

## SPARGING

The same hose connection for wort hydration is used to connect from the water mixer to the sparge arms.

- ❖ Connect the hose to the spurge arms assembly.
- ❖ Adjust the hot and cold valves to obtain the desired flow rate and temperature.
- ❖ Whilst the mash is standing increase the temperature in the HLT by 10°C.

## 4.2 Operating the Copper

### FILLING

- ❖ The sweet wort from the Mash Tun is pumped across to the Copper via the underback.
- ❖ When the float switch (if one is fitted) is activated the immerser heaters are no longer inhibited and can be switched on so that the incoming wort is heating as it fills the Copper.



### CONTROLLING THE BOIL

- ❖ The boil can be controlled by switching on or off the three immersion heaters independently.
- ❖ Bittering hops are added at the start of the boil.

### CASTING

- ❖ After the specified boil time, add the required number of “copper fining tablets (one per barrel and one for luck) ten minutes prior to the end of the boil time. At the end of the boil check the specific gravity is slightly higher than that required in FV (if it is not, boil for another 20–30 minutes and check again). The Copper is ready to empty or “cast”.
- ❖ Aroma hops are generally added 15 minutes before the cast.
- ❖ Open and close the relevant valves so that wort from the Copper recirculates from the upper dish outlet through the pump and back to the Copper via the whirl inlet for about fifteen minutes.
- ❖ Before the end of the recirculation period set up the route through the Heat Exchanger to the chosen FV remembering to make the hose connection from the filling main to the FV.
- ❖ Set up the route for the cooling liquor from CLT and back to HLT through the HE.
- ❖ After the fifteen minutes the recirculation valve back to the whirl inlet is closed and the pump is switched off continue to whirl for another fifteen minutes. Switch on the copper pump and slowly open the forward flow valve to the Heat Exchanger simultaneously start the CLT pump and open the HL to HE valve.

## 4.3 Operating the Heat Exchanger

### WORT COOLING

- ❖ The hot wort from the Copper is cooled as it is pumped through the parallel plate Heat Exchanger. Cold water on one side of the plates cools the hot wort on the other side of the plates. Both liquids are pumped through the “paraflow” in opposite directions. The resultant heated water is pumped to the HLT ready for the next days brewing or cask washing and the cooled wort is collected in the FV and “pitched” with yeast.

- ❖ The desired temperature of the cooled wort is achieved by adjusting the wort flow rate – normally full flow and the cold water flow rate – throttled back as required and reading the resultant temperature ex Heat Exchanger.
- ❖ When the wort transfer is complete close all the valves and switch off both pumps.



### **FV COLLECTION**

- ❖ Immediately after adding the aroma hops put on your goggles and spray the inside of the FV with peracetic acid (terminal sterilant). This oxidises any bacteria and degrades into water and thus will not require rinsing and takes about 20 minutes to work.
- ❖ The original gravity has to be corrected to the required value.
- ❖ Measure the dry dip and take the specific gravity at 20°C, assuming the specific gravity is higher than required. Add the required amount of water necessary to give the target specific gravity. Use the following formula.
- ❖ Existing volume X existing SG / required SG = required volume.
- ❖ Subtract the existing volume from the required volume to determine the amount of water to be added (or look up the dip equivalent to the required volume and run to that level using the dipstick).
- ❖ Add the yeast.

### **FV CLEANING**

- ❖ Hose out as much “soil” as possible
- ❖ Put on your goggles and rubber gloves
- ❖ Make up five gallons of detergent to 1.5% (see appendix)
- ❖ Close the FV outlet valve
- ❖ Connect the FV outlet to the circulating pump inlet
- ❖ Add the detergent to the FV to be cleaned
- ❖ Fix the flow pipe to the inlet spigot on the FV lid and connect this pipe to the pump outlet with a flexible hose
- ❖ Tighten the FV lid
- ❖ Check all pipe connections
- ❖ Plug in the circulating pump
- ❖ Open the FV outlet
- ❖ Switch on the pump
- ❖ Now go and have a cup of coffee or a beer!
- ❖ Pump the detergent into an empty tank for reuse or if “spent” run to the drain
- ❖ Rinse the tank and check with phenolphthalein indicator that all detergent has been removed as below
- ❖ Close the tank and keep it airtight

## LINE CLEANING

- ❖ All hoses and lines should be washed out with hot water and then be left filled with detergent.
- ❖ Prior to use they should be rinsed and the presence of residual detergent tested for with one or two drops of phenolphthalein indicator (blood red indicates further rinsing is required).

**BEWARE: PHENOLPHTHALEIN IS A VERY VICIOUS AND ALMOST INSTANTANEOUS LAXATIVE**

## 4.4 Brewery Water System

### CLT OPERATION

- ❖ The CLT is filled as it empties through a ball float valve fed from the pressure water supply.
- ❖ The CLT is cooled to the desired temperature by means of the cooling jacket, which is fed from the cooling circuit.
- ❖ If a temperature controller is supplied, the desired CLT temperature is adjusted by pressing set on the CLT temperature controller on the main Brewhouse control panel and then adjusting it up or down and finally pressing set.

### HLT OPERATION

- ❖ The hot liquor is usually the “return liquor” from cooling the previous day’s wort in the heat exchanger however, the HLT is fitted with an electric immersion heater for trim heating of the hot liquor.
- ❖ The HLT can be topped up with cold water by hose for the nearby wall tap.

## 4.5 Brewery Cooling System

### REFRIGERATION UNIT

The refrigeration unit is a self-contained air-cooled unit.



## 4.6 Fermenting and Conditioning the Beer

### FERMENTING

The yeast used is either reconstituted dried yeast or repitched healthy yeast collected from a previous brew and stored under mild refrigeration (it must not be allowed to freeze).

Reconstituted dried yeast comes in 500g packets. We use between 125 and 150g per brew (depending on SG and quantity). If the packets are resealed and refrigerated under the same conditions as for liquid yeast (see below) it will keep for up to 2 weeks without appreciable reduction in viability.

The yeast should be rehydrated by mixing with at least 10 times its own weight of boiled water cooled to 37°C. It is added to the FV “pitched” once the required SG has been reached. (When you are and experienced and there is no likelihood of reboiling the wort becoming necessary due to human error, the yeast can be added as the FV is filling). Yeast multiplies as it ferments and approximately 7 times the quantity pitched, is harvested.

If using the repitched yeast, it should be checked for possible bacterial infection and viability (number of dead cells) using a microscope, methylene blue stain (colours or dead cells are blue) and a haemocytometer (which gives an accurate way of counting the cells).

The beer will ferment for 3–4 days @ 28°C prior to chilling and the addition of auxiliary finings which electrostatically assist the precipitation of the yeast and the consequent effectiveness in cask of the isinglass finings. Depending on the temperature and atmospheric conditions, this precipitation takes anything from 24 hours to 4 days.

## 4.7 Casking and Bottling for free sales, Jug Bar, James Fewell and Lord Mayor’s Bars

It has to be decided whether the beer is to be used for casking, bottling or a combination of both.

Cask beer is a living beverage containing a small proportion of yeast which is left in suspension which will affect the beer (but perfectly drinkable flavourwise). The yeast continues to ferment the residual sugar in the beer and causes a certain amount of carbon dioxide to dissolve in it. It is this dissolved carbon dioxide which is referred to as “condition”. The beer also needs time to mature (otherwise it will taste “green” – immature). It is advisable to empty each FV in one operation to avoid losing the natural condition built up in the tank.

### RACKING

The appropriate number of casks (which will have been pre-rinsed on return to the brewery) will be rinsed, have a keystone bung fitted in the “head”, sterilised with hot water filled and kept full until one cannot hold one's bare hands on the cask and that temperature is maintained for at least 60 seconds. They will then be emptied, manually, (visually) inspected for foreign bodies and taint (smell) prior to being filled through the orifice in the belly and the shive fitted.

Depending on the ultimate destination, number of movements and length of time prior to use, the appropriate quantity of freshly diluted isinglass finings (the final clarification agent) will be added. Although the addition rate usually only varies with the type of beer being produced and the slight changes in composition of the new seasons materials relative to those of the previous season, the fining rate is cross-checked with each batch of beer using predetermined quantities of beer and finings prior to racking each tank.

Once the eventual fate of the cask beer is determined prior to fining, quantity to be used is decided. Finings act a finite number of times (about 4) and after each cask movement the fining time is extended thus the more times the cask is likely to be moved proportionately more finings (up to 15%) need to be used.



## **BOTTLING**

The beer we bottle is truly bottled draught beer and is termed bottled conditioned. That is the same physical reactions and changes occur in the bottles as in the casks.

The bottles are new and apart from those we use in the Prestoungrange Gothenburg and supply locally are “one trip”. The former are treated in the same way as if they were casks. Brand new bottles only require rinsing with peracetic acid.

Because the “bottle conditioned beer” requires a slightly higher level of carbon dioxide than in draught beer, it is further “primed” with a sugar solution of “krausened” with 10% newly brewed beer (one or two days in FV).

The bottled beer will require “conditioning” for two or three weeks (depending on ambient storage temperature). As the yeast deposit is not held to the bottom of the bottle with finings, the beer has to stand for at least 24 hours to permit settling (although drinking the yeast sediment provides vitamin B12 Niacin and Riboflavine – also found in Marmite which is made from surplus Brewers’ Yeast).

### **4.8 Pumping to the James Fewell and Lord Mayor’s Bars**

The casks are stillaged on their bellies or in Scotland – “craned” on end to allow the finings to work for the last time.

Stillage beers have a tap inserted in the keystone plug in the head of the cask (which becomes the end) and a spile (conical wooden peg) inserted into the “tut” in the “shive”.

Initially, the spile is of porous bamboo which allows the excess condition to “work” once this has occurred (anything from one to three days). A hard spile (grain going across the diameter) is used to keep the satisfactory level of condition in. The spile is loosened or removed whilst the beer is being served (i.e. at the beginning of each opening time) and replaced at the end.

In the case of “craning”, an extractor (long tube within a tube with both tubes valved) is inserted through the keystone (which is uppermost – the cask being on its end). The valve in the outer tube serves the same function as the spile. The valve in the inner tube controls the flow to the place where the beer is being served.

If the distance from the cellar to the bar is long (or if traditional “tall fonts” are used as opposed to “beer engines” which are effectively hand pumps) the beer is assisted to the point of dispense by either electric pump with a pressure drop demand switch “Flo-jet” gas (CO<sub>2</sub> Nitrogen or compressed air) operated diaphragm valve with pressure drop control, or air top pressure. (CO<sub>2</sub> or Nitrogen negates the beer being “real”.)

All the pipes and dispense apparatus are flushed out with water after a cask empties and should be detergent cleaned at least once a week – more often if the bars are busy.



# Appendices

## A.1 Types of Beer

Beer can be brewed in two ways. Either one uses modern technology or the traditional means such as we are doing in our microbrewery at The Prestoungrange Gothenburg. There are also two main types of beer – ale and lager.

The ale family includes stouts, milds, bitters, old ales and barley wines.

- ❖ **Ales** – such as Deuchars IPA are brewed with top fermenting yeast at cellar temperature. It is a shorter more vigorous fermentation and the yeast forms a thick head at the top of the fermenting vessel. Ales are fuller-bodied with nuances of fruit or spice and a pleasant hop finish. Ales are often darker than lagers, ranging from rich gold to reddish amber.
- ❖ **Dry Beers** – such as Ashahi, Bud Dry, have a crisp and clean finish since more of the natural sugars are turned into alcohol during brewing. This process results in a medium-golden beer that tastes less bitter and leaves little aftertaste
- ❖ **Light Beers** – such as Stella Artois Lite, are extremely light in colour and body, and mild in flavour. Light beers are highly carbonated with low bitterness and no aftertaste. Light beers have fewer calories and/or lower alcohol content.
- ❖ **Draught Beers** – such as Belhaven Best and Caledonian 80/- come light or dark in any style. Draught beer is simply any beer served from a keg or cask. Fresh tasting and easy to drink, draught beer in bottles or kegs has slightly lower carbonation levels so is less filling than other bottles and cans.
- ❖ **Malt Beers** – such as Hoegaarden Grand Cru or Duval, are higher in alcohol content with 5.5% to 8.0%. Malt beers boast a rich, full flavour – heavier and sweeter than other beers. Their colour ranges from deep gold to amber and then to firelight red.

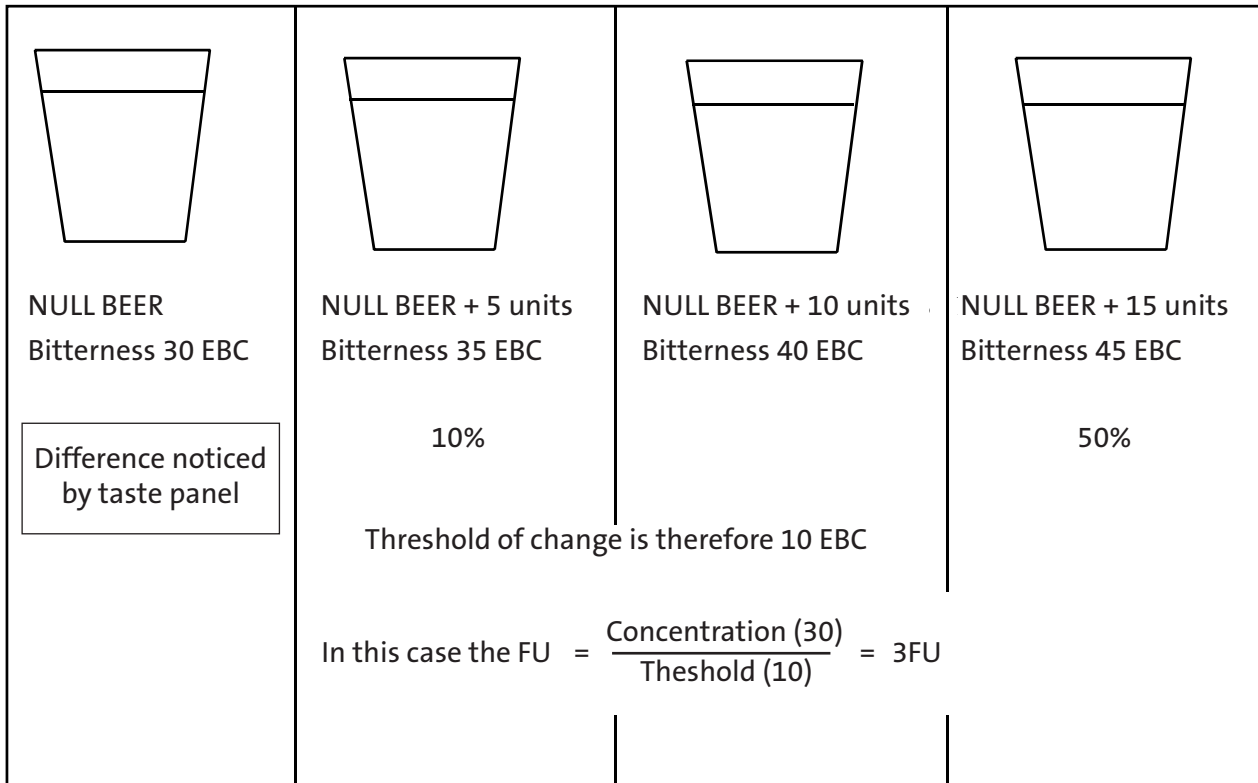
Stout Beers – such as Guinness or Murphy's are deep, dark and flavourful. Smoother and creamier, stout earns its character from brewing with highly roasted malts. Stout features intense malt and caramel flavours and depending on the variety ranges from sweet to dry and distinctively bitter.

Lagers – such as Carling, Becks or Stella Artois are brewed with a bottom fermenting yeast, one that sinks to the bottom of the fermenting vessel at a cooler temperature for flavour followed by a long period of cool conditioning. Pale golden colour, carbonated and lightly hopped, lager is a hot weather crowd-pleaser that tastes crisp and refreshing. When it comes to lagers the best known variety is a Pilsner.

## A.2 Measurement of Flavour Strength (FU's)

$$\text{FU} = \frac{\text{Concentration}}{\text{Threshold}}$$

*e.g.*



There are nine primary flavour 'notes' in any normal beer, with each note having a level of intensity called a Flavour Unit:

- 1 Bitterness
- 2 Carbonation
- 3 Aromatic Kettle Hop
- 4 Alcoholic
- 5 Sweet
- 6 Fruit
- 7 Caramel (Sweet ... /Dry...)
- 8 Acidity
- 9 DMS

<b>BEER TYPE</b>	<i>Colour EBC</i>	<i>Original gravity</i>	<i>Bitterness EBC</i>	<i>Alcohol % vol.</i>	<i>CO<sub>2</sub> Vol. Draught + Bottle</i>	<i>Caramel in flavour units</i>	<i>Bitter in flavour units</i>	<i>Principal aromatic flavouring Hops</i>	<i>Taste difference Hop Oil (mg)</i>	<i>Sweet in flavour units</i>	<i>Fruity in flavour units</i>	<i>Alcohol in flavour units</i>
<b>BITTER</b>	12–25	36–42	25–35	3.0–4.0	1.0 DR 2.5 BTL	1–4	3–6	EASTKENT T 2–4 FU Golding (4 mg/L)	1	1	1–3	
<b>MILD</b>	25–100	33–38	15–20	3.0–3.5	1.0 DR 2.5 BTL	3–20	1–2	FUGGLES 1–3 FU (3 mg/l)	1	1–3	1–2	
<b>DRY IRISH STOUT</b>	150–300	38–50	40–50	3.8–4.3	1.0 DR 2.5 BTL	40–100	6–10	FUGGLES 2–4 FU (10 mg/l)	2.5	0.5	1	
<b>PILSNER (PILSEN)</b>	6–10	49	40–55	5.5	2.5 DR 3.0 BTL	0.5–1.0	6–10	SAAZ 6–10 FU (7 mg/l)	0.7	1–2	1–1.5	
<b>U.S LAGER</b>	6–10	49	15–20	5.0	2.5 DR 3.0 BTL	0.5–1.0	1–2	TETNANG 0.5 FU (1 mg/l)	0.5	2.5–3.5	2–3	
<b>PILSEN GERMAN</b>	6–14	49	30–40	5.0	1.5 DR 3.0 BTL	1.0–3.0	4–6	HALLER– TAU 5–9 FU	1	1–2	1–1.5	
<b>SPECIAL BITTER</b>	15–30	>55	30–40	>6.0	1.0 DR 2.5 BTL 3–5 FU (8 mg/l)	1.5–6.0	2–5	EASTKENT	1.5	1.5–4.0	2–4	1.5–2.5 FU
<b>EXPORT STOUT</b>	120–250	80	40	>7.5	DR 2.5 BTL	30–60	4–7	FUGGLES 2–3 FU (9 mg/l)	3	2–3	2–5	2.0–3.0 FU



# FOWLER'S ALES [PRESTOUNGRANGE]

THE PRESTOUNGRANGE GOTHENBURG, PRESTONPANS, EAST LoTHIAN, SCOTLAND EH32 9BE

**BREWHOUSE CONTROL SHEET**

**BREW DATE** .....

**BREW N<sup>o</sup>.** .....

**QUALITY** .....

**BREWSET** .....

## MASHING

## MALT GRIST

		QUALITY	WEIGHT Kg
MASHING IN STARTED			
MASHING IN STOPPED			
LIQUOR STRIKE TEMP.			
MASH TEMP.			
LIQUOR USED			
<b>OTHER ADDITIONS</b>			

## WORT RUNNING TO COPPER

STARTED		STARTING GRAVITY	
STOPPED		FINNISHING GRAVITY	
SPARGE TEMP.		COPPER UP GRAVITY	
LIQUOR USED			

## WORT BOILING

## HOP GRIST

		QUALITY	Wt. Kg	ADD. TIME
BOILING STARTED				
BOILING STOPPED				
CASTING GRAVITY				
CASTING VOLUME				
<b>OTHER ADDITIONS</b>				
		DESCRIPTION	Wt. Kg	ADD. TIME

## WORT COOLING

STARTED		HL VOLUME START	
STOPPED		HL VOLUME FINNISH	
WORT EXIT TEMP.		HL TEMP.	
TEMP IN FV		FV N <sup>o</sup>	

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THE PRESTOUNGRANGE GOTHENBURG, PRESTONPANS, EAST LoTHIAN, SCOTLAND EH32 9BE

**BREWHOUSE CONTROL SHEET**

**BREW DATE** .....

**BREW N<sup>o</sup>.** .....

**QUALITY** .....

**BREWSET** .....

## MASHING

## MALT GRIST

		QUALITY	WEIGHT Kg
MASHING IN STARTED			
MASHING IN STOPPED			
LIQUOR STRIKE TEMP.			
MASH TEMP.			
LIQUOR USED			
<b>OTHER ADDITIONS</b>			

## WORT RUNNING TO COPPER

STARTED		STARTING GRAVITY	
STOPPED		FINNISHING GRAVITY	
SPARGE TEMP.		COPPER UP GRAVITY	
LIQUOR USED			

## WORT BOILING

## HOP GRIST

		QUALITY	Wt. Kg	ADD. TIME
BOILING STARTED				
BOILING STOPPED				
CASTING GRAVITY				
CASTING VOLUME				
<b>OTHER ADDITIONS</b>				
		DESCRIPTION	Wt. Kg	ADD. TIME

## WORT COOLING

STARTED		HL VOLUME START	
STOPPED		HL VOLUME FINNISH	
WORT EXIT TEMP.		HL TEMP.	
TEMP IN FV		FV N <sup>o</sup>	

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THE PRESTOUNGRANGE GOTHENBURG, PRESTONPANS, EAST LoTHIAN, SCOTLAND EH32 9BE

**BREWHOUSE CONTROL SHEET**

**BREW DATE** .....

**BREW N<sup>o</sup>.** .....

**QUALITY** .....

**BREWSET** .....

## MASHING

## MALT GRIST

		QUALITY	WEIGHT Kg
MASHING IN STARTED			
MASHING IN STOPPED			
LIQUOR STRIKE TEMP.			
MASH TEMP.			
LIQUOR USED			
<b>OTHER ADDITIONS</b>			

## WORT RUNNING TO COPPER

STARTED		STARTING GRAVITY	
STOPPED		FINNISHING GRAVITY	
SPARGE TEMP.		COPPER UP GRAVITY	
LIQUOR USED			

## WORT BOILING

## HOP GRIST

		QUALITY	Wt. Kg	ADD. TIME
BOILING STARTED				
BOILING STOPPED				
CASTING GRAVITY				
CASTING VOLUME				
<b>OTHER ADDITIONS</b>				
		DESCRIPTION	Wt. Kg	ADD. TIME

## WORT COOLING

STARTED		HL VOLUME START	
STOPPED		HL VOLUME FINNISH	
WORT EXIT TEMP.		HL TEMP.	
TEMP IN FV		FV N <sup>o</sup>	

# FOWLER'S ALES [PRESTOUNGRANGE]

THE PRESTOUNGRANGE GOTHENBURG, PRESTONPANS, EAST LoTHIAN, SCOTLAND EH32 9BE

### FERMENTATION CONTROL SHEET

**BREW DATE** .....

**BREW N<sup>o</sup>.** .....

**QUALITY** .....

**FV N<sup>o</sup>.** .....

DATE	TIME	GRAVITY	TEMP°C	OBSERVATIONS	INITIAL

