



PLASTIC PALLETS

Made Easy

SMART Ideas. SMARTER Results.

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Why make a plastic pallet?

Cleanliness and preservation of wood are two primary reasons. The plastic pallet is naturally clean and washable. Wood, while it may be a lower cost raw material is neither clean nor washable. Plastic is recyclable, wood is not. The performance of either material is good for pallet making. Plastic can more easily be shaped for form, strength, and conservation of material.

What is the structural foam process?

There are many methods for forming plastics. Extrusion, thermoforming, blow molding and injection molding are most commonly used to produce plastic pallets. Of these methods, the most commonly used is the structural foam injection molding process.

Structural foam molding as a process is about forty years old. Thermoplastic plastic resins are reduced in density by adding a foaming agent for foaming in the melting process. For pallet making, the most common thermoplastic is high density polyethylene (HDPE) and the most common blowing agent is Nitrogen.

The injection molded product (pallet) has an integral skin, a cellular core and a high strength to weight ratio, ideal for a load bearing application such as a pallet.



Illustrated: Section of a structural foam plastic pallet showing freedom of form, strength of ribs, and the integral skin, cellular core.

In addition to plastic pallets, the structural foam process has been widely applied to furniture, automotive, communications, agriculture, drainage, electronics, office, recreational and many other applications. Thermoplastic resins include polycarbonates, ABS, polypropylene, styrene and by far most common, high density polyethylene.



What exactly is a plastic pallet?

It can be any size and any shape. While the 40" x 48" (English) or the 1000 x 1200 (metric) are the most common sizes, there are many more attributes. They may be single deck stackable, double deck, one-way, reusable, four-way entry, etc. They can be colored, have texture, non-slip surfaces, etc. They usually are molded in one piece but can be made in two or more pieces that are either welded or mechanically fastened together.



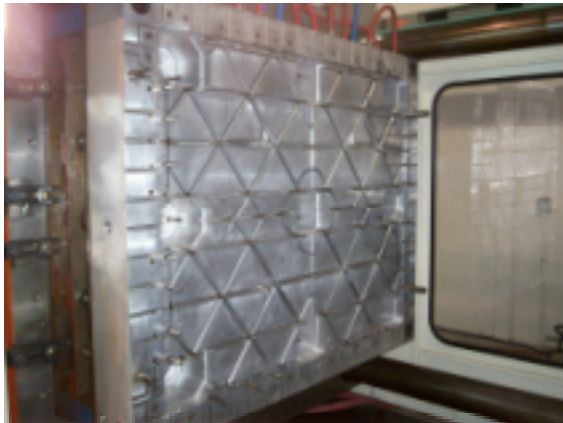
Illustrated: An array of structural foam plastic pallets showing different sizes, colors, stackable and double deck designs.

Molds for plastic pallet making.

Molds for making structural foam plastic pallets are typically made from high grade aluminum. This has many advantages including mold cost, shorter cooling cycles and long life.

Aluminum works well because the structural foam injection molding process is a low pressure type. Because of the presence of the blowing agent the resultant gas bubbles allow the plastic to flow easily and at very low pressures inside the mold. Thus, aluminum works very well and has ample strength.

The molds are also ported for multiple nozzles (filling points). The use of multiple nozzles means that the plastic has a shorter flow path in the mold. The combination of gas in the plastic and the multi-nozzles together with aluminum molds is the reason why structural foam injection is the preferred process for making a plastic pallet.

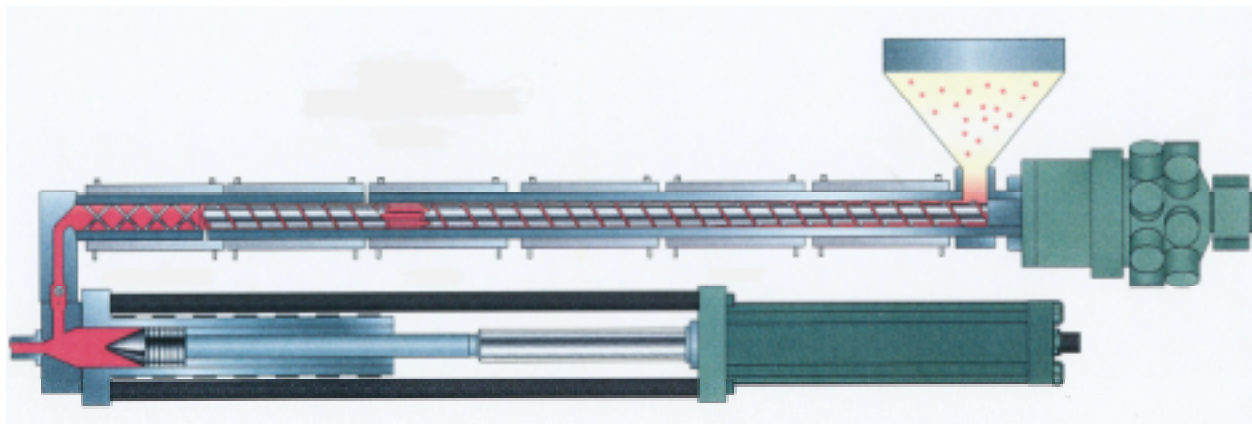


Illustrated: Female and male halves of a typical aluminum mold for making a stackable structural foam plastic pallet.

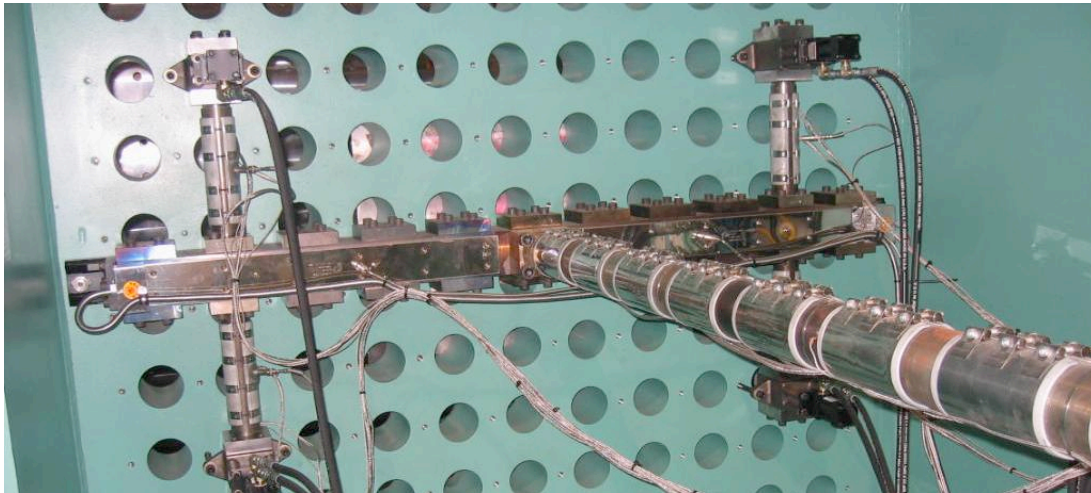
Machines for plastic pallet making.

Wilmington Machinery has been building the structural foam injection machines for making plastic pallets for over 35 years. Different from standard solid injection molding machines, the structural foam machines always have two-stage injection units and multi-nozzle manifolds.

A two-stage injection unit is a combination extruder/accumulator. The extruder melts the thermoplastic material and allows inert Nitrogen gas to be pumped into and mixed with the melt. The multi-nozzle manifold distributes the melt/gas mix to multiple ports on a single mold or to multiple ports on multiple molds. Another advantage of the structural foam injection process is the ability to run multiple molds at the same time - and they can be for different pallets at the same time.



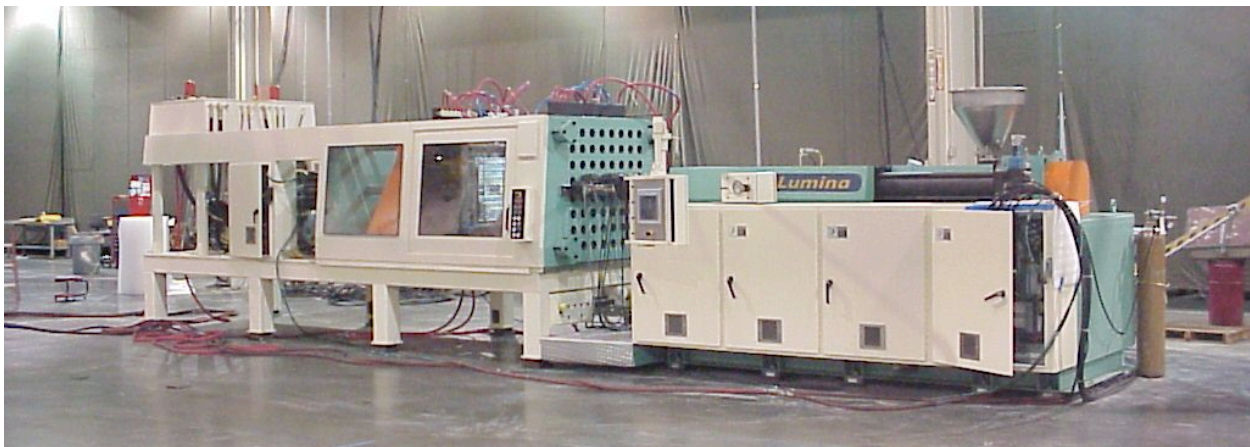
Illustrated: Single screw melting extruder coupled to hydraulic ram actuated accumulator (shooting pot).



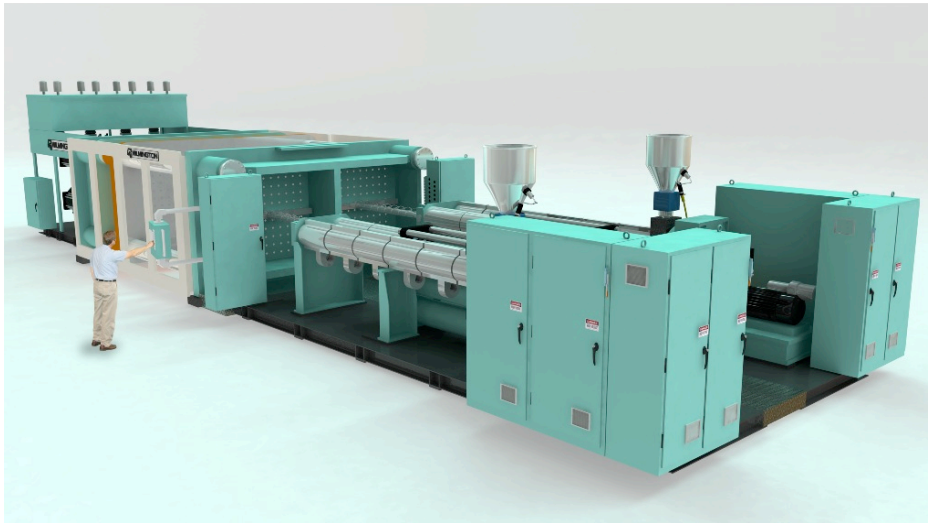
Illustrated: Multi-nozzle manifold configurable for mold ports on a 6" x 6" grid.

In addition to having two-stage injection units and multi-nozzle manifolds, the machines have large, fast and low tonnage presses (clamps) - low tonnage because of the low cavity pressures developed in the structural foam injection process. The clamps are also different as the stationary platen has the characteristic 6" x 6" hole pattern for the configurable multi-nozzle manifold.

The presses are sized for one mold, two molds, four molds or even more. The platens to which the molds attach range in size from 54" x 70" to 110" x 200" (1370 x 1778 to 3150 x 4877) in tonnages ranging from 350 – 2000 US (310 – 1770 metric). The presses are built in a low profile configuration for ease of setup and maintenance and also to allow top mounted robots in low ceiling plants.



*Illustrated: **LUMINA** Model 1600h 350 ton suitable for one 40" x 48" (1000x1200) stackable pallet.*



*Illustrated: **LUMINA** Model 1000 WP 1000 ton (880 metric) suitable for four 40" x 48" (1000 x 1200 metric) stackable pallets or two 40" x 48" (1000 x 1200 metric) single piece double deck pallets.*

Specifications for these machines and the seven other **LUMINA** models are attached. Wilmington Machinery also builds machines to match a specific need. It is typical to mix and match the capacities of the extruder, the accumulator and the press to the application as the machines are designed for modular construction.

LUMINA Pallateer Systems.

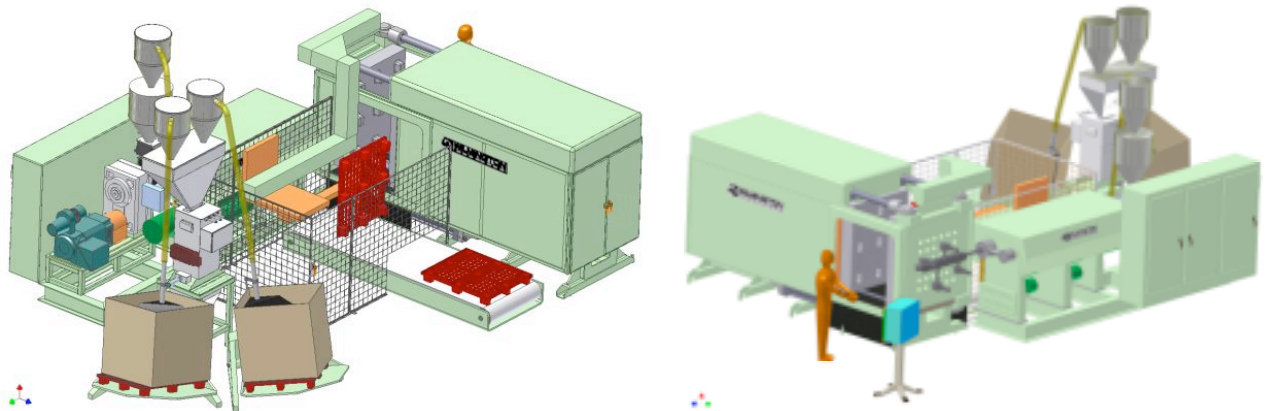
The newest addition to the **LUMINA** family of structural foam injection machines is the Pallateer Series. They are highly automated and integrated systems comprised of the finest components dedicated to making high quality, low cost pallets from up to 100% recycled material. They accomplish this with minimum labor, energy and floor space.

The Pallateer Series consists of three system types:

- **SYSTEM PM-1** molds one single deck pallet with each cycle for pallets weighing up to 25 pounds (11.4kg). It will produce over 240,000 pallets per year in continuous operation.
- **SYSTEM PM-3** molds two single deck or top/bottom of a double deck pallet with each cycle for pallets weighing up to 50 pounds (22.8kg) total. It will produce over 480,000 single deck pallets per year in continuous operation.
- **SYSTEM PM-5** molds one double deck (single piece) pallet with each cycle for pallets weighing up to 50 pounds (22.8kg). It will produce over 200,000 pallets per year in continuous operation.



A Pallateer System is provided as a complete turnkey including molding machine, mold(s), robot with convey or for automated pallet removal, plastic resin blending/loading equipment, Nitrogen generator for foaming the plastic and mold chiller. Everything including know-how, demonstration and training.



Shown: **LUMINA PALLATEER** System #1 producing single deck nestable type pallet.



One Piece Double Deck Type (blue)
System #PM-5

One Piece Single Deck Nestable Type (black)
Systems #PM-1 or PM-3

Two Piece (welded) Double Deck Type (yellow)
Systems #PM-1 or PM-3

Three popular types of pallets made on the PALLATEER Systems.
Center (black) nestable one-way pallet made on System #PM-1 or PM-3.
Left (blue) double deck rackable one-piece made on System #PM-5.
Right (yellow) double deck rackable two-piece made on System #PM-1 or PM-3.

Cost of machines.



LUMINA General Purpose Structural Foam Injection Molding Machines range in price from approximately \$1,000,000 US to approximately \$4,000,000 US not including molds or accessories - the lesser amount for a low capacity machine suited for one mold; the larger amount for a high capacity machine suited for 2 – 8 molds.

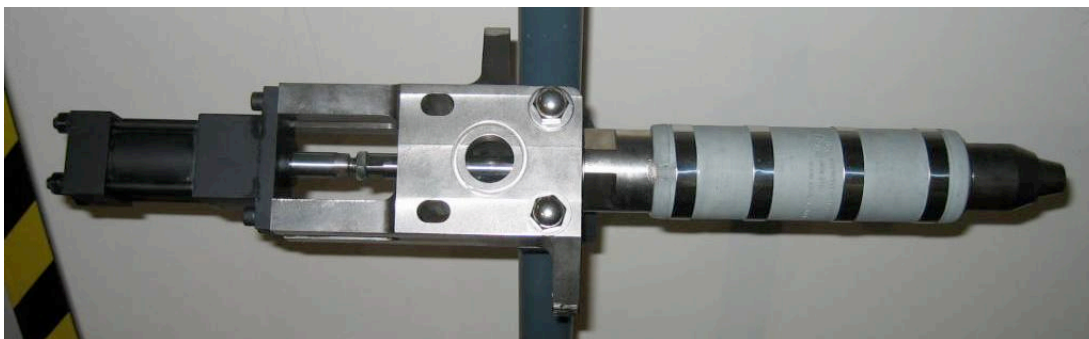
The **LUMINA** Pallateer Systems are priced approximately 20% below the general purpose type machines. They are sold only as complete systems and range in price from approximately \$1,525,000 US to \$2,625,000 dependent upon machine capacity, pallet type and mold complexity.

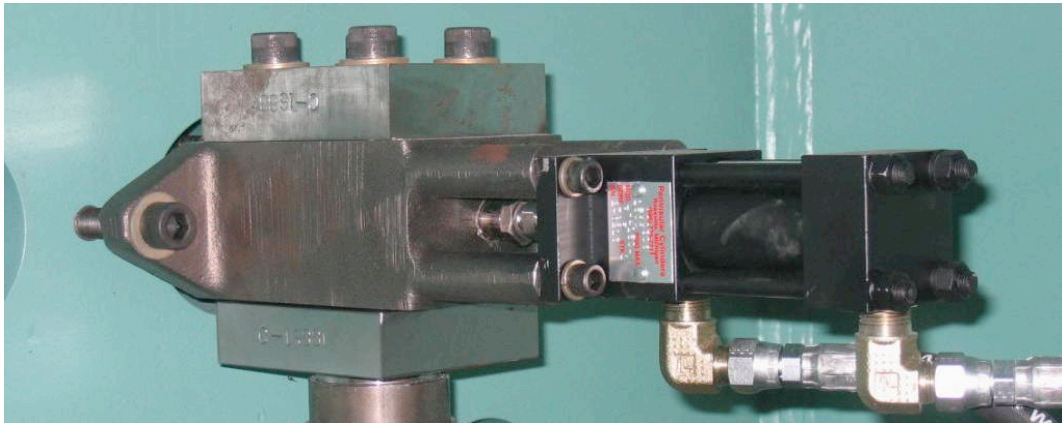
The machines seem to be expensive compared to solid injection machine types of comparable tonnage. However, when one compares the platen area (mold mounting area), the injection capacity, the two-stage injection unit type, the direct gas injection capability, and other attributes that make them ideal for pallet production, they are reasonably priced.

They also have an extraordinary long life given the low pressure nature of the process. In short, they produce structural foam plastic pallets better, faster, lighter and more economically than any alternative.

Machine accessories.

The most important machine accessory is the nozzle. It is at the heart of the structural foam injection molding machine to deliver low weight, high quality plastic pallets at fast cycle times. Configurable and individually sequenced, these nozzles allow the filling of the mold to take place at low cavity pressure, and still produce pallets with maximum strength and appearance.





Illustrated: Wilmington's all new Economy Nozzle featuring a forged body with greatly improved plastic flow characteristics.

Nozzles cost between \$1000 US to \$1500 US dependent upon their length, pressure and flow ratings and purchase quantity. Adaptors between nozzles cost between \$750 US to approximately \$1250 US dependent upon their length and pressure rating.

Robots for structural foam machines.

Robots have the advantage of not only reducing labor, but reducing cycle time and assuring cycle consistency. A modern servo-electric robot is fast, reliable and intelligent. It is programmed to do exactly what is needed in parts removal at exactly the right time and in exactly the same manner. They greatly improve the safety at the machine and allow operating personnel to perform value added tasks rather than performing parts removal tasks in a guarded but still potentially hazardous area of the injection machine.

Robots can be of side entry or top entry type. The top entry type requires less floor space and can be faster than the side entry type. Wilmington builds its structural foam machines as low profile to accept the top entry type robots in plants without high ceilings thus reducing plant construction costs.

All Wilmington machines are built "robot ready" including machine logic to interface with robot logic and special safety gate construction and machine logic considerations.



Illustrated: Typical top entry type robot as manufactured by Wittmann.



Example of Ranger Platen-Mounted Side-Entry Robot

Platen-Mounted Robot Base supports cantilevered main beam at mold center

Illustrated: Typical side entry type robot as manufactured by Ranger

Machine Accessories.

The Wilmington Structural Foam Injection Machine as previously mentioned, utilizes inert Nitrogen gas to foam the plastic. Nitrogen is an inexpensive gas when purchased in bulk at low pressure. In this case, a Nitrogen Compressor is required to pressurize the gas sufficiently for it to flow into the extruder barrel and mix with the molten plastic.



Illustrated: A typical Nitrogen Compressor capable of pressurizing the gas to approximately 2000 PSI (140 bar)



Alternatively, a Nitrogen Generator will both produce Nitrogen and compress it. This equipment, while more expensive to purchase than a compressor, is preferred for simplicity and lower cost for the Nitrogen gas.



Illustrated: A typical Nitrogen Generator capable of generating and pressurizing the gas to approximately 2000 PSI (140 bar)

A Material Handling System is required to load the extruder hopper with a blend that may consist of virgin plastic pellets, regrind or recycle, color, and other additives as required. The systems can be as simple as a hopper mounted type that performs the metering and mixing functions to more elaborate systems of grinders, holding bins, mezzanine mounted blending systems, etc.



Illustrated: Typical hopper mounted loading/blending system with capacities of 1000 lb/hr (450 kg/hr)



Illustrated: Typical floor mounted resin blending system with integral loaders with capacities to 3000 lb/hr (1350 kg/hr)

Cost of the structural foam plastic pallet.

As mentioned at the beginning of this paper, wood is a relatively inexpensive raw material, while plastic is not. The cost of the plastic raw material is the most expensive cost component. Labor, utilities, machine amortization are typically small by comparison.

The structural foam molding process does much to reduce the plastic material cost by reducing its weight (through foaming) by 10-20%. The weight of the pallet by its design is of great importance. The structural foam injection method produces pallets with weight saving open grid design strengthened by strategically placed ribs and other light weight design features.

For example, a single deck stackable pallet produced on a single cavity mold on a **LUMINA** 1600h may cost as follows:



HDPE Plastic Material at typical 22 lbs. (10 kg)	\$4.40 – 12.00 US
Machine Amortization	1.55
Labor	.50
Overhead	1.25
Utilities	<u>.40</u>
Pallet Cost	\$8.10 – 15.70 US (each)

The lower plastic raw material cost assumes 100% recycled HDPE at \$.20/lb US.
The higher cost assumes virgin HDPE raw material at \$.80/lb US.

Getting started.



*Shown: Three popular types of pallets.
From left:
One piece double deck type,
one piece single deck nestable type,
two piece double deck type*



There are some immediate questions relative to the design and manufacture of the pallet including:

- Is it a single deck stackable type?
- Is it a double deck type?
- Is it intended to be rackable?
- What is its size?
- What is the load carrying capacity – both static and dynamic?
- What is the expected plastic material?
- What is the form of the plastic material? Pellet? Flake? Other?
- How many pallets must be produced annually?
- How many hours per year will the machine operate?
- What color is the pallet?
- What is the color of the plastic material?
- Do you have a photo or drawing of the pallet or a similar pallet?

Wilmington Machinery offers both pallet design and prototyping services. Usually, the weight of the pallet is predictable at the conclusion of the design service as is the cost of the pallet. Once again, the cost will be influenced by both the weight and the cost of the plastic material.

Machines are sized to match the production requirement. Once again, there are Wilmington **LUMINA** Series machines suited for pallet production from one to eight (1-8) molds.

Quantities and capacities of accessories like nozzle, robots, material handling and gas systems are sized according to the size and weight of the pallet and the number of molds. Years of experience assure that these accessories are suited to the task and will perform equally as well as the machine and molds.

Turnkey Solutions.



By now, you should have a good idea of what it takes and what it will cost to produce a structural foam plastic pallet.

Wilmington Machinery stands ready to provide you with a true engineered solution to assure your immediate and ongoing success at plastic pallet making. Our offer is complete including machine, molds, accessories, know-how, training and startup. And once again, we have been doing this for over 35 years!

Keeping you successful.

First and foremost, what we build and supply is ruggedly constructed and designed for continuous operation. Machines are routinely equipped with either modem or Ethernet interface so that we can help you troubleshoot should the need arise.

Our service staff is fully trained in mechanics, hydraulics and electronics. Our entire company has a strong service understanding and capability. We choose machine components that are readily available worldwide. We are located at an Atlantic port city which facilitates shipping.

We hope that this document has been informative and helpful. Please let us know if you have any questions.

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We look forward to doing business with you!