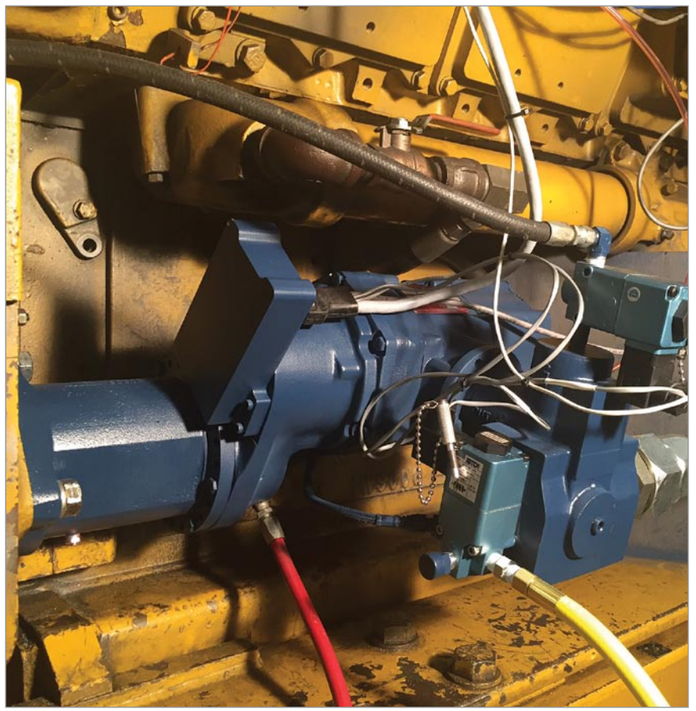
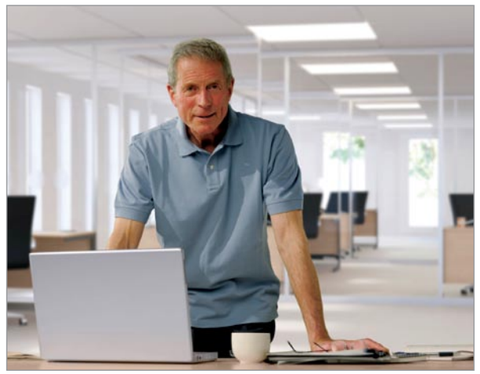
TDI *TURBOGUARD*™ | SMART START SYSTEM

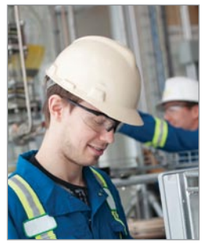
ANOTHER TDI *TURBOTWIN*™ RELIABILITY BREAKTHROUGH: *TURBOGUARD*™ AIR STARTERS

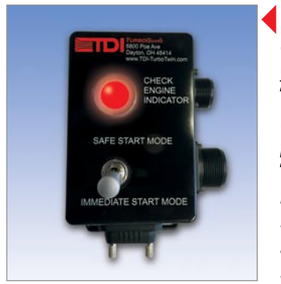
TDI engineers are constantly designing new features and functionality to improve the reliability of engine operations and assure successful starting under the most challenging conditions. The problem of hydrolock has been vexing engine manufacturers for many years. After testing the *TURBOGUARD* system on their own laboratory engines and seeing its split second responsiveness, *TURBOGUARD* was tested at a number of engine manufacturers laboratories around the world. The test results proved 100% positive at every location.

TURBOGUARD will be appearing on a number of OEM engines soon and is available immediately as a retrofit safeguard to any engines where the T100-B and T100-V are installed.









The TurboGuard control box allows you to choose "safe start mode" with TurboGuard protection, or "immediate start mode" for normal starting when you are doing multiple starts or testing.

TECH DEVELOPMENT

Anything Less Than a *TURBOTWIN* Air Starter is a Compromise

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TDI *TURBOGUARD*™ | SMART START SYSTEM

A RELIABILITY BREAKTHROUGH PREVENTING ENGINE DAMAGE & DOWNTIME CAUSED BY HYDROLOCK

This 3 min. informative video explains the cause of hydrolock and how TurboGuard prevents it. View the movie at ***www.tdi-airstarter.com/turboguard*** *or on YouTube by searching TurboGuard*

APPLICATIONS

Workboats & Marine

Power Generation/ Remote Starts

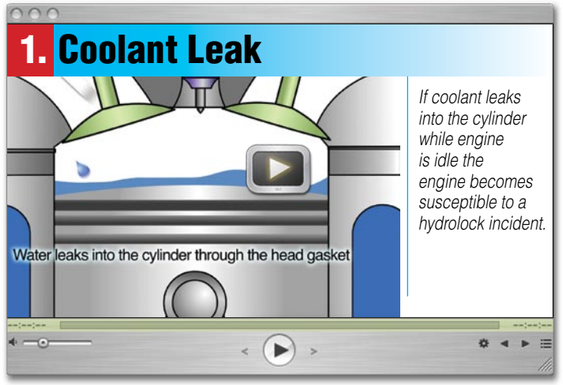
Auxiliary/Emergency Power

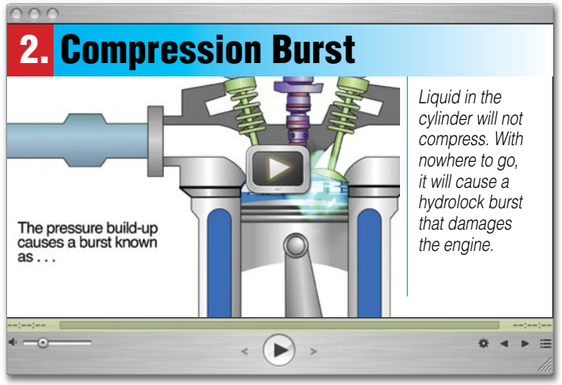
Engines w/Long Periods Between Starts

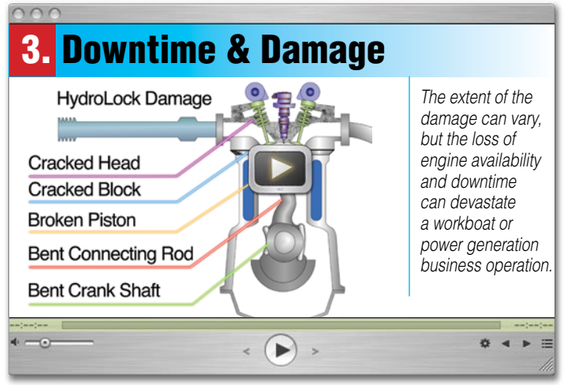
TECH DEVELOPMENT

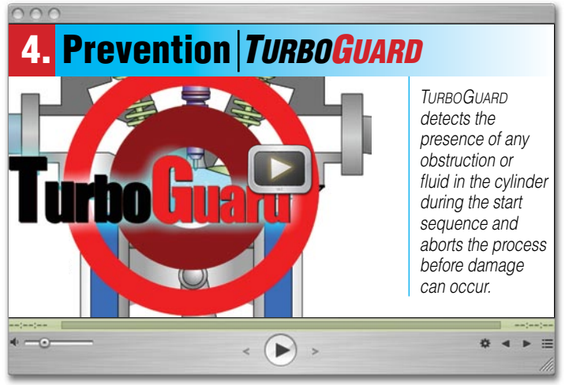
Anything Less Than a *TURBOTWIN* Air Starter is a Compromise

TDI *TurboGuard*™ | FINALLY A PROTECTIVE SAFEGUARD AGAINST HYDROLOCK ENGINE DAMAGE





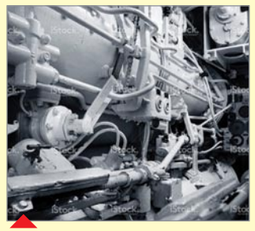




TurboGuard's Soft Start Reduces Wear on Ring Gear. The reduced impact will extend pinion and ring gear life up to three times.

What Applications Have the Greatest Need for TurboGuard?

Workboats & Marine *engines are susceptible to leaking coolant or fluids after being in port for periods of time.*



Engines with Long Periods Between Starts *are candidates for TurboGuard because during those times, the engine is vulnerable to leaking coolant.*

Power Generation/Remote Starts *with no operator present to blow down the engine, TurboGuard is a safeguard.*

Remote Automatic Gas Compression Stations *are often unmanned and have long periods of time between starts — meaning coolant leaks can go unnoticed.*

HOW HYDROLOCK HAPPENS & HOW *TurboGuard* PREVENTS IT

What is Hydrolock?

HydroLock occurs when the engine is started with coolant in a cylinder. The coolant is driven through the cylinder at very high pressures during the compression cycle. Because liquids do not compress, as the pressure builds, there is no place for it to go causing a burst known as HydroLock.

What Damage Does it Cause?

The high pressure burst can cause bent connecting rods, broken pistons, a cracked block, damaged cylinder head, and broken crankshaft. The damage could require a completely new engine. Perhaps the biggest problem is the cost of downtime to your operation as you wait for parts and repair, or have to move the old engine out and wait for the replacement engine to arrive.

How Does TDI TurboGuard Prevent HydroLock?

TDI's *TurboGuard* Smart Starter detects the presence of leaking coolant, extraneous fluids, or any other type of obstruction in the cylinders during the start sequence. *TurboGuard* automatically shuts the starting process down before damage occurs – preventing a hyrdolock incident.

Introducing TDI's Proprietary Smart Starter Control

TDI's innovative smart starter technology has the ability to regulate air pressure, speed, and other variables in such a precise wa it can determine if there are cylinder obstructions and abort before coolant is pushed through the system to cause damage. This is a significant engineering acomplishment because a typical turbine air start cycle goes from 0 to 1500 rpms in just 5 seconds.

How TurboGuard Smart Starting Works

TurboGuard 's intelligent control system has extended the normal five-second cycle to 10 seconds using relay valves, solenoids, and precise control of speed and air pressure. As the engine is slowly rotated, the starter system monitors for anomalies in the process indicating a hydrolock condition. If an obstruction is identified, the starter sequence is aborted. If no obstruction is detected, the engine will be brought to normal crank speed utilizing a "soft-start pressure ramp" to minimize impact torque between starter pinion and engine ring gear. In cases where normal start conditions are apparent, *TurboGuard*s feature a recent start time which allows the protective feature to be by-passed.

TurboGuard Assures a New Level of Engine Reliability

Your engine has many built-in safeguards, but protection against hydrolock is not one of them. With *TurboGuard* there is a new level of protection against the threat of leaking head gaskets, oil from valves, or other obstructions that make their way into a cylinder. Being able to abort the start cycle before damage is done delivers a new level of engine reliability.

TurboGuard is a Safeguard for Your Business

It's estimated that one hydrolock incident can cost between $50,000-$1 million dollars in downtime and replacement costs. *TurboGuard* isn't just a new reliability feature for your start system; it's a quality process safeguard that minimizes the possibility of a catastrophic loss of engine availability. If assuring and protecting the uptime for your fleets, pumping stations, and operations is a core value, choosing *TurboGuard* is a no-brainer.

The TurboGuard Start System Fits All Kinds of Engines

Presently, *TurboGuard* is designed to fit on all large reciprocal engines from 70-300 liters. It fits the same engine market as TDI's T100-B and T100-V models. It's more than just a starter, but a complete start system made up of the turbine air starter, the control unit, integrated relay valves, solenoids and other components.