



⌚ High resolution negative silicone rubber impressions of perforation on stone personal elements for technological studies

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Stefano Viola¹, Matteo Gios², Umberto Tecchiati¹, Stefano Viola¹¹Dipartimento di Beni Culturali e Ambientali - Sezione di Archeologia, Università degli Studi di Milano, Milan, Italy;²Département F.-A. Forel – Laboratoire d'Archéologie Préhistorique et Anthropologie, Geneva, Switzerland.**1 Works for me** dx.doi.org/10.17504/protocols.io.bp2ymqfw**VIOLA@PrEcLab**

Stefano Viola

Dipartimento di Beni Culturali e Ambientali - Sezione di Arc...

ABSTRACT

Although several scientific papers mention the use of HD silicone based impression materials for the study of small perforations, until today there are no published explicit and detailed protocols in this research's field. This technique is particularly useful in the field of the technological study of prehistoric ornaments, in particular for drilling methods. Unfortunately, the originals are often not suitable to be analysed with the main high magnification methods (they are delicate objects; they cannot be moved; they have several hidden points for direct observation) and require the development of a specific study methodology. To explain the method in detail, we propose a procedure divided into 11 phases, and some intermediate steps, capable to obtain an accurate replica suitable for SEM analysis. This procedure is applied on a Neolithic carnelian bead (hard stone) from Mali (G. Calegari Private Collection, Milan) as part of a scientific research aimed at documenting the technological indicators present on the object and their interpretation. Impressions were taken on the hole on the two faces (hole A and B) and part of the surfaces (surface A and B). Thanks to the very short contact times and the good mechanical characteristics of the used product (HD negative impression silicone) the procedure is a safe, easy, cheap, portable, low-time consuming and very effective, especially in the case of hidden surfaces such as inside of perforations.

EXTERNAL LINK<https://sites.unimi.it/preclab/progetti/microbeads/>**DOI**<dx.doi.org/10.17504/protocols.io.bp2ymqfw>**EXTERNAL LINK**<https://sites.unimi.it/preclab/progetti/microbeads/>**PROTOCOL CITATION**

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**EXTERNAL LINK**<https://sites.unimi.it/preclab/progetti/microbeads/>**KEYWORDS**

Material culture, Archaeology, Jewellery, SEM analysis, Impressions, Silicone moulding

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GUIDELINES

The total time of application of the protocol is approximately 70 minutes.

A few precautions are essential for the safe application of the protocol:

(1) Careful evaluation of the degree of porosity and fragility of the object (Phase 1). Do not use latex gloves to touch the archaeological object or the equipment; (2) the best results are obtained with temperatures between 15-25° C at 50% humidity; (3) protection while working with acetone (use of glasses and mask).

The protocol is based on the direct experience of one of the authors (SV) and from a extensive scientific literature. Below a brief basic bibliography:

- KENOYER, J. M. "Using SEM to Study Stone Bead Technology." *Stone Beads of South & South-East Asia: Archaeology, Ethnography and Global Connections*, edited by Alok Kumar Kanungo, Indian Institute of Technology-Gandhinagar & Aryan Press, 2017, pp. 405–33.
- M. SAX, K. JI, *The technology of jades excavated at the Western Zhou, Jin Marquis cemetery, Tianma-Qucun, Beizhao, Shanxi province: recognition of tools and techniques*, "Journal of archaeological science", 2013, 40, pp. 1067-1079.
- L. FIORENZA, S. BENAZZI, O. KULLMER, *Morphology, wear and 3D digital surface models: materials and technique to create high-resolution replicas of teeth*, "Journal of Anthropological Sciences", 2009, 87, pp. 2011-218.
- M. SAX, N. D. MEEKS, *Methods of engraving mesopotamian quartz cylinder seals*, "Archeometry", 1995, 37, 1, pp. 25-36.
- J. J. ROSE, *A replication technique for scanning electron microscopy: applications for anthropologists*, "American Journal of Physical Anthropology", 1983, 62, pp. 255-261.

Proper application of release agent. The application of at least one layer of release agent is often recommended. In this case, on the basis of personal tests carried out by one of the Authors (SV) on carbonates (marble) and due to the extremely compact nature of the raw material of the object presented in this protocol, it was decided not to apply the release agent (normally polyvinyl alcohol in aqueous solution).



DPI: glasses, mask

MATERIALS TEXT

List of materials needed:

- Coltene microSystem® (dispenser gun MKII, mixing tip, oral tip, jet bite – cartridge 4 x 25 ml.)
- Silicone type A Coltene Affinis precious, light body
- Precision plastic tweezers
- Distilled water
- Acetone
- Dishwashing liquid (surfactant cleaner)
- Resealable plastic bags (Minigrip™)
- Paintbrush (very fine)
- Toothbrush (soft)
- Metal bowl
- Adhesive Putty (UHU Patafix)

The total cost of materials is about 150 euros



All materials needed

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Preliminary evaluation

5m

1 Evaluation phase

5m

Careful evaluation of the degree of porosity and fragility of the object involved in the mold-making process. In our case it is a compact object, not cracked, made on a hard raw material (carnelian). It is very important to assess whether the surface may be stained by the use of low-viscosity precision dental impression silicones (by reading the scientific literature; carrying out preliminary tests on a small point of the object).



The african carnelian bead (face A)

Preliminary cleaning and blocking 35m

2 *Preliminary cleaning phase of the archaeological object* 34m

Gestures: actions prior to taking the actual mold impression. Not all actions are always necessary: for example, the last one (1.3) is mandatory in cases where we have to make impressions on an incomplete and/or unstable object.

2.1 **Washing.** Holding the piece in your hands, you clean it with demineralised water and then with acetone using a soft, clean toothbrush or cotton (about 3'). 3m



Water



Acetone

- 2.2 **Drying.** Leave the piece to dry completely in an open resealable envelope to prevent the dust from settling again (time taken about 30', at a temperature of about 18° C).



- 2.3 **Creation of support and object locking.** In our case (broken bead with strongly biconical holes) it is necessary to create an adhesive paste support that blocks the piece and contains the silicone. A release agent layer is not applied because it will be on contact with a hard stone.



The support made on adhesive paste

mould-making

8m

1m 30s

3 Pouring phase I

Working time: 1'

Taking the molds by injection of impression material into the bead drill A and on surface of the object (3 set of drill hole impressions). Gestures: pouring by dispenser gun; ejection of a little amount of mixed fluid (and discard it) from the dispenser to let air out of the tip; completely fill the end of the tip so that the inlet hole is full to prevent an air column from being injected (time taken: 30").



The complete Coltene microSystem®



Dispenser gun MKII; jet bite cartridge; mixing tip; oral tip

- 3.1 **Drill hole impression A.** In this case, strongly biconical holes, a impression is produced in two stages: first one face and then the other. The pouring starts from the bottom and continues with a circular movement to make the silicone adhere to the walls in the best possible way, continuing to rise in a regular way and remaining in an axial position to fill the voids. 30s



Face A, drill hole A

- 3.2 **Surface impression A.** Spread the silicone by injecting and advancing regularly to prevent air bubbles from forming. Leave the excesses of impression material to facilitate the subsequent demoulding phase. 30s



Face A, surface A

4 *Hardening phase I*

2m

The hardening (demoulding time of silicone : 2') of the mixture begins as soon as you start injecting the mixture.

5 *Demoulding phase I*

30s

Gestures: To be carried out by hand or without sharp tools (plastic tweezers) according to a continuous and delicate movement.



Face A

6 *Pouring phase II*

1m 30s

Working time: 1'

Taking the molds by injection of impression material into the bead drill B and on surface of the object (3 set of drill hole impressions). Gestures: after changing the mixer tip and its terminal (oral tip), everything as phase 3, step 3.1 and 3.2 (time taken: 30").

6.1 Drill hole impression B. Like step 3.1.

30s



Face B, drill hole B

6.2 Surface impression B. Like step 3.2.

30s



Face B, surface B

7 Hardening phase II

2m

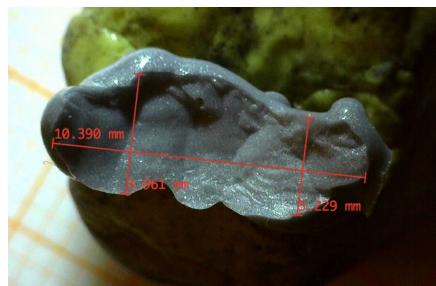
Demoulding time of silicone : 2'

8 Demoulding phase II

30s

Gestures: like in phase 5



9 Observation of molds by microscope (checking for imperfections, air bubbles, etc.).

Face A, sup A

10 Storage of molds in resealable plastic bags at room temperature.

1m



Molds in plastic bags

11 Final cleaning stage of the archaeological object

Removal of any residues of silicone impression material. Any slight halo due to the silicone oil can be removed by washing the piece with distilled water and acetone.

11.1 Washing. Use of paintbrush, distilled water and dishwashing surfactant.

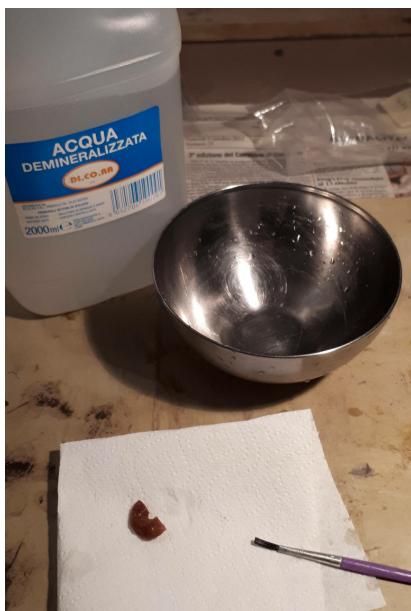
30s



Water and surfactant

11.2 **Rinsing.** Use of paintbrush and demineralised water.

30s



Water

11.3 **Drying.** Leave the piece to air dry completely (time taken about 15', at a temperature of about 18^{15m} C).



Air dry