WESTERN MARYLAND RAILWAY COMPANY

Report of Dynamometer Car Tests with Resulting Tonnage Ratings on the

H9a 2-8-0 type J1 4-8-4 type 12 2-10-0 type and M2 4-6-6-4 type with Graphs, Charts and Nine Photographs

Connellsville Sub-Division
West Sub-Division
Lurgan Sub-Division
May 26, 1947 to July 15, 1957

Office of Superintendent Motive Power,
Hagerstown, Md.,
August 1, 1947.

Foreword

The primary object of these tests was to obtain authentic information concerning the characteristics of the H9-a, I2, M2 and J1 class locomotives, particularly from the standpoint of operating efficiency and obtain any other information of practical or technical importance.

Test Personnel

S.M.Roth	Supervisor Locomotive Performance, W.M.Ry.Co. - In charge of test
H.J.Koch,Jr.	Assistant Mechanical Engineer, W.M.Ry.Co.
L.N.Schoppert	Mechanical Draftsman, W.M.Ry.Co.
G.B.Ecker	Hulson Company Service Engineer - Draft instruments
G.W.Padgett	Baltimore & Ohio Dynamometer Car Operator
C.E.Heilig	Baldwin Locomotive Works Mechanical Engineer
H.L.Odgers	Baldwin Locomotive Works Mechanical Engineer

Selection of Territory for the Tests

The physical characteristics of the road from Bowest Junction to Deal on the Connellsville Sub-Division present the most favorable conditions for the development of locomotive efficiency. For this reason the principal tests were conducted between the points above referred to, the results of which are shown in Table Nos. 1 to 8 inclusive and Chart Nos. 1 and 2. On Page No. 6 chief results of the tests are summarized.

Tests were conducted between Hagerstown and Cumberland when going to and coming from the Elkins Division. Due to the irregularities encountered on the Hagerstown Division, test data obtained could not be consistently used for comparison in general, however, desirable information was obtained, particularly between Hancock and Big Pool where permissible speeds could be attained to develop higher drawbar horsepower, especially on the J1 and M2 class locomotives, which require higher speeds to develop the maximum drawbar horsepower. Chart No. 2 shows the maximum drawbar horsepower developed.

A special test was conducted from Cumberland to Rutherford, Pa., using Engine 1410 to get authentic information on the operating characteristics of the J1 class locomotives operating in through service on coal trains between the above mentioned points. Table No. 11 shows the results of this test and Table No. 12 shows the results of test from Rutherford, Pa. to Hagerstown.

Duration of Tests

Tests were started May 26, 1947 and completed July 15, 1947. They were conducted on the Elkins Division between Cumberland and Bowest or Dickerson Run, Pa., and Hagerstown Division between Hagerstown and Cumberland, including one test from Cumberland to Rutherford, Pa., and return to Hagerstown.

Condition of the Locomotives

The four classes of locomotives tested were given classified repairs (except the J1 class, new locomotive) and were in good condition in every respect.

Comparison of Test Data between Locomotives Classes

The test data accepted for comparison between locomotive classes was in close agreement in every respect.

Method of Conducting Tests

The method used with respect to obtaining and calculating test data is in accordance with A.S.M.E. recommended practice. The coal used for tests between Bowest Junction and Deal was supplied from Consolidation Coal Company and of the same quality and weighed on the tender by scale measurement in pounds.

The amount of water used from tender was determined by one inch scale measurements of depth of tank, calibrated in gallons. The same procedure was followed with respect to coal and water measurement during all tests. The quality of the coal, however, was irregular, except as previously stated, between Bowest Junction and Deal.

Due to variable conditions on Connellsville Sub-Division during westward trips, test data could not be consistently used for comparison, however, information of practical importance was obtained, particularly drawbar pull when starting maximum tonnage trains and operating at slow speeds on the heavy grade from G.C. Junction to Colmar.

General Test Analysis

Table Nos. 1 to 4 inclusive show the results that can be expected on the four classes of locomotives when they are operated at or near maximum capacity for periods of long duration. It is of course understood that where the road profile is undulating, the firing and water evaporation rates are reduced and evaporation per pound of coal is increased, which favorably affects the economy of locomotive operation. The difference in efficiency of locomotive operation between the four classes of locomotives tested from Bowest Junction to Deal, as shown in Table Nos. 1 to 4 inclusive, is reflected under operating conditions more favorable for economic locomotive operation.

The actual overall results during the tests from Bowest or Dickerson Run to Cumberland are shown in Table Nos. 5 to 8 inclusive. It is interesting to note that the difference of percentages of coal used and pounds coal per thousand gross ton miles between the class locomotives on which comparisons were made are in most every instance in close agreement with that shown during the efficiency test period from Bowest Junction to Deal.

Referring to Item 7 of Table Nos. 9 and 10, it will be observed that the average back pressure of the J1 class is slightly higher than on the other classes tested, during the test period, between Bowest Junction and Deal. It will be noted in Items 4 and 9 of Table Nos. 9 and 10 that the average speed is considerably higher, and the average steam pressure drop from boiler to steam chest is decidedly lower on the J1 class locomotive. With an average pressure drop from boiler to steam chest of only eight pounds, a relatively higher average sustained steam chest pressure at cylinders is attained on the J1 over the H9-a, I2 and M2 class locomotives. The high average steam chest pressure of 247 pounds, along with higher average speed on the J1 class over the other classes of locomotives tested accounts for the slight increase in back pressure. The tests revealed that the Class J1 locomotive, under all operating conditions, working from minimum to maximum cut-off at speeds up to

50 M.P.H., developed back pressures ranging from 4 pounds to 19 pounds respectively. With this locomotive working at maximum capacity at 50 M.P.H., the back pressure was 10 pounds.

Based on the rated tractive effort of the four classes of locomotives tested, Chart No. 1 shows that when the train speed is more than 5 to 7 M.P.H., the J1 class is superior with respect to drawbar pull in relation to speed, which is largely due to the high steam chest pressure attained in relation to boiler pressure on the J1 class locomotive under all operating conditions.

Operating Characteristics

Connellsville Sub-Division

J1 versus H9-a Class Locomotives

It will be observed from Table Nos. 1 and 2 where the operating conditions were comparable during the tests, Bowest Junction to Deal, that the J1 class shows definite and notable superiority over the H9-a class locomotive in every respect, except drawbar pull at speeds below 5 M.P.H., as shown on Chart No. 1. The rated tractive effort of the H9-a class is 900 pounds more than the J1 class, and the difference in the actual calculated tractive effort of the two locomotives was 1488 pounds in favor of the H9-a class during the tests, due to the latter having undersize driving tires.

The tests definitely show that both locomotives have the same hauling capacity up to 5 M.P.H., after which the J1 class shows improvement in drawbar pull and drawbar horsepower, and this feature progressively increases with the increase of train speed. Due to the possibility of stopping heavy tonnage trains on ruling grades, the maximum tonnage rating for ruling grades for the J1 class should not exceed the tonnage rating for the H9-a class locomotives on the Connellsville Sub-Division.

I2 versus M2 Class Locomotives

Referring to Table Nos. 3 and 4, it will be noted that the operating efficiency of the two locomotives for the most part is in close agreement, but favorable in some respects to the M2 class locomotive, particularly with respect to drawbar pull and drawbar horsepower above 20 M.P.H. There is 800 pounds difference in the rated tractive effort favorable to the I2 class, but the difference of actual calculated tractive effort between the two locomotives during the tests was inconsequential, as shown on Table No. 10.

The tests show that the drawbar pull is slightly greater up to 20 M.P.H. on the I2 class locomotive. At train speeds more than 20 M.P.H. the drawbar pull and drawbar horsepower is greater on the M2 class locomotive, and this feature progressively increases with the increase of train speed.

The tests developed that the present tonnage rating for Classes I2, M2 and H9-a is correct for economical operation on the Connellsville Sub-Division, and that the tonnage rating for the J1 class should be the same as the H9-a class locomotives. On heavy grade territory the cost of operation is ordinarily less when operating the larger locomotives having the greater tractive effort. However, the tests show in Table Nos. 5 to 8 inclusive on the Connellsville Sub-Division that the J1 class is comparable to the I2 and M2 class locomotives from the standpoint of cost per thousand gross ton miles, and of course, less maintenance and more availability.

Between Hagerstown and Cumberland

J1 versus H9-a Class Locomotives

The tests show that the present maximum tonnage rating for H9-a is approximately correct for the J1 class, except from Hagerstown to Cumberland the tonnage rating can be consistently increased over the H9-a class, which is due to the road profile westward and the operating characteristics of the J1 class locomotive.

I2 versus M2 class Locomotives

The operating characteristics of the I2 and M2 class locomotives between Hagerstown and Cumberland are comparable to the Connellsville Sub-Division.

The difference between the four classes tested from the standpoint of economical operation can be based proportionately on the results obtained, as shown in Table Nos. 1 to 8 inclusive, regardless of the territory over which they are operated.

Cumberland to Rutherford

J1 Class Locomotive

As previously stated, one test was conducted from Cumberland to Rutherford, Pa., to obtain detailed information concerning the performance of this class locomotive operating in through service with heavy tonnage coal trains between the above mentioned points. The results of this test are disclosed in Table No. 11, and as a matter of pertinent information Table No. 12 shows the results of the eastward trip, Rutherford to Hagerstown.

Significance of Charts

Chart No. 1 shows the drawbar pull in relation to train speeds up to 50 M.P.H. on J1 and M2 class, and up to 40 M.P.H. on H9-a and I2 class locomotives.

Chart No. 2 shows the drawbar horsepower in relation to train speeds up to 50 M.P.H. on J1 and M2 class, and up to 40 M.P.H. on H9-a and I2 class locomotives.

The information shown on Chart Nos. 1 and 2 is the result of Dynamometer car tests for the duration of the tests under all operating conditions.

Referring to Chart No. 1, it is interesting to note the points where the drawbar pull curve of the J1 class crosses the curves of the H9-a and I2 classes, i.e., at 5 and 28 M.P.H. respectively, also the point where the curves intersect on the I2 and M2 class locomotives.

It will be observed on Chart No. 2 the drawbar horsepower in relation to speed corresponds with the drawbar pull at the various speeds shown on Chart No. 1, and the curves intersect at the same points.

The improvements of the J1 and M2 class locomotives over class H9-a and I2 with respect to drawbar pull and drawbar horsepower, as shown in Table Nos. 1 and 2, is a matter of no small importance and should not be overlooked.

The information revealed by Chart Nos. 1 and 2 is substantiated by Table Nos. 1 to 4 inclusive, particularly Items 7 which show an increase in average speed of 21.9% to 40.0% on J1 class over H9-a class, and 13.1% to 16.6% on M2 class over I2 class locomotives. The four classes of locomotives were operated at or near maximum capacity for the duration of the test period from Bowest Junction to Deal under comparable operating conditions.

Summary of Tests

Improvements in favor of J1 Class versus H9-a Class Locomotives

This data is the result of tests from Bowest Junction to Deal, coal trains and fast freight trains, with locomotives working at or near maximum capacity under comparable operating conditions, except Items 13 and 14, which are the results of entire test or trip.

1. Actual running time reduced 17.8 to 28.6%
2. Average speed increased 21.9 to 28.6%
3. Average drawbar pull increased 7.4 to 16.1%
4. Average drawbar horsepower increased 27.9 to 30.0%
5. Maximum drawbar horsepower increased 33.6 to 44.1%
6. Water used from tender decreased 3.1 to 7.0%
7. Water per drawbar horsepower hour from tender, 25.5 to 27.3% less
8. Coal saving 18.0 to 23.6%
9. Coal used per square foot grate area per hour, 24.8 to 29.8% less
10. Coal per drawbar horsepower hour - lbs. decrease 35.8 to 41.3%
11. Coal per M.G.T.M., decrease 19.2 to 23.7%
12. Evaporation per pound of coal, increase 13.45 to 26.75%
13. Coal saving including terminal use 18.2 to 19.8%
14. Cost per M.G.T.M. - duration of trip - decrease 13.0 to 13.4%

I2 Class versus M2 Class Locomotives

This data is the result of tests from Bowest Junction to Deal, coal trains and fast freight trains, with locomotives working at or near maximum capacity under comparable operating conditions, except Items 13 and 14, which are the results of entire test or trip.

1. Actual running time, decrease in favor of M2 class 11.5 to 14.3%
2. Average speed, increase in favor of M2 class 13.1 to 16.6%
3. Average drawbar pull, increase in favor of M2 class 1.5 to 5.0%
4. Average drawbar horsepower, increase in favor of M2 class 15.1 to 16.1%
5. Maximum drawbar horsepower, increase in favor of M2 class 10.8 to 16.1%
6. Water used from tender, decrease in favor of I2 class on coal trains 6.4%
   Water used from tender, decrease in favor of M2 class on fast freight trains .3%

7. Water per drawbar horsepower hour from tender - lbs. decrease in favor of M2 class 7.7 to 16.2%
8. Coal saving in favor of I2 class on coal trains 2.5%
   Coal saving in favor of M2 class on fast freight trains 7.5%
9. Coal used per square foot grate area per hour - lbs. decrease in favor of I2 on coal trains 2.0%
   Coal used per square foot grate area per hour - lbs. decrease in favor of M2 on fast freight trains 5.1%
10. Coal per drawbar horsepower hour - lbs. decrease in favor of M2 10.9 to 20.3%
11. Coal per M.G.T.M., decrease in favor of I2 class on coal trains .7%
    Coal per M.G.T.M., decrease in favor of M2 class on fast freight trains 8.3%
12. Evaporation per pound of coal, increase in favor of M2 class 3.8 to 7.9%
13. Coal saving including terminal use in favor of I2 class on coal trains 3.67%
    Coal saving including terminal use in favor of M2 class on fast freight trains 4.3%
14. Cost per M.G.T.M. - duration of trip - same on coal trains
    Cost per M.G.T.M. - duration of trip - decrease favorable to M2 class on fast freight trains 2.9%

Conclusion

The overall operating characteristics in favor of J1 class locomotive versus Classes H9-a, I2 and M2 as revealed by the tests are as follows:

1. Flexibility of locomotive account of its adaptability for all classes of service.

2. Availability for service.

3. Practicability of operating in through service without terminal attention at intermediate points. This was previously demonstrated during a test run of locomotive No. 1401 which was operated in through service from Bowest, Pa. to Rutherford, Pa. and return to Hagerstown, a distance of 333 miles, without cleaning the fire or dumping the ash pan. This locomotive could have been run on to Cumberland without cleaning fire or dumping the ashes, making a total of 412 miles.

4. Based on the rated tractive effort of the four classes of locomotives tested, ability to handle same tonnage and maintain higher sustained speeds under comparable operating conditions. More rapid acceleration with rated tonnages.

5. Operating efficiency and fuel economy.

Table No. 1

Test of J1 Class versus H9-a Class Locomotives
Coal Trains Bowest Junction to Deal - 63 Miles

	Locomotive No. 1410	Locomotive No. 847	Difference	Difference Percent
1. Test No.	3	14	---	---
2. Weather condition	Clear	Clear	---	---
3. Duration of test - hrs. mins.	2 - 48	3 - 15	27	15.6
4. Number of stops and mins.	2 - 20	1 - 15	---	---
5. Running time - hrs. mins.	2 - 28	3 - 0	32	17.8
6. Working distance - miles	63	63	---	---
7. Average speed - M.P.H.	25.6	21.0	4.6	21.9
8. Maximum speed - M.P.H.	40	37	3	8.1
9. Number of cars - loads, empties	40 - 0	40 - 0	---	---
10. Tonnage	3097	3059	38	1.2
11. Gross ton miles	195111	192717	2394	1.2
12. Average drawbar pull	48137	41457	6680	16.1
13. Average drawbar horsepower	3250	2540	710	27.9
14. Drawbar horsepower hours - equated	7995	6248	1747	28.0
15. Maximum drawbar horsepower	3900	2920	980	33.6
16. Water used from tender - gals.	17648	18981	1333	7.0
17. Water used including condensed exhaust steam - gals.	19413	20879	1466	7.0
18. Water per hour from tender - gals.	7174	6327	847	13.4
19. Water per hour from tender and condensed exhaust steam - gals.	7891	6960	931	13.4
20. Water used from tender and condensed exhaust steam - lbs.	161775	173992	12217	7.0
21. Water per drawbar horsepower hour from tender - lbs.	18.4	25.3	6.9	27.3
22. Water per drawbar horsepower hour from tender and condensed exhaust steam - lbs.	20.2	27.8	7.6	27.3
23. Water per thousand ton miles - gals.	99.5	108.3	8.8	8.1
24. Coal used - lbs.	24600	30000	5400	18.0
25. Coal used - tons	12.3	15.0	2.7	18.0
26. Coal used per hour - lbs.	10000	10000	---	---
27. Coal used per hour - tons	5.0	5.0	---	---
28. Coal used per square foot grate area per hour - lbs.	93.7	133.5	39.8	29.8
29. Coal per drawbar horsepower hour - lbs.	3.08	4.80	1.72	35.8
30. Coal per thousand gross ton miles - lbs.	126	156	30	19.2
31. Evaporation per pound of coal including condensed exhaust steam - lbs.	6.58	5.80	.78	13.45

Test of J1 Class versus H9-a Class Locomotives
East Freight Trains Bowest Junction to Teal - 63 Miles

	Locomotive No. 1410	Locomotive No. 847	Difference	Difference Percent
1. Test No.	6	16	---	---
2. Weather condition	Clear	Rain	---	---
3. Duration of test - hrs. mins.	2 - 49	3 - 38	49	22.6
4. Number of stops and mins.	2 - 34	2 - 29	---	---
5. Running time - hrs. mins.	2 - 15	3 - 9	54	28.6
6. Working distance - miles	63	63	---	---
7. Average speed - M.P.H.	28.0	20.0	8	40.0
8. Maximum speed - M.P.H.	40	36	4	11.1
9. Number of cars - loads, empties	46 - 2	51 - 2	---	---
10. Tonnage	2887	2673	14	.5
11. Gross ton miles	181881	180999	882	.5
12. Average drawbar pull	45283	42152	3131	7.4
13. Average drawbar horsepower	3290	2530	760	30.0
14. Drawbar horsepower hours - equated	7403	5693	1710	30.0
15. Maximum drawbar horsepower	3920	2720	1200	44.1
16. Water used from tender - gals.	17989	18570	581	3.1
17. Water used including condensed exhaust steam - gals.	19788	20427	639	3.1
18. Water per hour from tender - gals.	7995	5895	2100	35.8
19. Water per hour from tender and condensed exhaust steam - gals.	8795	6485	2310	35.8
20. Water used from tender and condensed exhaust steam - lbs.	164900	170225	5325	3.1
21. Water per drawbar horsepower hour from tender - lbs.	20.25	27.18	6.93	25.5
22. Water per drawbar horsepower hour from tender and condensed exhaust steam - lbs.	22.27	29.90	7.63	25.5
23. Water per thousand ton miles - gals.	108.8	112.9	4.1	3.6
24. Coal used - lbs.	24000	31400	7400	23.6
25. Coal used - tons	12.0	15.7	3.7	23.6
26. Coal used per hour - lbs.	10666	9968	698	7.0
27. Coal used per hour - tons	5.3	5.0	.3	7.0
28. Coal used per square foot grate area per hour - lbs.	100.0	133.1	33.1	24.8
29. Coal per drawbar horsepower hour - lbs.	3.24	5.52	2.28	41.3
30. Coal per thousand gross ton miles - lbs.	132	173	41	23.7
31. Evaporation per pound of coal including condensed exhaust steam - lbs.	6.87	5.42	1.45	26.75

Table No. 3

Test of I2 Class versus M2 Class Locomotives
Coal Trains Bowest Junction to Deal - 63 Miles

	Locomotive No. 1111	Locomotive No. 1205	Difference	Difference Percent
1. Test No.	20	26	---	---
2. Weather condition	Clear	Clear	---	---
3. Duration of test - hrs. mins.	3 - 0	2 - 45	15	8.3
4. Number of stops and mins.	1 - 15	1 - 19	---	---
5. Running time - hrs. mins.	2 - 45	2 - 26	19	11.5
6. Working distance - miles	63	63	---	---
7. Average speed - M.P.H.	22.9	25.9	3.0	13.1
8. Maximum speed - M.P.H.	35	39	4	11.4
9. Number of cars - loads, empties	50 - 0	55 - 0	---	---
10. Tonnage	3997	4024	27	.7
11. Gross ton miles	251811	253512	1701	.7
12. Average drawbar pull	53143	55785	2642	5.0
13. Average drawbar horsepower	3520	4050	530	15.1
14. Drawbar horsepower hours - equated	8553	9842	1289	15.1
15. Maximum drawbar horsepower	3970	4400	430	10.8
16. Water used from tender - gals.	23775	25297	1522	6.4
17. Water used including condensed exhaust steam - gals.	26153	27827	1674	6.4
18. Water per hour from tender - gals.	8645	10410	1765	20.4
19. Water per hour from tender and condensed exhaust steam - gals.	9510	11451	1941	20.4
20. Water used from tender and condensed exhaust steam - lbs.	217938	231889	13950	6.4
21. Water per drawbar horsepower hour from tender - lbs.	23.2	21.4	1.8	7.7
22. Water per drawbar horsepower hour from tender and condensed exhaust steam - lbs.	25.5	23.6	1.9	7.5
23. Water per thousand ton miles - gals.	103.9	109.8	5.9	5.7
24. Coal used - lbs.	36000	36900	900	2.5
25. Coal used - tons	18.00	18.45	.45	2.5
26. Coal used per hour - lbs.	13091	15185	2094	16.0
27. Coal used per hour - tons	6.55	7.59	1.04	16.0
28. Coal used per square foot grate area per hour - lbs.	125.3	127.8	2.5	2.0
29. Coal per drawbar horsepower hour - lbs.	4.21	3.75	.46	10.9
30. Coal per thousand gross ton miles - lbs.	143	144	1	.7
31. Evaporation per pound of coal including condensed exhaust steam - lbs.	6.05	6.28	.23	3.8

Table No. 4

Test of I2 Class versus M2 Class Locomotives
Fast Freight Trains Bowest Junction to Deal - 63 Miles

	Locomotive No. 1111	Locomotive No. 1205	Difference	Difference Percent
1. Test No.	22	28	---	---
2. Weather condition	Rain	Clear	---	---
3. Duration of test - hrs. mins.	3 - 7	2 - 55	12	6.4
4. Number of stops and mins.	1 - 26	3 - 37	---	---
5. Running time - hrs. mins.	2 - 41	2 - 18	23	14.3
6. Working distance - miles	63	63	---	---
7. Average speed - M.P.H.	23.5	27.4	3.9	16.6
8. Maximum speed - M.P.H.	37	40	3	8.1
9. Number of cars - loads, empties	66 - 2	64 - 2	---	---
10. Tonnage	3795	3833	38	1.0
11. Gross ton miles	239085	241479	2394	1.0
12. Average drawbar pull	53164	53965	801	1.5
13. Average drawbar horsepower	3530	4100	570	16.1
14. Drawbar horsepower hours - equated	8119	9430	1311	16.1
15. Maximum drawbar horsepower	3715	4650	935	25.2
16. Water used from tender - gals.	23890	23826	64	.3
17. Water used including condensed exhaust steam - gals.	26279	26208	71	.3
18. Water per hour from tender - gals.	8914	10359	1445	16.2
19. Water per hour from tender and condensed exhaust steam - gals.	9806	11395	1589	16.2
20. Water used from tender and condensed exhaust steam - lbs.	218992	218400	592	.3
21. Water per drawbar horsepower hour from tender - lbs.	24.52	21.05	3.47	14.2
22. Water per drawbar horsepower hour from tender and condensed exhaust steam - lbs.	26.97	23.16	3.81	14.1
23. Water per thousand ton miles - gals.	109.9	108.5	1.4	1.3
24. Coal used - lbs.	37600	34800	2800	7.5
25. Coal used - tons	18.8	17.4	1.4	7.5
26. Coal used per hour - lbs.	14029	15130	1101	7.9
27. Coal used per hour - tons	7.01	7.57	.56	7.9
28. Coal used per square foot grate area per hour - lbs.	134.2	127.3	6.9	5.1
29. Coal per drawbar horsepower hour - lbs.	4.63	3.69	.94	20.3
30. Coal per thousand gross ton miles - lbs.	157	144	13	8.3
31. Evaporation per pound of coal including condensed exhaust steam - lbs.	6.82	6.28	.46	7.90

Table No. 5

Test of J1 Class versus H9-a Class Locomotives
Coal Trains Bowest to Cumberland (Knobmount Yard) - 90 Miles

	Locomotive No. 1410	Locomotive No. 847	Difference	Differen Percen
1. Test No.	3	14	---	---
2. Duration of trip - hrs. mins.	4 - 42	5 - 24	42	12.9
3. Total delays (including terminals) - hrs. mins.	0 - 49	1 - 2	13	21.0
4. Running time actual - hrs. mins.	3 - 53	4 - 22	29	11.0
5. Average speed - M.P.H.	23.17	20.61	2.56	12.9
6. Number of cars - loads, empties	40 - 0	40 - 0	---	---
7. Tonnage	3097	3059	38	1.2
8. Gross ton miles	278700	275300	3400	1.2
9. Water used from tender including condensed exhaust steam - gals.	21965	22696	731	3.2
10. Coal used (including terminals) - tons	14.4	17.6	3.2	18.2
11. Coal per thousand gross ton miles - lbs.	103	128	25	19.5
12. Cost per thousand gross ton miles	.267	.307	.040	13.0

Table No. 6

Test of J1 Class versus H9-a Class Locomotives
Fast Freight Trains Dickerson Run to Cumberland (Knobmount Yard) - 96 Miles

	Locomotive No. 1410	Locomotive No. 847	Difference	Differenc Percent
1. Test No.	5	16	---	---
2. Duration of trip - hrs. mins.	5 - 33	5 - 33	---	---
3. Total delays (including terminals) - hrs. mins.	1 - 25	0 - 39	46	1.2
4. Running time actual - hrs. mins.	4 - 8	4 - 54	46	15.6
5. Average speed - M.P.H.	23.22	19.69	3.63	18.5
6. Number of cars - loads, empties	46 - 2	51 - 2	5	---
7. Tonnage	2887	2873	14	.5
8. Gross ton miles	282900	281600	1300	.5
9. Water used from tender including condensed exhaust steam - gals.	23505	23972	467	1.9
10. Coal used (including terminals) - tons	14.6	18.2	3.6	19.8
11. Coal per thousand gross ton miles - lbs.	103	129	26	20.1
12. Cost per thousand gross ton miles	.258	.298	.040	13.4

Table No. 7

Test of I2 Class versus M2 Class Locomotives
Coal Trains Bowest to Cumberland (Knobmount Yard) - 90 Miles

	Locomotive No. 1111	Locomotive No. 1205	Difference	Difference Percent
1. Test No.	20	26	---	---
2. Duration of trip - hrs. mins.	5 - 15	4 - 32	43	13.5
3. Total delays (including terminals) - hrs. mins.	1 - 5	0 - 44	21	32.30
4. Running time actual - hrs. mins.	4 - 10	3 - 48	22	8.8
5. Average speed - M.P.H.	21.60	23.64	2.04	9.4
6. Number of cars - loads, empties	60 - 0	55 - 0	5	---
7. Tonnage	3997	4024	27	.67
8. Gross ton miles	359700	362200	2500	.69
9. Water used from tender including condensed exhaust steam - gals.	28268	30716	2442	8.6
10. Coal used (including terminals) - tons	21.8	21.0	.8	3.67
11. Coal per thousand gross ton miles - lbs.	121	116	5	4.21
12. Cost per thousand gross ton miles	.267	.267	---	---

Table No. 8

Test of I2 Class versus M2 Class Locomotives
Fast Freight Trains Dickerson Run to Cumberland (Knobmount Yard) - 96 Miles

	Locomotive No. 1111	Locomotive No. 1205	Difference	Difference Percent
1. Test No.	22	28	---	---
2. Duration of trip - hrs. mins.	5 - 10	5 - 7	3	.97
3. Total delays (including terminals) - hrs. mins.	0 - 45	1 - 8	23	51.0
4. Running time actual - hrs. mins.	4 - 25	3 - 59	26	9.8
5. Average speed - M.P.H.	21.75	24.60	2.75	12.6
6. Number of cars - loads, empties	66 - 2	54 - 2	12	---
7. Tonnage	3796	3833	38	1.00
8. Gross ton miles	371900	375600	3700	.99
9. Water used from tender including condensed exhaust steam - gals.	30374	31197	823	2.7
10. Coal used (including terminals) - tons	23.0	22.0	1.0	4.3
11. Coal per thousand gross ton miles - lbs.	124	117	7	5.6
12. Cost per thousand gross ton miles	.268	.260	.008	2.9

Table No. 9

Test of J1 Class versus H9-a Class Locomotives
Data Obtained Bowest Jct. to Deal on Fast Freight Trains - 63 Miles

	Average			
	Locomotive No. 1410	Locomotive No. 847	Difference	Differen Percen
1. Test No.	5	16	---	---
2. Throttle position	F	F	---	---
3. Cut-off percent	57.5	55.0	2.5	4.5
4. Speed - M.P.H.	28.0	20.0	8.0	40.0
5. Boiler pressure - lbs.	255.0	220.0	35.0	15.9
6. Steam chest pressure - lbs.	247.0	204.6	42.4	21.2
7. Exhaust or back pressure - lbs.	18.0	17.3	.7	4.0
8. Pressure drop through superheater - lbs.	6.3	7.4	1.1	14.8
9. Pressure drop, boiler to steam chest - lbs.	8.0	15.4	7.4	48.0
10. Superheat temperature - degrees F.	721	705	16	2.3
11. Water delivery temperature to boiler - degrees F.	241	237	4	1.7
12. Front end draft arrester drum	15.8	15.6	.2	1.3
13. Front end draft back of arrester drum	11.3	11.6	.3	2.6
14. Firebox draft	1.88	2.05	.17	8.3
15. Ash pan draft	.22	.19	.03	---
16. Smoke reading No.	Clear	2	---	---
17. Nozzle opening actual - square inches	40.38	34.02	6.3	18.5
18. Boiler H.P.	5260	3460	1810	52.4
19. Rated tractive effort - lbs.	70600	71500	900	1.2
20. Actual tractive effort - lbs.	70600	72088	1488	2.0
21. Boiler working pressure - lbs.	255	220	---	---
22. Cylinders - dia. x stroke	26½x32	27x32	---	---
23. Drivers - dia. - inches	69	60½	---	---

Table No. 10

Test of I2 Class versus M2 Class Locomotives
Data Obtained Bowest Jct. to Deal on Fast Freight Trains - 63 Miles

	Average				
	Locomotive No. 1111	Locomotive No. 1205		Difference	Difference Percent
		No. 1 E	No. 2 E		
1. Test No.	22	28		---	---
2. Throttle position	F	F		---	---
3. Cut-off percent	66	60		6	9.0
4. Speed - M.P.H.	23.5	27.4		3.9	16.6
5. Boiler pressure - lbs.	240	250		10	4.1
6. Steam chest pressure - lbs.	222.4	216.0	219.0	3.4	1.5
7. Exhaust or back pressure - lbs.	16.2	15.3	16.8	.6	3.7
8. Pressure drop through superheater - lbs.	9.9	27.8		18.0	1.8
9. Pressure drop, boiler to steam chest - lbs.	17.6	34.0	31.0	13.4	76.0
10. Superheat temperature - degrees F.	690	645		45	6.5
11. Water delivery temperature to boiler - degrees F.	236	236		---	---
12. Front end draft - arrester drum	14.2	18.0		3.8	26.8
13. Front end draft - back of drum	8.7	12.9		4.2	48.2
14. Firebox draft	1.84	2.14		.30	16.3
15. Ash pan draft	.188	.081		.107	56.9
16. Smoke reading No.	2	1		---	---
17. Nozzle opening actual - square inches	45.72	29.40	29.40	16.32	35.6
18. Boiler H.P.	4680	6156		1476	31.5
19. Rated tractive effort - lbs.	96300	95500		800	.8
20. Actual tractive effort - lbs.	96711	96642		169	.2
21. Boiler working pressure - lbs.	240	250		---	---
22. Cylinders - dia. x stroke	30x32	22-1/8x32		---	---
23. Drivers - dia. - inches	60-3/4	69		---	---

Table No. 11

Test of J1 Class Locomotive with Coal Train
from Cumberland, Md. to Rutherford, Pa. - 160 Miles

	Locomotive No. 1410
Cumberland to Hagerstown	
1. Test No.	8
2. Weather condition	Clear
3. On duty - hrs. mins.	5 - 14
4. Road delays - hrs. mins.	0 - 54
5. Terminal time Cumberland - hrs. mins.	0 - 28
*6. Terminal time Hagerstown - hrs. mins.	0 - 48
7. Running time - hrs. mins.	3 - 4
8. Average speed - M.P.H.	25.1
9. Number of cars - loads, empties	102 - 0
10. Tonnage	7975
11. Water used from tender - gals.	16499
12. Coal used on test - tons (exoluding terminals)	10.95
13. Kind of coal	Slack Gas
14. Gross ton miles	631700
15. Coal per thousand gross ton miles - lbs.	60
16. Cost per thousand gross ton miles	.163
* Changing crews, taking water and air test	
Hagerstown to Rutherford	
1. On duty - hrs. mins.	4 - 6
2. Road delays - hrs. mins.	0 - 5
3. Terminal time Rutherford - hrs. mins.	1 - 11
4. Running time NC Tower to Lurgan - hrs. mins.	1 - 12
5. Average speed - M.P.H.	27.6
6. Running time NC Tower to Rutherford - hrs. mins.	2 - 45
7. Average speed - M.P.H.	29.8
8. Number of cars - loads, empties	100 - 0
9. Tonnage	7825
10. Water used from tender - gals.	11371
11. Coal used Hagerstown to Lurgan - tons	4.35
12. Coal used Lurgan to Leesburg - tons	1.0
13. Coal used Hagerstown to Rutherford (exoluding terminals) - tons	7.8
14. Kind of coal	Good quality ge
15. Gross ton miles	643400
16. Coal per thousand gross ton miles - lbs.	61
17. Cost per thousand gross ton miles	.165
Cumberland to Rutherford	
1. On duty - hrs. mins.	9 - 20
2. Road delays - hrs. mins.	0 - 59
3. Terminal time - hrs. mins.	2 - 27
4. Running time - hrs. mins.	5 - 54
5. Average speed - M.P.H.	27.1
6. Train in transit - hrs. mins.	7 - 41
7. Water used from tender - gals.	28400
8. Coal used (inoluding terminals) - tons	21.2
9. Gross ton miles	1275100
10. Coal per thousand gross ton miles - lbs.	61
11. Cost per thousand gross ton miles	.164
Two helpers used Williamsport to Hagerstown	
One H9 class helper used Hagerstown to Leesburg	

Table No. 12

Test of J1 Class Locomotive
from Rutherford, Pa. to Hagerstown, Md. - 82 Miles

	Locomotive No. 1410
1. Test No.	9
2. Weather condition	Clear
3. On duty - hrs. mins.	5 - 15
4. Road delays - hrs. mins.	0 - 45
5. Terminal time Rutherford - hrs. mins.	1 - 5
6. Terminal time Hagerstown - hrs. mins.	0 - 23
7. Running time - hrs. mins.	3 - 2
8. Average speed - M.P.H.	27.03
9. Number of cars - loads, empties	42 - 6
10. Tonnage	2222
11. Water used from tender - gals.	13153
12. Coal used on test - tons (excluding terminals)	8.8
13. Coal used - tons (including terminals)	11.0
14. Kind of coal	R. M. Gas Inferior quality
15. Gross ton miles	183900
16. Coal per thousand gross ton miles - lbs.	120
17. Cost per thousand gross ton miles	.336

Cumberland, Md. to Rutherford, Pa.
and return to Hagerstown, Md. - 242 Miles

	Locomotive No. 1410
1. Total gross ton miles	1459000
2. Total coal used - tons	32.2
3. Total pounds of coal per thousand gross ton miles	68
4. Total cost per thousand gross ton miles	.186

Tonnage Ratings of Classes H9, H9-a, J1, I2 and M2 Locomotives Based on Dynamometer Car Tests

Lurgan Sub-Division

Westward		Eastward	
Class Engine	Lurgan to Hagerstown	Hagerstown to Lurgan	
		Drag	Fast Frt.
J1	2250	3800 * 8000	3600

West Sub-Division

Westward		Eastward			
Class Engine	Hagerstown to Cumberland	Cumb. to Williamsport			Williamsport to Hagerstown
		Drag	Fast Frt.	WM-4	
H9,H9-a	3600	8000	3600	2200	2500
J1	4000	8000	5500	3600	2500
I2	4800	10500	7500	5000	3400
M2	4800	10500	7500	5000	3400

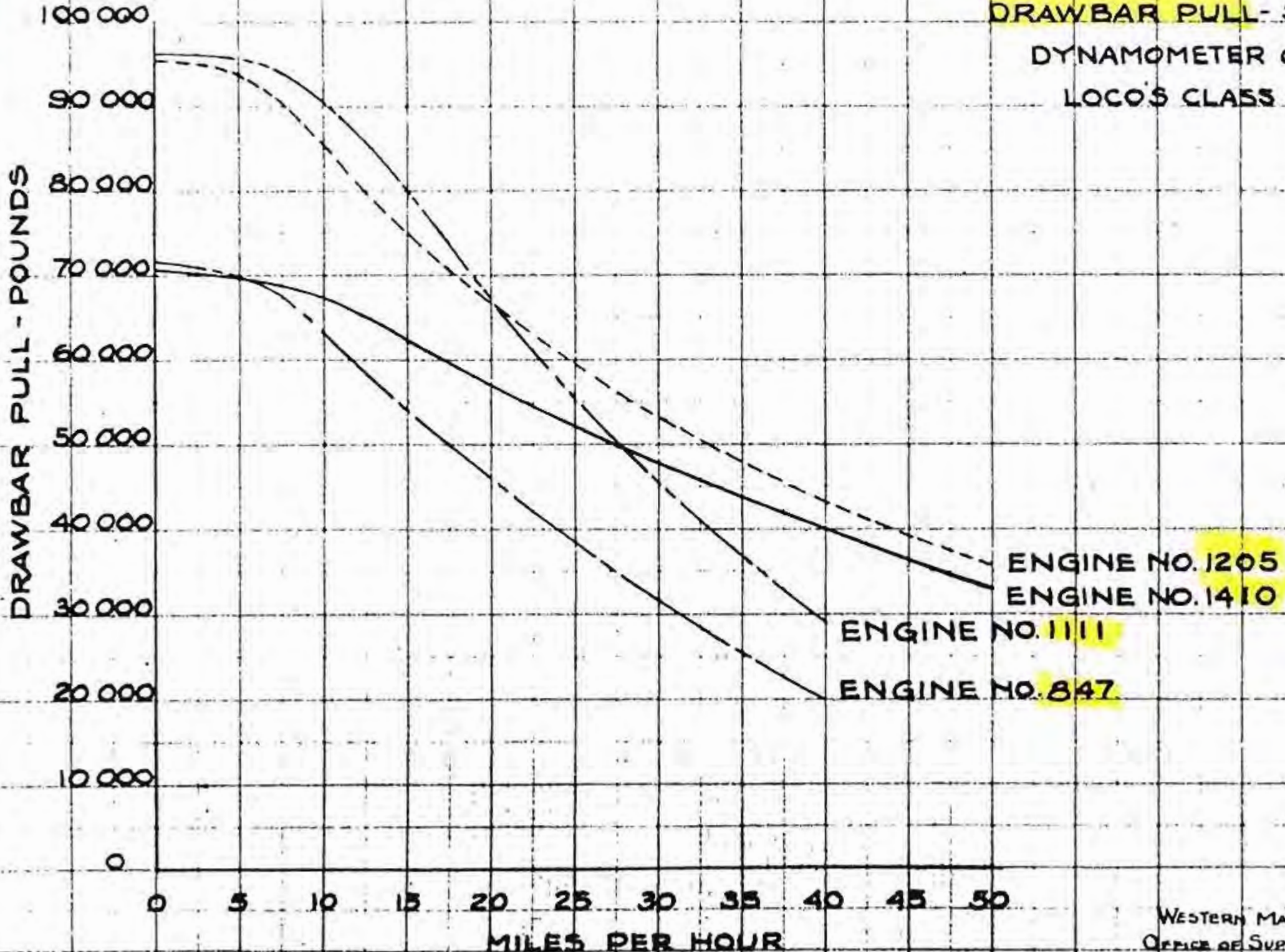
Connellsville Sub-Division

Westward		Eastward	
Class Engine	Cumberland to Deal	Bowest to Deal	
		Drag	Fast Frt.
H9,H9-a	1100	3100	2500
J1	1100	3100	2800
I2	1600	4000	3700
M2	1600	4000	3700

* H9 or J1 Class Helper

CHART NO. 1

DRAWBAR PULL - SPEED CURVES
DYNAMOMETER CAR TESTS
LOCO'S CLASS H9a, I2, J1, M2



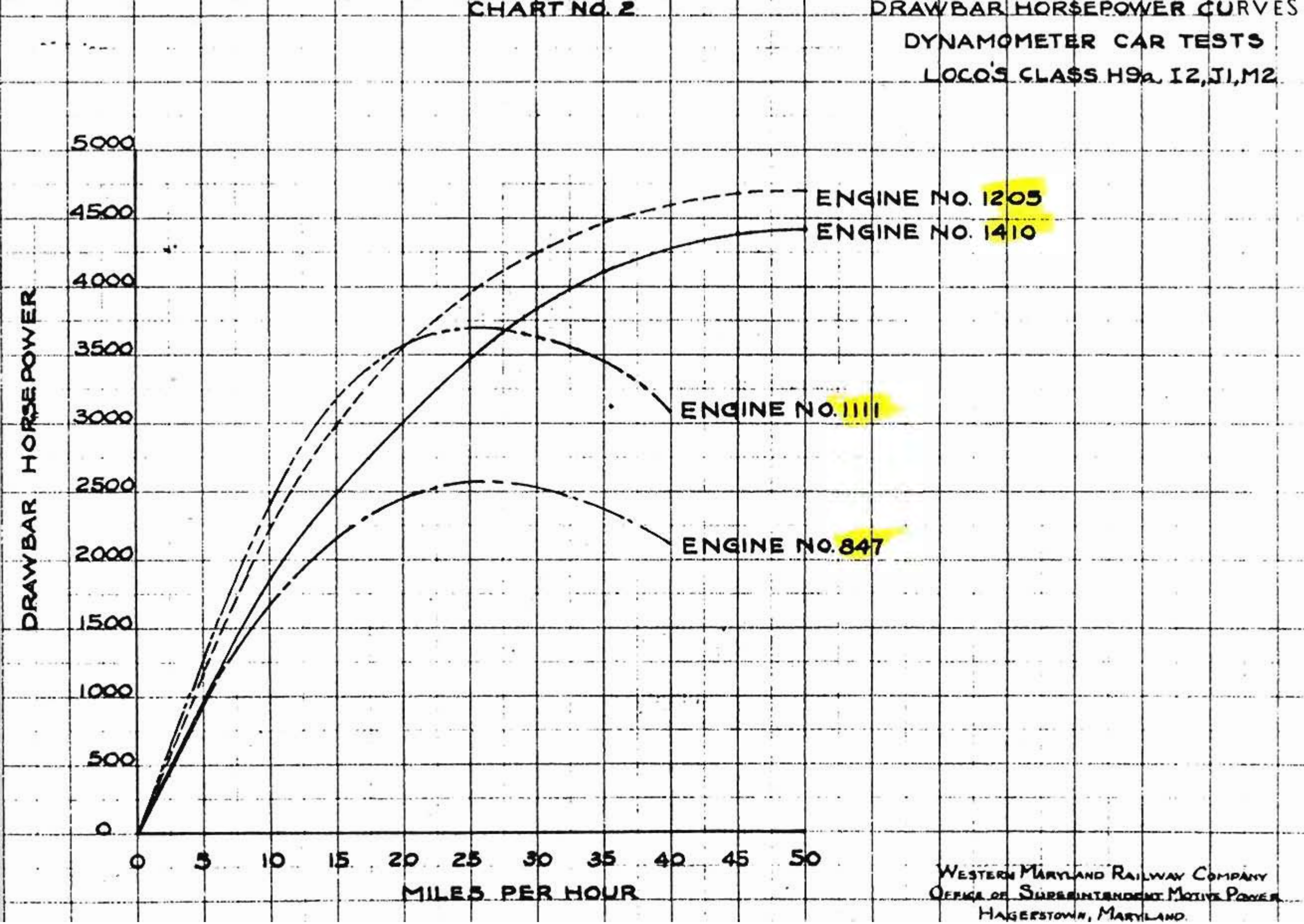
WESTERN MARYLAND RAILWAY COMPANY
OFFICE OF SUPERINTENDENT MOTIVE POWER

CHART NO. 2

DRAWBAR HORSEPOWER CURVES

DYNAMOMETER CAR TESTS

LOCO'S CLASS H9a, I2, J1, M2



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OFFICE OF SUPERINTENDENT MOTIVE POWER
HAGERSTOWN, MARYLAND