TerraFrigo refrigeration systems

TFGuard®

The highly efficient TFGuard® corrosion-resistant coating

TerraFrigo refrigeration systems

Company Limited "TerraFrigo»

Russian manufacturer of industrial cold-storage plants, heat-exchange equipment, transport refrigeration, vehicle air conditioners and special-purpose equipment with TerraFrigo brandname.

+7 985 644 14 88
terrafrigo.org

+7 985 644 14 88
terrafrigo.org

TFGuard® coating extends the life of the heat exchange equipment, ensures its consistently high performance in aggressive environments, as well as significant cost savings for maintenance and operation.

6000 hours

corrosion resistance
The anticorrosion coating passed the corrosion test in a salt fog chamber according to ASTM B-117

500-hour

sea water test

40 µm

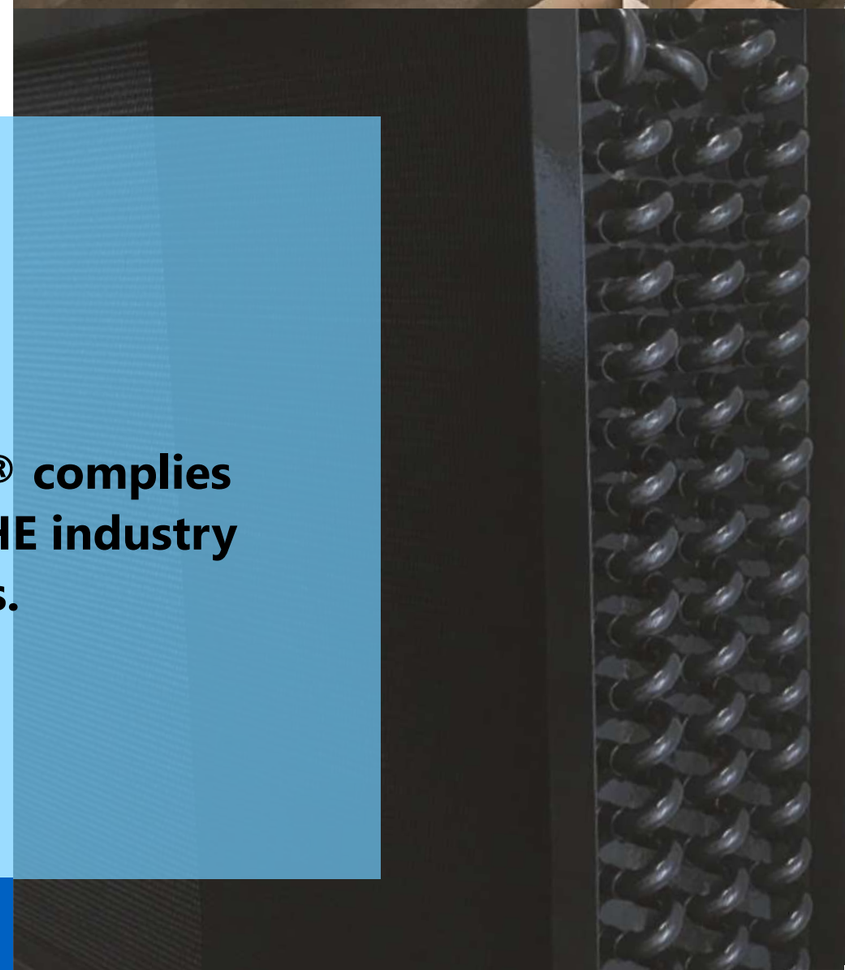
layer thickness
does not affect air flow

Unique production technique

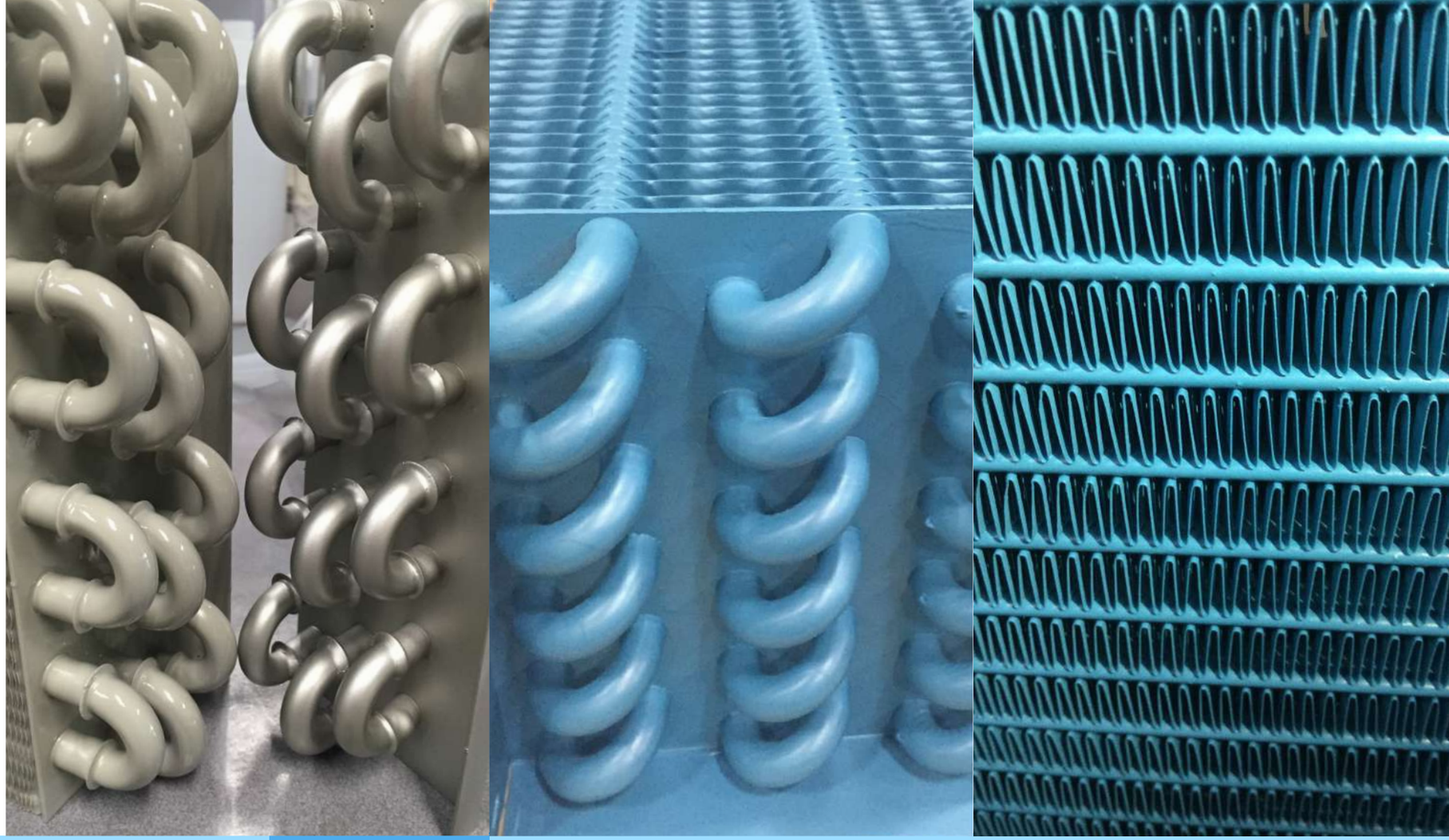
The special TFGuard® siloxane coating protects the heat exchange part of the equipment, manifold and housing from the destructive substances.

TFGuard® coating is applicable to Cu/Cu (copper/copper) and Al/Cu (aluminum/copper) heat exchangers.

TFGuard® complies with MCHE industry standards.



Advantages of TF Guard® coating



- High Chemical and Germicidal protection
- Water based, without hazardous components
- Short drying time - 20 minutes
- Fits for factory and field application
- Applied by spraying or dipping
- UV protection
- High adhesion with fluxed surfaces
- Odourless
- Economical coverage and easy service

Technical description

The coil will receive a uniform coating on all surfaces, including fin edges, with a thermoset, modified phenolic epoxy coating.
Application of coating will be through multiple coats by immersion or flow coating to a film thickness of approximately 1.0 mil.

Coating provides corrosion protection in a 6,000 hour salt spray test in accordance with ASTM B-117 and humidity resistance of >2,000 hours per ASTM D2247.

Chemical resistance is demonstrated via 100+ acetone double-rubs per ASTM 5402.

Coating also exhibits superior hardness of 5–6H per ASTM D3363, adhesion of 5B per ASTM B3359 and impact resistance of 160 in./lbs (ASTM D2794).

If the coils are to be subjected to direct ultraviolet (UV) exposure, a spray-applied UV-resistant topcoat is an option.

Specifications

Salt Spray: ASTM B-117: 6,000+ hours
Humidity: ASTM D-2247: 2,000+ hours
Solvent Resistance: ASTM-5402: 100 acetone double rubs
Dry film thickness: ~1 mils
Cross-hatch adhesion: ASTM B-3359: 5B
Hardness: ASTM-D3363: 5–6H
Gloss: 20–60 on 60 degree meter (topcoat dependent)
Mandrel: ASTM-D522: >1/4 inch
Impact: ASTM D-2794: 160 lb/inch steel; 40 lb/inch aluminum
pH range (14 day liquid spot test): 2.4–12.6
Temperature cycling (4 hours at –75°C; 4 hours at 190°C): 4B–5B adhesion after 5 cycles
Dry heat resistance (4 hours at 200°C; 20 minutes at 232°C): 4B–5B adhesion after 5 cycles
Simulated sea water resistance: 500 hours
Microchannel Compatible
Abrasion resistance: 30–40 mg loss per 1000 cycles
Meets FDA 175.300 for indirect food contact
Meets MIL Spec: MIL-C-18467, MIL-E-480 andMIL-STD-883 Method 1101
Meets Other Specs: Honeywell MC 7200-01 and GE F50T17
At approximately 2 mils thickness, Thermal Conductivity is less than 1.0 w/mK
Dielectric Strength [ISO 2376:2010(e)]: 286 volts per mil of thickness

Coating types

Beige primer (basic parts) + black dye (pigment). Lamella and basic parts

It has anti-corrosion properties and salt fog resistance. Cleaner (pretreatment) + Water-based coating for heat exchangers (black) + Hardener

Beige primer + black dye + grey dye (for chemical aggressive media, premium product). Basic parts

Cleaner (pretreatment) + Water-based coating for heat exchangers (black) + Base + Hardener

Beige primer (basic parts) + water-repellent dye

Cleaner (pretreatment) + Water-based coating for heat exchangers (black, hydrophobic) + Base + Hardener

Beige primer (basic parts) + water-absorbent dye

Cleaner (pretreatment) + Water-based coating for heat exchangers (black, hydrophilic) + Base + Hardener

Beige primer (basic parts) + antibacterial dye

Cleaner (pretreatment) + Water-based coating for heat exchangers (black, antibacterial, hydrophilic) + Base + Hardener

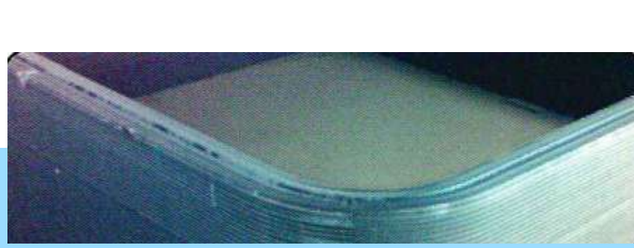
Other products

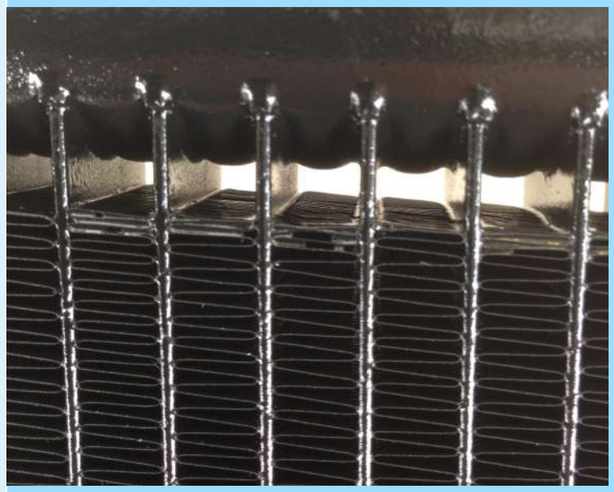
Multi-layer siloxane coating of tube sheets, casing with low content of volatile substances

Extremely resistant chemical protection of heat exchangers, galvanized, copper and steel parts of equipment from aggressive environments.

Polyurethane coating without organic volatile substances

Self-leveling polyurethane coating for pallets and utility water tanks for hygienic and anti-corrosion purposes. The properties obtained exceed the stainless-steel parameters.





Transparent/Colour coating

The heat exchanger treatment agent can be supplied as a clear coat or painted in specific colors with anti-corrosion properties and UV protection to meet the needs of manufacturers and consumers.

Multi-layer siloxane coating

The coating technology includes a multi- layer siloxane component that can withstand the hardest service conditions including wastewater and operating on offshore oil rigs.

As a topcoat (mastic primer), a multi-level siloxane coating eliminates corrosion of collectors, tube sheets, compressors and pallets throughout the service lifetime of the equipment.

This coating and its application technique are the best among similar solutions.

Multi-layer siloxane coating was tested at the most severe industrial exposure conditions in the Middle East. This coating did not show any deterioration after multiple years.

Electrostatic production coating

The heat exchanger is coated with an elastic cationic epoxy electrostatic coating evenly applied to all metal surfaces.

The electro-coat process shall ensure complete heat exchanger encapsulation of all conductive surfaces with uniform dry film t hickness from 0.6-1.2 mils (15-25 µm).

E-coating shall meet 4B-5B rating for cross-hatch adhesion per ASTM B3359-93.

Corrosion durability will be confirmed through testing to no less than 6,000 hours salt spray resistance per ASTM B117-90 using scribed aluminum test coupons.

After electrostatic coat cure, heat exchanger shall receive a spray-applied, 2K polyurethane black topcoat to prevent UV degradation of epoxy e-coat film.

Electrostatic coat meets these test standards:
ASTM B117 / DIN 53167 Salt Spray - 6,048 hours;
ASTM B117-G85 Modified Salt Spray - 2,000 hours;
DIN 50018 Kesternich - 120 cycles;
GM9540P-97 Accelerated Corrosion Test (120 cycles).

Maintenance

The heat-exchanging surface of the fin pack determines the cooling capacity and consequently energy consumption. However, pollution in between the fins can have a disastrous effect on cooling capacity.
A regular professional and thorough cleaning can limit down time, warranty voidance and even prevents unwanted production stops.

This procedure must be strictly followed by the user of the TFGuard® coated equipment, frequency of maintenance as per cleaning cycle in the cleaning matrix.

Cleaning chemicals

Approved Cleaners:
NU CALGON: EVAP Green and CAL Clean, diluted as per instructions.

Cleaning equipment

A high pressure cleaner with a good dosing unit for the cleaning chemical is preferred.

It's important

Acid cleaners must be pH 3-7.

Alkaline cleaners must be pH 7-13.

No cleaners shall stay on the coil surface for > 5 minutes, followed by a thorough rinse.

Do not apply glycol based chemicals < 5%.

Cleaning Matrix

		Cleaning cycle		
Exposure conditions	Additional selections	Monthly	Quarterly	Half yearly
Marine	Within 5 miles from the ocean			
	High fin density >14fpi	✓		
	Directly facing the ocean	✓		
	Subject to other pollutants like sand, leafs, dust, fibres, dirt etc	✓		
	Micro Channel	✓		
	Others		✓	
Industrial	Within 2 miles from industrial exhaust			
	High fin density >14fpi	✓		
	Directly facing industry exhaust	✓		
	Subject to other pollutants like sand, leafs, dust, fibres, dirt etc	✓		
	Micro Channel	✓		
	Others		✓	
Marine/Industrial	Within 2 miles from industrial exhaust & within 5 miles from the ocean			
	High fin density >14fpi	✓		
	Directly facing industry exhaust	✓		
	Subject to other pollutants like sand, leafs, dust, fibres, dirt etc	✓		
	Micro Channel	✓		
	Others	✓		
Rural	Inland low humidity			
	High chemical concentrations	✓		
	Others		✓	
Urban	Highly poluted areas			
	High concentration of fuel combustion		✓	
	Others		✓	
Industrial Specifics	Directly installed on the mentioned production facility			
	Meat, Fish processing, Mushrooms, Bottling fruit juices, Winery	✓		
	Chemical Industry, Foundry	✓		
	Refineries, Oil and gas	✓		
	Automotive, Aeroplanes	✓		
All other environments				✓

Tests

Resin coating.
Measurement of antibacterial activity on plastics and other non-porous surfaces.

Norm: ISO 22196-07
Test Germs: Staphylococcus epidermidis DSM 18857 and Escherichia coli DSM 1576/ATCC 8739.

This investigation was performed and supervised according to the standard operating procedure “SOP to ISO 22196 (Mod)” by a contract partner of Textile Lab.

The laboratory and process are continually monitored by independent, external authorities, as well as by internal audits.

Test description

During the test, a thin liquid-film containing the bacteria (1.25x10^4 CFU / cm2) is applied directly to the test sample (5cm x 5cm). To avoid desiccation a foil is applied.
Immediately after inoculation, the bacteria from the reference sample are separated from the sample and the enveloping foil surfaces using ultrasound and vortex devices and the number of viable germs is determined. A further set of reference samples and samples given anti-microbal treatment is incubated with bacteria in a liquid-film and the enveloping foil in a damp environment at 37C. After a minimum of 24 hours, the bacteria are separated from the sample surfaces using ultrasound and vortex devices and the number of viable germs is determined.

Test results

Results test 1 specimen	t0 (cells/cm2)			t24 (cells/cm2)			Reduction [%]	Log Reduction
Coating without additive	$5,6 \times 10^3$	$8,5 \times 10^3$	$6,6 \times 10^3$	$3,2 \times 10^3$	$4,1 \times 10^3$	$4,9 \times 10^3$	-	-
Coating with additive				$<1 \times 10^1$	$<1 \times 10^1$	$<1 \times 10^1$	> 99,99	**> 4**
Super hydrophilic coating without additive	$6,7 \times 10^3$	$6,6 \times 10^3$	$7,5 \times 10^3$	$5,6 \times 10^3$	$5,3 \times 10^3$	$6,0 \times 10^3$	-	-
Super hydrophilic coating with additive				**$<1 \times 10^1$**	**$<1 \times 10^1$**	**$<1 \times 10^1$**	**> 99,99**	**> 4**

Coating and Hydrophilic coating are both meeting the ISO 22196 criteria for antibacterial working referring to the above tested Bacteria.

Certificate

CERTIFICATE OF COMPLIANCE

MANUFACTURING FACILITY CERTIFIED BY ISO 9001, certificate # QSC 296 AND ISO 14001

INDEPENDENT TEST LABORATORY: **COT BV**, HAARLEM, NETHERLANDS, signs for lab specs

LABORATORY CERTIFIED BY ISO 9001, certificate # NL10000931 issued by Bureau VERITAS and ISO 17025, *ISO 17025 accreditation with number L535,* *valid up to 1 January 2020, see for the actual situation of the accreditation the website of the Raad voor Accreditatie www.rva.nl The accreditation concerns the tests summarized in the scope only.*

COT bv
Jan Tadamaweg 40
2031 CV Haarlem
Postbus 2112, 2002 CC Haarlem
Tel: +31(0) 23 - 52 19 944
Fax: +31(0) 23 - 52 77 229

By Ben Alblas, COT Laboratory Manager

COIL PROTECTION

		Aluminum Coil 25 µm 1 mil
1	ASTM B 117	10 000 hours
2	ASTM G 85 annex 5	3 000 hours
3	Kesternich SFW 2,0 S	40 cycles
4	Cycle exchange ISO 20340	6000 hours
5	Taber Abraser	1000 cycles
6	Flexibility ISO 1519	passed *
7	Humidity ASTM D 2247 - 99	2000 hours
8	Adhesion B 3359	G0/5B
9	Pencil Hardness BH	passed *
10	Impact LBS 100 / sqinch ASTM D2794	passed *
11	Seawater Immersion 110 hours	passed *
12	Mandrel Bend: 1/8 inch ASTM D522/93A	passed *
13	Heat resistance 360 C 4 hours / -42C 9 days	passed *

* manufacturer specs

CERTIFICATE OF COMPLIANCE

COIL PROTECTION

		Aluminum Coil 25 µm
1	ASTM B 117	10 000 hours
2	ASTM G 85 annex 5	3 000 hours
3	Kesternich SFW 2,0 S	40 cycles
4	Cycle exchange ISO 20340	1000 hours
5	Taber Abraser	1000 cycles
6	Flexibility ISO 1519	passed *
7	Humidity ASTM D 2247 - 99	2 000 hours*
8	Adhesion ASTM B - 3359	G0 / 5B
9	Pencil Hardness BH	passed *
10	Impact LBS/sqinch ASTM D2794	passed*
11	Seawater immersion	110 hours*
12	Heat resistance 360 C 4 hours	passed*

* manufacturer specs

Sign and Stamp:

Dercom

MULTI COAT SILOXANE PROTECTION

		Mastic 180-250 µm Multi 50-70 µm
1	ASTM B 117	10000 hours
2	ASTM G 85 annex 5	3000 hours
3	Kesternich SFW 2,0 S	40 cycles
4	Cycle exchange ISO 20340	1000 hours
5	Taber Abraser	1000 cycles
6	Flexibility ISO 1519	passed *

* manufacturer specs

Sign and Stamp:

Dercom

CERTIFICATE OF COMPLIANCE

PAN COATING

		Galvanised steel Pan 1000 µm
1	ASTM B 117	3000 hours
2	ASTM G 85 annex 5	3000 hours
3	Kesternich SFW 2,0 S	40 cycles
4	Cycle exchange ISO 20340	1000 hours
5	Taber Abraser	1000 cycles
6	Flexibility ISO 1519	passed *

* manufacturer specs

Sign and Stamp:

Dercom