Higher Fluorine Content Fluoroelastomers

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In the early 1950's, fluoroelastomer polymers were introduced by the M. W Kellog Company. In 1957, DuPont introduced their fluoroelastomer polymer, Viton®. This new polymer family met the high performance sealing applications need of the aerospace industry. Since that time fluoroelastomers have spread to many industries including automotive, chemical handling and processing, petroleum refining and transportation.

The benefits of fluoroelastomers come from their ability to maintain physical properties at high temperatures and resistance to a broad range of chemicals. Traditionally, one of the drawbacks of fluoroelatomers, relative to other elastomeric polymers, has been its low temperature limitations.

Additional benefits include:
Low permeability to a broad range of substances, including oxygenated automotive fuels.
Exceptional resistance to atmospheric oxidation, sun and weather.
Excellent resistance to fungus and mold.
Low burning characteristics.

As the benefits have been established, the expectations and new applications continue to push the capability of fluoroelastomers to their limits. For example, smaller engine compartments and higher output engines have resulted in higher automotive under hood temperatures. The California Air Resource Board and Environmental Protection Agency are implementing longer life expectations to- 15 years or 150,000 miles. Wider use of MBTE, (methyl t-butyl ether), as an octane enhancer in fuel blends also affects certain grades of fluoroelastomers.

Oil well use of corrosion inhibitors attacks and embrittles standard fluoroelastomers. Finding the balance of properties has resulted new types and grades to meet theses more challenging applications.

Increasing the fluorine content of the polymer improves its resistance to fluids, (as demonstrated by reduced volume swells), but does not improve low temperature flexibility. Reeves refers to these higher fluorine polymers as "F types". Grades have also been developed to provide improved chemical resistance **and** improved low temperature properties. Reeves refers to these as "GFLT types".

Reeves Brothers Inc. has developed formulations utilizing both of these polymer types. Coated fabrics have been manufactured commercially. Unsupported rubber sheet, ranging in thickness from .016" to .125", could be manufactured. The compound is peroxide cured and does not contain any lead additives. Typical physical properties of these fluoroelastomer formulations are listed below:

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TABLE 1

Type Fluoroelastomer	Viton A	Viton A	“F”	“GFLT”
TYPE CURE	bisphenol	bisphenol	Peroxide	Peroxide
COLOR	Black	Black	Black	Green
Specific Gravity	1.90	1.88	1.90	1.89
Hardness, Shore A	91	70	65	63
Tensile, p.s.i.	1209	1197	1684	2099
Elongation, %	171	225	380	394
T90, ODR, 350°F, 3° arc, 30 minute	20'	24'	2.0’	1.7’
Cure conditions.	20' @ 350°F	20' @ 350°F	20’ @ 340°F	30’ @ 320°F
Post cure	4 hr @ 450°F	4 hr @ 450°F	none	none

TABLE 2

Fluoroelastomer name		Monomer Constituents	Percent Fluorine
Viton A	dimer	Vinylidene fluoride (VF2), Hexfluoropropylene (HFP)	66
Viton B	trimer	Vinylidene fluoride (VF2), Hexfluoropropylene (HFP), Tetrafluoroethylene (TFE)	68
Viton F	trimer	Vinylidene fluoride (VF2), Hexfluoropropylene (HFP), Tetrafluoroethylene (TFE)	70
Viton GF	trimer	Vinylidene fluoride (VF2), Hexfluoropropylene (HFP), Tetrafluoroethylene (TFE) + Fluorinated vinyl ether (CSM)	70
Viton B70	trimer	Vinylidene fluoride (VF2), Hexfluoropropylene (HFP), Tetrafluoroethylene (TFE), + Fluorinated vinyl ether,	66
Viton GLT	trimer	Vinylidene fluoride (VF2), Hexfluoropropylene (HFP), Tetrafluoroethylene (TFE), + Fluorinated vinyl ether,	64
Viton GFLT	trimer	Vinylidene fluoride (VF2), Hexfluoropropylene (HFP), Tetrafluoroethylene (TFE), + Fluorinated vinyl ether,	67
ETP	trimer	Ethylene, Tetrafluoroethylene (TFE), perfluoromethylvinyl ether (PMVE)	67
VTR-8550	trimer	Vinylidene fluoride (VF2), Hexfluoropropylene (HFP), Tetrafluoroethylene (TFE)+improved cure site monomer(icsm)	70

References:

R. Stevens, DuPont Dow Elastomers, Long-Term Heat Aging of Various Fluoroelastomers, Rubber and Plastics News, February 21, 2005

DuPont Dow Elastomers, Technical Information VTR-8600 and VTR-8605

L.E. Crenshaw and D.L. Tabb, “Fluoroelastomers”, Vanderbilt Rubber Handbook, thirteenth edition