Factory Standard

LAP GmbH Laser Applikationen
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1 PURPOSE

This Factory Standard should be treated as a supplement to the current standards for technical drawings. It closes gaps which are not covered by the Geometrical Product Specifications (GPS), and defines how technical drawings by LAP GmbH Laser Applikationen should be read. This Factory Standard also defines general tolerances, as well as general prescriptions and expectations for manufacturing procedures and delivery conditions, unless otherwise agreed.

2 GENERAL

2.1 SCOPE OF VALIDITY

This Factory Standard is structured according to the following hierarchy:

1. Indications on drawings above
2. Part-specific agreements above
3. Factory standards above
4. GPS standards

2.2 LANGUAGE

The document language is German. If there are multilingual indications on technical drawings, the German original takes precedence in the event of contradictions.

2.3 EXPORT FORMATS

Export formats such as STEP files, IGES, DXV or DWG will be provided on request. The associated technical drawings form the contractual basis. In the case of deviations between the export format and the technical drawing, the information on the drawing takes precedence. It is therefore recommended that you check the export formats against the drawing before use.

2.4 MATERIAL REQUIREMENTS

LAP GmbH Laser Applikationen expects that, during manufacture of parts ordered, only materials which conform to the European ordinances RoHS (in the version current on the date of ordering) and REACH (in the version current on the date of ordering) shall be used.
3 MEASUREMENTS AND TOLERANCES

3.1 EXPECTATIONS FOR TOLERANCE INDICATIONS

LAP GmbH Laser Applikationen expects that, for measurement tolerance indications, the production process is adjusted to a defined position within the tolerance. To enable this, the process parameters ‘diffusion’ and ‘position’ must fulfill the minimum requirements and be appropriately monitored and regulated.

The requirements in Section 3.5 apply to designated testing dimensions.

3.2 GENERAL TOLERANCES

The following lists the general tolerances which apply to all dimensions in technical drawings without explicit tolerance information, and all non-specified shape and position tolerances. The tolerances comply with DIN EN ISO 2768-1 and 2768-2. Metrologically, the measurements are determined by means of two-point measurement. If not specified otherwise, the independence principle applies to all parameters.

If the standards DIN EN ISO 2768-1 and 2768-2 are withdrawn, LAP GmbH Laser Applikationen expects that the general tolerances will be observed according to the Factory Standard.

3.2.1 Measurements of length

<table>
<thead>
<tr>
<th>Tolerance class</th>
<th>Limit deviations in mm for nominal dimension range in mm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt; 0.5</td>
</tr>
<tr>
<td>f (fine)</td>
<td>± 0.05</td>
</tr>
<tr>
<td>m (medium)</td>
<td>± 0.10</td>
</tr>
<tr>
<td>c (coarse)</td>
<td>± 0.15</td>
</tr>
</tbody>
</table>

3.2.2 Curve radius and bevel heights

<table>
<thead>
<tr>
<th>Tolerance class</th>
<th>Limit deviations in mm for nominal dimension range in mm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt; 0.5</td>
</tr>
<tr>
<td>f (fine)</td>
<td>± 0.2</td>
</tr>
<tr>
<td>m (medium)</td>
<td>± 0.4</td>
</tr>
</tbody>
</table>
### 3.2.3 Angle dimensions

<table>
<thead>
<tr>
<th>Tolerance class</th>
<th>Deviation limits in angle units for nominal dimension range of the shortest side in mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>f (fine)</td>
<td>± 1 °</td>
</tr>
<tr>
<td>m (medium)</td>
<td>± 30'</td>
</tr>
<tr>
<td>c (coarse)</td>
<td>± 1 ° 30'</td>
</tr>
</tbody>
</table>

### 3.2.4 Straightness and evenness

<table>
<thead>
<tr>
<th>Tolerance class</th>
<th>General tolerances for straightness and evenness in mm for nominal dimension range mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>H</td>
<td>0.02  0.05  0.1  0.2  0.3  0.4</td>
</tr>
<tr>
<td>K</td>
<td>0.05  0.1   0.2  0.4  0.6  0.8</td>
</tr>
<tr>
<td>L</td>
<td>0.1   0.2   0.4  0.8  1.2  1.6</td>
</tr>
</tbody>
</table>

### 3.2.5 General tolerances for perpendicularity

<table>
<thead>
<tr>
<th>Tolerance class</th>
<th>General tolerances for perpendicularity in mm for nominal dimension range mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>H</td>
<td>0.2   0.3   0.4  0.5</td>
</tr>
<tr>
<td>K</td>
<td>0.4   0.6   0.8  1</td>
</tr>
<tr>
<td>L</td>
<td>0.6   1.0   1.5  2</td>
</tr>
</tbody>
</table>

### 3.2.6 Symmetry

<table>
<thead>
<tr>
<th>Tolerance class</th>
<th>General tolerances for symmetry in mm for nominal dimension range mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>H</td>
<td>0.5</td>
</tr>
<tr>
<td>K</td>
<td>0.6   0.8   1</td>
</tr>
<tr>
<td>L</td>
<td>0.6   1.0   1.5</td>
</tr>
</tbody>
</table>

### 3.2.7 Radial and axial run-out

<table>
<thead>
<tr>
<th>Tolerance class</th>
<th>General tolerances for radial and axial run-out in mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>H</td>
<td>0.1</td>
</tr>
<tr>
<td>K</td>
<td>0.2</td>
</tr>
<tr>
<td>L</td>
<td>0.5</td>
</tr>
</tbody>
</table>
3.2.8  Roundness

The general tolerance for roundness is the minimum of the diameter tolerance and the general tolerance for the run-out.

3.2.9  Parallelism

The general tolerance for parallelism is the maximum of the measurement tolerance and the general tolerance for straightness / evenness.

3.2.10 General tolerances for threads

Thread specifications in technical drawings without tolerance indications should be produced in accordance with DIN EN ISO 965-1 (medium quality). This means for external threads without indication = 6g and internal threads without indication = 6H.

3.2.11 Dimensioning symbols

LAP GmbH Laser Applikationen uses symbols which are not DIN-compliant for drilling specifications. The symbols have the following meanings:

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Indication for counterboring in a cylindrical shape. The diameter prescribes the target measurement.</td>
</tr>
<tr>
<td></td>
<td>Indication for counterboring. Specifications for counterbore diameter and point angle.</td>
</tr>
<tr>
<td></td>
<td>Depth of the previously indicated feature</td>
</tr>
</tbody>
</table>
3.3 POSITIONAL TOLERANCE FOR INDICATIONS ON DRAWINGS

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
<th>Outline</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>The tolerated median plane of the groove must lie between two parallel planes at distance ( a ), ( a = 0.05 \text{ mm in the example} ), symmetric to the median plane ( b ) of both outer surfaces. Distance ( a ) must be defined in the drawing.</td>
<td><img src="image1" alt="Diagram" /></td>
</tr>
<tr>
<td></td>
<td>The square symbol defines a profile tolerance for the square outline in relation to a central axis with a position tolerance. The positional tolerance, 0.2 mm in the example, is derived from the 3.2.1 length dimensions, with the dimension behind the square symbol being the rated dimension. Fine tolerance in the example.</td>
<td><img src="image2" alt="Diagram" /></td>
</tr>
<tr>
<td></td>
<td>The central axis (reference C) of the pitch circle has a position tolerance of 0.2 mm in the example. The elements on the bolt circle have a positional tolerance in the example of 0.2 mm to reference A. The positional tolerance, 0.2 mm in the example, is derived from the 3.2.1 length dimensions, with the diameter of the pitch circle being the rated dimension for both tolerances. Fine tolerance in the example.</td>
<td><img src="image3" alt="Diagram" /></td>
</tr>
</tbody>
</table>

3.4 FITS WITH ENVELOPE REQUIREMENTS

Fits which require compliance with the envelope requirement ⬃ should be checked with a plug gauge in accordance with DIN EN 2245. The depth of inspection corresponds to 2/3 of the indicated drilling depth or the entire depth in the case of through holes. The plug gauges must be listed in the supplier’s inspection equipment monitoring and must be indicated in the test plan for the workpiece and regularly checked. On request, the identification number and calibration date of the inspection equipment must be provided to LAP GmbH Laser Applikationen.
3.5 TEST DIMENSIONS

In technical drawings, the important inspection features must be labelled in accordance with DIN EN 406-10, as shown:

A short-term machining capability (Cm, Cmk) of at least 1.33 (to be demonstrated in the event of inspection) and a process capability (Cp, Cpk) of at least 1.0. Proof of capability must be provided at the request of LAP GmbH Laser Applikationen.

3.6 MEASURING PARAMETERS TO DEFINE DEVIATIONS IN SHAPE

3.6.1 Reference system
In case of doubt, the largest surface is reference level A and is determined by three grid points which are as far away from each other as possible. Reference level B is the largest surface perpendicular to A and is determined by two grid points. Reference surface C is perpendicular to A and B and is the larger surface of the two. It is determined by a grid point.

For round parts, reference A is the central axis and reference B is the larger front surface.

For technical drawings with coordinate measurements, the surfaces with the coordinate 0 are the reference levels. Reference surface A with 3 grid points is the largest surface, and reference surface B with 2 grid points is the second largest.

3.6.2 Roundness and cylindrical shape
The roundness should be determined using an appropriate number of measuring points (at least 20), distributed across the circumference. For substitute calculation of the circle, the least square circle (LSCI) should be used. If the associated measurement is labelled Ⓗ, the element should be evaluated according to the envelope requirement (MCCI) for a wave, and according to the maximum inscribed element (MICI) for a hole.

For cylindrical shapes, the measuring points must be recorded on at least 3 levels.

As a rule of thumb for the minimum number of measuring points to be recorded, the following values are defined. Significant deviations from this requirement must be agreed in advance with LAP GmbH Laser Applikationen:

<table>
<thead>
<tr>
<th>Size of the diameter (mm)</th>
<th>Minimum number of measuring points (roundness)</th>
<th>Minimum number of measuring points (cylindrical form)</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 10</td>
<td>12</td>
<td>30</td>
</tr>
<tr>
<td>&lt; 10 ≤ 30</td>
<td>24</td>
<td>60</td>
</tr>
<tr>
<td>&lt; 30 ≤ 100</td>
<td>36</td>
<td>90</td>
</tr>
<tr>
<td>&lt; 100 ≤ 400</td>
<td>72</td>
<td>180</td>
</tr>
<tr>
<td>&lt; 400</td>
<td>144</td>
<td>360</td>
</tr>
</tbody>
</table>
3.6.3 Flatness

The evenness should be captured using a suitable number of measuring points, dependent on the surface to be measured, distributed across the surface to be measured. The points must be distributed over at least three lines and must be distributed across the entire dimensions of the surface.

As a rule of thumb for the minimum number of measuring points to be recorded, the following values are defined. Significant deviations from this requirement must be agreed in advance with LAP GmbH Laser Applikationen:

<table>
<thead>
<tr>
<th>Size of the surface</th>
<th>Minimum number of measuring points</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 100 mm²</td>
<td>10</td>
</tr>
<tr>
<td>≤ 1 000 mm²</td>
<td>40</td>
</tr>
<tr>
<td>≤ 5 000 mm²</td>
<td>50</td>
</tr>
<tr>
<td>≤ 10 000 mm²</td>
<td>60</td>
</tr>
<tr>
<td>&gt; 10 000 mm²</td>
<td>80</td>
</tr>
</tbody>
</table>

3.7 DIMENSIONING FOR MORE THAN ONE DIMENSION ELEMENT

Geometrical features that can be connected, associated or assigned unequivocally by means of an extension line, construction line or symmetry line do not need to be identified by a preceding specification/modification symbol “number x” according to DIN EN ISO 14405 (per the version current on the date of the last change to the drawing).

Dimensions and their tolerances that apply to more than one dimension element are therefore taken to apply to all features e.g. if the features are connected by an extension line.
# SURFACES

## 4.1 ROUGHNESS AND ROUGHNESS INDICATIONS

The indications Ra and Rz in LAP GmbH Laser Applikationen technical drawings are to be understood as follows.

<table>
<thead>
<tr>
<th>Value in the drawing</th>
<th>Meaning – DIN EN ISO 4287 and EN ISO 1302d</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ra 10 or Rz 60</td>
<td></td>
<td>Cut edge without requirements. For laser-cut parts, scale-free and bump-free.</td>
</tr>
</tbody>
</table>
| Ra 6.3 or Rz 40      | Limit length wave \( \lambda_c = 2.5 \text{ mm} \)  
Filter = FALG (area, linear, Gauss) | Cut edge with connecting slide grinding. |
| Ra 3.2 or Rz 20      | \( \lambda_c = 2.5 \text{ mm}; \) for workpiece features < 17.5 mm, the number of measuring sections must be adjusted.  
Filter = FALG (area, linear, Gauss)  
Rmr0 5% / Rmr(5) 50% | Machining with a uniform processing technique for surfaces without decorative aspects. |
| Ra 1.6 or Rz 10      | \( \lambda_c = 0.8 \text{ mm}; \) for workpiece features < 5.6 mm, the number of measuring sections must be adjusted.  
Filter = FALG (area, linear, Gauss)  
Rmr0 5% / Rmr(2) 60% | Machining with a uniform processing technique for surfaces with decorative aspects or functional surfaces |
| Ra 0.8 or Rz 6.3     | \( \lambda_c = 0.8 \text{ mm}; \) for workpiece features < 5.6 mm, the number of measuring sections must be adjusted.  
Filter = FALG (area, linear, Gauss)  
Rmr0 5% / Rmr(1) 70% | Finish-smoothed for functional surfaces with fitting or running characteristics |
| Ra 0.2 or Rz 2.5     | \( \lambda_c = 0.8 \text{ mm}; \) for workpiece features < 5.6 mm, the number of measuring sections must be adjusted.  
Filter = FALG (area, linear, Gauss)  
Rmr0 5% / Rmr(0.6) 80% | Finish-smoothed for functional surfaces with fitting or running characteristics for high demands |
| Rz 0.1               | Limit length wave \( \lambda_c = 0.08 \text{ mm}; \) for workpiece features < 0.56 mm, the number of measuring sections must be adjusted.  
Filter = FALG (area, linear, Gauss)  
Rmr0 5% / Rmr(0.02) 80% | Polished surfaces, e.g. for precision waves |
4.2 IMPRESSION-DEPENDENT SURFACES

4.2.1 Anodised layers

For parts to be anodised per the technical drawings, the following guidelines apply for the coating:

1. Classification according to DIN EN 17611 (in the version current on the date of the last drawing change).
3. Layer thickness of the oxide layer class 20. This corresponds to 20µm ± 4µm. The measurements in the technical drawing apply to the part after coating.
4. For sealing, LAP GmbH Laser Applikationen requires hot sealing. If other processes are used, they must be indicated in the master sample approval.
5. Contact and support points must be agreed with LAP GmbH Laser Applikationen; visible surfaces and fitting surfaces must not be used for contact. Parts may not be deformed by clamping.
6. Blind holes with diameter < 3.5 mm must be closed.
7. The designation matt means that the surface is to be given a homogeneous appearance by means of shot blasting.
8. Colouring: Silver corresponds to C-0 (EV1); black corresponds to C-35.
9. Processing residues must be completely removed. All holes must be free of salts and other deposits.
10. See also the section on impression-dependent surfaces for the requirements of colour appearance, imperfections, scratches etc.
4.2.2 Powder coating

If not indicated otherwise in the technical drawing, the following guidelines apply to coating:

1. Classification, designations and test conditions according to DIN EN 55633 \textit{(in the version current on the date of ordering)}.

2. Corrosiveness category C2, interior application, unheated, atmosphere with low contamination.

3. The coating is for decorative purposes; the expected protection duration is short (2-5 years).

4. The measurements in the technical drawing apply to the part after coating and hardening.

5. The colour is indicated \textit{per RAL} on the technical drawing or in the order text.

6. The following table applies to the coating thicknesses and pre-treatment on various materials:

<table>
<thead>
<tr>
<th>Material</th>
<th>Pre-treatment</th>
<th>Powder coating [µm] base</th>
<th>Powder coating [µm] top</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel</td>
<td>Sa 2.5 blasting</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>Galvanised steel</td>
<td>Sweep blasting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stainless steel</td>
<td>Sa 2.5 blasting</td>
<td></td>
<td>80</td>
</tr>
<tr>
<td>Aluminium</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

As acceptance criteria for the dry coating thickness, the standard values apply: The average value of all the measurements must be at least equal to or greater than the agreed target coating thickness. All individual values of the dry coating thickness must be equal to or greater than 80% of the target coating thickness. Max. 20% of the measuring values may fall below the target coating thickness. No value may exceed the specified maximum coating thickness. The maximum coating thickness is 3x the target coating thickness.

7. Threads must always be free of coating material.

8. As contact points, use threaded holes where possible. If no threads are available, the alternative contact points must be agreed with LAP GmbH Laser Applikationen.

9. The surface structure of the decorative colour coating should be matt with a fine structure.

10. See also the section on \textit{impression-dependent surfaces} for the requirements of colour appearance, imperfections, scratches etc.
4.2.3 Varnish

If not indicated otherwise in the technical drawing, the following guidelines apply to varnishing:

1. Classification, designations and test conditions according to DIN EN ISO 12944 (in the version current on the date of order).
2. Corrosiveness category C2, interior application, unheated, atmosphere with low contamination.
3. The coating is for decorative purposes; the expected protection duration is short (2-5 years).
4. The measurements in the technical drawing apply to the part after coating and drying.
5. The colour is indicated on the drawing or in the text of the order in RAL.
6. The following table applies to the coating thicknesses and pre-treatment on various materials:

<table>
<thead>
<tr>
<th>Material</th>
<th>Pre-treatment</th>
<th>Powder coating [µm] base</th>
<th>Powder coating [µm] top</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel</td>
<td>Sa 2.5 blasting</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>Galvanised steel</td>
<td>Sweep blasting</td>
<td>-</td>
<td>80</td>
</tr>
<tr>
<td>Stainless steel</td>
<td>Sa 2.5 blasting</td>
<td>-</td>
<td>80</td>
</tr>
<tr>
<td>Aluminium</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

As acceptance criteria for the dry coating thickness, the standard values apply: The average value of all the measurements must be at least equal to or greater than the agreed target coating thickness. All individual values of the dry coating thickness must be equal to or greater than 80% of the target coating thickness. Max. 20% of the measuring values may fall below the target coating thickness. No value may exceed the specified maximum coating thickness. The maximum coating thickness is 3x the target coating thickness.

7. Threads must always be free of coating material.
8. The surface structure of the decorative colour coating should be matt with a fine structure.
9. See also the section on impression-dependent surfaces for the requirements on colour appearance, imperfections, scratches etc.

4.2.4 Blackening

Two procedures are admissible for blackening copper and copper alloys:

1. Potassium persulfate stain for a matt deep black surface.
2. Black burning with copper(II) nitrate. This 2nd procedure makes the surfaces powdery black; the parts may be heated up to max. 320°C.
4.2.5 Nickel plating

Unless otherwise indicated in the technical drawing, nickel plating should be carried out according to DIN EN ISO 1456 ‘Metallic and other inorganic coatings – galvanised nickel coatings’.

The term nickel plating corresponds to E-0-E of DIN EN ISO 4042 *(in the version current on the date of the last change to the drawing)*. Nickel – no layer thickness prescribed – no colour gloss level blank.

4.2.6 Zinc coating

Unless otherwise indicated in the technical drawing, zinc coating should be carried out by means of galvanic zinc coating *(ISO 4042, DIN EN ISO 19598)* *(in the version current on the date of the last change to the drawing)*. In welded groups nickel plating should be in accordance with DIN EN ISO 1461 *(in the version current on the date of the last change to the drawing)*. The zinc coating should be executed in silver.

1. Pre-treatment, coating thicknesses and test procedures should comply with the standard.
2. The term ‘cut surfaces’ on the technical drawing indicates that the parts to be coated can be punched, water jet cut or laser cut.
3. It must be agreed with LAP GmbH Laser Applikationen whether processing into rack or barrel goods is to be carried out. Possible necessary support points must also be agreed; visible surfaces and fitting surfaces must not be used for attachment.
4.3 TOLERABLE VISUAL DEVIATIONS

To evaluate impression-dependent surfaces, a test film (see picture) can be ordered from Qualitätsgemeinschaft Industriebeschichtungen QIB e.V.; this enables the features tolerated by LAP GmbH Laser Applikationen to be evaluated.

On the drawing, this is indicated on the specification of the coating as point: Defect size x.x mm² / max. Y units, where x.x corresponds to the defect class on the test film. Otherwise the defect size 0.75 mm² / max. 7 units applies.

Figure 1: Test film by Qualitätsgemeinschaft Industriebeschichtung, basis of the features tolerated by LAP GmbH Laser Applikationen for impression-dependent surfaces

To coordinate the surfaces, a sample piece should be created which is approved as a reference sample by LAP GmbH Laser Applikationen after inspection. The test is carried out in diffuse daylight.

The following measurable features are evaluated:

1. Bubbles
2. Craters
3. Impressions
4. Tears
5. Colour differences
6. Stains
7. Gloss level differences
8. Scratches
9. Runners
10. Lenses
11. Weak points
12. Orange skin
13. Spots/inlays
14. Pores
4.4 SURFACE TREATMENT

4.4.1 Slide machining (smooth grinding, barrel finishing)

The term ‘smooth grinding’ on the drawing indicates that the component should be smooth ground, whereby LAP GmbH Laser Applikationen does not specify the procedure, granulate, additives, number of workpieces per load or retention time. LAP GmbH Laser Applikationen expects that the parts will achieve the edge condition indicated in the technical drawing by means of smooth grinding and that the parts are not damaged by processing (scratches, bumps, deformations). The process must be determined by the supplier and approved using a sample. After that, LAP GmbH Laser Applikationen expects this approved process/process parameter to be applied when reordering.

4.4.2 Brushing

The term ‘brushing’ without further explanation requires the generation of a uniform, matt deco structure on aluminium surfaces. A uniform surface appearance without visible grooves, scratches, cavities, inlays or other surface defects according to DIN EN 17611 / E4 and E6 must be achieved (in the version current at the date of the last change to the drawing). The deco structure should be generated by the following tool:

- Tool: Fleece flap wheel
- For pre-treatment: Grain A104/80
- For final treatment: Grain A104M

Non-ferrous metals and ferrous materials may not be processed with tools and machines which are used to generate the deco structure. The treatment direction is defined in the technical drawing. LAP GmbH Laser Applikationen will supply reserve samples on request.

4.4.2.1 Brushing examples

The following figures serve as examples. The treatment direction is defined in the technical drawing.

Figure 2: Sample 1_Drawing extract – Observe direction of brushing
The following figures show the surface structure under the respective lighting conditions. The actual surface structure is documented with reserve / limit samples.

4.4.3 Glass bead blasting

The term ‘glass bead blasted’ on the drawing indicates that the visible surface of the component is treated for decorative purposes. The main focus is on removing surface defects and creating a homogeneous, matt appearance. The glass bead blasting must be carried out before further surface processing (such as anodising). The choice of bead size is the responsibility of the supplier. The surface qualities achieved must be approved using a sample. After that, LAP GmbH Laser Applikationen expects this approved surface to be provided when reordering.
5 DELIVERY INSTRUCTIONS

5.1 GENERAL

The delivery instructions apply to all articles for which there are no special agreements on packaging and state of delivery.

The supplier guarantees the application of packaging materials which grant the object of delivery sufficient protection against external, quality-reducing influences. This applies in particular to surface-coated goods, or goods with enhanced requirements concerning decorative properties.

The introduction of returnable packaging should be evaluated from an ecological and economical point of view and is preferred by LAP GmbH Laser Applikationen. The nature of such packaging must, however, be agreed with LAP GmbH Laser Applikationen in advance.

Insofar as goods are not ordered explicitly as an assembly group, they must be delivered separately according to type, i.e. only the same parts may be contained in a packaging unit. Mixed packaging of different parts (e.g. including left and right types) is not permitted!

The packaging must be labelled with the following information:

- LAP article number and variant index
- LAP order number
- Amount per packaging item

The delivery note must be included with the freight documents or be visible from outside and be attached to the packaging in a way that is protected from damage and soiling.

If goods are delivered as bulk material, they should be additionally packaged in tear-resistant fabric or PE bags so that they do not get lost if the outer packaging is damaged.

All delivered goods must be free from contamination and processing residues. Direct contact of the goods with uncoated packaging materials is not permissible (contamination of the goods).

If the goods are delivered on exchangeable pallets or in pallet cages, the exchange criteria defined by the European Pallet Association e.V. must be fulfilled by the empty containers used (www.epal-pallets.de).
5.2 MECHANICS

Purchased parts which tend towards corrosion during transport or storage must be protected by the supplier with suitable corrosion protection agents agreed with LAP GmbH Laser Applikationen. During storage in an air-conditioned environment, corrosion protection for at least 12 months must be guaranteed.

Conserved component parts must be wrapped in foil bags or oiled paper so that the outer packaging does not become contaminated by the preserving agent.

The packaging must be sufficiently stable to protect the goods and must not contaminate the goods.

Component parts with decorative or functional surfaces must be separated and packaged in such a way that damage from transport and storage is not possible.

Distortion-sensitive component parts must be protected by special outer packaging against the impact of mechanical force.

5.3 OPTICAL SYSTEM

It is not permissible to roll or wrap up multiple component parts in a strip of optical paper. Glass panes must be wrapped in paper individually for handling reasons.

Blister packaging which form-fits to the optical elements is preferred. This packaging must, however, guarantee a non-slip fit of the optical systems when opening and closing. Returnable packaging and disposable blister packaging must be agreed with LAP GmbH Laser Applikationen before being introduced.

For cleanliness reasons, the use of the following materials for direct packaging of optical systems is not permitted:

- Cardboard
- Foam
- Gel packs

The optical elements must be cleaned before packaging, insofar as the technical drawing does not indicate any explicit requirements for this.

5.4 ELECTRONICS

Packaging must protect components adequately. Handling, environmental and mechanical influences must be addressed. Packaging containing items requiring special protection from electrical discharge (ESD) must have clearly visible warning notices on the outside of the packaging. Receiving and warehousing of such components must be possible without removing the ESD protection. Distortion-sensitive parts and components must be protected by special outer packaging against the impact of mechanical force. Even if packaged in PE foam (mechanical and ESD protection), the item must be further surrounded by a conductive protective bag. If not otherwise agreed for an item, PCBs must be individually packaged in conductive ESD bags and delivered in ESD cartons or ESD small load carriers with compartments.
6 CLEANLINESS

The following chapters define the requirements for technical cleanliness and its inspection. The cleanliness level is defined on the drawing. If none is given, cleanliness level RS2 applies.

6.1 CLEANLINESS LEVEL RS0

Cleanliness level RS0 applies to all optical components of a laser (individual parts and/or groups).

Examples: Lenses, achromats, mirrors, optical filters

These must be free of the following contaminants given as examples, which can be detected by the methods given under Inspection:

- dust,
- chips, abraded particles, particles of any kind,
- oil, grease, cooling lubricant,
- water and other liquids,
- galvanic residues,
- washing and rinsing residues,
- packaging and packing residues,
- corrosion,
- scale,
- flux,
- other foreign substances or adhesions (such as stickers, where not explicitly required by a technical specification [drawing, product specification or the like]),
- and may not have any NON-material-specific odours.

Specification of cleanliness is on the drawing per ISO 10110 (Optics) or VDA Vol. 19 Part 1 (Mechanics - in the version current on the date of ordering).

The surface must be normal for the material and type of treatment.

Inspection: Contact-free, optical inspection with transmitted or incident light, if necessary with magnification

Inspection room: Cleanroom Class 6 per ISO 14644-1 (corresponds to Class 1.000 FS209E (in the version current on the date of ordering)).
6.2 CLEANLINESS LEVEL RS1

Examples: Components that generate or guide beams (e.g. focus car)

These must be free of the following contaminants given as examples, which can be detected by the methods given under Inspection:

- dust,
- chips,
- oil, grease, cooling lubricant,
- water and other liquids,
- galvanic residues,
- washing and rinsing residues,
- packaging and packing residues (such as abraded particles),
- corrosion,
- scale,
- flux,
- blasting residue,
- other foreign materials or adhesions (such as stickers, where not explicitly required by a technical specification [drawing, product specification or the like]).

The surface must be normal for the material and type of treatment. Discolouration due to thermal treatment is permitted.

**Inspection:** Wipe test with white, abrasion-resistant paper or lint-free cleaning swab, plus visual inspection (magnified if necessary)

**Inspection room:** Low-dust environment
6.3 CLEANLINESS LEVEL RS2

RS2 applies to assembly groups and components taken to cleanliness level RS1 through additional cleaning measures, and so qualified for more demanding use.

**Examples:** Components with subordinate or peripheral functions, not in the vicinity of laser beams (chassis plate, housing etc.)

These must be free of the following contaminants given as examples, which can be detected by the methods given under **Inspection**:

- dust,
- dust and other coarse dirt or manufacturing residues,
- oil, grease, cooling lubricant,
- galvanic residues,
- packaging and packing residues (such as abraded particles),
- corrosion,
- flux.

The surface must be normal for the material and type of treatment. **Discolouration due to thermal treatment is permitted.**

**Inspection:** Visual inspection (with or without magnification as desired)

6.4 CLEANLINESS LEVEL RS3

- Assemblies and components before any cleaning.

**Inspection:** Visual inspection
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| 1          | 2          | 05/09/2018 | - Point 3.7 modified.  
- Point 3.9 added.  
- Point 6 added.  
- Standards in Point 7 added. | ALa    |
| 2          | 3          | 29/01/2021 | - Point 5.4 added.  
- Point 6.3 modified.  
- Included in new draft. | MRo / JFr |
| 3          | 4          | 06/07/2021 | - Factory Standard in new format  
- In the Factory Standard, “in the version current on the date of ordering” added for referenced standards  
- Page 4 Point 2.2. “in the event of contradiction” added  
- Page 7 Point 3.2.11 Dimensioning symbols “point angle” added  
- Page 8 Point 3.3 positional tolerance for indications on drawings modified  
- “Common tolerances and tolerance zones” chapter deleted  
- Page 9 Point 3.5 Test dimensions figure modified  
- Page 9 and 10 “Shape tolerances” chapter divided into Chapter 3.6.2 “Roundness and cylindrical shape” and 3.6.3 “Flatness”  
- Page 13 Point 4.2.2 and Page 14 Point 4.2.3 Colour, “per RAL” added  
- Page 16 Point 4.3 renamed to “Tolerable visual deviations”  
- Page 17 Point 4.4.2 “with shaft” on fleece flap wheel removed and 4.4.2.1 Brushing examples added  
- Page 18 Point 4.4.3 Blasting changed to Glass bead blasting  
- Page 23 Point 6.2 Cleanliness level RS2 “Discolouration due to thermal treatment is permitted” added explanation of dust deleted  
- Page 24 Point 7 Standards directory chapter modified | MRo / JMu |