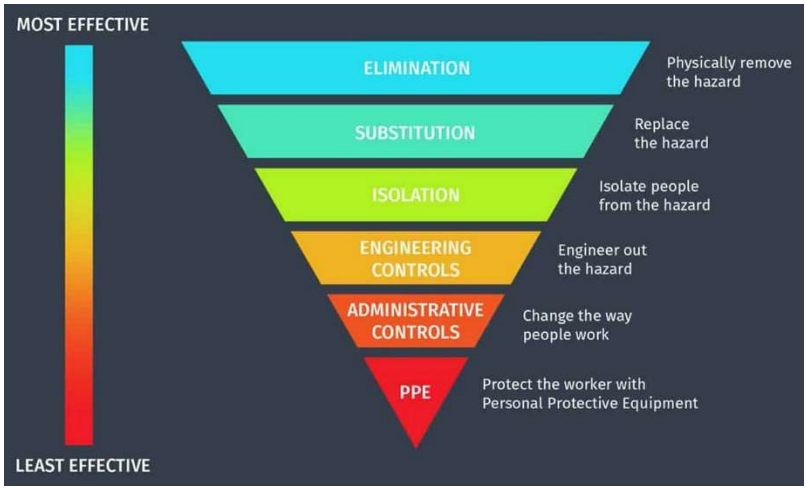
Master Brewers Safety Toolbox Talk

Controlling Brewery Hazards: Hierarchy of Control

Hazards are those things that can harm us. They include longer term harm, like exposure to a chemical, which doesn't show up for years, or the harm can be immediate, like a severe burn. We control the hazard to prevent harm. Potential harm includes potential serious injury or fatality—a brewery burn is one example. While not everyone is burned by hot wort, the potential is always present. Burns can be minor, such as reddened skin, or serious injuries can occur, like those received by an electrician a few years ago when a kettle of hot wort boiled over (Lasbury, 2021). Control of hazards is critical. Recognition is key.

It is important to be able to recognize hazards. Studies have found that workers typically fail to identify more than 55% of hazards in their immediate work environment (Albert et al., 2017). If I don't recognize a hazard, I won't protect myself from it. Thorough hazard assessments are necessary to identify hazards. Once identified, controls are determined. The most effective controls provide the most effective protections. If the best controls were in use, we wouldn't be hearing about injuries in breweries.

The hierarchy of control has six levels of control. Each level provides an increased level of protection compared to the level below it. The controls are elimination, substitution, isolation, engineering, administrative, and personal protective equipment (PPE). The higher up in the hierarchy the control is, the more protection it typically can provide from hazards. Administrative controls and PPE are controls that can provide some protection from hazards, but alone they may not provide enough protection. Because we as humans make errors, administrative and PPE controls may not work when we need them. Let's use the harm of hot wort contact due to kettle boil over to explain the levels of control.



Hierarchy of control measures. (Safe Work Australia. CC BY 4.0)

Elimination is control by physically removing the hazard. We must boil wort to create our beers, so we cannot eliminate the hazard of hot wort. We could eliminate having a brewer boil the wort by having a robot do it, but what fun would that be? Besides, it is impractical.

Substitution is control by replacing the hazard. Substitution is impractical for boiling wort but works well for chemicals. Instead of using highly dangerous chemicals, we can substitute safer chemicals to meet our needs.

Isolation keeps the brewer away from the hot wort. An example is to have the brewer watch the boiling kettle from outside a glass enclosure in which has been placed. A conveyor could be used to drop ingredients into the kettle. The brewer would never enter the room and wouldn't be exposed to a boil over. This may be impractical too. However, isolation is great for milling grain. The mill can be enclosed in a separate room, and the grain dust can be trapped in a collector so no one can breathe in the dust. This collection of dust eliminates the need for respiratory protection and dramatically reduces the potential for fire. It also eliminates beer spoiled by contact with grain dust.

Engineering can be used to eliminate the hazard of hot wort contact. Engineering controls are permanent and work automatically to protect the brewer. There are many ways to provide engineering control: position a shield between the brewer and the kettle to stop the splashing wort. The shield is in addition to any manway closure. If the closure is open at boil over, the shield is still in the way as protection. Alternatively, a sensor can be placed in the kettle. If the wort rises high enough, the sensor triggers a protective action. This action could shut off heat to the kettle or spray water on the wort. Remember that engineered controls may require testing to confirm proper function.

To protect effectively, the following controls require the worker to act. An error can be made that prevents the control from providing protection as intended. Some larger breweries may have the option of having workers perform activities in a control room. An evaluation needs to be completed to assess what actions are feasible and can be performed to protect employees.

Administrative controls dictate the way in which a brewer works. Brewery policies and procedures are administrative controls, as are OSHA regulations, ANSI standards, electrical codes, ASTM vessel standards, and UL standards. Procedures, laws, and regulations must be followed. However, these are written directions and policies and depend on the employee to follow the rules.

Best practices are also administrative controls. Best practices are the methods and techniques that we use simply because they keep a worker from harm. We follow best practices because it is the right thing to do. They may also preserve quality and limit loss of product. Administrative controls are not fail-safe, however. Someone can accidentally or willingly fail to follow a procedure or policy.

There are many examples of administrative controls. The best administrative control for boil over is free and is effective. Kettles are engineered with 35–50% freeboard space to allow liquids to expand and still be contained within the kettle. However, many breweries deliberately overfill their kettles (and fermenters) to squeeze out a few more gallons. There is risk associated with overfilling. The equipment was purposely designed with this freeboard space and ignoring the design specifications can lead to unexpected or unwanted consequences.

PPE is the weakest and least effective control, and it is the control that too many companies rely on to protect their employees. To choose PPE, we must assess the hazard of contact with hot wort.

At 140°F, 5 sec of contact creates a second-degree blistering burn. At 167°F, 5 sec of contact causes a third-degree, full-thickness injury (Moritzand Henriques, 1947). Beyond third-degree skin burns are fourth-degree bone burns.

Based on this assessment, are sandals, shorts, and short-sleeved shirts adequate? Probably not. A brewer recently told the story of his rubber-booted foot entering the hot liquids in the floor drain. The protective grating was not covering the drain. He quickly removed the boot from his foot, and a large amount of skin came off with the boot. If I use this boot-covered contact as an example, then I can assume that rubber boots and gloves provide limited protection at best.

Note that the hot liquids did not flow into his boot, which would have been worse. “Pants over the outside of boots” limit wort entering boots.

In summary, each of the six levels of control provides an increased level of protection to the brewer when an event occurs. During an event, we need controls that protect and will not fail. Failure is painful.

References

Albert, A., Hallowell, M., Skaggs, M., and Kleiner, B. 2017. Empirical measurement and improvement of hazard recognition skill. Saf. Sci. 93:1-8. DOI: https://doi.org/10.1016/j.ssci.2016.11.007.

Lasbury, M. E. 2021. Recent injuries remind us that craft brewing is a killer job. Indiana on Tap. Available online at

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Moritz, A. R., and Henriques, F. C., Jr. 1947. Studies of thermal injury: II. The relative importance of time and surface temperature in the causation of cutaneous burns. Am. J. Pathol. 23:695-720. PMCID: PMC1934304.

If you have any questions regarding process details, please see your supervisor/manager or a member of the Safety Committee.

Check out the Safety Toolbox Talk on *Hose Fitting Attachment Methods* for additional information.