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### Comparative tests of rock drill bits for piston machines

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Miguel Leon Cepeda

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T 325

COMPARATIVE TESTS OF ROCK DRILL BITS FOR PISTON  
MACHINES

BY

Thos ROBSON C. &  
M.L.CEPEDA.

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A

THESIS

submitted to the faculty of the

SCHOOL OF MINES AND METALLURGY OF THE UNIVERSITY OF  
MISSOURI

in partial fulfillment of the work required for the

Degree Of

BACHELOR OF SCIENCE IN MINE ENGINEERING  
(Metal Mining Option Course)

Rolla, Mo.

1914.

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Approved by C. V. Forbes  
Professor of Mining

17333

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### Introduction.

The object of this thesis is to find out the relative cutting qualities of different kinds of rock drill bits. The bits tested were: the regular cross bit, the Z bit of the Southeast Missouri type and the bull bit of the Joplin type. All these bits were made on a No. 5 Leyner Sharpener and were tempered as nearly alike as possible. All conditions were kept as nearly uniform as possible during the various tests; air pressure, length of stroke, size of bit, etc., the only variables entering being the difference in bits and personal equation of operators.

The following data are the result of practical experiments done with different kind of bits, using an Ingersoll-Rand C 110. Butterfly machine working under a pressure of 80 lbs.

The Machine was mounted on a vertical column which was fixed in a wooden frame made for the purpose.

The rock used for the experiments was hard granite from Southeast Missouri. Holes were drilled slightly inclined downwards so as to hold the amount of water necessary for wet drilling. Water was put in by hand.

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**TESTS OF ROCK DRILL BITS**

Machine Ingersoll-Rand C 110.  
 Kind of Bit Regular Cross Bit.  
 Gauge 1-3/4 "  
 Length of Steel Starter  
 Kind of Steel 1" Octagon Jessop  
 Air Pressure 80#

Names  
Thos Robson C.  
M.L. Cepeda.  
 Date  
March 13/20/14.

CHUCK TO ROCK.	TOTAL DISTANCE DRILLED	DISTANCE DRILLED	TIME	SPEED FMS. PR. MIN.	GAUGE		REMARKS
					START	FINISH	
8.8 "	3.3	3.3	1'00"	3.3	1.75		
5.5	4.2	0.9	19"	2.5			Dull.
14.2		3.2	1'00"	3.2	1.75		
11.0		2.8	"	2.8			
8.2		2.3	"	2.3			
5.9						1.75	
8.1		2.6	"	2.6	1.75		
5.5		2.3	"	2.3		1.70	
3.2	13.2						N. G.
10.4		3.1	"	3.1	1.75		
7.3		1.3					75#
6.0		2.3	"	2.3			Dull.
3.2	7.2					1.75	



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**TESTS OF ROCK DRILL BITS**

5

Machine Ingersoll-Rand C. 110.

Kind of Bit Regular Cross Bit

Names

Gauge

Thos Robson C.

Length of Steel Second

M.L. Cepeda

Kind of Steel 1" Octagon Jessop

Date

Air Pressure 80 lbs.

CHUCK TO ROCK.	TOTAL DISTANCE DRILLED	DISTANCE DRILLED	TIME	SPEED FMS. PR. MIN.	GAUGE		REMARKS
					START	FINISH	
23.1 "	7.5	7.5	2"	3.75	1.7	1.6	
15.6	14.7	7.2	2"	3.60	1.6		
8.4	19.4	4.7	1' 20"	3.20		1.5	Bit
3.7							O. K.
23.6	23.3	3.9	1"	3.9	1.5		
19.7	26.6	3.3	"	3.3			
16.4	28.5	1.9	"	1.9			
14.5	30.6	2.1	"	2.1			
12.4	32.3	1.7	"	1.7			
10.7	36.3	4.0	2"	2.0			
6.7	38.7	2.4	1"	2.4		1.45	
4.3							
22.3	40.9	2.2	57"	2.3	1.45		
20.1	43.6	2.7	1"	2.7			
17.4	46.3	2.7	36"	4.5			
14.7							

continued in next page



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**TESTS OF ROCK DRILL BITS**

6

Machine Ingersoll-Rand C. 110.

Kind of Bit Regular Cross Bit

Names

Gauge .....

Thos Robson C.

Length of Steel Second

M.L.Cepeda

Kind of Steel 1" Octagon Jessop

Date

Air Pressure 80 lbs

CHUCK TO ROCK.	TOTAL DISTANCE DRILLED	DISTANCE DRILLED	TIME	SPEED FMS. PR. MIN.	GAUGE		REMARKS
					START	FINISH	
21.7	50.2	3.9	1'	3.9	1.45		
17.8	54.0	3.8	"	3.8			75 #
14.0	58.3	4.3	"	4.3			
9.7	62.7	4.4	"	4.4			
5.3	64.1	1.4	20"	4.2		1.40	
3.9							
24.1	68.3	4.2	1'	4.2	1.40		
19.9	73.2	4.7	"	4.7			
15.0	78.2	<u>5.0</u>	"	<u>5.0</u>		1.38	
10.0							
17.9	81.8	3.6	"	3.6	1.38		
14.3	86.3	3.5	"	3.5			75 #
10.8	88.4	3.1	"	3.1			75 #
7.7	91.1	2.7	"	2.7		1.35	
5.0							
continued in next page							



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**TESTS OF ROCK DRILL BITS**

8

Machine Ingersoll-Rand C 110.

Kind of Bit Regular Cross Bit.

Names

Thos Robson C.

Gauge .....

M.L.Cepeda

Length of Steel Third.

Date

Kind of Steel 1" Octagon Jessop

Air Pressure 80 lbs

CHUCK TO ROCK.	TOTAL DISTANCE DRILLED	DISTANCE DRILLED	TIME	SPEED FMS. PR. MIN.	GAUGE		REMARKS
					START	FINISH	
21.1	3.5	3.5	1'	3.5	1.50		
17.6	7.5	4.0	"	4.0			
13.6	10.9	3.4	"	3.4			
10.2	14.4	3.5	"	3.5		1.40	Fair
6.7							
26.3	18.3	3.9	"	3.9	1.40		
22.4	25.3	7.0	2'	3.5			
15.4	28.1	2.8	1'	2.8		1.30	
12.6							
25.3	32.9	4.8	"	4.8	1.30		
20.5	36.4	3.5	"	3.5			70 #
17.0	40.3	3.9	"	3.9		1.25	75 #
13.1							
26.0	44.1	3.8	"	3.8	1.25		
22.2	47.4	3.3	"	3.3			
18.9	50.9	3.5	"	3.5			
15.4	54.1	3.2	"	3.2			
12.2	57.0	2.9	"	2.9			
19.3	58.9	1.9	44"	2.6		1.20	
17.4							

continued in next page

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**TESTS OF ROCK DRILL BITS**

Machine Ingersoll-Rand C 110.

Kind of Bit Regular Cross Bit

Names

Gauge .....

Thos Robson C.

Length of Steel Three

M.L. Cepeda

Kind of Steel 1" Octagon Jessop.

Date

Air Pressure 90 lbs

CHUCK TO ROCK.	TOTAL DISTANCE DRILLED	DISTANCE DRILLED	TIME	SPEED FMS. PR. MIN.	GAUGE		REMARKS
					START	FINISH	
25.8	66.00	7.1	2'	3.55	1.20		
18.7	73.8	7.8	"	3.9			
10.9							
29.1	81.4	7.6	"	3.8	1.20		
21.5	88.0	6.6	"	3.3			
14.9							
27.0	92.3	4.3	"	2.15	1.20		
22.7	98.6	6.3	"	3.15			
16.4	103.6	5.0	"	2.50			
11.4							
26.2	109.1	5.5	"	2.75	1.20		
20.7	116.9	7.8	"	3.9		1.15	
12.9							
25.7	122.1	5.2	2' 15"	2.31	1.15		
20.5	129.0	6.9	"	3.07		1.10	
13.6							
25.3	132.1	3.1	2'	1.6	1.1		
22.2							Sticks
26.9	133.7	1.6	1' 55"	0.9	1.1		
25.3							

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**TESTS OF ROCK DRILL BITS**

10

Machine Ingersoll-Rand C 110.

Kind of Bit Z Bit

Gauge 2"

Length of Steel Starter

Kind of Steel 1" Octagon Jessop

Air Pressure 80 lbs.

Names

Thos. Robson C.

M.L. Cepeda

Date

CHUCK TO ROCK.	TOTAL DISTANCE DRILLED	DISTANCE DRILLED	TIME	SPEED FMS. PR. MIN.	GAUGE		REMARKS
					START	FINISH	
15.8		1.9	1'	1.9			
14.0	3.3	1.5	"	1.5		1.85	Bent
12.5							
13.2		3.5	"	3.5		1.7	
9.7	7.6	4.1	"	4.1		1.65	Broken
5.6							edges
17.0		2.4	"	2.4	2.0		
14.6		2.7	"	2.7			
11.9		2.9	"	2.9			
9.0		3.4	"	3.4		1.85	Bent
5.6	11.4						
17.7		2.4	"	2.4	1.85		
15.3		2.2	"	2.2			N.G.
13.1	46.00						
8.4		2.0	"	2.0	2"		
6.4	3.9	1.9	"	1.9		1.8	Dull
4.5							



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**TESTS OF ROCK DRILL BITS**

Machine Ingersoll-Rand C 110.

12

Kind of Bit Z Bit

Names

Gauge 1-3/4 "

Thos. Robson C.

Length of Steel Second

M.L. Cepeda

Kind of Steel 1" Octagon Jessop

Date

Air Pressure 80 lbs.

CHUCK TO ROCK.	TOTAL DISTANCE DRILLED	DISTANCE DRILLED	TIME	SPEED INS. PR. MIN.	GAUGE		REMARKS
					START	FINISH	
25.0	0.9	0.9			1.75		
24.1	5.3	4.4	1'	4.4			
19.7	9.9	4.6	"	4.6			
15.1	14.9	5.0	"	5.0			
10.1	19.1	4.2	"	4.2			75#
5.9	21.0	1.9	30"	3.8		1.55	
4.0							
22.7	24.4	3.4	1'	3.4	1.55		
19.3	28.2	3.8	"	3.8			
15.5	32.0	3.8	"	3.8			
11.7	35.7	3.7	"	3.7			
8.0	39.2	3.5	"	3.5		1.45	
4.5							
23.2	43.3	4.1	"	4.1	1.45		
19.1	47.2	3.9	"	3.9			
15.2	49.7	2.5	"	2.5			70#
12.7	52.7	3.0	"	3.0			75#
9.7	57.3	4.6	"	4.6		1.35	Chipped
5.1							off

continued in next page

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**TESTS OF ROCK DRILL BITS**

13

Machine Ingersoll-Rand C 110.

Kind of Bit Z Bit.

Names

Gauge 1-3/4 "

Thos. Robson C.

Length of Steel Second

M.L. Cepeda

Kind of Steel 1" Octagon Jessop

Date

Air Pressure 80 lbs

CHUCK TO ROCK.	TOTAL DISTANCE DRILLED	DISTANCE DRILLED	TIME	SPEED INS. PR. MIN.	GAUGE		REMARKS
					START	FINISH	
23.0	61.8	4.5	1'	4.5	1.35		
18.5	67.6	5.8	"	5.8			
12.7	73.5	5.9	"	5.9			
6.8	76.1	2.6	30"	5.2		1.35	
4.2							
15.0	79.2	3.1	1'	3.1	1.35		
11.9	82.9	3.7	"	3.7			
8.2	86.9	4.0	"	4.0			
4.2							
22.6	90.8	3.9	"	3.9	1.35		
18.7	94.8	4.0	"	4.0			
14.7	100.1	5.3	"	5.3			
9.4	104.9	4.8	57"	5.0		1.30	
4.6							
15.8	109.5	4.6	1'	4.6	1.30		
11.2	114.2	4.7	"	4.7			
6.5							



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**TESTS OF ROCK DRILL BITS**

Machine Ingersoll-Rand C. 110.

14

Kind of Bit Z Bit

Names

Gauge 1-3/4 "

Thos. Robson C.

Length of Steel Second

M. L. Cepeda.

Kind of Steel 1" Octagon Jessop.

Date

Air Pressure 30 lbs.

CHUCK TO ROCK.	TOTAL DISTANCE DRILLED	DISTANCE DRILLED	TIME	SPEED INS. PR. MIN.	GAUGE		REMARKS
					START	FINISH	
25.5		2.5	1'	2.5	1.75		
23.0		2.1	"	2.1			
20.9		2.0	"	2.0			
18.9		1.8	"	1.8			
17.1		3.5	2'	1.75			
13.6		2.2	"	1.1			Blunt &
11.4	14.1						bent
24.0	4.2	4.2	1'	4.2	1.75		
19.8	8.6	4.4	"	4.4			
15.4	13.2	4.6	"	4.6			
10.8	17.6	4.4	"	4.4			
6.4	19.8	2.2	30"	4.4		1.5	
4.2							
26.75	23.7	3.9	1'	3.9	1.50		
22.8	27.3	3.6	"	3.6			
19.2	31.1	3.8	"	3.8			
15.4	34.7	3.6	"	3.6			
11.8	39.1	4.4	"	4.4			

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**MISSOURI SCHOOL OF MINES  
MINING LABORATORY**

**TESTS OF ROCK DRILL BITS**

Machine Ingersoll-Rand C 110

15

Kind of Bit Z Bit

Names

Gauge 1-3/4 "

Thos. Robson C

Length of Steel Second

M. L. Cepeda

Kind of Steel 1" Octagon Jessop

Date

Air Pressure 90 lbs

CHUCK TO ROCK.	TOTAL DISTANCE DRILLED	DISTANCE DRILLED	TIME	SPEED FMS. PR. MIN.	GAUGE		REMARKS
					START	FINISH	
7.5	42.0	3.8	1'	3.3		1.45	
3.7							
25.9	47.2	4.3	"	4.3	1.45		
21.6	51.0	3.8	"	3.3			
17.8	55.4	4.4	"	4.4			
13.4	59.4	4.0	"	4.0			
9.4	63.5	4.1	"	4.1		1.4	
5.3							
26.0	67.1	3.6	"	3.6	1.4		
22.4	70.7	3.6	"	3.6			
18.3	74.2	3.5	"	3.5			
15.3	77.5	3.3	"	3.3			
12.0	80.6	3.1	"	3.1			
8.9	84.8	4.2	1' 15"	3.36		1.35	
4.7							
26.3	88.0	3.2	1'	3.2	1.35		
23.1	92.0	4.0	"	4.0			
19.1	96.4	4.4	"	4.4			
14.7	100.6	4.2	"	4.2			
10.5	104.8	4.2	"	4.2			

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**MISSOURI SCHOOL OF MINES  
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**TESTS OF ROCK DRILL BITS**

16

Machine Ingersoll-Rand C 110  
 Kind of Bit Z Bit  
 Gauge 1-3/4 "  
 Length of Steel Second  
 Kind of Steel 1" Octagon Jessop.  
 Air Pressure 80 lbs

Names

Thos. Robson C  
M.L. Cepeda

Date

CHUCK TO ROCK.	TOTAL DISTANCE DRILLED	DISTANCE DRILLED	TIME	SPEED FMS. PR. MIN.	GAUGE		REMARKS
					START	FINISH	
6.3	107.0	2.2	30"	4.4		1.3	
4.1							
25.5	111.1	4.1	1'	4.1	1.3		
21.4	116.2	5.1	"	5.1			
16.3	121.2	5.0	"	5.0			
11.3	126.6	4.3	"	4.3			
7.0	127.4	1.9	30"	3.8		1.3	
5.1							
26.3	131.6	4.2	1'	4.2	1.3		
22.1	136.3	4.7	"	4.7			
17.4	141.0	4.7	"	4.7			
12.7	144.8	3.8	"	3.8			
8.9	147.9	3.1	"	3.1		1.25	
5.8							
27.0	150.2	2.3	"	2.3	1.25		
24.7	153.3	3.1	"	3.1			
21.6	153.8	0.5					
21.1	157.3	3.5	"	3.5			
17.6	161.5	4.2	"	4.2			
13.4	164.9	3.4	"	3.4			

continued in next page





The following curves have been plotted from the preceding data and show more clearly the relative cutting qualities of the different kinds of rock drill bits used.

### Conclusion.

Some of the results obtained by the experiments tend to show: that the Z bit cuts faster in the long run than the regular cross bit.

The disadvantage in using Z bits being: that starters chip-off at the edges easily. This may be obviated by using a bigger cross bit starter and then following it up with the Z bit starter or directly with Z bit second.