

# Aflex Hose and BIOFLEX<sup>®</sup>

## The World's Leading Manufacturer of PTFE Flexible Hose



Aflex Hose, founded in 1973, pioneered the concept of PTFE lined flexible hose for the transfer of process fluids more than 30 years ago.

Corroflon convoluted PTFE hose and other types of PTFE hose, manufactured and supplied by Aflex, are used by major Chemical, Pharmaceutical and Food companies worldwide.

Over the years, hundreds of thousands of custom-built hoses have been designed and built to cope with the most difficult of operating conditions, and Aflex have continuously developed and expanded their product range having pioneered and introduced Antistatic hose, Polypropylene Braided hose and many other innovations in response to customer demands.

In 2001, Aflex fulfilled the most stringent demand yet.

Customers, worldwide, had always asked for the ultimate PTFE lined flexible hose... one product which incorporates the advantages of both convoluted and smoothbore designs. A product which is sufficiently flexible, like convoluted, yet which retains the advantages offered by smoothbore, like fast flow rate and cleanability.

After years of painstaking research and development, Aflex launched such a hose ... **Bioflex**.

Bioflex is a smooth bore, highly flexible, PTFE lined hose. Its design overcomes the disadvantages of conventional smooth bore and convoluted PTFE flexible hose designs, dramatically improving on many of their individual technical performance parameters.

The key feature of Bioflex PTFE hose is the PTFE liner design, which comprises integral rib sections which support the tube against kinking, vacuum and pressure, and highly compressed web sections which give a smoothbore inner surface and excellent flexibility.

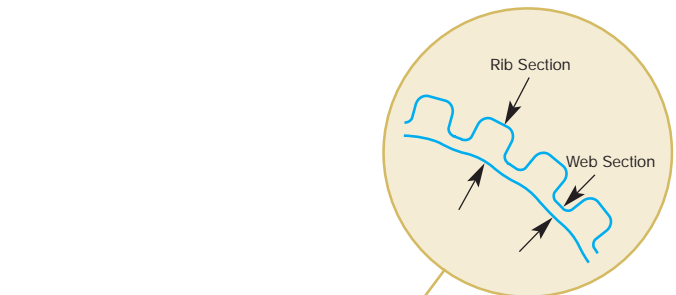
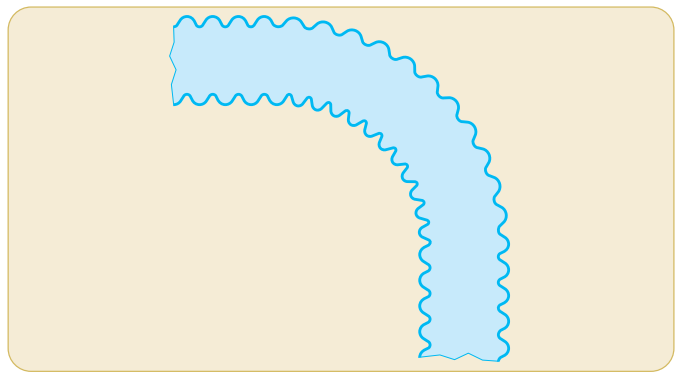
Another feature is the integral PTFE lined and flared end fitting design (see next page) which is available for all the standard end fittings on Bioflex Hose Assemblies.

This provides clean, full-bore flow through the end fitting without any entrapment points - unlike conventional fittings, which introduce a bore restriction, also a crevice at the end of the fitting tail.

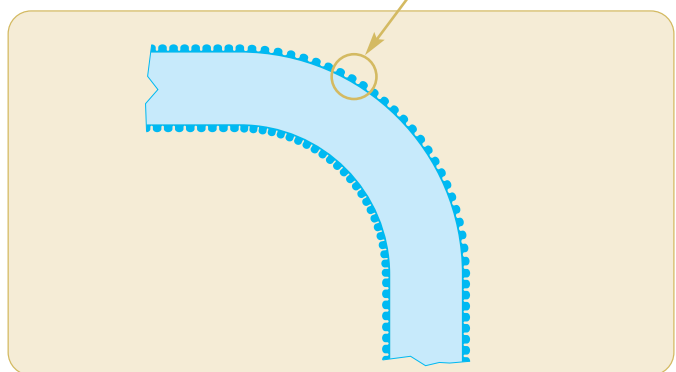
This PTFE lining also protects the end fitting from any corrosive media passing through the hose bore.

Today, Bioflex has become the established standard in process fluids applications all over the world, and continues to be introduced into new applications every day.

### Conventional Convoluted PTFE Liner



### Bioflex PTFE Liner

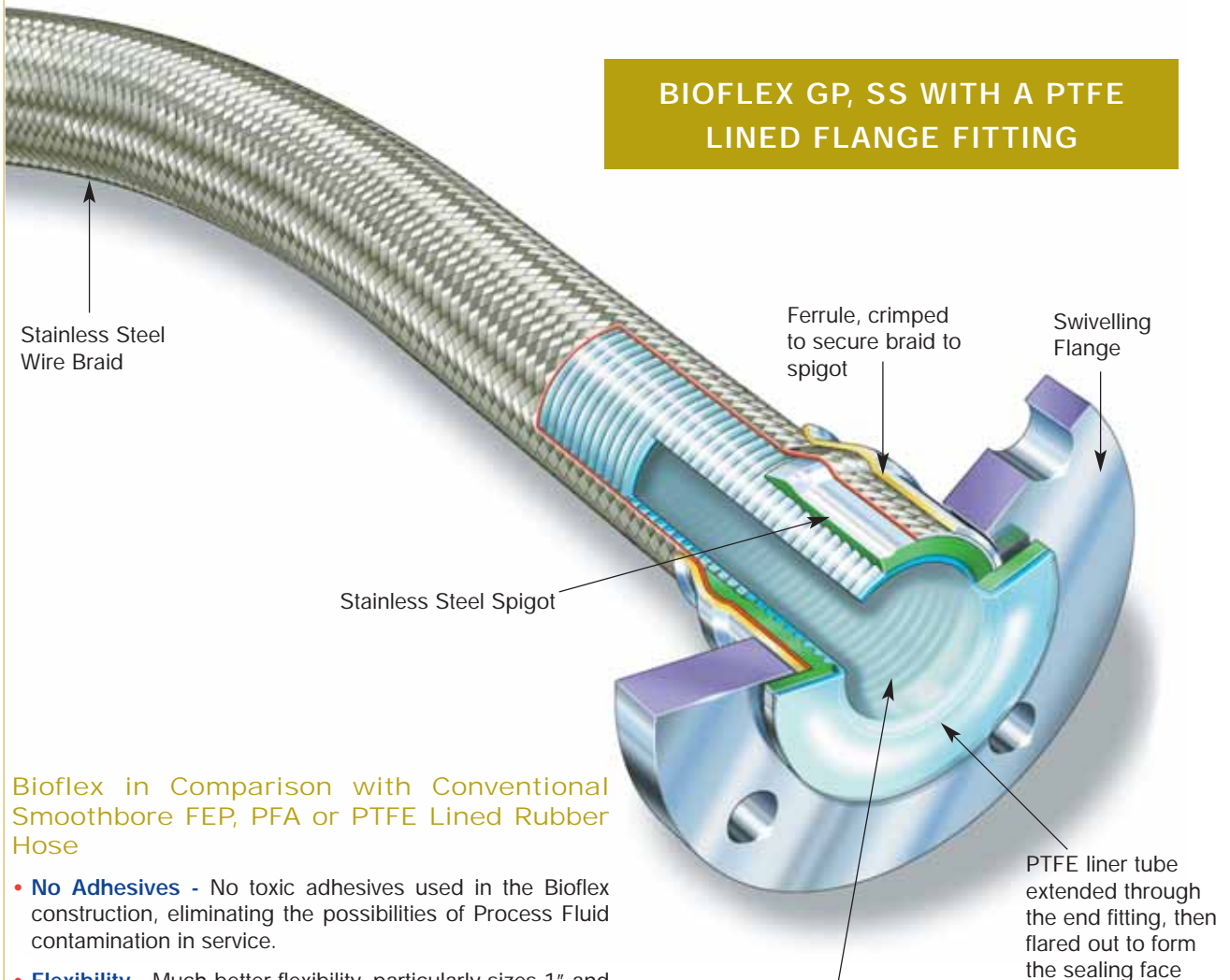


**® Bioflex is a Patent Protected Product**

# Bioflex Hose-Design and Comparative Properties

## Bioflex in Comparison with Convoluted PTFE Hose

- **Hygienic Cleanability** - much better, due to no internal convolutions.
- **Flow Rates** - more than 2x higher.
- **Pressure Ratings** - more than 1.5x higher.
- **Gas Permeation Resistance** - more than 3x better.
- **Self Draining** - 100% self draining when at an angle (The Internal Convolutions in Convoluted hose retain fluid).



## Bioflex in Comparison with Conventional Smoothbore FEP, PFA or PTFE Lined Rubber Hose

- **No Adhesives** - No toxic adhesives used in the Bioflex construction, eliminating the possibilities of Process Fluid contamination in service.
- **Flexibility** - Much better flexibility, particularly sizes 1" and above.

## Bioflex in Comparison with Silicone Rubber Hose

- **Hygienic Cleanability** - much better, due to the non-stick PTFE Liner.
- **Chemical Resistance** - considerably improved, particularly to strong oxidising acids and bases.
- **Temperature & Pressure Ratings** - much higher temperature and pressure capability.
- **Steam Resistance** - permanently resistant to steam sterilising (unlike silicone hose, which has a limited life).

### Bioflex PTFE liner tube:

- externally convoluted
- smooth bore, with slight ripples
- internal surface finish is 'mirror smooth', generated by hot polishing during manufacture

# Bioflex Hose - Special Test Programs (1)

Bioflex has been designed to fulfil the most demanding of customer expectations and, as such, has been subjected to a highly complex and rigorous Proof Testing Programme in comparison with competitive hose products.

## Test No. 1. The 'Rolling U' Test.

Bioflex samples were run side by side with competitors' products, including smoothbore FEP, PTFE or PFA lined Rubber hose products, and also smooth flex products, on a 'Rolling U' test rig.



The 1" bore samples were "Rolled" at the minimum bend radius and at the maximum working pressure quoted for the competitor's product.

Results were as follows:

- Rubber Covered Bioflex Hose - 1,500,000 cycles, no failure.  
- No leakage occurred, so test discontinued. No signs of damage, or wear.
- Competitor's smoothbore FEP lined Rubber Covered Hose - 9,149 cycles to failure.  
- Hose leakage caused by severe failure of the hose liner, breakage of the helix wire and damaged rubber and braid.
- Competitor's convoluted smooth flex type hose, SS Braid - 7,151 cycles to failure.  
- Hose leakage caused by very severe failure of the hose liner and braid components.

These remarkable results confirm the claims made by Aflex, that Bioflex is the best designed, toughest and most reliable PTFE lined hose product available today.

# Bioflex Hose - Special Test Programs (2)

## Test No. 2. The Permeability Test.

Fixed lengths of Bioflex were pressurised to 30 Bar with Helium Gas, and compared with samples of standard convoluted PTFE hose.

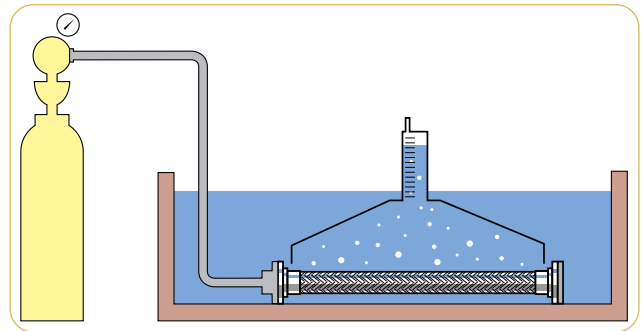
### Results

Bioflex has more than 2.5 x the permeation resistance of standard convoluted hose. Under identical conditions, the permeation levels were:

1" Bioflex = 138 millilitres of helium per metre per hour

1" Convoluted = 371 millilitres of helium per metre per hour

The permeability, or diffusion of gases and some fluids through PTFE is a problem in certain, very specific applications. Bioflex hose offers significant advantages in such applications.



## Test No. 3. The Flow Rate Test.

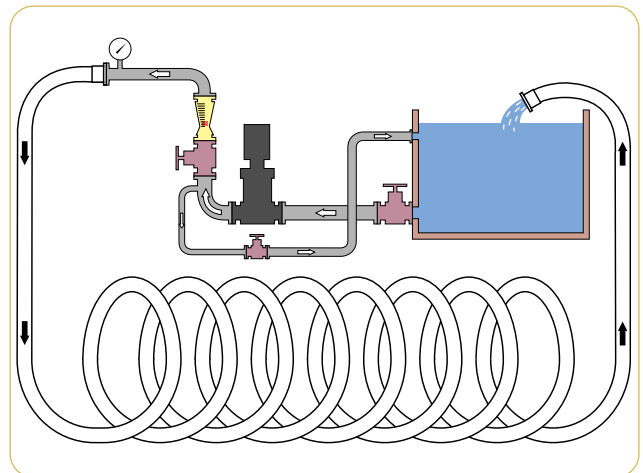
The test apparatus illustrated opposite was used to measure the flow rate of Bioflex, both in a straight configuration and coiled to its Minimum Bend Radius. The test medium was water.

### Results

Comparisons were made with samples of standard convoluted hose with the same diameter on the inside of the convolutions as the Bioflex inside diameter. These show that Bioflex is capable of delivering 2 - 3 times the flow rate of convoluted hose, in both the hose configurations.

Additional tests have shown that the flow rate through a Bioflex hose is actually greater than that of a convoluted hose which is one size larger. For example, 1½" Bioflex has a higher flow rate than 2" convoluted hose. It is therefore possible to use a smaller Bioflex hose, fitted with full size end fittings, to replace a convoluted hose more effectively, and more economically!

This remarkable improvement is due to the fact that the turbulent flow created by the convolutions in the standard product is virtually eliminated by the much smoother bore of Bioflex.



# Bioflex Specifications.

## Temperatures, Pressures & Flow Rates

### Temperature vs Pressure

Due to its extremely strong construction, Bioflex has outstanding resistance to temperature and pressure, much higher than that of conventional convoluted PTFE lined hose.

### Maximum Working Pressure (MWP) Variation with Temperature:

Hose with SS Braid as per Graph.

Hose with PB Braid, pressure as listed (Page 10) from -30°C to +80°C and 50% less from 80°C to 100°C.

Hose with RC, FP and SI grades as per Graph, BUT only within the temperature range for the particular grade of rubber cover, as given below.

### Maximum Operating Temperatures (Internal Fluid Only):

SS	-70°C to +260°C
PB	-30°C to +100°C
SS,RC & SS, FP	-40°C to +140°C
SS, SI	-40°C to +200°C
KYB	-40°C to +120°C

(Subtract 20°C from the above maximum temperature limits if the temperature is external to the hose).

### Flow Rates

In practice, flow rates will vary with hose flexing, fluid viscosity, end fitting design and other parameters, but Bioflex hose flow rates are always around 2 times better than convoluted PTFE hose, when comparing hose assemblies with PTFE lined (non bore-restricted) end fittings.

#### Bioflex Hose - Flow Rate Calculation

If it is required to determine the flow rate of a particular hose assembly, or if it is required to determine the pressure required to generate a certain flow rate, then this can sometimes be approximately calculated by the Bioflex supplier.

It should be noted that calculations can only be made for fluids with a viscosity equal to water, and for hose assemblies with PTFE lined end fittings (no bore restrictions at the ends of the hose).

The following information should be given to the supplier:

To calculate the Flow Rate in Cubic Metres per Hour:

- Pressure in Bars at the Entry into the Hose Assembly
  - Pressure in Bars at the Exit from the Hose Assembly
  - The hose configuration (roughly straight, or 33% Bends, or 66% Bends, or 100% Tightly Coiled)
- > (Subtracted to calculate Pressure Drop over the Hose Length)

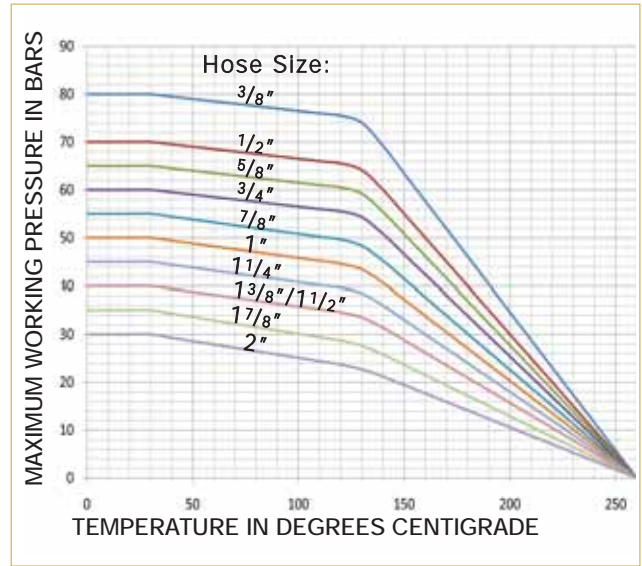
OR To Calculate the Pressure Drop in bars over the length of the Hose Assembly:

- Required Flow Rate in Cubic Metres per Hour
- The hose configuration (roughly straight, or 33% Bends, or 66% Bends, or 100% Tightly Coiled)

### Non-Whistling

The 'whistling' noise created by turbulent flow when steam or other gases are passed through a convoluted hose is completely eliminated when using Bioflex.

Temperature & MWP Graph for Bioflex GP, SS and AS, SS



### Temperature vs Vacuum

All sizes of Bioflex GP, SS and AS, SS are usable at full vacuum up to 130°C. Above this, the vacuum resistance should be reduced 1% for every degree above 130°C.

Other hose grades the same, BUT ONLY within the temperature limits for the particular hose grade.

# Bioflex Sizes, Grades, Bend Radius and Dimensions

Nominal Hose Bore Size		Actual Bore Size		Bioflex Grade (Braid & Cover)	O/D of Tube, Braid or Rubber		Minimum Bend Radius		*Maximum Continuous Hose Length	
in	mm	in	mm		in	mm	in	mm	Ft	Mtrs
3/8	10	3/8	9.5	TO	0.47	12.0	1 3/8	35	60	18
				SS	0.50	12.8	3/4	19	60	18
				RC	0.68	17.4	3/4	19	60	18
1/2	15	1/2	12.7	TO	0.60	15.5	2 3/8	60	60	18
				SS	0.65	16.6	1 1/2	38	60	18
				PB	0.77	19.5	1 1/2	38	60	18
				RC/FP	0.83	21.0	1 1/2	35	60	18
				SI	0.83	21.0	1 1/2	35	60	18
				KYB	0.69	17.5	1 1/2	35	60	18
5/8	16	5/8	16.0	TO	0.76	19.4	2 1/2	64	60	18
				SS	0.81	20.6	1 3/4	45	60	18
				PB	0.92	23.3	1 3/4	45	60	18
				RC/FP	0.98	25.0	1 3/4	45	60	18
				SI	0.98	25.0	1 3/4	45	60	18
				KYB	0.85	21.5	2 1/2	64	60	18
3/4	20	3/4	19.0	TO	0.91	23.2	3	75	60	18
				SS	0.96	24.5	2	50	60	18
				PB	1.10	27.9	2	50	60	18
				RC/FP	1.20	30.4	2	50	60	18
				SI	1.20	30.4	2	50	60	18
				KYB	1.62	26.0	3	75	60	18
7/8	22	7/8	22	TO	1.06	27.0	3 1/2	90	60	18
				SS	1.11	28.2	2 3/8	60	60	18
				PB	1.26	32.0	2 3/8	60	60	18
				RC/FP	1.31	33.2	2 3/8	60	60	18
				SI	1.31	33.2	2 3/8	60	60	18
				KYB	1.17	29.7	3 1/2	90	60	18
1	25	1	25.4	TO	1.22	31.0	4 3/4	110	60	18
				SS	1.27	32.3	2 3/4	70	60	18
				PB	1.48	37.7	2 3/4	70	60	18
				RC/FP	1.47	37.7	2 3/4	70	60	18
				SI	1.47	37.7	2 3/4	70	60	18
				KYB	1.31	33.4	4 3/4	110	60	18
1 1/4	32	1 1/4	32	TO	1.47	37.3	5 1/2	140	60	18
				SS	1.56	39.5	4	100	60	18
				PB	1.74	44.3	4	100	60	18
				RC/FP	1.75	44.3	4	100	60	18
				SI	1.75	44.5	4	100	60	18
				KYB	1.56	39.7	5 1/2	140	60	18
1 3/8	35	1 3/8	34.9	TO	1.62	41.2	6 1/2	160	60	18
				SS	1.70	43.1	4 3/4	120	60	18
				PB	1.88	47.8	4 3/4	120	60	18
				RC/FP	1.90	48.1	4 3/4	120	60	18
				SI	1.90	48.1	4 3/4	120	60	18
				KYB	1.69	42.9	6 1/4	160	60	18
1 1/2	40	1 1/2	38	TO	1.77	45.0	7	180	56	17
				SS	1.85	47.0	5 1/2	140	56	17
				PB	2.00	50.8	5 1/2	140	56	17
				RC/FP	2.05	52.0	5 1/2	140	56	17
				SI	2.05	52.0	5 1/2	140	56	17
				KYB	1.88	47.7	7	180	56	17
1 5/8	48	1 5/8	47.6	TO	2.17	55.2	11	280	43	13
				SS	2.25	57.1	7 1/2	190	43	13
				PB	2.44	62.0	7 1/2	190	43	13
				RC/FP	2.45	62.1	7 1/2	190	36	11
				SI	2.45	62.1	7 1/2	190	36	11
				KYB	2.25	57.3	11	280	43	13
2	50	2	50.8	TO	2.33	59.1	12	300	33	10
				SS	2.40	61.0	8	200	33	10
				PB	2.60	66.0	8	200	33	10
				RC/FP	2.60	66.0	8	200	26	8
				SI	2.60	66.0	8	200	26	8
				KYB	2.43	61.7	12	300	33	10

\*Maximum Continuous Lengths - for sizes from 3/8", 10mm up to 1", 25mm lengths of up to 36 mtrs, 120 ft, can be supplied to special order.

# Bioflex Sizes, Grades, Pressures & Weights

Nominal Hose Bore Size		Actual Bore Size		Bioflex Grade (Braid & Cover)	Maximum Working Pressure of Hose*		Burst Pressure		Weight per Unit Length	
in	mm	in	mm		Bar (N/m <sup>2</sup> )	psi	Bar (N/m <sup>2</sup> )	psi	Kg/Mtr	lb/ft
3/8	10	3/8	9.5	TO	5	72	20	290	.06	.04
				SS	80	1160	500	7200	.14	.09
				RC	80	1160	500	7200	.22	.15
1/2	15	1/2	12.7	TO	5	72	20	290	.15	.10
				SS	70	1015	400	5800	.29	.19
				PB	35	500	140	2000	.22	.15
				RC/FP	70	1015	400	5800	.39	.26
				SI	70	1015	400	5800	.39	.26
				KYB	10	145	40	580	.19	.13
5/8	16	5/8	16.0	TO	5	72	20	290	.17	.11
				SS	65	940	380	5500	.35	.23
				PB	33	480	130	1900	.25	.17
				RC/FP	65	940	380	5500	.47	.31
				SI	65	940	380	5500	.47	.31
				KYB	10	145	40	580	.20	.13
3/4	20	3/4	19.0	TO	5	72	20	290	.20	.13
				SS	60	870	300	4350	.40	.27
				PB	30	440	120	1750	.28	.19
				RC/FP	60	870	300	4350	.55	.37
				SI	60	870	300	4350	.55	.37
				KYB	10	145	40	580	.24	.16
7/8	22	7/8	22	TO	4	60	16	230	.28	.19
				SS	55	800	220	3200	.52	.35
				PB	27.5	400	110	1600	.38	.25
				RC/FP	55	800	220	3200	.74	.50
				SI	55	800	220	3200	.74	.50
				KYB	10	145	40	580	.33	.22
1	25	1	25.4	TO	4	60	16	230	.36	.24
				SS	50	720	200	2900	.63	.42
				PB	25	360	100	1450	.47	.31
				RC/FP	50	720	200	2900	.92	.62
				SI	50	720	200	2900	.92	.62
				KYB	10	145	30	430	.41	.27
1 1/4	32	1 1/4	32	TO	3	43	12	175	.45	.30
				SS	45	650	180	2600	.85	.57
				PB	23	330	90	1300	.72	.48
				RC/FP	45	650	180	2600	1.15	.77
				SI	45	650	180	2600	1.15	.77
				KYB	6	87	24	350	.53	.35
1 3/8	35	1 3/8	34.9	TO	2	29	8	115	.54	.36
				SS	40	580	160	2320	1.00	.67
				PB	20	290	80	1160	.86	.58
				RC/FP	40	580	160	2320	1.38	.92
				SI	40	580	160	2320	1.38	.92
				KYB	6	87	20	290	.68	.45
1 1/2	40	1 1/2	38	TO	2	29	8	115	.66	.44
				SS	40	580	160	2320	1.10	.74
				PB	20	290	80	1160	.90	.60
				RC/FP	40	580	160	2320	1.55	1.04
				SI	40	580	160	2320	1.55	1.04
				KYB	6	87	20	290	.78	.52
1 5/8	48	1 5/8	47.6	TO	2	29	8	115	.82	.55
				SS	35	500	140	2000	1.38	.92
				PB	18	250	72	1040	1.12	.75
				RC/FP	35	500	140	2000	1.94	1.30
				SI	35	500	140	2000	1.94	1.30
				KYB	6	87	16	230	.97	.65
2	50	2	50.8	TO	2	29	8	115	1.25	.84
				SS	30	430	120	1750	1.90	1.27
				PB	15	215	60	870	1.60	1.07
				RC/FP	30	430	120	1750	2.56	1.71
				SI	30	430	120	1750	2.56	1.71
				KYB	6	87	12	175	1.42	.95

\*MWP: the Maximum Working Pressure of a hose assembly is limited to the lowest of the MWP's of either of the two end fittings, as given for each end fitting design on pages 19-33, or of the hose itself as listed above. MWP of the hose reduces with Temperature as given on page 8

# Bioflex Hose: Special Usage Conditions

## Cleaning & Sterilising Systems - CIP, SIP and Autoclave

CIP & SIP – The primary consideration is whether the cleaning and purging cycle is likely to develop an electrostatic charge on the internal surface of the liner, in which case AS is required.

AS hose and Static charge generating systems are fully described on page 15.

CIP systems using high electrical resistivity solvents like Toluene will require AS hose.

Another problem arises when the cleaning fluids or WFI or steam are purged out of the line using nitrogen, compressed air or another gas, because droplets of liquids or water in the gas then generate a multi-phase condition until they are cleared out, which will generate a static charge, and so will require AS hose.

In applications where an AS hose is not acceptable (in spite of the full approvals ratings, see page 12) it will be necessary to consult with Aflex Hose for a solution.

Autoclave – Autoclave sterilisation does not normally involve any high flow rates through the hose bore, so static is not a problem. Bioflex grades GP and AS, with SS or HB braids can be autoclaved an indefinite number of times throughout their normal service life.

The rubber covered grades, RC and SI, are also able to withstand many autoclave cycles at normal autoclave temperatures (121°C, 250°F), although eventually the rubber may discolour and/or degrade. Consult Aflex Hose for more specific information.

## PTFE Hose - Use with Halogens

PTFE hose liners can react chemically with Fluorine, Chlorine Trifluoride and Molten Sodium Metal, and so must not be used with these chemicals.

When PTFE lined hose is used with the halogens Chlorine and Bromine, or any corrosive halogen compounds which diffuse easily and are gaseous for example HF or HCL gas, or phosgene, then trace quantities may diffuse through the PTFE liner to the outside.

Only trace quantities are required, mixed with atmospheric moisture, to create a serious corrosion condition with stainless steel wire braid in particular.

If these conditions apply, consult Aflex Hose for a more suitable alternative hose product.

## “Penetrating” Fluids and Gases

Like other plastics and rubbers, in certain special circumstances PTFE is sometimes subject to diffusion through the tube wall, dependant upon the nature of the chemical, and the pressure and temperature of operation.

As mentioned above, Gaseous Halogens represent a specific problem. Automotive fuels, on the other hand, diffuse much less through PTFE than through other rubbers and plastics.

Some other types of penetrating fluids can also diffuse through PTFE to varying degrees, which may or may not present a problem. Known examples are sulphur trioxide, glacial acetic acid and methyl methacrylate.

Consult with Aflex Hose if these, or any other gases or fluids which are known to be penetrating are to be used.

## Gas/Fluid Cycling

There are some applications where the fluid passing through the hose turns into a gas, then back into a fluid, then into a gas etc., in a cyclic sequence.

This is normally associated with changes in temperature and/or pressure.

For complex reasons these conditions are extremely damaging to the hose liner, whatever material it is made from.

For example, hoses are sometimes used to pass steam, water, steam etc into rubber moulding presses, in order to heat the mould, then rapidly cool it before reheating in the next cycle. Hoses of all types fail rapidly in such an application, and PTFE lined hose is no exception.

Consult Aflex Hose for further information if these conditions apply.

## Connecting Assemblies for use in Applications

The lengths of hose assemblies, and their configuration and use when connected into the application must always be in accordance with the Hose Configuration information at the end of this literature.

When being connected for use in applications, the end fittings on hose assemblies must be connected to correct mating parts in the correct way, using the correct tools - spanners, clamps, nuts and bolts etc.

The connections must be sufficiently tightened to ensure that the joint is leak-free, but must not be over-tightened as this can damage the sealing surfaces, especially with PTFE lined and flared end fittings.

In applications involving the transfer through the hose of expensive or dangerous fluids or gases, the connections must be pressure tested first before being put in to service. This should be done with some harmless media, like water or compressed air, to 1<sup>1</sup>/<sub>2</sub> times the maximum working pressure of the hose assembly, as defined in this brochure.

If in doubt, consult Aflex Hose for advice.

## Special Applications

Aflex Hose PTFE lined hose products are not acceptable for use in the following, special applications:

- Radioactive Applications involving high energy radiation, including Gamma radiation (degrades PTFE).
- Medical Implantation Applications (Not tested for use).
- Aerospace Applications (exclusive contract applies).
- Applications on all types of USA Military Equipment, including tanks, vehicles, weapons, FCS equipment and all others (exclusive contract applies).



## **Bioflex and Quality Assurance, Certification and Approvals, and Hose Testing**

### **BS EN ISO 9001:2008**

Aflex products are all manufactured in accordance with BS EN ISO 9001: 2008 Quality Management Systems independently assessed and registered by National Quality Assurance Limited (NQA).

### **USP CLASS VI and ISO 10993-5, 6, 10 and 11 GUIDELINES**

Natural and Antistatic PTFE Hose Liners, Platinum Cured Silicone Rubber Covers (White and Clear) and EPDM Rubber Cover (Blue) have been independently tested in accordance with USP protocols and are found to conform to the requirements of USP Class VI Chapter <88>.

Natural and Antistatic PTFE Hose Liners now also meet the more stringent USP Class VI and ISO 10993-6,10 and 11 guidelines at 121°C (250°F) with a "no reaction" classification.

Natural and Antistatic PTFE Hose Liners and Platinum Cured Silicone Rubber Covers (White and Clear) have also been tested in accordance with USP protocols and are found to conform to the requirements of USP Class VI <87>, the L929 MEM Elution Test and are considered non-cytotoxic.

Natural and Antistatic PTFE Hose Liners have now been further tested and have passed the more stringent USP Class VI and ISO 10993-5 guidelines at 121°C (250°F).

### **FDA**

The Materials used to manufacture the natural PTFE Tube liner conforms to FDA 21 CFR 177.1550, and the antistatic PTFE liner conforms to FDA 21 CFR 178.3297.

### **3-A Sanitary Standards**

The PTFE used in the liner is manufactured solely from materials which meet the requirements of the 3-A Sanitary Standards.

### **BPSA LEACHABLES and EXTRACTABLES TESTING**

Aflex Hose Natural and Antistatic PTFE Hose Liner Tube has been independently tested in accordance with BPSA recommendations, and found to be satisfactory.

Copies of the Test Report are available for specific assessments to be made.

### **Pharmaceutical Manufacturers Approvals**

Most of the major pharmaceutical manufacturing companies in the world have audited and/or approved Aflex Hose as a Hose Supplier.

### **CE Marking (Europe only)**

Aflex has been assessed by Zurich Engineering and found to comply with the Pressure Equipment Directive 97/23/EC (European Community) Conformity Assessment Module D1, approved to CE Mark applicable hose products, accompanied by a Hose Usage Data Sheet, and a Declaration of Conformity.

### **Attestations of Conformity to ATEX Directive 94/9/EC (Potentially Explosive Atmospheres)**

Available for hose and assemblies for components used in Gas Zones 1 & 2 and Dust Zones 21 & 22, when applicable.

### **Material Certification to EN10204**

Available for all the hose or hose assembly components.

### **Certificates of Conformity to EN45014**

Are available for all products.

### **Fuel Hose Approval to SAE J1737**

Bioflex hose samples have been tested and approved to SAE J1737 for Automotive Fuel Hose applications.

### **Hose Testing**

Each assembly is pressure tested to 1.5 times maximum working pressure before despatch, and pressure test certificates can be supplied.