2 The Fundamentals

After both parties have reached an agreement for conducting the brewhouse evaluation, a binding appointment is made.

The parties should first agree which beer (or if applicable, which two beers) should be brewed for the evaluation. The batches of a single type of beer should be analyzed sequentially in the order they were brewed during regular operations. If contractual provisions stipulate that two different beers are to be brewed for the evaluation, parameters for each of the various standard values should be specified for every beer, if necessary.

2.1 Production of Test Batches (Brewhouse Evaluation)

The following number of batches are recommended for conducting a brewhouse evaluation, which can be divided into two parts:

Mechanical:	maximum number of batches brewed per day; there is a three-batch minimum [13]
Analytical:	half of the maximum number of batches per day, but as agreed upon, at least three batches of the same beer

The mechanical and analytical assessments are performed on the same batches of wort.

A preliminary analysis of the raw materials, grist, kettle wort prior to boiling, hot cast-out wort and cold pitching wort should be carried out prior to the evaluation for purposes of orientation.

If machinery or other parts of the brewhouse are subsequently replaced or refurbished, there can be no guarantee regarding the performance of the existing parts of the brewhouse beyond the standard technical guarantees from the supplier. At the most, goals can be formulated which are then verified by means of separate evaluations performed before and after any changes to the brewhouse occur.

The brewhouse evaluation is based on one type of beer. The batches of wort are analyzed, and the mean values calculated, which in turn serve as the basis for the evaluation.

The individual values are to be checked for outliers arising from any process and system-related disruptions which may have occurred during production of the batches used in the evaluation. The mean values of the results must be rounded to the respective decimal places specified in each of the recommended analyses below. In cases of doubt, the standard values of MEBAK® and the statistical metrics for the analysis (r, R) must be taken into account. If more than six batches are used in the evaluation, the confidence intervals may also have to be considered.

2.1.1 Internal Evaluation

An internal evaluation is carried out in cooperation with staff members of both parties, i.e. the buyer and the supplier. All relevant samples must be analyzed in a laboratory with DIN EN ISO/IEC 17025 accreditation.
If the results of an internal evaluation are not deemed agreeable by both parties, the parties must bring in an independent expert (by mutual agreement) to review the analysis results and documents, in order to provide a neutral, expert opinion. The degree of success achieved within the framework of the evaluation should be documented.

2.1.2 Evaluation by an Independent Expert

An independent evaluation is conducted by the buyer and the supplier under the supervision of an expert. All relevant samples must be analyzed in a laboratory with DIN EN ISO/IEC 17025 accreditation.

2.1.3 Reporting Evaluation Results

Evaluation result – “no deficiencies”:
The parameters specified in the guarantee concerning the performance were demonstrated to have been completely fulfilled in the evaluation.

Evaluation result – “with minor deficiencies”:
The brewhouse or parts of it comply with the parameters specified in the guarantee and is/are being used as intended by the buyer. The deficiencies identified must be rectified by the party responsible within a period of time mutually agreed upon by both parties.

Evaluation result – “with significant deficiencies”:
Several key parameters were not met; however, the brewhouse or parts of it can still be used as intended by the buyer with some limitations. The deficiencies identified must be rectified by the party responsible within a period of time mutually agreed upon by both parties. After corrective measures have been taken, parts of the evaluation must be repeated to ensure compliance.

Evaluation result – “with critical deficiencies”:
The brewhouse or parts of it cannot be used as intended by the buyer. The deficiencies identified must be rectified by the party responsible within a period of time mutually agreed upon by both parties. After corrective measures have been taken, a new, complete evaluation must be conducted.

2.1.4 Costs Associated with the Brewhouse Evaluation

It is recommended that the cost of the brewhouse evaluation, as well as those for the analyses, be included as part of the contractual agreement. If the evaluation reveals any significant or critical deficiencies, the cost of conducting a subsequent evaluation must be borne by the party responsible for incurring the cost.
In case of differences of opinion regarding the outcome of the evaluation, both parties must submit to the opinion provided by the independent expert contracted to conduct the evaluation as described in section 2.1.2 – Evaluation by an Independent Expert.

2.2 General Information

In order to simplify the brewhouse evaluation, the test batches should be produced without the re-utilization of by-products to the greatest extent possible. If this cannot be avoided, then the quantity of any by-products being reintroduced in the brewhouse must be measured and taken into account.
If by-products are returned to the brewing process (e.g. hot break material and/or last runnings), any standard values impacted by this procedure must be agreed upon by the contract partners and documented in writing.

Figure 1: General information sheet

Type of beer(s):	
Number of batches/24 h:	
Number of batches analyzed:	
pH adjustment:	yes/no
if yes, then method/volume/time:	
Enzyme additions:	yes/no
if yes, then procedure/volume/time:	
Other additions or removals:	yes/no
if yes, then procedure/volume/time:	
Utilization of last runnings (refer to section 2.2 – General Information, paragraph 1):	yes/no
if yes, then extract/volume/time:	
Utilization of hot break material (refer to section 2.2 – General Information, paragraph 1):	yes/no
if yes, then extract/volume/time:	

Water	mash liquor:	hl
	volume of sparge liquor:	hl
	continuous/non-continuous:	
Malt	type:	kg
	type:	kg
	type:	kg
Adjuncts	type:	kg
	type:	kg
	type:	kg

Hops	product:	time of addition:		kg
	product:	time of addition:		kg
	product:	time of addition:		kg

2.3 Isomerization Rate (Bitterness Yield, Hop Yield)

It is well known that the isomerization rate of the acids derived from hops is dependent on various factors. Among others, the point in the wort boiling process at which the hops are added (the mean boiling time of the hops), the hop product itself and the number of additions can influence hop isomerization. Moreover, the composition of ions in the wort, particularly the concentrations of Ca and Mg, the wort pH, the duration of the boil and the holding time in the whirlpool all affect the isomerization rate of the bitter compounds in hops. Furthermore, the protein content of the wort also plays a role. Finally, the configuration of the brewing equipment (time required for adding hops) can impact the rate of isomerization. For the reasons listed above, it is difficult to define standard values, making it necessary for the buyer and the supplier to reach a mutual agreement based on their particular situation. The ratio of iso-*α*-acids measured in the cold wort to the quantity of wort α-acids added during wort production serves as the key value for expressing isomerization rates.

2.4 Standard Values for the Test Batches

First wort concentration:

Lauter tun: 16.0–21.0 % w/w [13]

When brewing ten or more batches per day, the soluble extract in the spent grain must be corrected to a higher concentration.

Mash filter and mash filter press: > 22.0 % w/w [13]

Cast-out wort concentration:

Lauter tun: 10.0–14.5 % w/w [13]

The following standard values are based on a cast-out wort concentration of 12.0 % w/w.
The standard values impacted by higher wort concentrations, including those typically encountered in high gravity brewing, must be adjusted accordingly.

Membrane filter and mash filter: 10.0–14.5 % w/w [13]