

# Oil Solutions

ABN 63 501 706 062



 **V30**  
**Vacuum Filtration Unit**

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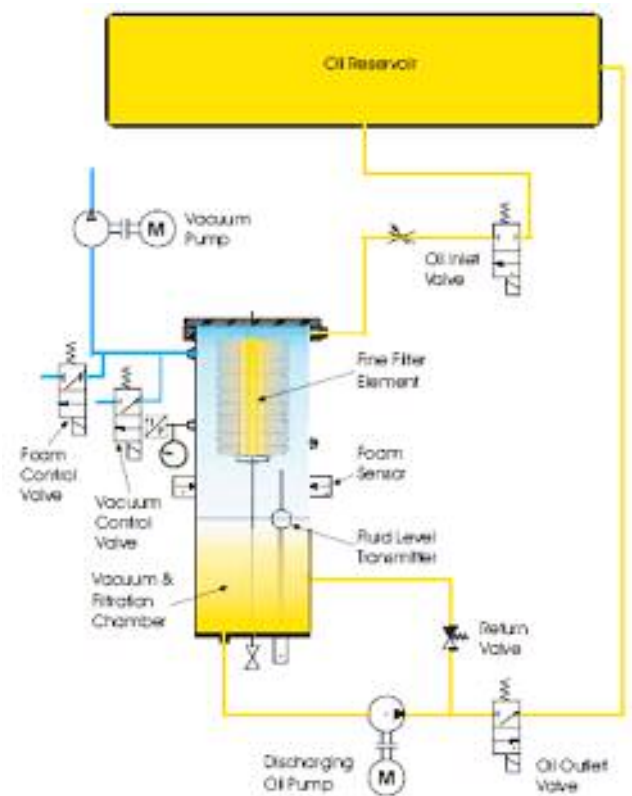
**Efficient Filtration Systems**

# The V30 CJC™ Vacuum Filter

The CJC™ Vacuum Oil Filter Unit is designed for maintenance of the oil operating in power transformers.

The CJC™ Vacuum Oil Filter Unit consists of a vacuum chamber and a filter insert. A vacuum pump maintains the pressure in the chamber at the lowest possible level. At this pressure water (H<sub>2</sub>O) evaporates and is removed from the oil. The gas content of the oil (transformer fault gases, H<sub>2</sub>, CH<sub>4</sub>, CO, CO<sub>2</sub>, C<sub>2</sub>H<sub>2</sub>, C<sub>2</sub>H<sub>4</sub>, C<sub>2</sub>H<sub>6</sub>, COS as well as Nitrogen, N<sub>2</sub> and Oxygen, O<sub>2</sub>) is reduced during its stay in the vacuum chamber.

When the oil is pumped back into the transformer it is absolutely dry. With time, typically a few weeks, the oxygen concentration in the oil is reduced by a factor of 10, and less oxygen means less oxidation i.e. slower ageing of the transformer.



V30 Flow & working principles

## Protecting your transformer investment.

Danish oil filtration experts, C.C. Jensen A/S have spent 6 years developing a compact degassing unit to protect electrical transformers in close co-operation with some of the leading transformer oil experts in Scandinavia, and have now gained 2 years of successful field experience with the unit. The new product is called the V30.

In most cases during the tests, the oxygen level decreased to a point where the transformer became chemically inert, and the life expectancy has been more than doubled, thereby lowering the overall power production costs significantly.

The general trend world-wide is to privatise the electric power generation and distribution sector, and private owners now face the challenges of the free market for power exchange.

The owners have to be able to deliver the required power at any time, and secondly, they have to obtain a reasonable cost level in order to be able to deliver the generated power at a competitive price.

The reasonable cost level has in many ways become increasingly harder to achieve, ironically sometimes as a direct consequence of the higher loads and more frequent load changes which tends to heighten the stress applied to all the mechanical and electrical equipment involved in the generation and distribution of the power.

Transformers in particular are very sensitive to the increased load, and they are at the same time some of the most expensive pieces of equipment in the power supply chain, and huge savings can be obtained if the transformers are maintained in a more effective manner.

The life span of a transformer is basically determined by the life span of the cellulose insulation used in the transformer. The cellulose-based Kraft paper is in most cases submerged in the oil used for the cooling and insulation of the transformer, and is consequently both inaccessible and directly exposed to

all the chemical reactions in the oil. The obvious way to maintain the cellulose is therefore to maintain the oil.

**The ageing of cellulose is dictated by 4 main factors:**

- ◆ The temperature of the transformer
- ◆ The presence of oxygen
- ◆ The presence of water
- ◆ The presence of acids

The temperature of the transformer is only partially controllable, so the main focus in transformer maintenance should be placed on the internal chemical reactions.

The oxygen promotes the oxidation of both oil and paper, and the by-products of the oxidation are water and acid, which again accelerates the degradation of the cellulose, meaning that the ageing process is most likely to escalate rapidly if it is not inhibited. The process can not be stopped completely, however, as oxygen is present in the paper molecules themselves, and the final result is a situation where the paper has lost its mechanical strength and becomes porous. The task for the maintenance engineers is therefore to postpone the final stage as much as possible.

The allowable acid content of the oil is a much-discussed issue, but it is now commonly agreed that the acid's impact on the condition of the paper is much higher than previously assumed. Tests have revealed that the life span is reduced by a factor of up to 5 times if the acid content is high. An additional disadvantage of a high acid content is the formation of sludge, as this particulate contamination will lower the flash-over voltage of the insulation oil drastically.

Depending on the temperature of the oil, approximately 99% of the water produced by the oxidation will be absorbed in the cellulose, which unfortunately is where it is able to inflict the highest degree of damage. Recent research has indicated a substantial reduction of the lifetime of the paper if it is wet.

The ratio between the water content of the cellulose and the oil is quite established, but varies with the temperature, meaning that the water content of the cellulose can be reduced by reducing the water content of the oil.

Since the oxygen in the transformer oil initiates these problems, it can be seen that removing the oxygen will to a large extent bring the degradation process to a halt.

The easiest way to remove the oxygen is to install a degassing unit on the transformer. The principle of a degassing unit is to draw oil out of the transformer, expose it to a vacuum, and then return it to the transformer in a gas free condition. The principle is well known and has been applied to transformer oils for many years, primarily in order to reduce the water content by vacuum distillation, but it has had some disadvantages until now:

First, the transformer had to be shut down and the oil transferred to a vacuum plant, thereby sometimes restricting the power output of a power plant, and secondly, most of the water actually remained in the cellulose inside the transformer.

The ideal solution is to expose the transformer to continuous degassing and filtration, thereby obtaining oxygen and particle removal and a gradual water reduction. The new V30 from C.C.Jensen is a positive and viable solution to this complex and potentially expensive problem.

# The V30 CJCT<sup>TM</sup> Vacuum Filter Models

V30	V30a	V30 M - Monitor
<p>The V30 CJCT<sup>TM</sup> vacuum filter unit is designed to remove moisture, oxygen and other gases from transformer oil. The PLC control of the unit provides highly efficient degassing and drying of oils. Furthermore the built in fine filter (3 µm absolute) removes contaminating particles.</p> <p>By lowering the oxygen content (down to 200ppm) and moisture content (down to 3 ppm) in the transformer oil the ageing processes (oxidation processes) of the insulation cellulose and oil are slowed considerably thereby extending the operational life of the transformer.</p> <p>The ultimate pressure in the vacuum chamber is 2 mbar. This pressure is reached when the transformer oil is virtually free of gases and moisture.</p> <p>85% of all gases and 75% of the water will be removed from the oil in one pass. The V30 systems have been installed on transformers ranging in size from 2000 to 55000 L of oil.</p>	<p>The V30a CJCT<sup>TM</sup> vacuum filter unit is designed to remove moisture, oxygen and other gases from fluids. The CJCT<sup>TM</sup> Vacuum Filtration unit is particularly suited for degassing power transformers. The unit provides highly efficient deaeration and drying of oils and furthermore the built in fine filter (3 µm absolute) removes contaminating particles. <b>The V30a, similar to the V30, has been specially designed for long term degassing without maintenance.</b> The control of the system is analogue and therefore virtually fault free.</p> <p>By lowering the oxygen concentration (down to 200 ppm) and moisture concentration (down to 3 ppm) in the transformer oil the ageing processes (oxidation processes) of the insulation cellulose and oil are slowed considerably thereby extending the life expectancy of the transformer.</p> <p>The ultimate pressure in the vacuum chamber is 2 mBar (0.5 mBar optional). This pressure is reached when the transformer oil is virtually free of gases and moisture. 85% of all gases in the transformer oil will be removed in one pass. When extremely low gas oxygen concentration has been reached (&lt;500 ppm) the efficiency is 50%.</p>	<p>The V30 - Monitor vacuum filter unit is designed to remove moisture, oxygen and other gases from transformer oil and to monitor the state of the transformer. <b>The PLC control combined with the patented degassing method provides the possibility of constantly monitoring the gas content of the transformer oil. Thus the unit is able to sound alarm in case of abnormal gas production well ahead of any Buchholtz Relay, as the V30 will monitor even the dissolved gases and not just free gas.</b></p> <p>The built in fine filter (3 µm absolute) removes contaminating particles.</p> <p>By lowering the oxygen content (down to 200ppm) and moisture content (down to 3 ppm) in the transformer oil the ageing processes (oxidation processes) of the insulation cellulose and oil are slowed considerably thereby extending the operational life of the transformer.</p> <p><b>Several running modes are possible depending on the size and state of the transformer. The unit can be optimised for water removal, gas removal or particle removal.</b> If the transformer contains a high level of moisture (in excess of 3% in the cellulose) setting the unit for maximum water removal is recommended.</p> <p>The ultimate pressure in the vacuum chamber is 2 mbar. This pressure is reached when the transformer oil is virtually free of gases and moisture.</p>

# Extending Transformer Life By Degassing With a V30 System

- ◆ The BLA 15/25 Filter Insert can hold about 800mL of water. The filter insert will act as a buffer during a time of increased water level in the oil. The filter insert can hold water corresponding to a 20 ppm increase for a transformer with 25000 L of oil.
- ◆ The V30 degassing system can remove up to 86% of all gases in one pass through the vacuum chamber. This corresponds to a maximum of 6480 L/day that can be degassed.
- ◆ Research has shown that keeping an oxygen level in the transformer oil below 2000 ppm rapidly decreases the production of CO and CO<sub>2</sub>. Production of these gases indicate wear on the cellulose. I.E. an oxygen concentration below 2000 ppm halts the cellulose degradation. The V30 can keep a 100 T transformer oxygen free (<2000 ppm).
- ◆ Presence of water (H<sub>2</sub>O) in the transformer system speeds up paper and oil degradation. Water is produced inside the transformer and must thus be removed in order not to accelerate the ageing. The V30 removes water from the oil very efficiently. Down to 3 ppm at 30°C. Efficiency is 80-90% at water contents above 20ppm. Most of the water in a transformer is present in the cellulose. Removing water from the oil slowly removes water from the cellulose as an equilibrium btw. oil and cellulose is reached. At an oil temperature of 30°C the V30 can remove up to 300 mL of H<sub>2</sub>O from the oil per day.
- ◆ Particles in the oil is also an accelerating factor of the ageing rate. The BLA filter insert in the V30 system removes particles down to 0.8 µm. Particles in the oil lowers the interfacial tension (IFT). New oil has an interfacial tension of around 50 dynes per centimetre (or mN/m) and sludge begins to form when the IFT of the oil degrades to around 22 mN/m. Filtering the oil through the BLA insert keeps the IFT at a high value thus preventing sludge formation. Sludge can adhere to the cellulose insulation thus lowering the heat exchange and increasing winding temperature.
- ◆ It is a known fact that acid in transformer oil speeds up ageing. The V30 in itself does not remove acid from the oil (This can be done using a CJC acid reducing filter element), however on site measurements have shown that the water which is removed from the transformer system is acidic (pH=3.7). This indicates that water soluble acidic compounds are removed from the transformer oil using a CJC V30 degassing system.

## Acid reduction in oil

### CJC EC, EO and EL-inserts are used for improving oil quality.

Among other things:

- ◆ Reduction of total acid number (TAN)
- ◆ Increasing surface tension
- ◆ Reducing the power factor (tan delta)
- ◆ Increasing the break down voltage

Reducing the acidity of oil in transformer oil extends the life time of the oil  
The E-series inserts should be used in conjunction with CJC type B filter insert.

The amount of acid reducing filtration material needed to restore a given oil varies from oil to oil and is among other factors dependent on water content, temperature of the system oil and particular contamination.

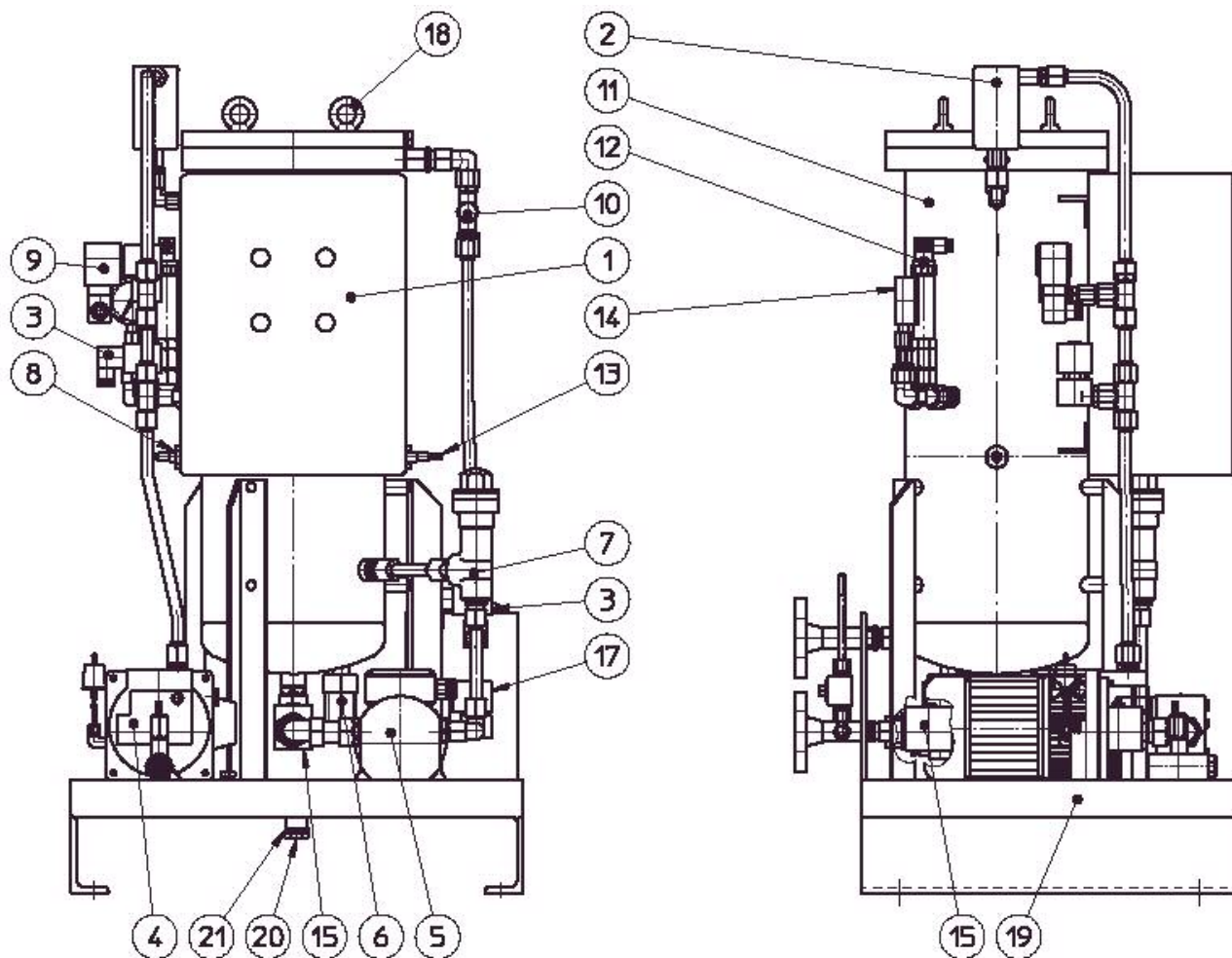
For transformer oil you can expect to reach levels at or better than the standards for new oil.



# Specifications

Drip pan mounted  
 Oil pump: Rotan  
 Vacuum pump: Busch R5  
 Electric control box  
 Flanges inlet/outlet: DN20 PN16  
 Supply voltage: 3x230-400/440V or 1x230V

Frequency: 50/60Hz  
 Design temperature: 80°C  
 Oil Cleaning Capacity: 4.5 L/min  
 Weight: 150 kg  
 Pressure in Vacuum Chamber: 2 mbar



- |                         |                             |                                  |
|-------------------------|-----------------------------|----------------------------------|
| 1 Electric Control Box  | 8 Proportional Valve, Air   | 15 Sample Point #8               |
| 2 CJC Auto Air Vent     | 9 Throttle Valve            | 16 Proportional Valve, Oil       |
| 3 Solenoid Valve        | 10 Vacuum Chamber           | 17 Ring Bolt M10                 |
| 4 Vacuum Pump           | 11 Pressure Transmitter     | 18 Drip Pan f. V30               |
| 5 Level Sensor          | 12 Form Sensor, Transmitter | 19 Plug 1/2"                     |
| 5 Oil Circulation Pump  | 13 Vacuum Gauge             | 20 Form Sensor, Transmitter      |
| 6 By-pass Valve         | 14 Shut Off Valve           | 21 Copper Packing<br>22x30x2.0mm |
| 7 Form Sensor, Receiver |                             |                                  |

# Oil Solutions Product Range

The CJC Filter Inserts are depth filters with a rating of 3 micron absolute (~B3>75) offering a very high dirt holding capacity. Their pump capacities range from 0.75 to 100 Litres/Minute. They also have Filter Separator units combining off-line filtration with continuous water separation.



CJC have a wide range of off-line filter units complete with integral circulating pumps, mobile units, with or without a drain tank and options including electronic control and monitoring. CJC units are very efficient and would be some of the most economical units to on the market to operate.



*CJC™ filtration systems are available in a wide variety of designs including mobile units, multi units on a single drain tank and featuring electronic control and operation monitoring*

## TEST EQUIPMENT

- ◆ Digital measuring devices for: Temperature, Flow ,RPH with Data output via PC or printer
- ◆ Test couplings and accessories:
- ◆ Adaptation threads, Plug-in system
- ◆ Test hoses:



## ACCESSORIES:

- ◆ Level gauges
- ◆ Air filters
- ◆ Filler breathers
- ◆ Valves two & three-way
- ◆ Throttle and shut-off valves
- ◆ Flow indicators

## SPECIALIST FILTRATION EQUIPMENT:

### Oil Solutions Design, Manufacture, Install & Service

We custom build filter trolleys for special purposes.

The one to the right has three large capacity elements.

It is built on a tank base to make changing of elements a breeze. The oil in the filter housing is drained into the tank below and then after the element is changed the oil can be sucked back up into the filter housing again.

The unit is also equipped with a filter bypass valve to enable it to be used as a transfer unit.

Each filter element is of 3 um (micron) absolute, with a dirt holding capacity of 4.0 litres of solids of which up to 2,000 ml can be of water.

**Oil Solutions** was set up to provide quality economical solutions for industry, reducing production costs by improving oil cleanliness through careful servicing of reservoirs and improving oil filtration were necessary. We are the Oil Service Specialists



## Efficient Filtration Systems

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