



3M ESPE

3M Deutschland GmbH
Location Seefeld
3M ESPE · ESPE Platz
82229 Seefeld · Germany
info3mespe@mmm.com
www.3MESPE.com

3M, ESPE, Express, Imprint, Lava, Penta and Pentamix are trademarks of 3M Company or 3M Deutschland GmbH. Used under license in Canada.

All other trademarks are owned by other companies.

©2013, 3M. All rights reserved.

01 (03.2013)

Imprint™ 4

VPS Impression Material



Technical Data Sheet

3M ESPE

Contents

1. 3M ESPE – Great impressions	3
2. Portfolio overview	4 – 5
2.1 Recommended materials for the 1-step technique	
2.2 Recommended materials for the 2-step technique	
3. Material composition	6 – 7
4. Shortest intra-oral setting time through active self-warming	8 – 10
4.1 Time saving opportunity	
4.2 Accelerated setting and active self-warming	
5. Super-hydrophilicity	10 – 11
6. Physical and mechanical properties	12
6.1 Tensile strength	
6.2 Overview mechanical properties	
7. Clinical results	13 – 14
8. Clinical case	15



3M ESPE – Great impressions



Since the introduction of the first elastomeric impression materials decades ago, 3M™ ESPE™ has constantly improved and expanded its impressioning portfolio. Today, it offers a variety of high-performance vinyl polysiloxane (VPS) and polyether impression materials, fast and easy-to-use mixing devices and other impression-related products and accessories, as well as a digital impression solution. Numerous awards from trade publications and positive feedback from thousands of loyal customers agree: all 3M ESPE products are designed to reliably make superior impressions for perfectly fitting final restorations, helping dental professionals to optimize their impression procedures.

With the introduction of Imprint™ 4 VPS Impression Material, 3M ESPE offers a new product line for exceptionally precise impressions: the innovative VPS material allows for an unprecedented short intra-oral setting time due to its active self-warming – caused by a unique chemical reaction. This 3M ESPE exclusive technology significantly accelerates the setting of the material, resulting in noticeable time savings. And because the reaction starts at the end of the working time, you can take the time you need to make your impressions.

Moreover, Imprint 4 is the first VPS impression material that is truly hydrophilic in the unset state. And that's the crucial time – when the material is in contact with the moist oral environment. This super-hydrophilic behaviour helps to capture the finest details for unbelievably accurate impressions.

Features and benefits at a glance:

Active self-warming

For accelerated setting

Shortest intra-oral setting time

For real time-saving

Adequate working time

For a stress-free procedure

Super-hydrophilicity

For excellent flow and finest detail reproduction

Fresh material colours

For enhanced readability

Pleasant minty taste

For more patient comfort



Indications:

Imprint™ 4 VPS Impression Material is especially developed and designed for all kinds of precision impressions using the 1-step and 2-step impression techniques, i.e. crown and bridge, inlay and onlay, implant, and orthodontic impressions.

Portfolio overview









2

Available in a wide range of viscosities – from putty to ultra-light body – Imprint™ 4 VPS Impression Material offers essential benefits for the 1-step and 2-step impression techniques. All tray materials – including putty – are available for fast and convenient automatic mixing with the Pentamix™ 3 and Pentamix™ 2 Automatic Mixing Unit from 3M ESPE.

The working and setting times of Imprint 4 “Super Quick” and “Regular” setting materials are perfectly aligned when using the recommended material combinations:

1-step technique

2.1 Recommended materials for the 1-step technique

Tray material	Colour	Recommended wash material	Colour
Imprint™ 4 Penta™ Heavy Hydrophilic heavy body		Imprint™ 4 Light	
		Imprint™ 4 Regular	
Imprint™ 4 Penta™ Super Quick Heavy Fast setting hydrophilic heavy body		Imprint™ 4 Super Quick Light	
		Imprint™ 4 Super Quick Regular	
Imprint™ 4 Penta™ Putty Putty consistency		Imprint™ 4 Regular	

For the **1-step technique**, the ideal tray material should be hydrophilic so it can perform well in the moist intra-oral environment plus it has a somewhat lower hardness in the set stage so that it can easily be removed from the patient's mouth. Imprint 4 heavy body VPS materials have been designed to fully meet these requirements. If an increased flowability of the wash material is desired, the light viscosities are recommended. If it is more important for the wash material to remain in place at the tooth, the regular viscosities are recommended. In addition, all Imprint 4 wash materials are super-hydrophilic to capture finest details in the moist intra-oral environment.

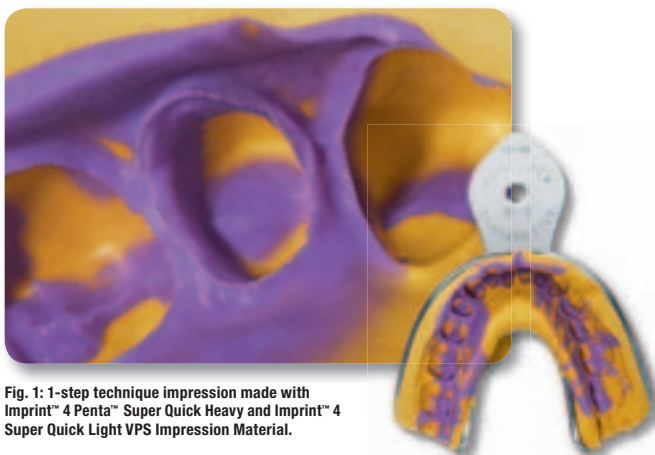


Fig. 1: 1-step technique impression made with Imprint™ 4 Penta™ Super Quick Heavy and Imprint™ 4 Super Quick Light VPS Impression Material.

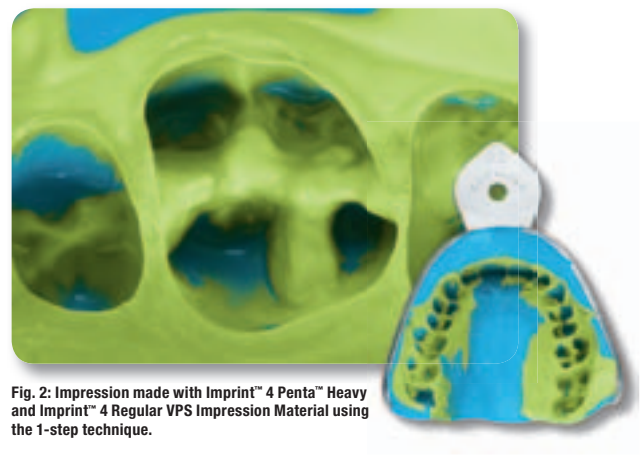
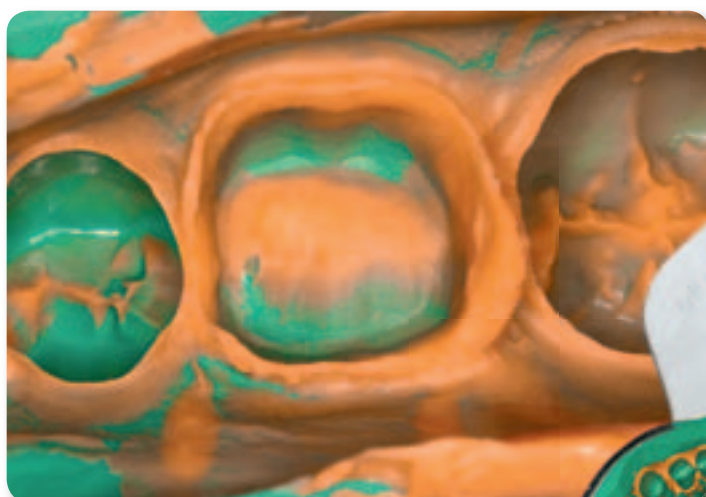


Fig. 2: Impression made with Imprint™ 4 Penta™ Heavy and Imprint™ 4 Regular VPS Impression Material using the 1-step technique.

2.2 Recommended materials for the 2-step technique

Tray material	Colour	Recommended wash material	Colour
Imprint™ 4 Penta™ Putty Putty consistency		Imprint™ 4 Super Quick Ultra-Light	
		Imprint™ 4 Light	
Imprint™ 4 Penta™ Super Quick Heavy Fast setting hydrophilic heavy body		Imprint™ 4 Super Quick Light	
		Imprint™ 4 Light	

In the **2-step technique**, it is important for the tray material to allow high insertion pressure so the wash material can be pushed deep into the sulcus. Plus, tray materials need to have good carving properties as well as high hardness in the set stage. The wash material must be able to generate very thin layers on the set tray material. The ideal solution is a wash material with low viscosity and high structural viscosity (thixotropy), allowing it to flow very well when pressure is applied. Therefore, Imprint™ 4 Ultra-Light and Light consistency washes are ideally suited for the 2-step technique especially in combination with Imprint™ 4 Penta™ Putty.



2-step technique

Fig. 3: 2-step technique impression made with Imprint™ 4 Penta™ Putty and Imprint™ 4 Super Quick Ultra-Light VPS Impression Material.



Material composition

3

Imprint™ 4 VPS Impression Material is an addition-cured silicone (vinylpolysiloxane, VPS). The setting reaction which cures the material is based on platinum-catalysed hydrosilylation. The unique features of Imprint 4 material are mainly the result of the development of a novel setting accelerator as well as a pioneering wetting enabler.

In addition to conventional components, all Imprint 4 heavy body and wash materials contain different reactive unsaturated carbosilane (UCS) compounds. The proven polyfunctional UCS crosslinker known from 3M ESPE's Express™ 2 VPS Impression Material is utilized as network builder, providing the material with a strong reinforced network. Additionally, a newly developed monofunctional UCS is also used as a setting accelerator.

Exemplified formulation of Imprint™ 4 VPS Impression Material:

Base	Catalyst
Vinyl polydimethylsiloxane	Vinyl polydimethylsiloxane
Dimethyl (methyl hydrogen) polysiloxane	Silica filler
Silica filler	Silane-treated silica
Silane-treated silica	Platinum catalyst
Polyethylene glycol, siloxane terminated	Pigments
Modified polyalkyleneoxide wetting enabler	Polyfunctional UCS crosslinker
Polyfunctional UCS crosslinker	
Monofunctional UCS setting accelerator	
Peppermint flavour	

It is well known that increasing temperatures accelerate chemical reactions, and this is especially true for the setting reaction (hydrosilylation) of VPS impression materials in general.

With Imprint 4 VPS material, 3M ESPE has integrated a second mechanism which causes the **active self-warming** of the impression material. This is done by capping reactive components with a novel UCS setting accelerator. Due to the carefully chosen reactivity of the UCS setting accelerator, the warming reaction does not start until the end of the working time. This means the working time of the material is not adversely affected by self-warming but the intra-oral setting gets the additional “kick”. The result is a significant reduction of the intra-oral setting time, providing Imprint 4 Super Quick materials with the shortest intra-oral setting time compared to competitive VPS precision impression materials.

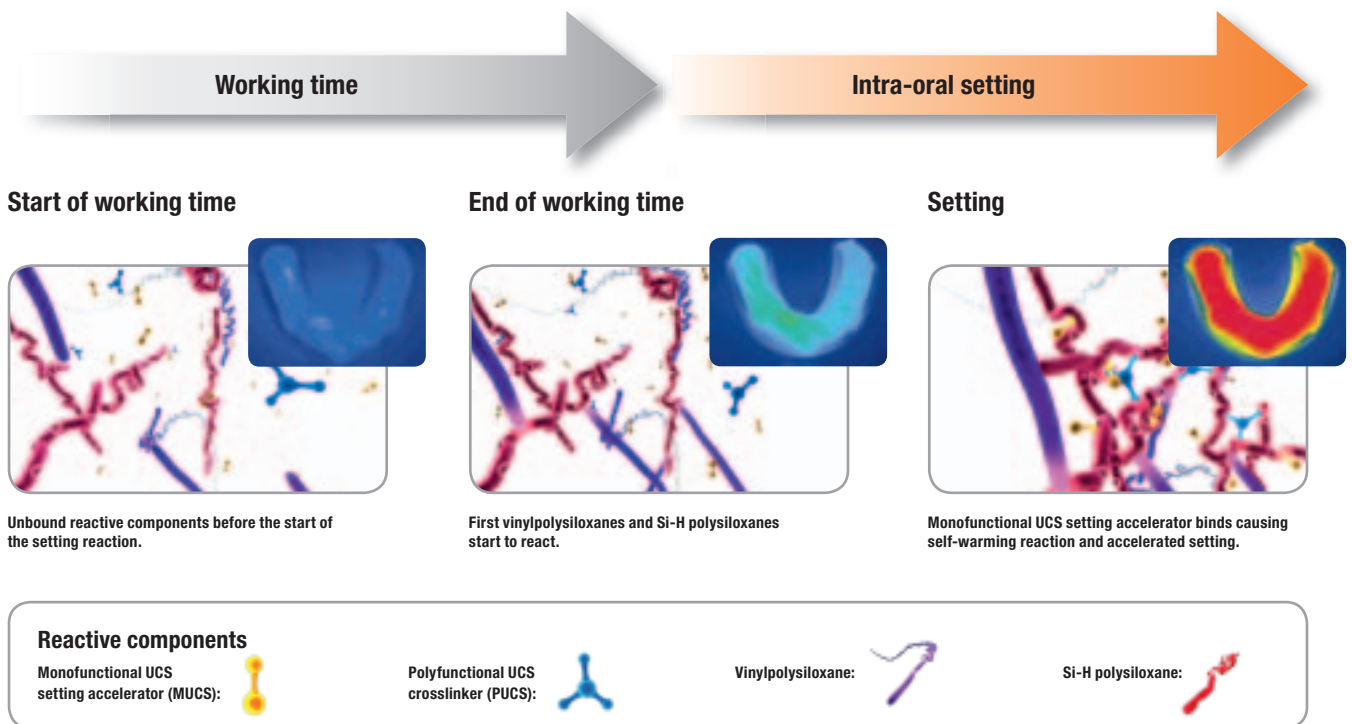


Fig. 4: Schematic representation of the setting reaction of Imprint™ 4 VPS Impression Material.

Hydrophilicity describes the affinity of a material or surface for water or aqueous solutions. By adding a novel modified polyalkylene oxide wetting enabler, it is possible to achieve outstanding hydrophilicity not only for the final impression but also for the uncured material from the first seconds of mixing. The wetting enabler synergistically increases the effectiveness of the proven surfactant and enables superior hydrophilicity in the uncured paste state as well – true **super-hydrophilicity**.

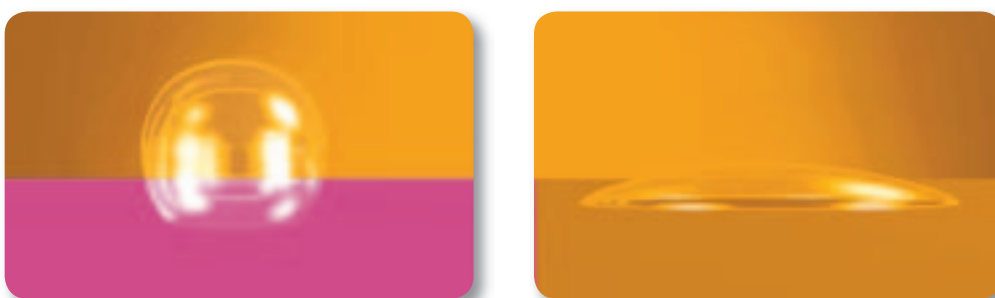


Fig. 5: Hydrophobic (left) versus hydrophilic behaviour of a water droplet on impression material (schematic pictures).

Physically, this custom mix of surfactant and wetting enabler modifies the surface energy of the unset paste significantly, which allows the material to reproduce details better in the moist oral environment. This property is unique since it allows Imprint 4 material to develop outstanding hydrophilicity already shortly after mixing.

Shortest intra-oral setting time through active self-warming



Imprint™ 4 VPS Impression Materials are available in two setting regimes with exceptionally short intra-oral setting times while adequate working times are maintained.

The “Super Quick” materials are the ideal solution for 1- or 2-unit cases. A working time of up to 1:15 minutes at room temperature and up to 35 seconds of intra-oral working time allow ample time for this most common indication.

With a working time of up to 2:00 minutes at room temperature and up to 1:00 minute intra-orally, the “Regular” setting materials offer more working time – which is especially valuable for larger cases.

Imprint™ 4 “Super Quick” setting materials

- Shortest **intra-oral setting time** available on the market
- Ideally suited for **1- or 2-unit** cases

Imprint™ 4 “Regular” setting materials

- Long working time of 2:00 minutes for larger cases
- **Significantly reduced intra-oral setting time**

The tray can be inserted immediately after loading and once the tray is seated it is not necessary to add any unused working time. The indicated intra-oral setting times are always valid. There is no minimum working time – the total setting time is the intra-oral setting time plus the working time actually used.

Imprint™ 4 Penta™ Putty with a kneadable consistency for automatic mixing in the Pentamix™ System from 3M ESPE provides enough working time – up to 1:30 minutes – plus an intra-oral setting time of 2:30 minutes. In combination with Imprint 4 wash materials, significant time can be saved, especially if the 2-step technique is used.

4.1 Time saving opportunity

Due to its exceptionally short intra-oral setting times, Imprint 4 VPS material helps to save time – especially the Super Quick heavy/wash combination. The below graph shows the time saving of Imprint™ 4 Super Quick wash materials compared to competitive VPS materials. The indicated times were defined for a case with a working time of 20 seconds, e.g. loading and seating a dual arch/double bite tray (e.g. Premier® Triple Tray®) with simultaneous intra-oral syringing of the wash material.

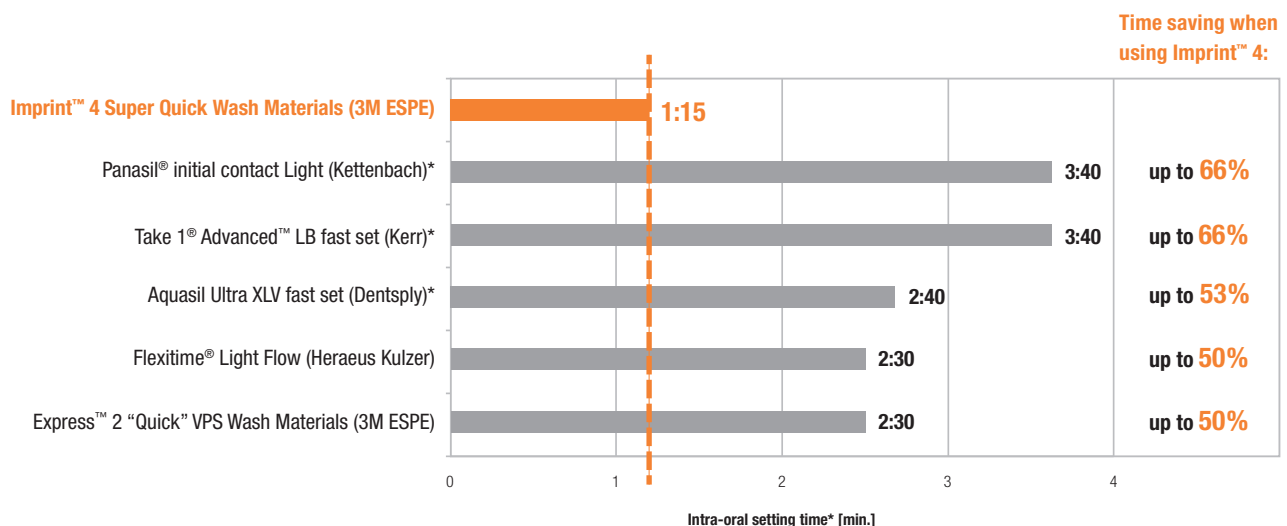


Fig. 6: Intra-oral setting times of leading VPS impression materials according to the respective manufacturers' instructions for use in a single-unit case with 20 seconds' working time.
 *Manufacturer indicates only total setting time. Calculated intra-oral setting time = total setting time minus 20 seconds working time.

4.2 Accelerated setting and active self-warming

With Imprint™ 4 VPS Impression Material, a new dimension of setting behaviour of VPS impression materials is reached by employing the temperature sensitivity of the hydrosilylation setting reaction. Imprint 4 material offers accelerated setting in the mouth whereas the working time remains unaffected. This setting behaviour allows for a more efficient workflow: a reduced intra-oral setting time results in a time-saving procedure and less stress for dentists and patients alike.

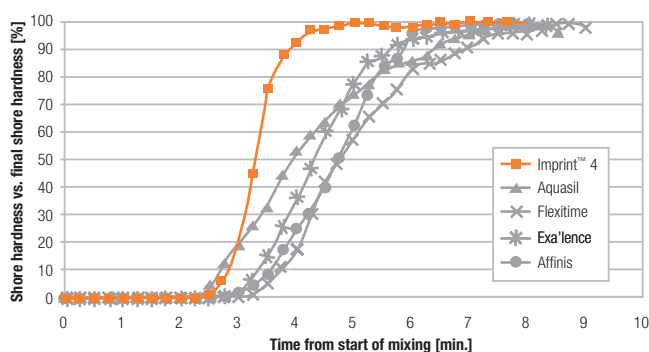


Fig. 7: Progression of setting reaction characterized by Shore hardness increase measured in different fast setting heavy bodies. Intra-oral setting times are shorter than those measured at room temperature (23 °C / 73.4 °F). Materials tested: Imprint™ 4 Super Quick Heavy (3M ESPE), Aquisil Ultra Heavy Fast Set (Dentsply), Flexitime Heavy Body (Heraeus Kulzer), Affinis Fast Heavy Body (Coltène), EXA'lence HB fast set (GC).
Source: J.C. Farr, H. Hoffmann, A. Maurer, P. Osswald, E. Wanek, Shore Hardness increase of Tray Materials during setting, CED IADR 2012, #674

The progression of setting is associated with an increase in material hardness. The maximum Shore hardness is reached at the end of the setting process. Thus, the faster the Shore hardness achieves its maximum, the faster the setting reaction is. Consequently, an increase in Shore hardness in relation to time is a reasonable method to measure the setting progression.* As shown in Fig. 7, Imprint 4 VPS material shows the steepest increase in Shore hardness and thus the fastest setting behaviour.



* see also: Shore Hardness of VPS Materials from Unset to Set Consistency, M. Neglia, D. Nobrega, G. Kugel, R.D. Perry, Tufts University, Boston, MA, AADR2012, #1023

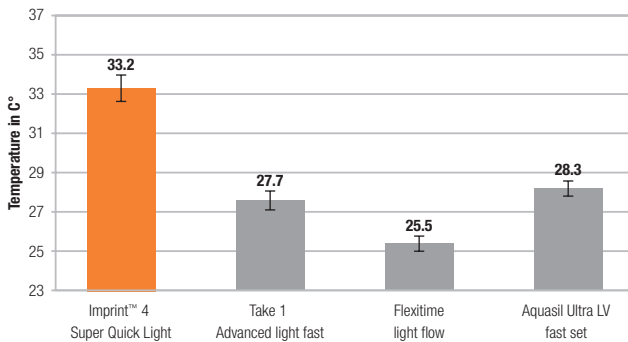


Fig. 8: Maximum temperature increase of different VPS impression materials, Measurements were taken at room temperature: maximum temperature is lower than in the mouth.
 Source: S. Bhatt, J. Bair, R. Perry, G. Kugel, Shore Hardness and Temperature of VPS Materials During Setting, submitted for publication at IADR 2013

Imprint™ 4's active self-warming is responsible for the accelerated setting reaction in the mouth resulting in a short intra-oral setting time. Inside the mouth, the material warms up to body temperature (37 °C/98.6 °F) which also increases patient comfort during impression taking.

Fig. 8 shows that only Imprint 4 VPS impression material displays a significant temperature increase, compared to competitive VPS materials.

Infrared images (Fig. 9) display temperature differences as colours. The temperature range was chosen between 21 °C/69.8 °F (dark blue) and 37 °C/98.6 °F (white). Again, only Imprint 4 material shows a visible rise in temperature to body temperature.

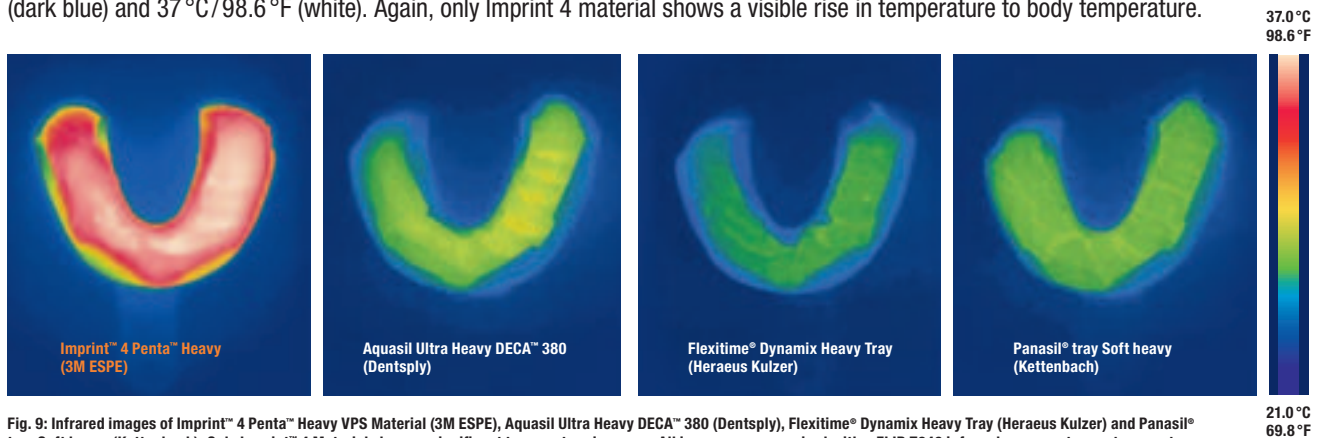


Fig. 9: Infrared images of Imprint™ 4 Penta™ Heavy VPS Material (3M ESPE), Aquasil Ultra Heavy DECA™ 380 (Dentsply), Flexitime® Dynamix Heavy Tray (Heraeus Kulzer) and Panasil® tray Soft heavy (Kettenbach). Only Imprint™ 4 Material shows a significant temperature increase. All images were acquired with a FLIR T640 infrared camera at room temperature (23 °C/73.4 °F). Images show the materials at the time of their maximum temperature. Source: 3M ESPE internal tests

Super-hydrophilicity

Highly detailed impressions are a prerequisite for perfectly fitting restorations. Detail reproduction capability must be maintained even under challenging conditions. Good flowability and excellent wetting properties are key features for an impression material that performs outstandingly even in a moist environment. Imprint 4 VPS wash materials are already super-hydrophilic in the unset state. After setting, the hydrophilicity of an impression material is essential for model manufacturing. An impression with high wettability helps to create precise, void-free dental models without the need to use additional wetting agents when pouring.

To demonstrate the super-hydrophilicity of Imprint 4 VPS materials, a setup was chosen with a side by side interface of two different unset light body wash materials (competitive VPS materials shown left and Imprint 4 wash material shown right, both 40 sec. after start of mixing). When a water droplet is placed precisely at the middle of the interface, it flows to the material with the higher hydrophilicity i.e. with the higher affinity for water or another aqueous solution (like saliva or blood).

In direct comparison with competitive VPS materials, the water droplet always flows to the more hydrophilic Imprint™ 4 Material.



Fig. 10: A water droplet of 25 µl (microliter) was applied ...



Fig. 11: ... to the interface of two unset light body VPS impression materials (40 sec. after start of mixing). All measurements were performed at room temperature (23°C/73.4°F).

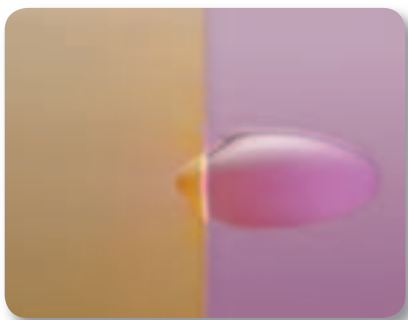


Fig. 12: Aquasil Ultra XLV (Dentsply) vs. Imprint™ 4 Light (3M ESPE).

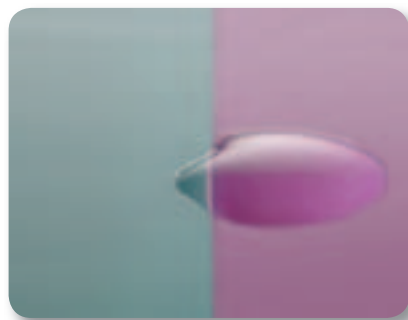


Fig. 13: Flexitime® Light Flow (Heraeus Kulzer) vs. Imprint™ 4 Light (3M ESPE).

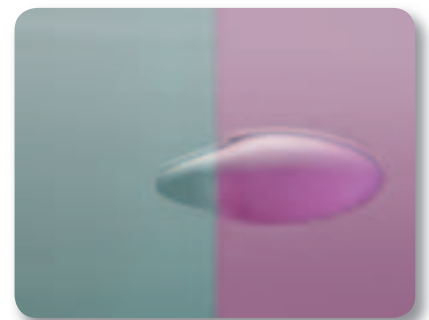


Fig. 14: Panasil® initial contact Light (Kettenbach) vs. Imprint™ 4 Light (3M ESPE).

Source: 3M ESPE internal tests.

The method most often used to determine the hydrophilicity of an impression material is the contact angle measurement. In this test, a water droplet is placed on the surface of a specimen and then the spread of the water droplet across the surface is observed and the contact angle is measured. The lower the contact angle, the better the wettability and the higher the hydrophilicity of the impression material.

Fig. 15 shows the contact angle values 2 seconds after placing the water droplet on unset Imprint 4 Light material and competitive VPS impression materials with comparable setting times and viscosities (Shakourian et al., AADR 2012, #1024). The water droplets were placed 20 seconds after start of mixing. Imprint 4 material shows the lowest contact angle and therefore the highest hydrophilicity.

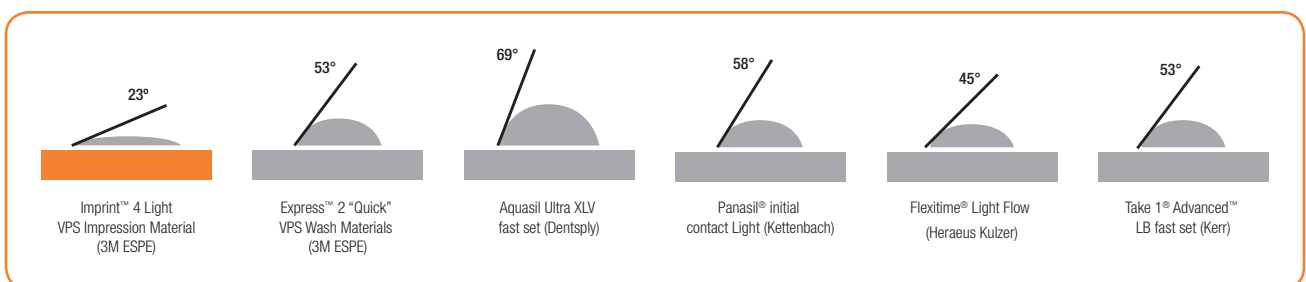


Fig. 15: Contact angles after 2 sec. on unset impression material for Imprint™ 4 Light and competitive VPS impression materials in the same setting version and with comparable viscosity. Source: N. Shakourian, M. Neglia, D. Nobrega, G. Kugel, R. Perry, Comparing Hydrophilicity of VPS Materials in the Unset Stage; AADR 2012, #1024

Physical and mechanical properties

6

6.1 Tensile strength

When an impression material is removed from the patient's mouth, it is exposed to high compressive and tensile forces. Imprint™ 4 VPS Impression Material has a strong ability to withstand these forces due to its high tensile strength. This tensile strength is a result of a reinforced network formed with the polyfunctional UCS crosslinker. Tearing of impression material, especially at the margin, would result in an unsatisfactory impression and an insufficient marginal fit of restoration.

Figures 16 and 17 show that the preparation line is accurately captured by Imprint 4 material. No tearing of the impression material can be observed – even at the most critical areas where the material has flowed deep into the sulcus.



Fig. 16: Crown preparation on lower first premolar.



Fig. 17: Accurate and detailed impression of the situation. Impression made with Imprint™ 4 Penta™ Super Quick Heavy and Imprint™ 4 Super Quick Light Material in the 1-step technique. (Photo courtesy of Dr. Gunnar Reich, Germany)

6.2 Overview mechanical properties

The following table provides an overview on the mechanical properties of selected Imprint 4 tray and wash materials:

Mechanical properties	Imprint™ 4 Penta™ Super Quick Heavy (tray material) (LOT: B: AWT-0033; C: AWT-0034)	Imprint™ 4 Regular (wash material) (LOT: AWT-0039)
Consistency A+B [mm] (ISO 4823:2000)	34	39
Recovery from deformation [%] (ISO 4823:2000)	99.4	99.7
Strain in compression [%] (ISO 4823:2000)	2.2	3.8
Detail reproduction (ISO 4823:2000)	Pass	Pass
Linear dimensional change [%] (ISO 4823:2000)	- 0.38	- 0.41
Shore hardness after 15 min (DIN 53505)	62	50
Shore hardness after 24 h (DIN 53505)	69	53
Tensile strength after 24 h [MPa] (3M ESPE internal)	–	3.68
Contact angle on unset material (20 s after mixing at a drop age of 2 s) [°] (3M ESPE internal)	–	14
Contact angle on set material (drop age of 2 s) [°] (3M ESPE internal)	43	9
Contact angle on set material (drop age of 10 s) [°] (3M ESPE internal)	10	–
Working time at 23 °C of Imprint™ 4 Super Quick [min:s]	1:15	1:15
Mouth removal time of Imprint™ 4 Super Quick [min:s]	1:15	1:15
Working time at 23 °C of Imprint™ 4 [min:s]	2:00	2:00
Mouth removal time of Imprint™ 4 [min:s]	2:00	2:00

Clinical results



In an in-office evaluation, more than 3000 impressions were taken with Imprint™ 4 VPS Impression Material. 300 dentists from four countries – Germany, France, Italy, and the U.S. – participated in the evaluation. The dentists' feedback confirms the very high clinical acceptance: 88% of the testers were very satisfied or satisfied with Imprint 4 VPS material (Fig. 18). **89% would recommend Imprint 4 VPS impression material to their colleagues** (Fig. 19).

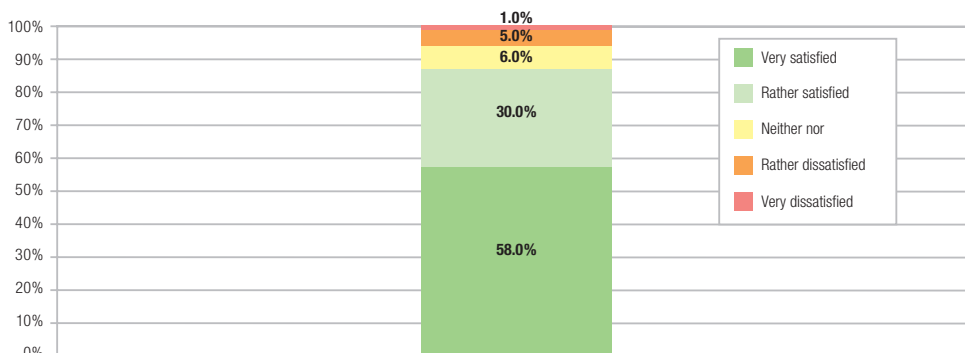


Fig. 18: General satisfaction with Imprint™ 4 VPS Impression Material.
Source: Field evaluation in Europe and the U.S. conducted by 3M ESPE and Key Group Research.

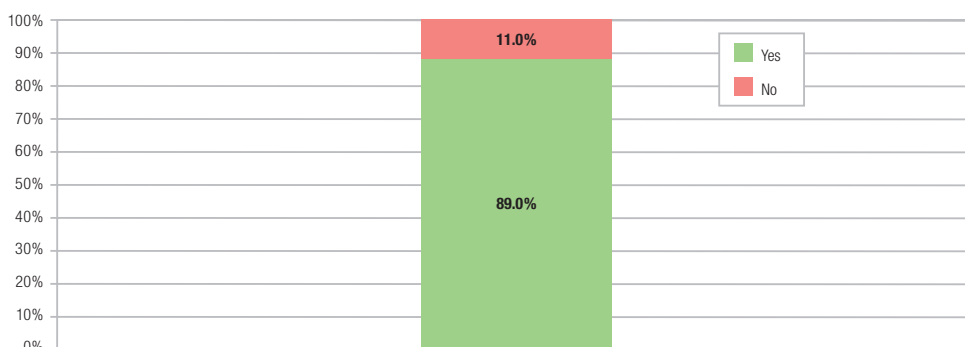


Fig. 19: Recommendation rate for Imprint™ 4 VPS Impression Material.
Source: Field evaluation in Europe and the U.S. conducted by 3M ESPE and Key Group Research.

The short intra-oral setting time, combined with adequate working time (Figs. 20 and 21), was mentioned as one of the most significant application benefits. Impression accuracy including high detail reproduction (Figs. 22 and 23) was another reason for dentists' overall satisfaction with Imprint 4. Imprint 4 material delivers extremely detailed and precise impressions thanks to its super-hydrophilicity, and thus allows for reliable and high-quality impression taking even under challenging moist conditions.

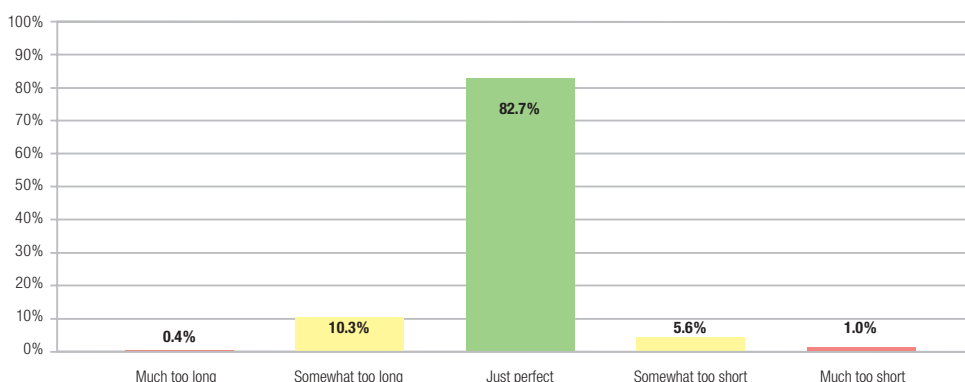


Fig. 20: Dentists' ratings for working time of Imprint™ 4 Tray and Wash Materials.
Source: Field evaluation in Europe and the U.S. conducted by 3M ESPE and Key Group Research.

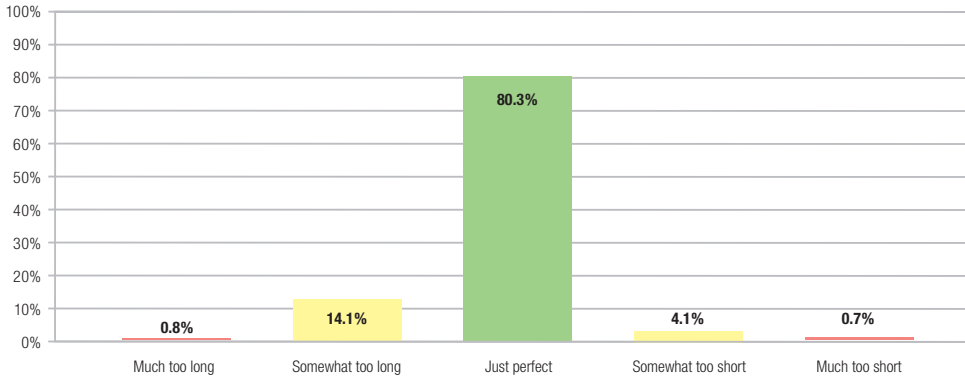


Fig. 21: Dentists' ratings for intra-oral setting time of Imprint™ 4 Tray and Wash Materials.
 Source: Field evaluation in Europe and the U.S. conducted by 3M ESPE and Key Group Research.

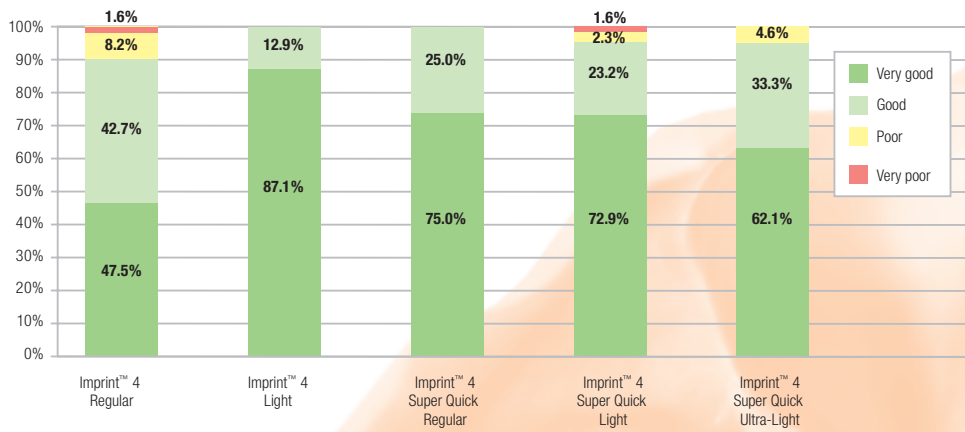


Fig. 22: Detail reproduction of Imprint™ 4 Wash Materials.
 Source: Field evaluation in Europe and the U.S. conducted by 3M ESPE and Key Group Research

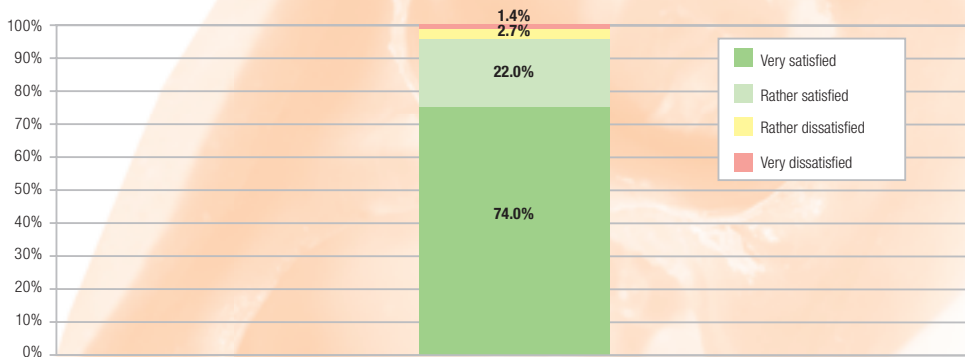


Fig. 23: Satisfaction with fit of final restorations using Imprint™ 4 VPS Impression Material.
 Source: Field evaluation in Europe and the U.S. conducted by 3M ESPE and Key Group Research.

Clinical case

8

Replacement of an insufficient glass ceramic inlay

Dr. Gunnar Reich, Munich, Germany



Fig. 24: Initial situation: glass ceramic inlay at tooth 46 needs to be replaced due to chipped disto-lingual ridge and insufficient margins.



Fig. 25: 3M™ ESPE™ Astrigent Retraction Paste is injected into the sulcus for hemostasis and gingiva displacement.



Fig. 26: To achieve optimum results, 3M™ ESPE™ Astrigent Retraction Paste is left on for 2 minutes.



Fig. 27: Situation ready for impression taking.



Fig. 28: Imprint™ 4 Super Quick Light is syringed around the preparation using 3M™ ESPE™ Intra-oral Syringe Green.

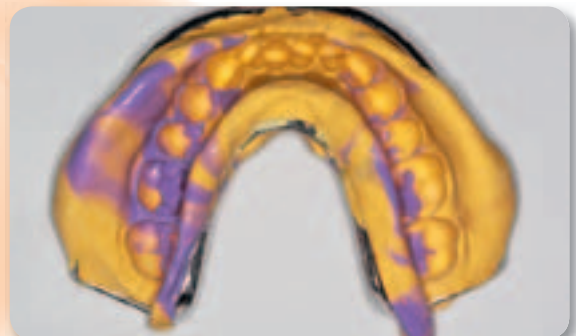


Fig. 29: Precision impression made in the 1-step heavy body/light body technique using Imprint™ 4 Penta™ Super Quick Heavy (tray material) and Imprint™ 4 Super Quick Light (wash material).

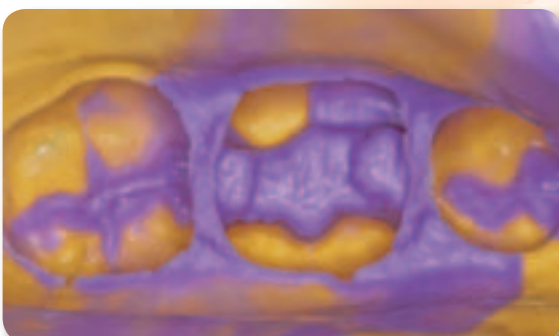


Fig. 30: Impression detail of the preparation area.



Fig. 31: Final Lava™ Ultimate (3M ESPE) onlay restoration.