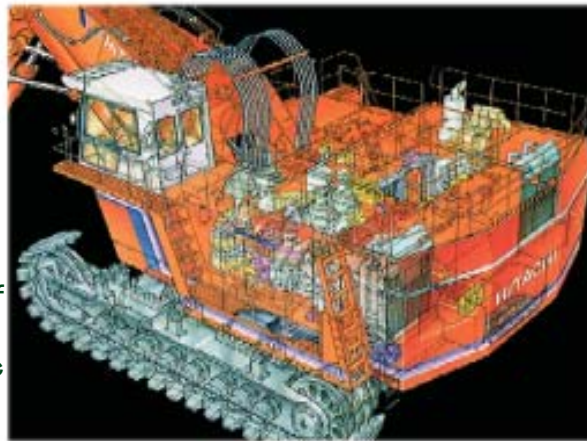


## Coatings Case Study

### Thermal Barrier Coatings Reduce Exhaust Temperatures Below Ignition Temperature of Hydraulic Oil

#### Overview:

The owner/operator of a hydraulic excavator, used in a mining application, was concerned with engine room fires caused by ruptured hydraulic lines. When a hydraulic line failed (an all too common occurrence) the spray of hydraulic oil could come in contact with the exhaust housings of the excavator's two 900 HP diesel engines. Hydraulic oil has an ignition point of 207°C (404.6°F) and will ignite when exposed to this temperature. Documented previous failures of hydraulic lines spraying oil that was ignited by engine exhaust have resulted in millions of dollars in lost/damaged equipment.



#### Setting up the Test:

The Hitachi EX3500-2 hydraulic excavator was an excellent test case as the machine is equipped with identical left- and right-side diesel engines designed to power hydraulic pumps. The machine is typically operated 23 hours every day with only a one hour shutdown to allow routine maintenance and fueling. During an extended shutdown the right-hand engine exhaust manifolds and turbo exhaust housings were coated with thermal barriers (TCB-107 and TCB-109).

#### The Role of Coatings:

While the performance coatings offered by Team Synergy Coatings can be divided into four general categories, this application calls for a thermal barrier. By utilizing a thermal barrier, heat is kept within the exhaust manifold and turbo exhaust housing. In addition to accelerating the exhaust gas velocity (which reduces back pressure and reduces fuel contamination due to reversion), surface temperatures of the manifold and housing are significantly reduced.

#### Test Parameters:

To begin the test, temperature probes were secured to the number 1 and 2 uncoated exhaust manifolds of the left-hand engine during the machines daily shutdown. The probes were connected to a German made Testo 177-T4 temperature data logger that took and saved temperature readings every 60 seconds. During the excavators next shutdown (after 23 hours of continuous operation), the data from the Testo 177-T4 was downloaded to a computer and the probes were relocated to the number 1 and 2 coated exhaust manifolds

of the right-hand engine.

The excavator was operated for an additional 23.5 hours with exhaust temperatures recorded each and every minute. During the machines next stop the information was again downloaded and the information recorded is displayed on the table below.

#### Test Results:

Test Parameter	Uncoated	Coated
Number of Readings	1,388	1,388
Max. Temperature Recorded	346.2°C	211.7°C
Min. Temperature Recorded	68.5°C	47.4°C
Avg. Temperature Recorded	263.1°C	94.0°C
Number of Readings > 207°C	1,193	2
Avg. % of Readings > 207°C	85%	0.001%
Avg. % of Readings < 207°C	15%	99.99%

Note that the referenced 207°C is the ignition point of hydraulic oil and that of the two readings recorded for the coated exhaust manifold one was 207.1°C while the other the maximum temperature of 211.7°C.