PET PREFORM SYSTEMS
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Ensuring Quality and High Yield, from Pellet to Preform

PET is a technically challenging material, and making PET preforms – and ultimately, PET bottles – is a highly competitive, quality- and productivity-driven business. As a preform molder, you need the highest level of control over every aspect of your process from the moment PET pellets are delivered until finished preforms are shipped off for blow-molding. Material conditions, processing efficiency, energy consumption, final preform quality – all need to be controlled and managed to the highest degree or your operation cannot be successful.

In this challenging environment, Conair excels. Only Conair has the breadth of equipment, the advanced technology, the comprehensive knowledge and experience, to bring together a complete preform molding cell and guarantee low energy costs, high yields and optimum end-product quality. We have the global manufacturing, engineering, installation, service and support capabilities to bring everything together successfully. Conair has an international PET team ready to take ownership of your project and see it through to completion.

Material handling, drying, blending, process temperature control, preform handling and scrap reclaim systems are optimized to the rigid requirements of PET preform production. Energy consumption is minimized at every stage of the process. Plant-wide controls track all critical parameters, compensate when conditions change, and generate the documentation to confirm what you already know: that your manufacturing cell is running smoothly and every preform meets the same high quality standards.

Drying Energy Costs As Low As 0.069 kWh per kg

CONAIR’S GLOBAL PET PREFORM CAPABILITIES

<table>
<thead>
<tr>
<th>Sales</th>
<th>Parts</th>
<th>Service</th>
<th>Manufacturing</th>
</tr>
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When building a new preform-molding plant or adding a new molding cell into an existing facility, processors face a complex task. Not only do you need to specify all the equipment, you also need to figure out how the plant is going to be configured, how it is going to function, and ensure that installation is completed correctly and on time. On a project of this kind it is absolutely imperative to have the assistance of an expert – someone with the knowledge, experience and vision to see the project through from start to finish.

Unlike other suppliers who claim to offer “turn-key’ systems, Conair is the only company with the broad-based equipment know-how, the organizational depth, process expertise and defined procedures to get you up, running and profitable – on time and on budget. Conair has designed, engineered and installed PET preform-molding plants all over the world. We have the experience and procedures in place to do the job right… large or small… new facility or plant expansion.
Every plant is unique and the material handling and bulk storage system will be designed depending on how the PET resin is delivered and how it will be used. Conair systems can handle PET that arrives by rail, bulk truck, or in bulk bag containers and convey it to storage at rates up to 25,000 lb/hr (11,364 kg/hr) over long conveying distances. Components include:

- Vacuum railcar unloading equipment
- Silos
- Vacuum pumps, receivers and dust collectors
- Bulk-bag unloading stations and intermediate storage bins
- Conveying controls and inventory monitoring systems

Everything is engineered with one purpose: to ensure the quality of the PET resin being delivered is maintained throughout your plant. This means that the vacuum/pressure pumps are kept cool to minimize heating of the material being conveyed, which can cause agglomeration and angel hair. Silos are made of epoxy-lined carbon steel, stainless steel or aluminum to prevent contamination, reinforced to handle the heavy PET pellets, and designed for ideal flow characteristics. Conveying systems are configured to reduce conveying distances, save energy, minimize dust generation and prevent PET degradation. FDA-approved materials are used when required.
Conair recommends welded silos for PET applications. Made of steel or aluminum, they are factory-built and delivered to your plant ready for installation. Because there are no bolts, seams or gaskets, material hang-up points are eliminated. Welded silos are guaranteed to be water-tight.

The inside of welded steel silos is epoxy-coated to keep material contamination-free, and the exterior is primed and enamel coated to prevent rusting. Welded aluminum silos require no external painting or internal coatings. Storage capacities can range from 838 to 9,826 ft³ (24 to 278 m³).

Conair installation crews can set the silo in place on a pre-poured concrete pad and connect all accessories and install the loading and unloading equipment so your silo is ready for use in just one day.
Accuracy in Blending and Feeding

To be sure of consistent quality in the finished bottle, you need consistency in raw materials, so accuracy is critical in blending of PET materials for the production of preforms. Virgin PET, in-house regrind and post-consumer reclaimed material, colorants and additives need to be precisely metered and thoroughly mixed.

If you use reclaimed PET in your preforms, you probably have a very specific target percentage. Below that target and they won’t meet environmental and economic commitments. Over the target and the blend may need to be recrystallized or you risk having the amorphous regrind agglomerate (clump together) in process equipment. Therefore, accuracy to within 0.5% – the Conair standard – is required.

Conair TrueBlend™ gravimetric blenders are among the most accurate in the industry. An improved control algorithm intelligently analyzes dozens of weight readings in a matter of milliseconds, filtering out electronic noise and the effects of vibration. After every dispense cycle, the control adjusts automatically for minor variations in dispensing, as well as for changes in resin bulk density and particle geometry. The mixing chamber is totally enclosed, ensuring that all pellets and minor ingredients are accounted for.

For PET preform producers who have special requirements, TrueBlend units can also be customized to include such unique options as:

- Flow inducers in material bins.
- Optional vertical augers, which operate whenever the dispense valve is open, ensure that even difficult-to-flow materials like PET bottle regrind flakes are fed smoothly to the weigh bin. No material hang-ups.

High-temperature blending components – including load-cells, level sensors and air cylinders, are specified for their ability to stand up to temperatures of 350°F (175°C) and higher. Electronic components are isolated from elevated temperatures. This prevents premature failure or generation of erroneous data that results in diminished mixing accuracy. Now you can confidently blend high levels of regrind direct from the crystallizer or you can dry preform materials before they are blended, preventing separation of ingredients in the drying hopper.

TrueBlend blenders are available in sizes from 175 lb/hr (79 kg/hr) to 12,000 lb/hr (5443 kg/hr), configured to handle eight or more individual ingredients. Systems for dispensing solid or liquid colorants are also available.
Most preform molders add color concentrate at the machine feed throat, so they need the accuracy and consistency of Conair TrueFeed™ gravimetric feeders. A patented rotating metering tube dispenses colorants so precisely that many users find they actually can use less expensive colorant without compromising quality. TrueFeed units are self-calibrating and color changes can be made in less than 60 seconds.
Energy-Efficient Dryers Ensure Consistent Preforms

Drying is the single most important variable in PET preform processing. If drying procedures are not meticulously followed and residual moisture remains above 0.005%, the material will undergo a chemical change during melt processing, losing intrinsic viscosity (IV) and physical properties. Fortunately, no one knows drying quite as well as we do. A pioneer in the development of desiccant drying, Conair has been working closely with resin suppliers and processors to develop equipment and procedures that can eliminate moisture-related quality issues while saving energy too.

In 2006, Conair began piloting one of the first drying systems designed especially for high-volume PET preform producers. The EnergySmart™ system actually recycles heat energy normally lost in the drying process so that total energy consumption is cut by up to two-thirds, compared to conventional desiccant dryers. Today, EnergySmart users are reporting energy use as low as 0.069 kWh per kg, without sacrificing product quality.

Just as important, however, is the concept of “total process visibility.” PET preform molding is a complex and fluid process, with material constantly being brought in, dried and conveyed to the molding machine. To produce a consistent product, this very fluid process must remain stable even as material and ambient conditions change. That’s the idea behind a control technology called Optimizer™ Mode.

For effective drying, the proper temperature profile (as specified by resin suppliers and good manufacturing practices) needs to be established in the bed of PET. Too much heat and air flow will result in wasted energy; too little will result in poor drying performance. That’s the idea behind a control technology called Optimizer™ Mode.

Just as “cruise control” maintains a car’s speed over changing terrain, Optimizer Mode regulates air temperature and flow based on information gathered by a Conair Drying Monitor and sensitive dew-point instruments. Once the proper conditions are established, they can be locked in with the touch of a finger. The controls have the ability to fine-tune the air flow, temperature and dew point to maintain conditions within the hopper regardless of throughput changes or variations in material temperature or ambient conditions. Settings can also be memorized for instant recall.
Your energy costs will depend on your specific application situation, including such factors as:
- Initial moisture content of material
- Final moisture level required for consistent part quality
- Drying temperature selected
- Regeneration load
- Molding machine feedthroat temperature required
- Altitude of the molding plant

Every Conair PET drying system is designed and installed to guarantee you the lowest kWh/kg rates over time, given the conditions existing in your plant.

The thinking behind a single-stage EnergySmart system, which was developed for processors who don’t necessarily run extremely high volumes of PET, but who want the total process visibility that the EnergySmart controls make possible. The patented Conair Drying Monitor™ probe extends through the material bed and six integral temperature sensors register the temperature at each position. Other sensors monitor air temperature and dew point at the entrance and exit of the drying hopper.

These data are constantly fed to microprocessor-based controls to give you a detailed picture of the entire drying process, so you can optimize settings for maximum quality and energy efficiency even as material and ambient conditions change over time. When viewed in the form of trending graphs, this information becomes invaluable for quality-control validation and for troubleshooting.
Energy-Efficient Dryers Ensure Consistent Preforms (cont.)

Other Conair drying innovations include:
- **Gas Heat**
  In high-volume drying applications, gas-fired air heaters are often more cost-efficient than electrical heaters. The new Conair drying systems can be built to use both gas or electric energy so that you can use the most economical fuel available at any given time.
- **Unique Insulated Hopper** with mass flow.
- **Carousel Plus™ Technology**
  The dryers used in the dehumidified-air circuit of the EnergySmart™ system are among the most efficient available. The desiccant-wheel assembly has less structural mass and less desiccant to heat and cool than other dryers. The solid-state desiccant honeycomb is not subject to contamination like the loose beads in twin-tower or dual-bed dryers, so it needs to be replaced less often, and when it does need to be replaced, changing the desiccant wheel is much simpler than replacing large volumes of desiccant beads.
- **Faster Desiccant Preheat**
  It can take 6 to 12 hours to bring large twin-tower desiccant tanks up to temperature, but the Conair desiccant wheel can be ready to go in 12 minutes or less.
- **Secondary Dryers**
  When height restrictions don’t allow the primary drying hopper to be mounted above the molding machine, Conair may recommend a secondary dryer – a turbo heater with a variable frequency drive on the fan motor – that captures hot air exiting the hopper, reheats it if necessary, and returns it to the hoppers to maintain material temperature with minimal energy input.
- **Aftercoolers**
  Conair recommends the use of aftercoolers on the return air line to the dryer. Some suppliers claim to have eliminated the need for after-coolers by reclaiming heat for preheating material. However, this is not advisable because the aftercoolers protect downstream components and the desiccant from contamination by dust and volatiles. This is especially important when PET regrind is being processed.

A high-speed molding process like PET preform molding requires rapid cooling. But when warm moist air comes in contact with the mold, condensation will form on the cold steel. This, in turn, can cause corrosion and part defects. The solution? Mold-space dehumidification. As the industry’s foremost authority on polymer drying, Conair knows about dry air. We can supply equipment and materials to dehumidify the area around the mold in a single machine, or we can create a dry-air environment in an entire molding room. Either way, you’ll never have to worry about condensation problems again.
According to major PET material suppliers, preform and bottle properties benefit from a high intrinsic viscosity (IV). It can reduce the likelihood of haziness in preforms and will generally yield a more uniform wall thickness in blown bottles. Since moisture in the polymer can degrade IV during processing, proper drying is critical. If drying process parameters – dew point, temperature, air flow and residence time – are properly regulated, drying will have no negative effect on the IV of PET.

Likewise, drying also should have no adverse effect on acetaldehyde (AA) levels. AA is a degradation byproduct that develops when PET is heated. The small amounts potentially found in PET bottles are not dangerous to humans. However, residual AA can affect the taste and odor of package food or beverages and so it is important not to overheat the PET during process. By paying proper attention to temperature and residence time, and using the advanced controls available, preform molders can be certain that drying does not contribute to AA development.
When conveying PET within the molding plant, it is critical to keep the material in good condition. Exposure to humid ambient air should be minimized, especially after the material has been dried. Conair has set the industry standard in material handling for more than 50 years.

Most preform molders will use a central vacuum conveying system to move material from silos or a bulk-bag unloading station to dryers, blenders and, eventually, to receivers on the molding machines. Providing the motive force behind the system is usually a Conair positive displacement pump, which provides the strongest vacuum power available. Where compact, quiet regenerative vacuum pumps are preferred, Conair can supply these units as well.

Especially when you use PET regrind in your material mix, you’ll want to control dust and fines that can foul vacuum pumps and dryer filters, and contaminate desiccant. That’s why we recommend that every material-handling system include a dust collector. Conair dust collectors include an integrated canister for capturing dust and a cartridge filter that automatically releases entrained dust with each vacuum cycle.

DuraLoad receivers are recommended on bulk storage bins and primary and secondary drying hoppers. Features specially developed for PET drying applications include a high-heat vacuum lid with sequencing valves, tubing and other components built to stand up to harsh 350°F (175°C) operating conditions. Closed-loop venting and a robust slide gate on the receiver discharge prevent ambient air from entering the hopper.

Dry-air conveying, to prevent moisture regain, is available if dried material needs to be conveyed to a secondary drying hopper on the machine, or when blending takes place after material has been dried.
One of the first products to carry the Conair name, over 50 years ago, was a vacuum loader that eliminated the need for an operator to manually haul material up to the machine hopper. Today, Conair is the leading supplier of innovative central vacuum systems that allow PET preform molders to move millions of pounds of resin each year – safely and efficiently.
Running high-cavitation tooling on short cycles in a highly competitive market environment, PET preform molders need the most advanced heat-transfer systems available. And yet, since cooling can be a costly production necessity, you need to keep energy use to a minimum and reduce operating costs. We can engineer application-specific heat-transfer systems, taking advantage of our extensive line of air- and water-cooled central chillers, cooling towers and pump tanks.

The key to rapid heat transfer (and shorter molding cycles) is turbulent flow in the cooling lines. And the key to turbulent flow is ensuring adequate pressure and water volume. Turbulence can normally only be achieved by increasing flow rates to a minimum of about 4.8 gal/min/ton (5 liters/min/kW) of cooling capacity. Pumps must be sized for the maximum cooling load possible. However, plants do not always operate at maximum capacity under the most challenging conditions.

To deal with this situation, Conair recommends using variable-frequency drive (VFD) units on all pumps. A VFD allows the speed of the pump motor to be changed as the cooling load fluctuates, thus reducing energy consumption dramatically. In a plant running at 80% capacity, variable frequency pump drives can achieve energy savings of almost 50%, and the cost reduction is even more dramatic at lower levels of capacity utilization (See Chart).

Variable frequency drives are also cost-effective in cooling towers. A temperature sensor placed in the tower water can provide feedback to the VFD fan controller, ramping fan speed up and down as needed to maintain a consistent, economical water temperature regardless of ambient conditions.

**POTENTIAL ENERGY SAVINGS USING VARIABLE FREQUENCY DRIVE (VFD)**

<table>
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<tr>
<th>OPERATING LOAD (% OF FULL LOAD)</th>
<th>ANNUAL ELECTRICAL COST* BY PUMP SIZE (HP AND KW)</th>
<th>VFD SAVINGS COMPARED TO FULL LOAD**</th>
</tr>
</thead>
<tbody>
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<td></td>
<td>25 Hp 18.65 kW</td>
<td>50 Hp 37.3 kW</td>
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<tr>
<td>100%**</td>
<td>$17,695</td>
<td>$35,478</td>
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<tr>
<td>80%</td>
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</table>

*Based on 95% efficient motors, $0.10/kWh utility cost with no demand or power factor penalty impacts.

**Without VFD, motors run at full load regardless of system demand.
For more than 40 years, R-22, also known as Freon, has been the refrigerant of choice for industrial cooling systems, including the chillers used commonly in PET preform molding plants. However, R-22 is a hydrochlorofluorocarbon (HCFC) that, when released into the atmosphere, can damage the Earth’s ozone layer. That’s why an amendment to the Montreal Protocol, an international environmental agreement and the U.S. Clean Air Act, established a schedule for the phase-out of HCFCs including R-22.

Knowing the change was coming, Conair began in 2008 to switch to non-ozone-depleting substitutes like R-410A and R134a – becoming the first chiller suppliers in the plastics industry to do so. Today, Conair heat-transfer experts can help you understand the new technology and select the right chilling system for your operation. In the meantime, we’ll continue to service existing Freon-based chillers until that refrigerant is no longer available, sometime around 2020.
control your company’s network. Remote access is available through a virtual private network (VPN) client. ControlWorks product modules include:

- **Bulk Storage Module**
  Monitor silo levels up to 36 sensors.

- **Blending Module**
  Connect up to 64 blenders for entering set-up parameters and reporting material use.

- **Drying Module**
  Control and monitor up to 32 dryers, display and log operating values and alarms, and trend dew point versus energy consumption.

- **Central Water Module**
  Monitor and control all pumps, valves and fans in up to 3 central water systems; record operating values and alarms.

- **Conveying Control Module**
  Links to 3 loading control systems and hundreds of connected devices; monitor and adjust load times, discharge times, purge time, regrind cycles, material alarms and proofing.

Miscellaneous I/O modules make it possible to monitor any combination of analog, digital, RTD or thermocouple inputs.

With ControlWorks, you can view performance data, store blender recipes, retrieve information and diagnostics and process-data trending as they occur. ControlWorks automatically logs all reportable data and stores it in a Postgre SQL or a user-provided Oracle database. Reports can be generated on a schedule or on-demand in Microsoft® Excel® format.
Just as a universal remote control at home allows you to operate many of the settings of your entertainment system, ControlWorks allows you to interface with the controls on auxiliaries and monitor their operation from a central location. Also, just as your TV remote allows you to adjust your television settings without getting off the couch, ControlWorks lets you check and change the control settings on your auxiliary equipment without racing across the plant floor. It gives PET preform molders a huge boost in convenience and productivity in a very affordable package.
Size Reduction

Processors today need to use more in-process PET scrap. The “green” movement encourages it and the potential material-cost savings make it economically smart. Fortunately, technological advances are making it easier every day. Conair equipment and processing knowledge will help you produce a uniform regrind particle size, with minimal dust and low energy consumption.

The restricted tangential cutting chamber available in Conair CBW or CW granulators, and a 2nd flywheel for added inertia, are ideal for press-side or centralized grinding of preform scrap. The signature “constant cutting circle” concept allows the rotor knives to adjust outward toward the bed knives and screen, eliminating screen clogging, minimizing heat buildup and reducing dust and fines generation. A swing-open removable screen cradle provides wide-open access to the cutting chamber for fastest cleaning and blade maintenance in the industry.

Once regrind drops through the screen and into the catch bin, it needs to be conveyed away without producing additional dust. The best choice here is a vacuum conveying system with oversized blower and large diameter conveying lines to maintain the quality and integrity of the material. In the cyclone above the storage vessel, a rotary airlock will reduce the velocity of the regrind exiting the cyclone and ensures that most of the airborne dust goes through into the dust collector.

To remove 99% of fines from regrind you may need an elutriator like the Conair Model EL24C. This highly efficient system separates desirable regrind and drops it into a material surge bin. From there it can be reintroduced to the process stream. The unusable fines travel through a take-off blower and into another cyclone that separates the fines for disposal.
Conair PET experts have designed automated scrap reclaim systems for most of the major PET packaging producers and they know the secret to making effective use of granulated scrap in PET processing is uniformity. If you are putting granulated scrap back into your process, you need to pay close attention to how it is treated during size reduction. A clean, uniform granulate, with minimal fines and dust, is critical to efficient and profitable operation. However, because PET is brittle and tends to shatter, this is not always easy. A tangential cutting chamber will help prevent preforms from bouncing on top of the rotor and creating dust, while an open rotor reduces heat build-up. Sharp, properly adjusted knives cut cleanly instead of smashing the scrap. Finally, a vacuum conveying system helps to prevent PET regrind from impacting blower impeller blades, which could create additional fines.
Virgin PET is crystallized during manufacture and, in this condition, can be dried at higher temperatures like any other hygroscopic polymer. However, once the crystalline pellets are melt processed, the material reverts to its amorphous state, so PET regrind must be re-crystallized — by heating it past its glass-transition temperature of 160°F (70°C) — it can be dried conventionally. Conair offers a range of solutions for preparing PET regrind for reprocessing.

- **Vertical Agitating Crystallizers.**
  These units are similar to conventional hot-air (non-desiccant) dryers, with the addition of a vertical agitator, which keeps the PET moving to prevent agglomeration or clumping as it is heated by hot air entering through a spreader cone in the bottom of the hopper. Crystallizers don’t require much floor space and are relatively inexpensive. After crystallization, PET regrind can be further dried to the required low dew point with a conventional desiccant dryer or blended with virgin before final drying.

- **Infra-Red Drum (IRD) Dryer.**
  This alternative drying/crystallizing technology involves metering material into a horizontal rotating drum where it tumbles under infrared radiation. The temperature can be quite low in the initial stages of the drum to crystallize the amorphous regrind and then raised in the latter stages for more complete drying. The primary advantage of the IRD is a relatively short residence time in the dryer (which, coupled with IR heating can be quite energy efficient). However, to achieve the low residual moisture level (50 ppm) required for preform molding, the drying process usually needs to be finished in a conventional desiccant dryer.

Conair PET experts can help develop the crystallizing/drying solution that best suits your needs.
and higher. Electronic components are isolated from elevated temperatures. This prevents premature failure or generation of erroneous data that results in diminished mixing accuracy. Now you can confidently blend high levels of regrind direct from the crystallizer or dry preform materials before they are blended, preventing separation of ingredients in the drying hopper.

TrueBlend blenders are available in sizes from 175 lb/hr (79 kg/hr) to 12,000 lb/hr (5443 kg/hr), configured to handle eight or more individual ingredients. Systems for dispensing solid or liquid colorants are also available.
Total Customer Support

Conair is the leading producer of auxiliary equipment for plastics processing in the world. We make and market over 450 different products, including resin-drying systems, blenders, feeders and material-conveying systems, temperature-control equipment, granulators and extrusion solutions. Conair is also a leader in plastics process integration, engineering and installing complete manufacturing systems that help plastics processors manage their valuable raw materials, handle their critical manufactured parts, and improve their process yield.

At Conair, we know what matters to you. We are customer focused. Global. Responsive. Innovative. Resourceful. Respectful. And we are determined to earn your trust, win your business and help ensure your success. That’s why Conair is also committed to giving you the highest level of aftermarket support in the industry, responding quickly to a call for technical assistance or a spare part any time of the day or night, anywhere in the world. If your situation requires an in-plant service visit, it will be handled by trained and certified service technicians who know your equipment and how important it is to your business.

WHERE WE ARE:

- Corporate Office and Technology Center – Cranberry Township, PA, USA
- Conair in China – Shanghai, China
- Conair in Taiwan – Taipei, Taiwan
- Conair in Singapore – Singapore
- Conair in The Philippines – Manila, Philippines
- Conair in India, Ahmedabad, Gujarat, India
- Conair Mexicana – Monterrey, Mexico

IMPORTANT FACTS

- Founded in 1956
- Over 350 employees worldwide
- Six separate product lines, over 450 individual products
- Global offices for 40 years
- Installations across North America and around the world
- One company with the breadth of line, the depth of knowledge, and the range of resources to give you tailored solutions

Your purchase order is only the beginning of our relationship and not the end.
Conair fields a multi-disciplinary team of specialists whose only task is to provide PET preform producers and other PET processors around the world with products and services to meet their unique requirements. This all-star organization includes representatives from engineering, sales, project management and service. Between them, team members have over 150 years of experience in the field.

Recognizing the global nature of the PET-processing market, the Conair team also includes international PET specialists serving China, Southeast Asia and Taiwan. In India, the team makes the NuVu-Conair joint-venture factory in Ahmedabad home base. PET processors in Latin America are served by specialists from North America and from Conair Mexicana in Guadalupe, Nueva Leon (Monterrey).

The Conair PET Team has just one purpose: helping customers stay competitive by optimizing their process, cutting costs and increasing efficiency.

THE PET TEAM

High-temperature blending components – including load-cells, level sensors and air cylinders, are specified for their ability to stand up to temperatures of 350°F (175°C) and higher. Electronic components are isolated from elevated temperatures. This prevents premature failure or generation of erroneous data that results in diminished mixing accuracy. Now you can confidently blend high levels of regrind direct from the crystallizer or dry preform materials before they are blended, preventing separation of ingredients in the drying hopper.

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Conair fields the world’s largest and most experienced team of auxiliary equipment parts and service specialists.

- Unparalleled Expertise
- Total Training
- Preventative Maintenance Programs
- Valuable Parts & Service Information Always Available at www.conairgroup.com

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