HENDRIX COLLEGE
Campus Sustainability Fund Committee

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Project Application

The Hendrix College Campus Sustainability Fund Committee is charged with allocating funding to sustainable and environmental projects proposed by members of the Hendrix community that benefit the campus. Applications are required to abide by CSFC policies and procedures found on Hendrix.edu/CSFC. There is no minimum or maximum funding amount for projects nor an expected duration or scope. The applicant and his or her project team commit to working with the CSFC in order to ensure that the project is completed as well as providing at least one status update about ongoing projects each semester.

Projects with total costs under $2500 are reviewed on a rolling basis during the academic year. Project Applications with higher total costs are due at 11:59PM on October 1st, February 1st, or April 1st of a given year (or the next business day if this date falls on a weekend). This document (in .doc format) must be submitted in a single e-mail along with any attachments with "CSFC Project Application" and your name as the subject and document file to CSFC@Hendrix.edu.

Part 1: Executive Summary

Project Title: In-Vessel Composting System to Manage Pre and Post-Consumer Cafeteria and Ground Landscape Waste.
Application Date: October 1st.
Total Funding Requested: $164,763.60

Primary Applicant Name: William O'Brochta
Complete All That Apply:
X Student Class and Major(s): 2016, Politics and Mathematics
__Faculty: Department and Position:
__Staff: Department and Position:
__Alumni: Class and Major(s):
__Community Member: Relationship to the College:
Hendrix ID: 380932
Campus Mailbox (or address): Box 3915
E-Mail: obrochtawj@hendrix.edu
Phone: 540-525-6607
Electronic Signature: William John O'Brochta

Project Advisor (faculty or staff member, required for student applicants): Stakeholder Meeting Group:

- Mr. Tim Siebenmorgen, Executive Vice President and Chief Financial Officer
- Mr. Mike Flory, Executive Director of Culinary Services
- Mr. Skip Hartsell, Director of Facilities Management
- Mr. Jim Wiltgen, Executive Vice President and Chief Financial Officer
- William O'Brochta

Part 2: Abstract

Please provide a 150 to 200 word abstract describing the entirety of your project.

This project involves a full installation of an in-vessel composting system designed to handle all waste from the cafeteria and from grounds. The compost will be sold to local farmers. The project will divert about 11000 cubic yards of food waste from the landfill yearly and has a projected return on investment of about two years with the sale of the compost.

Part 3: Project Plan

1. **Project Description**

Provide an adequate (varies depending on the project size, but a few pages is generally detailed enough) summary of your entire project including the goals for the project, how you will implement it, and your rationale for proposing such a project.

The planning for this project began in 2010 when the Village at Hendrix, in cooperation with then President Dr. Tim Cloyd, began exploring the possibility of installing a composting system to handle all food and landscape waste produced by the College. Though the land previously allocated to this project has been reserved for other uses, this project is now formally being proposed due to the creation of the Campus Sustainability Fund Committee.

This project was most requested by students when establishing the CSFC. Project details have been advertised as being available to all interested students. Input has specifically been requested from ECC and Garden Club. Student Senate has been specifically involved in keeping the student body aware of the project.

Project Requirements: The proposed solution must address the following criteria.

- Effective management of 500 cubic yards of pre and post-consumer food waste and yard waste.
- Compost produced that is high enough in quality to sell to local farmers.
- Must make a convincing case for return on investment to the CSFC.
- Minimizes the amount of bulking agent required.
- Odor and pests must be effectively managed.
- System must require very little management and time involvement by Facilities Management staff.
- System must be easy to use and company should provide good quality support.
- System must be fully automated, high quality, and long lasting.

- Minimizing capital costs is a priority, but not if this involves sacrificing system reliability.

Project Justification:
As landfills keep filling up, garbage incineration is becoming increasingly unpopular and other waste disposal options are becoming ever harder to find. Composting provides a way not only of reducing the amount of waste that needs to be disposed of, but also of converting it into a product that is useful for gardening and landscaping. Many educational programs focus on reducing, reusing, and recycling our wastes. Composting fits in with this idea but takes it a step beyond. It is well documented that preventing organic residues from going to landfill avoids methane emissions, preserves organic carbon and nutrients, and improves the physical, chemical, and biological soil properties.

On-site composting is a practical and responsible way to handle organic wastes and produce a stabilized organic planting medium full of active microbes. It involves specialized techniques for handling and managing large volumes of food and yard wastes, paying attention to the environmental factors that produce quality humus compost while avoiding flies and odors. The on-site composting system attempts to mimic nature's process of decomposition by producing a similar product- humus compost.

The advantages of in-vessel composting include: organic waste is retained on-site until composted, eliminates the need to transport raw waste on highways to a landfill, the composting process can be completed rapidly resulting in product stabilization/sanitation in two weeks, while in the composter raw wastes are isolated from the environment until the composting process is complete, the site manager has precise control of moisture, temperature and aeration during the composting process, raw waste loses all offensive odors within 24 hours of composter start-up and maintains a rapid decomposition process year-round regardless of the external ambient conditions.

We plan to initiate an in-vessel composting system that utilizes the yard and food waste in a safe and healthy manner from Hendrix College, creating a return on investment through: savings from waste management (tipping fees), usage of the humus compost for garden and landscaping to Hendrix community members who desire it, the ability to market the responsible treatment of such wastes, and the creation of "green" jobs in the education industry in Arkansas.

Currently, American Composting, Inc. is the largest organics recycler in Arkansas located on 85 acres in North Little Rock, AR. In fact, they recycle over 250,000 cubic yards of waste materials every year making them one of the largest in the South Central region of the United States using the windrow composting system. Needless to say they provide a large geographic area with compost and have plans to expand to service all areas in Arkansas and parts of Texas, Oklahoma, Louisiana, and Tennessee.

While much smaller, the compost we will locally generate will be a very rich, quality, superior compost product to sell to the public produced using an in-vessel composting system. While the organic matter may compare to the compost from a windrow system,

what makes this compost far superior is its aerobic microbial activity. Specifically, this product will be sold at a price comparable to certain high-end organic compost products.

The compost's customer base will include giving Hendrix College and staff the right of first refusal to purchase it. In addition, we plan to establish partnerships with local nurseries to resell our product in order not to leave stockpiles of unsold compost on campus. We will also reach out to local farmers to gauge their interest in purchasing the product. We also plan to gain exposure through word of mouth and publicity since we will be the only in-vessel composting operation in Arkansas producing such a unique product in such a unique way.

The product will consist of recycling all of the organic waste stream from grounds maintenance and the dining services of Hendrix College which keeps it out of the landfill and/or municipal water facility, converts "trash" into a valuable resource that creates life for all living organisms, starts a zero waste initiative and creates local "green" jobs for the community. Additionally, we will need to supplement the organic waste with bulking agent like wood chips from local landscaping companies and paper recycled in the Bailey Library.

All compost is not the same. Simply put, what goes into it does effect what comes out at the end. Optimally, compost contains extremely high microbial (bacteria, nematodes, protozoa and fungal hyphae) numbers. These aerobic microbes multiply in a web of feeding that when combined with soil, add organic matter that contain the energy that plants depend on and thrive off. Besides the necessary soil microbes, composting requires heat, water, air and organic materials with the right amounts of carbon and nitrogen, which are all mixed in the proper ratio. Their metabolic activity creates the heat and by-products that make the composting process work. Composting material goes through three distinct temperature phases.

What distinguishes this compost from say that of American Composting, Inc.'s or products similar to Miracle Gro® is the method in which it is produced, the ingredients and its age at the time of sale. This compost will be produced in an in-vessel composter vs. the more commercial long windrows from American Composing, Inc. or the mass production of lab made chemically infused Miracle Gro® type products.

This compost will be produced from start to finish in approximately 2-3 weeks and immediately put on the market after it cools when it has optimal microbial activity creating energy plants need for life. American Composting, Inc.'s large-scale commercial production requires 6-9 months of turning and curing. During that time, much of the energy (microbes) in the compost is expended in the form of heat resulting in an organic material possibly good for amending with soil but without the extremely high microbial numbers that one expects out of quality compost. Also, the windrow system produces methane. Inorganic type products like Miracle Gro® actually kill off microbial activity and diminish the good qualities of soil.

This compost will consist of utilizing the pre and post consumer food waste from dining services and mixing with chipped and shredded yard (grounds) waste from Hendrix College, along with some local wood chips and recycled paper. The resulting product will be a consistent premium organic matter with extremely high microbial activity. American Composting, Inc.'s compost consists of utilizing the organic waste from various municipalities, landscapers, contractors, waste management firms, wood and paper producers, wood product manufacturers, food and beverage processors, fiber processors, livestock producers and other commercial and agricultural waste generators. Although similar, batches in large commercial operations tend to vary as the ingredients change thus resulting in unstable microbial activity, which is further reduced because of long curing periods. Inorganic type products like Miracle Gro® do contain organic matter infused with chemicals that make for good mediums and provide food to plants, however, it is not natural and to keep the plants thriving, one must replenish with the same type product.

Other advantages in producing small daily batches of compost include the level of control. In general, compost is either dominated by bacteria or fungi, which tend to buffer the pH levels sought. Some plants prefer their nitrogen in ammonium form and some in nitrate form, making compost that fosters production of one over the other is another area of control that cannot be mimicked except by nature.

The problem with most compost is that of buyer beware. The consumer really has not a clue about what they are purchasing. Our compost will quickly develop a good reputation for producing consistent results and will be marketed to assure the consumer of its extremely high microbial activity, which again is the purpose of using compost in the first place.

Another worthy mention on product development includes the incorporation and creation of teams of environmental studies students from Hendrix College and the unlimited exchange of ideas potentially forming environmentally conscience products or service enhancements to the industry.

We will generate approximately 150 gallons of cafeteria waste per day (calculated before late night dining existed). Grounds maintenance averages approximately 10 cubic yards of yard trimmings (waste) per month, which will be utilized in the compost operation. In addition to the yard waste from the campus, additional wood chips and sawdust, respectively, from local tree service companies will be utilized to provide the carbon needed to complete the aerobic composting process.

We will initiate agreements with local tree service companies to bring the chipped/shredded wood (their waste) to Hendrix. In return, we will agree to use their service of chipping/shredding of any yard waste from the campus that requires it. It is believed that Hendrix will not need to purchase and maintain a chipper/shredder. That way, all of the yard waste from Hendrix College stays on farm and the need to purchase chipper/shredder equipment can be evaluated further.

Daily, approximately 2 cubic yards of organic waste from Hendrix College will be loaded into the composter and after an initial 2 week curing period, will produce at least 1.5 cubic yards daily for the market, which compares to approximately 2 dump trucks worth weekly. So, we will sell about 500 cubic yards of compost per year for between $50 to $75 per cubic yard.

Competitive Bidding Process:
I contacted four companies for quotes on the in-vessel composting system itself.

Green Mountain Technologies, Van Calvez:
Mr. Calvez was willing to work with me on providing a quote for a composting system through Green Mountain. However, I have yet to actually receive a quote from the company. His preliminary estimate for a system for us was $190,000.

BW Organics, John Willis:
Mr. Willis responded very quickly to my request for a quote from his company, located in Sulphur Springs, Texas. This in-vessel system is a rotary drum, nothing else. Mr. Willis quoted his Model 205 composting system, which can handle six cubic yards. This unit is trailer mounted for easy transportation. Added to this system is a loading auger and a mixer. The total delivered price was quoted as $48,500 including delivery less unloading, set-up, and electrical. The BW Organics system is regarded as generally reliable, with recommendations (though not particularly strong ones) from a college. However, they did state that future units were purchased from DT Environmental instead of from BW Organics. It was also determined that the size of the unit was rather small compared with other units. This is apparently a common problem since the college outgrew the size of the unit and had to purchase another one.

DT Environmental, Steve Peerce:
Mr. Peerce was extremely helpful in answering questions and provided a quick and thorough quote. He quoted the Enviro-Drum 6-20 system for $136,240 less delivery, unloading, and electrical. This is a 16 cubic yard unit. Mr. Peerce indicates that our level of compost output would not lend itself to reducing the size of the system smaller than his quotation. The Enviro-Drum comes highly recommended from several sources, including colleges and correctional institutions. The system is fully automated and a mixer and trammel as well as a stacking conveyor. The system includes automatic temperature monitoring and direct control over all components of the system. It is also built out of very high quality materials.

FOR Solutions, Nicholas Smith-Sebasto:
Dr. Smith-Sebasto responded to my quote request promptly. He provided a quote for his Model 500 composting system at $137,500 with few other details.

Full Description of Process:

1. Waste generated:
    a. Pre-consumer waste dumped into 96 gallon wheeled trash cart in the kitchen. We researched containers to transport the compost material

from the caf to the location of the composter. Most colleges transport the waste in trash carts similar to those used for residential trash and recycling. This is likely the most viable option, although other types of bins were investigated. Toter makes commercial quality 96 gallon waste carts with high quality wheels for about $90 each.

b. Post-consumer waste (including napkins) collected in 96 gallon trash cans in the dish room. This includes all food except liquids and bones. The only change to dish room procedures will be turning to the trash can to scrape the waste into it. Trash cans already exist in the dish room for putting in waste that is too big to be compacted in the disposal.
c. Pre and post-consumer waste in the trash cans is brought down on the freight elevator to the loading dock. Waste will be collected before breakfast, after breakfast, and after lunch. The breakfast run will consist of food from the previous night (dinner and late night). The run after breakfast will consist of breakfast. The lunch run will consist of food from lunch.
d. Landscape waste will be brought directly over to the composting unit. This waste will already be piled by Facilities.
e. Paper generally recycled through the library will be delivered to the composting unit by Facilities. Paper need not be shredded.
f. Excess bulking agent required will be donated by a local tree service. Twenty local tree service companies were contacted to see about the feasibility of donating wood chips for the composting system. Five said they were interested in starting this service. Several of these companies can deliver to us on a regular schedule of up to two dump truck loads per week each, far exceeding the amount of wood chips we need.
g. Dining Services and Facilities have completed a labor feasibility study to determine that about 50 hours of labor will be required to maintain the system and approximately three additional seconds of cleaning time per tray will be required to scrape off the compost in the dish room. Thus, the labor estimate is between 50 and 75 additional hours of labor per week to operate the system. This additional labor will be paid for by the profits made by the composting system. Additional revenue will be directed back into the CSFC Fund.

2. Loading: The system will be loaded three times daily. Loading the system involves placing all new waste in the infeed auger, washing and returning the 96 gallon trash cans, checking the system, recording the weight of material added, and adding appropriate amounts of bulking agent.
3. Unloading: the system will automatically unload into a static pile. The static pile will need to be moved to a sales pile as it cools.
4. Movement: The first static pile will be allowed to cool before being transferred into a pile of compost ready for sales.
5. Sales: The compost will be sold by the cubic yard at a rate of approximately $50 to $75 per cubic yard. Compost will be donated to the Hendrix Community Garden and the Hendrix Dining Services Garden at no charge as requested. Hendrix community members will also have the opportunity to purchase the

compost in bulk. Compost will be sold by the cubic yard to local nurseries and farmers through contractual agreements. Management of the sales will be conducted by Facilities Management.

We have reached out to local farmers and garden centers in the central Arkansas area to ask about their interest in purchasing the compost. Hocotts Garden Center and Flower Depot are most interested in purchasing compost from us. They indicated that regular pick-up schedules of a given quantity would not be a problem and that they would be able to meet our supply. We also contacted farmers, some of whom might be interested, but this presents a bigger challenge in terms of logistics.

Regulations and Permits:
On composting regulations: we must follow the regulations for the state of Arkansas since the state has such regulations. We do not need to use federal regulations since the state ones exist. State of Arkansas regulations supersede the federal regulations. In Arkansas, we do not need a permit for the system. "Compost offered for sale or distribution must contain a label indicating recommended safe use and application rates and restrictions on the use of the product. If the compost is distributed in bulk, signs or printed literature must accompany the product." We will provide this basic literature listing the sources of composting material (the cafeteria, the wood chip companies, et. cetera) to the garden centers we contract with.

On if we need a business license: I called a lot of different people at the Faulkner County Clerk's Office and the City of Conway. We are not required to have a business license. The City of Conway does not issue business licenses. There is nothing additional required for Faulkner County either. As long as we meet the City zoning requirements, neither the City nor the County care if we are selling the compost. And, the state does not care because we are producing a limited amount. So, that is all good news.

Possible Locations and Requirements:
There are several possible locations that meet the following requirements:

1. Accommodate composter forty feet long and ten feet wide. The out-feed conveyor is twenty-four feet long and delivers directly into a pile.
2. The compost produced per month will be approximately the size of a thirty cubic yard dumpster. A common size for this pile is twenty-two feet long by eight feet wide by five feet high. Thus, the overall area needed for the system will be approximately forty feet long by fifty feet wide, accommodating static piles for excess bulking agent.
3. The system will work by the out-feed conveyor dumping compost in a pile. The compost will rest in the pile and cool until it can be moved into a second pile where it can be packed and sold. A small staging area will be needed in order to load the compost into the system and load the finished compost into barrels.
4. Relatively easy access from the SLTC and for compost buyers. This means the area needs to be accessible to Facilities carts driving the waste from the SLTC and to trucks (half ton pickup trucks) picking up the compost.

5. Able to access for instillation. There must be the ability of a moving truck (eighteen wheeler or flatbed) to unload the system on a road near the desired site.
6. Some amount of security. The system can be password protected. However, the area should be regularly patrolled or enclosed so that farmers purchasing the compost can record the amount purchased and theft can be discouraged.
7. Be located on Hendrix College owned property (not the Village).
8. Must have the ability to connect to an electrical outlet or have the capability of being wired for electrical in a few hours.
9. Be relatively flat in grade and require only minimal work to prepare the site.

Facilities has requested that the composting system go in a structure. They have planned the size of the structure to be about 50' by 40' with space for the compost system and piles for wood chips and finished compost. The building will need access to water, power, and a hard floor surface. The composting system prefers three phase power if necessary. The building will need to satisfy zoning regulations as set by the City of Conway.

We have contacted the City of Conway Permitting Department to discuss the requirements for siting a building. We need to have a meeting with them to get precise estimates on building costs. Knowledge about the permitting process will help inform where the system should be located.

They prefer that the building be open upon delivery. The easiest situation is for their truck to drive in next to a concrete slab and lift the system off the truck and onto the slab. This means that we will only need to have the slab ready when they deliver the system and can construct the building around the slab, which will give us more time to work on the building.

Though it has been requested that a building be constructed, there are no sustainable benefits or operational benefits to the construction of such a building. Rather, the building exists solely for aesthetic purposes. Materials waiting to be fed into the system can easily be covered by tarps and compost coming out of the system need not be covered since it will be sold to a garden center that places it in an open, outside container. Therefore, the CSFC and student money will contribute to some of the site work associated with a concrete pad and hooking up electrical connections for the system. The College, if they continue to request an enclosure, will be responsible for providing the funding for such an building.

We have worked to identify three possible locations: the Facilities Management yard, an area by the Hendrix Garden, and an area by the Old IT building. We will cost out all three alternatives before choosing one, though the Facilities Management yard can be considered the leading candidate and will be chosen unless unforeseen problems arise. I have consulted with Ward Davis of the Village at Hendrix, and he supports the idea of the system as the major stakeholder in the area.

The following locations fit these requirements:

- Site 1 and Site 2: These areas off of Washington Avenue used to contain an old building near the church (1) or the old white house (2). The area is near the Hendrix garden, so people working in the garden could monitor the system. It also has the advantage of being close to the garden for a source of some compostable material. Both sites allow for good visibility to the Hendrix community and ease of access for loading compost and unloading the system. The locations are some distance from the SLTC and there is no existing road infrastructure on which the Facilities vehicles can travel. Security is not the greatest due to the sites' distance from the Facilities warehouse. Farmers purchasing compost would need to check-in with Facilities employees at the warehouse before coming to collect the compost. Driving Facilities vehicles to the site is not a problem, but could be easier. The site is already pretty clear and flat. The system could certainly fit comfortably in either site. Should an educational garden be added to this area, the composting system would be a great educational opportunity for children. There are existing electrical connections at the church and at PSafe.

- Site 3: Location near the Old IT building. This is probably the most open and least preferable location.
- Site 4 and Site 5: These two sites are located behind the Facilities building. They offer superior security and relatively easy access for deliveries. The sites are not too far away from the SLTC. Site four would be inside the Facilities Bull Pen. Security and monitoring would be of no concern in this case. Site five has more difficult access. A path may have to be cut from the existing parking lot to the site for unloading the system and for farmers purchasing compost. Electrical connections in Site four would likely require running a connection from one of the Facilities Barns; Site five could do the same or run electrical from the Tennis Courts. Both sites are relatively flat. There are not many opportunities for seeing the system as someone drives by any part of College property, so promotion to the general public may be limited.

2. Partners

Describe how and how many students will be involved with the project as well as how the project will benefit students. List and describe the involvement of other project team members, departments, or organizations sponsoring the project.

- This project is being sponsored by the CSFC. Thus, all members of the CSFC will be directly involved in the planning and execution of the project.
- Mike Flory and Dawn Hearne will oversee the collection of collecting pre and post-consumer food waste in the cafeteria. The Utilities will move the full trashcans down to the dock. Emily Lee has been particularly helpful and supportive with composting efforts in the dish room in the past.
- Movers will move the trashcans to the composter. Grounds staff will move the yard waste to the composter. Sharron Russell will oversee this process as Director of Operations. I suspect we will rely on Charles Coker for assistance with electrical set-up and electrical maintenance.
- The original project, called the Village Farm, was initiated by former President Cloyd and partially planned by Village CEO Ward Davis.
- Britt Ann Murphy, Director of the Library, will work with us to get the recycled paper. John Shutt, Periodicals/Reference Assistant and Night Supervisor, will also assist with gathering the paper.
- There is a possibility that the CSFC will partner with the Office of the Chaplain to donate cooked food of good quality to local food pantries.

3. Outcomes

Describe how this project will improve sustainability at Hendrix and how you will educate students about the project. Directly discuss the relationship and benefit the project has to as many different facets of sustainability and the environment as possible.

- This project will eliminate tipping and hauling of food and landscape waste to the Conway Landfill saving fees, labor, and gasoline.
- The project will utilize previously useless wood chips from tree services, reducing the impact on the landfill and giving tree services a stable location to drop off wood chips.
- The project will produce compost on site that can be used at Hendrix.
- The project will produce compost that can be sold. This will generate revenue as well as be a local and organic source of compost.
- The project will result in Facilities Management staff becoming trained on how to properly make compost.
- The project will reduce the need for local farmers and garden centers to purchase their own compost from other locations father away and will result in a higher quality produc.
- The project provides for educational opportunities and awareness opportunities for students, faculty, and staff.
- Compost can be used in the Hendrix Garden for free.

- Students will be educated about the project by tours of the system, artwork placed directly on the system, and artwork and awareness signage that will be placed in the cafeteria.
- The project allows for expansion to composting biodegradable cups and trays from the Burrow as well as pizza boxes. ECC members will be encouraged to begin these projects. Additionally, we could switch over to compostable items such as paper towels.

4. Project Benchmarking and Innovation

Why should this project be done at Hendrix? How have other schools or organizations addressed this issue?

- Hendrix has been talking about composting food waste for the better part of decade. One of the most common topics discussed among students with regard to the cafeteria is the amount of waste produced. Though we certainly realize that the post consumer waste can be reduced with education and awareness, which ECC is currently engaged, it is impossible to reduce this amount of waste below about a tenth of a pound at the very best schools. Additionally, the pre consumer waste has currently been minimized using tray tracking technology. Thus, even with educational opportunities, waste will remain. During the survey to institute the CSFC, the most common suggestion for the new Committee was to address food waste.
- Hendrix attempted to purchase an in-vessel composter on two previous occasions: as a Senior Gift and as part of the Village Farm.
- This would be a major achievement for the new CSFC and an impressive collaboration between all the departments represented on the CSFC.
- Many other colleges and universities have undertaken similar projects. As has been typical, Hendrix appears to be behind the curve when it comes to composting systems. They range in size from massive units at Ohio State University and ones that serve all the Washington State Correctional Facilities to systems at Gustavus Adolphus College, Davidson College, Clemson University, and Warren Wilson College to name a few examples. These systems have been very successful and have been used to great effect for environmental branding and marketing.

5. Assessment and Metrics

What are measures for success of this project? How will you measure the benefits of the project? Then, complete the included tables using the provided table key.

- Quantities of material going into the composting system will be recorded by Facilities staff as well as the amount of compost sold. A statement of the profit or loss from the system will be produced once per semester.
- The major measure of success is that the system is installed in a given location and is working properly.
- The installation part of this project is considered finished once the system is installed, is operational, is permitted, and is producing compost that is being sold.

See separate budget sheet.

6. Vision

How does this project benefit the Hendrix community long term? Could this project be expanded in the future? If so, how?

- This project is part of a vision to make Hendrix zero waste. John Brown University is already a zero waste institution. One of the easiest types of waste to address because it is mostly generated form one place is food waste. Food waste is also one of the only parts of a zero waste plan that can easily make something useful and make money. It also has a major educational component.
- The projected life of this in-vessel composting system is more than twenty years. According to the manufacturer and various schools with systems installed, they have experienced few problems over more than a decade of use.
- This system is intentionally sized large for our current output of food waste. If Hendrix decides to expand the student population in the future, this same system will be able to handle the additional waste. It is our hope that the amount of waste generated per student will decrease over time, but the system can also handle local compost from community members or a future second student garden. As the school switches over to more environmentally friendly paper products, these can be composted.
- Of course, an additional system could be purchased if the first one became too small.

7. Timeline and Milestones

Create a timeline including the major events and milestones occurring during the project. Include events others working on the project are responsible for. Preference is given to a Gantt chart; calendars are also acceptable.

Research Phase:

- Determine need and baseline potential savings.
- Determine student interest and potential staff and faculty support: We have been able to demonstrate that students and faculty are extremely interested in this project, and they have been specifically asked for their input in the project.

- Determine past research and work done at Hendrix related to composting, especially the Village Farm project: I conducted meetings with Dr. Cloyd and Dining Services to understand what progress has already been made on this project.
- Research successful implementations at other schools: I contacted several other colleges to see their systems and how we could learn from their systems.
- Establish criteria for a successful project: See below.

Request for Proposals Phase:

- Contact companies to request proposals based on criteria: We contacted four companies to get proposals.
- Follow-up with companies for questions.
- Select a company to work with and discuss details of the instillation with them: DT Environmental, a highly recommended compost system company, was selected to work with.

Planning Phase:

- Find sources for bulking agent including paper from the library and tree trimming services: the Bailey library will supply recycled paper and tree trimming companies have agreed to supply wood chips.
- Determine what permits will be needed, if any, and how they will be obtained: No permits will be needed. We are not required to report to the Arkansas Department of Environmental Quality if we produce fewer than 500 cubic yards of compost. The City of Conway does not require a business license to sell the compost. Zoning permits will be required for the building that we will be constructed to house the system.
- Find farmers to purchase the compost and agree on a possible price with them: We have identified nurseries that are willing to purchase the compost as well as several farmers who are interested. The expected sales price is $50 to $75 per cubic yard.
- Provide suggestions for the location of the project: The leading location is the Facilities Management Yard. We are also exploring the Old IT Building and near the Hendrix Garden.
- Coordinate with stakeholders to plan how the daily operations of the composting system will work and how the instillation will be completed: We have had weekly meetings with Dining Services, Facilities Management, and the Business Office in coordination with Student Affairs to coordinate efforts.
- Determine how the composting system will be transported to Hendrix: DT Environmental will ship the system to us and arrange all costs.
- Do a cost-benefit analysis and calculate return on investment: The Business Office has been working on cost benefit calculations.
- Negotiate a payment plan with DT Environmental: We have agreed on a payment plan outlined below.
- Complete this Project Application.

Discussion Phase:

- Discuss the project with the CSFC: The project has been under review with the CSFC since our first meeting in September.
- Review project with stakeholders: This proposal has been revised based on input from project stakeholders.

Approval Phase:

- Approve the project through the CSFC: The CSFC voted to continue working on this project on October 8th. The final vote on approving the system will take place on November 5th.
- Obtain approval for the location of the system, if necessary. The Facilities Management yard has been cleared for the system.

Preparation for Instillation Phase:

- Sign the contract with DT Environmental: Expected contract date in mid-November 2015.
- Complete registration with the Arkansas Department of Environmental Quality.
- Prepare the site for instillation: complete the concrete pad for instillation.
- Finalize library paper supply, wood chip supply, and sign contracts for farmers to purchase the compost: These will be finalized in spring 2016.
- Complete a walk through of the waste collection process: Mike Flory has conducted a walk through of the system. We have already completed a full waste audit finding that 800 students during a lunch period generated 95 gallons of post-consumer food waste.
- Identify Facilities staff members who will work on the composting system and give them pre-training: Training will take place in spring 2016.
- Review the system with Dining Services employees: Training will take place in spring 2016.

Instillation Phase:

- Install the in-vessel composting system.
- Receive training from DT Environmental on operation of the system.
- Complete first batch of compost.

Post-Instillation Phase:

- Inspect the unit daily and the composting output for improvements.
- Review the waste collection process to ensure that a quality product is being produced and all waste is being collected.
- Receive feedback from Facilities and Dining Services staff members as well as compost purchasers and tree service companies on how well the system is working.
- Track waste and bulking agent as it is received and output as it is sold.
- Monitor payment and funding of the system.

Maintenance Phase:

- Check with DT Environmental to see if payment plan can be expedited based on revenue.
- Follow regular maintenance schedule.
- Complete project status report every semester.

8. Project Lifespan

What is the expected lifespan of the project? Who will be overseeing the project during that time? How will you ensure that the project is maintained?

- The expected lifespan of the installation phase is one year. The goal is to have the system approved by spring 2016 and installed by that time, if possible.
- The expected return on investment is under ten years.
- I will be overseeing the project though the installation phase. Once the project is installed, responsibility for maintenance will be turned over to Facilities Management and the CSFC. The CSFC will be responsible for overseeing the maintenance of the project and ensure that it produces a quality product.

9. Reporting

How will you track and report the progress of the project to the CSFC?

- This project is subject to the semester reporting procedure established by the CSFC.
- Records will be maintained by Facilities Management and given to the CSFC upon request.

10. Budget

Provide a detailed, itemized budget for the entirety of the project listing all costs you are requesting the CSFC to cover for the lifespan of the project and where these items will be purchased. Include initial costs and operation and maintenance costs. Discuss opportunities for scaling the size of the project up or down.

See separate budget sheet.

Is there confirmation that students want to spend future CSFC money on this project? Yes. We have had positive responses from student stakeholder groups. We feel that the opportunity has been available to comment on the proposal if there are questions. All CSFC meetings are open to anyone and Senate has specifically been involved in learning about the progress made on the system. We have recently specifically solicited feedback from students through Senate on this very item. We will evaluate such feedback as it is received.

Will the College be responsible for any costs? Yes. The CSFC will be responsible for capital costs involved with sustainable aspects of the project. Labor costs will be paid for by savings from the compost sales. The College will be responsible for costs that have no sustainable justification, such as a building.

The company will provide a formal contract to me in the next few weeks for us to sign at the November meeting. The contract will ask for $40,000 upon signing, $28,120 on

delivery, $28,120 in February of 2017, and the $40,000 balance in October 2017. Basically, we shifted a payment up from the proposed plan and reduced the February 2017 payment. On the $68,120 that they will carry after delivery, they are asking for a nominal interest fee, which I said would be fine.

The quote will be good until whenever we sign the contract. The company understands that we will be signing in November or December.

They will take care of shipping quotes. The budget has $6000 in delivery worked into the proposal, and we will pay them for delivery. They will not mark-up the delivery cost for arranging delivery for us.

Their lead time is 3 or 4 months, so if we sign in November, they will be ready in early spring to deliver the system.

11. Attachments

List the file names of any supporting or pertinent information attached to this application.

117228 6-20 ENVIRODRUM LAYOUT - HENDRIX COLLEGE ARKANSAS.pdf
enviro-drum_operation_manual_030113.pdf
dte_enviro_drum_-_small.pdf
Hendrix College Purchase Agreement 101915.pdf
Cost-Benefit Compost.xlsx

Cost-Benefit Chart for Composting Project

William O'Brochta

Item	Initial	Monthly (8 mo/yr)	Life (30 yr)	Notes
In-Vessel Composter	-138283.6	0	0	Quote of $136,240 plus 3% interest on $68,120 balance after delivery
Delivery (est.)	-6000	0	0	
Installation Labor	-480	0	0	1 day, 4 people
Enclosure	-18000	0	0	Includes materials for basic concrete pad and instillation and remaining money for actual enclosure
Electrical Instillation	-1000	0	0	Includes parts and labor
Replacement Parts	0	0	-500	
Wheeled Cart	-1000	0	0	
Monthly Operation (Low)	0	-2437.5	-585000	$12.50 per hour, 48 hr/wk, 195 hr/mo
Monthly Operation (High)	0	-3400	-816000	$12.50 per hour, 68 hr/wk, 272 hr/mo
Vehicle Wear	0	-27.6	-6624	$0.575 per mile, 0.6 miles, 4 times daily, 20 days/mo
Food Waste Tipping	0	506.25	121500	150 gal./day is 16.875 tons at $30 per ton
Yard Waste Tipping	0	67.5	16200	4500 lbs/month is 2.25 tons at $30 per ton
Subtotal (Low)	-164763.6	-1891.35	-454424	
Subtotal (High)	-164763.6	-2853.85	-684924	
		PLUS		
Compost Sales (Low)	0	3125	750000	500 cubic yards per year at $50 per cubic yard
Total (Low)	-164763.6	1233.65	295576	
Total (High)	-164763.6	271.15	65076	
		OR		
Compost Sales (High)	0	4687.5	1125000	500 cubic yards per year at $75 per cubic yard
Total (Low)	-164763.6	2796.15	670576	
Total (High)	-164763.6	1833.65	440076	

Payment Plan to DT Environmental

Assuming No Compost Sales

Cost	138283.6	Initial Balance	33906.58	Other Costs	26,480
Date	Payment	Balance to Pay	Reserved for CSFC	Balance in CSFC	
Contract (November 1, 2015)	40,000	98,284	5,000	-37,573	
1-Feb-16	28120	70,164	5,000	-8,667	
1-Oct-16	0	70,164	5,000	20,240	
1-Feb-17	28,120	42,044	5,000	21,026	
1-Oct-17	42,044	0	5,000	7,889	
1-Feb-18	0	0	5,000	36,796	
1-Oct-18	0	0	5,000	65,702	

Assuming Low Compost Sales

Cost	138283.6	Initial Balance	33906.58	Other Costs	26,480

Date	Payment	Balance to Pay	Reserved for CSFC	Revenue	Balance in CSFC
Contract (November 1, 2015)	40,000	98,284	5,000	0	-37,573
1-Feb-16	28120	70,164	5,000	0	-8,667
1-Oct-16	0	70,164	5,000	0	20,240
1-Feb-17	28,120	42,044	5,000	10,000	31,026
1-Oct-17	42,044	0	5,000	10,000	27,889
1-Feb-18	0	0	5,000	10,000	66,796
1-Oct-18	0	0	5,000	10,000	105,702

Assuming High Compost Sales

Cost	138283.6	Initial Balance	33906.58	Other Costs	26,480
Date	Payment	Balance to Pay	Reserved for CSFC	Revenue	Balance in CSFC
Contract (November 1, 2015)	40,000	98,284	5,000	0	-37,573
1-Feb-16	28120	70,164	5,000	0	-8,667
1-Oct-16	0	70,164	5,000	0	20,240
1-Feb-17	28,120	42,044	5,000	18,750	39,776
1-Oct-17	42,044	0	5,000	18,750	45,389
1-Feb-18	0	0	5,000	18,750	93,046
1-Oct-18	0	0	5,000	18,750	140,702

DARITECH INC

8540 Benson Road, Lynden, WA 98264
Phone 360-354-6900 Toll Free 800-701-3632 Fax 360-354-7522
www.daritech.com

PURCHASE AGREEMENT

Date: October 19, 2015

Name:	Hendrix College	Dealer:	DariTech, Inc.
Contact:	William O'Brochta	Contact:	Steve Peerce
Address:	1600 Washington Avenue	Address:	8540 Benson Road
City, State, Zip:	Conway, AR 72032	City, State, Zip:	Lynden, WA 98264
Phone:	501-329-6811	Phone:	206-595-4398
Fax:		Fax:	360-354-7522

Description	Price
6-20 EnviroDrum In-Vessel Composter System (Detail of System on Attached Quotation) Terms: $40,000 Deposit due upon order $28,120 Plus freight due upon delivery $28,120 Due February 2017 $40,000 Plus interest accrued on balance of $68,120 at the rate of 3% due October 2017	$136,240.00 + Freight

Down Payment	**See Terms Above**	**Sub Total**	136,240.00
Due Upon Delivery	(%) ($)	**Sales Tax**	Out of State
Due Upon Completion	(%) ($)	**Freight**	TBD
Remaining Balance	(%) ($)	**Labor**	
Finance Charge	(%) ($)	**Less Trade-In**	
# Months/Payment Per Month	(#) ($)	**TOTAL**	136,240.00+Freight

ACCEPTANCES

The undersigned purchasers are in accordance to purchase the listed products in the description of this agreement.

A letter from the lending institution verifying financing and agreement of payment schedule will be provided prior to placement of order. A UCC 1 will be filed for all equipment delivered to the farm and it is agreed the purchaser's insurance company will insure all products.

BUYER: The above conditions, prices and specifications are satisfactory, and authorization is hereby made to proceed. **Signature:** _____ ___/___/___	**SELLER:** We agree to fulfill this contract as written and hereby acknowledge receipt of deposit. **Signature:** _____ ___/___/___

Dealer's guaranty and manufacturer warranty appear on the following page of this contract and are an integral part thereof.

TERMS AND CONDITIONS OF SALE

Risk of loss transfers to the Buyer on delivery. Seller retains title and rights to possession until final payment is made and upon any default in Buyer's obligation to remit payment hereunder. Seller shall have the right to claim and repossess said equipment without demand or notice, without any court order or other process of law, and without regard for inconvenience or hardship created by said equipment's absence and pursue any other remedy available at law or in equity.

Buyer is advised to read all of the terms on the front and the reverse side of the Purchase Agreement, together with all attachments hereto, before signing. This Purchase Agreement and any attachments hereto contain the entire agreement between parties with respect to the subject matter hereto and cannot be modified, amended, waived or rescinded except in a written instrument signed by both Seller and Buyer.

DARITECH INC. LIMITED WARRANTY

Daritech Inc., equipment is warranted by Industrial Mfg., for a period of one year from the date of installation of the original equipment against defects in materials and workmanship when installed. Serviced and operated in accordance with the Company's written instructions, subject to the exclusions and limitations set forth below. The Company's sole obligations under this warranty are as follows:

The Company will, at its option, repair or replace equipment which proves to be defective in materials or workmanship during the warranty period. Normal wear items, labor, transportation, and services charges are not included.

Damage to all equipment and/or related parts due to abuse or misuse by operator or animals is excluded from this Limited Warranty. The entire part must be returned for warranty consideration. This Warranty extends only to the original purchaser and may not be transferred. It is valid on the original installation unless the Company otherwise agrees in writing.

This Warranty is in lieu of all other express warranties, obligations, and liabilities.

ALL IMPLIED WARRANTIES INCLUDING ANY IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE HEREBY DISCLAIMED AND EXCLUDED. IN NO EVENT SHALL THE COMPANY BE LIABLE FOR SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES OR FOR ANY DELAY IN WARRANTY PERFORMANCE DUE TO CAUSES BEYOND ITS CONTROL. ANY EXPRESS WARRANTIES NEED TO BE INCLUDED IN COMMENTS ON REVERSE SIDE.

DTE ENVIRONMENTAL

QUOTATION

May 28, 2015

Attention:

William O'Brochta
Hendrix College

From:
Steve Peerce
DT-Environmental

Subject: Hendrix College EnviroDrum In-Vessel composter quotation

Dear Mr. O'Brochta-

Per your request, DT-Environmental is pleased to offer our 6-20 EnviroDrum In-Vessel composter system for your facility. All DTE equipment is built with top quality components for longevity in highly demanding applications. Many of our drums rotate as frequently as one revolution per minute, 24/7/365, and have done so trouble free for years. Insulation on the inside of the drum protects the shell from heat related stress, abrasion, and corrosion. The negative air pressure operation allows for 100% capture of exhaust for ease of odor treatment with a biofilter.

Other features include:

- Skid mounted for ease of installation and maintenance
- Stationary ends for greater capacity and heat retention
- Continuous flow operation
- Heavy duty drive system, idler wheels and bearings
- Touchscreen PLC control
- Remote support

In order to meet PFRP (Process to Further Reduce Pathogens) of 131^0F for 72 hours, the proposed 6-20 EnviroDrum system can take up to 5 yards^3/day of compostable material, dependent on feedstock characteristics and operational goals. Given your 150 gallons (.75 yards^3) of food/day, and associated

bulking agents, you will be feeding the drum 2-3 yards^3/day of material. Dependent on shrinkage, this will result in 8-14 days retention time, allowing you to meet PFRP in the drum. Additional curing may be necessary for commercial application of the compost.

Feedstock will be blended in the mixer and augered into the drum. The PLC control will allow customizing the process and automation of the drum operation. A blower on the infeed end of the drum pulls air countercurrent to the composting material, maintaining negative air in the drum and providing ease of treatment of the exhaust with a biofilter. The trommel screen on the discharge end of the drum will screen out contaminants and overs, which can be used again as a bulking agent.

Labor requirements will be 1-2 hours/day, primarily to mix feedstocks and move discharged compost.

Pricing includes:

- Drum composter
- 1.5 cubic yard single auger mixer
- Infeed auger
- Trommel screen
- Stacking conveyor
- PLC control
- Supervision of installation
- Startup and commissioning
- Training

Does not include:

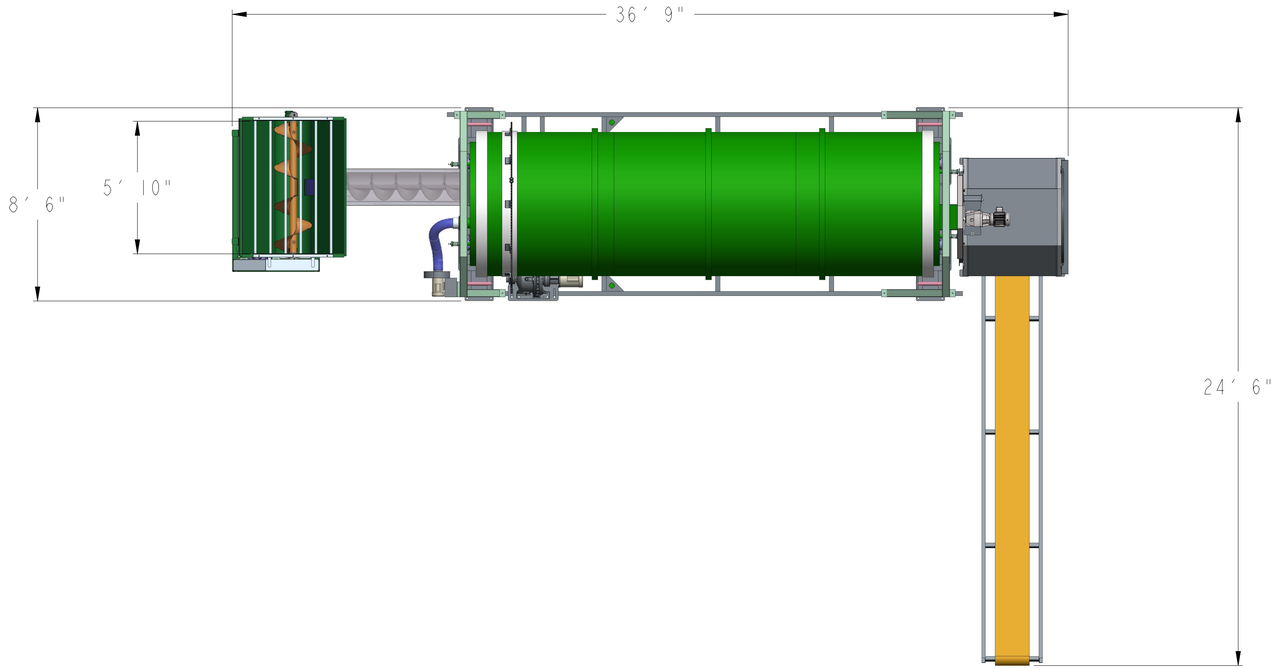
- Delivery
- Unloading
- Installation labor
- Electrical connections at site
- Permits
- Taxes
- Buildings

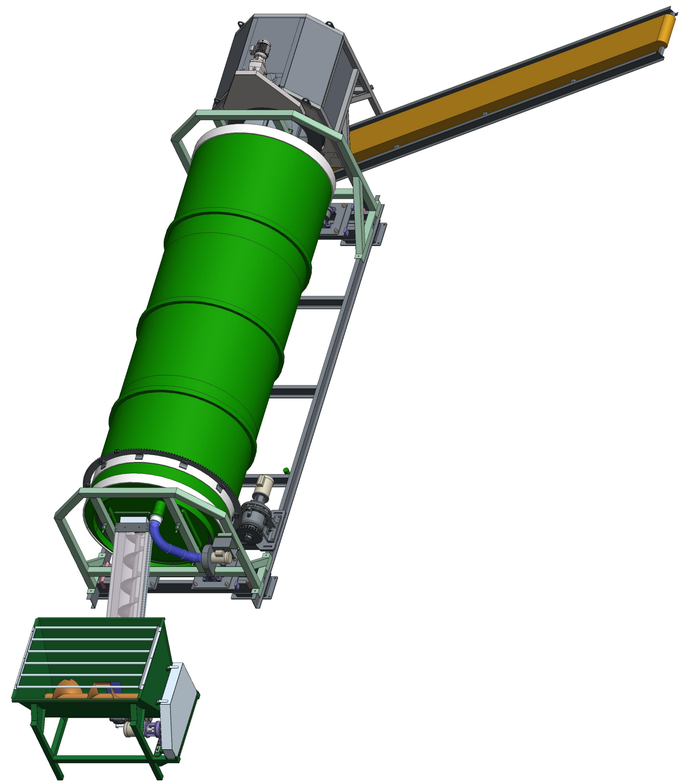
Price: $136,240
FOB Lynden, WA

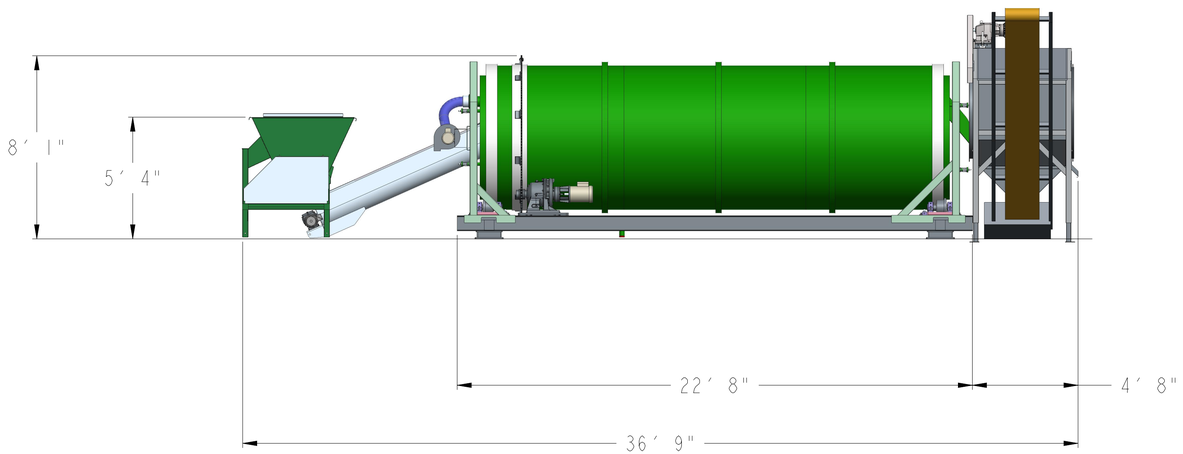
Please let me know any question.

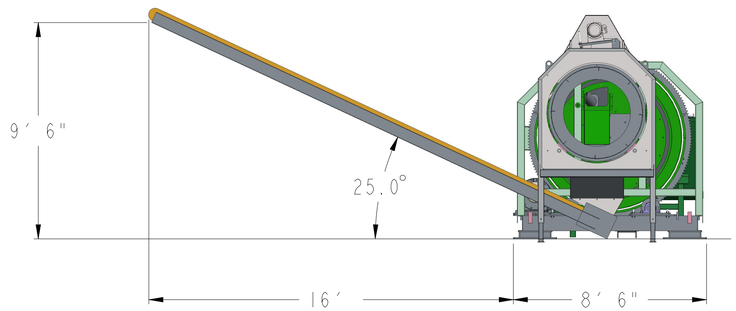
Best regards-

Steve Peerce
DT-Environmental









ALL DIMENSIONS IN INCHES UNLESS NOTED

THIRD ANGLE PROJECTION

SCALE 0.025

GENERAL TOLERANCES UNLESS NOTED

X.X	±0.060
X.XX	±0.015
X.XXX	±0.005
FRACTION	±1/16
ANGLE	±1°
ØHOLE	±1/64
SAW LENGTH	+0 -1/16

DARITECH INC

DESCRIPTION: 6-20 ENVIRODRUM LAYOUT - HENDRIX COLLEGE, ARKANSAS

MATERIAL

DRAWN	DATE	DRAWING	REV	SIZE
WSV	May-28-15	117228		D

1 OF 1

DTE ENVIRONMENTAL

ENVIRO-DRUM

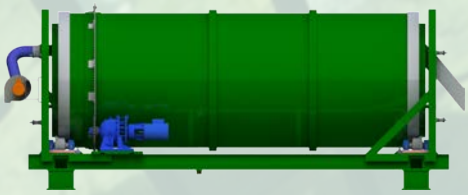
In-Vessel Composting By DT-Environmental

Complete the cycle...

US Patent # 8,728,801

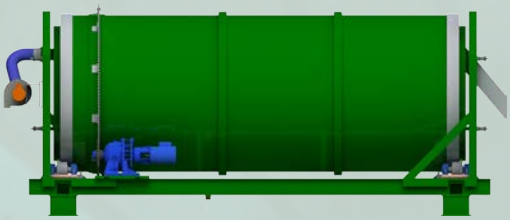
5-14 ENVIRO-DRUM

The *5-14 ENVIRO-DRUM*, up to 8 yards operating capacity



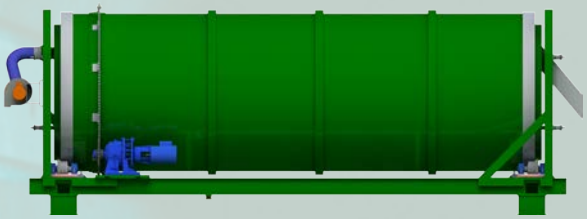
6-16 ENVIRO-DRUM

The *6-16 ENVIRO-DRUM*, up to 13 yards operating capacity



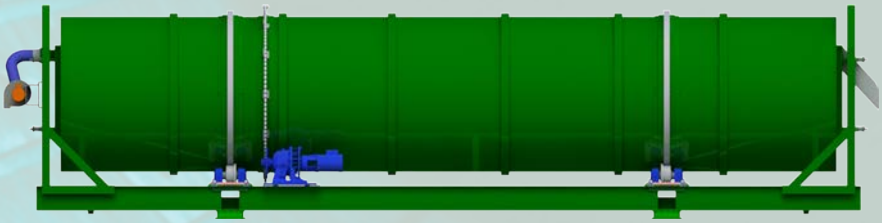
6-20 ENVIRO-DRUM

The *6-20 ENVIRO-DRUM*, up to 17 yards operating capacity



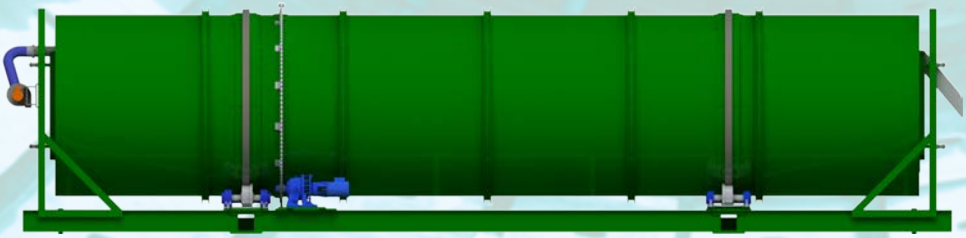
6-32 ENVIRO-DRUM

The *6-32 ENVIRO-DRUM*, up to 27 yards operating capacity



8-40 ENVIRO-DRUM

The *8-40 ENVIRO-DRUM*, over 60 yards operating capacity



Mixers do an excellent job of shredding and blending the feedstock before entry into the drum. Numerous other mixer options and sizes are available.

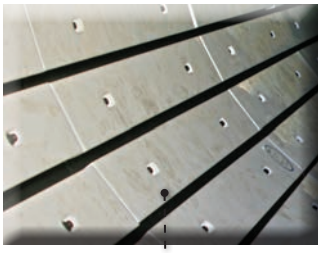
Trommel screen can be integrated into stationary exit end, providing automated screening of overs.

Finished compost stacked and stored.

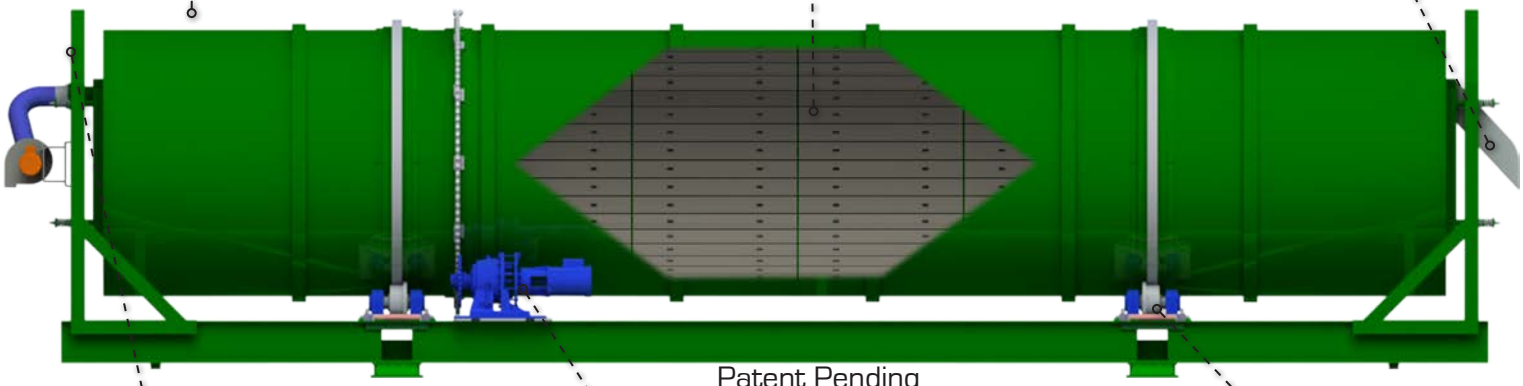
The Anatomy of an EnviroDrum - *An Insiders View*

Control Panel:
Control panel can be installed in a heated enclosure.

Insulation Boards:
Linear boards on the inside provide insulation, abrasion barrier, and host bacteria in spaces.

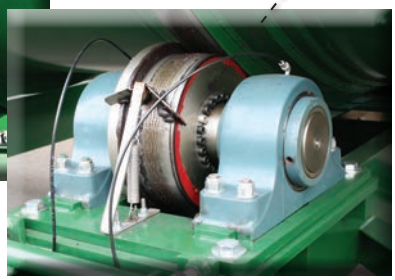


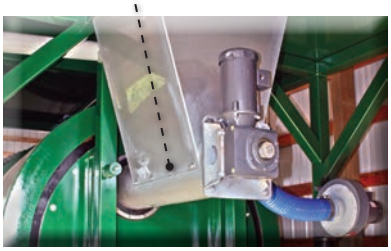
Exit Chute:
Continuous operation provides many options for conveyance of finished material.



Patent Pending

Motor and Wheels:
Heavy duty drive motor and idler wheels ensure longevity and trouble free operation.





Feed Auger:
Infeed auger supports continuous operation with uninterrupted air supply.

ENVIRO-DRUM

"We have been dealing with DTE for years and have always appreciated the effort and thought that goes into their equipment. By bringing the quality and workmanship of large industrial systems to our operation, DTE has given us an affordable means of accomplishing our composting goals."

The DTE ENVIRO-DRUM is built with excellent workmanship to ensure great performance and value for years to come. Organic waste handling systems from DT-Environmental help eliminate tipping fees and transport costs by closing the loop and turning your waste into a fertile soil amendment. With the Enviro-Drum as the central system component, DTE can affordably accelerate the composting process, reducing the footprint and making on-site waste management feasible.

Features include:

- **Proven composting technology**
- **Fixed ends provide greater capacity for better value**
- **Heavy rubberized industrial coating**
- **Internal boards protect vessel from heat fluctuations**
- **HDPE boards protect inside of vessel from wear**
- **Heavy duty drive system, idler wheels and bearings for longevity**
- **Air can be easily contained and directed to a biofilter for odor control**

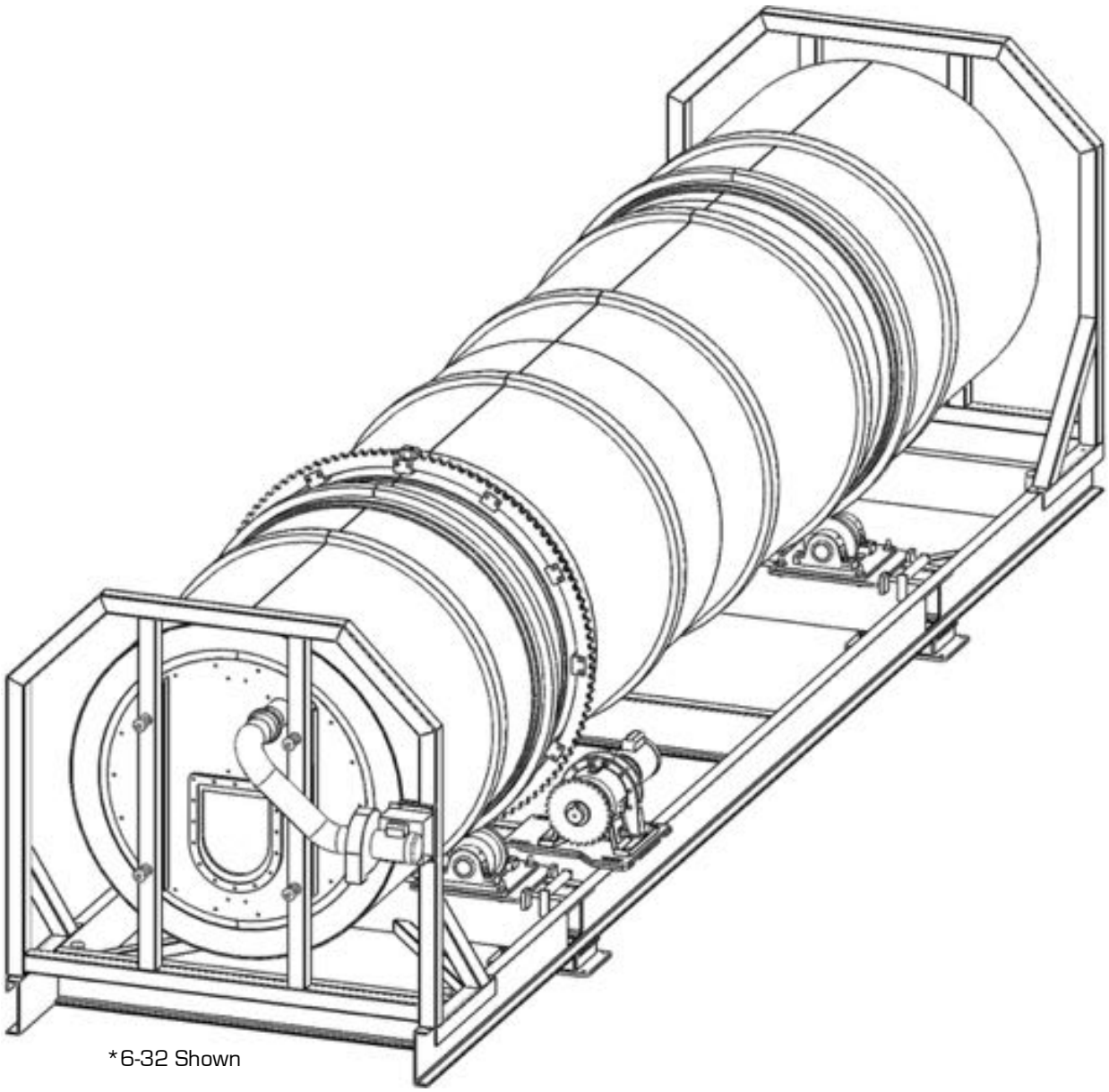
DTEnvironmental
Subsidiary of DariTech, Inc.
8540 Benson Rd.
Lynden, WA 98264
(800) 701-3632
(360) 354-6900
www.dtenvironmental.com

Authorized Representative:

ENVIRO-DRUM

In-Vessel Composting By DT-Environmental

Operation & Maintenance
For Models;
5-14
6-16
6-20
***6-32**
8-40



*6-32 Shown

Revision Sheet

Release No.	Date	Revision Description
Rev. 0	8/1/12	Manual Completion
Rev. 1	4/4/13	Added Wiring Diagrams & flow diagram, updated control images

Table Of Contents

Preface

-These instructions are supplied with the system and;

- The purpose of this manual is to provide an overview of the safety, operation & maintenance of this product.
- This manual is designed to be modular and is only in relation to the mentioned product.
- This manual should always be kept with or near the equipment even when the equipment is sold.
- It is the responsibility of the end user to test and maintain the unit to assure continued effectiveness of the machine.

-We reserve the right to make changes due to technical developments in the data and images in this manual.

Arrangement

--This manual is arranged in 6 primary sections, with pages, paragraphs, figures, and tables numbered in sequence.

Section 1 – Safety

-Contains critical information essential to the safety of any personnel working on or around the machine.

Section 2 – Equipment Overview

-This section contains the purpose of the machine, a description of the equipment, a flow diagram of the Enviro-Drum system & what to expect when the machine is running optimally.

Section 3 – Panel Controls

-This section identifies and describes the process to program & operate the Enviro-Drum.

Section 4 – Operation

-Covers pre-operational checks & starting and stopping procedure.

Section 5 – Maintenance

-This section contains information for performing preventative maintenance on the machine components & their locations.

Section 6 – Wiring Diagram

-Contains Wiring Diagrams for a 6-32 model.

Explanation of Symbols

-The following symbols are used within this manual to alert the reader to important information or potentially hazardous conditions.

-Safety Symbols draw attention to adjacent text and should always be read and thoroughly understood.

	**WARNING!** Warning signals danger to life or health of personnel. Death or serious injury may result if the danger is not avoided.
	**CAUTION!** Caution signals dangerous situations. Injury may result is the danger is not avoided.
	**ATTENTION!** Attention signals important information on risks for product or the environment.

Section 1 – Safety

1.1 Obligation of Care

-This product has been designed and constructed while taking careful analysis and standards and other specifications to be compiled with to ensure a safe level of security. This safety can only be achieved in practice. It is part of the owner's obligation to plan and check these measures.

-The owner must ensure that:

- Everyone that works with or performs activities in connection with the Enviro-Drum carefully reads this manual.
- Safety equipment is available on site (hearing & eye protection).
- Any power sources and access doors are equipped with locking devices.
- The power source is shut off and locked before lubricating, servicing, adjusting or any other preventative maintenance related work is carried out.
- Safety fences have been installed around equipment to protect from hazardous falls or bodily injury. Safety fences must meet local requirements regarding workers safety and be in place during operation.

1.2 Personnel Qualifications

-All personnel who perform work on or around the Enviro-Drum and related equipment must carefully read and understand the instructions and act in accordance with them.

- All employees, individuals, or persons who operate and/or maintain the Enviro-Drum system shall be properly instructed in its safe operation and management.
- Training shall be provided upon hire, or whenever new or added equipment or machinery is made a part of the system.
- No employee or other person shall be permitted to operate the system without the proper training and knowledge of safe system operation.
- The operator may only carry out work on the equipment if trained, or accompanied by an experienced personnel.
- All equipment handled/moved with lifting devices must be performed by qualified personnel.
- Electrician's license for any electrical work. The electrician must follow NEC standards.
- All welding work to be performed by trained welders.
- In addition special qualifications are required for the following activities:
    - Cleaning
    - Installation
    - Commissioning
    - Operation
    - Preventative Maintenance
    - Shut-down

1.3 Safety Precautions

-Operation of the Enviro-Drum involves high voltage electrical and heavy, moving machinery. Safety awareness is essential. You can help prevent accidents that may cause injury to you and others or damage to the equipment by reading all the safety precautions and incorporating them with standard shop safety rules.

- Do not operate equipment/machinery for other than the intended purposes.
- Never operate equipment/machinery or use hazardous substances or chemicals unless you have been properly trained to do so.
- Respect the machinery; approach moving parts with extreme caution.
- Always be attentive for machine malfunctions or unusual noises. These can indicate problems requiring immediate attention.
- Electricity, heavy equipment/machinery are used and should be handled with appropriate precautions.
- The safety guards for belts, pulleys, pumps, and motors are kept in place during operation.

1.3 Safety Precautions (Continued)

- The Enviro-Drum:
  - Is only used for its intended purpose.
  - Should only be operated if it is in perfect working order.
  - Check the operation of the safety equipment on a regular basis
  - Any work to be carried out is performed by a qualified individual.
- Operating personnel, who require training, only work on the system under the supervision of an experienced personnel.
- The personal protective equipment required for personnel carrying out operation, maintenance and repairs is made available and used properly.
- Perform your own safety inspections regularly, making equipment and operating alterations when unsafe conditions exist.

Always shut off and lock the power supplies before installing, adjusting and or servicing any equipment.

- Follow the maintenance and safety instructions on the labels affixed any electrical equipment.
- All electrical work must be carried out by an electrician.
- Keep hands, feet and clothing away from all moving parts.
- Never use any equipment if any part seems damaged or has signs of abnormal wear.
- Make sure that no one stands close to moving parts before starting any motor.
- Before working on equipment (components, housings, etc), disconnect them from the electrical power source. Secure main switches or emergency stop switches with a padlock to ensure they cannot be switched back on again.
- All electrically conductive parts which may come into contact with someone or something must be connected to each other and to an earth conductor by an additional equipment bond.
- Do not open or dismantle devices. Risk of injury may incur.
- Do not remove any protective devices. Risk of injury may incur.
- Always wear proper ear protection in loud areas.
- Always keep the control cabinet, all electricity supply units, and electrical controls units closed. Access is only permitted to authorized personnel.
- Protect live and high-voltage components against moisture. Under no circumstances may water jets or high-pressure cleaners be directed at them.
- Keep work areas clean and clear of debris, trash, and other accumulations as they may be fire and tripping hazards.
- ADHERE TO SAFETY RULES and when in doubt, consult an expert. References should always be made to federal, state, and local rules, ordinances, regulations, laws, codes, and guidelines. Where there is inconsistency, always take the safest, most restrictive approach.

For additional safety information you can find local safety procedures via the Web Sites below.

Location	Administrated by	Web Site
In Canada	Canadian Center for Occupational Health and Safety	www.ccohs.ca
In USA	Occupational Safety and Health Administration	www.osha.gov
In European Union	European Agency for safety and Heath at Work	www.europe.osha.eu.int

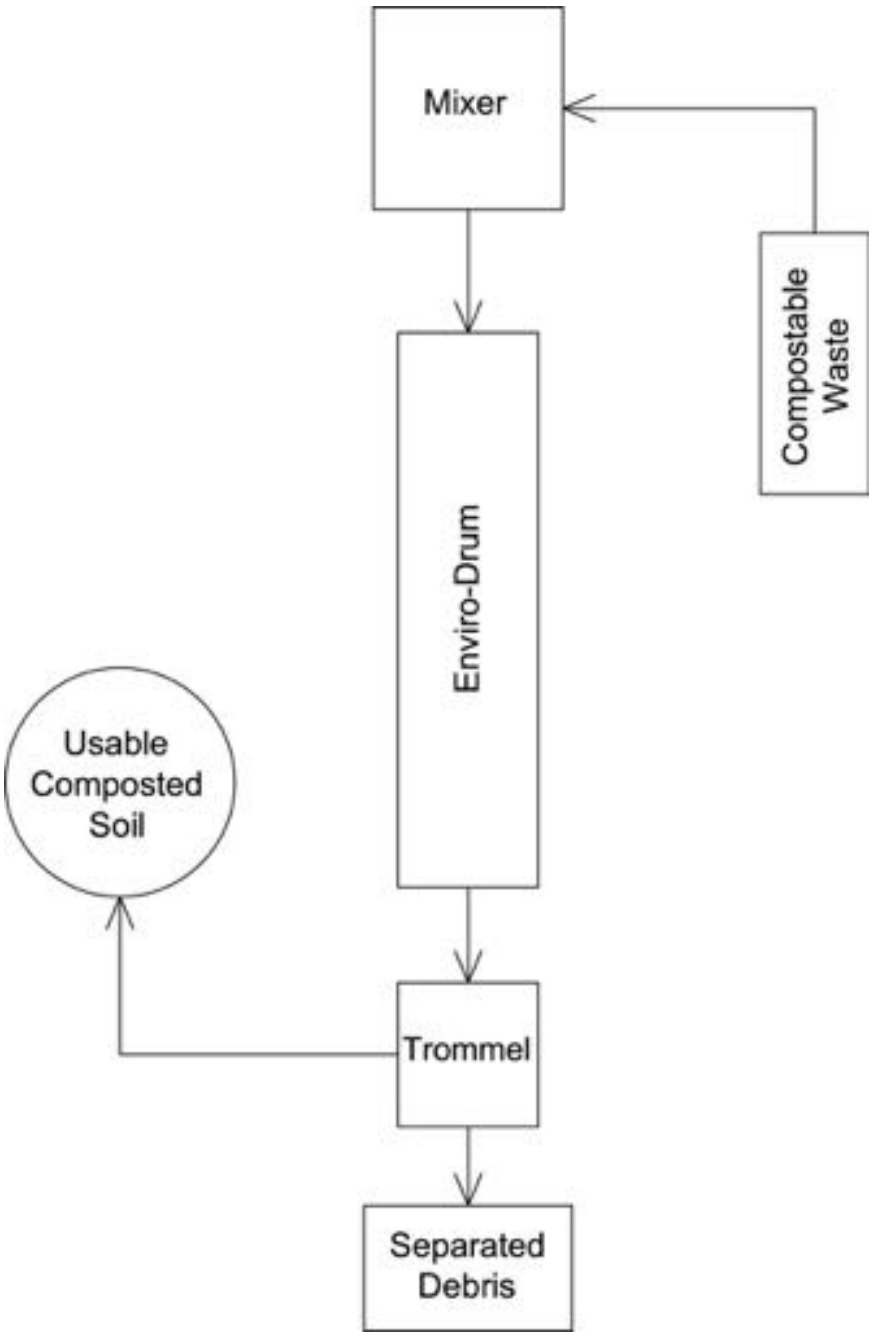
Section 2 - Equipment Overview

-The DTE Enviro-Drum is built for onsite waste composting. It is designed as an economical, reliable, easy method for the digestion of waste material into fresh usable soil. The EnviroDrum uses electrical sensors and motors to power the components necessary to complete this process.

-This manual is created for a typical Envirodrum system and controls & layout may vary depending on the type of installation.

2.1 Block Flow Diagram

-The following block diagram shows a process flow for a typical installation for composting waste material.

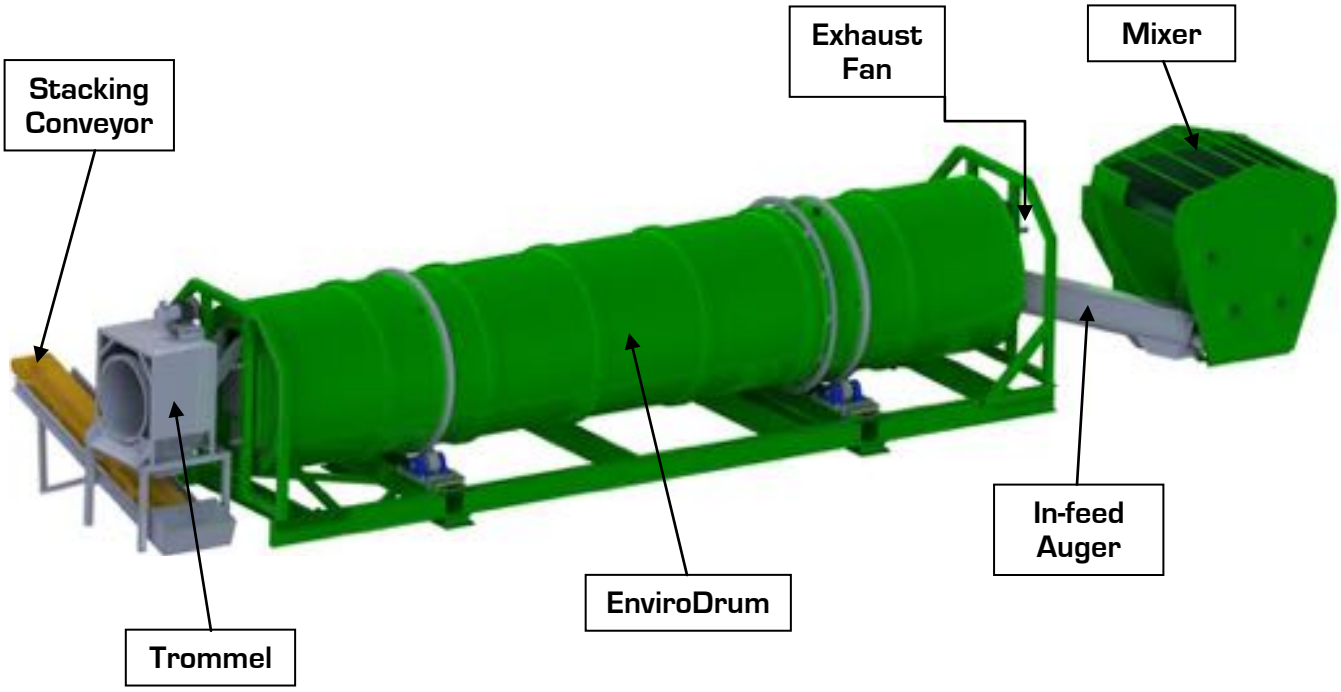


Block flow Diagram Description

In summary:

- Compostable waste material is collected & unloaded into the mixer
- The Mixer has preprogrammed load sensors that will activate the mixer when the set weight has been reached.
- After the compostable waste has been mixed it will then be fed into the Enviro-Drum
- In the Drum the waste material will mix with air & heat from bacteria. The bacteria will then consume the waste material and turn it into soil.
- Trommel will separate larger unwanted debris. The remaining Soil will go onto storage.

2.2 Machine Components



-Mixer - A compost mixer combines and aerates compost materials, such as kitchen scraps and yard waste, for faster conversion into nutrient rich soil.

-In-feed Auger – An Auger is a drilling device that includes a rotating helical screw blade to act as a screw conveyor to move material. The rotation of the blade causes the material to move.

-Exhaust Fan - Is used to control the interior environment by venting out unwanted odors, particulates, moisture, air and other contaminants which may be present. An exhaust fan is used to vent the warm, moist air to the outside, where it can be disperse harmlessly or be directed to a biofilter.

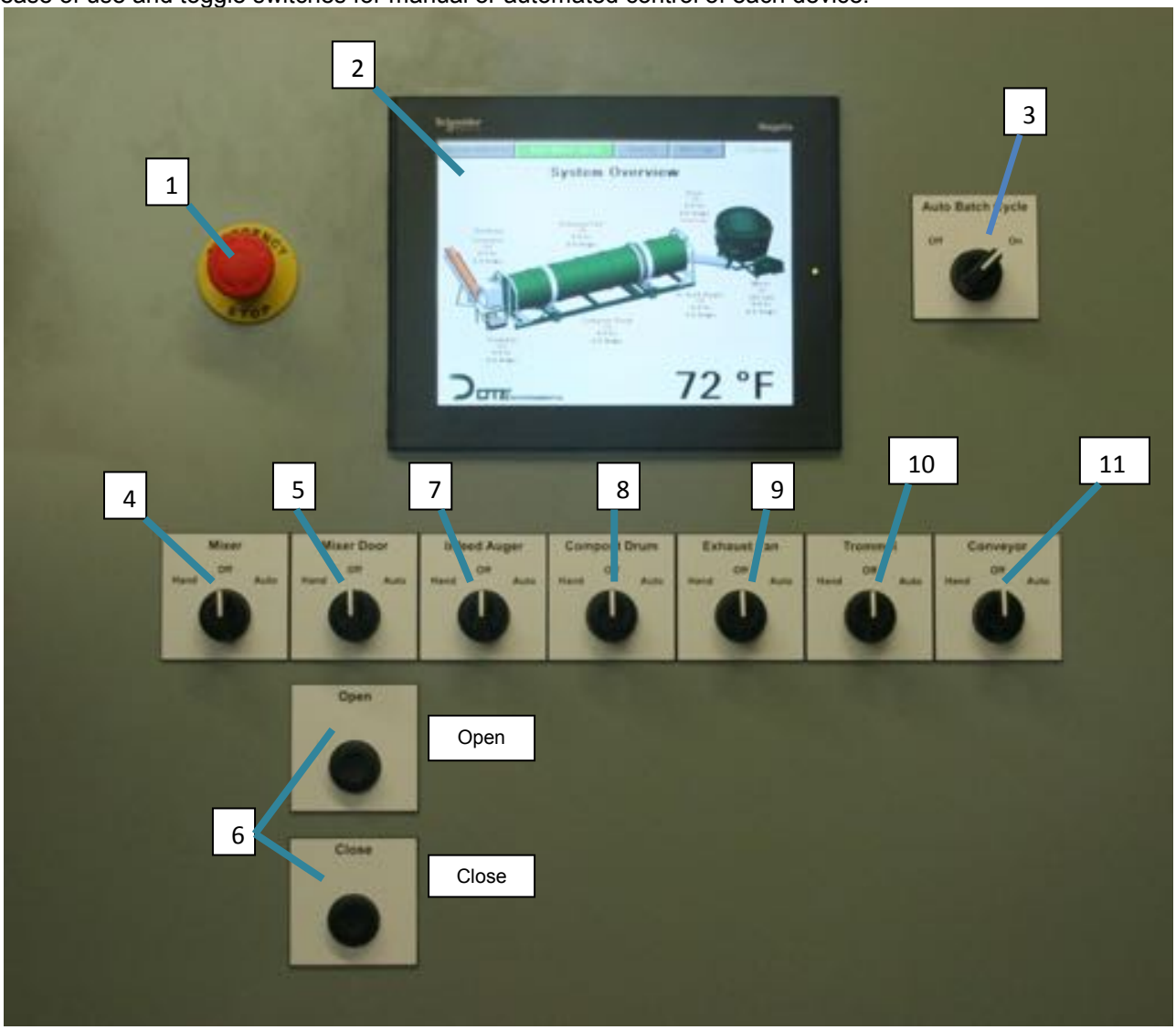
-Compost Drum - The compost drum is an in-vessel composter that is mounted on heavy duty idler wheels. The drum will continually rotate, turning compostable solids inside. This turning mixes air and heat with the compost waste solids and speeds up the composting process.

-Trommel - The Trommel is a screened cylinder used to separate materials by size - for example, separating the biodegradable fraction of mixed compostable waste.

-Conveyor - The Conveyor is a common piece of mechanical handling equipment that moves materials from one location to another.

2.3 Control Cabinet

-The Control Cabinet is the brain center for the Enviro-Drum system. The cabinet controls the operation of each device through a PLC (Process Logic Controler). The cabinet features a touch screen display for ease of use and toggle switches for manual or automated control of each device.



1.	Emergency Stop Button	• Press to stop all devices (see following page for details).
2.	Touch Screen Display	• Touch screen operates all PLC devices.
3.	Auto Batch Cycle	• On / Off switch for Auto Batch Cycle
4.	Mixer	• Hand, Off, Auto switch for Mixer operation
5.	Mixer Door	• Closes / Opens the mixer door
6.	Open / Close	• Manually opens and closes mixer door when set to Hand operation mode.
7.	In-feed Auger	• Hand, Off, Auto switch for In-feed Auger
8.	Compost Drum	• Hand, Off, Auto switch for Compost Drum
9.	Exhaust Fan	• Hand, Off, Auto switch for Exhaust Fan
10.	Trommel	• Hand, Off, Auto switch for Trommel
11.	Conveyor	• Hand, Off, Auto switch for Conveyor

2.4 Emergency Stop

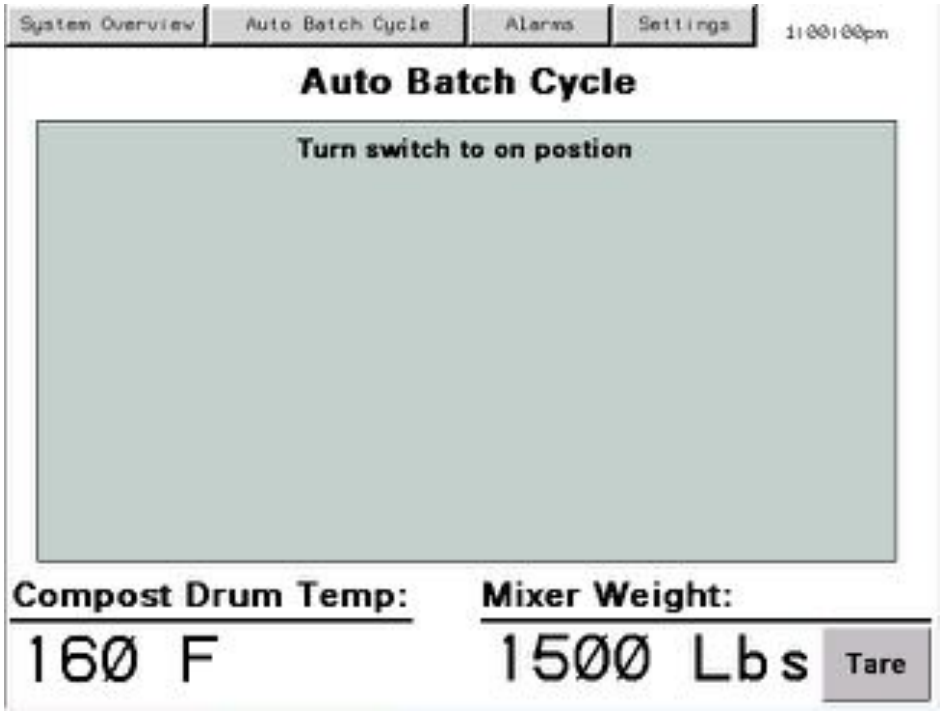
-The Emergency Stop Button can be pressed at anytime to immediately stop all components. An emergency stop screen will appear on the touch screen display after the button has been pressed.

-The screen will remain in an active stop until it is acknowledged and reset.

•To reset twist the emergency stop button on the front of the cabinet to release the “Emergency Stop Device.” You will be prompted with a new screen that will require you to set all devices to off before returning to normal operation.

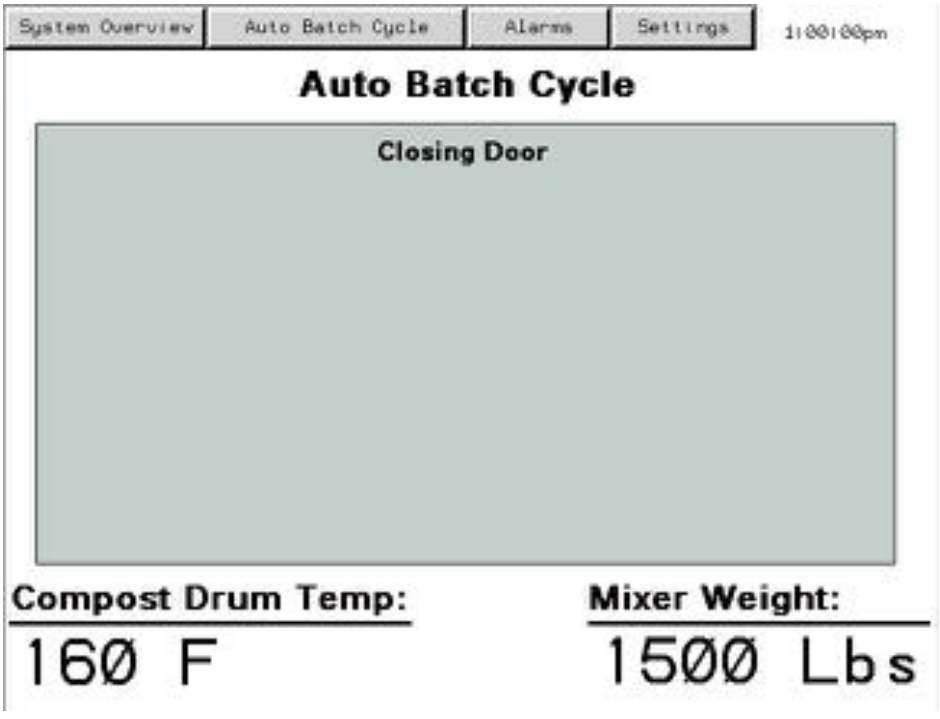
2. 5 Auto Batch Cycle

-The Auto Batch Cycle allows hand off operation of the Enviro-Drum. This section will help explain the different screens associated with the Auto Batch Cycle through a cycle operation.

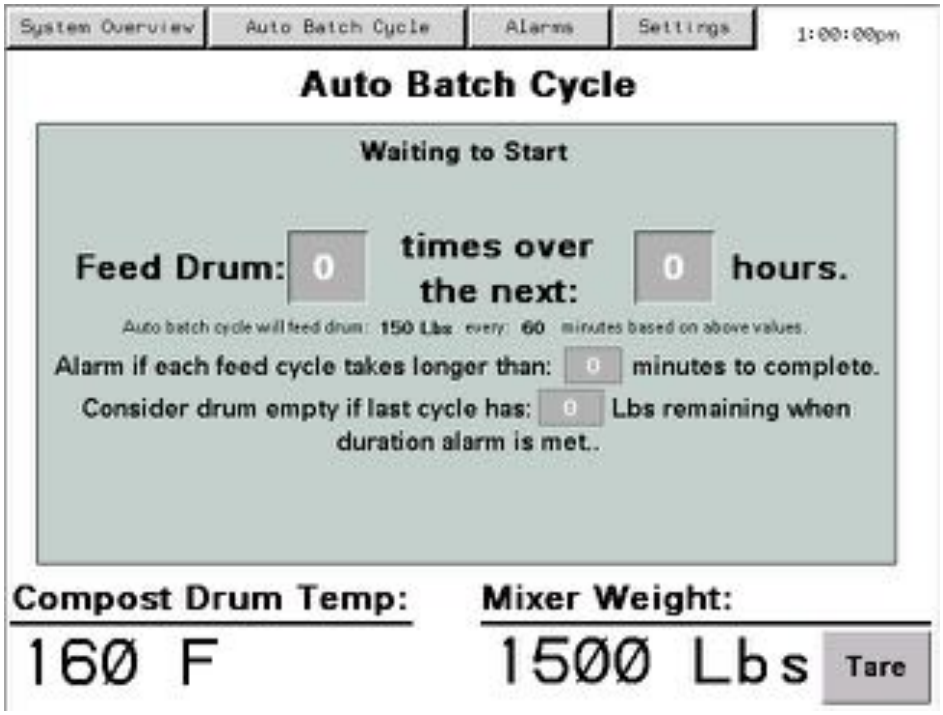


-When pressing the Auto Batch Cycle tab you will be asked to "Turn the switch to On position" via the control switch on the control cabinet.

-Once the Auto Batch Cycle switch has been switched to On the mixer door will close.

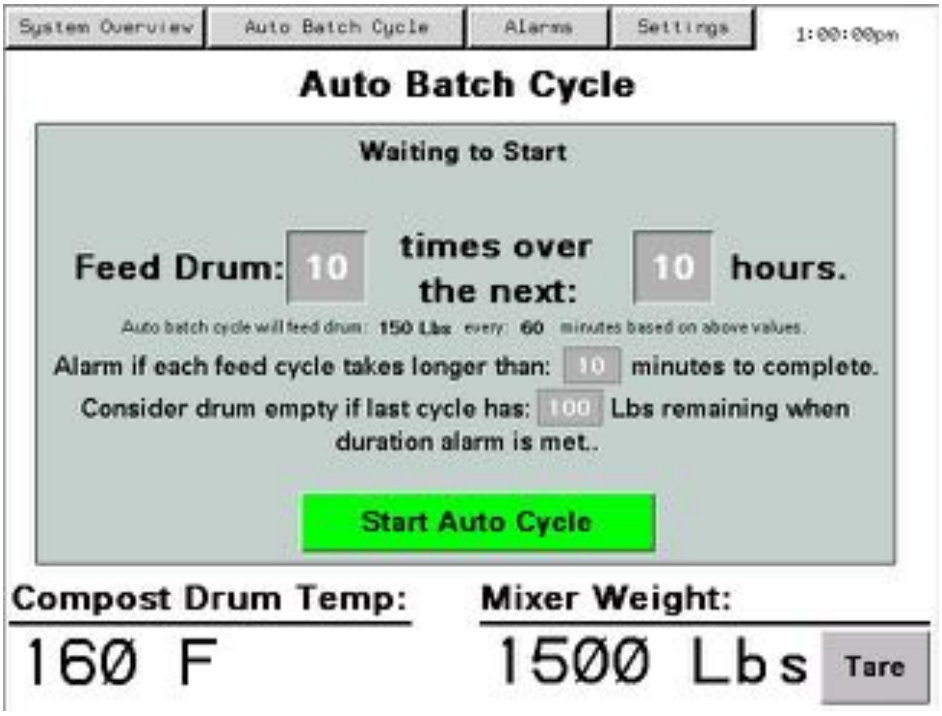


Auto Batch Cycle



-Once the mixer door has closed the inputs can be set to the desired numbers of feeds and time they will be fed.
(see section 3.3 for help with set-up).

-Once the above variables have been set then you can start the Auto Batch Cycle. Pressing “Start Auto Cycle,” that will appear at the bottom of the screen will begin the Auto Batch Cycle.



-Once started the pre-mix cycle will start and continue until the pre-mix time has passed.

-When the pre-mix cycle has finished the mixer door will open.

-After the mixer door has opened the material will be fed into the compost drum. The remaining Feed cycles and weight left in the mixer will also be shown.

-Once the drum has stopped feeding then the cycle will be ready for its next feed cycle. You can either wait for the cycle to start automatically or you have the option to press “Start Next Cycle Now” to repeat the process the whole Auto Batch Cycle from the beginning.

Section 3 – Panel Controls

3.1 Understanding Screen Layout

-The screen is set-up into four different tabs at the top of the screen, System Overview, Auto Batch Cycle, Alarms and Settings. To view a different tab, simply touch the one you want to view with your index finger and you will be taken to the selected screen. Current time is also show in the top right corner (see section **3.5.1** for set-up).

3.2 System Overview Screen

-The System Overview screen shows all of the components that are currently in operation, the frequency they are running and Amps as well as the current operating temperature of the Compost Drum. It is the first screen that you will see and will provide the best overview of each piece of equipment.

3.3 Auto Batch Cycle Screen

The Auto Batch Cycle works in conjunction with other components in the system. Each component will need to be set-up for the Auto Batch Cycle to work properly. The set-up and operation of each device will be explained as you progress further in this manual.

-The Auto Batch Cycle screen provides a simple view of the Compost Drum Temp and the current Mixer Weight (seen on the bottom of the screen image). The Auto Batch Cycle can only be initiated while the mixer door is closed.

Setting the Auto Cycle

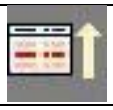
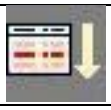
- Press “Feed Drum” value to input how many times you want to feed the drum compost.
- Press “time over the next” value to input the amount of hours you wish the cycle to run.
  - -For example if you wanted to feed the drum 16 times over the next 96 hours (4 days) than you would have the cycle turning on every 6 hours. (96 / 16 = 6)
- Press the input value associated with the Alarm to enter a failsafe if the machine malfunctions.
- Press the input value associated with Lbs remaining to enter a value
- Press “Start Auto Cycle” to begin the Auto Batch Cycle.
- Press the “Tare” button in the bottom right hand corner to reset the weight to 0lbs (for recalibrating scale).

3.4 Active Alarms Screen

-The Active Alarms screen will any alarms that are currently active, the date they were activated, time, state and an error message of what triggered the alarm.

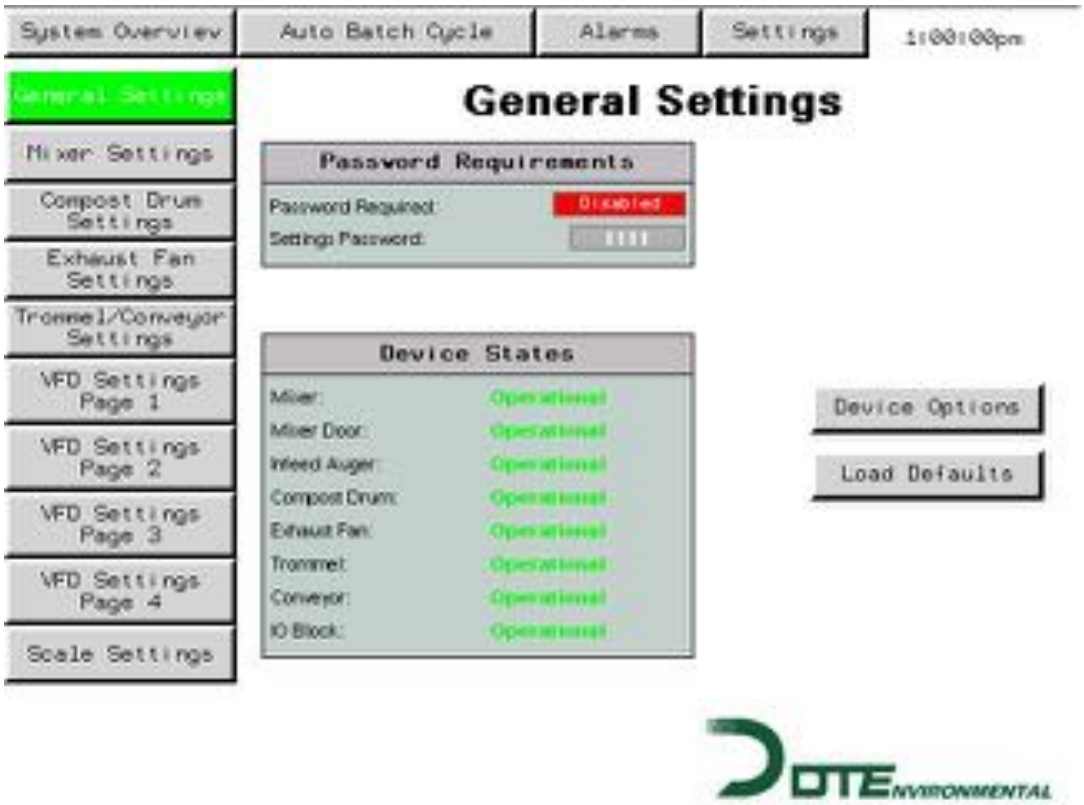
Navigating the Active Alarms Screen

-There are six buttons under the Active Alarms title; each one has a different function.

					
Acknowledge All Alarms	Acknowledge Selected Alarm	Up	Down	Page Up	Page Down

• Press “Active Alarms” to show current alarms that are active.
• Press “Alarm History” to bring up the dates of all past alarms.
• Press “Acknowledge All Alarms” to clear the Active Alarm screen of all Active alarms. (They will still show up in Alarm History).

3.5 General Settings Screen



-Pressing the Settings Tab will bring up the General Settings screen. On this screen you will see all the settings related to the Mixer, Compost Drum, Exhaust Fan, Trommel/Conveyor, VFD (Variable Frequency Device) and Scale settings and be able to adjust them accordingly.

Setting up a password

•Press on Disabled in the Red.
•Press Enable.
•You will be prompt to Enter a password.

After setting up a password you will be prompted for a password when selecting a different tab besides System Overview.

Device States

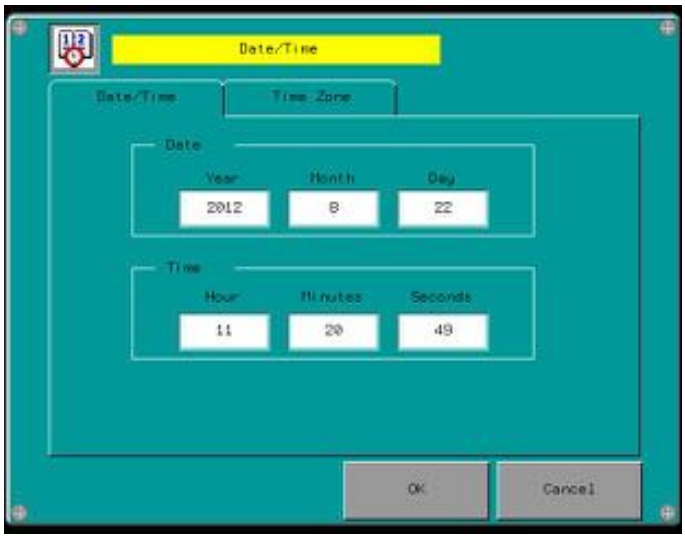
A Device States will display the status that a device is in:

Operational – displayed when a device is working properly.
Not Available – displayed when a devices' overload breaker has been tripped.

•Press "Device Options" to bring up the display settings.
•Press "Load Defaults" to reset all settings to factory settings.

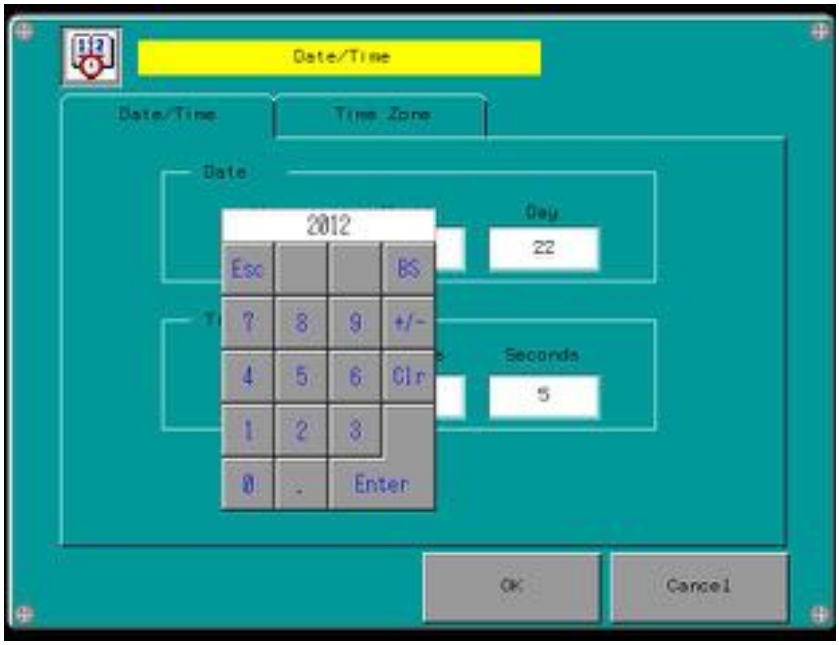
3.5.1 Setting the Date/Time

This page is written to show / explain the set up of the date/time settings only. Operation of any other feature on this screen is to the risk of the end user.



•Press the Date/Time box to open the Date/Time setting screen.
•Press “To Run Mode” at the bottom of the screen to return to the Device settings page.

Date/Time



• Press an input that corresponds with the feature above it that you want to set

• A numerical screen will appear.

• Enter the input matching the subject and then hit Enter to input that data.

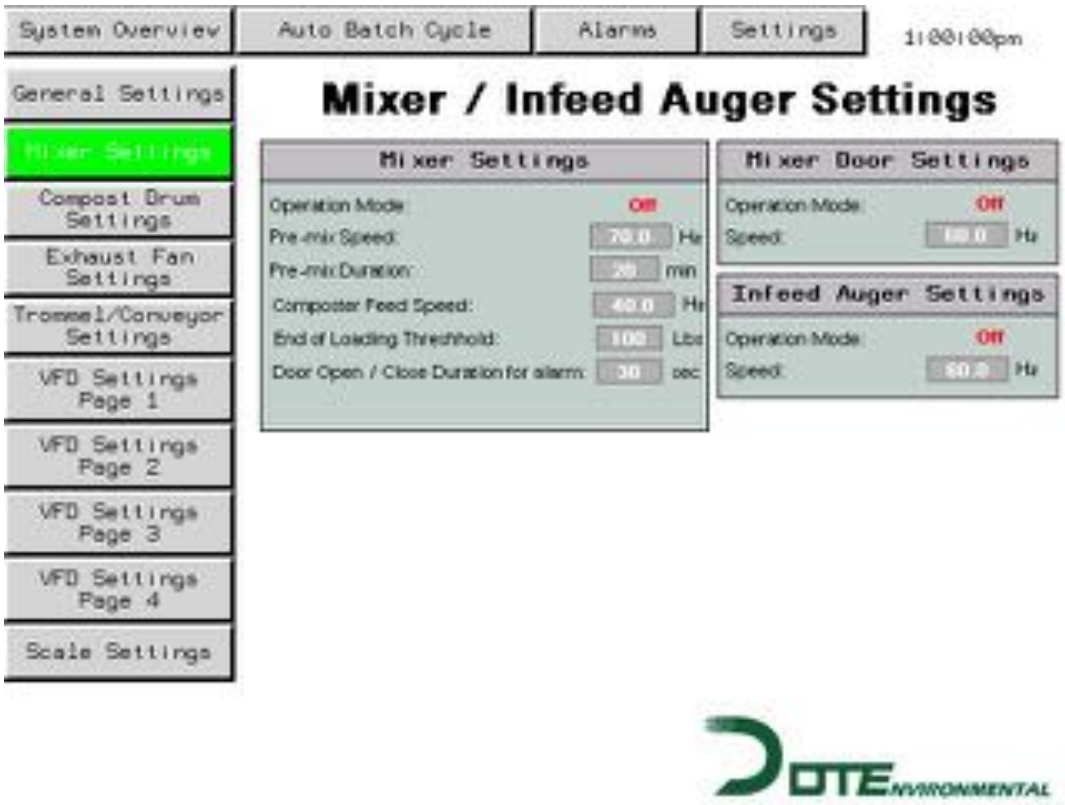
• “Hour,” under Time settings, is a 24 hour setting (1pm = 13 etc.).

• After all the inputs are set hit “OK” at the bottom of the screen to return to the System Configuration screen.

• Hit “To Run Mode” to return to the Device settings page.

3.6 Mixer / In-feed Auger Settings

Before continuing make sure you have proper understanding of each device before setting up or changing these devices. Improper settings of these devices could result in permanent damage to the motor and the system.



-Mixer / In-feed Auger Settings screen allows you to control the duration and frequency of the Mixer, Auger and Mixer Door.

Mixer Settings

-**Operation Mode** will display the current mode the device is in. (Hand, Off or Auto).
•Press “Pre-mix Speed” input to set the Speed in the Auto Batch Cycle for the Pre-Mix cycle.
•Press “Pre-mix Duration” input to set the amount of time you want the Mixer to run.
•Press “Composter Feed Speed” input to set the Hz of the feeder.
•Press “End of Loading Threshold” input to set the Lbs for the feed to stop loading into the auger.
•Press “Door Open/ Close Duration for Alarm” input to set the duration of the alarm.

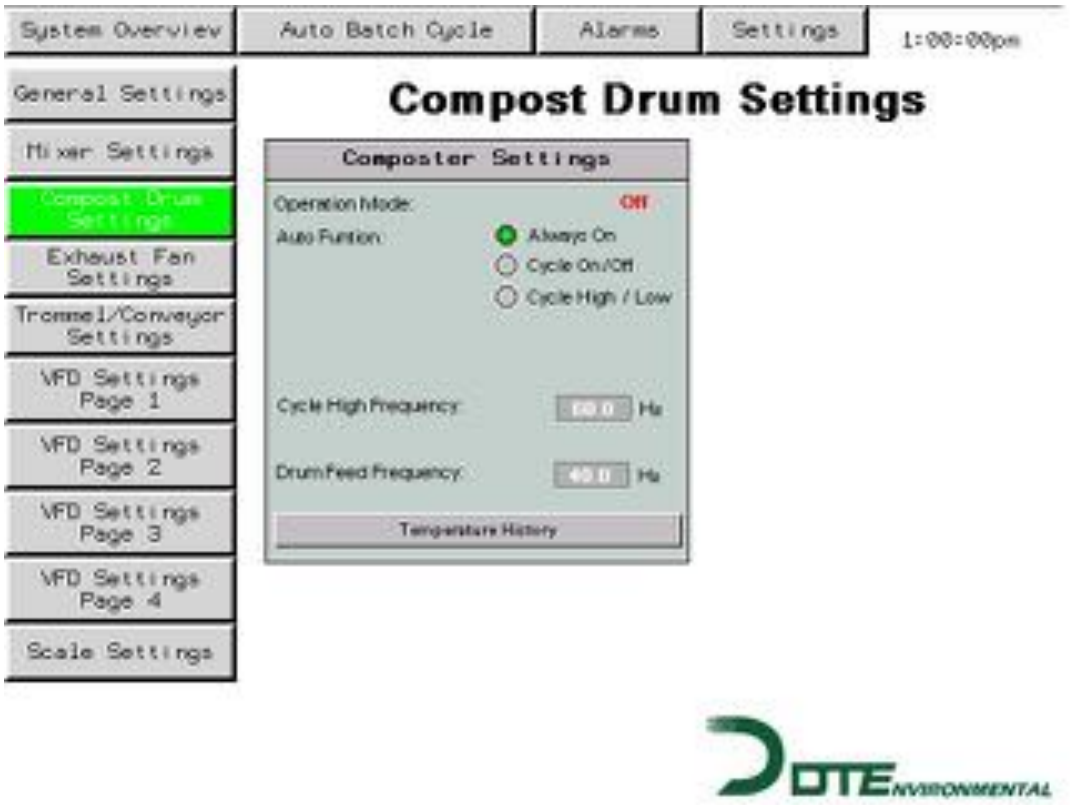
Mixer Door Settings

-**Operation Mode** will display the current mode the device is in. (Hand, Off or Auto).
•Press “Speed” input to set the Hz for the mixer door to open.

In-feed Auger Settings

-**Operation Mode** will display the current mode the device is in. (Hand, Off or Auto).
•Press “Speed” input to set the Hz for the auger speed.

3.7 Compost Drum Settings



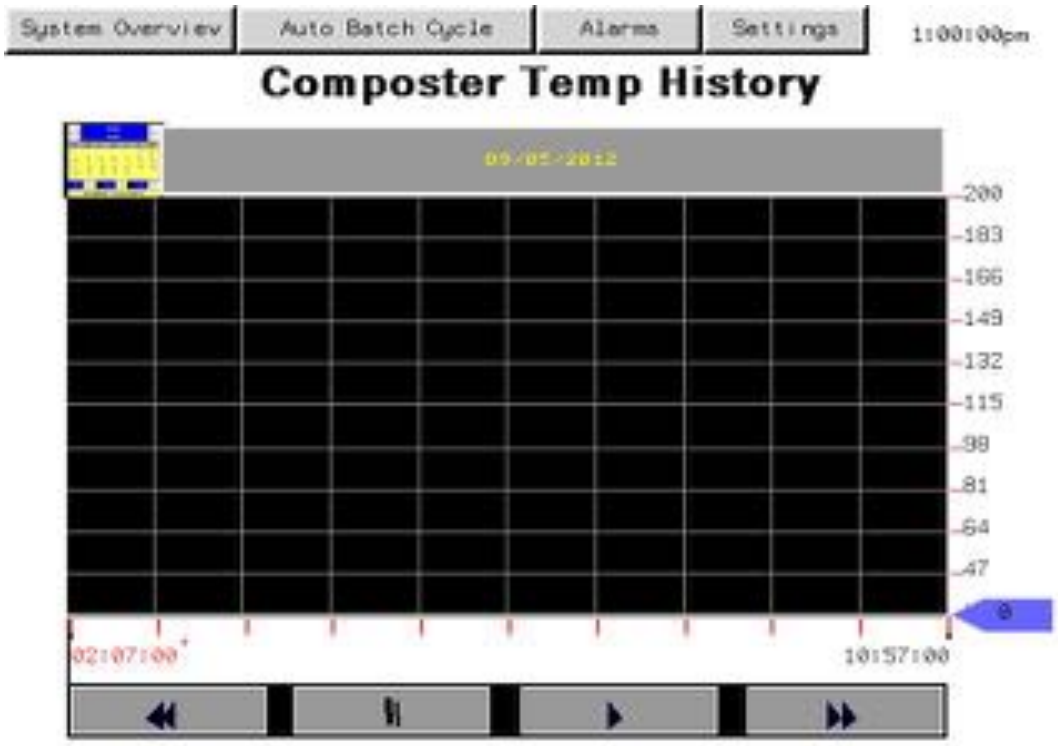
-The Compost Drum Settings screen allows you to control the duration and frequency on high and low for the compost drum.

Compost Drum Settings

-**Operation Mode** will display the current mode the device is in. (Hand, Off or Auto).
•Press “Always On” the Compost Drum will run continuously to the set frequency.
•Press “Cycle” to use the following set-up:
- •Press “Cycle High Duration” input to set the amount of time you want the device to run on High.
- •Press “Cycle Low Duration” input to set the amount of time you want the device to run on Low.
- •Press “Cycle High Frequency” input to set the Hz you want the device to run on in High Duration.
- •Press “Cycle Low Frequency” input to set the Hz you want the device to run on in Low Duration.
- •Press “Drum Feed Frequency” to set the Hz for batch speed.

•Press “Temperature History” to display past temperatures, for different cycles, of the Compost Drum. (see **3.7.1** Temperature History)

3.7.1 Temperature History



-The Temperature History graph displays the variations of temperature inside the Composter. The current date will be displayed at the top of the screen and an interactive calendar to the top right. This graph can be utilized in many different ways and is a great asset in discerning the composters temperature ranges.

Navigating the Screen

-There are four buttons at the bottom of the screen; each one provides a different function to navigate the chart.

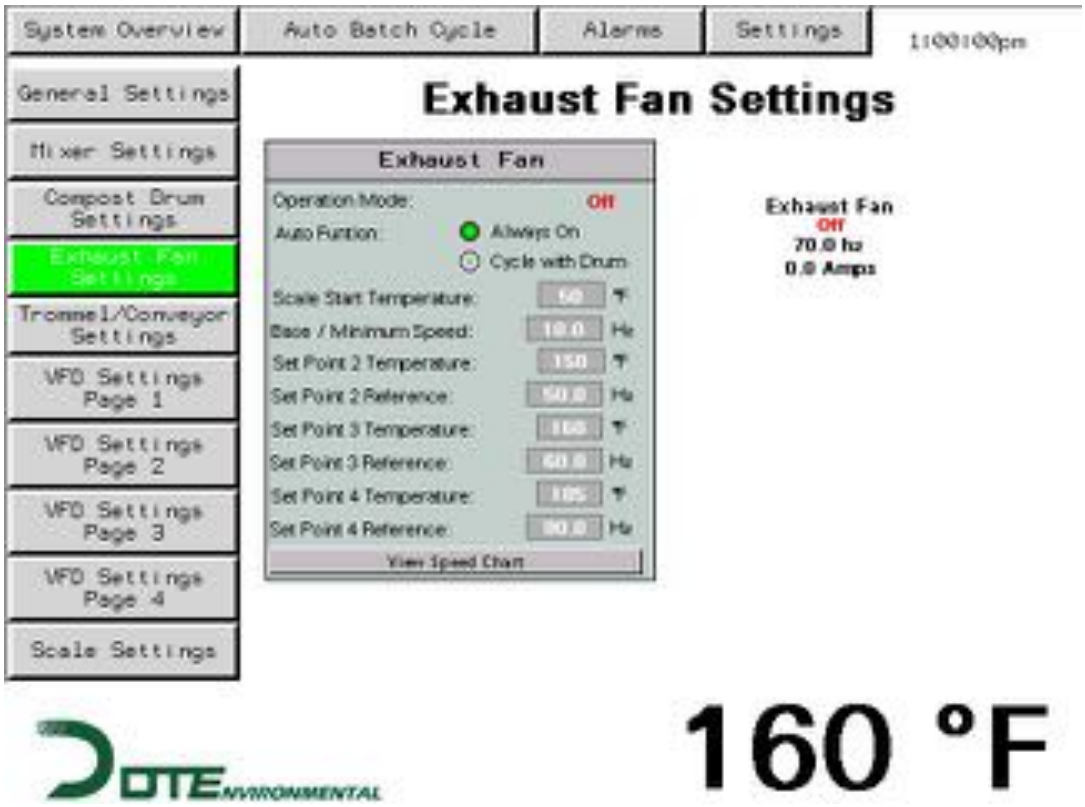
Back 30 Minutes | Hold Time | To Current Time | Forward 30 Minutes

-Above the “back 30 minutes” and “forward 30 minutes” buttons displays two times. The one on the right displays current time and to the left displays past time. Using the four buttons will change the past time in 30 minutes increments. These inputs allow for a more pin point measurement on the graph and help track down temperature fluctuations.

•Press the calendar in the top right corner to bring up the calendar screen.

-The calendar will allow access through the graphs history to give a broader look at the composter’s temperature history or simply to view a past day for the composter drum.

3.8 Exhaust Fan Settings Screen



-The Exhaust Fan Settings screen shows the current temperature inside the drum, the current operating Hz and amps. There are different set points that you must set for the Exhaust Fan to vent off heat and moisture. The Fan speed is controlled at 4 initial temperature set points (settings typical starting point at 50°F at 10Hz and then setting point 2 to trigger at 150°F with a reference speed of 70 Hz etc).

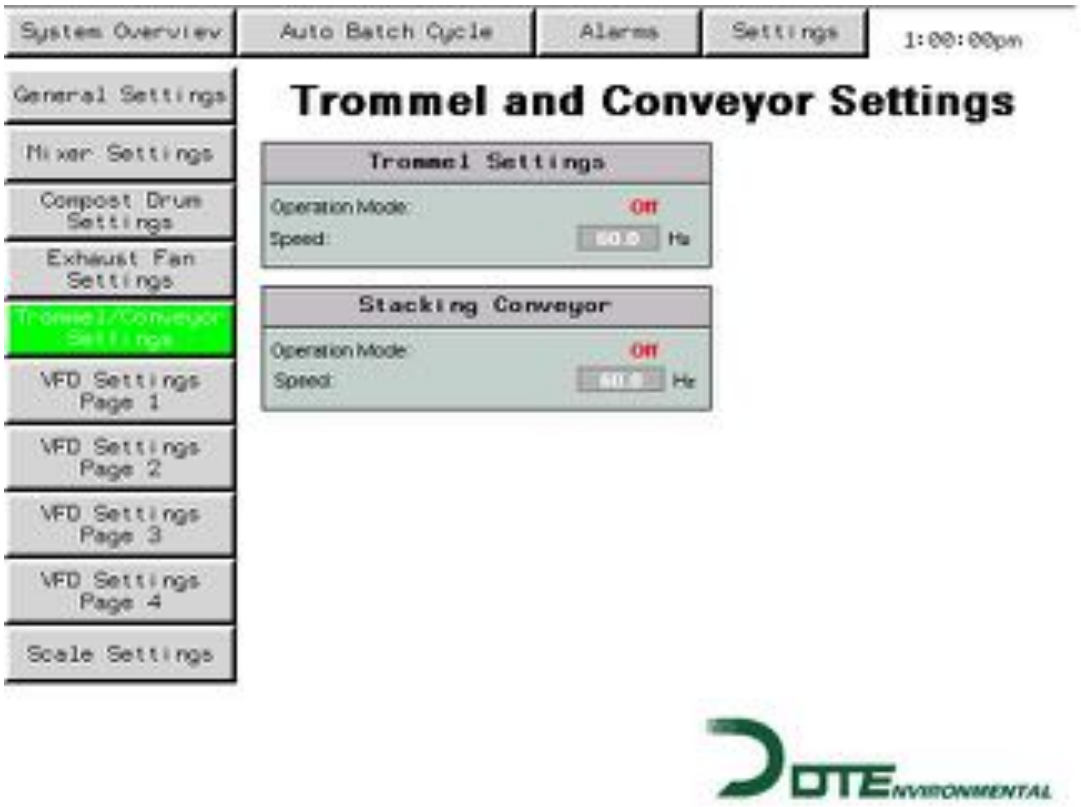
Exhaust Fan Settings

-**Operation Mode** will display the current mode the device is in. (Hand, Off or Auto).
•Press “Always On,” the Exhaust Fan will be constantly on at its highest frequency
•Press “Cycle with Drum” to use the temperature settings when the compost drum is in a cycle. (Fan will remain on, at its base speed, even when the drum is not in cycle).

•Press “Scale Start Temperature” input to set the °F set point to start.
•Press “Base / Minimum Speed” input to set the minimum Hz for the exhaust fan to operate.
•Press “Set point 2 Temperature” input to set the °F set point trigger.
•Press “Set point 2 Reference” input to set the Hz for the fan speed.
•Press “Set point 3 Temperature” input to set the °F set point trigger. •Press “Set point 3 Reference” input to set the Hz for the fan speed.
•Press “Set point 4 Temperature” input to set the °F set point trigger.
•Press “Set point 4 Reference” input to set the Hz for the fan speed.

•Press “View Speed Chart” to view the current set point graph you have set.

3.9 Trommel and Conveyor Settings



-Trommel and Conveyor Settings screen allows you to control the speed of the Trommel and Stacking Conveyor.

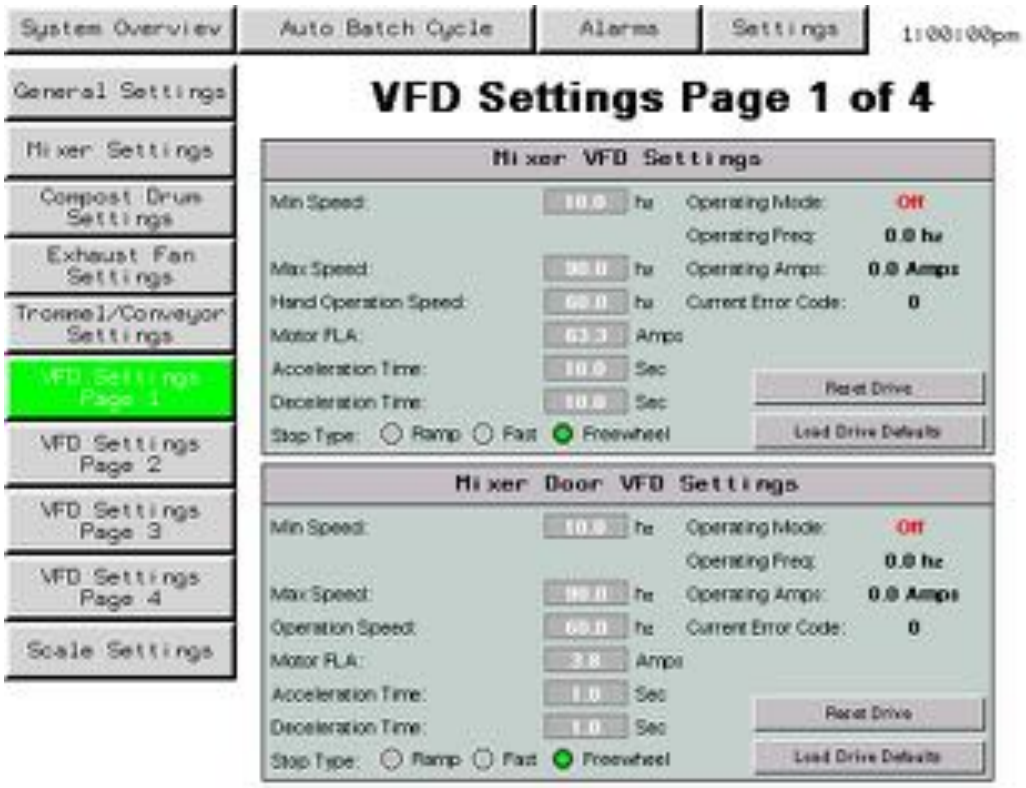
Trommel Settings

-**Operation Mode** will display the current mode the device is in. (Hand, Off or Auto).
•Press “Speed” input to set the operational speed for the Trommel.

Stacking Conveyor Settings

-**Operation Mode** will display the current mode the device is in. (Hand, Off or Auto).
•Press “Speed” input to set the operational speed for the conveyor.

3.10 VFD Settings Page 1



All VFD settings, pages 1 – 4, are range limiters for all other device settings and will override them with the maximum or minimum input values set.

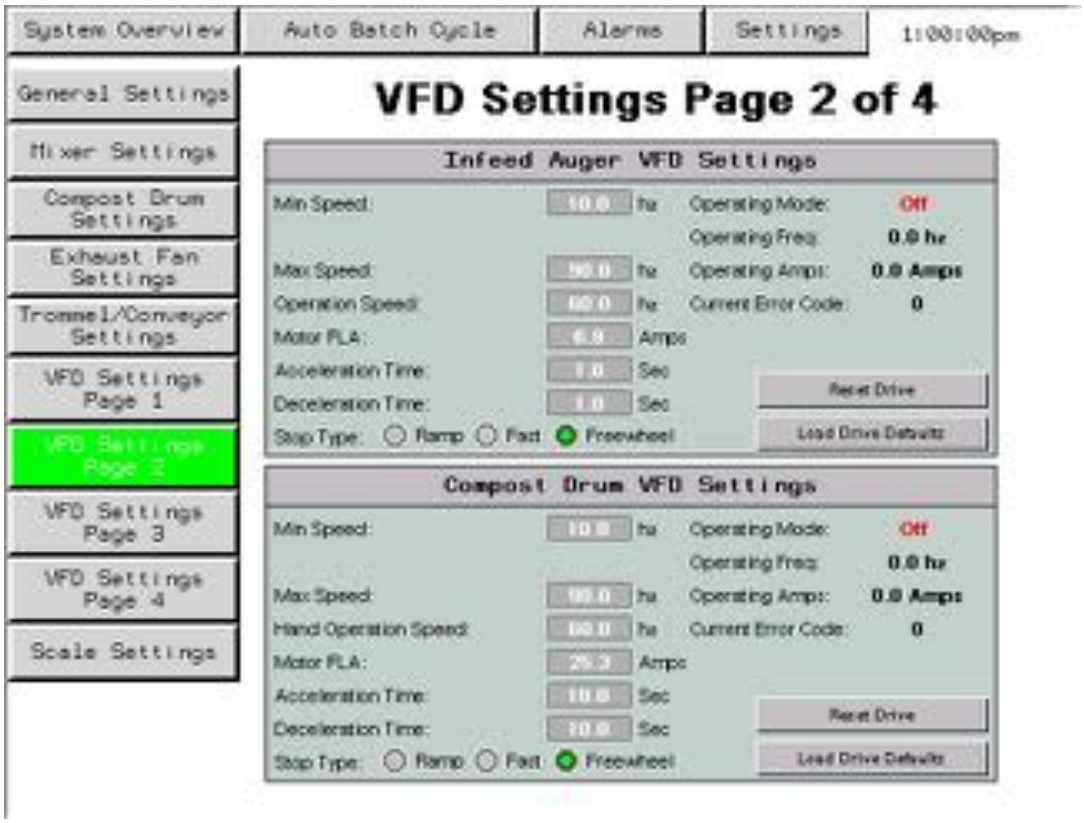
Mixer VFD and Mixer Door VFD Settings

•Press “Min Speed” input to set the Min Hz at which the device will run.
•Press “Max Speed” input to set the max Hz at which the device will run.
•Press “Hand Operation Speed” input to set the Hz that device will run.
•Press “Motor FLA” input to set the maximum amps at which the device will run.
•Press “Acceleration Time” input to set the time it will take to accelerate the device.
•Press “Deceleration Time” input to set the time it will take to decelerate the device.
•Press “Stop Type” Ramp, Fast, or Freewheel to set the devices stopping type.
Ramp – Will ramp up or down the speed at the set Acceleration/ Deceleration time.
Fast – Acts like a brake and will stop the device as fast as possible.
Freewheel – Will shut off the device and let it spin freely till it stops on its own.
-**Operation Mode** will display the current mode the device is in. (Hand, Off or Auto).
-**Operating Freq** will display the current operating frequency
-**Operating Amps** will display the current operating amps.

-Current Error Code will display the error code that the device has failed

•Press “Reset Drive” to reset an active fault on the device (use only with Admin instructions).
•Press “Load Drive Defaults” to set all input values to their default values.

3.11 VFD Settings Page 2



All VFD settings, pages 1 – 4, are range limiters for all other device settings and will override them with the maximum or minimum input values set.

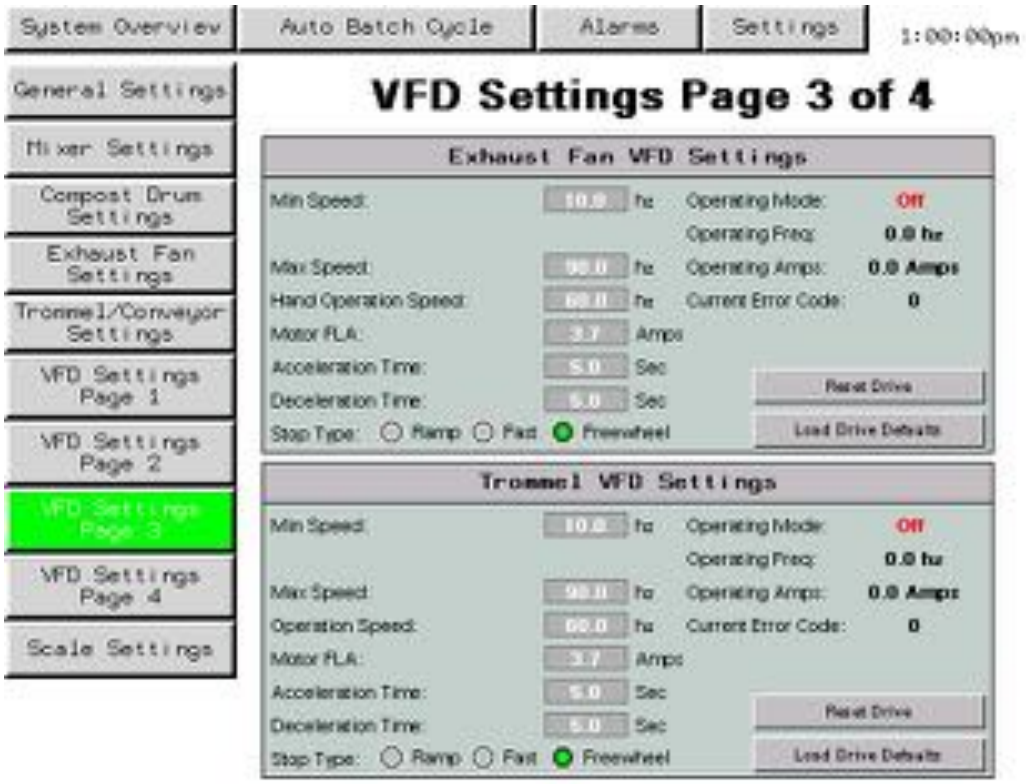
In-feed Auger and Compost Drum VFD Settings

•Press “Min Speed” input to set the Min Hz at which the device will run.
•Press “Max Speed” input to set the max Hz at which the device will run.
•Press “Hand Operation Speed” input to set the Hz that device will run.
•Press “Motor FLA” input to set the maximum amps at which the device will run.
•Press “Acceleration Time” input to set the time it will take to accelerate the device.
•Press “Deceleration Time” input to set the time it will take to decelerate the device.
•Press “Stop Type” Ramp, Fast, or Freewheel to set the devices stopping type.
Ramp – Will ramp up or down the speed at the set Acceleration/ Deceleration time.
Fast – Acts like a brake and will stop the device as fast as possible.
Freewheel – Will shut off the device and let it spin freely till it stops on its own.
-**Operation Mode** will display the current mode the device is in. (Hand, Off or Auto).
-**Operating Freq** will display the current operating frequency
-**Operating Amps** will display the current operating amps.

-Current Error Code will display the error code that the device has failed

•Press “Reset Drive” to reset an active fault on the device (use only with Admin instructions).
•Press “Load Drive Defaults” to set all input values to their default values.

3.12 VFD Settings Page 3



All VFD settings, pages 1 – 4, are range limiters for all other device settings and will override them with the maximum or minimum input values set.

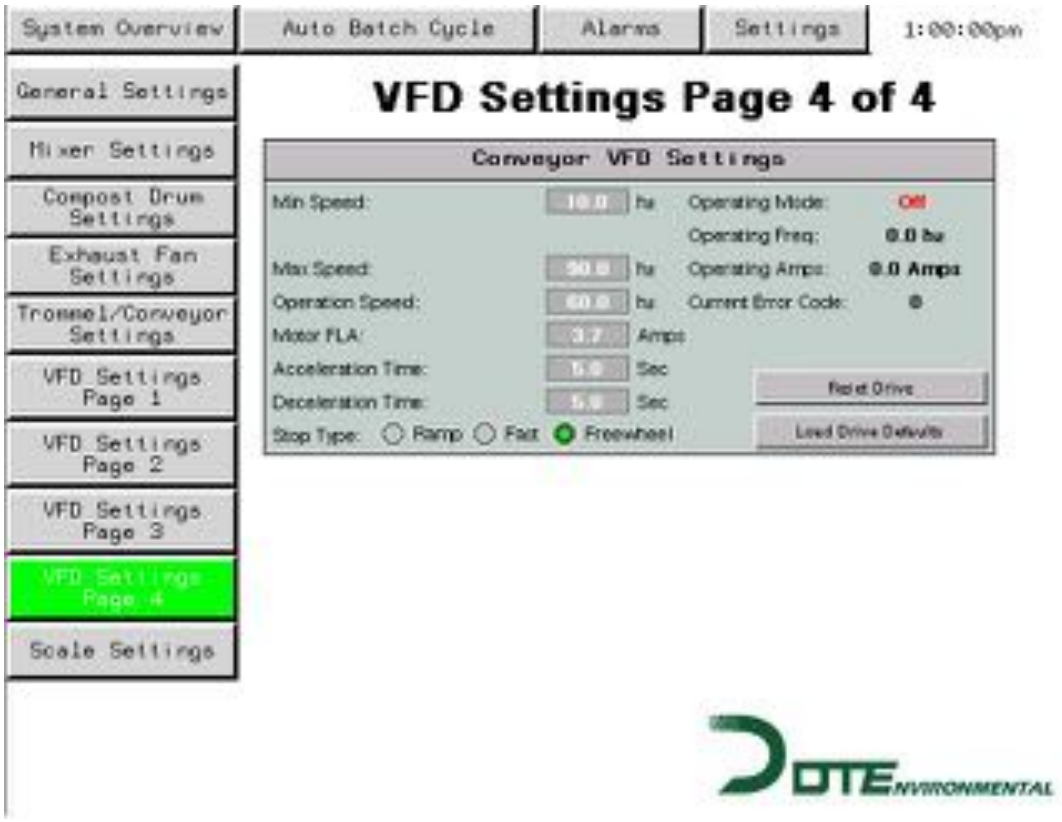
Exhaust Fan and Trommel VFD Settings

•Press “Min Speed” input to set the Min Hz at which the device will run.
•Press “Max Speed” input to set the max Hz at which the device will run.
•Press “Hand Operation Speed” input to set the Hz that device will run.
•Press “Motor FLA” input to set the maximum amps at which the device will run.
•Press “Acceleration Time” input to set the time it will take to accelerate the device.
•Press “Deceleration Time” input to set the time it will take to decelerate the device.
•Press “Stop Type” Ramp, Fast, or Freewheel to set the devices stopping type.
Ramp – Will ramp up or down the speed at the set Acceleration/ Deceleration time.
Fast – Acts like a brake and will stop the device as fast as possible.
Freewheel – Will shut off the device and let it spin freely till it stops on its own.
-**Operation Mode** will display the current mode the device is in. (Hand, Off or Auto).
-**Operating Freq** will display the current operating frequency
-**Operating Amps** will display the current operating amps.

-Current Error Code will display the error code that the device has failed

•Press “Reset Drive” to reset an active fault on the device (use only with Admin instructions).
•Press “Load Drive Defaults” to set all input values to their default values.

3.13 VFD Settings Page 4



	**All VFD settings, pages 1 – 4, are range limiters for all other device settings and will override them with the maximum or minimum input values set.**

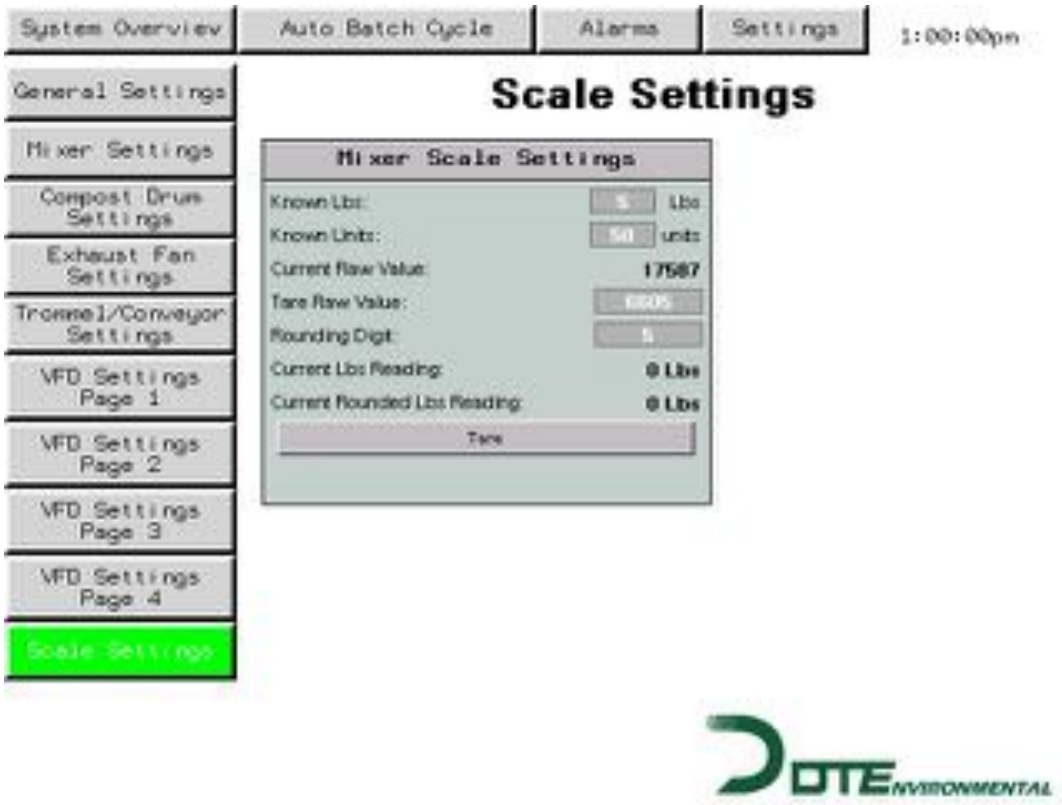
Conveyor VFD Settings

•Press “Min Speed” input to set the Min Hz at which the device will run.
•Press “Max Speed” input to set the max Hz at which the device will run.
•Press “Hand Operation Speed” input to set the Hz that device will run.
•Press “Motor FLA” input to set the maximum amps at which the device will run.
•Press “Acceleration Time” input to set the time it will take to accelerate the device.
•Press “Deceleration Time” input to set the time it will take to decelerate the device.
•Press “Stop Type” Ramp, Fast, or Freewheel to set the devices stopping type.
Ramp – Will ramp up or down the speed at the set Acceleration/ Deceleration time.
Fast – Acts like a brake and will stop the device as fast as possible.
Freewheel – Will shut off the device and let it spin freely till it stops on its own.
-**Operation Mode** will display the current mode the device is in. (Hand, Off or Auto).
-**Operating Freq** will display the current operating frequency
-**Operating Amps** will display the current operating amps.

-Current Error Code will display the error code that the device has failed

•Press “Reset Drive” to reset an active fault on the device (use only with Admin instructions).
•Press “Load Drive Defaults” to set all input values to their default values.

3.14 Scale Settings



Mixer Scale Settings

•Press “Known Lbs” input to set Lbs to a desired weight for the scale to trigger the mixer.
•Press “Known Units” input to enter the unit increments (ex. 50 Units = 5Lbs).

-Current Raw Value displays the numerical number associated with the load sensor. For example if 17587 increase to 17637, which is an increase of 50 units, than the scale weight will increase by 5lbs. The “Known Units” input is directly related to the Current Raw Value and adjusting the Known Units will change when more Lbs will be added to the current Lbs reading.

•Press “Tare Raw Value” input to set the dead load of the mixer. This will act like a ghost weight; adding any extra weight onto the scale that you do not want to be added to the total weight value..
•Press “Rounding Digit” input to set the amount that will be round (ex. Units of 5; 5,10,15,20 etc.).

-Current Lbs Reading will display the net Lbs that are in the Mixer.
-Current Rounded Lbs Reading will show how much Lbs there are with the current Rounding Digit.

•Press “Tare” will zero out, reset, the current Lbs reading to zero.

Section 4 – Operation

4.1 Pre-Operation Check

Perform the following checks prior to starting the DTE Enviro-Drum:

1. Walk around the machine looking for any conditions not permitting the safe start-up and operation of the equipment (i.e. missing guards, loose or missing components, or signs of maintenance work). Correct as required.

2. Ensure that the equipment and work area are clean and clear of any obstructions that may I interfere with operation.

4.2 Starting and Stopping Procedures

A. Start-up Procedure

1. Ensure that the pre-operational checkout was performed.
2. Switch on the main power to operation panel
3. Turn ON Mixer control
4. Turn ON In-feed Auger control
5. Turn ON Compost Drum control
6. Turn ON Trommel control
7. Turn ON Stacking Conveyor control

.

B. Stopping Procedure

1. Turn OFF Mixer control
2. Turn OFF In-feed Auger control
3. Turn OFF Compost Drum control

	**Compost Drum will start to roll backwards due to the weight of compost inside the drum. This is perfectly normal; the motors are designed to handle this back roll.**

4. Turn OFF Trommel control
5. Turn OFF Stacking Conveyor control
6. Place the electrical disconnect in the OFF position to lockout all energy sources to the operation panel if long-term shutdown is desired.

Section 5 – Maintenance

5.1 Preventative Maintenance

	**Words with numbers attached at the end, correspond with the Grease List.**

Daily

1. Check Grease on "tires" (Steel bands on drum that ride on idler wheels). Recommended method: With rubber glove on hand, take handful of grease[1] and hold on tire as drum is turning.

	**Do this above fencing/ guard rails only. Do not reach down by wheel area. Doing such could result in serious injury.**

- **Inspect:**
  2. Chain- Lube as needed
  3. Exit chute- Clean as needed
  4. Blower- Clean as needed

Weekly

5. Grease idler wheel bearings- Two pumps each with standard grease gun[2]
6. Lube drive chain[3]
7. Grease floating ends- Two pumps each[4]

- **Recommend clean up of excess grease on idler wheels for neatness. System must be shut down.**

Annually

8. Change main gearbox oil[5]

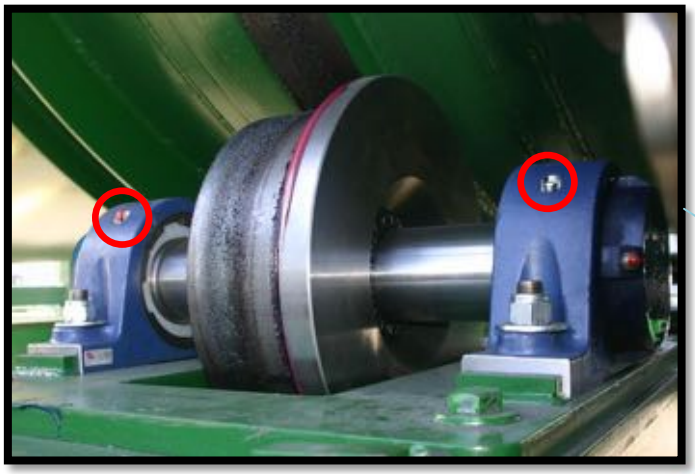
Grease List:

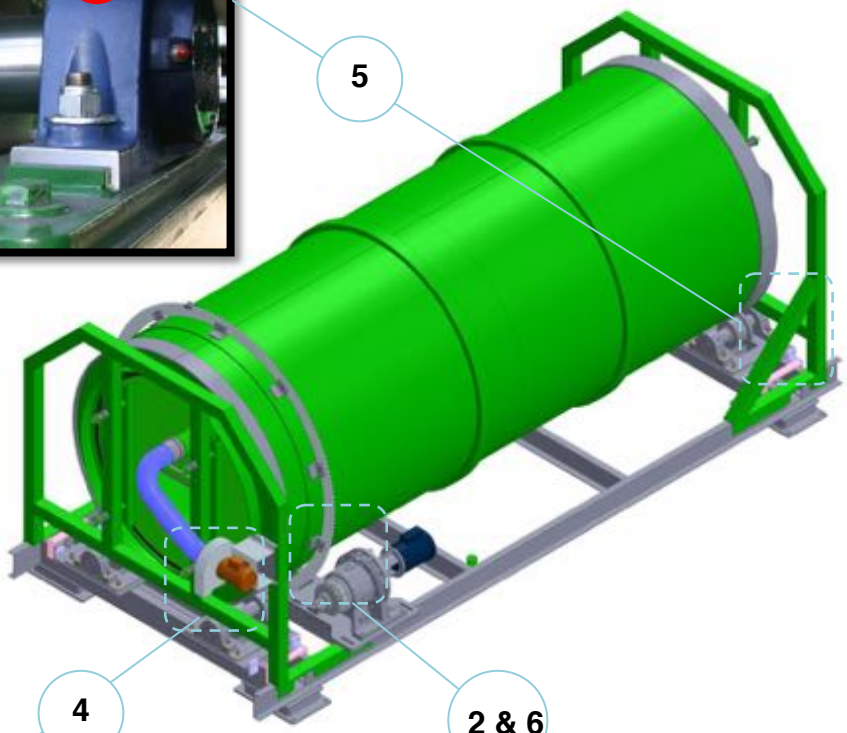
1- Tire grease- Any standard grease, in bucket
2- Idler wheel bearing grease- Molykote G-4700 Extreme Pressure Synthetic Grease ***(Caution: Improper mixing of unlike grease can cause bearing failure)***
3- Chain lube- Clean, used engine oil
4- Floating end grease- Standard tube grease
5- Main gearbox oil- MOBILGEAR 600XP 150

	**Under no circumstances reach in or around safety fencing while machine is rotating. Always turn off and lock-out machine before removing safety fencing.**

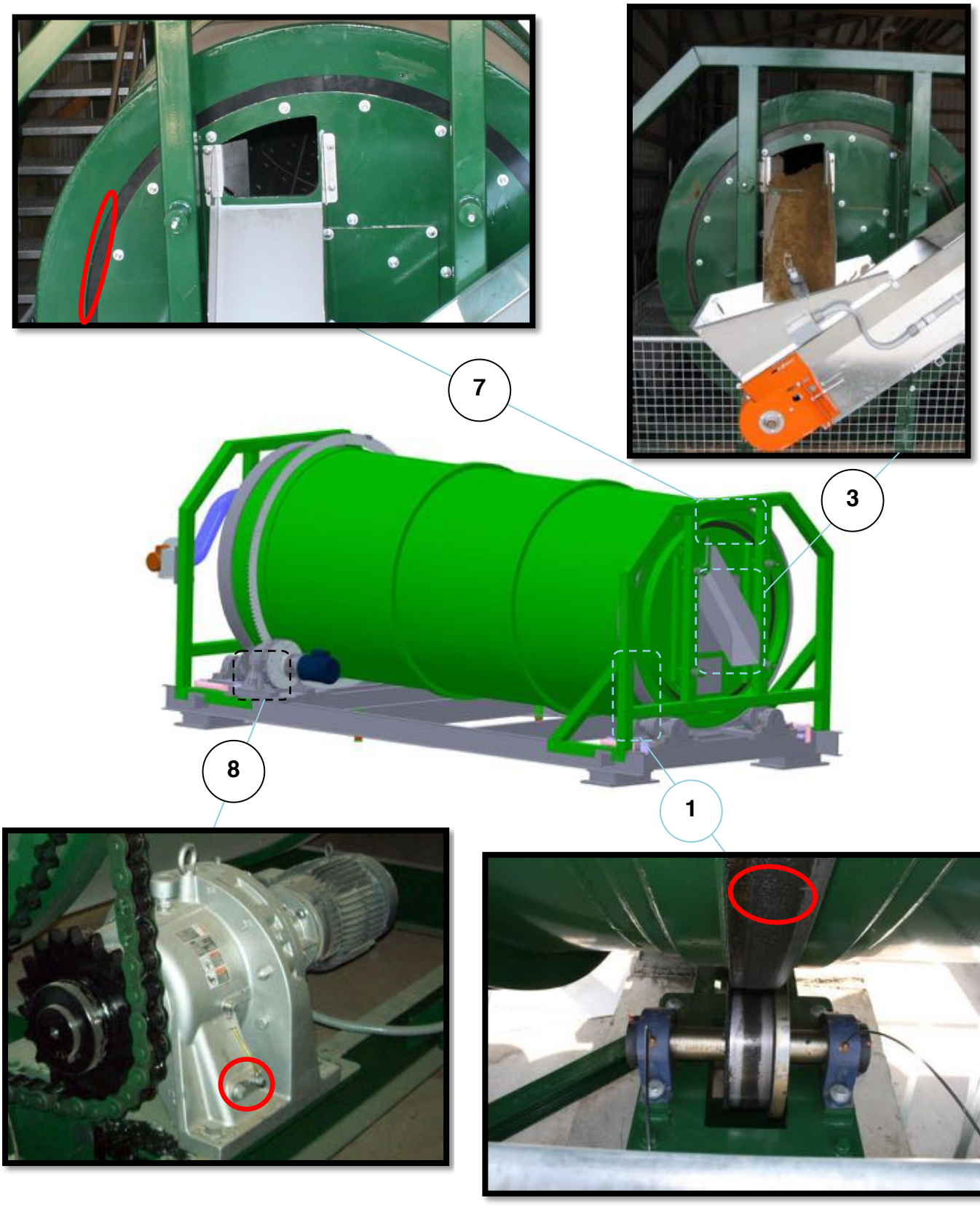
5.2 Preventative Maintenance Locations

-Preventative maintenance locations are associated with the order sequence of the Preventative maintenance list (5.1). Refer to 5.1 Preventative Maintenance for instructions on these locations. Grease locations and lubrication areas will be indicated in red.

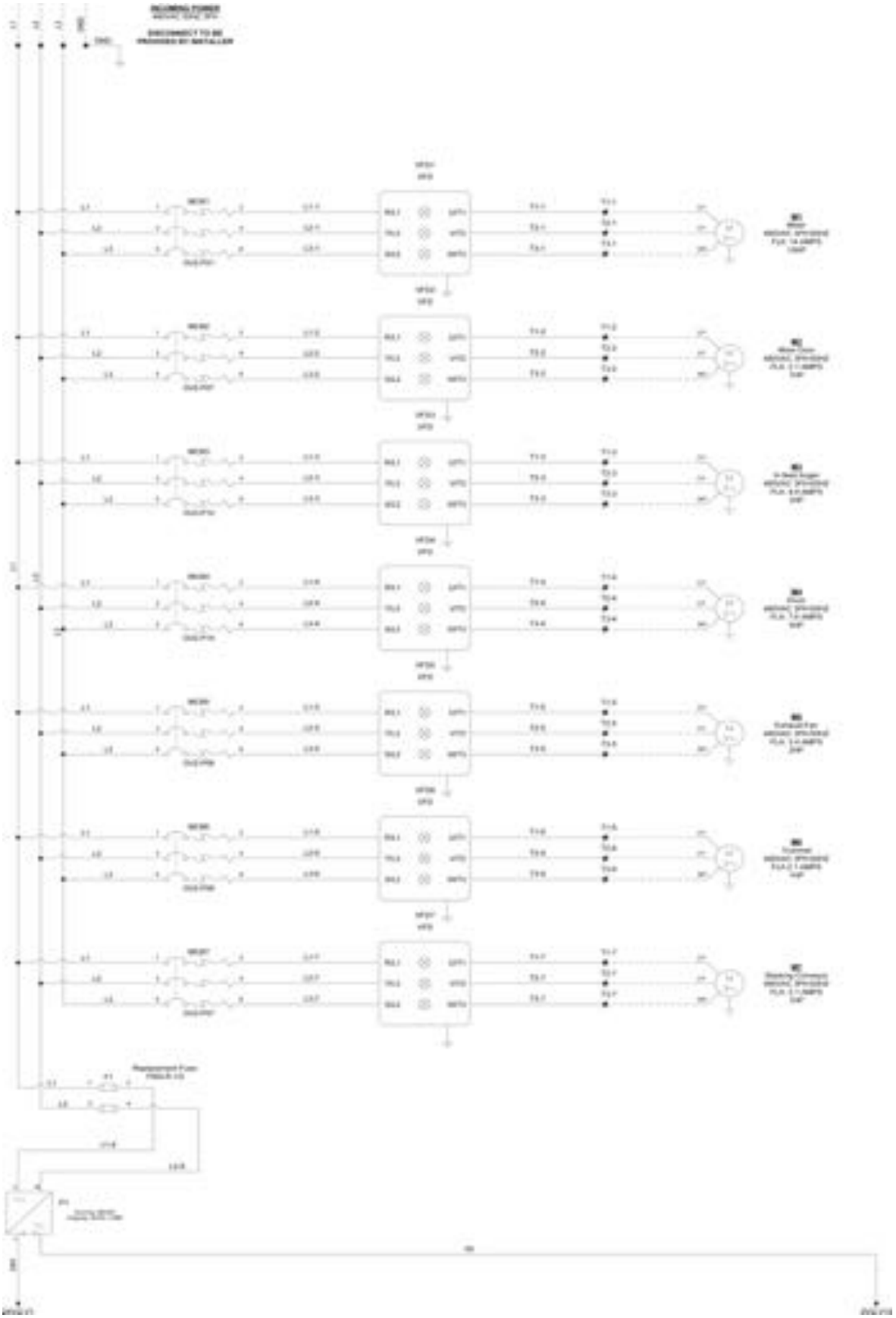


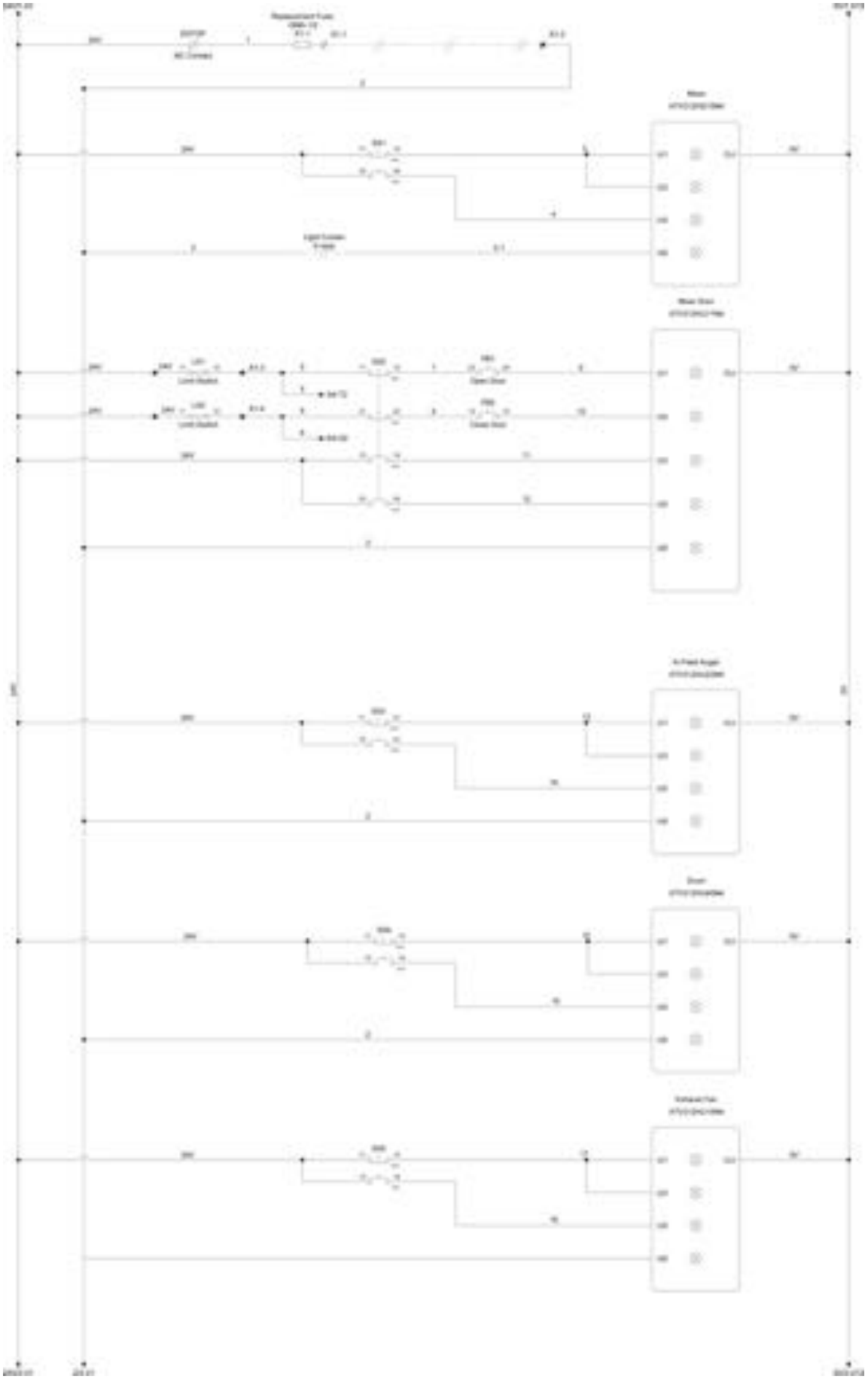


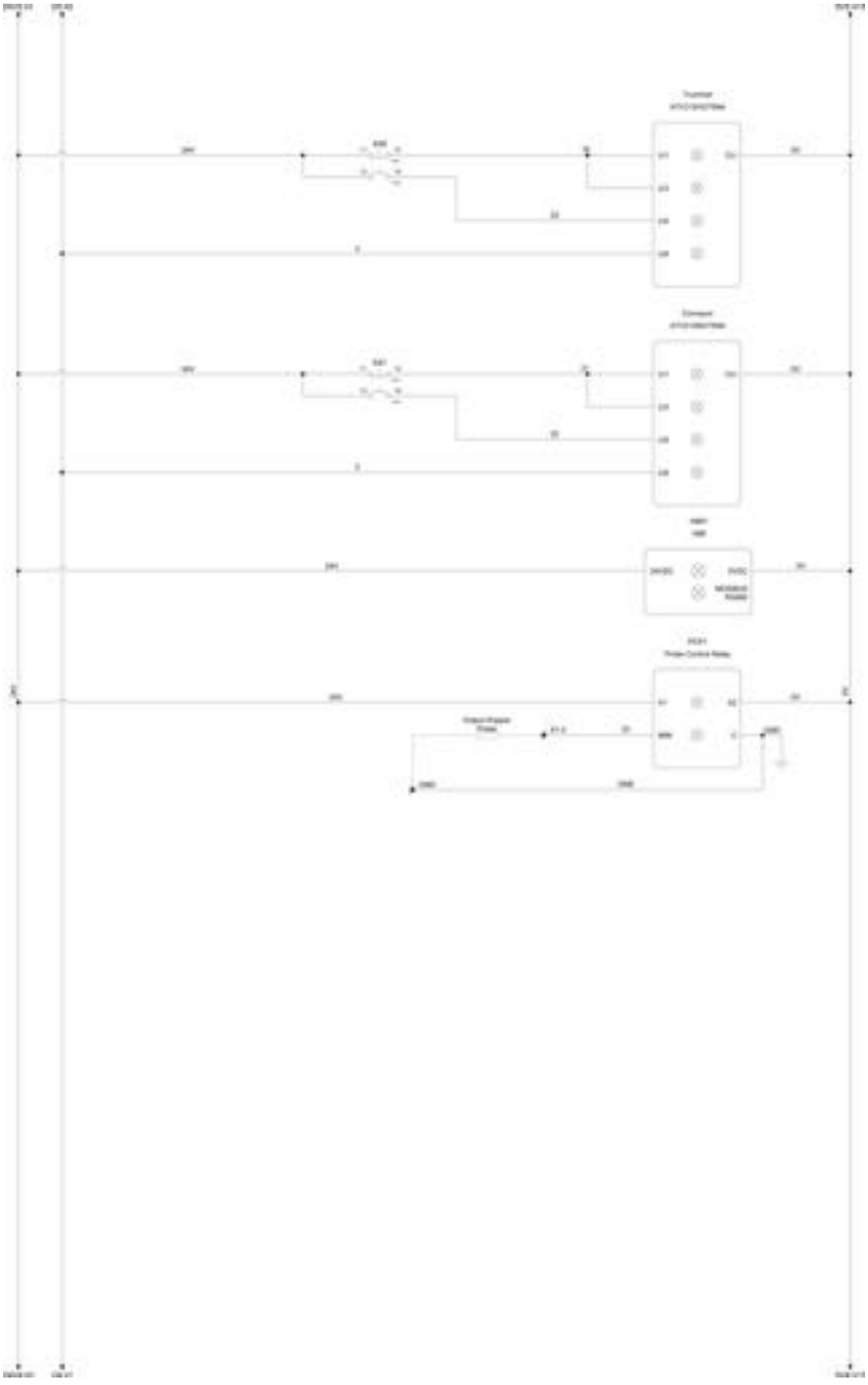
Preventative Maintenance Locations

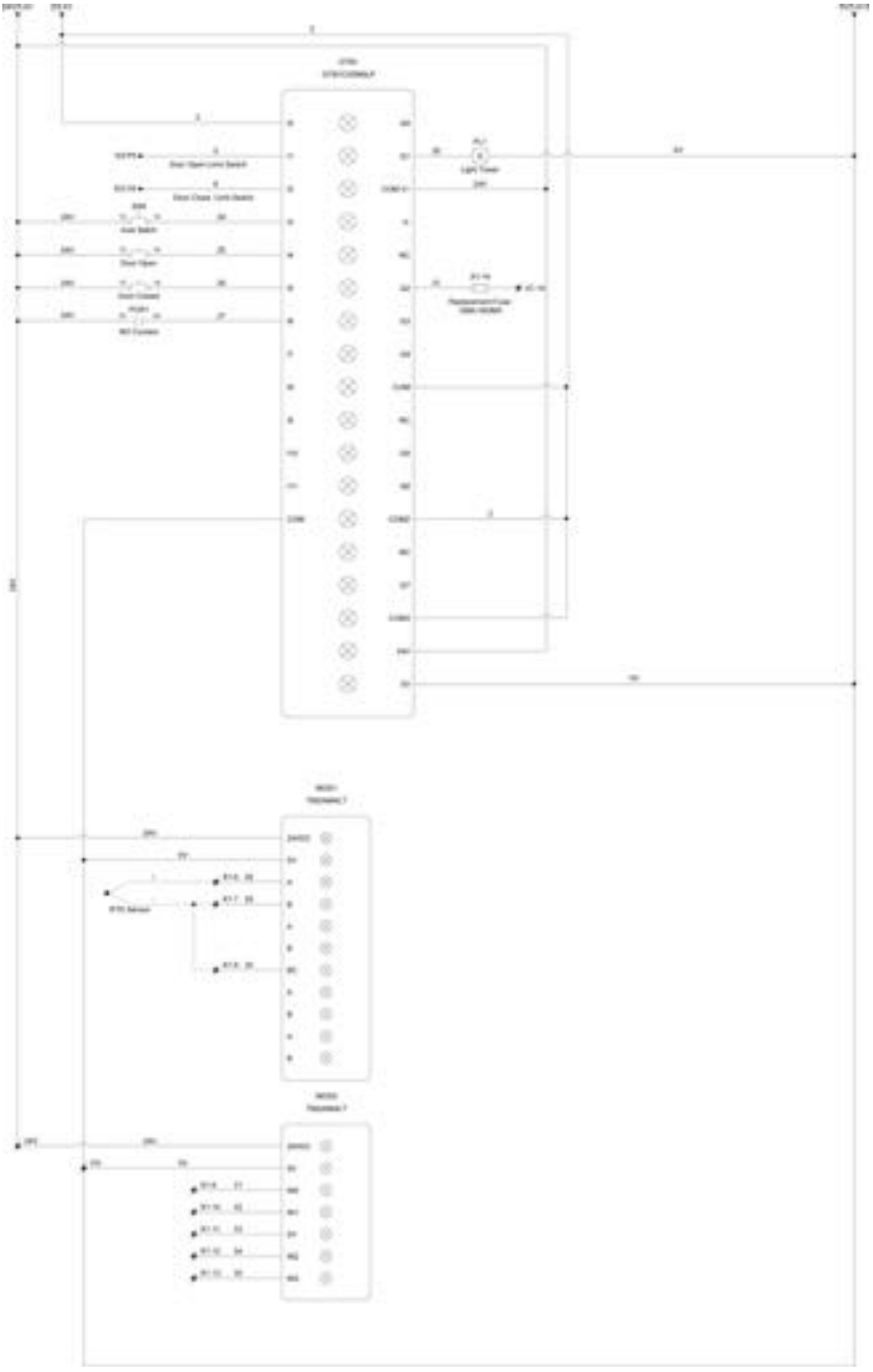


Section 6 – Wiring Diagram / Parts List









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