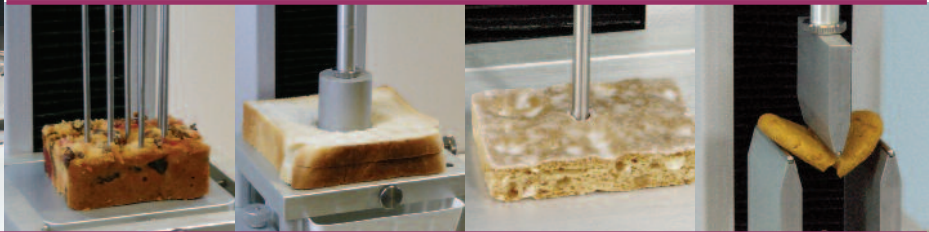




**FTC** FOOD TECHNOLOGY  
CORPORATION



Some simple guidelines for texture testing . . .

# Bakery

## What does Texture Analysis mean to the Bakery Industry?

The textural profile of bakery products is critical to consumer selection and perception. Bakery products have a narrow range of associated textural characteristics recognised and anticipated by the consumer. The consumer often interprets any deviation from this ideal as a loss in quality. Prime objectives of the commercial bakery are to develop products; which fit within this narrow textural spectrum, maintain these characteristics consistently throughout production, and ensure that textural quality does not deteriorate during the products' specified shelf-life.

Instrumental texture analyses combined with sensory expertise are invaluable tools for the measurement of bakery texture.

- From a **manufacturer's** perspective, a biscuit producer may want to optimise the texture of the dough fed into a rotary moulder - they want it hard enough not to stick to the mould but soft enough to fill it!
- From a **customer's** perspective, this could be the springiness of fresh bread; the consumer wants it springy to appear fresh whilst the ready-made sandwich producer needs it strong enough to withstand mechanical handling.

## Some Texture Analysis Experiences Within The Total Quality Loop

### RESEARCH & DEVELOPMENT

"...texture profile analysis enabled us to investigate the effect of amylases on the extension of bread shelf-life"

"...we used it to investigate the effect of microbial transglutaminase on puff pastry and croissant tenderness"

### QUALITY DEPARTMENT

"...texture analysis gave us an objective means to measure crumb texture of our bread so that it was firm enough to go through the slicer"

"...texture testing gave us a way to check the hardness of shortening before we added it to our puff pastry"

### PRODUCT DEVELOPMENT

"...texture analysis helped us to measure the effect of shortening substitution in a low fat muffin product"

"...we used it in the development of a pastry pie lid suitable for the microwave"

**TOTAL  
APPROACH TO  
QUALITY**

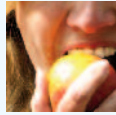
### PROCESS DEVELOPMENT

"...texture testing helped us to optimise the oven profile used in the baking of our digestive biscuits"

"...we used simple penetration testing to perfect the mixing and handling conditions of our short textured dough in relation to behaviour in the rotary moulder"

# How do I know that I need to measure the texture of my bakery product?

Food texture analysis is primarily concerned with how a food material feels, behaves and performs. There are two principle approaches that can be taken to food texture measurements:



### Sensory based

Texture treated as a perception or human experience, which is correlated to what we feel.

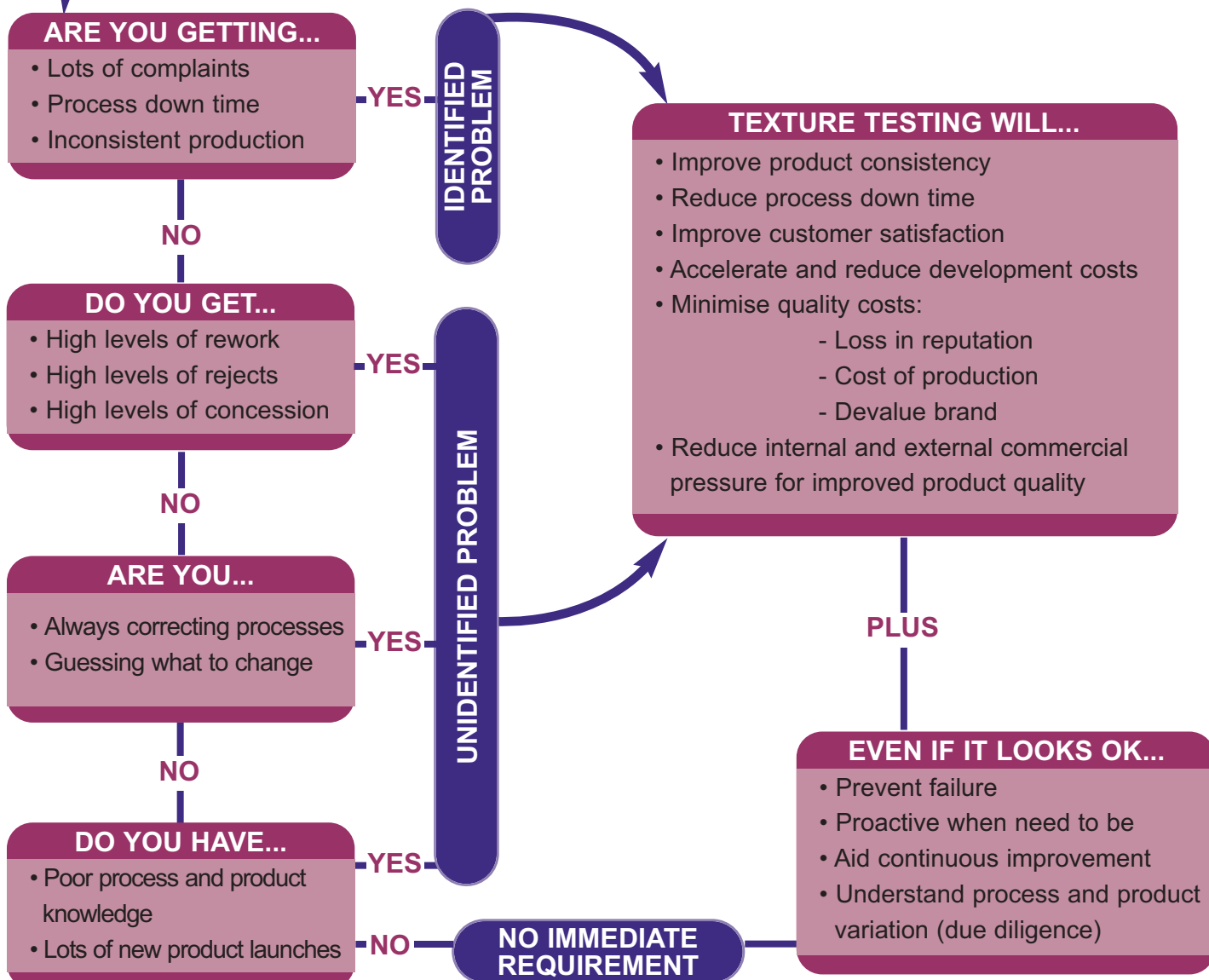


### Engineering based

Texture treated as a condition, which can be monitored and manipulated during manufacture.

Whatever approach is taken, the methods followed should be simple, practical and, most importantly, generate information of "real" value on the product being tested.


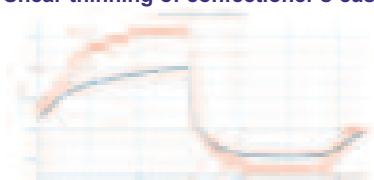
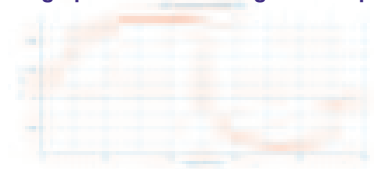
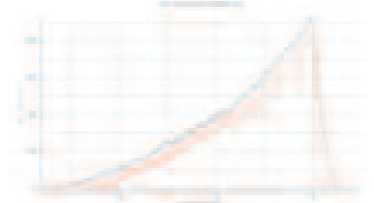
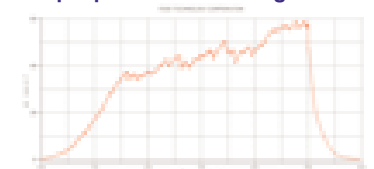
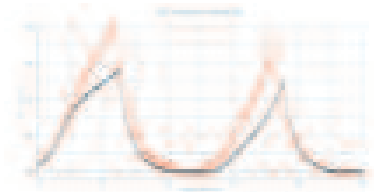
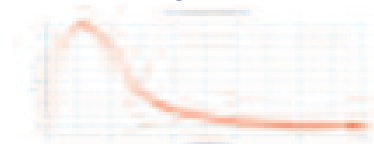

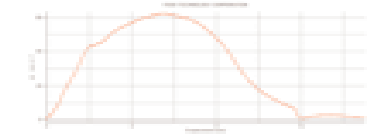


## Do I have a texture related problem?



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PRODUCT	DESCRIPTION	
<b>VISCOUS LIQUIDS</b>  SUGAR SYRUPS & GLAZES BATTERS PUREES & CONCENTRATES CUSTARDS, CREAMS & SPREADS		Thick and viscous concentrated liquids with unsupported structures and high soluble solids content. Made from processed fruits, sugars, fats or blends of ingredients to form pumpable semi-solid slurries, which must be tested within holding containers.
<b>PLASTIC &amp; VISCOUS SOLIDS</b>  FONDANTS & FILLINGS ICING & MARZIPAN BAKERY FATS SHORT DOUGH		Smooth viscous pastes or weak gels supporting emulsion of particulates. Self-supporting in structure, they can be squeezed, and squashed, cut and spread when exposed to forces beyond their yield or failure point.
<b>PARTICULATES</b>  BISCUIT PIECES CROUTONS MIXED PEEL & DRIED FRUIT CHOCOLATE CHIPS FRUIT PREPARATIONS PIE FILLINGS		Small, irregular and non-uniform particulate pieces. <ul style="list-style-type: none"> <li>• <b>Baked</b> products have brittle or expanded structures</li> <li>• <b>Dried</b> fruits have sticky, fibrous dense consistencies</li> <li>• <b>Fruit</b> and <b>vegetables</b> are fleshy with soft moist textures</li> <li>• <b>Chocolate</b> and confectionery pieces are hard and waxy</li> <li>• <b>Meats</b> have non-uniform fibrous, solid structures</li> </ul>
<b>UNHOMOGENOUS SOLIDS</b>  FRUITED LOAVES & CAKES CHRISTMAS PUDDINGS JAMS FLANS & QUICHES		Rigid foams or set gels containing large amounts of suspended particulates. This could be dried fruits, nuts, meats and vegetables, all of which will influence texture measurements if single test location is used.
<b>HOMOGENOUS SOLIDS</b>  BREAD & BAGELS MUFFIN & SPONGE CAKES DOUGHNUTS AMERICAN STYLE PANCAKES CRUMPETS		Homogenous, highly elastic products baked to form rigid aerated structures. High degree of elasticity is expected when fresh, which reduces as product becomes stale.  Viscous element becomes apparent when tested beyond elastic memory or as moisture content decreases.
<b>EXTENSIBLE SOLIDS</b>  LAMINATED OR DEVELOPED DOUGH TORTILLAS & PANCAKES PIZZA BASES PITTA BREADS		Thin and/or elastic products that are torn or stretched during handling or consumption.
<b>MULTILAYERED</b>  PUFF PASTRY CROISSANTS DANISH PASTRIES		Multilayered and expanded or risen textures made up from lots of thin laminated layers. Products have a high fat content, which coats individual layers during cooking.
<b>FLEXIBLE SOLIDS</b>  GINGER BREAD FLAPJACKS AMERICAN STYLE SOFT COOKIES		Flexible rigid structures with soft malleable textures. These products bend readily and tend to sag if snapped. High particulate and moisture content, which directly influences texture.
<b>BRITTLE SOLIDS</b>  BISCUITS BREAD STICKS WAFERS TACOS CRACKERS		Very hard, brittle and open textures that fracture easily when deformed, e.g. cut, snapped, penetrated or squashed.  Exhibit a single massive failure, almost like an explosion when small amount of stress is created.
<b>PARTICULATE SOLIDS</b>  CRISP BREADS RICE CAKES OAT CAKES MUESLI BARS		Moulded or re-formed self-supporting structures with mixed physical characteristics. Made up from small expanded particulates with crisp outer shell and hollow centres or dense pressed particles.

# CORE CHARACTERISTICS




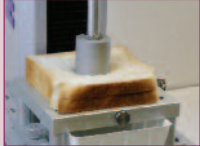
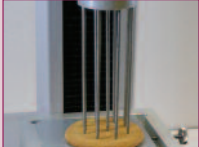
<ul style="list-style-type: none"> <li>• Deposit tailing (stringiness)</li> <li>• Whipped strength and aeration</li> <li>• Flow and structural recovery</li> <li>• Mouthfeel and coating</li> <li>• Consistency thickness</li> <li>• Gelling profile</li> </ul>	<p style="text-align: center;"><b>SEMI-SOLID</b></p> <p style="text-align: center;">FLOWS IF UNSUPPORTED, POURED, PUMPED, EXTRUDED OR SPREAD DURING HANDLING OR CONSUMPTION</p> 	<p>Shear thinning of confectioner's custard</p> 
<ul style="list-style-type: none"> <li>• Fat hardness and tempering changes</li> <li>• Work softening during mixing and processing</li> <li>• Sheetting properties</li> <li>• Flow yield force and strength</li> <li>• Gel strength, break and elasticity</li> <li>• Surface stickiness, dough hardness and mould adhesion</li> </ul>		<p>Dough penetration testing for mix quality</p> 
<ul style="list-style-type: none"> <li>• Freshness and crunchiness</li> <li>• Baking resilience</li> <li>• Effect of moisture migration</li> <li>• Hydration and bowl life studies</li> <li>• Moisture-related toughness</li> <li>• Roasting properties</li> <li>• Meat toughness</li> <li>• Fruit integrity</li> </ul>		<p>Crouton bowl-life testing with Kramer Shear Cell</p> 
<ul style="list-style-type: none"> <li>• Bake profile</li> <li>• Freshness</li> <li>• Gelled strength &amp; elasticity</li> <li>• Crumb variation</li> <li>• Fruit toughness</li> <li>• Crust hardness</li> </ul>		<p>Multiple penetration testing of fruit cake</p> 
<ul style="list-style-type: none"> <li>• Staling</li> <li>• Crumb hardness</li> <li>• Elasticity and recovery comparisons</li> <li>• Crust toughness</li> <li>• Consistency &amp; failure properties over time</li> <li>• Shelf-life prediction &amp; changes</li> <li>• Baking &amp; oven profile</li> </ul>		<p>TPA testing of staling bread</p> 
<ul style="list-style-type: none"> <li>• Process consistency</li> <li>• Extension and gluten development</li> <li>• Rollability and toughness</li> <li>• Dough hardness, elasticity &amp; stickiness</li> </ul>		<p>Burst strength of flour tortilla</p> 
<ul style="list-style-type: none"> <li>• Lift properties</li> <li>• Breakdown resilience</li> <li>• Toughness</li> <li>• Staling changes</li> </ul>		<p>Cross-sectional shearing of croissant</p> 
<ul style="list-style-type: none"> <li>• Oven profile</li> <li>• Flexibility over life</li> <li>• Storage hardening</li> <li>• Chewiness and moisture uptake</li> <li>• Stickiness and tooth compaction</li> </ul>		<p>Bend properties of soft cookie</p> 
<ul style="list-style-type: none"> <li>• Storage softening</li> <li>• Checking potential and prediction</li> <li>• Fracture force</li> <li>• Brittleness and friability characteristics</li> <li>• Shortness and breakdown</li> </ul>		<p>Snap testing of bread stick</p> 
<ul style="list-style-type: none"> <li>• Crispness over time</li> <li>• Hardness from bake</li> <li>• Flexibility and softening</li> <li>• Expansion and extruded characteristics</li> </ul>		<p>Rice cake penetration with multiple needle probe</p> 

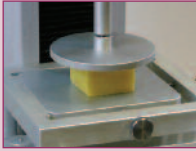




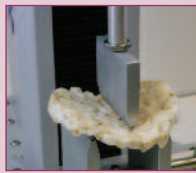
**SOLID**

SELF-SUPPORTING STRUCTURE, DEFORMED, SQUASHED, SHEARED OR SNAPPED DURING HANDLING OR CONSUMPTION



## CHOOSING THE RIGHT FIXTURE

	EXTRUSION	BULK ANALYSIS	MULTIPLE POINT ANALYSIS
<b>VISCOUS LIQUIDS</b> SUGAR SYRUPS & GLAZES BATTERS PUREES & CONCENTRATES CUSTARDS, CREAMS & SPREADS	TMS EXTRUSION CELL (432-026) TMS-EXTRUSION CONE (432-027) TMS EXTRUSION PLATEN SET (432-029)	Measure individual pieces in bulk like eating a spoonful of croutons or biting into an apple pie  Allow decanted samples to recover structure before testing consistency 	Multiple site tests are used to measure products with variable textures like pushing a fork into a fruit cake
<b>PLASTIC &amp; VISCOUS SOLIDS</b> FONDANTS & FILLINGS ICING & MARZIPAN BAKERY FATS SHORT DOUGH			
<b>PARTICULATES</b> BISCUIT PIECES CROUTONS MIXED PEEL & DRIED FRUIT CHOCOLATE CHIPS FRUIT PREPARATIONS PIE FILLINGS	Use multiple blades of Kramer Shear Cell to measure crouton hardness 	FTC STANDARD SHEAR COMPRESSION CELL (432-240) TMS MINI KRAMER SHEAR/ OTTAWA CELL (432-033) TMS CRISPINESS CELL (432-296)	
<b>UNHOMOGENOUS SOLIDS</b> FRUITED LOAVES & CAKES CHRISTMAS PUDDINGS JAMS FLANS & QUICHES			TMS MULTIPLE NEEDLE PROBE (432-249)
<b>HOMOGENOUS SOLIDS</b> BREAD & BAGELS MUFFIN & SPONGE CAKES DOUGHNUTS AMERICAN STYLE PANCAKES CRUMPETS	Hold containers in place when carrying out extrusion tests with the TMS Container Grips (432-038) 		Large cylinders can be used to press into the centre of sliced bread to measure freshness 
<b>EXTENSIBLE SOLIDS</b> LAMINATED OR DEVELOPED DOUGH TORTILLAS & PANCAKES PIZZA BASES PITTA BREADS			
<b>MULTILAYERED</b> PUFF PASTRY CROISSANTS DANISH PASTRIES			
<b>FLEXIBLE SOLIDS</b> GINGER BREAD FLAPJACKS AMERICAN STYLE SOFT COOKIES	Make hardness measures from cross-section of biscuit to assess checking potential 		TMS MULTIPLE NEEDLE PROBE (432-249) TMS JUNIOR MULTIPLE PROBE FIXTURE (432-252)
<b>BRITTLE SOLIDS</b> BISCUITS BREAD STICKS WAFERS TACOS CRACKERS			TMS MULTIPLE NEEDLE PROBE (432-249) TMS JUNIOR MULTIPLE PROBE FIXTURE (432-252)
<b>PARTICULATE SOLIDS</b> CRISP BREADS RICE CAKES OAT CAKES MUESLI BARS			TMS MULTIPLE NEEDLE PROBE (432-249) TMS JUNIOR MULTIPLE PROBE FIXTURE (432-252)

PENETRATION	SHEARING	COMPRESSION	SNAPPING	TENSION
<p>Use small cylinders, balls, needles and cones to push into a sample like pushing your finger into soft icing</p>	<p>Cut across a section of the sample just like biting into a croissant or cutting marzipan</p>	<p>Squash a small sample with a flat or rounded probe like squeezing fresh bread in your hand or squashing with your tongue</p>	<p>Snap brittle samples with rigid structures to measure their break flexure properties, just like breaking a biscuit in half</p>	<p>Stretch or pull a sample to see how it extends and stretches like pushing your thumb through puff pastry</p>
<p>1" PERSPEX HEMISPHERICAL (432-096) 1" BALL PROBES (432-088)</p>			<p>Compress cored samples of viscous pastes to measure deformability</p> 	
<p>10MM Ø AND SMALLER S.S. CYLINDERS (432-066 TO 432-074) TMS FMBRA DOUGH POTS (432-034)</p>	<p>TMS LIGHTWEIGHT BLADE SET (432-245) TMS WIRE SHEAR PROBE AND PLATE (432-242)</p>	<p>TMS 75MM Ø COMPRESSION PLATEN (432-010)</p>		
<p>2MM Ø NEEDLE PROBE (432-087)</p>		<p>Shear across sample to measure cutting consistency of particulate products like fruit cake</p> 		
<p>1" PERSPEX HEMISPHERICAL OR BALL PROBE (432-096 &amp; 432-088) TMS AACCC 36MM Ø CYLINDER (432-036)</p>	<p>TMS LIGHTWEIGHT BLADE SET (432-245) TMS LARGE CRAFT KNIFE (432-295)</p>			<p>Burst strength testing can be used to measure rollability of flour tortillas</p> 
<p>2MM Ø CYLINDER (432-076) 15° S.S. CONE (432-085)</p>		<p>Measure flexure properties and storage hardening of soft bake products</p> 		<p>TMS EXTENSIBILITY FIXTURE (432-046) TMS LARGE WEDGE GRIP KIT (432-297)</p>
<p>2MM Ø CYLINDER (432-076) 15° S.S. CONE (432-085)</p>	<p>TMS LIGHTWEIGHT THREE POINT BEND (432-248)</p>			
<p>2MM Ø CYLINDER (432-076) 15° S.S. CONE (432-085)</p>	<p>Precision shearing with large craft blade gives a good measure of croissant toughness</p> 			
<p>2MM Ø CYLINDER (432-076) 15° S.S. CONE (432-085)</p>			<p>TMS LIGHTWEIGHT THREE POINT BEND (432-248)</p>	<p>Bend products to assess bonding strength of particulate components in rice cakes</p> 
<p>2MM Ø CYLINDER (432-076) 15° S.S. CONE (432-085)</p>	<p>TMS LIGHTWEIGHT BLADE SET (432-245) TMS LARGE CRAFT KNIFE (432-295)</p>		<p>TMS LIGHTWEIGHT THREE POINT BEND (432-248)</p>	<p>Please Note: Accessories listed in each category are examples of those most suited to the application. Only one accessory is normally required per application to perform the majority of tests.</p>

## APPLICATION SHEETS

- Process shear effects on the structure of custards and confectionery creams
- Yield and spreading properties of sauces and fillings
- Fruit and vegetable integrity of pie fillings and sauces
- Measure bowl-life changes in croutons
- Hardness testing of unhomogenous products such as fruit cakes and Christmas puddings
- Gel hardness, fruit integrity and spreading characteristics of jams and jellies
- Set properties of rough chopped peanut butter as a comparison between reduced and full fat product
- Stickiness testing of bakery jams as indicator of depositing properties
- White sliced bread crumb texture and resilience for sandwich manufacturer
- Elasticity and springiness testing of mallow filling
- Hardness testing of hard baked cookie as an indicator of crispness
- Firmness of confectioner's icing to assess functional performance in sheet roller
- Measure cross-sectional hardness of butter and bakery fats following ISO 16305 to optimise mixing properties
- Marzipan hardness as an indicator of consistency for sheeting
- Stress relaxation to measure visco-elasticity of bread and cake crumb

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