Dynamic Sealing at Low Temperatures

John Rogers
James Walker & Co. Ltd

James Walker

High performance sealing technology

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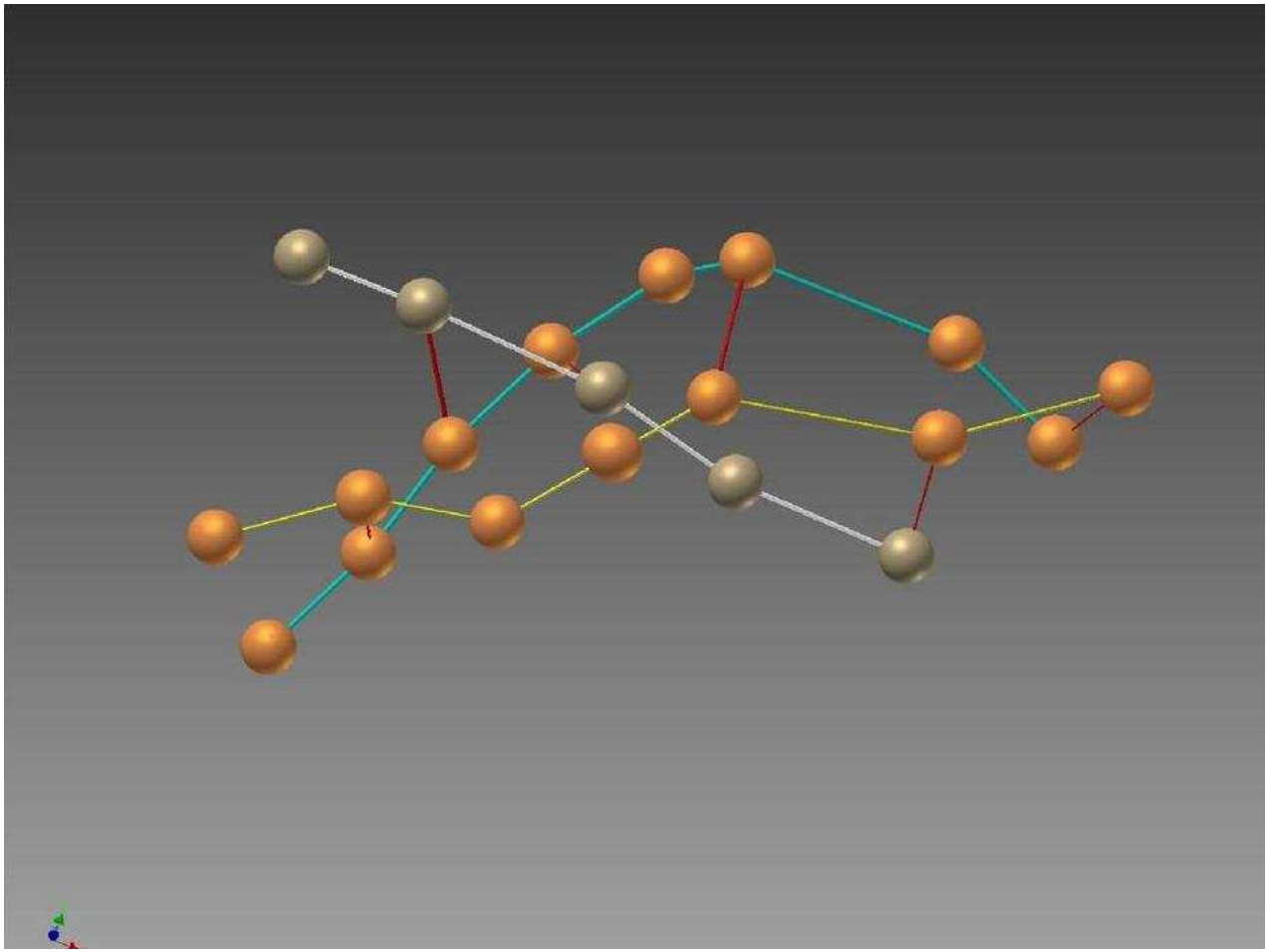
Presentation Overview

- What happens to elastomers at low temperatures?
- Static sealing
- Dynamic sealing (slow speed, ¼ turns)
- Summary of factors that influence results

What Happens to Elastomers at Low Temperatures?



How can this be Measured?

Materials Included in the Study

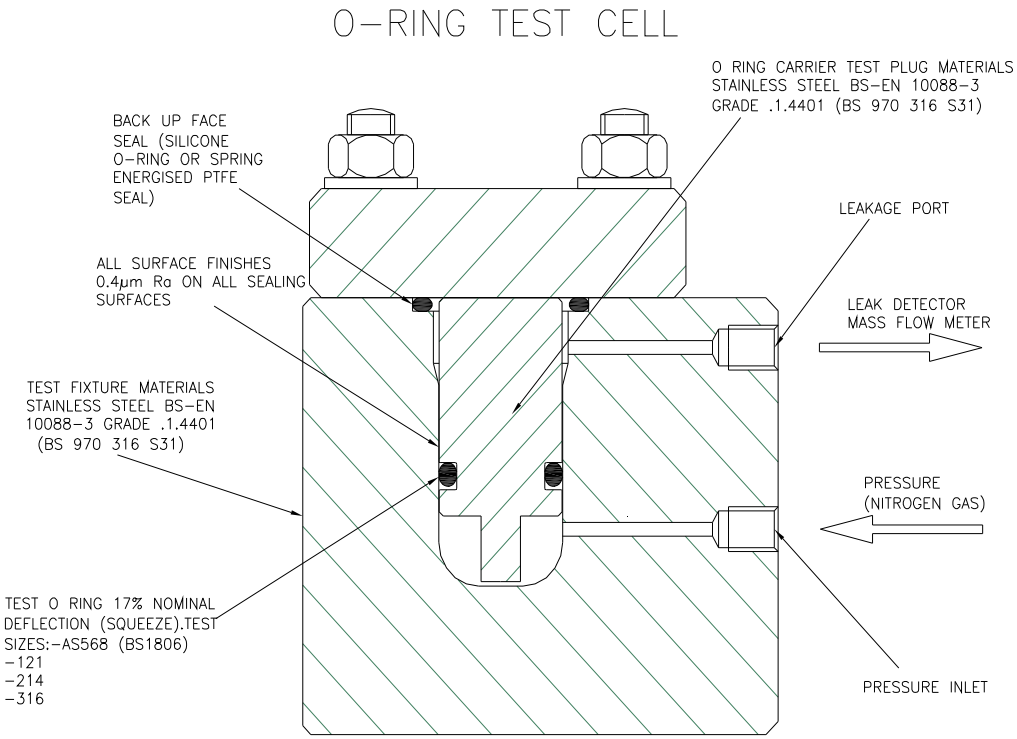
‘FKM-LT’	Based on a low temperature ASTM D1418 ‘Type III’ terpolymer
HNBR – LT	An HNBR elastomer designed for low temperature sealing

Test Method	FKM-LT	LT- HNBR
Tg by DSC, ℃	-33	-44
TR_{10}	-32	-36
Gehman T_{70}	-30	-41

Static Sealing: Radial squeeze

14% squeeze, 83% groove fill
5.33mm c/s (316 size) O-rings
100 bar nitrogen
Seals lubricated

1. Pressurised before cooling
2. Pressurised after cooling



Test Results

PBC	FKM-LT	HNBR-LT
Min. temperature in which all 3 seals held pressure	**-54℃**	**-53℃**

PAC	FKM-LT	HNBR-LT
Min. temperature at which all 3 seals held pressure	**-31℃**	**-41℃**

Static Sealing: Axial squeeze

14% squeeze, 83% groove fill
5.33mm c/s (312 size) O-rings
100 bar nitrogen
Seals lubricated

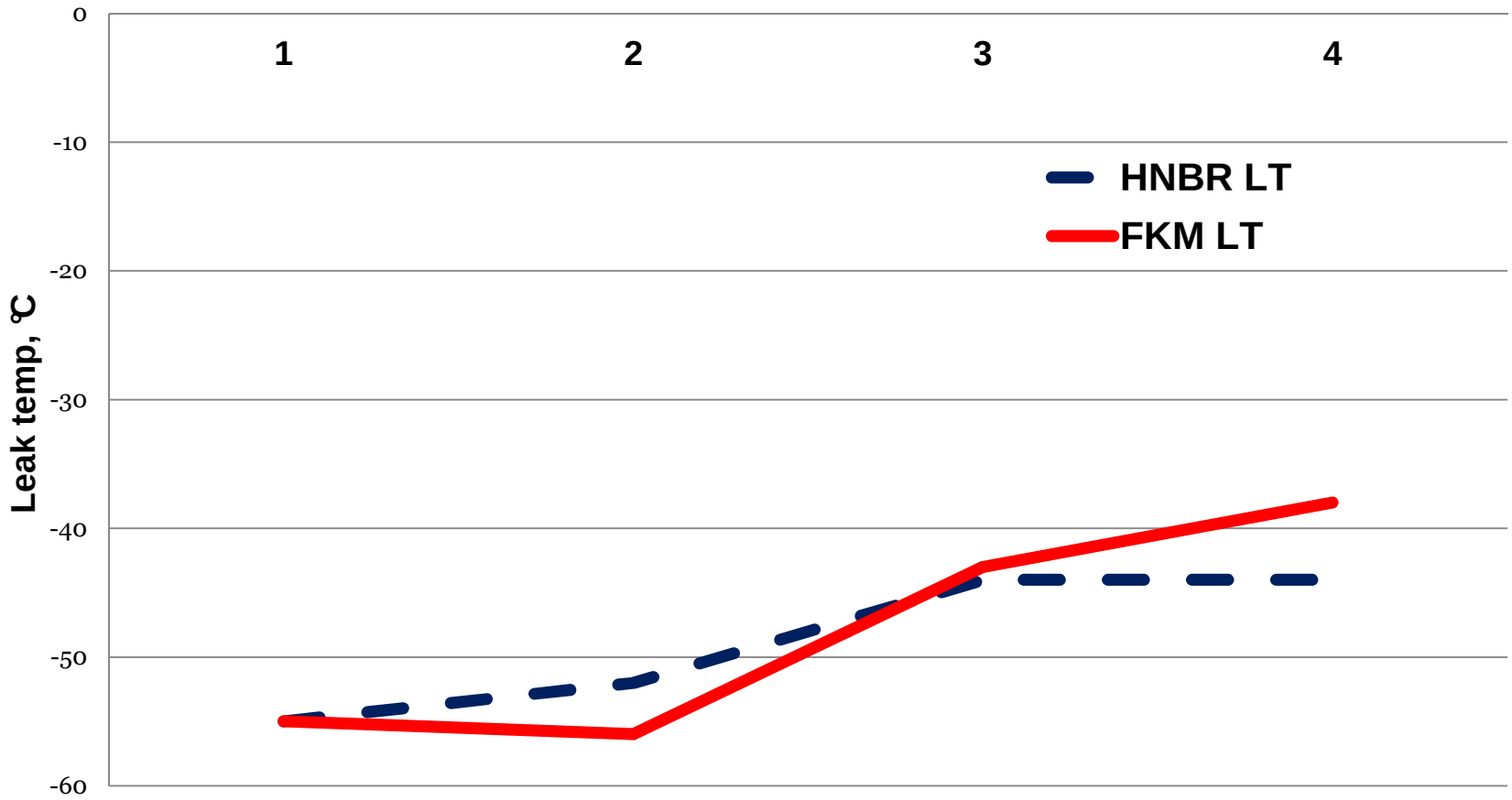
1. Pressurised before cooling
2. Pressurised after cooling

Test Results

PBC	FKM-LT	HNBR-LT
Min. temperature in which all 3 seals held pressure	**-54℃**	**-56℃**
Previous test	**-54℃**	**-53℃**

PAC (3 cycles)	FKM-LT	HNBR-LT
Min. temperature at which all 3 seals held pressure	**-52℃**	**-54℃**
Previous test	**-31℃**	**-41℃**

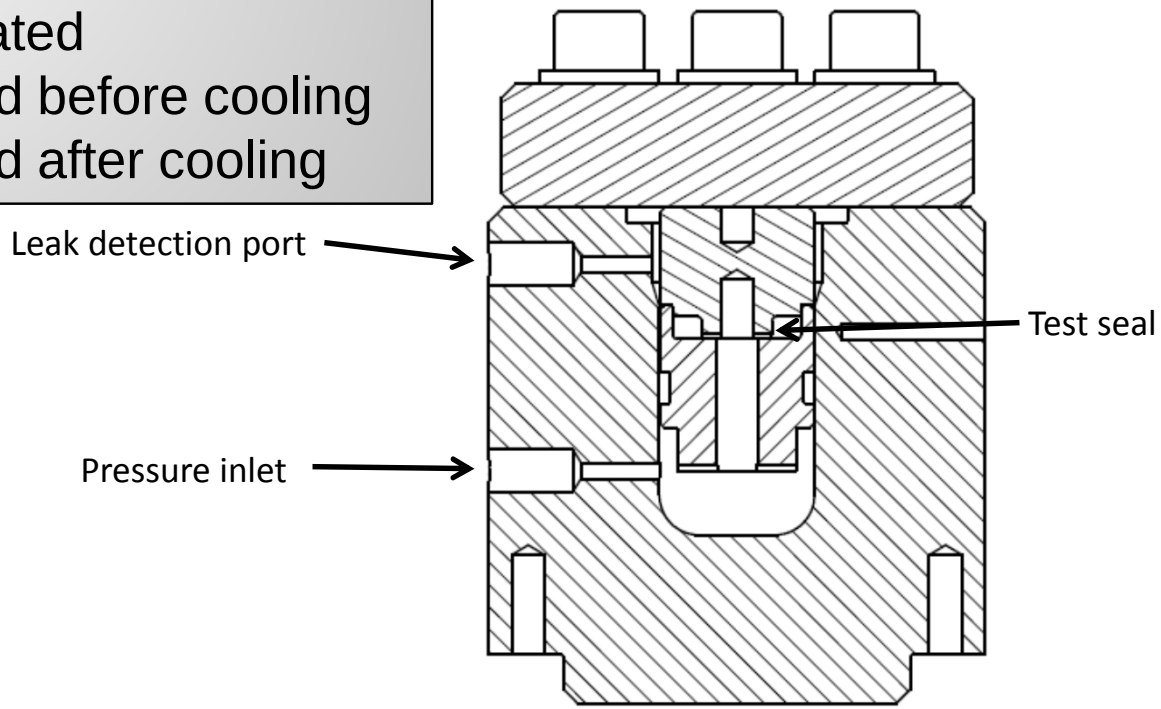
Decay with Thermal / Pressure Cycling



Unlubricated Static Sealing

14% squeeze, 83% groove fill
5.33mm c/s (312 size) O-rings
100 bar nitrogen
Seals unlubricated

1. Pressurised before cooling
2. Pressurised after cooling



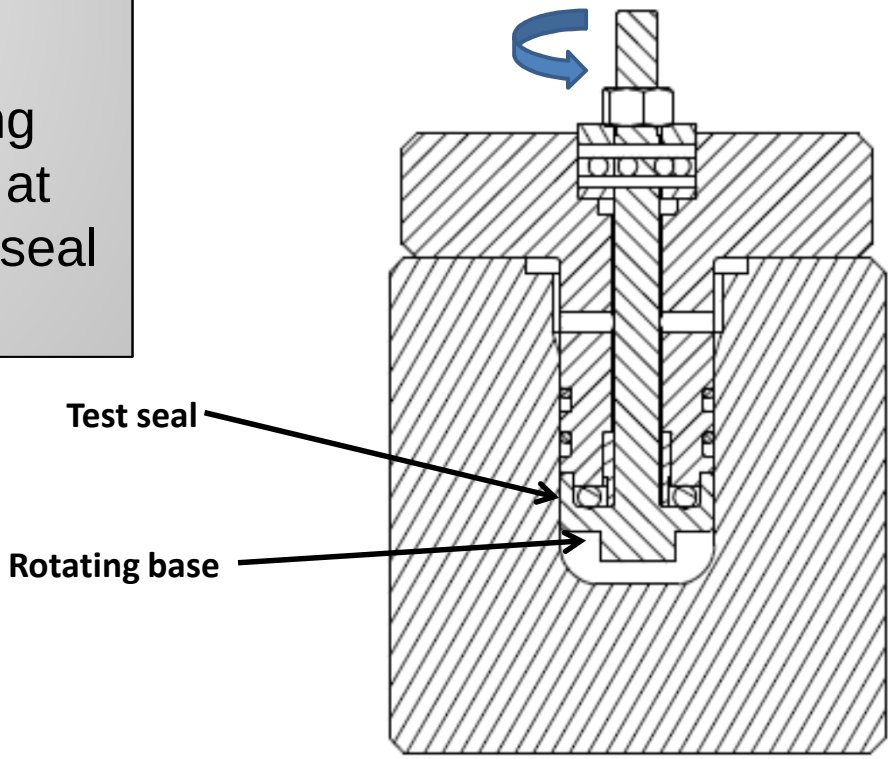
Test Results

PBC	FKM-LT	HNBR-LT
Min. temperature in which all 3 seals held pressure	**-30℃**	**-38℃**
Previous test	**-54℃**	**-56℃**

PAC (3 cycles)	FKM-LT	HNBR-LT
Min. temperature at which all 3 seals held pressure	**-30℃**	**-37℃**
Previous test	**-52℃**	**-54℃**

Unlubricated Dynamic Sealing – Axial squeeze

20% squeeze, 83% groove fill
5.33mm c/s (310 size) O-rings
100 bar nitrogen
Seals unlubricated
1. Pressurised before cooling
2. Pressurised after cooling at min. temp that would retain seal at 5 x ¼ turns of stem

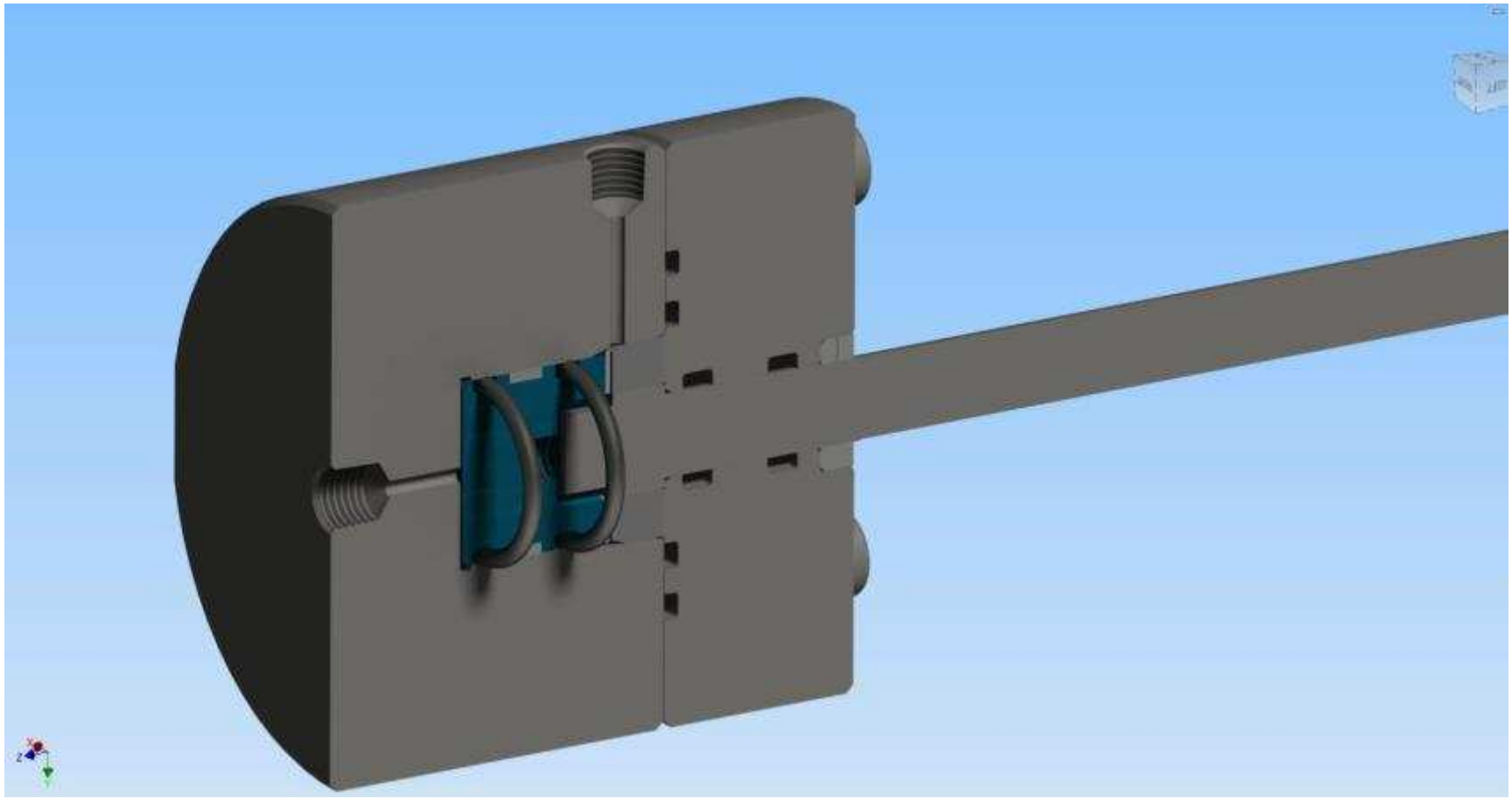


Test Results

PBC	FKM-LT	HNBR-LT
Min. temperature in which all 3 seals held pressure	**-39℃**	**-39℃**
Previous test	**-30℃**	**-38℃**

‘Dynamic’	FKM-LT	HNBR-LT
Min. temperature at which all 3 seals held pressure	**-35℃**	**-36℃**

Dynamic Sealing: Radial squeeze



Range of Test Results

Range of test results when considering all test methods included in this programme so far:

O-ring samples, minimum sealing temperatures, ℃	FKM - LT	HNBR - LT
	-30℃ to -54℃	-36℃ to -56℃

Summary

Factors that influenced results for a given seal material in this study included:

- Seal Lubrication
- Level of Squeeze
- Housing arrangement
- Static or moving

Further Work

- We are repeating the dynamic testing at 600bar to study the effects of system pressure
- Tests with the radial squeeze valve type test fixture are progressing as a comparison to the axial squeeze unit
- The influence of contact media is also included in the programme along with housing surface finish and seal cross-section
- A dedicated test facility to look at application-specific testing will be available from June
- We are working with a professional body to develop an industry standardised test for low temperature sealing

Acknowledgements

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For the test data used for this presentation

Thank you for your attention

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