

HYPERLINE FX

PTFE Lined Smoothbore Flexible Hose



TEMPERATURE RESISTANT

CHEMICAL RESISTANT

VERY FLEXIBLE

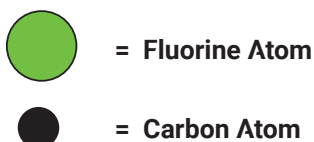
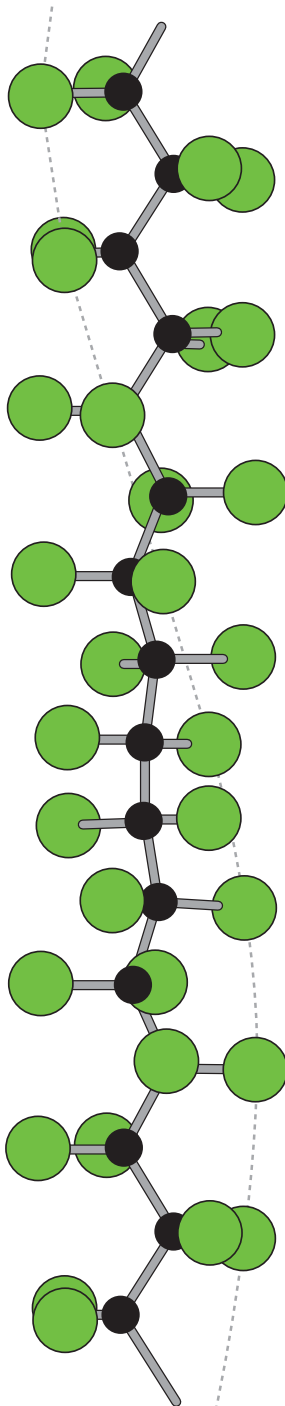
SMOOTHBORE

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PTFE - THE OPTIMUM CHOICE FOR HOSE LININGS

Section from a PTFE Molecule, 16 Angstrom Units long



PTFE, or Polytetrafluoroethylene, comprises of long-chain molecules of carbon atoms, each linked to two fluorine atoms.

The fluorine atoms provide a helical spiral which surrounds the carbon chain and protects it.

It is this structure which creates the unique properties for which PTFE is well-known.

- **Excellent Chemical Resistance**

PTFE is renowned as the most chemically resistant material known. Only a very few, very unusual substances and conditions can affect it, like Fluorine gas at high temperature and pressure and liquid, boiling sodium metal.

PTFE lined hoses can therefore be used for a wider variety of chemicals than any other hose type, making it the ideal choice for very corrosive chemical applications and multi-product applications.

- **Non-Stick Surface**

The use of PTFE as a surface for cookware products has demonstrated to the world how easily cleanable PTFE surfaces are.

This means that PTFE lined hoses can be purged 100% clean more quickly, easily and reliably than any other type of hose.

- **Excellent Temperature Range**

The cookware application also demonstrates another of PTFE's many attributes - temperature resistance. PTFE itself can be used as a hose liner at temperatures from -150°C up to $+260^{\circ}\text{C}$, dependent upon the hose design and the application conditions.

This is the widest temperature range of any rubber or plastic hose lining material.

- **Hose Design**

The only issue with PTFE as a hose lining material is the best way it can be integrated in to the hose design. This is where Aflex Hose have a proven record of success over the last 40 years.

HYPERLINE FX HOSE DESCRIPTION

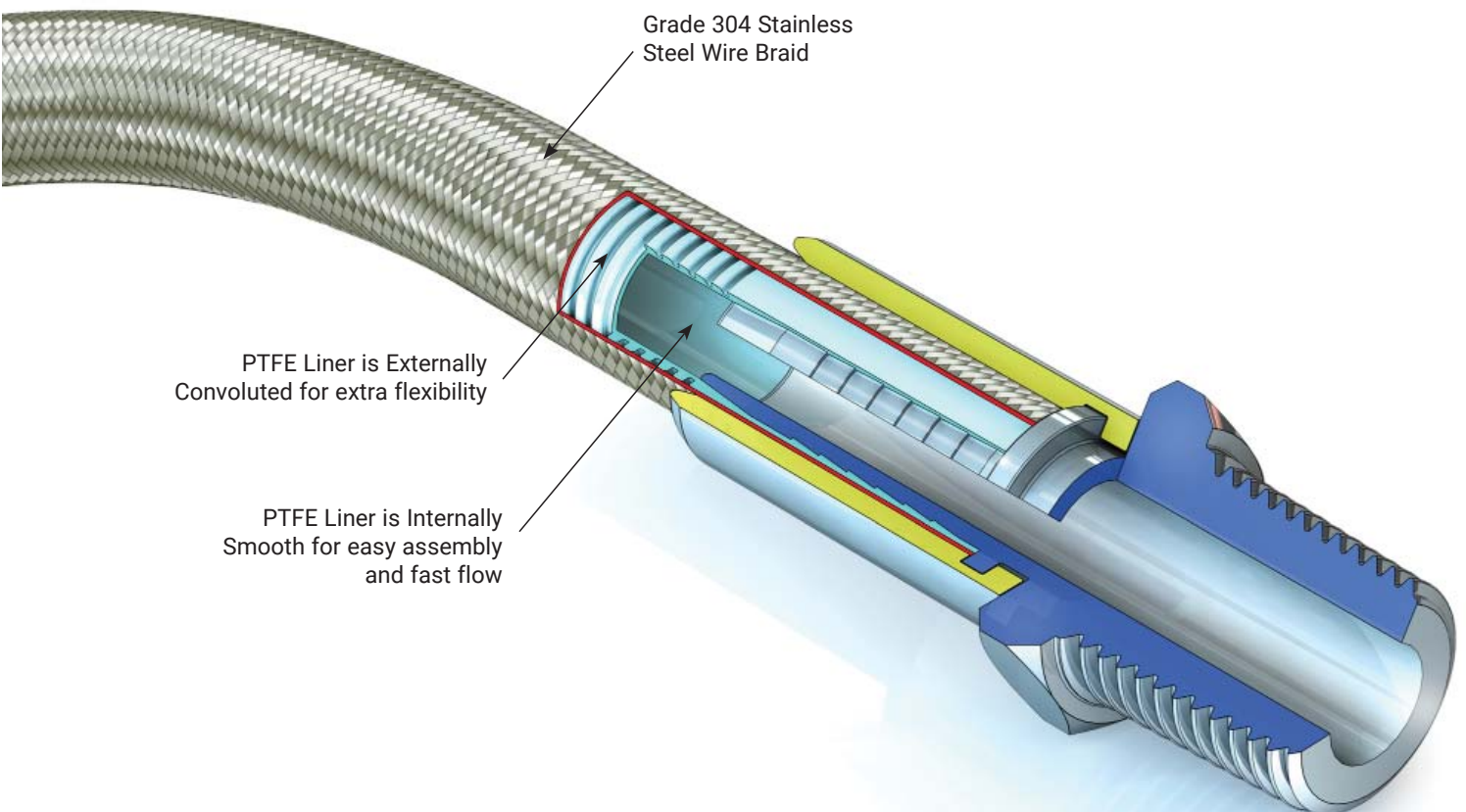
There is a fundamental problem with larger sizes of standard, smooth bore PTFE hose products - as the hose size increases above 1/4", so smooth bore PTFE lined hose become significantly less flexible, and more easily kinked.

One solution is to use a conventional convoluted PTFE lined hose, but the internal convolutions make the hose difficult to assemble, and reduces fluid flow rates due to turbulent flow.

Hyperline FX is a new and revolutionary solution to all these problems, providing a unique and patented hose liner design which is flexible in the larger bore sizes, yet which retains a smooth bore.

The advantage of a smooth bore as compared with a convoluted bore is that it is easy clean, and does not create "turbulent flow", which drastically reduces fluid flow rates.

HYPERLINE FX, SS HOSE ASSEMBLY WITH A HYDRAULIC FIXED MALE END FITTING CRIMPED ON TO THE HOSE



STANDARD GRADES AVAILABLE

- Hyperline FX, TO** - Natural PTFE Tube Only, No Braid.
- Hyperline FX, AS, TO** - Antistatic Black PTFE Tube Only, No Braid.
- Hyperline FX, SS** - Natural PTFE Tube external AISI 304 Stainless Steel Wire Braid.
- Hyperline FX, AS, SS** - Antistatic Black PTFE Tube, external AISI 304 Stainless Steel Wire Braid.
- Hyperline FX, AM** - Natural PTFE Tube, Black Aramid Fibre Braid.
- Hyperline FX, AS, AM** - Antistatic Black PTFE Tube, Black Aramid Fibre Braid.

HYPERLINE FX HOSE GRADES

Natural PTFE Tube Lining



Hyperline FX Natural PTFE Tube is for use in all applications where fluids or gases are being conveyed which do not generate a risk of static charge development (see "AS").

Tube Only (no braid)



TO grade hose (available in both GP and AS) is a lightweight hose, used in applications where working pressures are low and where there is no need for the physical protection offered by an external braid.

Stainless Steel Wire Braid (SS Grades)



The braid supports the PTFE liner tube against internal pressure and protects against mechanical abuse. Often used in applications involving high temperatures and working pressures. High tensile 304 stainless steel wire is used to give maximum pressure resistance and external protection to the hose.

Aramid Fibre Braid (AM Grades)



The aramid fibre is "Tecnora", a higher specification fibre than Kevlar, with excellent temperature, tensile and abrasion resistant properties.

For applications requiring minimum weight for maximum pressure reinforcement.

Antistatic PTFE Linings (AS Grade)



When electrically resistive fluids like solvents and fuels, or multiphase mixtures are passed through natural PTFE hose at high flow rates, a static charge build up occurs on the inner wall of the PTFE liner. This can discharge to the nearest conductor (e.g. SS braid) that creates a pin-hole in the PTFE liner resulting in a leak-path.

Antistatic PTFE includes a small quantity of a special high purity carbon black, which ensures safe static charge dissipation in accordance with International Standards.

Antistatic Hose Assemblies

When "AS" (Antistatic) grade hose is specified the hose or hose assembly supplied will be tested in accordance with EN ISO 8031 to meet the Antistatic requirements of EN 16643. This requires, for an antistatic liner or antistatic cover, that the resistance between an appropriately placed foam electrode and a metallic end fitting will be between 10^3 to 10^8 ohms per assembly. For hose assemblies which meet these requirements an appropriate Grade "Ω" marking is applied in accordance with EN 16643 if requested.

Note: When in service, at least one end fitting must be connected to earth, to permit dissipation of the static charge from the end fitting.

EC - ELECTRICAL CONTINUITY

(Also known as 'Electrically Bonded' & 'M' grade)

All Hyperline FX hose assemblies are electrically continuous, except AM (Aramid Fibre) and TO (Tube Only) grade hose assemblies. Electrical Continuity requires that the hose assembly supplied is electrically continuous, or conductive, between metal end fittings at each end of the hose (whether GP or AS grade).

The requirements for this are specified in the German Document BRG 132 and EN 16643, when tested in accordance with EN ISO 8031, which requires that the resistance between end fittings shall be <100 Ohms per assembly. For hose assemblies that meet this requirement a Grade "M" marking is applied in accordance with EN 16643.

HYPERLINE FX HOSE: SPECIFICATIONS AND PROPERTIES

SPECIFICATIONS FOR HYPERLINE FX HOSE GRADES

Specifications listed below are for non-AS Grades. For AS Grades the specifications are all the same, except that "AS" is added to the Grade Reference, and the Part Number reads "-110-" in place of "-100-".

Nominal Hose Size	*Actual Hose Bore Size		Hose Grade	Outside Diameter of Tube or Braid		Minimum Bend Radius		Maximum Working Pressure (MWP)		Weight per Unit Length		Hose Part Number
	in	mm		in	mm	in	mm	in	Bar	Psi	Kg/mtr	
1/4	6.8	0.270	TO	9.0	0.354	38	1 1/2	4	60	.041	.027	92-100-04
			SS	9.6	0.378	19	3/4	88	1280	.092	.062	92-100-04-01-02
			AM	9.6	0.378	38	1 1/2	62	900	.056	.038	92-100-04-01-55-01
5/16	7.9	0.312	TO	10.0	0.394	38	1 1/2	4	60	.056	.037	92-100-05
			SS	10.6	0.420	19	3/4	84	1220	.126	.084	92-100-05-01-02
			AM	11.3	0.445	38	1 1/2	59	850	.075	.050	92-100-05-01-55-01
3/8	10.0	0.394	TO	12.5	0.492	50	2	4	60	.070	.047	92-100-06
			SS	13.5	0.534	25	1	80	1160	.160	.107	92-100-06-01-02
			AM	13.5	0.534	50	2	56	810	.100	.067	92-100-06-01-55-01
1/2	13.6	0.536	TO	16.2	0.640	76	3	4	58	.110	.074	92-100-08
			SS	17.5	0.690	38	1 1/2	60	870	.225	.151	92-100-08-01-02
			AM	17.5	0.690	76	3	42	600	.140	.094	92-100-08-01-55-01
5/8	16.7	0.658	TO	20.0	0.787	100	4	3	44	.161	.108	92-100-10
			SS	21.1	0.831	50	2	50	730	.336	.226	92-100-10-01-02
			AM	21.1	0.831	100	4	35	510	.204	.137	92-100-10-01-55-01
3/4	19.8	0.780	TO	23.2	0.913	126	5	3	44	.179	.120	92-100-12
			SS	24.2	0.953	63	2 1/2	42	610	.383	.257	92-100-12-01-02
			AM	24.2	0.953	126	5	29	430	.236	.158	92-100-12-01-55-01
1	26.0	1.023	TO	30.3	1.193	150	6	2	29	.268	.180	92-100-16
			SS	31.7	1.250	75	3	40	580	.540	.362	92-100-16-01-02
			AM	31.7	1.250	150	6	28	400	.354	.237	92-100-16-01-55-01

***Hydraulic Bore Size** - The actual bore sizes of Hyperline FX hose are slightly larger than the nominal size, to allow the insertion and assembly of standard Hydraulic Fittings, using ferrules supplied by Aflex Hose (see page 9).

PROPERTIES

Temperatures and Pressures

Hyperline FX, SS Grades - The MWP listed above should be reduced by 1% for each 1°C above 160°C (1% for each 1.8°F above 320°F) up to a maximum of 260°C (500°F).

Hyperline FX, AM Grades - The MWP listed above should be reduced by 1% for each 1°C above 130°C (1% for each 1.8°F above 266°F) up to a maximum of 180°C (356°F).

Maximum Working Pressures (MWP) listed are calculated on the basis of a 3:1 safety factor relative to the burst pressure, so Burst Pressure = 3 x MWP. If MWP is required based on a 4:1 safety factor (e.g. EN 16643 requirement), multiply the listed value by 0.75.

Vacuum Resistance

Hyperline FX, SS Grades are vacuum resistant to -0.9bar up to 150°C (300°F).

LOOSE HOSE LENGTHS

Loose hose is supplied in random lengths up to a maximum of 18 metres (60 feet) long.

ASSEMBLED HOSE LENGTHS

Hyperline FX hose assemblies are made up to the specific lengths required. The hose length is taken as the length from the sealing face at one end of the hose to the same at the other end. The length tolerance is normally +2% / -0%. Closer tolerances are available to special order.

Excellent Flow Rates

Compared with conventional convoluted hose designs, Hyperline FX has excellent flow rates due to the smooth bore, which prevents the turbulent fluid flow which occurs in convoluted hose products.

Reduced Diffusion Rates

Hyperline FX is much more resistant to diffusion of liquids or gases than other PTFE hose products, due to its highly compressed, non-porous PTFE matrix. Hyperline FX has been successfully tested to SAE J1737 for resistance to automotive fuel diffusion.

Non-Stick Internal Surface

Hyperline FX hose has a smooth bore, non-stick liner which is effectively "self-cleaning", and which resists material build-up inside the hose which may cause bore constriction.

HYPERLINE FX

EN 16643 HOSE ASSEMBLY ELECTRICAL PROPERTY GRADES

The hose assembly electrical property grades and electrical resistance limits are defined within EN 16643 and tested in accordance with BS EN ISO 8031. Aflex Hose electrically conductive (**EC**) assemblies are defined in EN 16643 as *electrically bonded* and given the symbol **M**. M-grade assemblies exhibit a maximum electrical resistance of 100Ω between end fittings. Aflex Hose anti-static (**AS**) PTFE liners and rubber covers are termed *static dissipative* within EN 16643 and given the symbol **Ω** followed by letters that specify either the liner, cover or both; **L**=liner, **C**=cover, **CL**= cover & liner. Ω-grade covers or liners exhibit an electrical resistance of 10³-10⁸ Ω.

The table below identifies each EN 16643 electrical grade for a hose assembly along with a brief description and example assembly configuration.

EN16643 Electrical Grade For Hose Assembly	EN16643 Description	Example Hose Assembly
Grade M	Electrically bonded without static-dissipative lining or cover	HFX GP SS Sarlink Ends Fixed male
M/Ω-L	Electrically bonded and static-dissipative lining	HFX AS SS Sarlink Ends Fixed male
M/Ω-C	Electrically bonded and static-dissipative cover	HFX GP SS EPDM (AS) Ends Fixed male
M/Ω-CL	Electrically bonded and static-dissipative cover and lining	HFX AS SS EPDM (AS) Ends Fixed male
I	Electrically insulated (no electrical bonding AND no static-dissipative layers)	HFX GP AM Ends Fixed male
Ω-L	Static dissipative lining without electrical bonding	HFX AS AM Ends Fixed male
Ω-C	Static dissipative cover without electrical bonding	HFX GP AM EPDM(AS) Ends Fixed male
Ω-CL	Static dissipative cover and lining without electrical bonding	HFX AS AM EPDM(AS) Ends Fixed male

HYPERLINE FX HOSE COVER OPTIONS AND APPLICATIONS

ALTERNATIVE DESIGN OPTIONS - HOSE COVERS

For certain applications, it is an advantage to have a flexible plastic or rubber outer cover extruded on to the hose. The cover provides protection for the braid, as well as being easy to clean, and can be printed with a continuous text line.

Covered hose is, however, only available to special order, so price and availability are very dependent upon quantities required.

Options are:

Flexible PVC :

from -10°C ($+14^{\circ}\text{F}$) to $+60^{\circ}\text{C}$ ($+140^{\circ}\text{F}$) max. In transparent or a wide variety of solid or translucent colours.

Nylon 11 :

from -40°C (-40°F) to $+120^{\circ}\text{C}$ ($+248^{\circ}\text{F}$) max. In natural, semi-transparent or black.

Sarlink, Hytrell, Polyurethane :

from -40°C (-40°F) to $+125^{\circ}\text{C}$ ($+257^{\circ}\text{F}$) max. Others may also be available.

EPDM Rubber :

from -40°C (-40°F) to $+140^{\circ}\text{C}$ (284°F) max. In Blue or (antistatic) Black.

Silicone Rubber :

from -73°C (-100°F) to $+204^{\circ}\text{C}$ (400°F) max. Peroxide cured, in natural (semi-transparent) or white.

Other rubbers may also be available.



APPLICATIONS FOR HYPERLINE HOSE

Automotive and Motorsport :

Replacing conventional PTFE hoses in ESP systems, fuel systems, braking systems and oil lines.

Refrigeration :

Refrigerant feed lines to freezer plates, where the high resistance to permeation, together with the flexibility and chemical resistance, are primary advantages.

Steam and Gas Lines :

Where the smooth bore ensures non-turbulent gas flow, leading to noise free operation at higher flow rates, and longer service life.

Industrial applications :

In general where the ease of assembly to end fittings together with the higher flow rates, chemical and temperature resistance and resistance to permeation make Hyperline FX the optimum choice.



HYPERLINE FX HOSE ASSEMBLY SUPPLY OPTIONS

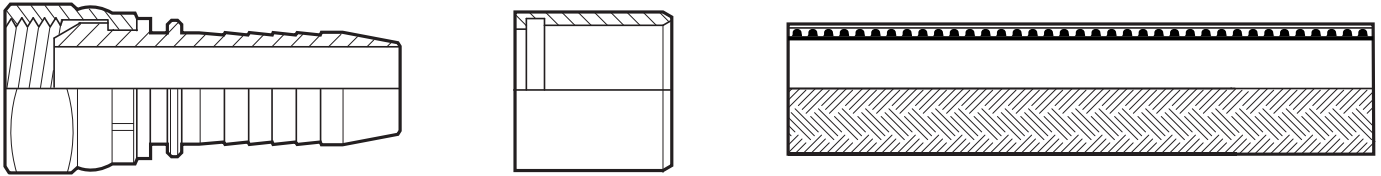
SUPPLY OPTIONS

Hyperline FX hose can either be supplied as made up and crimped hose assemblies, or as loose hose for customers to assemble themselves, using ferrules supplied by Aflex Hose, and standard hydraulic end fittings, which can also be supplied by Aflex Hose if required.

EASIER ASSEMBLY

Hyperline FX is very flexible, and is designed to replace conventional flexible tape wrapped convoluted or autoconvoluted PTFE hoses in application where **faster, cleaner fluid flow or ease of assembly** is paramount. SS or MS ferrules and crimp diameters can be supplied to suit any conventional hydraulic hose tail end fittings.

Problems associated with assembling fittings to convoluted hoses, such as leakages, the need for special or sleeved spigots, the need to de-convolute etc. disappear - Hyperline FX is literally as easy to assemble as any smooth bore hose.



ASSEMBLY INSTRUCTIONS

1. Cut the hose to the desired length using a cut off machine with a high tensile steel blade, allowing for the length of the end fittings.
2. Push the ferrule onto the hose (chamfered end first) and insert the fitting and push into the hose until it meets the collar on the fitting. Align the ferrule over the collar.
3. Place the assembly into the swaging machine and swage down the ferrule to the recommended swage dimension as given in Aflex Document AS-42. Check using a vernier or micrometer.

To find AS-42 and the current swage diameters, consult the Aflex Hose I-Bay system. To obtain the I-Bay address, please contact Aflex Hose.

FERRULES TO SUIT

Hose Size	Ferrule Part Number*
1/4	01-170-04-04-(*03 or 04)
3/8	01-170-06-06-(*03 or 04)
1/2	01-170-08-08-(*03 or 04)
5/8	01-170-10-10-(*03 or 04)
3/4	01-170-12-12-(*03 or 04)
1	01-170-16-16-(*03 or 04)

*Note: Ferrule Part Numbers end in -03 for Stainless Steel (Grade 303 or 304), and -04 for Mild Steel (Zinc Plated).

PRESSURE TESTING INSTRUCTIONS

All self-assembled hose assemblies must be pressure tested to 1.5 x MWP before end use.

HYPERLINE FX HOSE AUTO-CUT HOSE LENGTHS



Self assembly customers who manufacture large numbers of hose assemblies require perfectly cut hose ends, to facilitate easy, quick assembly of end fittings.

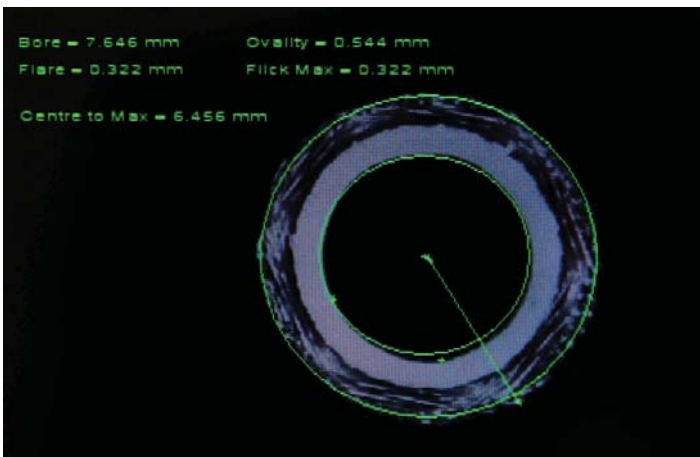
Aflex Hose have developed an automatic hose cutting machine which is able to cut stainless steel braided grades of Smoothbore and Hyperline FX hose, in sizes up to 1" bore, in minimum cut lengths of 60mm ($2\frac{3}{8}$ "), no maximum length.

This system is applicable to (uncovered) stainless steel braided grades of Smoothbore and Hyperline FX hose, in sizes up to 1" bore, in minimum cut lengths of 60mm ($2\frac{3}{8}$ "), no maximum length.

In addition, Aflex have developed a fully automated inspection system which checks the cut ends for diameters, ovality and protruding cut wire ends.

This inspection system is only applicable to regularly supplied large quantities of cut lengths and is limited to cut lengths which are less than 0.4 metres (16 inches) in length.

Automated washing equipment is available for short cut lengths, capable of achieving the required tolerance levels for particle size and count.



HYPERLINE FX HOSE SPECIAL USAGE CONDITIONS

PTFE Hose-Use with Alkali Metals, Halogens and Halogen containing Chemicals

PTFE hose liners react chemically with Fluorine, Chlorine Trifluoride and molten Alkali Metals.

When PTFE lined hose is used to carry Chlorine or Bromine, either as gasses or fluids, they will diffuse into and through the PTFE liner wall thickness. Trace quantities will then combine with atmospheric moisture to corrode any braid/rubber outer coverings.

Heavily halogenated chemicals, like Hydrogen Fluoride, Hydrogen Chloride, Phosgene (Carbonyl Chloride) Carbon Tetrachloride and other organic chemicals with a high halogen content can also be absorbed and transmitted through the PTFE liner tube.

Other “Penetrating” Fluids and Gases

Sulphur Trioxide, Methyl Methacrylate, Caprolactam and Glacial Acetic Acid are some other chemicals which can be absorbed and transmitted through the PTFE liner tube wall.

Generally, however, as a hydrophobic (non-wetting) material, PTFE is very resistant to the absorption of chemicals. In some cases, PTFE has superior resistance to diffusion, for example to the diffusion of automotive fuels, in comparison with all other plastics and rubbers.

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 hoses are no exception.

Please contact Aflex Hose for further information if these conditions apply.

Connecting Assemblies for Use in Applications

The lengths of hose assemblies and their configuration in use when connected into the application must always be in accordance with the Hose Configuration information at the end of this product 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 not be over tightened as this can damage the sealing surfaces.

In applications involving the transfer through the hose of expensive or dangerous fluids or gases, the hoses and connections must be pressure tested in situ before being put in to service. This should be done with some harmless media to 1½ times the maximum working pressure of the hose assembly, as stated in the product literature.

If in doubt please contact Aflex Hose for advice.

Special Applications

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

All Radioactive Applications involving high energy radiation, including Gamma radiation (degrades PTFE)

All Medical Implantation Applications.

All Aerospace Applications.

Hyperline FX and Quality Assurance, Certification and Approvals

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 The British Standards Institution (BSI).

EN16643

Hyperline FX meets the requirements of EN16643 (SC), which include the electrical and electrostatic requirements of hose assemblies

TS16949

Aflex Hose Ltd manufactures PTFE flexible hose for the automotive industry in accordance with TS16949 and is assessed and certified by The British Standards Institution (BSI).

ISO 14001

Aflex Hose Ltd have been successfully assessed to the requirements of ISO 14001, by the British Standards Institution (BSI). By gaining this accreditation Aflex Hose Ltd are demonstrating our commitment to reducing our impact on the environment

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.

Automotive Fuel Hose - SAE J1737

Tested and approved for automotive fuel hose use in accordance with SAE J1737.

CE Marking (Europe only)

Aflex has been assessed by The British Standards Institution (BSI) and found to comply with the Pressure Equipment Directive 2014/68/EU 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 2014/34/EU (Potentially Explosive Atmospheres)

Available for hose 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 BS EN ISO/IEC 17050

Are available for all products.

HOSE CONFIGURATION & LENGTH CALCULATIONS

- FOR BEND RADIUS

HOSE CONFIGURATION REQUIREMENTS

Hose Assemblies are usually connected at both ends in service. They may then either remain in a fixed, or static configuration or in a flexing, or dynamic configuration.

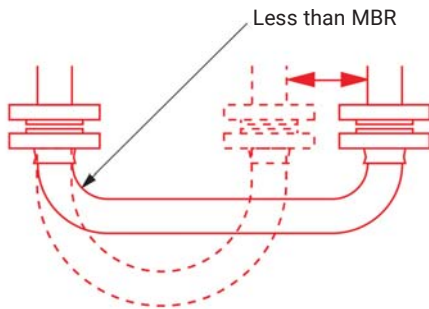
Whether static or dynamic, the First Rule concerning the configuration of the hose is that the bend radius of the hose must never be less than the Minimum Bend Radius (MBR) for the hose as listed in the relevant hose brochure.

The most common situation when this is likely to occur is when the hose is flexed at the end fitting, with stress being applied to the hose at an angle to the axis of the end fitting. Typically, this happens either because the length of the hose is too short, or because the weight of the hose plus contents creates a stress at an angle to the end fitting.

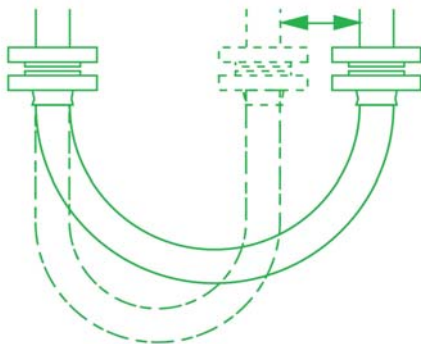
The Second Rule, therefore, if possible, is to design the configuration to ensure that any flexing in the hose takes place away from the end fittings.

(DYNAMIC) CONFIGURATION

INCORRECT - Hose too short

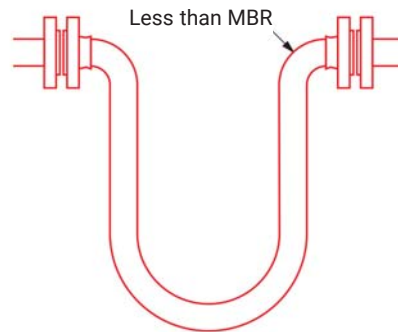


CORRECT - No flex at End Fittings

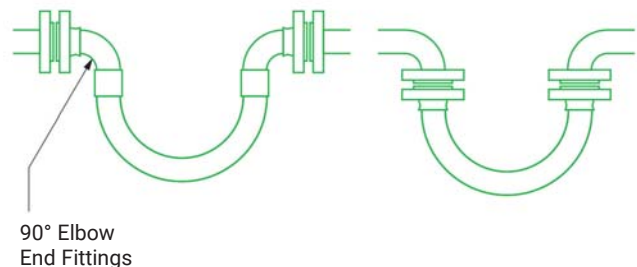


(STATIC) CONFIGURATION

INCORRECT - Weight of hose is at 90° to Axis of End Fittings



CORRECT - No flex at end fittings



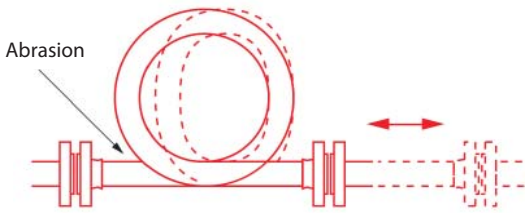
HOSE CONFIGURATION & LENGTH CALCULATIONS

- FOR ABRASION & TORQUE

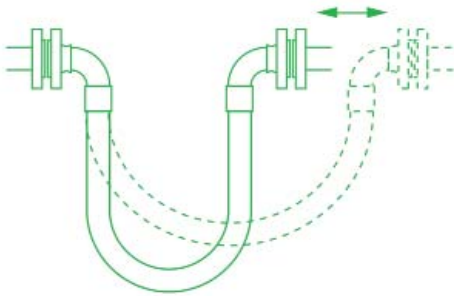
The Third Rule is that the hose configuration should always be designed, and supported where necessary, to avoid any possibility of external abrasion.

In some cases, the length, configuration and angle of the hose can be designed to avoid abrasion. In others, static or moving support frames or support wheels are required.

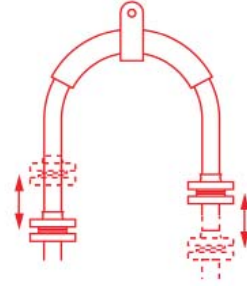
INCORRECT - Abrasion against hose



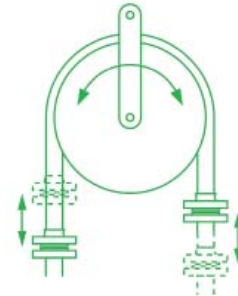
CORRECT - No hose abrasion



INCORRECT - Abrasion inside support



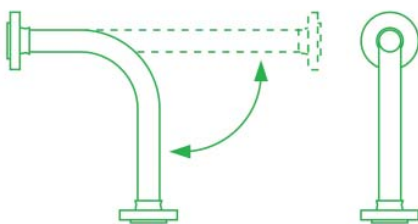
CORRECT - No abrasion over support



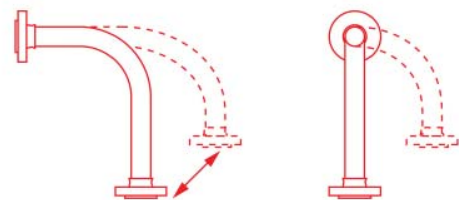
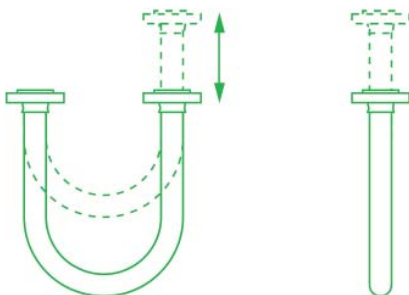
The Fourth Rule is that the hose must not be subjected to torque, either during connection, or as a result of the flexing cycle.

Torque (twist) in the hose can be applied during connection if the hose is accidentally twisted, or if the second end being connected is a screwed connection, and the hose is subjected to torque during final tightening.

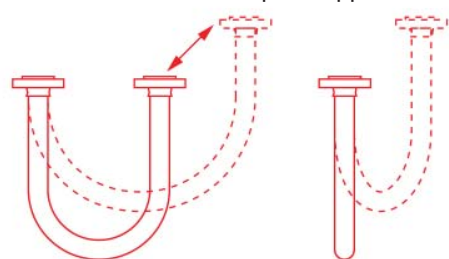
In a flexing application, if any flexing cycle of the hose occurs in 3 dimensions instead of 2, then torque will also occur:



CORRECT - Flexing movement takes place in 2 dimensions



INCORRECT - Flexing movement takes place in 3 dimensions so torque is applied



HOSE CONFIGURATION & LENGTH CALCULATIONS

- FOR LENGTH CALCULATIONS

CALCULATING THE HOSE LENGTH

The formula for calculating the bent section of the hose length around a radius is derived from the basic formula that the circumference of a circle = $2\pi R$, where R = the radius of the circle, and π = a constant, = 3.142.

So, if the hose goes around a 90° bend, which is $\frac{1}{4}$ of a full circumference, and the radius of the bend is R , then the length of the hose around the bend is = $\frac{1}{4} \times 2\pi R$. Or half way round, in a U-shape, = $\frac{1}{2} \times 2\pi R$.

Note :

In calculating the length of a hose assembly, the (non-flexible) length of the end fittings must be added in, also the length of any straight sections of hose, as in the following example:

Example :

To calculate the length for a 2" bore size hose with flange end fittings, to be fitted in a 90° configuration with one leg 400mm long, the other 600mm long.

Length of Bent Section (yellow) = $\frac{1}{4} \times 2\pi R$ (334)

$$= \frac{1}{4} \times 2 \times 3.142 \times 334 = 525\text{mm}$$

Length of top, Straight Section, including the top end fitting length

$$= 600 - 334 = 266\text{mm}$$

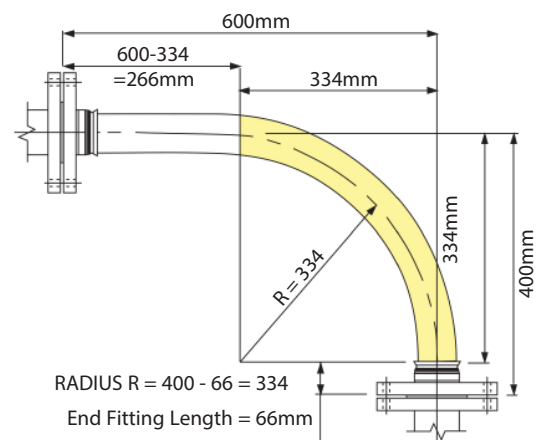
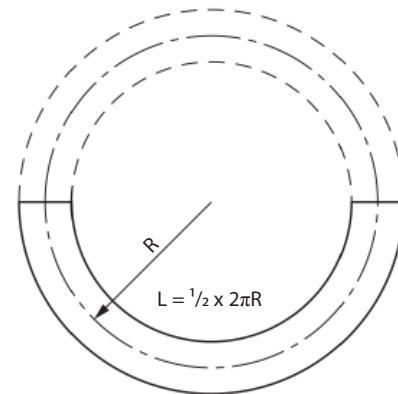
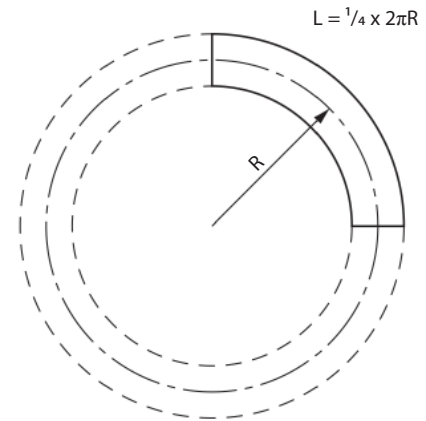
Length of bottom end fitting = 66mm

Total length of Hose Assembly = $525 + 266 + 66 = 857\text{mm}$

Things to consider

- A hose will normally take the longest radius available to it to go around a corner, not the MBR! Also - always remember to include the non-flexible end fitting lengths.
- In dynamic applications, remember to always calculate the lengths for the most extended configuration during the flexing cycle, not the least extended.
- If the configuration is simply too complex for calculation, then obtain a length of flexible tubing of some kind, mark on paper, or a wall, or floor, or both where the connection points will be relative to each other, scaled down if necessary, then manually run the flexible tubing between them with full radii round bends. Measure the extended length, then scale up if necessary to determine the approximate length of the hose.

If in doubt, consult Aflex Hose.



CONDITIONS OF SALE

DEFINITIONS

- (1) "Aflex Hose" shall mean Aflex Hose Limited
- (2) "Aflex Hose Products" shall mean those products which are manufactured by Aflex Hose Ltd and are described on the Aflex Hose website.
- (3) "Factored Products" shall mean products which are supplied by Aflex Hose, but are not manufactured by Aflex Hose Ltd, and are purchased by Aflex Hose from another supplier or manufacturer.
- (4) "Customer" shall mean the individual or entity that is purchasing Aflex Hose Products hereunder.
- (5) "Full Product Brochure" shall mean the brochure for each specific product available at <http://www.aflex-hose.com/products-and-markets>.

GENERAL

- (6) These Conditions of Sale form the basis of the contract of sale between Aflex Hose and the Customer. In the event of any conflict between the terms and conditions set forth in these Conditions of Sale and any other Customer document, these Conditions of Sale shall govern, unless otherwise agreed to in writing and authorized and signed for by a Director or General Manager of Aflex Hose.
- (7) Unless otherwise agreed to in writing, delivery will be at cost from Aflex Hose's facilities Brighouse, West Yorkshire, England. Title and all risks of loss or damage pass to the Customer upon delivery to the Customer or third party carrier. Delivery dates specified by Aflex Hose are only Aflex Hose's best estimates and Aflex Hose's only responsibility will be to use reasonable commercial efforts to meet all specified delivery dates.

CUSTOMER RESPONSIBILITIES AND OBLIGATIONS

- (8) It is the Customer's strict responsibility to review all of the usage conditions and usage limitations given for the Aflex Hose Products which are intended for use in a particular application, to ensure that the application conditions are in compliance with those usage limitations. The usage conditions and limitations are referred to in these Conditions of Sale, and are further specified in the relevant Full Product Brochure. The Customer shall consult the latest, up to date hose product information and Full Product Brochure at the time of ordering, which are only available and downloadable from the Aflex Hose website at <http://www.aflex-hose.com/products/>, or on request from Aflex Hose. The Customer here represents and warrants that it has read and understands the applicable Full Product Brochure and the usage conditions and the usage limitations set forth therein, and has ensured their compliance with the application conditions.
- (9) If the Customer sells or assigns any Aflex Hose Products to any other person or entity, the Customer shall ensure that the final end user of the Aflex Hose Products is supplied with these Conditions of Sale, the applicable Full Product Brochures, the Aflex Hose website address, together with notification of the requirement to review the usage conditions and limitations. The Customer shall include the terms and conditions set forth herein in its Conditions of Sale to any third party. The Customer hereby agrees and acknowledges that Aflex Hose shall have no liability whatsoever for claims arising in whole or in part out of the Customer selling or assigning the Aflex Hose Products to a third party that does not use the Aflex Hose Products in accordance with Aflex Hose's usage requirements and limitations ("Non-Conforming Use Claims"). The Customer shall indemnify and hold harmless Aflex Hose, its officers, directors, employees, affiliates and representatives for any and all claims, damages, penalties and losses arising out of or related to Non-Conforming Use Claims.
- (10) The Customer agrees and acknowledges that for any intended hose application in which special conditions apply which are not defined, or not defined sufficiently in the Product Brochure, the Customer shall write to Aflex Hose requesting written advice relating to any usage limitations resulting from special conditions. The Customer shall ensure the design suitability and safety of the Aflex Hose Products in their intended applications, giving particular consideration to any special condition relating to, but not restricted to the chemical and electrostatic compatibility of the fluids or gases passing through, the possibility of diffusion of fluid or gases through the PTFE hose lining, the possibility of external corrosive conditions, the types and likelihood of excessive mechanical abuse, such as abrasion (internal or external), crushing, excessive flexing or vibrations, etc. and any excessive temperature and/or pressure "pulsing" conditions, or any other condition which may cause premature hose failure. The Customer shall consider, and take account of the degree of risk involved in any hose failure, including the provision of adequate protection in the event of any risk to any persons. In applications where any type of hose failure would lead to financial losses if the hose is not replaced immediately, the Customer

agrees and acknowledges that it shall be the Customer's responsibility to order and hold in stock spare hose(s) accordingly. The Customer shall advise Aflex Hose in writing at the time of placing the enquiry and on any purchase order if there are any special requirements for the hose, including special cleaning, or drying, or extra testing requirements which are in addition to normal industrial standards.

FACTORED PRODUCTS

- (11) The Customer accepts that Aflex Hose are not expert in the technical features which apply to Factored Products and their use in application. Aflex Hose will pass on to the Customer all the written information which they have regarding the Factored Product, but the Customer shall be responsible for ensuring that this and any other necessary Factored Product information is obtained and is reviewed which is sufficient to ensure that the Factored Product is fit for purpose in the intended usage application. If any application requirements apply which are not fully covered by the information which the Customer can obtain, then the Customer undertakes not to use or supply the Factored Product for use in that application. The Customer is also responsible for ensuring that the Factored Product will not be subjected to levels of usual or accidental physical abuse in service which would cause the Factored Product to fail. The Customer agrees and acknowledges that Aflex Hose, its officers, directors, employees, affiliates and representatives shall not be held liable for any claims or obligations arising out of the Customer's failure to fulfill any or all of its responsibilities set forth in this Section 11.
- (12) If the Customer has any doubts concerning these or any other usage conditions and limitation or safety parameters, the Customer shall consult Aflex Hose at the number and address in the Notice Provisions below and request a written response to any queries.

HOSE SERVICE LIFE; 24 MONTH WARRANTY

- (13) It is not possible to guarantee a minimum service life for any of the Aflex Hose Products or Factored Products which can be applicable for every type of application. As such, Customer acknowledges that, except as provided below in Sections 14, 15 and 16 Aflex Hose is not guaranteeing a minimum service life of any of the Aflex Hose Products.
- (14) Service life predictions or guarantees can only be given in cases where all the relevant information concerning the application is given in writing to Aflex Hose, and Aflex Hose subsequently replies in writing with the service life prediction prior to the order being placed.
- (15) If such a written undertaking is not sought and given, Aflex Hose shall not be held liable for any Aflex Hose Product or Factored Products failure which the Customer considers to be premature, excepting failures which are due to faulty materials or manufacturing defects which occur within 24 months or 12 months, as applicable, of supply as provided in Section 16 below.
- (16) Aflex Hose warrants its Aflex Hose Products to be free from faulty materials or manufacturing defects from the date of the delivery, for 24 months; provided, however, that all Hose Assemblies which are "ETH" (Electrical Trace Heated) Grade or are Factored Products are only warranted for 12 months.
- (17) AFLEX HOSE MAKES NO WARRANTY OF ANY KIND WHATSOEVER, EXPRESS OR IMPLIED OTHER THAN AS SPECIFICALLY STATED HEREIN, AND THERE ARE NO WARRANTIES OF MERCHANTABILITY AND/OR FITNESS FOR A PARTICULAR PURPOSE WHICH EXCEED THE OBLIGATIONS AND WARRANTIES SPECIFICALLY STATED HEREIN.

PRODUCT FAILURE

- (18) In the event of an Aflex Hose Product failure during the applicable warranty period set forth in Section 16, the Customer shall provide Aflex Hose with written notification within forty-eight (48) hours of discovering the fault. Aflex Hose requires that the Aflex Hose Products not be cut up or tampered with, but should be decontaminated and returned to Aflex Hose, plus a decontamination certificate, for examination and analysis of the fault. The Customer should also provide full details in writing of the application conditions under which the hose failed, including Pressure, Vacuum, Temperature, Flexing and any cycling of any of these, also the fluids, gases and any cleaning products passed through the hose, and the total time that the hose has been in service also the original order number and the Serial Number for the hose. The Customer may send its own witness to the examination if required. Aflex Hose will provide a Non-Conformance Report to the Customer. The Customer shall bear the cost of returning the Aflex Hose Products that have failed; provided, however, as set forth in Section 20 below, Aflex Hose shall reimburse the Customer for any shipping costs if it is determined that the failure is covered by the warranty set forth in Section 16.

CONDITIONS OF SALE CONTINUED

(19) In the event of a Factored Product failure, the Customer shall advise Aflex Hose with written notification within 48 hours of discovering the fault. The failed product shall not be tampered with or de-constructed in any way, but shall be decontaminated as required to render it fully safe and free from harmful substances and held awaiting advice concerning its disposition from Aflex Hose. Full details concerning the application, the time in use in the application and a full description of the type of failure shall be supplied to Aflex Hose, who shall pass this information on to the supplier or manufacturer of the Factored Product for advice concerning the appropriate course of action. The Customer will then be advised as to the disposition of the failed product.

(20) If Aflex Hose determines that faulty materials or a manufacturing defect in the Aflex Hose Product or Factored Product is responsible for the product failure, the maximum liability shall be the invoice value of the failed product itself, or the invoice value of the whole customer order as determined by Aflex Hose in its sole discretion, along with any reasonable costs for removal and replacement of the product, and costs for packing and dispatching the failed product back to Aflex Hose.

UNTESTED HOSE FOR SELF ASSEMBLY BY CUSTOMERS

(21) Aflex Hose sometimes supplies "loose" hose, without end fittings attached to a Self Assembly Customer, who will then cut the hose to length and attach end fittings to make up Hose Assemblies for their own use, or for sale to their own customers.

(22) Unless the Customer requests, and Aflex Hose confirms that the 'loose' hose is pressure tested before supply, such testing is not normally applied by Aflex Hose, because this testing requirement is otherwise satisfied by the Self Assembly Customer during his own testing of the finished Hose Assemblies made up using the "loose" hose. Self Assembly Customers agree and acknowledge that they are solely responsible for carrying out hydrostatic pressure testing of 100% of such assemblies to 1.5 times the Maximum Working Pressure (MWP) of the hose assembly as specified in the relevant Full Product Brochure before supply for end use, to validate both the hose and the end fitting attachment.

(23) When pressure testing braided hoses with a plastic or rubber outer cover, the cover will mask any signs of leakage for a time. The Customer agrees and acknowledges that after the hydrostatic pressure test, it is required to test each covered hose assembly with an internal helium gas pressure of 30 Bar (450 psi) for hose sizes up to 1" and 15 Bar (225 psi) for hose sizes above 1", with the hose assembly immersed in water to enable leak detection by gas bubbles, for a minimum test period of 5 minutes.

(24) The "Self Assembly" Customer agrees and acknowledges that it shall determine and approve the Design Suitability of the hose assemblies for their intended use before supply and that, except as set forth in Section 25, it shall indemnify and hold Aflex Hose harmless from any Claims and Losses arising from Design Suitability for a Self Assembly Customer. This includes proceeding in accordance with Section (8) and Section (9) above.

(25) Aflex Hose's liability is limited to Aflex Hose Products which are assembled by approved Self Assembly Customers if all the hose and fitting components were supplied by Aflex Hose or approved for use by Aflex Hose in writing, and they were assembled and tested in accordance with Aflex Hose's current Manufacturing and Testing Instructions, available to approved Self Assemblers in an I-Bay on the Aflex Hose website.

UNTESTED HOSE ASSEMBLIES

(26) Aflex Hose is sometimes requested by Customers to attach non-standard end fittings to hose assemblies which they, supply, and in some cases it is not possible to connect these fittings to the Aflex Hose pressure test system. In such cases a "concession not to test" is obtained from the Customer, and a label is attached to the hose assembly, warning that it requires pressure testing before use. The Customer agrees and acknowledges that Aflex Hose shall have no liability whatsoever if the Customer does not comply with the warning that requires pressure testing before use.

FORCE MAJEURE

(27) Aflex Hose shall not be liable for any delay in delivery, failure to deliver or default in performing in accordance with any Customer's order if the delay or default is due to: (a) fires, floods, strikes, or other labor disputes, accidents to Aflex Hose's production facilities, acts of sabotage, riots, natural disasters, difficulties procuring materials, shortages of raw materials, interference by civil or military authorities, whether legal or de facto, governmental restrictions, including but not limited to failure to obtain export licenses, delays in transportation or lack of transportation facilities, restrictions imposed by federal, state or other governmental legislation or,

rules or regulations thereof, including a force majeure event occurring in respect to one of Aflex Hose's suppliers; or (b) any other cause beyond Aflex Hose's control.

GOVERNING LAW; JURISDICTION

(28) These Conditions of Sale and all rights, duties and obligations hereunder, including any and all other Customer agreements and orders shall be governed by and subject to English Law.

(29) The Customer acknowledges and agrees that any disputes arising out of or related in any way to this Agreement, including a breach of this Agreement, shall be brought exclusively in the courts of England, United Kingdom. Furthermore, Customer knowingly, voluntarily and irrevocably (a) consents to the exclusive jurisdiction of these courts, (b) waives any immunity or objection, including any objection to personal jurisdiction or the laying of venue or based on the grounds of forum non convenience, which it may have from or to the bringing of the dispute in such jurisdiction, (c) waives any personal service of any summons, complaint or other process that may be made by any other means permitted by England, United Kingdom, (d) waives any right to trial by jury, (e) agrees that any such dispute will be decided by court trial without a jury, (f) understands that it is giving up valuable legal rights under this Section 29, including the right to trial by jury, and that it voluntarily and knowingly waives those rights.

LIMITATIONS OF LIABILITY

(30) Aflex Hose Products and Factored Products have not been designed or tested for use in aerospace, medical implantation or radioactive applications, and such use is therefore strictly prohibited unless written approval from Aflex Hose has been given. Customer agrees and acknowledges that it is aware of the limitations set forth in this Section 30 and hereby agrees that Aflex Hose shall not have any liability whatsoever in the event Customer uses Aflex Hose Products and Factored Products for aerospace, medical implantation or radioactive applications. Customer agrees to indemnify Aflex Hose, its officers, directors, employees, affiliates and representatives for any and all Claims and Losses arising out of Customer's use of the Aflex Hose Products and Factored Products for aerospace, medical implantation or radioactive applications.

(31) Aflex Hose will not accept liability for any failures of the Aflex Hose Products and Factored Products which are caused by Customers failing to perform their Responsibilities as specified in these Conditions of Sale.

(32) NOTWITHSTANDING ANYTHING TO THE CONTRARY HEREIN, IN NO EVENT SHALL AFLEX HOSE BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL, CONSEQUENTIAL, EXEMPLARY, OR PUNITIVE DAMAGES, LOSS OF PROFITS OR REVENUE, LOSS OF PROCESS PRODUCTS, DAMAGE TO EQUIPMENT, DOWNTIME COSTS, OR LOSS OF USE EVEN IF INFORMED OF THE POSSIBILITY OF SUCH DAMAGES. TO THE EXTENT PERMITTED BY APPLICABLE LAW, THESE EXCLUSIONS AND LIMITATIONS WILL APPLY REGARDLESS OF WHETHER LIABILITY ARISES FROM FAILURE OF THE PRODUCT(S), BREACH OF CONTRACT, FAILURE TO DELIVER ON TIME, WARRANTY, TORT (INCLUDING, BUT NOT LIMITED TO, NEGLIGENCE), BY OPERATION OF LAW, OR OTHERWISE.

COMPLETION OF BULK HOSE ORDERS

(33) Due to the nature of the production of PTFE hose, Aflex Hose reserves the right to call an order complete in the following situations. If a product is a standard Aflex product (as listed in Aflex product brochures) a figure of +10% of original order quantity can be supplied. If the product is a non-standard product and outside the Aflex standard product range the figure of +/- 10% of the original order quantity can be supplied. Goods supplied within these parameters would render the order complete.

NOTICE PROVISIONS

(34) Any written notice required to be provided to Aflex Hose shall be sent to the following address: Aflex Hose Limited, Spring Bank Industrial Estate, Watson Mill Lane, Sowerby Bridge, Halifax, West Yorkshire, HX6 3BW.

EXCLUSION OF CISG

(35) The United Nations Convention on Contracts for the International Sale of Goods shall not apply to these Conditions of Sale and any and all other Customer documents.

BIOFLEX ULTRA
CORROFLON
CORROLINE+
PHARMALINE N&X
SMOOTHBORE
HYPERLINE FX
VISIFLON

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