

Biomass and the Boiler Inspection Authorities

Graham Flowers IEng., SOE, MIPlantE.
Technical Specialist – Pressure
RSA Engineering Inspection &
Consultancy

Boiler Examination



- Why do boilers need to be examined?
- In some cases it's the Law!
- The Pressure Systems Safety Regulations.
- Health & Safety Executive + Industry Guidance.
- Industry examples.
- Insurance perspective.

Why we examine



- During the early part of the 19th century steam was employed as a motive power to drive the cotton mills of the north west, mainly in the Manchester area.
- Boiler explosions were a regular event.
- Not all explosions would be pressure related.

Why we examine



- Steam boilers fired by coal.
- Many incidences of flue gas explosions.
- Some pressure explosions related to mechanical wear.

Why we examine



Example	Typical location	Pressure/ Volume	TNT Equivalent	Typical Damage
Disposable Lighter	Your Pocket	Notional	0.15g (firework)	Risk of Injury
Gas Lighter Refill (typical canister)	Your Home	5psi , 0.3 bar 0.0006m ³	25g (Thunder-flash)	Severe Injury Risk to Life & Property
Gas Cylinder (4.5 kg)	Your BBQ/Patio	200psi , 13 bar 0.012m ³	120g (Hand grenade)	Severe Injury Possible Loss of Life Slight Damage to Property
Air Receiver (250 bar litre)	Local Garage	150psi , 10 bar 0.15m ³	300g (Anti-Personnel Mine)	Severe Injury Probable Loss of Life Medium Damage to Property
Steam Boiler (1000 kg/hr)	Dry Cleaners	150psi , 10 bar 1.5 m ³	2kg (Anti-Tank Mine)	Injury/Loss of Life (single figures) Severe Damage to Property
Steam Boiler (5000 kg/hr)	Factory/Hospital	200psi , 13 bar 27m ³	45kg (Aircraft Bomb) (Small)	Injury/Loss of Life (double figures) Catastrophic Damage to Property
Steam Boiler (25000kg/hr)	Factory/ Power Station	350psi , 23 bar 126m ³	275kg (Aircraft Bomb) (Medium)	Loss of Life Major Site Impact Widespread Damage to Property

Why we examine



- Mid 19th century a decision to reduce the burden of the costs related to these explosions saw the birth of the Manchester Steam Users Association (1854)
- Increased levels of examinations saw a remarkable fall in loss of collateral and loss of life.
- Examinations were to be enshrined in Law.

It's the Law!



- Several versions of legislation culminating in the last version of the Factories Act in 1961.
- These still in use under the current Health and Safety at Work Act 1974.
- Examinations still prescriptive eg. 14 months for a steam boiler, 26 months for an Air Receiver.

It's the Law!



- Then Flixborough.
- Enquiry adjudged that there was a systematic failure in both understanding of process by site personnel, and supervision of repairs.
- Incorrect use of pipe bellows allowed catastrophic failure with massive loss of contents of hazardous fluid (Cyclohexane).
- Identified need for more than steam and compressed air to be considered.

The Pressure Systems Safety Regulations 2000



- 1989 The Pressure Systems and Transportable Gas Container Regulations.
- The birth of the Written Scheme of Examination.
- 2000 The Pressure Systems Safety Regulations.
- Both considered more than steam and air, and allowed a Risk Based Inspection (RBI) approach to examination.

The Pressure Systems Safety Regulations 2000



- Written Scheme of Examination (Reg.8) main provisions:
 1. Safe Operating Limits (Reg.7)
 2. Schedules of plant to be examined.
 3. Procedures for examination (Reg.9)
 4. Lists of items considered for exclusion from examination under certain provisos.
 5. Maintenance & repairs/modifications (Regs.12 & 13)
 6. Record keeping (Reg.14)

H&SE + Industry Guidance



- Guidance is continually updated to meet current requirements.
- PM5 and PSG02 were 2 such documents.
- Updates considered and agreed.
- CEA, H&SE and SAFed involved in both documents.
- H&SE PM5 is replaced with INDG436
- SAFed PSG02 is replaced with BGO1

The Focus of a Written Scheme of Examination



- Written Schemes of Examination will vary for solid fuel.
- Design parameters should take note of residual heat. (SOL not necessarily WP)
- Mechanical wear and corrosion/erosion should feature.
- Ideally maintenance procedures should be adopted to monitor rates of corrosion/erosion.

Repairs and/or modifications RSA

- If I need to repair my boiler/pressure vessel, who do I use?
 - Repairs and /or modifications are subjects for discussion with your competent person.
 - Always use an experienced repairer.
 - Always repair to recognised code.
 - Refer to BGO1 section 9 for further guidance.

Industry examples of Biomass firing problems



Medium sized Power Generation site

- DP 151 bar
- WP 135 bar (approx)
- Replacement of wall and roof tubes after 8 years due to corrosion/erosion.
- Original tube wall 5.8mm reduced to 1.6mm

Industry examples of Biomass firing problems



Large Tropical Gardens.

- Designed for woodchip
- Design Temp <100 Deg C
- Suffered flue gas explosion – possibly due to incorrect installation.
- Boiler still not operational – awaiting modifications to fuel conveyor system.

Industry examples of Biomass firing problems



Comments from Surveyors report.

“The actual operation of the boiler and how it integrates with the three main boilers will require to be kept under observation and may over time require adjustments in the light of experience and possibly may not be achieved.

It will also require to be shown over time that dust produced by the operation and cleaning has no effect on the main boilers. If this is not possible then we would consider that this boiler could not be operated with safety and it would require to be separated from the main plant.”

“Wood storage – there are fire hazards with this, we note these facilities are in the process of being changed,”

Industry examples of Biomass firing problems



Large instant coffee producer – fluidised bed
burning spent coffee grounds. Flue gas explosion

- Built 2000
- Natural circulation 2 gas pass design
- Utilising platen tubes forming sealed gas passes
- DP 23 bar
- Output 14,000 Kg/hr

Industry examples of Biomass firing, flue gas explosion

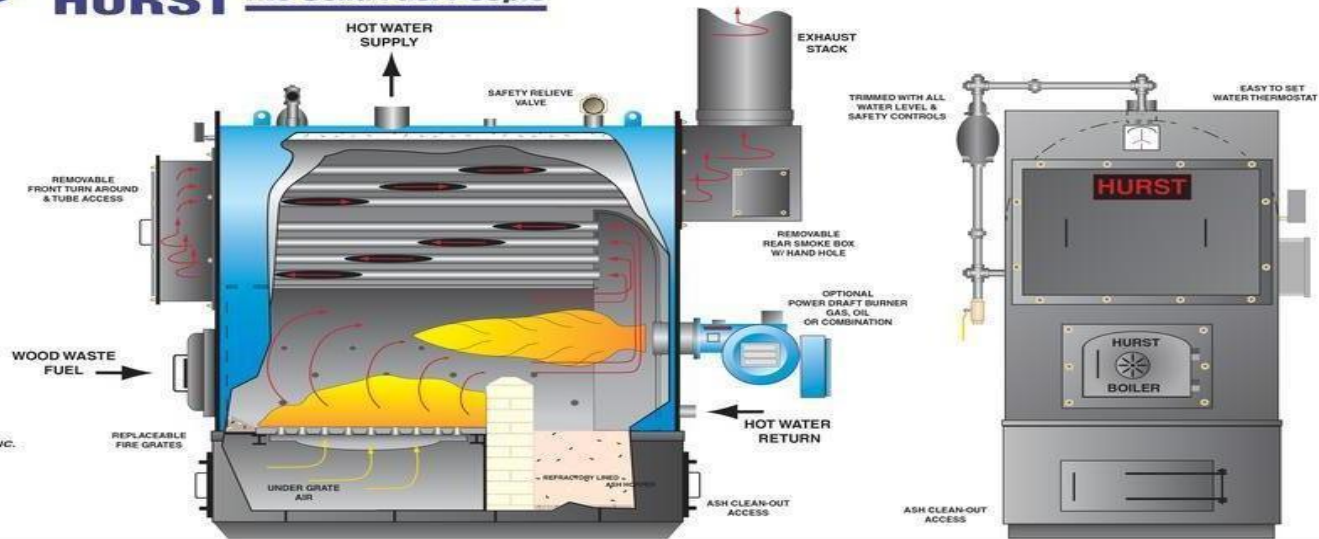


Multi fuel example boiler



HURST *The Solid Fuel People*

Hand Fired System



HURST BOILER & WELDING CO., INC.
 P. O. Drawer 530
 21971 Highway 319 N.
 Coolidge, Georgia 31728
 Toll Free: 1-877-994-8778
 Tel: (229) 346-3545
 Fax: (229) 346-3874
 Email: info@hurstboiler.com

The FireBox LPD HF design is suitable for applications to produce low pressure steam or hot water in ranges from 3,450 – 20,700 lbs/hr (3.4 mmBTU – 20 mmBTU) output at 15 PSI steam or 30 PSI hot water. This system is designed by HBC to combine the best technologies from the "old school" of biomass combustion and the latest advanced combustion control technologies. HBC's new hand fired systems are particularly suited for operations with extremely low labor cost environments. This combination enables these systems to provide a flexible and reliable operation utilizing a wide range of biomass waste with moisture contents ranging from 8 – 50% and requiring minimal fuel preparation. Ash removal is a manual operation. The boiler vessel is a two pass hybrid design incorporating a water tubed boiler-type water membrane and a two-pass fire tube scotch marine vessel. The boiler vessel is a three-pass fire tube firebox design that inherently provides an extended water membrane in the furnace area greatly reducing the amount of refractory required.

CAT# W-01

HURST FIREBOX LPD HF

MULTI FUEL 50, 100 & 150 HP

Hand Fired System

Modular Packaged

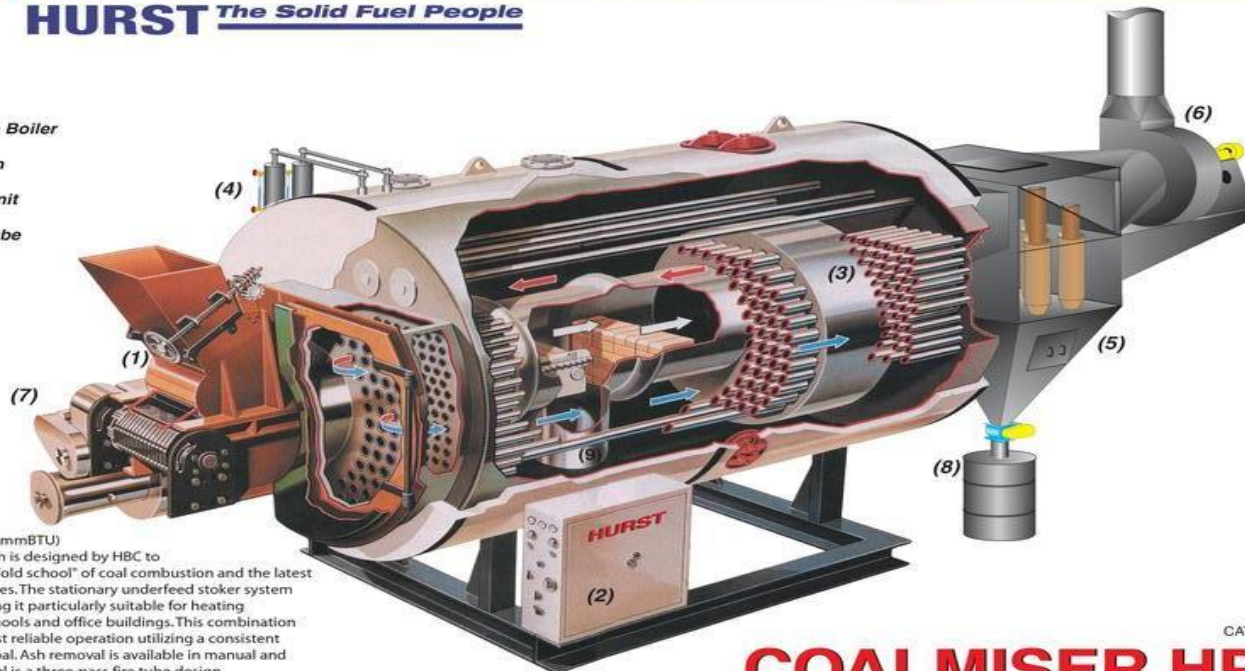
Solid fuel example boiler



HURST *The Solid Fuel People*

Revolving Stoker Bed
Chain Grate Combustion System

- (1) Chain Grate Stoker
- (2) Control Panel (PLC)
- (3) Three Pass Scotch Marine Boiler
- (4) Operating Controls
- (5) Fly Ash Collection System
- (6) Induced Draft Fan
- (7) Combustion Air Blower Unit
- (8) Ash Collection Can
- (9) Primary Ash Discharge Tube



CoalMiser HPD is suitable for applications to produce high pressure steam or hot water in ranges from 2,000 – 8,000 lbs/hr (2 mmBTU – 7.7 mmBTU) output from 150 up to 400 PSI. This system is designed by HBC to combine the best technologies from the "old school" of coal combustion and the latest advanced combustion control technologies. The stationary underfeed stoker system provides a very low turn-down rate making it particularly suitable for heating applications in greenhouses, factories, schools and office buildings. This combination enables these systems to provide the most reliable operation utilizing a consistent single "grade" of low sulfur bituminous coal. Ash removal is available in manual and automatic configurations. The boiler vessel is a three-pass fire tube design incorporating a wet back turnaround that eliminates the need for rear door refractory.

CAT# C-01

COALMISER HPD

COAL FIRED

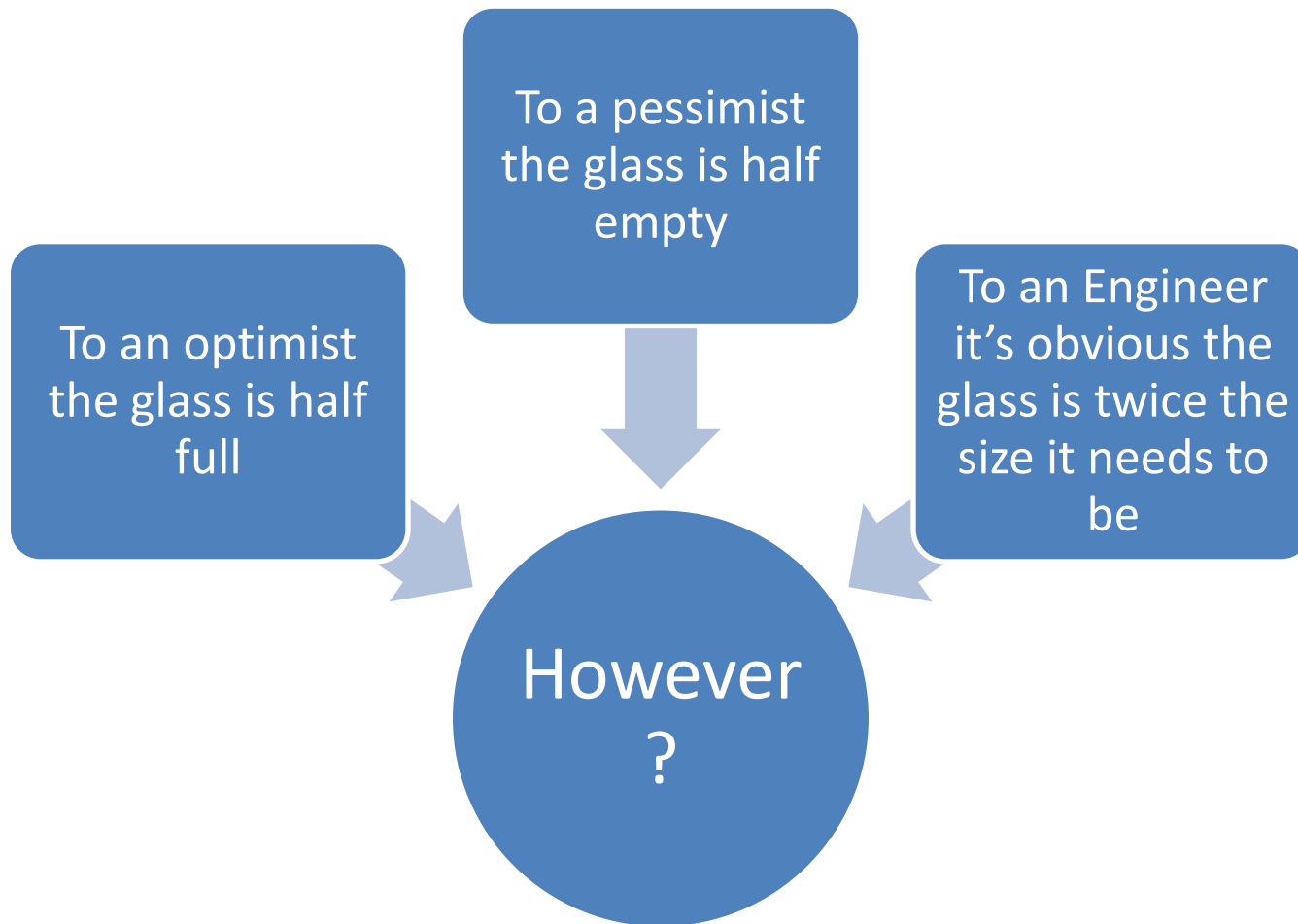
Modular Packaged

Insurance perspective



- Insurance is now independent of inspection.
- However inspection still used in assessing insurance risk.
- Insurance risk assessment based on individual cases.
- Even when a known piece of equipment is being used, underwriters could still say they need to see it running for a specified time before providing cover for a specific risk.

And Finally



Remember



- To a Yorkshire man it's obviously time for someone else to go to the bar.
- Any Questions ?