HUSKY®

Keeping our customers in the lead

Supplier Quick Reference

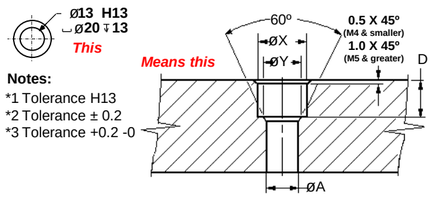
Common Drawing Features and Manufacturing Practices

All dimensions in millimeters unless otherwise specified

1) Scope and Purpose

This document is a quick reference for Husky Suppliers. It is designed to complement drawings that do not fully describe specific component features. This document is not intended to replace or supersede drawing specifications: Full detail of these features is obtained by combining the drawing with the quick reference information. The quick reference is applicable on drawings where designated as follows: UNDEFINED DRAWING FEATURES TO COMPLY WITH HS534 "SUPPLIER QUICK REFERENCE"

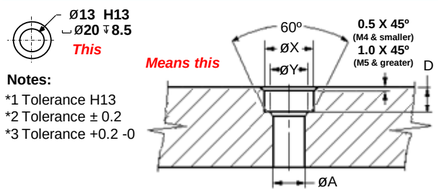
2) Metric Counterbore Holes



Notes:
*1 Tolerance H13
*2 Tolerance ± 0.2
*3 Tolerance +0.2 -0

Screw Size	Drill Size	Counterbore Diameter	Countersink Diameter	Counterbore Depth
	A*1	X*2	Y*3	D*2
	Nom.	Nom.	Min.	Nom.
M1.6	1.8	3.5	2.0	1.8
M2	2.4	4.2	2.6	2.2
M2.5	2.9	5.0	3.1	2.7
M3	3.4	6.0	3.6	3.4
M4	4.5	8.0	4.7	4.6
M5	5.5	10.0	5.7	5.7
M6	6.6	11.0	6.8	6.8
M8	9.0	15.0	9.2	9.0
M10	11.0	18.0	11.2	11.0
M12	13.0	20.0	14.2	13.0
M16	17.0	26.0	18.2	17.5
M20	21.0	33.0	22.4	21.5
M24	25.0	38.0	26.4	25.5
M30	31.0	48.0	33.4	31.5
M36	37.0	57.0	39.4	37.5
M42	43.0	66.0	45.6	43.5
M48	49.0	75.0	52.6	50.0

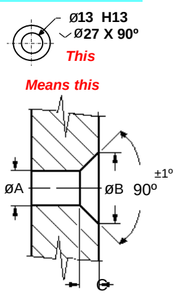
3) Counterbore Holes for Metric LHCS



Notes:
*1 Tolerance H13
*2 Tolerance ± 0.2
*3 Tolerance +0.2 -0

Screw Size	Drill Size	Counterbore Diameter	Countersink Diameter	Counterbore Depth
	A*1	X*2	Y*3	D*2
	Nom.	Nom.	Min.	Nom.
M3	3.4	6.0	3.6	2.4
M4	4.5	8.0	4.7	3.2
M5	5.5	10.0	5.7	4.0
M6	6.6	11.0	6.8	4.7
M8	9.0	15.0	9.2	6.0
M10	11.0	18.0	11.2	7.0
M12	13.0	20.0	14.2	8.5
M16	17.0	26.0	18.2	10.5
M20	21.0	33.0	22.4	13.0

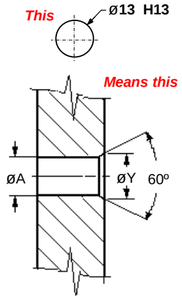
4) Metric Countersink Holes



Screw Size	Drill Size	Countersink Diameter	Countersink Depth
	A*1	B*2	C
	Nom.	Nom.	For Ref.
M3	3.4	6.8	1.7
M4	4.5	9.3	2.4
M5	5.5	11.5	3.0
M6	6.6	13.6	3.5
M8	9	18.2	4.6
M10	11	22.6	5.8
M12	13	27.0	7.0
M16	17	33.8	8.4
M20	21	40.6	9.8

Notes:
*1 Tolerance H13
*2 Tolerance ± 0.2

5) Metric Clearance Holes

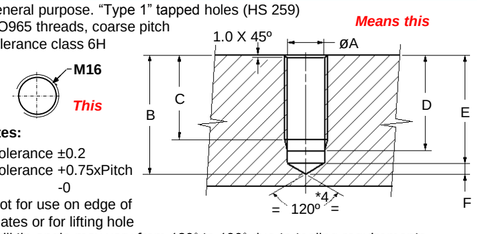


Screw Size	Drill Size	Countersink Diameter
	A*1	Y*2
	Nom.	Nom.
M1.6	1.8	2.0
M2	2.4	2.6
M2.5	2.9	3.1
M3	3.4	3.6
M4	4.5	4.7
M5	5.5	5.7
M6	6.6	6.8
M8	9.0	9.2
M10	11.0	11.2
M12	13.0	14.2
M16	17.0	18.2
M20	21.0	22.4
M24	25.0	26.4
M30	31.0	33.4
M36	37.0	39.4
M42	43.0	45.6
M48	49.0	52.6

Notes:
*1 Tolerance H13
*2 Tolerance +0.2 -0

6) Metric Thread Installations

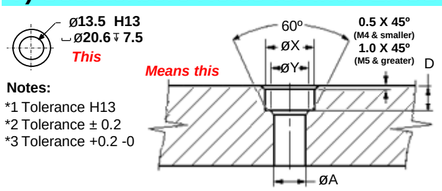
- General purpose. "Type 1" tapped holes (HS 259)
- ISO965 threads, coarse pitch
- Tolerance class 6H



Notes:
*1 Tolerance ±0.2
*2 Tolerance +0.75xPitch -0
*3 Not for use on edge of plates or for lifting hole
*4 Drill tip angle may vary from 120˚ to 180˚ due to tooling requirements

Thread	Pitch	Tap Drill A Nom.	Tap Drill A Max.	Tap Drill A Min.	Tapping B*1 Nom.	Tapping C*2 Nom.	For Ref. D*2 Min.	For Ref. E Nom.	For Ref. F Nom.
M3	0.5	2.5	2.599	2.459	9.5	6	7.5	8.778	0.722
M4	0.7	3.3	3.422	3.242	12.5	8	10.1	11.547	0.953
M5	0.8	4.2	4.334	4.134	16	10	12.4	14.788	1.212
M6	1	5	5.153	4.917	18.5	12	15	17.057	1.443
M8	1.25	6.75	6.912	6.647	24	16	19.75	22.051	1.949
M10	1.5	8.5	8.676	8.376	30	20	24.5	27.546	2.454
M12	1.75	10.25	10.441	10.106	35	24	29.25	32.041	2.959
M16	2	14	14.21	13.835	45	32	38	40.959	4.041
M20*3	2.5	17.5	17.744	17.294	56	40	47.5	50.948	5.052
M24	3	21	21.252	20.752	67	48	57	60.938	6.062
M30	3.5	26.5	26.771	26.211	83	60	70.5	75.35	7.65
M36	4	32	32.27	31.67	98	72	84	88.762	9.238
M42	4.5	37.5	37.799	37.129	114	84	97.5	103.175	10.825
M48	5	43	43.297	42.587	130	96	111	117.587	12.413
M56	5.5	50.5	50.796	50.046	150	112	128.5	135.422	14.578

7) Counterbore Holes for Inch LHCS



Notes:
*1 Tolerance H13
*2 Tolerance ± 0.2
*3 Tolerance +0.2 -0

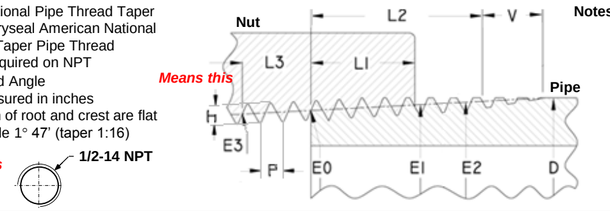
All dimensions in millimeters unless otherwise specified

Screw Size		Drill Size	Counterbore Diameter	Countersink Diameter	Counterbore Depth
		A*1	X*2	Y*3	D*2
Inch	Inch	Nom.	Nom.	Min.	Nom.
#4	0.1120	3.5	5.5	-	2.0
#8	0.1640	4.9	8.0	-	2.5
#10	0.1900	5.6	9.5	-	3.0
1/4	0.2500	7.1	11.1	-	4.0
5/16	0.3125	8.7	13.5	-	5.0
3/8	0.0375	10.3	15.9	10.5	6.0
1/2	0.5000	13.5	20.6	14.0	7.5

8) NPT / NPTF Pipe Threads

ANSI/ASME B1.20.1

- NPT – National Pipe Thread Taper
- NPTF – Dryseal American National Standard Taper Pipe Thread
- Sealant required on NPT
- 60° Thread Angle
- Pitch measured in inches
- Truncation of root and crest are flat
- Taper angle 1° 47' (taper 1:16)



This 1/2-14 NPT

Notes: *1 Truncation from point of thread triangle to flat (not displayed on drawing). Minimum = 0.033P for all pitches. See table for maximum. For NPTF threads, refer to ANSI B1.20.3 on limits on crest and root truncation
*2 Requires taper with reamer before tapping
*3 Tapping drills given for taper with reamer for NPT threads 1 1/4" and greater

Basic dimensions given to 5 or 6 decimal places to eliminate errors when calculating gauge dimensions (do not imply a greater degree of precision)

NPT Thread (Inch)	Threads Per Inch	Outside Pipe Diameter	Pitch of Thread	Height of Thread	Truncation Max.*1	Pitch Diameter Start of Ext. Thread	Handtight Engagement Length	Handtight Engagement Diameter	Effective Thread Length	Effective Thread Diameter	Wrench Makeup Length, Internal Length	Wrench Makeup Length, Internal Diameter	Vanish Thread Length	Tapping Drills *3 Drill Size (Inch)	Tapping Drills *3 Eq. (mm)
		D	P	h	f	E0	L1	E1	L2	E2	L3	E3	V		
1/16"	27	7.9375	0.940816	0.752602	0.09144	6.887972	4.064	7.141972	6.63194	7.3025	2.82194	6.711696	3.2639	C	6.1468
1/8"	27	10.287	0.940816	0.752602	0.09144	9.233154	4.1148	9.48944	6.70306	9.652	2.82194	9.056624	3.2639	Q	8.4328
1/4"	18	13.716	1.411224	1.128776	0.12446	12.125706	5.7912	12.487402	10.20572	12.7635	4.23418	11.861038	4.89712	7/16"	11.1125
3/8"	18	17.145	1.411224	1.128776	0.12446	15.545054	6.096	15.926054	10.35812	16.1925	4.23418	15.28064	4.89712	37/64"	14.68374
1/2"	14	21.336	1.814322	1.451356	0.14224	19.264122	8.128	19.772122	13.55598	20.111466	5.44322	18.924016	6.29412	45/64"	17.85874
3/4"	14	26.67	1.814322	1.451356	0.14224	24.579072	8.6106	25.117298	13.86078	25.445466	5.44322	24.238966	6.29412	29/32"	23.02002
1"	11 ½	33.401	2.208784	1.767078	0.16002	30.826202	10.16	31.461202	17.34312	31.91002	6.62686	30.412182	7.66318	1-9/32"	32.54502
1 1/4"	11 ½	42.164	2.208784	1.767078	0.16002	39.551102	10.668	40.217852	17.95272	40.67302	6.62686	39.137082	7.66318	1-15/32"	37.30752
1 1/2"	11 ½	48.26	2.208784	1.767078	0.16002	45.620686	10.2108	46.287436	18.3769	46.76902	6.62686	45.206412	7.66318	1-23/32"	43.65752
2"	11 ½	60.325	2.208784	1.767078	0.16002	57.633108	11.0744	58.325258	19.2151	58.83402	6.62686	57.219088	7.66318	2-5/32"	54.77002
2 1/2"	8	73.025	3.175	2.54	0.19812	69.076062	17.3228	70.15861	28.8925	70.881748	6.35	68.679314	11.01598	2-25/32"	70.64502
3"	8	88.9	3.175	2.54	0.19812	84.851748	19.4564	86.0679	30.48	86.756748	6.35	84.455	11.01598	3-9/32"	83.34502

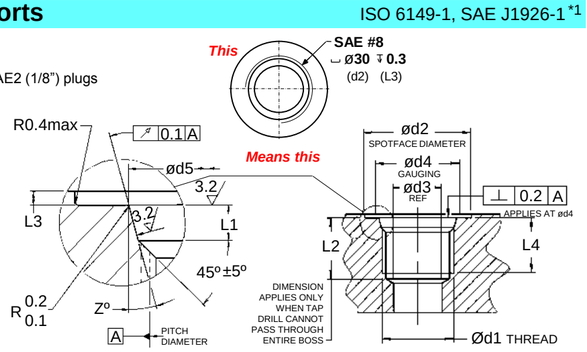
*2

All dimensions in millimeters unless otherwise specified

9) SAE Straight Thread Ports

ISO 6149-1, SAE J1926-1*1

Notes:
*1 Amended by HS 336
*2 Tolerance ±1.0. Exception: ±0.2 for SAE2 (1/8") plugs
*3 Recommended drills as per HS 225
*4 Tolerance ±0.05. Diameter d5 to be concentric with thread pitch diameter within 0.127mm. No longitudinal and spiral tool marks allowed.
*5 Tolerance ±0.2
*6 Tap drill depths given for bottoming taps only
*7 Recommended spotface depth. Tolerance [+0.3, -0.2]
*8 Full thread depth
*9 Tolerance ±1°
*10 Standard hydraulic applications: 90 durometer nitrile (N552-90)



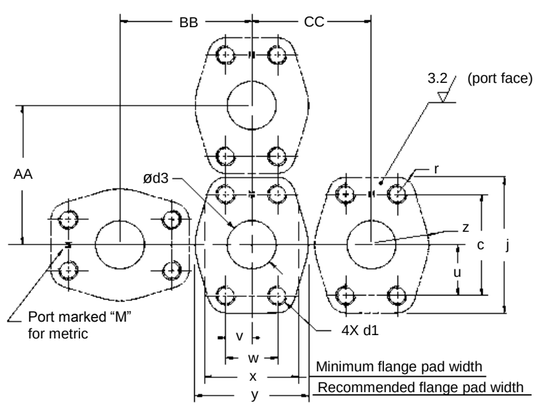
d1		Thread Nominal Size (Inch)	Thread Tap Drill Dia (mm) Min.	Thread Tap Drill Dia (mm) Max.	d2*2 Fittings & Plugs [Standard]	d2*2 Plugs Only [Optional]	d3*3 Max.	d4 Min.	d5*4 Nom.	L1*5 Nom.	L2*6 Nom.	L3*7 Fittings	L3*7 Plugs	L4*8 Min.	Z*9 Nom.	O-Ring Size*10
INCH	SAE #															
Nom.	Nom.		Min.	Max.	Nom.	Nom.	Max.	Min.	Nom.	Nom.	Nom.	Nom.	Nom.	Min.	Nom.	
1/8"	-2	5/16-24 UNF-2B	6.78	7.04	17	12	6.35	11	9.15	2.1	12	0.3	3.5	10	12°	3-902
1/4"	-4	7/16-20 UNF-2B	9.73	10.03	21	16	8.7	15	12.45	2.6	14	0.3	3.5	11.5	12°	3-904
3/8"	-6	9/16-18 UNF-2B	12.75	13.08	25	21	11.2	18	15.7	2.7	15.5	0.3	3.5	12.7	12°	3-906
1/2"	-8	3/4-16 UNF-2B	17.32	17.68	30	24	16	22	20.65	2.7	17.5	0.3	5	14.3	15°	3-908
5/8"	-10	7/8-14 UNF-2B	20.27	20.68	34	28	20	26	24.0	2.7	20	0.3	5	16.7	15°	3-910
3/4"	-12	1 1/16-12 UN-2B	24.69	25.15	41	34	20	32	29.2	3.5	23	0.3	5	19	15°	3-912
7/8"	-14	1 3/16-12 UN-2B	27.86	28.32	45	38	25	35	32.4	3.5	23	0.3	5	19	15°	3-914
1"	-16	1 5/16-12 UN-2B	31.04	31.50	49	42	30	38	35.55	3.5	23	0.3	5	19	15°	3-916
1 1/4"	-20	1 5/8-12 UN-2B	38.99	39.45	58	50	38	48	43.55	3.5	23	0.3	5	19	15°	3-920
1 1/2"	-24	1 7/8-12 UN-2B	45.34	45.80	65	58	45	54	49.9	3.5	23	0.3	5	19	15°	3-924
2"	-32	2 1/2-12 UN-2B	61.21	61.67	88	75	50	70	65.75	3.5	23	0.3	5	19	15°	3-932

All dimensions in millimeters unless otherwise specified

10) Four-Bolt Split Flange Ports

ISO 6162

Notes:
*1 Code 61: 2.5 MPa to 35 MPa series
Code 62: 40 MPa series
*2 Tolerance +0, -1.5
As per ISO 6162
*3 Tolerance ±0.25
*4 Radius
*5 Dimensions AA, BB, and CC provide 1.5mm clearance between same size flanges
*6 Four general purpose "type 1" tapped holes (as per HS 259).
*7 Minimum full thread depth - For reference only.

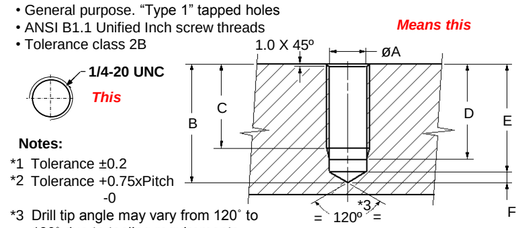


Port Size INCH	Port Size SAE #	Code*1	d3*2 Nom.	w*3 Nom.	v*3 Nom.	c*3 Nom.	u*3 Nom.	y Max.	j Nom.	x Min.	z*4 Nom.	r*4 Nom.	AA*5 Min.	BB*5 Min.	CC*5 Min.	d1*6 Nom.	t1*7 Min.
Nom.	Nom.																
3/4"	-12	61	19.1	22.3	11.15	47.6	23.8	52	65	41	26	9	68	61	55	M10-1.5	16.5
1"	-16	61	25.4	26.2	13.1	52.4	26.2	59	70	48	29	9	72	67	61	M10-1.5	14.5
1 1/4"	-20	61	31.8	30.2	15.1	58.7	29.35	73	79	54	37	10	82	78	75	M10-1.5	16.5
1 1/2"	-24	61	38.1	35.7	17.85	69.9	34.95	83	94	64	41	12	96	90	85	M12-1.75	19.5
2"	-32	61	50.8	42.9	21.45	77.8	38.9	97	102	76	49	12	104	102	99	M12-1.75	19.5
2 1/2"	-40	61	63.5	50.8	25.4	88.9	44.45	109	114	89	54	13	117	114	111	M12-1.75	21.5
3"	-48	61	76.2	61.9	30.95	106.4	53.2	131	135	106	66	14	137	136	133	M16-2	28.5
3 1/2"	-56	61	88.9	69.9	34.95	120.7	60.35	140	152	119	70	16	155	148	142	M16-2	28.5
4"	-64	61	101.6	77.8	38.9	130.2	65.1	152	162	132	76	16	164	160	155	M16-2	25.5
3/4"	-12	62	19.1	23.8	11.9	50.8	25.4	60	71	48	30	10	75	70	66	M10-1.5	16.5
1"	-16	62	25.4	27.8	13.9	57.2	28.6	70	81	54	35	12	84	80	75	M12-1.75	21.5
1 1/4"	-20	62	31.8	31.8	15.9	66.6	33.3	78	95	60	39	14	99	90	83	M12-1.75	18.5
1 1/2"	-24	62	38.1	36.5	18.25	79.3	39.65	95	113	70	48	17	116	108	101	M16-2	25.5
2"	-32	62	50.8	44.5	22.25	96.8	48.4	114	133	86	57	18	137	128	120	M20-2.5	33.5

All dimensions in millimeters unless otherwise specified

11) Inch Thread Installations

- General purpose. "Type 1" tapped holes
- ANSI B1.1 Unified Inch screw threads
- Tolerance class 2B

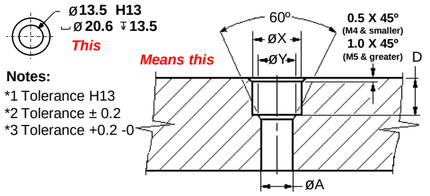


Notes:
*1 Tolerance ±0.2
*2 Tolerance +0.75xPitch -0
*3 Drill tip angle may vary from 120˚ to 180˚ due to tooling requirements

All dimensions in millimeters unless otherwise specified

Thread	Threads Per Inch	Tap Drill A Nom.	Tap Drill A Max.	Tap Drill A Min.	Tapping B*1 Nom.	Tapping C*2 Nom.	Tapping D*2 Min.	For Ref. E Nom.	For Ref. F Nom.
Inch	Nom.	Nom.	Max.	Min.	Nom.	Nom.	Min.	Nom.	Nom.
#4	40	2.26	2.3851	2.1565	10.4	5.7	7.6	9.747	0.653
#8	32	3.45	3.5306	3.3020	13.5	8.3	10.68	12.504	0.996
#10	24	3.80	3.9624	3.6830	16.0	9.7	12.87	14.903	1.097
1/4	20	5.11	5.2578	4.9784	20.3	12.7	16.51	18.825	1.475
5/16	18	6.53	6.7310	6.4008	24.4	15.9	20.13	22.515	1.885
3/8	16	7.94	8.1534	7.7978	28.7	19.1	23.86	26.408	2.292
1/2	13	10.72	11.0236	10.5918	37.3	25.4	31.26	34.205	3.095
5/8	11	13.49	13.8684	13.3858	46.0	31.8	38.73	42.106	3.894
3/4	10	16.67	16.8402	16.3068	54.1	38.1	45.72	49.288	4.812
1	8	22.23	22.6060	21.9710	70.9	50.8	60.32	64.483	6.417
1 1/4	7	28.18	28.5242	27.8130	87.1	63.5	74.39	78.965	8.135
1 1/2	6	34.00	34.2900	33.5280	103.9	76.2	88.9	94.085	9.815
1 3/4	5	39.29	39.8272	38.9636	121.6	88.9	104.14	110.258	11.342
2	4.5	45.25	45.5930	44.6786	138.9	101.6	118.53	125.837	13.063

12) Inch Counterbore Holes



Notes:
*1 Tolerance H13
*2 Tolerance ± 0.2
*3 Tolerance +0.2 -0

Screw Size		Drill Size	Counterbore Diameter	Countersink Diameter	Counterbore Depth
		A*1	X*2	Y*3	D*2
Inch	Inch	Nom.	Nom.	Min.	Nom.
#4	0.1120	3.5	5.5	-	3.0
#8	0.1640	4.9	8.0	-	5.0
#10	0.1900	5.6	9.5	-	6.5
1/4	0.2500	7.1	11.1	-	7.0
5/16	0.3125	8.7	13.5	-	9.0
3/8	0.0375	10.3	15.9	10.5	10.5
1/2	0.5000	13.5	20.6	14.0	13.5
5/8	0.6250	16.7	25.4	17.5	17.0
3/4	0.7500	19.8	30.2	21.0	20.0
1	1.0000	26.2	41.3	27.9	27.0
1-1/4	1.2500	33.3	50.8	34.8	33.0
1-1/2	1.5000	39.7	60.3	41.7	38.9
1-3/4	1.7500	46.0	69.9	48.5	45.2
2	2.0000	53.0	79.4	55.4	52.0

All dimensions in millimeters unless otherwise specified

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HUSKY®

Keeping our customers in the lead

Supplier Quick Reference

Common Drawing Features and Manufacturing Practices

All dimensions in millimeters unless otherwise specified

13) ISO 7/1 - Rc, Rp or R Pipe Threads (BSPT)

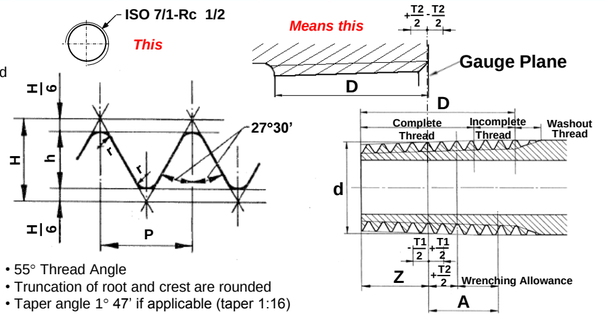
ISO 7/1

Internal Threads
(sealing on the thread)
- ISO 7/1-Rc: taper pipe thread
- ISO 7/1-Rp: parallel pipe thread

External Threads
(sealing on the thread)
- ISO 7/1-R: taper (always) pipe thread

H = .960491 P
h = .640327 P
r = .137329 P

Thread Inspection
- ISO 7/2



- 55° Thread Angle
- Truncation of root and crest are rounded
- Taper angle 1° 47' if applicable (taper 1:16)

ISO 7/1 Thread	Thread Per Inch	Pitch of Thread	Depth of Thread	Basic Diameter at Gauge Plane			Gauge Length (distance to Pipe end)				Gauge Plane Position	Length of Useful Thread (Pipe)			Fitting Allowance
		P	h	d	d2	d1	Z	T1/2	Z		T2/2	D			A
		Nom.	Nom.	Major	Pitch	Minor	Basic	(+/-)	Max.	Min.	(+/-)	Basic	Max.	Min.	mm
1/16"	28	0.907	0.581	7.723	7.142	6.561	4	0.9	4.9	3.1	1.1	6.5	7.4	5.6	2.5
1/8"	28	0.907	0.581	9.728	9.147	8.566	4	0.9	4.9	3.1	1.1	6.5	7.4	5.6	2.5
1/4"	19	1.337	0.856	13.157	12.301	11.445	6	1.3	7.3	4.7	1.7	9.7	11	8.4	3.7
3/8"	19	1.337	0.856	16.662	15.806	14.95	6.4	1.3	7.7	5.1	1.7	10.1	11.4	8.8	3.7
1/2"	14	1.814	1.162	20.955	19.793	18.631	8.2	1.8	10	6.4	2.3	13.2	15	11.4	5
3/4"	14	1.814	1.162	26.441	25.279	24.117	9.5	1.8	11.3	7.7	2.3	14.5	16.3	12.7	5
1"	11	2.309	1.479	33.249	31.77	30.291	10.4	2.3	12.7	8.1	2.9	16.8	19.1	14.5	6.4
1-1/4"	11	2.309	1.479	41.91	40.431	38.952	12.7	2.3	15	10.4	2.9	19.1	21.4	16.8	6.4
1-1/2"	11	2.309	1.479	47.803	46.324	44.845	12.7	2.3	15	10.4	2.9	19.1	21.4	16.8	6.4
2"	11	2.309	1.479	59.614	58.135	56.656	15.9	2.3	18.2	13.6	2.9	23.4	25.7	21.1	7.5
2-1/2"	11	2.309	1.479	75.184	73.705	72.226	17.5	3.5	21	14	3.5	26.7	30.2	23.2	9.2
3"	11	2.309	1.479	87.884	86.405	84.926	20.6	3.5	24.1	17.1	3.5	29.8	33.3	26.3	9.2
4"	11	2.309	1.479	113.03	111.551	110.072	25.4	3.5	28.9	21.9	3.5	35.8	39.3	32.3	10.4
5"	11	2.309	1.479	138.43	136.951	135.472	28.6	3.5	32.1	25.1	3.5	40.1	43.6	36.6	11.5
6"	11	2.309	1.479	163.83	162.351	160.872	28.6	3.5	32.1	25.1	3.5	40.1	43.6	36.6	11.5

All dimensions in millimeters unless otherwise specified

14) ISO 228 - G Pipe Threads (BSPP)

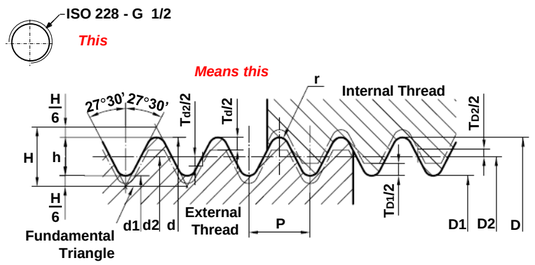
ISO 228-1

Internal Threads
(sealing not made on the thread)
- ISO 228-1- G: parallel pipe thread

External Threads
(sealing not made on the thread)
- ISO 228-1- G: parallel pipe thread, Tolerance class A

H = .960491 P
h = .640327 P
r = .137329 P

For Port Applications
An o-ring and washer or a bonded washer is needed to achieve a proper seal



Thread Inspection
- ISO 228-2

- Profile of threads identical to parallel thread specified in ISO 7-1
- Truncation of crest as per T_{D1} and T_d (see table below)
- 55° Thread Angle

ISO 228-1 Thread	Thread Per Inch	Pitch of Thread	Depth of Thread	Basic Diameters at Gauge Plane			Tolerances on Pitch Diameter				Tolerances on Minor Diameter		Tolerances on Major Diameter	
		P	h	d=D	d2=D2	d1=D1	T_{D2}		T_{d2}		T_{D1}		T_d	
		Nom.	Nom.	Major	Pitch	Minor	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper
1/16"	28	0.907	0.581	7.723	7.142	6.561	0	0.107	-0.107	0	0	0.282	-0.214	0
1/8"	28	0.907	0.581	9.728	9.147	8.566	0	0.107	-0.107	0	0	0.282	-0.214	0
1/4"	19	1.337	0.856	13.157	12.301	11.445	0	0.125	-0.125	0	0	0.445	-0.25	0
3/8"	19	1.337	0.856	16.662	15.806	14.95	0	0.125	-0.125	0	0	0.445	-0.25	0
1/2"	14	1.814	1.162	20.955	19.793	18.631	0	0.142	-0.142	0	0	0.541	-0.284	0
5/8"	14	1.874	1.162	22.911	21.749	20.587	0	0.142	-0.142	0	0	0.541	-0.284	0
3/4"	14	1.814	1.162	26.441	25.279	24.117	0	0.142	-0.142	0	0	0.541	-0.284	0
7/8"	14	1.814	1.162	30.201	29.039	27.877	0	0.142	-0.142	0	0	0.541	-0.284	0
1"	11	2.309	1.479	33.249	31.77	30.291	0	0.18	-0.18	0	0	0.64	-0.36	0
1-1/8"	11	2.309	1.479	37.897	36.418	34.939	0	0.18	-0.18	0	0	0.64	-0.36	0
1-1/4"	11	2.309	1.479	41.91	40.431	38.952	0	0.18	-0.18	0	0	0.64	-0.36	0
1-1/2"	11	2.309	1.479	47.803	46.324	44.845	0	0.18	-0.18	0	0	0.64	-0.36	0
1-3/4"	11	2.309	1.479	53.746	52.267	50.788	0	0.18	-0.18	0	0	0.64	-0.36	0
2"	11	2.309	1.479	59.614	58.135	56.656	0	0.18	-0.18	0	0	0.64	-0.36	0
2-1/4"	11	2.309	1.479	65.71	64.231	62.752	0	0.217	-0.217	0	0	0.64	-0.434	0
2-1/2"	11	2.309	1.479	75.184	73.705	72.226	0	0.217	-0.217	0	0	0.64	-0.434	0
2-3/4"	11	2.309	1.479	81.534	80.055	78.576	0	0.217	-0.217	0	0	0.64	-0.434	0
3"	11	2.309	1.479	87.884	86.405	84.926	0	0.217	-0.217	0	0	0.64	-0.434	0
3-1/2"	11	2.309	1.479	100.33	98.851	97.372	0	0.217	-0.217	0	0	0.64	-0.434	0
4"	11	2.309	1.479	113.03	111.551	110.072	0	0.217	-0.217	0	0	0.64	-0.434	0
4-1/2"	11	2.309	1.479	125.73	124.251	122.772	0	0.217	-0.217	0	0	0.64	-0.434	0
5"	11	2.309	1.479	138.43	136.951	135.472	0	0.217	-0.217	0	0	0.64	-0.434	0
5-1/2"	11	2.309	1.479	151.13	149.651	148.172	0	0.217	-0.217	0	0	0.64	-0.434	0
6"	11	2.309	1.479	163.83	162.351	160.872	0	0.217	-0.217	0	0	0.64	-0.434	0

All dimensions in millimeters unless otherwise specified

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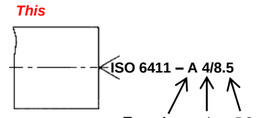
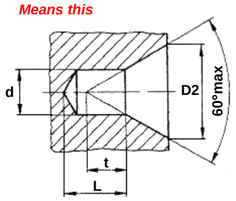
15) Centre Holes (for Manufacturing)

- ISO 6411 - Simplified representation of centre holes
- Type A centre holes (as per ISO 866)
- No protecting chamfers
- Center holes required on finished part
- Dimension L depends on length of centre drill
- L should not be less than t

Pilot Diameter	Countersink Diameter	Length
d	D2	t
Nom.	Nom.	For Ref.
1	2.12	0.9
2	4.25	1.8
4	8.5	3.5
6.3	13.2	5.5
10	21.2	8.7

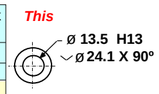




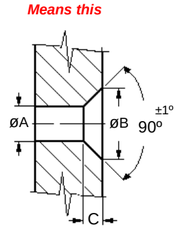
16) Inch Countersink Holes

Screw Size		Drill Size	Countersink Diameter	Countersink Depth
		A*1	B*2	C
Inch	Inch	Nom.	Nom.	For Ref.
#4	0.1120	3.5	6.7	1.6
#8	0.1640	4.9	9.3	2.2
#10	0.1900	5.6	10.6	2.5
1/4	0.2500	7.1	13.7	3.3
5/16	0.3125	8.7	16.9	4.1
3/8	0.0375	10.3	20.1	4.9
1/2	0.5000	13.5	24.1	5.3
5/8	0.6250	16.7	30.5	6.9
3/4	0.7500	19.8	36.8	8.5

All dimensions in millimeters unless otherwise specified

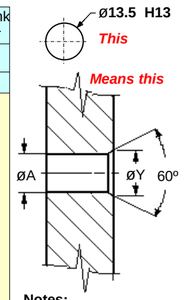


Notes:
*1 Tolerance H13
*2 Tolerance ± 0.2



17) Inch Clearance Holes

Screw Size		Drill Size	Countersink Diameter
		A*1	Y*2
Inch	Inch	Nom.	Nom.
#4	0.1120	3.5	-
#8	0.1640	4.9	-
#10	0.1900	5.6	-
1/4	0.2500	7.1	-
5/16	0.3125	8.7	-
3/8	0.0375	10.3	10.5
1/2	0.5000	13.5	14.0
5/8	0.6250	16.7	17.5
3/4	0.7500	19.8	21.0
1	1.0000	26.2	27.9
1-1/4	1.2500	33.3	34.8
1-1/2	1.5000	39.7	41.7
1-3/4	1.7500	46	48.5
2	2.0000	52.4	55.4



Notes:
*1 Tolerance H13
*2 Tolerance +0.2 -0

All dimensions in millimeters unless otherwise specified

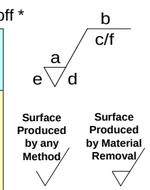
18) Surface Roughness

Surface Roughness Selection (ANSI Y14.36M, HS 514)

Ra (µm)	Recommended Applications
≥ 12.5	Not machined sand mold casting, flame cut or hot rolled parts surfaces
12.5	Machined and then painted clearance surfaces or clearance surfaces not visible in parts assembly
6.3	Large clearance outside diameters or drilled clearance holes (vibrations)
3.2	Turned and milled datum surfaces (tol. ≥ 0.025mm), housing fits (no gasket or seal), mating surfaces (e.g. pad, face)
1.6	Turned and milled datum surfaces (tol. < 0.025mm), pressed fits, keyways, etc.
0.8	Apply only where required for the functionality or assembly of the parts. Limit to areas where absolutely needed
≤ 0.4	Precision sliding or rotating surfaces, friction surfaces, precision bearings, etc.

Standard Roughness Cutoff *

X < Ra ≤ Y (unit: µm)		Roughness Cutoff (unit: mm)
-	0.02	0.08
0.02	0.1	0.25
0.1	2	0.8
2	10	2.5
10	-	8



* If no roughness cutoff value is indicated

Symbol Value Application

a = roughness value Ra in micrometers
b = production method. treatment. coating. other text. or note callout
c = roughness cutoff or sampling length in millimeters
d = direction of lay
e = minimum material removal requirement in millimeters
f = roughness value other than Ra in micrometers preceded by its parameter symbol. Note: Rz shall not be used.

Note: b, c, d, e and f are optional

19) ISO Limits and Fits

ISO 286, Parts 1 & 2

This **50 P7** *Means this* **50 - .017 / - .042**

This **50 u6** *Means this* **50 + .086 / + .070**

All values in micrometers unless otherwise specified (1 µm = 0.001mm)

Basic Size (mm)		Holes (Internal Features)																	Shafts (External Features)														
Over	To	C11	D9	F8	E8	G7	H6	H7	H8	H9	H10	H11	H12	H13	K7	N7	P7	S7	U7	c11	d9	e9	f7	f8	g6	h6	h7	h8	h9	h11	j6	k6	m6	n6	p6	s6	u6
0	3	+120 +60	+45 +20	+20 +6	+28 +14	+12 +2	+6 0	+10 0	+14 0	+25 0	+40 0	+60 0	+100 0	+140 0	0 -10	-4 -14	-6 -16	-14 -24	-18 -28	-60 -120	-20 -45	-14 -39	-6 -16	-6 -20	-2 -8	0 -6	0 -10	0 -14	0 -25	0 -60	+4 -2	+6 0	+8 +2	+10 +4	+12 +6	+20 +14	+24 +18
3	6	+145 +70	+60 +30	+28 +10	+38 +20	+16 +4	+8 0	+12 0	+18 0	+30 0	+48 0	+75 0	+120 0	+180 0	+3 -9	-4 -16	-8 -20	-15 -27	-19 -31	-70 -145	-30 -60	-20 -50	-10 -22	-10 -28	-4 -12	0 -8	0 -12	0 -18	0 -30	0 -75	+6 -2	+9 +1	+12 +4	+16 +8	+20 +12	+27 +19	+31 +23
6	10	+170 +80	+76 +40	+35 +13	+47 +25	+20 +5	+9 0	+15 0	+22 0	+36 0	+58 0	+90 0	+150 0	+220 0	+5 -10	-4 -19	-9 -24	-17 -32	-22 -37	-80 -170	-40 -76	-25 -61	-13 -28	-13 -35	-5 -14	0 -9	0 -15	0 -22	0 -36	0 -90	+7 -2	+10 +1	+15 +6	+19 +10	+24 +15	+32 +23	+37 +28
10	18	+205 +95	+93 +50	+43 +16	+59 +32	+24 +6	+11 0	+18 0	+27 0	+43 0	+70 0	+110 0	+180 0	+270 0	+6 -12	-5 -23	-11 -29	-21 -39	-26 -44	-95 -205	-50 -93	-32 -75	-16 -34	-16 -43	-6 -17	0 -11	0 -18	0 -27	0 -43	0 -110	+8 -3	+12 +1	+18 +7	+23 +12	+29 +18	+39 +28	+44 +33
18	24	+240 +110	+117 +65	+53 +20	+73 +40	+28 +7	+13 0	+21 0	+33 0	+52 0	+84 0	+130 0	+210 0	+330 0	+6 -15	-7 -28	-14 -35	-27 -48	-33 -54 -40 -61	-110 -240	-65 -117	-40 -92	-20 -41	-20 -53	-7 -20	0 -13	0 -21	0 -33	0 -52	0 -130	+9 -4	+15 +2	+21 +8	+28 +15	+35 +22	+48 +35	+54 +41 +61 +48
24	30																																				
30	40	+280 +120 +290 +130	+142 +80	+64 +25	+89 +50	+34 +9	+16 0	+25 0	+39 0	+62 0	+100 0	+160 0	+250 0	+390 0	+7 -18	-8 -33	-17 -42	-34 -59	-51 -76 -61 -86	-120 -280 -130 -290	-80 -142	-50 -112	-25 -50	-25 -64	-9 -25	0 -16	0 -25	0 -39	0 -62	0 -160	+11 -5	+18 +2	+25 +9	+33 +17	+42 +26	+59 +43	+76 +60 +86 +70
40	50																																				
50	65	+330 +140 +340 +150	+174 +100	+76 +30	+106 +60	+40 +10	+19 0	+30 0	+46 0	+74 0	+120 0	+190 0	+300 0	+460 0	+9 -21	-9 -39	-21 -51	-42 -72 -48 -78	-76 -106 -91 -121	-140 -330 -150 -340	-100 -174	-60 -134	-30 -60	-30 -76	-10 -29	0 -19	0 -30	0 -46	0 -74	0 -190	+12 -7	+21 +2	+30 +11	+39 +20	+51 +32	+72 +53 +78 +59	+106 +87 +121 +102
65	80																																				
80	100	+390 +170 +400 +180	+207 +120	+90 +36	+125 +72	+47 +12	+22 0	+35 0	+54 0	+87 0	+140 0	+220 0	+350 0	+540 0	+10 -25	-10 -45	-24 -59	-58 -93 -66 -101	-111 -146 -131 -166	-170 -390 -180 -400	-120 -207	-72 -159	-36 -71	-36 -90	-12 -34	0 -22	0 -35	0 -54	0 -87	0 -220	+13 -9	+25 +3	+35 +13	+45 +23	+59 +37	+93 +71 +101 +79	+146 +124 +166 +144
100	120																																				
120	140	+450 +200 +460 +210 +480 +230	+245 +145	+106 +43	+148 +85	+54 +14	+25 0	+40 0	+63 0	+100 0	+160 0	+250 0	+400 0	+630 0	+12 -28	-12 -52	-28 -68	-77 -117 -85 -125 -93 -133	-155 -195 -175 -215 -195 -235	-200 -450 -210 -460 -230 -480	-145 -245	-85 -185	-43 -83	-43 -106	-14 -39	0 -25	0 -40	0 -63	0 -100	0 -250	+14 -11	+28 +3	+40 +15	+52 +27	+68 +43	+117 +92 +125 +100 +133 +108	+195 +170 +215 +190 +235 +210
140	160																																				
160	180																																				
180	200	+530 +240 +550 +260 +570 +280	+285 +170	+122 +50	+172 +100	+61 +15	+29 0	+46 0	+72 0	+115 0	+185 0	+290 0	+460 0	+720 0	+13 -33	-14 -60	-33 -79	-105 -151 -113 -159 -123 -169	-219 -265 -241 -287 -267 -313	-240 -530 -260 -550 -280 -570	-170 -285	-100 -215	-50 -96	-50 -122	-15 -44	0 -29	0 -46	0 -72	0 -115	0 -290	+16 -13	+33 +4	+46 +17	+60 +31	+79 +50	+151 +122 +159 +130 +169 +140	+265 +236 +287 +258 +313 +284
200	225																																				
225	250																																				
250	280	+620 +300 +650 +330	+320 +190	+137 +56	+191 +110	+69 +17	+32 0	+52 0	+81 0	+130 0	+210 0	+320 0	+520 0	+810 0	+16 -36	-14 -66	-36 -88	-138 -190 -150 -202	-295 -347 -330 -382	-300 -620 -330 -650	-190 -320	-110 -240	-56 -108	-56 -137	-17 -49	0 -32	0 -52	0 -81	0 -130	0 -320	+16 -16	+36 +4	+52 +20	+66 +34	+88 +56	+190 +158 +202 +170	+347 +315 +382 +350
280	315																																				
315	355	+720 +360 +760 +400	+350 +210	+151 +62	+214 +125	+75 +18	+36 0	+57 0	+89 0	+140 0	+230 0	+360 0	+570 0	+890 0	+17 -40	-16 -73	-41 -98	-169 -226 -187 -244	-369 -426 -414 -471	-360 -720 -400 -760	-210 -350	-125 -265	-62 -119	-62 -151	-18 -54	0 -36	0 -57	0 -89	0 -140	0 -360	+18 -18	+40 +4	+57 +21	+73 +37	+98 +62	+226 +190 +244 +208	+426 +390 +471 +435
355	400																																				
400	450	+840 +440 +880 +480	+385 +230	+165 +68	+232 +135	+83 +20	+40 0	+63 0	+97 0	+155 0	+250 0	+400 0	+630 0	+970 0	+18 -45	-17 -80	-45 -108	-209 -272 -229 -292	-467 -530 -517 -580	-440 -840 -480 -880	-230 -385	-135 -290	-68 -131	-68 -165	-20 -60	0 -40	0 -63	0 -97	0 -155	0 -400	+20 -20	+45 +5	+63 +23	+80 +40	+108 +68	+272 +232 +292 +252	+530 +490 +580 +540
450	500																																				
500	560		+435 +260	+186 +76	+255 +145	+92 +22	+44 0	+70 0	+110 0	+175 0	+280 0	+440 0	+700 0	+1100 0	0 -70	-44 -114	-78 -148	-280 -350 -310 -380	-600 -670 -660 -730		-260 -435	-145 -320	-76 -146	-76 -186	-22 -66	0 -44	0 -70	0 -110	0 -175	0 -440		+44 0	+70 +26	+88 +44	+122 +78	+324 +280 +354 +310	+644 +600 +704 +660
560	630																																				
630	710		+490 +290	+205 +80	+285 +160	+104 +24	+50 0	+80 0	+125 0	+200 0	+320 0	+500 0	+800 0	+1250 0	0 -80	-50 -130	-88 -168	-340 -420 -380 -460	-740 -820 -840 -920		-290 -490	-160 -360	-80 -160	-80 -205	-24 -74	0 -50	0 -80	0 -125	0 -200	0 -500		+50 0	+80 +30	+100 +50	+138 +88	+390 +340 +430 +380	+790 +740 +890 +840
710	800																																				
800	900		+550 +320	+226 +86	+310 +170	+116 +26	+56 0	+90 0	+140 0	+230 0	+360 0	+560 0	+900 0	+1400 0	0 -90	-56 -146	-100 -190	-430 -520 -470 -560	-940 -1030 -1050 -1140		-320 -550	-170 -400	-86 -176	-86 -226	-26 -82	0 -56	0 -90	0 -140	0 -230	0 -560		+56 0	+90 +34	+112 +56	+156 +100	+486 +430 +526 +470	+996 +940 +1106 +1050
900	1000																																				
1000	1120		+610 +350	+263 +98	+360 +195	+133 +28	+66 0	+105 0	+165 0	+260 0	+420 0	+660 0	+1050 0	+1650 0	0 -105	-66 -171	-120 -225	-520 -625 -580 -685	-1150 -1255 -1300 -1405		-350 -610	-195 -455	-98 -203	-98 -263	-28 -94	0 -66	0 -105	0 -165	0 -260	0 -660		+66 0	+106 +40	+132 +66	+186 +120	+586 +520 +646 +580	+1216 +1150 +1366 +1300
1120	1250																																				
1250	1400		+700 +390	+305 +110	+415 +220	+155 +30	+78 0	+125 0	+195 0	+310 0	+500 0	+780 0	+1250 0	+1950 0	0 -125	-78 -203	-140 -265	-640 -765 -720 -845	-1450 -1575 -1600 -1725		-390 -700	-220 -530	-110 -235	-110 -305	-30 -108	0 -78	0 -125	0 -195	0 -310	0 -780		+78 0	+126 +48	+156 +78	+218 +140	+718 +640 +798 +720	+1528 +1450 +1678 +1600
1400	1600																																				
1600	1800		+800 +430	+350 +120	+470 +240	+182 +32	+92 0	+150 0	+230 0	+370 0	+600 0	+920 0	+1500 0	+2300 0	0 -150	-92 -242	-170 -320	-820 -970 -920 -1070	-1850 -2000 -2000 -2150		-430 -800	-240 -610	-120 -270	-120 -350	-32 -124	0 -92	0 -150	0 -230	0 -370	0 -920		+92 0	+150 +58	+184 +92	+262 +170	+912 +820 +1012 +920	+1942 +1850 +2092 +2000
1800	2000																																				
2000	2240		+920 +480	+410 +130	+540 +260	+209 +34	+110 0	+175 0	+280 0	+440 0	+700 0	+1100 0	+1750 0	+2800 0	0 -175	-110 -285	-195 -370	-1000 -1175 -1100 -1275	-2300 -2475 -2500 -2675		-480 -920	-260 -700	-130 -305	-130 -410	-34 -144	0 -110	0 -175	0 -280	0 -440	0 -1100		+110 0	+178 +68	+220 +110	+305 +195	+1110 +1000 +1210 +1100	+2410 +2300 +2610 +2500
2240	2500																																				
2500	2800		+1060 +520	+475 +145	+620 +290	+248 +38	+135 0	+210 0	+330 0	+540 0	+860 0	+1350 0	+2100 0	+3300 0	0 -210	-135 -345	-240 -450	-1250 -1460 -1400 -1610	-2900 -3110 -3200 -3410		-520 -1060	-290 -830	-145 -355	-145 -475	-38 -173	0 -135	0 -210	0 -330	0 -540	0 -1350		+135 0	+211 +76	+270 +135	+375 +240	+1385 +1250 +1535 +1400	+3035 +2900 +3335 +3200
2800	3150																																				

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