

Refrigerator Assembly Line

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This assembly line is designed for refrigerator final assembly, utilizing a modular and standardized architecture compatible with mainstream household and commercial refrigerator models for continuous production. The line comprises a conveyor system, assembly stations, inspection units, logistics interfaces, and a central control system, facilitating the complete process from cabinet infeed to finished product outfeed.

I. Conveyor System

The main line utilizes heavy-duty roller conveyors with adjustable pitch and a load capacity ≥ 500 kg/m. Guide rails are installed along both sides of the track to ensure cabinet stability during transfer. Conveyor speed ranges from 0.5–2.0 m/min, featuring variable frequency drive synchronized with upstream stamping, foaming, and pre-assembly stages. Lift-and-rotate mechanisms are integrated at designated stations to enable multi-angle access for assembly and inspection.

II. Assembly Station Layout

The line consists of 12 standard assembly stations sequenced as follows:

1. **Cabinet Pre-assembly:** Installation of liners, doors, and gaskets.
2. **Refrigeration System Mounting:** Installation of compressors, condensers, evaporators, and tubing.
3. **Electrical System Integration:** Connection of main control boards, power cords, and sensor harnesses.
4. **Door Hinge & Latch Installation.**
5. **Trim Part Assembly:** Mounting of front panels, handles, and decorative strips.
6. **Functional Test:** Operation of refrigeration cycle, temperature response, and noise level measurement.
7. **Leak Detection:** Negative pressure leak testing; leakage rate ≤ 5 Pa/min.
8. **Energy Performance Calibration:** Connection to test rigs for recording power consumption and cooling capacity.
9. **Pre-packaging Preparation:** Labeling, barcode scanning, and protective film wrapping.
10. **Finished Product Packaging:** Bagging, boxing, and case sealing.
11. **Outfeed Buffer Zone:** Equipped with AGV docking interfaces for product transfer.
12. **Exception Handling Station:** Manual intervention point with audible/visual alarms and emergency stop devices.

III. Inspection & Control System

The line integrates a PLC + SCADA central control system. Sensors at each station provide real-time operational feedback. Key parameters—including current, voltage, pressure, temperature, and rotational speed—are acquired and stored in the MES. Out-of-tolerance data triggers a line stop and logs fault codes for unit-level traceability. Inspection stations employ industrial cameras and laser distance sensors to verify dimensional accuracy, such as door gap uniformity and panel flatness.

IV. Logistics & Interfaces

The infeed interfaces with the cabinet conveyor line; the outfeed connects to packaging areas and warehouse AGV channels. Inter-station buffers and error-proofing mechanisms prevent material congestion or empty slots. The system supports integration with ERP/MES platforms for production scheduling, work order tracking, and quality data feedback.

V. Technical Specifications

- **Throughput:** ≥ 300 units/hour (model-dependent)
- **Equipment Uptime:** $\geq 95\%$
- **Defect Rate (Post-inspection):** $\leq 0.3\%$
- **Power Supply:** 380 V / 50 Hz, 3-phase, 5-wire
- **Air Supply:** 0.6–0.8 MPa clean compressed air
- **Environment:** Temperature 15–30°C, Humidity 40–70% RH; dust-free and non-corrosive atmosphere

The assembly line features a compact structure and high scalability, allowing rapid reconfiguration of station layouts to accommodate product iterations. It is suitable for mass manufacturing environments, balancing throughput, quality assurance, and traceability, providing stable technical support for refrigerator production.