



Grain Storage and Grinding



Objective: On this page, we aim to capture how farms store grain on farm and process it as well as provide bin dimensions and maximum bushel storage for various structures. In addition, we provide examples of corn processing methods that maximize the feed value for cows.

Grain bin storage: There are several different brands of grain bins that are commercially available. Most farms will choose a reputable dealer that can service the setup after it's built. This is a very similar approach to making a purchase decision for a TMR mixer wagon. Some common brands in the Midwest include the following, but are not limited to: Sukup, Conrad American, GSI, Brock, Sioux, and Adams. A storage bin with a drier floor and fan (no heat), unloading system, and concrete base will range in cost of \$4.50-\$5.50/bushel to build new (2024).

One of the most common bin brands throughout the Midwest is Sukup bins. Below are some typical bin dimensions provided from their website. There are many different styles and sizes that can fit any operation's needs. Working with your bin dealer to best determine your needs is recommended.

Link to bin dimensions (page 11-13 and 15): <https://sukup.com/assets/brochures/Grain-Bins-DESB-update.pdf>

Other Storage Considerations:

Grain handling system: When considering which type of system to use to bring corn into the bin, maximizing efficiency should be top of mind. This means matching the unloading equipment with the equipment that is unloading the corn so that harvest delays are minimized. The goal is to keep corn away from the combine so the operator can continue harvesting.

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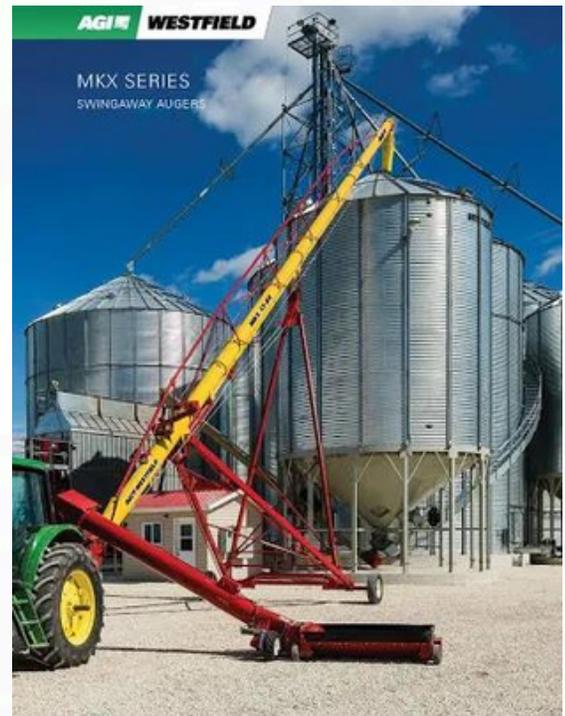


Grain leg: One option to handle grain is to use a leg as pictured here. This setup is a dual-purpose dump pit which serves for unloading during grain harvest and commodity deliveries for the feed center. The unloading conveyor runs from the pit to the grain leg where it's taken up the leg and dispersed to its proper place of storage. In a harvest situation, the leg will direct the corn to the wet bin to be drier and once dried, transferred to a holding bin (pictured on the left of this image). This system is operated with a computer system that controls the leg system and is integrated with the bin drier system to maximize throughput and efficiency.



Another consideration with grain legs and dump pits is to build a pit large enough to hold an entire semi. This allows the driver to dump the truckload within a few minutes, which greatly reduces wait time for unloading as well as the harvester in the field. These decisions are farm specific and will vary depending on the needs of the operation.

Grain auger: Another handling option is to use a grain auger to transfer corn to the storage unit. Grain augers are a tried-and-true way of getting corn from the field and into the bin. There are many brands and options on the market that can fit any operation's needs. They will require a power source to rotate the auger. Either a tractor with PTO or a mounted electric motor are the most common power sources. Grain augers create flexibility of where you want to place your grain since they are very easy to move. Most times, they are temporarily set up so that at the end of the season you can clean them and store them out of the way. There are greater safety considerations to account for when using these because the PTO shaft is usually around the unloading work area, so operators need to be mindful of this, and the throughput of a grain auger will usually be less than a dump pit/grain leg setup, so overall efficiency is lower.



Grain drying: Continuous flow and bin systems are the most common options for drying. In the picture above with the grain auger setup, the cone bin pictured is a wet holding bin. The advantage of the cone bin is that it is easier to clean compared to a flat bin. Wet corn can build up on walls and in crevasses,

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which is harder to do in a cone bin. Corn is transferred from the bin to the continuous flow drier (to the left of cone bin) as it has capacity for more corn to dry. This is done with a computer system that automatically senses when the desired drying point is reached, and then transports corn from the dryer to a storage bin. The wet bin's main objective is to feed the continuous drying system. One example of continuous flow systems can be found here (pages 7-11): <https://sukup.com/assets/brochures/Grain-Dryers-2023.pdf>

Another option to dry corn is to use a regular storage bin with a perforated floor and heated fan. This is less efficient than a continuous flow system because the bin must heat all corn within it versus only a bit at a time. This type of system also requires agitation within the bin to take warm grain on the floor and rotate to the top so that grain can get to floor level near the heat source and be dried. One bonus with a bin drier is that you can use it for regular storage in the event all other bins are full.

Grain processing: When processing corn on farm, the most used practices include roller mills and hammer mills. Once ground, the corn needs to be stored flat in a bay or transferred to another bin for feeding. Keeping the ground corn dry and clean will help to limit shrink and maintain quality of the product.

Roller mills: These tend to have a higher capacity, but often do not process the corn as fine as a hammer mill. They are also much more expensive units. A maintenance schedule should be followed for optimal performance. These units are less commonly used on farms throughout the Midwest, but are commonly found in commercial feed mills, given their high through-put.



IFA Roller Grinder: At ~\$40,000 USD, this system is more costly than a hammer mill. There is typically less deviation in particle size and more throughput than a hammer mill as the unit can process 8 tons

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per hour. This roller grinder can run rollers at variable speeds, compared to a roller mill where the rollers run at the same speed.



Hammer mills: There are several commercial versions of hammer mills, including Sudenga, Valmetal, and Winona. All of these have been evaluated with positive feedback. Typically, a 20 hp motor is going to be the most recommended to prevent damaging screens prematurely on hammer mills. The most ideal screen size is 3/32" – 7/64", which will produce a micron size from 300-500. These are known for the minimal maintenance that is required; however it is important to replace the screens and hammers occasionally and evaluate the grinder and product on a regular basis with micron tests in order to prevent poor processing.

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LIBERATOR - MILL: GRINDING CAPACITY IN POUNDS PER HOUR

The chart below shows average grinding capacities for the Sudenga Industries, Inc. hammer mill. Due to differences in moisture content, electrical voltages, and trash in the grain, Sudenga Industries, Inc. does not guarantee performance at these levels. Actual capacities may be higher or lower than indicated by the following chart.

Screen Size	Mill Motor	Dry Corn	Wet Corn	Wheat	Barley
3/32"	5	1,500	N/A	1,500	1,500
	7.5	2,250	N/A	2,250	975
	10	3,000	N/A	3,000	1,300
	15	4,500	N/A	4,500	2,000
	20	6,000	N/A	6,000	2,800
1/8"	5	2,500	2,500	2,500	1,100
	7.5	3,750	3,000	3,750	1,650
	10	5,000	4,000	5,000	2,200
	15	7,500	6,000	7,500	3,300
	20	10,000	8,000	10,000	4,400
5/32"	5	3,000	2,500	3,000	1,300
	7.5	4,500	3,750	4,500	1,950
	10	6,000	5,000	6,000	2,600
	15	9,000	7,500	9,000	3,900
	20	12,000	10,000	12,000	5,200
3/16"	5	3,500	3,000	3,500	1,550
	7.5	5,250	4,500	5,250	2,325
	10	7,000	6,000	7,000	3,100
	15	10,500	9,000	10,500	4,650
	20	14,000	12,000	14,000	6,200
7/32"	5	4,000	N/A	N/A	N/A
	7.5	6,000	N/A	N/A	N/A
	10	8,000	N/A	N/A	N/A
	15	12,000	N/A	N/A	N/A
	20	16,000	N/A	N/A	N/A
1/4"	5	4,500	N/A	N/A	N/A
	7.5	6,750	N/A	N/A	N/A
	10	9,000	N/A	N/A	N/A
	15	13,500	N/A	N/A	N/A
	20	18,000	N/A	N/A	N/A
5/16"	5	N/A	N/A	N/A	N/A
	7.5	N/A	N/A	N/A	N/A
	10	N/A	N/A	N/A	N/A
	15	N/A	N/A	N/A	N/A
	20	N/A	N/A	N/A	N/A

Below are examples of hammer mills on farms.

Valmetal Hammer Mill: This unit on a dairy in Illinois is run by a 15 hp motor and is fed by a 6" (15 cm) auger. It processes approximately 100 bushels or an estimated 5,600 lb (2,540 kg) per hour. The farm normally lets the unit run the entire feeding shift. The unit was purchased in December 2022 for \$4,000

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USD and the farm spent an additional \$1,600 USD for a variable speed drive on the auger, plus the cost for the shed around the hammer mill. The farm initially fed the mill too fast and couldn't keep up, however learned if it was fed too slowly, fines would build up and clog the hammer mill. This unit has eliminated the cost of grinding at the local feed mill.

Milling Results from Valmetal: The report from the Valmetal hammer mill demonstrates that it has been effective in on-farm grinding. Overall, the micron size in this sample is adequate, along with the standard deviation of micron size. Other samples have also indicated that the mill is doing well over time.

GRAIN PARTICLE SIZE DETERMINATION

TEST RESULTS:

U.S. SIEVE #	MICRON OPENING	WEIGHT (GRAMS)	PERCENT	PERCENT LESS THAN
4	4750	0.40	0.30	99.70
6	3350	0.20	0.15	99.55
8	2360	0.10	0.08	99.47
12	1700	1.30	0.98	98.50
16	1180	10.70	8.03	90.47
20	850	21.60	16.22	74.25
30	600	27.30	20.50	53.75
40	425	20.40	15.32	38.44
50	300	14.70	11.04	27.40
70	212	10.10	7.58	19.82
100	150	8.70	6.53	13.29
140	106	7.80	5.86	7.43
200	75	5.60	4.20	3.23
270	53	4.30	3.23	0.00
PAN	45	0.00	0.00	0.00
TOTAL		133.2		

ANALYSIS:

Relative Corn Index (RCI)	443.4
Mean Particle Size (DGW)	461 microns
Standard Deviation (SGW)	2.34
1 Standard Deviation Distribution	197 - 1079 microns
Surface Area (CM ²) / Gram	141.3
Particles / Gram	198740

Results From Valmetal Processor





Dry Corn is moved with auger from holding bin directly to the stationary grinder in shed.



Sudenga Hammer Mill: This unit on a Minnesota dairy is much older and is run with a 30 hp motor. It processes approximately 2,450 lb (1,110 kg) per hour. For this volume, it is running 7 hours a day and can process enough corn to feed 1,800 cows at 9.5 lb (4.3 kg) of corn per day, for a total of 17,000 lb (771 kg) per day. Originally, the farm had corn sent to a bin after it was processed, however, that did not flow well and it was hard to clean, resulting in sanitary issues. Now the farm transfers the processed corn into a budget-friendly hoop building and stores it in a commodity bay.

The farm has found that regular maintenance is important to ensure consistent results. Regular maintenance on their site has included switching screens every 3 months (\$300 USD) as well as flipping and then replacing the knives on the mill at 3-month intervals or approximately 630 hours at 7 hours per day.



TEST RESULTS:

U.S. SIEVE #	MICRON OPENING	WEIGHT (GRAMS)	PERCENT	PERCENT LESS THAN
4	4750	0.00	0.00	100.00
6	3350	0.00	0.00	100.00
8	2360	0.00	0.00	100.00
12	1700	0.40	0.43	99.57
16	1180	1.40	1.52	98.05
20	850	4.80	5.21	92.83
30	600	11.70	12.70	80.13
40	425	22.30	24.21	55.92
50	300	12.20	13.25	42.67
70	212	19.20	20.85	21.82
100	150	12.10	13.14	8.69
140	106	3.30	3.58	5.10
200	75	3.70	4.02	1.09
270	53	1.00	1.09	0.00
PAN	45	0.00	0.00	0.00
TOTAL		92.1		

ANALYSIS:

Relative Corn Index (RCI)	478.2
Mean Particle Size (DGW)	350 microns
Standard Deviation (SGW)	1.92
1 Standard Deviation Distribution	182 - 670 microns
Surface Area (CM ²) / Gram	160.8
Particles / Gram	119713

Results from Sudengo processor

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Winona hammer mill: This unit is currently run by a 25 hp motor after the initial 10 hp motor was causing too many issues. The corn for this unit comes from a 10,600-bushel Sukup bin that gets dried corn from the farms' grain set-up down the road. Through trial and error, the farm found a preferred screen size of 7/64". Screens are changed out every few months as visual wear is seen. This is an inexpensive maintenance task to keep the unit running smoothly. The farm also built an 11' (3.4 m) high platform for holding the grinder and providing area to do maintenance on the grinder.



GRAIN PARTICLE SIZE DETERMINATION

TEST RESULTS:

U.S. SIEVE #	MICRON OPENING	WEIGHT (GRAMS)	PERCENT	PERCENT LESS THAN
4	4750	0.00	0.00	100.00
6	3350	0.00	0.00	100.00
8	2360	0.10	0.09	99.91
12	1700	0.80	0.71	99.20
16	1180	8.00	7.14	92.05
20	850	14.70	13.13	78.93
30	600	19.60	17.50	61.43
40	425	15.80	14.11	47.32
50	300	13.30	11.88	35.45
70	212	9.60	8.57	26.88
100	150	14.90	13.30	13.57
140	106	8.70	7.77	5.80
200	75	4.60	4.11	1.70
270	53	1.90	1.70	0.00
PAN	45	0.00	0.00	0.00
TOTAL		112.0		

ANALYSIS:

Relative Corn Index (RCI)	453.4
Mean Particle Size (DGW)	406 microns
Standard Deviation (SGW)	2.27
1 Standard Deviation Distribution	179 - 923 microns
Surface Area (CM ²) / Gram	156.7
Particles / Gram	234224

RANKING	PARTICLE SIZE UNIFORMITY (standard deviation)
Excellent	< 2.0
Good	2.0 - 2.2
Average	2.2 - 2.8
Poor	> 2.8

