Machinery insurance
Machinery insurance
| 1  | Introduction                  | 5   |
| 2  | Scope of cover                | 7   |
| 3  | Insured items                 | 8   |
| 4  | Insured perils                | 10  |
| 5  | General conditions            | 12  |
| 6  | Exclusions                    | 13  |
| 7  | Sum insured                   | 17  |
| 8  | Property valuation            | 18  |
| 9  | Premium calculation           | 24  |
| 10 | Deductible (excess)           | 25  |
| 11 | Risk inspection               | 26  |
| 12 | Clauses/cover extensions      | 29  |
| 13 | Indirect damage insurance     | 31  |
| 14 | Rating                        | 32  |
| 15 | Claims handling               | 34  |
| 16 | Outlook                       | 37  |

Appendix: Index of terms

38
1 Introduction

The origin of boiler and machinery insurance is inseparably linked with harnessing and utilising power. Virtually nothing has changed in everyday life as radically as power generation. The invention of the steam engine in the early 19th century launched the industrial revolution, ushering in a new era with decisive, far-reaching changes.

The advent of the steam engine also created novel hazards and prompted the need for an entirely new range of insurance covers. Technical covers including boiler and pressure vessel insurance and machinery insurance were designed to protect equipment such as steam boilers, turbines, generators and motors which generate or utilise power. Moreover, changing socio-economic factors, which shifted the workplace from the home to the factory floor, prompted the need for employers’ liability and workmen’s compensation insurance.

Today’s ever greater power demands for producing capital and consumer goods coupled with increased urbanisation continues to spur developments toward attaining higher performance machines and installations of enhanced efficiency. Technological advancement has led to new materials which must withstand more stringent design parameters such as higher pressures, temperatures, operating speeds, etc. This, in turn, has led to greater stresses and increased exposure to both material and operating failures. The development of higher performance machines targets greater capacity and efficiency as an ongoing objective, and manufacturers vigorously vie with one another to push the limits of technology.

Machinery insurance has always been instrumental in promoting the acceptance of new technologies. A direct correlation between the economic climate and the acceptance of new technology remains. For instance, nuclear power plant facilities and high output thermal and hydroelectric power plants could have never been built and operated without the backing of adequate insurance protection. Even financially strong enterprises would have hardly had the means to absorb potential or even actual losses incurred.

Apart from surging technological progress, an adverse competitive environment also compels industry players to tighten production and testing schedules so that new machines and equipment are often installed onsite without prior comprehensive testing. Insurers may also provide cover for machines and equipment which, in response to greater commercial pressures, feature novel designs and new, unproven materials and processes. Underwriters are advised to exercise caution when providing cover for this category of risk.

This brochure is designed to assist underwriters in this challenging field of insurance by providing sound fundamentals before discussing specific technical details and typical problem areas of machinery insurance.
Apart from conventional fire and extended perils coverage, no commercial property risk management programme is complete without considering mechanical and electrical equipment breakdown exposure. Any device that uses, generates or alters mechanical or electrical power is subject to break down.

Machinery insurance provides cover against a wide range of losses from breakdown of plant production equipment, electrical equipment, boilers, pressure vessels, heating and cooling equipment, etc.

In addition to material damage, equipment breakdown frequently results in substantial consequential loss such as business interruption, extra expenses and ancillary services interruption (eg power generation, refrigeration systems, etc). Insurance can be extended to include these consequential losses either as stand-alone covers or as endorsements to the direct damage cover.

The primary focus of engineering insurance cover is not the type of perils insured, since policies, by and large, provide quasi all-risk cover; rather, the special features of the insured items are the decisive criteria in this insurance category.

Consequently, it is evident that a broad spectrum of items can be insured, eg power plants, printing machines, chemical installations, computers etc. The great diversity of insurable items naturally implies an equally wide range of different insurance requirements. All engineering covers in force today can be subdivided basically into two main categories, ie single project covers and those annually renewable. Boiler and machinery insurance covers constitute the largest share of the latter category.

Since machinery covers were first introduced, the scope of cover has changed to optimally comply with client needs and is still subject to ongoing modification. As will be discussed, the scope of cover may vary from country to country, but the basic elements of all policies remain the same.

### 2 Scope of cover

#### Engineering insurance

<table>
<thead>
<tr>
<th>Material damage cover</th>
<th>Renewable</th>
</tr>
</thead>
<tbody>
<tr>
<td>EAR CAR</td>
<td>Boiler explosion</td>
</tr>
<tr>
<td>Defects Liability</td>
<td>Machinery insurance</td>
</tr>
<tr>
<td></td>
<td>Contractors’ plant</td>
</tr>
<tr>
<td></td>
<td>Computer</td>
</tr>
<tr>
<td></td>
<td>Low voltage &amp; electronic equipment etc</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Consequential loss covers</th>
<th>Non-renewable</th>
<th>Renewable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delay in startup (DSU)</td>
<td>Business insurance (BI)</td>
<td></td>
</tr>
<tr>
<td>Force majeure (FM)</td>
<td>Deterioration of stock (DOS)</td>
<td></td>
</tr>
<tr>
<td>Liquidated damages (LD)</td>
<td>Extra expenses etc</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Casualty</th>
<th>Non-renewable</th>
<th>Renewable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Third party liability Bodily injury</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
3 Insured items

Machinery insurance covers a truly diverse spectrum of machines and equipment in commercial and production facilities. Cover is granted only for those machines and equipment items which are cited in the policy schedule and are in use or intended for use at the site indicated in the policy. Therefore, the insured items must be accurately described, particularly in cases where cover is granted not only for stand-alone machines but for entire plants.

For insurance purposes, machine items are described according to the following three categories:

**Individual listing**
A specific, detailed list and brief description of each item insured. The list should include specifications such as rating, continuous working capacity (kW), operating speed (rpm), safety value load, etc; year of manufacture, manufacturer’s name and registration number, new replacement value.

**Blanket groups**
Insurance covers for specific machine and equipment categories, eg blanket all boilers. Policies in this category provide cover for all items of that particular specification (in our example, boilers).

**Comprehensive form**
This category includes all machines and equipment installed at the insured site(s).

The comprehensive form of cover is so broad that it includes many items of low value, which are hardly worth insuring. However, since the cost of insuring each of these items individually would be prohibitive, an adequate deductible is mandatory for this cover to keep insurance cost within an economically justifiable level.

---

**Ready for use**
Plant facilities and machines are considered ready for use after successful testing and commissioning and as such are ready for commercial operation.

Test procedures for equipment acceptance by the buyer (operator) are detailed in the works and/or supply contract. A Provisional Acceptance Certificate (PAC) is issued after these tests have been successfully completed. It cites all minor defects or deficiencies which will not jeopardise safe operation of the item.

The responsibility for the insured object is then transferred from the builder/supplier to the buyer/operator, ie the buyer/operator now bears the responsibility for the risk of loss, except for the minor defects or discrepancies cited in the PAC.

The need for machinery insurance also arises at this point. The successful testing/commissioning of the insured item is the sole prerequisite for machinery insurance eligibility, and cover is not extended for losses encountered prior to successful testing/commissioning. The testing/commissioning phase of any item must be covered elsewhere, usually within the scope of the relevant Erection All Risk (EAR) policy (builders’ risk).

After the machines/items have been installed at the insured location and are ready for use, they can be initially insured and remain covered irrespective of whether they are in use, not in use, dismantled for cleaning, maintenance or overhauling or are being moved on the premises or during the course of subsequent re-erection. Re-commissioning of machines and equipment after overhauling or repair is covered within the scope of machinery insurance. However, this cover excludes the testing/commissioning of new machines.
The terms *blanket* and/or *comprehensive* are typically found in US policies. In the European market, it is more common to find schedules containing a detailed list of individual items. This is because, in Europe, the insured is required to complete a relevant questionnaire and furnish the insurer with the requested information regarding the machines and equipment to be insured. The insured bears all responsibility for any inaccurate information.

By contrast, it is common practice in the US for the insurer to obtain the relevant information at the insured premises. Consequently, the insured is obligated to permit a survey and to answer all questions correctly and in good faith such that the insurer is able to adequately assess the exposure at the insured premises.

The term *blanket* often leads to misunderstanding by insurers more familiar with the European form. A US policy written on the blanket basis, does not – as is often erroneously assumed – lack the full details on all the covered machines and equipment. By inspecting the plant(s), the insurer obtains the information required to correctly assess the risk and gauge the cover price. However, the insurer considers this type of information confidential and therefore does not integrate it in the policy or make it available to potential competitor(s), brokers or other insurance companies.

If the insured provides the underwriting information on the basis of a completed questionnaire typical for the European form, it is customary to integrate the questionnaire in the policy.

Regardless of the manner used to describe the insured machines and equipment (insured items), certain components and parts are excluded from coverage.

Cover excludes the following:
- Exchangeable tools
  - drills
  - crusher bits, etc.
- Non-metallic parts
  - foundation blocks
  - furnace refractories
  - conveyor belts
- Feedstock and media, eg:
  - fuels, catalysts, etc.

The following types of equipment are customarily excluded from machinery insurance:
- Office machines
- Data processing equipment
- Vehicles
- Mobile construction equipment
Machinery insurance is a quasi all risk cover and provides protection (subject to specific exclusions) against any sudden and unforeseen physical loss or damage to the insured machines and equipment. Emphasis is placed on the term *sudden and unforeseen* or, quite often, on the synonymous term *sudden and accidental* which is regarded as a single concept. By itself, the term *sudden* is of little significance since any damage in insurance nomenclature which can no longer be prevented would be considered sudden damage, irrespective of the time frame in which it occurred, provided that, based on general experience, such an event could not have been reasonably expected.

Any loss or damage under machinery insurance cover must be sudden and unforeseen (accidental) insofar as the insured is concerned. The term *unforeseen* (or accidental) denotes damage which the insured neither noticed in time nor could have had foreseen despite a degree of competence reasonably expected from the machine operator. In this context, the insured is understood as the management of the insured including the operations manager. Moreover, the insured is obliged to carefully monitor machine operation for unusual noises, vibrations, output reduction, etc and to respond immediately – even interrupting operations – to prevent or minimise possible machine damage.

The term sudden and unforeseen is essential to distinguish accidental loss or damage from wear and tear which is defined as a predictable operating parameter within routine maintenance and servicing and therefore does not qualify as an indemnifiable event under machinery insurance. Some policy wordings introduce the term accidental and then set forth its scope of definition.

Policy forms, which rely solely on the term *sudden and unforeseen loss or damage* followed by a fairly long list of exclusions to define the cover, often led and still lead to questions of what would actually be covered by the policy. This prompted insurers to list some of the primary perils, eg on-the-job accidents relating to maladjustment, loose parts, entry of foreign objects, centrifugal force serrations, defective or faulty design, material or manufacturing and erection faults, improper operation, lack of skill, carelessness, malicious intent of employees, etc. However, despite this listing of some of the covered perils, the quasi all risk cover type is maintained by supplementing the list with the following wording: *any other accident not hereinafter excluded.*
5 General conditions

General policy conditions to be observed:

• The insured shall ensure that all insured machines and equipment are maintained in good working order and that they are not habitually or intentionally overloaded. The insured shall fully observe the manufacturers’ instructions for operation, inspection and overhaul as well as governmental, statutory, municipal and all other binding regulations in force regarding the operation and maintenance of the insured machines and equipment.

• Unless an endorsement is signed by the insurer to ensure policy continuance, it will be void in the event of the following conditions: any material change in the original insured item; alteration, modification or addition to an insured item; non-observance of specified operating conditions resulting in increased risk of loss or damage, or changes in the insured’s status (such as business discontinuation and liquidation or receivership).

• The insured must immediately notify the insurers of any occurrence which might give rise to a claim under the policy, and supply all required particulars and proof of claim.
The list of exclusions must be accurate and complete. Machinery insurance is intended to provide so-called quasi all risk cover in conjunction with a standard fire and extended perils policy. To achieve this goal, exclusions listed in the machinery insurance must be co-ordinated with the perils covered under the fire and extended perils policy.

6.1 General exclusions

Apart from the more specific engineering exclusions dealt with subsequently, there are also so-called general exclusions, ie:

- Damage arising from wilful acts, wilful negligence by the insured or its management.
- Nuclear risks: losses arising from ionising radiation or radioactive contamination from any nuclear fuel, or from any nuclear waste from the combustion of nuclear fuel, as well as losses caused by, contributed to, or arising from nuclear weapons.
- Political risks such as war, civil war, civil commotion, riots, etc.
- Consequential loss, damage or liability of any nature.

6.2 Standard fire and extended perils exclusions

The primary excluded perils are usually those covered by a standard fire and extended perils policy, eg fire, lightning, explosion, major perils, theft, burglary, etc.

The extent to which perils are covered under such policies varies from country to country. Machinery insurance often includes elementary perils such as windstorm, frost (freezing), ice drift and ground settlement. However, the following perils are always excluded: earthquake, seaquake, tsunami, rockfall, flood, inundation, hurricane, typhoon, cyclone and volcanic eruption.

6.2.1 Distinction between fire insurance and machinery insurance

In fire insurance, fire is generally understood as hostile fire. Furnace heat damage is not regarded as fire damage. Damage due to glowing embers or heated objects not in flame which scorch or burn holes without igniting a fire is not regarded as fire damage.

A friendly impellent fire is one which remains within a specific confinement area, eg the combustion chamber of a furnace or a gas turbine. Essentially, fire is required to generate heat by means of combustible media (oil, gas or other fuel). Damage does not occur as long as the combustion process remains under control. However, process irregularities may lead to damage such as local overheating in the combustion chamber. Such damage would be excluded from fire policies and falls within the scope of the machinery insurance. Any resulting fire damage, should it occur, would fall within the scope of the fire policy.

Loss or damage to machines and equipment is frequently caused by electrical phenomena. A short circuit can often result in fire and, conversely, a fire can cause a short circuit.

The fire policy excludes loss or damage to machines, equipment, electrical conductors resulting from the direct effect of electrical power itself, eg overvoltage, surge voltages, increasing temperatures due to overloading as well as loss or damage to protective devices (safety gear, fuses, etc) occurring during the normal operation of such devices.
Loss or damage due to lightning, however, is covered within the scope of the fire policy. In some countries, machinery policies also cover fire losses of electrical equipment arising from sudden and unforeseen electrical phenomena in the equipment itself. Any resulting fire, loss or damage to other machines or equipment, however, falls within the scope of the fire policy. Loss or damage caused by explosion is covered by the fire policy.

Explosion is understood as an instantaneous manifestation of fire, triggered by expanding gases or vapours. With respect to pressure vessels (e.g., steam boilers, cylinders, or vessels for vapour, gas or liquid, or boiling units, steam pipes), explosion damage is deemed to have occurred only if the walls of the receptacle are damaged to such extent that the pressures inside and outside the receptacle are instantaneously equalised.

In fire insurance, however, explosion peril does not include distortion, whether or not accompanied by the rupture of any part of the pressure plant caused by crushing stress through forces related to steam or other fluid pressure (apart from the pressure associated with ignited flue gases). Furthermore, it does not encompass the destruction of rotating machines caused by centrifugal forces nor loss or damage caused by implosion (instantaneous deformation of a vacuum receptacle caused by external overpressure). Consequently, this loss or damage is not considered to be an explosion in the sense of fire insurance and thus falls within the scope of the machinery insurance.

Machinery insurance also provides cover for loss or damage in the case of sudden and violent bursting of pressure plants by internal steam force or other fluid pressure (except pressure of chemical action or of flue gas ignition) causing structural physical displacement of any part of the pressure plant together with forcible ejection of its contents. Damage caused by fire preceding or following such events, however, is excluded from machinery cover.

6.3 Machinery-specific exclusions

The following four exclusions are typical to machinery insurance:

1. Foreseeable events, e.g., consequences of normal operation, any continual mechanical, thermal, chemical or electrical effects, wear and tear, corrosion, erosion, undue deposits, mud, boiler scale, etc.

2. The events listed above often give rise to claims disputes, particularly regarding the exposure defined as corrosion.

Modern science classifies the various types of corrosion as follows:

A Corrosion in the absence of mechanical stresses:
- Uniform corrosion
- Shallow pit formation
- Crevice corrosion
- Galvanic corrosion
- Corrosion by differential aeration
- Deposit attack
- Selective corrosion
  - Intergranular
  - Transgranular
- Dew point corrosion
- Corrosion by condensed water
- Idle corrosion
- Microbiological corrosion
- Scaling (high temperature oxidation)
- Accelerated oxidation
- Subsurface corrosion

B Corrosion types under additional mechanical stresses:
- Stress corrosion cracking (SCC)*
- Corrosion fatigue (low cycle corrosion fatigue)
- Strain-induced corrosion
- Corrosion – erosion
- Cavitation corrosion
- Fretting corrosion

*SCC is defined as the failure of metals under the combined effect of tensile stress and a corrosive environment.
Loss or damage caused by any of these corrosion types has the following common characteristics:
- Develops gradually
- Results in machines and equipment from ongoing exposure (operation and standstill)
- Can be detected through modern materials testing methods and is therefore not understood as sudden and unforeseen.

The interpretation as to what degree of loss or damage caused by the above-mentioned foreseeable events is indemnifiable varies considerably from country to country.

2. Any faults or defects existing at the time of policy inception which were known or should have been known to the insured or its management.

3. Breakdown caused by testing or experiments in which normal operating stresses are willingly exceeded.

- Short-term overstressing cannot be avoided while inspecting the operational integrity of safety gear under excessive conditions which may occur during any operational phase. However, the following events are expressly covered:
  - Disconnecting a turboset under full load conditions;
  - Short-circuit testing of a transformer; and
  - Emergency brake testing for a cableway.

- The testing exclusion rules out experiments such as setting the minimum pressure or load on a boiler safety valve in excess of the design value or increasing the trip rate of an over-speed guard, etc.

4. Machinery insurance does not cover loss or damage for which manufacturers, suppliers or others are liable by law or under contractual obligations.

- This exclusion does not, however, apply to the extent that manufacturers, suppliers, contractors or other parties are unable to discharge their liability, and the insured is able to provide evidence of this fact.

Furthermore, this exclusion applies only during the manufacturer’s warranty period which is usually between 12 and 24 months after the service period commences. Notwithstanding the material damage, business interruption cover, if provided, would be triggered despite this exclusion.
The sum insured (SI) is an amount mutually agreed upon between insurer and insured and serves as the basis for determining specific obligations, described in greater detail in the insurance policies. The sum insured is a policy parameter used to establish the indemnifiable amount in case of loss and to calculate the premium for the insured risk.

With respect to material damage covers such as fire insurance and machinery insurance, it is customary to gear the sum insured to the total value of the insured property.

The sums insured for various lines of business can be classified as follows:

<table>
<thead>
<tr>
<th>Line of business</th>
<th>SI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Property (material damage)</td>
<td>New Replacement Value</td>
</tr>
<tr>
<td></td>
<td>(NRV)</td>
</tr>
<tr>
<td>Business interruption</td>
<td>Gross profit/additional cost</td>
</tr>
<tr>
<td>Special covers</td>
<td>First loss amount</td>
</tr>
</tbody>
</table>

For some policies (particularly in the US or US-dominated markets), the sum insured is often replaced by an indemnity limit per loss event.
8 Property valuation

Machinery insurance is understood as accident insurance and cannot be construed as life insurance for machines. Machines have defined service lives governed by operating conditions, wear and tear as well as obsolescence resulting from ongoing technological development.

Therefore, machine owners must establish annual depreciation schemes and allocate proper reserves for replacing machines and equipment at the end of their service lives.

Machinery insurance cover is designed to ensure that the necessary capital will be available at any time during the machine service life for new procurement in the event of total loss or for repair in case of partial loss (Figure 1).

Establishing the correct sum insured is often difficult and depends on the line of business insured.

In the case of policies written on a sum insured basis, the value of the insured property/machines must equal the total value of the insured property. In the case of machinery insurance, this value should equal the new replacement value (NRV). Otherwise, an average clause applies, ie the indemnity is reduced in the same proportion as the sum insured bears to the total value of the insured property/machines.

New replacement value (NRV): replacement cost of the insured machinery and plant with new machines of the same type and specifications. NRV also includes all freight costs to the site, erection costs, custom duties and other fees.

In several countries, price adjustment formulas are integrated into the policy since relevant machine purchase prices are often difficult to obtain from manufacturers. These formulas are based on governmental or other official indices for materials and wages and comply with the standard price revision clause for supply contracts.

\[
SI = \left( a + b \cdot \frac{R}{R_0} + c \cdot \frac{W}{W_0} \right) \times SI_o
\]

SI: Sum insured for new opening year
SIo: Sum insured for closing year
R: Raw material price index at end of closing year
Ro: Raw material price index at end of previous year
W: Wage index at end of closing year
Wo: Wage index at end of previous year
a: Percentage factor for fixed costs portion
b: Percentage of materials
c: Percentage of wages

The above-mentioned percentages vary somewhat from one supplier to another and also from country to country.
Based on the calculated property valuation, the indemnity limit is confined to the actual cash value of the damaged item; otherwise, the insured would stand to gain an enrichment from the insurance.

“The limit of the insurer’s liability for loss on the property of the insured shall not exceed the actual cash value thereof at the time of the accident. If, with respect to the damaged property of the insured, the repair or replacement of any part or parts of an item is involved, the insurer shall not be liable for the cost of such repair or replacement in excess of the actual cash value of said part or parts or in excess of the actual cash value of the item, whichever value is less. Actual cash value in all cases shall be ascertained with proper deductions for depreciation.”

8.1 Actual cash value (ACV) basis

Machine and equipment service life must be established and defined. It is inappropriate to operate machines up to the point of their ultimate failure or total breakdown. Machine service life is generally defined as the period during which a machine will provide normal service and efficiency and generate products of commercially acceptable quality.
Machine availability is a key factor for determining its degree of economic efficiency. For this reason, overhauls are performed at predetermined intervals to replace critical components and effectively prevent unplanned downtime. Useful service life is based on the following criteria: experience with similar machines, operating history, non-destructive tests on parts and components, theoretical service life calculation, long-term materials behaviour.

The outcome of these studies is summarised and forms the basis for manufacturers’ recommendations regarding parts replacement at specified intervals during a given operating period.

Agreement should be reached with the insured for establishing depreciation amounts or the actual cash value, since the service lives of entire machine units, parts and components vary widely according to various parameters and machine operating factors. The following formula may be used as a general guideline:

\[
ACV = NRV \left(1 - \frac{A}{SL}\right)
\]

**Numerical example**

NRV: USD 1 000 000  
Machine age on the accident date: 15 years  
Designed service life: 30 years

\[
ACV = NRV \left(1 - \frac{A}{SL}\right) = 1 000 000 \left(1 - \frac{15}{30}\right)
\]

ACV = USD 500 000

Depending on the inflation rate and useful machine service life, the actual value of an insured item could be greater than the initial purchase value.

**Example:**

<table>
<thead>
<tr>
<th>Purchase value</th>
<th>100%</th>
</tr>
</thead>
<tbody>
<tr>
<td>NRV after 10 years</td>
<td>163%</td>
</tr>
<tr>
<td>(5% annual inflation)</td>
<td></td>
</tr>
</tbody>
</table>

\[
ACV = 163 \left(1 - \frac{10}{30}\right) = 108.6\%
\]

The actual cash value is still widely used and is thoroughly justified as the indemnity limit.
8.2 Repair or replacement basis

For many years, US insurers offered a repair or replacement cover, subject to additional premium, as an option to the actual cash value basis. In the US market, it is now known as the standard cover and is erroneously often referred to as *new for old*. The insurer agrees that material damage (of the insured) as specified in the policy is understood as the amount actually paid by the insured to repair or replace the property insured, subject to the following provisions:

“The damaged property shall be repaired or replaced within twelve months from the accident date unless such period is extended by written consent of the insurer.

The insurer's liability for any repair or replacement shall be limited to the smaller of the following: (1) the cost at the time of the accident to repair said property, or (2) the cost at the time of the accident to replace said property on the same site with property of like kind, capacity, size and quality; provided that if replacement is in the form of property of an improved kind or quality or of larger capacity or size, the liability of the insurer shall not exceed the amount that would be paid if the replacement had been made by property of like kind, capacity, size and quality.

The insurer shall not be liable for (1) any increase in the cost of repair or replacement necessitated by any ordinance or law regulating or restricting repair, construction or installation, (2) loss or damage to property obsolete to the insured, or (3) the cost of repairing or replacing any part or parts of an item which is in excess of the cost of repairing or replacing the entire item.

If any damaged property is not repaired or replaced, the insurer's liability regarding such property shall be limited to the actual cash value.”

The repair or replacement cover arose primarily due to the second-hand machine market in the USA, which offers a wide spectrum of used machines and equipment. Since most claims are partial losses, repair can be made at costs below the actual cash value.

The trend of including machinery insurance in *Property All Risk* covers resulted in the repair or replacement basis gaining momentum in the international market.

Second-hand machine markets are virtually non-existent outside the US, and this form of cover may result in insurers having to pay for new machines or equipment. This in turn leads to the expression *new for old* which is not the intention of this cover type.

8.3 Comparing valuation methods

The primary difference between the actual cash value basis and the repair or replacement basis can be summarised as follows:
There is no difference between the two methods for partial losses in which the repair costs remain below the actual value.

In case of a so-called constructive total loss (a loss in which the repair cost would exceed the actual cash value), indemnity under the actual cash value basis would be restricted to the actual cash value of the insured item when the loss event occurred. Thus, repair would be considered no longer economically justifiable. The insured would be in a position to purchase a new machine with allocated reserves (depreciation) and the insurance indemnity (Figure 2).

The repair or replacement basis stipulates that insurers pay full repair costs unless the same machine type is available on the second-hand market, in which case the insured would have to accept it as a replacement (Figure 3).
The risk premium for an insured item (Rp) is a function of loss frequency (q) in a given (annual) period, the claims amount (c) plus a surcharge (z) to compensate for specific perils and administrative costs.

\[ Rp = q \times (c + z) \]

Experience shows that loss frequency for specific items remains fairly constant over the period but that the claims amount increases continually in line with inflation and spare parts price increases due to diminishing stock levels, resulting in the need for greater risk premium (Figure 4).

Figure 4: Useful service life

For practical reasons, machinery insurers have set a premium rate (PR) for a wide range of given machines and equipment, which is based on the ratio between the risk premium and another characteristic factor, i.e., the sum insured.

Assuming claims frequency (q) is constant for a given insured item and the claims amount (c+z) varies in relation to inflation, the sum insured (SI) must vary in relation to inflation to permit a constant premium rate (PR). Therefore, if the NRV is used as the SI, the required premium in real terms is established in most cases.
The deductible is an amount carried by the insured and mutually agreed upon with the insurers.

Normally, only those losses above a certain amount, and not the first dollar, are covered to maintain the insurance premium at an economically justifiable level. The insurance community has an interest in ensuring that all members keep the loss burden as low as possible. Hence, the policy will not indemnify loss or damage resulting from an insured event (any one accident) until the amount of loss or damage exceeds the deductible and then the policy will pay only the amount of loss or damage exceeding the deductible (excess).

The amount of the excess depends on various parameters, e.g., type, size and complexity of the machines and equipment, manufacturers’ experience, financial strength of the insured, etc.

Insurers will set the minimum deductible based on technical parameters, and the insured can then select a higher deductible if desirable, subject to his financial strength and inclination for risk. Obviously, the final premium will be adjusted to reflect the level of the selected deductible.
11 Risk inspection

While there is a current trend in many industrialised countries to waive requirements for compulsory inspections required for plant operations, onsite engineering inspection remains a key factor in machinery insurance. Inspections are designed principally to safeguard human life and prevent accidents which could have been either mitigated or precluded through engineering experience and expertise. Furthermore, federal and local regulations in many countries stipulate that operating authorisation for certain machines and equipment is contingent upon inspections, eg boilers and pressure vessels.

These mandatory inspections are performed either by government agencies or by inspectors from insurance companies licensed by the relevant authorities.

In addition to the assurance offered by regular inspections of boilers and pressure vessels, insurers also rely on the feedback from scheduled, governmental inspections of all machines and equipment as a key information source for assessment and pricing of risk.

Detailed information on the following topics is of particular interest to insurers:

**Physical condition of the machines and equipment**

It is best to inspect the physical condition of a machine when dismantled during major overhauls. Several sophisticated non-destructive diagnostic tests have been developed which also permit testing of functional integrity during machine operation.

**Loss-related problems associated with older machines**

In this case, the insurer should ascertain that the specific machine type and all required spare parts are still being manufactured prior to granting any cover.

**Unconventional features**

Industry’s ongoing investment in new and unconventional products has led to the use of many special purpose machines with unconventional features. The risks inherent in operating such equipment warrant prudent evaluation.

**Plant configuration**

All technical machines and equipment in a given facility must be overhauled according to specified maintenance schedules. Some type of damage often occurs during overhauls, even if all necessary precautions are observed. Whenever possible, inspection of critical components of machines and equipment should be performed without total disassembly.

If these aspects are not observed, the insurer would have to increase the premium accordingly by applying risk aggravating factors.
Loss history
The insurer should obtain a copy of the loss history of the machines and equipment to be covered. A detailed list must cite all major damage, repairs and modifications during commissioning, testing and operation. These factors should be reflected in the premium level and may even raise the question of the basic insurability of the machines.

Maintenance
Proper and ongoing maintenance is vital for damage prevention.

Repair costs can be reduced by implementing the manufacturer’s preventive maintenance plan since components would normally be replaced before damage occurs. This implies that spare parts inventories can be planned on the basis of the most frequent malfunctions incurred.

Diagnostic checks are employed to obtain an early warning for repair needs. They can be performed during normal operation of machines and equipment or during scheduled and brief shutdowns.

Many diagnostic checks can be made by means of permanently installed control instruments. Extended range inspection and test equipment permits more precise detection of defects and abnormal conditions. For example:

- Infrared imaging for determining local hot spots in transformers and furnaces
- Oil spectrography for analysing the presence of metal particles in oil
- X-ray inspection of welds
- Ultrasonic inspection for detecting flaws and cracks in shafts and machine casings
- Endoscopic inspection of turbine blades
- Vibration monitoring, etc.
It is often advisable and/or necessary to supplement the standard policy form with conditions specific to the risk or the machines and equipment to be insured. Numerous clauses have already been drafted and new ones are continually being developed. They are designed to specify a particular hazard, or to cite acceptance of technical specifications and regulations or exclusions or cover extensions.

Some of the most frequent clauses are cited below:

**Pressure plant explosion**
In addition to indemnifying the damage to the pressure plant resulting from its own explosion, coverage is extended to indemnify damage as a direct result of explosion to the adjacent property which belongs to the insured or is in the insured’s custody or control.

In this context, explosion is defined as the sudden and violent bursting of a pressure plant (boiler, pressure vessel, etc) by the force of internal steam or other fluid pressure (other than the pressure of ignited flue gases), resulting in the physical destruction of any part in conjunction with the forcible ejection of its contents. This additional cover is subject to a liability limit and premium supplement.

**Restricted service life**
The indemnity provided for components subject to high and rapid wear and exhibiting limited service life is restricted to the value of such components at the time of the indemnifiable occurrence, taking into account the length of their service lives.

**Adjacent property**
Adjacent property is normally not insurable under the machinery insurance policy. However, for consequential damage arising from an insured event, cover up to an aggregate indemnity limit may be granted against an additional premium.

**Debris removal**
Debris removal costs are covered under the machinery insurance policy and are included in the total repair costs in the event of an indemnifiable claim. If experience shows that these costs are very high for particular machines or equipment, an indemnity limit should be stipulated by special endorsement.

**Expediting expenses**
Expediting costs, comprising extra charges for overtime, nightwork, work on public holidays and express freight (excluding air freight), may be covered by endorsement and subject to additional premium.
12 Clauses/cover extensions

Air freight
Air freight charges may be covered if necessitated to expedite repairs of an insured item. The premium is calculated on an aggregate indemnity limit also taking into account the type and location of the plant and distances from suppliers.

Various job locations
A situation of aggravated risk exists if machines and equipment are used at various premises and sites. The premium must therefore be increased and special clauses applied to satisfy this cover requirement.

Water damage
Cover may be extended to include water damage only if it is caused by the breakdown of an insured item (e.g., fractured penstocks, valves or turbine casings, etc.). Furthermore, this category of loss excludes water damage or any other damage caused by natural hazards (except windstorm). This extension is subject to additional premium.

Machine foundations
Machine foundations and other civil engineering works or structural elements of a building representing an integral part of an insured machine may be included in the policy by an endorsement to cover damage costs as well as other additional costs required for gaining access to repair the machine. These items and their new replacement values must be listed separately in the endorsement. This extension is subject to additional premium.

Machines and equipment used in subterranean applications
It is advisable to include a clause waiving the insurer’s liability for insured machines and equipment used in subterranean applications for which loss or damage could result from gas explosions, water ingress, liquefied sand and clay or the collapse of tunnels, shafts and/or their support structures.
13 Indirect damage insurance

Thus far, discussion has focused on insurance which indemnifies loss or damage to tangible property (machines and equipment) resulting directly from a loss event. In the majority of accidents involving boilers and machines, loss is not limited to the costs of repairing or replacing the property damaged or destroyed. Financial loss may be substantially greater than the loss to the actual machines and equipment in the case of goods which could not be produced or sold, the spoilage of goods due to inadequate power, heat or refrigeration, or increased operating expenses incurred by the use of alternative production methods.

Indirect damage insurance is not addressed in this brochure. Since it complements machinery insurance – either in the form of a separate policy or as an endorsement to the relevant machinery insurance policy – only its main features will be highlighted. The most frequently requested indirect damage covers are:

**Business interruption (BI)**
Investments in machines and equipment are designed solely with the intention of generating profit. Business interruption insurance covers financial loss resulting from total or partial business downtime caused by the damage or destruction of insured machines and equipment. For the most part, this insurance is designed to cover net profits, fixed expenses and loss minimisation costs. The cover indemnifies gross profit (net profit plus fixed expenses) that could have been earned had the loss event not occurred.

**Extra expense insurance**
This insurance covers extra expenses incurred by the insured to continue his business without interruption while the damage from an insured loss event is being remedied. It represents a special form of business interruption cover specifically adapted to service-oriented operations which must continue on a daily basis, eg dairies, utilities, newspaper printers, etc.

Payments continue as long as the insured items are inoperable, resulting in additional expenses over and above those which would have been insured had the accident not occurred.

This cover can be granted only in cases where other immediate facilities and/or other means are available to the insured to permit operation to continue.

**Consequential damage insurance**
This insurance covers the indirect loss of perishable goods spoiled as a result of insufficient power, light, heat, steam or refrigeration and arising solely from damage to the insured machines and equipment.

This cover is required mostly by businesses with the following exposures:
- Production processes requiring heat, steam or refrigeration, eg pharmaceutics, synthetics, processed foods, malt beverages, greenhouses, dairies, etc.
- Production processes dependent upon continuous uninterrupted power to avert product damage, eg synthetic fibres, plastics, smelting, etc.
- Perishable products in cold storage dependent on refrigeration, eg fish, meat, vegetables, frozen foods, etc.

Consequential damage insurance usually covers damage to the insured’s goods and those which others have entrusted to his care and custody. This feature is important to owners of cold stores where space is leased to third parties for perishable goods storage. The indemnity is limited to the actual cash value of the damaged goods. Perishable property subject to spoilage must be specified.
Statistics reveal that losses differ widely in terms of frequency and severity from one industrial branch to another since perils are determined largely by the type of industry and the relevant operating environment. For example, a steam turboset of the same type and output rating is exposed to far less adverse conditions when installed inside a power generating facility of a public utility than when located in an open-air oil refinery. The nature of these different parameters has resulted in various risk categories for numerous types of industries, and Swiss Re’s Machinery Breakdown rating guide covers a comprehensive range of industrial groups.

The industrial groups as defined are further subdivided into categories of major machines according to different types and output ratings. Other equipment and components are listed as miscellaneous.

The breakdown of rates according to different machine and equipment categories necessitates itemised values at least in the case of larger machine and equipment installations. The more detailed the itemised values submitted by the policyholder, the more accurate the assessment and rating. This applies particularly to large factories with a diversity of machines and equipment.

Swiss Re has extensive documentation on rate levels used in many industrialised countries and can therefore provide relevant rating guides. However, the rates and deductibles (excesses) indicated in such a rating guide are valid only for machines and equipment operating under moderate exposure, which can be described as follows:

- Plant management and technical staff should be experienced and well qualified to operate such machines and equipment;
- Safety measures, maintenance and loss prevention should be commensurate with modern standards;
- Machines and equipment must have successfully passed reliability tests in similar installations, i.e. they may not be prototypes;
- The plant should be up to date and not obsolete;
- The political, social and economic environment should be stable.

Rate structures should be adjusted accordingly if these exposure factors are not met. In the worst case, machines and equipment would have to be declared uninsurable.

The rating guide contains detailed instructions for adjusting the premium to reflect various factors which alleviate or aggravate risk.
Any loss event implies impairment for the insured and the threat of his economic resources in addition to various attendant problems. Machinery insurance is designed to relieve the policyholder of this burden, but the insurance does not cover every type of loss event. A procedure for establishing prompt proof of the insurer’s liability as well as competent and professional handling of claims are vital for both contractual parties.

**Policyholder obligations**

The policyholder must proceed as follows in case of a loss event:

- The insurer must be informed as soon as practically possible.
- The insurer must also be informed in writing about the possible accident cause, estimated loss amount, etc. The key points must be covered in the initial loss event report.
- Information must be submitted to substantiate the claim.
- All efforts must be made during and immediately after the loss event to safeguard the insured property from further damage. Any and all instructions from the insurer must be observed.
- The damaged insured items must not be modified in any way which would make it more difficult or even impossible to determine the cause of the damage. Modification is permissible if it will reduce the loss or is required by public authorities.
- Damage repair may begin immediately if vital for further plant operation and provided the loss survey is not adversely affected.
- The insurer will not be liable for loss or damage unless notice is received within the agreed time frame stated in the policy.

**Loss survey**

The insured or the insurer may demand that a loss survey be conducted immediately. The insured must prove the indemnity amount. The loss survey may be conducted either by the insured, insurer or by an independent loss adjuster.

**Checklist for proving coverage in the event of loss or damage:**

- Does the plant schedule specify the damaged item and sum insured?
- Did the damage occur within the policy period?
- Did damage arise from defects existing at policy inception?
  - Policies will generally not indemnify those defects known to the insured but not reported to the insurer. The burden of proof rests in establishing that such defects existed before policy inception and that they were the primary cause of any resultant damage.
- Has the premium been paid?
- Was the claim reported to the insurer within the specified time limit?
- Is the loss or damage covered by the policy?
- How did the loss occur? What were the causes?
  - Does the damage comply with the criterion *sudden and unforeseen*?
- What was actually damaged?
- Did the loss occur inside or outside the insured premises?
- Did the insured breech certain specifications or regulations?
Indemnity calculation and loss settlement

Unless otherwise agreed, the maximum indemnifiable amount is either the actual cash value of the damaged item or the indemnity limit per loss event. Generally, a distinction is made between partial losses (PL) and total or constructive total losses (CTL).

Partial losses are the most frequent type of damage. A partial loss results if repair costs (RC) for the damaged item are less than the actual cash value (ACV).

Repair costs are less than the actual cash value (partial loss) (Figure 5).

• The indemnifiable amount for these losses is the same, irrespective of the cover basis, ie the actual cash value basis (A) or repair or replacement basis (B).

• The indemnifiable repair costs are those required to restore machines and equipment to their state immediately prior to the loss event. Costs are also covered for dismantling and re-erection, spare parts, transportation and customs duties.

Repair costs are equal to or greater than the actual cash value (constructive total loss) (Figure 6).

• A total loss arises if an insured item is so severely damaged that it can no longer be repaired. A constructive total loss (CTL) arises when the repair costs are equal to or greater than the actual cash value of the damaged item.

• The maximum indemnifiable amount determined for the total or constructive total loss is one of the following, depending on the basis on which the policy had been concluded:
  - actual cash value of the damaged item;
  - the cost incurred to restore it to the state immediately prior to the loss event; or
  - the cost to replace it with a machine similar in type, capacity, size.

Regardless of whether or not the policy was concluded on the repair or replacement basis, the insured is not entitled de facto to a new machine in case of a constructive total loss. The insurer’s liability is restricted either to the full repair costs, the replacement cost of a second-hand machine (if available) or a new machine replacement, whichever is less.

Under-insurance (actual cash value basis)

The term under-insurance applies if the sum insured of an item is lower than its new replacement value. If under-insurance is determined in a loss settlement, full indemnity will not be paid. Indemnification may be calculated using the following formula:

\[ I = \frac{SI}{NRV} \times RC - D \]

I: Indemnity
SI: Sum Insured
NRV: New replacement value
RC: Repair costs
D: Deductible
15 Claims handling

Figure 5:
Partial loss

Figure 6:
Total or constructive total loss
Monoline machinery cover traditionally underwritten by professional engineering insurers is currently on the decline. It is generally felt that this insurance will be gradually superseded by multiline covers such as *Industrial All Risk* or *Property All Risk*.

However, the integration of machinery insurance in other insurance forms is not a recent development. Policyholders have traditionally sought all-inclusive covers for protection against property impairment, irrespective of its cause.

The insured’s primary motives and justification for All Risk cover include:

- Clear formulation of the policy terms, conditions and restrictive claims adjustment period;
- Prevention of cover overlap between different insurance lines and associated price benefit;
- Avoiding coverage gaps: comprehensive insurance cover is offered as a so-called “sleep-easy package”.

For many years, all-inclusive policies have been available in various countries and incorporate many individual lines. Such integrated policies have traditionally comprised an aggregate of individual and easily identifiable monolines, with machinery insurance as a component of such integrated packages. Its identification as a distinct monoline has made it possible to define specific terms and conditions, to acquire statistics for each line, to provide appropriate technical services and to maintain the image of machinery insurance as a special line.

A truly comprehensive blanket all risk cover, however, is not technically justifiable. It is impossible to assess all known and unknown risks, and hence such policies would be burdened by extensive conditions and exclusions. Conversely, all risk policies with inadequate terms, conditions and exclusions will lead to numerous losses and ultimately have an adverse effect on the insurance industry as a whole, which is not in the long-term interests of the insured parties.

*Property All Risk* covers are well established and advantageous for certain industries. While corporate risk managers are potential clients for property covers, they are also key clients of monoline machinery insurers. Sophisticated insurance buyers are also interested in issues beyond the scope of insurance cover and therefore rely on the special expertise of machinery insurers for further developing their safety management programs. Although the concept of *Property All Risk* covers may pose a challenge to traditional machinery insurers, their expertise will be required, regardless of whether the policy is a property all risk or monoline type.

Many engineering insurers include technical service as an integrated part of their proposals. In some markets, legally compulsory inspections are conducted by machinery insurers as a service. Machinery insurers also conduct other loss prevention inspections which are normally an integrated part in the insurance coverage.

In conclusion, it can be stated that the in-depth and comprehensive technical expertise gained by machinery insurers in this particular field will continue to benefit both clients and the insurance industry at large.
### Appendix: Index of terms

<table>
<thead>
<tr>
<th>Term</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actual cash value (ACV)</td>
<td>19</td>
</tr>
<tr>
<td>Blanket groups</td>
<td>8</td>
</tr>
<tr>
<td>Boiler explosion</td>
<td>7</td>
</tr>
<tr>
<td>Breakdown</td>
<td>7</td>
</tr>
<tr>
<td>Business interruption (BI)</td>
<td>7</td>
</tr>
<tr>
<td>Comprehensive form</td>
<td>8</td>
</tr>
<tr>
<td>Consequential loss covers</td>
<td>7</td>
</tr>
<tr>
<td>Constructive total loss (CTL)</td>
<td>35</td>
</tr>
<tr>
<td>Contractor’s all risks (CAR)</td>
<td>7</td>
</tr>
<tr>
<td>Contractor’s plant</td>
<td>7</td>
</tr>
<tr>
<td>Corrosion</td>
<td>14</td>
</tr>
<tr>
<td>Delay in start-up</td>
<td>7</td>
</tr>
<tr>
<td>Deterioration of stock (DOS)</td>
<td>7</td>
</tr>
<tr>
<td>Engineering insurance</td>
<td>7</td>
</tr>
<tr>
<td>Erection all risks (EAR)</td>
<td>7</td>
</tr>
<tr>
<td>Explosion</td>
<td>14</td>
</tr>
<tr>
<td>Extra expenses</td>
<td>7</td>
</tr>
<tr>
<td>Force majeure (FM)</td>
<td>7</td>
</tr>
<tr>
<td>Individual listing</td>
<td>8</td>
</tr>
<tr>
<td>Liquidated damage (LD)</td>
<td>7</td>
</tr>
<tr>
<td>Low voltage &amp; electronic equipment</td>
<td>7</td>
</tr>
<tr>
<td>Material damage cover</td>
<td>7</td>
</tr>
<tr>
<td>New for old</td>
<td>21</td>
</tr>
<tr>
<td>New replacement value (NRV)</td>
<td>18</td>
</tr>
<tr>
<td>Partial loss</td>
<td>35</td>
</tr>
<tr>
<td>Pressure plant explosion</td>
<td>29</td>
</tr>
<tr>
<td>Provisional acceptance certificate (PAC)</td>
<td>8</td>
</tr>
<tr>
<td>Ready for use</td>
<td>8</td>
</tr>
<tr>
<td>Repair or replacement basis</td>
<td>21</td>
</tr>
<tr>
<td>Service life</td>
<td>20</td>
</tr>
<tr>
<td>Sudden and unforeseen/accidental</td>
<td>10</td>
</tr>
<tr>
<td>Under-insurance</td>
<td>35</td>
</tr>
</tbody>
</table>
Max Bommeli, dipl. Masch. Ing. HTL, is a retired member of Swiss Re’s senior management. He joined Swiss Re in 1971. Following initial reinsurance training he worked as underwriter in the Engineering department. He has vast experience in underwriting in all classes of engineering insurance.