# REQUEST FOR PROPOSALS

## AUTOMATED GRANULAR MATERIAL MIXING AND PACKING SYSTEM - AGMMPS

### OPPORTUNITY

ME470 Inc. has recently embarked upon the development of a new product line of material handling systems. Recent successes in the Container Packing Division have attracted potential customers for the development of a new product line. This is in response to a need to mix and fill a number of granular materials in resealable flexible bags. There are numerous situations which require repetitive processes which if they could be automated would yield improved efficiency and reliability at reduced costs. In order to make such systems available to a wide range of users it is desirable to explore the potential of developing an low-cost, fully-automated system which can provide this capability. In the past this process was performed manually. Along with the development of the necessary technology it is imperative that its efficient implementation be in a form suitable for easy operation and inexpensive maintenance.

This product development project will involve the concept definition, concept engineering design study and documentation and finally prototype fabrication of an automated, resealable bag filling system, AGMMPS. A demonstration of the proposed concept to potential customers using a "proof-of-concept" prototype will be part of this development project.

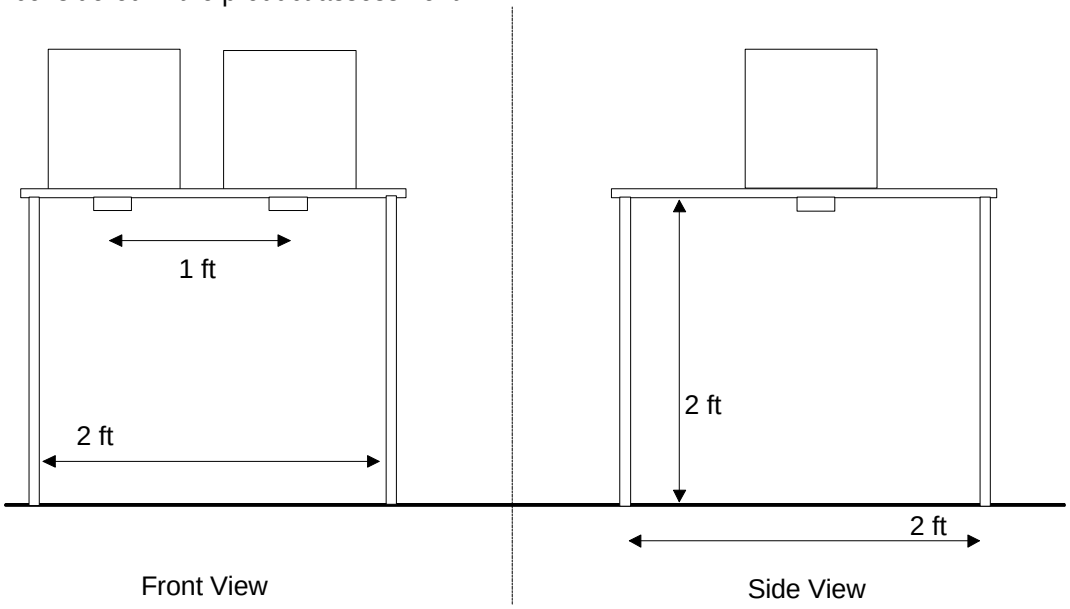
### PROJECT REQUIREMENTS: Each design team must:

1. Develop a design for the AGMMPS and document the design in the form of a detailed engineering design proposal. The greatest measure of merit will be associated with meeting all project scheduling and cost goals and demonstrating a robust design. The design must be based upon sound engineering analysis and simulation of the system component's performance and its operation are critical components of the design proposal. The results of this project must be presented in a Critical Design Review and the performance of the prototype presented at a Summary Presentation at the completion of the project.
2. Fabricate a "proof-of-concept" prototype for the system described by the proposal. The prototype must be capable of demonstrating the fully autonomous operation. The prototype will also be used to demonstrate the durability, reparability, and portability of the proposed design.
3. Develop a validation test plan and be prepared to demonstrate the operation of the prototype of the AGMMPS on or about April 23, 1999.
4. Follow established procedures for collecting and reporting time spent on the project and cost accounting records for the entire project.

### SPECIAL CONSIDERATIONS AND SYSTEM PERFORMANCE REQUIREMENTS:

1. The AGMMPS must be able to fill resealable flexible bags with a mixture of dry materials, seal the bag and place the bag on moving conveyor belt.
2. The bags will be filled with granular materials dispensed from two separate bins of dissimilar materials. The relative proportions of the materials and the rate at which the system operates should be user selectable over its operating range.
3. The bags are to be filled by "volume" and that volume should be easily user selectable.
4. The surface of the moving belt is smooth rubber. The belt is 6 inches wide and can move at any rate up to 6 in/sec.
5. The empty bags are to be bulk loaded into the AGMMPS.

6. The system must be completely portable and powered by “on-board” energy sources so that it can be used in situations where normal electric power is not available.
7. The system must be fully contained within a 2 ft (wide)x 2 ft (deep) x 2 ft.(high) cube (the industry standard Model Z2000 Double Bin Hopper/Conveyor System). The moving belt will translate laterally from left to right (when facing the 2’x2’x2’ cube) and be located at the “bottom” - “front” of this region. A schematic of the Z2000 is shown in the sketch below. Bags can only be loaded into the “front face”, the product will not be accessible from the top, bottom or “other” three sides.
8. Target product specifications will be defined by the individual design group based upon a recent “customer survey” but consideration should be given to cost, the rate at which the bags can be filled, reliability of the system, accessibility and ease of maintenance and energy consumption.
9. The prototype should be designed to use a wide range of “granular” materials. They will range in nominal particle diameter from 0.1 to 0.5 in..
10. The granular materials are a gravity-feed from two separate hoppers through 2.4 in ID (approx.) PVC tube orifices. The two fill tubes are spaced along the lateral-top centerline of the 2 ft (wide)x 2 ft (deep) x 2 ft (high) region in which the AGMMPS must be contained.
11. The AGMMPS and all subsystems must be powered with electric or stored mechanical energy sources. No chemical (solid, liquid or gas) sources will be allowed.
12. All electronic components (i.e. motors, servos, computers, wiring, circuit boards, etc.) must be able to be removed from and reinstalled into the prototype system in 20 minutes by two people with manual hand tools only.
13. Since environmental impact is an issue in all product development projects, the “recycle-ability” of the system and the nature of all the proposed fabrication processes will be strongly considered in the product assessment.




Model Z2000 Double Bin Hopper

SPECIAL CONSIDERATIONS FOR THE PROTOTYPE AND PROOF-OF-CONCEPT DEMONSTRATION

The prototype system for the proof-of-concept demonstration should satisfy the following:

1. Each design team will be provided a Stamp II microprocessor, Serial servo controller (8 channel), the opportunity to select from a small group of electric motors, a single electronic motor speed controller, 4 servos (3 “small” and one “large”), and selected rechargeable battery packs as well as appropriate manuals for this equipment.
2. Total project costs cannot exceed $400. - this includes $250. provided by ME470, Inc. and up to $150. from the design team. This cost includes all out-sourced parts, raw materials, tools, administrative costs(copying, viewgraphs, etc.) and expendable supplies(glue, wire, etc.).
3. Component parts can be either fabricated in-house or purchased from outside vendors (out-sourced). All out-sourced parts must be accounted for in the overall cost at their full retail value. Groups cannot “out-source” fabrication processes.
4. All “in-house” parts must be fabricated by the design team using the facilities provided in B19, Fitzpatrick Hall.
5. The completed prototype and all “scrap” materials are the property of the AME department.
6. No steel materials (or any other material “harder” than aluminum) can be used on the prototype without explicit written approval of the management team.
7. The prototype will demonstrate its performance by filling and sealing Hefty brand “One Zip” slider bags, a sample of which will be provided by the management team.

## CURRENT PROCESS AND CAPABILITIES

Currently a variety of granular materials are packaged using the industry standard Model Z2000 Double Bin Hopper/Conveyor System. This is accomplished in a manual fashion with using a single worker who operates manual “valves” attached to the Model Z2000. This approach requires the worker to fill interim contains with the specified volume, individual bags are then filled, sealed and placed on the conveyor belt by hand. Current practice indicates that an experienced worker can process materials at rate of 4 per minute when working 45 minutes an hour (5 min. breaks every 15 min). The filling and measuring process can be performed with a tolerance of ± 5% of the desired volume. This is a tedious, repetitive process prone to operator error. There are also numerous applications in which the operator is exposed to dust particles from the granular material which can create health hazards with extended exposure.

Initial and operating costs should demonstrate a capability which would be competitive with a minimum wage worker performing the filling operation and that worker would be replaced by an individual who would monitor the operation of a series of these machines.

# Customer Survey

ME470 Inc. is embarking on another new product development venture and since you are a user of "granular material" packing equipment we appreciate your willingness participate in this survey. We ask that you provide your perspective on your requirements for this type of product. Your responses will be used to help us in this new development effort. We intend to develop this product to be compatible with the industry standard Model Z2000 Double Bin Hopper/Conveyor System and will be able to mix and package a range of granular materials in the standard Model A1 resealable, flexible bag. In order to provide a new and innovative product we also plan that this new design be completely portable and not require any external power sources. Please circle your response to each of the following.

1. What would be your desired maximum through-put rate for this device (bags per minute)?

2 4 6 8 10 12

2. How frequently would you like to be required to restock the bags in the packaging system (minutes) when packaging at the maximum rate?

4 8 12 16 20 >20

3. What maximum weight would you consider to be acceptable for this product (lb)?

10 15 20 30 40 >40

4. How long would you require a fully portable unit to be able to operate (min)?

15 30 45 60 75 >75

4. What would you consider an acceptable installation time into the Model Z2000 (min)?

<1 1 3 5 >5

5. Do you consider spillage of the material to be:

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| acceptable | | | | absolutely unacceptable |

6. Do you rate internal access for cleaning:

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| not very important | | | | critical |

7. Do you rate internal access for maintenance:

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| not very important | | | | critical |

8. Do you rate ease in filling with empty bags:

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| not very important | | | | critical |

9. Please rank following features in order of importance to you:

small number of moving parts, operator safety, reliability, cost, maximum packaging capacity, operating cleanliness, required maintenance, ability for user to replace parts

## Customer Survey Results

A sample of 100 potential customers responded to our survey. The following summarizes their responses.

1. What would be your desired maximum through-put rate for this device (bags per minute)?
2 (8%) 4(16%) 6(42%) 8(21%) 10(10%) 12(3%)

2. How frequently would you like to be required to restock bags in the packaging system (minutes) when packaging at the maximum rate?
4(0%) 8(25%) 12(30%) 16(40%) 20(0%) >20(5%)

3. What maximum weight would you consider to be acceptable for this product (lb)?
10(0%) 15(33%) 20(60%) 30(7%) 40(0%) >40(0%)

4. How long would you require a fully portable unit to be able to operate (min)?
15(10%) 30(55%) 45(25%) 60(0%) 75(10%) >75(0%)

4. What would you consider an acceptable installation time into the Model Z2000 (min)?
<1(15%) 1(22%) 3(60%) 5(3%) >5(0%)

5. Do you consider spillage of the material to be:
1(0%) 2(12%) 3(25%) 4(58%) 5(5%)
acceptable absolutely unacceptable

6. Do you rate internal access for cleaning:
1(0%) 2(0%) 3(5%) 4(12%) 5(83%)
not very important critical

7. Do you rate internal access for maintenance:
1(0%) 2(0%) 3(8%) 4(12%) 5(80%)
not very important critical

8. Do you rate ease in filling with empty bags:
1(3%) 2(10%) 3(43%) 4(31%) 5(13%)
not very important critical

| item | times #1 | times #2 | times #3 | times #4 | |
|---|---|---|---|---|---|
| number of parts | | 4 | 12 | 16 | 32 |
| operator safety | | 2 | 3 | 14 | 19 |
| reliability | 30 | 24 | 23 | 5 | 82 |
| cost | 43 | 33 | 17 | 3 | 96 |
| maximum capacity | 27 | 18 | 16 | 11 | 72 |
| cleanliness | | 9 | 12 | 31 | 52 |
| maintenance | | 8 | 14 | 11 | 33 |
| part replacement | | 2 | 3 | 9 | 14 |
| total | 100 | 100 | 100 | 100 | |