



PPG Pipeline Solutions

Experience, performance and reliability



**PPG Protective &
Marine Coatings**

Bringing innovation to the surface.™



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PPG Protective & Marine Coatings (PPG) is a world leader in protective coatings for the storage and transportation of any liquid or gas.

PPG has a long heritage in the protection of steel for the storage and transportation of oil, gas, chemicals, waste and potable water. With the introduction of the market-leading PHENGUARD™ range in 1974, PPG transformed the coatings market by offering an easy-to-apply and easy-to-clean three-coat system with excellent resistance to a wide range of organic acids, alcohols, edible oils, fats and solvents. Today, over 20 million m² of steel is protected with the PHENGUARD system worldwide.

Being the largest coatings company in the world, PPG invests over USD 500 million yearly in research and development in order to continue building on its leading technology position. With the increasing demand of biodiesels and gasoline/ethanol blends, PPG developed the NOVAGUARD™ product range of one-coat systems that offer excellent resistance against the most severe acids.

PPG's expertise in pipe coatings dates back to the 1960s and its liquid applied coatings are now used globally for internal and external oil-, gas- and (potable) water pipelines in the most extreme environments. Building on this heritage, PPG today offers a range of advanced pipe coating solutions. In addition, PPG has the supply capabilities to manage huge, complex projects, such as mega water schemes in South Africa and also has the recognized technical knowledge to support highly specialized in situ refurbishment projects.

PPG's pipeline solutions

PPG innovative solutions have been developed to help customers become more efficient and lower their total cost of ownership by offering longer lasting protection to reduce maintenance frequency, increased efficiency for new-build projects, and effective solutions for touch-up and maintenance tasks.

General solutions

PPG's general coating solutions deliver added value through versatility, long service life, ease of application and consistent quality. PPG has now developed a range of three versatile products that will cover most coating standards and needs.

With the SIGMALINE™ 855 1:1 polyurethane for externals, the SIGMALINE 403HS epoxy as a gas flow coat and the SIGMALINE 523 epoxy coating for internal pipelines for oil, potable water and waste water, PPG helps reduce complexity, switching times and costs.

General protective coatings solutions for your pipeline requirements

Area	External	Internal
Gas	SIGMALINE 855 1:1	SIGMALINE 403HS
Oil	SIGMALINE 855 1:1	SIGMALINE 523
Potable water	SIGMALINE 855 1:1	SIGMALINE 523
Waste water	SIGMALINE 855 1:1	SIGMALINE 523

Specialty solutions

PPG's range of specialty pipeline solutions have been proven in the most demanding situations:

- The SIGMALINE 2500 phenolic epoxy coating can resist temperatures up to 150°C in subsea conditions
- The SIGMALINE 2000 phenolic epoxy coating can resist the most corrosive chemical environments
- The SIGMALINE 855 repair kit enables easy maintenance and repair of field joints, welds, touch-ups after transport, and also for the field repair of FBE
- The SIGMALINE 415 and 445 in situ coating solutions enable refurbishment of existing pipelines by pig application

PPG's range of specific pipeline solutions help you become more efficient, reduce downtime, and make application and maintenance easier – so you lower your total operational costs.

Solutions for water pipelines

Potable water solutions

Epoxy coatings have been used for decades and are still the most trusted and reliable lining for water tanks and water transportation pipes. Liquid applied coatings are, both practically and economically, far superior solutions over the alternatives.

In the past, legislative developments have identified solvent traces in freshly applied coatings to have possible taste and even health influences. It is for this reason that PPG developed the *SIGMALINE 523* product, which is a specialist coating for use in potable water storage and supply systems. Completely solvent-free, *SIGMALINE 523* epoxy is a safe and WRAS-BS6920-certified coating solution for pipelines that transport drinking water.

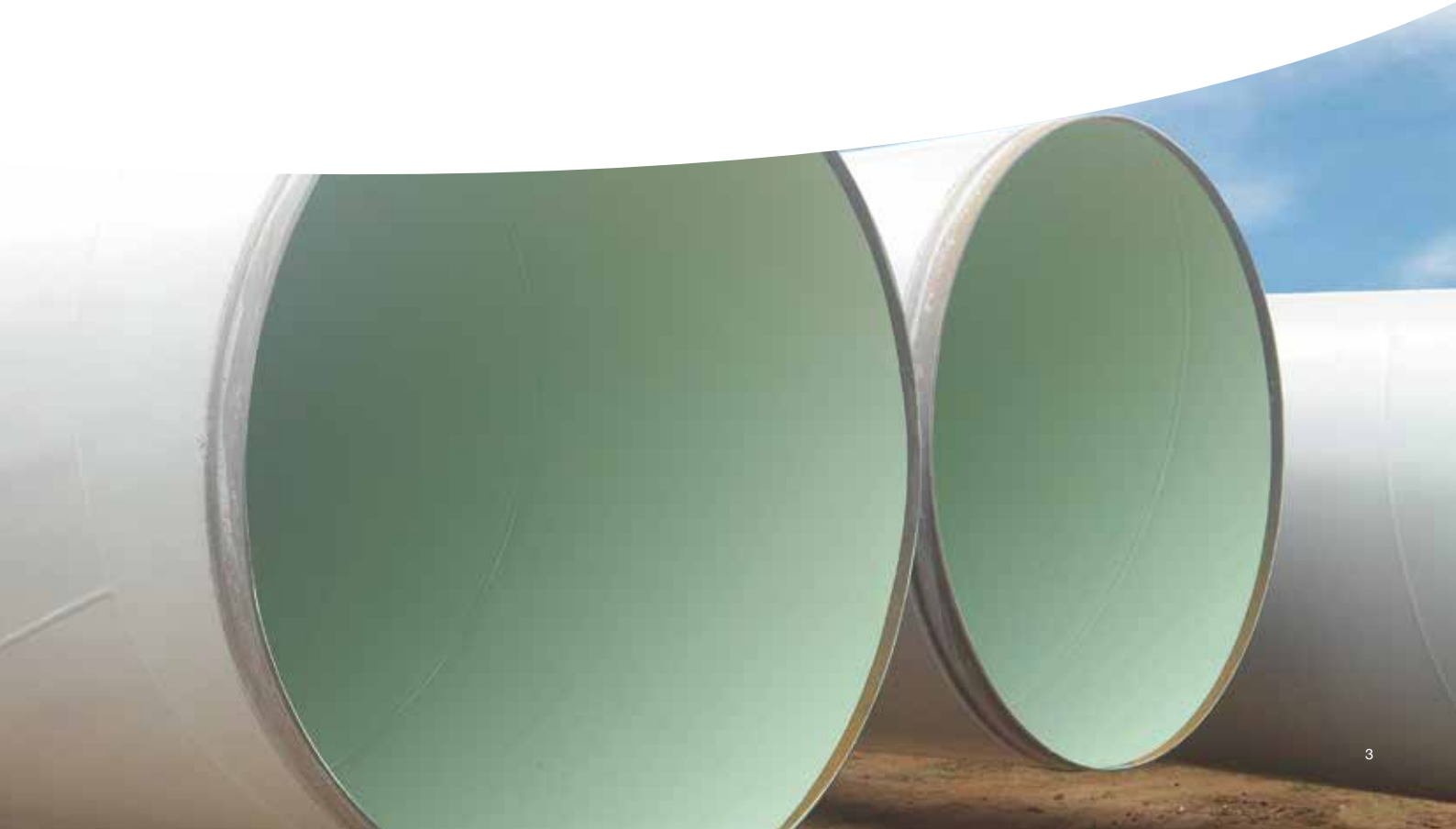
PPG has also developed alternative solutions to meet specific European standards. The table below gives an overview of the most widely used standards. Outside the products used in this table, PPG offers a wide range of alternatives complying with national and international standards. Please consult your PPG representative for specific queries.

Product	Specification
SIGMALINE 523	WRAS 23°C - BS6920 (UK)
SIGMALINE 523	WRAS 60°C - BS6920 (UK)
SIGMAGUARD CSF 585	KIWA (NL), ACS (FR), NSF (USA)

Waste water solutions

Waste water forms an aggressive corrosive environment. It requires additional chemical and abrasion resistance. Although PVC sheeting and PVC pipes are widely used solutions for waste water lines, epoxy coatings are the preferred technology for larger capacity waste water lines. This is an economical solution that provides the appropriate chemical and abrasion resistance against wear and tear.

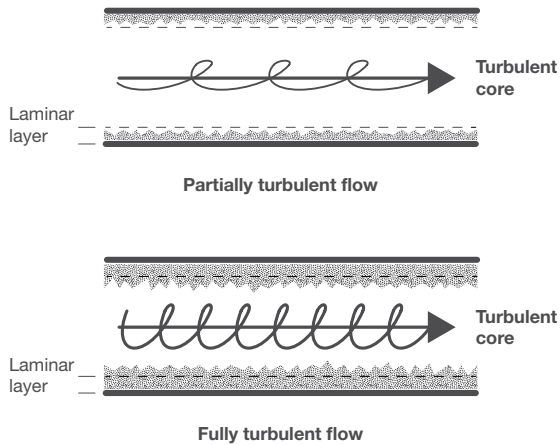
The *SIGMALINE 523* coating is PPG's general solution for domestic waste water lines. For the toughest conditions that require additional chemical and abrasion resistance, PPG has developed the *SIGMALINE 2000* solvent-free phenolic epoxy coating, which can resist a wide pH range.



Solutions for oil and gas pipelines

Gas solutions

Although natural gas is not a very corrosive substance, its pipelines require a sophisticated coating to protect steel interiors during manufacturing, transportation and installation procedures. This is not just to protect the steel, but also to ensure a smooth surface that enhances the flow of gas.



As a thin-film, high-solids epoxy flow coating, the *SIGMALINE 403HS* coating is designed to reduce friction within the pipeline. Due to the excellent anticorrosive performance of the *SIGMALINE 403HS* flow coat and its leveling effect, the internal pipeline surface remains smoother when in service. As the picture shows, the laminar layer is thinner when using the *SIGMALINE 403HS* coating, resulting in better flow of the gas, thereby increasing transport capacity and decreasing overall transport cost.

Demanding conditions

For highly corrosive wet sour gas, the *SIGMALINE 2000* coating forms an excellent solution, combining additional chemical resistance with excellent flow enhancement properties.

Product	Specification
SIGMALINE 403HS	API RP 5L2, EN10301
SIGMALINE 2000	Extensive testing of performance under wet sour gas*

* SIGMALINE 2000 has been tested by an external body during 180 days' exposure under 1 bar pressure at 40°C without showing any defects. Gas composition included 3% H₂S, 5% H₂O and 5% CO₂.

Oil solutions

Due to excellent chemical resistance and anticorrosive performance, epoxy coatings are widely used as internal linings for oil. The *SIGMALINE 523* coating forms both an economical and reliable solution for oil pipe lines. PPG has also developed the *SIGMALINE 2000* phenolic epoxy for high-end anticorrosive performance and high chemical- and temperature resistance (up to 90°C operating temperature).





Solutions for pipeline externals

Solutions for buried pipeline externals

Due to their strong mechanical resistance, polypropylene, polyethylene and fusion-bonded epoxies are widely used solutions for pipeline externals. However, polyurethanes are increasingly preferred for this use. Polyurethanes provide quick dry-to-handle times and high thicknesses resulting in good mechanical resistance. The application process of polyurethanes is much simpler and requires less heating and cooling, resulting in saving energy costs and reducing CO₂ emissions. Finally, polyurethanes are also easy to repair.

PPG has developed the *SIGMALINE* 855 1:1 coating specifically for this need and is certified according to EN10290, AWWA C222-08 and SANS 1271. It is used in a wide range of heavy-duty applications where its excellent adhesion ensures reliability, superb corrosion resistance, high-level abrasion resistance, plus water- and impact resistance. In addition, the *SIGMALINE* 855 1:1 coating reduces repair and maintenance times due to its fast-curing characteristics (dry to handle in 4 - 7 minutes).

It is also available in a special repair kit for touch-ups and field joint application. In-house expertise is available to PPG customers to advise on the set up of plural pumps and ensure optimized spraying of the *SIGMALINE* 855 1:1 coating.

PPG has developed the *SIGMALINE* 2500 phenolic epoxy specifically for situations with elevated operating temperatures up to 150°C that need excellent chemical resistance.

Solutions for atmospheric pipeline externals

PPG offers a wide range of fast-drying, easy-to-apply ISO12944-certified systems for atmospheric exposure. For C4 and C5I exposure conditions, PPG offers the SIGMAZINC™ 105 product: an anti corrosive epoxy primer that can be overcoated after only 25 minutes, enabling two- or three-coat application in one day. The SIGMAFAST™ 278 epoxy coating is a high solids (80%), easy to apply buildcoat.

	Product	DFT
C4		
Primer	SIGMAZINC 105	50 µm
Buildcoat	SIGMAFAST 278	120 µm
Finish (optional)**	SIGMADUR 568	50 µm
C5I		
Primer	SIGMAZINC 105	60 µm
Buildcoat	SIGMAFAST 278	180 µm
Finish (optional)**	SIGMADUR 568	50 µm

* The mentioned *SIGMAZINC* 105/*SIGMAFAST* 278 systems without a topcoat meet the anticorrosive requirements according to ISO12944-6

** A topcoat can be added to meet aesthetic conditions, should this be required.

In addition to these systems, PPG has a wide range of alternative solutions that can meet your specific needs. Please contact your PPG representative to benefit from personalized advice for any atmospheric solutions.

PPG's capabilities

PPG is known in the pipeline industry for its long-lasting, high-performance products and high levels of technical expertise. Its complete portfolio of solutions that include maintenance and repair solutions, and its global organization, scale and capacity enable the supply and servicing of the largest projects anywhere in the world.



Proven long-lasting performance

The development of the gas pipeline infrastructure in The Netherlands began in the 1960s with PPG products used from the outset. Recent case studies from the 'Gasunie' show the excellent performance of pipelines that have been in service for 22 years. Due to an airport extension, some pipes needed to be moved, which gave a unique opportunity for inspection. The results confirmed that pipelines coated with the *SIGMALINE 403* product had performed very well: there was no corrosion or blistering and the original coating thickness was still intact.



High levels of technical expertise

PPG has a long track record of partnering with the global, leading specialized pipeline refurbishment applicators for in situ pipeline refurbishment. PPG's *SIGMALINE 415* epoxy coating and *SIGMALINE 445* phenolic epoxy coating have been specifically designed to support refurbishment of pipelines by coating pigs. The combination of PPG's established partnerships, experience and specialized technical support staff enables customers to extend pipeline lifetimes, resulting in significantly reduced cost. Indeed, case studies have shown that investments for in situ refurbishment paid back in 4 years, due to the enhanced flow properties (with up to 7% increase after refurbishment).



A complete offer

As a solution provider, supplying the initial coating is only the start. PPG's specialized technical support staff can advise on maintenance and repair options and provide special repair kits for PPG products; for example, the *SIGMALINE 855* polyurethane. Also, PPG can demonstrate dual cartridge repair kits that can be used for on-site repairs, offering an excellent solution for field joints. PPG's *SIGMALINE 855* repair kits can also be used for the repair of FBE and PE, which has been tested by and used for major oil companies.



Global scale and capacity

As well as its renowned technical expertise, PPG also has the scale and capacity to supply coatings for the largest pipeline projects in the world. As evidence of this capacity, PPG recently supplied the *SIGMALINE 855* polyurethane for the externals and *SIGMALINE 523* epoxy for the internals of a South African pipeline project, which runs over a length of 46 kilometers. PPG was able to supply 400,000 liters over several months to match the hectic schedule.



Product overview PPG pipeline solutions

For a complete overview of PPG's pipeline solutions, and the relevant technical datasheets, please check the corporate website: www.ppgpmc.com

This table shows an overview of the key characteristics of our products mentioned in this brochure.

Use	Volume solids	Dry-to-touch at 20°C	DFT	Approvals	Comment
SIGMALINE 403HS					
Epoxy flow coat for gas internals	78%	3.5 hours	50-75 µm	API RP 5L2, EN10301	
SIGMALINE 855 1:1					
Solvent-free polyurethane for externals	100%	4-7 minutes	500-1500 µm	EN10290, AWWA C222-08 and SANS1217	
SIGMALINE 523					
Solvent-free epoxy for potable water, waste water and oil internals	100%	3 hours	600 µm	WRAS - BS6920	
SIGMALINE 2000					
Phenolic epoxy for pipeline internals and externals	100%	6 hours	600-1500	Saudi Aramco APCS 113, EN10289	Up to 90°C
SIGMALINE 2500					
Phenolic epoxy for pipeline internals and externals	100%	30 minutes	600µm	Saudi Aramco APCS 113, NORSOK M501 – system 7C	Up to 150°C
SIGMAGUARD CSF 585					
Solvent-free epoxy for potable water internals	100%	1.5 hours	250-400 µm	KIWA (NL), ACS (FR), NSF (USA)	
SIGMALINE 415 / 445					
Epoxy/phenolic epoxy for in situ application	82%/70%	overcoating after 16 hours/12 hours	50-100 µm	In-house testing	In situ specialty solution



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