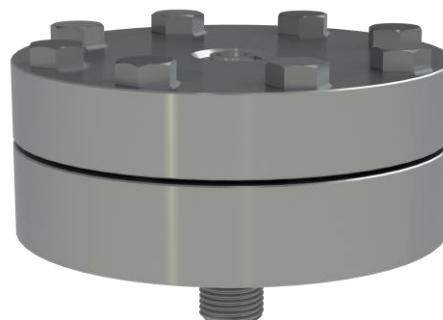


USL-T type seal - internal diaphragm threaded type

Design description

The USL-T construction is designed for those applications where the existing process connection is of a threaded type. The USL-T functions as an adaptor to a large diaphragm seal. The USL-T consists of an upper and lower housing. The lower housing creates the transition from the diaphragm size to the actual small process connection.



Housing / diaphragm combinations

Body Material	Diaphragm material		
(Lower part)	General name	UNS	Wst.
AISI 316(L)	AISI 316L	S31603	1.4404
	AISI 304L	S30400	1.4306
	AISI 321	S32100	1.4541
	AISI 316 UG	S31603	1.4435
	Alloy C276	N27600	2.4810
AISI 304L	AISI 304L	S30400	1.4306
AISI 310 MoLn	25-22-2 LMN	S31050	1.4466
AISI 316 UG	AISI 316 UG	S31600	1.4435
AISI 321	AISI 321	S32100	1.4541
AISI 904(L)	AISI 904L	N08904	1.4539
Alloy 20	Alloy 20	N08020	2.4660
Alloy 400	Alloy 400	N04400	2.4360
Alloy 600	Alloy 600	N06600	2.4816
Alloy 625	Alloy 625	N06625	2.4856
Alloy 825	Alloy 825	N08825	2.4858
Alloy B2	Alloy B2	N10665	2.4617
Alloy C-22	Alloy C-22	N06022	2.4602
Alloy C-276	Alloy C-276	N10276	2.4810
Duplex F44	254 SMO (6Mo)	S31254	1.4547
Duplex F51/F60	Duplex 2205	S32205	1.4462
Duplex F53	Super Duplex 2507	S32750	1.4410
Duplex F55	Super Duplex 2507	S32750	1.4410
Nickel 201	Nickel 201	N02201	2.4068
Titanium Gr. 2	Titanium Gr. 1	R50250	2.7025
AISI 316(L)	Tantalum	R60702	-
PTFE lined			

All upper part materials are standard AISI 316(L) except for Titanium versions where the upper part is Titanium as well.

1) The lined lower part is only possible in combinations with G male connections.

Process connection

Standard	Female thread	Male thread
ISO 228-1 (BSP)	G ¼ – G 2	G ¼ A – G 1.5 A
ANSI B 1.20.1 (NPT)	¼ NPT – 2" NPT	¼" NPT – 1.5" NPT
DIN 13-1 (M)	M10 - M20	M10 - M20
ISO 7-1 (BSPT)	Rc ¼, Rc ½	R ¼, R ½

Gold coatings

Two types of gold coating thickness can be applied on the USL-T seals, both suitable for corrosion protection and hydrogen permeation. The selection possibilities are:

- 25 µm thickness
- 40 µm thickness

-> See datasheet "Gold coatings"

Polymer solutions

Polymer solutions come in several executions and forms. The technical data on thickness and temperature limitation can be found in datasheet "polymer solutions". The upper part of the USL-T can be executed with:

- PTFE coating
- ECTFE (Halar®) coating
- PFA coating
- FEP coating
- PTFE sheet

The lower part of the USL-T is not suitable for coating because of the threaded constructions. The coating on the threads will damage after mounting.

-> See datasheet "Polymer solutions"

Capillary tube and armor (protection)

The standard capillary mounting position is top side (axial) of the seal. Alternatively, the capillary can be placed at the side of the seal (radial). The standard tube material is TP316 (316SS), optionally available in Alloy 400. There are three options in ID of the capillary; 2mm, 1mm, and 0.7mm. Badotherm capillaries are always protected against mechanical forces by armor. This doubled shielded armor consist is standard AISI 304, and optionally AISI 316. Additionally, the armor could be protected with a PVC sleeve in white, black, optionally with ATEX114 approval to protect against dust and water ingress and possibly corrosive ambient atmosphere.

-> See datasheet "Capillary lines"

Cooling options

There are several ways to protect the instrument from elevated temperatures, such as the extended direct mount (EDM), a temperature reducer (TR) or by means of capillary.

-> See datasheet "cooling devices"

Material Certification

Material traceability and related certification are applicable for all process wetted parts. Material certification possibilities depend on the type of seal, the assembly construction and the materials used.

Material certification is in accordance with EN10204 3.1.

Additional material certification and testing can be provided on request, such as Positive Material Identification (PMI), Intergranular corrosion (IGC) testing, material certification in accordance with EN10204 3.2, NACE conformity for ISO-15156 (MR-0175) and/or ISO-17945 (MR-0103), NORSOK M-630 and many more.

-> Please note that the responsibility for material selection always rests with the user.

Flange Marking & Traceability

All flanges are marked by the forging shop with heat number, material designation, size, and rating. Badotherm adds a Badotherm reference number and the manufacturers name to the flange for traceability purposes.

Flanges and origin

The seal parts are made from forged materials according to the applicable standards. The standard sourcing of flanges is of international origin. Optionally regional preference can be requested, for example materials from EU origin.

Testing

All seals are helium tested according the EN 13185 test procedure A.3 up to 10^{-9} mbar l/s before used on a diaphragm seal application.

-> See datasheet "Diaphragm Seal testing"

Cleanliness of the wetted parts

All parts are standard cleaned from excessive oil and grease. When additional requirements are needed, the parts can be cleaned according customer requirements and cleaning specifications.

Retaining bolts & nuts

The retaining bolts between upper and lower part can be selected in different materials and are in the size M10 up to 125 bar and 5/8" up to 248 bar.

Grade bolt	Grade nut	Material
ISO 3506-1 A2-70	-	AISI 304
ISO 3506-1 A4-70		AISI 316
ASTM F593F		AISI 304
ISO 3506-1 A4-70		AISI 316
ASTM A193 B7	ASTM A194 2H	Carbon steel
ASTM A193 B8M	ASTM A194 8M	AISI 316

Torque

The closing between upper part and lower part is done with 4 or 8 bolts, depending on the pressure rating. The torque of the M10 bolts is 35 Nm (25.81 ft-lb) and for the 5/8" UNC bolt torque is 100Nm.

Gaskets

For the USL-T a gasket is supplied for the closing between the upper and the lower part of the USL-T. The gaskets are virgin PTFE, Garfite N, or camprofile stainless steel with graphite layer. The gasket area of the lower part is matching the process connection. The design has a matching ID of the lower part based on the S40 of the ASME 16.10.

Material	Operating temperature
Virgin PTFE	-200 / +260°C
Garfite N ¹	-73 / +343°C
Camprofile	-200 / + 500°C

1: Garfite N cannot be used on steam applications

Pressure

The maximum working pressure of the USL is limited. The maximum allowed operating pressure (MAOP) of the upper and lower construction is depending on the type of bolts used. The maximum pressure of the assembly is depending on the selection and of bolts and gasket and lower part pressure class.

Size	Grade	MAOP @ 20°C	MAOP @ 400°C
8 x M10	ISO 3506-1 A2-70	125 bar	80 bar
8 x 5/8"	ASTM F593C/F	248 bar	145 bar
8 x 5/8"	ASTM A192 B7/B8M	248 bar	145 bar

Based on the assumption bolts and body materials has same expansion coefficients. Some materials are limited by material specification and are not able to meet 400°C.

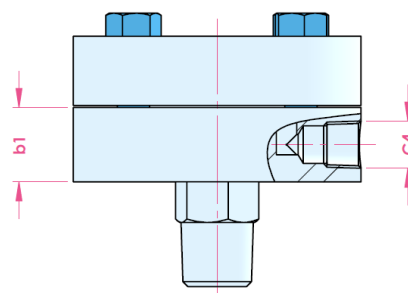
Flushing ports

The USL-T diaphragm seal is suitable to be equipped with one or two flushing ports. This ports can be left open, or fitted with needle valves, blind plugs or vent plugs. The type and size of the port can be selected within below size.

Size	Standard	Sealant
1/4" NPT-f	ANSI B1.20.1	Tape or paste
1/2" NPT-f	ANSI B1.20.1	Tape or paste
G 1/4"	ISO 228-1	gasket ISO 1179
G 1/2"	ISO 228-1	gasket ISO 1179
1/2" Socket weld	ASME 16.9	weld
1/2" Butt weld	ASME 16.11	weld

Thickness with flush ports

USL-T lower parts are perfectly suitable for flush connections. However some sizes will need extra thickness of the lower part. Below a table with a "rule of thumb" to determine the new thickness of the lower part. The flush channel to the chamber is 6mm.



Flush size (C4)	b1 (standard)	b1 (high pressure)
1/4" G/NPT	b1=20	b1=38.0
3/8" G/NPT	b1=28	
1/2" G/NPT	b1=30	
1/2" butt weld	b1=24	
3/4" butt weld	b1=30	
1/2" socket weld	b1=35	b1=41
3/4" socket weld		

All dimensions in mm

Example performance calculation

Whether a diaphragm seal can be used for a specific measurement, depends on the size of the diaphragm. That size is restricted by the size of the diaphragm seal.

For pressure transmitters, Badotherm offers an online performance calculation tool to calculate its performance and to ensure that the diaphragm size is suitable for your measurement.

The table below presents the minimum span of the respective diaphragm sizes with standard process conditions. As rule of thumb, a TPE of max 5% is often considered acceptable, but it depends per situation.

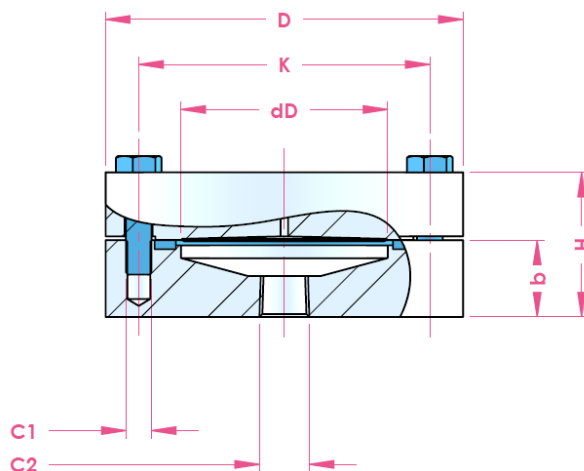
Minimum span table

dD	AP/GP	DP
81mm	110 mbar	20 mbar

Pressure transmitter; ambient temperature -10...+30°C; process temperature 100°C with BSO 22 fill fluid; 3 meter capillary; ID 1mm

See the general overview of all diaphragm sizes with several standard situations and in combination with Badotherm pressure gauges.

Dimensions table: Female threaded



Maximum Allowable Operating Pressure: 125 bar

ASME 1.20.1 – NPT tapered thread

Thread size (C2)	dD	D	H	b	K	C1	weight
1/4" NPT-f	81.0	140.0	55.0	30.0	114.0	M10	< 4.5 kg
1/2" NPT-f							
3/4" NPT-f							
1" NPT-f			59.1	34.1			
1.5" NPT-f							
2" NPT-f							

All dimensions in mm.

ISO 228 – G (BSP) Parallel thread

Thread size (C2)	dD	D	H	B	K	C1	weight
G 1/4	81.0	140.0	55.0	30.0	114.0	M10	< 4.5 kg
G 1/2							
G 3/4							
G 1							
G 1.5							
G 2"							
			59.1	34.1			
			77.5	52.5			

All dimensions in mm.

ISO 228 – G (BSP) Parallel thread

Thread size (C2)	dD	D	H	b	K	C1	weight
M12x1.5	81.0	140.0	55.0	30.0	114.0	M10	< 4.5 kg
M20x1.5							

All dimensions in mm.

ISO 7 – Whitworth tapered thread

Thread size (C2)	dD	D	H	b	K	C1	weight
Rc ¼	81.0	140.0	55.0	30.0	114.0	M10	< 4.5 kg
Rc ½							

All dimensions in mm.

Maximum Allowable Operating Pressure: 248 bar

ASME 1.20.1 – NPT tapered thread

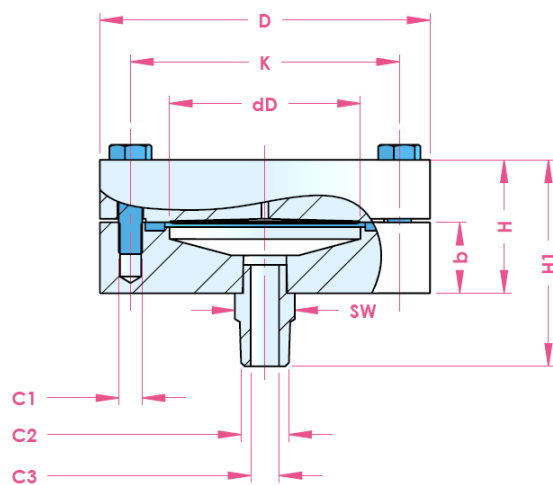
Thread size (C2)	dD	D	H	b	K	C1	weight
1/2" NPT-f	81.0	160.0	63.0	38.0	122.0	5/8"	<10.0 kg

ISO 228 – G (BSP) Parallel thread

Thread size (C2)	dD	D	H	b	K	C1	weight
G 1/2	81.0	160.0	63.0	38.0	122.0	5/8"	<10.0 kg

All dimensions in mm.

Dimensions table: Male threaded



Maximum Allowable Operating Pressure: 125 bar

ASME 1.20.1 – NPT tapered thread

Thread size (C2)	dD	D	H	H1	b	K	C1	C3	SW	weight
1/4" NPT-m	81.0	140.0	55.0	83.0	30.0	114.0	M10	6.0	22	< 4.5 kg
1/2" NPT-m				86.0				8.0		
3/4" NPT-m				87.0				10.0		
1" NPT-m				105.0				12.0	36	
1.5" NPT-m				108.0					50	

All dimensions in mm.

ISO 228 – G (BSP) Parallel thread

Thread size (C2)	dD	D	H	H1	b	K	C1	C3	SW	weight
G 1/4 A	81.0	140.0	55.0	83.0	30.0	114.0	M10	6.0	22	< 4.5 kg
G 1/2 A				86.0				8.0		
G 3/4 A				87.0				10.0		
G 1 A				105.0				12.0	36	
G 1.5 A				108.0					50	

All dimensions in mm.

DIN 13-1 – Metric ISO thread

Thread size (C2)	dD	D	H	H1	b	K	C1	C3	SW	weight
M12x1.5	81.0	140.0	55.0	83.0	30.0	114.0	M10	6.0	22	< 4.5 kg
M20x1.5				86.0				8.0		

All dimensions in mm.

ISO 7 – Whitworth tapered thread

Thread size (C2)	dD	D	H	H1	b	K	C1	C3	SW	weight
R ¼	81.0	140.0	55.0	83.0	30.0	114.0	M10	6.0	22	< 4.5 kg
R ½				86.0				8.0		

All dimensions in mm.

Maximum Allowable Operating Pressure: 248 bar

ASME 1.20.1 – NPT tapered thread

Thread size (C2)	dD	D	H	H1	b	K	C1	C3	SW	weight
1/2" NPT-m	81.0	160.0	63.0	91.0	38.0	122.0	5/8"	8.0	22	<10.0 kg

ISO 228 – G (BSP) Parallel thread

Thread size (C2)	dD	D	H	H1	b	K	C1	C3	SW	weight
G 1/2 A	81.0	160.0	63.0	91.0	38.0	122.0	5/8"	8.0	22	<10.0 kg

All dimensions in mm.

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DSS 7014 – 9th of September 2020

Change log

Date	Change
22-4-2020	Added extra size tables for ISO metrical and Whitworth tapered.
14-5-2020	Added size b to the size table and drawings
9-9-2020	H1 dimension ¾" male is changed to 69.5mm
	Added a note for PTFE lined lower part "only possible in combination with G thread male.
	Nuts removed from retaining bolt table for M10 sizes.

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