

GEAPS

EXCHANGE 2016



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Wes Peterson

Improving Grain Dryer Efficiency

Methodology

Maintenance

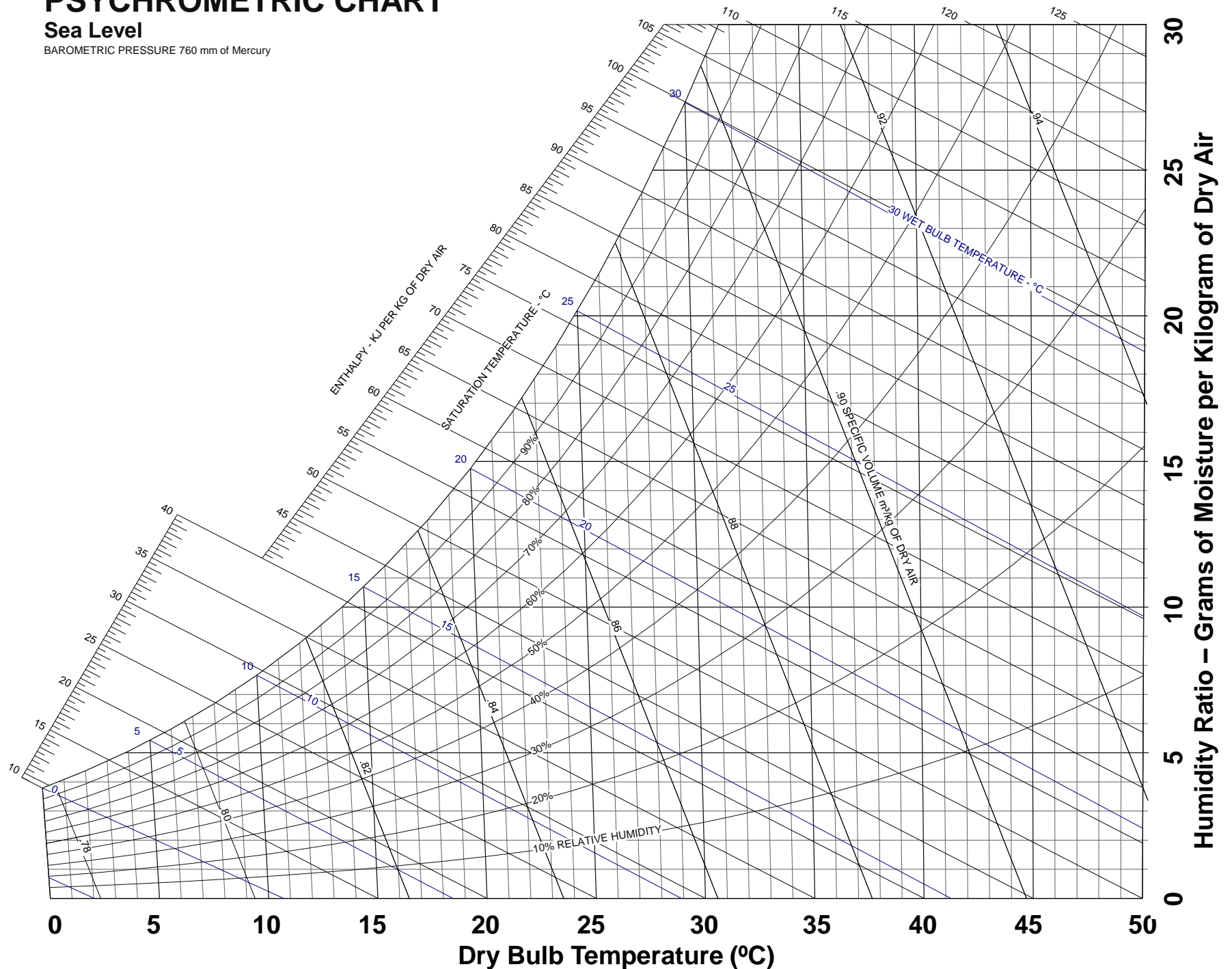
Operations

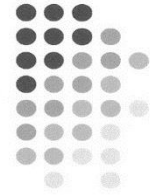
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PSYCHROMETRIC CHART

Sea Level

BAROMETRIC PRESSURE 760 mm of Mercury

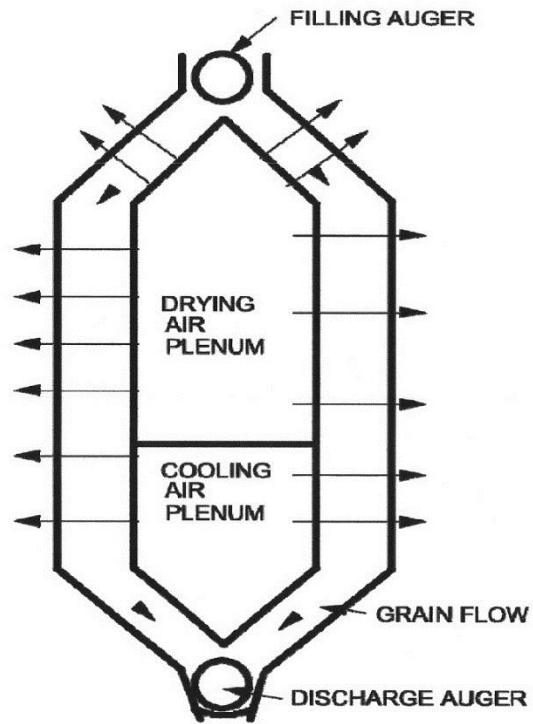




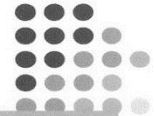
Types of Dryers

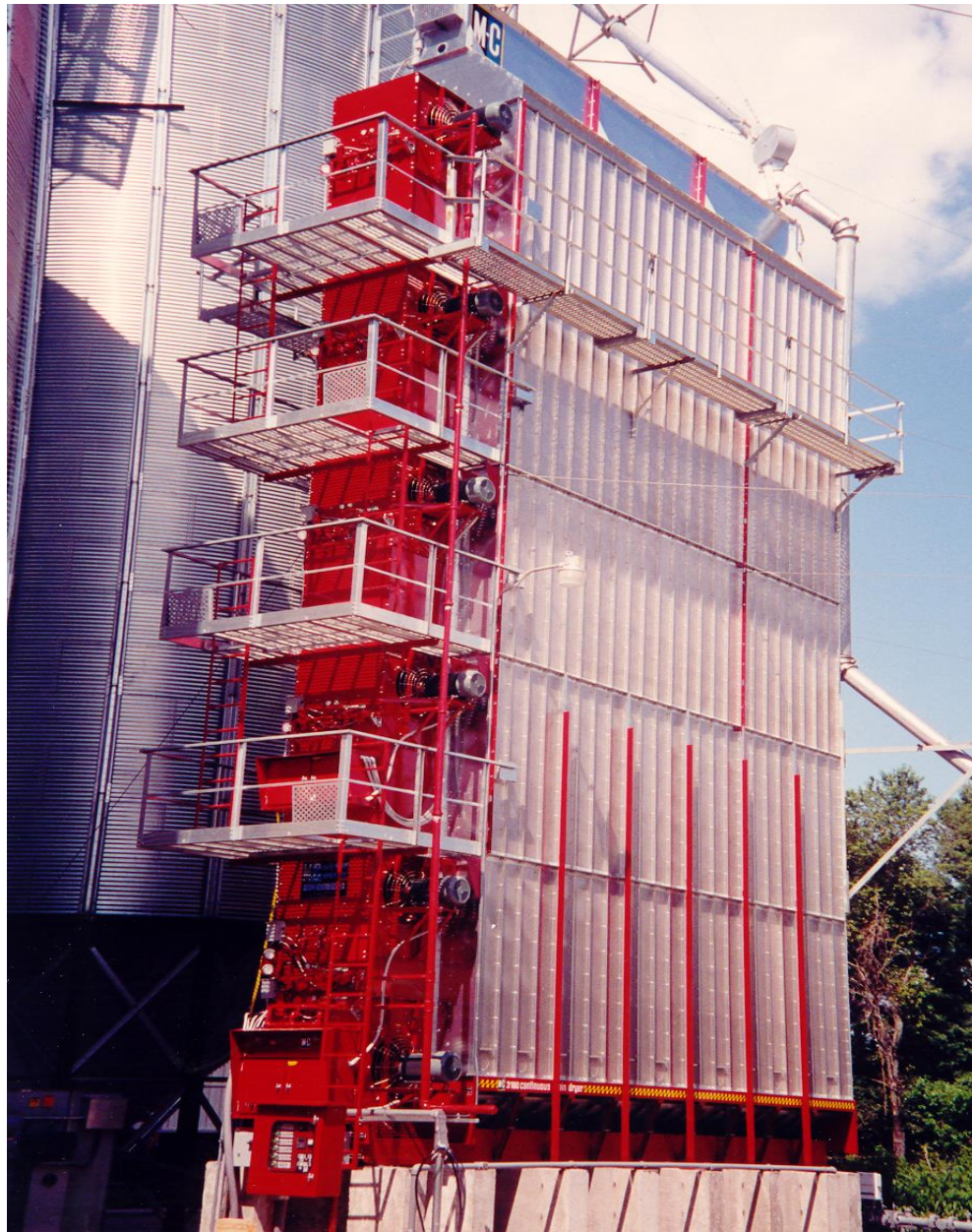
Names reflect air flow pattern

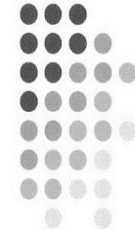
- Cross-Flow Column Dryer
 - (batch and continuous)
- Batch bin dryers (high temperature)
 - Bin Dryers
 - Roof Dryers
- Mixed-flow dryers (Counter and concurrent flow)
- In-Bin Continuous flow dryers (Counter-flow)
- Ambient Air / Low temperature bin dryer
(10°F increase in air temperature)
- Combination drying



Conventional Crossflow Column Dryer
In-Dryer Cooling

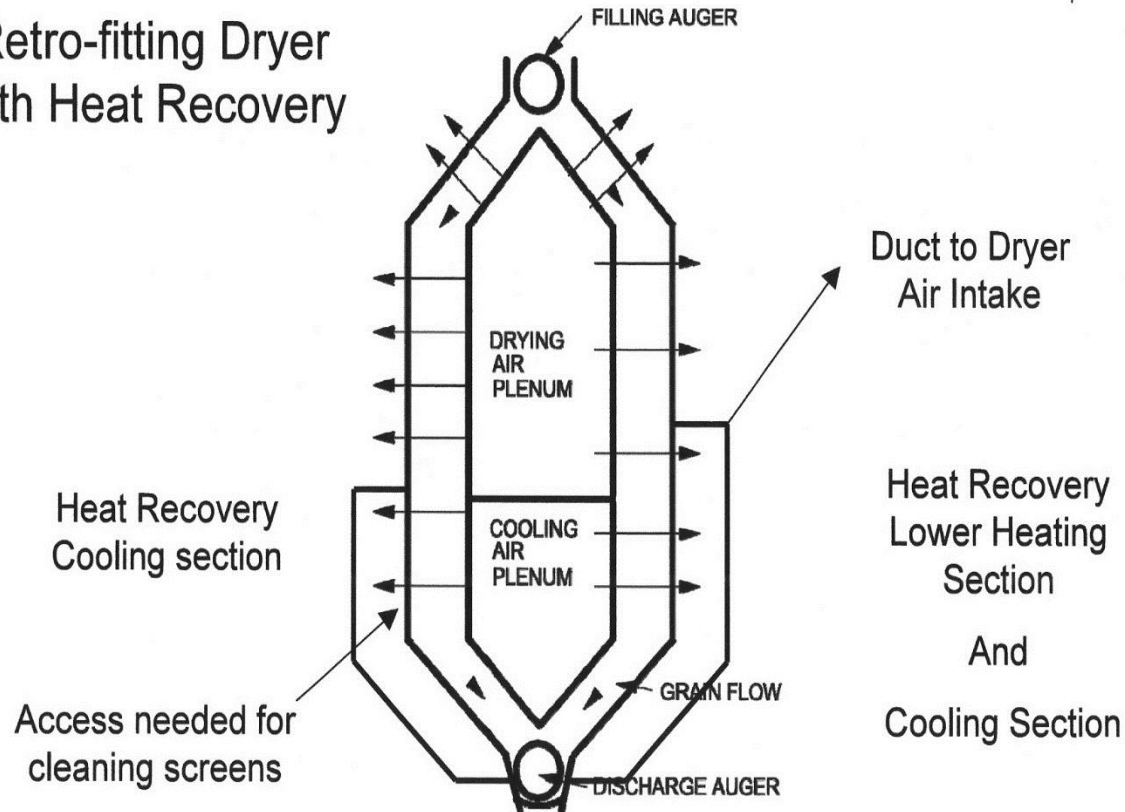




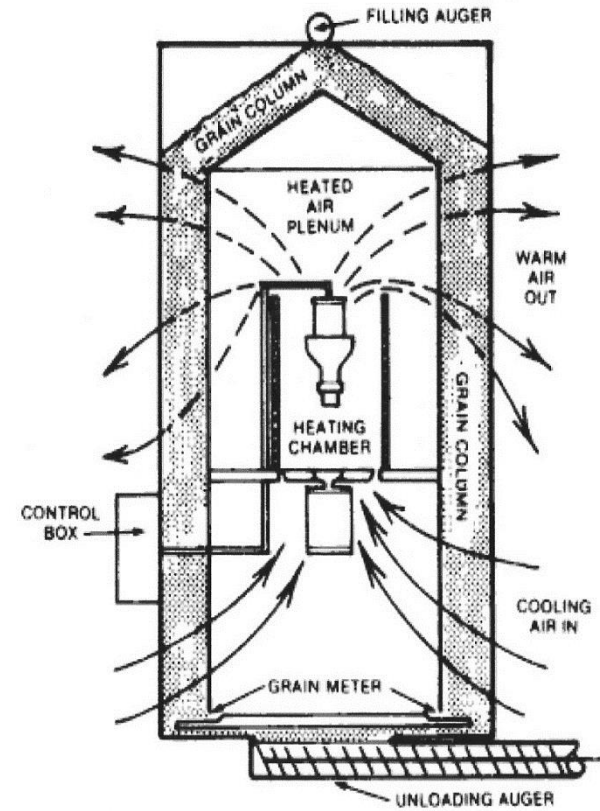
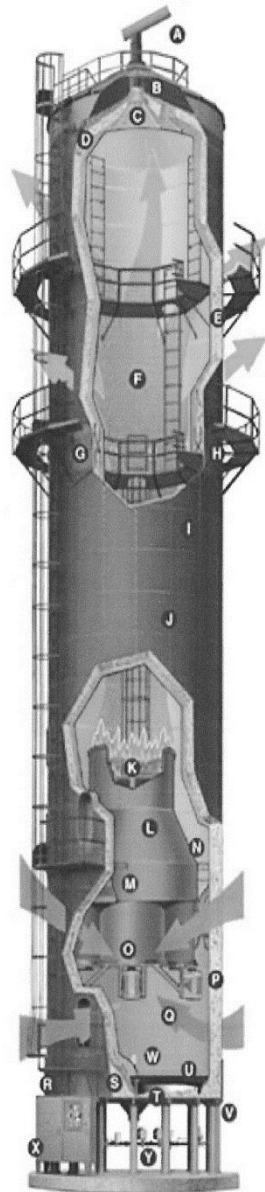
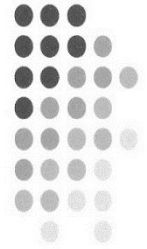


Duct Work for Heat Recovery

Retro-fitting Dryer
with Heat Recovery

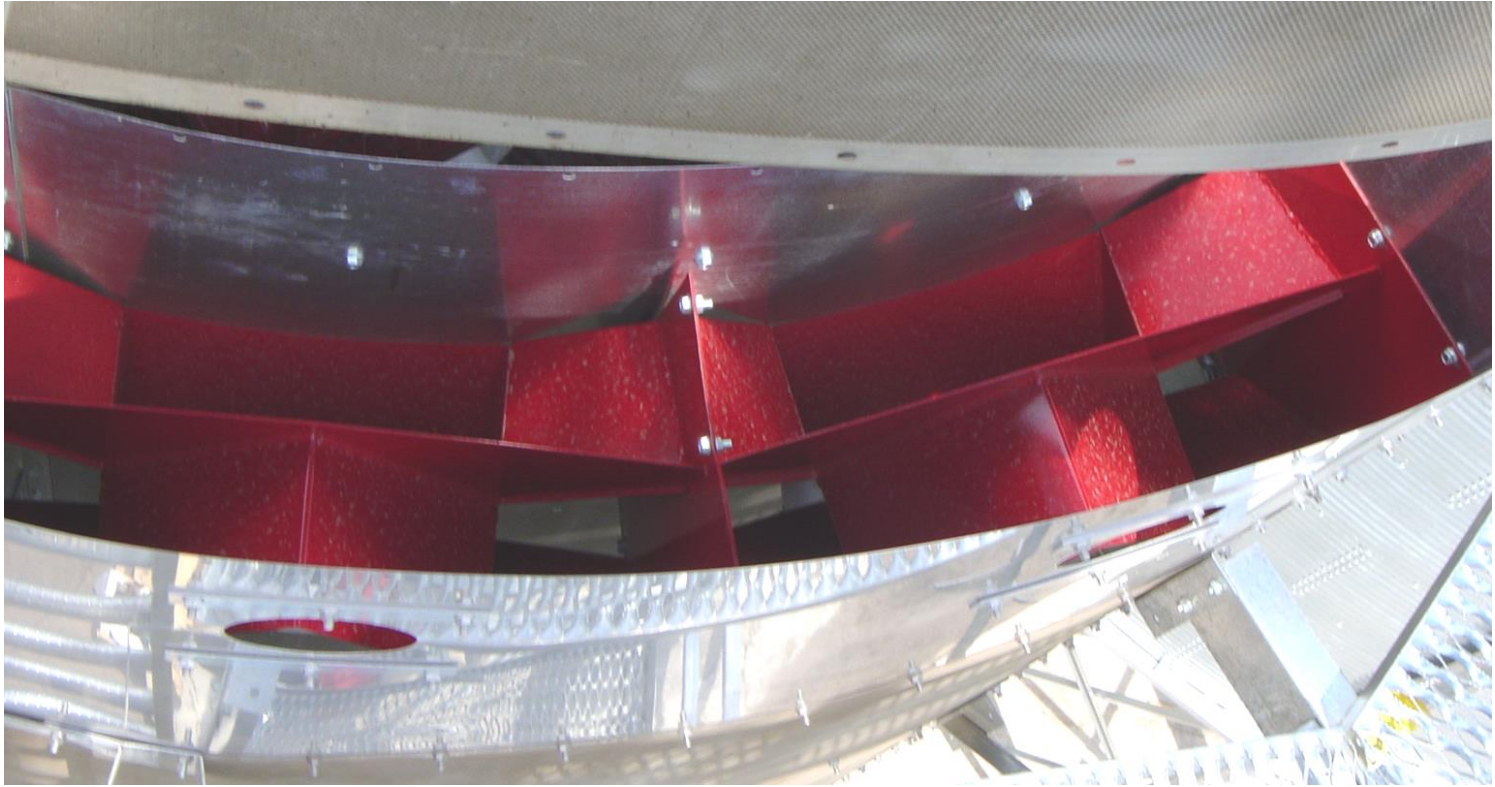


Reverse Flow Cooling

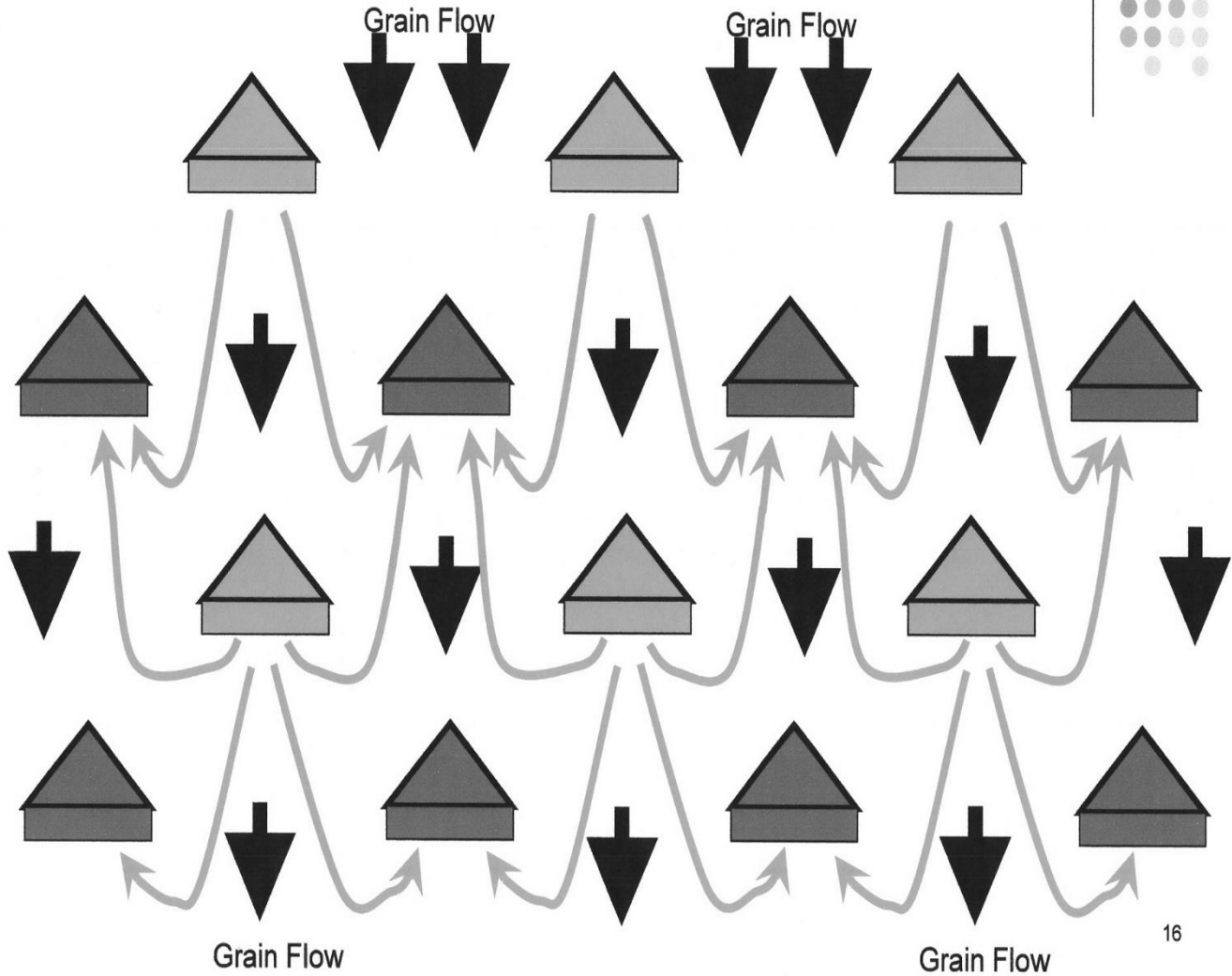
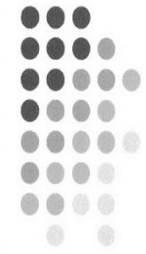


Courtesy of Zimmerman Dryers

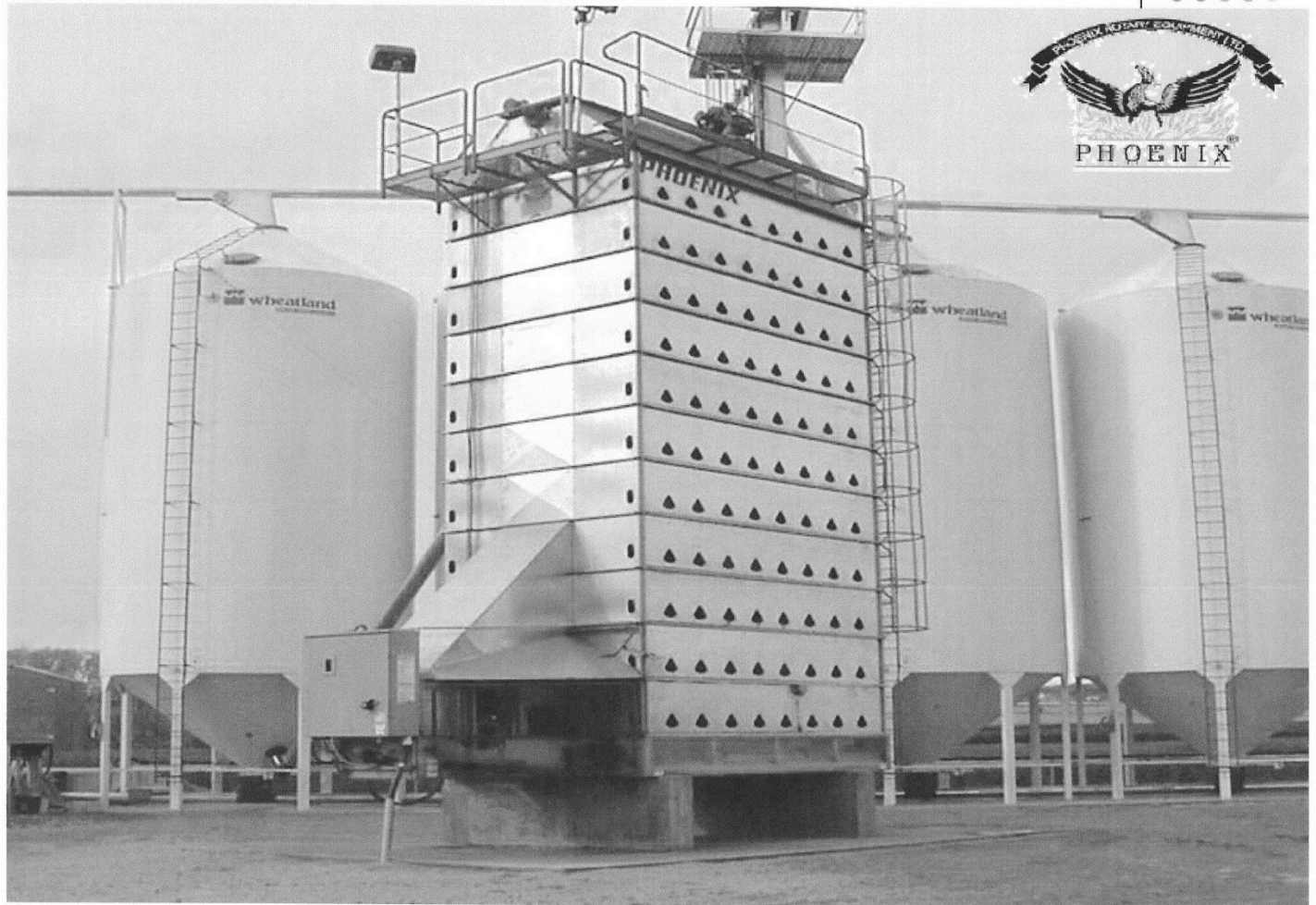
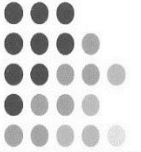


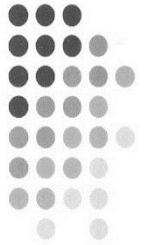


Mixed Flow Dryer - Air Flow Patterns



Mixed-Flow Dryer





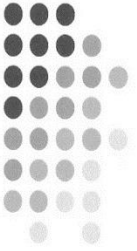
Dryeration

- Transfer hot grain (120 to 140°F) to cooling bin
- Moisture: 2-3% above storage moisture content
- Grain allowed to “Temper” for 4 to 12 hours
- Cool grain
 - Remainder of drying occurs as grain cools
 - Moisture reduction: ~0.4% per 10°F of temperature decrease
- Transfer grain to storage bin

- Energy savings: 15% - 25%
- Dryer capacity: increases up to 70%
- Improved grain quality
 - Fewer stress cracked kernels and breakage

	Cracks	Breakage
● Rapid cooling	43.6%	11.3%
● Dryeration	7.6%	6.7%





Dryer Energy Efficiency

- No dryer performance standards
- Limited independent dryer test data
- Limited research data

- Buyer beware!

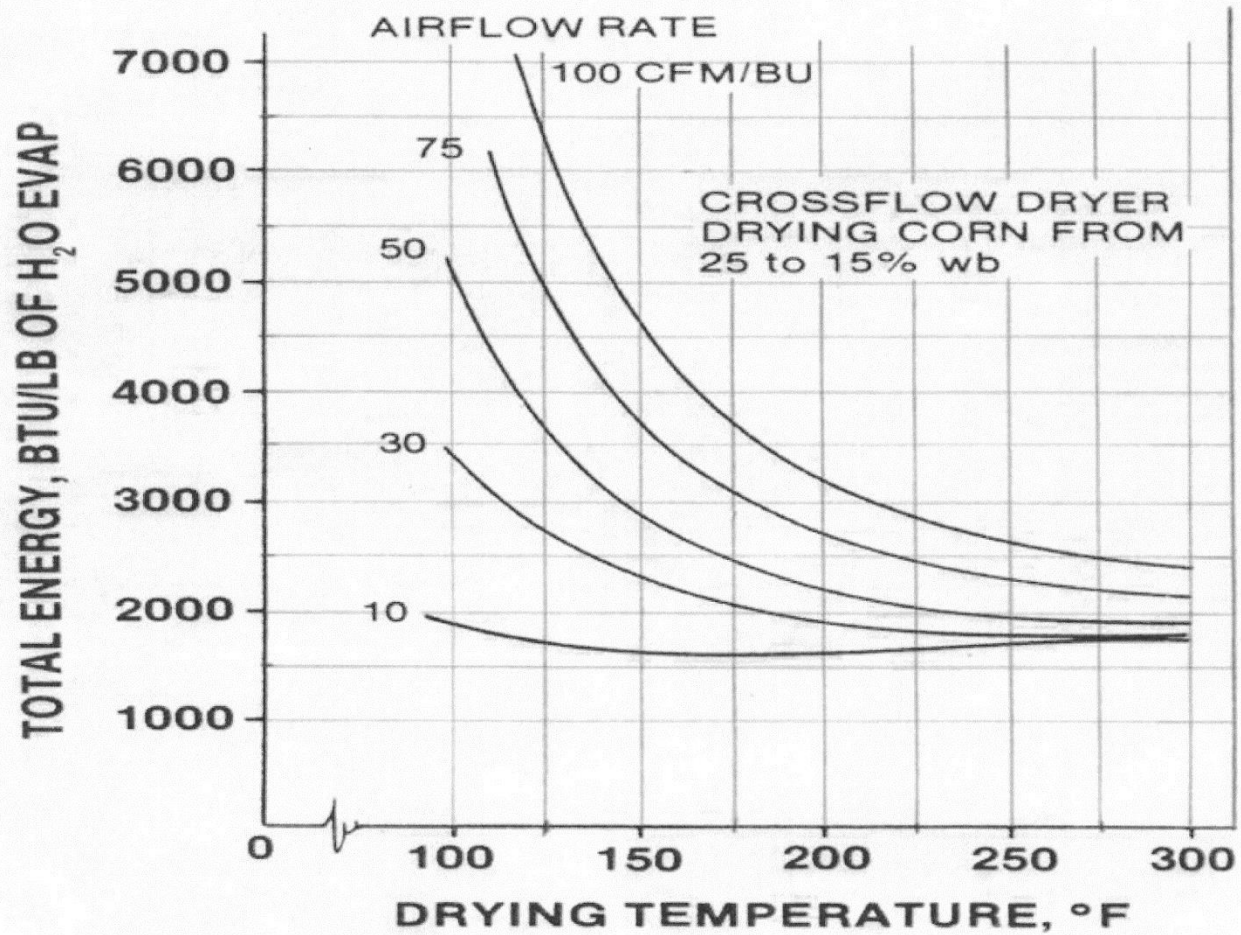
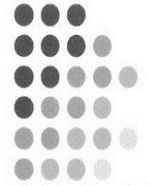
- Rule of thumb fuel usage
- - High Temp. dryer w/o heat recovery
 - 0.02 gallon propane/ bushel / % moisture removed
 - 0.018 Therms NG / bushel / % moisture removed
 - 0.01 kWh Electricity



- **BTU= CFM X Temperature Rise X1.1**



Cross-Flow Column Dryer

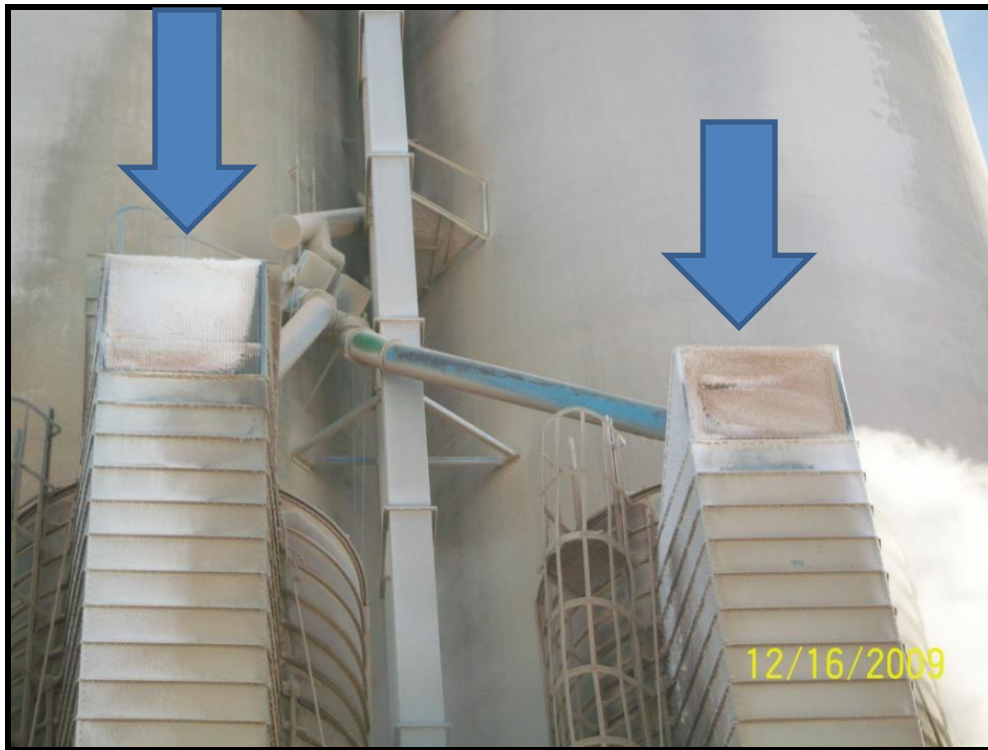


Maintenance Procedures



Reduced Air Flow

- ▶ Frosted/Plugged Air Inlet



- Plugged Exhaust Screen



Plugged Exhaust Screens



Plugged Exhaust Reduced Air Flow



Structural Failure Grain Column Now Wider

**Air Flow Has
Changed**



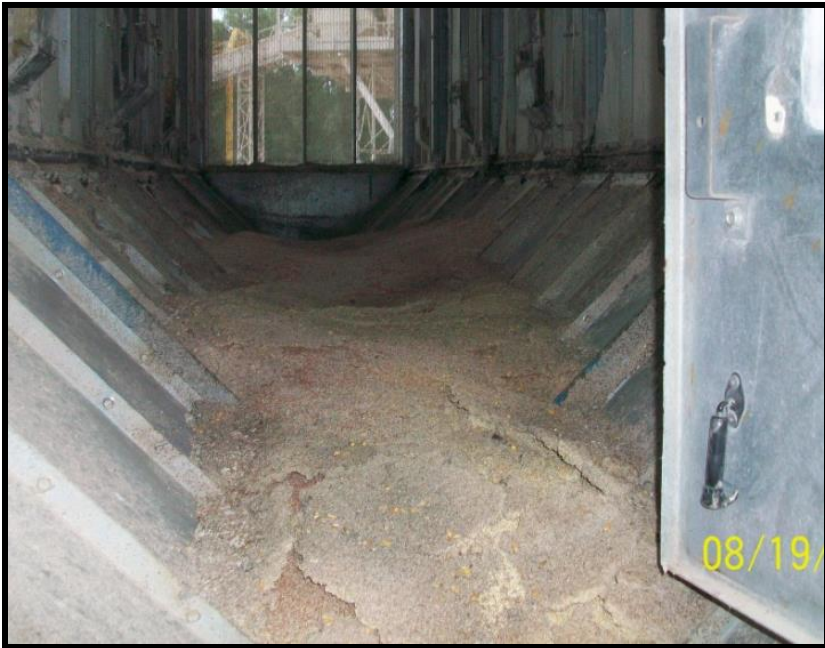
Gap At Fan Outlet Reduced Airflow To Grain



Fines Build-up

**Fines Can Add To
Combustion**

- Grain In Air Space



Wet Grain At Dryer Top Never Gets Dry



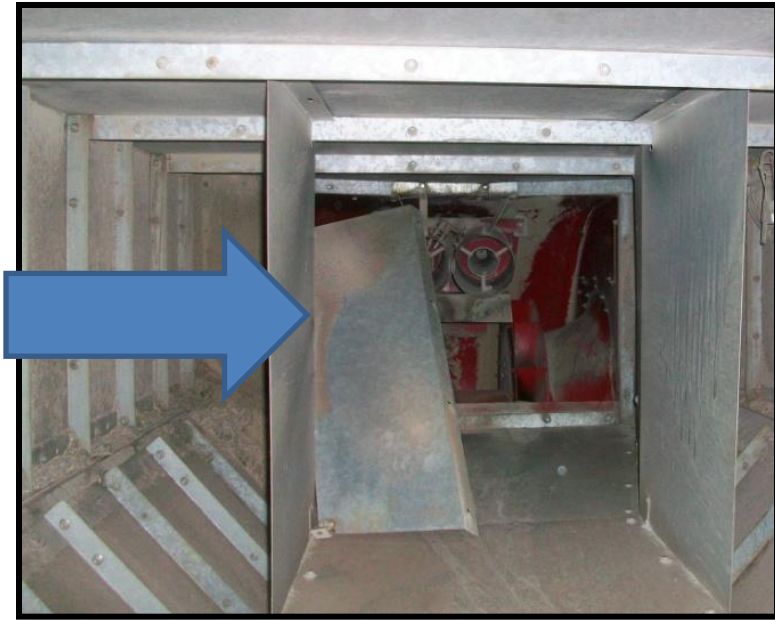
Plugged Grain Turner Reduced Grain Flow



Air Flow & Burner Problems

Loose Duct Sheet

- Moisture Covering Burner



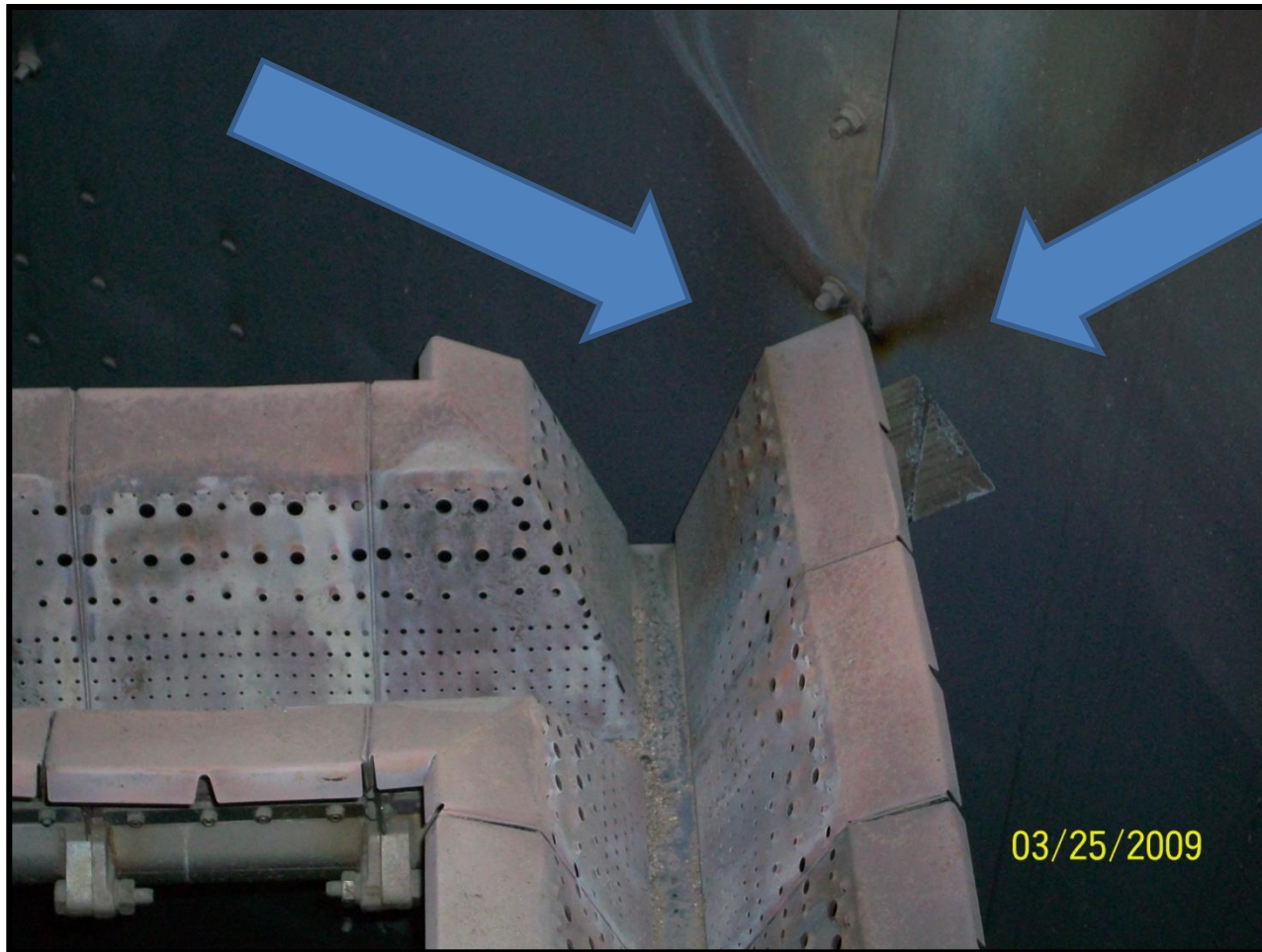
Burner Ports Plugged

- ▶ It Was Left Uncovered



Not All Burner Parts Are In Place

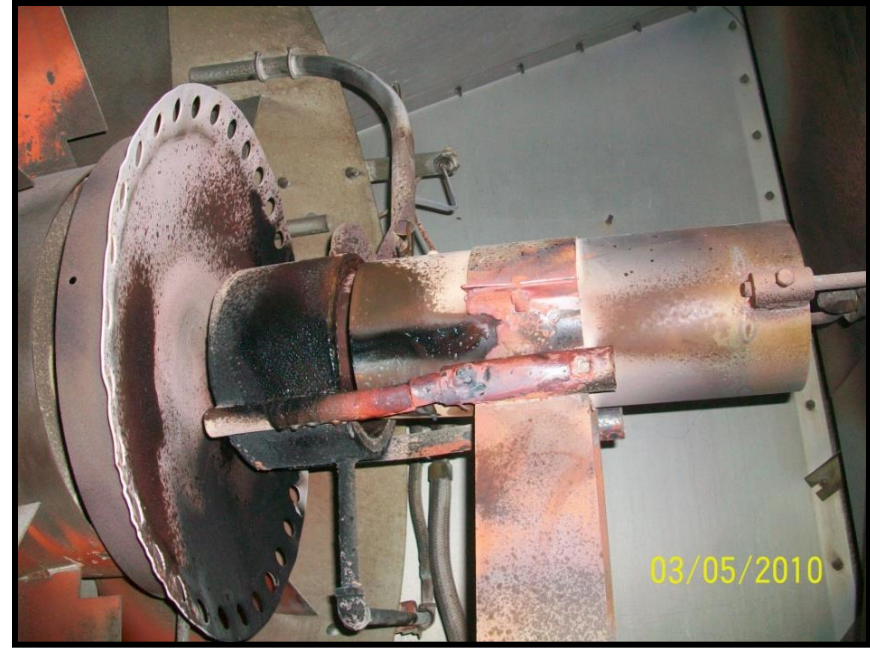
- ▶ Evidence Of Tall Flame On Side



Cracked Burner Causes Uneven Flame



Burners Needing Repair



Venturi Air Inlet

Cleaned



▶ **Plugged**



Burners With Debris

Vertical Fired



Up-Fired



Up-Fired Low Pressure Burners



Burner Not Covered

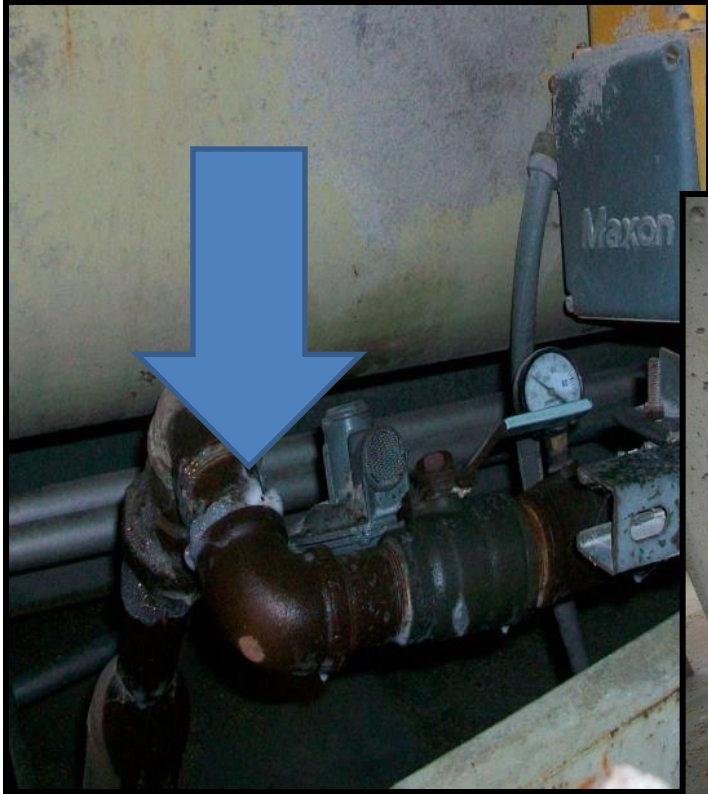
**Water by Expensive
Controls**



Water Running Out Of Fuel Manifold



If You Smell Gas, It Is Leaking!



NFPA 86

Standard For Ovens & Furnaces

8.7.2.3

Means for testing all fuel gas safety shutoff valves for valve seat leakage shall be installed.



- **While keeping mechanical and electrical equipment in safe and working order can be a learned behavior...some learn better than others**



Operators Manual

Routine operational guidelines include understanding the manual...

- **Sometimes just knowing where it is ...is a start**



Highlight or reproduce periodic maintenance schedules outlined in manuals

Most manuals will have them scheduled



Tech Training

Discipline yourself and/or staff to follow it correctly

Value of experienced operators “not a rookie thing”

PRODUCE YOUR OWN CHECKLIST CONSISTENT WITH YOUR FACILITY

- **Have this done by your experienced operators. Value the experienced operators**

High temp dryer is not for inexperienced operators

Provide advanced technical training...manufacturer or dealer support can help you with this



Maintenance is more than just housekeeping



MAINTENANCE OR SUBSISTANCE

Value of true maintenance versus fixing to get by

Inspections based on four values

- **Cleanliness – is the equipment or component clean?**
- **Functionality – is the equipment or component functional?**
- **Integrity – is the equipment or component in good working order?**
- **Safety – is the equipment or component safe?**
 - **Can equipment be safe but not clean?**
 - **Can equipment lack integrity but be functional?**
 - **Can equipment be functional, yet not safe?**
 - **Etc.**

An inspection with these values in mind will always identify a fault and determine the priority of the repair



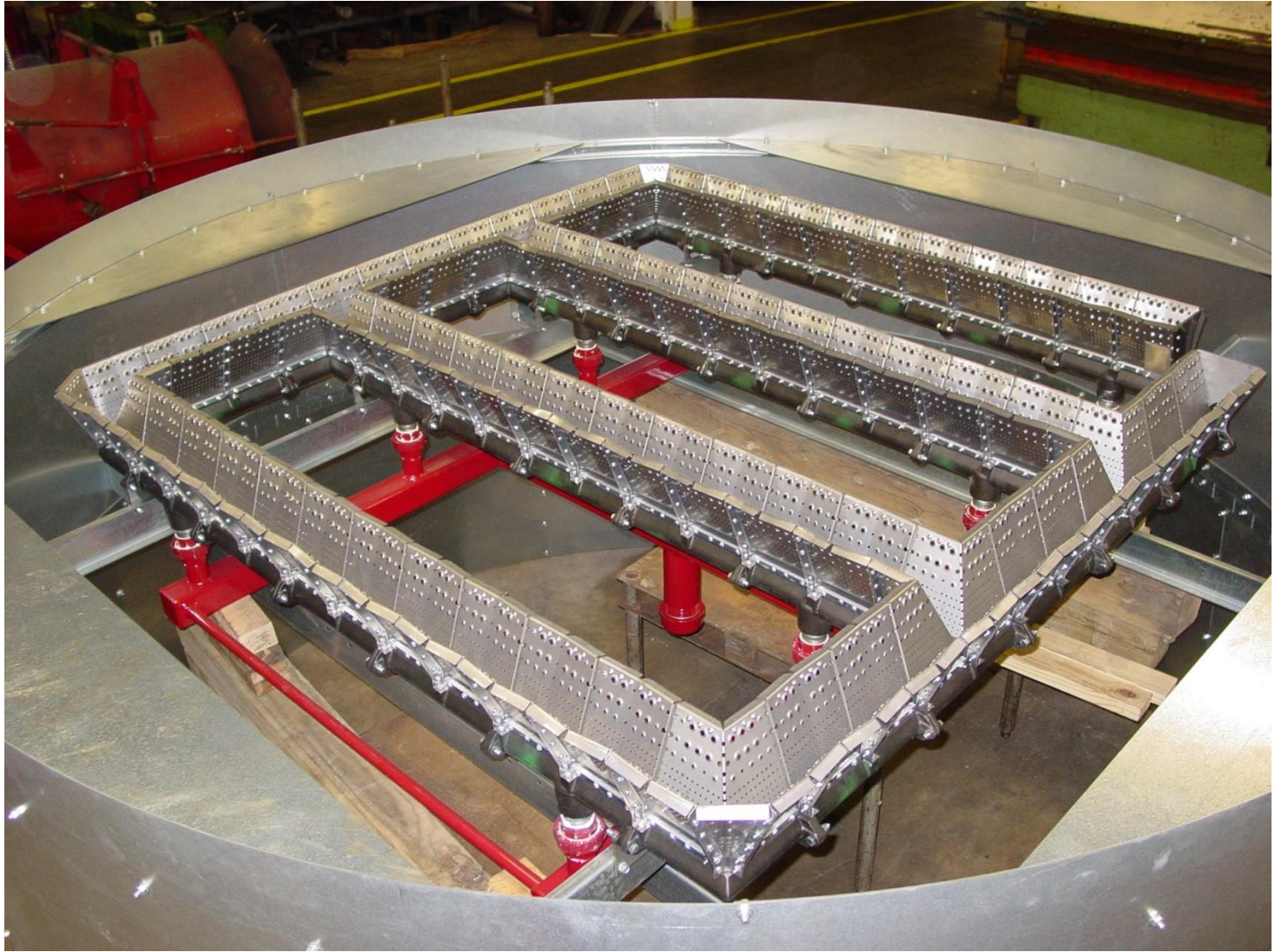
- **Make fuel train a completely separate inspection and report**

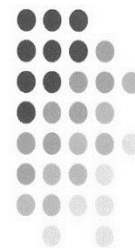






Maxon NP3 Low Pressure High Efficiency Burner





Moisture Sensors / Testers

- Inaccurate readings
 - Spoilage / Overdrying
- Replace battery before season
- Testers not accurate
 - Above 22%
 - underestimate hot grain (above 90F) by
at least 1 to 2 %.
- Checking Calibration:
 - Compare to certified unit (coop or feed mill)

Refer to Purdue U Fact Sheet #14





Cost of Overdrying

Bushels Dried	Percent Overdry	Wasted Gas \$2.00/Therm	Shrink Loss (bu)	Total Loss at \$5.00/bu
100,000	0.5%	\$910	\$585	\$3,834
	1%	\$1,820	\$1,163	\$7,634
	1.5%	\$2,730	\$1,734	\$11,401
	2%	\$3,640	\$2,299	\$15,135

BE SAFE!!!!!!

Thank you



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