Jotun Marine Tank Coating Notes

The Jotun Marine Tank Coating Notes apply only to the following cargo tank coating materials and systems supplied by JOTUN. The data provided gives guidance on the compatibility of the Jotun cargo tank coatings with cargoes carried in the marine bulk liquid trade. The information in this document must be used in combination with the information published on www.jotunprl.com.

JOTUN Cargo Tank Systems

Tankguard Zinc	1 x 100 µm Dry Film Thickness (DFT)
Tankguard CPC	2 x 125 µm DFT
Tankguard HB	3 x 100 µm DFT
Tankguard HB Classic	2 x 150 µm DFT
Tankguard Special	3 x 100 µm DFT
Tankguard Special Ultra	3 x 100 µm DFT

For the Resistance List information to be valid the coating system(s) shall be applied and cured in accordance with the relevant Technical Data Sheet, Application Guide (if available) and Project Specification issued by Jotun.

The information in this document supersedes all previously published data. The data provided herein is to the best of our knowledge correct, and is given in good faith. Although comprehensive, it is by no means exhaustive, and the advice contained is subject to change without prior notice. The data, advice and guidance are subject to modification based on experience, our policy of continuous product development, feedback from industry, and testing.

The product resistance list is regularly updated to include many proper shipping names, trade names, and synonyms for cargoes and noxious liquid substances, which have been transported by sea in bulk liquid form. Many of these names have in recent years been established through Tripartite Agreements and registered with the Secretariat of the International Maritime Organisation in accordance with regulation 3(4) of Annex II to MARPOL 73/78.

As cargoes may vary due to changes in their constituents, composition, or concentration without the knowledge of JOTUN, JOTUN will accept no responsibility for the performance of its products, arising out of such changes, or changes to the conditions under which the cargoes are transported.

General notes

I. Shop Primers.

This list applies to JOTUN cargo tank systems, which have been applied directly to abrasively blasted carbon steel. The list does not apply if the coating systems are applied over existing shop primers, - all shop primer must be removed. The list does not apply to any other substrates, unless there is a written agreement with JOTUN.

II. Application & Curing.

This list is not valid unless the JOTUN cargo tank systems are applied and cured in strict accordance with the correct prevailing JOTUN specification and procedure. It is particularly important to apply each coat of the system, and the complete system, within the dry film thickness range specified by JOTUN.

Excessive dry film thickness will be detrimental to coating integrity, will increase ventilation time after unloading, and will increase the risk of cross contamination between cargoes.

Low dry film thickness will leave the system at risk of failure due to potential blistering, and subsequent breakdown.

The coating must be cured according to the Technical Datasheet prior to exposure to water or cargoes. In addition, some cargoes require additional curing, ref. specific notes.

III. Hot cure

Hot cure may be carried out by exposure of the coating to hot water, or a suitable hot cargo for 3 days at 60°C, 2 days at 70°C or 1 day at 80°C. (For Tankguard Special Ultra ONLY, the required duration is 16 hours at 60°C, 6 hours at 70°C and 3 hours at 80°C). Under no circumstances should the temperature of the curing medium exceed 85°C.

Examples of suitable hot cargoes are: caustic soda, vegetable oil, animal oil or lubricating oil.

As an alternative to hot curing by way of a cargo, a Butterworth (or similar) system may be used. In either case it is vitally important that the entire coated surface attains the minimum specified temperature for the specified time. This can be ensured by the following:

- The adjacent space must be free of ballast or cargo in order to reduce the heat loss and also prevent a possible cold wall effect coating detachment. If the ambient temperature is low, thermal insulation and / or hot air flushing of the tank outside may be necessary to reduce the heat loss.
- Continuously monitor the steel temperature during the curing period.
- Temperature gauges should be installed at the “worst” locations on the reverse side of the tank interior steel plates.
- By ensuring that the discharged hot water has a temperature above the cure temperature one may have additional control of the operation.

A record of the curing operation data, with measured temperatures should be retained for future reference.

IV. Stowage Time.

This list applies to continuous stowage up to a maximum time of 6 months, unless shorter times are indicated in the notes. For longer stowage periods, or special stowage conditions approval from JOTUN must be obtained.

V. Cargo Temperature.

Guidance given in this list is based on stowage temperatures not exceeding 35°C for those cargoes not requiring heating. Cargoes, which are solid or viscous at normal ambient temperature, will need to be heated for loading, stowage, and unloading. The temperature noted in the list is the maximum temperature allowed for stowage. This temperature may be increased by a maximum of 10°C, for loading and unloading provided the time at the higher temperature does not exceed 48 hours.

N.B. When stowing cargoes the temperature of the cargo must not exceed the maximum stowage temperature for cargoes in adjacent tanks.

VI. First Cargoes.

It is recommended that the first cargo loaded into tanks coated with JOTUN cargo tank systems should be a non-sensitive cargo. JOTUN does not recommend the loading of sensitive cargo which may be affected by transmission of small traces of solvent retained in the newly applied tank coating.

VII. New Cargoes

As mentioned in the introduction, this list is regularly updated to include Proper Shipping Names, Trade Names, and Synonyms for cargoes that have been registered through IMO Tripartite procedures. This is an ongoing process, and as time progresses further names may be added to the list after assessment by JOTUN. JOTUN will be pleased to carry out assessment of cargo/coating compatibility on provision of Proper Shipping Name, and/or Trade Name/Synonym, complete technical data, and a sample for testing, where considered necessary by JOTUN. Data and enquiries should be sent to; Jotun Technical Sales Support.

VIII. Coating Discolouration.

Coatings can be discoloured by the carriage of some cargoes. The discolouration may be due to naturally occurring coloured components of the cargo, which are adsorbed to the surface of the coating. Alternatively, synthetic dyes may have been added to the cargo for special reasons. (Example: diesel oil for agricultural/industrial use is often dyed for tax exemption reasons!). Whatever the cause of discolouration by adsorption, the chemical resistance of the coating is not usually affected. However, adsorbed discolouration may cause cleaning problems, and may present a contamination threat depending on subsequent cargoes.

JOTUN will not be held responsible for the consequences of discolouration caused by cargoes.

Tank Cleaning chemicals are available from some cleaning chemical suppliers, which are effective at removing adsorbed discolouration, without impacting the coating system. NB! It should be noted that carbon deposits from **Flue gas Inert Gas systems** are readily adsorbed to the surface of all tank coatings. Presence of carbon deposits will aggravate discolouration caused by adsorption of cargoes. Owners, managers, and operators are encouraged to ensure that Inert Gas systems are operating effectively.

IX. Inert Gas Systems

Emissions from Inert Gas systems may contribute to, and indeed aggravate coating discolouration, if not functioning effectively, as described above. They may also contribute to a reduction in coating life. Carbon emissions may be adsorbed to the surface of the coating, causing (and aggravating) discolouration, and increasing the potential for contamination of subsequent cargoes. This will require significant resources to remove them (chemicals, labour costs, and time), resulting in reduced utilization of tanks. High SO_x and NO_x emissions from poorly maintained inert gas systems can create harmful acidic conditions leading to coating damage, particularly in zinc coated tanks.

Inert gas systems should be regularly checked and maintained to control emissions to design levels.

X. Cargo Contamination in epoxy coated tanks.

Freshly applied cargo tank coatings may present a small contamination potential – see "First cargoes" note earlier (note VI). Similarly, tank coatings are known to absorb cargoes, particularly over long voyages, and at high ambient temperatures. The absorbed cargo will start to evaporate from the coating immediately after unloading of the cargo, provided the tank is effectively ventilated. There are a number of factors which influence the rate of evaporation, but temperature and efficiency of ventilation have the greatest effect.

To minimize the potential for cross contamination between cargoes, the previous cargo should be removed from the tank, and the coating, by complete removal of liquid cargo in the first instance, followed by effective ventilation for up to 24 hours, or until a steady “gas free” condition is produced at all levels in the tank. The tank may then be

washed with hot seawater @ 60-70°C for a maximum time of 6 hours, during which time effective ventilation must continue. The tank should then be flushed with clean cold fresh water, drained, mopped dry, and then ventilated to a dry condition.
N.B. Seawater used for hot tank washing must not be fresh or brackish water. It must be saline seawater.

JOTUN recommends that edible end-use or sensitive cargoes are not loaded into tanks which previously carried absorbing cargoes (R1A, R1B, R2, R16 or R18 designated cargoes), until the absorbed cargo has been removed. JOTUN will accept no responsibility for cross contamination between cargoes.

XI. Acidic & Alkaline Cargoes.

Tankguard Zinc, in common with all zinc silicate coatings, has poor resistance to acidic and alkaline environments. They are however compatible with some mildly acidic or mildly alkaline cargoes within the pH range 5.5 – 10.0.

Diluted solutions of some cargoes can become aggressive towards coatings if left in tanks. JOTUN recommend that after all tank washing activities, the tank must be flushed with fresh water so that the final pH of any residues is neutral. All residues after washing must be completely removed by draining, mopping, and finally by ventilation.

XII. Beverages and Potable Liquids.

JOTUN cargo tank coatings are resistant to several of these cargoes. JOTUN will accept no responsibility for changes in taste or odour of these cargoes, when carried in tanks coated with JOTUN cargo tank coatings.

These cargoes should not be carried until the tank has been in service for some time (three cargo voyages after launch). Similarly, these cargoes should not be carried immediately after a R1A, R1B, R2, R16 or R18 cargo.

XIII. Tank Cleaning & Cleaning Chemicals.

JOTUN recognizes the need for tank cleaning with or without the addition of tank cleaning chemicals. Tank cleaning also helps to minimize potential contamination between cargoes. However, tank cleaning cannot be done entirely without risk to the coating. It must be recognized that some chemicals, whilst being efficient cleaning agents, may not be compatible with the coatings, and the activity of tank cleaning

exposes the coating to a corrosive environment. This can shorten the life of the coating, leading to premature and expensive re-coating. Clearly this has to be balanced against earnings. Some general rules can be applied;

- Increase in cleaning temperature increases risk of coating failure.
- Increase in cleaning time increases risk of coating failure.
- Increase in frequency of cleaning increases risk of coating failure.
- Increase in concentration of chemicals increases risk of coating failure.

Tank cleaning therefore should be done at the lowest effective temperature, for the shortest time, using the lowest effective concentration of chemical, and as seldom as possible.

Tankguard CPC, Tankguard HB, Tankguard HB Classic, Tankguard Special and Tankguard Special Ultra epoxy coatings demonstrate good compatibility with tank cleaning chemicals provided they are used at the concentration and temperature recommended by the supplier. Solutions of chemicals in water should not exceed a temperature of 70°C, and the maximum period for washing is 6 hours. Spot cleaning chemicals may be used at the manufacturers recommended concentration, but only at ambient temperature, and contact time must be limited to a maximum of 1 hour.

Some tank cleaning chemicals are acidic or alkaline in solution. Tankguard Zinc is more sensitive to these tank cleaning chemicals, due to possible reaction with zinc in the coating. Greater care has to taken in the selection and use of cleaning chemicals for Zinc Silicate coatings. Chemicals recommended by the manufacturers may be used at the concentration and temperature recommended by the manufacturer, provided the solution is within the range pH 5.0 – pH 12.0, the contact time is limited to a maximum of 3 hours, and the temperature is limited to a maximum of 50°C. It is recommended that for spot cleaners used at high concentration a small test is done on the zinc coating to ensure there is no harmful effect on the coating. Highly acidic or alkaline cleaning chemicals will react with the coating, and will cause damage.

JOTUN does not advise on the efficacy of cleaning chemicals. **Appendix 1 to these General Notes gives an overview of relevant cleaning chemicals from various**

suppliers. The information and advice given in Appendix 1 is given in good faith, and JOTUN will not be held responsible for the consequences of changes in composition, or mode of use of chemicals supplied by other companies. JOTUN will be prepared to carry out evaluation of coating/cleaning chemical compatibility, on provision of complete technical data, and samples for testing, where necessary.

XIV. Abbreviations used in this List.

ASTM - American Society for Testing of Materials
EC - European Community
FFA - Free Fatty Acid
FOSFA - Federation of Oils, Seeds and Fats Associations Ltd.
IMO - International Maritime Organisation.

Marpol 73/78 - International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978.

Marpol Category - Marpol Category - The Pollution Category (X, Y, Z) assigned to each product under Annex II of MARPOL 73/78. “OS” means the product was evaluated, and found to fall outside the categories X, Y, or Z. “I” indicates that the product is an Annex I product.

NIOP - National Institute of Oilseed Products
UN. No. - Number assigned by the United Nations committee of Experts on the Transportation of Dangerous Goods.

Ship Type - 1, 2, & 3 type chemical tankers. Type 1 is the most sophisticated, capable of carrying chemicals presenting the most severe environmental and safety hazards. Type 3 is the least sophisticated, capable of carrying chemicals with lesser hazards.

D No. - The identification number for the product in the Jotun Cargo Resistance List.

Specific Notes

Explanation of Resistance Data

R	=	Resistant without any specific notes.
NR	=	Not Resistant.
R1-18	=	Resistant with limitation - See Specific Notes.
NT	=	Not Tested
FS	=	Further Specification/Information needed

If no temperature is stated, the carriage temperature should not exceed 35ºC.
A temperature e.g. 70ºC shows the maximum stowage temperature in degrees Celsius for that cargo.

1A). AGGRESSIVE CARGOES.

These cargoes can cause slight softening and swelling of the coating system. The coating will however recover hardness as the cargo evaporates from the coating, after unloading. The stowage time for these cargoes must not exceed 60 days. After unloading of these cargoes, the tanks should not be brought into contact with water or steam before the coating is restored to its original condition. This may be obtained by ventilating the tank with dry air until it is in a steady state gas-free condition. After ventilation, loading of further R1A, R1B, R2, R16 or R18 cargoes, aqueous cargoes, or ballast water, or further cleaning with (sea)water cannot take place within 30 days for Tankguard HB, 20 days for Tankguard HB Classic, 10 days for Tankguard Special and Tankguard Special Ultra. If a hot cure has been carried out for Tankguard Special Ultra the recovery time can be reduced to 5 days.

R1A cargoes must not be carried until the coating has been in service for three (3) months (3 months after the carriage of first cargo), carrying unrestricted (R) cargoes only, or after a hot cure is done.

1B). AGGRESSIVE CARGOES.

These cargoes can cause slight softening and swelling of the coating system. The coating will however recover hardness as the cargo evaporates from the coating, after unloading. The stowage time for these cargoes must not exceed 90 days. After

unloading of these cargoes, the tanks should not be brought into contact with water or steam before the coating is restored to its original condition. This may be obtained by ventilating the tank with dry air until it is in a steady state gas-free condition. After ventilation, loading of further R1A, R1B, R2, R16 or R18 cargoes, aqueous cargoes, or ballast water, or further cleaning with (sea)water cannot take place within 30 days for Tankguard HB, 20 days for Tankguard HB Classic, 10 days for Tankguard Special and Tankguard Special Ultra. If a hot cure has been carried out for Tankguard Special Ultra the recovery time can be reduced to 5 days.

R1B cargoes must not be carried until the coating has been in service for three (3) months (3 months after the carriage of first cargo), carrying unrestricted (R) cargoes only, or after a hot cure is done.

2). VERY AGGRESSIVE CARGOES

These cargoes can cause moderate softening and swelling of the coating system. The coating will however recover hardness as the cargo evaporates from the coating, after unloading. The stowage time for these cargoes must not exceed 30 days. After unloading of these cargoes, the tanks should not be brought into contact with water or steam before the coating is restored to its original condition. This may be obtained by ventilating the tank with dry air until it is in a steady state gas-free condition. After ventilation, loading of further R1A, R1B, R2, R16 or R18 cargoes, aqueous cargoes, or ballast water, or further cleaning with (sea)water cannot take place within 30 days for Tankguard HB, 20 days for Tankguard HB Classic, 10 days for Tankguard Special and Tankguard Special Ultra. If a hot cure has been carried out for Tankguard Special Ultra the recovery time can be reduced to 5 days.

R2 cargoes must not be carried until the coating has been in service for three (3) months (3 months after the carriage of first cargo), carrying unrestricted (R) cargoes only, or after a hot cure is done.

3). ANIMAL OILS, VEGETABLE OILS and FATS.

These cargoes contain varying amounts of Free Fatty Acids (FFA), depending on type, origin, age, and quality of oil. Solid or semi-solid types such as Palm Oil, Tallow (Lard),

are transported at elevated temperatures to facilitate cargo handling. Excessively high temperatures and/or prolonged heating can cause an increase in FFA content, especially in the region around heating coils, and in heat exchangers.
The Free Fatty Acid (FFA) content of oils is usually expressed as % FFA, and is measured according to ASTM D – 1980. In accordance with ASTM D – 1980 the amount of FFA in an oil is expressed as its "Acid Value". Acid value is approximately equal to 2 X the % FFA. For example oil with an Acid Value of 5 will have a % FFA of approximately 2.5. The maximum acceptable levels of FFA's for JOTUN cargo tank coatings are as follows;

Cargo Tank Coating	Maximum Acceptable Acid Value (ASTM D-1980)	Approximate %FFA
Tankguard Zinc	**4**	**2%**
Tankguard CPC	**30**	**15%**
Tankguard HB	**30**	**15%**
Tankguard HB Classic	**30**	**15%**
Tankguard Special	**80**	**40%**
Tankguard Special Ultra	**No Limit**	**up to 100%**

The water contained in the oil must not exceed 1%, as water may increase the FFA level above the maximum limits (not applicable for Tankguard Special Ultra) and no free mineral acid content is permitted.

Certain vegetable oil derivatives such as Fatty Acid Distillates and Acid Oils have been known to contain traces of mineral acids, as well as water, and free fatty acids. They are very aggressive towards coating systems. These products may only be carried provided specific approval has been given by JOTUN. Please contact your local Jotun office for further information.

End users are advised to consult FOSFA, NIOP Rules and Qualifications, and EC Regulations concerning FFA levels, and prior cargoes, when transporting oils in coated tanks.

4). HYDROLYSABLE CARGOES, and AMINES.

Esters, chlorinated or brominated compounds, amine cargoes and others will react with any moisture present to form aggressive by-products, which will attack the coating and/or carbon steel. Such cargoes must therefore be free from moisture and be carried in completely dry tanks, which are protected against water ingression.

The water content of these cargoes must not exceed 0.02% (200ppm).

After unloading these cargoes the tank should be cleaned in accordance with the procedure detailed in herein.

5). CRUDE OIL and CRUDE OIL DERIVATIVES.

Crude Oil and Fuel Oil may contain variable amounts of acidic materials, which may be detrimental to Tankguard Zinc.

The maximum acceptable Neutralisation Number (ASTM D 664) for these cargoes is 0.4.

7). UNLEADED GASOLINE

Many unleaded gasoline products may have considerable amounts of oxygenated solvents added to them to improve their combustion characteristics. Methyl tert-butyl ether (MTBE) and ethyl alcohol are common additives to gasoline.

1. The coating is fully compatible with unleaded gasoline containing MTBE as the sole oxygenated additive, provided the concentration is less than 20% by volume.
2. The coating is fully compatible with unleaded gasoline containing ethyl alcohol (ethanol) as the sole oxygenated additive, for concentrations up to 99% by volume when carried in accordance with Specific note 1A.
3. The coating is fully compatible with unleaded gasoline containing methyl alcohol (methanol) as the sole oxygenated additive, for concentrations up to 20% by volume when carried in accordance with Specific note 1A.
4. The coating is fully compatible with unleaded gasoline containing isopropyl alcohol (isopropanol) as the sole oxygenated additive, for

concentrations up to 20% by volume when carried in accordance with Specific note 1A.

For unleaded gasoline containing additives different to the above, different concentrations, or mixtures, JOTUN must be consulted for specific advice.

8). COATING DISCOLOURATION.

The coating may be discoloured by this cargo. The discolouration will not affect the resistance of the coating, but may make tank cleaning more difficult, and also increase the risk of contaminating subsequent cargoes. See also General notes.

9). ZINC PICK-UP

Certain cargoes are sensitive to the presence of zinc particles, which could possibly be picked up during transportation in zinc coated tanks. Small particles of zinc picked up by the cargo will have no effect on the Tankguard Zinc, but may affect the quality of the cargo.

11). pH sensitive cargoes

Products in this class can be transported, provided that the pH is within the range 5.5-10.0.

12). MOLASSES.

Molasses may be carried in tanks coated with Tankguard Zinc if the pH of the cargo is between 5.5 – 10.0. The pH of molasses may decrease during transportation due to fermentation. After unloading molasses, tanks should be washed with hot seawater, flushed with fresh water, and then lightly steamed. Any residual water after steaming must be neutral. The tank should then be drained, mopped out, and finally ventilated to a dry condition.

14). PHENOL & CRESOLS

Tankguard Zinc is resistant to Phenol and Cresols provided the coating has been in service for at least 3 months.

16). EXTREMELY AGGRESSIVE CARGOES.

These cargoes can cause moderate softening and swelling of the coating system. However, the coating will recover hardness as the cargo evaporates from the coating, after unloading. The stowage time for these cargoes must not exceed 30 days (with the exception of 1,2-dichloroethane (EDC) and acrylonitrile, where 60 days stowage can be accepted, for Tankguard Special Ultra ONLY). After unloading of these cargoes, the tanks should not be brought into contact with water or steam before the coating is restored to its original condition. This may be obtained by ventilating the tank with dry air until it is in a steady state gas-free condition. After ventilation, loading of further R1A, R1B, R2, R16 or R18 cargoes, aqueous cargoes, or ballast water, or further cleaning with (sea)water cannot take place within 10 days for Tankguard Special and 5 days for Tankguard Special Ultra.

For Tankguard Special Ultra ONLY, after unloading of acrylonitrile, the tank may be flushed with water in order to reduce the cargo vapour content of the tank

Methyl alcohol (methanol) cargo must be pure (contamination with acetaldehyde, formaldehyde, formic acid, acetone and acetic acid should be below 30 ppm per contaminant). The methyl alcohol should be "water free" (maximum permissible water 0.020 % or 200 ppm). Samples of the methyl alcohol must be taken prior to both loading and discharge. The sample has to be sealed, properly marked and dated and retained on board for a minimum of 6 months after discharge of the methyl alcohol cargo.

Prior to carriage of these cargoes, the coating must be hot cured within 3 months in service (3 months after the carriage of first cargo) whilst carrying unrestricted (R) cargoes only.

Hot cure must be carried out for these cargoes, and cannot be substituted by post curing, i.e. three (3) months in service.

18). TANKGUARD SPECIAL ULTRA; METHYL ALCOHOL AND VINYL ACETATE.

These cargoes can cause moderate softening and swelling of the coating system. The coating will, however, recover hardness as the cargo evaporates from the coating, after unloading. After unloading of methyl alcohol the tank may be flushed with water in order to reduce the cargo vapour content of the tank. Before subsequent loading of further R1A, R1B, R2, R16 or R18 cargoes, aqueous cargoes, or ballast water, or further cleaning with (sea)water the tank must be ventilated with dry air until it is in a steady state gas-free condition and restored to its original condition. Any of these cargoes shall not be loaded until after 5 days of ventilation.

Methyl alcohol (methanol) cargo must be pure (contamination with acetaldehyde, formaldehyde, formic acid, acetone and acetic acid should be below 150 ppm per contaminant). The methyl alcohol should be "water free" (maximum permissible water 0.10 % or 1000 ppm). Samples of the methyl alcohol must be taken prior to both loading and discharge. The sample has to be sealed, properly marked and dated and retained on board for a minimum of 6 months after discharge of the methyl alcohol cargo.

Prior to carriage of these cargoes, the coating must be hot cured within 3 months in service (3 months after the carriage of first cargo) whilst carrying unrestricted (R) cargoes only.

Hot cure must be carried out for these cargoes, and cannot be substituted by post curing, i.e. three (3) months in service.

If a hot cure is not carried out, note 2 apply.