Targets:

The device should be able to transport an object weighing up to 2 pounds at a speed of 1 foot per second.

The device should be able to distinguish the material of the objects between metal and non-metal objects. Distinguish the size of the object into two ranges, 1-2 inches square 2-4 inches square. The device must be able to make these decisions within one second of the object passing in front of the sensor, and with an accuracy rate no lower than 98%

The device must be controlled by an industry recognizable Allen-Bradley Programmable-Logic Controller. There should be a minimum of 5 hardware errors that the instructor can control.

The device must be able to sort objects into 4 different bins, and sort with an accuracy rate no lower than 95%.

The device must be fully manufactured and fully operational with respect to the customers needs and the project targets by Friday, April 3rd, 2020.

The Mission Critical Targets of this design are:

- Distinguish between metallic and non-metallic objects.
- Distinguish accurately at a rate of 98% or more.
- Have a minimum of 5 hardware errors.
- Sort with an accuracy rate no lower than 95%.
- Sort into 4 different bins.
- Meet or exceed all Customer needs and project targets.

Mission Critical Targets are shown in red in the table below.

Need	Metric	Target
Transport	Capacity	2 lbs
	Speed	1 ft/s
Distinguish	Material	Metal, Non-Metal
	Size	Range of 1-2 in. and 2-4 in. square
	Speed	Distinguish in 1 Second
	Accuracy	Correct Distinguish Rate of 98%
Train	Control	Allen Bradley PLC Controlled
	Errors	5 Controllable Hardware Errors
Budget	Cost	Cost does not exceed $1,000
Sort	Accuracy	Correct Sorting Rate of 95%
	Size and Material	Sort into 1. Large Metal, 2. Small Metal, 3. Large Non-Metal, 4. Small Non-Metal
Completed Device	Time	Finish Design and Assembly by April 3rd 2020
	Functionality	Device meets or exceeds all Customer Needs and Project Targets

Our team put together this list of targets, from a discussion centered around our customer's needs and out functional decomposition. We believe that if our device can meet each one of these targets then in the end we will deliver a product to the TCC AMTC that meets or exceeds all of their needs. Once we made a list of these targets, we then discussed critical targets. To our group, critical targets are perceived as targets that absolutely have to be met in order for this product to satisfy the needs of our customer. If these critical targets are not met then we would consider this product a failure because it could not be used by the customer as it was intended too.

Testing Methods:
Each need will have its own testing method to ensure all targets are met within a given percent error.

For transportation, our team will test the ability of the conveyor to support our target capacity by stress testing each section, ensuring that the conveyor will be able to support capacities greater than our target capacity at each section of the conveyor and reinforce areas where needed. For the speed component of transporting, our group will record multiple values of the time it takes to move the object from one point on the conveyor to another point. Our team will adjust the speed of the conveyor as needed after obtaining a set of timer values then repeating the testing process until our speed matches 1 foot per second.

For detection, the ability to correctly distinguish between metal and non-metal in junction with small and large objects will need to be within a 2% error and within 1 second of the object passing by the sensors. We will test material and size as separate processes to ensure individual sensors are correctly distinguishing objects and the logic outputs the decision within 1 second. Our group will repeat these tests modifying the distance of the object from the sensor and the position/orientation of the object, recording if the sensor was able to distinguish the object properly and how fast the detection process took. If we do not meet our targets after obtaining a set of results, then we will determine the cause of error and attempt to resolve it through modification of the logic or recalibrating the sensors then redo the testing procedure until we achieve our targets.

Testing the accuracy of our sorting process will occur after we can correctly detect the material and size of the object, and be able to transport the object from the beginning of the conveyor to the end of the conveyor. We are aiming for a sorting accuracy of at least 95%. To achieve this, we will do test runs and record where errors occur. Since there are four configurations of objects (small metal, large metal, small non-metal, large non-metal), we will test the sorting process for each configuration, looking for unique errors that can potentially occur for each configuration. The testing process will place the object at the beginning of the conveyor and let the sensors and logic direct the object to the correct configuration bin.

For training, our group will devise a minimum of five separate ways for the sorting process to fail. This test will occur after we have a working configuration of the assembly line. Each failure will have its own testing method. Failures include loose/faulty wiring on sensors and PLC cards, sensor miscalibration, actuator polarity reversed, and incorrect logic design.

- To test software errors, we will create a copy of the working logic and modify it such that there will be failures with either sensor input values or an actuator activating. After making the modification, we will do several test runs with each type of object to ensure the planned failure is being implemented properly by following the same testing procedure as the sorting test.
- For hardware failures, we will configure/calibrate sensors and actuators incorrectly such that readings will be incorrect and cause procedural errors and then test the results following the same procedure

When we believe we have the assembly line completed and ready for final testing, we will test each mode to do a final check of their functionality. To do this, we will repeat the testing methods previously described to verify the workings of each process.

Discussion Of Measurement:

Resources needed to validate the design are a workstation controller laptop, which should be provided by AMTC. A scale will be needed to verify the weights of our test sorting objects, as we encounter weights that the system cannot handle we can decipher what the upper weight limits of the conveyor system are and either modify our conveyer so that it can transport materials of the desired weight or instruct our user to only sort objects under 2 lbs. The group will also use a stopwatch timer to test the time it takes for the conveyor to move materials and for the sensors to detect and sort. The conveyer can not be set to move faster than the time needed for the sensors to detect the materials, which is 1 second per the team target.

For the detection method the group will need a ruler or tape measure to determine the minimum distance needed between the object and the sensor for proper sorting. Whether or not objects are sorted correctly will be determined via visual inspection, therefore no special tools are needed to aid in this endeavor.

Appendix: Tables

Critical Targets and Metrics

Need	Metric	Target
Distinguish	Material	Metal, Non-Metal
	Accuracy	Correct Distinguish Rate of 98%
Train	Errors	5 Controllable Hardware Errors
Budget	Cost	Cost does not exceed $1,000
Sort	Accuracy	Correct Sorting Rate of 95%
	Size and Material	Sort into 1. Large Metal, 2. Small Metal, 3. Large Non-Metal, 4. Small Non-Metal
Completed Device	Functionality	Device meets or exceeds all Customer Needs and Project Targets

Non Critical Targets and Metrics

Need	Metric	Target
Transport	Capacity	2 lbs
	Speed	1 ft/s
Distinguish	Size	Range of 1-2 in. and 2-4 in. square
	Speed	Distinguish in 1 Second
Train	Control	Allen Bradley PLC Controlled
Completed Device	Time	Finish Design and Assembly by April 3rd 2020