From: The Department of Technology, The Royal Dental College, Copenhagen, Denmark.

SETTING EXPANSION OF AMALGAM: INFLUENCE OF THE DIRECTION OF CONDENSATION

by

KNUD DREYER JØRGENSEN

KAREN HOLST

In the numerous measurements of the setting expansion of amalgam reported in the course of time, the expansion has nearly always been determined parallel to the direction of condensation. Only a few authors (among others *G. V. Black*) have demonstrated dimensional changes at right angles to the direction of condensation, while no one seems to have examined whether the expansion varies in relation to this factor.

Without attempting to discuss the various theories put forward to explain the setting expansion of amalgam it should be pointed out that it must be concluded from at least two of these theories that the expansion can be different in different directions of amalgam, depending upon the direction of the condensation pressure. Further it can be concluded that if such a difference exists, higher expansion will occur in the direction of the condensation. It is, however, hardly possible to predict the magnitude of this difference.

The clinical significance of the setting expansion of amalgam is still imperfectly known, but it is obvious that, in general, the

expansion perpendicular to the packing direction must be the more interesting factor to consider.

For these reasons the present study was undertaken.

METHODS

Cubic test specimens with an edge length of 6 mm were made by condensing triturated amalgam in a special steel mold (Fig. 1), which was square in cross-section, and 15 mm high. The lower end of the mold could be closed with a piston, about 2 mm high, attached to a circular foot. In most of the tests the amalgam was condensed in the mold with a piston, about 15 mm in height, under a continuous pressure applied for three minutes. In a single experimental group the amalgam specimens were prepared by hand condensation with the usual intermittent pressure; the plugger had a flat, rectangular working face with an area of 3.6 mm^2, and the condensation pressure was 2 kg.

The brands of amalgam alloy to be tested were mixed with mercury in accordance with the manufacturers' instructions, after which amalgamation was accomplished in a Wig-L-Bug mixer. The brands were: Solila Alloy (Amalgamated Dental Co.), New True Dentalloy (S. S. White Dental Mfg. Co., G. B.), and Splitter Amalgam 50 % (Degussa).

The expansion of the amalgam specimens was measured by a Johansson Mikrokator (type S 510-7), set at a gauge pressure of 1.0 ± 0.3 g. The specimens were placed on the instrument by means of a centering device (see Fig. 2) to ensure that their undersurface rested on a flat steel disc, approximately 4.5 mm in diameter. A similar steel disc was centered on the upper surface of the test specimen, and the contact point of the microcator was placed against the center of this disc. The purpose of this special arrangement was to avoid support of the specimens on the relatively unstable edges, inevitable with the mold used, and thus to eliminate what was considered a source of considerable systematic error.

With the present technique the initial reading could be taken ten minutes after mixing was started. The expansion was mea-

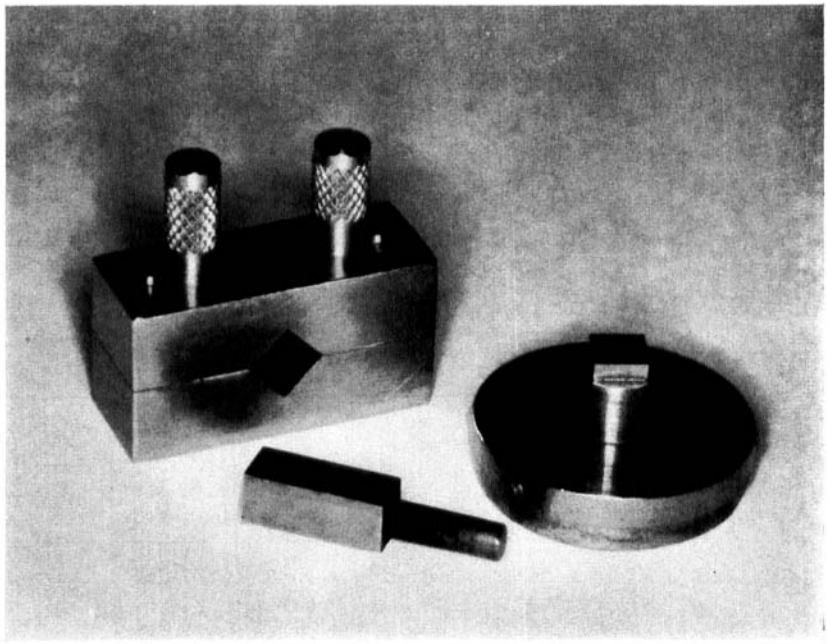

Fig. 1. Steel die and pistons used for the preparation of the cubic test specimens.

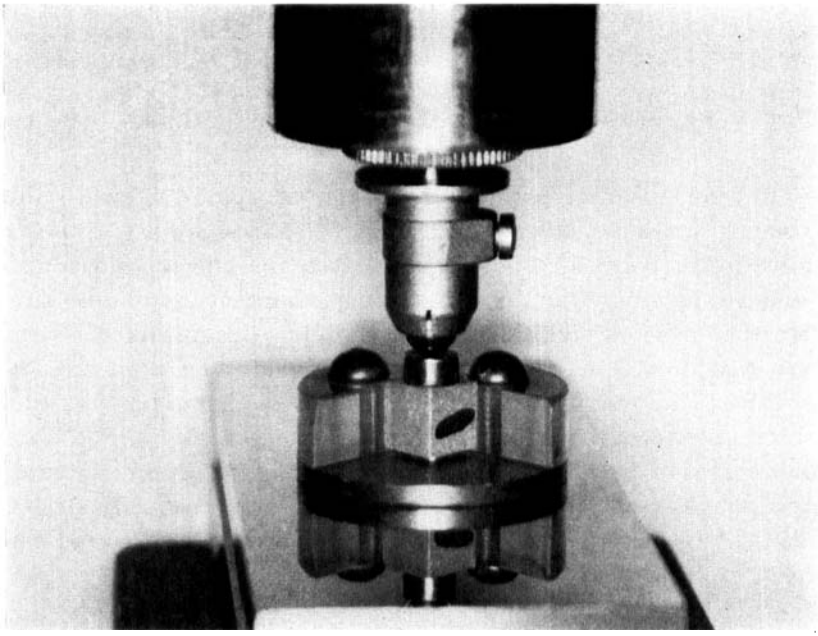

Fig. 2. Centering device for placing the cubic specimens on the foot of the microcator. Note the two steel discs under and on top of the specimens to prevent inaccuracies of measurement due to projecting cube edges.

sured alternately parallel and perpendicular to the direction of condensation on every second test specimen. Each expansion test was run for 24 hours from start of trituration.

RESULTS

The experimental findings appear in Table I. Fig. 3 shows typical expansion curves for measurements taken parallel and at right angles to the direction of condensation, respectively (Solila Alloy, 60 kg). For each series ten tests were carried out parallel

Table I

Brand	Condensation	Expansion in per cent parallel to direction of condensation	Expansion in per cent at right angles to direction of condensation	Difference
Solila Alloy	Piston 30 kg	0.223±0.034	0.169±0.031	significant
» »	» 60 »	0.151±0.009	0.124±0.011	highly significant
» »	» 120 »	0.091±0.024	0.067±0.016	almost significant
New True Dentalloy	» 60 »	0.138±0.017	0.104±0.014	highly significant
Splitter Amalgam 50 %	» 60 »	0.072±0.043	0.043±0.027	not significant
Solila Alloy	Hand condensation	0.036±0.017	0.045±0.011	not significant

to the condensation pressure, and ten at right angles to the pressure (except that the number of tests was only five for Splitter Amalgam 50 %). Table I gives the mean values and standard deviations found for each experimental group, and further the level of significance is given for differences between the expansion at right angles and parallel to the condensation pressure. The data show that in several cases there is a clear difference between the expansion in the two directions, and that the expansion parallel to the pressure is higher. The difference, however, is very slight in all cases, viz. approximately 0.03—0.05 %. For hand condensation no difference was found between expansion in the two directions.

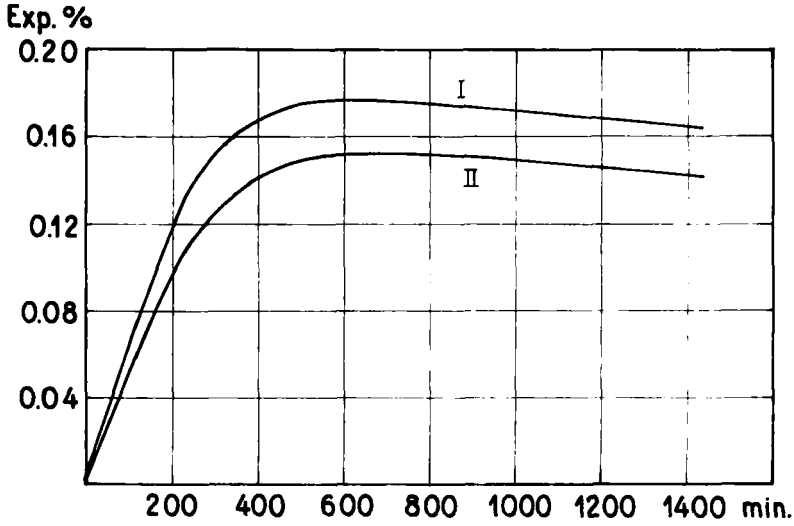

Fig. 3. Typical expansion curves for measurements parallel to the condensation pressure (upper curve) and perpendicular to the pressure (lower curve).

SUMMARY

The setting expansion of amalgam was measured parallel and at right angles to the direction of condensation. When condensation was performed by a continuous pressure on a piston, the setting expansion in the direction of the pressure would generally show a slight — though statistically highly significant — increase over the expansion perpendicular to the pressure. Test specimens made by hand condensation showed the same expansion in either direction.

RÉSUMÉ

EXPANSION DE PRISE DE L'AMALGAME: INFLUENCE DE LA DIRECTION DE LA CONDENSATION

L'expansion de prise de l'amalgame a été mesurée parallèlement à la direction de la condensation et perpendiculairement à celle-ci. Lorsque la condensation était effectuée par pression continue sur un piston, l'expansion de prise dans la direction de la pression présentait une augmentation légère, mais significative

du point de vue statistique, par rapport à l'expansion perpendiculaire à la pression. Les spécimens d'épreuve faits par condensation manuelle présentaient la même expansion dans l'une et l'autre direction.

ZUSAMMENFASSUNG

DIE ABBINDEEXPANSION DES AMALGAMS IN ABBHÄNGIGKEIT DER KONDENSATIONSRICHTUNG

Eine Untersuchung wurde durchgeführt über die Abbindeexpansion von Silberamalgam parallel mit bezw. senkrecht zu der Kondensationsrichtung. Bei Versuchen, wo die Kondensation durch einen kontinuierlichen Druck von einem Kolben erfolgte, war im allgemeinen ein deutlicher, obgleich geringer Unterschied zwischen der Expansion in den beiden Richtungen zu verzeichnen; dageben gab es keinen Unterschied, wo das Amalgam handkondensiert war.

Address: *Royal Dental College*
4, Universitetsparken
Copenhagen Ø
Denmark.