



The puraDYN<sup>®</sup>  
Bypass Oil Filtration System

Summary Brief

---

## ABSTRACT

The **puraDYN**® Bypass Oil Filtration System (hereafter **puraDYN** System) is an advanced and proven technology that delivers continuous clean oil to internal combustion engines, automatic transmissions and hydraulic systems. By maintaining optimal lubrication characteristics, vehicle responsiveness and sustainability are maximized on a continuous basis. The **puraDYN** System safely and significantly extends oil drain intervals and prolongs engine life both critical to maintaining vehicle uptime. The purpose of this summary brief is to present the value and benefits of the **puraDYN** System based upon more than 15 years of both real world and laboratory testing.

Engine oil does not wear out – it just gets dirty<sup>1</sup>. The standard full-flow filter cannot, by itself, filter contaminants to a 1-micron level (the point at which there is a significant reduction in engine wear rates)<sup>2</sup>. The patented **puraDYN** System's fine filtration process, which filters solid contaminants to below 1 micron; eliminates liquid and harmful gaseous contaminants; and replenishes the base additives thru a patented additive package incorporated in the replacement element; continually provides clean oil to the engine and eliminates the causes of dirty oil (i.e., contamination saturation and additive depletion).

## INTRODUCTION

A responsive and sustainable fleet requires peak engine performance in a variety of environments. Under demanding conditions, oil becomes so contaminated with solid, liquid and gaseous contaminants, as well as depleting its base additive package, that it loses its ability to lubricate, cool and seal moving components. Thus, oil change intervals become critical to maintaining engine performance. Oil change logistics require frequent and time-consuming fleet downtime. The **puraDYN** System addresses these problems by keeping lubricating oil free of contaminants and replenishing the base additives during use and allowing the engine to maintain peak performance through extended intervals. Extended intervals facilitate successful missions by reducing fleet downtime and maintaining fleet availability.

## BENEFITS

The **puraDYN** Bypass Oil Filtration System essentially revitalizes oil real-time, which gives the fleet a distinctive advantage.

- Continuous engine oil refinement
- Extends oil drain intervals
- Reduces new oil purchases up to 90%
- Technology can decrease the generation of waste oil by up to 90%, and in doing so, decreases the demand for new oil
- Fuel Consumption Savings from peak engine performance provided thru continuously clean oil<sup>3</sup>
- Significant cost savings through reduced oil changes, labor and vehicle downtime
- Enhance engine reliability and durability

---

## ENVIRONMENTAL IMPACT

The California Environmental Protection Agency certified the **puraDYN** System as a 'Pollution Prevention' Technology: In its certification, the CAL EPA states, in part, "*The **puraDYN**<sup>®</sup> System has been shown to be an effective means of extending engine oil change intervals without adversely affecting engine wear or performance. The Bypass Oil Filtration System filters a portion of the total oil flow, removing particulate matter, water, coolant, and fuel. Extended drain intervals reduce the use of new oil, generation of used oil, and potential of spills while draining and handling used oil.*"

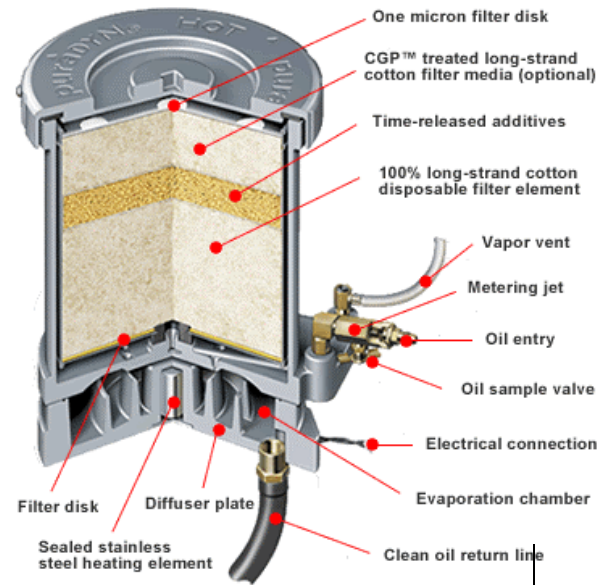
**PuraDYN** FIELDDED and ACCEPTED at the following GOVERNMENT AGENCIES and INDUSTRY COMPANIES:

- Asplundh Tree Expert Company
- Broward Co. (FL) Fleet Services
- City of Dallas (TX)
- City of Houston (TX)
- City Public Svcs. (San Antonio, TX)
- Dole Fresh Fruit Co.
- DOT – Florida
- DOT – Michigan
- DOT – Texas
- Freightliner Trucks
- Ft. Worth Carriers (Dillard's)
- Hare Express
- Strategic Alliance with Honeywell/FRAM<sup>®</sup>
- Jefferson Co. (CO) Schools
- Kirby Inland Marine
- Miami Airport
- Miami-Dade (FL) Fire Rescue
- Miami-Dade (FL) GSA
- Montgomery Co. (MD)
- PACCAR (Kenworth & Peterbilt trucks)
- P & O Ports
- Rinker Materials
- San Antonio (TX) Water
- United Rentals, Inc.
- US GSA
- Vulcan Chemicals

- Initial CAL EPA certification in 1994, and re-certification in 1998 and 2003  
<http://www.calepa.ca.gov/CalCert/CertifiedTech/puraDYN.htm>
- Under evaluation by US Department of Energy (FreedomCAR and Vehicle Technologies Program)  
<http://avt.inel.gov/obp.html>
- In use by General Services Administration (GSA)

## TECHNOLOGY LEADERSHIP

**HOW IT WORKS:** Contaminated oil enters through the metering jet at a slow measured flow rate. The oil then passes through the replaceable filter element, where total base number (TBN) additives are replenished and the unbleached, CGP<sup>®</sup>-treated, long-strand cotton fibers, tightly compressed to resist channeling, remove contaminants down to less than one micron, while neutralizing acids and sulfur compounds. The filtered oil then enters the heated evaporation chamber, where fuel vapors and water are evaporated and immediately vented. The clean oil is then gravity-fed back to the sump. The **puraDYN<sup>®</sup>** bypass oil filtration system does not affect the engine's oil flow or pressure. It does not replace the conventional full-flow filtration system – it enhances and works in conjunction with it.



The **puraDYN** System was designed with a number of key technologies:

- 1) Evaporation chamber with thin-filming geometries. Induces rapid vaporization of unwanted liquid and gaseous contaminants such as water, fuel vapors, etc. Such contaminants are subsequently vented to atmosphere (or engine induction system) through the evaporation chamber vent valve.
- 2) Process for chemical grafting (patent-pending; CGP<sup>®</sup>) filtration media has been proven to attract and hold solid contaminants below 1 micron.
- 3) Replenishes base additives using a time released additive package to maintain oils proper viscosity and total base number (TBN).
- 4) Reliable/Durable design – Die-casted aluminum construction for weight optimization, heat transfer, and cost effectiveness, manufactured within an ISO 9001:2000 Certified Quality Management System.
- 5) Intellectual Property – Sole-sourced technology; no other mobile bypass filtration system can filter solid contaminants to below 1 micron, evaporate liquids and harmful gaseous contaminants and replenish additives to significantly extend oil change intervals.

---

## FIELD TESTING

Department of Energy:

FreedomCAR & Vehicle Technologies Program Oil Bypass Filter Technology Evaluation  
Real world testing by the Idaho National Engineering and Environmental  
Laboratory (INEEL) Transportation Technology and Infrastructure Department  
**puraDYN**<sup>®</sup> System - positive results to date - visit <http://avt.inel.gov/obp.html>

Aggreko (Global Power and Generator equipment manufacturer)  
Extensive Test Program 1999-2000+  
Now Standard on Generators (Cummins engines)

Vulcan Chemicals (Global Chemical Manufacturer and Distributor)  
Fleet Testing; Standard on Fleet vehicles; 600K+ Miles w/o oil change on some  
trucks  
Ongoing Product Improvement Evaluations

Iveco (UK) – Defense/Aerospace Contractor  
Comprehensive Test Program (2002, 2004)  
Now standard on Generators (Iveco engines)

## INDEPENDENT LAB TESTING

Southwest Research Institute (2000, 2001, 2002)  
Filter Capacity and Contaminant Removal SAE HS806-95  
Average Efficiency Ratings 93.2% – 99.8%

Note: Lab results for mechanical, hazardous material, and intellectual property tests are available on an as needed, confidentiality agreement, basis.

---

## SUMMARY

**paraDYN** Filter Technologies Incorporated manufactures, markets and distributes worldwide the **paraDYN** system for use with substantially all internal combustion engines and hydraulic equipment that use lubricating oil. The **paraDYN** system continuously cleans oil through a patented, sole source, advanced technology utilizing a unique high-efficiency filtration and evaporation process.

As a result of the oil being kept constantly clean, the **paraDYN**<sup>®</sup> filter element is simply replaced and an oil analysis sample is taken at the regular scheduled maintenance time. In addition, the **paraDYN** System protects the environment by eliminating the need to dispose of used oil, a primary source of hazardous waste, and thereby minimizes possible EPA issues while also conserving oil usage.

<b>paraDYN<sup>®</sup> System Benefits</b>
1. Significant and safe extension of oil drain intervals
2. Up to 90% decrease in new oil purchases
3. Up to 90% decrease in waste oil generated
4. An extension of engine life due to less wear / fewer overhauls
5. Savings from replacement of worn engine parts
6. Less service downtime
7. Increased human and equipment productivity
8. Energy conservation / fuel efficiency

In conclusion, the **paraDYN** System is the only patented, high-efficiency bypass oil filtration system that addresses the three major issues that cause oil to lose its characteristics to cool, lubricate and seal by:

- Filtering solid contaminants to below one micron, incorporating the patent-pending CGP<sup>®</sup> process for chemical grafting for enhanced soot filtration
- Effectively removing liquid and harmful gaseous contaminants through a heated evaporation chamber, and
- Replenishing base additives using a time-released additive package to maintain oil's proper viscosity and TBN.

Technology leadership has been the key for **paraDYN** to provide substantial value to our end-users.

---

## APPENDIX A:                    **puradYN**<sup>®</sup> SYSTEM FUNCTION

The **puradYN** System is unique in its inherent ability to address all forms of contaminants that occur in oils utilized in internal combustion engines and hydraulic systems.

- **Solid contaminants** - for example wear metals, soot (carbon), dirt (silicon), sludge (glycol), etc.
- **Liquid contaminants** - water, fuel (NB light hydrocarbons), etc.
- **Gaseous contaminants** – sulfur dioxide, sulfur trioxide, nitrous oxide etc.
- **Acidic contaminants** – sulfuric acid, nitric acid. (Typically present as a result of reaction between liquid and gaseous contaminants).

To effectively remove these contaminant groups – and (of critical importance to oil quality) prevent the formation of certain contaminants - the **puradYN** System incorporates the actions of: -

- **Filtration**
- **Evaporation**

The **puradYN** System is the only patented, high-efficiency bypass oil filtration system that addresses the three major issues that cause oil to lose its characteristics to cool, lubricate and seal by:

- Filtering solid contaminants to below one micron, incorporating the patent-pending CGP<sup>®</sup> process for chemical grafting for enhanced soot retention
- Effectively removing harmful gaseous and liquid contaminants through a heated evaporation chamber, and
- Replenishing base additives using a time-released additive package to maintain oil's proper viscosity and TBN

### **FILTRATION**

On entering the **puradYN** System, oil will initially pass through a filter consisting of long strand, unprocessed cotton. (Note CGP<sup>®</sup> – under separate heading).

We need to recognize the reasons for using this (cotton) filter medium as well as the effect of fine filtration combined with essential chemical reactions that take place in the cotton filter.

Unprocessed cotton provides an excellent filtration material and is the basis for the ability of the **puradYN** System to provide an absolute filtration capability of below 1 micron.

#### **Why below 1-micron filtration? :-**

1. Particulate size of less than one micron will not have an abrasive effect in an engine or hydraulic oil.
2. Most quality engine oils will keep solid contaminants (such as sludge) in suspension to a particle size of 3-4 microns. When the particle size agglomerates to greater than this the

---

contaminant will fall out of suspension to be deposited in the sump or other areas of the engine, with resultant detrimental effect on the qualities of oil and engine performance.

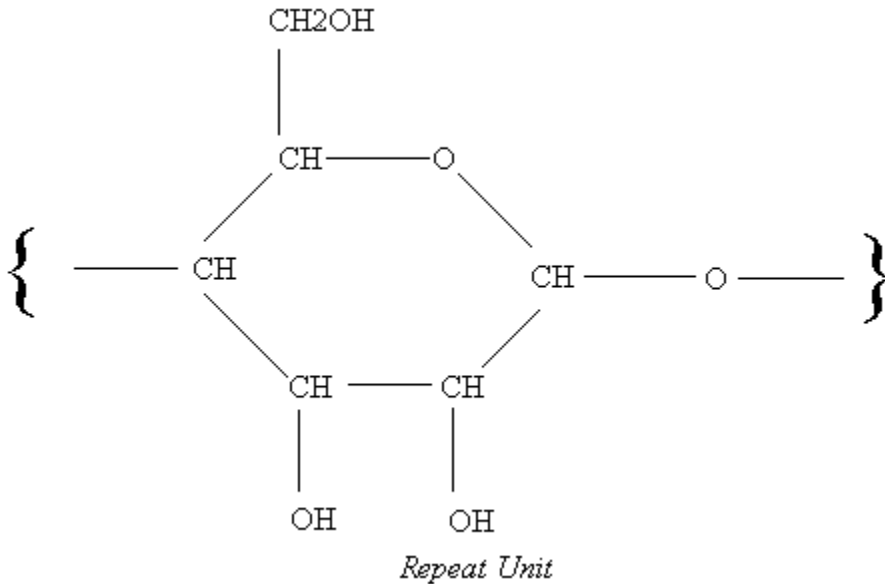
**Cotton - background information.**

Cotton is a form of natural fiber made predominantly from cellulose (approx. 90%). However other constituents are also present, which are critical to the function of the **puraDYN** System. Cellulose itself is a polysaccharide consisting of long chains of carbohydrate repeat units.

Cotton is made up of the following constituents: -

<b>Constituent</b>	<b>Proportion</b>
Cellulose	85-90%
Water (absorbed)	6-8%
Protein, wax	2-8%
Other minerals (Calcium, magnesium, etc.)	1%

Cellulose is the chief structural material of the vegetable world. The purest forms occur naturally in a fibrous state. The simplest fundamental cellulose repeat unit is: -



The above molecule would be part of a long chain, typically with >10,000 repeat units.

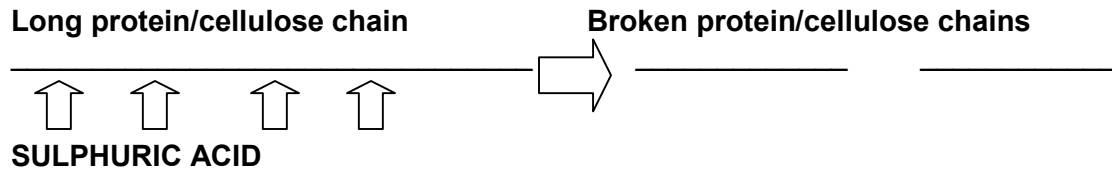
**Contaminants – sulphur oil impurities**

Sulfur is found in varying amounts in fuels used by internal combustion engines worldwide. Sulfur compounds typically occur in oil as a by-product of combustion in the form of sulfur dioxide (SO<sub>2</sub>) and sulfur trioxide (SO<sub>3</sub>). This is absorbed into the oil in gaseous form and is then converted to acid by reacting with water, due to the heat and pressure of the engine. Acids can then trigger polymerization of the oil or other forms of degradation. The polymerization will

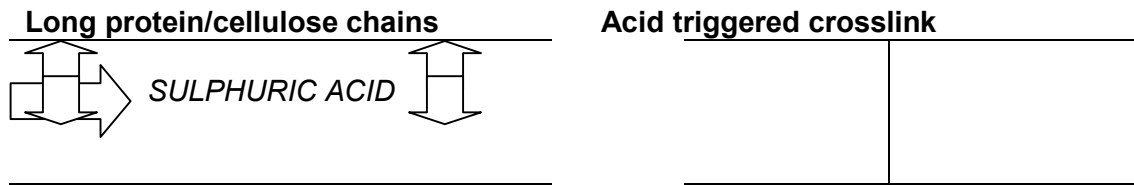
cause the oil to become much more viscous and thus its ability to shear and instantly flow will greatly diminish.

The **puraDYN** System can obviate this effect: -

1. Due to the heat and pressure generated by an internal combustion engine sulfur dioxide will react with water contaminant in oil to form sulfuric acid. Sulfuric acid in the oil will enter the **puraDYN** filter and will react with the protein and cellulose, causing protein and cellulose degradation by attacking the linkages, which in turn retain the acid through the formation of chemical bonds.



2. The acid can also cross-link the protein and cellulose chains; i.e. as well as breaking down the main chain it can also link existing chains: -



The **puraDYN** System uses cotton, which has traces of protein and water as opposed to pure cellulose. The reason for cotton being used is that protein will react more readily with, and retain, acid contaminants.

In summary, the presence of the water in the engine oil will convert virtually all sulfur dioxide / trioxide present into a chemically reactive entity (i.e. the acid), which will in turn react with the protein in the ways described above, thereby removing it from the oil and permanently holding it within the cotton. With the **puraDYN** System the acid is retained in the filter chamber, thereby avoiding subsequent acid induced degradation of the oil in the engine and damage to engine components.

## EVAPORATION

Equally important to the effect of filtration is that of evaporation.

### **Removal of Liquid and Gaseous contaminants**

It is understood that water is present in oil due to condensation or as a by-product of combustion. It is also understood that the heat of the engine will evaporate water. However, critically, the evaporative action takes time due to the fact that, in an internal combustion engine, there is a large volume of oil relative to surface area.

We engender the opposite effect with the heated diffuser plate in the **puraDYN** System – i.e. a small volume of oil relative to surface area – this is known as the **“thin film evaporation**

---

**effect”** and is critical to the performance of the **puraDYN** System in removing and, vitally, preventing the formation of harmful contaminants.

We have discussed the effect of the cotton filter in the **puraDYN** System in addressing acid contamination, however, it would obviously be of greater benefit to oil condition (in terms of maintaining alkali additive levels and the fundamental ability of the oil to flow and shear) if acid build up was prevented in the first place.

This is achieved by the **puraDYN** System due to the evaporation chamber – water and sulfur dioxide / trioxide will pass through the filter and flow over the diffuser plate. This is where the thin film evaporation effect will allow the release of both liquid contaminant (water) and gaseous contaminant (SO<sub>2</sub> & SO<sub>3</sub>). Liquids and gases are evaporated by the same process, preventing the formation of sulfuric acid; the same will also apply to nitric or other acids that might be formed.

In general terms: - ***Prevention is better than cure.***

Due to this effect alkali additives in engine oil – calcium and magnesium – will not be depleted and the condition of the oil will remain stable.

Aluminum is the material used in the evaporation chamber due to its ability to quickly and uniformly radiate heat generated by the heating element. **Note:** - the **puraDYN** System will not add heat to engine or hydraulic oil – tests have proven that hydraulic oil entering the system at 50°C will exit at the same temperature; on engine applications a slight cooling effect (+/- 0.5°C) is noticed.

---

APPENDIX B:

REFERENCE DOCUMENTATION

<sup>1</sup>SAE Publication # 942032

Impact of Electric Mobile Oil Refiners on Reducing Engine and Hydraulic Equipment Wear and Eliminating Environmentally Dangerous Waste Oil

<sup>2</sup>SAE Publication # 660081

A Modern Approach to Piston Ring-Bore Assembly Wear Determination

<sup>3</sup>SAE Publication # 831317

Extending Engine Life and Reducing Maintenance through the Use of a Mobile Oil Refiner