

Manufacturing Excellence

Two-Wheeler Electric Vehicle Assembly Process

A comprehensive technical guide covering the complete manufacturing workflow from component preparation to final quality validation



Process Type

Modular Assembly



Complexity

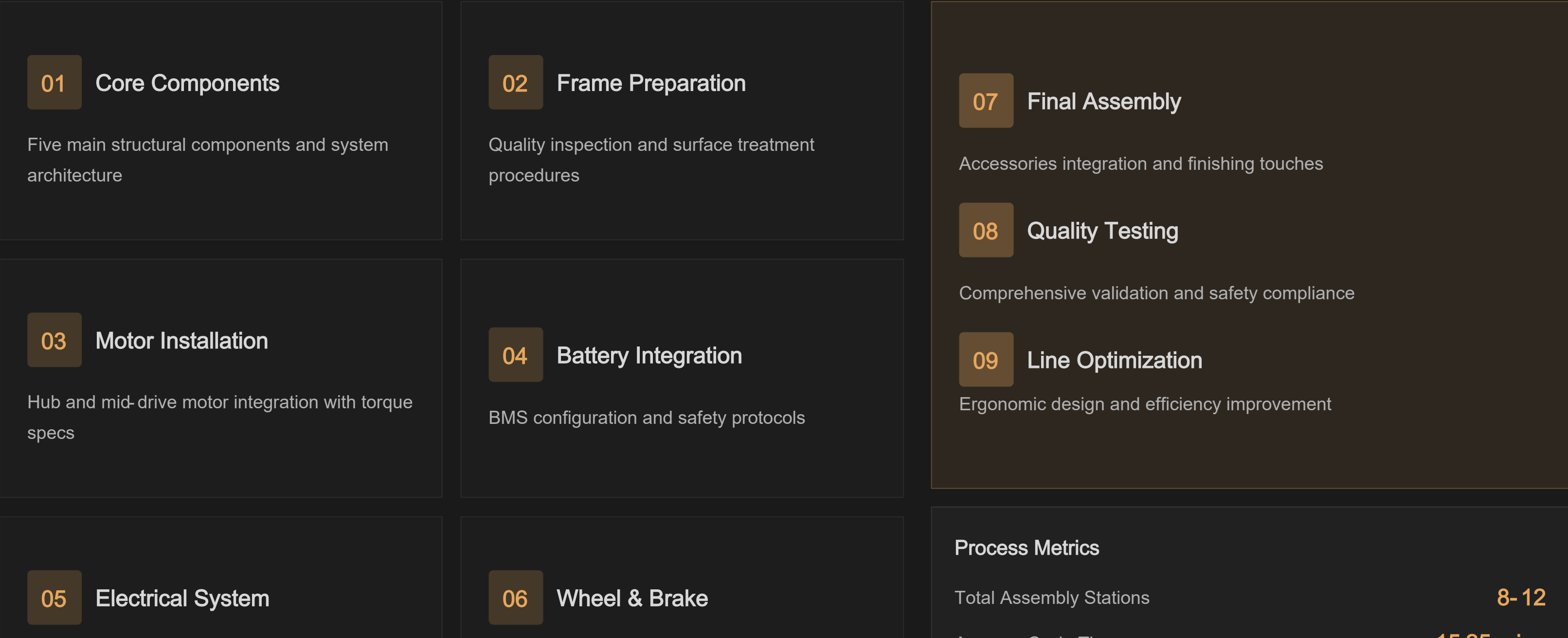
High Precision



Quality Standard

ISO 9001 Certified

Assembly Process Overview



Core Components & System Architecture

Five Main Structural Components

Every electric two-wheeler consists of five fundamental building blocks that form the complete system architecture. These components work in seamless integration to deliver safe, efficient, and reliable electric mobility.



Frame

The structural backbone providing mounting points for all components

- Aluminum Alloy 6061- T6
- Steel (High Strength)
- Carbon Fiber (Premium)



Electric Drive

Converts electrical energy into mechanical motion

- Hub Motor (Front/Rear)
- Mid- Drive Motor
- Power: 250W- 750W+



Controller

Electronic brain managing power delivery and system protection

- Brushless/Brushed
- Regenerative Braking
- Thermal Protection



Battery Pack

Energy storage system with advanced lithiumion cells

- Voltage: 36V/48V/60V
- Capacity: 10-20Ah
- Li-ion Technology

Component Categorization

Mechanical

Frame, drive system (chain/belt), brakes, wheels, tires, suspension

Electrical

Motor, battery, controller, display, sensors, wiring harness

Structural

Suspension systems, accessories (fenders, racks, lights)

System Integration

Hidden wiring harnesses connect all electrical components within the frame, emphasizing "clean integration" for aesthetics and durability.

Overload Protection



Frame Preparation & Quality Inspection

🔍 Visual & Structural Inspection

The assembly process begins with comprehensive frame inspection to ensure structural integrity and dimensional accuracy. Frames are examined for cracks, welding defects, and surface imperfections that could compromise safety or aesthetics.

✔ Crack Detection

Visual and dye penetrant inspection for hairline cracks

✔ Weld Quality

Verify uniform weld beads, no porosity or undercuts

✔ Dimensional Check

CMM measurement against CAD specifications

✔ Surface Finish

Ra roughness measurement and visual consistency

✔ Mounting Points

Thread integrity and hole positioning verification

✔ Alignment

Rear dropout parallelism and head tube alignment

🔧 Surface Treatment Process

After inspection, frames undergo surface preparation and coating application to enhance durability and corrosion resistance.

Degreasing & Cleaning

Step 01

⚙️ Mounting Point Preparation

Final preparation ensures all mounting points are clean, properly threaded, and ready for component installation.

Thread Chasing & Cleaning

Step 02

🧪 Frame Material Properties

Aluminum Alloy

Density: 2.7 g/cm³

Strength: 270-310 MPa

Most Common

Steel

Density: 7.85 g/cm³

Strength: 400-550 MPa

Heavy-Duty

Carbon Fiber

Density: 1.6 g/cm³

Strength: 600-1000 MPa

Premium

📋 Quality Checkpoints

✔ Dimensional accuracy±0.1mm

✔ Surface roughness Ra 1.6µm

✔ No cracks or structural defects

✔ Uniform coating adhesion

Motor Installation & Drivetrain Integration

Motor Type Selection & Installation

Motor selection depends on application requirements, terrain, and load capacity. Proper installation ensures optimal performance and longevity.

Hub Motor Installation

Mounted directly in wheel hub for simplicity and cost-effectiveness.

Position: Front or Rear Wheel

Torque: 35-80 Nm

Power: 250W - 500W

Mid-Drive Motor

Mounted at crankset for better torque and weight distribution.

Position: Bottom Bracket

Torque: 60-120+ Nm

Power: 250W - 750W+

Torque Selection Guide

Urban Commuting

City riding, moderate hills, light loads

60-70 Nm

Commercial Delivery

Stop-and-go, medium loads, frequent use

70-85 Nm

Heavy-Duty Logistics

Steep inclines, 200kg+ payloads, industrial

85-120+ Nm

Installation Procedure

1

Mount Motor

Secure with torque arms, align properly.

2

Connect Drivetrain

Install chain/belt, set tension and alignment.

3

Wire Controller

Connect motor, sensors, and battery.

4

Install Sensors

Mount speed and torque sensors.

5

Test & Calibrate

Verify operation, calibrate controller.

Battery Integration & BMS Configuration

⚠ Most Delicate Assembly Step

Battery integration is the most critical and delicate operation. It requires specialized training, ESD protection, and stringent safety protocols to prevent thermal runaway and ensure long term reliability.



Battery Specifications

Modern e-vehicles use lithium-ion packs for high energy density and long cycle life.

Voltage:	36V/48V/60V
Capacity:	10-20Ah
Energy:	360- 1200Wh
Cycle Life:	800 - 1500



BMS Functions

The Battery Management System is the brain, ensuring safe and optimal operation.

- ✓ Cell Balancing
- ✓ Voltage/Current Monitoring
- ✓ Temperature Sensing
- ✓ Short Circuit Protection

🛡 Safety Protocols

⚠ **Overcharge Protection**
Prevents charging beyond max voltage, avoiding thermal runaway.

🔧 **Thermal Management**
Monitors cell temperatures and activates cooling if limits are exceeded.

⚡ **Short Circuit Prevention**
Detects and isolates shorts within microseconds to prevent damage.

🔌 BMS Wire Harness Integration

The wiring harness connects all components, using highquality connectors for reliable communication.

Voltage Sense Wires	Temperature Sensors
Communication CAN Bus	Power Distribution

Electrical System & Wiring Harness

System Integration & Clean Routing

The electrical system integrates all electronic components into a cohesive network. Modern designs emphasize "clean integration" with minimal exposed wiring for aesthetics, durability, and protection.

Controller

The electronic brain managing power, acceleration, and safety.

Mounting: Central frame, protected

Throttle

Twist grip or thumb throttle for variable speed control.

Position: Right handlebar, ergonomic

Display Unit

LCD/LED display for speed, battery, mode, and diagnostics.

Features: Backlight, USB charging

Lighting

LED headlight, taillight, turn signals for safety.

Power: 12V/24V DC, 515W

Electrical Safety Testing

Rigorous testing ensures safety, reliability, and compliance.

Insulation

Hi-Pot test to verify insulation integrity.

Grounding

Continuity test for grounding.

Function

Verify all functions work correctly.

Connector Types

Bullet

Secure, high current connections

Motor

Deutsch

Waterproof, vibration - resistant

Controller

JST

Compact signal connections

Sensors

Protection Ratings

Waterproofing

IP67

Vibration

✓

Temperature

-20°C to 60°C

Wheel Assembly & Brake System Installation

● Wheel Assembly & Tire Setup

Proper wheel assembly ensures stability, efficiency, and safety. Tire selection impacts traction, rolling resistance, and ride comfort.

🛞 Rim & Spoke

Check rim integrity, spoke tension, and hub bearing smoothness.

Spoke Tension: Uniform & within spec

Lateral Runout: < 0.5mm deviation

📐 Wheel Truing

Adjust spoke tension for lateral and radial alignment.

Lateral Error: < 0.3mm

Radial Error: < 0.5mm

🔄 Tire Selection & Pressure Specifications

Urban		Mountain		Hybrid	
Size:	700c	Size:	26"-29"	Size:	27.5"-28"
Pressure:	50-70 PSI	Pressure:	30-50 PSI	Pressure:	40-65 PSI

⚙️ Hydraulic Disc Brake Setup

Hydraulic systems provide superior stopping power and modulation.

1. Caliper Mounting

Align to rotor, torque bolts to 5-7 Nm.

2. Rotor Installation

Clean hub, mount rotor, torque to 4-6 Nm.

3. Brake Line & Bleeding

Route carefully, bleed system for firm lever feel.

🛡️ Brake Safety Standards

Lever Force: < 150N

Stopping Distance: < 5m @ 25km/h

Fade Resistance: ✓

Final Assembly & Accessories Integration

Completing the Assembly

The final stage focuses on ergonomic adjustments, accessory installation, and comprehensive pre-delivery inspection. Every component must be properly aligned and torqued.

Handlebar

Align and adjust for ergonomics. Torque clamp bolts to 57 Nm.

Adjustment: Height/Angle

Saddle

Mount and adjust height for proper leg extension (2530° at bottom dead center).

Height: Inseam - 5cm

Chain/Belt

Install and tension. Check alignment. Lubricate chain.

Deflection: 10-15mm

Pedals

Install on crank arms. Apply grease to threads. Torque to 3035 Nm.

Thread: 9/16" (R/L)

Torque Specifications & Thread Locking

Proper torque and thread locking is critical for safety and reliability.

Fastener

M6: 8- 10, M8: 1825, M10: 30-40 Nm






Thread Locker

Apply to critical fasteners (motor, brakes)

Critical

Double-check all fasteners before shipping

Pre-Delivery Inspection

-  Verify all fasteners
-  Check component alignment
-  Test electrical functions
-  Verify tire pressure
-  Final cleaning

Packaging & Documentation

Protection

Foam, cardboard, and plastic to prevent damage.

Documentation

Manual, warranty, charger, keys, and certificates.

Quality Testing & Validation Procedures

Multi-Stage Quality Validation

Every vehicle undergoes rigorous testing to ensure safety, performance, and reliability. Testing covers electrical safety, mechanical integrity, and roadworthiness.

Functional

Verify all electrical and mechanical systems operate correctly.

- ✓ Motor performance
- ✓ Battery output
- ✓ Controller response

Safety

Ensure safetycritical systems meet regulatory standards.

- ✓ Electrical (Hi Pot)
- ✓ Brake performance
- ✓ Lighting function

Road Testing

Real world testing for ride quality, handling, and performance.

- ✓ Stability & handling
- ✓ Acceleration/braking
- ✓ Noise & vibration

Waterproof

Verify water resistance for reliable operation in wet conditions.

- ✓ IP67 rating verified
- ✓ Connector seals
- ✓ No water ingress

Defect Classification

Critical

Motor failure, brake malfunction, battery short.

Safety Risk

Major

Battery not charging, display malfunction.

Function Affected

Minor

Surface scratches, misaligned decals.

Cosmetic

Compliance Standards

CE

UL

EN 17128

ISO 9001

Production Line Optimization & Ergonomics

Ergonomic Workstation Design

Optimized workstations use ergonomic principles to reduce fatigue, prevent injury, and improve productivity. Adjustable height and proper reach zones are key.

Adjustable Height

Tables adjustable from 95-114cm accommodate 90% of operators.

Range: 95-114cm (5th-95th percentile)

360 ° Rotation

Rotating clamps allow access to all frame areas without repositioning.

Benefit: Reduces operator fatigue

Line Balancing Optimization Results

Using RPW methods, line balancing achieves dramatic efficiency improvements.

Line Efficiency	Idle Time	Balance Delay
85.2% <small>(from 33.4%)</small>	73min <small>(from 149)</small>	14.7% <small>(from 66.5%)</small>

Assembly Line Layout

- 1

Frame Prep
Inspection & surface treatment
- 2

Motor Install
Motor & drivetrain integration
- 3

Battery & BMS
Battery integration & wiring
- 4

Electrical
Controller, display, & lighting
- 5

Wheels & Brakes
Wheel assembly & brake setup
- 6

Final Assembly
Accessories & pre-delivery inspection
- 7

Quality Testing
Comprehensive validation

Automation & Smart Tech

- 3D Sensing**

Real-time workstation adjustment
- PLC Control**

Programmable logic for sequencing
- MES Integration**

Manufacturing execution system

Manufacturing Excellence Through Precision Assembly

Excellence in electric two-wheeler manufacturing is achieved through meticulous attention to every detail of the assembly process, from component preparation to final validation.



Quality Control

8-stage validation process ensures every vehicle meets standards



Line Efficiency

85%+ efficiency through ergonomic design and line balancing



Safety Standards

Full compliance with CE, UL, EN 17128, ISO 9001



Worker Safety

Ergonomic workstations reduce injury risk and improve productivity



Systematic. Precise. Reliable.

The assembly line that drives the future of electric mobility