1908

Test made on the Missouri School of Mines power plant

Leland R. Walker

George Hewitt Boyer

Alfred Leo Nye

T202

Test

Made On the

Missouri School of Mines Power Plant.

L.R.Walker

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A.T.Nye.

The primary object of this thesis was to obtain the total efficiency of the Missouri School of Mines Power Plant.

Preparations were made to determine the amount of power required in heating the buildings,but owing to the mildness of the weather during the time allotted for this work we were forced to discontinue this part of the test.

We were therefore forced to confine our work to the testing of the efficiencies of the various units.

The plant comprises three 130 Horse Power Heine Safety Boilers,one 75 Horse Power Ideal Engine,one 35 Horse Power Brownell Engine,one 7 Horse Power Davis and Rankin Vertical Engine,one Laidlaw-Dunn-Gordon Air Compressor,three pumps for supplying water for school purposes,a pump for supplying water to the boiler and 50 K.W. Westinghouse 220 Volt Direct Current Generator which is direct connected to the Ideal Engine previously mentioned.

Note. We have mentioned only those units in use during our test.

For location of the different units mentioned see plate No.I

We have endeavored to simplify the explanation of our work by means of tables. In the boiler runs we give in tabular form our original readings. This is followed by a table compiled for calculating purposes. A third table shows the results of the test. In the Ideal Engine and Dynamo test, the original readins and the results derived from them are compiled in one table.

Explanation of Tables.

Explanation of Tables (continued)

Table IIIc Page (19) Gives the results obtained from test #3.

Table IIId Page (19) Gives the final result obtained from all three runs.

Table IV. page (24) Gives the readings taken on the Brownell Engine which unfortunately proved of no value.

Table V, page (22) Gives the original readings taken on the Ideal Engine and Westinghouse Dynamo together with the results obtained from them on run # 1.

Table VI, page (22) Obtained on run # 2 on the engine and dynamo. When this run was made the speed indicator was lost and the average speed shown by run #I was used in the calculation

Table VII, page (23) Obtained on run #3 on the Engine and Dynamo.

Table VIII, page (29) Gives the original readings and results of volumetric test on the air compressor.

In the accompanying blue prints we have endeavored to show in a simple and graphic manner the relations between the results obtained during the entire test.

Explanation of Blue Prints.

Plate I, page ( ) Is a ground plan of that part of the M.S.M. Power Plant directly identified with this thesis.

Explanation of Blue Prints (continued)

Plate II, page ( ) Gives plan and elevation of the elliptical tank used for storage of water.

Plate III, page ( ) Gives plan and elevation of the oblong tank used for storage of water.

Plate IV & V, page ( ) & ( ) Show average indicator cards obtained from the test of the Ideal Engine

Plate VI,&VII, page ( ) & ( ) Shows average indicator cards obtained from test on the Air Compressor.

Plate VIII, page ( ) Shows the relation obtained during run # I on the dynamo, between amperes and efficiency with the voltage constant.

Plate IX, page ( ) Shows the relation obtained during run #2 on the dynamo between amperes and efficiency with the voltage constant.

Plate X, page ( ) Shows the relation obtained during run #3, on the dynamo, between amperes and efficiency with the voltage constant.

Plate XI, page ( ) Shows the relation obtained during run #1 on the engine and dynamo between amperes and the horse power developed by the engine with the voltage constant.

Plate XII, page ( ) Shows the relation obtained during run #2 on the engine and dynamo between amperes and the horse power developed by the engine with the voltage constant.

Explanation of Blue Prints (continued)

Plate XIII, page ( ) Shows the relation obtained during run #3 on the engine and dynamo between amperes and the horse power developed by the engine with the voltage constant.

Plate XIV, page ( ) Shows the relation obtained during the volumetric run on the Air Compressor, between efficiency and speed in R.P.M. with a constant pressure of 50#.

Plate XV, page ( ) Shows the relation obtained during the volumetric run on the Air Compressor, between efficiency and speed in R.P.M. with a constant pressure of 75#.

Plate XVI, page ( ) Shows the relation obtained during the volumetric run on the Air Compressor, between efficiency and speed in R.P.M? with a constant pressure of 100#.

Plate XVII, page ( ) Shows the relation obtained during the volumetric run on the Air Compressor, between efficiency and speed in R.P.M., with a constant pressure of 125#.

Plate XVIII, page ( ) Shows the relation obtained during the volumetric run on the air compressor, between pound of air issuing from the orifice and speed in R.P.M. with a constant pressure of 75#.

Explanation of Blue Prints (continued)

Plate XIX, page ( ) Shows the relation obtained during the volumetric run on the air compressor, between pounds of air issuing from the orifice and speed in R.P.M. with a constant pressure of 75#.

Plate XX, page ( ) Shows the relation obtained during the volumetric run on the air compressor, between pounds of air issuing from the orifice and speed in R.P.M. with a constant pressure of 100#.

Plate XXI, page ( ) Shows the relation obtained during the volumetric run on the air compressor, between pounds of air issuing from the orifice and speed in R.P.M. with a constant pressure of 125#.

Plate XXII, page ( ) Shows the relation obtained during the volumetric run on the Air Compressor, between pounds of air issuing from the orifice and speed in R.P.M. with a constant pressure of 150#.

Plate XXIII, page ( ) Shows the relation obtained during the volumetric run on the air compressor, between gage pressure and efficiency with a constant speed of 45 R.P.M.

Explanation of Blue Prints (continued)

Plate XXIV, page ( ) Shows the relation obtained during the volumetric run on the air compressor, between gage pressure and efficiency with a constant speed of 60.R.P.M

Plate XXV, page ( ) Shows the relation obtained during the volumetric run on the air compressor, between gage pressure and efficiency with a constant speed of 64 R.P.M.

Plate XXVI, page ( ) Shows the relation obtained during the volumetric run on the Air Compressor, between gage pressure and efficiency with a constant speed of 70 R.P.M.

Boiler Tests.

The three Heine Boilers previously mentioned are connected in series,only two of these being in use at one time,the third being laid up for repairs.

Each boiler is of 130 H.P.,one H.P. being equivalent to 30# of water evaporated per hour,from 100 degrees Fr. to steam of 70# gage pressure. Each boiler has one shell 42" in diameter, 19' 6 1/2" long, 67 boiler tubes 3 1/2" diameter by 16' long, connecting two water legs,surrounded by suitable brickwork. These boilers are designed to carry a safe working pressure of 160# per square inch. The water f or these boilers is supplied by 2" feed pipe.

Three tests were made on these boilers,namely:- On Feb.22, 1908,from 9 o'clock A.M. to 5 P.M.,ON April 11,1908 from 8 A.M. to 1.40 P.M., on April 13th,1908 from 1.15 P.M. to 3.45 P.M.

The following preliminary preparations were made for these runs:

A water meter was connected in the 2" water feed pipe to boilers. The result of the calibration and description of this meter appears on page number (20).

The grate areas were measured,the dimension of each being 5' X 5'7".

Suitable holes for taking the temperature of draft were bored.

A fair sample of the coal was taken,the moisture,calorific power and the percent ash being determined. Also by method of cone and quartering, ~~method~~ a fair sample of the ash, remaining, after each run was taken and the calorific power of the ash obtained. These ahalyses appear on page ( ).

The readings taken during the various runs are inserted in tabular form, They are self explanatory and the calculation as far as possible will appear in these tables.

Conclusions on Boiler Tests.

Total Time of 3 runs	16 hours 10 min.
Total Amount of Coal Consumed	9105 pounds
Pounds of Coal burned per hour	563.1 pounds
Grate Area 55.833 sq. ft.	
Pounds of Coal burned per square foot of grate area/hr.	10.085 pounds
Stack Area 9.6' square feet	
Pounds of coal burned per square foot of stack area/hr.	58.65 pounds
Pounds of water evaporated per pound of coal used.	5.699 pounds
Pounds of water evaporated per pound of volatile matter	7.490 pounds
A verage horse power developed per hour	82.75 HP.

Coal has 7861.11 cal.heating power

Ash " 1879.75 " " "

Volatile matter 5981.36 " " "

Horse Power developed by coal	134.14
Horse power developed by volatile matter	102.07 HP

Boiler Efficiencies

$$\frac{82.75}{134.14} = 61.69\%$$

$$\frac{82.75}{102.07} = 81.077\%$$

Table #I Date Feb.22,1908

Time.	Coal weight in pounds	Gage	Temp. degrees C.	Draft. in inches.
9:00	189	75	149	.3
	197			
9:20	197	.74	174	.3
	186			
9:40	178	85	114	.3
	173			
9:50	171	95		.3
10:00	Run until 10:30	98	109	.3
10:20		90	120	.3
10:40	174	87	116	.3
	183			
11:00	173	77	118	.3
	173			
11:20		85	123	.25
	until			
11:40	12:03	80	119	.25
12:00		81	98	.25
	172			
12:20		80	107	.20
	172			
12:40	172	80	119	.25
	172			
1:00	until 1:25	90	111	.25
1:20		85	107	.30
1:40	172	80	100	.25
2:00	172	81	118	.30
	174			
2:20	174	85	110	.25
	until			
2:40	2:46	75	110	.30
	176			
3:00	176	80	114	.20
	174			
3:20	171	85	124	.25
	until	90	125	
3:40	3.50	90	133	.25
4:00	550	90	120	.25
4:20	until			
		89	122	.25
4:40	5.00			
5.00		88	107	.25

Table Ia.

Watermeter Readings.

Time	Meter Reading In Gallons	Temperature Degrees C.
9:10	11878	73.5
9:25	11948	78.
9:40	12011	78.5
10:00	12099	76.
10:20	12251	66.
10:40	12388	55.5
lo:00	12598	46.
11:20	12673	41.
11:40	12685	35.5
12:00	12762	31.
12:20	12865	26.5
12:40	12964	24.4
1:00	13043	20.5
1:20	13112	19.
1:40	13212	18
2:00	13292	17.5
2:20	13387	17.0
2:40	13578	16.5
3:00	13677	16.0
3:20	13761	16.0
3:40	13806	15.5
4:00	13844	15.5
4:20	13944	18.5
4:40	14053	15.5
5:00	14139	15.5

Table Ib.

This Table is from Table I and Ia for use in Calculation.

Time	Coal #	Water Gal	Water	Water Av. Cent.	H O Av. Fr.	Gage Av Av	Flue Gas Av. Temp.	Flue Gas Av. Fr.	Flue Draft Av.
9:00 to 10.30	1094	441	3601	72	161.6	86	128	262.4	.30
10:30 to 12:00	703	443	3701	41.7	107.1	83.3	116	240.8	.26
12:00 to 1:25	688	375	3133	24.3	75.7	83	108.4	227.1	.25
1:25 to 2:45	692	466	3894	17.6	63.7	81	111.2	232.2	.28
2:45 to 3:50	697	222	1855	15.9	60.6	86	118.2	244.7	.25
3:50 to 500	550	314	2624	15.5	59.9	90	122	251.6	.25

Table Ic
Calculations from Above Table.

Time	Pounds of H20 evaporated per pound of coal to 212 degrees	BP developed	HP developed per hour
9:00 to 10:20	3.48	113.67	75.78
10:30 to 12:00	6.02	112.9	75.24
12:00 to 1:25	5.364	106.95	75.48
1:25 to 2.45	6.695	134.28	94.74
2:45 to 3:50	3.178	64.20	58.32
3:50 to 5:00	5.705	93.04	79.74
	6)30.442		6)459.30
	5.074 Average No of lb.of H20/one lb.coal		76.55 Average HP/hr

Table II

Time	Coal	Gage	Temperature degrees C.	Draft in inches.
8:00	246	83	146	.3
	346			
8.30	until 8.55	85	146	.3
		87	150	.3
9:00	614	80		
	585			
9:20	until	76	181	.3
	10:45	80	150	.3
9:30				
		77	147	.3
10:00		75		
10:30				
		73	110	.25
10;45				
	546	61	114	.25
11:00	546			
		65	110	.25
11:30	until			
		75	112	.25
12:00	12:50			
		8o	81	.26
12:30				
		76		
12:50				
	223	73	88	.25
1:00	223			
1:20	until			
	1:40	70	88	.25
1:40				

Table IIa

Time	Meter Reading in Gallons.	Temperature Degrees C.
8.00	16026	46
8:30	16240	49
9:00	16418	65
9:30	16568	67
10:00	16690	64
10:30	16912	71
11:00	17198	68
11:30	17251	68
12:00	17375	67
12:30	17520	54
1:00	17654	49
1:40	17840	48

Table IIb. 4-11-08 Run.

Compulation Table.

Time	Coal #	Water Gals.	Water Lbs.	Water Aver deg. C.	Water Av. deg. F.	Gage Av.	Flue Gas Av. C.	Flue Gas Av. Temp F.	Flue Draft Av
8:00 to 9:00	692	392	3275	533	127.9	85.1	147	296.6	.3
9:00 to 10:45	1199	637	5322	66.7	152.	79.1	154.8	310.6	.3
10:45 to 12:50	1092	555	4637	65.6	150.1	71.5	118.6	245.5	.25
12:50 to 1:40	446	230	1922	50.3	122.5	75.	85.	185.	.25

Calculations from Above Table Table llc.

Time	Pounds of H20 evaporated per pounds of coal to 212 deg.	HP Developed	HP developed per hour
8 to 9:00	5.32	106.71	106.71
9:yo 10:45	4.872	169.23	96.66
10.45 to 12:50	4.661	74.926	35.94
12:50 to 1:40	4.859	62.807	75.36
	4)19.712		4)322.67
	4.928# Av H20 evaporated		78.17 Av.HP Developed/hr.

Table III

Time	Coal	Gage	Temperature degrees C.	Draft in inches
1:25	326	77	176	.25
1:27	326 until 2:00			
2:00		85	177	.25
2:30	300	77	157	.25
3:00	300 until	87	171	.25
3:30	3.45	80	170	.25
4:00		82	122	.20

Table IIIa

Time	Meter Reading in Gallons	Temperature degrees C.
1:00	20732	34
1:30	20792	32
2:00	20968	32
2:30	21511	25
3:00	21431	24
3:30	21645	24
4:00	21645	24

Table No. 111 b.

Time	Coal #	Water Gals	Water Lbs.	Water Av. Deg.C	Water Av. Deg.F	Gage Av.	Flue Gas Av. C	Flue Gas Av. F	Flue Draft Av
1:15 to 2:00	652	204	1704	32.6	90.6	81	177	350.6	.25
2:00 to 3:45	600	677	5657	25.8	78.6	82	155	311	.25

Table 111c
Computation of Above Table.

Time	Pounds of H20 Evaporated per pounds of Coal to 212 deg.	HP Developed	HP Developed per hour
1:15 to 2:00	3.037	57.39	76.50
2:00 to 3:45	11.15	193.93	110.82

2) 14.187
7.094 Av. H20 evaporated per lb.coal.

2) 187.32
93.61 Av. HP developed/hr

Table IIId.

Run.No.	Average amount of H20 Evaporated on each run per lb.of coal	Average HP Developed per hour on each run
I	5.074	76.55
II	4.928	78.17
III	7.094	93.61
Final Average	5.699	82.78

Calibration of Water-meter.

In this calibration we used a barrel with a measured capacity of 212.3 liters,which reduced to gallons 56.089

The water used was obtained direct from the feed pipe of the boiler and was passed through the meter at a temperature of 35 degrees C. which was close to the average temper ature of the water fed to the boiler during the runs.

Data.

Meter Readings	Diff. In Gal.
7143.1	
7199.1	56.0
7255.2	56.1
7311.2	56.0
7367.4	56.2
7423.4	56.0
	5)280.3
	56.06

Average Reading 56.06 gal

Calculated " 56.089 "

Error .029

The barrel used being rough for this work,no corrections have been made in amount obtained in runs.

Above mentioned meter was connected in the feed of the boiler and was used in all runs to measure amount of water.

Test for the Efficiency of Ideal Engine and the Westinghouse Generator.

These tests were made on Ideal Engine and Direct Connected Westinghouse Generator used for furnishing electrical power and light for the School of Mines.

Brief Description.

The Ideal Engine is a high speed,center crank,self oiling,automatic,direct connected type with a slide valve. It develops 75 HP at 290 R.P.M. This rating is based on 90# initial steam pressure and 1/4 cut off. The cylinder is 11" in diameter with a 12" stroke. The feed pipe is 3 1/2 in diameter. The engine is arrainged with extended sub base and shaft for direct connection to the dynamo.

The Generator is 50 K.W. 250 volt compound would D.C. engine type. Designed to operate at a speed of 280 to 300 R.P.M Normal full load rating is 200 Amp. at 250 volts.

These tests were made on this engine in conjunction with the boiler tests. In each case the load on the engine was the power used in running the shops as this load is light,the work was necessarily limited to efficiencies at light load.

All the original readings taken during the run,the caclulations therefrom appear in tabular form. Relations of these readings and their significence are shown by blue prints. See index.

February 22,1908 Table V.

Time.	M.E.P.	R.P.M.	Steam HP	Volts.	Amperes	HP Developed	Eff
9:40	26.3	265	40.16	224	86	25.24	62.84
10:00	17.54	267	26.98	222	64	19.94	73.9
10:20	24.4	265	37.23	222	86	25.54	68.6
10:40	20.	265	30.54	220	75	22.12	72.42
11:00	19.45	264	29.58	218	74	21.63	73.12
11:20	21.1	267	32.45	220	76	22.41	69.06
11:40	12.33	267	19.27	224	34	10.21	52.98
12:00	9.86	274	15.51	226	18	6.45	41.42
12:20	7.1	272	11.13	226	18	5.46	48.96
12:40	7.1	265		226	18	0.0	
1:05	16.20	265	24.74	222	60	17.86	72.19
1:20	16.6	267	25.35	222	56	16.67	65.75
1:40	17.9	267	27.54	222	60	17.86	64.85
2:00	21.	267	32.31	222	72	21.42	66.3
2:20	17.6	267	27.08	224	56	16.82	66.11
2:40	17.8	267	27.38	224	56	16.82	62.87
3:00	18.1	267	27.18	226	60	18.18	66.89
3:20	16.7	267	26.58	222	52	15.48	58.24
3:40	16.7	273	26.27	222	54	16.08	61.20
4:05	14.3	268	22.08	222	50	14.71	66.62
4:10	8.3	272	12.82	222	10	2.9	22.62
4:40	8.2	273	12.66	222	9	2.61	20.62
5:00	8.6	274	13.58	222	9	2.61	19.22

April 11,1908 Speed Indicator lost and speed taken from Engine.

Table VI.

Time	M.E.P.	S-HP	Volts.	Amperes	HP developed	Eff
8:00	7.67	12.03	222	8	2.38	19.53
9:00	7.67	12.03	222	10	2.97	24.69
9:20	10.55	16.23	222	30	8.92	54.96
10:00	12.33	18.54	222	36	10.62	57.34
10:45	12.19	18.96	222	40	11.90	63.44
12:00	6.03	9.46	222	8	2.36	24.95
1:00	6.03	9.45	222	8	2.38	24.87
1:20	8.52	13.70	222	20	5.95	43.43
1:40	14.1	21.22	222	45	13.39	63.40

April 13th,1908

Table VII.

1:25	17.4	26.76	222	40	11.90	44.46
1:27	14.25	21.92	222	50	14.88	67.88
2:30	16.93	24.87	222	56	16.67	67.03
3:00	15.07	23.18	222	60	17.86	77.05
3:30	15.07	23.18	222	60	17.86	77.05
4:00		23.18	222	48	14.28	61.76

Table IV.

Test on 35 HP Brownell Engine.

Time	R.P.M.	Gage
9:25		74
	241	
9:40		85
	125	
9:50		92.5
	125	
10:00		100
	175	
10:20		90
	129	
10:25		91
	133	
11:00		80
	170	
11:25		85
	172	
11:45		85
	130	
11:50		87.5
	125	
12:45		80
	120	
1:30		85
	117	
1:50		80
	78	
2:20		85
	116	
2:45		75
	92	
3:10		80
	102	
3:17		85
	118	
3:45		90
	124	
4:10		90
	118	
5:00		92

These readings were taken in order to determine the efficiency of the Brownell Engine.. As there were not attachments for taking indicator cards and it was impossible to determine the HP by the blower and mill,these readings proved of value and we were unable to make even an approximate estimate of its efficiency.

The Air Compressor.

The Compressor is a Laidlaw-Dunne-Gordon Duplex,Two Stage Air Compressor with an intercooler between the low and high pressure cylinder.

The steam 8" in diameter with an 8" stroke,the low pressure cylinder is 18" in diameter 8" stroke,high pressure cylinder is 7 1/2" in diameter with an 8" stroke.

This air is used for pumping purposes,the air being utilized in an air lift pump. The air is delivered to the well through a 2" pipe,it is here reduced to 1/2" pipe which extends a distanc of 562' down discharge pipe.

The well is 608' deep and the water rises to 234' from the surface.

In the first run we obtained indicator cards from both steam cylinders,at various speeds. Unfortunately the pumping records of this run were lost. The fittings used in taking these cards,such as valves,pipes,etc. were taken and used for other purposes about the school. But by means of these cards we obtained the mechanical efficiency of the engine. The load being at all times the same this result was used in the calculations for total efficiency. Enough fittings remained to permit us to take indicating cards from the steam cylinders.

We were able to get a number of cards with but slight variation,no matter at what number of revolutions the compressor was running. This area was 2.3 with a 50# spring which gave a M.E.P. of 52.25# per square inch.

The following run was made, the steam pressure varying but slightly.

Time	R.P.M.	H.P. Gage
3.37	110	150
3.55	105	"
4:03	88	"
4.15	116	"
4.20	76	"
4.23	82	"
4.27	110	
4.28	110	
4.40	110	

The water rose in the oval tank 10 3/4 inches.

The water rose in the square tank 22"

This amount of water pump 235' in 63 minutes gives a horse power of 5.59 per minute.

By multiplying each revolution perminute by the number of minutes the compressor ran at that rate, adding these results and dividing by the total number of mihutes (63), we found the average R.P.M. to be 100.

$$H.P. \quad \frac{P\ l\ a\ n}{33000}$$

$$H.P. \quad \frac{52.25 \times .6667 \times 50.266 \times 200}{33000}$$

$$H.P. \quad 21.21.$$

$$Eff. \quad \frac{5.59}{21.21} \quad 26.31\%$$

26.31% we consider to be a good average efficiency of the air lift pumping system.

By averaging the high pressure cards for various speeds during compressor runs we obtained H.P. of 18.56.

As previously mentioned the sum of the H.P. of the steam end was 52.25

$$\frac{18.56}{27.60} = 67.26\%$$ mechanical efficiency of the Compressor. Varification of this efficiency could not be made as mentioned before, the steam fittings having been taken, but as this run was made at almost constant steam pressure we considered the above results reasonably accurate.

Volumetric Efficiency of Air Compressor.

In this test the air was throttled down and permitted to escape through a half inch pipe into a tank, the amount of air excaping being determined by means of a formula explained later. The machine during the test, was run under different pressures, controlled in two ways.

First, by keeping the speed constant and permitting excess air to excapt by partly closing the valve to obtain the desired pressure. The second manner to obtain the pressure was by opening the valve and increasing the speed. The object being tp determine at what speed at a given pressure, the engine must be run to give the compressor the greatest volumetric efficiency. The results of these tests are shown later by means of curves.

Explanation of Formula.

When a certain pressure is obtained, and the compressor continues to compress air, to keep this pressure constant, just so much air as supplied by the compressor must be permitted to escape. This air was allowed to escape into the tank previously mentioned.

From the tank it escaped into the arid orifice of 2" 13/16 in diameter. The temperature and velocity of air was determined, thus enabling the following formula for weight of air per second escaping.

w c.6299
e Constant necessary for the given sized orifice.
i inches of water in the water tube which has a direct bearing on velocity of air
t temperature of escaping air.

NO.	H20 inchs.	Temp. deg	Temp.of absolut	R.P.M.	Wt.of air issuing per.Min.	Amt.Atms compressed per min.	Eff.	Gage
1	1.9	45	573.8	90	4.426	7.836	56.49	50
2	1.9	45	573.8	90	4.426	7.836	56.49	50
3	.4	42	568.4	45	2.041	3.918	52.08	50
4	.7	42	568.4	60	2.700	5.224	51.68	75
5	.7	42	568.4	64	2.700	5.572	48.45	75
6	.2	45	573.8	95	4.541	8.271	54.91	75
7	.7	49	581.	60	2.670	5.274	57.11	75
8	3.5	53	588.6	125	5.932	10.89	54.5	75
9	1.8	56	593.6	100	4.236	8.706	48.65	100
10	2.4	56	593.6	100	4.891	8.706	57.49	100
11	1.0	55	591.8	64	3.168	5.572	56.75	100
12	1.4	53	588.6	88	3.752	7.662	48.96	100
13	.9	54	590.	70	3.004	6.095	49.30	125
14	.2	52	586.4	42	1.421	3.657	38.76	125
15	.6	49	581.	60	2.472	5.224	47.32	125
16	1.3	51	584.4	84	3.605	7.313	50.06	125
17	.6	52	586.4	64	2.461	5.572	44.16	150
18	1.4	49	581.	72	3.776	6.269	60.24	150