

Use Aeration to Maintain Grain Quality



Fremont Corn Expo

January 4, 2018



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NDSU



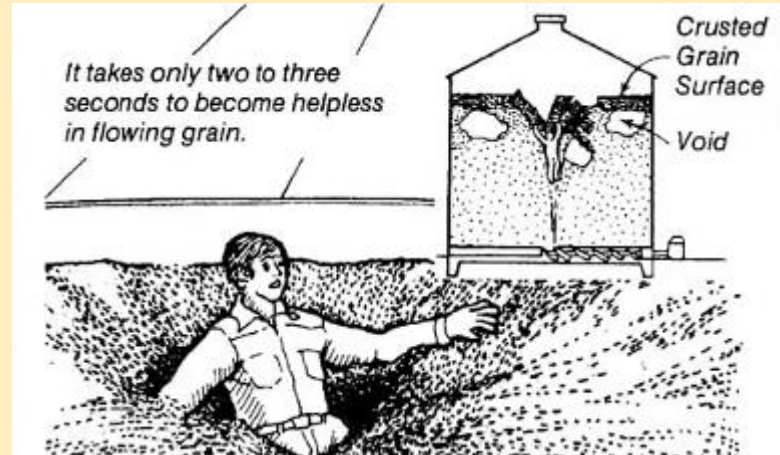
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Grain Hazards



Bridging transfers load to the bin wall



**CAUGHT IN THE GRAIN!
AE-1102**



Moldy Grain Health Hazard

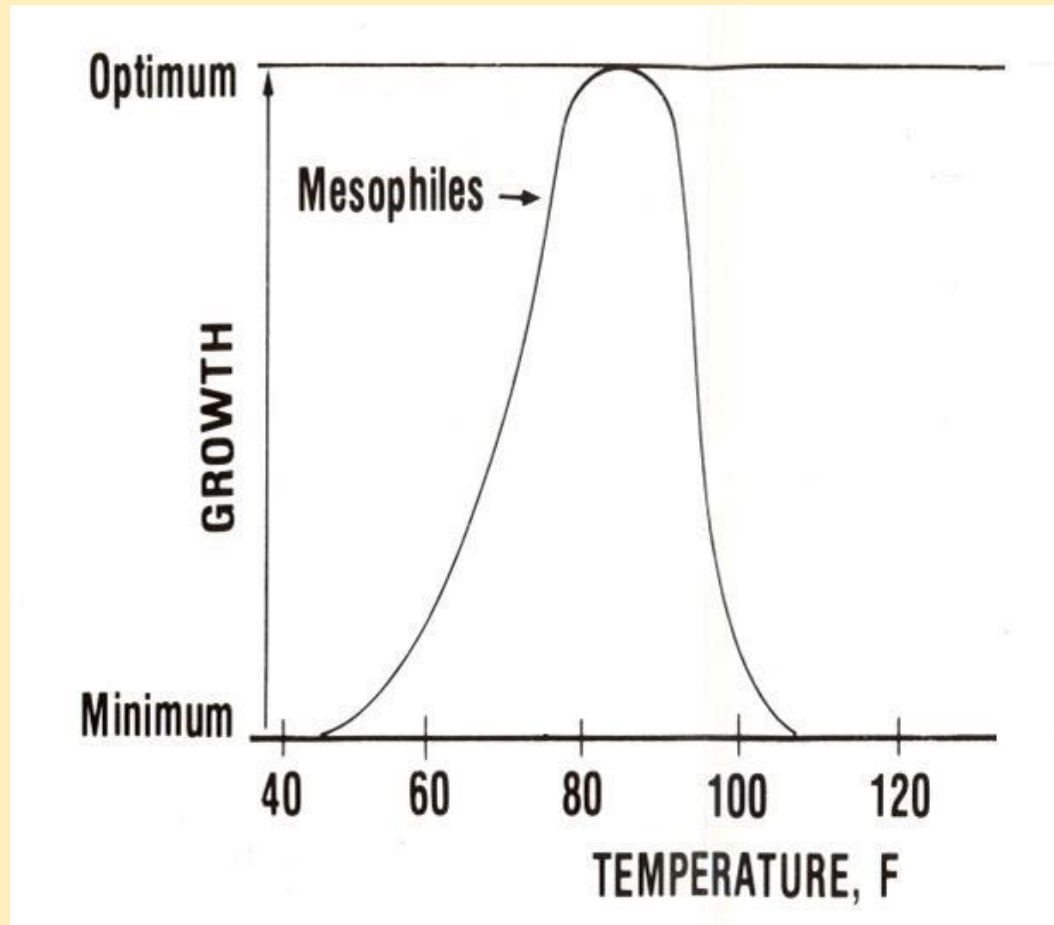
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Grain Storage Problems

- Mold (spoilage)
 - Moisture
 - Temperature
- Insects
 - Temperature
 - Cleanliness
 - Grain Protectant
 - Long-term storage



Mold Growth Curve



Recommended Long-Term Storage Moisture Content

HRS Wheat



EMC = 13.3%

Air



EMC @ 70°F & 60% RH



Grain	EMC	Moisture
Barley	11.8%	12%
Canola	8.0%	8%
Corn	12.8%	13%
Flaxseed	8.3%	8%
Soybeans	10.2%	11%
Sunflower		
Non-Oil	9.6%	10%
Oil	7.4%	8%
Wheat	13.3%	13.5%

“Approximate” Allowable Storage Time for Cereal Grains (Days)

Moisture Content (%)	----- Grain Temperature (°F) -----					
	30°	40°	50°	60°	70°	80°
	Approximate Allowable Storage Time (Days)					
14	*	*	*	*	200	140
15	*	*	*	240	125	70
16	*	*	230	120	70	40
17	*	280	130	75	45	20
18	*	200	90	50	30	15
19	*	140	70	35	20	10
20	*	90	50	25	14	7
22	190	60	30	15	8	3
24	130	40	15	10	6	2
26	90	35	12	8	5	2
28	70	30	10	7	4	2
30	60	25	5	5	3	1

* Exceeds 300 days

Storability

- **Cracked, broken, immature grain spoils easier**
- **Test weight is an indicator of storability**
- **Variety variation**



Moisture Measurement

➤ Representative Sample

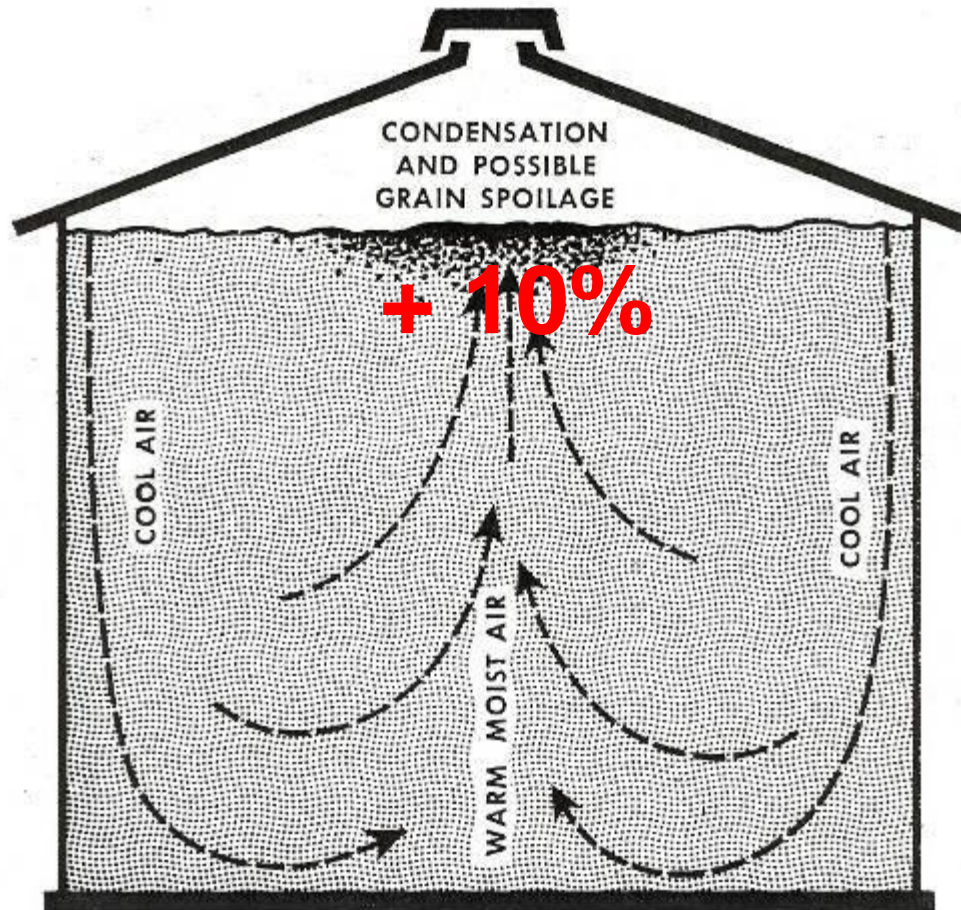
➤ Follow Instructions

- Adjust for temperature
 - May not be accurate $<40^{\circ}\text{F}$
- Electronic meters more sensitive to outside of kernel (*Moisture and Temperature Variation*)
 - Moisture & Temp. variation after rapid drying
- Meters affected by condensation
- Affected by growing conditions & etc.

Recommend:

- Measure moisture content
- Place sample in sealed container for ~ 6-12 hrs.
- Warm to $\sim 70^{\circ}\text{F}$
- Recheck moisture

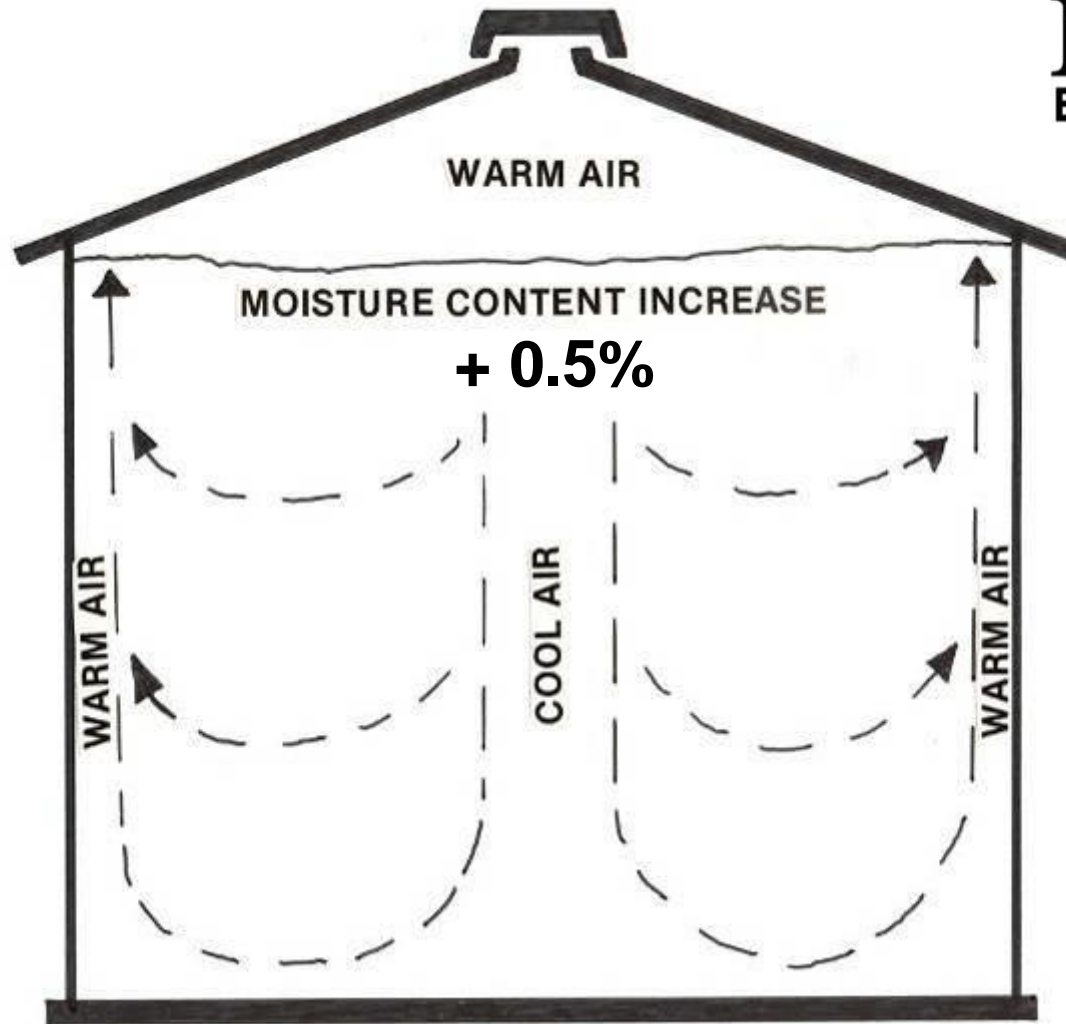




Fall and Winter Moisture Migration

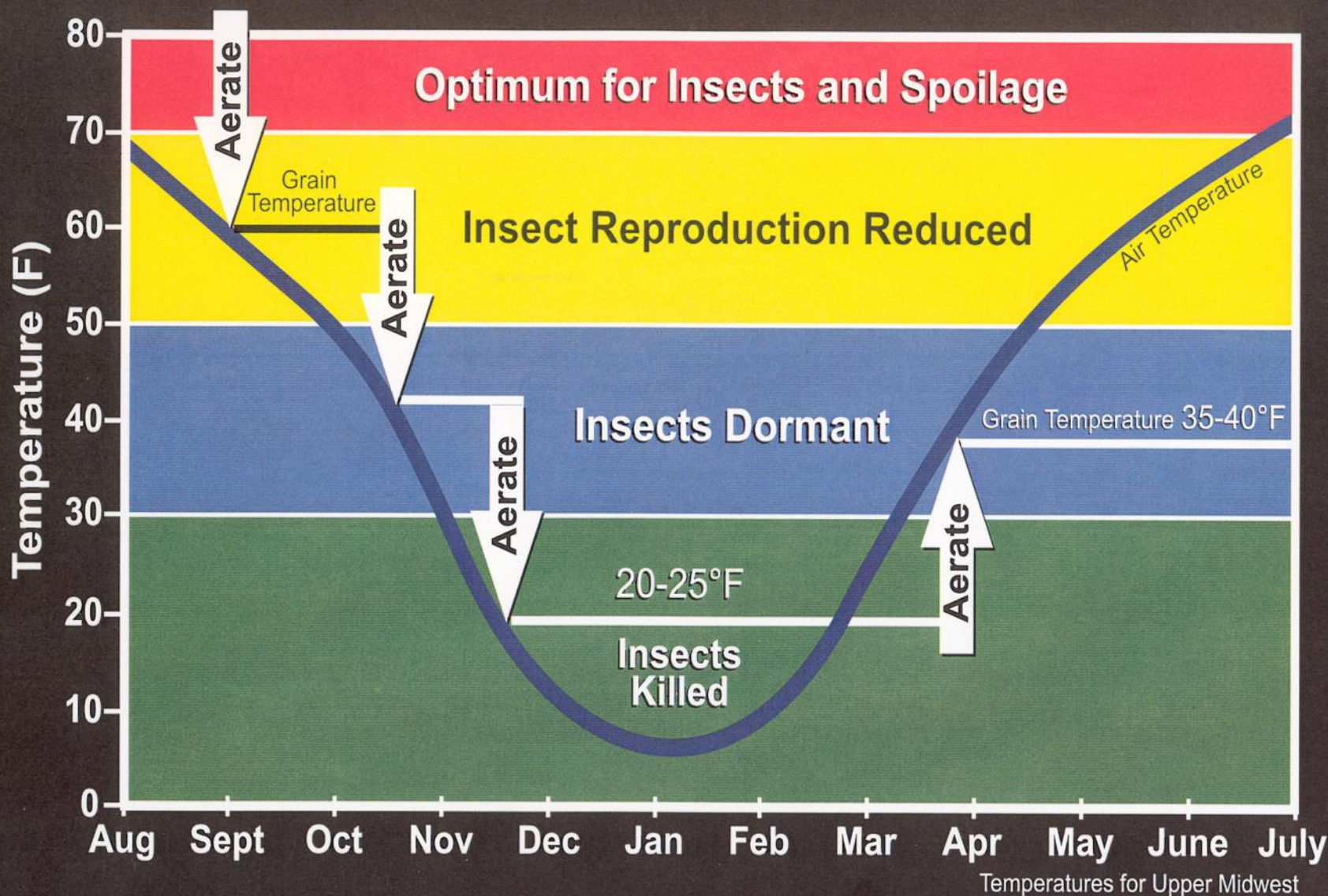
Grain Stays Warm without Aeration





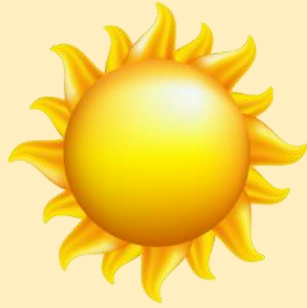
Spring and Summer Moisture Migration

Cool Grain to Prevent Storage Problems



* Prevent crusting due to moisture migration by cooling grain to within 15°F of average outdoor temperatures.

* Cooling grain by 10°F doubles its allowable storage time

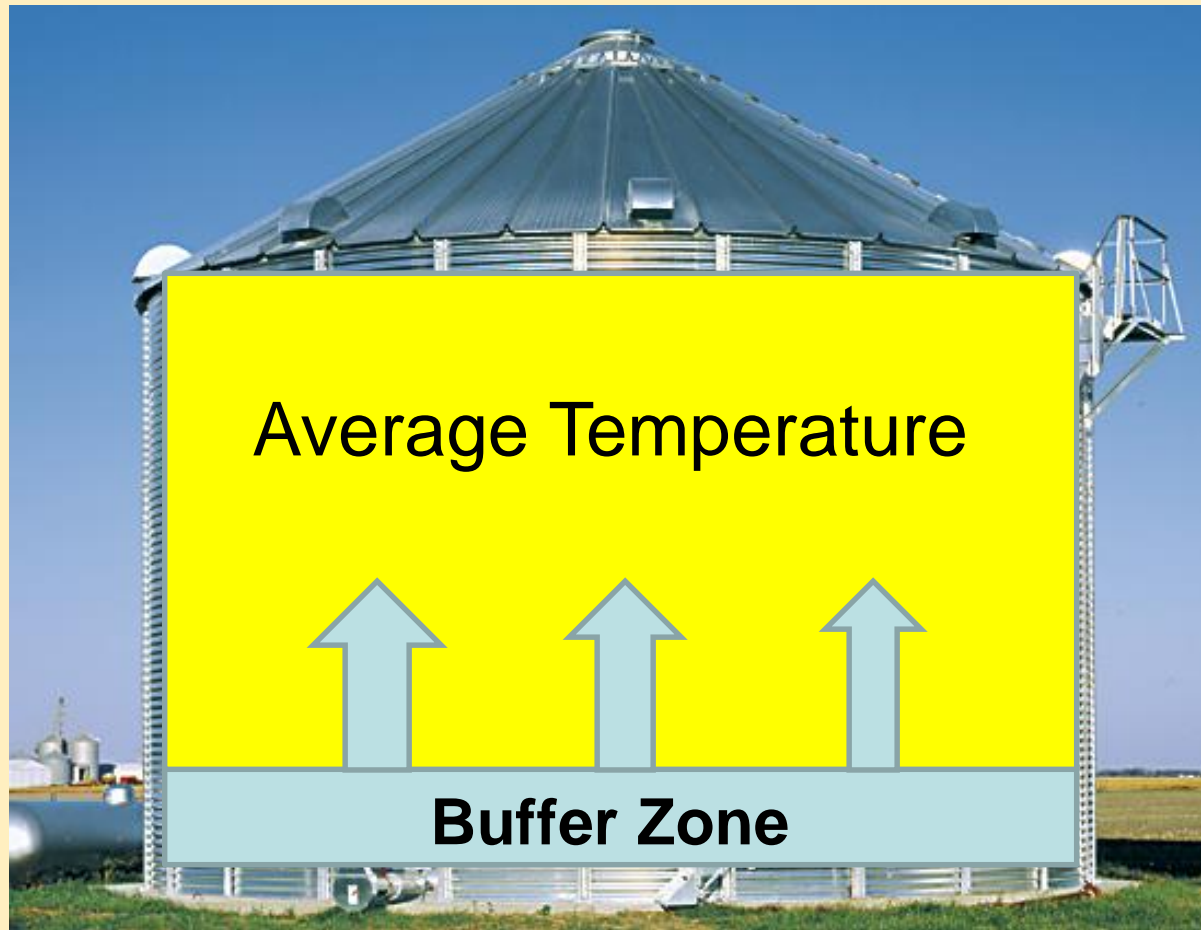


North Central Region States

Average Monthly Maximum and Minimum Temperature, °F

		ND	SD	NE	KS	MN	IA	MO	WI	IL	MI	IN	OH
Jan	Max	16	27	36	39	19	31	38	23	36	30	32	36
	Min	-3	7	14	19	-1	14	21	6	19	17	16	20
April	Max	52	59	63	67	55	62	66	55	66	58	62	63
	Min	29	34	38	43	34	41	44	33	43	37	38	41
July	Max	80	86	88	93	82	86	88	80	87	82	84	85
	Min	57	61	65	69	61	67	67	59	66	61	62	65
Oct	Max	55	60	65	70	58	63	67	55	68	60	64	65
	Min	32	35	40	46	36	43	45	37	45	41	41	44

Aeration Grain Temperature



Aeration Cycle Time

Cooling Time:

$$\frac{15}{cfm/bu} = hrs$$

$$15 / 0.2 cfm/bu = 75 hrs$$

Corn – 39,900 bushels

42 ft. diameter, 36 ft. depth

5.0 hp, 24-inch axial fan, 0.25 cfm/bu

Cooling time = 60 hrs.



Fan Selection Program

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University of Minnesota Fan Selection for Grain Bins

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Bin and Crop Inputs

Select a crop: Bin Diameter, feet:
Floor Type: Full Duct Grain Depth, feet:
Desired airflow (cfm/bu):

Estimated Fan Requirements [Show Table](#)

(to get desired airflow when bin is full)

Bin capacity (bushels):	5,542
Total airflow (cfm):	5,542
Estimated static pressure (inches of water):	7.12
Estimated fan power needed (hp):	10.34

Fan Selection [Show Fan Data](#)

Select a fan: [Add a New Fan](#)
Fan arrangement: Parallel Series Number of fans on bin:

Results

[Airflow vs Depth Table](#) [Airflow Graph](#) [System Graph](#)

Aeration Investment

42 ft diameter, 36 ft deep, 39,900 bu of Corn level full

At 0.25 cfm/bu Cooling time = 60 hrs./cycle

5.0 hp 24-inch Axial Fan, 5 hp fan uses \approx 5 kWh/hr

10 cycles x 60 hrs = 600 hrs total/yr

5 kWh/hr x 600 hrs = 3,000 kWh

3,000 x \$0.10 kwh = \$300.00

\$300 / 39,900 bu = \$0.008/bu

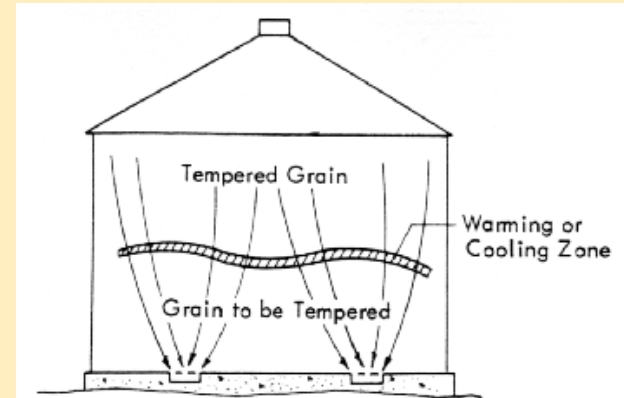
$\leq 1\text{¢}/\text{bu}$ – yr for insect and mold protection



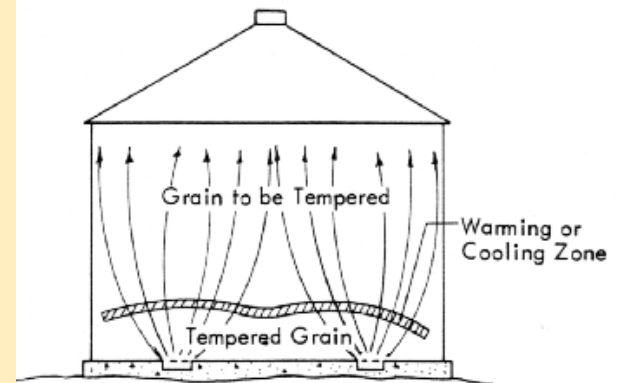
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Positive or Negative Airflow

- **Negative Airflow:**
 - Reduced condensation under steel roofs
 - Roof damage if vents freeze (use neg. pressure switch)
 - Last grain to cool is at bottom
- **Positive Airflow:**
 - Condensation under steel roofs
 - Cool in small steps
 - Heat of compression raises air temp. 3-5° F
 - Last grain to cool at top



Negative pressure—cooling or warming zone moves down through the grain.



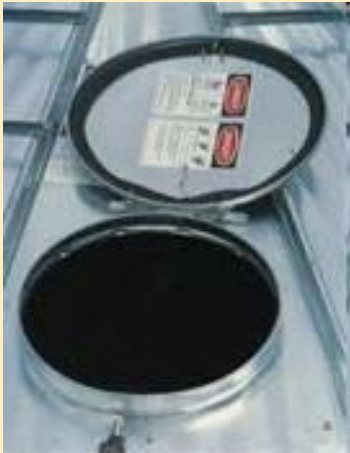
Positive pressure—cooling or warming zone moves up through the grain.

Fans Off During Snow/Rain/Fog



WARNING

Condensation may freeze over vents when outside air temperatures are near or below freezing

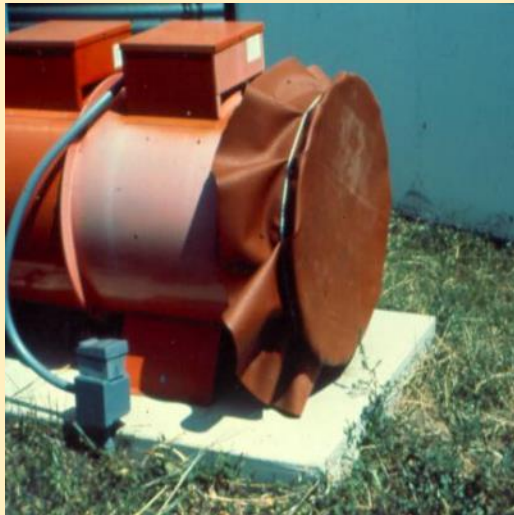


**Leave fill and
access open**



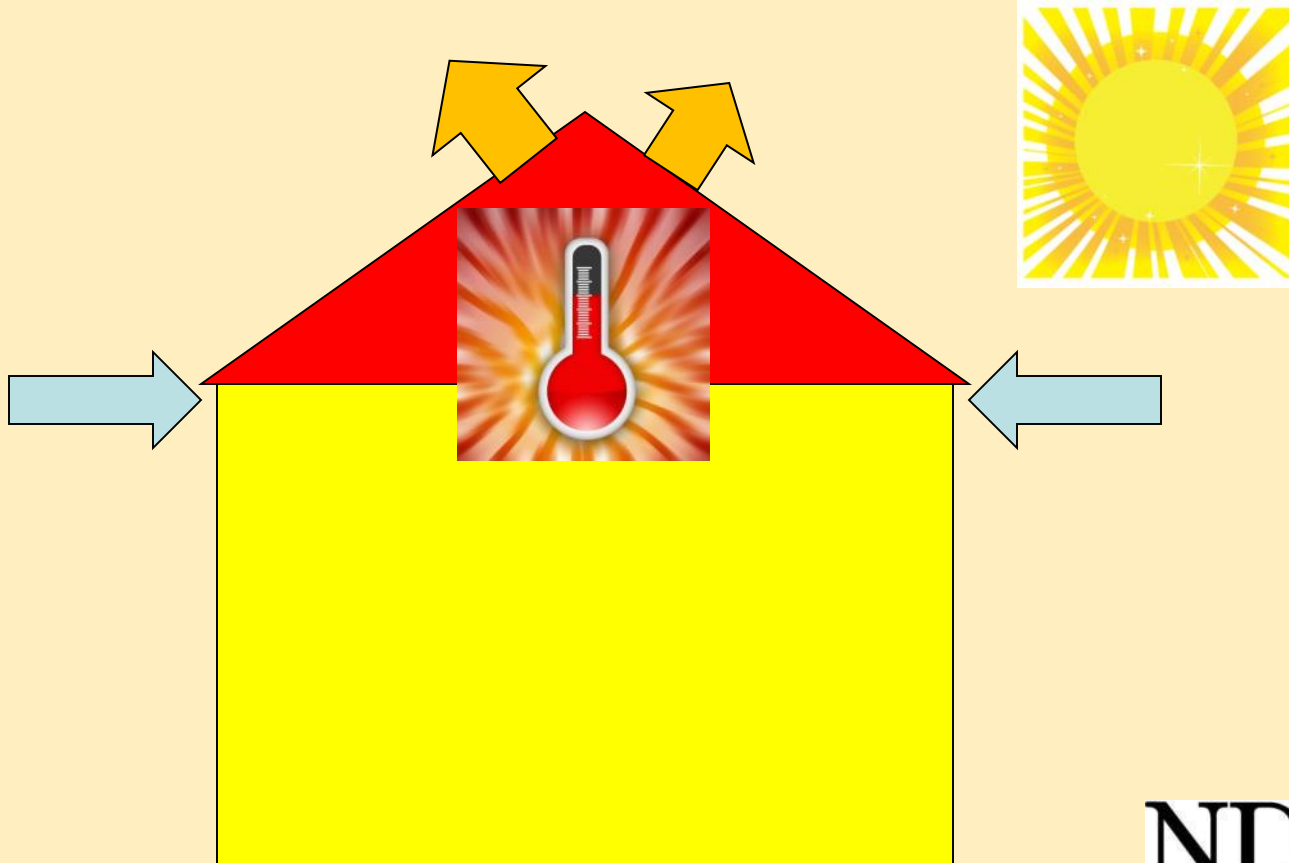
**Iced over vents
will damage bin**

Cover Fans When Not Operating



- Keep snow & pests out
- Keep damp air out
- Prevents spring warm-up
 - Wind aeration
 - Chimney effect

Ventilate Bin Headspace



Spring & Summer Cooling

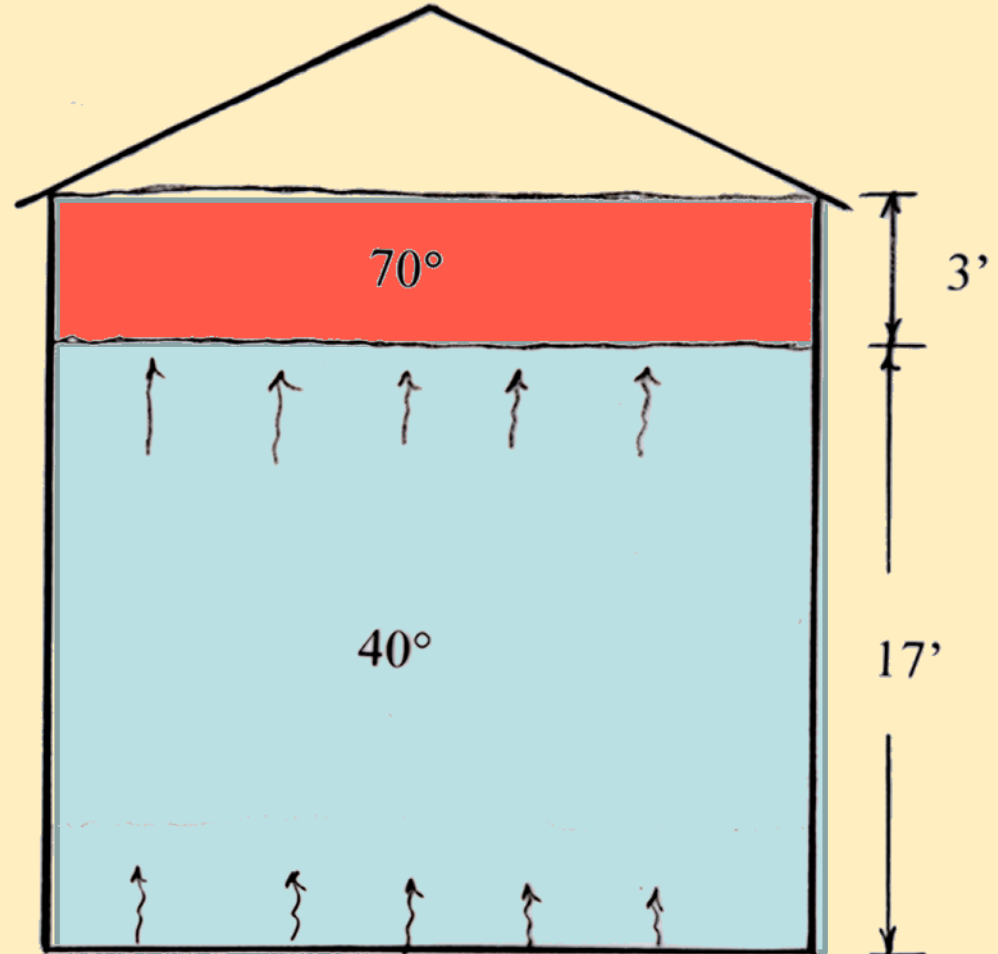
Cooling Time

$$15 / 0.2 \text{ cfm/bu} = 75 \text{ hrs}$$

$$3/20 = 0.15 \approx 11 \text{ hrs}$$

Coolest at sunrise

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Management



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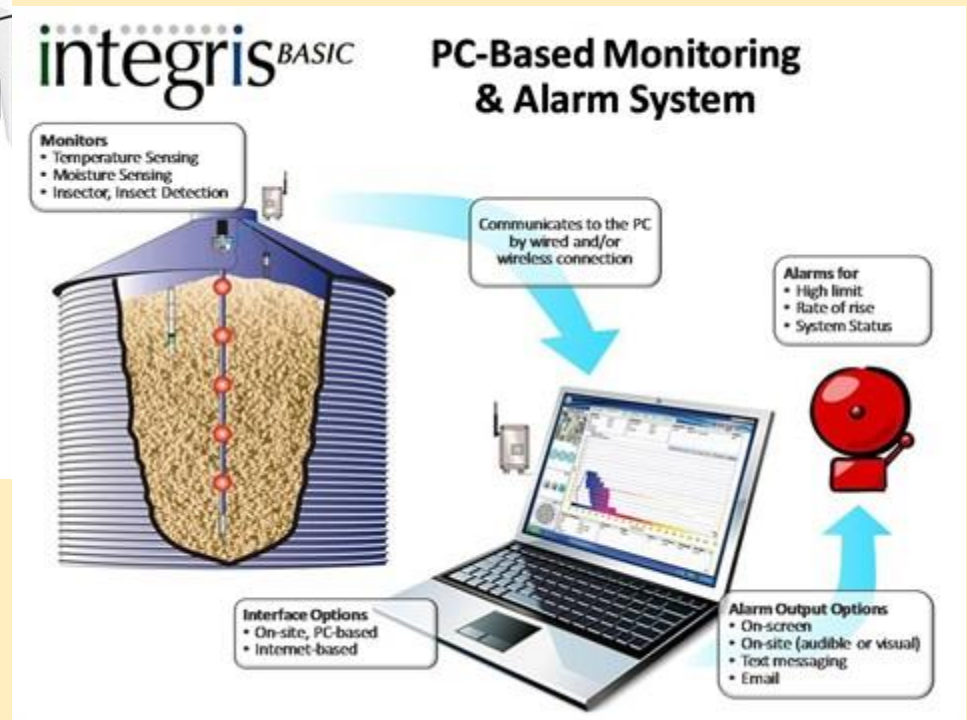
Monitor:

- Temperature
- Moisture
- Insects

How often should I check my grain?

- 2-weeks until cooled
- 2-4 weeks during winter
- 2-weeks spring & summer

Sensors & Fan Controllers

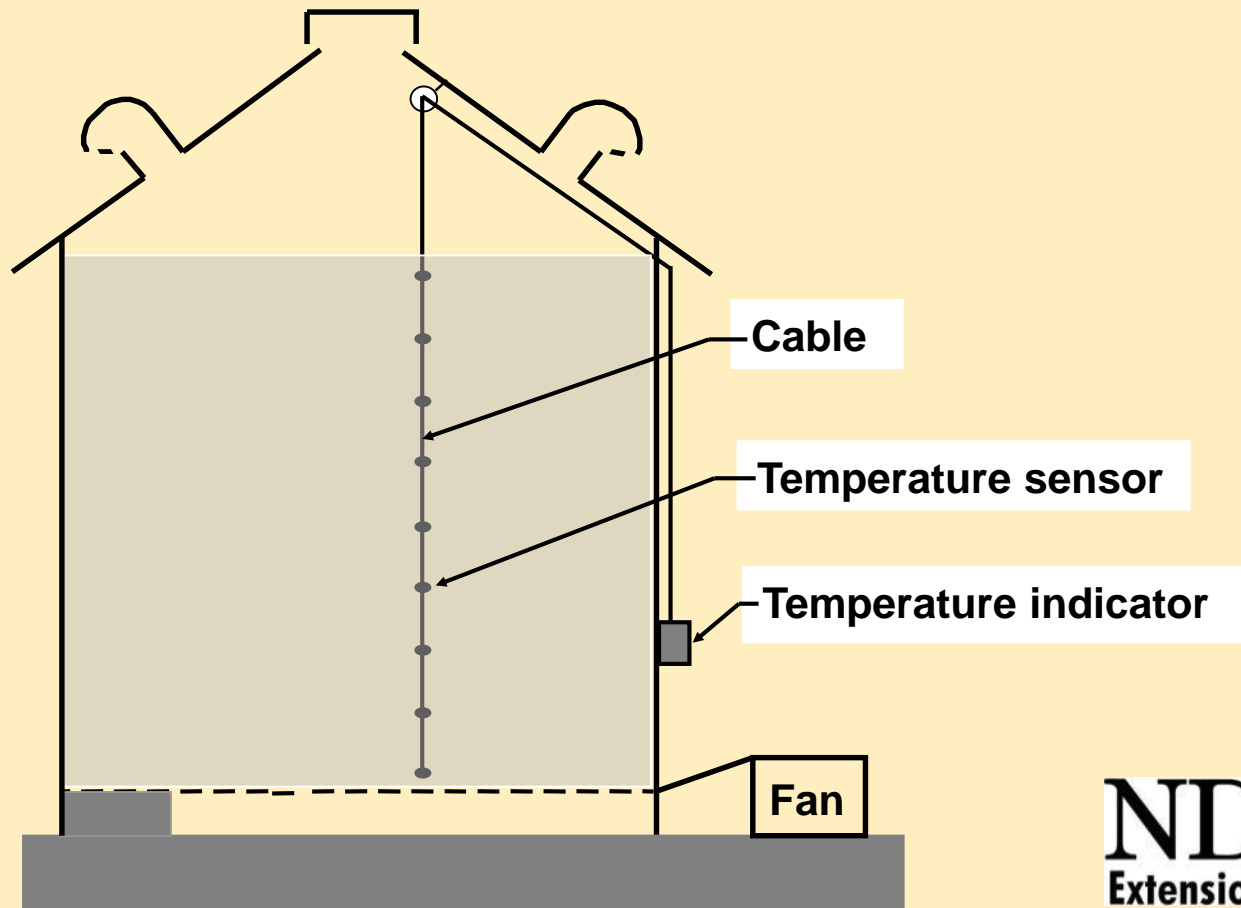


Partial list of vendors

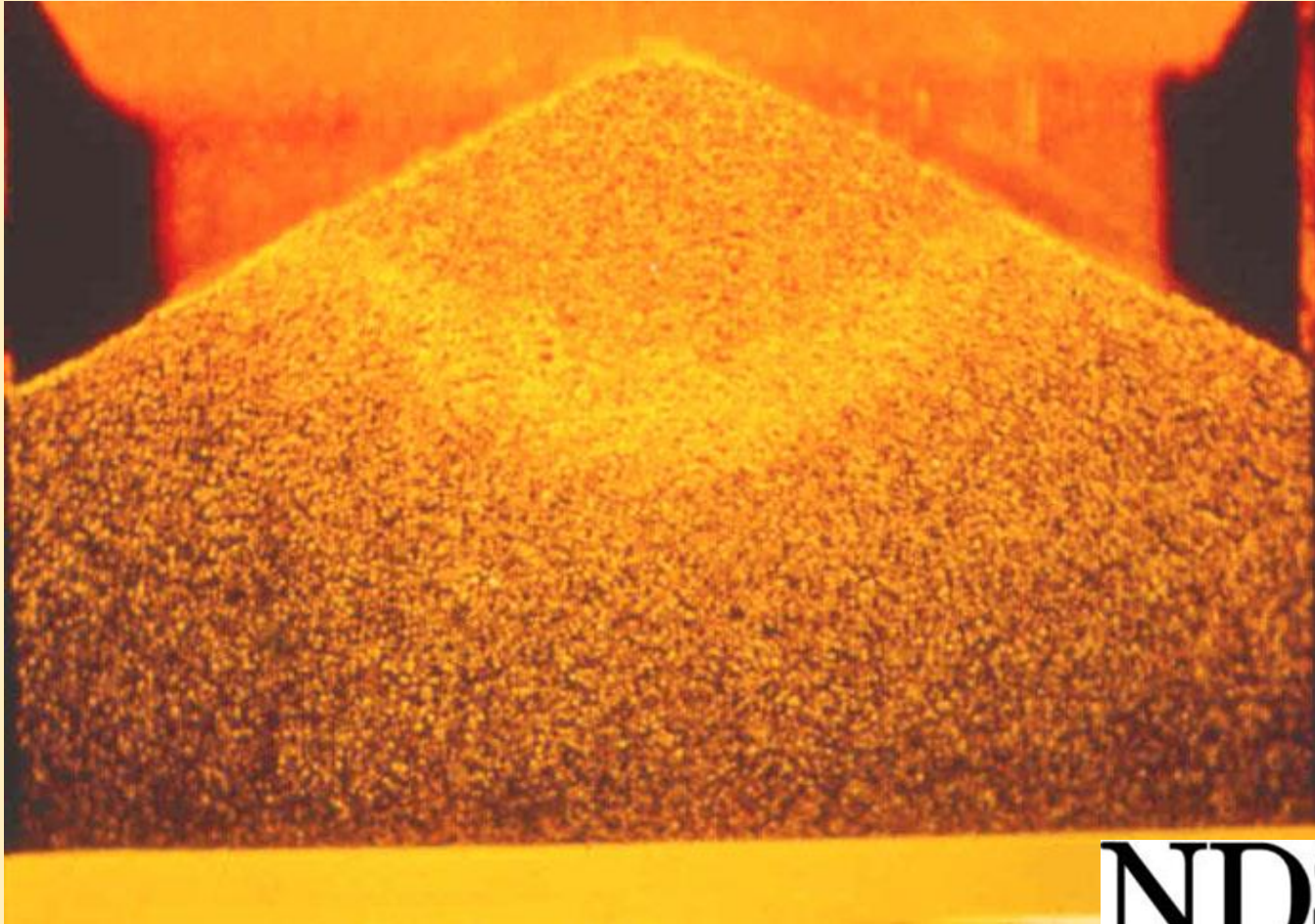
- ❖ OPI
- ❖ The Boone Group
- ❖ AgriDry
- ❖ GSI
- ❖ Caldwell/Chief-Agri

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Senses only grain near cable



Core and Level Bins



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For More Information



Internet Search: NDSU Grain Drying & Storage

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