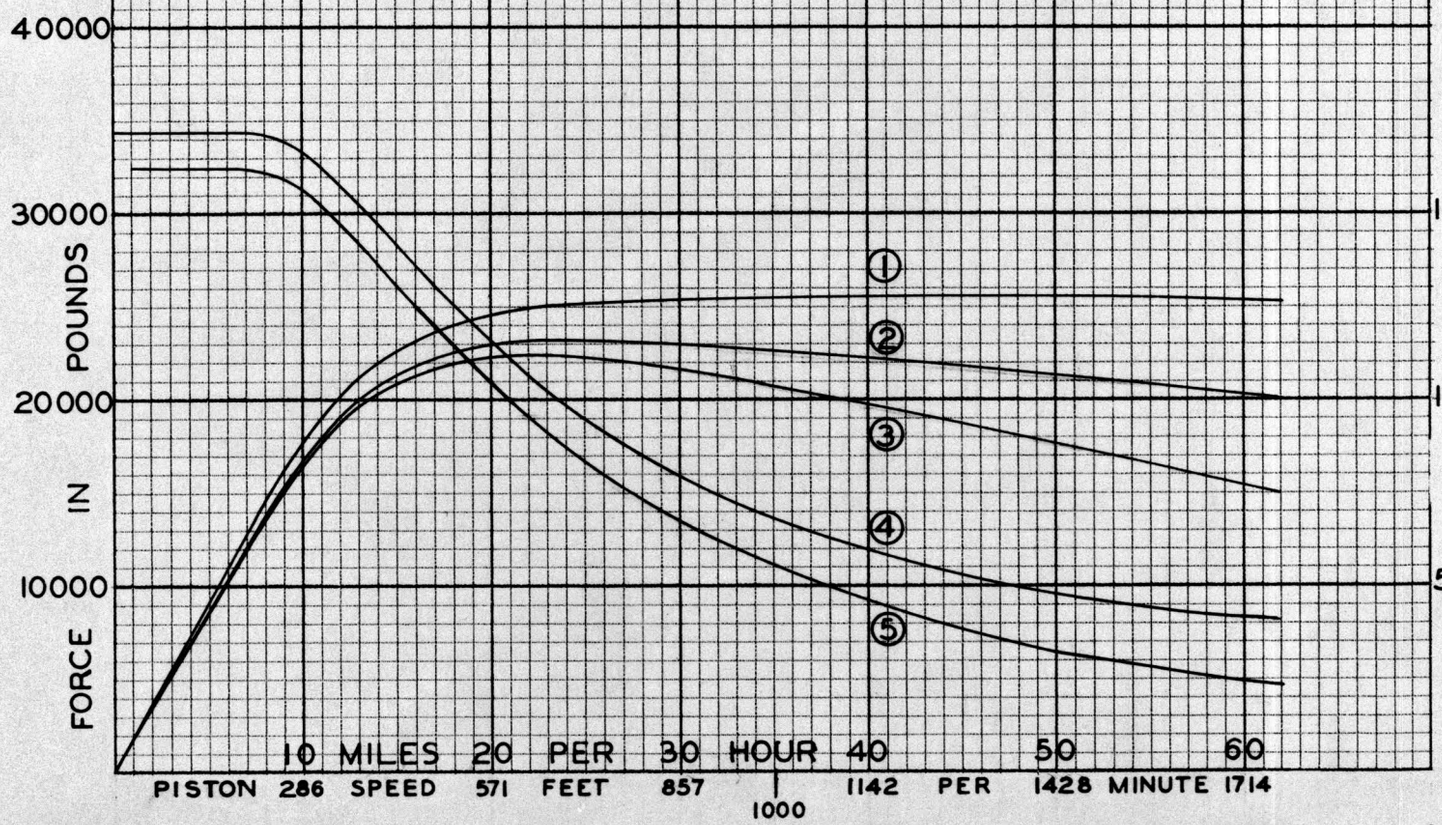
UNION PACIFIC RAILROAD COMPANY

RESEARCH AND MECHANICAL STANDARDS

HORSEPOWER-FORCE-SPEED CURVES

4451-4480 CLASS STEAM LOCOMOTIVE
0-6-0 TYPE
51" DIA. DRIVERS
180 PSI BOILER PRESSURE
21" x 26" CYLINDERS
34,400# MAX. TRACT. FORCE
159,000# WT. ON DRIVERS
4.62 ADHESION FACTOR

① CYLINDER HORSEPOWER
② DRIVER "
③ DRAWBAR "
④ CYLINDER TRACT. FORCE
⑤ DRAWBAR FORCE



9-16-39

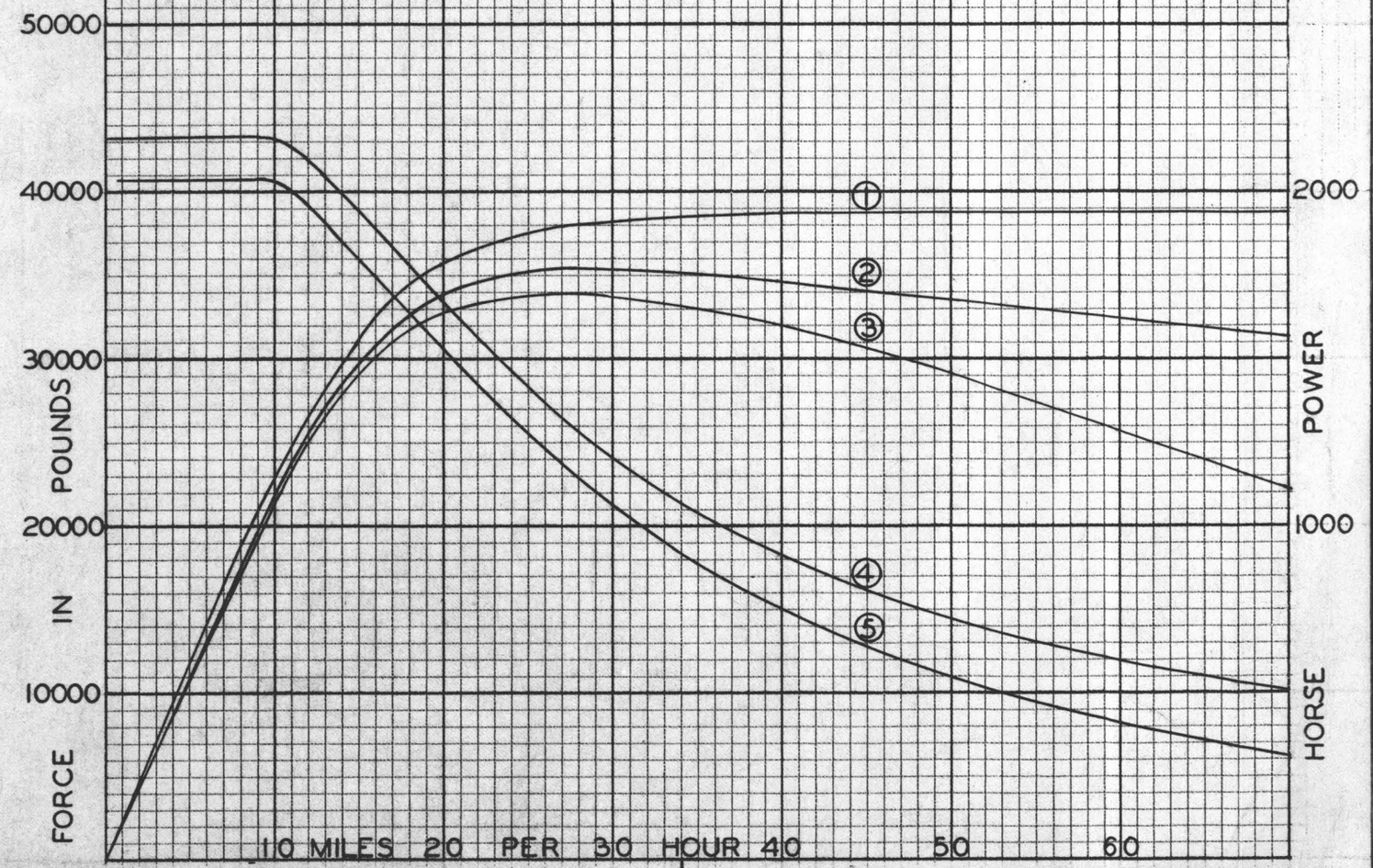
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UNION PACIFIC RAILROAD COMPANY
RESEARCH AND MECHANICAL STANDARDS

HORSEPOWER-FORCE-SPEED CURVES

201-358 CLASS STEAM LOCOMOTIVE
2-8-0 TYPE
57" DIA. DRIVERS
200 PSI BOILER PRESSURE
22"X 30" CYLINDERS
43,305 MAX. TRACTIVE FORCE
191,100* WT. ON DRIVERS
4.41 ADHESION FACTOR

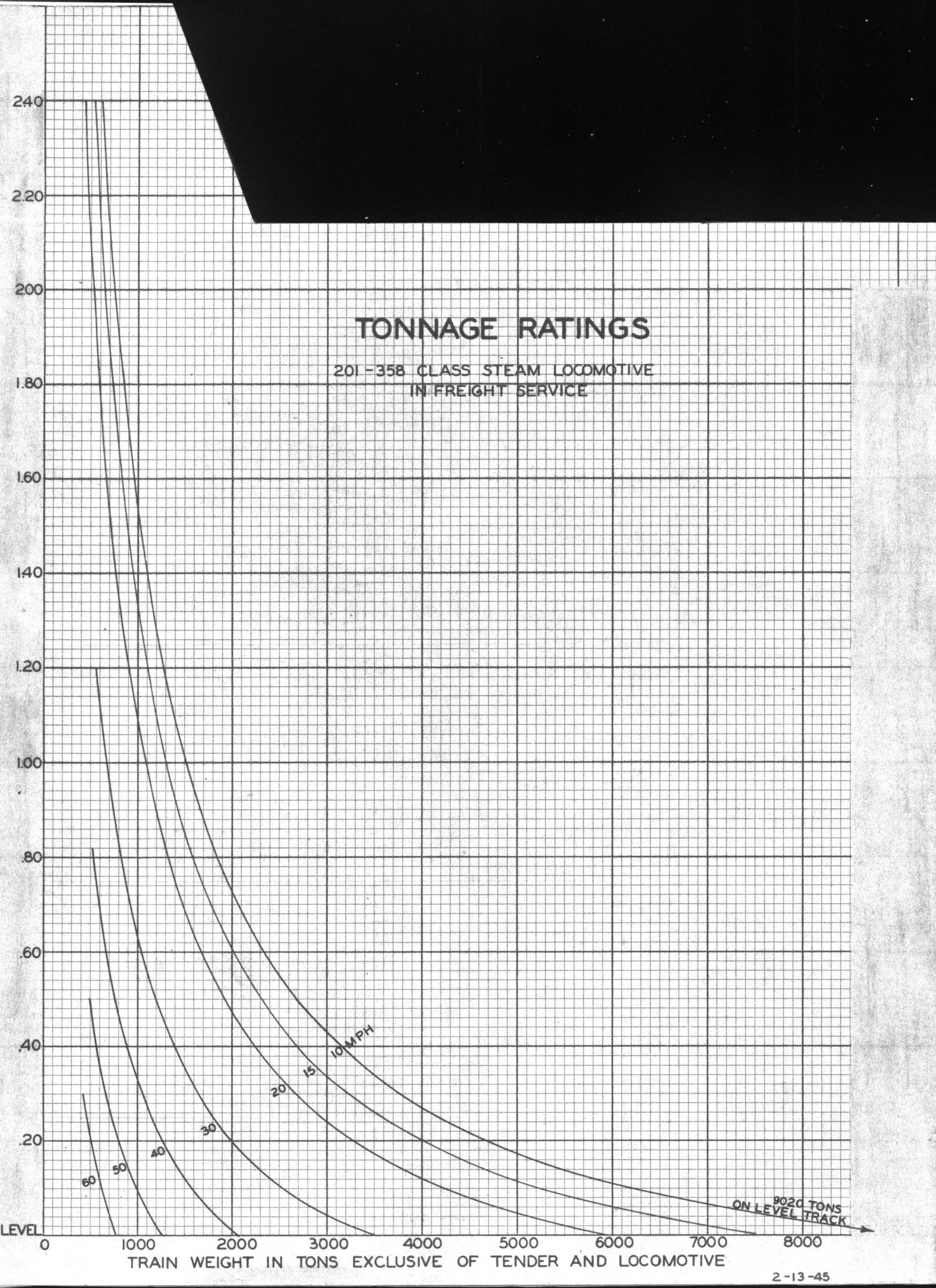
① CYLINDER HORSEPOWER
② DRIVER "
③ DRAWBAR "
④ CYLINDER TRACT. FORCE
⑤ DRAWBAR FORCE



9-18-39

TONNAGE RATINGS

201 - 358 CLASS STEAM LOCOMOTIVE
IN FREIGHT SERVICE



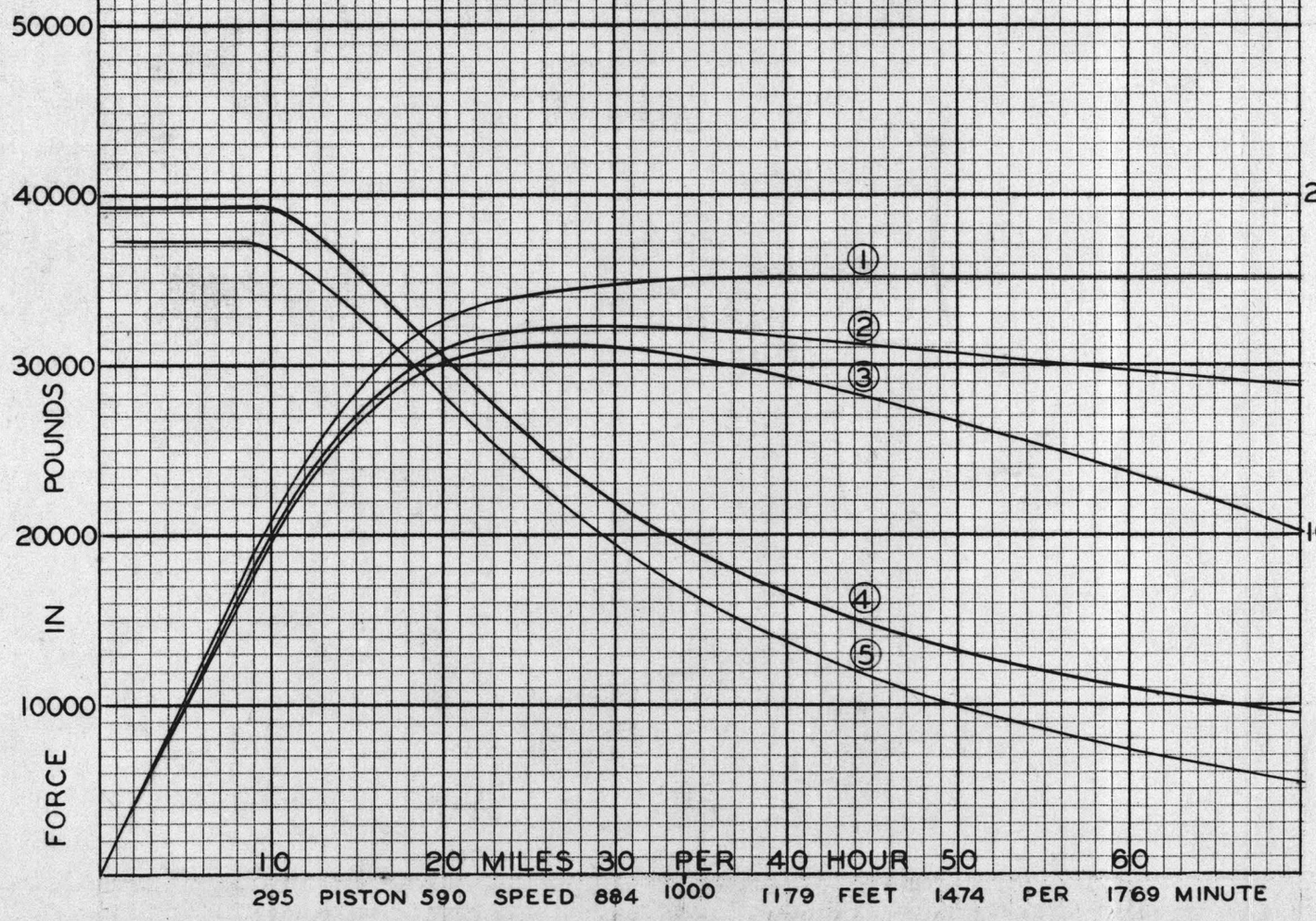
2-13-45

UNION PACIFIC RAILROAD COMPANY
RESEARCH AND MECHANICAL STANDARDS

HORSEPOWER-FORCE-SPEED CURVES

420-477 CLASS STEAM LOCOMOTIVE
2-8-0 TYPE
57" DIA. DRIVERS
200 PSI BOILER PRESSURE
21"X30" CYLINDERS
39,460# MAX. TRACTIVE FORCE
163,200# WT. ON DRIVERS
4.13 ADHESION FACTOR

① CYLINDER HORSEPOWER
② DRIVER "
③ DRAWBAR "
④ CYLINDER TRACT. FORCE
⑤ DRAWBAR FORCE



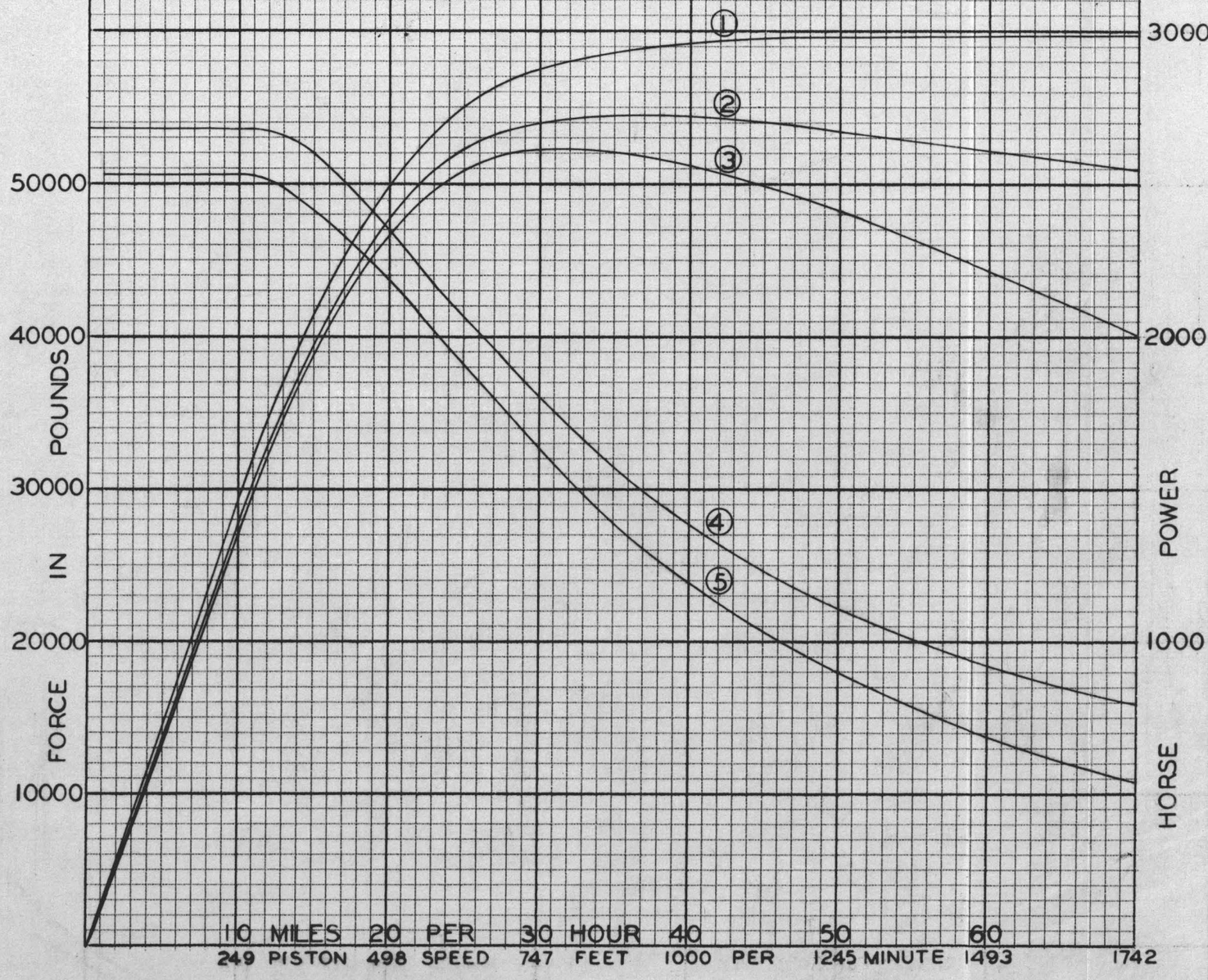
9-16-39

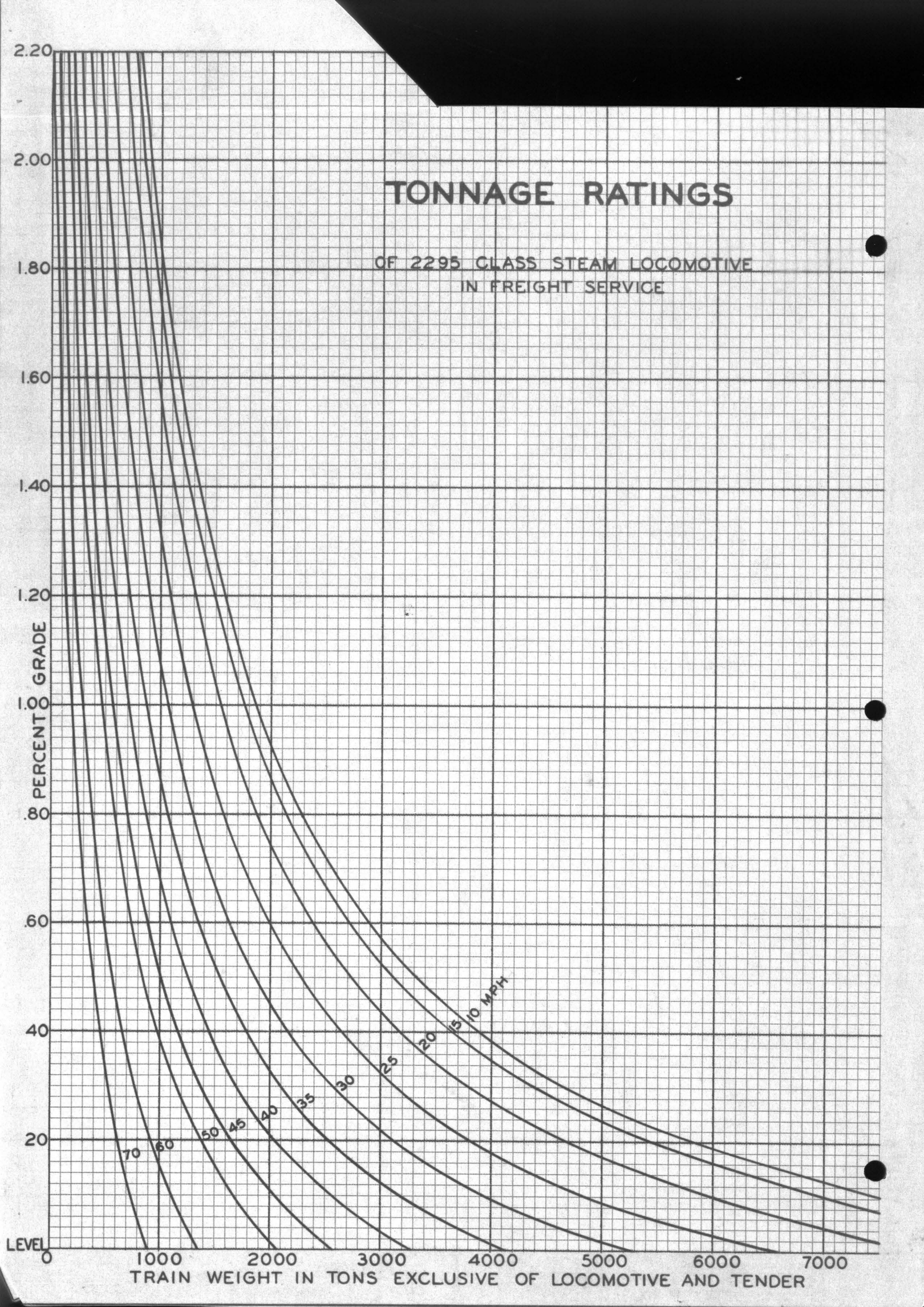
UNION PACIFIC RAILROAD COMPANY
RESEARCH AND MECHANICAL STANDARDS

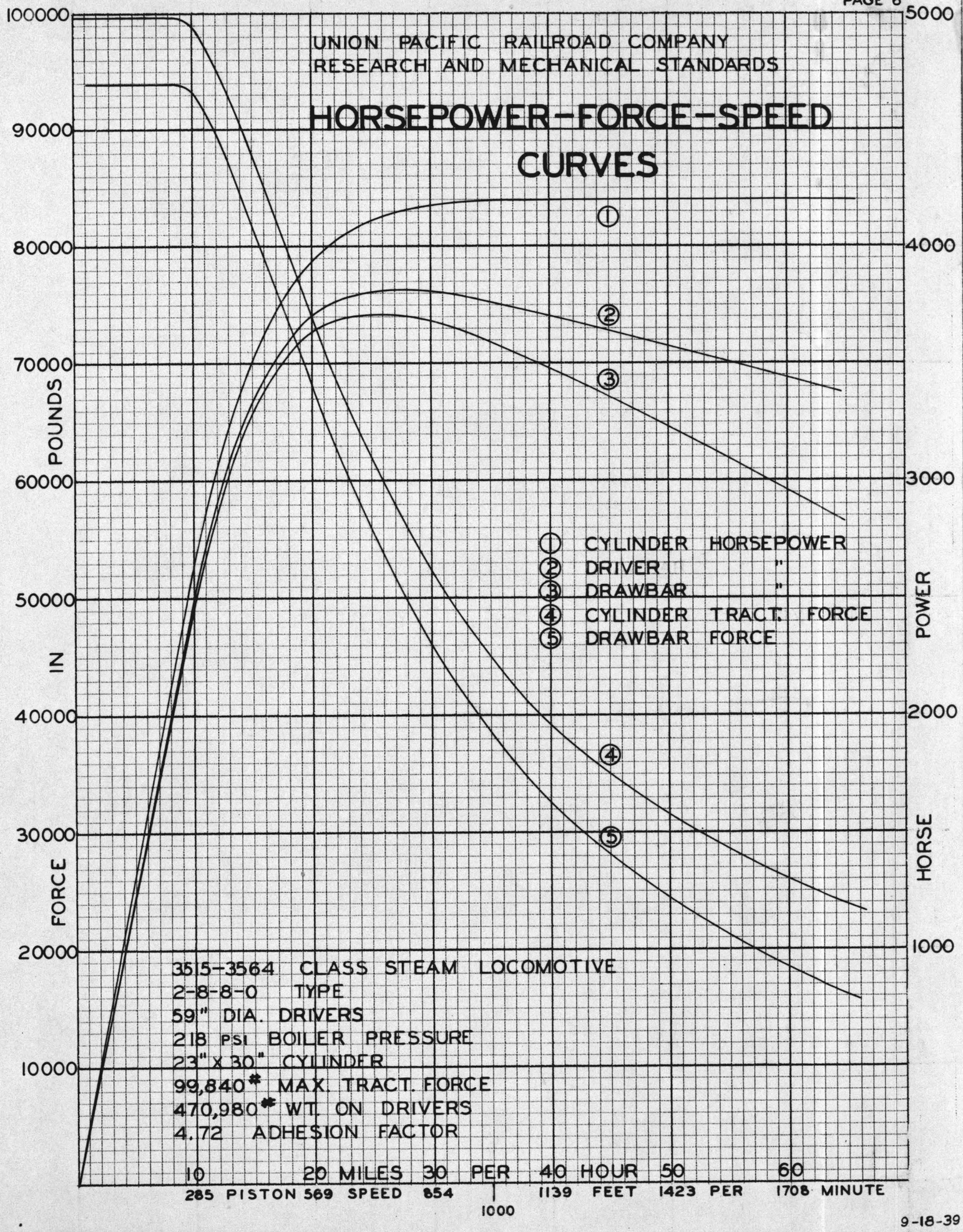
HORSEPOWER-FORCE-SPEED CURVES

2295-2304 CLASS STEAM LOCOMOTIVE
2-8-2 TYPE
63" DIA. DRIVERS
210 PSI BOILER PRESSURE
26"x28" CYLINDERS
53,630# MAX. TRACTIVE FORCE
228,000# WT. ON DRIVERS
4.25 ADHESION FACTOR

① CYLINDER HORSEPOWER
② DRIVER "
③ DRAWBAR "
④ CYLINDER TRACT. FORCE
⑤ DRAWBAR FORCE




TONNAGE RATINGS
OF 2295 CLASS STEAM LOCOMOTIVE
IN FREIGHT SERVICE
2.20
2.00
1.80
1.60
1.40
1.20
1.00
.80
.60
40
20
LEVEL
PERCENT GRADE
70
60
50
45
40
35
30
25
20
15
10 MPH
0
1000
2000
3000
4000
5000
6000
7000
TRAIN WEIGHT IN TONS EXCLUSIVE OF LOCOMOTIVE AND TENDER

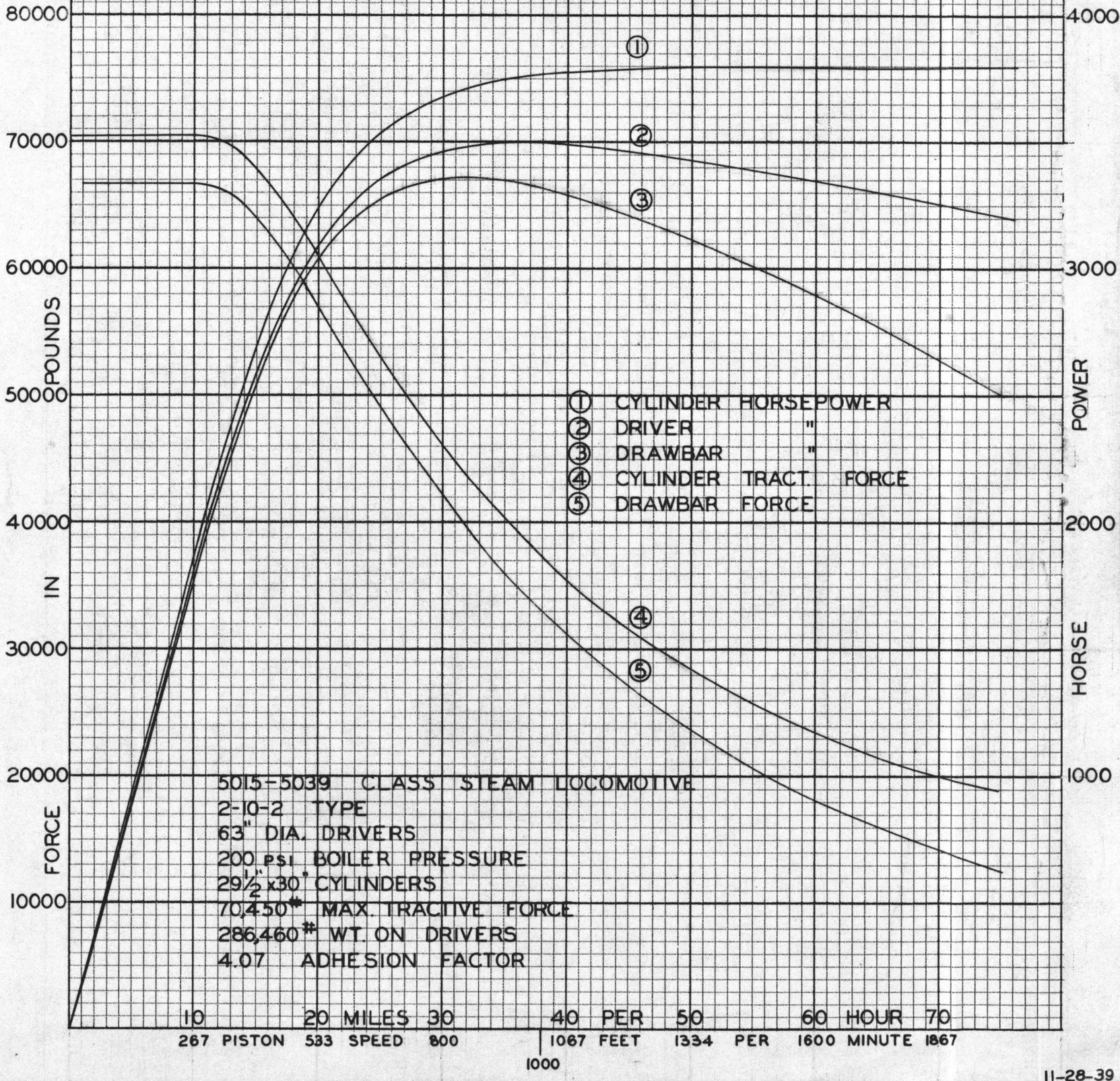


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9-18-39

UNION PACIFIC RAILROAD COMPANY
RESEARCH AND MECHANICAL STANDARDS

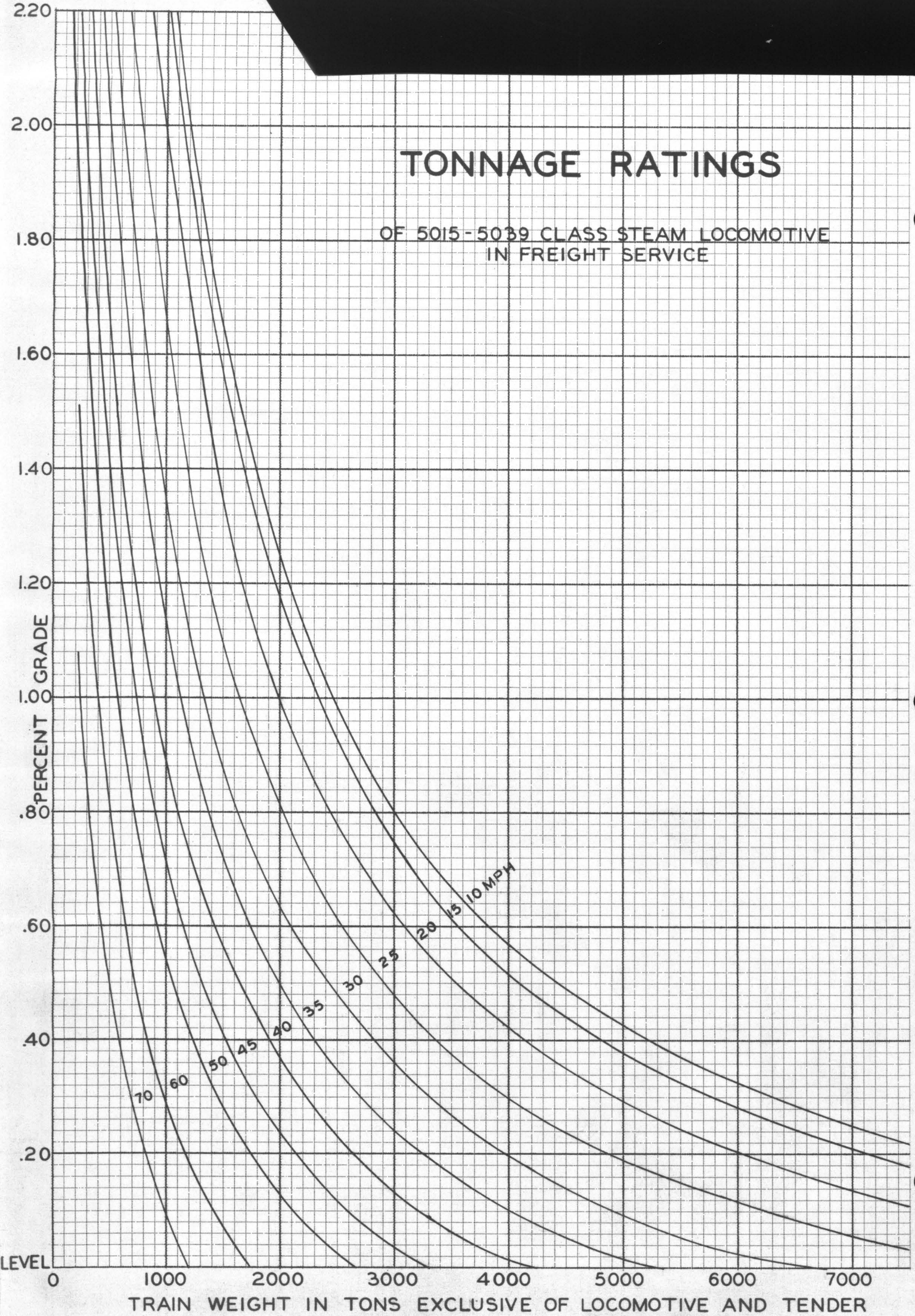
HORSEPOWER-FORCE-SPEED CURVES



11-28-39

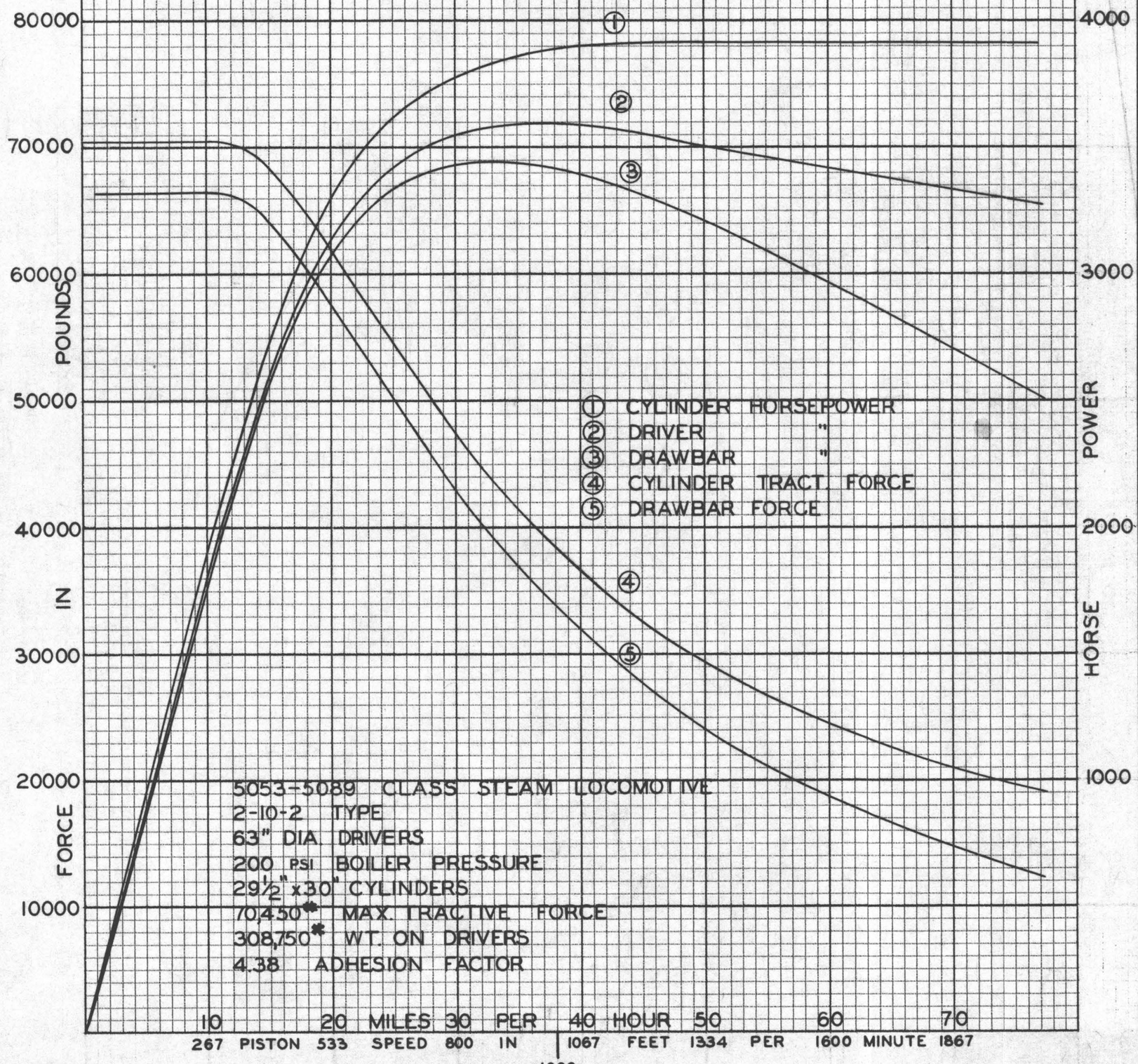
TONNAGE RATINGS

OF 5015-5039 CLASS STEAM LOCOMOTIVE
IN FREIGHT SERVICE



UNION PACIFIC RAILROAD COMPANY
RESEARCH AND MECHANICAL STANDARDS

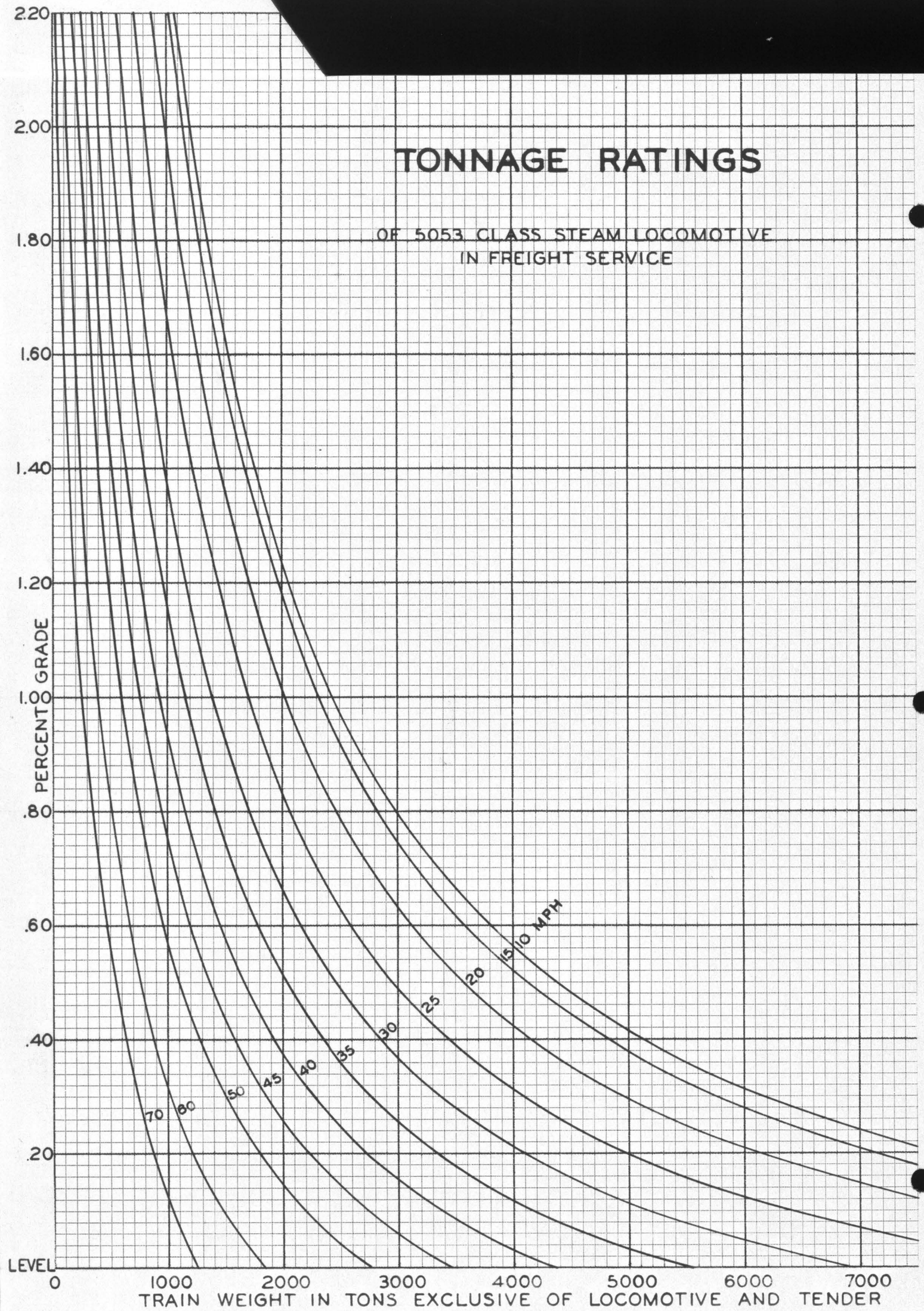
HORSEPOWER-FORCE-SPEED CURVES



12-8-39

TONNAGE RATINGS

OF 5053 CLASS STEAM LOCOMOTIVE
IN FREIGHT SERVICE

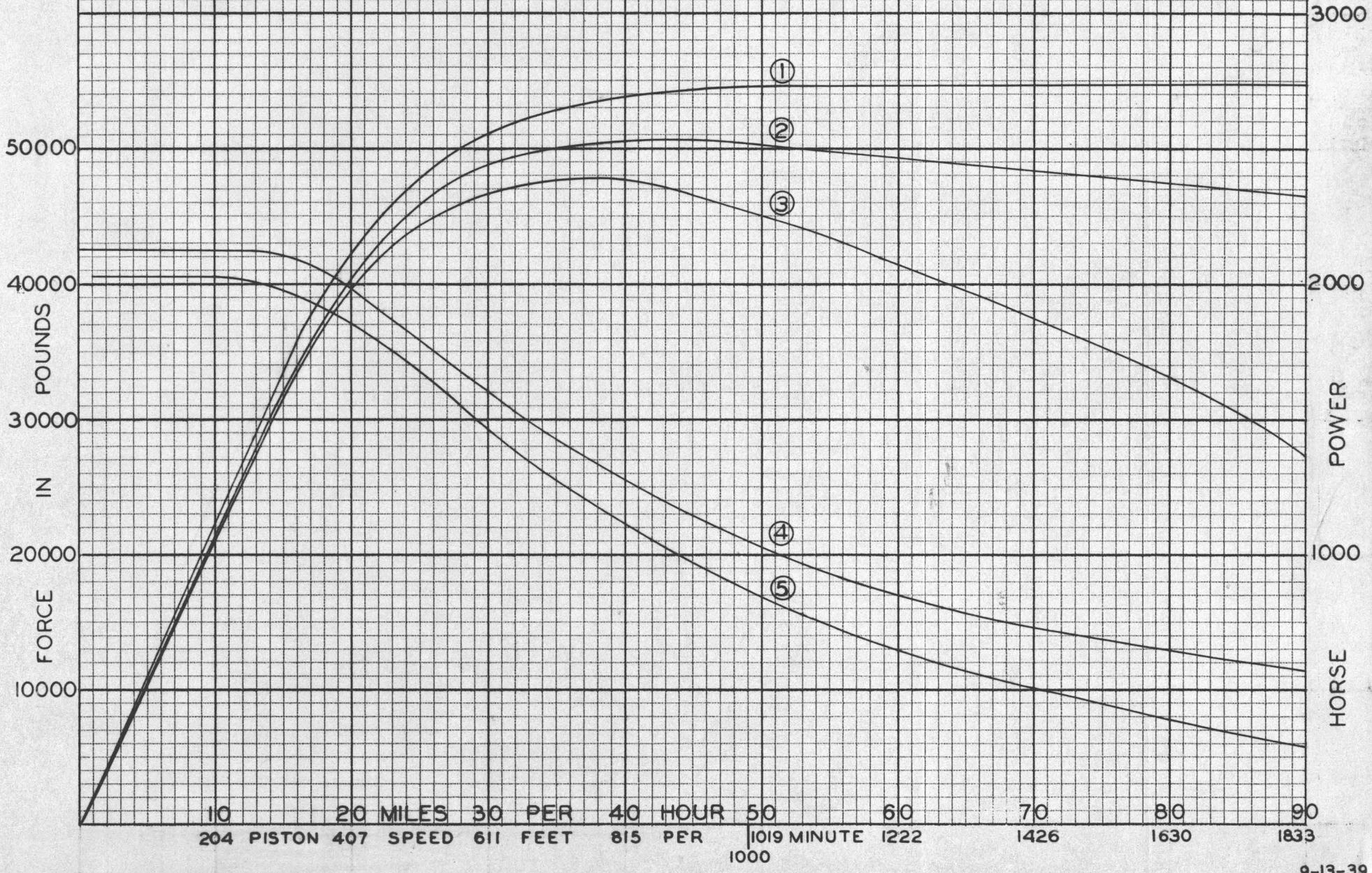


UNION PACIFIC RAILROAD COMPANY
RESEARCH AND MECHANICAL STANDARDS

HORSEPOWER-FORCE-SPEED CURVES

2860 CLASS STEAM LOCOMOTIVE
4-6-2 TYPE
77" DIA. DRIVERS
220 PSI BOILER PRESSURE
25" x 28" CYLINDERS
42,500# MAX. TRACTIVE FORCE
167,000# WT. ON DRIVERS
3.93 ADHESION FACTOR

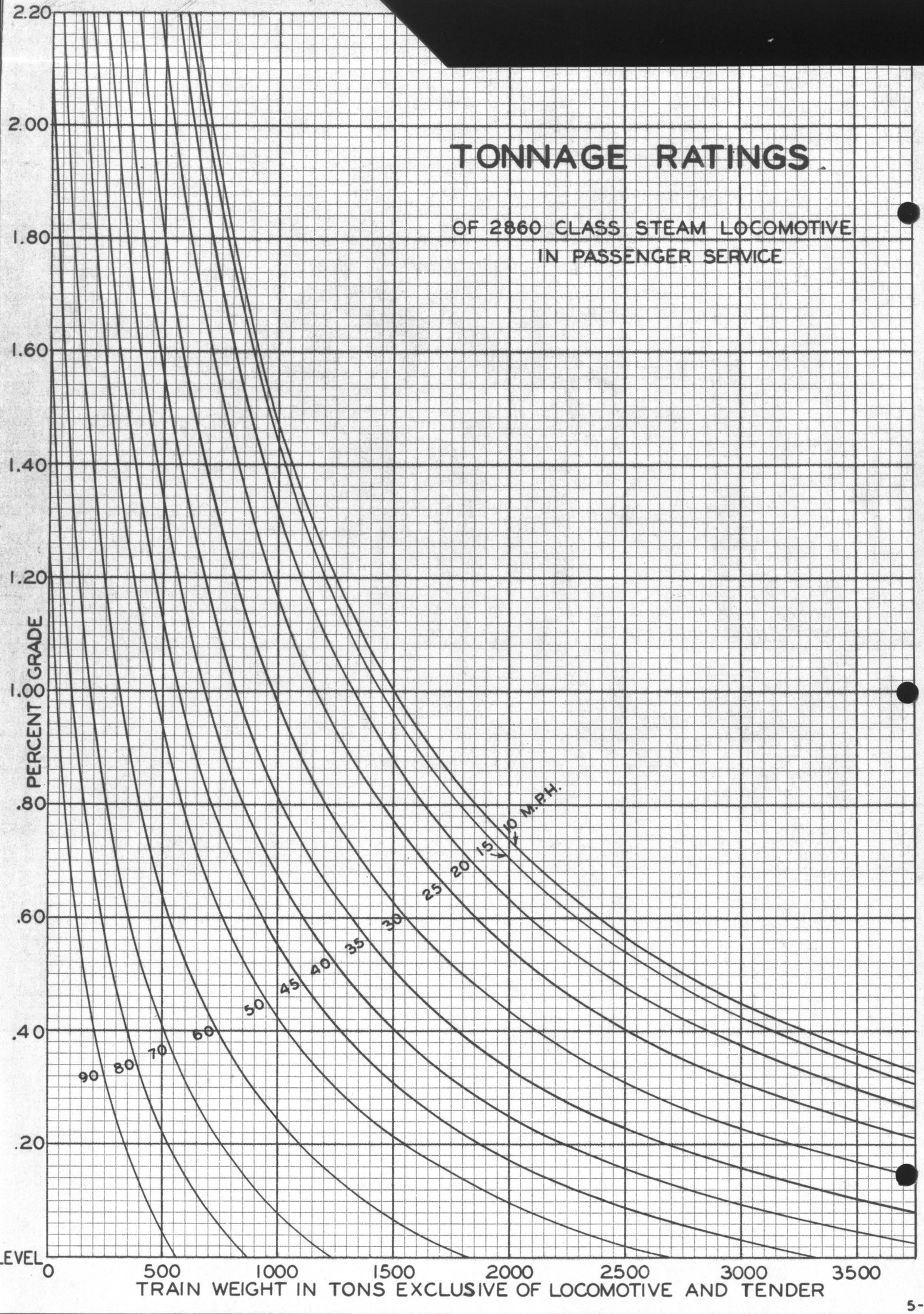
① CYLINDER HORSEPOWER
② DRIVER "
③ DRAWBAR "
④ CYLINDER TRACT. FORCE
⑤ DRAWBAR FORCE



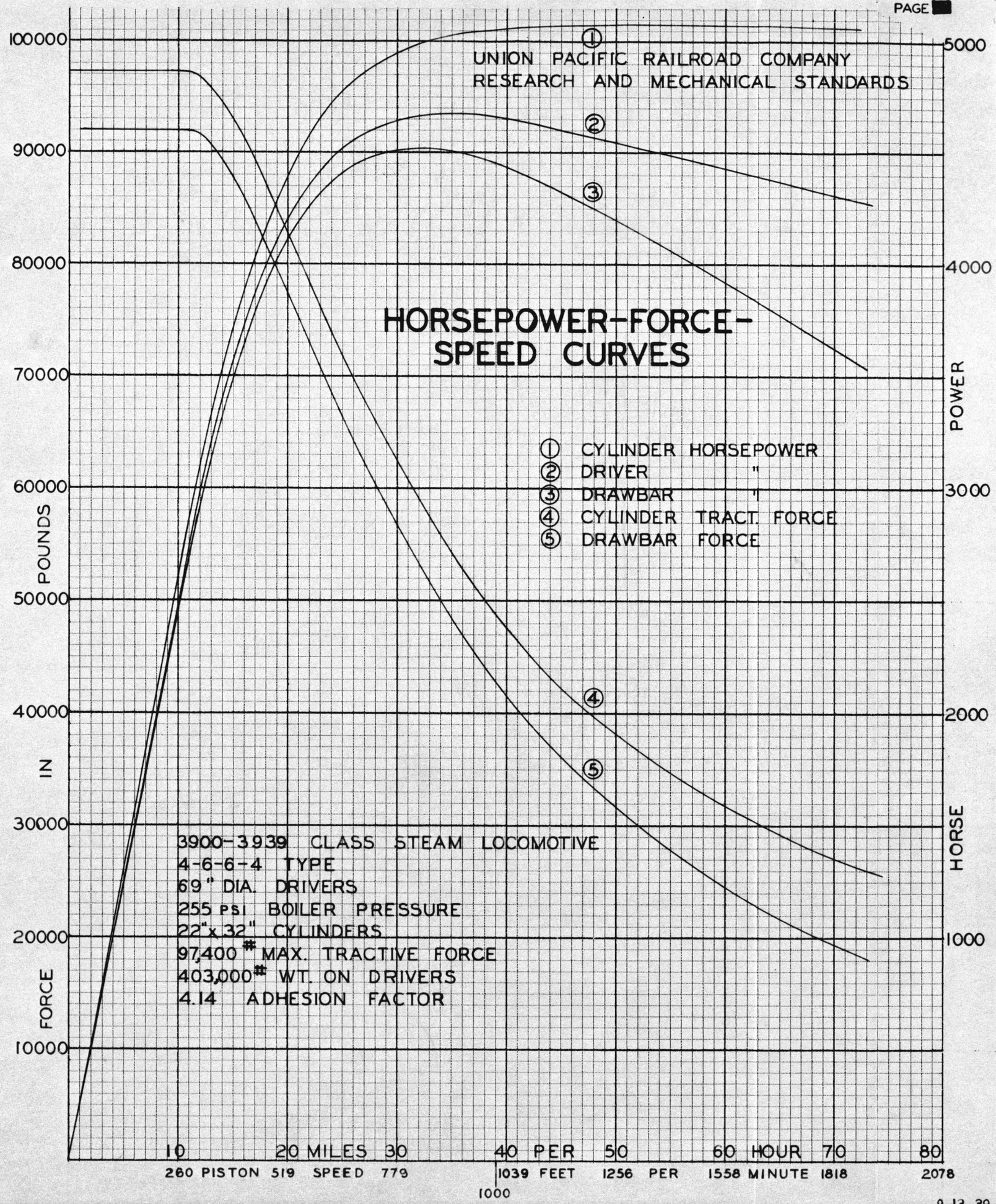
9-13-39

TONNAGE RATINGS.

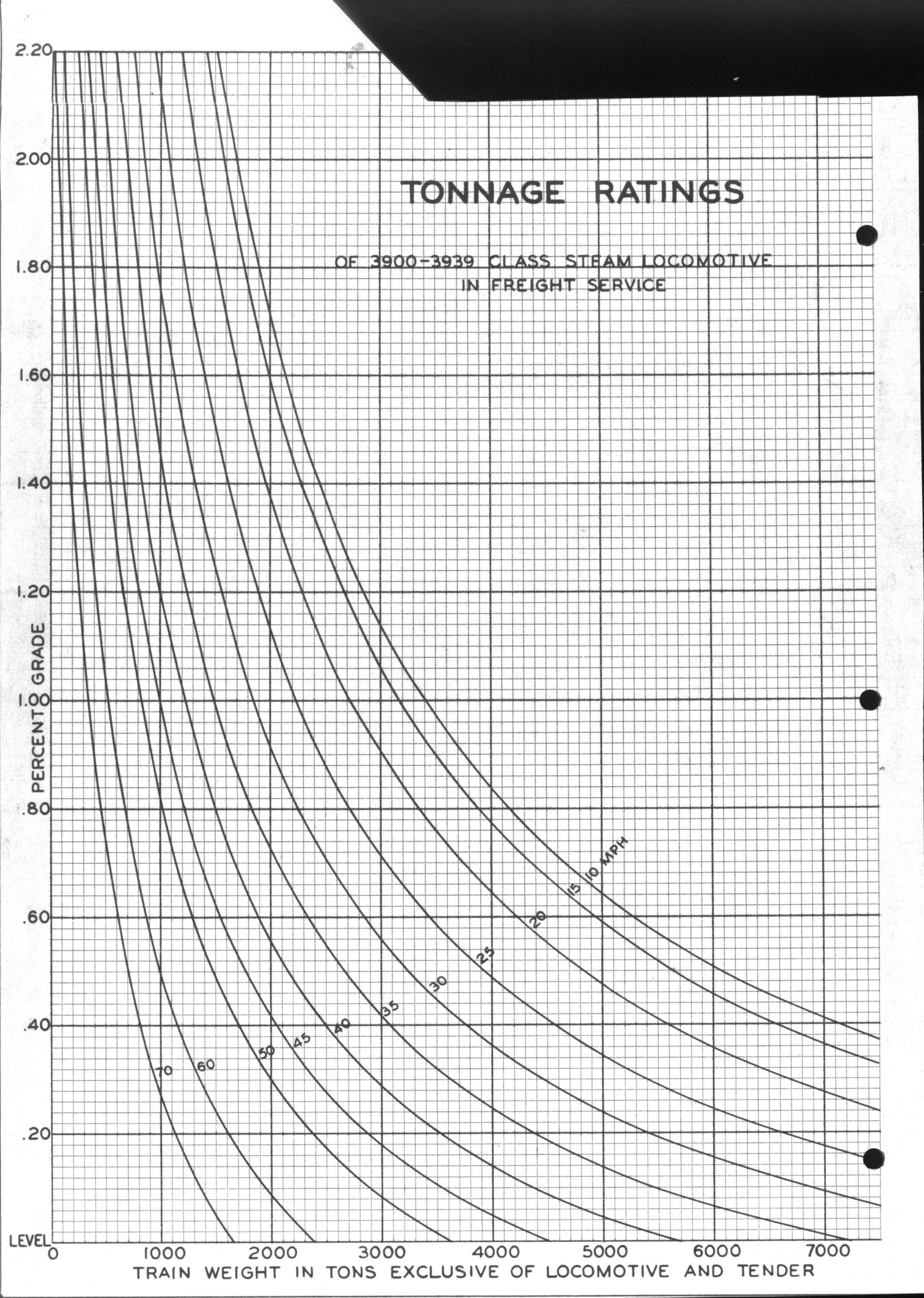
OF 2860 CLASS STEAM LOCOMOTIVE
IN PASSENGER SERVICE



5-1-42


UNION PACIFIC RAILROAD COMPANY
RESEARCH AND MECHANICAL STANDARDS
HORSEPOWER-FORCE-SPEED CURVES
① CYLINDER HORSEPOWER
② DRIVER "
③ DRAWBAR "
④ CYLINDER TRACT. FORCE
⑤ DRAWBAR FORCE
3900-3939 CLASS STEAM LOCOMOTIVE
4-6-6-4 TYPE
69" DIA. DRIVERS
255 PSI BOILER PRESSURE
22"x32" CYLINDERS
97,400# MAX. TRACTIVE FORCE
403,000# WT. ON DRIVERS
4.14 ADHESION FACTOR
POUNDS FORCE IN
POWER
HORSE
100000
90000
80000
70000
60000
50000
40000
30000
20000
10000
5000
4000
3000
2000
1000
10 20 MILES 30 40 PER 50 60 HOUR 70 80
260 PISTON 519 SPEED 779 1039 FEET 1256 PER 1558 MINUTE 1818 2078
1000

9-13-39


TONNAGE RATINGS
OF 3900-3939 CLASS STEAM LOCOMOTIVE
IN FREIGHT SERVICE
2.20
2.00
1.80
1.60
1.40
1.20
1.00
.80
.60
.40
.20
LEVEL
PERCENT GRADE
0
1000
2000
3000
4000
5000
6000
7000
TRAIN WEIGHT IN TONS EXCLUSIVE OF LOCOMOTIVE AND TENDER
10 MPH
15
20
25
30
35
40
45
50
60
70

TONNAGE RATINGS

OF 3930-3999 CLASS STEAM LOCOMOTIVE
IN FREIGHT SERVICE

PERCENT GRADE

2.60
2.40
2.20
2.00
1.80
1.60
1.40
1.20
1.00
.80
.60
.40
.20
LEVEL

10 MPH
15
20
25
30
35
40
45
50
60
70

20450 TONS ON LEVEL TRACK

0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10000 11000 12000 13000 14000 15000

TRAIN WEIGHT IN TONS EXCLUSIVE OF LOCOMOTIVE AND TENDER

2-13-45

UNION PACIFIC RAILROAD COMPANY
RESEARCH AND MECHANICAL STANDARDS

HORSEPOWER-FORCE-SPEED CURVES

① CYLINDER HORSEPOWER
② DRIVER "
③ DRAWBAR "
④ CYLINDER TRACT FORCE
⑤ DRAWBAR FORCE

3950-3969 CLASS STEAM LOCOMOTIVE
4-6-6-4 TYPE
69" DIA DRIVERS
280 PSI BOILER PRESSURE
21"x 32" CYLINDERS
97,350# MAX. TRACTIVE FORCE
405,000# WT. ON DRIVERS
4.16 ADHESION FACTOR

FORCE IN POUNDS: 110000, 100000, 90000, 80000, 70000, 60000, 50000, 40000, 30000, 20000, 10000

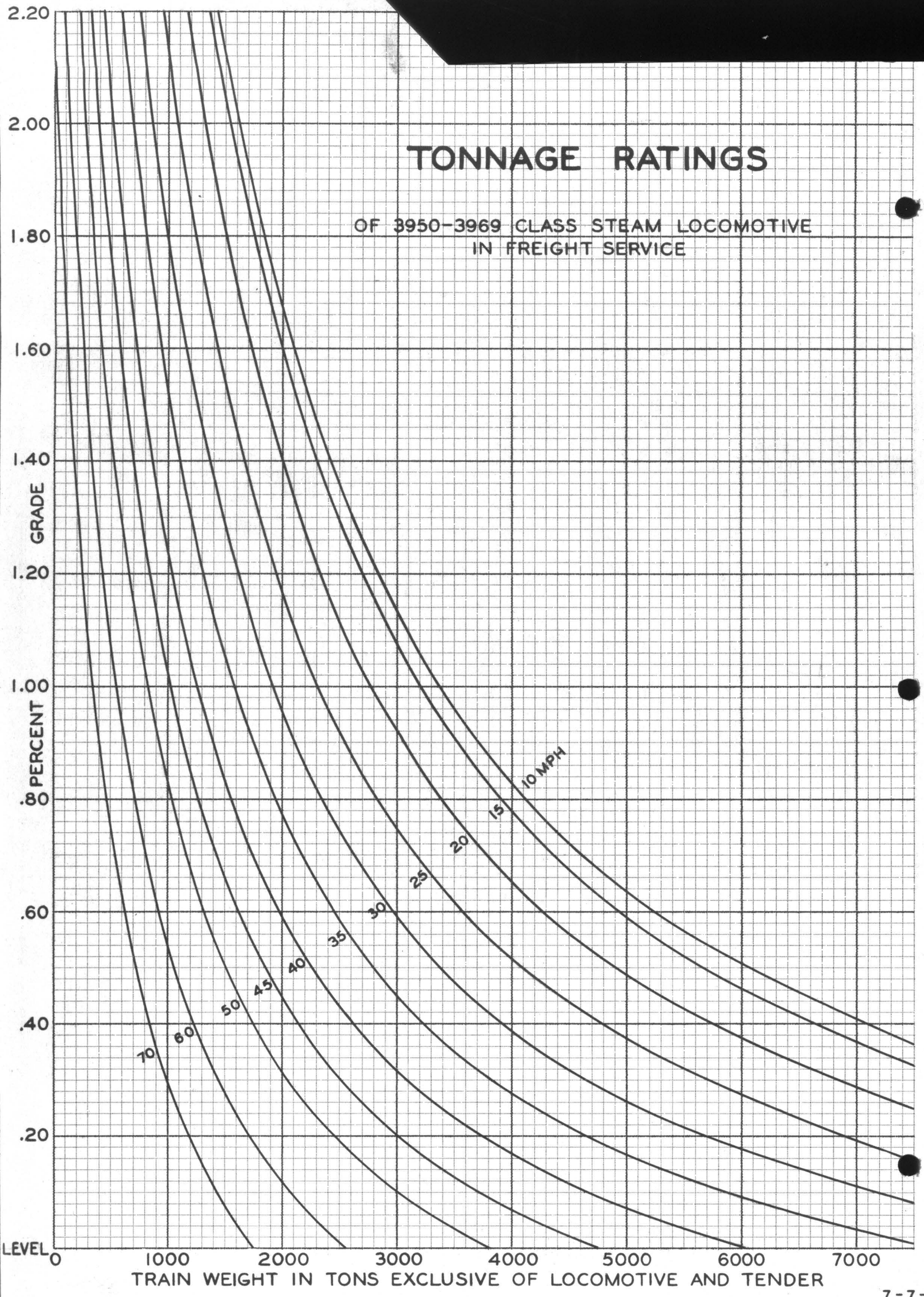
HORSE POWER: 5500, 5000, 4000, 3000, 2000, 1000

10 20 MILES 30 40 PER 50 60 HOUR 70 80
260 PISTON 519 SPEED 779 1039 FEET 1256 PER 1558 MINUTE 1818 2078
1000

7-7-42

TONNAGE RATINGS

OF 3950-3969 CLASS STEAM LOCOMOTIVE
IN FREIGHT SERVICE



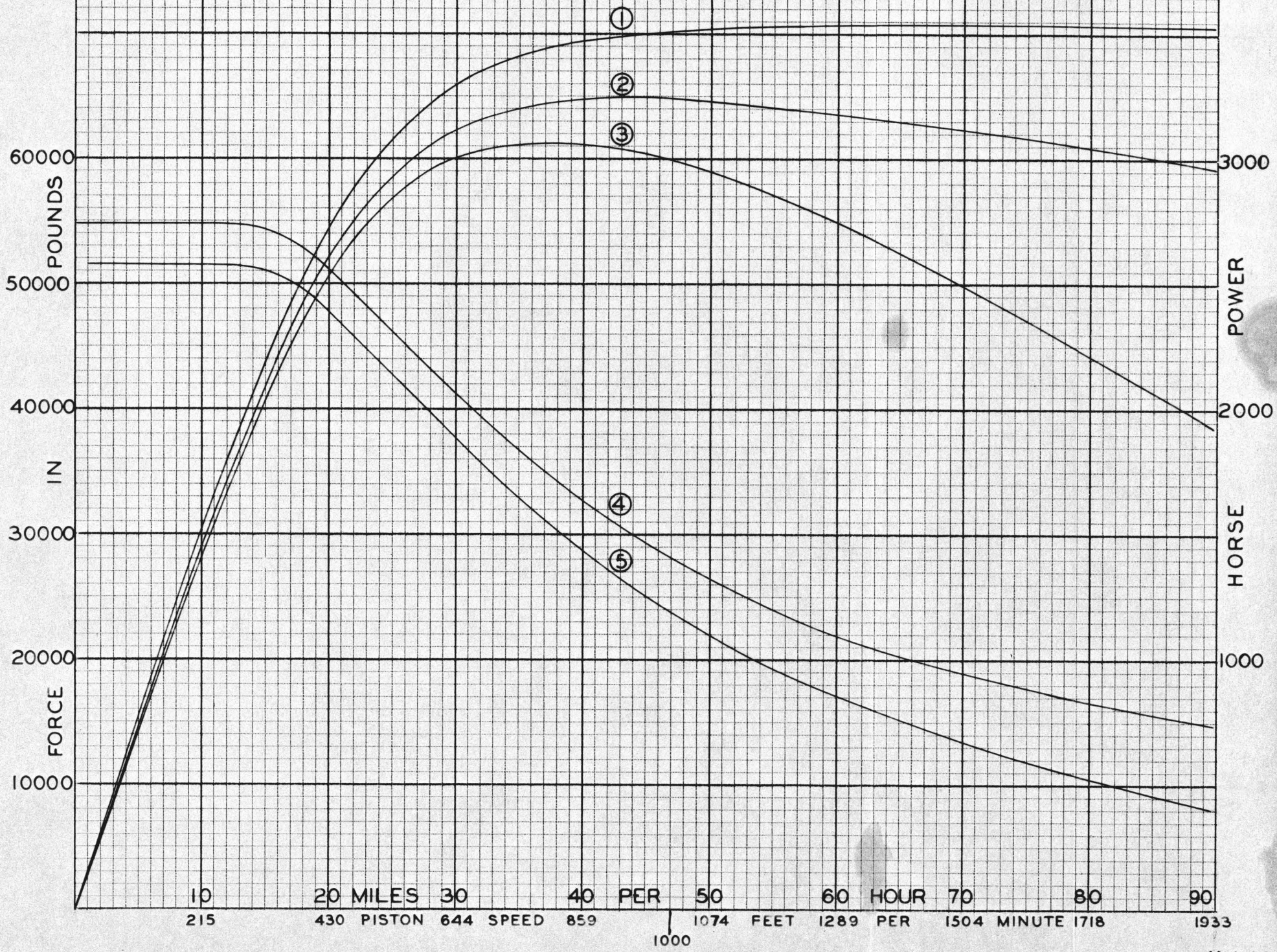
7-7-42

UNION PACIFIC RAILROAD COMPANY RESEARCH AND MECHANICAL STANDARDS

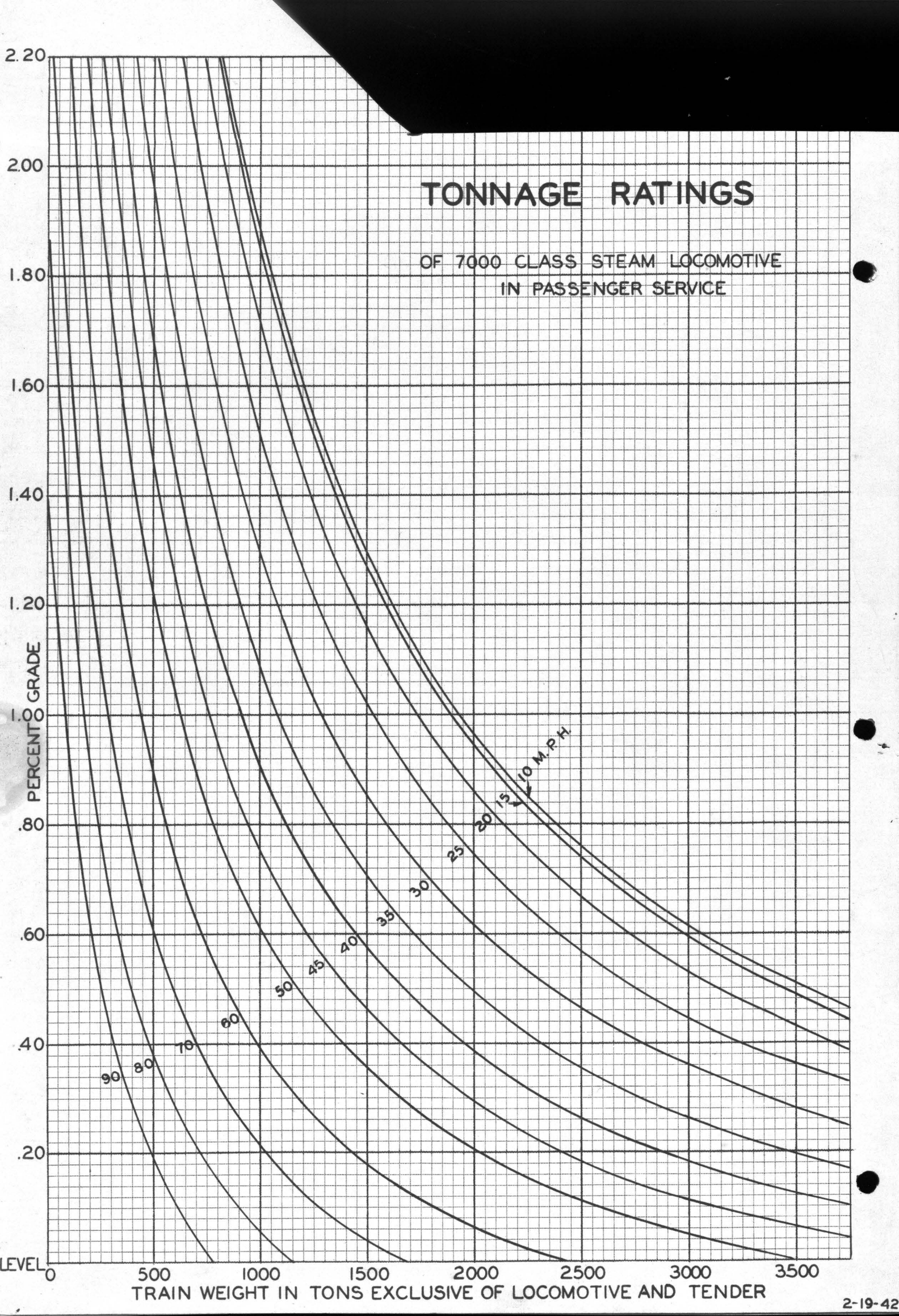
HORSEPOWER-FORCE-SPEED CURVES

7000-7039 CLASS STEAM LOCOMOTIVE
4-8-2 TYPE
73" DIA. DRIVERS
200 psi BOILER PRESSURE
29"x28" CYLINDER
54,840# MAX. TRACT. FORCE
230,200# WT. ON DRIVERS
4.25 ADHESION FACTOR

① CYLINDER HORSEPOWER
② DRIVER "
③ DRAWBAR "
④ CYLINDER TRACT. FORCE
⑤ DRAWBAR FORCE

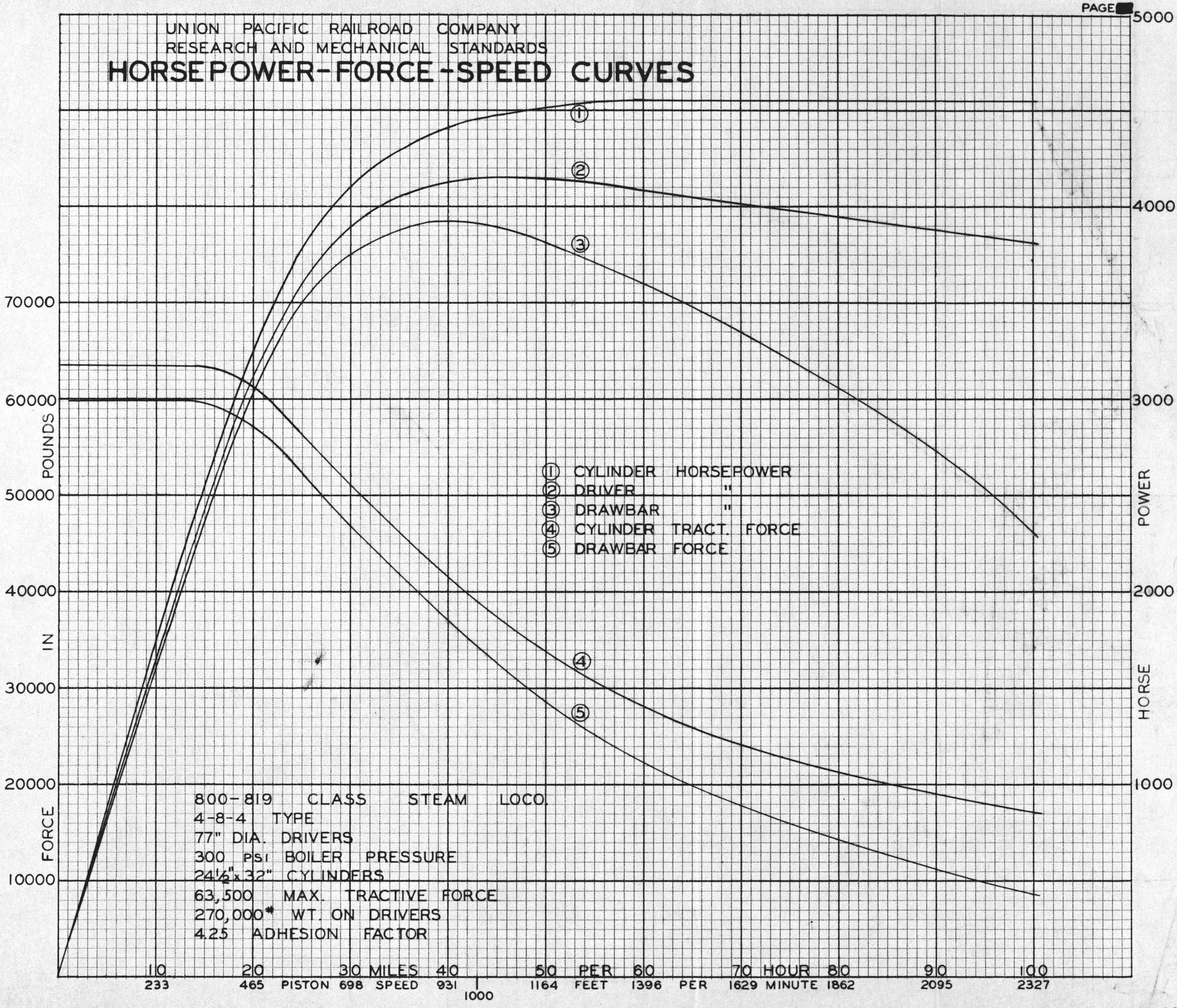


11-1-38


TONNAGE RATINGS
OF 7000 CLASS STEAM LOCOMOTIVE
IN PASSENGER SERVICE
2.20
2.00
1.80
1.60
1.40
1.20
1.00
.80
.60
.40
.20
LEVEL
PERCENT GRADE
0
500
1000
1500
2000
2500
3000
3500
TRAIN WEIGHT IN TONS EXCLUSIVE OF LOCOMOTIVE AND TENDER
10 M.P.H.
15
20
25
30
35
40
45
50
60
70
80
90
2-19-42

UNION PACIFIC RAILROAD COMPANY
RESEARCH AND MECHANICAL STANDARDS

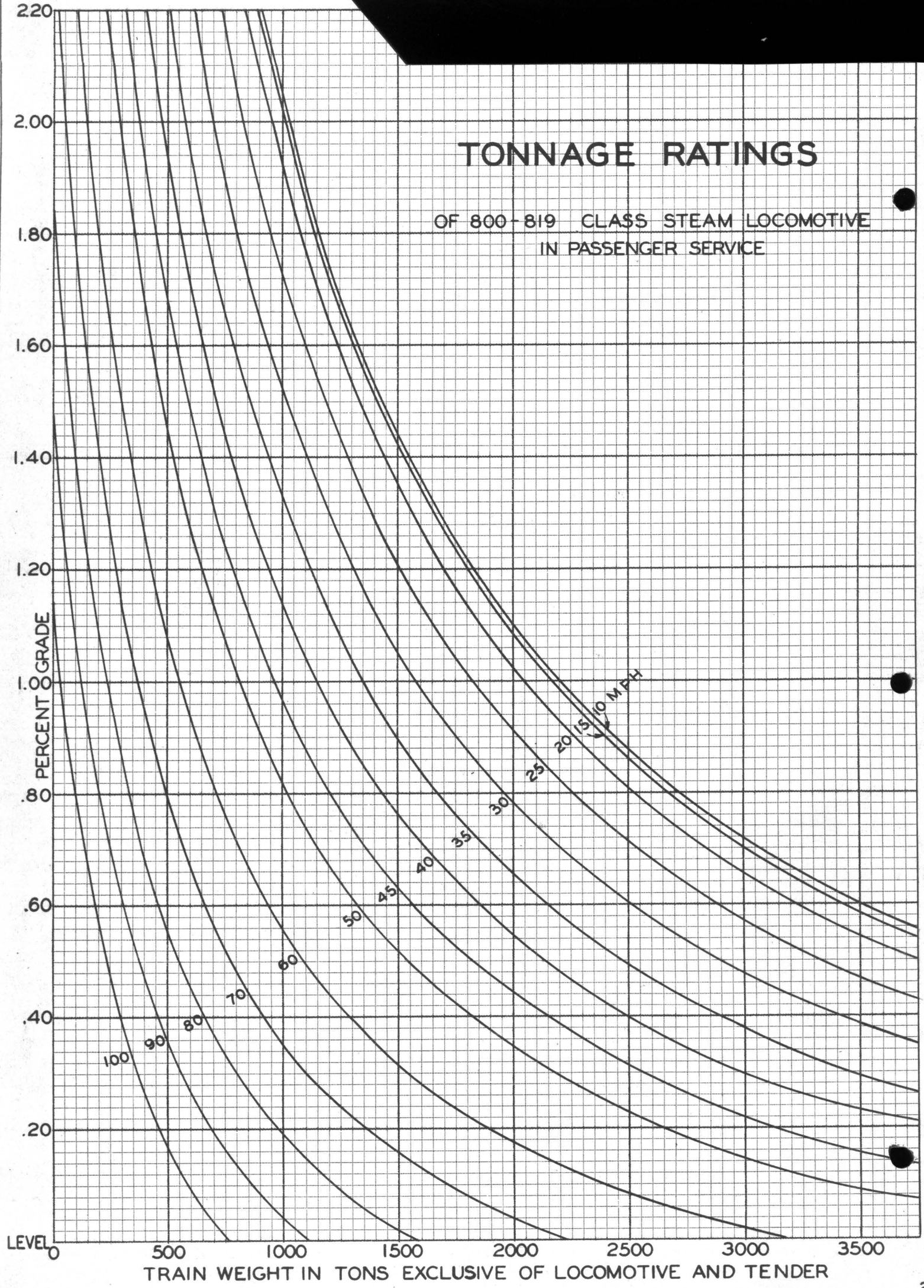
HORSEPOWER-FORCE-SPEED CURVES



10-12-38

TONNAGE RATINGS

OF 800-819 CLASS STEAM LOCOMOTIVE
IN PASSENGER SERVICE



UNION PACIFIC RAILROAD COMPANY
RESEARCH AND MECHANICAL STANDARDS

HORSE POWER-FORCE SPEED CURVES

① DRAWBAR HORSEPOWER } CALCULATED
② DRAWBAR FORCE } A.R.E.A. METHOD
③ DRAWBAR HORSE POWER } FROM DYNAMOMETER
④ DRAWBAR FORCE } CAR TESTS

POUNDS FORCE IN
140000
130000
120000
110000
100000
90000
80000
70000
60000
50000
40000
30000
20000
10000

HORSE POWER
6000
5000
4000
3000
2000
1000

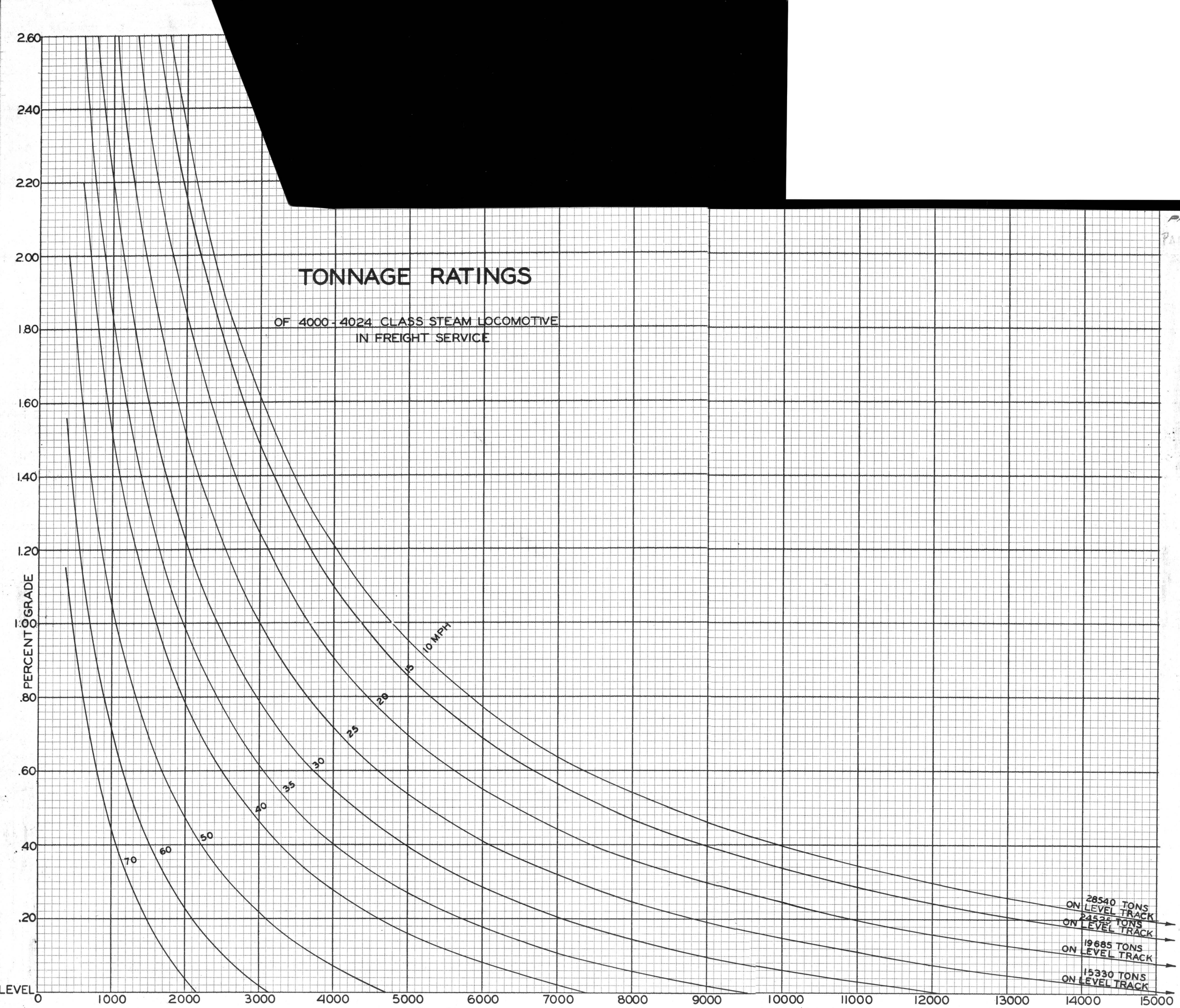
4000-4019 CLASS STEAM LOCOMOTIVE
4-8-8-4 TYPE
68" DIA. DRIVERS
300 PSI. BOILER PRESSURE
23¾" x 32" CYLINDERS
135 375# MAX TRACTIVE EFFORT
540 000# WT ON DRIVERS
4.00 ADHESION FACTOR

10 20 MILES 30 40 PER 50 60 HOUR 70
264 PISTON 527 SPEED 791 FEET 1054 PER 1318 MINUTE 1582
1000

4-15-42

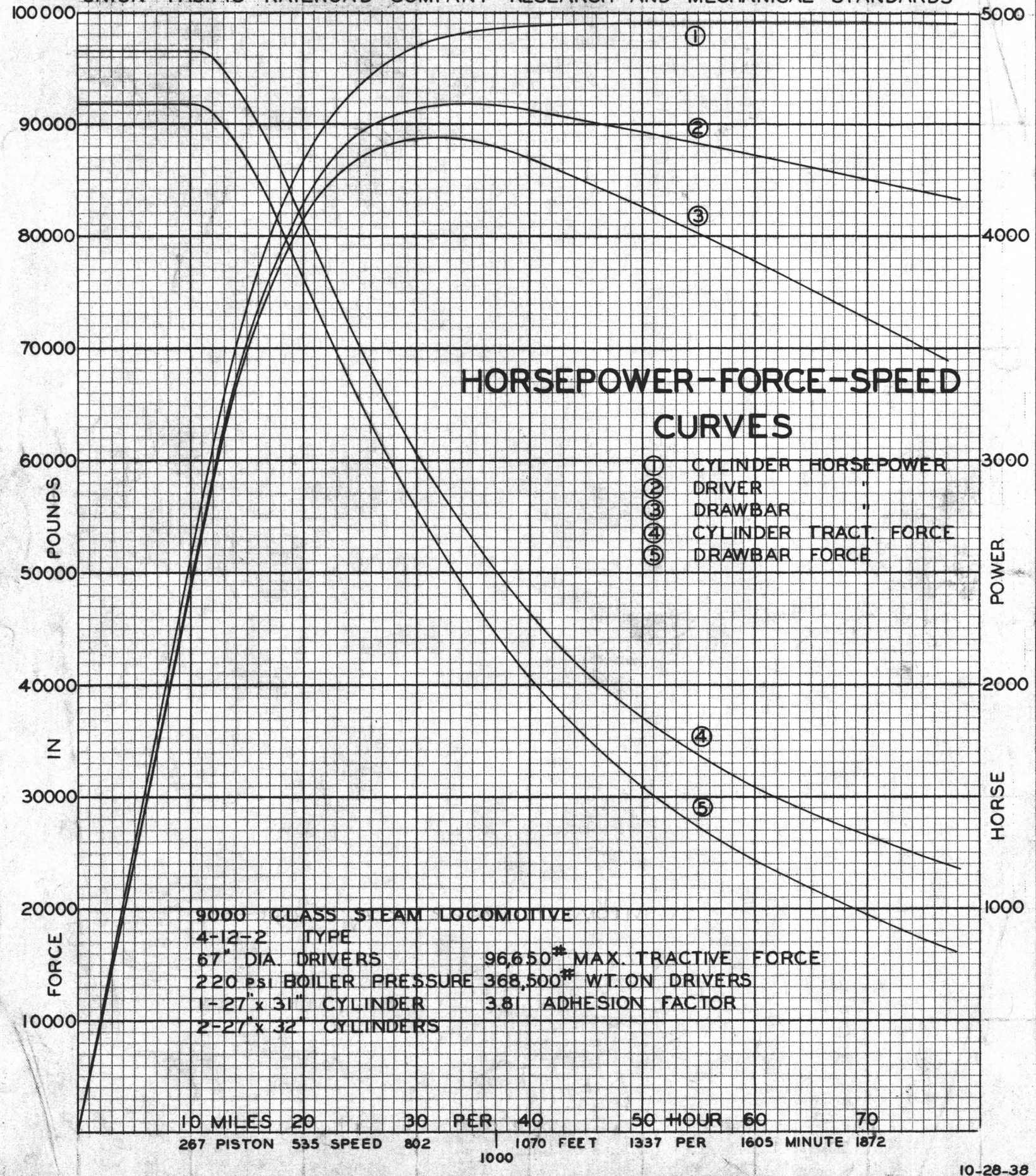
TONNAGE RATINGS

OF 4000 - 4024 CLASS STEAM LOCOMOTIVE
IN FREIGHT SERVICE

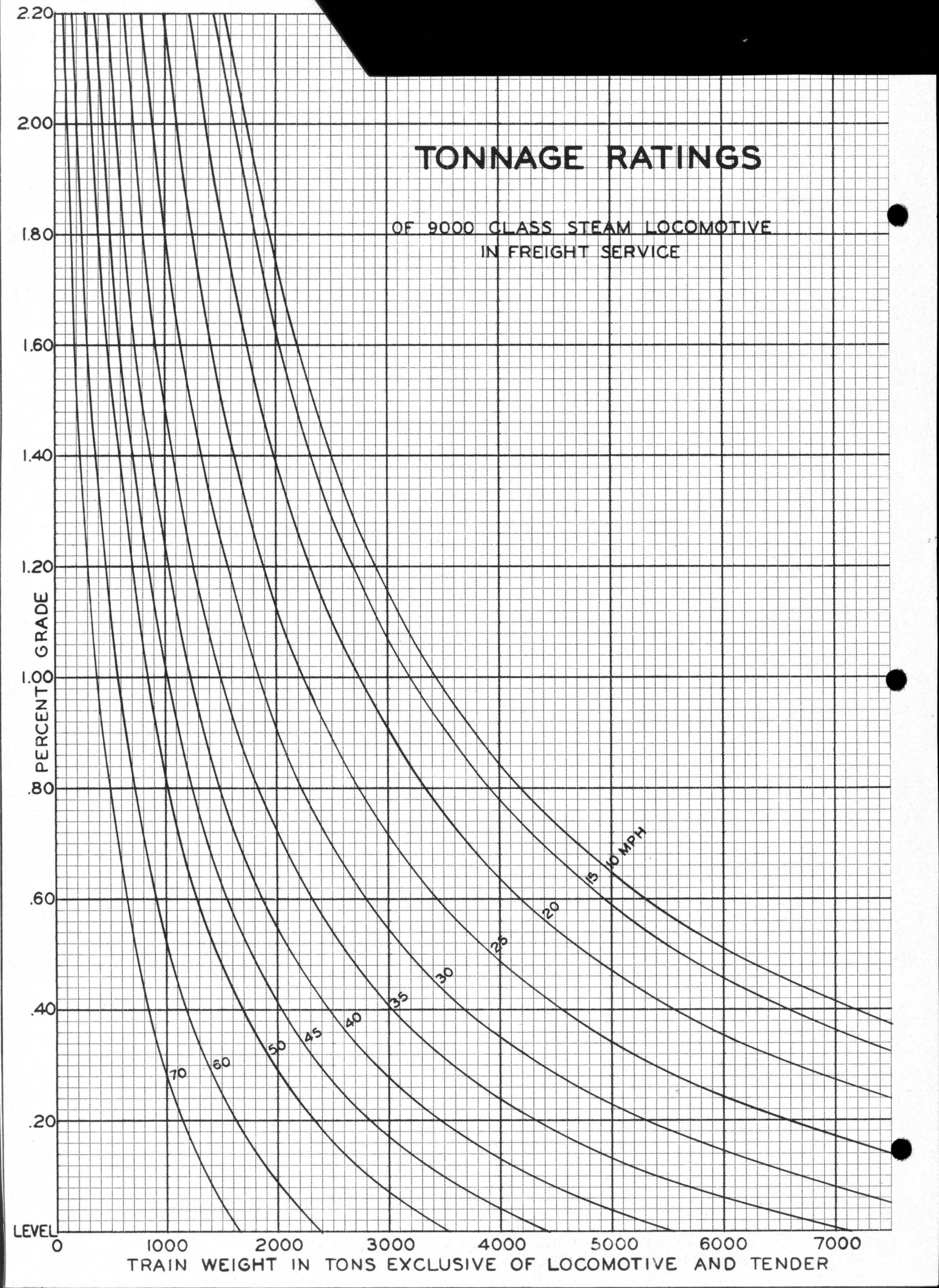


2-13-45

UNION PACIFIC RAILROAD COMPANY RESEARCH AND MECHANICAL STANDARDS



10-28-38


TONNAGE RATINGS
OF 9000 CLASS STEAM LOCOMOTIVE
IN FREIGHT SERVICE
PERCENT GRADE
2.20
2.00
1.80
1.60
1.40
1.20
1.00
.80
.60
.40
.20
LEVEL
0
1000
2000
3000
4000
5000
6000
7000
TRAIN WEIGHT IN TONS EXCLUSIVE OF LOCOMOTIVE AND TENDER
10 MPH
15
20
25
30
35
40
45
50
60
70

UNION PACIFIC RAILROAD COMPANY
RESEARCH AND MECHANICAL STANDARDS

HORSEPOWER-FORCE-SPEED CURVES

5400 H.P. D.E. LOCOMOTIVES
(LA-1 LA-2 LA-3)
(SF-1 SF-2 SF-3)

BUILDER-ELECTRO-MOTIVE CORP.

EQUIPMENT

LA:
- 6 MODEL 12-201-A 900 H.P. ENGINES
- 6 MODEL 544 600 V.D.C. GENERATORS-G.E.
- 12 MODEL 716 TRACTION MOTORS-G.E.
- GEAR RATIO 25:52

SF:
- 6 MODEL 486 600 V.D.C. GENERATORS-WEST.
- 12 MODEL 366 TRACTION MOTORS-WEST.
- GEAR RATIO 24:52

WHEEL DIAMETER 36"
MAX. DESIGN SPEED 117 M.P.H.

① DRIVER HORSEPOWER
② DRAWBAR HORSEPOWER
③ DRIVER TRACTIVE FORCE
④ DRAWBAR FORCE

25% ADHESION (AVE. WT. ON DRIVERS)

LIMIT OF G.E. CURVE

64,300 LBS. MAX. FOR 4 HOURS (WITH AUX BLOWERS)

SERIES TO PARALLEL TRANSITION

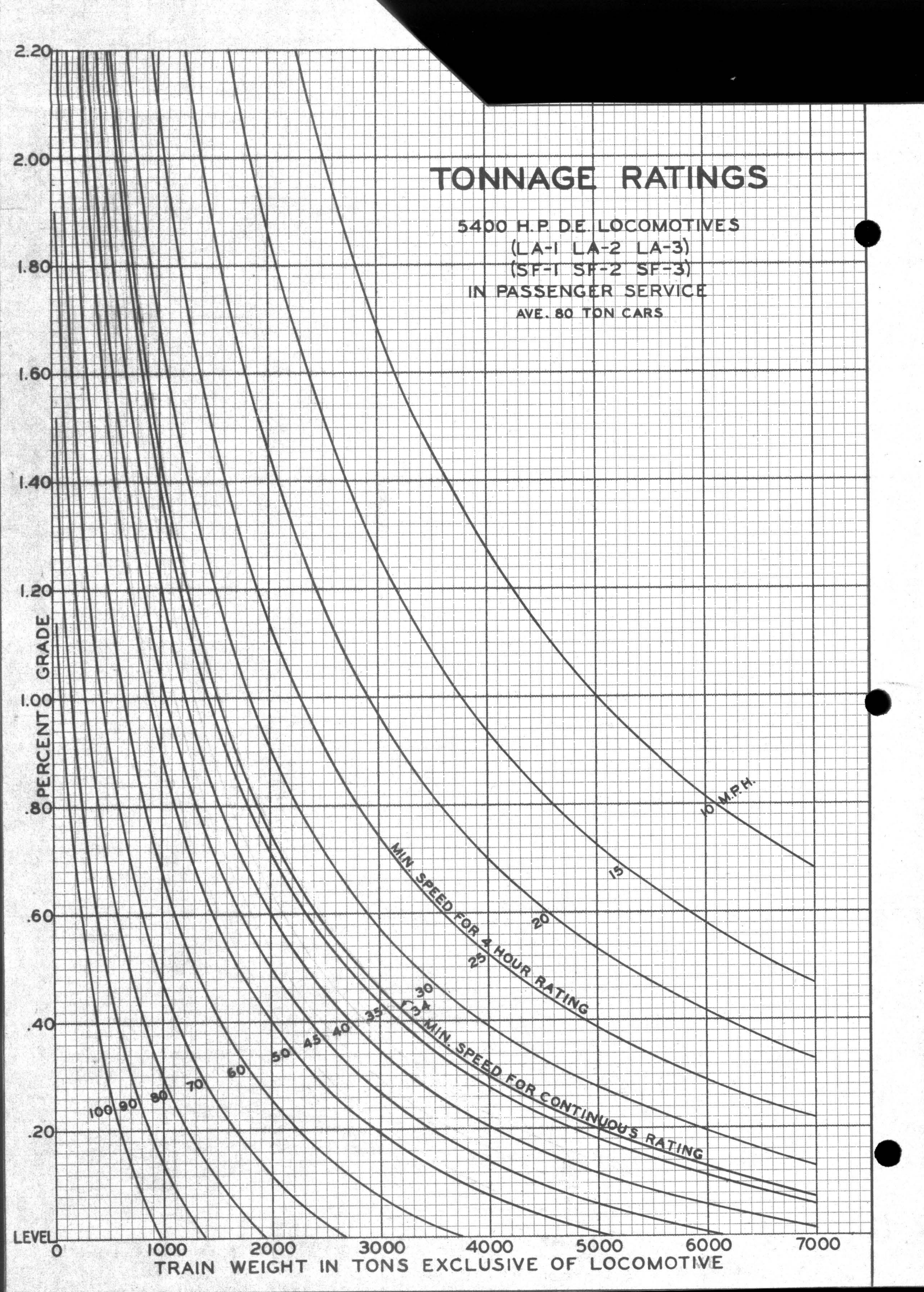
46,800 LBS. MAX. CONTINUOUS

PARALLEL TO SHUNT TRANSITION

POUNDS FORCE IN — 160000, 150000, 140000, 130000, 120000, 110000, 100000, 90000, 80000, 70000, 60000, 50000, 40000, 30000, 20000, 10000

POWER HORSE — 5000, 4000, 3000, 2000, 1000

MILES PER HOUR — 10, 20, 30, 40, 50, 60, 70, 80, 90, 100


TONNAGE RATINGS
5400 H.P. D.E. LOCOMOTIVES
(LA-1 LA-2 LA-3)
(SF-1 SF-2 SF-3)
IN PASSENGER SERVICE
AVE. 80 TON CARS
PERCENT GRADE
2.20
2.00
1.80
1.60
1.40
1.20
1.00
.80
.60
.40
.20
LEVEL
0
1000
2000
3000
4000
5000
6000
7000
TRAIN WEIGHT IN TONS EXCLUSIVE OF LOCOMOTIVE
10 M.P.H.
15
20
25
30
35
40
45
50
60
70
80
90
100
MIN. SPEED FOR 4 HOUR RATING
MIN. SPEED FOR CONTINUOUS RATING