Skills Alberta - Skill 19

Industrial Control

Post-Secondary Competition

Day 2 - 2026

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1. General Description

1.1 Contextualization

Edmonton International Airport (EIA) is the primary air passenger and air cargo facility for the Province of Alberta's capital city. It is a hub facility for Northern Alberta and Northern Canada providing regularly scheduled non-stop flights to over fifty communities in Canada, the United States, Latin America and Europe. It is Canada's largest major airport by total land area, and 5th busiest airport by passenger traffic. The Skill 19 project represents that portion of automated process for sorting and transporting passenger luggage within EIA.

1.2 Terminology Definitions

1.2.1 Lit light

When the sequence describes a lit light, it means that light will be continuously ON.

1.2.2 Flashing light

When the sequence describes a flashing light, it means that light will be cycling continuously ON for 1 sec and OFF for 1 sec

1.2.3 Fast flashing light

When the sequence describes a flashing light, it means that light will be cycling continuously ON for 0.5 sec and OFF for 0.5 sec

1.3 Process Diagram
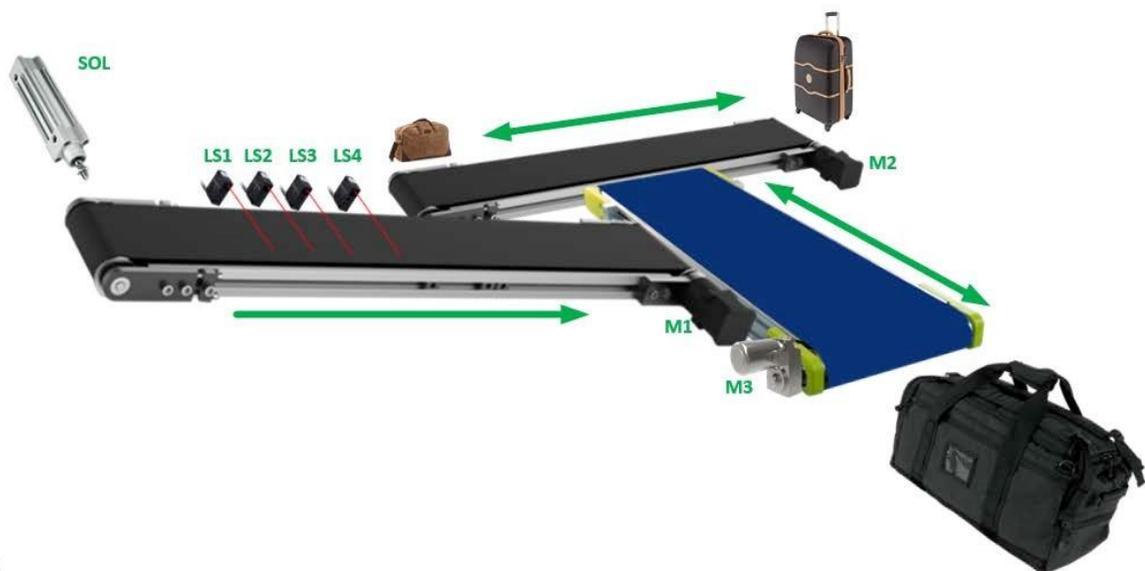
1.4 Process Equipment Function

This section describes the function of each component use in the process.

1.4.1 Indicating lights - Wall (L1& L2)

The indicating lights are used to indicate the process state.

1.4.1.1 Amber indicating light – Wall (L1)

This indicating light indicates that the process is running, in either manual or automatic mode, or in clear out sequence.

1.4.1.2 White indicating light - Wall (L2)

This indicating light is indicating that the process is ready to start or that the process needs to be reset.

1.4.2 Green pilot light – Door (L4)

This pilot light is indicating the detection of luggage's size in automatic mode or the size selection in manual mode.

1.4.3 Solenoid (SOL)

The solenoid controls a pneumatic actuator, which controls baggage access to the conveyor distribution system. The solenoid must be energized to allow baggage to access the conveyor system. The solenoid is simulated with a white pilot light.

1.4.4 Blue pilot light - Door (L5)

This pilot light is indicating that energy is available to the PLC's outputs.

1.4.5 Red pilot light - Door (L6)

This pilot light is indicating that an over-height baggage is detected

1.4.6 Maintained 3 position selector switch (SS1)

This selector will be used to select between manual operation (Hand), stopped process (OFF) or automatic operation (AUTO). The process will not start, or run, if the selector is in the center position (OFF).

1.4.7 Maintained 3 position selector switch (SS2)

This selector will be used to select baggage size between small, regular and oversized while in manual mode. Left position is small size, center position is regular size and right position is oversized.

1.4.8 Emergency Stop push-pull button (PB1)

As described in material portion (Day 1) documentation, this button is activating the MCR/emergency Stop circuit which de-energize all of the PLC's outputs.

1.4.9 Green Momentary Push button (PB2)

This push button will be used to start the process in either automatic or manual mode.

1.4.10 Red Momentary Push button (PB3)

This push button will be used to stop the process in either automatic or manual mode. (non-emergency condition).

1.4.11 Black Momentary Push button (PB4)

This push button will be used to reset the process in either automatic or manual mode.

1.4.12 3 Pole Contactor (K1)

This contactor is feeding the unidirectional Sorting Belt Conveyor motor (M1)

1.4.13 3 Pole Forward-Reverse Contactor (K2)

This contactor is feeding the bidirectional Size Belt Conveyor motor (M2). The forward direction is sending luggage to the regular size side while the reverse direction is sending luggage to the small size side.

1.4.14 3 Pole Forward-Reverse Contactor (K3)

This contactor is feeding the bidirectional distribution belt motor (M3). The forward direction is sending luggage to the size belt side while the reverse direction is sending luggage to the oversized side.

1.4.15 Optical sensors [Limit switches] (LS1 to LS4)

The optical sensors are replaced by limit switches for the purpose of this project. They are used to detect the baggage size.

2. Off Mode Description

When the mode selector (SS1) is in the center position (OFF), all the outputs will be de-energized except for the blue pilot light (L5). This output shall be activated at all times (including when the process is stopped) which will result in having the pilot light constantly lit as long as the emergency stop button is not pressed.
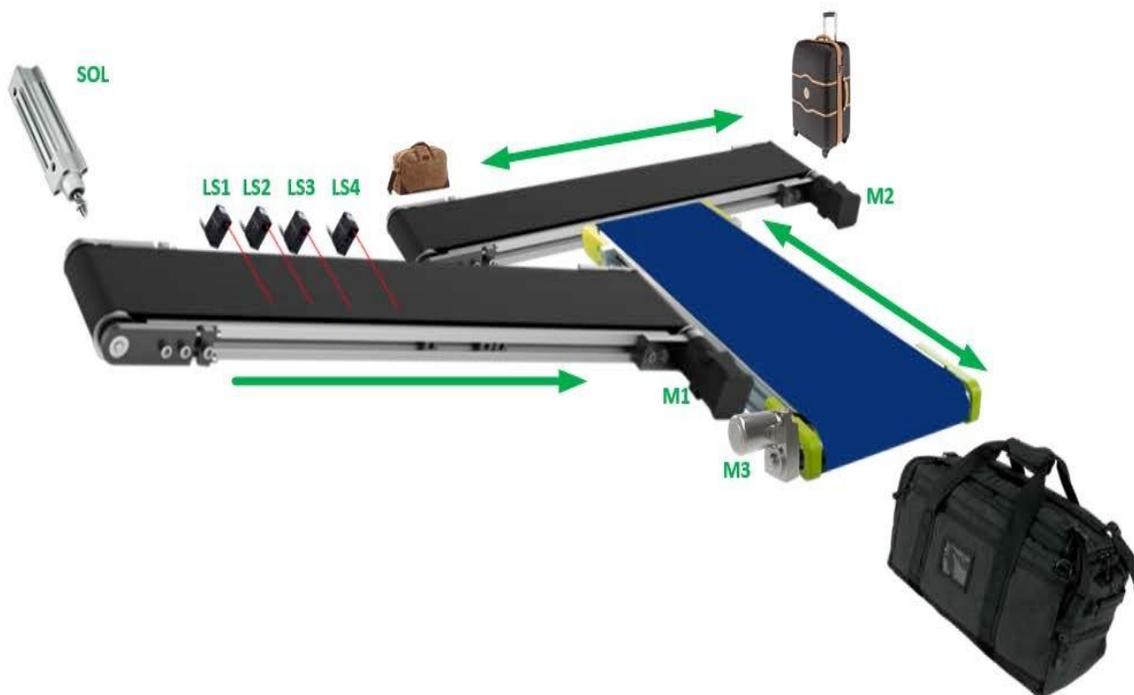
3. Manual Mode Description

The purpose of the Manual mode is to have the baggage sorting and transporting operation work under the direct supervision of the operator.

There is no size detection in this mode as the operator selects the destination of the luggage. The operator will take care of manually removing any over-height baggage and bring them to the oversized area.

3.1 Initialization and process start

In order to start the process in Manual mode, the selector switch SS1 must be in the Manual position. The white indicating light (L2) will flash announcing to the operator that the process is ready to start in manual mode. All other outputs are de-activated except for the blue pilot light (L5).

The operator needs to select the luggage size with selector switch SS2, then the operator will start the process by pressing the green push button (PB2).

3.2 Manual process

Once the manual mode is started by pressing PB2:

- The solenoid (SOL) will be activated
- The white indicating light (L2) will be de-energized
- The amber indicating light (L1) will light.
- The green pilot light (L4) will indicate the size selection:
  - Flashing if small size is selected
  - Lit if regular size is selected
  - Fast Flashing if oversized is selected
- The sorting belt (K1) will be energized
- The distribution belt will run in the oversized direction (K3_R) if oversized is selected, otherwise it will run in the size belt direction (K3_F)
- The size belt will run in the small direction (K2_F) if small size is selected or in the regular direction (K2_R) if regular size is selected. It won't be running if the oversized is selected.
- The Solenoid will be deactivated by LS1 and re-activated by LS4

Once the process starts, the process must be stopped before selecting another luggage size. SS2 position change won't have any effect on the process.

3.3 System Stop

To normally stop the process, the operator needs to press the red push button (PB3) and the following will occur:

- All the running belt conveyors will stop
- Solenoid will deactivate
- The green pilot light (L4) and the amber indicating light (L1) will be turned off
- The white indicating light (L2) will flash indicating that the manual mode is back to its "ready to start" state, which means the operator can start the process again by pressing the green push button (PB2).

4. Automatic Mode Description

The purpose of the Automatic mode is to have the baggage sorting and transporting operation work without the direct supervision of the operator.

There is a size detection in this mode as the operator doesn't have to select the destination of the luggage. When required, the operator will still have to take care of manually removing any over-height baggage and bring them to the oversized area.

4.1 Initialization and process start

In order to start the process in Automatic mode, the selector switch SS1 must be in the Auto position. The white indicating light (L2) will light announcing to the operator that the process is ready to start in automatic mode. All other outputs are deactivated except for the blue pilot light (L5).

Before starting the process in automatic mode, the operator must make sure no baggage remains on any belt as it may end in an improper destination.

The operator starts the process by pressing the green push button (PB2).

4.2 Automatic process

Once the automatic mode is started:
- The white indicating light (L2) will be de-energized
- The amber indicating light (L1) will light
- The sorting belt will run (K1)
- The solenoid (SOL) will be activated (pneumatic actuator will allow new luggage to access the sorting belt)

Then, the process will endlessly wait for a luggage size detection.

As soon as the first proximity sensor (LS1) detects a luggage, the solenoid (SOL) will be deactivated, keeping new luggage from entering the process.

Once the luggage is delivered in the appropriate destination (see size detection section for details), the solenoid will be re-activated to allow new luggage to be sorted. This process will cycle as long as the process is not stopped.

4.3 Size detection

Once detected on the running Sorting Belt, all passenger baggage will be sorted into one of three (3) categories, based on size: Small, Regular and Oversized. This size evaluation will happen when the luggage reaches the 4th proximity sensor (LS4).

4.3.1 Small size detection

When the 4th proximity sensor is activated, if only the 3rd sensor (LS3) is detecting, this means a small luggage is on the sorting belt and the following will occur:

- The distribution belt will run in the size belt direction (K3_F)
- The size belt will run in the small direction (K2_F)
- The green pilot (L4) light will flash
- After a delay of 10 seconds
    - The distribution belt (K3_F) will stop.
- After an additional delay of 5 seconds:
    - The size belt (K2_F) will stop
    - The green pilot (L4) light will turn off.

4.3.2 Regular size detection

When the 4th proximity sensor is activated, if only the 2nd and 3rd sensor LS2 & LS3) are detecting, this means a Regular luggage is on the sorting belt and the following will occur:

- The distribution belt will run in the size belt direction (K3_F)
- The size belt will run in the Regular direction (K2_R)
- The green pilot (L4) light will be lit
- After a delay of 10 seconds
    - The distribution belt (K3_F) will stop.
- After an additional delay of 5 seconds:
    - The size belt (K2_R) will stop
    - The green pilot (L4) light will turn off.

4.3.3 Over-length size detection

When the 4th proximity sensor is activated, if all sensors (LS1, LS2 & LS3) are detecting, this means an over-length luggage is on the sorting belt and the following will occur:

- The distribution belt will run in the size oversized direction (K3_R)
- The green pilot (L4) light will fast flash
- After a delay of 10 seconds
  - The distribution belt (K3_R) will stop.
  - The green pilot (L4) light will turn off.

4.3.4 Over-height detection

Between the first (LS1) and the second sensor (LS2) there is a height barrier (not shown in the process diagram) that keeps over-height baggage from entering the sorting process. If a bag is simply "standing up", it will fall on the sorting belt and keep going on its journey.

This means that if a luggage is held in front of the first sensor (LS1) for more than 5 seconds without activating the second sensor (LS2), an over-height baggage is on the sorting belt and the following will occur:

- The sorting belt will stop (K1)
- The red pilot (L6) light fast flash to warn the operator an over-height baggage is detected

The operator then needs to manually remove the luggage from the sorting belt and bring it to the oversized area.

The operator will then be able to restart the process using the black push button (PB4).

Once the process is restarted, the red pilot light will turn off and the sorting belt (K1) will restart. The process will wait again for a luggage size detection.

5. Emergency Stop

In either manual or automatic mode, upon the activation (push) of the emergency stop button (PB1):

- All Outputs are de-energized by the MCR
- The solenoid (SOL) will be de-energized
- The amber indicating light (L1) will turn off
- The white indicating light (L2) will flash to warn the operator that the process needs to be reset upon reset of the e-stop button (PB1)*

[*: as all the outputs are de-energized by the MCR, the reaction of the controls will only be visible when the E-stop button (PB1) will be pulled back to its non-activated state.]

As long as the emergency stop button is pushed, the operator won't be able to reset the process.

Once the emergency stop button is pulled, no belt should run, the operator will be able to reset the process using the black push button (PB4).

Once the process is reset, the white indicating light (L2) will become lit or flash, indicating that the original mode is back to its "ready to start" state; which means the operator can start the process again by pressing the green push button (PB2).

L5 will become lit indicating power to PLC outputs

6. Input and Output Table

The following tables are a recommended assignment of the inputs and outputs for your programmable control. As controllers vary in how they are connected and function, you must check your PLC to see if these assignments are suitable.

6.1 Inputs

Input Detail	Symbol	Contact Type	PLC inputs Assignment	Information supplied at state (1)
Master Control Relay / Emergency Stop Circuit	MCR	NO	In0	E-Stop Button not pressed
Green push button	PB2	NO	In1	Button pressed
Red push button	PB3	NC	In2	Button not pressed
Black push button	PB4	NO	In3	Button pressed
3 positions Selector Switch 1 - Left Position	SS1_1	NO	In4	Selector in HAND position (Left)
3 positions Selector Switch 1 - Right Position	SS1_3	NO	In5	Selector in AUTO position (Right)
3 positions Selector Switch 2 - Left Position	SS2_1	NO	In6	Selector in SMALL position (Left)
3 positions Selector Switch 2 - Right Position	SS2_3	NO	In7	Selector in OVERSIZED position (Right)
Optical sensor 1	LS1	NO	In8	Limit switch not activated
Optical sensor 2	LS2	NO	In9	Limit switch not activated
Optical sensor 3	LS3	NO	In10	Limit switch not activated
Optical sensor 4	LS4	NO	In11	Limit switch not activated

6.2 Outputs

Amber indicating light - Wall	L1	Q0	Light ON
White indicating light - Wall	L2	Q1	Light ON
Solenoid	SOL	Q2	Light ON (Imitating Solenoid Operating)
Green pilot light - Door	L4	Q3	Light ON
Blue pilot light - Door	L5	Q4	Light ON
Red pilot light - Door	L6	Q5	Light ON
Contactor K1	K1	Q6	Contactor activates
Contactor K2 Forward	K2_F	Q7	Contactor activates
Contactor K2 Reverse	K2_R	Q8	Contactor activates
Contactor K3 Forward	K3_F	Q9	Contactor activates
Contactor K3 Reverse	K3_R	Q10	Contactor activates

7. Completion Checklist

- Overcurrent devices are in the closed position (on)

- Main Disconnect in the open position (off)

- Emergency Stop in the closed position (pulled out)

- SS1 and SS2 in the middle position

- Control panel door cleaned, closed, and secured

- Floor of work area clean and free of hazards

- Labels on wall mounted devices, control panel door devices, overcurrent devices, and contactors

Process testing will begin with the operator closing the disconnect, selecting the mode and pressing start.