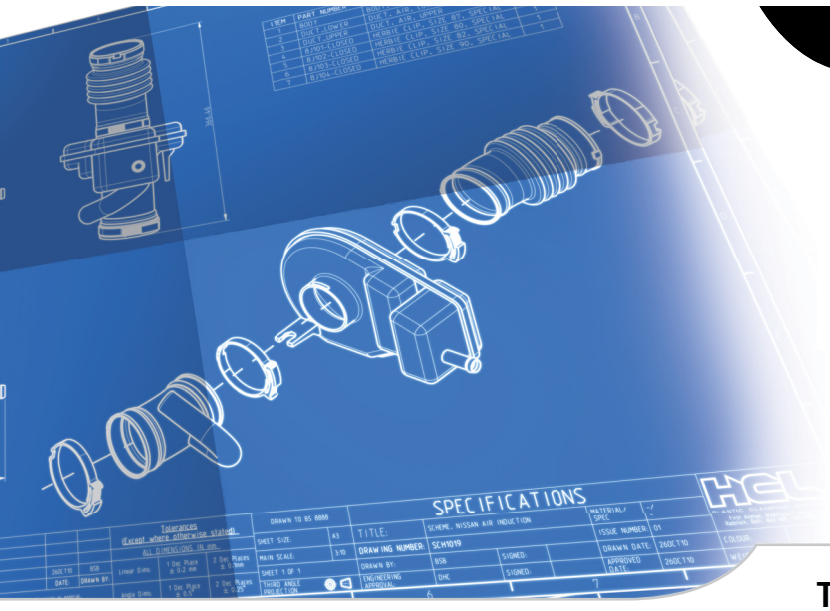


Clamping Design & Installation

The following section provides general information on clamping related technical issues. For certain products, more comprehensive information is available in the form of a Technical booklet.

For additional information, please refer to www.hcl-clamping.co.uk or contact HCL directly.

Pipe fitting design

An effective clamping solution relies, not only on the hose and hose clamp, but also on the pipe fitting. In order to select a fitting for optimum sealing performance, the following points must be taken into consideration:

- A barbed profile is normally best for sealing, however, this may not be true for thin walled or low pressure applications.
- The pipe fitting should be sized in order that the hose stretches slightly over the fitting. Undersize fittings may cause the hose to bunch up, thus creating a leak path. Oversize fittings will make it difficult to apply the hose.
- The pipe fitting should be of sufficient strength to withstand the compressive force of the clamp. This is particularly relevant for heavy duty clamps.

Diameter vs Axial thrust

Pressure inside a hose will create an axial thrust, which will tend to force the hose off the end of the pipe fitting. The purpose of a hose clamp is to retain the hose on the fitting, despite the axial thrust.

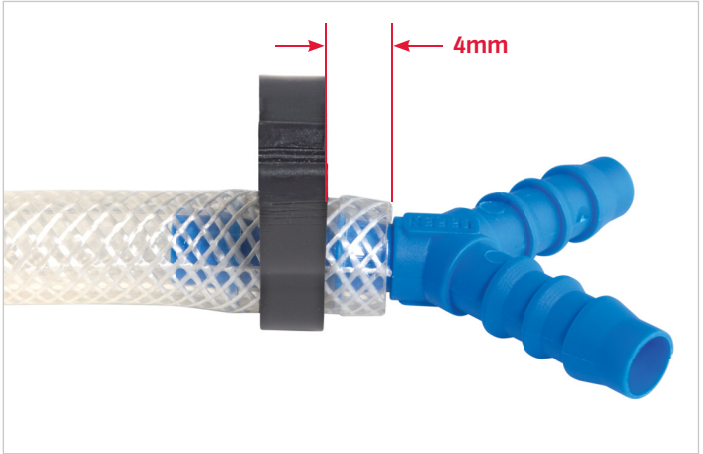
Axial thrust is proportional to the pressure in the hose and the square of the hose diameter. Therefore, for a given pressure, the axial thrust of a 200mm internal diameter hose is 100 times greater than for a 20mm internal diameter hose. For this reason, heavy duty hose clamps are required for large diameter hoses, where the pressure is significant.

Tensioning

Tightening the clamp to the correct tension is essential for reliable performance.
For Worm Drive, Screw and Bolt clamps, a maximum torque figure is provided. The higher the input torque for a given clamp, the higher the clamping force will be. However, this figure must not be used to compare the relative strength of clamps; as other factors, such as the screw thread and the band width also play a part.
Information on recommended tensioning for the Herbie Clip® range can be found in the Herbie Clip® and Ezyclik™ Technical Booklet.

Hose clamp positioning

Tightening a hose clamp will result in compression of the hose. Upon compression, there will also be a certain amount of hose distortion. If the clamp is positioned too close to the end of the hose, there is a risk the clamp will slip off. Ensure that the clamp is at least 4mm from the end of the hose, as shown.



Clamping Environment

The application environment has a very important bearing on clamp and material selection.

Temperature

Generally, Nylon 6.6. hose clamps have a working temperature ceiling of 125°C (150°C for Glass-filled Nylon 6.6.). For applications that exceed 150°C, steel clamps should be used.

Weathering

For plastic hose clamps, exposure to UV radiation is the main cause of degradation. However, HCL's black plastic clamps are enriched with UV inhibitors and heat stabilisers, giving them a working life in excess of 10 years.

Steel clamps are more resistant to UV degradation, and will last in hot sunny conditions well in excess of 10 years. Zinc plated steel clamps (W1-W2) can be used in dry climates, however, Stainless steel (W3-W5) should be selected for climates that are humid, or have significant rainfall.

Chemical

For corrosive environments, such as wet or salt water weathering: plastic or W4/W5 steel clamps should be used.

For highly corrosive applications requiring long life (25+ years): ultra-high grade materials must be used. This includes Nylon 11 or Nylon 12 for plastic clamps, and Titanium or High Nickel/Chromium alloys for steel clamps.

Sterilisation

In medical applications, it is common practice to sterilise the clamps before use. This is typically an aggressive process, to which only certain materials are resistant (W1-W2 steel clamps are not recommended for sterilisation).

The table below gives the material resistance to commonly used sterilisation methods:

Material	Gamma Radiation	Ethylene Oxide	Autoclave
Stainless Steel W3 - W5	Excellent	Excellent	Excellent
Nylon & Glass-filled Nylon	Physically compatible with commonly used sterilisation doses, but may discolour to brownish hue.	Very Good. Some susceptibility to oxidising agents	Very Good. Components may swell slightly due to water absorption
Polypropylene	Excellent up to commonly used sterilisation doses (approximately 6 M-Rad)	Fair. May stress crack in EtO/CFC mix due to moulding stresses	Poor. Parts may distort due to low heat deflection temperature.

Stainless Steel is also rated as excellent for the following methods of disinfecting and sterilisation:
■ Formalin ■ Isopropyl Alcohol ■ Ethyl Alcohol ■ E-Beam ■ Dry Heat

Material Information – Plastic

A variety of polymers may be used to manufacture plastic hose clamps. The correct material for each application must be selected depending on the environmental conditions and the required performance of the clamp.

For the Herbie Clip® and Ezyclik™ hose clamps, the standard polymer is Nylon 6.6, however, other materials are available on request.

Nylon 6.6.

Nylon 6.6. is a high strength, temperature and creep resistant polymer. For outdoor applications black is recommended, as this has the best UV resistance. Please note that Nylon 6.6. is a hygroscopic (water absorbing) material. Herbie Clips® are supplied in a moisturised state and should not be allowed to dry out before they are applied. If the clamps are dry and stiff, the simple addition of water for 24 hours will re-moisturise the clamps. Once the clamps have been fitted, moisturisation is no longer an issue.

Glass-filled Nylon 6.6.

Available for the Ezyclik™-P on request only. Increased strength and temperature resistance over standard Nylon 6.6.

Polypropylene

Inferior to Nylon 6.6. in almost every respect but it does have improved chemical resistance (particularly to strong acids) over Nylon 6.6. The clamps also do not need to be moisturised.

More information on plastic material properties can be found in the Herbie Clip® and Ezyclik™ Technical Booklet

Material Information – Metal

Steel hose clamps are manufactured in a range of different material grades, specified as W1 to W5, depending on their corrosion resistance. The grades are defined as follows:

'W' Rating	Composition	USA	UK	Germany	
		AISI	BS	WIN	DIN
W1	Screw - Zinc Plated Steel Cr3	–	–	1.0214	Qst 36-3
	Band & Housing - Zinc Plated Steel Cr3	–	–	1.0935	–
W2	Screw – Zinc Plated Steel Cr3	–	–	1.0214	Qst 36-3
	Band & Housing – Stainless Steel	430	430 S 17	1.4016	X8 CrNi 18 10
W3	Stainless Steel	301 / 430	301 S 21 / 430 S 17	1.4310 / 1.4016	X12 CrNi 17 7 / X8 Cr17
W4	Stainless Steel	304	304 S 15	1.4301	X5 CrNi 18 10
W5	Stainless Steel	316	316 S 33	1.4436	X5CrNiMo 17 13 3

The following table provides a more detailed composition analysis of the various metals that are used to make steel hose clamps:

	Units	AISI 201	W3 AISI 301		W4 AISI 304		AISI 304	W5 AISI 316	AISI410	W3 AISI 430	Steel	Monel 400
Composition	%	C - 0.15 max Mn 5.5-7.5 Si 1 max Cr 16-18 Ni 3.5-5.5	C - 0.15 max Mn 1 max Si 2 max Cr 16-18 Ni 6-8		C 0.08 Mn 1 max Si 2 max Cr 18-20 Ni 8-10.5		C 0.12 Mn 2 max Si 1 max Cr 17-19 Ni 10.5-13	C 0.08 max Mn 2 max Si 1 max Cr 16-18 Ni 10-14 Mo 2-3	C 0.15 max Mn 1 max Si 1 max Cr 11.5-13.5	C 0.12 max Mn 1 max Si 1 max Cr 16-18	C 0.4-0.6 Mn 0.6-0.9 P 0.04 max S 0.05 max	C 0.3 max Mn 1.25 max Si 0.5 max Ni 63-70 S 0.024 max Fe 1.25 max Cu 31.5
Physical Properties												
Structure	–	AUSTENITIC								MARTENSITIC	FERRITIC	–
Density	g/cm³	7.75	8.03						7.75		7.83	–
Melting Point	°C	1398-1454	1398-1421		1398-1454			1371-1398	1470-1560	1426-1510	–	1196-1220
Continuous Heat Resistance	°C	760	810		835				635	760	–	485
Electrical Properties												
Magnetic Behaviour	–	Non-magnetic							Magnetic			
Magnetic Permeability	–	1.02			1.008				700-1000	600-1100	1500-2000	–
Electrical Resistivity at 21°C	µ ohm/cm²	69.0	72.0						57.0	60.0	17.2	5.1
Mechanical Properties												
			Annealed	Hardened	Annealed	Hardened	Annealed	Hardened				
Elongation	%	40	50	18	50	7	50	7	5	57	60	17.2	5.1
Breaking Strength	MPa	70	56	105	56	105	56	105	52	45		30	52
Yield Strength	MPa	32	21	77	21	77	21	77	21	28		39	17
Hardness	R_B	90-95	70-95		75-95				75-85	75-85	75-90	80-95	60-80
Corrosion Resistance												
Fresh Water	–	Good			Very Good			Excellent	Good			Good-Fair	Good
Industrial	–	Good			Very Good			Very Good	Fair			Fair	Good
Marine	–	Fair			Good			Very Good	Poor			Poor	Excellent
Salt Water	–	No			No			Good	No			No	Excellent
Acid	–	Fair			Good			Good	Fair			No	Good
Bases	–	No			No			Good	No			No	Good