

LEADING THE WAY IN MINING SHOVEL PRODUCTIVITY

HOW THE NEXT GENERATION OF CAT® MINING SHOVELS BEAT THE COMPETITION IN HEAD-TO-HEAD PRODUCTION STUDIES.

The only thing certain in mining is that commodity prices will always be uncertain. That's why it pays to make sure every machine in your operation is as productive and as cost-efficient as possible, especially your loading tools. In this report, we'll look at the results of two shovel production studies and explore some of the reasons why the latest Cat® shovels came out on top.

Loading tool productivity plays a big role in determining how many truckloads you can run every day. The Cat 6015B and 6020B are designed to maximize that productivity. They looked good from an engineering standpoint but Caterpillar wanted to find out how well these new next-generation machines actually work under real job site conditions.

To that end, Caterpillar recently completed two carefully controlled production studies. Led by Kent Clifton, a Cat Senior Applications Consultant for mining product support, the Cat team set up studies on a pair of customer sites in Ohio – a large quarry operation for the 6015B and a coal overburden operation for the 6020B. Although the sites represented very different operations, Clifton says they provided good test conditions with similar types of materials for both machines.

The studies pitted the Cat 6015B Tier IV machine against two worthy competitors in the 100-tonne class – the Hitachi EX1200-6 and Komatsu PC1250-8. The 200-tonne Cat 6020B went up against the Komatsu PC2000-8. All five machines were tested for productivity and fuel efficiency in truck loading applications.

By every measure, the Cat shovels ended up delivering the equivalent of an extra hour's worth of production every shift in a real-world test.

ELIMINATING VARIABLES

"The results we were looking for," Clifton explains, "are numbers that accurately reflect the performance differences between the various machines. The way to get those reliable results is to eliminate as many variables as possible."

The tests were performed in mine site areas where the team had complete control of all activities. The Cat and competitive machines worked on the same bench, consisting of well-shot and fragmented material, using identical loading procedures.

Clifton adds, "We set up the loading parameters to reduce any possibility of material spilling out of the hauler beds. Plus we used the same operator in the shovels and haulers. The shovel operators had experience in all of the machines prior to the study. Every one of these guys would be considered world-class operators, so we could count on consistent, efficient machine operation throughout."

To ensure accurate payload results, an advanced scale truck was brought in and positioned on a carefully leveled pad. Each truck was weighed empty as it came in and weighed full as it left, with photographs taken to document potential mud or debris buildup that might affect the results. In addition, the truck beds were scanned both empty and full to determine the hauled material's weight-per-unit-of-volume.



The Cat shovels were equipped with a 17.9 yd³ (13.7 m³) bucket on the 6020B and a standard 10.6 yd³ (8.1 m³) bucket on the 6015B. The competitive machines were outfitted with buckets as close in size as available – around 10.0 yd³ (7.6 m³) on the Hitachi and Komatsu PC1250-8, and 17.8 yd³ (13.6 m³) on the Komatsu PC2000-8.

“We did everything we could, but no study can eliminate all variables,” Clifton notes. “For example, the material density during the 6020B study was a little higher than we anticipated, so we technically should have been using a 15.7 yd³ (12 m³) bucket to reduce stresses on the shovel. However, since those conditions were the same for both machines, we reported the results we got. Customers should always follow the bucket size recommendations to avoid long-term damage to machine components.”

DIGGING INTO THE RESULTS

The goal of the test was to simulate real working conditions, so the loading schedule was set to mirror a typical day on each site. “We tried to run at least 30 trucks an hour past the 6015B and 15 trucks an hour past the 6020B,” Clifton says. **“That’s what the operators were used to because that’s what they do every day.”**

Cycle-time and tons-per-hour results were equalized to reflect a .70-minute truck exchange time. “That actually sells the truck operators a little short, though,” Clifton notes. “In some cases they averaged a little faster than that, but we used the equalized truck exchange data to reflect the most accurate production results for the shovels.”

When you dig into the raw numbers, a pattern quickly appears. “By just about every measure, the Cat shovels demonstrated a clear production advantage,” Clifton says.

EQUALIZED EXCHANGE PRODUCTION RESULTS

	Cat 6015B	Hitachi EX1200-6	Komatsu PC1250-8	Cat 6020B	Komatsu PC2000-8
Avg. Truck Load Time	1.35 min	1.55 min	1.94 min	3.37 min	3.86 min
Avg. Trucks/Hr.	29.99	26.49	24.34	14.73	13.17
Tons/Hr. (Tonnes/Hr.)	1838.61 (1641.62)	1619.49 (1445.97)	1416.57 (1264.79)	2598.8 (2320.36)	2285.4 (2040.54)

Both Cat shovels show about a 30-second advantage in average truck loading times over the Komatsu machines (.49 min). That adds up to more truckloads per hour – a truck and a half more for the 6020B and up to four and a half more for the 6015B.

“That extra truck and half an hour translates into a lot of additional revenue,” Clifton says. “At a coal operation, for example, it costs about \$1,300 an hour in revenue to have a truck sitting in the shop. So that extra truck-and-a-half advantage produced by the 6020B would generate roughly \$1,950 in revenue every hour. If you’re hauling gold ore, it might easily be worth twice that or more.”

Faster truck loading comes from faster cycle times (which the 6015B produced despite having a 30% larger average payload compared to the PC1250) and results in more tons per hour. In that category, both Cat shovels delivered impressive advantages over the competitive machines.

Match Up	Tons Per Hour
Cat 6015B vs. Komatsu PC1250-8	24% - Advantage Cat
Cat 6015B vs. Hitachi EX1200-6	18% - Advantage Cat
Cat 6020B vs. Komatsu PC2000-8	13.7% - Advantage Cat

“Those are big numbers that none of us really expected to see,” Clifton says. “Our goal was simply to gauge how our newest shovels compared with the competition, good or bad. **The results we got ended up being pretty satisfying.**”

CONTRIBUTING FACTORS

Clifton points out that a number of design factors contribute to the success of the next-generation Cat shovels.

“Looking at the 6015B, its advantages start with raw power,” he says. “At 813 gross horsepower (606.25 kW), the Cat C27 is the most powerful engine in the 6015B’s class size. That’s one of the reasons that it could deliver fast cycle times even though it was using a larger standard bucket than the competitive machines.”

Other factors include increased bucket fill due to greater crowd and breakout forces, and speed advantages in certain parts of the load-swing-dump cycle.

“The studies provide some interesting details about the loading cycle,” Clifton says. “For example, the average load, dump and swing-loaded times were about the same for the 6015B and the Komatsu, but the return-to-dig/swing-empty was significantly faster for the Cat machine.”

Cycle Time Breakdown	Cat 6015B	Komatsu PC1250-8
Avg. Bucket Load Time - Minutes	0.17	0.17
Avg. Swing Loaded Time - Minutes	0.09	0.09
Avg. Dump Time - Minutes	0.07	0.07
Avg. Swing Empty Time - Minutes	0.09	0.11
Avg. Loader Cycle Time - Minutes	0.42	0.44
Avg. Bucket Payload - Tons (Tonnes)	15.57 (13.90)	11.95 (10.66)
Avg. Passes/Truck	4.03	5.21

Even more impressive, Clifton says, is that when you combine the 6015B’s larger bucket and substantially higher average payload, the Cat shovel was able to fill each truck in one full pass less than the Komatsu machine—averaging at 4.03 passes vs. 5.21 passes over the course of the study.

Clifton adds, **“This means the Cat shovel saved an average of .42 minutes—a little over 25 seconds—on every truck load.** Those small differences add up. If you extrapolate the .42-minute advantage over 30 trucks an hour, you get a timesavings of 12.6 minutes every hour. So you’re essentially getting more than an hour’s worth of extra production for every five hours you run with the 6015B over the Komatsu. That’s a hard-dollar difference that you can take straight to your bottom line.”

For more information on the full line of Cat Hydraulic Mining Shovels, contact your local Cat dealer or visit www.cat.com/HMS.

