Solberg Crankcase Ventilation Systems
Achieve Environmental Compliance and Improve Engine Performance

Solberg’s Crankcase Ventilation Systems (CV) capture hazardous oil mist and particulate emissions (blow-by) vented from the crankcases of reciprocating engines and gen-sets. These systems promote environmental compliance by safeguarding the surrounding environment. Whether an open or closed style system, CV’s control crankcase pressure and prevent seal leaks via manual or automatic controls. Additionally, these protect an engine’s turbocharger, intercooler and exhaust catalyst from contamination, resulting in optimized engine performance and a reduction in costly repairs.

Solberg manufactures CV’s for a variety of applications and markets including stationary power, marine power and landfill gas to energy. For any crankcase ventilation application, the most critical design criteria are: 1.) Vented blow-by flow and 2.) Required crankcase pressure; however, each application has its own unique challenges. Solberg not only provides custom product solutions, but is also a resource for industry and equipment knowledge based on extensive field and project experience.

The remainder of this document details common customer challenges and Solberg’s crankcase ventilation solutions for the stationary, marine and landfill gas to energy markets.

Stationary Engines

Challenge

The U.S. EPA’s RICE NESHAP emissions standard (Reciprocating Internal Combustion Engine National Emissions Standards for Hazardous Air Pollutants) requires most power plant operators to upgrade their stationary non-emergency diesel (compression ignition) engines over 300HP with oxidation catalysts, emissions monitoring and controls and open or closed crankcase ventilation systems. In addition to the equipment itself, installation and construction is often required. Due to the large scope of the standard and a fast approaching May 2013 deadline, operators are struggling to understand the requirements and to find compliant solutions.

Solberg Solution

The market trend for municipal power plants is to use partners who are single sources for all compliance components, installation and construction. This prompted Solberg to align with turn-key contractors to include our crankcase ventilation systems as part of a total solution. Solberg’s value to these partnerships is our ability to interpret the EPA specifications and to provide a high performing compliant solution.
Among contractors and operators, there is debate regarding whether to install open or closed crankcase ventilation systems. Open systems vent to atmosphere while the outlet of a closed style is tied into an engine’s intake system. RICE NESHAP allows for either: Owners and Operators of engines operating without a crankcase ventilation system must do one of the following prior to May 2013: (1) Install a closed crankcase ventilation system that prevents crankcase emissions from being emitted to the atmosphere, or (2) install an open crankcase ventilation system that reduces emissions from the crankcase by filtering the exhaust stream to remove oil mist and hazardous particulate emissions.

A high efficiency open CV is the best way to protect an engine’s intake system, turbocharger and exhaust catalyst while preventing hazardous atmospheric emissions and meeting RICE NESHAP guidelines. The results are optimized engine performance due to cleaner combustion air and a reduction in costly repairs, because untreated oil mist and particulate crankcase emissions are never routed back through the engine.

If a closed crankcase system is preferred or required for a particular project, filtration efficiency is extremely critical. If oil mist and particulate bypass the filter, all downstream engine components are in jeopardy of contamination and damage. Also, these untreated crankcase emissions will migrate through the engine and negatively impact the total exhaust emissions.

In either configuration, Solberg’s comprehension of RICE NESHAP requirements and engine characteristics allows for an ideally sized system to handle the emissions while maintaining engine performance.

### Marine Engines

#### Challenge

Safety, uptime and minimizing maintenance are primary objectives for marine engine operators. Critical maritime applications include propulsion and electric power for military ships, tugs and cruise ships. Given the confined nature of the crew and passengers, emissions control is paramount. Crankcase emissions primarily consist of oil mist and become breathing and slipping hazards on ship decks. Once on the deck or ship structure, the oil can cause environmental damage by washing into the surrounding waterways.

#### Solberg Solution

Solberg developed an enhanced version of our standard vacuum assisted open crankcase ventilation system to address the specific challenges of marine applications. Marine engine brands including MAN Diesel and Fairbanks Morse are prevalent in U.S. Navy applications. These engines typically employ open crankcase ventilation systems and ideally operate under slight crankcase pressure of 1-2” H2O (2.5-5 mbar). Excess crankcase pressure results in oil leaks and contamination of the surrounding area. Our unique re-circulation piping configuration maintains an engine’s natural crankcase pressure and eliminates the need for adjustments via a control valve. Additionally, the piping provides natural pressure relief in case the internal filter element becomes completely clogged or the vacuum source fails. These self-sustaining features allow the crew to focus their attention on critical ship duties.
From an emissions standpoint, these systems include 99.97% efficient filters for 0.3 micron oil mist and particulate. The filters provide clean breathing air on the ship and prevent contamination on the deck and into the surrounding waterways.

**Landfill Gas to Energy**

**Challenge**

Landfill gas to energy (LFGTE) is a renewable movement that has grown quickly over the past several years. By employing the latest gas treatment equipment and gen-set technology, landfill owners and operators use this gas to create electricity for their facilities and for sale to the grid. Landfills are heavily monitored by State and Federal environmental agencies and gen-set emissions are scrutinized because they are visible if not properly filtered and treated.

Given the impurity of the fuel source, engine OEM’s recommend venting the dirty crankcase blow-by out of the engine to help optimize performance and increase oil and component life. The Caterpillar 3516 and 3520 models are the most common engines used in U.S. LFGTE applications. In order to meet the manufacturer’s crankcase operating pressure requirements, an open crankcase ventilation system is the recommended accessory. A vacuum source combined with a high efficiency filter pulls clean outside air into the crankcase, purges the dirty blow-by, captures the resulting emissions and exhausts clean air to atmosphere. However, installing the ideal system has its challenges. For example, although Solberg designs in safety and control mechanisms for our 3520 CV system, both improper installation (mounting height and drain connections) and inadequate crankcase vents/piping account for most of the field issues reported by landfill operators.

Solberg crankcase ventilation systems are capable of pulling high vacuum levels in the range of -10 to -50” H₂O (-25 to -125 mbar) depending on the model and style. These high vacuum levels are necessary to provide extended filter maintenance intervals. During operation, the first indication of a problem is the inability to maintain the Caterpillar recommended -.1 to -1” H₂O (-0.25 to -2.5 mbar) in the crankcase despite the large capacity CV. An operator will try to compensate for this by increasing the vacuum produced by the crankcase ventilation system. However, instead of adequate vacuum in the crankcase, the result is a large volume of oil suction and migration directly from valve cover vents, through the vent piping and into the crankcase ventilation system. Consequently, there is drastic reduction in filter life and crankcase oil levels.
Solberg Solution

Solberg partnered with our largest landfill gas to energy customer to determine the root cause. We hypothesized that excess blow-by flow was to blame for high velocity and pressure drop through the crankcase vents and downstream piping, but we needed to prove it. By performing onsite flow testing on a Caterpillar 3520, we determined that the vented blow-by was nearly double the published value. This is primarily due to premature ring wear caused by the corrosive landfill gas source. The excessive flow discovery led to one conclusion: The area of the four factory installed valve cover vents was too small to handle the worn engine blow-by, which led to excessively high velocity, pressure drop and an inability to achieve vacuum in the crankcase. Operators compensated by pulling more vacuum with the CV, resulting in extreme suction and oil migration downstream. We also noticed that the problem was often exacerbated once oil began to fill the downstream vent piping.

As a result of this joint analysis, our customer added four additional valve cover vents to increase the flow area and reduce the velocity and restriction. The operator was then able to achieve the required crankcase vacuum while eliminating the oil suction and migration problems. Since then Solberg has discussed the challenge and solution with an industry user group and Caterpillar to generate awareness. To date, multiple operators have implemented similar valve cover/piping configurations and have reported positive performance results.

Summary

In each of these cases, a challenge and resulting solution was highlighted; however, these are only a few of many issues encountered by engine operators on a daily basis. Our extensive time in the field with customers and prospects has resulted in a vast knowledge base. Solberg’s mission is to be a resource for industry and equipment information while providing high performance crankcase ventilation systems.