KÖB Viessmann Wood Boilers

Introduction to biomass boilers, hydraulic design, & accumulators

Reliable Efficient Adaptable Lifelong

The REAL investment for a reduced carbon footprint, reduced operating, and lower maintenance costs.

George Fletcher B.Sc.

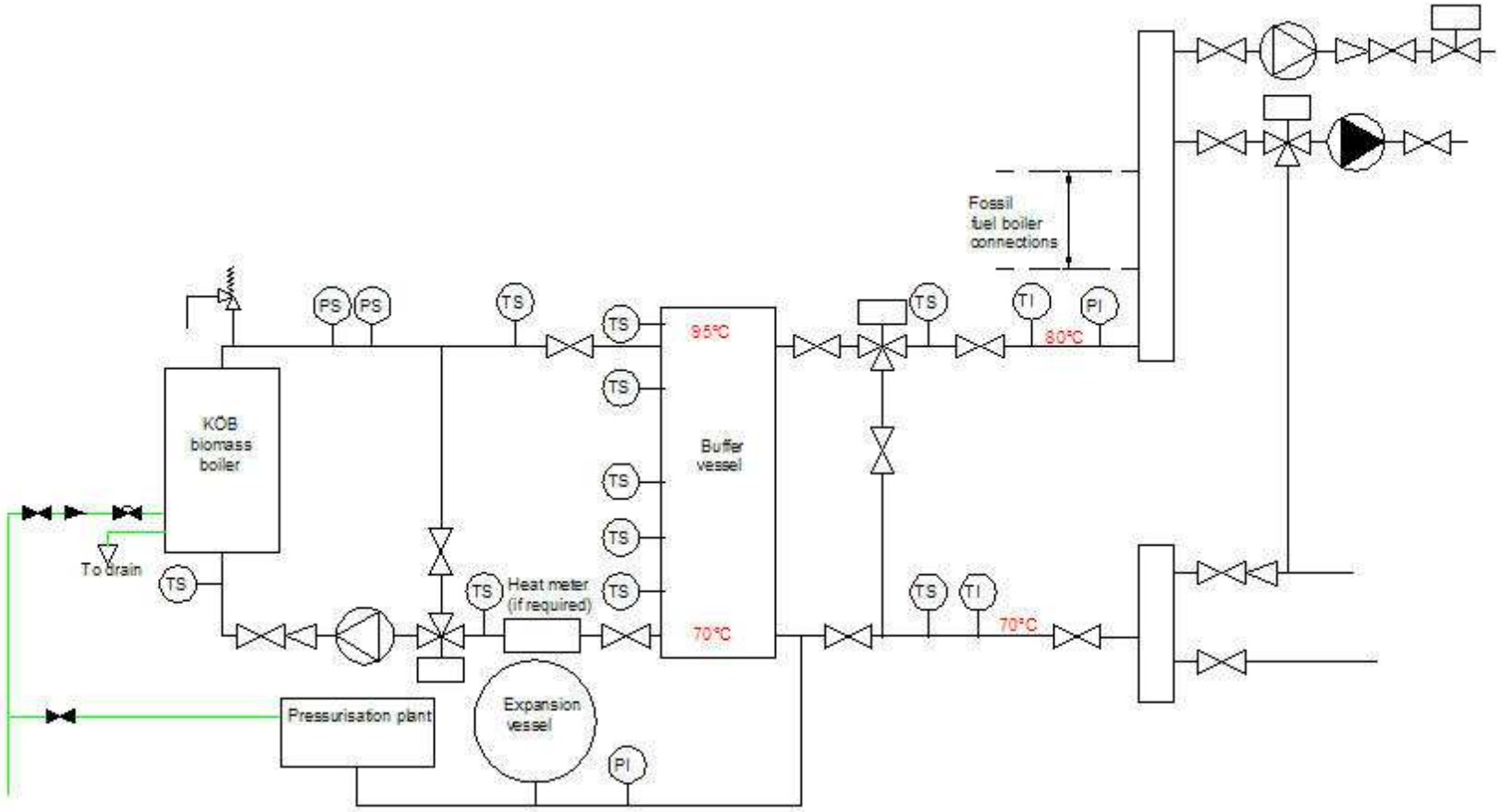
Mobile: 07824 328 551

fleg@viessmann.com

Technical considerations

- Well specified plant will operate automatically at high efficiency with clean emissions except NOx which is high.
- Must have emergency cooling coil to meet EN 303-5
- Fuel supply chain – current lack of developed infrastructure is a major barrier; must match fuel quality with boiler specification.
- Site issues – physical location of boiler house & fuel store.
- Biomass boilers are much larger than fossil fuel fired boilers.
- Size of fuel store & location; above or below ground.
- Fuel delivery methods, tip, shovel, blow, clamshell grab.
- Vehicle access and manoeuvring.
- Hydraulic integration & design. Buffer vessels & other heat sources.
- System controls, BMS, or control from biomass boiler panel.
- Chimney construction, height, colour, & appearance.
- Legislation – Clean Air Act & Building Regulations Part J
- Renewable Heat Incentive for commercial applications

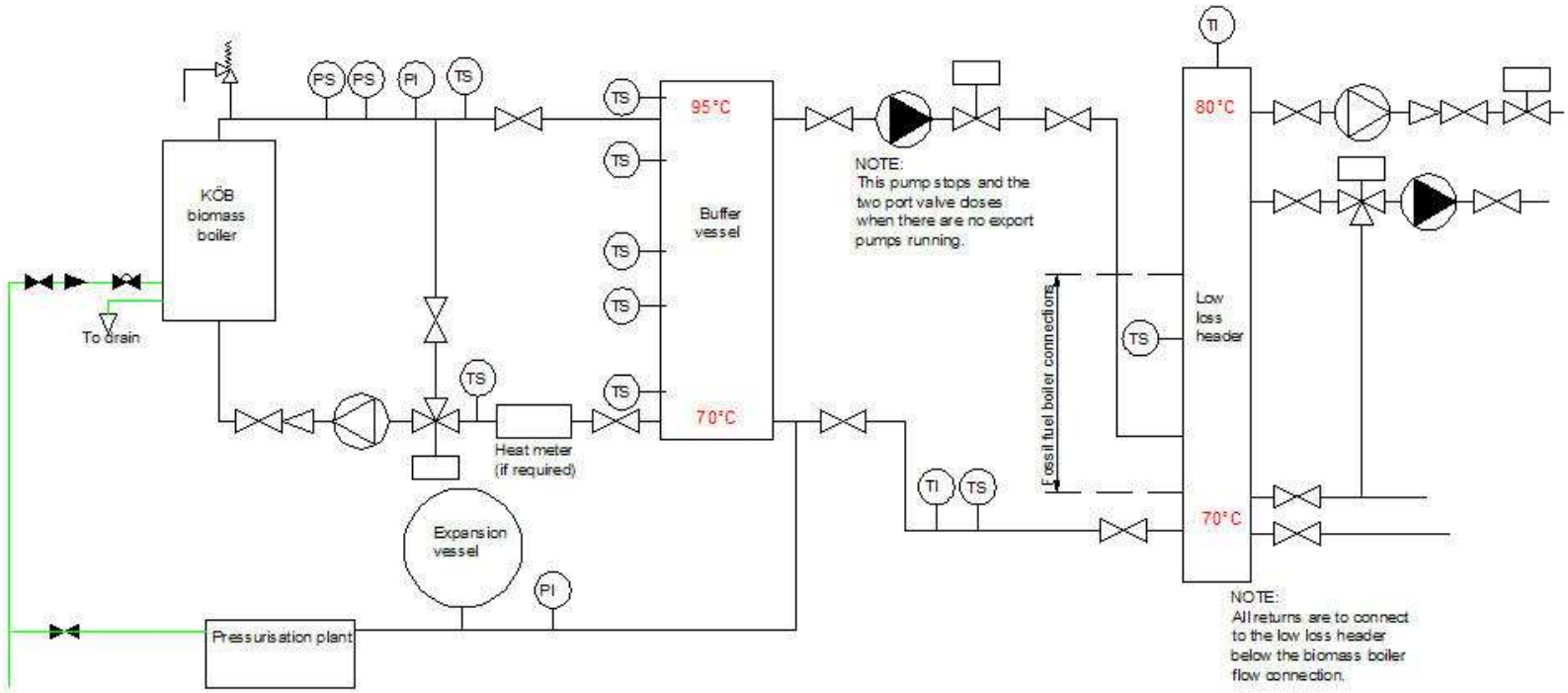
Another very good schematic using flow & return headers



It is recommended that high and low pressure switches are fitted to every boiler. Water level detectors are preferred on large boilers instead of low pressure switches.

The fossil fuel boiler can be connected as shown or it can be connected directly to the accumulator (buffer vessel) if both boilers are of a similar size.

A very good schematic with a low loss header



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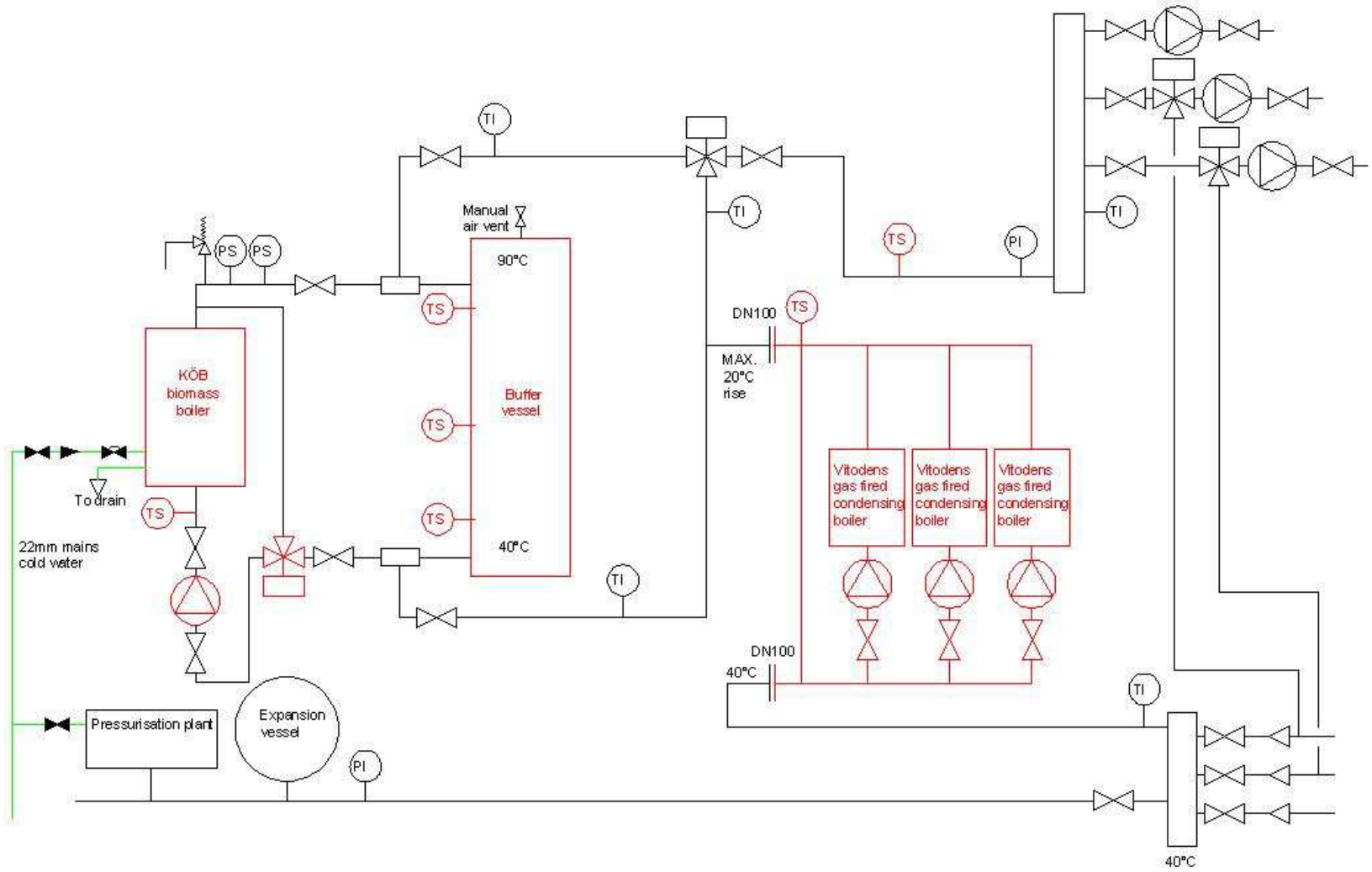
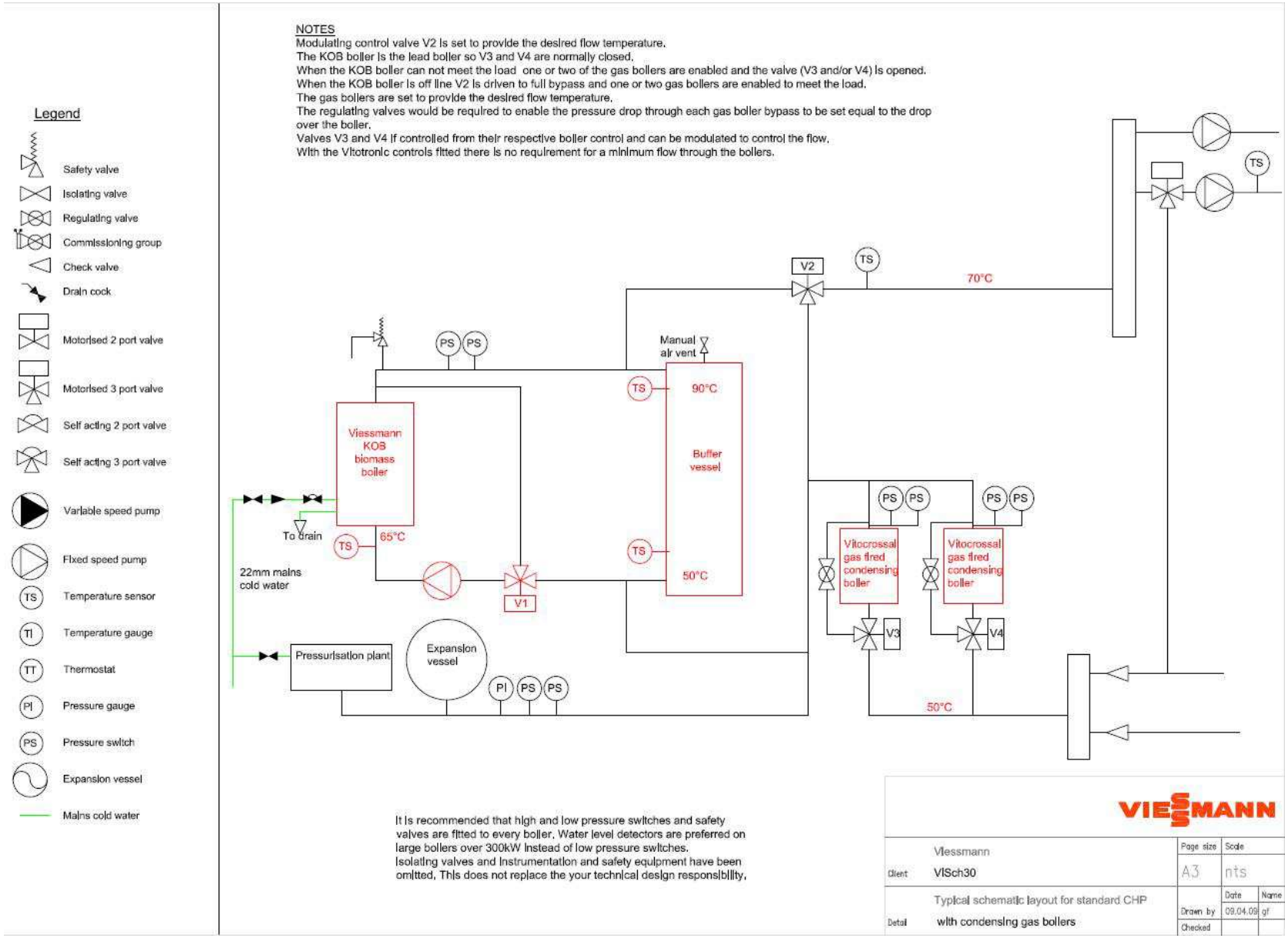
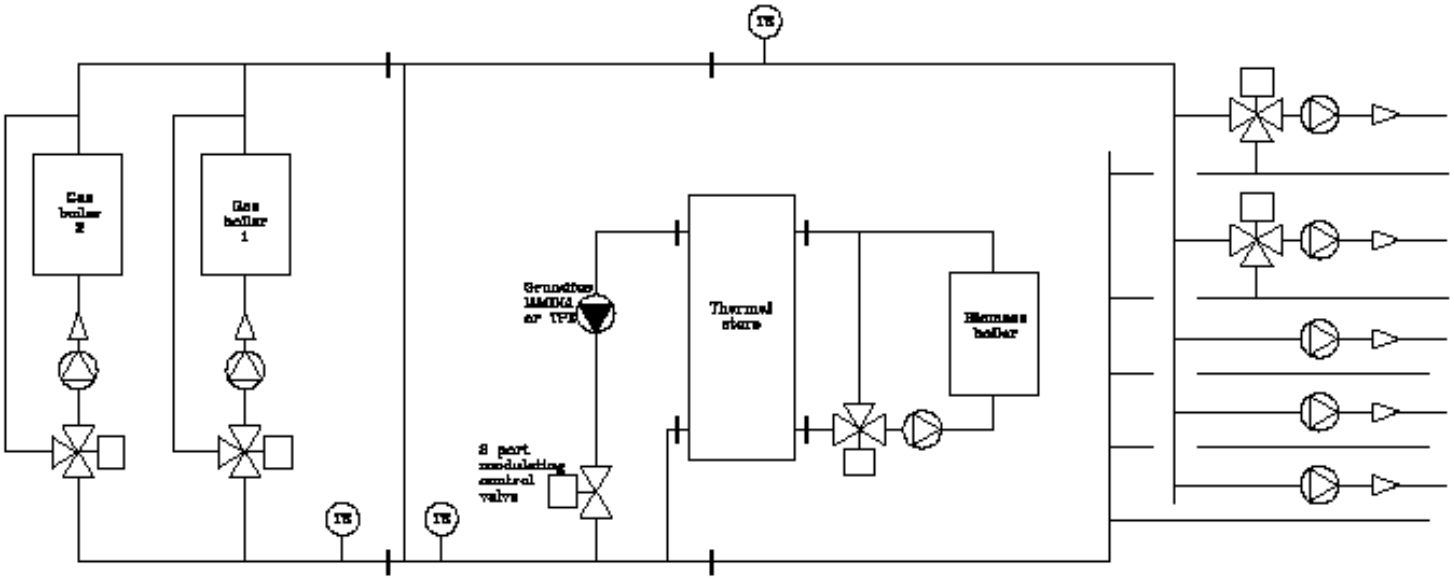
Wall mounted condensing gas and biomass



Floor standing gas or oil boilers and biomass



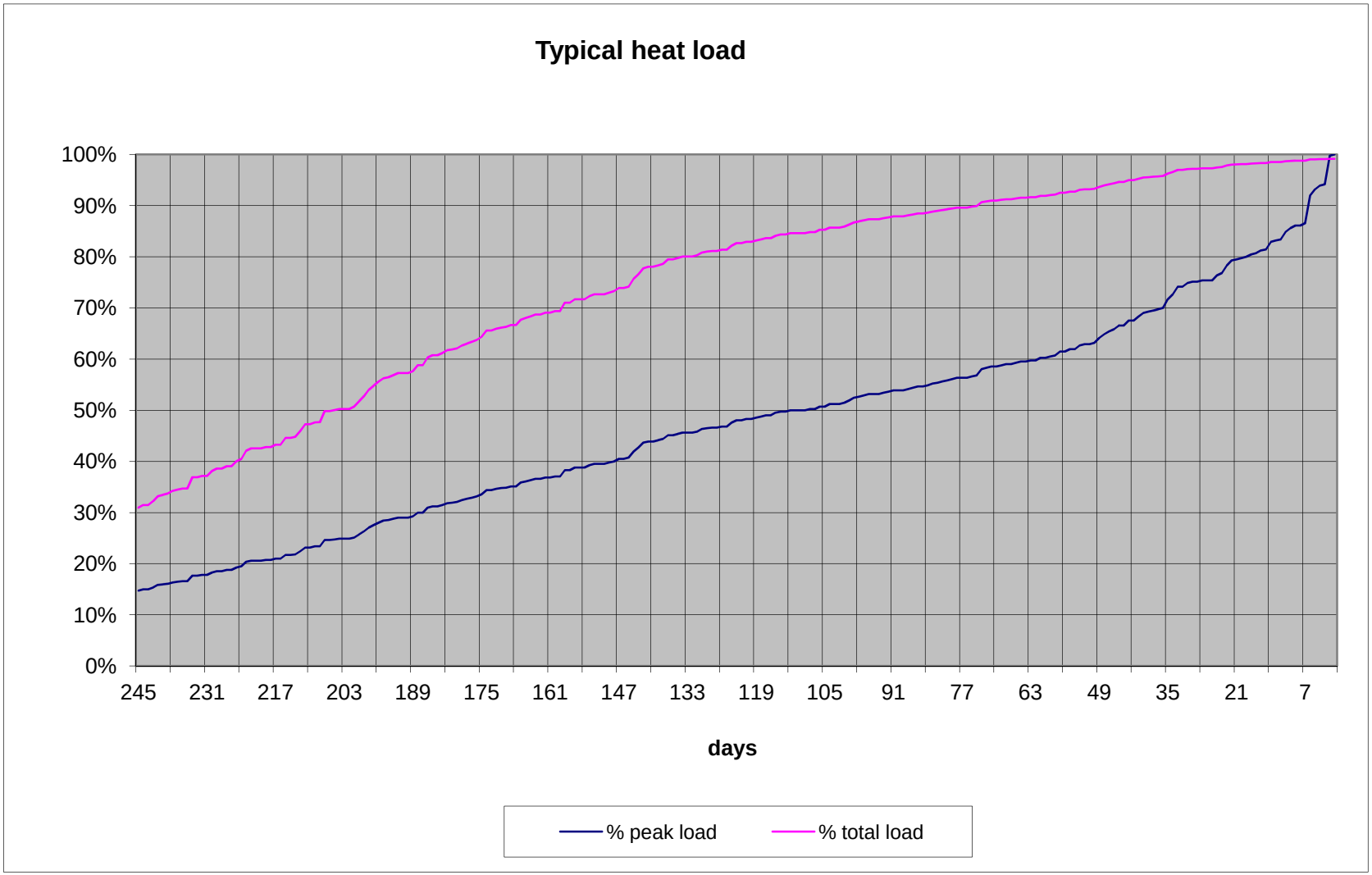
A variation with large fossil fuel boilers where biomass is 30% peak load



The biomass system can be sized for:

- Peak load
  - Biomass use maximized and fossil fuel use minimized - possibly
  - Larger, more expensive system as boiler is oversized for most of the year
  - Part load operation lowers efficiency if load variable
- Base load (generally 30 – 40% peak load)
  - Operates near design capacity, so efficiency high
  - Capital costs much lower
  - Conventional system required for peak lopping and stand-by
- 90% load (biomass boiler at around 60% peak heating load)
  - Offers excellent value for money
  - Intermediate capital cost
  - Conventional system required for peak lopping and stand-by
  - Both boilers of similar size
  - Good overall efficiency

LOAD DURATION ASSESSMENT



Heating value of wood Pellets 8%MC 4.59kW.hr/kg & chip at moisture contents

20%MC 3.90 kW.hr/kg 35%MC 3.05 kW.hr/kg 50%MC 2.19 kW.hr/kg

Boiler sizing

- Biomass boilers only turn down to around 30%MCR
- Specify high efficiency boilers with auto-ignition
- The alternative is kindling – lower efficiency
- For low use buildings can double fuel consumption
- Select biomass boiler between 30% & 60% peak
- With fossil fuel boiler(s) at 100% & 60% peak load
- Biomass boiler is best when working hard
- Must provide around 1 hour run at low load periods
- Pressurised systems required for 90 - 95^{0}C

Boiler and accumulator sizing

- Around 90% of heat load is met at 60% peak load
- This should give a 90% fuel substitution
- Take care with accumulator controls
- Biomass boilers take time to get up to load
- Pellet boilers 5 to 15 minutes
- Chip boilers 15 to 45 minutes
- If boiler starts when accumulator is empty then the fossil fuel boiler will run

What do accumulators offer

- They provide three important services
- They isolate the boiler from load variations
- They provide a sink for heat at low loads
- They enable a higher heat output than boiler MCR with suitable controls
- With high specification insulation low heat loss
- Heat loss as low as 2^0C per day is possible
- Store at 95^0C return at 70^0C or less
- Heat supply whilst boiler gets up to load
- Can design constant running boiler with huge buffer

How to size an accumulator

- A quick guide is 10 to 30 litre/kW for chip or pellets
- Consider minimum run at low load
- Around one hour at LCR will satisfy this
- Consider boost output at peak load
- Heat stored + output = short term peak
- This requires a practical selection
- Spread sheets can aid sizing
- Consider other factors if they exist

Sizing an accumulator

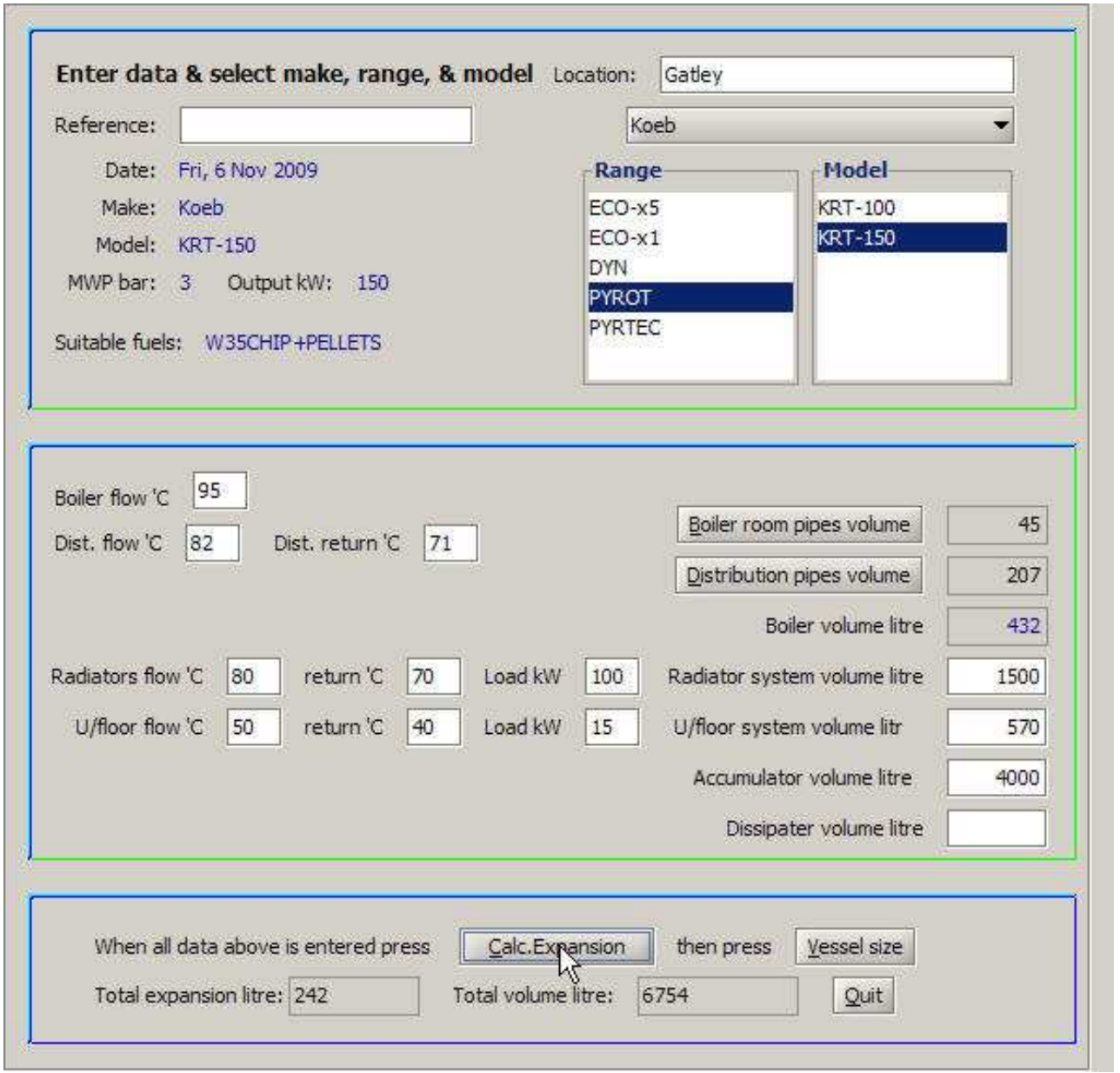
SIMPLIFIED METHOD FOR CALCULATING THE SIZE OF ACCUMULATORS

This calculation uses two formulae to calculate the minimum suggested size of the accumulator based on the boiler rating and boiler flow and system return temperatures.
The first calculation is based on 3/4 hour firing at lowest firing rate.
The second calculation is based on storing enough heat to meet the the boiler output at MCR during the heat-up period for the boiler. The minimum size is 1,000 litre.

Model	KRT-100	KRT-150	KRT-220	KRT-300	KRT-400	KRT-540
Boiler MCR (kW)	90	135	200	270	360	480
Boiler LCR (kW)	30	45	60	80	100	140
Start-up time pellets	6	6	6	6	6	6
Start-up time 25%MC chip	8	8	8	8	8	8
Start-up time 35%MC chip	10	10	10	10	10	10
	At low load	At full load				
Boiler flow (degC)	90	90	Adjust temperatures to suit application			
System return (degC)	60	60	Adjust temperatures to suit application			
Vol @ LCR	658	986	1315	1753	2192	3069
Buffer volume for start-up						
Start-up pellets	263	395	584	789	1052	1403
Start-up 25%MC chip	351	526	779	1052	1403	1870
Start-up 35%MC chip	438	658	974	1315	1753	2338
Total volume pellets	1000	1381	1900	2542	3244	4471
Total volume 25% chip	1008	1512	2094	2806	3595	4939
Total volume 35% chip	1096	1644	2289	3069	3945	5406

Please note that this spreadsheet is to offer an indication of the accumulator capacity in various applications. It is not a prcise calculator, only an indicator.
If you have any comments please email them to fleg@viessmann.com
As more information is gained then the figures above may be revised.

System expansion



Expansion calculation

The Expansion Calculator provides the Heating System Total Volume and Total Expansion. It is provided for your assistance by gf consulting.
Please send comments & suggestions to:
info@gf-consulting.co.uk

Date: null
CUSTOMER: Gatley : _exp02.pdf
BOILER: Koeb KRT-150

Output data	
Boiler room pipes	45 litre
Boiler volume	432 litre
Buffer volume	4000 litre
Distribution pipes	207 litre
Radiator system	1500 litre
UFH system	570 litre
Boiler degC	95 degC
Distribution flow	82 degC
Distribution return	71 degC
Radiators	80 degC
Underfloor	50 degC
Total volume	6754 litre
Expansion	242 litre
Cold feed	**11 m**
High pressure	**26 m**
Low pressure	**7 m**
Gas pressure	**7 m**
Expansion vessel	**675 litre**
Boiler room pipes volume	50nb, 20m, 39 litre
Boiler room pipes volume	40nb, 5m, 6 litre
Distribution pipes volume	50nb, 80m, 157 litre
Distribution pipes volume	40nb, 40m, 50 litre

Because biomass boilers are normally fitted with accumulators it is essential that the system expansion is calculated to prevent the system pressure rising above the set point.
On very large systems you can find expansion vessels with built in compressors or Warmac type inert gas systems.
Systems should conform to the HSE Guidance Note PM5.

Fuel store sizing

Suggested minimum fuel stores for chip and pellets

Capacity of chip delivery vehicle	30	cu.m.
Capacity of pellet delivery vehicle	31	cu.m.
Hours per week - boiler enabled	84	hours

Chip stores are normally based on one week at peak load + one delivery + 10% — Weeks 1

& pellet stores on three weeks at peak load + one delivery + 10% — Weeks 2

The boiler rating is at maximum continuous output

Boiler ouput as % of peak load: 1

Highlight nearest value: 0.6

		Fuel store size			Weekly use			Annual use			
KÖB Viessmann boiler range	kW	Pellet		Chip	Pellet		Chip	Pellet		Chip	MW.hr
Pyrtec 1250	1250	**123**	cu.m.	**205**	40	cu.m.	156	364	ton	498	1,712
Pyrtec 950	950	**102**	cu.m.	**164**	31	cu.m.	119	277	ton	379	1,301
Pyrtec 720	720	**85**	cu.m.	**132**	23	cu.m.	90	210	ton	287	986
Pyrtec 530	530	**72**	cu.m.	**106**	17	cu.m.	66	154	ton	211	726
Pyrtec 390	390	**62**	cu.m.	**87**	13	cu.m.	49	114	ton	156	534
Pyrot 540	480	**68**	cu.m.	**99**	16	cu.m.	60	140	ton	191	657
Pyrot 400	360	**60**	cu.m.	**83**	12	cu.m.	45	105	ton	144	493
Pyrot 300	270	**53**	cu.m.	**70**	9	cu.m.	34	79	ton	108	370
Pyrot 220	200	**48**	cu.m.	**61**	6	cu.m.	25	58	ton	80	274
Pyrot 150	135	**44**	cu.m.	**52**	4	cu.m.	17	39	ton	54	185
Pyrot 100	90	**41**	cu.m.	**45**	2.9	cu.m.	11	26	ton	36	123

Fuel costs compared

Fuel		netCost(p/kW.h)	eff	finalCost(p/kW.h)
Electricity		12	100	12
LPG	51p/litre	6.9	80	8.6
Light Fuel oil	64p/litre	6.4	75	8.5
Light Fuel oil	48p/litre	4.8	75	6.4
Kerosene	45p/litre	4.8	75	6.4
Natural gas	4p/kW.h	4.5	75	6.0
Pellets	£200/ton	4.2	85	5.0
Wood chip	£100/ton	2.9	85	3.4
Logs	£50/ton	1.5	80	1.8

Final cost = (net cost) * 100 / efficiency

Renewable Heat Incentive example

Total load MWh	Peak load kW	%biomass	Bio blr kW	MWh biom	MWh oil	Cost biomass	Cost oil	RHI	Net cost	RHI T1 MWh	Finance over 10yr	Total cost
480	400	100	400	480	0	£16,134	£0	£23,520	-£7,386	525.60	£20,000.00	£12,614.45
480	400	60	240	442	38	£14,844	£3,277	£17,977	£143	315.36	£12,000.00	£12,143.06
480	400	55	220	422	58	£14,198	£4,915	£16,831	£2,282	289.08	£11,000.00	£13,282.20
480	400	50	200	408	72	£13,714	£6,144	£15,781	£4,077	262.80	£10,000.00	£14,077.09
480	400	45	180	384	96	£12,908	£8,192	£21,635	-£535	236.52	£9,000.00	£8,464.88
480	400	40	160	350	130	£11,778	£11,059	£19,412	£3,425	210.24	£8,000.00	£11,425.19
480	400	35	140	317	163	£10,649	£13,926	£17,190	£7,385	183.96	£7,000.00	£14,385.50
480	400	30	120	288	192	£9,681	£16,384	£15,063	£11,002	157.68	£6,000.00	£17,001.55
480	400	25	100	240	240	£8,067	£20,480	£12,553	£15,995	131.40	£5,000.00	£20,994.63

This example compares an oil fired installation with a biomass and oil fired installation.
You need to use your own data for the capital cost and finance.
This example shows that the boiler sizing is now more complicated.

We are here to help

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Mobile: 07824 328 551

www.viessmann.co.uk www.gf-consulting.co.uk