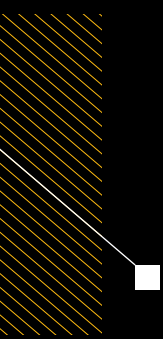




# CAT<sup>®</sup> PAYLOAD

IS THE RISING COST OF PRODUCTION  
**KEEPING YOU UP AT NIGHT?**





## ONBOARD PAYLOAD MEASUREMENT SAVES MONEY AND TIME

Operating costs only seem to go one way. Up. Fuel prices remain high and volatile. Margins are increasingly tight, so there's little room in operating budgets for waste or inefficiencies (make that NO room). Labor shortages make it hard to find experienced equipment operators, and it costs more than ever to train new operators.

Onboard payload measurement is one way to help reduce operating costs. It goes a long way toward increasing efficiency and reducing wasted effort. It also makes operating equipment easier, so good people want to stay and inexperienced operators can get up to speed more quickly.



HIGH FUEL PRICES



MAINTENANCE COSTS ON THE RISE



LABOR SHORTAGES AT RECORD HIGHS

## WHAT IS PAYLOAD MEASUREMENT?

Payload measurement and production measurement are blanket terms used by heavy equipment manufacturers and suppliers when referring to onboard payload weighing and data collection. These technologies are natural offshoots of the sensor and computer technology built into virtually every piece of modern heavy equipment.

Onboard payload weighing also provides valuable production measurement and material tracking data. This data is available for individual machines, plus it can provide valuable fleet-wide operational efficiency data.

For loading tools such as wheel loaders, monitoring the exact weight of each loader bucket payload helps to increase loading efficiency and payload accuracy. Used in conjunction with truck payload weighing, it can also provide additional detail about both machine and operational production efficiencies.





## THREE WAYS PAYLOAD MEASUREMENT CUTS COSTS

A good payload measurement system provides accurate, on-the-go weighing, along with real-time operator feedback. Payload information can be transmitted to the production office, as well. There, the data can be used to monitor the amount and type of material moved by each machine, and to generate a range of reports on the production and efficiency of the entire load/haul operation.

For loading tool operators, payload measurement helps reduce costs in three key ways:

- 1 **ELIMINATES UNNECESSARY CYCLES** – Being able to meter that final bucket load helps the operator avoid making an extra trip from the stockpile, reducing loading times and saving fuel. Operators know exactly how much material is needed to reach the target payload weight (assumes starting with a fresh tare weight), and they can see exactly how much is in the bucket, so they can quickly make adjustments to the final bucket load at the stockpile before traveling to the truck.
- 2 **IMPROVES OVERALL SITE EFFICIENCY** – Payload measurement increases overall site efficiency because trucks are loaded to the correct, target weight more often. Fewer reloads or returns for top-off means less time and money is wasted.
- 3 **MANAGES CHANGING MATERIAL WEIGHT** – Although the volume of the material in a wheel loader bucket may look the same every time, the actual weight of the material can vary significantly based on changes in material density and moisture content. Experienced operators can make an educated guess at the difference in weight, but a wrong guess can be costly. (See sidebar.)

### MOISTURE MATTERS: WEIGHING WET VS. DRY MATERIAL

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In absorbent materials such as sand or fill dirt, the outside of a stockpile may be relatively dry, but as the machine digs in deeper it can become wetter and heavier. A study conducted by the Virginia Department of Transportation found that wet sand can weigh as much as 7.8% more than dry. For a standard 24-ton on-highway dump truck payload, that can result in nearly two extra tons of weight.

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#### VIRGINIA DOT STUDY:



Wet sand weighs up to **7.8%** more than dry.

DRY  
SAND

1 TON =  
**2000 LBS**  
(907 kg)

WET  
SAND

1 TON =  
**2156 LBS**  
(978 kg)

Weight difference in a 24-ton payload:

**3744 LBS**  
(1698 kg)

## SAVE ON MAINTENANCE COSTS & TIRE LIFE

Along with cycle time benefits, payload measurement can also reduce equipment maintenance and repair costs. Although the results are hard to quantify and all things being equal, making fewer cycles to load a truck will cause less wear and tear on the loading tool.

More significantly, overloading a truck causes increases in suspension and frame stresses, along with excessive transmission wear and engine strain. It also dramatically increases fuel usage and tire wear. Studies show that regularly overloading off-highway trucks results in as much as a 50% reduction in tire life. That's why equipment manufacturers make recommendations for hauling weight ranges in relation to truck wear life. Caterpillar, for example, recommends following a 10/10/20 policy for off-highway hauling equipment:

**10/10/20 POLICY:** No more than 10% of all payload should exceed 10% above the rated target payload, and at no time should rated target payload be exceeded by 20%.

## RID YOUR BALANCE SHEET OF FINES AND REVENUE LOSSES

While maintenance costs affect long-term equipment operating costs, overweight fines have a more immediate impact on the bottom line.

As we've seen, simply loading wet sand vs. dry can add almost two extra tons to the payload of a standard on-highway 24-ton truck. That additional load can easily result in overweight fines that add up quickly. Fines vary from region to region, but one company in Canada reported fines of \$450 per 1000 kg (2205 lbs.) over the legal on-road limit.

To avoid overweight fines, there are cases where companies routinely underload their trucks by up to 10%. That means they are essentially using 11 trucks to do the work of 10, resulting in lost time, increased fuel usage and other factors that increase costs and reduce profitability.

This example illustrates why underloading can be as much of an issue as overloading. Underloads are even more of an issue in waste applications, where material densities are generally lighter but may vary greatly. With a good production measurement system, the waste-industry loader operator can see when there is a need to tamp more material down into the truck bed and when to load less.

Again, the goal is to get a payload on board that is as close as practical to the maximum allowed for the hauling tool. If per-truck dumping fees apply, or where revenues are based on tonnages hauled, it pays to know that every truck is loaded to its maximum capacity.



### TRADE ESTIMATES FOR MISLOADED TRUCKS

#### AGGREGATES MANAGER

estimates that an average of **15-20%** of loaded trucks are at incorrect weight. \*



#### FOR CONSTRUCTION PROS

suggests that most on-highway loads run between **5-8%** under weight of maximum legal gross vehicle weight (GVW). \*\*







## REDUCE RELOADS FOR QUICK PAY BACK



For wheel loader operators in quarry applications, accurate payload measurement helps to avoid the all-too-common need for a fully-loaded truck to dump an overload and return to the queue. Eliminating reloads results in significant operational efficiency gains, as well as hard dollar savings that can quickly pay for the cost of a production measurement system.

In one study conducted by Caterpillar, a quarry customer loading sand six days a week was dumping 22 misloaded trucks per day. Just by avoiding the lost time involved in dumping and reloading those trucks, the Cat® Production Measurement system saved the customer \$292,000 in the first year. Factor in the extra fuel burned, plus the extra machine wear and tear caused by the unnecessary reload cycles, and the savings become even more significant.



### CASE STUDY 17% LOADING PRODUCTION GAIN

**PAYLOAD:** SAND | **TARGETS:** 39,936 TRUCK LOADS/YEAR | **WORKING:** 6 DAYS/WEEK

#### RESULTS

PREVENTED **22**  
MISLOADED TRUCKS

#### SAVINGS

**\$292,000**  
ANNUALLY

... **PAYBACK: 6 DAYS** ...



## SIMPLIFY PROCESS CONTROL

The above example illustrates the importance of process control in any loading operation. Monitoring bucket payload variances due to moisture content and material density fluctuations or fill factors helps to simplify process control. Rather than waiting to weigh each fully-loaded truck, the loader operator can track the actual weight of the truck payload as it's being loaded.

Still, it's important to monitor each truck's empty tare weight. It's a smart practice to regularly look for variations caused by excessive mud and even fuel load. The weight of fuel alone can add/subtract 500 lbs. to 1,000 lbs. (227 kg to 454 kg) to the GVW of an on-highway truck.

Payload weighing is just one element in good process control. Other measures may include weighing empty trucks before loading or providing wash bays to help remove mud and maximize payload.

Tight process control combined with accurate payload weighing can help to achieve ideal payload margins. For quarry loading applications, which typically use wheel loaders with very accurate on-board scales that can weigh empty trucks on the way into the yard and are able to provide wash bays, payload margins can be as tight as 1-2% of GVW. On construction sites, which often load trucks using excavators with somewhat less accurate on-board scales and may have little or no on-site payload infrastructure, a 3-5% margin is more realistic.

### QUARRY PROCESS CONTROL TARGET



PAYLOADS WITHIN  
**1-2% GVW**

### CONSTRUCTION PROCESS CONTROL TARGET



PAYLOADS WITHIN  
**3-5% GVW**

## PASS MATCH LOADERS AND TRUCKS MORE ACCURATELY

Tracking payload-per-pass data helps managers make better decisions about fleet makeup and load/haul configurations. If the data shows that an operator is two-and-a-half-passing most trucks, it may pay to use a larger loader. A loader that can consistently two-pass those trucks will eliminate that extra half pass.

It's important to note that a "half pass" is another full pass with half a load. An undersized loader is effectively using 50% more fuel to carry that material, so using a larger loader may help to reduce long-term fuel usage.

## USE DATA TO MANAGE MATERIAL MORE PROFITABLY

Raw payload data from a production measurement system can be used in many ways.

Operators can monitor daily production from the cab. Managers can track material delivered to customers, or make sure the right amount of material gets moved to the right place the first time. Where deadline bonuses and late-completion fines are on the line, the benefits of tracking payload data add up quickly.

There are other creative ways to put payload data to work, as well:

- A governmental agency in Illinois stocks road salt every year and sells it out to different counties during the winter. The agency uses their production measurement system to track salt usage by county and by storm event. So, if County A has a big storm on Sunday and Monday, and County B has a smaller storm a few days later, they're able to see that 35 tons went to County A for the first storm and 20 tons went to County B for the next one.
- Onboard payload data can provide valuable checks and balances. If the hauling unit records 120 tons in a shift, the loading tool records 110, the belt scale records 125, and everyone understands that one tool works within this amount of error and another works with a different error, you can more quickly identify scale errors or production anomalies (such as changing material densities, qualities issues, etc.).
- One other use for payload data is tracking blast yields. If, for example, wheel loader operators recognize that too much of the newly-blasted material won't fit through the crusher, they can pick up the oversize material, weigh it and set it off to the side. The recorded data now shows that "Blast A produced X tons of oversize material." The next time a blast is needed in the same area, engineers can adjust hole size and spacing to achieve better fragmentation.

## ATTRACT AND RETAIN GOOD OPERATORS

For the loader operators, onboard payload weighing helps them work faster and with more confidence. It makes their job easier and less stressful, so they feel more successful and more likely to remain on the job.

Onboard data displayed in the loading tool provides instant feedback, so new operators can more quickly get a feel for what it takes to perform loading tasks quickly. Training time is reduced and new operators become productive in less time.

Production measurement may also help to reduce extra personnel overtime costs that come as a result of inefficient loading practice or the need to repeatedly reload trucks.





## THREE ADVANTAGES OF CAT PRODUCTION MEASUREMENT

As a starting point for comparison between the wide range of available OEM and third-party systems, let's take a closer look at Cat Production Measurement for Medium Wheel Loaders. This system offers three competitive advantages:

**1 ONBOARD AND OFFBOARD MONITORING CAPABILITY** – Operators can track daily production right from the cab, including weights, load and cycle counts and daily totals. They can also print truck payload tickets on the spot using an optional printer. In the office, managers can view payload details and key performance indicators online in near real time to manage material movement and help keep operations running efficiently and productively.

**2 LOW-LIFT WEIGH: 10% CYCLE TIME ADVANTAGE** – Low-Lift Weigh is a feature found only on Cat Wheel Loaders with Cat Production Measurement. Wheel loader scale systems typically deliver a weight to the operator starting at about 65% of the travel range as the bucket is lifted.

With Low-Lift Weigh, the operator gets an estimated bucket payload weight at only 35-40% of the bucket lift. The estimated weight can then be used in conjunction with a Tip-Off feature that tracks the changing payload weight as the operator tips unneeded material back onto the stock pile. Once the target bucket weight is achieved, the bucket can be lifted the rest of the way through the weigh range for accurate measurement while traveling to the truck.

This procedure can deliver a total cycle time improvement of as much as 10% because the bucket only needs to be lifted once to accurately top off a truck load, instead of going through as many as three lifts with older systems.

**3 COMPLETE MACHINE INTEGRATION: LOW COST AND DURABILITY** – Cat Production Measurement utilizes components that are standard on every Cat Wheel Loader – including electronic control modules, bucket and lift detent sensors, hydraulic pressure sensors and the in-cab display. Aftermarket systems need to duplicate these components. Because these components are standard, the only investment is in the activation software. The entire system comes at a lower cost, helping customers make the most of their investment. Plus, all the components have been thoroughly field tested along with the machine to make sure they will deliver long service life under harsh working conditions.





## LOADING TOOL PAYLOAD MEASUREMENT: A SMART INVESTMENT

Whether you choose Cat Production Measurement on a Cat Wheel Loader or a system from a third party or other OEM, the benefits of production measurement for wheel loaders can help you get a good night's rest.

- Improved loading accuracy
- Elimination of reloads
- Cycle time improvements
- Data for improving operational efficiencies
- Savings in time, labor, fuel and other hard costs
- Recoupment of potential lost revenue

For a quick look at the potential cost benefits to your operation by using payload measurement to avoid truck recycles, use the online calculator at [ma-catinfo.com/payloadcalculator](https://ma-catinfo.com/payloadcalculator). You will get an estimate of savings per year resulting from the elimination of reloads, plus an estimated payback time for the Cat Production Measurement system.

For additional information, visit [cat.com/productionmeasurement](https://cat.com/productionmeasurement).

\* [https://www.aggman.com/wp-content/uploads/sites/3/2011/08/0psIII\\_AGRM07111.pdf](https://www.aggman.com/wp-content/uploads/sites/3/2011/08/0psIII_AGRM07111.pdf)

\*\* <https://www.forconstructionpros.com/profit-matters/article/20976513/take-aim-at-maximum-haul-truck-loads-with-payload-management-systems>