Comparison between Aeroflex & NBR/PVC products

Specifications	Aeroflex	NBR/PVC Products	Remarks
Raw Material	EPDM - Few double bonded molecular structure in a strand	NBR + PVC - Has more double bonds in a strand	- When compared NBR/PVC has more double bonds than EPDM & when the cross-linking occurs, not all of the bonds are linked hence there is a high probability of surface and mass deterioration in short time. - Whereas EPDM has few double bonds and most of the double bonds are linked hence a very low chance of surface and mass deterioration.
Chemical Name of Raw Material	Ethylene Propylene Diene Monomer or generally known as Ethylene Propylene Terpolymer	Acrylonitrile (Vinyl Cyanide) + Poly Vinyl Chloride	- The main raw material of NBR has a chemical name as Acrylonitrile (Vinyl Cyanide) which itself is a toxic chemical and is listed in United States Fire Administration as a Hazardous material.
Density	3 ~ 6 Pounds/Cu. Feet (48 ~ 96 Kg. / Cu. Mt.)	Each brand has different density but most of them are in the range of 2.5 ~ 8 Pounds/Cu. Ft. (40 ~ 128 Kgs./Cu. Mt.)	- According to theory of Thermal Insulation, generally a density of 3 ~ 6 Pounds/Cu. Feet (48 ~ 96 Kg. / Cu. Mt.) is considered as the ideal density for low thermal conductivity. Aeroflex uses this theory and applies it to production process while considering the water vapor absorption and permeability properties. If density is lower than 3 Pounds / Cu. Ft. (48 Kgs. / Cu. Mt.), the cell wall will be thin and will break due to vapor pressure in the atmosphere causing the insulation to absorb water vapor / moisture resulting in higher thermal conductivity and rise in energy bills. If the density is higher than 6 Pounds/Cu. Ft. (96 Kg. / Cu. Mt.) the cell wall will be thicker, hence promoting higher conduction, convection rate and bigger cells, which will increase the thermal conductivity.
Cell Structure	Small cell structure (Closed cell structure)	Bigger and rough cell structure (Closed cell structure)	- Aeroflex is made with fine cell structure, which promotes slow conduction period & high resistance to flow of heat transferred by convection from one side of the cell to the other – resulting in low and stable thermal conductivity throughout. - On the other hand when the cell structures are big, there are fewer of them in the insulation causing heat transfer from one cell to other, faster & causing the heat flow from one side of the cell to the other at a faster rate – resulting in higher thermal conductivity.

Outside and Inside surface of insulation tube	Dense skin inside as well as outside	Dense on the outside but no or very sparse (thin) skin on the inside	- Aeroflex has a very dense skin on the outer surface of the tube as well as on the inside surface thus creating a perfect vapor & moisture barrier on cooling lines. - While NBR/PVC has a dense skin on the outside but most of the manufacturers compromise on the inside skin. The thin inside skin has the vulnerability of absorbing moisture and vapor from the inside, if there is residue of moisture present between the insulation and piping during installation. Further the polarity of the material itself attracts water absorption.
Polarity to Water	Non-Polar	Polar (Molecules have similar polarity as water)	- As the molecules of NBR/PVC has similar polarity as water, it tends to absorb water and looses its insulation property and increase the thermal conductivity - On the other hand Aeroflex is made from EPDM, which is a non-polar material and has different polarity as water molecules hence it does not react with water and retards water vapor and moisture.
Weather & UV Resistance	Excellent	Moderate	- Aeroflex is made of EPDM which itself has a very good UV and Weather resisting property. EPDM is used in making various automotive parts including window strips where UV & Weather resistance is required. Aeroflex has been installed in some of the severe regions where the weather patterns are extreme (-15^{o}C in winter & +45^{o}C in summer). - As NBR is a polar material– the insulation deteriorates and cracks when exposed to weather or ozone. It is recommended to paint the insulation or install a barrier against weather and ozone.
Thermal Conductivity	0.037 W/mK at 24^{o}C (0.25 BTU. in/ft^{2}. hr. ^{o}F at 75^{o}F) in accordance with ASTM C177 & DIN 52613	Each brand of NBR/PVC based insulation has different thermal conductivity ranging from 0.037 ~ 0.045 W/mK at 24^{o}C (0.25 ~ 0.30 BTU. in/ft^{2}. hr. ^{o}F at 75^{o}F) in accordance with ASTM C177 & DIN 52613	- Aeroflex uses EPDM as its main raw material with a blending technology cross-linking the cell structure to produce a closed cells with a dense surface skin on outer as well as inner surface. - While NBR/PVC is also vulcanized to create cross-linking structure but due to too many double bonds in the raw materials – not all are bonded and cross-linked, producing a sparse skin outside as well as inside with a bigger cell structure resulting in a higher thermal conductivity.
Temperature Range	-57^{o}C ~ 125^{o}C (-70^{o}F ~ 257^{o}F)	-40^{o}C ~ 105^{o}C (-40^{o}F ~ 221^{o}F)	- Glass transition of NBR/PVC is approx. –20^{o}C (–4^{o}F) i.e. at this temperature the insulation becomes hard & brittle and is difficult to install. - Glass transition of EPDM is approx. –50 ^{o}C ~ -60^{o}C (-58^{o}F ~ -76^{o}F).

			- Most of the rubber insulation are cross-linked polymer (Thermosetting) thus it will not melt at high temperatures. Service Temperature of NBR is 105^{o}C, while for EPDM is 125^{o}C
Physical Strength	Fair	Excellent	- NBR/PVC based insulation has better tensile strength and better reformation. AEROFLEX insulation has a weaker physical strength but it is easy to cut for neat and tidy job.
Corrosion of Copper, Steel	Very good resistance to corrosion	Fair resistance to corrosion	- Aeroflex uses a small amount of Chlorine and Bromine in the production process. In fact Aeroflex can be used on Stainless steel pipes without any cause of concern for corrosion. - NBR/PVC blended product has a very high amount of Chlorine (as PVC itself has a Chloride in it – Poly Vinyl Chloride) & Bromine as fire retardant resulting in corroding copper and stainless steel pipes. The manufacturers of NBR/PVC products recommend not using their product for Stainless Steel piping or ducting.
Water Absorption	Less than 5% by weight	Each brand has its own water absorption rate ranging from 5~20% by weight	- Due to closed cell structure, dense skin (outside as well as inside) & non-polarity of the raw material – Aeroflex has a better resistant to water absorption compared to NBR/PVC based insulation.
Water Vapor Permeability Moisture Resistance	0.10 Perm-inch More than 5000	Each brand has different water vapor permeability value ranging from 0.10 ~ 0.30 Perm-inch Ranging from 1,000 ~ 7,000	- Water Vapor Permeability and Moisture resistant value play an important role in the quality of insulation. If WVP is high – the resulting moisture penetration is also high. Alternately low moisture resistance will have higher moisture penetration.
Nitrosamine Content	No Nitrosamine found according to US FDA test standard	Most of the rubber insulation has Nitrosamine content ranging from 100 ppb up to 20,000 ppb.	- Its been scientifically proven that Nitrosamine can cause cancer.
Flammability, Smoke Density & Toxicity	UL94-V0 – Passed	UL94-V0 - Passed	
	ASTM E-84 25/50	Only few manufacturers of NBR/PVC blend technology have passed ASTM E-84 25/50 fire rating	- This standard was created; keeping in mind not only the flames spread but also smoke density. In most cases of accidental fire, it's the toxic smoke that causes casualty rather than fire itself. Its been noted, in several proven cases, that during an accidental fire the victims fell unconscious because of the smoke than the fire itself making them unable to save

Flammability, Smoke Density & Toxicity cnt'd			their own lives. - To pass this standard the samples are burnt in a 24-feet long chamber and the flame spread & smoke density is measured, which should be no more than 25 & 50 respectively. - NBR/PVC blend use halogen as their main flame retardant and these halogen create a high percentage of toxic smoke density, when burnt, preventing most manufacturers in passing this standard. Additionally even the small amount of this smoke is considered toxic to human health.
	IMO FTP, Annex 1, Part 5 & Part 2	Few manufacturers of rubber insulation have passed Part 5. And Part 2.	- IMO stands for International Marine Organization and it's a fact that more lives are lost on sea due to onboard fire. Keeping this in mind IMO has created this test where the criteria is to have the least minimum fire spread and lowest level of toxicity. Although Aeroflex test results came fairly on fire rating but the toxicity results were much better than the acceptable criteria. - The few NBR/PVC manufacturers, who opted to test for this particular test, went with Part 5 only. Its to be noted that Part 5 of IMO FTP Code deals with Flame spread and not considering any toxicity or smoke density. On the other hand Part 2 deals with Smoke and Toxicity levels. Due to the intense use of halogenated-based flame retardant and the toxic raw material itself – it is not possible for NBR/PVC products to pass this standard.