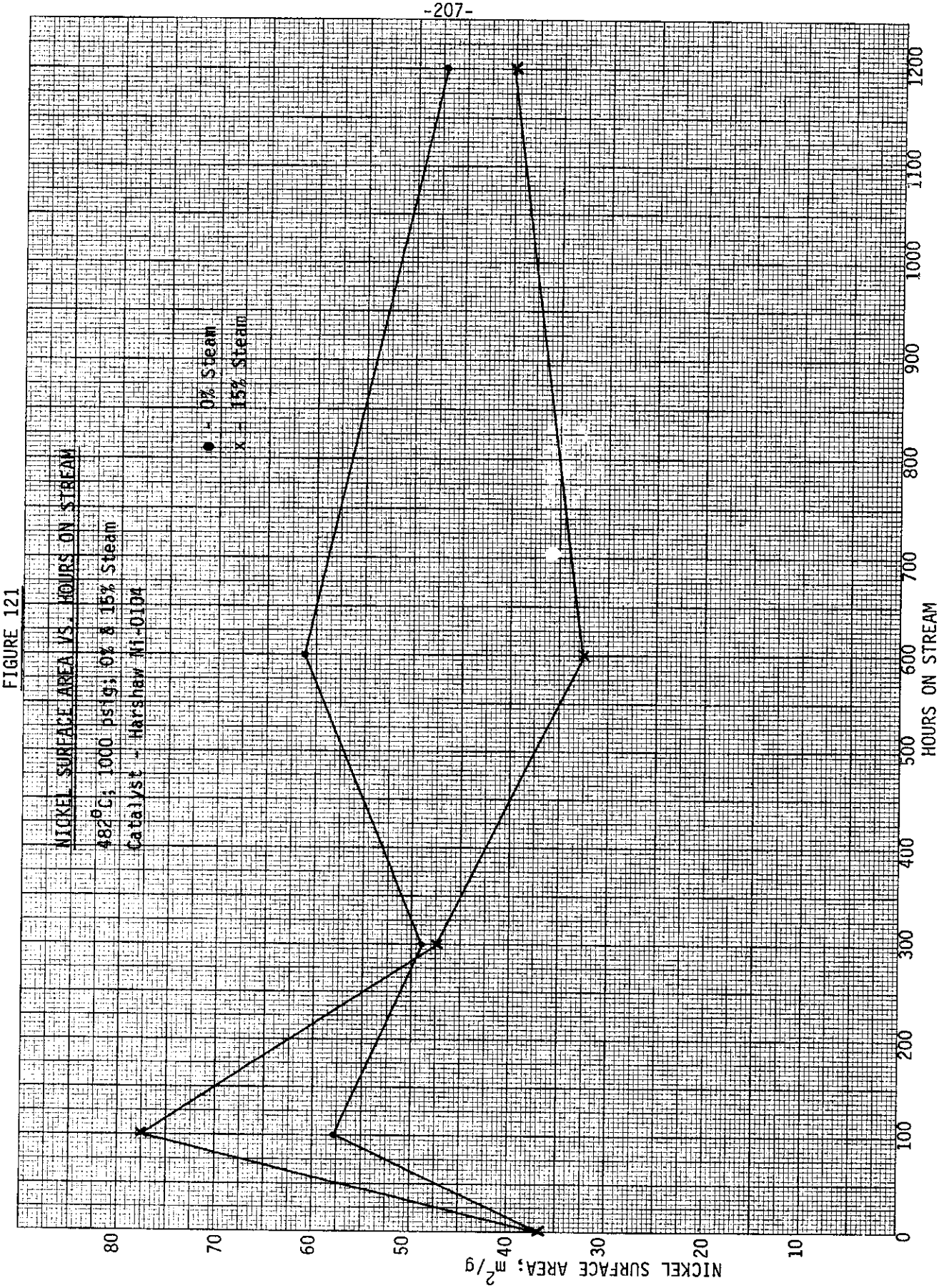
FIGURE 121


NICKEL SURFACE AREA VS. HOURS ON STREAM
482°C; 1000 psig; 0% & 15% Steam
Catalyst - Harshaw Ni-0104
● - 0% Steam
x - 15% Steam
NICKEL SURFACE AREA; m²/g
HOURS ON STREAM
0
10
20
30
40
50
60
70
80
100
200
300
400
500
600
700
800
900
1000
1100
1200

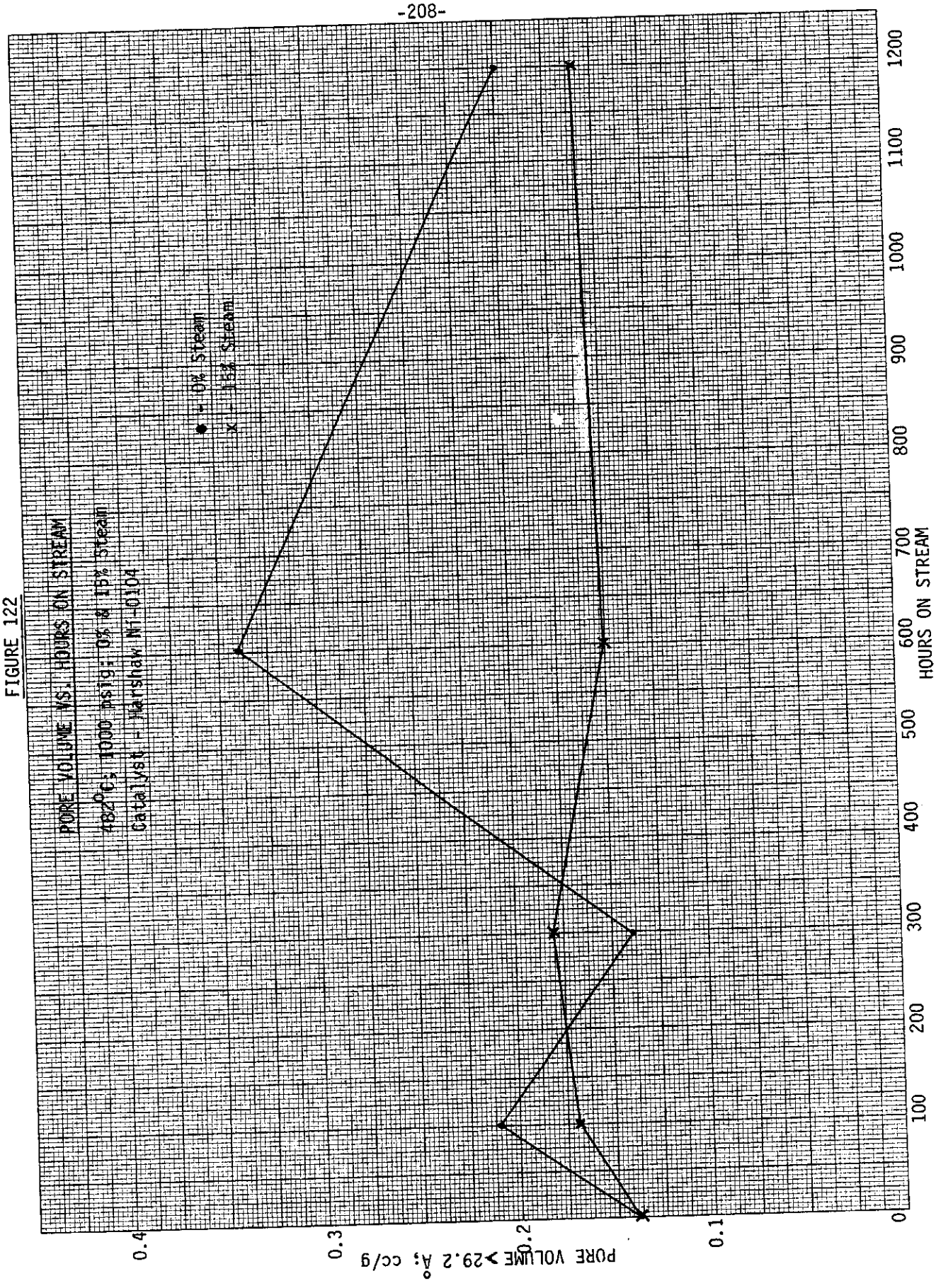

PORE VOLUME VS. HOURS ON STREAM
482°C; 1000 psig; 0% & 15% Steam
Catalyst - Harshaw Ni-0104
● - 0% Steam
× - 15% Steam
PORE VOLUME >29.2 Å; cc/g
0.4
0.3
0.2
0.1
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
HOURS ON STREAM

FIGURE 122

FIGURE 123

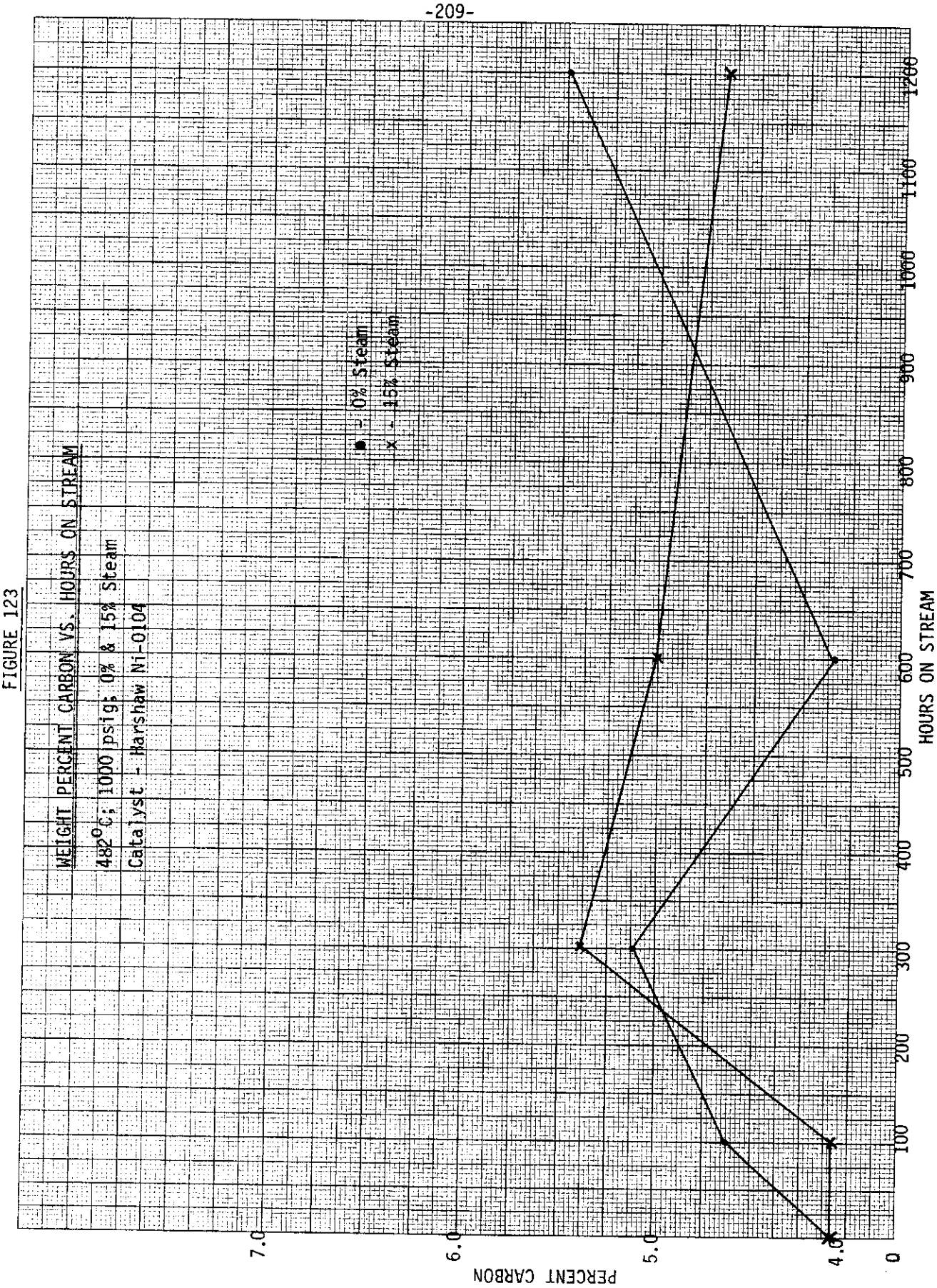

WEIGHT PERCENT CARBON VS. HOURS ON STREAM
482°C; 1000 psig; 0% & 15% Steam
Catalyst - Harshaw Ni-0104
● - 0% Steam
x - 15% Steam
PERCENT CARBON
7.0
6.0
5.0
4.0
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
HOURS ON STREAM

FIGURE 124

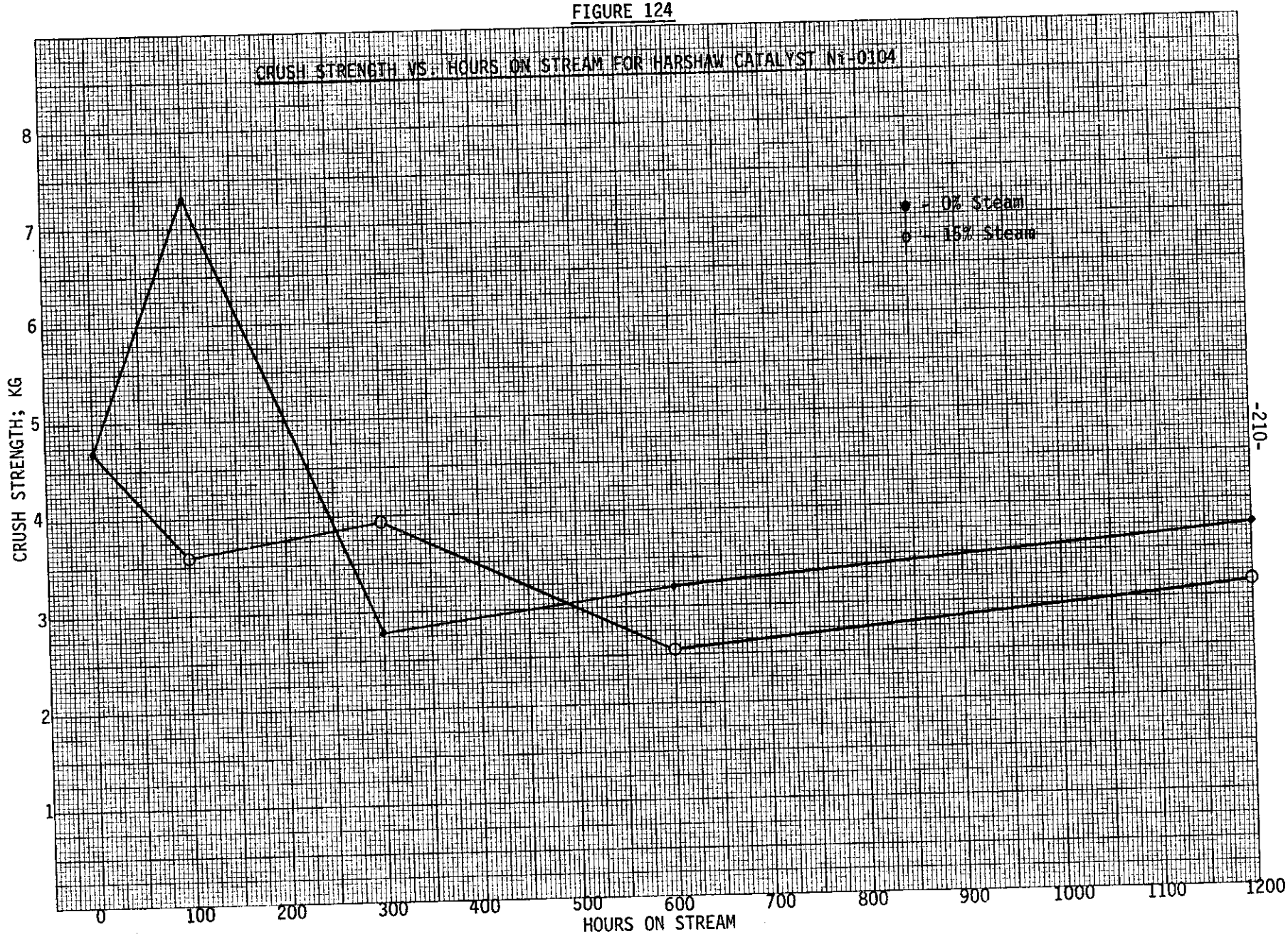

CRUSH STRENGTH VS. HOURS ON STREAM FOR HARSHAW CATALYST Ni-0104
CRUSH STRENGTH; KG
HOURS ON STREAM
● - 0% Steam
○ - 15% Steam
1
2
3
4
5
6
7
8
0
100
200
300
400
500
600
700
800
900
1000
1100
1200

FIGURE 125

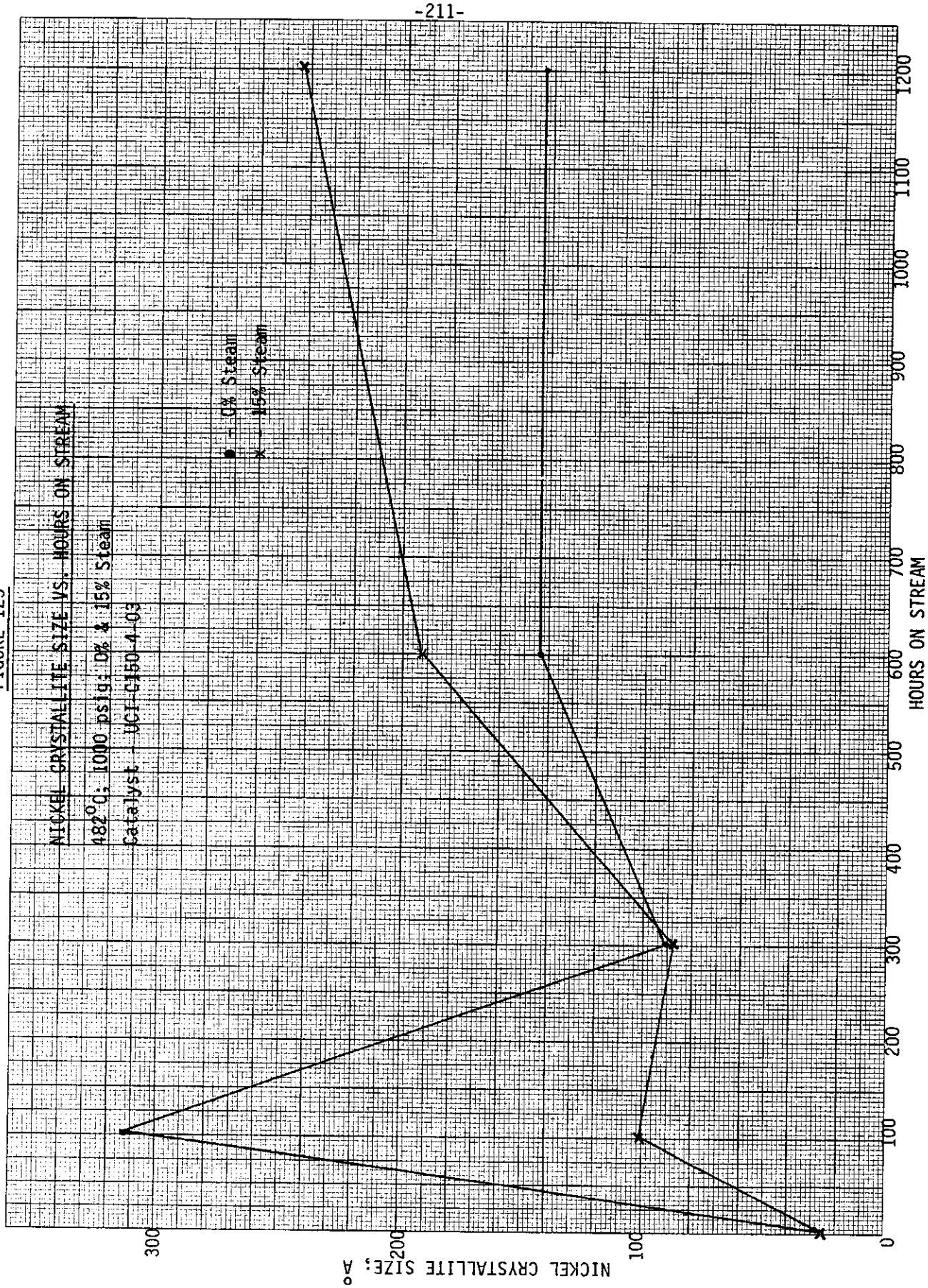

NICKEL CRYSTALLITE SIZE VS. HOURS ON STREAM
482°C; 1000 psig; 0% & 15% Steam
Catalyst - UCI-C150-4-03
● - 0% Steam
x - 15% Steam
NICKEL CRYSTALLITE SIZE; Å
HOURS ON STREAM
0
100
200
300
400
500
600
700
800
900
1000
1100
1200

FIGURE 126

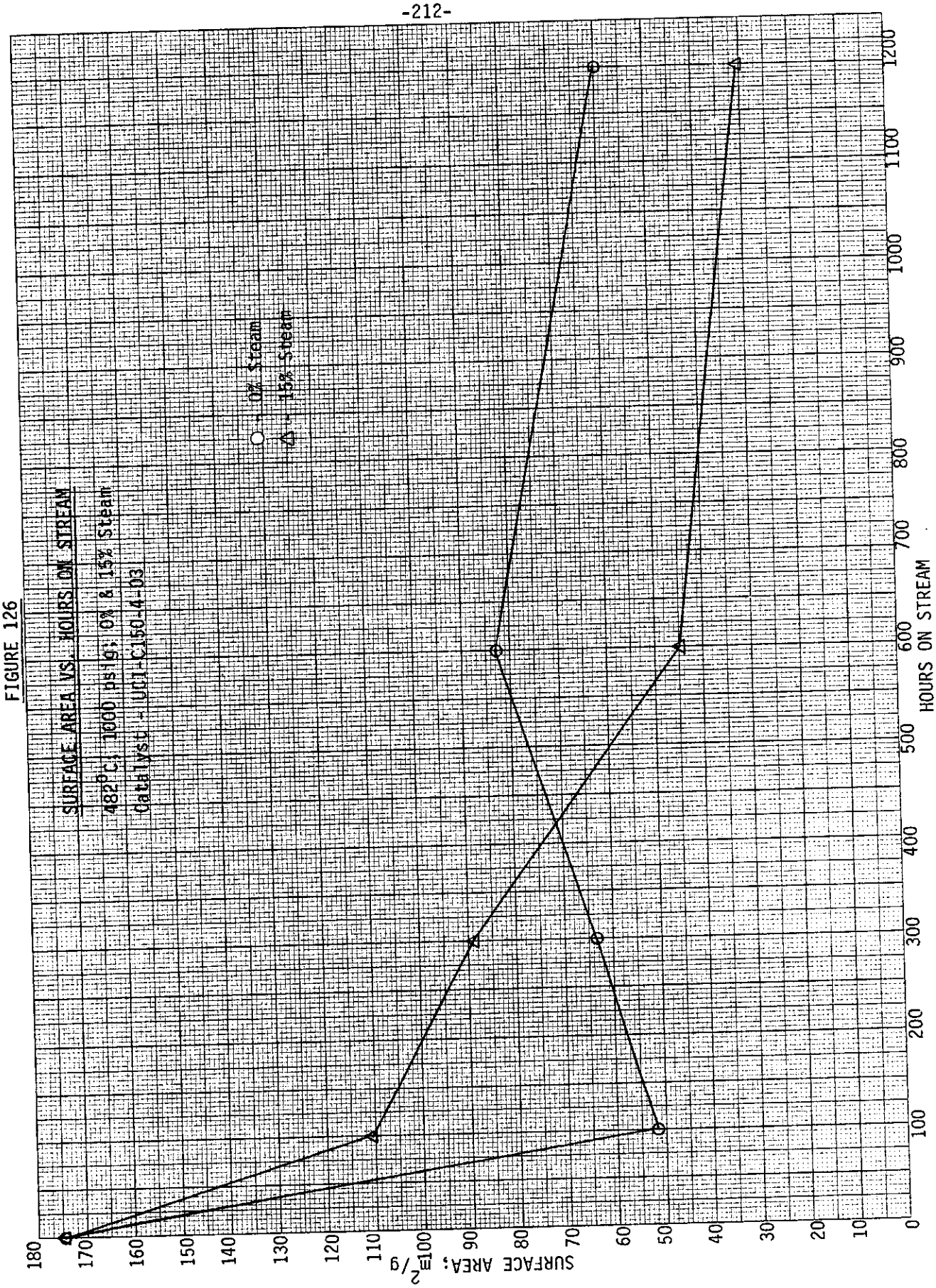

SURFACE AREA VS. HOURS ON STREAM
482°C; 1000 psig; 0% & 15% Steam
Catalyst - UOP-C150-4-03
○ - 0% Steam
△ - 15% Steam
SURFACE AREA; M²/g
HOURS ON STREAM
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
100
200
300
400
500
600
700
800
900
1000
1100
1200

FIGURE 127

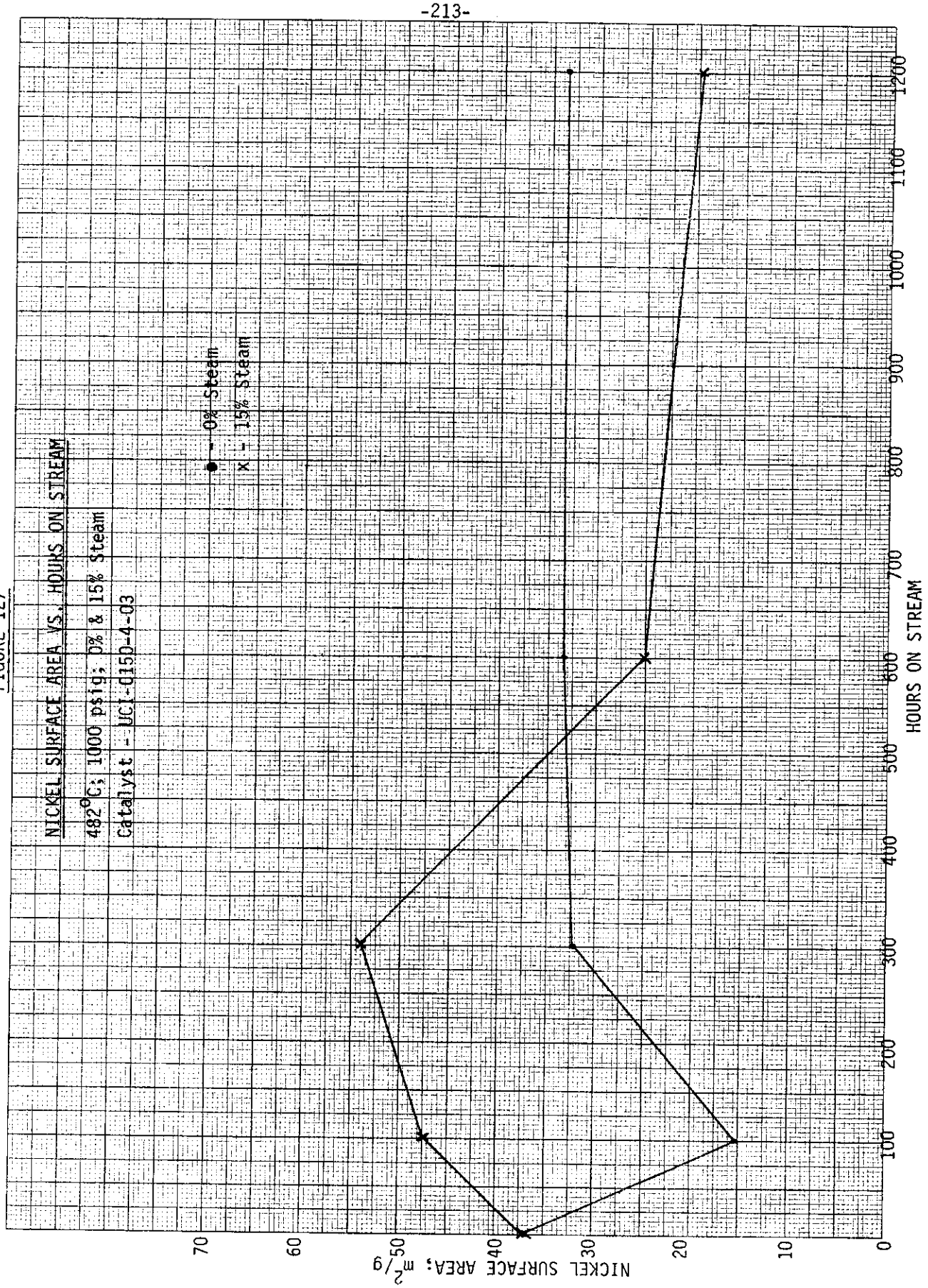
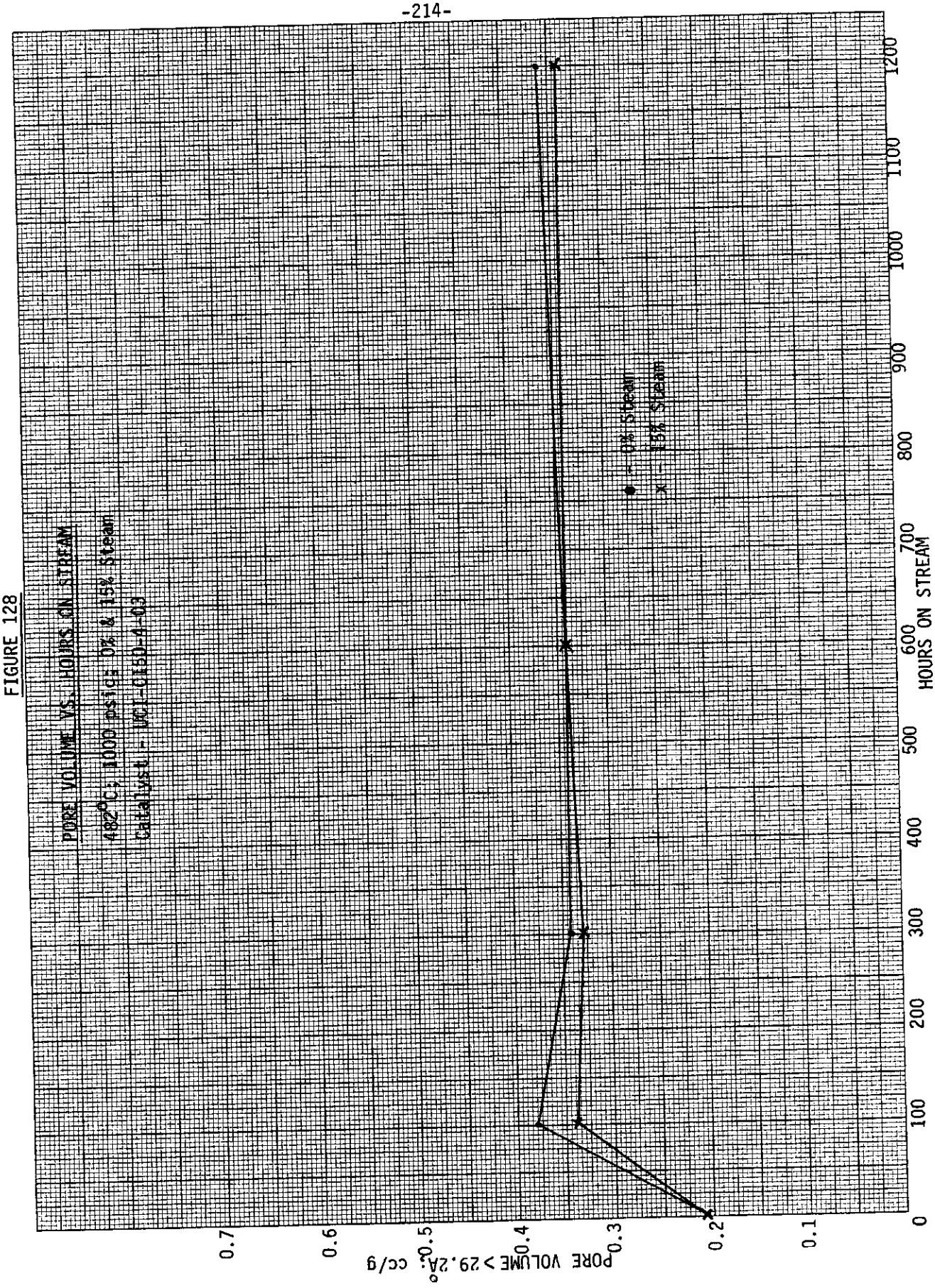

NICKEL SURFACE AREA VS. HOURS ON STREAM
482°C; 1000 psig; 0% & 15% Steam
Catalyst - UCI-C150-4-03
● - 0% Steam
x - 15% Steam
NICKEL SURFACE AREA; m²/g
HOURS ON STREAM
0
10
20
30
40
50
60
70
100
200
300
400
500
600
700
800
900
1000
1100
1200

FIGURE 128


PORE VOLUME VS. HOURS ON STREAM
482°C; 1000 psig; 0% & 15% Steam
Catalyst - UCI-C1BO-4-03
● - 0% Steam
× - 15% Steam
PORE VOLUME >29.2Å: cc/g
HOURS ON STREAM
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
100
200
300
400
500
600
700
800
900
1000
1100
1200

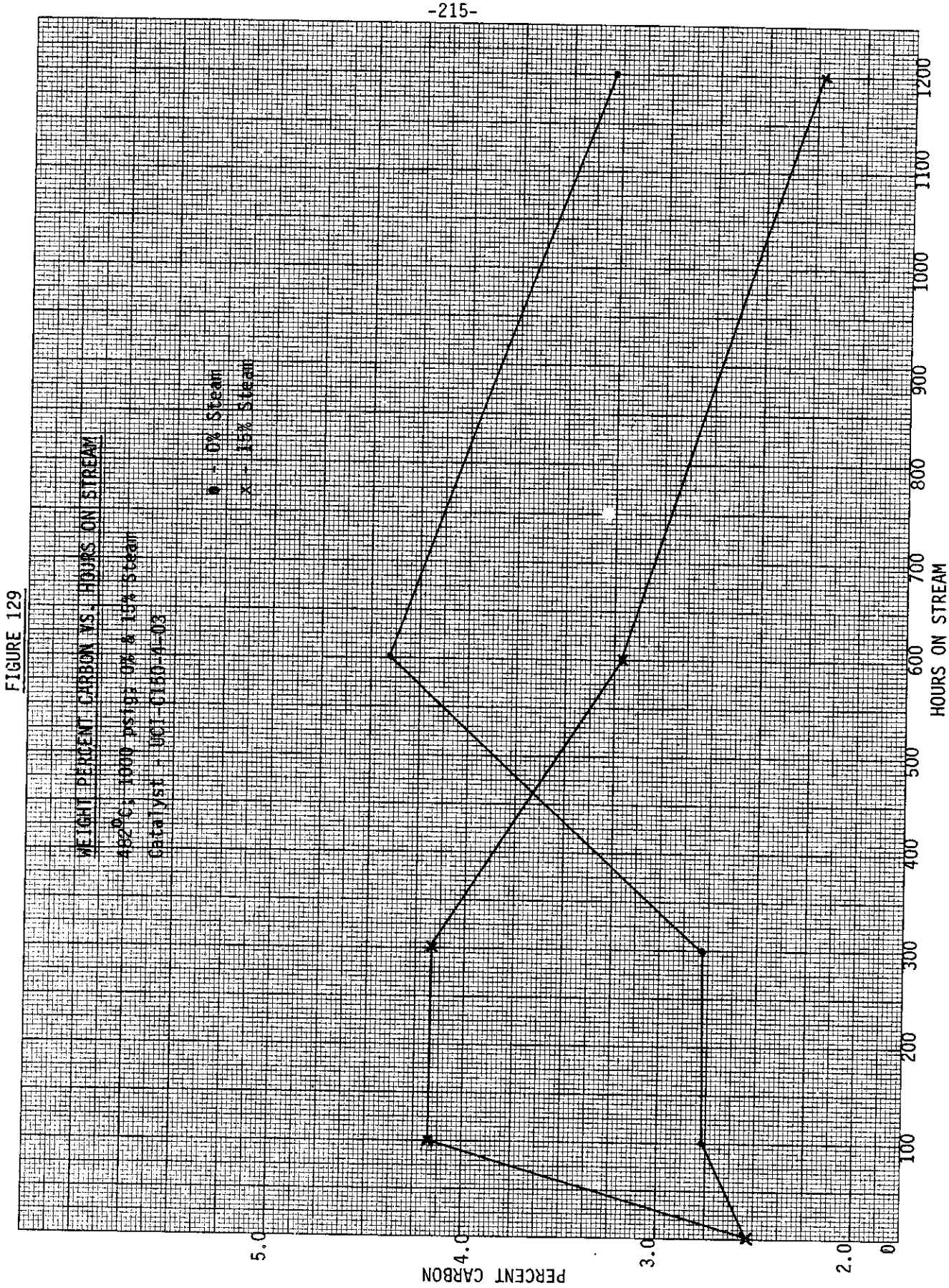

WEIGHT PERCENT CARBON VS. HOURS ON STREAM
482°C; 1000 psig; 0% & 15% Steam
Catalyst - UCT-0150-4-03
● - 0% Steam
x - 15% Steam
PERCENT CARBON
5.0
4.0
3.0
2.0
0
HOURS ON STREAM
100
200
300
400
500
600
700
800
900
1000
1100
1200

FIGURE 129

FIGURE 130

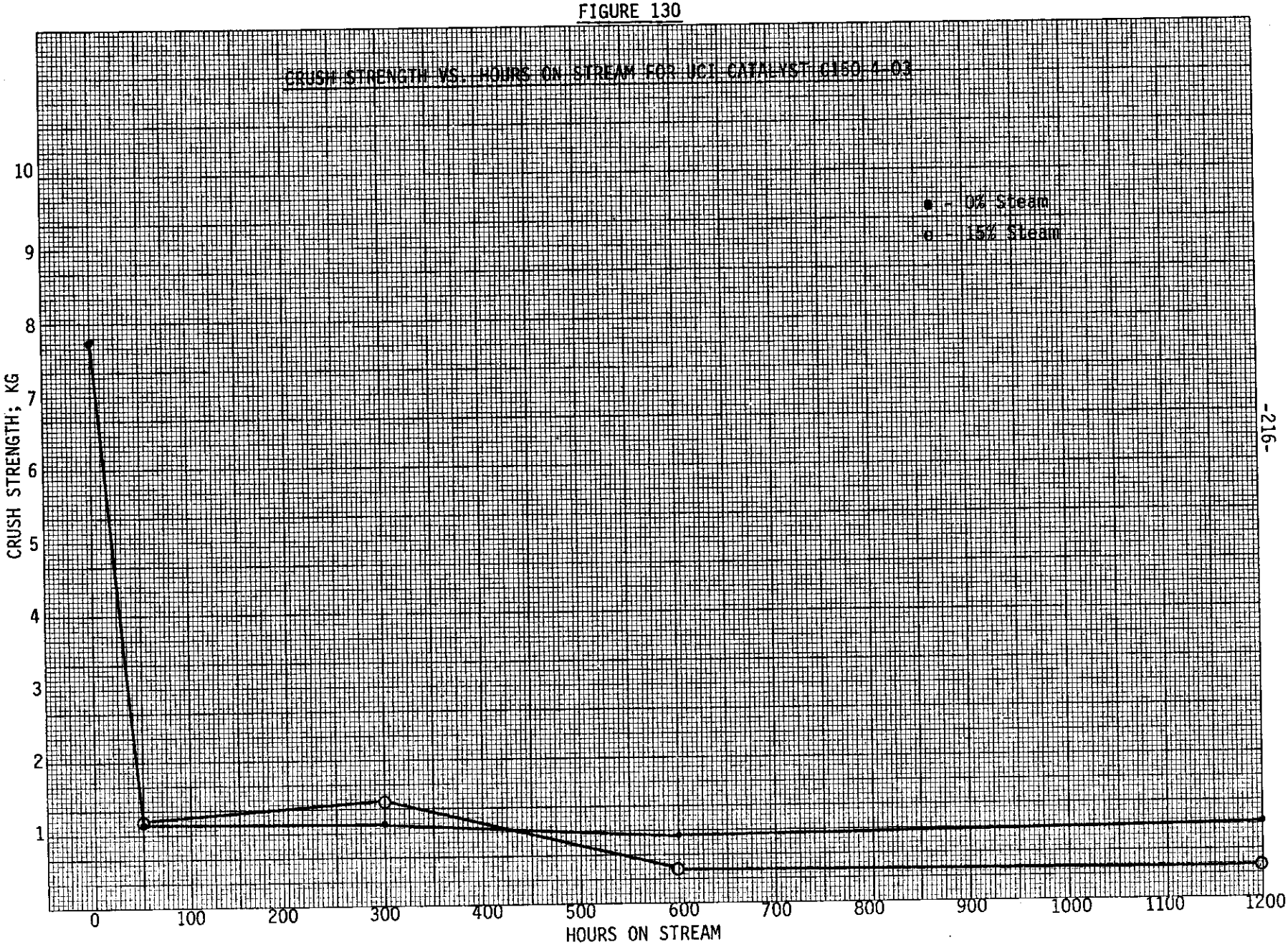

CRUSH STRENGTH VS. HOURS ON STREAM FOR UCI CATALYST G150-1-03
● - 0% Steam
o - 15% Steam
CRUSH STRENGTH; KG
HOURS ON STREAM
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1
2
3
4
5
6
7
8
9
10

FIGURE 131

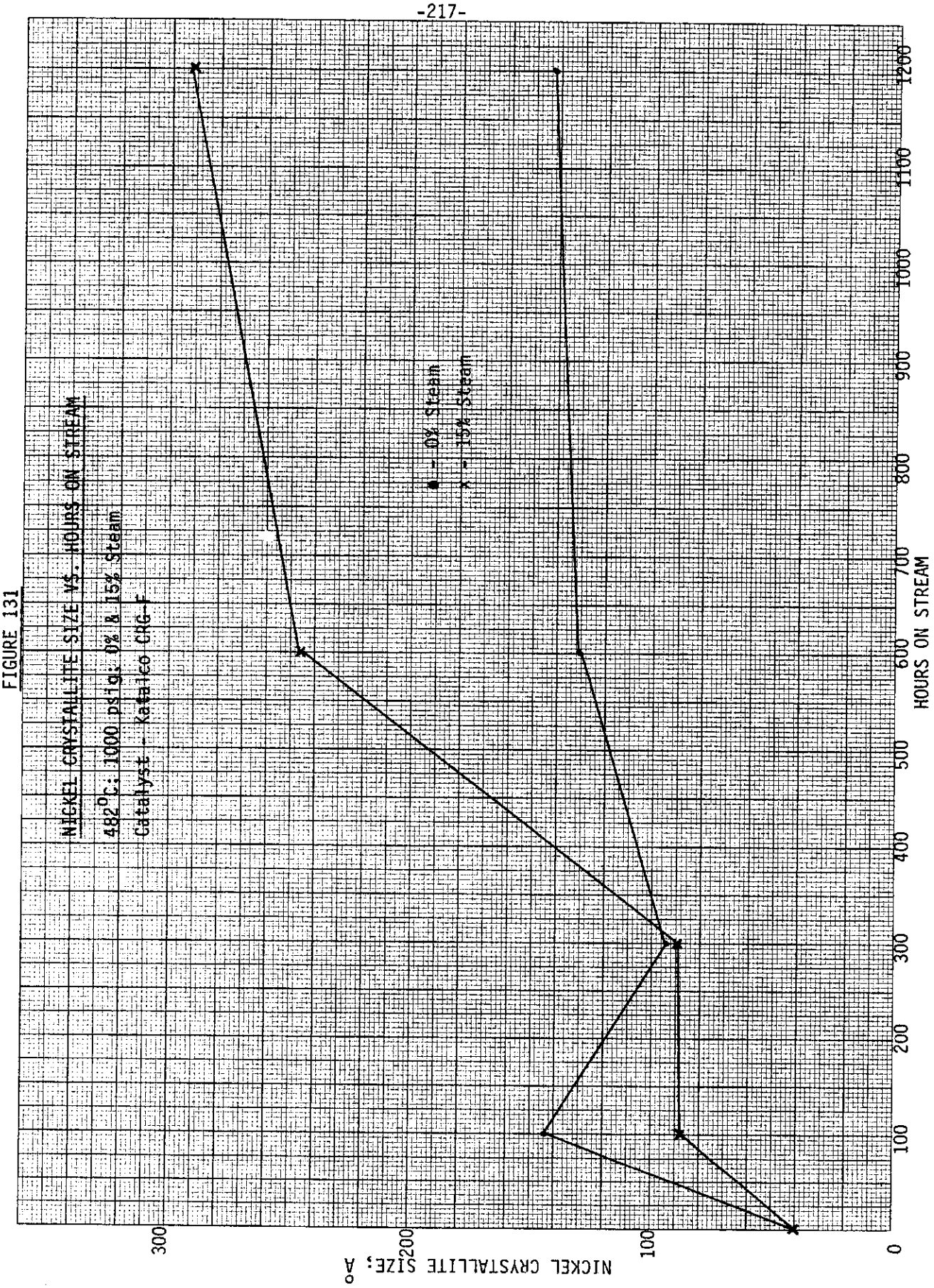

NICKEL CRYSTALLITE SIZE VS. HOURS ON STREAM
482°C.; 1000 psig; 0% & 15% Steam
Catalyst - Katalco CRG-F
● - 0% Steam
x - 15% Steam
NICKEL CRYSTALLITE SIZE; Å
HOURS ON STREAM
0
100
200
300
400
500
600
700
800
900
1000
1100
1200

FIGURE 132

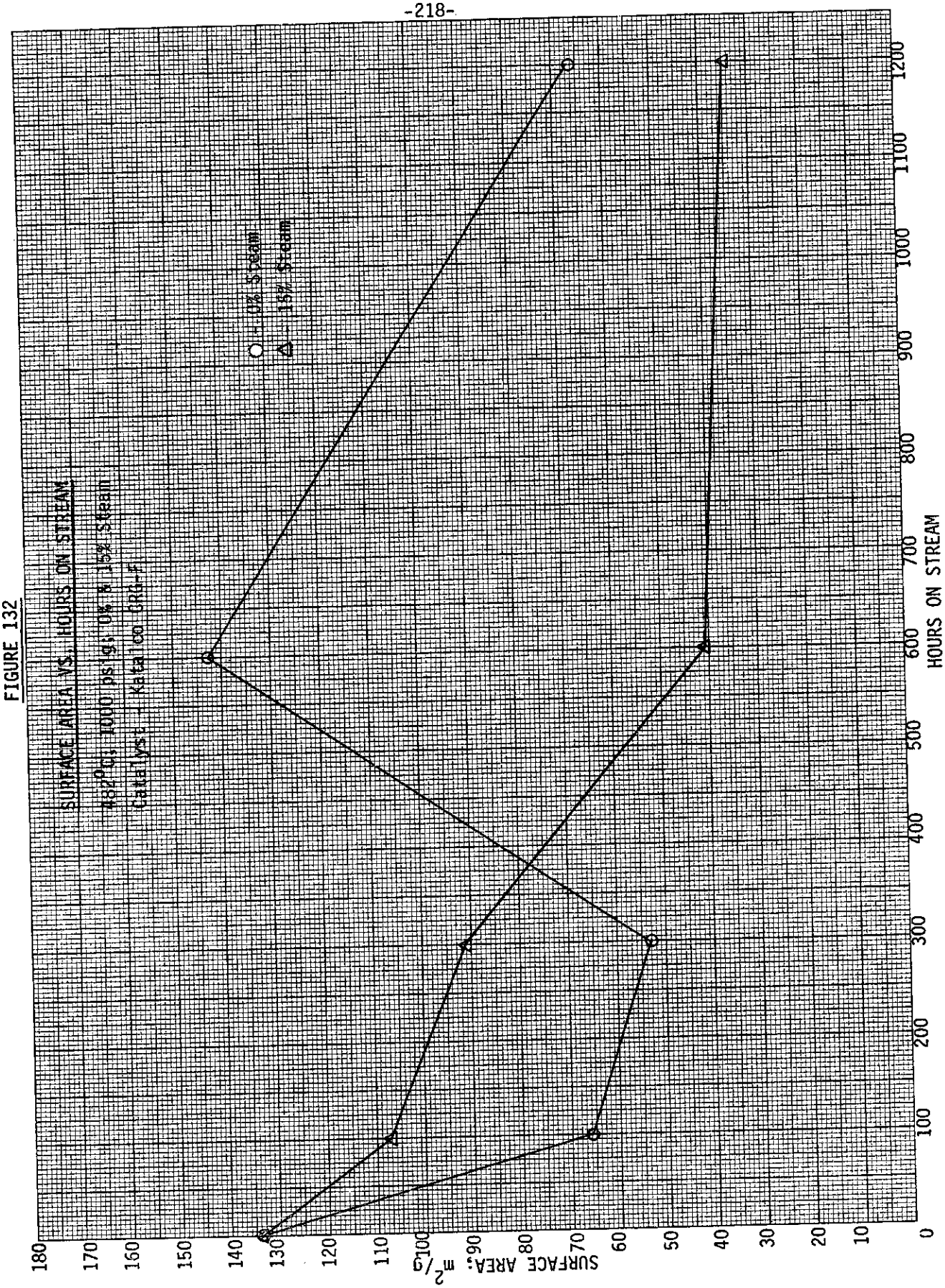

SURFACE AREA VS. HOURS ON STREAM
482°C; 1000 psig; 0% & 15% Steam
Catalyst - Kata'co GRG-F
O - 0% Steam
Δ - 15% Steam
SURFACE AREA; m²/g
HOURS ON STREAM
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
100
200
300
400
500
600
700
800
900
1000
1100
1200

FIGURE 133

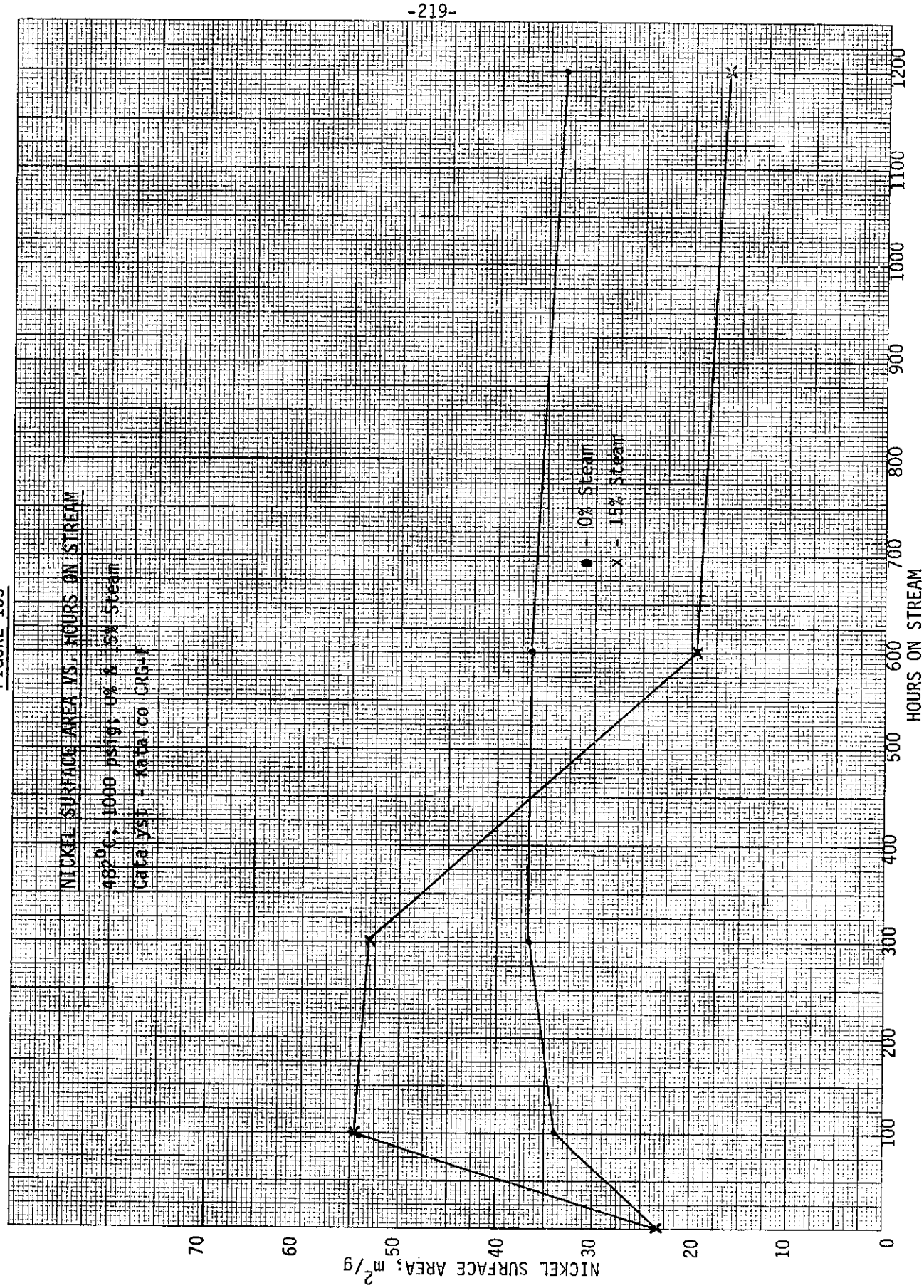

NICKEL SURFACE AREA VS. HOURS ON STREAM
482°C; 1000 psig; u% & 15% Steam
Catalyst - Katalco CRG-F
● - 0% Steam
x - 15% Steam
NICKEL SURFACE AREA; m²/g
HOURS ON STREAM
0
10
20
30
40
50
60
70
100
200
300
400
500
600
700
800
900
1000
1100
1200

FIGURE 134

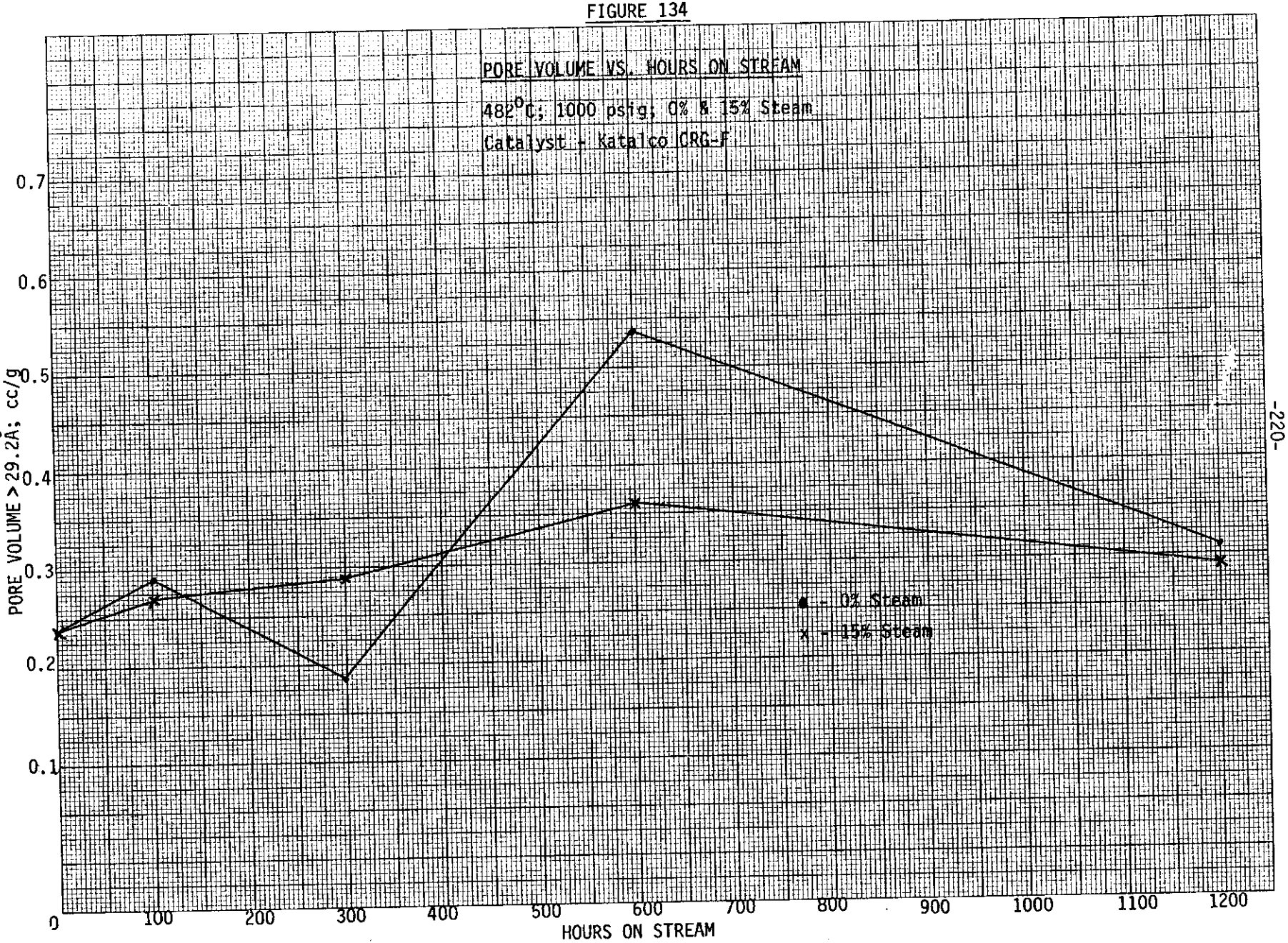

PORE VOLUME VS. HOURS ON STREAM
482°C; 1000 psig; 0% & 15% Steam
Catalyst - Katalco CRG-F
PORE VOLUME > 29.2Å; cc/g
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
100
200
300
400
500
600
700
800
900
1000
1100
1200
HOURS ON STREAM
● - 0% Steam
× - 15% Steam

FIGURE 135

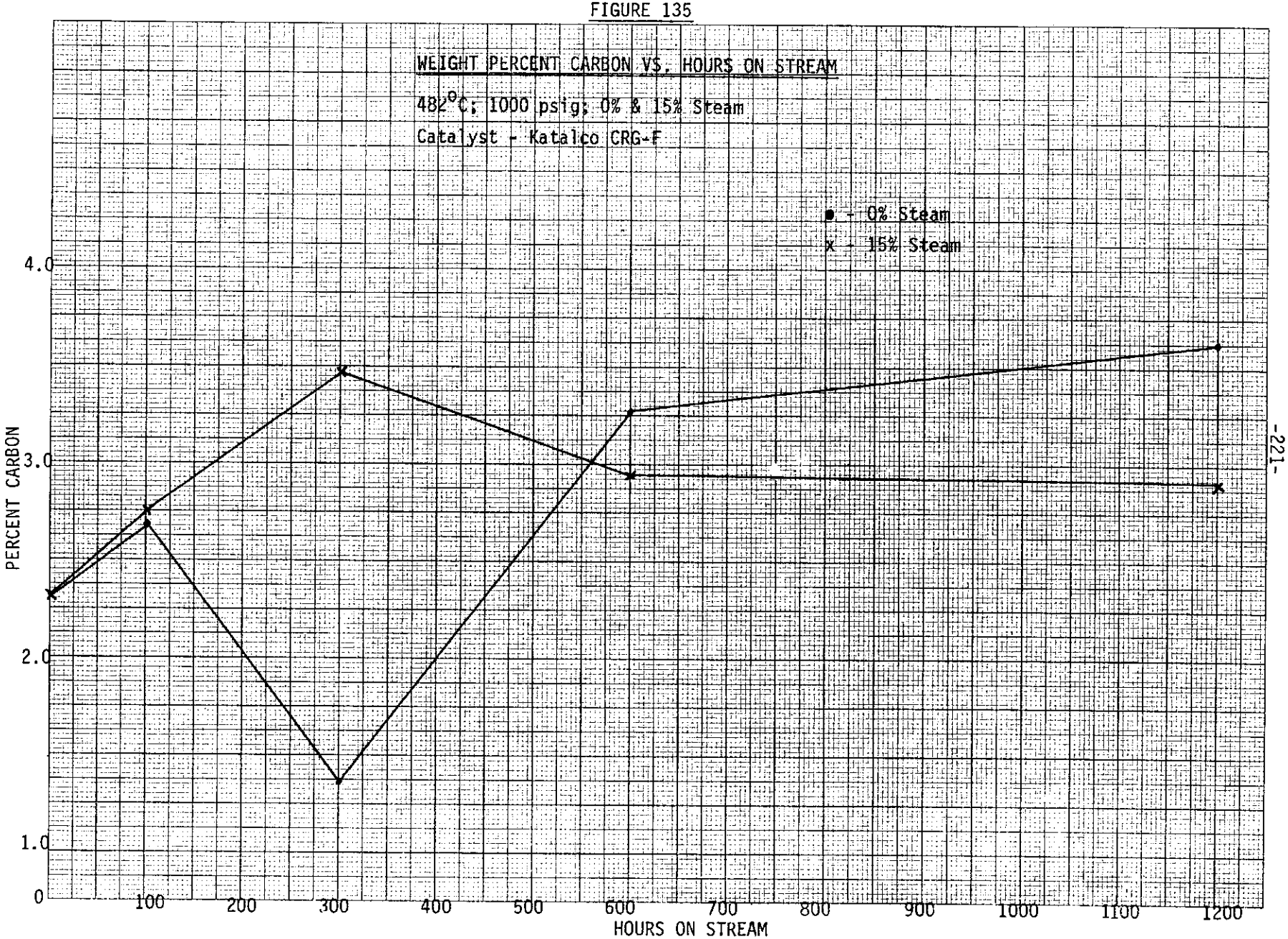

WEIGHT PERCENT CARBON VS. HOURS ON STREAM
482°C; 1000 psig; 0% & 15% Steam
Catalyst - Katalco CRG-F
● - 0% Steam
x - 15% Steam
PERCENT CARBON
4.0
3.0
2.0
1.0
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
HOURS ON STREAM

FIGURE 136

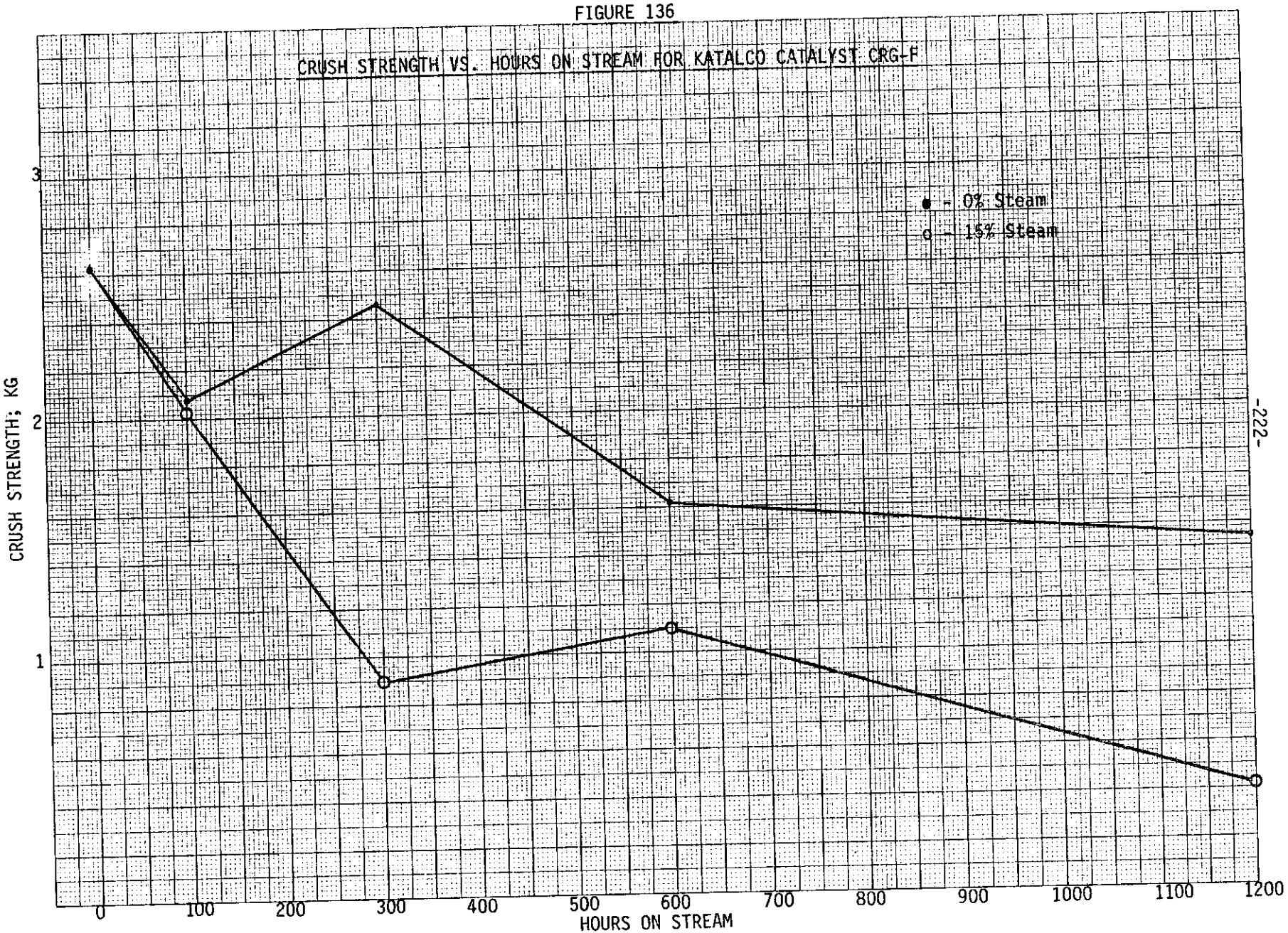

CRUSH STRENGTH VS. HOURS ON STREAM FOR KATALCO CATALYST CRG-F
● - 0% Steam
○ - 15% Steam
CRUSH STRENGTH; KG
3
2
1
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
HOURS ON STREAM

FIGURE 137

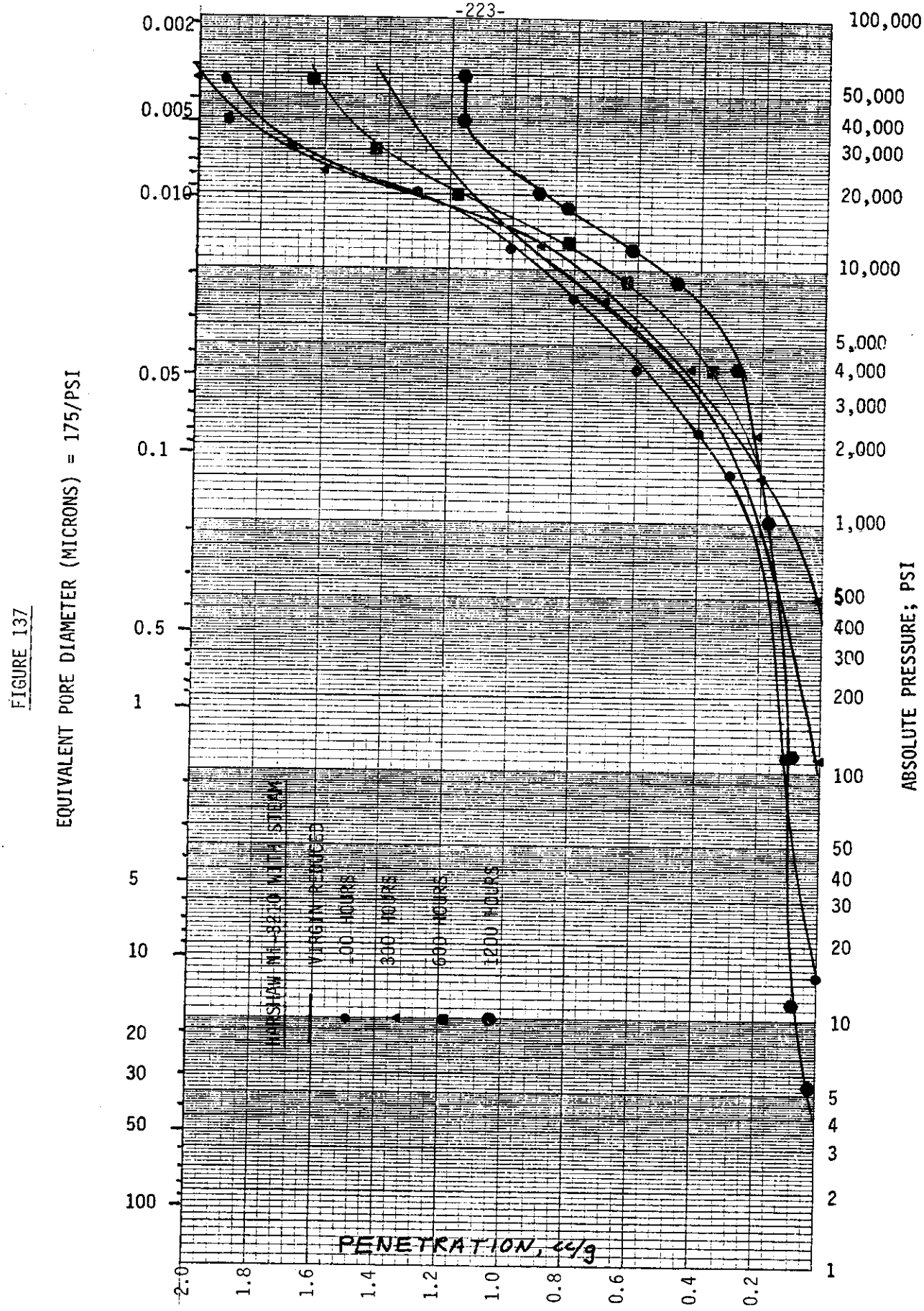
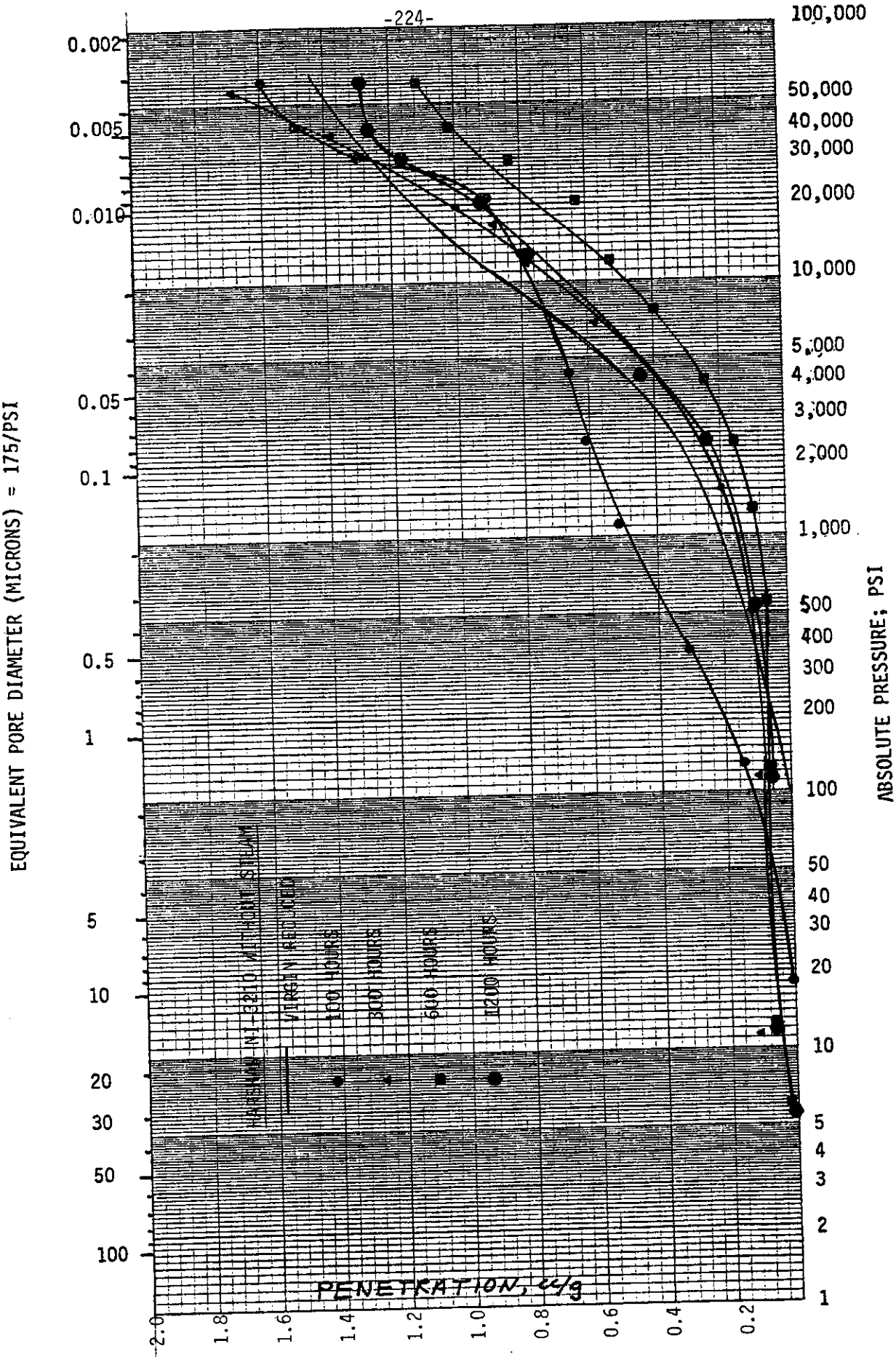

EQUIVALENT PORE DIAMETER (MICRONS) = 175/PSI
0.002
0.005
0.010
0.05
0.1
0.5
1
5
10
20
30
50
100
100,000
50,000
40,000
30,000
20,000
10,000
5,000
4,000
3,000
2,000
1,000
500
400
300
200
100
50
40
30
20
10
5
4
3
2
1
ABSOLUTE PRESSURE; PSI
HARSHAW Ni-3270 WITH STEAM
VIRGIN PELLET
30 HOURS
60 HOURS
120 HOURS
PENETRATION, cc/g
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2

FIGURE 138


EQUIVALENT PORE DIAMETER (MICRONS) = 175/PSI
0.002
0.005
0.010
0.05
0.1
0.5
1
5
10
20
30
50
100
100,000
50,000
40,000
30,000
20,000
10,000
5,000
4,000
3,000
2,000
1,000
500
400
300
200
100
50
40
30
20
10
5
4
3
2
1
ABSOLUTE PRESSURE; PSI
HASTELLOY N-3210 WITHOUT STEAM
VIRGIN REFLUXED
100 HOURS
300 HOURS
600 HOURS
1200 HOURS
PENETRATION, cc/g
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2

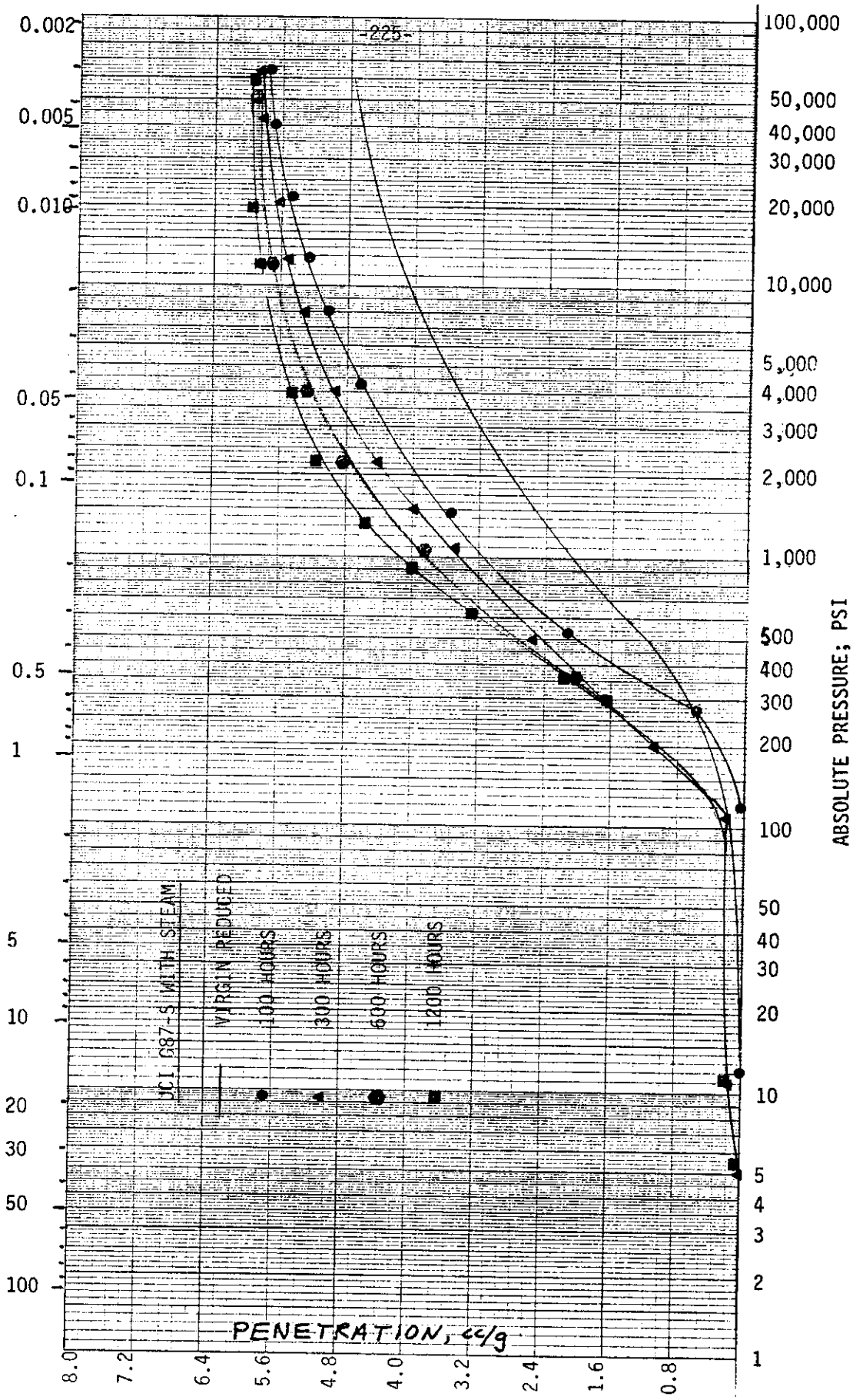
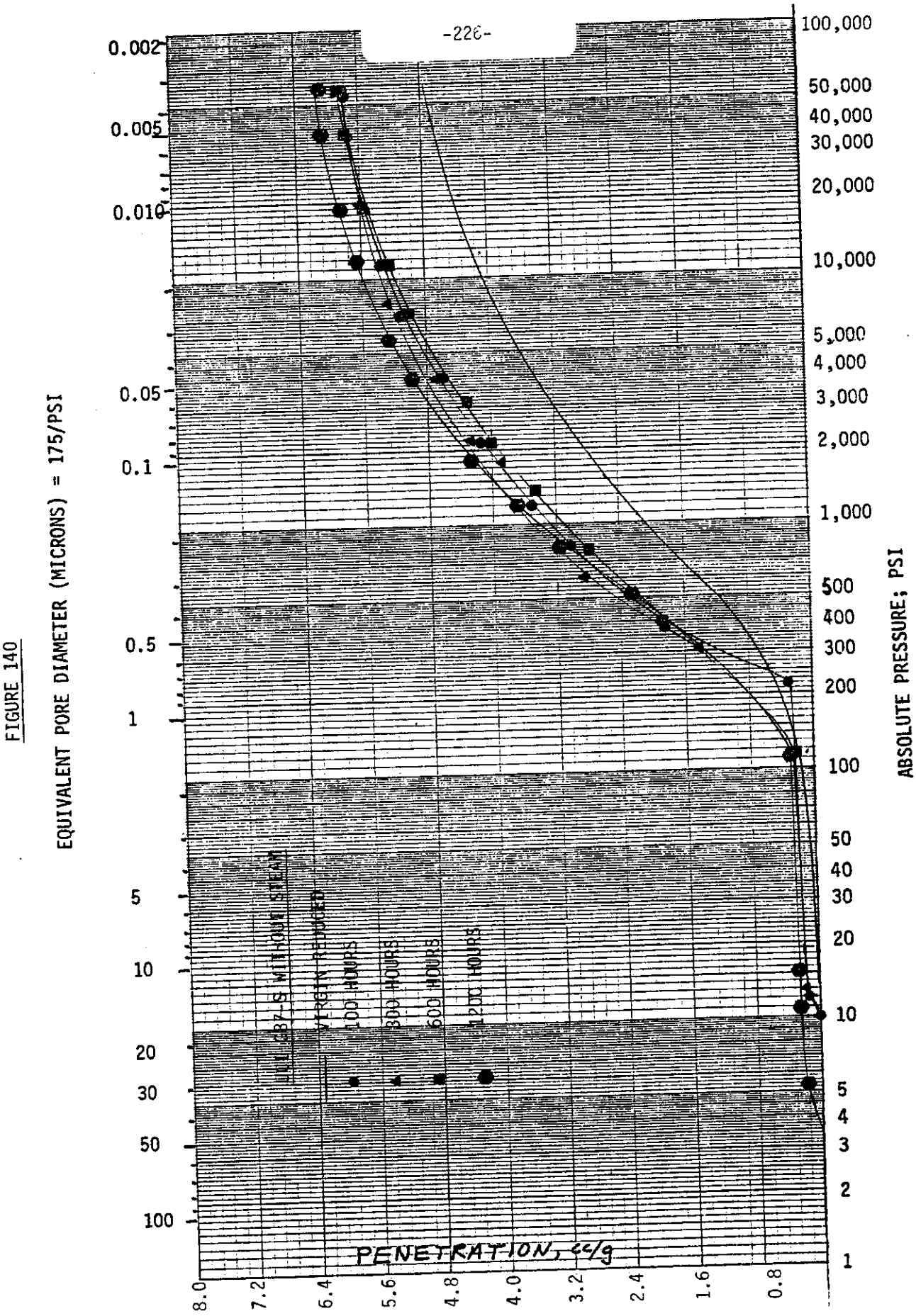

EQUIVALENT PORE DIAMETER (MICRONS) = 175/PSI
0.002
0.005
0.01
0.05
0.1
0.5
1
5
10
20
30
50
100
100,000
50,000
40,000
30,000
20,000
10,000
5,000
4,000
3,000
2,000
1,000
500
400
300
200
100
50
40
30
20
10
5
4
3
2
1
ABSOLUTE PRESSURE; PSI
UCI 087-S WITH STEAM
VIRGIN REDUCED
100 HOURS
300 HOURS
600 HOURS
1200 HOURS
8.0
7.2
6.4
5.6
4.8
4.0
3.2
2.4
1.6
0.8
PENETRATION, cc/g

FIGURE 139

FIGURE 140


EQUIVALENT PORE DIAMETER (MICRONS) = 175/PSI
0.002
0.005
0.010
0.05
0.1
0.5
1
5
10
20
30
50
100
ABSOLUTE PRESSURE; PSI
100,000
50,000
40,000
30,000
20,000
10,000
5,000
4,000
3,000
2,000
1,000
500
400
300
200
100
50
40
30
20
10
5
4
3
2
1
PENETRATION, cc/g
8.0
7.2
6.4
5.6
4.8
4.0
3.2
2.4
1.6
0.8
JULIA 87-S WITHOUT STEAM
VIRGIN REVIVED
100 HOURS
300 HOURS
600 HOURS
1200 HOURS

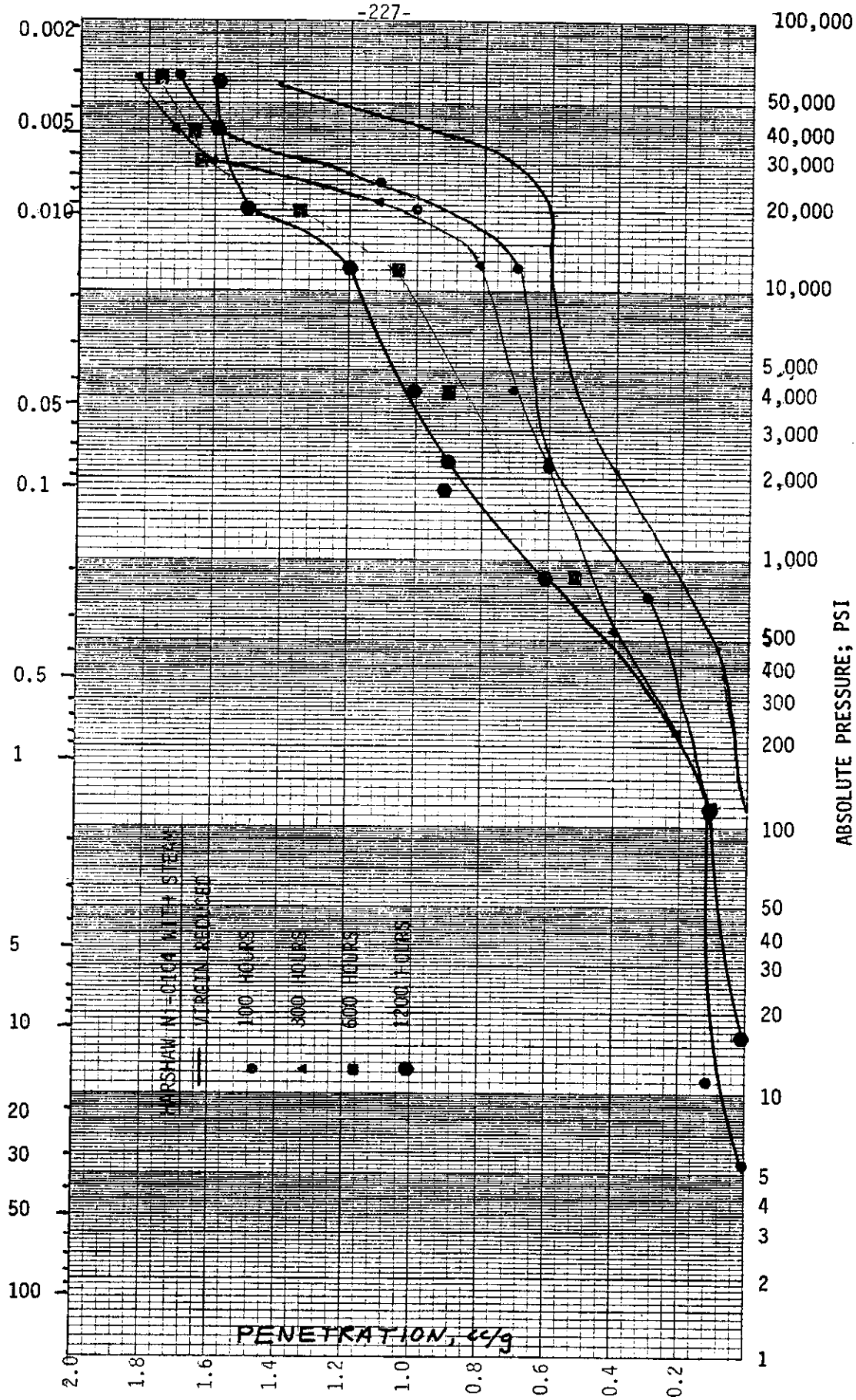

EQUIVALENT PORE DIAMETER (MICRONS) = 175/PSI
0.002
0.005
0.010
0.05
0.1
0.5
1
5
10
20
30
50
100
100,000
50,000
40,000
30,000
20,000
10,000
5,000
4,000
3,000
2,000
1,000
500
400
300
200
100
50
40
30
20
10
5
4
3
2
1
ABSOLUTE PRESSURE; PSI
HARSHAW Ni-0104 WITH STEARIC
VIRGIN REDUCED
100 HOURS
300 HOURS
600 HOURS
1200 HOURS
PENETRATION, cc/g
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2

FIGURE 141

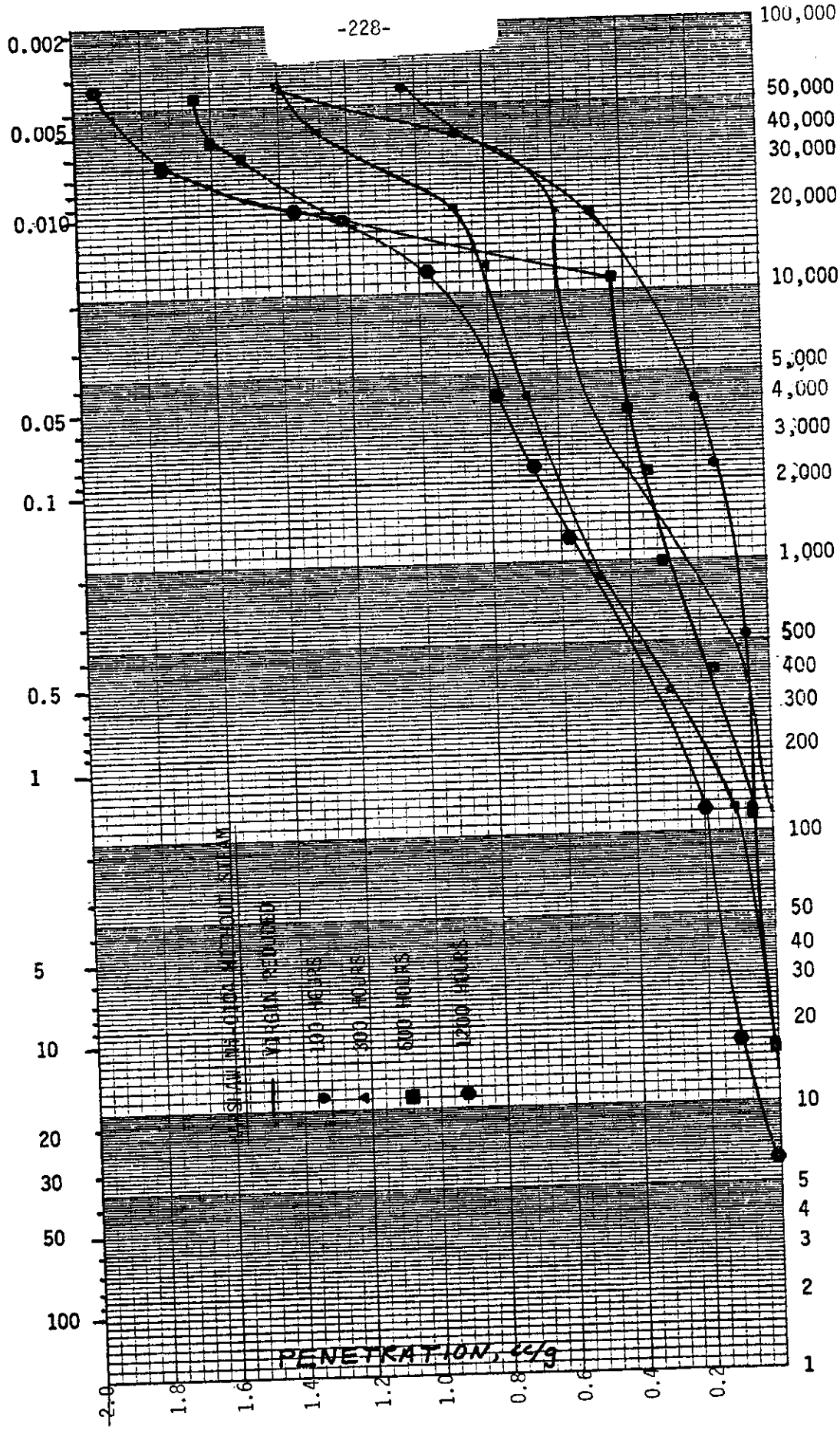
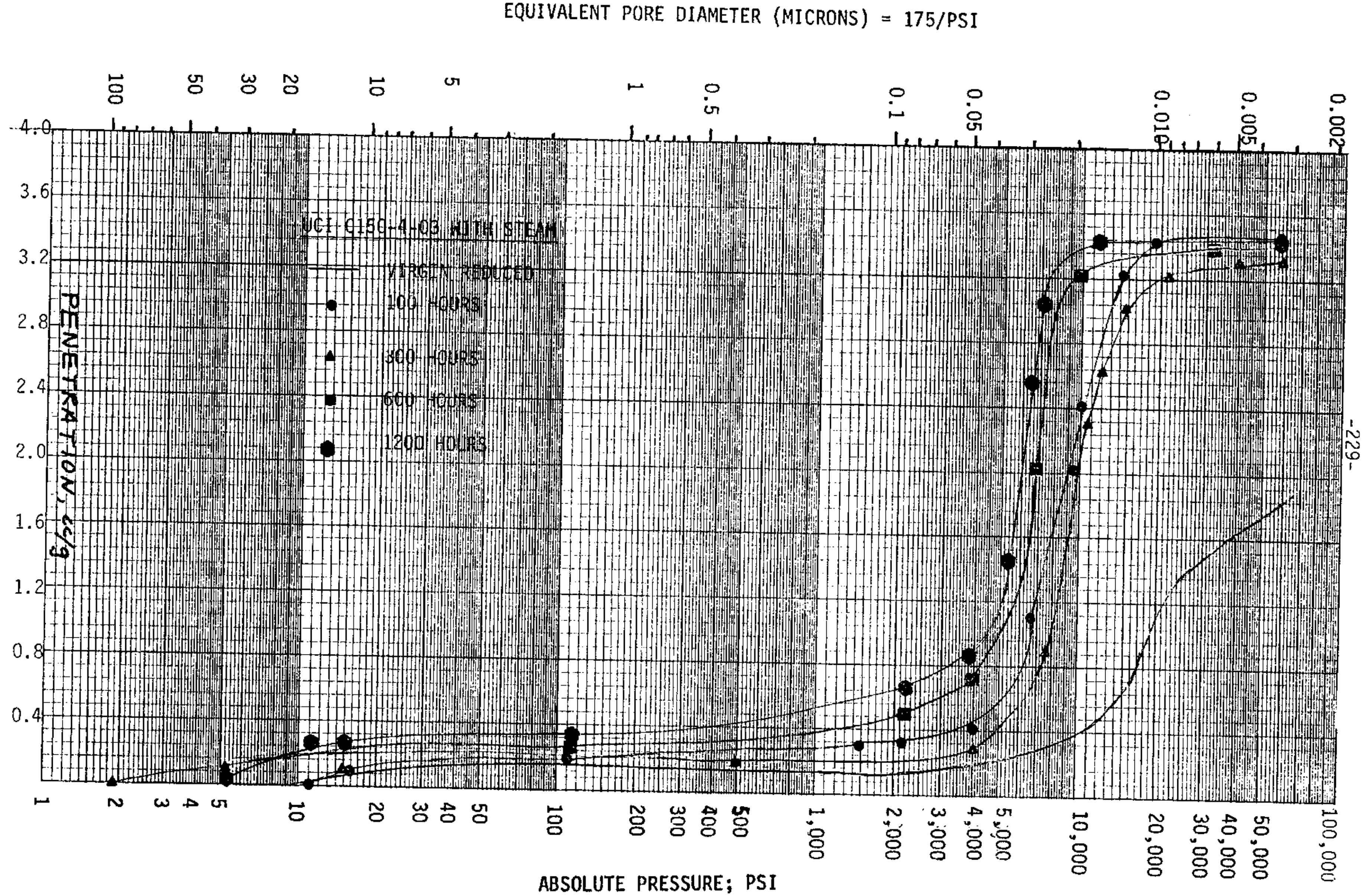

EQUIVALENT PORE DIAMETER (MICRONS) = 175/PSI
0.002
0.005
0.010
0.05
0.1
0.5
1
5
10
20
30
50
100
ABSOLUTE PRESSURE; PSI
100,000
50,000
40,000
30,000
20,000
10,000
5,000
4,000
3,000
2,000
1,000
500
400
300
200
100
50
40
30
20
10
5
4
3
2
1
PENETRATION, cc/g
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
VIRGIN REFORMER
100 HOURS
300 HOURS
600 HOURS
1200 HOURS
STEAM REFORMER WITH COUNTER STEAM

FIGURE 142

FIGURE 143


EQUIVALENT PORE DIAMETER (MICRONS) = 175/PSI
100
50
30
20
10
5
1
0.5
0.1
0.05
0.010
0.005
0.002
4.0
3.6
3.2
2.8
2.4
2.0
1.6
1.2
0.8
0.4
PENETRATION, cc/g
UCI C150-4-03 WITH STEAM
VIRGIN REDUCED
100 HOURS
300 HOURS
600 HOURS
1200 HOURS
1
2
3
4
5
10
20
30
40
50
100
200
300
400
500
1,000
2,000
3,000
4,000
5,000
10,000
20,000
30,000
40,000
50,000
100,000
ABSOLUTE PRESSURE; PSI

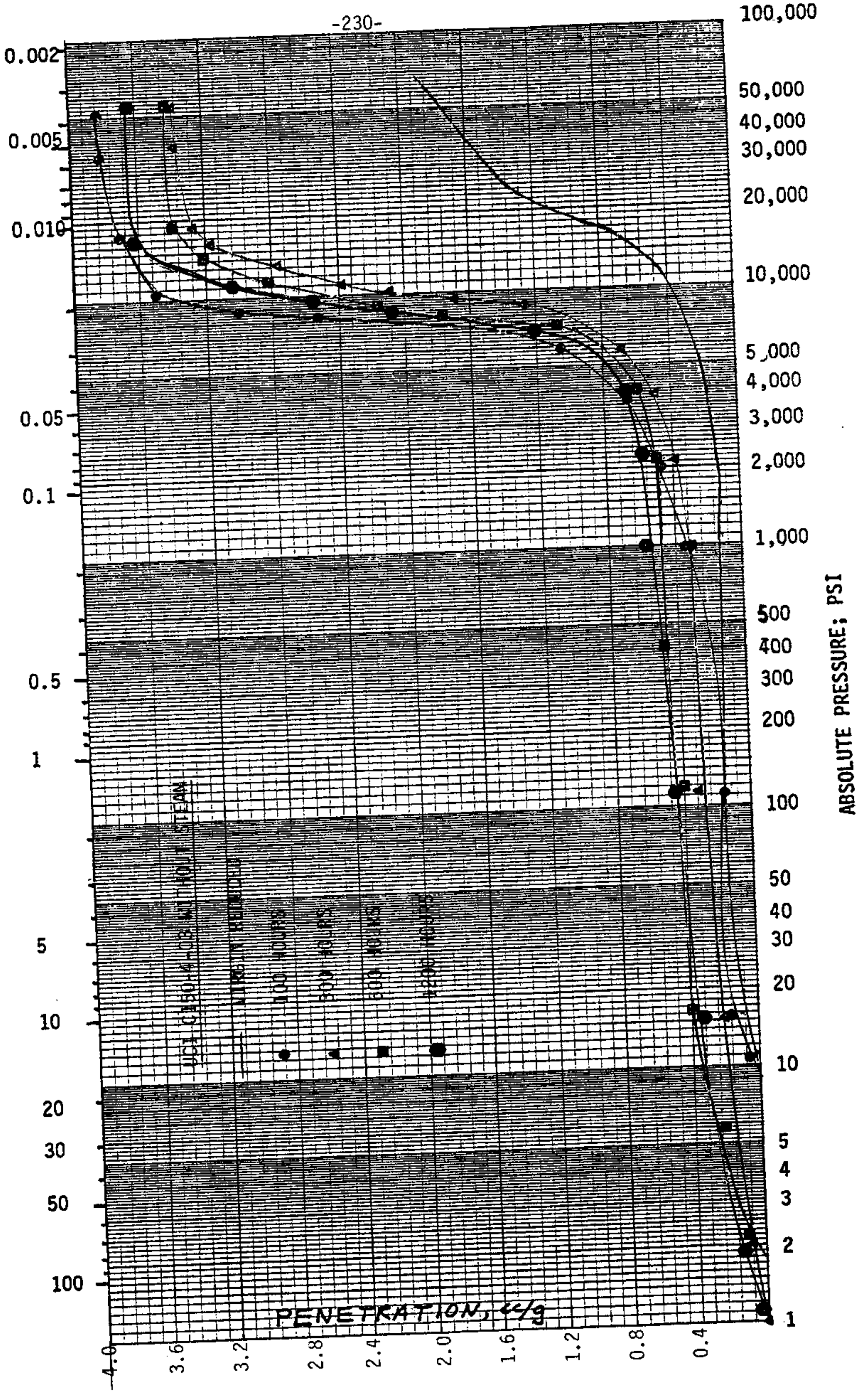

EQUIVALENT PORE DIAMETER (MICRONS) = 175/PSI
0.002
0.005
0.010
0.05
0.1
0.5
1
5
10
20
30
50
100
ABSOLUTE PRESSURE; PSI
100,000
50,000
40,000
30,000
20,000
10,000
5,000
4,000
3,000
2,000
1,000
500
400
300
200
100
50
40
30
20
10
5
4
3
2
1
PENETRATION, cc/g
4.0
3.6
3.2
2.8
2.4
2.0
1.6
1.2
0.8
0.4
STEAM
VIRGIN REDUCED
100 HOURS
500 HOURS
800 HOURS
1200 HOURS

FIGURE 144

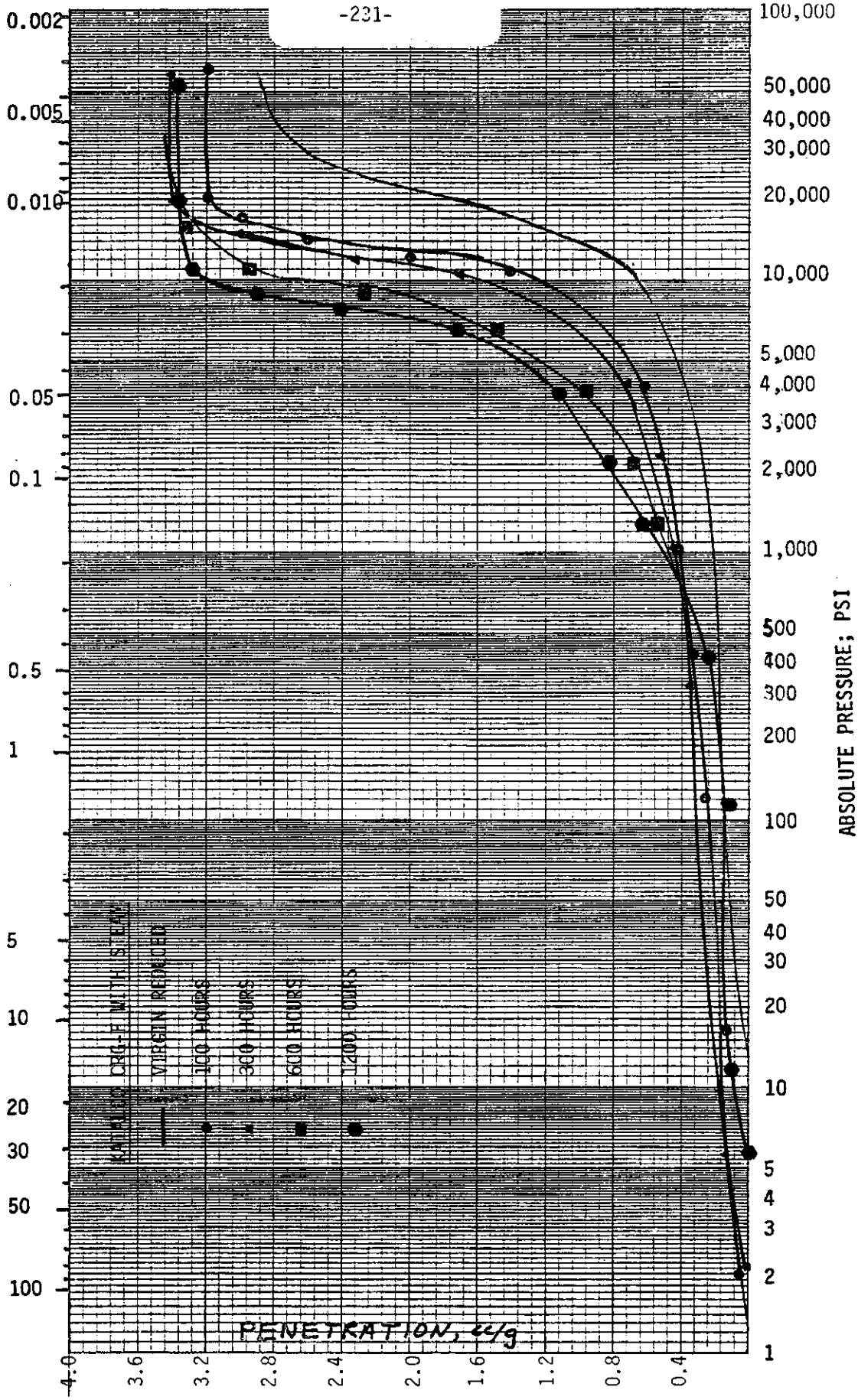

EQUIVALENT PORE DIAMETER (MICRONS) = 175/PSI
0.002
0.005
0.010
0.05
0.1
0.5
1
5
10
20
30
50
100
ABSOLUTE PRESSURE; PSI
100,000
50,000
40,000
30,000
20,000
10,000
5,000
4,000
3,000
2,000
1,000
500
400
300
200
100
50
40
30
20
10
5
4
3
2
1
PENETRATION, cc/g
4.0
3.6
3.2
2.8
2.4
2.0
1.6
1.2
0.8
0.4
KAYDON CRG-F WITH STEAM
VIRGIN REDUCED
100 HOURS
300 HOURS
600 HOURS
1200 HOURS

FIGURE 145

FIGURE 146

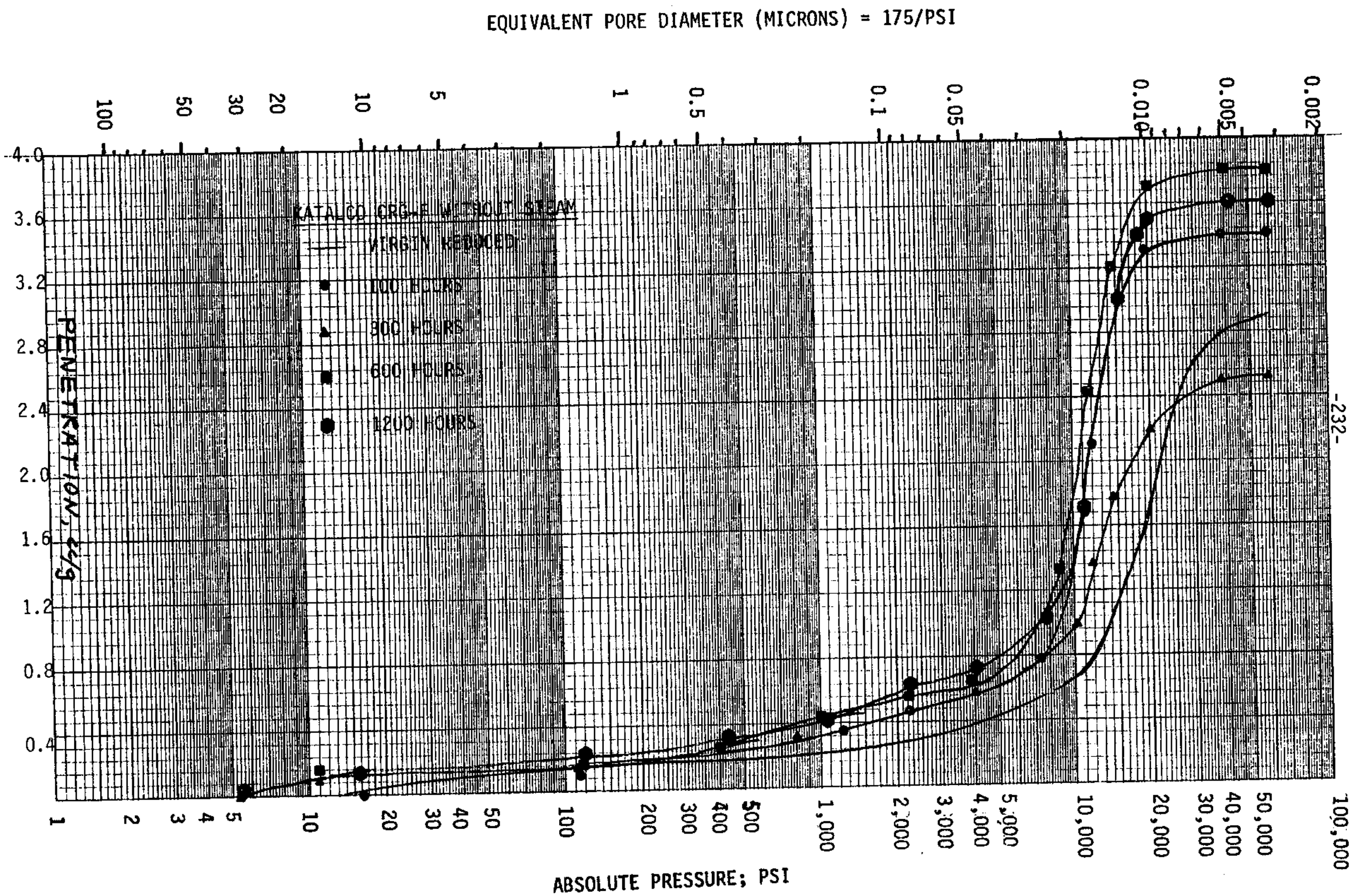
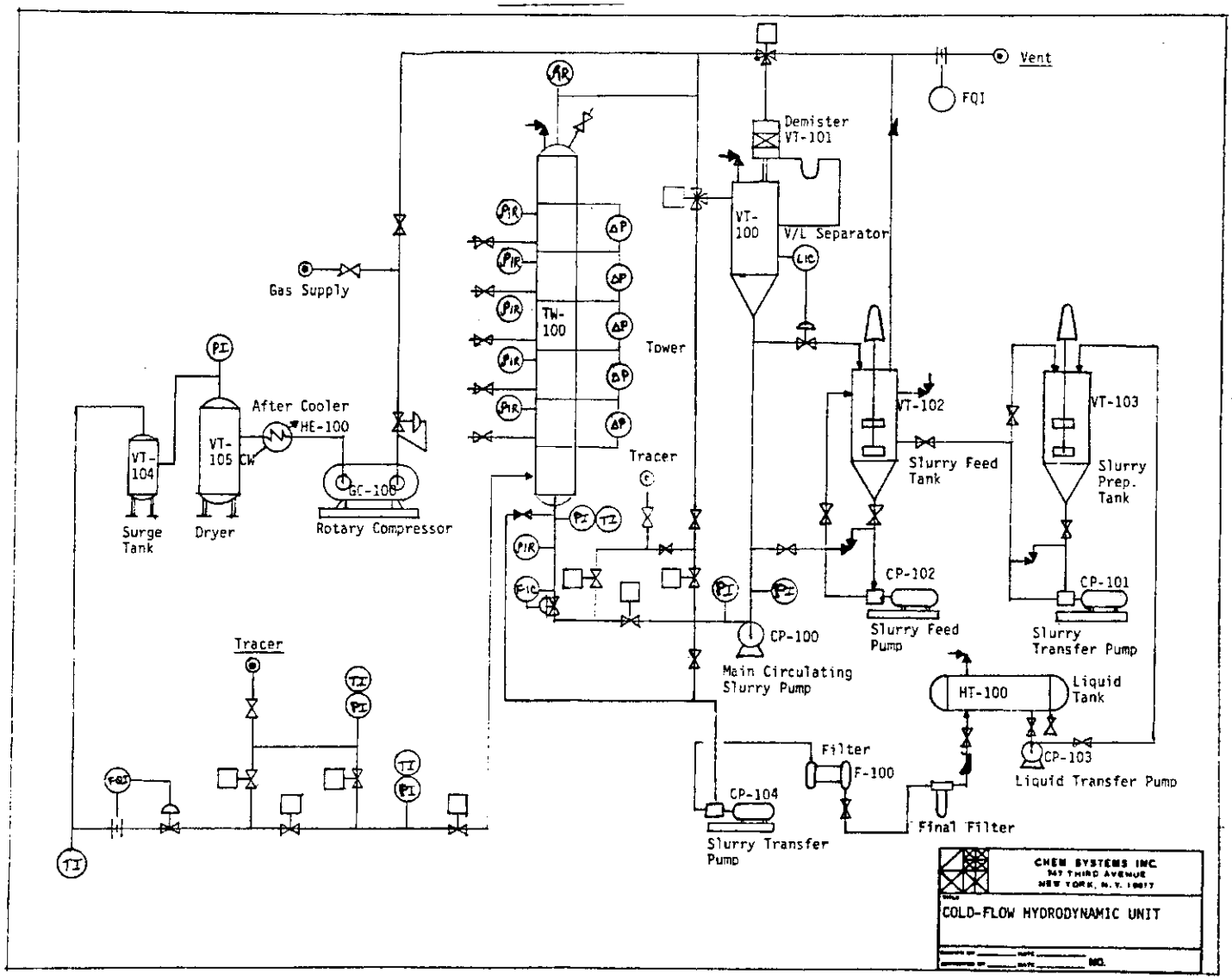

EQUIVALENT PORE DIAMETER (MICRONS) = 175/PSI
KATALCO CRG-F WITHOUT STEAM
VIRGIN REDUCED
100 HOURS
300 HOURS
600 HOURS
1200 HOURS
PENETRATION, cc/g
ABSOLUTE PRESSURE; PSI
100
50
30
20
10
5
1
0.5
0.1
0.05
0.010
0.005
0.002
4.0
3.6
3.2
2.8
2.4
2.0
1.6
1.2
0.8
0.4
1
2
3
4
5
10
20
30
40
50
100
200
300
400
500
1,000
2,000
3,000
4,000
5,000
10,000
20,000
30,000
40,000
50,000
100,000

FIGURE 147



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