



VOL.XXIX



Newsletter

# FILM PRESERVATION

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FILM: A COLLECTION OF STORIES UNFOLDED.

"Frame by Frame, Story by Story: Film, A Canvas for Curators."

# FILM PRESERVATION



CINETECA NACIONAL IS ONE OF MEXICO CITY'S GREATEST TREASURES.

## ABOUT US

Cobeal is behind some of the most advanced film archives in Latin America. From **Cineteca Nacional** to **Estudios Churubusco**, the **Centro de Capacitación Cinematográfica (CCC)**, **UNAM**, and other universities and national archives, Cobeal's engineering quietly safeguards the visual memory of Mexico.

Each facility is built like a living organism: temperature, humidity, and air chemistry, held in perfect balance. Our systems don't just store film; they preserve it at the molecular level. Whether it's nitrate reels from the golden age or digital masters from modern productions, Cobeal designs environments that last for centuries.



# FILM STORAGE

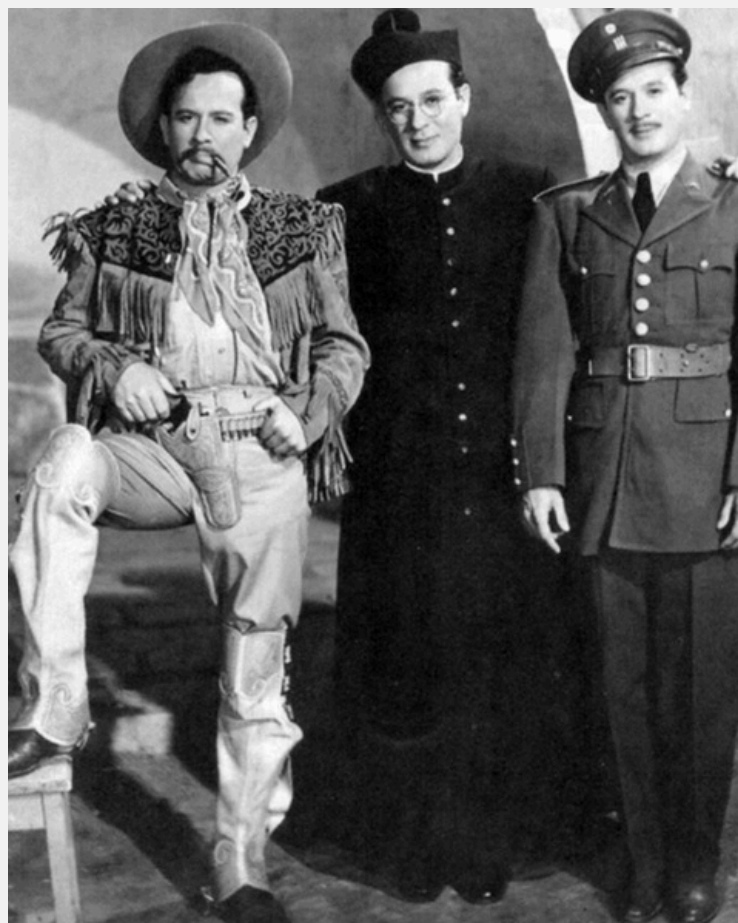
At Cobeal, film preservation begins with the understanding that temperature, humidity, and air chemistry determine the lifespan of nitrate and acetate-based media. Decay is not inevitable. It is a chemical reaction that can be slowed, isolated, and controlled. Our systems are built to give cultural institutions that control.

## Temperature & Humidity as Preservation Tools

Every degree percentage point matters. At 65°F and 40% relative humidity, a fresh acetate film might last 50 years before showing signs of vinegar syndrome. Lower that temperature by just 15°F while keeping humidity stable, and its projected life extends to over 150 years.

Cobeal designs systems around that principle: reducing both temperature and water vapor content to create a stable, low-reactivity environment. Using desiccant-based dehumidification and precision refrigeration, our installations maintain the ISO-defined climate zones for archival materials—room (68°F), cool (54°F), cold (40°F), and frozen (32°F)—and keep relative humidity consistently between 30% and 45% with  $\pm 2\%$  tolerance.

Each climate band corresponds to measurable preservation benefit. At cold (40°F), both black-and-white and color film meet ISO recommendations for long-term stability. At frozen (32°F), film life is extended exponentially—though Cobeal systems are engineered to balance those benefits against the specific vulnerabilities of composite media, such as magnetic sound tracks that can delaminate if frozen too rapidly.





# REGISTRO NACIONAL DE ARCHIVOS PRIVADOS



## SYSTEM DESIGN & INTEGRATION

Cobeal cold vaults are engineered as sealed environmental ecosystems—insulated, humidity-controlled, and sensor-verified. Our air handling units use desiccant rotors and precision scroll compressors that modulate both sensible and latent heat load, maintaining constant dew-point control even under varying load conditions.

Every vault includes:

- **Independent zones** for nitrate, acetate, and polyester film segregation, each with distinct safety and humidity profiles.
- **Desiccant-based dehumidification loops** to stabilize relative humidity without rapid cycling.
- **Positive-pressure air circulation** to prevent infiltration of polluted or humid air.
- **Redundant chillers and emergency power integration** to ensure environmental continuity during power failure.
- **Fire-safe and blast-relief architecture** in nitrate rooms compliant with NFPA 40 standards, including oxygen-limiting fire suppression and vented containment panels.

HUMIDITY CONTROL &  
CONDENSATION MANAGEMENT

Condensation is a greater threat than cold. Cobeal’s systems integrate barrier rooms and staging zones that prevent moisture shock when films move between cold storage and work areas. These buffer spaces are maintained at intermediate conditions—typically **55°F and 50% RH**—allowing gradual acclimatization of film cans.

Smart sensor arrays continuously log dew point and alert staff to transient risk conditions. The goal is stability, not just cooling.

AIR QUALITY &  
FILTRATION

Even trace gases accelerate deterioration. Our systems achieve pollutant levels far below standard office or gallery environments:

Pollutant	Target (ppb)	Equivalent (µg/m³)
Sulfur dioxide	1	2.7
Nitrogen dioxide	2.6	5
Ozone	2	4
Formaldehyde	4	5
Acetic acid	4	10

Each vault includes a multi-stage filtration stack—HEPA/ULPA particulate filtration, activated carbon for organic vapors, and potassium permanganate media for acid scavenging. Air exchanges are carefully balanced to protect against static pressure loss and vibration, maintaining laminar air movement over shelves and reels.

## MONITORING & PREDICTIVE MAINTENANCE

All Cobeal systems operate under continuous data logging and AI-assisted trend analysis. Integrated sensors monitor temperature, RH, dew point, and gas composition, transmitting data to both local displays and secure remote servers. Alerts are configured for both deviation and rate-of-change detection, allowing early intervention before environmental drift causes chemical harm.

For institutions with limited staff, the same platform can operate in autonomous preservation mode, adjusting system load and dehumidifier setpoints dynamically to maintain ISO conditions.

## FILM CONTAINERS & MICROCLIMATES

Cobeal recognizes that the microenvironment inside a film can or archival box can either reinforce or undermine vault-level control. We advise polypropylene or inert metal enclosures lined with acid-free materials and, when appropriate, sealed with molecular sieves or acetic acid scavengers. At low temperature, sealing prevents external moisture infiltration; at ambient conditions, venting prevents acid buildup. Our environmental algorithms adjust vault airflow to complement whichever method the collection employs.

## EMERGENCY RESILIENCE & REDUNDANCY

A film vault must be prepared not only for slow decay but also for sudden loss. All Cobeal preservation systems include **power-loss recovery logic** that ramps temperature gradually after outages, preventing condensation shock. Facilities are equipped with dual electrical feeds and automated generator switchover. Nitrate rooms include **gas sensors**, **pressure-relief vents**, and **fire compartmentalization** in compliance with NFPA 40.

Cobeal's environmental redundancy ensures that even during a blackout or equipment failure, conditions remain within tolerances long enough for safe recovery.

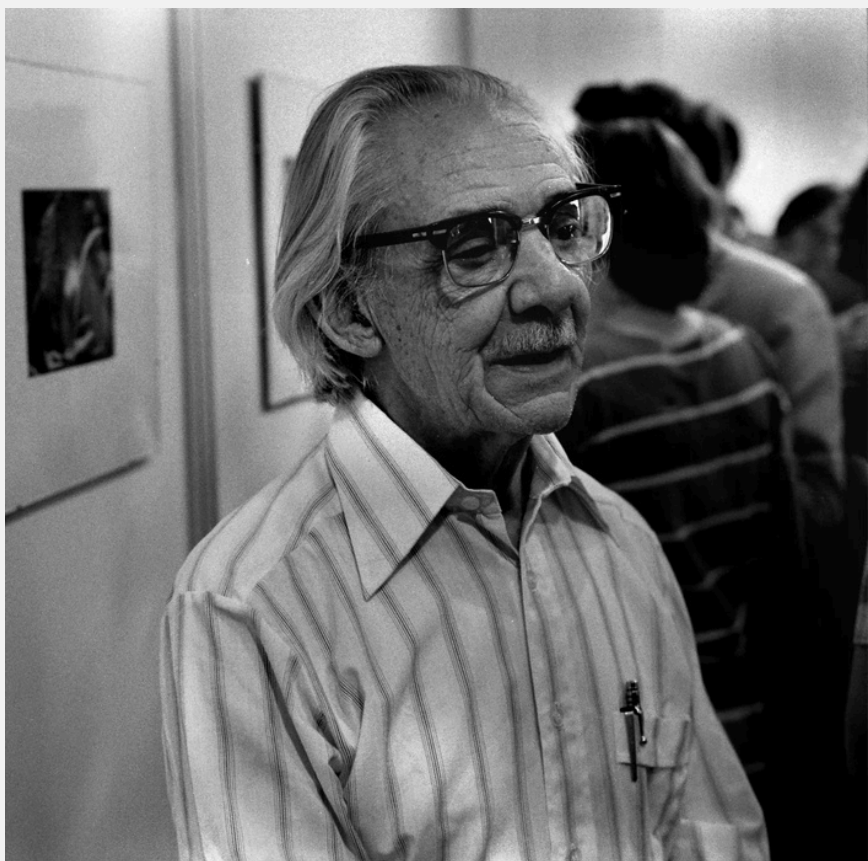


## LONG-RANGE PRESERVATION PLANNING

Cold and dry storage is not simply a static condition. It is the foundation of a long-range preservation strategy.

Cobeal's monitoring tools allow curators to model decay risk and forecast the effective lifespan of each material class, integrating IPI's predictive curves into our interface.

Institutions can schedule duplication and digitization based on scientific thresholds: A-D Strip levels, measured acidity, or cumulative time above critical humidity points, rather than emergency response.



## PHILOSOPHY OF CONTROL

Cobeal's philosophy is simple: **preservation is a function of environmental control, not reaction.**

We build systems that do not just meet ISO or IPI standards—they verify, record, and maintain them automatically.

Every vault is a living, monitored ecosystem, where air chemistry, temperature, and humidity are precisely balanced to arrest the very chemistry of decay.



## FILM PRESERVATION

# ENVIRONMENTAL SETPOINTS

Category	Temperature (°F / °C)	RH (%)	Pollutant Limit (ppb / µg/m³)	Film/Decay Notes	Cobeal Technical Countermeasure
Paper records	65 / 18.3	35–45 ±5	—	Standard archival paper	Tight control of RH & filtered air
B&W non-acetate film	65 / 18.3	35 ±5	—	Silver stable	Precision cooling; desiccant backup
B&W acetate film	35 / 1.67	35 ±5	—	Prevent vinegar syndrome	Cold vaults, VOC scrubbing
Color film & prints	50 / 10	35 ±5	—	Dye fade risk	Cold stabilization; low UV
Transition/barrier rooms	50 / 10	35–45 ±5	—	Acclimatization	Dew-point management
Processing/exhibit/research	70 ±5 / 21.1	35–50 ±5	—	Human activity	Air curtains; particle monitoring
Magnetic/electronic media	≥46 / ≥7.8	35–45	—	Avoid condensation	Condensation-safe ventilation
Airborne pollutants	—	—	SO <sub>2</sub> 1 / 2.7; NO <sub>2</sub> 2.6 / 5.0; O <sub>3</sub> 2.0 / 4.0; HCHO 4.0 / 5.0; CH <sub>3</sub> COOH 4.0 / 10.0	—	Activated-carbon, permanganate, and HEPA/ULPA stages maintain sub-ppb levels.
Film gauges (35mm–8mm)	—	—	—	Nitrate, acetate, or polyester bases	Separate vault classes; dynamic monitoring by gauge type

## Environmental Continuity & Long-Term Stability

Each Cobeal vault is designed not only to meet these environmental setpoints, but to maintain them continuously over decades. Every installation includes automated calibration, sensor redundancy, and real-time verification against ISO and IPI benchmarks. Our systems balance preservation efficiency with operational sustainability: using low-GWP refrigerants, heat-recovery loops, and adaptive power management to reduce lifecycle cost without compromising precision.

Whether the archive houses nitrate film, acetate reels, or digital masters, the environment remains stable, documented, and verifiable. This ensures that preservation is not an act of storage, but a sustained process of control.



# POLLUTANT GAS LIMITS

Pollutant	Max after filtration	Mass conc. ( $\mu\text{g}/\text{m}^3$ )	Notes
Sulfur dioxide ( $\text{SO}_2$ )	1 ppb	2.7	
Nitrogen dioxide ( $\text{NO}_2$ )	2.6 ppb	5	
Ozone ( $\text{O}_3$ )	2.0 ppb	4	
Formaldehyde ( $\text{HCHO}$ )	4.0 ppb	5	
Acetic acid ( $\text{CH}_3\text{COOH}$ )	4.0 ppb	10	
Research rooms	—	—	Must have at least office-quality filtration

## Air Chemistry and Preventive Filtration

Invisible contaminants are among the most aggressive agents of film decay. Trace gases such as sulfur dioxide, nitrogen dioxide, ozone, formaldehyde, and acetic acid accelerate oxidation, embrittle cellulose bases, and destabilize color dyes long before visible damage appears. Cobeal systems maintain pollutant concentrations far below measurable harm thresholds through multi-stage filtration and continuous monitoring. Air first passes through activated-carbon and permanganate media to capture acidic and oxidizing compounds, then through HEPA or ULPA filters to remove fine particulates.

Beyond removal, Cobeal's control systems verify air chemistry dynamically. Sensors positioned at supply and return points compare gas loads and automatically adjust fan pressure or filter banks to sustain sub-ppb levels. For nitrate and acetate storage, this ensures that even in long-duration cold environments, residual off-gassing does not accumulate within the vault. Each installation's filtration strategy is modeled to local air quality and material load, minimizing replacement frequency while maintaining precision.

The result is a self-regulating microclimate—quiet, stable, and chemically inert—where the air itself becomes part of the preservation system.

# FILM GAUGES, MATERIALS, AND TYPICAL DECAY

Film Gauge	Base Material	Date Range of Use	Typical Decay Mode	Remarks
35mm	Cellulose nitrate (to early 1950s); later polyester	1893–present	Nitrate decay (flammable); mechanical damage; color fading	Professional theatrical; highest image quality; most nitrate hazard
16mm	Acetate (triacetate, propionate, butyrate); later polyester	1923–present	Vinegar syndrome; shrinkage; magnetic track decay	Most common archival gauge; used in education, industry
Regular 8mm	Acetate	1932–1980s	Vinegar syndrome; shrinkage; color fading	Home and amateur film; reversal stock common
Super 8mm	Acetate or polyester	1965–present	Vinegar syndrome (acetate); color fading; mag track decay	Smaller sprocket holes; used by advanced amateurs
70mm / IMAX	Polyester	1950s–present	Color fading, mechanical wear	Extremely stable base; high tensile strength

## Material Behavior and Storage Strategy

Each film gauge carries its own vulnerabilities, driven by chemistry and manufacturing history. Nitrate stock, once the standard for 35mm production, is chemically unstable and flammable, demanding sub-40°F, oxygen-controlled environments. Acetate films, while safer, undergo hydrolysis that releases acetic acid—the “vinegar syndrome” that can infect adjacent reels if uncontrolled. Polyester bases, now the global standard, offer long-term dimensional stability but remain sensitive to pollutants and temperature cycling.

Cobeal vaults are engineered to manage these materials as a system, not as isolated reels. Independent climate zones, vapor isolation barriers, and gas-phase filtration prevent cross-contamination between nitrate, acetate, and polyester collections. Real-time chemical sensors track off-gassing trends, allowing curators to separate and treat vulnerable films before decay accelerates. By aligning environmental control with material science, Cobeal transforms storage into an active preservation process: scientifically measured, continuously verified, and fully adaptable to evolving collections.

# COBEAL SOLUTIONS



Preservation begins with control, and control begins with engineering. Cobeal's film vaults are not passive rooms but closed environmental systems—integrated structures that manage air chemistry, humidity, temperature, and power as one continuous equation.

Each design is calibrated to the chemical thresholds of the materials it protects, using desiccant-based dehumidification, low-vibration air handling, and multi-stage gas scrubbing to stabilize conditions within  $\pm 2\%$  of target.

*"Sin la cámara ves el  
mundo de una manera; con  
ella, lo ves de otra."*

*-Graciela Iturbide*

Every Cobeal installation includes dynamic zoning for nitrate, acetate, and polyester film, ensuring that no medium endangers another. Redundant chillers and positive-pressure loops maintain stability even during power fluctuations. In parallel, real-time sensors track temperature, RH, dew point, and airborne contaminants, alerting staff to micro-variations long before degradation can occur.

Beyond engineering precision lies philosophy. Cobeal's systems are designed to think like curators—anticipating risk, adapting to load, and recording every parameter as verifiable evidence of preservation. The result is measurable confidence: collections that remain stable, safe, and scientifically documented for generations.

# PRESERVATION PROBLEMS WITH COBEAL SOLUTIONS

Problem	Detection Method	Symptoms	Remedy	Cobeal System / Solution
<b>Mechanical damage</b> (All film gauges)	Visual inspection	Tears, torn perforations, broken splices	Physical repair	Stable airflow control and anti-static filtration prevent mechanical stress during handling; Cobeal's laminar flow work zones reduce particulate impact.
<b>Careless handling</b> (All gauges)	Visual inspection	Dirt, scratches, abrasions	Cleaning, preservation copying	Cleanroom-grade filtration (HEPA/ULPA), low-velocity air curtains, and workbench airflow zones maintain contaminant-free environments.
<b>Mold, mildew, and fungus</b> (All gauges)	Visual inspection	Matte-white spots, white web growth	Cleaning, improved storage	RH control ( $\leq 35\%$ ), UV-free air disinfection, and positive pressure zones suppress microbial growth; real-time spore alerts in Cobeal's archival modules.
<b>Acetate decay</b> (All acetate base film)	A-D strips, smell, shrinkage, visual inspection	Vinegar odor, shrinkage, curling, cracked emulsion, white powder, A-D $>0$	Slow by improving storage, isolate, copy before advanced decay	Cold storage vaults ( $\leq 35^{\circ}\text{F}$ ), dew-point-stabilized RH ( $\sim 35\%$ ), and sealed microzones prevent acid vapor propagation; Cobeal's VOC scrubbing neutralizes acetic emissions.
<b>Color fading</b>	Visual inspection	Color shift, contrast loss, washed-out look	Improve storage, copy before advanced fading	Cold and low-humidity stabilization at $10^{\circ}\text{C}$ , RH 35%; Cobeal's LED/low-UV lighting modules minimize photo-oxidative dye loss.
<b>Nitrate decay</b> (35mm nitrate only)	Visual inspection, smell, rusty cans	Image fading $\rightarrow$ sticky emulsion $\rightarrow$ softening $\rightarrow$ congealing $\rightarrow$ brown powder	Improve storage, copy before decay, hazardous disposal	Dedicated nitrate vault design: sub- $40^{\circ}\text{F}$ zones, $\text{O}_2$ -scrubbed air, blast-relief panels, and gas detection integrated with Cobeal fire-safe modules.
<b>Magnetic sound track decay</b> (Acetate film)	A-D strips, smell, shrinkage	Film base loses flexibility, mag track separates, vinegar odor	Improve storage, copy sound early	Magnetic-safe temperature ( $\geq 7^{\circ}\text{C}$ ), low dew point, and balanced airflow reduce adhesion loss; Cobeal's humidity precision ( $\pm 2\%$ ) preserves binder elasticity.





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assessments



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