

# QUALITY PERFORMS.



**Solutions** for high performing  
Metalworking Fluids

**X** Additin® **X** Calcinate™

**QUALITY WORKS.**

**LANXESS**  
Energizing Chemistry

# SOLUTIONS FOR CHALLENGING APPLICATIONS

## ADDITIVES FOR THE LUBRICANT INDUSTRY. SOLUTIONS FOR HIGH PERFORMANCE

Under the brand names Additin® and Calcinate™ the LANXESS Lubricant Additives business unit offers high-performing additives for all kind of metalworking applications. LANXESS additives for metalworking fluids are perfectly suited to meet current challenges and trends like the replacement of chlorinated paraffins, the shrinking availability of group I base oils or the change of manufacturing processes, caused e.g. by the fast growing demand for electric vehicles.

## SUSTAINABILITY FOR A GOOD ECOLOGY AND ECONOMY

In recent years, LANXESS has developed new additives used to manufacture environmentally acceptable lubricants that can be certified to the new European Ecolabel (EEL). Some additives are even based on renewable raw materials.

## QUALITY WITHOUT COMPROMISE

One of LANXESS primary goals is the ongoing improvement of our high quality level. Activities in this context are geared to our ISO 9001 and ISO 14001 certifications, which serve as an incentive to continuously improve our production processes.

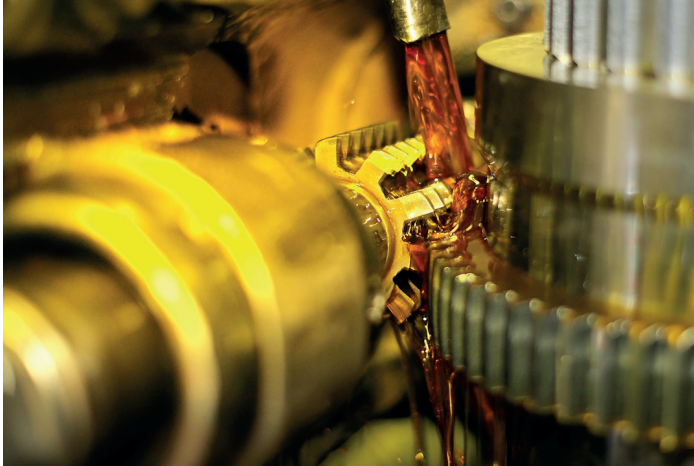
## FOCUSING ON CHALLENGES

Thanks to a worldwide distribution system, additives as well as excellent technical expertise are available practically everywhere around the world. We are a leading solution provider for industrial lubricant applications worldwide.

	Product description	Chemical description	Characteristics	Applications
<b>Additin® EP</b>	Extreme-pressure additives (light and dark, active and in-active sulfur carriers)	Sulfurized compounds like fatty oils, fatty acids and/or olefins, esters	Improves extreme- pressure characteristics (load-carrying capacity) and protection against wear	Metalworking fluids, transmission and slide-way oils, greases
<b>Additin® SP</b>	Specialties	Ester, N-containing heterocycles: Triazole and thiadiazole derivatives	Improves lubricity, antiwear effect and load-carrying properties and acts as deactivator for non-ferrous metals	Hydraulic, transmission, turbine, compressor, engine and special oils, greases, metalworking fluids
<b>Calcinate™</b>	Synergistic Extreme pressure additives and corrosion inhibitors for ferrous metals	Overbased calcium sulfonates	Acts as a synergistic extreme-pressure booster in combination with selected Additin® EP products and improves the anti-corrosion properties	Metalworking fluids, transmission and slide-way oils, greases

# EXTREME-PRESSURE ADDITIVES

## MORE THAN JUST OIL-SOLUBLE SULFUR



### Applications

Products in the Additin® Extreme-Pressure (EP) range are generally used as a backbone in the formulation of modern neat oil and water-based metalworking fluids as well as greases, transmission and slideway oils. LANXESS provides the right solution for any application and offers competent assistance for selecting the most suitable alternatives.

### Mode of action:

#### Reduced cutting force and lower friction

Additin® EP products chemically react with the metal surface to form a protective sulfur-containing film. This reduces direct metal-to-metal contact, thereby reducing friction as well as adhesive wear, caused by cold welding.

This product group was specially developed to meet the latest requirements of the lubricant oil industry and offers precisely the characteristics required in high-performance environments:

- Low-odor, light-colored additives with good solubility in most base fluids
- Multifunctional performance due to efficient friction reduction and galling protection
- Less harmful to environment and humans compared to existing chlorine based technology



## Additin® EP / light-color, low-odor sulfur carriers

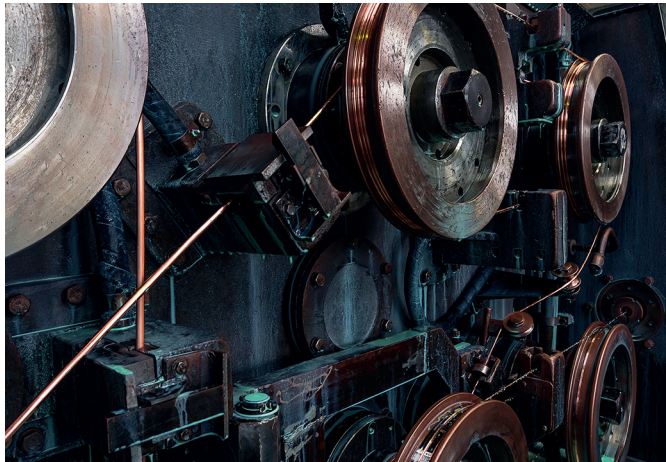
Additin®	Chemical basis	Total sulfur	Active sulfur	Viscosity 40 °C	Color	Cu-Corr. 3h/100 °C	Main applications				
							Metalworking fluids	Industrial gear oils	Greases	Slideway oils	Water-miscible
		approx. %	ASTM-D 1662 approx. %	ASTM-D 445 approx. mm <sup>2</sup> /s	ASTM-D 1500 typical	ASTM-D 130 typical	Oils Cutting	Forming	Water-miscible		
<b>Based on esters</b>											
RC 2310	Fatty acid ester	11	1	30	3,5	1b	■				■
RC 2315	Fatty acid ester	15	4	45	3,5	1b	■				■
RC 2317	Fatty acid ester	17	8	55	4,5	3a-3b	■	■			■
<b>Based on triglycerides</b>											
RC 2410	Triglyceride	10	1	350	3,5	1b	■	■			■
RC 2411	Triglyceride	9,5	< 1	230	3	1b	■	■			■
RC 2415	Triglyceride	15	5	300	4	3a-3b	■	■	■		
RC 2416	Triglyceride	15	5	230	5,5	1b-3a	■	■	■		
RC 2418	Triglyceride	18	9	220	4,5	3b-4c	■	■	■		
<b>Based on olefins</b>											
RC 2515	Fatty acid ester / Olefin	15	4	640	4	1b	■	■		■	■
RC 2516	Fatty acid ester / Olefin	15	4	650	4	1b	■	■		■	■
RC 2526	Fatty acid ester / Olefin	26	15	750	4,5	3a-4b	■	■	■		
RC 2540	Dialkylpentasulfide	40	36	45	2,5	3b-4b	■	■	■		■
RC 2541	Dialkylpentasulfide	40	35	45	2,5	1b	■	■			■
RC 2542	Dialkylpentasulfide	40	35	45	3	1b	■	■			■
RC 2547	Sulfurized isobutene	47	20	3,4	1,5	1b-2a				■	■

## Additin® EP / dark-color sulfur carriers

Additin®	Chemical basis	Total sulfur	Active sulfur	Viscosity 40 °C	Color	Cu-Corr. 3h/100 °C	Main applications				
							Metalworking fluids	Industrial gear oils	Greases	Slideway oils	Water-miscible
		approx. %	ASTM-D 1662 approx. %	ASTM-D 445 approx. mm <sup>2</sup> /s	ASTM-D 1500 typical	ASTM-D 130 typical	Oils Cutting	Forming	Water-miscible		
RC 2811 (M 28.001)	Triglyceride	11	1	1400	D8	1b	■	■	■		■

# SPECIALTIES

## SOLUTIONS FOR PARTICULAR REQUIREMENTS



### Synthetic esters and polymers

These additives are based on selected raw materials to optimize affinity to different metal surfaces, such as stainless steel (e.g. Additin® RC 8100) or aluminum (e.g. Additin® RC 8103).

### EP additives and non-ferrous metal deactivators

Non-ferrous metal deactivators with special EP properties (e.g. Additin® RC 8210) play an important role in reducing corrosion and aging. These additives act as synergists to primary and secondary antioxidants.

### Additin® SP / synthetic esters and polymers

Additin®	Chemical basis	Density	Viscosity	Mineral oil content	Main applications					
		20 °C	40 °C		Metalworking oils/fluids	Power transmission oils	Industrial gear oils	Greases	Other	
		ASTM-D 941 approx. kg/m <sup>3</sup>	ASTM-D 445 approx. mm <sup>2</sup> /s	approx. %						
RC 8000	Sulfur-linked polymer	990	highly viscous	0	■				■	
RC 8012	Sulfur-containing semi-synthetic ester	950	60	0	■	■	■		■	Offshore lubricants
RC 8100	Polycarboxylate	1000	3000	0	■				■	Slideway oils
RC 8103	Trimethylpropane ester of special fatty acids	940	85	0	■				■	Slideway oils

### Additin® SP / extreme-pressure additives and non-ferrous metal deactivators

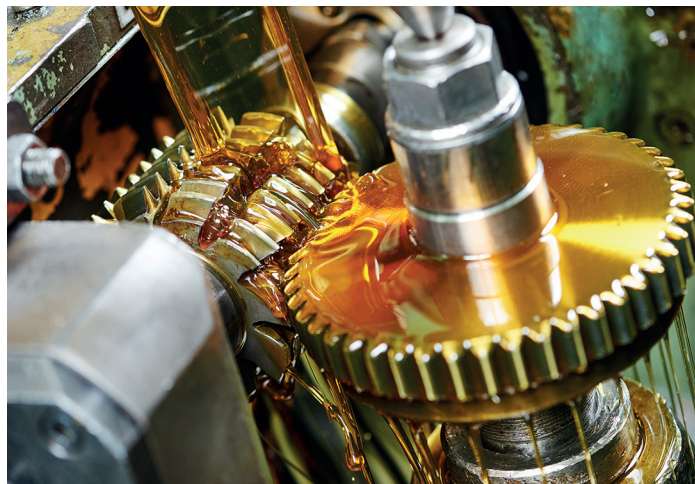
Additin®	Chemical basis	Density	Bulk density	Sulfur content	Mineral oil content	Main applications					
		20 °C				Metalworking oils/fluids	Power transmission oils	Industrial gear oils	Automotive gear oils	Greases	Other
		ASTM-D 941 approx. kg/m <sup>3</sup>	approx. kg/m <sup>3</sup>	approx. %	approx. %						
RC 8210	Dimercapto thia-diazole derivative	1070	-	30	0	■	■	■	■	■	
RC 8213	Dimercapto thia-diazole derivative	1080	-	36	0	■	■	■	■	■	
RC 8239	Tolyltriazole derivative	950	-	0	0	■	■	■	■	■	Fuels



# CALCINATE™ OVERBASED CALCIUM SULFONATE CORROSION INHIBITORS AND EXTREME PRESSURE ADDITIVES

## Rust inhibitors and EP-synergists

Our complete line of Calcinate™ overbased calcium sulfonates are used for both corrosion inhibition on ferrous metals and EP performance in industrial and metalworking lubricant applications. These products can be used on a variety of metals. They may find use in metal working fluids, industrial oils and grease. Overbased detergents can also be effectively used to prevent wear and provide EP performance to lubricants, particularly in synergistic combinations with sulfurized olefins like Additin® RC 2540. Typically products containing amorphous calcium carbonate are used for applications where oil clarity is critical, while products containing the crystalline form of calcium carbonate are used when additional EP performance is required.



Property	Method	Calcinate™						
		NC	C300CS	C300R	OTS	OR	C-400CLR	C-400W
Carbonate form			Crystalline	Amor-phous	Amor-phous	Amorphous	Amorphous	Crystalline
Average micelle size, nm		0.5–10	40–80	10–30	10–30	10–30	10–30	100–200
Calcium, wt%	ASTM D4951	2.7	10.5	12.0	12.0	15.2	15.2	14.5
Ca sulfonate, wt%	ASTM D3712	44.5	18.5	28	28.3	18.5	18.5	17.6
TBN, mg KOH/g	ASTM D2896	30	285	305	305	405	405	385
Viscosity @ 100°C, cSt	ASTM D445	55	100	75	75	75	75	–
Viscosity @ 25°C, cPs	–	–	–	–	–	–	–	40,000
Sp. gravity @ 15°C	ASTM D4052	0.96	1.10	1.13	1.13	1.20	1.20	1.15
Color (dilute)	ASTM D1500	5	5	5	5	5	5	5
Free alkalinity, mg KOH/g		–	20	21	30	10	1	–
Copper strip corrosion	ASTM D130	1b	1b	1b	1b	1b	1b	1b
Rust	ASTM D665A	Pass	Pass	Pass	Pass	Pass	Pass	Pass
4-Ball Wear*	ASTM D4172	0.63	0.35	0.33	0.31	0.31	0.32	0.36
4-Ball EP*, weld	ASTM D2783	160	200	200	200	200	250	250
Pin and Vee-Block*, lb.	ASTM D3233A	977	2353	1315	1963	1618	1686	4500

\* 10% in 100 SUS naphthenic oil

# ADDITIVES FOR METALWORKING FLUIDS IN ELECTRIC VEHICLE PRODUCTION

Additive	Deep drawing	Stamping/ Fine Blanking	Cold impact extrusion	Cu- and Al- Wire Drawing	Fin Stamping	Grinding	Honing	Broaching
<b>Polar, Friction Reducing Additives</b>								
Additin® RC 2416	■		■					
Additin® RC 2515	■		■					■
Additin® RC 2516	■	■	■	■		■		
Additin® RC 5001				■		■		
Additin® RC 5010		■		■	■	■	■	
Additin® RC 8103		■	■	■	■			■
Additin® RC 8100								
<b>Highly Reactive EP Additives</b>								
Additin® RC 2317						■	■	
Additin® RC 2418						■	■	■
Additin® RC 2526	■	■	■					■
Additin® RC 2540	■	■				■	■	■
Additin® RC 5201/5202						■		
Additin® RC 5250						■		
<b>Yellow Metal Inhibitor</b>								
Additin® RC 5800				■				
Additin® RC 8239	■	■	■	■	■	■	■	■
<b>EP-Additive and Yellow Metal Inhibitor</b>								
Additin® RC 8213							■	
<b>Overbased Ca-Sulfonates</b>								
Calcinate™ OR	■	■				■		■
Calcinate™ C-300 CS	■	■	■					
Calcinate™ C-400W			■					
<b>Anti-wear Additives</b>								
Additin® RC 3038	■	■						
Additin® RC 3080			■					■
Additin® RC 3740		■					■	
Additin® RC 3760						■	■	
Additin® RC 3880	■							
Additin® RC 3890	■	■	■			■		■
<b>Additive Packages</b>								
Additin® RC 9410						■		
Additin® RC 9720	■	■	■					■
<b>Antioxidant</b>								
Additin® RC 7120	■	■	■		■	■		■

Data provided in the table above is characteristic of the product grade, and does not constitute a specification. Further information is given in technical and material safety data sheets for individual Additin® and Calcinate™ products. Samples, supplementary data, formulating advice and papers/presentations giving further details of our additive chemistry can be supplied on request.

# SULFUR CARRIERS

## PROPERTIES AND ADVANTAGES IN METALWORKING APPLICATIONS

### Sulfur Carriers

Sulfur carriers are sulfur containing organic compounds, made from olefins, natural oils or synthetic esters. They contain 1 to 5 sulfur atoms, forming a kind of bridge between the olefin and ester parts.

Sulfur carriers work perfectly as EP-additives in metalworking applications by forming protective layers of metal sulfide which prevent galling and cold welding under high mechanical or thermal stress. Polar centers from the ester or triglyceride part increase their ability to adsorb on metal surfaces and to form friction reducing layers already at low machining temperatures.

Sulfur carriers are not labelled as hazardous components. Some of them are partially made from renewable raw materials and/or suitable formulation components in EU Ecolabel and US VGP compliant formulations.

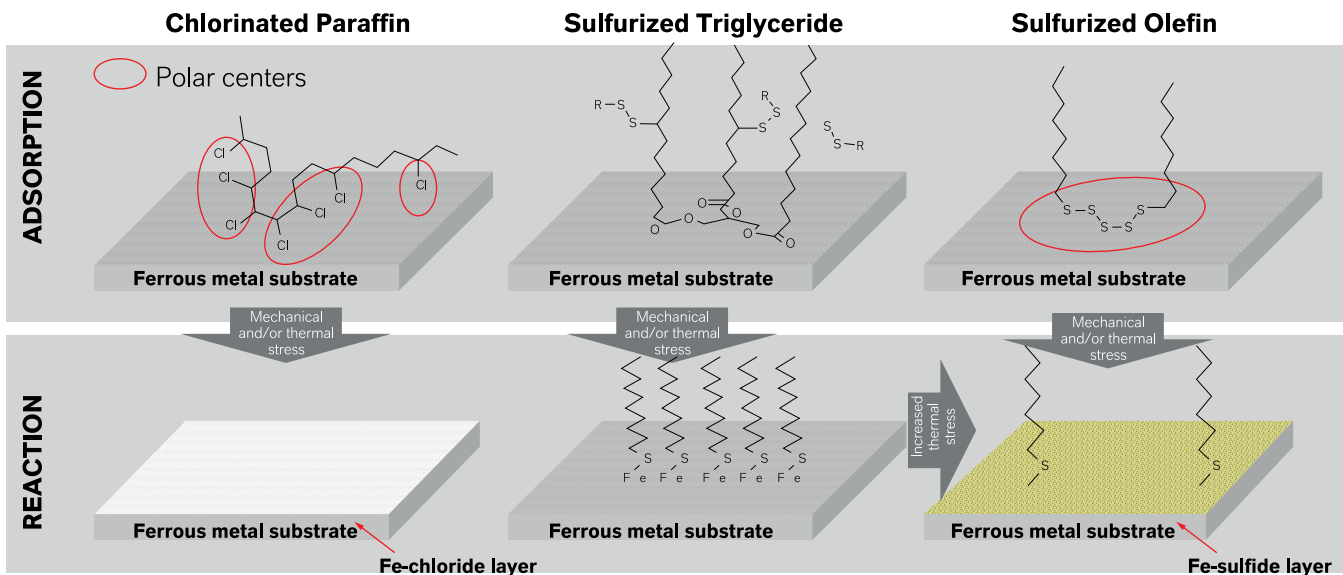
**LANXESS developed its first light colored sulfurized ester Additin® RC 2317 in 1957. Most sulfur carriers at that time were dark in color, with a strong odor and limited stability.**

### Chlorinated paraffins

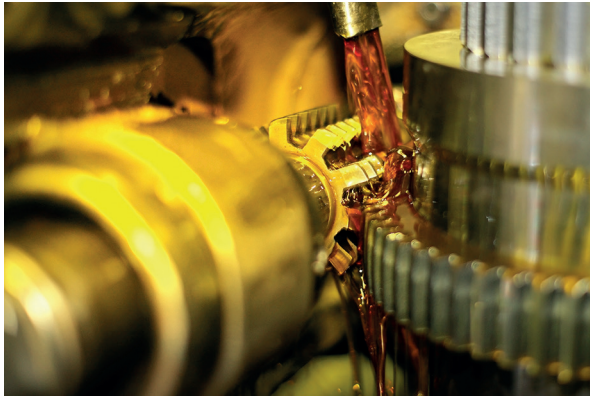
Chlorinated paraffins are another group of EP-additives which are still used in some metalworking processes. They can effectively prevent cold welding at low machining speeds. At higher machining speeds that also entail higher temperatures on tools and workpieces, they tend to decompose and form hydrogen chloride which causes severe tool wear. In presence of water or moisture, chlorinated paraffins hydrolyze and form hydrochloric acid which corrodes tools, workpieces and the entire machine tool.

Short chain chlorinated paraffins are already banned in many countries because they are persistent and bioaccumulative and suspected of causing cancer. There are also intentions to ban or restrict the use of medium chain chlorinated paraffins by the European Union and the United Nations Environment Program.

Formation of Adsorption and Reaction Layers by EP-Additives





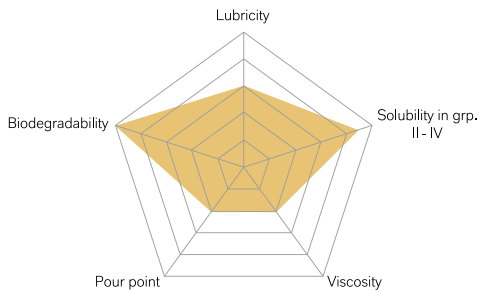


## Sulfur Carrier Properties

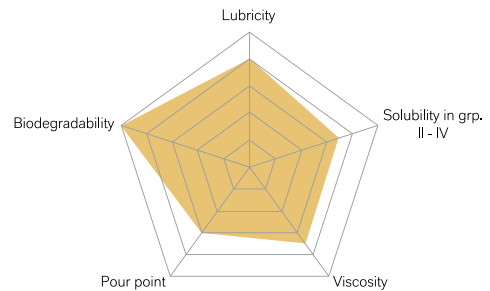
Compared to chlorinated paraffins, Additin® RC 2xxx sulfur carriers are extremely versatile and are ideal for reducing friction and preventing adhesive and abrasive wear in boundary lubrication. They provide outstanding efficiency over a broad temperature range from slow to high speed machining processes. Even more, their performance can be further increased by using synergistic combinations with overbased sulfonates, polycarboxylates and other polar compounds. The choice of sulfur carriers can be adapted to the specific requirements of different metalworking processes by varying properties like total sulfur content, active to inactive sulfur ratio, lubricity, polarity, solubility in different base oils, corrosion to copper and yellow metals and others.

### Raw material related properties of Additin® RC sulfur carriers.

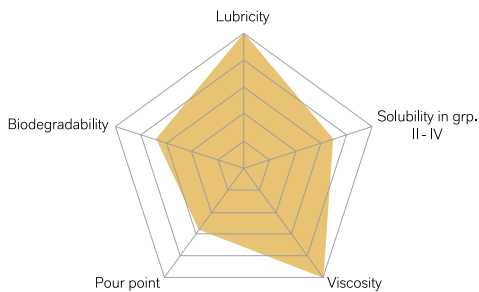
#### Sulfurized Ester



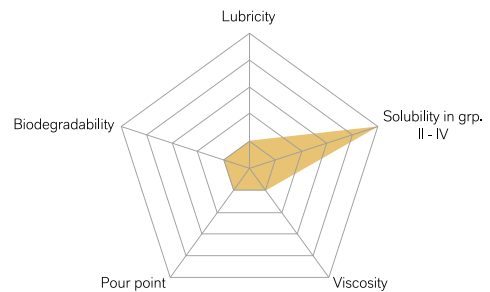
#### Sulfurized Triglyceride



#### Sulfurized Triglyceride/Olefin

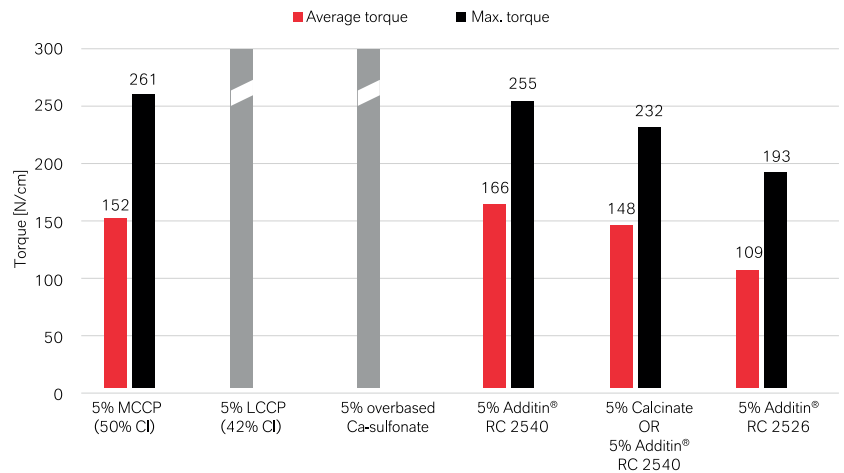


#### Sulfurized Olefin



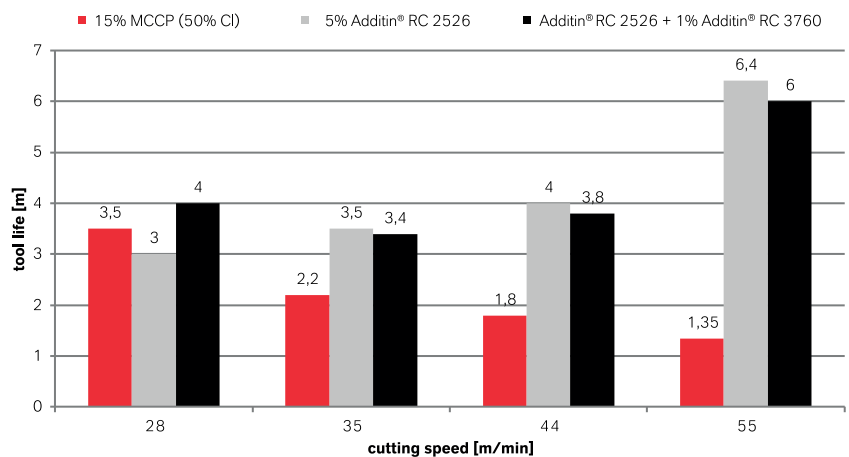
## Thread cutting in stainless steel, test results

Some laboratory tests and field tests demonstrate the advantage of using sulfur carriers in metal-working fluids: When thread cutting stainless steel, the performance advantages of sulfur carriers as single additives or in synergistic combination with an overbased calcium sulfonate, are clearly visible. With 5% medium chain chlorinated paraffin (MCCP), diluted in group I ISO VG 46 mineral oil, the recorded average torque was 152 N/cm and the maximum torque was 261 N/cm. Tests with 5% long chain chlorinated paraffin or 5% overbased calcium sulfonate failed because the tapping tool broke in each attempt. When running the tapping torque test with a cutting oil containing 5% of active sulfurized olefin Additin® RC 2540, the average torque was slightly higher and the maximum torque was slightly lower than with the MCCP. The synergistic combination of the overbased calcium sulfonate Calcinat<sup>TM</sup> OR and Additin® RC 2540 led to a further reduction of average and maximum torque whilst the lowest torques were achieved with 5% Additin® RC 2526 which is a special sulfurized mixture of triglycerides and olefins, offering high polarity and high sulfur activity.



## Milling oil test results, cutting speed vs. tool life

A field test on a milling machine again highlights the deficiencies of chlorinated paraffins. A milling oil containing 15% MCCP showed significantly reduced tool life with increasing machining speed: The tool life declined from 3.5 meters cutting path at a cutting speed of 28 meter per minute to only 1.18 meters at 55 meters per minute cutting speed. The chlorinated paraffin containing cutting oil was significantly outperformed by only 5% of the special sulfurized EP additive Additin® RC 2526. At 28 m/min cutting speed, 1% antiwear additive Additin® RC 3760 were added to exceed the performance of the MCCP containing cutting oil. At higher cutting speeds, Additin® RC 2526 becomes very efficient and clearly outperforms the chlorinated paraffin, even without the addition of other additives.

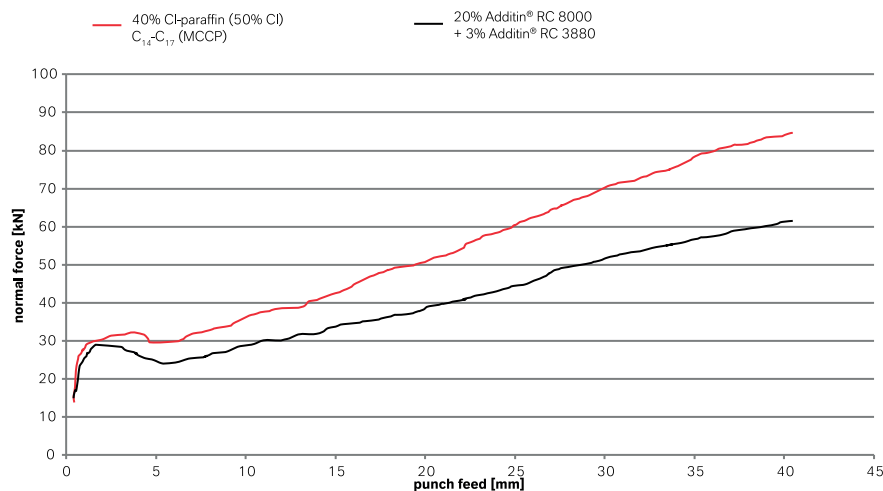
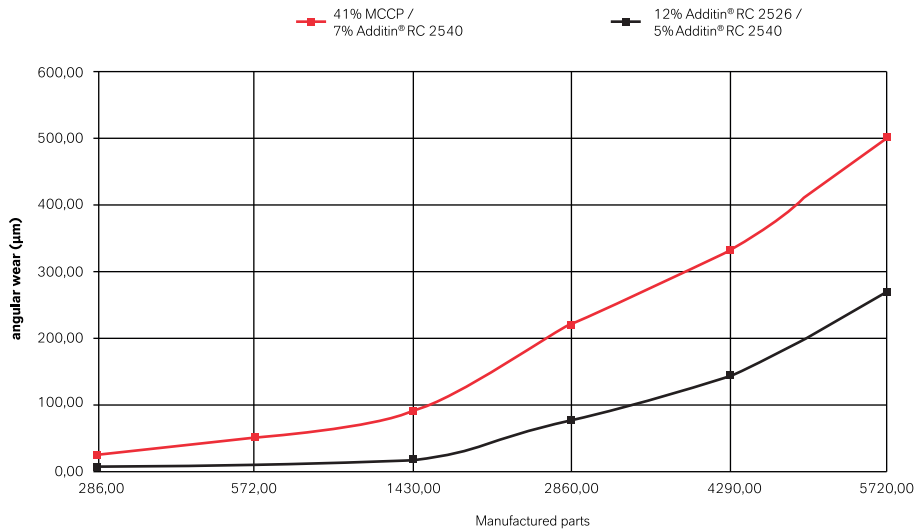


## Propagation of angular wear of TiN coated broaching tools

When broaching high alloyed steel work pieces by using TiN coated tools, a broaching oil containing a combination of chlorinated paraffin and sulfurized olefin showed increasing angular wear after manufacturing some hundred parts, The increasing wear was also caused by the decomposition of CLP, followed by corrosion of the TiN coating of the broaching tool. The performance of the CLP containing formulation was outperformed by a synergistic combination of LANXESS sulfur carriers: A reduction of the tool wear by 50% was possible with a broaching oil containing Additin® RC 2540 and Additin® RC 2526.

## Press-In test results

The high surface pressures of stamping and fine blanking processes require EP additives that effectively prevent adhesive wear. Both can be achieved e.g. by using Additin® RC 8000, a polymeric sulfur carrier which is able to form pressure stable, friction reducing protective layers. In a "Press-In test" which is used to simulate the fine blanking process it was possible to reduce adhesion and friction force by 30% with a combination of Additin® RC 8000 and the polar AW additive Additin® RC 3880 compared to a forming oil containing 40% of chlorinated paraffin.



## Sulfur carriers outperform chlorinated paraffins in many aspects:

- Excellent performance even at high machining speeds which can be further improved by synergistic combinations with other additives
- Different molecular structures make them easily adaptable to multiple applications
- No increase of tool wear at high machining speeds and temperatures
- LANXESS has considerable technical expertise and offers consulting to help guide you in developing CLP replacement formulations with superior performance characteristics



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Unless specified to the contrary, the values given have been established on standardized test specimens. The figures should be regarded as guide values only and not as binding minimum values. Kindly note that the results refer exclusively to the specimens tested. Under certain conditions, the test results established can be affected to a considerable extent by the processing conditions and manufacturing process.

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