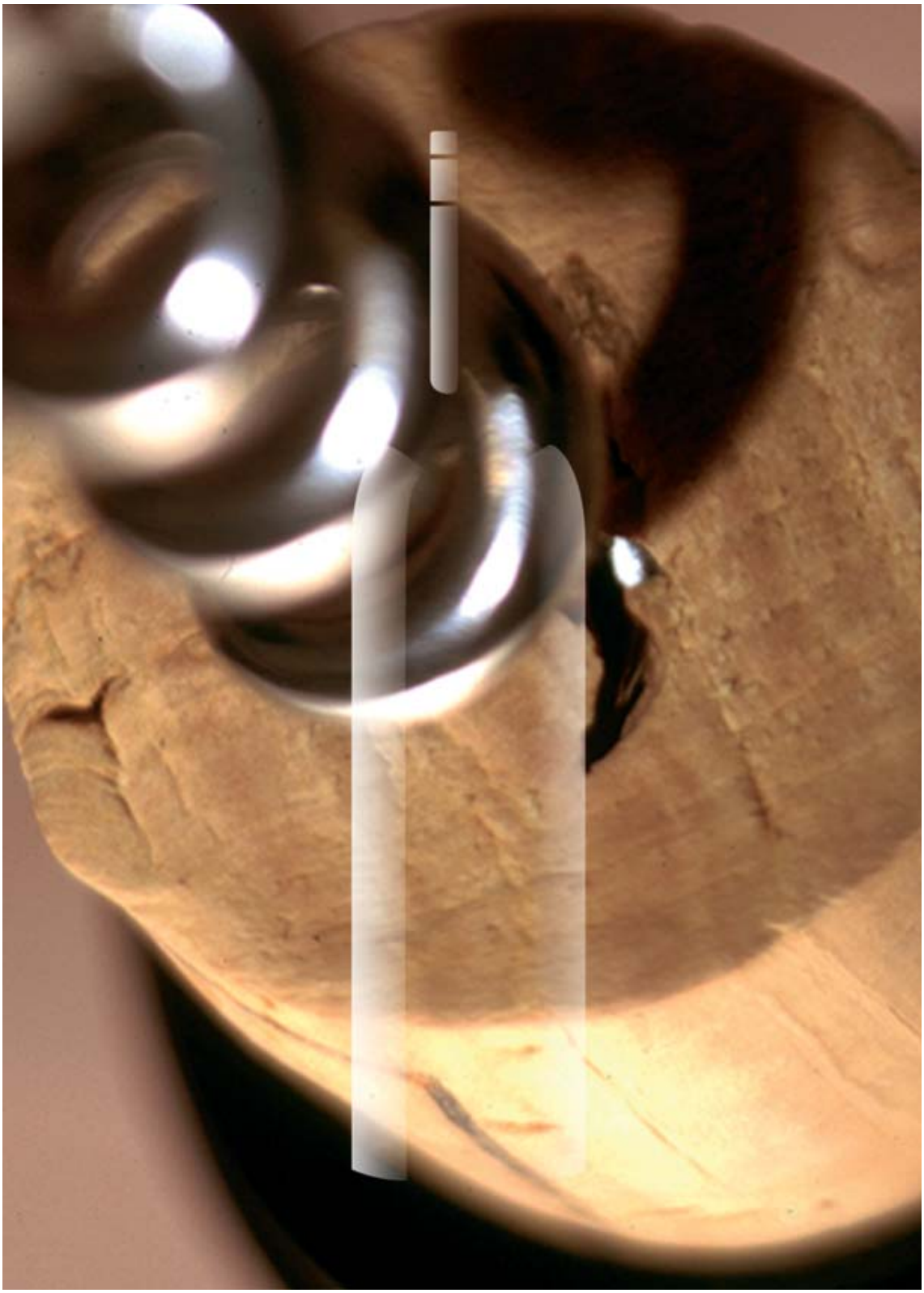
NATURAL CORK

TECHNICAL INFORMATION

Real Cork. Real Wine.



Foreword

Wine, bottle and cork. For generations this combination has fed our imagination and shaped our civilization. These three traditional components reflect human ingenuity and our dependence upon nature. A tradition that is synonymous with evolution, attentive to scientific progress and technological innovations. In the past few decades the wine world has developed more rapidly than it had in previous centuries resulting in an enormous improvement in cork quality. The Cork Industry could not afford to neglect this vast evolution. The progress in the Portuguese Cork Industry, over the past few years, has been truly impressive, ranging from cork harvesting and the updating the processing of raw material, to the creation of new products and implementing strict systems of quality control. Today, Portugal has the most modern cork stopper closure manufacturing facilities in the world, setting the standard for the industry worldwide. In the following pages, you will find useful information, practical advice and know-how to help you make the most of this incomparable closure.

Real Cork. Real Wine.

Index

Real Cork. Real Wine.

1. Cork.
A natural product,
with unique qualities.

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Cork is the name given to the bark of the cork oak tree (Quercus Suber L.), a tree found throughout the Western Mediterranean Basin, where it is grown in plantations known as "montados" (dehesas in Spain). Among the many unique characteristics that distinguish it from other trees in its species, is the tree's ability to have its outer layer of bark stripped which then regenerates itself. The bark that is stripped is called cork. Harvesting the bark is a very skilled operation that follows a strict code of practice including the legal period of time between each stripping, the ripeness of the bark and the weather conditions prevailing during the harvest. It is only carried out by experienced professionals, with minimum harvesting intervals of nine years in order to cause no harm to the tree. The first cork extraction occurs after the tree reaches a circumference of 70 centimeters at a height of 1.20 meters from the ground. However, the characteristics needed for the manufacture of cork closures are only obtained after the third harvest. This generally happens when the cork oak tree is approximately 40 years of age and at this stage, cork is known as "amadia".

The average lifespan of a cork oak tree varies between 170 and 200 years, which means that a cork oak tree will be able to regenerate cork suitable for the manufacture of closures, about 17 times. Light, impermeable both to liquids and gases, compressible, elastic, and an excellent thermal and acoustic insulator,

resilient and very resistant to wear and tear, cork is a material that has been greatly valued since the beginning of history.

The first references on cork date back to 3000 B. C., in China, where it was used for fishing apparatus. Cork's unique properties were also known to the Egyptians, Babylonians, Assyrians, Phoenicians and Persians. During the classic Greco- Latin period, it was generally used in the construction of various types of floats, beehives, and shoe soles. But it is with wine that cork has its strongest and most intimate relationship. Since man began to produce and consume wine, cork has always been the perfect sealing material, whether in amphoras, barrels or bottles. However, the exploitation of cork oak on a large industrial scale really started in the last quarter of the Eighteenth century, stimulated by the increasing use of glass containers to store wine.

The "montado" is a regularly planted landscape in Portugal, covering approximately 21% of forest area yielding more than 50% of the worldwide cork production. Although cork plantations grow throughout the country; the cork oak tree is most commonly associated with the Alentejo region, where the largest concentrations are found. The "montado" occupies an area of 2.2 million hectares worldwide; it is situated mainly in the Mediterranean basin and Portugal accounts for approximately 33% of the total area.

2. The Cork Closure.
An incomparable product.

Real Cork. Real Wine.

2. The Cork Closure. An incomparable product.

Cork is one of the most appreciated natural products. For three centuries cork has established a relationship with wine that has guaranteed it a remarkable place in the universe of cultural references. Recent market studies carried out in the United Kingdom, Australia and United States demonstrated that over 76% of the consumers in these key markets prefer wines sealed with a cork closure and that the type of closure used is an important factor when consumers choose their bottle of wine (1).

The Unique Characteristics of the Cork Closure

The natural properties of cork offer the wine industry a closure with incomparable characteristics. The main properties of cork are:

• **Lightness.** It weighs only 0.16 grams per cubical centimeter. A cork contains approximately 89.7% of a gas similar to air.

• **Flexibility, elasticity and compressibility**. These properties are due to the 750,000,000 cells (40,000,000 cells/cm^3) that compose a cork closure.
These cells are watertight with a gaseous mixture in the centre core, similar to air, allowing the cork stopper to be easily compressed when inserted into the bottleneck. Once decompressed, the cork stopper can recover its initial size, demostrating its perfect suitability to the bottleneck. This elasticity is also dynamic throughout time, allowing for glass expansion and contraction caused by temperature variations during storage, thereby assuring the complete sealing of the bottle at all times.

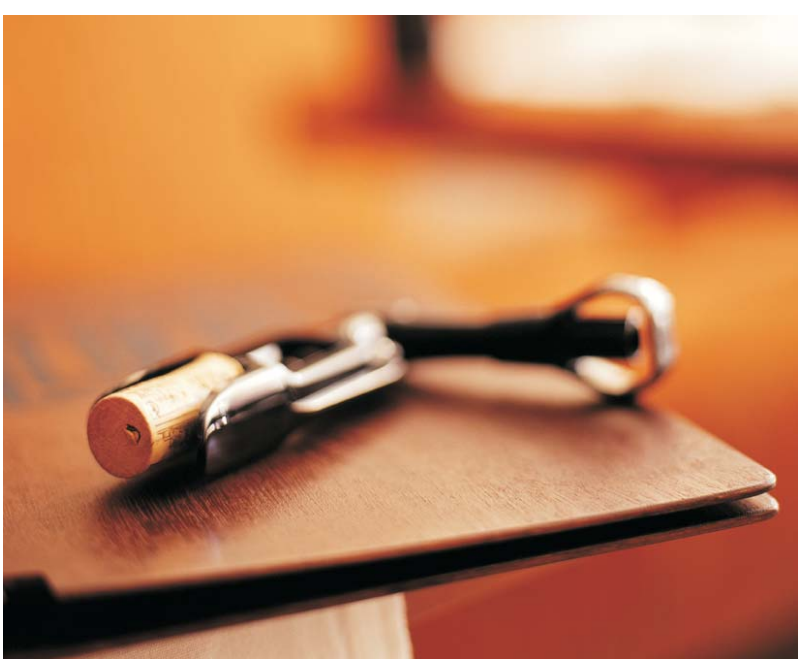
• **Impermeable** to liquids and virtually all gases, thanks to the suberin and ceroids that are present in the cells.

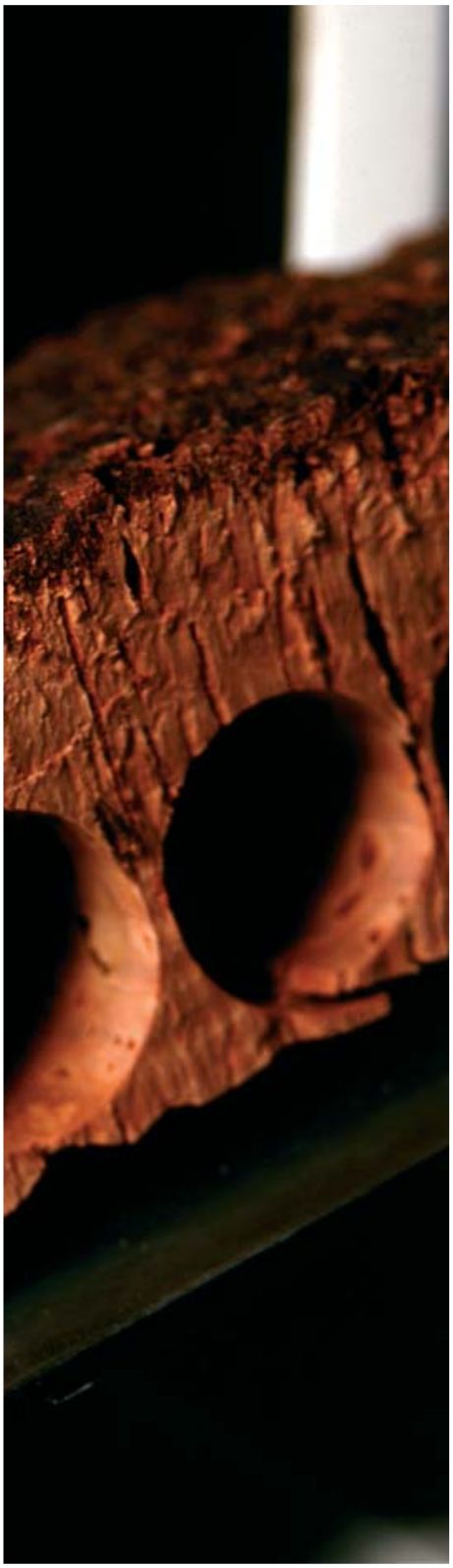
• **Resistant to wear and tear**. Due to its specific chemical and structural composition, cork presents a high resistance to humidity and oxidation.

• **Recyclable, renewable and reusable**. Cork can be recycled by grinding. The resulting granules can be used in other products, for example wall panels, shoe soles, fishing floats, etc. Recycled cork is not used in the production of cork

stoppers. The industrial use of cork guarantees the sustainability of the "montados", thereby contributing to maintaining nature's balance and its associated ecosystems.

(1) According to a study carried out by Moulton Hall in December of 2002 to monitor consumer attitudes towards natural cork stoppers and other wine bottle closures, 76% of the consumers preferred cork (national percentages were: United States, 80%; United Kingdom, 78%, and Australia, 71%). The study indicated that consumers were well informed about the various types of closures available and confirmed that the type of closure used to seal the bottle is an important factor when choosing wine. In order to make a conscientious choice, more than half the consumers requested more label information regarding the type of stopper used, as well as closure information on the supermarket shelves. The conclusions of the study fully demonstrated that the consumers are increasingly convinced of the technical qualities of cork closures and their reliability. This preference becomes increasingly apparent as more and more consumers become aware that there are alternative closures available but still demonstrate their preference for wine sealed with a cork stopper.





3. The most recent advances in the cork industry.

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By combining historical knowledge with modern technology, the Cork Industry is today one of the most advanced and innovative industrial sectors. The Portuguese Cork Industry has invested heavily in Research and Development. As a result, between 2000 and 2002, more patents were registered (35) during this period than throughout the preceding 10 years (19). In terms of individual company investments, it is estimated, that in the last five years, more than 400 million euros ($US 480 million) were invested in modernization, new facilities and new technology. The Portuguese Cork Industry has launched a new example of industrial management, guaranteeing complete control throughout the supply chain from the forest to the consumer. Today, the Cork Industry is totally committed to quality and to client satisfaction.

Coordinated Quality Management

It is noteworthy that, in the last five years, the Cork Industry has constructed new industrial units at a considerable pace. In addition, some of the most advanced cork companies have carried out extensive R&D activities. These include strategic diversification policies, quality control, personnel training, health and safety, hygiene, environmental issues and improved manufacturing processes. These combined advances have had a positive impact upon the Quality Management System within the Cork Industry that has led to the adoption of the 'International Code of Cork Stopper Manufacturing Practice' and to the 'Systecode Accreditation System'. The Systecode Accreditation is the Cork Industry's great leap towards the defeat of TCA.

The beginning of the 1990's, marked the launching of the Quercus Project (1992-1996), a **C.E. Liège (The European Cork Federation)** initiative, involving six countries and several independent laboratories, with the aim of studying in greater depth the taints and off-flavours occurring in wine. Using the

recommendations of previous studies and with the new discoveries made within the scope of this vast project, the knowledge on the origins of 2,4,6 Trichloroanisole (TCA), Tetrachloroanisole (TeCA) and Pentachloroanisole (PCA) became better understood (see page 20).
Quercus made it possible to have a clearer idea of the mechanisms that formed TCA, how the contamination was passed into wine and how to set up rules for its prevention.
The International Code of Cork Stopper Manufacturing Practice (ICMP) was thus created - a set of practical norms for the manufacture of cork stoppers. This has **resulted in substantial quality improvements throughout the cork industry.**

In 1997, the code became an international reference. It is a dynamic code, incorporating every new discovery and technological advance. It is currently in its fourth edition. In the continued drive towards quality achievement, the International **SYSTECODE** Certification was implemented in 1999.
The objective is to ensure that companies manufacturing cork closures comply with the rules in the **International Code of Cork Stopper Manufacturing Practice**. In the year 2000, with the first **SYSTECODE** edition, 87 Portuguese companies were certified. This number increased to 143 in 2001, 218 in 2002 and by 2003, a total of 249 Portuguese companies obtained the Systecode Certificate of Conformity. In 2004, this number reached a grand total of 274 accredited companies. Approximately 90% of these companies are APCOR members. **Currently the ICMP, and subsequent SYSTECODE Certification is one of the most important modernizing factors at the heart of the Cork Industry. The companies awarded Certificates of Conformity have an absolute regard for Health and Safety, Hygiene, Legal requirements and Environmental issues.**

The Systecode is a certification that guarantees that the cork closure production conforms to specifically defined criteria within the ICMP. Each manufacturer awarded the Certificate of Conformity will have been examined by Bureau Veritas, an International firm specializing in Production and Process Audits, to ensure that the company's manufacturing practices conform to the set of rules laid down by C.E. Liège. The audit is an annual event that commenced in 1999 and its impact has resulted in an improvement in the consistent taste of wine bottled since 2001.

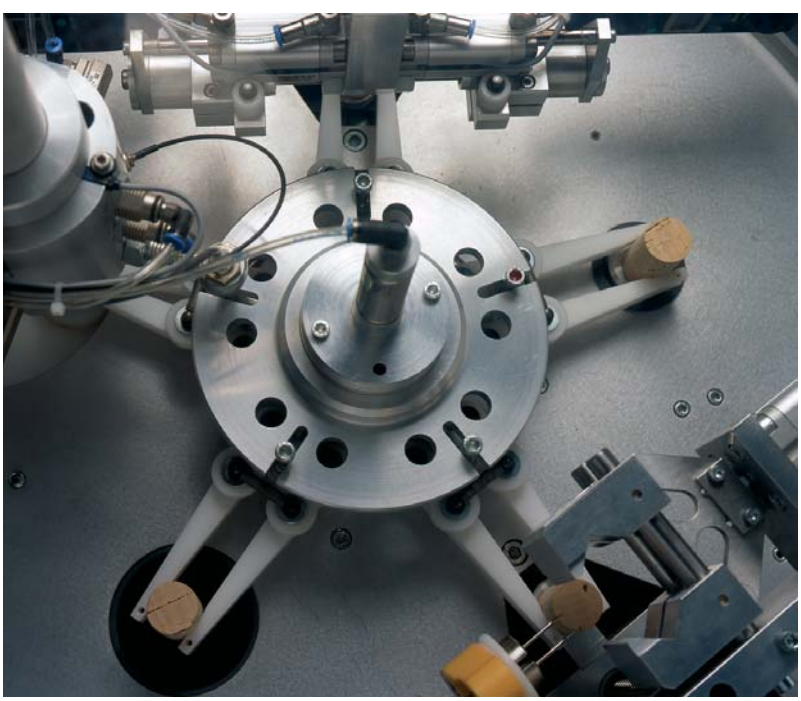
TCA (2,4,6-trichloroanisole) is an innocuous natural chemical compound. It is frequently found in wood, wine, water, soil, vegetables and fruit, as well as in cork stoppers. TCA is the main agent responsible for the organoleptic deviation associated with the musty aroma and taste in wine. Sensory detection of TCA can occur at extremely low concentrations and is often measured within a range of nanograms per liter of wine. One nanogram per liter is often expressed as one part per trillion (ppt) and is roughly equivalent to a grain of sand placed in an Olympic size swimming pool.

Individual detection of TCA in wine depends on a great deal of variables including the wine matrix, the sensory environment and individual sensitivity to TCA. Tests of trained personnel under sensory controlled conditions, suggest a range of sensory detection from 2ppt –10ppt. The average level of sensory detection was 6ppt.

Consumers frequently use the term "corked" to describe deviations in aroma or taste related to mustiness. However, this expression is incorrect because, while cork can be a possible source of TCA in wines, it is certainly not the only one. In fact, contamination may occur in wine barrels where the wine is aged, in glass bottles contaminated by the wooden palettes used in their transportation and airborne contamination can occur in wine bottling establishments, especially when timber has been used as a construction material.

TCA is a compound that does not cause health problems in any way but, due to its aroma and strong contamination capability, is a major concern for the wine and cork industries. They have taken serious measures to significantly reduce TCA contamination and are aiming to totally eradicate it.
The practical advice found in this manual is an excellent aid in preventing cork stopper and wine contamination by TCA or other Chloroanisoles, such as Tetrachloroanisole or Pentachloroanisole.

TCA contamination and formation mechanisms.
TCA is an exogenous product to wine, wood or cork stoppers. It can be highly contaminant, moving from one material to the next with relative ease. If it is present in the atmosphere or water, it can easily move into glass bottles, barrels and cork stoppers. However, the direct formation of TCA in some of these products can also take place. Primarily this is due to the presence of Trichlorophenol in any one of the products. For Trichlorophenol to emerge, it is necessary for a substance containing phenols to come into contact with a chlorinated substance. If, for example, we wash a wooden barrel with a cleaning product containing



chlorine, we raise the probabilities of this process occurring. In the same way, if we were to wash a cork stopper with chlorine, we create the possibility of Chlorophenols being generated. The Cork Industry has banished this practice in the washing processes of cork closures. The International Code of Cork Stopper Manufacturing Practice (ICMP) strictly forbids the use of chlorine, or any by-product, in any phase of the cork stopper manufacturing. The most common substance for washing cork closures is hydrogen peroxide. The synthesis of Chlorophenols that leads to Chloroanisoles (the substances responsible for the musty taste/aroma in wine) occurs in the majority of cases due to the action of certain fungi-related species. In the case of cork closures, if the best manufacturing practices are not followed correctly, these fungi will be found when boiling the raw material and in the stabilization period thereafter. In addition to the norms determined by the ICMP, some companies have developed individual techniques for the control of eventual TCA development or the TCA itself.

CTCOR - the Technological Cork Centre has developed Symbios, a preventive process that, by altering the characteristics of the environment through the application of chemical additives, enables the development of microorganisms in controlled conditions as well as simultaneously provoking a denaturation of the enzymes.
Thus it intends to promote the development of benign native microorganisms (non TCA producing microorganisms that compete with the other species responsible for the production of haloanisoles), to destroy harmful microbiological species that have the potential of forming undesired metabolites, thus inhibiting the biosynthesis of chloroanisoles during the cork transformation phases. This preventive system of treating cork is applied in the boiling phase. Its added advantage is the increased extraction of hydro-soluble matters from cork, such as polyphenols, which leads to "cleaner" cork strips, consequently having advantageous repercussions throughout the manufacturing process of technical cork stoppers.

The Portuguese Cork Association (APCOR) is also carrying out a Research and Development project to investigate the elimination of cork contaminated by haloanisoles, based on the use of biotechnological strategies. It aims to trace and search for natural samples of different origins of microorganisms capable of metabolizing and/or degrading chloroanisoles. The process identifies specific microorganisms with proteins (enzymes) responsible for the process of degradation.

The creation of these proteins and their application in different phases of production (for example through the treatment or washing of stoppers) may lead to the elimination of contaminating chloroanisoles found in cork. Alternatively, it aims to develop fungi lineages with capacity to degrade chlorophenols (but without the production of chloroanisoles) and that can be used in the initial production process, with the objective of replacing the native fungi, found in cork, with the capacity to produce chloroanisoles.

4. Types of cork closures.

4. Types of cork closures.

The Cork Industry has developed a complete range of cork products, available in countless sizes and formats, in order to adapt to the wide variety of bottles and wine types. The cork closures can, however, be grouped in the following categories

- natural cork closures
- multi-piece natural cork closures
- colmated natural cork closures
- champagne and sparkling wine cork closures
- technical cork closures
- agglomerated cork closures
- capsulated cork closures (bar top cork stoppers)

Natural cork closure

Cork closures are excellent seals for glass containers. This closure promotes wine maturation and allows the noble ageing to take place through the innumerable chemical and physical processes in the internal bottle environment. The gradual evolution of wine in the bottle occurs in an environment with low oxygen content, but with just the right amount to allow the wine to evolve correctly. So far, only the **natural cork stopper** has been able to provide this perfect balance, allowing the correct evolution of wine and the formation of the greatly appreciated "bouquet". The "bouquet" is constituted by a set of pleasant aromas, which develop during the maturation period of bottled wine. It is a valued element, which depends on the intrinsic quality of the wine and the conditions in which it matures. The airtight property assured by the cork stopper is not only indispensable for the period of maturation, but also in wines for quick consumption.
With a **natural cork** closure, it is possible to assure excellent wine conservation without interfering with the prevailing harmony between its various components.

Natural cork closure

Due to cork's cell construction, compressibility and elasticity, it is the only closure capable of assuring this type of wine conservation. In addition, it is the only natural material capable of adapting correctly to the internal irregularities of the bottleneck, guaranteeing a perfect closure during storage, even when expansion or contraction of the glass occurs due to temperature variation. We can expect perfect sealing capabilities for dozens of years. This period may be further prolonged, as long as the cork closure is of a high quality and is kept in ideal wine storage conditions (with adequate temperature, pressure, humidity level and with minimal thermal variation, throughout each season of the year). For the wine consumer, the natural cork stopper is perceived as a sign of quality and an essential element in the ritual of opening and consuming a wine bottle, contributing significantly to positive differentiation and valuation (Moulton Hall, December of 2002).

Formats: The natural cork closure is manufactured by punching a one-piece cork strip. They are produced in many different cylindrical or conical forms and sizes. The most common measurements are indicated in the next table (length x diameter), although they may vary according to individual manufacturers' specifications.

	54x24 a 26mm	49x24 a 26mm	45x24 a 26mm	38x24 a 26mm	38x22mm	33x21mm
Bordeaux, Burgundy or Rhône type bottle (75cl) with a CETIE*or Italian specification neck finish	**ok**	**ok**	**ok**	**ok**	**ok**	—
50 cl bottles with the same neck finish	—	—	**ok**	**ok**	**ok**	**ok**
Half bottles with 37,5 cl	—	—	—	**ok**	**ok**	**ok**
Prolonged maturation	**ok**	**ok**	**ok**	**ok**	—	—
Medium maturation	—	—	—	—	**ok**	**ok**

ok = Suitable for use/recommended | *** CETIE** - International Technical Centre for Bottling and related Packaging

The use of longer cork closures is common in wines associated with a prolonged maturation period. However, it is necessary to mention that the sealing quality of a cork closure through time depends more on the chosen diameter than on its length.

The idea is to use a cork closure that surpasses the bottleneck by 6 mm while bearing in mind that it should not be compressed by more than 33% its diameter during insertion into the bottle; otherwise cell structure can be damaged.
In the general classification of natural cork closures, the following categories are normally found, graded according to visual criteria: A, B, C and D.
The classification is based on a sample of sufficient size to be representative of the lot, showing the range of quality variation that can be found in the consignment (the size of the sample can vary according to manufacturer).
Alternatively, it is the client who determines the sample and looks for a supplier to execute the order.

Determining Cork Quality
Volumic Mass – The volumic mass of agglomerated and technical cork stoppers gives indications concerning the consistency of the manufacturing process. Eventually, its compressibility and elasticity may be evaluated by this property.
Humidity – Cork stopper humidity should be between 4% and 7%.
Surface Treatment – There are two types of products used in the surface treatment: paraffin and silicone. The treatments with paraffin aim at waterproofing as well as improving sealing. The treatments with silicone only aim to lubricate the cork closure, facilitating insertion during bottling and cork extraction. The type and quantity of treatment depend upon the type of wine, the type of bottle, the maturation period and the bottling machine. For the wines that need a maturation period in the bottle (superior to 18 months), a paraffin treatment should be done first, followed by a silicone treatment.

Extraction Force – The extraction force of a cork stopper in a bottle tends to decrease over time. The values advised are between 20 daN and 40 daN (24 hours after bottling)
Visual Standards – The visual classification of cork closures depends on the amount and size of pores (lenticels), bark, belly and cracks found on its surface.
Sampling – Always account for the batch size and follow the accepted standard sample tables, for example the NP 2922, ISO 2859 or ISO 3951 standard.

Multi-piece natural cork closure

The multi-piece natural cork closure is manufactured with two or more pieces of natural cork, glued together by an FDA (Food and Drug Administration, USA Department of Heath and Human Services)-approved food contact glue. They are closures made from strips of thinner cork, which are too thin to produce one-piece natural cork stoppers. They also have greater densimetric characteristics. Regarding the most common sizes and grades, these are basically the same as the natural one-piece cork closure grades. The multi-piece cork closures are also used in large size bottles, which require cork closures of a larger size, which are harder to manufacture as one-piece natural closures. The multi-piece cork closure is not recommended for prolonged maturation periods.

Multi-piece natural cork closure

Colmated natural cork closure

Colmated corks are natural cork closures with their pores (lenticels) sealed exclusively with cork dust, which results from rectifying natural cork stoppers. For the cork dust to adhere to the pores (lenticels), FDA-grade natural resin and rubber glues are used, and occasionally in this process, a water-based glue can also be used.

Colmation has two essential benefits:
• improves the visual aspect of the cork closure
• and it improves its performance

Colmated cork closures have a homogenous visual appearance and good mechanical characteristics.
They are manufactured in a variety of forms and dimensions. However the most common cylindrical form and sizes are those indicated below (length x diameter), although these may vary according to the manufacturer. All the variables previously mentioned in the section "Determining Cork Quality" must be observed. Moreover, there is a general classification which divides the cork stoppers into 3 grades (A, B, C or I, II, III), according to the level of colmation. Regardless of this, each manufacturer has specific products that may not integrate any of the above grades

Colmated natural cork closure

Champagne and sparkling wine cork closure

As the name suggests, these corks were especially conceived to seal **champagne, sparkling and gasified wines**. Sparkling wine cork closures are considered to be in the **technical cork** category, as they are produced from an agglomerate cork granule body. On one of the ends, two or three selected natural cork disks are glued. Sparkling wine cork closures have a **larger diameter** than average corks. Their larger diameter is essential in retaining the high internal pressures in gasified wine bottles. To get the best physical, chemical and microbiological performance sparkling wine corks are subject to meticulous manufacturing and rigorous quality controls.

They are basically available in the following grades: **"Extra", "Superior", 1st and 2nd**. This may, however, vary according to the manufacturer.

	45x24	38x24	38x22mm	33x21mm
Bordeaux, Burgundy or Rhône type bottle (75cl) with a CETIE* or Italian specification neck finish	**ok**	**ok**	**ok**	—
Half bottles with 37,5 cl with same neck finish	—	—	**ok**	**ok**
Medium maturation	**ok**	**ok**	**ok**	—

ok = Suitable for use/recommended | *** CETIE** - International Technical Centre for Bottling and related Packaging

Champagne cork closure

Technical cork closures

Technical corks were created for bottled wines that are consumed within a period of two to three years. They consist of a very dense agglomerate cork body with natural cork disks glued on one or both ends. Technical corks with a disk on both ends, are designated 1+1 technical corks. With two natural cork disks, they are known as 2+2 technical corks, and with two disks on one end, 2+0 technical corks. An approved food contact glue is used to bond the disks to the agglomerated cylindrical body. This type of closure is chemically very stable and mechanically very resistant. Their exemplary performance, given the torsion to which they are submitted in the bottling and opening phases, is remarkable. They have demonstrated their excellent sealing capacities throughout time, (Australian Wine Research Institute, Wine Bottle Closure Trial), maintaining the necessary free concentration in the bottle, while avoiding premature oxidation and yet remaining free of undesirable odors.

The most common sizes are:

	44x23,5mm	40 or 39x23,5mm
Bordeaux, Burgundy or Rhône type bottle (75cl) with a CETIE*or Italian specification neck finish	**ok**	**ok**
Half bottles with 37,5 cl with same neck finish	—	**ok**
Short period of maturation	**ok**	**ok**

ok = Suitable for use/recommended | *** CETIE** - International Technical Centre for Bottling and related Packaging

As the body of the cork closure is agglomerated, the quality of the technical cork is satisfactorily homogeneous. However the visual standard of the cork disks used on the ends vary. The standard of these disks, is generally classified in 3 grades: A, B and C, with C being the lowest grade. This classification can vary according to manufacturer.

Technical cork closure 1+1

Agglomerated cork closure

Agglomerated cork closures are entirely made of granulated cork, derived from by-products that are a result of the manufacture of natural cork closures. Agglomerated cork closures are manufactured by individual molding, by extrusion or block molding. In both methods, approved food contact glues are used to bind the cork granules together. Agglomerated corks are an economical solution in assuring good sealing for a period that should not, in general, exceed 12 months. Besides the economical advantage they represent for low-priced wines, these corks are completely batch homogeneous. As this product is the result of a highly industrialized process, the only category variation of agglomerated cork closures is in the chosen cork granule size and in the surface treatment used.

Normally they are manufactured in the following sizes:

	44x23,5mm	38x23,5mm	33x23,5mm
Bordeaux, Burgundy or Rhône type bottle (75cl) with a CETIE* or Italian specification neck finish	**ok**	**ok**	—
Half bottles with 37,5 cl with same neck finish	—	—	**ok**
Period of maturation	**x**	**x**	**x**

ok = Suitable for use/recommended | **x** = Not suitable for use/not recommend
*** CETIE** - International Technical Centre for Bottling and related Packaging

Regarding quality, all the variables referred to in the previous paragraph (**"Determining Cork Quality"** in the Natural Cork Closures section), must be observed. Concerning its classification, these cork stoppers present themselves in categories that vary according to specific weight and granule size of the raw materials used.

Agglomerated cork closure

Capsulated cork closure (bar top cork stopper)

Capsulated corks are natural (or colmated) cork closures with a **wooden, PVC, porcelain, metal, glass or other material bonded onto the top of the cork**. This stopper is generally used in the bottling of spirits, liquors and fortified wines that are ready for **immediate consumption**. The main examples are Port Wines, Sherry, Madeira Wines, Calvados, Moscatel from Setúbal and also Whisky, Vodka, Cognac, Armagnac, Brandy and Liquors. Capsulated cork closures are very practical for barmen and consumers, allowing **easy reuse** – an important factor for bottles whose contents are not consumed at one time.

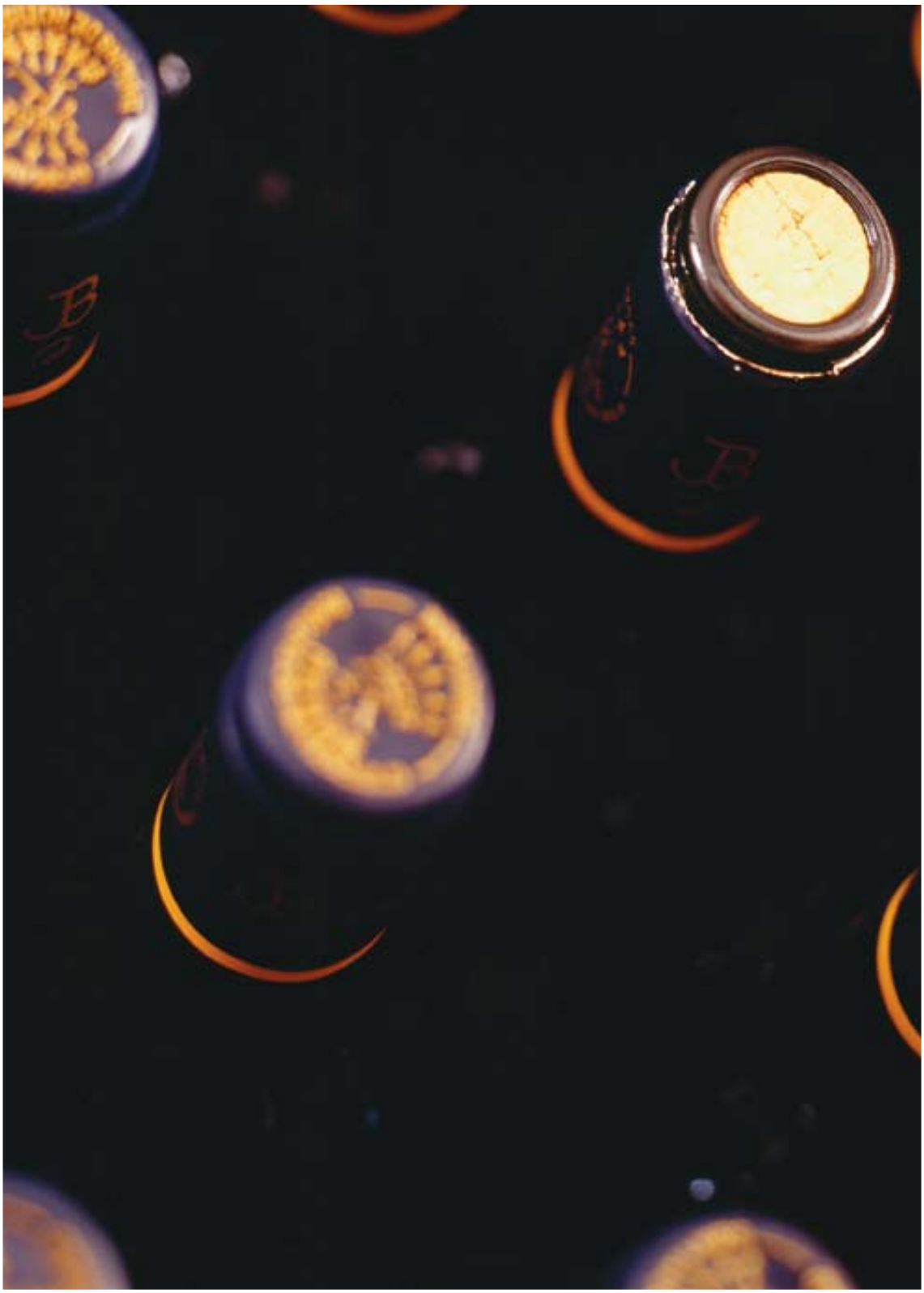
In the market, the most common sizes are those suitable for bottles with the most common neck specification.

Note that, in this type of cork, it is not necessary for the stopper to have a diameter 6 mm larger than the internal diameter of the bottleneck. A 2 mm interference fit is sufficient to allow easy reuse without compromising the correct bottle sealage.

The most common measures are:

27x20mm
27x19,5mm
27x18,5mm
24x17mm (20cl bottles)
18x13,5mm (miniature bottles)

Capsulated cork closure



5. Bottling, transportation and wine storage.

Real Cork. Real Wine.

5. Bottling, transportation and wine storage.

Bottling serves two basic purposes:

1. Wine division, facilitating its transportation and storage in good conservation conditions, while supplying the consumer with wine packaged in the quantity of choice.
2. Allow a maturation period in bottled wine, thereby creating added value.

Basic rules for bottling, transporting and storing wine.

Bottling, transportation and wine storage are crucial stages in the life of wine. As such, certain basic rules must be observed in order to be able to make the most of the cork closure.

These basic rules should be followed:

• The correct **selection of the right size and grade of the cork closure** to suit the size, bottle and wine type is of fundamental importance.
• Correct **storage of the cork closure** before bottling is important.
• Best practice in the **bottling, transportation and storage of wine is of paramount importance if wine is to be delivered to the consumer in optimum condition.**

Selecting a cork closure

• The corks to be used must be chosen bearing in mind the **bottling dimension of the bottleneck**, as well as the **type of wine** and its length of maturation.
• For the majority of wines, the diameter of the natural cork stopper should be at least **6 mm** larger than the diameter of the internal bottleneck. For prolonged maturation periods, a diameter superior to 6 mm is advisable, but should not exceed 8 mm.
• Wines of long maturation may be sealed with l**onger and wider diameter** cork closures. If a longer cork closure is used, it is necessary to always respect the headspace between the bottom of the cork and the surface of the wine (the vacuity). Normally the vacuity should be a minimum of 15 mm.
• In gasified wines (internal pressure above average), the cork closure chosen should have a diameter superior to that for still wines. As an example, for wines with a bottle pressure of about 1 bar, a cork stopper with a diameter of 8 mm above that of the internal bottleneck diameter, is generally recommended (Figure 1).

Storage of cork closures

• Whenever possible, the cork closures should be used soon after delivery. Long storage periods should always be avoided. The advisable maximum period of storage is six months, in correct storage conditions.

• The polythene bags holding the cork closures should only be opened upon use. In general, the corks are sealed in gas barrier bags, sanitized with SO_2 (sulfur dioxide). This gas acts simultaneously as an antiseptic preservative and an antioxidant, thus protecting the cork.

• Cork closures that are not used may be resealed in bags injected with SO_2 (between 0.5 g and 4 g of SO_2 per bag of 1000 corks).

Correct storage conditions for cork closures:

• In ventilated and dry places with a mild and stable temperature between **15 ºC** (59F) and **20 ºC** (68F) and a relative humidity level between **40%** and **70%** (Figure 2).

• In odor-free places with good ventilation and kept away from mould, all types of fuels and chemical products, such as cleaning products and inks.

• In places where there is no chlorine-treated wood or chlorinated products (such as newly constructed roof structures or transport palettes).

The observation of all the above recommendations is essential in maintaining the cork stopper free from any type of external contamination while ensuring that its physical and chemical characteristics remain intact.

Figure 1

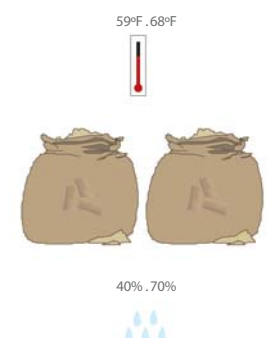


Figure 2

Bottling, transportation and wine storage

• By taking advantage of cork's compressibility, the bottling machine should gently compress the cork closure and gently insert it into the bottleneck.

• The correct compression is 2 mm less than the diameter of the bottleneck. A cork closure with a diameter of 24 mm should be compressed to 16.5 mm for it to correctly enter an 18.5 mm diameter bottleneck (Figure 3).

Figure 3

• Cork closure compression must never be greater than 33% of its diameter or this can damage cork's internal structure, compromising its elasticity and consequently the correct bottle sealing ability. Hence, for a cork closure with a diameter of 24 mm, the maximum compression is 8 mm.

• Due to its elasticity, cork recovers its volume within the first five to 10 minutes after it has been bottled, adapting itself to the irregularities of the bottleneck and exerting a uniform force throughout the glass surface. Therefore bottles should remain vertical and should not be laid in a horizontal position immediately after corking (Figure 4).

Figure 4

It is possible to maximize the recovery properties of the cork within the bottle by ensuring adequate line speed prior packing. This is done by prolonging the circulation time of the bottle on the conveyor belt. All that is needed is the addition of carpet sections to the conveyor belt, which goes from the bottling to the labeling machines, organizing them in a pressed S shape in order to save space.

Bottled wine, except in rare cases, is not immune to **environmental temperature** variations during its transportation and even when it is in the distributors' warehouse.

These temperature variations are responsible for:

• Variation in the bottleneck diameter due to the natural contraction and expansion of glass.

• Variation in the wine volume. As an indication, wine expands on average about **0.2 ml** per degree Celsius with temperature increase, which consequently increases the bottle pressure.

Although the **variations in the bottleneck diameter** can be naturally compensated by the excellent elastic properties of cork, the same cannot be said in relation to the **variation in the wine volume and consequently internal bottle pressure**. To avoid this problem, the following recommendations should be observed when bottling wine:

1. The temperature in the bottling hall should be between **15º and 20º** Celsius (59F to 68F) when wine is bottled (Figure 5).

2. The bottling machine should be calibrated to allow a minimum headspace of **15 mm** between the surface of the wine and the cork stopper (values for 750 ml bottles). This headspace is essential in allowing wine expansion without leakage, in the event of an increase in temperature during transportation or storage. Before the choice of bottle is made, the length of the cork closure and the fill height of the wine in the bottle must be determined to ensure there is sufficient headspace and the product conforms to the Weights and Measures legislation in the country in which it is going to be sold (Figure 6).

3. In sparkling or gasified wines, this headspace should be greater.

4. To minimize the effect of alterations in the internal bottle pressure that can lead to wine leakage, it is advisable that the wine should be filled into the bottle under vacuum or sparged with an inert gas. These steps will improve wine protection from premature oxidation and microbial reactions (Figure 7).

Figure 5

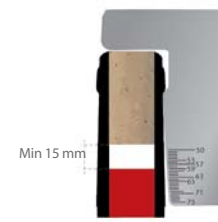


Figure 6

Figure 7

5. It is necessary to frequently control the internal bottle pressure in wines that have just come off the bottling line to see if the vacuum or sparging system is functioning correctly. The internal bottle pressure, in the case of still wines, must be close to zero (Figure 8).
6. In extreme conditions, high internal bottle pressures prevent the cork from adapting to the bore of the bottleneck, forcing the wine to be expelled from the bottle, until the internal pressure is once again balanced. In this case, a continuous wine leakage does not occur, but only an expulsion of a few milliliters, until the internal pressure is re-established. Such problem is caused by excessive internal bottle pressure and not by a cork closure fault. Occasionally if wine is expelled because of a built up of pressure within the bottle, usually through wine expansion caused by a rise in temperature, the cork's sealing capacity is permanently damaged and the bottle will continue to leak after the pressure has equalized, although at a very slow rate.

Other precautions to take into account when bottling

Regarding the bottling premises, it should be assured that:
• It is free of flying insects, especially lepidopterous (Figure 9).
• It is correctly ventilated, by using forced ventilation/exhaustion systems.
• It has a constant room temperature between 15º and 20º degrees Celsius (59F to 68F) (Figure 10).
The bottles should be removed from the palettes only at the time of bottling. They must also be clean and dry (if bottles are washed before filling almost all the bottle washing machines have an automatic drying system).
The palettes with bottles must be kept in a warehouse with mild temperatures and a dry environment, without mold and without chlorine treated wood or composites. The layer pads on the palettes, separating the layers of bottles, must not be made of wood composites or cardboard. Never wet the cork closures with water or wine before bottling. In the past, this technique was used to clean the stoppers and facilitate insertion into the bottleneck; however, this causes liquid to accumulate in the cork pores, developing off-tastes and aromas that can slowly migrate into the wine.

Currently, corks arrive at wineries completely ready for use and they do not need any additional treatment. If, for any other reason, it is necessary to clean the corks, then a sulfite solution releasing SO_2 is advisable.
The interior of the bottleneck must be clean and dry prior to corking. Should the bottleneck be humid, it will have a fine, incompressible, liquid film, which will

cause difficulties in the cork's expansion (Figure 11). In standard bottles, the top end of the cork closure should be a maximum of 1 mm below the bottle rim and ideally, the cork closure should be +/- 0.5 mm from the rim. If the cork closure is well below this level, it is likely to greatly increase internal bottle pressure (specially in the case of non-vacuum or non-CO_2 flush bottle or where the vacuity level is minimal) and the excess internal pressure will cause leakage or seepage (minor leakage) which can contribute to the growth of fungi on the end of the cork exposed to the air. On the other hand, problems will arise when applying the capsule if the cork closure is protruding above the rim of the bottle.

Cork closures with a humidity level less than 4% must be returned to the supplier to undergo a re-hydration process.

Cork closures with a humidity level greater than 7% must be returned to the supplier to undergo drying.

Figure 8

Figure 9

Figure 10

Figure 11

Bottling equipment maintenance.

The maintenance of the bottling equipment is fundamental for the good performance of cork closures and consequently prolonging the life of the wine. The following are important maintenance factors:

• Keep the cork chutes and all the mechanical parts of the corking machine absolutely clean.

• Ensure that the central piston and centering cone alignment are correct.

This is essential for the good insertion of the cork closure into the bottleneck (Figure 12).

• Frequently check the wear and tear of the compression jaws, because even a minimum defect can cut grooves on the side of the cork closure during insertion into the bottle. This can cause leakage and ingress of air (Figure 13).

• The bottling machine should work with gentleness, especially during cork compression and the cork closure should be eased into the bottleneck without undue force (Figure 14).

• Clean all areas that come into contact with cork closures with products free of chlorine (Figure 15).

• Before bottling begins, the machine should undergo a sterilization process.

A high-pressure jet-wash is advisable with a metabisulfite water solution at 80 degrees Celsius (176 F) and then dry thoroughly.

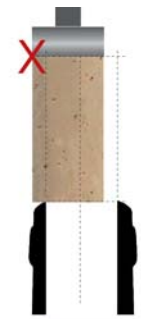


Figure 12

Figure 13

Figure 14

Figure 15

Wine expulsion and continuous leakage

The wine passing between the bottleneck and the cork closure causes wine seepage or "Couleuse" . This problem may have various causes that can be avoided by complying with the rules stated earlier.

Figure 7

The causes of this problem are:

• **Excessive internal bottle pressure**. Excessive internal pressure does not cause continual wine leakage but rather a temporary wine expulsion of a few milliliters. This leakage only occurs until the internal bottle pressure has reduced to zero.

• **Defects in the compression jaws.** These defects can be the result of the wearing down of the jaws, which may end up cutting grooves on the side of the cork closure.

• Inadequate cork closure diameter, resulting in insufficient pressure against the inside of the bottleneck compromising its watertight capability.

• "Green Cork". This is a problem found on cork closures manufactured from inadequately dried cork.

However, it is only when there is a great amount of green cork present that leakage arises. A green cork closure can contract when in the bottleneck. It may also begin to wrinkle laterally and distort, allowing the wine to leak. It is a completely random problem and appears very rarely in finished cork stoppers because of the meticulous levels of control in all manufacturing stages from the primary inspection of palettes, the visual selection during grading, to the final quality inspection of the palettes, the visual selection during grading and with the final quality inspection of the finished product.

• Insect channels. Caused by insects when the cork bark is still on the tree. This defect is easily detectable when cork closures are being graded and corks with this defect are removed and so it is rare to find this defect on a finished cork closure.

• Production defects. These problems may appear during the production process, but are easily detectable, due to the existence of a rigorous quality control system during the various manufacturing phases.

Other recommendations for the correct transportation and storage of bottled wine

The transport of bottled wine

If extreme conditions are encountered during long-range shipments, it is always advisable to transport bottles in a **vertical position** (Figure 16). The use of thermally insulated containers is another alternative to transport wine in the **coolest seasons of the year,** especially wine that is carried between continents.

Figure 16

If the wine is to be carried in **maritime containers**, it is essential to know what was previously shipped in the container during the last shipment.

If the container is not **clean, odor free and completely dry,** it should be rejected. If this is not possible, then it should be cleaned with a strong water jet solution of metabisulfite, not forgetting to properly dry the container afterwards, since during transportation the humidity formed by condensation promotes fungi which can later generate Chloroanisoles or other compounds responsible for undesirable odors.

Storage of bottled wine

The expression "the cellar makes the wine" is as old as it is true.
The temperature, humidity and hygiene of the cellar all contribute towards the final quality of the wine. The cellar must obey the following criteria:

- Room temperature between 15º C (59F) and 20º C (68F), without great thermal amplitude, during the day and throughout the year.
- Humidity level between 40% and 70%.
- The cellar must be free of insects and rodents. This does not include spiders, as they are excellent insect predators.
- The cellars must not have chemically treated wood.
- The cellars must be free of all odors specially moldy/musty smells.
- Chemical products, such as paint or cleaning products, must not be kept in the cellar.

During the maturation of wine, bottles must be stored horizontally. However, wine stored in cases for transportation can be stored vertically provided the storage is only for a relatively short period of time. Under these circumstances wine has sufficient volatility to keep the bottom end of the cork sufficiently moist so it may maintain its excellent elastic property, retaining an airtight seal.

6. Uncorking a bottle of wine. A ritual with rules.

6. Uncorking a bottle of wine. A ritual with rules.

Drinking a glass from a good bottle of wine gives enormous pleasure. However, some important aspects need to be considered in order to make the most out of this unique experience. Right from the start, great care is needed when extracting the cork closure.

Depending on the age of the bottle, the cork will be in different stages of evolution. In a new wine, there will be a very robust cork closure, but in more mature wines, the cork closure will have softened. In the very old wines, generally with a bottle age of more than 35 years, weaker corks will be found due to their already fragile internal structure. These corks require great care as they often break during extraction. In the case of very old wines, a heated tong can be used as an alternative to the corkscrew, without needing to extract the cork closure (See Demonstration). With new or very old wines, it is necessary to ensure that the corkscrew has a totally vertical extraction force.

The "sommelier" double impulse corkscrew is quite common and always allows a vertical cork extraction. Other models exist that do not use impulse and always function vertically. For a really fast and efficient extraction, there is the Rabbit corkscrew model, from Metrokane™, which does the work in a few seconds without any effort. The blade corkscrew, which extracts the cork closure from the sides without damaging its internal structure, can be used with wines of any age, but especially when opening older wines.

One of the main parts of a corkscrew is its spiral. This has to be at least 7 cm in length, to be able to deal with longer corks, and should have a sharp point. In terms of material, the spiral must be a single-piece, completely smooth and without sharp edges. The spirals with a PTFE (Teflon™) surface or similar material are the recommended as they pierce the cork with ease, without damaging its internal structure.

The opening of the bottle should be made carefully and calmly. First, the capsule that protects the bottleneck must be removed, approximately one centimeter below the top rim of the bottle. After that, especially if the bottle is old, the bottleneck and the top of the cork stopper must be wiped with a clean cloth. The point of the corkscrew is then placed in the center of the cork closure taking

care to insert the spiral of the corkscrew far enough but not so deep so that it perforates the bottom of the cork. This operation is not possible with every design of corkscrews, especially some that are not hand operated. If the spiral is not inserted deep enough the cork is not extracted and the screw can pull through the middle of the cork. If particles of cork do fall into the wine because the spiral of the corkscrew has been inserted too far, there is no serious problem and one should remember these small particles are organically harmless, even if consumed.

Blade Corkscrew

"Sommelier"
Double implulse corksrew

If this were to happen, they are normally poured into the first glass, which is then generally served to the host. In the case of sparkling wine, the bottle must be opened with care and without agitation. After removing the muselet, the cork stopper must be held firmly. Thereafter, the bottle, and not the cork, must be turned, in order to prevent an exaggerated twist of the cork stopper. On removal, the cork will emit that unique 'pop', a reason for joy, and enrichment of our senses - something only cork can do.

"Rabbit"

"Velvet"

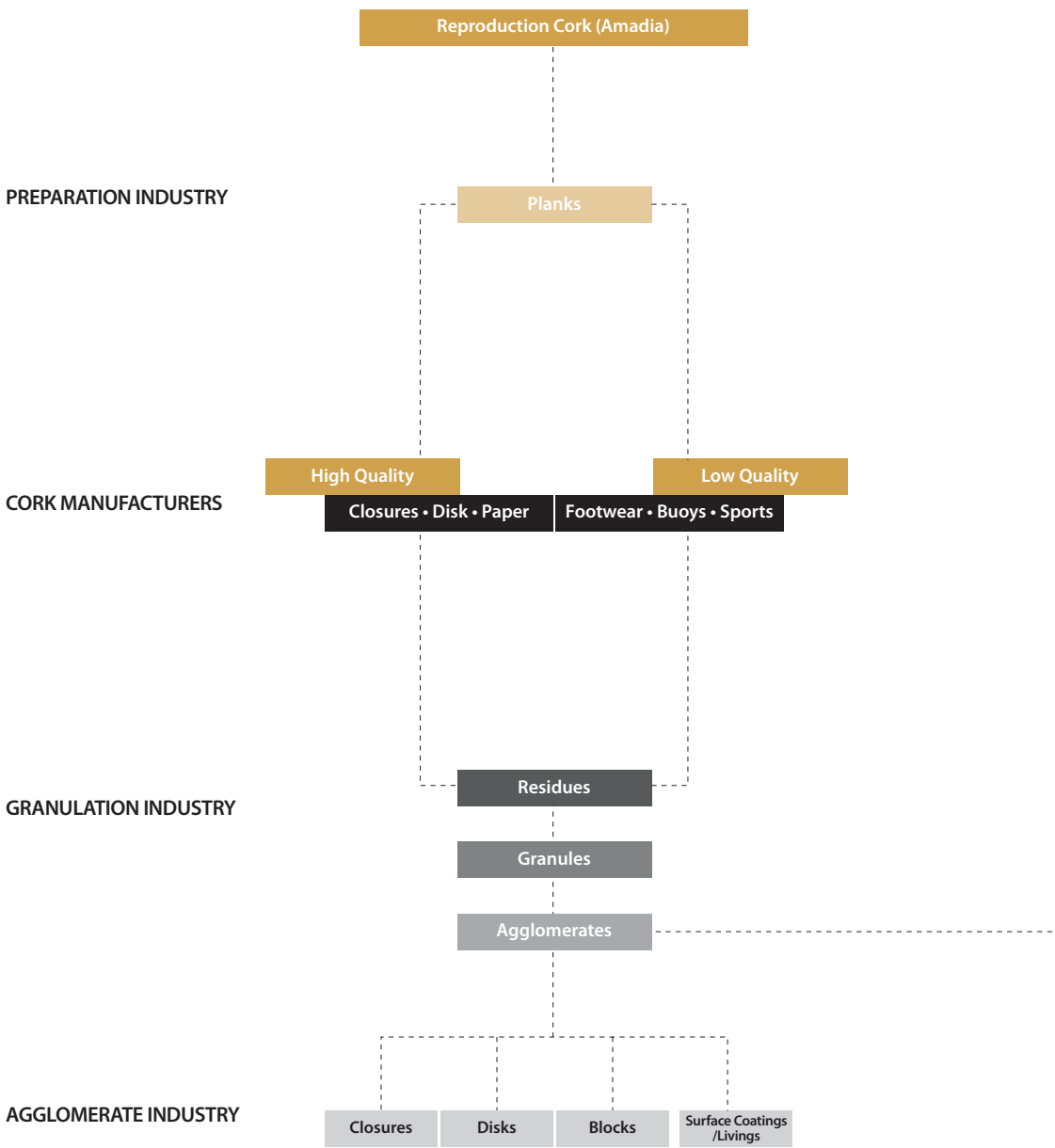
Demonstration

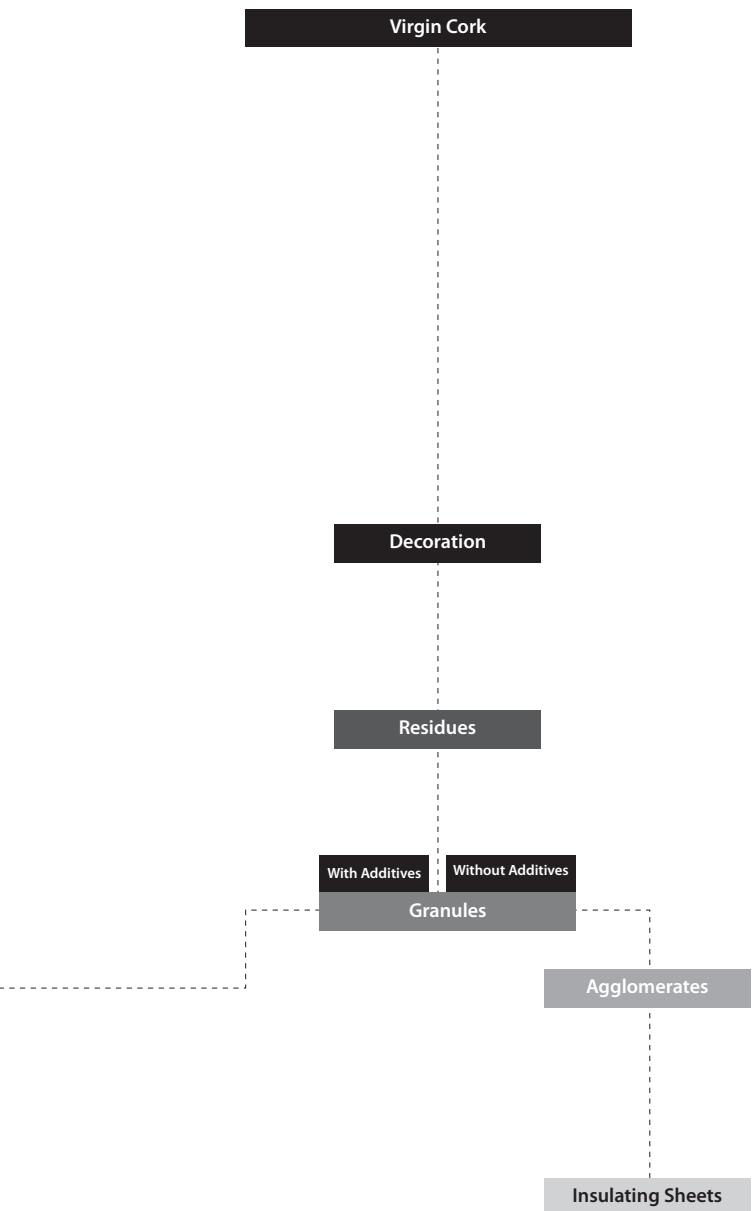
1 - Heat the tongs on a gas burner until it is blazing hot and apply it to the bottleneck for 30 seconds.

2 - Immediately after removing the tongs from the bottleneck, apply a brush of ice-cold water to the glass surface that was in contact with the tongs. Alternatively, ice or cold water may be applied directly to the bottleneck. The glass will immediately break leaving a clean, splinter free, cut. The wine is thus ready to be decanted.

Demonstration

Cork processing schematic




Virgin Cork
Decoration
Residues
With Additives
Without Additives
Granules
Agglomerates
Insulating Sheets

7. Cork industry - Modern and Environment Friendly.

Real Cork. Real Wine.

7. Cork industry - Modern and Environment Friendly.

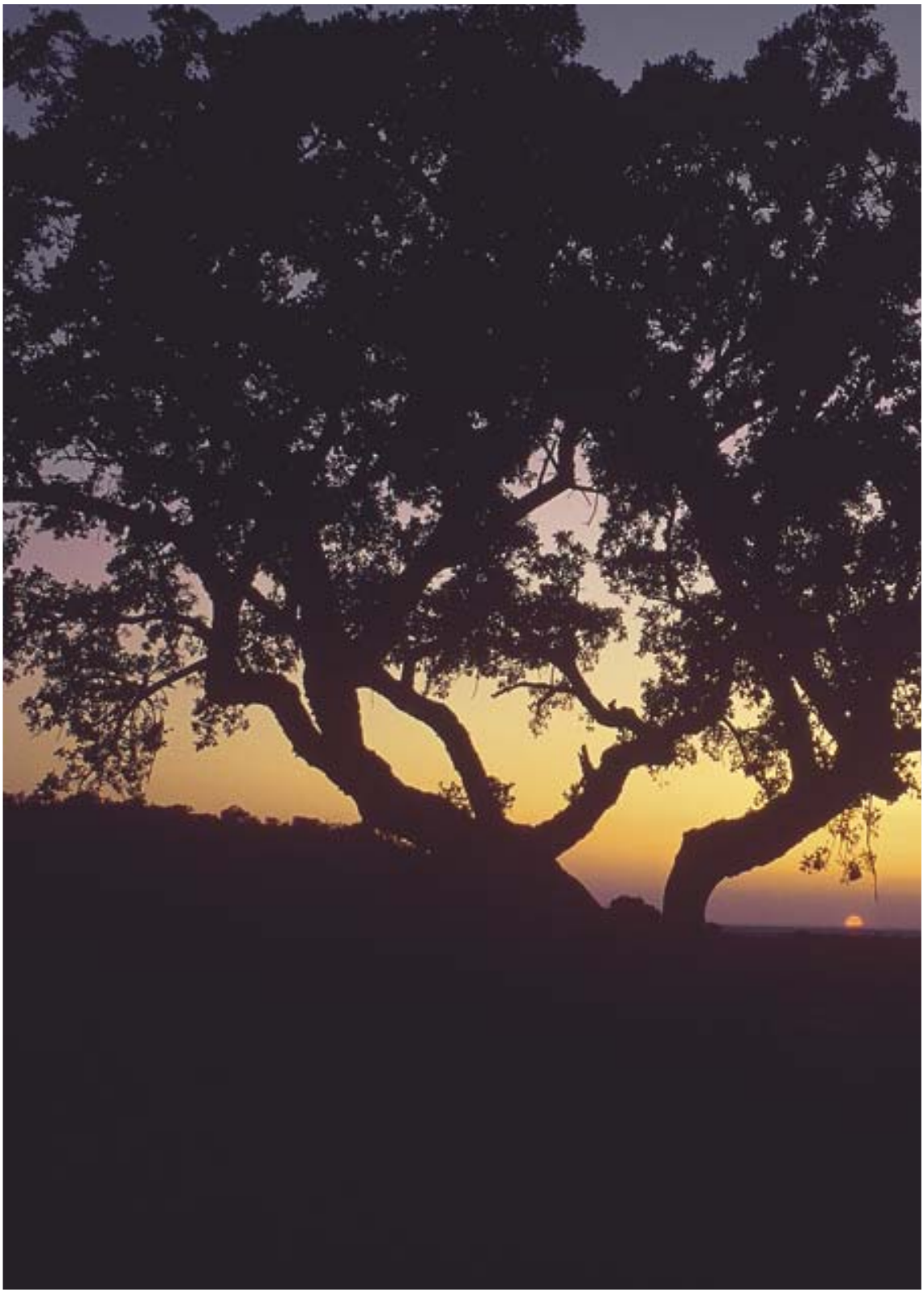
The Cork Industry, by manufacturing cork closures, guarantees the sustainability of the "montado" and consequently the preservation of many species of flora and fauna that live there. The "montado" is a richly diverse ecosystem that coexists and is of crucial importance in the conservation of the environment. As well as supporting the existing fauna and flora, it also provides a good living standard to the people engaged in its cultivation, many of whom inhabit areas where the soil is poor and climatic conditions are hostile.

Although about only a quarter of the cork production is used in the manufacture of cork closures, this share generates about 70% of the industry's income.

However, there is another reason that makes this a truly unique industry: its eco-efficiency. Throughout the entire manufacturing process, waste cork, from the manufacture of cork stoppers, is transformed into other useful products of excellent quality. Cork closures, floor panels and paving, decorative articles for the home and office, art and design materials, shoe soles, footwear, applications for the automobile, military and aerospace industries, chemical products for pharmaceutical motives, and many other items, are all manufactured from the granules obtained from grinding cork waste and from lower quality cork. In other words, throughout the transformation process of cork, not one gram of raw material is wasted. Even cork dust is used to generate electric power.

In addition to this efficiency, recycling of used cork closures is now an activity that is strongly expanding.

As these corks cannot be reused in the wine industry, they are ground down and are used to manufacture many other products with a great variety of applications, while still maintaining all the positive characteristics of natural cork. This means that the cork stopper is the only completely natural, renewable and recyclable closure.



8. Contacts.

8. Contacts.

APCOR

APCOR is the Portuguese acronym for Associação Portuguesa de Cortiça (Portuguese Cork Association). The mission of APCOR is to represent and promote the Portuguese Cork Industry and all cork-based products. Representing the majority of the Portuguese Cork Industry, APCOR has a membership of over 300 Portuguese companies, accounting for approximately 80% of the total national production and 85% of all cork exports.

APCOR is committed to ensuring that its members adopt the best internationally recognized standards of manufacturing practice to produce natural cork stoppers of the highest quality for the wine industry and its consumers.

APCOR conducts international promotional activities that add value to all cork products.

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Notes

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