



“Simplicity is the ultimate sophistication”

How to simplify methods to achieve an excellent composite restoration.

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Summary

Successful restorative treatment depends upon many factors, with effective adhesion and mechanical durability of composite materials being among the most important. Every aspect of treatment is based upon consecutive steps utilising dental procedures, which tend to be complicated. Any reduction in the number of steps needed decreases the risk of clinical bias performed by the operator. Therefore, simplifying every step of composite restoration placement is advisable, if it does not hinder quality of treatment. Based on research article solutions for simpler and faster procedures for carious cavity preparation the following are proposed in this article: cavity isolation; adhesive bonding system application; shade selection; placing and shaping of composite material; and finishing and polishing of the composite filling following polymerisation

KEY WORDS

Caries, cavity, adhesion, composite material, polishing

Restoring a carious cavity with composite materials is the most common clinical procedure performed in dental practices. Successful treatment depends upon a variety of factors linked to step of the restorative procedure. The most important steps when it comes to composite restoration are:

Carious cavity preparation



Cavity isolation from saliva and moisture from within the patient's oral cavity



Adhesive bonding



Shade selection, plus placing and shaping the composite material



Adaptation, finishing and polishing the composite following polymerisation

The main reasons for composite fillings failing are mechanical breakage of the composite material and development of secondary caries below it, as a result of leakage between the dentition and filling material.

The most important factor determining success of restorative treatment with composite materials is based upon establishing a stable and strong connection between the enamel or dentine and the bonding system and composite material. Shaping and finishing the polymerised filling is also of great significance. All the planning and treatment procedures, as well as choice of dental materials, should be considered secondary to these two aspects of conservative treatment.

1.

Carious cavity preparation

At the stage of tooth tissue preparation, the most important goal of the procedure is, of course, the removal of tissues affected by cariogenic bacteria and the inhibition of further destruction within the tooth. From the point of view of longevity in terms of clinical success, it is equally important to prepare the tissues in such a way as to achieve maximum strength of adhesion^[1]. The key element here is to smooth the edges of a cavity localised in enamel properly to facilitate adequate saturation of the bonding systems and/or orthophosphoric acid etchant to the surface of the enamel^[2].

This part of the procedure is easy to perform following preparation, using diamond medium grit burs, smooth the enamel margins with burs with diamond superfine grit burs or use a flat, abrasive surface in the form of abrasive discs made of polyester with a coating of aluminium oxide^[3].



Fig. 1 Smoothing the enamel edge of the defect and giving it a proper shape using a diamond-coated bur with a yellow gradation.



Fig. 2 Final polishing of the enamel before starting the adhesive procedure using OptiDisc™ abrasive discs (Kerr).

2.

Cavity isolation from saliva and moisture from within the patient's oral cavity

Effective isolation of the oral cavity from moisture access during the adhesive process increases adhesion strength by about 20%, compared to fillings where isolation was not used^[4]. The easiest way to carry out this process is by using dental dam, which will ensure proper isolation of the treatment area.

In the case of conservative dentistry procedures, the rubber dam is an additional element that increases the effectiveness of the procedure, as a result of isolation of the cavity from contamination with the patient's saliva, and from moisture associated with the interior of the patient's mouth^[5].



Fig. 3 Thanks to the universal frame and rubber with a marked place for all teeth in the oral cavity, the OptiDam™ (Kerr) system significantly shortens and facilitates the rubber dam installation procedure.



Fig. 4 Tightly applied dental dam, providing isolation from oral moisture for two adjacent teeth with extensive cavities.

Therefore, for adhesive procedures, it is reasonable to use a rubber dam system that is as simple and quick to apply as possible, the application of which will not be a dominant procedure within the entire treatment process, but only one of its elements^[6].

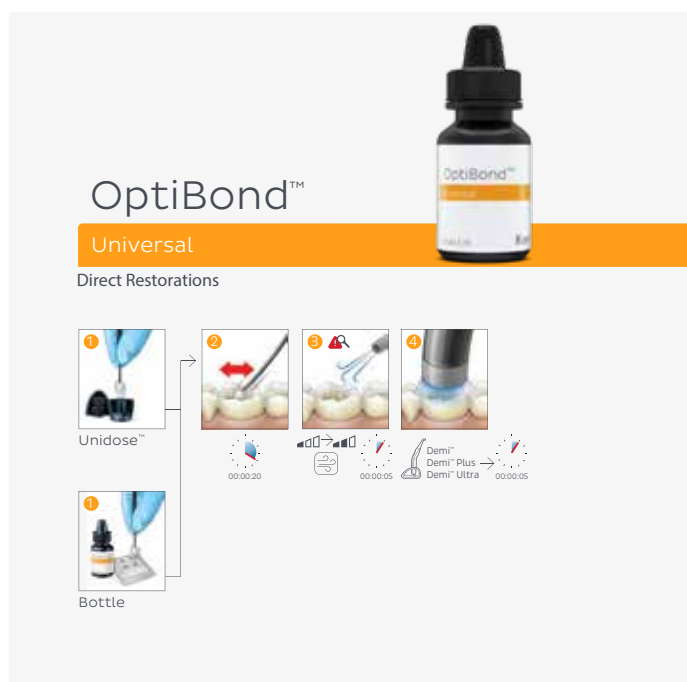
3.

Adhesive bonding

The success of each composite filling depends on the application of the bonding system because it determines the mechanical retention of the composite material in the cavity, the avoidance of bacterial microleakage at the edges of the filling resulting in secondary caries, and the lack of chemical irritation of the tooth pulp and postoperative hypersensitivity^[7]. That is why this aspect of conservative treatment is constantly being developed and thoroughly tested: in order to achieve the best possible adhesion of composite materials to enamel and dentine. Over the years of development, highly reliable bonding systems have been created by constantly improving the procedures for their use, which, unfortunately, was often associated with adding additional stages to the procedure and increasing its complexity.

According to published research, the greatest strength of adhesion to both enamel and dentine is produced by bonding systems that require etching of enamel and dentine (total-etch procedure), applying a hydrophilic primer, then applying a hydrophobic adhesive layer and polymerisation of material^[8, 9]. The procedure (based on the OptiBond™ FL bonding system by Kerr) involves performing ten consecutive steps in a strictly defined manner to achieve maximum adhesion. Meanwhile, in clinical work, it is now possible to use universal, self-etching adhesives with much easier application, which may require only a few successive steps (for example, OptiBond™ Universal adhesive from Kerr).

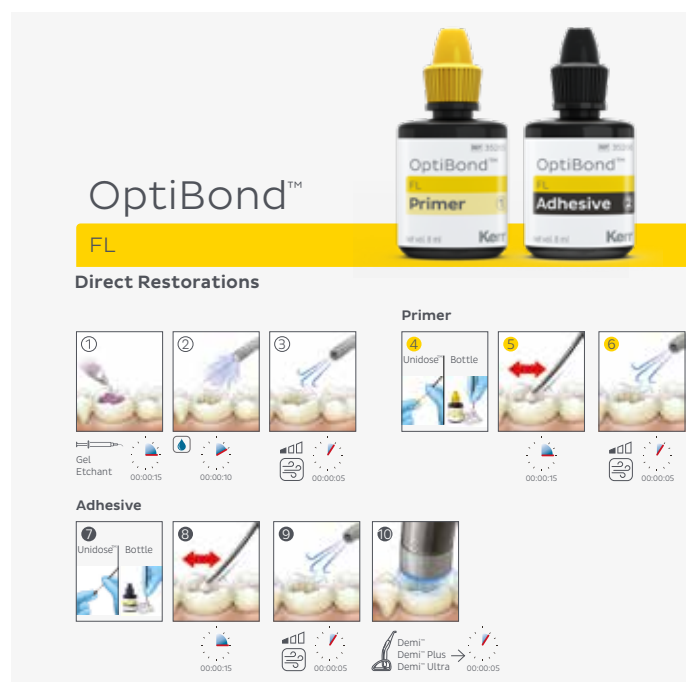
Most studies, however, overlooked the clinician's skill level in the everyday conditions of a dental practice. The need to pay attention to the dentist's experience in achieving an effective outcome of the rather complicated procedure of applying bonding systems indicated the validity of simplifying the



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entire process, even at the expense of the chemical perfection of the materials^[10]. The strength of adhesion achieved with the use of bonding systems of various complexity applied by dentists with different clinical experience was compared (most often it concerned students of different years, trainees and academic lecturers). Highly complex procedures were only effective when used by the most experienced dentists. Operators with less experience, or working under time pressure, achieved better adhesion using adhesive systems with a simpler application procedure, i.e., universal self-etching adhesive systems^[11].

Such research demonstrates that, as healthcare professionals, we should always strive to simplify clinical procedures, if as this is not done at the expense of the quality of the treatment itself. In the case of universal self-etch bonding systems, apart from simplifying the procedure, an additional advantage is the elimination of the step associated with etching dentine with orthophosphoric acid, which reduces the risk of postoperative hypersensitivity.



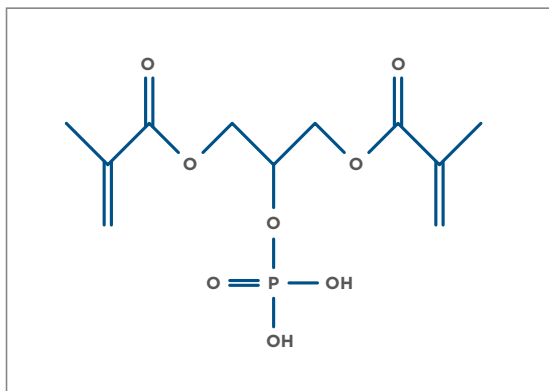
Kerr OptiBond™ FL - Technique guide

The type of monomer used in self-etching bonding systems can also contribute to achieving a significantly higher adhesive strength than in the case of using the dentine etching procedure^[12]. Comparison of numerous studies of various self-etch bonding systems using different monomers through meta-analysis showed that in the case of application of self-etching systems on enamel, the type of monomer is irrelevant^[13, 14].

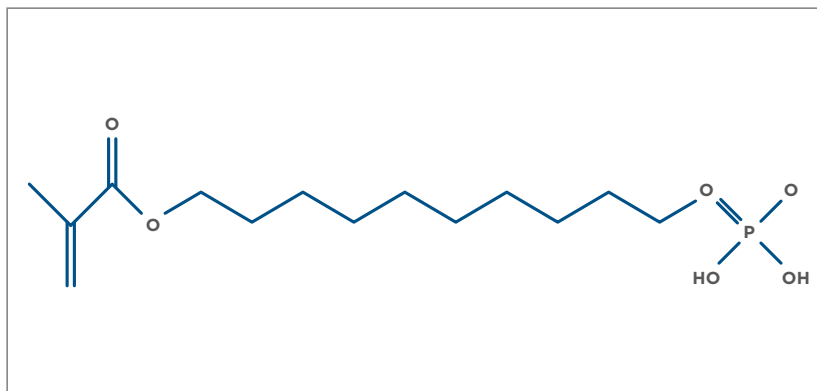
In the case of application of self-etch systems on dentine tissue, the highest adhesion efficiency can be achieved using bonds containing 10-MDP or GPDM monomer.

All other monomers are characterised by weaker adhesion to dentine^[15]. The addition of the GPDM monomer to the bonding system determines the greater strength of adhesion of the composite material to the dentine, while the addition of the 10-MDP monomer increases the resistance of the bond to changes in temperature in the patient's mouth (thermocycling) and extends the time during which the adhesion maintains a high value^[16, 17].

The simplified application procedure of the universal self-etch bonding system, ensuring the



GPDM monomer



MDP monomer

maximum adhesion strength, requires the following steps (using OptiBond™ Universal by Kerr as an example):

- Selective etching of **ONLY** the enamel with orthophosphoric acid for 15 seconds
- Rinsing off orthophosphoric acid and drying the enamel and dentine
- Application of the bonding system by rubbing it into the enamel and dentine for 20 seconds
- Apply air to the bonding system with a gentle stream for 5 seconds
- Polymerisation of the bonding system for 10 seconds

When carrying out such a procedure, close attention should be paid to the step related to the application of orthophosphoric acid. It should

be a material characterised by high viscosity, so that there is no uncontrolled flow of acid on the surface of the dentine. It also requires the operator to pay more attention to etch dental tissues with orthophosphoric acid.

The activity that often raises the most uncertainty on the part of the operator is the method of air blowing and drying of the bonding system, due to the imprecision of the description of the activity itself, as well as the chemical differences within the bonding systems that determine how this step of the procedure is performed. Most self-etch bonding systems use a mixture of water and alcohol as the solvent. The addition of water to the bond facilitates the process of smear layer penetration by the resin, but it may affect the final quality of adhesion, hence the required removal of the solvent by air blowing and drying. In the case



Fig. 5 Orthophosphoric acid should only be applied to the enamel, which is possible if the material is characterised by high viscosity.



Fig. 6 The procedure of rubbing the bonding system into the tooth tissue should take at least as many seconds as recommended by the manufacturer - or more - but it must not be shortened.

of bonding systems based on a mixture of two solvents (water/alcohol), the blowing stage is very important and should be significantly extended, even to several dozen seconds, therefore ensuring the removal of the solvent^[18].

The bonding system process described above relates to OptiBond™ Universal, which contains a system of **THREE** solvents: water, alcohol, and acetone. Thanks to the addition of acetone as a solvent, it is possible to remove the solvent with a shorter blowing time and achieve deeper penetration of the resin into the dentine tissue^[19].



Kerr OptiBond™ Universal

4.

Shade selection, placing and shaping of composite material

The next step, at which we can significantly shorten and simplify the procedure of conservative treatment, is the selection of the colour of the composite material matching the colour of the natural dentine, and its application in the oral cavity. This is possible with the use of chromatic composite materials characterised by the chameleon effect, i.e., matching the colour to the existing visible tooth tissues at the edges of the cavity^[20].

The best solution, however, seems to be a technology that can be found in some composite materials, called ART. – Adaptive Response Technology. It consists of combining colour effects obtained thanks to the addition of special dyes and the chameleon effect. With such a material, the chameleon effect is the main factor responsible for the colour of the filling and its fusion with the colour of the tooth tissues, but not the only one. It is supplemented with pigment elements, which enhance the chameleon effect^[21] and allow it to be effectively used with the full range of shades from the VITA shade guide and in the case of aesthetic fillings in anterior teeth. An example is SimpliShade™ from Kerr, which fully combines chameleon effect technology with the addition of colour pigments.

One Technology, it's All You Need.



Ternary Solvent System

Kerr's patented formula is enriched with our **GPDM Monomer** and novel **Ternary Solvent System**, effectively etching the enamel while promoting the priming and sealing of dentin. Collectively, this results in a more reliable and less sensitive technique.

- **WATER**
Enhances etching power and wetting ability, facilitating penetration of adhesive in dentinal tubules
- **ACETONE**
Enhances shelf-life stability and increases acidity and etching during application due to its quick evaporation
- **ETHANOL**
Facilitates the formation of a homogeneous adhesive layer, resulting in a less technique sensitive application



Fig. 7 Vita Classic shade guide, where a cavity was prepared on each tooth and a class V and IV filling was placed using one of the three dedicated shades of SimpliShade™ (Kerr) material. The photo taken with a polarising filter shows a perfect colour match of the material with a chameleon effect.

This material, combining the characteristics of “classic” and “modern” composite materials, instead of one universal colour (which is not able to adapt to the full range of teeth colours) has at its disposal 3 colours: light, medium and dark, which allow you to adjust to all the colours that can be found in dental tissues. Light colour (LIGHT) is most effective in colour matching with shades A1, B1, B2,

C1, D2. Intermediate colour (MEDIUM) works best with shades A2, A3, C2, D3, D4. The dark colour (DARK) will ensure a perfect colour match to the tooth tissues with shades A3.5, A4, B3, B4, C3, C4.

Thanks to the addition of a dye, the effect of increased translucency of the material is reduced, so it also works well in the case of III and IV class cavities in the aesthetic zone^[22].

SimpliShade™

Simplified Universal Composite System

LIGHT



MEDIUM



DARK





Fig. 8 Class V fillings made of SimpliShade™ (Kerr) material placed in teeth 16, 15, 14 – all in one shade, MEDIUM.

5.

Adaptation, finishing and polishing of composite filling surface following polymerisation

Adaptation, smoothing and polishing of the surface of the composite filling following polymerization is of great importance for the durability of the filling, its acceptance by the patient, as well as the patient's health. Following polymerization on the surface of the composite, an oxygen inhibition layer remains in form of incompletely polymerised composite with a thickness of about 20 μm ^[23]. In the case of layering a composite material inside the cavity, it is useful because it facilitates a strong, chemical connection between subsequent layers of material. On the outer surface of the filling, however, it should be completely removed, because there it will be subject to rapid degradation in contact with the oral cavity environment^[24]. This will cause discolouration of the composite filling in a short time due to the binding of food colouring substances on its surface, and rapid abrasion of an outer layer of the filling, which will change the occlusal contact points and may contribute to marginal leakage and secondary caries. In addition, the lack of perfect polishing of the surface of the filling makes it easier for cariogenic bacteria to attach to the composite material and form a layer of plaque on its surface more quickly, increasing the risk of caries development in other parts of the patient's oral cavity^[25].



Tips

If we are dealing with an extensive class IV cavity, or a situation in which we want to cover the actual colour of the tissue in the cavity (this happens most often in the case of dark brown reparative dentine), then we should apply an opaque material in UNIVERSAL or WHITE to the base of the cavity and continue to build with the selected material removal. In the case of class IV cavities, the opaque material should be used as the first, palatal layer of the filling, on which we will apply the appropriate shade of the composite.



Fig. 9 Set of accessories needed for perfect polishing of composite fillings localized in interdental spaces of teeth.



Fig. 10 Set of accessories used for polishing of class I composite fillings in occlusal surfaces of teeth

The procedure of smoothing and polishing restorations should allow the appropriate instruments to come into contact with ANY surface of the completed restoration. In the case of fillings in molars and premolars, the hard-to-reach surfaces are the inside of all the grooves on the occlusal surfaces, while in the anterior section, the interdental walls of class III and IV fillings below the contact point are the most difficult to polish.

Existing polishing procedures also assume the use of many consecutive steps and instruments, even with easily accessible surfaces^[26]. Therefore, during everyday clinical work, time dependent dentists often pay less attention to hard-to-reach surfaces.

The standard procedure for polishing class I and II restorations in the posterior region should therefore include a simplified procedure using different shaped rubber cups. It is advisable to use rubber cups containing diamond particles such as Opti1Step™ (Kerr) type, which allow for effective work in a wide range of circumstances, both without water cooling (max 5000 rpm), and with water cooling (max 20,000 rpm), and without the use of additional abrasive paste. Systems of this type are characterised by variable

abrasiveness depending upon the pressure applied to the composite surface by the rubber. With more pressure, the abrasion is greater, while less pressure has a smoothing and polishing effect on the surface. The procedure for polishing easily accessible surfaces of class I and II fillings can therefore be significantly simplified and can be easily supplemented with an element related to the inside of the fissures and the slopes of the occlusal surface cusp with the use of Occlubrush™ (Kerr) abrasive brushes with built-in abrasive particles of silicon carbide.

Only the flexible bristles of the brush are able to penetrate into the fissures on the occlusal surfaces and ensure proper polishing of the composite there, as a result of which there will be no increased bacterial plaque retention^[27].

Smoothing the surface of easily accessible composite fillings in the anterior section is most easily accomplished with the OptiDisc™ (Kerr) system of abrasive discs with increased flexibility. In this procedure, the flexibility of the surface of the abrasive disc allows the surface of the filling to be shaped and polished as effectively as with rubber bands and brushes with additional polishing paste. Unfortunately, the shape of these instruments does not allow them to penetrate into the interproximal



Fig. 11 Final smoothing of the filling using the universal Opti1Step™ rubber (Kerr) dedicated to smooth, easily accessible surfaces.



Fig. 12 Difficult-to-reach fissures and cusps slopes on the occlusal surfaces of fillings can be polished effectively with the Occlubrush™ brush (Kerr).

spaces of class III and IV restorations without the risk of damaging the contact points. These hard-to-reach surfaces should be additionally polished with Hawe™ Finishing and Polishing Strip (manual abrasive strips) which are the only strips that enable you to bypass the contact point safely and polish the surface of the filling below it.

When it comes to the final surface treatment of composite fillings, it is therefore important to simplify the procedures for finishing surfaces that are easy to access as much as possible, in order to be able to spend the “saved” time on polishing hard-to-reach surfaces with dedicated instruments to achieve perfect polishing.

The effectiveness of simplifying procedures for conservative treatment when it comes to composite fillings in carious defects is most easily appreciated in everyday clinical work using examples of patient treatment.



Fig. 13 Optidiscs can be used for polishing of enamel margins around prepared cavities to achieve better adhesion



Fig. 14 Special design of Optidisc centre makes it impossible to damage tissue or composite material when polishing

Case Report Molar Region

This patient suffered from a class II interdental cavity in the lower molar. The caries had developed so much that the enamel ridge over the contact point was broken off. OptiDam™ by Kerr rubber dam was placed to isolate the tooth within the oral cavity. The caries was completely removed, but its extent meant there were difficulties when correctly reconstructing the anatomical contact point. A sectional matrix with a flexible clamping ring was used to make it possible to model the contact point at the appropriate height.

The use of the bonding system, OptiBond™ Universal, was planned, which allowed for selective etching of the enamel, without etching the dentine.

Then, the bond was applied to the cavity, following the appropriate application procedure: rubbing of the bond for 20 seconds into enamel and dentine, drying with a stream of air for 5 seconds, and polymerisation.

The cavity was filled with SimpliShade™ in the colour MEDIUM, as the shade of the tooth tissues was estimated using a simplified method. Following the layered application of the material, polymerisation and polishing of the filling were carried out. The planned effect of colour adaptation of the filling and tooth tissues was fully successful.



Fig. 15 Extensive class II cavity in the second molar, requiring urgent intervention due to pain experienced by the patient.



Fig. 16 The rubber dam allows you to isolate the teeth from moisture from the patient's oral cavity.



Fig. 17 Prepared cavity on the proximal and occlusal surface, ready for the procedure of filling with a composite material.



Fig. 18 Inserted sectional moulding, with a profiled shape that allows the reconstruction of the contact point in the anatomically correct place.



Fig. 19 Filling made of OptiShade composite material with chameleon effect in MEDIUM shade.

Case Report Incisal Region

This patient came to dental practice with severely discoloured class III and IV fillings in the area on teeth 21 and 22. The examination revealed the presence of secondary caries, which qualified the fillings for removal. OptiDam™ dental dam was placed, and the filling was removed from tooth 21 and 22, after which the carious cavity was prepared. Selective enamel etching with orthophosphoric acid for 15 seconds and the OptiBond™ Universal bonding system were used due to the lower viscosity of the bond compared to two-bottle systems. The SimpliShade™ chromatic

composite in UNIVERSAL OPAQUE and LIGHT shades was used as a filling. Opaque material was used as the palatal layer of the restoration, approximately 0.5mm thick. It was covered with a material in the shade LIGHT due to the colour of the teeth, which was defined as A1. The whole surface was polished using OptiDisc™ and Hawe™ Finishing and Polishing Strip in the interdental spaces. The final aesthetic effect turned out to be very pleasing for the patient.



Fig. 20 Leaky class IV and class III filling in incisors visible from the labial side.



Fig. 21 From the palatal side, the development of secondary caries around both fillings can be seen, probably already affecting the dentine under the fillings.



Fig. 22 Prepared cavity with visible smoothing of the marginal enamel around the preparation.



Fig. 23 OptiBond™ Universal universal, low-density, self-etch bonding agent was used because it is the best at penetrating orthophosphoric acid-etched enamel.



Fig. 24 Fillings made using SimpliShade™ material in LIGHT and UNIVERSAL OPAQUE shades visible from the labial side.



Fig. 25 The same fillings visible from the palatal side, the perfect “blend” of the colours of the composite material with the tooth tissues is noticeable.

About **Maciej Mikołajczyk DDS PhD**



Graduated from the Dental Faculty of Lodz Medical University. Author and co-author of multiple thesis on minimally invasive treatment in prosthetics and traumatology.

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SIMPLICITY

BY KERR

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OptiBond™ Universal Bonding Agent



Maxcem Elite™ & Maxcem Elite™ Chroma Universal Resin Cement



Three trusted brands. One solution for simplifying your restoration workflow and inventory management. Zero compromise.

Disclosure: Dr. Maciej Mikołajczyk is a consultant for Kerr.

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