

Readme – Ex2 Group 8

Group: 08

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1. Overview:

This program creates a fully automated control system for the "Auto-Ein Bar" bakery line, developed as part of Assignment B for the Automation course. The application uses PLC ladder logic to manage the entire production lifecycle—from raw material inventory management and kneading to temperature-controlled proofing, baking, and quality assurance based on analog sensor inputs.

2. Operator Manual:

This section outlines the standard operating procedures for running the production line, including startup, daily production loops, and shutdown.

A. Pre-Operation Setup: The project file is pre-configured with the required variables in the Watch1 window. Before starting the operation, you must enter valid initial inventory values into the following input registers to satisfy the start-up conditions:

- D1110: Flour (Input1_kemach)
- D1120: Water (Input2_water)
- D1130: Yeast (Input3_shmarim)
- D1140: Oil (Input4_oil)
- D1150: Spices (Input5_tavlinim)

B. Standard Production Workflow: The process is linear. Please execute the steps in the following order:

1. Start of Day:

- **Action:** Press Switch X10.

- **Indicator:** Lamp **Y10** turns ON and remains lit.
- **Note:** The machine will not start if the flour inventory is below 100kg or if the raw material ratios are insufficient.

2. Material Preparation:

- **Action:** Switch ON **X2**.
- **Process:** Materials are weighed and transferred from inventory to the mixing containers.
- **Indicator:** Lamp **Y5** turns ON for 3 seconds.

3. Kneading:

- **Action:** Switch ON **X1**.
- **Process:** Materials move to the mixer and kneading begins.
- **Indicator:** Lamp **Y1** turns ON (remains on until proofing starts).

4. Proofing:

- **Action:** Perform a **Double-Click** on Switch **X11**.
- **Process:** Dough moves to the proofing chamber.
- **Indicator:** Lamp **Y1** turns OFF. Lamps **Y2** and **Y3** blink alternately for 3 seconds.

5. Baking:

- **Action:** Automatic (No operator intervention required).
- **Process:** Dough moves to the oven immediately after proofing.
- **Indicator:** Lamp **Y4** turns ON for 4 seconds.

6. Quality Assurance (QA):

- **Action:** Switch ON **X3**.
- **Process:** The system samples the Analog Input (D8281). The valid range is **1 to 5**.
 - **Pass:** Lamp **Y6** turns ON for 5 seconds. The loaf is moved to the shelf.
 - **Fail:** Lamp **Y6** remains OFF. The operator must retry (toggle **X3**).
 - **Failure:** If the test fails twice, the batch is discarded, and the tray resets.

7. Batch Completion & Reset:

- **Action:** Wait for Lamp **Y6** to turn OFF (or for the discard process to finish).
- **Reset:** Turn OFF (Down) all switches that are currently up (**X1, X2, X3**).
- **Next Batch:** The system is now ready. Start again from **Step 2 (Switch X2)**.

3. Continuous Operation & End of Day

A. Multi-Iteration Production

The system supports continuous production.

- Once the switches are reset (Step 7), immediately raise **X2** to begin the next loaf.
- Production continues as long as sufficient inventory remains in the registers.

B. End of Day Procedure

The operational day ends automatically in two scenarios:

1. **Inventory Depletion:** If raw materials drop below the required minimum for a new batch.
2. **Emergency Stop:** If the operator presses **X7**.

Visual Indicator: Upon termination, Lamp **Y10** will blink for 3 seconds and then turn OFF. All system variables and timers will reset automatically.

4. Safety Mechanisms & Edge Cases

The program implements specific logic to handle the edge cases described in the project report:

1. **Prevention of False Positive QA (Y6 Safety):** The system ensures that the "Quality Passed" indicator (Y6) never turns ON solely based on a valid analog sensor reading. It strictly requires the operator's activation of switch **X3** to validate the signal and approve the loaf.
2. **Emergency Stop Resource Handling (X7):** Pressing the Emergency Stop (**X7**) halts the machine immediately. The logic accounts for the fact that raw materials are consumed at the start of the cycle; therefore, a mid-cycle stop correctly resets the

system for a new day while acknowledging the consumed materials of the interrupted batch.

3. **Strict Sequential Processing:** The code enforces a linear progression. For example, the Proofing stage cannot begin until the Kneading stage has fully completed. This prevents the operator from skipping critical production steps.
4. **QA Retry Limiter:** To prevent infinite testing loops, the system counts the attempts on switch **X3**. If a third attempt is made, the system ignores the check, forcing the operator to reset the batch (simulating a discard of the failed loaf).
5. **Inventory Validation (Negative Inputs):** To handle potential user errors in the Watch Window (e.g., entering negative inventory values), the system relies on the strict condition that Flour must be at least 100kg. This serves as a master validation check to prevent the machine from running with invalid data.
6. **Continuous Production Logic:** The system is designed to support multiple consecutive iterations within a single "Day." The inventory logic dynamically updates after each stage, allowing the machine to immediately start a new loaf cycle if sufficient raw materials remain, without requiring a system restart.