D The Use of Carbide Threading Tools for Oil Pipes

（1）Three factors of affecting the machining quality of carbide threading tools for oil pipes and tool machinability

(a) External factors of the tools, including
① Rationality of the design of the tool structure;
② Blade face, the profile accuracy, degree of finish and the condition of surface structure;
③ Enforcing quality of cutting edge;
④ Manufacturing accuracy of the rod and the quality of the accessories, such as break chips.
(b) Internal factors of the inserts, including
① Quality and performance of the base material of inserts
② Quality and performance of the top coating of inserts
③ Materials, performance of the heat treatment of tool rods
(c) Use factors of tools, including
① Correct choice and use of tools
② The statue of thread processing equipment
③ Mode and effect of cutting cooling
④ Workability and homogeneity of the machined materials
⑤ Correct choice for cutting specification of thread processing

（2）Two processing mode of carbide threading tools for oil pipes

① Mode of threading (used to process thread oil pipes, casing pipes and boring rod)
The features of the cutting movement
rotational movement of the workpieces (pipes or connectors). The principle cutting movement is occurred.
.Movements and intermittent bites while the tools (threading and roughing tools) move along the generatrix of taper thread
.threading is used as the most widely way of processing the thread of oil pipes. According to the production conditions and threading machine, there are two ways: single insert threading and packaged inserts (two blades in general) threading with tools units. All the drill rod connectors are threaded by single insert threading.
② Mode of processing threading head(only used to process thread oil pipes, casing pipes)
The features of the cutting movement
.workpieces (pipes or connectors) are positioned and clamped firmly and still
.movements and intermittent bites while the tools (threading and roughing tools) rotate around the workpiece axis and move along the generatrix of taper thread
.The ways for processing are internal cropping and external cropping. They are fit for producing oil pipes, tubings and processing connectors efficiently in large number. External cropping contains packaged threading inserts (three blades in general) and roughing tools units; internal cropping contains single insert threading insert and packaged blades in roughing tools units.

(3) Suggestions for selecting carbide threading inserts for oil pipe

(1) Threading inserts for tubing and casing:

(A) Condition for mass production

(a)insert for threading machine of threaded head

external threading inserts (completed inserts):

P8W1-31/ P8W1-32/ P8W1-33; P10W1-31/2/3; P5BW1-31/2/3。

internal threading inserts:

P8N1-7; P10N1-8; P5BN1-5;

(b)insert for threading machine of threaded turning

external threading inserts

completed inserts:

C8W1-31/C8W1-32; C10W1-31/C10W1-32; C5BW1-31/C5BW1-32

BC8W2-31/BC8W2-32; BC10W2-31/BC10W2-32

C8W1-3; C10W1-4;

single insert:

B8W2-3; B10W2-4; B5BW2-2

S8W2-3; S5BW2-2

BM8W2-3; BM10W2-4;

K8W2-4; K5BW2-3

5BW1-3; C5BW1-5

internal threading inserts:

C8N1-7; C10N1-8; C5BN1-5; C5BN1-2

B8N2-3; B8N2-5; B10N2-4; B5BN2-3

S8N2-4; S5BN2-2

K8N2-4; K5BN2-3

SK8N1-3; SK8N1-5

(B)Insert for pilot production (processing in threaded turing) :

external threading:

10W1-2; 8W1-2;

8W3-2; 10W3-2;

5BWL3;

internal threading:

10N4-2; 8N4-2;

10N3-2; 8N3-2;

5BNL3-1;

(2)Threading insert of drill rod(processing in threaded turing):

Type Ⅰ:ordinary

Type Ⅱ:ordinary

Type Ⅲ:mainly used on external and internal thread for tool joint below 31/2’’

(4)Cutting figures of carbide threading inserts for oil pipe

The right design of teeth structure and load will progress the quality and efficiency of carbide threading inserts,also will increase the service life of inserts.The different feed ways will deside the cutting figures of single teeth insert (e.g.drillrod connector insert),but not desided by the teeth structure.

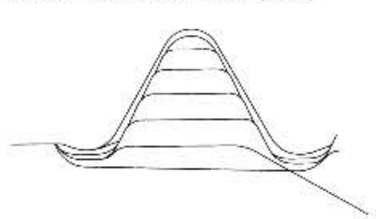
(1)Thread cutting condition of one time feeding

If the power and stiffiness of threading machine is enough large,finish the thread cutting by the one time feeding will be the most favorable alternatives.Which will increase the efficiency and design the cutting figures more reasonable,increasing the service life of inserts.

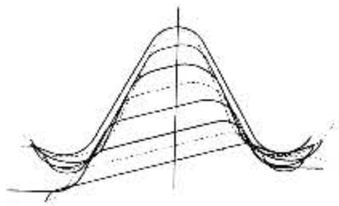
Notes:no matter the threading insert finish thread cutting by one time feed or repeatedly feed,the last fine teeth must whloely cover the threading teeth and ensure the chipping allowance is reasonable.(the side tooth is 0.07-0.12mm,tooth top and tooth bottom is 0.10-0.20mm)

e.g 1:The cutting figures of internal round threading of P8N1-7 casing connector(D-1)

2: The cutting figures of external round threading of casing pipe body formed by P8W1-31/P8W1-32/P8W1-33. (D-2)



图D-1

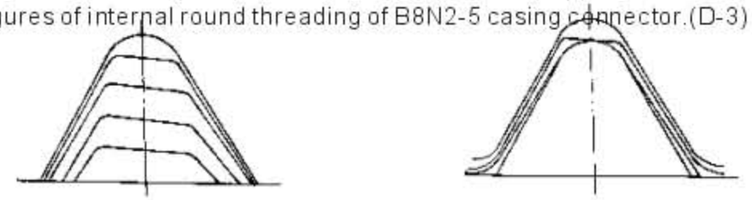


图D-2

(2)Thread cutting condition of repeatedly feeding

If the power and stiffiness of threading machine is not enough large to complete the one time feed, have to use the repeatedly feeding.In this case,the first process should cut down the most chipping allowance,(specially for the 3 tooth or more),so the allocation of the first process will diside the design of inserts cutting figures.The next process for roughing tooth ,the chipping allowance will be small.

e.g 1:The cutting figures of internal round threading of B8N2-5 casing connector.(D-3)



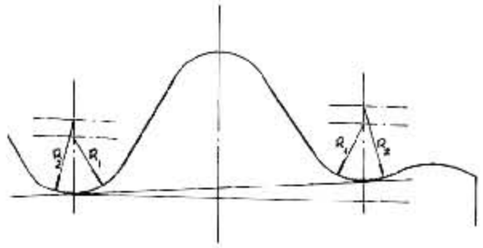
图D-3

2:The cutting figures of internal buttress threading of P5BN1-5 casing connector.(K-4)

图D-4

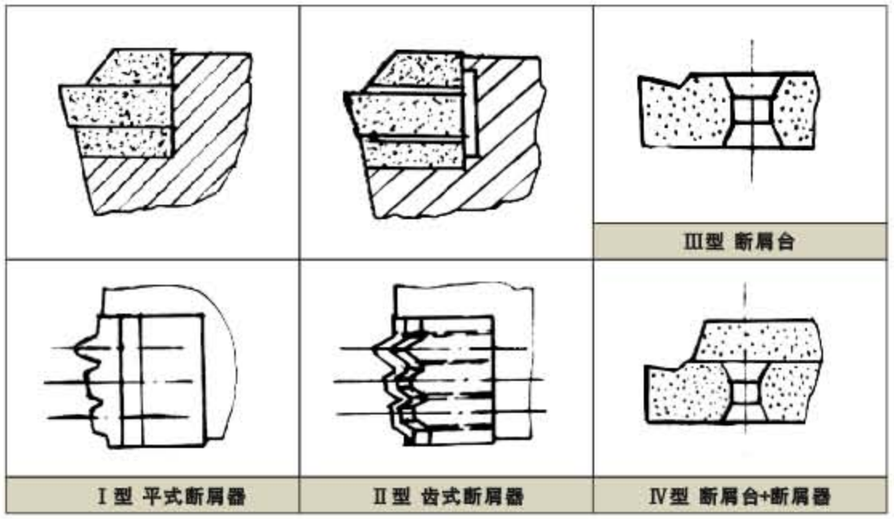
(5) “Double circular-arc” structure of refined bottom tooth of carbide threading inserts for iol pipe

As the table D-5,the round threading inserts of tubing,casing and the connector ,with the “double circular-arc” structure on the refined bottom tooth,i.e.R1≈R1+(0.2-0.3),(R1=0.508mm or 0.432mm) will help to avoid the flaws of “plat teeth” and “Crash” on the tooth of the thread.



图D-5 finishing tooth of insert

(6) Severial types of flute and chipbreaker of of carbide threading inserts for oil pipe



图D-6

（7）The several forms of oil pipe thread blade clamping structure and cutter arbor structure

The cutter arbor is a connecting part between the blade and the cutter holder (or tool apron), which must have sufficient strength, rigidity and precision.

The head of cutter arbor is part that is clamping the blade; the stem is part that is installed into the cutter holder (or tool apron)

The structure of the head of arbor, namely, part of clamping the blade, is mainly determined according to the blade shape. It requests not only sufficient strength and rigidity, but also requests that the rigidity of clamping blade, the position’ s accuracy and reliability, the ease of use and the chip removal and the chip-breaking are ensured.

The different structures and shapes of the blades have corresponding clamping structures: it can be found in the type-labeling instructions for the oil pipe thread cutter shank of cemented carbide.

The up-packing type (the structure of M and C) is the clamping structure of no hole square-shaped blade (or fan-shaped blade), which is used mostly for processing the joint internal threads of oil pipes and casings. The screw of hook-shaped nut with the left thread and right thread at the both ends play the role of pressuring plate that is clamping the blade and the guide chip plate tightly.

The draw-in type of inclined pulling rod (the P structure) is a draw-in type champing structure with a double-tapered-hole blade, which has a two-way clamping effect. The precision needed of the tapered hole of blade should be guaranteed. It is characterized by compact structure, reliable positioning and higher blade material utilization rate. The blades (double tapered-hole blades) of oil pipes, casings and drilling stems and others are all suitable for use.

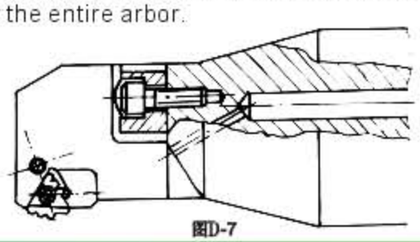
The two-way clamping structure with core rod pressuring plate slope (the J structure) is mainly used for the clamping between the drilling stem joint thread blade and the triangle straight hole cutter of oil pipe thread of sucker rod assembly.

The wedge slope lateral clamping (the F structure) is used for the clamping structure of long prismoid strip, non-coated, regrinding-type blades, which is Used in processing the external threads of oil pipe, casing body, with features of clamping firm and multiple usage by re-grinding along the cutter edge surface after the cutter edge abrasion, the blade center height can be adjusted as required when using.

The lateral clamping of standing mounted blade (the G structure) is mainly used for the clamping structure of the standing mounted triangular indexable buttress casing thread single-tooth blade. It is good at its blade strength and rigidity, with features of clamping firm. This structure has clamping in the two directions of upward pressure and lateral pressure respectively.

The arbor's shank is mounted into the cutter holder (tool apron), the average arbor shank section is square or rectangular. In some CNC threading lathe for processing the internal thread, the shank section is round shape. The arbor shank size should ensure the arbor shank of sufficient strength and rigidity requirements, and ensure that the ending length of arbor head should be short as much as possible to prevent the generation of cutting vibration and thread surface ripple.

In most cases, the arbor shank and head is an integral structure, but there is also a modular assembly structure that the head and shank is separated from each other, which is mainly used the internal thread arbor, as shown in diagram D-7. When the head is damaged, we just have to replace for the head, without need to replace for the entire arbor.



图D-7

（四）The use of carbide threading tools for oil pipes

In order to maintain that the two blade edges on both sides have roughly the same normal relief angle of side cutting edge when processing the thread, the blade installed in the arbor is on the need to tilt at an angle; its value should be equal to or near to the thread helix angle. Therefore,
It is associated with the thread pitch and the thread diameter. The tilt angle has been processed out of the arbor, between about 0 ° ~1 ° 20, which are divided into the four sub-grades. Therefore, when the arbors are chose and used, users should choose the appropriate arbor sized after the pipe thread sizes (the diameter and the thread pitch) have been determined. The pipe thread arbor size (diameter and pitch) is determined, to select the appropriate arbor size. The A, B, C, D in the cutter arbor labeling instruction ⑥ on page C-050 of this sample book indicate the arbor sizes applicable to different diameter pipes.
The cutter arbor and the arbor Parts are required to be manufactured from the high-quality steel. And they should be heat-treated to maintain and achieve the required hardness and strength; the chip breaker should be made of the cemented carbide. The arbor basal face and positioning surface etc. shall be grinded so as to achieve the required accuracy.

（8）Suggestions for selecting cutting parameters of carbide threading inserts for oil pipe

(1)Recommended cutting speed(Table D-1)

Type	Steel grade		
	Plain	Secondaryhigh	High
	J55 H40 K55 M65	N80 C75 L80	P110 C90 T98 Q125
	Cutting speed(m/m)		
Uncoated insert	90~120	80~100	---
Costed insert	140~200	120~180	100~160

注：表列数据为带冷却液充分冷却时的选择；如为干切削则速度应低20%

(2)Recommended feeding frequence and depth(table D-2)

Type			Feed squence											
			1	2	3	4	5	6	7	8	9	10	11	12
			Penetration of a tool (mm)											
Round threading(8tooth/Inch)	Internal threading	2 tooth insert	0.60	0.40	0.35	0.30	0.20	0.20						
		3 tooth insert	0.80	0.60	0.40	0.20								
		5 tooth insert	1.75	0.25										
		7 tooth insert	1.80	0.20										
		7 tooth insert	2.00											
	External threading	2 tooth insert	0.70	0.45	0.40	0.30	0.20							
		3 tooth insert	0.85	0.60	0.35	0.20								
		3 tooth insert	2.00											
		3 tooth insert	2.00											
Round threading(10tooth/Inch)	Internal threading	2 tooth insert	0.55	0.40	0.35	0.20	0.15							
		3 tooth insert	0.80	0.55	0.20									
		4 tooth insert	1.00	0.50	0.15									
		8 tooth insert	1.60											
	External threading	2 tooth insert	0.55	0.50	0.35	0.20								
		3 tooth insert	0.90	0.55	0.15									
		4 tooth insert	1.05	0.50	0.15									
		3 tooth insert	1.60											

(2)Recommended feeding frequence and depth(table D-2)

Type			Feed squence											
			1	2	3	4	5	6	7	8	9	10	11	12
			Penetration of a tool(mm)											
Round buttress threading(5 tooth/inch)	Internal threading	1tooth insert	0.35	0.30	0.25	0.25	0.20	0.20	0.20					
		3 tooth insert	0.50	0.40	0.35	0.30	0.20							
		5tooth insert	1.30	0.45										
	External threading	1tooth insert	0.45	0.35	0.30	0.25	0.25	0.20						
		2 tooth insert	0.45	0.40	0.35	0.35	0.20							
		3 tooth insert	0.55	0.50	0.40	0.30								
		3 tooth insert	1.75											
Drillrod connector threading	Internal threading	4y1、4y2、5y3 single teeth insert	0.50	0.45	0.40	0.40	0.35	0.30	0.25	0.20	0.15	0.15	0.10	
		4y4、4y5 single teeth insert	0.50	0.45	0.45	0.40	0.35	0.35	0.35	0.30	0.30	0.25	0.15	0.10
		4y6 single teeth insert	0.45	0.45	0.40	0.40	0.30	0.30	0.25	0.20	0.20	0.10		
	External threading	4y1、4y2、5y3 single teeth insert	0.50	0.45	0.45	0.40	0.35	0.30	0.30	0.25	0.20	0.10		
		4y4、4y5 single teeth insert	0.55	0.50	0.45	0.40	0.40	0.35	0.35	0.35	0.30	0.20	0.10	
		4y6 single teeth insert	0.50	0.45	0.40	0.40	0.35	0.35	0.25	0.20	0.10			

P.S:The feeding frequency in the table should be decreased if the thread for drillrod connectors be roughing turned by plain tool then refined by form tool.

（四）The use of carbide threading tools for oil pipes

（9）A number of issues that should be noticed in using oil pipe thread cutting tool

（1）Before using it, the user should be aware of the tool structure, processing requests and operating requirements

(2) The arbor must be correctly and securely clamped onto the cutter holder (ortool apron). Before installation, the tool holder and arbor base surface should be wiped clean. The arbor shank base surface of general threading machine should be aligned by using a dial indicator to make it parallel or perpendicular to the screw axis. The alignment error should be within the 0.015mm/100mm. Other wise the error of thread form will be caused and even beyond the tolerance.

(3) The thread blade should be installed correctly onto the blade slot of arbor. The side positioning facesof the blade are pushed by hand firmly, and then tightening the clamp screw. The positioning of blade should be accurate and reliable, clamping firm. The clamping screw or other clamping components and chip breaker etc should be replaced in time if any damage to avoid damage in the thread blades when cutting. Each time when the blade being changed, the blade slot of arbor and all the basal surfaces of the blade should be wiped clean, not allowing any chips being clamped in side, otherwise it will affect the positioning accuracy or make the blade broken.

(4) The lathe tapered plate must be accurately adjusted to minimize the processing thread taper error.

(5) According to the different thread diameters and the thread pitch sizes, the bottom surfaces of the blade slot on the thread arbor have different blade edge tilt angles to accommodate the change requirements of helix angle, improving the situation in the lateral rear angle of the blade, the user should pay attention to it in the selection of cutter arbors.

(6) In the process, we should always pay attention to the thread surface condition, the blade edge status and the threading machine operating state, in order to adjust operations at any time to maintain the normal process. The most common thread surface defects are corrugated and scuffing, the factors that result in their occurrences are many, some in the thread blades aspect, and another in the lathe aspect and so on. The scuffing occurrence may be due to the causes that: either the finish degree of blade, or tiny edge chippings and notches in the blade, or the chip buildup sticked with the blade or thescratch wound caused by the chip. It is the most vulnerable to a "docking" scuffing occurrence (refer to oilpipe, busing round thread) that the circular arc of finish turning teeth bottom at one side is a whole circular arc. In processing the thread, the depth of cut is not enough so that it fails to process the complete allowanceof rough machining, therefore the clear scuffing would occur on the top of thread. If the rigidity of machine tool system is poor, it is easy that the scuffing occurs on the top of several teethat the ending of pipe (whenthe blade is cutting). The ripple on the thread surface was due to the vibration of the system. And it is likely tocause ripples that: either the poorer stiffness of system, the machine power is not enough, or because theblade is too sharp (such as the situation that the edge of non-coated blades is not intensified), orthe excessive wear and tear of blade, or because the system self-oscillation frequency is closer to the frequency of forced vibration in cutting. If the above scuffing and ripple defects occur, we should treat them according to the concrete circumstances and causes.

(7) When processing the oil pipe thread, the thread must be inspected for its precision using a single parameter measurement instrument and the thread gauge. If it is found that the tooth height and the toothprofile angle is out of tolerance during the thread parameters examination, it is associated commonly witha tooth profile precision of the blade. The blade must be checked for the tooth profile accuracy or replacedwith a new blade. If the finish tooth tip has a "collapse point" phenomenon, which can easily lead to that the tooth height is increased and out of tolerance. The tooth tip wear is easily leading to that the tooth height is decreased and out of tolerance. Accordingly, it will affect the change of tooth profile angle. The errors caused by other parameters such as thread pitch, taper degree, thread standoff and others are often related to the poor adjustment of machine tool, as a result, it is required to re-adjust the machine.

(8) The right blade cutting edge is essential to strengthen the process of thread processing. The coated thread blades themselves as finished products have been conducted with a reasonable cutting edge strengthening process in the manufacturer. It is more appropriate that the cutting edge rounding radius should be chosen as R = 0.04 ~ 0.06mm. The rounding radiuses on the top and bottom of blade teeth should be uniform; their difference is not allowed to be too large. The non-coated regrinding blades tend to be not strengthened on their cutting edges in the manufacturer. If the abnormal conditions (such as corrugated, etc.) occur in processing, the operator can use a small triangle whetstone (silicon carbide or diamond whetstone) to make a careful grinding on the blade edge along the direction of the edge to achieve the strengthening requirements of cutting edges. The re-grinded blade edge should be treated as such.

(9) Under the current situation, oil pipe thread must be fully cooled in processing, still with the coolant supply as the main way. This is the important factor to improve the quality of the thread processing and the tool life. The coolant should be just sprayed to the cutting part of the cutter exactly. If possible, high-pressure coolant injection can be used. And through the front edge surface or bottom of the blade and the chip breaker or the small slots of pads, the coolant will be jetted directly to the blade cutting area, the effect is very obvious. Also it helps increase the chip removal effect.

(10) The regrinding of blades: generally the coated blade is not suitable for regrinding. And generally the non-coated blades should be re-grinded. The regrinding is only conducted on the front edge surface of the blade in the direction of the front edge surface of the original blade. The regrinding should not be implemented on the grinding wheel machine by holding the blade or the arbor in the hands, but should be carried out in the tool grinding machine by adopting a special fixture. The grinding wheel size recommended is as below:

JR1, particle size 120#-180 #, density75 %: sBW100 × 20 × 35

the common Problems, the causes and the recommended solutions: (as shown in table D-3)

Table D-3 Frequently Asked Questions and the causes and the recommend solutions

Frequently Asked Questions	The causes and the recommend solutions
(1) The vibration and the ripple caused in cutting	(1) Checking that if the rigidity of system is enough, if the exserted length of workpiece or cutting arbor is too long, if the mainshaft bearing is adjusted properly, if the blade is clamped firm and so on. (2) The spindle speed is reduced or increased by one or two gears fortrial processing to choose the revolution that can avoid ripples. (3) For the non-coated blade, if the cutting edge of blade has never been strengthened originally, now we can use a fine whetstone to lap gently the cutting edge in the field (along the edge direction). Or we process several workpieces on the new cutting edge, then the ripples can be alleviated or eliminated.

Table D-3 Frequently Asked Questions and the causes and the recommend solutions

Frequently Asked Questions	The causes and the recommend solutions
(2) The blades wear quickly, the durability is short	(1) Checking that if the cutting data selected is too high, especially, if the cutting speed and cutting depth is too large. If so, the adjustment must be implemented. (2) Whether it fails to supply sufficient coolant. (3) The chips jam the blades that lead to tiny crack tipping which increases the cutting-tool wear. (4) The blade champing is strong or loosing during cutting. (5) The blade itself has quality problems.
(3) The large chippings come off from the blade or the blade is cracked	(1) If some scraps or rigid grains have been clamped inside, that leads to cracks or stress during clamping. (2) The cutting chips wind and break the blade. (3) The cutting blade comes under accidental collision during blade moving. (4) The cutter fight of the preorder cutters such as roughing cutters etc. leads to subsequent crack of thread blades. (5) For the machine tool that retracts its cutters by hand, when retracting for many times, the cutter fights would be caused by the suddenly increasing load on the cutting edge due to the slow motion of last retracts. (6) The material quality of workpieces is not uniform or their machinability is very poor. (7) The blade itself has quality problems.
(4) The errors of pipe thread teeth profile are out of tolerance	(1) The finish turning teeth cutting edge of blade has been worn, and it is needed to be replaced by new one. (2) The finish turning teeth of blade have a "collapse tip" phenomenon; we should appropriately reduce the cutting speed and the cutting depth. (3) The blade or the arbor is installed improperly such as the basal surface fails to be aligned during installing; the basal surface of blade fails to be leaned against firmly. (4) The cutting edge has tiny crack tipping, the cutter must be replaces in time. (5) The blade has some chip buildup, to avoid it, we should increase appropriately the cutting speed, or use fine whetstone to gently lap and remove the buildup, or replace for the blade.