DV GROUP

THE CHALLENGES OF PREVENTIVE MAINTENANCE ON POWER ELECTRONICS

WHITE PAPER

CONTENTS

THE CHALLENGES OF PREVENTIVE MAINTENANCE

THE CHALLENGES OF PREVENTIVE MAINTENANCE

Any breakdown triggers a crisis period. This difficulty can be more or less important and can result in three critical consequences:

ECONOMIC IMPACT

A stoppage on a production can lead to large financial losses for your company.

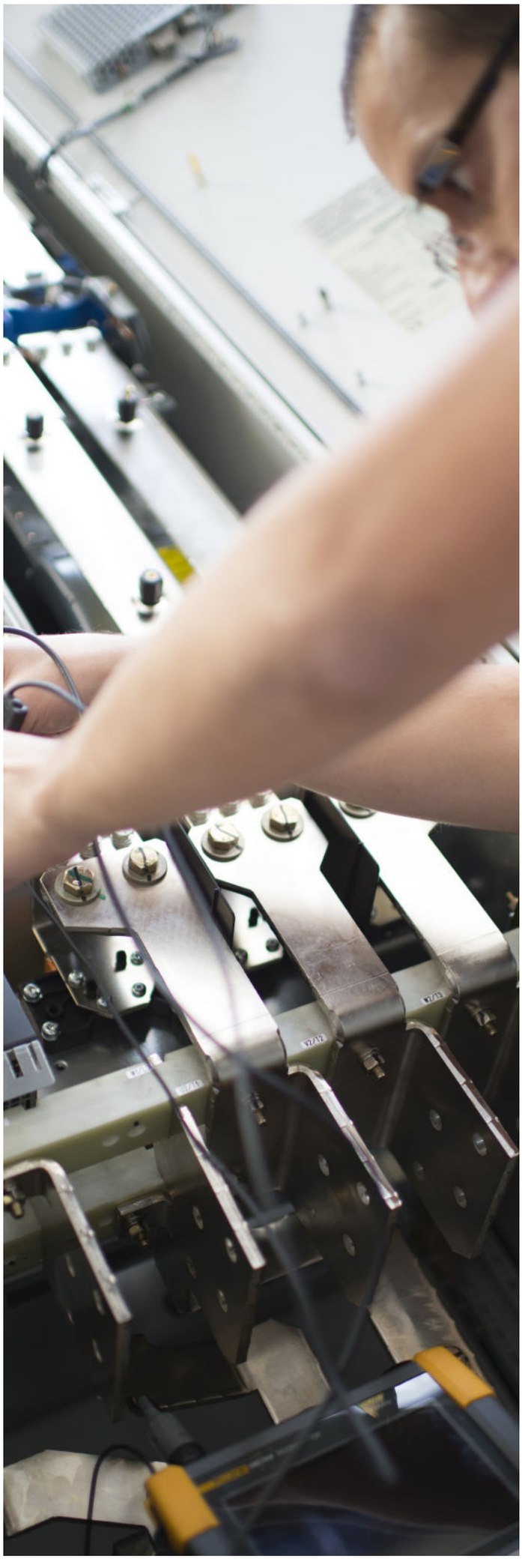
ENVIRONMENTAL IMPACT

A breakdown can cause environmental risks such as river water pollution, the discharge of noxious vapour into the air etc. One single breakdown can lead to an ecological catastrophe.

HUMAN IMPACT

Any emergency situation generates confusion, so constitutes a threat for personal safety.

As human and environmental impact is not acceptable, the thinking will centre on the **economic** aspect. The criticality of the impact is modulated according to the maintainability of the system (obsolete system), funnel effects and production necessities. The thinking is therefore essentially financial, taking into account production necessities, the product's MTBF and also the MTTR, the technical aspect and ability to make the product more reliable being a certainty.



«JUST IN TIME», A UNIVERSAL PROBLEM

Lean, «just in time» or even **«5 zero»** is a **method of production organisation** and **management** specific to the **industrial** sector.

Its origins go back to **stock problems** encountered by Japanese shops. Indeed, these were very small and often only had **one article per reference**. The creator of Toyotism, **Taiichi Ohno**, was inspired by it and applied it in his own factories.

Today, just-in-time management is a problem shared by many companies in France and the world over...

It is not steered by production either, but by logistics, which carries a great risk of loss of turnover in the case of the loss of a production unit. Technical and technological solutions exist, however, in order to lessen the probability of the breakdown of critical equipment...

60% of French companies operate a «JUST IN TIME» system

75% of CRITICAL MACHINES are fitted with frequency converters

82 min A PRODUCTION STOPPAGE is declared every 82 minutes

5 milliards euros is the COST of these production CUTS in FRANCE

THE AIM OF PREVENTIVE MAINTENANCE

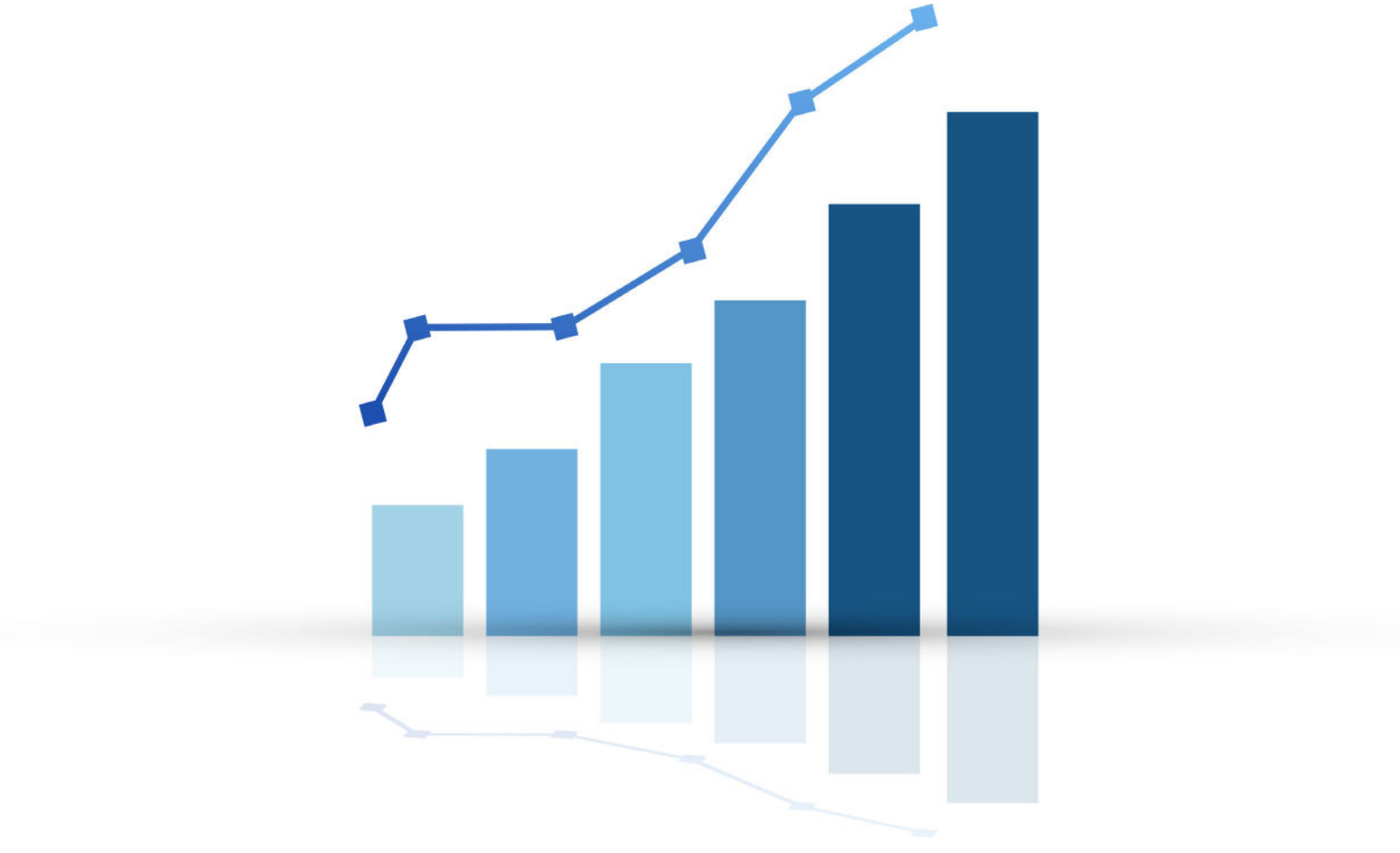
The aim of preventive maintenance is therefore to have some **measured action allowing economic gain and less team tension through making the production system reliable**. This economic interest can be direct (a decrease in maintenance costs) or indirect (related to production costs).

The analysis is therefore the optimisation of the preventive maintenance budget and the following elements have to be taken into account:

- ✓ Rate of system breakdowns (maintenance rate and risk rate)
- ✓ Product MTBF
- ✓ Product MTTR
- ✓ Economic impact on production

The analysis of these four criteria will allow us to give a **proportionate response to the economic risks run**. The choice of preventive action on power electronics therefore takes into account the rate of the risk of the breakdown of the Drive components in relation to the possible budget for this action.

The necessity of carrying out this action in a healthy environment should be noted and the temperature of the cabinet (filters, air-conditioning, obstruction of the ventilation conduit etc.) and any existing pollution **MUST BE ADDRESSED**. The environment is necessarily the first preventive maintenance measure in order to envisage a return on sustainable investment.
The analysis of the deterioration of the MTBF will give us a pertinent indicator of the triggering of preventive measures.



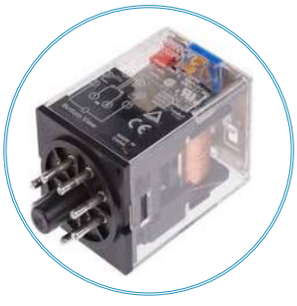
PREVENTIVE MEASURES ON FREQUENCY CONVERTERS

PREVENTIVE MEASURES ON FREQUENCY CONVERTERS

The frequency converter involves components which are sensitive to temperature and network quality. Several categories of components can be defined:

POWER COMPONENTS

Rectifier, undulator

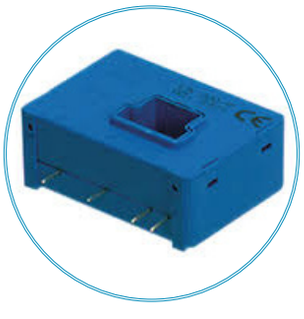


ELECTRO-MECHANICAL COMPONENTS

Turbines, ventilators, contactors, relays

PASSIVE COMPONENTS

Capacitors, snubbers , bus filtering



CURRENT MEASUREMENT

Current collectors

ELECTRICAL CONNECTIONS

Connectors

OPTICAL COMPONENTS

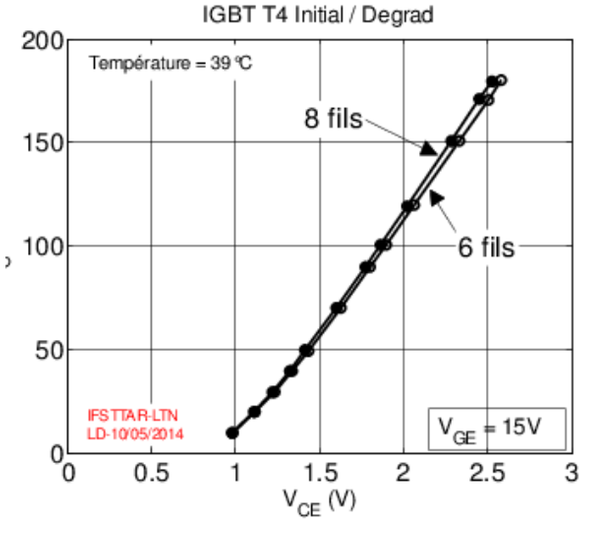
Opto couplers, fibreoptics

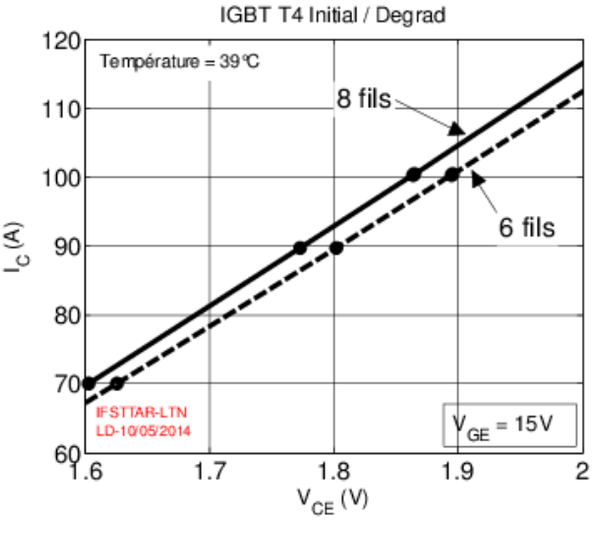
Electronic elements have a nominal lifespan defined by the component manufacture and requiring maintenance intervals appropriate to usage and environmental conditions.

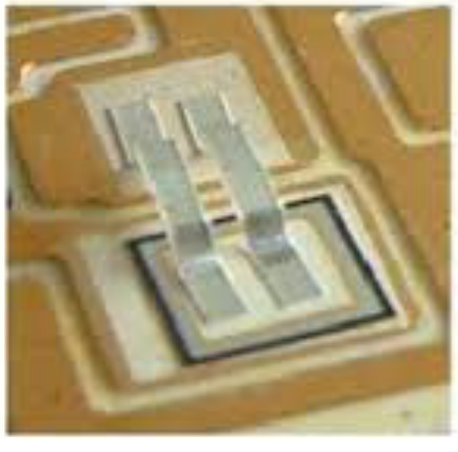
POWER COMPONENTS

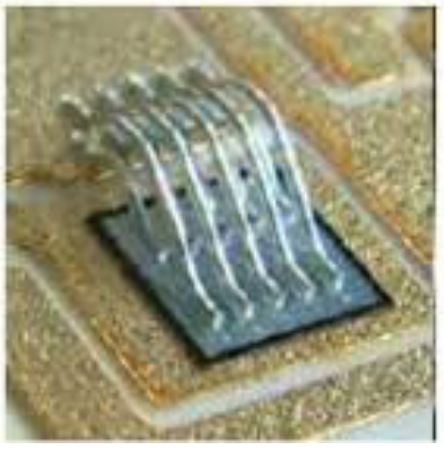
Thermal dissipation is an essential issue in the lifespan of power components. The reduction in the sizes of converters requires an **efficient cooling system**, any deviation leading to damage (of bonding wires, leakage current etc.) on these components and/or the entire system. The failure rate is **10 times greater at 100 c** than at 40 c.
The following elements should therefore be checked and/or corrected:

- Dissipation surface area (dissipator obstruction, air flow, water flow etc.)
- Surface resistance quality (frequency of oil change, ice)
- Ambient temperature (air-conditioning)
- Humidity level (damage to equipment)
- Atmospheric pressure
- Turbine quality, ventilation
- Snubber quality (di/dt limit and turn off)
- Quality of the contact and bus tightening (contact capacity: turn off and common mode circulating current)
- Avalanche effect signalling







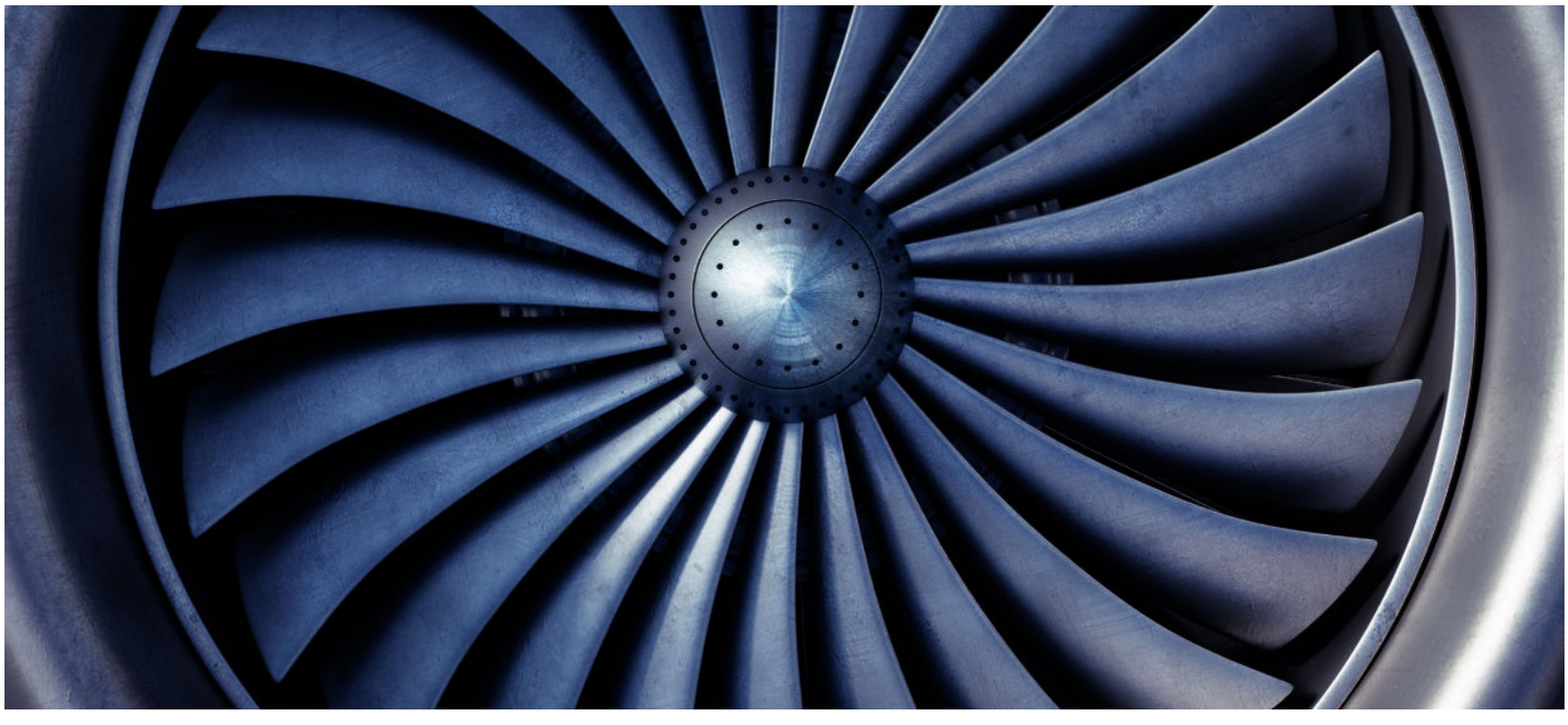


ELECTRO-MECHANICAL COMPONENTS

Thermal dissipation is an essential issue, based on the **mono-phase convective effect**. The maintenance of air flow is therefore of prime importance.
The following elements should therefore be checked and/or corrected:

- Obstruction of the air conduit
- Ventilator change
- Change of turbine bearings
- Contactor mechanical failure
- Change of auxiliaries

THERMAL DISSIPATION IS AN ESSENTIAL ISSUE



PASSIVE COMPONENTS

The lifespan of chemical condensers depends on the **operating temperature** (Arrhenius equation), as well as the ripple current.

The lifespan of a 105 degree condenser will on average be **4 times higher** than an 85 degree condenser. This same equation applies to the product's ambient temperature (decrease of 10 degrees = twice the lifespan). This lifespan is reduced through heating owing to the ripple current.

The condenser is subject to **slight variation in lifespan** owing to the voltage at its terminals and the rule is the use of a condenser at 80% of its nominal value. On the other hand, it is very sensitive to HF current.

The following elements should therefore be checked and/or corrected:

- Capacitor value and ESR of the bus capacities
- Bus energy restitution rate
- Bus balancing resistance
- Absence of ripples on the bus (bearer)
- Change in the electro-chemical capacities outside these ratings by 105 degrees
- Snubber check (ZC value, leak etc.)

The lifespan of a 105 degree condenser will on average be 4 times higher than an 85 degree condenser.

CURRENT MEASUREMENTS

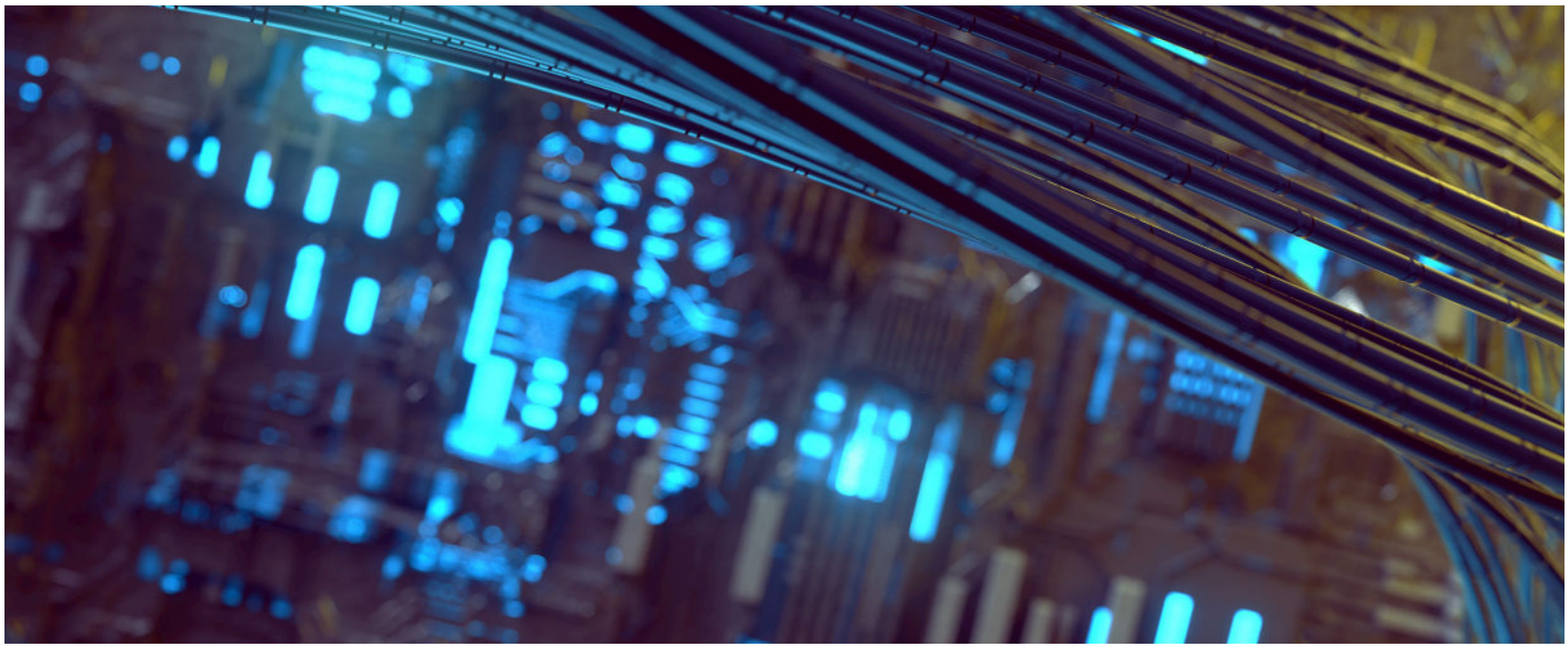
Principally, there are Hall effect captors, Hall voltage being proportionate to intensity and inversely proportional to the thickness of the material, temperature having a strong influence on the deterioration of this component:

- Voltage output at I=0
- Captor linearity

ELECTRICAL CONNECTIONS

Pollution, oxidisation and vibrations are obviously important elements in the connections failure and tightening is another important point to check.

Power connection points should be checked and have nf «contact» capacity, being able to boost common mode circulation currents.



OPTICAL COMPONENTS

Optocouplers are reliable elements, however here again **temperature is highly damaging** for lifespan, either of a convection type or generated by a raised collector current.

In addition, it should be noted that the CTR deteriorates over time and a **safety coefficient** is taken into account in the design of electronic cards.

Optical fibres are sensitive to **torsion**, a mechanical constraint.

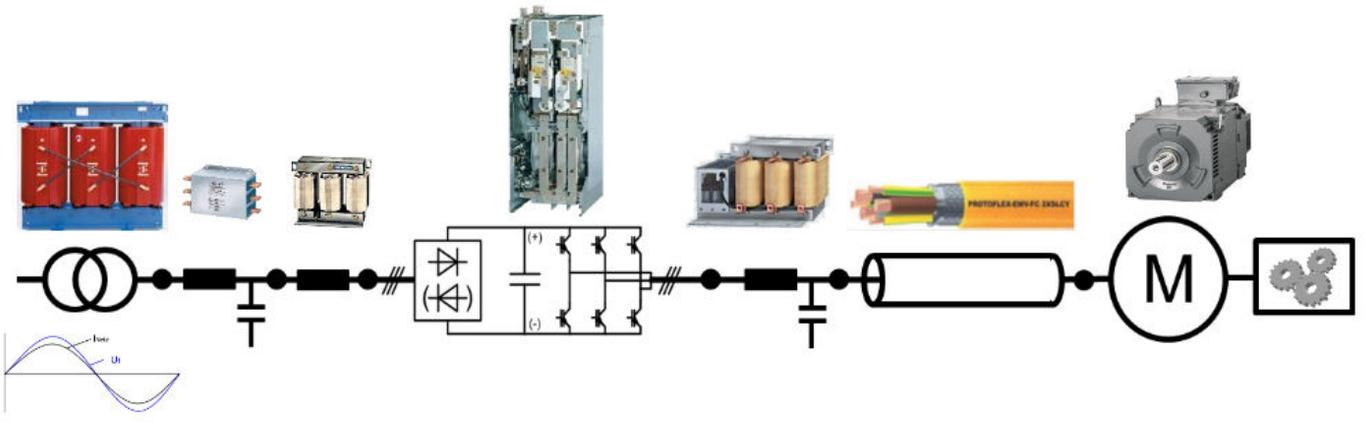
It is difficult to find a datasheet giving a lifespan for transmitting or receiving diodes, however from experience, it is not rare to have faulty driver cards.

A dynamic data transmission test allows us to characterise its operation, but not the component deviation.

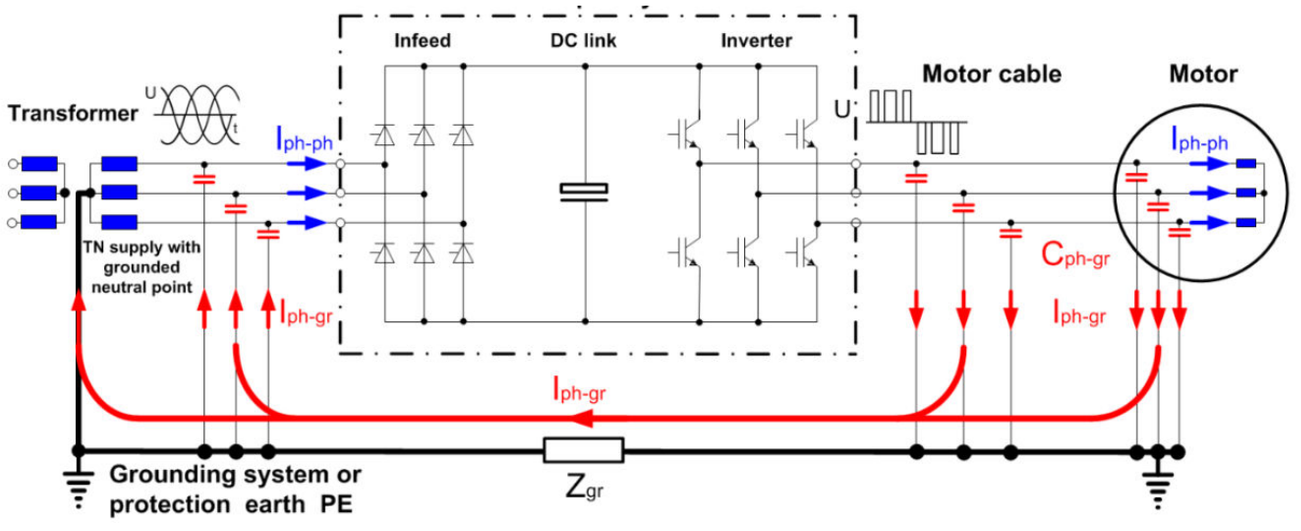
OPTOCOUPLERS ARE RELIABLE ELEMENTS

NETWORK QUALITY

As the frequency convertor is a non-linear charge and a network polluter, switch mode power supplies, as well as the intermediary bus, essentially filter the root and lifespan is therefore strongly affected by network quality. Voltage dips are also highly influential.



Common mode circulating current



PREVENTIVE MAINTENANCE: 2 POSSIBILTIES...

SYSTEMATIC PREVENTIVE MAINTENANCE

Systematic preventive maintenance is the pre-established time-interval check or a defined number of uses without prior checks.

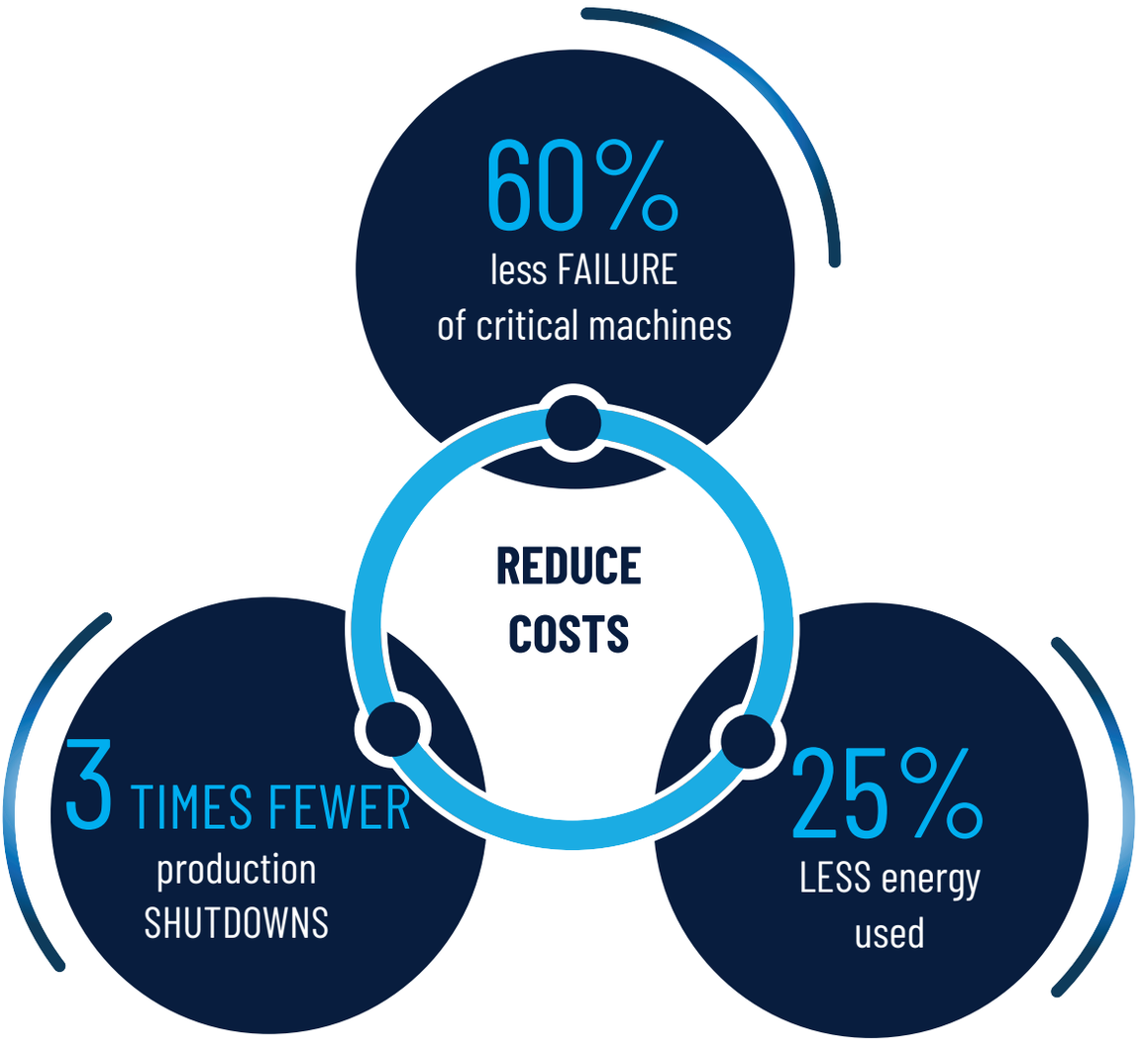
CONDITIONAL PREVENTIVE MAINTENANCE

Conditional preventive maintenance measures (also called predictive or early maintenance) involve the repair and replacement of the part and/or fluids following a check and analysis of deterioration indicators.

This type of preventive maintenance does not automatically lead to a reaction. It is a function of the desire to act or the company's budgetary constraints. The manufacturer must then trust the technician's diagnosis.

THE 3 REASONS FOR PREVENTIVE MAINTENANCE

REASON 1: ECONOMY



The main aim of preventive maintenance is to **minimise the risk of failure** for manufacturing equipment.

It is a **response to planned obsolescence** and a guarantee of **improved equipment performance**.

If can be viewed as **fundamental and mandatory** for critical machines, for which:

✓Shutdown brings about a **production outage or regulatory obligations**.

✓Failure poses a **threat to the safety of teams and equipment**.

REASON 2 : PEACE OF MIND

PLANNING

Planning will make it possible to **organise** and **anticipate** production outages. The maintenance manager can thus take advantage of the company's **non-productive periods** in order to involve maintenance teams.

SECURITY

In the context of highly-polluted industrial production, particularly by **dust**, if it is poorly maintained the drive will become clogged and the **probability of fire will increase considerably**.

ANTICIPATION

Both planning and reducing the fire risk within the plant will **lift** the pressure off the manager and allow him/her **more time** to optimise production.

COHESION

With fewer breakdowns, teams also experience **less stress** related to their maintenance roles. Teams are **blamed less** for the cause of the failure and their work is less disrupted owing to unexpected breakdowns.

PREVENTIVE MAINTENANCE

95% = AVAILABILITY RATE
average for critical machines

CORRECTIVE MAINTENANCE

80% = AVAILABILITY RATE
average for critical machines

REASON 3 : OPTIMISATION

1/**IMPROVE BUDGET MANAGEMENT**

REDUCTION of 30% in MAINTENANCE costs over the life of the machine

2/ **RETURN ON INVESTMENT OVER THE LIFESPAN OF THE MACHINE**

25% increase in the LIFESPAN of critical machines

3/ **IMPROVE THE MAINTENANCE MANAGER'S PERFORMANCE INDICATORS**

75% increase in the time between 2 breakdowns on critical machines

3 TIPS FOR SUCCESSFUL MAINTENANCE

THE KEYS TO SUCCESS

1/ An effective PREVENTIVE MAINTENANCE plan...

2/ An optimal DIAGNOSIS capacity...

3/ Field EXPERIENCE...

AN EFFECTIVE PREVENTIVE MAINTENANCE PLAN...

THE 4-STEP METHOD

SITE SURVEY

✓ Machine survey (inspection and information gathering)

✓ Save settings

✓ Live measurements

✓ Report recommending preventive or corrective measures

DEPOLLUTION /CHECKS

✓ Checking critical machine elements (power components, intermediate bus, fan, etc.)

✓ Intervention report

APPROVAL / MEASURE

✓ Motor drive torque check and approval

✓ Taking current signals and voltage on line and motor

✓ Approval report

RECOMMENDATIONS

✓ Summary of inspections

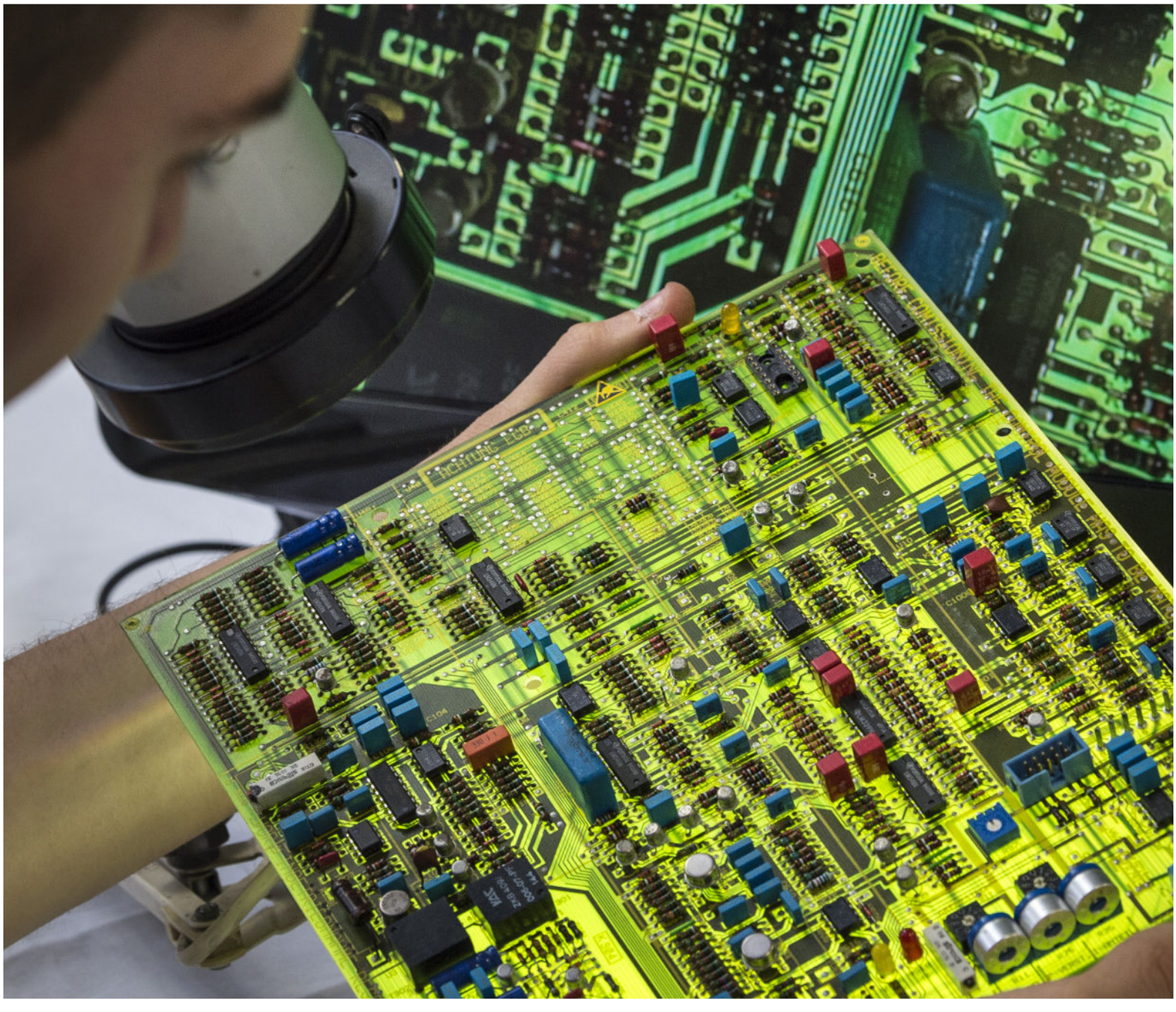
✓ Visual condition

✓ Statement of measurement curves

✓ Product status

✓ Conclusions and potential recommendations

OPTIMAL DIAGNOSTIC CAPACITY



DIAGNOSIS

PREVENTIVE MAINTENANCE BY EXPERT TECHNICIANS

The preventive maintenance of a variable speed drive corresponds to the fourth level of industrial maintenance expertise. Years of experience are required to fully master the method and to deal with numerous unforeseen elements, in order to offer an optimal service.

AMPEROMETRIC CLAMP

Measures the intensity of a current released into a circuit without having to disconnect the circuit to insert an ammeter in series.

THE RLC

A device for measuring the resistance, inductance and capacity of an electronic component.

MULTIMETER

A multimeter is a device for measuring analogue signals. It has several functions (voltmeter, ammeter, ohmmeter, circuit-breaker tests for both forward and reverse bias)

AIR COMPRESSORS

Used to provide efficient power to construction tools and machines. Air compressors can be operated by internal combustion engines. Their ability to pressurise the air allows electricity to be transmitted via pipes or tubes.

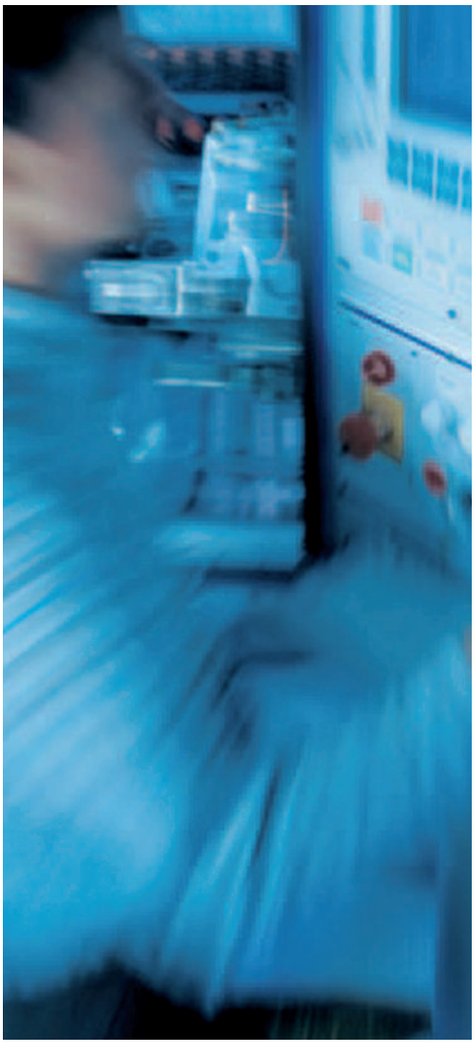
THERMAL CAMERA

Records the different infra-red radiation (heat waves) emitted by the bodies, which vary according to their temperature. It reproduces the heat stored by a body, or shows the thermal flow of a panel due to an anterior focal point.

FIELD EXPERIENCE

DV GROUP : MORE THAN 50 YEARS' EXPERIENCE IN PREVENTIVE MAINTENANCE

For 50 years, DV GROUP has been supporting its customers and their industrial changes.
By increasing our skills and know-how, we have become the sole and preferred point of contact for many industries and companies seeking a partner that can guarantee their productivity.



75
Expert technicians

250
Preventive maintenance interventions on variable speed drives in 2019

3,000
Customers use our preventive maintenance service

DV GROUP : MULTI-PROCESS EXPERIENCE

AGRI-FOOD INDUSTRY

Some compressors used to generate refrigeration are equipped with electronic variable speed drives, as well as fans, diffusers and air extractors. Maintenance is essential to avoid breaking the cold chain entailing a legal obligation to discard production.

PHARMACEUTICAL

As for the agri-food sector, pharmaceutical companies must comply with extremely strict rules regarding the preservation of these products, such as the need to keep them cold and avoid variations in temperature. Any failure of a refrigeration machine directly impacts production volume.

AUTOMOTIVE

The automotive industry is one of the sectors most affected by just-in-time management. A breakdown on a critical machine can have catastrophic consequences, leading to a production outage and a net loss of several tens of thousands of euros in a few hours. It is thus advisable to carry out preventive maintenance on critical machines such as the press or the corrective leveller annually in order to avoid a production outage. Similarly, preventative maintenance is required for solvent-extractor fans with important safety-related issues.

METALLURGY

The metallurgy sector also uses high-power variable speed drives for certain machines, including:
- The foundry
- The rolling mill
- The winder
- The lifting bridge

PAPER MILL - PLASTICS PROCESSING

The same maintenance problem can be found in winders capable of winding and unwinding long wires in order to gain space. Likewise, the extruder in plastics processing to give a defined shape to the material through pressure.

DV GROUP

EXPERT IN MOTION TECHNOLOGY

0 825 825 826

contact@dv-group.com

www.dv-group.com