Lets Get Started: An Intro to Boiler Installation and Regulations

Choose Biomass Week – Arctic Energy Alliance

Feb 1, 2024

David Dubois, Manager of Business Development

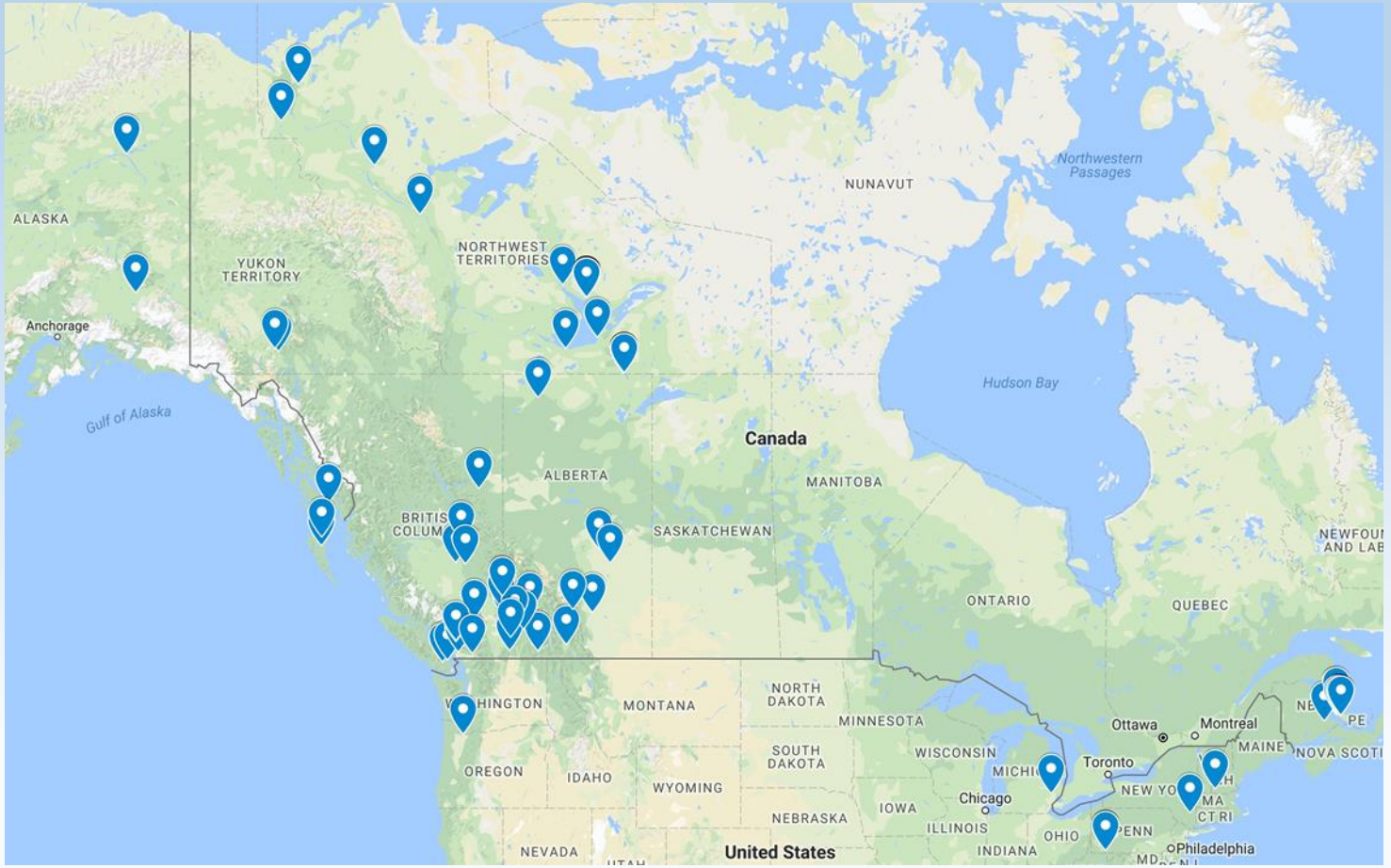
Fink Machine Inc

FINK MACHINE INC.

State of the Art Bio Energy Heating Systems
Revolutionary Wood Heating Technology
Highly Economical for Commercial, Industrial Buildings

Who is Fink Machine Inc.?

- Based in Enderby, BC – traditional territory Splatsin FN
- Canada's Largest Supplier of Commercial Scale Biomass Boiler Systems
- First install 2003
- Approx. 170 installations totaling over 58 MW



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About Fink Machine Inc.

- Distributor of Mawera boilers product since 2003
- Distributor of Schmid Boilers 2019
- We offer clients:
  - System design
  - Fabrication of equipment
  - Installation, commissioning services
  - Online and remote system monitoring
  - Training & On-site servicing
- Own/Operate ½ MW Private Utility District Energy System



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Types of Installations

- Existing building – close to fuel storage
  - Depends on space and location
- New building
  - Depends on site
- Pre-fab or Containerized
  - Plug and Play
  - Minimize onsite
  - Remote or Rural

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Installation Code CSA B365-17 (R2022)

- Applies to installation, alteration and maintenance of solid burning appliances
- Includes furnaces, boilers, stoves, ranges, space heaters, factory-built fireplaces and water heaters
- Solid fuels include cordwood, chips, sawdust, peat logs, pellets, kernel corn and coal
- Does not apply to incinerators, site-built fireplaces, process equipment, portable appliances
- Applies in the absence of local specific code
- Certified local designers and installers can provide specifics



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Solid-fuel Fires Central Heating Appliances B366.1-11 (R2020)

- Applies to manually or automatically fueled solid-fuel-fired central heating appliances that have provision for venting directly to the outdoors by means of flue pipes, chimneys, etc.
- Applies to factory- or field-assembled appliances that have been or could have been completely assembled at the manufacturer's plant and transported in the assembled condition
- Does not cover fireplaces, incinerators, space heaters, or stoves.
- Applies in the absence of local specific code

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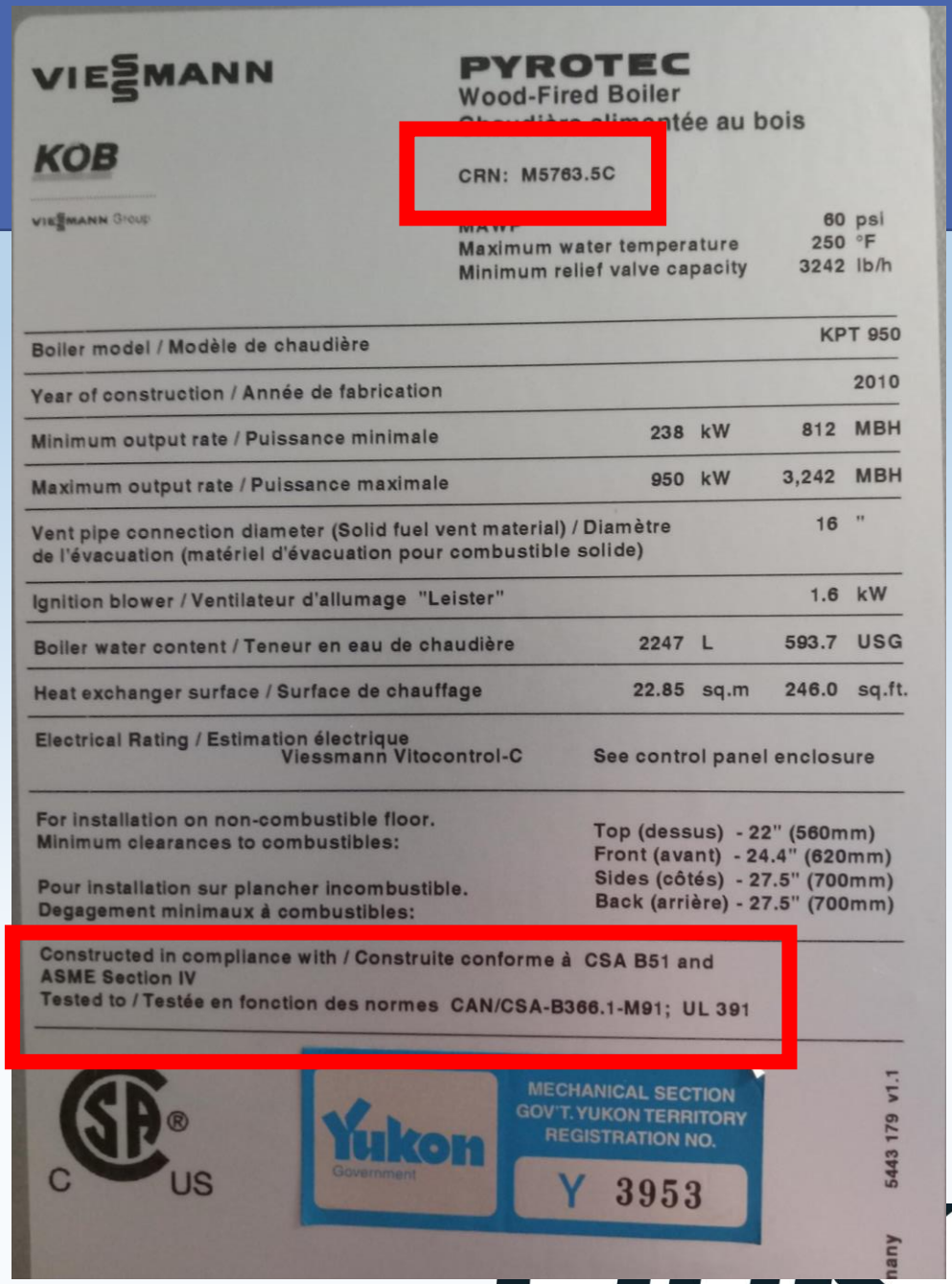
Pressure Vessel Regulation

- Typical North American Standard is American Society of Mechanical Engineers (ASME)
  - Boiler and Pressure Vessel Code (BPVC) Section IV – Rules for Construction of Heating Boilers
- Provinces/territories are responsible for Boiler code and application.
  - Most codes reference ASME standard for pressure vessels
  - Head Boiler inspector can interpret code and allow exemptions
- Canadian Registration Number (CRN) identifies that the design has been accepted and registered for use in the province or territory
- Mainly applies to commercial and not residential



Performance Testing of solid-biofuel burning Heating Appliances - CSA B415.1-22

- New in 2022
- Sets testing methods and limits for particulate matter in solid fuel appliances
- Applicable up to 150 kW
- Aligns with EPA standard
- Used by Jurisdictions to address air quality
- Recognizes CEN EN303-5

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CEN EN 303-5 Certification

- Similar role as CSAB366/ASME/CRN but Europe Standard
- Also includes emissions similar to CSA B415
  - Different testing protocol
- Different steel and fabrication requirements
- Cannot be used in pressurized systems in Canada – except PEI
  - Different jurisdictions define pressurised systems differently
  - Open vs Closed

Electric Certification

- Pre-certified using CSA standard
- Possible for site certification depending on local authority
- Prefabricated plants certified by CSA or Intertek, etc.

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Wood Fuel Standards

- CAN/ISO-ISO 17225 solid biofuels standards adapted by CSA

http://www.nrcan.gc.ca/energy/renewable-electricity/bioenergy-systems/biofuels/7399

Natural Resources Canada | Ressources naturelles Canada

Solid Biofuels Bulletin No. 3

CAN/CSA-ISO
SOLID BIOFUELS STANDARDS

This is the third in a series of bulletins, introducing the CAN/CSA-ISO series of standards on solid biofuels and summarizes details related to fuel classifications, specifications and test methods.

CAN/CSA-ISO Solid Biofuels Standards at a Glance

The CAN/CSA-ISO Solid Biofuels Standards are voluntary standards developed for residential, commercial and industrial energy applications. Intended stakeholders include:

- Solid biomass fuel producers
- End users and consumers
- Equipment manufacturers
- Testing laboratories
- Regulators.

There are numerous benefits to adhering to these standards. Market adoption of the standards will:

- Facilitate domestic and international trade
- Enhance uptake of new technologies
- Promote public safety and contribute to a more sustainable industry
- Minimize emissions of pollutants
- Facilitate quality assessment of solid biomass resources.

The series of CAN/CSA-ISO Solid Biofuels Standards published in 2015 were developed to standardize the following: terminology; specifications and classes; and test methods for raw and processed biofuel materials originating from forestry, arboriculture, agriculture, horticulture and aquaculture.

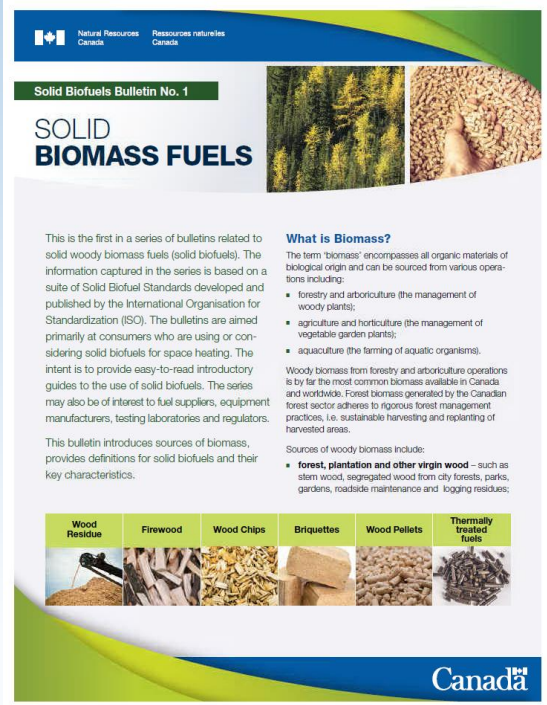
Natural Resources Canada's Solid Biofuels Bulletins uses the term "biomass fuels" interchangeably with "biofuels". The CAN/CSA-ISO Standards use the term "biofuels" which is retained in these bulletins when referencing specific standards' titles.

Development of Solid Biofuels Standards

The International Organisation for Standardization (ISO) established a Technical Committee[2] (TC238) responsible for developing solid biofuels standards at the international level.

- ISO/TC238 is comprised of 24 voting countries and 14 observing countries. Canada is a voting member.
- ISO/TC238 plans to publish 55-60 standards on solid biofuels.

Canada



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Solid Biofuels Bulletin No. 1

SOLID
BIOMASS FUELS

This is the first in a series of bulletins related to solid woody biomass fuels (solid biofuels). The information captured in the series is based on a suite of Solid Biofuel Standards developed and published by the International Organisation for Standardization (ISO). The bulletins are aimed primarily at consumers who are using or considering solid biofuels for space heating. The intent is to provide easy-to-read introductory guides to the use of solid biofuels. The series may also be of interest to fuel suppliers, equipment manufacturers, testing laboratories and regulators.

This bulletin introduces sources of biomass, provides definitions for solid biofuels and their key characteristics.

What is Biomass?

The term 'biomass' encompasses all organic materials of biological origin and can be sourced from various operations including:

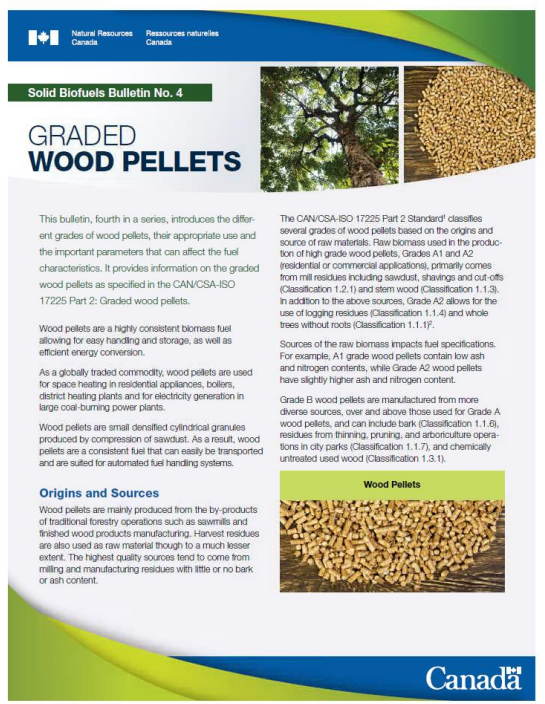
- forestry and arboriculture (the management of woody plants);
- agriculture and horticulture (the management of vegetable garden plants);
- aquaculture (the farming of aquatic organisms).

Woody biomass from forestry and arboriculture operations is by far the most common biomass available in Canada and worldwide. Forest biomass generated by the Canadian forest sector adheres to rigorous forest management practices, i.e. sustainable harvesting and replanting of harvested areas.

Sources of woody biomass include:

- **forest, plantation and other virgin wood** – such as stem wood, segregated wood from city forests, parks, gardens, roadside maintenance and logging residues;

Canada



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Solid Biofuels Bulletin No. 4

GRADED
WOOD PELLETS

This bulletin, fourth in a series, introduces the different grades of wood pellets, their appropriate use and the important parameters that can affect the fuel characteristics. It provides information on the graded wood pellets as specified in the CAN/CSA-ISO 17225 Part 2: Graded wood pellets.

Wood pellets are a highly consistent biomass fuel allowing for easy handling and storage, as well as efficient energy conversion.

As a globally traded commodity, wood pellets are used for space heating in residential appliances, boilers, district heating plants and for electricity generation in large coal-burning power plants.

Wood pellets are small densified cylindrical granules produced by compression of sawdust. As a result, wood pellets are a consistent fuel that can easily be transported and are suited for automated fuel handling systems.

Origins and Sources

Wood pellets are mainly produced from the by-products of traditional forestry operations such as sawmills and finished wood products manufacturing. Harvest residues are also used as raw material though to a much lesser extent. The highest quality sources tend to come from milling and manufacturing residues with little or no bark or ash content.

The CAN/CSA-ISO 17225 Part 2 Standard[1] classifies several grades of wood pellets based on the origins and source of raw materials. Raw biomass used in the production of high grade wood pellets, Grades A1 and A2 (residential or commercial applications), primarily comes from mill residues including sawdust, shavings and cut-offs (Classification 1.2.1) and stem wood (Classification 1.1.3). In addition to the above sources, Grade A2 allows for the use of logging residues (Classification 1.1.4) and whole trees without roots (Classification 1.1.1)[2].

Sources of the raw biomass impacts fuel specifications. For example, A1 grade wood pellets contain low ash and nitrogen contents, while Grade A2 wood pellets have slightly higher ash and nitrogen content.

Grade B wood pellets are manufactured from more diverse sources, over and above those used for Grade A wood pellets, and can include bark (Classification 1.1.6), residues from thinning, pruning, and arboriculture operations in city parks (Classification 1.1.7), and chemically untreated used wood (Classification 1.3.1).

Canada

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Questions?

David Dubois – david@finkmachine.com

Keeping the System Going: Biomass Maintenance

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Core Safety Considerations

What are the core safety considerations when operating a biomass boiler?

- Carbon Monoxide
- Oxygen Shortage
- Steam Explosion Hazard
- Fire

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Wood Fuel Combustion

- **Wood Fuel Combustion = A 3-Step Process**
  - Drying
  - Devolatization (Gasification)
  - Combustion

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Wood Fuel Combustion

- **The 3 T's**
  - Time
  - Turbulence
  - Temperature

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PYROT® - Combustion Air Flow

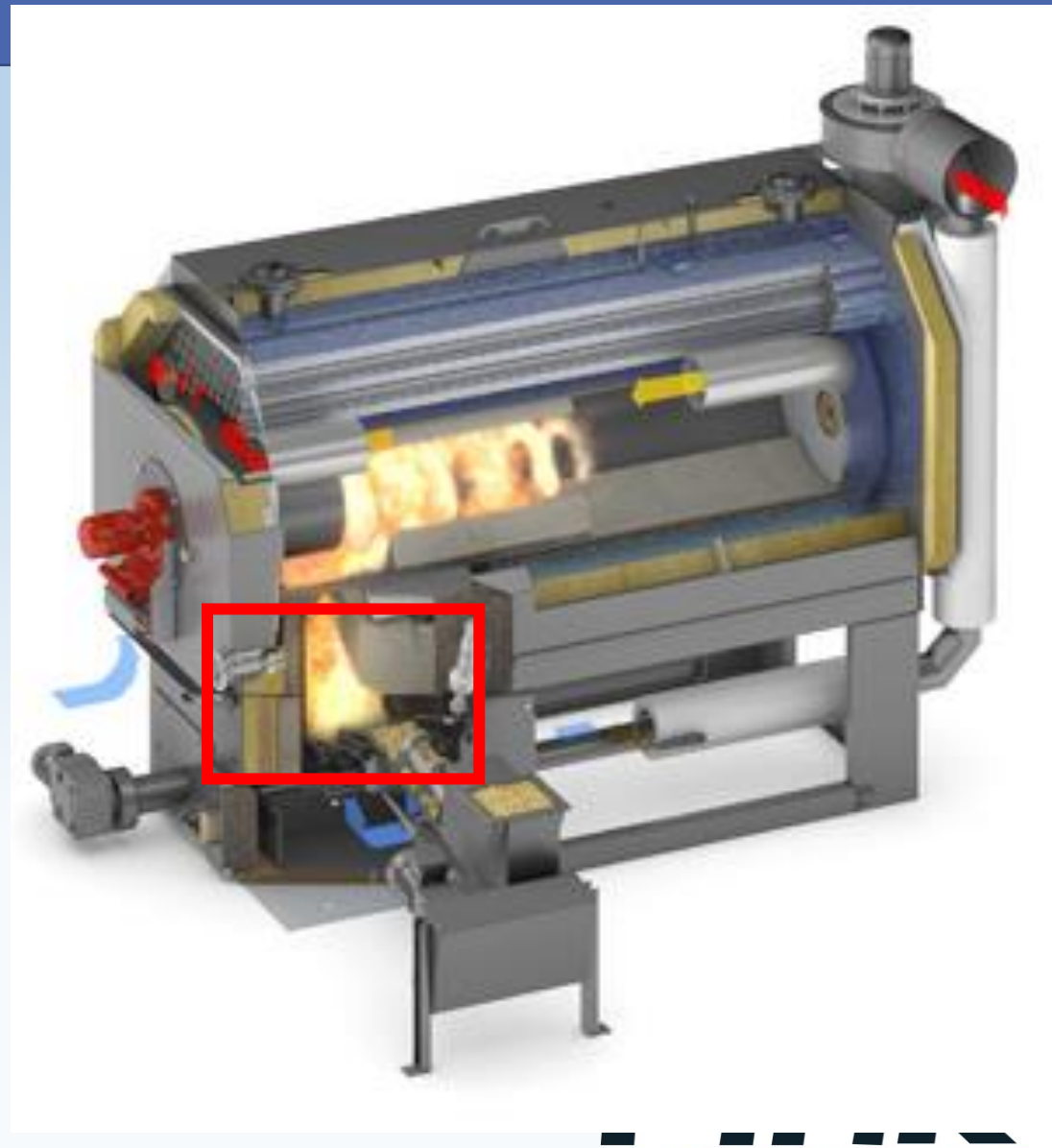
Primary Burn Chamber

- **Exhaust Blower**
  Induces a negative pressure in the fire box

- **Primary Air Vent/Fan**
  Allows fresh air into the primary burn chamber.

- **Recirculation Gas**
  Pushed back into the primary burn chamber and is used to maintain cooler temperatures and lower oxygen levels.

- **Gasification**
  Gasses are produced during the primary burn that are combusted in the secondary burn chamber/zone



PYROT® - Combustion Air Flow

Secondary Burn Chamber

- **Rotation Blower**

The rotation blower injects secondary fresh air and mixes it with combustion gases produced in the primary burn.

- **Heat Exchanger**

The heat produced in the secondary burn chamber is pulled up through the heat exchanger by the exhaust blower and the exhaust is expelled out the chimney. Water is heated

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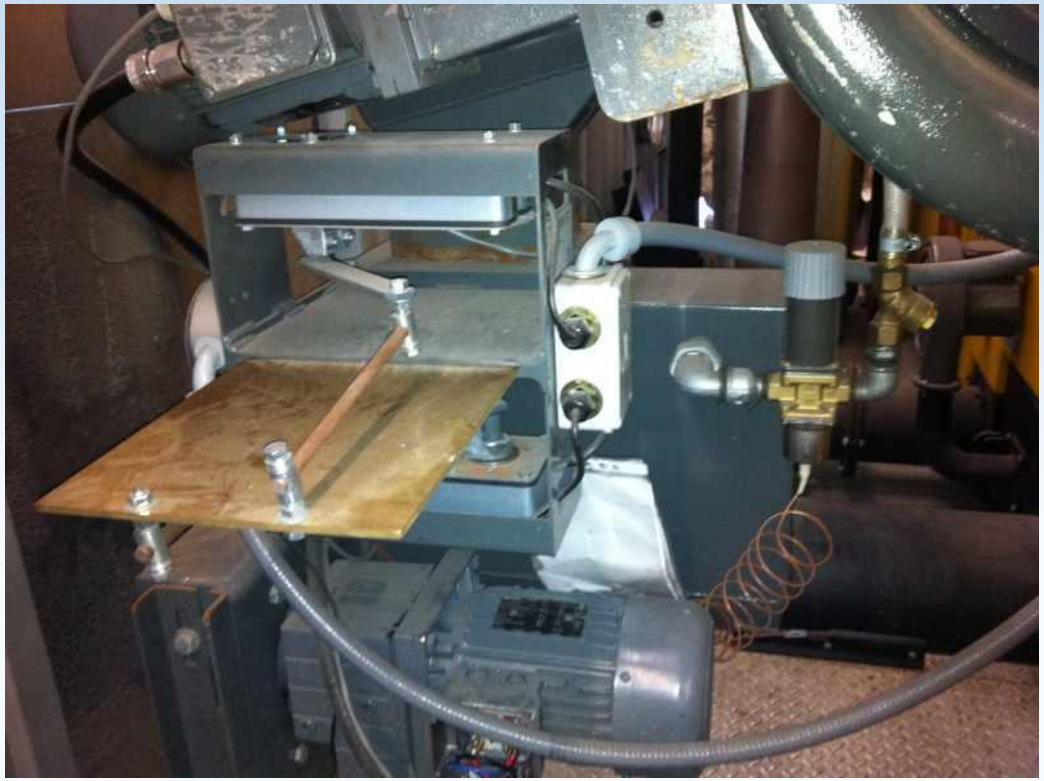
PYROT® - Fuel Flow



Sliding Gate

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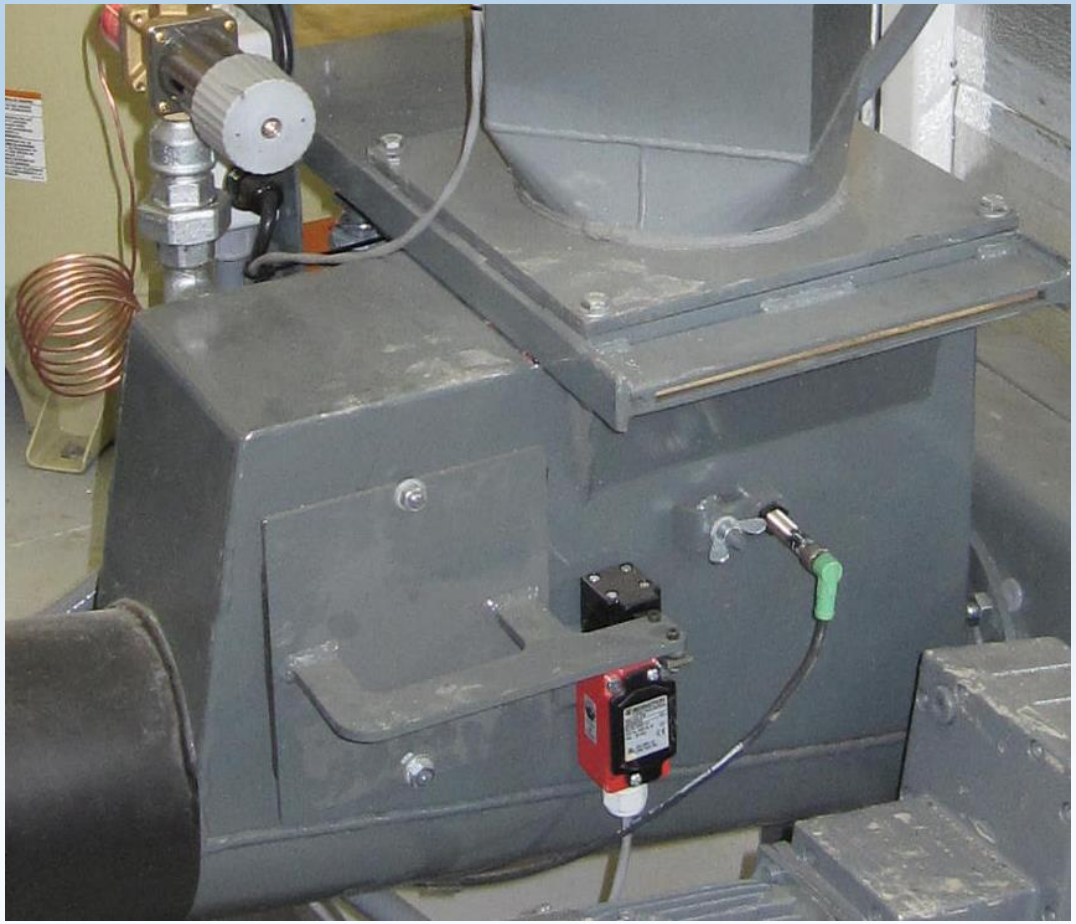
PYROT® - Fuel Flow

Metering Bin

Stage one of fuel supply
Is controlled by light barrier in the metering container and the limit switch on the sliding gate



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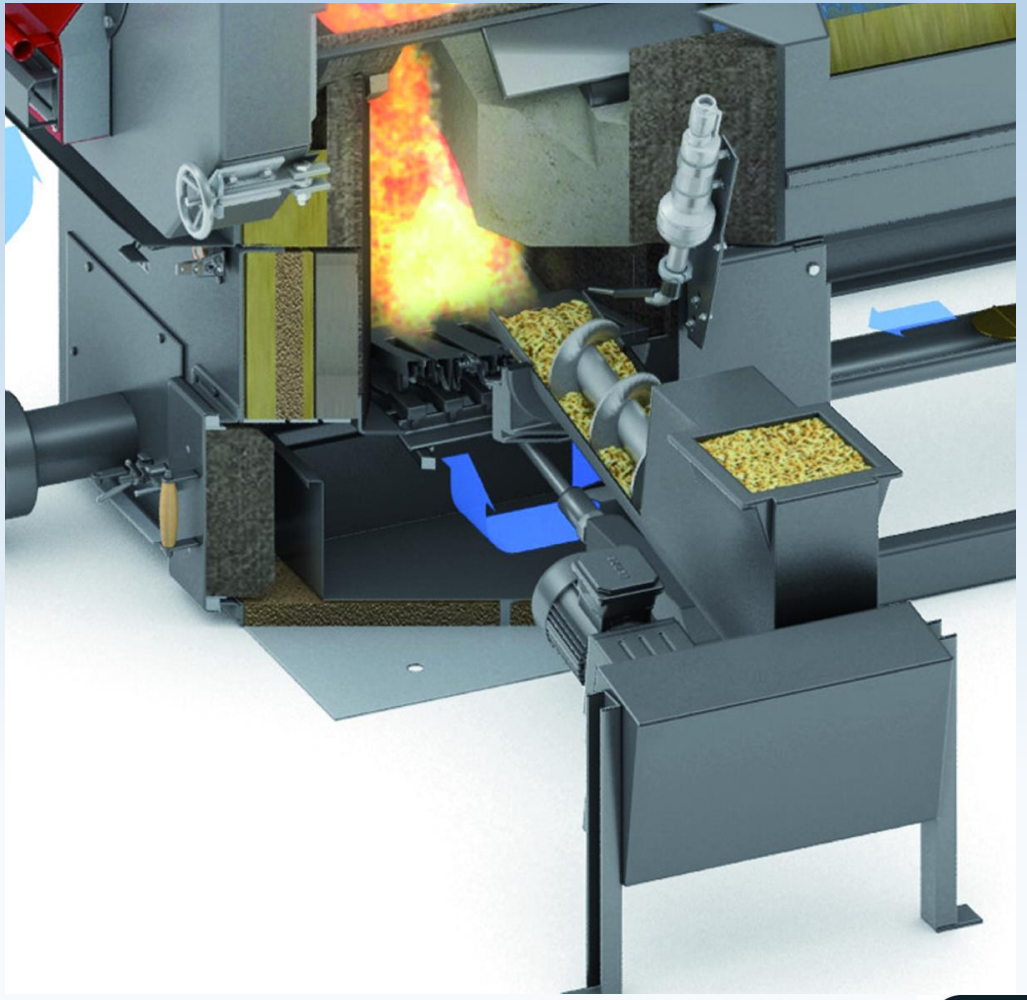
PYROT® - Fuel Flow

Infeed Module

Controls the amount of fuel loaded into the fire box



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PYROT® - Fuel Flow

Fire Box

Inside the fire box, the burning fuel will be worked down the moving grate towards the ash auger.

The moving grate is controlled by the grate drive motor.

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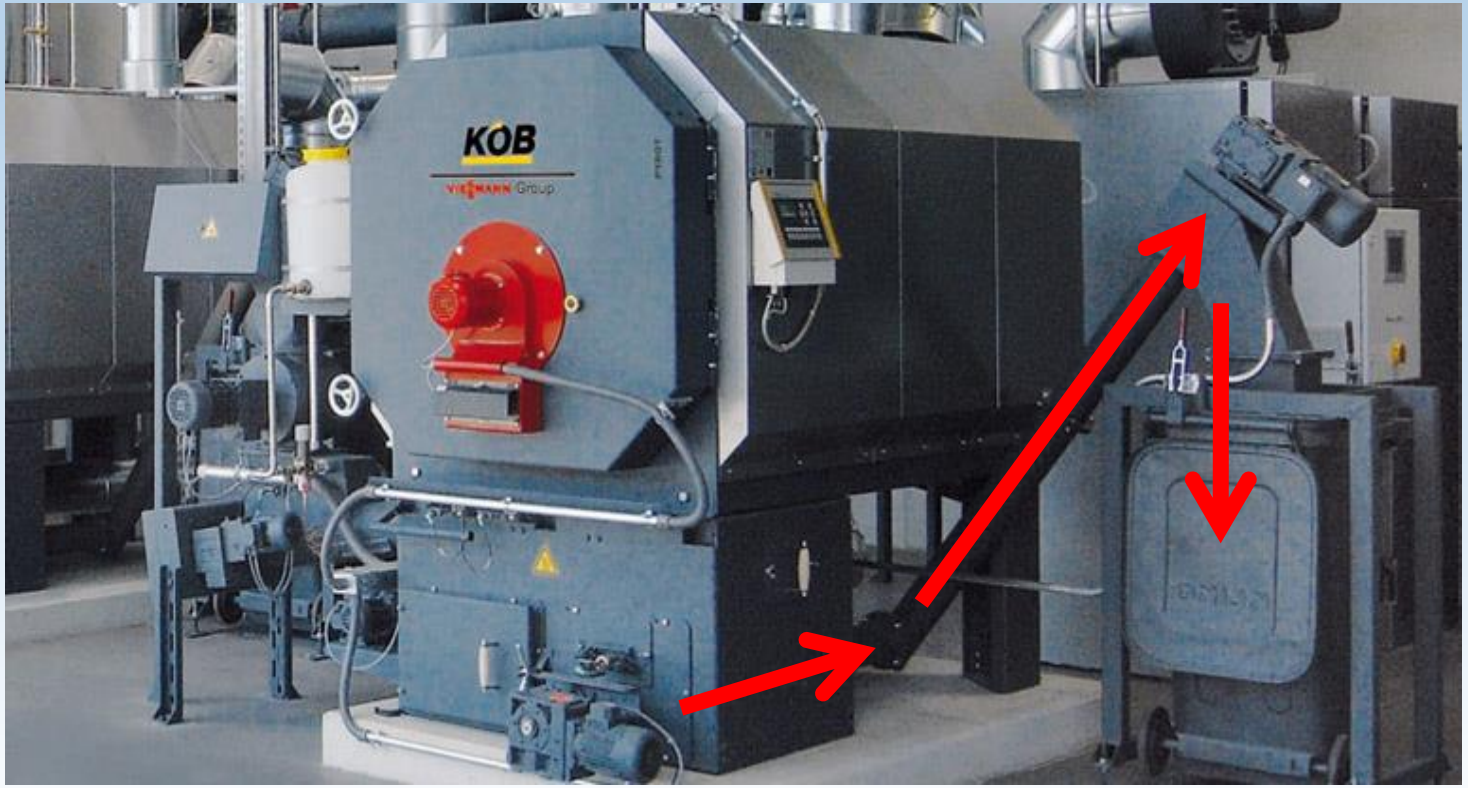
PYROT® - Fuel Flow



Automatic Ash Extraction System

Ash is augured from the trough in the fire box and then up and into the ash can with the ash transport auger

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Key Properties of Biomass Fuels

- Moisture Content - Chips
- Ash Content - Chips and Pellets
- Particle Size – Chips and Pellets (Dust)
- Contamination - Chips

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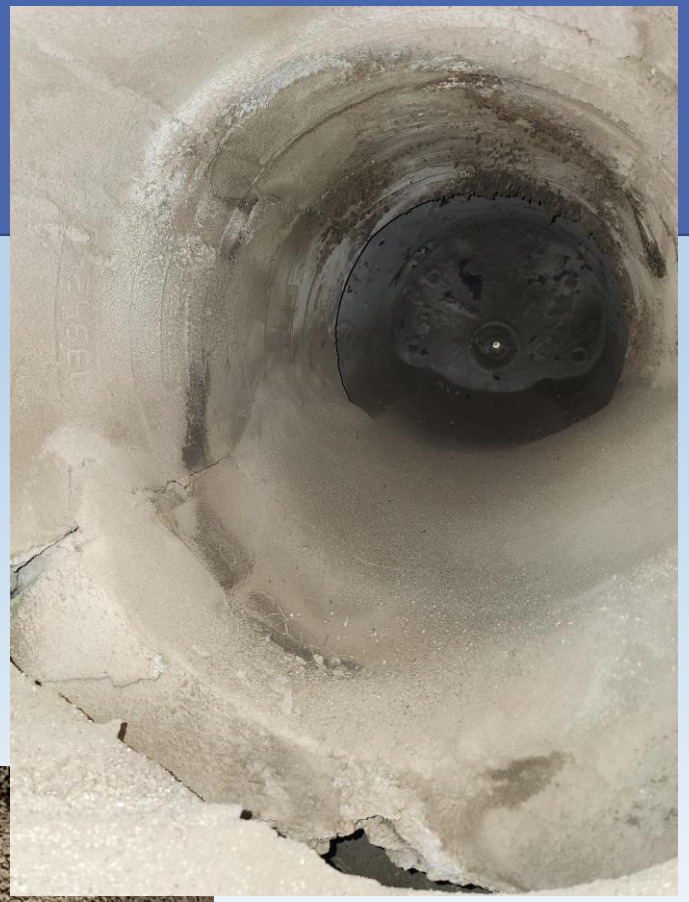
Moisture Content

- Water does not burn
- Too wet impacts auto ignition
- More moisture more fuel volume
- Boiler type
  - Wet fuels – large grate
  - Dry fuels – smaller gate
    - Flue gas recirculation
- Potential freezing (not pellets)

Sources of Ash

- Primary Source of Ash
  - Bottom Ash from boiler
  - Cyclone Ash
- Secondary Source of Ash
  - Fly Ash from ESP – usually larger systems MW+



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Ash Residues - Clinkers

What is clinker?

- If ash is heated above it's sintering (softening) point (1150-1200 C), it changes the state of aggregation and turns doughy or viscous.
- When cooled, turns solid again and sticks to refractory and grate elements.

Impact mineral content:

- higher mineral content means more ash.
- higher mineral content usually means lower ash sintering points.
- lower sintering point will lead to clinkers.
- clinkers destroy the grate and refractory over time.

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Particle Distribution

- Generally, not an issue with pellets
- Not all chips are created equal
- Auger Sized correctly – may cause jamming or bridging
- Fines cause problems with non-combusted material

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Buffer Storage Tank

- Allows for modulation of boiler
- Absorbs Excess heat at shut down
- Faster Response Time
- Prevents Cycling
- Improves efficiencies
- Hydraulic Separator from boiler
- Buffer Tank = Battery

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PYROT® - Cleaning and Maintenance

PPE is required including mask googles and gloves

Areas to be cleaned

- **Heat exchanger tubes**
- **Combustion Chamber**
- **Exhaust Fan**
- **Firebox**

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PYROT® - Cleaning and Maintenance

Areas to be cleaned

- **Light Barriers and Inspection Windows**
- **Ash Can**
- **Recirculation Gas Line**
- **Exhaust gas collector**
- **Ash Bin**

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PYROT® - Cleaning and Maintenance

Automatic Tube Cleaning System

- **Solenoids are fired sequentially with 100 psi air to clean ash out of the heat exchanger tubes**

- **With automatic tube cleaning, the tubes will need to be cleaning manually every 600 hours**

- **Without automatic tube cleaning this should be done every 300 hours.**

- **See Operation and Maintenance Instructions for all cleaning intervals and descriptions.**

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Operator Check-Sheets

Boiler Cleaning Check List

Date					
Scrape the fire box					
Flick the hammers and grates					
Clean the light barrier lenses					
Clean the O2 sensor					
Clean the light barrier on augers					
Brush the fire tubes					
Scrape the secondary chamber					
Clean the inside of the front door					
Empty the ash drawer					
Empty the ash bin					
Cleanout under the air shot system					
Check the retzy clean outs					
Check the chimney clean out					
Grease the auger bearings x7					
Grease the auger chains x3					
Check hydraulic oil					
Brush the exhaust blower					
Check the grate drive shear pin					

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KRT (PYROT) Daily Maintenance Checklist

Boiler	
Month	

Date	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Boiler Status																															
Outdoor Temp																															
Boiler Output																															
Boiler Supply Temp																															
Boiler Return Temp																															
Building Supply Temp																															
Building Return Temp																															
System Pressure																															
Firebox Check																															
Bunker Fuel Level																															
Visual Check																															
Check Visu Computer																															
Operator Initials																															

Notes

Date	Description



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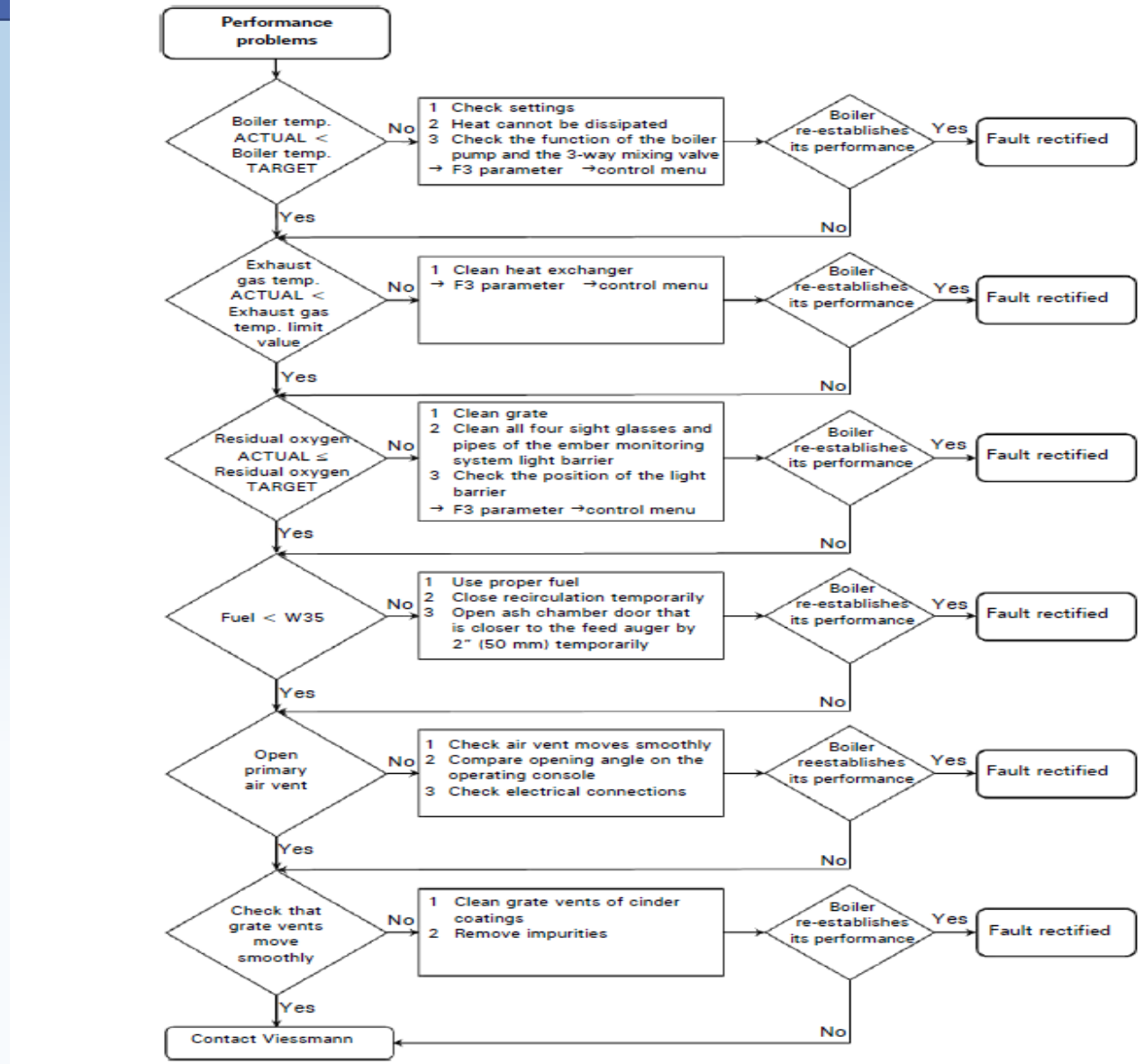
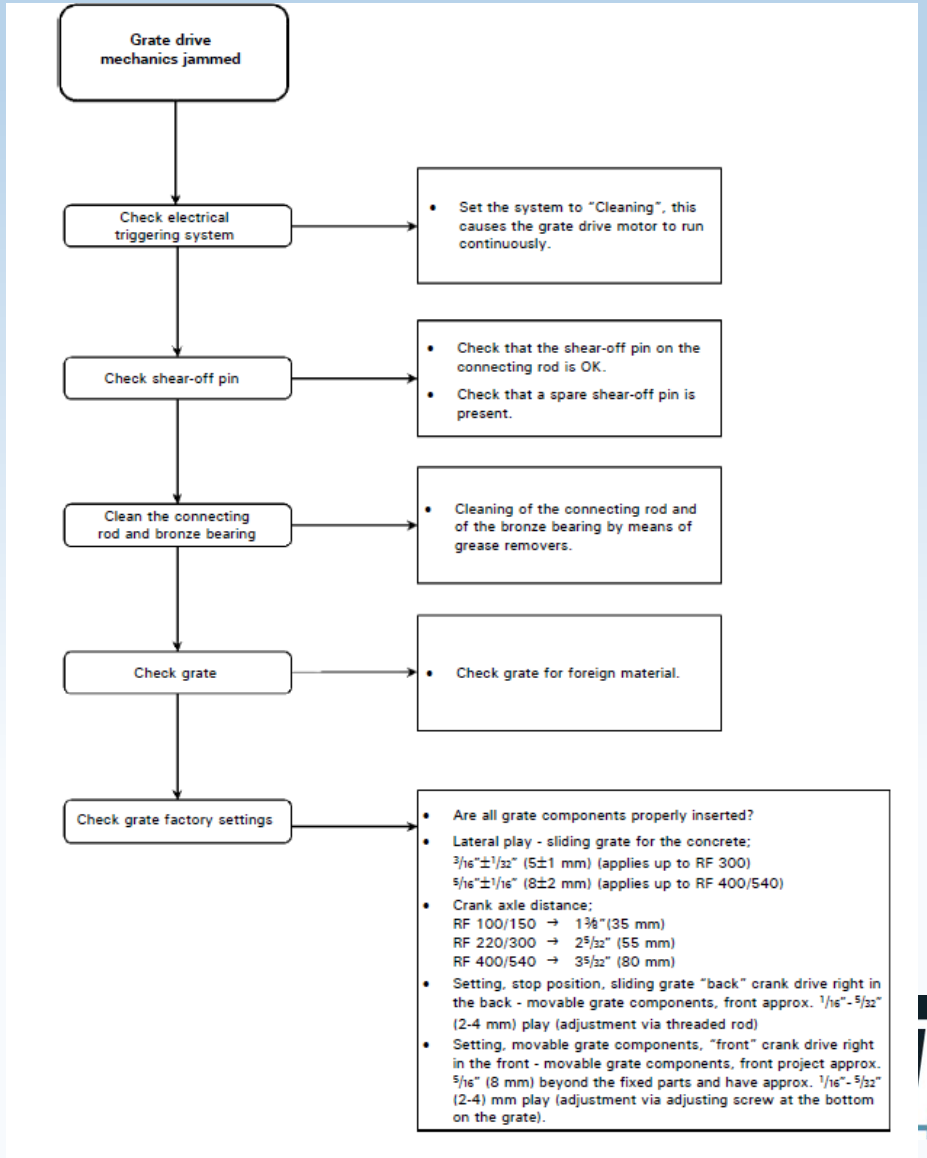
Facility Housekeeping

- Be Aware of Dust and ash build up in Facility
- Try and empty fuel storage when system is shut down

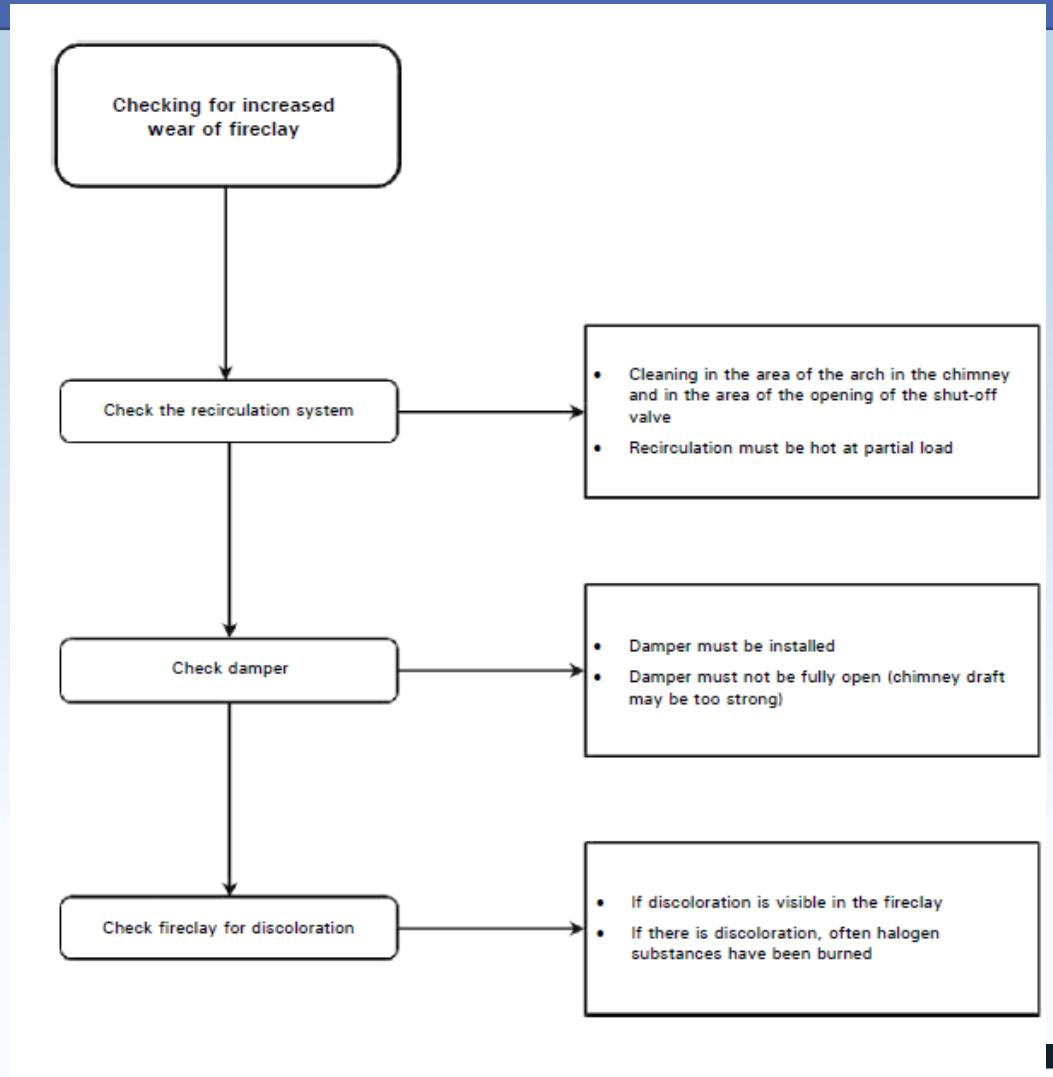
PYROT® - Troubleshooting Performance



PYROT® - Troubleshooting Grate Drive



PYROT® - Troubleshooting Firebrick



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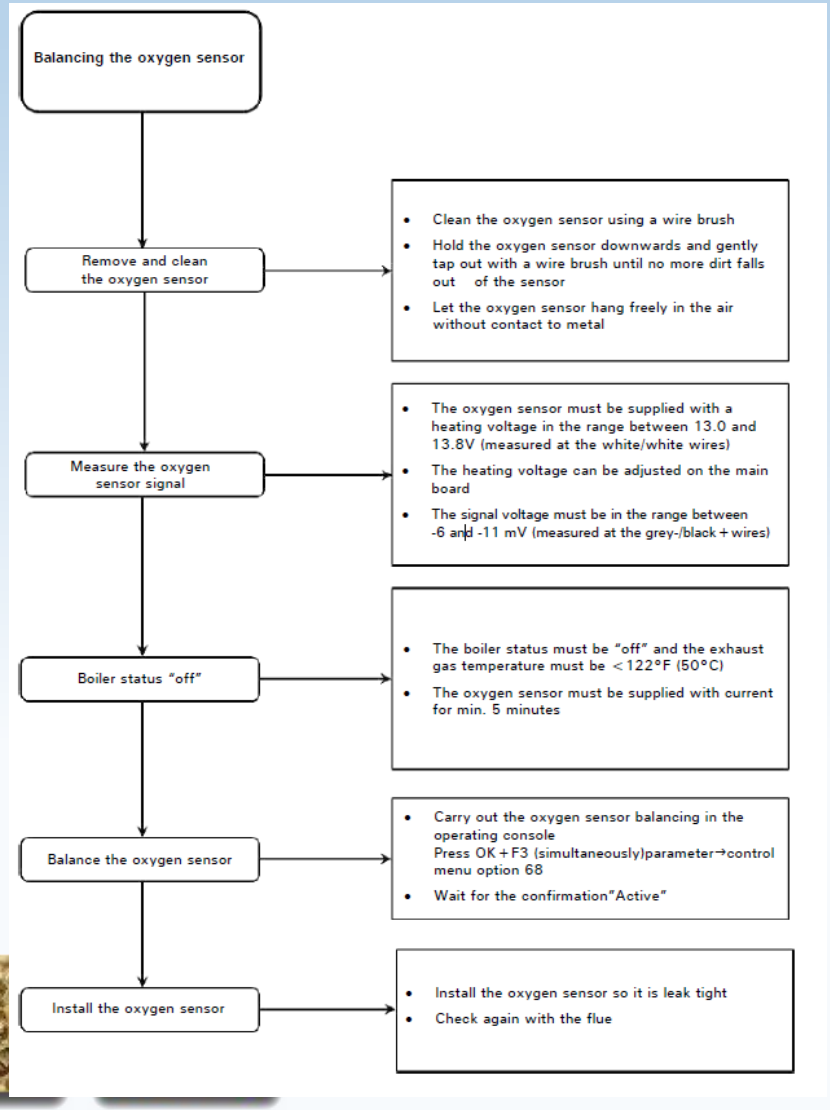
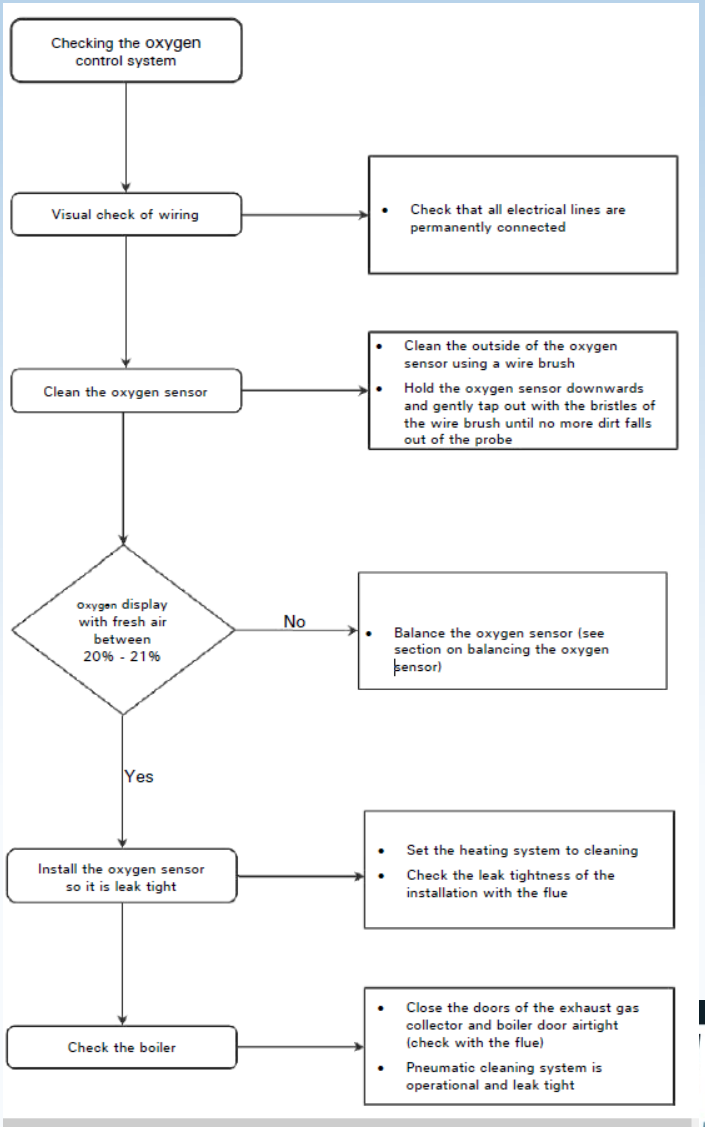
PYROT® - Troubleshooting Oxygen Control System





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PYROT® - Troubleshooting Heating System Fault Codes

Fault No.	Text displayed	Indicator	Possible cause	Check / remedy
01	Excess temperature (red light at F1, F2, F3)	Fixed high limit N21	- Incorrect setting in the control module - Defective component (pump or valve) - Sudden drop in output to zero. The feed auger then has to be emptied. The heat produced by this can result in excess temperature. Activate the function "Dissipate excess heat"	- Why could the heat not be dissipated? - Check the boiler pump and mixing valve - Activate the function "Dissipate excess heat" - Unscrew the protective cap on the fixed high limit and press the reset button (not possible until the boiler temperature is less than 158°F (70°C) and press OK
03-17	Interruption or short-circuit, sensor	- Sensor . . .	- Damaged sensor connection line - Indicator defective	Call a qualified electrician
09	Oxygen sensor (red light at F3)	- Oxygen sensor in the flue gas pipe	- Indicator very soiled - Indicator defective - Error in the electronics	- Readjust oxygen sensor - Acknowledge with OK
18	Permanent code (red light at F3)	- Operating hours lapsed before the permanent code has been entered	- Permanent code has not been entered	- Call Viessmann
19	Repeat heating up (red light at F3)	- Exhaust gas temperature sensor - Oxygen sensor	- Fuel too moist - Oxygen sensor imprecise - Igniter defective - The combustion chamber filling time is too short	- Use suitable, dry fuel - Readjust oxygen sensor. - Replace ignition device - Readjust combustion chamber - Acknowledge with OK
20	Water level in extinguishing Water container (red light at F3)	- Level float switch in extinguishing water container	- Not enough water in the extinguishing water container	- Fill extinguishing water container - Acknowledge with OK
25	Light barrier, ember monitoring system (red light at F3)	- Light barrier for ember monitoring system	- Sight glass soiled; deposits of ash in the openings - Defective indicator	- Remove and clean sight glasses on both sides - Remove dust and ash deposit from the openings - Refer to the section, "Cleaning" - Acknowledge with OK
26	Light barrier, feed auger (red light at F3)	- Light barrier in the metering container for the feed auger	- Light barrier soiled - Clogging in the metering container	- Clean light barrier - Remove clogging - Acknowledge with OK
96	Feed auger pipe too hot	- Temperature sensor on the feed auger	- Power failure - Consequent malfunction caused by excess temperature - Light barriers for ember monitoring system soiled	- Call a qualified electrician - Check light barriers for embers - Acknowledge with OK
81-93	BUS error, no connection to the (red light at F3)	- Data transmission line for the bus connection	- Bus connection interrupted	- Check plug connections - Replace data transmission line - Call Viessmann
53-54	Extraction system ... silo door open (red light at F4)	- Limit switch for silo door	- Silo door open	- Check and close silo door - Acknowledge with OK

Key Parameters for Success

- Fuel Quality directly Impacts Maintenance
- Regular monitoring and preventative maintenance is critical
- Operator Training and transfer of knowledge
- Remote monitoring

https://www.youtube.com/watch?v=AF071VgmINw

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Questions?

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