Cat® Batteries

Management Guide

- Battery Basics
- Battery Maintenance
- Testing and Charging
- Causes of Battery Failure

Contents

Your battery starts the ball rolling. It converts chemical energy into the electrical energy necessary to power your machine, delivering voltage to the starter, and stabilizing the voltage to keep your engine running. If the engine doesn't start, nothing runs. With proper maintenance and testing, you can count on reliable starting so you can get on with business. Effective system management leads to fewer failures and less downtime. This guide discusses preventive maintenance and repair management for your batteries to help you minimize O&O costs and maximize productivity.

This management guide offers information, tips, and ideas but is not intended as a technical manual or a substitute for the advice and recommendations of our parts and service experts. By referencing this manual and following the recommendations in your Operations and Maintenance Manual, you can maximize the productivity, service life, and value of your Cat® machines.

Manage it well. Make it last.

This guide gives you the tools to get maximum value from your Cat® batteries. Both Heavy and General Duty batteries are designed to deliver dependable starting power in any condition or application.

Following a planned maintenance program and recommended guidelines can help lower your owning and operating costs. And your Cat® dealer is always available to answer questions and provide whatever help you need.

Battery Basics

Quality, Long-life Batteries

Cat® Batteries are offered worldwide in Battery Council International (BCI) group sizes for Cat and other manufacturers' equipment. The full Cat® Heavy Duty (HD) line-up includes wet maintenance-free and maintenance free accessible flooded lead acid battery options. You can get Cat quality and reliability that fit a range of applications and budgets in our Cat® General Duty (GD) battery line. General Duty batteries offer wet maintenance free and low maintenance flooded lead acid batteries. They also include valve regulated lead acid (VRLA) batteries in AGM (Absorbed Glass Mat) and Gel designs. This line of batteries are wet cell or flooded batteries and covers all of your starting and cycling applications.

Cat® Heavy Duty (HD) Batteries

Cat HD batteries are used in all Cat equipment and generator sets. They are designed to provide industry-leading Cold Cranking Amp (CCA) capability and maximum vibration resistance.

Cat® General Duty (GD) Batteries

Cat General Duty batteries provide sure starts and are ideal for automotive, light truck, bus, marine, industrial, agricultural, stationary power, and recreational use.

Cat Battery Recycling Program

This program makes discarding spent batteries easy, through your Cat dealer. Your batteries will be properly handled and 100 percent recycled to meet all environmental regulatory standards in North America.

Machine Storage

- Disconnect switch and keyswitch: off
- If machine storage is extended to 30 days, monitor battery Open Circuit Voltage (OCV). If below 12.45 Volts, provide boost charge.
- OCV is the voltage between the terminals when the two terminals are not connected to any circuit. (No electric current flows between the terminals).
- Batteries below 12.00 OCV may already have had their performance and service life compromised. Warranty is voided on batteries left discharged below 12.00 OCV

Note: Batteries are hazardous materials. Use correct Personal Protection Equipment (PPE) when working with batteries.

Battery Specifications

HD Batteries

BCI Group Size	Part No.	CCA ≈	RC Mins †	Volts	Amp. Hr. Capacity @20 Hrs.	Construction Notes	Accessibility – Fluid Level Check Hours	BCI Overall Dimensions			Nominal Weight		Nominal Acid to Fill Qt (liter)	Flooded / Gel /AGM	Wet / Dry
								Length In (mm)	Width In (mm)	Height In (mm)	Wet Lb (Kg)	Dry Lb (Kg)			
8D	153-5720	1500	465	12	210	C/MFA	A - 1000	20.5 (520)	10.8 (275)	9.8 (248)	132 (59.9)	–	–	Flooded	Wet
4D	153-5710	1400	425	12	200	C/MFA	A - 1000	20.5 (520)	8.6 (218)	9.8 (248)	119 (54.0)	–	–	Flooded	Wet
4D	153-5700	1125	305	12	145	C/MFA	A - 1000	20.5 (520)	8.6 (218)	9.8 (248)	101 (45.8)	–	–	Flooded	Wet
31	175-4390	1000	180	12	90	C/MFA/S	A - 1000	12.9 (329)	6.8 (172)	9.3 (236)	60 (27.2)	–	–	Flooded	Wet
31	175-4370	825	190	12	100	C/MFA/S**	A - 1000	12.9 (329)	6.8 (172)	9.3 (236)	61 (27.2)	–	–	Flooded	Wet
31/30H	115-2422	1000	170	12	90	C/MFA	A - 1000	12.9 (329)	6.8 (172)	9.5 (241)	63 (28.6)	–	–	Flooded	Wet
31/30H	9X-3404	950	165	12	100	C/MF	NA	13.0 (331)	6.8 (172)	9.5 (241)	58 (26.3)	–	–	Flooded	Wet
31/30H	3T-5760	750	165	12	100	C/MF	AV - 1000	13.0 (331)	6.8 (172)	9.5 (241)	56 (25.4)	–	–	Flooded	Wet
65	230-6368	850	140	12	70	C/MF	NA	11.9 (304)	7.5 (191)	7.5 (191)	46 (20.9)	–	–	Flooded	Wet
24	153-5656	650	110	12	52	C/MF	NA	11.0 (279)	6.9 (174)	6.5 (174)	39 (17.7)	–	–	Flooded	Wet

Construction Notes:

Batteries use SAE taper post design and are shipped wet except as:

LAC = Low Maintenance – Hybrid Construction

C = Calcium Lead Alloy Grid Design

MF = Maintenance Free Non-Accessible

MFA = Maintenance Free Accessible

A = Accessible

NA = Non-Accessible

AV = Accessibility Varies – Depends on supplier used.
If it has caps, it is accessible and fluid levels should be checked.

S = Stud Terminals

+ = Shipped Dry Only

* = Side Terminals Only

** = Starting and Deep Cycle Battery

*** = Deep Cycle and Starting Battery

≈ = Cold Cranking Amps or 30 seconds at 0°F (-18°C)

† = Reserve Capacity Minutes minimum of 25 amp output at 80°F (27°C)

STD = Dual, Top-mounted Terminals—Stud and SAE Post. Marine Deep Cycle/ Starting Battery

BCI/DIN/EN Cross Reference
European Reference Information

BCI Group Number	BCI Assembly Figure	Maximum Dimensions (mm)			Hold-down	Lifting Edge	Positive Terminal Location	DIN Code		EN Codes
		Length	Width	Height						
40R	15	278	175	175	B1	No	Right	T6	LB3	66LB
41	15	293	175	175	B4	No	Right	T65	N/A	54LB
42	15	242	175	175	B4	No	Right	T5	LB2	45LB
47	24	242	175	190	B3	Yes	Right	H5	L2	55L2
48	24	278	175	190	B3	Yes	Right	H6	L3	66L3
49	24	354	175	190	B3	Yes	Right	H8	L5	99L5
90	24	242	175	175	B3	Yes	Right	T5	LB2	45LB
91	24	278	175	175	B3	Yes	Right	T6	LB3	66LB
92	24	315	175	175	B3	Yes	Right	T7	LB4	77LB
93	24	354	175	175	B3	Yes	Right	T8	LB5	88LB
94R	24	315	175	190	B3	Yes	Right	H7	L4	77L4
95R	24	394	175	190	B3	Yes	Right	H9	L6	
97R	15	252	175	190	B4	No	Right	H5	L2	55L2
98R	15	283	175	190	B4	No	Right	H6	L3	66L3
99	34	207	175	175	B1	Yes	Left	T4	LB1	36LB
99R	24	210	175	175	B3	Yes	Right	T4	LB1	36LB
N/A	N/A	175	175	190	B3	Yes	Right	H3	L0	32L0
N/A	N/A	207	175	190	B3	Yes	Right	H4	L1	45L1

Terminal Position and Cell Layout

6-VOLT ASSEMBLIES – TERMINAL POSITIONS & CELL LAYOUTS

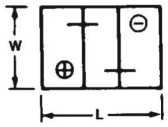


FIG. 1 (2L, 2N)

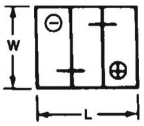


FIG. 2 (1, 2, 3, 3D, 4, 5D, 7D, 9D, 19L, GC2, GC2H)

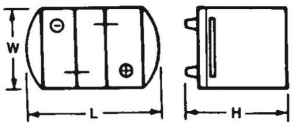


FIG. 2B (17HF)

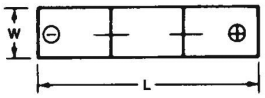


FIG. 5 (2E, 3EH, 4EH)

12-VOLT ASSEMBLIES – TERMINAL POSITIONS & CELL LAYOUTS

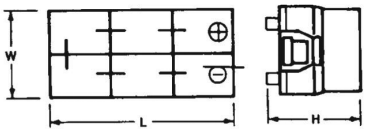


FIG. 8 (4B[3], 4D, 6D, 8D[3])

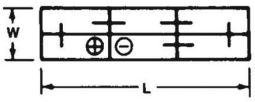


FIG. 9 (3EE, 3ET)

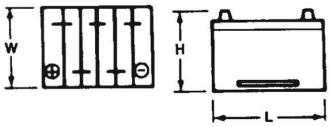


FIG. 10 (12T, 20H, 21, 24, 24H, 24T, 25, 26, 27, 27H, 29H, 30H, 34, 50, 51, 52, 86, U1[4], U2[4])

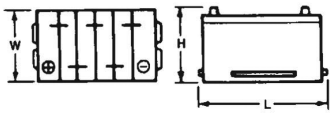


FIG. 10F (16TF, 45, 46)

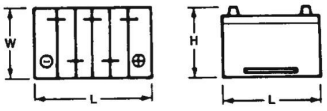


FIG. 11 (21R, 22NL[1], 22R, 24/24F, 24R, 26R, 27R, 29HR, 30HR, 32N, 34R, 35, 51R, 85, LM, U1R[4])

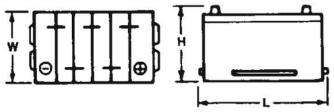


FIG. 11F (22F, 22HF, 22NF, 24F, 27F, 27HF, 29NF, 33)

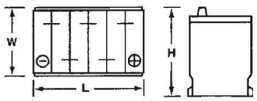


FIG. 11H (121R, 124R)

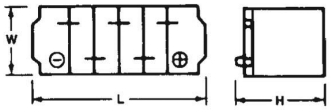


FIG. 11L (17TF, 23)

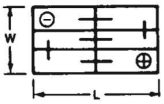


FIG. 12 (60)

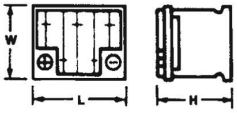


FIG. 13 (66)

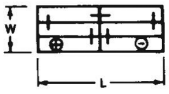


FIG. 14 (53)

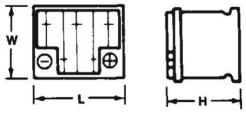


FIG. 15 (39, 40R, 41, 42, 43, 44, 96R, 97R, 98R)

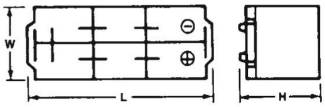


FIG. 16L (4DLT)

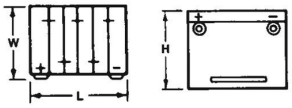


FIG. 17 (70, 71, 72, 73, 74, 75, 76, 77, 78, 101)

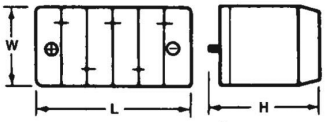


FIG. 18 (28, 31[2])

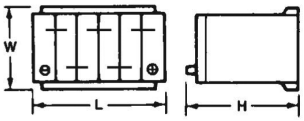


FIG. 19 (36R, 54, 55, 56, 58R)

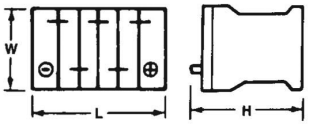


FIG. 20 (61, 62, 63, 64)

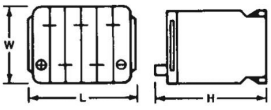


FIG. 21 (59, 65)

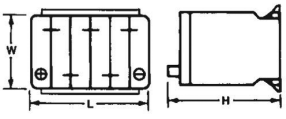


FIG. 22 (57)

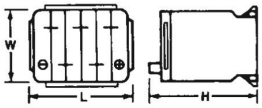


FIG. 23 (58R)

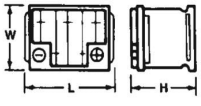


FIG. 24 (47, 48, 49, 90, 91, 92, 93, 94R, 95R, 99R)

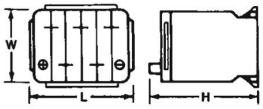


FIG. 25 (58)

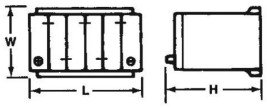


FIG. 26 (58)

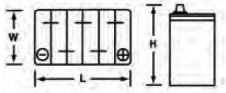


FIG. 28 (151R)

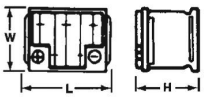


FIG. 34 (99)

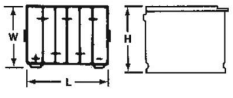


FIG. 35 (79, 100)

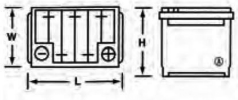


FIG. 39 (67R)

Footnotes for Cell Layout Section

[1] Pencil posts supplied as O.E.
[2] SAE or 3/8" stud posts.
[3] SAE or special "bus"side terminals
[4] Special lawn mower "L" terminals.

* *Source: Battery Council Int'l*

Battery Maintenance

Inspection

Check Battery Box

Open box frequently for general maintenance:

- Tighten loose terminals.
- Clean off terminal corrosion and reassemble connections using dielectric grease or petroleum jelly.
- Clean off dust and dirt accumulation anywhere on the battery, as it may short out the batteries if it becomes wet.
- Tighten hold-downs when necessary.

Note: If your engine is cranking slow, check the load or have it tested by a Cat dealer. Refer to page 11 for load test.

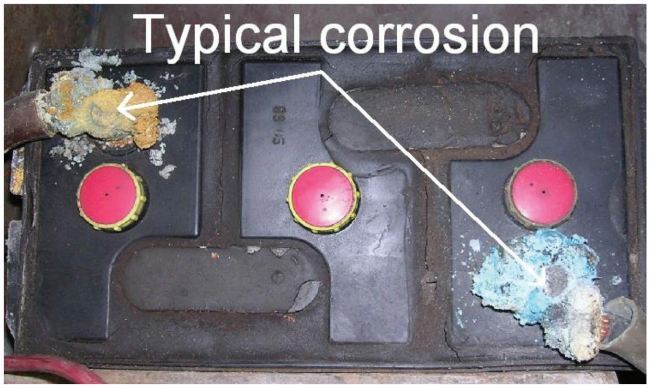
Check for Damaged Case

Cracked cases may be an indication that battery hold down clamps are too tight.

Signs of overcharging. Evident by streading down the sides of the case. Time to check charging output and electrolyte levels in batteries.

Check for Terminal Corrosion

Use battery post and terminal tool 1U9921 to clean if necessary. The terminal and post should have a shiny appearance after cleaning. Sometimes, fine grit sandpaper may be required to achieve a shiny clean surface.



Battery post and terminal tool part number 1U9921.

Cleaning the Battery

Batteries can be cleaned with one of the following solutions:

- **Baking Soda**—Combine 0.1 kg (0.2 lb) of baking soda with 1L (1.1 qt) of clean water.
- **Ammonia**—Combine 0.1 kg (0.2 lb) of ammonia soda with 1L (1.1 qt) of clean water.

Remove the cleaning solution from the battery and neutralize the battery by rinsing the battery with clean water.

Note: Rapid air movement from compressed air combined with dust, dirt, or other forms of debris can create static electricity. Static electricity may lead to an explosion when in the vicinity of a battery, resulting in personal injury or death. Never use compressed air for cleaning in the vicinity of a battery.

Check Cable Tightness

Tighten to terminal torque requirements. It is recommended to verify for specific machine application.

Terminal	Torque
Stud terminal with 5/16 x 18 thread size	95 to 105 in-lb (11 to 12 N•m)
Stud terminal with 3/8 x 16 thread size	119 to 329 in-lb (13.5 to 37.2 N•m)
SAE standard post design	50 to 70 in-lb (5.6 to 8.8 N•m)
"L" terminal 1/4 x 20 fastener	78 to 132 in-lb (9 to 14 N•m)

Maintain Electrolyte Level

Checking the fluid level of your battery cells periodically is important due to evaporation caused by continuous charging.

Check the electrolyte level:

- Remove the cap and look into the hole.
- If the fluid or electrolyte level of a cell is low (fluid level should be maintained at 5 to 7 mm below the bottom of the cell inspection hole; plate grids are not to be exposed), add de-ionized water or mineral-free water into the cell.
- Inspect electrolyte levels every 1000 hours if accessible. In warmer climates, check more frequently, such as every 500 hours.
- If the charging voltage is too high, the water can actually boil inside the cells. To fix this, adjust the charger to a lower level. In a machine application, the machine charging voltage is a set voltage. In a generator set application, depending on the charge, the voltage may be adjustable.
- Batteries left discharged will sulphate. Overcharging causes the battery to dry out and shorten battery life.

Testing and Charging

Temperature Effects on Charging and Battery Life

- Elevated ambient temperatures cause shorter battery service life.
- In high ambient applications battery life is dependent on maintenance and water additions.
- Caterpillar recommends adding water periodically to maximize battery service life.

Recommended Charge Voltages

Temp °C	Temp °F	Flooded			VRLA	
		MF (CA/CA)	Maint (AN/AN)	Low Maint (AN/CA)	AGM	GEL
		Float	Float	Float	Float	Float
80	170	12.90	12.70	12.90	12.90	12.80
60	140	12.94	12.70	12.90	12.90	12.80
40	104	13.32	13.02	13.02	13.02	13.02
20	**68**	**13.80**	**13.50**	**13.50**	**13.50**	**13.50**
0	32	14.46	14.16	14.16	14.16	14.16
-30	-22	15.90	15.60	15.60	15.60	15.60

Load Test

The load test determines if the battery has the minimum capacity to adequately perform all the required functions.

1. Remove surface charge
2. Measure OCV

   **Should be 12.45 OCV for 12V batteries.*
3. If the OCV is 12.45 or greater, perform the load test.

Battery	Minimum Voltage
12 Volt	11.5 Volt
8 Volt	7.67 Volt
6 Volt	5.75 Volt

Load Tester Instructions

The load to apply is 1/2 the battery's rated CCA for 15 seconds. The voltage should be equal to or greater than the listed minimum voltage while under the load.

Minimum Acceptable Voltage Under Load Test at Specified Battery Temperature			
Battery Temperature	**12V Battery**	**8V Battery**	**6V Battery**
10°C (50°F) or greater	9.5	6.3	4.7

If you do not have the Cat Battery Load Tester (464911):
There are some load testers available that have one preset load, and are not capable of selecting the proper load based on the battery's CCA. That style of tester makes it difficult to determine the proper amount of time to leave the load applied. Features of a good load tester will have the ability to select the correct load to apply to the battery, along with a digital voltmeter capable of reading voltage in 0.1 volt increments. The load tester should be portable allowing the test to be performed on the machine in the field, have heavy duty test leads, an amp meter capable of reading the load that is applied, and internal cooling which will help keep the unit cool while under load to extend life of the tool. A load of half the battery's CCA for 15 seconds. With load still applied, read and record the voltage.

Causes of Battery Failure

Notice

Find the cause of the failure before you install a new battery or return the original battery to service. Failure to do so could result in a repeat failure.

Use the following to determine the cause of the failure.

No Apparent Failure Mode

The battery does not show any signs of failure. Inspect the battery for the following conditions:

- Poor connections and/or an open circuit
- Corroded, loose and damaged connections in the cranking circuit
- Corroded battery terminal posts
  Note: Refer to page 8 if these conditions are present.

Leaking Battery Case

A cracked or a broken case can be caused by the following:

- A defect in quality or manufacturing
- Foreign material trapped under the battery at the time of installation
- Abuse
- Allowing a discharged cell or a dead cell to freeze
- The battery hold-downs are too tight.
- The battery hold-downs are too loose. Inspect the battery for eroded areas at the point of contact with the battery hold-downs.
- The battery case will appear to be leaking. The battery vent plug holes may be partially locked.

Overcharging

Caused from inadequate charge voltage settings, high operating temperatures, and poor maintenance practices.
A faulty voltage regulator can cause an above-normal charging rate to any battery type.

Undercharging

The following examples are causes of undercharging:

- An alternator that is not matched to the load demands
- A faulty alternator
- Loose or broken alternator drive belts
- Insufficient time between engine start and engine stop
- A machine or engine that is operated with the disconnect switch (if equipped) in the OFF position
- Extended storage of a machine or engine with the disconnect switch (if equipped) in the ON position
- A machine that is parked or stored with an accessory left ON
- The alternator voltage regulator is set too low
- Moisture and/or debris can cause the battery to self-discharge

To avoid undercharging, batteries connected in series should be of the same part number or same chemistry and capacity

Contaminated Electrolyte

Contaminated electrolyte can be caused by adding contaminated water to a battery during its service life. Adding contaminated water to a battery can shorten its life.

Causes of Battery Failure

Vibration

Internal and external damage to any battery type can be caused by vibration. The effects of vibration may vary according to the type of battery.

Cat General Duty battery and Cat Heavy Duty battery
Effects of vibration:

- Short circuiting within the battery cell
- Dark electrolyte
- Plate material that appears to be peeling, corroding, separating, or splitting

All other battery types
Effects of vibration:

- An exploded battery due to an open circuit inside one cell
- A shorted cell in the battery may be due to an increase in the charging current, overheating, and excessive gassing.
- A cracked battery case
- Loose battery terminal posts
- Poor cranking speed

Sulfation

Micro-crystalline particles on the surface of the battery plates can be caused by the following:

- Using a battery with the electrolyte level below the top of the plates
- A discharged battery that is being stored for more than one month
- While the machine is in storage, the disconnect switch is left in the ON position.

You cannot reverse the effects of sulfation that is produced over long periods of time.

The battery will permanently lose some of the ability to store electricity and the ability to deliver electricity if some sulfation occurs. The ability to store electricity and the ability to deliver electricity at the full capacity depends on the duration of the sulfated condition.

The sulfation has the following effects on a battery:

- The battery cannot pass a load test.
- The battery cannot accept a normal charging current.

Expect more from the experts

Following the information and maintenance practices outlined in this guide can help you keep your Cat batteries in peak condition. Your Cat dealer is ready to help with questions, service, or just some advice along the way. We're built to put you in control.

Call your Cat dealer for more information.

LET'S DO THE WORK.™

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