

DLC-Coated Inserts for Non-Ferrous Metals

PD1005 / PD1010

KORLOY
TECH-NEWS



- Welding and chipping resistant coated grades specialized for machining non-ferrous metals.
- Advanced DLC-Coated Grades maximized resistance to welding and wear of coating enables quality machining at high speeds.

Advanced DLC-Coated Inserts for Non-Ferrous Metals such as Aluminum and Copper

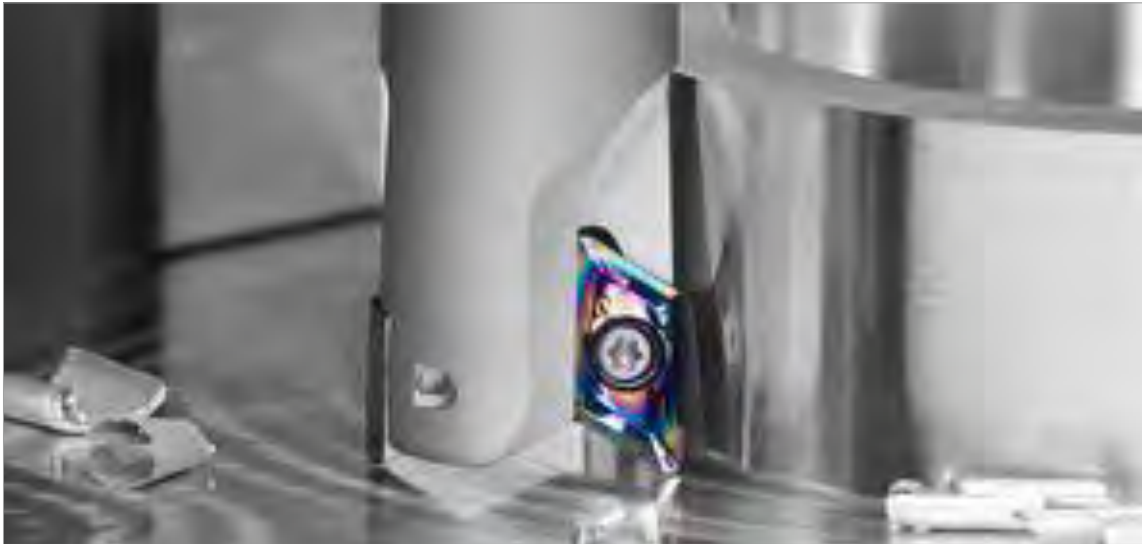
PD1005 / PD1010

Non-ferrous metals such as aluminum and copper have relatively low melting points, causing heavy welding on the tool edges during machining. The dulled cutting edges bring about poor surface finish of workpieces while high cutting load increases the chance of sudden chipping, resulting in unstable tool life.

To provide our customers with a satisfactory grade solution for non-ferrous metal machining, KORLOY has developed DLC (Diamond-Like Carbon) coated grades.

PD1005 is a grade for workpieces made of aluminum or copper, and for continuous cutting. The latest DLC coating with maximized wear and welding resistance enables high speed machining for those materials, delivering excellent surface finish in continuous cutting of general non-ferrous metals.

PD1010 is a grade for workpieces made of forged aluminum or AISi alloy, and for interrupted cutting. The combination of the chipping-resistant substrate and DLC coating greatly improves toughness, providing stable and long tool life in interrupted cutting or when machining nonferrous metals of high hardness.



Advanced DLC coating

- Maximized resistance to wear and welding.

Chipping resistant substrate



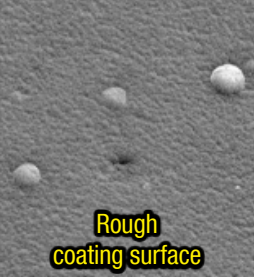
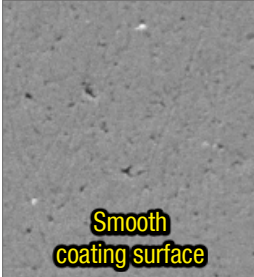
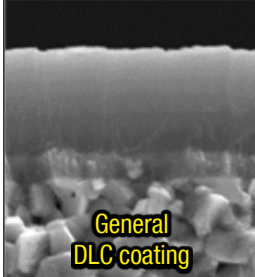
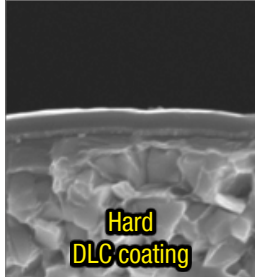
- Stable tool life at high interruptions and for non-ferrous metals of high hardness.
- Dedicated grades specialized for non-ferrous metals.

Development of New PD Series

Ultra-hard H-DLC coating

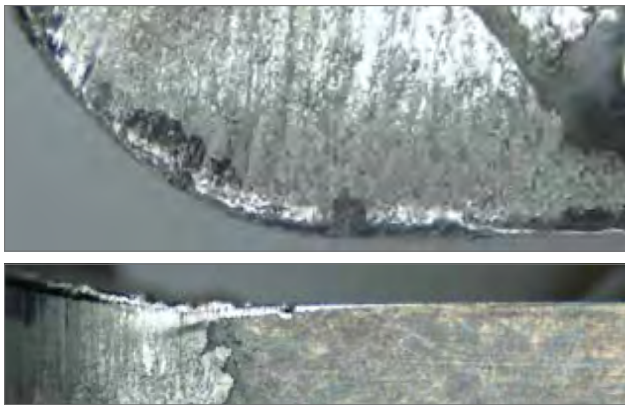
- DLC coating = Diamond-Like Carbon, amorphous carbon coating with physical properties similar to those of diamonds.
- High hardness and lubrication ideal for nonferrous metal machining with a high probability of build-up edge occurring.



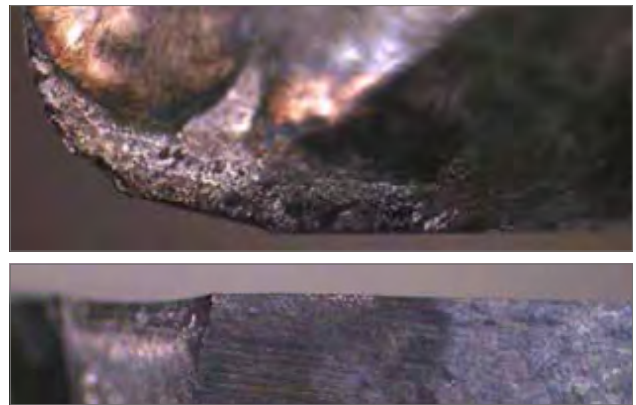
 <p>General DLC Hardness of coating: 3000 HV Friction coefficient: < 0.25</p>	 <p>DLC Hardness of coating: 6500 HV Friction coefficient: < 0,15</p>
 <p>Rough coating surface</p>	 <p>Smooth coating surface</p>
 <p>General DLC coating</p>	 <p>Hard DLC coating</p>

Problems When Machining Non-Ferrous Metals

1. Build-up edges

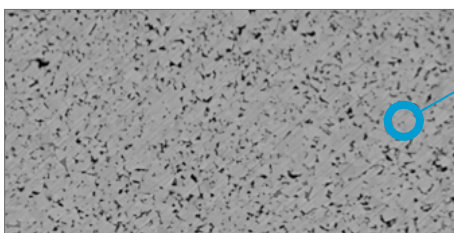


2. Unexpected chipping



Substrate features

Chipping resistant substrate



Optimized proportion of WC particles and Co binders for each workpiece material provides improved resistance to chipping and wear. The ultrafine structure which has been made uniform attains stable machinability at all corners.

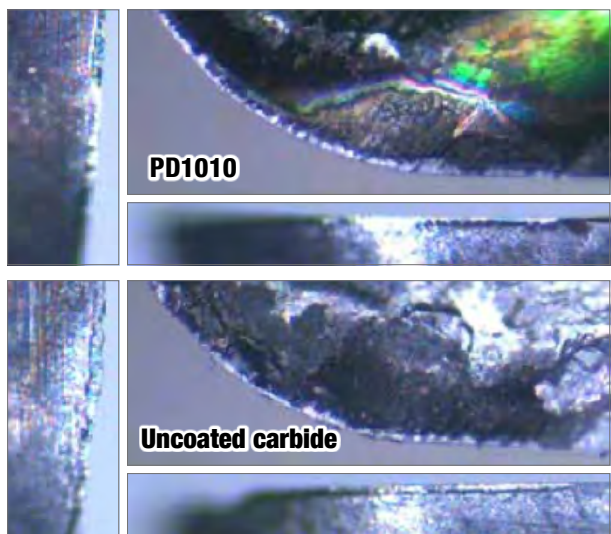
Development Effects

Milling of forged aluminum

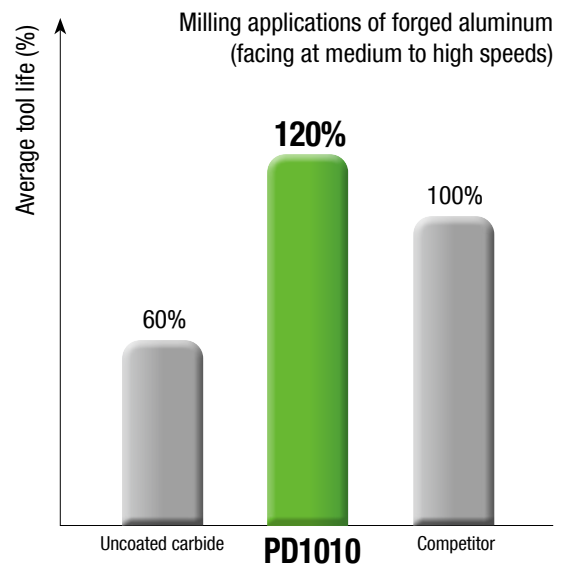
- **Workpiece** AlZn5.5MgCu
- **Cutting conditions** $vc = 1.0 \text{ m/min} \cdot fz = 0.2 \text{ mm/z} \cdot ap = 1.0 \text{ mm} \cdot ae = 70 \text{ mm} \cdot \text{dry}$
- **Tools** **Insert** XEKT19M508FR-MA **Holder** PAXCM5100HR-A

Sorten Eigenschaften



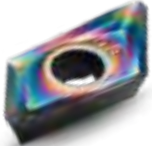

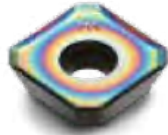
Improved resistance to welding and chipping



Extended tool life



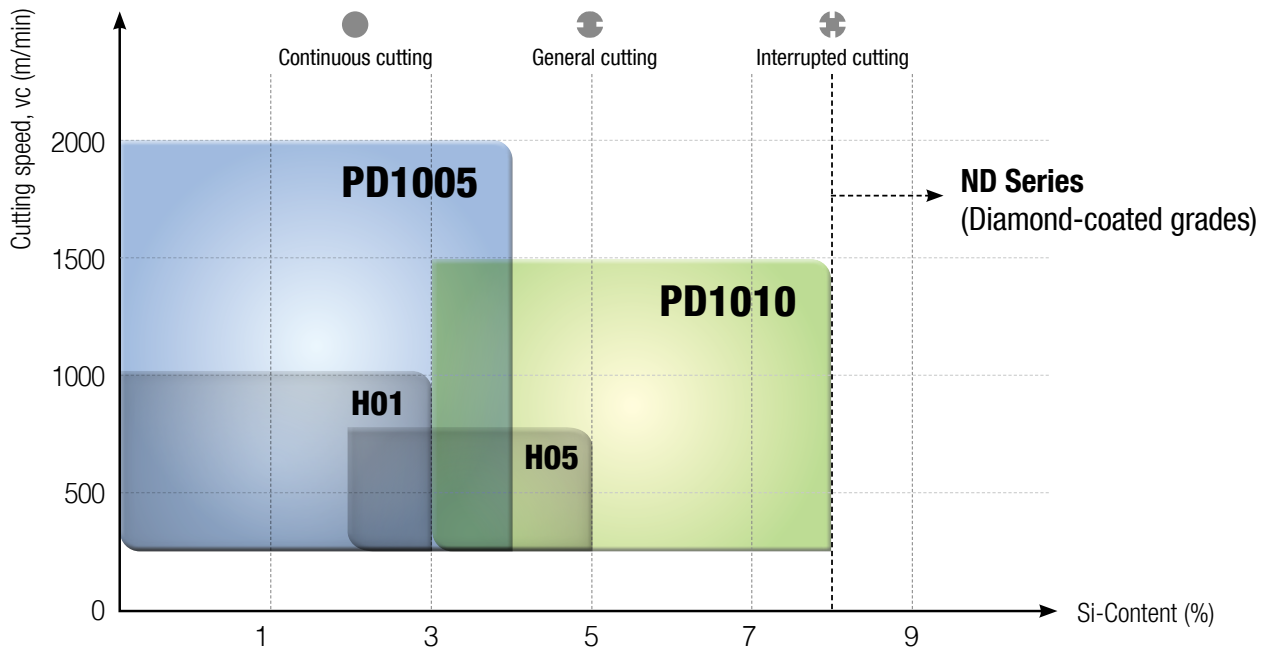
Applicable Products

Cutting type	Name		
Cutting	AK		AR
			
Milling	Pro-X Mill	Alpha Mill	Future Mill (FMA, FMP)
			

Guideline for Grades Application

Recommended grades by Si content (%) for aluminum alloy

- **PD1000 Series** Higher speed and feed availability compared to uncoated grades.
- Expanded application range for workpieces of higher Si content.
- table and long tool life



Recommended Cutting Conditions

Cutting type	Workpiece	Application	CB	Grade	Recommended cutting conditions		
					vc (m/min)	Cutting: fn (mm/rev) Milling: fz (mm/t)	ap (mm)
Turning	Soft, non-ferrous (Si < 4%)	Medium to finishing cutting	AK	PD1005	200 - 350 - 500	0,03 - 0,2 - 0,4	0,1 - 2,0 - 4,0
	Hard, non-ferrous (Si < 8%)			PD1010	150 - 275 - 400	0,03 - 0,2 - 0,4	0,1 - 2,0 - 4,0
	Soft, non-ferrous (Si < 4%)	Medium to rough cutting	AR	PD1005	200 - 350 - 500	0,05 - 0,25 - 0,5	0,5 - 2,2 - 4,0
	Hard, non-ferrous (Si < 8%)			PD1010	150 - 275 - 400	0,05 - 0,25 - 0,5	0,5 - 2,2 - 4,0
Milling	Soft, non-ferrous (Si < 4%)	General cutting	MA	PD1005	300 - 1150 - 2000	0,10 - 0,25 - 0,4	0,5 - 8,0 - 16,0
	Hard, non-ferrous (Si < 8%)			PD1010	200 - 850 - 1500	0,10 - 0,25 - 0,4	0,5 - 8,0 - 16,0

Cutting Performance



PD1005

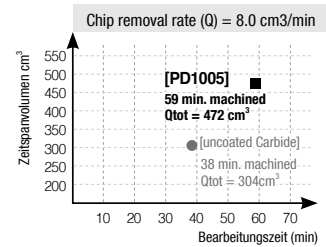


Uncoated carbide



Performance evaluation of PD1005 with AK (Turning)

Workpiece Aluminum alloy (AlZn5.5MgCu)
Cutting conditions $vc = 400 \text{ m/min} \cdot fn = 0.2 \text{ mm/rev}$
 $ap = 1.0 \text{ mm} \cdot$ outside turning · dry
Tools
Insert VCGT160404-AK (PD1005)
Holder SVJCL2525-M16



➔ **55% increased cutting volume compared to uncoated grades**



PD1005

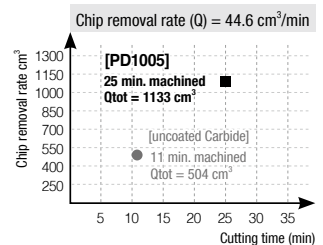


Uncoated carbide

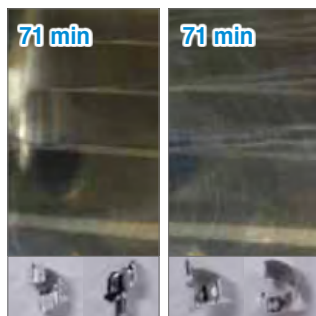


Performance evaluation of PD1005 with Pro-X Mill (Milling)

Workpiece Copper (C1020)
Cutting conditions $vc = 2000 \text{ m/min} \cdot fz = 0.1 \text{ mm/rev}$
 $ap = 1.0 \text{ mm} \cdot ae = 70 \text{ mm} \cdot$ wet
Tools
Insert XEKT19M508FR-MA (PD1005)
Holder PAXCM5100HR-A



➔ **125% more cutting volume compared to uncoated grades**



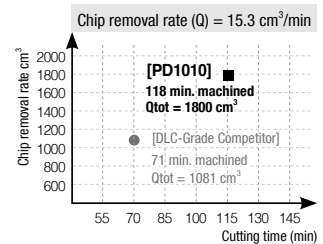
PD1010

DLC-Grade Competitor



Performance evaluation of PD1010 with Alpha Mill (Milling)

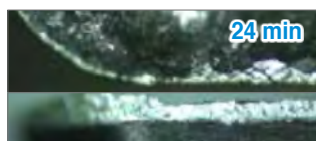
Workpiece Aluminum alloy (AlMg1SiCu)
Cutting conditions $vc = 800 \text{ m/min} \cdot fz = 0.1 \text{ mm/rev}$
 $ap = 3.0 \text{ mm} \cdot ae = 20 \text{ mm} \cdot$ dry
Tools
Insert APMT1604PDFR-MA (PD1010)
Holder AMC3100HS



➔ **67% increased cutting volume and better surface finish of the machined workpiece compared to the competitors DLC grade**



PD1010

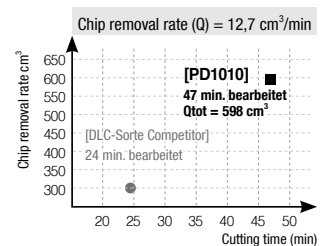


DLC-Grade Competitor



Performance evaluation of PD1010 with Pro-X Mill (Milling)

Workpiece Aluminum casting alloy
Cutting conditions $vc = 200 \text{ m/min} \cdot fz = 0.2 \text{ mm/rev}$
 $ap = 2.0 \text{ mm} \cdot ae = 50 \text{ mm} \cdot$ wet
Tools
Insert XEKT19M508FR-MA (PD1010)
Holder PAXCM5100HR-A



➔ **99% more cutting volume compared to the competitors DLC grade**

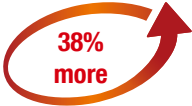
Application Examples

Automotive clutch housing

- **Workpiece** Aluminum die casting alloy, Al-Si8Cu3 (Fe) (Si 8%)
- **Cutting conditions** $vc = 400 \text{ m/min} \cdot fn = 0.25\text{-}0.3 \text{ mm/rev} \cdot ap = 1.0\text{-}1.5 \text{ mm} \cdot \text{wet}$
- **Tools** **Insert** CNMG120408-HA (PD1005) **Holder** PCLNR2525-M12



PD1005	80 ea / corner
Competitor	30 ea / corner



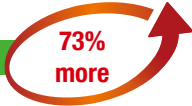
➔ **38% more machined workpieces compared to the competitor**

Automotive aluminum wheel

- **Workpiece** Aluminum forged alloy, Al-Si7Mg (Fe) (Si 7%)
- **Cutting conditions** $vc = 260\text{-}337 \text{ m/min} \cdot fn = 0.6\text{-}0.7 \text{ mm/rev} \cdot ap = 2.0\text{-}3.0 \text{ mm} \cdot \text{wet}$
- **Tools** **Insert** VCGT220530-AR (PD1010) **Holder** S40T-XVXCR-22-DG



PD1010	450 ea / corner
Competitor	330 ea / corner



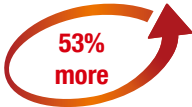
➔ **73% more machined workpieces compared to the competitor**

Automotive differential carrier

- **Workpiece** Aluminum forged alloy, Al-Si7Mg (Fe) (Si 7%)
- **Cutting conditions** $vc = 740 \text{ m/min} \cdot fz = 0.15 \text{ mm/rev} \cdot ap = 1.0\text{-}1.5 \text{ mm} \cdot \text{wet}$
- **Tools** **Insert** XEKT19M504FR-MA (PD1010) **Holder** PAXS5032HR-A




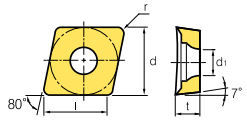

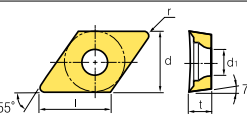

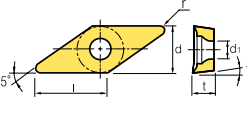
PD1010	900 ea / corner
Competitor	480 ea / corner



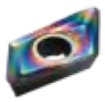
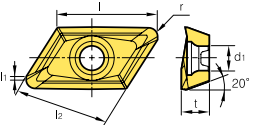

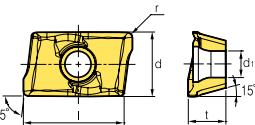

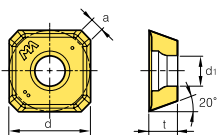

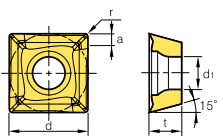
➔ **53% more machined workpieces compared to the competitor**



Available Stock (Turning)

Insert	Designation		Grade		Dimensions (mm)					Cutting conditions		Figure
			PD1005	PD1010	l	d	t	r	d1	Feed rate. fn (mm/rev)	Depth of cut. ap (mm)	
AK		CCGT	060204-AK	- ▲	6.0	6.35	2.38	0.4	2.8	0.02-0.15	0.10-3.00	
			09T302-AK	- ▲	9.4	9.525	3.97	0.2	4.4	0.02-0.20	0.05-3.00	
			09T304-AK	- ▲	9.2	9.525	3.97	0.4	4.4	0.02-0.30	0.10-5.00	
			120404-AK	- ▲	12.4	12.7	4.76	0.4	5.5	0.03-0.50	0.10-5.00	
	DCGT	070204-AK	- ▲	7.3	6.35	2.38	0.4	2.8	0.02-0.30	0.10-4.00		
		11T302-AK	- ▲	11.4	9.525	3.97	0.2	4.4	0.02-0.30	0.05-4.00		
		11T304-AK	- ▲	11.2	9.525	3.97	0.4	4.4	0.03-0.50	0.10-5.00		
		11T308-AK	- ▲	10.8	9.525	3.97	0.8	4.4	0.03-0.50	0.10-5.00		
	VCGT	110302-AK	- ▲	10.5	6.35	3.18	0.2	2.8	0.02-0.20	0.05-3.00		
		110304-AK	- ▲	10.0	6.35	3.18	0.4	2.8	0.02-0.25	0.10-4.00		
		160404-AK	- ▲	15.6	9.525	4.76	0.4	4.4	0.03-0.40	0.10-5.00		
		160408-AK	- ▲	14.0	9.525	4.76	0.8	4.4	0.03-0.50	0.10-5.00		

Available Stock (Milling)

Milling	Designation		Grade		Dimensions (mm)							Figure	
			PD1005	PD1010	l	l2	l1	d	t	r	d1		a
Pro-X Mill		XEKT	19M504FR-MA	- ▲	18	16.4	1.4	-	5	0.4	4.4	-	
			19M508FR-MA	- ▲	18	16.4	1.0	-	5	0.8	4.4	-	
			19M512FR-MA	- ▲	18	16.4	0.6	-	5	1.2	4.4	-	
			19M516FR-MA	- ▲	17.5	16.4	0.5	-	5	1.6	4.4	-	
			19M520FR-MA	- ▲	17.5	16.4	0.5	-	5	2.0	4.4	-	
			19M530FR-MA	- ▲	17	16.4	0.7	-	5	3.0	4.4	-	
			19M532FR-MA	- ▲	17	16.4	0.5	-	5	3.2	4.4	-	
			19M540FR-MA	- ▲	16.5	16.4	0.5	-	5	4.0	4.4	-	
			19M550FR-MA	- ▲	16	16.4	0.4	-	5	5.0	4.4	-	
Alpha Mill		APMT	1604PDFR-MA	- ▲	16.4	-	-	9.41	5.76	0.8	4.5	-	
FMA		SEET	14M4AGFN-MA	- ▲	-	-	-	14.0	4.0	-	4.4	2.64	
FMP		SDET	130504R-MA	- ▲	-	-	-	13.5	5.56	0.4	5.56	2.2	

▲ : Stock item Europe

Notes



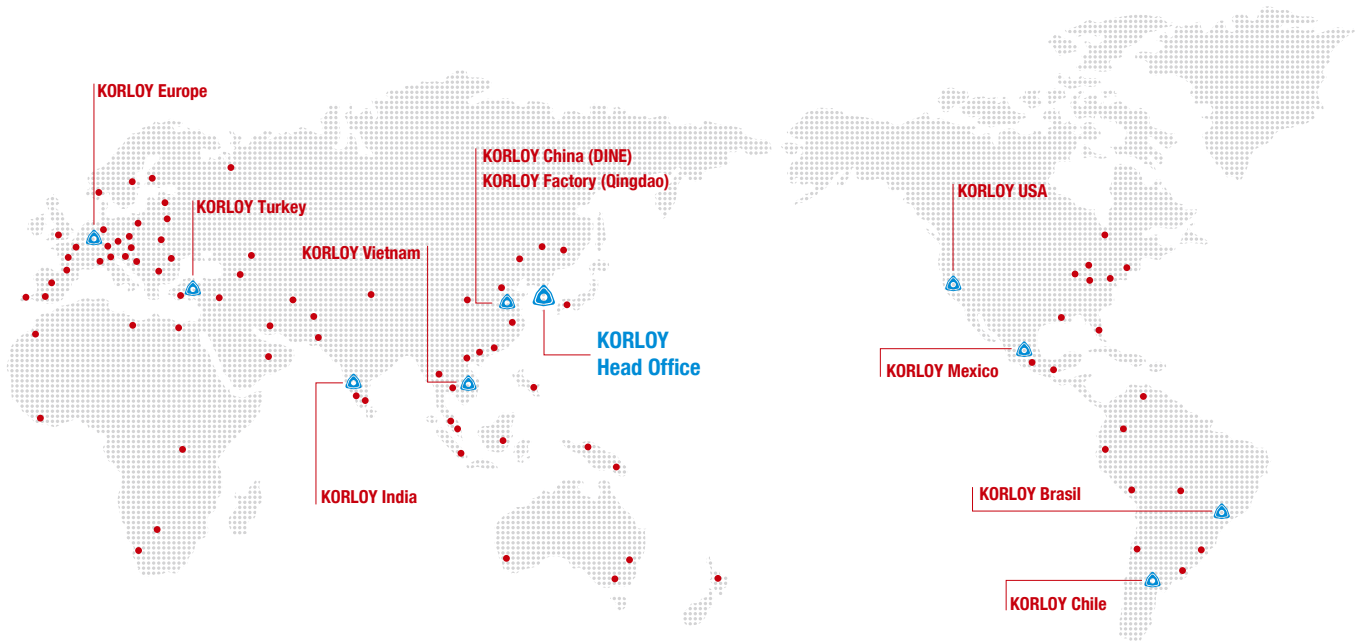
For the safe metal cutting

- Use safety supplies such as protective gloves to prevent possible injury while touching the edge of tools.
- Use safety glasses or safety cover to hedge possible dangers. Inappropriate usage or excessive cutting condition may lead tool's breakage or even the fragment's scattering.
- Clamp the workpiece tightly enough to prevent its movement while its machining.

Properly manage the tool change phase because the inordinately used tool can be easily broken under the excessive cutting load or severe wear, and it may threaten the operator's safety.

- Use safety cover because chips evacuated during cutting are hot and sharp and may cause burns and cuts. To remove chips safely, stop machining, put on protective gloves, and use a hook or other tools.

- Prepare for fire prevention measures as the use of the non-water soluble cutting oil may cause fire.
- Use safety cover and other safety supplies because the spare parts or the inserts can be pulled out due to centrifugal force while high speed machining.



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