

Ribbon Blenders: A Best Practices Guide



A White Paper Prepared By Charles Ross & Son Company



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Abstract

This white paper presents some basic best practices for efficient processing in a Ribbon Blender. The ideas discussed here are recommendations based on practical and technical experience gained by Ross over several decades as a leading supplier of Ribbon Blenders to the process industries worldwide.

The objective of this paper is to provide a better understanding of the operating principles, important features and even the intrinsic limitations of Ribbon Blenders. While many proven applications are enumerated in the following chapters, these are not intended to be taken as process guarantees. Sufficient knowledge of the product being mixed (bulk density, shear sensitivity, flow characteristics, etc.) and detailed discussions with a trusted manufacturer – ideally accompanied by blender testing and simulation trials, when possible – must necessarily form the basis for confirming the best mixing strategy for your particular requirements.

Introduction

The classic Ribbon Blender serves multi-purpose uses in the manufacture of food, beverage, pharmaceutical, cosmetic, chemical, plastic, agricultural and other products. Given its versatility and economy, the Ribbon Blender is often the choice for most straightforward blending requirements.

In a well-made Ribbon Blender, precisely designed and fabricated ribbons turn within a close-tolerance horizontal trough to produce a balanced lateral and radial movement of the batch materials. Blending cycles are relatively fast and mix quality is not hard to duplicate from batch to batch. In principle, it requires very little maintenance even when subjected to frequent product changeovers. Scaling up from a pilot Ribbon Blender operation to large volume production is also generally uncomplicated. Despite these proven advantages, as with other types of mixers and process equipment, optimal mixing performance in the Ribbon Blender still starts with proper sizing, specification and customization. This white paper outlines some strategies for achieving just that, operating to maximum efficiency and ensuring a long service life out of your Ribbon Blender.



Blender selection and specification

Some of the most crucial best practices in ribbon blending takes place even before the blender is installed. In procuring a new blender, one must recognize the important parameters for sizing, as well as features that can be modified to better handle a particular application. Off-the-shelf models are available at basic prices and help manufacturers with very urgent needs but it should be noted that customizing the multi-purpose Ribbon Blender to meet your own process requirements need not drastically add to the capital cost and lead time. The key is to define your objectives in detail so you can confidently select a Ribbon Blender that is neither under-specified nor over-engineered.

The desired batch volume determines the size of the blender but product **bulk density** identifies the appropriate blender class: standard or heavy-duty. Industry-wide, most standard Ribbon Blenders can typically handle bulk densities of around 35 lbs/cu.ft. More robust blenders are required for denser products. If you intend to produce different recipes in one blender, factor in the lowest and highest densities to come up with the correct blender capacity and motor size.

Drive arrangement is another major factor that differentiates Ribbon Blenders from various suppliers. To date, the most reliable drive design is the one-piece motor reducer, also called a gearmotor. This direct drive arrangement is more efficient and compact compared to antiquated belt drives which relied on flexible belts and a set of pulleys to help produce the desired speed and torque ranges. Belt-driven and chain-driven Ribbon Blenders tend to suffer from losses in horsepower and efficiency through slippage. Belts and chains also impose overhung loads which can limit the longevity of motor/reducer bearings. Their limited flexibility typically cannot accommodate high start/stop blending cycles. Belts stretch during their life especially when new so a Ribbon Blender would need tension adjustment when first installed and as the belt wears or stretches.



How do ribbon blenders work?

Ribbon blenders consist of a U-shaped horizontal trough and an agitator made up of inner and outer helical ribbons that are pitched to move material axially, in opposing directions, and also radially. This combination promotes fast and thorough blending. Tip speeds in the range of 300 feet/min are typical.



By comparison, modern gearmotors deliver higher operating efficiency and better performance along with several practical advantages. Because overhung loads on the motor and reducer-shaft bearings are eliminated in gearmotors, service life is longer. Maintenance required to align and adjust belts and couplings is eliminated as well. Today's compact gearmotor designs enable smaller mounting platforms which improve the Ribbon Blender's overall space requirement. Just as important, gearmotors are designed to work well with electronic inverters which provide enhanced speed control, overload protection and adjustable starting torques.

Common Ribbon Blender Processes

Powder Blending. Perhaps the most common operation done on the Ribbon Blender is batching dry ingredient blends. Examples include baking mixes, tablet formulations, powdered flavors, protein supplements, chemical additives, etc. A typical mix cycle usually takes no longer than 15 minutes and, with the ribbon agitator continuing to run, the discharge step is also completed quickly. It is a straightforward process which a basic Ribbon Blender can easily handle provided it is sized for the right bulk density. But depending on the characteristics of the powders, some optional features are worth considering such as:

- To reduce dusting, opt for a dust-tight discharge valve and clamps to secure the gasketed cover.
- Install lantern rings on the packing gland when handling fine or abrasive powders. Maintaining a slight positive pressure of air during blending will prevent particles from penetrating the stuffing box and protect the shaft from wear.

Coating Particles with a Minor Ingredient. Another use for the Ribbon Blender is coating solid particles with a minor component which can be another solid that is significantly smaller in size (for instance, coating polyethylene beads with a fine powder lubricant) or a liquid ingredient (like spraying flavoring oil into roasted coffee beans). In these kinds of processes, the presence of a minor or trace ingredient necessitates more accurate mixing. Close tolerances – in the range of 1/8 to 3/16 in. – between the outer ribbon and the U-shaped trough become very useful in eliminating “dead zones” within the blender where product can stagnate. The interior stainless-steel surfaces must be well-polished and each weld should be “radiused”. Adding scrapers to the ribbon agitator further minimizes material build-up along the end walls of the vessel. The method and rate of addition of the minor component also affects mixing efficiency and must be considered during blender selection.

Mixing Solids of Different Shapes and Sizes. A good representative of this product category is the trail mix, a snack consisting of nuts, dried fruit, seeds, chocolate, pretzels, granola and other ingredients. Specialty plastic blends composed of various crumbs, pellets and beads is another example. The different components vary in shape, size and density. Achieving a thorough blend must often be balanced with minimizing damage on the more delicate pieces. Fast and gentle mixing in a Ribbon Blender is a practical method for preparing this type of blends. With very sensitive recipes, however, a paddle-style agitator may be supplied instead of the double ribbon design which inherently generates pinch points near the vessel walls wherein relatively large and delicate particles may be compressed. Testing is recommended to confirm the appropriate mixer speed, cycle time and agitator design for a particular product.



Preparing Solid-Liquid Suspensions. Ribbon Blenders are also utilized for mixing discrete solid pieces within a low-viscosity liquid vehicle. Examples include ready-to-eat soups, pasta sauces, pet food and the like. Equipped with a liquid-tight flush valve, Ribbon Blenders built for this type of application can include jacketing around the trough to control product temperature. During discharge, continuous agitation holds particulates in suspension as the product is pumped to downstream packaging equipment.

Slurry and Paste Mixing. Wet applications of the Ribbon Blender are not limited to water-like consistencies. This machine is also commonly used for a wide range of viscous materials from food recipes like cake batter, guacamole and egg salad to industrial formulations such as carbon black dispersions, specialty adhesives and plaster slurries.

Vacuum Drying. Agitated vacuum drying is another process done on horizontal blenders equipped with a ribbon agitator, paddle blades or a combination of both. It is an efficient method for removing volatile components from pharmaceutical granulations, chemicals, plastics, ceramics, metals, and other materials. The combination of reduced pressure and constant agitation accelerates drying even at low temperatures. Vacuum-rated blenders are thus ideal for processing heat-sensitive materials with minimal risk of thermal degradation. The operation also facilitates complete recovery of costly solvents and safe disposal of any harmful volatiles removed from the closed system.

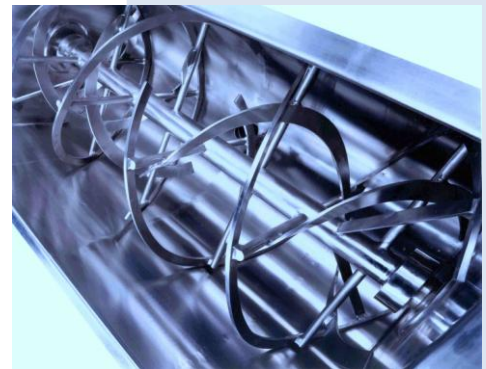


Blender Snapshot: Ross 18-cu.ft. Ribbon Blender for Baking Mixes

Powdered components include sugar, corn syrup solids, cocoa, palm oil, milk, sweet cream, starch and salt.

Model Name: 42B-18 Ribbon Blender

- Maximum working capacity: 18 cu.ft.
Full holding capacity: 22 cu.ft.
- Bulk density rating: 35 lbs/cu.ft.
Maximum batch weight: 630 lbs
- Stainless steel type 304 wetted parts polished to 60-grit finish.
- Trough dimensions: 24" W x 60" L x 29" D
- One-piece, removable cover with safety switch to prevent operation of agitator when the cover is open. Clamps and silicone gaskets are installed for dust-tight operation.
- Solid double ribbon agitator shaft designed for center discharge. Top shaft speed: 50 rpm.
- Two-piece aluminum stuffing boxes with adjustable and replaceable braided Teflon packing.
- Direct drive gear reducer.
- 7.5 HP TEFC motor.
- 4" knife gate discharge valve located 36" above the floor.
- 7.5 HP NEMA 1 Variable Frequency Drive (inverter) enabling start/stop and variable speed adjustment of the ribbon agitator, mounted and wired to the blender.



Some Do's and Don'ts

Do choose the proper location. The Ribbon Blender is normally supplied as a floor-mounted design which requires bolting to an appropriate and substantially level floor. It can also be installed on a stable mezzanine. Note that bolting the Ribbon Blender to an un-level surface may deform the trough and cause clearance issues between the trough and ribbon.

Do size your blender properly. Batch volume (not mass) defines the size of the Ribbon Blender but bulk density determines the right horsepower. Most standard-duty agitator shafts and spokes are recommended for bulk densities up to 35 lbs/cu.ft. only. Heavy-duty blenders are typically required for denser products. Running an overweight batch on a light-duty Ribbon Blender, even when the product level (volume) is below maximum, could overload the motor or lead to more serious mechanical failure. For this reason, it is very important to know the accurate bulk density of your material.

Do not underfill your blender. Optimal mixing in a Ribbon Blender requires enough batch material – equivalent to at least 30-40% of the rated volumetric capacity. Working with smaller volumes, the blender may fail to generate adequate contact between the agitator and the product.

Do inform your blender supplier if you intend to remove the agitator after every batch. In most applications, there is no need to remove the agitator shaft when cleaning. However, some companies prefer to do so to eliminate cross-contamination of highly sensitive batches. To ensure proper alignment, simple customizations can be made, including match marks on the shaft flanges. More elaborate modifications allow operators to quickly raise the agitator out of the blender without moving the end shafts, bearings or seals.

Do use a Variable Frequency Drive (VFD) to allow slow start under full load and protect the system against a spike in start-up torque. Electronic soft starters work just as well but enable only single speed operation during blending.

Do fine-tune shear input. When mixing a range of products on a single machine, take advantage of the Ribbon Blender's versatility not only through variable speed but also with an interchangeable paddle agitator (to handle fragile components) or with high speed chopper blades (to disperse lumps). Chopper blades can be installed through the side of the vessel or mounted on the top cover.

Customize your Ribbon Blender

Ask your blender supplier about optional features that could help increase productivity, lower operating costs, and improve operator friendliness. Examples include:

- **Bag Dump Station**



- **Discharge Extruder**



- **Automated Covers and Valves**



- **Built-in Controls**



Ross Ribbon Blenders in operation across various industries



1-cu. ft. Laboratory Sanitary Ribbon Blender for Pharmaceuticals



18-cu. ft. All-Stainless Steel Vacuum-Rated Ribbon Blender built for a Food Manufacturer



52-cu. ft. Ribbon Blender for Building Materials. Unit is supplied with pneumatic charging port and dual flush plug valves.



R&D Ribbon Blender for Fuel Cell Materials



90-cu. ft. Ribbon Blender fabricated in Hastelloy for Polymer Processing.



120-cu. ft. Sanitary Ribbon Blender for Flavor Concentrates



515-cu. ft. Ribbon Blender/Reactor built for a Petrochemical Company



385-cu. ft. Carbon Steel Ribbon Blender for Ceramic Powders