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0. Introduction

This Process Instruction (PI) outlines out the surface treatment process.

1. Aim

This Process Instruction (PI) describes the surface quality guidelines in respect of metal parts supplied to GOTEC.

GOTEC GmbH carries out pre-curing processes of metal, aluminium or vibration damping plastic parts for in automotive industry.

The quality of the rubber-metal connection is decisive for the life-span and the properties of the final product.

The quality of the rubber-metal connection is conditional on the surface of each metal part.

To ensure quality treatment certain quality requirements and limitations are set out for manufactured parts. Such requirements put certain constraints on the treatment process.

2. Scope of application

This instruction is a supplement to the current framework agreement! This instruction shall apply to all parts.

3. Terms, definitions

For the purpose of any process development, all process-relevant items must be marked “X” while not applicable items must be marked “O”. “X” items must be agreed with the customer followed by a record in writing. Each operation sheet is completed and filed in an individual folder for each article / product.

4.1 Degreasing

a) Any remains of oil that have not be removed in the GOTEC cleaning process are likely to reduce the adherence between rubber and metal. Zinc soaps, molybdenum compounds, sulphur, scale etc. may cause the same reaction.

b) The chemical effect of the cleaning process may be impaired by unwanted agents.

c) Oils and/or other substances used in an earlier procedure must be removable in a course of a single process. Otherwise there is no guarantee of adhesiveness to metal.

d) A standard degreasing process (where elements are moved from gitterboxes) must not be used for decreasing of flat disks, shields, wheels etc. and/or any easily-jamming parts. Such parts tend to adhere to each other, which prevents surface degreasing.

Special treatment is required in this case. Parts are degreased individually, positioned vertically or on the barrel line. This is not always possible, particularly if parts tend to stick to each other.

e) Buckets may only be degreased on a barrel line.

f) All parts, in particular plastic elements, must be heat resistant (> 140^{o} C).

g) 100% degreasing of parts which are used as bearing carriers, parts with welded rings, elements with slots where liquids easily deposit is not possible and additional treatment such as phosphating is required.

h) The barrel process must not be used for degreasing of fittings or parts with narrow tolerances and/or thin wall sections. No standard mixing/stirring must be used either as such parts are easily destroyed. Decreasing involves more manual labour.

4.2 Sand blasting

a) Threaded elements must not be blasted to avoid damage. If blasting cannot be avoided thread functionality or accuracy of dimensions shall not be guaranteed.
This also applies to fittings and narrow tolerances and thin wall elements. If blasting is ultimately agreed with the customer it is presumed that no damage may occur in the barrel process.

b) Sand blasting is not efficient if used on half-shells, parts with slots, flat disks or easily-jamming parts as they lap each other and cover each other's surfaces, which may affect metal surface adhesion. A grooving-type solution may help cure the problem.

c) The offer does not specify surface roughness. All the necessary information is available from the Quality Management Department. Surface roughness specification must be agreed after calibration. With some base materials, however, it may only be possible to obtain standard roughness. Any non-standard specifications must always be agreed with the client as they require individual treatment.

d) Subject to material hardness sand blasting may cause an increase in the diameter of an element. The customer should allow for such an option in its plans at the material calibration phase.

e) Blasting is not a perfect solution for bushings or sleeves – the length to diameter ratio (e.g. 2:1) is decisive here, as the blasting agent may not properly reach the inside of the element.

4.3 Zinc-nickel coating, rack coating

a) As zinc and nickel coating is ineffective on areas with spills of excessive rubber and splatters of adhesive any surface area exposed to this type of risk is deemed substandard as far as its resistance to corrosion is concerned.

b) Both the materials used in elements and the methods of coating (sealed or unsealed) may cause colour deviations with yellow tint or blue tint. Such variations do not affect the quality of the zinc – nickel coating and no quality claims will be accepted.

c) The geometry of a part (undrcuttings, edges, corner fittings, radii) may produce some deviations of the layer thickness falling incidentally below the tolerance limit.

d) The wall thickness of the hollow core in inner holes may also be an adverse factor preventing the formation of the necessary coat layer and reducing the protection against corrosion. Inner holes are not subject to assessment under salt spray test results.

e) All points of contact and/or adherence with the frame and their adjacent areas cannot be coated, which reduces anti-corrosion protection. Such points are not subject to evaluation of salt spray test results. Such points differ in colour from the rest of the part.

f) The process does not offer a reliable method of applying a zinc-nickel layer on phosphated surfaces – the reason being that the phosphate layer may not always be removable due to its thickness and resistance, which may prevent effective zinc-nickel coating.

g) When a part is immersed in the bath, air bubbles and after-bath marks may form around undrcuttings, non-through holes or reams. As the coating cannot be applied in the areas around bubbles such spots are easily affected by rust. Bath marks generate stains and smudges. They do not impair the anti-corrosion protection but they are still visual defects.
The rack coating must not be used for deep non-though holes. Such holes are not only visual defects but also absorb chemical substances, which produces changes in bath characteristics and and a negative quality effect.

h) The zinc-nickel coat should always be applied after calibration to avoid any cracking of the brittle zinc-nickel layer. Cracking may be related to the thickness of the layer (ca. >10 µm) and the calibration dimensioning. It may also affect the resistance to corrosion. This rule applies to calibration markers and grooving.

i) The thickness of the layer may vary along the butting/end face of the part depending on the positioning of the anode mounted in the bath tank. The differences in the thickness of the layer may fall beyond the tolerance limit.

k) For built-up parts, depending on their load, sanding is recommended as a pre-treatment before the a zinc-nickel coat and an adhesive are applied. This procedure ensures that the adhesion of the surface meets the required criteria. Special substrates can also be used instead of sanding to produce a required adhesion.

l) A zinc-nickel coat may only be applied to the base iron material. It is not possible on an oil covered surface.

4.4 Phosphating

a) To prevent any damaging of parts the barrel method must not be used to phosphate all threaded elements. If the barrel line has to be used to phosphate any parts no claims shall be accepted in respect of thread functionality or dimensions.
The same is applicable to fitting and tolerances below 0.1 mm and thin walled elements.

b) Phosphating is not effective on half-shells, parts with slots, flat disks or easily-jamming parts as the strength of the adhesion of metal surfaces may be reduced. Special grooving is recommended.

c) Copper brass and aluminium brass cannot be zinc phosphated. Such surfaces should be activated in the iron phosphating process.

d) Aluminium part surfaces can only be activated to some extent. This means that the differences in the thickness and the resistance of the oxide layers result in a poor activation and consequently reduced adhesion.

e) Castings may only be phosphated conditionally with no additional treatment. Blasting is absolutely necessary to eliminate any casting skin or oxide layers. No surface etching is allowed in the zinc phosphating process as acid residues accumulate in pores and gradually diffuse promoting the metal surface oxidation (rusting) when parts are in storage,

f) Bearing carriers, parts with welded rings, components with narrow slots etc. easily accumulate liquids. In adverse conditions, with liquids remaining in such parts for a long period of time and no possibility of being 100% removed, rust formation will follow.

4.5 Coating with bonding agents

a) The geometry of a part (undercuttings, edges, corner fittings, radii) may produce some variations in the layer thickness falling incidentally below the tolerance limit.

b) The bath process may produce sagging on the surface. Such occurrences must be discussed and agreed with the customer.

c) Measurement points and methods must be agreed with the customer.

d) A leak of excessive bonding agent may occur on the butting/end face of a part or a lateral surface of a part. Limiting standards must be agreed with customer.

e) Defective areas occur on parts in the process of full coating or automated chain coating with the use of part holders. Sizes and locations of all [predictable] defective areas must be discussed and agreed with the customer. Edge defects occurring when a part is taken off the holder must also be agreed with the customer unless such defects can be avoided.

f) In partial coating, when some sections of the part must be shielded to protect them from coating, each coat-free area must be agreed with the customer including the minimum and maximum limits of the coated surface. There is no clear division line. With the use of grips, handles and shields, the boundary is a broken line.

g) The roll process must not be used on parts with post-extrusion reductions of lateral surface as the bonding agent cannot be applied on lateral surfaces.

h) Convex and concave surfaces including hollow cores are areas of frequent coating failures due to undercuttings and shadows if the coating is applied on the axis of revolution rather than along the axis. This means that 100% cover of such surfaces is impossible.

5. Guidelines, notes

None

6. Required documents

Quotation, current framework agreement.

7. Records / Documentation

This instruction is subject to reviews and recording. In the event of any amendments and/or alterations, the latest issue must be incorporated in the quality records. This instruction is a binding regulation valid for the minimum of 3 years effective from the date of amendment/alteration.

8. Change tracking

The quality assurance representative is responsible for the change tracking in relation of this process document. All amendments/alterations shall be introduced by the Chemical Surface Treatment Department. In the event of any process modification, the process owner shall be responsible for all the necessary communications.

9. Copies [for the attention of]

Customers.

10. Appendices/Enclosures/Schedules

Check list.

CHECK LIST (Internal use only)

Description	OK N/A	comment	advice to customer
4.1 Degreasing a) Remains of oil, zinc soaps, molybdenum compounds, scale			

etc. b) Inadmissible materials c) Oil, single process d) Flat disks, blocking parts e) “Buckets/scoops” f) Heat resistant (> 140 °C) g) Bearing carriers, welded rings h) Fitted tolerances **4.2 Blasting** a) Threaded parts, fittings, tolerance defects b) Half-shells, parts with slots, flat discs c) Roughness d) Blasting – material hardness e) Bushes/hollows – length ratio **4.3 Zinc-nickel coating – the rack process** a) Excessive rubber or bonding agent b) Colour variations c) Variation in geometry of layer thickness, d) Hollows/inner holes – thin layer e) Rack and frame contact points f) Phosphated surface coating g) Undercuttings, non-through holes, air bubbles h) Zinc-nickel layer – calibrated parts i) Length of parts, butterface – differences in thickness k) Pre-treatment before zinc-nickel coating, balsting l) Only iron base coating			
Description	OK N/A	comment	advice to customer
4.4 Phosphating a) Threaded parts b) Half-shells, elements with slots, flat discs or c) Copper brass and aluminium			

d) Activation of aluminium parts – reduced adhesion. e) Castings f) Bearing carriers, welded rings **4.5 Adhesive coating** a) Part geometry, layer variances, b) Bath process – patches c) Measure points and methods d) Excess of bonding agent on butting face and lateral surfaces e) Defect locations f) Sectional/partial coating, g) Rolling process - reductions h) Convex or concave formations on surfaces intended for coating			