P19433: Upcycled Plastic Bottle Chip Melter
Test Procedures
Revision: 2
Date: 1/17/19

Test Procedures:

1. T1- Temperature and Heat Testing
    a. ERE1- Melting temperature range
        i. Use an IR temperature sensor to measure the temperature of the melting plastic in different locations
            1. How- Visually check the arduino program software for IR Temperature Sensor temperature located facing the center of top and bottom steel plates
            2. Who- Nick and Deryck
            3. Where- User Screen
            4. When
    b. ERE2- Adjusting thermostat
        i. Use an IR temperature sensor to ensure the heated surface reaches the set temperature and that the temperature is maintained.
            1. How- Using microcontroller to maintain temperature within a 20 degree range
            2. Who- Nick and Deryck
            3. Where- User Screen
            4. When
    c. ERE3- Maximum temperature differential over plate
        i. Set thermostat to a temperature and use an IR temperature sensor to measure temperature at multiple points on the surface of the plate and calculate the difference in temperature.
            1. How- Microcontroller will control temperatures difference
            2. Who- Nick and Deryck
            3. Where- User Screen
            4. When
    d. ERE10- Temperature of contact surfaces
        i. Use IR temperature sensor to measure the temperature of potential contact surfaces after the system has heated up.
            1. How- Use IR temperature sensor to measure contact surfaces on the machine
            2. Who- Team
            3. Where- Exposed frame/ Metal areas
            4. When
2. T2- Machine Dimensions

    a. ERE5- Machine footprint
        i. Measure the outer dimensions of the machine
            1. How- Use tape measure to measure dimensions
            2. Who- Team
            3. Where- Outermost part of the system
            4. When
3. T3- Compression Testing
    a. ERE9- Measure pressure required to form uniform melted plastic sheet
        i. Extend car jack to furthest height possible to compress the mold and measure the pressure
            1. How- Use pressure sensor to measure the pressure of the jack when it is fully extended
            2. Who- Team
            3. Where- Assigned Cubicle on MSD Floor
            4. When
4. T4- Safety
    a. ERE15- Pinch points
        i. Identify pinch points
            1. How- Visually identify pinch points by inspecting machine while simulating routine operation
            2. Who- Team
            3. Where- Assigned Cubicle on MSD Floor
            4. When
    b. ERE16- Sharp edges/points
        i. Sand down any sharp edge and points.
            1. How- Run a cloth over sanded edges to make sure the cloth does not snag or tear.
            2. Who- Team
            3. Where- Assigned Cubicle on MSD Floor
            4. When
    c. ERE17- Electrocution hazards
        i. Ensure all conductive wires are insulated and that there are no shorts from high voltage lines to contact surfaces. Keep all wires organized and away from potential areas of contact with user.
            1. How- Inspect the machine for exposed wire, use voltmeter to make sure metal surfaces are properly grounded
            2. Who- Nick and Deryck
            3. Where- Assigned Cubicle on MSD Floor
            4. When-
    d. ERE18- Components are not powered when disconnect is engaged
        i. Ensure there is no power in the system when disengaged
            1. How-Use a multimeter to measure voltage across nodes in device to ensure there is no voltage in devices when disconnect is engaged.
            2. Who- Nick & Deryck

3. Where- Assigned Cubicle on MSD Floor
4. When-

5. T5- Production
    a. ERE4- Products per hour
        i. Create an operation manual to follow and compare the amount of time it takes to produce multiple products
            1. How- Run the machine procedure for 3 hours for 5 days, record number of sheets produced
            2. Who- Team
            3. Where- Assigned Cubicle on MSD Floor
            4. When-
    b. ERE8- Number of workers needed to operate
        i. Operate the machine with as few team members as possible
            1. How- Run machine procedure using only 1 team member, increase and run again if necessary
            2. Who- Team
            3. Where- Assigned Cubicle on MSD Floor
            4. When-
    c. ERE12 - Ability to move machine
        i. Evaluate how easily machine moves
            1. How- Put the machine on an industrial scale to measure the weight, measure how much force needed to pull or push the machine
            2. Who- Team
            3. Where- Assigned Cubicle on MSD Floor
            4. When-
    d. ERE19- Cost to run Machine
        i. Account for all production costs (plastic chips, electricity costs, etc.) to determine if the estimated revenue is greater than the total costs to produce the plastic sheet
            1. How-
            2. Who-
            3. Where-
            4. When-
    e. ERE22- Life cycle of machine parts
        i. Estimate life cycle using data sheets and specifications of main components of machine
            1. How- Evaluate spec sheets to estimate lifetime of machine
            2. Who- Team
            3. Where- Assigned Cubicle on MSD Floor
            4. When-
6. T6- Product Quality
    a. ERE6- Sheet size of 6”x6”
        i. Measure the final melted plastic sheet with a tape measure

1. How- Measure 5 finished sheets with a tape measure and compare
2. Who- Team
3. Where- Assigned Cubicle on MSD Floor
4. When-

b. ERE7 - Sheet thickness
   i. Measure thickness of final melted plastic sheet with calipers
      1. How- Measure 5 finished sheets with calipers and compare
      2. Who- Team
      3. Where- Assigned Cubicle on MSD Floor
      4. When-

c. ERE11 - Acceptable plastic chip size
   i. Test a variety of plastic chip sizes to determine the ideal size for melting in the machine
      1. How- Create various sizes of plastic chips (.5", 1", etc…) and test, try to find chips as big as possible so the user can do minimal plastic cutting
      2. Who- Team
      3. Where- Assigned Cubicle on MSD Floor
      4. When-

d. ERE14 - Skilled operators
   i. Have an outside person from P19433 to operate the machine under supervision
      1. How- Have Harold run machine using provided video instructions
      2. Who- Harold
      3. Where- Assigned Cubicle on MSD Floor
      4. When-

7. T7- Power
   a. ERE13 - Maximum voltage of machine
      i. Make sure the power cable is providing the correct maximum voltage on each line at the electronics box.
         1. How- Use voltmeter to check the input line voltages inside the electronics box and ensure the input is correct.
         2. Who- Nick and Deryck
         3. Where- 240V outlet in MSD Lab
         4. When-

8. T8- Equipment
   a. ERE20- Total Machine cost <$800
      i. Create an economical BOM and regularly update the budget plan
         1. How- Regularly check BOM to verify machine is within budget
         2. Who- Team
         3. Where- N/A
         4. When- Once machine is completed
   b. ERE21- Machine can be broken down to transport to El Sauce, Nicaragua

i. Design machine using components and techniques that can be easily deconstructed
    1. How- Evaluate feasibility of taking apart machine for easier transportation
    2. Who- Team
    3. Where- Assigned Cubicle on MSD Floor
    4. When- Once machine is completed

c. ERE23- Force to tip over >500N - Resistance to tipping
    i. Observe how easily machine moves
        1. How- Put the machine on a ramp and change the angle to see at what point the machine will tip over
        2. Who- Team
        3. Where- Assigned Cubicle on MSD Floor
        4. When-