

6.07

White paper

Yes, you need a combi

Executive Summary

Combi-steamers are the type of foodservice equipment that comes along every so often and changes how kitchens do business. They are widely used around the world, particularly in Europe, although acceptance has been more measured in the United States.

The principle benefit of a combi is the ability to cook a wide range of high-quality foods in a single unit that uses moist heat, dry heat or some combination of the two. This versatility is also what makes the combi a fairly complex piece of cooking equipment and subject to continual technical innovation.

Operationally, combis fall into two broad categories—those with integral boiler systems that heat water separately for distribution as steam in the cooking cabinet, and those without boilers. The latter generate steam spontaneously within the cooking cabinets by a variety of means. This differentiation can result in wide variations in cost, food quality, high-volume cooking performance, utility usage, and maintenance expense.

All else equal, boiler combis are costlier to buy and maintain, but deliver steam faster and more reliably. Methods by which steam is created in boilerless combis vary considerably. Of particular interest in this paper is a new design on the market that exhibits excellent steam generation and temperature/humidity control without a separate boiler.

Beyond the technical issues, it is important to understand how combis can help operators in all foodservice segments produce a wide range of high quality food in greater quantities using less labor. For large roasts, combis can reduce shrinkage by nearly a third. Excellent retherming capabilities make cook/chill programs and banqueting more productive. Restaurants and delis are expanding their menus and improving their profitability with combis that are easy to program, smaller units that can be stacked, and newer models with water-saving automatic cleaning.

Improve your understanding of combis and combi-cooking, then start shopping. You need one!

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Introduction

Combi-cooking has been easily integrated into foodservice operations worldwide, particularly in Europe, where many of the most popular combis were first introduced. From the beginning, the capacity and versatility of the units, along with the high quality of the food produced, were benefits clearly desired by chefs and kitchen managers almost everywhere but the United States. Acceptance in America was slow and uneven, mainly due to the different approaches and economic models at work among different segments of the foodservice industry.

For instance, non-commercial institutional feeding, such as school, hospital, military and prison cafeterias were fairly early adopters. Managers in those kitchens saw immediately the benefits of cooking high volumes of a wide range of menu items quickly in the same piece of equipment by virtue of convection heat, steam and a combination of the two.

Restaurants and delis, on the other hand, found many objections to counter the fairly obvious benefits. Early units were large and ungainly where kitchen space is always at a premium. The justification that a combi can replace a separate steaming cabinet and convection oven, while true, didn't necessarily make sense for cook-to-order restaurants that might need to bake and steam at the same time. The equipment was expensive to purchase and to own. High maintenance and repair costs were well-documented. Only well-capitalized chains would consider the economic justifications for combi-cooking.

As time went on, more and more U. S. manufacturers brought combis to market, and the choices and justifications became more apparent. Today, just about any type of foodservice operation can capitalize on the benefits of combi-cooking. And now buyers have another problem: There are several fundamentally different products out there under the "combi" label. These differences not only contribute to lower or higher prices, but

significantly affect the product quality, flexibility and energy savings combis are known for. This white paper will examine the essential features of today's combi-ovens and try to show you what to look for when considering this type of equipment for your kitchen.

* * *

What makes it a combi?

Most people already know that combis or combi-steamers are ovens that have the ability to cook with dry heat, moist heat or a combination of the two. Cooking with at least some moisture added to heated air is nothing new. Convection ovens with steam injection features have been around for a long time. What makes an oven a combi is the ability to generate enough steam in the cabinet to cook at 212°F (100°C.)

Boiler

The first combi-steamers created steam through separate boilers and then circulated it throughout the oven cabinet with a fan. By introducing dry convection heat, the oven temperature could be raised beyond steaming-only temperature and thus cook with super-heated steam. This provided hot, humid conditions that cooked food quickly without drying it out. "Wet" foods were started out with dry heat only, using moisture from the food to achieve a hot humid environment. Steam from the boiler could be introduced later in the cycle if needed, to maintain these conditions.

Boilerless

While many improvements to combi-ovens were made over the years, the fundamental design of a water fed reservoir with separately heated boiler is still used today in many units. However, another type of oven was developed that claimed combi status without the use of a boiler. These "boilerless" or steam injection combis were based on the idea that cold water could simply be run into the unit and sprayed on the oven's heating elements to produce steam as needed. No need for the reservoir and the additional heating element required to generate steam separately. This design made it more difficult to cook with steam only, especially for long periods of time. But without the boiler, these combis occupy a smaller footprint, use less water and are less expensive to buy and maintain.

Humidity control

A third resulting difference among combi-steamers has to do with the ability of the operator to *control* the amount of moisture in the cooking cabinet at any given time. With the technology described above, steam can be added at any time and in varying amounts. But how does anyone know how much is enough or how much is *too* much? Precise control of humidity in the cooking environment depends on two additional functions: the ability to release or vent excess steam when required, and the ability to *measure* the

relative humidity in real time. A few manufacturers have developed the digital control technology necessary for an operator to select a humidity level and have the machine measure conditions in the cabinet and add or remove moisture automatically as needed. Combis with true humidity control have increased flexibility and productivity by an order of magnitude. Delicate baking, low-temperature steaming, overnight roasting, high temperature grilling, and perfect retherming are just a few examples of what can be done in a single oven with this kind of control over the cooking process.

* * *

The boiler question

In recent years there has been a legitimate debate over the virtues of boiler and boilerless combis. Each basic design has its advantages and flaws. Often, the quality of the combi and its results depend on how its manufacturer has balanced one against the other.

Boiler combis—high performance, high maintenance

The basic advantage of boiler combis is performance. A boiler combi can give the operator a full cabinet of steam already at temperature very quickly. In the case of steam-only “mode”, dry heat elements are not needed at all. This energy-saving aspect is balanced against the energy required to preheat and operate the boiler at all times, whether steam is required or not.

The fundamental knock on boiler combis is the build-up of mineral scale in the boiler and the resulting expense of periodic professional de-scaling service. Without such service, performance can decline rapidly over time and cause a variety of failures. Compared to boilerless combis, maintenance and replacement costs associated with the boiler itself increase the cost of ownership and operation. Water usage in boiler combis is also very high.

Conventional boilerless combis—not so hot?

The advantages of boilerless combis are self-defining. In most cases, they are cheaper to make, cheaper to own and cheaper to operate. On the other hand, they aren’t particularly efficient, and in many cases are not capable of generating enough steam to recover properly. Thus, true steaming for full loads is difficult to achieve. At the very least, cooking times are extended and product quality can suffer.

A boilerless combi sprays water from a cold water line directly onto a very hot surface—either some part of the heating element itself, or onto the outside of a heat exchanger. The former design builds steam more quickly than the latter, although not nearly as fast as boiler combis. In addition, mineral deposits build up on the heating elements diminishing their efficiency and decreasing their useful life. The latter design avoids direct contact of water on heating elements. But, the heat exchanger is a much cooler surface, so steam builds even more slowly and less consistently. In steam-only

mode, water is constantly cooling the heating element or the heat exchanger, reducing the efficiency of the entire system.

Advanced Steam Technology—the best of both

There is at least one combi that effectively bridges the gap between boiler and conventional boilerless designs. [The SmartCombi™ from Henny Penny](#), introduced in the U. S. at the end of 2006 employs something called Advanced Steam Technology. (Fig 1.) This unit has no boiler and so avoids the maintenance and repair issues. Yet the design concept produces as much steam as needed almost instantly while preserving the efficiencies of both heating element and heat exchanger. How? By spraying water onto a specially designed rim that rotates with the fan. This rim is positioned toward the outer edge of the fan, taking advantage of high “circumferential” speeds to “mist” water evenly into the heated cooking chamber. Water droplets below a certain size are instantly turned to steam.

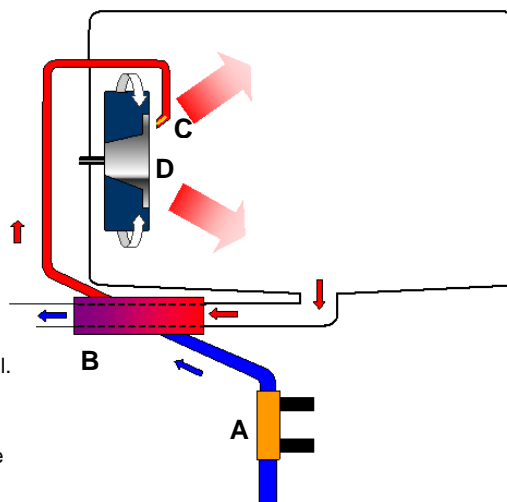
Fig. 1—Advanced Steam Technology



Above: Hot water from heat exchanger is regulated to spray on rim of high speed fan wheel. Water is misted to steam immediately.

Right:

- A. Water flow control module regulates pressure
- B. Integrated heat exchanger
- C. High amp thermocouple controls flow to rim
- D. High RPM fan wheel with rim to mist water



This patent-pending system addresses boilerless issues in a few different ways. First, the water flow to the diffusing rim is carefully regulated, insuring a constant rate regardless of variations in ambient water pressure. Second, sophisticated high-amp thermocouple sensors constantly measure actual conditions inside the cabinet, compare that information with demand and then control both the water flow to the rim and the cabinet temperature *in tandem*. This is important to understand because the system not only establishes the ideal proportion of hot air and water needed to produce steam instantly, it also renders the most efficient use of water and heat when cooking at temperatures above and below the boiling point of water.

The problem of mineral scale is also minimized. Hard water deposits will form fairly evenly through out the cabinet surface itself, rather than on heating elements or within boiler mechanisms that require professional service. The advantage is simply that scale

build-up causes no performance issues whatsoever. It is also easy to control simply by periodic cleaning with a commonplace descaling cleaner.

* * *

Control

Measuring humidity is more important than you think

In the case of Advanced Steam Technology, the ability to precisely control the cooking climate inside the cabinet enabled its designers to do more than tout perfectly cooked food. It helped them develop a more efficient and ultimately less costly way to generate steam in the first place.

Thermocouples and feedback loops may be fun for engineers to discuss, but it shouldn't be too surprising that foodservice operators on the whole aren't that interested in fancy humidity control technology. They're interested in results, ease-of-use and operating costs, pretty much in that order. Having said that, it bears repeating that *measuring and maintaining a desired level of humidity* is the best way to achieve the results they want and probably the only way to do so consistently.

Humidity comes from two sources: the food itself during initial cooking, and the addition of steam from the steam generating mechanism. Operators need to understand clearly whether a 50% humidity setting on their combi means that steam will be introduced during half of the duration of the cooking cycle, or whether there will actually be 50% humidity at all times in the cabinet. Once the food begins cooking, the two are likely to be very different. A full load of whole chickens, for example, will cook off a great deal of moisture. Without some means of measuring and *removing* excess humidity, humidity levels in the cabinet can easily climb to 80 or 90%. Reducing the humidity selection manually mid-cycle or turning the moist heat mode on or off during cooking amounts to guesswork.

Programming

As long as the combi features some version of electronic controls operators are usually able to create and store pre-set cooking programs. This feature is quite popular across the range of foodservice applications because it allows any user with minimal training to cook a variety of menu items at the touch of a button. Here, the control panel and user interface can be an important consideration, as well. Icons are used on most control panels to simplify basic operation. Some manufacturers have introduced food symbols that are pressed to select common factory-set cooking programs. Others use the food symbols for easy navigation to entire categories of programmed items. Main differences among models are the number of programs that can be stored and how easy or difficult it is to create, find and select them.

* * *

Capacity

So far, we have described some very sophisticated machinery that can create ideal cooking conditions for a variety of foods and do so in a more efficient way than most conventional equipment. However, we have yet to make the economic case for owning one. That argument begins with capacity.

Most combi ovens come in a variety of sizes from large, 20-rack/40-pan units with roll-in food carts to more recent models designed to hold five or six full-size pans. The power requirements relate directly to the size of the units and to the pan/capacity configuration. Top of the line combis will provide all the muscle you need to cook full loads quickly. Some manufacturers offer slightly less expensive versions with lower power ratings for foodservice applications where flexibility is more important than sheer volume at speed.

With the potential choice of power options, the foodservice manager should consider available pan capacity. Combis are designed to cook evenly with full loads. So it makes sense to know how much you *could* cook at one time. This becomes even more important when you trade longer cook times for lower power.

Unfortunately for the combi buyer, the answer is not always simple. Rack inserts that hold pans directly must be available or adaptable for the different sized pans that are in common use. Racks, of course, are much cheaper than combis, so a combi that adapts to different racks also makes sense.

For specific information on [Henny Penny SmartCombi™](#) racking solutions, see *Additional Information* at the end of this paper.

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The bottom line

In general, combis offer tremendous flexibility for the foodservice operator in terms of equipment utilization, labor productivity and cooking performance. Each of these aspects will have greater or lesser impact on bottom line profits for different foodservice segments. So let's take them one at a time.

Add a unit, multiply the value

A big selling argument in favor of combis that has not been well-articulated in the market is the idea that one combi can replace two or more conventional appliances, such as separate steamers, convection ovens, proofing cabinets or grills, thus saving floor space and maximizing the utilization of the new equipment investment. With a good combi, this is certainly the case. But the argument needs to be carried forward to where the true value lies. Many non-commercial operators, for instance, recognizing the inherent value of the combi's flexibility, order multiple units to replace conventional equipment. The benefit of saving floor space for some other use doesn't make a great deal of sense when you can replace a steaming cabinet, proofing cabinet and convection

oven with three combis that can each handle all three functions with standardization of pans, racks and accessories, while cranking out more than three times the product.

Restaurants and other commercial establishments attach much more value to floor space. But a similar disconnect in the argument occurs. What good is one combi that does three things if I need them all at the same time? These operators may want to take a page from the non-commercial book and consider multiple combis. In a smaller volume operation, the way to do this is to buy two smaller units and stack them in the same footprint. This is much easier to do than it was even a few years ago. Most manufacturers offer at least two capacities in a stackable version. An operator can, for example, install two six-pan units, or put a six-pan on a ten pan. With a high capacity rack/pan version, an operator can reserve the occasional need for high volume while having separate units in operation for a variety of simultaneous cooking tasks.

More skill time for skilled labor

Cooking good food is labor-intensive work. Much of that work, however, consists of checking on items, stirring, changing settings, combining separately cooked ingredients, adding or removing pan covers, turning or rearranging food as it cooks, etc. Combis have automated much of that work with multi-step cooking programs and the ability to create practically any ideal cooking climate. The result is that skilled labor has more time to plan menus, prepare complex items, manage the kitchen and consider strategic bottom line issues, such as energy conservation, supply chains or waste reduction. With programmable operation, the need for unskilled labor *and* supervision is reduced. Training costs are also minimized. Overnight cooking and automatic self-cleaning are other ways that a good combi can increase output while actually lowering labor costs.



Save floor space and add flexibility by stacking two units.

Fast cooking, no waste, very little shrinkage

One thing that is difficult to comprehend until you have actually cooked with one is how fast a good combi can cook amazing quantities of high-quality food. Speed is typically a function of the use of moist, intense heat that is constantly circulating throughout the cabinet. What is more remarkable are the combis that cook full loads so evenly, there is almost no over or under cooking anywhere in the cabinet. All combis are not capable of this, however. Air flow, cabinet design and racking are tricky issues to be carefully resolved in order to achieve constant, thorough circulation. One important feature to look for is an auto-reversing fan. Typically, auto-reverse fans spin one way for a short period of time and the reverse direction. In a properly designed cabinet, this duplicates the same air flow pattern in the opposite direction in an alternating fashion ensuring that the location and orientation of an item will have no affect on its cooked quality. Again, profitability skyrockets when you are able to cook more items per load in less time and with little or no waste.

Probably the best individual example of profit opportunities through combi cooking has to do with shrinkage of large roasts. Some combis have been shown to produce as little as 10 to 15% shrinkage, compared to 30% or more in regular ovens and even 18-20% in conventional slow-cook ovens. Further, Delta-T and slow roast cooking programs produce even core temperatures throughout each roast. High ticket items, such as Prime Rib, properly cooked in a combi can yield *up to 30% more servings per roast*.



Less shrinkage in a combi can mean up to 30% more servings per roast!

Energy and water conservation

Combis are powerful cooking machines. But a well-designed combi will incorporate many energy and water-saving features that increase the efficiency of the unit and minimize overall utility costs to the operator.

Every combi is a little different in the way it uses and transmits heat for cooking and generating steam. It is essential that your combi incorporates some form of integrated heat exchanger. This simple component pulls heat from piping hot drain water and uses it to heat incoming fresh water, thus protecting drain plumbing and lowering the work load on the heating elements without any additional energy consumption. Another built-in energy conserving feature to look for is a low-energy cooking function, which reduces energy demand when certain cooking techniques do not require it. Door seals and glass construction are very important in conserving heat energy. Multi-paned glass reflects energy back into the cabinet and helps keep water vapor and moisture from collecting along seals. Be sure the cabinet is fully insulated.

Water consumption has always been an issue with combis. According to Energy Star, a typical 10-pan boiler combi uses between 30 and 40 gallons of water per hour. (Fig 2.) Although steam injection boilerless combis cut that consumption by roughly two thirds, they are much less efficient in their use of power. We have shown how the newer Advanced Steam Technology boilerless design does a better job of using heat energy to create steam. In fact, it uses even less water on average than steam injection combis because a patent pending water flow control module maintains consistent water pressure without the need for recalibrating and clearing nozzle flow. Plus software regulates flow to demand, conserving energy required to heat water unnecessarily.

Fig. 2—comparing operating water consumption

10-pan combi	Boiler	No Boiler	SmartCombi/AST
Estimated average water consumption	30-40 gal/hr*	10-15 gal/hr*	Less than 13 gal/hr**

*As published by Energy Star http://www.energystar.gov/index.cfm?c=healthcare.fisher_nickel_feb_2005

**Manufacturer's installation guide. This rate calculated for constant steaming. Actual rate for comparison would be less.

Self-cleaning features also vary considerably among combis. Most offer several cleaning program choices, depending on how soiled the cabinet may be or how long a time the operator wishes the unit to be unavailable. Combi self-cleaning adds to the total water consumption. But, again, some manufacturers have figured out ways to reduce this. For example, on the SmartCombi, three different cleaning times are available, but they all use the same amount of water. The cleaning process, called WaveClean,[™] takes advantage of the water spray/diffusion rim technology to create agitating “wavelets” across the surfaces of the cabinet interior. This helps loosen and clean baked on material using a limited amount of water.

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Conclusion

Combi-cooking has already changed the way many institutional kitchens prepare food, and it is catching on rapidly in many other segments. Newer, more compact designs with a wider range of features are partly responsible. But the economics of cooking quickly, accurately, in large quantities, with a minimum of labor are undeniable.

Although sophisticated models can be expensive to purchase, they become quite affordable to own when increased yield, profitability and productivity are factored in. This is particularly true when cooking large roasts and whole birds.

It is important to choose wisely when buying combis. Size and capacity are factors that may relate to volume and menu variability. More important, performance can vary from model to model depending on the design. Combis with separate boilers, for instance, are known to create steam very quickly but present certain unavoidable maintenance issues. Boilerless—or steam injection—designs tend to require less water and maintenance but aren’t always reliable in their steam production. Some manufacturers, however, are introducing boilerless combis with designs that do a better job of steam generation.

As is often the case, the best choice depends on your particular application. Time to get shopping, though. The economic benefits and value to your customers are too good to ignore.

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Visit Henny Penny at www.hennypenny.com

Sources and background

Background—markets, economic justifications

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<http://www.caterersearch.com/Articles/2006/10/12/309410/how-to-cut-the-cost-of-cooking.htm>

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http://www.energystar.gov/index.cfm?c=healthcare.fisher_nickel_feb_2005

Additional information

Henny Penny SmartCombi™ racking and Crosswise Plus pans

The new Henny Penny Smart Combi comes in two power versions, designated as Series 1 and Series 2. The racking system for higher-powered Series 2 units accept (1) full size sheet pan or (2) 1/1 GN or full size steam table pans per shelf. The lower-powered Series 1 units can be equipped with two different racks, one for inserting (1) 1/1 GN or (1) full-size steam table pan per shelf crosswise, or a narrower rack for inserting (1) 1/ GN or full-size steam-table pan lengthwise.

Working on the principle that pans are cheaper than either rack inserts or combis, Henny Penny offers a line of special pans for use with the standard crosswise racking for lower power (Series 1) units. The pans, called Crosswise Plus, nearly doubles the per shelf capacity by having a much wider dimension than standard steam table pans or 1/1GN pans. Special “wings” allow the Crosswise Plus items to fit directly on a standard side-to-side racking insert while extending deeper into the cabinet.

With this system it is possible to load up a Series 1 unit with significantly more food than comparable units. A full Crosswise Plus load can take a little longer to cook in the low-power unit, but you wind up with a lot more food per load, ready to go. The profits can really add up, especially when cooking large roasts or whole birds.



Special pans for added capacity

Crosswise Plus pans are designed with special wings that to fit side-to-side racks while extending deeper into cabinet than standard steam pans or GN pans.