Improving the storage conditions for composite historical objects: do oxygen-free conditions keep their promise?

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Museum of Carriages

- since 1922:
  exhibition area at
  Schoenbrunn Castle
- 1947:
  collection established
- only then:
  scientific studies and
  conservation treatments
  of the objects started

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The collection

- 101 court vehicles
- 50 private vehicles of the nobility
- altogether more than 5000 objects
- probably biggest collection of historic utensils for riding and court uniforms

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Storage

- objects
  - saddles, sleigh harnesses, pad blankets
  - complex composition
- historic storage area
  - under the roof
  - annual climatic changes
  - dust
  - insect pests
  - air pollution

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Condition of the objects

- corrosion of metallic parts
- beginning decomposition of leather and textile fibres

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Selection of objects (1)

- pad blankets
  - series of identical objects available
  - complex combination of different materials
  - textile fibres, leather, and metallic parts
  - manageable size

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Selection of objects (2)

- sleigh harnesses
  - series of identical objects available
  - complex combination of different materials
  - wood, horsehair, metal, leather, and textile
  - bigger size and harder to manage

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Preparation of the objects

- vacuuming
- partial cleaning
  - metallic threads/blankets: cotton swabs/saliva
  - metallic parts/harnesses: scalpel or cotton swabs/ethanol
- photographic documentation

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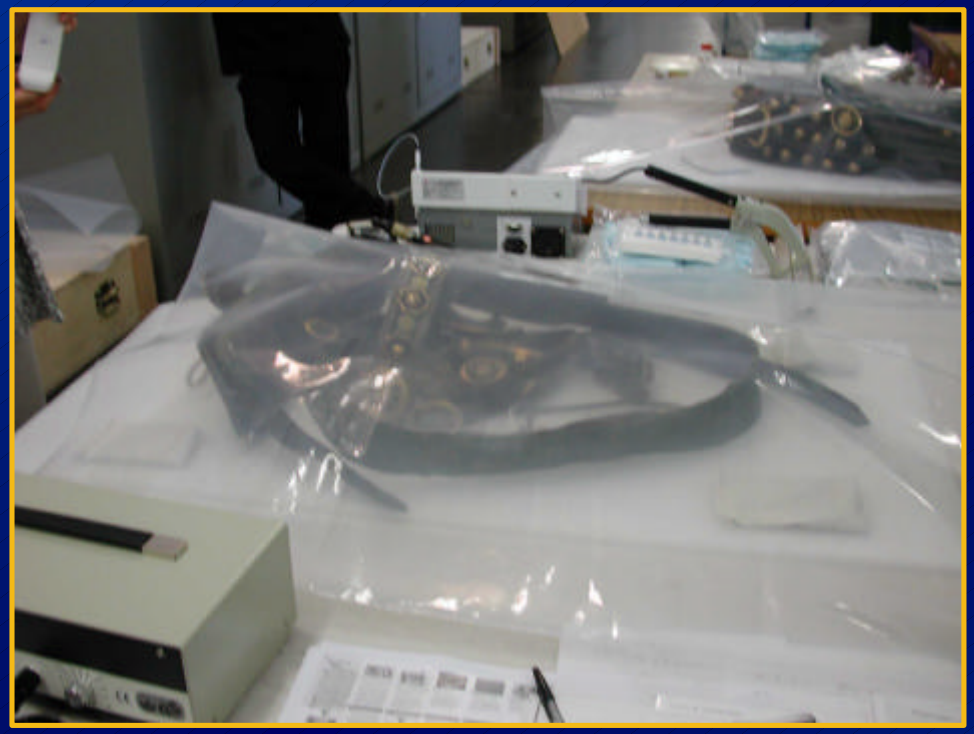
Packing of the objects (1)



- selection of plastic foils
  - ambient conditions: PE and PE/PA-compound
  - under nitrogen: aluminium oxide coated and EVOH-foil
- addition of
  - devices to control the climate
  - indicating and reading devices

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Packing of the objects (2)

- oxygen-free packing
  - with and without nitrogen filling
  - addition of oxygen scavengers: ATCO 2000 FTM
  - Ageless-Eye indicators to check the oxygen free conditions

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Packing of the objects (3)

- sealing
  - mobile sealing device
- verifying
  - tightness by visible inspection
  - oxygen-free conditions using oxygen measurements

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Storing the packed objects

- storage duration of 1,5 years
  - temperature and relative humidity
  - discoloration of A/D-Stripes, metal pieces (Pb, Cu, brass, Ag) and Ageless-Eye indicators
  - changes of the object conditions

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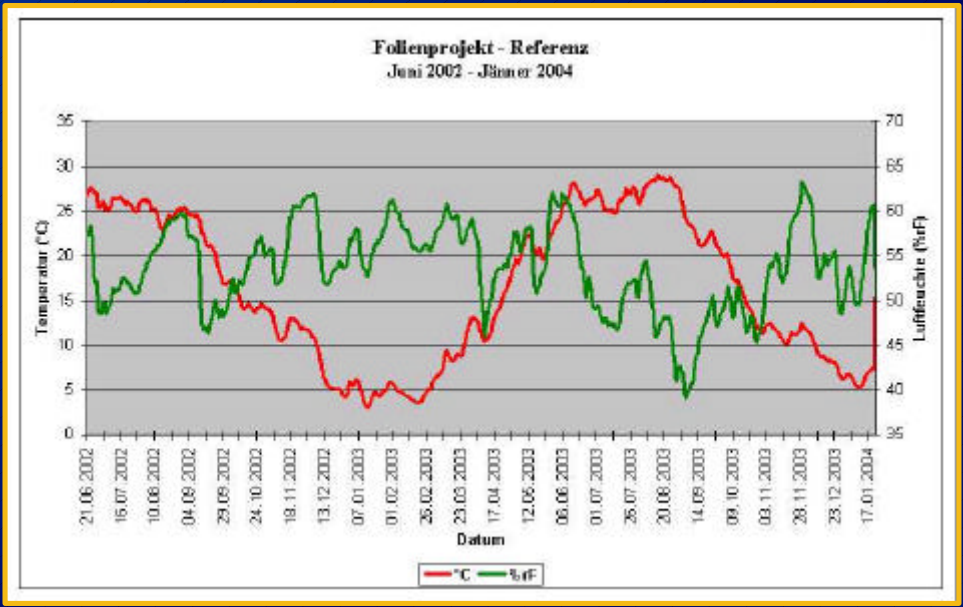
Results (1)



- temperature and relative humidity
  - storage area
  - strong annual changes
  - temperature: 3 - 29 °C
  - relative humidity: 39 - 63 %RH

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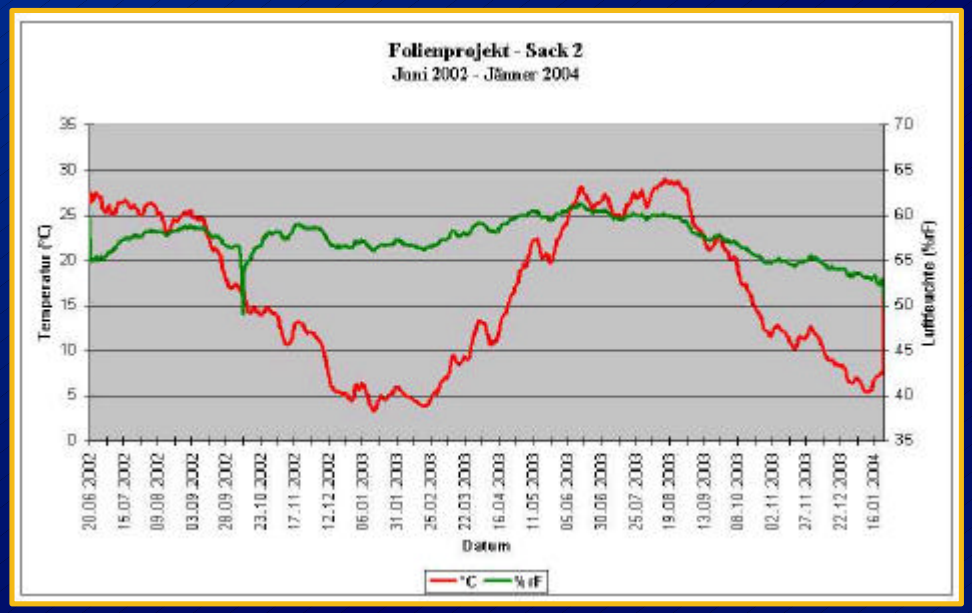
Results (2)



- temperature and relative humidity
  - inside the bags
  - relative humidity stabilised: 53 - 61 %RH
  - oxygen-free bags normally more humid
  - Silica Gel shows no effect
  - buffering of humidity by the objects

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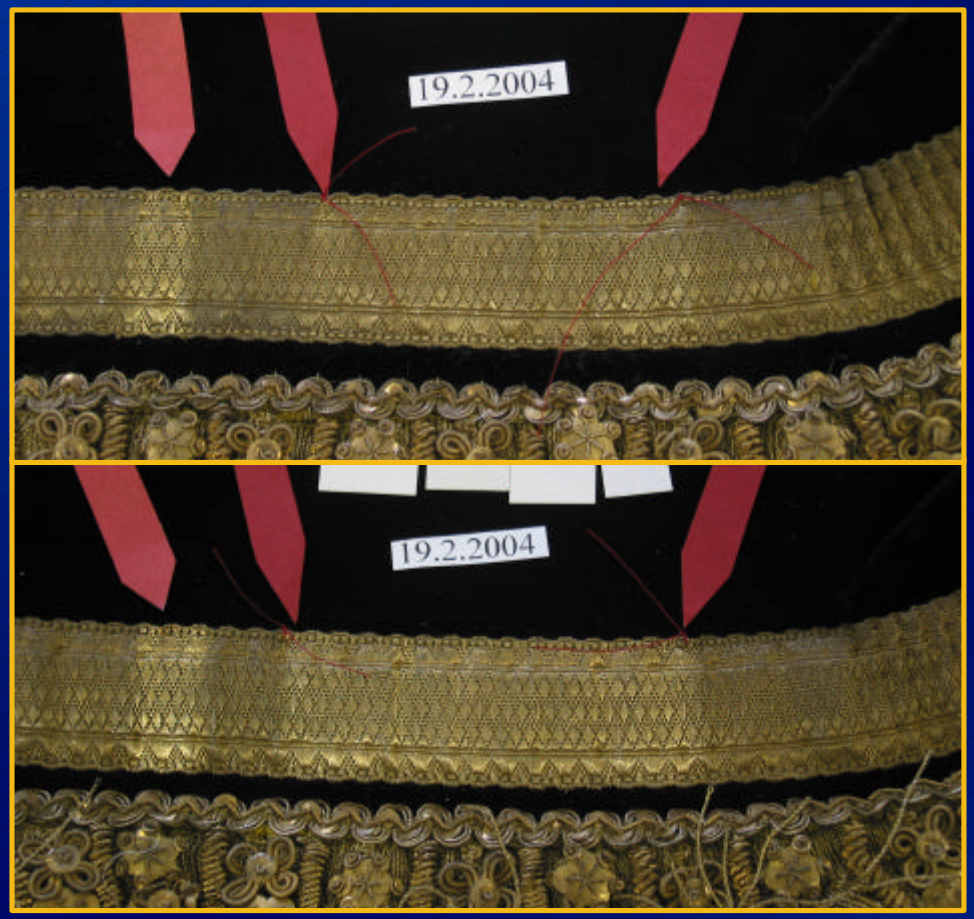
Results (3)



- object condition
  - aluminium oxide coated foil
  - also oxygen-free packing
  - darkening of the cleaned parts under nitrogen
  - in ambient conditions only weak darkening
- Ageless-Eye discoloured

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Results (4)

- object condition
  - EVOH-foil
  - also oxygen-free packing
  - weak darkening of the cleaned parts under nitrogen
  - in ambient conditions stronger darkening

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Results (5)

- object condition
  - PE/PA-compound
  - packing in ambient conditions only
  - slight darkening of the cleaned parts

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Results (6)

- object condition
  - PE-foil
  - packing in ambient conditions only
  - slight darkening of the cleaned parts

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Results (7)

- oxygen-free packing
  - EVOH-foil
  - high tightness
  - strong discoloration of copper plates
  - slight changes of Ag

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Results (8)

- packing under ambient conditions
  - EVOH-foil
  - no discoloration of copper and silver plates

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Results (9)

- oxygen-free packing
  - aluminium oxide coated foil
  - high tightness
  - discoloration of Cu and Ag plates

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Results (10)

- packing under ambient conditions
  - aluminium oxide coated foil
  - no discoloration of Cu and Ag plates

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2nd Series of packing

- packing of smaller objects
- checking the regulation of the relative humidity
  - environmental conditions 50 %RH
  - partially addition of preconditioned Silica Gel (40 %RH)

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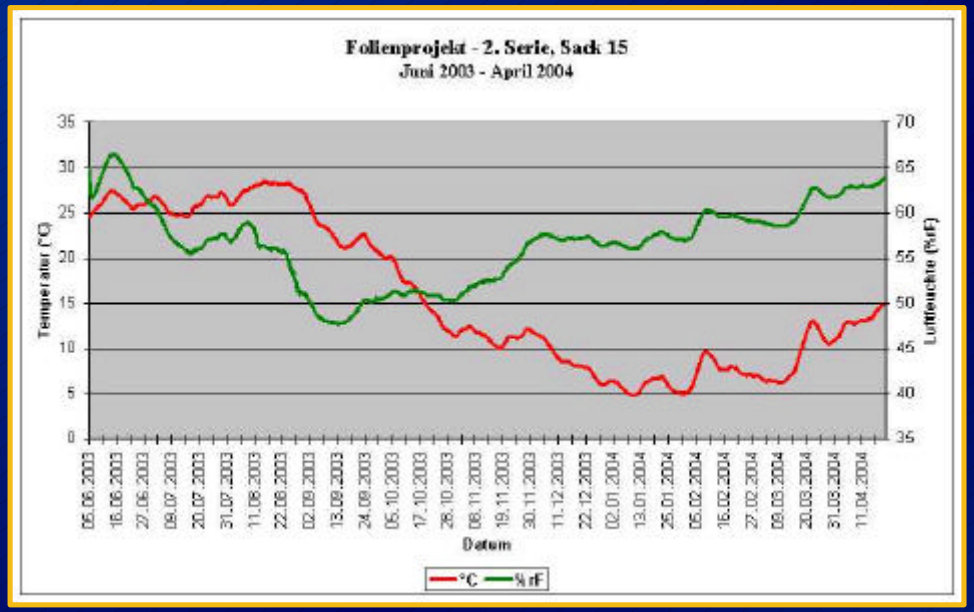
Results - 2nd Series (1)



- temperature and relative humidity
  - PE-foil
  - without Silica Gel
  - strong variations of the relative humidity: 45 - 63 %RH

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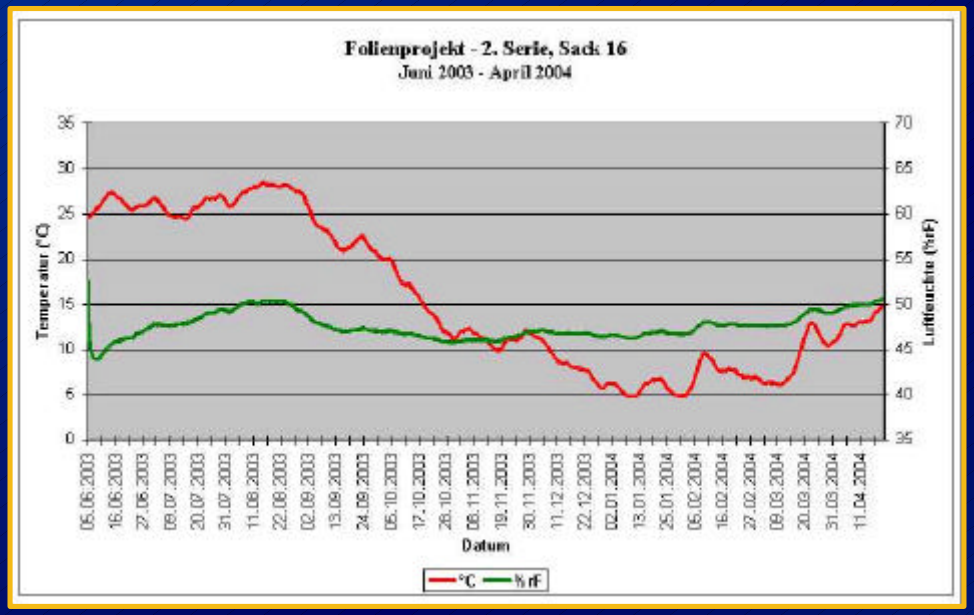
Results - 2nd Series (2)



- temperature and relative humidity
  - PE-foil
  - with Silica Gel
  - relative humidity stabilised: 44 - 51 %RH

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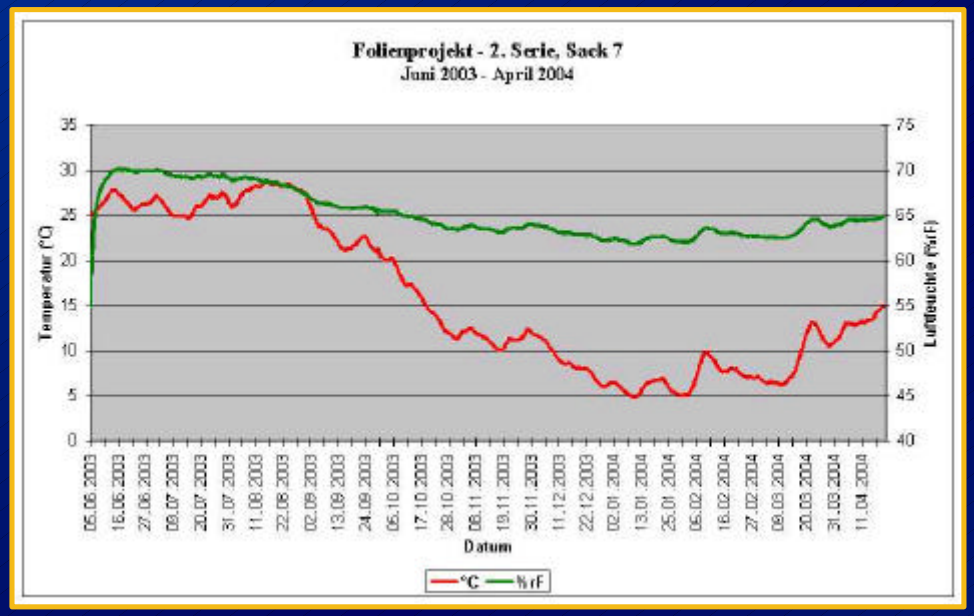
Results - 2nd Series (3)



- temperature and relative humidity
  - EVOH-foil
  - oxygen-free conditions
  - without Silica Gel
  - variations of the relative humidity: 62 - 70 %RH
  - relative humidity in ambient conditions: 48 - 58 %RH

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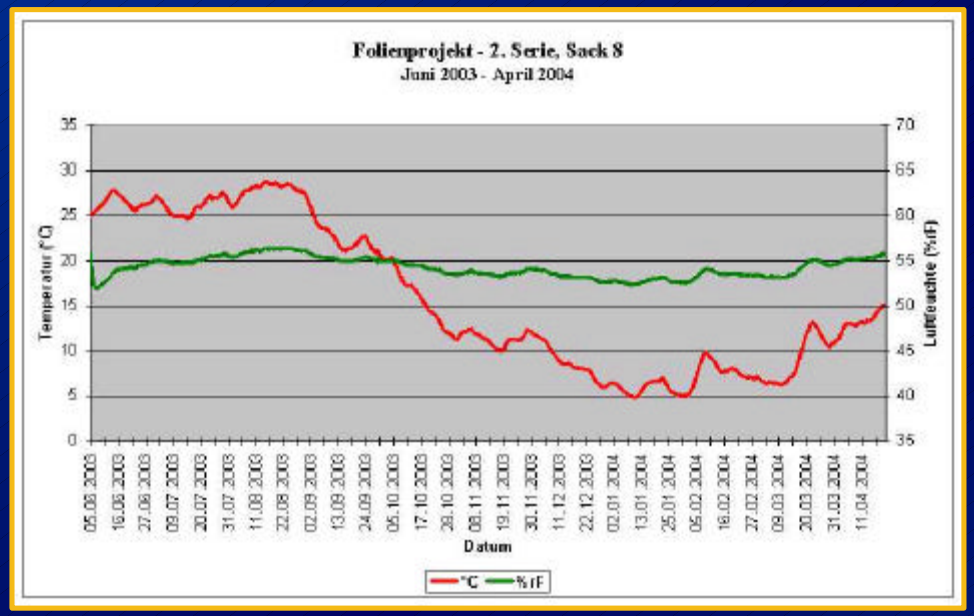
Results - 2nd Series (4)



- temperature and relative humidity
  - EVOH-foil
  - oxygen-free conditions
  - with Silica Gel
  - relative humidity stabilised and reduced: 52 - 57 %RH
  - relative humidity in ambient conditions: 44 - 53 %RH

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Conclusions (1)

- generally foils show good performance for
  - visibility of objects
  - protection against dust, insect pests and air pollution from storage cases
  - stabilising the relative humidity
  - barrier against oxygen where necessary

- controlling the relative humidity is more difficult
  - preconditioned Silica Gel shows effect only partly
  - environmental conditions during packing are more important

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Conclusions (2)

- oxygen-free conditions
  - generally relative humidity is higher
  - similar or even stronger darkening of the cleaned parts in comparison to storage under ambient conditions
  - discoloration of copper and silver plates probably due to sulphur containing compounds
  - discoloration of Ageless-Eye indicators using the aluminium oxide coated foil

? for the objects chosen, no detectable improvement compared to packing under ambient conditions

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Open questions

- adaptation of foils on purpose
- improvement of regulation of the relative humidity
- optimisation of oxygen-free storage
- cause for the discoloration of copper and silver plates under oxygen-free conditions
- cause for the discoloration of Ageless-Eye indicators using aluminium oxide coated foils
- long-term behaviour

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