



piqlFilm and the Arctic World Archive (AWA)

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Service provider and technology
innovator within secure data storage
& long-term digital preservation

- Founded in 2002 by Rune Bjerkestrand
- Headquarter in Drammen, Norway
- Operating in the digital preservation and data storage market with new innovative technology
- Supported by prestigious research programmes (Horizon 2020, Eurostars, Norwegian Research Council)



Co-funded by
the European Union





"Piql provides a secure and migration-free offline preservation medium"

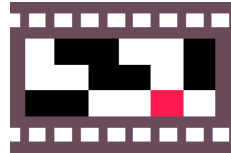
What have we done?



Data



Binary codes



Bits-on-Film

We have digitised the film

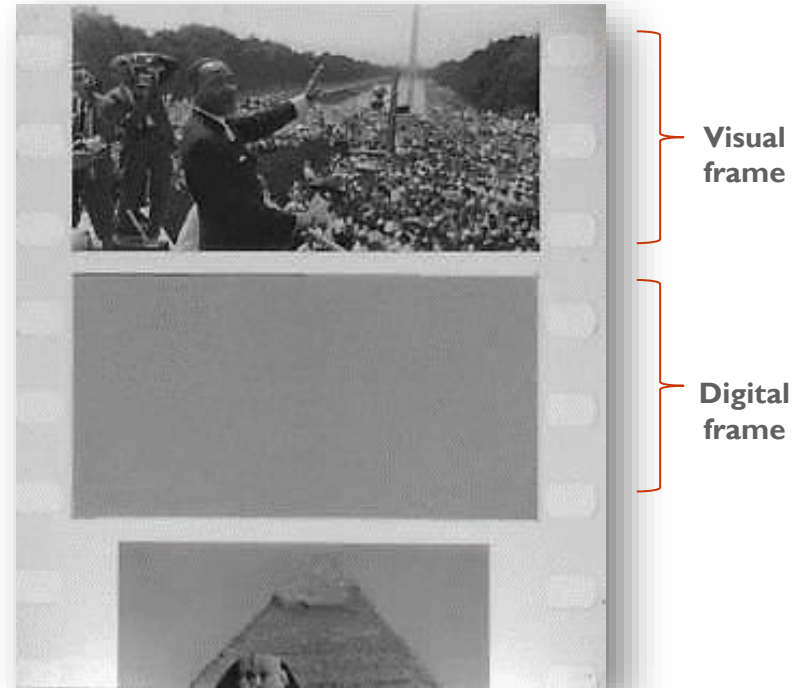
- We write digital bits and bytes onto 35mm photosensitive film
- piqlFilm – nano-film with tested longevity of a minimum of 500 years
- piqlBox – created by a new polymer material tested to last more than 500 years

Why the piqlFilm is unique?

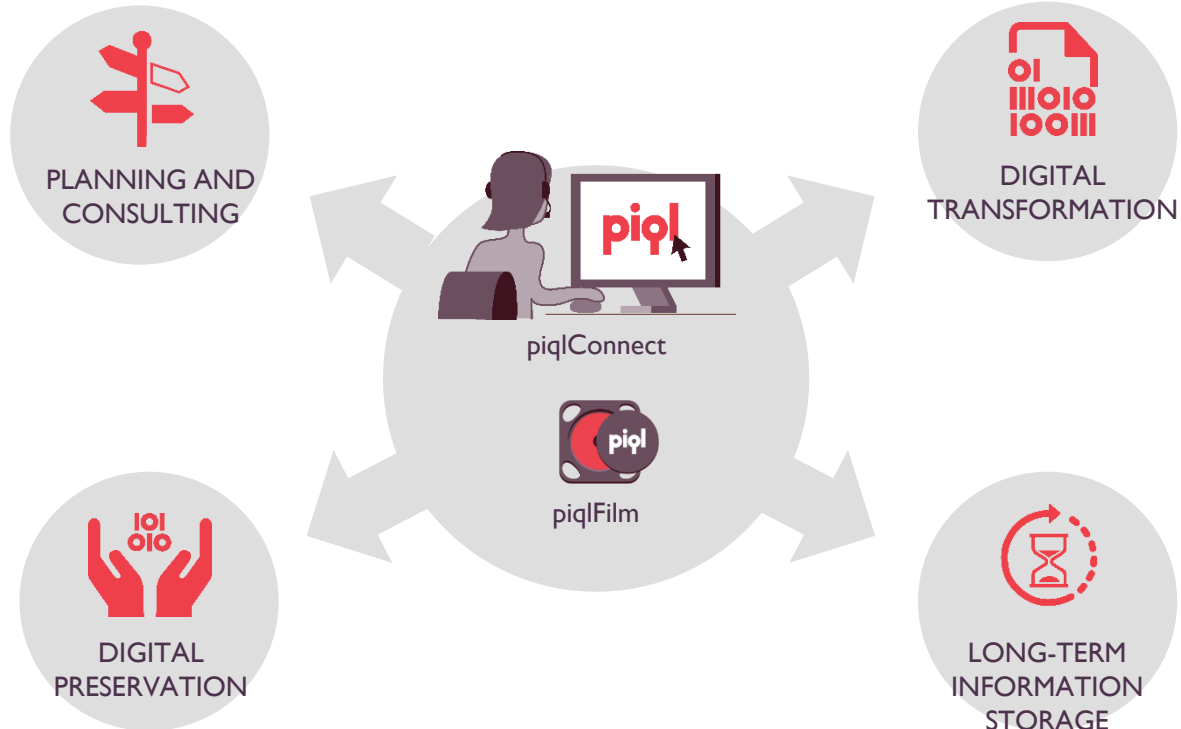


A Flexible Data Storage medium

- Visual and digital information stored on the same medium.
- Self-contained - includes all information in a human-readable format to recreate the reading technology and understand the content in the future.
- Film is an unalterable, secure and offline medium.
- Integrates with the IT environment – data searchable.



piqlConnect – Archival as a Service solution



What is our core technology?

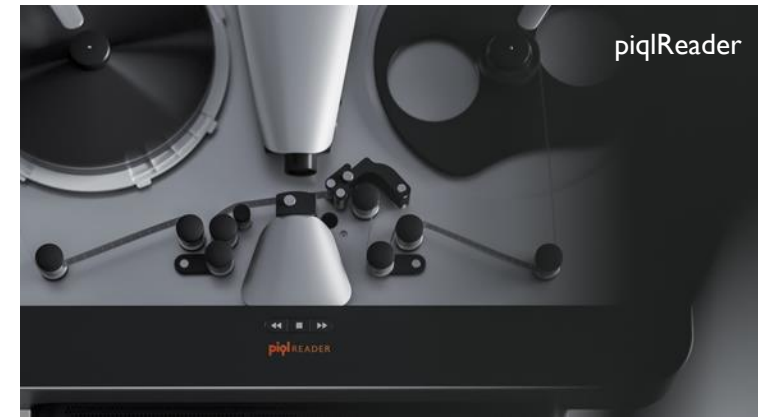
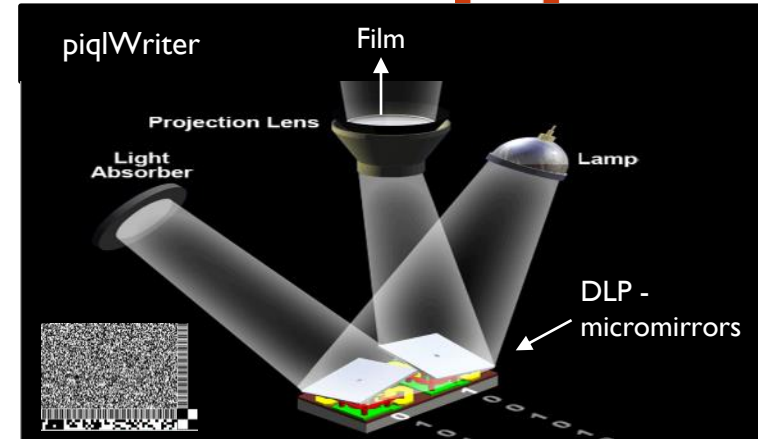


Technology “Bits on Film”:

piqlWriter: data written as high-density QR codes
Encode binary data to a 2D barcode.

piqlProcessor: photographic processing of film
Transform the latent image into a visible and permanent image

piqlReader: an open platform for data verification and retrieval
Image capturing (Scanning)
Decoding software (open source)



piqlFilm – Offline Storage Medium

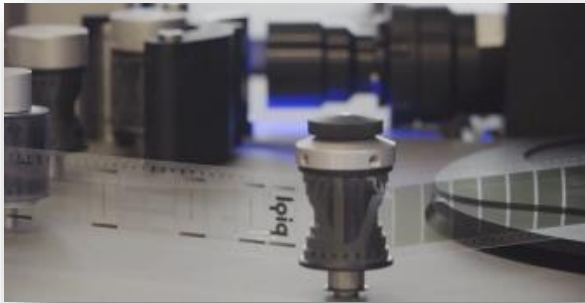


- The film base is a transparent polyester film - PET (polyethylene terephthalate) of 100 microns thickness.
- A low-speed, high-contrast,
- Black and white, negative film
- Extremely fine grain (20 nm to 40 nm)
- high resolving power (1180 line pairs per mm)
- Life expectancy – 750 years

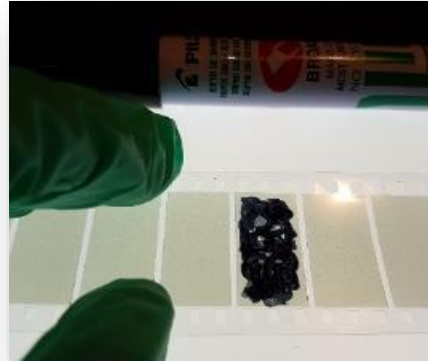
How do we make sure the film is reliable?



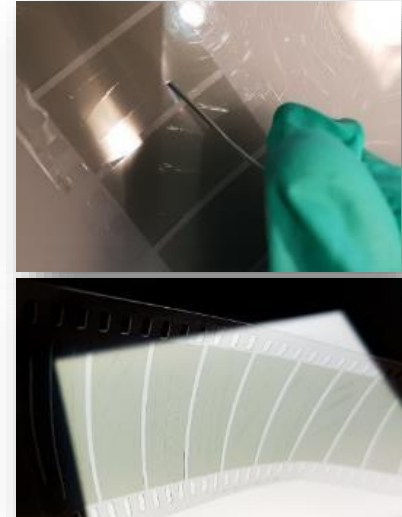
Readback Stress test



Frame loss test



Scratch test



How do we test longevity on the piqlFilm?



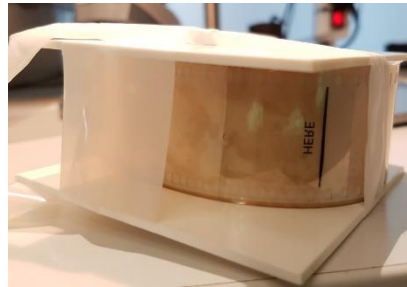
Accelerated life testing - ISO standard for calculating lifetime expectancy on polymers

The film is placed in heat chambers at different temperatures and humidity-controlled (ISO 18901, ISO 18936).

- The chemical reaction is faster as the temperature is increased (Arrhenius - ISO 18924)
- Digital data is restored from film stored at 55, 65, 75 and 85°C.
- Extrapolation to estimate the lifetime at 21°C
- Film mechanical properties are tested



Picture 1: ISO 18901. Free hanging film, stored in the climatic chamber.



Picture 2: ISO 18936. Film sample after accelerated aging, attached to piqlBox material on its top and bottom.



Picture 3: ISO 18936. Each sample is placed in two sealed aluminum bags during accelerated aging.

How do we storage the piqlFilm?



piqlBox: piqlFilm storage container - lifetime of 1500 years

- Polypropylene: Heterophasic copolymer (PPB2)
- Protects against dust and water splashing (IP54 code (International Protection Marking, IEC standard 60529))
- Photographic Activity Test (per ISO 18916) – Silver Image Interaction, Gelatin Staining and mottle evaluated.

Label on piqlBox- lifetime of 1500 years

- PET (#430)
- Thermal transfer printer,



Arctic World Archive



A safe repository for
world memory





Our goal

To ensure precious memories and valued cultural items are never lost, but can be kept forever without the risks of data corruption or technology obsolescence





Arctic World Archive

Protecting
World
Memory

The vault is located in Svalbard, deep inside a secure and safe abandoned coal mine.

A unique geopolitically stable area:

- Spitsbergen (Svalbard) Treaty (1920) provides for Norwegian sovereignty over Svalbard
- A declared demilitarised zone by 42 nations



Environmental Conditions in AWA



- The AWA vault is designed to conform with ISO 18911:2010 (practice for storage of photographic films)
- Environmental characterization of the AWA vault was performed by the Norwegian Defense Research Establishment (FFI):
 - Natural ventilation reduces the accumulation of gases released from the mine walls and bedrock.
 - Permafrost keeps the temperature at -5 °C, increasing the lifetime of the piqlFilm.
 - The mine is dry and cold with no rain or meltwater entering the tunnels. Reduces the concentration of microorganisms present on surfaces and in biofilms.
 - Regarding radioactivity, coal contains radionuclides (uranium, thorium, potassium-40). The mine does not have coal wastes reducing the risk of degradation of the ground surface.
 - The steel container used for storing the piqlBoxes provides extra shielding from radiation.

How do we storage the piqlFilm in AWA?



The piqlBox is bagged

- Heat-seal aluminium bag
- Humidity in film at bagging is controlled and low
- Protect against:
 - Water, Dust, Oxygen, Ozone
 - Corrosive gases, Fungal growth
 - Light, Insects, Microbiological attack
 - Absorption of humidity at low temperatures

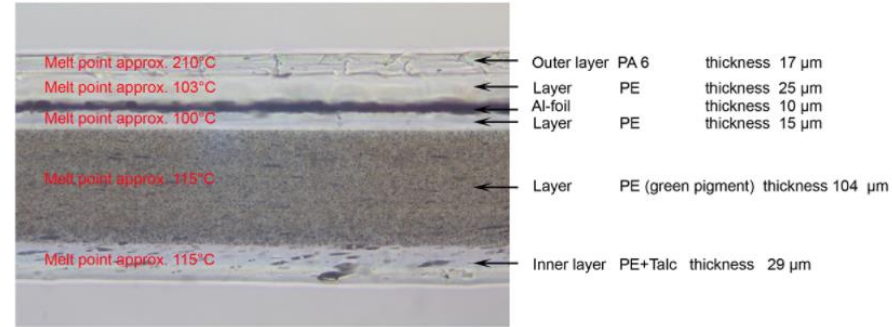


Figure 4. LM image of a microtomed cross section of the bag

☑ Test Conditions

#	Time	Temperature	Rel. humidity inside	Rel. humidity outside
1	365000 days	2 °C	0 %	100 %

Cumulative results

Total water vapor transmission	355.886 ml/package
Total vapor transmission/m ²	2224.290 ml/m ²
Total water transmission	0.286 g/package
Total water transmission	1.787 g/m ²

Combining the preservation qualities of film with the user-friendliness of digital technologies



Ultra-secure data storage



UNALTERABLE

By using a true WORM medium, we make it impossible to modify or delete recorded data.



SECURE

We safeguard your data from cyberattacks, logical threats as well as EMP and physical threats

Long-term digital preservation



MIGRATION-FREE

Avoid the risk of data loss, save time and get a predictable long-term cost.



FUTURE-PROOF

Data retrieval is possible independent of technology obsolescence



PERMANENT

Our film and box are tested to keep your data for 500 years.

Common



FLEXIBLE

We can store data both in digital and visual format



SEARCHABLE

Your data is fully searchable, so you'll always find what you need.

Thank you

piql

