

INTERSTATE COUNCIL FOR STANDARDIZATION, METROLOGY AND CERTIFICATION  
(ISC)

INTERSTATE STANDARD

GOST  
9.402-2004

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Unified system of protection against corrosion and ageing

# PAINTWORK COATINGS

Preparation of metal surfaces for painting

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## Foreword

The purposes, main principles and basic procedures of work on interstate standardization are established by GOST 1.0-92 "Interstate standardization system. Basic provisions" and by GOST 1.2-97 "Interstate standardization system. Interstate standards, rules and recommendations for interstate standardization. Procedures for development, adoption, application, updating and cancellation"

### Data on the standard

1 DEVELOPED by Research Institute of Paintwork Coatings with Pilot-production Engineering Plant "Victoria" (Open Society Research Institute for PVC with PEP "Victoria")

2 SUBMITTED by Federal Agency on Technical Regulating and Metrology of Russian Federation

3 ADOPTED by Interstate Council on Standardization, Metrology and Certification (report No.26, dated December, 8, 2004)

Votes in favor:

Short name of the country according to IC (ISO 3166) 004—97	Country code according to IC (ISO 3166) 004-97	Abbreviated name of national standards body
Azerbaijan	AZ	Azstandart
Armenia	AM	Armstandart
Belarus	BY	Gosstandart of the Republic of Byelorussia
Kazakhstan	KZ	Gosstandart of the Republic of Kazakhstan
Kyrgyzstan	KG	Kyrgyzstandart
Moldova	MD	Moldova-Standard
Russian Federation	RU	Federal agency on technical regulating and metrology
Tajikistan	TJ	Tadjikstandart
Turkmenistan	TM	Head State Inspectorate "Turkmenstandartlari"
Uzbekistan	UZ	Uzstandart
Ukraine	UA	Gospotrestandart of Ukraine

4 The basic normative positions of International Guide ISO/IEC 21:1999 "Adoption of International Standards as regional or national standards" are taken into account in this Standard.

5 Interstate Standard GOST 9.402-2004 is introduced as the national standard of the Russian Federation since 01.01.2006 by Order No. 149-st, dated 09.06.2005, of Federal Agency on Technical Regulating and Metrology.

6 IN PLACE OF GOST 9.402-80

*The information on introduction (cancellation) of this Standard is published in the index "National Standards".*

*The information on amendments to this Standard is published in the index "National Standards", and the text of amendments is published in information indices "National Standards". In case of revision or cancellation of this Standard the relevant notice will be published in information index "National Standards".*

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## Introduction

The metals (ferrous and non-ferrous) unprotected by coatings when operating in the conditions of the temperate, maritime, tropical climate (outdoors or indoors) are exposed to corrosion which can result in their destruction. Therefore to protect against corrosion, and also to give decorative appearance to articles the metal surfaces shall be protected by means of paintwork coatings.

The first operation in the process of painting of metal surfaces is surface preparation. Surface preparation is sequential process. Depending on quantity of stages the result of surface preparation can be surface cleaning or additional chemical conversion of a metal surface with formation of conversion coatings (chromate, phosphate, oxide).

Conversion coatings due to their insulation properties inhibit the mechanism of underfilm corrosion and improve physical-and-mechanical properties of the subsequent paintwork layer that is capable of resisting against corrosion processes and providing required service life of an article.

This Standard not only establishes requirements to quality of a painted surface, but also contains recommendations for processes of the surface preparation, that enables obtaining required quality.

Characteristics of paintwork coatings to a great extent depends on a condition of the surface prepared for painting. The major factors influencing these characteristics are presence of a rust, scale, contamination (dust, oils, salts, moisture), quality of conversion coatings. This Standard regulates the requirements to condition of the metal surfaces which are subject to painting.

In this Standard a great deal of attention is paid to processes of chemical preparation of a surface. Recommendations for choice of processes of a surface preparation depending on type of metal and conditions of operation of the painted articles are given. Mechanical surface preparation is presented in the form of the review of relevant methods. Concerning a scope, efficiency and restrictions of mechanical surface preparation references to the international standards are given.

When choosing type of the nonmetallic inorganic coatings used for painting of nonferrous metals and alloys thereof, one shall be guided by GOST 9.303-84. In this Standard the requirements to phosphate coatings on ferrous metals are stated only.

The processes of surface preparation of nonferrous metals: oxidation, anode oxidation and aluminum chromating, zinc and cadmium chromating are specified in GOST 9.305-84.

In this Standard the basic terms and definitions concerning surface preparation are given. Assessment of the surface prepared for painting, is given in accordance with the international standards. The references to the basic international standards on surface preparation of steel substrates prior to painting are given in this Standard.

Requirements for health protection and safety of the personnel and environmental protection are included in this Standard.

This Standard does not concern financial aspects, but failure to comply its requirements may result in serious economic consequences as low-quality preparation of an article surface essentially reduces service life of a paintwork coating.

Adoption of this Standard will promote optimization of processes of surface preparation in the industry that will undoubtedly result in improvement of painting quality.

**I N T E R S T A T E S T A N D A R D****Unified system of protection against corrosion and ageing****PAINTWORK COATINGS****Preparation of metal surfaces for painting****Date of Introduction — 2006—01—01****1 Scope**

This Standard extends on articles, parts, assembly units and semimanufactured articles (hereinafter referred to as articles) made of ferrous, nonferrous metals and alloys and establishes the general requirements for quality of an article surface intended for painting, and surface preparation technology, including painting by methods of cathodic and anodic electrostatic deposition and application of powder coatings.

**2 Referenced documents**

The following interstate standards are referred to in this Standard:

GOST 9.008-82 Unified System of Protection against Corrosion and Aging. Metal and non-metal inorganic coatings. Terms and definitions

GOST 9.010-80 Unified System of Protection against Corrosion and Aging. Compressed air for atomization of paint materials. Technical requirements and methods of control

GOST 9.032-74 Unified System of Protection against Corrosion and Aging. Paintwork coatings. Groups, requirements and designations

GOST 9.072-77 Unified System of Protection against Corrosion and Aging. Terms and definitions

GOST 9.104-79 Unified System of Protection against Corrosion and Aging. Paint coatings. Groups of service conditions

GOST 9.301-86 Unified System of Protection against Corrosion and Aging. Metal and non-metal inorganic coatings. General requirements

GOST 9.305-84 Unified System of Protection against Corrosion and Aging. Metal and non-metal inorganic coatings. Process operations for coating production

GOST 9.314-90 Unified System of Protection against Corrosion and Aging. Water for electroplating production and washing schemes. General requirements

GOST 9.401-91 Unified System of Protection against Corrosion and Aging. Paint coatings. General requirements and accelerated test methods on stability against climatic factors

GOST 9.410-88 Unified System of Protection against Corrosion and Aging. Powder polymeric coatings. Typical technological processes

GOST 12.0.002-80 Occupational safety standards system. Terms and definitions

GOST 12.0.004-90 Occupational safety standards system. Organization of training for labor safety. General rules

GOST 12.1.003-83 Occupational safety standards system. Noise. General safety requirements

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- GOST 12.1.004-91 Occupational safety standards system. Fire safety. General requirements
- GOST 12.1.005-88 Occupational safety standards system. The general sanitary-and-hygienic requirements for air of a working area
- GOST 12.1.007-76 Occupational safety standards system. Noxious substances. Classification and general safety requirements
- GOST 12.1.010-76 Occupational safety standards system. Explosion safety. General requirements
- GOST 12.1.012-90 Occupational safety standards system. Vibrating safety. General requirements
- GOST 12.1.016-79 Occupational safety standards system. Working area air. Requirements for measurement techniques of harmful substance concentrations
- GOST 12.2.003-91 Occupational safety standards system. Production equipment. General safety requirements
- GOST 12.3.002-75 Occupational safety standards system. Manufacturing processes. General safety requirements
- GOST 12.3.005-75 Occupational safety standards system. Painting works. General safety requirements
- GOST 12.3.008-75 Occupational safety standards system. Manufacturing of metal and non-metal inorganic coatings. General safety requirements
- GOST 12.3.009-76 Occupational safety standards system. Loading and unloading works. General safety requirements
- GOST 12.3.010-82 Occupational safety standards system. Tote-box. Safety requirements under operation
- GOST 12.3.016-87 Occupational safety standards system. Construction. Anticorrosive work. Safety requirements
- GOST 12.3.028-82 Occupational safety standards system. Treatment processes by abrasive and elbow tools. Safety requirements
- GOST 12.4.004-74 Filter-gas-respirators RPG-67. Specifications
- GOST 12.4.010-75 Occupational safety standards system. Individual protective gears. Special mittens. Specifications
- GOST 12.4.013-85\* Occupational safety standards system. Goggles. General specifications
- GOST 12.4.021-75 Occupational safety standards system. Ventilation systems. General requirements
- GOST 12.4.023-84 Occupational safety standards system. Protective face shields. General technical requirements and control methods
- GOST 12.4.028-76 Occupational safety standards system. Respirators ШБ-1 "Lepestok". Specifications
- GOST 12.4.029-76 Special aprons. Specifications
- GOST 12.4.034-2001 (EN 133—90) Occupational safety standards system. Individual protective gears for respiratory organs. Classification and marking
- GOST 12.4.068-79 Occupational safety standards system. Dermatologic individual protective gears. Classification and general requirements
- GOST 12.4.099-80 Women's overalls for protection against non-toxic dust, mechanical effects and general industrial contaminations. Specifications
- GOST 12.4.100-80 Men's overalls for protection against non-toxic dust, mechanical effects and general industrial contaminations. Specifications
- GOST 12.4.121-83 Occupational safety standards system. Filtering protective masks. Specifications
- GOST 12.4.131-83 Women's smock-frocks. Specifications
- GOST 12.4.132-83 Men's smock-frocks. Specifications
- GOST 12.4.137-84 Safety leather shoes for protection against oil, petroleum products, acid, alkaline, non-toxic and explosive dust. Specifications

\* GOST R 12.4.013-97 "Occupational safety standards system. Goggles. General specifications" is in force in the Russian Federation.

- GOST 17.2.3.02-78 Nature protection. Atmosphere. Regulations for establishing permissible emissions of noxious pollutants from industrial enterprises
- GOST 380-94 Plain carbon steel. Qualities
- GOST 701-89 Concentrated nitric acid. Specifications
- GOST 857-95 Synthetic hydrochloric acid. Specifications
- GOST 1381-73 Hexamethylenetetramine for industrial use. Specifications
- GOST 1625-89 Formalin for industrial use. Specifications
- GOST 2184-77 Sulphuric acid for industrial use. Specifications
- GOST 2263-79 Sodium hydroxide for industrial use. Specifications
- GOST 2567-89 Technical hydrofluoric acid. Specifications
- GOST 2789-73 Surface roughness. Parameters and characteristics
- GOST 2874-82\* Drinking water. Hygienic requirements and quality control
- GOST 3134-78 White spirit. Specifications
- GOST 3647-80\*\* Abrasives. Grain sizing. Graininess and fractions. Test methods
- GOST 3956-76 Silica gel for industrial use. Specifications
- GOST 4147-74 Reagents. Ferric chloride hexahydrate. Specifications
- GOST 4148-78 Reagents. Ferrous (II) sulphate heptahydrate. Specifications
- GOST 4197-74 Reagents. Sodium nitrite. Specifications
- GOST 4204-77 Reagents. Sulphuric acid. Specifications
- GOST 4220-75 Reagents. Potassium bichromate. Specifications
- GOST 4233-77 Reagents. Sodium chloride. Specifications
- GOST 4461-77 Reagents. Nitric acid. Specifications
- GOST 5100-85 Technical soda ash. Specifications
- GOST 5272-68 Corrosion of metals. Terms
- GOST 5632-72 High-alloy steels and corrosion-proof, heat-resisting and heat treated alloys. Grades
- GOST 6552-80 Orthophosphoric acid. Specifications
- GOST 6709-72 Distilled water. Specifications
- GOST 8505-80 Nefras-C 50/170. Specifications
- GOST 9045-93 Cold-rolled thin sheets of low-carbon steel for cold stamping. Specifications
- GOST 9485-74 Ferric sulphate 9-hydrate. Specifications
- GOST 9976-94 Commercial trichlorethylene. Specifications
- GOST 10678-76 Thermal orthophosphoric acid. Specifications
- GOST 11078-78 Sodium hydrate purified. Specifications
- GOST 11964-81 Commercial cast iron and steel shot. General technical requirements
- GOST 12265-78 Molded rubber boots protecting against oil, petroleum products and fats.
- Specifications
- GOST 13078-81 Sodium liquid glass. Specifications
- GOST 14192-96 Marking of cargoes
- GOST 19281-89 (ISO 4950-2—81, ISO 4950-3—81, ISO 4951-3—79, ISO 4995—78, ISO 4996—78, ISO 5952—83) Rolled steel with increased strength. General specifications
- GOST 19433-88 Dangerous goods. Classification and marking
- GOST 20010-93 Production rubber gloves. Specifications
- GOST 20072-74 Heat-resistant steel. Specifications
- GOST 26319-84 Dangerous cargo. Package
- GOST 27597-88 Electronics items. Method of corrosion resistance estimation
- GOST 27651-88 Women's overalls for protection against mechanical influence of water and alkalies.
- Specifications
- GOST 27652-88 Men's overalls for acid protection. Specifications
- GOST 27653-88 Men's overalls for protection against mechanical influence of water and alkalies.
- Specifications
- GOST 27654-88 Women's overalls for acid protection. Specifications
- GOST 27772-88 Rolled products for structural steel constructions. General specifications

\* SanPiN 2.14.1074-2001 "Drinking water. Hygienic requirements for quality of water of the centralized systems of drinking water supply. Quality control" is in force in the Russian Federation

\*\* GOST R 52381-2005 is in force in the Russian Federation.

**Note** — When using this Standard the validity of reference standards is expedient to be checked up by the index "National standards", compiled as of January, 1st of current year, and by the relevant information indexes published in current year. If the reference standard is replaced (amended) when using this Standard, guidance by the replaced (amended) standard shall be made. If the reference standard is withdrawn without replacement, clause where the reference is given to it, applies in a part where this reference is not mentioned.

### 3 Terms and definitions

The terms in accordance with GOST 9.008, GOST 9.072, GOST 12.0.002, GOST 5272, GOST 17.1.1.01, and also following terms with relevant definitions are used in this Standard.

**3.1 Surface preparation:** Treatment of basic metal to be covered by mechanical, electrochemical and/or chemical way for the purpose of improvement of adhesion of paint and varnish material and corrosion properties of the surface painted.

**3.2 Rust:** Visible products of corrosion consisting, in case of ferrous metals, mainly, of hydrated iron oxides.

**3.3 Scale:** Thick layer of oxides, formed in the course of melting or heat treatment of steel.

**3.4 Contamination grade :** Totality of contaminations: oil, lubricants, salts, dust per unit area of article being treated.

**3.5 Oxidation grade :** Conditionally estimated corrosion damages of the processed basic metal surface, having different chemical and physical nature.

**3.6 Cleaning grade from oxides:** conditionally estimated corrosion damages of metal surface after treatment by one of ways of oxide removal.

**3.7 Dew-point:** Temperature at which the moisture from air is condensed on a solid surface.

**3.8 Secondary corrosion:** Moderate formation of rust on steel surface as a result of surface preparation.

**3.9 Conversion coating:** Nonmetallic inorganic coating obtained as a result of chemical or electrochemical interaction of metal and solution. The structure of a conversion coating contains ions of the metal treated.

### 4 General requirements

4.1 At the production area intended for surface preparation and storage of articles, the ambient temperature shall be of not below 15 °C, and relative air humidity of not over 80 %.

The surface preparation and storage of the articles treated in need may be carried out indoors and outdoors at an ambient temperature of not below 5 °C.

The temperature of the steel surface, the surface processed for painting, shall be by 3 °C above a dew-point.

**Note** — Surface preparation of large-sized articles, and also the structures painted outdoors or indoors at an ambient temperature of below 5 °C, shall be carried out by agreement with the customer for short-term protection. Classification of articles by dimensions shall be made in accordance with GOST 9.410.

4.2 Presence of water on the prepared surface of an article, corrosive fluids and vapors thereof is not permitted.

4.3 After surface preparation the articles shall immediately be painted. If necessary, storage of articles after surface preparation shall be carried out under the conditions preventing from contamination of a surface and corrosion.

Periods of storage:

in case of absence of nonmetallic inorganic coatings (phosphate, chromate, etc.): not longer than 16 hours;

in case of presence of nonmetallic inorganic coatings: not longer than 72 hours for the articles painted by liquid paint and varnish materials, and not longer than 16 hours: for the articles painted by techniques of electrodeposition (by the techniques of cataphoresis and anaforesis) and powder polymeric materials.

4.4 On surfaces of the articles subject to preparation for painting, burrs, sharp edges in radius of less than 2.0 mm, weld splashes, soldering flows, burns, residual fluxes are not permitted.



Presence of burrs, sharp edges, weld splashes and fluxes of the soldering and their arrangement on surfaces of nonspecific parts is permissible, if it is established by normative documentation for article.

4.5 On a surface of cast articles nonmetallic macroinclusions, burns, discontinuity of metal in the form of blisters, cracks, seals, roughness in the form of bosses, thickenings, scabs, folds, except for specified in normative documentation for casting are not permitted.

4.6 Hot galvanized rolled stock for painting shall be made according to normative documentation where oiling is provided, but with no passivation and with no crystallization pattern.

4.7 The surfaces that are subject to preparation for painting, shall be classified by contamination grade (table 1) and oxidation grade (table 2).

Table 1 — Contamination grades and the characteristic of the contaminated surface

Contamination grade	The characteristic of contaminated surface
First	Availability of thin layers of mineral oils, lubricant, coolants, mixed with a metal shaving and dust, to 2 g/m <sup>2</sup>
Second	Availability of thick layers preservative greases, oils and hard removable contamination, graphite greases, deposits, grinding and polishing pastes over 2 g/m <sup>2</sup>
Note. Degrees of contamination of articles shall be determined by gravimetric method according to Appendix A.	

Table 2 — Oxidation grades and characteristic of the oxidized surface

Oxidation grade	Characteristic of the oxidized surface
A	Steel surface is almost completely covered by roll scale strongly bound to metal, but almost with no rust
B	Steel surface has started to rust, roll scale starts to separate from it
C	Steel surface with separated roll scale as a result of corrosion or from which scale has been removed; on a surface at visual inspection separate pittings are observed
D	Steel surface with separated roll scale as a result of corrosion on which pittings is observed on the whole surface at visual inspection

4.8 The grade, type and quantity preservative and technological (roll) oils are recommended to be agreed with the manufacturer of metal.

Roughness of metal surfaces shall be determined in accordance with GOST 2789 and GOST 9.032.

4.9 For 1st and 2nd classes of coatings in accordance with GOST 9.032 application cold rolled steels with 1st group of surface furnish in accordance with GOST 9045 with the contents of surface carbon not over 7 mg/m<sup>2</sup> on surfaces is permissible. These indicators shall be coordinated between the consumer and the manufacturer of steel.

4.10 Estimation of oxidation of surface of nonferrous metals and alloys is established taking recommendations of Appendix 2 of GOST 27597 into account.

## 5 Surface preparation

5.1 Main objective of surface preparation is removal from it the substances interfering painting and accelerating corrosion processes, and also obtaining of the surface providing required adhesion with a metal substrate for paintwork coating.

5.2 Surface preparation consists of a number of operations, first of which is cleaning of contamination. Cleaning may be carried out by mechanical, chemical (by means of potable water, solvents, chemical substances), thermal (by flame or annealing) methods. Methods of removal of contamination are listed in the Appendix B

5.3 Chemical methods of surface preparation are basically used at the automobile plants, enterprises of mechanical engineering, instrument making, manufactures of home appliances, etc. Mechanical methods of surface preparation are used at painting of large-sized metalware in construction, petroleum and gas industry, shipbuilding and ship repair, power, municipal economy etc.

5.4 When choosing method of surface preparation an initial condition of a surface, operating condition, material and article characteristics shall be taken into account.

5.5 To make the surface more corrosion resistant after cleaning special chemical surface preparation shall be carried out: phosphating, chromating, passivating. As a result of chemical surface preparation the inorganic nonmetallic coatings raising adhesion and service life of the subsequent paintwork coating are formed.

Basic schemes of processes of surface preparation for painting are listed in table 3.

Table 3 — Basic technological schemes of metal surface preparation

Number of the scheme of surface preparation	Degreasing		Simultaneous degreasing and etching	Washing with water	Simultaneous degreasing and anorphous phosphating	Phosphating		Anode oxidation	Chromating	Chemical oxidizing	Washing with water	Filling and impregnation	Passivation	Drying
	with solvent	with water solution				amorphous	crystal							
1	+	—	—	—	—	—	—	—	—	—	—	—	—	—
2	—	+	—	+	—	—	—	—	—	—	—	—	—	+
3	—	+	—	+	—	—	—	—	—	—	—	—	+	+
4	—	+	—	+	—	—	+	—	—	—	+	—	+	+
5	—	+	—	+	—	—	+	—	—	—	+	—	+	+
6	—	—	+	+	—	—	+	—	—	—	+	—	—	+
7	—	—	+	+	—	—	+	—	—	—	+	—	+	+
8	—	+	—	+	—	+	—	—	—	—	+	—	+	+
9	—	+	—	+	—	+	—	—	—	—	+	—	+	+
10	—	—	+	+	—	+	—	—	—	—	+	—	—	+
11	—	—	+	+	—	+	—	—	—	—	+	—	+	+
12	—	—	—	—	+	—	—	—	—	—	+	—	—	+
13	—	—	—	—	+	—	—	—	—	—	+	—	+	+
14	—	+	—	+	+	—	—	—	—	—	+	—	—	+
15	—	+	—	+	+	—	—	—	—	—	+	—	+	+
16	—	+	—	+	—	—	—	—	—	+	+	—	—	+
17	—	+	—	+	—	—	—	+	—	—	+	—	—	+
18	—	+	—	+	—	—	—	+	—	—	+	+	—	+
19	—	—	+	+	—	—	—	—	+	—	+	—	—	+
20	—	—	+	+	—	—	—	—	+	—	+	—	+	+
21	—	+	—	+	—	—	—	—	+	—	+	—	—	+
22	—	+	—	+	—	—	—	—	+	—	+	—	+	+

**Notes:**

- 1 Sign “+” means that the given operation is carried out, and sign “—” means that this operation is not carried out.
- 2 In case of presence of scale or rust on a surface of painted articles it shall be removed by etching or machining with preliminary or simultaneous degreasing. On occasion by agreement with the customer painting on densely bound scale in the availability of the positive conclusion of testing laboratory accredited in accordance with the established procedure, for particular system of a paintwork coating and specified conditions of operation is permissible.
- 3 If process of preparation of nonferrous metal surface provides operation of alkaline etching after it clarification is carried out.
- 4 In place of phosphating application of phosphatizing primers is permissible, in this case degreasing shall be carried out with solvent or water solution.
- 5 Prior to painting by electrostatic deposition no drying of moistened surface is permissible.
- 6 Last washing of articles prior to painting by electrostatic deposition and application of coatings shall be carried out with demineralized (electrical conductance of not over 20  $\mu\text{S}/\text{cm}$ ) or distilled water.
- 7 To provide high quality crystalline phosphatic coating a chemical activation shall be carried out according to 5.13.
- 8 The surfaces with the first contamination grade shall be subject to simultaneous degreasing and phosphating. Surfaces with the second contamination grade prior to application of amorphous coatings shall be subject to preliminary degreasing.

5.6 Specific technological scheme of chemical surface preparation, providing necessary quality of surface preparation, shall be chosen with aid of table 4 depending on operating conditions, material and article performance.

Table 4 Choice of the technological scheme of chemical surface preparation depending on of operating conditions, material and property of article surface

Operating conditions in accordance with GOST 9.104	Article		Scheme number according to table 3 or treatment type	
	Material	Property		
Y1, XJ1, YXJ1, T1, OM1, B1, B2, B5, O1	Metal of 1st and 2nd groups	From cold rolled metal.	4 to 7	
Y1, Y2 XJ3, YXJ2, T2, OM3, B3, T3, O1		From hot rolled metal with preliminary removed scale in the thickness to 2 mm	4 to 11, 15	
Y3, YXJ3, YXJ4		Large-sized	1 to 15	
Y1, XJ2			Steam-ejecting treatment according to table B.1 (Appendix B)	
YXJ3, YXJ4			1, 2 or according to table B.1 (Appendix B)	
Y1, XJ1, YXJ1, T2, OM3		Metals of 3rd group and nonferrous metals	From steel and pig-iron moulding, forged pieces and hot punchings	1, 2
Y1, XJ1, T1, O1, OM1, B1			From steel and pig-iron moulding in thickness over 2 mm	4, 6, 9, 11, 14, 15
B1, B2, B3, B5			Partially painted: unpainted part	1, 3, 12 to 15
T1, Y1, XJ1, YXJ1			Painted part	2
			Perceiving vibrating loads	9 to 11, 14, 15
B1, B2, B3, B5	Large-sized, painted for preservation		1, 2	
B1, B2, B3, B5	Metals of 3rd group and nonferrous metals		Partially painted	1, 2
Y1, XJ1, XJ2, YXJ1, T1, OM1, OM2, O1, B1, B2, B5			All kinds of articles	4 to 7, 19 to 22
Y1, Y2, XJ3, YXJ2, T1, T2, OM3, B3, YXJ4	Hot- and electrogalvanized steel			4 to 8, 11 to 15, 19 to 22
Y1, XJ1, XJ2, YXJ1, T1, T2, OM1, OM2, B1, B2, B5	Aluminum and its alloys		All kinds of articles	11, 16 to 22
Y2, YXJ2		10 to 11, 17 to 22		
Y1, XJ3, YXJ3, T3, O3, OM3, B3, YXJ4		3, 10 to 11, 16 to 22 or according to table B.1 (Appendix B)		
T1, Y1, XJ1, YXJ1, O1, B2, B5, OM1, OM2		Aluminum foundry alloys		16 to 22
B1, B2, B3, B5	Any metals	Completely painted	1 to 2	
Y1, XJ1, YXJ1, T1, T2, OM1, OM2, B5	Titanium-based alloys	All kinds of articles	1 to 3	
Y1, XJ1, T1, T2, O1, OM1, OM2, OM2, B5, T3, O4	Copper and copper alloys		1 to 3	

Table 4, concluded

Operation conditions in accordance with GOST 9.104	Article		Scheme number according to table 3 or to treatment kind
	Material	The characteristic	
T1, T2, XJ1, Y1, YXJ1, OM1, B1, Y2, XJ2, OM2, B5, B3, YXJ4	Aluminum castable alloys	Articles of all types	4 to 7, 19 to 22 or according to table B.1 (Appendix B)
	Zinc alloys		1 to 22
Y1, Y2, XJ2, YXJ1, T3, OM3, YXJ4	Nonferrous metals and alloys thereof		1 to 3
T1, Y1, O1, M1	1st group sheet metal with densely bound rolling scale	From metal more than 2 mm thick	1 to 3
<b>Notes</b> 1 Types of ferrous metals of 1st, 2nd, and 3rd groups are listed in table E.1 (Appendix E). 2 Application of other technological schemes of surface preparation is permissible, if they meet requirements of corrosion protection for the given operating conditions.			

5.7 According to structural features, purpose and other specificity of articles application of schemes of preparation of the surface, listed in table 3, under operating conditions, not provided for the particular schemes specified in table 4 may be used by agreement with the customer and developer of an article.

5.8 Preparation of surface of the articles operating in special mediums in accordance with GOST 9.032, shall be carried out such, as for operating conditions Y1, XJ1, YXJ1, T1, T2, OM1, OM2, B5, O1.

5.9 Final choice of the technological scheme of surface preparation shall be made taking into account requirements of table 4 and such factors as compatibility and required useful life of the chosen system of a paintwork coating, availability of the relevant equipment, accessibility of a surface etc.

5.10 Surface preparation is multiphase process. In case of complex articles when transferring from one stage of treatment to the following one certain quantity of working solution remains. For a proper correcting of working solution composition this quantity which often has significant size shall be taken into account. Approximate amount of solution remaining on a surface depending on complexity group are listed in table 5.

Table 5 — Amount of solution remaining on a surface depending on group of complexity of an article

Article shape in accordance with GOST 9.410	Group of complexity of article	Amount of remaining solution, cm <sup>3</sup> /m <sup>2</sup> , not over
Simple	1	50
Intermediate	2	150
Complex	3	300
<b>Note</b> — At treatment of surface of especially small articles in baskets or in drums amount of solution remaining on a surface is equated to the amount established for subordinate group of complexity of articles.		

### 5.11 Degreasing

Degreasing shall be carried out by means of potable water, solvents, and alkaline substances. Kinds of treatment and sequence of degreasing operation fulfillment are listed in table 6.

Table 6 — Basic technological schemes of degreasing

Type of contamination	Number of the scheme of degreasing	Treatment with hot water by temperature 70 °C to 90 °C	Heating to temperature of trickling of greases	Way of treatment				
				With solvent		With water solution		
				Submersion or dispersion	Holding in vapors	Emulsion compound	Alkaline solution	
					in single bath	consistently in two baths		
Availability of thin layers of the mineral oils mixed with dust, greases coolants, mixed with metal shaving and dust	1	—	—	+	—	—	—	—
	2	—	—	—	+	—	—	—
	3	—	—	—	—	—	+	—
	4	—	—	+	+	—	—	+
	5	+	—	—	—	—	+	—
	6	—	—	—	—	—	—	+
Availability of thick layers preservative greases and oils	7	—	+	+	—	—	—	—
	8	+	—	—	—	—	+	—
	9	—	+	—	—	—	—	+
	10	—	—	+	+	—	—	—
	11	—	—	—	—	—	—	+
	12	+	—	—	—	—	—	+
Availability of graphite greases, deposits, grinding and polishing pastes	13	—	—	+	+	—	+	—
	14	—	—	+	—	—	+	—
	15	—	—	—	—	+	+	—
	16	—	—	—	—	+	—	+
	17	—	—	—	—	+	—	—
	18	+	—	—	—	+	+	—

Note — Sign “+” means, that the given operation is carried out, sign “—“ operation is not carried out.

### 5.11.1 Degreasing by potable water

The method consists in supply of flush of potable water on a surface to be cleaned. Pressure of water depends on contamination being removed, such as water-soluble materials, loose coat of a rust and old paintwork coatings with slight adhesion, and should be not over 70 MPa. Removal of oil, grease, etc. is carried out with water by temperature of not lower than 70 °C. If in the course of degreasing the surfactants are used, the subsequent washing of surface with pure potable water shall be carried out.

### 5.11.2 Steam-ejecting treatment

5.11.2.1 Steam-ejecting treatment shall be carried out by steam-and-water mix by temperature of 130 °C to 140 °C and pressure of 0.9 to 3.0 MPa.

5.11.2.2 When injecting to steam-and-water stream of washing concentrate steam-ejecting degreasing of a metal surface is carried out.

5.11.2.3 When injecting to a steam-and-water stream of a concentrate for simultaneous degreasing and phosphating simultaneous degreasing and amorphous phosphating a metal surface is carried out.

5.11.2.4 After the steam-ejecting treatment spent with application of chemical substances, articles shall be washed out with potable water and dried.

5.11.2.5 In case of the articles painted by liquid paints and maintained in the XJ13, T3, Y3, YXJ13, YXJ14, OM3 conditions in accordance with GOST 9.104, after steam-ejecting treatment the subsequent washing and drying may not be carried out unless it results in deterioration of protective properties of paintwork coatings.

### 5.11.3 Degreasing by solvents

5.11.3.1 As solvents for surface degreasing stabilized ethylene trichloride, ethylene tetrachloride, white-spirit (nefras-C4—155/200), nefras-C 50/170 may be used.

5.11.3.2 Degreasing shall be carried out by the chlorinated solvents when being available the equipment, enabling of recycling the waste solvents.

5.11.3.3 Ethylene trichloride is not permitted to be used for treatment of:

- articles moistened with water or water solutions;
- articles made of aluminum and alloys thereof, containing considerable amount of shavings or being of small thickness (less than 0.5 mm);
- articles made of the titan and alloys thereof, used in aircraft engineering.

5.11.3.4 Hydrogen ion exponent pH of water extract of ethylene trichloride shall be not less than 6. When using unstabilised ethylene trichloride the stabilizer CTAT-1 in amount of 5 to 10 kg/m<sup>3</sup> or 0.01 kg/m<sup>3</sup> of one of following substances: triethylamine, monobutylamin, urotropin shall be added.

5.11.3.5 Degreasing by solvents may be carried out as in a combination with other methods of degreasing in technological process, and independently.

In table 7 ways of treatment and technological modes of degreasing by solvent at removal of various kinds of oil contaminants are listed.

Table 7 — Technological modes of degreasing by solvents

Solvent	Temperature, °C	Pressure of a liquid, MPa (kgs/cm <sup>2</sup> )	Duration of treatment, minutes		
			Submersion	Dispersion	In solvent vapors
Ethylene trichloride	20 ± 5	—	1—5	—	—
Ethylene tetrachloride	121 ± 5	—	—	—	2—3
Stabilised ethylene trichloride in accordance with GOST 9976	15 to 40	0.05 to 0.30 (0.5 to 3.0)	—	1—2	—
Stabilised ethylene trichloride in accordance with GOST 9976	87 ± 5	—	—	—	2—3
White-spirit in accordance with GOST 3134	20 ± 5	—	1—5	—	—
Nefras-C 50/170 in accordance with GOST 8505	20 ± 5	—	1—5	—	—

5.11.3.6 Mass concentration of oils in the solvents intended for treatment by a method of holding in solvent vapors, shall not be over 600 kg/m<sup>3</sup>, for treatment by immersing and dispersion methods prior to drying shall be 2 kg/m<sup>3</sup>.

5.11.3.7 At small volume of output manual treatment of a surface by the rags moistened with white spirit or nefrasom-with 50/170 is permissible. The rags shall be changed as frequently as possible.

#### 5.11.4 Degreasing by emulsion compounds

5.11.4.1 Emulsion compounds shall be used, in general for degreasing of metal surfaces with the second contamination grade in the presence of graphite greases, gomes, grinding and polishing pastes. Technological modes of treatment by emulsion compounds are listed in table 8.

Table 8 — Technological modes of treatment by emulsion compounds

Material of processed articles	Mass concentration of compound, kg/m <sup>3</sup>	Hydrogen ion exponent, pH	Temperature, °C	Pressure of a liquid when treating by dispersion method, MPa (kgf/cm <sup>2</sup> )	Duration of treatment, minutes	
					immersing	dispersion
All metals	Any emulsion compound	8.2 to 10.0	15 to 70	0.1 to 0.2 (1.0 to 2.0)	5 to 20	1 to 2

5.11.4.2 When deteriorating degreasing emulsion solution shall be replaced. The need in such replacement is determined by experiment for each particular technological process.

5.11.4.3 Emulsion degreasing solutions shall be used when being available the equipment for neutralization and sterilization of the waste solutions.

#### 5.11.5 Degreasing by alkaline water solutions

5.11.5.1 Degreasing of metals shall be carried out by specified grade of a commercial cleaning agent (hereinafter CA), chosen according to applicable technological process and meeting requirements as to quality of the degreasing established for given process.

5.11.5.2 When preparing the surface of large-sized articles of intricate shape, repair preparation of a surface, tinting articles as an assembly, etc., degreasing shall be carried out with aid of brushes or cleaning cloth, moistened with white spirit or CA water solutions.

When preparing the surface the brushes and cleaning cloth used shall not leave traces (hairlines, parts of pile, cloth, etc.) on a processed surface.

5.11.5.3 When using water alkaline solutions the article shall prior to painting be washed out with potable water and fat-free surface shall be dried unless after that any other operations of preparation of a surface are carried out.

5.11.5.4 Alkaline water solution shall periodically be cleared from oil and metal pollutants.

5.11.5.5 Mass concentration of oils in the water alkaline solutions intended for treatment by methods of immersing and dispersing, shall not be over 2 kg/m<sup>3</sup>.

5.11.5.6 Modes and parameters of alkaline water solutions are listed in tables C.1, C.2 (Appendix C), methods of control and correction are given in Appendix E.

#### 5.12 Descaling, derusting and cleaning from severe contamination

5.12.1 Surface descaling and derusting shall be carried out by mechanically, thermally or chemically. Surface cleaning from severe contamination (weld slag, foundry burning-in, melted welding compounds, grinding paste, residual sand blend, old paintwork coatings, etc.) shall be carried out mechanically.

5.12.2 Condition of initial metal surface shall be estimated according to table 2. The grade of descaling and derusting of metal surface of 1st and 2nd groups depending on operating conditions shall be chosen according to table 9.

Table 9 — Descaling and derusting grades of metal article surface depending on operating conditions

Designation of cleaning grade	Characteristic of the cleaned surface	Designation of conditions of operation of paintwork coatings in accordance with GOST 9.104	Characteristic of articles to be treated and material
1	Scale and rust visible by six-fold magnification are not detected	Y1, YXJ1, XJ1, T1, O1, OM1, OM2, B5	Articles made of metals of 1st and 2nd group, being subject to painting according to 1st and 2nd classes in accordance with GOST 9.032
2	Scale, rust, burning-in, residual sand blend and other nonmetal layers visible under normal vision are not detected	Y1, Y2, YXJ1, YXJ2, XJ1, XJ2, T1, T2, T3, O1, OM1, OM2, OM3, B5	Articles made of metals of 1st and 2nd groups, being subject to phosphating and painting
3	There are stains and strips of firmly adhering scale and casting skin on an area of not over 5 % of surface, visible under normal vision. On any of sites of a article surface scale occupies not over 10 % of the area of a plate in the size 25 × 25 mm	Y1, Y2, YXJ1, Y1, YXJ2, YXJ3, YXJ4, XJ1, XJ2, XJ3, T2, T3	Articles made from pig-iron and steel molding, forgings and hot stampings, rolled stock and articles of the intricate shape
4	The rust and exfoliated scale are removed from surface	YXJ4	Out-of-the-way places of large-sized articles of the intricate shape made from metal in thickness of not less than 4 mm

#### Notes

1 Types of ferrous metals of 1st and 2nd groups are listed in table E.1 (Appendix E).

2 Welds are cleared of slag and poorly adjoining scales. After welding with aid of electrodes the welds with a flux coating shall be cleared from residual flux and neutralized. Value pH of the surface wetted by distilled water, should be 6.0 to 8.0; the control is carried out with aid of the appropriate indicator.

5.12.3 Surfaces of articles with cleaning grade 4 (table 9) shall not be subject to painting.

5.12.4 Way of descaling and derusting surfaces of 1st and 2nd group metals, providing required cleaning grade, shall be chosen according to table 10.

Table 10 — Maximum descaling and derusting grade when using various methods

Way of descaling and derusting	Descaling and derusting grade at initial oxidation rate of surface				Example of application
	A	B	C	D	
Etching	1	2	1	1	Treatment of articles of any shape. Removal of scale and rust from out-of-the-way places (cradles, holes, grooves, etc.)
Jet treatment	1	2	1	1	Treatment of large-sized articles (trimming of welds, removal of corrosion products, etc.), local removal of scale, rust or old paintwork coatings prior to repair painting
MECHANIZED cleaning (by rotating brushes, air-operated hammers, with use of emery cloth, etc.)	2	4	3	3	Same
Mechanical cleaning by the hand tools	3	4	4	3 to 4	»

Note. Hand cleaning is permissible at presence of slight rust or corrosion traces on a surface. In this case 1st or 2nd cleaning grade from oxides is reached.

5.12.5 If service life of painting coating system used, for example as a result of abrasive deterioration, destroying influence of substances, etc., is less than service life established for this system in any climatic conditions, painting of a surface with cleaning grade 4 is permissible to be carried out by agreement with the customer and developer of article.

5.12.6 Metal wares in thickness of 4 mm and over, maintained in the conditions of C5 in accordance with GOST 9.104 whose service life is not over 12 months due to abrasive deterioration and destroying influence of hostile environment, having surfaces with degrees 3 and 4 cleaning from oxides may be painted by using of technological schemes 1 to 3 of surface preparation according to table 3 and also primers-coat-converters of rust or rust converters may be used.

#### 5.12.7 Mechanical cleaning of surface

5.12.7.1 Mechanical cleaning of article surfaces shall be carried out with aid of the hand tools and mechanized tools, special equipment, and also by methods abrasive jet machining and water jet treatments.

5.12.7.2 Hand cleaning shall be carried out with use of wire brushes, palette-knife, scrapers, abrasive cloths, hammers for chipping rusts.

5.12.7.3 Mechanized cleaning shall be carried out with use of rotating wire brushes, various types of grinding adaptations, jackhammers, wire guns.

The areas of the surface inaccessible for treatment by the mechanized tools, shall be prepared manually. Cleaning shall be carried out so that there are no damages or defects of a surface (hairlines, dents, etc.).

#### 5.12.7.4 Dry abrasive jet cleaning

Centrifugal abrasive jet cleaning shall be carried out on motionless installations or in mobile devices of jet cleaning where the abrasive arrives at first at rotating wheels or blades, and then in regular intervals with the high speed is scattered on surface to be cleaned.



Abrasive jet cleaning by the compressed air shall be carried out by abrasive delivery in an air stream supplied at high speed from a nozzle to the surface to be cleaned. The abrasive can be injected into an air stream from a vessel being under pressure, or it is entrapped by an air stream in the course of suck from a vessel which is not under pressure. A small amount of water may be added in an air-abrasive stream for dust elimination in a range of the size of the suspended particles less than 50  $\mu\text{m}$ . The water consumption makes 15 to 25  $\text{dm}^3/\text{h}$ .

Abrasive jet cleaning with aid of vacuum or a suction head shall be carried out with the difference, that the nozzle is built in suction head which is tightly fixed on a steel surface and is designed for collecting of the waste abrasive and contaminants. The air-abrasive stream can also be entrapped on a surface when using the decreased pressure in suction head.

#### 5.12.7.5 Wet abrasive jet cleaning

Wet abrasive jet cleaning with compressed air shall be carried out to similarly jet cleaning with compressed air with addition of liquid (usually potable water) therefore a surface is cleaned by action of air stream, potable water and abrasive on it.

Suspension jet cleaning consists in delivery of a mixture of small abrasive particles with liquid with aid of the pump or compressed air on a surface to be cleaned.

Jet cleaning by a liquid under pressure shall be carried out with aid of liquid stream (usually potable water) with an abrasive which through a nozzle is directed on a surface to be cleaned. The stream is a liquid which is under pressure, and the amount of the abrasives added is, as a rule, less than at wet abrasive jet cleaning by the compressed air. An abrasive shall be entered either in dry condition (with or without aid of air), or in the form of liquid paste.

Jet cleaning with sweeping is a special case of use of jet cleaning and is intended for cleaning of organic and metallic coatings or to provide them roughness when removing surface layer. Jet cleaning with sweeping shall be carried out so that firmly adhering coating, being under the first layer, would not be punched and broken with exposure of substrate at collision with an abrasive. Required conditions of cleaning of a surface shall be coordinated between interested parties. As a rule, for jet cleaning with sweeping air stream under low pressure and a small abrasive powder is used.

Spot jet cleaning represents the usual form of jet cleaning by the compressed air when only separate spots (for example, rust or welding stains) on a surface are subjected to treatment.

Water jet cleaning consists in supply of sheet of potable water under pressure upon a surface to be cleaned. Pressure of water depends on contamination being removed, such as water-soluble agents, loose rust and old paintwork coatings with poor adhesion. If in the course of cleaning surface-active agents are added in water the subsequent washing of a surface by potable water is necessary.

Usually the following methods of water jet cleaning are used:

- cleaning by a stream of potable water under high pressure (70 to 170 MPa);
- cleaning by a stream of potable water under ultrahigh pressure (over 170 MPa).

#### 5.12.7.6 Flame cleaning

Surface shall be burned by flame of oxygen-acetylene torch. Scale and rust shall be removed by effect of fire stream and high temperature. After cleaning surface by a flame it shall be treated by means of wire brushes with a mechanical drive and prior to painting cleaned in addition from dust and loose contaminants. Flame cleaning shall be used at metal thickness of not less than 6 mm.

5.12.7.7 For jet abrasive treatment pig-iron or steel shot in accordance with GOST 11964 or grinding materials in accordance with GOST 3647 shall be used.

Jet abrasive treatment shall be carried out at metal thickness of not less than 3 mm. Jet abrasive treatment of thin-walled articles is permissible unless their geometrical shape is broken.

5.12.7.8 Articles made of corrosion-proof steels after cleaning by a grinding material shall be subject to etching for removal of metal powder.

When using nonmetal abrasives no etching shall be used.

5.12.7.9 After machining air-blast cleaning shall be carried out with aid of the compressed air in accordance with GOST 9.010.

5.12.7.10 At wet abrasive jet cleaning a mixture of abrasive with water in the ratio from 1:2 to 1:6 shall be used.

5.12.7.11 To prevent ferrous metals from of corrosion one of the components listed in table 11 is brought in hydroabrasive suspension.

Table 11 — Corrosion inhibitors for wet abrasive jet cleaning

Inhibitor	Mass concentration, kg/m <sup>3</sup>
Tannin	20.0 to 30.0
Potassium (sodium) bichromate in accordance with GOST 4220	0.5 to 1.0
Soda ash in accordance with GOST 5100	1.5 to 2.5
Sodium nitrite in accordance with GOST 4197	2.0 to 10.0

Note — If after wet abrasive jet cleaning no subsequent chemical surface preparation is provided, then prior to painting washing of surface with potable water shall be carried out. When using chrome compounds as inhibitors washing may not be carried out.

### 5.12.8 Etching

5.12.8.1 Solution compositions and etching conditions of ferrous and nonferrous metals are given in GOST 9.305 and in the table C.3 (Appendix C).

5.12.8.2 Solution compositions are corrected by adding an etching concentrate or appropriate components.

5.12.8.3 Permissible mass concentrations of iron salts in etching solutions are listed in table 12.

Table 12 — Permissible concentrations of iron salts in etching solutions

Iron salt	Permissible mass concentrations, kg/m <sup>3</sup> , when treating	
	by submerging	by dispersion
Ironic sulfate in accordance with GOST 4148 or GOST 9485	150 to 180	250 to 300
Ironic chloride in accordance with GOST 4147	200 to 220	300 to 380
Ironic phosphate	20 to 25	15 to 18

5.12.8.4 To remove scale and rust from a surface of large-sized articles out of 1st and 2nd group metals etching paste shall be used; it is applied with spatula, plaster shovels or paste spray gun and kept during 1 to 6 h, after that the surface is washed out with water and passivating paste shall be applied to surface and kept during 0.5 to 1.0 h, then a surface is washed out and dried.

5.12.8.5 Mixture ratios of etching and passivating pastes are given in the table C.4 (Appendix C).

5.12.8.6 When preparing surface of the articles intended for Y1, Y2, Y1, YXJ4 operating conditions, in case of impossibility of application of abrasive jet method of cleaning or other methods, providing required properties of coating, for surfaces with A oxidation grade the primers — rust converters shall be used.

5.12.8.7 Thick layers of scale and rust from articles made of ferrous metals of the intricate shape shall be removed by immersing of article into melt of sodium hydroxide at a temperature of 420°C to 480°C or in melt of mixture of sodium hydroxide and sodium nitrate at a temperature of 450°C to 500°C in the ratio of 3:1 for a period of 10 to 45 minutes. In this case operation of degreasing shall not be carried out. Other methods providing required cleaning grade of a surface from oxides may be used.

5.12.8.8 Compounds for simultaneous degreasing and etching and treatment modes are given in the table C.5 (Appendix C).

### 5.13 Chemical activation of metal surface prior to phosphating

5.13.1 Chemical activation shall be carried out after cleaning of a surface from oxides, oil, and other contaminations prior to operation of crystal zink-phosphating for the purpose to provide fixed quality of a phosphatic coating, obtaining of phosphatic coatings with fine-grane structure, reduction of weight of a phosphatic coating per unit surface, reducing of phosphatizing concentrate consumption.

5.13.2 Titanic activators АФ-1, АФ-4, АП-4 represent powder-like products. Activators shall be brought into a washing bath prior to phosphating or into degreasing bath depending on the available equipment. Activator bringing-in into degreasing bath is of effect only when using a method of dispersion. It is more preferable to add the activator in the second degreasing bath.

5.13.3 Activating compounds prior to bringing-in into a washing bath shall be dissolved in distilled (demineralized) water in compliance with requirements of the table D.1 (Appendix D).

5.13.4 Process conditions with activating solutions are given in the table C. 6 (Appendix C).

5.13.5 Because solutions of titanate activators АФ-1, АФ-4, АП-4 are susceptible to the coagulation, activating solutions shall periodically be refreshed. The control and correcting of activating solutions are listed in Appendix E.

5.13.6 Replacement of an activating solution shall be carried out at deterioration of phosphatic coating (increasing crystals in the size and weight in a layer), but at least once every two weeks.

5.13.7 The consumption of activating compound depends on production conditions and it shall be specified after test on the particular equipment for surface preparation.

#### 5.14 Phosphating

5.14.1 When preparing for painting on a metal surface phosphatic coatings of two types can be generated: crystal (zinc-phosphatic) or amorphous (iron-phosphatic).

Zinc-phosphatic coatings are formed in solutions on the basis of the monosubstituted zinc phosphate which can also contain nickel, manganese, calcium cations etc.

Iron-phosphatic coatings are formed in solutions on the basis of the monosubstituted phosphates of alkaline metals or ammonium phosphate.

5.14.2 Phosphating is used mainly for treatment of ferrous metals, and also zinc, aluminum, and cadmium. Characteristics of metal phosphatizing ability are listed in table E.1 (Appendix E).

5.14.3 Prior to phosphating the surface shall be cleaned from scale, rust, fats, oils, finger-prints and other extraneous substances by the methods compatible to chosen way of phosphating, and carefully washed out.

5.14.4 It is necessary to refuse methods and materials of surface cleaning, promoting formation macrocrystalline structures and increasing in weight of a phosphatic coating prior to crystal phosphating. For this purpose strongly alkaline CA (pH over 12) are not recommended to be used. If for descaling and derusting operation of etching by acids has been carried out prior to phosphating neutralised washing and chemical activation according to 5.13 shall be carried out.

5.14.5 Prior to painting by methods of cathodic or anodic electrodeposition, and also prior to painting by powder paints prior to zinc-phosphating operation the chemical activation according to 5.13 shall be carried out.

5.14.6 For the purpose of increasing of corrosion resistance the phosphatic coatings shall be treated by special passivating agents.

5.14.7 The basic types of phosphatic coatings and their characteristic are listed in table 13.

Table 13 — Characteristics of conversion phosphatic coatings

Type and components of phosphatizing compound	Type of conversion coating	Appearance of a phosphatic coating	Weight of phosphatic coating per unit area, g/m <sup>2</sup> , when applying on			
			ferrous metals	aluminum	zinc	cadmium
Classical (Zn <sup>2+</sup> , H <sub>2</sub> PO <sub>4</sub> <sup>-</sup> , oxidizer)	Zink-phosphate, zink-iron-phosphate	Color from light grey to deep grey; crystal	1.5 to 9.0	1.5 to 9.0	1.5 to 5.0	1.5 to 9.0
With low zinc (Zn <sup>2+</sup> , Ni <sup>2+</sup> , H <sub>2</sub> PO <sub>4</sub> , oxidizer)			1.5 to 5.0	1.5 to 5.0	1.5 to 5.0	1.5 to 5.0
Three-cation (Zn <sup>2+</sup> , Ni <sup>2+</sup> , Mn <sup>2+</sup> , H <sub>2</sub> PO <sub>4</sub> , oxidizer)			1.5 to 5.0	1.5 to 5.0	1.5 to 5.0	1.5 to 5.0
Amorphous (Na <sup>+</sup> , K <sup>+</sup> , NH <sub>4</sub> <sup>+</sup> , H <sub>2</sub> PO <sub>4</sub> <sup>-</sup> , oxidizer)	Phosphate of metal being treated plus iron oxides in case of treatment of ferrous metals	Color iridescent from light yellow to azurine; amorphous	0.1 to 1.0	Less than 0.3	0.1 to 1.0	to

5.14.8 Recommendations on phosphating for maintenance of good physical-and-mechanical properties and increase of corrosion resistance of paintwork coatings are listed in table 14.

Table 14 — Recommendations on phosphating for maintenance of good physical-and-mechanical properties and increase of corrosion resistance of paintwork coatings

Metal to be treated	Type of phosphatizing compound	Weight of phosphatic coating, g/m <sup>2</sup>	Scope
Ferrous metals of 1st and 2nd groups, zinc, aluminum, cadmium	Classical, with low zinc, three-cation	1.5 to 5.0	Prior to painting by liquid paint and varnish materials
	Amorphous	0.1 to 1.0	
	With low zinc, three-cation	1.5 to 4.0	Prior to painting by methods of anodic and cathodic electrodeposition
	Classical, with low zinc, three-cation	1.5 to 3.0	Prior to painting by powder paints and prior to painting with the subsequent deformation
	Amorphous	0.1 to 1.0	

5.14.9 Technological parameters of application, conditions and ways of correcting, control technique of phosphatizing solutions, consumption of chemicals shall be used according to normative documentation for particular mixture.

5.14.10 Articles with applied phosphatic coating shall be washed out with potable water and subject to hot drying. At some types of painting with using of water paint materials, for example prior to painting by an electrodeposition method, articles may not be dried.

5.14.11 Formation of sludge is the normal phenomenon of phosphating process however deposition of sludge on articles shall be avoided. Phosphating baths should be cleared from sludge by filtration, sedimentation etc.

5.14.12 For preparation of phosphatizing solutions distilled, demineralized or potable water complying with requirements of the table D.1 (Appendix D) shall be used. At application of potable water the consumption of phosphatizing compounds is increased by 10 % to 15 %.

To prepare working solution of mixture for simultaneous degreasing and amorphous phosphating potable water shall be used.

5.14.13 Methods of control and correcting of phosphatizing solutions are given in Appendix E.

### 5.15 Passivation

5.15.1 Passivation operation shall be carried out after the surface has been degreased by water solutions with the purpose of prevention from formation of secondary corrosion at drying of articles made of steel of 1st and 2nd groups unless the subsequent treatment is carried out.

5.15.2 Operation of passivation shall be carried out after operations of phosphating and chromation with the purpose of increase of corrosion resistance of phosphate and chromate coatings.

5.15.3 Passivating compounds and technological modes of treatment are listed in table C.7 (Appendix C).

5.15.4 For passivation prior to painting chrome free compounds on the basis of complex fluoride compounds of titan, zirconium or hafnium, and also water-soluble polymeric compounds improving corrosion resistance of the subsequent paintwork coatings.

5.15.5 Preparation, control and correction of passivating solutions are given in Appendix E.

5.15.6 Articles with the coatings obtained by chemical or electrochemical methods from copper and alloys thereof, corrosion-proof steels, and also articles with zink-barium-phosphate and zink-magnesium-phosphate coatings shall be passivated in accordance with GOST 9.305.

### 5.16 Washing

5.16.1 After each technological stage of chemical surface preparation washing of a surface shall be carried out by potable water. The number of steps of washing is dependent on technological process. The increase in number of steps of washing improves a quality of a prepared surface.

5.16.2 Chemical components of the previous technological stage after washing can remain on surface of article, therefore water in last bath of washing shall be controlled according to table 15.

Table 15 — Controllable qualities of water in last washing bath

Operation after which washing is carried out	Operation prior to which washing is carried out	Controlled quality	Permissible value of a controlled quality, point, not over
Degreasing	Etching	Alcalinity	0.5
	Activation		1.0
	Phosphation		0.5
	Passivation		0.1
	Drying		0.1
Etching	Activation	Acidity	0.5
	Phosphation		1.0
	Passivation		0.8
Phosphating	Passivation	Acidity	1.0
Chromating	Passivation	Acidity	1.0

5.16.3 Quality of source potable water and permissible concentration of contaminants in last bath of washing prior to drying from moisture and painting depend on type of put paintwork coatings and conditions of their operation. Requirements for water of last washing bath are listed in table 16.

Table 16 — Requirements for water of last washing bath

Type of paintwork coating to be applied	Operating conditions in accordance with GOST 9.401	Quality of water		
		Source water	Water in washing bath	
			Controlled parameter	Permissible value of controllable parameter
Liquid paint and varnish materials	YXJ1, YXJ2, YXJ3, T1, T2, T3, OM1, OM2, OM3, O1, B5, YXJ4	Distilled water in accordance with GOST 6709, 3rd categories in accordance with GOST 9.314	Conductivity, $\mu\text{S}/\text{cm}$ , not over	50
		Drinking water in accordance with GOST 2874, 2nd category in accordance with GOST 9.314, condensate	Alcalinity (after degreasing), point, not over	0.5
			Acidity (after phosphating, chromating, passivation), point, not over	0.5
Electrodeposited paint and varnish materials	Any	Distilled water in accordance with GOST 6709, 3rd category in accordance with GOST 9.314	Conductivity, $\mu\text{S}/\text{cm}$ not over	40
Powder paint and varnish materials	YXJ1, YXJ2, YXJ3, T1, T2, T3, OM1, OM2, OM3, B5, YXJ4	Distilled water in accordance with GOST 6709, 3rd category in accordance with GOST 9.314	Conductivity, $\mu\text{S}/\text{cm}$ , not over	40
		Drinking in accordance with GOST 2874, 2nd categories in accordance with GOST 9.314, a condensate	Alcalinity (after degreasing), point, not over	0.5
			Acidity (after phosphating, chromating, passivation), point, not over	0.5

5.16.4 Duration of washing at any stage of technological process shall be not less than 0.5 minutes

5.16.5 Washings shall be used at both immersing method, and jet method; they are intended for performance of two basic functions: washing and entrapment. Washing baths shall be flowing, entrapment bath shall be standing, but with returning of the entrapped solution in the previous technological bath (the counterflow scheme).

For decrease in water consumption and dump waste waters provision of counterflow schemes of washings is recommended.

5.16.6 Water consumption for washing  $Q$ , dm<sup>3</sup>/h, is found using the following formula

$$Q = n q F \sqrt[N]{\alpha} K_1 K_2, \quad (1)$$

where  $n$  stands for number of single baths of washing, direct-flow steps of washing or baths (including cascade) with independent (intrinsic) supply and discharge of water;

$q$  stands for specific carrying out (entrainment) of a solution, cm<sup>3</sup>/m<sup>2</sup> (table 5);

$F$  stands for the area of a surface to be treated, m<sup>2</sup>/h;

$\alpha$  stands for the factor considering number of entrapment baths:  $\alpha = 0.4$  at one,  $\alpha = 0.15$  at two and  $\alpha = 0.06$  at three entrapment baths;

$N$  stands for number of steps of flowing washing;

$K_1$  stands for ratio of dilution, found using the following formula

$$K_1 = \frac{C_0}{C_{\text{нд}}}, \quad (2)$$

where  $C_0$  stands for concentration of solution in a technological bath, points;

$C_{\text{нд}}$  stands for maximum permissible concentration of technological solution in last washing bath, points;

$K_2$  stands for the factor taking a method of treatment (at method of immersing  $K_2 = 1$ , at jet method  $K_2 = 1.1$ ) into account.

## 5.17 Drying of prepared articles

5.17.1 Ways and modes of drying of articles are listed in table 17.

Table 17 Ways of drying of articles after chemical surface preparation

Article characteristic	Way of drying	Temperature, °C
Thick-walled and large-sized articles	Compressed air or hot air blowing from heat guns	15 to 110
The articles transported on pendant or intermittent or continuous belt conveyors: degreased, phosphated, passivated chromated	In drying chambers of deadend type and in periodic and continuous chambers of through passage	60 to 130
		Not over 60
Articles transported by telfer, jib or autooperator: degreased, phosphated, passivated chromated	In drying periodic chambers with closed shutters	60 to 130
		Not over 60
Note - Drying shall be carried out prior to complete drying of a surface.		

5.17.2 When degreasing articles with aid of brushes or cleaning cloth, moistened with white spirit, article surfaces may be wiped by dry pure cleaning cloth which does not leave pile, and blown by dry cleaned compressed air.

5.17.3 The drying chambers of any type, providing recirculation of hot air, gas-dynamic blast of articles and removal from them moisture vapors are used.

5.17.4 Drying of the parts transported in drums made of polypropylene, shall be carried out not taking out them from drums in drying chamber with circulation of heated air in temperature of not over 80 °C.

5.17.5 Quality of compressed air for blasting of articles shall be in compliance with requirements of GOST 9.010.

### 5.18 Surface preparation for repair painting

5.18.1 Preparation of articles for repair painting shall be carried out according to table 18.

Table 18 — Requirements for surface preparation for repair painting

Operating conditions of paintwork coatings in accordance with GOST 9.104	Degree of surface preparation for repair painting	Method of removal of contaminants and corrosion products	Performance of prepared surface
Y1, XJ1, YXJ1, T1, T2, OM1, OM2, B5	1	Old paintwork coating, corrosion products and oil contamination shall be completely removed	Oil contaminations are not permitted; cleaning grade of a surface is 2. Subsequent surface preparation is carried out as for newly made articles
Y2, XJ2, Y1, XJ3, YXJ3, YXJ2, T3, OM3	2	Old paintwork coating, rust and exfoliating scale contamination shall be completely removed, then a surface shall be degreased	Strongly adjoining thin intermittent layer of the first coat, separate spots of rust, small pieces of scale, densely adjacent to substrate, slight film-like deposit with rusty shade in earlier corroded places are permissible
YXJ4	3	Loose adjoining contaminants of organic and inorganic origins, local damages of the old paintwork coating which peel off substrate shall be removed from surface	The intact paintwork coating, skintight to metal is permissible

5.18.2 Remaining old paintwork coating is permissible to be on the surface if it promotes increase of service life and improvement of corrosion resistance of paint and varnish compound being applied and also if it is compatible with surface.

5.18.3 For removal of paintwork coatings from articles as assembly or from separate parts remover on the base of solvents or caustic soda, efficient for the particular kind of paint and varnish system shall be used. The example of alkaline mixture for removal of paintwork coating is given in table C.8 (Appendix C).

5.18.4 Liquid removers shall be used when using methods of dipping and dispersion, pastelike shall be used when using method of hand application. After peeling or swellings of paintwork coating it shall be removed by brush or spatula.

5.18.5 Choice of remover shall be carried out individually in every particular case. Use of removers shall be carried out under the technological instruction accompanied each remover. Names of removers are listed in table F.1 (Appendix F).

5.18.6 For degreasing partially or completely painted articles alkalescent, neutral water compounds or white spirit shall be used.

5.18.7 Duration of removal operation of paintwork coating is dependent on system of this coating, its thickness, characteristic of initial surface, and also adhesion of paintwork coating to be removed.

## 6 Quality control of surface preparation

6.1 Condition of a surface of articles shall be controlled not later than 6 hours after surface preparation, and, in addition, immediately prior to painting at a period of storage over 6 hours.

6.2 When initiating secondary corrosion on the prepared surface it shall be removed, if it impairs the properties of subsequent paintwork coating.

6.3 If surface preparation consists of several operations, the control in need shall be performed after every operation.

When treating articles in through-pass units for chemical surface preparation or in the automatic transfer lines, consisting of several stages, a quality assessment of prepared surface shall be carried out by results of performance of the basic stage (phosphating, chromating etc.).

#### 6.4 Quality assurance of degreasing

6.4.1 Quality of degreasing should comply with requirements of table 19.

Table 19 — Quality assurance of degreasing

Degreasing grade	Time period prior to rupture of water film at test by a wettability method, sec	Presence of oil spot on a filtering paper at test by drop method	Presence of dark spot on napkin at test by rubbing method
First	Over 30	No	Poorly expressed, indistinct
Second	Less than 30	Poorly expressed, indistinct	Obviously expressed

#### 6.4.2 Control of degreasing grade by wettability method

Method shall be used for the control of surface after its degreasing by CA water solutions.

The method consists in determination of time interval of keeping of continuous potable water film on the processed surface until its rupture; it is based on ability of water or solution film not to form drops and remain on a pure surface of metal during certain time.

When determining degreasing grade an article (specimen) shall be submerged in water with salt content in accordance with GOST 6709 or sprayed on a surface of article (specimen) solution containing 50 g of nigrosine in 1 dm<sup>3</sup> of water with salt content in accordance with GOST 6709.

Discontinuity of films shall visually be inspected at daylight or artificial illumination, in this case a surface removed from edges and sharp edges less than by 10 mm is not taken into consideration.

Degreasing grade is characterized by time interval in seconds from the start of test until film rupture.

#### 6.4.3 Control of degreasing grade by drop method

Method shall be used to the control of surfaces after degreasing by organic solvents and water washing solutions. Prior to test a degreased surface of article (specimen) shall be dried.

2 or 3 drops of solvent are applied on a surface of an article (specimen) and let maintain 15 s.

A sheet of a filtering paper shall be applied to the surface area under test and pressed to surface until complete absorption of solvent in a paper.

2 to 3 drops of pure solvent are applied on other sheet of a filtering paper and let maintain until its complete evaporation.

At daylight or artificial illumination appearance of both sheets of filtering paper are compared.

Degreasing grade is determined by presence or absence of oil stain on the first sheet.

#### 6.4.4 Control of degreasing grade by rubbing method

Method shall be used for the surfaces degreased by water washing solutions and organic solvents.

Quality of degreasing of metal surfaces prior to painting is visually inspected at daylight or artificial illumination. The prepared surface is rubbed by pure rags. Degreasing grade is determined by presence or absence of dust traces and fatty contaminants on a surface.

#### 6.5 Control of descaling and derusting grade

6.5.1 Descaling and derusting grade shall be determined by means of plate made from transparent material in size 25 × 25 mm with mutually perpendicular lines forming small squares in sizes 2.5 × 2.5 mm which is moved on article surface.

6.5.2 Descaling and derusting grade is determined by the ratio of number of the small squares occupied by scale and rust, to the total number of the small squares expressed as percentage. The control shall be carried out according to table 9. The control may visually be carried out after mechanical surface preparation according to [1].

#### 6.6 Quality control of phosphating

6.6.1 Weight of a phosphatic coating per surface unit area shall be found from Appendix E.



Weight of phosphatic coating for conformity to requirements of table 13 shall be found periodically depending on particular conditions, but at least once a week.

6.6.2 Appearance of phosphatic coating shall visually be inspected.

Coloration of phosphatic coating depends on type of phosphatizing mixture used, metal grade, preliminary treatment (mechanical, heat) according to table 13. The colour shade is not normalised.

Non-uniform coloration of coating on the articles, passed heat treatment, and also offshade of phosphatic coating is permissible at keeping required protective properties of the paintwork coating applied.

Presence of rust and white salt touch (sludge), except for hard-to-reach surfaces of articles of a intricate configuration is not permitted.

6.6.3 Control of protective properties of phosphatic coatings shall be carried out in a combination to paintwork coating in accordance with GOST 9.401 only.

#### 6.7 Surface control for pH

Surface measurement of pH shall be carried out immediately after drying of the articles, having passed surface preparation for painting. Multipurpose test paper moistened with distilled water shall be placed on an article surface for a period of 30 s, then paper shall be removed and its color shall be compared with respect to pH scale.

The random testing shall be carried out in places of moisture collection and junctions of members.

The pH of surface may be determined by pH of water flowing down at last stage of washing; pH of surface should be from 6 to 8.

#### 6.8 Control of chemical oxide and anode-oxide coatings

The control of chemical oxide (chromate, passive etc.) and anode-oxide coatings on nonferrous metals and their alloys shall be carried out in accordance with GOST 9.301.

### 7 Requirements for the operations carried out under surface preparation

7.1 Dangerous and harmful production factors when operating on surface preparation shall be removed or reduced down to permissible levels according to effective normative documentation and sanitary norms.

7.2 Surface preparation under production conditions shall be carried out in conformity to requirements of fire protection of premises, buildings and other construction structures.

7.3 Quantity and nomenclature of principal types of the fire fighting equipment necessary for protection of area for surface preparation shall be chosen according to effective standards established taking into account requirements of GOST 12.1.004. Automated fire extinguishing installation and the fire alarm installation, and non automatic drencher and gas fire extinguishing installations and hand fire alarm for buildings and structures. In case of absence of automated fire extinguishing installations the premises shall be provided with foam extinguishers and carbon-dioxide fire extinguishers, cases with sand, asbestos cloths and other fire-extinguishing means in accordance with GOST 12.1.004.

7.4 Processes of surface preparation carried out in premise where painting shall be carried out, including transportation and storage, shall be carried out taking into account requirements of GOST 12.1.010.

7.5 Requirements to production processes of surface preparation shall be established in accordance with GOST 12.3.002 and GOST 12.3.005 according to:

choice of applied production processes;

choice of production premises and areas (for the processes which are carried out outside production areas);

source materials, compounds, concentrates used;

production equipment used;

ways of material storage and transportation, starting and treated articles and waste products;

applied protecting gears of the attendants;

safety requirements established in the standard and technological documentation.

7.6 General requirements for processes of surface preparation shall be used in accordance with GOST 12.3.008. Processes of surface preparation shall be developed so that they provide the content of harmful substances in air of a working area below maximum permissible concentrations and do not pollute environment (air, soil, reservoirs) by emissions of harmful substances. The list of harmful substances and their maximum permissible concentration in air of working area shall be established according to normative documentation.

7.7 Requirements when working with the compounds used for surface preparation are specified in accordance with GOST 12.1.007.

7.8 When carrying out processes of surface preparation for repair anticorrosive works the requirements of GOST 12.3.016 shall be guided.

#### **7.9 Requirements for production areas**

7.9.1 Production areas where of article surface preparation shall be carried out, should have personal service premises, illumination, water drain according to normative documentation, and also ventilation, air conditioning and air heating in accordance with GOST 12.4.021.

In places of probable inflow of chemical substance vapors into working area air exhaust devices according to normative documentation shall be provided.

7.9.2 General sanitary-and-hygienic requirements for conditions of a microclimate and the permissible content of harmful substances in working area air in premise where surface preparation of metals shall be carried out are specified in accordance with GOST 12.1.005.

#### **7.10 Requirements for industrial equipment**

7.10.1 The general requirements to the equipment used for surface preparation shall be specified in accordance with GOST 12.2.003.

7.10.2 The construction of the industrial equipment should prevent from loads, capable to cause the destructions that may be dangerous for the attendants.

7.10.3 Operation of the industrial equipment should not lead to static-charge accumulation in dangerous amount. At operation of the industrial equipment with nonelectrical energy (for example, pneumatic, steam power) measures shall be provided for prevention from effect of steam, compressed air, etc.

7.10.4 The industrial equipment, whose operation is accompanied by evolving hazardous substances, should be equipped by devices for their removal, providing permissible concentrations of hazardous substances to working area, and also emissions of such substances in an environment, not exceeding corresponding norms. The control of working area air shall be conducted in accordance with GOST 12.1.016.

7.10.5 Degreasing of articles by the chlorinated hydrocarbons and emulsion compounds on base thereof shall be carried out under condition of complete mechanization and automation of technological process in special tight installations. Contact of integuments of attendants working with solvents is not permitted. Similar requirements extend for operations with removers whose mixture contains chlorinated and aliphatic solvents.

7.10.6 When using the abrasive tools the requirements of GOST 12.3.028 shall be guided.

7.10.7 Loading and return of shots into installations for shot cleaning and wet jet cleaning, supply and stopping of compressed air, sand and a pulp shall be carried out by mechanized ways.

7.10.8 Shot blasting, hydrosandblast and loading chambers should be equipped by interlocks of starting devices. When carrying out abrasive jet cleaning a working area shall be fenced to prevent from dust diffusion.

7.10.9 When operating all kinds of ultrasonic equipment attendants' close contact with working fluid, the ultrasonic tools and processed parts is not permitted.

7.10.10 Characteristics and permissible noise levels at workplaces, general requirements to protection against noise, noise characteristics of machines, mechanisms, vehicles, and also noise measurements shall be specified in accordance with GOST 12.1.003.

7.10.11 Protection against vibration influence shall be specified in accordance with GOST 12.1.012. Norms of vibration of machines should be established in the operational documentation for them and should be checked up by services concerned.

7.10.12 Supply of the working solutions, compressed air, thermal and electric power to the stationary equipment shall be carried out at maintenance of attendants with necessary protective gears.

#### **7.11 Requirements for storage and transportation**

7.11.1 Storage of chemical substances shall be carried out in the places equipped with racks and cases and supplied with stock, adaptations, individual protective gears necessary for work with harmful chemical substances.

7.11.2 Chemical substances shall be stored in the intact package in accordance with GOST 26319 with the complete set of the accompanying documentation issued when due hereunder. When operating industrial containers the requirements of GOST 12.3.010 shall be observed.

7.11.3 Filling of tanks, containers and other large vessels with deleterious substances and their emptying shall be carried out by mechanized ways.

7.11.4 Transportation of chemical substances shall be carried out in operable clean container. Transportation of large bottles with acids and liquid alkalis on special handcarts shall be carried by two persons at a speed not over 5 km/h.

7.11.5 Substances and mixtures shall be stored in the containers having marking in accordance with GOST 14192 and signs in accordance with GOST 19433.

7.11.6 Inflammable substances shall be stored at working area in minimum necessary amounts, but not over shift norm.

7.11.7 Handling operations shall be carried out by mechanized means in accordance with GOST 12.3.009.

#### **7.12 Requirements for the personnel**

7.12.1 Workers, experts and the heads providing surface preparation to painting, should be trained and examination according to GOST 12.0.004.

7.12.2 The persons not younger than 18 years, having passed preliminary medical inspection according to the current legislation shall be admitted to production processes of surface preparation.

#### **7.13 Requirements for utilization of attendants' individual protective gears**

7.13.1 attendants' individual protective gears (hereinafter IPG):

goggles: in accordance with GOST 12.4.013;

protective clothes for work with acids: in accordance with GOST 27652, GOST 27654;

protective clothes for work with alkalis: in accordance with GOST 27651, GOST 27653;

individual protection gears for respiratory organs:— in accordance with GOST 12.4.034, GOST 12.4.028, GOST 12.4.004;

gauntlets: in accordance with GOST 12.4.010;

individual protective gears for the face: in accordance with GOST 12.4.023;

dermatological protective gears: in accordance with GOST 12.4.068;

leather special footwear: in accordance with GOST 12.4.137;

rubber boots: in accordance with GOST 12265;

rubber gloves: in accordance with GOST 20010;

overalls: in accordance with GOST 12.4.131 and GOST 12.4.132;

coveralls: in accordance with GOST 12.4.099 and GOST 12.4.100;

aprons: in accordance with GOST 12.4.029;

filtering gas masks: in accordance with GOST 12.4.121.

7.13.2 At abrasive jet cleaning for protection of respiratory organs individual protective gears with the forced air feed.

7.13.3 Choice of IPG shall be carried out taking specified production factors into account and according to assortment of the overalls, special footwear, etc.

7.13.4 The persons having no IPG, appropriate to nature of production processes, are not permitted to be admitted for service.

7.13.5 Overalls shall be subject to dedusting and washing according to the instruction for its operation.

#### **7.14 Requirements for neutralization of production residue**

7.14.1 For decrease of production residue in production processes of surface preparation the closed low-waste technological schemes shall be applied.

7.14.2 Sewage from units of chemical surface preparation prior to dump in the city water drain system or reservoirs shall preliminary be diluted with potable water to appropriate maximum permissible concentration (hereinafter maximum concentration limit), established in normative documentation.

7.14.3 Neutralization of spent solutions shall be carried out by any of reasonable chemical or physical-chemical methods of sewage treatment to the appropriate maximum concentration limits established in normative documentation.

7.14.4 Maximum concentration limit of chemical substances when dumping in reservoirs shall be chosen according to effective sanitary norms.

7.14.15 Maximum concentration limit of polluting substances in atmospheric air of inhabited localities shall be chosen according to effective sanitary norms. The control of the content of maximum permissible emissions (hereinafter MPE) in atmosphere shall be chosen in accordance with GOST 17.2.3.02.

7.14.16 Recycling of waste shall be carried out according to procedure of accumulation, transportation, neutralization, and burial of toxic industrial wastes according to normative documentation, and also according to the sanitary norms which are not permitting excess of limiting amount of accumulation of toxic industrial wastes in the territory of the enterprise, and rules of preservation of the environment against production wastes.

When being absent the equipment or possibility for neutralization being unavailable industrial waste shall be transferred to the specialized enterprises or other enterprises having the licence for carrying out the given kind of operations.

**Appendix A**  
**(recommended)**

**Determination of total contamination of steel articles**

**A.1 Determination of total contamination of steel articles (in particular, car bodies)**

**A.1.1 Equipment, materials, reagents**

General purpose laboratory balance of not below 2nd class of accuracy with the maximal limit of weighing 200 g or other with similar technical and metrological characteristics.

The template made of pressboard, metal or plastic, with an opening in the size of 10 × 20 cm, in the area of 2 dm<sup>2</sup>.

Fabric cotton (calico, muslin, shirt, lawn, etc.), not keeping hairs on metal surface, in size of 10 × 10 cm, in the area of 1 dm<sup>2</sup>.

**A.1.2 Method of determination**

A.1.2.1 A fabric piece shall be weighed. Result of weighing  $M_1$ , g, is recorded to within the fourth decimal place.

A.1.2.2 The template shall be placed over the contaminated surface and the surface in the opening of template shall be carefully wiped with fabric piece, with trying to transfer the whole contamination on a fabric.

A.1.2.3 A fabric piece shall be weighed. Results of weighing  $M_2$ , g, is recorded to within the fourth decimal place.

**A.1.2.4 Processing of results**

Total contamination  $X_2$ , g/m<sup>2</sup>, is found using the following formula

$$X_2 = \frac{M_2 - M_1}{S} 100, \quad (\text{A.1})$$

where  $M_1$  stands for weight of pure fabric piece, g;

$M_2$  stands for weight of fabric piece with contamination, g;

$S$  stands for the area of the wiped surface, dm<sup>2</sup>.

Arithmetic-mean value of four parallel determinations, the admissible divergence between which should not exceed 10 % is taken as result of the analysis.

**A.2 Determination of the total contamination of steel in a delivery condition**

**A.2.1 Equipment, materials, reagents**

General purpose laboratory balance of not below 2nd class of accuracy with the maximal limit of weighing 200 g or other with similar technical and metrological characteristics.

Filtering paper in accordance with GOST 12026.

Steel samples in accordance with GOST 9045 in a condition of delivery in the size of 150 × 70 mm.

Solvent in accordance with GOST 8505 or GOST 3134.

Silica gel in accordance with GOST 3956, moisture of 2 %.

**A.2.2 Carrying out determination**

A.2.3 Samples shall be weighed. Result of weighing  $M_1$ , g, is recorded to the fourth decimal place.

A.2.4 Samples shall be wiped three times with a solvent, each time changing rags, dried during 20 min in air in vertical position, and then in dessicator during 20 min and weighed. Result of weighing  $M_2$ , g, is recorded to within the fourth decimal place.

**A.2.5 Processing of results**

Total contamination of steel  $X$ , g/m<sup>2</sup>, is found using the following formula

$$X = \frac{M_1 - M_2}{S}, \quad (\text{A.2})$$

where  $M_1$  stands for weight of the sample with contamination in a delivery condition, g;

$M_2$  stands for weight of the sample after degreasing by solvent, g;

$S$  stands for the area of the sample, m<sup>2</sup>.

The arithmetic-mean value of four parallel determinations, admissible difference between which should not exceed ±0.14/m<sup>2</sup>, is taken as the result of the analysis.

**Appendix B  
(informative)**

**Methods of removal of contamination**

Table B.1

Substance to be removed	Method of contamination removal	Recommendations
Grease and oil	<p>Degreasing: with water</p> <p>by steam-ejecting method</p> <p>by emulsion compounds</p> <p>by water CA solutions</p> <p>by organic solvents</p>	<p>Potable water with addition of surface-active agents is recommended to be used. Pressure over 70 MPa may be used. After degreasing to wash out a surface with potable water</p> <p>Potable water is recommended to be used. If surface-active substances are added to water, after degreasing to wash out the surface with potable water.</p> <p>After degreasing to wash out a surface with potable water</p> <p>Same</p> <p>If at cleaning manual rubbing by rags is used, frequent changing is necessary, or else after evaporation of solvent oil and grease remain on a surface</p>
Water-soluble contaminants, for example salts	<p>Removal with water</p> <p>Steam-ejecting treatment</p> <p>Removal with alkaline CA solutions</p>	<p>Potable water is recommended to be used. Pressure over 70 MPa may be used.</p> <p>After steam-ejecting treatment to wash out a surface with potable water</p> <p>After treatment washing out surface with potable water is recommended, because aluminum, zinc and some other types of metal surfaces can be exposed to corrosion if the concentrated alkaline solutions are used</p>
Scale	<p>Etching</p> <p>Dry abrasive jet cleaning</p> <p>Damp abrasive jet cleaning</p> <p>Gas-flame cleaning</p>	<p>After etching to wash out a surface with potable water</p> <p>If necessary to remove the dust residue and friable adjournment by blowing with dry compressed air containing no oil by suction or by means of vacuum</p> <p>After cleaning to wash out a surface with potable water</p> <p>For removal from a surface of the articles remained after burning out mechanical cleaning with the subsequent removal of dust and friable adjournment can be required</p>
Rust	<p>Etching</p> <p>Dry abrasive jet cleaning</p> <p>Damp abrasive jet cleaning</p> <p>Flame cleaning</p> <p>Cleaning by the mechanized tool</p> <p>Water jet cleaning</p> <p>Spot jet cleaning</p>	<p>After etching to wash out a surface with potable water</p> <p>If necessary to remove the dust residue or friable adjournment by blowing with dry compressed air not containing oil by suction or by means of vacuum</p> <p>After cleaning to wash out a surface with potable water</p> <p>For removal of the products, remained after burning out, from a surface mechanical cleaning with the subsequent removal of dust and friable adjournment can be required</p> <p>Mechanical brushes may be used for cleaning of places with friable rust. In case of strongly stuck rust the polishing is permissible. The rests of dust and friable adjournment shall be removed.</p> <p>For removal of friable rust is used. No influence on a profile of steel surface is exerted</p> <p>For local removal of rust is used</p>

Table B1, conclud.

Substance to be removed	Method of contamination removal	Recommendations
Paintwork coatings	Hand treatment of surface by rags	The removers (pastes) based on solvents for the coatings sensitive to organic solvents are recommended to be used. Residual remover should be removed by washing of surface with solvent. For saponifiable coatings alkaline pastes are recommended to be used. After treatment a surface shall be fully be washed out with potable water. Small areas of surface are subject to wiping
	Dry abrasive jet cleaning	Residual dust and friable adjournment can be removed by blowing away with dry compressed air containing no oil or by means of vacuum
	Wet abrasive jet cleaning	For removal of a paintwork coating with poor adhesion. In case of strongly stuck coatings cleaning under ultrahigh pressure over 170 MPa is used. After cleaning to wash out a surface with potable water
	Local jet cleaning	It is used for local removal of coatings
Corrosion products of zinc	Jet cleaning with sweeping	Jet cleaning of zinc with sweeping may be carried out with aid of aluminum oxide (corundum), silicates or stone crumbs.
	Removal by alkaline water solutions CA	For removal of local stains of corrosion of zinc it is permissible to use 5 % (by weight) ammonia solution in a combination with the synthetic tampon bearing abrasives. Alkaline cleaners may be used for larger areas. At high values pH zinc is sensitive to corrosion
Note — At washing and drying of the structures having grooves and rivets, they shall be treated with extra care.		

### Appendix C (recommended)

#### Mixtures and modes of technological solutions of chemical surface preparation

##### C.1 Mixtures and degreasing modes

C.1.1 When degreasing by alkaline CA solutions ready to use shall be used.

C.1.2 Technological parameters of degreasing of various materials with commercial washing agents are listed in table C.1.

Table C.1

Material	Method of treatment	Technological parameter				
		Mass concentration on CA, kg/m <sup>3</sup>	Alcalinity, points	Pressure of liquid, MPa (kgf/cm <sup>2</sup> )	Temperature, °C	Duration of treatment, minutes
Rolled steel, steel and pig-iron moldings	Submersion	15 to 30	9 to 35	to	50 to 70	5 to 20
	Dispersion	5 to 15	3 to 16	0.08 to 0.2 (0.8 to 2.0)	50 to 65	1 to 5
Aluminum, aluminum alloys, zinc alloys	Submersion	10 to 20	8 to 20	—	50 to 60	5 to 15
	Dispersion	5 to 15	3 to 16	0.08 to 0.2 (0.8 to 2.0)	50 to 60	1 to 5

Table C.1, concluded

Material	Method of treatment	Technological parameter				
		Mass concentration on CA, kg/m <sup>3</sup>	Alcalinity, points	Pressure of a liquid, MPa (kgf/cm <sup>2</sup> )	Temperature, °C	Duration of treatment, minutes
Copper and alloys thereof, silver, nickel, covar, invar, superinvar, titan and alloys thereof	Submersion	20 to 40	20 to 40	—	60 to 80	3 to 15
	Dispersion	5 to 15	3 to 15	0.08 to 0.2 (0.8 to 2.0)	40 to 60	1 to 5
Magnesium alloys	Submersion	15 to 50	10 to 55	—	70 to 80	3 to 15
Sized or painted surfaces	Dispersion	4 to 10	2 to 5	0.08 to 0.2 (0.8 to 2.0)	30 to 60	1 to 5
	Submersion	10 to 20	9 to 22	—	30 to 60	5 to 20

C.1.3 Washing solutions shall be prepared with the water in compliance with requirements of table D.1 (Appendix D).

C.1.4 Mixtures for surface preparation of large-sized articles are listed in table C.2.

Table C.2

Material of article to be treated	Method of treatment	Solution structure		Mode of treatment		
		Components	Mass concentration, kg/m <sup>3</sup>	Temperature, °C	Pressure of liquid, MPa (kgf/cm <sup>2</sup> )	Duration, minutes
All metals and alloys	Submersion, rubbing by brushes or rags	Orthophosphoric acid in accordance with GOST 6552 or GOST in 10678 density of 1740 kg/m <sup>3</sup> Surface active agent	15 to 30	20 to 40	—	5 to 15
			0.5 to 10			
	Dispersion	Orthophosphoric acid in accordance with GOST 6552 or GOST in 10678 density of 1740 kg/m <sup>3</sup> Surface active agent	15 to 30	20 to 40	0.2 to 0.4 (2 to 4)	1 to 5
			0.3 to 1			

C.1.5 As surface active agents nonionic (synthanol, neonols etc.), anionic (linear alkyl sulfates, alkylaryl sulfates and linear sulfonates) and other biologically decomposable surface active agents are applied.

C.1.6 Necessity of replacement of alkaline solutions shall be found experimentally by deterioration in quality of degreasing. Spent degreasing solution shall completely be replaced after use up expending for correction of half of initial amount of a washing agent.

## C.2 Structures of solutions and etching conditions

C.2.1 Structures of solutions and etching conditions are listed in table C.3.

Table C.3. Structures of solutions and modes of etching of ferrous and nonferrous metals

Material or characteristic of article	Solution structure			Etching conditions				
	Component	Mass concentration, kg/m <sup>3</sup> , when treating		Submersion		Dispersion		
		Submersion	Dispersion	Temperature, °C	Duration, minutes	Temperature, °C	Pressure of liquid, MPa (kgf/cm <sup>2</sup> )	Duration, minutes
Articles from 1st and 2nd groups of metals	Sulfuric acid in accordance with GOST 2184 or GOST 4204 Inhibitor (katapin, ПБ-6, XOCII-10 and other)	200 to 250	50 to 100	60 to 80	10 to 30	60 to 80	0.1 to 0.2 (1.0 to 2.0)	3 to 5
		1 to 5	5 to 10					
Articles from 1st and 2nd groups Metals	Hydrochloric acid in accordance with GOST 857 Sulfuric acid in accordance with GOST 2184 or GOST 4204 Inhibitor (katapin, ПБ-6, XOCII-10 and other)	30 to 50	—	15 to 35	3 to 30	—	—	—
		175 to 200						
		1 to 5						
	Hydrochloric acid in accordance with GOST 857 Inhibitor (katapin, ПБ-6, XOCII-10 and other)	200 to 250	50 to 100	15 to 35	10 to 30	15 to 35	0.1 to 0.2 (0.1 to 2.0)	2 to 3
		1 to 5	5 to 10					
	Sulfuric acid in accordance with GOST 2184 or GOST 4204 Sodium chloride in accordance with GOST 4233	120 to 170	—	65 to 85	6 to 8	—	—	—
		140 to 180						
Sulfuric acid in accordance with GOST 2184 or GOST 4202 Sodium chloride in accordance with GOST 4233 Additive ЧМ	125 to 200	—	15 to 35	50 to 60	—	—	—	
	30							
	1 to 2							
Articles made of steel, having welds, pig-iron molding	Orthophosphoric acid in accordance with GOST 6552 or GOST 10678 Mixture 1120*	100 to 150	50 to 100	70 to 80	20 to 60	60 to 80	0.1 to 0.2 (1.0 to 2.0)	5 to 8
		100 to 150	—	15 to 40	20 to 60	—	—	—



Table C.3, continued

Material or characteristic of article	Solution structure			Etching conditions				
	Component	Mass concentration, kg/m <sup>3</sup> , when treating		Submersion		Dispersion		
		Submersion	Dispersion	Temperature, °C	Duration, minutes	Temperature, °C	Pressure of liquid, MPa (kgf/cm <sup>2</sup> )	Duration, minutes
Articles from 3rd group of metals	Hydrochloric acid in accordance with GOST 857 Nitric acid in accordance with GOST 701 or GOST 4461 Ironic chloride in accordance with GOST 4147	200 to 300	—	15 to 35	30	—	—	—
		50 to 100						
		20 to 120						
	Sulfuric acid in accordance with GOST 2184 or GOST 4204 Nitric acid in accordance with GOST 701 or GOST 4461 Hydrofluoric acid in accordance with GOST 2567	80 to 110	—	15 to 35	10 to 60	—	—	—
		100 to 200						
		15 to 50						
Articles from 3rd group of metals	Nitric acid in accordance with GOST 701 or GOST 4461 Hydrofluoric acid in accordance with GOST 2567	350 to 400	—	15 to 35	10 to 20	—	—	—
		15 to 25						
	Hydrochloric acid in accordance with GOST 857 Urotropin in accordance with GOST 1381	100 to 250	—	15 to 35	10 to 30	—	—	—
		10 to 20						
	Hydrochloric acid in accordance with GOST 857 Sulfuric acid in accordance with GOST 2184 or GOST 4204 Inhibitor KC	100 to 250	—	15 to 35	5 to 20	—	—	—
		300 to 400						
2 to 3								

Table C.3, continued

Material or characteristic of article	Solution structure			Etching conditions				
	Component	Mass concentration, kg/m <sup>3</sup> , when treating		Submersion		Dispersion		
		Submersion	Dispersion	Temperature, °C	Duration, minutes	Temperature, °C	Pressure of liquid, MPa (kgf/cm <sup>2</sup> )	Duration, minutes
	Hydrochloric acid in accordance with GOST 857	300 to 600	—	15 to 35	5 to 10	—	—	—
	Nitric acid in accordance with GOST 701 or	80 to 100						
Aluminum and aluminum alloys	Caustic soda in accordance with GOST 2263	40 to 60	—	45 to 60	Not over 2	—	—	—
	Caustic soda in accordance with GOST 2263	10 to 15	—	40 to 55	Not over 2	—	—	—
	Sodium nitrite in accordance with GOST 4197	5 to 10						
	Soda ash in accordance with GOST 5100	12 to 15						
Caustic soda in accordance with GOST 2263	20 to 35	—	40 to 55	Not over 2	—	—	—	
	Soda ash in accordance with GOST 5100							20 to 30
High-silica aluminum alloys	Nitric acid in accordance with GOST 701 or GOST 4461	230 to 280	—	13 to 35	5 to 20	—	—	—
	Hydrofluoric acid in accordance with GOST 2567	7 to 10						
	Nitric acid in accordance with GOST 701 or GOST 4461	40 to 52	—	15 to 40	1 to 3	—	—	—
Hydrofluoric acid in accordance with GOST 2567	130 to 140							

Table C.3, continued

Material or characteristic of article	Solution structure			Etching condition				
	Component	Mass concentration, kg/m <sup>3</sup> , when treating		Submersion		Dispersion		
		Submersion	Dispersion	Temperature, °C	Duration, minutes	Temperature, °C	Pressure of a liquid, MPa (kgf/cm <sup>2</sup> )	Duration, minutes
High-silica aluminum alloys	Nitric acid in accordance with GOST 701 or GOST 4461	660 to 680	—	—	Not over 3	—	—	—
	Hydrofluoric acid in accordance with GOST 2567	120 to 140	—	—		—	—	—
Copper and alloys thereof	Sulfuric acid in accordance with GOST 2184 or GOST 4204	180 to 200	—	15 to 35	1 to 20	—	—	—
	Sulfuric acid in accordance with GOST 2184 or GOST 4204	8 to 12	—	15 to 35	2 to 30	—	—	—
	Ironic sulfate (III) in accordance with GOST 9485	90 to 110	—					
Copper and its alloys with strong oxidised surface and beryllium bronzes	Caustic soda in accordance with GOST 2263	400 to 600	—	136 to 145	2 to 30	—	—	—
	Sodium nitrite in accordance with GOST 4197	200 to 250	—					
Superinvar invar, covar without scales	Hydrochloric acid in accordance with GOST 857	400	—	60 to 80	0.1 to 0.3	—	—	—
	Sulfuric acid in accordance with GOST 2185 or GOST 4204	200	—					
	Hydrochloric acid in accordance with GOST 857	1000	—	15 to 25	1 to 2	—	—	—
	Hydrochloric acid in accordance with GOST 857	1000	—	60 to 80	20 to 60	—	—	—
	Formalin in accordance with GOST 1625	50	—					
Covar, invar, superinvar with firm scale layer	Hydrochloric acid in accordance with GOST 857	1000	—	40 to 50	10 to 15	—	—	—
	Urotropin in accordance with GOST 1381	40 to 50	—					

Table C.3, concluded

Material or characteristic of article	Solution structure			Etching condition				
	Component	Mass concentration, kg/m <sup>3</sup> , when treating		Submersion		Dispersion		
		Submersion	Dispersion	Temperature, °C	Duration, minutes	Temperature, °C	Pressure of a liquid, MPa (kgf/cm <sup>2</sup> )	Duration, minutes
	Hydrochloric acid in accordance with GOST 857	1000	—	60 to 80	20 to 60	—	—	—
	Formalin in accordance with GOST 1625	50						
	Hydrochloric acid in accordance with GOST 857	400	—	15 to 35	15 to 30	—	—	—
	Sulfuric acid in accordance with GOST 2184 or GOST 4204	200						
Permalloy	Hydrochloric acid in accordance with GOST 857	150	—	15 to 35	15 to 30	—	—	—
	Nitric acid in accordance with GOST 701 or GOST 4461	750						
	Sulfuric acid in accordance with GOST 2184 or GOST 4204	1000						
Nickel, Monel metal	Sulfuric acid in accordance with GOST 2184 or GOST 4204	500	—	15 to 35	2 to 3 times by 2 to 3 sec with intermediate washing with water	—	—	—
	Nitric acid in accordance with GOST 701 or GOST 4461	5000						
	Sodium chloride in accordance with GOST 4233	5 to 10						

\* Mixture 1120 may be applied on surface by brush or a surface may be wiped with rags moistened with this mixture.

C.3 Structures of etching and passivating pastes are listed in table C.4.

Table C.4 — Structures of etching and passivating pastes

Component	Weight, kg
<b>Etching paste</b>	
Water in accordance with GOST 2874	170
Inhibitor (ИБ-5, katapin, XOCII-10, etc.)	5
Petrov's contact	5
Sulfuric acid in density of 1840 kg/m <sup>3</sup> in accordance with GOST 2184 or GOST 4204	77
Orthophosphoric acid in density of 1700 kg/m <sup>3</sup> in accordance with GOST 6552 or GOST 10678	24
Hydrochloric acid in density of 1190 kg/m <sup>3</sup> in accordance with GOST 657	213
Sulfite-cellulose liquor	146
Diatomite	360
<b>Passivating paste</b>	
Water in accordance with GOST 2874	492
Sulfite-cellulose liquor	96
Sodium hydroxide in accordance with GOST 2263	9
Potassium (sodium) bichromate in accordance with GOST 4220	23
Diatomite	380
Note — Prepared for use mixtures according to normative documentation thereof may be used.	

C.4 Mixtures for simultaneous degreasing and etching and treatment modes are listed in table C.5.

Table C.5 — Mixtures for simultaneous degreasing and etching and treatment modes

Material or characteristic of article	Solution			Mode of treatment				
	Structure	Mass concentrations, kg/m <sup>3</sup>	When treating		Submersion		Dispersion	
		Submersion	Dispersion	Temperature, °C	Duration, minutes	Temperature, °C	Pressure of a liquid, MPa, (kgf/cm <sup>2</sup> )	Duration, minutes
Rolled steel and steel moulding	Sulfuric acid in accordance with GOST 2184 or GOST 4204	200 to 250	50 to 100	60 to 70	5 to 15	50 to 60	0.08 to 0.20 (0.08 to 2.0)	3 to 5
	Surface active agent (anionic and-or nonionic)	2 to 5	0.5 to 1.0					
	Orthophosphoric acid in accordance with GOST 2184 or GOST 4204	20 to 30	20 to 30	50 to 60	10 to 30	50 to 60	0.08 to 0.2 (0.8 to 2.0)	3 to 5
	Surface active agent (anionic and-or nonionic)	2 to 5	0.5 to 1.0					
Steel articles, having welds, cast-iron moldings	Orthophosphoric acid in accordance with GOST 6552 or GOST 10678	150 to 200	50 to 100	70 to 80	5 to 15	60 to 70	0.08 to 0.2 (0.08 to 2.0)	3 to 5
	Surface active agent (anionic and-or nonionic)	2 to 5	0.5 to 1.0					

C.5 Modes of metal article treatment in solutions of activators are listed in table C.6.

Table C.6 — Modes of metal article treatment in solutions of activators

Material or characteristic of article	Mixture	Method of treatment	Value of exponent pH	Mass concentration, kg/m <sup>3</sup>	Mode of treatment		
					Temperature, °C	Pressure of liquid, MPa (kgf/cm <sup>2</sup> )	Duration, minutes
Articles from 1st and 2nd groups of metals	АФ-4, АП-4 АФ-1	Dispersion	8 to 10	0.5 to 3.0	20 to 40	0.1 to 0.2 (1.0 to 2.0)	Not less than 0.5
			7.2 to 9.0	0.4 to 3.0			
	АФ-4, АП-4 АФ-1	Submersion	8 to 10	0.5 to 3.0	20 to 40	—	Not less than 1
7.2 to 7.8			0.4 to 3.0				
АФ-4, АП-4 in fat-free solution АФ-1 in degreasing solution	Dispersion	—	—	0.5 to 3.0	40 to 70	0.1 to 0.2 (1.0 to 2.0)	According to normative documentation
				0.4 to 0.5			
Springs, articles with carburized and nitrated surfaces	Hydrochloric acid in accordance with GOST 857 Urotropin in accordance with GOST 1381	Submersion	—	50—100	15 to 35	—	1.0 to 2.0
				40 to 50			

C.6 Passivating mixtures and technological modes of treatment are listed in table C.7

Table C.7 — Passivating mixtures and technological modes of treatment

Article characteristic	Passivating solution	Mass concentration, kg/m <sup>3</sup> , when treating		Mode of treatment			
				Submersion		Dispersion	
		by submersion	by dispersion	Temperature, °C	Duration, minutes	Temperature, °C	Duration, minutes
Articles from of 1st group metals for interoperational treatment	Sodium nitrite in accordance with GOST 4197	4 to 5	1 to 2	50 to 60	1 to 2	45 to 50	1 to 2
	Mono - or triethanolamine	5 to 10	3 to 5	40 to 60	2 to 3	40 to 60	1 to 2
	The substances containing hexavalent chrome converted to chromic anhydride	0.1 to 0.2	0.1 to 0.2	40 to 50	0.5 to 1.0	40 to 50	0.5 to 1.0

Notes 1 The passivation by sodium nitrite and mono-or triethanolamine shall be used only for interoperational protection with obligatory washing of surface with potable water prior to painting.  
 2 When treating by method of dispersion pressure of liquid should be 0.08 to 0.2 MPa (0.8 to 2.0 kgf/cm<sup>2</sup>).  
 3 The passivation of phosphatic coating prior to painting by electrodeposition method may not be carried out, and replaced by washing with demineralized or distilled water.

C.7 Example of structure of alkaline solution used for removal of paintwork coating is given in table C.8.

Table C.8 — Structure of alkaline solution for removal of paintwork coating

Solution structure	Mass concentration, kg/m <sup>3</sup>	Temperature, °C
Sodium hydroxide in accordance with GOST 2263 or GOST 11078	100 to 300	70 to 95
Sodium carbonate in accordance with GOST 5100	50 to 100	
Sodium silicate in accordance with GOST 13078	10 to 20	

Botop Steel

**Appendix D**  
**(obligatory)**

**Requirements for quality of the source water used for preparation of technological solutions**

Requirements to quality of the source water used for preparation of various technological solutions, are listed in table D.1.

Table D.1

Technological stage	Source water
Degreasing, etching	Potable water in accordance with GOST 2874, 2nd category in accordance with GOST 9.314, condensate
Activation, phosphating, chromating, passivation	Distilled water in accordance with GOST 6709, 3rd category in accordance with GOST 9.314
Washings between technological stages and initial stages of washing prior to painting	Potable water in accordance with GOST 2874, 2nd category in accordance with GOST 9.314, condensate
<p>Note — If is necessary to increase physicochemical and protective properties of paintwork coatings to be applied the water hardness and the contents of salts of iron, chlorides, sulphates, and solid residue in source potable water and in water of 2nd category shall be decreased.</p>	

**Appendix E**  
**(recommended)**

**Control and correcting of the mixtures used for surface preparation**

**E.1 Control and correcting of alkaline water degreasing solutions**

E.1.1 Total alkalinity of degreasing solutions shall be found by titration using mixture of indicators bromocresol green and methyl orange solutions of hydrochloric acid of molar concentration  $\text{HCl } c$ , equal to  $0.1 \text{ mol/dm}^3$ . In this case by spent volume of hydrochloric acid,  $\text{cm}^3$ , alkalinity in conventional units — points is determined.

E.1.2 Correcting of alkaline solutions shall be carried out by 10 % solution of washing agent or directly by dry washing composition at decrease of alkalinity by 3 to 6 points when treating by submersion and by 2 to 3 points when treating by dispersion.

E.1.3 In case of formation of a considerable quantity of foam as defoaming agent synthetic primary alcohols of fraction  $C_{10} — C_{13}$ ,  $C_{12} — C_{14}$   $0.4 \text{ kg/m}^3$ , white spirit  $0.1$  to  $0.4 \text{ kg/m}^3$ , tributyl phosphate  $0.1 \text{ kg/m}^3$ , etc.

E.1.4 Prior to painting no silicones or mixtures on their basis shall be used as defoaming agent. Especially it concerns priming by method of electrodeposition or drawing of water paint and varnish materials on metals.

**E.2 Control and correcting of activating solutions**

E.2.1 Control of activating solutions on the basis of titanate activators of AФ-1, AФ-4, АП-4 types prior to phosphating operation shall be carried out according to normative documentation for phosphating process used.

If the activator according to technological process shall be added into the second degreasing bath its control shall not be carried out.

If the activator according to technological process shall be added into washing vessel prior to phosphating operation the control of an activating solution shall be carried out in accordance with the analysis of the total alkalinity and pH.

E.2.2 Method of determination of the total alkalinity of activating solution shall be carried out according to E.1.1.

**E.2.3 Determination of pH**

Determination of pH shall be carried out with aid of laboratory pH-meter of any construction according to normative documentation for it.

**E.2.4 Correcting with aid of activating mixture**



At bringing solutions of activators of АФ-1, АФ-4, АП-4 types in alkaline degreasing solution correcting of solution shall be carried out simultaneously with correcting of solution of commercial washing liquid, on the base that a parity between the CA content in solution and the activator makes 1.0:0.1 accordingly. Correcting of degreasing solution shall be carried out at decreasing in the total alkalinity by 3 points.

Correcting of a degreasing solution with aid of solutions of activators of АФ-4 type shall be carried out simultaneously with correcting of CA solution as follows: 0.33 m<sup>3</sup> of concentrated 3 %-th solution of activators of АФ-1, АФ-4 or АП-4 types are brought in every 1 m<sup>3</sup> of concentrated 10 % CA solutions. Besides, every day prior to the work is begun the concentrated 3 %-s' solution of the activator in amount of 10 % of initial value are added to degreasing solution.

E.2.5 Correcting by solutions of activators of АФ-1, АФ-4, АП-4 types when bringing in washing water shall be carried out by initial mixtures АФ-1, АФ-4, АП-4, accordingly, on the base of computation, that bringing of structure АФ-1 of 0.45 kg and 0.60 kg of structure АФ-4 or АП-4 in 1 m<sup>3</sup> a working solution raises its alkalinity by 1 point.

E.2.6 Because solutions of activators of АФ-1, АФ-4, АП-4 types are susceptible to coagulation, every day after the work is terminated 10 % of activating solution shall be poured off and prior to the work is started solution volume shall be added by just made activating solution.

E.2.7 Replacement of activating solution shall be carried out at deterioration of phosphatic coating (increase in the crystal size and weight of a coating per unit area), but at least once every two weeks.

### E.3 Control of phosphating quality

E.3.1 Types of ferrous metals of groups 1 to 3 and characteristics of their phosphating ability are listed in table E.1.

Table E.1

Metal group	Metal type	The characteristic phosphating ability
1	Ordinary carbonaceous steels in accordance with GOST 380, light-gage low-carbon steel in accordance with GOST 9045, strengthened rolled steel in accordance with GOST 19281, rolled steel for construction in accordance with GOST 27772, rolled sheet from carbonaceous steel, high and ordinary quality in accordance with GOST 16523	May be phosphated
2	strengthened rolled steel (low-alloy steels) in accordance with GOST 9281, grey cast iron	May be phosphated
3	High-alloy steels and corrosion-resistant, heat resistant and high-temperature alloys in accordance with GOST 5632 and GOST 20072	May not be phosphated
<p><b>Notes</b></p> <p>1 Articles made of hot rolled metal shall be phosphated after scale removal.</p> <p>2 Experimental selection of modes of treatment is required for phosphating metals of group 2.</p> <p>3 Iron-phosphate coating shall be used for articles made of metals of group 1.</p> <p>4 Phosphating of high-strength steels shall be carried out in the solutions used under standard documents for them.</p> <p>5 To obtain electrodeposited paintwork coatings with high protective characteristics carbonaceous steel of types 08, 08кп, 08Ю shall be used, where the amount of carbonaceous contamination on surface does not exceed 7 mg/m<sup>2</sup>.</p>		

### E.3.2 Control and correcting of phosphatizing solutions

E.3.2.1 Correcting of phosphatizing solutions shall be carried out by means of a correcting concentrate and oxidizer solution if sodium nitrite is used as an oxidizer. When phosphating aluminum or hot galvanized steel the correction may be carried out with aid of fluoride solutions.

E.3.2.2 To correct working phosphatizing solution correcting phosphatizing concentrate shall be used; it is measured out continuously into working solution via dispensing pump or periodically by hand. Periodic dispensing is permissible at partial loading as to productivity of phosphating bath.

Speed of delivery of phosphatizing concentrate  $v$ , dm<sup>3</sup>/h, is found using the formula

$$v = P \cdot S \quad (E.1)$$

where  $R$  stands for the consumption of correcting concentrate, dm<sup>3</sup>/m<sup>2</sup>;

$S$  stands for the area of the articles treated for a period of one hour, m<sup>2</sup>.

**Note.** It should bear in mind that with no correcting of working phosphatizing solution by correcting phosphatizing concentrate 0.15 to 0.2 m<sup>2</sup> of surface area can be treated in 1 dm<sup>3</sup> phosphatizing solution under condition of maintenance of coating quality. The concentration of sodium nitrite in phosphatizing solution should be constant; it is dependent on the grade of phosphatizing concentrate and technological parameters of phosphating process. Replenishment by sodium nitrite shall be made in the form of 5 % to 20 %- water solution.

E.3.2.3 Correcting with phosphatizing concentrate by hand shall be carried out while changing the following indicators: mass cation concentration, total and free acidity in conformity to requirements of the technological instruction for utilization of phosphatizing concentrate.

**Note** — Free acidity shall be found by titration of 10 cm<sup>3</sup> of working phosphatizing solution with sodium hydroxide solution in molar concentration of NaOH *c*, equal to 0.1 mol/dm<sup>3</sup> with the methyl orange indicator; the total acidity shall be found with the phenolphthalein as indicator. In this case acidity is determined in conventional units — points by the spent volume of sodium hydroxide in cubic centimetres.

### E.3.3 Determination of weight of phosphatic coating falling to surface unit area

The method is applicable for:

- phosphatic coatings on iron and steel;
- phosphatic coatings on zinc and cadmium;
- phosphatic coatings on aluminum and its alloys.

The method is used only for phosphatic coatings which contain no additional layers, for example oil, polymers on water base or on solvents, and also wax.

Gravimetric method does not find out presence of places where the phosphatic coating have not been formed, or the spots whose thickness is less than the minimum value established for areas to be measured. Besides, the particular value obtained on each area to be measured, is appropriate to average thickness of this area.

#### E.3.3.1 Equipment used

The beakers made of glass or other material where phosphatic coatings may be dissolved.

General purpose laboratory balance of not below 2nd class of accuracy with the maximum limit of weighing 200 g or other, being of similar technical and metrological characteristics.

#### E.3.3.2 Requirements for samples of metal

Samples should have the maximum weight 200 g and total surface, sufficient for measuring a loss of weight with sufficient accuracy in conformity to the requirements for materials or articles. To provide sufficient measurement accuracy the total surface should comply with the requirements listed in table E.2.

**Table E.2** — Correlation of the sample area and the required weight of coating per unit surface

Weight of coating per unit surface, g/m <sup>2</sup>	Minimum total sample area, cm <sup>2</sup>
Less than 1	400
1 to 10	200
10 to 25	100
25 to 50	50
Over 50	26

E.3.3.3 The sampling method should comply with requirements of normative documentation for an article.

#### E.3.3.4 Means and methods for removal of coatings

To prepare solutions reagents of qualification “chemically pure” or “analytically pure” and the distilled water or water of identical purity may be used.

#### E.3.3.5 Method of removal of phosphatic coatings from iron and steel

Removal method of manganese-phosphatic coatings

For removal of manganese-phosphatic coatings the water solution containing 50 g of chromic anhydride (VI) shall be used.

The dried sample with phosphatic coating in area *S*, m<sup>2</sup>, is weighed. Result *m*<sub>1</sub>, g, is recorded to within the fourth decimal place. Then the sample is submerged into solution for a period of 15 minutes to remove coating; temperature of solution is maintained equal to 75 °C (± 5°C). After sample is removed from solution it should immediately be washed in flowing potable water, and then in distilled water, quickly dried up and again weighed. Operation is repeated until the constant weight *m*<sub>2</sub>, g is obtained

For each sample just made solution should be used.

Removal method of zink-phosphatic coatings

Solutions for coating removal:

Solution A: water solution containing: caustic soda 100 g, (ethylenediaminetetraacetic acid — tetrasodium salt dihydrate): 90 g and triethanolamine: 4 g in 1 dm<sup>3</sup> of solution;

Solution B: solution containing 50 g/dm<sup>3</sup> of chromic anhydride (VI).

Dried sample with phosphatic coating in area  $S$ , m<sup>2</sup>, shall be weighed at analytical balance. The result of weighing  $m_1$ , g, is recorded to within the fourth decimal place. Then the sample shall be submerged in solution A, whose temperature is maintained equal to 75 °C (± 5°C), for a period of 5 minutes to remove coating, or in solution B at the same temperature for a period of 1.5 to 2.0 minutes. After the sample is drawn out of solution it shall immediately be washed in flowing potable water, and then in the distilled water, quickly dried and again weighed. Operation shall be repeated until constant weight  $m_2$ , g is obtained.

For each sample just made solution shall be used.

Method of removal of iron-phosphatic coatings

The water solution containing 50 g/dm<sup>3</sup> of chromic anhydride (VI) CrO<sub>3</sub>.

The dried sample with phosphatic coating in area  $S$ , m<sup>2</sup>, shall be weighed at analytical balance. The result of weighing  $m_1$ , g, is recorded to within fourth decimal place. Then the sample is submerged in a solution, whose temperature is maintained equal to 75 °C (± 5 °C), to remove coating. After taking the sample out of solution it shall immediately be washed out in pure flowing water, and then in the distilled water, quickly dried and again weighed. Operation is repeated until the constant weight  $m_2$ , is obtained.

For each sample a just made solution shall be used.

E.3.3.6 The method of removal of phosphatic coatings from zinc and cadmium

The solution, containing 20 g of ammonium bichromate per 1 dm<sup>3</sup> of 25 % to 30 % solution of ammonia. When preparing the solution temperature should be not over 25 °C.

The dried sample with phosphatic coating in area  $S$ , m<sup>2</sup>, is weighed at analytical balance. The result of weighing  $m_1$ , g, is recorded to within the fourth decimal place. Then the sample is submerged into a solution, whose temperature is not above 25 °C, for a period of 3 to 5 minutes to remove coating. This operation shall be carried out at operating exhaust ventilation. After extraction of the sample from solution it shall immediately be washed out in flowing potable water, and then in the distilled water, quickly dried, again weighed and its weight  $m_2$  determined.

For each sample the just made solution shall be used.

E.3.3.7 The method of removal of crystal phosphatic coatings from aluminum and alloys thereof

Solution for coating removal: nitric acid in mass fraction of the basic substance of 65 % to 70%.

The dried sample with phosphatic coating in area  $S$ , m<sup>2</sup>, is weighed at analytical balance. The result of weighing  $m_1$ , g, is recorded to within the fourth decimal place. Then the sample shall be submerged for 5 minutes into solution for coating removal; whose temperature is maintained equal to 75 °C (± 5°C), or for 15 minutes into the same solution at a temperature of 25 °C (± 5°C). After extraction of the sample from a solution it shall at once be washed in flowing potable water, and then in the distilled water, quickly dried and again weighed. Operation is repeated until the constant weight  $m_2$ , is obtained.

For each sample the just made solution shall be used.

E.3.3.8 Registration of results

Weight per unit area  $m_s$ , g/m<sup>2</sup>, is found using the formula

$$m_s = \frac{m_1 - m_2}{S}, \quad (\text{E.2})$$

where  $m_1$  stands for weight of the sample with coating, g;

$m_2$  stands for weight of the sample after coating has been removed, g;

$S$  stands for the area of coating of the sample, m<sup>2</sup>.

The arithmetic-mean value of three determinations, the admissible difference between which does not exceed 0.05 g/m<sup>2</sup> at confidence probability  $P = 0.95$  is taken as the result of the analysis

#### E.4 Preparation, control and correcting of passivating solutions

E.4.1 Demineralized water with specific conductivity not over 20 μS/cm in accordance with GOST 6709 shall be used in order to prepare passivating solutions on the base of chromic anhydride and the basic chromic bichromate.

E.4.2 For preparation of passivating solutions on the base of potable water alkalinity of water shall be reduced by 2 points by adding 45 %-solutions of formic acid. Addition of 10 cm<sup>3</sup> of formic acid solution in 100 cm<sup>3</sup> of water reduces alkalinity by 1 point.

E.4.3 Determination of total alkalinity shall be carried out according to E.1.1.

E.4.4 At the control of passivating solutions in the course of work pH and mass concentration of hexavalent chrome shall be found.

E.4.5 Correcting of working passivating solution shall be carried out based on results of the analysis of chrome (VI) and measurement of pH as follows.

Working passivating solution during the day shall be corrected as to content of chrome by adding of the basic chromic bichromate or chromic anhydride.

If pH of passivating solution is over 5, nitric acid shall be added

If pH is less than 3, correcting shall be carried out by adding of caustic soda solution (approximately in concentration of 20 %) until pH, equal to 3.0 to 5.0 is obtained.

Replacement of passivating solution shall be carried out once every 3 months

E.4.6 Correcting of solutions of mono- and trietanolamine shall be carried out depending on losses of the solution volume which has been carried away with articles being treated.

E.4.7 Correcting of solutions for passivation of high-alloy steels shall be carried out with aid of concentrated solutions of components.

**Appendix F**  
**(informative)**

**Materials and chemicals, used for surface preparation for painting**

F.1 Materials and chemicals, used for surface preparation for painting, are listed in table F.1.

Table F.1

Material, chemical
<b>Removers</b> СД, СП-6, СП-7, АФТ-1, СПС-1, СПС-2, СНБ-9, ТФ, autoremoover
<b>Inhibitors</b> КАТАРИН, ХОСП-10, Икос-3
<b>Solvents</b> White spirit (Nefras C4—155/200), Nefras 50/150
<b>Passivating mixture</b> Chromic anhydride (CrO <sub>3</sub> )
<b>Activating mixtures</b> АФ-1, АФ-4, АП-4
<b>Mixtures for crystalline phosphating steel, galvanized steel, aluminum</b> КФ-1, КФ-3, КФ-7, КФ-12, КФ-12К, КФ-14, КФ-14К, КФ-15, КФ-15К, КФ-16, КФ-16К, КФ-17, КФ-17К, Фосфотех-Ц1, Фосфотех-Ц2, Фосфотех-11, Фосфотех-11К, Фосфотех-14, Фосфотех-14К, Фосфотех-15, Фосфотех-15К, КФ-12М, Фосфотех-18, ФК-1, ФК-2, ФК-3, ФК-4, ФК-5, ФК-6, КНЦ-12, КНЦ-12Н, Фоскон Н-2, Фосфолит-1, Фосфолит-2
<b>Mixtures for amorphous phosphating</b> КФА-8, КФА-9, КФА-10, Фосфотех-А1, Фосфотех-А2, Фосфотех-4А, Фосфотех-4В, Фосфотех-4С, ФК-7
<b>Commercial washing compounds</b> КМ-1, КМ-2, КМ-17, КМ-18М, КМ-19, КМ-21, КМ-22, КМ-25, КМ-26, КМ-27, КМ-28, КМ-29, ХОС-3, КИМОС П, КОС-6, КМУ-1, МД-2, АПОЛИР К, МС-15, МС-37, МЛ, ВИМОЛ, ЛАБОМИД ТН, ЛАБОМИД-102, ЛАБОМИД-203, ТЕМП 100Д, ТЕМП 200Д, СОФАЛ; КОМОС-1, КОМОС-11, КОМОС-19, КОМОС-20, ТМОК-П, ТМОК-6П, ТМОК-100, ТЕМП-500, ЭЛЕКТРИН М, ЭКОС М, ПТС, ХС-2М, ТМОК-6Пу, ЭКОС, ПТС-5, БФК, ФОСКОН 200, ФОСКОН 200-1, ФОСКОН 200-2
<b>Emulsion compounds</b> К-1-СА-31, СА-57, Вертолин-74, Термос-1 (Термос-2), Эмульсин, Рельсин, ЭК-1-5-100
<b>Salts</b> Sodium bifluoride, potassium fluoride dihydrate
<b>Rust converters</b> Принкор-1, СФ-1

F.2 Other materials and mixtures meeting requirements on corrosion resistance of GOST 9.401 and characteristics, listed in table 14, may be used.

**Bibliography**

- [1] ISO 8501-1:1988 "Preparation of steel substrates prior to application of paints and related articles — Visual assessment of surface cleanliness — Part 1: Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings"

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