

CASE STUDY



Reduce Engine Failures and Cut Maintenance Costs on Haul Trucks

A MineCare customer shares how they protect haul truck engines and turbochargers from catastrophic failures with effective use of real-time data, avoiding \$750,000 in maintenance costs in just a few months time.

CASE 1:

Low Horsepower on Komatsu 830E Haul Truck

CASE 2:

High Exhaust Temperatures and Temperature Differential

CASE 3:

Low Boost Air Pressure

Challenge

Today's mining haul trucks have powerful diesel engines for hauling heavy loads, using huge volumes of compressed air to burn fuel efficiently. Turbochargers provide a continuous stream of boost air to make this possible, and any disruption to this flow can have detrimental effects. The following examples of problems related to turbochargers illustrate how potential disasters can be averted through the effective use of real-time monitoring tools.

Solution

With the majority of mining mobile equipment running high power diesel engines, failures are common and many go unnoticed until additional damage occurs. MineCare is the only system available with plug-and-play interfaces to the majority of mining equipment manufacturers. It is the only real-time maintenance monitoring system that can be deployed on many types of machinery with little preparation, allowing maintenance departments to immediately monitor and prevent avoidable maintenance costs. By proactively handling real-time data and alerts from equipment, Modular customers are empowered to respond to day-to-day operations, preventing failures, reducing downtime and maintenance costs, and maximizing valuable resources.

Outcome

\$750,000 in maintenance costs avoided.

“The real-time proactive features of the MineCare system are directly attributable to reducing turbocharger failures, resulting in significant maintenance cost savings at our operations.”

—Corporate Reliability Advisor

Case 1: Low Horsepower on Komatsu 830E Haul Truck

After the MineCare system signaled a low horsepower alarm, the maintenance team responded to find broken bolts on one of the haul truck's rear turbochargers. Consequently, the engine was shut down, preventing catastrophic failure and avoiding a potential cost of \$288,000 in maintenance repairs.

A low horse power alarm (Figure 1) on a haul truck, from the on-board Cummins Cense interface, sent the maintenance team jumping to action. The alarm indicated that the propulsion system adjusted HP load on the engine had been reduced to its minimum value for an excessive period of time.

Upon receiving this alarm, the MineCare attendant immediately notified the operator, confirming what seemed like a low engine power condition. A real-time monitoring (RTM) session was launched to pinpoint the issue, providing a graph that reported a low horsepower of 0.64KW and other abnormal indications.

As a precaution, the truck was immediately shut down while the maintenance team analyzed the data sent to them by the MineCare attendant from a remote monitoring center. Using that data, the breakdown crew knew exactly where to look as they inspected the engine, quickly confirming that bolts had broken on the snail casing of the right-hand turbocharger. The casing had begun to separate from the turbine cover (Figure 2) resulting in a loss of horsepower.

Id	Equipment	Notification Type	Event Type	First Occurrence	Last Occurrence	Snapshot
16817	06D17	Non-Critical OEM E...	HP Low	05-Oct-2009 20:29:...	05-Oct-2009 20:29:...	✓

Figure 1: Low horsepower event triggered from the GE interface in the MineCare system.

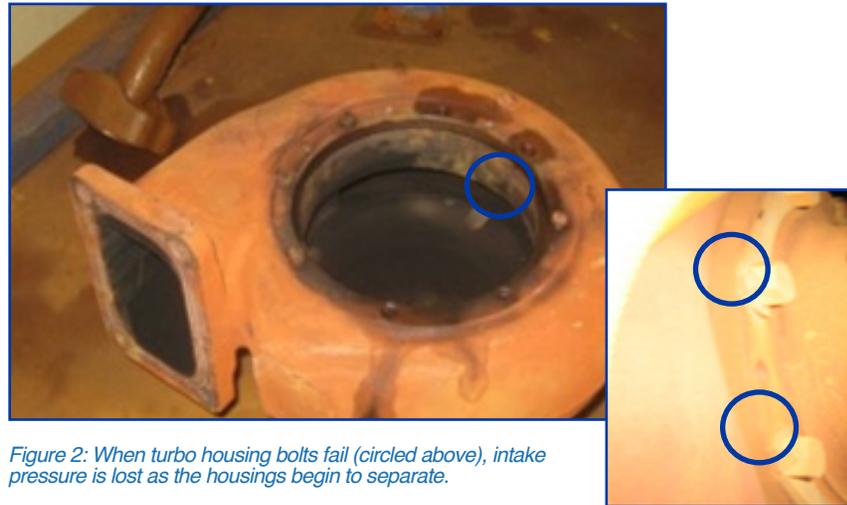


Figure 2: When turbo housing bolts fail (circled above), intake pressure is lost as the housings begin to separate.

Outcome

Using the MineCare system's real-time diagnostic tools, the on-site maintenance team worked closely with the MineCare attendant in a remote location, quickly troubleshooting and protecting an engine turbocharger from catastrophic failure.

**POTENTIAL COST
AVOIDED:
\$288,000**

Case 2: High Exhaust Temperatures and Temperature Differential

Following a high exhaust temperature alarm received by the MineCare system, the maintenance team quickly diagnosed a turbocharger failure in progress and shut down the truck to prevent catastrophic engine failure, avoiding a potential cost of \$188,000 in maintenance repairs.

Similar to Case 1, the MineCare attendant received an alarm from a different mine site on the Incoming Notifications screen, signaling both high exhaust temperature and low boost pressure alarms on the right-hand exhaust bank (Figure 3) for a Komatsu 830E haul truck.

The experienced maintenance staff attributed a sudden and mismatched rise in cylinder temperatures to either turbocharger failure or loss of intake manifold pressure due to a leak. Because both scenarios can cause a shortage of boost air intake, real and validated data was needed to troubleshoot the defect.

On receiving this alarm in the Incoming Notification screen, snapshots were opened (Figure 4). MineCare data confirmed that the right-hand side of the engine was running 200-250 degrees hotter than the left-hand side of the engine; based on this validated information, the truck was shut down within 2-3 minutes of the initial alarm.

20435	High #8 Right Bank Cylinder Exhaust Temperatu...	03-Oct-2009 15:08:07
20436	High #7 Right Bank Cylinder Exhaust Temperatu...	03-Oct-2009 15:08:14
20437	High #5 Right Bank Cylinder Exhaust Temperatu...	03-Oct-2009 15:08:19
20438	Low #1 Left Bank Cylinder Power Active	03-Oct-2009 15:08:31
20439	High #8 Right Bank Cylinder Power Active	03-Oct-2009 15:08:33
20440	High #7 Right Bank Cylinder Power Active	03-Oct-2009 15:08:36
20441	High #5 Right Bank Cylinder Power Active	03-Oct-2009 15:08:37
20442	High #3 Right Bank Cylinder Exhaust Temperatu...	03-Oct-2009 15:08:43
20443	High #3 Right Bank Cylinder Power Active	03-Oct-2009 15:09:04
20444	Low #8 Left Bank Cylinder Power Active	03-Oct-2009 15:09:40
20445	High #1 Right Bank Cylinder Exhaust Temperatu...	03-Oct-2009 15:10:23
20446	Low Intake Manifold Pressure Right Bank Active	03-Oct-2009 15:11:22
20447	High #6 Right Bank Cylinder Exhaust Temperatu...	03-Oct-2009 15:11:46

Figure 3: Alarms indicating a sudden rise in right hand exhaust bank temperatures and an overall loss of intake manifold pressures. Event 20435, when expanded in Figure 4, shows the difference between right and left exhaust temps more clearly.

Parameter	Sample MaxV
BHp	1801.7765
Engine Speed	1904.25
Speed	25.0
Incline Angle	7.7999997
PayLoad	253.0
#1 Right Bank Exh Port Temper...	725.3945
#2 Right Bank Exh Port Temper...	668.31116
#3 Right Bank Exh Port Temper...	740.5334
#4 Right Bank Exh Port Temper...	714.7001
#5 Right Bank Exh Port Temper...	753.31116
#6 Right Bank Exh Port Temper...	725.3945
#7 Right Bank Exh Port Temper...	759.42224
#8 Right Bank Exh Port Temper...	772.2001
#1 Left Bank Exh Port Temperat...	503.8667
#7 Left Bank Exh Port Temperat...	538.31116
#8 Left Bank Exh Port Temperat...	531.6445
#6 Left Bank Exh Port Temperat...	581.6445

Figure 4: Snapshot data from event 20435 shows a difference of roughly 200 degrees between right (purple) and left (blue) exhaust temperatures.

The breakdown crew found that a hose between the turbocharger and aftercooler had detached, preventing the compressed air from reaching the right bank of cylinders and elevating their temperatures. This leak also caused the original low boost pressure alarm. The breakdown crew fitted a new hose and clamp to the turbo-charger (Figure 5), and the truck was immediately sent back to work.

A similar defect related to boost air pressure was observed on another truck engine, and the RTM feature was used to validate the exhaust temperature. Figure 6 is shown below for comparison with Case 2, and for general informational purposes highlighting the capabilities of the MineCare system.



Figure 5: Example of the hose that detached from the turbocharger and aftercooler.

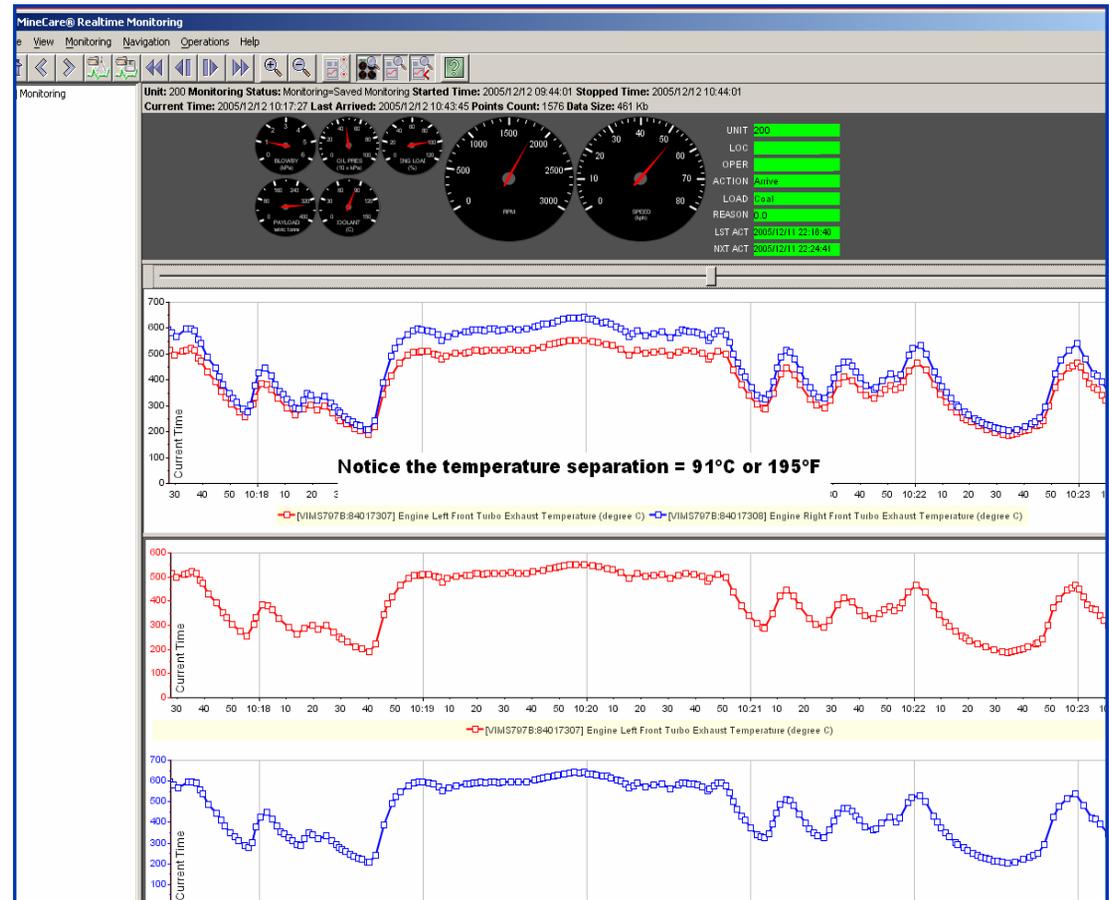


Figure 6: Example of how the MineCare system can be used to prevent a turbocharger defect by monitoring exhaust temperature differential.

Outcome

Working together from remote sites, and using both the MineCare system and their experience to quickly identify rising temperatures, the maintenance team diagnosed an impending failure in just a few minutes time, shutting down the truck before costly engine damage occurred.

**POTENTIAL COST
AVOIDED:
\$188,000**

Case 3: Low Boost Air Pressure

The MineCare system received alarms indicating both a low boost pressure and an abnormal exhaust temperature from a haul truck. The maintenance team quickly diagnosed a fault in the turbocharger and shut the truck down, preventing catastrophic failure and avoiding a potential cost of \$280,000.

When the MineCare attendant received a low boost air pressure alarm from a haul truck engine, a real-time monitoring session was initiated to identify the fault by polling all the relevant engine parameters under load. A snapshot of parameters revealed low boost pressure from the left-hand intake manifold, and a distinct separation of the exhaust temperatures between the left- and right-hand exhaust manifolds. The MineCare attendant immediately questioned the operator about the truck's performance, and the operator indicated a brief loss of power. A nearby operator simultaneously reported smoke coming from the problem truck's exhaust.

Upon analysis of the snapshot data, the MineCare system attendant requested the problem truck to park up in a safe place immediately. The breakdown crew found that the turbocharger had failed due to several bolt failures on the snail housing, causing the turbine vanes and the turbine housing to come into contact (Figure 7).

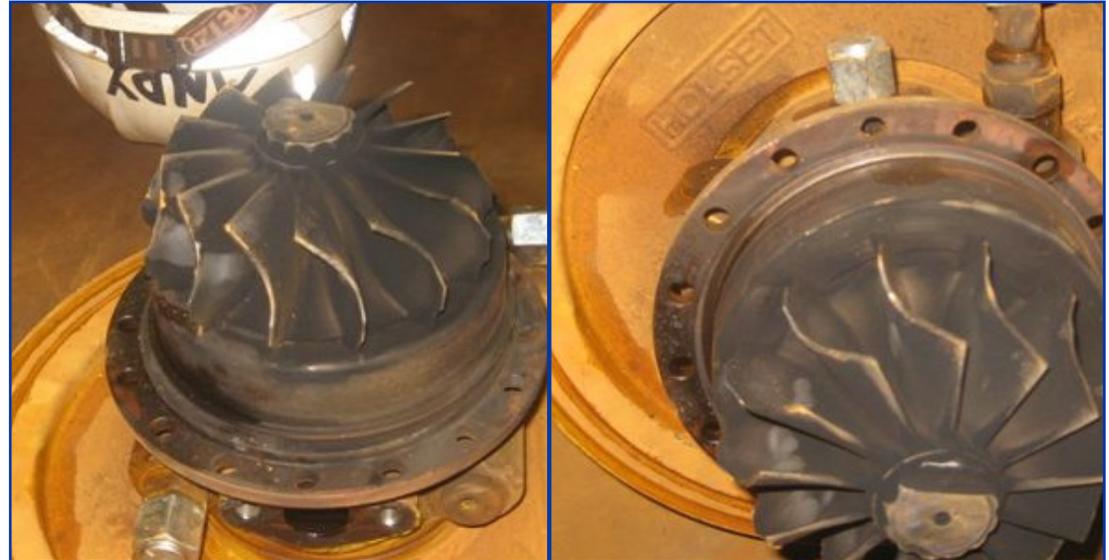


Figure 7: The dismantled turbocharger's turbine vanes are exposed, showing the damage they suffered during the incident.

The snapshot captured by the mine's maintenance team (Figure 8), displays left and right bank exhaust temperatures with the difference between them shaded in yellow. Purple and green colored ovals highlight the two different groups of exhaust temperatures. Similarly, the yellow circle near the X-axis highlights the difference in boost air pressure of each side of the intake manifold.

Outcome

Early detection and validation by the MineCare system prevented any further engine damage. Providing warnings of impending failures is just one of the ways this system helped this customer reduce maintenance costs, increase safety, and lower the risk of equipment failure.

**POTENTIAL COST
AVOIDED:
\$280,000**

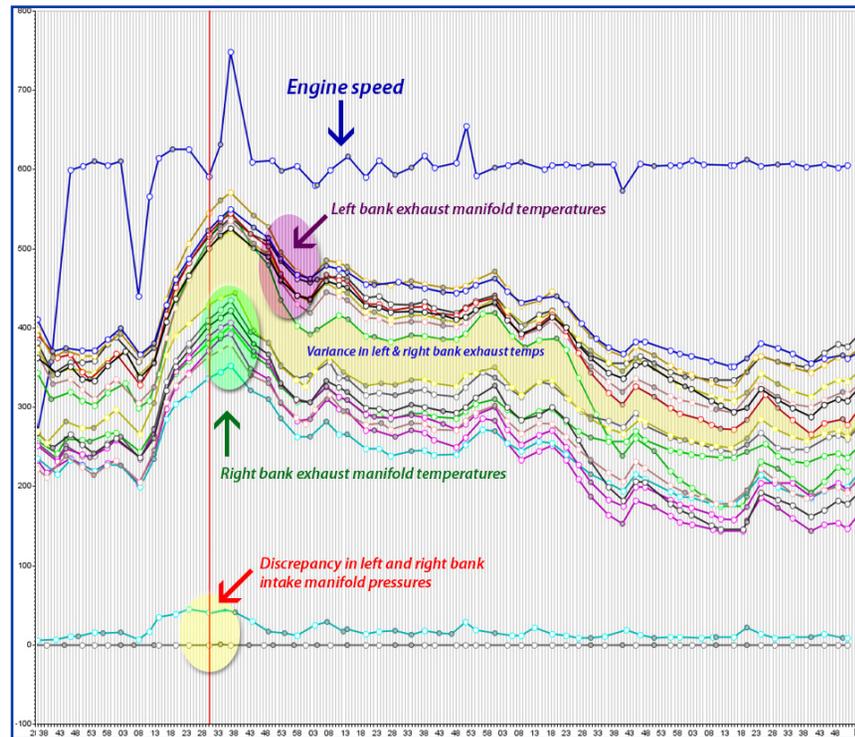


Figure 8: Snapshot of exhaust temperature and intake manifold pressure differential. The gap between right and left bank exhaust is highlighted in yellow.

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Please contact your Modular account manager for more information on how the MineCare system can empower your maintenance team to achieve excellence.

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