

**KOBELCO**

**Locking It All Inside**



Integrated  
**Noise & Dust**  
Reduction  
Cooling System

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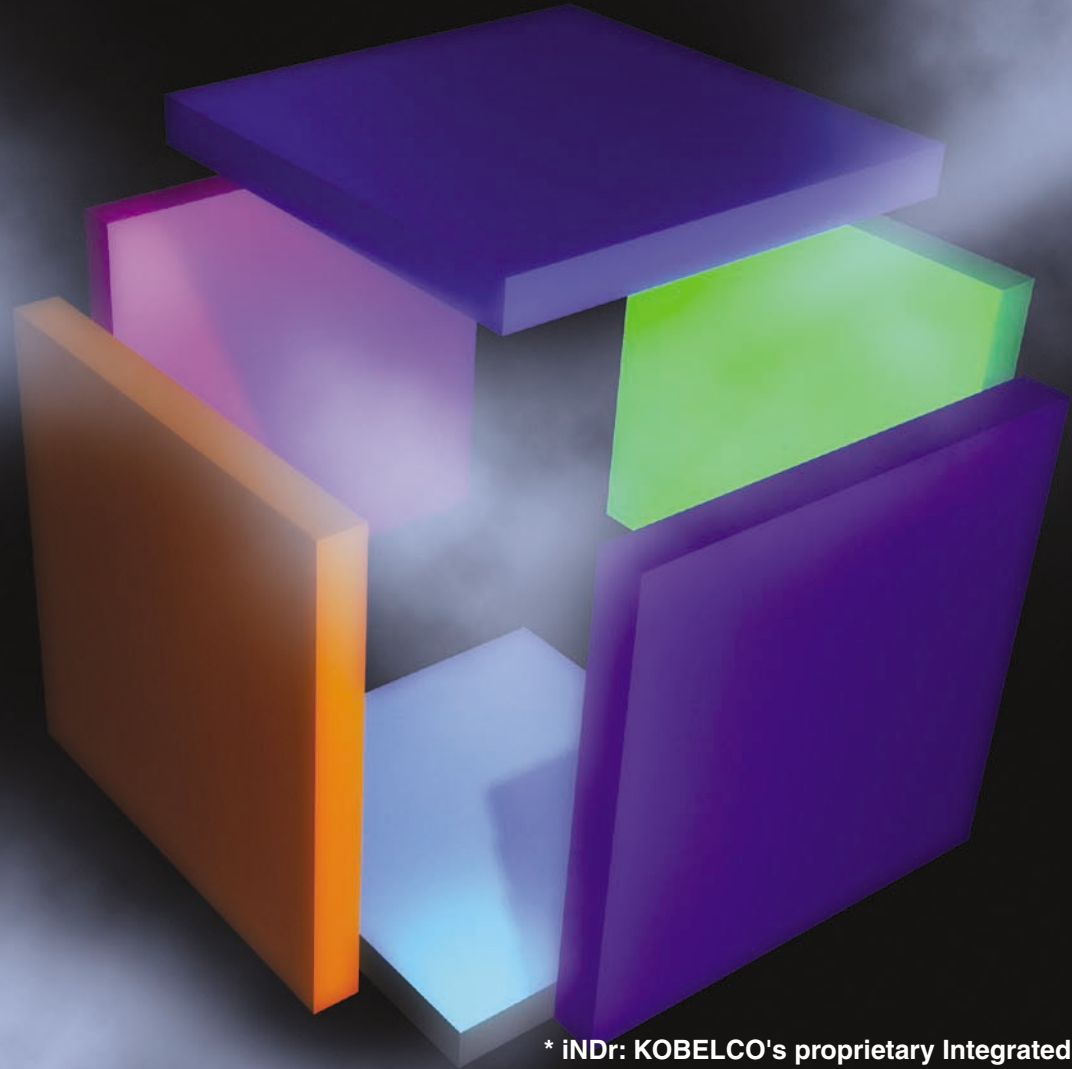
[www.kobelco-kenki.co.jp/english\\_index.html](http://www.kobelco-kenki.co.jp/english_index.html)

*That's KOBELCO!*  
Your First Choice


# What Does iNDr Lock Inside?

## Heat, noise and dust:

the air transmits them; the air carries them to places they don't belong. And that's where iNDr technology begins.



\* iNDr: KOBELCO's proprietary Integrated Noise and Dust Reduction Cooling System.



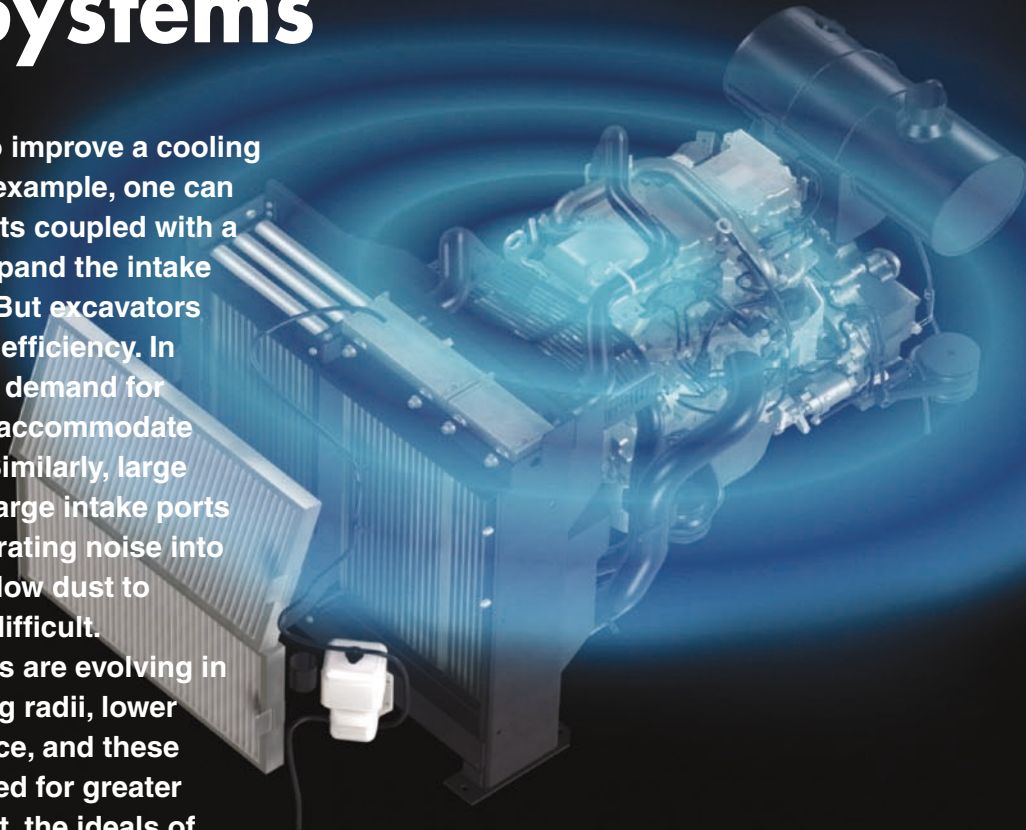
# **iNDR is KOBELCO's exclusive cooling system for hydraulic excavators.**

Hydraulic excavators move with a lot of power that's generated by a large engine. The engine isn't exclusively designed for excavator work, however. In fact, it's almost the same engine you'd find in a truck. And just like a truck, it'll overheat if it isn't properly cooled. To keep things running smoothly, several cooling components are built into the design, like the radiator, oil cooler and intercooler. But these components all need one thing to function properly: wind. And unlike a truck, which sucks in air as it travels, a hydraulic excavator stays pretty much in one place while it works. So it needs a fast-spinning fan to provide the cooling components with the wind they need. We think of the fan and the cooling components as parts of one overall cooling system. And now, we're proud to introduce the next step in cooling-system evolution: KOBELCO's exclusive iNDR.



# The Dilemma of Conventional Cooling Systems

One can do several things to improve a cooling system's effectiveness. For example, one can use large cooling components coupled with a powerful cooling fan, and expand the intake port to increase air volume. But excavators need more than just cooling efficiency. In today's market, there is high demand for compact designs that can't accommodate large cooling components. Similarly, large cooling fans are noisy, and large intake ports not only leak even more operating noise into the surroundings but also allow dust to penetrate, making cleaning difficult. In short, hydraulic excavators are evolving in the direction of smaller swing radii, lower noise, and easier maintenance, and these goals all conflict with the need for greater cooling efficiency. In the past, the ideals of quiet operation and easy maintenance have often been sacrificed in order to keep the engine cool.



# Offset Duct: The Key To iNDr

This is what sets the iNDr system apart. In contrast to conventional systems, which use a large fan near the intake port to cool the engine, iNDr creates a "wind pathway" that naturally introduces air into the system with a fan located further inside the machine. Air, as we know, transmits heat, carries dust, and vibrates with sound. Control the air, and all other problems can be solved. This is what the "wind pathway" approach makes possible.

## The Magic of Ducts

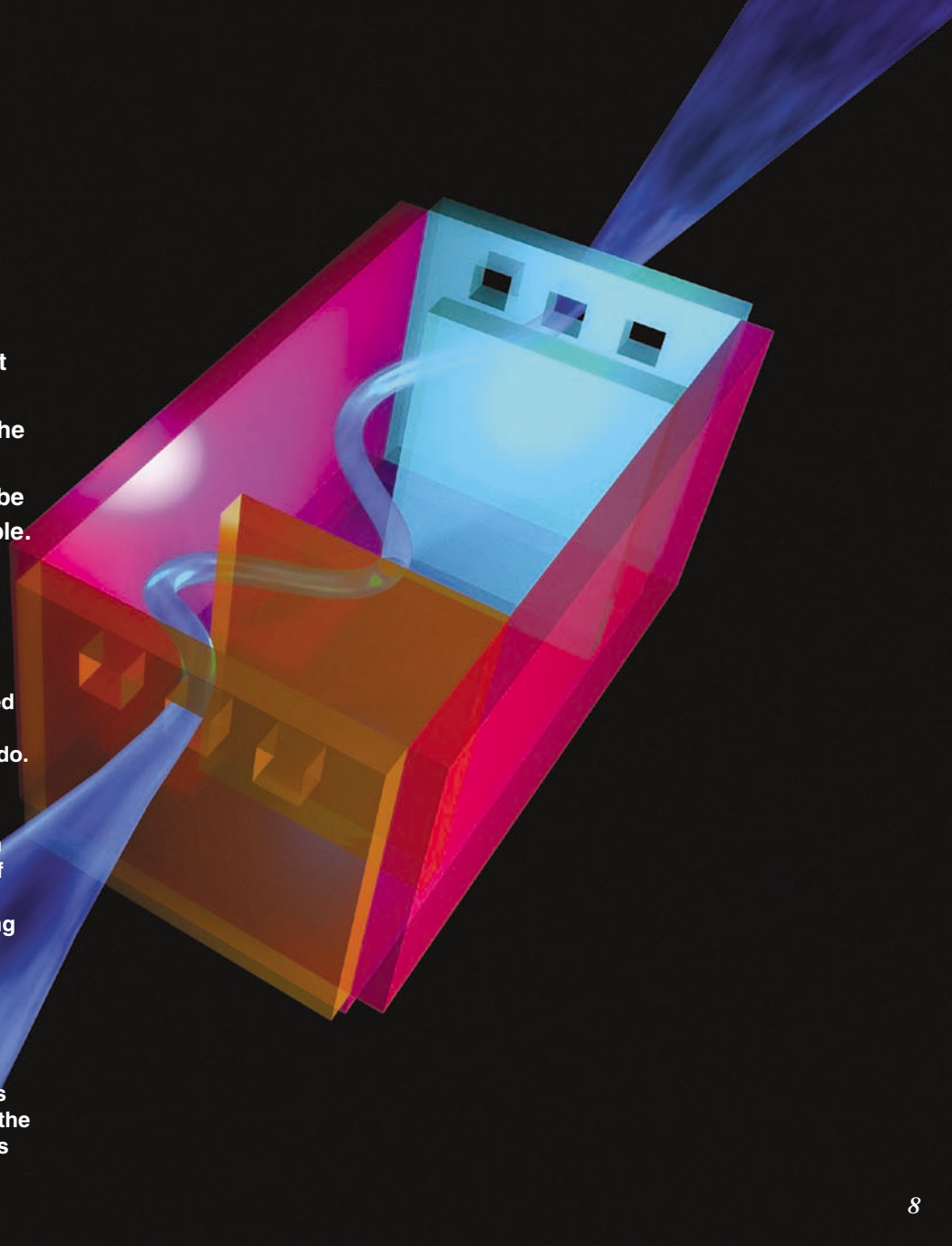
To create a "wind pathway," we started with an enclosed duct that connects the air intake port to the exhaust port, and laid out all of the cooling components and the engine inside it. This is the basic iNDr concept. Because the air can only enter and exit at certain, concentrated points, it becomes much easier to reduce noise and prevent dust penetration. And this is precisely what KOBELCO engineers set out to do.

## The Offset Concept

Sound waves lose much of their energy when they hit an obstacle such as a wall. Even the noise of an excavator can be significantly reduced if the sound waves are forced to reflect off many surfaces before being emitted outside. The secret is to keep the sound source from connecting directly to the outside air. This is why we built angles into our "wind pathway."

## The Concept of Masking

For allergy sufferers, a gauze mask offers effective protection by preventing pollen in the air from entering the body. The iNDr filter works in the same way. Just as the mask helps to maintain the body's health, the iNDr filter protects the inner workings of the excavator. Again, the key is the "wind pathway."



# After Six Years of Development, iNDr Is Born

## The First Step: The 2001 Ultimate-Low Noise Project

Even the most brilliant concept has little value unless it's given a physical form. The acoustic engineers at Kobe Corporate Research Laboratories (Kobe Steel), a facility renowned for its work in acoustics, joined forces with excavator developers at Kobelco Construction Machinery, Co., Ltd. in 2001 to begin the Ultimate Low-Noise Project. By "ultimate low-noise," they meant a reduction of 10dB in operating noise, a tremendous challenge that some said was impossible. Six years later, iNDr achieved that goal.

### iNDr Approach 1 — Noise Reduction

The team first took the obvious steps of studying ways to improve KOBELCO products and researched competitors' noise-reduction technologies, keeping themselves open to any information that might prove useful. This included the investigation of noise reduction technologies in unrelated fields, such as home appliances.

### iNDr Approach 2 — Easy Radiator Cleaning

At the same time, a high priority was given to designing excavators that were highly reliable and easy to maintain. For the radiator in particular, attention was given not only to careful material selection and fin design, but also to the goal of easy cleaning. Various technical solutions were tried in a rapidly evolving process.

### iNDr Approach 3 — Focusing on the Needs of Users in Field

Hydraulic excavators are frequently used in environmental recycling fields. One of the high-level features in demand for these applications is a special anti-dust design, about which KOBELCO has acquired impressive specialized knowledge. The need for a dust shield is an everyday fact of life in waste management work and other job environments where a great deal of airborne dust is generated.



## Patent Pending Duct Design

Noise reduction is achieved by building prototypes of different designs and measuring the noise they generate. The number of decibels a machine generates is expressed as a noise value that can't be hidden or falsified. The most effective design emerges slowly through repeated, minor alterations, using the noise value as a guide. The incredible quiet of the iNDr system is the result of painstaking adjustments in the height, width and depth of the intake and exhaust ports, which are the only points where noise escapes directly from the machine.



# An Entirely New Concept Is Locked In!



The Integrated Noise and Dust Reduction Cooling System is the world's most advanced cooling system that does exactly what its name implies by minimizing noise and dust penetration.



## Noise Is Locked In!

Excavators make noise in many different ways, including the engine, the hydraulic system and travel noise. The proportion of the total noise accounted for by the cooling fan is actually quite large. In most excavator designs, the fan is located just inside the intake port in order to maximize air flow. This means that the sound of the fan can be heard directly outside the machine. To solve this problem, we offset the fan and moved it further in so that there's no direct line between the fan and the outside air. Sound waves generated by the fan and engine hit several internal duct walls and lose much of their energy before reaching the outside. In some cases, this innovative design has reduced the noise level at the intake port by more than 10dB compared with previous excavator models. That's right, 10dB: the seemingly impossible goal our engineers set for themselves at the start of their project. As a result, we succeeded in building the world's first ultra-quiet excavator.



## Why We Say "Ultimate-Low-Noise"

Different noise standards apply to hydraulic excavators, depending on engine output. For example, under EU Noise Emission Regulations Stage 2, an excavator with an engine output of 110kW (20-ton class) must operate at a noise level of 103dB or less. But because iNDr has enabled us to build excavators that are much quieter than regulatory requirements, we needed a new term to show that conventional noise categories simply don't apply. This is why we say, "Ultimate Low-Noise."

## 10dB Less! The Realization of Ultra-Quiet Operation

These figures compare the iNDr system with a conventional SK235SR-2 machine, unloaded and running in high idle, with measurements taken one meter from the rear left side.

### Column How Much Is 10dB?

Noise levels are measured in decibels (dB), but there's no one-to-one correspondence between the physical energy being measured and the perception of that energy by human ears. For example, an increase of 3dB represents a doubling of sound energy, but is essentially imperceptible to the human ear. An increase of 5dB represents a tripling of sound energy and can be clearly perceived. A decrease of 10dB, on the other hand, reduces sound energy to one-tenth its previous level and sounds less than half as loud to the average listener. This is a remarkable reduction in noise that is much more striking that the figure "10dB" suggests.



# Clean Operation Is Locked In!

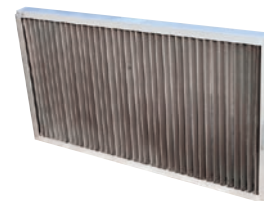
Although passenger cars have radiators, few car owners bother to clean them on a regular basis. But hydraulic excavators are built to dig dirt. If they work on a dry day, they spend many hours operating in a cloud of dust. If the cooling components get clogged with dust, their heat-exchanging efficiency drops, leading to the risk of overheating. To solve this problem, the duct environment created by iNDr is kept almost completely dust-free. This not only keeps the cooling components running at top efficiency, but also keeps the air cleaner at the engine's intake port. By removing the dust problem at the source, we've improved reliability and made the machine easier to maintain. Operators no longer have to bother with the periodic inspection and cleaning of cooling components. Instead, all they have to do is check the iNDr filter for dirt.



## ■ The iNDr Filter: A Great Dust Blocker



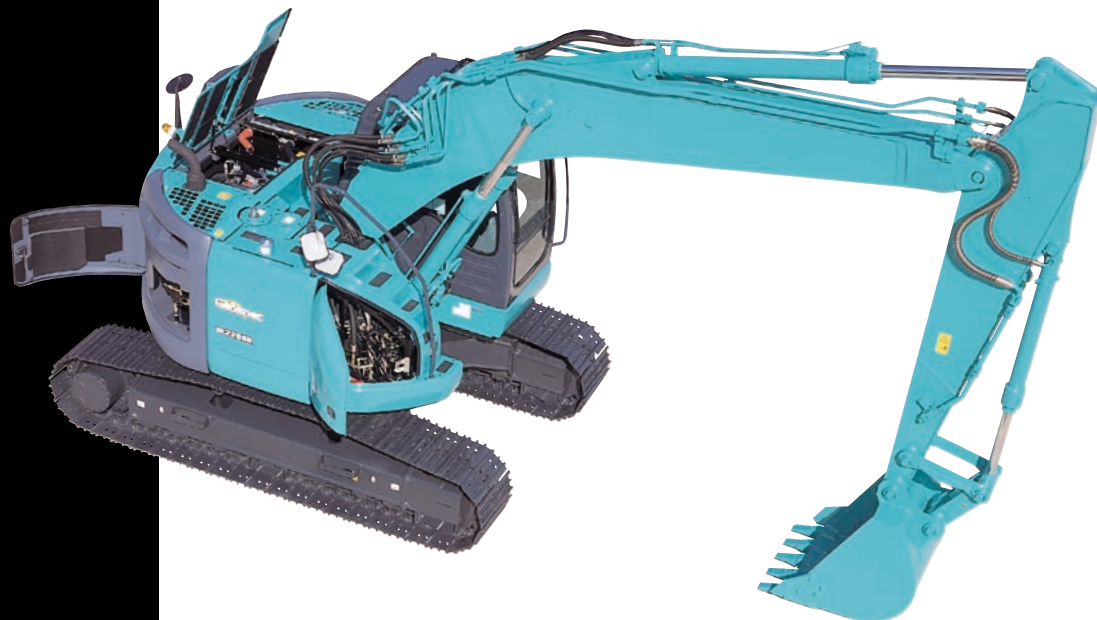
Outside air goes directly from the intake port through the iNDr filter, which removes the dust. The filter features a 60-mesh screen, which means it has sixty holes per inch both vertically and horizontally, with a wide front surface area and an accordion structure that resists clogging.



## ■ Visual Checking and Easy Cleaning



When checking and cleaning a conventional cooling system, one must deal with several different components like the radiator, oil cooler and intercooler, which all must be handled in different ways. But with the iNDr filter, there's just one filter in one place. If it looks dirty during start-up inspection, it can be cleaned easily and quickly.



# iNDr Has Everything Locked In- That's How It Opens the Door to the Future!

The first small-tail-swing excavator fitted with iNDr hit the market in 2007, marking the end of the introductory chapter in iNDr development. But the real iNDr story is just beginning. Low noise and easy maintenance are two features in demand for every hydraulic excavator, regardless of size. And the same is true for environmental recycling machines. iNDr is the dream, the future, and the wings to get there. We at KOBELCO have no doubt that the iNDr tale will continue to be a first-class success story.

