

# ISO/ASTM 52928:2024-05 (E)

## Additive manufacturing of metals - Feedstock materials - Powder life cycle management

---

<b>Contents</b>		<b>Page</b>
Foreword .....		v
Introduction .....		vi
1	Scope .....	1
2	Normative references .....	1
3	Terms and definitions .....	1
4	Symbols and abbreviations .....	2
5	Powder properties .....	3
5.1	General .....	3
5.2	Particle size distribution .....	3
5.2.1	General .....	3
5.2.2	Dynamic image analysis .....	4
5.2.3	Laser diffraction and light scattering .....	4
5.2.4	Dry sieving .....	5
5.2.5	Light or scanning electron microscopy (SEM) images .....	5
5.3	Chemical composition .....	5
5.3.1	General .....	5
5.3.2	Combustion methods .....	6
5.3.3	Flame AAS .....	7
5.3.4	X-ray fluorescence spectroscopy (XRF) .....	7
5.3.5	Inductively coupled plasma optical emission spectrometry (ICP-OES) .....	7
5.3.6	Energy-dispersive X-ray spectroscopy (EDX) .....	7
5.4	Characteristic densities .....	8
5.4.1	General .....	8
5.4.2	Apparent density .....	8
5.4.3	Tap density .....	8
5.4.4	Skeletal (true) density .....	8
5.4.5	Packing behaviour .....	8
5.5	Determination of powder density .....	9
5.5.1	Determination of the closed porosity of particles via indirect methods .....	9
5.5.2	Gas pycnometry .....	9
5.5.3	Metallographic section with porosity analysis .....	9
5.6	Shape and morphology .....	9
5.6.1	General .....	9
5.6.2	Image analysis .....	11
5.6.3	Scanning electron microscopy (SEM) images .....	11
5.6.4	Light microscopy images .....	12
5.6.5	Determination of specific surface area .....	12
5.7	Flowability .....	12
5.7.1	General .....	12
5.7.2	Determination of flow rate .....	13
5.7.3	Measuring the angle of repose .....	13
5.7.4	Ring shear test method .....	13
5.7.5	Rotating drum with dynamic image analysis .....	13
5.7.6	Powder rotational rheometer .....	13
5.7.7	Hausner ratio (ratio of tapped to bulk density) .....	13

5.8	Contamination .....	14
5.8.1	Moisture content .....	14
5.8.2	Impurities .....	15
5.8.3	O/H content .....	15
5.8.4	N content .....	15
5.9	Absorption rate of the powder .....	15
5.9.1	General .....	15
5.9.2	Diffuse reflectance infrared Fourier transform (DRIFTS) .....	15
6	Powder life cycle .....	16
6.1	Batch requirement .....	16
6.1.1	General .....	16
6.1.2	Specification .....	16
6.1.3	Batch .....	16
6.1.4	Blend .....	16
6.1.5	Powder mix .....	16
6.1.6	Combine .....	16
6.1.7	Reuse metric .....	16
6.2	Traceability .....	17
6.2.1	General .....	17
6.2.2	Event history .....	17
6.2.3	Powder state .....	17
6.2.4	Labelling .....	17
6.3	Handling .....	18
6.3.1	General .....	18
6.3.2	Storage .....	18
6.3.3	Transfer .....	18
6.3.4	Repacking .....	19
6.4	Recycling/reuse of feedstock .....	19
6.5	Disposal .....	19
7	Powder quality assurance .....	20
7.1	Documentation requirements .....	20
7.2	Certificate of analysis (CoA) .....	20
7.3	Sampling .....	20
7.3.1	General remarks .....	20
7.3.2	Characterization of virgin powder and powder blends .....	21
7.3.3	Characterization of used powder .....	22
7.4	Powder analysis test methods .....	22
7.5	Monitoring and control of the environment .....	22
7.6	Test frequency .....	23
	Bibliography .....	24