# FIELD EVALUATION OF LUMMUS GIN MACHINERY – 2017

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#### <u>Abstract</u>

Lummus Corporation, as part of its continuous product development and improvement program, evaluated a variety of its products during 2017. The first test was a comparison of the lint removal performance of the current model 170-Saw Imperial III gin stand versus the new 203-Saw Imperial III gin. The second was a comparison of Lummus baling press capacities from original design parameters to the latest measured capacities (resulting from hydraulic and electrical controls optimization). These studies are conducted in order to document current product performance with the goal of finding ways always to improve capacity and/or efficiency.

#### **Introduction**

This paper covers testing performed at Central Rolling Plains Co-op Gin, along with a press capacity analysis of various models of Lummus baling presses (down-packing and up-packing) from numerous locations across the United States.

#### **Central Rolling Plains Co-op Gin**

Central Rolling Plains Co-op Gin is located in Roscoe, Texas. A photo of this gin plant is shown in Figure 1. The gin plant currently features two stages of drying and split 120" wide precleaning, five ginning/lint cleaning lines with centrifugal-type lint cleaning followed by tandem (2) saw-type lint cleaning, and an up-packing Lummus Gin Dor-Les<sup>®</sup> U.D. baling press. Ginning lines 1 through 4 feature Cherokee Avenger extractor feeders over 193-Saw Avenger gin stands (gin stands converted from their original 174-saw configuration), centrifugal-type lint cleaners/tandem Horn Super 86 controlled-batt saw-type lint cleaners (ginning lines 1 and 2) and Super-Jet<sup>®</sup>/tandem Lummus 108 Sentinel II Lint Cleaners (ginning lines 3 and 4). Ginning line 5 features all-Lummus machinery, including a 96" wide Model 700<sup>TM</sup> II extractor feeder over a 170-Saw Imperial<sup>TM</sup> III gin stand, followed by a Super-Jet<sup>®</sup> centrifugal-type lint cleaner and two 108" wide Sentinel<sup>TM</sup> II saw-type lint cleaners. In early 2017, the Lummus 170-Saw Imperial III gin stand was field converted to the latest configuration, the 203-Saw Imperial III.



Figure 1. Central Rolling Plains Co-op Gin

#### **Press Optimization**

As the number of operating ginning facilities in the United States continues to be reduced, the same (or more) bales of cotton are produced annually; thus, throughput capacities for the remaining gins are continually pushed to new limits. A key component of this capacity is the processing capacity of the baling press. To put press capacity in perspective, it is important to define press cycle time and how the bales per hour (BPH) press rating is calculated.

Press cycle time is defined as the time (in seconds) from the signal (buzzer/horn) that a bale is ready until the press is totally ready to start another cycle. For a down-packing press, this is from "box full" signal until the bale is ejected, ram had returned to "all up," and the box had lowered to the "all down" position. For an up-packing press, it is from the "box full" signal until the bottom ram has returned to the "all down" position. Dividing this press cycle time (in seconds) into 3,600 (the number of seconds in an hour) will yield the BPH rating of the press.

For example: A particular up-packing press' cycle time is 90 seconds (from "bale ready" signal until the bottom ram had dropped to the "all down" position). Dividing 90 into 3,600 yields a BPH rating for the press of 40 bales per hour.

It is important to note that, besides hydraulic system and electrical controls design, other items can contribute or detract from press cycle time. These include strapping cycle time (the time it takes to apply the ties or strap to the bale), lint batt conditioning and compression (typically moisture restoration/compression), and an improperly designed or installed lint slide (that can make proper lint feeding into the press difficult).

Lummus' line of universal density baling presses consists of both down-packing and up-packing models. The down-packing model is the Lift-Box<sup>TM</sup> Dor-Les<sup>®</sup>, which is available in Standard, High-Capacity, and UHC (Ultra High-Capacity) configurations, while the up-packing model is the Premier<sup>TM</sup> III Dor-Les, offered in both conventional and HS/VS<sup>TM</sup> configurations. The Lift-Box Dor-Les<sup>®</sup> Standard and High-Capacity models are shown in Figure 2, the UHC Ultra High-Capacity) Lift-Box<sup>TM</sup> Dor-Les<sup>®</sup> in Figure 3, and the Premier<sup>TM</sup> III Dor-Les<sup>®</sup> models in Figure 4. The HS/VS<sup>TM</sup> feeding and tramping system was first reported by Thomas, et. al. (2014), and it is premium option that is available for high-end capacity applications.

Additionally, available both on new presses and as a retrofit for existing presses, Lummus offers the UHS (Ultra High-Speed) Servo power turning system for the Lift-Box and Premier press lines. The UHS Servo system allows a Lift-Box press to turn in 5-6 seconds and a Premier press to turn in 6-7 seconds.



Figure 2. Standard Lift-Box<sup>™</sup> III Dor-Les<sup>®</sup> Press (left) and High-Capacity Lift-Box<sup>™</sup> III Dor-Les<sup>®</sup> (right).



Figure 3. UHC (Ultra High-Capacity) Lift-Box<sup>™</sup> III Dor-Les<sup>®</sup> Press.



Figure 4. Conventional Premier<sup>™</sup> III Dor-Les<sup>®</sup> Press (left) and HS/VS<sup>™</sup> Premier<sup>™</sup> III Dor-Les<sup>®</sup> Press (right).

## **Materials and Methods**

## Central Rolling Plains Co-op Gin

Near the end of the 2016/17 harvest season, two modules (each composed of four John Deere "rounds") from the same grower/field were set aside for testing. These modules were stripper harvested (burr extracted). One module was run through the 170 gin stand prior to its conversion, and after conversion to the 203 configuration, the second module (4 "rounds") was ginned. Both gin stands had processed approximately 1,000 bales on the gin saws at the time of sampling, so the saws were still in excellent condition but not absolutely "brand new." Three ginned seed samples were taken during each test, and these samples were tested for residual lint remaining on the seed (percent by weight). The three-sample results were then averaged for the 170 and 203.

During the 2017/18 ginning season, ginned seed samples from the Cherokee 193-saw gin (line 4) and the Lummus 203-saw gin (line 5) were simultaneously sampled for residual lint comparison. At the time of publication, the residual lint results were not available, but comparison photos of the ginned seed were taken.

#### **Press Optimization**

There was no actual testing protocol for this section of the study. Empirical data of known press cycle times as a result of hydraulic controls logic and Programmable Logic Controller (PLC) program optimization are presented in the Results and Discussion section.

## **Results and Discussion**

#### **Central Rolling Plains Co-op Gin**

The residual lint comparison between the 170-saw and 203-saw gins is shown in Figure 5.

Gin	Residual Lint (% by weight)
170-Saw Gin	10.6
203-Saw Gin	10.0

Figure 5. Residual lint comparison between Lummus 170-Saw and 203-saw gins.

In addition to the improved seed cleaning, the gin crew and management reported that the 203-saw gin was more effective at maintaining capacity and in reducing the amount of small seed passing through the ribs. As compared to the operation of the Cherokee 193's, the crew reported more trouble-free performance and more uniformly cleaned seed by the 203, regardless of the type of cotton being ginned.

The photos of the ginned seed from the Cherokee 193-saw gin (line 4) and the Lummus 203-saw gin (line 5) collected during the 2017/18 ginning season are shown in Figure 6.



Figure 6. Ginned seed from Cherokee 193-saw gin (left) and Lummus 203-saw gin (right).

While it appears that the 203 is more effective at uniformly cleaning the seed, the residual lint results are not available at the time of the writing of this paper, so the visual results are subjective.

# **Press Optimization**

A comparison of original design cycle times versus optimized cycle times (actual observed times) is shown in Figure 7.

	Cycle Time <sup>a</sup>	
Press Model		Optimized
Standard Lift-Box Dor-Les <sup>®</sup> (with one H-120 Pumping Unit)	22	25
Standard Lift-Box Dor-Les <sup>®</sup> (with two H-120 Pumping Units)	35	50-52
High-Capacity Lift-Box Dor-Les <sup>®</sup> (with HCLB Pumping Unit	45	52-65 <sup>b</sup>
UHC Lift-Box Dor-Les <sup>®</sup> (with HCLB Pumping Unit and UHC Booster Skid)`	60	60-70 <sup>b</sup>
Premier™ III Dor-Les <sup>®</sup> (with 2/125-HP Premier III Pumping Unit)	45	50 <sup>b</sup>
Premier™ III Dor-Les <sup>®</sup> (with 3/125-HP Premier III Pumping Unit)	60	65 <sup>b</sup>
Premier™ III Dor-Les <sup>®</sup> (with 4/125-HP Premier III Pumping Unit)	67	<b>70</b> <sup>b</sup>
Premier™ III Dor-Les <sup>®</sup> (with 5/125-HP HS/VS™ Pumping Unit)	75	75-80

a - contingent on type of bale tying/strapping system that is used

b - upper rate achieved through UHS (Ultra High-Speed) Power Turning

Figure 7. Original and optimized press cycle times for Lummus current production baling presses.

It is important to note that the entire combination of press features contribute to cycle time optimization, but one can easily see that through advanced technology and continual product improvement, even existing equipment can be made substantially more productive, which results in more bales within a given timeframe and, thus, reduced ginning cost per bale.

#### <u>Summary</u>

With smaller seed size and more brittle seed becoming the norm, gin stand evaluation will remain at the forefront for Lummus Corporation. This will ultimately result in a new generation of saw gins, which will be developed in the very near future. Also, advancing technologies will allow a multitude of opportunities for process monitoring throughout the ginning system, so that technology can take on a more significant role in the control of the various ginning processes. As new cotton cultivars are developed, the various performance characteristics of modern ginning machinery will have to be continually monitored, so as to maximize performance while preserving the best possible fiber quality for the market. Lummus Corporation is committed to maintaining its leadership role in these efforts, so our work continues.

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#### References

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