

Cooling System Training

DETROIT DIESEL

CORPORATION



Copyright 2003 The Penray Companies, Inc.

Understanding and Maintaining Diesel Engine Cooling Systems

DETROIT DIESEL

CORPORATION



Part 1

Understanding Cooling System Requirements

DETROIT DIESEL

CORPORATION





The Functions of Coolant

- ❑ Removes excess heat from the engine.
- ❑ Protects the engine components from corrosion.
- ❑ Protects the engine from freeze damage in cold weather.
- ❑ Prevents wet sleeve liner cavitation in diesel engines.



Introduction to Cooling System Problems

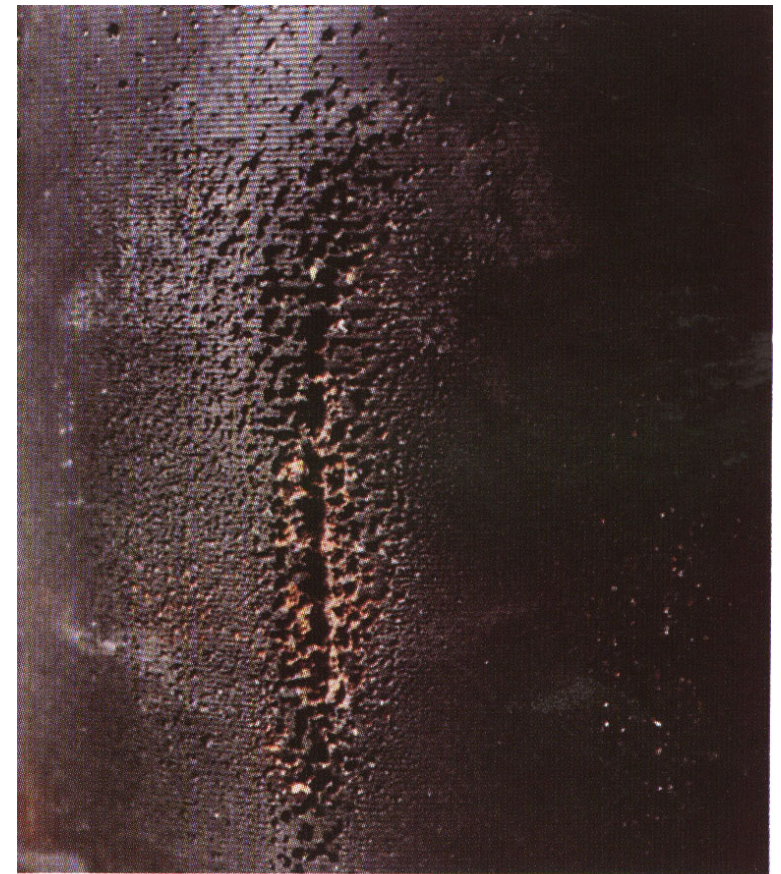
- ☑ **Corrosion family.**
 - ✓ **Cylinder liner cavitation/erosion.**
 - ✓ **Component corrosion.**
 - ✓ **Radiator metal corrosion.**





Cylinder Liner Cavitation-Erosion (Liner Pitting)

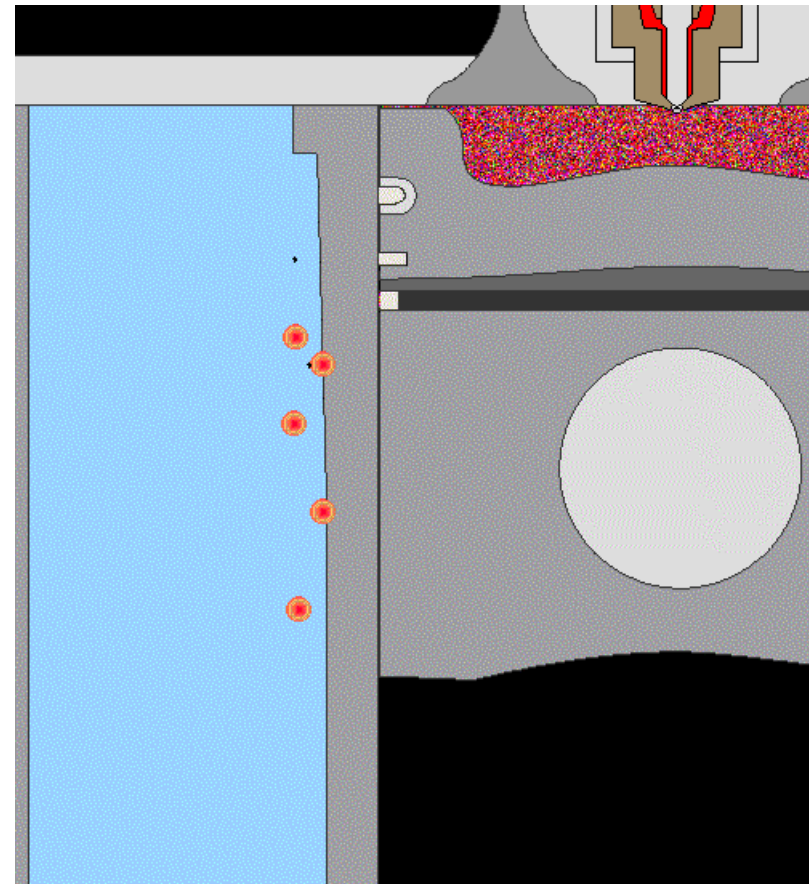
- ☑ This problem happens when air enters the cooling system.
- ☑ It is aggravated by the vibration of the liner caused by the movement of the piston.
- ☑ Nitrite prevents cavitation-erosion.





Cavitation-erosion (Liner Pitting)

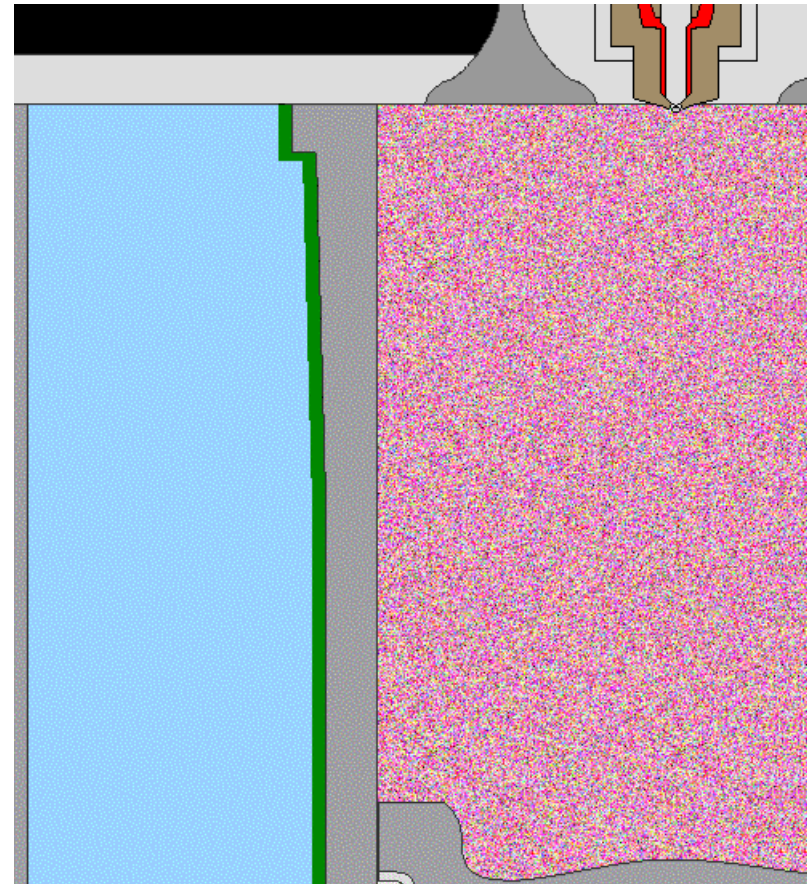
- ☑ In untreated systems, imploding bubbles of air bore through the steel liners.





Cavitation-erosion (Liner Pitting)

- ☑ In treated systems, imploding bubbles of air are blocked by nitrite.

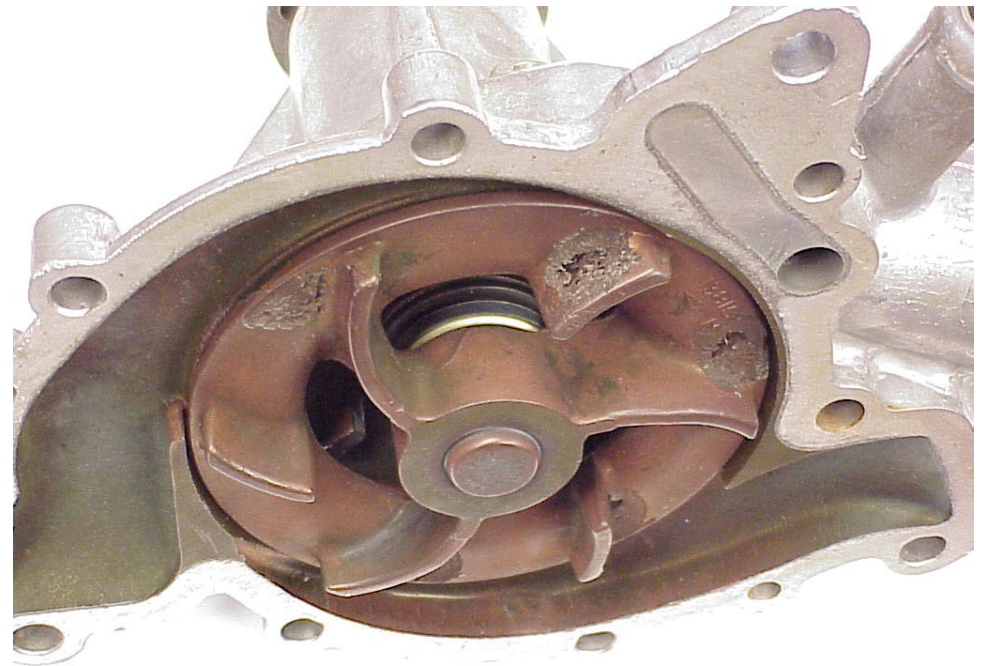




Water Pump Damage

Water pumps may fail in one of two ways:

- ❑ Corrosion or erosion of water pump metal components (pictured).
- ❑ Premature wear of water pump seals from solids in the coolant.



*Water pump from failed
ASTM 2809 test*



Corrosion of the Block or other Engine Components

- ❑ Metals susceptible to corrosion are: Aluminum, Iron, Solder, Steel, Copper, and Brass.
- ❑ To protect the engine from corrosion attack, a well designed coolant inhibitor package must be used.





Radiator Corrosion

- ❑ Direct attack on radiator metals, including solder bloom.
- ❑ Plugging of passages from either unstable inhibitors or corrosion products.

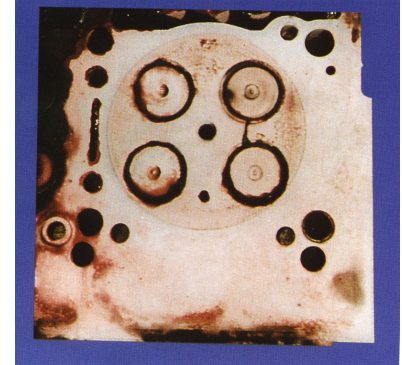




Cooling System Problems

(Cont.)

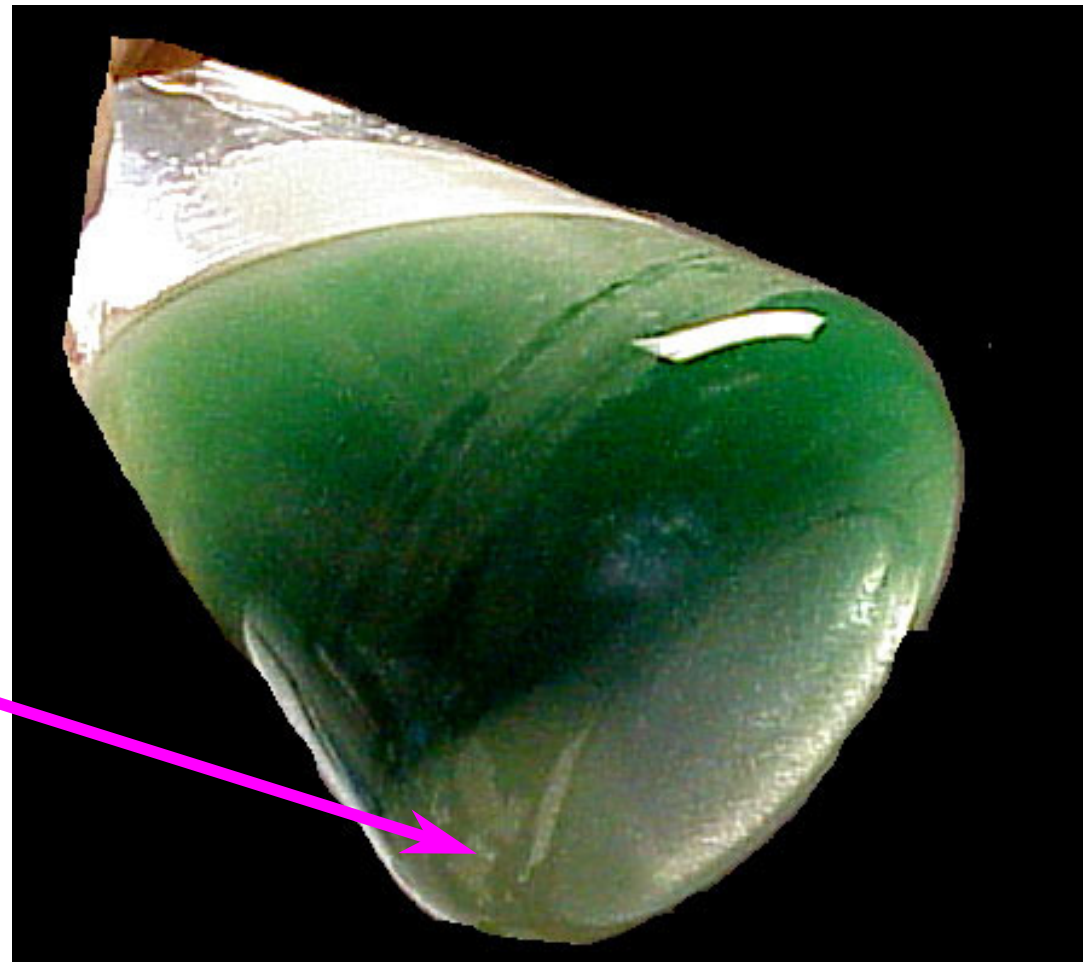
- ☑ **Scale and precipitate family.**
 - ✓ **Water pump seal failure.**
 - ✓ **Radiator plugging.**
 - ✓ **Silicate drop-out (green goo).**
 - ✓ **Scale formation on cylinder heads.**
 - **Overheating.**





Water Pump Seal Failure

- ☑ Solids in poorly formulated coolants may drop out and damage seals.





Drop-Out in Radiators

- ❑ Radiator passages can become plugged by unstable inhibitors, especially phosphate and silicate.
- ❑ Plugged radiators can no longer efficiently dissipate heat to the atmosphere, and the engine may overheat.





Drop-Out (Green Goo)

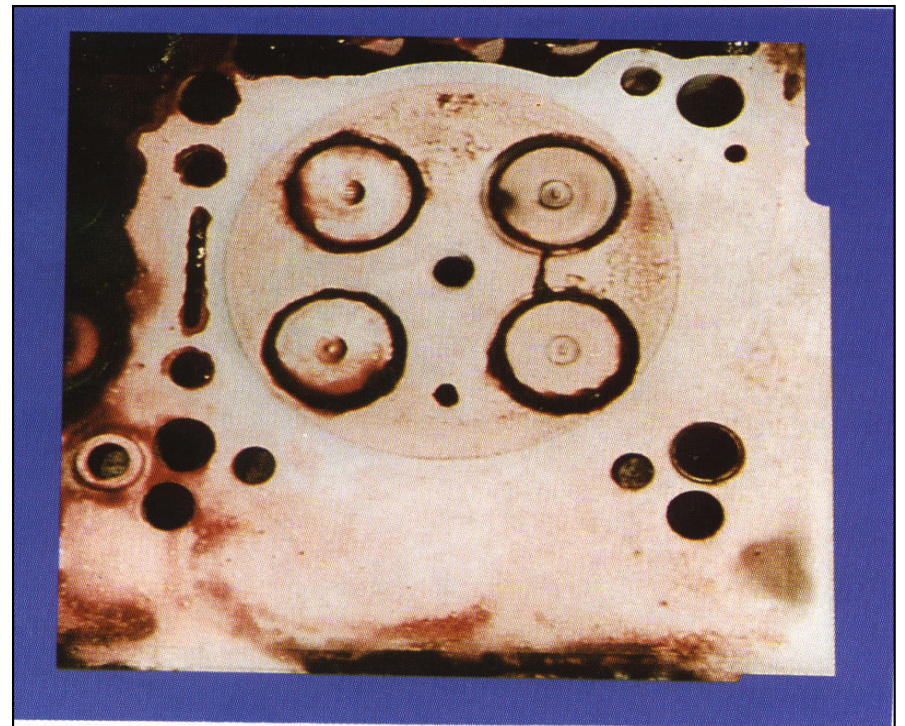
- ❑ Plugged radiators.
- ❑ Plugged heaters cores and oil coolers.
- ❑ Costly downtime and unnecessary wear on engine and cooling system.





Cylinder Head Scale

- ☑ Scale forms from chemicals found in drinking water.
- ☑ This is the problem that is prevented when customers follow DDC water quality recommendations.
- ☑ Scale can totally destroy an engine by causing overheating.





Phosphate (PO₄)

- ☑ Iron protection/pH control.
- ☑ Limited solubility in water and Ethylene Glycol.
- ☑ Does not dissipate.
- ☑ Drops-out easily, especially in the presence of hard water.



Molybdate (MoO_4)

- ☑ Reduces the nitrite concentration.
- ☑ Does not deplete in use, therefore topping off the system adds unnecessary solids.
- ☑ Needs oxygen to function.
- ☑ It is very expensive.
- ☑ The use of Molybdate complicates the evaluation of coolant chemistry.



Total Dissolves Solids (TDS)

- ☑ Solids Contribute To Corrosion.
- ☑ Drop-Out Caused By Solids.
- ☑ Minimizes The Life Of The Coolant.
- ☑ Minimizes The Life Of The Water Pump.

Part 2

Understanding Cooling System Requirements

DETROIT DIESEL
CORPORATION

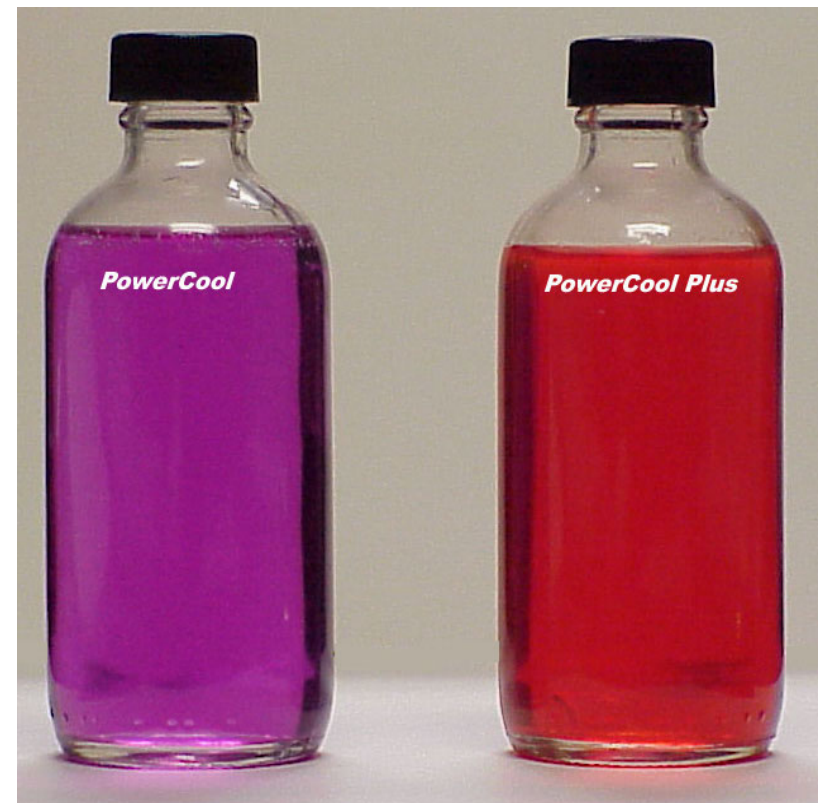




Initial Fill

(Factory-Fill or Replacement After Cooling System Service)

- ☑ **Coolant Composition.**
 - ✓ **Extended Service Antifreeze.**
 - Fully-Formulated Conventional Technology (TMC RP-329 type A).
 - Non-Nitrated Organic Acid Technology (OAT).
 - ✓ **Deionized Water.**





Extended Service Fully Formulated Technology

- ☑ Nitrite
- ☑ Nitrate
- ☑ Silicate
- ☑ Borate
- ☑ MBT/TT

The formulation uses a low silicate and phosphate free technology. It is engineered to protect all of the metals and components in any cooling system. It is the foundation of a Fill-For-Life® coolant program.



Coolant Maintenance

1. Traditional Extended Service Life Program

- ☑ **P.M. interval:**
 - ✓ 20,000 miles.
 - ✓ 3 months.
 - ✓ Or 500 operating hours.
- ☑ **Test the coolant with PowerTrac test strip.**
 - ✓ Nitrite concentration.
 - ✓ Freeze point (glycol concentration).
 - ✓ Molybdate.





Coolant Maintenance

1. Traditional Extended Service Life Program (continued)

- ☑ Add antifreeze if the freeze point is weak, add water if the freeze point is too strong.
- ☑ Finally, add coolant additive (or change filter) only if the nitrite concentration is less than 1,200 ppm.



Coolant Maintenance

2. Extended Service Life Need-Release Filter Program

- ☑ With proper initial fill coolant, spin on the Need-Release filter.





Coolant Maintenance

2. Extended Service Life Need-Release Filter Program (continued)

- ❑ At oil P.M. intervals, use a PowerTrac test strip to check coolant condition.
- ❑ Change the Need-Release filter at:
 - ✓ 15 months or
 - ✓ 150,000 miles or
 - ✓ 3,000 operating hours.
- ❑ Replace coolant at 600,000 miles.

Part 3

POWER COOL

Products

DETROIT DIESEL

CORPORATION





POWERCOOL

Extended Service Life Cooling System Products:

- ✓ ***POWERCOOL***
Extended Service Fully-Formulated
Antifreeze
- ✓ ***POWERCOOL Need-Release***® Extended
Service Life Filters



POWERCOOL

Advanced Cooling System Products:

- ✓ ***POWERCOOL 3000***
 - Supplemental Coolant Additives
 - Liquids
 - Spin-On Filters
- ✓ ***POWERCOOL 2000***
 - Supplemental Coolant Additives
 - Liquids
- ✓ ***POWERCOOL 3149***
 - Supplemental Coolant Additives for Series 149
 - Liquids
 - Spin-On Filters



***POWER*COOL**

Common Features

- ✓ **Low in Total Dissolved Solids.**
- ✓ **Premium Cooling System Protection.**
- ✓ **Phosphate-free technology to optimize water pump life.**
- ✓ **Distinctive color.**



POWERCOOL

**This is Your Engine's Liner
Without ~~POWER~~ COOL[®]**

ANY
?
QUESTIONS





POWERCOOL 2000 SCA

- ❑ Keeps “water only” systems running clean.
- ❑ Controls metal corrosion, cavitation erosion and formation of scale deposits.
- ❑ Adds minimum solids to the cooling system, optimizing the water pump life.
- ❑ Available only as liquid.



POWERCOOL 3000 SCA

- ❑ Contains corrosion inhibitors and *Stabil-Aid*®.
- ❑ Protects all metals against corrosion and cavitation.
- ❑ Prevents coolant gel.
- ❑ Prevents hot surface scale.
- ❑ Reduces downtime, maintenance expense and engine wear.
- ❑ Available in 6 sizes of spin-on filters and in 5 liquid containers.



POWERCOOL 3149 SCA

- ❑ Formulated specifically for SERIES 149 Engines.
- ❑ Silicate-free and phosphate-free.
- ❑ Available in liquid or convenient spin-on filters.
 - ✓ 4 oz. Maintenance 23518069
 - ✓ 32 oz. Pre-charge 23518070
 - ✓ 53 oz Pre-charge 23518071



POWERCOOL

Extended Service Antifreeze/Coolant

- ☑ **Fully-Formulated.**
(Requires no SCA pre-charge)
- ☑ **Low silicate, non-phosphate.**
formula eliminates gel problems.
- ☑ **Protects against hot surface scale**
formation.
- ☑ **Excellent cylinder liner protection.**
- ☑ **Protects for the life of the engine.**

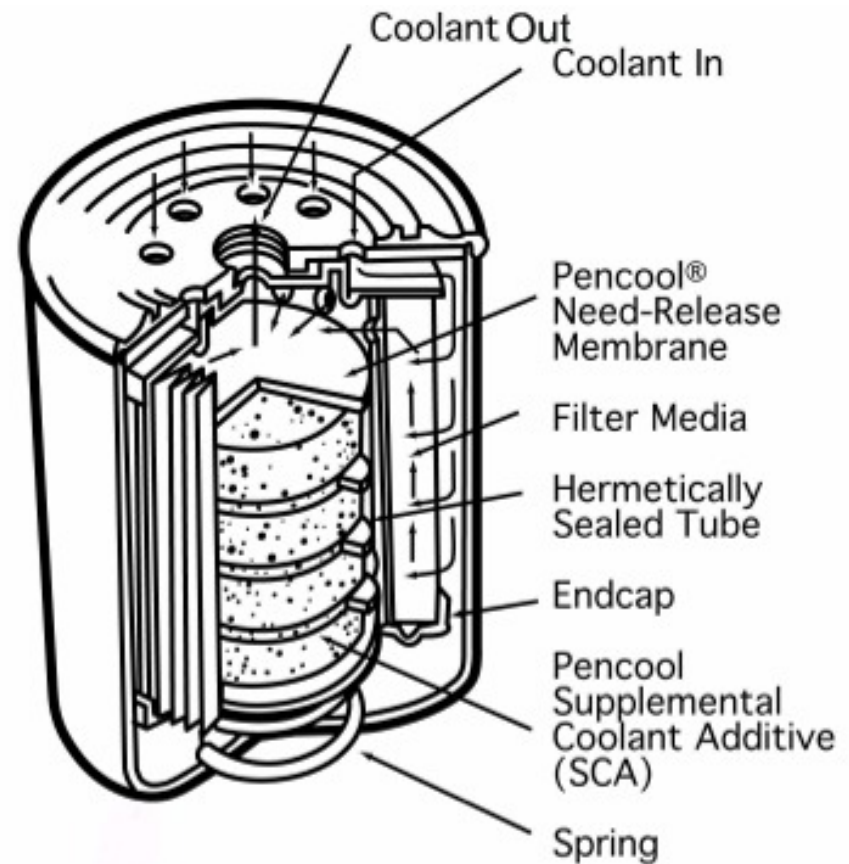


POWERCOOL

Extended Service Life **Need-Release**®

- ☑ **2 Sizes:**
 - ✓ **Cooling System Capacity**
 - 1-8 Gallon 23516488
 - 8-20 Gallon 23516489

- ☑ **150,000 miles, 15 months, 3,000 hours between changes.**





POWERCOOL

Extended Service Life **Need-Release**[®]

- ❑ **POWERCOOL** Extended Service Life Antifreeze used with **POWERCOOL Need-Release** filters, tested regularly, can run up to 600,000 miles.
- ❑ **Need-Release** lasts 150,000 miles, 15 months, or 3,000 hours.
- ❑ Releases SCA as needed, maintaining proper inhibitor levels.
- ❑ Reduces costs.
 - ✓ A Single **Need-Release** Filter replaces up to 10 standard filters.

***POWER*COOL** Fill-For-Life®
Extended Service Life
Coolant Maintenance Program

DETROIT DIESEL

CORPORATION





Fill-For-Life[®] Program

- ☑ Fully-formulated Extended Service **POWERCOOL** antifreeze / coolant.
(TMC RP-329 Type A or ASTM D-6210 specification).

- ☑ Extended Service Life *Need-Release* installed.
 - ✓ Change at 15 months/150,000 miles.

- ☑ *PowerTrac* test strips.
 - ✓ To detect road service invasion.



Summary

- ❑ Use Extended Service Life **POWER COOL** antifreeze and pure water.
- ❑ Maintain with Extended Service Life *Need-Release* or **POWER COOL** SCAs.
- ❑ When coolant change is necessary, recycle with reverse osmosis, fractional distillation, or ion exchange technologies.
- ❑ DDC approves this coolant program in service for 600,000 miles.
- ❑ Lowest operating cost.

Thank You

DETROIT DIESEL

CORPORATION



Copyright 2003 The Penray Companies, Inc.