

Entities & Attributes

Customer

- customer_id (PK)
- cust_name
- cust_email
- cust_phone
- cust_address

Manufacturer

- manufacturer_id (PK)
- manufacturer_name
- manufacturer_website

Product

- product_id (PK)
- manufacturer_id (FK)
- model_type
- model_price
- min_order_qty
- scale
- product_name

Inventory

- product_id (PK, FK)
- qoh
- reorder_level

Invoice

- invoice_number (PK)
- customer_id (FK)

- invoice_date
- total_amount
- shipping_charge
- invoice_status

Line

- invoice_number (FK)
- line_number (PK)
- product_id (FK)
- line_units
- unit_price
- line_status
- ship_date

Shipment

- shipment_id (PK)
- invoice_number (FK)
- line_number (FK)
- qty_shipped
- ship_date
- tracking_number
- shipment_status

Constraints

- Each customer_id, manufacturer_id, product_id, invoice_number, shipment_id, and line_number must be unique, not null, and numeric.
- cust_phone must have 10 digits.
- model_price, unit_price, and total_amount must be greater than or equal to 0.
- line_units, min_order_qty, and qty_shipped must be positive integers.
- invoice_status ∈ {Open, Partially Shipped, Closed}.

- `line_status` \in {Backordered, Partial, Fulfilled}.
- `shipment_status` \in {Created, Shipped, Delivered}.
- `model_type` \in {Car, Aircraft, Ship, Decal}.
- scale must match one of the standard values (1/144, 1/100, 1/72, 1/48, 1/35, 1/32, 1/24).
- `manufacturer_id` in Product must exist in Manufacturer.
- `product_id` in Inventory, Line, and Shipment must exist in Product.
- `customer_id` in Invoice must exist in Customer.
- `invoice_number` in Line and Shipment must exist in Invoice.
- `qty_shipped` for a line may not exceed `line_units`.
- A shipment's `ship_date` must be on or after `invoice_date`.
- If $qoh \leq reorder_level$, system triggers reorder of at least `min_order_qty`.

Business Rules

1. A customer may generate many invoices.
2. Each invoice belongs to one customer.
3. Each invoice can have many lines (products ordered).
4. Each line belongs to one invoice and references one product.
5. A product can appear on many lines.
6. A manufacturer can produce many products.
7. Each product has one inventory record.
8. Each invoice can have multiple shipments.
9. Each line can have multiple shipments (for partial delivery).
10. Backorders are handled by comparing `line_units` vs. `qty_shipped`.
11. Customers are billed only when items ship.
12. Line and invoice statuses update automatically based on shipments.

Assumptions

- The invoice acts as the "order header." No separate order table is needed.

- Shipment table captures partial deliveries.
- Inventory tracks current quantity (qoh) and triggers reorder using reorder_level and min_order_qty.
- Decals and models share the same Product table, distinguished by model_type.
- Prices are snapshotted in the Line table and do not change with later price updates.
- CC Bank (credit card processor) is external and not part of this model.
- One-to-one: Product ↔ Inventory
- One-to-many: Customer ↔ Invoice, Manufacturer ↔ Product, Invoice ↔ Line, Line ↔ Shipment