PIAB AB

STANDARD FOR DRAWINGS

DOC-0112129 Rev 10

Content

Revision history

Rev 07
Section 8 removed
Section 9 added

Rev 08
3.2 Viewing distance for visible surface changed from 2 m to 1 m

Rev 09
Section 10 added, matber, 2018-09-14

Rev 10
Standard for Plastic mouldings replaced

1 Scope

This standard applies to all PIAB AB's drawings unless explicitly stated on the drawing that this standard does not apply, partly or as a whole.
Generally the standards listed below are used by PIAB AB.
PIAB AB's Standard for drawings are seen as a complement and cover up for dimensions and tolerances not mentioned in these standards.

General tolerances

Technical drawings		
- Fundamental tolerancing principle	**SS-ISO 8015**	**DOC-0124054**
Edges of undefined sharpe		
- vocabulary and indications	**SS-ISO 13715**	**DOC-0123086**
GPS-indication of surface		
Texture in product doc.	**SS-ISO 1302**	**DOC-0124055**
Metrical threads	**SS-ISO 965**	**DOC-0112672**
Whitworth threads	**SS-ISO 228**	**DOC-0117741**
If nothing else		

Specified tolerances on drawing.

Machined parts	**SS-ISO-2768–1**	**DOC-0117524**
Casting dim. tolerances	**SS-ISO-8062**	**DOC-0111399**
Rubber mouldings	**SS-ISO-3302-1**	**DOC-0106320**
Plastic mouldings	**ISO 20457:2018**	**DOC-0604857**
Extruded profile in aluminium	**SS-EN-755**	**DOC-0107173, -5, -6**
Extruded precision profile in aluminium	**SS-EN-12020**	**DOC-0107170, -2**
Piab Marking of parts standard.		**DOC-0124053**

All dimensions mentioned are in millimeter (mm). Dimensions apply after surface treatment.

2 Threads

2.1 Tolerances

General tolerance for threads
Unless otherwise stated,
All Metric ISO threads are according to SS-ISO 965.
- Internal threads - class 6H
- External threads - class 6g

All Dryseal Pipe threads are according to ANSI B1.20.3

All Whitworth threads are according to ISO 228
- Internal threads - N/A
- External threads - class A

All dimensions and tolerances apply after surface treatment.

For threads with electrlythical threatment it's acceptable to exceed value of tolerance for internal diameter at internal threads or fall below value of tolerance for external diameter at external threads with 20%.

Tolerances for thread depth/length
Unless otherwise stated on the drawing, the tolerance for the thread length is always a positive value above the nominal dimension. The value is the thread pitch x 2. For example, a M8 external thread with pitch 1,25 mm have a thread length of $X^{+2,5}_{-0}$

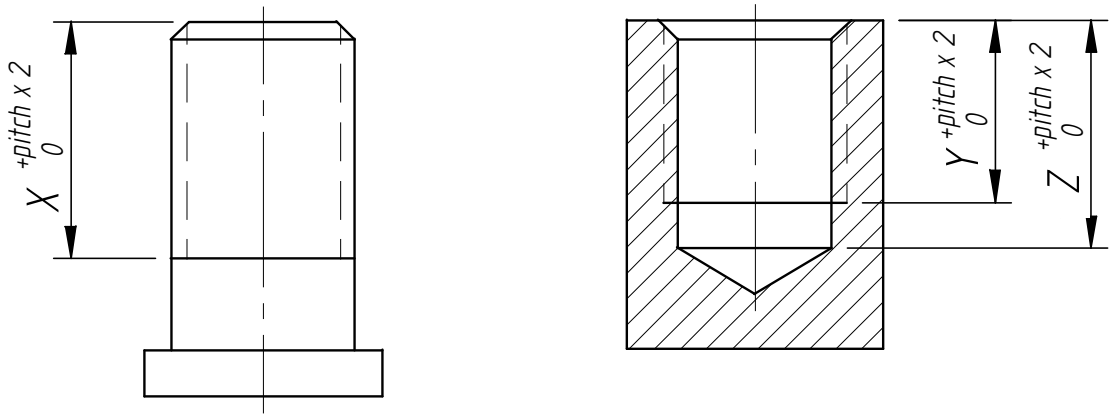


Figure 1.

Depth of blind hole. (Z)
Unless otherwise stated on the drawing, the depth of the blind hole is to be 1,5 x thread length. Ref. Figure 1. Ex. Z = 1,5 x Y

Tolerance for blind hole depth
Unless otherwise stated on the drawing, the tolerance of the blind hole depth is a positive value, 0 to +2 x thread pitch, above the nominal dimension.

2.2 Chamfers

Unless otherwise stated on the drawing, all threads must be chamfered according to table 1 and 2. Chamfers for threads not mentioned in the tables below are calculated using this formula:

A = chamfer diameter according to figure 1 (External thread)
B = chamfer diameter according to figure 1 (Internal thread)
d = Thread nominal minor diameter
D = Thread nominal major diameter

For external threads:
A = d x 0,95 rounded to one decimal point. Tolerance for A ≤ 6 ±0,1 and for A > 6 ± 0,15 .

For internal threads:
B = D x 1,05 rounded to one decimal point. Tolerance for B ≤ 6 ±0,1 and for B > 6 ± 0,15 .

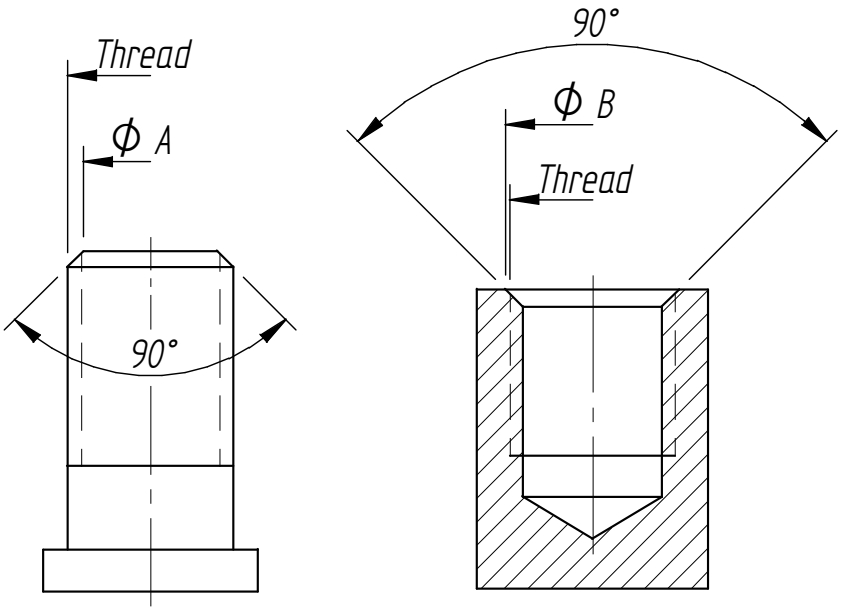


Figure 2.

Angular tolerance for chamfer are, if anything else is stated on drawing, ± 5° for the complete chamfer angle.
Ref. Figure 2. Ex. 90° ±5°

Table 1, ISO M threads

The following table also applies for threads with another pitch. For example, thread chamfer Ø 3,9 for external thread M5 applies for both M5x0,8 and M5x0,5.

Thread designation	Thread chamfer Ø A External thread	Thread chamfer Ø B Internal thread	Tolerance for Ø A and Ø B
M1,6	1,1	1,7	±0,1
M1,8	1,3	1,9	±0,1
M2	1,5	2,1	±0,1
M2,2	1,6	2,3	±0,1
M2,5	1,9	2,6	±0,1
M3	2,3	3,1	±0,1
M4	3,1	4,2	±0,15
M5	3,9	5,2	±0,15
M6	4,6	6,3	±0,15
M7	5,6	7,4	±0,15
M8	6,3	8,4	±0,15
M9	7,2	9,5	±0,15
M10	7,9	10,5	±0,15
M11	8,9	11,6	±0,15
M12	10,3	12,6	±0,15

Table 2, SS-ISO 228/1 G Threads

Thread designation	Thread chamfer Ø A External thread	Thread chamfer Ø B Internal thread	Tolerance for Ø A and Ø B
ISO-G 1/16	6,2	8,1	±0,15
ISO-G 1/8	8,1	10,2	±0,15
ISO-G 1/4	10,8	13,8	±0,15
ISO-G 3/8	14,2	17,5	±0,15
ISO-G 1/2	17,6	22	±0,15
ISO-G 3/4	22,9	27,8	±0,15
ISO-G 1	28,7	34,9	±0,2
ISO-G 1 1/2	42,6	50,2	±0,2
ISO-G 2	53,8	62,6	±0,2
ISO-G 2 1/2	68,6	78,9	±0,2
ISO-G 3	80,6	92,3	±0,2
ISO-G 3 1/2	92,5	105,3	±0,2
ISO-G 4	104,5	118,7	±0,2

3 Surface

3.1 Anodizing

Table 4.

Code	Color	Color reference	Thickness
AR01	Bordeaux red	0111030	20±5 µm
AR02	Bordeaux red	0112191	20±5 µm
AR03	Bordeaux red	0118189	20±5 µm

Above anodizing code refer to a set of 3 reference plates (nn-1, nn-2 and nn-3). Anodizing, color and surface threatment should, with visual comparision be equal to nn-2 plate.
The color is accepted to vary in the range of nn-1 and nn-3.
The surface must also comply with the reference plates regarding glossiness.
Comparing with reference plate must take place in normal office light (fluorent lamp 600-750 lux) and with a light background.

3.2 Surface quality

A surface indicated on the drawing as a visible surface must have a surface quality without defects that differs from the normal surface structure, visible at a viewing distance of 1 m.

Surfaces without indication on the drawing must have a surface quality without defects that differs from the normal surface structure, visible at a viewing distance of 3 m.

Viewing visible surface must take place in normal office light (fluorent lamp 600-750 lux) and with a light background, perpendicular to the surface.

3.3 Surface contamination

Contamination from surface treatment, polishing, machining, washing etc. must be removed completely before packaging. No undesirable residue from above mentioned operation may occur on the surface of the parts included in shipped packages.

4 Chamfer and fillets

4.1 Sharp edges

If nothing else is stated on the drawing shall external eges be L-0,3/ -0,1
and Internal edges shall be L+0,3 /+0,1. According to SS-ISO 13715.

5 *Key handles*

Key handles on the drawing are designated NG or SW. Dimension designated with NG or SW are excepted from the general tolerance on the drawing. The tolerance size is the same as för the general tolerance used on the specific drawing, but the entire tolerance size must deviate on the positive side for an internal key handle, and on the negative side for an external key handle.

Example, The general tolerance for the drawing reads ISO 2768-m, for a dimension 10, the tolerance size according to the standard is 0,4 mm, and deviates symmetrically from the basic size (10±0,2). An internal key handle on that drawing will then have a tolerance $10^{+0,4}_{-0}$ according to this standard, and an external key handle $10^{+0}_{-0,4}$

6 *Ejector pins, inlet and parting lines*

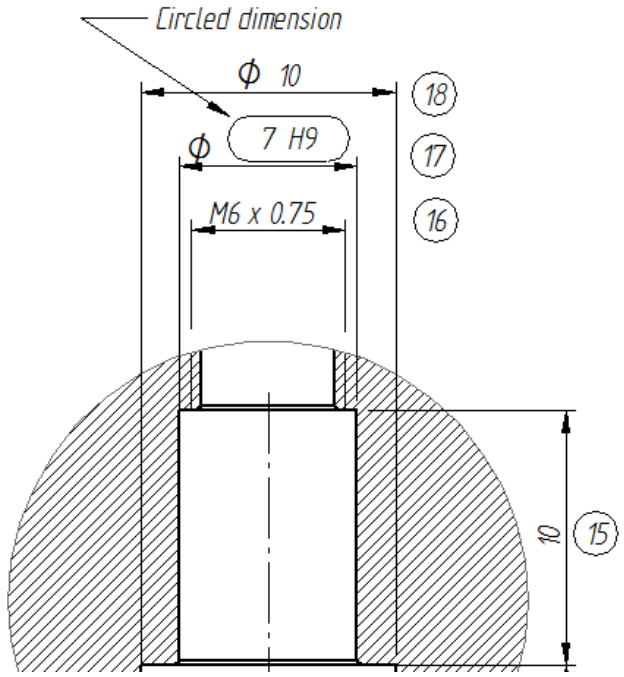
The location of marks from ejector pins, inlet and tool parting lines must be marked on a drawing and approved by PIAB AB before making the tool.

7 *Marking of parts.*

See Piab marking standard DOC-0124053 General principles for marking of items

9 *Critical dimensions*

Dimensions circled according to picture are appointed to be critical. Those dimensions are typically dimensions that have the smallest tolerances, affect fit/function or have safety and regulatory affects.



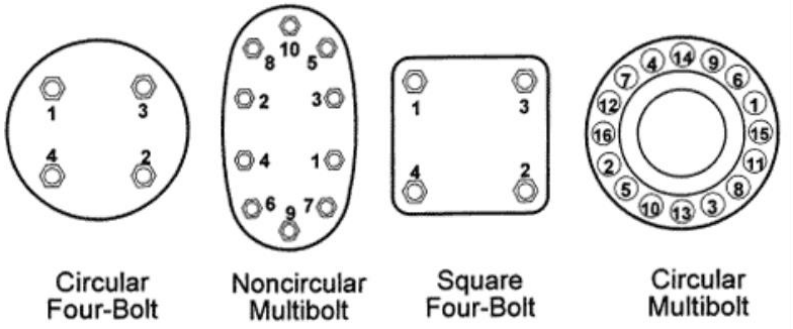
10 Tightening torque

If not otherwise stated on drawing section 10 applies for all below described screw joints.

Following needs to be considered :

- Screws with countersunk head: Because of the size of the contact surface and the countersink angle these screws generate a greater friction force against the contact surface and therefore the tightening torque must be increased by approximately 30 %.
- Screws and nuts with flange: These screws have a larger contact surface compared to ordinary screw as well and thereby larger friction radius, why the tightening torque must be increased by approximately 10 %.
- Set screw: Set screws have no skull, which reduces friction. The shape of the end that reaches material, on the other hand, has significance. The force is reduced by about 50-70% compared to standard screws since the friction is lower. Pointy model requires the lowest mounting moment, while the beveled, flat and tiled shape gives higher friction.
- Screw joint with soft gaskets/sealing should be re-tightened due to sag in the material., normally after 12-24 hours

Recommended tightening sequence for flanges and screw joint with gaskets and multiple bolts/screws



Assembly steps

1. Start with position 1 and then continue with pos 3, 4 and so on
2. Apply max half required torque on round 1
3. Apply final torque on round 2

10.1 Plain, oiled steel screw joint

The tightening torque (Mv) in Nm for plain, oiled steel screw applications when a torque wrench or torque controlled tightening equipment is used (torque tolerance max +/- 5%). Please see section 10.3 for conversion factor C for other material/lubrications.

Metric coarse

Thread M	Diameter d mm	Pitch P mm	Nominal stress As mm²	Property class acc. to ISO-898-1:2013				
				4.6	5.8	8.8	10.9	12.9
1,6	1,6	0,35	1,27	0,065	0,10	0,17	0,24	0,29
1,8	1,8	0,35	1,70	0,096	0,16	0,25	0,36	0,43
2	2	0,4	2,07	0,13	0,22	0,35	0,49	0,58
2,2	2,2	0,45	2,48	0,17	0,29	0,46	0,64	0,77

2,5 3	2,5 3	0,45 0,5	3,39 5,03	0,26 0,46	0,44 0,77	0,70 1,2	0,98 1,7	1,2 2,1
3,5 4 4,5	3,5 4 4,5	0,6 0,7 0,75	6,78 8,78 11,3	0,73 1,1 1,6	1,2 1,8 2,6	1,9 2,9 4,1	2,7 4,0 5,8	3,3 4,9 7,0
5 6 8	5 6 8	0,8 1 1,25	14,2 20,1 36,6	2,2 3,7 8,9	3,6 6,1 15	5,7 9,8 24	8,1 14 33	9,7 17 40
10 12 14	10 12 14	1,5 1,75 2	58 84,3 115	17 30 48	29 51 80	47 81 128	65 114 181	79 136 217
16 18 20	16 18 20	2 2,5 2,5	157 192 245	74 103 144	123 172 240	197 275 385	277 386 541	333 463 649
22 24 27	22 24 27	2,5 3 3	303 353 459	194 249 360	324 416 600	518 665 961	728 935 1350	874 1120 1620
30 33 36	30 33 36	3,5 3,5 4	561 694 817	492 663 855	819 1100 1420	1310 1770 2280	1840 2480 3210	2210 2980 3850
39 42 45	39 42 45	4 4,5 4,5	976 1121 1306	1100 1360 1690	1830 2270 2820	2930 3640 4510	4120 5110 6340	4940 6140 7610
48 52 56	48 52 56	5 5 5,5	1473 1758 2030	2040 2620 3270	3400 4370 5440	5450 6990 8710	7660 9830 12200	9190 11800 14700
60 64 68	60 64 68	5,5 6 6	2362 2676 3055	4050 4900 5910	6750 8170 9860	10800 13100 15800	15200 18400 22200	18200 22000 26600
72 76 80	76 76 80	6 6 6	3460 3889 4344	7060 8340 9770	11800 13900 16300	18800 22200 26100	26500 31300 36600	31800 37500 44000
85 90 95 100	85 90 95 100	6 6 6 6	4948 5591 6273 6995	11800 14000 16600 19400	19600 23400 27600 32300	31400 37400 44200 51700	44200 52700 62200 72700	53000 63200 74600 87300
σs = ReL eller Rp0,2 N/mm² nominellt				240	400	640	900	1080
$\kappa\left(1+\frac{S_H}{F_{pl}}\right)^{k}$ x σs N/mm²				26,16	43,60	69,76	98,10	117,72

UNC threads

Gänga UNC	Diameter d mm	Stigning P mm	Spänningsarea As mm²	Hållfasthetsklass enligt ISO-898-1:2013				
				4.6	5.8	8.8	10.9	12.9
No 4 No 5 No 6	2,845 3,175 3,505	0,635 0,635 0,794	3,9 5,14 5,86	0,31 0,45 0,58	0,58 0,84 1,1	0,94 1,4 1,7	1,3 1,9 2,5	1,7 2,4 3,1
No 8 No 10 No 12	4,166 4,826 5,486	0,794 1,058 1,058	9,04 11,31 15,58	1 1,5 2,3	1,9 2,9 4,4	3,1 4,6 7	4,4 6,5 10	5,5 8,1 12
1/4 5/16 3/8	6,35 7,938 9,525	1,270 1,411 1,588	20,5 33,8 50,0	3,6 7,3 13	6,7 14 24	11 22 38	15 31 54	19 38 68
7/16 1/2 9/16	11,112 12,7 14,288	1,814 1,954 2,117	68,6 91,5 117	20 31 44	38 57 82	61 93 133	87 131 187	108 163 234

5/8	15,875	2,309	146	61	114	183	259	323
3/4	19,05	2,54	216	107	200	322	455	568
7/8	22,225	2,822	298	172	320	516	729	909
1	25,4	3,175	391	257	479	772	1090	1360
1 1/8	28,575	3,629	492	365	679	1090	1550	1930
1 1/4	31,75	3,629	625	509	947	1530	2160	2690
1 3/8	34,925	4,233	745	672	1250	2020	2850	3550
1 1/2	38,1	4,233	907	884	1650	2650	3750	4680
1 3/4	44,45	5,080	1225	1400	2600	4190	5930	7390
2	50,8	5,644	1612	2100	3900	6290	8890	11100
2 1/4	57,15	5,644	2095	3030	5640	9090	12800	16000
2 1/2	63,5	6,350	2580	4150	7720	12500	17600	21900
2 3/4	69,85	6,350	3183	5590	10400	16800	23700	29500
3	76,2	6,350	3850	7320	13600	22000	31000	38700
3 1/4	82,55	6,350	4580	9380	17740	28100	39800	49600
3 1/2	88,9	6,350	5373	11800	21900	35400	50000	62300
3 3/4	95,25	6,350	6230	14600	27100	43700	61800	77100
4	101,6	6,350	7150	17800	33100	53300	75400	94000
σs = ReL eller Rp0,2 N/mm² nominellt				248	393	634	896	1117
$\kappa\left(1+\frac{S_F}{F_{ps}}\right)^k$ x σs N/mm²				23,03	42,84	69,11	97,66	121,75

10.2 Stainless steel screw joints (incl. acid proof)

The tightening torque (Mv) in Nm for waxed stainless steel screw applications when a torque wrench or torque controlled tightening equipment is used (torque tolerance max +/- 5%). Please see section 10.3 for conversion factor C for other material/lubrications.

NOTE! When tightening of screws of stainless steel or acid proof material, do not use impact wrenches due to the increased risk of shearing in the joint. Use stall tools when tightening screws and nuts of stainless steel or acid proof material.

Metric Coarse

Thread M	**Diameter d mm**	**Pitch P mm**	**Nominal stress As mm²**	**Property class acc. to SS-ISO 3506-1**							
				Austenitiska (A)			**Ferritiska (F) och Martensitiska (C)**				
				50	70	80	45	50	60	70	80
1,6	1,6	0,35	1,27	3,6	0,12	0,16	0,068		0,11		0,17
2	2	0,4	2,07	0,11	0,25	0,33	0,14		0,22		0,35
2,5	2,5	0,45	3,39	0,23	0,5	0,28	0,28		0,45		0,7
3	3	0,5	5,03	0,41	0,87	1,2	0,48		0,79		1,2
3,5	3,5	0,6	6,78	0,64	1,4	1,8	0,76		1,3		2
4	4	0,7	8,78	1	2	2,7	1,1		1,9		2,9
5	5	0,8	14,2	1,9	4,1	5,4	2,3		3,7		5,8
6	6	1	20,1	3,3	7	9,3	3,9		6,3		9,9
8	8	1,25	36,6	7,8	17	22	9,3		15		24
10	10	1,5	58	15	33	44	18		30		47
12	12	1,75	84,3	27	57	76	32		52		82
14	14	2	115	43	91	121	51		83		130
16	16	2	157	65	140	187	78		127		199
18	18	2,5	192	91	195	260	108		178		277
20	20	2,5	245	127	273	364	152		249		388
22	22	2,5	303	171	367	490	204		335		523
24	24	3	353	220	472	629	262		430		671
27	27	3	459	318	682	909	379		621		969

30	30	3,5	561	434	930	1240	517	848	1320
33	33	3,5	694	585	1250	1670	697	1140	1780
36	36	4	817	755	2160	2160	899	1470	2300
39	39	4	976	969	2080	2770	1150	1890	2950
σs = ReL eller Rp0,2 N/mm² nominellt				210	450	600	250	410	640
$\sqrt[k]{\kappa\left(1+\frac{S_F}{F_{ges}}\right)}$ x σs N/mm²				23,1	49,5	66	27,5	45,1	70,4

UNC threads

Thread M	Diameter d mm	Pitch P mm	Nominal stress As mm²	Property class acc. to SS-ISO 3506-1							
				Austenitiska (A)			Ferritiska (F) och Martensitiska (C)				
				50	70	80	45	50	60	70	80
1/4	6,35	1,270	20,5	3,6	7,7	10	4,3		7		11
5/16	7,938	1,411	33,8	7,3	16	21	8,7		14		22
3/8	9,525	1,588	50,0	13	28	37	15		25		38
7/16	11,112	1,814	68,6	20	44	59	24		40		61
1/2	12,7	1,954	91,5	31	66	89	37		60		93
9/16	14,288	2,117	117	44	95	127	53		87		133
5/8	15,875	2,309	146	61	131	175	73		120		183
3/4	19,05	2,54	216	108	231	308	128		210		322
7/8	22,225	2,822	298	172	369	493	205		337		516
1	25,4	3,175	391	258	553	737	307		504		772
1 1/8	28,575	3,629	492	366	784	1050	436		715		1090
1 1/4	31,75	3,629	625	511	1090	1460	608		997		1530
1 3/8	34,925	4,233	745	674	1440	1930	802		1320		2020
1 1/2	38,1	4,233	907	887	1900	2540	1060		1730		2650
σs = ReL eller Rp0,2 N/mm² nominellt				210	450	600	250		410		640
$\sqrt[k]{\kappa\left(1+\frac{S_F}{F_{ges}}\right)}$ x σs N/mm²				23,1	49,5	66	27,5		45,1		70,4

10.3 Conversion factor (C) for tightening torque for some common platings

Material, plating 1)			
screw	nut or mating thread	Lubrication	Conversion factor C
steel plain	steel plain	Dry Oil MoS2 wax	0,96 1 0,86 0,63
Steel phos	Steel plain or phos	Dry Oil MoS2 wax	0,90 0,86 0,77 0,63
steel fzy, fzb	steel fzy, fzb or plain	Dry Oil/emulsion wax	0,90 0,86 0,63
	light metal	Oil/emulsion	0,94

steel hdg	Steel plain or hdg	Dry Oil/emulsion wax	1,17 1,07 0,63
stainless and acid proof steel	stainless, acid proof steel or light metal	wax Oil/emulsion	1 0,84