ECM v3.1 — Engineering Blueprint

Autonomous Emotional Cycling Machine — Technical Specification
Core Emotion Framework (CEF)

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Version: 3.1 (Engineering Blueprint)

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0. Purpose and Scope

ECM v3.1 defines the **engineering-level specification** for the Autonomous Emotional Cycling Machine (ECM v3.x).
This blueprint establishes:

- mechanical architecture
- subsystem interfaces
- materials and tolerances
- calibration tolerances
- safety constraints
- assembly logic
- maintenance model

ECM v3.1 operationalizes the conceptual architecture of ECM v3.0 into a reproducible engineering standard.

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1. System Architecture Overview

ECM v3.1 consists of three mechanical modules and three autonomous subsystems:

Mechanical Modules

- Module A — Primary Wheel (Autonomous Version)
- Module B — Dual Micro-Wheels
- Module C — Cross-Center Choreography Ring

Autonomous Subsystems

- ARE — Autonomous Resistance Engine
- CRHCS — Center-Recognition & Height Calibration System
- ELMS — Emotional Load Mapping System

All modules connect through a unified **Mechanical-Autonomous Interface Layer (MAIL)**.

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2. Mechanical Specifications

2.1 Primary Wheel Assembly

Diameter: 42–48 cm
Material: High-density composite polymer with carbon-reinforced rim
Grip Surface: Non-slip thermoplastic elastomer
Rotation Tolerance:

- CW/CCW friction variance ≤ 1.5%
- Swing oscillation damping coefficient: 0.12–0.18

Height-Adjustment Rail:

- Vertical travel: 38 cm
- Locking precision: ±1 mm
- Motorized lift torque: 0.8–1.2 Nm

Sensors Embedded:

- 3-axis load sensors
- micro-tremor accelerometers
- grip-pressure pads

2.2 Dual Micro-Wheels

Diameter: 9–11 cm
Material: Polycarbonate core with silicone micro-grip
Independent Rotation:

- micro-CW/CCW friction variance ≤ 2%
- micro-Swing oscillation range: 6–12°

Autonomous Features:

- bilateral load balancing motors

- operator-recognition sensor array
- micro-resistance actuators (0.1–0.4 Nm range)

2.3 Cross-Center Choreography Ring

Outer Diameter: 58–64 cm
Material: Lightweight aluminum alloy with polymer track
Rotation System:

- stepper-motor sequencing
- timing precision: ±0.05 s
- transition torque: 0.4–0.7 Nm

Cue System:

- tactile pulse actuators (3–5 N)
- LED direction indicators
- optional auditory cues (40–55 dB)

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3. Autonomous Subsystems

3.1 Autonomous Resistance Engine (ARE)

Function: Dynamic resistance modulation across all wheels.

Components:

- dual-stage resistance motor
- torque sensor array
- adaptive load controller

Resistance Range:

- Primary Wheel: 0.3–2.8 Nm
- Micro-Wheels: 0.1–0.4 Nm
- Ring: 0.4–0.7 Nm

Response Time:

- < 120 ms from load detection to adjustment

3.2 Center-Recognition & Height Calibration System (CRHCS)

Function: Automatic detection of active center and height adjustment.

Sensors:

- posture alignment sensors
- vertical force distribution sensors
- center-engagement classifier

Height Adjustment:

- travel: 38 cm
- motor torque: 0.8–1.2 Nm
- calibration precision: ±1 mm

Safety Lock:

- engages during transitions
- disengages only under stable load

3.3 Emotional Load Mapping System (ELMS)

Function: Real-time emotional load inference.

Inputs:

- micro-tremor frequency
- grip pressure variability
- bilateral asymmetry
- motion irregularities
- transition hesitation

Output:

- load index (0–100)
- fatigue index (0–100)
- stability tier classification

Sampling Rate:

- 200–400 Hz

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4. Mechanical-Autonomous Interface Layer (MAIL)

MAIL defines the communication and control pathways between mechanical modules and autonomous subsystems.

Channels:

- torque feedback
- load mapping
- resistance commands
- sequencing commands
- height calibration signals

Latency Requirement:

- end-to-end < 50 ms

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5. Calibration Tolerances

5.1 Center Calibration

- height alignment tolerance: ±1 mm
- center-engagement detection accuracy: ≥ 92%

5.2 Resistance Calibration

- torque deviation ≤ 3%
- adaptive response time < 120 ms

5.3 Choreography Calibration

- transition timing precision: ±0.05 s
- sequencing error rate: < 1 per 500 transitions

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6. Safety Constraints

- automatic shutdown if load index > 85

- resistance reduction if fatigue index > 70
- transition blocking if stability tier < 2
- height lock during instability
- micro-wheel smoothing during operator drift
- emergency stop threshold: sudden load spike > 40%

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7. Assembly Logic

7.1 Assembly Order

1. Base frame
2. Primary Wheel rail system
3. Primary Wheel assembly
4. Micro-Wheel mounts
5. Choreography Ring frame
6. Autonomous subsystem integration
7. MAIL configuration
8. Calibration sequence

7.2 Required Tools

- torque-controlled driver
- alignment gauge
- calibration module
- vibration meter

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8. Maintenance Model

Daily

- visual inspection
- grip surface cleaning

Weekly

- torque variance check
- micro-wheel alignment test

Monthly

- ELMS recalibration
- ARE resistance curve test
- CRHCS height-alignment verification

Annual

- full mechanical teardown
- sensor replacement cycle
- firmware update

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9. Version Notes (v3.1)

ECM v3.1 introduces:

- full engineering specifications
- subsystem tolerances
- mechanical-autonomous interface
- assembly and maintenance models
- safety thresholds
- calibration tolerances

ECM v3.1 is the **engineering anchor** for all future ECM v3.x and ECM v4.x development.

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10. Conclusion

ECM v3.1 transforms ECM v3.0 from a conceptual autonomous device into a **fully specified engineering system**.
It defines the materials, tolerances, subsystems, and safety constraints required to build a reproducible, research-grade Autonomous Emotional Cycling Machine.

ECM v3.1 is the foundation for:

- ECM v3.x refinements
- ECM-Lite
- ECM-X
- ECM v4.0

It is the engineering backbone of the next generation of emotional technology.

ECM Disclaimer Block

(Three-Tier System for All ECM Documents)

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1. Practitioner-Level Disclaimer

Practitioner-Level Disclaimer

The Emotional Cycling Machine (ECM) and all associated protocols, guides, and training materials are **non-clinical, non-diagnostic, and non-therapeutic**.
They are designed exclusively for **educational, developmental, and skills-training purposes** within the Core Emotion Framework (CEF).

ECM practice does **not** assess, treat, or diagnose any psychological, emotional, or medical condition.
ECM should **not** be used as a substitute for mental-health care, psychotherapy, counseling, crisis intervention, or medical treatment.

Facilitators must:

- avoid interpreting emotional content
- avoid eliciting emotional disclosure
- avoid framing ECM as therapy
- stop use immediately if a participant shows signs of distress

Users experiencing acute emotional overwhelm, instability, or crisis should discontinue ECM practice and seek appropriate professional support.

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2. User-Level Disclaimer

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The Emotional Cycling Machine (ECM-Lite) is a **non-clinical educational tool** designed to support emotional awareness, clarity, and modulation.
It is **not** a therapeutic device and does **not** diagnose, treat, or assess any emotional or psychological condition.

Use ECM-Lite gently and discontinue if you feel overwhelmed, distressed, or physically uncomfortable.
ECM-Lite is intended for general emotional-skills practice and should not replace professional mental-health care or medical support.

3. Engineering / Conceptual Disclaimer

Engineering / Conceptual Disclaimer

This document describes the conceptual, mechanical, and engineering architecture of the Emotional Cycling Machine (ECM) within the Core Emotion Framework (CEF).
It is intended for **research, design, and technical reference** only.

The descriptions of emotional states, load, stability, or calibration are **conceptual constructs** within the CEF and are **not** clinical assessments or psychological measurements.
This document does **not** provide therapeutic guidance and should not be interpreted as mental-health instruction.

All emotional terminology is used in a **framework-specific, non-clinical sense**.