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Thanks to LILIN's experience in roller cone bits manufacturing for years, the roller cone bits designed and manufactured by LILIN show high performance and high reliability proved by the on-site testing and operation for thousands of hours. Each part of the design and processing technology of LILIN roller cone bit is able to meet the needs of the customers.

2 立林牙轮钻头技术特点 (Technical features)



立林公司拥有多年制造牙轮钻头的丰富经验,其设计、制造的牙轮钻头经过几千小时的现场实验,具有高性能和高可靠性。牙轮钻头设计和加工工艺的每一个细节都能满足客户的苛刻要求。

Thanks to LILIN's experience in roller cone bits manufacturing for years, the roller cone bits designed and manufactured by LILIN show high performance and high reliability proved by the on-site testing and operation for thousands of hours. Each part of the design and processing technology of LILIN roller cone bit is able to meet the needs of the customers.



1. 轴承结构 (bearing structure)

牙轮钻头的轴承结构主要分为三大类:滑动轴承、浮动轴承、滚动轴承。

There're three types of bearing structure in the roller cone bit, including journal bearing, floating bearing, rolling bearing.



滑动轴承 (Journal bearing)

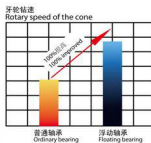
(1) 牙轮轴承表面的固体润滑层可以转移承载表面的热量。

The solid lubricating layer on the surface of the roller cone bit's bearing can transfer the heat off the bearing surface.



(2) 牙掌轴承表面堆焊耐磨合金能减小牙掌与牙轮之间的摩擦力,降低磨损,提高轴承承载能力、抗咬合能力和稳定性。

The wearing-resistant alloy bead welded on the bearing surface of the leg can mitigate the friction between the leg and the cone to reduce the wearing and improve the bearing capacity, anti-snapping ability and stability of the bearing.



浮动轴承 (Floating bearing)

在牙轮内孔和牙掌轴颈间设置一个环形浮动套,形成轴向浮动轴承;在牙轮和牙掌止推面间设置一个环形浮动垫片,构成轴向浮动轴承。在相同的钻井工况条件下,牙轮适应的转速可提高一倍,同时大大降低滑动摩擦产生的热量,提高了钻头的使用寿命。

Placing a floating ring between the inner hole of the cone and the neck journal of the leg makes a radial floating bearing; placing a ring-shaped float gasket onto the thrust surface between the cone and the leg makes an axial floating bearing. In this way, the rotary speed acceptable for the cone can be increased by 1 time if under the same working conditions of the drilling well, and the heat generated by the friction of sliding can also be significantly reduced, extending the service life of the bit.



滚动轴承 (Rolling bearing)

(1) 将圆柱滚动轴承放置于牙轮壳体的凹槽内,加大轴颈及滚动体尺寸。

Putting a cylindrical rolling element into the groove of the shell of the cone increases the size of the neck journal and the rolling element.



(2) 将圆柱滚动轴承设计加工成空心圆柱滚动体,这样可增加滚动的柔性和抗冲击性,也能增加润滑脂的储存空间,从而改善润滑条件。

Making the cylindrical rolling element hollow can enhance the smoothness and impact resistance of rolling and increase the storage space of grease lubricant, so as to improve the lubrication conditions.

(3) 圆柱滚动体的外表面是带有一定凸度的曲面。在一定程度上减轻滚动两端的边缘效应，延长滚柱寿命。

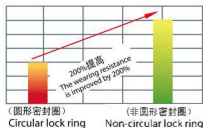
The outer surface of the cylindrical rolling element is a surface with a certain convexity, which mitigates the edge effect on both ends of rolling and extends the service life of the roller.

2. 密封及储油补偿系统

Sealing and oil storage compensation system

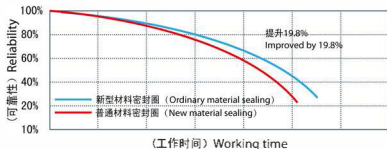
(1) 立林钻头使用具有自主知识产权的合成材料密封圈。其比起传统材料的密封圈具有更佳的耐磨性和密封可靠性。

The circular/non-circular lock ring in the roller cone bit uses the synthetic material developed by LILIN, which shows greater wearing resistance and sealing reliability than traditional sealing materials.



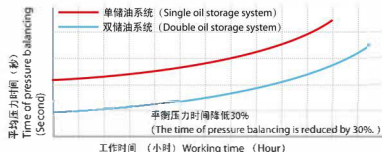
牙轮钻头中使用的旋转轴复合密封圈添加特殊材质后在台架试验条件下可降低摩擦系数40%以上，提高耐磨性2-3倍。

After adding special materials to the rotating-shaft composite lock ring in the roller cone bit, the coefficient of friction can be lowered by over 40% if under the bench test conditions, thus improving the wearing resistance by 2-3 times.



(2) 精密设计加工的双储油润滑补偿系统及选用的新型、高粘度和热稳定增强型润滑油能够显著提高轴承内外压力平衡速度，增加轴承承载能力，从而延长密封及整个轴承系统的寿命。

If using new high-viscosity lubricant grease with good thermal stability, the double-oil storage lubrication compensation system made through precise design and processing can significantly improve the speed of balancing the pressure inside and outside the bearing, enhance the bearing capacity of the bearing and extend the service life of the sealing and of the entire bearings system.



3. 水力系统 hydraulic system

(1) 双加长喷嘴的水力结构，能够及时清除由于钻进产生的大量岩屑，同时消除井底岩屑滞留区，加快岩屑上返。

Special hydraulic structure with double extended nozzles can remove large amount of drilling cuttings developed from drilling operations, and eliminate drilling cutting dead area at the bottom hole, so speed up removal of the drilling cuttings from the hole.



(2) 采用一个中心喷嘴和三个喷嘴的组合，增强井眼清洗能力，加快岩屑上返。

Three side nozzles and one center nozzle of the tricone bit can increase capacity of cleaning hole, expedite upward flow of drilling cuttings.

4. 切削结构 (Cutting structure)

钢齿钻头 (Steel tooth bit)

(1) 优化的齿形结构使齿面和齿顶磨屑的耐磨合金更厚、攻击性更强，有效提高牙齿的耐磨性，大幅提高机械钻速。

The optimized tooth structure makes the wearing-resistant alloy welded on the tooth surface and tooth top thicker and more "offensive", effectively improving the wearing resistance of the teeth and greatly increasing the rate of penetration.

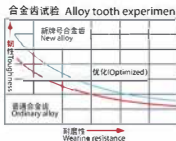
(2) 采用新式焊接工艺，在内排齿和外排齿表面采用新型焊接材料，使牙齿的耐磨性更强。

Through new welding technologies, new welding materials are welded on the surface of the inner row teeth and outer row teeth thus making the teeth more wearing-resistant.

镶齿钻头 (Insert tooth bit)

为应对高速钻井工况下恶劣工作环境，立林的技术工程师选用耐磨性更强、韧性更好的硬质合金齿，同时利用计算机仿真软件优化齿形结构和布齿方式，以减少重复破碎现象，降低牙齿磨损和提高机械钻速，这样钻压会更加均衡地加载在三个牙轮的每颗牙齿上面，实现均衡、稳定、持久钻进的目的。

The technical engineers of LILIN choose the tungsten carbide teeth with higher wearing resistance and stronger toughness for the poor working environment under high speed drilling conditions. Meanwhile, they use the computer simulation software to optimize the teeth structure and teeth placement to reduce repeated crushing, mitigate teeth wearing and lift the rate of penetration. Therefore, the drilling pressure can be spread over each tooth of the three cones in a more balanced way to ensure a balanced, stable and lasting



New “狼牙齿” 钻头 (The “Wolf Tooth” bit)

其主要特点是：1、选用切削效率更高的楔形齿作为主切削齿；2、提高合金齿材质的性能，使得牙齿更具耐磨性；3、特殊角度布齿结构可以发挥牙轮钻头的最大机械钻速。

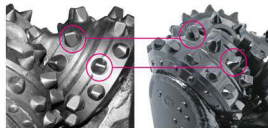
LILIN successfully developed the “Wolf Tooth” series drills, whose main features are as follows:

1. choosing the wedge-shaped tooth with high cutting efficiency as the primary cutting tooth; 2. improving the material quality of alloy tooth to give more wearing resistance to the tooth; 3. the top line of the tooth is made deflected to a certain angle, instead of being parallel to the cone generatrix, thus improving the rate of penetration.

“狼牙齿”能有效增大破碎坑面积，显著地提高了镶齿牙轮钻头的破岩效率，机械钻速可提高18.9%~80%，大大降低了钻井成本，提高了经济效益。

The “Wolf Tooth” can effectively increase the crushing area, thus dramatically improving the breaking efficiency of the insert tooth bit. The rate of penetration can increase by 18.9%-80% which significantly reduces the cost and guarantees better economic benefits.

齿形对比 (contrast)



狼牙齿钻头
(The “Wolf Tooth” bit)

常规齿钻头
(Usual Insert tooth bit)



普通牙齿井底覆盖图
Well bottom cover in case of ordinary tooth



“狼牙齿”井底覆盖图
Well bottom cover in case of the “Wolf Tooth”



5、钻头排径 (Bit Gauge protection)

(1) 为适应定向井、水平井的钻井要求，立林的设计师采用高密度、大直径全掌背布齿，保护掌尖、储油孔以及密封，有效增强钻头抗缩径能力。

To meet the drilling requirements of the directional well and horizontal well, the designers of LILIN use the high-density, wide-diameter whole leg back for teeth placement, to protect the shirrtail, oil storage hole and sealing, and effectively enhance the anti-hole shrinkage capacity of the bit.



(2) 掌尖及掌背黄蜡焊融合金能降低掌尖及掌背的磨蚀，保护密封系统，从而延长钻头使用寿命。立林公司使用新型焊材，优化焊接工艺，使掌尖及掌背的耐磨性提高20%以上。

The wearing-resistant alloy welded on the shirrtail and leg back can reduce the wearing of the top and back and protect the sealing system, thus prolonging the service life of the bit. By using new welding materials and optimizing the welding process, our company managed to improve the wearing resistance of the shirrtail and leg back by over 20%.

平均压力时间 (秒)
Time of pressure balancing (Second)



(3) 在牙轮钻头的外排与背锥之间镶装一排保护牙轮壳体和修整井壁的齿排，形成带有修边齿的牙轮钻头。这类钻头有更好的保径能力，并耐磨更长，累计进尺和寿命更长。

Inserting a teeth row protecting the cone shell and trimming the well shell between the gate rows and the heel produces the roller cone bit with trimming teeth, which boasts a good capacity of gauge protection, high quality of the well hole, cumulative drilling footage and longer service life.

2. 附加特征 (Additional features)



掌背强化 (G) 在研磨性地层或定向井和水平井中, 钻头掌背强化大大降低掌背磨损, 提高钻头保径能力, 延长钻头使用寿命, 缩短钻井时间, 降低钻井成本。

Extra gage protection (G): in case of the operation in abrasive formations or directional well and horizontal well, the intensity of the back by inserting teeth onto the leg back significantly reduces the wearing of the back, improves the gage protection capacity of the bit, extends the service life of the bit and reduces the drilling time and drilling cost.



掌背扶正块 (L) 牙掌采用凸形阶梯结构, 并镶嵌大直径合金齿, 在水平井和定向井工况条件下, 改善了钻头工作状态, 有效保护掌背和储油孔, 提高掌背抗磨损能力。

Strengthening block (L): the leg uses convex trapezoid structure and is inserted with large-diameter alloy tooth, which improves the working conditions of the bit, effectively protects the leg back and oil storage hole and strengthens the wearing-resistance of the back, in case of the operation in the directional well and horizontal well.



水平井钻头 (SP) 优化掌背布齿, 提高抗磨损能力, 增强钻头保径能力, 适合于水平钻井。

Horizontal well bit (SP): the optimization of teeth placement on the leg back improves the wearing-resistance and the gage protection capacity of the bit, which is suitable for horizontal drilling.

掌背金刚石复合齿保径 (Diamond compound teeth protection on the leg)



掌背金刚石复合齿占50% (D)
Diamond compound teeth on
the leg accounts for 50% (D)



掌背金刚石复合齿占100% (D1)
Diamond compound teeth on
the leg accounts for 100% (D1)

牙轮金刚石复合齿保径 (Diamond compound teeth protection on the cone)

钻头牙轮外排和背锥镶嵌金刚石复合齿, 可大大增强钻头保径能力, 延长钻头使用寿命, 适合于硬、极硬及研磨性强的定向井和水平井。

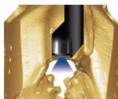
Inserting diamond compound teeth onto the gage row and the heel can greatly enhance the gage protection capacity of the bit and extend the service life of the bit, which is suitable for hard, very hard and highly abrasive formations and the directional well and horizontal well.



外排和背锥金刚石复合齿占50% (H)
Gage row & heel diamond
compound teeth accounts for 50% (H)



外排和背锥金刚石复合齿占100% (H1)
Gage row & heel diamond
compound teeth accounts for 100% (H1)



中心喷嘴 (C) 有效防止钻头泥包, 消除井底滞流滞流区, 加速岩屑上返, 提高钻头机械钻进, 适合低抗压强度、高可钻性的软至中硬地层。

Central nozzle (C): it effectively prevents bit bailing, eliminates the fluid stagnation zone at the well bottom, speeds up upward cutting and improves the rate of penetration of the bit, which is suitable for soft to medium-soft formations with low compressive strength and high.



加长喷嘴 (E) 可以加速岩屑上返, 消除井底滞流区, 减少重复破碎, 提高机械转速。

Extended nozzle (E): it speeds up upward cutting, eliminates the stagnation zone at the well bottom, reduces repeated crushing and improves the rate of penetration.



宽顶齿 (K) 加宽的齿顶, 旨在提高牙齿的井底破碎体积和井底覆盖率, 提高钻头在硬塑性地层中的机械钻进。适用于中软至中硬地层的泥岩、砂岩等塑性地层。

Wide-top tooth (K): widening the tooth top aims at increasing the crushing volume and coverage rate at the well bottom, which improves the rate of penetration of the bit in hard plastic formations. It is suitable for mudstone and sandstone stratum in the medium-soft to medium-hard formations.



楔形齿 (X) 具有切削效率高、抗磨损能力强等特性, 可有效提高钻头的机械钻进和延长钻头使用寿命。适合中软至中硬地层。

Wedge-shaped tooth (X): featuring high cutting efficiency and strong crushing resistance, it can effectively improve the rate of penetration and extend the service life of the bit, which is suitable for medium-soft to medium-hard formations.



圆锥齿 (Y) 该齿外形为圆锥形, 抗磨损性好, 具有高机械钻进, 适合在硬、脆脆性地层中钻进。

Conical-ended shape tooth (Y): shaped like a cone, this tooth shows good crushing resistance with a high rate of penetration, suitable for hard and hard-brittle formations.



半球形齿 (Y1) 该齿外形为半球形, 出露高度低, 适合在硬及高磨蚀性地层中钻进。

Hemi-spherical ended shape tooth: with a hemisphere shape, it produces a small exposure height, suitable for hard and high abrasive formations.



“狼牙齿” (WT) 具有切削效率高、抗磨损能力强、机械钻进快等特性, 适合中软至中硬地层。

“Wolf Tooth” (WT) “Wolf Tooth” has high cutting efficiency, anti-rock-breaking ability and higher ROP. It is appropriate for drilling medium-soft to medium-hard formations.

5 立林牙轮钻头技术参数表 (Technical parameters tables)

喷嘴尺寸表 (Nozzle Size Table)

钻头外径尺寸 Inch	钻头尺寸 mm	喷嘴外径 mm	喷嘴装配长度 mm
5 7/8 - 6 1/2	149.2 - 165.1	23.50 ± 0.05	19.06 ± 0.13
7 1/2	190.5	28.74 ± 0.05	20.62 ± 0.13
8 1/2 - 12 1/4	215.9 - 311.1	33.00 ± 0.05	26.97 ± 0.13
17 1/2	444.5	40.34 ± 0.05	26.97 ± 0.13

API 牙轮钻头公差 (Tolerance of API Roller Bit)

钻头外径尺寸	外径公差
英寸 (inch)	英寸 (inch)
3 3/8	0 ~ 0.0313 (1/32)
14 - 17 1/2	0 ~ 0.0625 (1/16)
17 5/8 - 26	0 ~ 0.0938 (3/32)
	毫米 (mm)
	0 ~ 0.79
	0 ~ 1.57
	0 ~ 2.38

牙轮钻头使用参数表 (Roller Cone Bit Operation Parameters Table)



适用环境 (Drilling Condition)	钻头 型号 (Model)	转速 (RPM)	钻头尺寸 (in/mm)																
			KN/mm																
			4 1/2 114.3	4 5/8 117.5	4 3/4 120.7	5 5/8 142.9	5 7/8 149.2	6 152.4	6 1/8 155.6	6 1/4 158.8	6 3/4 171.5	6 1/2 165.1	7 1/2 190.5	7 5/8 193.7					
复合钻井 (Motor Drilling)	LS417	300-60	0.35-1.03	40-118	41-121	42-124	50-147	52-154	53-157	54-160	56-164	60-177	58-170	67-196	68-200				
	LS437	300-60	0.35-1.03	40-118	41-121	42-124	50-147	52-154	53-157	54-160	56-164	60-177	58-170	67-196	68-200				
	LS447	300-60	0.35-1.03	40-118	41-121	42-124	50-147	52-154	53-157	54-160	56-164	60-177	58-170	67-196	68-200				
	LS517	300-60	0.35-1.05	40-120	41-123	42-127	50-150	52-157	53-160	54-163	56-167	60-180	58-173	67-200	68-203				
	LS537	300-60	0.35-1.05	40-120	41-123	42-127	50-150	52-157	53-160	54-163	56-167	60-180	58-173	67-200	68-203				
	LS547	220-40	0.50-1.10	57-126	58-129	60-133	71-157	75-164	76-168	78-171	79-175	86-189	83-182	95-210	97-213				
	LS617	220-40	0.50-1.10				71-157	75-164	76-168	78-171	79-175	86-189	83-182	95-210	97-213				
	LS627	220-40	0.50-1.10				71-157	75-164	76-168	78-171	79-175	86-189	83-182	95-210	97-213				
	LS637	220-40	0.50-1.20				71-171	75-179	76-183	78-183	79-191	86-206	83-198	95-229	97-232				
	LS647	220-40	0.50-1.20	23-80	24-82	24-84	71-171	75-179	76-183	78-187	79-191	86-206	83-198	95-229	97-232				
常规钻井 (Rotary Drilling)	LR114	220-80	0.20-0.70	29-80	29-82	30-84	29-100	30-104	30-107	31-109	32-111	34-120	33-116	38-133	39-136				
	LR214	220-80	0.25-0.70	23-80	24-82	24-84	36-100	37-104	38-107	39-109	40-111	43-120	41-116	48-133	48-136				
	LR115	220-80	0.20-0.70	23-80	24-82	24-84	29-100	30-104	30-107	31-109	32-111	34-120	33-116	38-133	39-136				
	LR125	220-80	0.20-0.70	23-80	24-82	24-84	29-100	30-104	30-107	31-109	32-111	34-120	33-116	38-133	39-136				
	LR135	220-80	0.20-0.70	23-71	24-71	24-72	29-100	30-104	30-107	31-109	32-111	34-120	33-116	38-133	39-136				
	LR415	220-80	0.20-0.60	23-80	24-82	24-84	29-86	30-90	30-91	31-93	32-95	34-102	33-99	38-114	39-116				
	LR435	220-80	0.20-0.70	23-81	24-84	24-87	29-100	30-104	30-107	31-109	32-111	34-120	33-116	38-133	39-136				
	LR515	220-80	0.20-0.80	40-91	41-94	42-97	29-114	30-116	30-122	31-124	32-127	34-137	33-132	38-152	39-155				
	LR535	220-80	0.35-0.80	40-103	41-106	42-109	50-114	52-119	53-122	54-124	56-127	60-137	58-132	67-152	68-155				
	LR117	170-60	0.35-0.90	40-114	41-117	42-120	50-128	52-134	53-137	55-140	56-143	60-154	58-149	67-171	68-174				
	LR127	170-70	0.35-1.00	40-120	41-123	42-127	50-143	52-149	53-152	55-155	56-159	60-171	58-166	67-191	68-194				
	LR137	140-60	0.35-1.05	57-137	58-141	59-145	60-165	62-172	63-175	65-178	66-181	70-192	68-187	83-209	85-212				
	LR217	120-60	0.50-1.20	40-103	41-106	42-109	71-171	75-179	76-183	78-187	79-191	86-206	83-201	95-229	97-232				
	LR317	100-45	0.70-1.30	40-109	41-112	42-115	100-186	104-194	107-197	109-200	111-203	120-220	117-215	136-252	138-257				
	LR417	180-70	0.35-0.90	40-114	41-117	42-120	50-129	52-134	53-137	55-140	56-143	60-154	58-149	67-171	68-174				
	LR437	180-60	0.35-0.95	40-120	41-123	42-127	50-136	52-142	53-145	55-148	56-151	60-163	58-157	67-181	68-184				
	LR447	180-60	0.35-1.00	57-120	58-123	59-127	50-143	52-149	53-152	55-155	56-159	60-171	58-166	67-191	68-194				
	LR517	140-50	0.35-1.05	57-120	58-123	59-127	50-150	52-157	53-160	54-163	56-167	60-180	58-173	67-200	68-203				
	LR537	130-40	0.50-1.05				71-150	75-157	76-160	78-163	79-167	86-180	83-173	95-200	97-203				
	LR547	130-40	0.50-1.05				71-150	75-157	76-160	78-163	79-167	86-180	83-173	95-200	97-203				
	LR517	100-40	0.50-1.05				71-150	75-157	76-160	78-163	79-167	86-180	83-173	95-200	97-203				
	LR527	100-40	0.50-1.05				71-150	75-157	76-160	78-163	79-167	86-180	83-173	95-200	97-203				
	LR537	90-40	0.75-1.20					104-179	107-183	109-187	111-191	120-206	116-196	133-229	136-232				
	LR737	90-40	0.75-1.20					104-179	107-183	109-187	111-191	120-206	116-196	133-229	136-232				
	LR837	200-40	0.50-1.30				71-186	75-194	76-198	78-202	79-206	86-223	83-216	95-246	97-252				
钻头连接螺纹 REG (API 正公母扣) / (英寸) Bts Connections (API REG PIN) (inch)			REG 2 3/8																
连接螺纹上最大扭矩 (千牛·米) Max.-up Torque Recommended (KN·M)			4.1-4.7 KN·M																

注：以上钻压和转速不允许同时使用最大值。
Note: Don't use the maximum WOB and maximum RPM at the same time

牙轮钻头使用参数表 (Roller Cone Bit Operation Parameters Table)

适用环境 (Drilling Condition)	钻头 型号 (Model)	转速 (RPM)	钻头尺寸(in/mm)														
				7 7/8 200	8 3/8 212.7	8 1/2 215.9	8 3/4 222.2	9 228.6	9 1/2 241.3	9 5/8 244.5	9 3/4 247.6	9 7/8 250.8	12 304.8	12 1/4 311.1	13 1/2 342.9	13 3/4 349.2	17 1/2 444.5
			KN/mm		钻压 (WOB) KN												
复合钻井 (Motor Drilling)	LS417	300-60	0.35-1.03	70-206	74-219	76-222	78-229	80-235	84-249	86-252	87-255	88-258	107-314	109-320	120-353		
	LS437	300-60	0.35-1.03	70-206	74-219	76-222	78-229	80-235	84-249	86-252	87-255	88-258	107-314	109-320	120-353		
	LS447	300-60	0.35-1.03	70-206	74-219	76-222	78-229	80-235	84-249	86-252	87-255	88-258	107-314	109-320	120-353		
	LS517	300-60	0.35-1.05	70-210	74-223	76-227	78-233	80-240	84-253	86-257	87-260	88-263	107-320	109-327	120-360		
	LS537	300-60	0.35-1.05	70-210	74-223	76-227	78-233	80-240	84-253	86-257	87-260	88-263	107-320	109-327	120-360		
	LS547	220-40	0.50-1.10	100-220	106-234	108-237	111-244	114-251	121-265	122-269	124-272	125-276	152-335	156-342	171-377		
	LS617	220-40	0.50-1.10	100-220	106-234	108-237	111-244	114-251	121-265	122-269	124-272	125-276	152-335	156-342	171-377		
	LS627	220-40	0.50-1.10	100-220	106-234	108-237	111-244	114-251	121-265	122-269	124-272	125-276	152-335	156-342	171-377		
	LS637	220-40	0.50-1.20	100-240	106-255	108-259	111-267	114-274	121-290	122-293	124-297	125-301	152-366	156-373	171-411		
	LS647	220-40	0.50-1.20	100-240	106-255	108-259	111-267	114-274	121-290	122-293	124-297	125-301	152-366	156-373	171-411		
常规钻井 (Rotary Drilling)	LR114	220-80	0.20-0.70	40-140	43-149	43-151	44-156	46-160	48-169	49-171	50-173	50-176	61-213	62-218	69-240	70-244	89-311
	LR214	220-80	0.25-0.70	50-140	53-149	54-151	56-156	57-160	60-169	61-171	62-173	63-176	76-213	78-218	86-240	87-244	111-311
	LR115	220-80	0.20-0.70	40-140	43-149	43-151	44-156	46-160	48-169	49-171	50-173	50-176	61-213	62-218	69-240	70-244	89-311
	LR125	220-80	0.20-0.70	40-140	43-149	43-151	44-156	46-160	48-169	49-171	50-173	50-176	61-213	62-218	69-240	70-244	89-311
	LR135	220-80	0.20-0.70	40-140	43-149	43-151	44-156	46-160	48-169	49-171	50-173	50-176	61-213	62-218	69-240	70-244	89-311
	LR415	220-80	0.20-0.60	40-120	43-128	43-130	44-133	46-137	48-145	49-147	50-149	50-150	61-183	62-187	69-206	70-210	89-267
	LR435	220-80	0.20-0.70	40-140	43-149	43-151	44-156	46-160	48-169	49-171	50-173	50-176	61-213	62-218	69-240	70-244	89-311
	LR515	220-80	0.20-0.80	40-160	43-170	43-173	44-178	46-183	48-193	49-196	50-198	50-201	61-244	62-249	69-274	70-279	89-356
	LR535	220-80	0.35-0.80	70-160	74-170	76-173	78-178	80-183	84-193	86-196	87-198	88-201	107-244	109-249	120-274	122-279	156-356
	LR117	170-80	0.35-0.90	70-180	74-191	76-194	78-200	80-206	84-217	86-220	87-223	88-226		109-280		122-314	156-400
	LR127	170-70	0.35-1.00	70-200	74-213	76-216	78-222	80-228	84-241	86-245	87-248	88-251	107-274	109-311	120-309	122-349	156-445
	LR137	140-60	0.35-1.05	70-210	74-223	76-227	78-233	80-240	84-253	86-257	87-260	88-263	107-304	109-327	120-343	122-367	156-467
	LR217	120-50	0.50-1.20	100-240	106-255	108-259	111-267	114-274	121-290	122-293	124-297	125-301	107-320	156-373	120-360	175-419	222-533
	LR317	100-45	0.70-1.30	140-260	149-277	151-281	156-289	160-297	169-314	171-318	173-322	176-326	152-366	218-404	171-411	244-454	311-578
	LR417	160-70	0.35-0.90	70-180	74-191	76-194	78-200	80-206	84-217	86-220	87-223	88-226	213-396	109-280	240-446	122-314	156-400
	LR437	160-60	0.35-0.95	70-190	74-202	76-205	78-211	80-217	84-229	86-232	87-235	88-238	107-290	109-296	120-326	122-332	156-422
	LR447	160-60	0.35-1.00	70-200	74-213	76-216	78-222	80-228	84-241	86-245	87-248	88-251	107-304	109-311	120-343	122-349	156-445
	LR517	140-50	0.35-1.05	70-210	74-223	76-227	78-233	80-240	84-253	86-257	87-260	88-263	107-320	109-327	120-360	122-367	156-467
	LR537	130-40	0.50-1.05	100-210	106-223	108-227	111-233	114-240	121-253	122-257	124-260	125-263	152-320	156-327	171-360	175-367	222-467
	LR547	130-40	0.50-1.05	100-210	106-223	108-227	111-233	114-240	121-253	122-257	124-260	125-263	152-320	156-327	171-360	175-367	222-467
	LR617	100-40	0.50-1.05	100-210	106-223	108-227	111-233	114-240	121-253	122-257	124-260	125-263	152-320	156-327	171-360	175-367	222-467
	LR627	100-40	0.50-1.05	100-210	106-223	108-227	111-233	114-240	121-253	122-257	124-260	125-263	152-320	156-327	171-360	175-367	222-467
	LR637	90-40	0.70-1.20	140-240	149-255	151-259	156-267	160-274	169-290	171-293	173-297	176-301	213-366	218-373	240-411	244-419	311-533
	LR737	90-40	0.70-1.20	140-240	149-255	151-259	156-267	160-274	169-290	171-293	173-297	176-301	213-366	218-373	240-411	244-419	311-533
	LR837	200-40	0.50-1.30	100-260	106-277	108-281	111-289	114-297	121-314	122-318	124-322	125-326	152-396	156-404	171-446	175-454	222-578
钻头连接螺纹REG (API 正规公螺纹) / (英寸)			REG 4 1/2					REG 6 5/8					REG 7 5/8				
Bits Connections (API REG PIN) (inches)																	
连接螺纹上紧扭矩推荐值 (千牛·米)			16.3-21.7					37.93-43.3					46.1-54.2				
Make-up Torque Recommended (KN · M)																	

注：以上钻压和转速不允许同时使用最大值。
Note: Don't use the maximum WOB and maximum RPM at the same time

IADC分类对照表 (IADC Classificaiton Table)

钻头类型 Types of Drill Bit	适应地层 Adaptation Formation		密封轴承系统 Sealed Performance of Drill Bit			
	系列 Series	特性 Characteristics	密封轴承 Sealed Bearing	密封轴承系统 Sealed Bearing System	密封轴承 Sealed Bearing	密封轴承系统 Sealed Journal Bearing
			4	5	6	7
1	1	低抗压强度 Low Crushing Resistance	LR114	LR115	LR116	LR117
		中抗压强度 Medium Crushing Resistance	LR124	LR125	LR126	LR127
		高抗压强度 High Crushing Resistance	LR134	LR135	LR136	LR137
		高抗压强度及高磨蚀性 High Crushing Resistance and High Abrasivity				
2	2	高抗压强度 High Crushing Resistance	LR214	LR215	LR216	LR217
		高抗压强度及高磨蚀性 High Crushing Resistance and High Abrasivity				
		高抗压强度及高磨蚀性 High Crushing Resistance and High Abrasivity			LR236	LR237
		高抗压强度及高磨蚀性 High Crushing Resistance and High Abrasivity				
3	3	半磨蚀性 Semi-Abrasive Formation			LR316	LR317
		高磨蚀性 High Abrasive Formation				
		高磨蚀性及高抗压强度 High Abrasive Formation and High Crushing Resistance			LR346	LR347
		高磨蚀性及高抗压强度 High Abrasive Formation and High Crushing Resistance			LR416	LR417
4	4	低抗压强度 Low Crushing Resistance		LR415		
		中抗压强度 Medium Crushing Resistance				
		高抗压强度 High Crushing Resistance				
		高抗压强度及高磨蚀性 High Crushing Resistance and High Abrasivity				
5	5	低抗压强度 Low Crushing Resistance			LR426	LR427
		中抗压强度 Medium Crushing Resistance		LR435	LR436	LR437
		高抗压强度 High Crushing Resistance			LR446	LR447
		高抗压强度及高磨蚀性 High Crushing Resistance and High Abrasivity		LR515	LR516	LR517
6	6	低抗压强度 Low Crushing Resistance			LR526	LR527
		中抗压强度 Medium Crushing Resistance		LR535	LR536	LR537
		高抗压强度 High Crushing Resistance			LR546	LR547
		高抗压强度及高磨蚀性 High Crushing Resistance and High Abrasivity			LR616	LR617
7	7	低抗压强度 Low Crushing Resistance			LR626	LR627
		中抗压强度 Medium Crushing Resistance			LR636	LR637
		高抗压强度 High Crushing Resistance				
		高抗压强度及高磨蚀性 High Crushing Resistance and High Abrasivity				
8	8	低抗压强度 Low Crushing Resistance				
		中抗压强度 Medium Crushing Resistance				
		高抗压强度 High Crushing Resistance				
		高抗压强度及高磨蚀性 High Crushing Resistance and High Abrasivity				

 注: IADC——国际钻井承包商
 Note: IADC——International Association of Drilling Contractors

钻头使用参数对照表 (LILIN bit comparison chart)

SERIES	FORMATIONS	5-seal roller bearing with gauge protection 5-滚动密封轴承及保径					7-Sealed friction bearing with gauge protection 7-滑动密封轴承及保径				
		LILIN	JZ	SMITH	HUGHES	REED	LILIN	JZ	SMITH	HUGHES	REED
1	Soft compaction 层状砂岩 软岩	LE110C LE110GL LE110GLAT100 LE110GLAT150	GAT10C GAT10GLAT100 GAT10GLAT150	80-FPM-1CT10	VS-67A-01 80-FPM-1CT10 80-FPM-1CT15	TT10L010 TT10L015	LE110G	HA110	80-FPM-1CT10	VS-67A-01 80-FPM-1CT10 80-FPM-1CT15	TO10GLAT100L011
		2	LE110GLAT120		RC120-01		LE110G	HA120		RC120-01 80-FPM-1CT15	SL120P12
		3	LE110GLAT120S LE110S	G010C-M030H	VS-67C-01 80-FPM-1CT15 MA-67C-01 80-FPM-1CT15	TT10L015S TT10S	LE110G	HA120S	MP100-F030H	VS-67C-01 80-FPM-1CT15 MA-67C-01 80-FPM-1CT15	PP10GL012
		4	LE104L	LE104L							
2	Med to Med-Hard compaction strength 中硬至中硬岩 中硬至中硬岩	1	LE110GLAT120 LE110GLAT150	80H	RC115		LE110GLAT120S LE110GLAT150S	HA110S HA120S	80H-0104	RC115-01 80-FPM-1CT15	PP110S
		2	LE121S				LE120G	8000G120S			
		3	LE121GLAT20S LE121S		RC121S		LE120G	8000G120S		RC121S	
		4	LE104L	LE104L							
3	Hard to Medium-Hard compaction strength 中硬至中硬岩 中硬至中硬岩	1	LE110GLAT120 LE110GLAT150				LE110GLAT120S LE110GLAT150S	8000G120S			
		2	LE121S				LE120G	8000G120S			
		3	LE121GLAT20S LE121S				LE120G	8000G120S			
		4	LE104L	LE104L							
4	Extremely Hard & compaction strength 极硬至极硬岩 极硬至极硬岩	1	LE110GLAT120 LE110GLAT150				LE110GLAT120S LE110GLAT150S	8000G120S			
		2	LE121S				LE120G	8000G120S			
		3	LE121GLAT20S LE121S				LE120G	8000G120S			
		4	LE104L	LE104L							
5	Soft to medium hard compaction strength 中硬至中硬岩 中硬至中硬岩	1	LE110GLAT120 LE110GLAT150				LE110GLAT120S LE110GLAT150S	8000G120S			
		2	LE121S				LE120G	8000G120S			
		3	LE121GLAT20S LE121S				LE120G	8000G120S			
		4	LE104L	LE104L							
6	Medium-Hard compaction strength 中硬至中硬岩 中硬至中硬岩	1	LE110GLAT120 LE110GLAT150				LE110GLAT120S LE110GLAT150S	8000G120S			
		2	LE121S				LE120G	8000G120S			
		3	LE121GLAT20S LE121S				LE120G	8000G120S			
		4	LE104L	LE104L							
7	Hard to Medium-Hard compaction strength 中硬至中硬岩 中硬至中硬岩	1	LE110GLAT120 LE110GLAT150				LE110GLAT120S LE110GLAT150S	8000G120S			
		2	LE121S				LE120G	8000G120S			
		3	LE121GLAT20S LE121S				LE120G	8000G120S			
		4	LE104L	LE104L							
8	Extremely Hard & compaction strength 极硬至极硬岩 极硬至极硬岩	1	LE110GLAT120 LE110GLAT150				LE110GLAT120S LE110GLAT150S	8000G120S			
		2	LE121S				LE120G	8000G120S			
		3	LE121GLAT20S LE121S				LE120G	8000G120S			
		4	LE104L	LE104L							

IADC钝钻头分级 (IADC dull bit grading)

切削结构 Cutting structure				轴承/密封 Bearing/sealing	直径 gauge	其它钝化特征 Others dull characteristics	起钻原因 Reason pulled
内排齿 Inner	外排齿 Outer	钝化特征 Dull char.	位置 Location				
1	2	3	4	5	6	7	8

1. 钢齿钻头 (steel tooth bits)
0—牙齿未磨损 (no loss of tooth height)
8—牙齿全部磨损 (total loss of tooth height)
2. 镶齿钻头 (insert bits)
0—无排齿、磨损和磨蚀
(no lost, worn and/or broken inserts)
8—无可用的切削结构
(all inserts lost, worn and/or broken)
3. BC—牙齿破裂 broken cone
BT—断齿 broken teeth/cutters
BU—钻头包壳 ballooned up bit
CC—牙齿裂纹 cracked cone
CD—牙齿开裂 coned dragged
CI—牙齿干涉 cone interference
CR—牙齿出心 core
CT—切削齿破裂 chipped teeth/cutters
ER—切削齿基体冲蚀 erosion
FC—齿顶圆磨 flat crested wear
HC—齿裂裂 heat checking
JD—落物堵塞 junk damage
LC—掉牙轮 lost cone
LN—掉喷嘴 lost nozzle
LT—排齿 lost teeth/cutters
OC—偏心磨损 off center wear
PB—钻头偏磨 pinched bit
PN—喷嘴堵塞 plugged nozzle/flow passage
RG—齿顶圆磨 rounded gauge
SD—掌齿损坏 shirttail damage
SS—自锐磨损 self sharpening wear
TR—钻齿磨钝 tracking
WO—钻头冲蚀 washed out bit
WT—切削齿磨钝 worn teeth/cutters
NO—无主要或其它磨损特征 no dull characteristics

- 1—1号牙轮 cone1
2—2号牙轮 cone2
3—3号牙轮 cone3
4. N—顶排齿 nose row
M—中排齿 middle row
H—外排齿 heel row
A—所有齿 ALL rows
5. 非密封轴承 non-sealed bearings
0—新轴承 new bearing/no life used
8—轴承使用完 all life used
密封轴承 sealed bearings
E—密封有效 seals effective
F—密封失效 seals failed
N—无法做出评价 not able to grade
6. I—直径无磨损 in gauge
1—磨损1/16英寸 1/16 in out of gauge
2—磨损2/16英寸 2/16 in out of gauge
3—磨损3/16英寸 3/16 in out of gauge
4—磨损4/16英寸 4/16 in out of gauge
7. BHA—改变井底钻具组合
change bottom hole assembly
CM—处理钻井液 condition mud
CP—到达钻头并深 core point
DP—钻完水泥塞 drill plug
DMF—井下马达失效 downhole motor failure
DTF—井下工具失效 downhole tool failure
DSF—钻柱失效 drill string failure
HP—井眼有问题 hole problems
8. HR—已封钻头规定使用时间 hours on bit
FM—地层改变 formation change
LH—井下落漏 left in hole
LOG—测井 run logs
PP—泵压异常 pump pressure
PR—机械钻速低 penetration rates
RG—钻杆修理 rig repair
TD—钻达总井深/下套管井深
total depth/casing depth
TO—扭矩变化 torque
TW—钻具扭转变 twist off
WC—气液异常 weather conditions

6 立林单牙轮钻头技术特点 (The single cone bit)



1、单牙轮钻头的牙齿大，破岩效率高，机械钻速快，适应各种地层，可穿透硬夹层，不怕软、硬交错的地层。

Single cone bit has big compacts, higher breaking rock efficiency and ROP is used in different formations. It can run through hard intercalated formations and soft & hard interlayers.

2、单牙轮钻头上镶嵌主动切削保径齿和被动抗磨保径齿，使钻头有较好的保径作用和侧削功能。

The single cone bit has excellent gauge protection and up reaming ability by setting active cutting gauge compacts on head body and wear-resistant gauge compacts on cone.

3、单牙轮钻头的双喷嘴系统提高了对牙轮和井底的清洗能力，有利于岩屑排出，确保钻头有更快的机械钻速。

Dual-nozzle system of single cone bit improves the cleaning ability of hydraulic system on the cone and bottom hole, expedites upward flow of cuttings and assures higher ROP.

4、单牙轮钻头轴承上设置大、小两道密封圈，确保密封的可靠性。

Two seal-courses of the big, small bearing of single cone bit are made from HNBR, assure reliability of the sealing.

5、单牙轮钻头是减速钻头，牙轮转速低于钻头转速，因此，它更适应于与井下动力钻具搭配使用。

Single cone bit is a kind of decelerating bit. Cone rotation speed is lower than bit rotation speed. Therefore it is suitable for drilling condition equipped downhole motor.

Hole Opener

7 扩孔器 (Hole Opener)

立林公司生产的扩孔器用于扩大导向孔直径，主要用于石油、天然气、电力等管道的水平定向钻进施工。该扩孔器设计用于地下多种岩石地层扩孔，牙轮部分由软地层用铁齿牙轮和硬地层用硬质合金镶齿牙轮两种，适用不同地层的切削剥蚀。

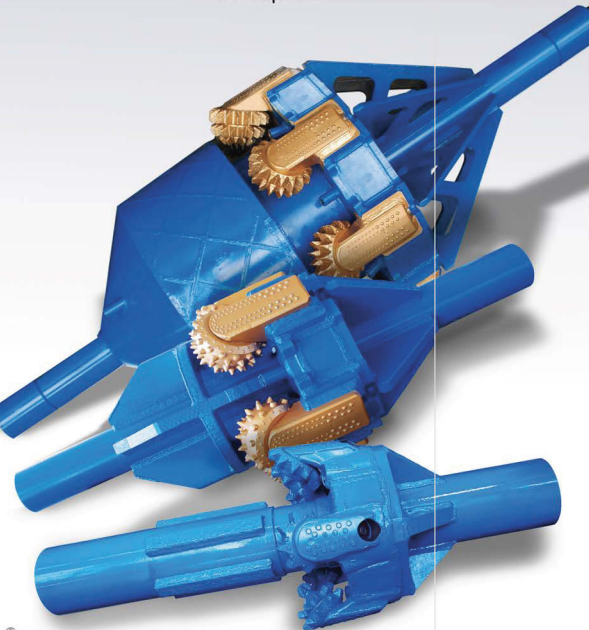
The hole opener produced by LILIN is used to expand the diameter of the pilot hole, mainly for horizontal directional drilling of oil, natural gas, electricity and other pipelines. Designed for the hole reaming in a variety of rock formations, this hole opener can apply to the cutting in different formations thanks to its two types of cones: the milled tooth cone for soft formations and the tungsten carbide inserted teeth cone for hard formations.

1. 主要特点包括 (Main features)

(1) 前扶正板或块 (Front strengthening plate/block)

前扶正板或块的主要作用是将扩孔器扶正于孔眼中心，同时也有支撑作用。30英寸及30英寸以下的扩孔器使用前扶正块；30英寸以上的扩孔器使用前扶正板。在前扶正板或块表面敷焊耐磨合金或镶硬质合金齿。为减轻扩孔器重量，在不影响支撑强度的前提下，前扶正板采用镂空设计。

The front strengthening plate/block mainly plays its role in strengthening the place of the hole opener in the center of the hole, also as a supporter. hole opener ≤ 30 inches use front strengthening blocks, while those >30 inches use front strengthening plates. Wearing-resistant alloy is welded on or tungsten carbide teeth are inserted onto the surface of the front strengthening plate/block. In order to reduce the weight of the hole opener the front strengthening plate is designed into a pierced work without affecting the supporting strength.





(2) 高速滚动轴承系统组合 (High - speed rolling bearing system combination)

立林扩孔器使用密封式高能滚动轴承系统，其滚动轴承系统以其严格的公差加工和选配组装。轴承圈形型密封圈是由氧化丁腈橡胶制成的，具有耐脂、高转速等特性，适合在各种工况条件下钻进。

LILIN hole opener uses a sealed high-energy rolling bearing system processed and assembled at an extremely strict tolerance. The circular locking ring of the bearing is made by hydrogenated acrylonitrile-butadiene rubber featuring good wearing resistance, oil resistance and a high rotary speed, suitable for the drilling under various working conditions.

(3) 润滑系统(Lubrication system)

每个扩孔器钻头都有一个密封式的自动补偿润滑系统，能够及时平衡轴承内外压力，保护轴承和密封系统。

The bit of each LILIN hole opener has a sealed, auto-compensation lubrication system which can balance the pressure inside and outside the bearing in time to protect the bearing and sealing systems.

(4) 牙轮和牙掌组合(Cone and leg combination)

牙轮的切削齿使用锥磨齿或者铣齿，牙齿耐磨性好，机械钻速快。强化掌实磨焊及全掌骨保护，牙轮部分背锥齿采用加强保护设计，有效增强钻头抗拉缩径能力。

The cutting tooth of the cone chooses conical-enrolled shape teeth or milled teeth promising good wearing resistance and a high rate of penetration. The intensified welding on the shirrtail and the protection of the whole leg back, as well as the gage protection on the cone effectively enhance the anti-hole shrinkage capacity of the cone.



(5) 喷嘴(Nozzle)

每一个牙轮和牙掌组合配备一个定向喷嘴，喷嘴有助于清洗、冷却牙轮，防止钻头泥包，有携屑岩屑和清洗孔壁的能力。在主轴芯轴的前部和后部设计至少一个径向或者轴向喷嘴，可进一步提高孔壁的清洗效果，加快进屑。

Every combination of the cone and leg is equipped with a directional nozzle whose ability to carry away the rock cuttings and clean the hole helps to clean and cool the cone and prevent bit bailing. Placing at least one radial or axial nozzle on the front and rear parts of the main spindle can further improve the cleaning of the hole and speed up cutting return.



(6) 后三角板(Rear triangular plate)

后三角板旨在增加支撑强度，在中途使用过程中容易退出。后三角板表面镀锌耐磨合金加强其耐磨性能。为减轻扩孔器重量，在不影响支撑强度的前提下，后三角板采用镂空设计。

The rear triangular plate aims at enhancing the supporting strength and is easy to quit in the course of operation. The wearing-resistant alloy welded on the surface enhances the wearing resistance of the plate. In order to reduce the weight of the underreamer, the rear triangular plate is designed into a pierced work without affecting the supporting strength.

2. 扩孔器的优点 (Benefits)

(1) 立林公司生产的扩孔器是低扭矩扩孔器, 可以使用小钻机扩孔, 降低钻孔成本。

LILIN hole opener has a low torque, which enables the drilling by small rigs, thus reducing the drilling cost.

(2) 立林扩孔器上的牙轮单元是可以替换的, 一套本体可以多次使用, 为客户节约工程费用。

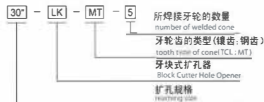
The cone units of LILIN underreamer are replaceable and each main body of the underreamer can be used many times, thus saving the cost for the customer.

(3) 生产大尺寸的三牙轮钻头或多牙轮钻头, 不仅加工难度大, 而且成本极高。使用扩孔器可以解决这些难题, 并且厂家可根据客户的要求生产各种规格的扩孔器。

The manufacturing of big-size tricone/multi-cone bits is faced with many difficulties and high costs, but these problems can be solved by LILIN hole opener. In addition, the manufacturer can produce hole opener of different specifications according to the customer's requirements.

产品名称: 牙轮式扩孔器 (Block Cutter Hole Opener)

型号介绍 (Introduction)



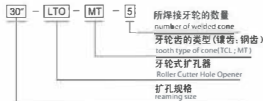
部分型号说明 (Please contact us for more specifications)

序号 No.	扩孔尺寸 Reaming size	扩孔尺寸 Reaming size	型号 type	扣型 thread	芯轴外径 OD of shaft	1套牙轮数量 Number of cone
1	30"	30"LK-MT/TCI-5	203	620-621	LC-MT	5PCS.
2	36"	36"LK-MT/TCI-5	228	620-621	LC-MT	5PCS.
3	44"	44"LK-MT/TCI-6	228	620-621	LC-MT	6PCS.
4	50"	50"LK-MT/TCI-6	241	620-621	LC-MT	6PCS.
5	56"	56"LK-MT/TCI-7	241	620-621	LC-MT	7PCS.
6	62"	62"LK-MT/TCI-8	241	620-621	LC-MT	8PCS.

可根据客户要求定制各种规格型号的扩孔器 (according to the customer's requirements hole openers of different specifications can be produced)

产品名称: 牙轮式扩孔器 (Roller Cutter Hole Opener)

型号介绍 (Introduction)



部分型号说明 (Please contact us for more specifications)

序号 No.	扩孔尺寸 Reaming size	型号 type	芯轴外径 OD of shaft	扣型 thread	牙轮型号 Cone type	1套牙轮数量 Number of cone
1	16"	16"LTO-MT/TCI-3	168	410-411	9/12LR517G	3PCS.
2	18"	18"LTO-MT/TCI-3	168	410-411	12/14LR517G	3PCS.
3	20"	20"LTO-MT/TCI-5	178	410-411	12/14LR517G	5PCS.
4	22"	22"LTO-MT/TCI-5	178	410-411	12/14LR517G	5PCS.
5	24"	24"LTO-MT/TCI-5	203	620-621	12/14LR517G	5PCS.
6	26"	26"LTO-MT/TCI-5	203	620-621	12/14LR517G	5PCS.
7	28"	28"LTO-MT/TCI-5	203	620-621	12/14LR517G	5PCS.
8	30"	30"LTO-MT/TCI-6	203	620-621	12/14LR517G	6PCS.
9	32"	32"LTO-MT/TCI-6	203	620-621	12/14LR517G	6PCS.
10	34"	34"LTO-MT/TCI-6	203	620-621	12/14LR517G	6PCS.
11	36"	36"LTO-MT/TCI-6	228	620-621	12/14LR517G	6PCS.
12	38"	38"LTO-MT/TCI-6	228	620-621	12/14LR517G	6PCS.
13	40"	40"LTO-MT/TCI-6	228	620-621	12/14LR517G	6PCS.
14	42"	42"LTO-MT/TCI-8	228	620-621	12/14LR517G	8PCS.
15	44"	44"LTO-MT/TCI-8	228	620-621	12/14LR517G	8PCS.
16	46"	46"LTO-MT/TCI-8	228	620-621	12/14LR517G	8PCS.
17	48"	48"LTO-MT/TCI-8	228	620-621	12/14LR517G	8PCS.
18	50"	50"LTO-MT/TCI-10	228	620-621	12/14LR517G	10PCS.
19	52"	52"LTO-MT/TCI-10	228	620-621	12/14LR517G	10PCS.
20	54"	54"LTO-MT/TCI-10	228	620-621	12/14LR517G	10PCS.
21	56"	56"LTO-MT/TCI-10	228	620-621	12/14LR517G	10PCS.
22	58"	58"LTO-MT/TCI-10	228	620-621	12/14LR517G	10PCS.
23	60"	60"LTO-MT/TCI-12	228	620-621	12/14LR517G	12PCS.
24	62"	62"LTO-MT/TCI-12	228	620-621	12/14LR517G	12PCS.
25	64"	64"LTO-MT/TCI-12	228	620-621	12/14LR517G	12PCS.

可根据客户要求定制各种规格型号的扩孔器 (according to the customer's requirements hole openers of different specifications can be produced)



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