

BAB VI

PENUTUP

6.1. KESIMPULAN

Dari perhitungan dalam menentukan besarnya biaya cargo tank coating dan analisa yang telah dilakukan, maka dapat disimpulkan beberapa point sebagai berikut :

- a. Sistem pengecatan yang dipakai untuk cargo tank coating adalah High Performance System dengan menggunakan cat epoxy, cargo tank coating harus diperlakukan secara khusus karena akan mempengaruhi mutu dan kualitas dari minyak yang akan diangkut.
- b. Metode yang dipakai untuk cargo tank coating ada tiga, yaitu:
 - Metode Airless spray, yaitu metode yang menggunakan alat airless spraying dan kompressor, dimana proses pengecatan dengan penyemprotan memakai tekanan udara.
 - Metode Roll, yaitu metode yang menggunakan alat roll untuk pengecatan dengan cara konvensional.
 - Metode Brush, yaitu metode pengecatan dengan menggunakan alat brush / kwas dan dilakukan dengan cara konvensional.
- c. Dalam penentuan besarnya biaya cargo tank coating dipengaruhi oleh:
 - Metode pengecatan yang digunakan, berpengaruh terhadap jumlah layer yang dihasilkan untuk memenuhi total dry film thickness yang ditentukan.

- Luasan daerah yang akan dicat, semakin luas daerah pengecatan semakin besar biaya pelaksanaan cargo tank coating.
- Jenis / type cat yang digunakan (produk cat), harga tergantung pasaran dan tidak sama untuk tiap galangan.
- Perusahaan / galangan yang melaksanakan pengecatan, berhubungan dengan fasilitas atau peralatan yang dipunyai dan kebijaksanaan galangan dalam menentukan standard unit price.

d. Ditinjau dari biaya – biaya pengecatan, yang terdiri atas :

- Biaya persiapan material
- Biaya material
- Biaya tenaga kerja
- Biaya overhead

Maka biaya persiapan merupakan bagian yang terbesar dibanding dengan biaya lainnya, yaitu kurang lebih 70 % dari biaya keseluruhan pengecatan.

e. Dari tabel 5.1. Perincian biaya tank coating dari tiga metode pengecatan dengan menggunakan type cat Tank Guard HB (Jotun) total biaya yang paling murah yaitu metode roll yaitu U\$ 470191.68 dibanding metode airless spray yaitu U\$ 471926.67 dan metode kwas paling mahal yaitu U\$ 483750.86.

f. Dari tabel 5.2. Perincian biaya tank coating dari ketiga metode pengecatan dengan menggunakan type cat Hempadur 1550 (Hempel) total biaya yang paling murah yaitu metode airless spray yaitu U\$ 450983.74 dibanding metode roll yaitu U\$ 470232.856 dan metode kwas yang paling mahal yaitu U\$ 483791.532.

- g. Dari segi teknis, metode yang paling bagus hasil pengecatannya dan memenuhi syarat adalah metode airless spray.
- h. Metode yang paling sesuai adalah metode airless spray karena dalam masalah biaya pengecatan dibanding dua metode lainnya tidak terpaut jauh dan dari segi teknis serta penampilan, metode ini lebih baik dibanding dengan metode lainnya.

6.2. SARAN

Berdasarkan kesimpulan yang telah dikemukakan diatas dan keadaan dilapangan, ada beberapa saran yang mungkin dapat dipertimbangkan oleh perusahaan / galangan, yaitu:

- a. Penggunaan metode airless spray untuk pengerjaan cargo tank coating karena metode tersebut secara umum terbukti lebih ekonomis dibanding metode lain.
- b. Meningkatkan ketrampilan / skill dari tenaga kerja galangan dalam melaksanakan cargo tank coating sehingga bisa memanfaatkan tenaga kerja semaksimal mungkin tanpa harus menggunakan jasa pengecatan pihak lain (sub contractor).
- c. Perlu dilakukan penelitian lebih lanjut mengenai total pengeluaran biaya cargo tank coating dengan menggunakan tenaga kerja galangan sehingga bisa diketahui secara pasti mengenai pengeluaran biaya pengecatan sesuai dengan schedule pengerjaannya dan sesuai dengan progress yang dicapai. Karena bila memakai jasa pengecatan, data – data mengenai detail tenaga kerja yang terlibat dan peralatan yang digunakan serta gaji tiap pekerja tidak boleh keluar.

DAFTAR PUSTAKA

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3. Guy E. Weismantel, Paint Handbook, McGraw Hill Inc, USA. 1981.
4. Ir. Heru Triady & Ir. Bara Frontasia, Laporan Cargo Coating Kapal LTTC-II, Sembawang, Singapore, Pertamina. 1994.
5. Jotun Protective Coating, Coating and Inspection Manual, Paint Manufacturer, Sandefjord, Norway. 1992.
6. Jotun Tank Coating Prosedures, Paint Manufacturer, Sandefjord, Norway. 1991.
7. KA. Chandler, Marine and Offshore Corrosion, Butterworth & Co, Ltd. 1985.



Jotun Protective Coatings

Marine

CONDITIONS DURING APPLICATION: Control of humidity and air/steel temp. is absolutely necessary to ensure smooth progress of work, regardless of weather conditions. The temperature of the steel and, during application of the paint, be at least 3°C above the dewpoint of the air — air temperature and relative humidity to be measured in close proximity to the steel. Hot air ventilation should be avoided as this may lead to surface drying/curing and solvent entrapment. Hot air may, however, be used to raise the temperature of the coating above the minimum curing temperature of 10°C when all solvents have evaporated. During application, the spray operator must be equipped with fresh-air hood. Furthermore, electric equipment used in tanks must be of explosion-proof type.

DRYING TIME: The drying times are evaluated according to BS 3900 Part C2 and BS 3900 Part C3. Drying times are generally related to air circulation, temperatures, film thickness and number of coats, and will be affected correspondingly. The figures given in the table are typical at:

- Good ventilation
- Recommended film thickness
- One coat on top of inert substrate

SUBSTRATE TEMPERATURE	SURFACE DRY	HARD DRY	CURED	DRY TO RECOAT ^a	
				MINIMUM	MAXIMUM ^a
10°C	7 h	24 h	14 d	32 h	12 d
23°C	3.5 h	6 h	7 d	16 h	7 d
35°C	2 h	4 h	3 d	8 h	4 d

^a evaluated according to BS 3900 Part C2

^a evaluated according to BS 3900 Part C3

Recommended data given for recoating with the same generic type of paint

Surface should be free from chalking and contamination prior to application. If the maximum dry to recoat time is exceeded, please contact Jotun Protective Coatings for advice.

AL RECOMMENDED

SYSTEM: Tankguard HB 3 x 100 microns (Dry Film Thickness)

APPLICATIONS: Lloyd's register of shipping; Corrosion control

AGE AND PACKING STORAGE : The product must be stored in accordance with national regulations. The product should be kept in a cool and well ventilated place protected from too high temperatures. Containers must be kept tightly closed.

HANDLING : Handle with care. Stir well before use.

CONTAINERS : 16 l CompA, 4 l Comp. B

HEALTH AND SAFETY: A health and safety data sheet is available for this product on request.

Observe the precautionary notices displayed on the container.

Under well-ventilated conditions. Do not breathe or inhale mist. When spraying, wear a mask. Avoid skin

Spillage on skin should immediately be removed with suitable cleanser, soap and water. Eyes should be flushed with water and medical attention sought immediately.

The information in this datasheet is given to the best of our knowledge based on laboratory testing and practical experience. As our products are often used under conditions beyond our control, we can not guarantee anything but the quality of the product itself. We reserve the right to change the given data without notice.

ISSUED FEB 90

THIS DATA SHEET SUPERSEDES ALL PREVIOUS ISSUES.



Jotun Protective Coatings
Marine



**JOTUN
PROTECTIVE
COATINGS**

TANKGUARD HB

PRODUCT DESCRIPTION: Tankguard HB is a high build epoxy coating with high resistance to a wide range of chemicals and solvents.

RECOMMENDED USE: Interiors of tanks. A separate resistance list is available.

TECHNICAL INFORMATION:

Colours	: Light grey and light green
Solids (% by volume)	: 50 ± 2
Specific Gravity	: 1.4 (after mixing)
Flash point	: 24°C (Setaflash)
Gloss	: Flat
Flexibility	: Good
Water resistance	: Very good
Chemical resistance	: Excellent
Solvent resistance	: Excellent
Abrasion resistance	: Very good

	Film thickness per coat in microns		Theoretical spreading rate Sq. m/l
	Dry	Wet	
Possible application range	80—120	160—240	63—4.2
Typical	100	200	5.0

APPLICATION DATA:

Application methods	: Airless spray. Brush may be used for minor touch-up
Mixing ratio (by volume)	: 4 parts Comp. A (base) to be mixed thoroughly 1 part Comp. B (curing agent)
Mixing	: ½ hour prior to use
Potlife (23°C)	: 8 hours. (Reduced at higher temp)
Thinner/Cleaner	: Jotun Thinner No. 17
Guiding data airless spray	: Pressure at nozzle: 15 MPa (150 kp/sq. cm, 2100 psi.)
Nozzle tip	: 0.018—0.027 (0.46—0.69 mm)
Spray angle	: 40—80°
Filter	: Check to ensure that filters are clean

SURFACE PREPARATION: Prior to blast-cleaning all sharp (burned/cut) edges to be ground smooth and weld spatter removed according to standards agreed on among the parties concerned. All steel to be coated must be blastcleaned to Sa 2½-3 (ISO 8501-1:1988/SS 05 590U) with an approved abrasive. It is important to maintain this standard until the first coat has been applied. If the steel changes colour or rust bloom begins to form, this reflects improper control with the dewpoint which makes counter measures, including reblasting, necessary. After blasting, the steel should be vacuum-cleaned to remove all dust before application of the paint. The handling of the scaffolding should also be performed in such a way that dust will not contaminate the paint work.



HEMPADUR* 15500

CURING AGENT 97580

Description:

HEMPADUR 1550 is a two component, amine adduct cured (phenolic epoxy (novolac) paint, which cures to a coating with excellent resistance to a wide range of chemicals as tabulated in separate CARGO PROTECTION GUIDE.

Recommended use:

As a tank lining according to the selected PAINTING SPECIFICATION.

Service temperatures:

Dry: Maximum: 160°C/320°F In water (no temperature gradient): 50°C/122°F

Wet service temperatures, other liquids:
Consult the corresponding CARGO PROTECTION GUIDE.

Approvals:

Accepted by Lloyd's Register of Shipping as a provisionally recognized corrosion resistant coating.
Approved for potable water by Water Research Centre, Great Britain.

Availability:

Subject to confirmation.

PHYSICAL CONSTANTS:

Colours/Shade nos: Off-white /11630- Light red/50900
Finish: Flat
Volume solids: 68%
Theoretical spreading rate: 6.8 m²/litre - 100 micron
273 sq.ft./US gallon - 4 mils
Flash point: 26°C/79°F
Specific gravity: 17kg/litre - 14.2 lbs/US gallon
Surface dry: 2-3 hrs at 20°C/68°F (ISO 1517)
Dry to touch: 6 (approx.) hours at 20°C/68°F
Fully cured: 10 days at 20°C/68°F (See REMARKS overleaf)
V.O.C.: 322 g/litre - 2.7 lbs/US gallon

Shelf life:

1 year from time of production. Depending on storage conditions, mechanical stirring may be necessary before usage.

The physical constants are subject to normal manufacturing tolerances. Further reference is made to 'Explanatory Notes' in the Hempel Book.

APPLICATION DETAILS:

Mixing ratio for 15500:

Base 15509: Curing agent 97580

8.9 : 1.1 by volume

93.8 : 6.2 by weight

Application method:

Airless spray - Brush (touch up)

Thinner (max. vol.):

0845 (2%) GR45 (2%) (See Remarks overleaf)

Pot life:

3 hours (20°C/68°F)

Nozzle size:

0.18" - 0.23"

Pressure pressures:

150-200 bar/2200-2900 psi

(Airless spray data are indicative and subject to requirements)

Cleaning of tools:

HEMPEL'S TOOL CLEANER 9961

Indicated film thickness, dry:

100 micron/4 mils; (See REMARKS overleaf)

Indicated film thickness, wet:

150 micron/6 mils

Overcoating interval, min:

36/24 hours (20°C/68°F) (See REMARKS overleaf)

Overcoating interval, max:

21 days (20°C/68°F) (See REMARKS overleaf)

HEMPADUR 15500

SURFACE PREPARATION:

For optimum performance to the full range of chemicals in accordance with the main CARGO PROTECTION GUIDE, abrasive blasting to very near white metal Sa 2½-3, SSPC-SP-305, with a surface profile corresponding to Rugolast No. 3, DN10, Keane-Tator Comparator 3.00/75, or ISO Comparator Rough Medium (G). Consult the corresponding CARGO BARRIER PAINTING SPECIFICATION.

APPLICATION CONDITIONS:

Use only where application and curing can proceed at temperatures above 10°C/50°F. The temperature of the paint itself must be above 15°C/59°F, best results are obtained at 17-23°C/62-73°F. Relative humidity max. 80%, preferably 40-60%. Apply on a dry and clean surface with a temperature above the dew point to avoid condensation. Provide adequate ventilation during application and drying in confined spaces. Consult the corresponding CARGO BARRIER PAINTING SPECIFICATION.

RECEIVING COAT:

None.

SUBSEQUENT COAT:

None.

REMARKS:

Min. thickness:

Minimum total dry film thickness for the system is 300 micron/12 mils. May be specified in higher film thickness than indicated depending on purpose and area of use. This will alter spreading rate and may influence drying time.

Overcoating:

Minimum:

Use in contact with potable water: 3 days (20°C/68°F between each coat)
Use without contact with potable water: 36 hours (20°C/68°F) between 1 and 2 coat
24 hours (20°C/68°F) between 2 and 3 coat
No solvent: 21 days (20°C/68°F)

Finishing:

Roughening of the surface is necessary if the maximum overcoating interval is exceeded. The thoroughly mixed BASE and CURING AGENT must be pre-cured before application (15 minutes at 20°C/68°F). At other temperatures, please see APPLICATION INSTRUCTIONS.

Finishing:

Keep finishing at an absolute minimum. Do not dilute the components separately - only the mixture. Resistance in the widest range of cargoes is provided by additional heat curing, see APPLICATION INSTRUCTIONS and CARGO PROTECTION GUIDE.

Notes:

HEMPADUR 1550 is for professional use only.

SAFETY:

Handle with care. Before and during use, observe all safety labels on packaging and paint containers, consult HEMPEL Material Safety Data Sheets and follow all local or national safety regulations. Harmful or fatal if swallowed; immediately seek medical assistance if swallowed. Avoid inhalation of possible solvent vapours or paint mist, as well as paint contact with skin and eyes. Apply only in well ventilated areas and ensure that adequate forced ventilation exists when applying paint in confined spaces or when the air is stagnant. Always take precautions against the risks of fire and explosions.

This product is a two-component system. It is intended for use on steel, aluminium, copper, zinc, lead, tin, iron, steel, stainless steel, titanium, etc. For details on the use of this product, see the explanatory material. The product is a two-component system. It is intended for use on steel, aluminium, copper, zinc, lead, tin, iron, steel, stainless steel, titanium, etc. For details on the use of this product, see the explanatory material. The product is a two-component system. It is intended for use on steel, aluminium, copper, zinc, lead, tin, iron, steel, stainless steel, titanium, etc. For details on the use of this product, see the explanatory material.

APPLICATION INSTRUCTIONS

For product description refer to the product data sheet



HEMPADUR* 15500

CHIRING AGENT 9 70

Notes:

These application instructions cover surface preparation, application equipment, and application of HEMPADUR 1550.

The following are general rules, which may be supplemented with more detailed descriptions when needed, for instance for major newbuilding/new constructions or extensive repair jobs.

Steel works:

All welds must be free of pinholes and must be of highest quality so that they can be protected by the paint. This means perfectly filled, smooth welds with a slightly wavy surface.

All welds must be complete and continuous without cracks and fine gas, which will cause coating discontinuity.

All weld spatters must be removed.

All sharp edges must be removed or rounded off in such a way that the specified film thickness can be built up on all surfaces. The radius of the rounding should be approximately 12 mm.

The steel must be of first class quality that should not have been allowed to rust more than corresponding to grade II of ISO 8501-1:1988. Any loose rust must be removed.

All steel work (including welding, flame cutting, grinding) must be finished before the surface preparation starts.

Surface preparation:

Prior to abrasive blast cleaning of the steel, remove oil, grease, salts and other contamination with a suitable detergent followed by high pressure fresh water hosing. Alkali deposits on new welding seams as well as soap traces from pressure testing of tanks to be removed by fresh water and scrubbing with stiff brushes. Control for absence of contamination according to separate guidelines.

On repair jobs, a rough blasting to remove all loosely adhering materials may be required before degreasing/washing is carried out.

Old steel: Even after a very thorough tank cleanings, pits may typically contain contamination in the form of remnants of old cargoes as well as water soluble salts. For this reason, repeated detergent washing plus abrasive blasting may be necessary. After a first blasting, a very thorough vacuum cleaning is carried out in order to remove any "cargo bleeding" occurs as well as controls for water soluble salts are made. Reference is made to separate instructions. Special care should be taken in evaluating pitted areas.

Grit blast to min Sa 2½, ISO 8501-1:1988, SSPC SP 10.

To obtain full chemical resistance according to the CARGO PROTECTION GUIDE, the steel surface must be a bare metal blast cleaned according to ISO 8501-1:1988, equivalent to white metal Sa 2½ (SSPC SP 10) and ISO 8501-1:1988, equivalent to white metal Sa 3 at the moment of abrasive blasting, but after a slight reduction at the moment of paint application.

The resulting surface profile must be equivalent to highest film system III/13, Renne-Fater Surface Comparator 67/5 mm, 3.0 or ISO 8501-1:1988, equivalent to white metal Sa 3.

Use steel grit, silica sand, aluminium silicate, or similar sharp edged abrasive of a good quality free of foreign matters, soft particles, and the like. Control for absence of contamination according to separate guidelines.

Steel grit with particle size of $0.2 - 1.2$ mm or aluminium silicate of $0.4 - 1.8$ mm will usually create the desired surface profile when the air pressure at the nozzle is 6-7 bar/85-100 psi.

The compressed air must be dry and clean. The compressor must be fitted with suitable oil and water traps.

When the abrasive blasting is completed, remove residual grit and dust by vacuum cleaning. Abrasive particles not removed by vacuum cleaning are to be removed by brushing with clean brushes followed by vacuum cleaning.

The importance of systematic working must be stressed when blasting. Poorly blasted areas covered with dust are very difficult to locate during the blast inspection made after the rough cleaning.

Shopprimed and previously painted surfaces: All shopprimer or existing coating materials to be completely removed. Avoid the use of zinc shopprimer. If the steel is shopprimed with zinc, it is very important that all zinc is removed by abrasive blast cleaning. Separate check procedures will be necessary to demonstrate the effectiveness of removal. More blast cleaning may be deemed necessary!

Use of a red zinc shopprimer will facilitate the visual check of the blast cleaning and is considered necessary in order to obtain an acceptable surface preparation.

Application equipment:

HEMADUR 1550 is to be applied by airless spray equipment. Spot coating and minor repairs can be carried out by brushing.

Airless spray equipment: A large pump is preferred, with a pump capacity of 8-12 litres/minute.

Pump ratio:	Min. 45:1
Nozzle orifice:	.018" through .023"
Nozzle pressure:	150-200 bar (2200-2900 psi)
(Spray data are indicative and subject to adjustment).	
Thinning, if required:	max. 2% / THINNER OS45.
Only add thinner to the mixed paint.	

Cleaning of equipment:

The whole equipment to be cleaned thoroughly with HEMPEL'S TOOLCLEANER 9961 after use.

Mixing, pot life:

- Mix the entire content of corresponding base and curing agent packings. If it is necessary to mix smaller portions, this must only be done by weighing base and curing agent in the prescribed weight ratio: 93.8 part by weight of base and 6.2 part by weight of curing agent. The accuracy of the balance must be $\pm 1\%$ of the required amount of base and curing agent, respectively.
- Stir the mixed paint thoroughly by means of a clean mechanical mixer until a homogeneous mixture is obtained.
- Allow the mixed paint to preheat before application, see Table below.
- Use all mixed paint before the pot life is exceeded. The pot life depends on the temperature of the paint as shown in table below (valid for a 70 liter can):

Temperature of mixed paint	15°C/59°F	20°C/68°F	25°C/77°F	30°C/86°F
Working time	25 minutes	15 minutes	10 minutes	5 minutes
Pot life	6 hours	3 hours	2 hours	1 hour

- At 15°C/59°F and below, the viscosity must be too high for application by spray gun.
- Temperatures of 30°C/86°F and above should be avoided.



Application procedure:

The first full coat is usually applied immediately after vacuum cleaning and stripe coat afterwards. The final dry film thickness of the three coat system must be between 3 000 000 micron.

The wet film thickness must be 150-175 micron and must be measured regularly.

Film-build/continuity: With this tank coating intended for aggressive cargoes, it is of special importance that a continuous, pinhole-free paint film is obtained at application each coat. An application technique which will ensure good film formation on all surfaces must be adopted. It is very important to use nozzles of the correct size, neither too big. Select small nozzles for spray application of complicated structures, while larger nozzles may be used for regular surfaces. A proper, uniform distance of the spray gun to the surface, 30-50 cm, should be aimed at. To obtain good and steady atomizing, the viscosity of the paint must be suitable and the spray equipment must be sufficient in output pressure and capacity. At high working temperatures, use of extra thinner may be necessary to avoid dust spray.

The paint layer must be applied homogeneously and as close to the specification as possible. The consumption of paint must be controlled and heavy layers must be avoided because of the risk of sag and cracks and solvent retention.

Furthermore, great care must be taken to cover edges, openings, rear sides of stiffeners etc. This, on these areas a stripecoat will usually be necessary.

The finished coating must appear as a homogeneous film with a smooth surface and irregularities such as dust, dry spray, abrasives, must be remedied.

Note: In the case of old, oil corroded steel, application of a diluted, extra first coat is recommended to obtain better "penetration" in the fine pits. For this purpose, it is relevant to dilute 5-10%. Application by brush is recommended and film thickness must be that the surfaces "saturated" only.

Stripe coating:

All places difficult to cover properly by spray application should be stripe coated by brushing immediately before the spray application. Typically, first stripe coat is applied after the first full coat and the second stripe coat after the second full coat.

Micro climate:

The actual climate conditions at the substrate during application:

The minimum surface temperature is 10°C/50°F.

The maximum surface temperature should preferably be below approximately 30°C/86°F. In a warm climate it is recommended to carry out application during nighttime. Application at high temperatures, up to approximately 40°C/105°F, is possible, but extra care must be taken to avoid poor film formation and excessive spraydust.

The steel temperature must be above the dew point. As a rule of thumb, a steel temperature which is 3°C/5°F above the dew point can be considered safe.

In confined spaces, supply an adequate amount of fresh air during application and drying to assist the evaporation of solvent.

Drying and curing:

In a dry film thickness of 100 micron, with a steel temperature of 20°C/68°F, a relative air humidity of maximum 80% and adequate ventilation, HEBPAULT 650 will be touch after 4-6 hours. Under these drying conditions, the paint film will accept light traffic after approximately 16 hours.

Correct formation of the paint film depends on an adequate ventilation during drying. The following figures are indicative for obtaining adequate ventilation:

Size of tank painted	Number of air shifts per hour until the minimum overcoating interval has elapsed
1 000 m ² /35 000 cu ft	40
400 m ² /14 000 cu ft	20
1 000 m ² /35 000 cu ft	15
400 m ² /14 000 cu ft	5

This ventilation must be maintained for a period corresponding to the minimum overcoating interval. During the following period until full curing a few air shifts per hour will suffice. Take actions to avoid "pockets" of stagnant air.

Safety precautions may require stronger ventilation than indicated above.

One litre undiluted HEMPADUR 1550 gives off in total 79 litres solvent vapour until it is completely dry.

The lower explosive limit, LEL, is 1.0%.

Because solvent vapours are heavier than atmospheric air, effective ventilation requires forced ventilation with exhaust from the lowest part of the tank.

Provided that adequate ventilation, recommended relative humidity, specified film thickness, and recommended minimum overcoating interval are kept, the following curing times are valid:

Steel temperature	10°C/50°F	15°C/59°F	20°C/68°F	25°C/77°F	30°C/86°F	35°C/95°F
Curing tank	8 days	10 days	10 days	8 days	7 days	6 days
Filling of tanks with water immediately after	10 days	10 days	10 days	7 days	7 days	6 days

Post curing is accomplished by carrying a hot cargo of mineral oil based lubricating oil or vegetable oil to provide a steel temperature in the tank of 60°C/140°F for 8 days or 50°C/122°F for 10 days. Other hot cargoes may also be used for postcuring, but only after HEMP EL's written approval. Reference is made to the CARGO PROTECTION GUIDE.

Provided observance of the above stated ventilation and relative humidity the following overcoating intervals in relation to the (steel) temperature are valid:

Steel temperature	10°C/50°F	15°C/59°F	20°C/68°F	25°C/77°F	30°C/86°F	35°C/95°F
Without contact with potable water						
Minimum after the first coat	4 days	2 1/2 days	30 hours	24 hours	18 hours	14 hours
after the second coat	2 1/2 days	1 1/2 days	24 hours	16 hours	12 hours	10 hours
In contact with potable water						
Minimum after the first coat	7 1/2 days	5 days	3 days	2 1/2 days	2 days	1 1/2 days
after the second coat	5 1/2 days	3 1/2 days	2 1/2 days	1 1/2 days	1 1/2 days	1 1/2 days

The maximum relative humidity before and between the coats should not exceed 80% and the steel temperature should always be above the dew point, in practice minimum 1°C/33°F above the dew point.

Dry spray is not acceptable as this will reduce the protective characteristics of the paint and make later tank cleaning difficult. Dry spray can be avoided by using mechanical stirrers, laying equipment and hot air.

Hold spraying at a right angle to and about 30 cm from surface making even parallel pattern area after to produce the specified wet film thickness in per specification.



Avoid dry spray (overspray creating excessive paint mist), e.g., by using a fan angle, and the lowest possible pressure. A small fan angle should also be used, if application is used, for "stripe coating" or for instance reverse sides of stiffeners.

Each layer must be applied homogeneously and as near as to the specification of micron dry film thickness, as possible. The consumption of paint must be controlled and heavy layers must be avoided because of the risk of sagging, cracks and solvent retention.

Surface irregularities such as dry spray, sagging, exaggerated thickness or embedded dust or abrasives will have to be remedied.

If a sandpapering between layers, for instance on the bottom, is needed, great care must be taken to avoid damage of otherwise intact surfaces. When using mechanical means only lightweight equipment should be used, orbital sander is recommended. Avoid sandpapering on top of welds or irregularities or near to vertical surfaces.

The finished coating must appear as a homogeneous surface without pores, runnels, pollution of any kind.

Dry film thicknesses:

For the standard specification the following applies to the dry film thickness:

The minimum dry film thickness is 300 micron, the maximum thickness to be aimed is approximately 600 micron. The minimum dry film thickness is evaluated according to the "90-5" rule, i.e. no more than 5% of the total number of individual measurements must be lower than the minimum dry film thickness, and the lowest individual measurement must be at least 90% of the minimum dry film thickness, i.e. 270 micron. Dry film thickness control is not to be carried out within the first 24 hours after application of final coat (20°C, sufficient ventilation). The measurement must be carried out using an electromagnetic dry film thickness gauge calibrated with shims placed on smooth steel substrate. The maximum dry film thickness can be evaluated according to the "8020" rule.

Taking into use: Do not use the tank before the coating is properly cured. When cut but before taking the tank into use for potable water, fill twice with water each time period of no less than 24 hours and finally flush with fresh water.

Repairs:

It is of great importance that all damage to the coating is repaired.

Repair shall be started up as soon as possible. Repair of mountings for staybolts must take place in connection with the dismantling of the staybolts, the tempo of work shall be adjusted to the touchup procedure.

It is important that the repaired areas, as well as the rest of the coated areas, are cured before the tank is taken into use or washed by the tank cleaning system.

The extent of damage to the coating can be evaluated by a seawater test. Wash the tanks with clean seawater by means of the tank cleaning machines until probes are heating, coils on tanktop are covered. Allow the water to stay for minimum 3 days, after which period the tank is emptied and cleaned with clean fresh water to remove salts.

The repair process:

General: Before mechanical treatment is started, surfaces to be repaired have to be cleaned for any salts and other contaminants.

Areas less than 5 x 5 cm.

The surface preparation can be executed by grinding to a clean metal surface, feathering edges of intact coating and slightly sanding the adjacent area.

Clean and wash with FREEMET'S THINNER 0045.

Touchup by brush to full film thickness with minimum 2 coats of FREEMET 1500.

Area up to 1 sq.m.

The surface preparation must be executed by vacuum blasting or open media blasting so that the steel has a proper roughness and a cleanliness to Sa 2 according to ISO 8501:1988. The overlapping zone must be sanded or sweep blasted to ensure a good adhesion of the new paint.

Clean and wash with HEMPEL'S THINNER 0845.

Touchup by brush to full film thickness with minimum 4 coats or by spray 3 coats HEMPAOUR 1550:

Areas more than 1 sq.m. or areas where several damaged spots are concentrated.

Treatment: Repeat the original specification.

Handle with care. Before and during use, observe all safety labels on packaging and paint containers, consult HEMPEL Material Safety Data Sheets and follow all local or national safety regulations. Harmful or fatal if swallowed; immediately seek medical assistance if swallowed. Avoid inhalation of possible solvent vapours or paint mist, as well as paint contact with skin and eyes. Apply only in well ventilated areas and ensure that adequate forced ventilation exists when applying paint in confined spaces or when the air is stagnant. Always take precautions against the risks of fire and explosions.



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