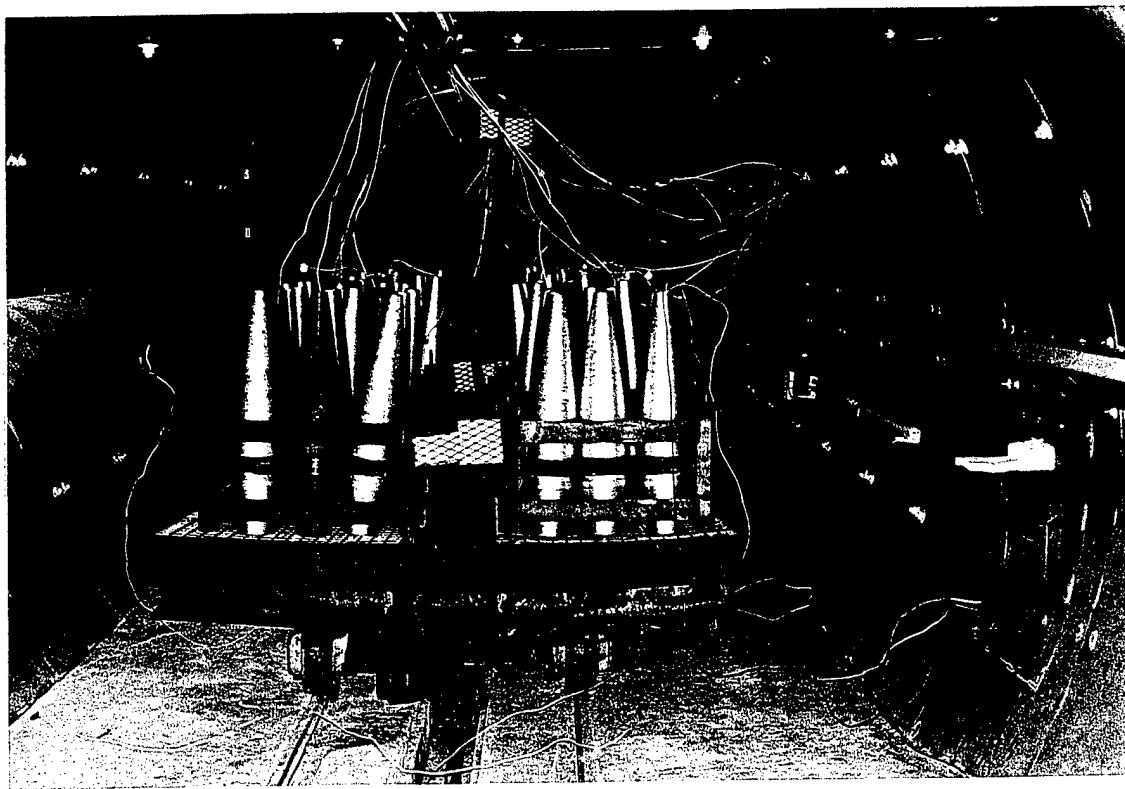


Photo E-13: Location of Insulation Samples on the Railcar, Above the Railcar, and on the South Chamber Wall.



Photo E-14: Chamber Exhaust Duct Insulation Sample.

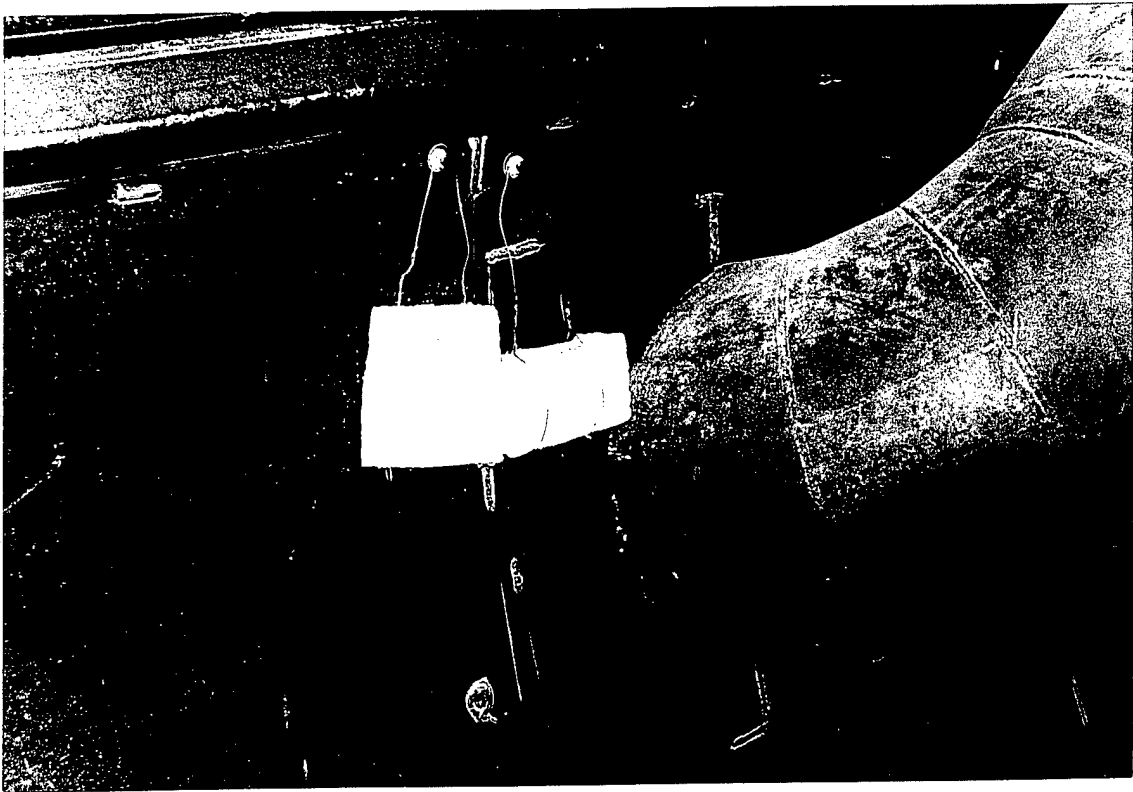


Photo E-15: Chamber Inlet Duct Insulation Sample.

APPENDIX F

TEST DATA

This Appendix includes the following detailed information for each test conducted during this field demonstration program.

- Narrative of test conditions
- Analytical data
 - Projectile extractions samples
 - Ship mine/depth bomb and chamber wipe samples
 - Insulation samples
- Temperature data
 - These figures depict temperature fluctuations (sinusoidal wave) caused by the faulty process control system. The control system was fine tuned during the early tests to minimize these fluctuations.
 - Data was collected for all of the temperature probes monitoring the system. However, data was only plotted for four of these points (adjacent to process probe, coldest, intermediate, and hottest) in order to depict temperature trends.
 - The datalogging frequency was increased from 15 minutes to 15 seconds after Test 26 to depict the temperature spikes that resulted from thermal degradation of the explosive residue.
- Continuous emission monitor data
 - These figures depict the daily automatic analyzer calibration spikes, the deviations from test conditions (system shutdowns) and increased activity which corresponds to the sublimation/thermal degradation of the explosive residue.

Table F-1

SPECIAL TEST SAMPLES

Test # A	Chamber Load:	<u>NA</u>	Date:	<u>NA</u>
	Explosive Type:	<u>NA</u>	Heatup Time:	<u>NA</u>
	Explosive Source:	<u>NA</u>	Time at Setpoint:	<u>NA</u>
	Temperature Setpoint:	<u>NA</u>	Cooldown Time:	<u>NA</u>

This test was deleted from the final plan.

NA= Not Applicable

Test B

Process Conditions

This test was conducted on 96 inert 175mm projectiles in a railcar configuration as shown in Figure D-10. The test conditions were 6 hrs at 500°F (260°C) ; then 24 hrs at 700°F (371°C). The oxidizer was started at 1538 hrs on 22 June and the system was "in process" at 1644 hrs. The system attained "steady state" at 500°F (260°C) at 2336 hrs. At 0811 hrs on 23 June the chamber setpoint was increased to 850°F (454°C). The test was concluded at 1500 hrs on 24 June with an operator initiated "cooldown". Since 850°F (454°C) could not be attained, 700°F (371°C) was established as the upper limit for this test.

Special Conditions

- Test was performed to establish the temperature profile for a typical railcar configuration of items to be tested and to establish the maximum practicable operating temperature of the system.

Analytical Considerations

- Chamber wipe samples (Figure 4.1) were taken the next afternoon. Wipe samples were taken from several locations inside the chamber, from the exhaust duct, and from the induced draft fan. The location of the samples is listed in Section 4.1.4.
- Analytical results showed explosive residues present in all samples. This was likely due to cross-contamination of the wipe samples. Yet there was no significant quantity of explosive present.

Comments

- The control temperature did not significantly exceed 700°F (371°C) even after 30 hours of continuous heating. The system had reached but not sustained 800°F (427°C) during proveout tests by DZB in 1993. A number of reasons for the shortfall in temperature were considered, including the difference in railcar configuration and thermocouple placement.

- "In process" - hot gas from the exhaust stack was circulating through the chamber.
- "Steady state" - temperature of Maples control thermocouple had reached set point and system clock had begun to count time at set point.
- "Cooldown" - ambient air was circulating through the chamber.

Table F-2

SPECIAL TEST SAMPLES

Test # B	Chamber Load:	175 mm	Date:	22 Jun 94
	Explosive Type:	None	Heatup Time:	7.9 Hrs
	Explosive Source:	None	Time at Setpoint:	8.6 hrs @500°F 30.8 hrs @700°F
	Temperature Setpoint:	500°F & 700°F 260°C & 371°C	Cooldown Time:	NR

Sample Description / Location	Explosive Concentration / Sample		Explosive Amount	Explosive Amount / Surface Area
	µg / sample RDX	µg / sample TNT	µg	mg / cm ²
Floor	6.2654	<MDL	6.2654	3.8916E-05
Wall	2.2443	<MDL	2.2443	1.3940E-05
Duct	2.5716	<MDL	2.5716	1.5973E-05
Elbow	1.7768	<MDL	1.7768	1.1036E-05
Fan	1.7768	<MDL	1.7768	1.1036E-05
Coldspot	2.7119	1.8398	4.5517	2.8271E-05
Rail	0.9819	0.7296	1.7115	1.0630E-05
Blank	6.1719	1.364	7.5359	NA

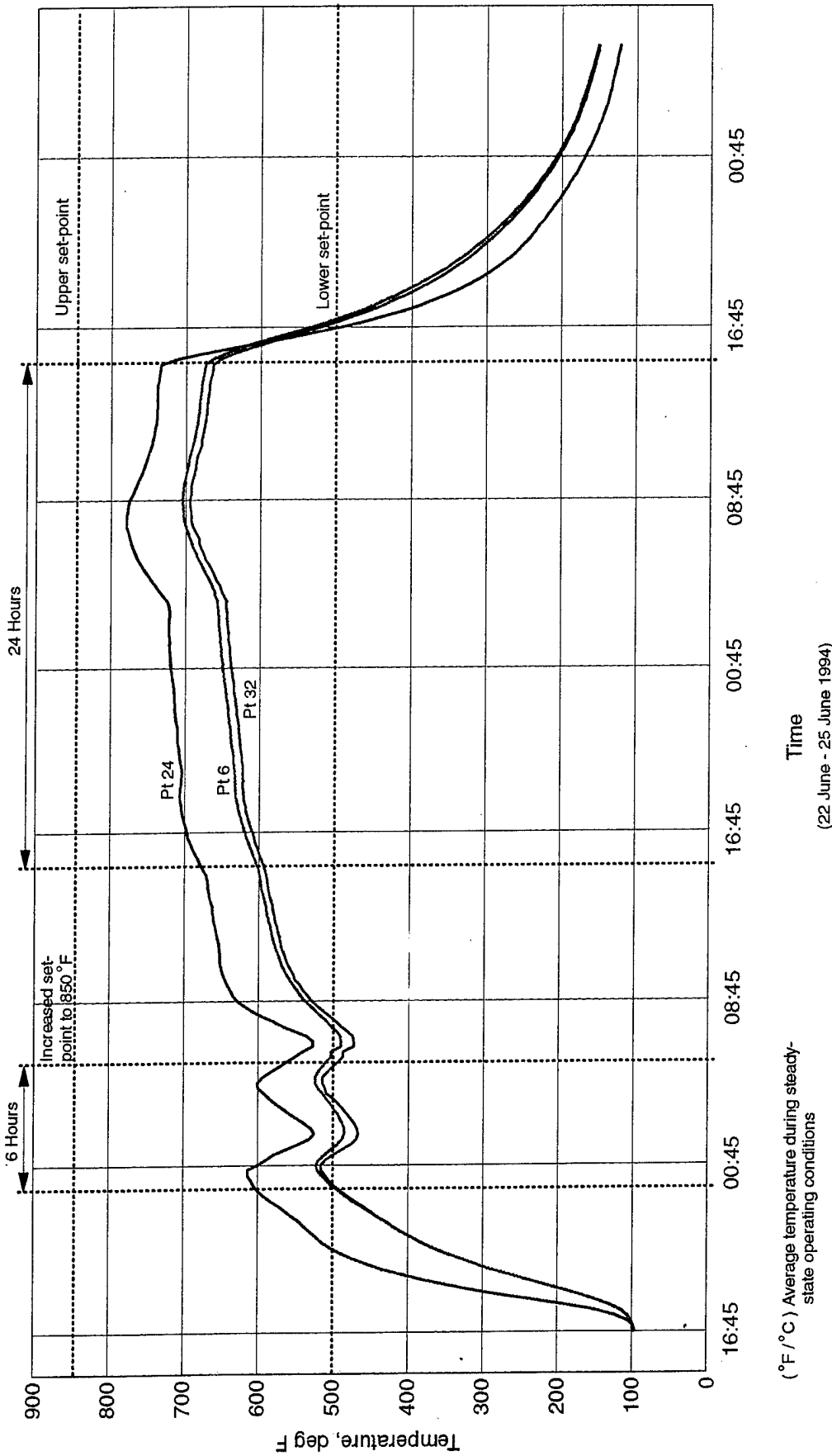
Special Abbreviations: NA=Not Applicable; ND=Not Detectable; NR=No Record

MDL for Analysis: 0.7 µg/sample RDX
0.3 µg/sample TNT

Smear Surface Area: 161 sq cm

HGD Test B

175 mm Projectiles - (96 Inert Rounds)



(°F / °C) Average temperature during steady-state operating conditions

Pt 32 (adjacent to process probe) (601 °F / 316 °C)
 Pt 6 (coldest) (612 °F / 322 °C)
 Pt 24 (hottest) (716 °F / 380 °C)

Time
(22 June - 25 June 1994)

Figure F-1 Test B - Average Temperature Profile - 15 minute Intervals

TEST 1

Process Conditions

This test was conducted on 192 3-inch projectiles in a railcar configuration as shown in Figure D-11. Twenty-four of the projectiles were spiked with TNT. The test conditions were 6 hrs at 500°F (260°C). The oxidizer was started at 0430 hrs on 26 June and went in process about 45 minutes later. The system reached steady state at 0918 hrs and the test was completed at 1533 hrs with an operator initiated cooldown of the system.

Analytical Considerations

- The projectiles were spiked by evaporation of a solution of TNT (reclaimed from demilitarized munitions) in acetonitrile.
- The spiked projectiles were sampled the next day. Chemical analysis revealed substantial residues of TNT and RDX. The likely source of cross-contamination was the nose plugs used to close the projectiles during sample extraction. Either new nose plugs or plugs decontaminated in the flash furnace were used for sample extraction in later tests. Analytical data for this test was considered not usable.

Table F-3

PROJECTILE EXTRACT SAMPLES

Test # <u>1</u>	Projectile Type:	<u>3-inch</u>	Date:	<u>26 Jun 94</u>
	Explosive Type:	<u>TNT</u>	Heatup Time:	<u>NR</u>
	Explosive Source:	<u>Spiked</u>	Time at Setpoint:	<u>NR</u>
	Temperature Setpoint:	<u>500°F</u> <u>260°C</u>	Cooldown Time:	<u>NR</u>

No usable analytical results.

NR=No Record.

TEST 3

Process Conditions

This test was conducted on a railcar of 96 175mm projectiles as shown in Figure D-12. Twenty-four of the projectiles were spiked with Comp B explosive. The test conditions were 6 hrs at 500°F (260°C). The oxidizer was started at 0102 hrs on 28 June with hot gas delivered to the chamber about 45 minutes later. The system reached steady state at 0739 hrs. The test was completed and cooldown of the system began at 1340 hrs.

Special Conditions

- Evaporation of the solution was slow so the test was started with the spike deposits of explosive still damp.

Analytical Considerations

- The projectiles were spiked by evaporation of a solution of Comp B in acetonitrile.
- Projectile and chamber wipe samples were taken the next day.
- Samples had organic contamination which was likely due to lubricants from the new nose plugs used during extraction. The analytical data from these sample were not usable due to the contamination.

Table F-4

PROJECTILE EXTRACT SAMPLES

Test # <u>3</u>	Projectile Type:	<u>175mm</u>	Date:	<u>28 Jun 94</u>
	Explosive Type:	<u>Comp B</u>	Heatup Time:	<u>NR</u>
	Explosive Source:	<u>Spiked</u>	Time at Setpoint:	<u>NR</u>
	Temperature Setpoint:	<u>500°F</u>	Cooldown Time:	<u>NR</u>
		<u>260°C</u>		

No usable analytical results.

NR=No Record.

Test B2

Process Conditions

This test was conducted on the empty railcar (without the projectiles, racks, or sand) from Test 1. The test conditions were 6 hrs at 550°F (288°C). The oxidizer was started at 0400 hrs on 30 June with the system in process at 0445 hrs. The system reached steady state at 0906 hrs and the test was completed at 1554 hrs with a control system automatically initiated cooldown of the chamber.

Special Conditions

- The test was performed seeking the source of the RDX contamination during Test 1.
- Gas samples were taken from the chamber exhaust duct at 0500 hrs. Discoloration of the glass connectors and milky water in the impinger was noted.

Analytical Considerations

- Wipe samples were taken from the railcar and chamber on 2 July. Samples of the chamber insulation were taken from gaps in the wall seams. Analytical results indicated that the railcar itself was one of the sources of contamination.

Comments

- No spikes were apparent on the CEM which might be attributable to explosives.

Table F-5

SPECIAL TEST SAMPLES

Test # B2	Chamber Load:	Empty car	Date:	30 Jun 94
	Explosive Type:	NA	Heatup Time:	4.9 Hrs
	Explosive Source:	NA	Time at Setpoint:	6.8 Hrs
	Temperature Setpoint:	550°F 288°C	Cooldown Time:	NR

Sample Description / Location	Explosive Concentration / Sample		Explosive Amount	Explosive Amount / Surface Area
	$\mu\text{g} / \text{sample RDX}$	$\mu\text{g} / \text{sample TNT}$	μg	mg / cm^2
Floor	<MDL	<MDL	ND	
Wall	<MDL	<MDL	ND	
Duct	<MDL	<MDL	ND	
Elbow	<MDL	<MDL	ND	
Fan	1.4962	<MDL	1.4962	9.2932E-05
Coldspot	<MDL	<MDL	ND	ND
Rail	<MDL	1.364	1.364	8.4720E-06
Blank #1	<MDL	<MDL	ND	ND
Blank #2 (prior to test)	<MDL	<MDL	ND	ND
Inside car (prior to test)	8.9305	1.6495	10.58	6.5714E-05
I-beam (prior to test)	4.8159	1.4275	6.2434	3.8779E-05
Wheel (prior to test)	1.6832	0.8248	2.508	1.5578E-05
Coupler (prior to test)	3.7405	1.3957	5.1362	3.1902E-05
Blank #3 (after test)	<MDL	<MDL	ND	ND
Inside car (after test)	<MDL	<MDL	ND	ND
I-beam (after test)	<MDL	<MDL	ND	ND
Wheel (after test)	<MDL	<MDL	ND	ND
Coupler (after test)	<MDL	<MDL	ND	ND
Insulation	1.5423	<MDL	1.5423	NA
Insulation	<MDL	<MDL	ND	NA
Insulation	<MDL	<MDL	ND	NA
Insulation	<MDL	<MDL	ND	NA
Insulation	0.4509	3.5685	4.0194	NA

Special Abbreviations: NA = Not Applicable; ND = Not Detectable; NR = No Record

MDL for Analysis: 0.7 $\mu\text{g}/\text{sample RDX}$
0.3 $\mu\text{g}/\text{sample TNT}$

Smear Surface Area: 161 sq cm

Test B3

Process Conditions

This test was conducted on an empty chamber to decontaminate it of any explosive residue. The test conditions were 6 hrs at 550°F (288°C). The system was started up at 0400 hrs on 3 July with steady state attained at 1020 hrs. The test was completed at 1624 hrs with a control system automatically initiated cooldown of the system.

Special Conditions

- The temperature of the locations where insulation samples were taken in Test B2 were monitored during the test.
- Gas sample of the chamber exhaust duct was taken for seven hours starting at 0700 hrs.

Analytical Considerations

- Area soil samples from around Building 117-15 were taken to determine the background contamination level.
- Wipe and insulation samples were taken from the chamber the next day.
- Samples were taken from untreated inert and flashed projectiles and projectile nose plugs.
- NOTE: No explosive residue was detected in the soil, insulation, and untreated flashed projectile samples. The untreated inert projectile and projectile nose plugs contained explosive residues.

Table F-6

SPECIAL TEST SAMPLES

Test # B3	Chamber Load:	None	Date:	3 Jul 94
	Explosive Type:	NA	Heatup Time:	5.0 Hrs
	Explosive Source:	NA	Time at Setpoint:	6.1 Hrs
	Temperature Setpoint:	550°F 288°C	Cooldown Time:	NR

Sample Description / Location	Explosive Concentration / Sample		Explosive Amount	Explosive Amount / Surface Area
	µg / sample RDX	µg / sample TNT	µg	mg / cm ²
Floor	<MDL	<MDL	ND	ND
Wall	<MDL	<MDL	ND	ND
Duct	<MDL	<MDL	ND	ND
Elbow	<MDL	<MDL	ND	ND
Fan	<MDL	<MDL	ND	ND
Coldspot	0.7949	<MDL	0.7949	4.9373E-06
Rail	<MDL	<MDL	ND	ND
Blank #1	<MDL	<MDL	ND	ND
Insulation	<MDL	<MDL	ND	NA
Insulation	<MDL	<MDL	ND	NA
Insulation	<MDL	<MDL	ND	NA
Insulation	<MDL	<MDL	ND	NA
Insulation	<MDL	<MDL	ND	NA
Inert projectile (not HGD treated)	6.64	1.125	7.765	NA
Flashed projectile (not HGD treated)	<MDL	<MDL	ND	NA
Projectile nose plugs (not HGD treated)	253.3	75.61	328.91	NA
Soil (not HGD treated)	<MDL	<MDL	ND	NA

Special Abbreviations: NA=Not Applicable; ND=Not Detectable; NR=No Record

MDL for Analysis: 0.7 µg/sample RDX
0.3 µg/sample TNT

Smear Surface Area: 161 sq cm

Test B4

Process Conditions

This test was conducted on an empty chamber to decontaminate the chamber of any explosive residue. The oxidizer was started at 0842 hrs on 4 July with heat going to the chamber at 0916 hrs at a control temperature of 850°F (454°C). Decontamination of the chamber occurred over the next three days with cooldown of the system starting at 1040 hrs on July 7.

Special Conditions

- A gas sample was taken from the chamber exhaust duct on 5 July from 0700 to 1400 hrs.

Analytical Considerations

- Wipe samples were taken from the chamber on 9 July.

Comments

- The control temperature reached 682°F (361°C), the chamber inlet temperature was 925°F (496°C), and the chamber air temperatures were 770 to 780°F (410 to 416°C).
- During this test several adjustments to the Maples controller were made in an effort to improve its performance. These adjustments included (1) reduction of the proportional control multiplier on the collector and fan, (2) reduction of the cycle time for control loops to 1-2 minutes, (3) narrower temperature tolerance on the collector, and (4) increased running temperature on the oxidizer and collector. These changes improved operation of the system but the heatup rate remained very slow.
- The induced draft fan motor failed at 1220 hrs on 7 July causing an emergency total shutdown. Cooldown of the chamber continued with the recirculation and portable fans. The motor was replaced on 8 July. The cause of the motor failure was not determined. It was thought that it was a mechanical/electrical failure due to usage over an extended time period and not due to the test operating conditions.

Table F-7

SPECIAL TEST SAMPLES

Test # B4	Chamber Load:	None	Date:	4 Jul 94
	Explosive Type:	NA	Heatup Time:	NR
	Explosive Source:	NA	Time at Setpoint:	24 Hrs
	Temperature Setpoint:	650°F 343°C	Cooldown Time:	NR

Sample Description / Location	Explosive Concentration / Sample		Explosive Amount	Explosive Amount / Surface Area
	µg / sample RDX	µg / sample TNT	µg	mg / cm ²
Floor	<MDL	<MDL	ND	ND
Wall	<MDL	<MDL	ND	ND
Duct	<MDL	<MDL	ND	ND
Elbow	1.7768	<MDL	1.7768	1.1036E-05
Fan	<MDL	<MDL	ND	ND
Coldspot	<MDL	<MDL	ND	ND
Rail	<MDL	<MDL	ND	ND
Blank	<MDL	<MDL	ND	ND
Grit	0.0687*	<MDL	0.0687	NA
Sand	<MDL	<MDL	ND	NA

Special Abbreviations: NA= Not Applicable; ND= Not Detectable; NR= No Record

*Measured as µg/gram.

MDL for Analysis: 0.7 µg/sample RDX
0.3 µg/sample TNT

Smear Surface Area: 161 sq cm

TEST 5

Process Conditions

This test was conducted on 192 3-inch projectiles in a railcar configuration as shown in Figure D-16. Twenty-four of the projectiles were spiked with HBX explosive. The test conditions were 6 hrs at 550°F (288°C). The oxidizer was started at 0710 hrs on 10 July and went into process at 0750 hrs. The system reached steady state at 1143 hrs and treatment was completed at 1800 hrs with an operator initiated cooldown of the system.

Analytical Considerations

- The projectiles were spiked by evaporation of a solution of HBX explosive in acetonitrile. The spiking solution was kept on a stir plate during the spiking procedure to prevent settling of the powdered aluminum.
- Spiked projectiles and wipe samples were taken on 11 July using acetonitrile.

Comments

- There were numerous temperature dropouts from steady state that were likely due to low proportional constants set on the collector and fan control loops during the previous test (Test B4). All spiked projectiles temperatures were greater than 555°F (292°C).

Table F-8

PROJECTILE EXTRACT SAMPLES

	Projectile Type:	3-inch	Date:	10 Jul 94
Test #	Explosive Type:	HBX	Heatup Time:	3.9 Hrs
5	Explosive Source:	Spiked	Time at Setpoint:	6.3 Hrs
	Temperature Setpoint:	550°F 288°C	Cooldown Time:	NR

Round #	Operating Temperature		Operating Temperature		Explosive Concentration		Sampling Dilution ml	Explosive Amount μg	Explosive Amount / Surface Area mg/cm^2	DRE* %
	°F	s dev	°C	s dev	$\mu\text{g}/\text{ml}$ RDX	$\mu\text{g}/\text{ml}$ TNT				
1	585	14.80	307	8.22	<MDL	0.0159	50	0.795	3.9356E-06	99.999
2	569	15.33	298	8.52	<MDL	<MDL	50	ND	ND	99.999
3	574	13.71	301	7.62	<MDL	0.0089	50	0.445	2.2030E-06	99.999
4	565	17.19	296	9.55	0.0131	0.0155	50	1.430	7.0792E-06	99.999
5	577	15.30	303	8.50	0.0112	0.0044	50	0.780	3.8614E-06	99.999
6	566	17.62	297	9.79	3.2669	3.1598	50	321.335	1.5908E-03	99.979
7	574	12.76	301	7.09	0.1071	0.1259	50	11.650	5.7673E-05	99.999
8	567	12.41	297	6.90	<MDL	<MDL	50	ND	ND	99.999
9	569	11.53	298	6.41	0.0411	0.0422	50	4.165	2.0619E-05	99.999
10	563	11.32	295	6.29	0.0846	0.1002	50	9.240	4.5743E-05	99.999
11	566	11.40	297	6.33	0.0271	0.0228	50	2.495	1.2351E-05	99.999
12	557	10.89	292	6.05	0.6576	0.655	50	65.630	3.2490E-04	99.996
13	579	13.95	304	7.75	0.2497	0.2576	50	25.365	1.2557E-04	99.998
14	570	12.04	299	6.69	0.0238	0.0276	50	2.570	1.2723E-05	99.999
15	569	11.23	298	6.24	0.0538	0.0631	50	5.845	2.8936E-05	99.999
16	559	11.70	293	6.50	0.0108	0.0162	50	1.350	6.6832E-06	99.999
17	565	11.52	296	6.40	<MDL	0.0124	50	0.620	3.0693E-06	99.999
18	565	11.51	296	6.40	0.1001	0.0942	50	9.715	4.8094E-05	99.999
19	580	13.88	305	7.71	0.0192	0.0206	50	1.990	9.8515E-06	99.999
20	572	12.46	300	6.92	0.0725	0.0809	50	7.670	3.7970E-05	99.999
21	591	18.72	310	10.40	0.0687	0.0692	50	6.895	3.4134E-05	99.999
22	575	13.72	301	7.62	1.1904	1.2146	50	120.250	5.9530E-04	99.992
23	590	18.98	310	10.54	0.8687	0.7638	50	81.625	4.0408E-04	99.995
24	590	14.66	310	8.14	14446	15823	50	1513450	7.4923E+00	NA

Special Abbreviations: NA=Not Applicable; ND=Not Detectable; NR=No Record; s dev=standard deviation.

*The DRE results for samples denoted by <MDL are calculated based on a value of one-half the MDL.

Extracted Round No: 24
Extracted Round Amount: 1.513 grams

MDL for Analysis: 0.007 $\mu\text{g}/\text{ml}$ RDX
0.003 $\mu\text{g}/\text{ml}$ TNT

Surface Area: 202 sq cm

Table F-9

CHAMBER WIPES

Test # <u>5</u>	Chamber Load:	<u>3-inch</u>	Date:	<u>10 Jul 94</u>
	Explosive Type:	<u>HBX</u>	Heatup Time:	<u>3.9 Hrs</u>
	Explosive Source:	<u>Spiked</u>	Time at Setpoint:	<u>6.3 Hrs</u>
	Temperature Setpoint:	<u>550°F</u> <u>288°C</u>	Cooldown Time:	<u>NR</u>

Wipe #	Location in System	Operating Temperature	Operating Temperature	Explosive Concentration / Smear		Explosive Amount	Explosive Amount / Surface Area
		°F	°C	µg / smear RDX	µg / smear TNT	µg	mg / cm ²
1	Blank	NA	NA	<MDL	<MDL	ND	ND
2	Floor	425	218	<MDL	<MDL	ND	ND
3	Wall	NR	NR	<MDL	<MDL	ND	ND
4	Duct	545	285	<MDL	<MDL	ND	ND
5	Elbow	545	285	2.4781	<MDL	2.4781	1.5392E-05
6	Fanblade	545	285	<MDL	<MDL	ND	ND
7	Coldspot	346	174	<MDL	<MDL	ND	ND
8	Rail	476	247	<MDL	0.8882	0.8882	5.5168E-06

Special Abbreviations: NA=Not Applicable; ND=Not Detectable; NR=No Record

MDL for Analysis: 0.7 µg/smear RDX
0.3 µg/smear TNT

Surface Area: 161 sq cm

HGD Test 5

3-inch Projectiles - HBX - (192 Rounds)

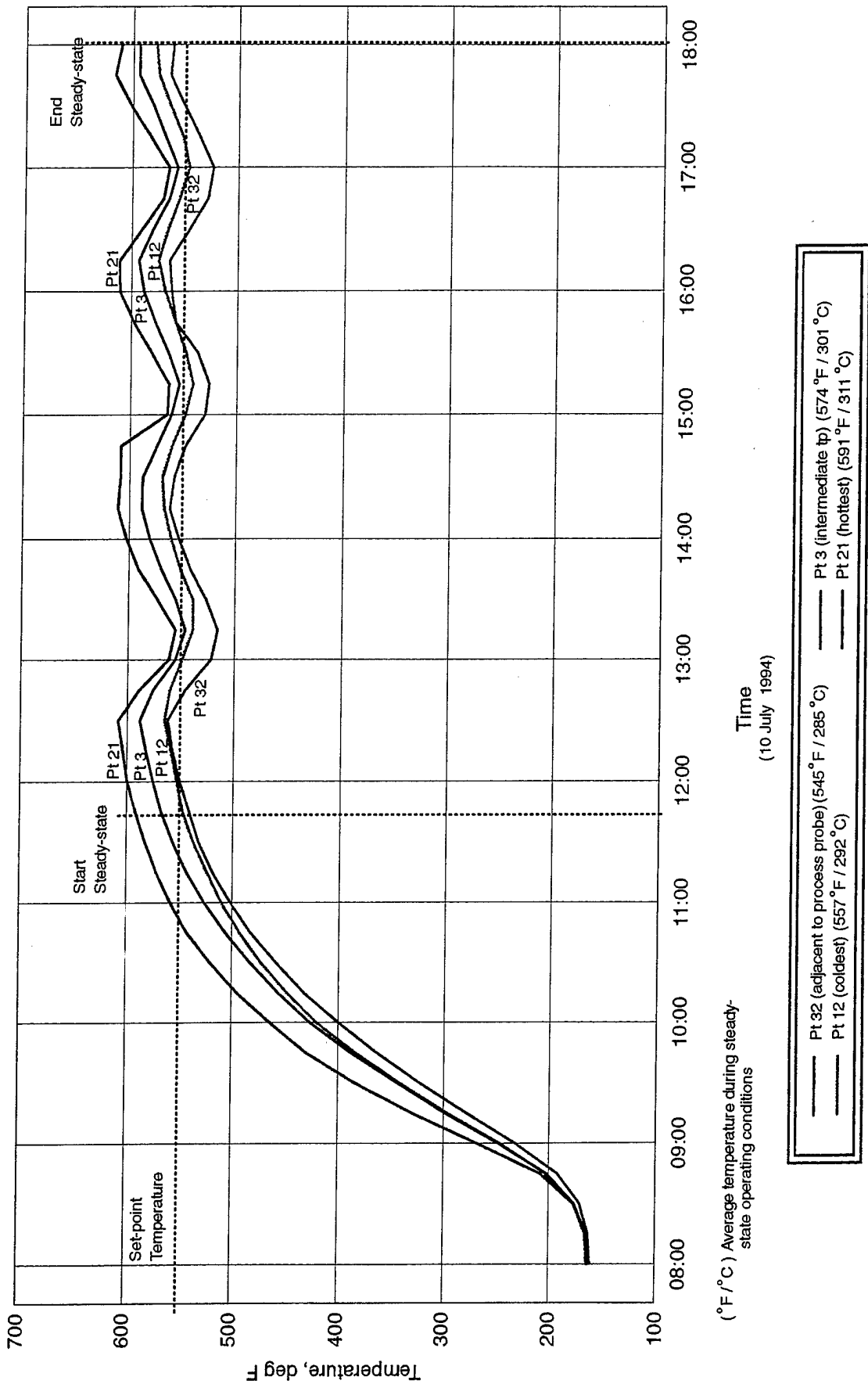


Figure F-2 Test 5 - Average Temperature Profile - 15 minute Intervals

HGD Test 5

3-inch Projectiles - HBX - (192 Rounds)

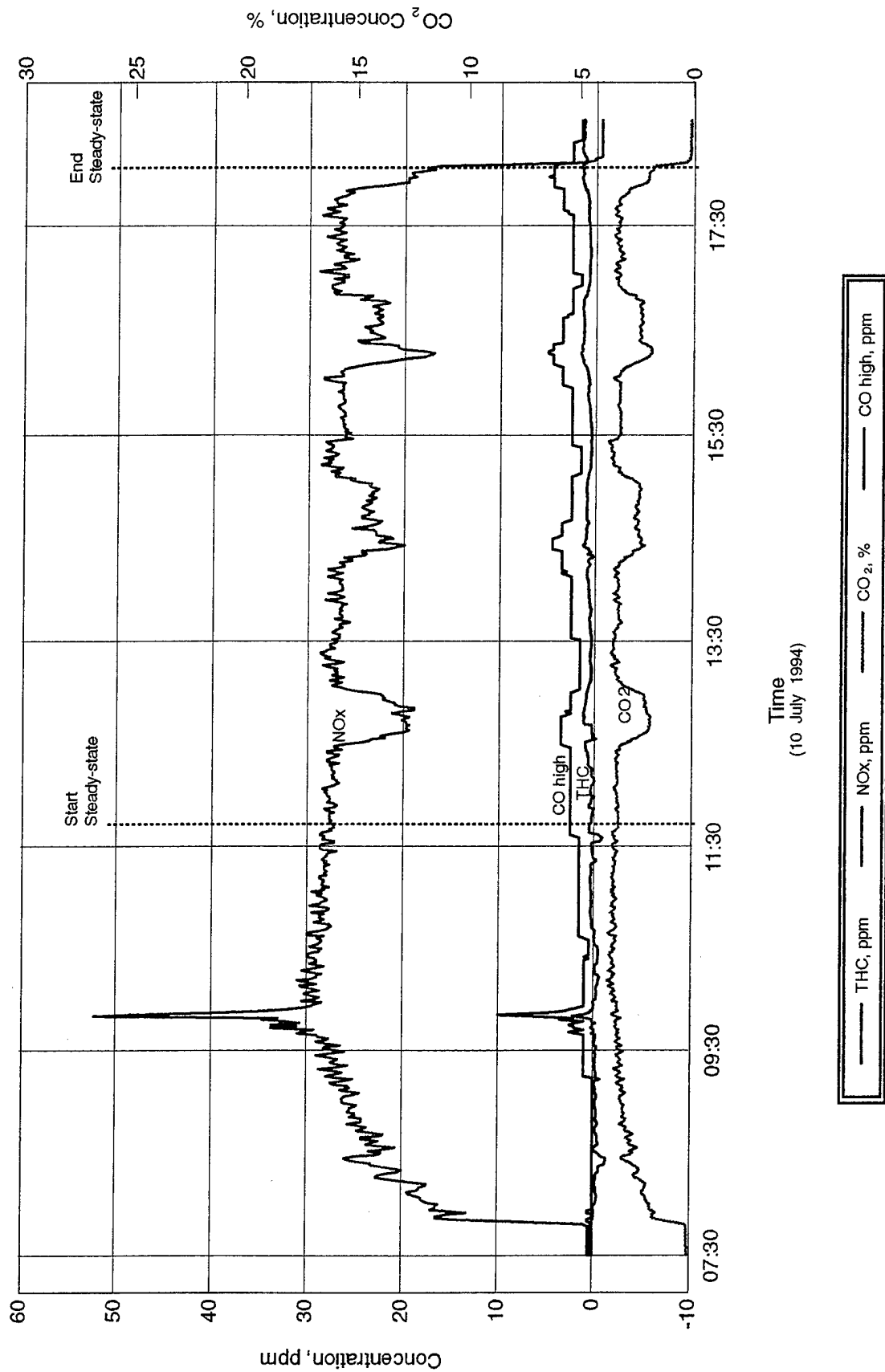


Figure F-3 Test 5 - CEM Profile - 1 minute intervals

TEST 2

Process Conditions

This test was conducted on 96 3-inch and 96 5-inch projectiles in a railcar configuration as shown in Figure D- 17. Twenty-four (12 3-inch and 12 5-inch) of the projectiles were spiked with RDX. The test conditions were 6 hrs at 500°F (260°C). The oxidizer was started at 0417 hrs on 12 July and chamber heatup began at 0502 hrs. Steady state was reached at 0902 hrs and the test was completed at 1506 hrs with an operator initiated cooldown. The sinusoidal variation in temperature profile was due to changes in control settings that were corrected in later tests.

Analytical Considerations

- The projectiles were spiked by evaporation of a solution of RDX in acetone.
- The projectiles were rinsed prior to spiking to remove scale. The solvent evaporated quickly by laying the projectile on its side.
- The spiked projectiles and chamber were sampled the next day using acetonitrile solution, and acetonitrile soaked wipes.

Comments

- The 3-inch projectiles heated quicker than the 5-inch projectiles; almost 100°F (56°C) during the first two hours. The control thermocouple was located in a 5-inch projectile.

CEM

- There were no significant changes in the CEM values during steady state operation. It should be noted that about 1 hour after startup [approximately 300°F(149°C)] there was a sharp increase in THC, and CO concentration.
- NOTE: The dips in NO_x correspond to drop in temperature which probably corresponds to shift in NO_x baseline due to more outside air being drawn and cooling the system.

Table F-10

PROJECTILE EXTRACT SAMPLES

Test # 2	Projectile Type:	<u>3-inch</u> <u>5-inch</u>	Date:	<u>12 Jul 94</u>
	Explosive Type:	<u>RDX</u>	Heatup Time:	<u>4.0 Hrs</u>
	Explosive Source:	<u>Spiked</u>	Time at Setpoint:	<u>6.1 Hrs</u>
	Temperature Setpoint:	<u>500°F</u> <u>260°C</u>	Cooldown Time:	<u>NR</u>

Round #	Size	Operating Temperature		Operating Temperature		Explosive Concentration		Sampling Dilution ml	Explosive Amount μg	Explosive Amount / Surface Area mg / cm^2	DRE* %
		°F	s dev	°C	s dev	$\mu\text{g} / \text{ml}$ RDX	$\mu\text{g} / \text{ml}$ TNT				
1	3 in.	539	36.41	282	20.23	4.4886	<MDL	50	224.430	1.1110E-03	99.988
2	3 in.	532	30.56	278	16.98	<MDL	<MDL	50	ND	ND	99.999
3	3 in.	530	26.64	277	14.80	<MDL	<MDL	50	ND	ND	99.999
4	5 in.	554	22.79	290	12.66	<MDL	<MDL	100	ND	ND	99.999
5	5 in.	509	17.91	265	9.95	0.2885	<MDL	100	28.850	4.5649E-05	99.999
6	5 in.	516	13.37	269	7.43	0.0734	<MDL	100	7.340	1.1614E-05	99.999
7	5 in.	536	14.83	280	8.24	<MDL	<MDL	100	ND	ND	99.999
8	5 in.	525	11.65	274	6.47	0.0168	<MDL	100	1.680	2.6582E-06	99.999
9	5 in.	515	11.39	269	6.33	0.0112	<MDL	100	1.120	1.7722E-06	99.999
10	3 in.	528	26.20	276	14.55	<MDL	<MDL	50	ND	ND	99.999
11	3 in.	525	22.67	274	12.60	0.0402	<MDL	50	2.010	9.9505E-06	99.999
12	3 in.	521	24.67	272	13.71	<MDL	<MDL	50	ND	ND	99.999
13	3 in.	538	26.02	281	14.46	0.0318	<MDL	50	1.590	7.8713E-06	99.999
14	3 in.	538	25.60	281	14.22	3.2243	<MDL	50	161.215	7.9809E-04	99.991
15	3 in.	539	29.56	282	16.42	0.2885	<MDL	50	14.425	7.1411E-05	99.999
16	5 in.	526	12.37	275	6.87	0.0739	<MDL	100	7.390	1.1693E-05	99.999
17	5 in.	523	13.14	273	7.30	0.0304	<MDL	100	3.040	4.8101E-06	99.999
18	5 in.	516	10.88	269	6.05	<MDL	<MDL	100	ND	ND	99.999
19	5 in.	536	14.36	280	7.98	0.0575	<MDL	100	5.750	9.0981E-06	99.999
20	5 in.	555	23.21	291	12.89	0.0094	<MDL	100	0.940	1.4873E-06	99.999
21	5 in.	524	11.18	274	6.21	0.0393	<MDL	100	3.930	6.2184E-06	99.999
22	3 in.	530	23.82	277	13.24	<MDL	<MDL	50	ND	ND	99.999
23	3 in.	546	26.42	286	14.68	37031	<MDL	50	1851550	9.1661E+00	NA
24	3 in.	538	30.02	281	16.68	<MDL	<MDL	50	ND	ND	99.999

Special Abbreviations: NA=Not Applicable; ND=Not Detectable; NR=No Record; s dev=standard deviation.

*The DRE results for samples denoted by <MDL are calculated based on a value of one-half the MDL.

Extracted Round No: 23
 Extracted Round Amount: 1.85 grams (3-inch)
 7.00 grams (5-inch) Note: 7g is the spike amount; no 5-inch round was sacrificed/extracted.

MDL for Analysis: 0.007 $\mu\text{g}/\text{ml}$ RDX
 0.003 $\mu\text{g}/\text{ml}$ TNT
 Surface Area: 202 sq cm (3-inch)
 632 sq cm (5-inch)

Table F-11

CHAMBER WIPES

Test # 2	Chamber Load:	<u>3-inch</u> <u>5-inch</u>	Date:	<u>12 Jul 94</u>
	Explosive Type:	<u>RDX</u>	Heatup Time:	<u>4.0 Hrs</u>
	Explosive Source:	<u>Spiked</u>	Time at Setpoint:	<u>6.1 Hrs</u>
	Temperature Setpoint:	<u>500°F</u> <u>260°C</u>	Cooldown Time:	<u>NR</u>

Wipe #	Location in System	Operating Temperature	Operating Temperature	Explosive Concentration / Smear		Explosive Amount	Explosive Amount / Surface Area
		°F	°C	µg / smear RDX	µg / smear TNT	µg	mg / cm ²
1	Blank	NA	NA	<MDL	<MDL	ND	ND
2	Floor	414	212	<MDL	<MDL	ND	ND
3	Wall	NR	NR	<MDL	<MDL	ND	ND
4	Duct	486	252	<MDL	<MDL	ND	ND
5	Elbow	486	252	1.917	<MDL	1.917	1.1907E-05
6	Fanblade	486	252	<MDL	<MDL	ND	ND
7	Coldspot	311	155	<MDL	<MDL	ND	ND
8	Rail	439	226	1.1222	<MDL	1.1222	6.9702E-06

Special Abbreviations: NA=Not Applicable; ND=Not Detectable; NR=No Record

MDL for Analysis: 0.7 µg/smear RDX
0.3 µg/smear TNT

Surface Area: 161 sq cm

HGD Test 2

3-inch / 5-inch Projectiles - RDX - (192 Rounds)

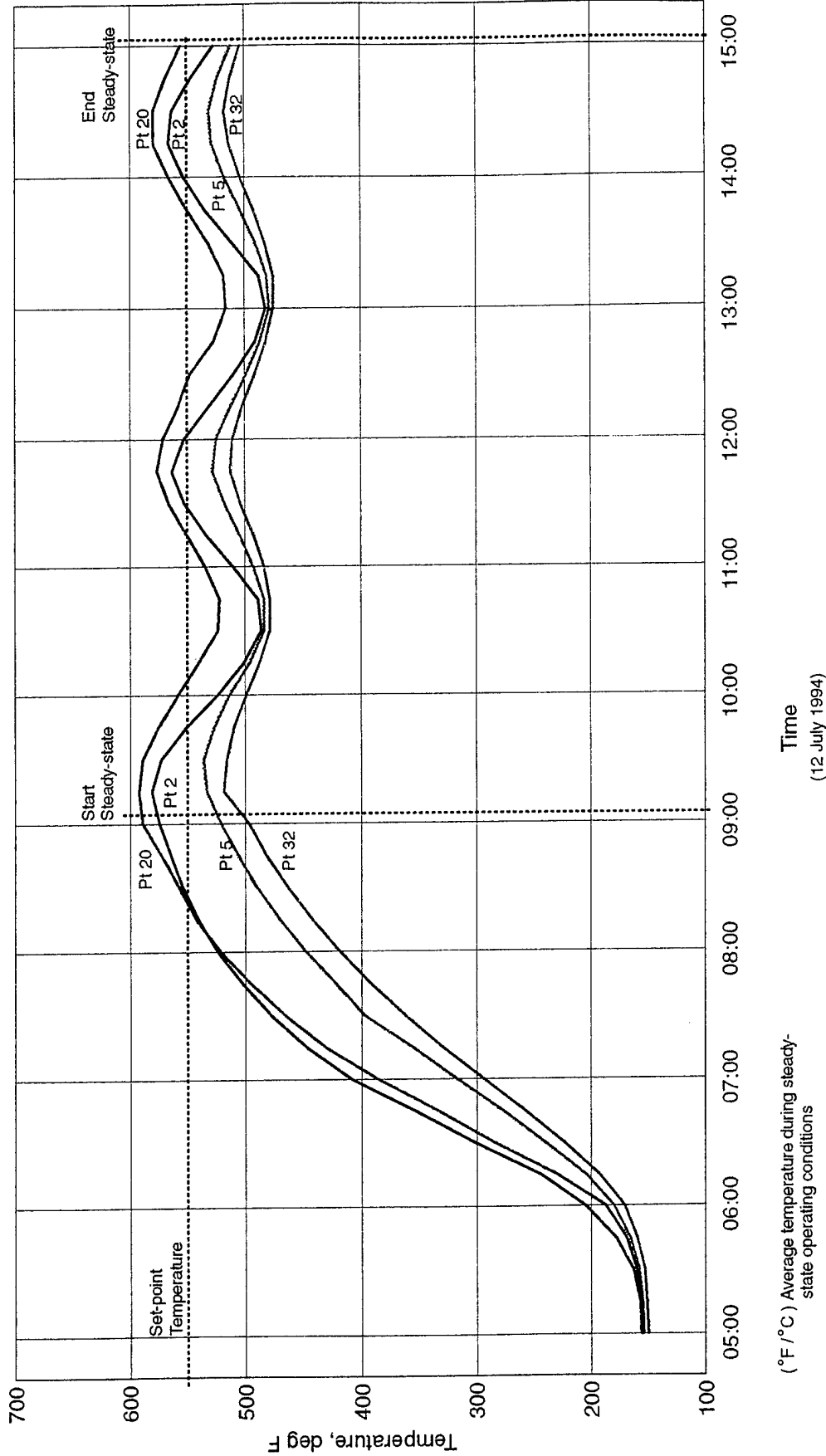


Figure F-4 Test 2 - Average Temperature Profile - 15 minute Intervals

HGD Test 2

3-inch / 5-inch Projectiles - RDX - (192 Rounds)

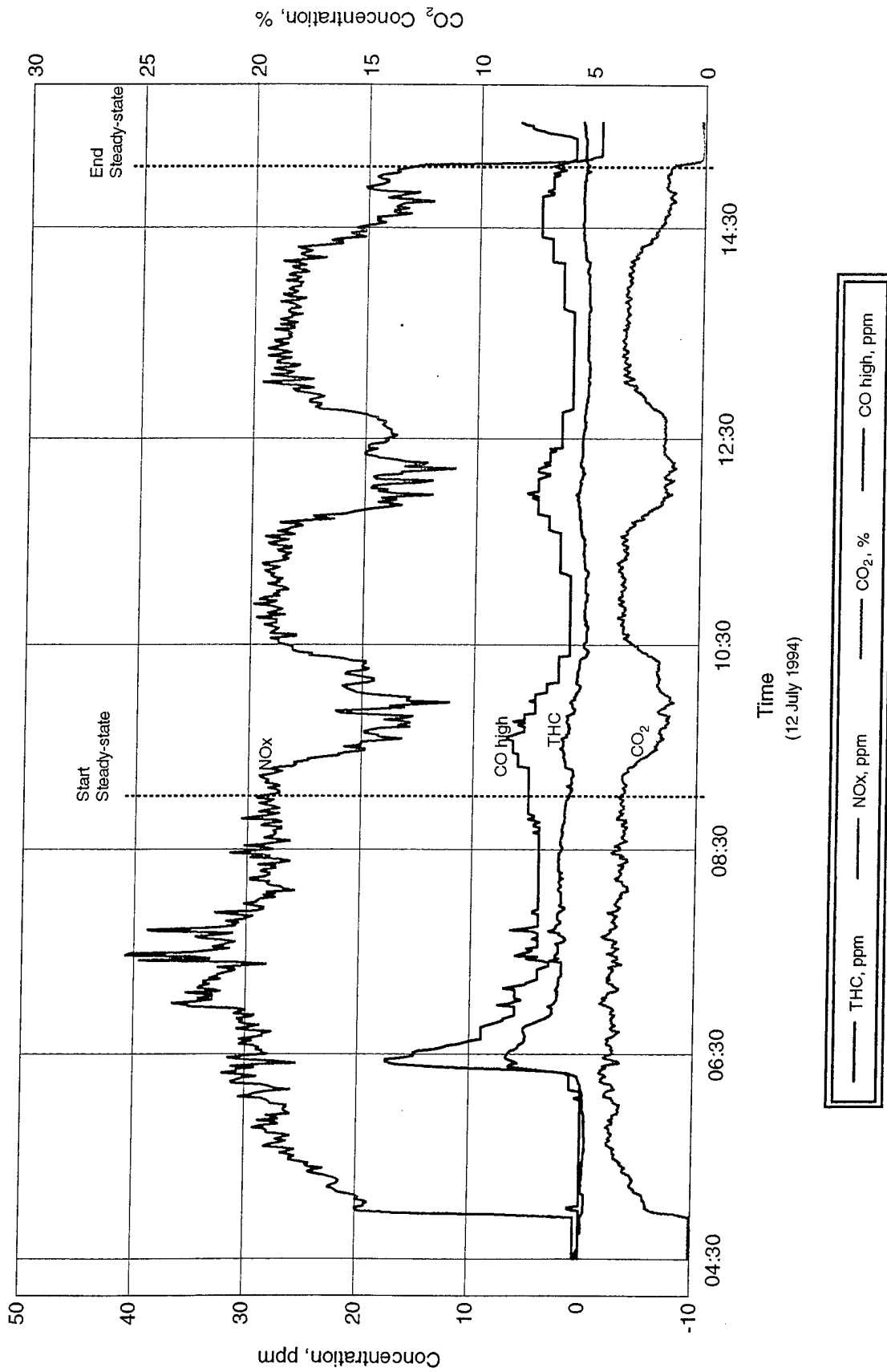


Figure F-5 Test 2 - CEM Profile - 1 minute Intervals

TEST 4

Process Conditions

This test was conducted under test conditions similar to Test 1 (6 hours treatment time, 24 3-inch projectiles spiked with TNT explosives) except the control temperature was increased from 500 to 550°F (260 to 288°C). The railcar configuration is shown in Figure D-18. The oxidizer was started at 0415 hrs on 15 July with heat to the chamber at 0500 hrs. The system reached steady state at 0837 hrs and the test was completed at 1445 hrs with an operator initiated cooldown.

Analytical Considerations

- The spiked projectiles and chamber were sampled the next day using acetonitrile.
- NOTE: The chromatograms for the projectiles had several unknown peaks in and around the RDX retention window. The peak at the RDX time is probably not RDX but falls at the right time. The residual amount of RDX in some of the samples is due to these peaks.

CEM

- No appreciable change in CO₂, THC, CO, NO_x. NOTE: NO_x decreases as temperature decreases.

Table F-12

PROJECTILE EXTRACT SAMPLES

Test # 4	Projectile Type:	3-inch	Date:	15 Jul 94
	Explosive Type:	TNT	Heatup Time:	3.6 Hrs
	Explosive Source:	Spiked	Time at Setpoint:	6.1 Hrs
	Temperature Setpoint:	550°F 288°C	Cooldown Time:	NR

Round #	Operating Temperature		Operating Temperature		Explosive Concentration		Sampling Dilution ml	Explosive Amount µg	Explosive Amount / Surface Area mg / cm ²	DRE* %
	°F	s dev	°C	s dev	µg / ml RDX	µg / ml TNT				
1	589	15.39	309	8.55	<MDL	<MDL	50	ND	ND	99.999
2	565	13.69	296	7.61	<MDL	<MDL	50	ND	ND	99.999
3	573	24.20	300	13.45	<MDL	0.0073	50	0.365	1.8069E-06	99.999
4	578	16.17	303	8.98	0.0108	<MDL	50	0.540	2.6733E-06	99.999
5	553	16.37	289	9.10	<MDL	0.0206	50	1.030	5.0990E-06	99.999
6	559	13.73	293	7.63	<MDL	<MDL	50	ND	ND	99.999
7	581	9.51	305	5.29	<MDL	<MDL	50	ND	ND	99.999
8	568	9.46	298	5.26	0.0108	0.0051	50	0.795	3.9356E-06	99.999
9	573	8.56	300	4.76	<MDL	<MDL	50	ND	ND	99.999
10	562	10.20	295	5.67	<MDL	<MDL	50	ND	ND	99.999
11	566	9.92	296	5.51	0.029	0.0079	50	1.845	9.1337E-06	99.999
12	556	9.83	291	5.46	0.0224	<MDL	50	1.120	5.5446E-06	99.999
13	573	9.75	301	5.42	<MDL	0.0057	50	0.285	1.4109E-06	99.999
14	566	9.75	297	5.42	<MDL	0.0051	50	0.255	1.2624E-06	99.999
15	575	9.18	302	5.10	<MDL	0.0044	50	0.220	1.0891E-06	99.999
16	558	11.53	292	6.40	<MDL	0.0054	50	0.270	1.3366E-06	99.999
17	567	8.35	297	4.64	<MDL	<MDL	50	ND	ND	99.999
18	562	7.61	294	4.23	<MDL	<MDL	50	ND	ND	99.999
19	579	8.29	304	4.61	<MDL	45076	50	2253800	1.1157E+01	NA
20	569	9.74	299	5.41	<MDL	<MDL	50	ND	ND	99.999
21	581	14.32	305	7.96	<MDL	0.0095	50	0.475	2.3515E-06	99.999
22	568	8.89	298	4.94	0.0281	0.0044	50	1.625	8.0446E-06	99.999
23	578	10.63	303	5.91	<MDL	0.0063	50	0.315	1.5594E-06	99.999
24	595	20.20	313	11.22	<MDL	0.013	50	0.650	3.2178E-06	99.999

Special Abbreviations: NA=Not Applicable; ND=Not Detectable; NR=No Record; s dev=standard deviation.

*The DRE results for samples denoted by <MDL are calculated based on a value of one-half the MDL.

Extracted Round No: 19
Extracted Round Amount: 2.254 grams

MDL for Analysis: 0.007 µg/ml RDX
0.003 µg/ml TNT

Surface Area: 202 sq cm

Table F-13

CHAMBER WIPES

Test # <u>4</u>	Chamber Load:	<u>3-inch</u>	Date:	<u>15 Jul 94</u>
	Explosive Type:	<u>TNT</u>	Heatup Time:	<u>3.6 Hrs</u>
	Explosive Source:	<u>Spiked</u>	Time at Setpoint:	<u>6.1 Hrs</u>
	Temperature Setpoint:	<u>550°F</u> <u>288°C</u>	Cooldown Time:	<u>NR</u>

Wipe #	Location in System	Operating Temperature	Operating Temperature	Explosive Concentration / Smear		Explosive Amount	Explosive Amount / Surface Area
		°F	°C	µg / smear RDX	µg / smear TNT	µg	mg / cm ²
1	Blank	NA	NA	<MDL	<MDL	ND	ND
2	Floor	375	191	<MDL	<MDL	ND	ND
3	Wall	NR	NR	<MDL	<MDL	ND	ND
4	Duct	541	283	<MDL	<MDL	ND	ND
5	Elbow	541	283	<MDL	<MDL	ND	ND
6	Fanblade	541	283	<MDL	<MDL	ND	ND
7	Coldspot	319	159	<MDL	3.1979	3.1979	1.9863E-05
8	Rail	475	246	<MDL	6.6506	6.6506	4.1308E-05

Special Abbreviations: NA=Not Applicable; ND=Not Detectable; NR=No Record

MDL for Analysis: . 0.7 µg/smear RDX
0.3 µg/smear TNT

Surface Area: 161 sq cm

HGD Test 4

3-inch Projectiles - TNT - (192 Rounds)

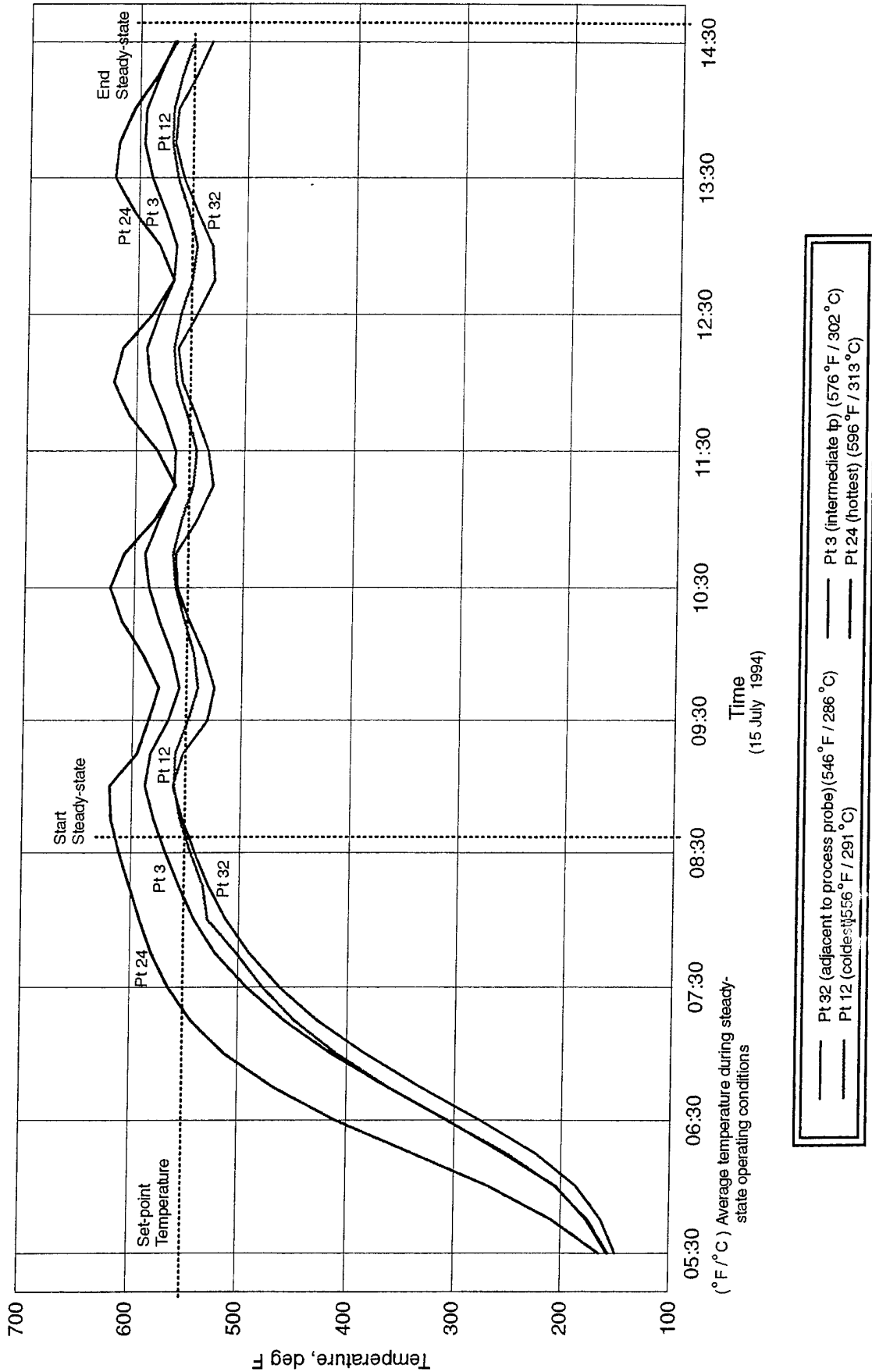


Figure F-6 Test 4 - Average Temperature Profile - 15 minute Intervals

HGD Test 4

3-inch Projectiles - TNT - (192 Rounds)

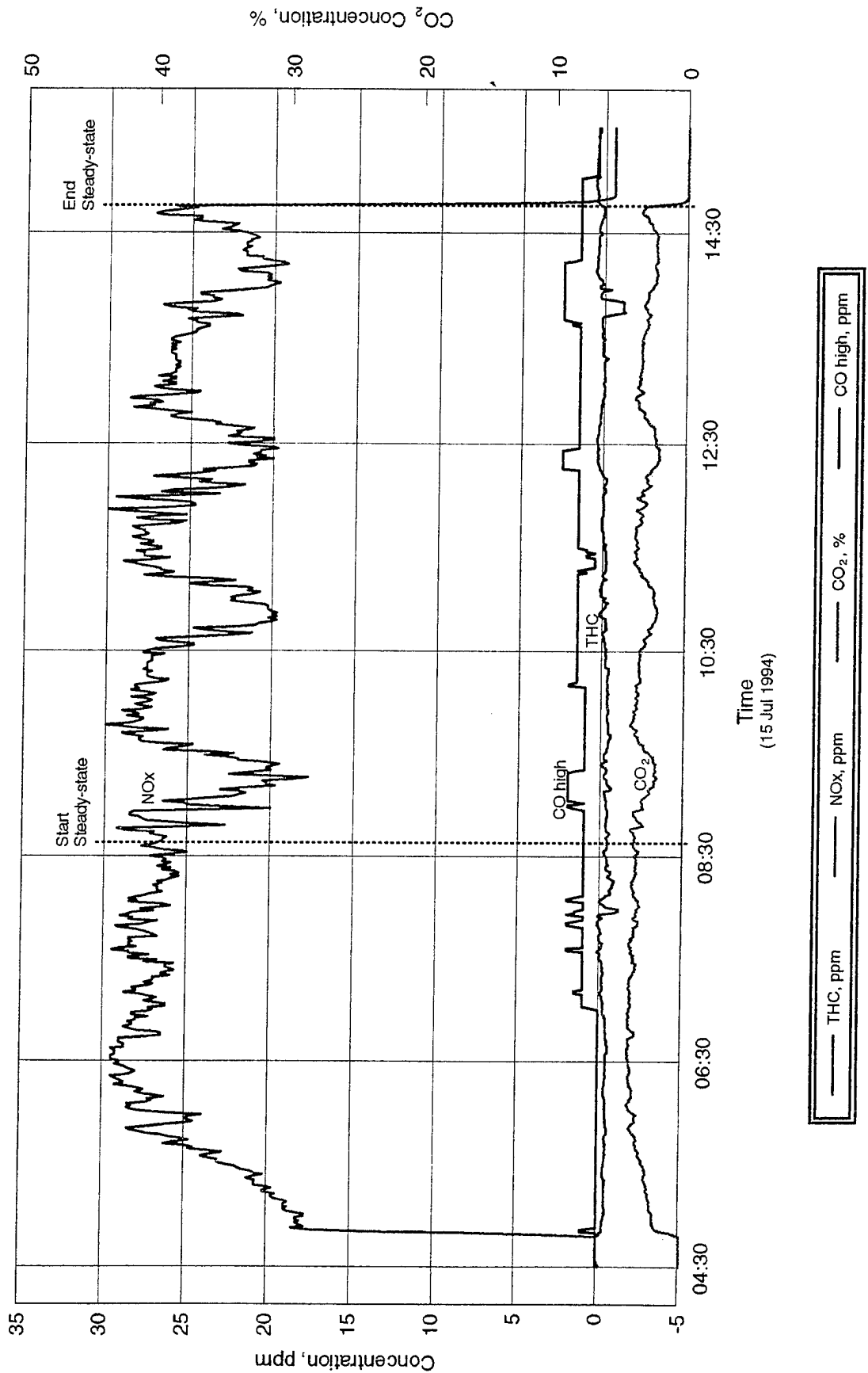


Figure F-7 Test 4 - CEM Profile - 1 minute intervals

TEST 6

Process Conditions

This test was conducted on 4 MK 25 ship mines, sawed in half (8 items total), in a railcar configuration as shown in Figure D-19. The mine halves were spiked with TNT explosive. The test conditions were 48 hrs at 700°F (371°C). The oxidizer was started at 1130 hrs on 16 July with heat to the chamber at 1210 hrs. System reached steady state at 0515 hrs on 17 July. Test was completed at 1015 hrs on 19 July with an operator initiated cooldown.

Special Conditions

- The auxiliary vent on the chamber inlet gas duct was closed.
- The mine halves were oriented on the railcar so the sawed ends faced the diffusers with the beveled end half in front and the flanged end half behind for each mine.
- Three thermocouples were located in each half of the mine, one about 10 inches (2.5 centimeters) from the sawed end near the spikes, one in the side-opening fuse well, and one in the equipment chamber of the flanged half.

Analytical Considerations

- The mine halves were spiked with a solution of TNT explosive in acetone. The mines were spiked by slowly dripping the solution on the selected area allowing the solution to dry on the surface as it dripped. The spiked areas included (1) on the flat of the strongback reinforcing plate at the sawed end of both halves, (2) on the left side of the strongback on the beveled end half, and (3) behind the gusset plate to right of center on the flanged end half. There was a total of two spikes per mine half, sixteen per railcar.

Comments

- The system shutdown at 1510 hrs due to power interruption, restarted at 1550 hrs. Another system shutdown at 2106 hrs due to high chamber pressure, no apparent cause.

- Visual inspection of mines noted heavily burnt outside, paint peeling, and hot-melt completely gone.

CEM

- CEM readings were higher than in previous tests; may be due to hot-melt or higher control temperature.

Table F-14

MINE/DEPTH BOMB WIPE SAMPLES

Mine/Depth Bomb Type:		MK25 Ship Mine	Date:	18 Jul 94
Test # 6	Explosive Type:	TNT	Heatup Time:	17.1 Hrs
	Explosive Source:	Spiked	Time at Setpoint:	53.0 Hrs
	Temperature Setpoint:	700°F 371°C	Cooldown Time:	NR

Wipe #	Operating Temperature		Operating Temperature		Explosive Concentration		Explosive Amount	Explosive Amount / Surface Area	DRE*
	°F	s dev	°C	s dev	µg/smear RDX	µg/smear TNT	µg	mg / cm ²	%
1	779	45.36	415	25.20	<MDL	<MDL	ND	ND	99.999
2	790	38.06	421	21.14	<MDL	<MDL	ND	ND	99.999
3	741	33.19	394	18.44	<MDL	<MDL	ND	ND	99.999
4	745	33.09	396	18.39	<MDL	<MDL	ND	ND	99.999
5	787	37.59	419	20.89	<MDL	0.5377	0.538	2.3177E-06	99.999
6	786	48.32	419	26.84	<MDL	0.4811	0.481	2.0737E-06	99.999
7	746	33.08	397	18.38	<MDL	<MDL	ND	ND	99.999
8	758	34.12	403	18.96	<MDL	0.6509	0.651	2.8056E-06	99.999
9	722	31.32	383	17.40	<MDL	<MDL	ND	ND	99.999
10	730	31.63	388	17.57	<MDL	0.6792	0.679	2.9276E-06	99.999
11	714	31.76	379	17.65	<MDL	0.3962	0.396	4.0845E-06	99.999
12	725	32.26	385	17.92	<MDL	<MDL	ND	ND	99.999
13	743	33.39	395	18.55	<MDL	<MDL	ND	ND	99.999
14	752	33.84	400	18.80	<MDL	<MDL	ND	ND	99.999
15	740	34.17	393	18.98	<MDL	<MDL	ND	ND	99.999
16	749	34.77	398	19.32	<MDL	0.4528	0.453	1.9517E-06	99.999

Special Abbreviations: NA=Not Applicable; ND=Not Detectable; NR=No Record; s dev=standard deviation.

*The DRE results for samples denoted by <MDL are calculated based on a value of one-half the MDL.

Spike Amount: 3 grams

MDL for Analysis: 0.7 µg/smear RDX
0.4 µg/smear TNT

Surface Area: 232 sq cm (except 97 sq cm at points 3, 7, 11, 15)

Table F-15

CHAMBER WIPES

Test # <u>6</u>	Chamber Load:	<u>MK25 Ship Mine</u>	Date:	<u>18 Jul 94</u>
	Explosive Type:	<u>TNT</u>	Heatup Time:	<u>17.1 Hrs</u>
	Explosive Source:	<u>Spiked</u>	Time at Setpoint:	<u>53.0 Hrs</u>
	Temperature Setpoint:	<u>700°F 371°C</u>	Cooldown Time:	<u>NR</u>

Wipe #	Location in System	Operating Temperature	Operating Temperature	Explosive Concentration / Smear		Explosive Amount	Explosive Amount / Surface Area
		°F	°C	µg / smear RDX	µg / smear TNT	µg	mg / cm²
1	Blank	NA	NA	<MDL	<MDL	ND	ND
2	Floor	661	349	<MDL	<MDL	ND	ND
3	Wall	NR	NR	<MDL	<MDL	ND	ND
4	Duct	704	373	<MDL	<MDL	ND	ND
5	Elbow	704	373	<MDL	<MDL	ND	ND
6	Fanblade	704	373	<MDL	<MDL	ND	ND
7	Coldspot	557	292	<MDL	<MDL	ND	ND
8	Rail	643	339	<MDL	<MDL	ND	ND

Special Abbreviations: NA=Not Applicable; ND=Not Detectable; NR=No Record

MDL for Analysis: 0.7 µg/smear RDX
0.4 µg/smear TNT

Surface Area: 161 sq cm

HGD Test 6

MK 25 Ship Mines - TNT - (8 Items)

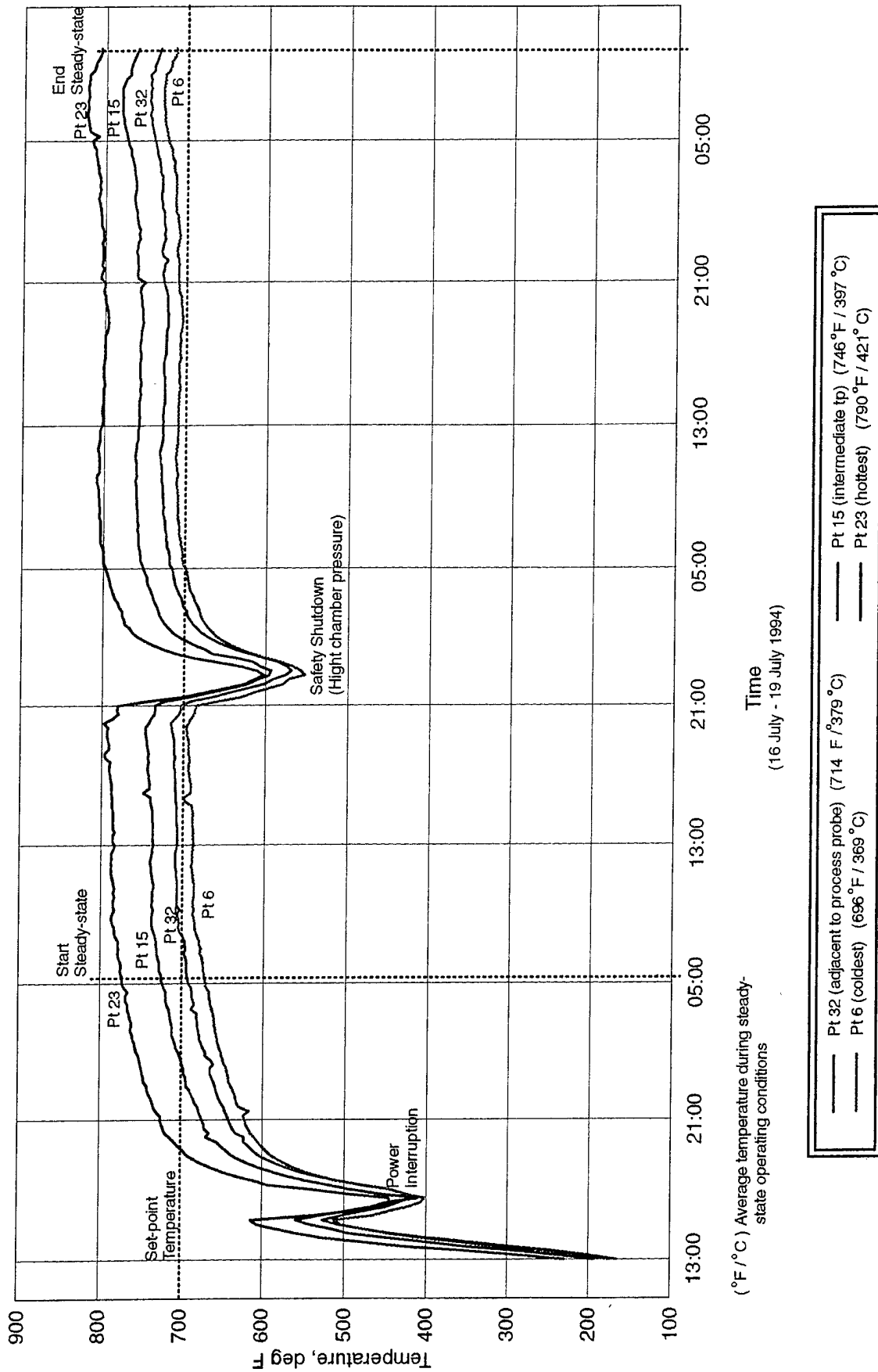


Figure F-8 Test 6 - Average Temperature Profile - 15 minute Intervals

HGD Test 6

MK 25 Ship Mines - TNT - (8 Items)

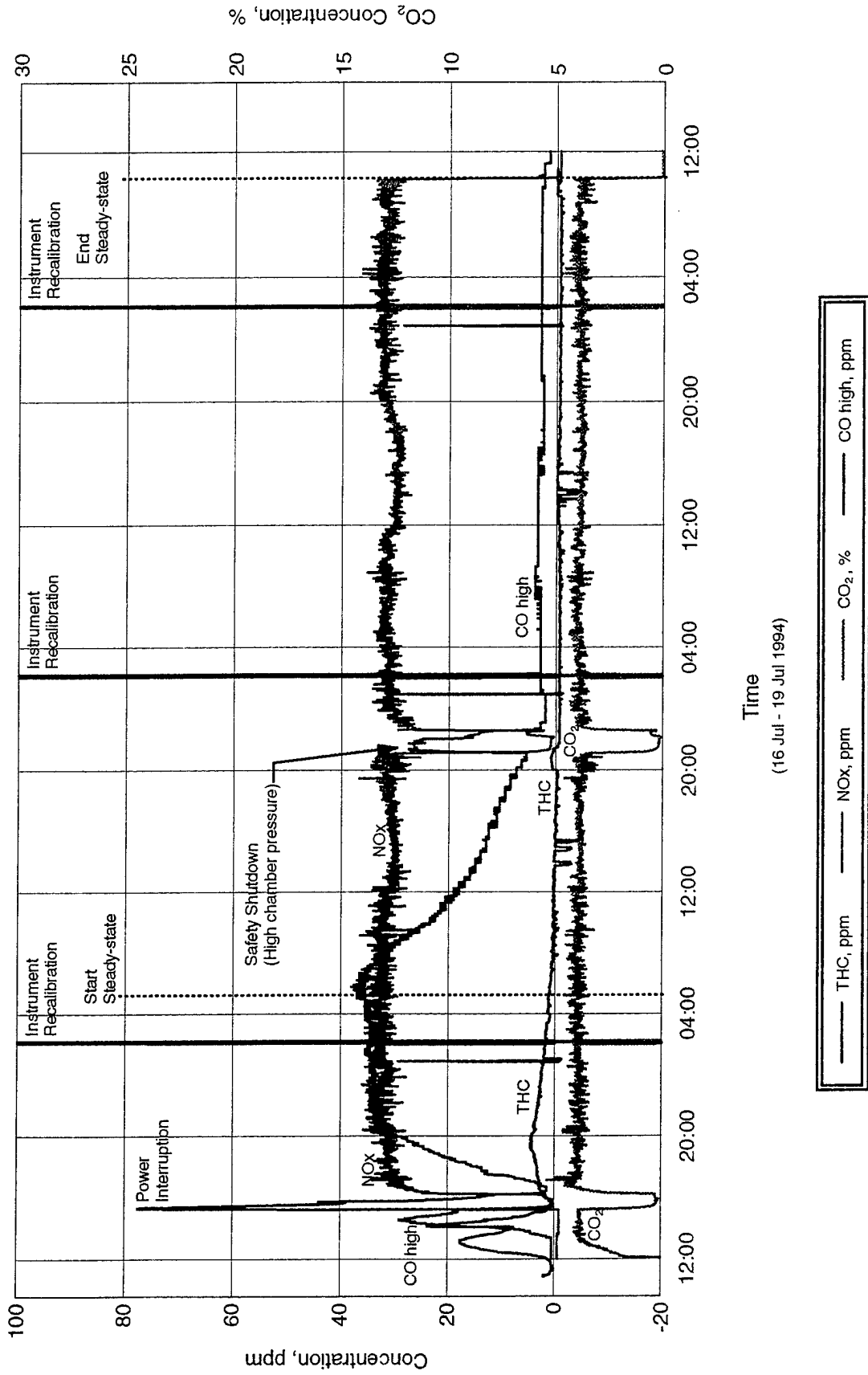


Figure F-9 Test 6 - CEM Profile - 1 minute Intervals

TEST 7

Process Conditions

This test was conducted under test conditions similar to Test 2 (6 hours treatment time, 12 3-inch and 12 5-inch projectiles spiked with RDX explosive) except the control temperature was increased from 500 to 550°F (260 to 288°C). The railcar configuration is shown in Figure D-20. The oxidizer was started at 0338 hrs on 22 July with system going in process at 0423 hrs. Steady state operation began at 0829 hrs with the test completed at 1440 hrs.

Special Conditions

- The auxiliary 3-inch vent on the chamber inlet gas duct was closed.

Analytical Considerations

- The spiked projectiles and chamber were sampled the next day using acetonitrile.
- TNT residue was noted in most samples. It appears from the analysis that the spiking solution was contaminated with TNT. A small peak was also seen at the right retention time, but corresponds to the peak at approximately 15 minutes. This small peak is probably not TNT, however, it could not be ruled out.

Comments

- A gas sample was taken from chamber exhaust duct.

CEM

- NOTE: NO_x monitor was recalibrated just as the system went into steady state.

Table F-16

PROJECTILE EXTRACT SAMPLES

Projectile Type:		3-Inch 5-Inch	Date:	22 Jul 94
Test #	Explosive Type:		Heatup Time:	4.1 Hrs
7	RDX			
Explosive Source:		Spiked	Time at Setpoint:	6.2 Hrs
Temperature Setpoint:		550°F 288°C	Cooldown Time:	NR

Round #	Size	Operating Temperature		Operating Temperature		Explosive Concentration		Sampling Dilution ml	Explosive Amount µg	Explosive Amount / Surface Area mg/cm ²	DRE*
		°F	s dev	°C	s dev	µg/ml RDX	µg/ml TNT				
1	5 in.	587	15.16	308	8.42	<MDL	0.0085	100	0.850	1.3449E-06	99.999
2	5 in.	557	9.77	291	5.43	<MDL	0.0071	100	0.710	1.1234E-06	99.999
3	5 in.	558	9.95	292	5.53	<MDL	0.0147	100	1.470	2.3259E-06	99.999
4	3 in.	556	15.65	291	8.70	<MDL	0.0048	50	0.240	1.1881E-06	99.999
5	3 in.	537	20.36	281	11.31	0.0432	0.0447	50	4.395	2.1757E-05	99.999
6	3 in.	563	13.65	295	7.58	<MDL	0.0102	50	0.510	2.5248E-06	99.999
7	3 in.	573	13.56	300	7.53	0.0784	0.0784	50	7.840	3.8812E-05	99.999
8	3 in.	585	15.18	307	8.43	<MDL	<MDL	50	ND	ND	99.999
9	3 in.	574	13.23	301	7.35	0.0956	0.1036	50	9.960	4.9307E-05	99.999
10	5 in.	563	10.40	295	5.78	<MDL	0.0059	100	0.590	9.3354E-07	99.999
11	5 in.	564	11.54	296	6.41	<MDL	0.0082	100	0.820	1.2975E-06	99.999
12	5 in.	549	11.17	287	6.21	<MDL	0.0068	100	0.680	1.0759E-06	99.999
13	5 in.	562	15.54	295	8.64	<MDL	0.0054	100	0.540	8.5443E-07	99.999
14	5 in.	572	9.23	300	5.13	<MDL	0.0113	100	1.130	1.7880E-06	99.999
15	5 in.	563	11.15	295	6.20	<MDL	0.0113	100	1.130	1.7880E-06	99.999
16	3 in.	571	10.74	300	5.97	<MDL	0.011	50	0.550	2.7228E-06	99.999
17	3 in.	565	10.63	296	5.90	0.033	0.0294	50	3.120	1.5446E-05	99.999
18	3 in.	566	11.89	297	6.61	<MDL	0.0071	50	0.355	1.7574E-06	99.999
19	3 in.	577	12.51	303	6.95	0.3861	0.6048	50	49.545	2.4527E-04	99.997
20	3 in.	587	17.82	309	9.90	<MDL	0.0074	50	0.370	1.8317E-06	99.999
21	3 in.	594	24.35	312	13.53	36155	<MDL	50	1807750	8.9493E+00	NA
22	5 in.	563	15.33	295	8.51	<MDL	0.0076	100	0.760	1.2025E-06	99.999
23	5 in.	612	15.57	322	8.65	34065	<MDL	100	3406500	5.3900E+00	NA
24	5 in.	569	10.70	299	5.94	<MDL	0.0093	100	0.930	1.4715E-06	99.999

Special Abbreviations: NA=Not Applicable; ND=Not Detectable; NR=No Record; s dev=standard deviation.

*The DRE results for samples denoted by <MDL are calculated based on a value of one-half the MDL.

Extracted Round No: 21, 23
 Extracted Round Amount: 1.81 grams (3-inch) (Extracted round samples were diluted to dissolve crystals prior to analysis.)
 3.41 grams (5-inch)

MDL for Analysis: 0.007 µg/ml RDX
 0.003 µg/ml TNT
 Surface Area: 202 sq cm (3-inch)
 632 sq cm (5-inch)

Table F-17

CHAMBER WIPES

Test # 7	Chamber Load:	3-inch 5-inch	Date:	22 Jul 94
	Explosive Type:	RDX	Heatup Time:	4.1 Hrs
	Explosive Source:	Spiked	Time at Setpoint:	6.2 Hrs
	Temperature Setpoint:	550°F 288°C	Cooldown Time:	NR

Wipe #	Location in System	Operating Temperature	Operating Temperature	Explosive Concentration / Smear		Explosive Amount	Explosive Amount / Surface Area
		°F	°C	µg / smear RDX	µg / smear TNT	µg	mg / cm ²
1	Blank	NA	NA	<MDL	0.6509	0.6509	4.0429E-06
2	Floor	432	222	<MDL	<MDL	ND	ND
3	Wall	NR	NR	<MDL	<MDL	ND	ND
4	Duct	552	289	<MDL	<MDL	ND	ND
5	Elbow	552	289	<MDL	<MDL	ND	ND
6	Fanblade	552	289	<MDL	<MDL	ND	ND
7	Coldspot	352	178	<MDL	0.5377	0.5377	3.3398E-06
8	Rail	490	254	<MDL	<MDL	ND	ND

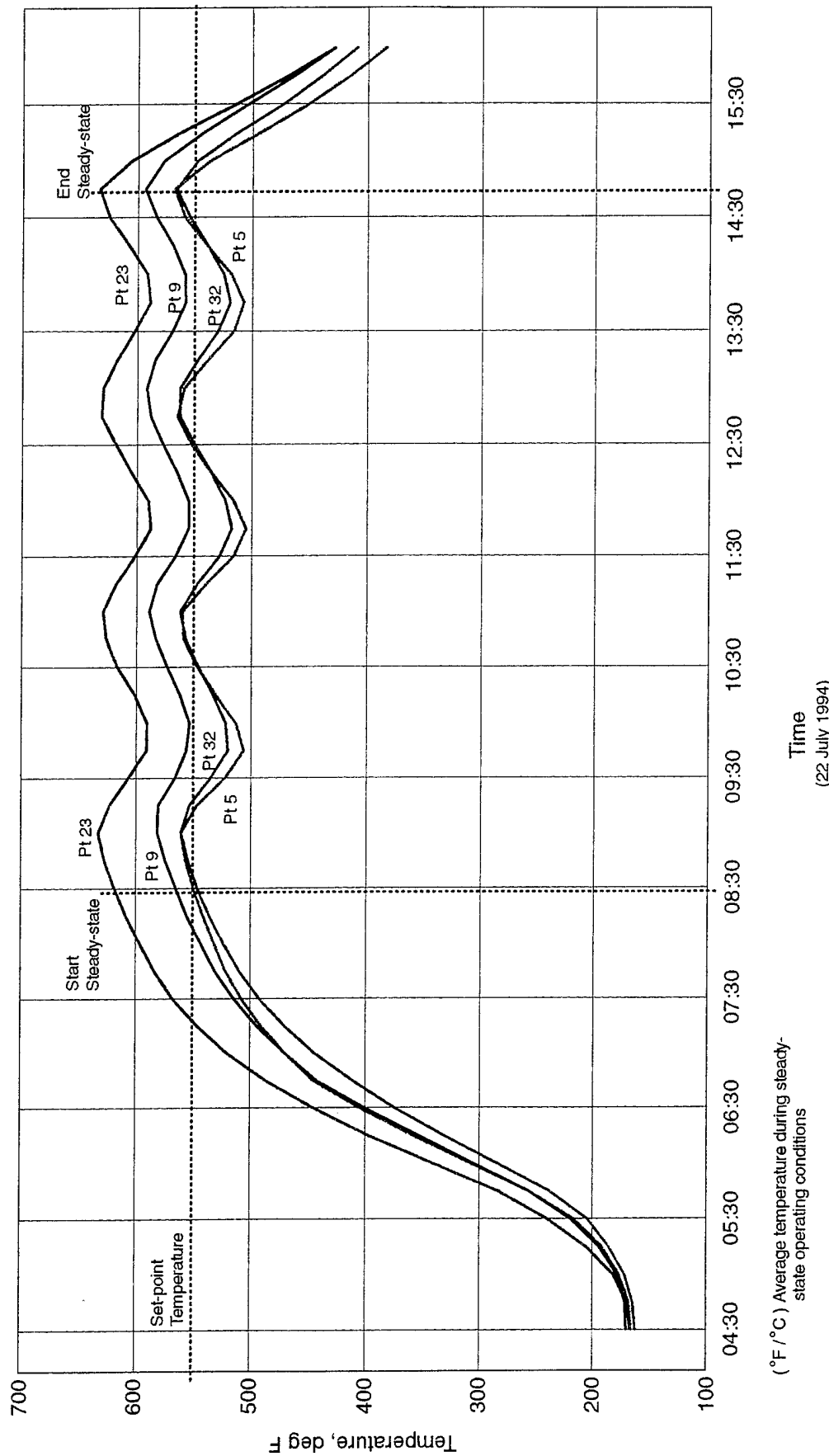
Special Abbreviations: NA=Not Applicable; ND=Not Detectable; NR=No Record

MDL for Analysis: 0.7 µg/smear RDX
0.3 µg/smear TNT

Surface Area: 161 sq cm

HGD Test 7

3-inch / 5-inch Projectiles - RDX - (192 Rounds)



- Pt 32 (adjacent to process probe) (542 °F / 283 °C)
- Pt 5 (coldest) (537 °F / 281 °C)
- Pt 9 (intermediate tp) (574 °F / 301 °C)
- Pt 23 (hottest) (612 °F / 322 °C)

(°F / °C) Average temperature during steady-state operating conditions

Time
(22 July 1994)

Figure F-10 Test 7 - Average Temperature Profile - 15 minute Intervals

HGD Test 7 3-inch / 5-inch Projectiles - RDX - (192 Rounds)

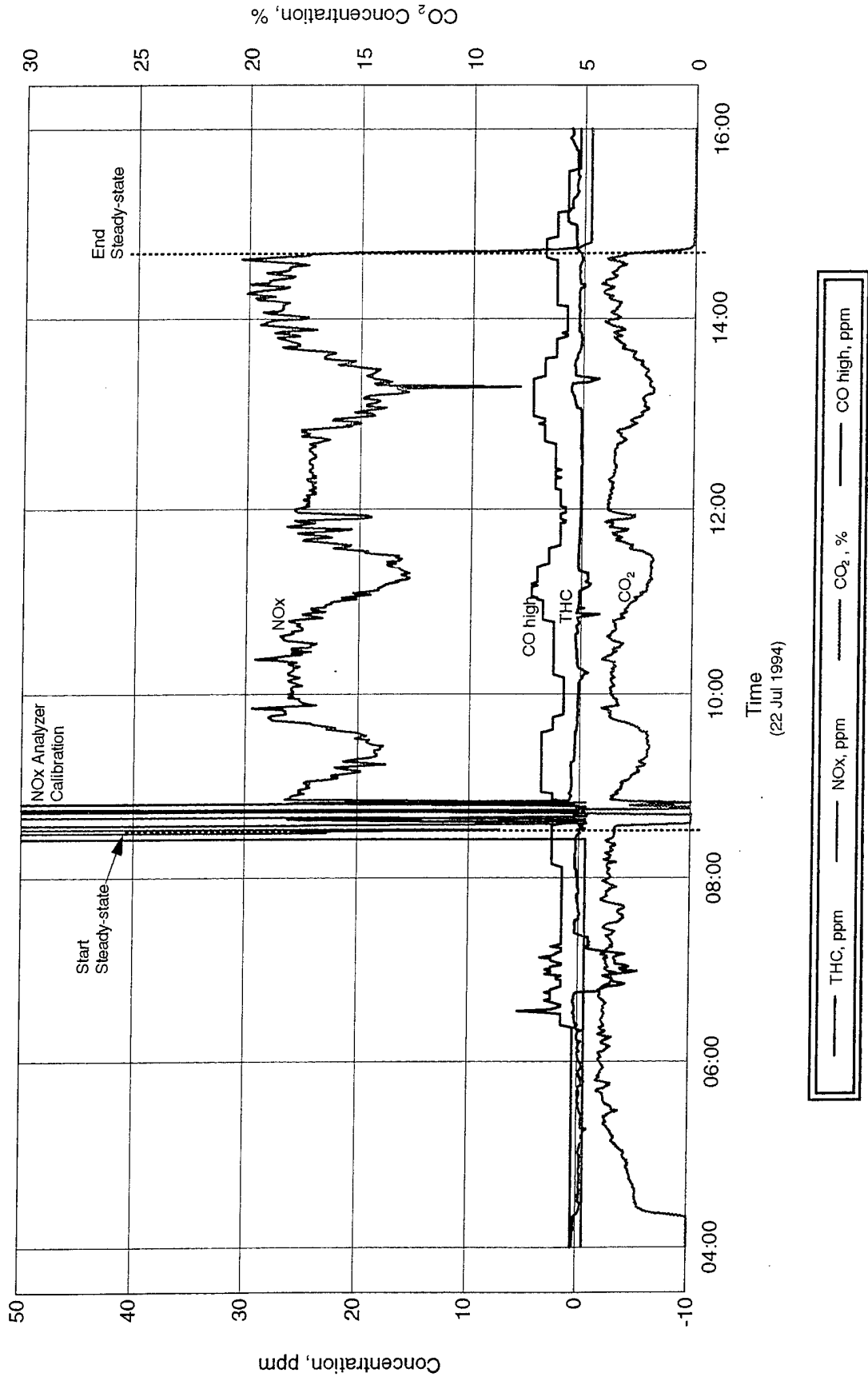


Figure F-11 Test 7 - CEM Profile - 1 minute Intervals

TEST 8

Process Conditions

This test was conducted under test conditions similar to Test 3 (6 hours treatment time, 24 175mm projectiles spiked with Comp B explosive) except the control temperature was increased from 500 to 550°F (260 to 288°C). The railcar configuration is shown in Figure D-21. The oxidizer was started at 0355 hrs on 24 July with heat to the chamber at 0435 hrs. Steady state was reached at 1122 hrs and the test was completed at 1740 hrs with an operated initiated cooldown.

Special Conditions

- The auxiliary vent on the chamber inlet gas duct was closed.
- Two types of insulation were installed in the chamber for tests on explosive vapor absorption into the insulation.

Analytical Considerations

- The spiked projectiles and chamber were sampled the next day using acetonitrile. Also samples of the insulation (one square inch by insulation thickness block) were taken.

Comments

- Signs of heat damage to the chamber concrete floor were noted.

CEM

- At about 0730 (approximately 400°F, 204°C) there are several spikes in the NO_x, CO, THC, which die off quickly.

Table F-18

PROJECTILE EXTRACT SAMPLES

Test # 8	Projectile Type:	175 mm	Date:	24 Jul 94
	Explosive Type:	Comp B	Heatup Time:	6.8 Hrs
	Explosive Source:	Spiked	Time at Setpoint:	6.3 Hrs
	Temperature Setpoint:	550°F 288°C	Cooldown Time:	NR

Round #	Operating Temperature		Operating Temperature		Explosive Concentration		Sampling Dilution ml	Explosive Amount µg	Explosive Amount / Surface Area mg / cm ²	DRE* %
	°F	s dev	°C	s dev	µg / ml RDX	µg / ml TNT				
1	587	13.39	309	7.44	<MDL	<MDL	500	ND	ND	99.999
2	559	10.85	293	6.03	<MDL	<MDL	500	ND	ND	99.999
3	561	8.96	294	4.98	<MDL	<MDL	500	ND	ND	99.999
4	560	9.64	293	5.35	<MDL	<MDL	500	ND	ND	99.999
5	550	9.70	288	5.39	<MDL	<MDL	500	ND	ND	99.999
6	553	11.51	290	6.39	0.0432	<MDL	500	21.600	1.1232E-05	99.999
7	586	10.61	308	5.89	<MDL	<MDL	500	ND	ND	99.999
8	572	7.98	300	4.43	<MDL	<MDL	500	ND	ND	99.999
9	563	7.30	295	4.05	<MDL	<MDL	500	ND	ND	99.999
10	556	8.32	291	4.62	<MDL	0.0051	500	2.550	1.3261E-06	99.999
11	558	7.75	292	4.31	<MDL	<MDL	500	ND	ND	99.999
12	553	8.61	290	4.78	<MDL	<MDL	500	ND	ND	99.999
13	582	10.88	306	6.04	<MDL	0.0045	500	2.250	1.1700E-06	99.999
14	571	8.30	300	4.61	<MDL	<MDL	500	ND	ND	99.999
15	567	8.05	297	4.47	<MDL	0.0068	500	3.400	1.7681E-06	99.999
16	567	8.26	297	4.59	<MDL	<MDL	500	ND	ND	99.999
17	559	5.68	293	3.15	<MDL	0.0093	500	4.650	2.4181E-06	99.999
18	557	7.49	292	4.16	<MDL	0.0048	500	2.400	1.2480E-06	99.999
19	586	11.96	308	6.64	<MDL	0.0048	500	2.400	1.2480E-06	99.999
20	576	7.58	302	4.21	0.053	<MDL	500	26.500	1.3781E-05	99.999
21	571	9.13	299	5.07	<MDL	<MDL	500	ND	ND	99.999
22	576	9.29	302	5.16	<MDL	0.0071	500	3.550	1.8461E-06	99.999
23	598	10.06	314	5.59	19823	15339	500	17581000	9.1425E+00	NA
24	571	10.63	300	5.90	<MDL	<MDL	500	ND	ND	99.999

Special Abbreviations: NA=Not Applicable; ND=Not Detectable; NR=No Record; s dev=standard deviation.

*The DRE results for samples denoted by <MDL are calculated based on a value of one-half the MDL.

Extracted Round No: 23
Extracted Round Amount: 17.58 grams

MDL for Analysis: 0.007 µg/ml RDX
0.003 µg/ml TNT

Surface Area: 1923 sq cm

Table F-19

CHAMBER WIPES

Test # <u>8</u>	Chamber Load:	<u>175 mm</u>	Date:	<u>24 Jul 94</u>
	Explosive Type:	<u>Comp B</u>	Heatup Time:	<u>6.8 Hrs</u>
	Explosive Source:	<u>Spiked</u>	Time at Setpoint:	<u>6.3 Hrs</u>
	Temperature Setpoint:	<u>550°F</u> <u>288°C</u>	Cooldown Time:	<u>NR</u>

Wipe #	Location in System	Operating Temperature	Operating Temperature	Explosive Concentration / Smear		Explosive Amount	Explosive Amount / Surface Area
		°F	°C	µg / smear RDX	µg / smear TNT	µg	mg / cm ²
1	Blank	NA	NA	<MDL	<MDL	ND	ND
2	Floor	453	234	<MDL	<MDL	ND	ND
3	Wall	NR	NR	<MDL	<MDL	ND	ND
4	Duct	560	293	<MDL	<MDL	ND	ND
5	Elbow	560	293	<MDL	<MDL	ND	ND
6	Fanblade	560	293	<MDL	<MDL	ND	ND
7	Coldspot	358	181	<MDL	<MDL	ND	ND
8	Rail	476	247	<MDL	1.8678	1.8678	1.1601E-05

Special Abbreviations: NA=Not Applicable; ND=Not Detectable; NR=No Record

MDL for Analysis: 0.7 µg/smear RDX
0.3 µg/smear TNT

Surface Area: 161 sq cm

HGD Test 8

175mm Projectiles - Comp B - (96 Rounds)

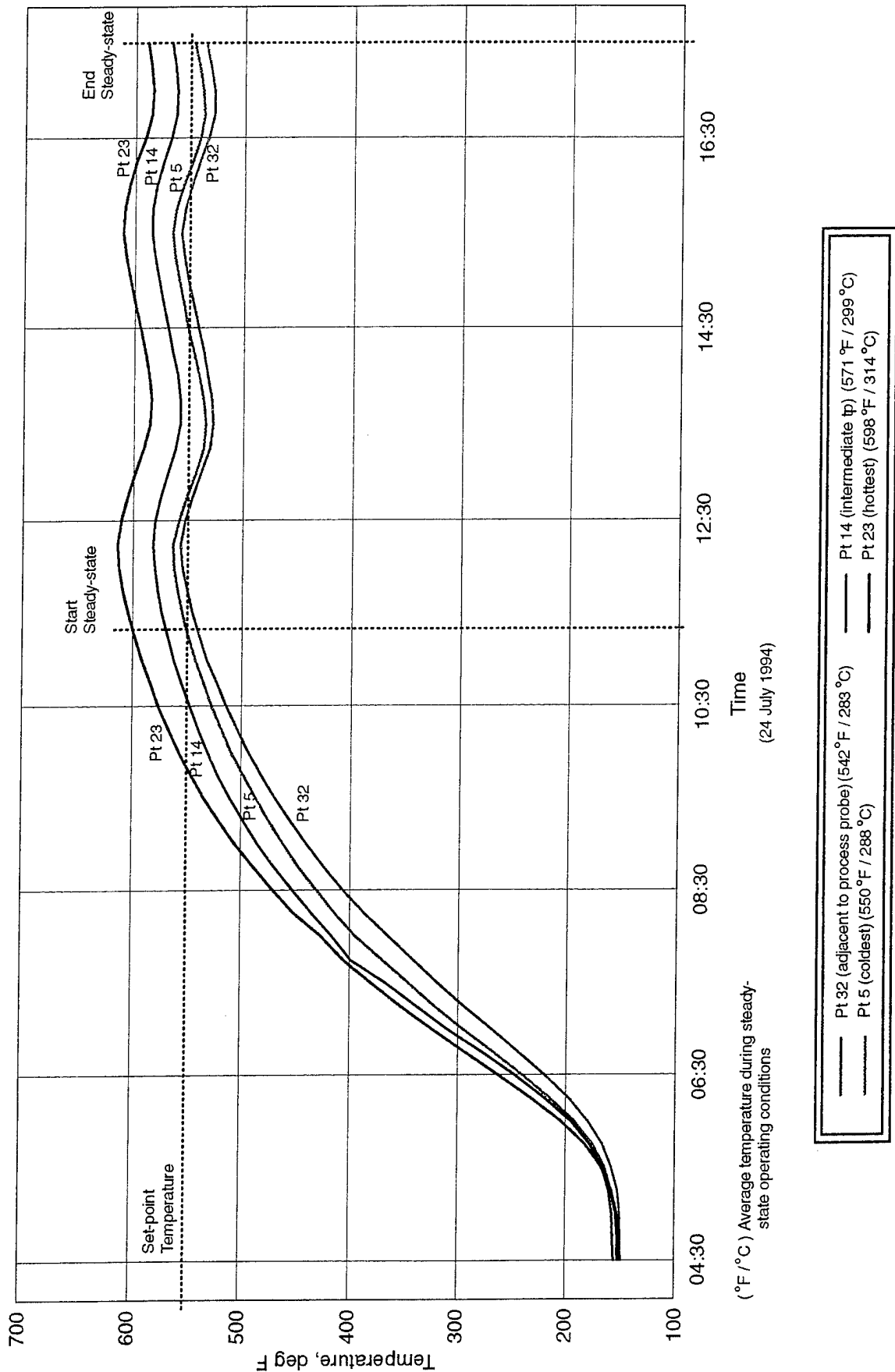


Figure F-12 Test 8 - Average Temperature Profile - 15 minute Intervals

HGD Test 8

175mm Projectiles - Comp B - (96 Rounds)

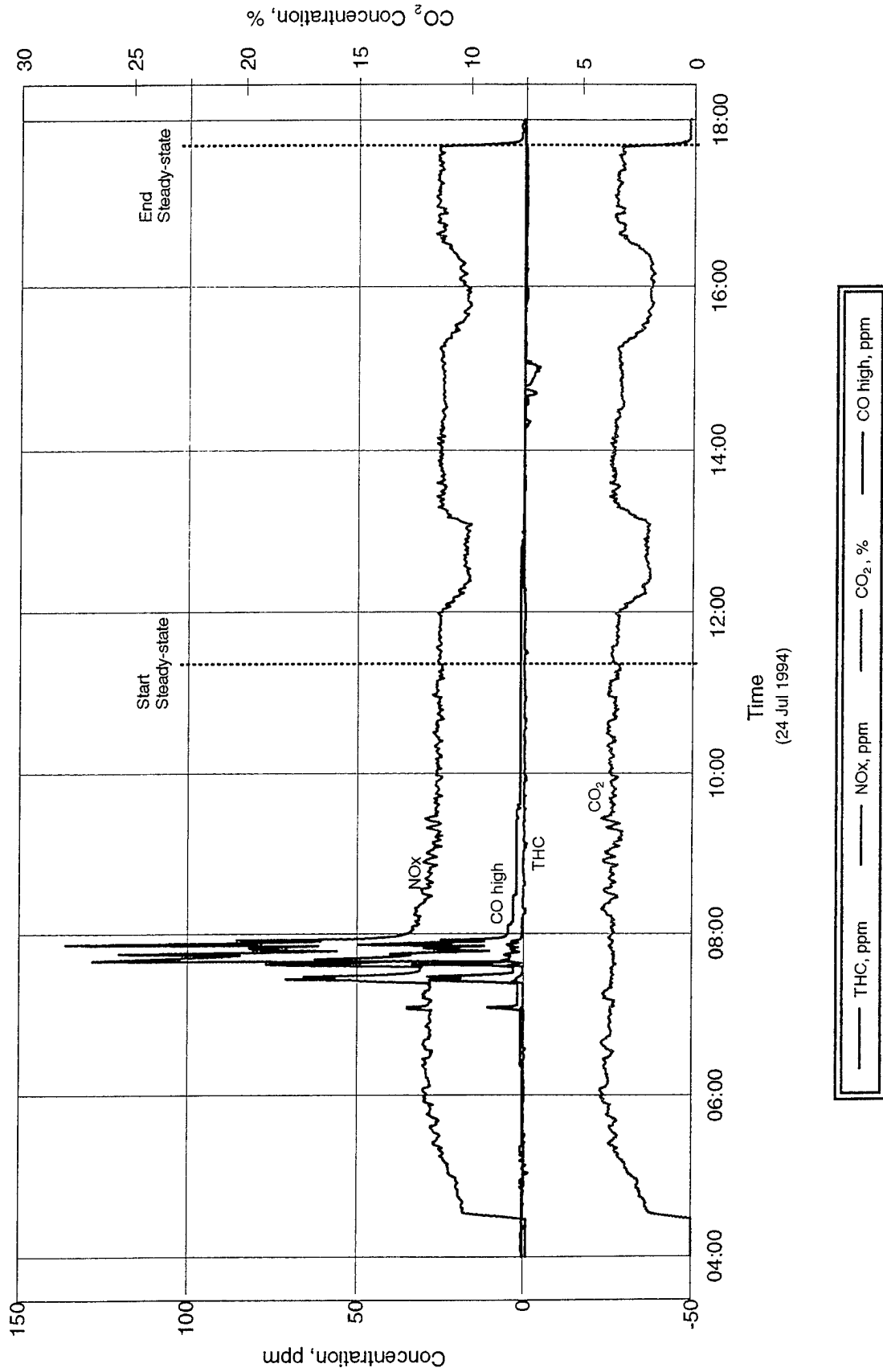


Figure F-13 Test 8 - CEM Profile - 1 minute Intervals

TEST 9

Process Conditions

This test was conducted under test conditions similar to Test 5 (6 hours treatment time, 24 3-inch projectiles spiked with HBX explosive) except the control temperature was increased from 550 to 600°F (288 to 316°C). The railcar configuration is shown in Figure D-22. The oxidizer was started at 0246 hrs on 26 July with heat to the chamber at 0326 hrs. Steady state was reached at 0814 hrs and treatment was completed at 1430 hrs with an operator initiated cooldown of the system.

Analytical Considerations

- Samples of the spiked projectiles and chamber were taken on July 28 using acetone.

Table F-20

PROJECTILE EXTRACT SAMPLES

	Projectile Type:	3-inch	Date:	26 Jul 94
Test #	Explosive Type:	HBX	Heatup Time:	4.8 Hrs
9	Explosive Source:	Spiked	Time at Setpoint:	6.2 Hrs
	Temperature Setpoint:	600°F 316°C	Cooldown Time:	NR

Round #	Operating Temperature		Operating Temperature		Explosive Concentration		Sampling Dilution ml	Explosive Amount µg	Explosive Amount / Surface Area mg / cm ²	DRE*
	°F	s dev	°C	s dev	µg / ml RDX	µg / ml TNT				
1	622	9.93	328	5.52	<MDL	<MDL	50	ND	ND	99.999
2	640	10.80	338	6.00	<MDL	<MDL	50	ND	ND	99.999
3	619	9.54	326	5.30	<MDL	0.004	50	0.200	9.9010E-07	99.999
4	613	10.49	323	5.83	<MDL	0.0119	50	0.595	2.9455E-06	99.999
5	594	10.44	312	5.80	<MDL	0.0042	50	0.210	1.0396E-06	99.999
6	615	9.61	324	5.34	<MDL	0.0079	50	0.395	1.9554E-06	99.999
7	634	9.64	335	5.36	<MDL	0.0108	50	0.540	2.6733E-06	99.999
8	625	8.13	330	4.52	<MDL	0.0105	50	0.525	2.5990E-06	99.999
9	618	8.37	326	4.65	<MDL	0.0108	50	0.540	2.6733E-06	99.999
10	611	7.95	322	4.42	<MDL	0.0153	50	0.765	3.7871E-06	99.999
11	602	8.24	317	4.58	<MDL	0.011	50	0.550	2.7228E-06	99.999
12	610	7.21	321	4.01	<MDL	0.013	50	0.650	3.2178E-06	99.999
13	626	9.19	330	5.11	<MDL	0.0065	50	0.325	1.6089E-06	99.999
14	629	8.70	332	4.83	<MDL	0.0051	50	0.255	1.2624E-06	99.999
15	616	7.66	325	4.26	<MDL	0.0057	50	0.285	1.4109E-06	99.999
16	613	7.50	323	4.17	<MDL	0.0076	50	0.380	1.8812E-06	99.999
17	609	6.89	320	3.83	<MDL	0.0074	50	0.370	1.8317E-06	99.999
18	615	7.25	324	4.03	<MDL	0.0093	50	0.465	2.3020E-06	99.999
19	620	7.82	327	4.35	<MDL	0.0054	50	0.270	1.3366E-06	99.999
20	633	9.25	334	5.14	<MDL	0.0065	50	0.325	1.6089E-06	99.999
21	652	13.83	344	7.68	16350	16499	50	1642450	8.1309E+00	NA
22	626	8.03	330	4.46	<MDL	0.0068	50	0.340	1.6832E-06	99.999
23	615	7.07	324	3.93	<MDL	0.0088	50	0.440	2.1782E-06	99.999
24	646	13.23	341	7.35	<MDL	0.0099	50	0.495	2.4505E-06	99.999

Special Abbreviations: NA=Not Applicable; ND=Not Detectable; NR=No Record; s dev=standard deviation.

*The DRE results for samples denoted by <MDL are calculated based on a value of one-half the MDL.

Extracted Round No: 21
Extracted Round Amount: 1.642 grams

MDL for Analysis: 0.007 µg/ml RDX
0.003 µg/ml TNT

Surface Area: 202 sq cm

Table F-21

CHAMBER WIPES

Test # 9	Chamber Load:	3-inch	Date:	26 Jul 94
	Explosive Type:	HBX	Heatup Time:	4.8 Hrs
	Explosive Source:	Spiked	Time at Setpoint:	6.2 Hrs
	Temperature Setpoint:	600°F 343°C	Cooldown Time:	NR

Wipe #	Location in System	Operating Temperature	Operating Temperature	Explosive Concentration / Smear		Explosive Amount	Explosive Amount / Surface Area
		°F	°C	µg / smear RDX	µg / smear TNT	µg	mg / cm ²
1	Blank	NA	NA	<MDL	<MDL	ND	ND
2	Floor	492	256	<MDL	<MDL	ND	ND
3	Wall	NR	NR	<MDL	<MDL	ND	ND
4	Duct	592	311	<MDL	<MDL	ND	ND
5	Elbow	592	311	<MDL	<MDL	ND	ND
6	Fanblade	592	311	<MDL	0.4811	0.4811	2.9882E-06
7	Coldspot	386	197	<MDL	<MDL	ND	ND
8	Rail	520	271	<MDL	0.7924	0.7924	4.9217E-06

Special Abbreviations: NA=Not Applicable; ND=Not Detectable; NR=No Record

MDL for Analysis: 0.7 µg/smear RDX
0.3 µg/smear TNT

Surface Area: 161 sq cm

HGD Test 9

3-inch Projectiles - HBX - (192 Rounds)

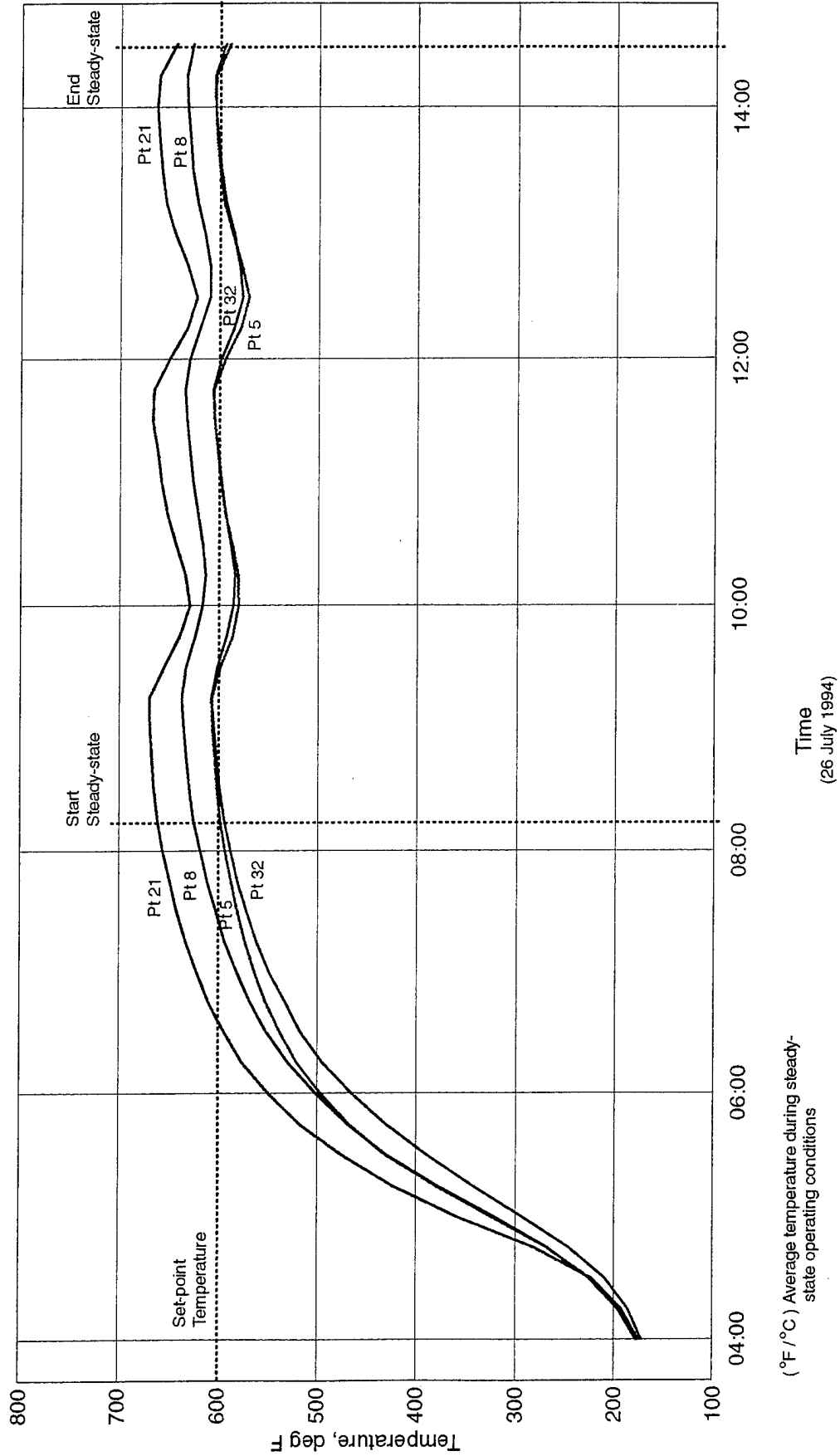


Figure F-14 Test 9 - Average Temperature Profile - 15 minute Intervals

HGD Test 9 3-inch Projectiles - HBX - (192 Rounds)

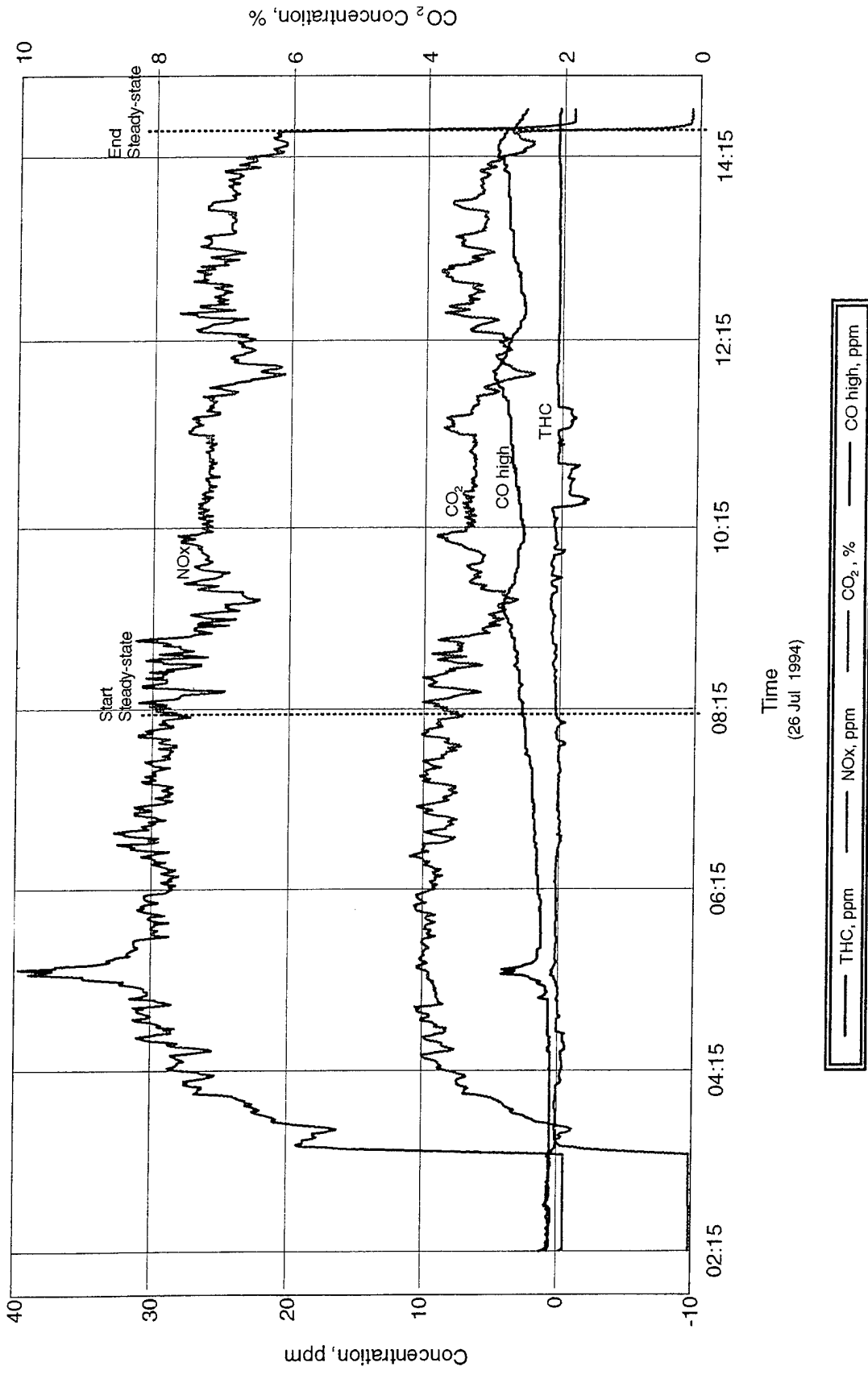


Figure F-15 Test 9 - CEM Profile - 1 minute Intervals

TEST 10

Process Conditions

This test was conducted on 96 3-inch and 96 5-inch projectiles in a railcar configuration as shown in Figure D-23. Twenty-four (12 3-inch and 12 5-inch) of the projectiles were spiked with Yellow D explosive. The test conditions were 12 hrs at 600°F (316°C). The oxidizer was started at 0057 hrs on 29 July with the system in process at 0142 hrs. Steady state was reached at 0759 hrs with the test completed at 2216 hrs with a control system automatically initiated cooldown of the system.

Analytical Considerations

- The projectiles were spiked by evaporation of a solution of Yellow D explosive in a 1:1 blend of acetone and water. The blend of acetone and water was selected as the solvent based on field tests of available solvents. Yellow D was not sufficiently soluble in acetonitrile, methanol, acetone, or water alone for preparation of a concentrated solution to be used for spiking.
- Samples were taken from the chamber and spiked projectiles the next day using HPLC water. Two samples were broken in shipment.

CEM

- There were several spikes around 0530 hrs at 500°F (260°C) that died away.
- NOTE: Large broad bands in the CO, and NO_x between 1330 and 2130 correspond to temperature drops in the system. Probably due to the system letting in outside air to compensate for temperature changes.

Table F-22

PROJECTILE EXTRACT SAMPLES

Projectile Type		3-inch 5-inch	Date:	29 Jul 94
Test #	Explosive Type:	Yellow D	Heatup Time:	6.3 Hrs
10	Explosive Source:	Spiked	Time at Setpoint:	14.3 Hrs
Temperature Setpoint:		600°F 316°C	Cooldown Time:	9.0 Hrs

Round #	Size	Operating Temperature		Operating Temperature		Explosive Concentration μg/ml Amm. Picrate	Sampling Dilution ml	Explosive Amount μg	Explosive Amount / Surface Area mg / cm ²	DRE* %
		°F	s dev	°C	s dev					
1	5 in.	648	7.23	342	4.01	<MDL	100	ND	ND	99.999
2	5 in.	625	7.86	329	4.37	0.0045	100	0.450	7.1203E-07	99.999
3	5 in.	625	6.91	330	3.84	<MDL	100	ND	ND	99.999
4	3 in.	604	10.91	318	6.06	0.0122	50	0.610	3.0198E-06	99.999
5	3 in.	616	17.04	324	9.47	Broken in shipm't	50	NR	NR	NA
6	3 in.	609	10.71	321	5.95	<MDL	50	ND	ND	99.999
7	3 in.	634	8.50	335	4.72	<MDL	50	ND	ND	99.999
8	3 in.	635	8.45	335	4.69	0.0093	50	0.465	2.3020E-06	99.999
9	3 in.	629	8.23	332	4.57	0.0046	50	0.230	1.1386E-06	99.999
10	5 in.	613	7.00	323	3.89	0.0093	100	0.930	1.4715E-06	99.999
11	5 in.	619	7.53	326	4.18	0.0059	100	0.590	9.3354E-07	99.999
12	5 in.	613	16.61	323	9.23	<MDL	100	ND	ND	99.999
13	5 in.	637	7.31	336	4.06	0.0059	100	0.590	9.3354E-07	99.999
14	5 in.	637	7.04	336	3.91	0.0053	100	0.530	8.3861E-07	99.999
15	5 in.	627	7.89	330	4.38	0.0056	100	0.560	8.8608E-07	99.999
16	3 in.	625	8.20	329	4.56	0.0095	50	0.475	2.3515E-06	99.999
17	3 in.	615	7.90	324	4.39	0.0119	50	0.595	2.9455E-06	99.999
18	3 in.	623	7.84	328	4.36	<MDL	50	ND	ND	99.999
19	3 in.	642	15.17	339	8.43	0.0056	50	0.280	1.3861E-06	99.999
20	3 in.	638	17.01	337	9.45	Broken in shipm't	50	NR	NR	NA
21	3 in.	651	11.51	344	6.40	8780	250	2195000	1.0866E+01	NA
22	5 in.	625	9.17	329	5.09	3700	2000	7400000	1.1709E+01	NA
23	5 in.	642	9.00	339	5.00	<MDL	100	ND	ND	99.999
24	5 in.	654	14.46	346	8.03	<MDL	100	ND	ND	99.999

Special Abbreviations: NA=Not Applicable; ND=Not Detectable; NR=No Record; s dev=standard deviation.

*The DRE results for samples denoted by <MDL are calculated based on a value of one-half the MDL.

Extracted Round No: 21, 22
 Extracted Round Amount: 2.20 grams (3-inch)
 7.40 grams (5-inch)

MDL for Analysis: 0.004 μg/ml Ammonium Picrate

Surface Area: 202 sq cm (3-inch)
 632 sq cm (5-inch)

CHAMBER WIPES

Test # <u>10</u>	Chamber Load:	<u>3-inch</u> <u>5-inch</u>	Date:	<u>29 Jul 94</u>
	Explosive Type:	<u>Yellow D</u>	Heatup Time:	<u>6.3 Hrs</u>
	Explosive Source:	<u>Spiked</u>	Time at Setpoint:	<u>14.3 Hrs</u>
	Temperature Setpoint:	<u>600°F</u> <u>316°C</u>	Cooldown Time:	<u>9.0 Hrs</u>

Wipe #	Location in System	Operating Temperature	Operating Temperature	Explosive Concentration / Smear	Explosive Amount	Explosive Amount / Surface Area
		°F	°C	µg / smear Amm. Picrate	µg	mg / cm ²
1	Blank	NA	NA	<MDL	ND	ND
2	Floor	509	265	<MDL	ND	ND
3	Wall	NR	NR	<MDL	ND	ND
4	Duct	605	318	<MDL	ND	ND
5	Elbow	605	318	<MDL	ND	ND
6	Fanblade	605	318	<MDL	ND	ND
7	Coldspot	395	202	<MDL	ND	ND
8	Rail	595	313	<MDL	ND	ND

Special Abbreviations: NA=Not Applicable; ND=Not Detectable; NR=No Record

MDL for Analysis: 0.4 µg/smear Ammonium Picrate

Surface Area: 161 sq cm

HGD Test 10

3-inch / 5-inch Projectiles - Yellow D - (192 Rounds)

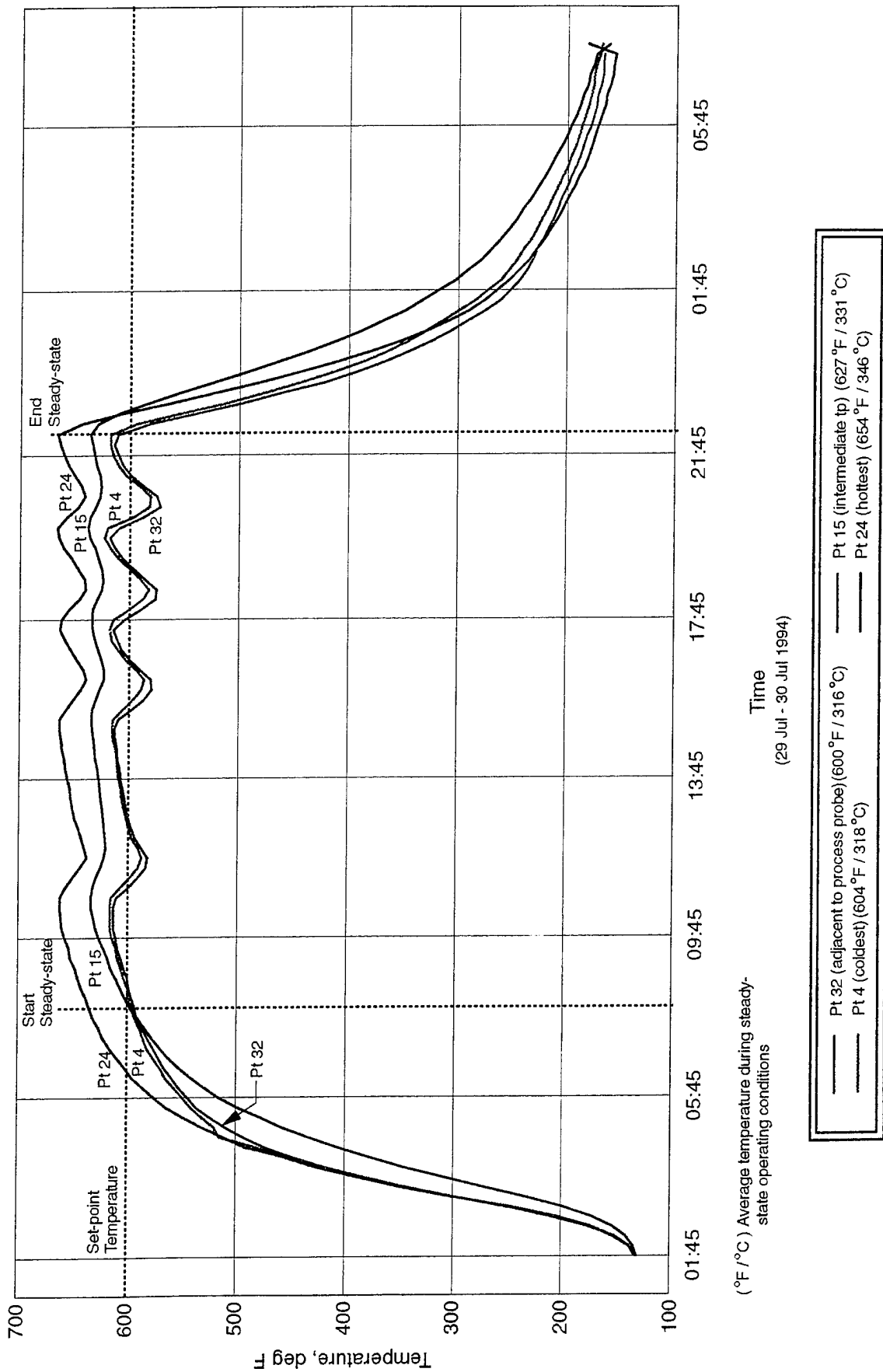
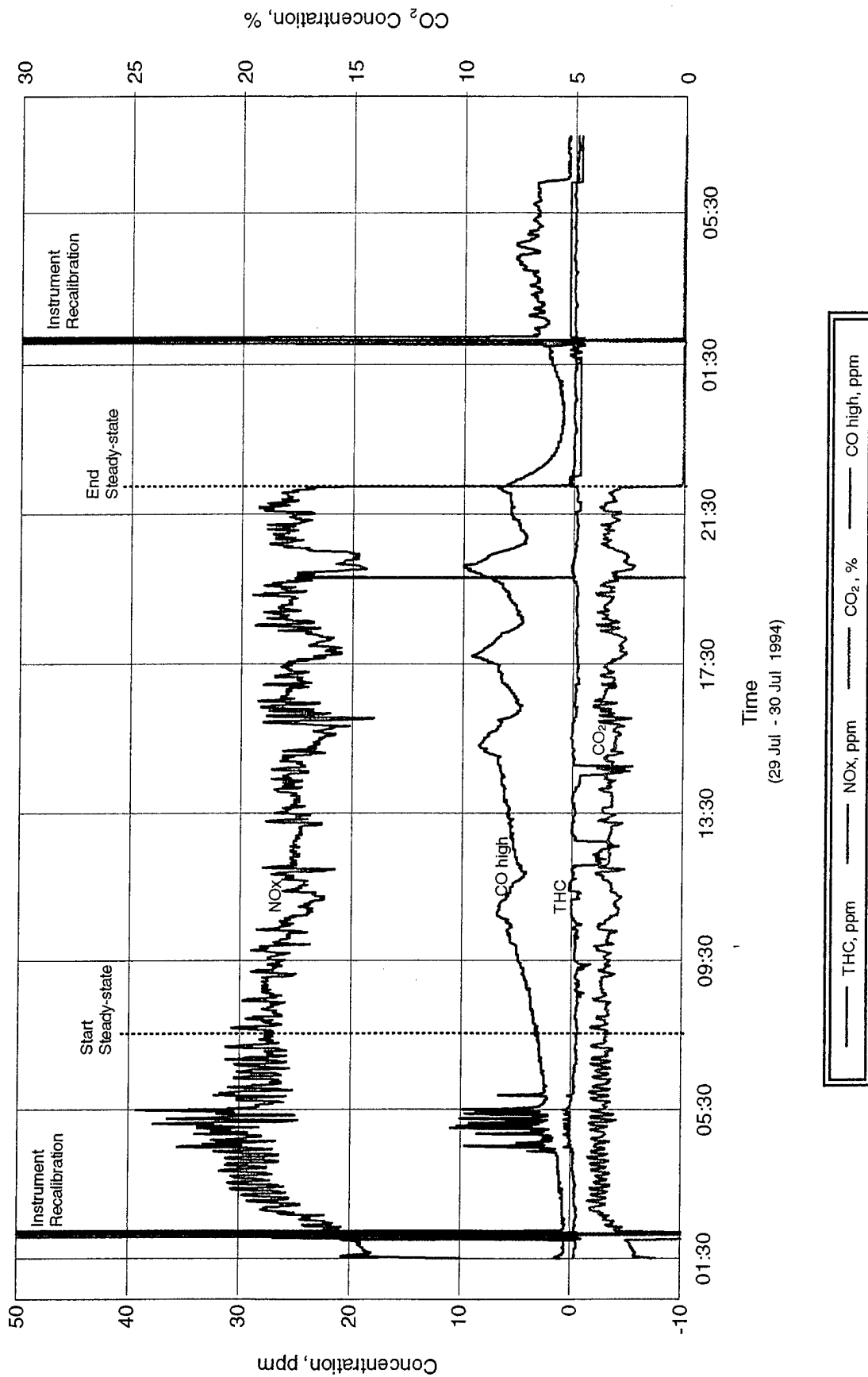


Figure F-16 Test 10 - Average Temperature Profile - 15 minute Intervals

HGD Test 10

3-inch / 5-inch Projectiles - Yellow D - (192 Rounds)



Time
(29 Jul - 30 Jul 1994)

— THC, ppm - - - NOx, ppm CO₂, % - . - . CO high, ppm

Figure F-17 Test 10 - CEM Profile - 1 minute Intervals

Table F-24

CHAMBER WIPES
Residue Accumulation from a Series of Tests

Tests: 1-10

Wipe #	Location in System	Operating Temperature*	Operating Temperature*	Explosive Concentration / Smear		Explosive Amount	Explosive Amount / Surface Area
		°F	°C	µg / smear RDX	µg / smear TNT	µg	mg / cm ²
1	Blank	NA	NA	NR	NR	NR	NR
2	Floor	470	243	<MDL	0.48	0.48	2.9814E-06
3	Wall	NR	NR	<MDL	0.42	0.42	2.6087E-06
4	Duct	573	301	<MDL	<MDL	ND	ND
5	Elbow	573	301	<MDL	0.4	0.4	2.4845E-06
6	Fanblade	573	301	<MDL	<MDL	ND	ND
7	Coldspot	378	192	<MDL	<MDL	ND	ND
8	Rail	514	268	<MDL	0.99	0.99	6.1491E-06

Special Abbreviations: NA=Not Applicable; ND=Not Detectable; NR=No Record

*Average operating temperature of tests 2, 4-10. Test period also includes tests 1, 3, B2, B3, B4.

MDL for Analysis: 0.7 µg/smear RDX
 0.4 µg/smear TNT

Surface Area: 161 sq cm

Test C

Process Conditions

This test was conducted on an empty chamber to decontaminate the chamber of any explosive residue that may have accumulated during Tests 1 through 10. Test conditions were 24 hrs at 700°F (371°C). The oxidizer was started at 0635 hrs on 1 August with heat added to the chamber at 0735 hrs. The system reached steady state at 1935 hrs on 2 August with the test complete at 1938 hrs on August 3 with cooldown of the system.

Analytical Considerations

- Chamber wipe samples were taken on 9 August.

SPECIAL TEST SAMPLES

Test # C	Chamber Load:	<u>None</u>	Date:	<u>1 Aug 94</u>
	Explosive Type:	<u>NA</u>	Heatup Time:	<u>36.0 Hrs</u>
	Explosive Source:	<u>NA</u>	Time at Setpoint:	<u>24.0 Hrs</u>
	Temperature Setpoint:	<u>700°F</u> <u>371°C</u>	Cooldown Time:	<u>NR</u>

Sample Description / Location	Explosive Concentration / Sample		Explosive Amount	Explosive Amount / Surface Area
	$\mu\text{g} / \text{sample RDX}$	$\mu\text{g} / \text{sample TNT}$	μg	mg / cm^2
Floor	<MDL	<MDL	ND	ND
Wall	<MDL	<MDL	ND	ND
Duct	<MDL	<MDL	ND	ND
Elbow	4.2487	<MDL	4.2487	2.6389E-05
Fan	<MDL	<MDL	ND	ND
Coldspot	0.607	<MDL	0.607	3.7702E-06
Rail	1.2691	<MDL	1.2691	7.8826E-06
Blank	<MDL	<MDL	ND	ND

Special Abbreviations: NA= Not Applicable; ND= Not Detectable; NR= No Record

MDL for Analysis: 0.7 $\mu\text{g}/\text{sample RDX}$
0.3 $\mu\text{g}/\text{sample TNT}$

Smear Surface Area: 161 sq cm

TEST 11

Process Conditions

Test 11 was conducted under test conditions similar to Test 6 [700°F (371°C) treatment temperature, 4 MK 25 Ship Mines spiked with TNT explosives] except the treatment time was decreased from 48 to 32 hrs. The railcar configuration is shown in Figure D-26. The oxidizer was started at 0942 hrs on 9 August with hot gas to the chamber at 1028 hrs. System reached steady state at 1332 hrs on 10 August. Test completed and a control system automatically initiated cooldown at 0412 hrs on 12 August.

Analytical Considerations

- Mine and chamber wipe samples were taken the next day using acetonitrile.

Comments

- System shutdown at 1433 hrs on 11 August due to power interruption; restart at 1452 hrs. Another power interruption shutdown at 1709 hrs; back on at 1801 hrs.
- Mines had scaled, rusty, discolored appearance; no hot-melt residue apparent.

CEM

- CEM monitor malfunction on total hydrocarbon measurements.

Table F-26

MINE/DEPTH BOMB WIPE SAMPLES

Mine/Depth Bomb Type:	<u>MK25 Ship Mine</u>	Date:	<u>9 Aug 94</u>
Test # <u>11</u>	Explosive Type:	<u>TNT</u>	Heatup Time: <u>27.1 Hrs</u>
	Explosive Source:	<u>Spiked</u>	Time at Setpoint: <u>38.7 Hrs</u>
	Temperature Setpoint:	<u>700°F 371°C</u>	Cooldown Time: <u>10.0 Hrs</u>

Wipe #	Operating Temperature		Operating Temperature		Explosive Concentration		Explosive Amount	Explosive Amount / Surface Area	DRE*
	°F	s dev	°C	s dev	µg/smear RDX	µg/smear TNT	µg	mg / cm ²	%
1	755	38.90	402	21.61	<MDL	<MDL	ND	ND	99.999
2	762	39.79	405	22.11	<MDL	<MDL	ND	ND	99.999
3	715	32.57	379	18.10	<MDL	<MDL	ND	ND	99.999
4	722	33.56	383	18.65	<MDL	<MDL	ND	ND	99.999
5	756	38.92	402	21.62	<MDL	<MDL	ND	ND	99.999
6	759	39.97	404	22.20	<MDL	<MDL	ND	ND	99.999
7	723	33.81	384	18.78	<MDL	<MDL	ND	ND	99.999
8	734	34.94	390	19.41	<MDL	<MDL	ND	ND	99.999
9	700	30.91	371	17.17	<MDL	<MDL	ND	ND	99.999
10	708	32.06	375	17.81	<MDL	<MDL	ND	ND	99.999
11	692	32.35	367	17.97	<MDL	<MDL	ND	ND	99.999
12	707	33.14	375	18.41	<MDL	<MDL	ND	ND	99.999
13	719	33.14	382	18.41	<MDL	<MDL	ND	ND	99.999
14	726	34.31	386	19.06	<MDL	<MDL	ND	ND	99.999
15	722	35.49	383	19.72	<MDL	<MDL	ND	ND	99.999
16	725	35.17	385	19.54	<MDL	<MDL	ND	ND	99.999

Special Abbreviations: NA=Not Applicable; ND=Not Detectable; NR=No Record; s dev=standard deviation.

*The DRE results for samples denoted by <MDL are calculated based on a value of one-half the MDL.

Spike Amount: 3 grams

MDL for Analysis: 0.7 µg/smear RDX
0.4 µg/smear TNT

Surface Area: 232 sq cm (except 97 sq cm at points 3, 7, 11, 15)

Table F-27

CHAMBER WIPES

Test # 11	Chamber Load:	MK25 Ship Mine	Date:	9 Aug 94
	Explosive Type:	TNT	Heatup Time:	27.1 Hrs
	Explosive Source:	Spiked	Time at Setpoint:	38.7 Hrs
	Temperature Setpoint:	700°F 371°C	Cooldown Time:	10.0 Hrs

Wipe #	Location in System	Operating Temperature	Operating Temperature	Explosive Concentration / Smear		Explosive Amount	Explosive Amount / Surface Area
		°F	°C	µg / smear RDX	µg / smear TNT	µg	mg / cm ²
1	Blank	NA	NA	<MDL	<MDL	ND	ND
2	Floor	570	299	<MDL	<MDL	ND	ND
3	Wall	NR	NR	<MDL	0.9142	0.9142	5.6783E-06
4	Duct	678	359	<MDL	<MDL	ND	ND
5	Elbow	678	359	<MDL	<MDL	ND	ND
6	Fanblade	678	359	<MDL	<MDL	ND	ND
7	Coldspot	530	277	<MDL	<MDL	ND	ND
8	Rail	682	361	<MDL	<MDL	ND	ND

Special Abbreviations: NA=Not Applicable; ND=Not Detectable; NR=No Record

MDL for Analysis: 0.7 µg/smear RDX
0.4 µg/smear TNT

Surface Area: 161 sq cm

HGD Test 11

MK 25 Ship Mines - TNT - (8 Items)

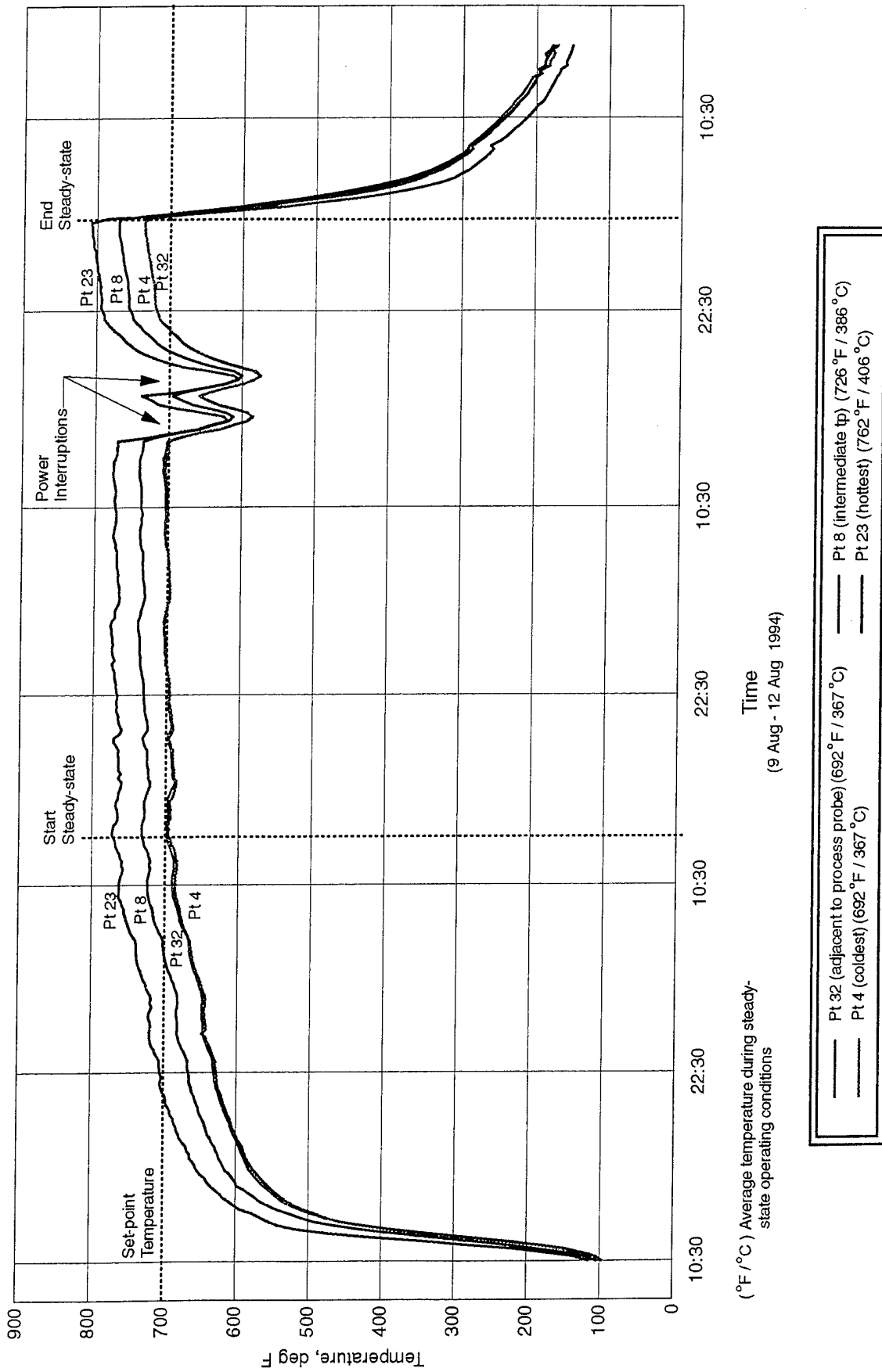


Figure F-18 Test 11 - Average Temperature Profile - 15 minute Intervals

HGD Test 11

MK 25 Ship Mines - TNT - (8 Items)

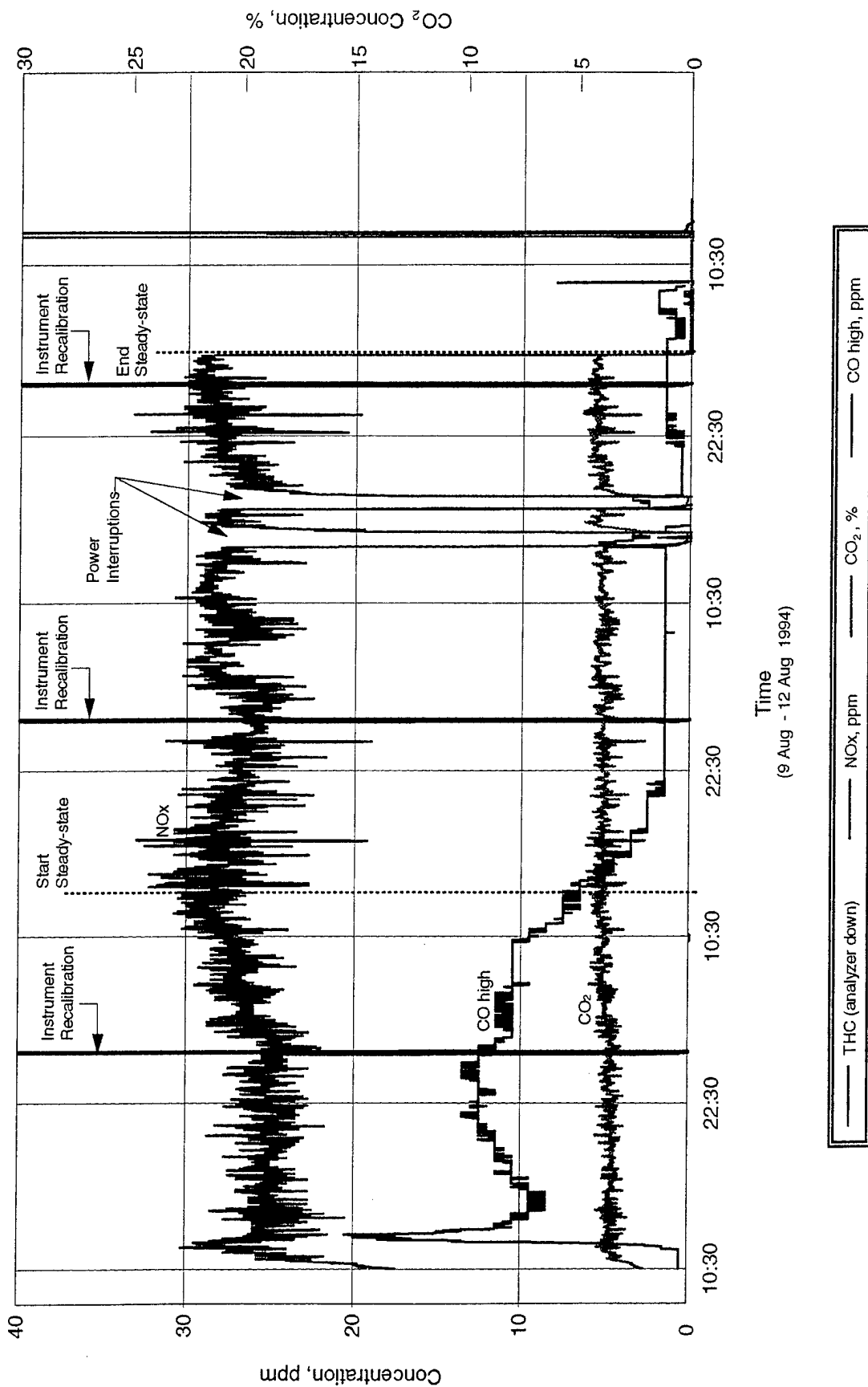


Figure F-19 Test 11 - CEM Profile - 1 minute intervals

TEST 12

This test was conducted under the same test conditions as Test 7 [6 hrs at 550°F (288°C), 12 3-inch and 12 5-inch projectiles spiked with RDX explosive]. The railcar configuration is shown in Figure D-27. The oxidizer was started at 0917 hrs on 13 August with the system in process at 1002 hrs. Steady state operation was reached at 1536 hrs. Test was completed at 0126 hrs on 14 August with a control system automatically initiated shutdown.

Analytical Considerations

- Spiked projectile, chamber, and insulation samples were taken the next day using acetonitrile.

Comments

- Power interruption shutdown at 2020 hrs, restart at 2051 hrs; another power interruption shutdown at 2147 hrs, back on at 2208 hrs.

CEM

- Fluctuations in the CEM readings during the power interruptions were noted. There was also a dip in the NO_x readings when the chamber temperature decreased.

Table F-28

PROJECTILE EXTRACT SAMPLES

Test # 12	Projectile Type:	3-inch 5-inch	Date:	13 Aug 94
	Explosive Type:	RDX	Heatup Time:	5.6 Hrs
	Explosive Source:	Spiked	Time at Setpoint:	9.8 Hrs
	Temperature Setpoint:	550°F 288°C	Cooldown Time:	10.1 Hrs

Round #	Size	Operating Temperature		Operating Temperature		Explosive Concentration		Sampling Dilution ml	Explosive Amount µg	Explosive Amount / Surface Area mg / cm ²	DRE* %
		°F	s dev	°C	s dev	µg/ml RDX	µg/ml TNT				
1	3 in.	580	40.36	305	22.42	<MDL	<MDL	50	ND	ND	99.999
2	3 in.	593	39.76	312	22.09	0.037	<MDL	50	1.850	9.1584E-06	99.999
3	3 in.	576	33.55	302	18.64	0.0149	<MDL	50	0.745	3.6881E-06	99.999
4	5 in.	568	25.37	298	14.10	<MDL	<MDL	100	ND	ND	99.999
5	5 in.	550	26.90	288	14.95	<MDL	<MDL	100	ND	ND	99.999
6	5 in.	567	22.78	297	12.65	<MDL	<MDL	100	ND	ND	99.999
7	5 in.	587	25.29	309	14.05	<MDL	<MDL	100	ND	ND	99.999
8	5 in.	574	19.82	301	11.01	<MDL	<MDL	100	ND	ND	99.999
9	5 in.	568	20.66	298	11.48	<MDL	<MDL	100	ND	ND	99.999
10	3 in.	576	32.15	302	17.86	0.037	0.1284	50	8.270	4.0941E-05	99.999
11	3 in.	551	92.77	289	51.54	0.02487	<MDL	50	1.244	6.1559E-06	99.999
12	3 in.	576	31.37	302	17.43	<MDL	<MDL	50	ND	ND	99.999
13	3 in.	589	35.84	309	19.91	<MDL	<MDL	50	ND	ND	99.999
14	3 in.	582	33.20	306	18.44	<MDL	<MDL	50	ND	ND	99.999
15	3 in.	579	31.88	304	17.71	<MDL	<MDL	50	ND	ND	99.999
16	5 in.	569	18.75	298	10.42	<MDL	<MDL	100	ND	ND	99.999
17	5 in.	568	18.43	298	10.24	<MDL	<MDL	100	ND	ND	99.999
18	5 in.	573	24.55	301	13.64	<MDL	<MDL	100	ND	ND	99.999
19	5 in.	582	23.91	305	13.28	0.0138	<MDL	100	1.380	2.1835E-06	99.999
20	5 in.	587	19.01	308	10.56	40682	<MDL	100	4068200	6.4370E+00	NA
21	5 in.	579	22.51	304	12.51	<MDL	<MDL	100	ND	ND	99.999
22	3 in.	581	31.67	305	17.59	<MDL	<MDL	50	ND	ND	99.999
23	3 in.	577	30.54	303	16.96	30071	<MDL	50	1503550	7.4433E+00	NA
24	3 in.	589	37.25	309	20.70	<MDL	<MDL	50	ND	ND	99.999

Special Abbreviations: NA=Not Applicable; ND=Not Detectable; NR=No Record; s dev=standard deviation.

*The DRE results for samples denoted by <MDL are calculated based on a value of one-half the MDL.

Extracted Round No: 20, 23
 Extracted Round Amount: 1.50 grams (3-inch) (Extracted round samples were diluted to dissolve crystals prior to analysis.)
 4.07 grams (5-inch)

MDL for Analysis: 0.007 µg/ml RDX
 0.003 µg/ml TNT
 Surface Area: 202 sq cm (3-inch)
 632 sq cm (5-inch)

CHAMBER WIPES

Test # 12	Chamber Load:	3-inch 5-inch	Date:	13 Aug 94
	Explosive Type:	RDX	Heatup Time:	5.6 Hrs
	Explosive Source:	Spiked	Time at Setpoint:	9.8 Hrs
	Temperature Setpoint:	550°F 288°C	Cooldown Time:	10.1 Hrs

Wipe #	Location in System	Operating Temperature	Operating Temperature	Explosive Concentration / Smear		Explosive Amount	Explosive Amount / Surface Area
		°F	°C	µg / smear RDX	µg / smear TNT	µg	mg / cm ²
1	Blank	NA	NA	<MDL	<MDL	ND	ND
2	Floor	471	244	<MDL	<MDL	ND	ND
3	Wall	NR	NR	<MDL	<MDL	ND	ND
4	Duct	542	283	<MDL	<MDL	ND	ND
5	Elbow	542	283	<MDL	<MDL	ND	ND
6	Fanblade	542	283	<MDL	<MDL	ND	ND
7	Coldspot	434	223	<MDL	<MDL	ND	ND
8	Rail	553	289	<MDL	<MDL	ND	ND

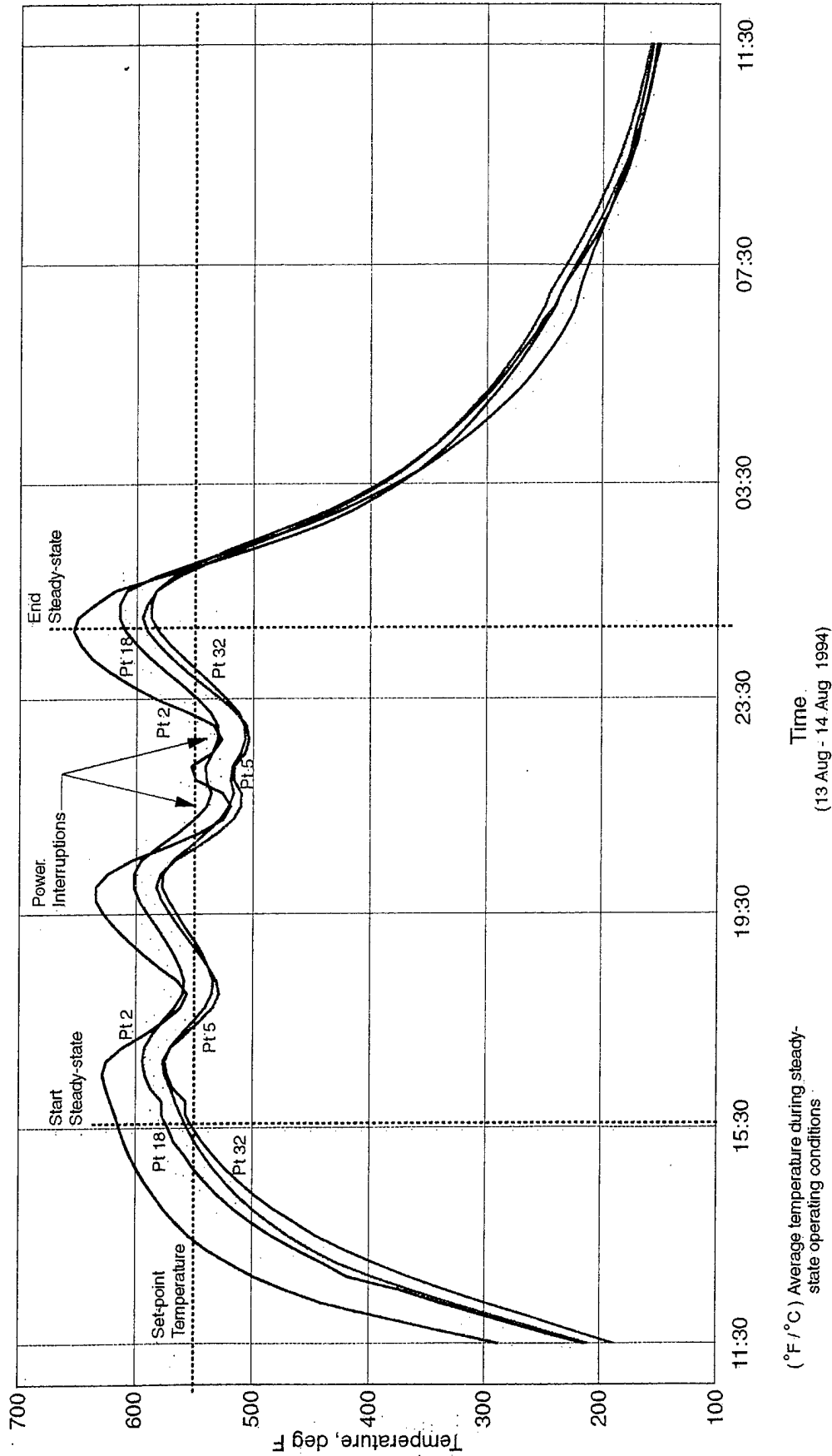
Special Abbreviations: NA=Not Applicable; ND=Not Detectable; NR=No Record

MDL for Analysis: 0.7 µg/smear RDX
0.4 µg/smear TNT

Surface Area: 161 sq cm

HGD Test 12

3-inch / 5-inch Projectiles - RDX - (192 Rounds)



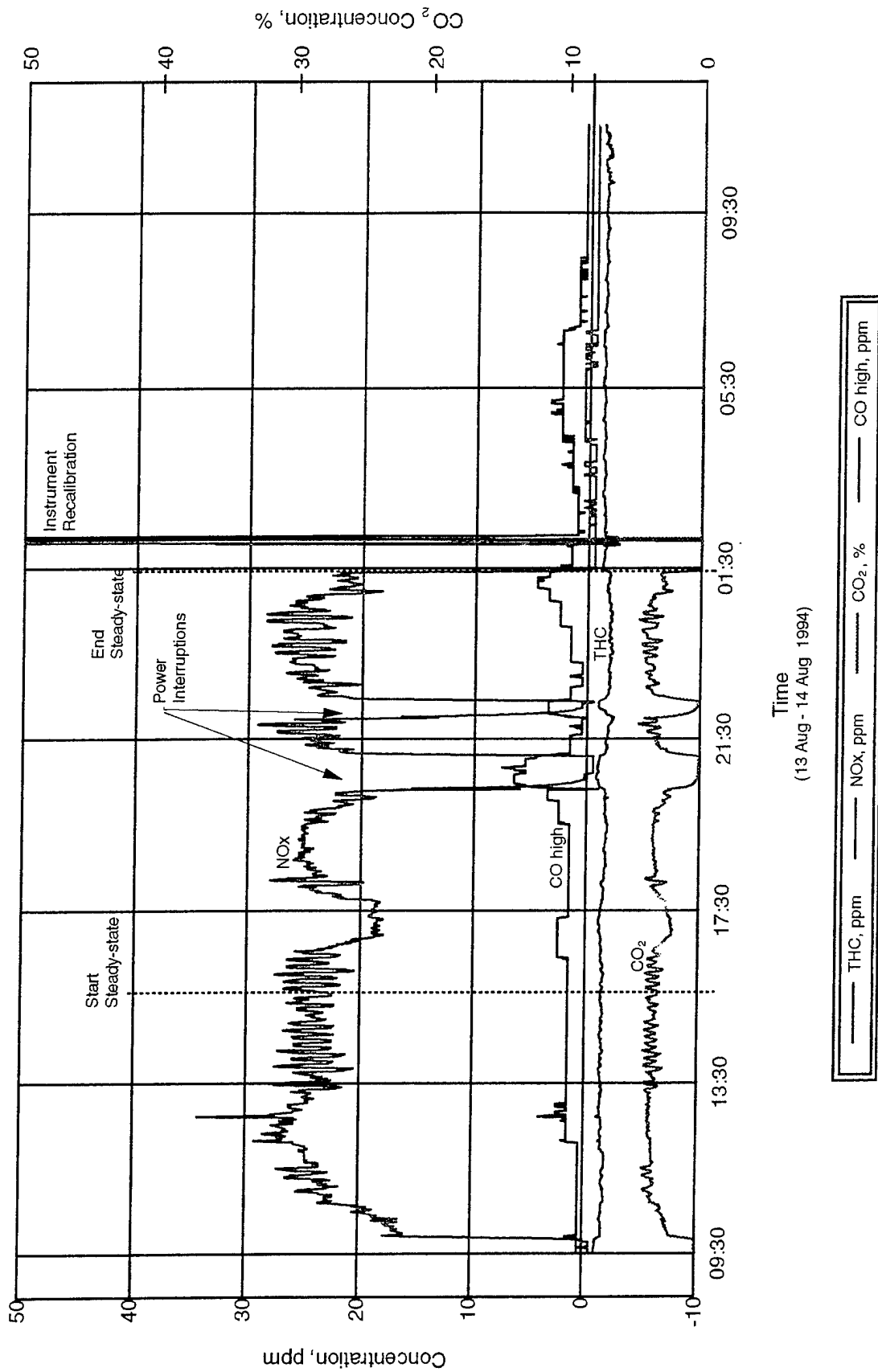
(°F / °C) Average temperature during steady-state operating conditions

Time
(13 Aug - 14 Aug 1994)

Figure F-20 Test 12 - Average Temperature Profile - 15 minute Intervals

HGD Test 12

3-inch / 5-inch Projectiles - RDX - (192 Rounds)



Time
(13 Aug - 14 Aug 1994)

Figure F-21 Test 12 - CEM Profile - 1 minute Intervals

TEST 13

This test was conducted under the same test conditions as Test 8 [6 hrs at 550°F (288°C), 24 175mm projectiles spiked with Comp B explosive]. The railcar configuration is shown in Figure D-28. The oxidizer was started at 0500 hrs on 15 August with hot gas to the chamber at 0545 hrs. Steady state operation was reached at 1347 hrs and test completion was at 1947 hrs with an operator initiated shutdown.

Special Conditions

- Gas sample of chamber exhaust duct was taken from 0700 to 1410 hrs.
-

Analytical Considerations

- Spiked projectile and chamber samples were taken the next day using acetone.

Comments

- Thermocouples 4, 5, and 6 were not installed in projectiles.

CEM

- At about 0930 hours (400°F, 204°C) there were spikes in the NO_x, CO, and THC readings, lasting about 1 hour.

Table F-30

PROJECTILE EXTRACT SAMPLES

Test # 13	Projectile Type:	175 mm	Date:	15 Aug 94
	Explosive Type:	Comp B	Heatup Time:	7.0 Hrs
	Explosive Source:	Spiked	Time at Setpoint:	6.0 Hrs
	Temperature Setpoint:	550°F 288°C	Cooldown Time:	NR

Round #	Operating Temperature		Operating Temperature		Explosive Concentration		Sampling Dilution ml	Explosive Amount µg	Explosive Amount / Surface Area mg / cm ²	DRE*
	°F	s dev	°C	s dev	µg / ml RDX	µg / ml TNT				
1	597	13.88	314	7.71	0.0061	<MDL	500	3.050	1.5861E-06	99.999
2	582	10.95	306	6.09	<MDL	<MDL	500	ND	ND	99.999
3	566	12.02	296	6.68	<MDL	<MDL	500	ND	ND	99.999
4	546	18.05	286	10.03	<MDL	<MDL	500	ND	ND	99.999
5	542	18.69	283	10.38	<MDL	<MDL	500	ND	ND	99.999
6	546	18.04	286	10.02	<MDL	<MDL	500	ND	ND	99.999
7	592	12.94	311	7.19	0.0132	<MDL	500	6.600	3.4321E-06	99.999
8	576	7.78	302	4.32	<MDL	<MDL	500	ND	ND	99.999
9	573	9.31	301	5.17	<MDL	<MDL	500	ND	ND	99.999
10	568	8.53	298	4.74	<MDL	<MDL	500	ND	ND	99.999
11	564	10.67	296	5.93	<MDL	<MDL	500	ND	ND	99.999
12	565	9.91	296	5.51	<MDL	<MDL	500	ND	ND	99.999
13	587	10.19	309	5.66	<MDL	<MDL	500	ND	ND	99.999
14	588	11.47	309	6.37	<MDL	<MDL	500	ND	ND	99.999
15	574	7.27	301	4.04	<MDL	<MDL	500	ND	ND	99.999
16	567	8.39	297	4.66	<MDL	<MDL	500	ND	ND	99.999
17	576	9.19	302	5.11	<MDL	<MDL	500	ND	ND	99.999
18	567	8.56	297	4.76	0.0099	<MDL	500	4.950	2.5741E-06	99.999
19	607	19.57	320	10.87	<MDL	<MDL	500	ND	ND	99.999
20	585	9.04	307	5.02	<MDL	<MDL	500	ND	ND	99.999
21	579	9.79	304	5.44	<MDL	<MDL	500	ND	ND	99.999
22	592	13.52	311	7.51	<MDL	<MDL	500	ND	ND	99.999
23	590	9.26	310	5.14	24113	15442	500	19777500	1.0285E+01	NA
24	581	12.77	305	7.10	<MDL	<MDL	500	ND	ND	99.999

Special Abbreviations: NA=Not Applicable; ND=Not Detectable; NR=No Record; s dev=standard deviation.

*The DRE results for samples denoted by <MDL are calculated based on a value of one-half the MDL.

Extracted Round No: 23
 Extracted Round Amount: 19.778 grams

MDL for Analysis: 0.004 µg/ml RDX
 0.0025 µg/ml TNT

Surface Area: 1923 sq cm

Table F-31

CHAMBER WIPES

Test # 13	Chamber Load:	<u>175 mm</u>	Date:	<u>15 Aug 94</u>
	Explosive Type:	<u>Comp B</u>	Heatup Time:	<u>7.0 Hrs</u>
	Explosive Source:	<u>Spiked</u>	Time at Setpoint:	<u>6.0 Hrs</u>
	Temperature Setpoint:	<u>550°F</u> <u>288°C</u>	Cooldown Time:	<u>NR</u>

Wipe #	Location in System	Operating Temperature	Operating Temperature	Explosive Concentration / Smear		Explosive Amount	Explosive Amount / Surface Area
		°F	°C	µg / smear RDX	µg / smear TNT	µg	mg / cm ²
1	Blank	NA	NA	<MDL	<MDL	ND	ND
2	Floor	499	259	<MDL	<MDL	ND	ND
3	Wall	NR	NR	<MDL	<MDL	ND	ND
4	Duct	556	291	<MDL	<MDL	ND	ND
5	Elbow	556	291	<MDL	<MDL	ND	ND
6	Fanblade	556	291	<MDL	<MDL	ND	ND
7	Coldspot	424	218	<MDL	<MDL	ND	ND
8	Rail	553	289	1.0484	<MDL	1.0484	6.5118E-06

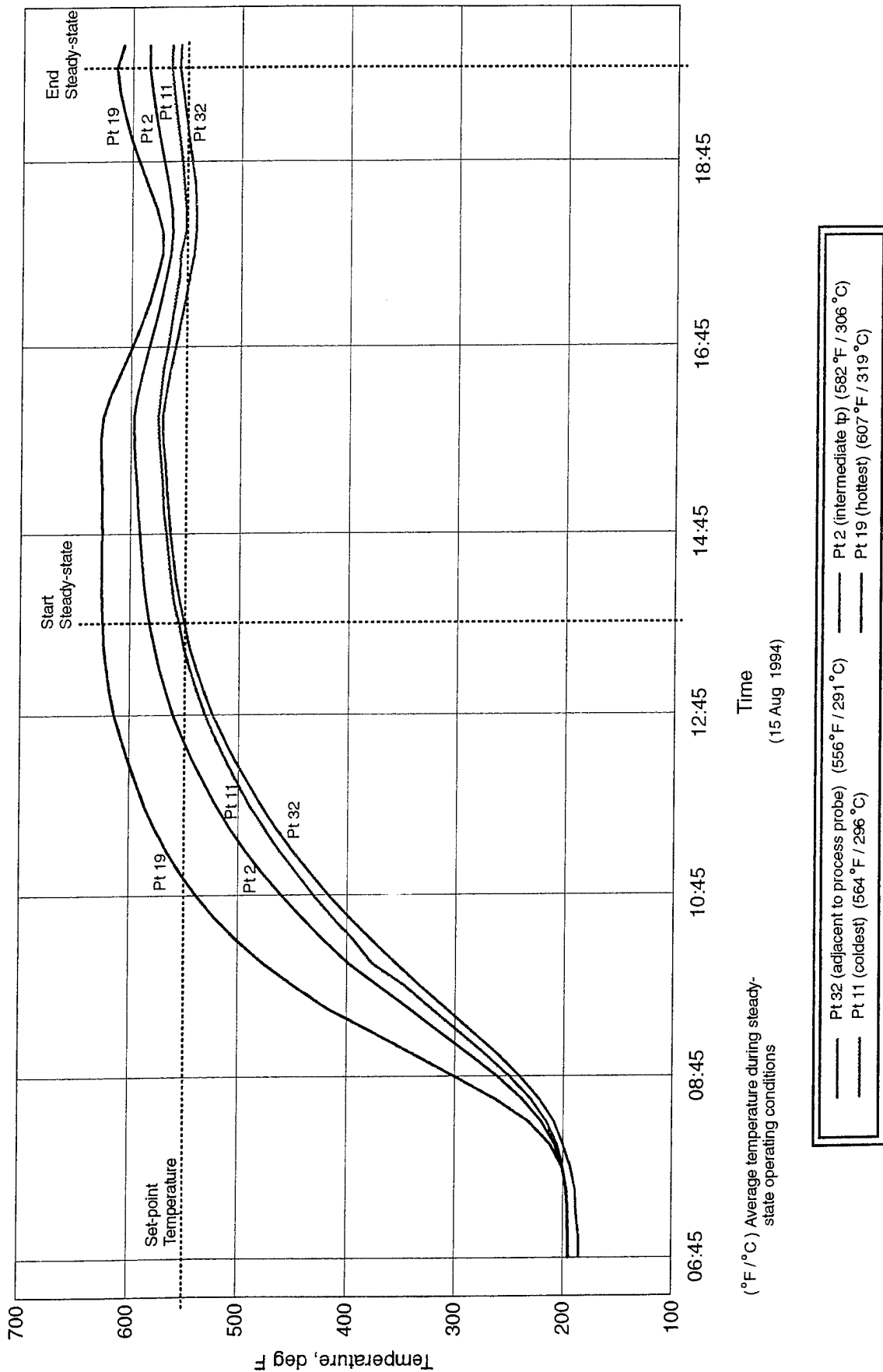
Special Abbreviations: NA=Not Applicable; ND=Not Detectable; NR=No Record

MDL for Analysis: 0.4 µg/smear RDX
0.25 µg/smear TNT

Surface Area: 161 sq cm

HGD Test 13

175mm Projectiles - Comp B - (96 Rounds)



(°F / °C) Average temperature during steady-state operating conditions
 Time
 (15 Aug 1994)

Figure F-22 Test 13 - Average Temperature Profile - 15 minute Intervals

HGD Test 13

175mm Projectiles - Comp B - (96 Rounds)

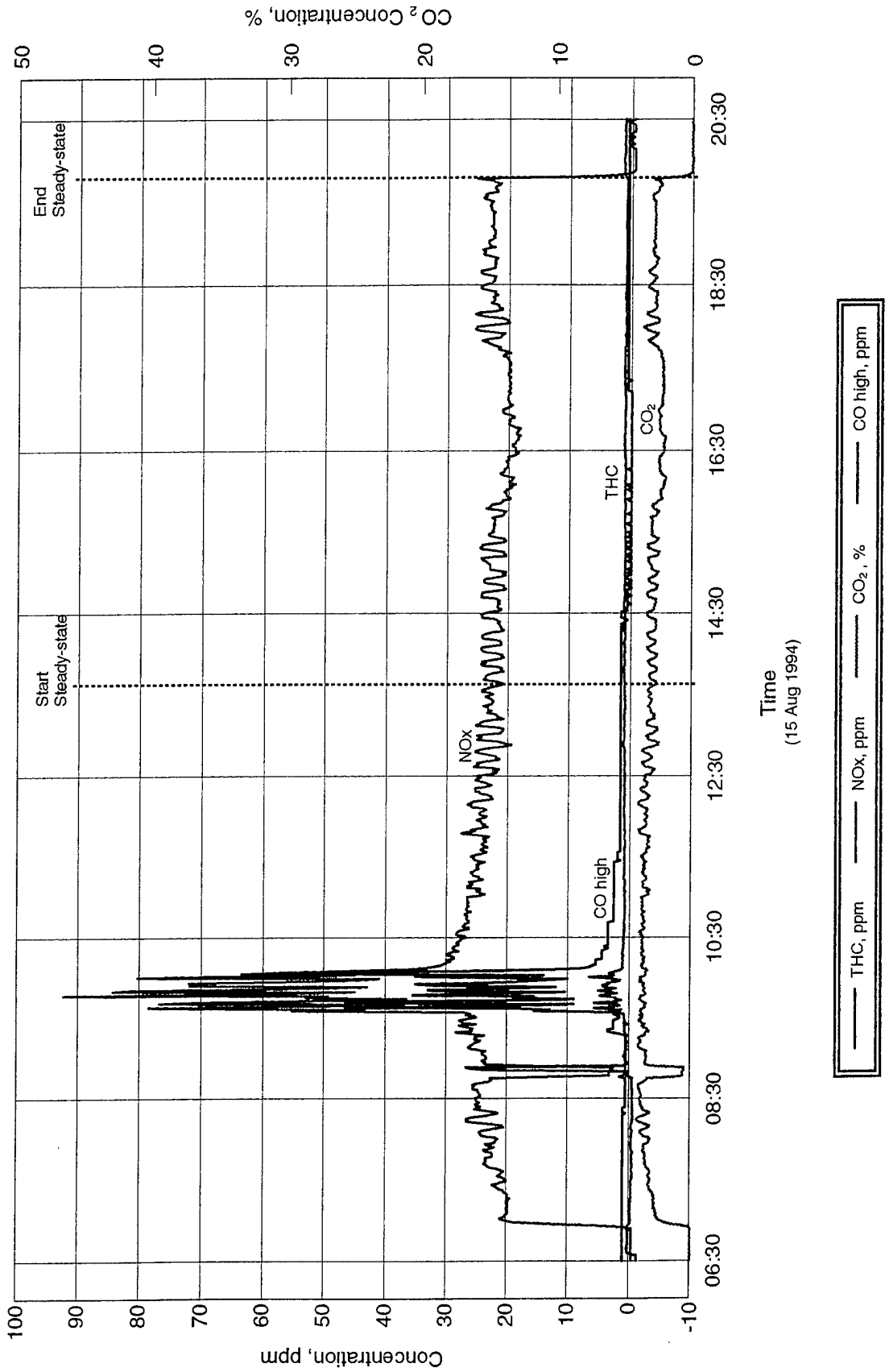


Figure F-23 Test 13 - CEM Profile - 1 minute Intervals

TEST 14

Process Conditions

This test was conducted under the same test conditions as Test 9 [6 hrs at 600°F (316°C), 24 3-inch projectiles spiked with HBX explosive]. The railcar configuration is shown in Figure D-29. The oxidizer was started at 0348 hrs on 17 August with heat to the chamber at 0448 hrs. Steady state operation was at 1057 hrs and treatment completed at 1658 hrs with a control system automatically initiated cooldown.

Analytical Considerations

- Spiked projectiles and chamber samples were taken the next day using acetonitrile.

CEM

- At 0630 hours (approximately 400°F, 204°C) there was peaks in the NO_x and CO readings, lasting about 15-20 minutes.

Table F-32

PROJECTILE EXTRACT SAMPLES

Projectile Type:	<u>3-inch</u>	Date:	<u>17 Aug 94</u>
Test #	Explosive Type:	Heatup Time:	<u>6.2 Hrs</u>
<u>14</u>	<u>HBX</u>	Time at Setpoint:	<u>6.0 Hrs</u>
Explosive Source:	<u>Spiked</u>	Temperature Setpoint:	<u>600°F</u> <u>316°C</u>
Temperature Setpoint:		Cooldown Time:	<u>NR</u>

Round #	Operating Temperature		Operating Temperature		Explosive Concentration		Sampling Dilution	Explosive Amount	Explosive Amount / Surface Area	DRE*
	°F	s dev	°C	s dev	µg / ml RDX	µg / ml TNT	ml	µg	mg / cm ²	%
1	666	4.06	352	2.26	<MDL	<MDL	50	ND	ND	99.999
2	638	4.57	337	2.54	<MDL	<MDL	50	ND	ND	99.999
3	649	5.30	343	2.94	<MDL	<MDL	50	ND	ND	99.999
4	638	5.24	337	2.91	<MDL	0.0087	50	0.435	2.1535E-06	99.999
5	636	5.62	335	3.12	<MDL	<MDL	50	ND	ND	99.999
6	631	5.52	333	3.07	<MDL	<MDL	50	ND	ND	99.999
7	650	5.47	343	3.04	0.0177	<MDL	50	0.885	4.3812E-06	99.999
8	643	5.64	340	3.13	<MDL	0.0111	50	0.555	2.7475E-06	99.999
9	656	5.62	347	3.12	<MDL	0.0091	50	0.455	2.2525E-06	99.999
10	628	6.00	331	3.33	0.011	<MDL	50	0.550	2.7228E-06	99.999
11	632	6.40	333	3.56	0.0105	0.0123	50	1.140	5.6436E-06	99.999
12	628	6.51	331	3.62	0.0154	0.0103	50	1.285	6.3614E-06	99.999
13	654	5.76	345	3.20	<MDL	<MDL	50	ND	ND	99.999
14	640	6.39	338	3.55	<MDL	<MDL	50	ND	ND	99.999
15	639	6.56	337	3.64	<MDL	<MDL	50	ND	ND	99.999
16	633	6.35	334	3.53	<MDL	<MDL	50	ND	ND	99.999
17	636	6.51	335	3.62	0.0138	0.0068	50	1.030	5.0990E-06	99.999
18	636	6.04	335	3.35	<MDL	<MDL	50	ND	ND	99.999
19	655	5.94	346	3.30	0.016	0.0107	50	1.335	6.6089E-06	99.999
20	657	5.89	347	3.27	<MDL	<MDL	50	ND	ND	99.999
21	659	6.55	348	3.64	17326	17171	50	1724850	8.5389E+00	NA
22	651	6.11	344	3.40	0.011	0.0087	50	0.985	4.8762E-06	99.999
23	663	6.00	351	3.33	<MDL	0.0091	50	0.455	2.2525E-06	99.999
24	671	5.51	355	3.06	0.0188	0.0147	50	1.675	8.2921E-06	99.999

Special Abbreviations: NA=Not Applicable; ND=Not Detectable; NR=No Record; s dev=standard deviation.

*The DRE results for samples denoted by <MDL are calculated based on a value of one-half the MDL.

Extracted Round No: 21
Extracted Round Amount: 1.7249 grams

MDL for Analysis: 0.004 µg/ml RDX
0.0025 µg/ml TNT

Surface Area: 202 sq cm

Table F-33

CHAMBER WIPES

Test # 14	Chamber Load:	3-Inch	Date:	17 Aug 94
	Explosive Type:	HBX	Heatup Time:	6.2 Hrs
	Explosive Source:	Spiked	Time at Setpoint:	6.0 Hrs
	Temperature Setpoint:	600°F 316°C	Cooldown Time:	NR

Wipe #	Location in System	Operating Temperature	Operating Temperature	Explosive Concentration / Smear		Explosive Amount	Explosive Amount / Surface Area
		°F	°C	µg / smear RDX	µg / smear TNT	µg	mg / cm ²
1	Blank	NA	NA	<MDL	<MDL	ND	ND
2	Floor	529	276	<MDL	<MDL	ND	ND
3	Wall	NR	NR	<MDL	<MDL	ND	ND
4	Duct	609	321	<MDL	<MDL	ND	ND
5	Elbow	609	321	1.1587	<MDL	1.1587	7.1969E-06
6	Fanblade	609	321	<MDL	<MDL	ND	ND
7	Coldspot	384	196	<MDL	<MDL	ND	ND
8	Rail	600	316	<MDL	<MDL	ND	ND

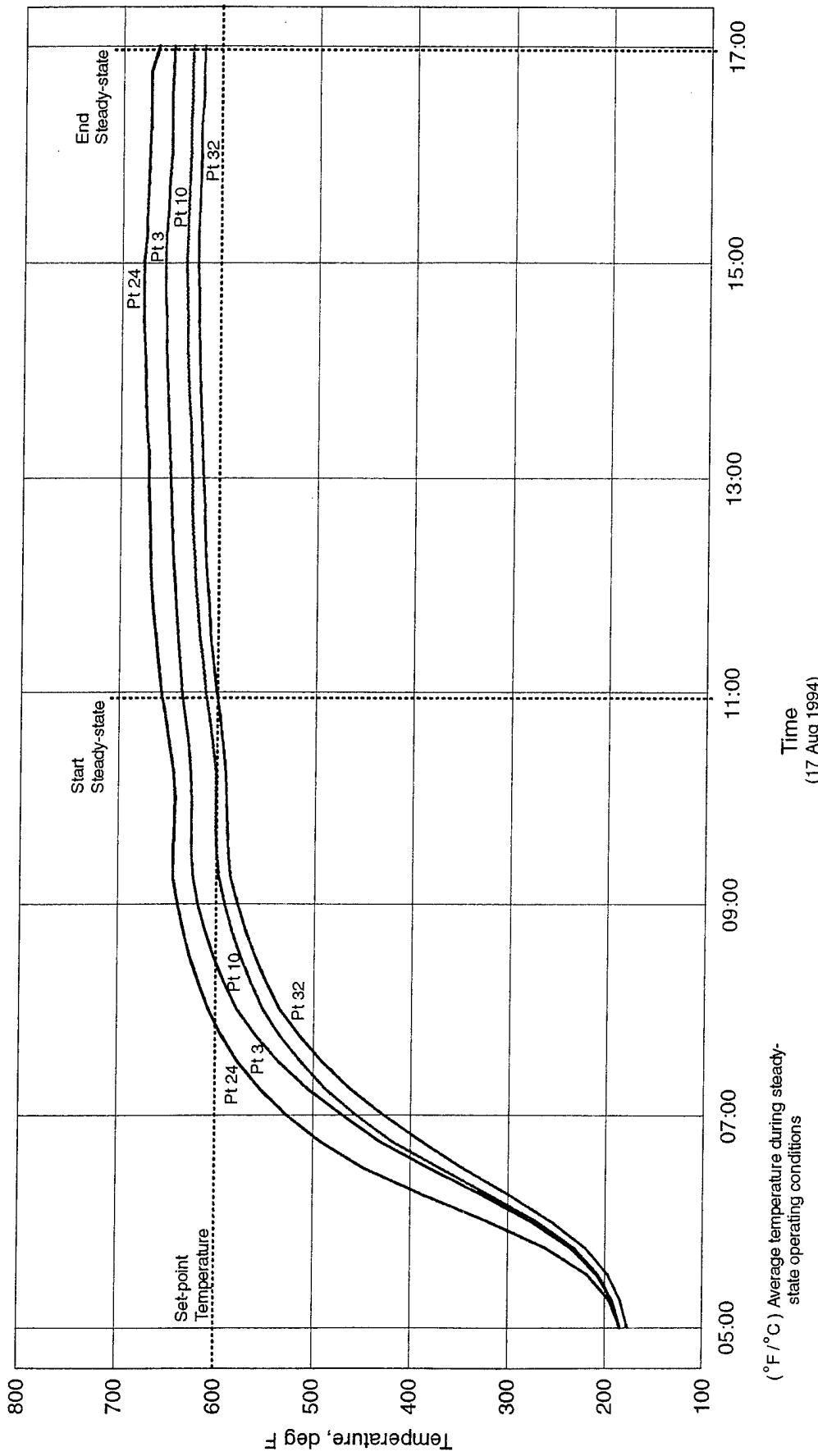
Special Abbreviations: NA=Not Applicable; ND=Not Detectable; NR=No Record

MDL for Analysis: 0.4 µg/smear RDX
0.25 µg/smear TNT

Surface Area: 161 sq cm

HGD Test 14

3-inch Projectiles - HBX - (192 Rounds)



— Pt 32 (adjacent to process probe) (616 °F / 324 °C)
 — Pt 10 (coldest) (628 °F / 331 °C)
 — Pt 3 (intermediate tp) (649 °F / 343 °C)
 — Pt 24 (hottest) (671 °F / 355 °C)

Figure F-24 Test 14 - Average Temperature Profile - 15 minute Intervals

HGD Test 14 3-inch Projectiles - HBX - (192 Rounds)

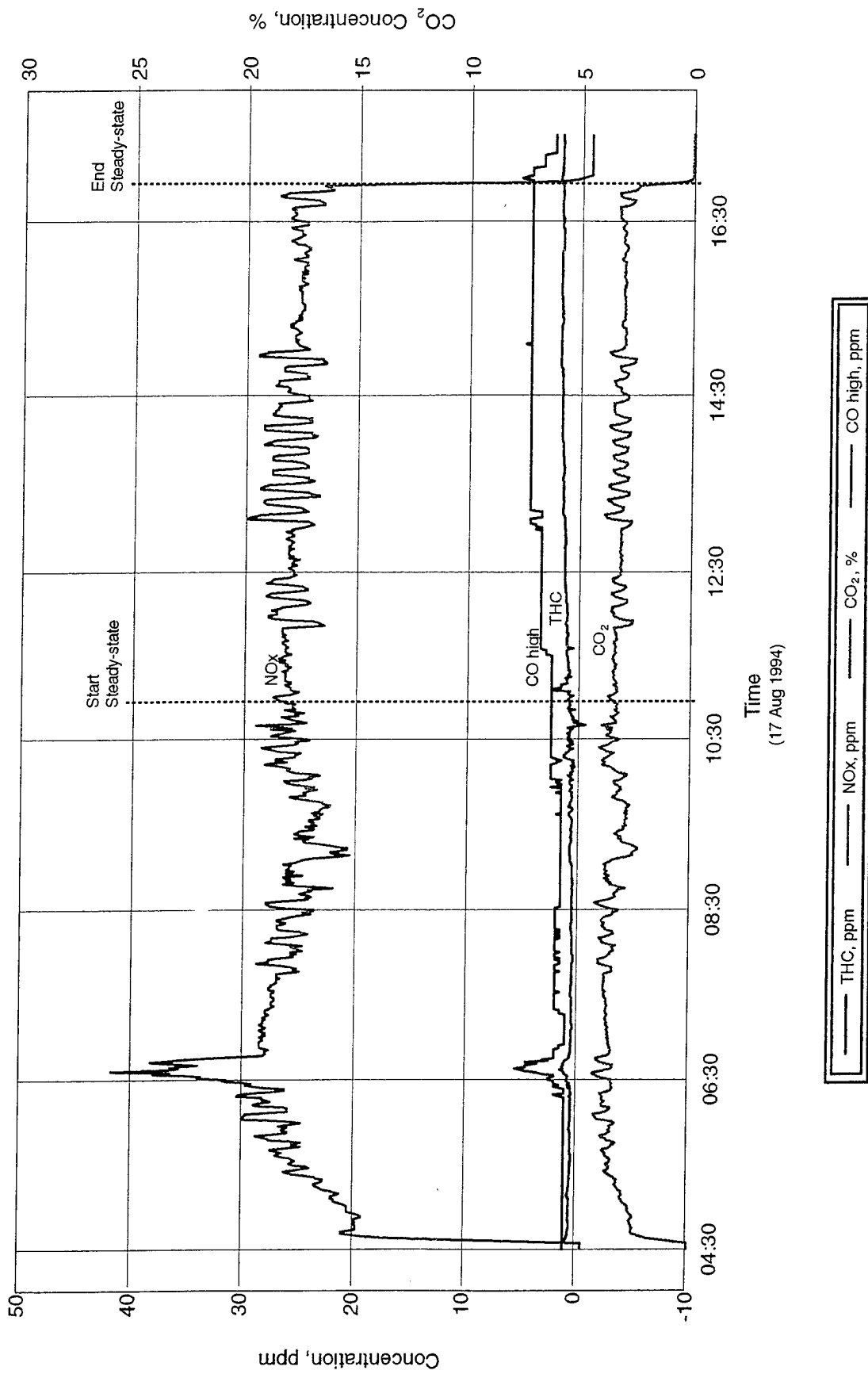


Figure F-25 Test 14 - CEM Profile - 1 minute Intervals

TEST 15

Process Conditions

This test was conducted under test conditions similar to Test 10 (treatment temperature 600°F (316°C), 12 3-inch and 12 5-inch projectiles spiked with Yellow D) except the treatment time was decreased from 12 to 6 hrs. The railcar configuration is shown in Figure D-30. The oxidizer was started at 0348 hrs on 20 August with hot gas flow to the chamber at 0448 hrs. Steady state operation was reached at 1229 hrs and the test was completed at 1829 hrs with a control system automatically initiated cooldown.

Analytical Considerations

- Spiked projectile and chamber wipe samples were taken the next day using HPLC water. The sacrifice 3-inch projectile was extracted with additional water (300 mL total) to dissolve the spike.

CEM

- NOTE: Many spikes in CEM data between 0800 and 0830 (approximately 400°F, 204°C).

Table F-34

PROJECTILE EXTRACT SAMPLES

Projectile Type		3-inch 5-inch	Date:	20 Aug 94
Test #	Explosive Type:		Heatup Time:	7.7 Hrs
15	Explosive Source:		Time at Setpoint:	6.0 Hrs
Temperature Setpoint:		600°F 316°C	Cooldown Time:	10.0 Hrs

Round #	Size	Operating Temperature		Operating Temperature		Explosive Concentration μg/ml Amm. Picrate	Sampling Dilution ml	Explosive Amount μg	Explosive Amount / Surface Area mg / cm ²	DRE* %
		°F	s dev	°C	s dev					
1	3 in.	655	2.41	346	1.34	0.0077	50	0.385	1.9059E-06	99.999
2	3 in.	624	2.67	329	1.48	<MDL	50	ND	ND	99.999
3	3 in.	649	2.38	343	1.32	<MDL	50	ND	ND	99.999
4	5 in.	629	3.26	332	1.81	<MDL	100	ND	ND	99.999
5	5 in.	621	4.56	327	2.54	<MDL	100	ND	ND	99.999
6	5 in.	615	3.62	324	2.01	<MDL	100	ND	ND	99.999
7	5 in.	646	3.46	341	1.92	<MDL	100	ND	ND	99.999
8	5 in.	635	5.86	335	3.26	<MDL	100	ND	ND	99.999
9	5 in.	637	3.37	336	1.87	<MDL	100	ND	ND	99.999
10	3 in.	629	2.60	332	1.44	<MDL	50	ND	ND	99.999
11	3 in.	624	2.58	329	1.43	0.0104	50	0.520	2.5743E-06	99.999
12	3 in.	617	2.62	325	1.45	<MDL	50	ND	ND	99.999
13	3 in.	643	2.62	339	1.45	<MDL	50	ND	ND	99.999
14	3 in.	638	3.07	336	1.71	<MDL	50	ND	ND	99.999
15	3 in.	635	3.37	335	1.87	0.0133	50	0.665	3.2921E-06	99.999
16	5 in.	631	4.36	333	2.42	<MDL	100	ND	ND	99.999
17	5 in.	619	3.58	326	1.99	<MDL	100	ND	ND	99.999
18	5 in.	620	3.80	327	2.11	<MDL	100	ND	ND	99.999
19	5 in.	662	2.82	350	1.57	<MDL	100	ND	ND	99.999
20	5 in.	649	5.95	343	3.30	3391	2000	6782476	1.0732E+01	NA
21	5 in.	633	3.76	334	2.09	<MDL	100	ND	ND	99.999
22	3 in.	629	2.62	332	1.45	<MDL	50	ND	ND	99.999
23	3 in.	650	3.06	343	1.70	<MDL	50	ND	ND	99.999
24	3 in.	673	2.73	356	1.52	6649	300	1994648	9.8745E+00	NA

Special Abbreviations: NA=Not Applicable; ND=Not Detectable; NR=No Record; s dev=standard deviation.

*The DRE results for samples denoted by <MDL are calculated based on a value of one-half the MDL.

Extracted Round No: 20, 24
 Extracted Round Amount: 1.99 grams (3-inch)
 6.78 grams (5-inch)

MDL for Analysis: 0.004 μg/ml Ammonium Picrate

Surface Area: 202 sq cm (3-inch)
 632 sq cm (5-inch)

CHAMBER WIPES

Test # <u>15</u>	Chamber Load:	<u>3-inch</u> <u>5-inch</u>	Date:	<u>20 Aug 94</u>
	Explosive Type:	<u>Yellow D</u>	Heatup Time:	<u>7.7 Hrs</u>
	Explosive Source:	<u>Spiked</u>	Time at Setpoint:	<u>6.0 Hrs</u>
	Temperature Setpoint:	<u>600°F</u> <u>316°C</u>	Cooldown Time:	<u>10.0 Hrs</u>

Wipe #	Location in System	Operating Temperature	Operating Temperature	Explosive Concentration / Smear	Explosive Amount	Explosive Amount / Surface Area
		°F	°C	µg / smear Amm. Picrate	µg	mg / cm ²
1	Blank	NA	NA	<MDL	ND	ND
2	Floor	550	288	<MDL	ND	ND
3	Wall	NR	NR	<MDL	ND	ND
4	Duct	603	317	<MDL	ND	ND
5	Elbow	603	317	<MDL	ND	ND
6	Fanblade	603	317	<MDL	ND	ND
7	Coldspot	403	206	<MDL	ND	ND
8	Rail	595	313	<MDL	ND	ND

Special Abbreviations: NA=Not Applicable; ND=Not Detectable; NR=No Record

MDL for Analysis: 0.4 µg/smear Ammonium Picrate

Surface Area: 161 sq cm

HGD Test 15

3-inch / 5-inch Projectiles - Yellow D - (192 Rounds)

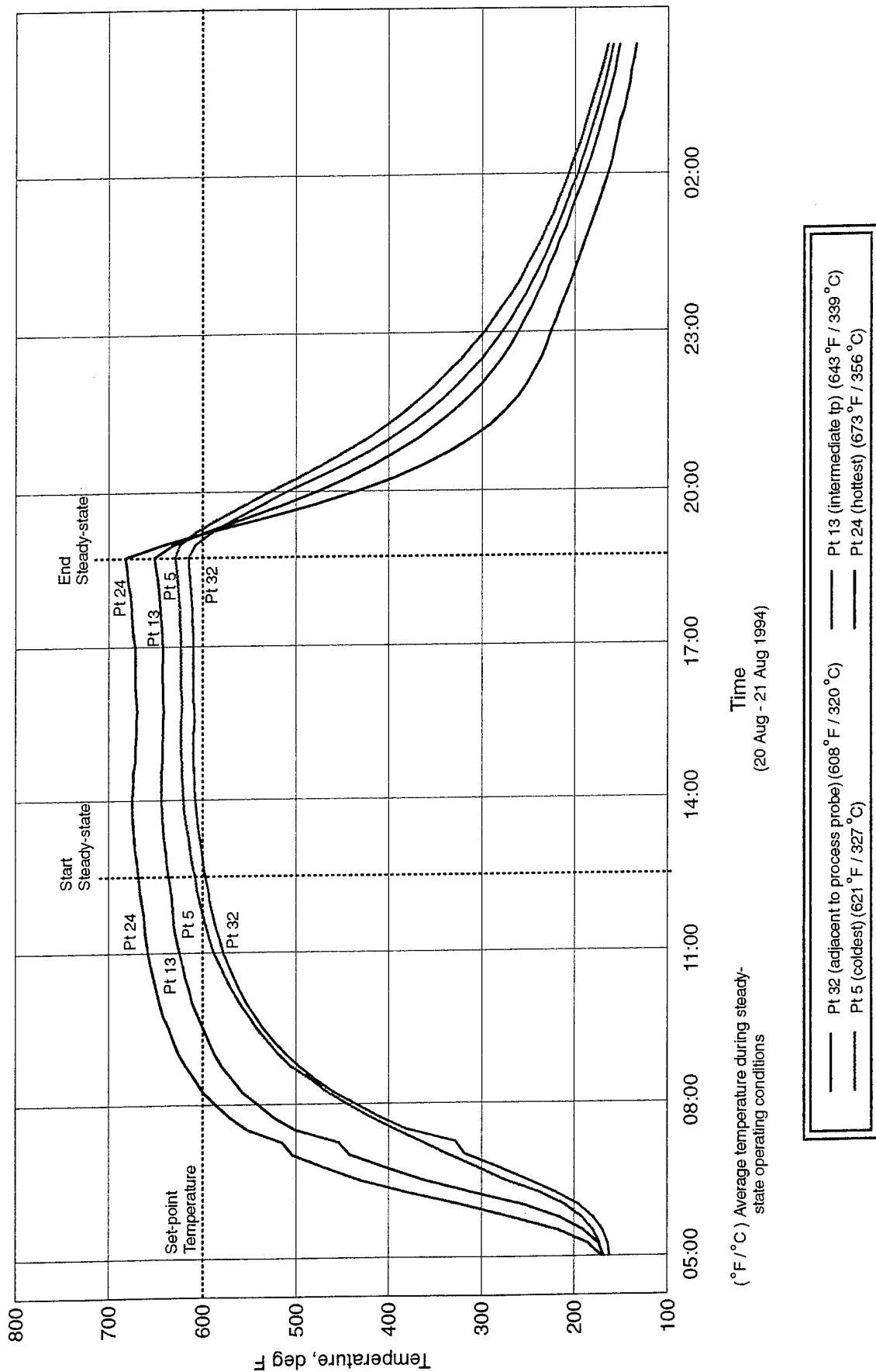


Figure F-26 Test 15 - Average Temperature Profile - 15 minute Intervals

HGD Test 15

3-inch / 5-inch Projectiles - Yellow D - (192 Rounds)

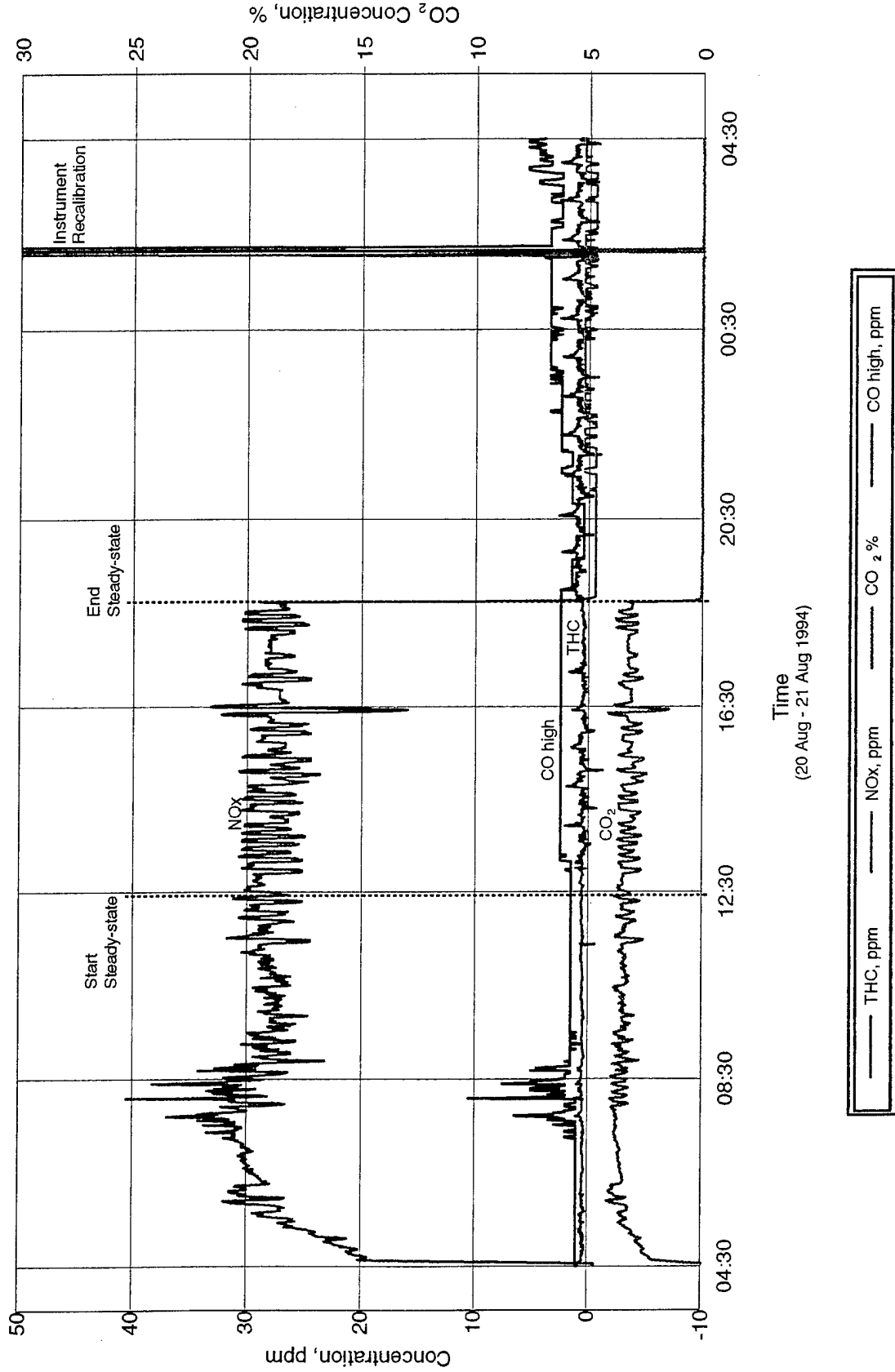


Figure F-27 Test 15 - CEM Profile - 1 minute intervals

TEST 16

Process Conditions

This test was conducted on 24 MK 54 Depth Bombs (sawed ends) in a railcar configuration as shown in Figure D-31. The test conditions were 32 hrs at 700°F (371°C). The test was performed on depth bombs which contained residues of HBX explosive from demilitarizing operations. The oxidizer was started at 1307 hrs on 21 August with heat to the chamber at 1348 hrs. Steady state was reached at 0008 hrs on 22 August. Test was completed with a control system automatically initiated cooldown at 0823 hrs on 23 August.

Special Conditions

- Bomb temperatures were taken by curling each thermocouple into a "U" shape and wedging it into the center nozzle of the bomb. The Maples control thermocouple was laid in the bowl of a bomb inside its own shield.

Analytical Considerations

- Wipe samples were taken from the center tube, the area around it including the gap/seam, the inner surface of the bowl, the flats between the three studs, one stud, and a small patch on the bowl opposite that stud using acetonitrile.

Comments

- No buildup residue of hot-melt or HBX was noted on the treated bombs. Colors and stains varied widely--gray, black, and red. All contained some very light ashy material, some light colored, some dark.

CEM

- NOTE: Increase in CO reading over several hours. This could be due to hot melt burnoff.
- Peaks noted on CEM about 90 minutes after heat was added to the chamber at approximately 400°F (204°C).

Table F-36

MINE/DEPTH BOMB WIPE SAMPLES

Mine/Depth Bomb Type:		MK64 Depth Bomb	Date:	21 Aug 94
Test #	Explosive Type:	HBX	Heatup Time:	10.3 Hrs
16	Explosive Source:	DemII	Time at Setpoint:	32.2 Hrs
Temperature Setpoint:		700°F 371°C	Cooldown Time:	7.6 Hrs

Wipe #	Operating Temperature		Operating Temperature		Explosive Concentration		Explosive Amount	Explosive Amount / Surface Area	DRE
	°F	s dev	°C	s dev	µg/smear RDX	µg/smear TNT	µg	mg / cm ²	%
1	737	11.01	391	6.11	<MDL	<MDL	ND	ND	NC
2	732	11.27	389	6.26	<MDL	<MDL	ND	ND	NC
3	726	11.38	385	6.32	<MDL	<MDL	ND	ND	NC
4	714	10.00	379	5.56	<MDL	<MDL	ND	ND	NC
5	723	8.89	384	4.94	<MDL	<MDL	ND	ND	NC
6	715	12.03	379	6.68	<MDL	<MDL	ND	ND	NC
7	730	68.27	388	37.93	<MDL	<MDL	ND	ND	NC
8	726	68.00	385	37.78	<MDL	<MDL	ND	ND	NC
9	730	9.81	388	5.45	<MDL	0.9142	0.914	3.7621E-06	NC
10	724	11.70	384	6.50	<MDL	<MDL	ND	ND	NC
11	719	67.30	381	37.39	<MDL	<MDL	ND	ND	NC
12	712	72.45	378	40.25	<MDL	<MDL	ND	ND	NC
13	734	11.23	390	6.24	<MDL	<MDL	ND	ND	NC
14	734	11.58	390	6.44	<MDL	<MDL	ND	ND	NC
15	735	11.51	390	6.40	<MDL	<MDL	ND	ND	NC
16	719	67.09	382	37.27	<MDL	<MDL	ND	ND	NC
17	729	11.99	387	6.66	<MDL	<MDL	ND	ND	NC
18	720	11.59	382	6.44	<MDL	<MDL	ND	ND	NC
19	743	11.04	395	6.14	<MDL	<MDL	ND	ND	NC
20	746	11.29	397	6.27	<MDL	<MDL	ND	ND	NC
21	731	68.32	388	37.95	<MDL	<MDL	ND	ND	NC
22	728	68.12	387	37.85	<MDL	<MDL	ND	ND	NC
23	749	12.04	398	6.69	<MDL	<MDL	ND	ND	NC
24	737	12.22	392	6.79	<MDL	<MDL	ND	ND	NC

Special Abbreviations: NA=Not Applicable; NC=Not Calculable; ND=Not Detectable; NR=No Record; s dev=standard deviation.

Estimated Residue Amount: No estimate is available for hot melt coated items.

MDL for Analysis: 0.7 µg/smear RDX
0.4 µg/smear TNT

Surface Area: 243 sq cm

CHAMBER WIPES

Test # 16	Chamber Load:	MK54 Depth Bomb	Date:	21 Aug 94
	Explosive Type:	HBX	Heatup Time:	10.3 Hrs
	Explosive Source:	Demil	Time at Setpoint:	32.2 Hrs
	Temperature Setpoint:	700°F 371°C	Cooldown Time:	7.6 Hrs

Wipe #	Location in System	Operating Temperature	Operating Temperature	Explosive Concentration / Smear		Explosive Amount	Explosive Amount / Surface Area
		°F	°C	µg / smear RDX	µg / smear TNT	µg	mg / cm ²
1	Blank	NA	NA	<MDL	<MDL	ND	ND
2	Floor	702	372	<MDL	<MDL	ND	ND
3	Wall	NR	NR	<MDL	<MDL	ND	ND
4	Duct	681	361	<MDL	<MDL	ND	ND
5	Elbow	681	361	<MDL	<MDL	ND	ND
6	Fanblade	681	361	<MDL	<MDL	ND	ND
7	Coldspot	543	284	<MDL	<MDL	ND	ND
8	Rail	689	365	<MDL	<MDL	ND	ND

Special Abbreviations: NA=Not Applicable; ND=Not Detectable; NR=No Record

MDL for Analysis: 0.7 µg/smear RDX
0.4 µg/smear TNT

Surface Area: 161 sq cm

HGD Test 16

MK 54 Depth Bomb - HBX - (24 Sawed Ends)

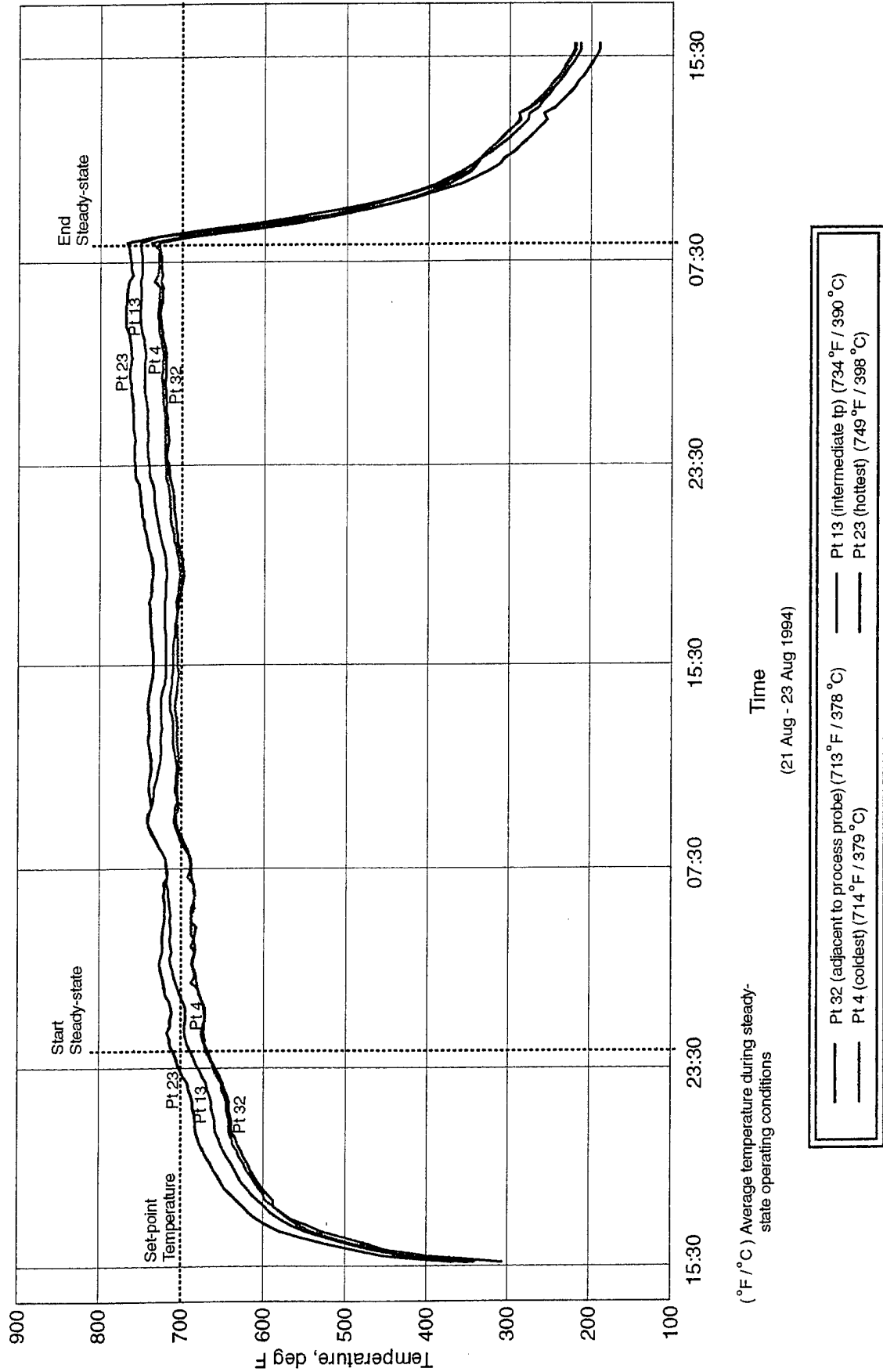


Figure F-28 Test 16 - Average Temperature Profile - 15 minute Intervals

HGD Test 16

MK 54 Depth Bombs - HBX - (24 Items)

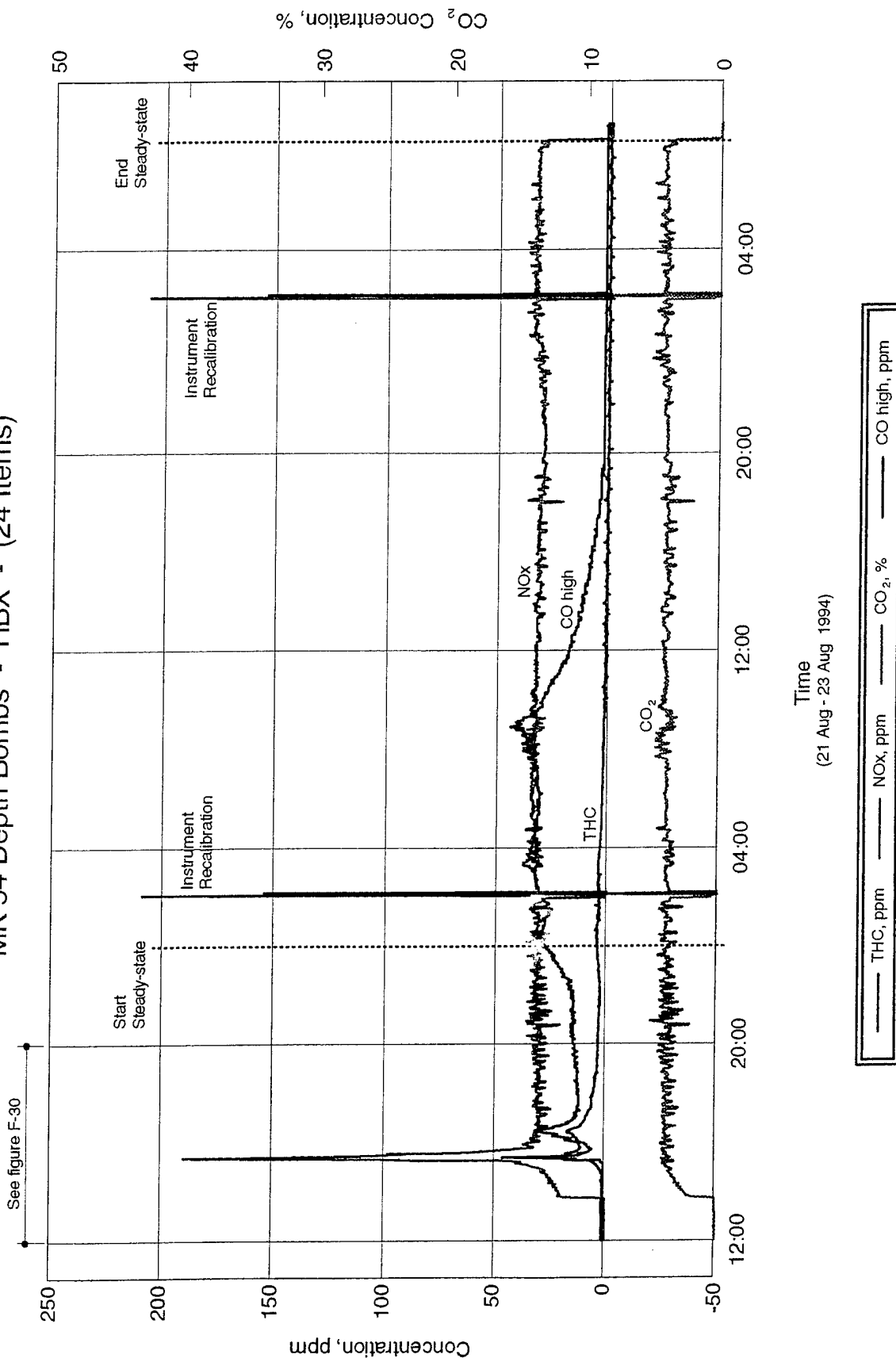


Figure F-29 Test 16 - CEM Profile - 1 minute Intervals

HGD Test 16

MK 54 Depth Bombs - HBX - (24 Items)

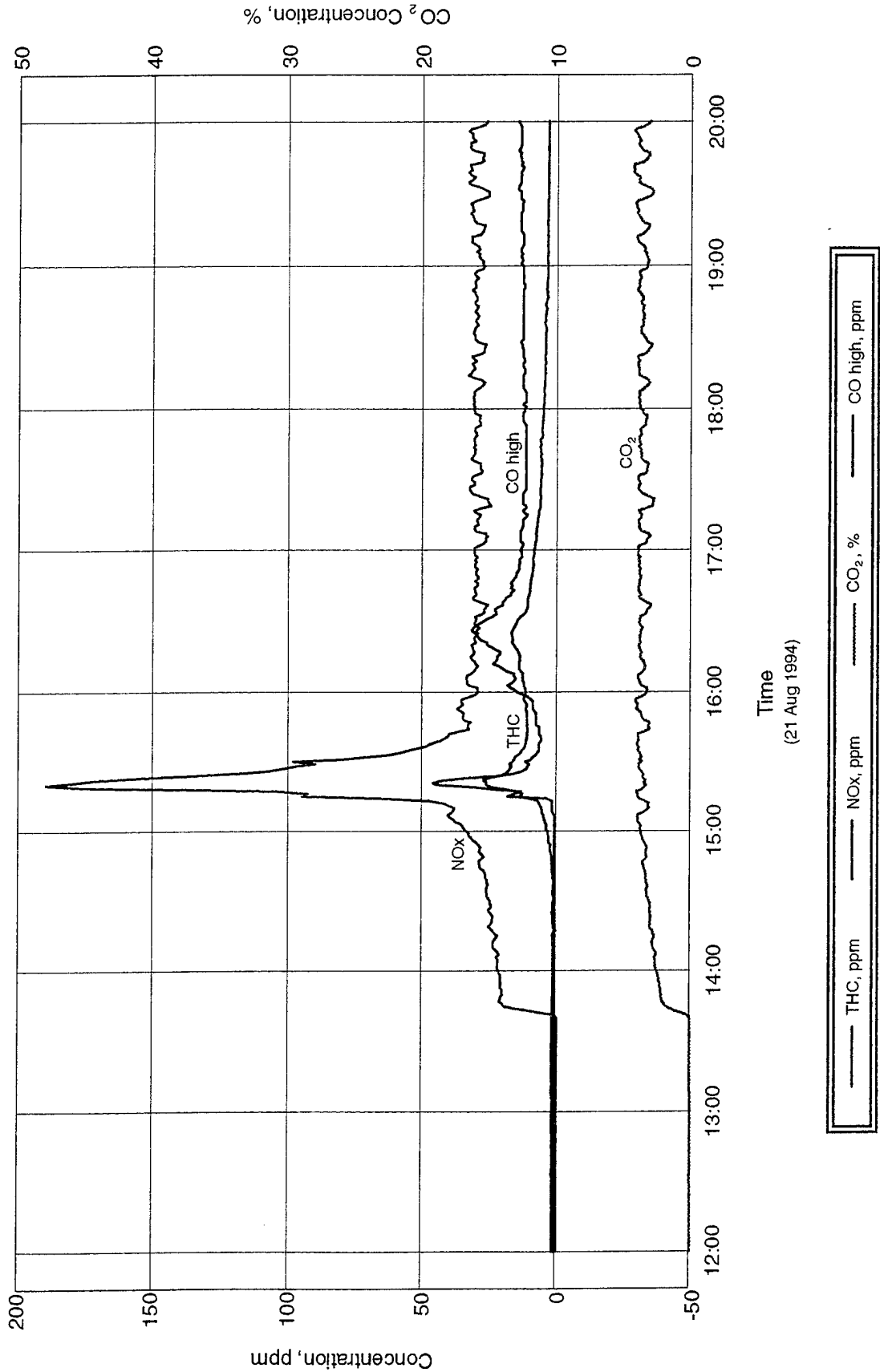


Figure F-30 Test 16 - CEM Profile - 1 minute Intervals

TEST 17

Process Conditions

This test was conducted under the same test conditions as Test 12, [6 hrs at 550°F (288°C), 12 3-inch and 12 6-inch projectiles spiked with RDX]. The railcar configuration is shown in Figure D-32. The oxidizer was started at 0348 hrs on 25 August with heat going to the chamber at 0448 hrs. Steady state operation was reached at 0853 hrs and the test was completed at 1454 hrs with a control system automatically initiated cooldown.

Analytical Considerations

- Spiked projectile and chamber wipe samples were taken the next day using acetonitrile. Problems encountered with 5-inch sacrifice projectile. Some solvent leaked into the fuse threads and evaporated; full recovery was not possible.

Comments

- Insulation samples were not installed in the chamber during this test.

Table F-38

PROJECTILE EXTRACT SAMPLES

Test # 17	Projectile Type:	3-inch 5-inch	Date:	25 Aug 94
	Explosive Type:	RDX	Heatup Time:	4.1 Hrs
	Explosive Source:	Spiked	Time at Setpoint:	6.0 Hrs
	Temperature Setpoint:	550°F 288°C	Cooldown Time:	10.6 Hrs

Round #	Size	Operating Temperature		Operating Temperature		Explosive Concentration		Sampling Dilution ml	Explosive Amount µg	Explosive Amount / Surface Area mg / cm ²	DRE* %
		°F	s dev	°C	s dev	µg / ml RDX	µg / ml TNT				
1	5 in.	BAD	NA	BAD	NA	<MDL	0.0183	100	1.830	2.8956E-06	99.999
2	5 in.	596	20.35	313	11.30	<MDL	<MDL	100	ND	ND	99.999
3	5 in.	599	11.83	315	6.57	0.0684	0.2464	100	31.480	4.9810E-05	99.999
4	3 in.	586	7.15	308	3.97	<MDL	0.0095	50	0.475	2.3515E-06	99.999
5	3 in.	602	6.25	317	3.47	0.0138	0.0099	50	1.185	5.8663E-06	99.999
6	3 in.	596	6.07	313	3.37	<MDL	0.0091	50	0.455	2.2525E-06	99.999
7	3 in.	621	6.42	327	3.57	<MDL	0.0171	50	0.855	4.2327E-06	99.999
8	3 in.	601	7.46	316	4.14	<MDL	<MDL	50	ND	ND	99.999
9	3 in.	602	40.11	317	22.28	<MDL	<MDL	50	ND	ND	99.999
10	5 in.	584	32.01	307	17.78	<MDL	<MDL	100	ND	ND	99.999
11	5 in.	575	31.95	301	17.75	0.0099	<MDL	100	0.990	1.5665E-06	99.999
12	5 in.	576	32.22	302	17.90	<MDL	0.0199	100	1.990	3.1487E-06	99.999
13	5 in.	599	35.09	315	19.49	<MDL	<MDL	100	ND	ND	99.999
14	5 in.	577	31.68	303	17.60	<MDL	0.0127	100	1.270	2.0095E-06	99.999
15	5 in.	585	27.75	307	15.41	<MDL	<MDL	100	ND	ND	99.999
16	3 in.	589	40.40	310	22.45	<MDL	<MDL	50	ND	ND	99.999
17	3 in.	590	42.34	310	23.52	<MDL	<MDL	50	ND	ND	99.999
18	3 in.	584	43.54	307	24.19	<MDL	<MDL	50	ND	ND	99.999
19	3 in.	602	45.19	317	25.10	<MDL	<MDL	50	ND	ND	99.999
20	3 in.	601	46.01	316	25.56	<MDL	<MDL	50	ND	ND	99.999
21	3 in.	614	47.99	323	26.66	39900	<MDL	50	1995000	9.8762E+00	NA
22	5 in.	593	35.77	312	19.87	<MDL	<MDL	100	ND	ND	99.999
23	5 in.	611	38.03	322	21.13	62974	<MDL	100	6297400	9.9642E+00	NA
24	5 in.	610	38.91	321	21.62	<MDL	<MDL	100	ND	ND	99.999

Special Abbreviations: NA=Not Applicable; ND=Not Detectable; NR=No Record; s dev=standard deviation.

*The DRE results for samples denoted by <MDL are calculated based on a value of one-half the MDL.

Extracted Round No: 21, 23
 Extracted Round Amount: 2.00 grams (3-inch) (Extracted round samples were diluted to dissolve crystals prior to analysis.)
 6.30 grams (5-inch)

MDL for Analysis: 0.007 µg/ml RDX
 0.003 µg/ml TNT
 Surface Area: 202 sq cm (3-inch)
 632 sq cm (5-inch)

CHAMBER WIPES

Test # 17	Chamber Load:	3-Inch 5-Inch	Date:	25 Aug 94
	Explosive Type:	RDX	Heatup Time:	4.1 Hrs
	Explosive Source:	Spiked	Time at Setpoint:	6.0 Hrs
	Temperature Setpoint:	550°F 288°C	Cooldown Time:	10.6 Hrs

Wipe #	Location in System	Operating Temperature	Operating Temperature	Explosive Concentration / Smear		Explosive Amount	Explosive Amount / Surface Area
		°F	°C	µg / smear RDX	µg / smear TNT	µg	mg / cm ²
1	Blank	NA	NA	<MDL	<MDL	ND	ND
2	Floor	513	267	<MDL	<MDL	ND	ND
3	Wall	NR	NR	<MDL	<MDL	ND	ND
4	Duct	587	308	<MDL	<MDL	ND	ND
5	Elbow	587	308	<MDL	<MDL	ND	ND
6	Fanblade	587	308	<MDL	<MDL	ND	ND
7	Coldspot	382	194	<MDL	<MDL	ND	ND
8	Rail	573	301	<MDL	<MDL	ND	ND

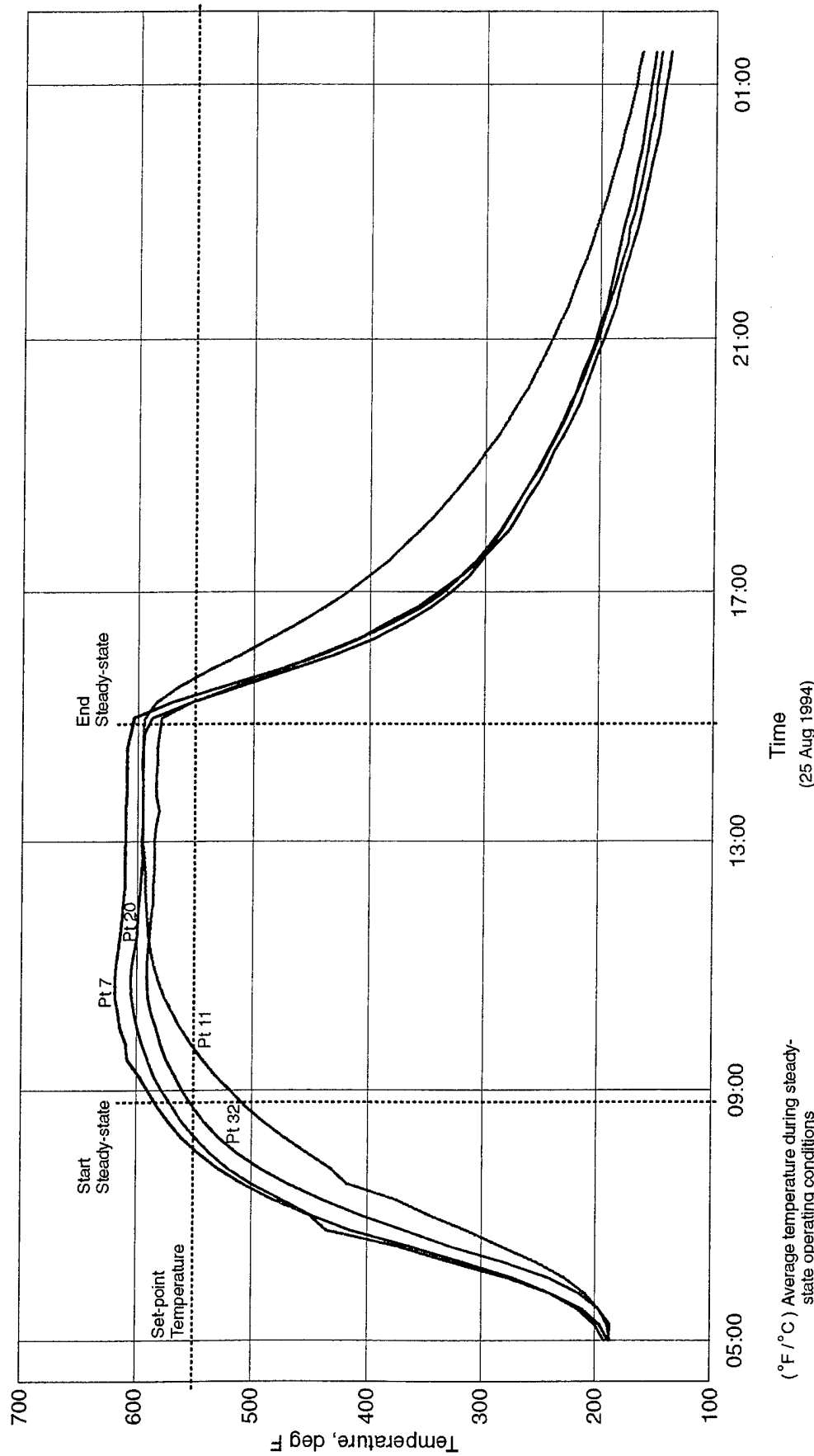
Special Abbreviations: NA=Not Applicable; ND=Not Detectable; NR=No Record

MDL for Analysis: 0.4 µg/smear RDX
0.25 µg/smear TNT

Surface Area: 161 sq cm

HGD Test 17

3-inch / 5-inch Projectiles - RDX - (192 Rounds)



(°F / °C) Average temperature during steady-state operating conditions

- Pt 32 (adjacent to process probe) (583 °F / 306 °C)
- Pt 11 (coldest) (575 °F / 301 °C)
- Pt 20 (intermediate tp) (601 °F / 316 °C)
- Pt 7 (hottest) (621 °F / 327 °C)

Figure F-31 Test 17 - Average Temperature Profile - 15 minute Intervals

HGD Test 17

3-inch / 5-inch Projectiles - RDX - (24 Rounds)

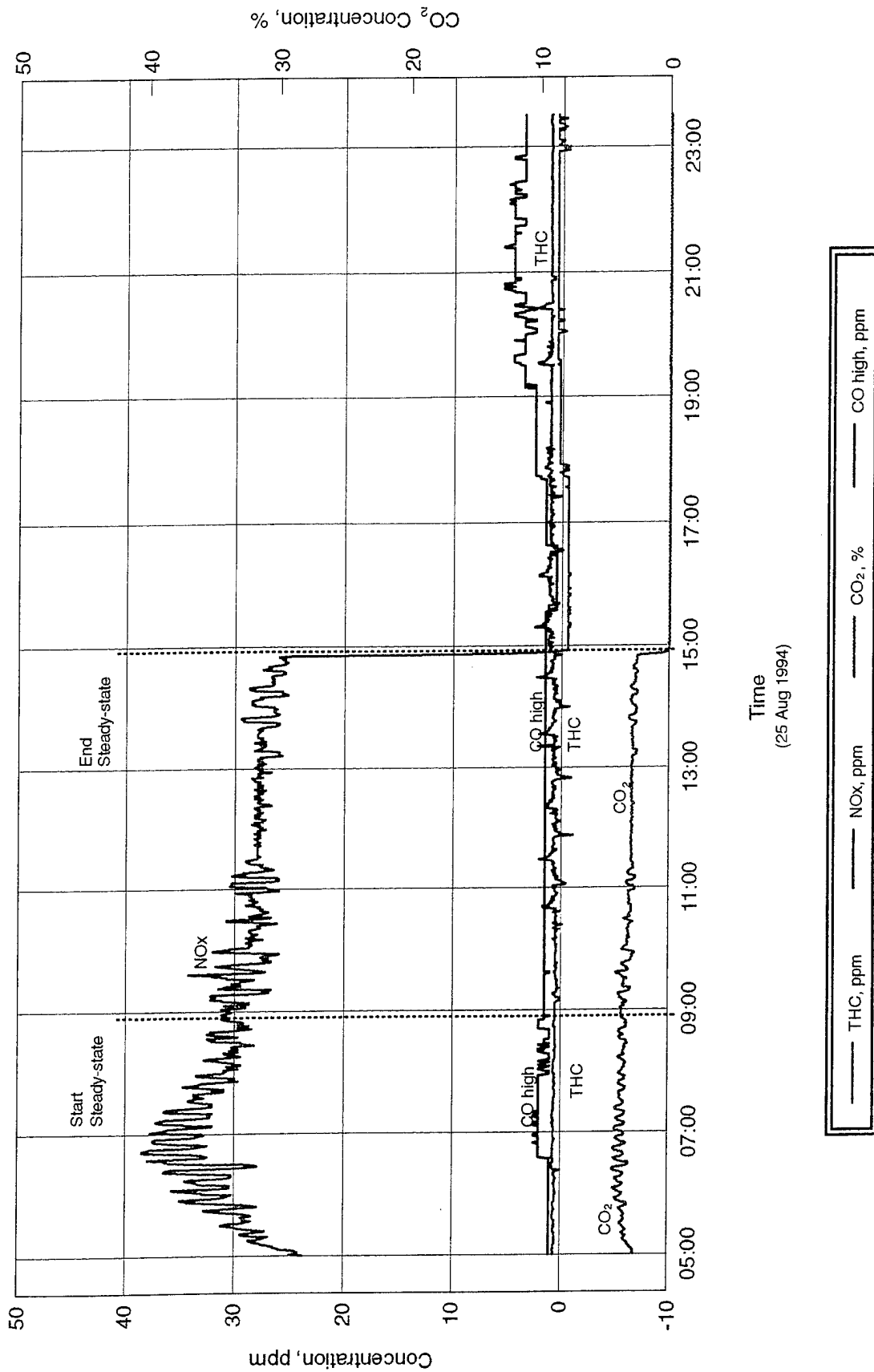


Figure F-32 Test 17 - CEM Profile - 1 minute Intervals

TEST 18

Process Conditions

This test was conducted under the same test conditions as Test 8 and 13, [6 hrs at 550°F (288°C), 24 175mm projectiles spiked with Comp B]. The railcar configuration is shown in Figure D-33. The oxidizer was started at 0348 hrs on 27 August with heat going to the chamber at 0705 hrs. Steady state was reached at 1416 hrs. Test completed was at 2119 hrs with a control system automatically initiated shutdown.

Special Conditions

- Sampled chamber exhaust gas from 0705 to 1225 hrs.

Analytical Considerations

- Spiked projectile, insulation, and chamber wipe samples were taken the next day using acetonitrile.

Comments

- System safety shutdown at 1516 hrs due to high collector and inlet temperatures. Probably false temperature reading after making changes in Maples control; back on at 1545 hrs.

CEM

- NOTE: Spikes in CEM at about 1000 hrs (approximately 400°F, 204°C) in NO_x, CO, and THC.

Table F-40

PROJECTILE EXTRACT SAMPLES

Test # 18	Projectile Type:	175 mm	Date:	27 Aug 94
	Explosive Type:	Comp B	Heatup Time:	7.2 Hrs
	Explosive Source:	Spiked	Time at Setpoint:	7.0 Hrs
	Temperature Setpoint:	550°F 288°C	Cooldown Time:	12.2 Hrs

Round #	Operating Temperature		Operating Temperature		Explosive Concentration		Sampling Dilution ml	Explosive Amount µg	Explosive Amount / Surface Area mg / cm ²	DRE*
	°F	s dev	°C	s dev	µg / ml RDX	µg / ml TNT				
1	599	16.92	315	9.40	<MDL	<MDL	500	ND	ND	99.999
2	585	13.21	307	7.34	<MDL	<MDL	500	ND	ND	99.999
3	574	13.69	301	7.61	<MDL	<MDL	500	ND	ND	99.999
4	561	17.07	294	9.48	<MDL	<MDL	500	ND	ND	99.999
5	570	12.42	299	6.90	<MDL	<MDL	500	ND	ND	99.999
6	556	18.06	291	10.03	<MDL	<MDL	500	ND	ND	99.999
7	596	15.13	314	8.41	<MDL	<MDL	500	ND	ND	99.999
8	585	13.26	307	7.37	<MDL	<MDL	500	ND	ND	99.999
9	579	13.40	304	7.44	<MDL	<MDL	500	ND	ND	99.999
10	571	11.56	299	6.42	<MDL	<MDL	500	ND	ND	99.999
11	569	10.96	299	6.09	<MDL	<MDL	500	ND	ND	99.999
12	569	13.65	299	7.58	<MDL	<MDL	500	ND	ND	99.999
13	593	15.82	312	8.79	<MDL	<MDL	500	ND	ND	99.999
14	580	11.65	305	6.47	<MDL	<MDL	500	ND	ND	99.999
15	575	11.61	302	6.45	<MDL	<MDL	500	ND	ND	99.999
16	573	11.25	301	6.25	<MDL	<MDL	500	ND	ND	99.999
17	570	9.69	299	5.38	<MDL	<MDL	500	ND	ND	99.999
18	569	11.88	298	6.60	<MDL	<MDL	500	ND	ND	99.999
19	595	15.93	313	8.85	<MDL	<MDL	500	ND	ND	99.999
20	601	14.38	316	7.99	<MDL	<MDL	500	ND	ND	99.999
21	587	12.98	308	7.21	0.0121	<MDL	500	6.050	3.1461E-06	99.999
22	624	16.50	329	9.17	<MDL	<MDL	500	ND	ND	99.999
23	623	20.30	328	11.28	24720	16694	500	20707000	1.0768E+01	NA
24	609	18.38	321	10.21	<MDL	<MDL	500	ND	ND	99.999

Special Abbreviations: NA=Not Applicable; ND=Not Detectable; NR=No Record; s dev=standard deviation.

*The DRE results for samples denoted by <MDL are calculated based on a value of one-half the MDL.

Extracted Round No: 23
Extracted Round Amount: 20.707 grams

MDL for Analysis: 0.004 µg/ml RDX
0.0025 µg/ml TNT

Surface Area: 1923 sq cm

Table F-41

CHAMBER WIPES

Test # 18	Chamber Load:	<u>175 mm</u>	Date:	<u>27 Aug 94</u>
	Explosive Type:	<u>Comp B</u>	Heatup Time:	<u>7.2 Hrs</u>
	Explosive Source:	<u>Spiked</u>	Time at Setpoint:	<u>7.0 Hrs</u>
	Temperature Setpoint:	<u>550°F 288°C</u>	Cooldown Time:	<u>12.2 Hrs</u>

Wipe #	Location in System	Operating Temperature	Operating Temperature	Explosive Concentration / Smear		Explosive Amount	Explosive Amount / Surface Area
		°F	°C	µg / smear RDX	µg / smear TNT	µg	mg / cm ²
1	Blank	NA	NA	<MDL	<MDL	ND	ND
2	Floor	454	234	<MDL	<MDL	ND	ND
3	Wall	NR	NR	<MDL	<MDL	ND	ND
4	Duct	565	296	<MDL	<MDL	ND	ND
5	Elbow	565	296	<MDL	<MDL	ND	ND
6	Fanblade	565	296	<MDL	<MDL	ND	ND
7	Coldspot	382	194	<MDL	<MDL	ND	ND
8	Rail	560	293	<MDL	<MDL	ND	ND

Special Abbreviations: NA=Not Applicable; ND=Not Detectable; NR=No Record

MDL for Analysis: 0.4 µg/smear RDX
0.25 µg/smear TNT

Surface Area: 161 sq cm

HGD Test 18

175mm Projectiles - Comp B - (96 Rounds)

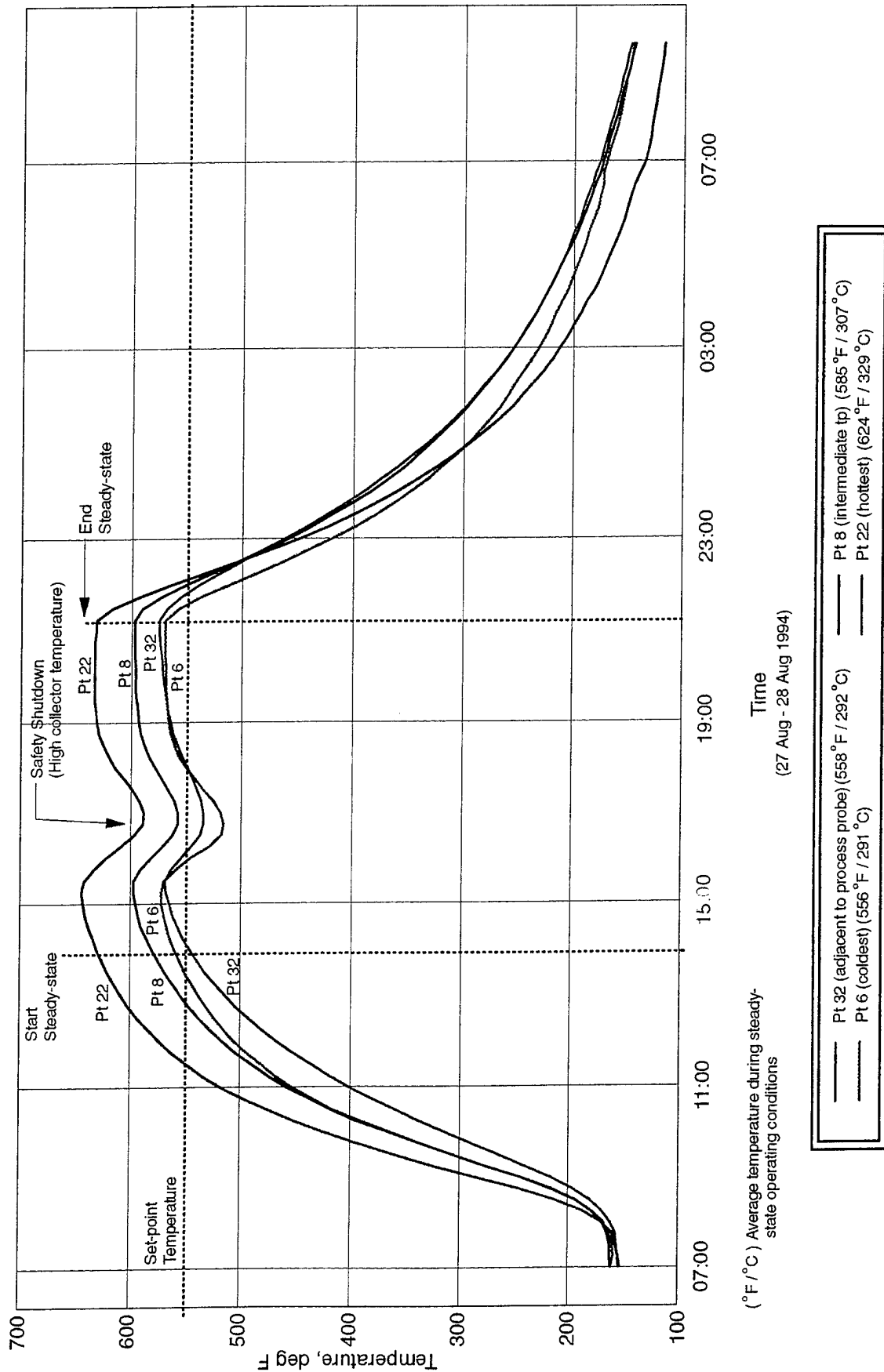


Figure F-33 Test 18 - Average Temperature Profile - 15 minute Intervals

HGD Test 18

175mm Projectiles - Comp B - (96 Rounds)

See Figure F-35

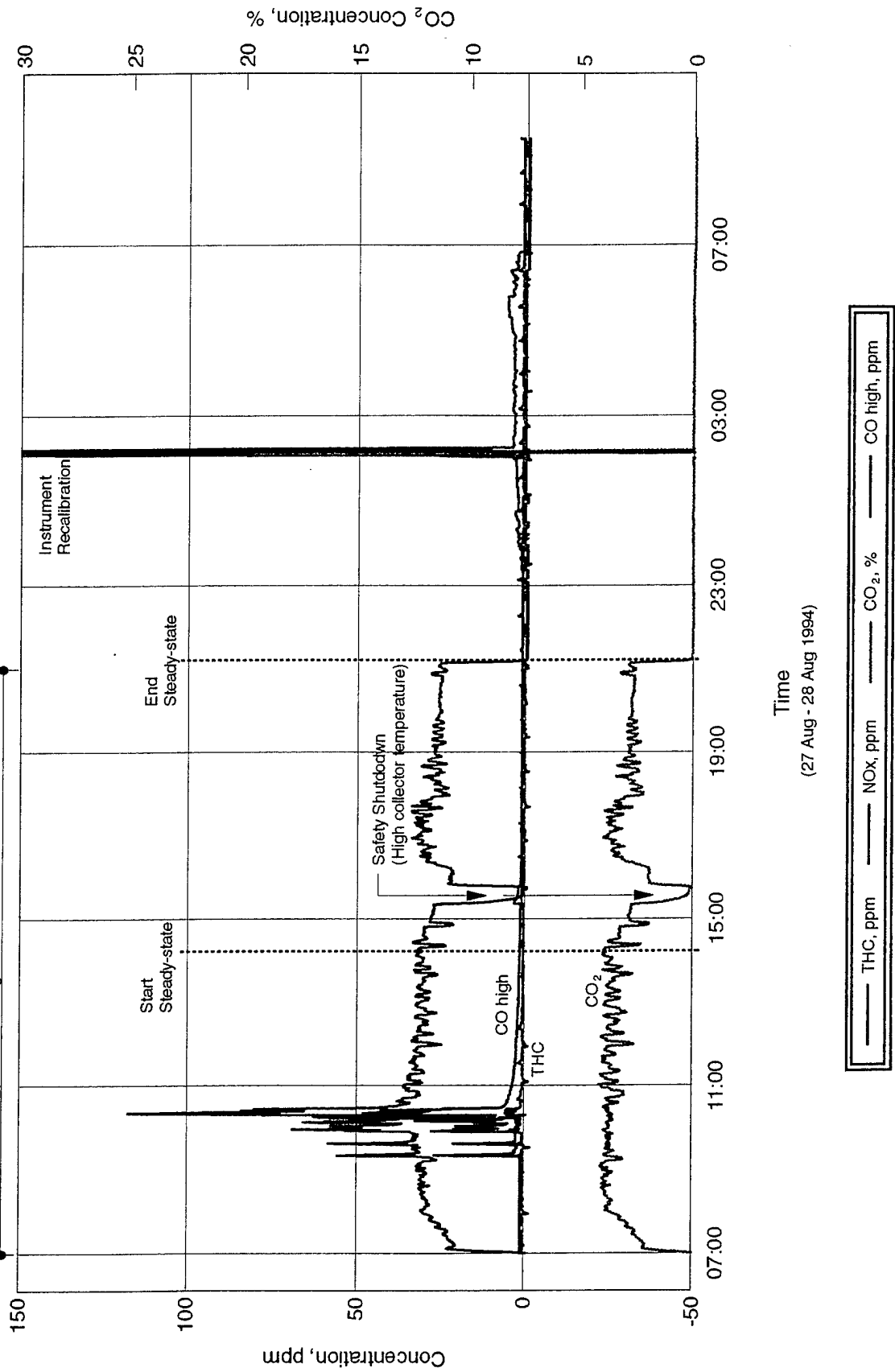


Figure F-34 Test 18 - CEM Profile - 1 minute Intervals

HGD Test 18

175mm Projectiles - Comp B - (96 Rounds)

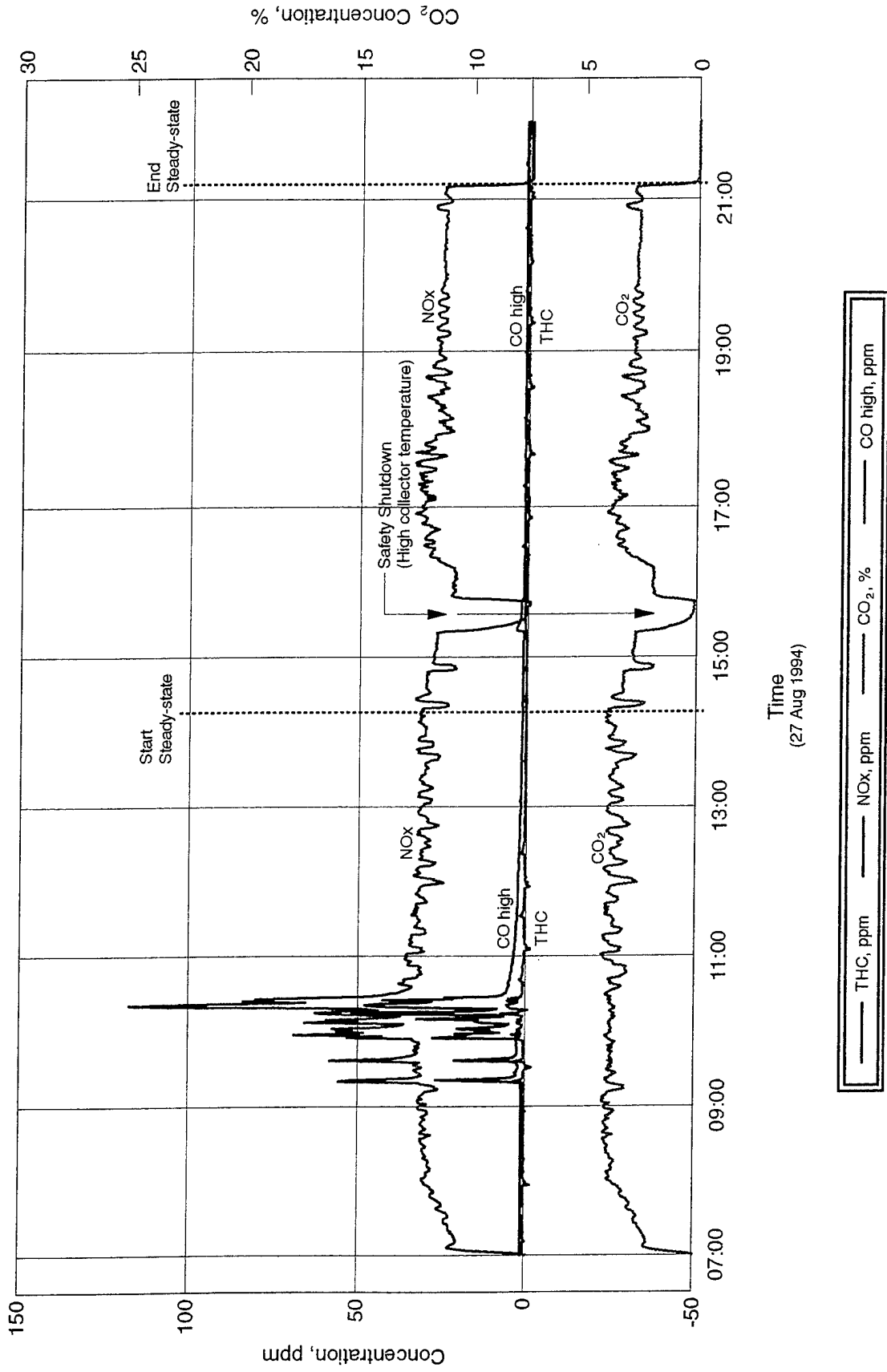


Figure F-35 Test 18 - CEM Profile - 1 minute Intervals

TEST 19

Process Conditions

This test was conducted under test conditions similar to Test 16 [700°F (371°C) treatment temperature, 24 MK 54 Depth Bombs containing HBX residue] except the treatment time was decreased from 32 to 24 hrs. The railcar configuration is shown in Figure D-34. The oxidizer was started at 0719 hrs on 29 August with hot gas to the chamber at 0749 hrs. System reached steady state at 0202 hrs on 30 August and test was completed at 0202 hrs on 31 August.

Special Conditions

- The Maples control thermocouple was placed in the center nozzle with a shield around the opening to prevent a draft. Heatup was slower than Test 16.

Analytical Considerations

- Bomb and chamber wipe samples were taken on 1 September using acetonitrile.

Comments

- Elevated readings were noted on the CEM during heatup.
- Bombs looked clean of HBX and hot-melt residue. Chamber had a well-defined area (lengthwise center of the chamber at the foot of the wall) covered in a granular ashy material that appeared red in chamber lighting but was mostly black in the sunlight. There was a dusty appearance on ducts, angles, etc. The rest of the floor area had a gray ashy color, lightly dusty. Sample was taken of this material.

CEM

- NOTE: Increase in CO readings over several hours, this could be due to tar burnoff.
- Spikes at about 0900 (approximately 400°F, 204°C) in the NO_x, CO, and THC.

Table F-42

MINE/DEPTH BOMB WIPE SAMPLES

Mine/Depth Bomb Type:		MK64 Depth Bomb	Date:	29 Aug 94
Test #	Explosive Type:	HBX	Heatup Time:	18.7 Hrs
19	Explosive Source:	Demil	Time at Setpoint:	24.0 Hrs
Temperature Setpoint:		700°F 371°C	Cooldown Time:	15.0 Hrs

Wipe #	Operating Temperature		Operating Temperature		Explosive Concentration		Explosive Amount	Explosive Amount / Surface Area	DRE
	°F	s dev	°C	s dev	µg/smear RDX	µg/smear TNT	µg	mg / cm ²	%
1	733	7.10	390	3.95	<MDL	<MDL	ND	ND	NC
2	736	9.20	391	5.11	<MDL	<MDL	ND	ND	NC
3	726	10.16	386	5.64	<MDL	<MDL	ND	ND	NC
4	717	8.05	381	4.47	<MDL	<MDL	ND	ND	NC
5	724	9.50	384	5.28	<MDL	<MDL	ND	ND	NC
6	710	6.76	377	3.75	<MDL	<MDL	ND	ND	NC
7	737	8.13	392	4.52	<MDL	0.0358	0.036	1.4733E-07	NC
8	729	7.15	387	3.97	<MDL	<MDL	ND	ND	NC
9	730	9.16	388	5.09	<MDL	<MDL	ND	ND	NC
10	725	8.27	385	4.59	<MDL	<MDL	ND	ND	NC
11	723	7.77	384	4.32	<MDL	0.0334	0.033	1.3745E-07	NC
12	721	8.55	383	4.75	<MDL	<MDL	ND	ND	NC
13	738	7.22	392	4.01	<MDL	<MDL	ND	ND	NC
14	734	6.79	390	3.77	<MDL	<MDL	ND	ND	NC
15	734	7.46	390	4.14	<MDL	<MDL	ND	ND	NC
16	727	6.77	386	3.76	<MDL	0.0123	0.012	5.0617E-08	NC
17	723	6.78	384	3.76	<MDL	<MDL	ND	ND	NC
18	719	7.27	382	4.04	<MDL	<MDL	ND	ND	NC
19	738	7.23	392	4.02	<MDL	<MDL	ND	ND	NC
20	744	6.88	396	3.82	<MDL	<MDL	ND	ND	NC
21	737	7.09	392	3.94	<MDL	<MDL	ND	ND	NC
22	732	6.79	389	3.77	<MDL	<MDL	ND	ND	NC
23	743	6.81	395	3.78	<MDL	<MDL	ND	ND	NC
24	733	8.07	390	4.48	0.011	<MDL	0.011	4.5267E-08	NC

Special Abbreviations: NA=Not Applicable; NC=Not Calculable; ND=Not Detectable; NR=No Record; s dev=standard deviation.

Estimated Residue Amount: No estimate is available for hot melt coated items.

MDL for Analysis: 0.4 µg/smear RDX
0.25 µg/smear TNT

Surface Area: 243 sq cm

Table F-43

CHAMBER WIPES

Test # <u>19</u>	Chamber Load:	<u>MK64 Depth Bomb</u>	Date:	<u>29 Aug 94</u>
	Explosive Type:	<u>HBX</u>	Heatup Time:	<u>18.7 Hrs</u>
	Explosive Source:	<u>Demil</u>	Time at Setpoint:	<u>24.0 Hrs</u>
	Temperature Setpoint:	<u>700°F 371°C</u>	Cooldown Time:	<u>15.0 Hrs</u>

Wipe #	Location in System	Operating Temperature	Operating Temperature	Explosive Concentration / Smear		Explosive Amount	Explosive Amount / Surface Area
		°F	°C	µg / smear RDX	µg / smear TNT	µg	mg / cm ²
1	Blank	NA	NA	<MDL	<MDL	ND	ND
2	Floor	633	334	<MDL	<MDL	ND	ND
3	Wall	NR	NR	<MDL	<MDL	ND	ND
4	Duct	681	361	<MDL	<MDL	ND	ND
5	Elbow	681	361	<MDL	<MDL	ND	ND
6	Fanblade	681	361	<MDL	<MDL	ND	ND
7	Coldspot	528	276	0.8828	<MDL	0.8828	5.4832E-06
8	Rail	684	362	<MDL	<MDL	ND	ND

Special Abbreviations: NA=Not Applicable; ND=Not Detectable; NR=No Record

MDL for Analysis: 0.4 µg/smear RDX
 0.25 µg/smear TNT

Surface Area: 161 sq cm

HGD Test 19

MK 54 Depth Bomb - HBX - (24 Sawed Ends)

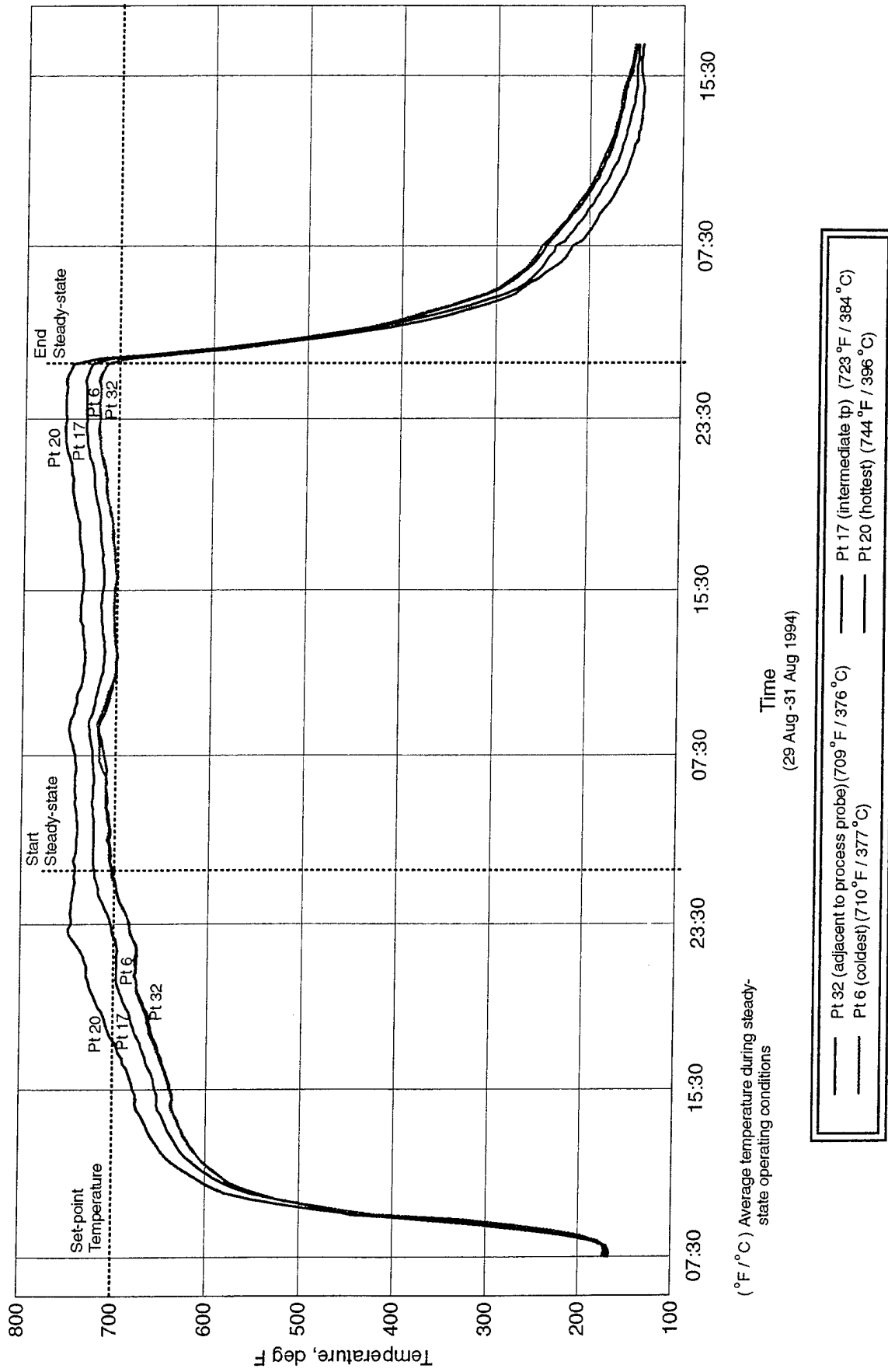
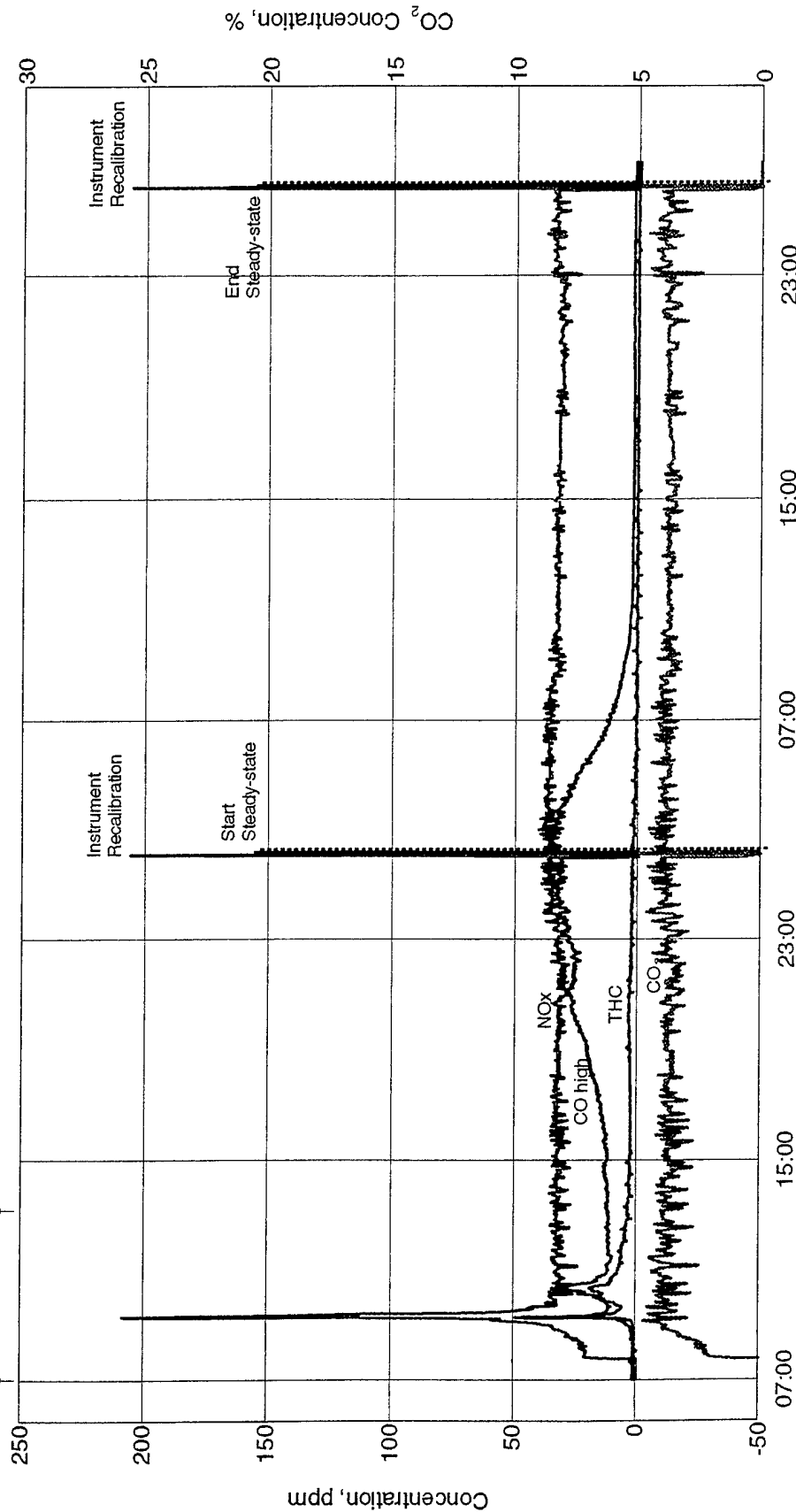


Figure F-36 Test 19 - Average Temperature Profile - 15 minute Intervals

HGD Test 19

MK 54 Depth Bombs - HBX - (24 Items)

See Figure F-38



Time
(29 Aug - 31 Aug 1994)

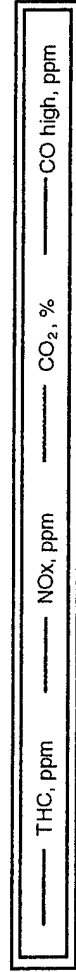


Figure F-37 Test 19 - CEM Profile - 1 minute Intervals

HGD Test 19
 MK 54 Depth Bombs - HBX - (24 Items)

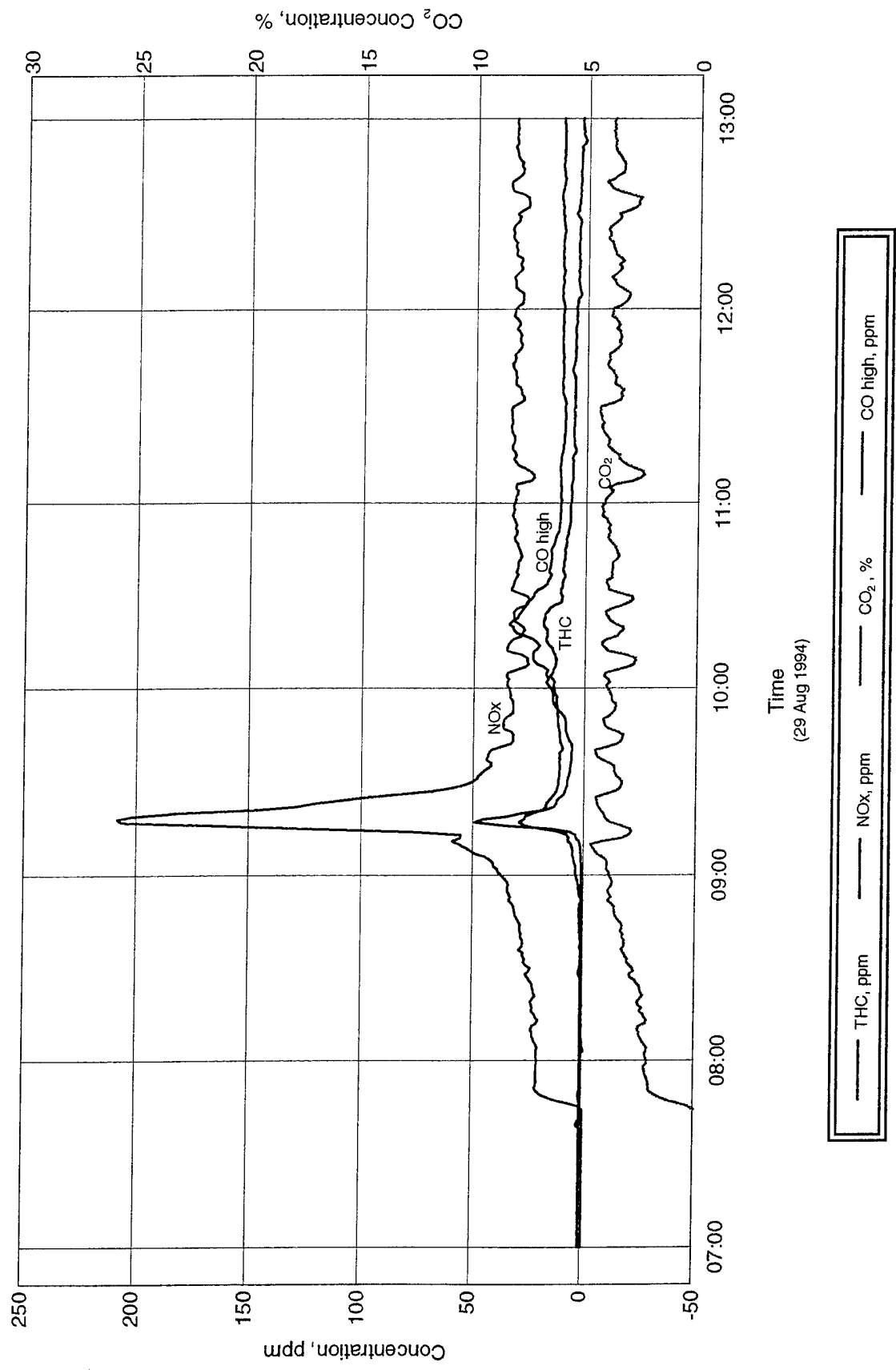


Figure F-38 Test 19 - CEM Profile - 1 minute Intervals

TEST 20

Process Conditions

This test was conducted under test conditions similar to Test 10 and 15 [600°F (316°C) treatment temperature, 12 3-inch and 12 5-inch projectiles spiked with Yellow D] except the treatment time was 8 hrs. The railcar configuration is shown in Figure D-35. The oxidizer was started at 0348 hrs on 3 September with heat to the chamber at 0433 hrs. Steady state was reached at 1328 hrs and the test was completed at 2130 hrs.

Analytical Considerations

- Spiked projectile and chamber wipe samples were taken the next day using HPLC water.

CEM

- NOTE: Spikes in CO, and NO_x around 0800 (approximately 500°F, 260°C). Also note spike in temperature around this same time.

Table F-44

PROJECTILE EXTRACT SAMPLES

Test # 20	Projectile Type: <u>3-inch</u> <u>5-inch</u>	Date: <u>3 Sep 94</u>
	Explosive Type: <u>Yellow D</u>	Heatup Time: <u>8.9 Hrs</u>
	Explosive Source: <u>Spiked</u>	Time at Setpoint: <u>8.0 Hrs</u>
	Temperature Setpoint: <u>600°F</u> <u>316°C</u>	Cooldown Time: <u>9.5 Hrs</u>

Round #	Size	Operating Temperature		Operating Temperature		Explosive Concentration $\mu\text{g/ml}$ Amm. Picrate	Sampling Dilution ml	Explosive Amount μg	Explosive Amount / Surface Area mg/cm^2	DRE* %
		°F	s dev	°C	s dev					
1	5 in.	652	6.12	345	3.40	<MDL	100	ND	ND	99.999
2	5 in.	632	6.17	333	3.43	<MDL	100	ND	ND	99.999
3	5 in.	621	6.53	327	3.63	<MDL	100	ND	ND	99.999
4	3 in.	618	7.20	325	4.00	0.0094	50	0.470	2.3267E-06	99.999
5	3 in.	606	7.37	319	4.09	<MDL	50	ND	ND	99.999
6	3 in.	631	7.94	333	4.41	0.0052	50	0.260	1.2871E-06	99.999
7	3 in.	639	7.26	337	4.03	<MDL	50	ND	ND	99.999
8	3 in.	647	7.51	341	4.17	<MDL	50	ND	ND	99.999
9	3 in.	633	7.47	334	4.15	0.0059	50	0.295	1.4604E-06	99.999
10	5 in.	626	6.59	330	3.66	0.006	100	0.600	9.4937E-07	99.999
11	5 in.	629	6.89	332	3.83	0.0115	100	1.150	1.8196E-06	99.999
12	5 in.	610	7.68	321	4.27	<MDL	100	ND	ND	99.999
13	5 in.	641	6.55	338	3.64	<MDL	100	ND	ND	99.999
14	5 in.	631	6.37	333	3.54	<MDL	100	ND	ND	99.999
15	5 in.	623	6.51	328	3.62	<MDL	100	ND	ND	99.999
16	3 in.	629	7.63	332	4.24	0.006	50	0.300	1.4851E-06	99.999
17	3 in.	622	7.82	328	4.34	<MDL	50	ND	ND	99.999
18	3 in.	621	8.20	327	4.56	<MDL	50	ND	ND	99.999
19	3 in.	638	7.62	337	4.23	0.0055	50	0.275	1.3614E-06	99.999
20	3 in.	655	6.75	346	3.75	9640	250	2410000	1.1931E+01	NA
21	3 in.	643	7.75	340	4.30	0.0065	50	0.325	1.6089E-06	99.999
22	5 in.	636	6.76	336	3.75	<MDL	100	ND	ND	99.999
23	5 in.	677	6.78	358	3.77	3521	2000	7041179	1.1141E+01	NA
24	5 in.	625	7.84	329	4.35	<MDL	50	ND	ND	99.999

Special Abbreviations: NA=Not Applicable; ND=Not Detectable; NR=No Record; s dev=standard deviation.

*The DRE results for samples denoted by <MDL are calculated based on a value of one-half the MDL.

Extracted Round No: 20, 23
 Extracted Round Amount: 2.41 grams (3-inch) (Extracted round samples were diluted to dissolve crystals prior to analysis.)
 7.04 grams (5-inch)

MDL for Analysis: 0.004 $\mu\text{g/ml}$ Ammonium Picrate

Surface Area: 202 sq cm (3-inch)
 632 sq cm (5-inch)

Table F-45

CHAMBER WIPES

Test # <u>20</u>	Chamber Load:	<u>3-inch</u> <u>5-inch</u>	Date:	<u>3 Sep 94</u>
	Explosive Type:	<u>Yellow D</u>	Heatup Time:	<u>8.9 Hrs</u>
	Explosive Source:	<u>Spiked</u>	Time at Setpoint:	<u>8.0 Hrs</u>
	Temperature Setpoint:	<u>600°F</u> <u>316°C</u>	Cooldown Time:	<u>9.5 Hrs</u>

Wipe #	Location in System	Operating Temperature	Operating Temperature	Explosive Concentration / Smear	Explosive Amount	Explosive Amount / Surface Area
		°F	°C	µg / smear Amm. Picrate	µg	mg / cm ²
1	Blank	NA	NA	<MDL	ND	ND
2	Floor	528	276	<MDL	ND	ND
3	Wall	NR	NR	<MDL	ND	ND
4	Duct	608	320	<MDL	ND	ND
5	Elbow	608	320	<MDL	ND	ND
6	Fanblade	608	320	<MDL	ND	ND
7	Coldspot	406	208	<MDL	ND	ND
8	Rail	595	313	2.1	2.1	1.3043E-05

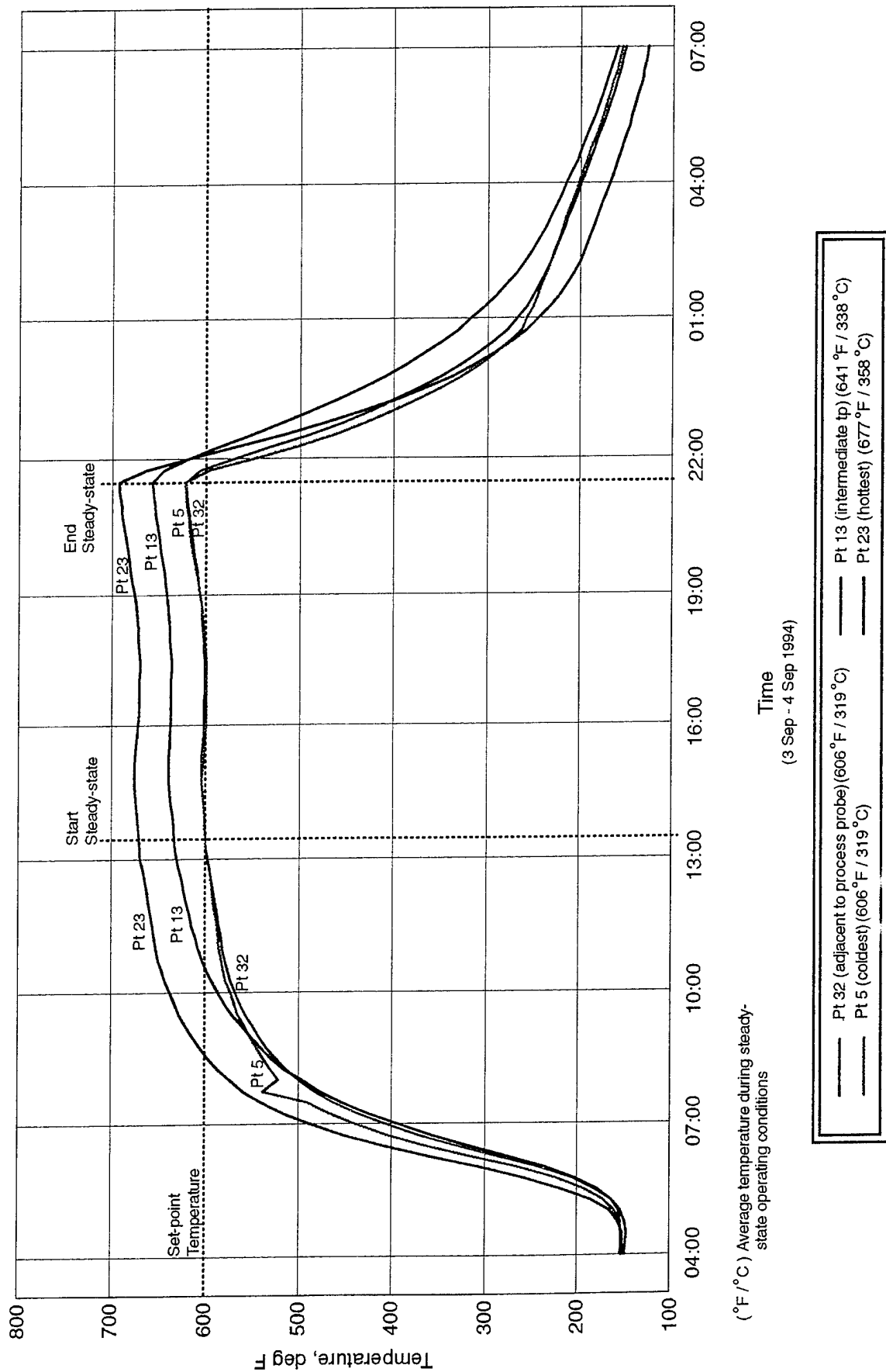
Special Abbreviations: NA=Not Applicable; ND=Not Detectable; NR=No Record

MDL for Analysis: 0.4 µg/smear Ammonium Picrate

Surface Area: 161 sq cm

HGD Test 20

3-inch British Projectiles - Yellow D - (192 Rounds)



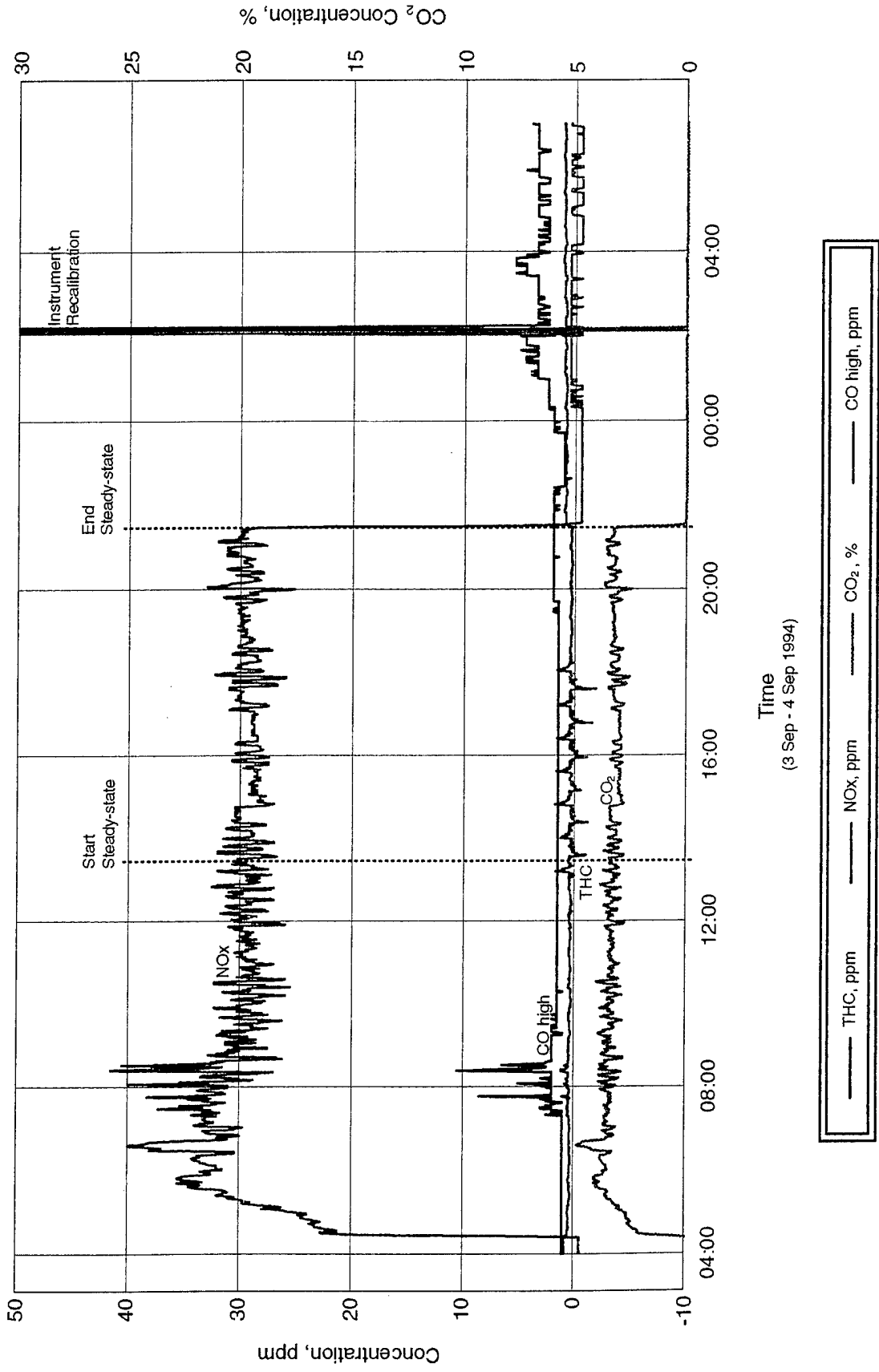
(°F / °C) Average temperature during steady-state operating conditions

Time
(3 Sep - 4 Sep 1994)

Figure F-39 Test 20 - Average Temperature Profile - 15 minute Intervals

HGD Test 20

3-inch / 5-inch Projectiles - Yellow D - (192 Rounds)



Time
(3 Sep - 4 Sep 1994)

Figure F-40 Test 20 - CEM Profile - 1 minute Intervals

CHAMBER WIPES

Residue Accumulation from a Series of Tests

Tests: 11-20

Wipe #	Location in System	Operating Temperature*	Operating Temperature*	Explosive Concentration / Smear		Explosive Amount	Explosive Amount / Surface Area
		°F	°C	µg / smear RDX	µg / smear TNT	µg	mg / cm ²
1	Blank	NA	NA	<MDL	<MDL	ND	ND
2	Floor	545	285	<MDL	<MDL	ND	ND
3	Wall	NR	NR	<MDL	<MDL	ND	ND
4	Duct	611	322	<MDL	<MDL	ND	ND
5	Elbow	611	322	<MDL	<MDL	ND	ND
6	Fanblade	611	322	<MDL	<MDL	ND	ND
7	Coldspot	401	205	<MDL	<MDL	ND	ND
8	Rail	608	320	<MDL	<MDL	ND	ND

Special Abbreviations: NA=Not Applicable; ND=Not Detectable; NR=No Record

*Average operating temperature of tests 11-20. Test period also includes test C.

MDL for Analysis: 1 µg/smear RDX
 0.6 µg/smear TNT

Surface Area: 161 sq cm

Test D

Process Conditions

This test was conducted on 480 inert 175mm projectiles to establish the temperature distribution with a full chamber load configuration as shown in Figure D-37. The test conditions were 6 hrs at 550°F (288°C). The oxidizer was started at 1408 hrs on 8 September with heat added to the chamber at 1525 hrs. Steady state was reached at 2340 hrs and the test was completed on 9 September at 0541 hrs with a control system automatically initiated cooldown.

Special Conditions

- Twenty-four projectiles were palletized on a standard 40 inch by 48 inch (102 centimeters by 122 centimeters) metal pallet by placing one projectile in every other position of a 5-inch projectile nose adapter pallet. The chamber accommodated 20 pallets in two tiers, two wide, extending lengthwise from the chamber exhaust duct to within 44 inches (112 centimeters) of the diffusers. The pallets were placed in the chamber with a forklift.

Comments

- Temperatures of the projectile ranged from 491°F (255°C) at the center of the lower tier near the door to 800°F (427°C) at the front of the upper tier near the diffusers.

SPECIAL TEST SAMPLES

Test # D	Chamber Load:	175 mm	Date:	6 Sep 94
	Explosive Type:	NA	Heatup Time:	8.2 Hrs
	Explosive Source:	NA	Time at Setpoint:	6.0 Hrs
	Temperature Setpoint:	550°F 288°C	Cooldown Time:	18.3 Hrs

No samples were taken.

NA = Not Applicable

HGD Test D

175mm Projectiles - (480 Inert Rounds)

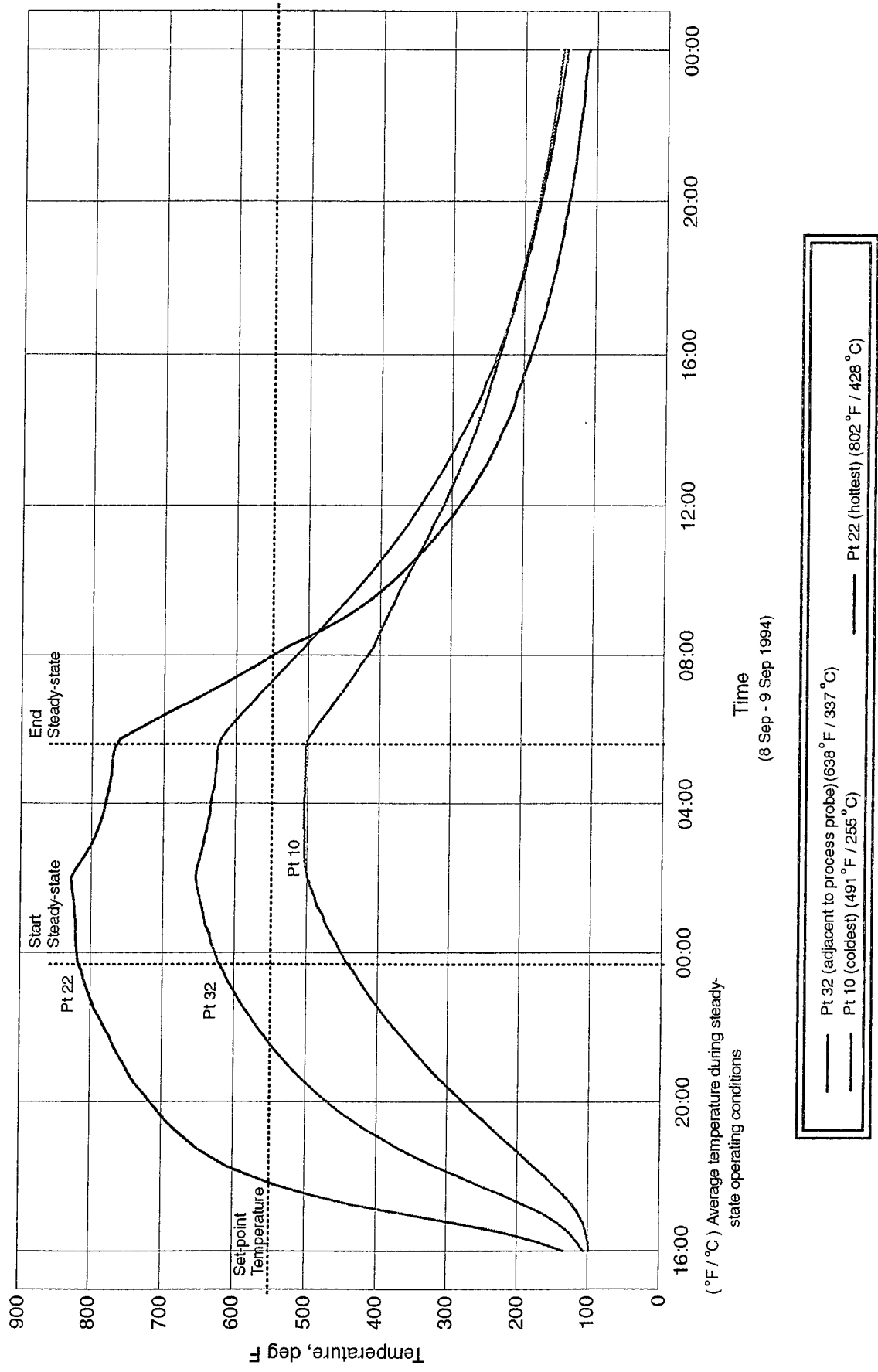


Figure F-41 Test D - Average Temperature Profile - 15 minute Intervals

TEST 21

Process Conditions

This test was conducted under the same test conditions as Test 19, [24 hrs at 700°F, (371°C) 24 MK 54 Depth Bombs containing HBX residue]. The railcar configuration is shown in Figure D-38. The oxidizer was started at 1245 hrs on 12 September with heat going to the chamber at 1345 hrs. System reached steady state at 2003 hrs on 13 September and test was completed at 1933 hrs on 14 September with an operator initiated cooldown.

Analytical Considerations

- Bomb and chamber wipe samples were taken the next day using acetonitrile.

Comments

- Thermocouple #18 may have been measuring chamber air temperature during test. It was found on the chamber floor; unknown if it was dislodged before or after test.
- System safety shutdown at 1500 hrs due to high collector temperature (wind gust suspected); restarted at 1530 hrs.

CEM

- Spikes in CO, NO_x, and THC occur at approximately 400°F (204°C) during heatup.

Table F-48

MINE/DEPTH BOMB WIPE SAMPLES

Mine/Depth Bomb Type:		MK54 Depth Bomb	Date:	12 Sep 94
Test #	Explosive Type:	HBX	Heatup Time:	30.3 Hrs
21	Explosive Source:	Demil	Time at Setpoint:	23.5 Hrs
Temperature Setpoint:		700°F 371°C	Cooldown Time:	12.5 Hrs

Wipe #	Operating Temperature		Operating Temperature		Explosive Concentration		Explosive Amount	Explosive Amount / Surface Area	DRE
	°F	s dev	°C	s dev	µg/smear RDX	µg/smear TNT	µg	mg / cm ²	%
1	758	7.63	403	4.24	<MDL	<MDL	ND	ND	NC
2	752	7.78	400	4.32	<MDL	<MDL	ND	ND	NC
3	748	9.01	398	5.00	<MDL	<MDL	ND	ND	NC
4	735	8.75	390	4.86	<MDL	<MDL	ND	ND	NC
5	734	9.74	390	5.41	<MDL	<MDL	ND	ND	NC
6	731	8.75	388	4.86	5.0551	2.716	7.771	3.1980E-05	NC
7	750	9.91	399	5.51	1.1512	<MDL	1.151	4.7374E-06	NC
8	750	9.81	399	5.45	<MDL	<MDL	ND	ND	NC
9	751	9.18	399	5.10	<MDL	0.7544	0.754	3.1045E-06	NC
10	744	10.22	395	5.68	<MDL	<MDL	ND	ND	NC
11	739	8.80	393	4.89	<MDL	<MDL	ND	ND	NC
12	733	10.23	389	5.69	<MDL	<MDL	ND	ND	NC
13	754	9.91	401	5.51	<MDL	<MDL	ND	ND	NC
14	752	8.03	400	4.46	<MDL	<MDL	ND	ND	NC
15	749	8.81	399	4.90	<MDL	<MDL	ND	ND	NC
16	739	8.26	393	4.59	<MDL	<MDL	ND	ND	NC
17	740	9.09	393	5.05	1.2513	<MDL	1.251	5.1494E-06	NC
18	642	16.96	339	9.42	<MDL	<MDL	ND	ND	NC
19	753	7.86	401	4.37	<MDL	<MDL	ND	ND	NC
20	759	7.58	404	4.21	<MDL	<MDL	ND	ND	NC
21	752	8.25	400	4.58	<MDL	<MDL	ND	ND	NC
22	746	9.30	397	5.17	1.3514	<MDL	1.351	5.5613E-06	NC
23	759	7.63	404	4.24	<MDL	<MDL	ND	ND	NC
24	746	8.20	397	4.56	<MDL	<MDL	ND	ND	NC

Special Abbreviations: NA=Not Applicable; NC=Not Calculable; ND=Not Detectable; NR=No Record; s dev=standard deviation.

Estimated Residue Amount: No estimate is available for hot melt coated items.

MDL for Analysis: 0.4 µg/smear RDX
0.25 µg/smear TNT

Surface Area: 243 sq cm

CHAMBER WIPES

Test # 21	Chamber Load:	MK54 Depth Bomb	Date:	12 Sep 94
	Explosive Type:	HBX	Heatup Time:	30.3 Hrs
	Explosive Source:	Demil	Time at Setpoint:	23.5 Hrs
	Temperature Setpoint:	700°F 371°C	Cooldown Time:	12.5 Hrs

Wipe #	Location in System	Operating Temperature	Operating Temperature	Explosive Concentration / Smear		Explosive Amount	Explosive Amount / Surface Area
		°F	°C	µg / smear RDX	µg / smear TNT	µg	mg / cm ²
1	Blank	NA	NA	<MDL	<MDL	ND	ND
2	Floor	660	349	<MDL	<MDL	ND	ND
3	Wall	NR	NR	1.3013	<MDL	1.3013	8.0826E-06
4	Duct	712	378	1.3013	<MDL	1.3013	8.0826E-06
5	Elbow	712	378	1.8513	0.7167	2.568	1.5950E-05
6	Fanblade	712	378	<MDL	<MDL	ND	ND
7	Coldspot	541	283	<MDL	<MDL	ND	ND
8	Rail	707	375	<MDL	1.0185	1.0185	6.3261E-06

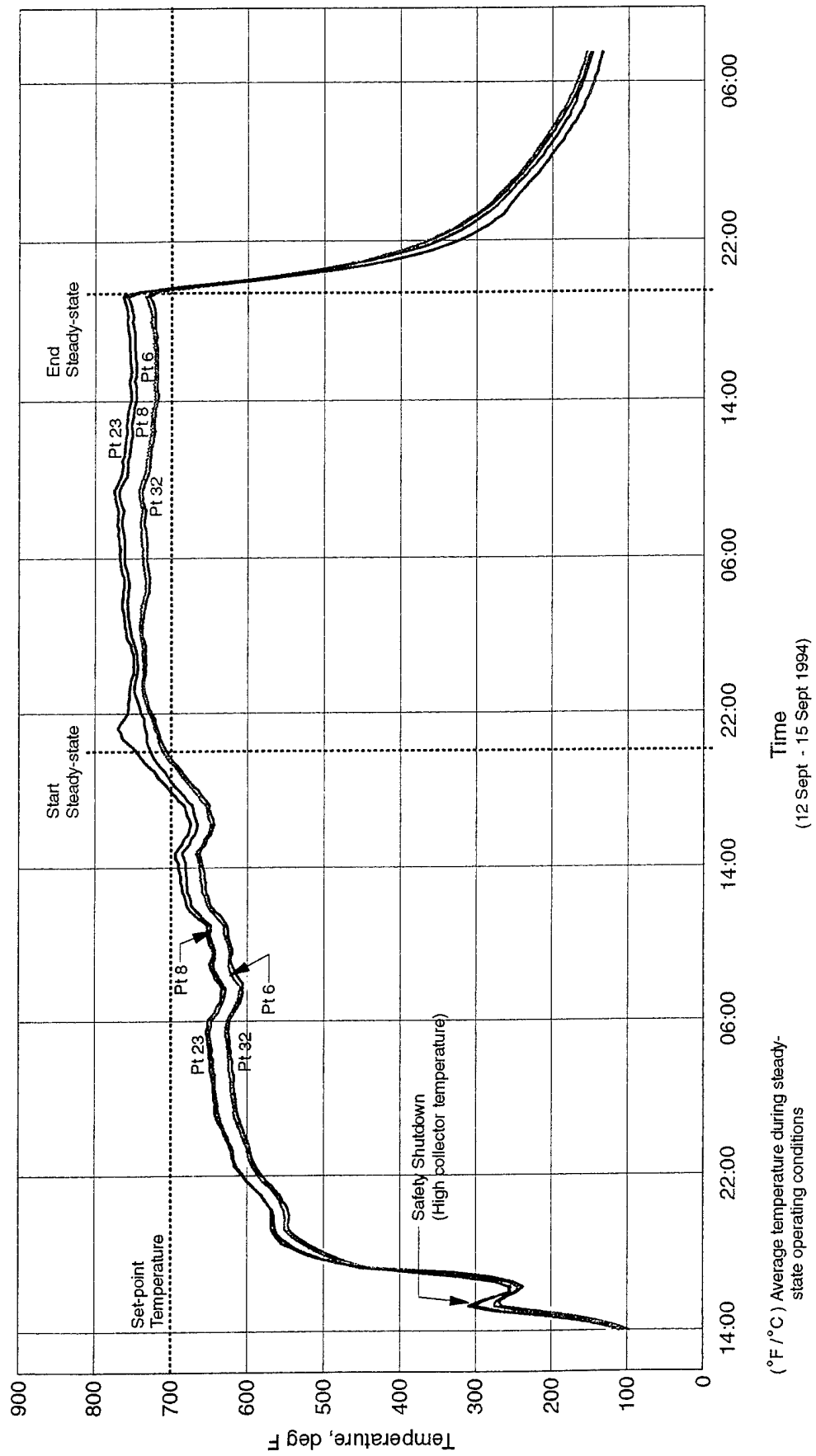
Special Abbreviations: NA=Not Applicable; ND=Not Detectable; NR=No Record

MDL for Analysis: 0.4 µg/smear RDX
0.25 µg/smear TNT

Surface Area: 161 sq cm

HGD Test 21

MK 54 Depth Bomb - HBX - (24 Sawed Ends)



(°F / °C) Average temperature during steady-state operating conditions

— Pt 32 (adjacent to process probe) (727 °F / 386 °C)
 — Pt 8 (intermediate tp) (750 °F / 399 °C)
 — Pt 23 (hottest) (759 °F / 404 °C)
 — Pt 6 (coldest) (731 °F / 388 °C)

Figure F-42 Test 21 - Average Temperature Profile - 15 minute intervals

HGD Test 21

MK 54 Depth Bomb - HBX - (24 Sawed Ends)

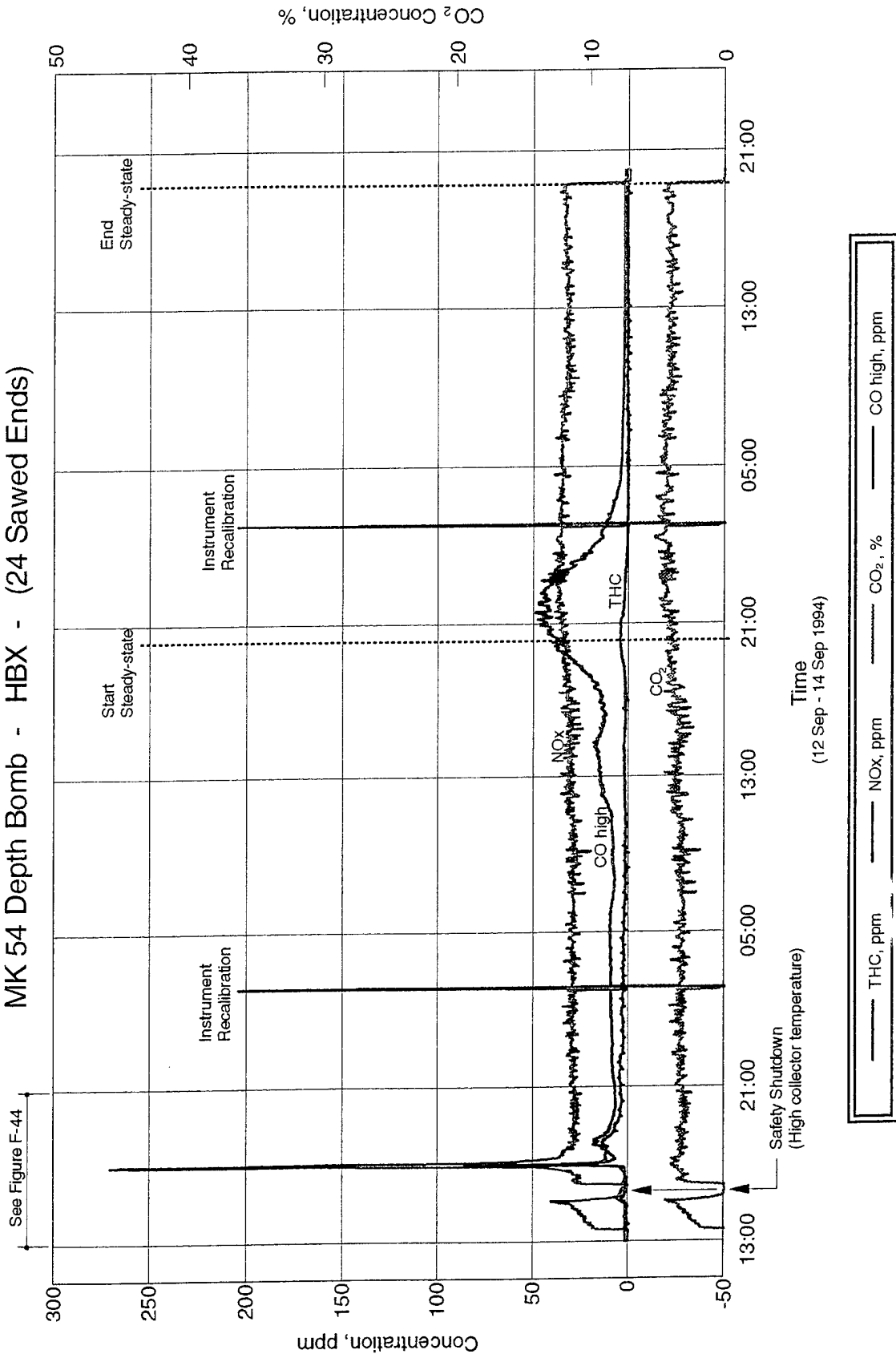


Figure F-43 Test 21 - CEM Profile - 1 minute Intervals

HGD Test 21
 MK 54 Depth Bomb - HBX - (24 Sawed Ends)

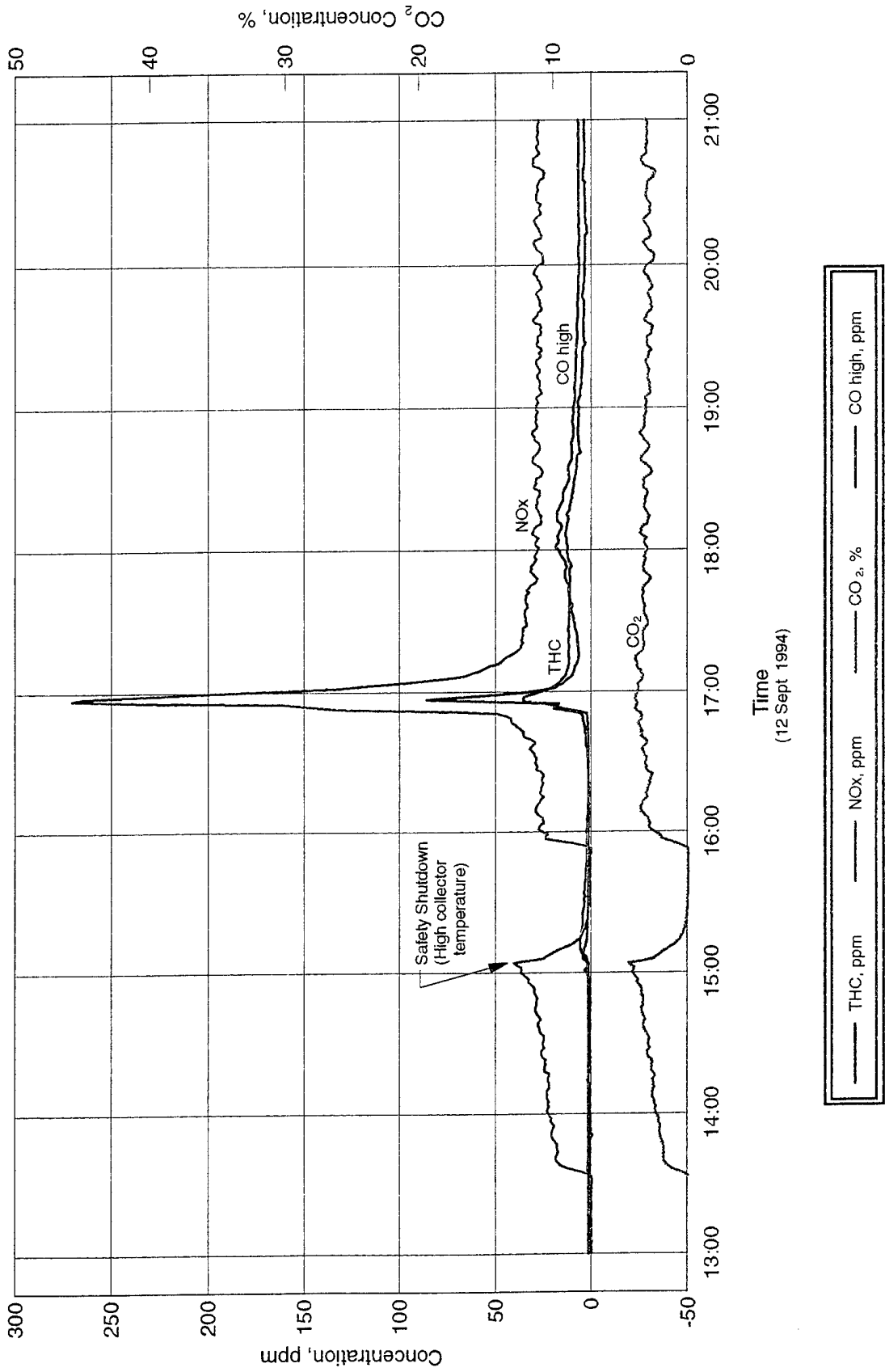


Figure F-44 Test 21 - CEM Profile - 1 minute Intervals

TEST 22

Process Conditions

This test was conducted on 192 106mm projectiles in a railcar configuration as shown in Figure D-39. The test was performed on 168 inert and 24 melted out projectiles which contained residues of Comp A explosive. The test conditions were 6 hrs at 550°F (288°C). The oxidizer was started at 0401 hrs on 16 September with the system in process at 0446 hrs. Steady state was reached at 0805 hrs. System went into a control system automatically initiated cooldown (error in initializing run time) at 1306 hrs with the control thermocouple cooling to 550°F (288°C) at 1325 hrs. Decision was made not to restart test; test was concluded after 5 hrs 20 mins treatment time.

Analytical Considerations

- Samples were taken from the chamber and spiked projectiles the next day. Projectile sample extraction with a blend of acetonitrile and hexane was tedious. A procedure was used where the solvents were added to the projectile, plugged with a rubber stopper, and rolled for 15 minutes. Sample was then pipetted directly from the projectile. Care was taken to only extract the acetonitrile layer. There was much variation in sample appearance--some were clear, some cloudy, some with suspended dark solids.

CEM

- Spikes occurred in NO_x, CO, and THC when chamber reached approximately 400°F (204°C) during startup.

Table F-50

PROJECTILE EXTRACT SAMPLES

	Projectile Type:	106 mm	Date:	16 Sep 94
Test # 22	Explosive Type:	Comp A-3	Heatup Time:	3.3 Hrs
	Explosive Source:	Demil	Time at Setpoint:	5.0 Hrs
	Temperature Setpoint:	550°F 288°C	Cooldown Time:	8.4 Hrs

Round #	Operating Temperature		Operating Temperature		Explosive Concentration		Sampling Dilution ml	Explosive Amount µg	Explosive Amount / Surface Area mg / cm ²	DRE* %
	°F	s dev	°C	s dev	µg / ml RDX	µg / ml TNT				
1	611	9.22	322	5.12	0.017	<MDL	200	3.400	5.3797E-06	99.999
2	636	9.12	336	5.07	0.0155	<MDL	200	3.100	4.9051E-06	99.999
3	619	10.91	326	6.06	0.0365	<MDL	200	7.300	1.1551E-05	99.999
4	600	9.99	315	5.55	0.0245	<MDL	200	4.900	7.7532E-06	99.999
5	611	10.93	322	6.07	<MDL	<MDL	200	ND	ND	99.999
6	601	10.00	316	5.55	0.0145	<MDL	200	2.900	4.5886E-06	99.999
7	620	10.10	327	5.61	<MDL	<MDL	200	ND	ND	99.999
8	635	12.62	335	7.01	0.04	<MDL	200	8.000	1.2658E-05	99.999
9	613	10.86	323	6.03	<MDL	<MDL	200	ND	ND	99.999
10	608	11.24	320	6.24	<MDL	<MDL	200	ND	ND	99.999
11	611	11.36	322	6.31	<MDL	<MDL	200	ND	ND	99.999
12	600	10.27	315	5.71	<MDL	<MDL	200	ND	ND	99.999
13	618	10.54	326	5.86	0.02	<MDL	200	4.000	6.3291E-06	99.999
14	618	10.16	326	5.64	<MDL	<MDL	200	ND	ND	99.999
15	613	11.56	323	6.42	0.0175	<MDL	200	3.500	5.5380E-06	99.999
16	604	11.66	318	6.48	<MDL	<MDL	200	ND	ND	99.999
17	601	12.38	316	6.88	<MDL	<MDL	200	ND	ND	99.999
18	607	10.02	319	5.57	<MDL	<MDL	200	ND	ND	99.999
19	650	12.47	343	6.93	<MDL	<MDL	200	ND	ND	99.999
20	614	10.67	323	5.93	<MDL	<MDL	200	ND	ND	99.999
21	635	11.34	335	6.30	<MDL	<MDL	200	ND	ND	99.999
22	610	11.41	321	6.34	<MDL	<MDL	200	ND	ND	99.999
23	636	11.95	336	6.64	<MDL	<MDL	200	ND	ND	99.999
24	623	12.06	328	6.70	<MDL	<MDL	200	ND	ND	99.999

Special Abbreviations: NA=Not Applicable; ND=Not Detectable; NR=No Record; s dev=standard deviation.

*The DRE results for samples denoted by <MDL are calculated based on a value of one-half the MDL.

Extracted Round No: None
 Estimated Round Amount: 7 grams
 MDL for Analysis: 0.01 µg/ml RDX
 0.006 µg/ml TNT
 Surface Area: 632 sq cm

CHAMBER WIPES

Test # 22	Chamber Load:	106 mm	Date:	16 Sep 94
	Explosive Type:	Comp A-3	Heatup Time:	3.3 Hrs
	Explosive Source:	Demil	Time at Setpoint:	5.0 Hrs
	Temperature Setpoint:	550°F 288°C	Cooldown Time:	8.4 Hrs

Wipe #	Location in System	Operating Temperature	Operating Temperature	Explosive Concentration / Smear		Explosive Amount	Explosive Amount / Surface Area
		°F	°C	µg / smear RDX	µg / smear TNT	µg	mg / cm ²
1	Blank	NA	NA	<MDL	<MDL	ND	ND
2	Floor	497	258	<MDL	<MDL	ND	ND
3	Wall	NR	NR	<MDL	<MDL	ND	ND
4	Duct	610	321	<MDL	<MDL	ND	ND
5	Elbow	610	321	<MDL	<MDL	ND	ND
6	Fanblade	610	321	<MDL	<MDL	ND	ND
7	Coldspot	375	191	<MDL	<MDL	ND	ND
8	Rail	576	302	<MDL	<MDL	ND	ND

Special Abbreviations: NA=Not Applicable; ND=Not Detectable; NR=No Record

MDL for Analysis: 1 µg/smear RDX
0.6 µg/smear TNT

Surface Area: 161 sq cm

HGD Test 22

106mm Projectiles - Comp A-3 - (192 Rounds)

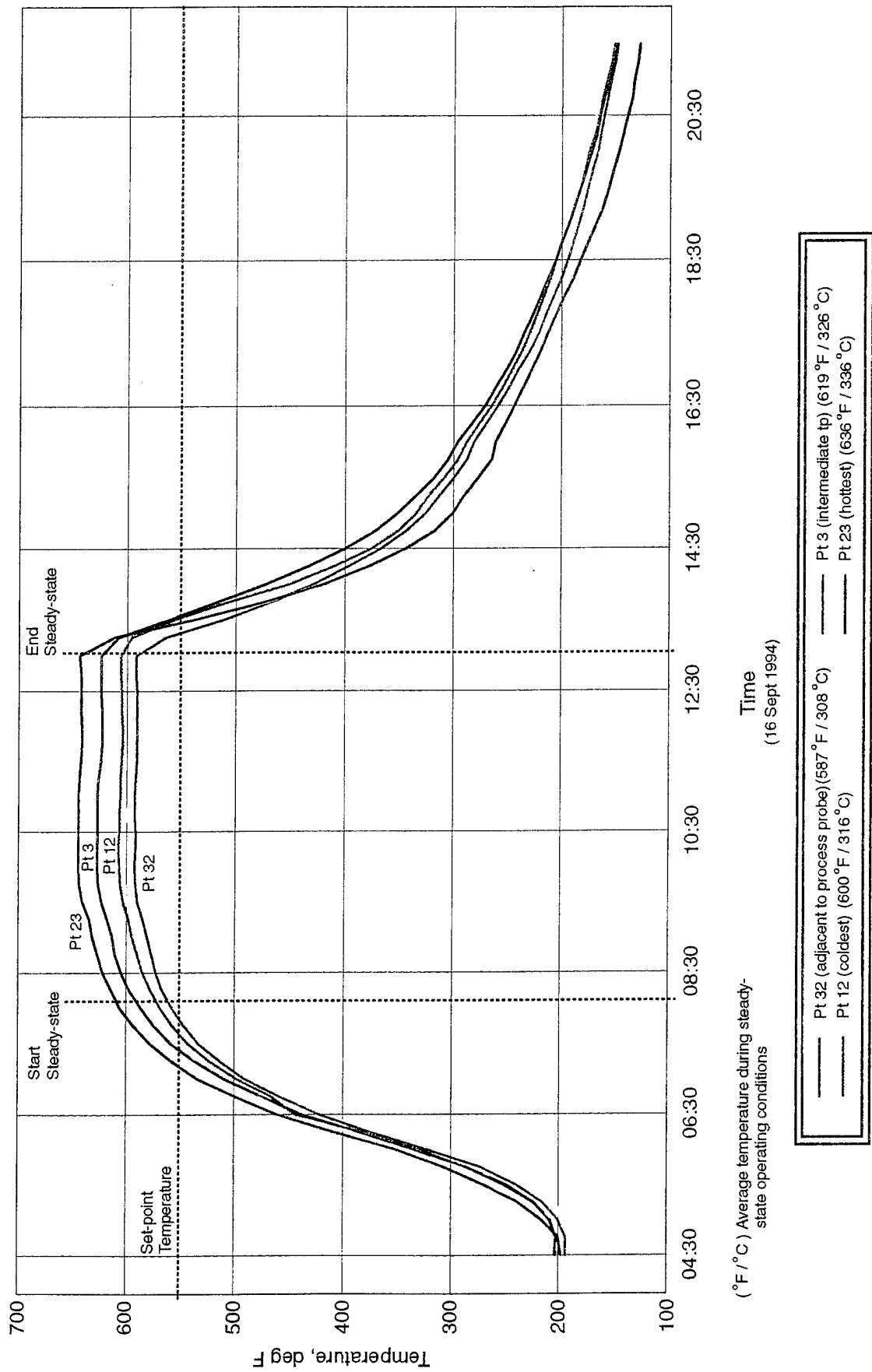


Figure F-45 Test 22 - Average Temperature Profile - 15 minute Intervals

HGD Test 22

106mm Projectiles - Comp A-3 - (192 Rounds)

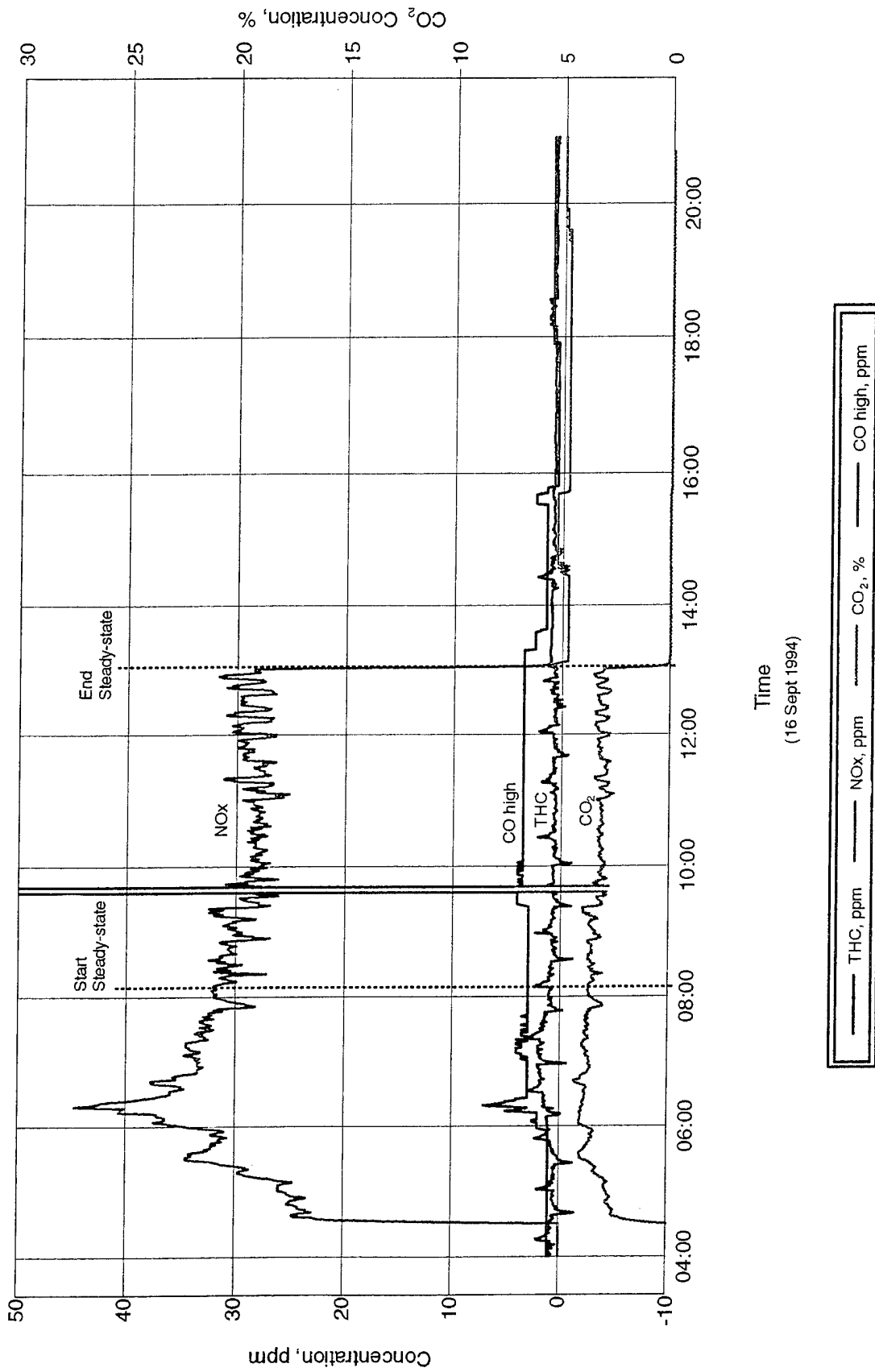


Figure F-46 Test 22 - CEM Profile - 1 minute Intervals

TEST 23

Process Conditions

This test was conducted on 96 175mm projectiles in a railcar configuration as shown in Figure D-40. The test was performed on 72 inert and 24 melted out projectiles which contained residues of Comp B explosive. The test conditions were 6 hrs at 550°F (288°C). The oxidizer was started on the afternoon of 17 September with hot gas flow to the chamber at 0405 hrs on 18 September. The system reached steady state operation at 1323 hrs and the test was completed at 1924 hrs with a control system automatically initiated cooldown.

Analytical Considerations

- Samples were taken from the chamber and projectiles using acetonitrile.

Comments

- Flashing of residues in the projectiles were noted by scorched thermocouple probes.
- System safety shutdown at 0712 hrs due to high collector temperature (erratic collector operation); hot gas flow back to the chamber at 0805 hrs. Power interruption at 0730 hrs on 19 September knocked system out of automatic cooldown mode; reset at 0745 hrs.

CEM

- Spikes at about 0700 (approximately 400°F, 204°C). There are several spikes in the THC, NO_x, and CO.

Table F-52

PROJECTILE EXTRACT SAMPLES

Test # 23	Projectile Type:	175 mm	Date:	18 Sep 94
	Explosive Type:	Comp B	Heatup Time:	9.3 Hrs
	Explosive Source:	Demil	Time at Setpoint:	6.0 Hrs
	Temperature Setpoint:	550°F 288°C	Cooldown Time:	12.3 Hrs

Round #	Operating Temperature		Operating Temperature		Explosive Concentration		Sampling Dilution	Explosive Amount	Explosive Amount / Surface Area	DRE*
	°F	s dev	°C	s dev	µg / ml RDX	µg / ml TNT	ml	µg	mg / cm ²	%
1	620	4.66	327	2.59	<MDL	<MDL	500	ND	ND	99.999
2	604	6.98	318	3.88	<MDL	<MDL	500	ND	ND	99.999
3	595	5.99	313	3.33	<MDL	<MDL	500	ND	ND	99.999
4	581	4.48	305	2.49	<MDL	<MDL	500	ND	ND	99.999
5	587	8.03	308	4.46	<MDL	<MDL	500	ND	ND	99.999
6	572	4.43	300	2.46	<MDL	<MDL	500	ND	ND	99.999
7	614	4.77	323	2.65	<MDL	<MDL	500	ND	ND	99.999
8	604	5.90	318	3.28	<MDL	<MDL	500	ND	ND	99.999
9	597	6.45	314	3.58	<MDL	<MDL	500	ND	ND	99.999
10	590	7.30	310	4.06	<MDL	<MDL	500	ND	ND	99.999
11	586	8.27	308	4.59	<MDL	<MDL	500	ND	ND	99.999
12	584	6.07	307	3.37	0.0105	<MDL	500	5.250	2.7301E-06	99.999
13	612	4.57	322	2.54	0.01	<MDL	500	5.000	2.6001E-06	99.999
14	623	6.02	328	3.34	0.01	<MDL	500	5.000	2.6001E-06	99.999
15	523	7.14	273	3.97	0.01	<MDL	500	5.000	2.6001E-06	99.999
16	589	7.36	309	4.09	<MDL	<MDL	500	ND	ND	99.999
17	581	7.99	305	4.44	<MDL	<MDL	500	ND	ND	99.999
18	580	5.34	304	2.96	0.0105	<MDL	500	5.250	2.7301E-06	99.999
19	614	4.85	323	2.70	<MDL	<MDL	500	ND	ND	99.999
20	635	6.34	335	3.52	<MDL	<MDL	500	ND	ND	99.999
21	610	6.74	321	3.74	<MDL	<MDL	500	ND	ND	99.999
22	643	4.25	339	2.36	<MDL	<MDL	500	ND	ND	99.999
23	650	4.38	344	2.43	<MDL	<MDL	500	ND	ND	99.999
24	637	4.11	336	2.28	<MDL	<MDL	500	ND	ND	99.999

Special Abbreviations: NA=Not Applicable; ND=Not Detectable; NR=No Record; s dev=standard deviation.

*The DRE results for samples denoted by <MDL are calculated based on a value of one-half the MDL.

Extracted Round No: None
 Estimated Round Amount: 20 grams

MDL for Analysis: 0.01 µg/ml RDX
 0.006 µg/ml TNT

Surface Area: 1923 sq cm

CHAMBER WIPES

Test # <u>23</u>	Chamber Load:	<u>175 mm</u>	Date:	<u>18 Sep 94</u>
	Explosive Type:	<u>Comp B</u>	Heatup Time:	<u>9.3 Hrs</u>
	Explosive Source:	<u>Spiked</u>	Time at Setpoint:	<u>6.0 Hrs</u>
	Temperature Setpoint:	<u>550°F</u> <u>288°C</u>	Cooldown Time:	<u>12.3 Hrs</u>

Wipe #	Location in System	Operating Temperature	Operating Temperature	Explosive Concentration / Smear		Explosive Amount	Explosive Amount / Surface Area
		°F	°C	µg / smear RDX	µg / smear TNT	µg	mg / cm ²
1	Blank	NA	NA	<MDL	<MDL	ND	ND
2	Floor	483	251	<MDL	<MDL	ND	ND
3	Wall	NR	NR	<MDL	1.0562	1.0562	6.5602E-06
4	Duct	604	318	<MDL	<MDL	ND	ND
5	Elbow	604	318	1.2012	10.562	11.7632	7.3063E-05
6	Fanblade	604	318	<MDL	<MDL	ND	ND
7	Coldspot	375	191	<MDL	<MDL	ND	ND
8	Rail	567	297	<MDL	0.6036	0.6036	3.7491E-06

Special Abbreviations: NA=Not Applicable; ND=Not Detectable; NR=No Record

MDL for Analysis: 1 µg/smear RDX
 0.6 µg/smear TNT

Surface Area: 161 sq cm

HGD Test 23

175mm Projectiles - Comp B - (96 Rounds)

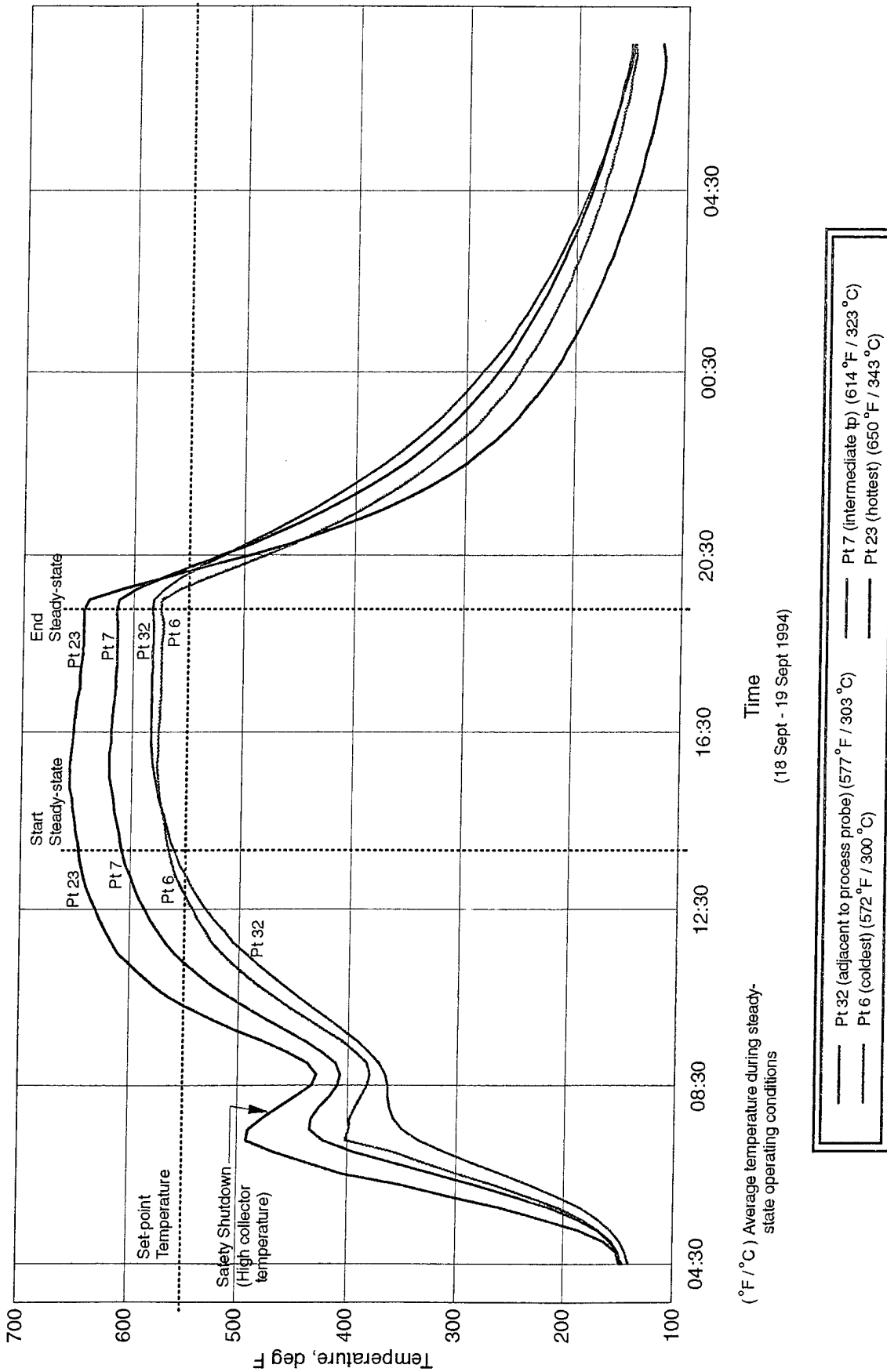


Figure F-47 Test 23 - Average Temperature Profile - 15 minute Intervals

HGD Test 23

175mm Projectiles - Comp B - (96 Rounds)

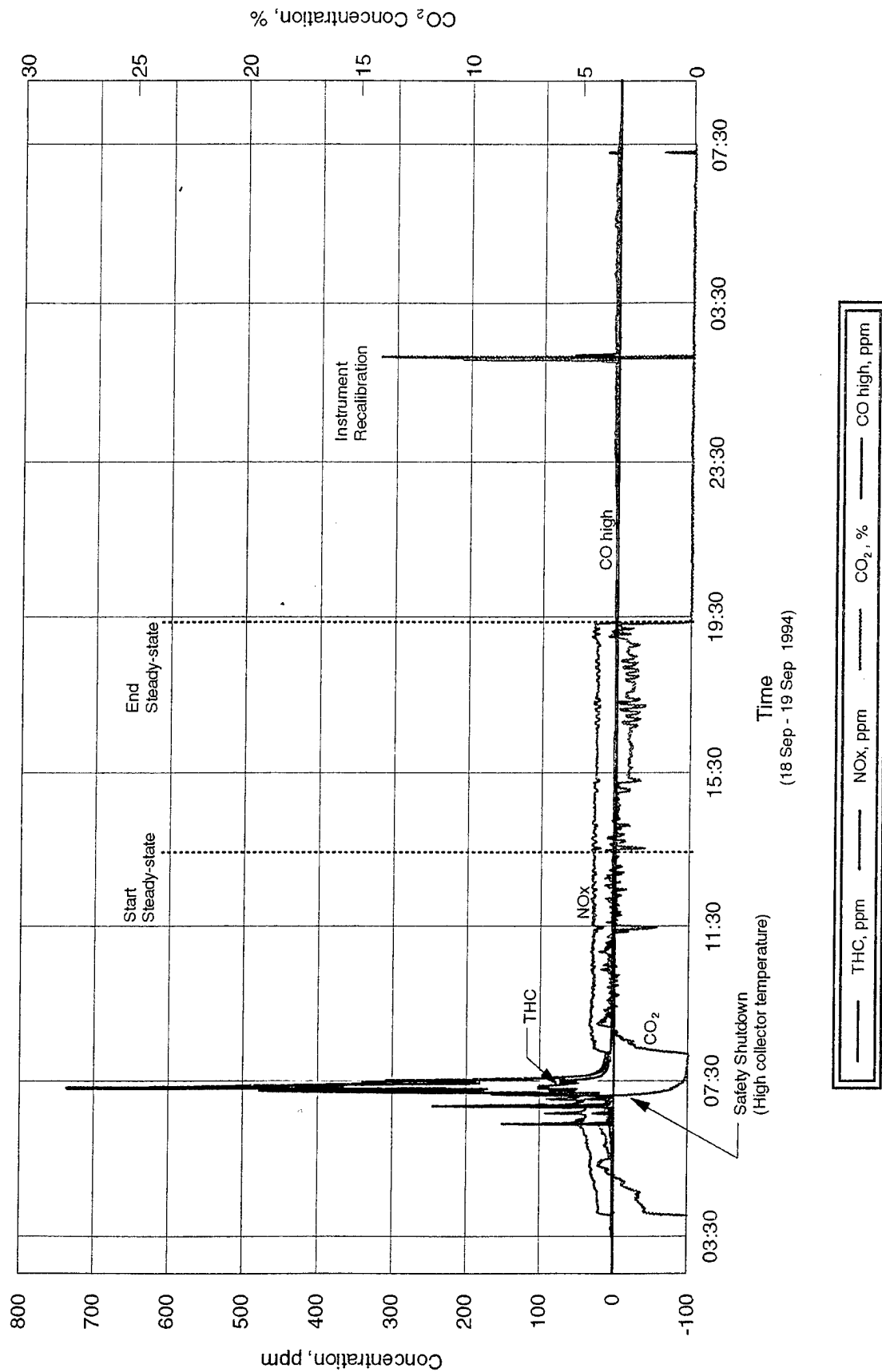


Figure F-48 Test 23 - CEM Profile - 1 minute intervals

TEST 24

Process Conditions

This test was conducted under the same test conditions as Test 15, [6 hrs at 600°F (316°C), 12 3-inch and 12 5-inch projectiles spiked with Yellow D]. The railcar configuration is shown in Figure D-41. The oxidizer was started at 0339 hrs on 20 September with the system in process at 0439 hrs. Steady state was reached at 1454 hrs. Test was completed at 0246 hrs on 21 September with a control system automatically initiated cooldown.

Analytical Considerations

- Chamber wipe samples were taken on 21 September and the spiked projectiles sampled on 22 September using HPLC water.

Comments

- Power interruption at 1607 hrs; oxidizer was restarted at 1653 hrs. Back to steady state at 2154 hrs.

Table F-54

PROJECTILE EXTRACT SAMPLES

Projectile Type		3-inch 5-inch	Date:	20 Sep 94
Test #	Explosive Type:		Heatup Time:	10.2 Hrs
24	Yellow D		Time at Setpoint:	11.9 Hrs
Explosive Source:		Spiked	Cooldown Time:	10.0 Hrs
Temperature Setpoint:		600°F 316°C		

Round #	Size	Operating Temperature		Operating Temperature		Explosive Concentration		Sampling	Explosive Amount	Explosive Amount / Surface Area	DRE*
		°F	s dev	°C	s dev	µg/ml Amm. Picrate	ml	µg	mg / cm ²	%	
1	5 in.	616	35.99	325	20.00	<MDL	100	ND	ND	ND	99.999
2	5 in.	621	39.19	327	21.77	<MDL	100	ND	ND	ND	99.999
3	5 in.	599	36.51	315	20.28	0.0066	100	0.660	1.0443E-06	ND	99.999
4	3 in.	589	43.55	309	24.20	<MDL	50	ND	ND	ND	99.999
5	3 in.	608	43.56	320	24.20	<MDL	50	ND	ND	ND	99.999
6	3 in.	605	42.61	318	23.67	<MDL	50	ND	ND	ND	99.999
7	3 in.	622	48.04	328	26.69	<MDL	50	ND	ND	ND	99.999
8	3 in.	612	43.37	322	24.09	<MDL	50	ND	ND	ND	99.999
9	3 in.	609	42.37	320	23.54	<MDL	50	ND	ND	ND	99.999
10	5 in.	599	34.52	315	19.18	<MDL	100	ND	ND	ND	99.999
11	5 in.	603	33.98	317	18.88	<MDL	100	ND	ND	ND	99.999
12	5 in.	593	32.52	312	18.07	<MDL	100	ND	ND	ND	99.999
13	5 in.	615	36.79	324	20.44	<MDL	100	ND	ND	ND	99.999
14	5 in.	603	32.25	317	17.92	<MDL	100	ND	ND	ND	99.999
15	5 in.	606	34.39	319	19.11	<MDL	100	ND	ND	ND	99.999
16	3 in.	605	40.55	318	22.53	<MDL	50	ND	ND	ND	99.999
17	3 in.	607	42.45	320	23.58	<MDL	50	ND	ND	ND	99.999
18	3 in.	597	40.78	314	22.65	<MDL	50	ND	ND	ND	99.999
19	3 in.	608	42.77	320	23.76	<MDL	50	ND	ND	ND	99.999
20	3 in.	616	45.56	325	25.31	<MDL	50	ND	ND	ND	99.999
21	3 in.	618	44.41	326	24.67	7270.433	250	1817608	8.9981E+00	NA	NA
22	5 in.	603	32.69	317	18.16	0.0045	100	0.450	7.1203E-07	ND	99.999
23	5 in.	614	33.81	323	18.78	<MDL	100	ND	ND	ND	99.999
24	5 in.	650	44.35	343	24.64	3286.699	2000	6573398	1.0401E+01	NA	NA

Special Abbreviations: NA=Not Applicable; ND=Not Detectable; NR=No Record; s dev=standard deviation.

*The DRE results for samples denoted by <MDL are calculated based on a value of one-half the MDL.

Extracted Round No: 21, 24
 Extracted Round Amount: 1.82 grams (3-inch)
 6.57 grams (5-inch)

MDL for Analysis: 0.1 µg/ml Ammonium Picrate

Surface Area: 202 sq cm (3-inch)
 632 sq cm (5-inch)

CHAMBER WIPES

Test # 24	Chamber Load:	3-inch 5-inch	Date:	20 Sep 94
	Explosive Type:	Yellow D	Heatup Time:	10.2 Hrs
	Explosive Source:	Spiked	Time at Setpoint:	11.9 Hrs
	Temperature Setpoint:	600°F 316°C	Cooldown Time:	10.0 Hrs

Wipe #	Location in System	Operating Temperature	Operating Temperature	Explosive Concentration / Smear	Explosive Amount	Explosive Amount / Surface Area
		°F	°C	µg / smear Amm. Picrate	µg	mg / cm ²
1	Blank	NA	NA	<MDL	ND	ND
2	Floor	492	256	<MDL	ND	ND
3	Wall	NR	NR	<MDL	ND	ND
4	Duct	599	315	<MDL	ND	ND
5	Elbow	599	315	<MDL	ND	ND
6	Fanblade	599	315	<MDL	ND	ND
7	Coldspot	418	214	<MDL	ND	ND
8	Rail	577	303	5.4	5.4	3.3540E-05

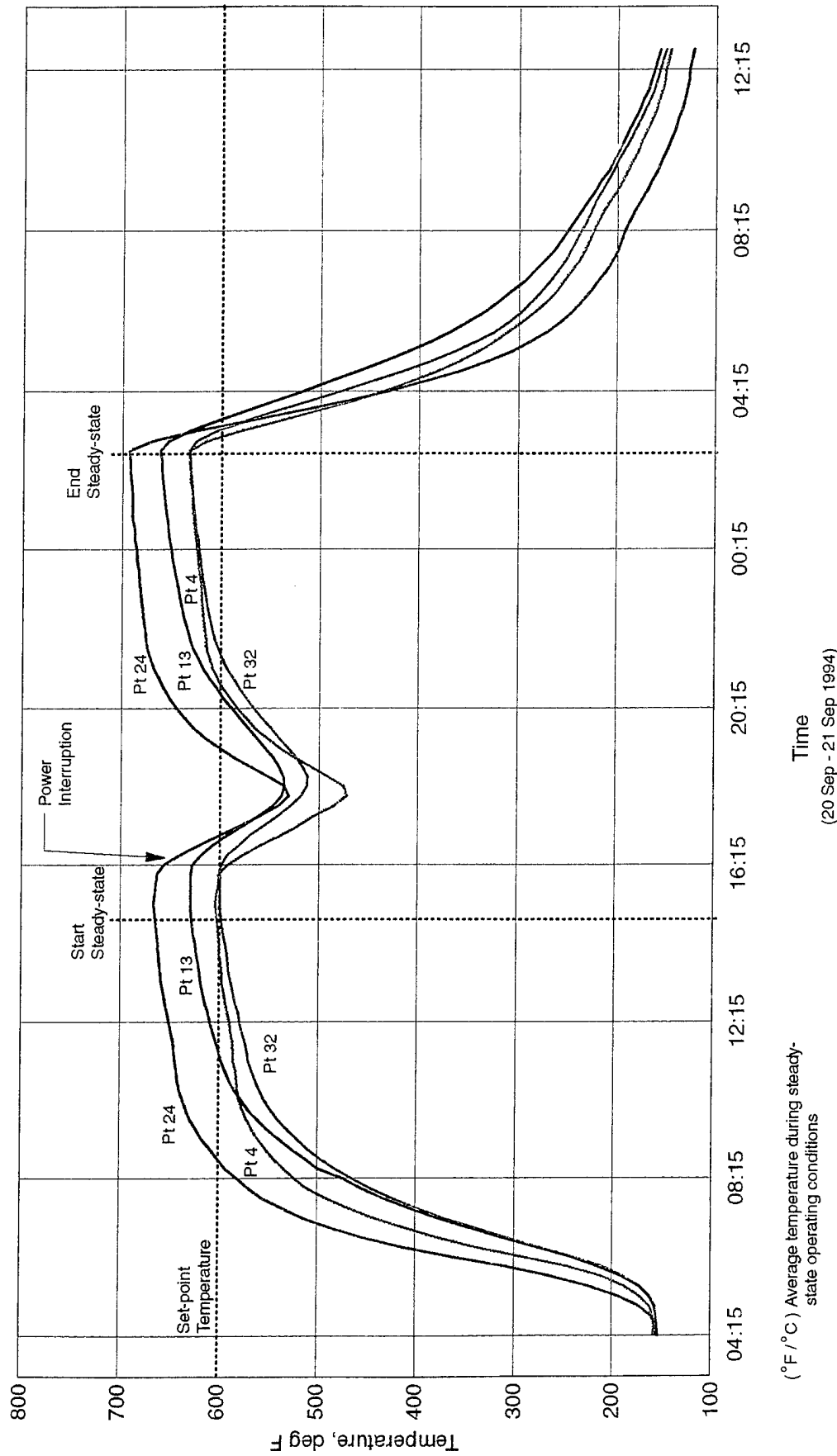
Special Abbreviations: NA=Not Applicable; ND=Not Detectable; NR=No Record

MDL for Analysis: 0.4 µg/smear Ammonium Picrate

Surface Area: 161 sq cm

HGD Test 24

3-inch / 5-inch Projectiles - Yellow D - (192 Rounds)



Time
(20 Sep - 21 Sep 1994)

Figure F-49 Test 24 - Average Temperature Profile - 15 minute Intervals

HGD Test 24

3-inch / 5-inch Projectiles - Yellow D - (192 Rounds)

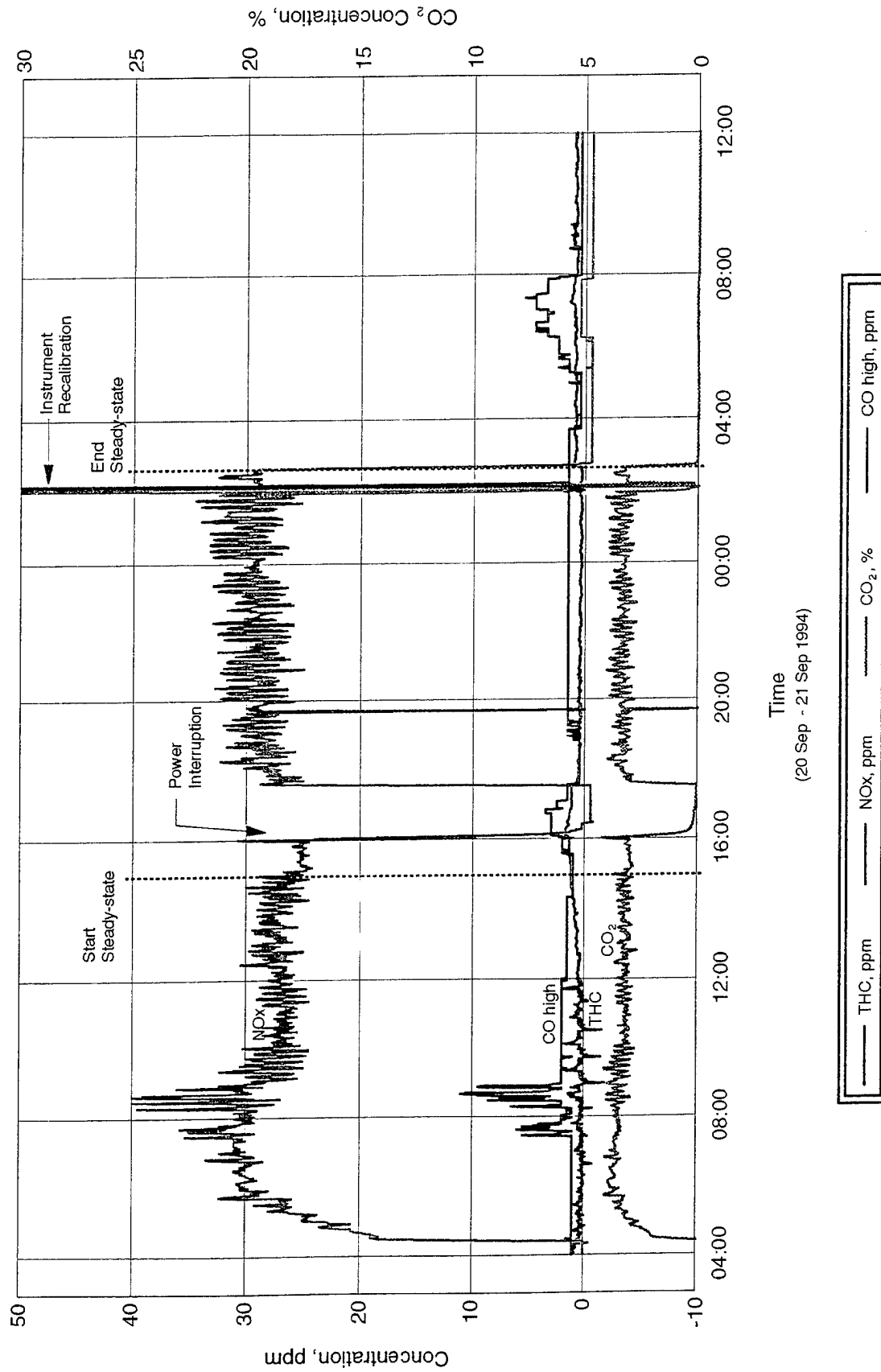


Figure F-50 Test 24 - CEM Profile - 1 minute Intervals

TEST 25

Process Conditions

This test was conducted under the same test conditions as Test 19 and 21, (24 hrs at 700°F (371°C), 24 MK 54 Depth Bombs containing HBX residue). The railcar configuration is shown in Figure D-42. The oxidizer was started at 1445 hrs on 21 September with heat to the chamber at 1610 hrs. Steady state was reached at 2354 hrs. Test was completed at 2355 hrs on 22 September with a control system automatically initiated cooldown.

Analytical Considerations

- Chamber wipe and depth bomb samples were taken on 24 September using acetonitrile.

CEM

- NOTE: The CO concentration increases significantly over several hours, most likely due to the burnoff of the hot melt.
- Spikes in the CO, NO_x, and THC are noted when chamber has warmed up to approximately 400°F (204°C).

Table F-56

MINE/DEPTH BOMB WIPE SAMPLES

Mine/Depth Bomb Type:		MK54 Depth Bomb	Date:	21 Sep 94
Test #	Explosive Type:	HBX	Heatup Time:	7.7 Hrs
25	Explosive Source:	Demil	Time at Setpoint:	24.0 Hrs
Temperature Setpoint:		700°F 371°C	Cooldown Time:	13.6 Hrs

Wipe #	Operating Temperature		Operating Temperature		Explosive Concentration		Explosive Amount	Explosive Amount / Surface Area	DRE
	°F	s dev	°C	s dev	µg/smear RDX	µg/smear TNT	µg	mg / cm ²	%
1	757	6.80	403	3.78	1.7518	<MDL	1.752	7.2091E-06	NC
2	752	6.15	400	3.42	<MDL	<MDL	ND	ND	NC
3	752	7.31	400	4.06	<MDL	<MDL	ND	ND	NC
4	731	7.09	388	3.94	1.4014	<MDL	1.401	5.7671E-06	NC
5	737	6.22	392	3.45	<MDL	<MDL	ND	ND	NC
6	729	10.98	387	6.10	1.9019	<MDL	1.902	7.8267E-06	NC
7	756	7.49	402	4.16	<MDL	<MDL	ND	ND	NC
8	750	6.40	399	3.55	<MDL	<MDL	ND	ND	NC
9	745	6.45	396	3.58	1.3514	<MDL	1.351	5.5613E-06	NC
10	738	5.98	392	3.32	1.8519	<MDL	1.852	7.6210E-06	NC
11	729	6.65	387	3.70	1.8018	<MDL	1.802	7.4148E-06	NC
12	732	8.19	389	4.55	1.5015	<MDL	1.502	6.1790E-06	NC
13	752	7.07	400	3.93	<MDL	<MDL	ND	ND	NC
14	752	6.48	400	3.60	<MDL	<MDL	ND	ND	NC
15	745	8.26	396	4.59	<MDL	<MDL	ND	ND	NC
16	737	7.28	392	4.05	<MDL	<MDL	ND	ND	NC
17	740	6.65	393	3.69	<MDL	<MDL	ND	ND	NC
18	729	7.08	387	3.93	2.6026	<MDL	2.603	1.0710E-05	NC
19	751	6.88	399	3.82	<MDL	<MDL	ND	ND	NC
20	755	8.12	401	4.51	1.8519	<MDL	1.852	7.6210E-06	NC
21	757	11.93	403	6.63	1.1512	<MDL	1.151	4.7374E-06	NC
22	752	7.62	400	4.23	<MDL	<MDL	ND	ND	NC
23	756	9.41	402	5.23	1.001	<MDL	1.001	4.1193E-06	NC
24	746	7.63	396	4.24	<MDL	<MDL	ND	ND	NC

Special Abbreviations: NA=Not Applicable; NC=Not Calculable; ND=Not Detectable; NR=No Record; s dev=standard deviation.

Estimated Residue Amount: No estimate is available for hot melt coated items.

MDL for Analysis: 0.4 µg/smear RDX
0.25 µg/smear TNT

Surface Area: 243 sq cm

CHAMBER WIPES

Test # <u>25</u>	Chamber Load:	<u>MK54</u> <u>Depth Bomb</u>	Date:	<u>21 Sep 94</u>
	Explosive Type:	<u>HBX</u>	Heatup Time:	<u>7.7 Hrs</u>
	Explosive Source:	<u>Demil</u>	Time at Setpoint:	<u>24.0 Hrs</u>
	Temperature Setpoint:	<u>700°F</u> <u>371°C</u>	Cooldown Time:	<u>13.6 Hrs</u>

Wipe #	Location in System	Operating Temperature	Operating Temperature	Explosive Concentration / Smear		Explosive Amount	Explosive Amount / Surface Area
		°F	°C	µg / smear RDX	µg / smear TNT	µg	mg / cm²
1	Blank	NA	NA	<MDL	<MDL	ND	ND
2	Floor	652	344	1.3514	<MDL	1.3514	8.3938E-06
3	Wall	NR	NR	<MDL	<MDL	ND	ND
4	Duct	711	377	1.2012	<MDL	1.2012	7.4609E-06
5	Elbow	711	377	<MDL	<MDL	ND	ND
6	Fanblade	711	377	<MDL	<MDL	ND	ND
7	Coldspot	539	282	<MDL	<MDL	ND	ND
8	Rail	703	373	1.1011	<MDL	1.1011	6.8391E-06

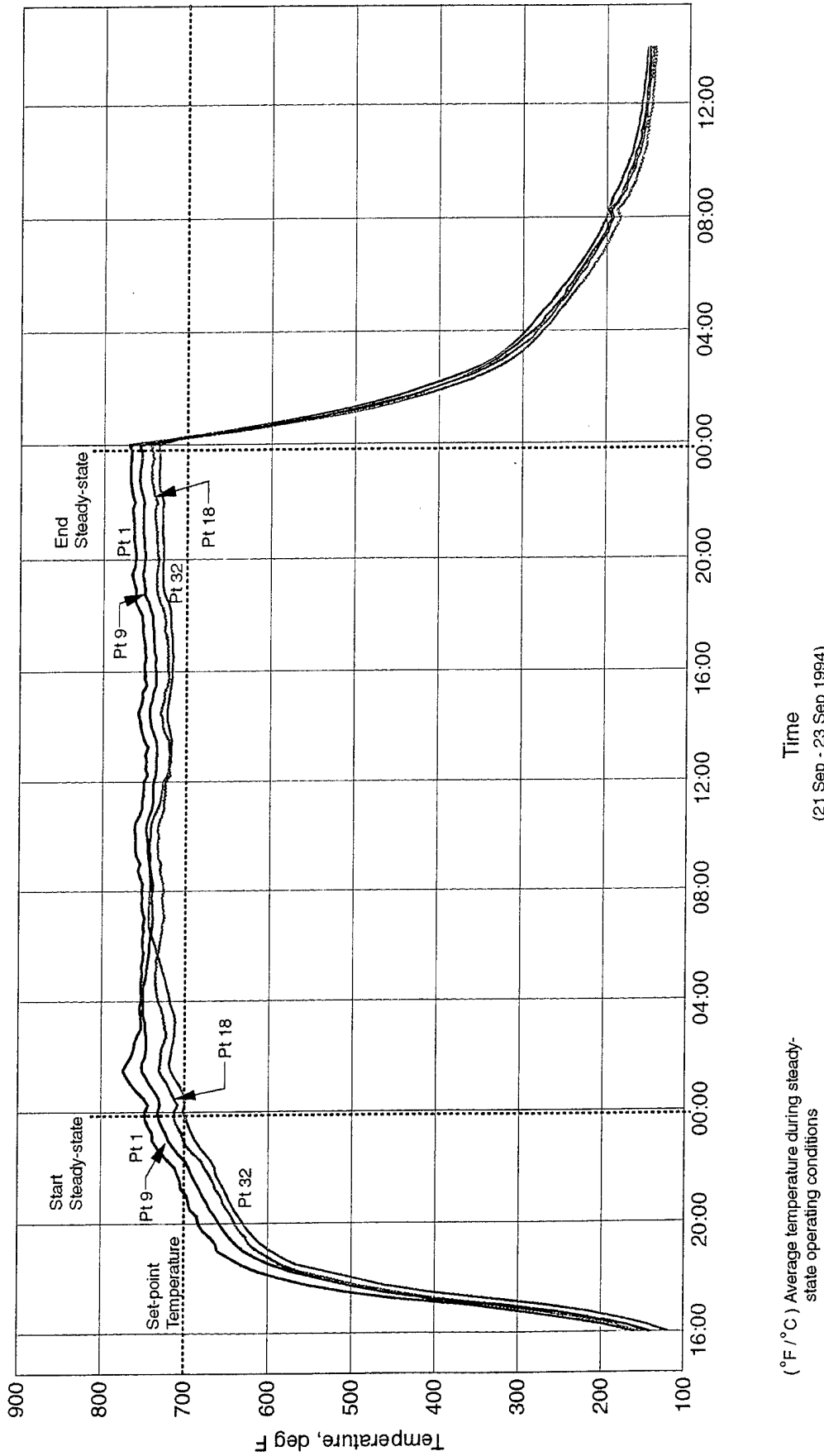
Special Abbreviations: NA=Not Applicable; ND=Not Detectable; NR=No Record

MDL for Analysis: 0.4 µg/smear RDX
0.25 µg/smear TNT

Surface Area: 161 sq cm

HGD Test 25

MK 54 Depth Bombs - HBX - (24 Sawed Ends)



(°F / °C) Average temperature during steady-state operating conditions

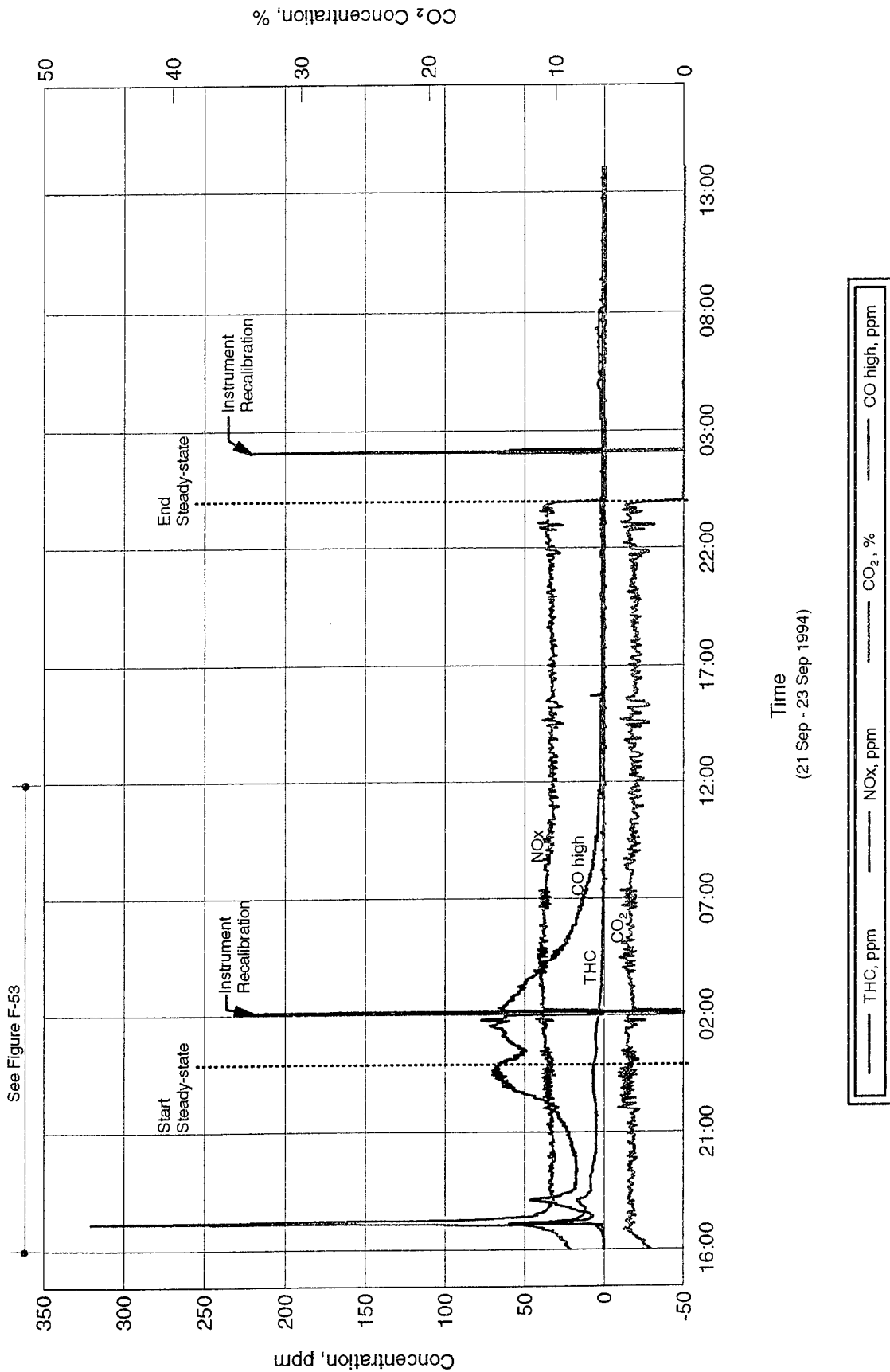
Time
(21 Sep - 23 Sep 1994)

- Pt 32 (adjacent to process probe) (726 °F / 386 °C)
- Pt 18 (coldest) (729 °F / 387 °C)
- Pt 1 (intermediate tp) (745 °F / 396 °C)
- Pt 1 (hottest) (757 °F / 403 °C)

Figure F-51 Test 25 - Average Temperature Profile - 15 minute Intervals

HGD Test 25 MK 54 Depth Bomb - HBX - (24 Sawed Ends)

See Figure F-53



Time
(21 Sep - 23 Sep 1994)



Figure F-52 Test 25 - CEM Profile - 1 minute intervals

HGD Test 25
 MK 54 Depth Bomb - HBX - (24 Sawed Ends)

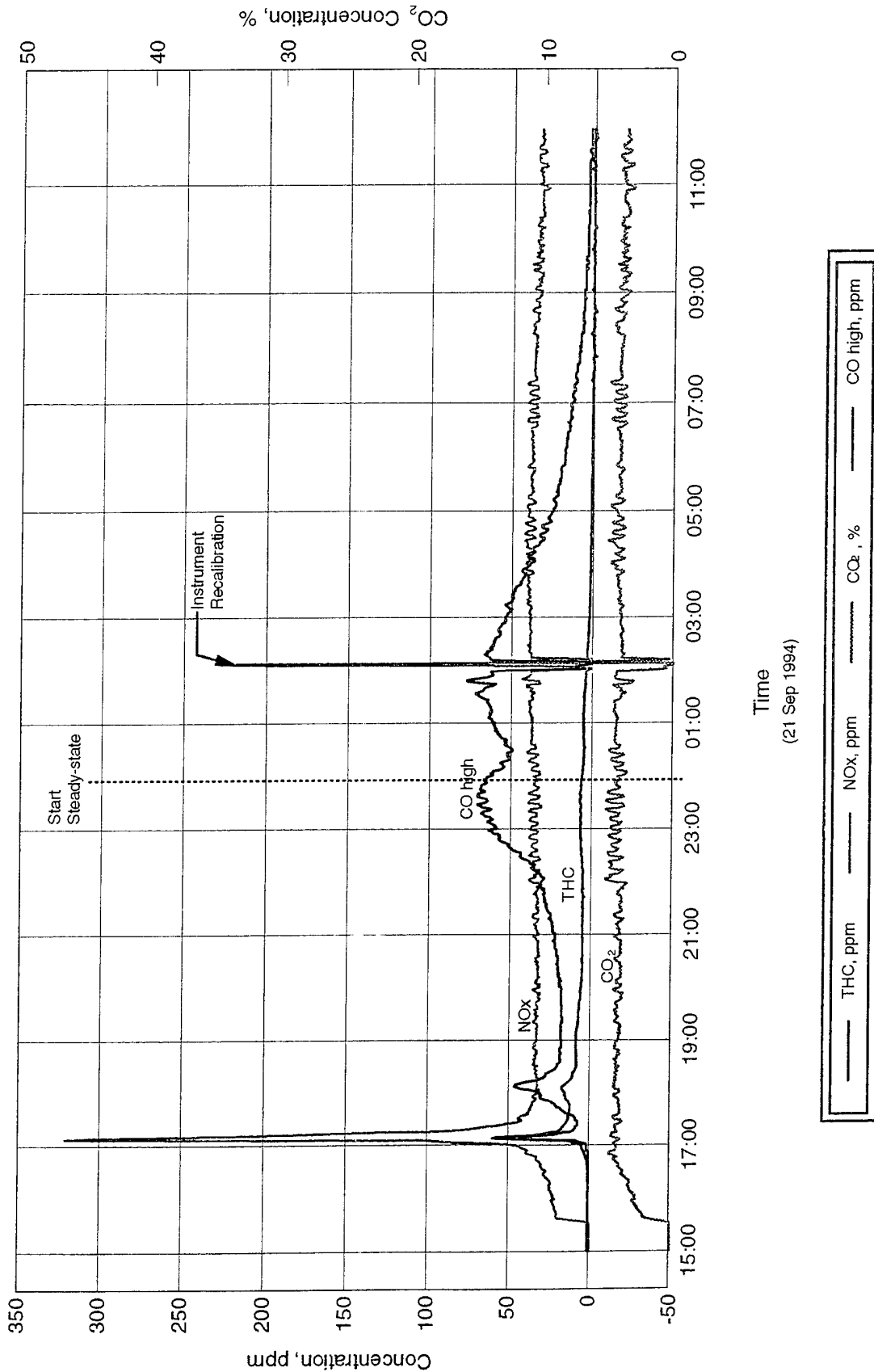


Figure F-53 Test 25 - CEM Profile - 1 minute Intervals

TEST 26A

Process Conditions

This test was conducted on MK 25 Ship Mines in a railcar configuration as shown in Figure D-43. The test conditions were the same as Test 11, [32 hrs at 700°F (371°C), 3 MK 25 Ship Mines spiked with TNT explosive]. The oxidizer was started at 1042 hrs on 25 September with hot gas flow to chamber at 1125 hrs.

Special Conditions

- The railcar contained 3 whole ship mines previously spiked by Weston with 5 lbs (2.3 kg) each of TNT over the hot-melt and two halves of an inert ship mine that was treated in Test 11. The spiked ship mines had 4 each, 3-inch (8 centimeters) diameter holes ground into the casing plus a flanged opening into the charge chamber.

Comments

- System safety shutdown at 1309 hrs; positive chamber pressure. Smoke was observed coming from the oxidizer stack which is normally clear. NO_x, CO, and total hydrocarbon CEM readings at maximum scale. Temperature readings of ship mines on left side near door ranged from 577 to 2379°F (303 to 1304°C). The oxidizer was restarted at 1316 hrs but smoke was seen in oxidizer stack and coming from chamber door track.
- System safety shutdown at 1323 hrs from loss of thermal oxidizer burner flame; accompanied by audible hiss as a mine flashed. Temperature readings of ship mines on right side near diffusers ranged from 840 to 1128°F (449 to 609°C). The oxidizer was restarted at 1328 hrs and the airflows were set up to ventilate the chamber with fresh air.
- Audible hisses occurred at 1332 and 1336 hrs with increased smoke emissions. Temperature readings of the ship mine on the right side near the door ranged from 882 to 1178°F (472 to 637°C).
- At 1400 hrs the maximum chamber temperature was 800°F (427°C) and declining. The CEM readings were onscale but had spent about 40 minutes above maximum scale. The flue gas collector was not operational.

- The next morning the chamber was examined. There was no visible damage to the chamber or its fixtures. The ship mine casings were not split or obviously distorted. Most surfaces were heavily coated with soot. There were pools of hot-melt that had run out of the holes in the ship mine casings onto the railcar bed. One had a splash pattern indicating molten hot-melt had spewed from the fill plug when the contents flashed. The collector was cleaned, lubricated, and returned to service.

HGD Test 26A

MK 25 Ship Mines - TNT - (5 Items)

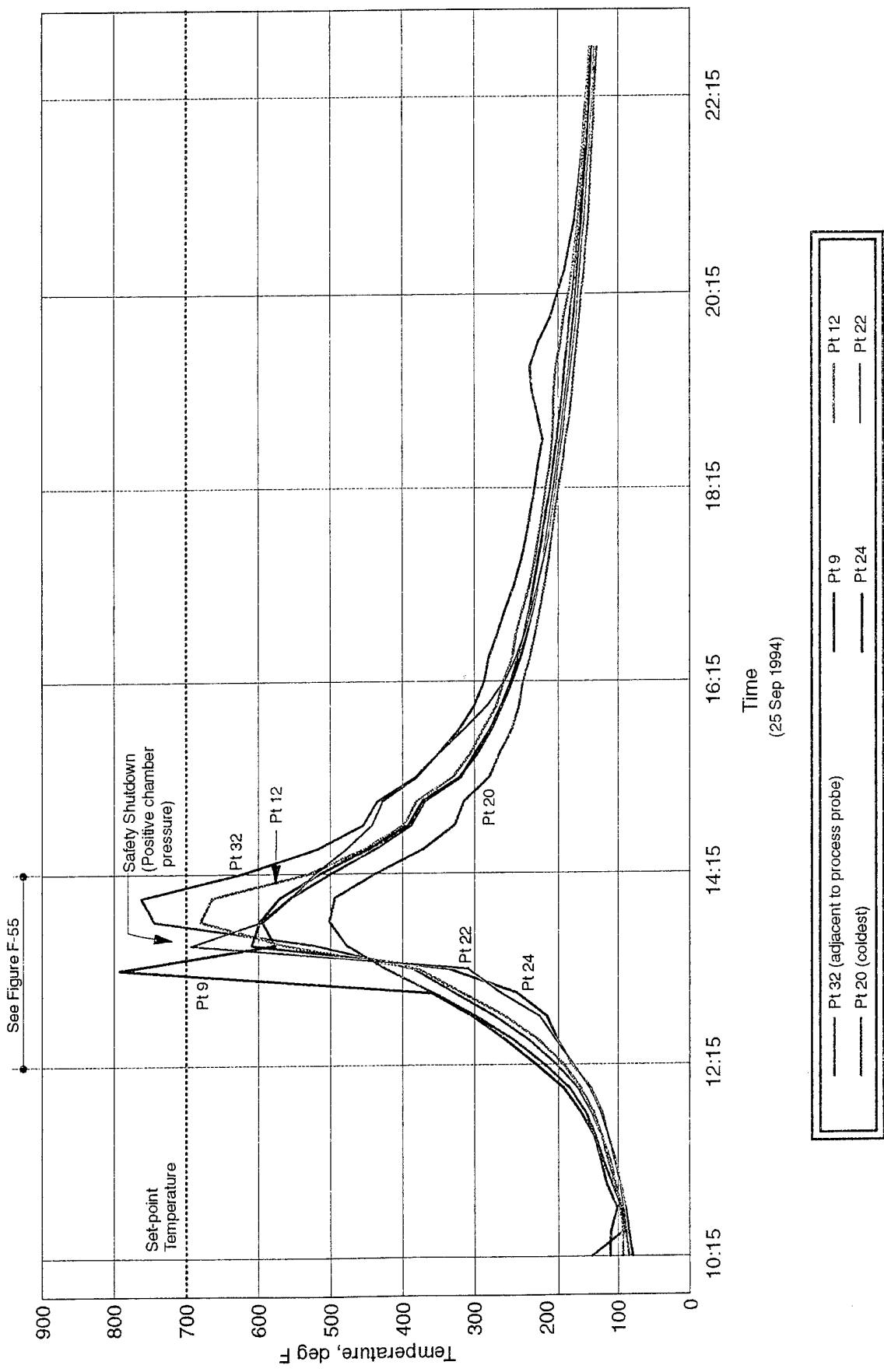


Figure F-54 Test 26A - Average Temperature Profile - 15 minute Intervals

HGD Test 26A

MK 25 Ship Mines - TNT - (5 Items)

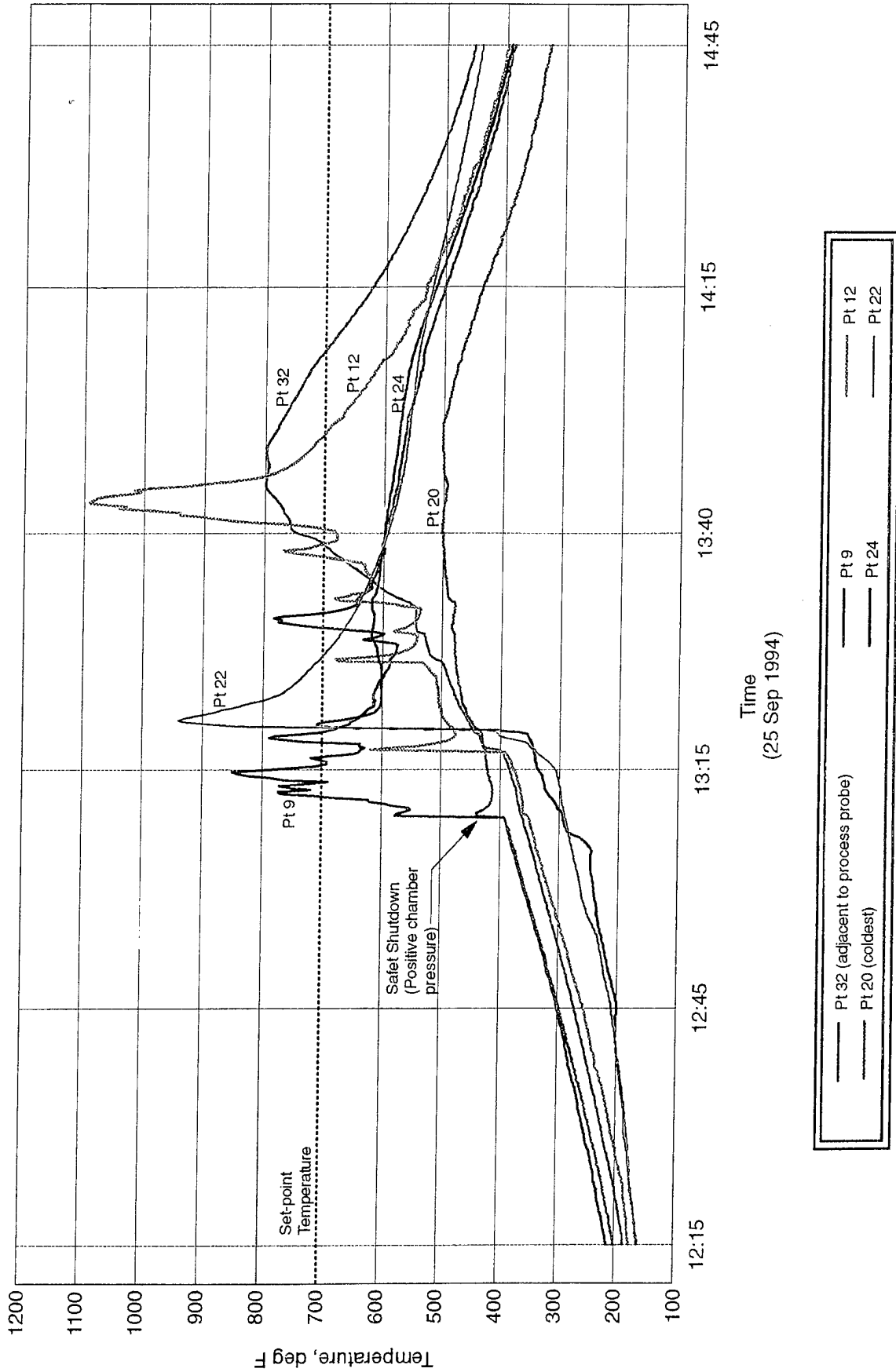


Figure F-55 Test 26A - Average Temperature Profile - 15 second Intervals

HGD Test 26A

MK 25 Ship Mines - TNT - (5 Items)

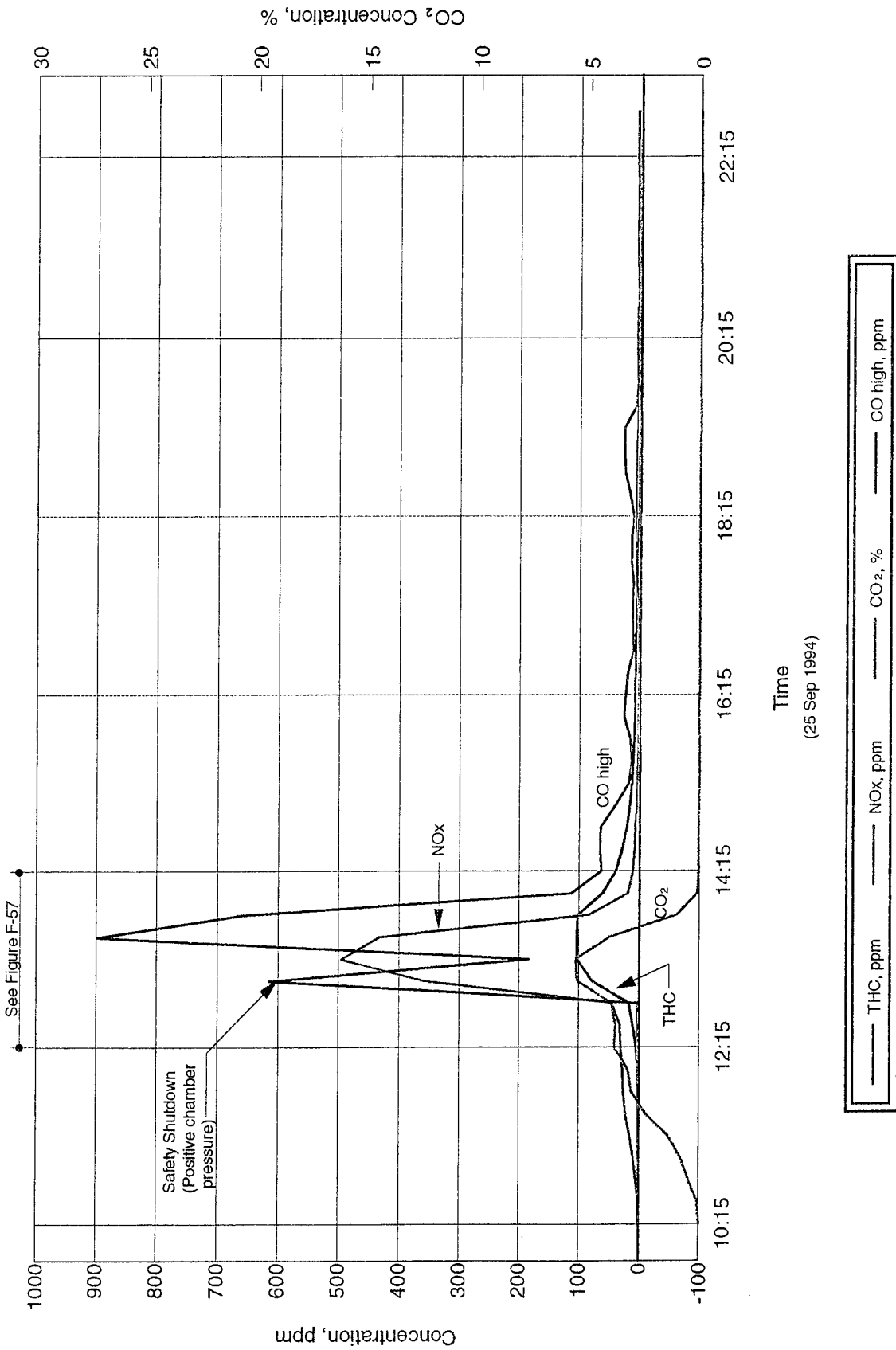


Figure F-56 Test 26A - CEM Profile - 15 minute Intervals

HGD Test 26A
 MK 25 Ship Mines - TNT - (5 Items)

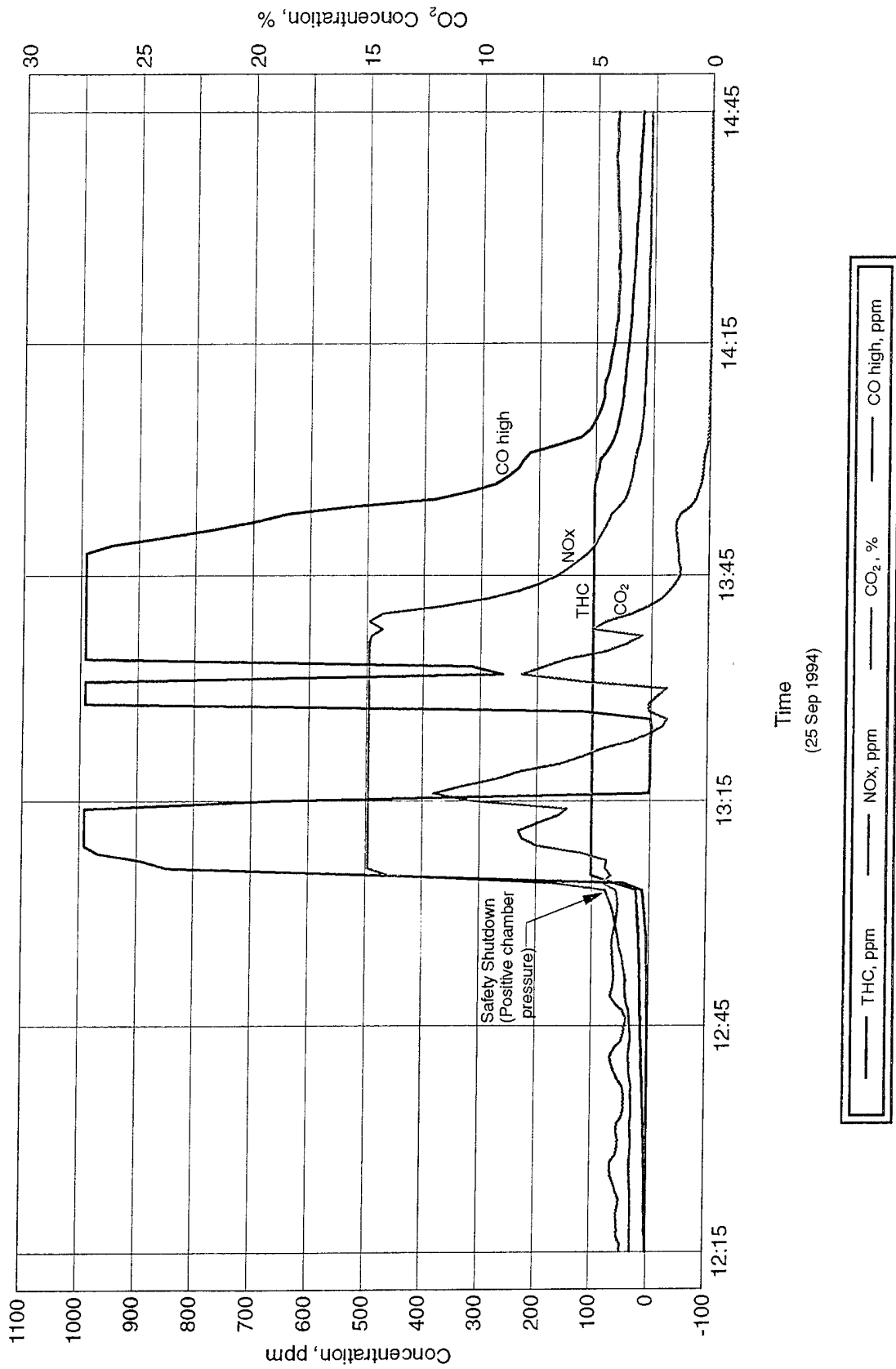


Figure F-57 Test 26A - CEM Profile - 1 minute Intervals

TEST 26B

Process Conditions

Test 26A was resumed as Test 26B on 26 September to complete decontamination of the MK 25 Ship Mines and any explosive residue remaining in the chamber and the system. The oxidizer was started at 0925 hrs with hot gas to the chamber at 1010 hrs. Steady state was reached at 2054 hrs and the test was completed at 0524 hrs on 28 September with a control system automatically initiated cooldown. The oxidizer was shutdown and the system put in an operator controlled cooldown at 0707 hrs so maintenance could reroute the fuel supply piping.

Analytical Considerations

- Ship mine and chamber wipe samples were taken on 29 September using acetonitrile.

Comments

- Most of the soot observed in earlier inspection was gone; some left in stagnant area between outlet duct and door. Reddish ash was observed in the diffuser end ship mine and heavy black ash was seen in the door end mines.

CEM

- There were no peaks in the CEM or temperature readings to indicate resumed flashing in the chamber.
- However, high CO readings probably indicate that hot melt was still burning off.

Table F-58

MINE/DEPTH BOMB WIPE SAMPLES

Mine/Depth Bomb Type:		MK25 Ship Mine	Date:	25 Sep 94	
Test # 26	Explosive Type:		TNT	Heatup Time:	17.1 Hrs
Explosive Source:		Old Spike	Time at Setpoint:	32.5 Hrs	
Temperature Setpoint:		700°F 371°C	Cooldown Time:	13.9 Hrs	

Wipe #	Operating Temperature		Operating Temperature		Explosive Concentration		Explosive Amount	Explosive Amount / Surface Area	DRE*
	°F	s dev	°C	s dev	µg/smear RDX	µg/smear TNT	µg	mg / cm ²	%
1	762	14.05	406	7.81	<MDL	<MDL	ND	ND	99.999
2	762	14.05	406	7.81	<MDL	<MDL	ND	ND	99.999
3	741	12.61	394	7.01	<MDL	<MDL	ND	ND	99.999
4	741	12.61	394	7.01	<MDL	<MDL	ND	ND	99.999
5	742	8.65	395	4.80	<MDL	<MDL	ND	ND	99.999
6	742	8.65	395	4.80	<MDL	<MDL	ND	ND	99.999
7	719	13.35	382	7.41	<MDL	<MDL	ND	ND	99.999
8	719	13.35	382	7.41	<MDL	<MDL	ND	ND	99.999
9	784	16.98	418	9.43	<MDL	<MDL	ND	ND	99.999
10	784	16.98	418	9.43	<MDL	<MDL	ND	ND	99.999
11	752	11.26	400	6.26	<MDL	<MDL	ND	ND	99.999
12	752	11.26	400	6.26	<MDL	<MDL	ND	ND	99.999

Special Abbreviations: NA=Not Applicable; ND=Not Detectable; NR=No Record; s dev=standard deviation.

*The DRE results for samples denoted by <MDL are calculated based on a value of one-half the MDL.

Estimated Residue Amount: 19 grams

MDL for Analysis: 1 µg/smear RDX
0.6 µg/smear TNT

Surface Area: 232 sq cm (approximate)

CHAMBER WIPES

Test # <u>26</u>	Chamber Load:	<u>MK25</u> <u>Ship Mine</u>	Date:	<u>25 Sep 94</u>
	Explosive Type:	<u>TNT</u>	Heatup Time:	<u>17.1 Hrs</u>
	Explosive Source:	<u>Old Spike</u>	Time at Setpoint:	<u>32.5 Hrs</u>
	Temperature Setpoint:	<u>700°F</u> <u>371°C</u>	Cooldown Time:	<u>13.9 Hrs</u>

Wipe #	Location in System	Operating Temperature	Operating Temperature	Explosive Concentration / Smear		Explosive Amount	Explosive Amount / Surface Area
		°F	°C	µg / smear RDX	µg / smear TNT	µg	mg / cm ²
1	Blank	NA	NA	<MDL	<MDL	ND	ND
2	Floor	630	332	<MDL	<MDL	ND	ND
3	Wall	NR	NR	<MDL	<MDL	ND	ND
4	Duct	718	381	1.001	0.8299	1.8309	1.1372E-05
5	Elbow	718	381	<MDL	<MDL	ND	ND
6	Fanblade	718	381	<MDL	<MDL	ND	ND
7	Coldspot	575	302	<MDL	<MDL	ND	ND
8	Rail	701	372	<MDL	<MDL	ND	ND

Special Abbreviations: NA=Not Applicable; ND=Not Detectable; NR=No Record

MDL for Analysis: 1 µg/smear RDX
0.6 µg/smear TNT

Surface Area: 161 sq cm

HGD Test 26B

MK 25 Ship Mines - TNT - (5 Items)

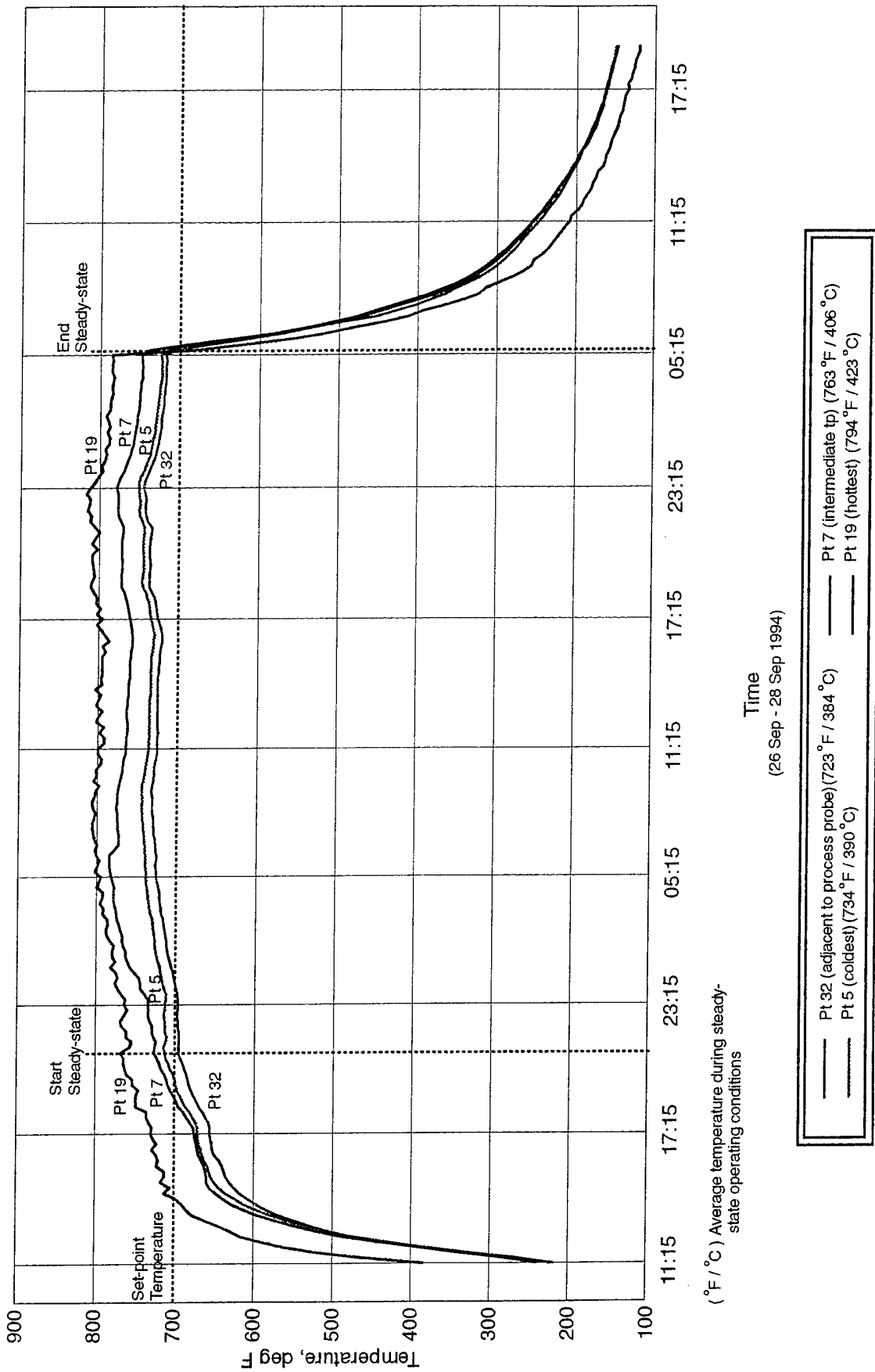
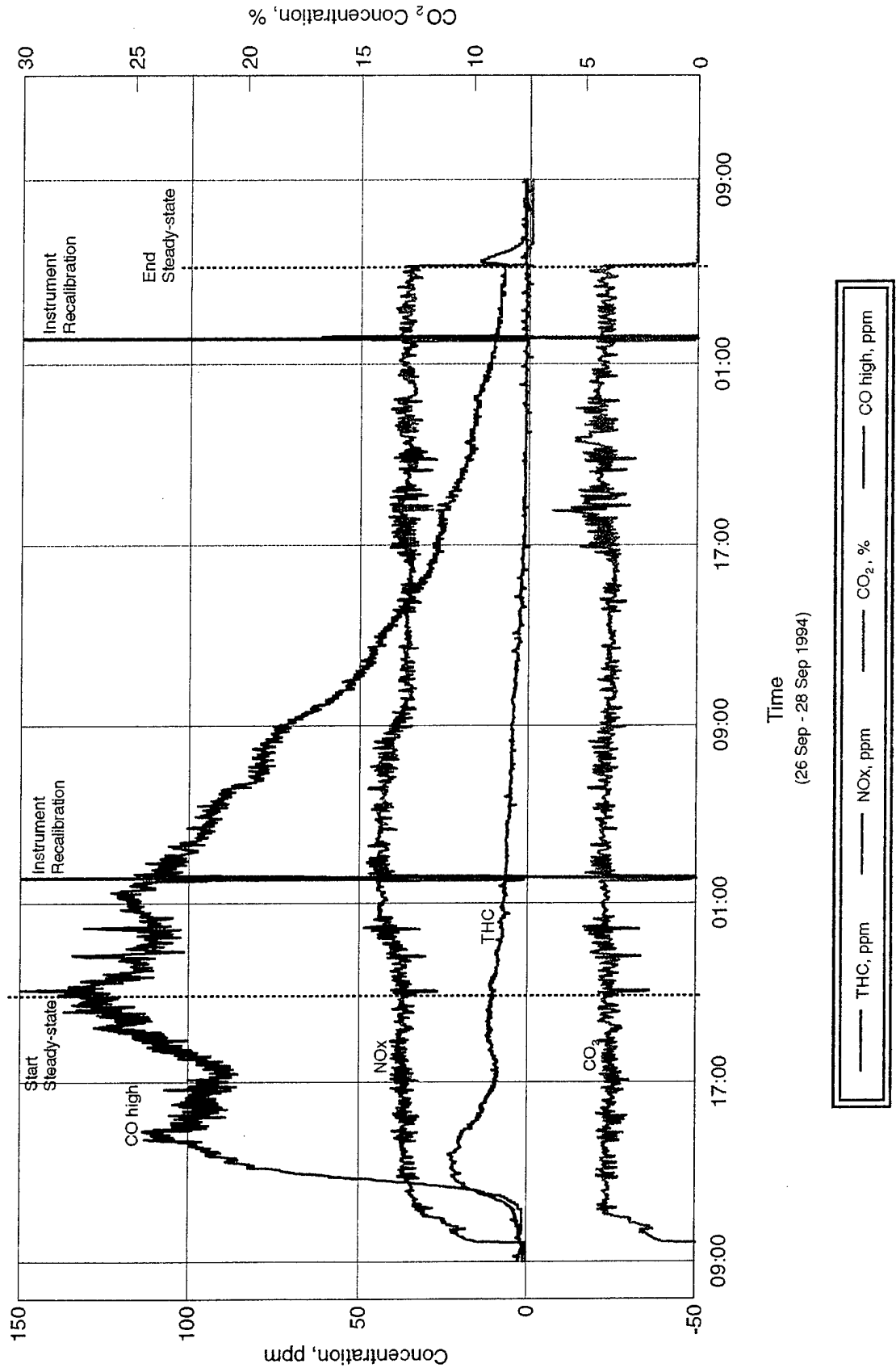


Figure F-58 Test 26B - Average Temperature Profile - 15 minute Intervals

HGD Test 26B
 MK 25 Ship Mines - TNT - (5 Items)



Time
 (26 Sep - 28 Sep 1994)

Figure F-59 Test 26B - CEM Profile - 1 minute Intervals

TEST 28

Process Conditions

This test was conducted under the same test conditions as Test 22, [6 hrs at 550°F (288°C), 24 106mm projectiles containing Comp A-3 residue). The railcar configuration is shown in Figure D-44. The oxidizer was started at 0955 hrs on 29 September with heat going to the chamber at 1041 hrs. Steady state was reached at 1531 hrs and the test was completed at 2201 hrs with a control system automatically initiated cooldown.

Analytical Considerations

- Projectile and chamber wipe samples were taken the next day using acetone/trile/hexane.

Comments

CEM

- No peaks were noted on the CEM or temperature probes.

Table F-60

PROJECTILE EXTRACT SAMPLES

	Projectile Type:	106 mm	Date:	29 Sep 94
Test # 28	Explosive Type:	Comp A-3	Heatup Time:	4.8 Hrs
	Explosive Source:	Demil	Time at Setpoint:	6.5 Hrs
	Temperature Setpoint:	550°F 288°C	Cooldown Time:	8.5 Hrs

Round #	Operating Temperature		Operating Temperature		Explosive Concentration		Sampling Dilution ml	Explosive Amount µg	Explosive Amount / Surface Area mg / cm ²	DRE* %
	°F	s dev	°C	s dev	µg / ml RDX	µg / ml TNT				
1	602	6.63	317	3.68	0.0165	0.04	200	11.300	1.7880E-05	99.999
2	598	5.43	315	3.02	0.014	0.0279	200	8.380	1.3259E-05	99.999
3	599	5.50	315	3.06	0.016	0.0419	200	11.580	1.8323E-05	99.999
4	590	5.69	310	3.16	0.0165	<MDL	200	3.300	5.2215E-06	99.999
5	579	6.08	304	3.38	0.012	<MDL	200	2.400	3.7975E-06	99.999
6	582	5.66	306	3.15	<MDL	<MDL	200	ND	ND	99.999
7	607	5.72	319	3.18	0.031	0.0238	200	10.960	1.7342E-05	99.999
8	596	5.61	313	3.12	0.014	<MDL	200	2.800	4.4304E-06	99.999
9	591	5.40	311	3.00	<MDL	<MDL	200	ND	ND	99.999
10	599	5.36	315	2.98	0.0175	0.0166	200	6.820	1.0791E-05	99.999
11	588	5.14	309	2.86	0.0285	0.026	200	10.900	1.7247E-05	99.999
12	587	5.34	308	2.97	<MDL	<MDL	200	ND	ND	99.999
13	598	5.95	315	3.30	<MDL	<MDL	200	ND	ND	99.999
14	590	5.51	310	3.06	0.0185	0.0132	200	6.340	1.0032E-05	99.999
15	591	5.47	310	3.04	<MDL	<MDL	200	ND	ND	99.999
16	589	5.60	309	3.11	<MDL	<MDL	200	ND	ND	99.999
17	584	5.36	307	2.98	<MDL	<MDL	200	ND	ND	99.999
18	578	5.44	303	3.02	<MDL	<MDL	200	ND	ND	99.999
19	623	8.43	328	4.68	0.0135	0.0132	200	5.340	8.4494E-06	99.999
20	617	7.89	325	4.39	<MDL	<MDL	200	ND	ND	99.999
21	596	5.45	313	3.03	<MDL	<MDL	200	ND	ND	99.999
22	617	7.09	325	3.94	<MDL	<MDL	200	ND	ND	99.999
23	595	5.99	313	3.33	<MDL	<MDL	200	ND	ND	99.999
24	614	7.47	324	4.15	<MDL	0.0121	200	2.420	3.8291E-06	99.999

Special Abbreviations: NA=Not Applicable; ND=Not Detectable; NR=No Record; s dev=standard deviation.

*The DRE results for samples denoted by <MDL are calculated based on a value of one-half the MDL.

Extracted Round No: None
Estimated Round Amount: 7 grams

MDL for Analysis: 0.01 µg/ml RDX
0.006 µg/ml TNT

Surface Area: 632 sq cm

Table F-61

CHAMBER WIPES

Test # 28	Chamber Load:	106 mm	Date:	29 Sep 94
	Explosive Type:	Comp A-3	Heatup Time:	4.8 Hrs
	Explosive Source:	Demil	Time at Setpoint:	6.5 Hrs
	Temperature Setpoint:	550°F 288°C	Cooldown Time:	8.5 Hrs

Wipe #	Location in System	Operating Temperature	Operating Temperature	Explosive Concentration / Smear		Explosive Amount	Explosive Amount / Surface Area
		°F	°C	µg / smear RDX	µg / smear TNT	µg	mg / cm ²
1	Blank	NA	NA	<MDL	<MDL	ND	ND
2	Floor	467	242	<MDL	<MDL	ND	ND
3	Wall	NR	NR	<MDL	<MDL	ND	ND
4	Duct	582	306	<MDL	<MDL	ND	ND
5	Elbow	582	306	<MDL	<MDL	ND	ND
6	Fanblade	582	306	<MDL	<MDL	ND	ND
7	Coldspot	388	198	<MDL	<MDL	ND	ND
8	Rail	555	291	1.011	1.6598	2.6708	1.6589E-05

Special Abbreviations: NA=Not Applicable; ND=Not Detectable; NR=No Record

MDL for Analysis: 1 µg/smear RDX
0.6 µg/smear TNT

Surface Area: 161 sq cm

HGD Test 28

106mm Projectiles - Comp A-3 - (192 Rounds)

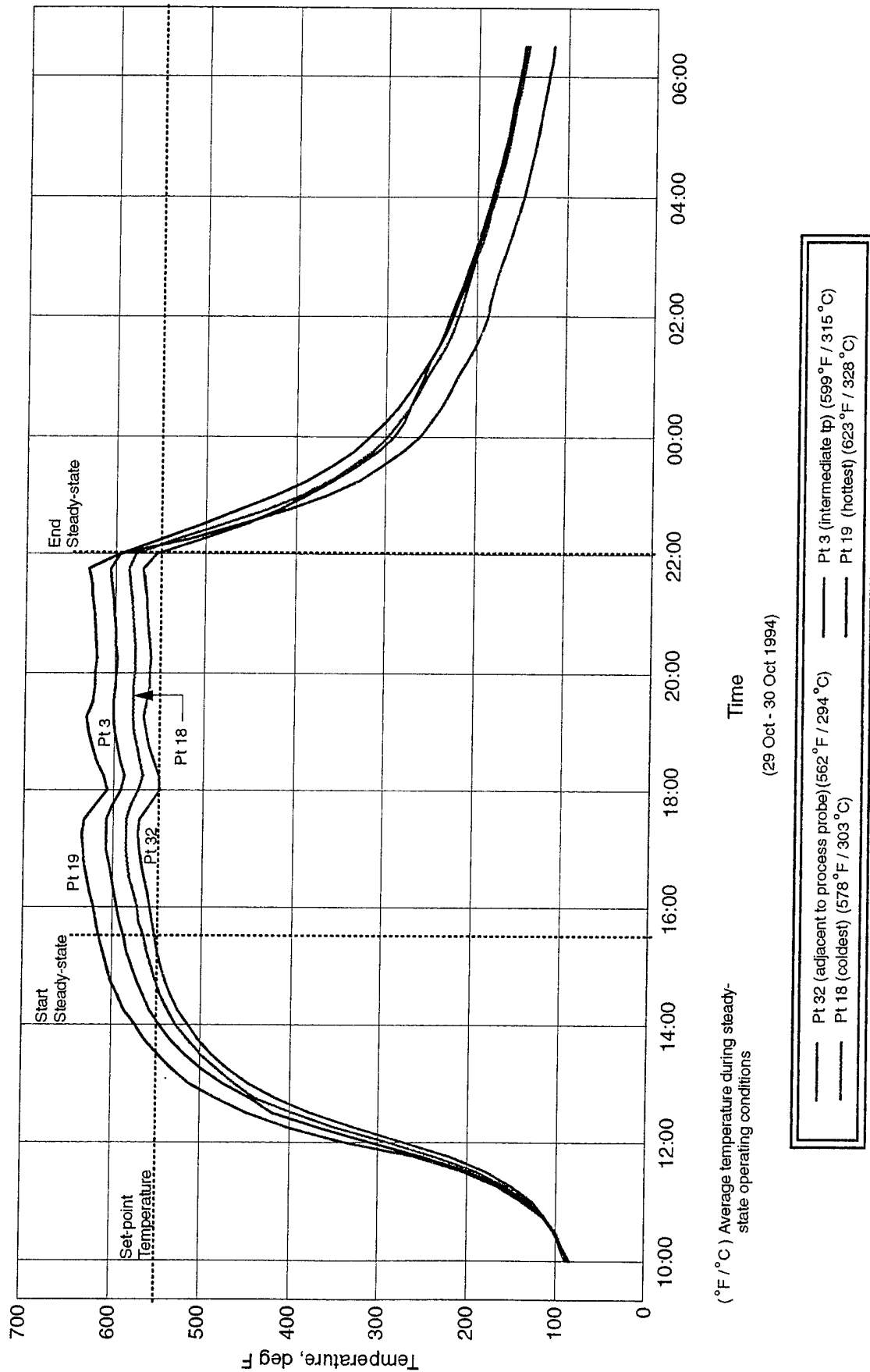
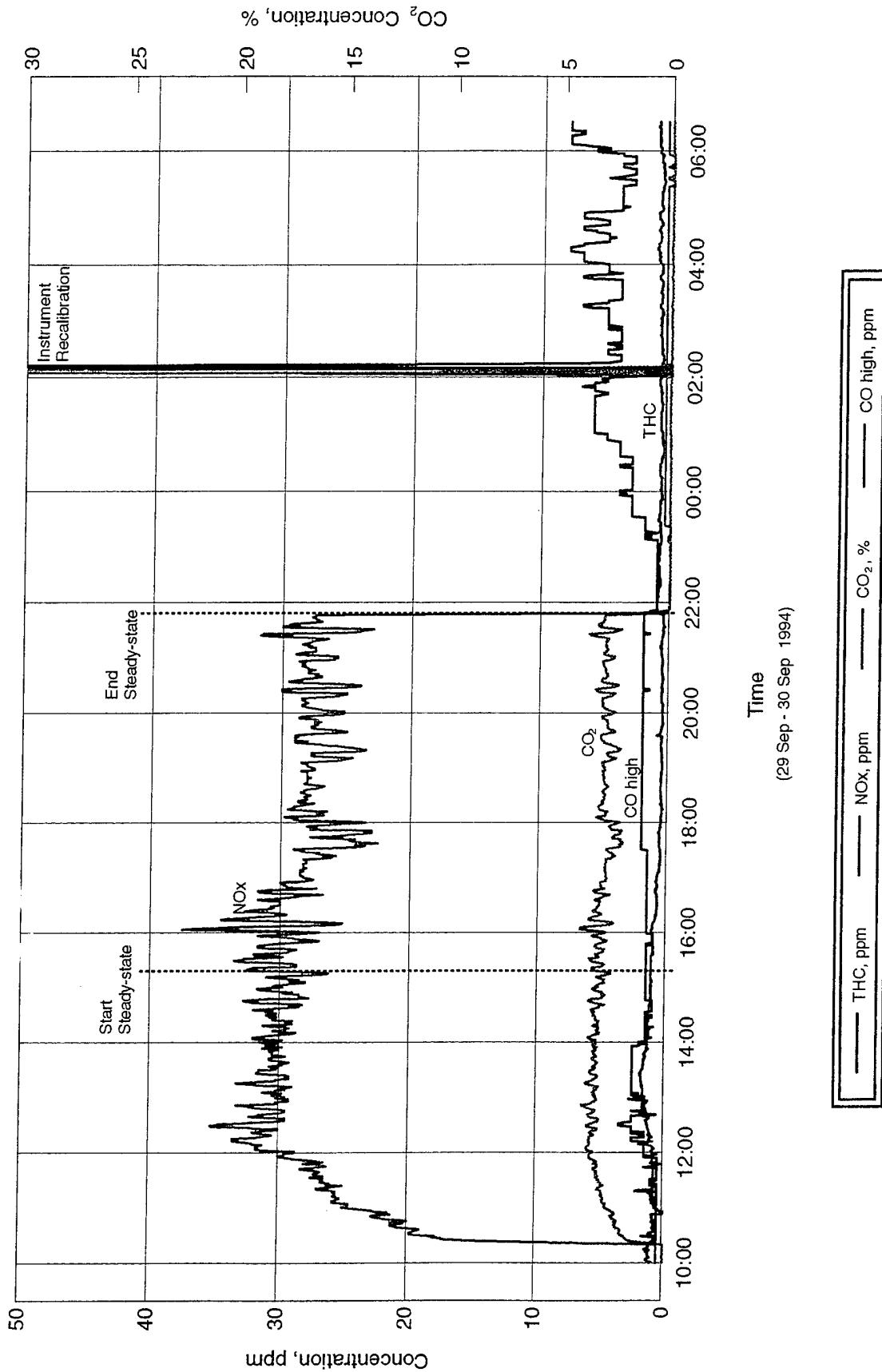


Figure F-60 Test 28 - Average Temperature Profile - 15 minute Intervals

HGD TEST 28

106 mm Projectiles - Comp A-3 - (192 Rounds)



Time
(29 Sep - 30 Sep 1994)

Figure F-61 Test 28 - CEM Profile - 15 minute Intervals

TEST 27

Process Conditions

This test was conducted under the same test conditions as Test 23, [6 hrs at 550°F (288°C), 24 175mm projectiles containing Comp B residue). The railcar configuration is shown in Figure D-45. The oxidizer was started at 0519 hrs on 1 October with heat to the chamber at 0604 hrs. Steady state was reached at 1319 hrs and the test was completed at 2142 hrs with a control system automatically initiated cooldown.

Special Conditions

- All 24 demilitarized projectiles were placed in the two racks at the diffuser end of the car. The control thermocouple was located in right rack, one row behind the demilitarized projectiles.

Analytical Considerations

- Chamber wipe and projectile samples were taken using acetonitrile.

Comments

CEM

- Peaks were noted on the CEM from 0807 to 0905 hrs. Temperature readings at 15 second intervals during this period showed peaks at projectile temperatures of 375 to 400°F (191 to 204°C) with increases in temperature of 50 to 500°F (28 to 278°C). There was a distinct peak per each projectile.

Table F-62

PROJECTILE EXTRACT SAMPLES

Projectile Type:	175 mm	Date:	1 Oct 94
Test #	Explosive Type:	Heatup Time:	7.2 Hrs
27	Comp B	Time at Setpoint:	8.4 Hrs
Explosive Source:	Demil	Cooldown Time:	12.5 Hrs
Temperature Setpoint:	550°F 288°C		

Round #	Operating Temperature		Operating Temperature		Explosive Concentration		Sampling Dilution	Explosive Amount	Explosive Amount / Surface Area	DRE*
	°F	s dev	°C	s dev	µg / ml RDX	µg / ml TNT	ml	µg	mg / cm ²	%
1	590	30.78	310	17.10	<MDL	<MDL	500	ND	ND	99.999
2	585	27.74	307	15.41	<MDL	<MDL	500	ND	ND	99.999
3	582	28.37	306	15.76	<MDL	<MDL	500	ND	ND	99.999
4	580	28.18	304	15.66	<MDL	<MDL	500	ND	ND	99.999
5	580	28.38	304	15.77	<MDL	<MDL	500	ND	ND	99.999
6	579	29.97	304	16.65	<MDL	<MDL	500	ND	ND	99.999
7	594	31.77	312	17.65	0.0125	<MDL	500	6.250	3.2501E-06	99.999
8	592	29.48	311	16.38	<MDL	<MDL	500	ND	ND	99.999
9	584	29.22	307	16.23	<MDL	<MDL	500	ND	ND	99.999
10	587	30.39	308	16.88	<MDL	<MDL	500	ND	ND	99.999
11	593	31.03	312	17.24	<MDL	<MDL	500	ND	ND	99.999
12	591	32.83	311	18.24	<MDL	<MDL	500	ND	ND	99.999
13	602	36.21	317	20.12	<MDL	<MDL	500	ND	ND	99.999
14	599	34.34	315	19.08	<MDL	<MDL	500	ND	ND	99.999
15	593	34.05	312	18.92	<MDL	<MDL	500	ND	ND	99.999
16	596	34.83	313	19.35	<MDL	<MDL	500	ND	ND	99.999
17	602	35.09	317	19.49	<MDL	<MDL	500	ND	ND	99.999
18	625	48.23	329	26.79	0.0105	<MDL	500	5.250	2.7301E-06	99.999
19	636	52.29	336	29.05	<MDL	<MDL	500	ND	ND	99.999
20	615	42.53	324	23.63	<MDL	<MDL	500	ND	ND	99.999
21	601	38.69	316	21.49	0.0125	0.0087	500	10.600	5.5122E-06	99.999
22	605	41.01	318	22.78	<MDL	<MDL	500	ND	ND	99.999
23	BAD	NA	BAD	NA	<MDL	<MDL	500	ND	ND	99.999
24	615	44.78	324	24.88	<MDL	<MDL	500	ND	ND	99.999

Special Abbreviations: NA=Not Applicable; ND=Not Detectable; NR=No Record; s dev=standard deviation.

*The DRE results for samples denoted by <MDL are calculated based on a value of one-half the MDL.

Extracted Round No: None
Estimated Round Amount: 20 grams

MDL for Analysis: 0.01 µg/ml RDX
0.006 µg/ml TNT

Surface Area: 1923 sq cm

Table F-63

CHAMBER WIPES

Test # <u>27</u>	Chamber Load:	<u>175 mm</u>	Date:	<u>1 Oct 94</u>
	Explosive Type:	<u>Comp B</u>	Heatup Time:	<u>7.2 Hrs</u>
	Explosive Source:	<u>Spiked</u>	Time at Setpoint:	<u>8.4 Hrs</u>
	Temperature Setpoint:	<u>550°F</u> <u>288°C</u>	Cooldown Time:	<u>12.5 Hrs</u>

Wipe #	Location in System	Operating Temperature	Operating Temperature	Explosive Concentration / Smear		Explosive Amount	Explosive Amount / Surface Area
		°F	°C	µg / smear RDX	µg / smear TNT	µg	mg / cm ²
1	Blank	NA	NA	<MDL	<MDL	ND	ND
2	Floor	436	224	<MDL	<MDL	ND	ND
3	Wall	NR	NR	<MDL	<MDL	ND	ND
4	Duct	572	300	<MDL	<MDL	ND	ND
5	Elbow	572	300	<MDL	<MDL	ND	ND
6	Fanblade	572	300	<MDL	<MDL	ND	ND
7	Coldspot	388	198	<MDL	<MDL	ND	ND
8	Rail	544	284	<MDL	<MDL	ND	ND

Special Abbreviations: NA=Not Applicable; ND=Not Detectable; NR=No Record

MDL for Analysis: 1 µg/smear RDX
 0.6 µg/smear TNT

Surface Area: 161 sq cm

HGD Test 27

175mm Projectiles - Comp B - (96 Rounds)

See Figure F-61

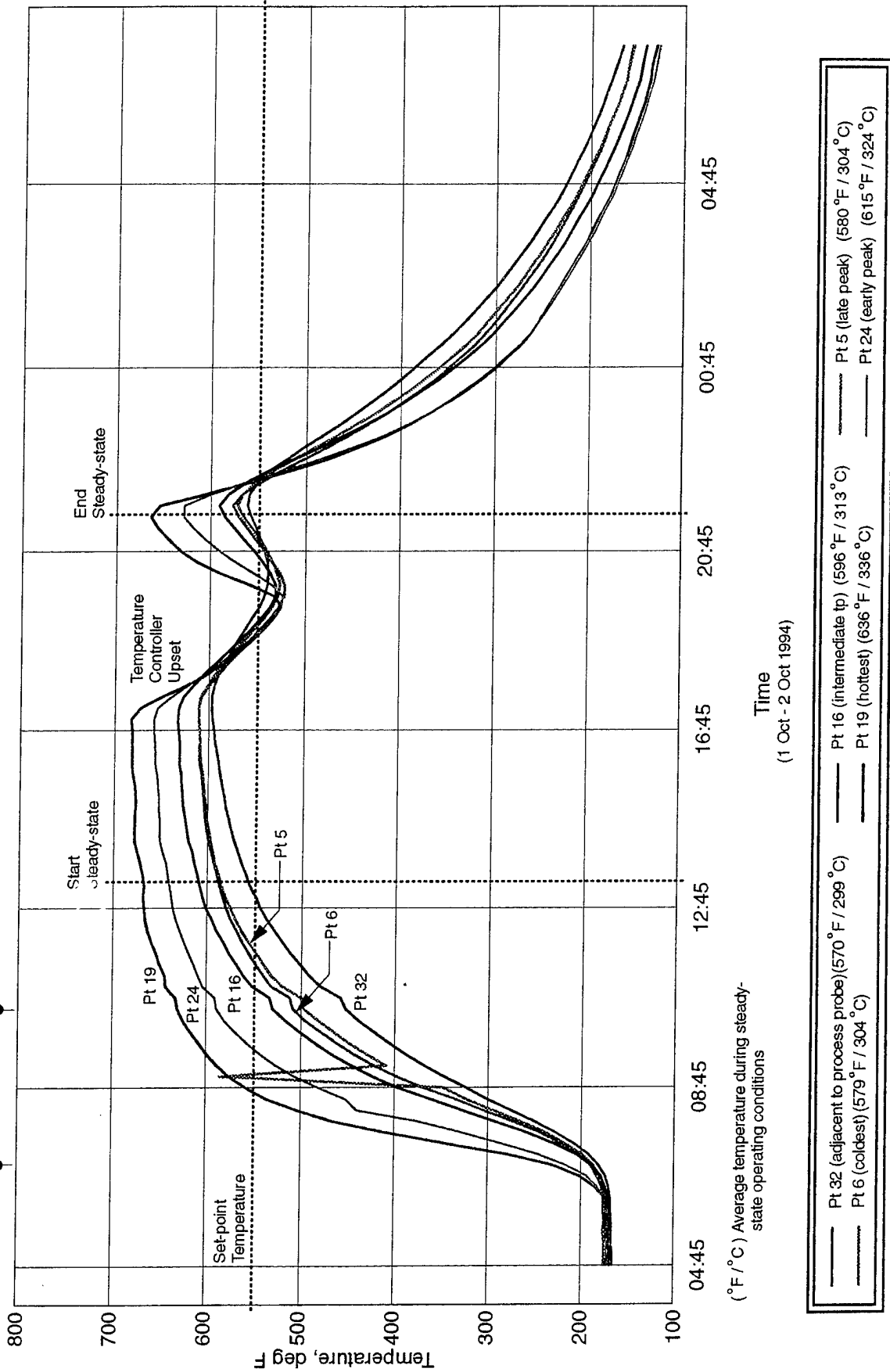


Figure F-62 Test 27 - Average Temperature Profile - 15 minute Intervals

HGD Test 27

175mm Projectiles - Comp B - (96 Rounds)

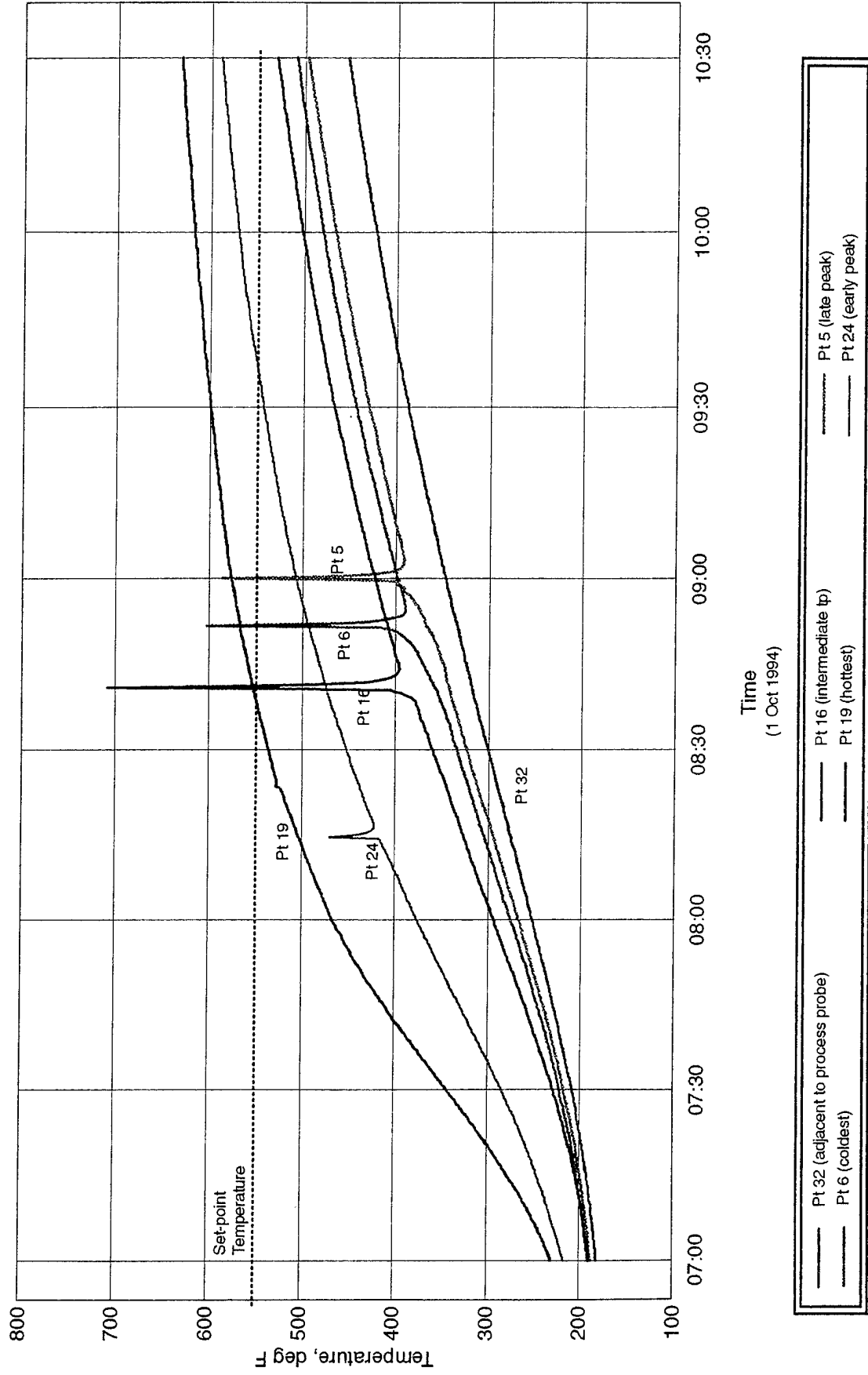


Figure F-63 Test 27 - Average Temperature Profile - 15 second Intervals

HGD Test 27 175 mm Projectiles - Comp B - (96 Rounds)

See Figure F-63

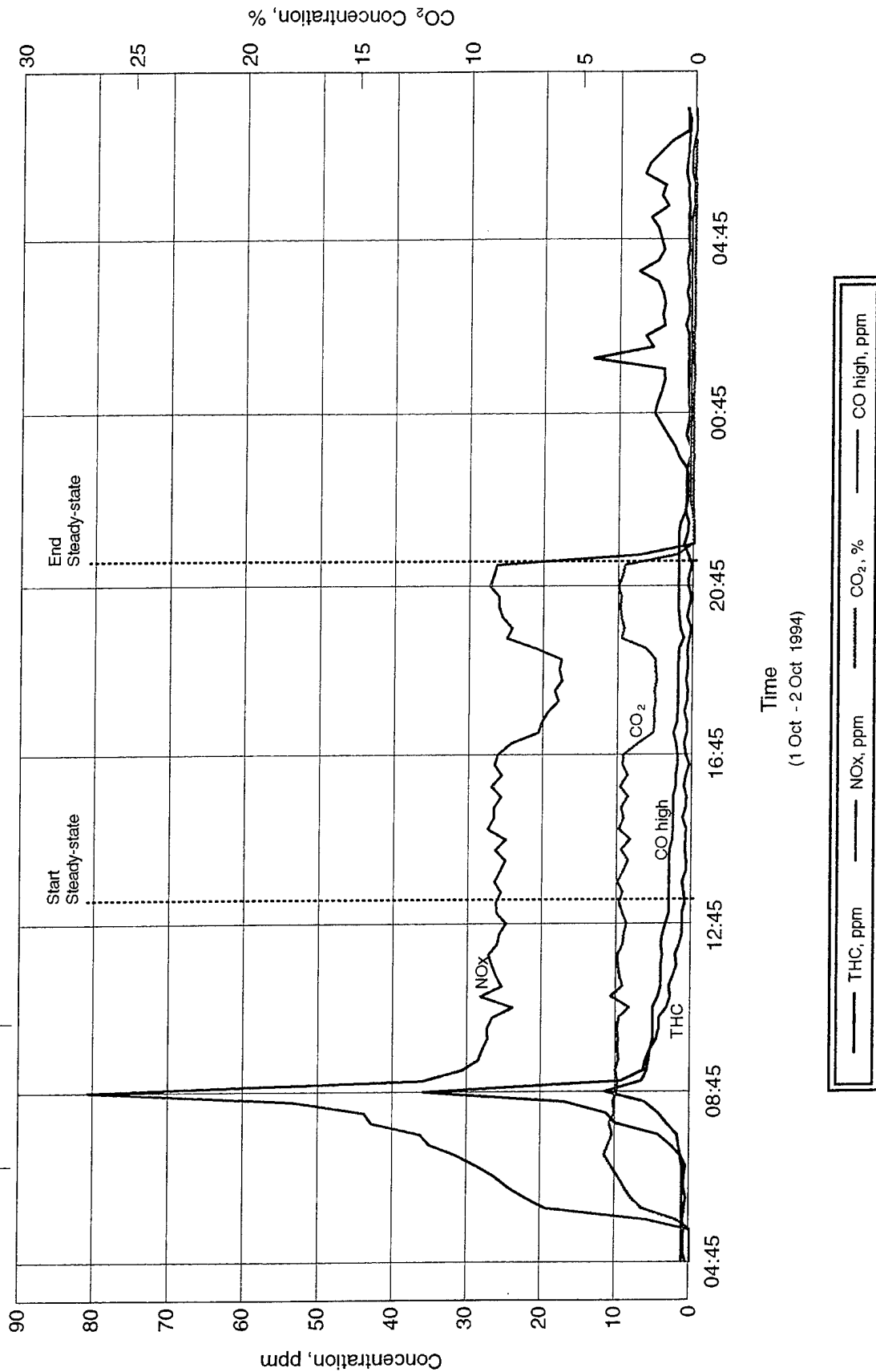


Figure F-64 Test 27 - CEM Profile - 15 minute Intervals

HGD Test 27

175mm Projectiles - Comp B - (24 Rounds)

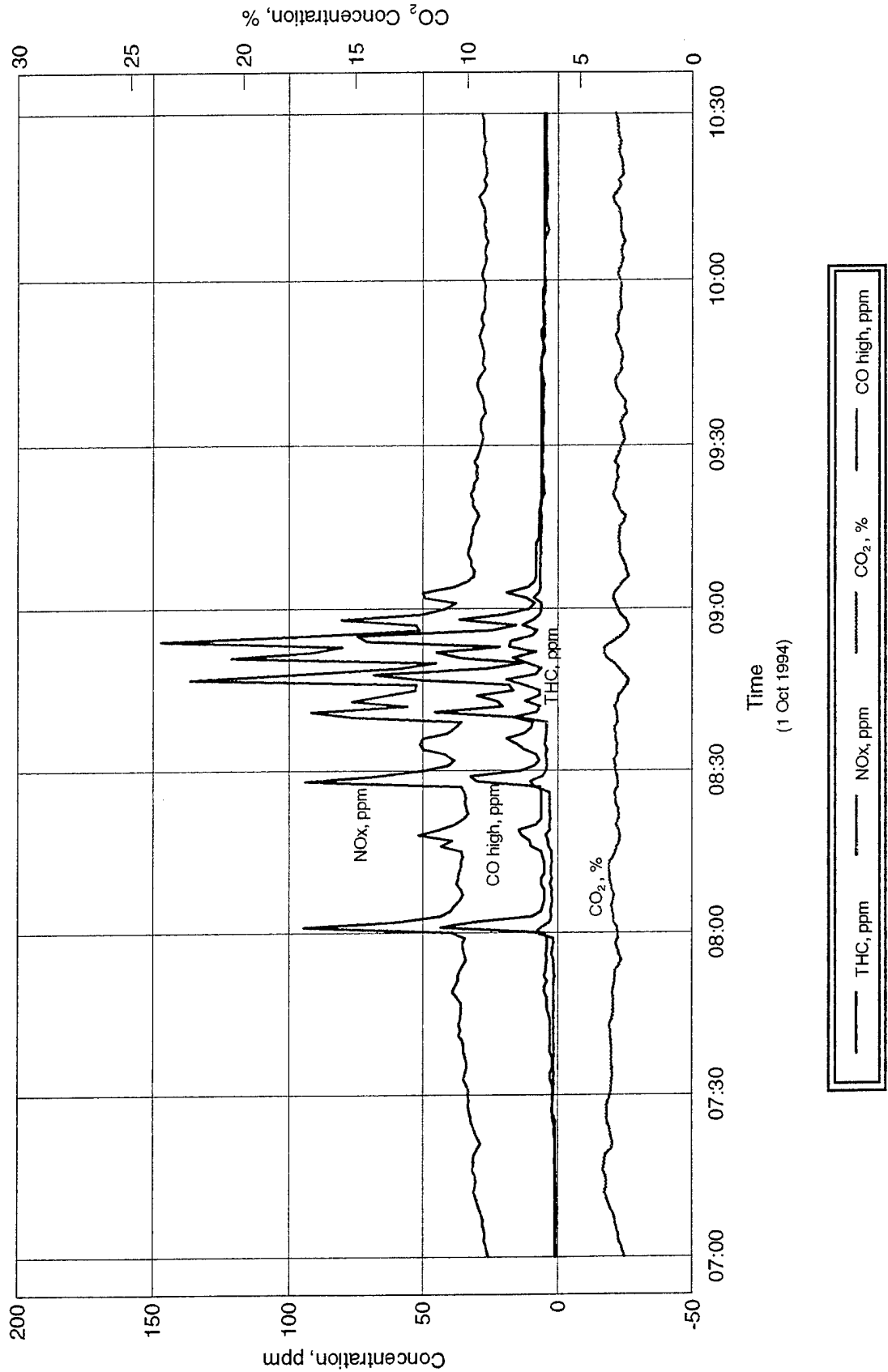


Figure F-65 Test 27 - CEM Profile - 1 minute Intervals

TEST 29

Process Conditions

This test was conducted under the same test conditions as Test 15 and 24, [6 hrs at 600°F (316°C), 12 3-inch and 12 5-inch projectiles spiked with Yellow D]. The railcar configuration is shown in Figure D-46. Started oxidizer at 0834 hrs on 2 October with heat to the chamber at 0919 hrs. Steady state was reached at 1717 hrs and test was completed at 2320 hrs with a control system automatically initiated cooldown.

Analytical Considerations

- Chamber wipe and spiked projectiles samples were taken the next day using HPLC water.

Comments

- System safety shutdown at 1138 hrs due to high collector temperature (collector actuator and gate binding). Oxidizer was restarted at 1203 hrs with hot gas flow at 1233 hrs.
- Temperature peaks were noted at projectile temperatures of about 500°F (260°C) with increases of up to 200°F (112°C).
- The collector slide gate was replaced and the actuator was serviced.

CEM

- There are peaks observed between 1330 and 1450 hrs (approximately 500°F, 260°C) then it flattens out.

Table F-64

PROJECTILE EXTRACT SAMPLES

Projectile Type: <u>3-inch</u> <u>5-inch</u>		Date: <u>2 Oct 94</u>
Test #: <u>29</u>	Explosive Type: <u>Yellow D</u>	Heatup Time: <u>8.0 Hrs</u>
Explosive Source: <u>Spiked</u>		Time at Setpoint: <u>6.0 Hrs</u>
Temperature Setpoint: <u>600°F</u> <u>316°C</u>		Cooldown Time: <u>21.4 Hrs</u>

Round #	Size	Operating Temperature		Operating Temperature		Explosive Concentration µg/ml Amm. Picrate	Sampling Dilution ml	Explosive Amount µg	Explosive Amount / Surface Area mg / cm ²	DRE* %
		°F	s dev	°C	s dev					
1	5 in.	657	9.87	347	5.48	<MDL	100	ND	ND	99.999
2	5 in.	650	12.68	343	7.05	<MDL	100	ND	ND	99.999
3	5 in.	627	9.70	331	5.39	<MDL	100	ND	ND	99.999
4	3 in.	625	6.76	330	3.76	<MDL	50	ND	ND	99.999
5	3 in.	645	7.30	341	4.05	<MDL	50	ND	ND	99.999
6	3 in.	641	7.07	338	3.93	0.0054	50	0.270	1.3366E-06	99.999
7	3 in.	660	7.43	349	4.13	<MDL	50	ND	ND	99.999
8	3 in.	652	7.70	345	4.28	<MDL	50	ND	ND	99.999
9	3 in.	647	8.11	341	4.51	<MDL	50	ND	ND	99.999
10	5 in.	632	11.15	333	6.19	<MDL	100	ND	ND	99.999
11	5 in.	632	12.33	333	6.85	<MDL	100	ND	ND	99.999
12	5 in.	620	6.64	327	3.69	<MDL	100	ND	ND	99.999
13	5 in.	652	12.56	344	6.98	<MDL	100	ND	ND	99.999
14	5 in.	661	8.05	349	4.47	<MDL	100	ND	ND	99.999
15	5 in.	642	12.34	339	6.85	<MDL	100	ND	ND	99.999
16	3 in.	636	8.30	335	4.61	<MDL	50	ND	ND	99.999
17	3 in.	642	8.34	339	4.63	<MDL	50	ND	ND	99.999
18	3 in.	634	7.09	334	3.94	<MDL	50	ND	ND	99.999
19	3 in.	653	7.35	345	4.08	<MDL	50	ND	ND	99.999
20	3 in.	655	7.50	346	4.17	<MDL	50	ND	ND	99.999
21	3 in.	662	7.75	350	4.31	6010	250	1502500	7.4381E+00	NA
22	5 in.	637	13.29	336	7.38	<MDL	100	ND	ND	99.999
23	5 in.	658	12.37	348	6.87	<MDL	100	ND	ND	99.999
24	5 in.	692	7.71	367	4.28	2230	2000	4460000	7.0570E+00	NA

Special Abbreviations: NA=Not Applicable; ND=Not Detectable; NR=No Record; s dev=standard deviation.

*The DRE results for samples denoted by <MDL are calculated based on a value of one-half the MDL.

Extracted Round No: 21, 24
 Extracted Round Amount: 1.50 grams (3-inch) (Extracted round samples were diluted to dissolve crystals prior to analysis.)
 4.46 grams (5-inch)

MDL for Analysis: 0.004 µg/ml Ammonium Picrate

Surface Area: 202 sq cm (3-inch)
 632 sq cm (5-inch)

CHAMBER WIPES

Test # 29	Chamber Load:	3-Inch 5-Inch	Date:	2 Oct 94
	Explosive Type:	Yellow D	Heatup Time:	8.0 Hrs
	Explosive Source:	Spiked	Time at Setpoint:	6.0 Hrs
	Temperature Setpoint:	600°F 316°C	Cooldown Time:	21.4 Hrs

Wipe #	Location in System	Operating Temperature	Operating Temperature	Explosive Concentration / Smear	Explosive Amount	Explosive Amount / Surface Area
		°F	°C	µg / smear Amm. Picrate	µg	mg / cm ²
1	Blank	NA	NA	<MDL	ND	ND
2	Floor	551	288	<MDL	ND	ND
3	Wall	NR	NR	<MDL	ND	ND
4	Duct	625	329	<MDL	ND	ND
5	Elbow	625	329	<MDL	ND	ND
6	Fanblade	625	329	<MDL	ND	ND
7	Coldspot	427	219	<MDL	ND	ND
8	Rail	608	320	<MDL	ND	ND

Special Abbreviations: NA=Not Applicable; ND=Not Detectable; NR=No Record

MDL for Analysis: 0.4 µg/smear Ammonium Picrate

Surface Area: 161 sq cm

HGD Test 29

3-inch / 5-inch Projectiles - Yellow D - (192 Rounds)

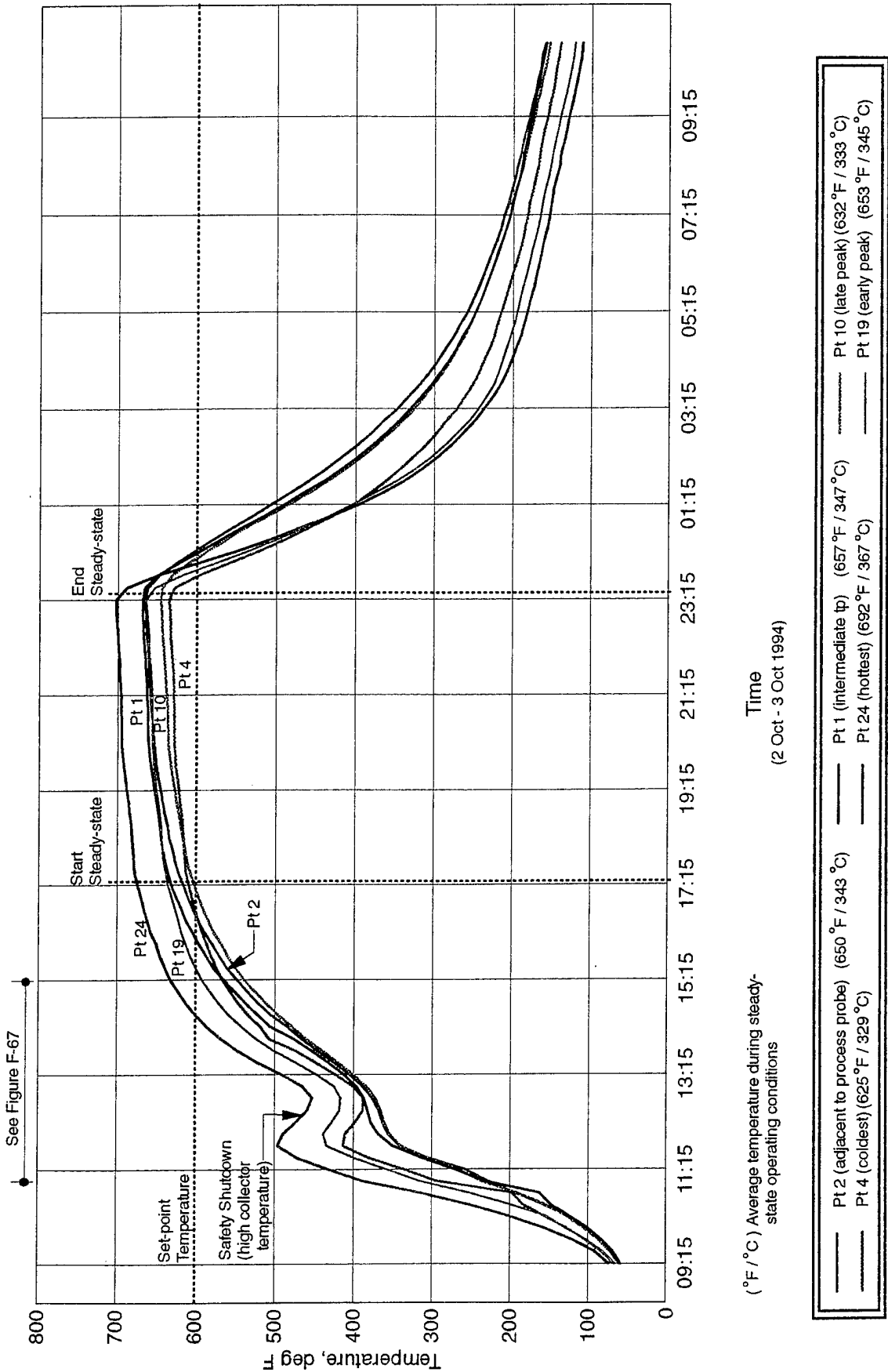


Figure F-66 Test 29 - Average Temperature Profile - 15 minute Intervals

HGD Test 29

3-inch / 5-inch Projectiles - Yellow D - (192 Rounds)

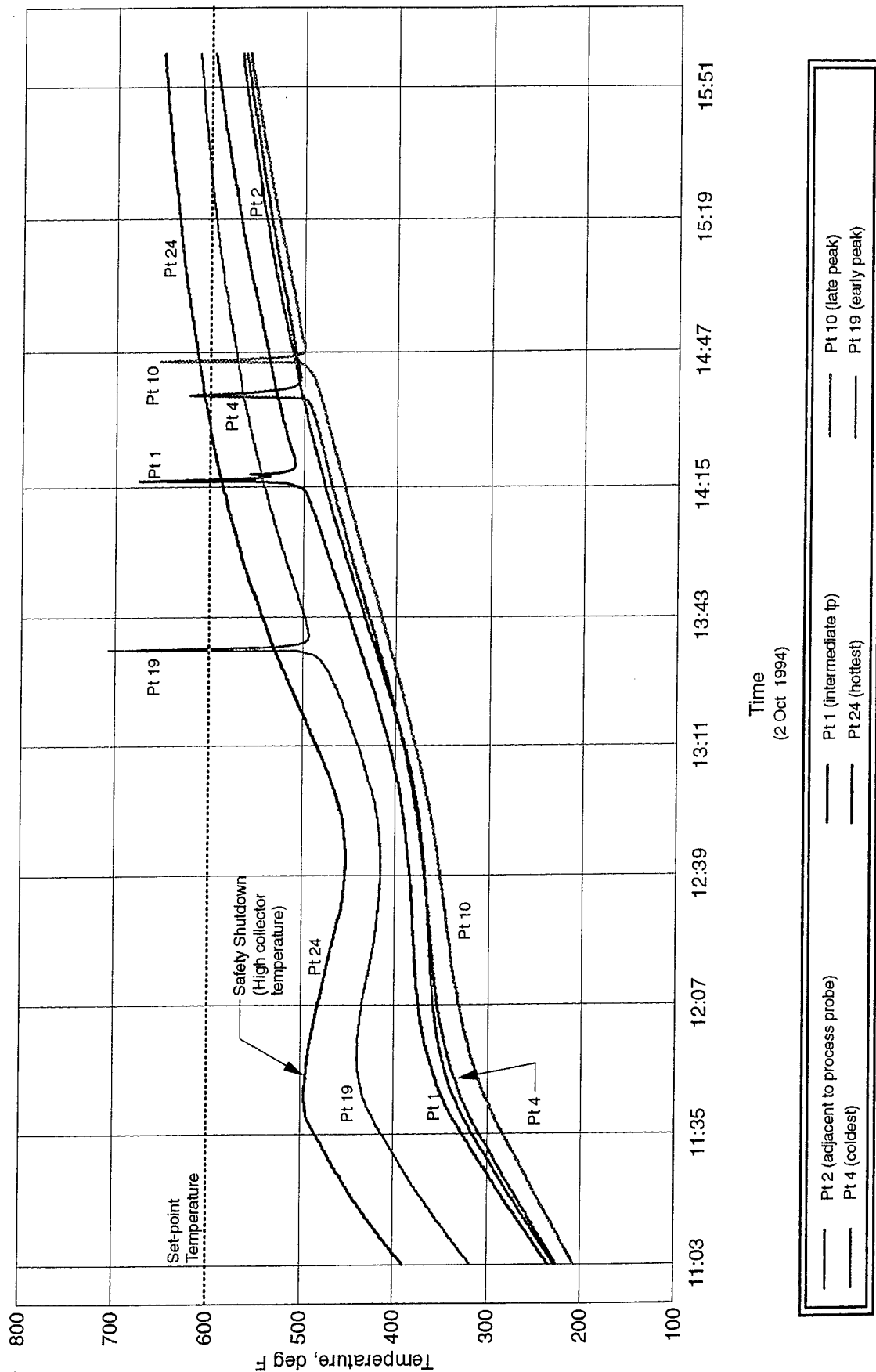


Figure F-67 Test 29 - Average Temperature Profile - 15 second Intervals

HGD Test 29

3-inch / 5-inch Projectiles - Yellow D - (192 Rounds)

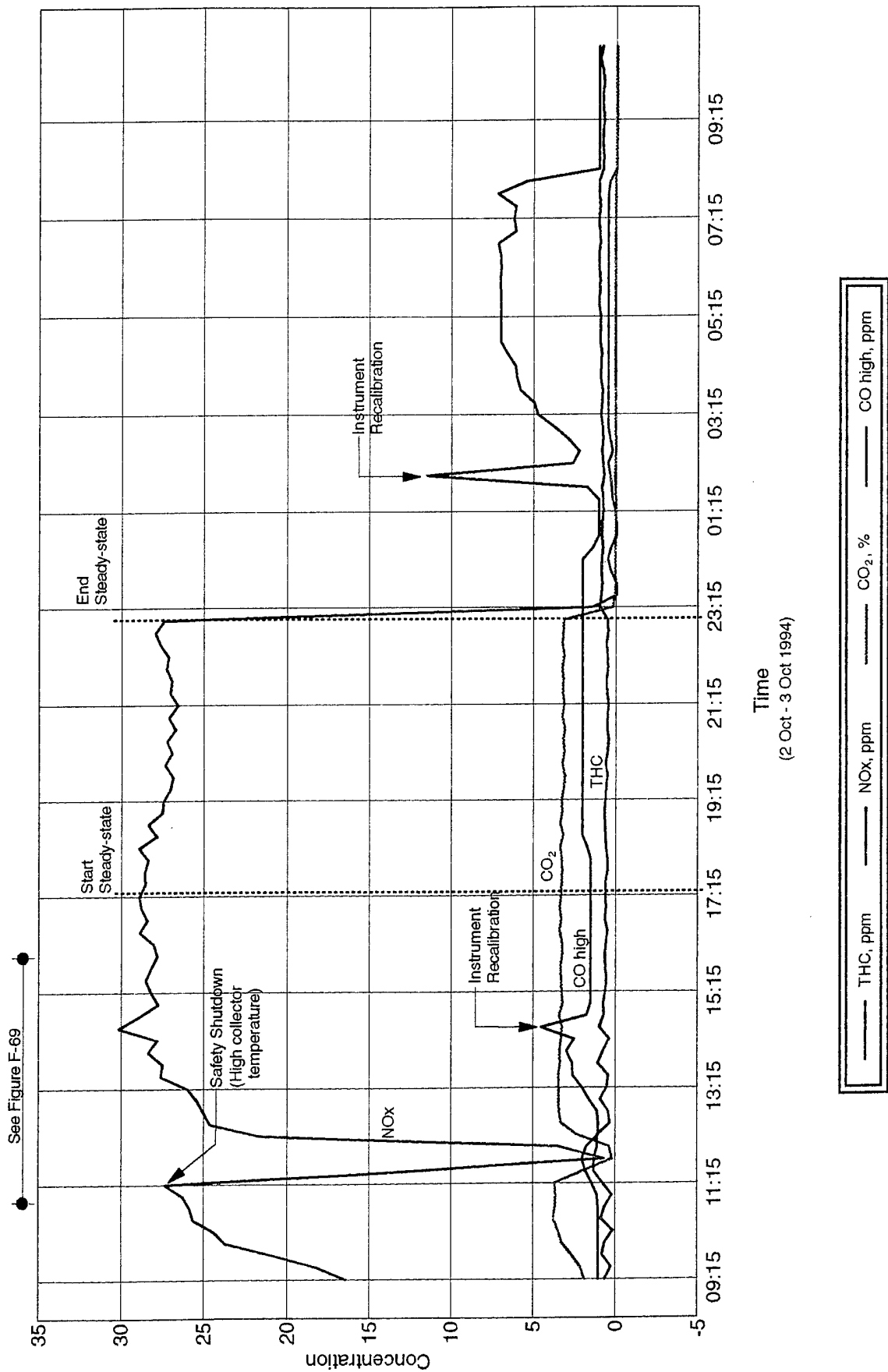


Figure F-68 Test 29 - CEM Profile - 15 minute Intervals

HGD Test 29

3-inch / 5-inch Projectiles - Yellow D - (192 rounds)

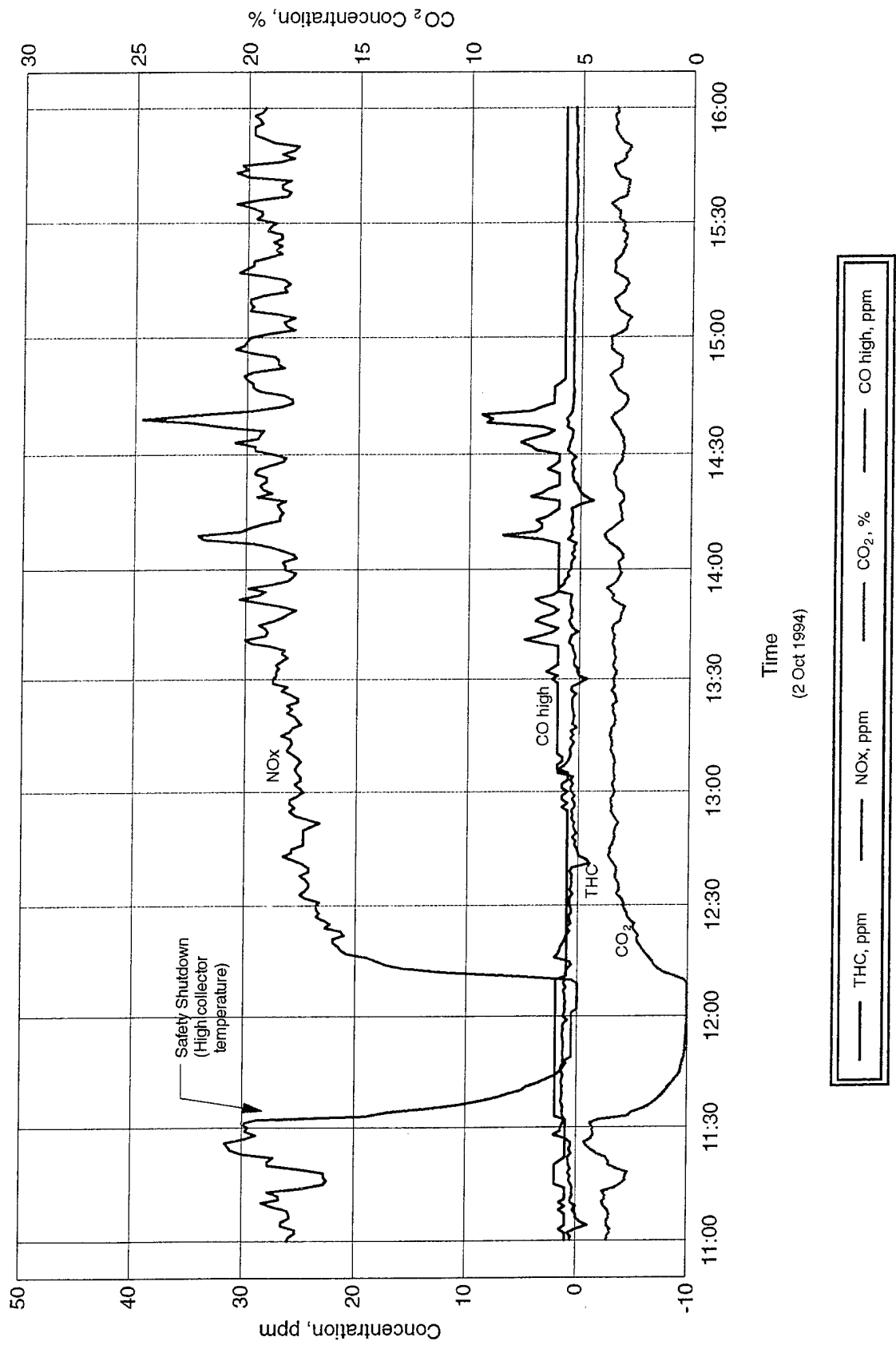


Figure F-69 Test 29 - CEM Profile - 1 minute Intervals

CHAMBER WIPES

Residue Accumulation from a Series of Tests

Tests: 1-29

Wipe #	Location in System	Operating Temperature*	Operating Temperature*	Explosive Concentration / Smear		Explosive Amount	Explosive Amount / Surface Area
		°F	°C	µg / smear RDX	µg / smear TNT	µg	mg / cm ²
1	Blank	NA	NA	<MDL	<MDL	ND	ND
2	Floor	521	272	<MDL	<MDL	ND	ND
3	Wall	NR	NR	<MDL	<MDL	ND	ND
4	Duct	608	320	<MDL	<MDL	ND	ND
5	Elbow	608	320	1.8018	<MDL	1.8018	1.1191E-05
6	Fanblade	608	320	<MDL	<MDL	ND	ND
7	Coldspot	410	210	<MDL	<MDL	ND	ND
8	Rail	582	306	1.001	1.094	2.095	1.3012E-05

Special Abbreviations: NA=Not Applicable; ND=Not Detectable; NR=No Record

*Average operating temperature of tests 2, 4-29. Test period also includes tests 1, 3, B2, B3, B4, C, D.

MDL for Analysis: 1 µg/smear RDX
 0.6 µg/smear TNT

Surface Area: 161 sq cm

Test "96"

Process Conditions

This test was conducted on 96 melted out 175mm projectiles which contained residues of Comp B explosive. The partial chamber load configuration is shown in Figure D-48. Test conditions were 2 hrs at 550°F (288°C). The oxidizer was started at 1212 hrs on 13 October with heat to the chamber at 1257 hrs. Steady state was reached at 0149 hrs on 14 October and the test was completed at 0350 hrs with a control system automatically initiated cooldown.

Special Conditions

- The test was performed as a preliminary test to a full chamber load test with 480 projectiles. The effects of the increased quantity of explosive residue (4 times greater than previous tests) on system operation was studied.
- The projectiles were palletized as described in Test D. Four pallets of melted out projectiles, two wide by two high, were placed in the chamber near the diffusers. The control thermocouple was located in a pallet of inert projectiles behind the melted out projectiles.

Comments

- A power interruption occurred at 1427 hrs. The oxidizer was restarted at 1444 hrs; back in process at 1518 hrs.
- Temperature peaks were noted at projectile temperatures of about 400°F (204°C).
- System operation was not effected by the increased quantity of explosive.

Table F-67

PROJECTILE EXTRACT SAMPLES

Test # "96"	Projectile Type:	175 mm	Date:	13 Oct 94
	Explosive Type:	Comp B	Heatup Time:	12.9 Hrs
	Explosive Source:	Demil	Time at Setpoint:	2.0 Hrs
	Temperature Setpoint:	550°F 288°C	Cooldown Time:	10.7 Hrs

Round #	Operating Temperature	Explosive Concentration		Sampling	Explosive	Explosive	DRE*
		µg / ml RDX	µg / ml TNT	Dilution	Amount	Amount / Surface Area	
				ml	µg	mg / cm ²	%
1	Range for all projectiles:	<MDL	<MDL	500	ND	ND	99.999
2	610°F - 795°F (321°C - 424°C)	<MDL	<MDL	500	ND	ND	99.999

Special Abbreviations: NA=Not Applicable; ND=Not Detectable; NR=No Record; s dev=standard deviation.

*The DRE results for samples denoted by <MDL are calculated based on a value of one-half the MDL.

Extracted Round No: None
 Estimated Round Amount: 20 grams

MDL for Analysis: 0.01 µg/ml RDX
 0.006 µg/ml TNT

Surface Area: 1923 sq cm

HGD Test "96"

175mm Projectiles - Comp B - (96 Rounds)

See Figure F-71

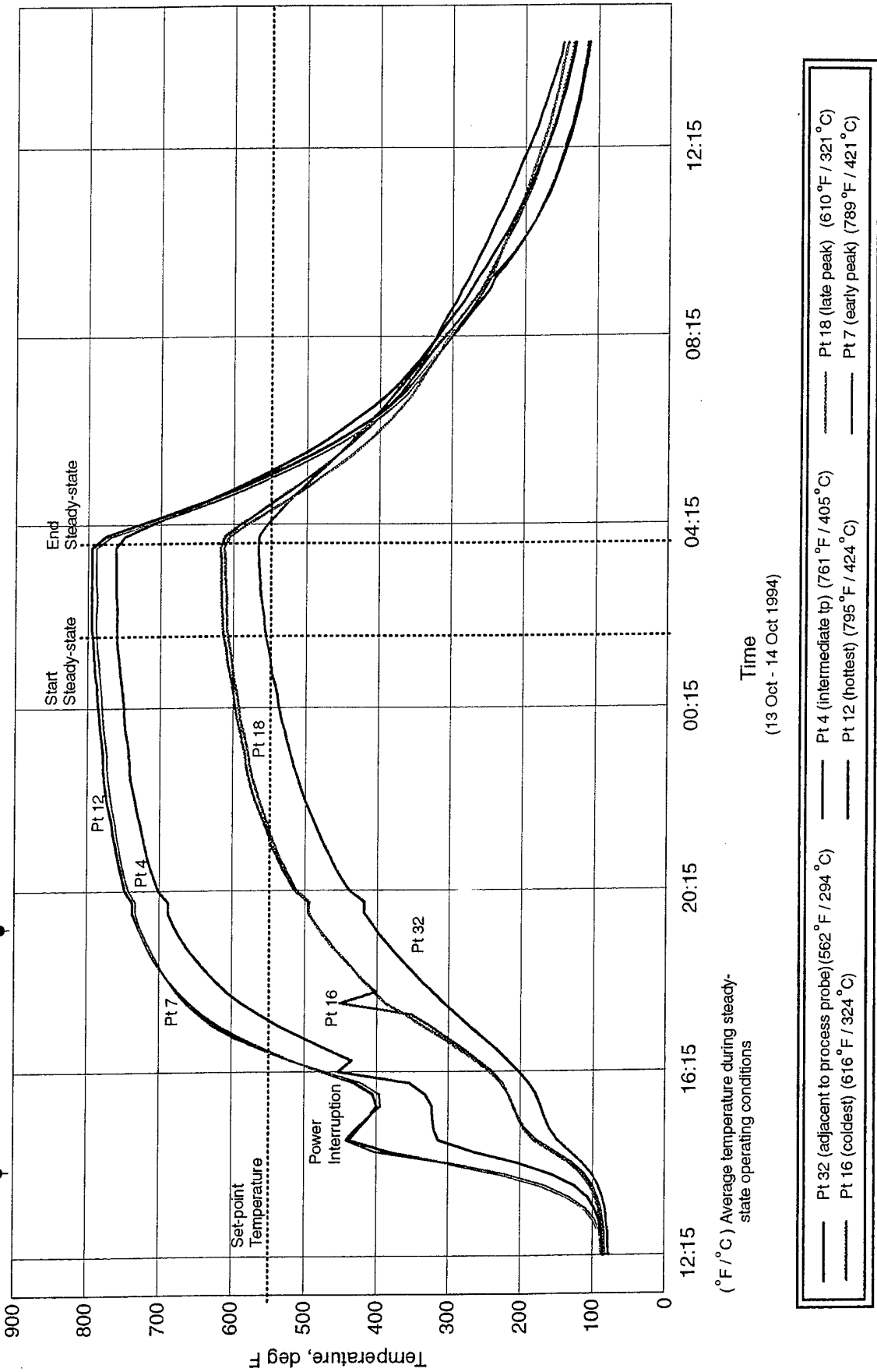


Figure F-70 Test "96" - Average Temperature Profile - 15 minute Intervals

HGD Test "96"

175mm Projectiles - Comp B - (96 Rounds)

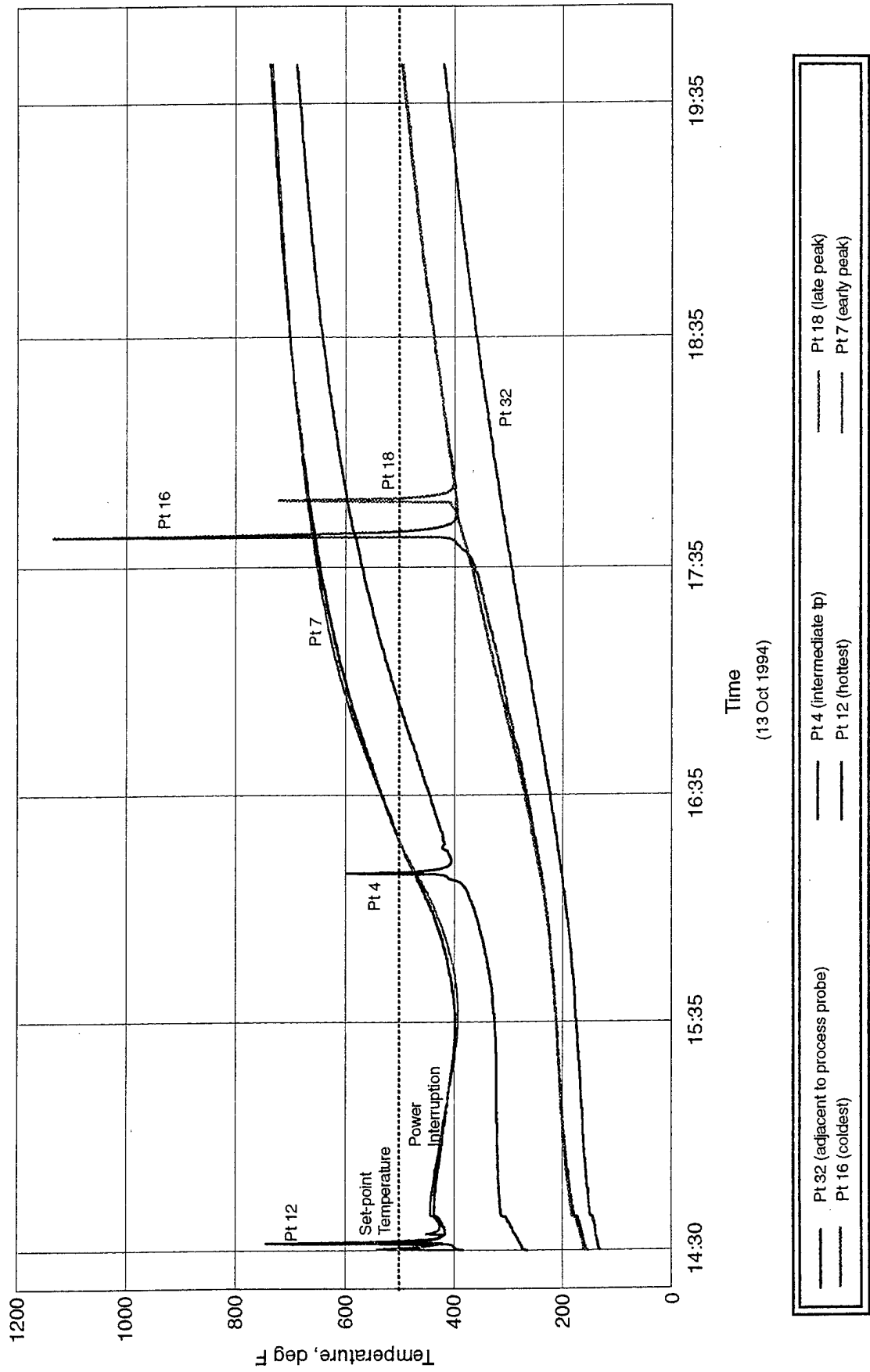


Figure F-71 Test "96" - Average Temperature Profile - 15 second Intervals

HGD Test "96" 175 mm Projectiles - Comp B - (96 Rounds)

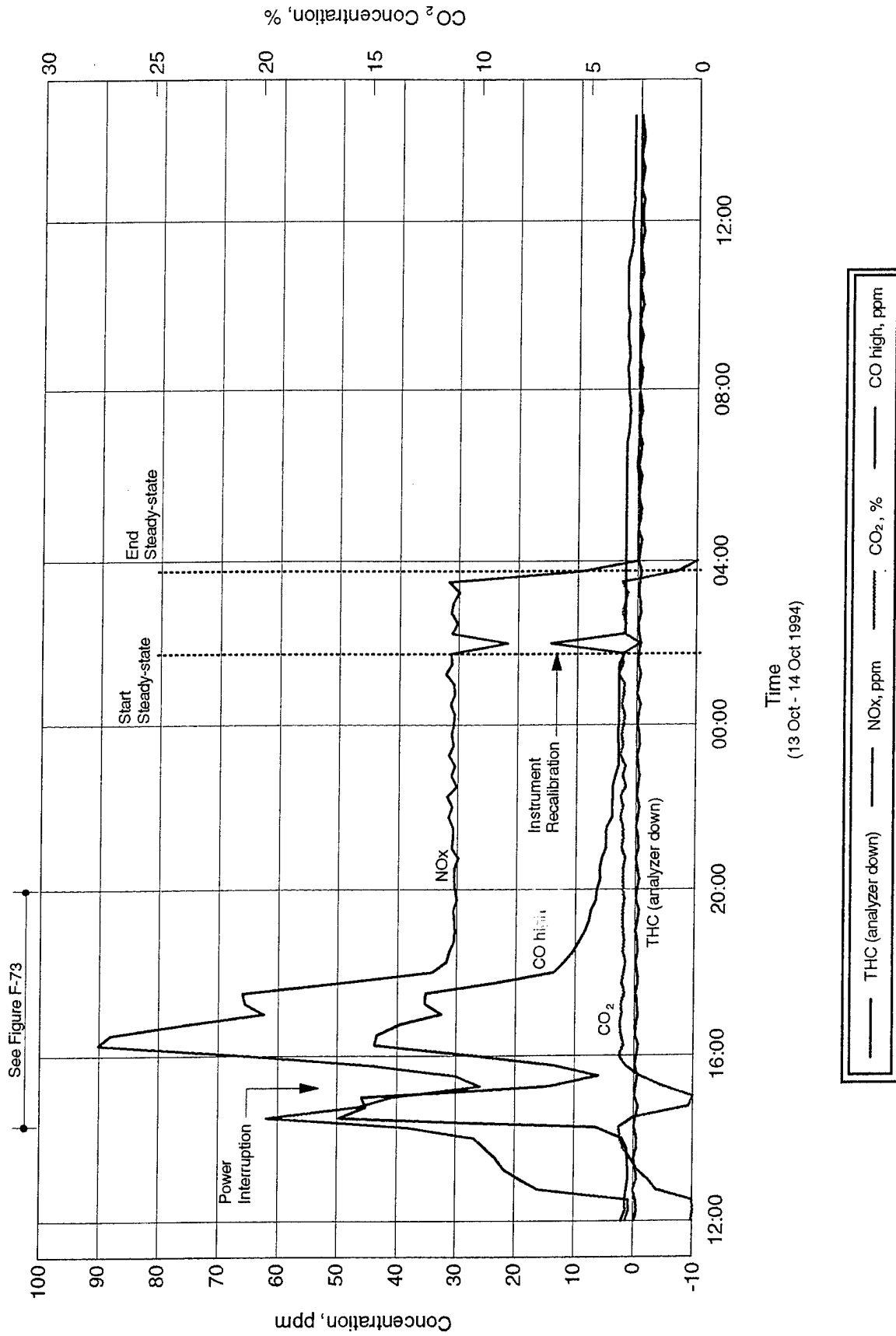


Figure F-72 Test "96" - CEM Profile - 15 minute Intervals

HGD Test "96"

175 mm Projectiles - Comp B - (96 Rounds)

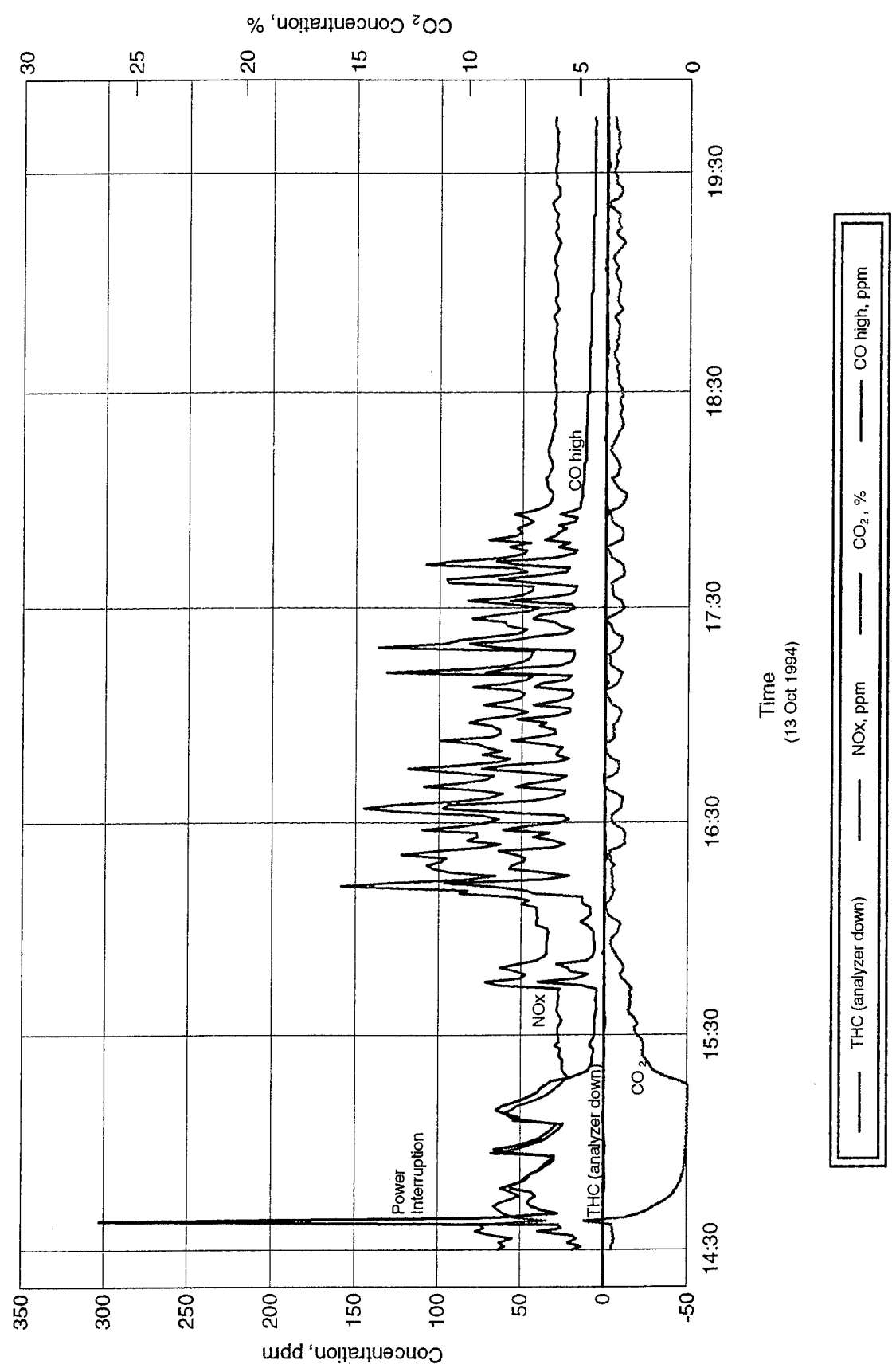


Figure F-73 Test "96" - CEM Profile - 1 minute Intervals

TEST 30

Process Conditions

This test was conducted on 480 demilitarized 175mm projectiles in a full chamber load configuration as shown in Figures D-49 and D49a. Test conditions were 6 hrs at 550°F (288°C). The oxidizer was started at 0637 hrs on 15 October with hot gas flow to the chamber at 0700 hrs. Steady state was reached at 0600 hrs on 16 October and the test was completed at 1203 hrs with a control system automatically initiated cooldown.

Special Conditions

- The test was performed as a trial test before the arrival of USACHPPM for stack sampling. The projectiles were palletized and arranged in the chamber as described in Test D. Thermocouple probes (32 TVA and 6 DZB) were installed in 38 projectiles. The measurement of the chamber temperatures was omitted.

Analytical Considerations

- Projectile and chamber wipe samples were taken on 18 October using acetonitrile. From the 38 projectiles that were monitored for temperature, the twenty-two TVA and two DZB projectiles with the lowest average steady state temperatures were sampled.

Comments

- Temperature peaks were noted during heatup from 0922 until 1830 hrs. There was a projectile temperature spread of about 280°F (156°C) during steady state operation.

CEM

- Peaks were noted on the CEM during heatup from 0855 to 1600 hrs with maximum readings at 1130 to 1145 hrs.
- NOTE: The peaks in the CEM correspond to the times when "flashes" are observed in the temperature probes.

Table F-68

PROJECTILE EXTRACT SAMPLES

Test # 30	Projectile Type:	175 mm	Date:	15 Oct 94
	Explosive Type:	Comp B	Heatup Time:	23.0 Hrs
	Explosive Source:	Demil	Time at Setpoint:	6.0 Hrs
	Temperature Setpoint:	550°F 288°C	Cooldown Time:	18.0 Hrs

Round #	Operating Temperature		Operating Temperature		Explosive Concentration		Sampling Dilution ml	Explosive Amount µg	Explosive Amount / Surface Area mg / cm ²	DRE* %
	°F	s dev	°C	s dev	µg / ml RDX	µg / ml TNT				
1	606	4.67	319	2.60	<MDL	<MDL	500	ND	ND	99.999
2	602	4.74	316	2.63	<MDL	<MDL	500	ND	ND	99.999
3	594	4.86	312	2.70	<MDL	<MDL	500	ND	ND	99.999
4	556	4.82	291	2.68	<MDL	<MDL	500	ND	ND	99.999
5	688	3.55	364	1.97	<MDL	<MDL	500	ND	ND	99.999
6	706	3.02	375	1.68	<MDL	<MDL	500	ND	ND	99.999
7	619	5.72	326	3.18	<MDL	<MDL	500	ND	ND	99.999
8	589	6.54	310	3.63	<MDL	<MDL	500	ND	ND	99.999
9	599	6.93	315	3.85	<MDL	<MDL	500	ND	ND	99.999
10	579	6.40	304	3.56	<MDL	<MDL	500	ND	ND	99.999
11	592	5.77	311	3.21	<MDL	<MDL	500	ND	ND	99.999
12	617	6.24	325	3.47	<MDL	<MDL	500	ND	ND	99.999
13	658	8.12	348	4.51	<MDL	<MDL	500	ND	ND	99.999
14	625	7.18	329	3.99	<MDL	<MDL	500	ND	ND	99.999
15	644	6.94	340	3.86	<MDL	<MDL	500	ND	ND	99.999
16	613	7.11	323	3.95	<MDL	<MDL	500	ND	ND	99.999
17	634	6.88	335	3.82	<MDL	<MDL	500	ND	ND	99.999
18	668	5.46	353	3.04	<MDL	<MDL	500	ND	ND	99.999
19	721	3.13	383	1.74	<MDL	<MDL	500	ND	ND	99.999
25	728	2.62	387	1.46	<MDL	<MDL	500	ND	ND	99.999
31	704	4.16	373	2.31	<MDL	<MDL	500	ND	ND	99.999
32	677	3.07	358	1.70	<MDL	<MDL	500	ND	ND	99.999
E	569	6.03	298	3.35	<MDL	<MDL	500	ND	ND	99.999
F	576	5.18	302	2.88	<MDL	<MDL	500	ND	ND	99.999

Special Abbreviations: NA=Not Applicable; ND=Not Detectable; NR=No Record; s dev=standard deviation.

*The DRE results for samples denoted by <MDL are calculated based on a value of one-half the MDL.

Extracted Round No: None
 Estimated Round Amount: 20 grams
 MDL for Analysis: 0.01 µg/ml RDX
 0.006 µg/ml TNT
 Surface Area: 1923 sq cm

CHAMBER WIPES

Test # 30	Chamber Load:	175 mm	Date:	15 Oct 94
	Explosive Type:	Comp B	Heatup Time:	23.0 Hrs
	Explosive Source:	Spiked	Time at Setpoint:	6.0 Hrs
	Temperature Setpoint:	550°F 288°C	Cooldown Time:	18.0 Hrs

Wipe #	Location in System	Operating Temperature	Operating Temperature	Explosive Concentration / Smear		Explosive Amount	Explosive Amount / Surface Area
		°F	°C	µg / smear RDX	µg / smear TNT	µg	mg / cm ²
1	Blank	NA	NA	<MDL	<MDL	ND	ND
2	Floor	NR	NR	<MDL	<MDL	ND	ND
3	Wall	NR	NR	<MDL	<MDL	ND	ND
4	Duct	NR	NR	<MDL	<MDL	ND	ND
5	Elbow	NR	NR	<MDL	<MDL	ND	ND
6	Fanblade	NR	NR	<MDL	<MDL	ND	ND
7	Coldspot	NR	NR	<MDL	<MDL	ND	ND
8	Rail	NR	NR	3.3534	3.4327	6.7861	4.2150E-05

Special Abbreviations: NA=Not Applicable; ND=Not Detectable; NR=No Record

MDL for Analysis: 1 µg/smear RDX
0.6 µg/smear TNT

Surface Area: 161 sq cm

HGD Test 30

175mm Projectiles - Comp B - (480 Rounds)

See Figure F-75

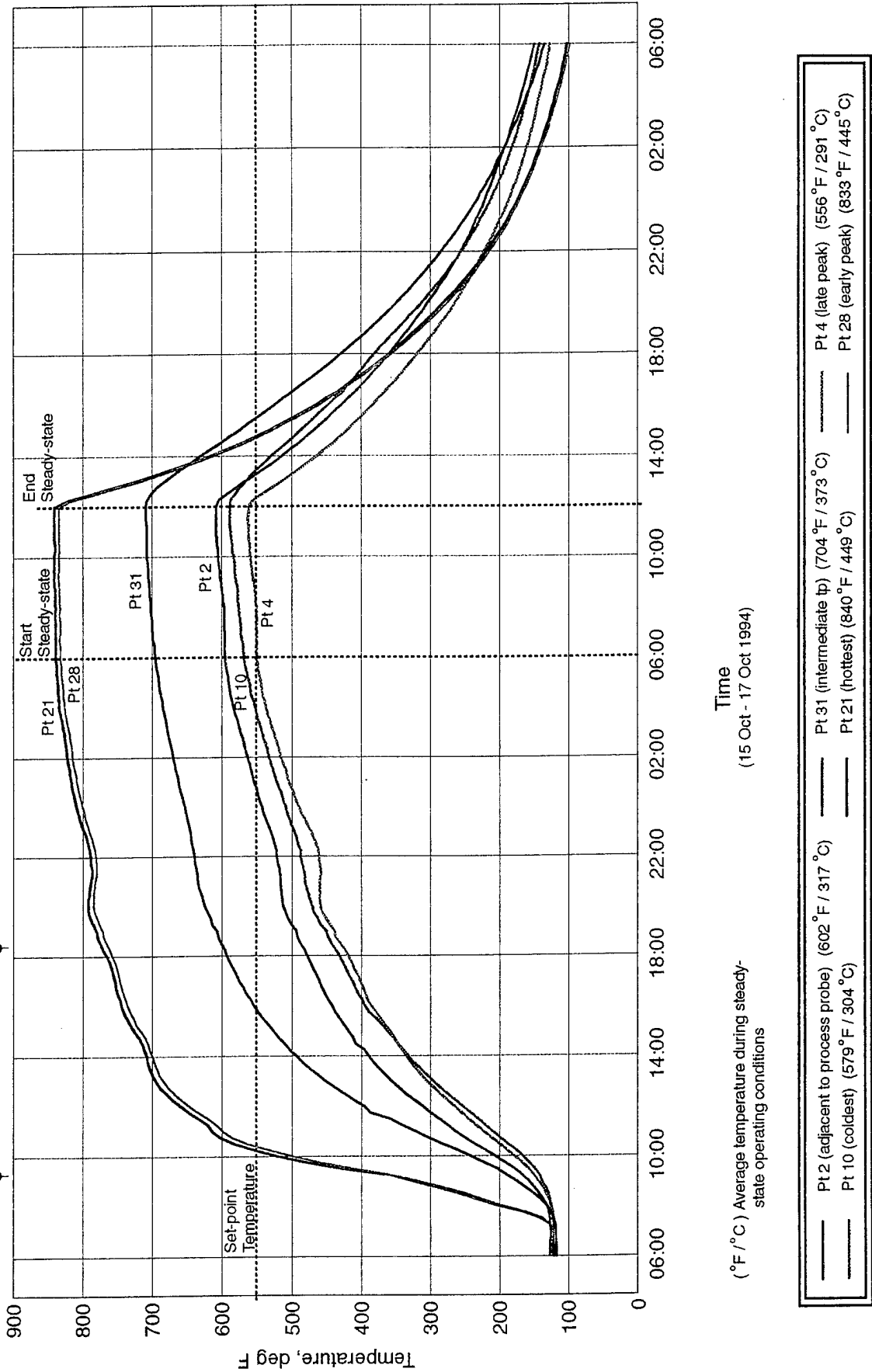


Figure F-74 Test 30 - Average Temperature Profile - 15 minute Intervals

HGD Test 30

175mm Projectiles - Comp B - (480 Rounds)

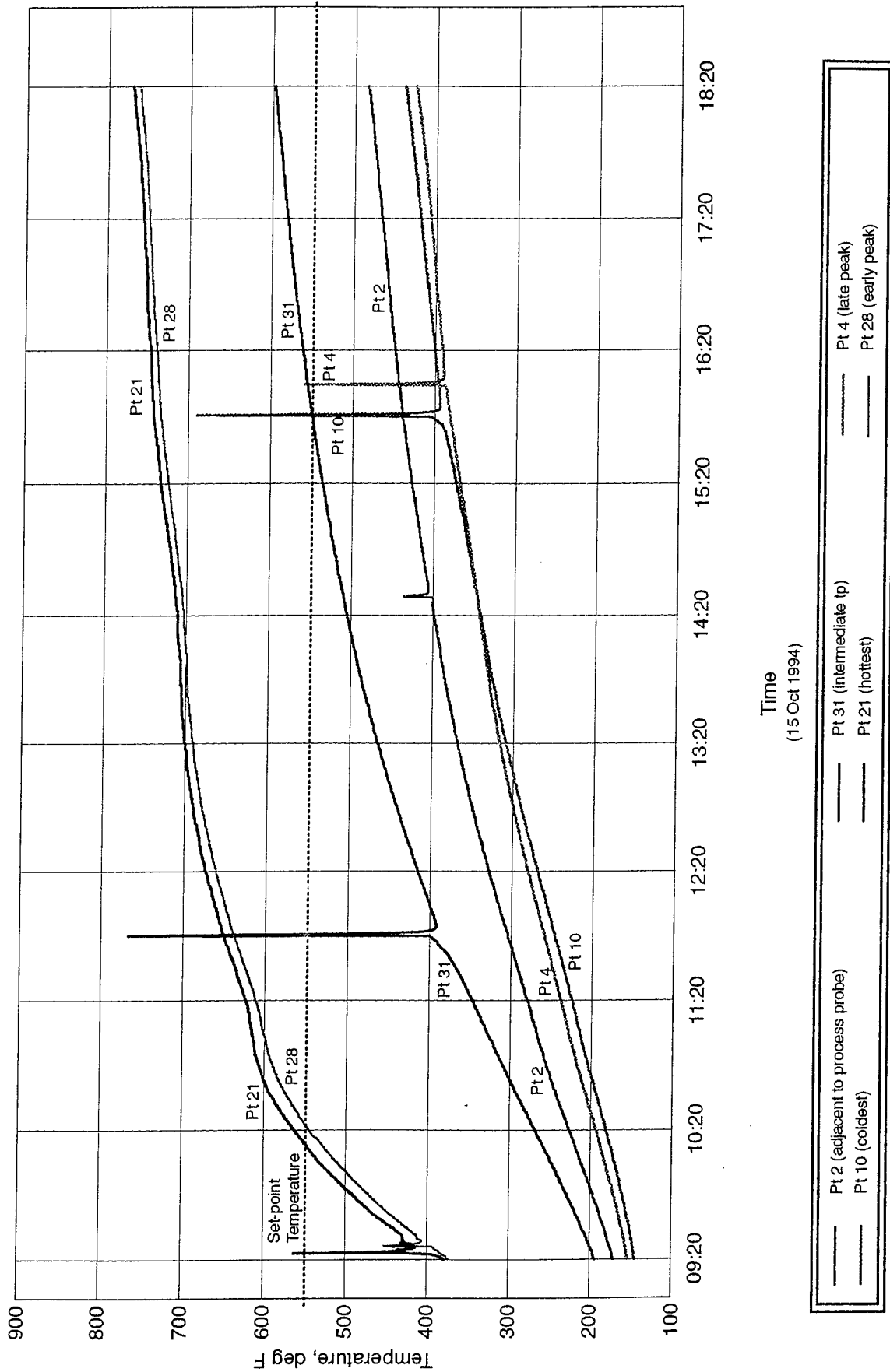
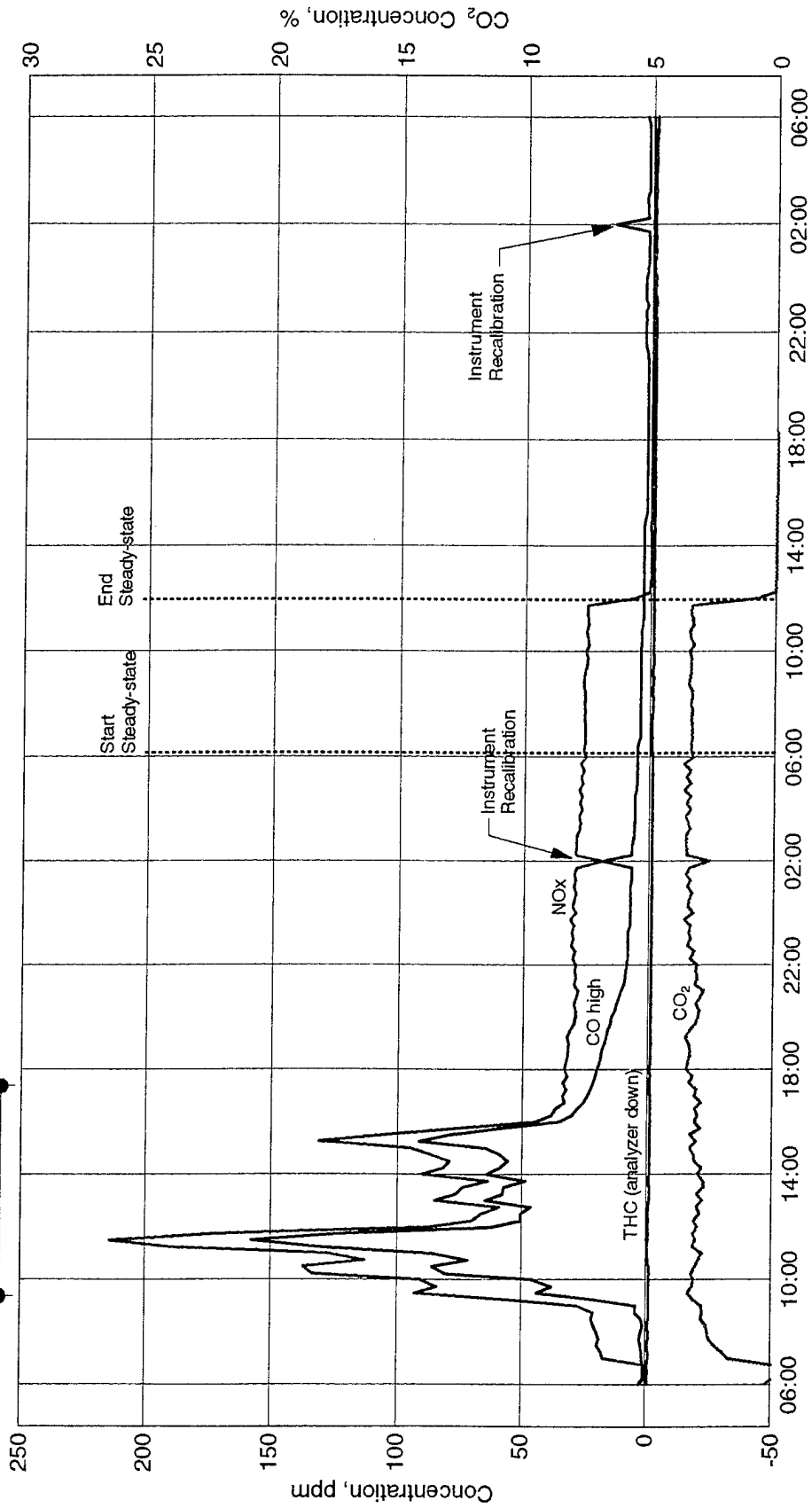


Figure F-75 Test 30 - Average Temperature Profile - 15 second Intervals

HGD Test 30 175 mm Projectiles - Comp B - (480 Rounds)

See Figure F-77



Time
(15 Oct - 17 Oct 1994)

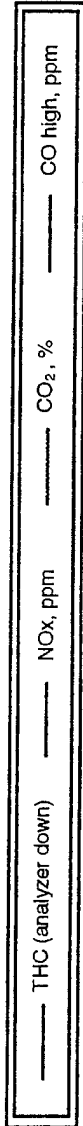
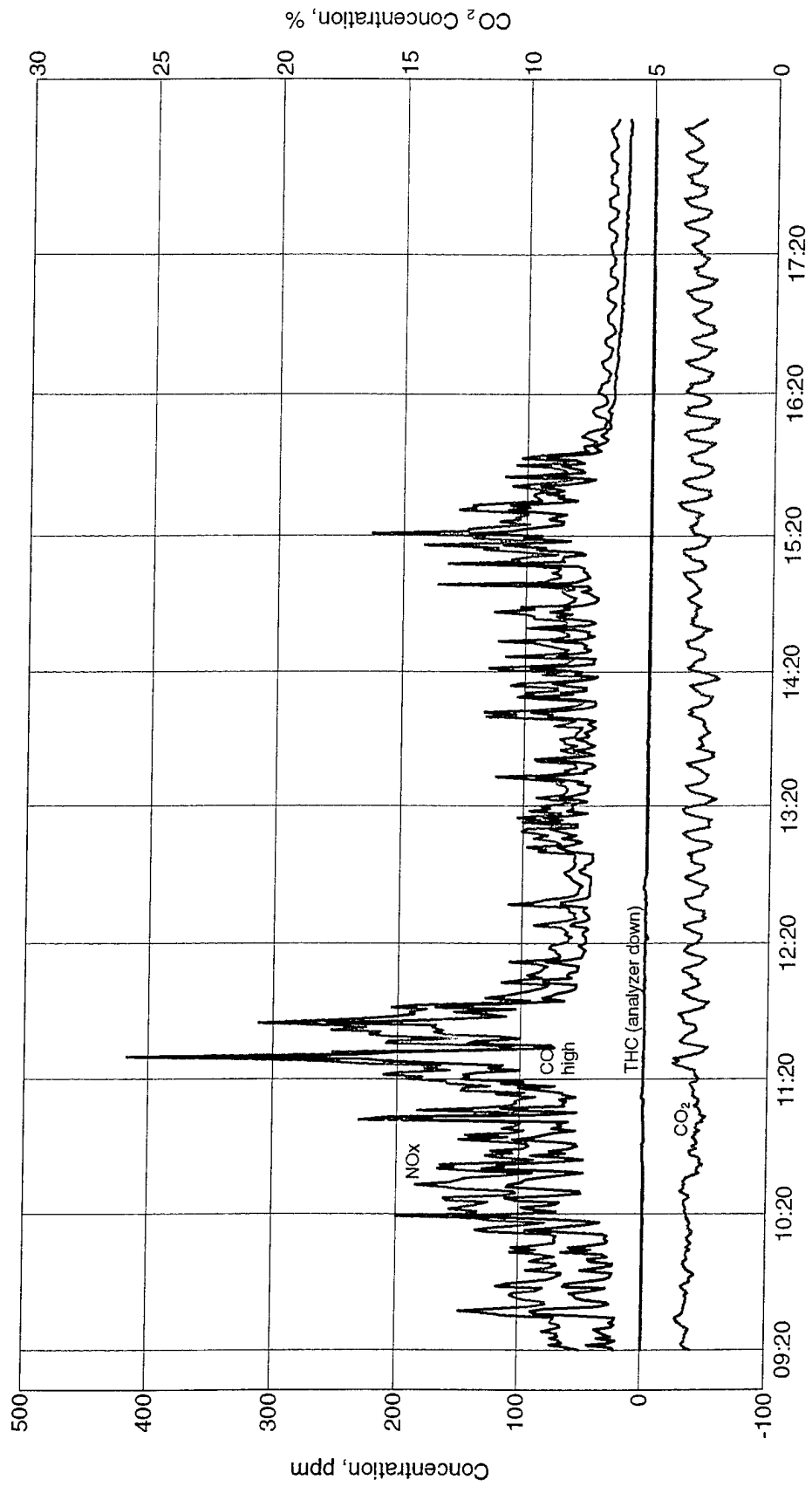


Figure F-76 Test 30 - CEM Profile - 15 minute intervals

HGD Test 30

175 mm Projectiles - Comp B - (480 Rounds)



Time
(15 Oct 1994)

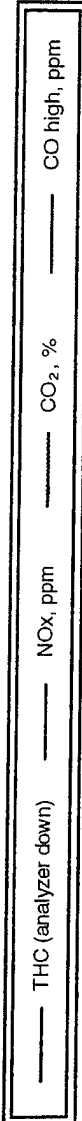


Figure F-77 Test 30 - CEM Profile - 1 minute Intervals

TEST 31

Process Conditions

This test was conducted under the same test conditions as Test 30, [(6 hrs at 550°F, (288°C) 480-175mm projectiles containing Comp B residue]. The chamber configuration is shown in Figures D-50 and D-50a. The oxidizer was started at 0614 hrs on 20 October with hot gas flow to the chamber at 0714 hrs. Steady state was reached at 0049 hrs on 21 October and the test was completed at 0650 hrs with a control system automatically initiated cooldown.

Special Conditions

- This test was the first in a series of four tests for atmospheric emissions sampling of the exhaust stack by USACHPPM. The data will be used in an application for a NPED permit for production mode operation of the system.
- USACHPPM began stack sampling for particulates, total hydrocarbons, NO_x, CO, and SO₂ at 1140 hrs but sampling was discontinued at 1305 hrs due to a broken glass joint in the sample train. Stack sampling for metals was taken from 0530 to 0630 hrs the morning of 21 October. (Their results are detailed in Appendix G.)

Analytical Considerations

- Projectile and chamber wipe samples were taken using acetonitrile. From the 38 projectiles that were monitored for temperature, the twenty-two TVA and two DZB projectiles with the lowest average steady state temperatures were sampled.

Comments

- USACHPPM had a problem with a pitot tube connection at 1020 hrs. The system was placed in manual. USACHPPM repaired the connection and heatup was resumed at 1035 hrs. System safety shutdown at 1042 hrs due to high collector temperature (probably due to manual manipulation of the system). Oxidizer was restarted at 1050 hrs with heat to the chamber at 1117 hrs.

CEM

- Temperature and CEM peaks were noted during heatup from 0845 until 1500 hrs.
- It appears that the CEM peaks correspond to the times when the shells are autoigniting (thermal degrading).

Table F-70

PROJECTILE EXTRACT SAMPLES

Test # 31	Projectile Type:	175 mm	Date:	19 Oct 94
	Explosive Type:	Comp B	Heatup Time:	17.6 Hrs
	Explosive Source:	Demil	Time at Setpoint:	6.0 Hrs
	Temperature Setpoint:	550°F 288°C	Cooldown Time:	16.9 Hrs

Round #	Operating Temperature		Operating Temperature		Explosive Concentration		Sampling Dilution ml	Explosive Amount µg	Explosive Amount / Surface Area mg / cm ²	DRE* %
	°F	s dev	°C	s dev	µg / ml RDX	µg / ml TNT				
1	602	9.25	317	5.14	<MDL	<MDL	500	ND	ND	99.999
2	591	9.46	311	5.26	<MDL	<MDL	500	ND	ND	99.999
3	580	9.99	305	5.55	<MDL	<MDL	500	ND	ND	99.999
4	606	9.77	319	5.43	<MDL	<MDL	500	ND	ND	99.999
5	699	6.66	371	3.70	<MDL	<MDL	500	ND	ND	99.999
6	704	6.98	373	3.88	<MDL	<MDL	500	ND	ND	99.999
7	605	10.38	318	5.77	<MDL	<MDL	500	ND	ND	99.999
8	608	10.46	320	5.81	<MDL	<MDL	500	ND	ND	99.999
9	606	11.14	319	6.19	<MDL	<MDL	500	ND	ND	99.999
10	586	10.98	308	6.10	0.011	<MDL	500	5.500	2.8601E-06	99.999
11	596	10.93	313	6.07	<MDL	<MDL	500	ND	ND	99.999
12	613	11.33	323	6.30	<MDL	<MDL	500	ND	ND	99.999
13	634	10.02	335	5.56	<MDL	<MDL	500	ND	ND	99.999
14	642	11.18	339	6.21	<MDL	<MDL	500	ND	ND	99.999
15	658	10.16	348	5.64	<MDL	<MDL	500	ND	ND	99.999
16	614	11.63	323	6.46	<MDL	<MDL	500	ND	ND	99.999
17	659	10.88	348	6.05	<MDL	<MDL	500	ND	ND	99.999
18	660	10.53	349	5.85	<MDL	<MDL	500	ND	ND	99.999
19	747	8.04	397	4.46	<MDL	<MDL	500	ND	ND	99.999
23	777	8.81	414	4.89	<MDL	0.0075	500	3.750	1.9501E-06	99.999
24	772	7.66	411	4.26	<MDL	<MDL	500	ND	ND	99.999
32	686	6.06	363	3.37	<MDL	<MDL	500	ND	ND	99.999
E	576	10.14	302	5.64	<MDL	<MDL	500	ND	ND	99.999
F	554	8.76	290	4.86	<MDL	<MDL	500	ND	ND	99.999

Special Abbreviations: NA=Not Applicable; ND=Not Detectable; NR=No Record; s dev=standard deviation.

*The DRE results for samples denoted by <MDL are calculated based on a value of one-half the MDL.

Extracted Round No: None
 Estimated Round Amount: 20 grams
 MDL for Analysis: 0.01 µg/ml RDX
 0.006 µg/ml TNT
 Surface Area: 1923 sq cm

Table F-71

CHAMBER WIPES

Test # 31	Chamber Load:	175 mm	Date:	19 Oct 94
	Explosive Type:	Comp B	Heatup Time:	17.6 Hrs
	Explosive Source:	Spiked	Time at Setpoint:	6.0 Hrs
	Temperature Setpoint:	550°F 288°C	Cooldown Time:	16.9 Hrs

Wipe #	Location in System	Operating Temperature	Operating Temperature	Explosive Concentration / Smear		Explosive Amount	Explosive Amount / Surface Area
		°F	°C	µg / smear RDX	µg / smear TNT	µg	mg / cm ²
1	Blank	NA	NA	<MDL	<MDL	ND	ND
2	Floor	NR	NR	<MDL	<MDL	ND	ND
3	Wall	NR	NR	<MDL	<MDL	ND	ND
4	Duct	NR	NR	<MDL	<MDL	ND	ND
5	Elbow	NR	NR	<MDL	1.6975	1.6975	1.0543E-05
6	Fanblade	NR	NR	<MDL	<MDL	ND	ND
7	Coldspot	NR	NR	<MDL	<MDL	ND	ND
8	Rail	NR	NR	3.8038	4.3381	8.1419	5.0571E-05

Special Abbreviations: NA=Not Applicable; ND=Not Detectable; NR=No Record

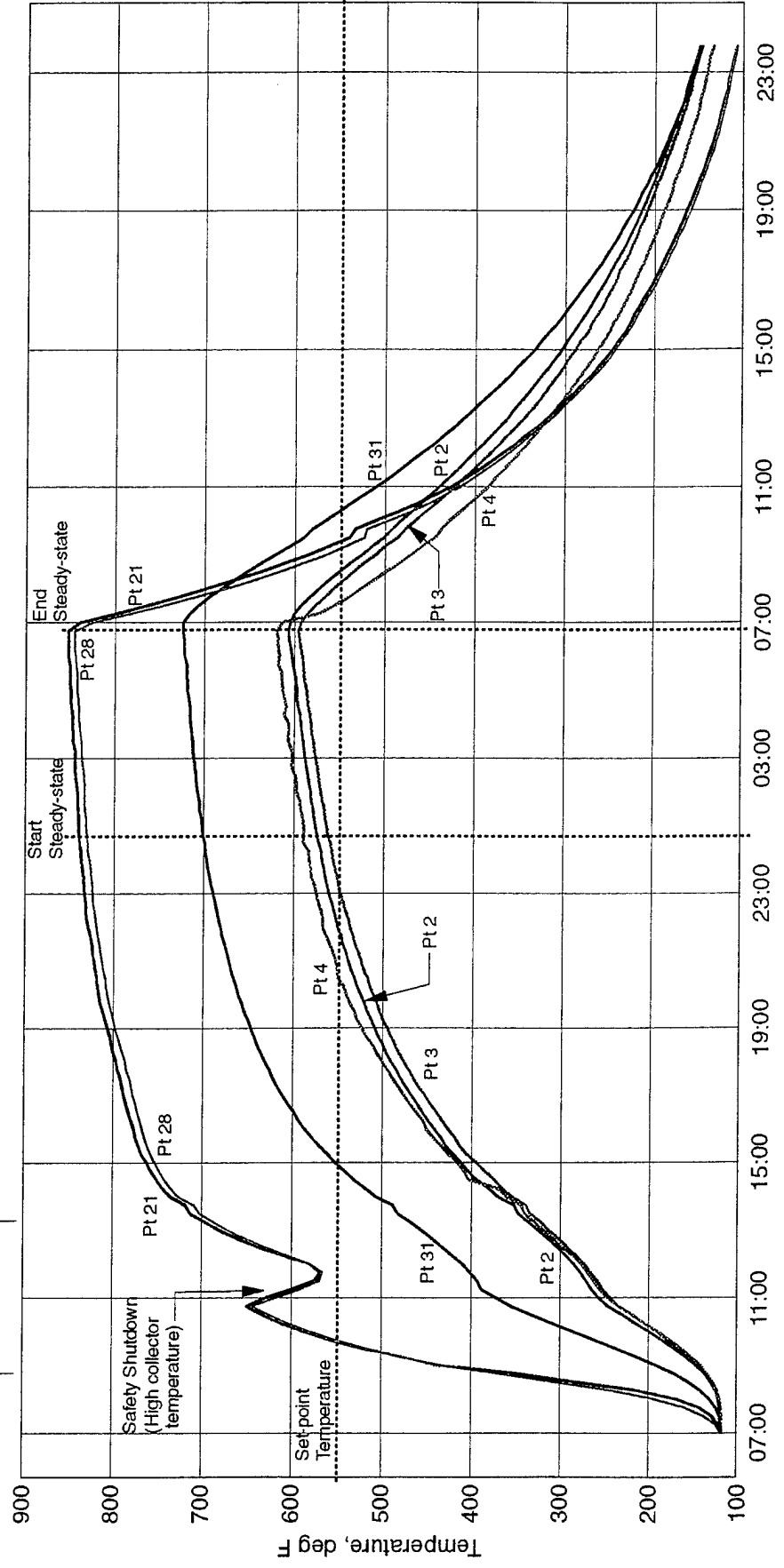
MDL for Analysis: 1 µg/smear RDX
0.6 µg/smear TNT

Surface Area: 161 sq cm

HGD Test 31

175mm Projectiles - Comp B - (480 Rounds)

See Figure F-79



(°F/°C) Average temperature during steady-state operating conditions

Time
(20 Oct - 21 Oct 1994)

——	Pt 2 (adjacent to process probe) (591 °F / 311 °C)	——	Pt 31 (intermediate tp) (714 °F / 379 °C)	——	Pt 4 (late peak) (606 °F / 319 °C)
——	Pt 3 (coldest) (580 °F / 305 °C)	——	Pt 21 (hottest) (846 °F / 452 °C)	——	Pt 28 (early peak) (838 °F / 448 °C)

Figure F-78 Test 31 - Average Temperature Profile - 15 minute Intervals

HGD Test 31

175mm Projectiles - Comp B - (480 Rounds)

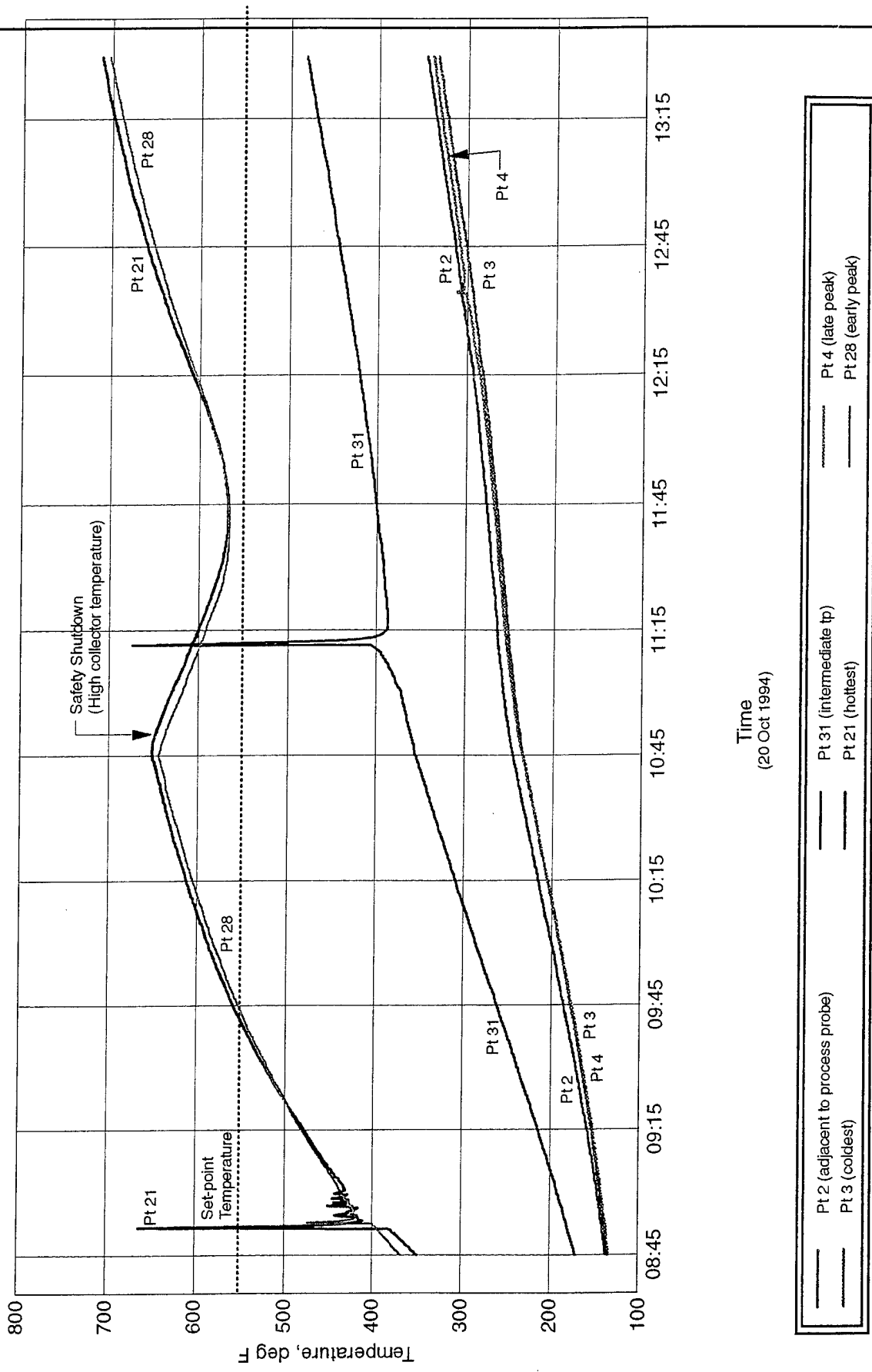


Figure F-79 Test 31 - Average Temperature Profile - 15 second Intervals

HGD Test 31

175 mm Projectiles - Comp B - (480 Rounds)

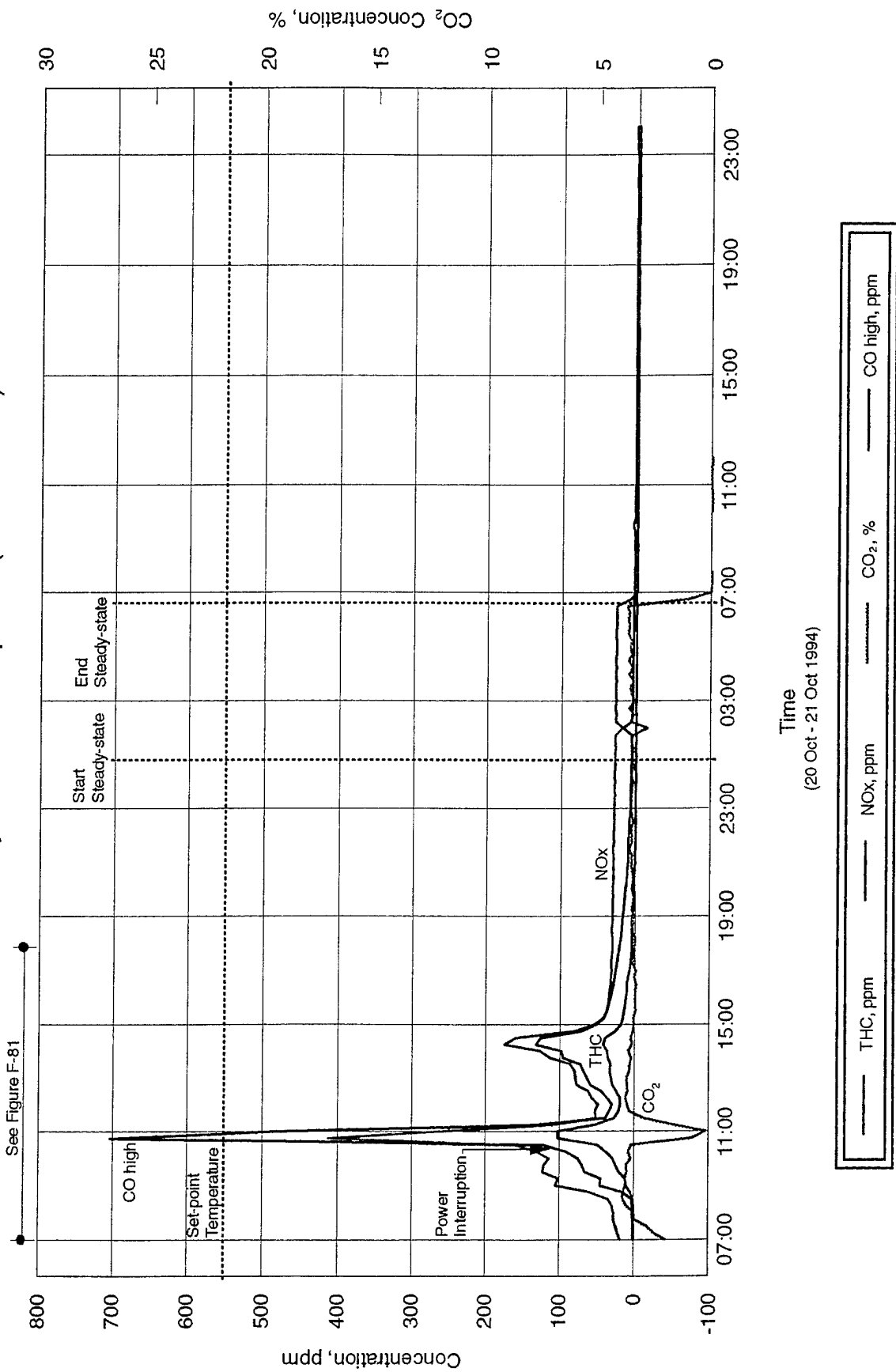


Figure F-80 Test 31 - CEM Profile - 15 minute Intervals

HGD Test 31

175 mm Projectiles - Comp B - (480 Rounds)

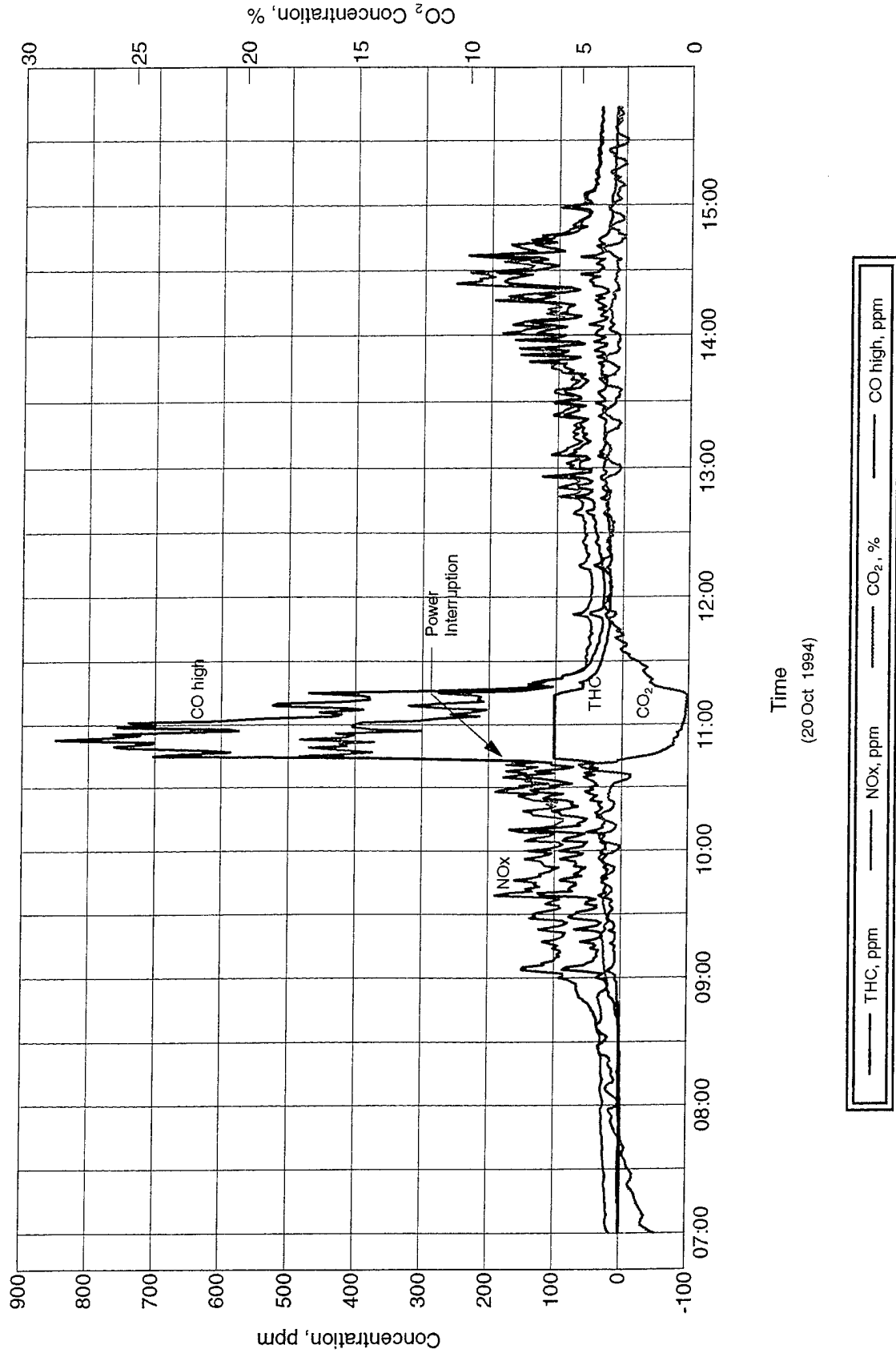


Figure F-81 Test 31 - CEM Profile - 1 minute Intervals

TEST 32

Process Conditions

This test was conducted under the same test conditions as Tests 30 and 31, (6 hrs at 550°F (288°C), 480-175mm projectiles containing Comp B residue). The chamber configuration is shown in Figures D-51 and D-51a. The oxidizer was started at 0826 hrs on 23 October with heat to the chamber at 0911 hrs. Steady state was reached at 0244 hrs on 24 October and the test was completed at 0845 hrs with a control system automatically initiated cooldown.

Special Conditions

- This test was the second of four stack sampling tests. USACHPPM sampled the stack for particulates, total hydrocarbons, NO_x, CO, and SO₂ from 1100 to 1345 hrs on 23 October. Metal sampling was done the next morning.
- Gas samples of the chamber exhaust duct were taken during heatup from 1100 to 1345 hrs by TVA.

Analytical Considerations

- Projectile and chamber wipe samples were taken using acetonitrile. From the 38 projectiles that were monitored for temperature, the twenty-two TVA and two DZB projectiles with the lowest average steady state temperatures were sampled.

Comments

- Temperature peaks began during heatup at 1053 hrs.

CEM

- CEM peaks began during heatup at 1115 hrs with the most activity between 1300 and 1500 hrs. This is also the time frame when temperature spikes were observed.

Table F-72

PROJECTILE EXTRACT SAMPLES

Test # 32	Projectile Type:	175 mm	Date:	23 Oct 94
	Explosive Type:	Comp B	Heatup Time:	17.6 Hrs
	Explosive Source:	Demil	Time at Setpoint:	6.0 Hrs
	Temperature Setpoint:	550°F 288°C	Cooldown Time:	17.8 Hrs

Round #	Operating Temperature		Operating Temperature		Explosive Concentration		Sampling Dilution ml	Explosive Amount µg	Explosive Amount / Surface Area mg / cm ²	DRE*
	°F	s dev	°C	s dev	µg / ml RDX	µg / ml TNT				
1	598	5.82	315	3.24	<MDL	<MDL	500	ND	ND	99.999
2	587	6.33	308	3.52	<MDL	<MDL	500	ND	ND	99.999
3	574	6.49	301	3.61	<MDL	<MDL	500	ND	ND	99.999
4	557	6.23	292	3.46	<MDL	<MDL	500	ND	ND	99.999
5	693	4.34	367	2.41	0.011	<MDL	500	5.500	2.8601E-06	99.999
6	703	4.30	373	2.39	0.012	<MDL	500	6.000	3.1201E-06	99.999
7	598	7.60	315	4.22	<MDL	<MDL	500	ND	ND	99.999
8	594	7.86	312	4.37	<MDL	<MDL	500	ND	ND	99.999
9	601	8.13	316	4.52	<MDL	<MDL	500	ND	ND	99.999
10	582	8.23	306	4.57	<MDL	<MDL	500	ND	ND	99.999
11	594	7.45	312	4.14	<MDL	<MDL	500	ND	ND	99.999
12	647	7.50	342	4.17	<MDL	<MDL	500	ND	ND	99.999
13	626	7.89	330	4.38	<MDL	<MDL	500	ND	ND	99.999
14	637	8.14	336	4.52	<MDL	<MDL	500	ND	ND	99.999
15	657	7.60	347	4.22	<MDL	<MDL	500	ND	ND	99.999
16	620	8.50	326	4.72	<MDL	<MDL	500	ND	ND	99.999
17	639	8.53	337	4.74	<MDL	<MDL	500	ND	ND	99.999
18	673	7.29	356	4.05	<MDL	<MDL	500	ND	ND	99.999
19	728	5.94	387	3.30	<MDL	<MDL	500	ND	ND	99.999
25	718	3.92	381	2.18	<MDL	<MDL	500	ND	ND	99.999
30	739	4.61	393	2.56	<MDL	<MDL	500	ND	ND	99.999
31	709	4.70	376	2.61	<MDL	<MDL	500	ND	ND	99.999
E	573	6.75	301	3.75	<MDL	<MDL	500	ND	ND	99.999
F	555	5.78	291	3.21	<MDL	<MDL	500	ND	ND	99.999

Special Abbreviations: NA=Not Applicable; ND=Not Detectable; NR=No Record; s dev=standard deviation.

*The DRE results for samples denoted by <MDL are calculated based on a value of one-half the MDL.

Extracted Round No: None
Estimated Round Amount: 20 grams

MDL for Analysis: 0.01 µg/ml RDX
0.006 µg/ml TNT

Surface Area: 1923 sq cm

CHAMBER WIPES

Test # <u>32</u>	Chamber Load:	<u>175 mm</u>	Date:	<u>23 Oct 94</u>
	Explosive Type:	<u>Comp B</u>	Heatup Time:	<u>17.6 Hrs</u>
	Explosive Source:	<u>Spiked</u>	Time at Setpoint:	<u>6.0 Hrs</u>
	Temperature Setpoint:	<u>550°F</u> <u>288°C</u>	Cooldown Time:	<u>17.8 Hrs</u>

Wipe #	Location in System	Operating Temperature	Operating Temperature	Explosive Concentration / Smear		Explosive Amount	Explosive Amount / Surface Area
		°F	°C	µg / smear RDX	µg / smear TNT	µg	mg / cm ²
1	Blank	NA	NA	<MDL	1.0185	1.0185	6.3261E-06
2	Floor	NR	NR	<MDL	1.1317	1.1317	7.0292E-06
3	Wall	NR	NR	<MDL	1.358	1.358	8.4348E-06
4	Duct	NR	NR	<MDL	1.2826	1.2826	7.9665E-06
5	Elbow	NR	NR	<MDL	1.358	1.358	8.4348E-06
6	Fanblade	NR	NR	<MDL	0.9053	0.9053	5.6230E-06
7	Coldspot	NR	NR	<MDL	0.9808	0.9808	6.0919E-06
8	Rail	NR	NR	2.5526	<MDL	2.5526	1.5855E-05

Special Abbreviations: NA=Not Applicable; ND=Not Detectable; NR=No Record

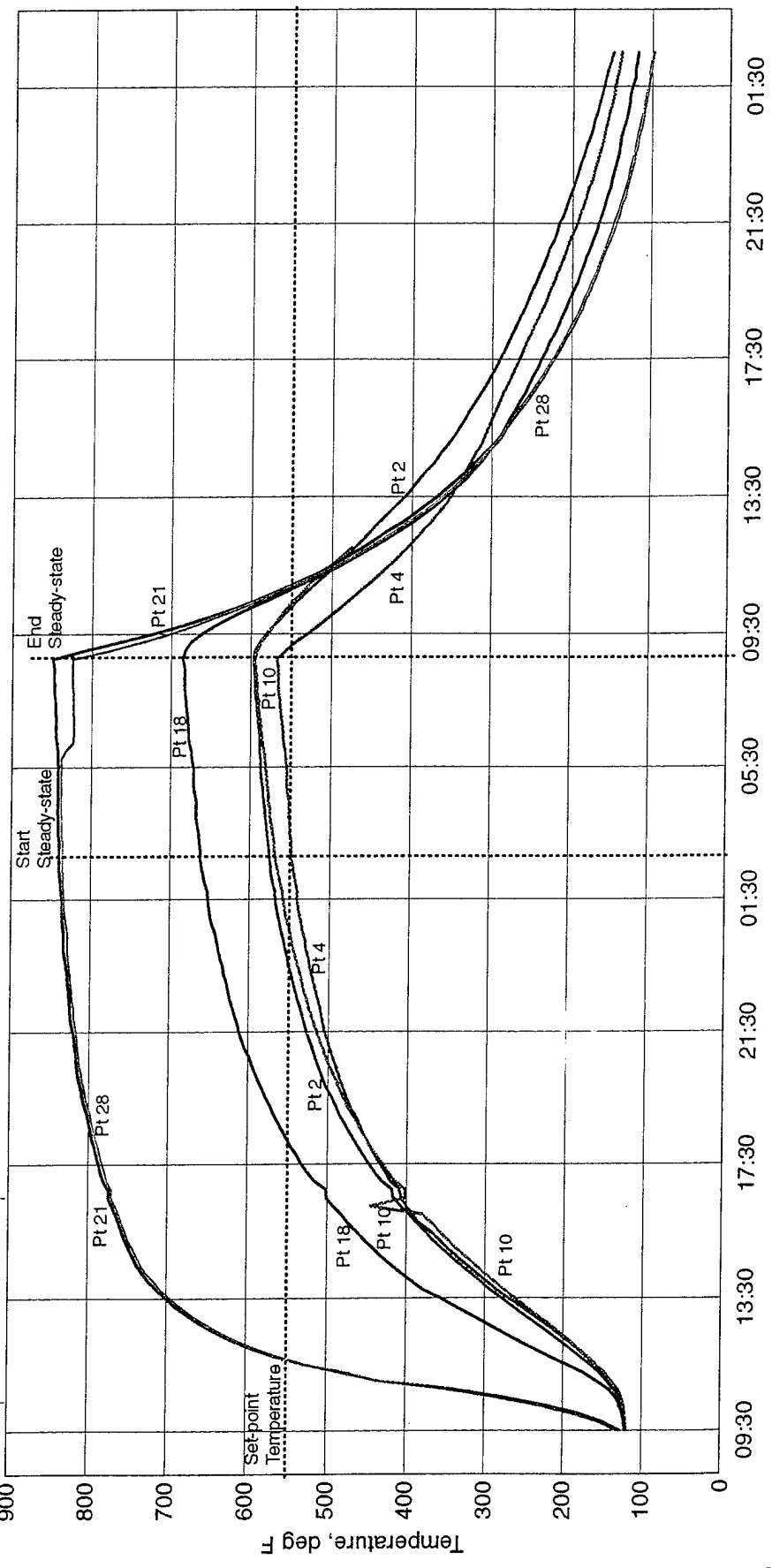
MDL for Analysis: 1 µg/smear RDX
 0.6 µg/smear TNT

Surface Area: 161 sq cm

HGD Test 32

175mm Projectiles - Comp B - (480 Rounds)

See Figure F-83



(°F / °C) Average temperature during steady-state operating conditions

Time
(23 Oct - 25 Oct 1994)

——	Pt 2 (adjacent to process probe) (587 °F / 308 °C)	Pt 10 (intermediate tp) (673 °F / 356 °C)	Pt 10 (late peak) (582 °F / 306 °C)
——	Pt 4 (coldest) (557 °F / 292 °C)	——	Pt 21 (hottest) (844 °F / 451 °C)	——	Pt 28 (early peak) (831 °F / 444 °C)

Figure F-82 Test 32 - Average Temperature Profile - 15 minute Intervals

HGD Test 32

175mm Projectiles - Comp B - (480 Rounds)

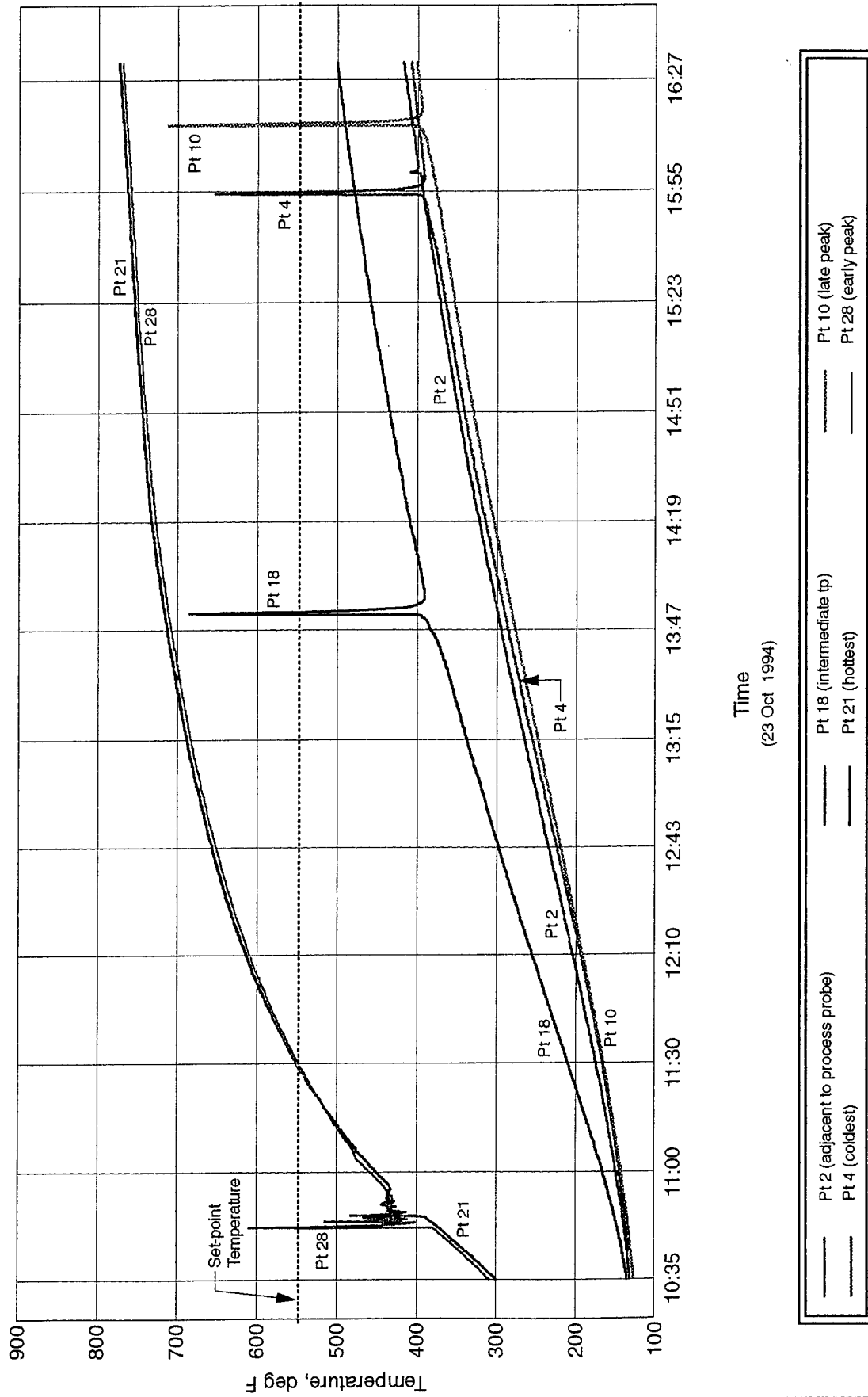
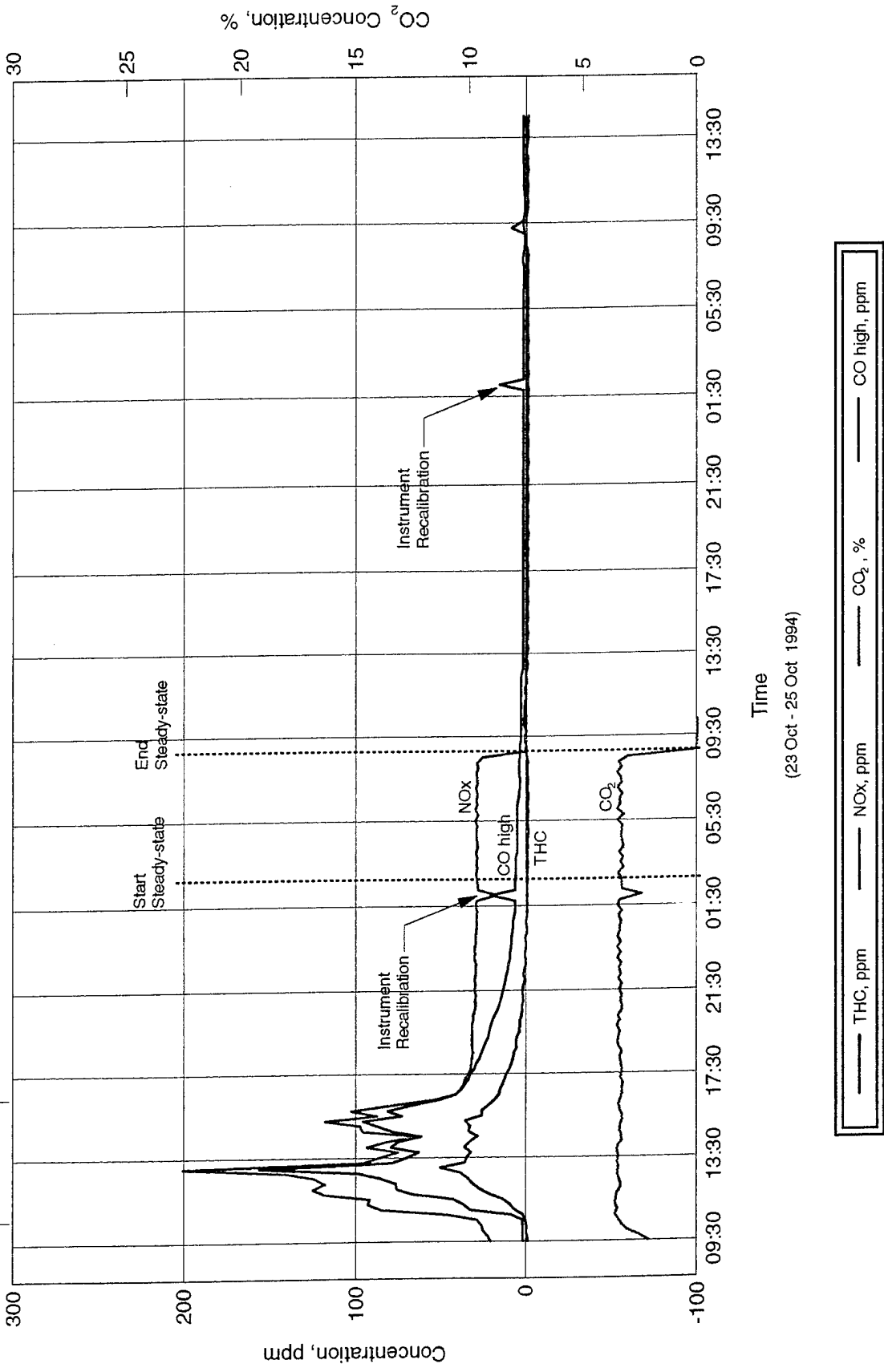


Figure F-83 Test 32 - Average Temperature Profile - 15 second Intervals

HGD Test 32

175 mm Projectiles - Comp B - (480 Rounds)

See Figure F-85



Time
(23 Oct - 25 Oct 1994)

Figure F-84 Test 32 - CEM Profile - 15 minute Intervals

HGD Test 32
 175 mm Projectiles - Comp B - (480 Rounds)

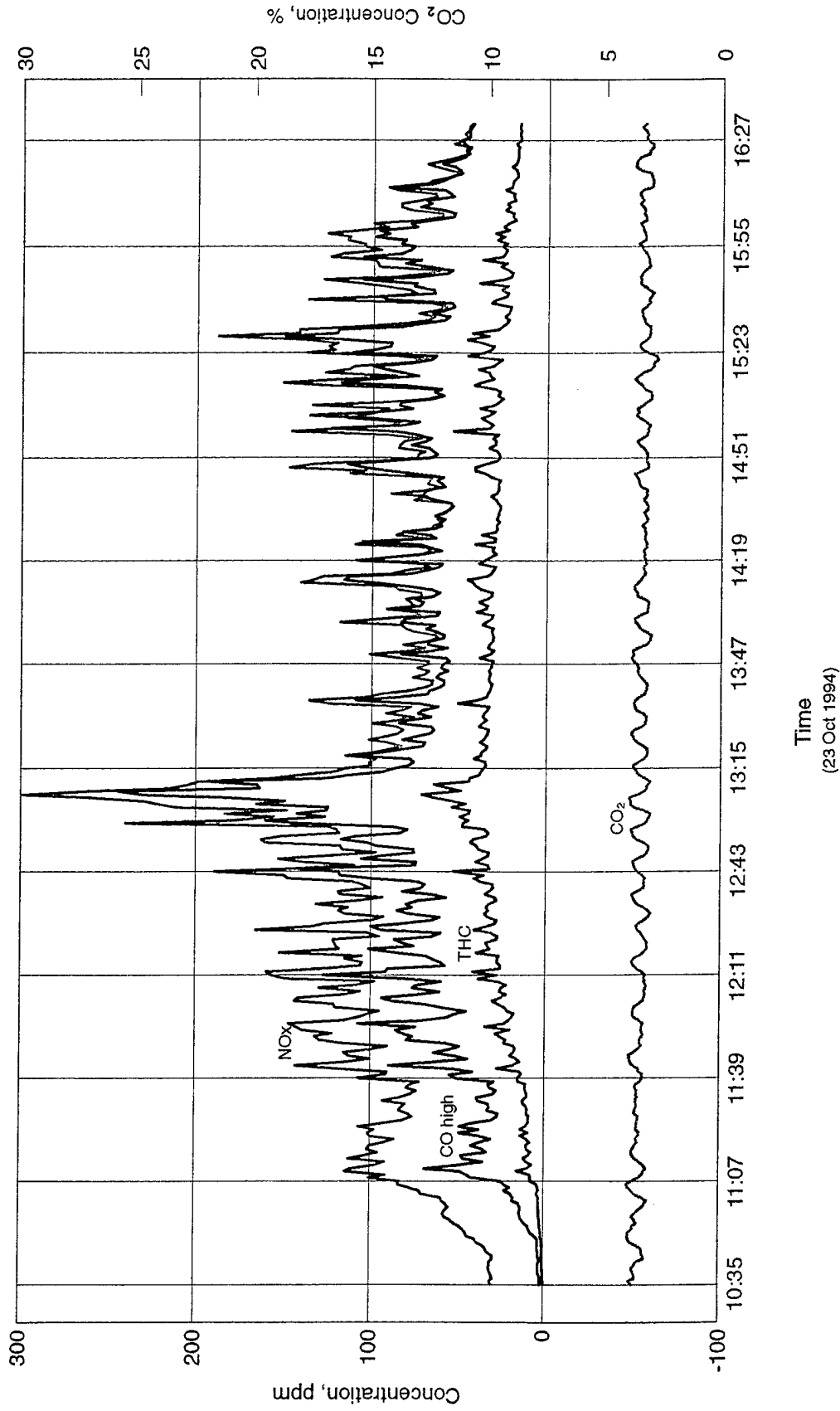


Figure F-85 Test 32 - CEM Profile - 1 minute intervals

TEST 33

Process Conditions

This test was conducted under the same test conditions as Tests 30, 31, and 32; (6 hrs at 550°F (288°C), 480-175mm projectiles containing Comp B residue). The chamber configuration is shown in Figures D-52 and D-52a. The oxidizer was started at 0803 hrs on 26 October with hot gas to the chamber at 1018 hrs. Steady state was reached at 0152 hrs on 27 October and the test was completed at 0753 hrs with a control system automatically initiated cooldown.

Special Conditions

- This test was the third of four stack sampling tests. USACHPPM sampled the stack for particulates, total hydrocarbons, NO_x, CO, and SO₂ from 1207 to 1450 hrs on 26 October. Metal sampling was done the next morning near the end of steady state.
- Gas samples of the chamber exhaust duct were taken during heatup from 1207 to 1450 hrs by TVA.

Analytical Considerations

- Projectile and chamber wipe samples were taken using acetonitrile. From the 38 projectiles that were monitored for temperature, the twenty-two TVA and two DZB projectiles with the lowest average steady state temperatures were sampled.
- NOTE: Data is semi-quantitative. There were broad peaks that appeared in samples from unknown interferences.

Comments

- Temperature peaks began during heatup at 1150 hrs.

CEM

- CEM peaks began during heatup at 1200 hrs with the CEM most active between 1300 and 1400 hrs. This corresponds to temperature spikes.

Table F-74

PROJECTILE EXTRACT SAMPLES

Test # 33	Projectile Type:	175 mm	Date:	26 Oct 94
	Explosive Type:	Comp B	Heatup Time:	15.6 Hrs
	Explosive Source:	Demil	Time at Setpoint:	6.0 Hrs
	Temperature Setpoint:	550°F 288°C	Cooldown Time:	17.6 Hrs

Round #	Operating Temperature		Operating Temperature		Explosive Concentration (see note below)		Sampling Dilution ml	Explosive Amount µg	Explosive Amount / Surface Area mg / cm ²	DRE* %
	°F	s dev	°C	s dev	µg/ml RDX	µg/ml TNT				
1	596	7.50	313	4.17	<MDL	<MDL	500	ND	ND	99.999
2	576	8.12	302	4.51	<MDL	<MDL	500	ND	ND	99.999
3	568	8.02	298	4.45	<MDL	<MDL	500	ND	ND	99.999
4	560	7.23	293	4.02	<MDL	<MDL	500	ND	ND	99.999
5	692	4.50	367	2.50	<MDL	<MDL	500	ND	ND	99.999
6	704	5.05	373	2.81	<MDL	<MDL	500	ND	ND	99.999
7	596	8.95	314	4.97	<MDL	<MDL	500	ND	ND	99.999
8	588	9.15	309	5.08	<MDL	<MDL	500	ND	ND	99.999
9	597	9.37	314	5.21	<MDL	<MDL	500	ND	ND	99.999
10	576	8.82	302	4.90	<MDL	<MDL	500	ND	ND	99.999
11	584	8.27	307	4.60	<MDL	<MDL	500	ND	ND	99.999
12	722	9.06	384	5.03	<MDL	<MDL	500	ND	ND	99.999
13	613	9.00	323	5.00	<MDL	<MDL	500	ND	ND	99.999
14	666	10.18	352	5.66	<MDL	<MDL	500	ND	ND	99.999
15	689	6.51	365	3.62	<MDL	<MDL	500	ND	ND	99.999
16	603	9.17	317	5.09	<MDL	<MDL	500	ND	ND	99.999
17	620	8.98	327	4.99	<MDL	<MDL	500	ND	ND	99.999
18	653	7.61	345	4.23	<MDL	<MDL	500	ND	ND	99.999
19	732	5.44	389	3.02	<MDL	<MDL	500	ND	ND	99.999
25	727	3.34	386	1.86	<MDL	<MDL	500	ND	ND	99.999
31	703	5.17	373	2.87	<MDL	<MDL	500	ND	ND	99.999
32	679	4.01	359	2.23	<MDL	<MDL	500	ND	ND	99.999
E	571	8.24	299	4.58	<MDL	<MDL	500	ND	ND	99.999
F	554	7.08	290	3.93	<MDL	<MDL	500	ND	ND	99.999

Note: Due to interferences in the samples, all analytical results are semi-quantitative.

Special Abbreviations: NA=Not Applicable; ND=Not Detectable; NR=No Record; s dev=standard deviation.

*The DRE results for samples denoted by <MDL are calculated based on a value of one-half the MDL.

Extracted Round No: None
Estimated Round Amount: 20 grams

MDL for Analysis: 0.01 µg/ml RDX
0.006 µg/ml TNT

Surface Area: 1923 sq cm

CHAMBER WIPES

Test # 33	Chamber Load:	175 mm	Date:	26 Oct 94
	Explosive Type:	Comp B	Heatup Time:	15.6 Hrs
	Explosive Source:	Spiked	Time at Setpoint:	6.0 Hrs
	Temperature Setpoint:	550°F 288°C	Cooldown Time:	17.6 Hrs

Wipe #	Location in System	Operating Temperature	Operating Temperature	Explosive Concentration / Smear		Explosive Amount	Explosive Amount / Surface Area
		°F	°C	µg / smear RDX	µg / smear TNT	µg	mg / cm ²
1	Blank	NA	NA	<MDL	<MDL	ND	ND
2	Floor	NR	NR	<MDL	<MDL	ND	ND
3	Wall	NR	NR	<MDL	<MDL	ND	ND
4	Duct	NR	NR	<MDL	<MDL	ND	ND
5	Elbow	NR	NR	<MDL	<MDL	ND	ND
6	Fanblade	NR	NR	<MDL	<MDL	ND	ND
7	Coldspot	NR	NR	<MDL	<MDL	ND	ND
8	Rail	NR	NR	4.1542	6.111	10.2652	6.3759E-05

Special Abbreviations: NA=Not Applicable; ND=Not Detectable; NR=No Record

MDL for Analysis: 1 µg/smear RDX
 0.6 µg/smear TNT

Surface Area: 161 sq cm

HGD Test 33

175mm Projectiles - Comp B - (480 Rounds)

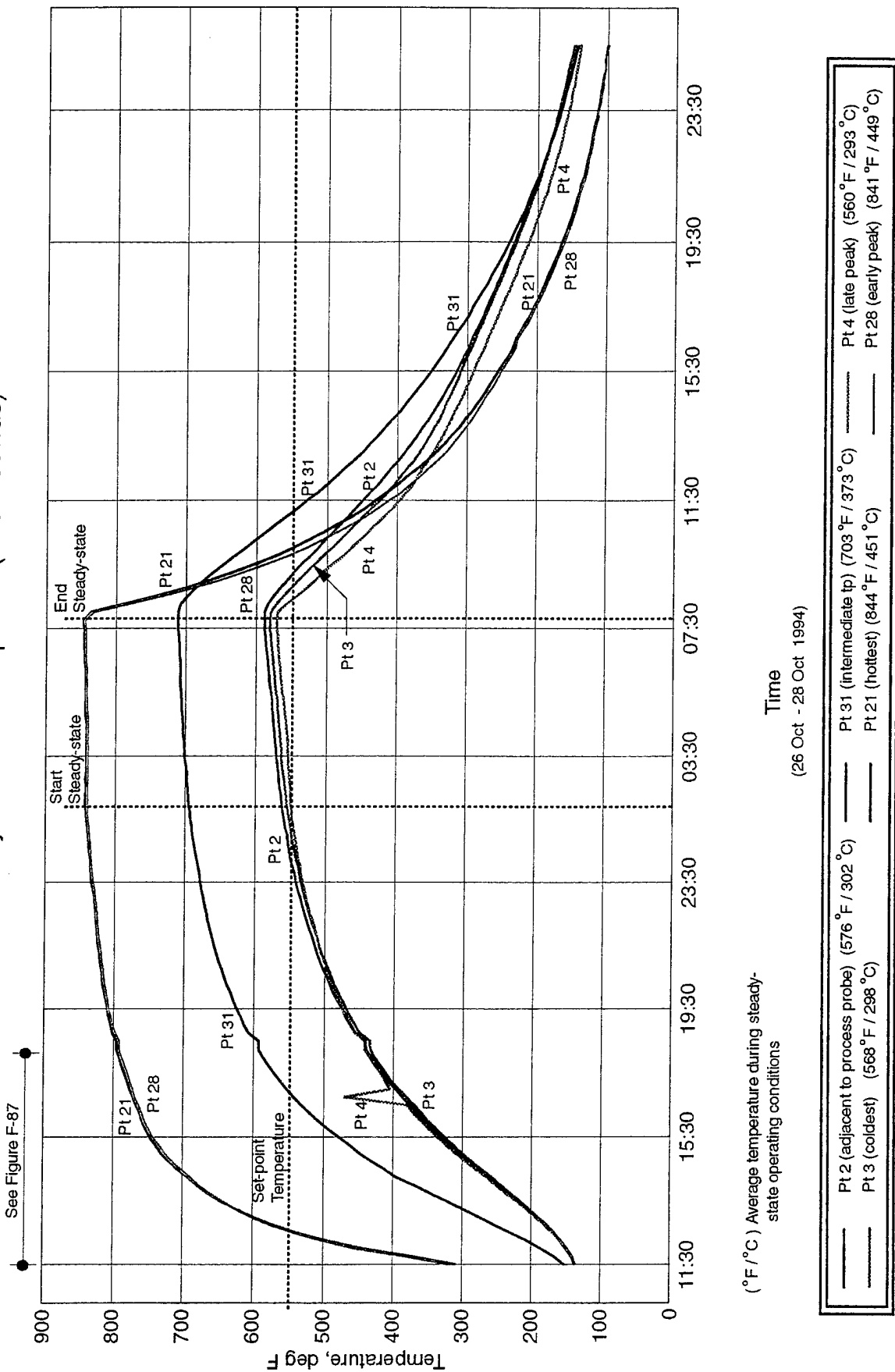


Figure F-86 Test 33 - Average Temperature Profile - 15 minute Intervals

HGD Test 33

175mm Projectiles - Comp B - (480 Rounds)

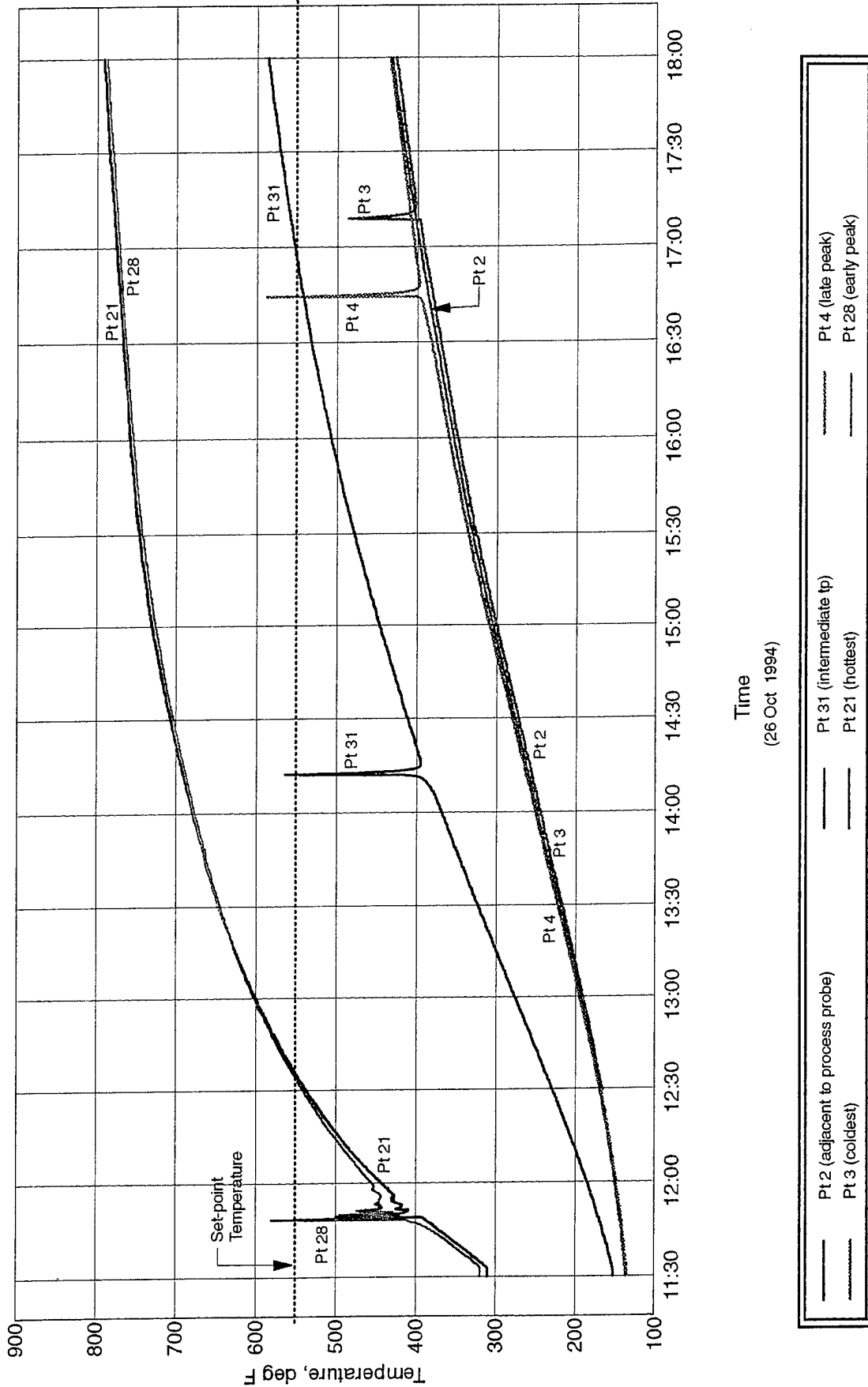


Figure F-87 Test 33 - Average Temperature Profile - 15 second Intervals

HGD Test 33

175 mm Projectiles - Comp B - (480 Rounds)

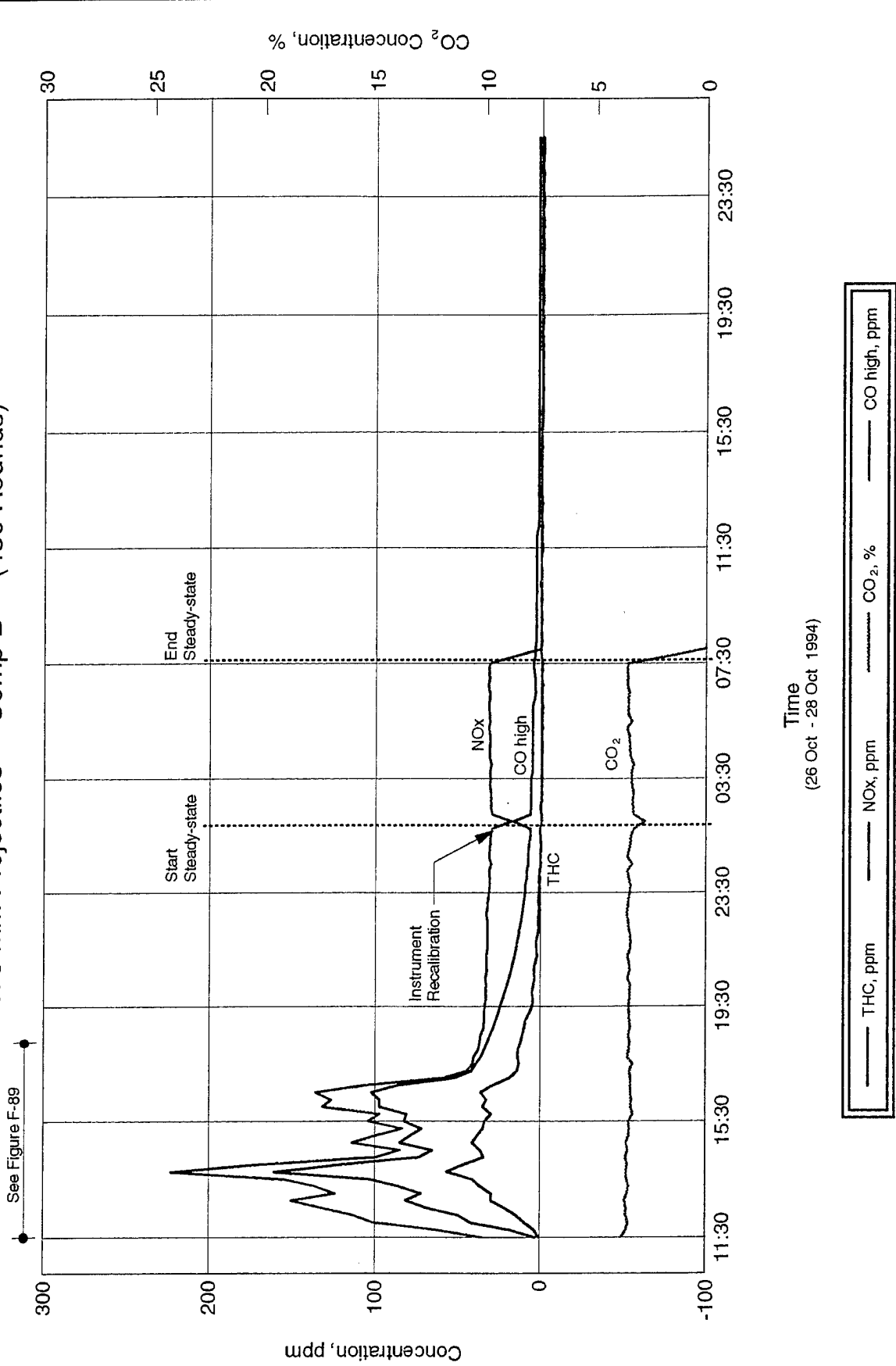


Figure F-88 Test 33 - CEM Profile - 15 minute intervals

HGD Test 33

175 mm Projectiles - Comp B - (480 Rounds)

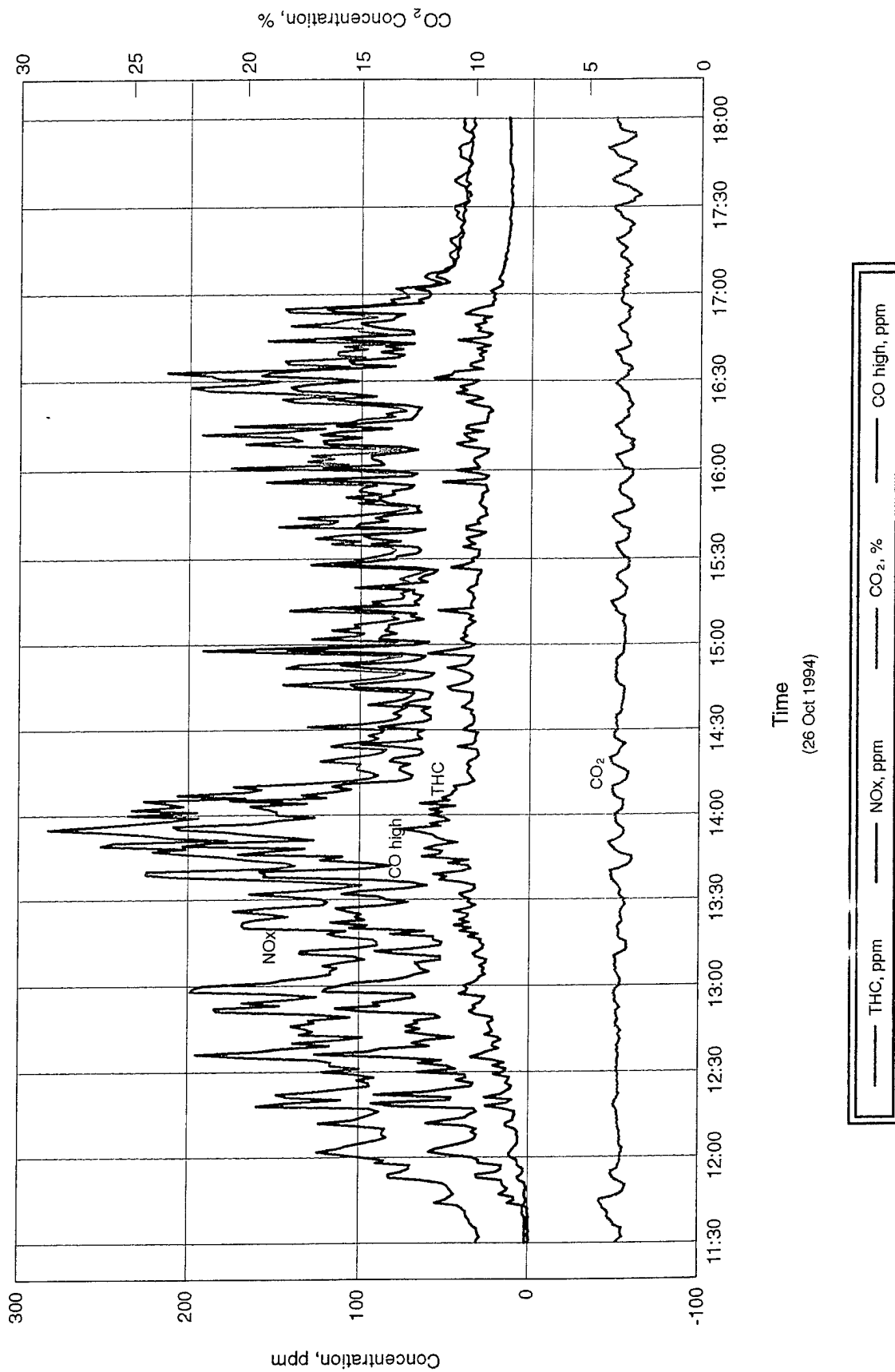


Figure F-89 Test 33 - CEM Profile - 1 minute Intervals

TEST 34

Process Conditions

This test was conducted under the same test conditions as Tests 30 through 33, (6 hrs at 550°F (288°C), 480-175mm projectiles containing Comp B residue). The chamber configuration is shown in Figures D-53 and D-53A. The oxidizer was started at 0756 hrs on 29 October with the system in process at 0824 hrs. Steady state was reached at 0211 hrs on 30 October and the test was completed at 0812 hrs with a control system automatically initiated cooldown.

Special Conditions

- This test was the fourth of four stack sampling tests. USACHPPM sampled the stack for particulates, total hydrocarbons, NO_x, CO, and SO₂ during heatup from 1025 to 1325 hrs.
- Gas sample of the chamber exhaust duct was taken during heatup from 1025 to 1325 hrs by TVA.

Analytical Considerations

- Projectile, insulation, and chamber wipe samples were taken. From the 38 projectiles that were monitored for temperature, the twenty-two TVA and two DZB projectiles with the lowest average steady state temperatures were sampled.
- NOTE: Data is semi-quantitative. There were broad peaks that appeared in samples from unknown interferences.

Comments

- Temperature peaks were noted during heatup from 1025 to 1600 hrs.

CEM

- CEM peaks began during heatup at 1025 hrs with most activity between 1045 and 1530 hrs.

Table F-76

PROJECTILE EXTRACT SAMPLES

	Projectile Type:	175 mm	Date:	29 Oct 94
Test #	Explosive Type:	Comp B	Heatup Time:	18.0 Hrs
34	Explosive Source:	Demil	Time at Setpoint:	6.0 Hrs
	Temperature Setpoint:	550°F 288°C	Cooldown Time:	NR

Round #	Operating Temperature		Operating Temperature		Explosive Concentration (see note below)		Sampling Dilution ml	Explosive Amount µg	Explosive Amount / Surface Area mg / cm ²	DRE* %
	°F	s dev	°C	s dev	µg / ml RDX	µg / ml TNT				
1	606	8.05	319	4.47	<MDL	<MDL	500	ND	ND	99.999
2	686	16.82	363	9.34	<MDL	<MDL	500	ND	ND	99.999
3	578	10.53	303	5.85	<MDL	<MDL	500	ND	ND	99.999
4	570	7.52	299	4.18	<MDL	<MDL	500	ND	ND	99.999
5	702	6.05	372	3.36	<MDL	<MDL	500	ND	ND	99.999
6	713	6.07	378	3.37	<MDL	<MDL	500	ND	ND	99.999
7	609	10.01	321	5.56	<MDL	<MDL	500	ND	ND	99.999
8	663	7.85	350	4.36	<MDL	<MDL	500	ND	ND	99.999
9	683	7.41	361	4.12	<MDL	<MDL	500	ND	ND	99.999
10	585	10.38	307	5.77	<MDL	<MDL	500	ND	ND	99.999
11	605	9.06	318	5.03	<MDL	<MDL	500	ND	ND	99.999
12	621	10.22	327	5.68	<MDL	<MDL	500	ND	ND	99.999
13	626	10.42	330	5.79	<MDL	<MDL	500	ND	ND	99.999
14	636	10.61	335	5.89	<MDL	<MDL	500	ND	ND	99.999
15	677	8.43	358	4.69	<MDL	<MDL	500	ND	ND	99.999
16	616	10.95	325	6.08	<MDL	<MDL	500	ND	ND	99.999
17	638	10.92	337	6.06	<MDL	<MDL	500	ND	ND	99.999
18	680	9.39	360	5.21	<MDL	<MDL	500	ND	ND	99.999
19	746	6.23	397	3.46	<MDL	<MDL	500	ND	ND	99.999
25	731	4.86	388	2.70	<MDL	<MDL	500	ND	ND	99.999
31	711	6.88	377	3.82	<MDL	<MDL	500	ND	ND	99.999
32	686	5.32	363	2.96	<MDL	<MDL	500	ND	ND	99.999
E	582	9.61	306	5.34	<MDL	<MDL	500	ND	ND	99.999
F	567	7.29	297	4.05	<MDL	<MDL	500	ND	ND	99.999

Note: Due to interferences in the samples, all analytical results are semi-quantitative.

Special Abbreviations: NA=Not Applicable; ND=Not Detectable; NR=No Record; s dev=standard deviation.

*The DRE results for samples denoted by <MDL are calculated based on a value of one-half the MDL.

Extracted Round No: None
Estimated Round Amount: 20 grams

MDL for Analysis: 0.01 µg/ml RDX
0.006 µg/ml TNT

Surface Area: 1923 sq cm

Table F-77

CHAMBER WIPES

Test # <u>34</u>	Chamber Load:	<u>175 mm</u>	Date:	<u>29 Oct 94</u>
	Explosive Type:	<u>Comp B</u>	Heatup Time:	<u>18.0 Hrs</u>
	Explosive Source:	<u>Spiked</u>	Time at Setpoint:	<u>6.0 Hrs</u>
	Temperature Setpoint:	<u>550°F</u> <u>288°C</u>	Cooldown Time:	<u>NR</u>

Wipe #	Location in System	Operating Temperature	Operating Temperature	Explosive Concentration / Smear		Explosive Amount	Explosive Amount / Surface Area
		°F	°C	µg / smear RDX	µg / smear TNT	µg	mg / cm ²
1	Blank	NA	NA	<MDL	<MDL	ND	ND
2	Floor	NR	NR	<MDL	<MDL	ND	ND
3	Wall	NR	NR	<MDL	<MDL	ND	ND
4	Duct	NR	NR	<MDL	<MDL	ND	ND
5	Elbow	NR	NR	<MDL	<MDL	ND	ND
6	Fanblade	NR	NR	<MDL	<MDL	ND	ND
7	Coldspot	NR	NR	<MDL	<MDL	ND	ND
8	Rail	NR	NR	<MDL	<MDL	ND	ND

Special Abbreviations: NA=Not Applicable; ND=Not Detectable; NR=No Record

MDL for Analysis: 1 µg/smear RDX
 0.6 µg/smear TNT

Surface Area: 161 sq cm

HGD Test 34

175mm Projectiles - Comp B - (480 Rounds)

See Figure F-91

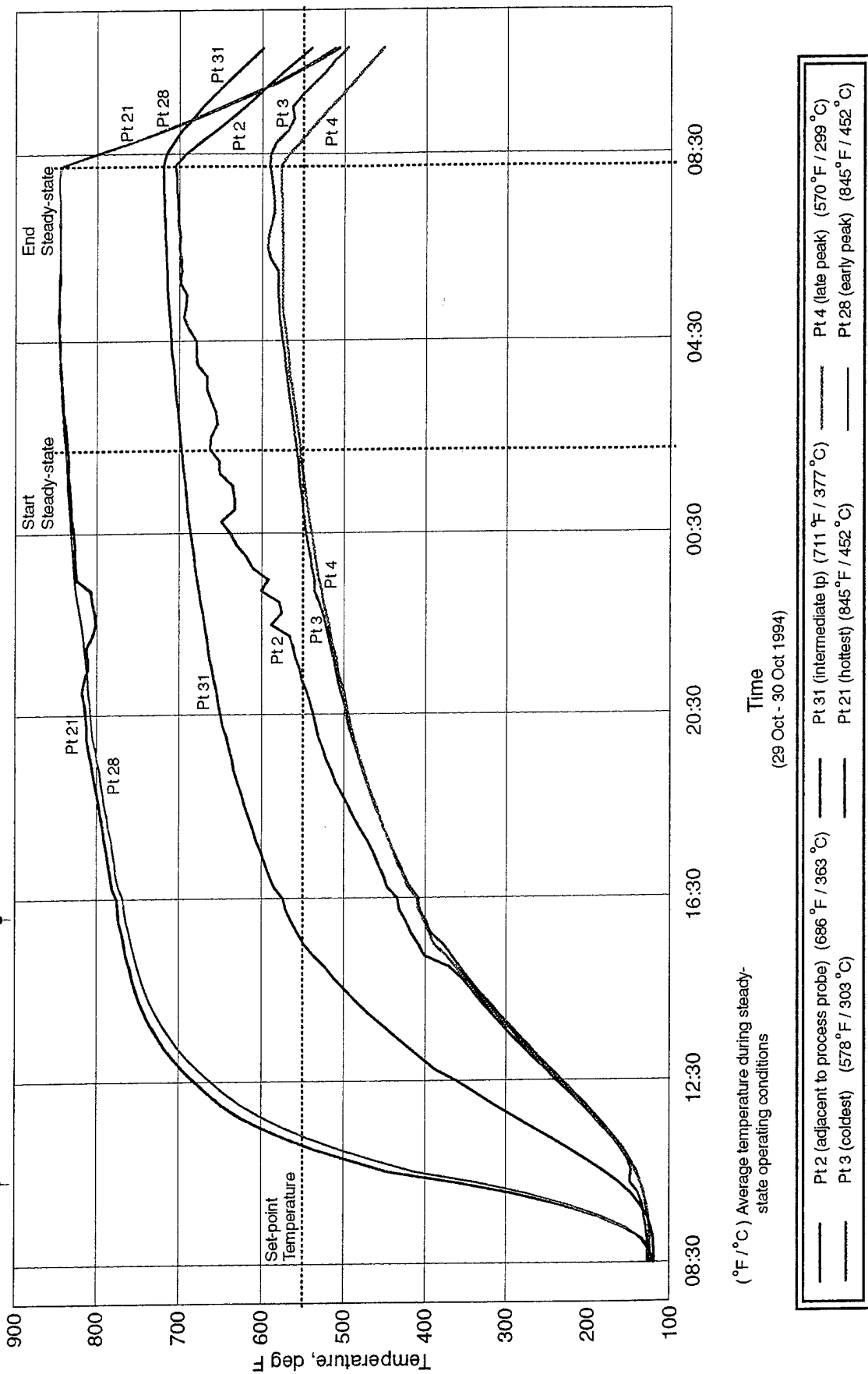
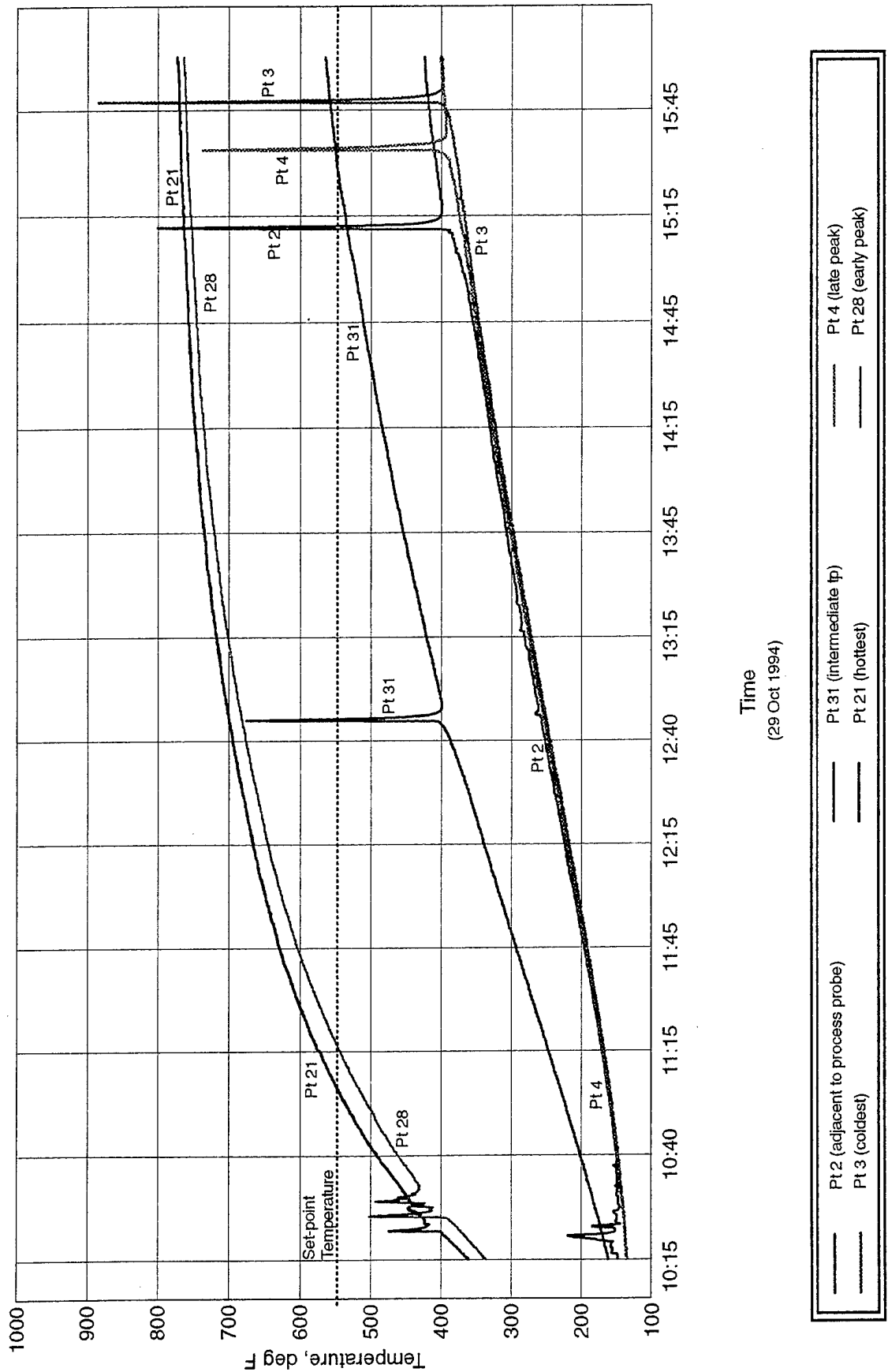


Figure F-90 Test 34 - Average Temperature Profile - 15 minute Intervals

HGD Test 34

175mm Projectiles - Comp B - (480 Rounds)



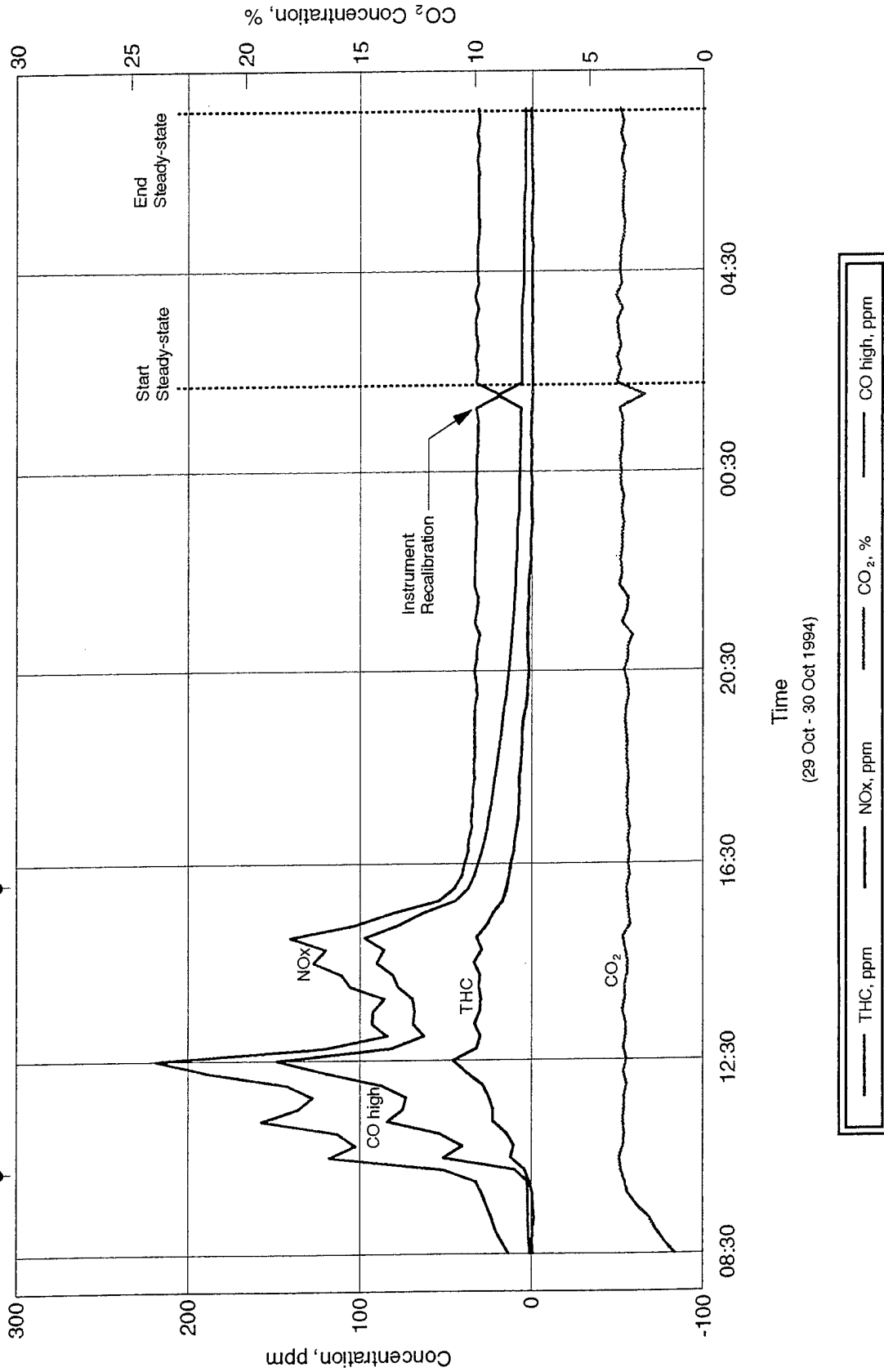
Time
(29 Oct 1994)

Figure F-91 Test 34 - Average Temperature Profile - 15 second Intervals

HGD Test 34

175 mm Projectiles - Comp B - (480 Rounds)

See Figure F-93

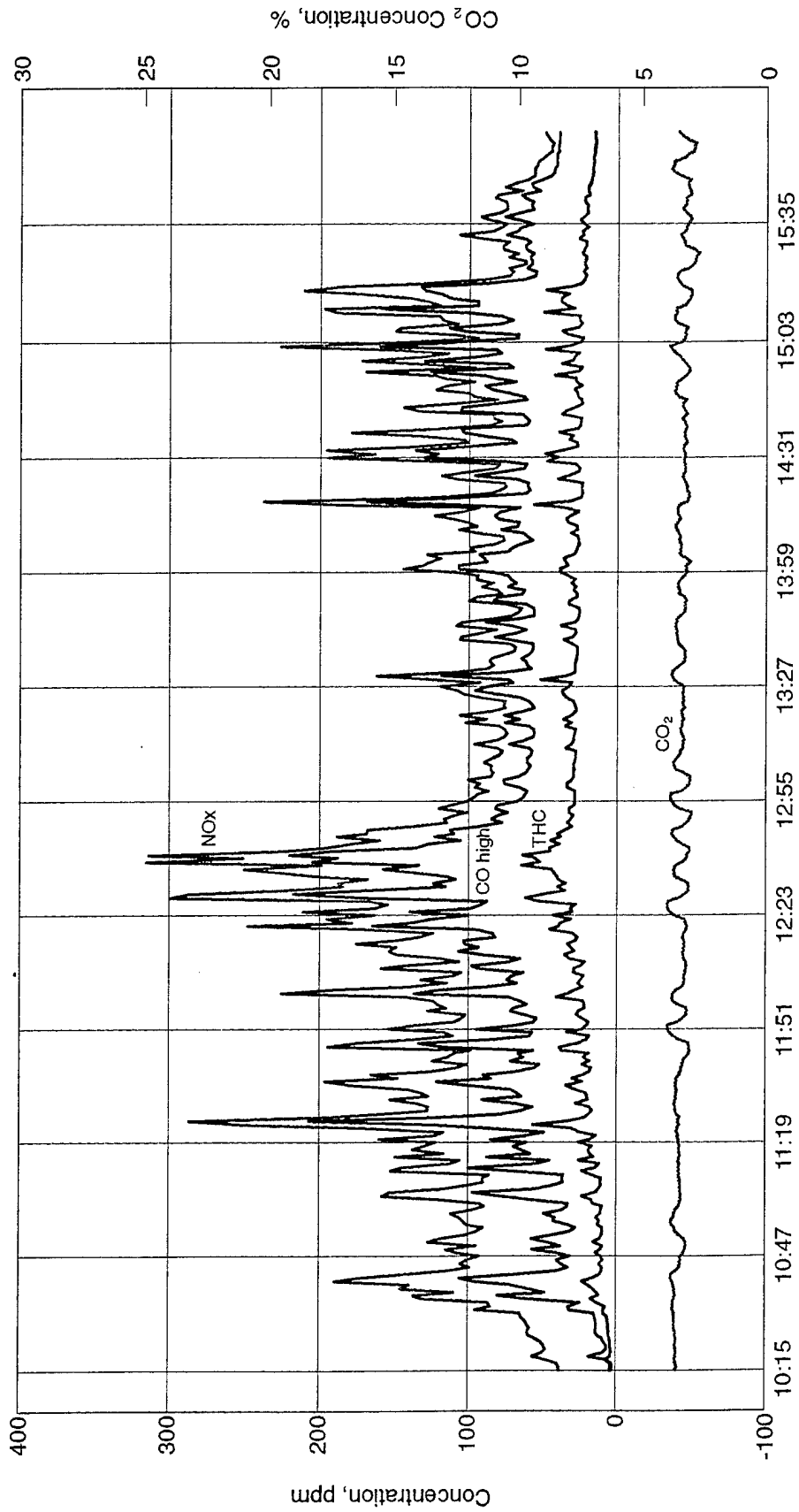


Time
(29 Oct - 30 Oct 1994)

Figure F-92 Test 34 - CEM Profile - 15 minute Intervals

HGD Test 34

175 mm Projectiles - Comp B - (480 Rounds)



Time
(29 Oct 1994)



Figure F-93 Test 34 - CEM Profile - 1 minute Intervals

Table F-78

CHAMBER WIPES
Residue Accumulation from a Series of Tests

Tests: 1-34

Wipe #	Location in System	Operating Temperature*	Operating Temperature*	Explosive Concentration / Smear		Explosive Amount	Explosive Amount / Surface Area
		°F	°C	µg / smear RDX	µg / smear TNT	µg	mg / cm ²
1	Blank	NA	NA	<MDL	<MDL	ND	ND
2	Floor	NR	NR	<MDL	<MDL	ND	ND
3	Wall	NR	NR	<MDL	<MDL	ND	ND
4	Duct	NR	NR	<MDL	<MDL	ND	ND
5	Elbow	NR	NR	<MDL	<MDL	ND	ND
6	Fanblade	NR	NR	2.2022	<MDL	2.2022	1.3678E-05
7	Coldspot	NR	NR	<MDL	<MDL	ND	ND
8	Rail	NR	NR	4.6547	1.4712	6.1259	3.8049E-05

Special Abbreviations: NA=Not Applicable; ND=Not Detectable; NR=No Record

*None of the chamber points shown in this table were measured for temperature in tests 30-34.

MDL for Analysis: 1 µg/smear RDX
 0.6 µg/smear TNT

Surface Area: 161 sq cm

Table F-79

INSULATION SAMPLES

Sample History of Test Conditions

Test #
8Time at Setpoint
6.8 HrsTemperature Setpoint
550°F / 288°C

Insulation Type / Location #	Location in System	Explosive Concentration / Sample		Explosive Amount	Explosive Amount / Volume
		µg / sample RDX	µg / sample TNT	µg	mg / cm ³
Kaowool 1	Railcar (mid-point)	<MDL	<MDL	ND	ND
Kaowool 2	Railcar (rear)	<MDL	<MDL	ND	ND
Kaowool 3	Wall (mid-point, duct side)	<MDL	<MDL	ND	ND
Kaowool 4	Ceiling (mid-point)	<MDL	<MDL	ND	ND
Kaowool 5	Wall (near door opposite duct side)	<MDL	<MDL	ND	ND
Kaowool 6	Duct	0.8828	<MDL	0.8828	5.5175E-05
Pyroblock 1	Railcar (mid-point)	<MDL	<MDL	ND	ND
Pyroblock 2	Railcar (rear)	0.7173	<MDL	0.7173	1.4639E-05
Pyroblock 3	Wall (mid-point, duct side)	<MDL	<MDL	ND	ND
Pyroblock 4	Ceiling (mid-point)	<MDL	<MDL	ND	ND
Pyroblock 5	Wall (near door, opposite duct side)	<MDL	<MDL	ND	ND
Pyroblock 6	Duct	<MDL	<MDL	ND	ND

Special Abbreviations: NA=Not Applicable; ND=Not Detectable; NR=No Record

MDL for Analysis:

0.7 µg/sample RDX
0.3 µg/sample TNT

Insulation Sample Volume:

16 cubic cm (Kaowool)
49 cubic cm (Pyroblock)

Table F-80

INSULATION SAMPLES

Sample History of Test Conditions

Test #	Time at Setpoint	Temperature Setpoint
8	6.8 Hrs	550°F / 288°C
9	6.2 Hrs	600°F / 316°C
10	6.3 Hrs	600°F / 316°C
C	24 Hrs	700°F / 371°C
11	38.7 Hrs	700°F / 371°C
12	9.8 Hrs	550°F / 288°C

Insulation Type / Location #	Location in System	Explosive Concentration / Sample		Explosive Amount	Explosive Amount / Volume
		$\mu\text{g} / \text{sample RDX}$	$\mu\text{g} / \text{sample TNT}$	μg	mg / cm^3
Kaowool 1	Railcar (mid-point)	<MDL	<MDL	ND	ND
Kaowool 2	Railcar (rear)	<MDL	<MDL	ND	ND
Kaowool 3	Wall (mid-point, duct side)	<MDL	<MDL	ND	ND
Kaowool 4	Ceiling (mid-point)	<MDL	<MDL	ND	ND
Kaowool 5	Wall (near door opposite duct side)	<MDL	<MDL	ND	ND
Kaowool 6	Duct	<MDL	<MDL	ND	ND
Pyroblock 1	Railcar (mid-point)	<MDL	<MDL	ND	ND
Pyroblock 2	Railcar (rear)	<MDL	<MDL	ND	ND
Pyroblock 3	Wall (mid-point, duct side)	<MDL	<MDL	ND	ND
Pyroblock 4	Ceiling (mid-point)	<MDL	<MDL	ND	ND
Pyroblock 5	Wall (near door, opposite duct side)	1.88	<MDL	1.88	3.8367E-05
Pyroblock 6	Duct	<MDL	<MDL	ND	ND

Special Abbreviations: NA=Not Applicable; ND=Not Detectable; NR=No Record

MDL for Analysis:

0.7 $\mu\text{g}/\text{sample RDX}$ 0.3 $\mu\text{g}/\text{sample TNT}$

Insulation Sample Volume:

16 cubic cm (Kaowool)

49 cubic cm (Pyroblock)

Table F-81

INSULATION SAMPLES

Sample History of Test Conditions

Test #	Time at Setpoint	Temperature Setpoint
See Table F-80 for test conditions prior to Test 13.		
13	6.0 Hrs	550°F / 288°C
14	6.0 Hrs	600°F / 316°C
15	6.0 Hrs	600°F / 316°C
16	32.2 Hrs	700°F / 371°C
17	6.0 Hrs	550°F / 288°C
18	7.0 Hrs	550°F / 288°C

Insulation Type / Location #	Location in System	Explosive Concentration / Sample		Explosive Amount	Explosive Amount / Volume
		µg / sample RDX	µg / sample TNT	µg	mg / cm ³
Kaowool 1	Railcar (mid-point)	<MDL	<MDL	ND	ND
Kaowool 2	Railcar (rear)	<MDL	<MDL	ND	ND
Kaowool 3	Wall (mid-point, duct side)	<MDL	<MDL	ND	ND
Kaowool 4	Ceiling (mid-point)	<MDL	<MDL	ND	ND
Kaowool 5	Wall (near door opposite duct side)	<MDL	<MDL	ND	ND
Kaowool 6	Duct	<MDL	<MDL	ND	ND
Pyroblock 1	Railcar (mid-point)	<MDL	<MDL	ND	ND
Pyroblock 2	Railcar (rear)	<MDL	<MDL	ND	ND
Pyroblock 3	Wall (mid-point, duct side)	<MDL	<MDL	ND	ND
Pyroblock 4	Ceiling (mid-point)	<MDL	<MDL	ND	ND
Pyroblock 5	Wall (near door, opposite duct side)	<MDL	<MDL	ND	ND
Pyroblock 6	Duct	<MDL	<MDL	ND	ND

Special Abbreviations: NA=Not Applicable; ND=Not Detectable; NR=No Record

MDL for Analysis:

0.4 µg/sample RDX
0.25 µg/sample TNT

Insulation Sample Volume:

16 cubic cm (Kaowool)
49 cubic cm (Pyroblock)

Table F-82

INSULATION SAMPLES

Sample History of Test Conditions

Test #	Time at Setpoint	Temperature Setpoint
19	24.0 Hrs	700°F / 371°C
20	8.0 Hrs	600°F / 316°C
D	6.0 Hrs	600°F / 316°C
21	23.5 Hrs	700°F / 371°C
22	5.0 Hrs	550°F / 288°C
23	6.0 Hrs	550°F / 288°C

Insulation Type / Location #	Location in System	Explosive Concentration / Sample		Explosive Amount μg	Explosive Amount / Volume mg / cm^3
		$\mu\text{g} / \text{sample RDX}$	$\mu\text{g} / \text{sample TNT}$		
Kaowool 1	Railcar (mid-point)	<MDL	<MDL	ND	ND
Kaowool 2	Railcar (rear)	<MDL	<MDL	ND	ND
Kaowool 3	Wall (mid-point, duct side)	<MDL	<MDL	ND	ND
Kaowool 4	Ceiling (mid-point)	<MDL	<MDL	ND	ND
Kaowool 5	Wall (near door opposite duct side)	<MDL	<MDL	ND	ND
Kaowool 6	Duct	<MDL	<MDL	ND	ND
Pyroblock 1	Railcar (mid-point)	<MDL	<MDL	ND	ND
Pyroblock 2	Railcar (rear)	<MDL	<MDL	ND	ND
Pyroblock 3	Wall (mid-point, duct side)	<MDL	<MDL	ND	ND
Pyroblock 4	Ceiling (mid-point)	<MDL	<MDL	ND	ND
Pyroblock 5	Wall (near door, opposite duct side)	<MDL	<MDL	ND	ND
Pyroblock 6	Duct	<MDL	<MDL	ND	ND

Special Abbreviations: NA=Not Applicable; ND=Not Detectable; NR=No Record

MDL for Analysis:

1 $\mu\text{g}/\text{sample RDX}$
0.6 $\mu\text{g}/\text{sample TNT}$

Insulation Sample Volume:

16 cubic cm (Kaowool)
49 cubic cm (Pyroblock)

Table F-83

INSULATION SAMPLES

Sample History of Test Conditions

Test #	Time at Setpoint	Temperature Setpoint
24	11.9 Hrs	600°F / 316°C
25	24.0 Hrs	700°F / 371°C
26	32.5 Hrs	700°F / 371°C
27	8.4 Hrs	550°F / 288°C

See Tables F-80 thru 82 for test conditions prior to Test 24.

Insulation Type / Location #	Location in System	Explosive Concentration / Sample		Explosive Amount	Explosive Amount / Volume
		µg / sample RDX	µg / sample TNT	µg	mg / cm ³
Kaowool 1	Railcar (mid-point)	<MDL	<MDL	ND	ND
Kaowool 2	Railcar (rear)	<MDL	<MDL	ND	ND
Kaowool 3	Wall (mid-point, duct side)	<MDL	<MDL	ND	ND
Kaowool 4	Ceiling (mid-point)	<MDL	<MDL	ND	ND
Kaowool 5	Wall (near door opposite duct side)	<MDL	<MDL	ND	ND
Kaowool 6	Duct	<MDL	<MDL	ND	ND
Pyroblock 1	Railcar (mid-point)	<MDL	<MDL	ND	ND
Pyroblock 2	Railcar (rear)	<MDL	<MDL	ND	ND
Pyroblock 3	Wall (mid-point, duct side)	<MDL	<MDL	ND	ND
Pyroblock 4	Ceiling (mid-point)	0.2508	<MDL	0.2508	5.1184E-06
Pyroblock 5	Wall (near door, opposite duct side)	<MDL	<MDL	ND	ND
Pyroblock 6	Duct	0.2919	0.2279	0.5198	1.0608E-05

Special Abbreviations: NA=Not Applicable; ND=Not Detectable; NR=No Record

MDL for Analysis:

1 µg/sample RDX
0.6 µg/sample TNT

Insulation Sample Volume:

16 cubic cm (Kaowool)
49 cubic cm (Pyroblock)

Table F-84

INSULATION SAMPLES

Sample History of Test Conditions

Test #	Time at Setpoint	Temperature Setpoint
28	6.5 Hrs	550°F / 288°C
29	6.0 Hrs	600°F / 316°C
*96	2.0 Hrs	550°F / 288°C
30	6.0 Hrs	550°F / 288°C
31	6.0 Hrs	550°F / 288°C
32	6.0 Hrs	550°F / 288°C
33	6.0 Hrs	550°F / 288°C
34	6.0 Hrs	550°F / 288°C

Insulation Type / Location #	Location in System	Explosive Concentration / Sample		Explosive Amount	Explosive Amount / Volume
		µg / sample RDX	µg / sample TNT	µg	mg / cm ³
Kaowool 1	Railcar (mid-point)	0.7496	<MDL	0.7496	4.6850E-05
Kaowool 2	Railcar (rear)	<MDL	<MDL	ND	ND
Kaowool 3	Wall (mid-point, duct side)	<MDL	<MDL	ND	ND
Kaowool 4	Ceiling (mid-point)	<MDL	<MDL	ND	ND
Kaowool 5	Wall (near door opposite duct side)	<MDL	<MDL	ND	ND
Kaowool 6	Duct	<MDL	<MDL	ND	ND
Pyroblock 1	Railcar (mid-point)	<MDL	<MDL	ND	ND
Pyroblock 2	Railcar (rear)	<MDL	<MDL	ND	ND
Pyroblock 3	Wall (mid-point, duct side)	<MDL	<MDL	ND	ND
Pyroblock 4	Ceiling (mid-point)	<MDL	<MDL	ND	ND
Pyroblock 5	Wall (near door, opposite duct side)	<MDL	<MDL	ND	ND
Pyroblock 6	Duct	<MDL	<MDL	ND	ND

Special Abbreviations: NA=Not Applicable; ND=Not Detectable; NR=No Record

MDL for Analysis:

1 µg/sample RDX
0.6 µg/sample TNT

Insulation Sample Volume:

16 cubic cm (Kaowool)
49 cubic cm (Pyroblock)