

# Irrigation Engine Ratings Guide



**CATERPILLAR<sup>®</sup>**

# Table of Contents

## Table of Contents

Rating Conditions .....	1
ISO 9001:2000 Certification .....	1
EPA Stationary Regulations .....	1
Abbreviations.....	1
Cat® Engines .....	2-3
Power Estimator .....	4-7
Diesel Engines	
Non-Certified Emissions Compliant.....	8
Tier 2 Emissions Compliant.....	9
Tier 3/Stage IIIA Emissions Compliant .....	10
Tier 4 Interim/Stage IIIB Emissions Compliant.....	11
Natural Gas Engines.....	12-14
Dealer Service.....	15-16
Rating Power Ranges.....	17
EPA & EU Non-Road Emissions Regulations.....	17

## Rating Conditions

### Diesel Engines — up to 6.6 liter

All rating conditions are based on ISO/TR14396, inlet air standard conditions with a total barometric pressure of 100 kPa (29.5 in. Hg), with a vapor pressure of 1 kPa (.295 in. Hg), and 25°C (77°F). Performance measured using fuel to specification EPA 2D 89.330-96 with a density of 0.845-0.850 kg/L @ 15° C (59° F) and fuel inlet temperature 40° C (104° F). Applies to advertised gross intermittent ratings.

### Diesel Engines — 7 liter and higher

All rating conditions are based on SAE J1995, inlet air standard conditions of 99 kPa (29.31 in. Hg) dry barometer and 25°C (77°F) temperature. Performance measured using a standard fuel with fuel gravity of 35° API having a lower heating value of 42,780 kJ/kg (18,390 btu/lb) when used at 29° C (84.2° F) with a density of 838.9 g/L.

### Natural Gas Engines

Engine rating obtained and presented in accordance with ISO 3046/1. (Standard reference conditions of 77° F, 29.60 in. Hg barometric pressure, 500 ft. altitude.) No overload permitted at rating shown. Consult altitude curves for applications above maximum rated altitude and/or temperature.

### Power Unit

May include radiator, engine base, control panel and wiring, air cleaner, cooling fan, clutch as an assembled unit. Attachments listed above may vary upon engine model.

### ISO 9001:2000 Certification

Factory-designed systems built at Caterpillar ISO 9001:2000 certified facilities.

### EPA Stationary Regulations

For important information related to the New Source Performance Standard (NSPS) for diesel stationary engines, refer to the EPA web site at [www.epa.gov](http://www.epa.gov).

### Abbreviations

NA	Naturally Aspirated
T	Turbocharged
TA	Turbocharged/Aftercooled
bhp	Brake horsepower
bkW	Brake kilowatts
LE	Low Emission
NSPS	New Source Performance Standard
SI	Spark Ignited
SI NSPS	Spark Ignited New Source Performance Standard
STD	Standard (stoichiometric) engine highest power rating
CAT	Standard (stoichiometric) engine Catalyst rating
MJ	Mega Joules
btu	British thermal unit
EPA	Environmental Protection Agency
EU	European Union



## **Compare the Total Cost of Cat® Diesel and Natural Gas Engine Power...**

Look at irrigation power sources and you're likely to find that Caterpillar® engines deliver one of the lowest lifetime costs compared to other diesel or natural gas stationary engines, utility electric power, automotive gasoline, or natural-gas-conversion engines. Before you choose, it pays to compare.

### **...To Other Engine Brands**

Cat® engines are built for long, hard, trouble-free days in the field. They're proven to deliver reliable operation, high fuel economy, and world-class emissions. Intelligent design means long service intervals and simple maintenance that minimizes downtime. Both diesel and natural gas engines incorporate the most advanced engine technologies for performance no one else can match.

Cat diesel engines are built with high-strength components for thousands of operating hours before overhaul. For emissions, Cat diesels set the standard. You can choose units that comply with U.S. EPA and EU Tier 2, Tier 3/Stage IIIA, and Tier 4/Stage IIIB regulations. ACERT® Technology, the latest diesel innovation, precisely shapes combustion to maintain performance and efficiency while dramatically reducing emissions. It also provides a foundation for the next level of emission regulations.

Cat natural gas engines combine the same robust components with innovative combustion design and advanced control systems that automatically and precisely regulate major engine functions for optimum fuel economy and stringent emissions reduction. Emissions comply with U.S. EPA, California Air Resources Board (CARB) and European Union standards.

Cat engines can be customized with remote communications, sound-attenuated and weather-protective enclosures, fuel tank bases, silencers, starting aids, cooling options, and other accessories.

## **...To Electric Power**

At first glance, all-electric systems may seem attractive. But if your site isn't near existing power lines, installation costs can be extreme — often more than the price of a Cat engine. Long-term costs run high, too. To get affordable rates, you might have to sign a long-term contract that allows the utility to interrupt or limit your power at any time. So when it's hot and dry and electricity demand soars — just when your crops need water most — your irrigation system could be idle.

Whether natural gas or diesel, a Cat engine ensures irrigating power whenever you need it — and often costs less to operate. You'll spend quite a bit less for maintenance than for utility bills and maintenance of power lines, motors, controls, and transformers. And when it's time to upgrade or repower, your Cat engine has high resale value. If you find electric pumping and drive systems are best for your operation, consider Caterpillar package generator sets — fast and easy to install, affordable, and reliable.

## **...To Automotive Engines**

Gasoline or natural-gas-conversion automotive engines look economical at first: buy them cheap, and when they wear out, scrap them and buy new ones. But in the long run, you'll pay a premium. And don't forget durability — you could be on your third or fourth automotive engine before a Cat engine is ready for overhaul.

## **Count on Your Cat Dealer**

A critical reason to choose Cat engines is the support you get from the Cat dealer network, the world's finest service organization with more than 1,800 locations. Wherever you are, your dealer is there to help you select, install, operate, and service your Cat diesel or natural gas engines. The parts and supplies you need are close by and in stock for fast delivery. Your dealer can provide a service and maintenance package to fit your needs — so you can focus on your crops. Caterpillar also offers flexible leases and other financing plans to make your project affordable.

## For Top Irrigation System Efficiency...

This selection guide will help you identify your irrigation power needs and choose the right Cat engine to meet those needs efficiently. High reliability and low lifetime cost often make Cat engine power your most attractive option.

First, follow these 12 steps to calculate the flywheel power your irrigation system requires. Then match your results to the selection charts on the following pages to see which Cat engine offers the best efficiency and economy. An automated Power Estimator is also available online at [www.cat.com/irrigation](http://www.cat.com/irrigation).

## Determine Total Dynamic Pumping Head

---

### 1. Static Head

Vertical distance pump must lift water from *pickup point to discharge*.

**Pickup point** is the draw-down water level in the well or the surface of stream or pond from which water is pumped.

**Discharge level**, in the case of a pivot or traveling system, is height of the sprinkler at highest point in the field.

---

### 2. Pressure Head

**For open discharge** to pond or canal, pressure head = 0.

**For sprinkler system** a fair initial estimate is 415 kPa (60 psi). Actual value varies from 275 kPa (40 psi) for a low pressure system to about 550 kPa (80 psi) for a high pressure system. Multiply kPa x 0.102 to get meters pressure head (psi pressure x 2.31 = ft. pressure head).

---

### 3. Friction Head

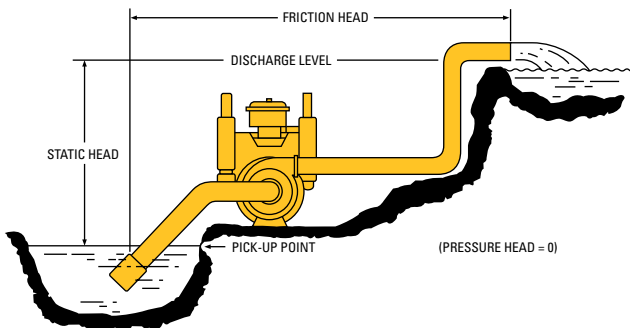
Estimate 1 m (ft) friction head per 100 m (ft) pipe run from pickup point to start of sprinkler system or to open discharge. Actual value based on pipe selection, bends, fittings.

---

### 4 Total Dynamic Pumping Head

Total of 1, 2, and 3.

## Centrifugal Pump taking water from pond to open discharge



**Preliminary Estimate**

**Final Calculation**

\_\_\_\_\_ m  
ft

\_\_\_\_\_ m  
ft

\_\_\_\_\_ m  
ft

\_\_\_\_\_ m  
ft

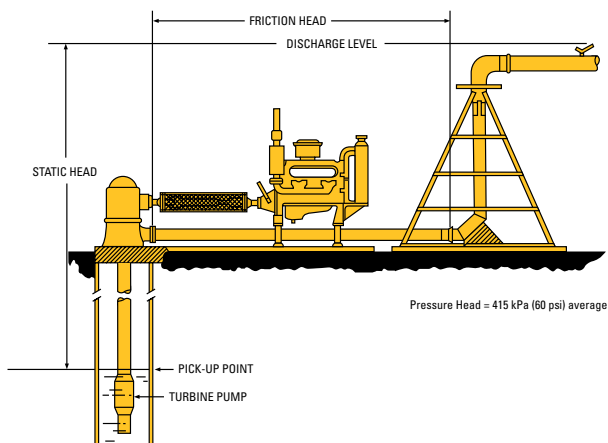
\_\_\_\_\_ m  
ft

\_\_\_\_\_ m  
ft

\_\_\_\_\_ m  
ft

\_\_\_\_\_ m  
ft

## Deep Well Pump delivering to sprinkler system



## Calculate Power to Deliver Needed Water Flow

### 5. Flow Rate Required

Will vary for crop, soil, terrain, and climate. To deliver 8.5 mm (1/3 in) per day to a quarter section [65 ha (160 acre)] field, estimate 63.5 L/s (1006 gpm).

### 6. Calculate Water Power Requirement

Power to pump required water, if pump and drive were 100% efficient.

$$\text{kW} = \frac{\text{Flow Rate (5)} \times \text{Total Dynamic Pumping Head (4)}}{102}$$

$$\text{hp} = \frac{\text{Flow Rate (5)} \times \text{Total Dynamic Pumping Head (4)}}{3,960}$$

### 7. Pump Efficiency

For preliminary estimate use 0.75.

### 8. Drive Efficiency

For direct-driven centrifugal pump use 1.0. For right angle drive use 0.95.

### 9. Calculate Pumping Power Requirements

$$\text{hp} = \frac{\text{kW (hp) (6)}}{\text{Pump Eff. (7)} \times \text{Drive Eff. (8)}}$$

### 10. Power to Drive Pivot or Traveling System

For pivot system, estimate 1.1 engine kW (1.5 hp) per tower. Irrigation system supplier will quote power for electric, hydraulic, or other drive.

### 11. Power for Engine Accessories and Cooling

For preliminary use, estimate 5% of engine kW or hp. Your Cat Engine supplier can provide this data; varies with engine speed, altitude, and climate.

### 12. Total Engine Flywheel Power

Sum of 9, 10, and 11.



## Notes

### Preliminary Estimate

### Final Calculation

\_\_\_\_\_ L/s  
gpm

\_\_\_\_\_ L/s  
gpm

\_\_\_\_\_ kW  
hp

\_\_\_\_\_ kW  
hp

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_ kW  
hp

\_\_\_\_\_ kW  
hp

\_\_\_\_\_ kW  
hp

\_\_\_\_\_ kW  
hp

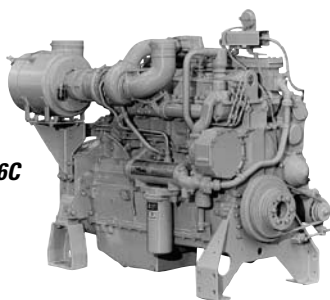
\_\_\_\_\_ kW  
hp

\_\_\_\_\_ kW  
hp

\_\_\_\_\_ kW  
hp

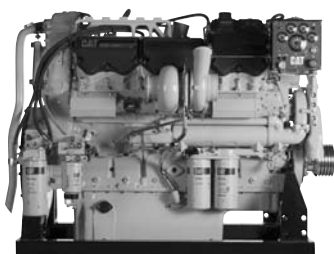
\_\_\_\_\_ kW  
hp

3406C



## NON-CERTIFIED EMISSIONS COMPLIANT

	1800 rpm		2000 rpm	
	bkW (bhp)	l/hr (gal/hr)	bkW (bhp)	l/hr (gal/hr)
3406C	242-287 (325-385)	57.8-70.9 (15.3-18.7)	242-328 (325-440)	63.2-83.3 (16.7-22.0)



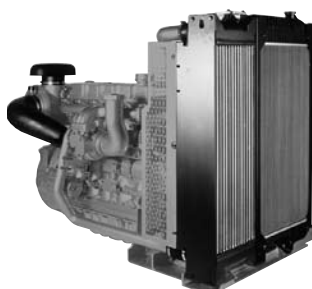
**C32 ACERT**

## TIER 2 EMISSIONS COMPLIANT POWER UNITS

	1800-2100 rpm	
	bkW (bhp)	l/hr (gal/hr)
<b>C27 ACERT</b>	597-653 (800-875)	141.6-160.9 (37.4-42.5)
<b>C32 ACERT</b>	709 (950)	172.6-180.2 (45.6-47.6)

Tier 2 refers to EPA (U.S.) requirements.

**C6.6 ACERT  
POWER UNIT**



## TIER 3/STAGE IIIA EMISSIONS COMPLIANT POWER UNITS

	2200 rpm	
	bkW (bhp)	l/hr (gal/hr)
<b>C4.4</b>	57.8 (77.5)	18.2 (4.8)
<b>C4.4</b>	68.8 (92.2)	21.7 (5.7)
<b>C4.4 ACERT</b>	88.5 (118.6)	24.5 (6.5)
<b>C4.4 ACERT</b>	90.3 (121)	25 (6.6)
<b>C6.6 ACERT</b>	115.6 (155)	32.9 (8.6)
<b>C6.6 ACERT</b>	128.3 (172)	37 (9.7)
<b>C6.6 ACERT</b>	142.8 (191.4)	40.7 (10.7)

	1800-2100 rpm		1800-2200 rpm	
	bkW (bhp)	l/hr (gal/hr)	bkW (bhp)	l/hr (gal/hr)
<b>C7 ACERT</b>	— —	— —	168 (225)	44.7-46.6 (11.8-12.3)
<b>C9 ACERT</b>	— —	— —	205-224 (275-300)	53.0-60.2 (14.0-15.9)
<b>C11 ACERT</b>	242-261 (325-350)	63.7-72.3 (16.8-19.1)	— —	— —
<b>C13 ACERT</b>	287-309 (385-415)	72.0-79.9 (19.0-21.2)	— —	— —
<b>C15 ACERT</b>	328-354 (440-475)	84.8-95.4 (22.4-25.2)	— —	— —
<b>C18 ACERT</b>	428-447 (575-600)	108.3-121.5 (28.6-32.1)	— —	— —

Tier 3 refers to EPA (U.S.) requirements. Stage IIIA refers to European requirements.



**C2.2  
POWER UNIT**

## TIER 4 INTERIM/STAGE IIB EMISSIONS COMPLIANT POWER UNITS

	2800 rpm		3000 rpm	
	bkW (bhp)	l/hr (gal/hr)	bkW (bhp)	l/hr (gal/hr)
<b>C1.1</b>	—	—	14.8 (19.8)	5.9 (1.6)
<b>C1.1</b>	—	—	15.6 (20.9)	6.5 (1.7)
<b>C1.5</b>	—	—	20.8 (27.9)	7.6 (2.0)
<b>C1.5</b>	—	—	21.1 (28.3)	7.9 (2.1)
<b>C2.2</b>	—	—	32.3 (43.3)	9.9 (2.6)
<b>C2.2</b>	38 (51)	11.5 (3.03)	— —	— —

Additional ratings may apply. Please contact your Cat dealer for more information.

## **Stationary Use Only Label**

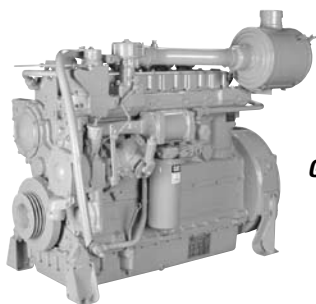
- Effective January 2004, the US EPA Nonroad Mobile SI rule restricts the use of SI natural gas engines within the United States. Caterpillar Natural Gas Engines are not certified for mobile applications within the US and are to be used in stationary use only applications that must be installed a minimum of twelve consecutive months at a location.

## **US EPA SI Stationary NSPS Regulations**

- Effective July 2007, the US EPA will enforce the new Spark Ignited New Source Performance Standard (SI NSPS) for stationary engines rated equal to or above 500 bhp.
- Effective January 1, 2008, this standard will be required for engines rated below 500bhp.

## **US EPA SI Stationary NSPS Non-air Fuel Ratio Site Compliant Capable:**

- The as-shipped non-air fuel ratio-controlled engine is capable of site compliance by the customer and will require customer specified and supplied 3-way catalyst and air fuel ratio control.
- This designation is used to describe rich burn catalyst emission ratings intended for use with 3-way catalysts.
- It is the customer's responsibility to coordinate and complete site emissions testing to demonstrate compliance to the NSPS.



**G3306**

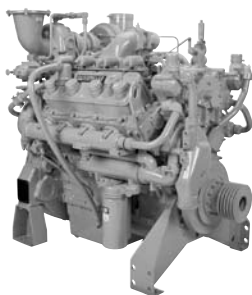
## ENGINE RATINGS

	Engine Config.	1800 rpm	
		bkW (bhp)	MJ/bkW-hr (btu/bhp-hr)
<b>G3304 NA</b>	STD/	71	11.14
	CAT	(95)	(7874)

	Engine Config.	1800 rpm	
		bkW (bhp)	MJ/bkW-hr (btu/bhp-hr)
<b>G3306 TA</b>	STD/	112-164	11.04-10.93
	CAT	(150-220)	(7806-7725)

	Engine Config.	1800 rpm	
		bkW (bhp)	MJ/bkW-hr (btu/bhp-hr)
<b>G3406 TA</b>	CAT	205 (275)	10.5 (7418)
	STD/	242 (325)	10.05 (7105)

**G3408**



## ENGINE RATINGS

	Engine Config.	1500 rpm		1800 rpm	
		bkW (bhp)	MJ/bkW-hr (btu/bhp-hr)	bkW (bhp)	MJ/bkW-hr (btu/bhp-hr)
<b>G3408 NA</b>	STD/	—	—	190	10.74
	CAT	—	—	(255)	(7590)
<b>G3408 TA</b>	CAT	248 (332)	10.62 (7507)	—	—
				—	—
<b>G3408 TA</b>	STD	—	—	298	10.59
		—	—	(400)	(7485)
<b>G3408C TA</b>	LE	—	—	317	9.75
		—	—	(425)	(6895)





## **Cat Dealer Network**

The reputation of Caterpillar as a quality supplier of engines has been built on our long commitment to service and support. No other engine manufacturer has the worldwide dealer network and parts distribution system that Caterpillar customers have come to rely on. Repowers, new engine installation, specialized engine arrangements for pumping applications — whatever you need, wherever and whenever you need it, your Cat dealer can provide it. From scheduled maintenance programs to parts and service support, diagnostics and emergency response — the Cat dealer network stands ready with the expertise, technology, and parts to keep you up and running at peak efficiency.

## **Industrial Service Distributor (ISD) Support**

Using Cat engines is a smart choice and now, it's an even more powerful choice. Caterpillar offers the opportunity for irrigation dealers to become certified service outlets for the Cat engines used in their equipment. The single-source service they can provide will benefit irrigation dealers and their customers.

As irrigation dealers join the Caterpillar ISD program, their technicians will have access to training, tooling, and inventory of Cat parts so they can enhance their product support capabilities and improve customer satisfaction.

## **Customer Support Agreement (CSA)**

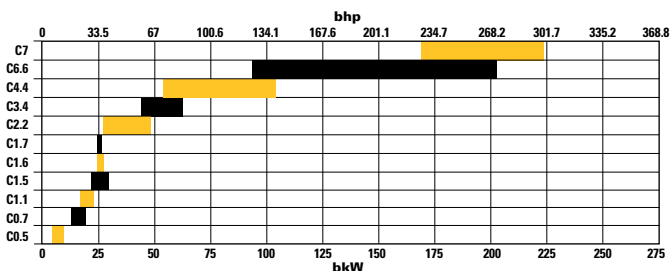
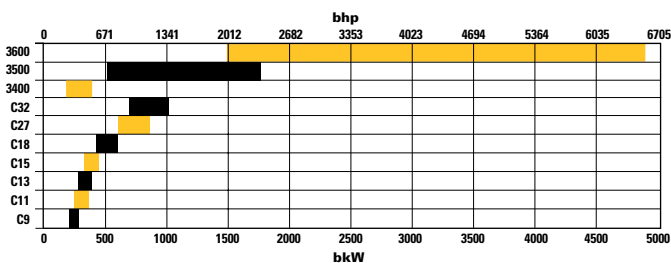
A CSA is a partnership between you and your Cat dealer to provide preventive maintenance and service. It is tailored to fit your business needs and can range from simple Preventive Maintenance Kits to sophisticated Total Cost Performance Guarantees. The flexible, individualized plans give you access to trained experts who know your Cat engine, maximizing productivity and minimizing costs. With a CSA, your Cat dealer can provide service in a more timely, convenient, efficient, and cost-effective manner.

## **Caterpillar Warranty and Extended Service Coverage (ESC)**

Caterpillar offers excellent standard and extended warranty coverage for industrial engines equipped with ACERT® Technology. The standard warranty period is 24 months or 3,000 hours, whichever comes first, with the first 12 months at unlimited hours. A third year of warranty covers five major components: cylinder block casting, cylinder head casting, crankshaft (excluding bearings), camshaft, and connecting rods. For details on other diesel or natural gas engine warranties, contact your local Cat dealer.

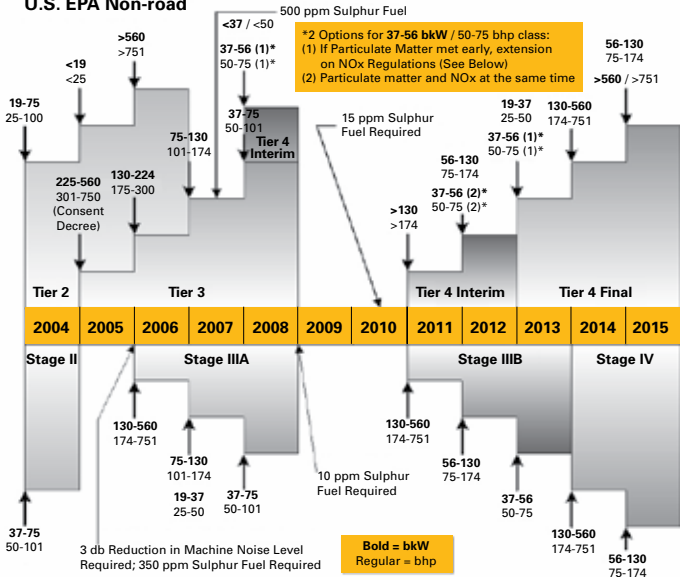
In addition to the standard Caterpillar warranty, your Cat dealer offers protection past the standard warranty period, including protection against unexpected repair bills, 100 percent parts and labor reimbursement for covered components, service at any Cat dealer or authorized repair facility within the covered territory, and a variety of coverage terms. The initial owner may purchase ESC up to one year after taking delivery of the engine. Coverage is available for up to five years, with various hour increments available for most applications and models.

## Additional Industrial Diesel Engine Ratings



## EPA & EU Non-Road Emissions Regulations\* Tier 3 Changes for Consent Decree Signatories

### U.S. EPA Non-road



### European Non-road

\*Additional information available at [www.cat.com/irrigation](http://www.cat.com/irrigation)

# **Caterpillar. Your Local Resource. Worldwide.**

Your Cat dealer is prepared to answer any questions you may have about Cat Power Systems, customer support, parts or service capability anywhere in the world. For the name and number of the Cat dealer nearest you, visit our website or contact Caterpillar Inc. World Headquarters in Peoria, Illinois, U.S.A.

World Headquarters:

**Caterpillar Inc.**

Peoria, Illinois, U.S.A

Tel: (309) 578-6298

Fax: (309) 578-2559

Mailing Address:

**Caterpillar Inc.**

Industrial Power Systems

P.O. Box 610

Mossville, IL 61552

**[www.cat.com/irrigation](http://www.cat.com/irrigation)**

**E-mail: [cat\\_power@cat.com](mailto:cat_power@cat.com)**

Materials and specifications are subject to change without notice. Rating ranges listed include the lowest and highest available for a specific engine or family of engines. Load factor and time at rated load and speed will determine the best engine/rating match.

LEDH5378-03 (8-09)

©2009 Caterpillar

All rights reserved.

CAT, CATERPILLAR, their respective logos, ACERT, "Caterpillar Yellow," the "Power Edge" trade dress as well as corporate and product identity used herein, are trademarks of Caterpillar and may not be used without permission.

**CATERPILLAR<sup>®</sup>**  
TODAY'S WORK. TOMORROW'S WORLD.™