

CYTEC



PC Defoamers

Defoaming Technology for
Synthetic and Petroleum
Fluids, Oils and Lubricants

**GLOBAL PRODUCT GUIDE –
Properties and Uses**

About Us

From defining more efficient processes for mining customers to developing new additives for polymer-based alternatives to wood and metals, the product lines of Cytec Specialty Chemicals are unified in their dedication to customer-driven innovation.

Working closely with our customers, we develop revolutionary technologies that enable them to improve performance and productivity, enter new markets, and refine new applications. How to improve mine profitability or coatings efficiency in the face of important environmental concerns? How to develop polymers that really stand up to UV light? How to use phosphines to create better, safer biocides and fumigants for agriculture? Our technology and sales teams work on-site with customers every day to address today's business challenges and troubleshoot tomorrow's.

The applications are diverse, but the commitment is uniform: finding better solutions for customers through continual research, ongoing collaboration and a passion for innovation.

An Expansive Portfolio

Cytec Specialty Chemicals is a complete solution provider for customers requiring high-value surface technologies in industries that include industrial coatings, automotive, architectural, wood and paper, graphics, adhesives and opto-electronics.

We offer our customers advanced and diverse products and technologies for surfaces with an emphasis on environmentally friendly products such as UV/EB curable resins and additives, powder coating resins and additives, as well as waterborne and solventborne liquid coatings resins and additives. We are committed to working with our customers to develop environmentally advanced solutions and we are dedicated to open communication concerning the safe handling, distribution, use and disposal of the products we make.

* Registered Trademark or Trademark

A Focus on Customer Satisfaction

Cytec Specialty Chemicals operates a globally integrated set of order fulfillment IT systems and processes. All Spec Chem personnel in the order fulfillment processes are dedicated to delivering customer satisfaction through reliable and cost-effective supply of product to our customers. Cytec Spec Chem has specialized personnel in Customer Service, Procurement, Manufacturing, Planning and Logistics to achieve this goal. In addition to timely and accurate order fulfillment, there is an equally important focus on maintaining safety and protecting the environment at all steps in the process, from the procurement of raw materials to the delivery of finished goods to the customer's door.

Dedication to Operational Excellence

Cytec's Spec Chem Manufacturing Organization operates globally to provide superior service to our customers in all regions. Our vision of operational excellence brings value to our customers through ongoing, continuous improvement initiatives, including Lean Manufacturing, Six Sigma Principles, and Best Practice Engineering. Our value proposition is driven by excellence in our Safety, Environmental, Quality Systems and Employee Development Programs. We are structured by business technology, which enables our sites to work transparently with R&D, Customer Service and the Businesses, to share best practices across common processes. We also are able to gain leverage from overall global manufacturing synergies to most efficiently meet customer needs.

Key Product Lines

- Liquid Coating Resins and Additives
- Mining Chemicals
- Phosphine and Phosphorus Specialties
- Polymer Additives
- Powder Coating Resins and Additives
- Pressure Sensitive Adhesives
- RADCURE* UV/EB
- Specialty Additives
- Specialty Urethanes

Key Words and Abbreviations 1

Introduction..... 2

Products, Properties, Features3-4

Performance and Application5-7

Test Methods..... 8

Troubleshooting 9

Contact Us..... **Back Cover**

Key Words	<i>Abbreviations</i>
SUS	Saybolt viscosity, Saybolt universal seconds
HDC	Heavy-duty crankcase oil
HDD	Heavy-duty diesel
PCMO	Passenger car motor oils
ATF	Automatic transmission fluid
PAO	Poly alpha olefin synthetic lubricant
VOC	Volatile organic compounds
HAPS	Hazardous air pollutants
PPM	Parts per million
FOD	Form of delivery
ISO 32	A standard low-viscosity grade hydraulic fluid
CPS	Centipoise viscosity

2 Introduction

Cytec PC defoamers effectively reduce or prevent foam formation in non-aqueous organic systems such as lubricants and oils. These petrochemical (PC) and synthetic lubricant defoamers are available in two convenient forms: a 40% active solution in a hydrocarbon solvent (PC 1244*, PC 1644*, PC 1844*, and PC 2544*) and as a viscous liquid which is 100% active (PC 1344*).

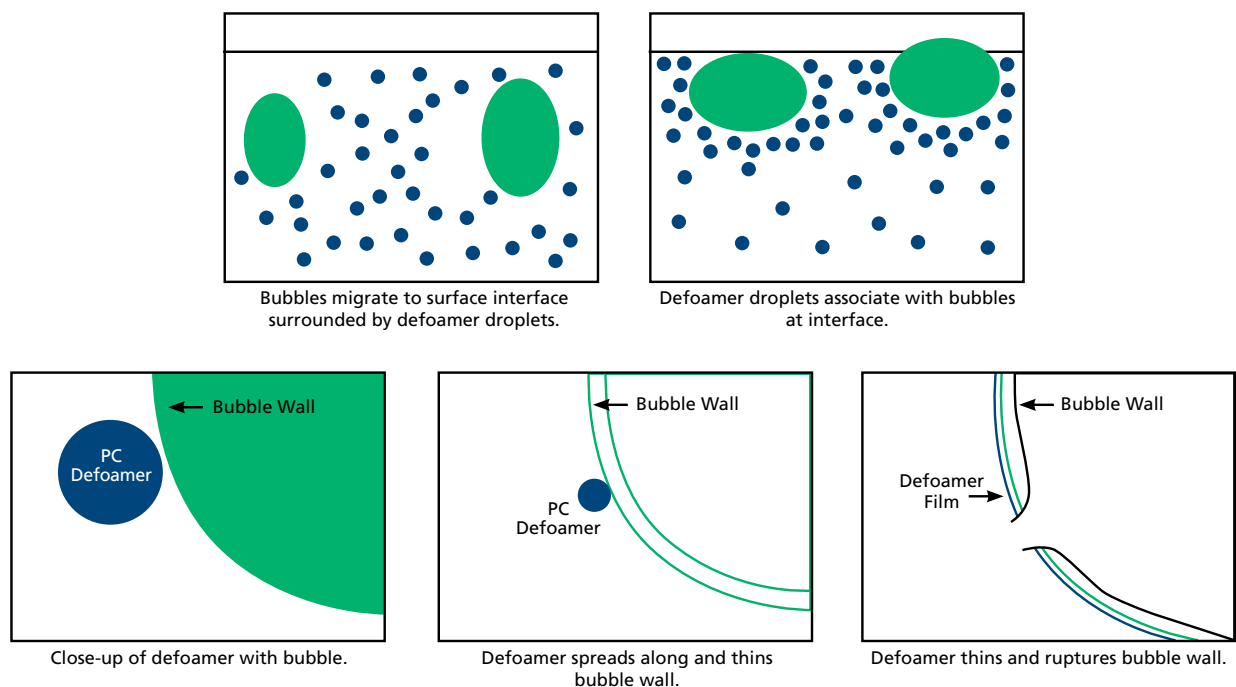
All are silicone-free. As received, they are stable during prolonged storage of four years or more. The physical properties for the PC defoamers are included in the chart “PC Defoamers for Oils and Lubricants” on the next page. For specific properties of these products, please refer to their data sheets.

PC defoamers effectively defoam both synthetic and petroleum systems due to their surface active

nature and limited compatibility. In order to effectively prevent foam formation and quickly break any foam that has formed, the defoamers exhibit a surface tension that is lower than the surrounding fluid, lubricant or oils. The optimum particle size, to ensure efficient product performance and long-term stability in a formulated oil, is 1 to 10 microns.

Due to the differential in surface tension between the defoamer and the fluids, oils or lubricants, the defoamer particles migrate to the surface to prevent foam formation. As materials flow from areas of low-surface tension to high-surface tension, fluid will flow away from the defoamer particle. A thinning of the bubble wall occurs until pressure differences become great enough to cause a rupture of the lamella of the air bubble. See *Figure 1* below.

Figure 1: Foam Bubble Formation and Rupture in Presence of Foam Inhibitor



* Registered Trademark or Trademark

PC Defoamers for Oils and Lubricants

Product	Properties								
	Solids, %	Viscosity, SUS, 38°C	Viscosity, Centapoise, 25°C	Solvent	Refractive Index, 25°C	Color, APHA max	Flash Point, °C	Specific Gravity, 16°C	Dosage/ppm**
PC 1244*	38-42	100-300	30-80	Hydrocarbon	1.4375-1.4420	150	59	0.84-0.86	150-500
PC 1344*	100		60,000-136,000		1.4645-1.4670	80	138	0.99-1.03	100-150
PC 1644*	38-42	150-330	30-80	Hydrocarbon	1.4380-1.4405	150	63	0.84-0.86	50-500
PC 1844*	38-42	400-1600	100-600	Hydrocarbon	1.4410-1.4445	150	65	0.84-0.86	150-250
PC 2544*	38-42	150-400	40-150	Hydrocarbon	1.4400-1.4420	150	71	0.84-0.86	50-500

**Recommended starting point. Optimization of dosage and incorporation is recommended.

Product	Applications														
	Sequence I	Sequence II	Sequence III	Sequence IV	Air Release	Group I	Group II	Group III	Turbine	Gear	Hydraulic	Auto Crankcase	HDDC	ATF	Synthetic Lubricants
PC 1244*	●	●	●		●	●	●	●	●	●	●	●	●	●	
PC 1344*	●	●	●		●	●	●	●	●	●	●	●	●	●	
PC 1644*	●●	●	●		●	●●	●	●	●●	●	●●	●	●	●●	
PC 1844*	●	●●	●●	●●	●●	●●	●	●	●●	●●	●	●●	●	●●	
PC 2544*	●●	●●	●●	●●	●	●●	●●	●●	●●	●●	●●	●●	●●	●●	●

● Recommended ●● Highly Recommended

* Registered Trademark or Trademark

4 Products, Properties, Features

Product	Features
PC 1244*	Prevents foam, rapid foam destabilization. For acid and neutral non-aqueous lubricants and fluids. Temperatures up to 204°C. Easy to disperse, excellent shelf stability.
PC 1344*	Similar properties compared to PC 1244™ defoamer. 100% active. FDA compliant.
PC 1644*	10-20% more efficient than PC 1244™ defoamer in specific applications. Broad application across many lubricants and fluids.
PC 1844*	High temperature and air release performance. Flash point >60°C. Excellent choice for Sequence II and IV fluids. Broad application across many lubricants and fluids. Needs high speed agitation to disperse properly.
PC 2544*	High temperature performance. Excellent for both synthetic and petroleum bases. Performance for Sequence IV across broad range of lubricants and fluids. Better performance than acrylic-silicone blends and polyacrylate defoamers.

* Registered Trademark or Trademark

Other Potential Applications

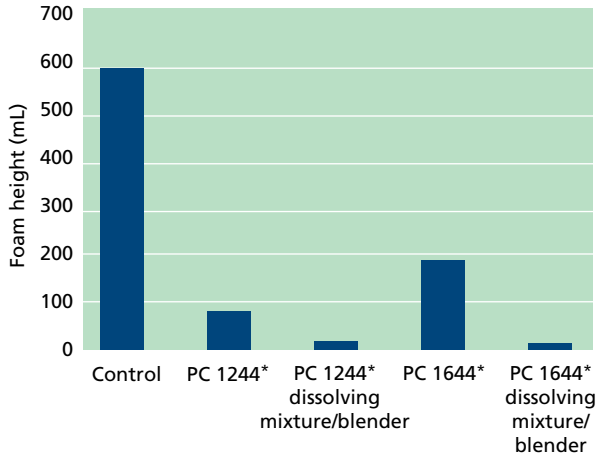
- Heat Exchange Fluids
- Used Oxidized Oils
- Reactor Coolants
- Oil Refining
- Solvent Recovery and Dehydration
- Low Temperature Distillations
- Bio-Based or Renewable Energy Feedstocks

Advantages of PC Defoamers

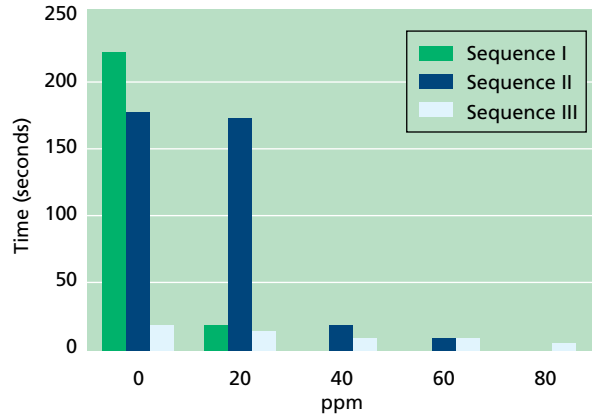
- Effectiveness over long shelf life
- Will not stabilize foam like silicones
- Broad effectiveness over range of fluids and lubricants
- Easy to incorporate
- Will not stabilize entrained air
- Stable at high temperatures
- Not readily absorbed onto filter media



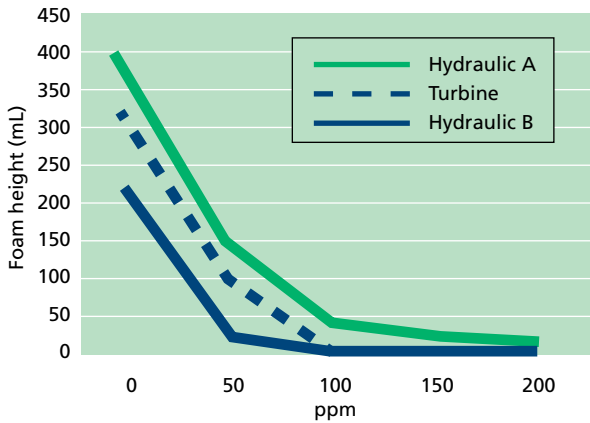
Effect of PC Defoamer Incorporation in SAE 50 Oil, 200 ppm FOD



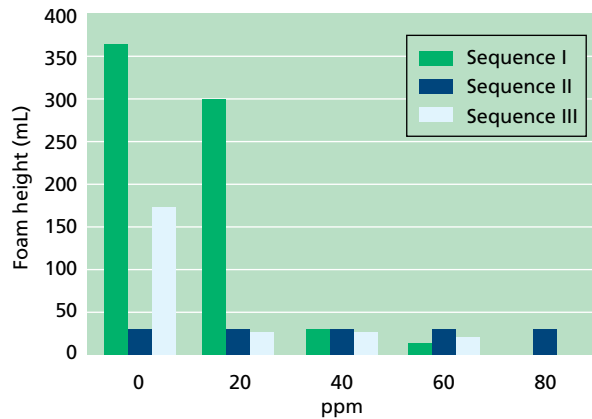
Turbine Oil (ISO 32) Foam Stability, PC 1644* Defoamer



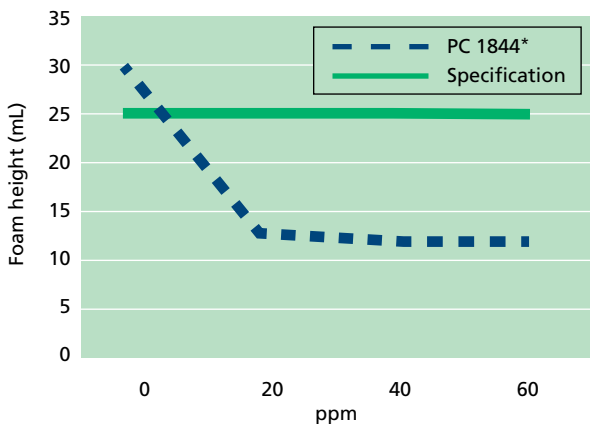
Turbine and Hydraulic Oils Sequence III Performance, PC 1644* Defoamer



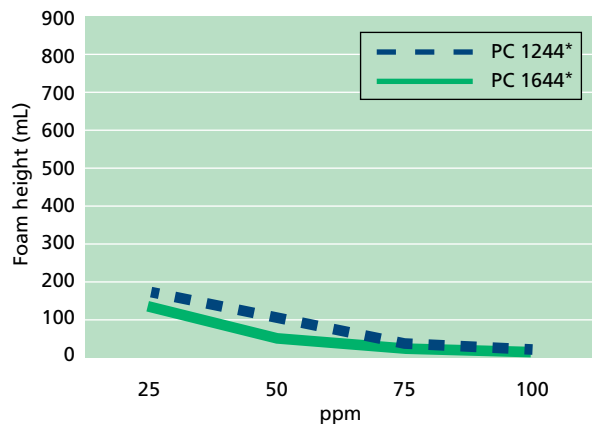
Turbine Oil (ISO 32) Performance, PC 1644* Defoamer



Turbine Oil (ISO 150) Performance



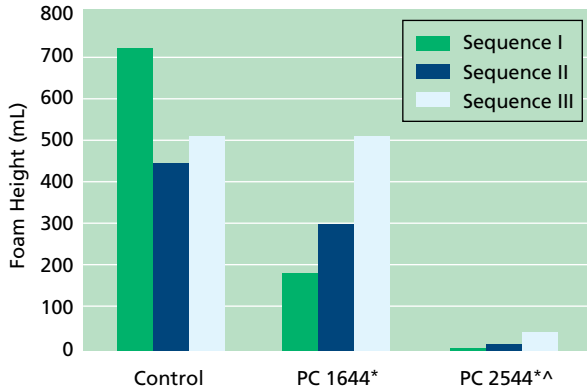
Turbine Oil Sequence III Performance



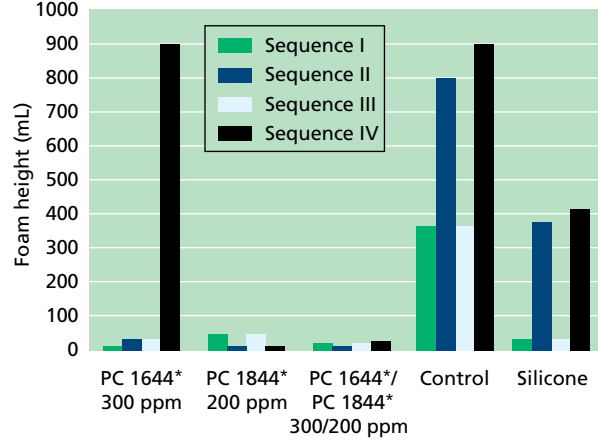
* Registered Trademark or Trademark

6 Performance and Application

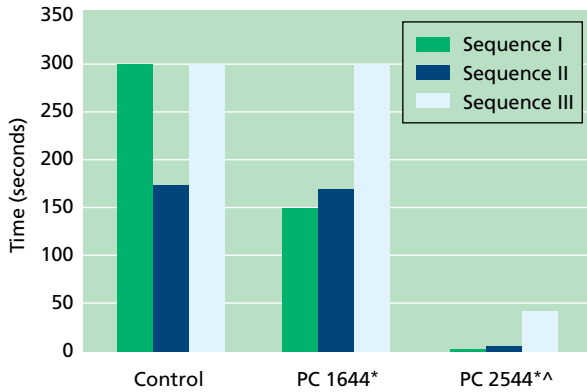
**Synthetic Oil, PAO Type
Foam Stability (initial), 500 ppm FOD**



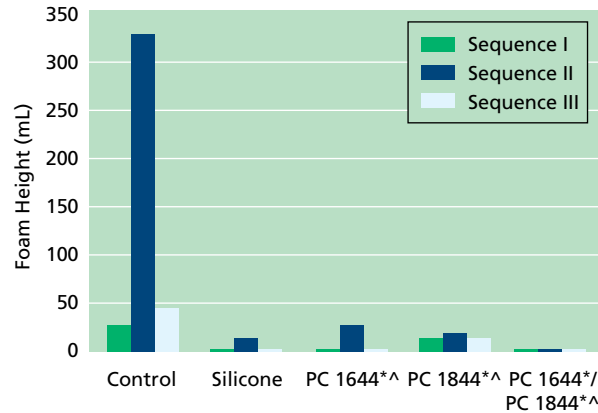
Heavy-Duty Diesel Crankcase Oil



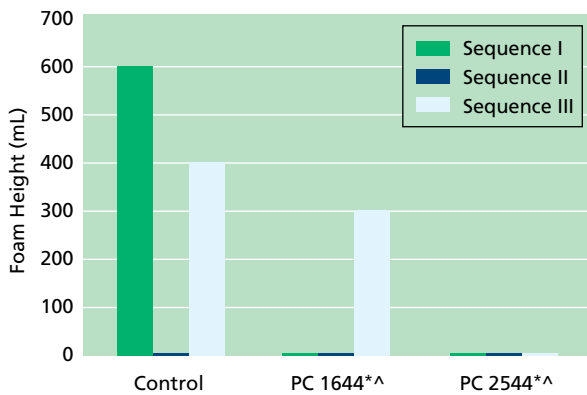
**Synthetic Oil, PAO Type
Performance, 500 ppm FOD**



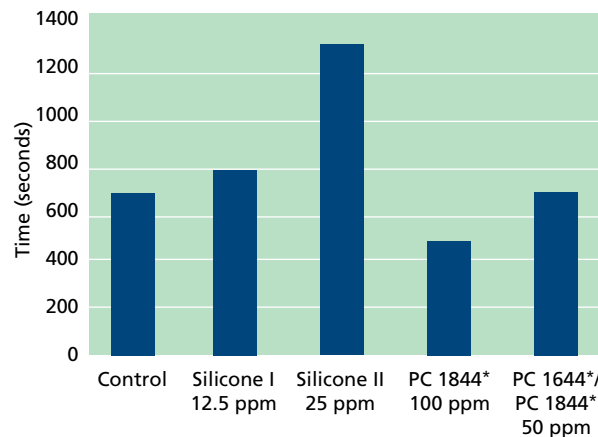
**Heavy-Duty Diesel Crankcase Oil
Performance, 200 ppm FOD**



**Synthetic Oil, PAO Type
Foam Stability (after 5 minutes), 500 ppm FOD**

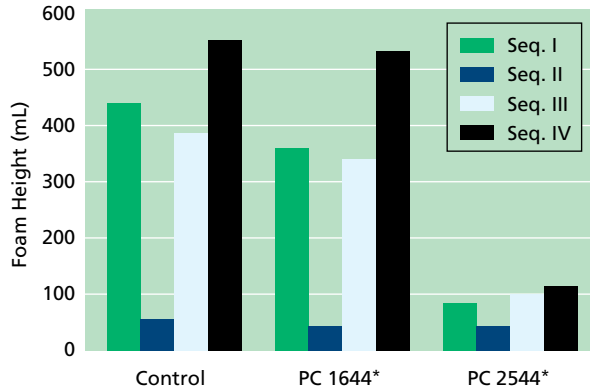


**Heavy-Duty Crankcase Oil
50°C, 300 mBar, Foam Stability**

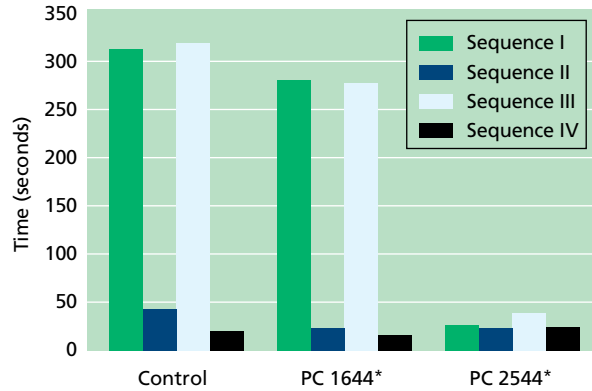


* Registered Trademark or Trademark
^ Very Low/No Foaming Activity

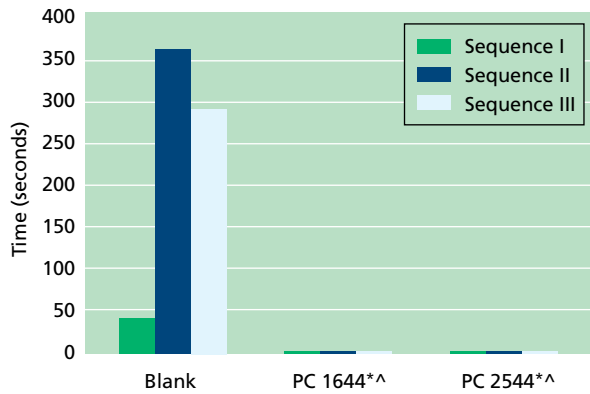
ATF
Performance, 125 ppm FOD



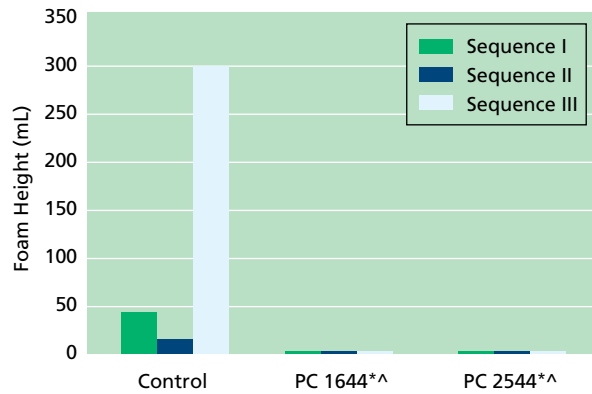
ATF
Foam Stability, 125 ppm FOD



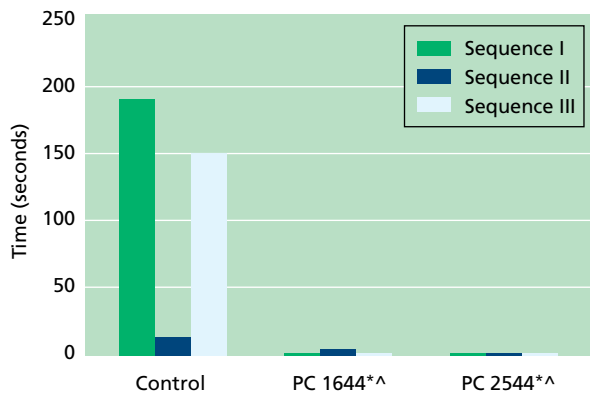
Gear Oil
Performance, 50 ppm FOD



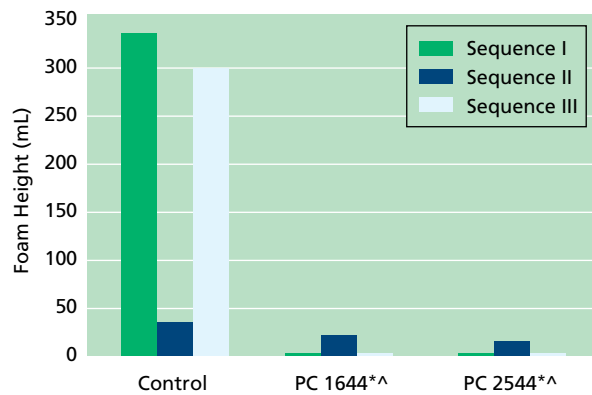
Gear Oil
Foam Stability, 50 ppm FOD



Industrial Oil
Foam Stability, 75 ppm FOD



Industrial Oil
Performance, 75 ppm FOD



* Registered Trademark or Trademark
^ Very Low/No Foaming Activity

8 Test Methods

Foam testing is conducted to determine the characteristics of an oil at specified temperatures.

Prior to mixing into the test oil, the defoamer solution is reduced to a 2% concentration in a petroleum solvent or light oil. The diluted defoamer solution is dispersed into the test oil via hand shaking vigorously for three minutes. Unless specified, Option A* is not run.

The testing conducted in this bulletin is based on ASTM D892, ASTM D6082 and ASTM D3427. Foam tendency and stability at various temperatures are determined using a modified version of ASTM D892 and ASTM D6082. Air release values are determined using the Impinger Method based on ASTM D3427.



The temperatures and air flow rates run in the modified ASTM D892 and ASTM D6082 foam tests are shown in the table below. Sequences I, II and III (ASTM D892) are run on all industrial and automotive oils. Sequence IV (ASTM D6082) is typically run on crankcase and transmission oils requiring this specification. The volume of foam and the time for complete foam collapse are recorded.

Standard Defoaming Test ASTM D892

Sequence #	Temperature (°C)	Air Rate (Bubbling mL/min)
I	24 ± 0.5	94.5 ± 5
II	93.5 ± 0.5	94.5 ± 5
III	24 ± 0.5	94.5 ± 5
IV**	150 ± 0.5	200 ± 5

**Standard Test ASTM D6082

ASTM D3427 is run to determine the tendency of the oil to entrain air and also its ability to release entrained air. Compressed air is blown through the test oil which has been heated to a temperature of 25°C, 50°C or 75°C depending on the viscosity of the oil. After the oil flow has been stopped, the time required for the entrained air in the oil to reduce in volume to 0.2% is recorded as the air bubble separation time.

*Option A is a different dispersion method for defoamers in lubricants that involves a high-speed blending from 18°C - 32°C (65°F - 90°F) at maximum speed for one minute.

Foaming Problem	<i>Recommended Actions</i>
<p>Good performance is obtained in both Sequences I and III, but failure is observed in Sequence II.</p>	<p>This usually indicates the oil needs a high-temperature performance defoamer. PC 1844* and PC 2544* may resolve this problem. They can be used individually or blended to achieve the performance required.</p>
<p>Poor foam performance is observed in both Sequences I and III.</p>	<p>This usually suggests that there is not enough defoamer in the lubricant. This problem may be solved by testing the defoamer at several different usage levels to identify the optimum use level or by simply increasing the defoamer use level.</p>
<p>Sedimentation or haziness are observed in the fully formulated oil.</p>	<p>This is usually due to an interaction with other highly surface-active additives, such as silicones. It is recommended that these highly surface-active additives be removed. If the problem disappears but the desired performance is not achieved, it is recommended that these highly surface-active additives be formulated back into the oil at the lowest possible level that yields the desired performance.</p>
<p>Good high-temperature performance is observed in Sequence II, but foam problems are exhibited in Sequences I and III.</p>	<p>This usually indicates the oil requires a different performance balance between room temperature and elevated temperature. Blending PC defoamers may give the desired performance. The combinations of PC 2544* with PC 1844*, or PC 1844* with PC 1644* are recommended.</p>
<p>Poor foam performance is observed in only Sequence I testing of ASTM D892. Good foam performance is observed in Sequences II and III.</p>	<p>This indicates the defoamer has not been well dispersed in the lubricant. This problem may be solved once the dispersion is improved. Recommended dispersion techniques include elevated temperatures, increased agitation and reducing the concentration of defoamer solution by further dilution.</p>

* Registered Trademark or Trademark

Contact Us

Cytec Surface Specialties Inc. North America

1950 Lake Park Drive
Smyrna, GA 30080 USA

Tel.: 1 800 433 2873 (USA)
Fax: +1 678 255 4746 (Outside USA)
customerservicena@cytec.com

Technical Service

Tel.: +1 678 255 4725
Fax: +1 678 255 4755

Cytec Surface Specialties SA/NV Europe

Erasmus Office Park
Square Marie Curie 11
B-1070 Brussels
Belgium

Tel.: ++32 2 560 45 11
Fax: ++32 2 560 45 21
surfsspec@cytec.com

Cytec Surface Specialties (Shanghai) Co Ltd Asia Asia Pacific/China

11D Junyao International Plaza
No. 789, Zhao Jia Bang Road
Xuhui District, Shanghai 200032

Tel.: +86 21 64228920
Fax: +86 21 64228980
china@cytec.com

Global Product Referral

Tel.: 1 800 652 6013 (USA)
Tel.: +1 973 357 3193 (Outside USA)
custinfo@cytec.com

Technical Service Europe

Cytec Surface Specialties Austria
Leechgasse, 21, A-8010
Graz, Austria

Tel.: +1 43 50 399 1400
Fax: +1 43 50 399 5014

Technical Service Thailand

Surface Specialties (Thailand) Ltd
888 Moo 8, Theparak Road,
Samrong Nuae
Amphur Muang,
Samut Prakarn 10270
Thailand

Tel.: +66 (0)2 753 0922
Fax: +66 (0)2 384 5892

Trademark Notice:

The ® indicates a Registered Trademark in the United States and the ™ or * indicates a Trademark in the United States. The mark may also be registered, the subject of an application for registration, or a trademark in other countries.

Notice: Cytec Industries Inc. in its own name and on behalf of its affiliated companies (collectively, "Cytec") decline any liability with respect to the use made by anyone of the information contained herein. The information contained herein represents Cytec's best knowledge thereon without constituting any express or implied guarantee or warranty of any kind (including, but not limited to, regarding the accuracy, the completeness or relevance of the data set out herein). Cytec is the sole owner or authorized user of the intellectual property rights relating to the information communicated. The information relating to the use of the products is given for information purposes only. No guarantee or warranty is provided that the product is adapted for any specific use. The user or purchaser should perform its own tests to determine the suitability for a particular purpose. The final choice of use of a product remains the sole responsibility of the user.

Pub. No. 250189, Version E-WW

www.cytec.com

©2008 Cytec Industries Inc. All rights reserved.