

ULTRA LOW EMISSIONS COMPOUND/SEAL FOR PZEV/LEV III

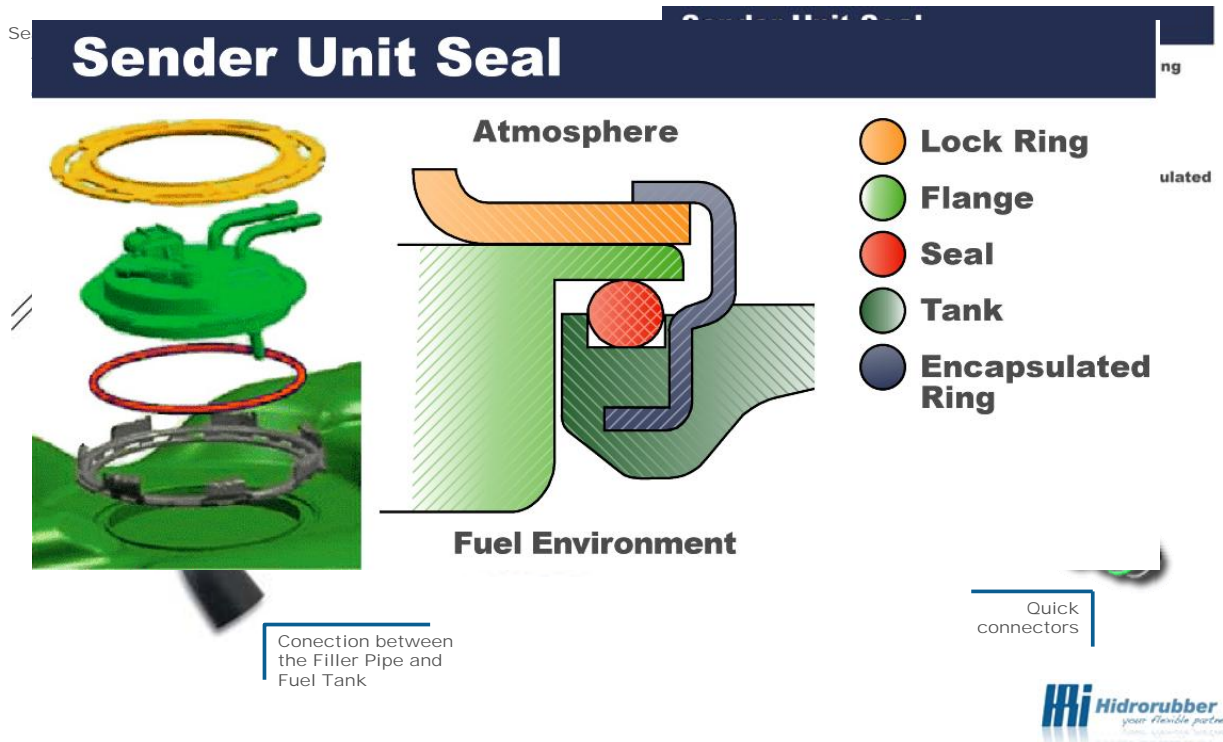
Aritz Nogues. November 9th 2011

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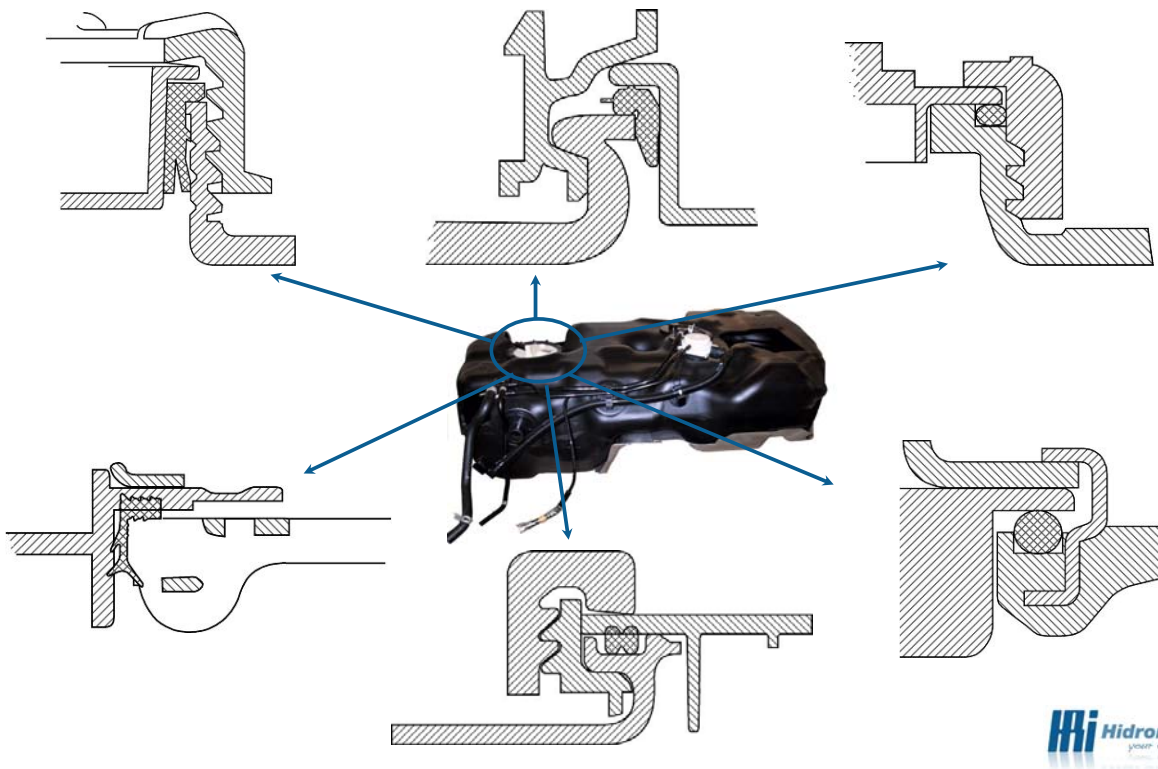
SUMMARY

- ① Location of rubber seals and gaskets in Fuel Tanks which influence the evaporative emissions.
- ② Historical review of the different designs used on the Sender Unit Seal.
- ③ Overview of the different worldwide emission legislations.
- ④ Market needs: Target: Reduce evaporative emission levels with CE10.
- ⑤ Evaporative emissions. A concern in the market. Current standard market compounds.
 - 5.1. Where do we currently stand?
 - 5.1.1. Permeation testings: Thwing Albert Cup test.
 - 5.1.2. Mechanical testings: Compression stress relaxation.
 - 5.1.3. Real O-Rings testing in MicroSHED. Evaporative emission results with CE10 (K3WORKS).
 - 5.2. New innovative development: **FKM 70GK**.
 - 5.2.1. Improvements on permeation vs today's compounds.
- ⑥ Economic impact.
 - 6.1. € vs mg/day.
- ⑦ Conclusions.
- ⑧ Questions?

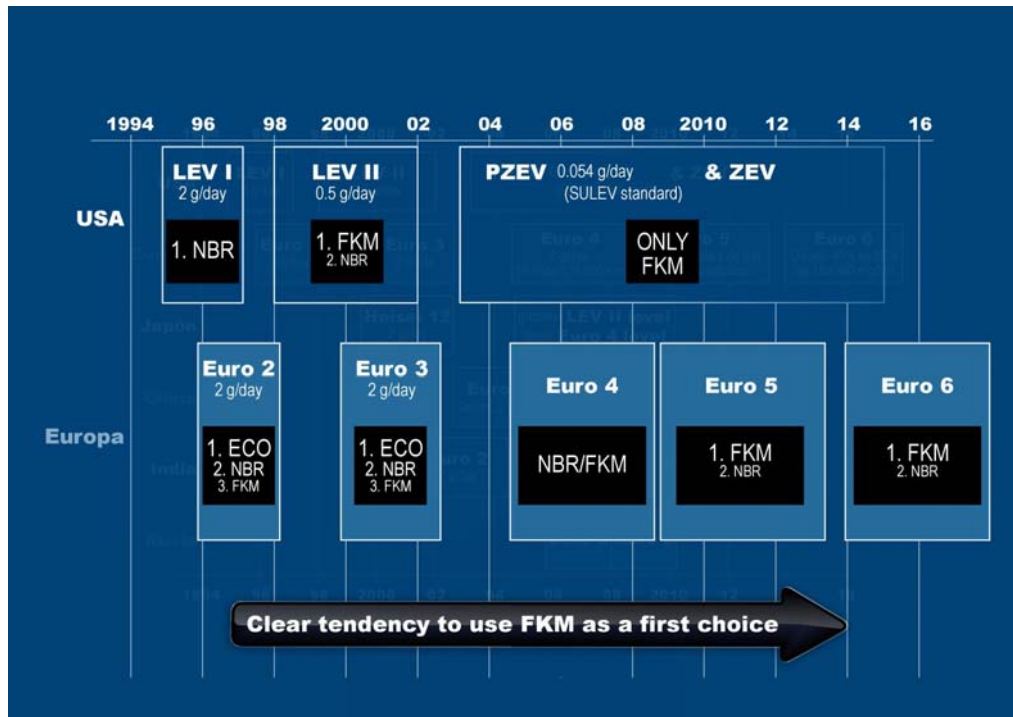
1 Location of rubber seals and gaskets in Fuel Tanks which influence the evaporative emissions.



2 Historical review of the different designs used on the Sender Unit Seal.



3 Overview of the different worldwide emissions legislation



4 Market needs: Target: Reduce evaporative emission levels with CE10.

- ➔ There is a clear tendency to go to lower evaporative emission tanks in the different markets, led by US legislation.
- ➔ Rubber seals are one of the biggest contributors to those evaporative emissions.
- ➔ TIER 1s are looking for lower permeability compounds with CE10 testing fuel.
- ➔ So far this is “only” a concern for PZEV market, but it may be extended to LEV III, which would significantly increase the market volume.

- 5 Evaporative emissions. A concern in the market.
Current standard market compounds.

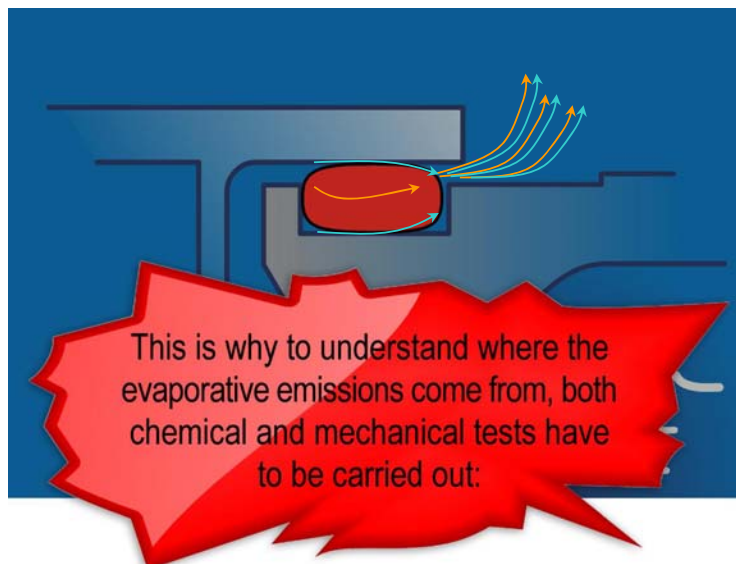
	Currently in serial	FKM 70R (VITON® B TYPE RANGE)
COLOUR	NBNP	
HARDNESS	68	69
FLUORINE CONTENT	N/A	~69%-69.5%
LOW TEMPERATURE RESISTANCE (Bending test)	-45°C	-35°C
TARGET MARKET	ECE, LEVII, PZEV	LEVII, PZEV

In which permeation levels are we now at with the current market compounds?

- 5 Evaporative emissions. A concern in the market.
Current standard market compounds.

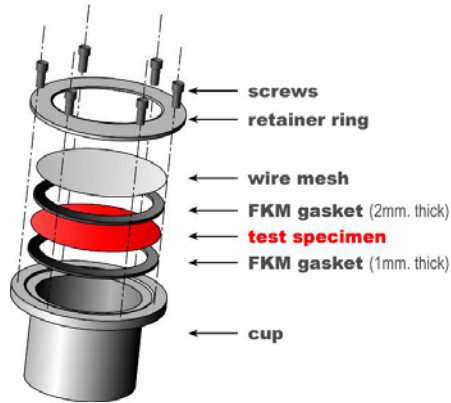
Evaporative emissions are linked basically to 2 factors:

chemical permeation + mechanical effect:



5 .1. Where do we currently stand?

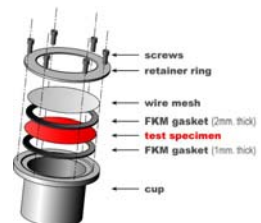
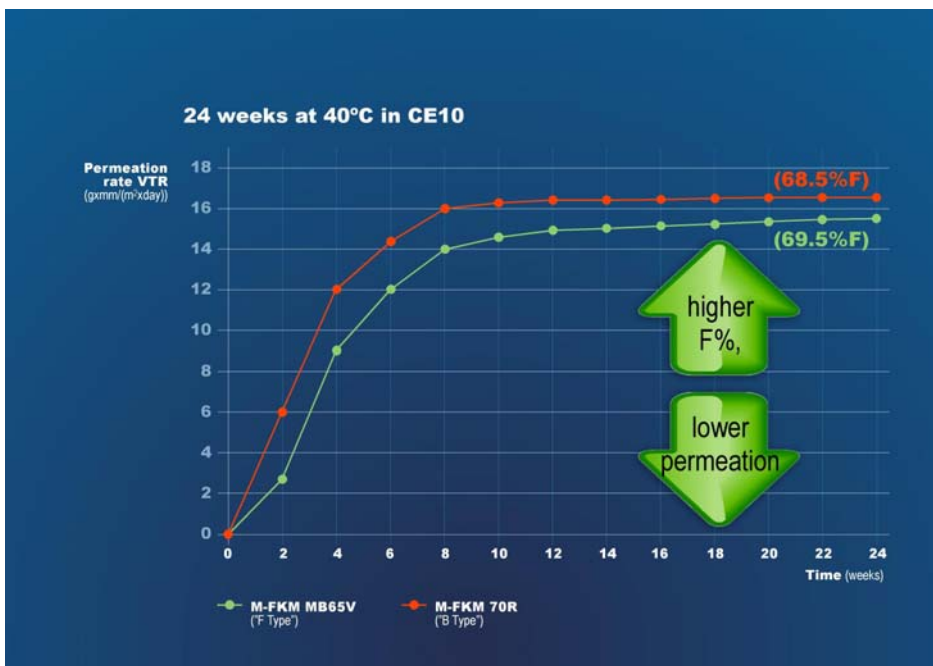
1. Permeation testings: Thwing Albert Cup test (SAE J2665):



Weekly measurement of weight loss with CE10 @ 40°C

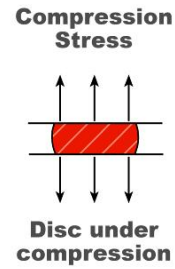
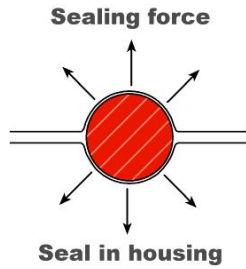
5 .1. Where do we currently stand?

1. Thwing-Albert Cup Method (SAE J2665)-> Chemical effect/permeation.



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2. Mechanical testing: Compression stress relaxation (ISO 3384-method B).

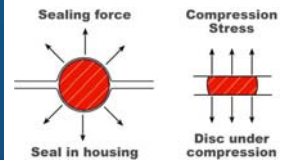
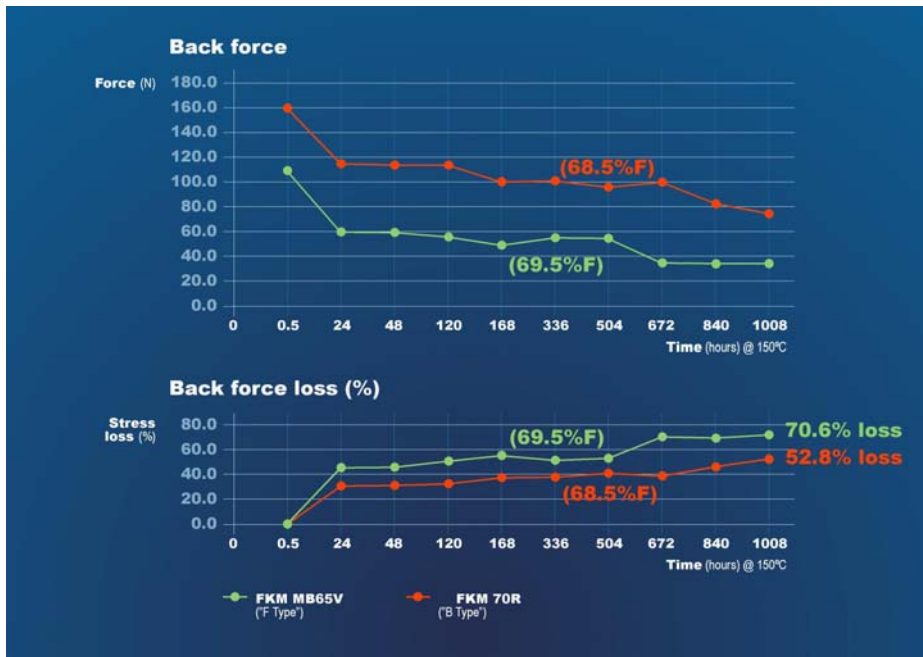


Consists of applying a constant deformation (25%) for a fixed time and measuring the back force loss the rubber suffers (ageing at 150°C, 1000 hours).



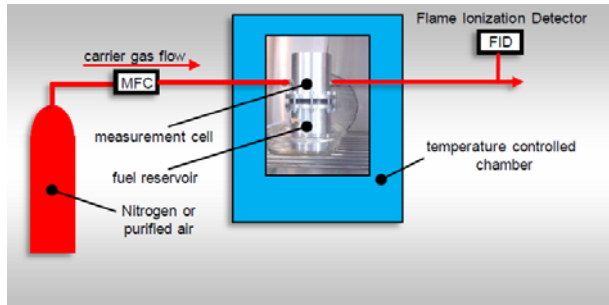
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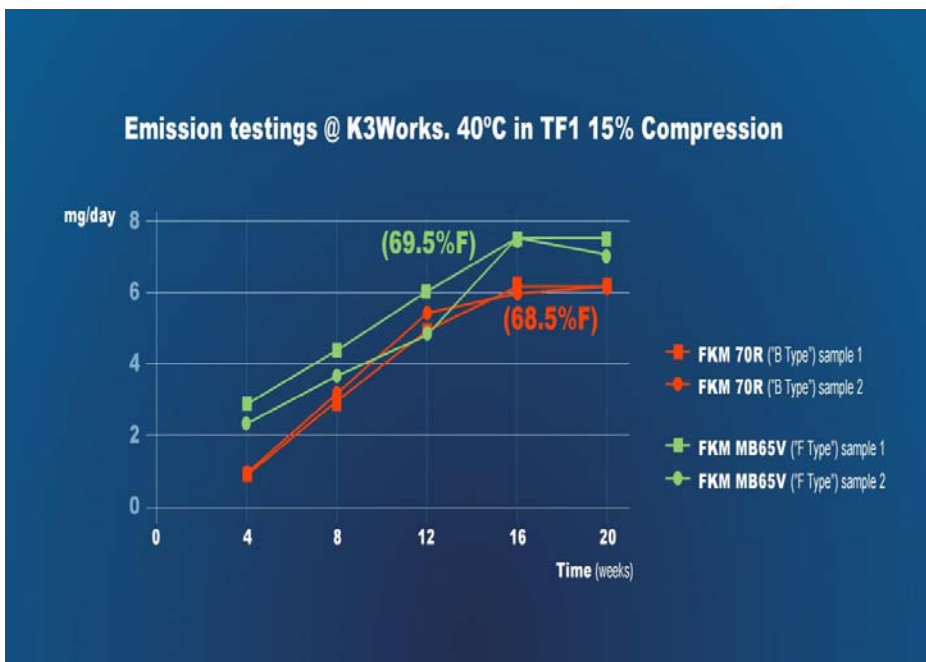
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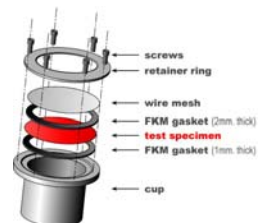
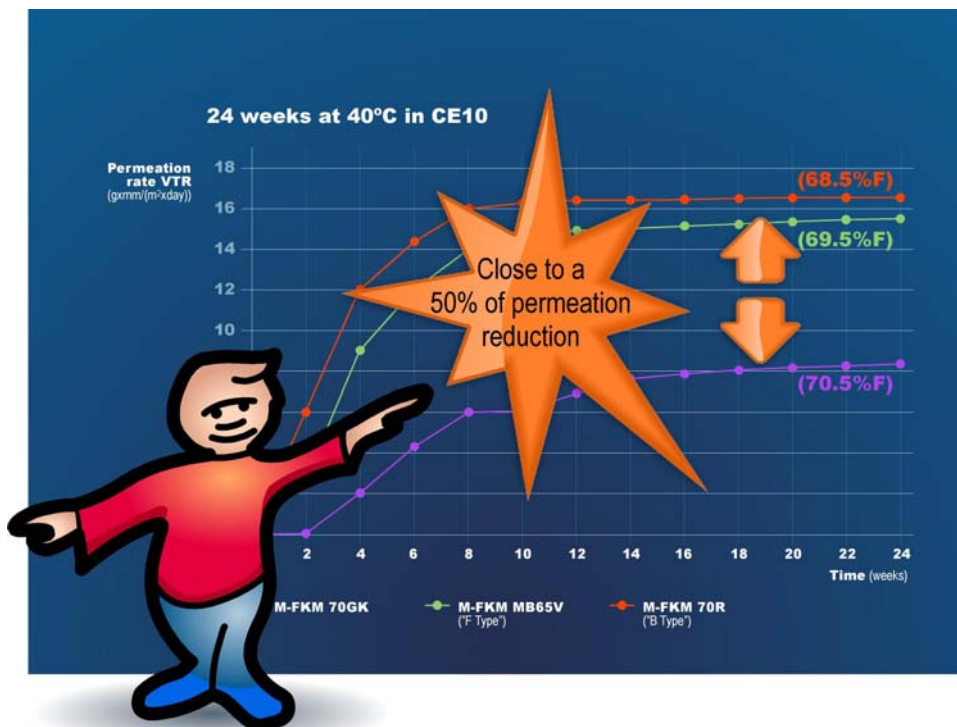
5 .2. New innovative development: FKM 70GK.

	Currently in serial production			New!!!
	NBR/PVC	FKM 70R (VITON® B TYPE® RANGE)	FKM MB65V (VITON® F TYPE® RANGE)	FKM 70GK
COLOUR				
HARDNESS	68	69	69	72
FLUORINE CONTENT	N/A	~68.5%	~69%-69.5%	~70.5%
LOW TEMPERATURE RESISTANCE (Bending test)	-45°C	-40°C	-35°C	-35°C
TARGET MARKET	ECE	ECE, LEVII, PZEV	LEVII, PZEV	PZEV/¿LEVIII?



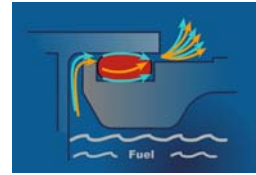
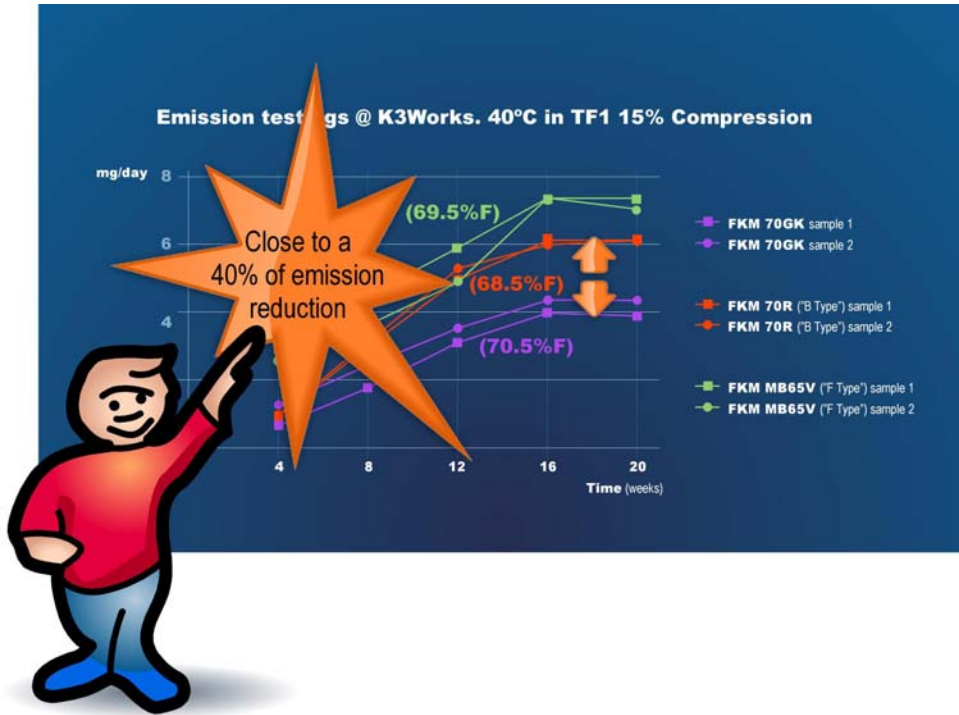
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6 Economic impact.



	Emission level (mg/day)	Cost level	Cost per Emission level
FKM 70R (reference)	6.3	1	6.3
FKM 70GK	4	1.4	5.6
FKM MB65V	7.2	1.2	8.64
NBR/PVC 70	430	0.2	86

This is the most cost efficient solution!



6 Economic impact.

	Emission reduction vs FKM 70R (6.3 mg/day)	€ difference vs FKM 70R (€ 1/unit)*	€/mg reduction
FKM 70GK	2.3	0.4	0.17

*Reference value.

- ➔ FKM 70GK is a highly cost efficient compound, because evaporative emissions reduction is proportionally higher than the cost difference compared to current market solutions.
- ➔ FKM 70GK compound could be eventually used to reduce the total cost of the Fuel Tank, replacing less efficient components on ultra low emission systems.

7 Conclusions.

- ➔ 1.- NBR or NBR/PVC compounds are not recommended for low permeation applications due to the very high emission values.
- ➔ 2.- Not always the highest Fluorine % FKMs have the best emission result: Chemical permeation is a very important property, but the mechanical behaviour has to be considered as well.
- ➔ 3.- When a special ultra low emissions FKM is not needed, **FKM 70R ("B type")** compound is recommended due to better emissions, cold T⁰ and cost performance compared to **FKM MB65V ("F type")**
- ➔ 4.- New **FKM 70GK** compound is probably the lowest emission compound in the market. It brings a benefit of ~40% of emissions reduction compared to the current standard market compounds, being the most cost efficient solution for ultra low emission systems.



tank.tech²⁰¹¹

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COMPOUND/SEAL FOR PZEV/LEV III

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