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Minimally Viable Decentralized Manufacturing Quality in an Era of AI

Background & Purpose

This document establishes a minimal, practical, and scalable baseline for quality assurance in a decentralized manufacturing ecosystem. It is designed for use by individual makers, small shops, and AI-driven design systems seeking to efficiently produce parts at low cost without unnecessary precision or certification overhead.

It replaces traditional bloated quality programs with a flexible standard that empowers everyday machinists, AI systems, and automated marketplaces to collaborate across the globe.

Who It's For

- Independent machinists and fabricators
- Local, garage-based, and small-scale CNC operators
- AI systems selecting manufacturing vendors
- Online marketplaces matching parts to capabilities
- Designers aiming for rapid prototyping, pilot builds, or low-cost commodity production

1. Tiered Tolerancing Philosophy

AI-optimized tolerancing is assumed. The looser the tolerance, the cheaper the part.

Tolerance Class	General Use Case	Typical Capability
Class A	Aerospace / Medical	CMM or metrology lab required
Class B	Fit-critical parts	Micrometers, indicators, gages
Class C	Commodity parts	Calipers, rulers, visual check

Default: Class C unless otherwise specified. Tolerances looser than ±0.010" are preferred.

2. Acceptable Measurement Tools

Tool	Permitted For
Calipers	ODs, IDs, lengths, non-critical features
Micrometers	Critical diameters if needed
Visual/fit	Deburring, cosmetics, threading checks

3. Machine & Shop Envelope Declaration

Each manufacturer must self-declare:
- Max part size
- Typical tolerance class
- Available operations (turning, milling, 3DP, etc.)
- Inspection tools available
- Experience/confidence level (1–5 stars)

Automated job boards will match only within declared capabilities.

4. Finishing and Deburring

A minimally acceptable finish includes:
- Deburring: via vibratory tumbler or hand tools (standard default)
- Cleaning: air-blown, wiped, or washed — no oil dripping
- Optional: light sanding or Scotch-Brite buffing

5. Packaging Requirements

Use common-sense, low-cost packaging:
- Envelope, padded mailer, or box
- Parts must survive courier handling
- Internal protection: 3D printed holders, foam, bubble wrap, or bagging

Bulk or individual packaging to be specified per job.

6. Basic Surface Treatments (Optional)

Treatment	Example DIY Method
Black oxide	Heat to red, quench in oil, temper in oven
Tumbled finish	Vibratory tumbler with medium grit media

Anodizing (basic)   Off-the-shelf kits or send out if needed

7. Default Acceptance Criteria

Unless otherwise specified:
- All dimensions meet Class C tolerance (±0.010")
- Part is burr-free and safe to handle
- Surface finish appropriate for functional use
- Part is clean and reasonably packaged
- No broken tools or foreign objects in packaging

End Goal

To enable the broadest possible participation in manufacturing, ensuring:
- Cost-effective, distributed production
- Integration with AI-designed products
- Confidence-based job matching
- Accessible quality standards for all makers

This document serves as a universal minimum viable contract for decentralized CNC manufacturing in an age of automated design and global supply fluidity.