

# DIN EN ISO/ASTM 52911-1:2020-05 (E)

## Additive manufacturing - Design - Part 1: Laser-based powder bed fusion of metals (ISO /ASTM 52911-1:2019)

---

| <b>Contents</b>                |   | <b>Page</b> |
|--------------------------------|---|-------------|
| <b>European foreword</b> ..... |   | <b>4</b>    |
| <b>Foreword</b> .....          |   | <b>5</b>    |
| <b>Introduction</b> .....      |   | <b>6</b>    |
| <b>1</b>                       | <b>Scope</b> .....  | <b>7</b>    |
| <b>2</b>                       | <b>Normative references</b> .....   | <b>7</b>    |
| <b>3</b>                       | <b>Terms and definitions</b> .....  | <b>7</b>    |
| <b>4</b>                       | <b>Symbols and abbreviated terms</b> .....  | <b>8</b>    |
| 4.1                            | Symbols .....   | 8           |
| 4.2                            | Abbreviated terms .....   | 9           |
| <b>5</b>                       | <b>Characteristics of powder bed fusion (PBF) processes</b> .....                     | <b>9</b>    |
| 5.1                            | General .....   | 9           |
| 5.2                            | Size of the parts .....   | 10          |
| 5.3                            | Benefits to be considered in regard to the PBF process .....                          | 10          |
| 5.4                            | Limitations to be considered in regard to the PBF process .....                       | 11          |
| 5.5                            | Economic and time efficiency .....  | 11          |
| 5.6                            | Feature constraints (islands, overhang, stair-step effect) .....                      | 12          |
| 5.6.1                          | General .....   | 12          |
| 5.6.2                          | Islands .....   | 12          |
| 5.6.3                          | Overhang .....  | 12          |
| 5.6.4                          | Stair-step effect .....   | 12          |
| 5.7                            | Dimensional, form and positional accuracy .....                                       | 13          |
| 5.8                            | Data quality, resolution, representation .....  | 13          |
| <b>6</b>                       | <b>Design guidelines for laser-based powder bed fusion of metals (PBF-LB/M)</b> ..... | <b>14</b>   |
| 6.1                            | General .....   | 14          |
| 6.1.1                          | Selecting PBF-LB/M .....  | 14          |
| 6.1.2                          | Design and test cycles .....  | 14          |
| 6.2                            | Material and structural characteristics .....   | 14          |
| 6.3                            | Support structures .....  | 15          |
| 6.4                            | Build orientation, positioning and arrangement .....                                  | 17          |
| 6.4.1                          | General .....   | 17          |
| 6.4.2                          | Powder spreading .....  | 17          |
| 6.4.3                          | Support structures design .....   | 18          |
| 6.4.4                          | Curl effect .....   | 19          |
| 6.5                            | Anisotropy of the material characteristics .....                                      | 20          |
| 6.6                            | Surface roughness .....   | 20          |
| 6.7                            | Post-production finishing .....   | 20          |
| 6.7.1                          | General .....   | 20          |
| 6.7.2                          | Surface finishing .....   | 21          |
| 6.7.3                          | Removal of powder residue .....   | 21          |
| 6.7.4                          | Removal of support structures .....   | 21          |
| 6.7.5                          | Adjusting geometric tolerances .....  | 21          |
| 6.7.6                          | Heat treatment .....  | 21          |
| 6.8                            | Design considerations .....   | 22          |
| 6.8.1                          | General .....   | 22          |
| 6.8.2                          | Cavities .....  | 22          |

|  |   |           |
|--|---|-----------|
| 6.8.3  | Gaps.....   | 22        |
| 6.8.4  | Wall thicknesses.....   | 22        |
| 6.8.5  | Holes and channels.....   | 23        |
| 6.8.6  | Integrated markings.....  | 23        |
| 6.9  | Example applications.....   | 23        |
| 6.9.1  | General.....  | 23        |
| 6.9.2  | Integral design (provided by CETIM — Technical Centre for Mechanical Industry).....                       | 23        |
| 6.9.3  | Gear wheel design (provided by Fraunhofer IGCV).....  | 25        |
| 6.9.4  | Impossible crossing (provided by TNO — The Netherlands Organisation for applied scientific research)..... | 26        |
| <b>Annex A (informative) Materials for PBF-LB/M.....</b> |   | <b>28</b> |
| <b>Bibliography.....</b>                                 |   | <b>29</b> |