

POKETONE

**New horizons in polymer performance
for automotive Industry**



POKETONE FOR THE FUEL APPLICATIONS



POKETONE™

The new choice for Fuel parts in automotives

POKETONE Polymers are a new class of engineering plastics- semi-crystalline aliphatic polyketones(PK). The resulting molecular chains are linear, perfectly alternating carbon monoxide and alpha olefin structures that possess a unique balance of strength, chemical resistance and barrier properties, making POKETONE Polymers widely used in hydrocarbon barrier, resistant applications This is a consequence of their di-polar nature which confers resistance to attack and permeation by aliphatic and aromatic hydrocarbons.

POKETONE Polymers well-suited for use in automotive applications, retaining both their appearance and properties following prolonged contact with a wide range of automotive fluids.

A UNIQUE BALANCE OF PERFORMANCE PROPERTIES

- Fuel resistance
- Chemical resistance
- Stiff, strong and wear resistance
- Balance of strength and toughness
- Dimensional stability

Table 1. POKETONE Polymer Properties

Property	ISO Test method	Unit	M71RS0A -BKO	M63AX0A -BKO
Density	1183	g/cm ³	1.22	1.24
Melting Temp.	11357	°C	197	222
HDT (0.45 Mpa)	75	°C	190	200
Tensile strength	527-1	MPa	54	58
Elongation at break	527-1	%	>200	>120
Flexural Strength	178	MPa	40	53
Flexural Modulus	178	MPa	850	1250
Impact Strength	179-1eA	KJ/m ²	18	24

Fuel test program in various fuel blends and chemicals

Table 2. Fuel

Criteria	
Test Lab	Element, Minnesota. www.element.com
Test protocol	WSS-M98P14-A1/A10 Rev. 1 dated 08/15/14.
Immersion conditions (Temp hrs/Fuel)	1) +60°C / 5,040 hrs / CM15A, CE10, B20 2) +60°C / 336hrs / Fuel C, CP Fuel, CM30A, CM50A, CM85A, CE22A, CE93A, CM20AME15 3) +90°C / 5,040hrs / B30A
Factors measured	Tensile strength, Elongation at break, ISO notched Charpy and Dimensional stability

Fuels

CM15A	85% Fuel C + 15% methanol(A) (A) Aggressive Me-OH(1ℓ) = Anhydrous Me-OH (995ml) + Formic acid (0.028ml/ℓ) + Aggressive water (5ml) * Aggressive water(1ℓ) = Distilled water + NaCl (0.99g) + Na2SO3(0.888g) + NaHCO3 (0.828g)
B30A	Biodiesel fuel blend (70% ULSD, 30% SME, and an aggressive additive package) * ULSD : aromatics 27.5%, saturated hydrocarbons 70.8%, and olefins 1.7% by volume * SME : Soy Methyl Ester
Fuel C	50Vol.% Isooctane 50Vol.% Toluene
CP Fuel	"sour fuel" to simulate higher level of acidity resulting from alcohol oxidation to acid
CM30A	70% Fuel C + 30% methanol(A) C=Fuel C, M=Me-OH, A: Aggressive Me-OH(1 ℓ)= Anhydrous Me-OH(995ml)+Aggressive water(5ml) *Aggressive water(1 ℓ)=Distilled water(990ml) + Formic acid(10ml)+NaCl(1mg)+Na2SO4(8mg)
CM50A	50% Fuel C + 50% methanol(A)
CM85A	85% Fuel C + 15% methanol(A)
CE22A	78% Fuel C + 22% ethanol + aggressive water
CE93A	7% Fuel C + 93% ethanol + aggressive water
CM20AME15	20% methanol composition
CE10	90% Fuel C + 10% Ethanol
B20	Biodiesel 20% petroleum diesel 80%

Table 3. Chemicals

Chemicals	
1	Gasoline (or Fuel C)
2	Bio-Diesel (B30)
3	Coolant (50/50 by wt%, coolant/ distilled water)
4	Engine Oil
5	Transmission Fluid
6	Battery Acid (6% H2SO4 by volume in distilled water)
7	Brake Fluid
8	Urea SCR fluid (30% by wt% Urea)

Table 4. contents & target

Gasoline/Flex Fuel Applications–Fuel Immersion of Plastics	
Tensile & Elongation ;	-25% max change from 336 h test interval
Notched Charpy ;	-25% max change from 336 h test interval
Volume Swell ;	+/-25% max change from 336 h test interval
Chemical Resistance and Properties after Fluid Exposure	
Tensile Strength at Break ;	-25% max change from initial
Tensile Elongation at Break ;	-25% max change from initial
No cracks, crazing, blistering, or irreversible softening (depolymerization) after chemical exposure and recovery after 24 hours at +23°C and atmospheric pressure	
Ozone Resistance- Plastics, molded, fuel preconditioned	
Fuel Permeation of Plastic and Elastomeric Plaques ; Acceptable rating = 000	

Table 5. Standard

Tensile Strength, Elongation, Volume test Standard	
Tensile, Elongation	ISO R 527 speed 50 mm/min.
Impact – Notched Charpy	ISO 179-1eA, 23°C±2°C
Volume Swell	ISO 1887
Chemical Resistance and Properties after Fluid Exposure	
Tensile strength at break	ISO R 527 speed 50 mm/min.
Elongation at break	ISO R 527 speed 50 mm/min.
Ozone Resistance- Plastics, molded, fuel preconditioned	
ISO 527 : Preconditioned in Fuel C, SAE J1681/ 1000h @+60°C	
Ozone exposure ASTM D1149 / Inspect & rate ASTM D1171	

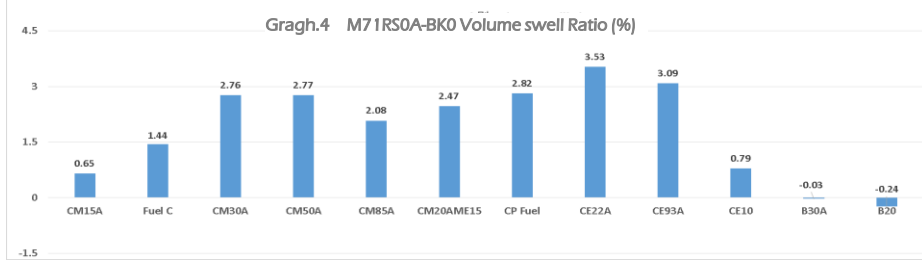
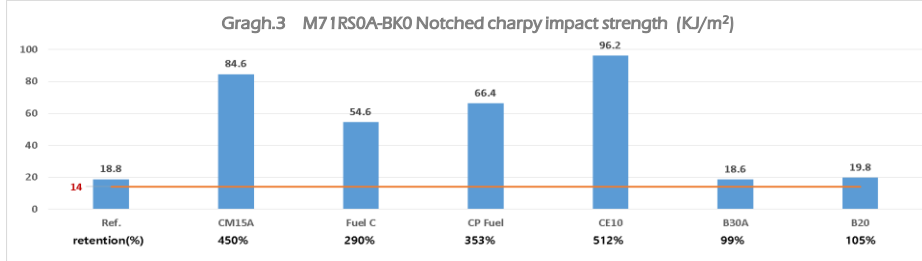
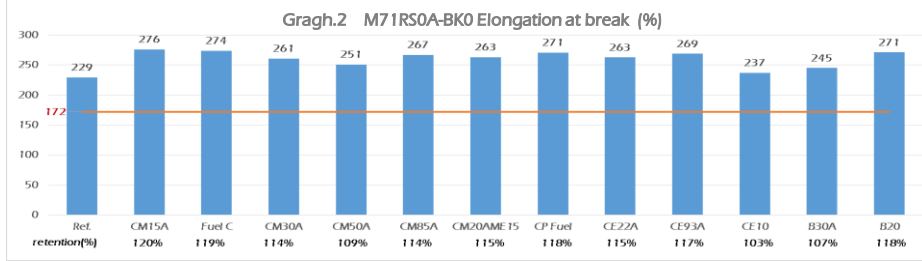
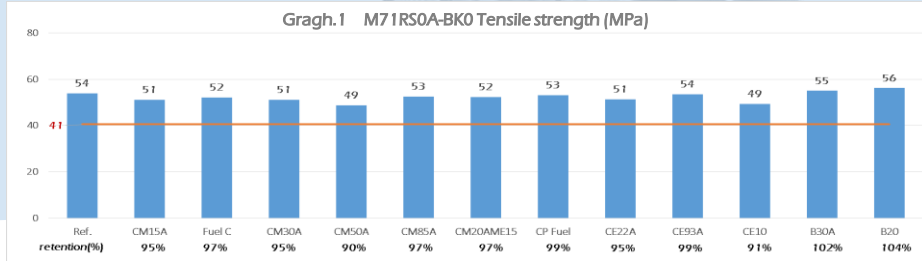
Excellent fuel resistance to various fuel type ; M71RS0A-BK0

Fuel

POKETONE Polymers showed at many current and potential fuel blends; Twelve fuels were tested under WSS-M98P14-A1/A10 Rev. 1.

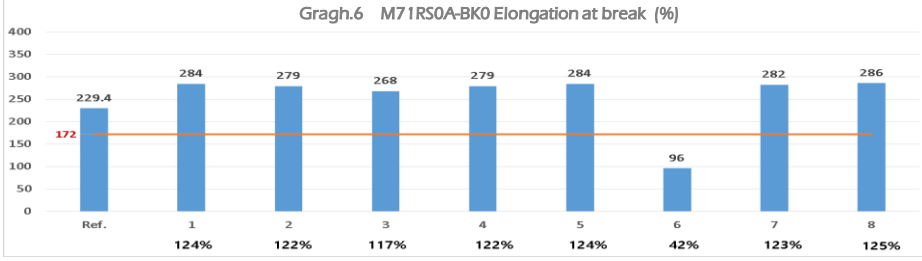
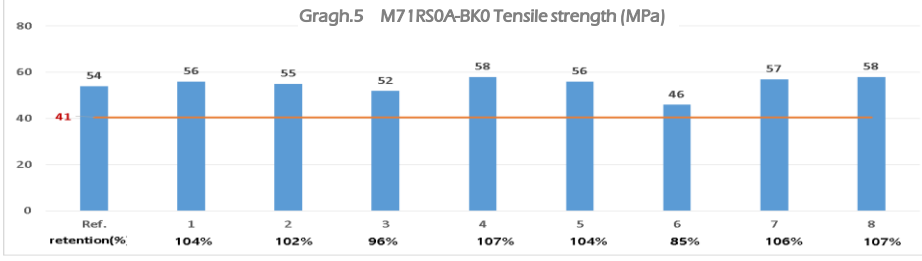
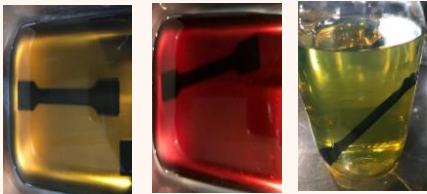
- Five methanol and aggressive water blends ; CM15A, CM30A, CM50A, CM85A, CM20AME15
- Three ethanol and (aggressive water) blend ; CE22A, CE93A, CE10
- Two Biodiesel ; B30A, B20
- Fuel C and CP Fuel

M71RS0A-BK0 demonstrate Excellent tensile strength retention rate overall 5,040 hours moreover wide range of methanol (15%~50%), ethanol (10%~93%), Bio-diesel, Fuel C and CP Fuel as well as elongation at break, impact strength and volume swell ratio.



Chemical

M71RS0A-BK0 demonstrate Excellent retention rate of tensile and elongation overall 168 hours in various fluids except battery acid, slightly decreased the elongation ; No cracks, crazing, blistering, or irreversible softening (depolymerization) after chemical exposure and recovery after 24 hours at +23°C and atmospheric pressure were noted to the specimens tested.



Ozone resistance

M71RS0A-BK0 demonstrate Inspect and rate per ASTM finally Rating for specimen numbers Ozone: 1-1 to 1-5 = 000 ; The test specimens met the requirements specified



<Pre conditioned in Fuel >



<Ozone resistance, Post Test >

POKETONE FOR THE FUEL APPLICATIONS

Excellent fuel resistance to various fuel type ; M63AX0A-BK0

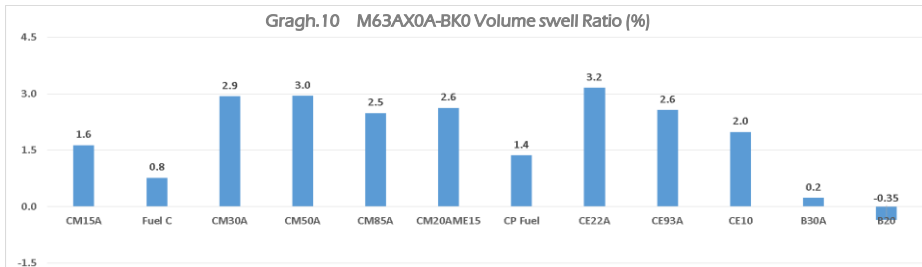
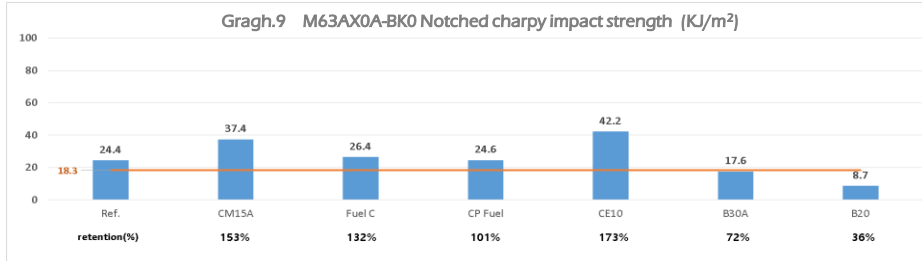
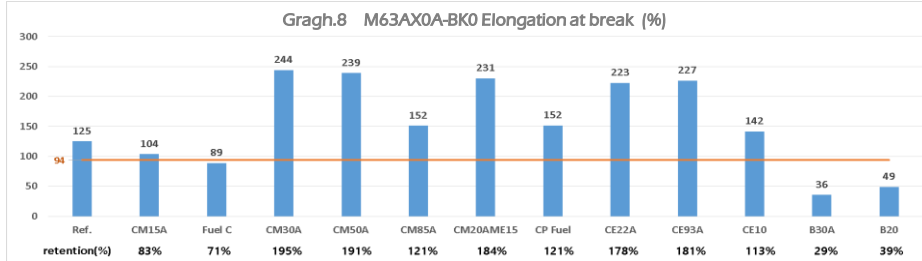
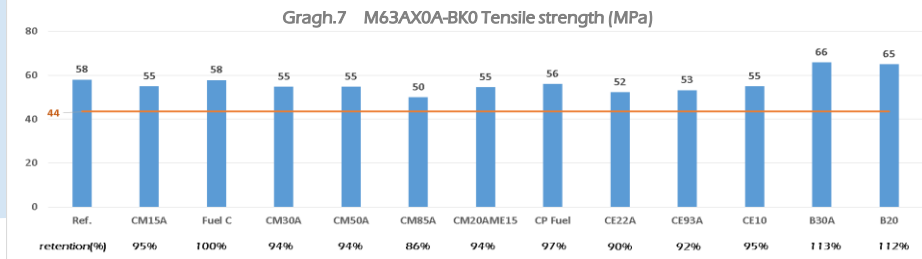
Fuel

M63AX0A-BK0 demonstrate Excellent tensile strength retention rate overall 5,040 hours moreover wide range of methanol (15%~50%), ethanol (10%~93%), Bio-diesel, Fuel C and CP Fuel.

But Elongation retention is very stable in wide range of methanol and ethanol fuel blends but very slightly decreased in Fuel C and showed decrease of retention in Bio-diesel and also at charpy impact test, the retention still decreased in Bio-diesel B30A, B20.

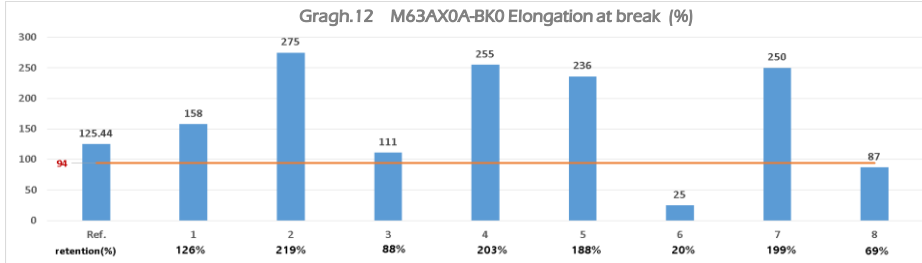
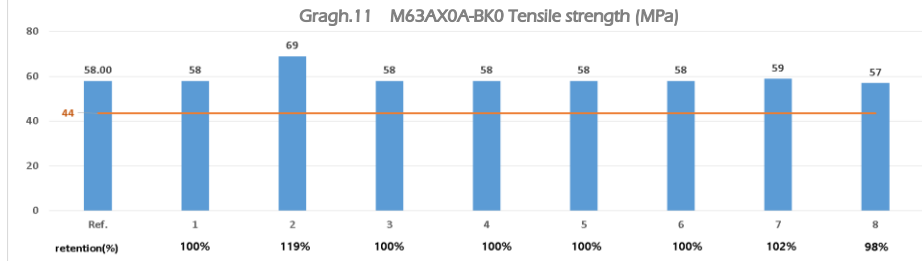
And dimensional stability, volume swell ratio is very stable similar M71RS0A-BK0. So M63AX0A-BK0 is excellent stable properties in methanol and aggressive water blends, ethanol and (aggressive water), Fuel C and CP Fuel

Comparison to M71RS0A-BK0, M63AX0A-BK0 is much higher HDT, initial tensile strength, flexural strength, flexural modulus and impact strength



Chemical

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Ozone resistance

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