

# **DURALLOY**<sup>®</sup>

## *Tribological Systems*



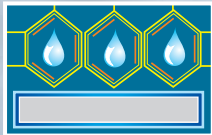
*High wear resistance*



*High surface hardness*



*Reduction of friction coefficients*



*Improved corrosion resistance*



*Adjustable tribological properties*



*High abrasion resistance*

**DURALLOY**<sup>®</sup>



## Functional surface treatments

for steel, stainless steel, grey cast iron, bronze and sintered metals

### What is DURALLOY®?

DURALLOY® is a special thin dense chromium coating in the range of 1.5 to 20 µm layer thickness. The specific structured surface of the DURALLOY® layer provides outstanding chemical resistance and material hardness for applications where conventional coating systems with comparable layer

thicknesses are ineffective. Due to its specific properties, in high friction applications the structured surface of the DURALLOY® layer significantly increases the wear and corrosion resistance of the coated material.

### What are the effects of DURALLOY®?

DURALLOY® is an extremely hard, crack-free, precise, very thin and ultrapure metallic chromium layer. By means of a high-energy process a nodular structured surface can be deposited on all types of metals, except for Magnesium and Titanium. Applications for Aluminium components are limited (please contact us for details). Due to the low process temperature of under 70 °C no changes to

the structure of the base material occur during plating, this essential advantage of the process ensures shape and hardness stability for any manufactured components. DURALLOY® provides effective protection against friction and vibration corrosion and thus increases considerably the wear resistance of the material when used, for example, in gears or with shaft-hub-joints.

### Suitable materials

The range of the materials that can be coated with DURALLOY® includes most of the widely used engineering metals: steels up to 62HRC and with a chromium content of 15 %, stainless steels,

grey cast iron, sintered metals and bronze. For surface treatment of each of the particular base materials specific DURALLOY® processes are available.

*(All technical values published in this brochure are subject to the test conditions specified. We therefore emphasise that the applications and operating conditions, along with the end*

*user's practical experience, will ultimately determine the level of performance achieved by the coating and/or coating system.)*

# D U R

## Comparison DURALLOY® / Hard Chromium

Characteristics	DURALLOY®	Hard Chromium
Layer thickness	1.5–20 µm	3–1,000 µm
Hardness	800–1,300 HV	850–1,050 HV
Structure	Uniform nodular structure	Variable cracked structure
Tribological characteristics	++	0
Fretting corrosion	++	0
Vibration corrosion	++	–
Corrosion resistance	2.5 µm: 96 h	25 µm: 96 h
Dynamic load	3.5 MPa	Undefined

*In comparison with the Hard Chromium process DURALLOY® has significant advantages*

## Fields of use



Picture: ©Astoria-Fotolia.com

- automotive sector
- industrial gears
- machine tools
- textile machines
- printing industry
- hydraulics

- medical technology
- bearing technology
- aerospace
- defence technology
- decorative applications
- offshore applications



Picture: ©Akio Koizumi-Fotolia.com



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Cover picture: ©Victor Spanner-Fotolia.com

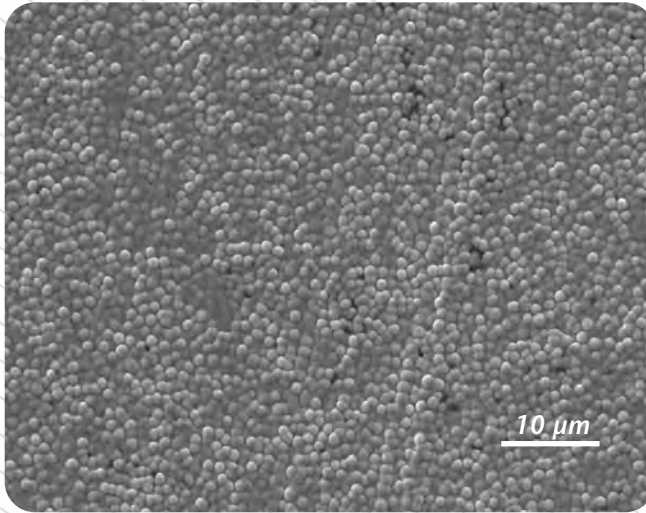
# ALLLOY®



## Functional surface treatments for steel, stainless steel, grey cast iron, bronze and sintered metals

### Characteristics of DURALLOY® TDC

An illustration of the nodular structure



- wear protection
- corrosion protection
- hardness
- effective lubricant reservoir
- dry-running characteristics
- damping features
- protection against vibration corrosion
- non-magnetic, not magnetisable
- outstanding adhesion

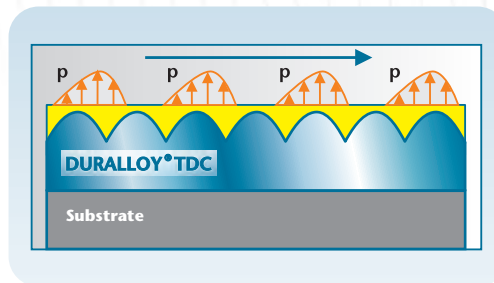
Micrograph of the DURALLOY® surface – a nodular structure like the skin of the gecko

Picture-Gecko: ©hans-petermoehling-Fotolia.com  
Picture leaf: ©nt-Fotolia.com

### DURALLOY® – effective with starved lubrication

The special structure of the DURALLOY® surface forms a converging gap geometry and enables the creation of pockets of lubricant. The specific gap geometry of the DURALLOY® surface will generate

a build-up of the oil pressure when needed. The lubricant pockets also form an oil reservoir for extreme conditions as for example where there is starved lubrication.

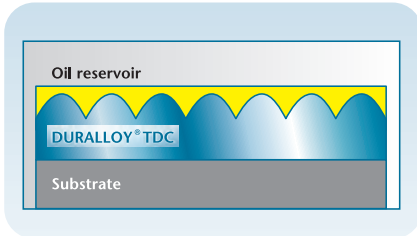


schematic diagram

# D U R

## DURALLOY®-process: Structured Chromium and Duplex Coatings

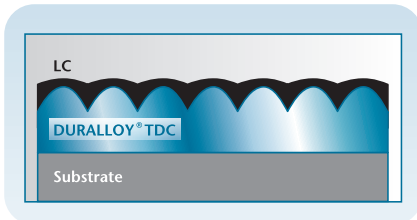
### Structured Chromium



Among the various DURALLOY® processes two key concepts can be recognised: the Structured Chromium layer features and the potential for layer combinations – Duplex coatings. Both concepts ensure a uniform nodular structure with random orientation.

Additional layers (Duplex coatings) can be applied either to improve the dry-running properties or to satisfy other specific requirements.

### Duplex Coatings



Continuous and homogeneous transitions in the microstructure, without any sharp edges, enables oil to be retained in the surface.

## DURALLOY® technical data at a glance

DURALLOY®	TDC (Thin Dense Chrome)	TDC-Multilayer	TDC-LC	TDC-Ag (Silver)
Structured Chromium (S)				
Duplex (D) Coatings	S	S	D	D
Composition	Cr	Cr+Cr	Cr/LC	Cr/Ag
Layer thickness [µm]	2.5–4 (max. 20)	10–20	3–5	3–5
Nodular structure	Yes	Yes	Yes	Yes
Hardness [HV]	800–1,300	800–1,300	800 (TDC)/200 (LC)	800/40 (Ag)
Process temperature [°C]	<70	<70	<70	<70
Application temperature [°C]	<350	<350	<350	<100
Corrosion resistance [h] according to DIN EN ISO 9227	96	500	300	<48
Chemical resistance	++	+++	+++	+



Production integrated  
DURALLOY® coating plant



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## Process Variants

### DURALLOY® – Structured chromium

#### DURALLOY® TDC

**Layer material:**  
Chromium (DURALLOY® TDC)

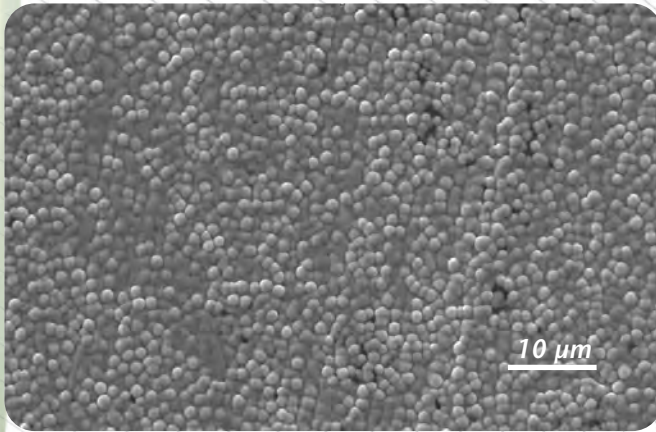
**Layer thickness:**  
2.5–4 µm (max. 20 µm)

**Hardness:**  
800–1,300 HV

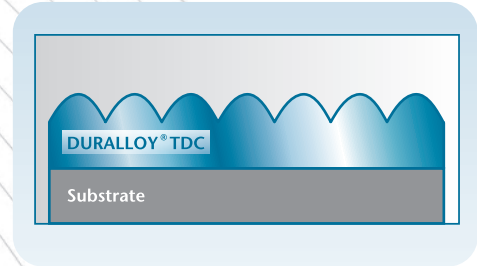
**Process temperature:**  
<70 °C

**Application temperature:**  
<350 °C

**Corrosion resistance  
(according to DIN EN ISO 9227):**  
96 h



*Applicable in cases of load by friction and vibration corrosion and by wear*



#### DURALLOY® TDC-Multilayer

**Layer material:**  
Chromium (DURALLOY® TDC)  
+ Chromium (DURALLOY® TDC) +...

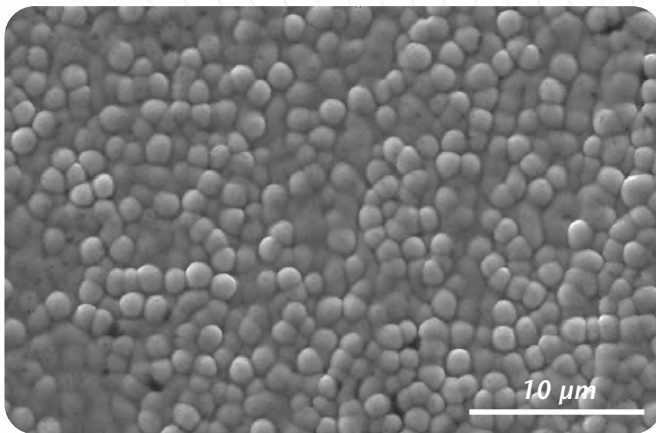
**Layer thickness:**  
10–20 µm

**Hardness:**  
800–1,300 HV

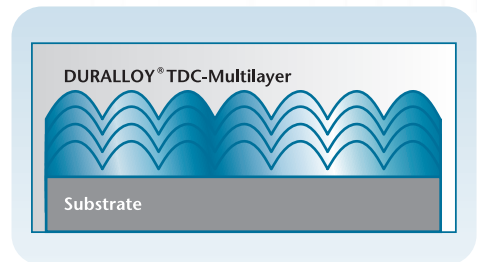
**Process temperature:**  
<70 °C

**Application temperature:**  
<350 °C

**Corrosion resistance  
(according to DIN EN ISO 9227):**  
500 h



*Applicable in cases of high corrosive load (offshore area, construction machines on ships..)*



# D U R

## Process Variants

DURALLOY® – Duplex (layer combinations)



### DURALLOY® TDC-LC

**Layer material:**

Chromium (DURALLOY® TDC) + LC

**Layer thickness:**

3–5 µm

**Hardness:**

800 HV (TDC)/200 HV (LC)

**Process temperature:**

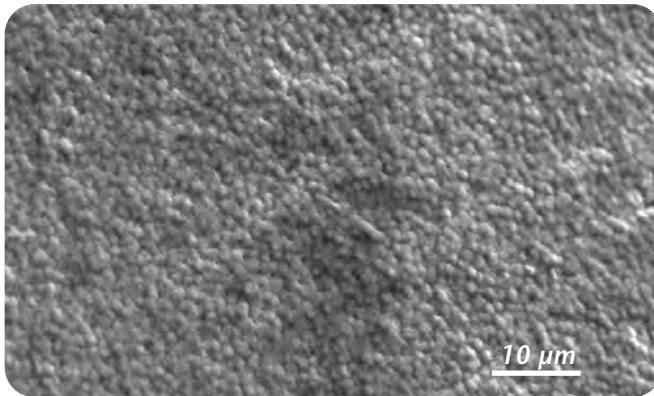
<70 °C

**Application temperature:**

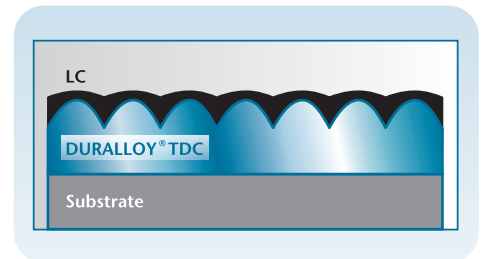
<350 °C

**Corrosion resistance**

(according to DIN EN ISO 9227):  
300 h



Applicable in cases of pressure load (linear guides, ball bearings) or exposure to aggressive gases (roller mills, metallurgy, defense technology)



### DURALLOY® TDC-Ag

**Layer material:**

Chromium (DURALLOY® TDC)  
+ Silver

**Layer thickness:**

3–5 µm

**Hardness:**

800/40 (Ag) HV

**Process temperature:**

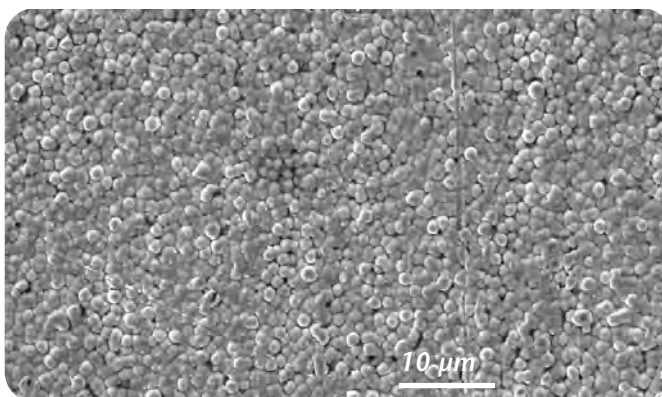
<70 °C

**Application temperature:**

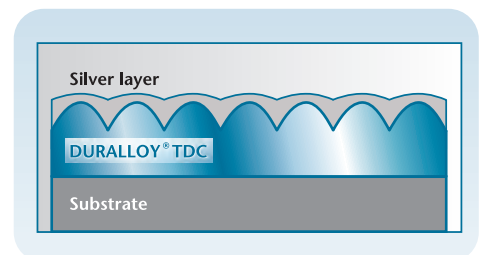
<100 °C

**Corrosion resistance**

(according to DIN EN ISO 9227):  
<48 h



Applicable in cases of load by starved lubrication, dry lubrication (e.g. vacuum technology)

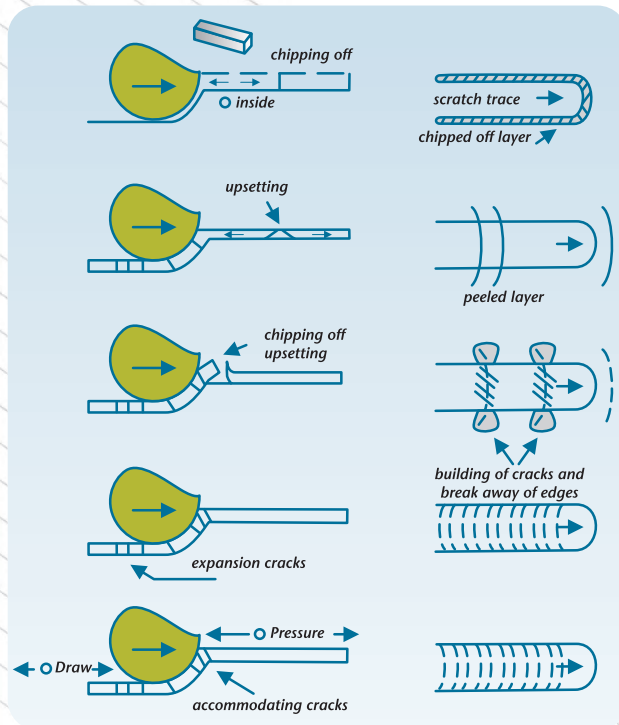


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# Characteristics

## DURALLOY®

### DURALLOY®-Scratchtest



A scratch test examines the behaviour of thin coatings under mechanical load, e.g. adhesion, cracking and chipping areas, deformation. The coating-substrate



system can then be assessed and evaluated with parameters like friction force and adhesion strength. The

DURALLOY® layer shows no irregular break away of edges during the scratch test but has straight cut edges demonstrating exceptional levels of adhesion.



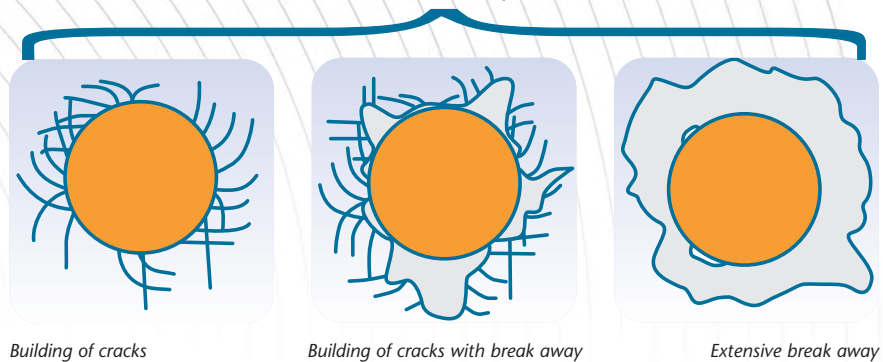
DURALLOY® TDC  
Layer thickness: 2.5µm



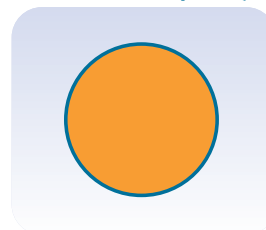
DURALLOY® TDC  
Layer thickness: 20µm

### DURALLOY®-ball impression test

#### Alternative layers



#### DURALLOY® quality



Schematic illustration of the determination of the adhesion of coatings on tool-steel or high-speed steel (Basic hardness at least 54 HRC, layer thickness max. 5µm. Evaluation: HRC impression, hundred fold magnification)

# D U R



## DURALLOY® applications

DURALLOY® coatings are specified for the following reasons:

- corrosion protection
- moving surfaces tribology
- low friction
- lubrication
- protection against friction and vibration corrosion
- wear protection
- high temperature performance

## DURALLOY® applications friction and wear situations

### Friction and vibration corrosion

- relative speed = 0
- power or torque transmission
- shaft-hub-joints, bearing seats, etc.

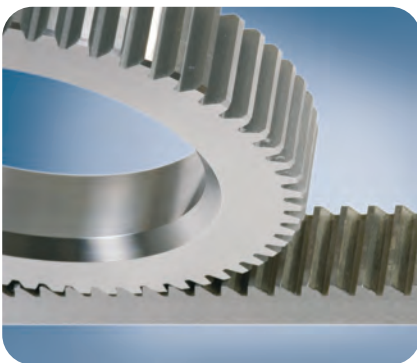
### Improvement of wear resistance with variable friction

- relative speed > 0, variable friction
- power transmission with limited lubrication
- slowly rotating bush and roller bearings, eccentric shafts, control gears, etc.

### Start-up and braking

- relative speed >> 0, hydrodynamic area
- variable power transmission with limited lubrication
- bush and roller bearings, gears, etc.

## DURALLOY® control gears for printing machines

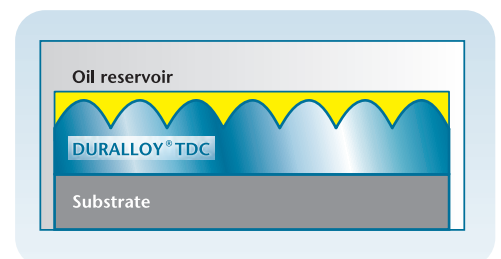


Picture: ©Ramona Heim-Fotolia.com

Control gears for sheet-fed printing machines have to meet high demands in terms of precision, longevity and maintenance-free, running.

Due to the DURALLOY® TDC coating on both, the driving toothed wheel as well as the driven gear the running life could be extended

by three times. In this application DURALLOY® TDC fulfils a double function – the higher hardness (about 1,000 HV) improves wear resistance and the DURALLOY® surface structure maintains an extensive lubricant reservoir on the surface.



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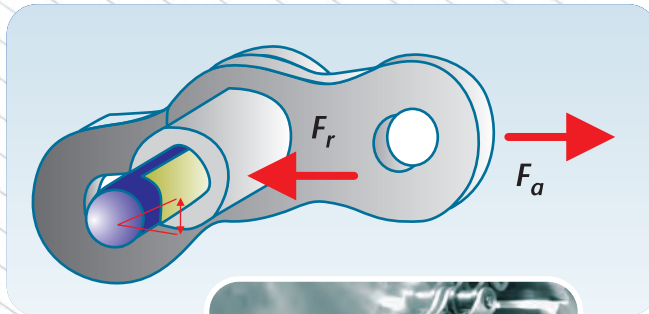
## Applications

### DURALLOY®

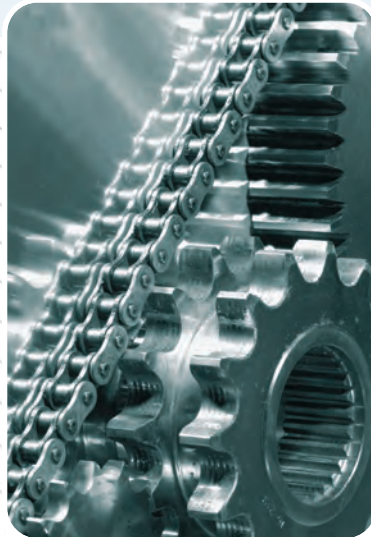
#### DURALLOY® chain pins for timing and conveyor chains

Chains are used to transmit forces and movements (timing chains) or to convey parts through the production process (conveyor chains). In both cases the dimensional stabil-

ity of the chain is the key to long-term operability. The dimensioned stability is mainly influenced by the wear processes on the chain pins, resulting in an increase in the length of the chain during use.

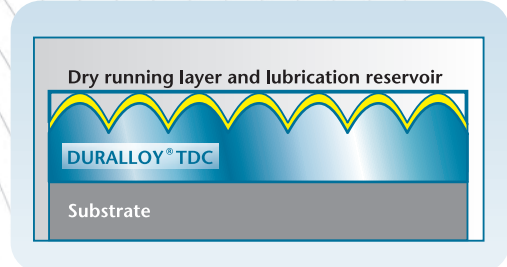


The main cause is the low relative speed between the chain pin and bush and the resulting poor lubrication situation.



Picture: ©christian42-Fotolia.com

Duralloy® coating on the pins increases wear resistance and improves the low speed lubrication, extending the life of the chain.



#### Aerospace: flight bearings

A multitude of flight bearings are nowadays coated with DURALLOY® in order to withstand the extreme conditions air traffic is exposed to in various climate zones around the world. Most of the bearings are coated all over on the bearing seat and also on the raceways. As well as good corrosion protection DURALLOY® offers protection against friction corrosion and also wear resistance of the raceway in the dynamically variable conditions of the rolling parts.



Picture: ©Daniel Ehrhardt-Fotolia.com

# D U R

## Protection against friction and vibration corrosion (e.g. oscillating sieve bearing) —

### Bearing shaft or housing seats

Shaft-hub-joints in dynamically loaded installations, for example in oscillating sieves, experience micro vibrations on mating surfaces due to inherent surface roughness

levels. This leads to corrosive wear in the contact areas and can lead to complete seizure of the shaft-hub-joints or, in the advanced stage, to the failure of the bearing.



Picture: ©Ramona Heim-Fotolia.com



Picture: ©Ramona Heim-Fotolia.com



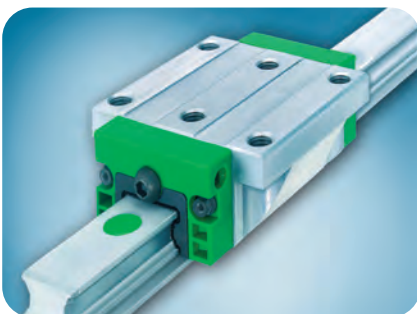
Picture: ©Victor Spanner-Fotolia.com

Disassembly and maintenance will be complicated or even made impossible by the formation of this fretting corrosion. By applying a DURALLOY® thin chromium layer the protection against vibration

corrosion will be improved significantly and with that the function of the bearing will be guaranteed long term. The DURALLOY® surface treatment can be applied on the shaft or on the bearing ring as necessary.

## Linear systems

**DURALLOY® offers protection against most process medias while moving, positioning or holding components during machining or production processes of various natures.**



Linear guide

- Guiding or running accuracy will not be affected by the DURALLOY® coating.
- DURALLOY® coatings have been proved in practice to be fatigue resistant for surface pressures up to 3.0 GPa.

- Wear protection will be improved by the higher hardness.
- Pockets of oil on the surface will improve lubrication in variable friction areas.
- DURALLOY® also provides protection against vibration corrosion.

A L L O Y ®

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