Condensers and reboilers for the space age

Compabloc®
The Compabloc “magic box”

The Compabloc® from Alfa Laval can truly be called a “magic box”. It is probably the most compact and efficient heavy-duty heat exchanger in the world. Its remarkable design adds a completely new dimension to the condenser and reboiler choices available – a dimension much smaller than you would previously have believed possible.

A unique concept
How is such wizardry possible? Like most magic, it seems easy when you know how. The Compabloc design is based on breakthrough technology that conjures up a whole range of significant advantages – all at the same time and in one compact unit. It operates with an extremely high thermal efficiency. Withstands aggressive media. Works at high pressures and temperatures. Features a welded plate pack. Can be tailored to suit your specific operating conditions. And requires a minimum of space.

In other words, it is the perfect choice for use in chemical and petrochemical applications, which are often characterised by stringent demands. You can install this small unit virtually anywhere – as a condenser or reboiler for distillation and stripping columns, as a condenser on top of reactors and in a wide range of other heat exchanger applications.

Designed for the space age
Compared with conventional shell-and-tube heat exchangers, the Compabloc works magic on your wallet. It not only requires a smaller volume and floor area, thus saving expensive space. It also substantially reduces investment costs and minimizes maintenance – with no sacrifices in reliability or safety.

Small wonder, then, that more than 2,500 Compabloc condensers and reboilers have been installed at chemical process plants all over the world since the design was first launched more than ten years ago.

The Compabloc has really worked its magic.
Adding a new dimension to condensers and reboilers

When you decide to install a condenser or reboiler, it is virtually standard practice to include a shell-and-tube unit in the specifications – it is the solution traditionally used by the chemical process industry.

However, in order to fully appreciate the advantages of the Compabloc design, you need to ignore traditional thinking and consider some new engineering ideas.

**Bulky & heavy ...**
Shell-and-tube condensers are extremely bulky, heavy items of equipment. This means there is only rarely any chance of mounting them anywhere else than at ground level – even though the place they are often needed is at the top of a distillation column. Shell-and-tube condensers take up a lot of the often limited floor space available because they are usually installed horizontally. They also require complicated, expensive piping that must reach from the top of the column down to the condenser and back. However, if you choose the option of installing a shell-and-tube condenser high up, you then have the problem of needing extremely costly foundations and structural work to support it.

Similarly, the best location for a reboiler is on the ground, close to the bottom of the column. But shell-and-tube based reboilers placed in this optimal location take up large amounts of the space that is often at a premium.

**... or compact & light**
By choosing a Compabloc design instead of a shell-and-tube unit, you can reduce the size of your condenser or reboiler by as much as 80%, automatically making the entire installation much lighter.

In condenser applications, this means you can install the Compabloc where it is most efficient, right at the top of the distillation column – or as close as space allows. No special construction work is needed, and the piping systems required will be minimal. If you prefer to place the Compabloc at ground level, you only require an absolute minimum of floor space to do so.

You also save considerable floor space if you choose a Compabloc unit as a reboiler – as well as adding a new dimension to the choices open to you. Suddenly it might even become possible to install a reboiler where such an installation was previously considered completely impractical.

**Breaking with tradition**
The choice between installations that are bulky and heavy and the compact, light and more modern alternative is a very simple one. You just need to forget about tradition and add a new, smaller dimension to your thinking.
The small size and large capacity of the Compabloc almost seem like magic, combining two criteria that are totally incompatible in shell-and-tube units.

The heat transfer coefficient of the Compabloc is two to four times that of a traditional shell-and-tube heat exchanger. Yet the Compabloc is also far more compact and the liquid hold-up volume is far smaller. Put these together, and you can reduce the size of your condenser or reboiler installation by a factor of five (or more) when you decide on a Compabloc unit instead of a traditional shell-and-tube solution.

Dramatic comparisons
In a volume of just 3 m^3, the Compabloc provides you with a heat transfer area equivalent to 1000 m^2 of a traditional shell-and-tube design. The tubular unit occupies a volume of at least 15 m^3 and needs considerable additional free space so that the tube bundle can be pulled out for cleaning. This results in a staggering difference in the footprint taken up by the two different technologies.

How much can you save?
Theory is one thing, practice another. What are the exact, quantitative benefits in your particular application? This is a fair question and we have a very practical answer.

If you are planning to install a new distillation column or to replace an existing condenser or reboiler, we simply suggest that you contact us with the key facts about your installation. We will then provide you with a no-obligation installation draft and a cost estimate so you can compare and judge for yourself what the Compabloc can do for you.

This service will cost you nothing, but it can ultimately save you a lot of money. An installation based on the Compabloc design will both take up a minimum of space and keep the cost to a minimum.

The Compabloc is so compact that you can even mount it directly on top of the column.
The Compabloc is based on an innovative concept completely different from traditional condensers and reboilers. If you are only familiar with the shell-and-tube design, you’ll be surprised how old-fashioned it really is and what a quantum leap the Compabloc represents, both technically and in terms of cost benefits.

**The heart of the matter**
The Compabloc heat exchanger is built around a pack of corrugated heat-transfer plates. These plates are welded alternately to form channels. The complete plate pack slides inside a four-column carbon steel frame bolted to pressure-retaining heads at the top and bottom. Four removable side panels contain the fluid inlet and outlet connections, and baffles direct the fluid media back and forth through the channels.

The corrugated plate pattern in the Compabloc creates a maximum of turbulence, which in turn results in outstanding heat transfer efficiency. The overall heat transfer coefficient is two to four times greater than in a corresponding shell-and-tube unit. In other words, a Compabloc requires only 25-50% of the heat transfer area of an equivalent tubular unit. That, in essence, is the advantage of the Compabloc.

**Perfect as a condenser ...**
When the Compabloc is used as a condenser, the vapour enters from the top of the unit and condenses on the cold plates while passing through the plate pack. The condensate exits at the bottom. The cooling media is forced through several passes with a series of baffles. This, together with the plate corrugations, maximizes heat transfer efficiency and minimizes fouling.

If the vapour contains non-condensable gases, a two-pass arrangement on the condensing side permits gas/liquid separation inside the Compabloc, eliminating any need for a special separator unit to do this. The main condensation takes place in the first pass. The subcooling of the non-condensable gases is achieved in the second pass, and this also serves as a mist eliminator.

**... and as a reboiler**
With its short flow path and large cross-section, the Compabloc is a perfect thermosiphon reboiler.

The feed enters at the bottom of the unit. When the liquid passes between the heated plates, it is brought to boiling point and a mixture of vapour and liquid leaves the unit through the outlet at the top.
In reboiler applications, the liquid enters from the bottom of the Compabloc. The vapour/liquid mixture is extracted from the top of the unit.
Corrosion and its effects have always been a significant threat to condensers and reboilers used in the chemical process industries. With shell-and-tube units, the traditional approach to dealing with corrosion has simply been to expect that it will arise, to keep an eye on the problem in the course of regular inspections, and then take the necessary measures when needed.

This is a risky approach, however. Corrosion developing faster than expected may cause product contamination or a dangerous mixing of fluids. Inspection, maintenance and repair work involve significant recurring downtime, with the worst-case scenario being an unexpected heat exchanger breakdown that results in a long standstill in production.

Aren’t exotic materials the answer?
The obvious way to avoid corrosion problems is to upgrade your condenser or reboiler by using a material that is resistant to any corrosion that might occur. However, the basic design of a shell-and-tube heat exchanger involves the use of very extensive metal surfaces, which means that replacing carbon steel with corrosion-resistant materials such as Hastelloy™ or titanium is an extremely expensive step.

Manufacturing shell-and-tubes in exotic material is therefore in most cases not a viable option because of the cost. This is why many plants decide to take a calculated risk and simply accept all the production disruption and expense associated with operating a condenser or reboiler that continuously suffers from corrosion.

Play it safe with Compabloc
It doesn’t have to be that way, however. With a Compabloc condenser or reboiler you can completely forget about corrosion. Due to the compactness of the design, the amount of heat transfer material used is significantly less than in a shell-and-tube unit. A Compabloc condenser or reboiler can therefore be constructed from virtually any metal that can be pressed and welded, and yet still be available at an economical price.

This means you can afford to choose the material that provides your particular installation with the best possible protection against corrosion – and then forget about the problem once and for all.

Think along new lines
With the Compabloc, you can begin by assessing the corrosiveness of the media in your production flow. You can then specify the exact material that will provide the best possible performance in your heat exchanger, confident that your choice will be economically feasible.

In oil refineries, for example, chlorides often come off with the top fraction, making titanium the obvious choice for the condenser. Where a titanium shell-and-tube condenser would be prohibitively expensive, a titanium Compabloc is both practical and economical. Your distillation column could then operate continuously and reliably at peak level with no unnecessary interruptions for servicing or repair.
Tailored to your specific needs

The Compabloc is based on a modular concept that makes it easy to tailor any unit to suit your particular process conditions. This gives you the best of both worlds – it is both economical and is easy to customize to your specific needs.

**What space is available?**
The basic advantage is the small space taken up by a Compabloc unit. Thanks to its high heat transfer coefficient, you can reduce the volume taken up by your condenser or reboiler by a factor of five. If you don’t have the floor space available for a shell-and-tube heat exchanger, the Compabloc is therefore the obvious choice.

But what if there’s not even sufficient floor space to install a Compabloc? Well, that’s no problem either.

**Creative installation**
If there is insufficient floor space available, a Compabloc condenser can be mounted directly on top of the distillation column. And apart from saving expensive floor space, you save a lot on piping by placing the Compabloc close to the column outlet.

Thanks to the low weight of the Compabloc, another option is to mount the unit suspended from the roof structure. Compabloc units can be mounted horizontally, vertically or inclined, or whatever is easiest for the specific installation. The possibilities are endless.

**Any medium, any metal**
The heat exchanger plates for a Compabloc unit are available in a wide range of resistant materials and, because of their light weight, they are relatively inexpensive. You can always afford the investment to avoid corrosion. The welded construction also eliminates any problems caused by media attacking gasket materials.

The way the inlets, outlets and baffles are arranged is tailored to your specific application. Two-pass and multi-pass flow configurations are easy to provide.

The Compabloc gives you complete freedom of choice as regards mounting – vertical, horizontal or suspended ...

You can tailor an installation solution to match your requirements perfectly.
Even though a shell-and-tube condenser or reboiler may rarely need routine servicing, it is crucial that it is installed so that any problems can be dealt with rapidly. You need to get your process restarted as soon as possible.

In a shell-and-tube installation, the tube bundle always has to be pulled out axially. This means that considerable extra space is needed - space that should be kept free of all other equipment. In practice, this is rarely the case. Everyone who has undertaken such service work will testify that it is an awkward and unpleasant task involving a lot of time, effort and manpower, as well as causing significant disruption in any production environment.

The easy way
In contrast, the unique design of the Compabloc means that service is simple. The side panels are easy to remove and visual inspection rapidly reveals exactly where the problem is.

The turbulence created when a liquid or vapour flows through a Compabloc unit ensures that fouling problems seldom occur, because of the high shear rate along the heat transfer wall. If cleaning is needed, the high turbulence and low hold-up volume of the Compabloc also make chemical cleaning-in-place (CIP) procedures both effective and economical. Appropriate cleaning solutions can quickly be circulated through the unit.

An alternative solution is simply to remove the panels and hydroblast the plates with a high-pressure water jet.

A matter of hours, rather than a week
In many condenser and reboiler applications, legislation compels operators to undertake annual inspections. With the use of exotic materials, these inspections can be avoided or carried out at much longer intervals. The installation of a Compabloc will also cut the operating downtime that results from an inspection by almost a week compared with a traditional shell-and-tube unit, providing a significant boost to profit margins.
By now we hope you are sufficiently convinced to contact us at Alfa Laval to discuss what Compabloc condensers and reboilers can do for you.

Should you need any further persuasion, here is a quick summary of the main benefits of the Compabloc. They all point in the same direction, because a Compabloc “magic box” works magic on your wallet.

**Economy of scale**
The heat transfer coefficient of the Compabloc is two to four times that of a traditional shell-and-tube heat exchanger. Combined with the sheer compactness of the Compabloc design, this means that you can scale down the size of your condenser or reboiler by a factor of five or more.

**Economy of installation**
Compared with a traditional shell-and-tube heat exchanger, the Compabloc takes up much less floor space. Its low weight means that you can also mount the Compabloc directly on the distillation column or suspend it from the roof structure, or virtually any other suitable fixture.

**Economy of configuration**
The Compabloc is based on a modular concept and can be tailored to fit your exact process requirements, with inlets and outlets positioned to best advantage. Choosing the exact plate material best suited to the medium you are using is also an economically viable proposition.

**Economy of service**
The Compabloc is easy to service thanks to the simple design of the unit. Should fouling occur or service become necessary, the Compabloc can be cleaned or repaired without moving it from the site. There are no unnecessary production standstills.

**Challenge us**
Present us with your requirements and challenge us to come up with a solution that is better than the traditional one.
Alfa Laval in brief

Alfa Laval is a leading global provider of specialized products and engineering solutions.

Our equipment, systems and services are dedicated to helping customers to optimize the performance of their processes. Time and time again.

We help our customers to heat, cool, separate and transport products such as oil, water, chemicals, beverages, foodstuff, starch and pharmaceuticals.

Our worldwide organization works closely with customers in almost 100 countries to help them stay ahead.

How to contact Alfa Laval

Contact details for all countries are continually updated on our web site. Please visit www.alfalaval.com for more information.