

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

01 Core Components

Five main structural components and system architecture

02 Frame Preparation

Quality inspection and surface treatment procedures

03 Motor Installation

Hub and mid-drive motor integration with torque specs

04 Battery Integration

BMS configuration and safety protocols

05 Electrical System

06 Wheel & Brake

07 Final Assembly

Accessories integration and finishing touches

08 Quality Testing

Comprehensive validation and safety compliance

09 Line Optimization

Ergonomic design and efficiency improvement

Process Metrics

Total Assembly Stations

8-12

Line Speed (St/h)

15-25

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+



Battery Pack

Energy storage system with advanced lithium-ion cells

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



Controller

Electronic brain managing power delivery and system protection

- Brushless/Brushed
- Regenerative Braking
- Thermal Protection

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

Q 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

Most Common

Strength: 270-310 MPa

Steel

Density: 7.85 g/cm³

Heavy-Duty

Strength: 400-550 MPa

Carbon Fiber

Density: 1.6 g/cm³

Premium

Strength: 600-1000 MPa

Quality Checkpoints

- ✓ Dimensional accuracy $\pm 0.1\text{mm}$
- ✓ Surface roughness Ra $1.6\mu\text{m}$
- ✓ 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

60-70 Nm

City riding, moderate hills, light loads

Commercial Delivery

70-85 Nm

Stop-and-go, medium loads, frequent use

Heavy-Duty Logistics

85-120+ Nm

Steep inclines, 200kg+ payloads, industrial

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 high quality 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

Display Unit

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

Features: Backlight, USB charging

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

Size:

700c

Pressure:

50-70 PSI

Mountain

Size:

26"-29"

Pressure:

30-50 PSI

Hybrid

Size:

27.5"-28"

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 46 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

Chain/Belt

Install and tension. Check alignment. Lubricate chain.

Deflection: 10-15mm

Saddle

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

Height: Inseam - 5cm

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 safety critical 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

EN 17128

UL

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

85.2% (from 33.4%)

Idle Time

73min (from 149)

Balance Delay

14.7% (from 66.5%)

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