STD4291

STANDARD

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Distribution: Scania, Supplier

Phosphate Conversion Coatings

Contents

Changes from previous issue

- The layout of the standard has been updated according to STD4444.
- Requirements for classification P1 have been replaced by the requirement to follow the recommendations from the chemical supplier.
- Recommendations added for procedure of verification of crystal coverage and crystal size using scanning electron microscope (SEM).
- Standard for condensation test now ISO 6270-2.
- Requirements related to process control have been removed from this standard.
- Example pictures of not approved manganese phosphate coatings added.
- Editorial changes

Changes are shaded.

1 Scope

This standard specifies requirements for phosphate conversion coatings on parts. The standard also specifies requirement on phosphating as a base for painting.

For additional information regarding phosphate conversion coatings and processes, see ISO 9717.

2 Specification in the technical documentation

Figure 1 presents how to write and interpret the phosphate property code in the technical documentation. Table 1 describes the application of the three classifications used in this standard.

The applicable types of conversion coatings and after treatments applicable for different classifications are stated in Table 2.

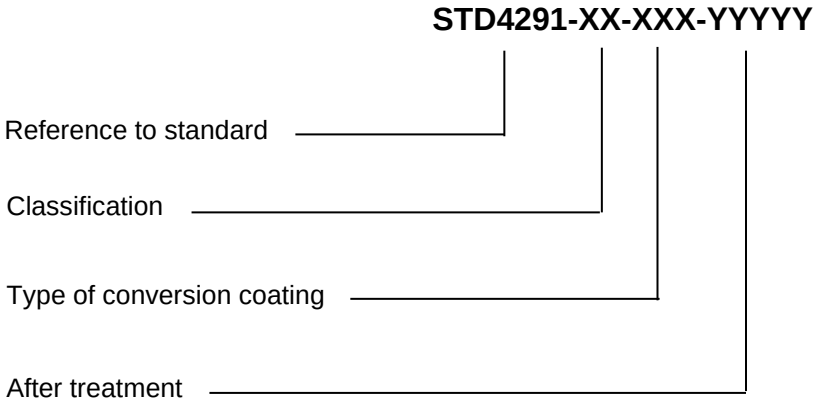

Figure 1 – Breakdown of the phosphate property code, according to STD4111

Table 1 – Interpretation of drawing designations

Drawing designation	Classification	Application
Not applicable[1)]	P1	Phosphate process as a base for painting.
STD4291-P2-…	P2	Phosphate process as a base for temporary corrosion resistance and friction control, with subsequent treatment with oil or wax or other friction controlling agent.
STD4291-P3-…	P3	Phosphate process to facilitate sliding action.

[1)] The requirements for the P1 classification are based on the requirements for the finish painted part. See STD4111.

Table 2 – Types of conversion coatings and after treatments applicable for the different classifications

Classification	Type of conversion coating[1) 2)]	After treatment
P1	Znph	None
P2	Znph or Mnph	Oiled, waxed or soaped
P3	Mnph	Oiled

[1)] Znph = Zinc phosphate conversions coating.
Mnph = Manganese phosphate conversions coating.
[2)] Other types of coatings exist, including zinc phosphate modified with iron and/or nickel and/or manganese. The modifying metal will normally be present in the form of a double salt such as $Zn_2Me(PO_4)\ H_20$, where Me represents Fe(II), Ni or Mn. Zn remains the main metal constituent of these coatings that, to avoid confusion, have not been given separate symbols. It should also be noted that metal from the substrate materials will often be incorporated in the conversion coating.

3 Requirements valid for all classifications P1, P2 and P3

General requirements in STD4111 applies for all surface coated parts at Scania.

Table 3 lists where in this standard the requirements are stated for each classification.

Table 3 – List of requirements for each classification

Classification	Requirements
P1	Section 4.1
P2	Sections 3.1–3.4, and section 4.2
P3	Sections 3.1–3.4, and section 4.3

3.1 Hydrogen embrittlement

During the phosphate conversion process, hydrogen can be absorbed in steel materials, which can cause failure. Standard STD3152 shall be followed to minimise the risks of hydrogen embrittlement.

3.2 Visual appearance

Phosphate conversion coatings shall evenly cover the metal surface and shall not show any white stains, corrosion products or fingerprints.

The zinc phosphate coating shall have a dull and grey colour.

The manganese phosphate coating shall have a dull appearance and dark grey to black colour.

It is recommended to always use pictures of approved surfaces as references when comparing.

3.3 Verification of coating mass per unit area

The coating mass per unit area shall be determined in accordance with ISO 3892. The requirements for the respective methods are stated in Table 4, and Table 5.

3.4 Verification of coverage and crystal size

Phosphate crystal coverage, crystal structure, and crystal size shall be investigated using Scanning electron microscope (SEM). It is recommended to evaluate several surfaces at a distance from each other.

For evaluation of coverage, the magnification shall be sufficiently low to cover a representative part of the surface. A magnification of 100x is recommended.

For evaluation of the crystal structure, a magnification of 500x to 1000x is recommended.

For evaluation of crystal size, the magnification shall be sufficiently high to resolve the individual crystals. A magnification of 1 500x is recommended.

The requirements for the respective methods are stated in Table 4, and Table 5.

Figures showing approved and not approved phosphate crystals can be found in Annex A and Annex B.

4 Requirements for specific classification (P1, P2 or P3)

4.1 Conversion coating as a base for painting, P1

When the function of the phosphate conversion coating is to provide a base for painting, the phosphating process shall ensure that the finish painted part can fulfil the requirements on corrosion resistance according to STD4113. The process shall follow the recommendations from the chemical supplier.

4.2 Conversion coating for corrosion protection, P2

The requirements for phosphate coatings on ferrous materials for the P2 classification are stated in Table 4.

Table 4 – Requirements for phosphate conversion coatings, classification P2

Property	**Method**	**Requirement**	
Coating type	-	Znph or Mnph	
After treatment	-	Oiled, waxed or soaped	
Coverage [%]	SEM (section 3.4)	100% of the metal surface Crystalline	
Coating mass per unit area [g/m^2]	ISO 3892	>10 g/m^2	
Crystal size [µm]	SEM (section 3.4)	Znph	5–15 µm
		Mnph	10–40 µm
Corrosion resistance	ISO 6270-2, 48h	No base metal corrosion	

For requirements of the appearance of Znph and Mnph crystals, see figures in Annex A and Annex B respectively.

4.3 Conversion coating to facilitate sliding action, P3

Classification P3 is used for manganese phosphate coatings on ferrous substrate to facilitate sliding action.

The specific requirements for classification P3 on ferrous materials are stated in Table 5. Examples of approved and not approved manganese phosphate coatings are shown in Annex B.

Table 5 – Requirements for phosphate conversion coatings, classification P3

Property	**Method**	**Requirement**
Coating type	-	Mnph
After treatment	-	Oiled
Coverage [%]	SEM (section 3.4)	100% of the metal surface Crystalline
Coating mass per unit area [g/m^2]	ISO 3892	5–20 g/m^2
Crystal size [µm]	SEM (section 3.4)	4–12 µm
Corrosion resistance	ISO 6270-2, 48h	No base metal corrosion
Pickling pits	Section 4.3.1	eq.1) X+3Y ≤ 30 eq 2) Max depth < 30 µm

4.3.1 Requirements for pickling pits, classification P3

The size (depth) and number of pickling pits shall be determined over a total length of 20 mm in a representative cross-section of the active working surface. If needed, several measuring lengths shall be added up to a total length of 20mm. For gear teeth, several tooth flanks may have to be measured to obtain the measuring length.

The sum of pickling pits of size ranges 10–20 µm and 20–30 µm shall meet the requirements of equation 1 (eq.1). The maximum pickling pit depth shall meet the requirements of equation 2 (eq.2). The requirements of eq.1) are illustrated by Figure 2.

eq.1) X+3Y ≤ 30

eq.2) Max depth < 30 µm

X = number of pickling pits with a depth within the range 10–20 µm
Y = number of pickling pits with a depth within the range 20–30 µm

The size (depth) of pickling pits is best determined by using an estimated reference line along the surface. See the example in Figure 3.

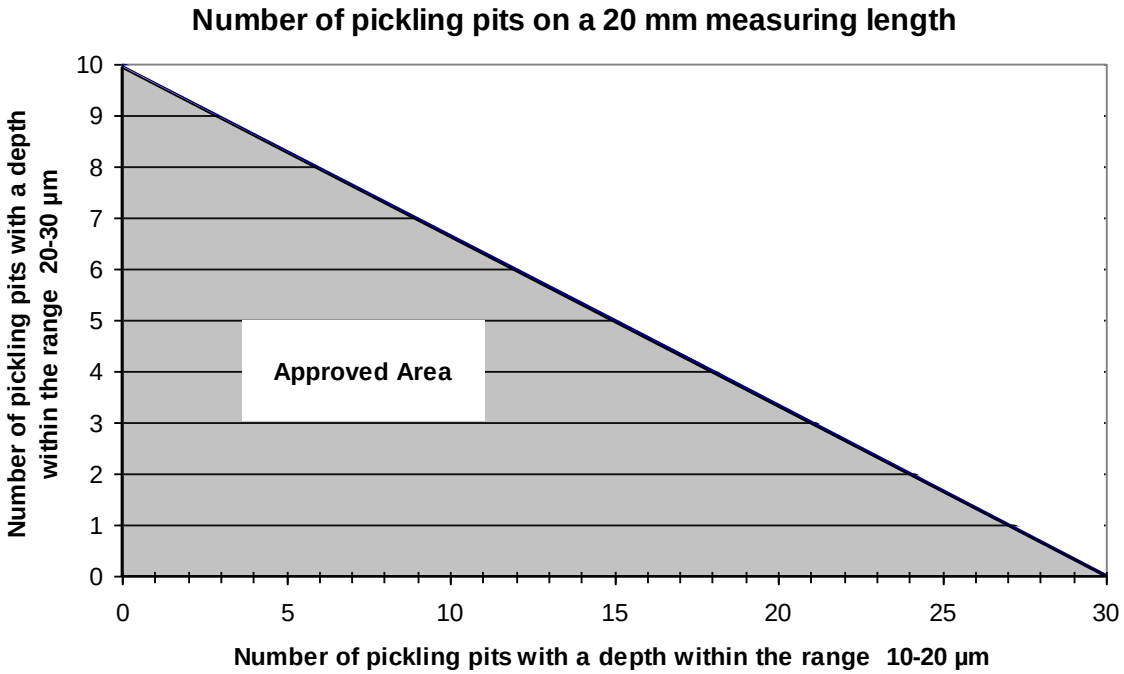

Figure 2 – Illustration of requirements according to equation 1.

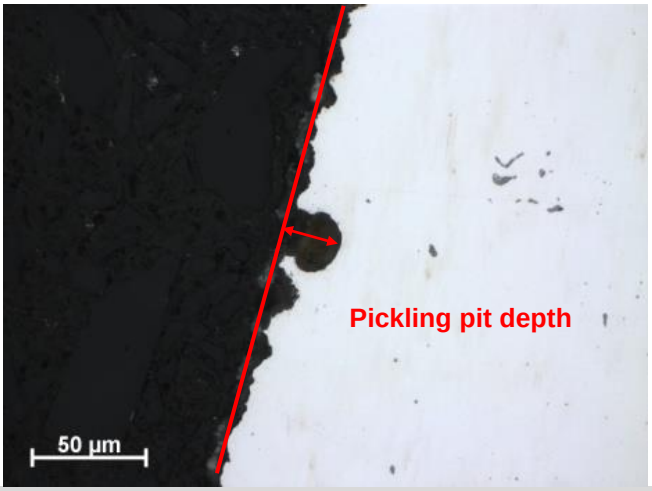

Figure 3 – Estimated reference line of surface facilitate measuring depth if pickling pits.

5 Referenced documents

References to standards, other than STD or CVS, refer to the highest level of the international standards (e.g. ISO or EN). International standards may be available as national editions at the respective national standardisation organisation (e.g. SS-ISO, SS-EN, DIN ISO, etc.).

5.1 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the issue cited applies. For undated references, the latest issue of the referenced document (including any amendments) applies.

ISO 3892	*Conversion coatings on metallic materials – determination of coating mass per unit area – gravimetric method*
ISO 6270-2	*Paints and varnishes – determination of resistance to humidity, Part 2: Condensation (in-cabinet exposure with heated water reservoir)*
STD3152	*Hydrogen embrittlement – general information*
STD4111	*Surface treatment – Directives and instructions*
STD4113	*Surface treatment – Painting of Metals – Requirements*

5.2 Informative references

The following documents, in whole or in part, are informatively referenced in this document and assist the user regarding a particular subject area.

ISO 9717	*Metallic and other inorganic coatings – Phosphate conversion coating of metals*

Annex A (normative) Zinc phosphate crystals

A.1 Approved zinc phosphate crystals

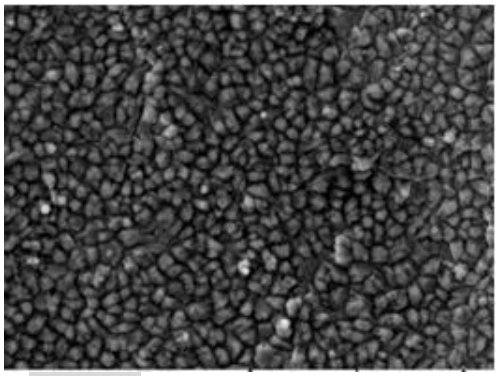

Figure 4 – Cold Rolled Steel (CRS). Dip application

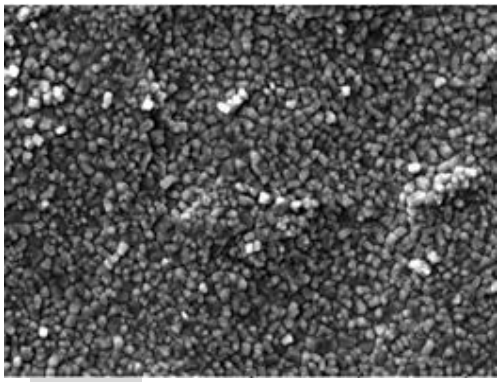

Figure 5 – Cold Rolled Steel (CRS). Dip application

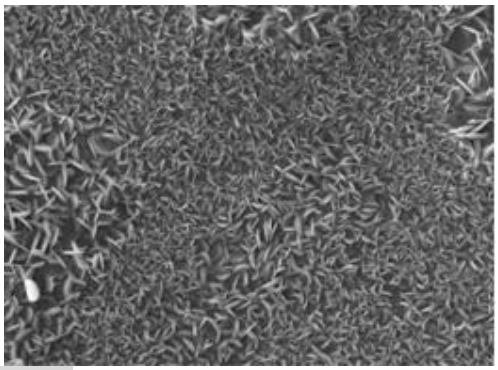

Figure 6 – Hot dipped galvanised steel (HDG). Spray application

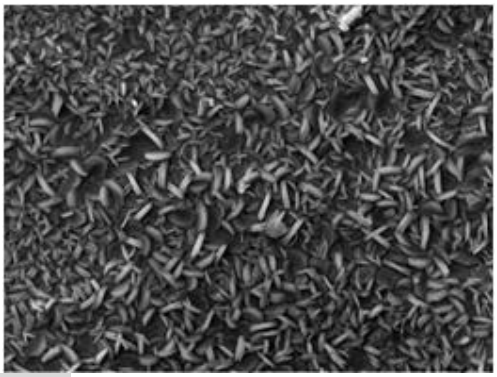

Figure 7 – Hot dipped galvanised steel (HDG). Spray application

A.2 Not approved zinc phosphate crystals

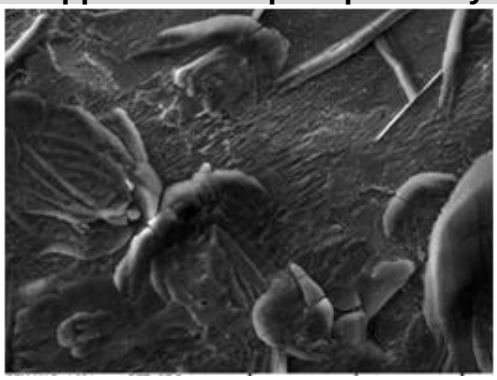

Figure 8 – Cold Rolled Steel (CRS)

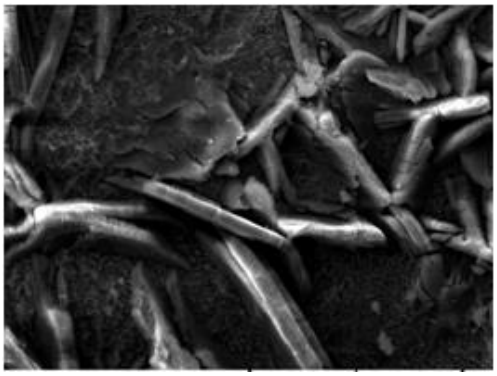

Figure 9 – Cold Rolled Steel (CRS)

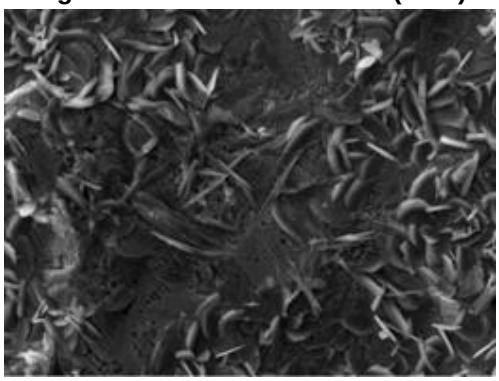

Figure 10 – Hot dipped galvanised steel (HDG)

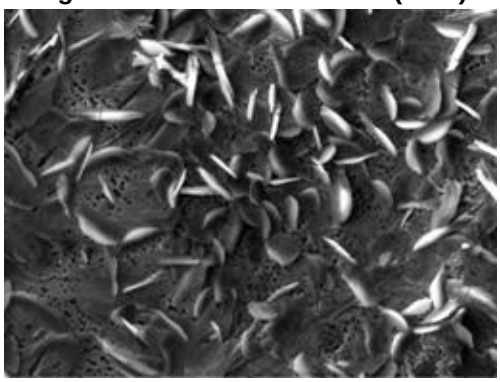

Figure 11 – Hot dipped galvanised steel (HDG)

Annex B (normative) Manganese phosphate crystals

B.1 Approved manganese phosphate crystals

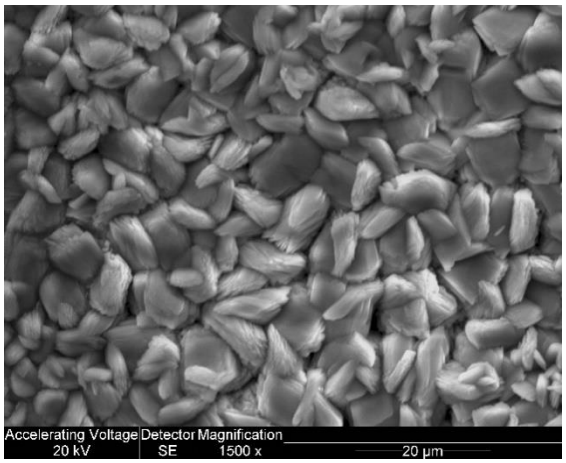

Figure 12 – Approved manganese phosphate coating on a steel-based material. Average crystal size about 10 µm.

B.2 Not approved manganese phosphate crystals

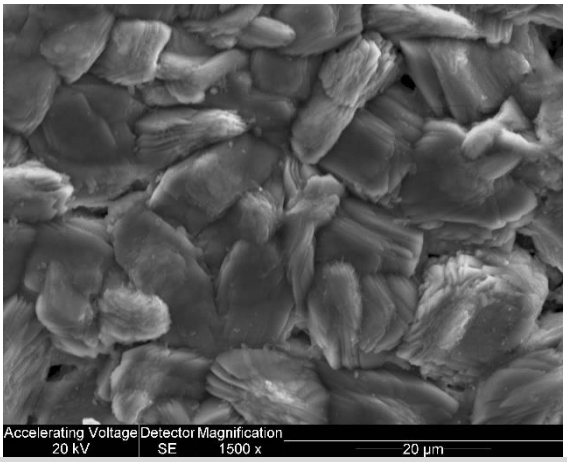

Figure 13 – NOT approved manganese phosphate coating. Average crystal size about 20 µm.

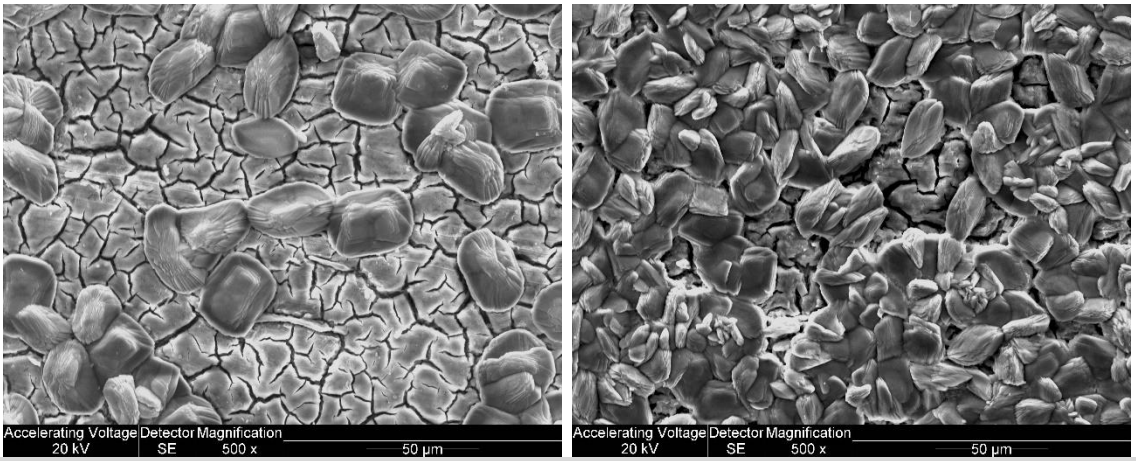

Figure 14 – NOT approved manganese phosphate coatings. Coverage left: 35–40%, and right: 85–90%.

Annex C (informative) Change history

Issue	Issue date	Changes from previous issue
6	2020-12-08	The layout of the standard has been updated according to STD4444. Requirements for classification P1 have been replaced by the requirement to follow the recommendations from the chemical supplier. Recommendations added for procedure of verification of crystal coverage and crystal size using scanning electron microscope (SEM). Standard for condensation test now ISO 6270-2. Requirements related to process control have been removed from this standard. Example pictures of not approved manganese phosphate coatings added. Editorial changes.
5	2014-03-26	Major revision to clarify the requirements in previous issue.
4	2013-08-16	New chapter 3.1.1 Visual appearance of approved and non-approved surfaces added.
3	2012-15-08	Editorial changes
2	2008-11-28	Note 2 in table 2 on page 5 has been added.
1	2008-01-02	First issue.