

English Version

## Aerospace series - Molybdenum disulphide dry lubricants - Coating methods

Série aéronautique - Lubrifiants solides à base de bisulfure  
de molybdène - Méthodes d'application

Luft- und Raumfahrt - Trockenschmierstoffe auf  
Molybdändisulfid-Basis - Beschichtungsverfahren

This European Standard was approved by CEN on 10 March 2011.

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## Contents

	Page
Foreword.....	3
1 Scope .....	4
2 Purpose of process .....	4
3 Normative references .....	4
4 Terms and definitions .....	5
5 Apparatus .....	5
5.1 For application by dipping.....	5
5.2 For application by spraying.....	5
5.3 For curing .....	5
6 Information for the processor .....	5
7 Surface roughness of parts prior to application .....	5
8 Surface preparation.....	6
8.1 Parts in titanium and titanium alloys .....	6
8.2 Parts in corrosion resisting steel.....	6
8.3 Parts in steel.....	6
9 Coating.....	6
9.1 Product .....	6
9.2 Generality .....	6
9.3 Application by dipping .....	6
9.4 Application by spraying .....	7
9.5 Other applications .....	7
10 Post-treatment.....	7
11 Removal of the film.....	7
12 Characteristics, requirements and test methods .....	7
13 Quality assurance .....	8
13.1 Approval of the processor .....	8
13.2 Process approval.....	8
14 Acceptance.....	9
14.1 Appearance and thickness .....	9
14.2 Adhesion.....	9
14.3 Heat curing .....	9
15 Re-treatment.....	9

## Foreword

This document (EN 2491:2011) has been prepared by the Aerospace and Defence Industries Association of Europe - Standardization (ASD-STAN).

After enquiries and votes carried out in accordance with the rules of this Association, this Standard has received the approval of the National Associations and the Official Services of the member countries of ASD, prior to its presentation to CEN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by December 2011, and conflicting national standards shall be withdrawn at the latest by December 2011.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 2491:1997.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

## 1 Scope

This European Standard defines the coating methods and characteristics of molybdenum disulphide dry film lubricants which may be applied to parts in titanium, titanium alloys, steel, corrosion resistant steel and nickel based alloys.

## 2 Purpose of process

To reduce wear, risk of seizing and, in some cases, fretting corrosion.

## 3 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 2133, *Aerospace series — Cadmium plating of steels with specified tensile strength  $\leq 1\,450$  MPa, copper, copper alloys and nickel alloys*

EN 2516, *Aerospace series — Passivation of corrosion resisting steels and decontamination of nickel base alloys*

EN 9100, *Quality Management Systems — Requirements for Aviation, Space and Defense Organizations*

EN ISO 1463, *Metallic and oxide coatings — Measurement of coating thickness — Microscopical method*

EN ISO 2431, *Paints and varnishes — Determination of flow time by use of flow cups (ISO 2431:1993, including Technical Corrigendum 1:1994)*

EN ISO 2884 (all parts), *Paints and varnishes — Determination of viscosity using rotary viscometers*

ISO 2859-1, *Sampling procedures for inspection by attributes — Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection*

ISO 8080, *Aerospace — Anodic treatment of titanium and titanium alloys — Sulphuric acid process*

ASTM D 2510:1983, *Standard test method for adhesion of solid film lubricant<sup>1)</sup>*

TR 4070, *Aerospace series — Molybdenum disulphide coatings list of commercial products*

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1) Published by: American Society for Testing and Materials (ASTM), 1916 Race Street, Philadelphia, PA 19103.

## 4 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

### 4.1

#### **batch**

parts subjected to the same dry lubricant application at the same time under the same condition

### 4.2

#### **pre-production parts**

parts representing future production

## 5 Apparatus

### 5.1 For application by dipping

Container with a lid, stirring device and temperature control.

The apparatus shall be capable of applying the specified thickness, for example by controlling the speed of immersion and removal and by draining or centrifuging the parts.

### 5.2 For application by spraying

A dry, oil free air fed gun shall be used, with settings adapted to the characteristics of the dry lubricant used and to the shape of the parts to be coated.

Preferably a mechanical stirring device in the reservoir.

NOTE 1 A device allowing for rotation of the parts to be coated and the automatic displacement of the gun will give a more uniform application.

NOTE 2 Use of an aerosol spray does not always ensure acceptable reproducibility. Moreover, the propellant shall not have any adverse effect on the substrate.

### 5.3 For curing

An oven capable of temperatures prescribed by the lubricant manufacturer.

## 6 Information for the processor

- Designation of the dry lubricant;
- number of the material standard and metallurgical condition of the latter;
- areas to be processed;
- thickness of the dry lubricant, if necessary, (see Table 1);
- duration and temperature of curing.

## 7 Surface roughness of parts prior to application

It shall be specified on the drawing or in the definition documents.

NOTE The surface roughness is an important factor affecting adhesion and behaviour of the film in service.

## **8 Surface preparation**

### **8.1 Parts in titanium and titanium alloys**

Anodising: ISO 8080, unless otherwise specified.

### **8.2 Parts in corrosion resisting steel**

Passivation: EN 2516, unless otherwise specified.

### **8.3 Parts in steel**

Cadmium plating EN 2133, without chromating. If necessary, the cadmium layer may be phosphated in an accelerated zinc phosphate bath to obtain a uniform and insoluble phosphate coating of a mass per unit area between 1 g/m<sup>2</sup> and 1,5 g/m<sup>2</sup> (i.e. a thickness of about 0,002 mm).

NOTE If the part has been de-embrittled, prior activation of the cadmium plating is necessary (i.e. in a potassium cyanide bath 30 g/l to 45 g/l for 15 s to 30 s at ambient temperature).

## **9 Coating**

### **9.1 Product**

TR 4070<sup>2</sup> gives a list of Molybdenum disulphide coatings commercial products.

Product to be applied shall conform to environmental, work safety and public health European regulations.

### **9.2 Generality**

It shall be performed:

- within 24 h, after surface preparation; all precautions shall be taken to prevent contamination or corrosion of the parts awaiting treatment;
- in a clean and dry environment, relative humidity between 40 % and 75 %, temperature (20 ± 5) °C avoiding any operations liable to contaminate the surfaces to be treated.

### **9.3 Application by dipping**

- Adjust the viscosity of the bath (see EN ISO 2431 or EN ISO 2884) to the value given by the manufacturer of the product to be deposited.
- If necessary, pre-heat the parts to about 50 °C.
- Immerse the parts at a speed determined by tests on pre-production parts.
- Keep the parts immersed for 2 s to 10 s.

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2) Published as ASD-STAN Technical report at the date of publication of this standard.

- Remove the parts at a speed determined by tests on pre-production parts.
- Drain parts.
- Dry parts avoiding handling them.
- If necessary, cure the coating in an oven. The temperature and duration shall comply with the values given by the manufacturer of the product to be deposited.

#### **9.4 Application by spraying**

- Adjust the viscosity (see EN ISO 2431 or EN ISO 2884) to the value given by the manufacturer.
- If necessary, pre-heat the parts to approximately 50 °C.
- Produce the coating by applying successive passes, the gun setting and its distance being determined by tests on pre-production parts.
- Dry parts avoiding handling them.
- If necessary, cure the coating in an oven. The temperature and duration shall comply with the values given by the manufacturer of the product to be deposited.

#### **9.5 Other applications**

Other application methods producing the same quality of deposit may be used (e.g. barrel deposition).

### **10 Post-treatment**

If the tolerances of the parts necessitate mechanical finishing, it shall be performed by honing, burnishing, barrel finishing or manual brushing according to the size of parts or the batch size.

### **11 Removal of the film**

The following processes are generally used separately or as a combination:

- removal by dry or wet abrasive blasting with fine grain;
- chemical removal (by pickling or solvents).

Following removal of the film, the parts shall be subjected to a visual and dimensional inspection.

### **12 Characteristics, requirements and test methods**

See Table 1.

Table 1

Characteristic	Requirement <sup>a</sup>	Test method
Appearance	Uniform colour, a variation of this indicates incorrect distribution of the fillers in the film  Absence of defects such as: scratches, pits, blisters, runs, indentations, foreign bodies, accumulation of particles, lack of uniformity or any other surface imperfection	Visual inspection
Thickness	Unless otherwise specified (0,01 ± 0,003) mm After mechanical finishing (0,005 ± 0,002) mm	Suitable method or EN ISO 1463  or with the purchaser's agreement, a method based on measurement of the mass of the dry lubricant deposited  In the case of dispute, EN ISO 1463 shall be applied.
Adhesion	No flaking, blisters, cracks	ASTM D 2510
Heat curing	The film shall not be damaged by a brief contact with a solvent.	For a maximum of 1 min, gently rub with a pad of cotton-wool impregnated with a solvent (e.g. methy-ethyl-ketone).
<sup>a</sup> On parts, if not possible, on accompanying test pieces.		

## 13 Quality assurance

### 13.1 Approval of the processor

The processor shall meet the requirements of EN 9100.

### 13.2 Process approval

Before beginning production, the processor shall apply the coating on pre-production parts and/or test pieces as agreed between the purchaser and processor. All the tests required by this standard (see Clause 12) shall be carried out on these coated pre-production parts and/or test pieces, unless otherwise agreed between the purchaser and processor.

If the test results are satisfactory for the purchaser, he shall give his written approval to commence production.

The process schedule shall not be changed thereafter without the prior agreement of the purchaser.

## **14 Acceptance**

### **14.1 Appearance and thickness**

See Table 1.

Unless otherwise specified, sampling in accordance with ISO 2859-1:

- sample size code letter, Table 1, special inspection level S3;
- simple sampling plan for normal inspection;
- acceptance quality level (AQL) 1,5.

### **14.2 Adhesion**

See Table 1.

The inspection level, the sampling plan and the acceptance quality level according to ISO 2859-1 shall be defined by the purchaser.

### **14.3 Heat curing**

See Table 1.

The inspection level, the sampling plan and the acceptance quality level according to ISO 2859-1 shall be defined by the purchaser.

## **15 Re-treatment**

After agreement of the purchaser, the parts not meeting the requirements may be reprocessed.



