EUROVENT 1/9

SURFACE TREATMENT of INDUSTRIAL FANS

EUROVENT 1/9

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This code of practice has been developed by EUROVENT/CECOMAF WG 1 representing the European manufacturers of fans with a substantial contribution of Dr. Håkan BARD.

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F O R E W O R D

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The surface finish of industrial fans and their ancillaries has over the years been a subject of much discussion between manufacturers and users. Often the user will have unique knowledge of the environmental conditions prevalent at this particular plant or the corrosive agents present in his gas stream.

Conversely the manufacturer will have amassed a lot of information gleamed from many applications and will have decided which finishes should be available for his standard ranges and whether they will be applicable to his manufacturing processes. From this will have followed decisions on the necessary paint finishing, galvanising, coating or other plant to be installed.

It was therefore decided within Eurovent WG1 Fans that a document such as here presented would be of value to both manufacturers and users. Not only would it be a repository of previous successful usage, but it would perhaps assist in reducing the large number of surface treatments curently specified, to a smaller number of standards. This would ensure that paints, for example, could be bought by the manufacturer in more economically viable quantities to the mutual benefit of both parties.

I would like to record the very hard work contributed by Dr. Håkan Bard in the preparation of this document and hope that it would be widely read and followed.

C O N T E N T S

A. General

This is a conceptual document describing surface treatment systems for corrosion protection and appearance aspects of industrial fans.

When selecting fan material and type of surface protection fundamental aspects as e.g. the following are governing:

- Outdoor / indoor /coast / inland / industrial environment
- Corrosive atmosphere (acid / alkaline)
- Temperature
- UV resistance
- Moisture, water, oil, soil
- Abrasion
- Life cycle requirements
- Material in product
- Repainting

Temperature resistance and the risk of development of poisenous gases need particular attention in applications like tunnel ventilation, where normal ventilation fans are used for smoke extraction at elevated temperature under fire emergency.

The transportation environment also must be considered, i.e. risk of mechanical damage, transport climate (transport by sea, climate zones), storage conditions etc.

Hot-dip galvanizing or other material selection are alternatives to painting.

The finishing coating can either be applied in the factory or after erection. The following factors should be considered:

- risk of transportation damage.
- possibility of repair painting after erection.
- it is often an advantage to apply the finishing coating after assembling and to select one-component products such as alkyd or vinyl.
- environment when applying finishing coating. All painting is unsuitable at a high moisture and pollution content. Painting with one-component coating is normally possible down to +3°C. Two-component coatings normally demand +15°C. Maximum application temperature is +50°C.
- the temperature of the objects surface must be at least 3°C above the current dewpoint.
- on site welding of painted structures requires safety equipment which results in high working costs.

B. Specification of surface treatment program

Environmental Class (M0, Ml, M2, M3, M4a, M4b)

determines the choice of surface treatment program.

Surface Finish Class (YKI, YK2, YK3, YK4)

indicates the requirements for preparatory treatment and manufacturing class. The Surface Finish Class refers to the final finish and the exterior which are obtained through the combination of manufacturing Class and Surface Treatment.

Manufacturing Class (TK1, TK2, TK3, TK8)

has an influence on corrosion protection and the finish. The Manufacturing Class refers to the manufacturing finish after manufacturing but prior to the pre-treatment.

Painting System

together with surface finish class and manufacturing class are determining factors for corrosion protection.

B1. Environmental classification

The following environmental descriptions and classes derive from the Swedish Standard BSK. For corrosion aspects, the environments is divided into environmental classes M0-M4. The classes M0-M2 cover most indoor environments and M3-M4 most outdoor and industrial environments.

Environmental class/ aggressivity

M0 / None

Indoors in dry air, e.g. in heated premises.

M1 / Insignificant

Indoors in air with varying temperature and humidity and insignificant contents of air pollution, e.g. unheated premises.

M2 / Moderately

Indoors with moderate humidity and air pollution. Outdoors, inland in air with low contents of air pollution, e.g. in areas not densely populated.

M3 / Great

Outdoors in air with high contents of aggressive air pollution, e.g. in densely populated areas or industrial area. Above sea or near the coast, however, not in a zone with salt water droplets.

M4A / Very great

Indoors and outdoors at a constant high air humidity or constant condensation. In salt or fresh water or in soil.

M4B / Very great

Indoors and outdoors in industrial areas with high contents of aggressive air pollution, e.g. certin chemical industries, refineries or synthetic fertiliser factories.

B2. Manufacturing Classes

B2.1 Manufacturing Class TK 1

All surfaces must be without surface imperfections (peaks, pits etc.).
All sharp edges rounded off. All gaps must be tightly welded.

1. The weldings concerned must have additional requirement K in welding class e.g. WDK.

2. Welding joints:

   a) Slag and slag residue shall thoroughly be cleaned off.
   b) Welding spatter must be removed.
   c) Pointed peaks must be evened. Pointed peaks refer to unevenness which feels sharp or pointed when touched by bare hand. Sharp edges or points must not be formed when evening out. Machine welding and well-done hand welding are not normally adjusted.
   d) Visible openings are pores which can cause corrosion pockets or prevent wetting must be accessible or welded and evened according to point c.

3. Tight welding of gaps:

   All gaps where moisture can seep in, must be welded together with cover welding, which must be free from pores. Examples of such gaps can be found between sheets and braces or between two bent sheets.
   The welding must be treated according to point 2.
   The tight welding which is done as unstructural welding must have the least possible effective throat.

4. Defects in steel surface:

   a) Visible surface imperfections, sharp edges and burrs must be ground down. Surface imperfections such as flaking, flashwelding a s o, to be filled with weld after grinding only in those cases where the material thickness has been considerably decreased.
   b) Flash-welding must be removed by grinding.

5. Sharp edges

   Sharp edges after punching, cutting and flashwelding must be rounded according to fig. New, sharp edges cannot, in this way be formed. Sharp edges refer to anomalies which feel sharp or pointy when touched by bare hand. Hot-rolled profiles are not regarded as having sharp edges.

B2.2 Manufacturing Class TK 2

Unevenness and sharp edges permitted if they do not lead to risk of injury when handling.

Outward edges on finished product must be broken.

1. Welding joints:

   a) Slag and slag residue must be removed.

   b) Welding spatter on visible surfaces must be cleaned. Only occasional smaller amounts of welding spatter are accepted. Inside and hidden surfaces are to be roughly cleaned.

   c) Exceptional defects such as excessive unevenness because of electrode changes, pore accumulation etc. must corrected.

2. Sharp edges:

   Sharp edges after punching, cutting and burning must be rounded only when there is risk of injury when handling. Outward edges on finished product must be rounded. Edges of hot rolled bars and thermally cut edges without burrs do not need to be rounded.

3. Defects on the steel surface:

   Are normally not adjusted. Small strike marks are allowed.

B2.3 Manufacturing Class TK 3

Unevenness and sharp edges are allowed if there is no risk of injury when handling. Surfaces which will later be insulated or which come in contact with flue gases, e.g. inside flue gas ducts, are not normally adjusted. Sharp edged etc. must, however, be ground if there is risk of injury.

C. Painting system

The environmental class determines the choice of painting system. Within every environmental class there is a number of painting systems to choose from, e.g.

- paint material for prime and top coat
- thickness of layers
- colour

Demands on lower environmental classes will be fulfilled by the higher classes.

Maximum temperature refers to the highest dry surface temperature caused by radiation or convection.

The number of layers will depend on type of object. Complex geometries may demand painting with an extra layer.

The expected life span of the selected type of painting system is approximate and based on experiencees from corresponding systems placed in an environment according to their environmental class and not exposed to any other influence. No consideration to e.g. chalking has been taken.

An example of a painting system applied for Environmental Class 3 is given below:

Primers

Code	Type of paint	Supplier* / Design	Colour in stock
GA	Two-comp. epoxy EBA958 / EBA962	INTERGARD EB PRIMER	06 Yellow**
GA	Two-comp. epoxy (standard when painting in Växjö)	INTERGARD FWA270 / FWA278	06 Yellow**
GB	Two-comp. zinc-rich epoxy SIS 185204	INTERZINK 72 EPA 069 / EPA 073	04 Grey / blue**
GE	Mod vinyl (PVC) Primer	INTERSHEEN 25	Beige
GK	Surface-tolerant epoxy primer	INTERPLUS 256 alt 356	Aluminium
GL	Latexprimer for steel surface	INTERCRYL 520 WB	01 Red / brown
GP	Alkyd zinc phosphate	INTERPRIME 306	01 Red / brown
GP	Alkyd zinc phosphate (standard when painting in Växjö)	AQUA AIR PRIMER G4456 (supplier Burcharths)	01 Red / brown
GS	Two-comp miopigment. epoxy	INTERGARD 400	Aluminium
GZ	1 -comp. zinc-rich epoxy ester	INTERZINK CPA 800 primer	04 Grey / blue**
FAG	Silicone resin HTA 097	INTERTHERM 50	05 Aluminium
FBG	Cumaron resin primer HTA 008 ALUMINIUM	INTERBOND	05 Aluminium**
FCG	2-comp. zinc-rich et hylsilicate QHA 027 / 028	INTERZINK 22	08 Grey / green

Finishing coats

TA	Two-comp. epoxy SIS 185202	INTERGARD 740 EL-SERE/ELA619	Glossy 28**
T B	Two-comp polyurethane SIS 185203	INTERHANE 799 PQ-SERIE/PQA015	Glossy 28** Blank
TD	Two-comp.modified epoxy SIS 185205	INTERTUF 303 Resin modified	Semi-Gloss 28** JC-SERIE/JCA003
TE	Mod vinyl MF-SERIE	INTERSHEEN 54	Semi-Gloss 28** Halvblank
TP	Alkyd DQ-SERIE	INTERLACK 645	Glossy 28** Blank
FAT	Silicon resin HTA 097	INTERTHERM 50	Semi-gloss Al Halvblank
FBT	Cumaron resin HTA 008 Aluminium	INTERBOND	Semi-gloss Al** Halvblank
FDG	Alkyd primer finishing paint RG-SERIE	INTERLAC 480 NCS3060-R80B**	Semi-gloss

A	B	C	D	E	F	G	H
3 (R31)	33	Sa 2 ½*4)	100	100	GP80 TP80	4	> 3
3	34	Sa 2 ½*4)	100	120	GA60 TA80	3	> 5
3	35	Sa 2 ½*4)	100	120	GA60 TD90	2	> 5
3	36	Sa 2 ½	100	120	GB40 TD120	2	>10
3	37	Sa 2 ½	60	75	FCG70 *1)TE60	4	>10
3	42	Sa 2 ½*4)	100	120	GA60 TB90	3	> 5
3	44	Sa 2 ½*4)	60	75	GA60 TE80	3	> 5
3	45	Sa 2 ½	60	75	GB40 TE100	3	>10
3	73	Sa 2 ½	100	120	GB40 TD160	3	>10
3	81	Sa 2 ½	400	400	FCG75 FAT60	4	> 5
4A (R41)	38	Sa 2 ½	100	120	GS80 TD200	3	> 5
4A (R43)	39	Sa 2 ½	100	120	GB40 GS120 TD120	3	> 5
4A (R43)	40	Sa 2 ½	100	120	GB40 GS120 TB 120	5	> 5 *3)
4A	41	Sa 2 ½	100	120	FCG70 *1)TD180	4	> 5
4A	46	Sa 2 ½	60	75	GB40 TE240	5	> 5 *3)
3 (Rs9)	91				Vfz	Fe/Zn class A acc to.SS 3583	

*1) = 30 µ sealer
*2) = Transport protection
*3) = Not under water
*4) = Cold rolled steel corresponding clean. as Sa 2½ does not to be blasted.

A = Environmental class
B = Painting System
C = Pre-treatment
D = Max. dry temp ^{o}C continuous
E = Max. dry temp ^{o}C intermittent
(Intermittent means 3-4 hours during a 4-week. period)
F = Paint System
G = Number of layers
H = Expected life span in years

D. Pretreatment before painting

D1. General

The ultimate effect and life span of the corrosion protection depends, to a great extent, on the steel surface's RUST GRADE before preparatory treatment and it's DEGREE OF CLEANING (degree of purity) after preparatory treatment according to SIS 05 59 00 / ISO 8501-1:1988. A high degree of accuracy results in a long life span, especially in aggressive environments.

D2. Preparatory treatment

- the preparatory treatment must be performed as short time as possible before painting to avoid re-rusting.
- the preparatory treatment must be performed indoors or outdoors when weather is dry. The temperature of the steel must be at least 3°C over the current dewpoint.
- transport protection and contamination's on the surface are suitably removed with emulsifying degreasing agents preferably in connection with high pressure washing. Large surface can be sweep blasted in order to increase adhesion. Thin sheet metal can also be phosphatized. Certain types of sheet metal require alkalic cleaning followed by rinsing with water.
- after preparatory treatment, the surface must be dusted of.

D3. Degree of rusting

The steel surface's DEGREE OF RUSTING is designated **A, B, C** and **D**.

A: steel surface largely covered with adhering mill scale but little, if any, rust

B: steel surface which has begun to rust and from which the mill scale has begun to flake.

C: steel surface on which the mill scale has rusted away or from which it can be scraped, but with slight pitting visible under normal vision.

D: steel surface on which the mill scale has rusted away and on which general pitting is visible under normal vision.

The A and B degree of rusting offers the best economical recovery through low surface profile which reduces paint consumption and increases the life span of the paint.

⇒ The C and D degree of rusting must be avoided.
⇒ The D degree of rusting is not permitted on material intended for supporting steel structures

D4. Preparation grades

The steel surface's PREPARATlON GRADES are designated:

St 2 = Thorough hand and power tool cleaning

St 3 = Very thorough hand and power tool cleaning

Sa 1 = Lightblast-cleaning

Sa 2 = Thorough blast- cleaning

Sa 2 ½ = Very thorough blast-cleaning

Sa 3 = Blast-cleaning to visually clean steel

D5. Preparatory treatment, comparison tables

The preparatory treatment can refer to ISO 8501-1:1988. The following table indicates the standards of different countries regarding preparation grades in comparison with ISO 8501-1.

SWEDEN	SS 05 59 00	St 2	St 3	Sa 1	Sa 2	Sa 2 ½	Sa 3
USA 1	ASTMD2200-67	Refers to ISO 8501-1:1988					
USA 2	SSPC Vis 1 67 T	Sp2	Sp 3	Sp 7	Sp 6	Sp 10	Sp 5
USA 3	NACE TM-01-70,TM-01-75	—	—	No 4	No 3	No 2	No 1
GERMANY	DIN 55928 Teil 4 Beiblatt	acc. To ISO-norm but exented					
UK	BS 4232:64	—	—	—	3rd qual.	2nd qual.	1st qual.
FRANCE	DS1, DS2, DS2 1/2, DS3	In accordance with ISO 8501-1:1988					
DENMARK	DS2 2019	Refers to ISO 8501-1:1988					
AUSTRALIA	AUS 1627 part 9 1974	Refers to ISO 8501-1:1988					
JAPAN	JSRA SPSS-11975	No comparison					

D6. Pretreatment when using different types of primers

Hot-rolled steel surfaces must be washed and blasted before painting. Surfaces of cold-rolled steel, galvanized steel, Al-Zn coated steel and aluminium have a surface structure which requires a primer with very good adhesion. They must be washed with degreasing agent before painting and carefully rinsed with water.

A: Hot rolled steel
B: Cold rolled steel
C: Hot-dip galv steel
D: Stainless steel
E: Aluminium
F: Al-Zn coated steel

	GA	**GB**	**GE** Vinyl	**GL**	**GK**	**GP**	**GR**	**GS**	**GZ**	**FAG**	**FBG**	**FCG**
A	B	B	b	b	b	b	b	b	b	b	B	b
B	L	B	l	l	l	l	b	l	b	b	B	b
C	L	—	—	l	—	—	—	l	b	b	—	—
D	B	—	l	—	—	—	—	b	—	—	—	—
E	L	—	l	l	—	—	b	l	—	—	—	—
F	L	—	l	l	—	—	—	l	—	b	B	—

b = blast cleaning
l = suitable without blast cleaning
— = not allowed

Primer

GA = 2-comp epoxy
GB = 2-comp zinc-rich epoxy
GE = Vinyl (PVC) primer

GK = Surface tolerant epoxy primer
GL = Latexprimer for steel
GP =Alkyd zinkfosfat
GS = 2-comp miopigm. epoxy primer
GZ = 1-comp zinc-rich epoxy ester

E. Resistibility of top coat

The following recommendations are based upon experiences from paint which is classified in accordance with it 's environmental class and not exposed to any significant influences.

A) appearance demands: chalking / yellowing outdoor, normal temp
B) appearance demands: chalking / yellowing at increased temp
C) mechanical resistance: e.g.:

HIGH	e.g. abrasive materials (e.g. sand)
MEDIUM	e.g. railing
LOW	e.g. rain and wind

D) acid Atmosphere
E) alkaline atmosphere
F) weather resistance: in aggressive industrial air
G) repair painting on site at air and object temp acc to below

	TA	**TB**	**TD**	**TE** (Vinyl)	**TP**	**FAT**	**FBT**
A	>5 year	>10 year	>1 year	>10 year	>10 year	>5 year	>5 year
B	Medium	high	medium	high	low	High	high
C	High	high	medium	low	medium	Low	low
D	PH>5	pH>4	pH>5	pH>4	—	—	—
E	PH<10	pH<9	pH<10	pH<9	—	—	—
F	High	high	high	high	low	—	—
G >15°C *	M	m	m	h	m	M	m
>10°C	M	m	m	m	m	M	m
>05°C	—	m	—	m	m	M	m

* l = surface to be ground & washed with degreasing agent
m = washed with degreasing agent
h = washed with degreasing agent which dissolves the old layer which gives high adhesion

Finishing Coatings

TA = 2-comp epoxy
TB = 2-comp polyurethane
TD = 2-comp mod. Epoxy

TE = Vinyl
TP = Alkyd

F. Surface Finish Classes

F1. Surface Finish Class YK 1

High surface finish class.
Primer / Finishing coat.
No runs.

All welds and edges must be painted with primer once, prior to the real primer coating. Puttying can be required.

The film thickness in corners and at edges must be equivalent to that measured on level surfaces. Continuous paint thickness without visible running, drops flaws or craters applied to an even, uniform surface.

The painted surface must be free from scratches, stroke marks and other defects which originate from the pad or finishing. Insignificant traces of the pad are permitted.

The orange peel effect, from over-spraying, is only permitted to a small degree and then not on visible surfaces. When repair painting, the painting layers are built up from the bottom. (Repainting)

F2. Surface Finish Class YK 2

Normal surface finish class.

Primer / Finishing coat.

Certain amount of runs allowed.

All welds and edges must be painted with primer once, prior to the real primer coating. Puttying can be required. The film thickness in corners and at edges must be equivalent to that measured on level surfaces.

Quite visible surfaces with our running. Small finish defects such as orange peel effect and insignificant over-spraying, small damages, scratches etc. are permitted. Large stroke marks and scratches are not permitted.
No primer bleeding when painting finishing coat.
Repair painting with brush permitted on small defects, etc.

F3. Surface Finish Class YK 3

No special requirements for surface finish

Primer without special coating program.

Runs allowed.

Small mechanical defects can be permitted, e.g.traces of pads.
There must be paint on all surfaces.

Repair with brush permitted.

F4. Surface Finish Class YK 4

No special requirements for surface finish

Transport protection

Runs allowed.

The layer of paint must cover all surfaces, without film-thickness requirements.

G. Repair Painting

G1. General

Repair painting of damages on painted surfaces which appeared during transport, storage or erection can normally be performed by professionally skilled personal.
Temporary corrosion protection can be performed by the erection personal of SE IND, that is

◊ Remove slag and nuggets from welds
◊ Clean metal surfaces and steel brush or machine grind damaged surfaces
◊ Wash surfaces with degreasing agent and apply GP primer with brush.

If the erection personnel of SE IND must perform permanent repair painting on, e.g. smaller damages, the following rules must be followed.

G2. Repair Painting

The surface should be carefully dusted off prior to painting. Repair painting is performed, at first hand, with the same painting system as was used on the present surface. Systems with zinc silicate primer are difficult to repair paint with the same paint type. Therefore, use zinc epoxy GB alternatively one-component GZ (Interzink CPA 800) if there are not demands for high heat resistance.

Systems with zinc-epoxy GB: Select GB when blasting to Sa 2½ and select GZ (Interzink CPA 800) when scraping / steelbrushing to St 2.

Systems with two-component paint require an object temperature of min 10ºC to harden If this cannot be reached, substitute with the one-component system according to the enclosed table.

Observe that at low object temperatures, the drying time is considerably slower. At 10ºC, the e.g. min. coating interval for many products is doubled, against the given times at 23ºC.

G3. Preparatory

A. Welds and flash-welded surfaces

1 Wash with water mixed with alkalic detergent to remove oil, soot, dirt and fluxing material. Rinse with clean water.
2 Remove flash-welded paint (Note! Don't forget the side of the thermically loaded surface). Grind down the edge against the painted surface.
3 Welds and surfaces around the welding must be pre-treated through, e.g. vacuum blasting or machine grinding according to requirements from the orderer. Lowest degree of accuracy = St2 acc to SS 055900 / ISO 8501-1:1988.

B. Transport and other mechanical damages

1 Wash damaged surfaces according to point A.1. above.
2 Pretreat rust damages according to point A.3.
3 Grind down the edge against the painted surface.

H. Galvanizing

H1. Thickness of layer / weight

Table 4 acc to SS 3583

A = Local coating thickness µm
B = Averages mass / area g / m^2 approx.

A	50	55	60	65	70	85	95	100	115	140	190	215
B	360	395	430	470	500	610	685	720	830	1010	1370	1550

H2. Selection of class of coating thickness acc. to SS 3583

Classes related to environmental conditions are defined as follows, with the corresponding specification of thickness under G5.

Class A

Intended for general use.

Class B

Intended for a very corrosive environment and (or) when a long life span is required.

Class C

Intended for extremely corrosive environment and (or) when an extremely long life span is required.

Before specifying class B or C, the hot-dip galvanizer should be consulted.

H3. Specification of hot-dip galvanizing

Demands concerning appearance, thickness, adhesion etc. acc. to SS 3583.
In addition the material quality of the base metal should be indicated as well as special wishes concerning the hot-dip galvanizing.

A1 = Min. local coating thickness

A2 = Average coating thickness on each sample

B1 = Min. local coating thickness

B2 = Average coating thickness on each sample

C1 = Min. local coating thickness

C2 = Average coating thickness on each sample

(mm)	A1 (µm)	A2 (µm)	B1 (µm)	B2 (µm)	C1 (µm)	C2 (µm)
Steel t > 6	85	95	100	115	190	215
Steel 3< t <6	70	85	85	95	115	140
Steel 1< t <3	50	60	60	70		
*Small items	70	55	not applicable			
Castings	70	85				

* Small items hot dip galvanized in baskets and subsequently centrifuged to remove excess zinc.

H4. Pre-galvanized steel

Fans of light construction may be built using components cold formed from pre-galvanized steel sheet or strip as described in EN 10142-A1.

Surface zinc coatings according to the definition +Z200, as given in the same standard, or higher, are adequate for Class Aapplications.

Slit or die-cut edges up to a thickness of 2 mm do not require additional treatment, as they are adequately protected against corrosion both by the zinc transfer produced by the cutting tool, and by the electro-chemical action of the nearby zinc-coated surface.

H5. Painting of hot-dip galvanized steel

Hot-dip galvanizing combined with painting, gives in most cases, a very good protection against corrosion, even in aggressive environments. The life span of such a duplexsystem is approx. twice as long as the lifespan of a zinc coat plus life span of paint, because they protect each other.